Copernicus Global Land Cryosphere and Water

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Outline

- A new Copernicus Service for Lakes (and rivers)
- Overview of the service and the products
- Focus on Cryosphere, Water Bodies and Water Level
- (Lake Surface Temperature and Water Quality in the next presentation by Steve Groom).

Copernicus Services

Atmosphere
(CAMS)

Marine
(CMEMS)

Land
(CLMS)

Climate
(C3S)

Emergency
(EMS)

Security

- Operational service
- Open and Free service
- Core service -> to foster downstream services (applications in the EO sector)
- Near Real Time production and reprocessing mode (data series)

Copernicus Services

- **Copernicus services address 6 main thematic areas:**
  - Apart from the Space Data (under delegation of ESA and EUMETSAT), EC signed delegation agreements with different institutions for the Copernicus Services
  - **Land Monitoring –** EEA (Local and Pan-European) & JRC (Global)
  - **Marine Monitoring –** CMEMS - Mercator Océan
  - **Atmosphere Monitoring –** CAMS - ECMWF
  - **Emergency Management** – CEMS – JR
  - **Security –** FRONTEX, EMSA, SatCen
  - **Climate Change** – C3S - ECMWF
  - The services have reached different degrees of maturity. Some are already operational (land monitoring and emergency management) while others are still in a pre-operational mode or in a development phase.

Cryosphere and Water Service

- Cryosphere - Snow area extent and snow water equivalent (ECV T.2)
- **Cryosphere/water - Lake Ice Coverage and Lake surface water temperature**
- **Water - Areas of water bodies** (ECV T.1.1)
- Water – Coastal
- **Water - Water level (lakes** and rivers) (ECV T.1.2)
- **Water – Lake Surface Reflectance, lake turbidity and trophic state**

Cryosphere and Water service

Cryosphere
Production Facility – FMI - Finland
- Snow Area Extent – **FMI / ENVEO+SYKE**
- Snow Water Equivalent – **FMI / SYKE+ENVEO**
- Lake Ice Extent – **FMI / SYKE**

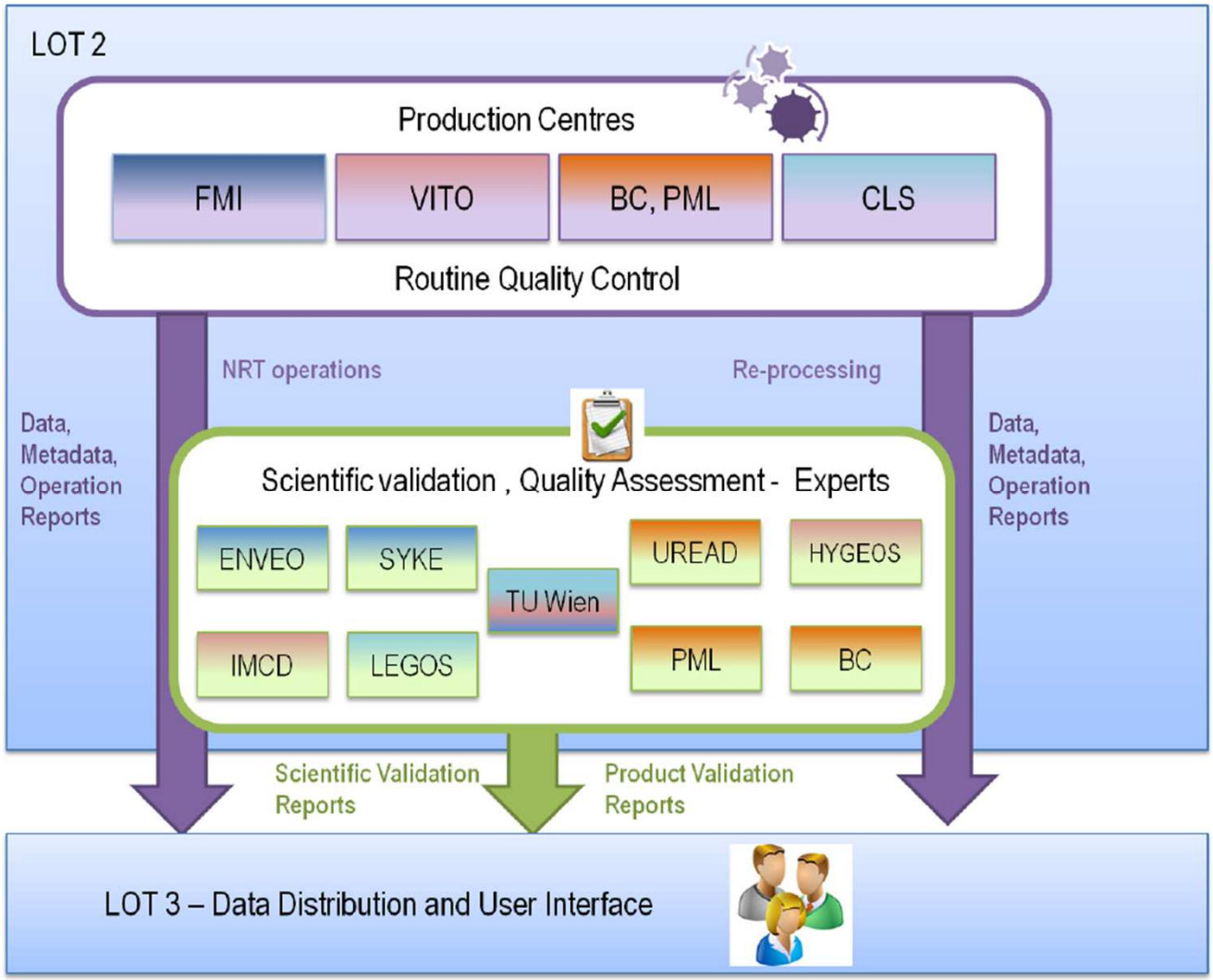
Water Bodies and Coastal Erosion
Production Facility – VITO - Belgium
- Areas af Water Bodies – **VITO / HYGEOS**
- Coastal Erosion – **VITO / IMDC**

