

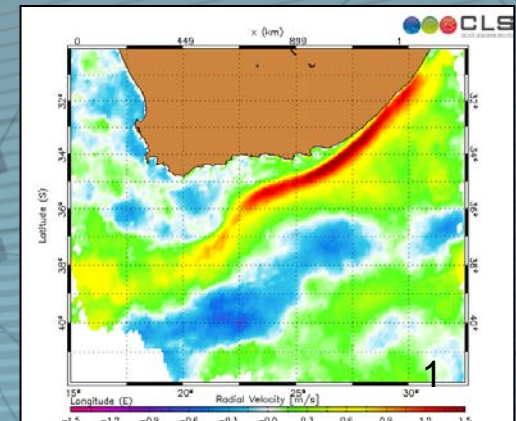
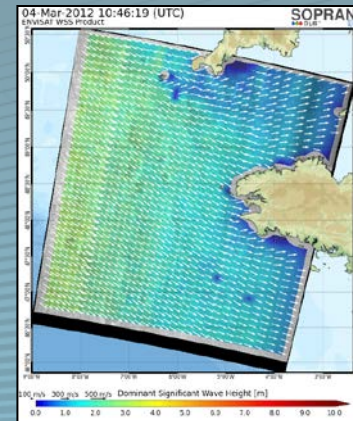
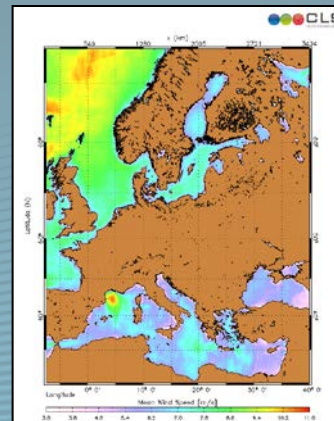
# A Marine Collaborative Ground Segment for the Sentinel1 missions

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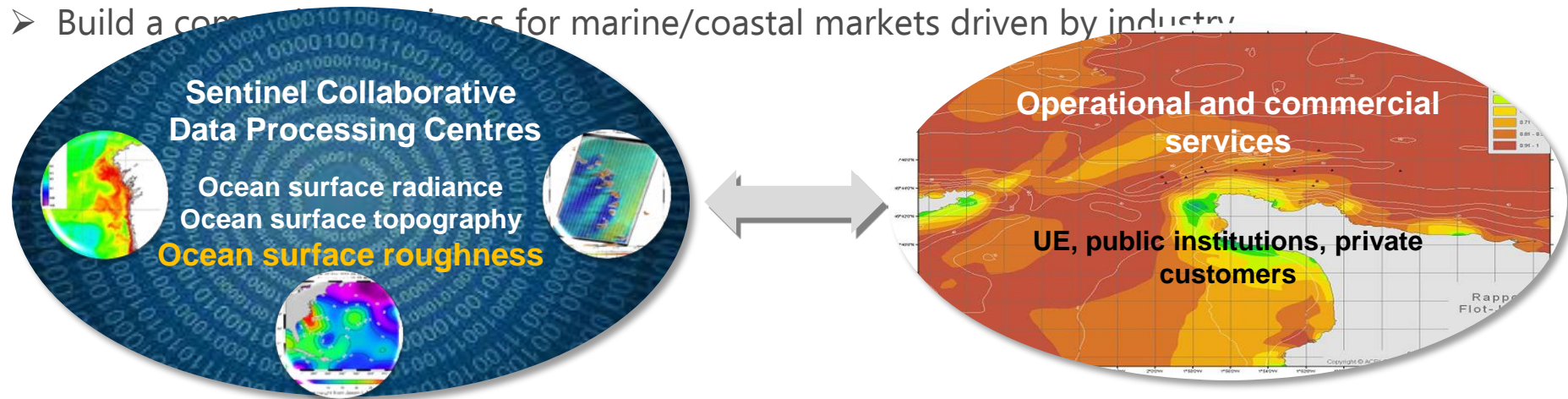
SEASAR, 18 June 2012



The French **Marine Collaborative Ground Segment** (MCGS) is the first European initiative of a collaborative ground segment

### Objectives:

- Develop satellite-based oceanographic services through dedicated processing centres, complementary to the Sentinel “core products”, in a collaborative manner with ESA/EUMETSAT
- Build a competitive business for marine/coastal markets driven by industry



**Budget:** About 5M€ for **R&D, prototyping, market analysis**

- 37% of national and regional funds
- 63% on partners' own resources



**Time-frame:** awarded by French government in Aug. 2011 for 30 months activity phased with the Sentinels mission planning

- ❖ Partnership of 8 actors in space oceanography



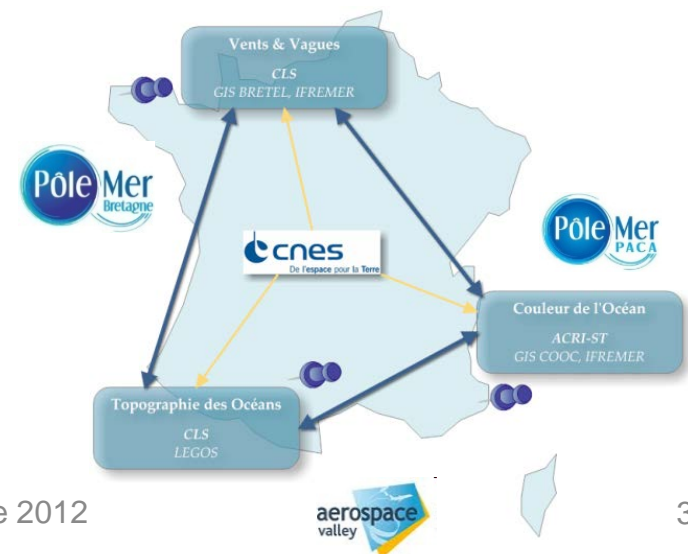
- ❖ MCGS consists of **3 distinct geographic platforms**

- ✓ The Ocean Colour platform (led by ACRI-ST in Région PACA)
  - ✓ The Ocean Topography platform (led by CLS Toulouse in Région Midi Pyrénées)
  - ✓ **The Wind, Waves and Currents platform** (led by CLS Brest in Région Bretagne)
- + Scientific objectives supervised by the research institutes (IFREMER, LEGOS, SHOM, GIS COOC, GIS Bretel) + Technical support from AS+.

