Overview of CONCEPTS Ice-Ocean Prediction Systems

from Research to Operations 2015-2016

Establishing a Core Environmental Prediction Capability in Canada

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The Need for Coupled Atmosphere-Ice-Ocean Prediction

The Government of Canada requires ice-ocean forecasts and information services for:
• Improved weather and wave prediction
• Coastal operations support
• Fisheries and aquaculture management
• Improved oil and gas exploration
• Marine transportation
• Coastal engineering
• Improved ice forecasts

Global Coupled Medium-range Deterministic Forecasts

• Coupled NWP system running in operations at CCMEP since July 2016.
  – GDPS coupled to GIOPS
  – Global, 10-km resolution
  – 25 km/14-hr forecast
  – 10 day forecast (Global)
• Horizontal resolution increase of atmospheric model to 15 km in 2017.
• Available on RPNWMS.
  – E.g. www.meteocentre.com
• MBC/MET (point)
  – Arm GRIB2: Quesnel Hatchery

The Regional Ice-Ocean Prediction System (RIOPS)

• Purpose: short-term marine
  – oil spill support
  – fishing support
• Surface flux parameterizations
• 4D-Var ice assimilation
• 3 km resolution in the Arctic
• 3DVar RIPS ice analyses
• RIPS ice-ocean component
• Improved ice-ocean modeling
• Surface currents
• Inception of landfast ice
• Inception of impact on operational systems

The Ice-Ocean Coupling

• Entire Arctic freshwater balance shown to be sensitive to surface flux parameterizations
• Improving consistency in atmosphere and ice-ocean models leads to more accurate simulations of ice conditions
• In particular ice roughness has a large effect and impacts net liquid and solid freshwater exports

Impact of Coupling on Forecasts for TC Neoguri

• Coupling results in ~4°C cooling of sea surface temperature for tropical cyclones
• With associated ~10% reduction in latent heat flux
• Leads to reduced intensification at all lead times (24-120h)

Parameterization of Landfast Ice

• Landfast ice is parameterized by estimating the drag of ice keels on the ocean bottom
• Currently evaluating impact on operational systems

CONCEPTS Ocean Navigator

• Five systems running in operations
  – Global Ice Ocean Prediction System (1/4 deg, daily/6hr)
  – Global Coupled Medium range WNP System (2km, 1st forecast, 24hr)
  – Regional Ice Ocean Prediction System (25 km, 4th forecast, every 6hrs)
  – Global Lakes Coupled Forecasting System (2km, 4th forecast, daily)
  – Coupled A-GO Gulf of St. Lawrence (2km, every 5 forecas)

• Several systems in various stages of development
  – Full Canadian regional ice-ocean system
  – Coastal (2km) system for east and west coast
  – Coupling with regional and ensemble NWP systems
  – Local-scale modeling (1km-2km)

Global Ice-Ocean Prediction System (GIOPS)

• Running in real time since January 2013
• Updated to GIOPSv2.1 on June 2015
• Available on RPNWMS.
  – http://northweather.gc.ca

Global Ice-Ocean Prediction with CICE

Applications and domains
• 1/4° Global
  – Medium-range forecasting
• Global 1° resolution (Coupled GDPS-SN
  – Seasonal forecasting
• North Atlantic
  – Short-term range forecasting
• Coupled NWP SST in GDPS
• East and West Coast 1/36° (CIFOS)
• Gulf of St. Lawrence Sea Ice (RIPS-GLO)
  – Seasonal

Sea ice, tropical cyclones, surface interactions

Canadian Ice Service

– CIS support
– METAREAs 17&18
– Tides, Ocean: NEMO

Parameterization represents well the Arctic Rivers

Running in real time since July 2014

CONCEPTS Systems Status and plans

High-resolution coupled atmosphere-ice-ocean prediction system

• In support of
  – Weather prediction for northern Canada
  – EC METARSSA Services
  – Marine emergency response
• Coupled atmosphere-ice-ocean model
  – GDPS
  – NEMO-GDW (2 km/6hr)
  – Sea ice coupling
  – Improved ice-ocean analysis
  – Auto-Reom
• 72 h forecasts (daily)

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