Lake Water
Production Facility – CEMS - UK
- Lake Surface Water Temperature – **PML / UREAD**
- Lake Surface Reflectances – **PML / BC**
- Turbity – **BC / PML**
- Trophic State – **BC / PML**

Water Level
Production Facility – CLS - France
- Lakes Water Level – **CLS / LEGOS**
- Rivers Water Level – **CLS / LEGOS**

A distributed organisation and architecture

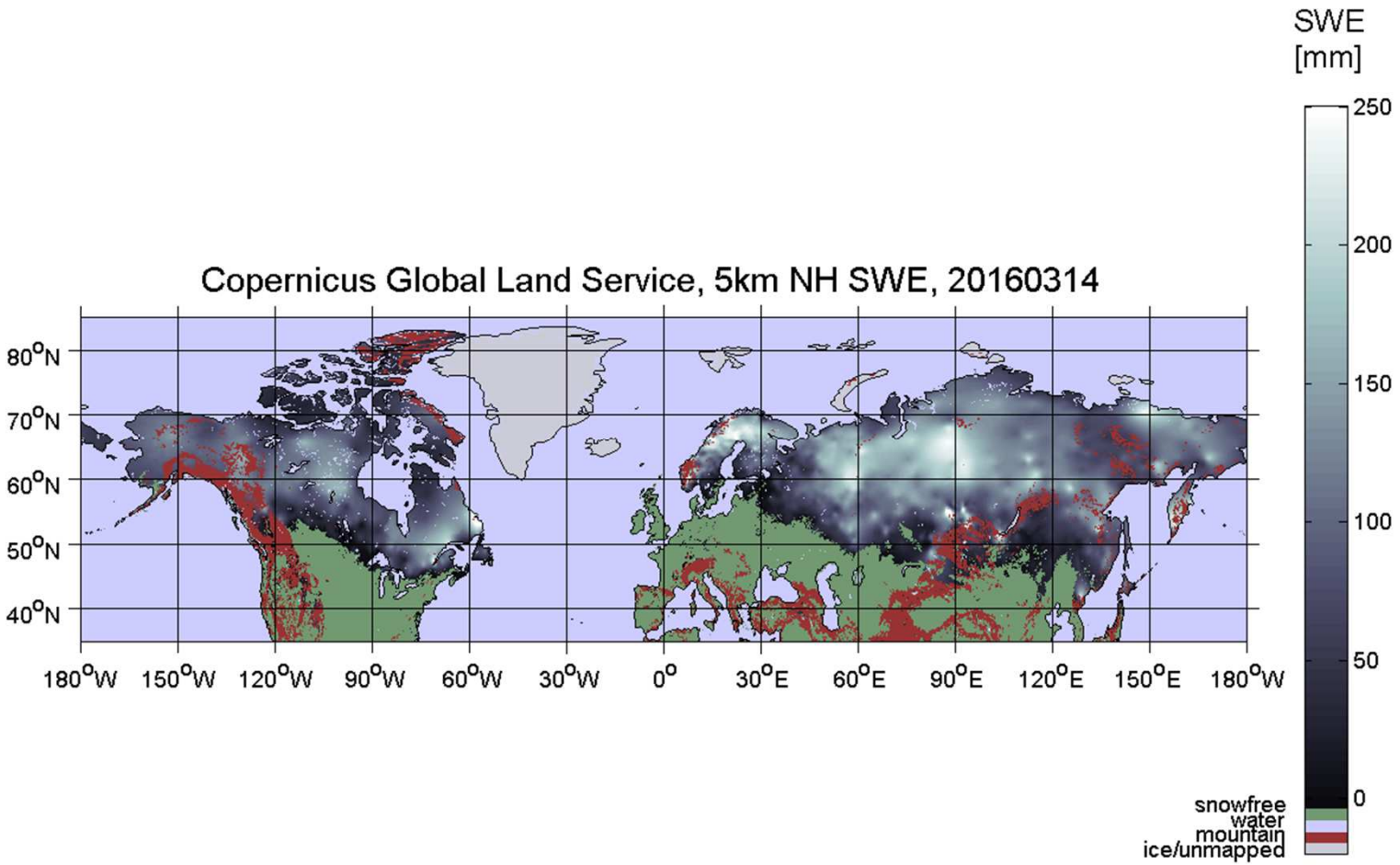
Cryosphere and Water service



