14B.6

# OCEAN MODEL SIMULATIONS OF A GAP WIND EVENT IN THE GULF OF TEHUANTEPEC

Jon M. Schrage[1], Carol Anne Clayson[1], David M. Schultz[2], and Ryan J. Machtmes[1]

[1]Dept. of Earth and Atmospheric Sciences
Purdue University
West Lafayette, IN

[2]NOAA/National Severe Storms Laboratory
Norman, OK

## 1. INTRODUCTION

Off the Pacific coast of southern Mexico, in the Gulf of Tehuantepec, strong northerly winds often create regions of strong mixing and cooling of ocean waters. These winds, known as tehuantepecers or "gap winds", are generated as cold air masses surge southward across the Gulf of Mexico and are forced through a narrow mountain pass across the Isthmus of Tehuantepec.

One particularly good example of this phenomenon occurred on March 13, 1993 in association with the well-documented "Superstorm". As the Superstorm advanced off the eastern coast of the United States, a strong polar high pushed southward and resulted in strong northerly winds of up to 30 m/s across the Gulf of Tehuantepec (Schultz et al., 1997).

## 2. MODEL

In this study, a high resolution, three-dimensional ocean model is used to attempt to simulate the oceanic response to the tehuantepecer that occurred on March 13, 1993. The model used is a version of the University of Colorado version (CUPOM) of the Princeton sigma-coordinate, free-surface ocean model described by Kantha and Piacsek (1997). With a peak resolution of 13.5 km and 38 vertical levels, the model has been configured for a relatively large region of the eastern North Pacific, a subdomain of which is shown in Fig. 1. The time step of the model is 4 minutes. Sensitivity studies at Purdue have demonstrated that the model's response to gap wind events is fairly insensitive to the underlying bottom topography. Therefore, for these simulations a simplified bottom topography has been utilized near the coast in which the depth of the ocean is a function of the distance to the nearest shoreline. The model was initialized using monthly average parameters from the NCEP Ocean-Data Assimilation System (ODAS). Surface fluxes of momentum, heat, and fresh water were specified using ECMWF operational analyses (NCAR ds111.3) for the six weeks prior to the onset of the tehuantepecer. During the gap wind event itself, momentum fluxes were specified using the output of an MM5 simulation of the event, providing input the ocean model at very high temporal and spatial resolutions. The MM5 simulation of this tehuantepecer has been thoroughly documented by Steenburgh et al. (1998).

## 3. RESULTS

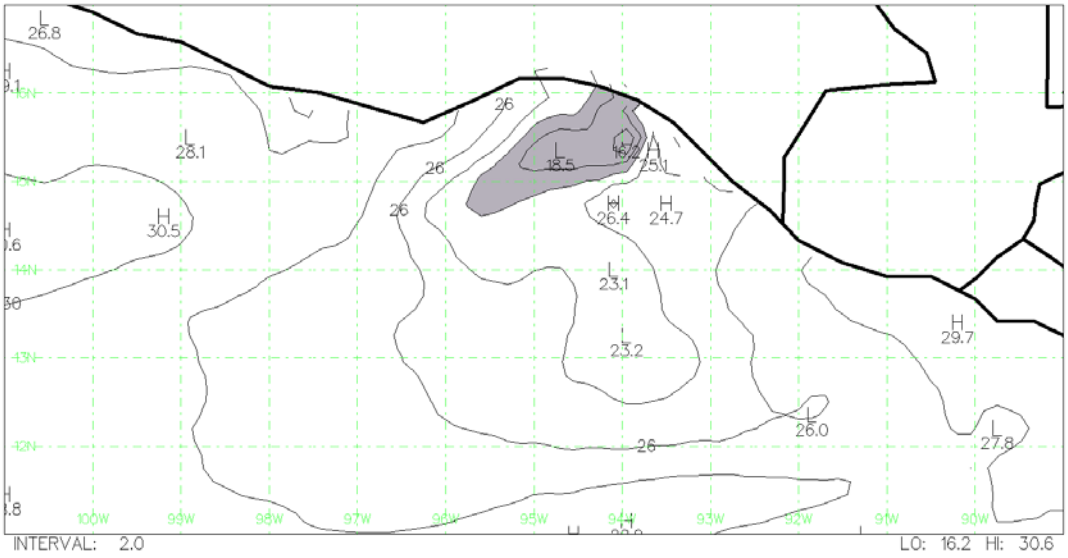
Sample results are shown in Fig. 1, which compares the modeled sea surface temperatures (Fig. 1a) and those obtained from multichannel sea surface temperature (MCSST) estimates (Fig. 1b). In both cases, the results are the average over a seven day period, approximately centered on the date of the gap wind event. The model accurately simulates the magnitude of the temperature anomaly, its areal extent, and the temperatures of the surrounding waters. The depth of the mixing, the impact on small-scale eddies, and the persistence of the cold anomaly are topics of further examination.

