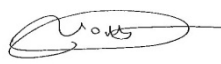
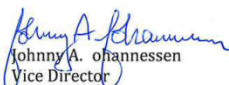




# GLOBCURRENT

## PRODUCT FORMAT AND CONTENT

|                                  |                    |
|----------------------------------|--------------------|
| <b>Customer</b>                  | ESA                |
| <b>Author</b>                    | Consortium         |
| <b>Distribution</b>              | Consortium and ESA |
| <b>ESA Contract Number</b>       | AO/1-7472/13/I-LG  |
| <b>Document Reference</b>        | TN-2               |
| <b>SoW Deliverable Reference</b> | D-150              |
| <b>Version/Revision</b>          | 3.1                |
| <b>Date of issue</b>             | 16 April 2014      |

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## Revision Change log

| Issue | Date              | Type           | Change description                         |
|-------|-------------------|----------------|--|
| 1.0   | 2 July 2014       | Initial draft  |  |
| 1.1   | 16 September 2014 | Revision       | Format change                              |
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| 1.3   | 10 November 2014  | Revision       | Input from PML and Isardsat                |
| 1.4   | 27 November 2014  | Revision       | Input from Ifremer                         |
| 2.0   | 27 November 2014  | Revision       | Format only                                |
| 3.0   | 12 March 2015     | Major revision | Reorganisation on the model of GHRSSST GDS |
| 3.1   | 16 April          | Revision       | Minor revision following ESA comments      |

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# 1. Introduction

## 1.1. Purpose and scope

The objective of this technical note is to define the format and content of the GlobCurrent products. It also provides rules to define the format new products in the future in a consistent manner. It defines the variable names that should be used, the global and variable attributes, the file naming conventions, the predefined codes for any metadata. This document relies heavily on the effort by GHRSSST team for its GHRSSST Data Specification (GDS) document [RD-1].

## 1.2. Document structure

This document is organized into the following sections:

- The first section provides an overview of the different classes of products in GlobCurrent,
- The second section describes the file naming convention applied to all GlobCurrent products
- The third section describes the general approach for the GlobCurrent products format and content.
- The following sections give the detailed format of each type of GlobCurrent product.

## 1.3. Applicable Documents

The following documents contain requirements and information applicable to this document:

- [AD-1] Statement of Work for DUE GlobCurrent project (SoW), EOP-SM/2450, Issue 2, 26 March 2013
- [AD-2] Requirement Baseline document for GlobCurrent V1 (RB-1) Deliverable D-040 of the GlobCurrent project, issued on July 2014.
- [AD-3] Technical Note (TN-1). Deliverable D-140 of the GlobCurrent project, issued on April, 29 2014.
- [AD-4] Interface Control Document (ICD). Deliverable D-70 of the GlobCurrent project, issued on July 2014.
- [AD-5] Requirement Baseline Document (RB-1). Deliverable D-40 of the GlobCurrent project, issued on April, 22<sup>nd</sup> 2014.
- [AD-6] netCDF Climate and Forecast (CF) Metadata Conventions version 1.6 available from: <http://cfconventions.org>
- [AD-7] COARDS Conventions available from [http://ferret.wrc.noaa.gov/noaa\\_coop/coop\\_cdf\\_profile.html](http://ferret.wrc.noaa.gov/noaa_coop/coop_cdf_profile.html)
- [AD-8] UDUNITS-2 package available from <http://www.unidata.ucar.edu/software/udunits/udunits-2/udunits2.html>

- [AD-9] ISO 8601, The International Standard for the representation of dates and times: [http://www.iso.org/iso/date\\_and\\_time\\_format](http://www.iso.org/iso/date_and_time_format)
- [AD-10] Unidata Attribute Conventions for Dataset Discovery (ACDD), available from <http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html>
- [AD-11] Current version (CF-1.6) of the standard name table can be found at: <http://cfconventions.org/standard-names.html>
- [AD-12] NASA Global Change Master directory (GCMD) Science Keywords and Associated Directory Keywords, available at: [http://gcmd.nasa.gov/Resources/valids/archives/keyword\\_list.html](http://gcmd.nasa.gov/Resources/valids/archives/keyword_list.html)

## 1.4. Reference documents

The following are the publications and web sites relevant to this document.

### 1.4.1. Documents

- [RD-1] The Recommended GHRSSST Data Specification (GDS), GDS 2.0 revision 5, 9 October 2012  
<https://www.ghrsst.org/documents/q/category/gds-documents/operational/>

### 1.4.2. Web sites

- [WEB-1] GlobCurrent external web site <http://www.globcurrent.org>
- [WEB-2] GlobCurrent internal web site <http://globcurrent.nersc.no>
- [WEB-3] DUE web site <http://due.esrin.esa.int>

## 1.5. Acronyms and abbreviations

|           |  |
|-----------|--|
| AATSR     | Advanced Along Track Scanning Radiometer (of ENVISAT)    |
| ADB       | Actions Data Base  |
| AMSRE     | Advanced Microwave Scanning Radiometer – E (of EoS Aqua) |
| AOI       | Area Of Interest   |
| AQUARI-US | Salinity mission (of NASA/CONAE)                         |
| AR        | Acceptance Review  |
| ARR       | Acceptance Review Report                                 |
| ASAR      | Advanced Synthetic Aperture Radar (of ENVISAT)           |
| ASCAT     | Advanced SCATterometer (of MetOp)                        |
| ATBD      | Algorithm Theoretical Basis Document                     |

|         |   |
|---------|---|
| AVHRR   | Advanced Very High Resolution Radiometer  |
| CDR     | Critical Design Review  |
| DIR     | Directory (of project participants)   |
| DMSP    | Defense Meteorological Satellite Program (of the USA)                                 |
| DUE     | Data User Element   |
| ENVISAT | Environment Satellite ( <a href="http://envisat.esa.int">http://envisat.esa.int</a> ) |
| ESA     | European Space Agency   |
| EO      | Earth Observation   |
| EU      | European Union  |
| FAQ     | Frequently Asked Questions  |
| FR      | Final Report  |
| GOCI    | Geostationary Ocean Color Imager  |
| HRDDS   | High Resolution Dynamic Diagnostic Data Sets  |
| Hs      | Significant Wave Height (also SWH)  |
| ICD     | Interface Description Document  |
| ITT     | Invitation To Tender  |
| KO      | Kick-Off  |
| MDT     | Mean Dynamic Topography   |
| MR      | Monthly Report  |
| MTR     | Mid-Term Review   |
| MDB     | Match-Up DataBase   |
| MetOp   | Meteorological Operational  |
| MTF     | Modulation Transfer Function  |
| MMDB    | Multi-sensor Match-up DataBases   |
| NOP     | Numerical Ocean Prediction  |
| NWP     | Numerical Weather Prediction  |
| OSC     | Ocean surface current   |
| PAR     | Preliminary analysis report   |
| PM      | Progress meeting  |
| PMP     | Project Management Plan   |
| PMR     | Passive Microwave Radiometry  |
| QR      | Qualification Review  |
| QRR     | Qualification Review Report   |
| RA-2    | Radar Altimeter 2 (of ENVISAT)  |
| RB      | Reference Baseline  |
| RD      | Reference Document  |
| SAR     | Synthetic Aperture RADAR  |
| SAR     | Scientific Assessment Report (of <i>SOS</i> )   |
| SAP     | Scientific Analysis Plan  |
| SIAR    | Scientific and Impact Assessment Report   |
| SLA     | Sea Level Anomaly   |
| SMOS    | Soil Moisture and Ocean Salinity (mission)  |
| SOS     | Surface Ocean Salinity and Synergy (project)  |
| SoW     | Statement of Work   |
| SPR     | Software Problem Report   |
| SR      | Scientific Roadmap  |
| SRR     | System Requirements Review  |
| SSH     | Sea Surface Height  |
| SSM/I   | Special Sensor Microwave Imager (of DMSP)   |
| SST     | Sea Surface Temperature   |

|      |   |
|------|---|
| STSE | Support to Science Element                |
| SWH  | Significant Wave Height                   |
| TBC  | To Be Confirmed                           |
| TBD  | To Be Determined                          |
| TDP  | Technical Data Package                    |
| TDS  | Test Data Set                             |
| TN   | Technical Note (short report 10-50 pages) |
| TOA  | Top of Atmosphere                         |
| TR   | Technical Report (long report > 50 pages) |
| UCM  | User Consultation Meeting                 |
| UM   | User Manual                               |
| URD  | User Requirements Document                |
| URL  | Universal Resource Locator                |
| WP   | Work Package                              |

## 2. GlobCurrent products

The GlobCurrent products can be categorized in different levels, corresponding to their level of processing (see also the standard definition of product levels in table 2.1). These levels are summarized below:

Table 2.1: Definition of GlobCurrent product levels

| Product level              | L2   | L3 Uncollated  | L3 Collated   | L3 Super-collated  | L4  |
|----------------------------|--|--|---|--|---|
| <b>Acronym</b>             | L2P  | L3U  | L3C   | L3S  | L4  |
| <b>Description</b>         | Geophysical variables derived from Level 1 or Level 2 source data at the same resolution and location as the Level 1 or Level 2 data, typically in a satellite projection with geographic information. | L2 data granules remapped to a space grid without combining any observations from overlapping orbits.        | <p>measurements combined from a single instrument into a space-time grid.</p> <p>Multiple passes/scenes of data can be combined. This applies also to products combining sequences of images to derive current vectors, such as the MCC method.</p> <p>This applies also to a mean of several passes or scenes such as a climatological mean field.</p> | <p>measurements combined from multiple instruments into a space-time grid.</p> <p>Multiple passes/scenes of data are combined.</p> | Data sets created from the analysis of lower level data that results in gridded, gap-free products. Data generated from multiple sources of satellite data using optimal interpolation are an example of L4 products. This also include any model data. |
|                            |  | L3 products do not use analysis or interpolation procedures to fill gaps where no observations are available |   |  |   |
| <b>Grid specification</b>  | Native to instrument   | Defined by data provider   | Defined by data provider  | Defined by data provider   | Defined by data provider  |
| <b>Temporal resolution</b> | Native to instrument   | Native to data stream  | Defined by data provider  | Defined by data provider   | Defined by data provider  |
| <b>Delivery timescale</b>  | As available, Ideally within 3 hours from acquisition at satellite   | As available, Ideally within 3 hours from acquisition at satellite   | As available, Ideally within 3 hours from acquisition at satellite  | As available, Ideally within 3 hours from acquisition at satellite   | Analyzed product processing window as defined by data provider.   |
| <b>Target accuracy</b>     | Native to data stream  | Native to data stream  | Native to data stream   | Native to data stream  | Native to data stream   |
| <b>Error</b>               | Native to data   | Native to data   | Derived from  | Derived from input   | Analysis error defined  |

|                              |   |   |  |                                  |   |
|------------------------------|---|---|--|----------------------------------|---|
| <b>statistics</b>            | stream if available, sensor specific error statistics otherwise | stream if available, sensor specific error statistics otherwise | input data for each output grid point. | data for each output grid point. | by data provider for each output grid point (no input data statistics are retained) |
| <b>Coverage</b>              | Native to data stream   | Native to data stream   | Defined by data provider               | Defined by data provider         | Defined by data provider  |
| <b>Current term measured</b> | Native to data stream   | Native to data stream   | Native to data stream                  | Native to data stream            | Native to data stream   |

The following tables give an overview of the currently identified types of GlobCurrent products per class as defined above, for which a unique format template is provided in this document. Note that there may be different actual products for a product type and class. For instance, a Level 4 (L4) product for geostrophic currents (CURgeo at a given depth) may be obtained from different sensors or methodologies (or available in different versions) and thus correspond to a distinct GlobCurrent product.

*Table 2.2: Definition of GlobCurrent L2P product types*

| <b>Product type</b>                      | <b>L2P geostrophic</b>  | <b>L2P Eulerian</b>  |
|--|---|--|
| <b>Parameter code</b><br>(see table 3.4) | <b>CURgeo_&lt;depth&gt;</b>   | <b>CUReul_&lt;depth&gt;</b>  |
| <b>Format section</b>                    | <b>5</b>  | <b>6</b>   |
| <b>Description</b>                       | Usually obtained along a satellite altimeter track. As it is estimated from the sea level height measured along this track, only the across track component of the geostrophic vector can be estimated. | Instantaneous Eulerian current usually measured by a radar, such as SAR, over a scene. Only the component of the current vector in the light of sight of the sensor can be estimated. Limitations include situations with low wind speed, where the current can not be estimated properly. |
| <b>Grid specification</b>                | Native to the used along track data.<br><br>Along-track altimeter SSH are usually available every 7km, so it means 14km resolution for the derived geostrophic across-track velocities.                 | Image projection of the radar. Resolution is typically about 10km for SAR.   |
| <b>Temporal resolution</b>               | Instantaneous measurement along the track, at data acquisition time   | Instantaneous measurement at radar scene acquisition time in the case of SAR.  |
| <b>Delivery time scale</b>               | Could be done in real time for operational altimeters.  | Depending on the satellite. Real-time for Sentinel-1.  |
| <b>Target accuracy</b>                   | Defined by provider.  | Defined by provider.   |
| <b>Error</b>                             | Defined by provider.  | Defined by provider.   |

|                              |   |   |
|------------------------------|---|---|
| <b>statistics</b>            |   |   |
| <b>Coverage</b>              | Global but with long revisiting time for altimeters | Regional for SAR (where image acquisitions are scheduled). Twice daily revisiting time can be achieved.   |
| <b>Current term measured</b> | Geostrophic current component across track          | Eulerian current component, in the line of sight direction (across-track for a SAR). Does not include the wind related currents (Ekman+Stokes). |

Table 2.3: Definition of GlobCurrent L3 product types

| <b>Product type</b>          | <b>Tracer motion</b>   | <b>Geostrophic</b>   |
|------------------------------|--|--|
| <b>Acronym</b>               | <b>CURstm_&lt;depth&gt;</b>  | <b>CURgeo_&lt;depth&gt;</b>  |
|                              | <b>8</b>   | <b>11</b>  |
| <b>Description</b>           | Maps of surface tracer motion velocities.<br><br>Can be estimated for instance at the surface from the SST and ocean colour feature tracking (maximum cross correlation method - MCC) with severe limitations. | Global mean of consecutive passes or scenes from a single instrument.<br><br>This is the case for instance of a mean climatological field derived from SAR Doppler currents. Though SAR measures instantaneous Eulerian current, the averaging process over multiple years of data results in the actual estimation of a mean geostrophic current. |
| <b>Grid specification</b>    | In the case of MCC, usually using geostationary SST or OC data, the grid covers at most the same area but usually with lower resolution.   |  |
| <b>Temporal resolution</b>   | In the case of MCC over geostationary data, the resolution is at most the time between two images.   | In the case of SAR, it is a multi-year mean.   |
| <b>Delivery time scale</b>   | Could be done in NRT.  | Climatological field.  |
| <b>Target accuracy</b>       |  |  |
| <b>Error statistics</b>      |  |  |
| <b>Coverage</b>              | Native to geostationary satellite for MCC.   | With SAR, it is a regional area with systematic or frequent acquisition (e.g.: Agulhas)  |
| <b>Current term measured</b> | Surface tracer motion  | Geostrophic current.   |

Table 2.4: Definition of GlobCurrent L4 product types

| <b>Product type</b> | <b>Geostrophic</b>          | <b>Ekman</b>                | <b>Eulerian</b>             | <b>Stokes drift</b>         | <b>Tidal</b>                |
|---------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| <b>Acronym</b>      | <b>CURgeo_&lt;depth&gt;</b> | <b>CURekm_&lt;depth&gt;</b> | <b>CUReul_&lt;depth&gt;</b> | <b>CURstk_&lt;depth&gt;</b> | <b>CURtid_&lt;depth&gt;</b> |
|                     | <b>7</b>                    | <b>10</b>                   | <b>9</b>                    | <b>12</b>                   | <b>13</b>                   |

|                              |   |  |  |   |  |
|------------------------------|---|--|--|---|--|
| <b>Description</b>           | Global maps of geostrophic currents.<br>Can be estimated through the optimal interpolation (OI) of multiple altimeter along-track data), eSQG (combination of altimeter and SST or SSS) or Modulation Transfer Function (altimeter and SST data). | Global maps of Ekman currents at different depths. | Global maps of Eulerian currents at different depths.<br><br>Can be estimated for instance by combining geostrophic currents and Ekman currents. | Stokes drift.<br>Can be estimated with a wave model (for instance WaveWatch3 model configuration at Ifremer). | Tidal currents estimated from FES2012 model provided by CNES/LEGOS |
| <b>Grid specification</b>    | True horizontal scales are greater 100km for altimeters (OI) but data are usually regrided to higher resolution global grids (0.1 or 0.25 deg resolution)   |  |  | Native to wave model (0.5 deg in GlobCurrent resampled on a 0.1 deg grid).                                    | 0.1 deg  |
| <b>Temporal resolution</b>   | Usually 10 days are used for altimeter optimally interpolated data (OI).  |  |  | 3 hours   | 3 hours  |
| <b>Delivery time scale</b>   | Up to daily for altimeter OI data, using sliding windows of 10 days of data.  |  |  | Model so can be run in hindcast and forecast.   | Predictive model that can be run for any date and time in advance. |
| <b>Error statistics</b>      | Bounded error variance  | Bounded error variance                             | Bounded error variance   | Bounded error variance  | Bounded error variance   |
| <b>Coverage</b>              | Depending on instrument. Global with altimeters.  |  | Depending on instrument. Global with altimeters.   | Global  | Global   |
| <b>Current term measured</b> | Geostrophic current vector (northward and eastward)   | Ekman current.                                     | Eulerian current vector (northward and eastward)   | Stokes drift vector (northward and eastward)  | Tidal current vector (northward and eastward)                      |



## 3. GlobCurrent filenames and supporting conventions

### 3.1. Satellite data files

Striving to achieve a flexible naming convention that maintains consistency across processing levels and better serves user needs, GlobCurrent uses a single form for all data files. An overview of the format is presented below along with example filenames. Details on each of the filename convention components are provided in Sections 3.3 through 3.5.

In addition, a best practice has been established for creating character strings used to describe GlobCurrent products and sources of ancillary data. These strings, and associated numeric codes for the current products, are used within some GlobCurrent data files but are not part of the filename convention itself. The best practice is described in 3.6.

The filenaming convention for GlobCurrent is shown below.

**<Indicative Date><Indicative Time>-GLOBCURRENT-<Processing Level>-<Parameter>-<Product String>-v< Product Version>-fv<File Version>.<File Type>**

The variable components within braces (“< >”) are summarized in Table 3.1 below and detailed in the following sections. Note that dashes (“-“) **are reserved** to separate elements of the file name and **should not** be used in any code or element of the filename. Example filenames are given later in this section. While no strict limit to filename length is mandated, producers are encouraged to keep the length to less than 240 characters to increase readability and usability.

*Table 3.1: File naming convention components for satellite data files.*

| Name              | Definition | Description   |
|-------------------|------------|---|
| <Indicative Date> | YYYYMMDD   | The identifying date for this data set, using the format YYYYMMDD, where YYYY is the four-digit year, MM is the two-digit month from 01 to 12, and DD is the two-digit day of month from 01 to 31. The date used should best represent the observation date for the dataset.  |
| <Indicative Time> | HHMMSS     | The identifying time for this data set in UTC, using the format HHMMSS, where HH is the two-digit hour from 00 to 23, MM is the two-digit minute from 00 to 59, and SS is the two-digit second from 00 to 59. The time used is dependent on the <Processing Level> of the data set:<br>L2P: start time of granule<br>L3U: start time of granule<br>L3C and L3S: centre time of the collation window |

|                    |  |  |
|--------------------|--|--|
|                    |  | L4: nominal time of analysis<br>All times should be given in UTC and should be chosen to best represent the observation time for this dataset. Note: providers should ensure the applications they use to determine UTC properly account for leap seconds. |
| <Processing Level> | The data processing level code (L2P, L3U, L3C, L3S, or L4)                           | The data processing level code, defined in Section 7.5.  |
| <Parameter>        | The type of current (or other geophysical quantity) data included in the file        | Conforms to the definitions for current and other quantities of interest for GlobCurrent, defined in Section 7.6.  |
| <Product String>   | A character string identifying the current product set. The string is used uniquely. | The unique “name” of the product line. See Section 7.7 for the product string lists, one each for L2P, L3, L4.   |
| < Product Version> | nn.n   | Version number of the product. A different version number must be associated with a product at each processor algorithm or configuration change. For example, “02.0”.  |
| <File Version>     | xx.x   | Version number for the file, for example, “01.0”.  |
| <File Type>        | netCDF data file suffix (nc)   | Indicates this is a NetCDF file containing data.   |

### 3.2. In situ data

The granularity and file naming of in situ data shall follow the convention adopted for the in situ data within the ESA GlobWave project, which itself was based on CF convention and existing efforts (at NDBC for instance). This convention is described below.

There shall be one file per platform, instrument and month. For platforms (such as buoys) having different onboard instruments, the respective data will therefore be put in two different files. Different instruments may indeed have different sampling times and often, different availability time ranges too.

If there is a significant interruption time (to be defined, more than one day for instance) or a significant change in the acquisition process (ex: maintenance change on the instrument, or replacement), then the data product for a specific platform/instrument may be split into two or more chronologically consecutive files within the current reference month.

A product containing the data from one instrument by one platform (buoy, ship,...) during one specific month will be named as follow :

**<Platform String>-<Start Date><Start Time>-<End Date><End Time>-<Sensor String>-<Product String>-v< Product Version>-fv<File Version>.<File Type>**

The variable components within braces (“< >”) are summarized in Table 3.2 below and detailed in the following sections. Note that dashes (“-“) **are reserved** to separate elements of the file name and **should not** be used in any code or element of the filename. Example filenames are given later in this section. While no strict limit to filename length is mandated, producers are encouraged to keep the length to less than 240 characters to increase readability and usability.

*Table 3.2: File naming convention components for in situ files.*

| <b>Name</b>  | <b>Definition</b>                           | <b>Description</b>   |
|--------------|---|--|
| <Platform>   | The identifier of the measuring platform.   | The identifier of the acquisition platform: if it as a WMO identifier, it shall be labelled WMO<identifier> otherwise it will use the provider identifier.   |
| <Start Date> | YYYYMMDD                                    | The date of the first measurement for this data set, using the format YYYYMMDD, where YYYY is the four-digit year,MM is the two-digit month from 01 to 12, and DD is the two-digit day of month from 01 to 31. The date used should best represent the observation date for the dataset. |
| <Start Time> | HHMMSS                                      | The time of the first measurement for this data set in UTC, using the format HHMMSS, where HH is the two-digit hour from 00 to 23, MM is the two-digit minute from 00 to 59, and SS is the two-digit second from 00 to 59. All times should be given in UTC.                             |
| <End Date>   | YYYYMMDD                                    | The date of the last measurement for this data set, using the format YYYYMMDD, where YYYY is the four-digit year,MM is the two-digit month from 01 to 12, and DD is the two-digit day of month from 01 to 31. The date used should best represent the observation date for the dataset.  |
| <End Time>   | HHMMSS                                      | The time of the last measurement for this data set in UTC, using the format HHMMSS, where HH is the two-digit hour from 00 to 23, MM is the two-digit minute from 00 to 59, and SS is the two-digit second from 00 to 59. All times should be given in UTC.                              |
| <Sensor>     | The instrument associated with the measured | Conforms to the definitions for current and other quantities of interest for GlobCurrent, defined in Section 7.6.  |

|                   |  |  |
|-------------------|--|--|
|                   | values of this file.   |  |
| <Product String>  | A character string identifying the current product set. The string is used uniquely. | a free field further explaining the content or origin of the data. <ul style="list-style-type: none"> <li>For a moored buoy, use the location of the buoy expressed as 'Lat_xx.yy[N S]_Lon_zz.ww[W E]' (exemple: Lat_27.35N_Lon_84.28W)</li> </ul> |
| <Product Version> | nn.n   | Version number of the product. A different version number must be associated with a product at each processor algorithm or configuration change. For example, "02.0".  |
| <File Version>    | xx.x   | Version number for the file, for example, "01.0".  |
| <File Type>       | NetCDF data file suffix (nc)   | Indicates this is a NetCDF file containing data.   |

### 3.3. <Processing Level>

Satellite data processing level definitions can lead to ambiguous situations, especially regarding the distinction between L3 and L4 products. GlobCurrent identified the use of analysis procedures to fill gaps where no observations exist to resolve this ambiguity. Within GlobCurrent filenames, the <Processing Level> codes are shown below in Table 3.3. GlobCurrent currently establishes standards for L2P, L3U, L3C, L3S, and L4. This is similar to the overview of GlobCurrent product levels given in table 2.1.

