GLOBCURRENT
INTERFACE CONTROL DOCUMENT

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Revision Change log

Issue	Date	Type	Change description
1.0	14 April 2014	Initial draft	
1.1	24 November 2014	Initial draft	Reformatting
1.2	26 January 2014	Revision	Corrections of ESA RIDs. Format moved to TN-2 document.
1.3	12 April	Revision	Added known processor interfaces
1.4	6 May	Revision	Completed TBD in interfaces

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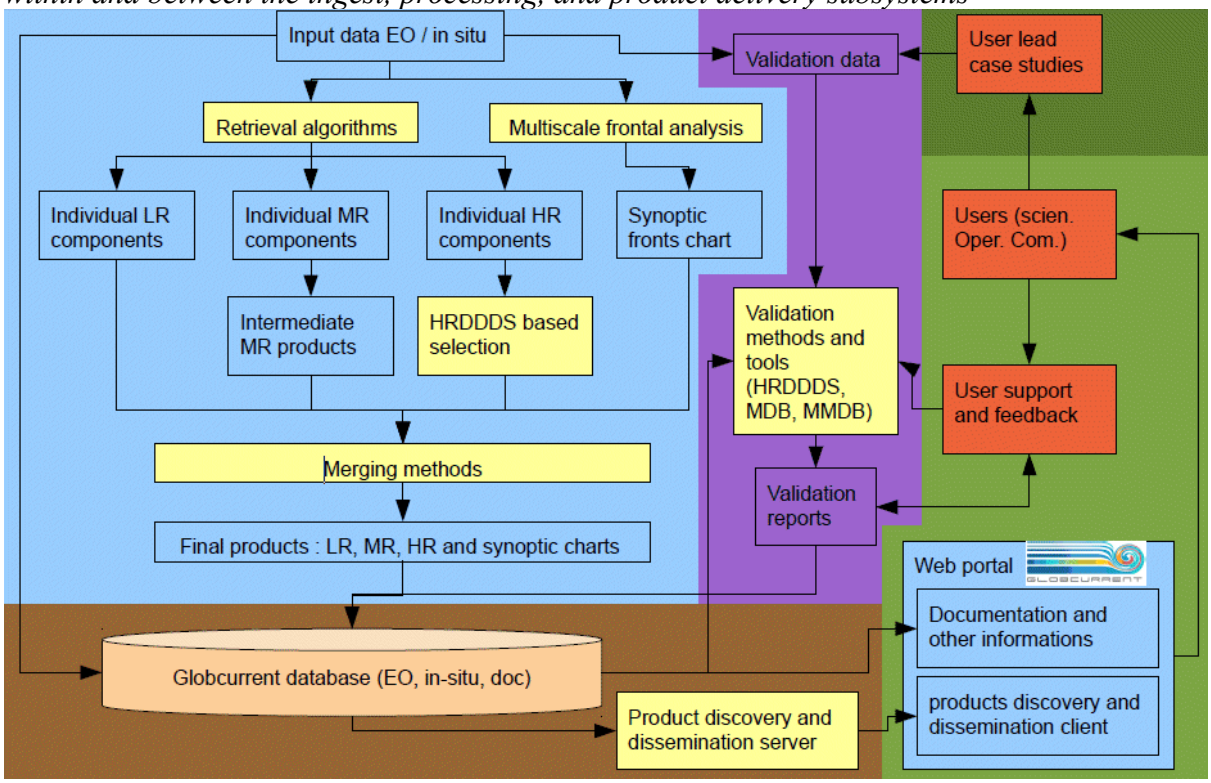
1 Introduction

1.1 Purpose and scope

This Interface Control Document (ICD) defines the internal and external interfaces of distinct components of the GlobCurrent processing system. The overall flow of the GlobCurrent system (Figure 1) involves interactions within and between:

- Processing algorithms and products (key elements in blue)
- Data operation (brown)
- Validation (purple)
- Use Case Study (dark green)
- Communication and user interface (light green)

Figure 1: Simplified overview of the data flow and processing components of the GlobCurrent system. Coloured regions are the key subsystems and arrows denote data flows within and between the ingest, processing, and product delivery subsystems



Core interfaces are connected to the processing algorithms (blue) and involve the formatting of, and access to, GlobCurrent products. In turn, external interfaces (i.e., input data feed and green, brown, and purple interactions) are broadly defined in terms of a) actors and remote services interacting with GlobCurrent, b) protocols to access source EO datasets, and c) the format of GlobCurrent output products.

