Global Precipitation Measurement

GPM Microwave Imager (GMI) Algorithm Development Approach

EGU General Assembly 2009
April 22, 2009

Erich Franz Stocker
GPM Dep. Proj. Sci. for Data
Erich.F.Stocker@nasa.gov
(301) 614-5178

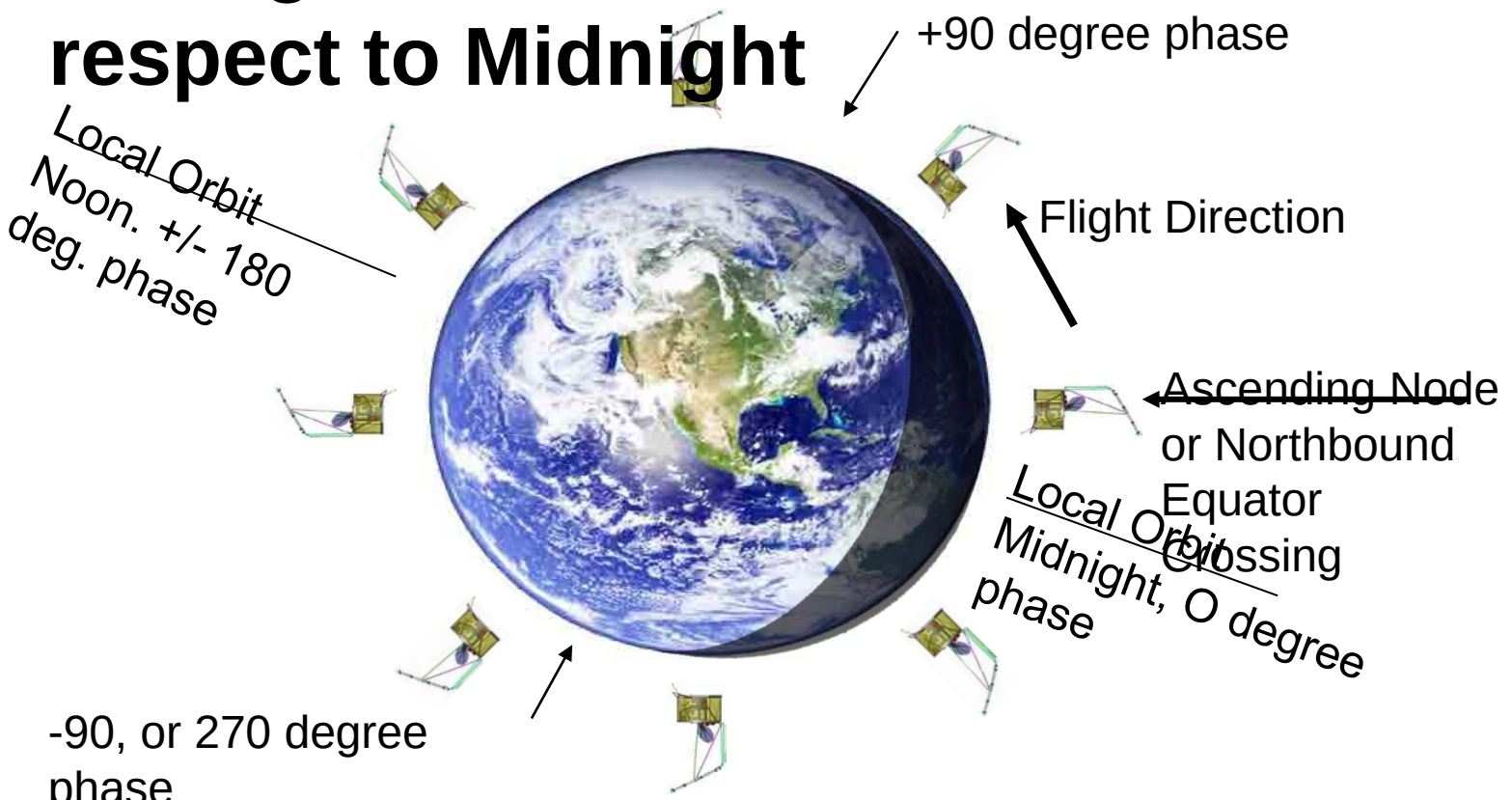
GMI L1 Algorithm Responsibilities

- ***Explanation of level 1***
  - *L1a granules are maintained in CCSDS scan packets*
    - *Quality control and packets grouped into designated granules*
    - *Current plans calls for a granule to be an orbit (but without overlap scans as in TRMM)*
  - *L1b granules are T_b*
    - *Calibrated and geolocated*
    - *Current plans call for granule to be an orbit*
    - *No overlap scans at beginning and end of the orbit as in TRMM*
  - *L1c granules are intercalibrated T_b (T_c)*
    - *Intercalibration done only if necessary*
    - *Current plans do not call for an intercalibration algorithm to be applied to GMI*
    - *Interacalibration algorithm is a "community" accepted algorithm to be applied among radiometer T_b products*
- ***Level 1a algorithm code is implemented by Precipitation Processing System (PPS)***
- ***Level 1b algorithm are developed jointly by***
  - *the PPS (which also implements the code)*
  - *contractor calibration subcontractors (RSS)*
  - *designated GPM instrument scientist (Dr. Jim Shiue)*
- ***Level 1c intercalibrated algorithms (where necessary for GMI) jointly prepared by the intercalibration algorithm team and PPS***

Calibration Responsibilities

- ***GMI contractor has responsibility for conducting calibration activities that will demonstrate that the GMI is operating within specifications***
