P4.15 IMPROVEMENTS TO THE SCAMPR ALGORITHM

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1. BACKGROUND

The Self-Calibrating Multivariate Precipitation Retrieval (SCaMPR) algorithm (Kuligowski 2002) was developed in order to combine the high spatial resolution and continuous availability of Geostationary Operational Environmental Satellite (GOES) data with the relative accuracy of microwave-based estimates of rainfall rate.

The original version of SCaMPR used rain rate estimates (Ferraro 1997) from the Special Sensor Microwave/Imager (SSM/I) onboard the Defense Meteorological Satellite Program (DMSP) F-13 and F-14 satellites as target values for calibration. Predictor data were derived from the GOES Imager, including brightness temperatures from channels 3 (6.9-µm), 4 (10,7-µm), and 5 (12.0-µm), several quantities derived from the channel 4 data, and rain rate estimates from the Auto-Estimator (A-E; Vicente et al. 1998) and GOES Multi-Spectral Rainfall Algorithm (GMSRA; Ba and Gruber 2001).

The calibration to the SSM/I rain rate estimates consists of two steps:

1. Selection and calibration of predictors for rain/no rain discrimination using discriminant analysis;
2. Selection and calibration of predictors for rainfall rate estimation using stepwise forward multiple linear regression.

Results for three test cases in Kuligowski (2002) indicated that SCaMPR represented some improvement over the A-E and GMSRA, mainly in the reduction of bias.

2. CHANGES TO THE ALGORITHM

A number of changes to the SCaMPR algorithm have either been implemented or are in the process of being implemented. These include:

- A more accurate footprint matching between the GOES and SSM/I data;
- Updating calibration after a fixed number of new raining pixels are available instead of after a fixed period of time;
- Including rain rate estimates from the DMSP F-15 satellite, the Advanced Microwave Sounding Unit (AMSU) on the National Oceanic and Atmospheric Administration (NOAA)-15 and -16 satellites (Ferraro et al. 2001) and the Tropical Rainfall Measuring Mission(TRMM) Microwave Imager (TMI; Kummerow et al. 2001);
- Addition of GOES Imager visible (0.69-µm) and channel 2 (3.9-µm) data for separate day/night calibration;
- Addition of other parameters derived from GOES Imager data, including cloud particle size and ice water path;
- Addition of Eta model fields such as precipitable water and relative humidity;
- Improvement of an experimental orographic correction.

In addition, the Hydro-Estimator (H-E; Kuligowski et al. 2002) has replaced the Auto-Estimator for both calibration and comparison purposes.

3. IMPACTS

As of this writing, the improved footprint matching has had marginal impact on the SCaMPR estimates, but the change in the calibration update requirements (fixed number of pixels instead of fixed time period) has led to some improvements in performance, mainly during dry periods when few raining pixels were available and calibration accuracy suffered as a result.

The inclusion of rain rate estimates from the additional microwave sensors also has had little impact on the estimates (Table 1); however, it has significantly reduced the amount of time required for training (Fig. 1), which in turn makes separate daytime and nighttime training more feasible, allowing visible-channel data to be effectively used. In the meantime, SCaMPR is outperforming the GMSRA in terms of both correlation and bias. The slight dry bias of the HE leads to better performance relative to SCaMPR, but the HE also exhibits a strong dry bias for heavier rainfall amounts (Fig. 2) that results in a slightly lower correlation with observations (Table 1). A comparison of 24-h totals for the three algorithms is given in Fig. 3.

Alg	RMSE (mm)	Bias	CC
H-E	11.5	0.85	0.55
GMSRA	18.3	1.86	0.48
SCaMPR (F13/14)	14.7	1.63	0.61
SCaMPR (all)	14.8	1.59	0.59

Table 1. Statistical comparison of the H-E, GMSRA, and SCaMPR with only the F-13/14 SSM/I data and with microwave rain rate estimates from all sources to daily raingauge data for the period 1-7 June 2001.

