2C.5 HURRICANE HEAT POTENTIAL ESTIMATES FROM MONTHLY VERSUS SEASONAL TEMPERATURE AND SALINITY DATA

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1 INTRODUCTION

A two-layered model approach incorporating surface height anomalies (SHA's) from the TOPEX/Poseidon radar altimeter, sea surface temperatures, and historic hydrographic data (temperature and salinity) were used by Goni et al. (1997) to understand ring dynamics. Shay et al. (2000) extended this approach of obtaining the upper-layer thickness fields to the calculation of hurricane heat potential estimates relative to the 26^{o}C isotherm following the ground work of Leipper and Volgenau (1972).

2 BACKGROUND

With all factors for Tropical Cyclone (TC) intensity change being equal, the estimate of hurricane heat potential provides a measure of the amount of heat available from the ocean. Shay et al. (2000) describes the importance of calculating the heat potential based on the surface to the depth of the 26^{0}C isotherm versus from the sea surface temperatures alone. The hurricane heat potential is defined as a measure of oceanic heat potential from the surface to the depth of the 26^{o}C isotherm, Leipper and Volgenau (1972).

Both Goni et al. (1999) and Mainelli-Huber et al. (2000, hereafter MSP) use a two-layer model, which requires a historic hydrographic (temperature and salinity) background state of the ocean. This background state is necessary to estimate the average density for each layer thus providing the reduced gravity, required to estimate the upper-layer thickness (Goni et al., 1997, Shay et al., 2000). Because of month-to-month discontinuities from within the historic hydrographic data base, MSP created a hurricane season data defined by averaging over all years the temperature and salinity data from 1 June through 30 November. As temperature and salinity profiles change on time scales less than the hurricane season time scale, monthly averages would provide a more representative background state of mesoscale ocean features, i.e. the western boundary currents, the Loop Current, and warm core rings.

In this paper, the difference in using monthly averaged versus hurricane season averaged temperature and salinity hydrographic data highlights oceanic features that may play a role in TC intensity change.

3 MONTHLY VERSUS SEASONAL TEMPERATURE AND SALINITY DATA

The hurricane season data base (half-degree) of temperature and salinity data created by MSP was obtained from the Naval Oceanographic Office Global Digital Environmental Model (GDEM) where data voids were filled with Levitus and Boyer 1994 (one-degree) historical temperature and salinity data. The monthly averages from GDEM, Levitus and Boyer 1994 and Levitus 1982 of temperature and salinity data were interpolated onto a 20km grid matching the output of the Miami Isopycnic Coordinate Ocean Model (MICOM). The MICOM was time-stepped out to simulate the ocean model having run for 19 and 20 years. Comparisons were conducted between the GDEM, the Levitus and Boyer 1994, and the three MICOM outputs for years 19, 20 and the weighted average between years 19 and 20 for each of the twelve months of the year. These comparisons were done for the Atlantic, Caribbean, and Gulf of Mexico basins as well as each basin separately. Linear regression analyzes revealed remarkable similarity between the historical and simulated data sets. For the month of August and all three basins combined, the GDEM versus the MICOM weighted average (GDEM versus Levitus and Boyer 1994) had a slope of 0.8 (0.88), an intercept of 7.9 (7.5), and a correlation coefficient of 0.89 (0.94).

Following MSP, the objectively analyzed surface height anomaly fields from blended radar altimeter data sets were interpolated onto the 20km grid points obtained from the MICOM output. The hurricane heat potential estimates thus obtained differ from MSP in that the temperature and salinity fields are based on simulations (at 20km spacing) versus historical data (at 55km spacing).

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4 HURRICANE HEAT POTENTIAL

MSP calculated hurricane heat potential estimates for the period 7-21 August 2001 based on the hurricane season averaged temperature and salinity data base, Fig. 1. Using the same SHA's and SST's, the hurricane heat potential estimates for the month of August are calculated based on the 20km MICOM temperature and salinity data for the month of August, Fig. 2.

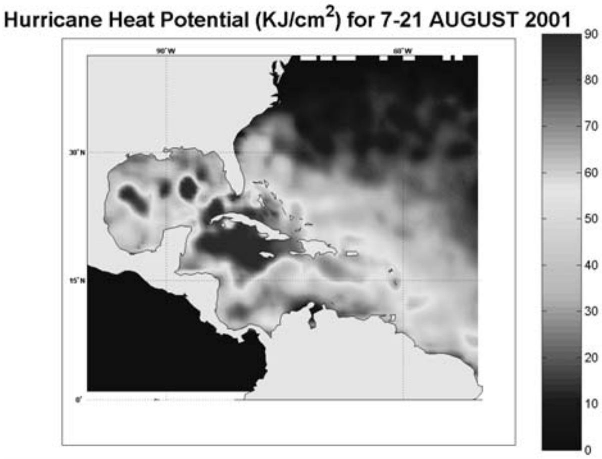

Figure 1. Hurricane heat potential for 7-21 August, 2001 based on a historic data base (55km spacing) averaged over 1 June through 30 November.

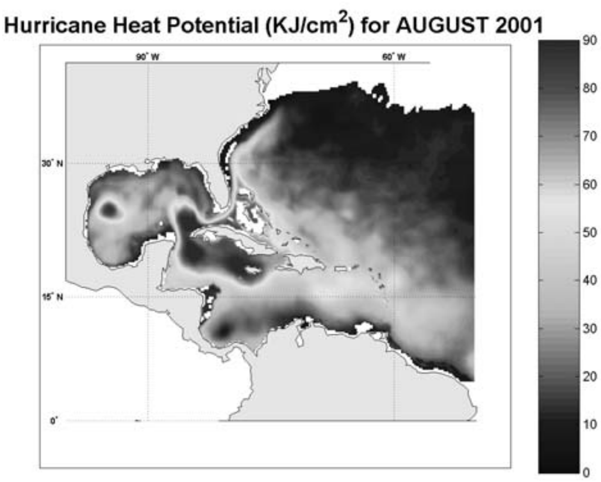

Figure 2. Hurricane heat potential for August 2001 based on a ocean model data base (20km spacing) for the month of August. The model output used was from the Miami Isopycnic Coordinate Ocean Model.

In general, higher hurricane heat potentials are expected when oceanic features have a deeper 26^{0}C isotherm than surrounding oceanic waters, i.e. western boundary currents, the Loop Current, and warm core rings. Though both figures look similar, note the detail contained in Fig. 2 of the western boundary current, not discernible in Fig. 1.

5 SUMMARY

Calculations of hurricane heat potential estimates have been based on seasonal and yearly (not discussed) historical hydrographic data. Using the monthly averages from an ocean model simulation on a 20km grid spacing instead of a seasonal average of historical hydrographic data on a 55km grid spacing to calculate hurricane heat potential reveals oceanic features otherwise not clearly depicted. This technique, coupled with observational data, will lead to a quantitative investigation of the oceanic variability and further understanding into the ocean's role in TC intensity changes, Jacob et al. (2000).

Acknowledgment: Research sponsored in the Division of Meteorology and Physical Oceanography at the University of Miami's Rosenstiel School of Marine and Atmospheric Science is by the National Science Foundation (ATM-01-08218).

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