Geophysical Research Abstracts,
Vol. 11, EGU2009-4934, 2009
EGU General Assembly 2009

Two-dimensional modelling of overwash at Santa Rosa Island during Hurricane Ivan

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Approximately 10% of the world's coastline consists of low-lying barrier coasts, which are susceptible to coastal flooding, dune overwash and breaching. Although several numerical cross shore models exist to calculate beach and dune profile change during storms, overwash and breaching are not necessarily incorporated. Additionally, these models assume longshore uniformity and therefore do not include longshore variation in for instance dune height, shoreline angle and wave conditions.

In order to simulate overwash on a barrier island we use a new numerical model for the nearshore and coast called XBeach (Roelvink et al., ICCE 2008). This process-based and time dependent model solves coupled short and long wave propagation, sediment transport and morphology in 2DH. The model has a robust numerical scheme, allowing it to simulate flooding and drying, thereby removing the need for separate dry and wet domains and procedures.

XBeach is used to model a section of Santa Rosa Island, Florida, during Hurricane Ivan in 2004. This island was heavily overwashed during the hurricane and breached in one location. The model is set-up using high resolution airborne LIDAR altimetry and bathymetry data and forced using surge and wave data from larger scale numerical models. The modelled final bed elevation is compared to airborne LIDAR data acquired three days after the storm.

The results show that XBeach is capable of simulating the complex hydrodynamics that occur during extreme overwash events. It is shown that the model can recreate the morphological developments that occurred on the island during the storm and that the model has considerable quantitative skill in predicting the final bed elevation.