### NASA PMM Land Surface Working Group (LSWG)

# Meeting Summary 5 August 2014, Baltimore, MD

#### Prepared by J. Turk, LSWG co-chair

**LSWG Attendance**: Dave Randel (CSU), Pierre Kirstetter (NOAA/NSSL), Veljko Petkovic (CSU), Joe Munchak (GSFC), Liao-Fan Lin (GA Tech), Steve Durden (JPL), Guosheng Liu (FSU), Song Yang (NRL), Yudong Tian (GSFC), Ken Harrison (GSFC), Christa Peters-Lidard (GSFC), Sarah Ringerud (CSU), Chris Kummerow (CSU), Giulia Panegrossi (ISAC/CNR), George Huffman (GSFC), Ralph Ferraro (NOAA), Ben Johnson (GSFC), Joe Turk (JPL).

#### Summary

The PMM Land Surface Working Group (LSWG) held its group meeting during the Tuesday night of the PMM science team meeting in Baltimore. The LSWG has traditionally been tasked with dual-purpose efforts. First, to carry out basic research efforts to quantify the microwave land surface properties (multi-channel emissivities and radar backscattering cross-section), both of which are highly variable owing to changing land surface conditions. The second is a more practical side, where these research findings, when appropriate, are to be tested and implemented by the GPM retrieval algorithms to improve precipitation estimation over land.

The PMM LSWG has telecalls (unless otherwise cancelled) on the first Wednesday of each month, at 11 AM Eastern time. Presentations are available at: <u>http://lswg.umd.edu</u>.

The group has made steady progress over the past three years in both aspects, examining both classification and physically-based approaches to emissivity and radar backscatter (there is a PMM radar sub-group that has focused on classifying land radar backscatter-Bob Meneghini, Steve Durden, Joe Munchak, amongst others). A land classification is implemented in the current Version-1 GPROF (land classification index to stratify the apriori databases, so the same land class database is used as the observation scene class). A number of physical emissivity approaches have been studied (coupled land surface modeling and bulk RT model; joint physical properties and emissivity retrievals) using AMSR-E and TMI data. Now that there are almost six months of GPROF retrievals running on the current MW imaging radiometers (GMI, TMI, SSMIS, AMSR2), the actions for the coming year were broken down into six general categories:

## 1) Focus on emissivity/sigma0 from a land surface physics perspective.

The surface properties have features that usually vary slowly (e.g., vegetation, soil type), diurnally varying (e.g., surface temperature) and more rapidly-varying (e.g., upper 2-3 cm soil moisture). The classification approaches, while useful for the algorithms, don't explicitly carry any physics so it is not possible to directly relate surface emissivity

features or changes to the underlying physical properties. The continued studies of the S1 type classification are important, but increased emphasis will be placed upon studying physical land properties. These studies should help point the way towards construction of over-land physical databases and how to use them in the retrieval itself (e.g. how to efficiently index and search the a-priori databases).

# 2) Evaluation of GPROF radiometer retrievals from land surface perspective.

Over land, much of the precipitation is driven by frontal systems, so looking at mean average zonal precipitation (as is commonly done with over-ocean precipitation over a month) is not especially meaningful. The group will focus its GPROF evaluation separated by land surface properties, e.g., terrain slope, surface temperature, cold/warm season. Pierre Kirstetter had a presentation during the PMM meeting where he showed the various evaluation metrics (versus NMQ) for various land types. Could also involve synthetic retrievals to better quantify the effect of the surface on the retrievals (J. Turk poster).

# 3) Evaluation amongst S0, S1, S2 GPROF variants, for self-consistency.

Currently only GPROF S1 (land classification) is running over land. As S0 gets implemented for more sensors, and some various methods for S2 are examined, eventually the retrieval variants will need to be examined for self-consistency. Not sure of status of current S0 retrieval variant. Will existing 15-class TELSEM continue to be used in S1?