Cryosphere: Snow Water Equivalent

Product: Northern Hemisphere 5km SWE
Status: Pre-operational

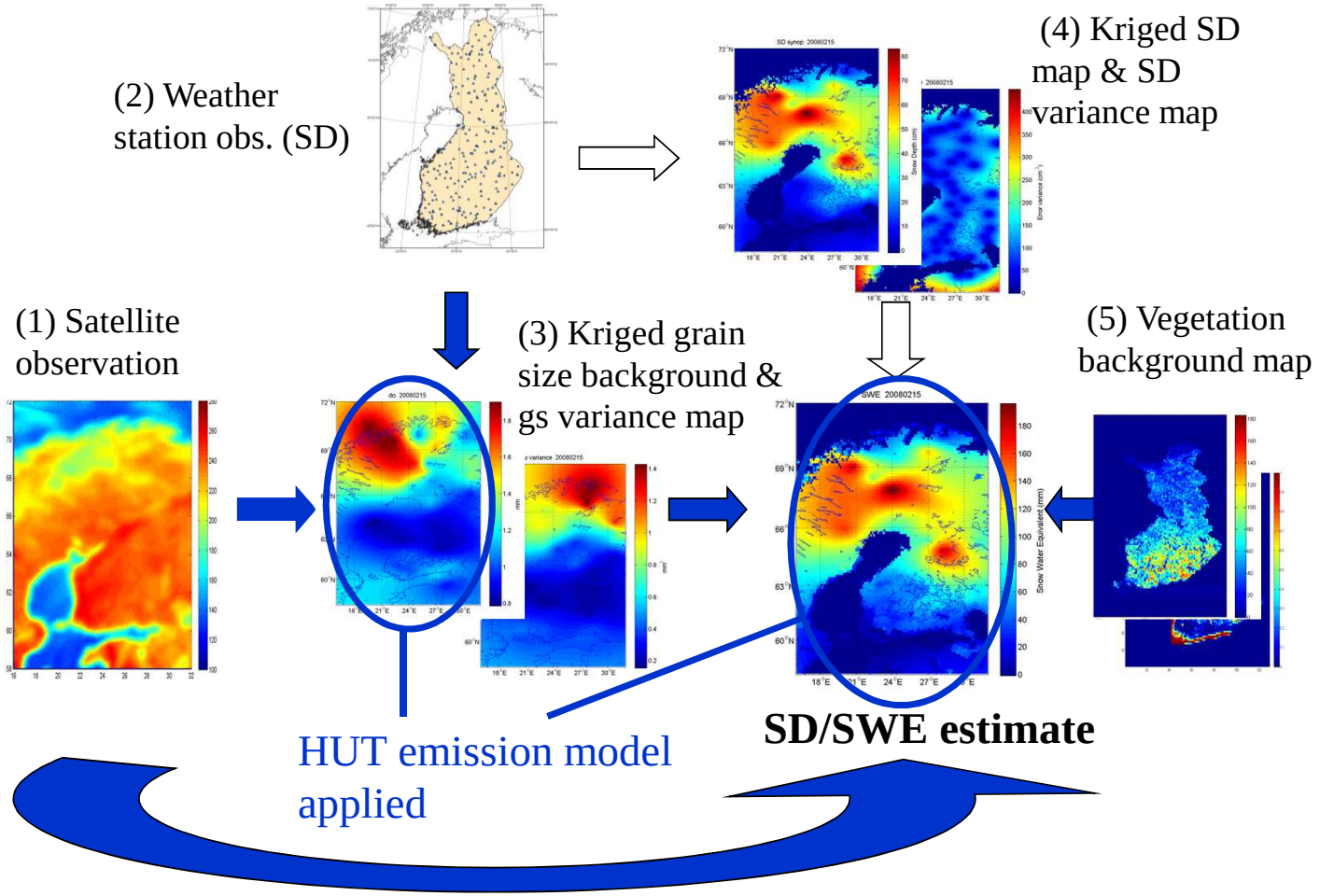
- Product Specifications:
  - Parameter: Snow Water Equivalent (m)
  - Domain: Northern Hemisphere
  - Projection: LatLon/WGS84
  - Pixel size: 0.05° (5 km)
  - Sensor: DMSP SSMIS + VIIRS/Sentinel-3 (and Synop WS data)
  - Accuracy: RMSE=30mm
- Applications:
  - Climate change indicator
  - Input for flood/ weather forecast