Table 3.3: GlobCurrent Processing Level Conventions and Codes

| Level    | <Processing Level> | Code Description  |
|----------|--------------------|---|
| Level 0  | L0                 | Unprocessed instrument and payload data at full resolution. GlobCurrent does not make recommendations regarding formats or content for data at this processing level.   |
| Level 1A | L1A                | Reconstructed unprocessed instrument data at full resolution, time referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and geo-referencing parameters, computed and appended, but not applied, to L0 data. GlobCurrent does not make recommendations regarding formats or content for data at this processing level. |
| Level 1B | L1B                | Level 1A data that have been processed to sensor units.   |

|         |                   |   |
|---------|-------------------|---|
|         |                   | GlobCurrent does not currently make recommendations regarding formats or content for L1B data.  |
| Level 2 | L2P               | <p>Geophysical variables derived from Level 1 or Level 2 source data at the same resolution and location as the Level 1 or 2 data, typically in a satellite projection with geographic information. These data form the fundamental basis for higher-level (current) products and require ancillary data and uncertainty estimates.</p> <p>Usually there will be one single file per orbit, pass or image acquisition. This is up to the provider.</p> <p>Note that products from geostationary satellite are classified as gridded products (see Level 3).</p>   |
| Level 3 | L3U<br>L3C<br>L3S | <p>Level 2 variables mapped on a defined grid with reduced requirements for ancillary data. Uncertainty estimates are still mandatory. Three types of L3 products are defined:</p> <ul style="list-style-type: none"> <li>• <b>Un-collated (L3U):</b> L2 data granules remapped to a space grid without combining any observations from overlapping orbits</li> <li>• <b>Collated (L3C):</b> observations combined from a single instrument into a space-time grid using several passes (or sequence of images such as with the Maximum Cross Correlation – MCC- method).</li> <li>• <b>Super-collated (L3S):</b> similar as L3C but with observations combined from multiple instruments into a space-time grid.</li> </ul> <p>For such product, there will be one single file per time step.</p> <p>Note that L3 GlobCurrent products do not use analysis or interpolation procedures to fill gaps where no observations are available.</p> |
| Level 4 | L4                | Data sets created from the analysis of lower level data that result in gridded, gap-free products. Current data generated from multiple sources of satellite data using optimal interpolation are an example of L4 GHRSSST products.  |

The distinction between L3 GlobCurrent and L4 GlobCurrent data is made primarily on whether or not any gap-filling techniques are employed, not on whether data from multiple instruments is

used in the L3 product. If no gap filling procedure (such as optimal interpolation) is used, then the product remains a L3 GlobCurrent product. GlobCurrent defines three kinds of L3 files: un-collated (L3U), collated (L3C), and super-collated (L3S). If gap filling is used to fill all observations gaps, then the resulting gap-free data are considered L4 GlobCurrent data products.

### 3.4. <Parameter>

The GlobCurrent team agreed to use the standard names from NetCDF Climate and Forecast (CF) convention [AD-6] for any geophysical quantity whenever they are defined. In addition, for variable names that do not already exist as part of the CF, GlobCurrent agreed on a list of acceptable names with a proposed definition.

The different kinds of currents are detailed later in this section and the relevant <Parameter> codes to be used in the filenames are provided.

#### **geostrophic\_velocity (GlobCurrent <Parameter>: CURgeo):**

CF Definition divides this parameter into two components (northward and eastward):

*surface\_geostrophic\_eastward\_sea\_water\_velocity*

*alias: surface\_eastward\_geostrophic\_sea\_water\_velocity*

*The surface called "surface" means the lower boundary of the atmosphere. A velocity is a vector quantity. "Eastward" indicates a vector component which is positive when directed eastward (negative westward). "Geostrophic" indicates that geostrophic balance is assumed. "Water" means water in all phases. surface\_geostrophic\_eastward\_sea\_water\_velocity is the sum of a variable part,*

*surface\_geostrophic\_eastward\_sea\_water\_velocity\_assuming\_sea\_level\_for\_geoid, and a constant part due to the stationary component of ocean circulation.*

Additional details: Geostrophic currents correspond to a particular simplification of the equations governing the horizontal components of velocity. It is valid when the largest terms in the equations of motion reduce to the Coriolis force and the pressure gradient. This can generally apply in the deep ocean over large (> 50-100 km) spatial and long (>2-10 days) temporal scales.

#### **ekman\_current\_velocity (GlobCurrent <Parameter>: CUREkm):**

Ekman currents result from the balance between friction (induced by wind stress) and Coriolis forces. The wind stress is often parametrized as a function of the square of the wind speed and a drag coefficient.

Under the assumptions of a steady, homogeneous, horizontal flow on a rotating Earth and an infinitely deep ocean, and considering a constant vertical eddy viscosity, the theoretical Ekman current at the surface flows at 45° to the right (left) of the wind direction in the northern (southern) hemisphere. Below the surface, the Ekman current speed decreases with depth, while the direction changes clockwise (anticlockwise) in the northern (southern) hemisphere. Both

effects result in the so-called Ekman spiral.

**stokes\_drift\_velocity (GlobCurrent <Parameter>: CURstk):**

As waves travel, the water particles that make up the waves do not travel in a straight line, but rather in orbital motions. Water particles do not move over a closed orbital path but instead have an additional movement in the direction of wave propagation. As the particles progress in an orbital motion, their movement is enhanced at the top of the orbit and slowed slightly at the bottom. The resulting Lagrangian current is called the Stokes drift.

**tidal\_current\_velocity (GlobCurrent <Parameter>: CURtid):**

Tides are related to gravitational variations associated to the Sun and Moon alignments, resulting in periodical changes in water levels.

**inertial\_current\_velocity (GlobCurrent <Parameter>: CURitl):**

When wind and wave forces that have set upper ocean motions cease to strongly act, water will not rest immediately. Energy imparted by the wind and waves takes time to fully dissipate. The Coriolis force will then continue to apply as a centripetal force, leading to rotational flows, referred as inertial currents. The period of rotation will vary with the local Coriolis parameter  $f$  (e.g. latitude dependent). As friction cannot be completely neglected, inertial oscillations in the real ocean decay in a few days. The amplitude of the inertial motion is proportional to the cumulative wind forcing term and inversely proportional to the water density and thickness of the mixed layer.

**internal\_wave\_related\_current\_velocity (GlobCurrent <Parameter>: CURiwv):**

Internal waves occur at the boundary between water layers of different densities.

**eulerian\_total\_current\_velocity (GlobCurrent <Parameter>: CUREul):**

Total velocity of the current as measured at a fixed point (by means of a currentmeter for instance)

**lagrangian\_total\_current\_velocity (GlobCurrent <Parameter>: CURlag):**

Total velocity of the current as measured along the fluid particle trajectory (by means of a drifting buoy for instance)

**surface\_tracer\_velocity (GlobCurrent <Parameter>: CURstm):**

This is the apparent average rate of displacement of a parcel of water (assuming surface properties are conserved). This is not defined as an instantaneous velocity, but an arithmetic average over a given period of time. This velocity should correspond to the total current acting

on fully submerged marine debris e.g. oil or person in water, but may not represent floating object with significant wind exposure e.g. liferafts.

The current codes and CF standard names (when existing) defined above and used within GlobCurrent are summarized along with their key characteristics in Table 3.4

*Table 3.4: GlobCurrent <Parameter> code and summary table.*

| <b>&lt;Parameter&gt;</b> | <b>CF Standard Name</b>   | <b>Approximate Depth</b>   | <b>Typically Observed by...</b>   |
|--------------------------|---|--|---|
| CURgeo_<depth>           | surface_geostrophic_eastward_sea_water_velocity<br>surface_geostrophic_northward_sea_water_velocity | Provided generally at 0 or 15 meters   | Altimeters or combination of altimeters and infrared radiometers (SST) through eSQG or MTF methodologies.                               |
| CUReul_<depth>           | None defined  | Provided generally at 0m (this is the case for instance for the first GlobCurrent Eulerian current product, sum of geostrophy at 0m and Ekman at 0m), significant wave height (hs), mixed layer depth (mld) or 15 meters | Combination of infrared (SST) and hyperspectral (ocean colour) imagers, or combination of altimeters with other sources (weather model) |
| CURstk_<depth>           | None defined  | Provided generally at significant wave height (hs)   | Calculated by wave forecasting models.  |
| CURekm_<depth>           | None defined  | Provided generally at significant wave height (hs), 0 or 15 meters   | Filtered timeseries (e.g., 20-day bandpass) using multiple platforms (e.g., for ageostrophic current)                                   |
| CURitl                   | None defined  | Estimated generally above mixed layer depth  | Continuous high resolution drifter position   |



|                |              |  |  |
|----------------|--------------|--|--|
| CURtid_<depth> | None defined | Provided generally at 0 meters           | Calculated by tide prediction models.  |
| CURiww         | None defined | Estimated generally at mixed layer depth | In situ profilers and surface manifestations seen by SAR and visible instruments                         |
| CURlag         | None defined | at significant wave height (hs)          | In situ drifters   |
| CURstm         | None defined | Provided generally at 0 meters           | Calculated by feature motion tracking (MCC, optical flow) from ocean colour or infrared radiometer data. |

In above table, <depth> can be:

- an actual depth value followed by the unit: for instance “**15m**” would be the 15 meters depth.
- A physical ocean layer. Possible values are:
  - “**hs**” for a depth equal to the significant wave height ( $H_{sw}$ )
  - “**mlD**” for the depth of the mixed layer

### 3.5. <Product String>

The product string is text string meant to provide additional information on the product content and origin, making it easy by looking at a filename to know at a glance what the file is about and how different it is from another product file. The current set of GlobCurrent product strings is listed in tables 3.8, 3.9, 3.10, respectively for L2, L3, L4 products.

The product string does not need to be unique as long as the processing level string and parameter string are different. **The important rule is that no file belonging to the same or a different dataset should have the same name. Filenames must be unique in all cases for any GlobCurrent product.**

It is possible for the preceding combination of filename components to result in a non-unique filename for any GlobCurrent product level. The product string can use a set of additional segregators to ensure each distinct file has a unique file name. Each one must be separated by a “\_” if more than one is used (example: “MED\_MCC” if combining the area and methodology components. The following segregators can be used and combined together:

- Source: provides the origin of the data, e.g. the platform or sensor (or a combination of both), model, etc...The codes for the source are listed in table 3.5. Included in the table are also codes for satellite platforms and sensors. The satellite platform and satellite sensor entries are also used in the netCDF global attributes, `platform` and `sensor`,

for all GlobCurrent product files. See Section 4.2 for more information on the required **global attributes**.

- **Area:** In the case of regional L3 or L4 products the additional segregator element must begin with a code that specifies the approximate region covered by the product. There are two primary reasons for this requirement, the first of which is to ensure uniqueness in the file names in the cases where a provider is using the same processing system to create products for multiple regions (for example, “GAL” (Galapagos Islands Region) and “MED” (Mediterranean Region)). The second reason is that users need to quickly identify at a glance the approximate domain of the products. Users should note that the geographical coordinates associated with each area code in table 2.2 are explicitly intended to be only approximate, and not strict. For example, a provider producing a near-global coverage data may choose to only produce data on a grid that extends to 85°S. Such a product would use the “GLOB” code. Users must retrieve the precise latitude and longitude limits directly from the NetCDF data files. New codes are assigned by the GlobCurrent project team and entered into the table on demand by providers.
- **Method:** Some type of current products, such as Eulerian (CUREul) or geostrophic (CURgeo) currents may be retrieved from various methodologies (analysis of altimeter along-track data, eSQG, MTF, MCC,...) sometimes using the same inputs and over the same area. The methodology unique code as provided in table 2.1 can be used to handle this.

The following tables provide the existing code strings for all above segregators. New strings are entered into the tables upon registration by the GlobCurrent Project Leader and agreement by the GlobCurrent expert team.

*Table 3.5: source code definition*

| Code           | Satellite                  | Sensor                         | Description  |
|----------------|----------------------------|--------------------------------|--|
| AMSRE          | Aqua                       | AMSRE                          | Advanced Microwave Scanning Radiometer-EOS (AMSRE)   |
| SEVIRI         | MSG1 or 2                  | SEVIRI                         | Spinning Enhanced Visible and Infra-Red Imager (SEVIRI)  |
| GOCI           | COMS                       | GOCI                           | Geostationary Ocean Color Imager (GOCI)  |
| CRYOSAT2_SIRAL | CRYOSAT-2                  | SIRAL                          | SAR Interferometer Radar Altimeter   |
| ENVISAT_ASAR   | ENVISAT                    | ASAR                           | Advanced Synthetic Aperture Radar (ASAR)   |
| ALT            | Multiple altimeter mission | Multiple altimeter instruments | Merging of several altimeters among ERS-1, ERS-2, Envisat, Topex, GFO, ...<br><br>The list of used altimeters should be documented in the global attributes. |
| WW3_IFR        |                            |                                | Ifremer version of WaveWatch3 wave prediction model  |
| New codes      |                            |                                | Please contact the GlobCurrent project team if you require new codes to be included in future revisions of   |

|  |                |
|--|----------------|
|  | this document. |
|--|----------------|

Table 3.6: area code definitions. Geographical limits are approximate, and users are advised to retrieve the precise latitude and longitude limits from within the data files.

| Code       | Approximate Region           | Description   |
|------------|------------------------------|---|
| GLOB       | 90°S to 90°N, 180°W to 180°E | Global coverage data sets   |
| MED        | 30°N to 46°N, 18°W to 36.5°E | Mediterranean Sea area  |
| AUS        | 70°S to 20°N, 60°E to 170°W  | Australian regional analysis area   |
| NWE        | 43°N to 60°N, 13°W to 9°E    | North-West of Europe  |
| NSEABALTIC | 66°N to 48°N, 10°W to 30°E   | North Sea and Baltic Region   |
| GAL        | 20°S to 20°N, 120°W to 69°W  | Area around the Galapagos Islands   |
| NCAMERICA  | 20°S to 62°N, 165°W to 30°W  | Area around the east and west coasts of North and Central America   |
| AGL        | 27°S to 45°S, 19°E to 40°E   | Area covering the Agulhas current and its retroflexion.   |
| New codes  |                              | Please contact the GlobCurrent project team if you require new codes to be included in future revisions of this document. |

Table 3.7: code definitions for current retrieval methodologies

| Code      | Description   |
|-----------|---|
| MCC       | Maximum Cross Correlation   |
| eSQG      | Enhanced Surface Quasi-Geostrophic  |
| OI        | Optimal Interpolation of multiple passes  |
| MTF       | Modulation Transfer Function  |
| MEAN      | Averaging of multiple passes or scenes  |
| New codes | Please contact the GlobCurrent project team if you require new codes to be included in future revisions of this document. |

### 3.6. GlobCurrent unique product identifier

This section describes the best practices that have been developed for creating unique product identifiers. Note that these strings are not part of the filename convention described above, but, like filenames, they apply to all GlobCurrent product levels : the product unique identifier is used to fill in the global attribute id described in table 4.1.

#### Best Practice for Establishing Product Identifiers

A best practice has been established for defining the text strings to be used as product unique identifier. While a rigid standard for the text strings is not possible, the following best practice should be applied to the extent possible for GlobCurrent datasets.

**<Producer>-<Processing Level>-<Parameter String>-<Product String>-v<Product Version>**

The definitions of the components match the definitions from the file naming convention, found in previous sections. The component <Product Version> is used to distinguish different versions of the same dataset and should be of the form *x.y* where *x* is the major and *y* is the minor version. The component <Producer> corresponds to the producing agency using the shortname or acronym listed in table 4.2.

The following tables provide the current lists of products identifiers (and corresponding product strings) in GlobCurrent.

*Table 3.8: Current list of L2P product codes defined in GlobCurrent*

| Product Id                                  | Product String  | Description   | Product level, type and format section |
|---|---|---|--|
| IsardSat-L2P-CURgeo_0m-CRYOSAT2_SIRAL-v01.0 | CRYOSAT2_SIRAL  | Across track geostrophic current from CryoSat-2 altimeter SIRAL | L2P CURgeo (section 5)                 |
|   |   |   |  |
|   |   |   |  |
|   |   |   |  |
| New codes                                   | Please contact the GlobCurrent team if you require new codes to be included in future revisions of this document. |   |  |

*Table 3.9: Current list of L3 product codes defined in GlobCurrent*

| Product Id                       | Product String  | Description                                   | Product type and format section |
|----------------------------------|---|---|---------------------------------|
| PML-L3S-CURstm_0m-GOCI_MCC-v01.0 | GOCI_MCC  | Surface tracer motion from GOCI ocean colour. | L3S CURstm (section 8)          |
|                                  |   |   |                                 |
|                                  |   |   |                                 |
| New codes                        | Please contact the GlobCurrent team if you require new codes to be included in future revisions of this document. |   |                                 |

*Table 3.10: Current list of L4 product codes defined in GlobCurrent*

| Product Id                    | Product String | Description                                       | Product level, type and format section |
|-------------------------------|----------------|---|--|
| CLS-L4-CURgeo_0m-ALT_OI-v01.0 | ALT_OI         | Geostrophic current at ocean surface from optimal | L4 CURgeo                              |

|                                    |   |  |                           |
|------------------------------------|---|--|---------------------------|
|                                    |   | interpolation of multiple altimeter tracks   | (section 7)               |
| CLS-L4-CURekm_hs-ERAWS_EEM-v01.0   | ERAWS_EEM   | Ekman current at significant wave height from ERA interim wind stress ( Rio et al, 2014.)                    | L4 CURgeo<br>(section 10) |
| CLS-L4-CURekm_15m-ERAWS_EEM-v01.0  | ERAWS_EEM   | Ekman current at 15 meter depth from ERA interim wind stress ( Rio et al, 2014.)                             | L4 CURgeo<br>(section 10) |
| CLS-L4-CUReul_hs-ALT_SUM-v01.0     | ALT_SUM   | Eulerian “total” current at significant wave height from the sum of geostrophic and Ekman current components | L4 CUReul<br>(section 9)  |
| CLS-L4-CUReul_15m-ALT_SUM-v01.0    | ALT_SUM   | Eulerian “total” current at 15 meter depth from the sum of geostrophic and Ekman current components          | L4 CUReul<br>(section 9)  |
| IFREMER-L4-CURstk_hs-WW3_IFR-v01.0 | WW3_IFR   | Stokes drift from Ifremer WaveWatch3 model   | L4 CURstk<br>(section 12) |
| IFREMER-L4-CURtid_0m-FES2012-v01.0 | FES2012   | Tidal current from FES 2012 tide model   | L4 CURtid<br>(section 13) |
| New codes                          | Please contact the GlobCurrent team if you require new codes to be included in future revisions of this document. |  |                           |

## 4. GlobCurrent Data Product File Structure

### 4.1. Overview of the GlobCurrent NetCDF File Format

GlobCurrent data files preferentially use the **NetCDF-4 Classic** format. While NetCDF-3 can store the metadata, it is computationally expensive to extract it from externally-compressed NetCDF-3 files. A major advantage to the use of NetCDF-4 format products from the producer's perspective is that no additional metadata records are required when using this format since one can easily extract it from the files without having to decompress the entire file.

The GlobCurrent formatted data sets must comply with the Climate and Forecast (CF) Conventions, v1.6 [AD-6] or later because these conventions provide a practical standard for storing oceanographic data in a robust, easily-preserved for the long-term, and interoperable manner. The CF-compliant NetCDF data format is flexible, self-describing, and has been adopted as a *de facto* standard for many operational and scientific oceanography systems. Both NetCDF and CF are actively maintained including significant discussions and inputs from the oceanographic community (see [http://cf-pcmdi.llnl.gov/discussion/index\\_html](http://cf-pcmdi.llnl.gov/discussion/index_html)). The CF convention generalizes and extends the Cooperative Ocean/Atmosphere Research Data Service (COARDS, [AD-7]) Convention but relaxes the COARDS constraints on dimension order and specifies methods for reducing the size of datasets. The purpose of the CF Conventions is to require conforming datasets to contain sufficient metadata so that they are self-describing, in the sense that each variable in the file has an associated description of what it represents, physical units if appropriate, and that each value can be located in space (relative to earth-based coordinates) and time. In addition to the CF Conventions, GlobCurrent formatted files follow some of the recommendations of the Unidata Attribute Convention for Dataset Discovery (ACDD, [AD-10]).

In the context of NetCDF, a variable refers to data stored in the file as a vector or as a multidimensional array. Each variable in a GlobCurrent NetCDF file consists of a 2-dimensional [i x j], 3-dimensional [i x j x k], or 4-dimensional [i x j x k x l] array of data. The dimensions of each variable must be explicitly declared in the dimension section.

The geolocation information includes the variables and dimensions necessary to structure the data arrays and locate in time and space each measurement. This is strongly dependent on the pattern of the data : satellite swath, regular grid, non regular grid, time series (buoy), trajectory (ship, drifting buoy). The corresponding specifications for each of these pattern are listed in section 4.5, in CDL language.

Within the NetCDF file, global attributes are used to hold information that applies to the whole file, such as the data set title. Each individual variable must also have its own attributes, referred to as variable attributes. These variable attributes define, for example, an offset, scale factor, units, a descriptive version of the variable name, and a fill value, which is used to indicate array elements that do not contain valid data. Where applicable, SI units should be used and described by a character string, which is compatible with the Unidata UDUNITS-2 package [AD-8].

All GlobCurrent files conform to this structure and share a common set of NetCDF global attributes. These global attributes include those required by the CF Convention plus additional ones required by the GlobCurrent. The required set of global attributes is described in Section 4.2 and GlobCurrent producers are free to add their own, as long as they do not contradict the GlobCurrent and CF requirements.

Following the CF convention, each variable also has a set of variable attributes. The required variable attributes are described in Section 4.3. In a few cases, some of these variable attributes may not be relevant for certain variables or additional variable attributes may be required. In those cases, the variable descriptions in each of the GlobCurrent product specifications (Sections 5 to 10) will identify the differences and specify requirements for each product. As with the global attributes, GlobCurrent are free to add their own variable attributes, as long as they do not contradict the GlobCurrent and CF requirements.

The data type encodings for each variable are fixed except for the experimental fields, which are flexible and can be chosen by the producing RDAC. **We recommend not to use any scaling or offset (usually through `scale_factor` and `add_offset` attributes) but to store plain values.** Clipping the data values (removing unnecessary precision digits) can greatly improve the file volume.

## 4.2. GlobCurrent NetCDF Global Attributes

Table 4.1 below summarizes the global attributes that are mandatory for every GlobCurrent NetCDF data file. More details on the CF-mandated attributes (as indicated in the Source column) are available at: <http://cfconventions.org/Data/cf-conventions/cf-conventions-1.6/build/cf-conventions.html#attribute-appendix> and information on the ACDD recommendations is available at <http://www.unidata.ucar.edu/software/netcdf-java/formats/DataDiscoveryAttConvention.html>.