- ***RSS who has been subcontracted by Ball (GMI contractor) to carry out their calibration responsibility has proposed both a short-term and long-term calibration effort***
  - *RSS will provide calibration code to PPS*
  - *RSS has allowed PPS to incorporate all or part of their calibration approach into the GMI L1b algorithm code*
- ***PPS and the GMI instrument scientist have the responsibility for developing the operational calibration code for GMI L1b routine production***
  - *PPS will based GMI calibration code upon the TMI code merged with the operationally implementable parts of the RSS calibration code produced for Ball*
  - *Much of the RSS approach can be integrated into the L1b code as it can be applied in an automated and routine fashion*
  - *Those "after the fact" aspects of the RSS calibration approach will be included in a quality control process and for long-term checking of GMI calibration.*
- ***Experience with calibration of previous microwave imagers has shown that warm load issues have contributed to calibration issues***
  - *GPM & GMI thermal design incorporates much to mitigate the warm load problem*
  - *GMI design includes noise diodes that could be used to check (or when necessary) replace/adjust problematic warm load anomalies*

Local Orbit Noon, Local Orbit Midnight, & Phase in Orbit with respect to Midnight



"SolarPhaseInOrbit" variable included in ancillary 1X HDF file along with "SolarBetaAngle" and "SunPresenceFlag" to show shadow periods.

Capturing Sun Angle Information for GMI

- ***While it is unlikely that GMI will have the same issues with emissive antenna as TMI, it is important to calculate and record information that would allow calibration adjustments***