Cryosphere: Snow Water Equivalent

Product: Northern Hemisphere 5km SWE
Status: Pre-operational

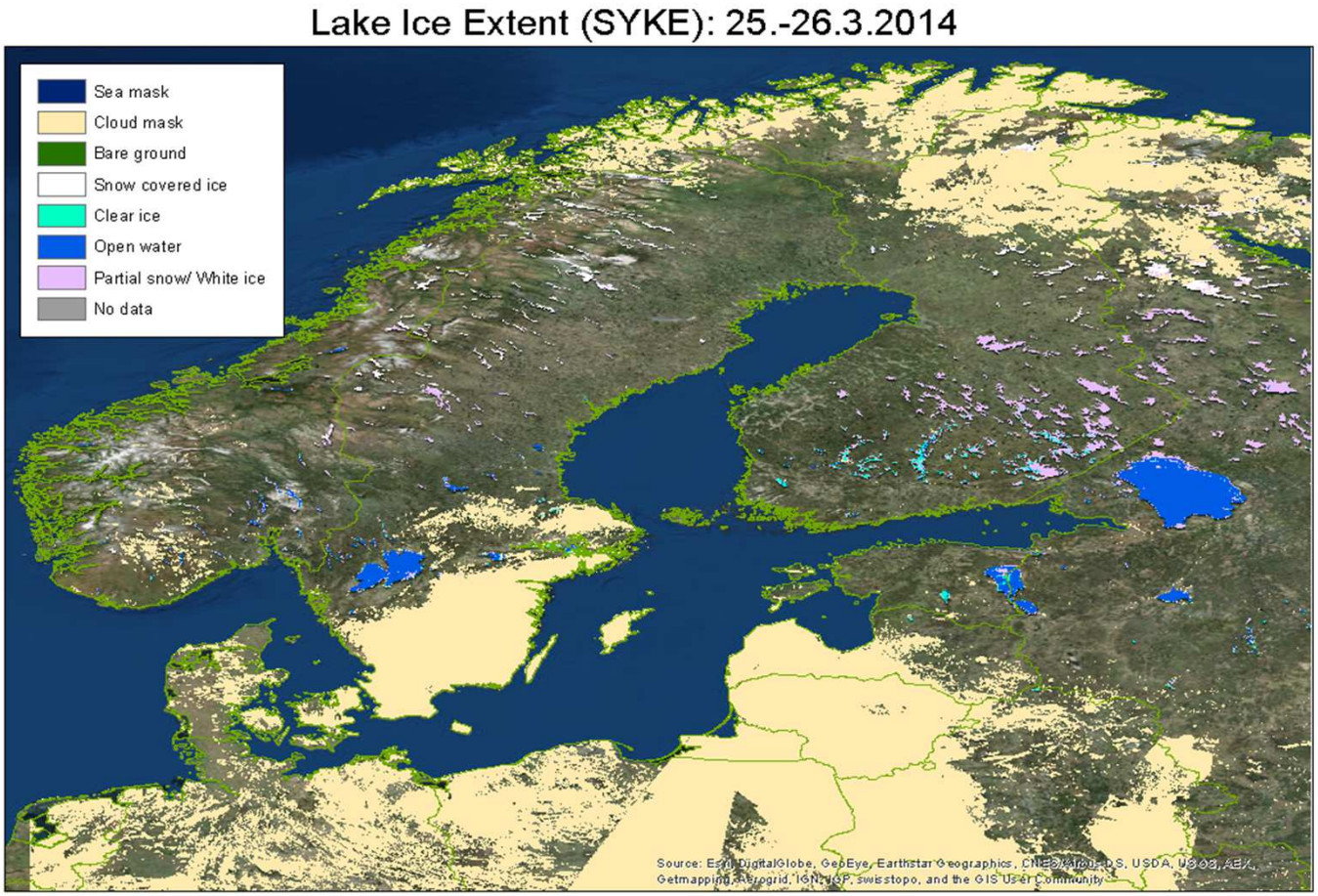
- Passive microwave radiometer data combined with ground-based synoptic snow observations (variational data-assimilation)
- Augmented using optical EO-data & IMS snow mask
- Extensive (ESA/EC) development legacy (GlobSnow/CryoLand)