*Table 4.1: Mandatory global attributes for GlobCurrent NetCDF data files (attributes in green applies only to in situ data files, attributes in orange are optional and reserved for some products)*

| Global Attribute Name | Format | Description  | Source |
|-----------------------|--------|--|--------|
| <b>Conventions</b>    | string | A text string identifying the netCDF conventions followed. This attribute should be set to the version of CF used and should also include the ACDD. For example: "CF-1.4, Unidata Observation Dataset v1.0". | CF     |

|                                 |        |   |          |
|---------------------------------|--------|---|----------|
| <b>title</b>                    | string | The "title" attribute gives a brief description of the dataset. Its use is highly recommended and its value will be used by THREDDS as the name of the dataset. It therefore should be human readable and reasonable to display in a list of such names. The "title" attribute is recommended by the " <a href="#">NetCDF Users Guide</a> " and the <a href="#">CF convention</a> .   | CF, ACDD |
| <b>summary</b>                  | string | The "summary" attribute gives a longer description of the dataset. Its use is highly recommended. In many discovery systems, the title and the summary will be displayed in the results list from a search. It should therefore capture the essence of the dataset it describes. For instance, we recommend this field include information on the type of data contained in the dataset, how the data was created (e.g., instrument X; or model X, run Y), the creator of the dataset, the project for which the data was created, the geospatial coverage of the data, and the temporal coverage of the data. This should just be a summary of this information, more detail should be provided in the recommended creator attributes, the recommended geospatial attributes, and the recommended temporal attributes. | ACDD     |
| <b>references</b>               | string | Published or web-based references that describe the data or methods used to produce it.   | CF       |
| <b>institution</b>              | string | Institution which the data originally come from. If a dataset is a simple reformatting without any modification the source institution is to be used.<br>See table 4.2for available codes.  | CF, ACDD |
| <b>institution_abbreviation</b> | string | Abbreviation of the above full institution name. See table 4.2for available codes.  | CF, ACDD |



|                            |        |   |          |
|----------------------------|--------|---|----------|
| <b>history</b>             | string | The "history" attribute provides an audit trail for modifications to the original data. It should contain a separate line for each modification with each line including a timestamp, user name, modification name, and modification arguments. Its use is recommended and its value will be used by THREDDS as a history-type documentation. The "history" attribute is recommended by the <a href="#">NetCDF Users Guide</a> and the <a href="#">CF convention</a> .                | CF, ACDD |
| <b>comment</b>             | string | Miscellaneous information about the data or methods used to produce it.   | CF, ACDD |
| <b>license</b>             | string | Describe any restrictions to data access, use, and distribution. GlobCurrent data sets should be freely and openly available to comply with the R/GTS framework, with no restrictions. However, if a user should submit a simple registration via a web form, for example, the URL could be given here. Default to “ GlobCurrent protocol describes data use as free and open.”   | ACDD     |
| <b>id</b>                  | string | The unique character string for this product. All products have one, and they are listed in table 3.5   | ACDD     |
| <b>naming_authority</b>    | string | The "id" and "naming_authority" attributes are intended to provide a globally unique identification for each dataset. The "id" value should attempt to uniquely identify the dataset. The naming authority allows a further refinement of the "id". The combination of the two should be globally unique for all time. We recommend using reverse-DNS naming for the naming authority. For example, naming_authority="org.globcurrent" and id="WW3/hindcast_global_050_stokes_drift". | ACDD     |
| <b>product_version</b>     | string | The product version of this data file   | GC       |
| <b>processing_software</b> | string | Name and version of the processing software   | GC       |

|                                 |         |  |      |
|---------------------------------|---------|--|------|
| <b>uuid</b>                     | string  | A Universally Unique Identifier (UUID). Numerous, simple tools can be used to create a UUID, which is inserted as the value of this attribute. See <a href="http://en.wikipedia.org/wiki/Universally_Unique_Identifier">http://en.wikipedia.org/wiki/Universally_Unique_Identifier</a> for more information and tools. | GC   |
| <b>globcurrent_version_id</b>   | string  | GlobCurrent format version used to create this data file. For example, "1.0".  | GC   |
| <b>netcdf_version_id</b>        | string  | Version of NetCDF libraries used to create this file. For example, "'4.1.1 of Dec 22 2011 16:33:39 \$'"  | GC   |
| <b>date_created</b>             | string  | The date and time the data file was created in the form "yyyymmddThhmmssZ". This time format is ISO 8601 compliant.  | ACDD |
| <b>date_modified</b>            | string  | Product last modification date in the form "yyyymmddThhmmssZ". This time format is ISO 8601 compliant.   | ACDD |
| <b>file_quality_level</b>       | integer | A code value:<br>0 = unknown quality<br>1 = extremely suspect (frequent problems, e.g. with known satellite problems)<br>2 = suspect (occasional problems, e.g. after launch)<br>3 = excellent (no known problems)   | GC   |
| <b>spatial_resolution</b>       | string  | A string describing the approximate resolution of the product. For example, "1.1km at nadir"   | GC   |
| <b>time_coverage_resolution</b> | string  | The resolution provides an idea of the density of the data inside the time range and should be an ISO8601 duration string (e.g., "P10D").  | ACDD |

|                                |        |  |      |
|--------------------------------|--------|--|------|
| <b>time_coverage_start</b>     | string | <p>Representative date and time of the start of the granule in the ISO 8601 compliant format of “yyyymmddThhmmssZ”. The exact meaning of this attribute depends the type of granule:</p> <ul style="list-style-type: none"> <li>• L2P: first measurement in granule (identical to ‘time’ netCDF variable)</li> <li>• L3U: start time of granule</li> <li>• L3C and L3S: representative start time of first measurement in the collation</li> <li>• L4: representative start time of the analysis (start_time and stop_time together represent the valid period of the L4 granule)</li> </ul> | ACDD |
| <b>time_coverage_end</b>       | string | <p>Representative date and time of the end of the granule in the ISO 8601 compliant format of “yyyymmddThhmmssZ”. The exact meaning of this attribute depends the type of granule:</p> <ul style="list-style-type: none"> <li>• L2P: last measurement in granule</li> <li>• L3U: stop time of granule</li> <li>• L3C and L3S: representative stop time of last measurement in collation</li> <li>• L4: representative stop time of the analysis (start_time and stop_time together represent the valid period of the L4 granule)</li> </ul>  | ACDD |
| <b>geospatial_lat_max</b>      | float  | Decimal degrees north, range -90 to +90.   | ACDD |
| <b>geospatial_lat_min</b>      | float  | Decimal degrees north, range -90 to +90.   | ACDD |
| <b>geospatial_lon_max</b>      | float  | Decimal degrees east, range -180 to +180.  | ACDD |
| <b>geospatial_lon_min</b>      | float  | Decimal degrees east, range -180 to +180.  | ACDD |
| <b>geospatial_vertical_min</b> |        | <p>Use the min attribute to describe a simple vertical minimum depth or height. If <b>geospatial_vertical_units</b> is not used, vertical is assumed to be in meters above ground.</p> <p>Further refinement of the geospatial bounding box can be provided by using the units and resolution attributes.</p>  | ACDD |

|                                     |        |  |      |
|-------------------------------------|--------|--|------|
| <b>geospatial_vertical_max</b>      |        | Use the max attribute to describe a simple vertical maximum depth or height. If <b>geospatial_vertical_units</b> is not used, vertical is assumed to be in meters above ground.<br><br>Further refinement of the geospatial bounding box can be provided by using the units and resolution attributes. | ACDD |
| <b>geospatial_vertical_units</b>    | string | meters   | ACDD |
| <b>geospatial_vertical_positive</b> | string | The <b>geospatial_vertical_positive</b> attribute indicates which direction is positive (a value of "up" means that z increases up, like units of height, while a value of "down" means that z increases downward, like units of pressure or depth).   | ACDD |
| <b>nominal_latitude</b>             | float  | Location latitude of acquisition platform. Only used in case of a fixed station (ex: moored buoy). This may differ from the actual GPS location provided in lat/lon variable. Decimal degrees north, range -90 to +90.   | GC   |
| <b>nominal_longitude</b>            | float  | Location longitude of acquisition platform. Only used in case of a fixed station (ex: moored buoy). This may differ from the actual GPS location provided in lat/lon variable. Decimal degrees east, range -180 to +180.   |      |
| <b>source</b>                       | string | Comma separated list of all source data present in this file. List current sources first, followed by Auxiliary sources. If the source is a GlobCurrent product, use the GlobCurrent unique string listed in 3.5. For other sources, following the best practice described in Section 3.5.             | CF   |
| <b>source_version</b>               | string | The version of the source data used, as provided by the original producer  |      |
| <b>wmo_id</b>                       | string | WMO identifier, if any. Use the source provider id if no WMO identifier is existing for this platform.   | GC   |

|  |        |   |    |
|--|--------|---|----|
| <b>buoy_network</b>                    | string | Identifier of the observation network to which the platform belongs to. Use one of the values provided in table 4.5.  | GC |
| <b>station_name</b>                    | string | Full name of the station (usually a location)   | GC |
| <b>station_id</b>                      | string | Identifier of the station in network (this is the provider id which may be different from the WMO id).  | GC |
| <b>sea_floor_depth_below_sea_level</b> | float  | Positive value in meters.   | GC |
| <b>site_elevation</b>                  | float  | Positive value in meters (for platforms on land such as lighthouses).   | GC |
| <b>platform</b>                        | string | Satellite(s) used to create this data file. Select from the entries found in the Satellite Platform column of table 3.5 and provide as a comma separated list if there is more than one.  | GC |
| <b>platform_type</b>                   | string | Type of platform. Select from the entries found in the platform type table 3.5.   | GC |
| <b>sensor</b>                          | string | Sensor(s) used to create this data file. Select from the entries found in the Satellite Sensor column of table 3.5 and provide as a comma separated list if there is more than one.   | GC |
| <b>band</b>                            | string | Name of the sensing band used. Can be: <ul style="list-style-type: none"> <li>• a band name for microwave sensors (C, Ku, Ka, L,...)</li> <li>• a wavelength for optical or infra-red sensors</li> <li>• a derived product such as Chl-a, SST, SPM, ...)</li> </ul> | GC |
| <b>sensor_description</b>              | string | Free description of the instrument  | GC |
| <b>sensor_manufacturer</b>             | string | Name of the company responsible for the instrument construction   | GC |
| <b>sensor_serial_number</b>            | string | Serial number of the instrument, following the manufacturer convention.   | GC |
| <b>sensor_install_date</b>             | string | Date and time at which the instrument was installed on the platform (buoy or ship), in the ISO 8601 compliant format of “yyyymmddThhmmssZ”.   | GC |

|                                |             |   |      |
|--------------------------------|-------------|---|------|
| <b>sensor_height</b>           | string      | Height (positive) or depth (negative) above sea surface at which the instrument is fixed, in meters.  | GC   |
| <b>sensor_sampling_period</b>  | string      | Sampling period of the instrument, in seconds. Applicable for instance to anemometer and wave sensors.  | GC   |
| <b>sensor_sampling_rate</b>    | string      | Sampling rate of the instrument, In Hz  | GC   |
| <b>sensor_calibration_date</b> | string      | Date and time at which the sensor was last calibrated, in the ISO 8601 compliant format of “yyyymmddThhmmssZ”.  | GC   |
| <b>sensor_history</b>          | String list | List of events or interventions on the sensor in the time interval covered by the data file. Specify a date and time in the ISO 8601 compliant format of “yyyymmddThhmmssZ” for each entry in this table. Includes for instance any maintenance operation or malfunction event.   | GC   |
| <b>sensor_type</b>             | string      | Type of sensor. Select from the entries found in the sensor type table 4.3  | GC   |
| <b>Metadata_Conventions</b>    | string      | Unidata Dataset Discovery v1.0  | ACDD |
| <b>metadata_link</b>           | string      | Link to collection metadata record at archive   | ACDD |
| <b>keywords</b>                | string      | The "keywords" attribute lists key words and phrases that are relevant to the dataset. Its use is highly recommended. The values in the list may be taken from a controlled list of keywords (e.g., the AGU Index list or the GCMD Science Keywords). If a controlled list is used, the "keywords_vocabulary" attribute may be used to identify the list. | ACDD |

|                                  |        |  |      |
|----------------------------------|--------|--|------|
| <b>keywords_vocabulary</b>       | string | The "keywords_vocabulary" attribute identifies the controlled list of keywords from which the values in the "keywords" attribute are taken. If you are following a guideline for the words/phrases in your "keywords" attribute, put the name of that guideline here. The use of this attribute is recommended and its value will be used by THREDDS to identify the vocabulary from which the keywords come. GlobCurrent recommends "NASA Global Change Master Directory (GCMD) Science Keywords" as defined in [AD-12] | ACDD |
| <b>standard_name_vocabulary</b>  | string | "NetCDF Climate and Forecast (CF) Metadata Convention"   | ACDD |
| <b>geospatial_lat_units</b>      | string | Units of the latitudinal resolution. Typically "degrees_north"   | ACDD |
| <b>geospatial_lat_resolution</b> | float  | Latitude Resolution in units matching <b>geospatial_lat_units</b> .  | ACDD |
| <b>geospatial_lon_units</b>      | string | Units of the longitudinal resolution. Typically "degrees_east"   | ACDD |
| <b>geospatial_lon_resolution</b> | float  | Longitude Resolution in units matching <b>geospatial_lon_resolution</b> .  | ACDD |
| <b>acknowledgement</b>           | string | A place to acknowledge various type of support for the project that produced this data.  | ACDD |
| <b>creator_name</b>              | string | Provide a name and email address for the most relevant point of contact at the producing organization or agency, as well as a URL relevant to this data set.   | ACDD |
| <b>creator_email</b>             | string |  | ACDD |
| <b>creator_url</b>               | string |  | ACDD |
| <b>project</b>                   | string | The "project" attribute provides the name of the scientific project for which the data was created. Example : "GlobCurrent"  | ACDD |
| <b>publisher_name</b>            | string | Name of the distributing agency (Ifremer/CERSAT for GlobCurrent)   | ACDD |
| <b>publisher_url</b>             | string | URL of the distributing agency ( <a href="http://cersat.ifremer.fr">http://cersat.ifremer.fr</a> )   | ACDD |
| <b>publisher_email</b>           | string | Email of help desk or contact point of the distributing agency   | ACDD |

|                                   |        |  |          |
|-----------------------------------|--------|--|----------|
| <b>processing_level</b>           | string | GHRSSST definitions are the options: L2 L3U, L3C, L3S, L4  | ACDD, GC |
| <b>cdm_data_type</b>              | string | Data feature type (point, station, swath, grid,...) as defined by Unidata CDM model : <a href="http://www.unidata.ucar.edu/software/netcdf-java/CDM/">http://www.unidata.ucar.edu/software/netcdf-java/CDM/</a>                | ACDD     |
| <b>analysis_period_start_time</b> | string | Reserved for products using the maximum cross correlation (or similar) method.<br><br>Representative date and time of the start of the data used in the MCC calculation in the ISO 8601 compliant format of “yyyymmddThhmmssZ” | GC       |
| <b>analysis_period_end_time</b>   | string | Reserved for products using the maximum cross correlation (MCC) method.<br><br>Representative date and time of the end of the data used in the MCC calculation in the ISO 8601 compliant format of “yyyymmddThhmmssZ”          | GC       |
| <b>template_size</b>              | string | Reserved for products using the maximum cross correlation (or similar) method.<br><br>Size of match-up template ('20 km', ...)   | GC       |
| <b>correlation_threshold</b>      | string | Reserved for products using the maximum cross correlation (or similar) method.<br><br>Threshold for the correlation over which the MCC is deemed reliable  | GC       |

The following tables provide the reference codes for some of the above attributes (for which a reference is made to these tables). New codes are assigned by the GlobCurrent team and entered upon request..

*Table 4.2: list of currently identified producing organizations and corresponding acronyms*

| <b>Organization full name</b>                                | <b>Acronym or short name</b> |
|--|------------------------------|
| Institut Francais de Recherche pour l'Exploitation de la Mer | Ifremer                      |
| Collecte Localisation Satellite                              | CLS                          |



|   |          |
|---|----------|
| Nansen Environmental and Remote Sensing Cente | NERSC    |
| Plymouth Marine Laboratory                    | PML      |
| isardSat                                      | isardSat |

Table 4.3: list of currently identified types of satellite sensors

| Sensor code          | Description  |
|----------------------|--|
| altimeter            | Onboard Jason-x, Envisat, Cryosat-2,...                        |
| sar                  | Synthetic Aperture Radar: onboard ERS, Envisat, Sentinel-1,... |
| infrared radiometer  | Onboard NOAA-xx, MSG-xx, METOP-x,...                           |
| microwave radiometer | AMSR-E, AMSR2, SMOS,...  |
|                      |  |

Table 4.4: list of currently identified types of observation platforms

| Platform code           | Description   |
|-------------------------|---|
| leo satellite           | Low earth orbit satellite, including for instance all polar orbiting satellites: ERS, EnviSAT, METOP, ... |
| geostationary satellite | Satellite in geostationary orbit:   |
| moored buoy             |   |
| drifting buoy           |   |
| ship                    |   |
| argo                    | Float from ARGO program   |

Table 4.5: list of currently identified buoy observation networks

| Network full name                  | Acronym or short name |
|------------------------------------|-----------------------|
| National Oceanographic Data Center | NODC                  |
|                                    |                       |
|                                    |                       |

Example for a file containing observation by a moored buoy:

```

:Conventions = "CF-1.6" ;
:netcdf_version_id = "4.1.1 of Dec 22 2011 16:33:39 $" ;
:date_created = "2012-05-02T05:25:SZ" ;

```

```

:id = "51002" ;
:naming_authority = "WMO" ;
:wmo_id = "51002" ;
:institution = "National Oceanographic Data Center" ;
:institution_abbreviation = "NODC" ;
:buoy_network = "NDBC" ;
:title = "Buoy observation from NODC provided for GlobWave
project" ;
:summary = ;
:station_name = ;
:sea_floor_depth_below_sea_level = 5001.8 ;
:site_elevation = 0. ;
:cdm_feature_type = "station" ;
:scientific_project = "GlobWave" ;
:restrictions = "Restricted to Ifremer and GlobWave usage" ;
:format_version = "2.0" ;
:history = "1.0 : Processing to GlobWave netCDF format" ;
:publisher_name = "Ifremer/Cersat" ;
:publisher_url = "http://cersat.ifremer.fr" ;
:publisher_email = "jfpiolle@ifremer.fr" ;
:creator_url = "http://cersat.ifremer.fr" ;
:creator_email = "jfpiolle@ifremer.fr" ;
:date_modified = ;
:processing_software = "Globwave python lib v1.0" ;
:references = ;
:data_source = "51002_201101" ;
:nominal_latitude = 17.0941666666667 ;
:nominal_longitude = -157.8075 ;
:geospatial_lat_min = 17.0941666666667 ;
:geospatial_lat_max = 17.0941666666667 ;
:geospatial_lat_units = "degrees" ;
:geospatial_lon_min = -157.8075 ;
:geospatial_lon_max = -157.8075 ;
:geospatial_lon_units = "degrees" ;
:geospatial_vertical_min = 0. ;
:geospatial_vertical_max = 0. ;
:geospatial_vertical_units = "meters above mean sea level" ;
:platform_type = ;
:sensor_type = "Directional accelerometer" ;
:sensor_description = ;
:sensor_manufacturer = ;
:sensor_part_number = ;
:sensor_serial_number = ;
:sensor_install_date = ;
:sensor_height = ;
:sensor_sampling_period = 20. ;
:sensor_sampling_rate = 1.706666666666667 ;
:sensor_calibration_date = ;
:sensor_history = ;
:time_coverage_start = "2011-01-01T00:40:00Z" ;
:time_coverage_stop = "2011-01-31T23:40:00Z" ;

```

### 4.3. GlobCurrent netCDF Variable Attributes

Table 4.6: Variable attributes for GlobCurrent netCDF data files

| Variable Attribute Name | Format                                  | Description  | Source   |
|-------------------------|---|--|----------|
| <b>_FillValue</b>       | Must be the same as the variable type   | A value used to indicate array elements containing no valid data. This value must be of the same type as the storage (packed) type; should be set as the minimum value for this type. Note that some netCDF readers are unable to cope with signed bytes and may, in these cases, report fill as 128. Some cases will be reported as unsigned bytes 0 to 255. Required for the majority of variables except coordinates, mask and flags. | CF       |
| <b>units</b>            | string                                  | Text description of the units, preferably S.I., and must be compatible with the Unidata UDUNITS-2 package [AD-8]. For a given variable (e.g. wind speed), these must be the same for each dataset. Required for the majority of variables except mask, quality_level, and l2p_flags.   | CF, ACDD |
| <b>long_name</b>        | string                                  | A free-text descriptive variable name.   | CF, ACDD |
| <b>valid_min</b>        | Expressed in same data type as variable | Minimum valid value for this variable (in storage type). The fill value should be outside this valid range. Note that some netCDF readers are unable to cope with signed bytes and may, in these cases, report valid min as 129. Some cases as unsigned bytes 0 to 255. Values outside of <b>valid_min</b> and <b>valid_max</b> will be treated as missing values. Required for all variables except variable time.                      | CF       |

|                      |   |   |          |
|----------------------|---|---|----------|
| <b>valid_max</b>     | Expressed in same data type as variable | Maximum valid value for this variable (in storage type). The fill value should be outside this valid range. Note that some netCDF readers are unable to cope with signed bytes and may, in these cases, report valid min as 127. Required for all variables except variable time.   | CF       |
| <b>standard_name</b> | string                                  | Where defined, a standard and unique description of a physical quantity. For the complete list of standard name strings, see [AD-11]. <b>Do not</b> include this attribute if no <code>standard_name</code> exists.   | CF, ACDD |
| <b>comment</b>       | string                                  | Miscellaneous information about the variable or the methods used to produce it.   | CF       |
| <b>source</b>        | string                                  | Used when the source for a variable is different from the main data source described in the global attribute <b>source</b> (this is the case for instance of ancillary variables).<br><br>For a data variable with a single source, use the GlobCurrent unique string listed in 3.5. If entries are missing, please contact the GlobCurrent team that will update the table accordingly.<br><br>If the data variable contains multiple sources, follow the <b>source</b> convention used for the global attribute of the same name, but provide in the comma-separated list only the sources relevant to this variable. | CF       |
| <b>references</b>    | string                                  | Published or web-based references that describe the data or methods used to produce it. Note that while at least one reference is required in the global attributes (See table 4.1), references to this specific data variable may also be given.   | CF       |

|                      |                                       |   |    |
|----------------------|---------------------------------------|---|----|
| <b>axis</b>          | String                                | For use with coordinate variables only. The attribute ‘axis’ may be attached to a coordinate variable and given one of the values “X”, “Y”, “Z”, or “T”, which stand for a longitude, latitude, vertical, or time axis respectively. See: <a href="http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.4/cf-conventions.html#coordinate-types">http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.4/cf-conventions.html#coordinate-types</a>   | CF |
| <b>positive</b>      | String                                | For use with a vertical coordinate variables only. May have the value “up” or “down”. For example, if an oceanographic netCDF file encodes the depth of the surface as 0 and the depth of 1000 meters as 1000 then the axis would set positive to “down”. If a depth of 1000 meters was encoded as -1000, then positive would be set to “up”.   | CF |
| <b>coordinates</b>   | String                                | Identifies auxiliary coordinate variables, label variables, and alternate coordinate variables. See the section on coordinate-system in 4.5. This attribute must be provided if the data are on a non-regular lat/lon grid (map projection or swath data).  | CF |
| <b>grid_mapping</b>  | String                                | Use this for data variables that are on a projected grid. The attribute takes a string value that is the name of another variable in the file that provides the description of the mapping via a collection of attached attributes. That named variable is called a <i>grid mapping variable</i> and is of arbitrary type since it contains no data. Its purpose is to act as a container for the attributes that define the mapping. See the section on mappings-and-projections in 4.5. | CF |
| <b>flag_meanings</b> | String                                | Space-separated list of text descriptions associated in strict order with conditions set by either flag_values or flag_masks. Words within a phrase should be connected with underscores.   | CF |
| <b>flag_values</b>   | Must be the same as the variable type | Comma-separated array of valid, mutually exclusive variable values (required when the bit field contains enumerated values; i.e., a “list” of conditions). Used primarily for <b>quality_level</b> variable.  | CF |

|                         |                                       |   |    |
|-------------------------|---------------------------------------|---|----|
| <b>flag_masks</b>       | Must be the same as the variable type | <p>Comma-separated array of valid variable masks (required when the bit field contains independent Boolean conditions; i.e., a bit “mask”). Used primarily for <b>l2p_flags</b> variable.</p> <p><i>Note: CF allows the use of both flag_masks and flag_values attributes in a single variable to create sets of masks that each have their own list of flag_values (see <a href="http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.5/ch03s05.html#id2710752">http://cf-pcmdi.llnl.gov/documents/cf-conventions/1.5/ch03s05.html#id2710752</a> for examples), but this practice is discouraged.</i></p> | CF |
| <b>depth</b>            | String                                | <p>Use this to indicate the depth for which the current data are valid.</p> <p>Follow the same rule as for parameter string to expressed depth, as defined in section 3.4</p>   | GC |
| <b>height</b>           | String                                | <p>Use this to indicate the height for which the wind (or any atmosphere) data are specified.</p>   | GC |
| <b>horizontal_scale</b> | String                                | <p>For ocean current measurement. Use this to indicate the horizontal spatial scale range of the retrieved ocean current. This is different from the resolution of a product.</p> <p>Use two values followed by a unit, or terms such as 'greater than' or 'lower than'. Examples: '100-500 km', 'greater than 100 km',...</p>  | GC |
| <b>temporal_scale</b>   | String                                | <p>For ocean current measurement. Use this to indicate the temporal scale range of the retrieved ocean current. This is different from the frequency of a product (for instance altimeter geostrophic current can be provided as daily grids whereas they are actually processed over a sliding window of ten days of data: the temporal scale is 10 days.</p> <p>Use a value followed by the time unit. Example: '10 days'.</p>  | GC |

|                    |        |  |  |
|--------------------|--------|--|--|
| <b>limitations</b> | String | Free text to indicate the limitations (in terms of validity and accuracy) of the retrieved parameter.<br>For instance, for a SAR-doppler retrieved Eulerian current, the following statement could be used: <i>'current retrieval is subject to high caution in the case of low wind speed conditions over the covered area'</i> |  |
|--------------------|--------|--|--|

#### 4.4. Definitions of storage types within GlobCurrent

Computer storage types referred to in this document are defined in table 4.7 and follow those used in netCDF.