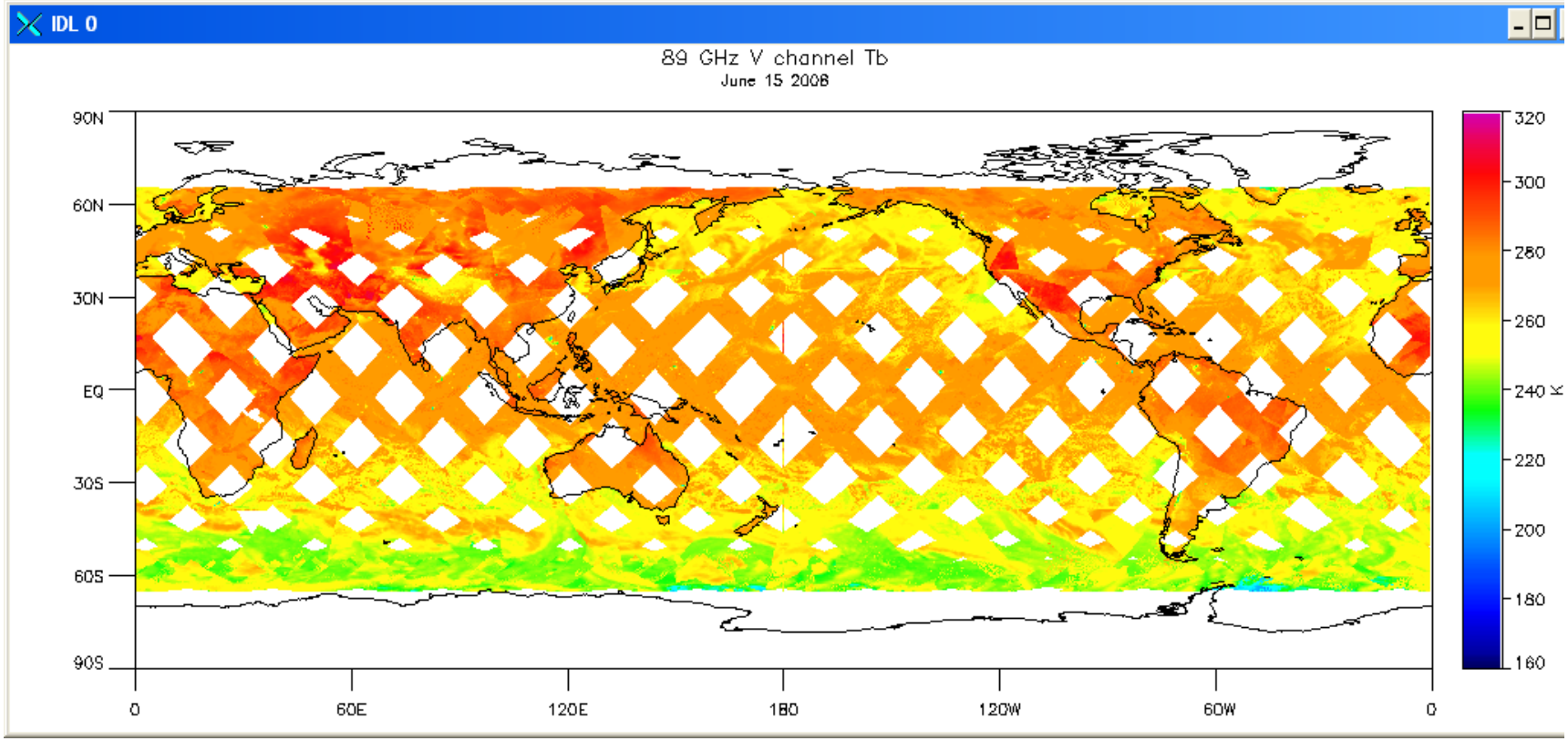
- ***Sun Angle data to be captured for GMI***
  - *SolarBetaAngle -- Sun elevation above the orbit plane*
  - *SolarPhaseInOrbit -- phase around orbit from local midnight*
  - *SunPresenceFlag -- =0 for spacecraft in shadow, =1 in sunlight*
  - *BodySunVector -- Sun Vector in spacecraft/instrument coordinates*
  - *BodySunElev -- Sun elevation above instrument horizontal plane*
  - *BodySunBeta -- Sun elevation in body X-Z plane, positive toward -Y*
  - *BodySunPhase -- Sun phase around body X-Z plane, from +Z toward +X*
  - *SunVecGCI -- Sun vector in geocentric inertial coordinates*

Synthetic and Simulated Data

- ***For ensuring the appropriate testing of algorithm code PPS is developing synthetic data***
  - *PPS defines synthetic data as made from the combination of data from similar channels from multiple existing satellites*
  - *So from PPS perspective synthetic data comes primarily from observational rather than from solely from model data*
  - *For details of current PPS synthetic data efforts, see poster:* Simulation of Global Precipitation Measurement Microwave Imager level 1 and Level 2 data by Yimin Ji
  - *Synthetic data is not the best way to ensure appropriate data completeness and inclusion. So, may not be the best and certainly not a complete way to test the science contained in algorithms*
- ***PPS will generate many synthetic data orbits to allow early testing of GMI algorithm code.***
  - *PPS will generate only GMI synthetic data*
  - *We will reverse T_b synthetic data to instrument counts to test the level 1B code*
  - *By processing 1A should essentially reproduce the synthetic T_b*
  - *Did this for TRMM and other projects such as Aquarius also do.*
- ***Under the sponsership of the science team and GPM Project Scientist, Dr. Tao's group is working on a satellite simulator for GPM***
  - *Generate both GMI and PR data*
  - *Based on modeling*
  - *Correctly represent all aspects of the GMI/PR data within the GPM satellite track and inclination*
  - *Allow testing of the science contained in the retrieval algorithms*
  - *Should be able to generate instrument counts*
  - *Available for mission simulations and Operational Acceptance Testing (OAT)*