Cryosphere: Lake Ice Extent

Product: Baltic 250m LIE
Status: Pre-operational

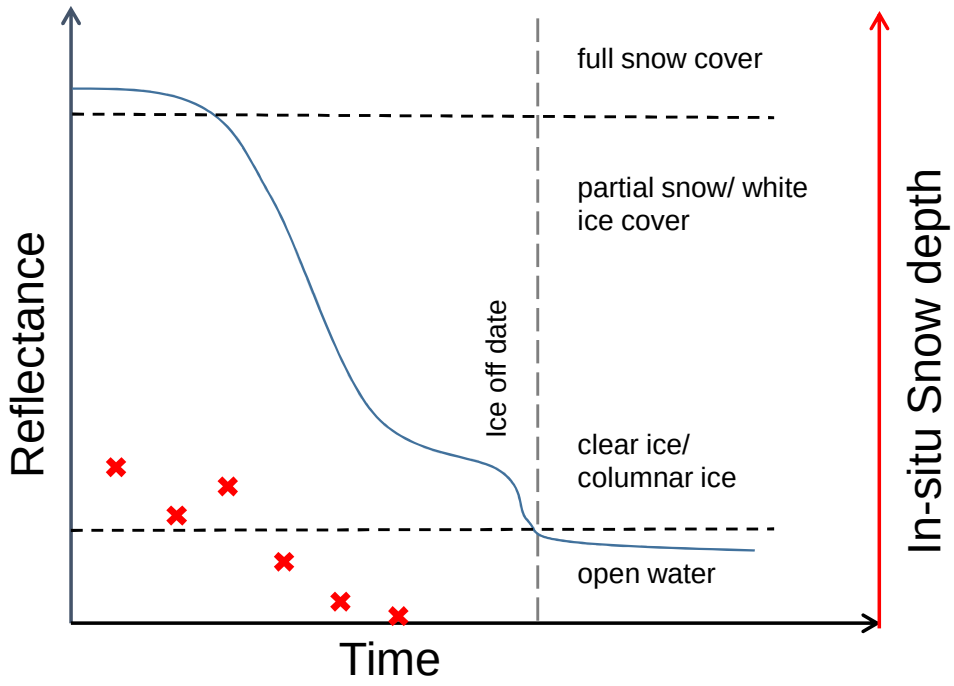
- Product Specifications:
  - Parameter: Lake Ice Extent (classes)
  - Domain: Baltic Sea (UL; LR: 71°N/5°E; 45°N/45°E)
  - Projection: LatLon/WGS84
  - Pixel size: 0.0025° (250m)
  - Sensor: Terra/MODIS
  - Accuracy: with same method for Terra/MODIS sensor :86%
- Applications:
  - Climate change indicator
  - Input for flood/ weather forecast
  - Recreational activities in winter time



Cryosphere: Lake Ice Extent

Product: Baltic 250m LIE
Status: Pre-operational

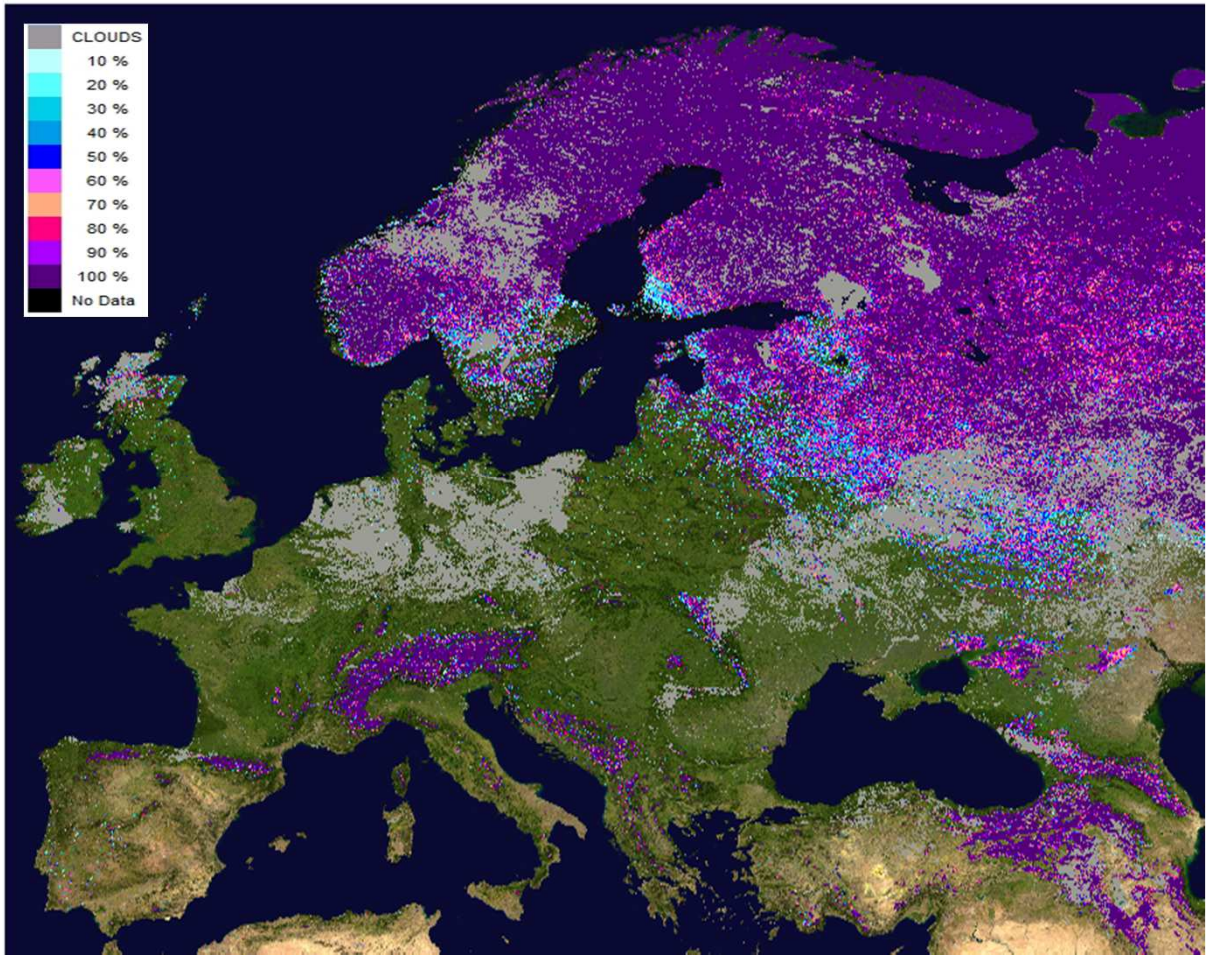
- Three class classification:
  1) Fully snow covered ice
  2) Clear ice/ Partial snow/ Partial white ice cover
  3) Open water
- Simple reference reflectance algorithm
  - Reference reflectances based on comparing in-situ measurements of snow depth on ice and ice phenology observations (Ice freeze up, break-up, totally ice-free...etc)
- Easily transferred to different instruments
  - Sentinel-3
  - Sentinel-2: Lacking the possibility of automated cloud masking in winter
- Hindered by clouds and polar night



