Impact of Megha-Tropiques data in GPM constellation based rainfall estimation

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Outline of the presentation

1. Status of the Megha-Tropiques mission
   • The archive of MADRAS
   • The SAPHIR instrument

2. Rainfall estimation with two constellations
   • Rationale
   • Method
   • Impact of SAPHIR

3. Intercomparison with other products
   • Quantitative agreement over the West African region
   • Discrepancies over the Indian subcontinent

4. Development of the error model

5. Conclusions & Perspectives
The status of the Megha-Tropiques mission

The mission in 1 slide!

- Indo-French Mission built by ISRO and CNES launched in October 2011
- dedicated to the monitoring of the water and energy cycle in the tropics
- Orbit with 20° inclinaison on the equator
- Nominal life: 3 years

EXTENDED for 2 years!

SCARAB
MADRAS
SAPHIR

GPM constellation configurations

Courtesy CNES
The status of the Megha-Tropiques mission

Past archive: MADRAS archive

MADRAS 89GHz sees Sandy over 2 days!

- Worked up to the end of January 2013
- Glitch issues
- Long commissioning phase
  - On going reprocessing with v7000
  - Still under restrictive data policy
  - should be broadly open current 2015

From Roca et al., 2014

See talk by N Viltard for more details
The status of the Megha-Tropiques mission

The SAPHIR instrument (1/2)

- 148 Parameters monitored
- About 100 alarms
- Every 6 month, calibration control on Amazonia and Titicaca Lake

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<th>CH3</th>
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The status of the Megha-Tropiques mission

The SAPHIR instrument (2/2)

Absolute Calibration

• Radiative transfert computations shows slight warm bias with radiosondes increasing way from 183GHz within the expected methodological uncertainties (but for the warmest channels).

• Same order of magnitude as other 183 GHz sounders (Wilheit et al., 2013)

Real Time delivery

Since May 2013 the SAPHIR L1A data are available in real time to registered users thanks to the EUMETCast link operated by EUMETSAT with the support of CNES/ISRO

Data are assimilated in the Météo-France global model since September 2014
Rainfall estimation with two constellations

Rationale for the TAPEER (UAGPI) at 1°/1 day

Accumulated Rainfall (in mm) = \( \overline{R_{\text{cond}}} \) (in mm/day) \times \text{Fraction (in %)}

1. training over a volume to obtain \( \overline{R_{\text{cond}}} \) using MW instantaneous rain rates estimates
2. training over a volume to obtain BTIR\(_{\text{threshold}}\) using - MW instantaneous rain mask and - IR imagery
3. use BTIR\(_{\text{threshold}}\) to obtain Fraction of the actual day using the IR imagery
Rainfall estimation with two constellations
Rationale for the TAPEER (UAGPI) at 1°/1 day

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Step 1 relies on the L2 retrieval of rainrates estimation (bias, etc...) Step 2 relies on the L2 detection (sensitivity, definition, etc..) Both steps depends (differently) on the training dataset volume and its representativity

Each step requires to identify the relevant L2 products and the adequate training volume
Rainfall estimation with two constellations
Rationale for the UAGPI at 1°/1 day Summer 2012 configuration

Accumulated Rainfall (in mm) = \( R_{\text{cond}} \) (in mm/day) \times \text{Fraction (in %)}

STEP1: Constellation for \( R_{\text{cond}} \)
BRAIN Estimation on TMI, AMSR2, SSMI F15, SSMIS F16,F17,F18
5° x 5 days optimized for estimating the mean with as many point as possible

STEP2: Constellation for Frac
BRAIN Detection on TMI, AMSR2, SSMI F15, SSMIS F16,F17,F18
Hong detection on SAPHIR
3°x1 day optimized for representativity of the BTIR threshold with daily update

SAPHIR 183 GHz
« Hong et al» Mask
Available as part of the SAPHIR UTH retrieval (Brogniez et al., 2014)

See talk of Clément Guilloteau

See also Posters:
- Viltard and Martini
- Kacimi and Haddad

Courtesy M. Alcoba
Rainfall estimation with two constellations
Results for the West African Monsoon region JAS2012

All products have a very good score compared to our research network

See talk of Marielle Gosset
Rainfall estimation with two constellations
The contribution of SAPHIR

Without SAPHIR the TAPEER product would have
• lower correlation
• higher RMSE

Courtesy J. Veslot
Intercomparison over monsoons regions
Seasonal mean of Product – TAPEER (mm/day)

Large differences in between the products over continental India

Less of a problem over continental Africa
Development of our error model
Tropical Amount of Rainfall with Estimation of Errors (TAPEER)

\[ E^2 \approx E^2_{\text{Calibration}} + E^2_{\text{Algorithm}} + E^2_{\text{Sampling}} \]

- Calibration / inter-calibration of instruments
- Instantaneous rain product errors + Multiple data merging method errors
- Space/time measurements occurrence
Development of our error model

Tropical Amount of Rainfall with Estimation of Errors (TAPEER)

\[ E^2 \approx E^2_{\text{Calibration}} + E^2_{\text{Algorithm}} + E^2_{\text{Sampling}} \]

Neglected (small)

Instantaneous rain product errors +
Multiple data merging method errors

Recent efforts on this aspect

Estimation based on variograms (Roca et al., 2010)
Development of our error model
Tropical Amount of Rainfall with Estimation of Errors (TAPEER)

Comparing the results of the 1998 constellation vs the 2012 constellation for JAS 2012

$F\left( |\text{Rain}_{12} - \text{Rain}_{98} | \right) < 3 \sqrt{\text{Var} \left( \text{Rain}_{12} - \text{Rain}_{98} \right)}$

See talk (next) from G. Huffman on the constellation sustainability

See Poster of Nicolas Taburet
Conclusions & Perspectives

- The SAPHIR instrument is in good health and the mission is extended for 2 years
- Developments are going on the use of the SAPHIR data for precipitation
- TAPEER products shows improvement when SAPHIR is used
  - Very good comparisons with rain gauge in Africa
  - Large divergence among the products over continental India
- On going analysis of summer 2012, 2013 and 2014 with research algorithm
- Megha-Tropiques data are available at [www.icare.univ-lille1.fr/mt](http://www.icare.univ-lille1.fr/mt)
  - Level 1 data from SAPHIR and SCARAB
  - Level 1 data from MADRAS (restricted access)
  - Precipitation products operationnal production in commissionning stage soon to be released
- Conférence in Paris 2nd half of November 2015 in preparation dedicated to the « Water and Energy cycles in the tropics »

Check [www.megha-tropiques.ipsl.polytechnique.fr](http://www.megha-tropiques.ipsl.polytechnique.fr)