Leveraging ISI Multi-Model Prediction for Navy Operations: Proposal to the Office of Naval Research

James Kinter
Director, Center for Ocean-Land-Atmosphere Studies
Professor, Climate Dynamics
Department of Atmospheric, Oceanic & Earth Sciences
George Mason University
284 Research Hall, Mail Stop 6C5
4400 University Drive
Fairfax, VA 22030 USA
telephone: (703) 993-5700 // fax: (703) 993-5770 // email: ikinter@gmu.edu

Award Number: N00014-13-1-0436
Progress Report: 01 February - 30 September 2013

LONG-TERM GOALS

The potential to leverage existing and planned efforts to produce sub-seasonal to seasonal (S2S[1]) climate predictions, by U.S. national laboratories participating in the National Multi- Model Ensemble (NMME) project and by U.S. Navy research and operational entities, for the purpose of advising and enhancing Navy operations, will be exploited. The proposed work will build on a review previously conducted by the principal investigator and collaborators of the existing and planned efforts at the relevant U.S. Navy centers and has the potential to enhance existing operational climatological products developed by the Climatology Division at NRL-Monterey and will seek to include Navy models in the NMME project.

The accuracy, timeliness, and information content of U.S. Navy operational products intended to provide tailored long-range operational environmental information for planning and decision support will be significantly enhanced by the targeted application of dynamical ensemble predictions.

OBJECTIVES

Stream-2 of the NMME project is ideally suited for collaboration to enhance ongoing Navy efforts in providing operational climatological products and in developing the next generation Navy seamless weather and climate prediction system. We propose to foster this collaboration in two areas: operational climatological products and the development of the next generation prediction system.

[1] The original proposed work addresses Intra-Seasonal to Interannual climate forecasts (ISI; 2 weeks to several years lead time). For the initial project period, the focus is on a subset of ISI, Sub-seasonal to Seasonal (S2S; 2 weeks to 3 months lead time).

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
30 SEP 2013		**00-00-2013 to 00-00-2013**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Leveraging ISI Multi-Model Prediction for Navy Operations: Proposal to the Office of Naval Research	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **George Mason University,Department of Atmospheric, Oceanic & Earth Sciences,4400 University Drive,Fairfax,VA,22030**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**3**	

APPROACH

We will develop methods and procedures by which the NMME Stream-2 data can be blended with the currently used data sets to produce improved guidance. The development will focus on the top-10 requested products in the U.S. Navy Advanced Climate Analysis and Forecast (ACAF) system, as determined from our initial investigation of Navy requirements:

(1) Waves (significant wave heights)

(2) Wind

(3) Ceiling and visibility

(4) Precipitation

(5) Storm formation and tracks (tropical and extra-tropical)

(6) Evaporative duct heights

(7) Air temperature

(8) Freezing level(s)

(9) Sea surface temperature (SST)

(10) Currents

While the hypothesis is simply stated – dynamical S2S forecasts can significantly enhance the information content of climatological products in support of U.S. Naval operations – the implementation is challenging. In particular, while the S2S predictability of some of these quantities, e.g., SST, is well known, it has not been evaluated for others that are more commonly used in weather prediction than climate analysis.

We first note some universal or overarching processes and analyses that will need to be developed. For illustrative purposes, we also describe how we will evaluate the NMME Stream-2 data to improve the provision of two of the top-10 ACAF requests. These two examples demonstrate contrasting approaches (i.e., statistical post- processing of forecast data vs. applying forecast data to drive or force application models) to using the NMME data.

Regardless of how the NMME data are used, some universal processes and analysis will need to be developed and applied. To understand the challenges we note several characteristics of the required processing and analysis:

(1) The NMME Stream-2 data includes hindcasts and real-time forecasts. The hindcasts are generated each month for 30 years. For each hindcast or forecast there are typically about 100 ensemble members.

(2) Depending on the field and the way it is used, the data may be monthly mean, daily or 3-hourly, so that ingesting, formatting and applying quality control to these data for Navy applications requires substantial effort.

(3) The data must be bias-corrected and calibrated, which is typically done based on the hindcasts and may be accomplished by simple linear corrections or more sophisticated techniques.

(4) The quality of the bias-corrected and calibrated NMME data must be assessed against available observational estimates.

(5) The NMME data must be applied as done in ACAF or other application models (e.g., WW3) for the 30-year hindcast period.

(6) The NMME-based climatological products must be evaluated against existing products to develop the best strategies for combining the products.

It should be noted that the fact that the NMME data includes approximately 100 ensemble members for each forecast means that rather detailed probabilistic information can be provided. Moreover, we also emphasize that the development of all of the processes and analyses requires close collaboration and interaction with the Climatology Division.

WORK COMPLETED

Worked completed includes:

(i) A search committee was formed to fill the position of post-doctoral research associate to be dedicated to this project. The search committee advertised the position and has evaluated the applications of 21 candidates. A short list of 4 candidates was formed and letters of reference were solicited. The committee is currently interviewing the short-list candidates and expects to make an offer in October, resulting in a new hire before the end of calendar 2013.

(ii) The NMME (CCSM4) high-frequency data (surface winds) have been post-processed in anticipation of using these data for predictability analysis and for forcing WW3.

(iii) The WW3 model has been installed and tested with obervational estimates of surface winds in anticipation of testing the model with NMME surface wind predictions.

(iv) The project team is coordinating with Associate Professor Tom Murphree (Naval Post-Graduate School) to identify key targets for predictability analysis that is of most benefit to the Climatology division at the Fleet Numerical Meteorology and Oceanography Center (FLENUMMETOCCEN).

RESULTS

Nothing to report at this time. The project is in its early stages.

IMPACT/APPLICATIONS

Ultimately, this project will enable the seamless application of NMME real-time forecasts for use in U.S. Navy forecast operations.