Cryosphere: Snow Cover Extent

Product: Pan-European 500m SCE
Status: Pre-operational

- Product Specifications:
  - Parameter: Fractional SE in %
  - Domain: 72°N 11°W – 35°N 50°E
  - Projection: LatLon/WGS84
  - Pixel size: 0.005° (500 m)
  - Sensor: MODIS (Backup VIIRS)
  - Accuracy: 10-20%
  - Archive of Daily Snow products since Nov 2000 (re-processed)
- Applications:
  - Climate change indicator
  - Input for snow melt runoff/ weather forecast
  - Water management, irrigation
  - Recreational activities in winter time

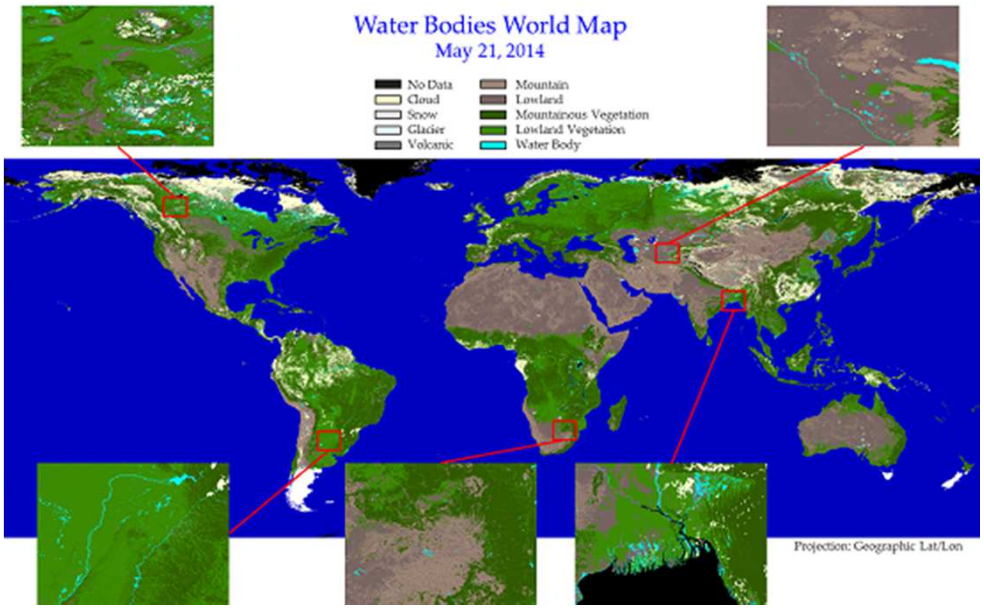


Areas of Water Bodies

Product: Global 1km WB
Status: pre-operational

- WB-V2 identifies pixels covered by water. The areas of water bodies are understood here with respect to the instrument resolution, i.e. surfaces more or less covered by water with a size of about 1km²
- Product Specifications:
  - Parameter: water bodies, quality layer
  - Domain: Global
  - Projection: LatLon/WGS84
  - Pixel size: 1km
  - Sensor: Proba-V
  - Time resolution: 10 days
  - Latency: 2-days after decade
  - Accuracy: 15% of omission (water surface ratio > 0.89); commission error=13,6%

