

Marine Flood Forecasting

A tool to help build resilience against climate change for communities along reef-lined coasts

Dr. William Skirving (NOAA, ReefSense), Dr. Curt Storlazzi (USGS), Dr. Robert McCall (Deltares), Dr. Ap van Dongeren (Deltares)
Dr. Derek Manzello (NOAA), Dr. Emily Smail (GEO Blue Planet), Dr. Isa Elegbede (GEO Blue Planet)

WaveFoRCE: Wave-driven Flood-forecasting on Reef-lined Coasts Early warning system



Tuvalu 2015 World Bank Traveller on WordPress.com



Kiribati Jonas Gratzler



Maldives 2020 Ahmed Nashiz



Marshall Islands 2008 USGS

What is WaveFoRCE?

- Marine flood forecasting system.
- Forecasts out to 10 days (240 hours) at hourly intervals, updated every 6 hours.
- Forecasts at points every 200m along every coral reef-lined coast in the world.
- WaveFoRCE will provide forecasts and historic flood data for:
 - Fair-weather wave-driven flooding
 - Storm surge
 - Extreme high tides
 - Climate driven inundation

Who will benefit from WaveFoRCE flood forecasts?

- 84 countries (not including the USA)
- 90% (43 out of 48) of the UN Small Island Developing States (SIDS).
- 26% (12 out of 46) of the UN Least Developed Countries (LDC).

Why is WaveFoRCE needed:

- Marine flooding is already a serious problem for most low-lying coasts
- Marine flooding is becoming more severe and more frequent due to climate change:
 - e.g. the Republic of the Marshall Islands has experienced 10 serious flood events over the past 30 years; 2 in the first 15 years and 8 in the last 15 years.
- Historic data and flood forecasts are necessary to build resilience against:
 - Loss of life
 - Loss of or damage to property, infrastructure and crops
 - Loss of habitable and farm land via erosion, salt intrusion and inundation
 - Loss of fresh water reserves via salt intrusion

WaveFoRCE accuracy:

WaveFoRCE has been tested at 36 different coastal sites within 8 different regions scattered from Guam to the US Virgin Islands.



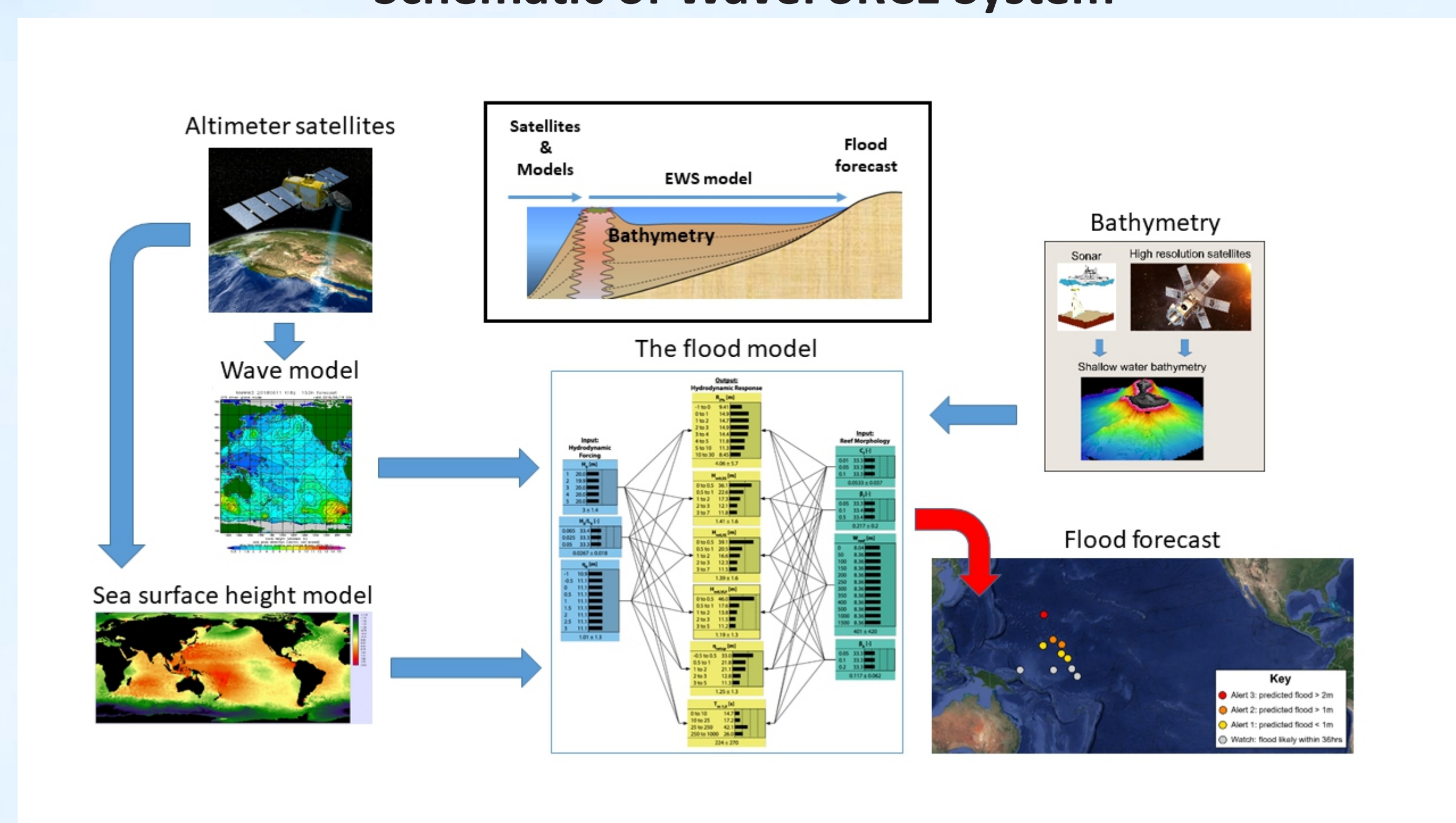
On average, WaveFoRCE has an 8% error for predicting flood levels when compared to a fully implemented high resolution model (i.e. Xbeach).