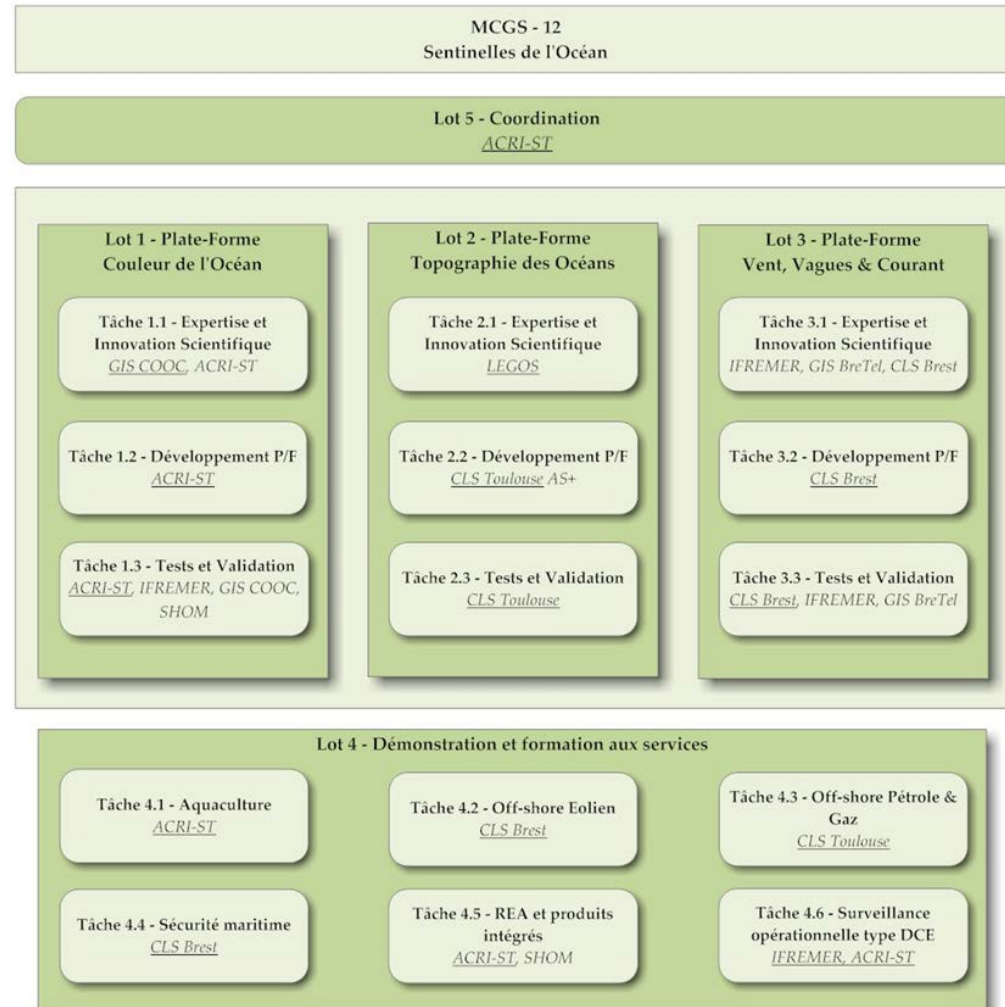
- ❖ Support by **3 French “Pôles de compétitivité”** (regional economic competitiveness clusters)

- ❖ Strong implication of the **CNES** for optimal national coordination and interface with **ESA/EUMETSAT**

- ❖ Strong collaboration with **ESA** to be initiated (data flow, processing functions) in order to be part of the “ESA Collaborative Ground Segment” network



- 3 industrial partners
  - ACRI-ST : Ocean Colour platform
  - CLS Toulouse: Sea-Surface Topography (supported by AS+)
  - CLS Brest: The Wind, Waves and Currents platform
  
- 2 institutional partners
  - IFREMER
  - SHOM
  
- 3 scientific partners:
  - GIS COOC
  - GIS Bretel
  - LEGOS



Under the coordination of ACRI-ST

## What will not be part of The Sentinel-1 Core Ground Segment (CGS)

- ❖ Sentinel-1 level-2 **Waves** products **derived for Wide Swath modes** (IWS and EWS)
- ❖ Sentinel-1 level-2 **Surface Currents** products derived from Doppler products
- ❖ Sentinel-1 level-2 Ocean **offline** products (NRT quality vs Scientific quality)
- ❖ **L2 Ocean products cross-calibration** between S1 and other GMES Contributing Missions
- ❖ NRT delivery (< 10 min) of Sentinel-1 level2 ocean products for operational services requiring direct access to data (e.g. CleanSeaNet service from EMSA)

## What the Marine Collaborative Ground Segment (MCGS) will do

- ❖ Define, develop and generate **S1 L2 Ocean products not provided by** the Core Ground Segment
- ❖ Define, develop and generate **higher level Sentinel-1 Ocean products (L3, L4)**
- ❖ Define, develop and generate **S1 L2 Ocean offline products cross-calibrated with other GMES contributing missions** (Radarsat-1/2, CSK, TSX, etc)
- ❖ Feasibility study to **upgrade French ground stations towards Sentinel-1** for GMES or French users needs (VIGISAT, Kerguelen, etc)

## Maritime security

- ❖ International agencies (e.g. EMSA) and National bodies in charge of State Action At Sea
  - NRT SAR Ocean products to improve detection and reliability assessment of oil spill and ships (e.g. CleanSeaNet service )

## Oil and Gas offshore industry

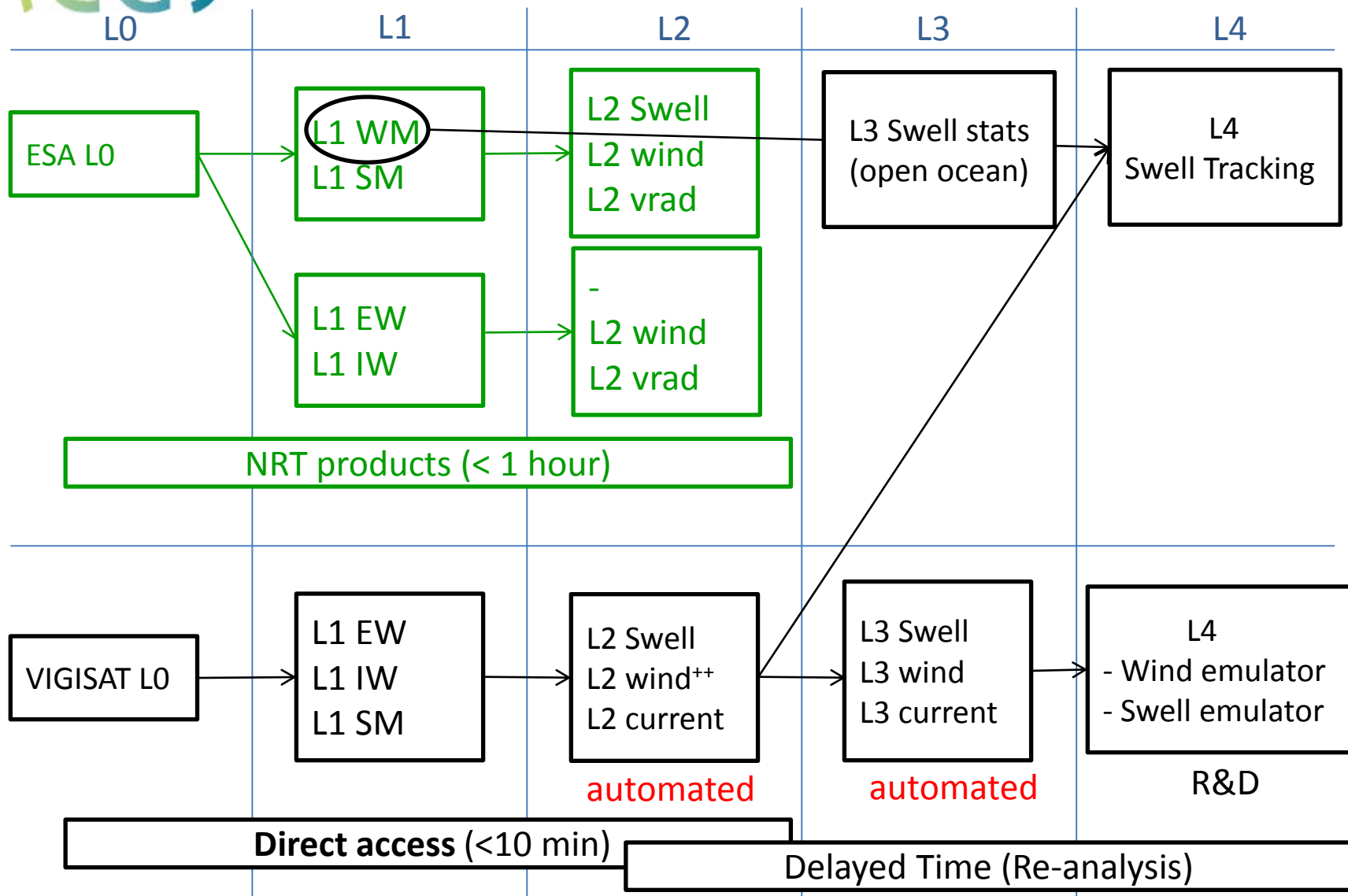
- ❖ Offshore companies involved in operations and sea
  - Emulation of coastal wind and swell fields derived from SAR observations (prototype development underway)

