

## **NAVGEN Platform Support**

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### **LONG-TERM GOALS**

The long-term goal of this ONR project is to prepare the technical framework for the associated ONR DRI on “Unified physical parameterization for seasonal prediction” which aims to develop generalized physical parameterizations that will enable a global prediction system useful for forecasts out to seasonal time scales. Targeted specifically at improving/extending the forecast capability of the Navy Global Environmental Model (NAVGEN; a successor to NOGAPS with new dynamical core and advanced physics) from weather prediction to seasonal prediction, potential PIs of the DRI will be able to work collaboratively and efficiently on model physics development using the technical framework developed by this project.

### **OBJECTIVES**

The objective of this project is to offer support (e.g., consultation, code updates and version control, data transfer, user feedback collection and implementation, etc.) for users of NAVGEN who obtain the system through the release of the code as determined by release guidelines. One of the primary objectives of this proposal is to establish a more comprehensive technical support capability for the NAVGEN users, particularly those who have projects supported by ONR. The distribution of NAVGEN to the scientific community will be accomplished by Naval Research Laboratory (NRL)-Monterey whose functions include, but are not limited to, making incremental improvements to the website, updating versions of the code as necessary, updating the NAVGEN documentation, providing user feedback to NAVGEN developers, and providing atmospheric and surface initial and boundary condition data for forecast model simulations.

### **APPROACH**

The Navy global forecast system is continuously upgraded and a recent significant milestone is the operation of the 4D-Var data assimilation system (NAVDAS-AR). The focus of the ONR DRI is on the development of the physical parameterizations to improve the weather prediction skill of NAVGEN and to extend its capability to seasonal prediction. Further improvement can be achieved by efforts from broader community dedicated to work on Navy’s modeling framework. We are building a centralized and automated code access system to distribute the software efficiently and effectively. This web-based system will have a two-tier infrastructure (Figure 1). NRL researchers

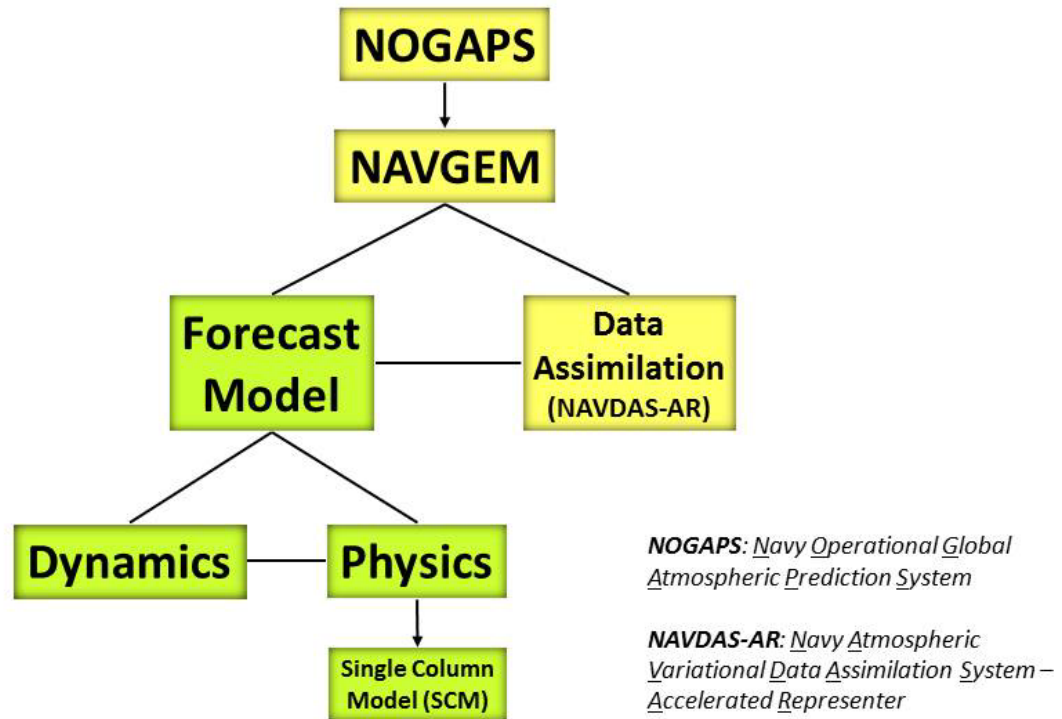
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have access for the Tier 1 system containing the operation version of NAVGEM and the NAVDAS-AR data assimilation system (Figure 1, whole diagram). Outside collaborators and PIs of the DRI will have access to the Tier 2 access to the NAVGEM software only (Figure 1, green blocks) and sets of initial and boundary forcing fields, as well as the validation data set. As the first step, a single-column version (SCM) of the model physics will be distributed for evaluating the physical parameterizations and upon completion of the evaluation of the SCM the distribution of the whole forecast model will follow. The key personnel are Mr. Tim Whitcomb (PI) and Dr. Tim Hogan (the primary NAVGEM developer who will help with SCM development). Dr. Jim Ridout, who is the PI of the ONR DRI project on “Unified physical parameterization for seasonal prediction”, will play an advisory role.



