Abstract View

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GATE Air-Sea Interactions II: Numerical-Model Calculation of Regional Sea-Surface Temperature Fields Using the GATE Version III Gridded Global Data Set

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ABSTRACT

The numerical model of air-sea interaction previously described in Brown *et al*. (1982), Pandolfo and Jacobs (1972) and Pandolfo (1969) is applied over a limited horizontal portion of the GATE III Gridded Global Data set (including continental grid points) to calculate a model-generated interface temperature field over a two-day period of GATE Period III.

The experiment provides a further estimate of the accuracy achievable in predicting sea-surface temperature over multi-day scales with limited-domain models nested within global data sets. It also demonstrates the degree of sensitivity of the model solutions to the inclusion of three additional atmospheric radiators (viz., an hypothesized tropical haze over the entire area simulated, a Saharan dust layer over its northern portions, and model-generated cloud); and to the thermodynamic effects of the parameterized cloud and rain-generating mechanism.

The initial oceanic temperature field was subjectively analyzed from GATE ship data and supplemented by climatological data. The sea-surface temperatures thus derived were qualitatively consistent in pattern with independent analysts of daily mean temperature based on GATE satellite and ship data. Both analyses show a belt of maximum temperature extending from the western boundary of the simulated area north-eastward to the African coast. In both analyses sea-surface temperatures decrease rapidly toward the southeast of the axis of maximum temperature. In our synoptic field it decreases more slowly toward the northwest. Actual values of analyzed temperature may differ locally by up to 2°C at locations sparse in ship data, but by less than the 0.50°C accuracy suggested by Krishnamurti *et al*. (1976) in data-rich portions of the limited area.

When the haze and model-generated cloud are included in the numerical simulation, model-generated daily mean temperatures change from the first to the second day of simulation in a manner that is also qualitatively consistent with that exhibited by day-to-day changes of the independently analyzed mean temperature. In the absence of these

additional radiators the model-generated temperatures exhibit unrealistic warming of sea-surface temperatures. The sensitivity of daily average model-generated interface temperature to the presence of individual radiators shows patterns of difference similar in intensity and scale to those of the day-to-day changes.

Model-generated hourly-average temperature fields show isolated, shallow, cool-water pools at locations with intense model-generated cloud and rain and at data-sparse locations of the limited area simulated. At their most intense, they are similar in scale and intensity to a feature observed at another time, and under similar conditions, in the vicinity of the AB-scale GATE array. Their presence in the model-generated solutions is directly attributable to inclusion of the salinity-stabilization mechanism suggested by Katsaros (1976). These features appear with greatest intensity when all three atmospheric radiators are included, and diminish noticeably in intensity as the atmospheric dust is removed. They are completely absent in a simulation in which model-generated cloud and rain are also omitted.

In that simulation, an isolated, shallow, warm-water pool appears in the presence of generally strong insulation, and at a location with light surface wind. It is similar in scale and intensity to a feature observed at another time, and under similar conditions, within the GATE-AB scale array (Peters, 1978).

A noticeable nocturnal temperature maximum in the northern coastal regions of the simulated area is present in the initial data, and is repeated in the model-generated nighttime temperature fields thereafter. It is complemented by a repeated model-generated coastal daytime temperature minimum slightly to the south. Observational data are not available to confirm this most pronounced diurnally-varying feature of the simulated sea-surface temperature fields.

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