HYDROCOASTAL

- The junction between the coastal zone and inland waters is a boundary between
  - Different science domains (hydrology and oceanography),
  - Different satellite measurement regimes.
  - Region of high variability in small spatial and temporal scales.
- HYDROCOASTAL aims to enhance our understanding of
  - interactions at this boundary,
  - the small-scale processes that govern these interactions,
  - to improve characterisation of variation at different time scales of inland water storage,
  - exchanges with the ocean and the impact on regional sea-level changes.

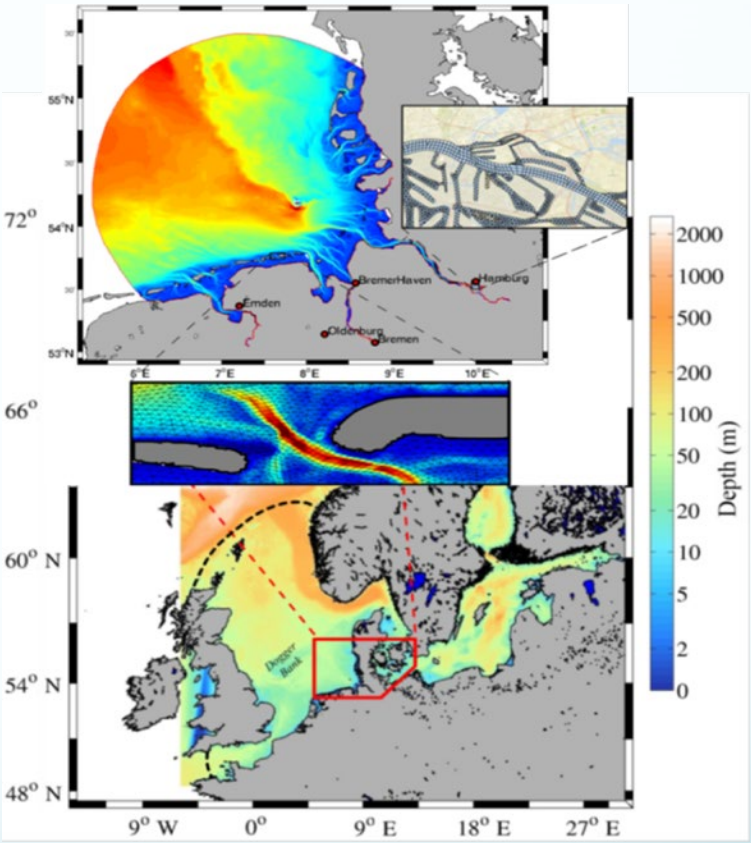


Image courtesy of U Bonn: German Coast of the North Sea and the Elbe Estuary

HYDROCOASTAL

The outputs of the HYDROCOASTAL will include:

- **State of the art review** of SAR Radar Altimetry and current challenges.
- **SAR / SARin satellite altimeter L2, L3 and L4 Test data set** over 18 Regions of Interest. Generated by 6 innovative SAR altimeter re-trackers
- Full descriptions of **processing algorithms** and **output products**.
- Evaluation of performance of the different re-trackers in a **Product Validation Report**
- **Global Output products**:
  - A Global L2 coastal and inland water SAR altimeter data set.
  - Time series (L3) and river discharge (L4) data sets for medium to large rivers
- A **Scientific Road Map** including recommendations for further developments, implementations and research for SAR altimetry

