**GSICS Annual Meeting: Microwave Subgroup Meeting**

 **1100-1300 UTC July 13, 2021**

**Attendees:**

China NSSC: Liu Congliang, Jieying He

NOAA: Mark Liu, Robbie Iacovazzi, Cheng-Zhi Zhou, Yong Chen, Xi Xiao, Ninghai Sun

EUMETSAT: Vinia Mattioli, Stephanie Linow

JAXA: Misako KACHI

Hamburg University: Martin Burgdorf

**1.** **Opening Remarks (Quanhua “Mark” Liu, NOAA)**

Understanding the radiosonde and RO data quality are very important, and hopefully these talks will shed some light on this.

**2. Comparison of COSMIC-2 Radio Occultation Retrieval Products with Vaisala RS41 and RS92 Radiosonde Water Vapor and Upper-air Temperature Measurements (Xi Xiao – NOAA)**

**Mark** – What model do you use as a background or first guess for the 1-D Var algorithm?

**Xi** – STAR uses GFS. UCAR uses GFS for real-time processing of COSMIC-2, but ECMWF for reprocessing. For COSMIC 1, UCAR used ECMWF.

**Mark** – The radiosonde only goes up to 30 km. How to validate COSMIC-2 above 30km?

Xi – Radiosondes normally cannot reach above 30 km. The COSMIC-2 uncertainty gets larger above 30 km. Going to higher heights with COSMIC-2, use L1 and L2 signal difference. It is more like geometric optics. Uncertainty is COSMIC-2 data compared to troposphere. Above 30 km can be impacted ionosphere signal, which creates an uncertainty.

**Mark** - RO reflectivity data is normally bias free, but you show some bias in temperature. Does radiosonde have bias, or RO data?

**Xi** – Humidity bias below 4 km probably comes from the RO. There can be super-refraction below 4km or ducting. There will be multiple solutions in the retrieval. It is a challenge for radio occultation. Yong Chen is leading the team.

**Robbie** – Does 1-D Var depend on NWP temperature, water vapor or both for the region with water vapor?

**Xi** – It uses both.

**Robbie** – Why does RS092 radiosonde have a warm bias around 17.8 km?

**Xi** – This is a known phenomenon. This is usually accounted for by a correction factor, but this is not perfect. The manufacturer provides this information. This occurs during daytime due to the sun’s heating. The rarified atmosphere does not thermodynamically remove heat from the instrument so well at upper levels.

**3.** **Augmenting Long-term Operational Microwave Radiometer Data Quality Assessment Robustness with COSMIC-2 Atmospheric Soundings (Robbie Iacovazzi – NOAA)**

**Mark** – Is it possible to create a dataset with collocated RO, ATMS/AMSU-A and radiosonde data?

**Robbie**  - Yes

**Mark** – Suggest working with Xi to create a one year long combined RO and radiosonde soundings with ATMS/AMSU-A data. This could be made available to the subgroup as a testbed for climate scientist or radiative transfer model developers.

ACTION (Robbie and Xi): Work together to create this collocated RO, ATMS/AMSU-A and radiosonde data.

**Yong**: For collocation do you consider nadir view or all scan angles?

**Robbie**: We match RO data at the peak elevation of the microwave weighting function for the appropriate scan angle. In turn, the scan angle is used during radiative transfer modeling to properly simulate the microwave data. If CRTM performance is not a noticeable function of scan angle, then all ATMS scan angles can be used and the O-B Ta values combined for all scan angles in the analysis.

**Mark:** Scan angle is coming from the L1a data or do you calculate it?

**Robbie:** The scan angle is calculated. A given array element in the scan direction is assumed to be associated with a given scan angle.

**Yong**: There is a seasonal cycle in the monthly mean O-B Ta time series during TP-2 for ATMS Ch 15. Does it come from the model or the data? In the model, there is a Zeeman effect that may be up to 1 K. So, this makes it unclear if it the data or model.

**Robbie**: This seasonal effect for ATMS 15 shown in slide 10 became apparent with COSMIC-2. It is unclear why the ECMWF sounding data did not create this same semi-annual O-B Ta bias cycle. Not shown is that before ECMWF data were available in 2014, a semi-annual cycle was evident. This is a future topic of study.

**Yong:** Maybe the change is due to the COSMIC-2 sample increase. Having so few data may be a problem during the first time period.

