Ocean & Coastal

Tides in fjords and estuaries with SWOT

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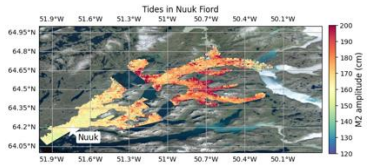
The aim is to use the new SWOT 10 meter resolution data to develop high resolution ocean tide models for Greenland.



Ocean and Coastal currents with SWOT and using geodetic methods.

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SWOT provides data very close to the coast and the aim in this project is to try to model coastal currents using geodetic and coastline information to steer the currents.

GNSS Reflectometry for Sea level around Greenland

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A number of new GNSS stations are capable of monitoring sea level variations using the reflected sea level signal. Methodology and interpretation of these data are the focus here.

Bathymetry and gravity using SWOT (ML)

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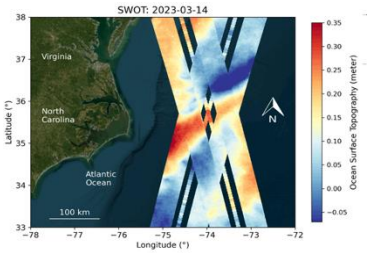
SWOT enables new possibilities to develop Bathymetry models. In this project the use of Machine learning will be taken to account for the huge variations in sea floor conditions.



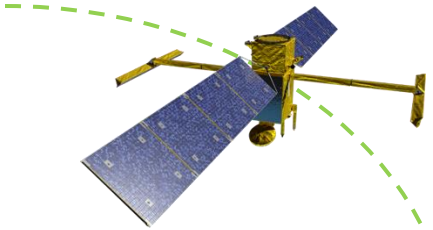
SWOT observed ocean topography

Hydrosphere Research Group

As part of the Geodesy and Earth Observation (GEO) Department, the Hydrosphere group monitors, among other things: the past and present sea level rise, sea surface anomalies, and the changes in the water level of lakes and rivers, which are important indicators of climate change. This is done using both satellite remote sensing and in-situ data.

Research carried out by the Hydrosphere group involves data from several satellite altimetry missions. These satellites can map the elevation of surface water, allowing us to derive water budget change over time or to model the ocean's surface. The Hydrosphere group has extensive experience assimilating data from multiple satellite missions to produce best informed models.

The newly launched SWOT satellite (2022) for the first time measures water surface elevation as 2D *images*, revealing unprecedented detail. It will allow us to revolutionize our understanding of the freshwater dynamics on land, as well as the ocean's topography and mean sea surface anomalies. The SWOT satellite is an exciting opportunity to dive into areas no one has investigated before and to let your imagination run free.



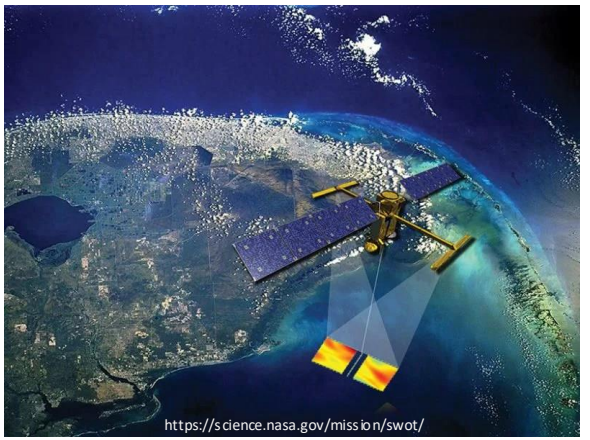
DTU Project Day 2025

STUDENT PROJECTS

DTU

DIVISION OF GEODESY AND EARTH OBSERVATION

Hydrosphere Group



Inland

Image segmentation for surface water mapping

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We want to utilize satellite multispectral optical- and SAR- images to generate a binary water mask over rivers, for which water extent could change drastically with season and geographic region. DL, ML or rule-based techniques may be used for developing a robust river masking algorithm.

Combine satellite altimetry data for robust river/lake timeseries

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In this project, you will combine satellite altimetry data from many satellite missions to obtain greater spatial and temporal density of observations. You may then compare your timeseries with gauge or model estimates.

