Self-Calibrating Multivariate Precipitation Retrieval (SCaMPR)

1. **Description/Theory:** The Self-Calibrating Multivariate Precipitation Retrieval (SCaMPR) uses microwave (MW)-derived rainfall rates to calibrate an infrared (IR)-based rainfall rate algorithm in an effort to provide high-resolution coverage in space and time at a higher accuracy than IR-only algorithms. After aggregating IR-based predictors to the footprints of Special Sensor Microwave/Imager (SSM/I) and Advanced Microwave Sounding Unit (AMSU)-based rain rate products and matching them in time, calibration is performed once a the matched data set contains a sufficient number of pixels with rain rates above 2.5 mm/h. The calibration is performed in two steps: first, discriminant analysis is used to select the predictor and threshold value that provides the best skill at matching the rain / no rain discrimination of the MW rain rates, and then stepwise forward linear regression is used to select the predictor and regression coefficients that provide the best match of the MW rain rates. Nonlinear transforms are added to the predictor set to more accurately capture the relationships involved. The resulting coefficients are then applied to subsequent IR imagery to produce rainfall rates. As new MW data become available, they are matched with the corresponding IR data and older matches are cycled out.

   Kuligowski, R. J., 2002: A self-calibrating GOES rainfall algorithm for short-term rainfall estimation. *J. Hydrometeor*., **3**, 112-130.

2. **Strengths and Weaknesses**

   Strengths: Since the calibration of SCaMPR is variable in space and time, it can account for differences in the relationship between IR brightness temperatures and rainfall rate that reflect differences in precipitation regime.

   Weaknesses: Since SCaMPR depends on MW rain rates for calibration, any errors in the MW rain rates will be reflected in the SCaMPR fields.

3. **Algorithm Inputs**

   A. Satellite Data

      1. **Geostationary**

         A. GOES-12 Imager (every 15 min – 6.9 μm, 10.7 μm, 13.3 μm, 15-30 min delay)
         B. GOES-11 Imager (every 15 min – 6.7 μm, 10.7 μm, 12.0 μm, 15-30 min delay)

      2. **Low Earth Orbit**

         A. DMSP F-13, 14 SSM/I rain rates (primary: EDR FNMOC algorithm, available on NOAA/NESDIS gp10.ssd.nesdis.noaa.gov, ~1.5 hour latency)
         B. NOAA-15, 16, 17 AMSU-B rain rates (current NESDIS algorithm, available on NOAA/NESDIS gp10.ssd.nesdis.noaa.gov, ~2.5 hour latency)

B. Ancillary Data

1. Model Data

None

2. In Situ

None

3. Other

None

4. Processing

A. Product Development Level 1

1. Create matched datasets of IR predictors and MW rain rates for calibration

   A. Aggregate corresponding IR predictors to most recently available MW footprints in each calibration region
   B. If there are more than 500 pixels with MW rain rates exceeding 2.5 mm/h, start deleting the oldest pixels in the matched dataset until the number is reduced to 500.

2. Create calibration coefficients
   A. For those regions with a sufficient number of calibration pixels, use discriminant analysis to determine the predictor(s) and corresponding coefficients that best replicate the rain / no rain discrimination of the MW data.
   B. For those regions with a sufficient number of calibration pixels, use stepwise forward linear regression to determine the predictor(s) and corresponding coefficients that best replicate the MW rain rates.

B. Product Development Level 2

1. Apply the calibration coefficients to the selected predictors to produce rainfall rate retrievals for current IR imagery at the full resolution of the IR imagery.

5. Output Products

A. SCaMPR instantaneous rainfall rates in mm/h

1. **Temporal/Spatial Resolution:** 15 min, 0.0443 lat, 0.0359 lon

2. **Spatial Coverage:** 15-60 N, 135-65 W.

3. **Dedicated Product Web Page Location:**
   http://www.star.nesdis.noaa.gov/smcd/emb/ff/scampr.html

4. **Processing Specifics**
   A. **Latency:** 15-30 min
   B. **Update Frequency:** 15 min

5. **Operational Availability of Product** (graphic only)
   A. **Source:** http://www.star.nesdis.noaa.gov/smcd/emb/ff/scampr.html
   B. **Latency:** 35 min
   C. **Update Frequency:** hourly
   D. **Available Record Length:** past 3 days

6. **Historical Availability of Product**
   A. **Source:**
      ftp://www.orbit.nesdis.noaa.gov/pub/smcd/emb/f_f/validation/Archive/Grids/
   B. **Update Frequency:** daily
   C. **Available Record Length:** last 30 days online; since 4 November 2004 offline

6. Planned Modifications/Improvements

Incorporate lighting data and PW / RH corrections; expand coverage area as far as computationally feasible; incorporate separate deep convective / other classification based on temperature differences between WV and IR window..

7. Capability of Producing Retrospective Data

Could be done over GOES coverage region but requires a significant amount of processing; quality expected to decrease somewhat as one goes back in time due to fewer MW instruments being available. No retrospectives possible prior to SSM/I launch in 1987.

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9. Additional Comments: none