JP1.3 VALIDATION OF A MICROWAVE-BASED TROPICAL RAINFALL POTENTIAL (TRaP) FOR LANDFALLING TROPICAL CYCLONES

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1. INTRODUCTION

The experimental Tropical Rainfall Potential (TRaP) using satellite data has been performed operationally in the SSD since the mid-1980s. The launch in the late 1980s by the military of the first microwave imager (SSM/I) under their Defense Meteorological Satellite Program (DMSP) started a new era for the TRaP technique. See Kidder et al. (2001) for a description of the history and execution of the technique since that time.

SSD is tasked with providing this product to several National Weather Service (NWS) agencies including the Tropical Prediction Center (TPC), the Central Pacific Hurricane Center (CPHC), various forecast offices, and the Climate PredictionAnalysis Center for use in their African Threats Assessment. In addition SSD has forged partnerships with meteorological centers in foreign countries such as Australia, Canada and Sri Lanka to extend TRaP generation to these areas on an experimental basis. The TRaP is also produced for the West Pacific region.

2. METHODOLOGY

Today the process incorporates a satellite-based observation of instantaneous rain rates (AMSU-B, SSM/I, TRMM, etc...) projected over time using official track forecasts (TPC, CPHC, Joint Typhoon Warning Center - JTWC) to determine a rain rate over any point. Current manual production of the areal TRaP begins within 24 hours of landfall with updates made as new forecasts or rain rate data become available right up to the point of landfall. Rain amounts are then integrated for every point in the image over a 24 hour period and the result is displayed graphically on the SSD Tropical Cyclone Page: http://www.ssd.noaa.gov/PS/TROP/trap-img.html

3. LIMITATIONS AND VERIFICATION

Several key assumptions are made in the TRaP technique. First, satellite derived rain rates are correct. In their verification of TRaPs generated during the 2001 Atlantic hurricane season Ferraro et. al. (2002) found that there was an overestimation of instantaneous AMSU rain rates below 7 mm h^{-1} and an underestimation of rain rates above 10 mm h^{-1}. A limited data set of SSM/I rain rates showed similar characteristics. TRaPs generated from TRMM rain rate data were not evaluated during the 2001 season.

It is also assumed that the magnitude and area of rain rates does not change over the 24 hour period that the TRaP is generated which would suggest that the TRaP is best suited for a tropical cyclone that has been in a steady state as it approached landfall. It is also assumed that the rain area moves in the forecast direction and speed of the storm. Deviations from the forecast

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speed can have significant impact on the TRaP and a change in the direction means that the maximum rainfall depicted in the areal TRaP graphic will be incorrect. Ferraro et. al. (2002) discuss this issue in relation to several landfalling tropical cyclones during the 2001 Atlantic season.

Finally, it is assumed that no outside influences are effecting the storm. Therefore the TRaP may not produce good results if the tropical cyclone was interacting with a frontal system, undergoing shear where convection may wax and wane, or entraining dry air. Furthermore orographic effects are not taken into account.

To verify the TRaPs for landfalling tropical cyclones in 2001, Ferraro et. al. took hourly rainfall totals from first order U.S. reporting stations to match to the closest hour of the 24-hour TRaP forecast with the objective of determining how well the TRaP performs in the location and magnitude of the observed rainfall. Toward this goal, the differences in the magnitude of the maximum TRaP and gauge values were computed, as well as their location difference.

For the three tropical cyclones that affected the US (Allison, Barry and Gabrielle) the errors for SSM/I TRaP magnitude were -40%, -3% and +48%, respectively, while the errors for AMSU were +60% for Allison and +70% for Gabrielle. The magnitude of the location errors of the SSM/I rainfall maximum ranged from 60 km in Barry to 198 km in Gabrielle; for AMSU the error was about 136 km in Allison and 128 km in Gabrielle. The reader is referred to Ferraro et. al. (2002) for additional verification statistics.

4. FUTURE DEVELOPMENTS

Efforts are underway to incorporate other agency forecasts in addition to the JTWC for the generation of TRaPS for landfalling tropical cyclones in the Eastern and Southern Hemispheres. Use of Meteo France bulletins for the Southwest Indian Ocean, Australian Bureau of Meteorology bulletins for the Southeast Indian and Southwest Pacific Oceans, Fiji Meteorological Service for portions of the Southwest and Southeast Pacific Oceans and the Japanese Meteorological Agency's Typhoon Warning Center for the Northwest Pacific Basin are under consideration.

To eliminate error introduced into the TRaPs from forecasts, the verification of TRaPS for 2002 will likely involve generating them after the fact using best track data and comparing the results against hourly rainfall totals. It is hoped that some of this verification data will be incorporated in the poster presentation.

5. REFERENCES

Ferraro, R., P. Pellegrino, S. Kusselson, M. Turk, S. Kidder, 2002: Validation of SSM/I and AMSU Derived Tropical Rainfall Potential (TRaP) During the 2001 Atlantic Hurricane Season. NOAA Tech Report NESDIS 105, 43 pp.

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