

EVALUATION OF TROPICAL RAINFALL POTENTIAL (TRaP) FORECASTS DURING THE 2004 AND 2005 U.S. HURRICANE SEASONS

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Background and Motivation

Tropical Rainfall Potential (TRaP)

- A technique for producing 24-h forecasts of potential rainfall from landfalling tropical systems by extrapolating current satellite-estimated rainfall rates along the predicted storm track (Fig. 1).
- Requires the following assumptions (Kidder et al. 2005):
 - The predicted storm track is correct.
 - The satellite-estimated rain rates are correct.
 - The spatial pattern of storm center-relative rainfall does not change with time.
- Evolved from “rule of thumb” approaches based on storm speed through estimates based on IR cloud types to microwave (MW)-based estimates extrapolated along storm tracks from operational centers.
- Objective evaluation (Ferraro et al. 2005) has shown that TRaPs have useful skill compared to North American Model (NAM) QPF guidance.
- Produced in real-time and available on the Web at <http://www.ssd.noaa.gov/PS/TROP/trap-img.html>.

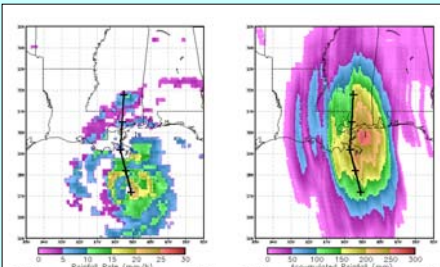


Figure 1. Instantaneous rain rate for Hurricane Katrina at 2335 UTC 28 August 2005 (left) and resulting 24-h TRaP accumulated rainfall (right). The predicted storm track is indicated in black, with plus symbols at 6-h intervals.

HE TRaPs

- Operational TRaP forecasts are produced using MW-based rain rate estimates, which are considered to be more accurate than IR-based estimates.
- TRaPs based on the IR Hydro-Estimator (HE; Scofield and Kuligowski 2003) could contain useful information, even if not as accurate as the MW-based TRaPs.

Methodology

HE TRaP Production

- Since HE spatial resolution is finer than microwave rain rates (4 km vs. ~10-16 km depending on the sensor) and has greater dynamic range (max 76.2 mm/h for HE vs. 30-50 mm/h for microwave), spatial and/or temporal smoothing should produce more comparable results.
- Spatial smoothing: smooth the HE using circular filters of radius 10 and 25 pixels
- Temporal smoothing: smooth the HE by taking the average rain rate during the previous 1, 3, and 6 h (see Fig. 2 for examples).

Data Sets

- The HE TRaPs were compared with the operational TRaPs for 11 landfalls of 10 different storms (Table 1).
- Stage IV radar / rain gauge data were used as the “ground truth”.

Storm Name	Date and Time of Landfall	Time of MW Overpass (Instrument)	Time of GOES Image	Start of 24-h Validation Period
T.S. Bonnie	1400 UTC 12 August 2004	0807 UTC (AMSU)	0800 UTC	0800 UTC
H. Charley	1945 UTC 13 August 2004	1513 UTC (SSM/I)	1515 UTC	1600 UTC
H. Frances	0400 UTC 5 September 2004	0342 UTC (AMSU)	0345 UTC	0400 UTC
H. Gaston	1400 UTC 29 August 2004	0812 UTC (AMSU)	0745 UTC	0800 UTC
H. Ivan	0650 UTC 16 September 2004	0227 UTC (SSM/I)	0230 UTC	0400 UTC
T.S. Arlene	1900 UTC 11 June 2005	1328 UTC (TRMM)	1330 UTC	1400 UTC
T.S. Cindy	0600 UTC 6 July 2005	2316 UTC/5 (AMSU)	2315 UTC/5	0000 UTC/6
H. Dennis	1930 UTC 10 July 2005	1232 UTC (SSM/I)	1230 UTC	1300 UTC
H. Katrina	2330 UTC 25 August 2005 (FL)	1435 UTC (SSM/I)	1430 UTC	1500 UTC
H. Katrina	1110 UTC 29 August 2005 (LA)	2335 UTC/28 (AMSU)	2330 UTC/28	0000 UTC/29
H. Rita	0730 UTC 24 September 2005	0251 UTC (SSM/I)	0245 UTC	0300 UTC

Table 1. Basic information for the eleven TRaP cases.

Results

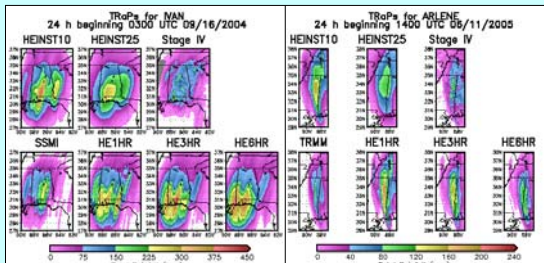


Figure 2. Sample TRaP comparisons for Hurricane Ivan (left) and Tropical Storm Arlene (right).

Results (cont.)

All-Event Comparison

- Figure 3 shows scatter plots of the HE TRaP versus the MW TRaP with regard to correlation coefficient (CC), volume bias, and Heidke Skill Score (HSS) conditioned on observed values of 50 mm or higher.
- The overall pattern is that the MW TRaPs are less biased than the HE TRaPs and have a greater relative correspondence with observations, particularly for heavier rainfall.
- The spatially-smoothed TRaPs generally perform best (particularly 25-pixel smoothing) overall, but that does not seem to be the case for the regions of heaviest rainfall, where there is no consistent “best” HE TRaP.

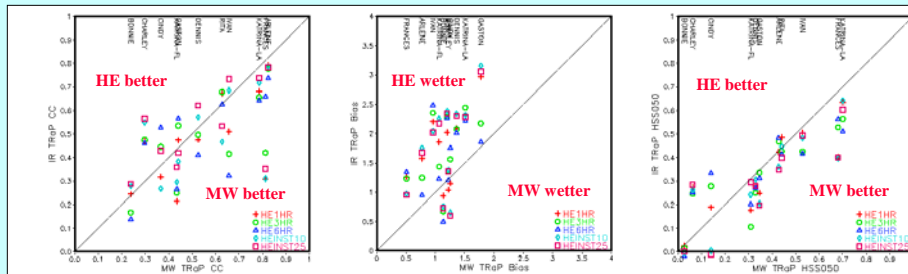


Figure 3. Scatter plots of correlation coefficient (left), volume bias (center), and 50-mm Heidke Skill Score (HSS) for the operational MW TRaPs versus the experimental IR HE TRaPs. The IR HE TRaPs are based on three different time averages (1HR, 3HR, 6HR) and two different spatial smoothing radii: 10 pixels (INST10) and 25 pixels (INST25).

Conclusions

- While the HE shows some skill, the MW remains the best single source for TRaP forecasts.
- However, it still has potential applications in an ensemble framework since at least some of the HE TRaPs outperformed the MW during most events.

Future Work

- Short term:** evaluate additional HE TRaP techniques (e.g., radial smoothing, time trend information).
- Longer term:** Develop a robust ensemble framework for TRaP that incorporates HE and MW TRaPs as well as climatology (see poster by Ebert et al. for details).

Acknowledgment: This work was supported in part by the GOES I-M Product Improvement Plan (GIMPAP). TRaP forecasts were provided by Jianbin Yang of QSS Group, Inc. and Clay Davenport of I. M. Systems Group (IMSG).

References

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