Current Synthetic Data 89GHz V

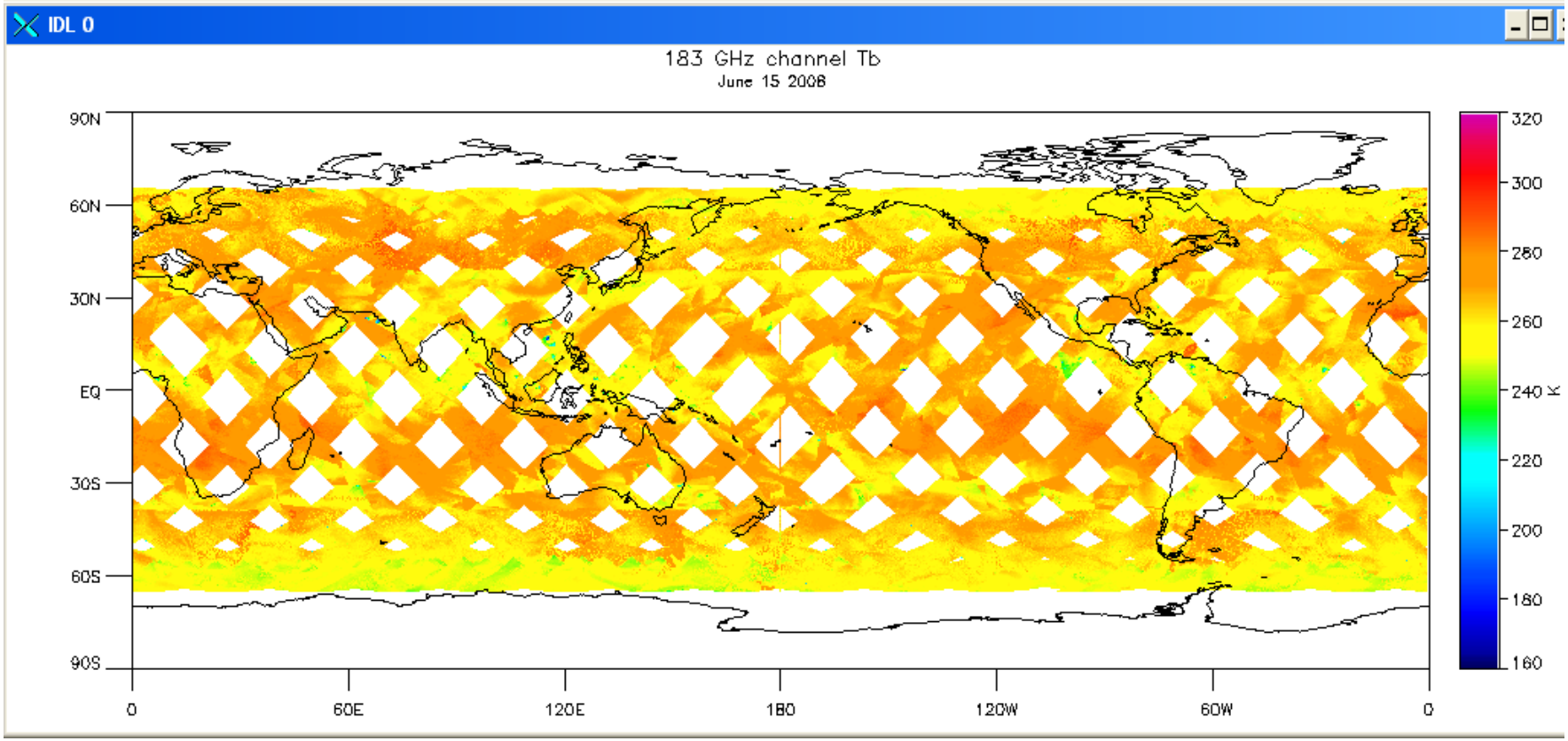
Synthetic GMI Tb of 89 GHz V Channel



See Yimin Ji poster for explanation

Current Synthetic data GMI 183 GHz

Synthetic GMI Tb of 183 ± 3 GHz Channel



See Yimin Ji poster for explanation

Conclusions

- ***PPS has responsibility for the coding of L1A, L1B and some of L1C GMI code***
- ***Considerable experience is brought forward from TMI calibration. However substantial interactions are taking place with the GMI contractor calibration efforts***
  - *Incorporate contractor calibration efforts into the production calibration*
  - *Integrate and translate all contractor provided calibration code*
  - *Use all appropriate calibration efforts to quality control calibration*
- ***Provide data early in the project for testing of algorithms***
  - *PPS generate orbits of synthetic data*
  - *GPM science team provided satellite simulator data for science code testing: appropriate months of data to allow testing of level 3 data*
- ***Simulated data used***
  - *Project mission simulations and*
  - *Operational acceptance testing*