Algorithm Inventory – SSM/I orbital, pentad and monthly rainfall

Updated 10 November 2008

1. Description/Theory

Reference: Ferraro, R.R., 1997: SSM/I derived global rainfall estimates for climatological purposes. *J. Geophys. Res.* **102,** 16,715 – 16,735.

The SSM/I operational precipitation rate algorithm, sometimes referred to as the "Ferraro algorithm", the "NESDIS algorithm" and the "FNMOC/EDR algorithm" (Fleet Numerical Meteorology and Oceanography Center, Environmental Data Record) is an 85 GHz scattering technique over land, and a combination 85 GHz scattering and 19/37 GHz emission approach over ocean. It is empirically tuned with ground based radar data. The algorithm has been unchanged for nearly a decade, however, it still serves as a benchmark algorithm that more advanced, and physically based approaches seek to improve upon.

Note: The algorithm is also being run for the DMSP F-16 and F-17 SSMIS in the EDR production, however, it should not be used in this format because the algorithm should account for the change of the 85 GHz to 91 GHz on SSMIS and FNMOC has not done this at this writing.

2. Strengths and Weaknesses

Strengths:

- Very simple to implement, under 100 lines of code.
- Screening for anomalous surfaces
- "Legacy" algorithm; unchanged for many years

Weaknesses:

- Known biases, in particular, over land, with tendency to overestimate in heavy rain event. Additionally, rain rates associated with emission component are based on limited data set
- It's an old algorithm with better alternatives

3. Algorithm Inputs

A. Satellite Data

1. Geostationary - None

2. Low Earth Orbit

A. DMSP F-13 and F-15 SSM/I TDR (climate products) and SDR (instantaneous product) radiances at 19, 22, 37 and 85 GHz. Data latency is 1 – 3 hours.

Note: Algorithm is applicable to any DMSP SSM/I, however, only F-13 and F-15 are operational at this writing (November 2008)

B. Ancillary Data - None

1. Other (i.e. topography data base)

A. Static Land/Sea/Coast databases are used for both the instantaneous and climate scale products

4. Processing (i.e. Level 2 processing ingests Level 1 products as input)

A. Product Development Level 1 - Generate SSM/I L1 orbital/swath products (known as FNMOC EDR files)

1. Input DMSP SSM/I SDR radiances.
2. Access ancillary data
3. Generate FOV specific SSM/I derived products (EDR's), including TPW, CLW, snow cover and sea-ice concentration.
4. When "possible rain" conditions are determined, enter retrieval algorithm and determine presence of rain, then calculate rain rate.
5. Store products in DMSP SSM/I EDR files; make accessible to users on FNMOC and NESDIS FTP server.

B. Product Development Level 2 – Generate SSM/I pentad rainfall at 1.0 and 2.5 degree

1. Generate 1/3 degree gridded fields of daily SSM/I (each satellite separately) TDR's; separate ascending and descending nodes.
2. Compute mean rain rate at particular grid size for five day period.
3. Output in binary format.

C. Product Development Level 2 – Generate SSM/I monthly rainfall at 1.0 and 2.5 degree

1. Generate 1/3 degree gridded fields of daily SSM/I (each satellite separately) TDR's; separate ascending and descending nodes.
2. Compute mean rain rate at particular grid size for monthly time period.
3. Output in binary format

5. Output Products

A. SSM/I Swath rain rates

1. **Temporal/Spatial Resolution:** Instantaneous; 12.5 and 25 km.

Note that at the time of this writing (November 2008), the time of the local ascending overpass for each of the DMSP satellites is as follows: DMSP F-13 1827; DMSP F-15 1847.

2. **Spatial Coverage:** 1400 km swath width

3. **Dedicated Product Web Page Location:**

http://www.osdpd.noaa.gov/PSB/SHARED_PROCESSING/SHARED_PROCESSING.html

4. **Processing Specifics**
   - **Latency –** 0 to 3 hours
   - **Update Frequency –** Whenever new orbit is received (orbits are approximately 100 minutes in length)

5. **Operational Availability of Product**
   - **Source –** Available via NESDIS FTP; contact Limin.Zhao@noaa.gov for registration form.
   - **Latency –** 0 to 3 hours
   - **Update Frequency -** Whenever new orbit is received (orbits are approximately 100 minutes in length)
   - **Available Record Length –** last 72 hours

6. **Historical Availability of Product**
   - **Source –** NOAA CLASS system: http://www.class.noaa.gov/; access DMSP EDRR files
   - **Update Frequency -** Daily
   - **Available Record Length:**
     i. **DMSP-F11:** January 1991 to April 1995
     ii. **DMSP-F13:** May 1995 to present
     iii. **DMSP-F14:** May 1997 to August 2008
     iv. **DMSP-F15:** March 2000 to present

B. SSM/I pentad and monthly rainfall

1. **Temporal/Spatial Resolution:** 5-day and monthly/1.0 and 2.5 degree.

Note that at the time of this writing (November 2008), the time of the local ascending overpass for each of the DMSP satellites is as follows: DMSP F-13 1827; DMSP F-15 1847.

2. **Spatial Coverage:** Global

3. **Dedicated Product Web Page Location:**
http://lwf.ncdc.noaa.gov/oa/satellite/ssmi/ssmiproducts.html

4. **Processing Specifics**

- **Latency –** Monthly
- **Update Frequency –** Monthly

5. **Operational Availability of Product - None**

6. **Historical Availability of Product**
   - **Source –** Web/FTP access at: http://lwf.ncdc.noaa.gov/oa/satellite/ssmi/ssmiproducts.html
   - **Update Frequency -** Monthly
   - **Available Record Length:**
     i. **DMSP-F8:** July 1987 – December 1991
     ii. **DMSP-F10:** January 1991 to November 1997
     iii. **DMSP-F11:** January 1991 to April 1995
     iv. **DMSP-F13:** May 1995 to present
     v. **DMSP-F14:** May 1997 to August 2008
     vi. **DMSP-F15:** March 2000 to present

6. Planned Modifications/Improvements

- None, although a capability to run near-real time SSMI and SSMIS GPROF 2004 is being developed and is available to researchers upon request.

7. Capability of Producing Retrospective Data

- Potentially through NOAA's Scientific Data Stewardship program.
- NOAA and the Cooperative Institute for Climate Studies (CICS) has reprocessed SSM/I rain products via GPROF 2004 for the period 1998 – 2008.

8. Contact Personnel

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9. Additional Comments

None.