## Marine renewable Energies

- ❖ Companies in charge of operational exploitation of offshore infrastructures
  - Early warning systems detecting highly energetic swell systems dangerous for the safety of offshore infrastructures (e.g. Protection of swell energy capture systems)
- ❖ Companies in charge of offshore sites selection and impact study
  - High resolution coastal climatology for wind and waves resource assessment

## Oceanography and meteorology

- ❖ Oceanographic research institutes or meteorological organisations
  - Validation of high resolution prediction models with SAR Ocean Products

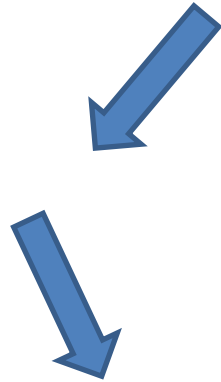


## L2 and L3 Wind products: new features (WP3210 + WP 3220)

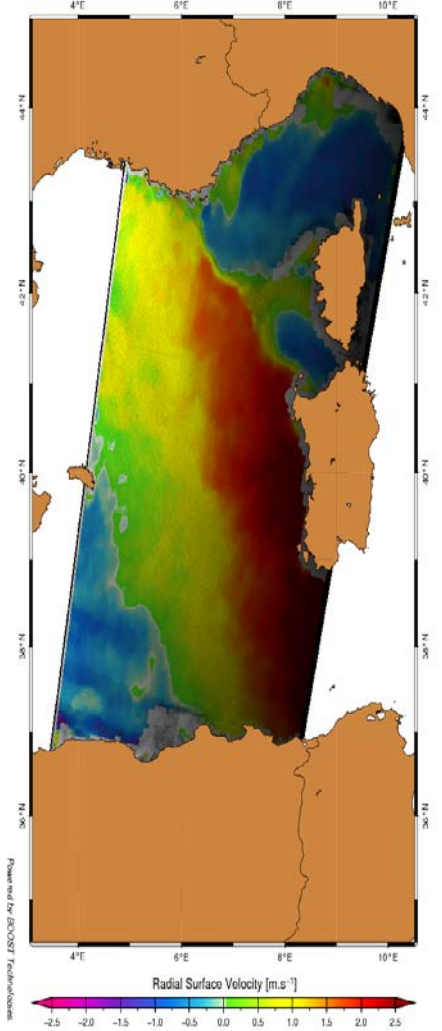
- ❖ **Mixed Doppler-NRCS wind inversion** : Validate the scheme and consolidate the software
- ❖ **Detection and Mapping of non-wind natural phenomena** that impact the NRCS part of wind inversion (rain cells, sea ice, internal waves ...)
- ❖ **Detection and removal of bright scattered pixels** that impact the NRCS part of wind inversion (offshore platforms and wind farms, boats...)
- ❖ **Definition of a Quality Index** based on the previous 2 bullets, L1 data flags, consistency of doppler, NRCS and wind from NWP models
- ❖ specification and prototyping of the **MCGS\_L2\_wind calibration / validation scheme**
- ❖ **specification of the L2 reprocessing** from Sentinel-1 L1 data and nowcast ancillary data or corrected RVL.
- ❖ **specification and implementation of L3 complementary** schemes according to user needs.