https://www.satoc.eu/projects/hydrocoastal

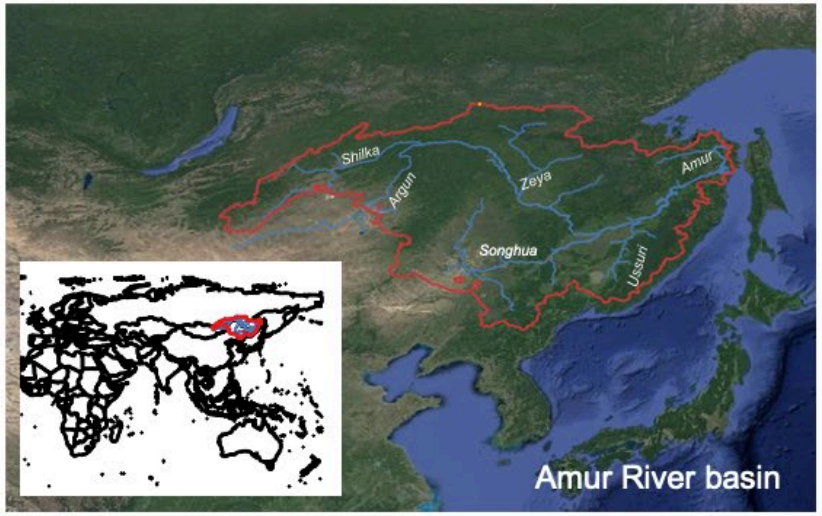
Amur Catchment Study

Catchment Modelling – Amur case study

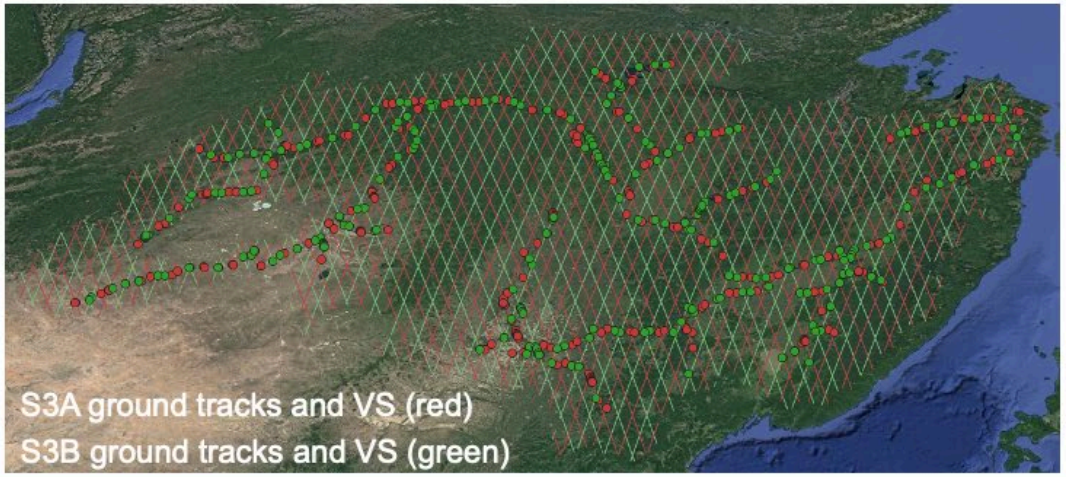
Objectives

1. Build a hydrologic-hydraulic model of the Amur River Basin
2. Process and evaluate satellite radar altimetry data from Sentinel-3 (and CryoSat-2) available in the basin
3. Inform the modeling system with water surface elevation data based on satellite radar altimetry
   a. Inform the hydrologic (rainfall-runoff) model with altimetry-derived discharge
   b. Inform the hydraulic model with water surface elevation observations from radar altimetry (cross section geometry and roughness)
4. Predict discharge, water level (and flood inundation) in the rivers and wetlands using the model

Demonstration on 1 large basin - a blueprint for global-scale application



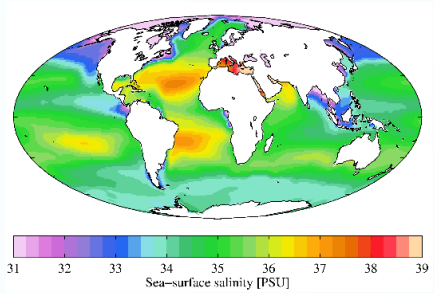

Mike Hydro River setup



RIDESAT: River discharge estimation from satellite sensors

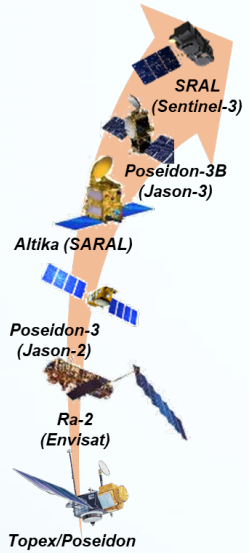
River discharge is defined as the volume of water flowing into a river in a unit time. It is fundamental for many applications related to:

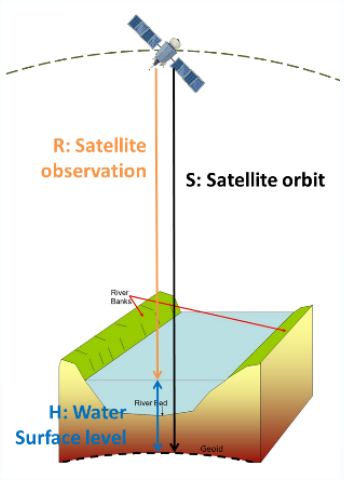
- ❑ the assessment of the water cycle
- ❑ the water resources management
- ❑ the flood prediction and hydraulic risk mitigation
- ❑ the identification and adaptation of the potential effects of climate change
- ❑ the reduction of the ocean salinity and the thermohaline circulation



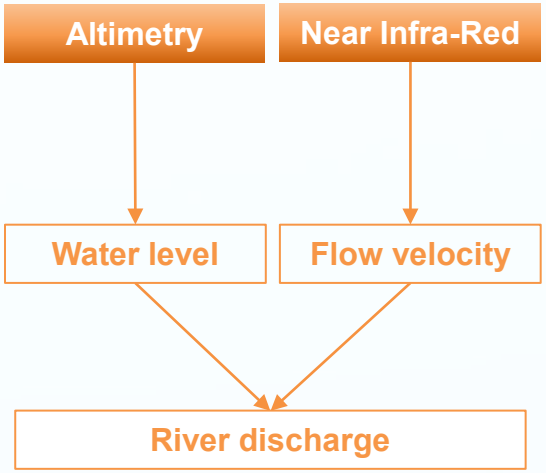
Among the 17 Sustainable Development Goals defined in 2015 by United Nations Member States, the **6th CLEAN WATER and SANITATION** underlines the need to take urgent measures for a *more efficient use and management of water to addressing the growing demand for water, threats to water security and the increasing frequency and severity of droughts and floods resulting from climate change.*

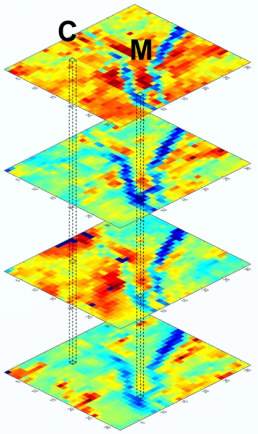
RIDESAT: River discharge estimation from satellite sensors

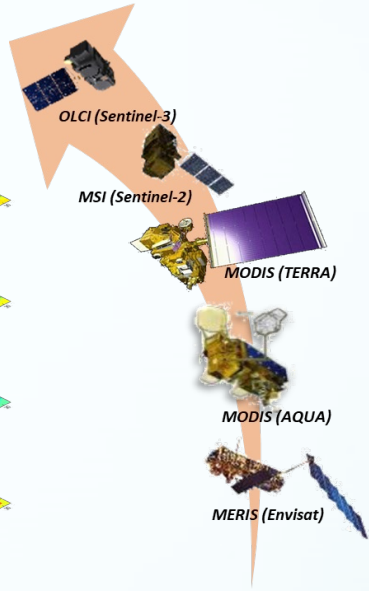




Water Surface Level: *H=S-R*



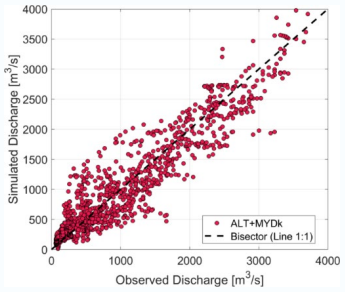




$$\frac{Q}{A_b} = \alpha(H - H_{min})^{\beta} \cdot \left(\frac{C}{M}\right)^{\gamma}$$

A_b	Basin Area
H	Water surface (from altimetry)
C/M	Reflectance ratio (from NIR band)
α, β, γ	Parameters

The products based on altimetry data alone performs well, but results are improved when information derived from NIR bands is included.