1.2 Document structure

This document is organized into the following sections:

- Section 1 (this section) outlines the scope and structure of the document
- Section 2 is an overview of the processing system in terms of its main external interfaces
- Section 3 summarizes the data format that users are exposed to
- Section 4 provides an overview of the core internal interfaces

1.3 Applicable Documents

[AD-1][	Statement of Work for DUE GlobCurrent project (SoW), EOP-SM/2450, Issue 2, 26 March 2013
[AD-2]	Product Format and Content document for GlobCurrent (project deliverable D-150) issued on 27 November 2014.
[AD-3]	Algorithm Theoretical Baseline Description (project deliverable D-160) issued on 5 December 2014.
[AD-4]	Technical Specification for GlobCurrent (project deliverable D-180) issued on 24 January 2015.
[AD-5]	Data Access Requirement Document, issued on 24 January 2015

1.4 Reference documents

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

1.4.1 Publications

[RD-1]	Bonjean F. and G.S.E. Lagerloef, 2002, Diagnostic Model and Analysis of the Surface Currents in the Tropical Pacific Ocean, J. Phys. Ocean., 32, 2938-2954.
[RD-2]	Larnicol, G., Guinehut, S., Rio, M.-H., Drevillon, M., Faugere, Y., and Nicolas, G. 2006, The global observed ocean products of the French Mercator project, in: Proceedings of the “15 years of progress in radar altimetry” ESA Symposium, ESA, Venice, 2006
[RD-3]	Madec G. 2008: "NEMO ocean engine". Note du Pole de modélisation, Institut Pierre-Simon Laplace (IPSL), France, No 27 ISSN No 1288-1619

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

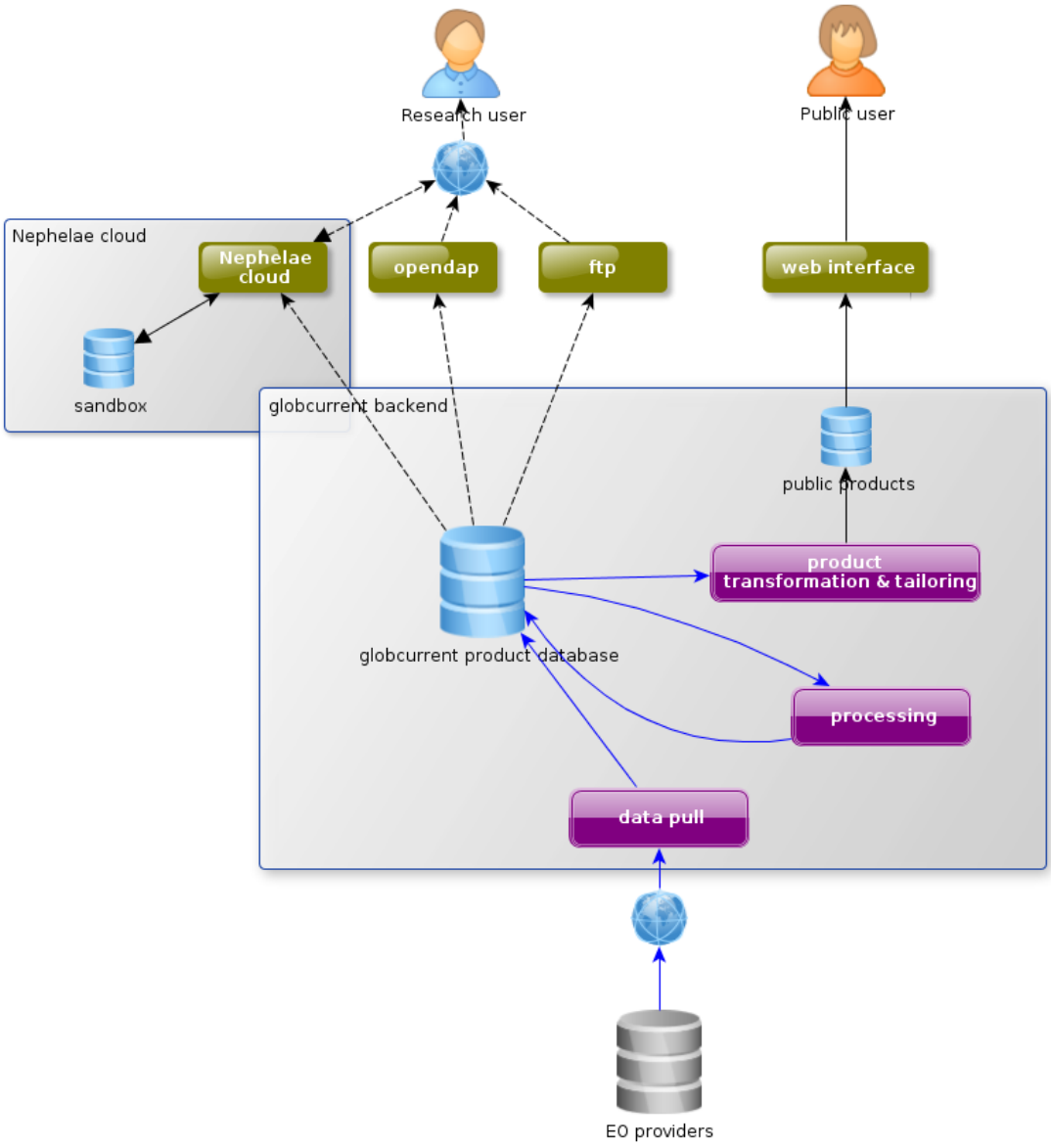
AATSR	Advanced Along Track Scanning Radiometer (of ENVISAT)
ADB	Actions Data Base
AMSRE	Advanced Microwave Scanning Radiometer – E (of EoS Aqua)
AQUARIUS	Salinity mission (of NASA/CONAE)
ASAR	Advanced Synthetic Aperture Radar (of ENVISAT)
ASCAT	Advanced SCATterometer (of MetOp)
ATBD	Algorithm Theoretical 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)
ENVISAT	Environnent Satellite (http://envisat.esa.int)
ESA	European Space Agency
EO	Earth Observation
EU	European Union
FR	Final Report
Hs	Significant Wave Height (also SWH)
ITT	Invitation To Tender
KO	Kick-Off
MR	Monthly Report
MTR	Mid-Term Review
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
RA-2	Radar Altimeter 2 (of ENVISAT)
RB	Reference Baseline
RD	Reference Document
SAR	Synthetic Aperture RADAR
SAR	Scientific Assessment Report (of *SOS*)
SAP	Scientific Analysis Plan
SIAR	Scientific and Impact Assessment Report
SMOS	Soil Moisture and Ocean Salinity (mission)
SOS	Surface Ocean Salinity and Synergy (project)
SoW	Statement of Work
SRR	System Requirements Review
SSH	Sea Surface Height
SSM/I	Special Sensor Microwave Imager (of DMSP)
SST	Sea Surface Temperature
SR	Scientific Roadmap
STSE	Support to Science Element
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 External interfaces

