BLENDING PARAMETRIC HURRICANE SURFACE FIELDS INTO CMC FORECASTS AND EVALUATING IMPACT ON THE WAVE MODEL FOR HURRICANE JUAN AND OTHERS.

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ABSTRACT

Currently, the Canadian operational version of WAM for the Atlantic is driven by the regional GEM model forecast 10 m level wind fields interpolated on a 0.5° latitude and longitude grid. Generally, when these forecast fields are good, the operational wave model also produces a good wave field forecast. However, the present operational data assimilation and forecast system often has difficulty representing and predicting hurricanes, leading to poor forecasts when the surface fields around the hurricane are used as input for models such as wave or a storm surge model. Despite the improvement of numerical models and mainly because of the high unpredictable nature of hurricane track, it is likely that human intervention will always be needed to correct the given numerical wind field used as input for these wind-driven models such as a wave or a storm surge model. In search of practical improvements in the shorter term, we propose in this study to blend parametric hurricane wind and pressure fields based on the Canadian Hurricane Centre trajectory forecasts into the operational surface fields used as input for the wave model. This is done through a system called SWIM (Surface Wind Interpolator and Modifier) which allows, for example, blending of the regional GEM model forecast wind and the parametric wind.

In this study we will briefly present some results of SWIM applied to the storm surge model and to the Canadian operational wave model for Hurricane Juan as a proof of concept. Results of SWIM will also be shown for other storm cases occurring during the 2004 hurricane season.

INTRODUCTION

At 12:10 a.m. ADT, Monday September 29, 2003, Hurricane Juan made landfall in Nova Scotia between Shad Bay and Prospect. (Bowyer,Peter, 2003 and 2004) Juan arrived as a Category 2 storm. The storm ripped northward through the province, weakening quickly as tropical cyclones do over land, arriving in Prince Edward Island as a marginal hurricane (Figure 1). The severity of the event certainly awakened people from the Atlantic region of our vulnerability to such meteorological phenomena and made the scientists aware that the cold water wall (colder water north of the Gulf Stream) that usually protects the Atlantic Provinces had some cracks in it.

Some work are currently in progress to incorporate a three-dimensional hurricane vortex in the initial conditions of the operational Canadian model GEM (Global Environmental Model) to improve its forecast accuracy in the presence of a hurricane (Figure 2). Although the 3D vortex insertion (McTaggart-Cowan, 2001, Kurihara, 1993 and Kurihara, 1995) shown, in general, improvements in hurricane forecast by numerical models, there are also cases where the "vortex bogussing" degrades the forecast (from disucussin during the 2and International workshop on Extratropical Transition, Halifax, Nova Scotia, November 17-21, 2003). Various studies seem to favor the data assimilation approach as the solution to get more constant improvement of hurricane forecasts by operational numerical models.

Despite the improvement of numerical models, hurricanes remain highly unpredictable and therefore, it is likely that human intervention will always be needed to correct the given numerical wind field used as input for these wind-driven models such as wave or a storm surge models. In Canada, the official hurricane forecast (track and intensity) is supplied by the Canadian Hurricane Centre (CHC). SWIM (Surface Wind Interpolator and Modifier) was developed to allow an operational blending of the regional GEM model forecast wind with hurricane parametric wind which follows the hurricane trajectory and the intensity forecast from CHC.

SWIM is a coupled system composed of an atmospheric feeder program supplying the pressure and the wind fields from GEM numerical outputs, two interpolator/communicator (INTERCOM) modules and wind driven model, or simply a receiver program which stores the modified atmospheric fields for further uses. When there is no hurricane, SWIM only acts as a spatial interpolator and communicator. In presence of a hurricane, the parametric wind model is run on a small domain following the hurricane. SWIM becomes a spatial and temporal interpolator. When a hurricane enters in the domain of the wet model, a blending process is applied and numerical surface fields having the presence of the hurricane results from it.