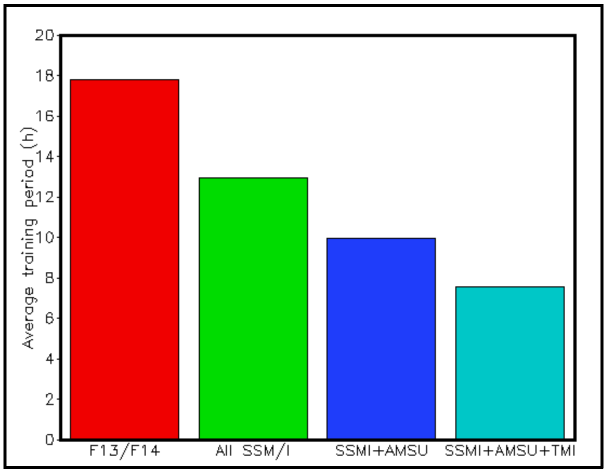

Figure 1. Average number of hours of data required updating the ScaMPR calibration as a function of input data source.

4. FUTURE WORK

After implementing the changes described here, SCaMPR will become available online in real-time during the first quarter of 2002. The estimates will be linked to the NOAA/NESDIS Flash Flood Home Page (http://orbit35i.nesdis.noaa.gov/arad/ht/ff/).

5. REFERENCES

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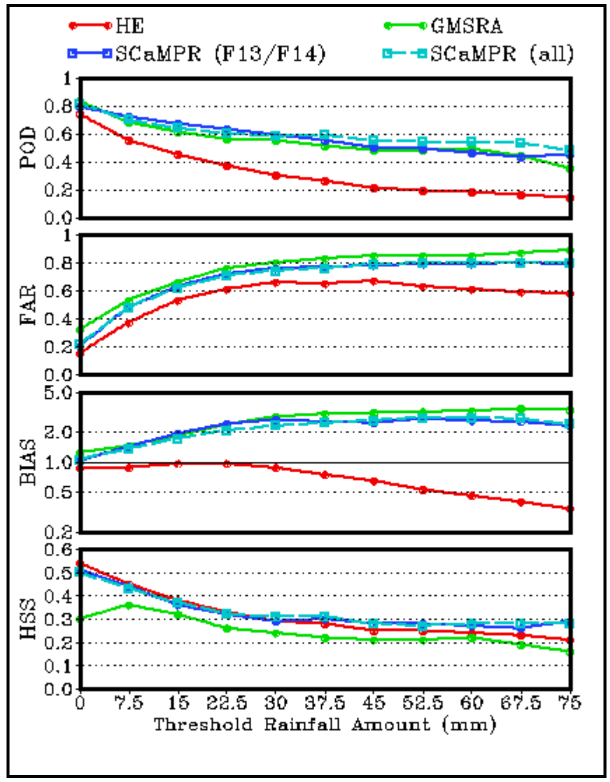

Figure 2. Skill scores (POD, FAR, bias, and HSS) for the HE and GMSRA compared to ScaMPR calibrated with just the F13/F14 data and with all microwave-based rain rate estimates.

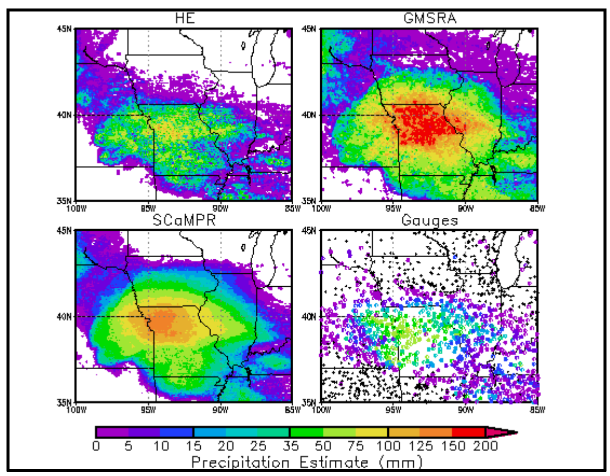

Figure 3. Comparison of rainfall totals from the HE, GMSRA, ScaMPR (with all microwave data for calibration) and rain gauges for the 24h ended 4 June 2001.

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