The following data flow and system breakdown illustrates the main external interfaces of the GlobCurrent system:

Figure 2: Data flow and main external interfaces of the GlobCurrent system.



These external interfaces include:

1. **EO data providers**: they provide the input data to the system and are interfaced with GlobCurrent through the **data pull** subsystem. There is unfortunately no standard protocol for data delivery by providers and GlobCurrent has therefore to be ready to interface with several possible access means: FTP, OpenDAP and local network access are initially provided and can be extended through connection plugins.
2. interfaces for a **direct access** to the GlobCurrent product archive through standard protocols such as FTP and OpenDAP

3. A **web user interface** communicating to provide user-friendly display and analysis functions of the GlobCurrent products.
4. **Direct access** to a sandbox environment on Ifremer *Nephelae* platform, allowing users or partners to remotely work with, (re)process, or analyse the GlobCurrent data

2.1 EO data providers

In GlobCurrent, the ingestion of the data is performed in a data driven way. The system must detect the availability of new data files (meaning data files not yet seen and ingested by GlobCurrent), which is the function of the **data pull subsystem**. This subsystem interfaces with the source data provider's archives that can be remote or local, available through various network protocols. It is not possible to cover all possible protocols but the GlobCurrent data pull subsystem is by design fully extensible so that new protocols can be added later. Initially, the following protocols are provided:

- FTP
- OpenDAP

2.1.1 FTP

FTP is a standard protocol that is still used by most of the data providers. Numerous clients, libraries and software support it natively. It is natively supported by the ***GlobCurrent*** data pull subsystem too.

FTP servers require login and password, which have to be requested from the original provider for each dataset ingested in ***GlobCurrent*** and configured in the data pull subsystem.

Data files can not be read directly through FTP and must be first downloaded to a local mirror archive or rolling archive, that are natively proposed by the data pull system.

The file organization and naming on a FTP server is completely dependent on the provider and may be different for each dataset. It has to be configured for each [AD-5]dataset in the data pull subsystem.

2.1.2 OpenDAP

The OPeNDAP Data Access Protocol (DAP) is a protocol for requesting and transporting data across the web. DAP 2.0 uses HTTP to frame the requests and responses.

Few datasets are uniquely available through OpenDAP though it is starting to be the case for several operational projects (such as MyOcean). It is therefore implemented within GlobCurrent for access to some existing [AD-5] datasets.

