Forecast Ecosystem Conditions in Gulf of Mexico OCS Habitats
Using Coupled Modeling and Climate Scenarios

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This quarterly report is filed per requirements of BOEM-NRL IAA # M16PG00027 with respect to our research project focused on climate-scale ocean model simulations for the Gulf of Mexico. The focus of this study is to forecast, through year 2050, marine ecosystem conditions in the Gulf of Mexico (GoM) using RCP climate scenarios prescribed by the NCAR CESM Large Ensemble (LE) atmospheric forcing.

1. WORK ACCOMPLISHED

The project's first long-term simulation (experiment 80.5) was completed; that is, the 1990-2020 baseline simulation forced with interannual ERA5 atmospheric surface forcing. Unfortunately, after initial analyses of the outputs, physical and biological, the simulation was deemed bad. While the surface physical fields were sensible, unrealistic sub-surface warming (as much as 12-16 C^{o} anomaly) was discovered throughout the open ocean. Investigation of the problem ensued, with in-depth examination of the parameterization (e.g., KPP mixing parameters), forcing, and input fields to find the source of the heat. While this investigation was involved and took time, the findings, in summary, were that i) two different version of HYCOM codes (configuration and input processing software and HYCOM model core) were being used that were not fully compatible with each other, and ii), somewhat related, there were bad values (large "special values") at the initial condition and open boundaries that were incidentally introduced into the mapping of the outer nest (values from Global HYCOM) into the inner nest (Gulf of Mexico model), thus propagating throughout the Gulf basin. The biogeochemistry was briefly examined and showed clearly that without proper physical structure, its performance also suffered. The solution to these problems is to upgrade HYCOM and reprocess the inputs. The new code identifies and properly masks special values (i.e., land, missing data).

While the aforementioned problems and rectification thereof consumed most of the effort this quarter, the configuration and processing of the input forcing for the projection simulations (2000-2050) was started.

2. PROBLEMS

As described above, but rectified successfully.

3. PLANNED ACTIONS FOR NEXT QUARTER

Upgrade to the latest HYCOM codes and rerun baseline simulation. As time allows, submit a projection simulation.

4. BUDGET

The project amount of $390K+$132K has been received in full.
Expenditures to date: ~$359K.