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Sea Surface Temperatures from Nimbus-7 SMMR Radiances

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ABSTRACT

Global displays of sea surface temperatures (SST's) from the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) are obtained with spatial sampling intervals as small as 50 km rather than the 150 km spacing normally used for such retrievals. An example is illustrated using a composite global SMMR data set for January 1979, a preliminary version of the SST retrieval algorithm, and a sampling interval of 100 km. The results were found to be in qualitative agreement with in situ and climatic data, insofar as such comparisons were attempted. In addition to the expected climatic patterns, the global oceanic isotherms contain oscillations that are clearly not instrumental but geophysical in nature.

Bunching of the isotherms south of Africa and South America is also evident.

In general, it can be seen that the isotherms in Fig. 1 oscillate meridionally. A few of these oscillations can be attributed to differing weather conditions between adjacent swaths, which are about 780 km wide and two days apart (except where faulty orbital data have been removed). It should be pointed out that the six-day orbital period is such that the swaths overlay each other within 10 km at the equator when composited over a month. Many of the oscillations are of shorter period (200–500 km) than this, however, and probably represent real geophysical waves.

There are a few features in the retrieval that are instrumental; these seem to result from the sensing of small but significant islands. For instance, Hawaii shows up as a small warm spot in the North Pacific. The islands scattered about the western tropical Pacific apparently lead to excessively warm estimates of SST. [The application of the radiance filters is responsible for the no-data (black) areas.]

There has been no attempt to produce SSTs with the best possible absolute accuracies. Rather the objective here is to indicate how well SST gradients can be delineated with these retrieval techniques applied to SMMR data. Thus, no offset correction has been applied. Such an offset correction would be more appropriate when a more elaborate retrieval algorithm, which also fully corrects for the water vapor and liquid water atmospheric constituents, is applied.

5. Conclusions

The preliminary results shown here indicate that reasonable patterns of SST can be achieved with the SMMR. A more refined algorithm is needed to achieve the absolute accuracy desired. For instance, the corrections needed for extreme atmospheric effects, mentioned earlier, would provide additional SST data as well as improve the accuracy (by 0.6°C in SST) now limited by water vapor and cloud water fluctuations (assuming a local variability of 2 cm of water in the column for vapor or 0.02 cm for clouds). It should be reiterated that the climatological zonal variation in the atmospheric water vapor from 0.5 to 5 cm has not been removed from the SSTs shown here. This alone contributes an SST error increasing to about 1°C as the water vapor departs from the mean value assumed in the retrieval (3 cm).

The comparison of these SST retrievals with in situ data is incomplete; a comparison with analyzed SST fields obtained from BT, XBT, and ship data between 30°N and 30°S in the North Pacific for January 1979 (Liu, 1982) has indicated agreement of about 1°C. (There is more structure on the SSTs from SMMR.) To the extent that it is possible to compare the detailed SST map from SMMR with the smooth isotherms from climatology (NAVAIR 1974–79), the general features are also in accord. (In the general area of the Gulf Stream, for instance, extreme maximum–minimum temperature differences shown in that climatology for the month of January are as high as 10°C.)

Additional comparisons of the SST's obtained by this preliminary technique are unwarranted. Comparisons are planned for SMMR data analyzed with a refined SST retrieval algorithm with analyzed fields obtained from FGGE ocean buoys, United States Fisheries reports, NOAA/PMEL analyses, and NOAA/NESS analyses based on AVHRR data from the NOAA satellites (McClain, 1981; McClain *et al.*, 1983).

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