Value (WB layer)	Label
0	Sea
70	Water
251	No data
255	No water

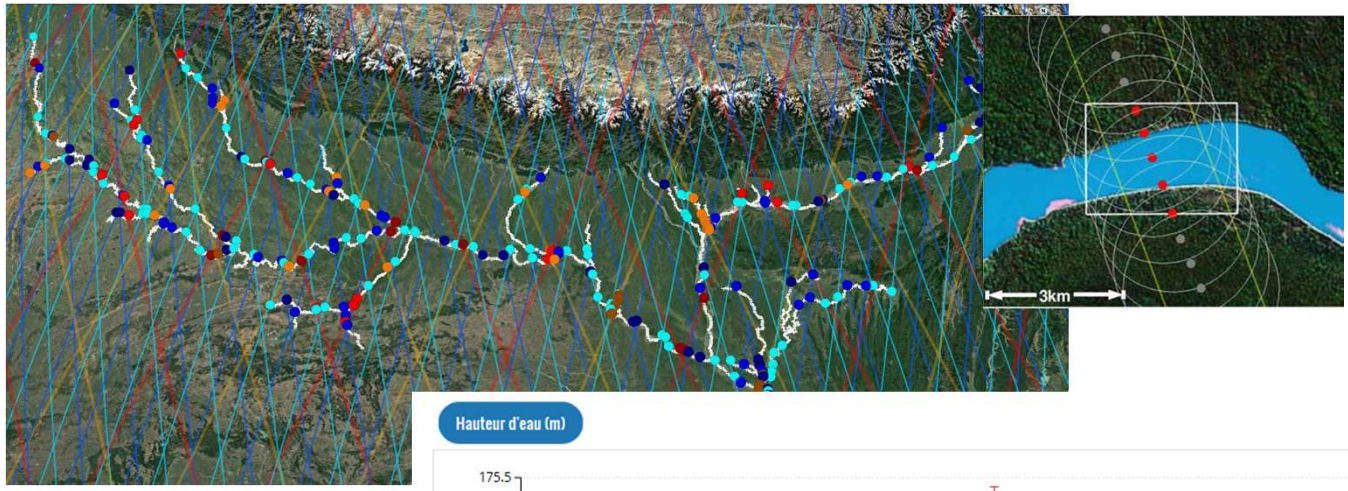


Value (QUAL layer)	Label
0	sea
71	Very Low
72	Low
73	Medium
74	High
75	Very High
76	Permanent
151	Lowland vegetation
152	Mountain vegetation
241	Glacier
242	Volcanic
243	Mountain no vegetation
244	Lowland no vegetation
251	No data
252	Cloud
253	Snow
254	SZA > 45°

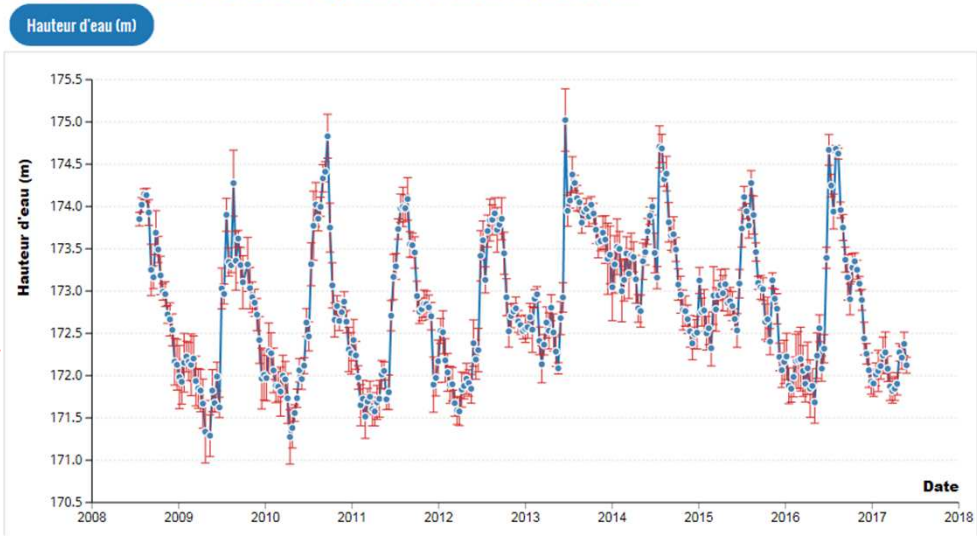
Water Level: Lakes and rivers

Product: Global water level
Status: pre-operational

- Water height w.r.t geoid where altimeters cross rivers or lakes
- Product Specifications:
  - Parameter: water height w.r.t geoid (m)
  - Domain: Global
  - Sensor: Jason-3, Sentinel-3a, Jason-2
  - Time resolution: 1-to-28 days
  - Latency: 2-days after decade
- Application
  - Monitoring of water levels at the scale of the hydrographic basin,
  - Water resource management
  - Contribution to drought monitoring.
  - Climate studies at the basin/continental scale.



