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NCAR Component of the Project

Establishing an IERS Sub-Center for Ocean Angular Momentum

Final Report

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The primary responsibilities of the NCAR component of this project are:

1.) Acting as liaison with the international ocean modeling community.

2.) Developing standardized algorithms to compute desired ocean model products, and providing template source code for these algorithms in widely used global ocean models.

Under the first activity, I am a member and have participated in three meetings (Kiel, Germany 8/99, Miami 3/00, and Santa Fe 3/01) of the World Climate Research Program Working Group on Ocean Model Development. At these meetings I presented an overview of the SBO structure and activities to the other working group members (representing most of the international ocean model development projects), distributed literature prepared by the SBO on computing ocean angular momentum quantities, and solicited contributions to the SBO data archive. This group has produced a landmark document: a report outlining the main technical developments in ocean modeling at all of the major international climate research centers. As a member of this working group I am a co-author on the report. This report is published in the journal Ocean Modeling and is available on-line at http://www.elsevier.nl. This report will provide an excellent supplement to the documentation of the IERS Sub-Center for Ocean Angular Momentum as an accessible description of ocean model design issues. As a sub-activity of the WCRP working group I am the coordinator of the Pilot Ocean Model Intercomparison Project. While this is a new activity that will not produce results during the proposal period, I will assure that the conclusions of this project that are relevant to the IERS community are communicated through the sub-center. I have also worked with several US modeling groups (primarily NPS and LANL) to disseminate their ocean model products to the geodesy community. Funds provided under this contract helped support travel cost to these meetings.

Under the second activity, I have worked primarily on developing ocean angular momentum diagnostic capabilities in the POP ocean model framework. The motivation for focusing on this particular code is that the US modeling groups doing the highest resolution global integrations are almost exclusively adopting this code. In addition there are two particular features of the code that make it well suited to OAM studies: a general curvilinear coordinate formulation and a built-in capability to correct for non-conservation of mass resulting from application of the Boussinesq approximation in the dynamical formulation of the model. The first of these two features facilitates truly global calculations without the necessity of non-physical filtering or smoothing operations near the pole. On the other hand it can substantially complicate accurate calculation of the coefficients in a spherical harmonic expansion due to the non-uniformity of the resulting discrete grid. The second feature, while potentially providing a more accurate estimation of OAM related quantities, also complicates their calculation somewhat due to the additional book keeping required. An additional complication is that the code is designed for and routinely used on distributed memory architecture computational platforms. The OAM diagnostics of interest all involve global integrals which require interprocessor communication to accomplish. We are currently testing several approaches to optimizing these diagnostics so that they incur as little overhead as possible. This is an important objective so that there be as little disincentive as possible to their routine use during ocean experiments where the primary research objective does not involve OAM. During the later part of the proposal period, this work has focused on two major global modeling efforts. The first is establishing a new global configuration with a nominal resolution of 1 degree of latitude and longitude suitable for use in climate duration (seasonal to centennial) simulations. This work has involved optimization of the grid design, topography representation and dissipation parameterizations. All of these have demonstrable impacts on the fidelity of the simulation of the large scale circulation and variability and, in consequence, on the prediction of ocean angular momentum quantities. This model will be released to the research community through the NCAR Climate System Modeling project. Multi-century integration with this model using NCEP reanalysis forcing is currently underway using computing resources secured in Japan. We will diagnose relevant oceanic angular momentum quantities from this run and submit them to the subcenter shortly after the integration is completed (early 2002). The second major effort has been to collaborate with the groups at Los Alamos National laboratory and several research groups within the US Navy (Naval Postgraduate School, Fleet Numerical and NRL Monterey) in configuring a global 0.1 degree simulation. This is the highest resolution global ocean simulation ever undertaken. I have specifically requested several additions to the planned model configuration, e.g., the inclusion of forcing by atmospheric pressure loading, that will provide for more accurate predictions of OAM quantities. A second integration of this class is currently being planned for integration on machines in Japan. We expect one and possibly both of these runs to be completed in late 2002, and as results become available I will begin processing OAM diagnostics for submission to the Sub-Center.