Table 4.7: Storage type definitions used in the GDS

| Name          | Storage Type          |
|---------------|-----------------------|
| byte          | 8 bit signed integer  |
| short         | 16 bit signed integer |
| int (or long) | 32 bit signed integer |
| float         | 32 bit floating point |
| double        | 64 bit floating point |
| string        | Character string      |

#### 4.5. GlobCurrent coordinate variable definitions

NetCDF coordinate variables provide scales for the space and time axes for the multidimensional data arrays, and must be included for all dimensions that can be identified as spatio-temporal axes. Coordinate arrays are used to geolocate data arrays on non-orthogonal grids, such as images in the original pixel/scan line space, or complicated map projections. Required attributes are **units** and **\_FillValue**. Elements of the coordinate array need not be monotonically ordered. The data type can be any and scaling may be implemented if required. **add\_offset** and **scale\_factor** have to be adjusted according to the sensor resolution and the product spatial coverage. If the packed values can not stand on a short, float can be used instead (multiplying the size of these variables by two).

'**time**' is the reference time of the current data array. GlobCurrent specifies that this reference time should be extracted or computed to the nearest second and then coded as continuous UTC time coordinates in **seconds from 00:00:00 UTC January 1, 1981** (which is the definition of the **GlobCurrent origin time**, chosen to approximate the start of operational satellite (AVHRR) data record). Note that the use of UDUNITS in GlobCurrent implies that that calendar to be used is the default mixed Gregorian/Julian calendar.

The reference time used is dependent on the <Processing Level> of the data and is defined as follows:

- L2P: start time of granule;
- L3U: start time of granule;
- L3C and L3S: centre time of the collation window;
- L4: nominal time of the analysis

The coordinate variable '**time**' stores the reference time in seconds for each current pixel. '**time**' also facilitates aggregation of all files of a given dataset along the time axis with such tools as THREDDS and LAS (this applies to gridded data only).

In the case of a product averaged over a large period of time, such as a global climatology, the conventions described in CF convention [AD-6] must be followed.

For instance when averaging several SAR acquisitions to produce a single mean map, the value in variable '**time**' variable should be the date of the first acquisition taken into account in the averaging process. An additional variable, **climatology\_bounds**, gives the first and last acquisition date taken into account in the averaging process, as shown in the example below:

*Table 4.8: temporal dimension and variables for a mean climatological field*

```
dimensions:
  time=1;
  nv=2;
  float time(time);
  time:climatology="climatology_bounds";
  time:units="days since 2000-1-1";
  float climatology_bounds(time,nv);
```

x (columns) and y (lines) grid dimensions are referred either as:

- '**lat**' and '**lon**' if data are mapped on a regular grid (some geostationary products).
- '**ni** and '**nj**' are used if data are mapped on a non-regular grid (curvilinear coordinates)
- 'cell' and 'row' for sensor scanning pattern (scan line, swath). "cell" must be used for the across-track dimension and '**row**' for the along-track dimension.

Note that all products are not gridded: for instance along-track data (e.g. altimeters) or trajectories (buoys, ships,...): in such case the main data dimension is 'time' if the data are chronologically ordered.

Coordinate vectors are used for data arrays located on orthogonal (but not necessarily regularly spaced) grids, such as a geographic (lat-lon) map projections. The only required attribute is



**units.** The elements of a coordinate vector array should be in monotonically increasing or decreasing order. The data type can be any and scaling may be implemented if required.

A **coordinate's** variable (= "**lon lat**"): must be provided if the data are on a non-regular lat/lon grid (map projection or swath data).

A **grid\_mapping** (= "projection name"): must be provided if the data are mapped following a projection. Refer to the CF convention [AD-6] for standard projection names.

### 4.5.1. Regular latitude/longitude grids

This is the simplest case. Many L3 and L4 products as well as some geostationary L2 products are provided on a regular lat/lon grid. On such a projection, only two coordinate variables are requested and they can be stored as vector arrays. Longitudes should range from -180 to +180, corresponding to 180 degrees West to 180 degrees East. Latitudes should range from -90 to +90, corresponding to 90 degrees South to 90 degrees North. There should be no **\_FillValue** for latitude and longitude and all pixels should have a valid value latitude and longitude.

Time can be a single value (all pixels in the file have the same time: this is the case of virtually all L4 products) or a two-dimensional array (a different time is set for each pixel: this can be the case of some L3).

When a different value is provided for each pixel, the dimensions of variable **time** are the same as for variables **lat** and **lon**. There is no dimension **time** in the file. The following CDL is provided as an example:

```
netcdf example {
  dimensions:
    lat = 1801 ;
    lon = 3600 ;
  variables:
    ...
}
```

In the case of a single value for all pixels, it is recommended that the **time** dimension be specified as **unlimited**. Although in L3 and L4 granules there is only one time dimension (**time=1**) and variable **time** has only one value (seconds since 1981), setting an unlimited dimension for **time** will allow netCDF tools and utilities to easily concatenate (and average for example) a series of time consecutive granules. The following CDL is provided as an example:

```
netcdf example {
  dimensions:
    lat = 1801 ;
    lon = 3600 ;
    time = UNLIMITED ;
  variables:
    ...
}
```

For these cases, **dimension** and **coordinate** variables shall be used for a regular lat/lon grid as shown in table 4.8. No specific variable attributes are required for other variables (like **northward\_geostrophic\_current\_velocity** as shown in the example given in table 4.9).

*Table 4.9: Example CDL for geographic regular latitude/longitude grids in the case of a single time value for all pixels*

```

dimensions:
    lon = 7200 ;
    lat = 521 ;
    time = 1 ;

variables:
    float lon(lon) ;
        lon:standard_name = "longitude" ;
        lon:long_name = "longitude" ;
        lon:units = "degrees_east" ;
        lon:axis = "X" ;
        lon:comment = "geographical coordinates, WGS84 projection" ;
    float lat(lat) ;
        lat:standard_name = "latitude" ;
        lat:long_name = "latitude" ;
        lat:units = "degrees_north" ;
        lat:axis = "Y" ;
        lat:comment = "geographical coordinates, WGS84 projection" ;
    int time(time) ;
        time:standard_name = "time" ;
        time:long_name = "reference time of SST field" ;
        time:units = "seconds since 1981-01-01 00:00:00" ;
        time:axis = "T" ;
        time:calendar = "standard" ;

```

The dimensions of a variable will then be (time, lat, lon) :

*Table 4.10: example CDL of a geophysical variable in regular lat/lon grid*

```

float northward_geostrophic_current_velocity(time, lat, lon) ;
    northward_geostrophic_current_velocity:standard_name =
"surface_geostrophic_northward_sea_water_velocity" ;
    northward_geostrophic_current_velocity:long_name = "northward
geostrophic velocity" ;
    northward_geostrophic_current_velocity:units = "m s-1" ;
    northward_geostrophic_current_velocity:valid_min = -10.f ;
    northward_geostrophic_current_velocity:valid_max = 10.f ;
    northward_geostrophic_current_velocity:_FillValue =
-3.40282e+38 ;

```

#### 4.5.2. Non-regular latitude/longitude grids (projection)

For gridded data using a specific projection (such as stereographic projection), lat/lon have to be stored in 2-D arrays. When data are gridded following the sensor pattern, no projection can be associated and lat/lon data have to be stored in 2-D arrays. Dimensions cannot be referred to as lat/lon any more since the x and y axes of the grid are not related to the latitude or longitude axis. Each variable must explicitly provide a reference to its coordinate variables (**coordinates** variable attribute) and to the related projection (**grid\_mapping** variable attribute) described in

a specific variable (for example, **stereographic\_polar** in the example given in table 4.10; refer to CF convention [AD-11] for standard names).

In these cases, **dimension** and **coordinate** variables shall be used for a non-regular lat/lon grid (projection) as shown in table 4.10. A specific projection coordinate variable shall be added (for example, **polar\_stereographic**), following the CF-1.6 convention. The specific variable attributes `'coordinates = "lon lat"'` and `'grid_mapping = "polar_stereographic"'` are required for each other variables (like `'northward_geostrophic_current_velocity'` in the example given in table 4.12). If the projection has additional information e.g. polar\_projection details, these shall be included in the **comment** attribute.

Note that variable attributes such as **grid\_mapping** may be set differently (when using a different kind of projection) or completely removed (for swath products or regular grids if required).

The dimension and variable **time** are addressed in the same way as for regular lat/lon grids.

*Table 4.11: Example CDL for non-regular latitude/longitude grids (projections) in the case of a single time value for all pixels*

```

dimensions:
    time = 1 ;
    ni = 790 ;
    nj = 830 ;

variables:
    int Polar_Stereographic_Grid ;
        Polar_Stereographic_Grid:grid_mapping_name = "polar_stereographic" ;
        Polar_Stereographic_Grid:straight_vertical_longitude_from_pole = 0.f ;
        Polar_Stereographic_Grid:latitude_of_projection_origin = -90.f ;
        Polar_Stereographic_Grid:standard_parallel = -70.f ;
        Polar_Stereographic_Grid:false_easting = 0.f ;
        Polar_Stereographic_Grid:false_northing = 0.f ;
        Polar_Stereographic_Grid:semi_major_axis = 6378273.f ;
        Polar_Stereographic_Grid:semi_minor_axis = 6356890.f ;
        Polar_Stereographic_Grid:proj4_string = "+proj=stere +a=6378273 +b=6356889.44891 +lat_0=-90 +lat_ts=-70 +lon_0=0" ;
    double time(time) ;
        time:axis = "T" ;
        time:long_name = "reference time of product" ;
        time:standard_name = "time" ;
        time:units = "seconds since 1978-01-01 00:00:00" ;
        time:calendar = "standard" ;
    float lat(nj, ni) ;
        lat:long_name = "latitude coordinate" ;
        lat:standard_name = "latitude" ;
        lat:units = "degrees_north" ;
    float lon(ni, nj) ;
        lon:long_name = "longitude coordinate" ;
        lon:standard_name = "longitude" ;
        lon:units = "degrees_east" ;

```

The dimensions of a variable will then be (time, nj, ni) :

*Table 4.12: example CDL of a geophysical variable in non-regular lat/lon grid*

```

float northward_geostrophic_current_velocity(time, lat, lon) ;
    northward_geostrophic_current_velocity:standard_name =
"surface_geostrophic_northward_sea_water_velocity" ;
    northward_geostrophic_current_velocity:long_name = "northward
geostrophic velocity" ;
    northward_geostrophic_current_velocity:units = "m s-1" ;
    northward_geostrophic_current_velocity:valid_min = -10.f ;
    northward_geostrophic_current_velocity:valid_max = 10.f ;
    northward_geostrophic_current_velocity:_FillValue =
-3.40282e+38 ;
    northward_geostrophic_current_velocity :grid_mapping =
"Polar_Stereographic_Grid" ;
    northward_geostrophic_current_velocity:coordinates = "lat lon" ;

```

### 4.5.3. Swath grids

In this case where data are gridded following the sensor pattern, no projection can be associated and lat/lon data have to be stored in 2-D arrays. Dimensions cannot be referred to as lat/lon anymore since x and y axes of the grid are no more related to the latitude or longitude axis. Instead, dimensions row and cell should be used to describe the swath. As a best practice, the cell dimension should refer to the cross-track direction and the dimension row should refer to the along-track direction of a polar orbiting (or similar) satellite sensor swath. For geostationary sensors ni also refers to the cross-disk direction and nj the along-disk direction. Each variable must explicitly provide a reference to its coordinate variables (using the **coordinates** variable attribute).

Dimension and coordinate variables shall be used for a non-regular lat/lon grid (swath product file) as shown in table 4.13. The specific variable attribute '**coordinates = "lon lat"**' is required for each of the variables (like '**northward\_geostrophic\_current\_velocity**' below in table 4.14).

Table 4.13: Example CDL for swath grids

```
dimensions:
    row = 1615 ;
    cell = 19 ;

variables:
    int time(row, cell) ;
        time:long_name = "time" ;
        time:units = "seconds since 1990-01-01 00:00:00" ;
        time:calendar = "standard" ;
    float lat(row, cell) ;
        lat:long_name = "latitude" ;
        lat:units = "degrees_north" ;
        lat:standard_name = "latitude" ;
    float lon(row, cell) ;
        lon:long_name = "longitude" ;
        lon:units = "degrees_east" ;
        lon:standard_name = "longitude" ;
```

The dimension of a variable will be (row,cell). Example :

Table 4.14: example CDL of a geophysical variable in swath grid

```
float northward_geostrophic_current_velocity(row, cell) ;
    northward_geostrophic_current_velocity:standard_name =
"surface_geostrophic_northward_sea_water_velocity" ;
    northward_geostrophic_current_velocity:long_name = "northward
geostrophic velocity" ;
    northward_geostrophic_current_velocity:units = "m s-1" ;
    northward_geostrophic_current_velocity:valid_min = -10.f ;
    northward_geostrophic_current_velocity:valid_max = 10.f ;
```

```

        northward_geostrophic_current_velocity:_FillValue =
-3.40282e+38 ;
        northward_geostrophic_current_velocity:coordinates = "lat lon" ;

```

If different depths are provided in a single file, the dimensions of a variable will be (depth, row, cell). Example :

```

float northward_ekman_current(depth, row, cell) ;
northward_ekman_current:_FillValue = -3.40282e+38 ;
northward_ekman_current:long_name = "northward ekman current
velocity" ;
northward_ekman_current:units = "m s-1" ;
northward_ekman_current:valid_min = - 10. ;
northward_ekman_current:valid_max = 10. ;
northward_ekman_current:coordinates = "lat lon" ;

```

#### 4.5.4. Time series

This data pattern corresponds to any fixed platform such as a moored buoy.

In this case where data are not gridded but vectorized along a time axis, no projection can be associated and lat/lon data have to be stored in 1-D arrays. Dimensions cannot be referred to as lat/lon anymore. Instead the main coordinate dimension is **time** and data are stored in chronological order along this time axis. Latitude, longitude and depth (which is optional) are defined once and are not changing with time: the main coordinate dimension is the dimension **station** for these coordinate variables.

Dimension and coordinate variables shall be used for time series data as shown in table 4.15. The specific variable attribute '**coordinates = "time lon lat"**' (or '**coordinates = "time lon lat depth"**' if depth coordinate is provided too) is required for each of the variables (like '**northward\_geostrophic\_current\_velocity**' below).

*Table 4.15: Example CDL for time series data*

```

dimensions:
    time = UNLIMITED ; // (1412 currently)
    station = 1 ;

variables:
    int time(time) ;
        time:units = "seconds since 1970-01-01 00:00:00" ;
        time:long_name = "time of measurement" ;
    float lat(station) ;
        lat:units = "degrees_north" ;
        lat:long_name = "latitude" ;
        lat:standard_name = "latitude" ;
    float lon(station) ;
        lon:units = "degrees_east" ;
        lon:long_name = "longitude" ;

```

```

lon:standard_name = "longitude" ;
float depth(station) ;
depth:units = "m" ;
depth:long_name = "depth" ;

```

The dimensions of a variable will then be (time). Example :

*Table 4.16: example CDL of a geophysical variable in a time series*

```

float dominant_wave_period(time) ;
dominant_wave_period:_FillValue = 9.96921e+36f ;
dominant_wave_period:long_name = "dominant wave period (spectral
peak period, Tp)" ;
dominant_wave_period:units = "s" ;
dominant_wave_period:comment = "inverse of the frequency with the
highest energy density in the reported spectrum." ;
dominant_wave_period:sampling_type = "Mean" ;
dominant_wave_period:averaging_length_in_minutes =
26.666666666666667 ;
dominant_wave_period:coordinates = "time lat lon depth"

```

#### 4.5.5. Trajectory, along-track

This data pattern corresponds to any moving platform such as a float, drifting buoy or ship, as well as along-track data (altimeter).

In this case where data are not gridded but vectorized along a platform track, no projection can be associated and lat/lon data have to be stored in 1-D arrays. Dimensions cannot be referred to as lat/lon anymore. Instead the main coordinate dimension is **time** and data are stored in chronological order along this time axis. Latitude and longitude are also defined for each time step as the device is moving.

Dimension and coordinate variables shall be used for trajectories and along-track data as shown in table 4.17. The specific variable attribute ‘**coordinates = "time lon lat"**’ (or ‘**coordinates = "time lon lat depth"**’ if depth coordinate is provided too) is required for each of the variables (like ‘**acrosstrack\_geostrophic\_current\_velocity**’ below).

*Table 4.17: Example CDL for trajectory and along-track data*

```

dimensions:
  time = 1412 ;

variables:
  int time(time) ;
  time:units = "seconds since 1970-01-01 00:00:00" ;
  time:long_name = "time of measurement" ;

```



```

float lat(time) ;
    lat:units = "degrees_north" ;
    lat:long_name = "latit
ude" ;
    lat:standard_name = "latitude" ;
float lon(time) ;
    lon:units = "degrees_east" ;
    lon:long_name = "longitude" ;
    lon:standard_name = "longitude" ;

```

The dimensions of a variable will then be **time**. Example:

*Table 4.18: example CDL of a geophysical variable in along-track data*

```

float acrosstrack_geostrophic_current_velocity(time) ;
    acrosstrack_geostrophic_current_velocity:long_name = "
acrosstrack geostrophic current" ;
    acrosstrack_geostrophic_current_velocity:units = "m s-1" ;
    acrosstrack_geostrophic_current_velocity:valid_min = -10.f ;
    acrosstrack_geostrophic_current_velocity:valid_max = 10.f ;
    acrosstrack_geostrophic_current_velocity:_FillValue =
-3.40282e+38s ;
    acrosstrack_geostrophic_current_velocity:coordinates = "time lon
lat"

```

## 4.6. Variables

**Note :** as the data are stored in NetCDF4 format, floating values should be stored as float or double. Therefore there is no need anymore of `scale_factor` and `add_offset` attributes as no scaling is applied to the stored values (internal features of NetCDF4 such as compression and digit precision being used instead).

### 4.6.1. Naming convention

GlobCurrent products will feature different current terms as well as other complementary variables (such as salinity, sea surface temperature, etc...). The list of variables will be different for each product. All these variables need to be uniquely and consistently named across all products if some products provide the same measured quantity. This section list all the identified variables. New variables can be added by the GlobCurrent team.

The rules behind the naming of these variables are as follow:

- avoid ambiguous naming such as 'u' and 'v' (for vector components). Explicit and unambiguous names are recommended.

- vectors should be stored as northward and eastward components (not module and direction). Explicit module variable can be provided in addition. For better integration in visualization tools, vector components must be named as:
  - northward\_<geophysical quantity>
  - eastward\_<geophysical quantity>
- some instruments can only measure a single component of the current vector. Use one of the following prefix:
  - *acrosstrack* for a vector quantity measured along a satellite track (altimetry derived velocities)
  - *lineofsight* for the radial component of the velocity (SAR derived velocities)
- avoid naming variables after the methodology (“mcc\_current”) or instrument (“sar\_doppler\_current”) used to retrieve it. Currents are a geophysical quantity and a proper naming needs to be found to describe the component measured.
- For geophysical quantity other than currents, use the conventions agreed in other projects (ex: GHRSSST for sea surface temperature)
- use “\_bias” and “\_stddev” suffixes to express respectively the bias and standard deviation of a quantity
- use “\_error” suffix to express the estimation error on a quantity

The proposed variable names in GlobCurrent for the different current terms are provided in table 4.19. The standard name is also provided when existing. A more comprehensive list and additional details are proposed in the next section.

*Table 4.19: Proposed variable names for the different current terms defined by GlobCurrent*

| Variable name                            | Standard name                                    | Description  | Units |
|--|--|--|-------|
| northward_geostrophic_current_velocity   | surface_geostrophic_northward_sea_water_velocity | Northward component of the geostrophic current vector at a given depth. "Northward" indicates a vector component which is positive when directed northward (negative southward). | m s-1 |
| eastward_geostrophic_current_velocity    | surface_geostrophic_eastward_sea_water_velocity  | Eastward component of the geostrophic current vector at a given depth. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).     | m s-1 |
| acrosstrack_geostrophic_current_velocity | None   | Component across the satellite track of the geostrophic current vector at a given depth.   | m s-1 |
| lineofsight_geostrophic_current_velocity | None   | Component in the line of sight of the satellite sensor of the geostrophic current vector at a given depth.   | m s-1 |
| northward_ekman_current_velocity         | None   | Northward component of the Ekman   | m s-1 |

|  |      |   |       |
|--|------|---|-------|
|  |      | current vector at a given depth. "Northward" indicates a vector component which is positive when directed northward (negative southward).   |       |
| eastward_ekman_current_velocity                  | None | Eastward component of the Ekman current vector at a given depth. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).                                  | m s-1 |
| northward_stokes_drift_velocity                  | None | Northward component of the Stokes drift vector at a given depth. "Northward" indicates a vector component which is positive when directed northward (negative southward).                               | m s-1 |
| eastward_stokes_drift_velocity                   | None | Eastward component of the Stokes drift vector at a given depth. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).                                   | m s-1 |
| northward_tidal_current_velocity                 | None | Northward component of the tidal current vector at a given depth. "Northward" indicates a vector component which is positive when directed northward (negative southward).                              | m s-1 |
| eastward_tidal_current_velocity                  | None | Eastward component of the tidal current vector at a given depth. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).                                  | m s-1 |
| northward_inertial_current_velocity              | None | Northward component of the inertial current vector. "Northward" indicates a vector component which is positive when directed northward (negative southward). t  | m s-1 |
| eastward_inertial_current_velocity               | None | Eastward component of the inertial current vector as measured at a fixed point. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).                   | m s-1 |
| northward_internal_wave_related_current_velocity | None | Northward component of the internal wave related current vector as measured at a fixed poin. "Northward" indicates a vector component which is positive when directed northward (negative southward). t | m s-1 |

|   |      |   |       |
|---|------|---|-------|
| eastward_internal_wave_related_current_velocity | None | Eastward component of the internal wave related current vector as measured at a fixed point. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).        | m s-1 |
| northward_eulerian_current_velocity             | None | Northward component of the total current vector as measured at a fixed point. "Northward" indicates a vector component which is positive when directed northward (negative southward).                    | m s-1 |
| eastward_eulerian_current_velocity              | None | Eastward component of the total current vector as measured at a fixed point. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).                        | m s-1 |
| northward_lagrangian_current_velocity           | None | Northward component of the total current vector as measured along the fluid particle trajectory. "Northward" indicates a vector component which is positive when directed northward (negative southward). | m s-1 |
| eastward_lagrangian_current_velocity            | None | Eastward component of the total current vector as measured along the fluid particle trajectory. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).     | m s-1 |
| northward_tracer_motion_velocity                | None | Northward component of a tracer motion velocity vector. "Northward" indicates a vector component which is positive when directed northward (negative southward).  | m s-1 |
| eastward_tracer_motion_velocity                 | None | Eastward component of a tracer motion velocity vector. "Eastward" indicates a vector component which is positive when directed eastward (negative westward).  | m s-1 |

*Table 4.20: Proposed variable names for the other relevant geophysical parameters in GlobCurrent. Additional parameters can be submitted to GlobCurrent project team.*

| Variable name                      | Standard name                   | Description   | Units |
|------------------------------------|---------------------------------|---|-------|
| sea_surface_temperature_skin       | sea_surface_temperature_skin    | Sea surface temperature at skin depth, according to GHRSSST definition in [RD-1]    | K     |
| sea_surface_temperature_subskin    | sea_surface_temperature_subskin | Sea surface temperature at subskin depth, according to GHRSSST definition in [RD-1] | K     |
| sea_surface_temperature_foundation | sea_surface_temperature_        | Sea surface temperature at foundation   | K     |

|                      |                                      |   |       |
|----------------------|--------------------------------------|---|-------|
| n                    | foundation                           | depth, according to GHRSSST definition in [RD-1]  |       |
| wind_speed           | wind_speed                           | Speed is the magnitude of velocity. Wind is defined as a two-dimensional (horizontal) air velocity vector, with no vertical component. (Vertical motion in the atmosphere has the standard name upward_air_velocity.) The wind speed is the magnitude of the wind velocity.<br><br>The height at which the wind is provided must be documented in variable attribute 'height'.                | m s-1 |
| northward_wind_speed | northward_wind                       | "Northward" indicates a vector component which is positive when directed northward (negative southward). Wind is defined as a two-dimensional (horizontal) air velocity vector, with no vertical component. (Vertical motion in the atmosphere has the standard name upward_air_velocity.)<br><br>The height at which the wind is provided must be documented in variable attribute 'height'. | m s-1 |
| eastward_wind_speed  | eastward_wind                        | "Eastward" indicates a vector component which is positive when directed eastward (negative westward). Wind is defined as a two-dimensional (horizontal) air velocity vector, with no vertical component. (Vertical motion in the atmosphere has the standard name upward_air_velocity.)<br><br>The height at which the wind is provided must be documented in variable attribute 'height'.    | m s-1 |
| wind_stress          | magnitude_of_surface_downward_stress | The surface called "surface" means the lower boundary of the atmosphere. "magnitude_of_X" means magnitude of a vector X. "Downward" indicates a vector component which is positive when directed downward (negative upward).  |       |
| eastward_wind_stress | surface_downward_eastward_stress     | The surface called "surface" means the lower boundary of the atmosphere. "Eastward" indicates a vector component which is positive when directed eastward (negative   |       |

|                       |                                   |   |  |
|-----------------------|-----------------------------------|---|--|
|                       |                                   | westward). "Downward" indicates a vector component which is positive when directed downward (negative upward). "Downward eastward" indicates the ZX component of a tensor. A downward eastward stress is a downward flux of eastward momentum, which accelerates the lower medium eastward and the upper medium westward. The surface downward stress is the windstress on the surface.   |  |
| northward_wind_stress | surface_downward_northward_stress | The surface called "surface" means the lower boundary of the atmosphere. "Northward" indicates a vector component which is positive when directed northward (negative southward). "Downward" indicates a vector component which is positive when directed downward (negative upward). "Downward northward" indicates the ZY component of a tensor. A downward northward stress is a downward flux of northward momentum, which accelerates the lower medium northward and the upper medium southward. The surface downward stress is the windstress on the surface. |  |

#### 4.6.2. data record format specification

The different GlobCurrent products are described in the GlobCurrent Requirement Baseline document [AD-5]. For each of these products, the detailed content of the delivered files is given in the following sections. It follows the general rules defined in sections 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5 of this document for each data acquisition pattern and specifies the specific vocabulary related to the measured quantity and measuring instrument for each respective product.