*Corresponding author address:* Dr. Jon M. Schrage, Dept. of Earth and Atmospheric Sciences, 1397 Civil Engineering Building, Purdue University, West Lafayette, IN 47906-1397; email: schragej@purdue.edu

## ACKNOWLEDGMENTS

We acknowledge with pleasure the support by the NASA TRMM program under grant NAG5-9822.

a.)




b.)

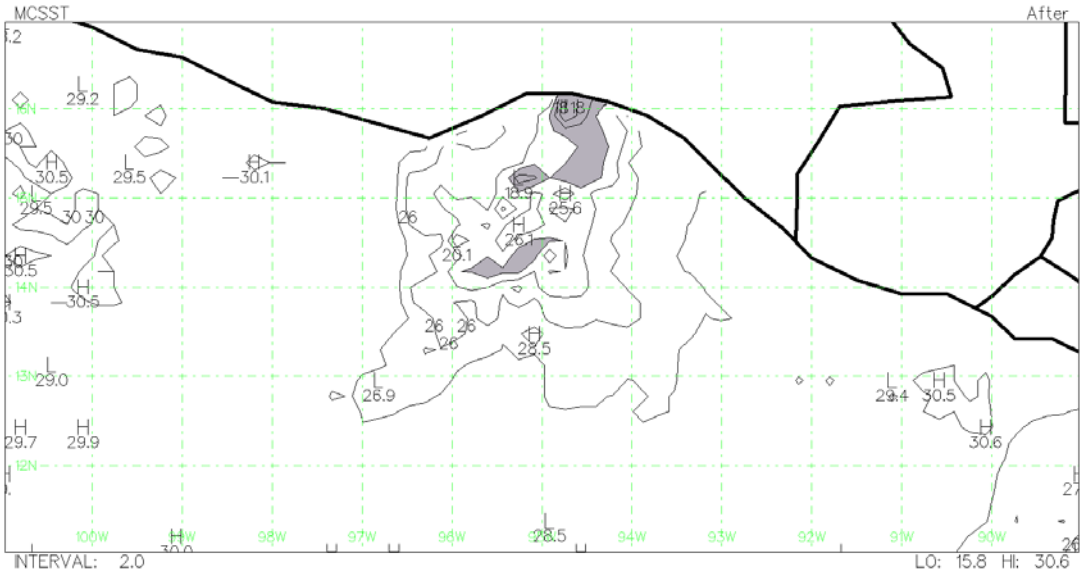



Figure 1. Average sea surface temperature (°C) for the period 11-17 March, 1993 in (a) the model and (b) MCSST data. Values below 22°C are shaded.


Kantha, L.H., and S. Piaczek, 1997: Computational ocean modeling, in *Handbook for Computer Science and Engineering*, ed. A. Tucker, CRC Press, 934-958.

Schultz, D.M., W.E. Bracken, L.F. Bosart, G.J. Hakim, M.A. Bedrick, M.J. Dickinson, and K.R. Tyle, 1997: The 1993 Superstorm cold surge: Frontal structure, gap flow, and tropical impact. *Mon. Wea. Rev.*, **125**, 2673-2691.

Steenburgh, W.J., D.M. Schultz, B.A. Colle, 1998: The structure and evolution of gap outflow over the Gulf of Tehuantepec, Mexico. *Mon. Wea. Rev.*, **126**, 2673-2691.