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(Final Report)

Development and Evaluation of a Global Version of the Miami Isopycnic-Coordinate Ocean Model

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OBJECTIVE: To test the ability of the Miami Isopycnic-Coordinate Ocean Model (MICOM) to simulate the global ocean circulation, setting the stage for the model's incorporation into coupled global climate models.

OBJECTIVE: An existing basin-scale model will be expanded to global domain; suitable atmospheric forcing fields, including precipitation and river runoff, will be selected; the modeling of abyssal flow will be improved by incorporating compressibility and particularly thermobaric effects; a sea-ice model will be added; parameterization options will be explored for subgrid-scale deep convection; parallel coarse- and fine-mesh simulations will be carried out to investigate the impact of grid resolution; the sensitivity of the model's solution to magnitude of vertical (diapycnal) exchange coefficient will be studied; and long-term trends in meridional heat transport and water-mass properties in model solutions will be documented and interpreted.

RESULTS TO DATE: MICOM's seven time-dependent forcing functions characterizing the atmospheric state were generated for the global domain by reanalyzing COADS ship observations with emphasis on the high southern latitudes and by adaptation of global precipitation fields from NOAA's

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microwaver sounder. The algorithm for detraining mixed-layer water into discrete isopycnic layers was improved to cover situations where the mixed layer shoals because of freshwater input (ice melt) rather than warming. The scheme for converting diapycnal mixing processes into interlayer mass fluxes was replaced by a more efficient scheme. The temperature effect on compressibility was incorporated to correctly model the interaction of bottom water generated at high northern and southern latitudes. The Los Alamos sea-ice model was adapted for use in MICOM and has been found to produce satisfactory results in 10-year test runs. A near-global coarse mesh version of MICOM [mesh size $1.4 \text{ deg} \times 1.4 \text{ deg} \cos(\text{lat.})$] was run for 600 years to study transients in the global thermohaline circulation and poleward heat fluxes; the model climate proved to be remarkably stable. An eddy-resolving version of MICOM [mesh size $0.225 \text{ deg} \times 0.225 \text{ deg} \times \cos(\text{lat.})$], initialized with spun-up fields from the coarse-mesh run, was integrated for 11 years. A limited-area model, driven by time-varying lateral mass fluxes from the global run, was successfully tested on the Loop Current eddy-shedding process in the Gulf of Mexico. A 2-deg near-global version of MICOM (not yet including the polar grid and the ice model) was coupled to a T21 version of NCAR's CCM3. After 15 years of integration starting from Levitus climatology, the coupled system shows negligible drift as far as oceanic surface and subsurface properties are concerned. However, deficiencies in the geographic distribution of precipitation generated by the atmospheric model may affect the steadiness of the coupled system state.

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