The table 4.21 provides an overview of the GlobCurrent product pixel data records that can be created for each input measurement contained within a GlobCurrent file. These records must include:

- ocean current variables, in blue. A GlobCurrent product will not contain all the variables listed here, as only a subset or a single current term may be offered in the product. However a current product must include at least one of these variables. It is forbidden to use any other current variables than the one listed here. Any missing current term will be added by the GlobCurrent team in this table.
- quality variables, in green
- error estimation variables, in orange

- ancillary variables, in yellow. These may be optional if they are specific to a single type of product for instance.

Table 4.21: GlobCurrent product data record content. Current variables are in blue (for each type of current) and associated error variables in orange.

| Variable Name<br>(Definition Section, CDL<br>Example)   | Description  | Units /<br>data type |
|---|--|----------------------|
| <p><b>northward_geostrophic_current_velocity</b><br/><b>eastward_geostrophic_current_velocity</b><br/>(Section 7.1, 7.2)</p> <p><b>acrosstrack_geostrophic_current_velocity</b><br/>(Section 5.1)</p>                   | <p>Geostrophic currents correspond to a particular simplification of the equations governing the horizontal components of velocity. It is valid when the largest terms in the equations of motion reduce to the Coriolis force and the pressure gradient.</p> <p>Different estimation or measurement techniques exist to measure this vector or a particular component of this vector.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to describe the issues or restrictions with the current retrieval.</p> | m s-1<br>float       |
| <p><b>northward_geostrophic_current_velocity_error</b><br/><b>eastward_geostrophic_current_velocity_error</b><br/>(Section 7.3, 7.4)</p> <p><b>acrosstrack_geostrophic_current_velocity_error</b><br/>(Section 5.1)</p> | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_geostrophic_current_velocity_error</b>. must be provided if variable</p>  | m s-1<br>float       |

|  |   |                |
|--|---|----------------|
|  | <b>northward_geostrophic_current_velocity</b> is provided.  |                |
| <b>northward_eulerian_current_velocity</b><br><b>eastward_eulerian_current_velocity</b><br>(section 9.2, 9.1)<br><br><b>lineofsight_eulerian_current_velocity</b><br>(Section 6.1)                   | <p>Total velocity of the current as measured at a fixed point (by means of a currentmeter for instance). Different estimation or measurement techniques exist to measure this vector or a particular component of this vector.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p> | m s-1<br>float |
| <b>northward_eulerian_current_velocity_error</b><br><b>eastward_eulerian_current_velocity_error</b><br>(Section 9.4, 9.3)<br><br><b>lineofsight_eulerian_current_velocity_error</b><br>(Section 6.2) | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_eulerian_current_velocity_error</b>. must be provided if variable <b>northward_eulerian_current_velocity</b> is provided.</p>  | m s-1<br>float |
| <b>northward_lagrangian_current_velocity</b><br><b>eastward_lagrangian_current_velocity</b><br>(No existing product yet)   | <p>Total velocity of the current as measured along the fluid particle trajectory (by means of a drifting buoy for instance)</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from</p>   | m s-1<br>float |



|   |   |                        |
|---|---|------------------------|
|   | <p>Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p>   |                        |
| <p><b>northward_lagrangian_current_velocity_error</b><br/> <b>eastward_lagrangian_current_velocity_error</b><br/> (No existing product yet)</p> | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must explicited in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_lagrangian_current_velocity_error</b>. must be provided if variable <b>northward_lagrangian_current_velocity</b> is provided.</p>  | <p>m s-1<br/>float</p> |
| <p><b>northward_surface_tracer_velocity</b><br/> <b>eastward_surface_tracer_velocity</b><br/> (section 8.2, 8.1)</p>                            | <p>Translation velocity of ocean features.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p> | <p>m s-1<br/>float</p> |
| <p><b>northward_surface_tracer_velocity_error</b><br/> <b>eastward_surface_tracer_velocity_error</b></p>  | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must explained in a corresponding attribute <b>comment</b> of this variable.</p>   | <p>m s-1<br/>float</p> |

|   |   |                |
|---|---|----------------|
| (Section 8.3, 8.4)  | This variable is mandatory for each corresponding current components (e.g. variable <b>northward_surface_tracer_velocity_error</b> . must be provided if variable <b>northward_surface_tracer_velocity</b> is provided.   |                |
| <b>northward_ekman_current_velocity</b><br><b>eastward_ekman_current_velocity</b><br>(Section 10.2, 10.1)             | <p>Ekman currents result from the balance between friction (induced by wind stress) and Coriolis forces. The wind stress is often parametrized as a function of the square of the wind speed and a drag coefficient.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p> | m s-1<br>float |
| <b>northward_ekman_current_velocity_error</b><br><b>eastward_ekman_current_velocity_error</b><br>(Section 10.3, 10.4) | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_ekman_current_velocity_error</b>. must be provided if variable <b>northward_ekman_current_velocity</b> is provided.</p>  | m s-1<br>float |
| <b>northward_stokes_drift_velocity</b><br><b>eastward_stokes_drift_velocity</b><br>(Section 12.2, 12.1)               | As waves travel, the water particles that make up the waves do not travel in a straight line, but rather in orbital motions. Water particles do not move over a closed orbital path but instead have an additional movement in the direction of wave propagation. As the particles progress in an orbital   | m s-1<br>float |

|  |   |                        |
|--|---|------------------------|
|  | <p>motion, their movement is enhanced at the top of the orbit and slowed slightly at the bottom. The resulting, Lagrangian, current is called the Stokes drift.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to describe the issues or restrictions with the current retrieval.</p> |                        |
| <p><b>northward_stokes_drift_velocity_error</b><br/> <b>eastward_stokes_drift_velocity_error</b><br/>         (Section 12.3, 12.4)</p> | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_stokes_drift_velocity_error</b>. must be provided if variable <b>northward_stokes_drift_velocity</b> is provided.</p>  | <p>m s-1<br/>float</p> |
| <p><b>northward_tidal_current_velocity</b><br/> <b>eastward_tidal_current_velocity</b><br/>         (Section 13.2, 13.1)</p>           | <p>Tides are related to gravitational variations associated to the Sun and Moon alignments, resulting in periodical changes in water levels.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and</p>   | <p>m s-1<br/>float</p> |

|  |   |                        |
|--|---|------------------------|
|  | <p><b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p>  |                        |
| <p><b>northward_tidal_current_velocity_error</b><br/> <b>eastward_tidal_current_velocity_error</b><br/>         (Section 13.3, 13.4)</p> | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_tidal_current_velocity_error</b>. must be provided if variable <b>northward_tidal_current_velocity</b> is provided.</p>  | <p>m s-1<br/>float</p> |
| <p><b>northward_inertial_current_velocity</b><br/> <b>eastward_inertial_current_velocity</b><br/>         (No existing product yet)</p>  | <p>When wind and wave forces that have set upper ocean motions cease to strongly act, water will not rest immediately. Energy imparted by the wind and waves takes time to fully dissipate. The Coriolis force will then continue to apply as a centripetal force, leading to rotational flows, referred as inertial currents.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to described the issues or restrictions with the current retrieval.</p> | <p>m s-1<br/>float</p> |
| <p><b>northward_inertial_current_velocity_error</b><br/> <b>eastward_inertial_current_velocity_error</b></p>                             | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding</p>   | <p>m s-1<br/>float</p> |

|   |  |                        |
|---|--|------------------------|
| <p>(No existing product yet)</p>  | <p>attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_inertial_current_velocity_error</b>. must be provided if variable <b>northward_inertial_current_velocity</b> is provided.</p>  |                        |
| <p><b>internal_wave_related_current_velocity</b><br/>(No existing product yet)</p>  | <p>Internal waves occur at the boundary between water layers of different densities.</p> <p>Use variable attribute '<b>source</b> = "&lt;code from Section 3.6 to specify the input product source.</p> <p>Use the variable attribute <b>depth</b> to specify at which depth this current term is valid (code from Section 3.4).</p> <p>Use the variable attributes <b>horizontal_spatial_scale</b> and <b>temporal_scale</b> to describe the scale range of the retrieved currents.</p> <p>Use the variable attribute <b>limitations</b> to describe the issues or restrictions with the current retrieval.</p> | <p>m s-1<br/>float</p> |
| <p><b>northward_internal_wave_related_current_velocity_error</b><br/><b>eastward_internal_wave_related_current_velocity_error</b><br/>(No existing product yet)</p> | <p>Error associated with the current component estimation. The definition of the error is left to the provider but must be explained in a corresponding attribute <b>comment</b> of this variable.</p> <p>This variable is mandatory for each corresponding current components (e.g. variable <b>northward_internal_wave_related_current_velocity_error</b>. must be provided if variable <b>northward_internal_wave_related_current_velocity</b> is provided.</p>   | <p>m s-1<br/>float</p> |
| <p><b>flags</b><br/>(Section 5.4 , 6.5, 7.5, 8.5, 9.5, 10.5, 12.5, 13.5)</p>  | <p>The variable <b>flags</b> is used to record any additional information considered important for the user of a data set.</p> <p>The variable <b>flags</b> is split into two sections: the first 5 bits of the variable <b>flags</b> are generic flags</p>  | <p>Flags<br/>int</p>   |

|   | <p>that are common to all data files; bits 5-15 are defined by the data provider and are specific to each data stream.</p> <p>The tables below define the bit field and their meanings. The least significant bit (bit 0) starts on the right.</p> <table border="1" data-bbox="597 512 1214 751"> <thead> <tr> <th>Bit</th> <th>Common flags</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Land</td> </tr> <tr> <td>1</td> <td>Ice</td> </tr> <tr> <td>2</td> <td>Lake (if known)</td> </tr> <tr> <td>3</td> <td>River (if known)</td> </tr> </tbody> </table><br><table border="1" data-bbox="597 842 1214 1178"> <thead> <tr> <th>Bit</th> <th>flags definition</th> </tr> </thead> <tbody> <tr> <td>4-15</td> <td>Defined by data provider and described in the <b>flag_meanings</b>, and <b>flag_masks</b> variable attributes.<br/><br/>Please refer to specific product documentation</td> </tr> </tbody> </table> | Bit              | Common flags | 0 | Land | 1 | Ice | 2 | Lake (if known) | 3 | River (if known) | Bit | flags definition | 4-15 | Defined by data provider and described in the <b>flag_meanings</b> , and <b>flag_masks</b> variable attributes.<br><br>Please refer to specific product documentation |  |
|---|---|------------------|--------------|---|------|---|-----|---|-----------------|---|------------------|-----|------------------|------|---|--|
| Bit   | Common flags  |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| 0   | Land  |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| 1   | Ice   |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| 2   | Lake (if known)   |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| 3   | River (if known)  |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| Bit   | flags definition  |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| 4-15  | Defined by data provider and described in the <b>flag_meanings</b> , and <b>flag_masks</b> variable attributes.<br><br>Please refer to specific product documentation   |                  |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |
| <p><b>quality_level</b><br/>(Section 5.5, 6.6, 7.6, 8.5, 9.6, 10.6, 12.6, 13.6)</p> | <p>The variable <b>quality_level</b> is used to provide an overall indication of data quality.</p> <p>The variable <b>quality_level</b> will reflect CEOS QA4EO (Quality Indicator) guidelines.</p> <p>An incremental scale from 0 no data,1 (bad e.g. cloud, rain, to close to land – under no conditions use this data) 2 (worst quality usable data), to 5 (best quality usable data) shall be used.</p>   | <p>Code byte</p> |              |   |      |   |     |   |                 |   |                  |     |                  |      |   |  |

## 5. Geostrophic current across-track (L2P CURgeo)

This section describes the format of Globcurrent L2P products, providing geostrophic current measurements along the satellite track (but giving the across-track component only of the geostrophic current vector). They are derived from altimetry (for instance high resolution SAR altimetry as provided by the CryoSat-2 mission or, if available along the project life, the Sentinel-3A mission).

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for along-track products as described in section 4.5.5, and the filenaming convention provided for L2P data in section 3.1. An example of such file name would:

### Example of an across-track geostrophic current L2P product:

20120202123542-GLOBCURRENT-L2P-CURgeo-CRYOSAT2\_SIRAL-v01.0-fv01.0.nc

The above file contains L2 geostrophic current data produced by GlobCurrent project. It was produced using version 1 of the processor using data from CRYOSAT-2 altimeter SIRAL and is version 1.0 of the file. The starting time of this orbit file is 02 February 2012 at 12:35:45.

Each product file shall provide the following content:

Table 5.1: General content of a GlobCurrent L2P geostrophic current product (L2P CURgeo)

| netCDF File Contents                           | Description   | Units             | Section        | Required  |
|--|---|-------------------|----------------|-----------|
| Global Attributes                              | A collection of required global attributes describing general characteristics of the file | Various           | 4.2            | Mandatory |
| Geolocation Data                               | Information to permit locating data on along-track or swath data                          | Various           | 4.5.5 or 4.5.3 | Mandatory |
| acrosstrack_geostrophic_current_velocity       | Across track component of the geostrophic current vector                                  | m s <sup>-1</sup> | 5.1            | Mandatory |
| acrosstrack_geostrophic_current_velocity_error | Error on the estimation of the across track component of the geostrophic current vector   | m s <sup>-1</sup> | 5.2            | Mandatory |
| acrosstrack_angle                              | Angle of the acrosstrack component, expressed in angular degrees clockwise from north.    | angular_degrees   | 5.3            | Mandatory |
| flags  | Flag mask as described in section 5.4.  |                   | 5.4            | Mandatory |
| quality_level                                  | Quality level associated with the retrieved current component as described in 5.5         |                   | 5.5            | Mandatory |

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 5.1. Variable <acrosstrack\_geostrophic\_current\_velocity>

Geostrophic velocity component of the ocean current perpendicular to the satellite track.

This component of the ocean current velocity is estimated from the along-track Sea Level Anomaly assuming an equilibrium between the pressure and Coriolis forces. First, along-track altimetric data is low-pass filtered using a Lanczos filter with a cut-off wavelength of 65 km. Then, velocities are estimated using finite differences. This approach is restricted to latitudes higher than 10 degrees.

Table 5.2: CDL example description of variable *acrosstrack\_geostrophic\_current\_velocity*

| Storage type definition   | Variable name definition                 | Description  | Unit              |
|---|--|--|-------------------|
| float   | acrosstrack_geostrophic_current_velocity | Absolute geostrophic velocity across satellite track pixel value | m s <sup>-1</sup> |
| <b>Description</b>  |  |  |                   |
| <pre>float acrosstrack_geostrophic_current_velocity (time) ;   acrosstrack_geostrophic_current_velocity:long_name= " geostrophic current component across Cryosat-2 satellite track";   acrosstrack_geostrophic_current_velocity:units = "m s-1" ;   acrosstrack_geostrophic_current_velocity:_FillValue = -3.40282e+38;   acrosstrack_geostrophic_current_velocity:coordinates = "lon lat" ;   acrosstrack_geostrophic_current_velocity:valid_min = -10.f ;   acrosstrack_geostrophic_current_velocity:valid_max = 10.f ;   acrosstrack_geostrophic_current_velocity:depth="0m";   acrosstrack_geostrophic_current_velocity:source="CRYOSAT2";   acrosstrack_geostrophic_current_velocity:horizontal_scale_range = "greater than 65 km";   acrosstrack_geostrophic_current_velocity:temporal_scale_range = "instantaneous";   acrosstrack_geostrophic_current_velocity:limitations = "Latitudes higher than +- 10 degrees";   acrosstrack_geostrophic_current_velocity:comment = "";</pre> |  |  |                   |
| <b>Comments</b>   |  |  |                   |
|   |  |  |                   |

### 5.2. Variable

#### <acrosstrack\_geostrophic\_current\_velocity\_error>

Surface geostrophic velocity error derived from the standard deviation of the altimetric noise measurements using error propagation. This variable represents the uncertainty of the across-track geostrophic current velocity measurement.



Table 5.3: CDL example description of variable `acrosstrack_geostrophic_current_velocity_error`

| Storage type definition   | Variable name definition                                    | Description   | Unit  |
|---|---|---|-------|
| float   | <code>acrosstrack_geostrophic_current_velocity_error</code> | Error estimation for the pixel geostrophic current value across the satellite track | m s-1 |
| <b>Description</b>  |   |   |       |
| <pre>float acrosstrack_geostrophic_current_velocity_error(time) ;   acrosstrack_geostrophic_current_velocity_error:long_name = "error on the estimation of acrosstrack geostrophic current" ;   acrosstrack_geostrophic_current_velocity_error:units = "m s-1" ;   acrosstrack_geostrophic_current_velocity_error:_FillValue = -3.40282e+38;   acrosstrack_geostrophic_current_velocity_error:coordinates = "lon lat" ;   acrosstrack_geostrophic_current_velocity_error:valid_min = -10.f ;   acrosstrack_geostrophic_current_velocity_error:valid_max = 10.f ;   acrosstrack_geostrophic_current_velocity_error:depth="0m";</pre> |   |   |       |
| <b>Comments</b>   |   |   |       |
|   |   |   |       |

### 5.3. Variable `<acrosstrack_angle>`

The local angle of the across satellite track direction. It is expressed in degrees between -180 and 180, starting from 0° being the north direction, clockwise.

Only the across track component of the geostrophic ocean current vector can be retrieved. The geographical orientation of this component must be known by the user for each pixel value. This value is normal to the satellite track for altimeters but must be expressed here as the direction angle with the geographical north (instead of providing a relative angle to the satellite track which would always be 90°).

Table 5.4: CDL example description of variable `acrosstrack_angle`

| Storage type definition  | Variable name definition       | Description  | Unit           |
|--|--------------------------------|--|----------------|
| float  | <code>acrosstrack_angle</code> | Local angle of the line of sight of the measuring instrument | angular_degree |
| <b>Description</b>   |                                |  |                |
| <pre>float acrosstrack_angle(time) ;   acrosstrack_angle:long_name = "value of the direction across the satel- lite track" ;   acrosstrack_angle:units = "angular_degree" ;   acrosstrack_angle:_FillValue = -3.40282e+38;   acrosstrack_angle:coordinates = "lon lat" ;   acrosstrack_angle:valid_min = 0.f ;   acrosstrack_angle:valid_max = 180.f ;</pre> |                                |  |                |

|  |
|--|
| <code>acrosstrack_angle:comment="positive clockwise, 0° is north pole direction";</code> |
| <b>Comments</b>  |
|  |

## 5.4. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.15.

The variable **flags** is used to :

- Define the type of surface of the pixel,
- Pass through native flags from the input data set and
- Record any additional information considered important for the user of a data set.

The variable **flags** is split into two sections:

- The first 4 bits of the variable **flags** are generic flags that are common to all data files as defined in table 54,
- Bits 4-15 are defined by the data provider and are specific to each input data stream.

*Table 5.5: Bit field definitions for the variable flags*

| Bit  | Common flags                                      |
|------|---|
| 0    | Set if over land (not set is assumed to be ocean) |
| 1    | Set if pixel is over ice                          |
| 2    | Set if pixel is over a lake (if known)            |
| 3    | Set if pixel is over a river (if known)           |
| 4-15 | Defined by L2 data provider                       |

The least significant bit (bit 0) starts on the right. GlobCurrent requires the following:

The variable **flags** holds Boolean (single bit) codes detailed in its **flag\_meanings** and **flag\_masks** attributes.

The **flag\_meanings**, **flag\_masks** attributes are used in the following manner:

The **flag\_meanings** attribute shall contain a space-separated list of (string) descriptions for each distinct flag value. For descriptions containing multiple words, the words shall be linked by underscores.

The **flag\_masks** attribute shall contain a comma-separated list of (numeric) mask values that isolate the bit or bits that encode each flag value, whose order matches that of the **flag\_meanings** values.

Bit 0 of the **flags** variable is used to record if an input pixel is over land or ocean surfaces. GlobCurrent specifies the following:

If an input pixel is classified as land covered bit 0 of the **flags** variable should be set to equal 1. By not setting this flag the pixel is assumed to be classified as over ocean.

Bit 1 of the **flags** variable is used to record if an input pixel records ice contamination. GlobCurrent specifies the following rules:

If an input pixel is classified as ice contaminated bit 1 of the **flags** variable should be set to 1.

Bit 2 of the **flags** variable is used to record if an input pixel contains any part of a lake. GlobCurrent specifies the following:

If an input pixel contains any part of a lake, bit 2 of the **flags** variable should be set to 1.

Bit 3 of the **flags** variable is optionally used to record if an input pixel contains any part of a river. GlobCurrent specifies the following:

If an input pixel contains any part of a river, bit 3 of the **flags** variable should be set to 1.

Flags or other information provided with the input data should be defined and assigned to the flags variable using bits 4-15 of the variable flags. It is recommended to use single bits for any information, no combination of multiple bits. If that is not possible, then an additional experimental byte field should be used instead. Definitions for bits 4-15, if used, should be given using the variable comment attribute.

The variable '**flags**' shall be included in GlobCurrent data files with the format requirements shown in 5.6.

