ABSTRACT

Atmospheric Moisture Fields Derived by Satellite Observations Over the Tropical Pacific Ocean. (May 1993)

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Values of precipitable water are retrieved over the tropical and subtropical Pacific Ocean from TOVS infrared and microwave channel brightness temperature and OLR observations by means of stepwise linear regression. The most useful temperature and moisture sensing channels are pre-selected from sensitivity tests of a radiative transfer model. Numerous models are developed and tested against collocated radiosonde observations and Nimbus-7 SMMR precipitable water estimates.

For RAOB comparisons, the best estimator used 15 TOVS predictors and captured 71.1% of the variance (± 0.62 g cm^{-2} standard error) for column precipitable water; for precipitable water of 700-500 mb bulk layer, these values were 71.7% and ± 0.17 g cm^{-2}. Little skill of estimated precipitable water was obtained for moisture above 500 mb. Regressions were less skillful against SMMR, unless collocation parameters were tightly controlled; SMMR was less acceptable than RAOBs because of observational drift and errors. Generally, the most skillful predictors were boundary layer brightness temperatures of TOVS channels and satellite estimated stability indices. 'Moisture channels' were hardly useful except for estimating middle and upper tropospheric moisture.

Additional regression models were constructed testing the sensitivity to different observational and meteorological characteristics. Models which used some *in situ* observations, surface observations or stabilities calculated from RAOB, were the most successful. The best of these explained 87.5% of the variance, but the regression selected almost no TOVS channels, relying instead on conventional RAOB and surface observations. A set of four regression models were developed, stratifying atmospheric characteristics on the basis of collocated OLR values. These models improved the variance explained by 5.0%; the model associated with the highest OLR values (275 W $m^{-2} \leq$ OLR; that is, no cloud) showed only marginal skill.

Precipitable water fields were generated from the best TOVS-only model for seven days in January 1983 and compared with SMMR-estimated fields, OLR fields and ECMWF precipitable water analysis. The TOVS regression model compared favorably to the SMMR analysis in amplitudes and features. It revealed more evolving synoptic signal than the ECMWF analysis. In synoptically active regions, it differed with respect to the OLR analysis, primarily because of actual differences in the vertical distribution of water vapor.