**GSICS Annual Meeting: Microwave Subgroup Meeting**

**1100-1300 UTC December 17, 2021**

**Attendees:**

CMA: Qifeng LU, Shengli WU

JAXA: Misako KACHI

NASA: Ed Kim

NOAA: Quanhua “Mark” Liu, Robbie Iacovazzi, Hu “Tiger” Yang, Ninghai Sun, Xun “John” Yang

UK Met Office: Fabien Carminati

Hamburg University: Martin Burgdorf

Unknown Affiliation: Hujy

This meeting focused on communicating the status of subgroup member agency microwave projects.

**1. [30 mins] CMA Microwave Group Status (Shengli Wu – CMA)**

*Question and Answer*

Tiger – Does the MWRI-2 have a larger antenna and different calibration system design?

* Shengli - Yes, it is different from former MWRI, which is end-to-end calibration. The MWRI-2 calibration is more similar to JMI and AMSR-2.
* Tiger - This will be a challenge for future fundamental climate data records

Tiger - MWTS-3 has low noise even for Channel 17 at 57 GHz. ATMS has 1.6 K noise, but MWTS-3 has less than 1 K. Specification is 3.6 K, but noise is much less. Does it have a longer integration time, or newer technology?

* No answer available

**2. [30 mins] University of Hamburg Microwave Group Status (Martin Burgdorf – U. of Hamburg)**

*Question and Answer*

Mark – Is the next project for three years?

* Martin - Yes. It could be, but the funding agency may fund only two years. The aim though is three years.

Tiger – Have you explored the ATMS lunar observations with both AMSU and MHS? We could have some cooperation with this topic after the pandemic.

* Martin
  + Would be glad to do this.
  + Had a one point of ATMS data on one slide, but it fit well with MHS points.
  + Would be good to do with AMSU-A at the lower frequencies. Want to be able to discern if there are systematic changes over that last few decades. ATMS could serve as a reference for the old satellites.

Ed – You showed lunar eclipse data? What is the geometry?

* Martin
  + Total lunar eclipse observed by NOAA-15.
  + The earth moves between the moon and the sun. In the earth shadow is fully covering the moon, the moon surface can begin to cool off.
  + To fully model this phenomenon, we need to understand how the solar irradiation changes over time, and how the lunar regolith responds to these changes.
* Tiger – By checking the satellite, sun, earth and moon geometries, it can be determined if we have a lunar eclipse. The sun-earth and sun-moon angle difference will be 180 degrees apart. You can use the SGP4 for this.

Ed – Sounds like you might have done some modeling. What is the effective emitting depth. How deep into the soil is it actually contributed.

* Martin - Modeling came from Liu and Jin 2021. The depth is about 10 cm.
* Tiger
  + We have done some study for the lunar model and depends on frequency.
  + When we simulate we use the temperature profile. The deepest we go is 1 meter.
  + Channels at 23 GHz there is some contribution from as deep as 10-20 cm, while for 183 GHz it can be as shallow as 1 cm. This is the cause of the temperature drift with respect to lunar phase angle.
  + There can be a lag between the full moon and the thermal response. Root cause of phase angle drift is thermal inertia. Low frequency can have a shift as large as 36 degree after full moon. It takes time for deeper layers to respond thermally.

**3. [30 mins] NOAA Microwave Group Report (Robbie Iacovazzi – NOAA)**

*Question and Answer*

Martin – Are there more maneuvers planned to observe the moon?

* Tiger – A roll maneuver to observe the moon in the earth view has been submitted for JPSS-2, but depends on the JPSS Flight Project managers. JPSS-1 there was a pitch maneuver to look at the moon. No plan for JPSS-2.
* Ed
  + So far, the currently operating ATMS did some maneuvers during commissioning. In one of those maneuvers we had the moon in cold space, and able to make some observations. It was not planned to use that data, as we did not expect to use the moon for cal/val.
  + With future ATMS we may try to make measurements when we know the moon is in space view, but this again this is subject to approval from the Flight Project.
  + After commissioning, there are no plans for further measurements.

