

# ESA: Addressing the Challenges of the new Era in Altimetry

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#### Welcome

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- On behalf of the Josef Aschbacher, Director of Earth Observation Programmes at the European Space Agency welcome to this "New Era of Altimetry, New Challenges" Conference
- The meeting provides a timely forum to celebrate how far we have come in the field of highperformance, precision altimetry, and to reflect on the user needs, gaps in observing capability, future challenges, and the path forwards to meet these challenges
- ESA has a rich heritage and has been one of the leaders in this domain, and the architect of a rich vein of sustained, uninterrupted altimetry missions (ERS-1, ERS-2, Envisat RA, CryoSat, Sentinel-3, Sentinel-6). More recently ESA has pioneered the development and establishment of of a robust sustained, GMES/Copernicus space component to support operational oceanography in Europe through 2030
- Today's new era of altimetry is the culmination of many years of sustained investment, research, and technical development, and comes from a vision which was developed from dialogue with user forums like this.

# Addressing Continuity: Essential Climate Variables

- Since 1992 ESA delivered and has executed its long-term vision to secure sustained altimeter observations for climate research and operational applications
- ERS-1, ERS-2, Envisat, CryoSat, and Sentinel-3A,B,C,D, and Sentinel-6A,B demonstrate progressive transition of new instrument capabilities from research to operations
- > 2 Decades of altimetry data enable Essential Climate Variables on sea level, ice sheets, and sea ice within ESA's CCI Programme:
  - sea-surface height (SSH)/sea level,
  - ice sheet surface elevation/volume change and
  - sea ice freeboard/thickness/volume change
- Combined polar (high inclination orbit) and non-polar altimetry (low inclination) <u>are required</u> to capture terrestrial/marine ice mass changes, ice sheet melt and river & lake freshwater fluxes and their impact on global sea level, dynamic ocean topography, and ocean circulation variability

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## Infusion of New Technology

#### **Monostatic Altimetry**

Incoherent Pulse-width limited (LRM)  $\rightarrow$  Coherent - CryoSat/Sentinel-3 (SAR)  $\rightarrow$  interleaved mode (Sentinel-6/Jason-CS)

#### **Bistatic Altimetry**

1d - CryoSat SAR Interferometry (SARIn) 2d – SWOT Imaging swath SAR altimetry (KaRIn)

#### SAR Advantages

- Improved range accuracy
- Finer resolution along-track SSH and sea-surface slope
- SSH and DOT retrieval from narrow leads within sea ice
- Valid SSH closer to the coast than before
- Sea ice elevation/freeboard/thickness

#### **SARIn Advantages**

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- Phase angle, isolation of echo origin (unambiguous elevation)
- Across-track elevation retrieval (Echo Phase unwrapping)
- Multi-faceted/multi-disciplinary: ice-sheet, glaciers, Lake Elevations
- Cross-track ocean slope, DOT at mesoscales

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### Over the Horizon



- Copernicus Sentinel-3 and Sentinel-6 altimetry series secure until ~2030
- ESA working closely with CNES to leverage CryoSat, Sentinel-3, AltiKa, and Sentinel-6/Jason-CS experience
- Challenge for ESA remains to balance R&D, with maintaining architectural vision for Copernicus altimetry
  - Progressive introduction of new technical capabilities for "enhanced continuity" of existing measurements
  - Address current gaps in "Copernicus Evolution"
  - Potential reconfiguration of altimetry within Next Generation Copernicus (> 2030)
- To fill critical gap in high-latitude, high inclination SARIn altimetry beyond CryoSat-2 (identified at EC Copernicus Ice & Snow User Workshop) to address:
  - Ice retreat, ice dynamics and ocean circulation;
  - Sustain sea-ice thickness measurements for operational use;
  - SAR Interferometry mandatory for ice-sheet margins, glaciers and ice caps (rugged topography);
  - Investigate Ku-/Ka-band twin-freq. + MWR combination for snow loading on sea ice and benefits of data for broader scientific applications.
- ESA looks beyond the present and seeks to address new scientific challenges and a broader range of altimetric products and services in Copernicus Next Generation

### ESA Future Strategy



Sustained observations to understand and attribute environmental trends

Ground-breaking science missions integrated into flexible observing systems

#### Translational science to transform scientific discoveries into practical solutions

Broad communication of the benefits of space-based EO to science and society

International cooperation to fill gaps in observations and build new capabilities

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http://www.cryosat2017.org/



#### North-American CryoSat Science Meeting

#### 20-24 March 2017 Banff, Alberta, Canada



This meeting is part of a broader 2017 ESA Earth Explorer science meeting, which also includes the Fourth Swarm Science Meeting and Geodetic Mission Workshop

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# Copernicus

New era of altimetry, new challenges

Vincent Toumazou European Commission DG GROW/Copernicus programme





Space

Copernicus EU





# COPERNICUS FUNDING

#### From research to operations







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## COPERNICUS SERVICES







- The High-Precision Ocean Altimetry (HPOA) mission is <u>an</u> <u>essential reference</u>.
- Safeguarding data quality, <u>ensuring the continuity of several</u> <u>decades</u> of European oceanography know-how and data calibration-validation of remarkable quality.
- Altimetry is an essential input to the ocean forecasting component of Copernicus. <u>Jason-3 forms the European</u> <u>backbone</u> of a constellation along with Sentinels 3 and 6.
- This constellation will help to <u>improve ocean forecast</u> <u>accuracy</u>, benefitting the Copernicus user community.





# Thank you for your attention





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