



The Ministry of Environment,
Sustainable Development,
Disaster and Beach
Management of Mauritius



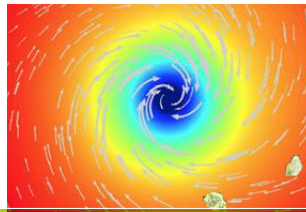
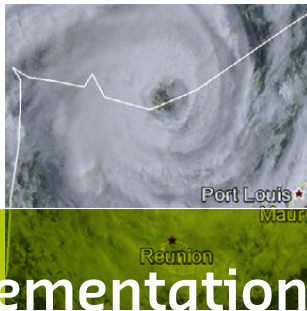
The Mauritius
Meteorological
Service



ADAPTATION FUND

Deltares

Enabling Delta Life



Implementation of an Early-Warning System for incoming storm surge and tide in the Republic of Mauritius

Summary

The Republic of Mauritius is the first Small Island Developing State (SIDS) in the Indian Ocean with its own tide and storm surge Early-Warning System for improving preparedness and resilience to events like cyclones.

The EWS was implemented in the context of the Climate Change Adaptation Programme in the coastal zone of Mauritius to increase the climate resilience of the coastal communities and funded by the Adaptation Fund.

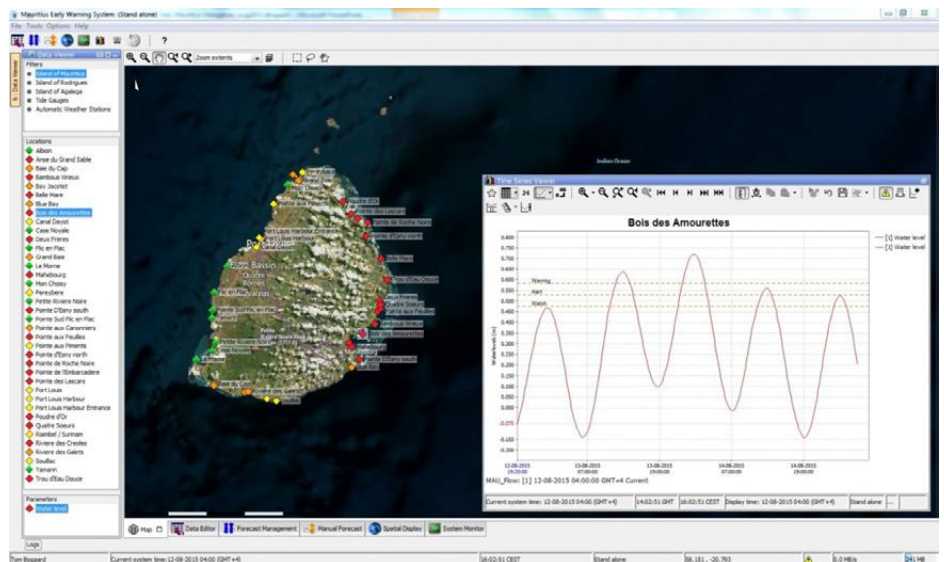
The storm surge model was developed together by Deltares and the Ministry of Environment, Sustainable Development, Disaster and Beach Management. It predicts where and when a storm surge is to be expected. The prediction is produced every six hours and covers a period of three days. This gives authorities enough time to evacuate the area. The storm surge prediction model covers the islands of Mauritius, Rodrigues and Agalega.

The nation-wide forecasting system produces three-day forecasts every six hours based on the most recent weather forecasts and the tropical cyclone bulletins issued by the Joint Typhoon Warning Center. The system has been installed at the

Mauritius Meteorological Service (MMS) in Vacoas, Mauritius

Introduction

The Republic of Mauritius (ROM) is a group of several islands in the South West of the Indian Ocean, where some of these islands are located at distances greater than 350 km from the main island. As a Small Island Developing State (SIDS), the ROM is particularly



Snapshot from Early-Warning System: Water level timeseries (with thresholds) for Mauritius main island.

vulnerable to the adverse effects of climate change, especially in the coastal zone, where a convergence of accelerating sea level rise and increasing intensity of tropical cyclones will result in considerable economic loss, humanitarian stresses, and environmental degradation.

