UTILITY OF COASTAL SEA SCIENCE

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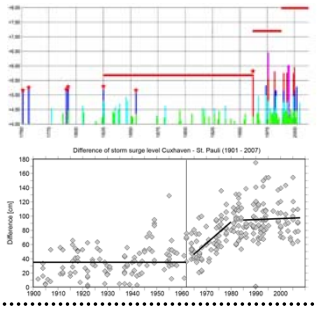
Coastal Research generates useful knowledge for different applications and different stakeholders.

We have constructed five categories of such usefulness – the different categories are not independent of each other, but cover a wide range of applications.

The emphasis on utility does not imply that all coastal science, or should, be "useful".

Making sense

Understanding of complex phenomena, and its use for supporting societal framing and decision making. Examples are consequences of eutrophication, or the manifestation of natural system variations vis-a-avis anthropogenic climate change.
A significant constraint is that science is not the sole supplier of such understanding, but other knowledge brokers are active as well.

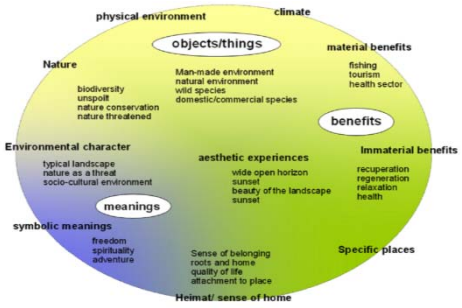


Storm surge heights (vertical bars) and dike heights (red horizontal lines) in Hamburg from 1750 to 2004.
The red stars indicate dyke failures.

Differences of storm surge heights at the mouth of the river Elbe and in Hamburg (some 140 km upstream of Cuxhaven).The 1962 event, after which significant engineering work was done, is marked by a vertical line.

Example: Storm surges in Hamburg

Storm surges in Hamburg have dramatically increased since 1962 (top). Claims were made that this would be due to more intense storms, but a more detailed analysis reveals that apart of an increase of sea level of about 20 cm in the 20th century it is mostly the modification of the configuration of the Elbe, by improving coastal defense and a deeper shipping channel mostly in 1962-1980 (bottom).



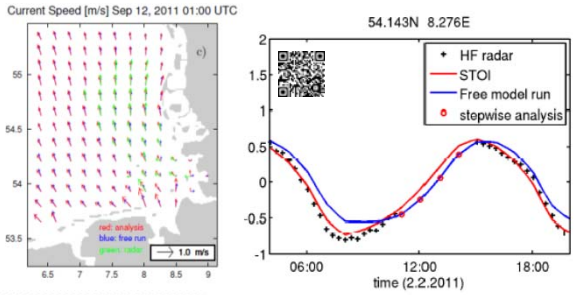
A landscape of values at the West coast of Schleswig-Holstein, Germany based on interviews with local citizen. This information helps to explain what local people associate with a coastal area and should be considered from their perspective in planning decisions.

Marine Spatial Planning (MSP)

is the public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives specified through a political process. MSP is a normative approach for decisions about competitive use of sea space based on several knowledge domains. Contributions from social science support the understanding of structures, perceptions, interests and power balances of involved actors and the effected population.

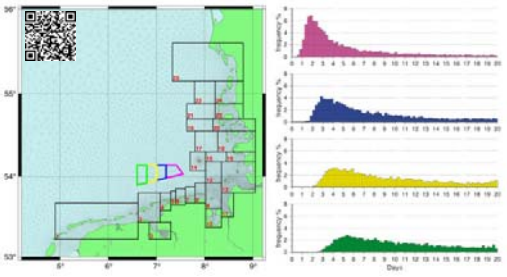
Monitoring

the assessment of the current status of the coastal environment and short term trends based on observation and related data analysis. Making data and assessments available for intermediate or final users. Examples are routine analysis and short-term forecasts of current environmental states.



Routine analysis of surface currents in the German Bight is maid available by the Coastal Observing System for Northern and Arctic Seas (COSYNA) on hourly basis. This product is based on assimilation of HF radar data into numerical model.

Left: Differences between free run, analysis and HF-radar observations (green arrows demonstrate the sub-region covered by radar). Right: Radial current velocity from HF radar (black crosses), the free model run (blue line), and the data driven analysis (red line)



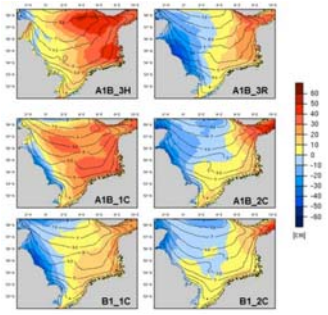
Oil pollution risk may be estimated using high-resolution meteo-marine hindcast data. Using a Lagrangian transport model estimates are provided on how long it may take for pollution originating from accidents in one of the colored boxes to reach one of the numbered target areas. The right panel shows the distribution of travel times for area 14 based on 13615 simulations initialized within the years 1958-1999. When combined with e.g. biological sensitivities, risk estimates can be given.

Hazard, risk and opportunities

Assessments for almost any kind of onshore and offshore operation. For the assessment of negative outlooks and positive perspectives comprehensive and homogeneous data are needed. We provide examples how coastal sea science may contribute to such assessments, particularly in cases where observed data are unavailable

Scenarios

A tool in assessing consequences of possible future developments, sketching related uncertainties or identifying developments with predetermined properties. Examples we refer to in this paper comprise the development of coastal protection, dredging of waterways, or the expected impacts of climate change.



Potential future changes in wind wave climate are important for any offshore operation and/or coastal protection. The figure shows estimated changes in 30-year averages of annual maximum significant wave heights towards the end of the 21st century derived from simulations with the wave model WAM driven by different atmospheric projections (from different models using different initial conditions and greenhouse gas scenarios). While there is considerable variability (and hence uncertainty) among the signals estimated from the different realizations, a tendency for long-term average annual maximum significant wave heights to become higher can inferred for the eastern part of the North Sea
(Grabemann ett al. 2014, under review).

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