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Potential of SAR altimetry for coastal sea level studies in the Baltic Sea

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Conventional Altimetry → BALTIC FROM SPACE WORKSHOP

esa

Measures range directly below satellite.

- Footprint is typically 100 km2
- Altimetry provide:
- Sea surface height,
- Wave height & wind speed

Parameters are degraded

from roughly 5-10 from Coast

When conventional altimetry is used ESA UNCLASSIFIED - For Official Use

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AND

SEA

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Mayerri

Zuropean Space Agency

footprint

Conventional Altimeters → BALTIC FROM SPACE WORKSHOP

Example:

Conventional satellites

Only gets to roughly 60 km from the Stockholm tide gauge.

Conventional satellite

ERS 1, ERS2, ENVISAT

Jason-1+2+3

SARAL /ALtiKA

Some coastal improvement through retracking

-> check coastalt.org

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Cryosat-2 and Sentinel-3A+B

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New generation SAR altimeters on

Cryosat-2 (since 2010)

Sentinel-3A (since 2016)

Sentinel-3B (from 2017)





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SAR altimetry advantage → BALTIC FROM SPACE WORKSHOP

The Altimets Radar beam is sliced up using delay Doppler

Along track resolution Is heavily improved from Roughly 7 km to 300 meters.

At the same time the chance Of coastal degradation is minimized





With 300 meters resolution observations Close to the coast and in fjords can now be made

Accuracy improved by factor 2

Observe very CLOSE TO COAST.

Cautions in VERY complicated archipelagio Regions like swedish "Skærgård" –



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Sentinel-3A/B data will become available soon.

First ever SAR repeated tracks

S3A observes every 27 days

S3B will observe in between S3A to provide observations every 13.5 days.



Potential users of Altimetry → BALTIC FROM SPACE WORKSHOP





Navigation : waves currents



Offshore

Ferries

Load/Unload
Waves, Mooring

Production/Resource

+

Operations

Sea level



• Waves • Wind • Search+Resque



testcenters



Off-shore windfarms

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Use of altimetry (e.g., S-3 data)

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Due to S3 revisit time of 14/27 days altimetry gain much larger value if it is integrated with a high resolution nested hydrodynamic models for local regions.

Example of waveforecast for a danish port

(lotus DHI)



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Altimetry in the Baltic Sea → BALTIC FROM SPACE WORKSHOP

The temporal correlation Between tide gauge Sea surface Height and satellite altimetry

Is higher in the Baltic sea than anywhere else on the Planet.

They nearly totally agree

Courtesy of Chris W. Hughes



Extreme waterlevel (Estonia)

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Notice all high waters last 25 years was captured by Altimetry With Sentinel-3A+B this will be even better.

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Satellite measures ABSOLUTE sea level change.

Tide gauges measures sea level change RELATIVE to land.

GPS Satellites Satellite Altimeter **GPS** Antenna Tide Gauge Benchmark/ Sea Surface (S) Earth's Surface (U) (N) © Thierry Guyot, LIENSs Earth's Center of Mass



Satellite altimetry also reveals Baltic absolute height



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This is important for vertical referencing and Improving ship traffic efficiency in the future as demonstrated in



Co-financed by the European Union Connecting Europe Facility



DTU16 Mean Dynamic Topography reveals Baltic sea level lies 0.5 meter above geoid and North Sea



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With Sentinel-3A and 3B SAR altimetry **all the way to the coast** of **highly accurate sea surface height, waveheight and wind-speed** Numerous new applications will be possible



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In the Baltic Fjords+Archipelago S3A+B will give observations. These would be more accurate if next generation SARin (two antennas) is used as Cryosat-2 demonstrated.



