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RESEARCH FOR GRAND CHALLENGES

DIGITAL EARTH

Time Series in the Digital Earth Project

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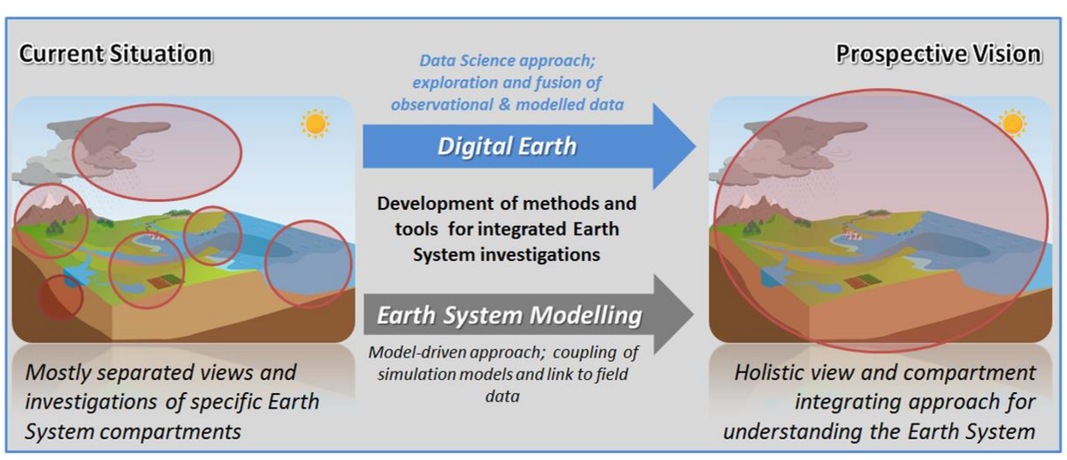
The Digital Earth Project

"Towards SMART Monitoring and Integrated Data Exploration of the Earth System - Implementing the Data Science Paradigm"



General concept of the Digital Earth project and its vision. [visualization: digitalearth-hgf.de]

For more information, visit digitalearth-hgf.de.