**Figure 1. NAVGEM 2-Tier Access System.** Tier 2 system (denoted by green), which consists of the model physics component (together with the dynamics component needed to integrate the model in time) and its single column model (SCM) version will be available for external collaborators, whereas the Tier 1 system, which also include the rest of the model components (denoted by yellow and green, i.e., the whole system), will be available for internal developers only.

## WORK COMPLETED

- Prepared a legal framework for the distribution of source code with ONR collaborators.
- Evaluated available version control systems for their suitability with distributed projects like this DRI.
- Surveyed DRI participants to assess both their research plans and technology baselines.
- Continued development of internal Subversion system for NAVGEM.
- Developed framework for displaying model diagnostics for the full NAVGEM model.

## RESULTS

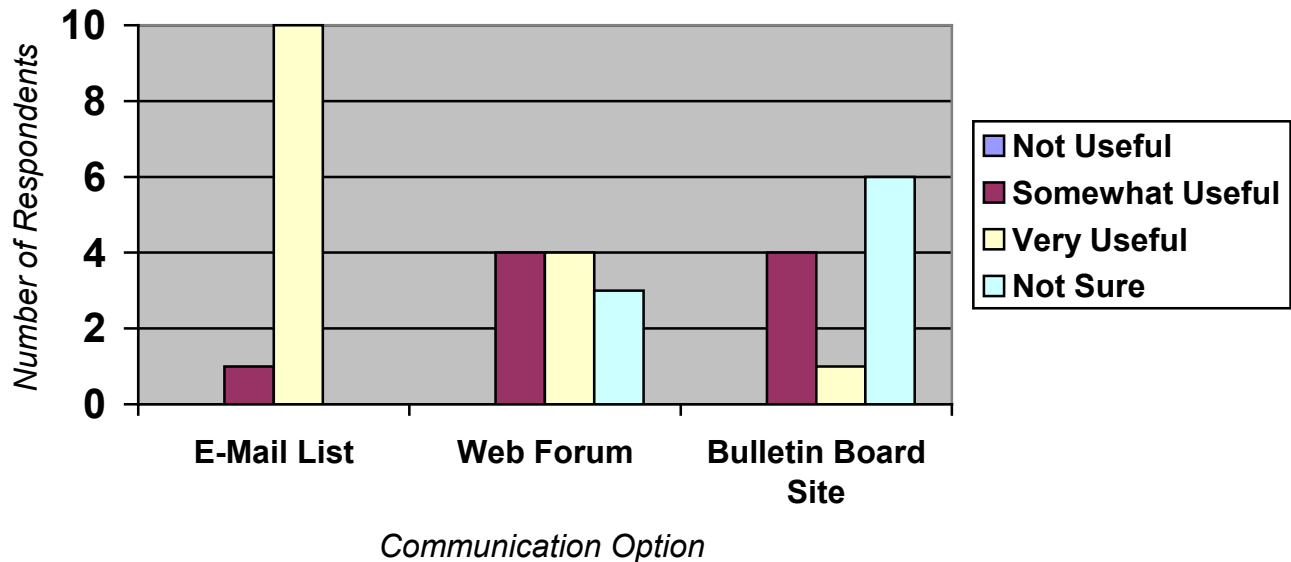
Researchers funded by this DRI will sign a Software Transfer Agreement with NRL Monterey. The Software Transfer Agreement will allow NRL Monterey to distribute the single-column model source code once it becomes available.