CONCLUDING REMARKS

For this study, SWIM was run with a receiver program which prepared the modified surface wind fields for the wave model WAM (WAMDI Group, 1988). Results from the wave model and the improvement of the wave forecast will be presented at the workshop.

In an operational mode, SWIM, if coupled with a wet model, will directly supply modified surface fields to this model allowing a quick solution from it in presence of a hurricane. In an ensemble mode, SWIM will allow running various simulations with different hurricane trajectory or intensity scenarios.

Further work will be done to implement SWIM operationally where it will be coupled with the Canadian WAM model and the MSC storm surge model.

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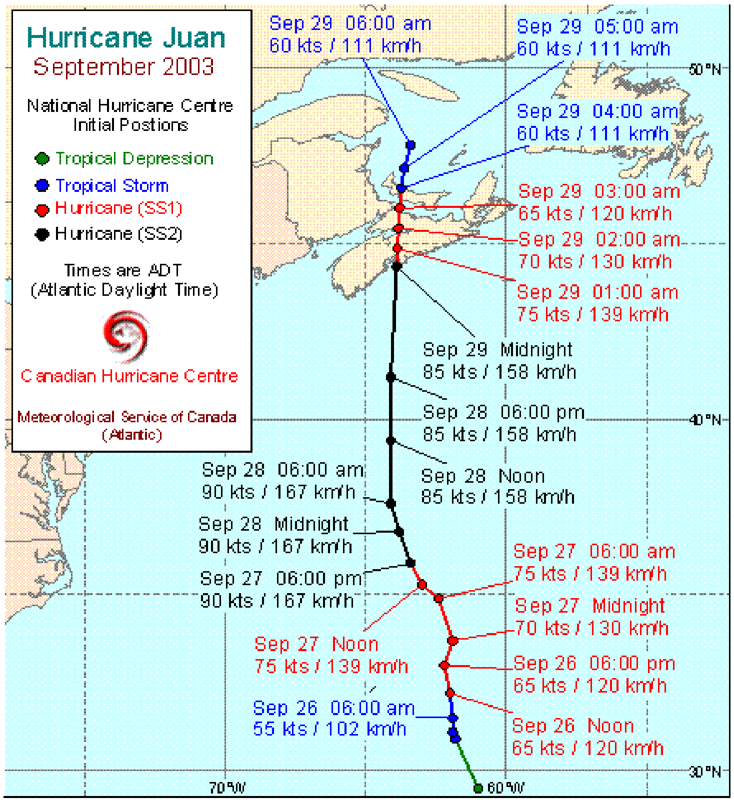

Figure 1 : Hurricane Juan trajectory from the Canadian Hurricane Centre.

