# NEW SEA-SURFACE TEMPERATURE ANALYSIS IMPLEMENTED AT NCEP[1]

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## 1. Introduction

A new Real-Time Global Sea Surface Temperature analysis (RTG_SST) has been developed specifically for use by the NCEP weather forecasting models. Each daily analysis uses the most recent 24-hours of *in situ* and satellite-derived surface temperature data and provides a global SST field on a 0.5-degree (latitude, longitude) grid. The RTG_SST, implemented in NCEP's operational job stream on 30 January 2001, currently provides the sea surface temperature fields for the regional Meso Eta Model, replacing the previously used NESDIS 50 km SST analysis.

This presentation describes the sequence of events in the development and implementation of the RTG_SST, compares its properties with those of the Reynolds-Smith analysis and the NESDIS 50 KM (satellite-only) analysis.

## 2. Background of the RTG_SST

Until recently, two different analyses were employed by the NOAA/NCEP/ Environ-mental Modeling Center, to provide ocean surface temperatures in EMC's short- and medium-range atmospheric forecast models. The Global Analysis/Forecast Systems used the 1-degree (latitude, longitude) Reynolds-Smith analysis (RS), run daily with the most recent 7-days data. The Meso-Eta used the NESDIS 50 KM analysis of satellite-retrieved SST's from NOAA AVHRR.

The RTG_SST, using both satellite and *in situ* data, had been under development specifically to meet the requirements of EMC's increased-resolution weather forecast models. A prototype RTG_SST was initially developed by the EMC Climate Modeling Branch; was modified by the EMC Ocean Modeling Branch; and

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final evaluations of its performance were carried out late in the fall of 2000.

During mid-December 2000, the Eta SST field, provided by the NESDIS 50 KM SST analysis, developed unrealistically warm areas in the NW Atlantic. Concern for the impact of these unusually warm areas on Eta model forecasts led to comparisons with the RS SST fields, which were significantly cooler in forecast-critical areas. Figure 1 shows the difference plot for 19 December 2000, where the NESDIS 50 KM was warmer than the RS by as much as 7 – 9°C in some areas[3]. On 20 December, the lower resolution RS was temporarily substituted for the NESDIS 50 KM analysis on an emergency basis.
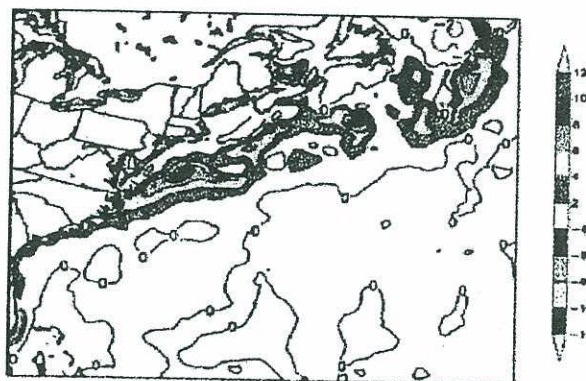


Figure 1. Difference between the NESDIS 50 KM and the RS SST analyses, for the Northwest Atlantic, 19 December 2000, with temperature in degrees Celsius.

[3] The NESDIS analysis is a bi-weekly analysis, ingesting only SST retrievals from the AVHRR instrument, and cannot be updated under persistent cloud cover. While these characteristics do not, *per se,* account for unrealistically warm areas, the analysis will have whatever bias there is in AVHRR retrievals and, in some areas, it may not have been updated for many days. During winter, intervals longer than 10 days when the satellite cannot "see" the ocean surface are not uncommon.