Table 5.6: CDL example description of flags variable

| Storage type definition  | Variable name definition | Description   | Unit      |
|--|--------------------------|---|-----------|
| short  | flags                    | The variable <b>flags</b> is used to<br><br>(a) define the type of surface of the pixel,<br>(b) pass through native flags from the input L2 SST data set and<br>(c) record any additional information considered important for the user of an L2P data set. | Bit field |
| <b>Example CDL Description</b>   |                          |   |           |
| <pre>short flags(time) ;   flags:long_name = "flags" ;   flags:coordinates = "lon lat" ;   flags:valid_min = 0s;   flags:valid_max = 2047s;   flags:flag_meanings = "land ice lake river";   flags:flag_masks = 1s, 2s, 4s, 8s ;   flags:comment = "These flags are important to properly use the data"</pre>  |                          |   |           |
| <b>Comments</b>  |                          |   |           |
| <p>The meaning of each bit of the variable <b>flags</b> shall be detailed in its <b>flag_meanings</b> and <b>flag_masks</b> attributes</p> <p>b0:1 = land surface;<br/> b1:1 = ice contamination;<br/> b2:1 = input data over lake surface;<br/> b3:1 = input data over river;</p> <p>b4:b15 set by the data provider.</p> <p>For this variable there is no <b>_FillValue</b> attribute.</p> |                          |   |           |

## 5.5. Variable <quality\_level>

The variable '**quality\_level**' provides an indicator of the overall quality of a current measurement in an GlobCurrent L2P file. GlobCurrent requires the following:

The variable '**quality\_level**' shall use an incremental scale from 0 to 5 to provide the user with an indication of the quality of the current data. The value 0 shall be used to

indicate missing data and the value 1 shall be used to indicate invalid data (under no conditions use this data). The remaining values from 2-5 are set at the discretion of the provider with the proviso that the value 2 shall be used to indicate the worst quality of usable data and the value 5 shall be used to indicate the best quality usable data. The provider is required to provide a description of the quality levels provided as part of the product documentation.

The variable **quality\_level** reflects the quality of current data from a single sensor and does not provide an indication of the relative quality between sensors.

The variable **quality\_level** shall be included with the format requirements shown in 5.7.

Table 5.7: CDL example description of quality\_level variable

| Storage type definition   | Variable name definition | Description  | Unit      |
|---|--------------------------|--|-----------|
| byte  | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>  |                          |  |           |
| <pre> byte quality_level (timei) ; quality_level:long_name = "quality level of ocean current pixel" ; quality_level:coordinates = "lon lat" ; quality_level:_FillValue = -128b; quality_level:valid_min = 0b; quality_level:valid_max = 5b; quality_level:flag_meanings = "no_data bad_data worst_quality                                low_quality acceptable_quality                                best_quality" ; quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ; quality_level:comment = "These are the overall quality indicators and are used for all GlobCurrent products" </pre> |                          |  |           |
| <b>Comments</b>   |                          |  |           |
|   |                          |  |           |

## 6. Eulerian current in line of sight (L2P CUReul)

This section describes the format of GlobCurrent L2P products providing Eulerian current measurements along the satellite in the light of sight of a radar (such as a SAR). They are derived for instance from SAR doppler (for instance as provided by the Envisat ASAR and, if available during the project, the Sentinel-1A SAR).

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for swath products as described in section 4.5.3, and the filenaming convention provided for L2P data in section 3.1. An example of such file name would be:

### In the line of sight geostrophic current L2P filename example:

20120202123542-GLOBCURRENT-L2P-CUReul\_0m-ENVISAT\_ASAR-v01.0-fv01.0.nc

The above file contains L2 Eulerian current data at ocean surface from ENVISAT ASAR produced by GlobCurrent project. It was produced using version 1 of the processor using data from ENVISAT ASAR and is version 1.0 of the file. The starting time of this image file is 02 February 2012 at 12:35:45.

Each product file shall provide the following content:

*Table 6.1: General content of a GlobCurrent L2P Eulerian current product (L2P CUReul)*

| netCDF File Contents                        | Description   | Units          | Section | Required  |
|---|---|----------------|---------|-----------|
| Global Attributes                           | A collection of required global attributes describing general characteristics of the file                     | Various        | 4.2     | Mandatory |
| Geolocation Data                            | Information to permit locating data on swath grids  |                | 4.5.3   | Mandatory |
| lineofsight_eulerian_current_velocity       | Eulerian ocean current value in the line of sight of the sensing instrument                                   | m s-1          | 6.1     | Mandatory |
| lineofsight_eulerian_current_velocity_error | Error in the estimation of the Eulerian ocean current value in the line of sight of the sensing instrument    | m s-1          | 6.2     | Mandatory |
| lineofsight_angle                           | Local angle of the current component in the line of sight, expressed in angular degrees clockwise from north. | angular_degree | 6.3     | Mandatory |
| incidence_angle                             | Local incidence angle of the measuring instrument   | angular_degree | 6.4     |           |
| flags                                       | Flag mask as described in section 5.4.  |                | 6.5     | Mandatory |
| quality_level                               | Quality level associated with the retrieved current component as described in 5.5                             |                | 6.6     | Mandatory |

|                                 |  |    |      |          |
|---------------------------------|--|----|------|----------|
| lineofsight_doppler_shift       |  | Hz | 6.7  | Optional |
| lineofsight_doppler_shift_error |  | Hz | 6.8  | Optional |
| sigma0                          |  | dB | 6.9  | Optional |
| sigma0_error                    |  | dB | 6.10 | Optional |

## 6.1. Variable <lineofsight\_eulerian\_current\_velocity>

This instantaneous velocity is that of the Doppler centroid anomaly (relative to the Doppler frequency given by the motion of the satellite relative to the Earth) after removal of any (predefined) range and azimuth bias estimates.

Table 6.2: CDL example description of the variable lineofsight\_eulerian\_current\_velocity

| Storage type definition  | Variable name definition              | Description   | Unit              |
|--|---------------------------------------|---|-------------------|
| float  | lineofsight_eulerian_current_velocity | Pixel Eulerian ocean current value in the line of sight of the sensing instrument | m s <sup>-1</sup> |
| <b>Description</b>   |                                       |   |                   |
| <pre>float lineofsight_eulerian_current_velocity (row, cell) ;   lineofsight_eulerian_current_velocity:long_name= "eulerian current component in the light of sight of SAR obtained from the SAR Doppler";   lineofsight_eulerian_current_velocity:units = "m s-1" ;   lineofsight_eulerian_current_velocity:_FillValue = -3.40282e+38;   lineofsight_eulerian_current_velocity:coordinates = "lon lat" ;   lineofsight_eulerian_current_velocity:valid_min = -10.f ;   lineofsight_eulerian_current_velocity:valid_max = 10.f ;   lineofsight_eulerian_current_velocity:depth="0m";   lineofsight_eulerian_current_velocity:horizontal_scale_range = "greater than approximately 10 km";   lineofsight_eulerian_current_velocity:temporal_scale_range = "instantaneous";   lineofsight_eulerian_current_velocity:limitations = "Stokes drift and Ekman current components are not included in the SAR Doppler current velocity";   lineofsight_eulerian_current_velocity:comment = "surface current calculated from the SAR Doppler shift";</pre> |                                       |   |                   |
| <b>Comments</b>  |                                       |   |                   |
| Above example is provided for SAR Doppler current retrieval. To be adapted by each provider.   |                                       |   |                   |

## 6.2. Variable <lineofsight\_eulerian\_current\_velocity\_error>

This is the combined (predefined) range and azimuth bias estimates of velocity retrieval error.

Table 6.3: CDL example description of the variable `lineofsight_eulerian_current_velocity`

| Storage type definition   | Variable name definition                                 | Description  | Unit  |
|---|--|--|-------|
| float   | <code>lineofsight_eulerian_current_velocity_error</code> | Error estimation for the pixel Eulerian ocean current value in the line of sight of the sensing instrument | m s-1 |
| <b>Description</b>  |  |  |       |
| <pre>float lineofsight_eulerian_current_velocity_error(row, cell) ; lineofsight_eulerian_current_velocity_error:long_name = "line-of-sight Doppler ocean current error" ; lineofsight_eulerian_current_velocity_error:units = "m s-1" ; lineofsight_eulerian_current_velocity_error:_FillValue = -3.40282e+38; lineofsight_eulerian_current_velocity_error:coordinates = "lon lat" ; lineofsight_eulerian_current_velocity_error:valid_min = -10.f ; lineofsight_eulerian_current_velocity_error:valid_max = 10.f ; lineofsight_eulerian_current_velocity_error:depth="0m";</pre> |  |  |       |
| <b>Comments</b>   |  |  |       |
|   |  |  |       |

### 6.3. Variable `<lineofsight_angle>`

Local angle of the line of sight of the measuring instrument. It is expressed in degrees, positive clockwise, starting from 0° being the north direction.

Only the the line-of-sight component of the ocean current vector can be retrieved. The geographical orientation of this component must be known by the user for each pixel value.

Table 6.4: CDL example description of the variable `lineofsight_eulerian_current_velocity`

| Storage type definition   | Variable name definition       | Description  | Unit           |
|---|--------------------------------|--|----------------|
| float   | <code>lineofsight_angle</code> | Local angle of the line of sight of the measuring instrument | angular_degree |
| <b>Description</b>  |                                |  |                |
| <pre>float lineofsight_angle(row, cell) ; lineofsight_angle:long_name = "line-of-sight angle" ; lineofsight_angle:units = "angular_degree" ; lineofsight_angle:_FillValue = -3.40282e+38; lineofsight_angle:coordinates = "lon lat" ; lineofsight_angle:valid_min = 0.f ; lineofsight_angle:valid_max = 180.f ; lineofsight_angle:comment="positive clockwise, 0° is north pole direction";</pre> |                                |  |                |
| <b>Comments</b>   |                                |  |                |
|   |                                |  |                |



## 6.4. Variable <incidence\_angle>

The angle between the incident [radar beam](#) and the vertical (normal) to the intercepting surface.

Table 6.5: CDL example description of the variable *lineofsight\_eulerian\_current\_velocity*

| Storage type definition  | Variable name definition | Description                                       | Unit           |
|--|--------------------------|---|----------------|
| float  | incidence_angle          | Local incidence angle of the measuring instrument | angular_degree |
| <b>Description</b>   |                          |   |                |
| <pre>float incidence_angle(row, cell) ;   incidence_angle:long_name = "local incidence angle" ;   incidence_angle:units = "angular_degree" ;   incidence_angle:_FillValue = -3.40282e+38;   incidence_angle:coordinates = "lon lat" ;   incidence_angle:valid_min = 0.f ;   incidence_angle:valid_max = 180.f ;   incidence_angle:comment="positive, 0° is nadir direction";</pre> |                          |   |                |
| <b>Comments</b>  |                          |   |                |
|  |                          |   |                |

## 6.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

In addition, the following bit is added:

Bit 4 of the **flags** variable is used to record if an input pixel is within a low speed area. GlobCurrent specifies the following rules:

If an input pixel is classified as a low wind speed area bit 4 of the **flags** variable should be set to 1.

Table 6.6: CDL example description of flags variable

| Storage type definition | Variable name definition | Description                          | Unit      |
|-------------------------|--------------------------|--------------------------------------|-----------|
| short                   | flags                    | The variable <b>flags</b> is used to | Bit field |

|  |  |   |  |
|--|--|---|--|
|  |  | <p>(a) define the type of surface of the pixel,</p> <p>(b) pass through native flags from the input data set and</p> <p>(c) record any additional information considered important for the user of an L2P data set.</p> |  |
|--|--|---|--|

### Example CDL Description

```
short flags(row, cell) ;
  flags:long_name = "flags" ;
  flags:coordinates = "lon lat" ;
  flags:valid_min = 0s;
  flags:valid_max = 2047s;
  flags:flag_meanings = "land ice lake river low_wind_area";
  flags:flag_masks = 1s, 2s, 4s, 8s, 16s ;
  flags:comment = "These flags are important to properly use the data"
```

### Comments

The meaning of each bit of the variable **flags** shall be detailed in its **flag\_meanings** and **flag\_masks** attributes

b0:1 = land surface;  
 b1:1 = ice contamination;  
 b2:1 = input data over lake surface;  
 b3:1 = input data over river;  
 b4:1 = low speed area

b5:b15 set by the data provider.

For this variable there is no **\_FillValue** attribute.

## 6.6. Variable <quality\_level>

The variable '**quality\_level**' provides an indicator of the overall quality of a current measurement in an GlobCurrent L2P file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 6.7: CDL example description of quality\_level variable

| Storage type definition | Variable name definition | Description                        | Unit   |
|-------------------------|--------------------------|------------------------------------|--------|
| byte                    | quality_level            | Overall indicator of ocean current | enumer |

|   |  |                     |     |
|---|--|---------------------|-----|
|   |  | measurement quality | ate |
| <b>Example CDL Description</b>  |  |                     |     |
| <pre> byte quality_level (row, cell) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;   quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;   quality_level:comment = "These are the overall quality indicators and are used for all GlobCurrent products" </pre> |  |                     |     |
| <b>Comments</b>   |  |                     |     |
|   |  |                     |     |

## 6.7. Variable <lineofsight\_doppler\_shift>

This is the Doppler shift velocity written in terms of frequency.

Table 6.8: CDL example description of the variable *lineofsight\_doppler\_shift*

| Storage type definition   | Variable name definition  | Description | Unit |
|---|---------------------------|-------------|------|
| float   | lineofsight_doppler_shift |             | Hz   |
| <b>Description</b>  |                           |             |      |
| <pre> float lineofsight_doppler_shift(row, cell) ;   lineofsight_doppler_shift:long_name = "line-of-sight Doppler shift" ;   lineofsight_doppler_shift:units = "Hz" ;   lineofsight_doppler_shift:_FillValue = -3.40282e+38;   lineofsight_doppler_shift:coordinates = "lon lat" ; </pre> |                           |             |      |
| <b>Comments</b>   |                           |             |      |
|   |                           |             |      |

## 6.8. Variable <lineofsight\_doppler\_shift\_error>

This is the Doppler shift velocity error written in terms of frequency.

Table 6.9: CDL example description of the variable *lineofsight\_doppler\_shift\_error*

| Storage type definition | Variable name definition        | Description | Unit |
|-------------------------|---------------------------------|-------------|------|
| float                   | lineofsight_doppler_shift_error |             | Hz   |

| Description   |
|---|
| <pre>float lineofsight_doppler_shift_error(row, cell) ;     lineofsight_doppler_shift_error:long_name = "line-of-sight Doppler shift error" ;     lineofsight_doppler_shift_error:units = "Hz" ;     lineofsight_doppler_shift_error:_FillValue = -3.40282e+38; lineofsight_doppler_shift_error:coordinates = "lon lat" ;</pre> |
| Comments  |
|   |

## 6.9. Variable <sigma0>

This is the normalized radar cross section.

Among four possible flavours of backscatter (VV,VH,HH,HV), any available can be included using the “polarization” global attribute, with values in the following table:

*Table 6.10: possible values for the variable attribute polarization*

| Code | Description           |
|------|-----------------------|
| hh   | Horizontal-Horizontal |
| vv   | Vertical-Vertical     |
| vh   | Vertical-Horizontal   |
| hv   | Horizontal-Vertical   |

*Table 6.11: CDL example description of the variable sigma0*

| Storage type definition  | Variable name definition | Description | Unit |
|--|--------------------------|-------------|------|
| float  | sigma0                   |             | dB   |
| Description  |                          |             |      |
| <pre>float sigma0(row, cell) ;     sigma0:long_name = "HH polarized radar cross section" ;     sigma0:units = "dB" ;     sigma0:_FillValue = -3.40282e+38;     sigma0:polarization = "hh" ; sigma0:coordinates = "lon lat" ;</pre> |                          |             |      |
| Comments   |                          |             |      |
|  |                          |             |      |

## 6.10. Variable <sigma0\_error>

This is a normalized radar cross section error.

Among four possible flavours of backscatter (VV,VH,HH,HV), any available can be included using the “polarization” global attribute, with values in table 6.10.

Table 6.12: CDL example description of the variable *sigma0\_error*

| Storage type definition   | Variable name definition | Description | Unit |
|---|--------------------------|-------------|------|
| float   | sigma0_error             |             | dB   |
| <b>Description</b>  |                          |             |      |
| <pre>float sigma0_error(row, cell) ;   sigma0_error :long_name = "HH polarized radar cross section error" ;   sigma0_error :units = "dB" ;   sigma0_error :_FillValue = -3.40282e+38;   sigma0_error:polarization = "hh" ;   sigma0_error:coordinates = "lon lat" ;</pre> |                          |             |      |
| <b>Comments</b>   |                          |             |      |
|   |                          |             |      |

## 7. L4 geostrophic (L4 CURgeo)

This section describes the format of GlobCurrent L4 geostrophic products (CURgeo), providing geostrophic current measurements over a grid using observations from multiple passes or satellites and an analysis methodologies. They are derived for instance from altimetry or from microwave radiometers (eSQG method) or infrared radiometer (MTF method).

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1 and the filenaming convention provided for gridded data in section 3. An example of such file name would be:

**Along-track geostrophic current L4 filename example:**

20120202000000-GLOBCURRENT-L4-CURgeo\_0m-ALT\_OI-v01.0-fv01.0.nc

The above file contains L4 geostrophic current data at 0 meter depth produced by GlobCurrent project from the optimal interpolation (“OI”) of multiples passes of altimeters (“ALT”). It contains data for 02 February 2012, was produced using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Each product file shall provide the following content:

*Table 7.1: General content of a GlobCurrent L4 geostrophic current product (L4geo)*

| netCDF Contents                              | File | Description   | Units   | Section | Required  |
|--|------|---|---------|---------|-----------|
| Global Attributes                            |      | A collection of required global attributes describing general characteristics of the file | Various | 4.2     | Mandatory |
| Geolocation Data                             |      | Information to permit locating data on regular gridded data.                              |         | 4.5.1   | Mandatory |
| eastward_geostrophic_current_velocity        |      | Estimated northward component of the geostrophic current vector.                          | m s-1   | 7.1     | Mandatory |
| northward_geostrophic_current_velocity       |      | Estimated eastward component of the geostrophic current vector.                           | m s-1   | 7.2     | Mandatory |
| northward_geostrophic_current_velocity_error |      | Error on the estimated northward component of the geostrophic current vector.             | m s-1   | 7.3     | Mandatory |

|   |  |       |     |           |
|---|--|-------|-----|-----------|
| eastward_geostrophic_current_velocity_error | Error on the estimated eastward component of the geostrophic current vector.   | m s-1 | 7.4 | Mandatory |
| flags                                       | Flag mask as described in section 5.4.   |       | 7.5 | Mandatory |
| quality_level                               | Quality level associated with the retrieved current vector as described in 5.5 |       | 7.6 | Mandatory |

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 7.1. Variable <eastward\_geostrophic\_current\_velocity>

This variable is used to describe the zonal component of the geostrophic current velocity.

Table 7.2: CDL example description of the variable eastward\_geostrophic\_current\_velocity

| Storage type definition   | Variable name definition              | Description | Unit  |
|---|---------------------------------------|-------------|-------|
| float   | eastward_geostrophic_current_velocity |             | m s-1 |
| <b>Description</b>  |                                       |             |       |
| <pre>float eastward_geostrophic_current_velocity (time, lat, lon) ;   eastward_geostrophic_current_velocity:long_name = "Absolute geostrophic   velocity: zonal component";   eastward_geostrophic_current_velocity:depth = "0m";   eastward_geostrophic_current_velocity:units = "m s-1" ;   eastward_geostrophic_current_velocity:coordinates = "lon lat" ;   eastward_geostrophic_current_velocity:_FillValue = -3.40282e+38;   eastward_geostrophic_current_velocity:horizontal_scale_range = "100km";   eastward_geostrophic_current_velocity:temporal_scale_range = "10 days";   eastward_geostrophic_current_velocity:comment = "Geostrophic velocities   calculated from altimeter maps of absolute dynamic Topography (CNES-CLS13   MDT+SLA eastward   eastward_geostrophic_current_velocity:source = "AVISO"   eastward_geostrophic_current_velocity:limitations = "geostrophic velo-   cities calculated from altimeter measurements are less accurate in coastal   areas and in seasonally ice-covered areas"</pre> |                                       |             |       |
| <b>Comments</b>   |                                       |             |       |
|   |                                       |             |       |

### 7.2. Variable <northward\_geostrophic\_current\_velocity>

This variable is used to describe the meridional component of the geostrophic current velocity.

Table 7.3: CDL example description of the variable *northward\_geostrophic\_current\_velocity*

| Storage type definition  | Variable name definition               | Description | Unit  |
|--|--|-------------|-------|
| float  | northward_geostrophic_current_velocity |             | m s-1 |
| <b>Description</b>   |  |             |       |
| <pre>float northward_geostrophic_current_velocity (time, lat, lon) ;   northward_geostrophic_current_velocity:long_name = "Absolute geostrophic velocity: meridian component";   northward_geostrophic_current_velocity:depth = "0m";   northward_geostrophic_current_velocity:units = "m s-1" ;   northward_geostrophic_current_velocity:coordinates = "lon lat" ;   northward_geostrophic_current_velocity:_FillValue = -3.40282e+38;   northward_geostrophic_current_velocity:horizontal_scale_range = "100km";   northward_geostrophic_current_velocity:temporal_scale_range = "10 days";   northward_geostrophic_current_velocity:comment = "Geostrophic velocities calculated from altimeter maps of absolute dynamic Topography (CNES-CLS13 MDT+SLA) ";   northward_geostrophic_current_velocity:source = "AVISO"   northward_geostrophic_current_velocity:limitations = "geostrophic velocities calculated from altimeter measurements are less accurate in coastal areas and in seasonally ice-covered areas"</pre> |  |             |       |
| <b>Comments</b>  |  |             |       |
|  |  |             |       |

### 7.3. Variable <eastward\_geostrophic\_velocity\_error>

This variable is used to describe the estimated error on the zonal component of the geostrophic current velocity.

Table 7.4: CDL example description of the variable *eastward\_geostrophic\_current\_velocity\_error*

| Storage type definition   | Variable name definition                    | Description | Unit  |
|---|---|-------------|-------|
| float   | eastward_geostrophic_current_velocity_error |             | m s-1 |
| <b>Description</b>  |   |             |       |
| <pre>float eastward_geostrophic_current_velocity_error (time, lat, lon) ;   eastward_geostrophic_current_velocity_error:long_name = "error on the estimation of the absolute geostrophic velocity: zonal component";   eastward_geostrophic_current_velocity_error:depth = "0m";   eastward_geostrophic_current_velocity_error:units = "m s-1" ;   eastward_geostrophic_current_velocity_error:coordinates = "lon lat" ;   eastward_geostrophic_current_velocity_error:_FillValue = -3.40282e+38;</pre> |   |             |       |



| Comments |
|----------|
|          |

#### 7.4. Variable <northward\_geostrophic\_current\_velocity\_error>

This variable is used to describe the estimated error on the meridional component of the geostrophic current velocity.

Table 7.5: CDL example description of the variable northward\_geostrophic\_current\_velocity\_error

| Storage type definition  | Variable name definition                     | Description | Unit  |
|--|--|-------------|-------|
| float  | northward_geostrophic_current_velocity_error |             | m s-1 |
| <b>Description</b>   |  |             |       |
| <pre>float northward_geostrophic_current_velocity_error (time, lat, lon) ;   northward_geostrophic_current_velocity_error:long_name = "error on the   estimation of the absolute geostrophic velocity: meridional component";   northward_geostrophic_current_velocity_error:depth = "0m";   northward_geostrophic_current_velocity_error:units = "m s-1" ;   northward_geostrophic_current_velocity_error:coordinates = "lon lat" ;   northward_geostrophic_current_velocity_error:_FillValue = -3.40282e+38;</pre> |  |             |       |
| <b>Comments</b>  |  |             |       |
|  |  |             |       |

#### 7.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 7.6: CDL example description of flags variable

| Storage type definition | Variable name definition | Description  | Unit      |
|-------------------------|--------------------------|--|-----------|
| short                   | flags                    | <p>The variable <b>flags</b> is used to</p> <p>(a) define the type of surface of the pixel,</p> <p>(b) pass through native flags from the input data set and</p> | Bit field |

|  |  |   |  |
|--|--|---|--|
|  |  | (c) record any additional information considered important for the user of an L2P data set. |  |
| <b>Example CDL Description</b>   |  |   |  |
| <pre>short flags(time, lat, lon) ;   flags:long_name = "flags" ;   flags:coordinates = "lon lat" ;   flags:valid_min = 0s;   flags:valid_max = 2047s;   flags:flag_meanings = "land ice lake river";   flags:flag_masks = 1s, 2s, 4s, 8s ;   flags:comment = "These flags are important to properly use the data"</pre>  |  |   |  |
| <b>Comments</b>  |  |   |  |
| <p>The meaning of each bit of the variable <b>flags</b> shall be detailed in its <b>flag_meanings</b> and <b>flag_masks</b> attributes</p> <p>b0:1 = land surface;<br/> b1:1 = ice contamination;<br/> b2:1 = input data over lake surface;<br/> b3:1 = input data over river;</p> <p>b4:b15 set by the data provider.</p> <p>For this variable there is no <b>_FillValue</b> attribute.</p> |  |   |  |

## 7.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 7.7: CDL example description of quality\_level variable

| Storage type definition   | Variable name definition | Description  | Unit      |
|---|--------------------------|--|-----------|
| byte  | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>  |                          |  |           |
| <pre>byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;</pre> |                          |  |           |

```
quality_level:valid_max = 5b;
quality_level:flag_meanings = "no_data bad_data worst_quality
                               low_quality acceptable_quality
                               best_quality" ;
quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;
quality_level:comment = "These are the overall quality indicators and
are used for all GlobCurrent products"
```

### **Comments**

## 8. Surface tracer motion L3S (L3S <CURlag>)

This section describes the format of Globcurrent L3S surface tracer motion products (CURstm), providing estimation of a motion drift at a specific depth (0m ). They can be obtained for instance partially and under some conditions from maximum cross correlation method over a sequence of SST or ocean colour scenes seen by a geostationary satellite. If The current vectors are processed over different depths, they must be provided in different products.

