Monitoring swimmer safety

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Type: Web Application

Project Phase: Operation and Maintenance

Purpose: Assessing swimmers safety as a result of morphological alterations, such as nourishment

Requirements: Knowledge on hydrodynamics

Relevant Software: Google Earth plug-in, compatible Browser (eg. Google Chrome)

About

Please note that this website is currently not running, but the principle and method can be applied to monitor other locations.

In the Netherlands, on average five people per year drown in the surf zone and in most cases rip currents play a role in these accidents. Rip currents can form spontaneously and suddenly in the surf zone, but they usually occur when waves break over a sand bar, water “piles up” between the bar and the beach, and flows out through gaps (rip channels) in the sand bar. Offshore directed velocities of over 1 m/s can be reached, which makes a rip current difficult to counter, even for adult swimmers. The website www.muienradar.nl provides daily predictions of swimming conditions for the beach of Egmond. The predictions are based on model computations of nearshore tidal, wind- and wave-driven currents. The prediction system provides lifeguards and beach visitors with information about the swimming conditions, with special attention to the occurrence of rip currents.

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Nourishments, and especially concentrated mega-nourishments like the Delfland Sand Engine, alter the morphological state of a beach. The wind, waves and tides have full play on the sand that becomes available, leading to the development of new sandbars, rips and feeder channels. Because of the modified coastline and the new and dynamic bottom features, the currents in the nearshore zone will differ from those in the natural situation. This may lead to less safe or even unsafe situations for swimmers.

In assessing the safety of bathing conditions, lifeguards typically rely on their experience and expert judgement. The daily routine at a lifeguard post is to judge the wave and weather conditions in the morning and decide which safety measures to take for the day. Once a mega-nourishment has dramatically changed the coastal system, the lifeguards loose (part of) their largely empirical knowledge base. In addition, the position of the sandbars and rip channels changes continuously due to the strong natural dynamics. This variability further complicates beach surveillance and bathing safety assessment. Overall, the predictability of swimmer safety around a mega- nourishment can be said to be less than before, until the nourishment has spread along the coast and the coastline has become more or less straight again.

5 Basic steps towards Building with Nature

Related Building solutions

Coastal buffer zones

Feeder beaches

Managed realignment

Perched Beaches

Related Projects

Adaptive monitoring of sand extraction areas - Maasvlakte 2 extension, NL

Sand nourishment - Hondsbossche Dunes, NL

Sand nourishment - Sand Engine Delfland, North Sea, NL

Related Tools

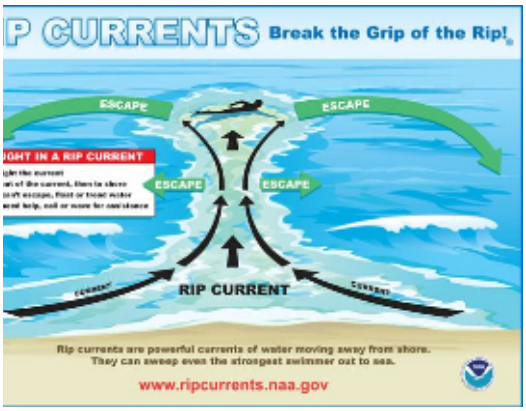
Geographical data and knowledge management - OpenEarth

Interactive group modelling - MapTable

Morphological predictor for mixed beds

Nearshore wave transformation table

Remote monitoring of bio -and morphological developments - ArgusBio



The introduction of a forecasting system for nearshore hydrodynamic conditions (partly) re-establishes the predictability of swimmer safety. It is the basis of a warning system which informs lifeguards, authorities and the public about when and where to expect dangerous currents and the associated hazard level. Sections of the beach where this level is too high can subsequently be closed off for swimmers or closely be monitored by the lifeguards. Thus, the system enables an efficient allocation of human resources, education of the public and possibly prevention of drowning accidents.

BeachWizard

A key component in developing a reliable nearshore hydrodynamic model is the availability of local up-to-date bathymetrical data. After all, the location and strength of the type of rip currents considered herein are to a large extent governed by the shape and height of the sand bars. Routinely surveying the bathymetry, however, is a costly matter. In the present project it is attempted to derive real-time bathymetrical data from Argus video imagery. The methodology to convert Argus images into an estimate of the bathymetry is called BeachWizard and is based on analysis of the wave breaking patterns (albedo in time-exposures derived from the video images). The BeachWizard technique was previously developed and tested in manual mode for the beach of Egmond. Testing and validation of the automated operational BeachWizard system for Egmond is currently in progress. More information on BeachWizard can be found in Dongeren 2008.

