Recent Developments in RPN Coupled Numerical Modelling

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The coupled numerical modelling group at Recherche en prévision numérique (RPN) is supporting research and development for environmental prediction based on coupling a variety of numerical prediction models. Much of this is being accomplished through the Atlantic Environmental Prediction Research Initiative (AEPRI) in Halifax, Nova Scotia, in collaboration with other government, industry, and academic partners. Significant progress has been made in projects particularly in collaboration with the Meteorological Service of Canada (MSC) - Atlantic, the Oceanography Department of Dalhousie University (Dal), and l'Institut Maurice-Lamontagne (IML) in Mont-Joli Québec. The main ongoing coupled modelling and AEPRI sub-projects are: atmosphere-ocean coupling via the NSERC/MARTEC/MSC Industrial Research Chair in "Regional Ocean Modelling and Prediction" in the Oceanography Department at Dal, coupling data assimilation and prediction systems for coastal applications, modelling the extratropical transition of hurricanes and typhoons (e.g., Ma et al., 2002), coupled atmosphere-wave models, coupled atmosphere/land-surface/hydrology models, coupling with estuary models, and developing expert systems for marine applications. Numerous Environment Canada (EC) scientists have gained valuable experience and made significant progress in projects in the areas of storm surge prediction, improved oil spill trajectory modelling, wave modelling, severe weather prediction, and streamflow prediction, including preparing some new and innovative forecast products which have been implemented.

In particular, a storm surge prediction system, in which the Dal coastal ocean model is driven by operational regional forecast model surface pressure and wind fields, was successfully tested in experimental mode at MSC-A (Bobanovic et al., 2002). Subsequently an operational storm surge prediction and alert system was transferred and implemented in the Maritimes Weather Centre in December 2000 and the Newfoundland Weather centre in January 2001. The alert portion notifies the duty forecasters of potential storm surge events. Based on the model output, NWP guidance, and observations, the duty forecaster may issue an advisory or a warning message for storm surge. The system proved effective several times since its implementation and has helped protect life and property during storm surge events. The storm surge prediction system has also been used to examine the increasing probabilities of flooding due to storm surge in a changing climate. This is part of a Climate Change Action Fund (CCAF) project in which AEPRI is playing a key role. The probable maximum storm methodology has been applied to the January 21, 2000 storm surge case, and the results have been diagnosed and included in the CCAF project report (Thompson et al., 2002).

The St. Lawrence Estuary is a relatively well observed and physically convenient "test-bed" for calibrating and validating many of the components of the environmental prediction system that is being developed. A related project at IML is entitled "Gulf of St. Lawrence Ice-Ocean-Atmosphere Climate Change, Detection and Impact on the Canadian Energy Sector". Through this collaboration we are helping improve the active coupling between atmosphere and ocean models and improve forecasts for maritime transport, search and rescue, and environmental emergencies. Following an initial study (Saucier et al., 2002) atmosphere, ocean and ice models are now completely coupled in a two-way interactive system. Experiments have demonstrated a significant positive impact of the interactions on the atmospheric precipitation and temperature forecasts in winter.

In another collaboration with IML entitled "Modèles atmosphérique et hydrologique couplés à l'échelle régionale: Région des lacs des Deux-Montagnes et Saint-Louis", an atmosphere-hydrology coupled modelling system has been validated on a 30-day period. This system consists of a distributed hydrological model (WATFLOOD 1 km), radar data (1 km), atmospheric model (35 km, 10 km and 3 km) and the IML hydrodynamic model. The first validation covers the hydrological basins contributing to the St. Lawrence River between Lachine and the Cornwall dam, Lac des Deux Montagnes, Lac St. Louis, and the Milles-Iles and des Prairies rivers between the St. Lawrence River and the Carillon dam (Outaouais River). This coupled modelling system is being used to improve radar data (collaboration with McGill University), to calibrate the hydrodynamic model (collaboration with IML), to prepare a system for forecasting the water level of the St. Lawrence River (collaboration with IML), and to validate and improve atmospheric model predictions.

AEPRI is becoming even more inter-disciplinary and is integrating activities amongst EC`s various sectors. For example, the SLICK oil spill model is being used to give support to a project to study birds oiled at sea, and the AEPRI partners are principal investigators in further projects on the prediction and mitigation of coastal flooding, as well as for a coupled atmosphere /ocean / biological / optical observing and prediction system to study pollution in coastal inlets. In this research project Dalhousie University, together with MSC and other partners, is developing the ability to observe and forecast physical, optical, and biological changes in the marine environment. Acquisition and construction of instrumentation are in progress for the coastal embayment component of this Marine Environmental Prediction System, and initial deployment is anticipated this spring in Lunenburg Bay, Nova Scotia.

Through this series of mutually beneficial collaborative research and development projects, partners are effectively leveraging limited resources to produce innovative and practical environmental prediction tools and products.

References

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