### L2 Wind products

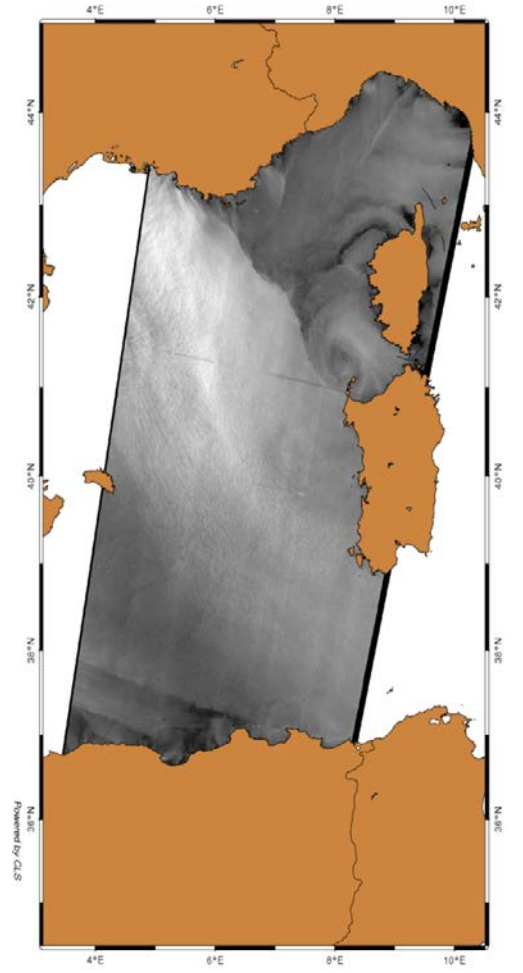


13-November-2007 09:42:39 (UTC)  
 ENVISAT WSM Product



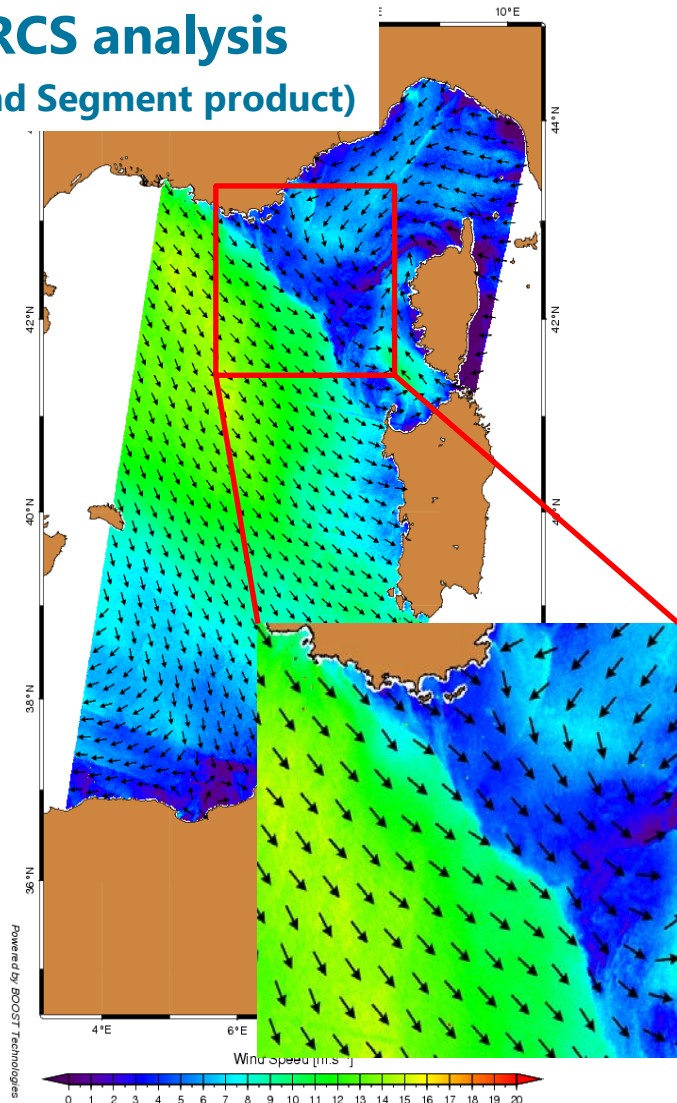
L2 Radial Surface Velocity field

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 ENVISAT WSM Product

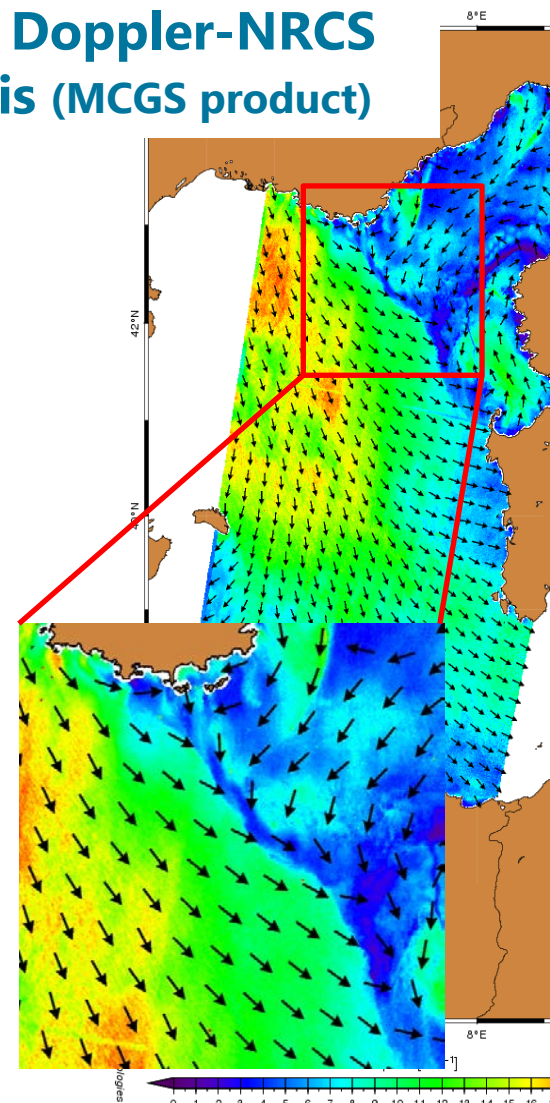


L1 product

### L2 Wind field based on NRCS analysis (Core Ground Segment product)

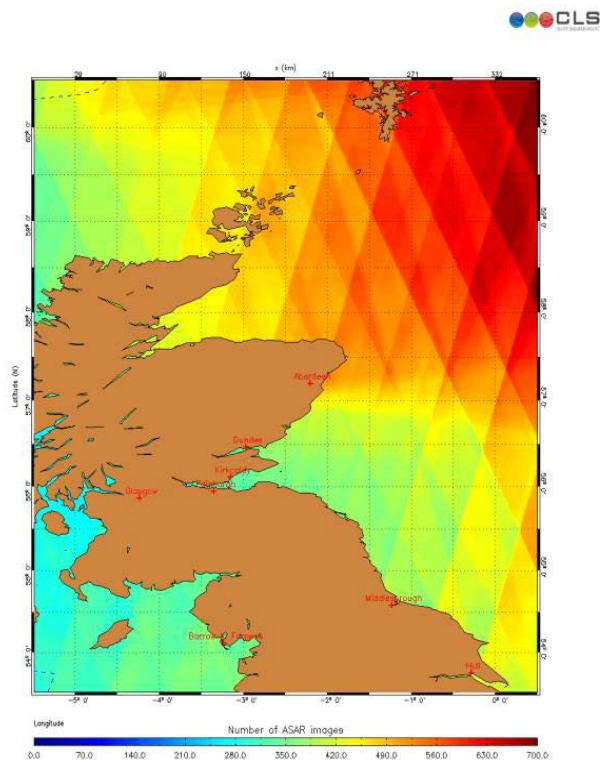


### L2 Wind field based on mixed Doppler-NRCS analysis (MCGS product)

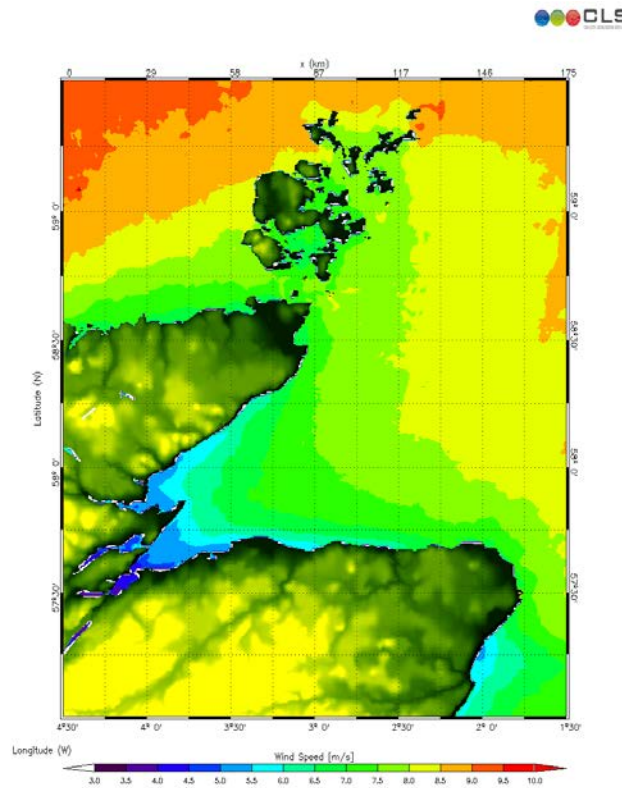


### L3 Wind products

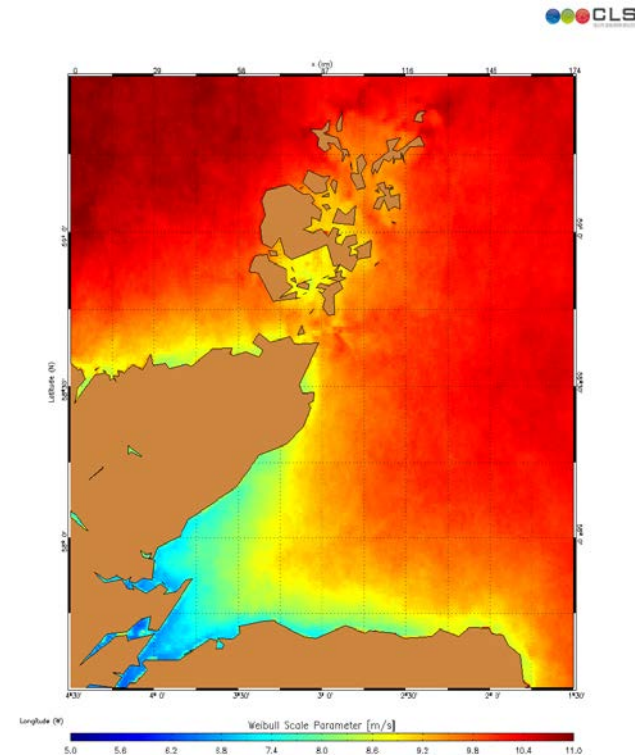
Mean Wind Velocity



Coverage density  
# of scenes

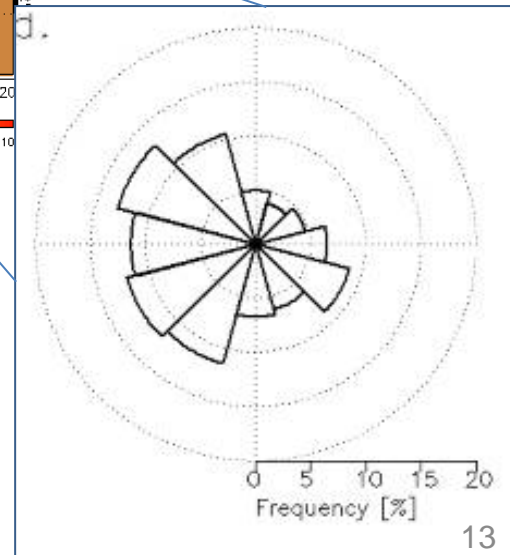
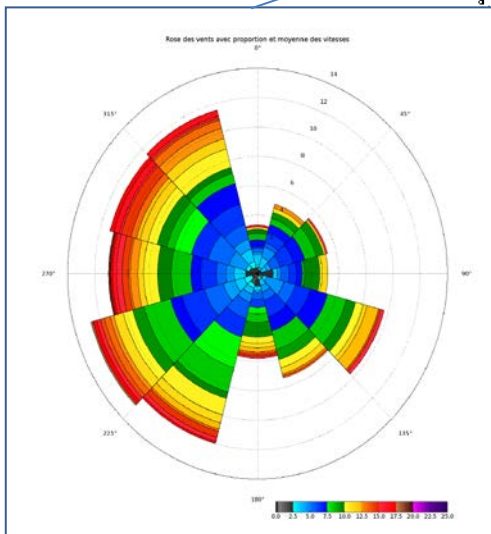
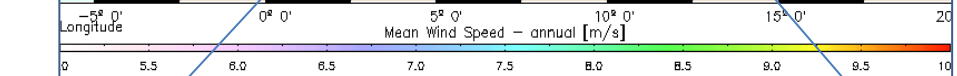