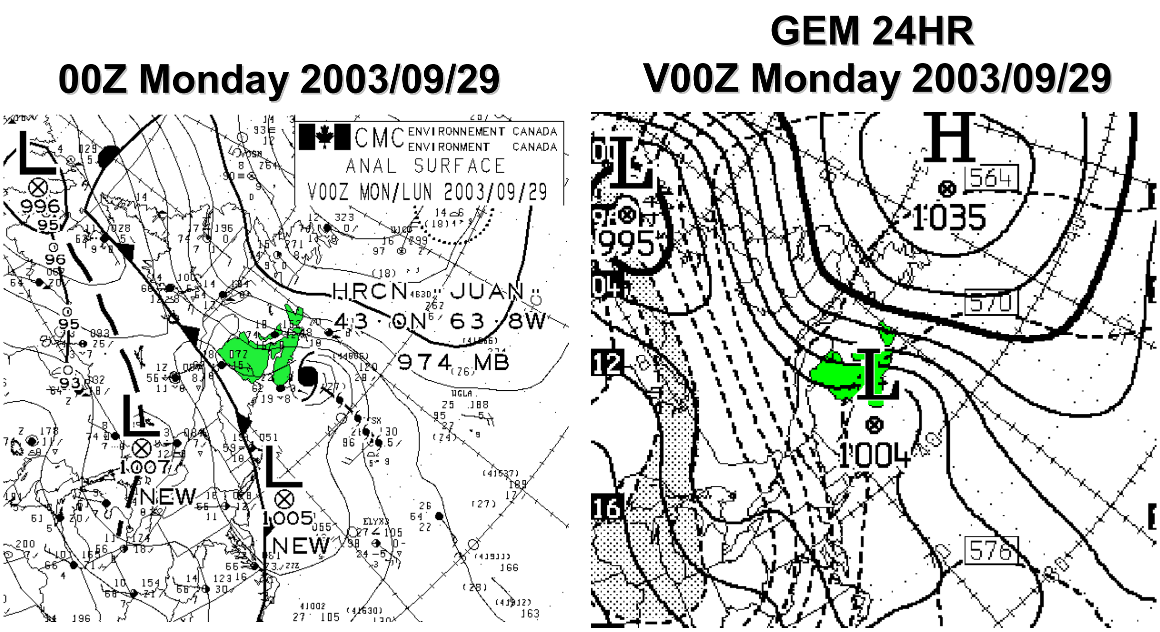

Figure 2: Canadian Meteorological Centre analysis versus the 24Hr GEM forecast valid at 0000 UTC on September 29 2003.

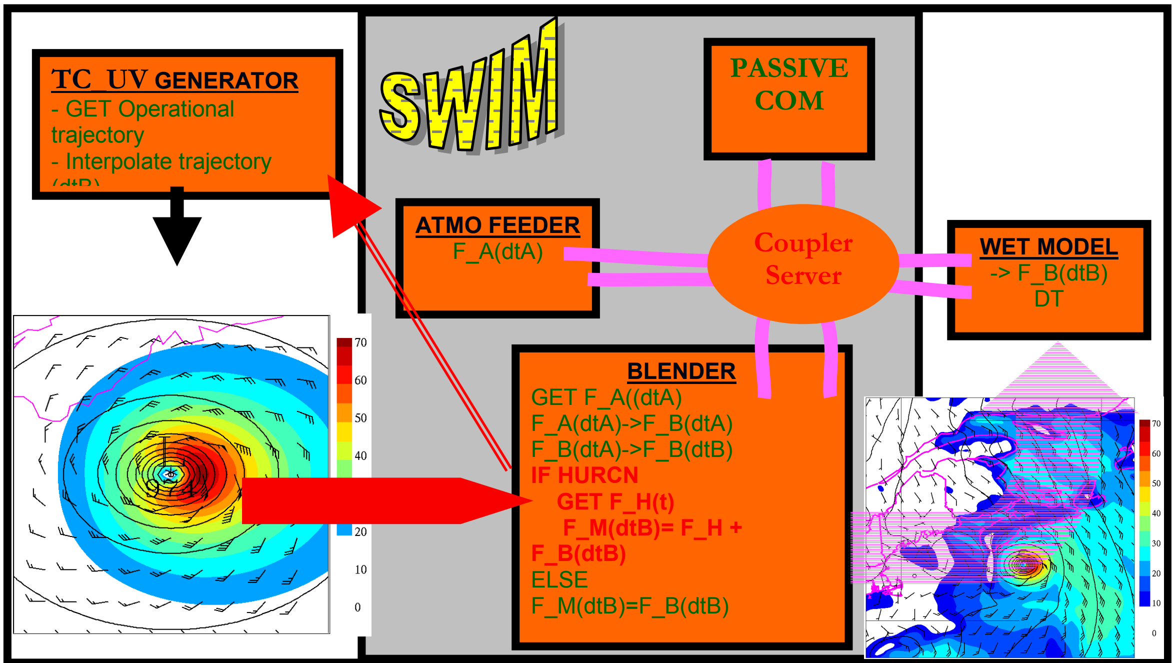

Figure 3: SWIM (Surface Wind Interpolator and Modifier), a coupled system to get surface wind field forecasts including a TC or hurricane signature.