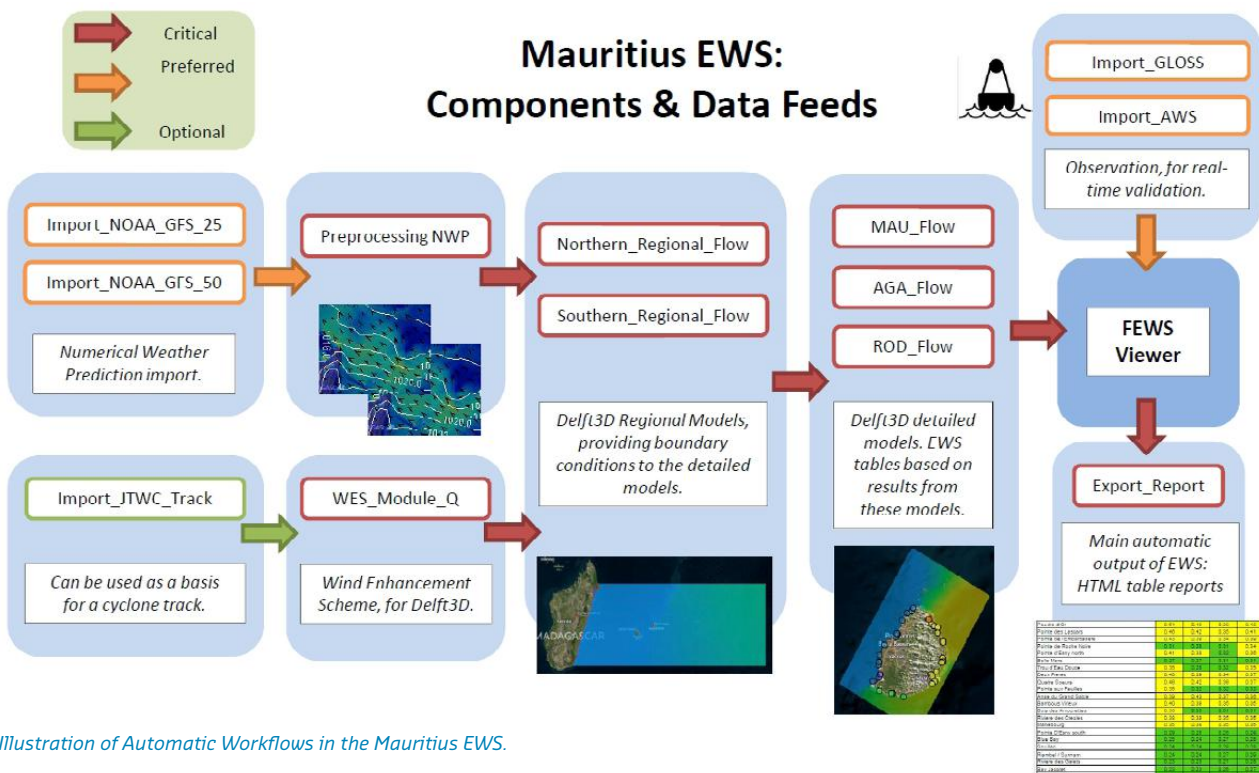
The visible and measurable effects of climate change in the coastal zone of the ROM have become more apparent over the last ten years. There is a direct linkage between climate change effects on coastal ecosystem services in particular coral reefs and lagoons and the integrity of the whole coastal zone of the ROM. As coral reefs are becoming increasingly vulnerable due to climate change, it is imperative that the critical ecosystem function of wave attenuation be envisaged. Adaptation therefore requires in situ changes in behaviour, site management, and appropriate technical interventions, as well as early warning systems that provide enough time for communities to move away from areas where the risk of storm surge and flooding is imminent. Storm surges and swell waves are expected to be aggravated through sea level rise and climate change effects on weather patterns. This will compound underlying trends of increasing coastal erosion and pressure on scarce land resources, and increase physical vulnerability of island populations, infrastructure and livelihood assets.

The Government of Mauritius has secured a grant from the Adaptation Fund Board (AF) for the implementation of the project "Climate Change Adaptation Programme in the Coastal Zone of Mauritius". This fund, set up under the Kyoto Protocol of the United Nations Framework



Convention on Climate Change, is targeted to assist developing-country parties to the above protocol that is particularly vulnerable to the adverse effects of climate change in meeting the costs of concrete adaptation projects.

The Ministry of Environment, Sustainable Development, Disaster and Beach management granted "The implementation of an Early Warning System for incoming storm surge in the Republic of Mauritius" (EWS for ROM) project to Deltares.