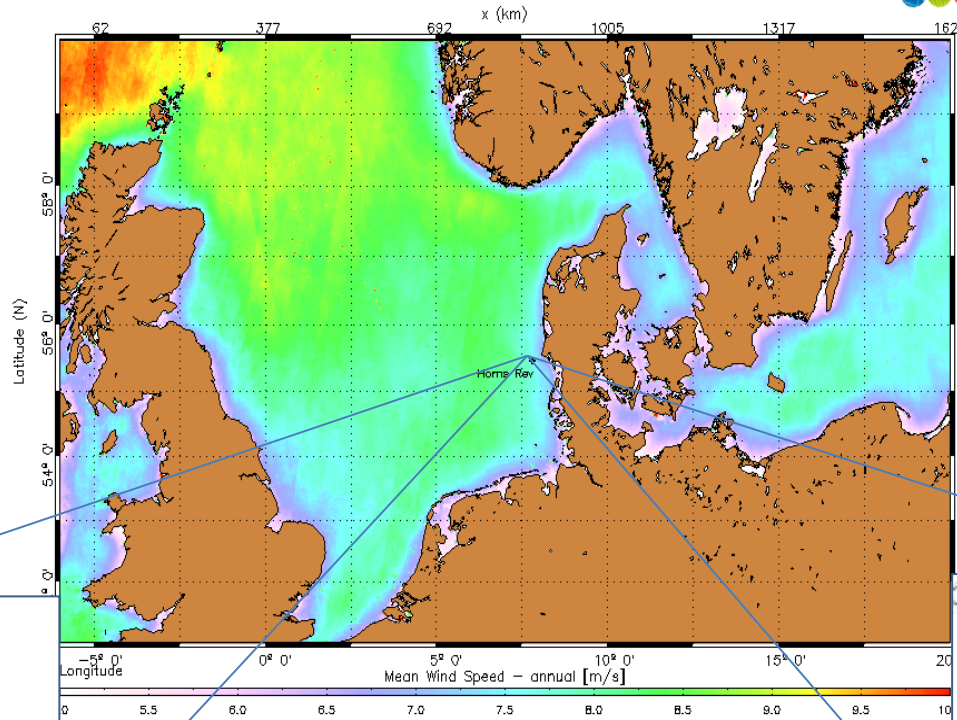


SEASAR 2012, Tromsøe, 18-22 June 2012



Weibull scale  
parameter

### L3 Wind products



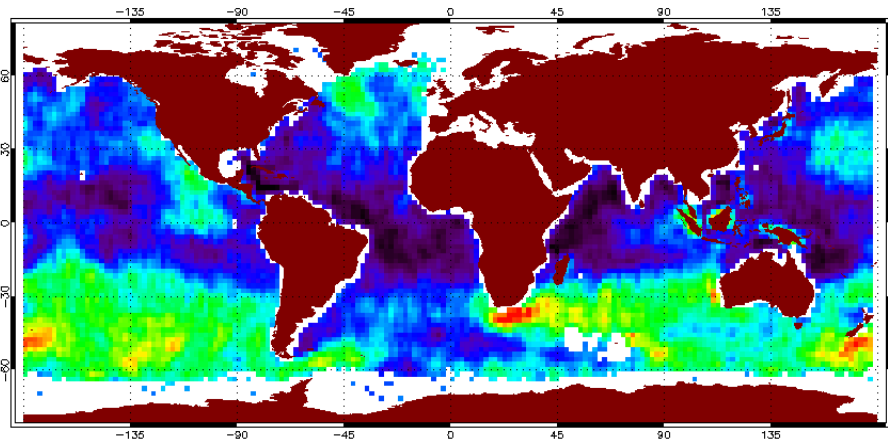
SEASAR 2012, Tromsøe, 18-22 June 2012

## L3 Wave Mode products : Swell statistics at global scale

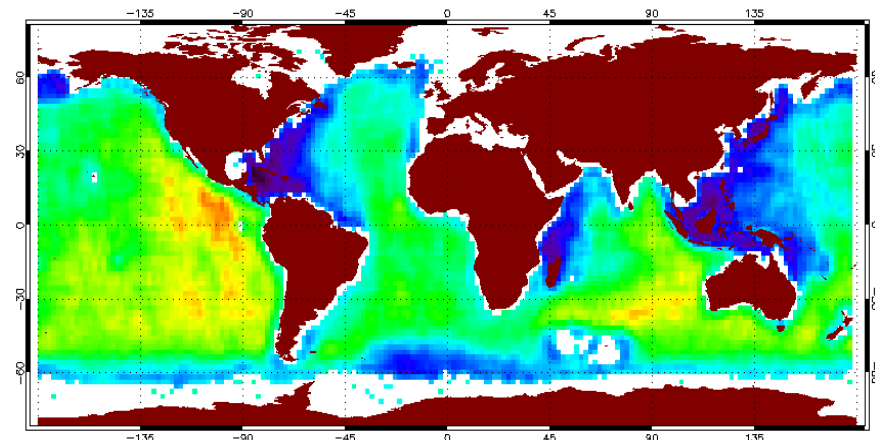
☐ Sentinel-1 Level-2 Wave Mode Ocean products will be retrieved at CLS Brest (VIGISAT) from ESA Core Ground Segment and processed to generate level-3 statistical products

**Cross-Swells:** 2 energetic swell systems ( $H_{ss} > 1\text{m}$ ) crossing at a significant angle ( $>45^\circ$ )

**Swell Statistical maps** can be processed over a year, per season, per month ...



2004 – Percentage Of Cross Seas ( $H_{s1}$  &  $H_{s2} > 1\text{ m}$ ) [%]

