ESPC Regional Arctic Prediction System

Shouping Wang
Naval Research Laboratory, 7 Grace Hopper Ave
Monterey, CA 93943
phone: (831) 656-4719 fax: (831) 656-4769 email: wang@nrlmry.navy.mil

Rick Allard
Naval Research Laboratory
Stennis Space Center, Mississippi
Phone (228)-688-4894 fax: (228)-688-4759 email: richard.allard@nrlssc.navy.mil

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LONG-TERM GOAL

The objective is to further develop, validate, and evaluate the capability of a fully coupled regional Arctic prediction system, designated as Regional Arctic Prediction System. The coupling will be achieved by linking three major predictive systems: COAMPS, NCOM and CICE. Various physical parameterizations and data assimilation package critical for the Arctic prediction system will be implemented and evaluated. The new coupled system is intended to provide the Navy the capability to conduct short-term (1 week) to extended (2 weeks) coupled weather forecasts for the Arctic region.

APPROACH

To achieve the stated objective, we plan to: 1) test the model coupler that has been developed to link the three components: atmosphere, ocean and sea ice, represented by COAMPS, NCOM, and CICE, respectively, in Regional Arctic Prediction System; 2) evaluate and validate an advanced momentum and energy flux parameterization across the interface; 3) implement and test a two-moment cloud microphysics package for mixed-phase clouds; 4) evaluate sensitivity of the Arctic weather forecast to key numerical parameters; and 5) conduct extensive validation and verification of the coupled system and demonstrate its capability over different Arctic areas and seasons.

WORK COMPLETED

1. Surface flux parameterization in the Arctic conditions

We started our project by carefully examining our options in improving surface flux parameterizations and tried to find the best way to implement the most advanced parameterization. Because COAMPS currently uses Louis surface flux scheme whose stability function is in a different form that from the Monin-Obukhov Similarity Theory (MOST). Therefore, it is problematic to implement the new improvement in the stability function from the science community since it is in the form of MOST form. We decided to take two approaches. For the first approach, we will implement a complete MOST formulation with the latest improvement on the stability function and roughness length. For the second, the Louis scheme will be modified to match the latest improved stability function. We will perform

evaluation and verification analyses of these two approaches. We believe that ultimately MOST formulation is more appropriate since most of improvements in the flux parameterization are based on MOST, which makes future implementation and improvement efforts easier.

2. Establish Collaboration with University of Alaska at Fairbanks (UAF)

In July 22-24, we visited UAF Geophysical Institute for discussions on the Arctic research. It was found that there is a great potential for close collaborations between GI and NRL Monterey in terms of both interest and scientific issues and projects. Following topics have been identified as promising and will be discussed further for detailed steps toward full collaborations.

a) Land surface-permafrost modeling. Permafrost is an important part of Arctic Cryosphere. UAF/GI has very strong expertise on this issue. Dr. Dmitry Nicolsky is a leading scientist on this issue.

b) Leads distribution. Dr. Jenny Hutchings investigates leads formation and its statistical characteristics such as leads distribution. This information will assist the development of leads parameterization in a regional sea ice model like CICE which is coupled with COAMPS.

We continue to have discussions on these science issues and will establish more firm collaboration with them in years to come.

IMPACT/APPLICATIONS

The overarching goal is to develop and evaluate fully coupled regional Arctic prediction system consisting of atmosphere-ocean-ice-wave components. The effort is an important step forward for the Navy for a more timely and accurate prediction of a rapidly changing Arctic environment. It will enhance the Navy's ability to exploit the environmental opportunity for tactical purposes to gain military superiority. It will also pave the way to a more advanced Navy's Arctic operation system in the future.

TRANSITIONS

None

RELATED PROJECTS

Related project is 6.2 NRL Base: A coupled Relocatable High-Resolution Arctic Modeling System, a joint project between Code7300 and 7500.