# Progress on an integrated marine Arctic prediction system for METAREAs

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In December 2007 Canada accepted official designation as the Issuing Service for meteorological Marine Safety Information (MSI) in the form of forecasts / warnings and ice bulletins for METAREAs XVII and XVIII as part of the Global Maritime Distress and Safety System (GMDSS).  These areas are in the Arctic bordering on Canada.  An important part of Environment Canada's involvement is the development of an integrated marine Arctic prediction system and satellite products in support of monitoring and warnings.  The integrated marine Arctic prediction system will feed into a highly automated information dissemination system.  In particular, our group is working on the development, validation and implementation of marine forecasts with lead times of 1 to 3 days using a regional high resolution coupled multi-component (atmosphere, land, snow, ice, ocean and wave) modelling and data assimilation system to predict near surface atmospheric conditions, sea ice (concentration, thickness, pressure, drift, ice edge), freezing spray, waves and ocean conditions (temperature and currents).  The core of the system is an Arctic extension of the highly successful Gulf of St. Lawrence (GSL, Faucher et al. 2010) coupled modelling system, with the GEM (Global Environmental Multi-scale) model as the atmospheric component coupled to the NEMO (Nucleus for European Modelling of the Ocean) ocean model and the CICE ice model. An ice-ocean data assimilation system is being developed in collaboration with Mercator-Océan using their SAM2 system for ocean data assimilation together with the 3DVAR ice analysis system developed at EC (Caya et al. 2010).  The following presents recent progress.

The GSL system has been running operationally at the Canadian Meteorological Centre (CMC) since June 2011. This system demonstrated the strong impact that a dynamic sea ice cover (Smith et al., 2012) can have on 48hr atmospheric forecasts leading to large changes in surface air temperature, low-level cloud cover, and precipitation. As a preliminary step for the METAREAs extension of the GSL system, the ocean model developed at the Maurice-Lamontagne Institute is being replaced by NEMO and initial evaluations indicate an equivalent performance.

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For the GEM model, a 4DVAR data assimilation system (Tanguay et al. 2011) has replaced the former 3DVAR system and the horizontal resolution of the operational Regional Deterministic Prediction System (RDPS) forecast model has been refined from 15 km to 10 km with a demonstrated improvement in forecasts, particularly over the METAREAs. These improvements were implemented operationally at CMC in October 2012.

The 3DVAR ice concentration analysis system has been operational at CMC since March 2011. Upgrades including assimilation of new passive microwave and scatterometer satellite data and an improved analysis-error standard deviation field for ice concentration were approved for experimental implementation at CMC in January 2013. A stand-alone high-resolution Regional Ice Prediction System (RIPS) for the Arctic has also been developed. This system is initialized using the 3DVAR ice analyses on a 5km North American grid (including the western Arctic) and produces daily 48hr ice forecasts, driven by the RDPS. Verifications demonstrate that RIPS produces a significant gain in forecast skill as compared to persistence of analyses. RIPS was approved for experimental implementation at CMC in March 2013.

A regional Arctic domain operational wave forecast model was implemented at CMC in March 2012. Work is in progress to migrate from the WAM model to the WaveWatch3 model.

Satellite atmospheric products are being developed for the METAREAs including: satellite-model based algorithms to detect fog and icing; data processing to determine cloud versus no cloud areas, stratiform versus convective clouds, and cloud top characteristics; and a synoptic weather-typing approach to quantifying forecast daily snowfall and snow depth over northern Canada.

The integrated METAREAs system is on schedule for full implementation in 2015.

**Reference**

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