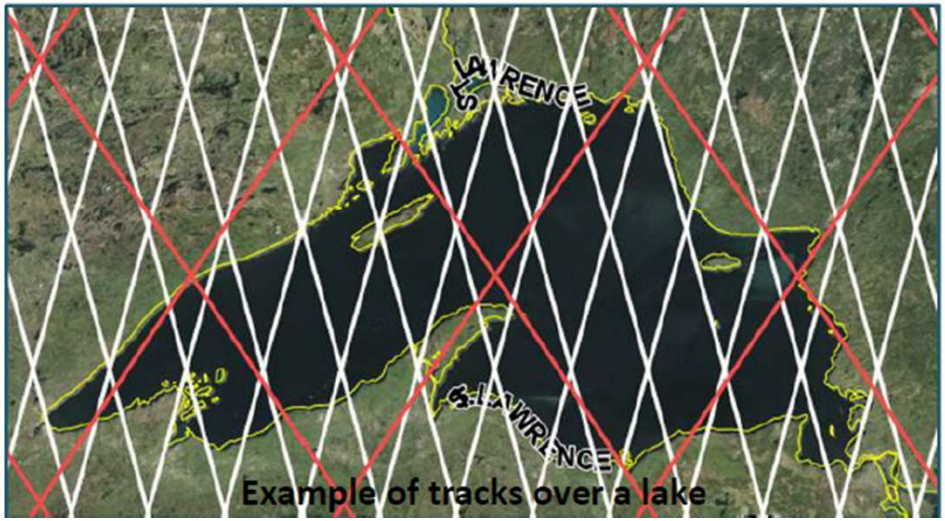
System built upon the Inheritage and the production THEIA/HydroWeb facility by LEGOS & CNES



Water Level: Lakes and rivers

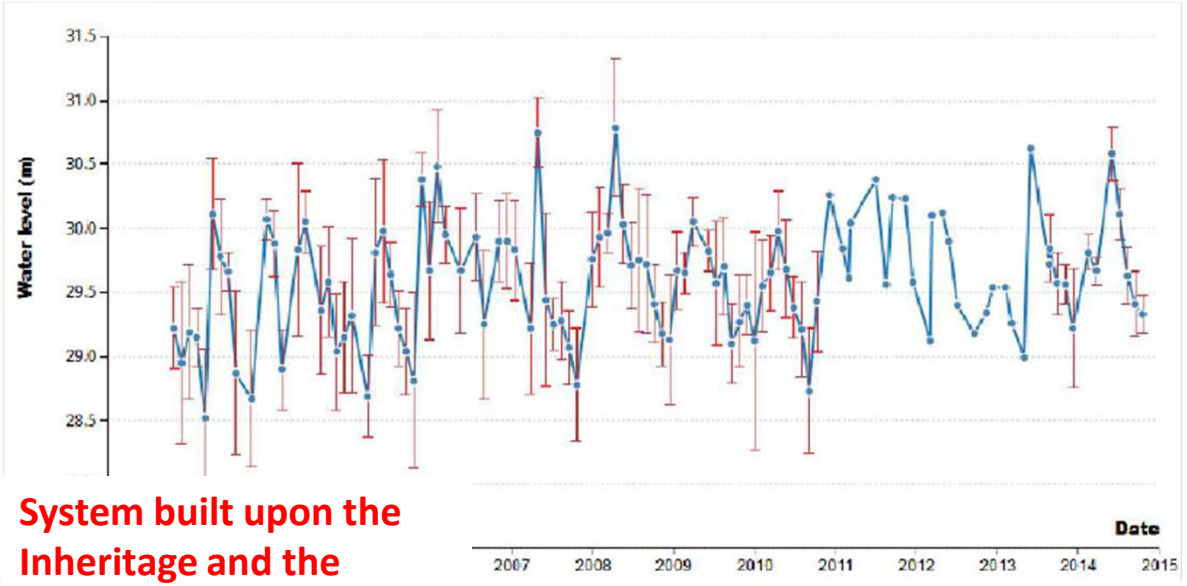
Level, surface & volume variation monitoring for lakes

- ✓ Three steps for each lake
- ✓ Use of all interesting high frequency measurement inside the lake shape for all missions
- ✓ Processing of a median water level for each lake taking into account :
  - The altitude
  - The lake profile
- ✓ Processing of the lake volume / surface variation :
  - hypsometric curve : relation between level and surface



Example of tracks over a lake

From Pacholczyk, Cretaux, Genero & Calmant



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From THEIA/Hydroweb web site