**Robbie:** Earlier in the period – for example 2014 - we still do not see a seasonal cycle, and this has higher COSMIC-1 sampling. Nothing though is conclusively ruled out at this point.

**Mark**: Yong has a good point. This could be a Zeeman effect. Recommend to use RO data cutoff at 40km, and gap fill with the ECMWF data. Also, ECMWF is assimilating the COSMIC-2 data after March 2020. The RO data does not change this feature.

**Yong**: GFS cuts off RO data at 50 km. It is not clear if ECMWF model assimilates all the RO data, or if the cut it at some height.

ACTION (Robbie): Contact someone from ECMWF and find out the altitude ranges of the COSMIC-2 RO data assimilated in their NWP model.

**4.** **GSICS Spectral Response Function Format (All)**

Robbie discussed the GSICS file and content data format, as well as the GSICS SRF data format. Mark discussed the newly released JPSS-2 ATMS spectral response function.

Mark made it clear that the raw data are usually proprietary, and need to gain permission to release these “original” data. The public release data are usually screened and remapped – e.g., using a cutoff of 40 dB signal, or interpolation to a regular frequency interval. This could make them less useful for radiative transfer modeling.

The main questions to the group are:

1) Is the present GSICS SRF data format adequate for the Microwave Subgroup, or does it require revision?

2) Do the more resolved original data need to be passed along with the less resolved public release SRF data?

**Manik** – Why do you want to have the spectral response in a particular format?

**Robbie** – The perceived action to the subgroup was to evaluate the GSICS SRF format for its suitability to the group.

**Manik**

Two platforms of SRF sharing

* GCC website: <https://www.star.nesdis.noaa.gov/smcd/GCC/instrInfo-srf.php> (Each group provides a link to the GCC website. This way we get the latest status on the SRF’s)
* GSICS Wiki: <http://gsics.atmos.umd.edu/bin/view/Development/Srf4Giro> (These SRF’s are in the suggested format.)

There is also an SRF Python Reader Code

* Google Colab: <https://colab.research.google.com/drive/13Icapoogf0FUkYpfnynFJQm0H68uDNy3?usp=sharing#scrollTo=iAc3rAHM6LSJ>
* SRFs that are in the GSICS standard format can be read directly by this software.

Regarding the formalization of GSICS SRF data formats

**Manik**: There was discussion years back regarding formalizing the format of the spectral response file names and formats. This was driven mainly by groups using the GIRO model lunar calibration community. This made it easier to ingest the SRFs into the model. This formalization is not considered a requirement, but it does have a advantages.

* There has been code created to read a particular SRF format that is available to all GSICS users. It is available on the Google Colab.
* SRFs in the GSICS format can be considered GSICS deliverables.

ACTION (Robbie and Manik): Link ATMS SRFs to the GCC Spectral Response Function web page.

**Mark**: On the GCC website, is there only one file that has all AMSU-A SRFs.

ACTION (Cheng-Zhi Zou): Determine what AMSU-A models are contained in the AMSU-A SRF file on the GCC website.

**Vinia**: Regarding Question 1

* Could XML schema be used, which could be transformed into NetCDF?
* Could we add error or accuracy information about the spectral response functions?

**Manik**:

* In the metadata of the current designed files, there are fields that can house errors. There are two uncertainty parameters that can be added to the metadata. These have been listed as optional in the SRF format document. Please visit this document here found at the following URL: <http://gsics.atmos.umd.edu/pub/Development/SrfNcdfConvention/20180730_NetcdfSrfConvention.docx>
* Regarding schema, there are cdl files on the SRF wiki page (<http://gsics.atmos.umd.edu/bin/view/Development/SrfNcdfConvention>)

**Robbie:** Are the two metadata parameters adequate?

**Vinia:** There could be overall, in-band, and out-of-band metadata. So it depends on the number of uncertainty parameters that we can generate.

**5. Microwave Subgroup Workshop (Mark)**

* Plan to have a workshop in October. Would like to poll the group regarding the form of the workshop. Send comments to Robbie about ideas related to the workshop. Workshop will be discussed in an email.
* Encouraging participants to write papers based on their presentation to MDPI remotes sensing Special Issue.

**Any Other Business**

There will be a Sounders Conference on July 28th. It is run by NOAA.

**Robbie**: It was sent to the group on June 28th at 5pm.