## 4) Development of new over-land databases for future GPROF Version 2.

The databases now are indexed by ancillary properties (land surface temp, total column vapor, land surface class). Since land surface temperature varies quite widely between various model analyses, the use of the 2-m air temperature for database indexing (to replace land temperature) was discussed (there was a poster on this at the PMM meeting). While the over-land database generation will still need to use a land surface temperature to do the forward RT simulations for the constellation satellites, the database will also carry the 2-m air temp and that can be used at retrieval (ie, retrieval gathers database entries with similar 2-m air temperature). For physical land databases, this is still a research topic, but it appears that index terms that provide information on vegetation (while not optimal, even an optical or infrared vegetation index could be used) and soil moisture (or proxy for) appear to be good candidates to better stratify/separate database entries that feed the over-land retrievals. This will be discussed further at upcoming land group telecalls. Also, this topic was revisited in more detail at the "sounder group" meeting on Thursday (see subsequent pages in this report summary).

## 5) Use of recent PMM field campaign data.

During IPHEX, there were a number of clear-air flights that took place before, during and after weather events. With the large number of aircraft radars and also the AMPR aircraft radiometer, there exists a good opportunity to study the fine-scale land surface properties (eg retrievals of clear scene emissivity, and observed radar backscatter cross-section) in more detail. Joe Turk to get in touch with Tim Lang to find good AMPR cases and locate what radar data are available for these cases. However, currently no current land-

based studies (that we are aware of) for the IPHEX data. Land surface group to discuss further focusing on IPHEX domain (like what has been done for SGP area).

# 6) More evaluation of MW sounder-based (crosstrack) retrievals.

Chris Kidd has been the main contact and developer, who has taken the existing GPROF retrieval code for the imagers, and adapting it for the MW sounders, using the modelsimulated profiles generated by Toshi Matsui (GSFC) to generate generic retrieval databases. Land group to carry out evaluations of the current sounder retrievals (mostly MHS until now, but eventually ATMS and SAPHIR), and compare to GMI from satellite-satellite coincidences. However, the sounder database is likely to undergo changes once the GMI-DPR combined retrievals are released. This topic was further discussed at the Thursday meeting (subsequent pages).

#### NASA PMM Sounder Algorithm Meeting

# Meeting Summary 7 August 2014, Baltimore, MD

#### Prepared by J. Turk

Attendance: Chris Kummerow (CSU), George Huffman (GSFC), Joe Turk (JPL), Bob Meneghini (GSFC), Joe Munchak (GSFC), Mircea Grecu (GSFC), Bill Olson (GSFC), Chris Kidd (GSFC), Nai-Yu Wang (NOAA), Yalei You (NOAA/Univ. MD.), Pierre Kirstetter (NOAA), H. Masunaga (Nagoya Univ.), (quite a few others walked in during the meeting, so this is not an inclusive list).

#### Summary

The discussions on the passive MW sounder retrievals were deferred to a Thursday midday meeting, in order to accommodate other meetings and to get the (as many of the) necessary people all in one place. Chris Kidd described the current implementation and adjustments that he has made to the existing MW sounder retrievals, which he has had to implement to get the retrieval to adequately represent global precipitation features.

Since the key members of the team working on the combined (GMI+DPR) retrieval were in attendance, the discussion mostly focused on a way forward to the "version 2" GPROF which, pending performance tests and evaluations, will replace the empirical imager databases (NMQ-based) that are used in Version 1 now. Also, these retrievals will be used to forward simulate the various MW sounder channels (at the 5 selected incidence angles, maybe less or more) and replace the existing MMF-based MW sounder databases. While it is desirable to wait for an entire year (i.e, until end of February 2015) of combined retrieval datasets in order to properly represent the seasons at all latitudes, and build the databases from this full year, the suggestion was made to use the Ku-band only retrievals beginning after October 2014, and get started with the forward model simulations for the constellation MW sounders. Joe Turk and Chris Kidd to test comparisons between GPROF-GMI retrievals and the MHS retrievals, using sat-sat coincidences. (not sure of time line on any of this).