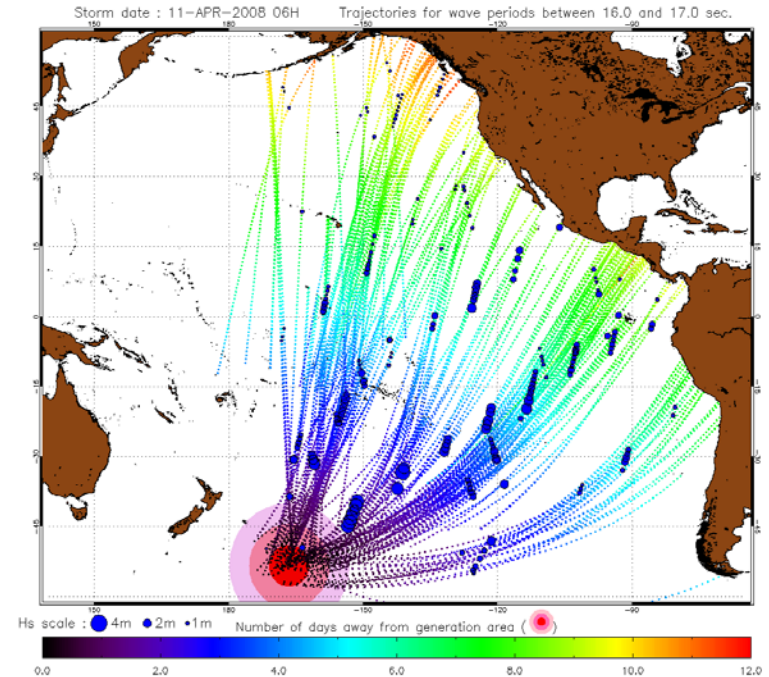


2004 – Number of detected Swells

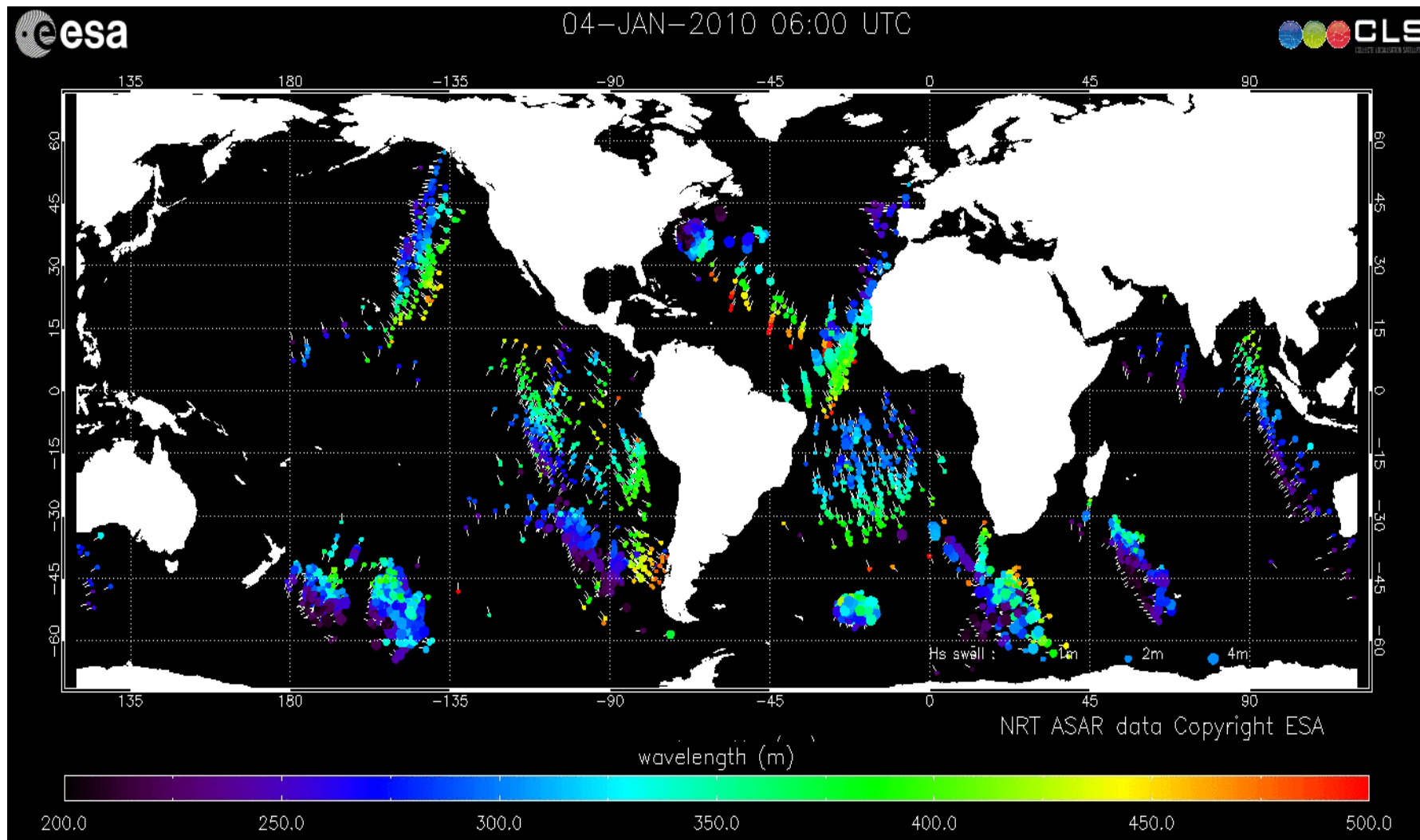
Application : Identification of risk area for navigation

## L4 Wave Mode products : swell tracking

- ❑ Propagation of swell observations given by S1 L2 Wave Mode Ocean products, considering
  - ✓ Group velocity
  - ✓ direction along great circles
  - ✓ Hs decreases with geometric spreading
  - ✓ Frequency dispersion and dissipation
  - ✓ Assumption: open ocean / no current
  
- ❑ Ocean swell field reconstruction when storm source is detected
  - ✓ Global point of view
  - ✓ Updated twice a day
  
- ❑ Advantages:
  - ✓ Based on propagation of observations only (unlike wave model)