OpenDAP access works with HTTP URLs linking to repositories and files, like in a FTP site. There is no need to download a complete file (meaning that in GlobCurrent the data pull subsystem only transmits an OpenDAP file link to the ingestion subsystem that subsets the source data through OpenDAP protocol), limiting the amount of data to download (contrary to FTP).

The standard OpenDAP server does not provide user authentication and access is therefore public.

The file organization and naming on a OpenDAP server is completely dependent on the provider and may be different for each dataset. It has to be configured for each [AD-5] dataset in the data pull subsystem.

For a complete description of a DAP interface, see Data Access Protocol (DAP) version 2, a complete technical description of the data access protocol is available at:
http://www.opendap.org/pdf/ESE-RFC-004v1.1.pdf

2.2 Interfaces to GlobCurrent product archive for direct access

The GlobCurrent archive is visible in read-only access through FTP and OpenDAP. Local access though Ifremer cloud is also provided.

2.2.1 Filenaming

The file naming conventions for satellite and in situ data are extensively described in the GlobCurrent Product Format and Content document [AD-2].

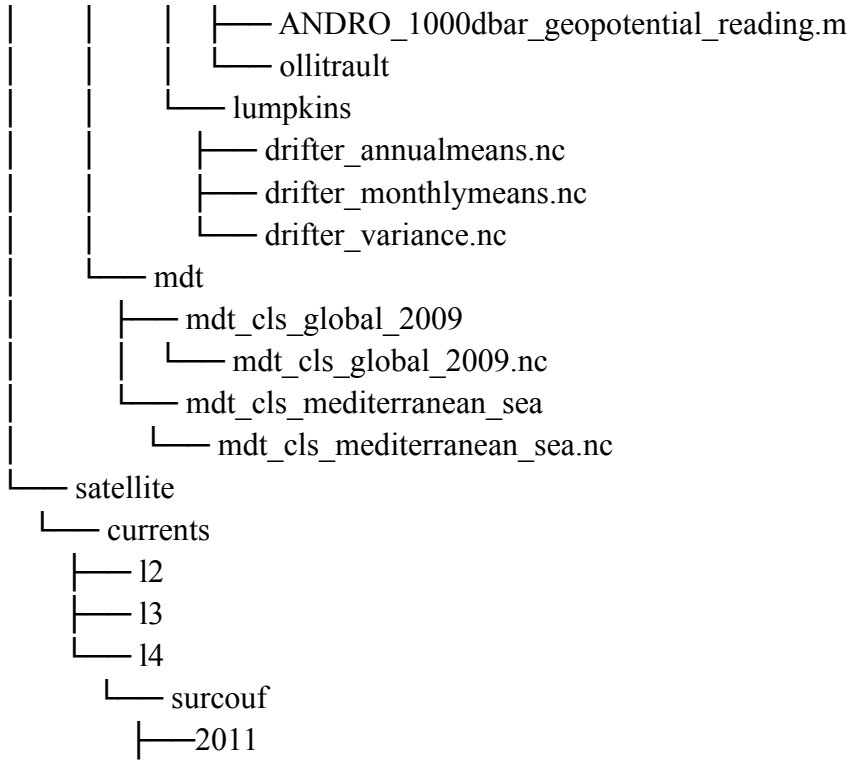
2.2.2 Organization

The data organization will have the following levels:

- product origin : *globcurrent* for datasets specifically produced by the project, *others* for any other input or validation data
- domain of data : *satellite, insitu, model, references* (climatologies, bathymetry, etc...)
- main quantity : *currents, mdt, sea_surface_temperature, wind, wave, ...*
- product level (for satellite data) : l2, l3, l4, …
- product name
- date, expressed as *YYYY/DDD*, *YYYY/MM* or *YYYY*

As an example :

```
data
├── globcurrent
└── others
    ├── insitu
    ├── model
    ├── references
    │   └── climatologies
    │       ├── currents
    │       │   └── insitu
    │       │       ├── ifremer_andro_1000dbar
```



2.2.3 Access protocols

a) FTP protocol

FTP access to GlobCurrent products is accessible to any identified user. Login will link directly to the root of the data organization described above. Only datasets authorized for the user profile will be visible and accessible.

Login and password are requested and obtained through the help desk of each instance (for Ifremer : cersat@ifremer.fr).

b) OpenDAP protocol

GlobCurrent products are accessible through OpenDAP at the following URL:

http://www.ifremer.fr/opendap/cerdap1/globcurrent/

It is not yet possible to provide login protected access to OpenDAP so OpenDAP access will be restricted to public GlobCurrent products. This will be revised once a new OpenDAP version is released with improved management of user access restrictions.

c) Cloud protocol

Ifremer makes available to GlobCurrent users a "sandbox" on its *Nephelae* cloud to remotely process and analyse the GlobCurrent data archive, without having to download the data.