Dam operation monitoring from space

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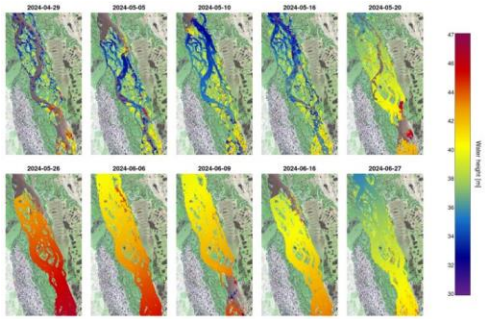
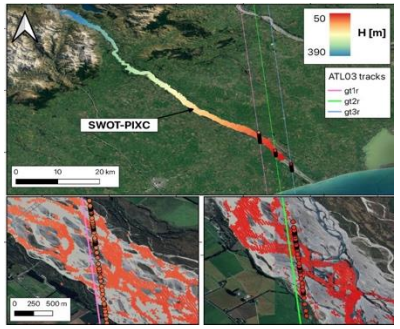
With satellites like SWOT and ICESat2, we can observe lake levels and extent of reservoirs as a function of time, and from this estimate the volume of water released at a dam. Are countries that do not publish their dam operations releasing the agreed amount of water to downstream countries?



Seasonal height and extent fluctuation over braided river seen by SWOT

Inland



SWOT vs ICESat-2 over braided river

Timeseries outlier detection algorithm

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Outliers in water heights observed from space could be due to land, ice, or even phase unwrapping errors. We would like to develop a timeseries outlier detection algorithm for river and lake height timeseries.

Filter design for SWOT data over rivers and lakes

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SWOT pixel cloud data provides surface water heights at resolutions as small as 20 m, though with large amounts of noise. We want to develop a spatial filter for this data over inland water to extract accurate river and lake heights at high resolution.

Impact analysis (ML/DL/rule-based) of SWOT flags

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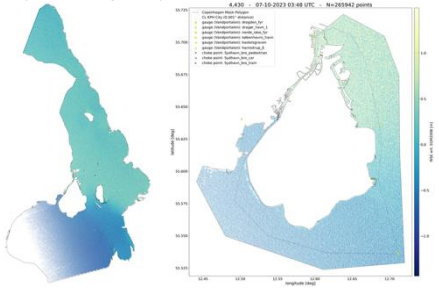
Observations from SWOT come with 32-bit quality flags, where each bit represents data degradation on different severities. We would like to develop a model and map each flag's impact on data accuracy.



SWOT captures height difference over Øresund - 1.2m in CPH

Ocean & Coastal

Wind effects on water surface levels in lakes and coastal areas

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The new SWOT satellite marks a leap in satellite altimetry. For the first time we can see water elevation from space in 2D. With this new possibility, can we see effects of wind on water in large lakes or coastal waters?

3D ocean subsurface reconstruction from 2D SWOT surface data and in-situ data(ML)

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SWOT 2D surface data can be merged with salinity, temperature and pressure information to perform a 3D sub-surface reconstruction in the Arctic Ocean

Adaptive filter design for SWOT gravimetry over oceans

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Current models take a too coarse approach, either discarding valid data or including too much and thereby causing contamination. To fully utilize the high-res. data, an adaptive filter would need to be developed, taking secondary data into account.

Currents and vorticity with SWOT and optical sensors

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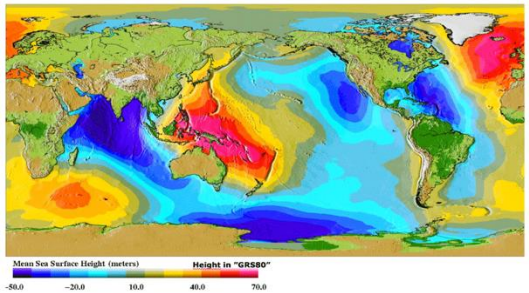
We have a 4D Variational assimilation model that is currently run at DTU Space to estimate vorticity and currents assimilating SWOT satellite data. During daylight we can verify this model using optical imagery.



DTU Mean Sea Surface