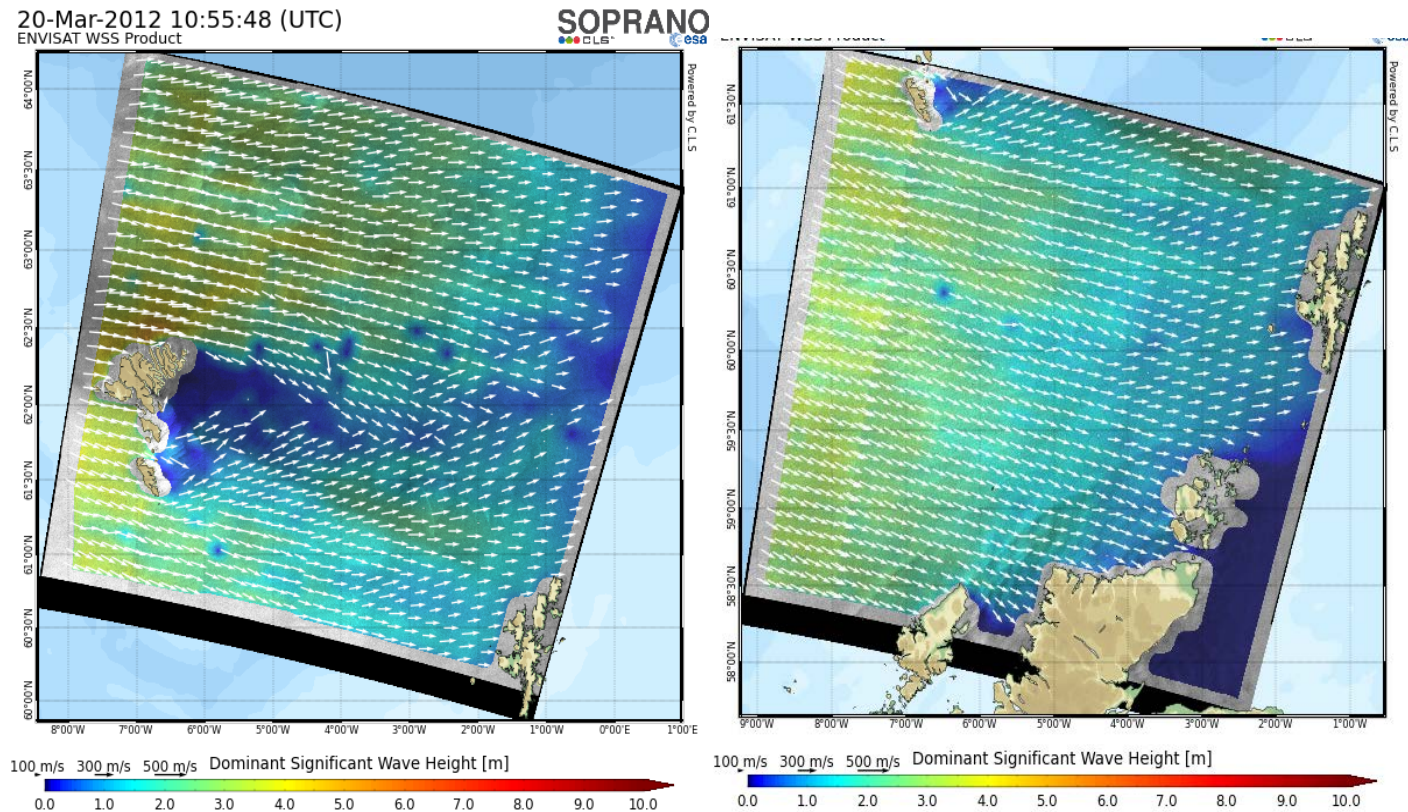
### L4 Wave Mode products : swell tracking



## L2 Wide Swath modes (major contribution to ensure continuity with ENVISAT)

- ❑ Cross-spectra estimation on TOPS EWS et IWS data (mostly used in coastal areas)
- ❑ Coastal Swell Fields (the MTF for IWS and EWS is verified by estimating the inversion filter that relates ASAR WSS spectra and WW3 spectra).

Illustration of island shadowing effects in swell propagation from two ASAR WSS swell fields.

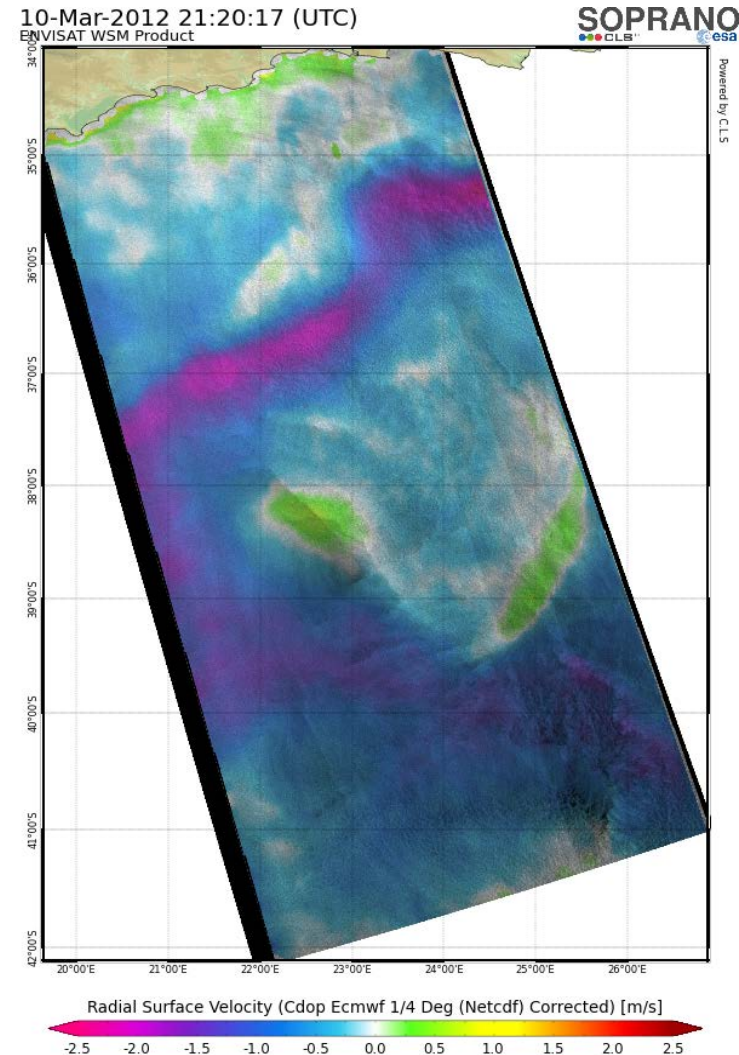




### L2 Surface Currents (important contribution of MCGS)

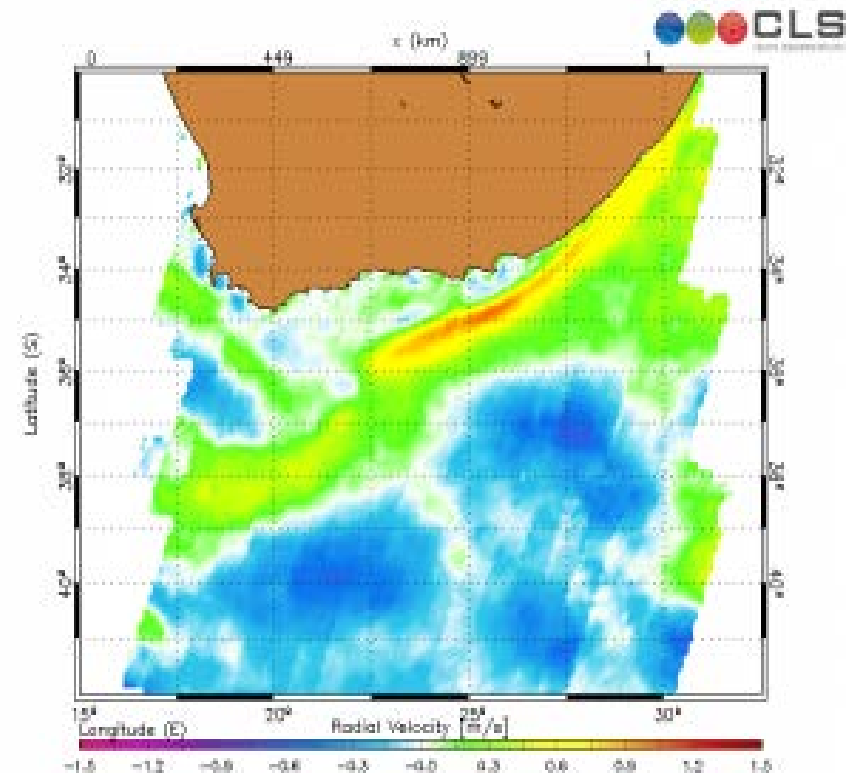
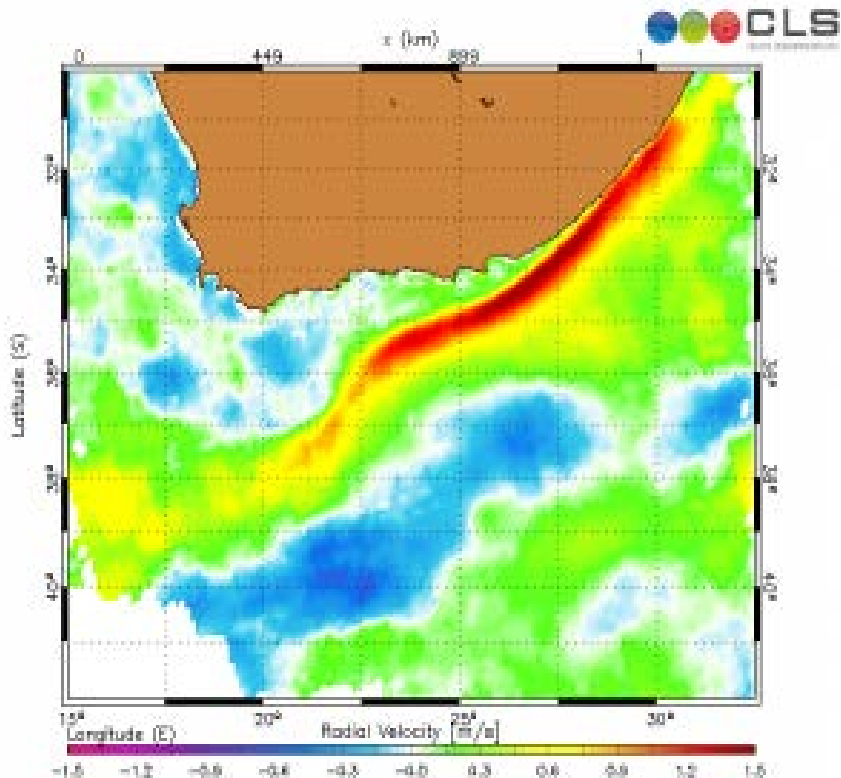
- ❑ Specify and prototype the processing chain to **remove wind velocity & waves' orbital velocity contribution** to the Doppler Anomaly to finally get the surface current-related RVL.
  