Each user needs to be registered and own an Ifremer account, to be requested to Ifremer/CERSAT help desk (cersat@ifremer.fr). Ifremer, depending on the intended usage and available resource on the cloud, will grant access on approval.

The user can then connect through ssh to a virtual machine allocated uniquely to each user, with the following properties :

1. Ubuntu Linux system
2. access permission to the GlobCurrent data archive
3. python distribution with most usual scientific packages : Numpy, Matplotlib, netCDF4,... (more packages on request)

Interactive access (for visualization for instance) can be obtained by installing a remote desktop client such as *NX Client* on the user side instead of interacting with the virtual machine through a ssh terminal.

Any other Linux distribution or third party tools (such as Matlab) to match more closely the user environment and habits must be arranged with Ifremer team.

Tools to run batch processing over large portions of the data archive on several servers in a distributed way will also be made available to the users on demand.

For more information, refer on the dedicated service page set up for OceanFlux project :
http://www.oceanflux-ghg.org/Products/Tools

3 File formats

The format of GlobCurrent products is extensively described in the GlobCurrent Product Format and Content document [AD-2].

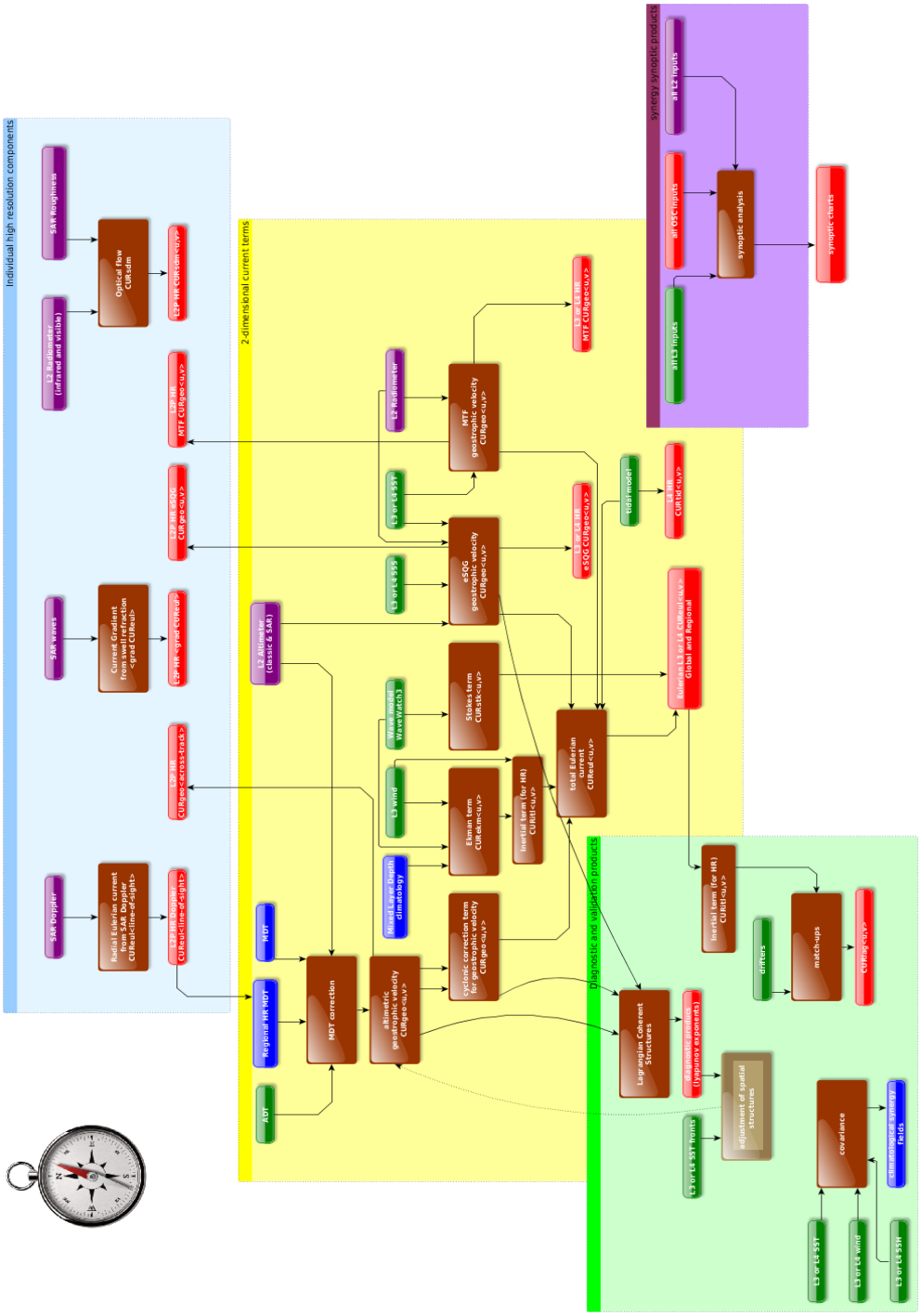
4 Processor interfaces

Processors implement algorithms to derive a specific current quantity or to perform some data transformation or analysis (merging, remapping, etc...). They take one or several files in input and deliver a GlobCurrent product in output:. These processors are described in the Technical Specification [AD-3]and the Algorithm Theoretical Baseline Document) [AD-4].

4.1 processor interfaces

The following figure presents the map of GlobCurrent products that will be implemented within the project scope. For each of these products, there will be a dedicated data processor that will be part of the overall GlobCurrent system.

Figure 3: Diagram of the different GlobCurrent processing chains



The table 1 summarizes for each of these processors all the interface and dependencies information :

- the name and identifier of the processing chain
- the GlobCurrent system version for which this processing chain will be implemented

- the reference (ATBD, publication,...) of the algorithm implemented in this processing chain
- the list of inputs required by this processing chain, as referenced in the DARD
- the type of processing applied to this chain : automatic processing (NRT), reprocessing of a long time series (backlog) or demonstration only over a short period of time (Demo)
- the dependencies of this processing chain on external interfaces (availability of remote data)