Many version control systems are available – the most commonly used at NRL currently is Subversion, which is a centralized system (CVCS) that requires network access to a server in order to access the source code. This works well for internal development (i.e. the NAVDAS-AR and NAVGEM source code is stored in a Subversion repository) and for systems with access through the NRL Monterey firewalls. However, most collaborators do not have access to internal NRL Monterey computer systems, which makes this a less-than-optimal choice. Distributed version control systems (DVCSs; e.g. Git or Mercurial) are designed to solve precisely this problem – development teams spread out over different computer networks with possibly no direct connection between them. Other external collaboration programs (like the modeling partnerships run by the UK Met Office ) are now exploring these options as well to mitigate some of the difficulties they've experienced in using CVCSs with external partners without access to their internal network.

Gauging the technical background and research plans of the DRI partners is critical in developing proper training materials to allow DRI researchers to both use the NRL Monterey programs in their research and allow them to transfer their improvements back into the main model development. A survey of the workshop participants showed that of the 11 responses, 8 had no experience with version control at all, and only 3 had experience with Subversion. Since DVCSs are slightly different in use than CVCSs, this represents an opportunity to create clear documentation for collaborators without their having to un-learn a previous system.

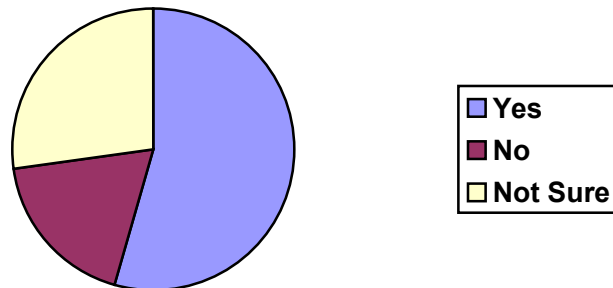
In the same survey, the overwhelming favorite for a collaboration method was an email list, with 10 out of 11 participants marking it as “Very Useful” and only 1 as “Slightly Useful” – other options (such as web forums and bulletin board sites) received a much more tepid response (see Figure 1).

### Preference for Collaborator Communication



*Figure 1 – Survey response for the question “How useful would the following methods of communication be to you for collaborating with other PIs and NRL?” The email list is the overwhelming favorite, with the increasing number of “Not Sure” entries reflecting more recent technologies.*

### Plans for Single-Column Model Research



*Figure 2 – Survey response for the question “Do you plan to use the single column model as part of your research and development?” Of the 11 responses, a majority (6) indicated that they would.*

Finally, we established that the development work in transferring the physics components of the NAVGEM model to a single-column model will be used by the collaborators: 6 out of 11 respondents stated that they would use the SCM, 3 were not sure, and only 2 were definitive “no” responses (see Figure 2).

Regardless of the version control system used with collaborators, the main NAVGEM repository used by NRL Monterey developers resides in Subversion. This year we continued internal user training and process refinements to help make the model development process smoother and dealing with frequent updates as NAVGEM was prepared for transition. Maintaining this internal system is a critical part in ensuring a path for NRL Monterey developments to be distributed to external collaborators and has already proved helpful in collaborations with the NRL Space Science Division in Washington, D.C. (including scientists funded by this DRI).

Since the development of any model parameterization relies on validation and verification, we began development of a framework for displaying user diagnostics. Most of the work focused on the full modeling system but these advances will be useful to individual developers in a single-column model framework as well. Unifying the diagnostic output between NRL Monterey and developers will make identification of promising modifications simpler and allow for improved communication between

### **IMPACT/APPLICATIONS**

Provide convenient access to the NAVGEM model code and data for external users, and promote scientific discussions of the results obtained from their research, leading to the synergic development of the model physics.

### **RELATED PROJECTS**

“Unified physical parameterization for seasonal prediction” (ONR DRI)

### **PUBLICATIONS**

T. Whitcomb, 2012: Navy global forecast system, NAVGEM: Distribution and user support. 2nd Scientific Workshop on ONR DRI: Unified Parameterization for Extended Range Prediction, 18–20 July 2012, Monterey, California, USA.