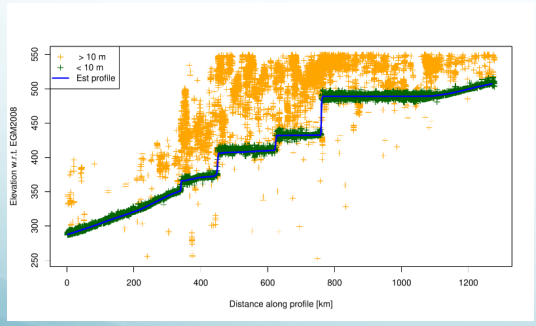
RIDESAT: River discharge estimation from satellite sensors

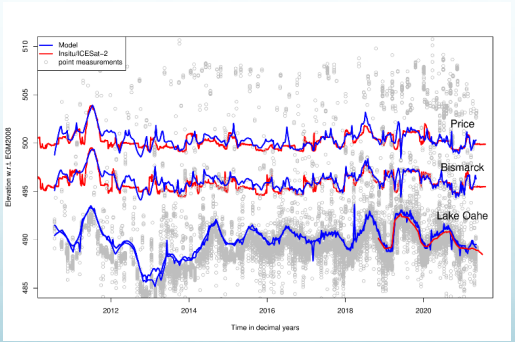
Altimetry

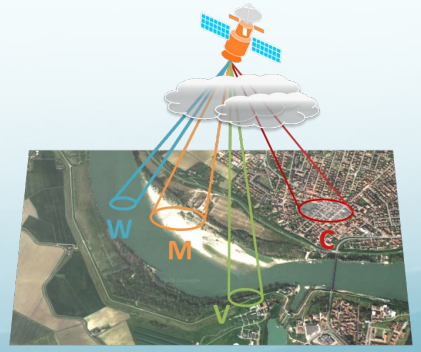
- Multi-mission approach for the estimation of densified time series from several satellite altimetry missions (Saral/Altika, Sentinel-3, Cryosat-2)
- State-space model to evaluate the time series at every section of the longitudinal profile of the river

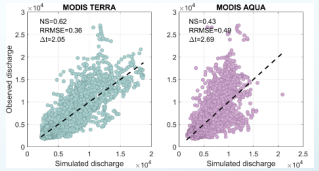
Near Infra-Red

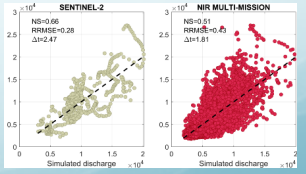
- The algorithm is based on the ration between the reflectance of a dry area (C) and a mixed area (M) considering also additional components: sediments (W) and vegetation (V).
- By considering multi-mission approach the temporal sampling of the time series is improved (1.6 days) with respect to the use of the single sensors.