- the location where the processing chain is operated : GlobCurrent processing platform at Ifremer or other system (offline)
- the output of the processing chain (type of product)
- the responsible for the implementation of the processing chain
- the processing environment required by the processing chain (operating system)
- the software dependencies of the processing chain
- the interface to the input datasets
- the interface for the data push to Ifremer for processing chains not operated on GlobCurrent system at Ifremer
- the format of the input data

Table 1: Interfaces and dependencies of the GlobCurrent processing chains

Name of processing	Id	Planned system version (v1, v2, v3)	Reference of the algorithm (even if it is a deliverable to come later)	List of inputs and sources (precise cross ref to DARD)	Automated processing (NRT) or backlog processing (long time series or periodic update) or demo (limited processing)	Dependencies (that may prevent to generate GC products in time or at all)	Is it run in GlobCurrent system (at Ifremer) or offline?	Outputs	Responsible for the implementation	Processing environment: OS, hardware requirements	Software dependencies (matlab, libraries, ...)	Interface for input data access	Interface with Ifremer GlobCurrent system	Input data format
Radial current from Envisat SAR Doppler CUReul	P001	V1	ATBD-1, Section 3	SAR Doppler (CUR-100)	Backlog	SAR Doppler (with no time constraint)	Offline	L2P HR CUReul	NERSC	Linux/Ubuntu 12.04 (not exclusive)	NORUT Doppler processor	local archive collected from ASAR rolling archive and EOLI	Delivered to Ifremer GC system through FTP push	netCDF
Radial current from Sentinel-1 SAR Doppler CUReul	P002	V3	ATBD-1, Section 3	SAR Doppler anomaly CUR-101	Demo	SAR Doppler (with no time constraint)	Offline	L2P HR CUReul	NERSC	Linux/Ubuntu 12.04 (not exclusive)	NORUT Doppler processor	local archive collected from scientific data hub	Delivered to Ifremer GC system through FTP push	netCDF
Regional HR mean current from Envisat SAR Doppler	P003	V2	ATBD-1, Section 3 and Appendix	P001 - L2P HR CUReul from doppler	Demo	Regional long timeseries of P001	Offline	Regional HR MDT current components	NERSC	Linux/Ubuntu 12.04 (not exclusive)	python/TBD	local archive	Delivered to Ifremer GC system through FTP push	netCDF
Sentinel-1 Current Gradient from swell refraction <grad CUReul>	P101	V3	reference in future version of ATBD	WAV-101	Demo	SAR waves (with no time constraint)	Offline	L2P HR <grad CUReul>	ODL	Linux/Ubuntu 12.04	python	ESA Sentinel-1 PDGS	Delivered to Ifremer GC system through FTP push	Geotiff
GOCI	P201	V3	ATBD-1,	Ocean	Backlog	Clear view of	**GlobCurre**	Regional	PML	Linux/Ubunt	python --	input data delivered on	To be run at	HDF5