Participants in the national Inception Workshop in Port Louis, Mauritius, to discuss this Early-Warning System (January 2015). Relevant stakeholders contributed, from different islands.

timely and safely in case of predicted extreme water levels.

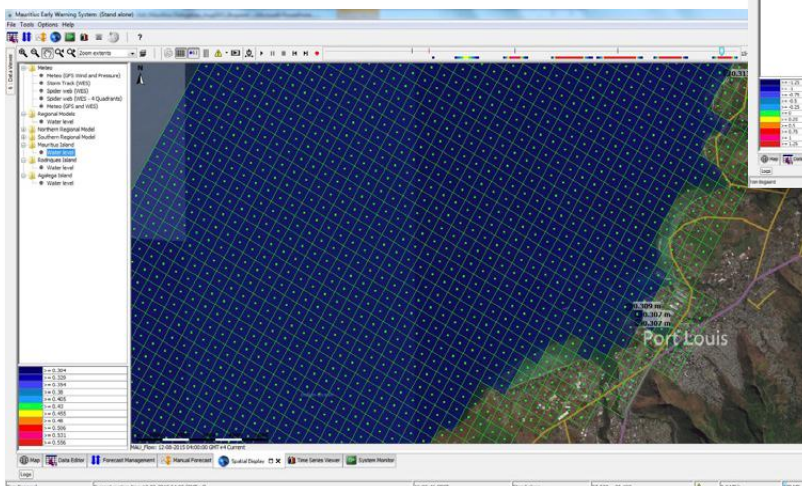
The project started in October 2014 and was completed in August 2015. It comprised several phases (inception, assessment, system design, implementation and capacity-building) during which Deltares' expertise and software were adjusted to the local desires and needs. Active participation in several workshops in Port Louis, Mauritius by Deltares specialists to meet and discuss with important stakeholders and system end-users was instrumental.

The Mauritius Early-Warning System for storm surge and tide was implemented using software from Deltares' Open-Source and free software Community, <http://oss.deltares.nl/>. A set of five 2DH Delft3D hydrodynamic models are run every six-hours with a forecast horizon of three days, simulating coastal water levels along the coast of the three main islands. Two regional models of horizontal resolution 5km force the three detailed models of 500m resolution; all models are forced at the surface by the 0.25° NOAA/GFS meteorological forecasts. In addition our Wind-Enhancement Scheme (WES) is used to blend detailed cyclone track bulletin's info with the larger-scale Numerical Weather Predictions. Further, data

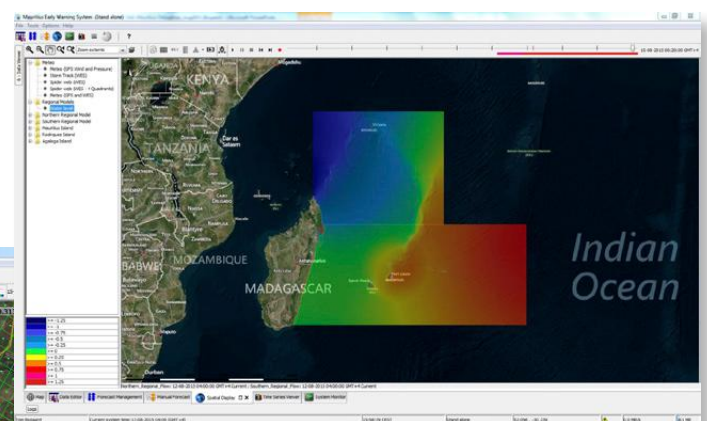
The immediate cause to develop such a system was the need felt by local authorities, the Mauritius Meteorological Services and the National Disaster Risk Reduction and Management Centre (NDRRMC), to have a high-quality tailor-made forecasting system to enable more effective preparedness and issuing of alerts. Major beneficiaries will be the coastal communities who will receive timely alerts (up to three days in advance) when a storm threatens flooding their part a certain island. It is expected that future loss of lives will be avoided due to tropical storm flooding, and that authorities are able to deploy limited resources in a more optimal way.