How to Use

The website Swimmer Safety Egmond is accessible through www.muienradar.nl. The only requirements for using the website are an internet connection and installation of the Google Earth plug-in (will automatically be indicated when needed). The website is known to encounter problems when accessed with Internet Explorer. For best visualisation, the use of Google Chrome is advised.

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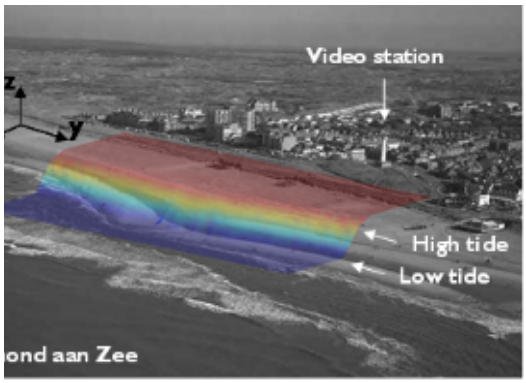
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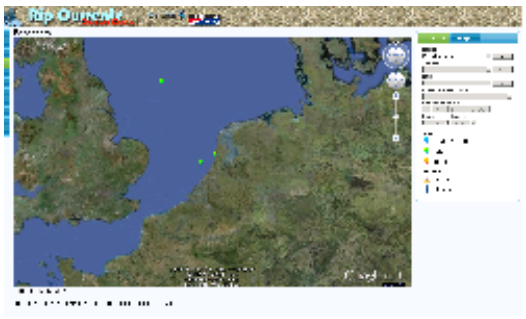

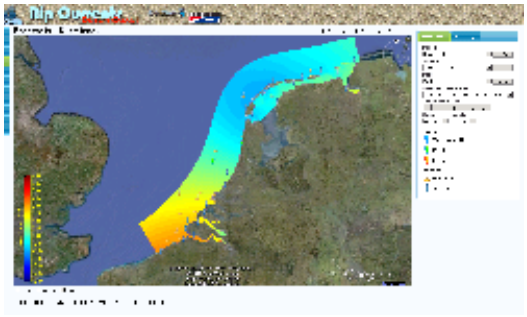

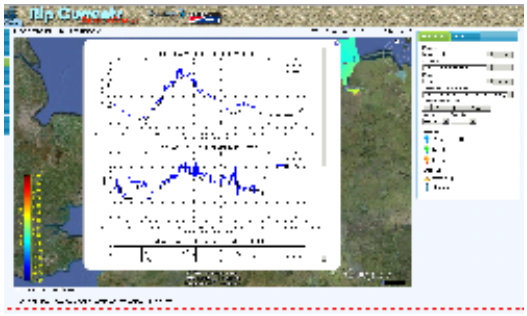

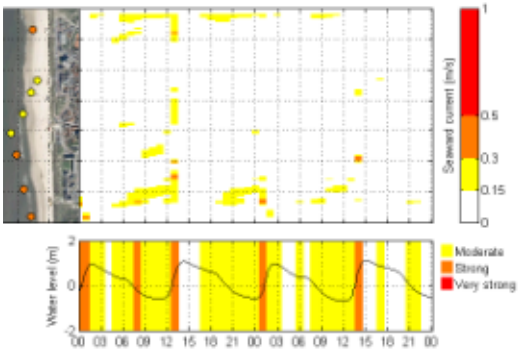

Functionality

The muienradar ('rip current radar') website provides general background on rip currents, gives an introduction to the CoSMoS model system and presents the 2-day hydrodynamic forecast for Egmond beach in a Google Earth viewer. Under the real-time forecast, the user can select for which model the results will be visualized. Subsequently, he can inspect the forecast data in map view and animate the results in time. For selected observation stations, timeseries of the model predictions can be inspected and the model performance can be assessed compared to field observations. Please note that it may take a while to load some of the larger model data sets.

At the most detailed model level, the offshore directed current velocities are translated into rip current warnings. If a certain threshold is exceeded, a warning marker will appear on the map at the rip current location. In the present setup, velocities between 0.15 and 0.3 m/s are considered a moderate rip strength, velocities between 0.3 and 0.5 m/s a strong rip strength and velocities above 0.5 m/s a very strong rip strength. A time-stack with offshore directed current magnitudes along the coast shows where and when rip currents are to be expected and allow for a quick inspection by the lifeguards.

It should be noted that the warnings do not define swimmer safety in general, but only give a measure of the absolute current magnitudes. Clearly, the risk to an individual person strongly depends on his/her level of fitness and environmental conditions, such as water temperature and wind direction. Therefore, the presented warnings are not meant to replace the judgment of the lifeguards or of the beach visitor but can be used as an additional source of information.