surface tracer velocity CURstv			Section 4.1	colour (VIS-005)		surface features (i.e.low % cloud and that features have a contrast)	**nt**	L3C CURstv (Korea)		u 12.04	tested with v2.7.8 with h5py, numpy & CV2 libraries	HDD		IFREMER	
Regional MDT inversion from HR SAR current	P401	V2	ATBD-1, Section 3 and Appendix	P003, SSH-601; CUR-800,801	Demo	P003	Offline	Regional HR MDT SSH inversion	CLS	standard Linux	python/TBD	P003 archive		Delivered to Ifremer GC system through FTP push	netCDF
Cryosat-2 across-track altimeter geostrophic velocity <CURgeo>	P301	V2	ATBD-1, Section 2 and Annex A	SSH-000	Backlog	L1B; Regional HR MDT; ADT; MDT	**GlobCurrent**	L2P (HR) CURgeo	isardSAT	standard Linux	matlab	ESA PDS (ftp://science-pds.cryosat.esa.int)		Integrated	netCDF
Sentinel-3across-track altimeter geostrophic velocity <CURgeo>	P302	V3	ATBD-1, Section 2 and Annex A	SSH-116	Backlog	L1B; Regional HR MDT; ADT; MDT	**GlobCurrent**	L2P (HR) CURgeo	isardSAT	standard Linux	matlab	ESA		Integrated	netCDF
Sentinel-3 across-track altimeter geostrophic velocity <CURgeo>	P402	V3	ATBD-1, Section 2 and Annex A	SSH-116	Demo	Availability of S3 L1 data	Offline	L2P (HR) CURgeo	CLS	standard Linux	None	ESA		Delivered to Ifremer GC system through FTP push	netCDF
L4 Altimetric geostrophic velocity CURgeo	P403	V1	ATBD-1, Section 2 and Annex A	SSH-603 Corrected MDT	Backlog	availability of AVISO products (SSH-603)	Offline	L4 CURgeo	CLS	standard Linux	None	see data files		Delivered to Ifremer GC system through FTP push	netCDF
Cyclonic correction term for geostrophic velocity <Ucyclo-geo,Vcyclo-	P501	V2	reference in future version of ATBD	Pxxx - L4 Altimetric geostrophic velocity <CURgeo>	Backlog	availability of data produced by P004	**GlobCurrent**	L4 CURgeo	Ifremer	standard Linux	python/cerbere	local network access to GlobCurrent datastore		Integrated	netCDF

geo>														
L4 Ekman velocity CURekm	P404	v1	ATBD-1, Section 2 and Annex A	WInd stress (WND-601)	Backlog	WND-600,601	Offline	L4 CURekm	CLS	standard Linux	None	local archive collected from ECMWF	Delivered to Ifremer GC system through FTP push	netCDF
L4 Ekman velocity CURekm	P405	v2	ATBD-2	WND-600, 601; WAV-600, 601	Backlog	Mixed Layer Depth climatology; L3 wind; Wave model WaveWatch3	Offline	L4 CURekm	CLS	standard Linux	None	see data files	Delivered to Ifremer GC system through FTP push	netCDF
L4 Stokes term CURstk	P502	v1	ATBD-1, Section 6 conversion of native coastal forecast service data to GC grid and format	WaveWatch 3 Hindcast stokes drift (WAV-600)	Backlog		**GlobCurrent**	L4 CURstk	Ifremer	Linux/Ubuntu 12.04	python/cerbere	local network access to ww3 repository	Integrated	netcdf CF 1.4
NRT L4 Stokes term CURstk	P503	v2	ATBD-1, Section 6 conversion of native coastal forecast service data to GC grid and format	WaveWatch 3 NRT stokes drift (WAV-601)	Automated (NRT)	availability of wave model WaveWatch3 at Ifremer coastal forecasting service	**GlobCurrent**	L4 CURstk	Ifremer	Linux/Ubuntu 12.04	python/cerbere	local network access to ww3 repository	Integrated	netcdf CF 1.4
L2P HR eSQG geostrophic velocity CURgeo	P504	V3	TN-1, Section 6	SSH-000 to SSH-114; SST-100 to SST-610; SAL-600	Backlog	L2 Altimeter (classic & SAR); L2 Radiometer; L3 or L4 SST and SSS	**GlobCurrent**	L2P CURgeo	Ifremer	Linux/Ubuntu 12.04	Will be defined at implementation step. Likely based on python.	local archive on cloud Nephelae	Integrated	netcdf CF 1.4
L4 eSQG geostrophic velocity CURgeo (u, v)	P505	V3	TN-1, Section 6	SSH-000 to SSH-114; SST-100 to SST-610; SAL-600	Backlog		**GlobCurrent**	L4 CURgeo	Ifremer	Linux/Ubuntu 12.04	Will be defined at implementation step. Likely based on python.	local archive on cloud Nephelae	Integrated	netcdf CF 1.4
L2P MTF	P506	V3	ATBD-1,	SST-100 to	Backlog	L2	**GlobCurre**	L2P CURgeo	Ifremer	Linux/Ubunt	Will be	local archive on cloud	Integrated	netcdf CF