UNFCCC National Action Plans:

WaveFoRCE provides information on historic flood events, enabling communities to assess vulnerabilities and identify gaps and needs at national and regional levels. This information will also allow for planning of social and engineering measures that will enable adaptation and build resilience. WaveFoRCE flood forecasts can then be used when implementing these plans, while the WaveFoRCE now-casts will provide valuable information that can be used during reporting on the effectiveness of these plans.

More specifically, WaveFoRCE will provide valuable data for various aspects of a National Action Plan, including: Assessment of Adaptation Needs; Implementation Strategies; and Reporting, Monitoring and Review.

Schematic of WaveFoRCE System



The box at the top center shows how the system is broken into three parts. The satellites and models provide wave height and sea surface elevation forecasts (left three items in schematic); note that the bathymetry is predetermined (top right of schematic); WaveFoRCE then takes these inputs and compares them with the precalculated flood levels (lower center of the schematic); and produces a flood forecast that is then output in a fit for purpose manner (bottom right of schematic).

Before and After flood photos



From left to right:

1. 2005, Tarawa, Kiribati. House flooded from the lagoon side of atoll.
2. 2014, Nanoiaki, Kiribati. Flood waters surround house and damage crops and wells.
3. 2008, Majuro, Marshall Islands. Flood waters over-wash entire island.
4. 2008, Majuro, Marshall Islands. Severe fair-weather flood event.

The Guardian article by Remi Chauvin and Eric Hilaire

Images provided by: NTNK Video, Matua Kamori, and The Marshall Islands Journal.

<https://www.theguardian.com/environment/ng-interactive/2015/mar/11/climate-change-in-the-marshall-islands-and-kiribati-before-and-after-interactive>

The WaveFoRCE team:

- National Oceanic and Atmospheric Administration (NOAA)
- US Geological Survey (USGS)
- Deltares
- Supporting agencies:
 - GEO Blue Planet
 - Commonwealth Scientific and Industrial Research Organisation (CSIRO)
 - Pacific Community (SPC)
 - ReefSense

WaveFoRCE provides historic and forecast marine flooding information that is necessary for the development of effective adaptation plans and to design engineering solutions to build resilience against marine flooding and its effects for communities living on low lying reef-lined coasts.



<https://waveforce.online>
william.skirving@noaa.gov