The products hereafter detailed shall be compliant with section 4 Format of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1, and the filenaming convention provided for L4 data in section 4.5.5. An example of such file name would be:

### Filename example for a eulerian surface current product:

20120202000000-GLOBCURRENT-L4-CURstm\_0m-GOCI\_MCC-v01.0-fv01.0.nc

The above file contains L4 tracer motion velocity data at ocean surface (“0m”) produced by GlobCurrent project, using the maximum cross correlation method (“MCC”) of sequences of ocean colour images from GOCI geostationary satellite. It contains data for 02 February 2012, was produced using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Table 8.1: General content of a GlobCurrent L3S lagrangian current product (L3Seul)

| netCDF Contents                   | File | Description  | Units   | Section | Required  |
|-----------------------------------|------|--|---------|---------|-----------|
| Global Attributes                 |      | A collection of required global attributes describing general characteristics of the file<br><br>In the case of the MCC method, the optional attributes must be provided: <ul style="list-style-type: none"> <li>• <b>analysis_period_start_time</b></li> <li>• <b>analysis_period_end_time</b></li> <li>• <b>template_size</b></li> <li>• <b>correlation_threshold</b></li> </ul> | Various | 4.2     | Mandatory |
| Geolocation Data                  |      | Information to permit locating data on regular gridded data.   |         | 4.5.1   | Mandatory |
| eastward_surface_tracer_velocity  |      | Estimated northward component of the tracer motion velocity vector.  | m s-1   | 9.1     | Mandatory |
| northward_surface_tracer_velocity |      | Estimated eastward component of the tracer motion velocity vector.   | m s-1   | 9.2     | Mandatory |

|   |  |       |     |           |
|---|--|-------|-----|-----------|
| northward_surface_tracer_velocity_error | Error on the estimated northward component of the tracer motion velocity vector. | m s-1 | 9.3 | Mandatory |
| eastward_surface_tracer_velocity_error  | Error on the estimated eastward component of the tracer motion velocity vector.  | m s-1 | 9.4 |           |
| flags                                   | Flag mask as described in section 5.4.   |       | 9.5 | Mandatory |
| quality_level                           | Quality level associated with the retrieved current vector as described in 5.5   |       | 9.6 | Mandatory |

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 8.1. Variable <eastward\_surface\_tracer\_velocity>

This is the eastward estimation of the apparent average rate of displacement of a parcel of water (assuming surface properties are conserved).

Table 8.2: CDL example description of variable eastward\_surface\_tracer\_velocity

| Storage type definition   | Variable name definition         | Description | Unit  |
|---|----------------------------------|-------------|-------|
| float   | eastward_surface_tracer_velocity |             | m s-1 |
| <b>Description</b>  |                                  |             |       |
| <pre>float eastward_surface_tracer_velocity (time, lat, lon) ;   eastward_surface_tracer_velocity:_FillValue = -3.40282e+38;   eastward_surface_tracer_velocity:long_name = "Surface tracer motion velocity: zonal component" ;   eastward_surface_tracer_velocity:units = "m s-1" ;   eastward_surface_tracer_velocity:depth = "0m" ;   eastward_surface_tracer_velocity:coordinates = "lon lat" ;   eastward_surface_tracer_velocity:horizontal_scale_range = "greater than 100km";   eastward_surface_tracer_velocity:temporal_scale_range = "1 hour";   eastward_surface_tracer_velocity:comment = "Surface tracer motion velocity estimated from maximum cross correlation between sequences of ocean colour scenes" ;</pre> |                                  |             |       |
| <b>Comments</b>   |                                  |             |       |
|   |                                  |             |       |

### 8.2. Variable <northward\_surface\_tracer\_velocity>

This is the northward estimation of the apparent average rate of displacement of a parcel of water (assuming surface properties are conserved).

Table 8.3: CDL example description of variable `northward_surface_tracer_velocity`

| Storage type definition   | Variable name definition                         | Description | Unit  |
|---|--|-------------|-------|
| float   | <code>northward_eulerian_current_velocity</code> |             | m s-1 |
| <b>Description</b>  |  |             |       |
| <pre>float northward_surface_tracer_velocity (time, lat, lon) ;   northward_surface_tracer_velocity:_FillValue = -3.40282e+38;   northward_surface_tracer_velocity:long_name = "Surface tracer motion velocity: meridional component" ;   northward_surface_tracer_velocity:units = "m s-1" ;   northward_surface_tracer_velocity:depth = "0m" ;   northward_surface_tracer_velocity:coordinates = "lon lat" ;   northward_surface_tracer_velocity:horizontal_scale_range = "greater than 100km";   northward_surface_tracer_velocity:temporal_scale_range = "1 hour";   northward_surface_tracer_velocity:comment = "Surface tracer motion ve- locity estimated from maximum cross correlation between sequences of ocean colour scenes" ;</pre> |  |             |       |
| <b>Comments</b>   |  |             |       |
|   |  |             |       |

### 8.3. Variable `<eastward_surface_tracer_velocity_error>`

This is the estimated error on the eastward apparent average rate of displacement of a parcel of water (assuming surface properties are conserved).

Table 8.4: CDL example description of variable `eastward_surface_tracer_velocity_error`

| Storage type definition   | Variable name definition                            | Description | Unit  |
|---|---|-------------|-------|
| float   | <code>eastward_surface_tracer_velocity_error</code> |             | m s-1 |
| <b>Description</b>  |   |             |       |
| <pre>float eastward_surface_tracer_velocity_error (time, lat, lon) ;   eastward_surface_tracer_velocity_error:_FillValue = -3.40282e+38;   eastward_surface_tracer_velocity_error:long_name = "Surface tracer mo- tion velocity error: zonal component" ;   eastward_surface_tracer_velocity_error:units = "m s-1" ;   eastward_surface_tracer_velocity_error:depth = "0m" ;   eastward_surface_tracer_velocity_error:coordinates = "lon lat" ;</pre> |   |             |       |
| <b>Comments</b>   |   |             |       |
|   |   |             |       |

## 8.4. Variable <northward\_surface\_tracer\_velocity\_error>

This is the estimated error on the northward apparent average rate of displacement of a parcel of water (assuming surface properties are conserved).

Table 8.5: CDL example description of variable northward\_surface\_tracer\_velocity\_error

| Storage type definition   | Variable name definition                | Description | Unit  |
|---|---|-------------|-------|
| float   | northward_surface_tracer_velocity_error |             | m s-1 |
| <b>Description</b>  |   |             |       |
| <pre>float northward_surface_tracer_velocity_error (time, lat, lon) ;   northward_surface_tracer_velocity_error:FillValue = -3.40282e+38;   northward_surface_tracer_velocity_error:long_name = "Surface tracer motion velocity error: meridional component" ;   northward_surface_tracer_velocity_error:units = "m s-1" ;   northward_surface_tracer_velocity_error:depth = "0m" ;   northward_surface_tracer_velocity_error:coordinates = "lon lat" ;</pre> |   |             |       |
| <b>Comments</b>   |   |             |       |
|   |   |             |       |

## 8.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 8.6: CDL example description of flags variable

| Storage type definition        | Variable name definition | Description  | Unit      |
|--------------------------------|--------------------------|--|-----------|
| short                          | flags                    | <p>The variable <b>flags</b> is used to</p> <ul style="list-style-type: none"> <li>(a) define the type of surface of the pixel,</li> <li>(b) pass through native flags from the input data set and</li> <li>(c) record any additional information considered important for the user of an L2P data set.</li> </ul> | Bit field |
| <b>Example CDL Description</b> |                          |  |           |

```

short flags(time, lat, lon) ;
  flags:long_name = "flags" ;
  flags:coordinates = "lon lat" ;
  flags:valid_min = 0s;
  flags:valid_max = 2047s;
  flags:flag_meanings = "land ice lake river";
  flags:flag_masks = 1s, 2s, 4s, 8s ;
  flags:comment = "These flags are important to properly use the data"

```

### Comments

The meaning of each bit of the variable **flags** shall be detailed in its **flag\_meanings** and **flag\_masks** attributes

b0:1 = land surface;

b1:1 = ice contamination;

b2:1 = input data over lake surface;

b3:1 = input data over river;

b4:b15 set by the data provider.

For this variable there is no **\_FillValue** attribute.

## 8.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 8.7: CDL example description of quality\_level variable

| Storage type definition   | Variable name definition | Description  | Unit      |
|---|--------------------------|--|-----------|
| byte  | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>  |                          |  |           |
| <pre> byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;   quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;   quality_level:comment = "These are the overall quality indicators and </pre> |                          |  |           |



|  |
|--|
| are used for all GlobCurrent products" |
| <b>Comments</b>                        |
|  |

## 9. Eulerian L4 (L4 <CUReul>)

This section describes the format of GlobCurrent L4 Eulerian products (CUReul), providing estimation of a “total” Eulerian current at a specific depth (hs or 15m). They can be obtained for instance by combining different current terms (such as geostrophic current and Ekman drift). If The current vectors are processed over different depths, they must be provided in different products.

The products hereafter detailed shall be compliant with section 4 Format of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1, and the filenaming convention provided for L4 data in section 4.5.5. An example of such file name would:

### Filename example for a eulerian surface current product:

20120202000000-GLOBCURRENT-L4-CUReul\_hs-ALT\_SUM-v01.0-fv01.0.nc

The above file contains L4 combined current data at significant wave height (“hs”) produced by GlobCurrent project. It contains data for 02 February 2012, was produced using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Table 9.1: General content of a GlobCurrent L4 Eulerian current product (L4eul)

| netCDF Contents                           | File | Description   | Units             | Section | Required  |
|---|------|---|-------------------|---------|-----------|
| Global Attributes                         |      | A collection of required global attributes describing general characteristics of the file | Various           | 4.2     | Mandatory |
| Geolocation Data                          |      | Information to permit locating data on regular gridded data.                              |                   | 4.5.1   | Mandatory |
| eastward_eulerian_current_velocity        |      | Estimated northward component of the Eulerian current vector.                             | m s <sup>-1</sup> | 9.1     | Mandatory |
| northward_eulerian_current_velocity       |      | Estimated eastward component of the Eulerian current vector.                              | m s <sup>-1</sup> | 9.2     | Mandatory |
| northward_eulerian_current_velocity_error |      | Error on the estimated northward component of the Eulerian current vector.                | m s <sup>-1</sup> | 9.3     | Mandatory |
| eastward_eulerian_current_velocity_error  |      | Error on the estimated eastward component of the Eulerian current vector.                 | m s <sup>-1</sup> | 9.4     |           |
| flags                                     |      | Flag mask as described in section 5.4.  |                   | 9.5     | Mandatory |
| quality_level                             |      | Quality level associated with the retrieved current vector as described in 5.5            |                   | 9.6     | Mandatory |

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 9.1. Variable <eastward\_eulerian\_current\_velocity>

This variable is used for describing the zonal component of the Eulerian current velocity.

Table 9.2: CDL example description of variable eastward\_eulerian\_current\_velocity

| Storage type definition  | Variable name definition           | Description   | Unit              |
|--|------------------------------------|---|-------------------|
| float  | eastward_eulerian_current_velocity | zonal component of absolute geostrophic velocity + surface Ekman velocity | m s <sup>-1</sup> |
| <b>Description</b>   |                                    |   |                   |
| <pre>float eastward_eulerian_current_velocity (time, lat, lon) ;   eastward_eulerian_current_velocity:long_name= "Absolute geostrophic velocity + 15m depth Ekman velocity: zonal component";   eastward_eulerian_current_velocity:depth="15m";   eastward_eulerian_current_velocity:units = "m s-1" ;   eastward_eulerian_current_velocity:_FillValue = -3.40282e+38;   eastward_eulerian_current_velocity:coordinates = "lon lat" ;   eastward_eulerian_current_velocity:horizontal_scale_range = "greater than 100km";   eastward_eulerian_current_velocity:temporal_scale_range = "10 days";   eastward_eulerian_current_velocity:comment = "meridional component of the combined current at 15m calculated as the sum of the geostrophic current and the Ekman current at 15m depth";   eastward_eulerian_current_velocity:limitations = "This combined current does not contain all the components of the ocean current at 15m. Tidal currents are missing, as well as inertial currents and internal wave currents ";</pre> |                                    |   |                   |
| <b>Comments</b>  |                                    |   |                   |
|  |                                    |   |                   |

### 9.2. Variable <northward\_eulerian\_current\_velocity>

This variable is used for describing the meridional component of the Eulerian current velocity.

Table 9.3: CDL example description of variable northward\_eulerian\_current\_velocity

| Storage type definition   | Variable name definition            | Description  | Unit              |
|---|-------------------------------------|--|-------------------|
| float   | northward_eulerian_current_velocity | meridian component of absolute geostrophic velocity + surface Ekman velocity | m s <sup>-1</sup> |
| <b>Description</b>  |                                     |  |                   |
| <pre>float northward_eulerian_current_velocity (time, lat, lon) ;</pre> |                                     |  |                   |

```

northward_eulerian_current_velocity:long_name= "Absolute geostrophic
velocity + 15m depth Ekman velocity: meridian component";
northward_eulerian_current_velocity:depth="15m";
northward_eulerian_current_velocity:units = "m s-1" ;
northward_eulerian_current_velocity:_FillValue = -3.40282e+38;
northward_eulerian_current_velocity:coordinates = "lon lat" ;
northward_eulerian_current_velocity:horizontal_scale_range = "greater
than 100km";
northward_eulerian_current_velocity:temporal_scale_range = "10 days";
northward_eulerian_current_velocity:comment ="meridional component of
the combined current at 15m calculated as the sum of the geostrophic current
and the Ekman current at 15m depth";
northward_eulerian_current_velocity:limitations ="This combined current
does not contain all the components of the ocean current at 15m. Tidal cur-
rents are missing, as well as inertial currents and internal wave currents ";

```

**Comments**

### 9.3. Variable <eastward\_eulerian\_current\_velocity\_error>

This variable is used for describing the error on the zonal component of the Eulerian current velocity.

Table 9.4: CDL example description of variable eastward\_eulerian\_current\_velocity\_error

| Storage type definition   | Variable name definition                 | Description | Unit  |
|---|--|-------------|-------|
| float   | eastward_eulerian_current_velocity_error |             | m s-1 |
| <b>Description</b>  |  |             |       |
| <pre> float eastward_eulerian_current_velocity_error (time, lat, lon) ; eastward_eulerian_current_velocity_error:_FillValue = -3.40282e+38; eastward_eulerian_current_velocity_error:long_name = "Absolute geo- strophic velocity + surface Ekman velocity: zonal component error" ; eastward_eulerian_current_velocity_error:units = "m s-1" ; eastward_eulerian_current_velocity_error:depth = "0m" ; eastward_eulerian_current_velocity_error:coordinates = "lon lat" ; </pre> |  |             |       |
| <b>Comments</b>   |  |             |       |

### 9.4. Variable <northward\_eulerian\_current\_velocity\_error>

This variable is used for describing the error on the meridional component of the Eulerian current velocity.

Table 9.5: CDL example description of variable `northward_eulerian_current_velocity_error`

| Storage type definition  | Variable name definition            | Description | Unit  |
|--|-------------------------------------|-------------|-------|
| float  | northward_eulerian_current_velocity |             | m s-1 |
| <b>Description</b>   |                                     |             |       |
| <pre>float northward_eulerian_current_velocity_error (time, lat, lon) ;   northward_eulerian_current_velocity_error: FillValue = -3.40282e+38;   northward_eulerian_current_velocity_error:long_name = "Absolute geostrophic velocity + surface Ekman velocity: meridian component error" ;   northward_eulerian_current_velocity_error:units = "m s-1" ;   northward_eulerian_current_velocity_error:depth = "0m" ;   northward_eulerian_current_velocity_error:coordinates = "lon lat" ;</pre> |                                     |             |       |
| <b>Comments</b>  |                                     |             |       |
|  |                                     |             |       |

## 9.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 9.6: CDL example description of flags variable

| Storage type definition  | Variable name definition | Description  | Unit      |
|--|--------------------------|--|-----------|
| short  | flags                    | <p>The variable <b>flags</b> is used to</p> <ul style="list-style-type: none"> <li>(a) define the type of surface of the pixel,</li> <li>(b) pass through native flags from the input data set and</li> <li>(c) record any additional information considered important for the user of an L2P data set.</li> </ul> | Bit field |
| <b>Example CDL Description</b>   |                          |  |           |
| <pre>short flags(time, lat, lon) ;   flags:long_name = "flags" ;   flags:coordinates = "lon lat" ;   flags:valid_min = 0s;   flags:valid_max = 2047s;   flags:flag_meanings = "land ice lake river";   flags:flag_masks = 1s, 2s, 4s, 8s ;</pre> |                          |  |           |

|  |
|--|
| <code>flags:comment = "These flags are important to properly use the data"</code>  |
| <b>Comments</b>  |
| <p>The meaning of each bit of the variable <b>flags</b> shall be detailed in its <b>flag_meanings</b> and <b>flag_masks</b> attributes</p> <p>b0:1 = land surface;<br/> b1:1 = ice contamination;<br/> b2:1 = input data over lake surface;<br/> b3:1 = input data over river;</p> <p>b4:b15 set by the data provider.</p> <p>For this variable there is no <b>_FillValue</b> attribute.</p> |

## 9.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 9.7: CDL example description of quality\_level variable

| Storage type definition  | Variable name definition | Description  | Unit      |
|--|--------------------------|--|-----------|
| byte   | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>   |                          |  |           |
| <pre>byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;   quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;   quality_level:comment = "These are the overall quality indicators and are used for all GlobCurrent products"</pre> |                          |  |           |
| <b>Comments</b>  |                          |  |           |
|  |                          |  |           |



## 10. L4 Ekman current (L4 <CUREkm>)

This section describes the format of GlobCurrent L4 Ekman products (CUREkm), providing estimation of Ekman current at a specific depth (hs or 15m). If Ekman currents are processed over different depths, they must be provided in different products.

The products hereafter detailed shall be compliant with section 4 Format of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1, and the filenaming convention provided for L4 data in section 4.5.5. An example of such file name would:

### Filename example for a Ekman current L4:

20120202000000-GLOBCURRENT-L4-CUREkm\_15m-ERAWS\_EEM-v01.0-fv01.0.nc

The above file contains L4 Ekman current data at 15 meter depth produced by GlobCurrent project. It contains data for 02 February 2012, was produced from ERA Interim wind stress data (“ERAWS”) through an Ekman Model scheme (“EEM”) using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Each product file shall provide the following content:

Table 10.1: General content of a GlobCurrent Ekman current product (L4ekm)

| netCDF Contents                        | File | Description   | Units   | Section | Required  |
|--|------|---|---------|---------|-----------|
| Global Attributes                      |      | A collection of required global attributes describing general characteristics of the file | Various | 4.2     | Mandatory |
| Geolocation Data                       |      | Information to permit locating data on regular gridded data.                              |         | 4.5.1   | Mandatory |
| eastward_ekman_current_velocity        |      | Estimated northward component of the Ekman drift vector.                                  | m s-1   | 10.1    | Mandatory |
| northward_ekman_current_velocity       |      | Estimated eastward component of the Ekman drift vector.                                   | m s-1   | 10.2    | Mandatory |
| northward_ekman_current_velocity_error |      | Error on the estimated northward component of the Ekman drift vector.                     | m s-1   | 10.3    | Mandatory |
| eastward_ekman_current_velocity_error  |      | Error on the estimated eastward component of the Ekman drift vector.                      | m s-1   | 10.4    | Mandatory |
| flags                                  |      | Flag mask as described in section 5.4.  |         |         | Mandatory |



|               |  |  |  |           |
|---------------|--|--|--|-----------|
| quality_level | Quality level associated with the retrieved current vector as described in 5.5 |  |  | Mandatory |
|---------------|--|--|--|-----------|

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 10.1. Variable <eastward\_ekman\_current\_velocity>

This variable is used for describing the zonal component of the Ekman current as calculated in the GlobCurrent project.

Table 10.2: CDL example description of variable eastward\_ekman\_current\_velocity

| Storage type definition   | Variable name definition        | Description | Unit  |
|---|---------------------------------|-------------|-------|
| float   | eastward_ekman_current_velocity |             | m s-1 |
| <b>Description</b>  |                                 |             |       |
| <pre>float eastward_ekman_current_velocity(time, lat, lon) ;   eastward_ekman_current_velocity:_FillValue = -3.40282e+38;   eastward_ekman_current_velocity:_long_name = "15m depth Ekman current velocity: zonal component" ;   eastward_ekman_current_velocity:units = "m s-1" ;   eastward_ekman_current_velocity:depth = "15m" ;   eastward_ekman_current_velocity:coordinates = "lon lat" ;   eastward_ekman_current_velocity:horizontal_scale_range = "75 km";   eastward_ekman_current_velocity:temporal_scale_range = "5-10 days";   eastward_ekman_current_velocity:comment = "This Ekman current was com- puted using the empirical model described in Rio et al, 2014 and taking ERA INTERIM wind stress data as input";   eastward_ekman_current_velocity:limitations = "Model parameters are cal- culated empirically using a global dataset of drifting buoy velocities. Some areas are less sampled than others (i.e. high latitudes), which may result in less accurate parameter estimates";</pre> |                                 |             |       |
| <b>Comments</b>   |                                 |             |       |
| The _FillValue should be the minimum value of the variable storage type (here float).   |                                 |             |       |

### 10.2. Variable <northward\_ekman\_current\_velocity>

This variable is used for describing the meridional component of the Ekman current as calculated in the GlobCurrent project.

Table 10.3: CDL example description of variable `northward_ekman_current_velocity`

| Storage type definition  | Variable name definition         | Description | Unit  |
|--|----------------------------------|-------------|-------|
| float  | northward_ekman_current_velocity |             | m s-1 |
| <b>Description</b>   |                                  |             |       |
| <pre>float northward_ekman_current_velocity(time, lat, lon) ;   northward_ekman_current_velocity: FillValue = -3.40282e+38;   northward_ekman_current_velocity:long_name = "15m depth Ekman current velocity: meridional component" ;   northward_ekman_current_velocity:units = "m s-1" ;   northward_ekman_current_velocity:depth = "15m" ;   northward_ekman_current_velocity:coordinates = "lon lat" ;   northward_ekman_current_velocity:horizontal_scale_range = "75 km";   northward_ekman_current_velocity:temporal_scale_range = "5-10 days";   northward_ekman_current_velocity:comment = " This Ekman current was com- puted using the empirical model described in Rio et al, 2014 And taking ERA INTERIM wind stress data as input";   northward_ekman_current_velocity:limitations = "Model parameters are calculated empirically using a global dataset of drifting buoy velocities. Some areas are less sampled than others (i.e. high latitudes), which may res- ult in less accurate parameter estimates";</pre> |                                  |             |       |
| <b>Comments</b>  |                                  |             |       |
| The <code>_FillValue</code> should be the minimum value of the variable storage type (here float).   |                                  |             |       |

### 10.3. Variable `<eastward_ekman_current_velocity_error>`

This variable is used for describing the error estimated on the zonal component of the Ekman current as calculated in the GlobCurrent project.