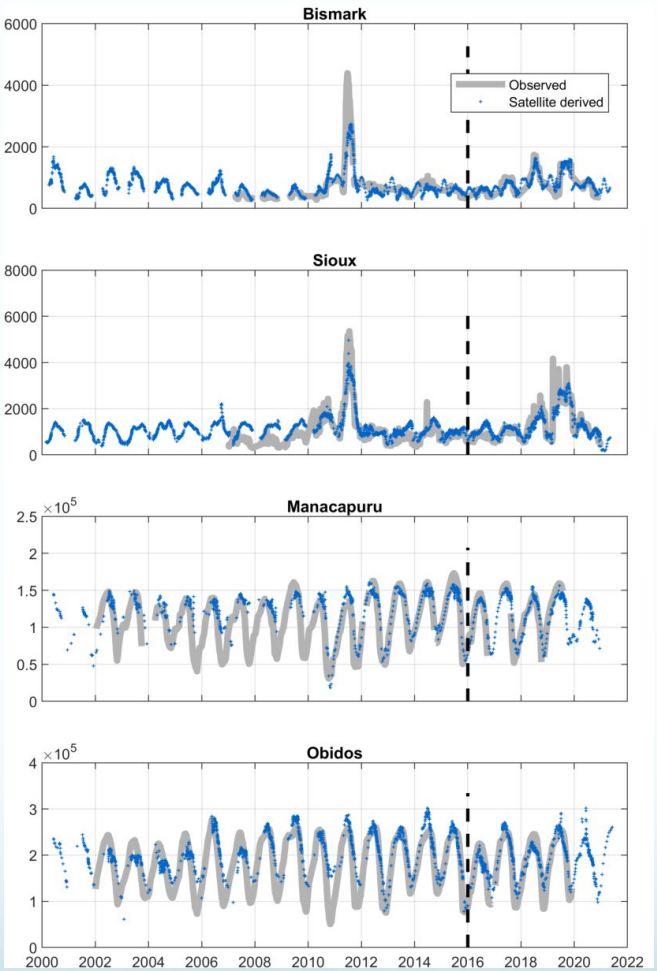


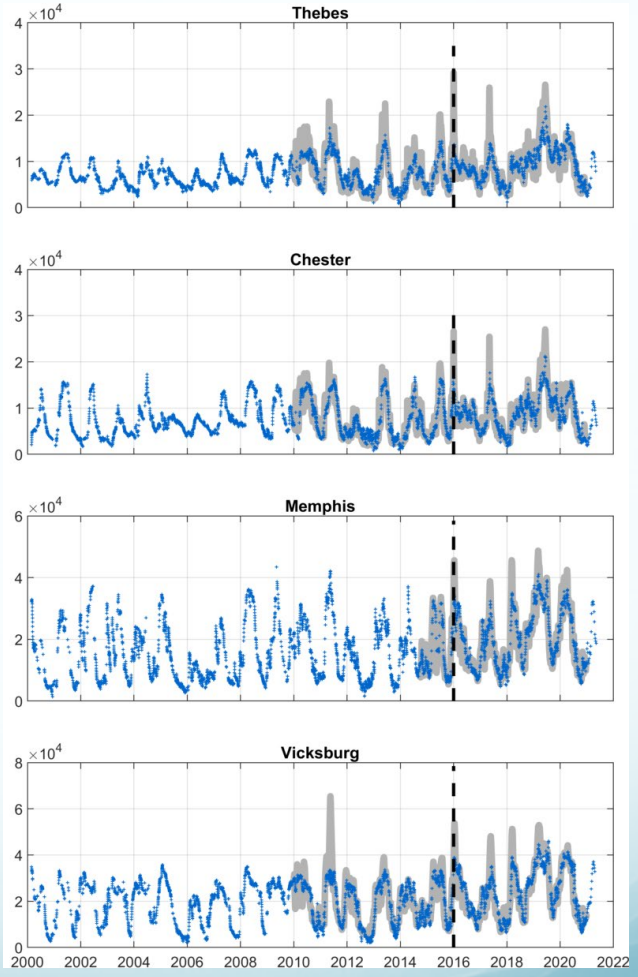
RIDESAT: River discharge estimation from satellite sensors

The method has been applied to several stations in Missouri, Mississippi and Amazon. Within the Hydrocoastal project numerous other stations are planned to be investigated.

$$Q_{ridesat} = \alpha \cdot (h - h_{min})^{\beta} \cdot CM^{\gamma}$$

$Q_{ridesat}$	Cal | Val
rRMSE	14% | 23%
NS	0.99 | 0.99
KGE	0.87 | 0.76



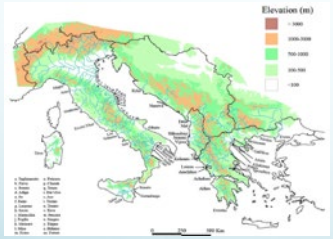


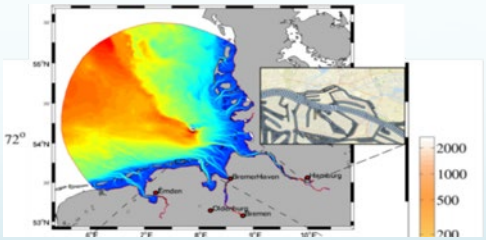
Impact Assessment

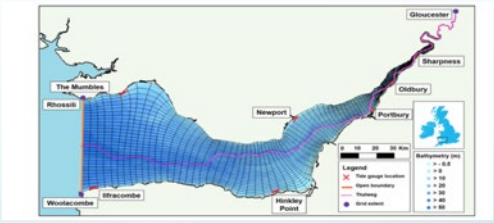
In the final year of the project a series of impact assessment studies will be carried out, to test and demonstrate the potential impact and benefits of the global dataset.

Coastal / Inland
- Severn Estuary (NOC)
- Baltic, German Bight, Elbe Estuary (U Bonn)
- Venice Lagoon (CNR)
- Thailand Coast (TU Delft)
- Ebro River and Delta (isardSAT)
- Wadden Sea (TU Delft)

Inland
- Operational Hydrological Forecasting (DTU Env)
- Lake Size, riverbank configuration (NUIM)
- Discharge Validation (CNR)
- Global Water Level Climatology (AHL, ATK)







Groups from outside the project team are welcome to engage with the project and carry out their own case studies. Please contact us with your suggestions!