Demo

A demo of the muienradar can be seen here:

ripcurrents04.wmv

Practical Applications

The muienradar website is in first instance intended for use by lifeguards and other authorities involved with swimmer safety on beaches. The predictions of the nearshore hydrodynamics are yet to be fully validated and more experience with the forecast system needs now to be gained.

1. Egmond Beach
2. Other applications

>> Read more

Egmond Beach

In a pilot study, a forecast system for Egmond Beach was set up. The lifeguards of Egmond aan Zee have identified a strong rip current as the biggest risk for swimmers on this beach. This rip current is located in a channel that interrupts the sand bar just north of the lifeguard station. In the summer of 2010, the lifeguards attributed the rescue of 16 people to this single rip current. Therefore, they feel the need to reduce the risk arising from this rip current.

The forecasts for Egmond Beach are produced with the fully automated Coastal Storm Modelling System (CoSMoS) developed by Deltares. CoSMoS is a Matlab-based shell, which schedules jobs to download real-time data from online databases, pre-process model input, start model simulations, post-process the output and send the results to a website. The workflow of CoSMoS consists of the main loop governing the job scheduling and facilitating data downloading and storage, whereas the model loop controls the different, possibly nested, model simulations. The interval of the main loop depends on the availability of forecast data and duration of model simulations and is 24 hours for the Egmond application. The forecast window depends on the available model boundary data (i.e. meteorological input) and is 2 days for this case.

To achieve sufficient model resolution in the nearshore zone, a nested model train is used. The different models incorporate the effect of tides, waves and meteorological forcing. After running the model loop, the results of the detailed computation are presented as map fields, time series and dedicated rip current warnings. To generate the warnings, the offshore directed current velocities are translated into rip current strength and location and presented as time-stack images. The post-processed model results and warnings are automatically published on the website www.muienradar.nl, where they are visualized in a Google Earth viewer. The compressed model results will in future also be stored on the OpenDAP server for public access.

Other applications

Real-time predictions of nearshore hydrodynamics may be of value in coastal applications other than swimmer safety. Parties interested in nearshore predictions can for instance be:

- Coastal zone managers who wish to monitor coastal erosion, beach maintenance, recreation, flood hazards;
- Harbour authorities who want to monitor navigation safety;
- Contractors and dredging companies who work in the coastal zone and need to schedule works and assess environmental impacts.

The requirements for a new application are:

- Development of a model system, or, if larger-scale ambient models are available, a detailed local model;
- Development of a dedicated website;
- (Network of) PC(s) with sufficient computational capacity and internet infrastructure;
- Preferably in-situ measurements for validation of the model predictions, or even data-assimilation;
- In case the local bathymetry is dynamic and not routinely surveyed, an (Argus) camera system can possibly be a solution to monitor the morphology.

The average beach visitor has little knowledge about rips and is usually unable to identify these dangerous currents. In future, the website can therefore also serve as a tool to educate and warn the public. To reach a larger community, the warnings can be distributed through mobile apps, local television stations, at hotels and camp sites or on information panels.

Lessons learned

- Involve the end users from the start of the project in the development of the website in order to meet their requirements;
- ‘Ease of access’ and ‘simplicity’ are two key requirements to achieve integration of the forecasts in the daily routine of the lifeguards.
- Pay attention to the IT facilities at the client side; an inferior internet connection, low screen resolution or slow PC can affect the performance and user perception of the website;
- The end users are not necessarily familiar with understanding model results and valuing model uncertainties. Communication and education on how to interpret the forecasts is crucial to make the project successful.

References

>> Read more

Literature

- Dongeren, A., Plant, N., Cohen, A., Roelvink, D., Haller, M., Catalan, P. (2008). Beach Wizard: Nearshore bathymetry estimation through assimilation of model computations and remote observations
- Schlooz, G. (2012). Convex coastline induced rip currents at the Sand Engine Delft University of Technology, M.Sc. Thesis
- Swinkels, C. (2012) Assessment of the hydrodynamic modelling of rip currents at Vlugtenburg. Deltares report 1204386-000
- Winter, G. (2012). Rip current characteristics at the Dutch coast: Egmond aan Zee. Delft University of Technology, M.Sc. Thesis

Presentations

- Pilot study Forecasting Swimmer Safety, *Rip Current Symposium*, 2012.
- Estimation of Bathymetries from Remote-Sensed Images for Real-time Forecasting, *Rip Current Symposium*, 2012
- Field Observations of Rip Currents in Wind-sea Dominated Environments, *Rip Current Symposium*, 2012
- Nearshore Operational Model for Rip Current Predictions, *AGU*, 2012.

Links

- Cosmos website
- Muienradar website