geostrophic velocity CURgeo			Section 6	SST-610		Radiometer; L3 or L4 SST	**nt**			u 12.04	defined at implementation step. Likely based on python.	Nephelae		1.4
L4 MTF geostrophic velocity CURgeo (u, v)	P507	V3	TN-1, Section 6	SSH-000 to SSH-114; SST-100 to SST-610; SAL-600	Backlog		**GlobCurrent**	L4 CURgeo	Ifremer	Linux/Ubuntu 12.04	Will be defined at implementation step. Likely based on python.	local archive on cloud Nephelae	Integrated	netcdf CF 1.4
L4 Eulerian velocity CUReul	P405	V1	Addition	geostrophic (P403); Ekman (P404)	Backlog	geostrophic and ekman terms must be previously processed	Offline	L4 CUReul	CLS	standard Linux	None	local processing storage	Delivered to Ifremer GC system through FTP push	netCDF
synoptic analysis	P102	V2	TN-1, Section 3	All L2, L3, and OSC inputs	Demo	(no time constraint)	Offline	Synoptic charts	ODL	Linux/Ubuntu 12.04	python	local storage	Integrated	TBD
Lagrangian Coherent Structures	P004	V2	ATBD-1, Section 6	L3/L4 combined Eulerian velocity CUReul	Backlog	(no time constraint)	Offline	Diagnostic products (Lyapunov exponents)	NERSC	Linux/Ubuntu 12.04 (not exclusive)	python/TBD	local storage	Integrated	netCDF
Inertial velocity CURint	P005	V2	TN-1, Section 4	WND-600 (TBD: global inertial from climatology; regional inertial from HR combined)	Demo	(no time constraint)	Offline	L3/L4 CURint	NERSC	Linux/Ubuntu 12.04 (not exclusive)	python/TBD	local storage	Integrated	netCDF
match-ups	P508	V2	Management Proposal	Eulerian L4 (P405) In situ drifters (CUR-800, 801)	Backlog	Simultaneous availability of Eulerian L4 and drifter data	**GlobCurrent**	CUReul vs CURlag	Ifremer	Linux/Ubuntu 12.04	python/cerbere	local storage	Integrated	NetCDF GlobCurrent NetCDF
covariance	P509	V2	TN-1, Annex 1	L3 or L4 SST, wind, and SSH	Backlog	(no time constraint)	**GlobCurrent**	Climatological synergy fields	Ifremer	Linux/Ubuntu 12.04	python/cerbere	local storage	Integrated	NetCDF

4.2 interface to Ifremer processing platform

GlobCurrent systems aims at being very flexible, by integrating very quickly new processors (either as standalone processors or within a sequence of processors to build a complete processing chain) in the GlobCurrent system, which key element is an orchestrator that runs the processors on the reception of predefined events (arrival of a new data file – data driven – or time – cron).

The orchestrator of GlobCurrent is language agnostic, meaning it can run any processors that can be launched in command line whether it is a binary executable (provided it runs on the target hardware) or an interpreted language program (python, IDL, matlab, ...). **However for cost effectiveness (no licenses), consistency of the overall pieces of software, sharing among partners and users, and easier integration in the processing system (and therefore more flexibility of GlobCurrent), it is requested to provide source code in python.** Other implementations are only accepted in the case of obvious and demonstrated impossibility.

For smoother integration and greater flexibility, the processor execution shall follow this form:

```
<python executable> <processing options>
```

With standard processing options as follow (the list is not comprehensive), to be used when it applies:

-i, --input	Input full filename or directory path
-o, --output	Output directory path (product name shall follow the GlobCurrent nomenclature and don't need to be provided)
-l, --log	Log directory path
-c, --config	Full path to configuration file
-d, --date	Date/Time to be processed, expressed as *YYYYMMDD**T**HHMMSS*
-s, --start	Start date/time of the processing frame, expressed as *YYYYMMDD**T**HHMMSS*
-e, --end	End date/time of the processing frame, expressed as *YYYYMMDD**T**HHMMSS*