IMPROVING OPERATIONAL WAVE MODELLING FROM SATELLITE MEASUREMENTS

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ABSTRACT

Modelling and forecasting sea-state is of great importance for many issues related to the safety of people and goods. Global Numerical Sea State Prediction (NSSP) models are operational in many National Weather Services (NWS) to provide sea state forecasts and analyses. Altimeters offer the opportunity to sample wave height measurements over the whole ocean surface with high accuracy and coverage. At global scale, a limited area model was implemented at la Reunion in 2006 with hurricane conditions. The purpose of this study is to assess the performances of some operational wind and wave models at global scale. Here, at regional scale in areas of occurrence of tropical cyclones, using all appropriate surface data from satellite sensors. Winds from several Numerical Weather Prediction models are evaluated and compared with satellite wind measurements (scatterometers, radars), and blended winds, merging model and scatterometer wind fields. For instance, the atmospheric models tend to underestimate wind, especially for high wind conditions, compared to the remotely sensed data. Such underestimate may exceed 5m/s. Because winds from tropical cyclones are very strong (above 65 kn), the drag formulation has been also revised. The case of GAMEDE, a tropical cyclone in the Indian Ocean in February 2007 has been carefully documented and analysed.

MOTIVATIONS

• Meteo-France is currently implementing a global 3rd generation (3G) model (WF-MAM), derived from ECMWF (ECMWF/WAM) model and is testing new parametrisations under development for the 4th generation (4G) model.
• A tropical cyclone event (GAMEDE) during winter 2006/2007 highlighted the limitations of wind and wave models in high wind conditions. The drag formulation has been revised. The case of GAMEDE, a tropical cyclone in the Indian Ocean in February 2007 has been carefully documented and analysed.

QUESTIONS

• Can winds from NWP models be used to forecast waves for Hurricane conditions (ECMWF, ARPEGE, ALADIN), instead of analytical models?
• Can global wave model catch hurricane wave states?
• Are 3rd generation wave models more adapted to such conditions, in comparison to 2nd generation ones?
• Is the wind drag formulation important at high wind speed?

EXPERIMENTAL SETUP

• One global domain and one limited area
• Hurricane analytical wind model
• Characteristics of hurricanes

MAIN RESULTS AND PERSPECTIVES

• Quality of the wind forcing is the dominant factor for hurricane sea-state modelling, as expected and the ALADIN-Reunion WAVE model (2D Boussinesq) is performing better than others WAM models we used. It is also true in the forecast period (Quilfen et al., 2009), however the wind structure asymmetry was not always well represented.
• The drag modification had a weak impact in our study (large hurricane case), in particular for MF-WAM, ALADIN (2007 version) and ALADIN HOLLAND (2008 version) models.
• Data from ENVISAT, JASON-1 and GFO satellites
• Because of the quick wind rotation in hurricanes (12h-leadtime), as expected and the RANKINE model performs similar results in a quarter + quadrant, whereas they are significant differences MF-WAM performs better.
• Small hurricane cases have to be investigated in the future and the wave model sensitivity to wind input frequency as well. Because of the quick wind rotation in hurricanes, the impact of exact non-linear interactions rather than DIA (Discret Interaction Approximation) has to be investigated as well.

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