Subsequently, on 30 December 2000, the Eta model misforecast significant snowfall for the DC/Baltimore area. Figure 2 shows the corresponding 12-hour accumulated precipitation predicted for the east coast, from the 24-hour Eta forecast valid 1200 UTC 30 December. The actions taken following this event, when only a dusting of snow followed a forecast of 4-to-6 inches, included parallel model runs with the RTG_SST and its subsequent preparation for rapid operational implementation.
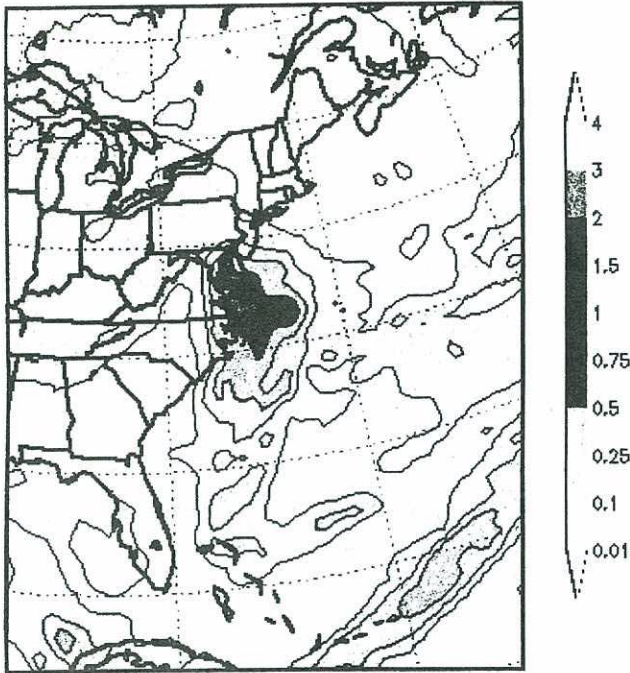


Figure 2. 24-hour Eta forecast of 12-hour accumulated precipitation, valid 1200 UTC 30 December 2000.

## 3.     Important features of the RTG_SST

The most important features of the RTG_SST and the principal differences between it and the Reynolds-Smith analysis, are the following.

▸0.5 x 0.5 (longitude, latitude) grid spacing;

▸Previous analysis as first-guess;

▸Only 24-hours of *in situ* and satellite data;

▸SST reports from moored buoys averaged within 24-h intervals;

▸Satellite-retrieved SST values averaged within 0.5 degree grid boxes;

▸Surface temperature for ice-covered water calculated using salinity climatology in Millero's (1978) formula, where the satellite-observed ice cover exceeds 50%;

▸Correlation-length-scale-parameter $\gamma$, for the correlation function: $\exp(-d^2/\gamma^2)$ where $d$, the distance between data and analysis-gridpoint locations, is calculated from a climatological temperature gradient, as $\gamma = \min(450, \max(225/|\Delta T|, 100))$. $\gamma$ and $d$ are in kilometers.

Data quality control criteria, and bias calculation and removal for satellite-retrieved SST, are the same as those of the RS SST.

The correlation-length-scale parameter, taking values between 111 km in the regions of highest climatological temperature gradient (Gulf Stream and Kuroshio), and 450 km where the gradient is low (Sargasso Sea), is a major change from the range of longer correlation scales employed by the Reynolds-Smith analysis and a critical element in the performance of the RTG_SST.

## 4.     Analysis evaluations

Evaluations of the RTG_SST analyses have shown it to produce realistically tight gradients in the Gulf Stream region of the Atlantic and the Kuroshio region of the Pacific, and to be in close agreement with SST reports from moored buoys in both oceans. In contrast to the NESDIS and RS analyses, this new analysis properly depicts the colder shelf water -- a feature critical in accurate producing model prediction of the 29-30 December 2000, east coast winter storm.

Comparisons had been made between analyses produced with the RTG_SST algorithm using different assignments of the correlation length scale ($\gamma$), during the early development phase. Figure 3.a illustrates the climatological temperature gradient from which $\gamma$ is calculated, for the Gulf Stream region: 20W – 80W and 30N – 60N; and 3.b provides a plot of the corresponding values of $\gamma$. In 3.c is the SST analysis using this variable correlation scale parameter; and comparative analyses with homogeneous correlation scale values: $\gamma = 111$ km, $\gamma = 300$ km, and $\gamma = 606$ km, are shown in 3.d, e, and f, respectively. 3.c and d show nearly identical Gulf Stream detail; however, away from the strong temperature gradients, where the SST contours of 3.d are noisy, the larger correlations scales used to produce the analysis of 3.c give a more realistic looking temperature field. 3.e and f show the Gulf Stream with increasingly and unrealistically smooth temperature contours.