The Mauritius Early-Warning System

During this project, the team developed and implement operationally a fully-automated Early-Warning System for incoming storm surge and tide for the Republic of Mauritius, such that coastal communities in Mauritius, Rodrigues and Agalega Islands are able to evacuate



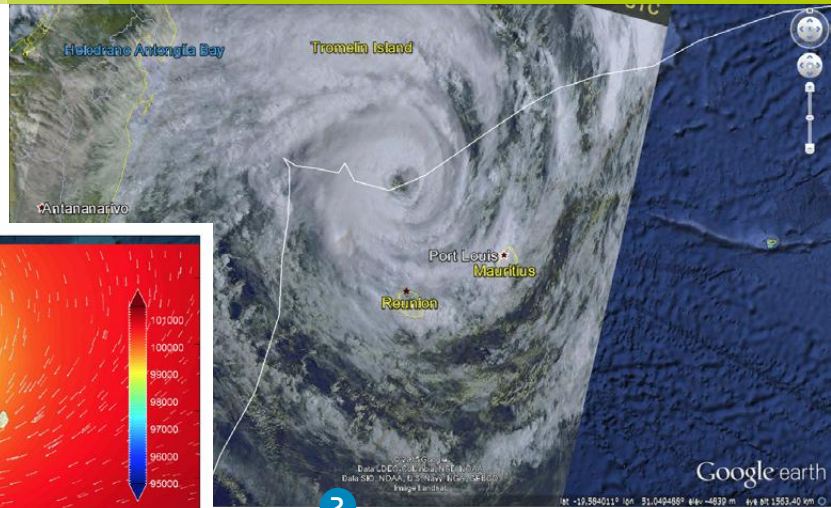
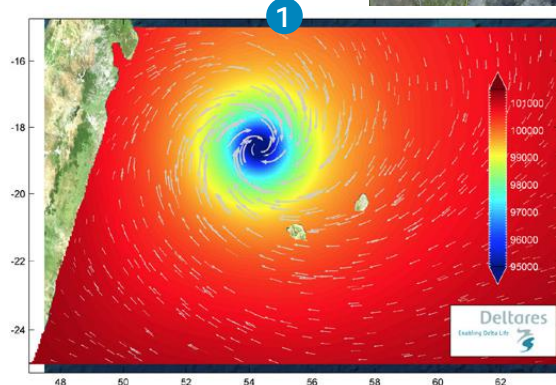
Snapshot from Early-Warning System: Detailed model grid near Port Louis, Mauritius.



Snapshot from Early-Warning System: Water levels on the two larger, regional hydrodynamic models.

Snapshot from Early-Warning System: Cyclone Gamede ① as represented in the EWS, and ② satellite image superimposed on GoogleEarth.

(source satellite image <http://www.meteo-spatiale.fr>).



is retrieved near real-time from available Automatic Weather Stations. All these workflows are managed by the operational platform software, Delft-FEWS.

Delft-FEWS is an open data handling platform initially developed as a hydrological forecasting and warning system; it is a sophisticated collection of modules designed for building a hydrological forecasting system customised to the specific requirements of an individual organisation. Because of its unique characteristics concerning data importing and processing and model connections, Delft-FEWS has also been applied in a wide range of different operational situations.

Delft3D is a world leading 3D modeling suite to investigate hydrodynamics, sediment transport and morphology and water quality for fluvial, estuarine and coastal environments. The software is used and has proven his capabilities on many places around the world, like the Netherlands, Italy, USA, Hong Kong, Singapore, India, Indonesia, Australia, Brazil, etc. The FLOW module is the heart of Delft3D and is a multi-dimensional (2D or 3D) hydrodynamic (and transport) simulation programme which calculates non-steady flow and transport phenomena resulting from tidal and meteorological forcing on a curvilinear, boundary fitted grid or spherical coordinates.

The end-product of the Mauritius Early-Warning System is a set of intuitive tables in HTML format for each island, containing time- and space-varying information on threshold crossings by predicted water levels. At multiple locations for each island, the operator is informed in one glance about the recommended preparedness level, from "Safe" to "Watch," "Alert" or "Warning" based on water level forecasts. The HTML page was designed together with the MMS and the NDRRMC, in order to be easy to interpret and disseminate by local authorities.

Future developments

Post-project, in September 2015, a Mauritian delegation visited Deltares in Delft including high-level representatives from the Ministry for the Environment and Sustainable Development, from the Mauritius Meteorological Service, and from the National Disaster and Risk Reduction Management Center. There were discussions on inclusion of wave modelling in the EWS, about best practices for disaster risk reduction and about dissemination of early warnings.

More information: zks-info@deltares.nl

More on:

<https://www.deltares.nl/en/news/cyclone-storm-surge-forecasts-for-mauritius/>

<http://www.govmu.org/English/News/Pages/Early-Warning-System-for-storm-surge-set-up-before-next-cyclonic-season.aspx>