Table 10.4: CDL example description of variable `eastward_ekman_current_velocity_error`

| Storage type definition   | Variable name definition              | Description | Unit  |
|---|---------------------------------------|-------------|-------|
| float   | eastward_ekman_current_velocity_error |             | m s-1 |
| <b>Description</b>  |                                       |             |       |
| <pre>float eastward_ekman_current_velocity_error(time, lat, lon) ;   eastward_ekman_current_velocity_error: FillValue = -3.40282e+38;   eastward_ekman_current_velocity_error:long_name = "15m depth Ekman cur- rent velocity: zonal component error" ;   eastward_ekman_current_velocity_error:units = "m s-1" ;   eastward_ekman_current_velocity_error:depth = "15m" ;   eastward_ekman_current_velocity_error:coordinates = "lon lat" ;</pre> |                                       |             |       |
| <b>Comments</b>   |                                       |             |       |
| The <code>_FillValue</code> should be the minimum value of the variable storage type (here float).  |                                       |             |       |

## 10.4. Variable <northward\_ekman\_current\_velocity\_error>

This variable is used for describing the error estimated on the meridional component of the Ekman current as calculated in the GlobCurrent project.

Table 10.5: CDL example description of variable northward\_ekman\_current\_velocity\_error

| Storage type definition   | Variable name definition               | Description | Unit  |
|---|--|-------------|-------|
| float   | northward_ekman_current_velocity_error |             | m s-1 |
| <b>Description</b>  |  |             |       |
| <pre>float northward_ekman_current_velocity_error (time, lat, lon) ;   northward_ekman_current_velocity_error: FillValue = -3.40282e+38;   northward_ekman_current_velocity_error:long_name = "surface Ekman current velocity: meridian component error" ;   northward_ekman_current_velocity_error:units = "m s-1" ;   northward_ekman_current_velocity_error:depth = "15m" ;   northward_ekman_current_velocity_error:coordinates = "lon lat" ;</pre> |  |             |       |
| <b>Comments</b>   |  |             |       |
| The _FillValue should be the minimum value of the variable storage type (here float).   |  |             |       |

## 10.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 10.6: CDL example description of variable flags

| Storage type definition | Variable name definition | Description  | Unit      |
|-------------------------|--------------------------|--|-----------|
| short                   | flags                    | <p>The variable <b>flags</b> is used to</p> <ul style="list-style-type: none"> <li>(a) define the type of surface of the pixel,</li> <li>(b) pass through native flags from the input data set and</li> <li>(c) record any additional information considered important for the user of an L2P data set.</li> </ul> | Bit field |

| Example CDL Description  |
|--|
| <pre>short flags(time, lat, lon) ;   flags:long_name = "flags" ;   flags:coordinates = "lon lat" ;   flags:valid_min = 0s;   flags:valid_max = 2047s;   flags:flag_meanings = "land ice lake river";   flags:flag_masks = 1s, 2s, 4s, 8s ;   flags:comment = "These flags are important to properly use the data"</pre>  |
| Comments   |
| <p>The meaning of each bit of the variable <b>flags</b> shall be detailed in its <b>flag_meanings</b> and <b>flag_masks</b> attributes</p> <p>b0:1 = land surface;<br/> b1:1 = ice contamination;<br/> b2:1 = input data over lake surface;<br/> b3:1 = input data over river;</p> <p>b4:b15 set by the data provider.</p> <p>For this variable there is no <b>_FillValue</b> attribute.</p> |

## 10.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 10.7: CDL example description of variable *quality\_level*

| Storage type definition  | Variable name definition | Description  | Unit      |
|--|--------------------------|--|-----------|
| byte   | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| Example CDL Description  |                          |  |           |
| <pre>byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;</pre> |                          |  |           |

```
quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;  
quality_level:comment = "These are the overall quality indicators and  
are used for all GlobCurrent products"
```

### **Comments**

The \_FillValue should be the minimum value of the variable storage type (here byte).

## 11. L3C mean geostrophic current (L3C <CURgeo>)

This section describes the format for a mean geostrophic current field built through the averaging of multiples scenes or passes. This applies for instance to a mean geostrophic current generated over a regional area from instantaneous SAR Eulerian current (“L2Peul”, section 6) : although the instantaneous scenes are Eulerian currents, the averaging process over multiple years result in an actual estimation of a mean geostrophic current and this product is therefore classified as a geostrophic current product.

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1, and the filenames convention provided for L3C data in section 3.1. An example of such file name would:

### **Filename example for a mean geostrophic current L3C from SAR doppler:**

20020202123542-GLOBCURRENT-L3C-CURgeo\_0m-ENVISAT\_ASAR\_AGL\_MEAN-v01.0-fv01.0.nc

The above file contains the collation (“L3C”) of multiple scenes of ENVISAR ASAR current data at 0 meter depth over Agulhas area (“AGL”), produced by GlobCurrent project. The first scene used in the collation process gives the time reference for the file (02 February 2012 at 12:35:42). the data fields were produced through an averaging scheme (“MEAN”) using version 1 of the processor and is version 1.0 of the file.

The format is the same as for the L4geo product described in section 6.1, except it is a climatological mean and the time coordinate is expressed in a different way, as defined in section 4.5.

```
dimensions:  
  time=1;  
  nv=2;  
  double time(time);  
    time:climatology="climatology_bounds";  
    time:units="days since 1960-1-1";  
  double climatology_bounds(time,nv);
```

## 12. L4 Stokes drift (L4 <CURstk>)

This section describes the format of Globcurrent L4 Stokes drift products (CURstk), providing the Stokes drift estimation over a grid using generally a wave model.

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1 and the filenaming convention provided for gridded data in section 3. An example of such file name would:

### Filename example for a Stokes drift product:

20020202000000-GLOBCURRENT-L4-CURstk\_hs-WW3-v01.0-fv01.0.nc

The above file contains L4 Stokes drift data at significant wave height produced by GlobCurrent project from WaveWatch 3 model (“WW3”). It contains data for 02 February 2012, was produced using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Each product file shall provide the following content:

Table 12.1: General content of a GlobCurrent Stokes drift L4 product (L4 CURstk)

| netCDF File Contents                  | Description   | Units   | Section | Required  |
|---------------------------------------|---|---------|---------|-----------|
| Global Attributes                     | A collection of required global attributes describing general characteristics of the file | Various | 4.2     | Mandatory |
| Geolocation Data                      | Information to permit locating data on regular gridded data.                              |         | 4.5.1   | Mandatory |
| eastward_stokes_drift_velocity        | Estimated northward component of the Stokes drift vector.                                 | m s-1   | 12.1    | Mandatory |
| northward_stokes_drift_velocity       | Estimated eastward component of the Stokes drift vector.                                  | m s-1   | 12.2    | Mandatory |
| northward_stokes_drift_velocity_error | Error on the estimated northward component of the Stokes drift vector.                    | m s-1   | 12.3    | Mandatory |
| eastward_stokes_drift_velocity_error  | Error on the estimated eastward component of the Stokes drift vector.                     | m s-1   | 12.4    | Mandatory |
| flags                                 | Flag mask as described in section 5.4.  |         | 12.5    | Mandatory |

|               |  |  |      |           |
|---------------|--|--|------|-----------|
| quality_level | Quality level associated with the retrieved current vector as described in 5.5 |  | 12.6 | Mandatory |
|---------------|--|--|------|-----------|

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 12.1. Variable <eastward\_stokes\_drift\_velocity>

As waves travel, the water particles that make up the waves do not travel in a straight line, but rather in orbital motions. Water particles do not move over a closed orbital path but instead have an additional movement in the direction of wave propagation. As the particles progress in an orbital motion, their movement is enhanced at the top of the orbit and slowed slightly at the bottom. The resulting Lagrangian current is called the Stokes drift. This is the eastward component of the Stokes drift vector.

Table 12.2: CDL example description of variable eastward\_stokes\_drift\_velocity

| Storage type definition  | Variable name definition       | Description   | Unit  |
|--|--------------------------------|---|-------|
| float  | eastward_stokes_drift_velocity | Estimated northward component of the Stokes drift vector. | m s-1 |
| <b>Description</b>   |                                |   |       |
| <pre>float eastward_stokes_drift_velocity (time, lat, lon) ;   eastward_stokes_drift_velocity:long_name = "Stokes drift: zonal component";   eastward_stokes_drift_velocity:depth = "hs";   eastward_stokes_drift_velocity:units = "m s-1" ;   eastward_stokes_drift_velocity:coordinates = "lon lat" ;   eastward_stokes_drift_velocity:_FillValue = -3.40282e+38;   eastward_stokes_drift_velocity:horizontal_scale_range = "50km";   eastward_stokes_drift_velocity:temporal_scale_range = "instantaneous";   eastward_stokes_drift_velocity:comment = "Estimated from Ifremer version of WaveWatch3 wave prediction model"   eastward_stokes_drift_velocity:source = "WW3_IFR"   eastward_stokes_drift_velocity:limitations = ""</pre> |                                |   |       |
| <b>Comments</b>  |                                |   |       |
|  |                                |   |       |

### 12.2. Variable <northward\_stokes\_drift\_velocity>

As waves travel, the water particles that make up the waves do not travel in a straight line, but rather in orbital motions. Water particles do not move over a closed orbital path but instead have an additional movement in the direction of wave propagation. As the particles progress in an orbital motion, their movement is enhanced at the top of the orbit and slowed slightly at the



bottom. The resulting Lagrangian current is called the Stokes drift. This is the northward component of the Stokes drift vector.

Table 12.3: CDL example description of variable `northward_stokes_drift_velocity`

| Storage type definition   | Variable name definition                     | Description  | Unit  |
|---|--|--|-------|
| float   | <code>northward_stokes_drift_velocity</code> | Estimated eastward component of the Stokes drift vector. | m s-1 |
| <b>Description</b>  |  |  |       |
| <pre>float northward_stokes_drift_velocity (time, lat, lon) ;   northward_stokes_drift_velocity:long_name = "Stokes drift: meridian component";   northward_stokes_drift_velocity:depth = "hs";   northward_stokes_drift_velocity:units = "m s-1" ;   northward_stokes_drift_velocity:coordinates = "lon lat" ;   northward_stokes_drift_velocity:_FillValue = -3.40282e+38;   northward_stokes_drift_velocity:horizontal_scale_range = "50km";   northward_stokes_drift_velocity:temporal_scale_range = "instantaneous";   northward_stokes_drift_velocity:comment = "Estimated from Ifremer ver- sion of WaveWatch3 wave prediction model";   northward_stokes_drift_velocity:source = "AVISO"   northward_stokes_drift_velocity:limitations = ""</pre> |  |  |       |
| <b>Comments</b>   |  |  |       |
|   |  |  |       |

### 12.3. Variable `<eastward_stokes_drift_velocity_error>`

This is the estimated error on the eastward component of the Stokes drift.

Table 12.4: CDL example description of variable `eastward_stokes_drift_velocity_error`

| Storage type definition   | Variable name definition                          | Description  | Unit  |
|---|---|--|-------|
| float   | <code>eastward_stokes_drift_velocity_error</code> | Error on the estimated northward component of the Stokes drift vector. | m s-1 |
| <b>Description</b>  |   |  |       |
| <pre>float eastward_stokes_drift_velocity_error (time, lat, lon) ;   eastward_stokes_drift_velocity_error:long_name = "error on the estima- tion of the Stokes drift velocity: zonal component";   eastward_stokes_drift_velocity_error:depth = "hs";   eastward_stokes_drift_velocity_error:units = "m s-1" ;   eastward_stokes_drift_velocity_error:coordinates = "lon lat" ;   eastward_stokes_drift_velocity_error:_FillValue = -3.40282e+38;</pre> |   |  |       |
| <b>Comments</b>   |   |  |       |
|   |   |  |       |

## 12.4. Variable <northward\_stokes\_drift\_velocity\_error>

This is the estimated error on the northward component of the Stokes drift.

Table 12.5: CDL example description of variable northward\_stokes\_drift\_velocity\_error

| Storage type definition  | Variable name definition              | Description   | Unit  |
|--|---------------------------------------|---|-------|
| float  | northward_stokes_drift_velocity_error | Error on the estimated eastward component of the Stokes drift vector. | m s-1 |
| <b>Description</b>   |                                       |   |       |
| <pre>float northward_stokes_drift_velocity_error (time, lat, lon) ;   northward_stokes_drift_velocity_error:long_name = "error on the estimation of the Stokes drift velocity: meridional component";   northward_stokes_drift_velocity_error:depth = "hs";   northward_stokes_drift_velocity_error:units = "m s-1" ;   northward_stokes_drift_velocity_error:coordinates = "lon lat" ;   northward_stokes_drift_velocity_error:_FillValue = -3.40282e+38;</pre> |                                       |   |       |
| <b>Comments</b>  |                                       |   |       |
|  |                                       |   |       |

## 12.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 12.6: CDL example description of flags variable

| Storage type definition        | Variable name definition | Description  | Unit      |
|--------------------------------|--------------------------|--|-----------|
| short                          | flags                    | <p>The variable <b>flags</b> is used to</p> <ul style="list-style-type: none"> <li>(a) define the type of surface of the pixel,</li> <li>(b) pass through native flags from the input data set and</li> <li>(c) record any additional information considered important for the user of an L2P data set.</li> </ul> | Bit field |
| <b>Example CDL Description</b> |                          |  |           |

```

short flags(time, lat, lon) ;
  flags:long_name = "flags" ;
  flags:coordinates = "lon lat" ;
  flags:valid_min = 0s;
  flags:valid_max = 2047s;
  flags:flag_meanings = "land ice lake river";
  flags:flag_masks = 1s, 2s, 4s, 8s ;
  flags:comment = "These flags are important to properly use the data"

```

### Comments

The meaning of each bit of the variable **flags** shall be detailed in its **flag\_meanings** and **flag\_masks** attributes

b0:1 = land surface;

b1:1 = ice contamination;

b2:1 = input data over lake surface;

b3:1 = input data over river;

b4:b15 set by the data provider.

For this variable there is no **\_FillValue** attribute.

## 12.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 12.7: CDL example description of *quality\_level* variable

| Storage type definition   | Variable name definition | Description  | Unit      |
|---|--------------------------|--|-----------|
| byte  | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>  |                          |  |           |
| <pre> byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;   quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;   quality_level:comment = "These are the overall quality indicators and </pre> |                          |  |           |

|  |
|--|
| are used for all GlobCurrent products" |
| <b>Comments</b>                        |
|  |

### 13. L4 tidal current (L4 <CURtid>)

This section describes the format of GlobCurrent L4 tidal current products (CURtid), providing the tidal current estimation over a grid using generally a tide prediction model.

The products hereafter detailed shall be compliant with section 4 of this document. Precisely these products shall follow geolocation information for regular gridded products as described in section 4.5.1 and the filenaming convention provided for gridded data in section 3. An example of such file name would:

**Filename example for a tidal current product:**

20020202000000-GLOBCURRENT-L4-CURtid\_0m-FES2012-v01.0-fv01.0.nc

The above file contains L4 tidal current data at ocean surface produced by GlobCurrent project from CNES/Legos FES-2012 model (“FES2012”). It contains data for 02 February 2012, was produced using version 1 of the processor and is version 1.0 of the file. The nominal time of the analysis is 00:00:00 hours.

Each product file shall provide the following content:

*Table 13.1: General content of a GlobCurrent tidal currentL4 product (L4 CURtid)*

| netCDF File Contents                   | Description   | Units   | Section | Required  |
|--|---|---------|---------|-----------|
| Global Attributes                      | A collection of required global attributes describing general characteristics of the file | Various | 4.2     | Mandatory |
| Geolocation Data                       | Information to permit locating data on regular gridded data.                              |         | 4.5.1   | Mandatory |
| eastward_tidal_current_velocity        | Estimated northward component of the tidal current vector.                                | m s-1   | 13.1    | Mandatory |
| northward_tidal_current_velocity       | Estimated eastward component of the tidal current vector.                                 | m s-1   | 13.2    | Mandatory |
| northward_tidal_current_velocity_error | Error on the estimated northward component of the tidal current vector.                   | m s-1   | 13.3    | Mandatory |
| eastward_tidal_current_velocity_error  | Error on the estimated eastward component of the tidal current vector.                    | m s-1   | 13.3    |           |
| flags                                  | Flag mask as described in section 5.4.  |         | 13.3    | Mandatory |

|               |  |  |      |           |
|---------------|--|--|------|-----------|
| quality_level | Quality level associated with the retrieved geostrophic current vector as described in 5.5 |  | 13.3 | Mandatory |
|---------------|--|--|------|-----------|

The following subsections give a more detailed description and CDL example of each geophysical variable.

### 13.1. Variable <eastward\_tidal\_current\_velocity>

Tides are related to gravitational variations associated to the Sun and Moon alignments, resulting in periodical changes in water levels. This is the eastward component of the tidal current generated by these variations.

Table 13.2: CDL example description of variable eastward\_tidal\_current\_velocity

| Storage type definition   | Variable name definition        | Description  | Unit              |
|---|---------------------------------|--|-------------------|
| float   | eastward_tidal_current_velocity | Estimated northward component of the tidal current vector. | m s <sup>-1</sup> |
| <b>Description</b>  |                                 |  |                   |
| <pre>float eastward_tidal_current_velocity (time, lat, lon) ;     eastward_tidal_current_velocity:long_name = "tidal current: zonal component";     eastward_tidal_current_velocity:depth = "hs";     eastward_tidal_current_velocity:units = "m s-1" ;     eastward_tidal_current_velocity:coordinates = "lon lat" ;     eastward_tidal_current_velocity:_FillValue = -3.40282e+38;     eastward_tidal_current_velocity:horizontal_scale_range = "10km";     eastward_tidal_current_velocity:temporal_scale_range = "instantaneous";     eastward_tidal_current_velocity:comment = "Estimated from CNES/Legos FES 2012 model used in altimetry"     eastward_tidal_current_velocity:source = "FES2012"     eastward_tidal_current_velocity:limitations = "???"</pre> |                                 |  |                   |
| <b>Comments</b>   |                                 |  |                   |
|   |                                 |  |                   |

### 13.2. Variable <northward\_tidal\_current\_velocity>

Tides are related to gravitational variations associated to the Sun and Moon alignments, resulting in periodical changes in water levels. This is the northward component of the tidal current generated by these variations.

Table 13.3: CDL example description of variable northward\_tidal\_current\_velocity

| Storage type definition | Variable name definition | Description | Unit |
|-------------------------|--------------------------|-------------|------|
|                         |                          |             |      |

|  |                                  |   |       |
|--|----------------------------------|---|-------|
| float  | northward_tidal_current_velocity | Estimated eastward component of the tidal current vector. | m s-1 |
| <b>Description</b>   |                                  |   |       |
| <pre>float northward_tidal_current_velocity (time, lat, lon) ;   northward_tidal_current_velocity:long_name = "tidal current: meridian component";   northward_tidal_current_velocity:depth = "hs";   northward_tidal_current_velocity:units = "m s-1" ;   northward_tidal_current_velocity:coordinates = "lon lat" ;   northward_tidal_current_velocity:_FillValue = -3.40282e+38;   northward_tidal_current_velocity:horizontal_scale_range = "10km";   northward_tidal_current_velocity:temporal_scale_range = "instantaneous";   northward_tidal_current_velocity:comment = "estimated from CNES/Legos FES 2012 model used in altimetry";   northward_tidal_current_velocity:source = "FES2012"   northward_tidal_current_velocity:limitations = "???"</pre> |                                  |   |       |
| <b>Comments</b>  |                                  |   |       |
|  |                                  |   |       |

### 13.3. Variable <eastward\_tidal\_current\_velocity\_error>

This is the estimated error on the eastward component of the tidal current.

Table 13.4: CDL example description of variable eastward\_tidal\_current\_velocity\_error

| Storage type definition  | Variable name definition              | Description   | Unit  |
|--|---------------------------------------|---|-------|
| float  | eastward_tidal_current_velocity_error | Error on the estimated northward component of the tidal current vector. | m s-1 |
| <b>Description</b>   |                                       |   |       |
| <pre>float eastward_tidal_current_velocity_error (time, lat, lon) ;   eastward_tidal_current_velocity_error:long_name = "error on the estimation of the tidal current velocity: zonal component";   eastward_tidal_current_velocity_error:depth = "hs";   eastward_tidal_current_velocity_error:units = "m s-1" ;   eastward_tidal_current_velocity_error:coordinates = "lon lat" ;   eastward_tidal_current_velocity_error:_FillValue = -3.40282e+38;</pre> |                                       |   |       |
| <b>Comments</b>  |                                       |   |       |
|  |                                       |   |       |

### 13.4. Variable <northward\_tidal\_current\_velocity\_error>

This is the estimated error on the northward component of the tidal current.

Table 13.5: CDL example description of variable `northward_tidal_current_velocity_error`

| Storage type definition   | Variable name definition                            | Description  | Unit              |
|---|---|--|-------------------|
| float   | <code>northward_tidal_current_velocity_error</code> | Error on the estimated eastward component of the tidal current vector. | m s <sup>-1</sup> |
| <b>Description</b>  |   |  |                   |
| <pre>float northward_tidal_current_velocity_error (time, lat, lon) ;     northward_tidal_current_velocity_error:long_name = "error on the estimation of the tidal current velocity: meridional component";     northward_tidal_current_velocity_error:depth = "hs";     northward_tidal_current_velocity_error:units = "m s-1" ;     northward_tidal_current_velocity_error:coordinates = "lon lat" ;     northward_tidal_current_velocity_error:_FillValue = -3.40282e+38;</pre> |   |  |                   |
| <b>Comments</b>   |   |  |                   |
|   |   |  |                   |

### 13.5. Variable <flags>

The variable **flags** is used to record any additional information considered important for the user of a data set. It follows the generic form described in table 4.21 and detailed content provided in section 5.4.

Table 13.6: CDL example description of flags variable

| Storage type definition  | Variable name definition | Description  | Unit      |
|--|--------------------------|--|-----------|
| short  | <code>flags</code>       | <p>The variable <b>flags</b> is used to</p> <ul style="list-style-type: none"> <li>(a) define the type of surface of the pixel,</li> <li>(b) pass through native flags from the input data set and</li> <li>(c) record any additional information considered important for the user of an L2P data set.</li> </ul> | Bit field |
| <b>Example CDL Description</b>   |                          |  |           |
| <pre>short flags(time, lat, lon) ;     flags:long_name = "flags" ;     flags:coordinates = "lon lat" ;     flags:valid_min = 0s;     flags:valid_max = 2047s;     flags:flag_meanings = "land ice lake river";     flags:flag_masks = 1s, 2s, 4s, 8s ;</pre> |                          |  |           |



|  |
|--|
| <code>flags:comment = "These flags are important to properly use the data"</code>  |
| <b>Comments</b>  |
| <p>The meaning of each bit of the variable <b>flags</b> shall be detailed in its <b>flag_meanings</b> and <b>flag_masks</b> attributes</p> <p>b0:1 = land surface;<br/> b1:1 = ice contamination;<br/> b2:1 = input data over lake surface;<br/> b3:1 = input data over river;</p> <p>b4:b15 set by the data provider.</p> <p>For this variable there is no <b>_FillValue</b> attribute.</p> |

### 13.6. Variable <quality\_level>

The variable ‘**quality\_level**’ provides an indicator of the overall quality of a current measurement in an GlobCurrent file. It follows the generic form described in table 4.21 and detailed content provided in section 5.5.

Table 13.7: CDL example description of quality\_level variable

| Storage type definition  | Variable name definition | Description  | Unit      |
|--|--------------------------|--|-----------|
| byte   | quality_level            | Overall indicator of ocean current measurement quality | enumerate |
| <b>Example CDL Description</b>   |                          |  |           |
| <pre>byte quality_level (time, lat, lon) ;   quality_level:long_name = "quality level of ocean current pixel" ;   quality_level:coordinates = "lon lat" ;   quality_level:_FillValue = -128b;   quality_level:valid_min = 0b;   quality_level:valid_max = 5b;   quality_level:flag_meanings = "no_data bad_data worst_quality                                 low_quality acceptable_quality                                 best_quality" ;   quality_level:flag_values = 0b, 1b, 2b, 3b, 4b, 5b ;   quality_level:comment = "These are the overall quality indicators and are used for all GlobCurrent products"</pre> |                          |  |           |
| <b>Comments</b>  |                          |  |           |
|  |                          |  |           |