Ed - Backus-Gilbert has been used in the past to try to achieve resolution improvements, but they are very modest. It seems like more noise in Slide 25 Figure D. Are you trying to achieve resolution improvement? If so, to what degree?

* Tiger –
  + We wanted to devise a method to keep noise down and refine spatial resolution.
  + A method was created to analytically determine the trade off that will keep noise down and improve resolution. Formerly, there was no quantitative way to do this.
  + When there is the goal of increasing the resolution from 5.2 deg to 3.3 deg beamwidth, it was discovered that we need to consider the adaptive window, instead of the fixed window.
  + This can keep the noise the same levels as traditional BGI, but improve the resolution.
* Jun
  + BGI is applied to antenna pattern matching problems. When applied to antenna matching, the root cause is the reconstruction window.
    - The window is fixed in former studies (3x3)
    - We enlarged the window and made it adaptive to scan angle changes. Want to incorporate all available observations in the reconstruction. More information is incorporated.
    - The bias caused by fixed window is reduced.
    - We use the tradeoff curve to decide what we want the noise to be. In this case under 0.65 K.

Ed – What does 0.65 K noise mean? Is the NEDT or some other measurement quality assessment?

* Jun - Error dominated by noise, instead of the fitting error.

Ed - Previous studies showed even trying to reduce resolution slightly can cause huge increases in noise. For example, they found BGI they could reduce footprint size. They would do that from sample scenes and decide if the increased noise was acceptable. The tuning was subject. They reduce footprint by 10-20%, but increased noise was not acceptable.

* Tiger
  + For ATMS has overlapping scans. How can this be exploited? For users they use sounding channels. We can degradate using BGI algorithm. ECMWF AAPP uses remapping based on the frequency. For ATMS BGI performance is better than the frequency domain-based ray mapping in terms of bias and noise. Especially when BGI is to reduce noise. It is important for NWP uses.
  + For the surface channels, could apply enhancement, but there is a trade-off. Can get some resolution enhancement, but not drastic change.
  + BGI is better than the average when we want to reduce noise.

**4. [30 mins] JAXA Microwave Group Status (Misako KACHI – JAXA)**

*Question and Answer*

Mark – Maybe 5G Wifi may affect 37 GHz. Do you have estimate of how large the impact?

* Misako - There is not impact estimate, we just wanted to remove any possibility of the issue occurring completely.

Ed – Any change to the onboard cal hardware?

* Misako
  + The onboard cal system is similar to AMSR2. Will check with colleague if it is different.
  + Heard that the engineers are working hard during pre-flight test with calibration, because there was some issue after launch with AMSR-2 and want to mitigate this for AMSR-3.

Tiger – Do you use a different technology for RFI.

* Misako - We don’t have anything special for onboard, we have two different channels to monitor.

**5. [15 mins] Workshop (Qifeng LU [CMA] and Mark Liu [NOAA])**

Qifeng - There will be a workshop to be held in late February about the past, current and future of microwave remote sensing

Possible Conference Conflicts

* Ed – There is an RFI workshop ECMWF is in February 14-18. <https://events.ecmwf.int/event/258/>
* Mark - TOVS conference was last June, so next one should be the end of 2022.

Qifeng - A separate short meeting about the workshop was held. This is to give some general outline as a call for paper, and present invitation.

Several suggestions were made that were incorporated into the document GSICS\_MWSG\_Workshop\_Feb2022\_Outline\_17DEC2021.docx

ACTION: Qifeng – Contact ECMWF

ACTION: Robbie and Mark – Rosenkrantz, Wentz or CP (Draft a letter before holiday)

Mark and Qifeng could create a combined presentation for future instrumentation.

Get contributions from others.

Shengli’s suggestions

* Maybe get user input about what kind of talks would attract them to the workshop. Invite researchers from remote sensing field.
* In China two plans for L-band radiometer. Can invite the PI or other researchers to do introduction on their project.
* Invitation list – we can take some time to get a clearer idea of who we need to invite.

ACTION(Robbie): Draft and send list of invited speakers will send today.