- ❑ Calibration / Validation process will be set up.

Illustration of RVL corrected from wind (ECMWF) over the Agulhas area on an ascending pass ENVISAT ASAR WSM.



## L3 Surface Currents

- Will be obtained by averaging collocated L2 Currents products (illustrated here with ASAR WSM wind corrected RVL)



Mean radial surface speed in the Agulhas from 329 ascending Envisat ASAR WSM.

Mean radial surface speed in the Agulhas from 252 descending Envisat ASAR WSM.

## WP3100 : questionnaire on user requirements

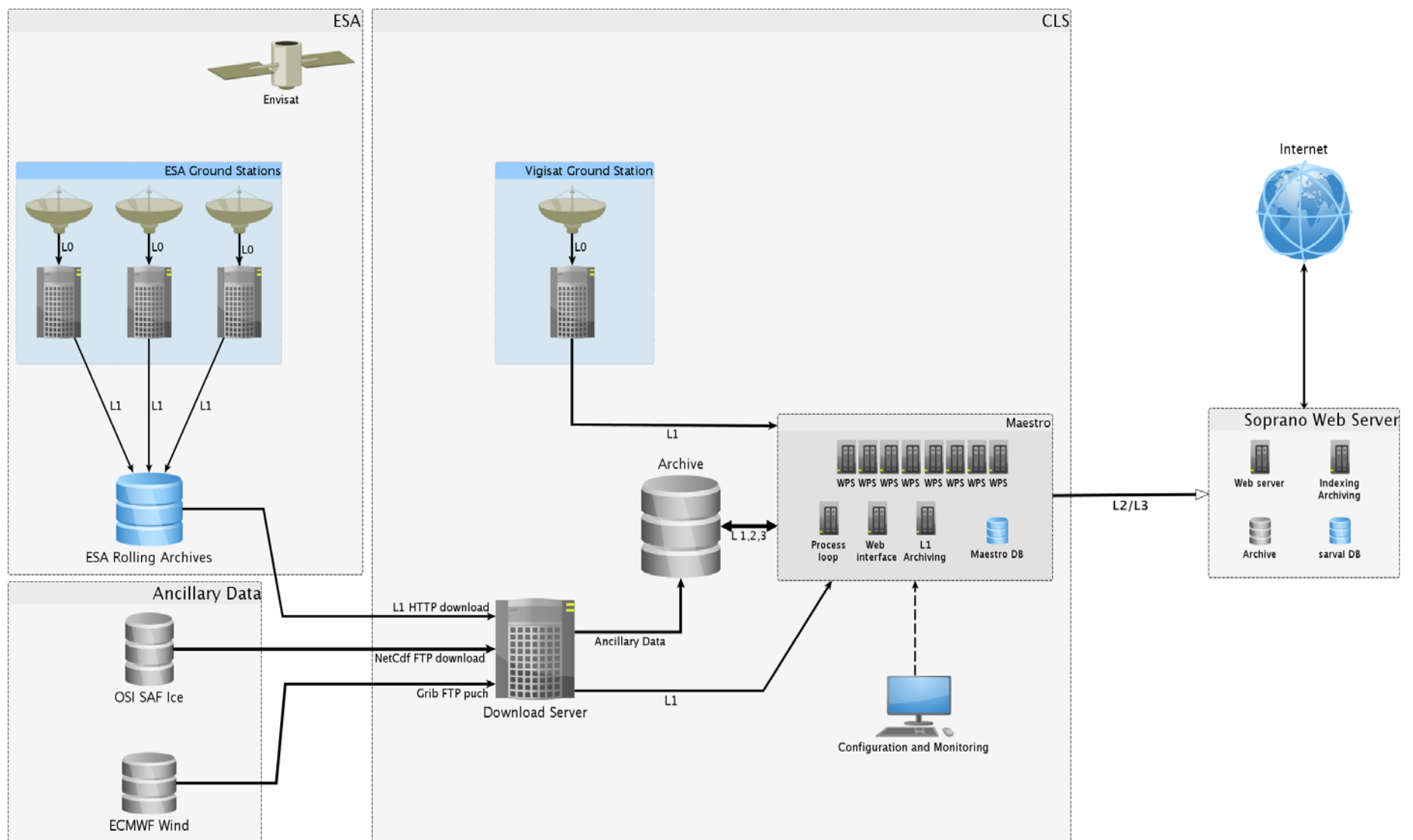
- Document with a short introduction to spatial remote sensing with SAR, and a description of Wind, Waves & Current L2/L3 products main features, and questioning the various practices and potential needs of the target community.
- Document (16pages) ready to be sent to the user community contact list of CLS (Marine Renewable Energies, Offshore Oil industry, companies and national bodies who have operations at sea, NWP institutes ...)
- Responses expected : September,
- Feedback to be analyzed by mid-October
- review and recommendations by scientific members of the consortium : end October

## WP3300 : processing architecture analysis (based on the VIGISAT experiences)

- study the end-to-end HW architecture evolution of the VIGISAT ground station to meet the Sentinel-1 data flow requirements,
- define the NRT (<10 min) L2 processing chains (WWC)
- define the L2 re-processing chains for offline products (WWC)
- define and prototype calibration/validation modules

## WP3400 : definition and prototyping of user interfaces (based on the SOPRANO experience)

- Specify the evolution of [www.soprano.cls.fr](http://www.soprano.cls.fr) towards a flexible web interface with user selectable options
- Implement and test these evolutions



## WP3500 : end-to-end tests

- monitoring the autonomous run of the end-to-end chain during 3 months, with user actions
- bugs corrections

## WP4000 : Demonstration & Training

- define demonstration scenarios
- organize a demonstration / training day



Thank you for your attention!

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[Soprano.cls.fr](http://Soprano.cls.fr)

[www.vigisat.eu](http://www.vigisat.eu)