IMPROVING COASTAL ECOSYSTEM BENEFITS UNDER INCREASING PRESSURE

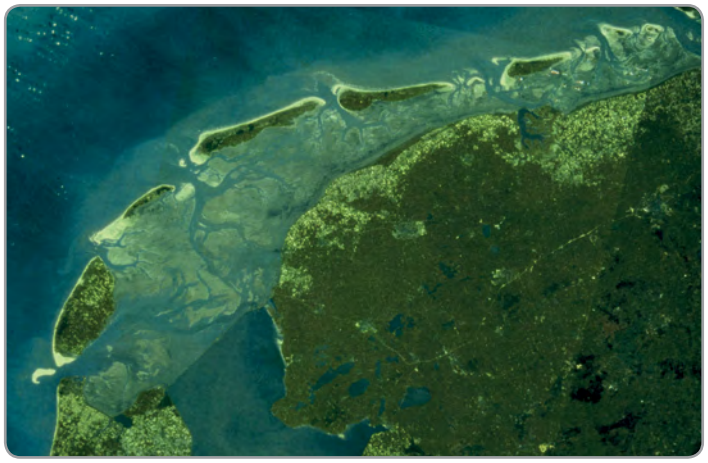
Modelling bird food sources, habitats and ecosystem services is possible by using Earth Observation.

The challenge

The Wadden Sea is an internationally relevant, highly productive estuarine area, and globally, one of the largest coastal wetlands in existence. Its diverse characteristics provide fertile feeding, nursery and breeding grounds for various species. Numerous ecosystem services are provided to humans through its diversity, functionality and aesthetics. However, in recent years increasing pressures have led to multiple changes in the area, for example the number of migratory bird species has decreased, and the area of spawning grounds for critical fishery species has been impacted. Earth observations help to monitor these issues and determine trends and potential pressure impact zones, particularly through the use of the new Sentinel series of satellite imagery, with the aim of nature conservation and monitoring ecosystem functioning.

The space based solution

Models such as 3D-biogeophyiscal process-based and Bayesian Networks help to investigate ecological structures behind shifting trends and provide a foundation to evaluate and forecast the impact of potential management strategies. Direct outputs such as maps of indicators generated by Delft-3D modelling suite and impact assessments developed through expert analysis are used by municipalities, and government agencies to evaluate regional productivity and species habitability throughout the Wadden Sea. Satellite images can be processed to detect areas with high mussel and cockle abundance, or the algae and phytoplankton which they feed upon; this can be used in the validation or support of modelling efforts or as stand-alone monitoring products as provided by the COPERNICUS platform. When these images are included in 3D models through the use of data assimilation methodologies (either automated calibration or state-updating), enhanced predictions on system trends and the dynamics within the Wadden Sea can be made. By incorporating the policy and management strategies into the modelling regime, impacts of the strategies on various ecosystem services and functions can be deduced by interpreting the resulting indicators. Additionally, Earth observations used by national and regional monitoring agencies can be used in conjunction with statistical modelling activities, such as Bayesian Networks, which are able to describe ecosystem services and highlight their potential trade-offs through probabilistic impact relationships. These networks are trained with a combination of remote sensing data and an ensemble of model outputs which aim to capture the impacts of management scenarios. This generates relationships between proposed policy and expected outcomes based on data.



Composite optical remote sensing image of the Dutch Wadden Sea, highlighting the intertidal mud flats.
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Benefits to Citizens

Without data from satellite missions and complimentary in-situ measurements, model development is limited; these data sets are critical for the foundation of Bayesian Networks. Satellite images provide information on vital proxies to quantity ecosystem services,

Thematic Area: BIODIVERSITY AND ENVIRONMENTAL PROTECTION

Region of Application: FRIESLAND GRONINGEN

Sentinel mission used: S1 S3

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trade-offs, and management strategies' impacts over time, helping inform on the decrease of birds whilst simultaneously providing data on key ecological indicators. Earth observation is much more cost-effective and less time consuming than monitoring programmes which require expensive vessels to conduct missions. Satellite images record near real-time observations; resulting maps are used to visualise and explain trends to policymakers. Moreover, space-based observation allows users to acquire continuous spatio-temporal data, improving the overall monitoring practices in the Wadden Sea. Earth observations, derived products and models used for the Wadden Sea support decision making and inform measures to protect and conserve this unique ecosystem.

One of the many nesting avian species residing in the Wadden Sea.

"Copernicus products provide us with vital marine ecosystem information which allows us to enhance our models and monitor ecologically relevant proxy variables in order to inform and advise policy directives and management."

Deltares

Outlook to the future

The development of ecological models based on satellite observation assists in the development and verification of the suitability and optimisation of managerial strategies. More accurate predictions will be possible thanks to higher data availability and the coupling of said data with predictive modelling techniques. More on this work can be found at http://www.ecopotential-project.eu/

Acknowledgements

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