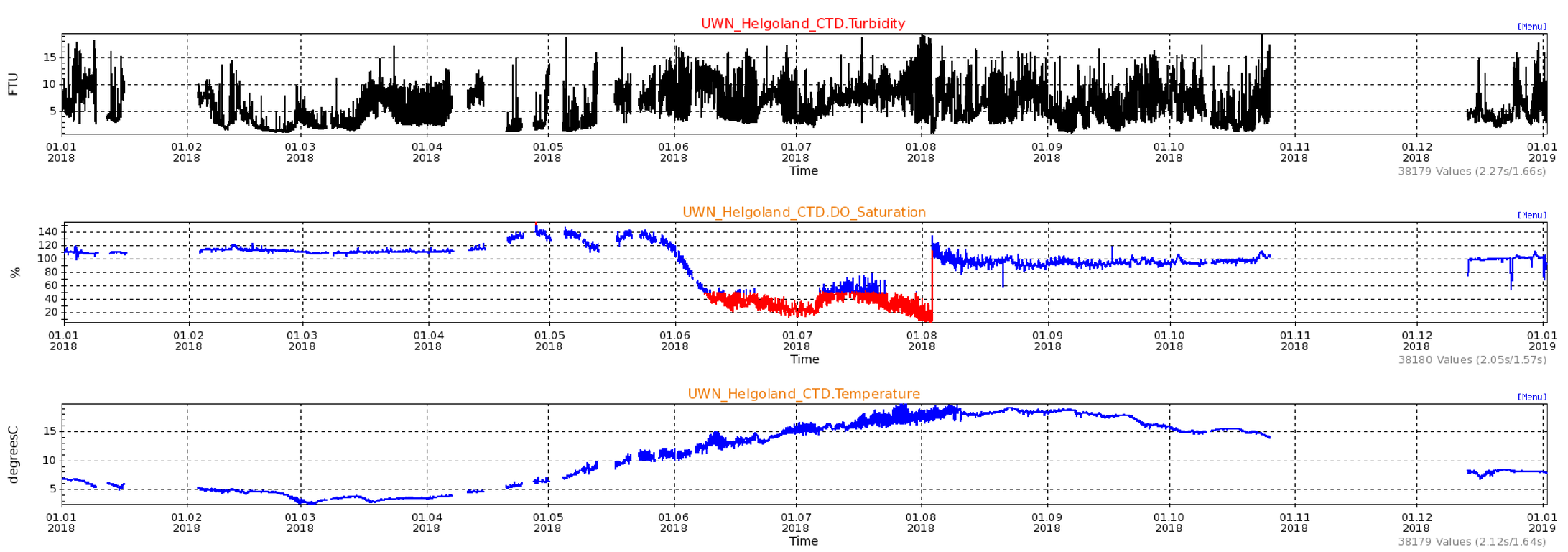
General Concept

The Digital Earth project is a collaboration of scientists from different earth and environmental science disciplines. It relies on data science methods to answer field-spanning questions, monitor environmental developments and explore existing data for new insights, as well as optimize future measurement campaigns.

Time Series Analysis in the Digital Earth Project

One challenge that arises in the Digital Earth project is the integration of data from varying sources with different spatial and temporal resolutions. This includes, among others, time series from measurement campaigns, such as water quality of the river Elbe or methane concentrations in the atmosphere. Analyzing these time series correctly and understanding their limitations is essential before combining findings from different sources, e.g. measurements and model data, to gain a comprehensive understanding of complex questions in the earth sciences.

Example: Time Series from the Helgoland Underwater Node



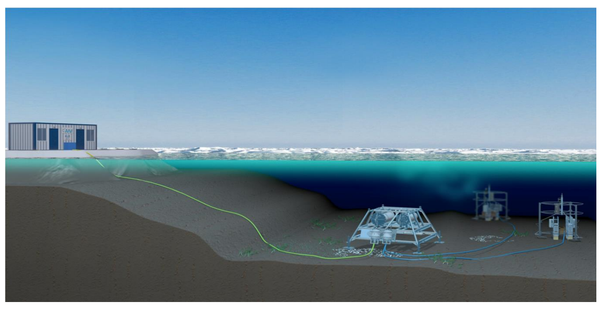
Time Series of the Helgoland Underwater Node from the 1st of January 2018 to the 1st of January 2019. [Data and plots: tsdata.hzg.de and codm.hzg.de]

The Underwater Node

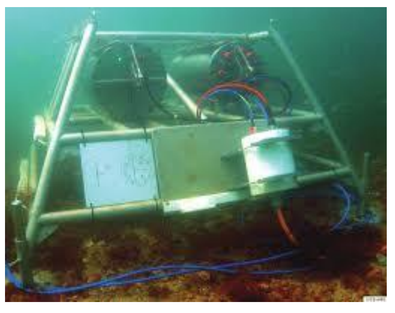
The Underwater Node near Helgoland is part of the Coastal Observing System for Northern and Arctic Seas, COSYNA . It was developed by the Helmholtz-Center Geesthacht (HZG), Centre for Materials and Coastal Research, and the Alfred-Wegener Institute (AWI), Helmholtz-Center for Polar and Marine Research. For further information, visit **cosyna.de**.

Underwater Nodes provide a power- and data-infrastructure to operate up to 10 independent sensor units, such as CTDs or ADCPs. They can be installed up to 30 km away from the shore and operate all year. Currently, three Underwater Nodes exist: one north of Helgoland, one in the Baltic Sea at Boknis Eck, and one in the fjord off Spitsbergen.

COSYNA combines observational data and recordings with remote sensing data and data assimilation models. In addition to the Underwater Nodes, measurements are gathered by automatic land-based stations, buoys, gliders and FerryBox systems installed on ferries, as well as by research vessels. This is supplemented by coastal remote sensing using radar and satellites. The data is available via the COSYNA data management portal **codm.hzg.de**.



Schematic view of an Underwater Node site. [hzg.de]



Underwater Node near Helgoland [photo: P. Fischer, AWI]

The Time Series

The Helgoland Underwater Node's CTD sensor operates at a depth of 10 meters and measures turbidity, oxygen saturation, temperature, pressure, salinity and chlorophyll fluorescence.
Each time series consists of about 38.000 data points, which were taken from the 1st of January 2018 to the 1st of January 2019. Gaps in the data are mostly due to maintenance. The Helgoland Underwater Node began operation in 2012 and is still running. Therefore, nearly 7 years of data are currently available.
The color-coding of data points in the above plots refers to quality control flags: blue stands for "probably good" data, red means "bad data", while black describes data that has not been quality controlled.

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