Microwave Sensors Subgroup (MWSG) Report

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OUTLINE

- Missions and objectives
- Focuses
- Update from WGCV-40
- Future work and recommendations

Missions & Objectives of MSSG

- Missions:
  - The mission of the Microwave Sensors subgroup is to foster high quality calibration and validation of microwave sensors for remote sensing purposes. These include both active and passive types, airborne and spaceborne sensors.
- Objectives
  - Facilitate international cooperation and co-ordination in microwave sensor calibration / validation activities by sharing information on sensor development and field campaigns.
  - Promote accurate calibration and validation of microwave sensors, through standardisation of terminology and measurement practices.
  - Provide a forum for discussion of current issues and for exchange of technical information on evolving technologies related to microwave sensor calibration / validation.
  - Provide calibration/validation support to CEOS virtual constellations and data application groups/communities by coordination of reference sites for both passive and active microwave sensors, and standardization of quality assurance of microwave remote sensing data.

MSSG covers passive and active…

All EO sensors operated in microwave spectrum, except SAR

- **Works currently focuses on:**
  - ✧ Microwave Radiometers (sounders, imagers)
  - ✧ Radar Scatterometers
  - ✧ Radar Altimeters
- Variation of sensors
- Variation of products

Characteristics of Microwave Sensors

- Relatively low spatial resolution (km, tens of km, hundreds of km) for atmospheric, oceanic, large-scale terrestrial environmental applications
- Data dependent on sensor and processing (model, retrieval, algorithm, cal/val)
- Importance of processing and quality control

Requirements and Challenges

- Climate and global change applications
  - ✧ Higher requirements, especially for climate and global change applications: sensitivity, accuracy, stability, traceability;
  - ✧ Cross-calibration requirements of sensors flown for different missions;
- No traceable standards available for microwave sensors;
- New developed sensors
  - ✧ Polarized radiometers and scatterometers
  - ✧ Interferometric synthetic aperture radiometers
  - ✧ Scatterometers for terrestrial applications
  - ✧ Wide swath and SAR altimeters…

Priorities and focuses

- Objectives
  - ✧ Support CDR from microwave;
  - ✧ Support CEOS VCs;
  - ✧ Benefit member agencies and communities;
- Priorities and focuses

MWR & SCAT Level 1 data

- ✧ Brightness temperature for MW radiometer
- ✧ Backscattering coefficient for radar scatterometer

MWR & ALT standards

- ✧ MWR Onboard calibrator (noise source, RAM blackbody)
- ✧ Prelaunch measurement and characterization
- ✧ GNSS-buoy references

Models and algorithms

Updates from WGCV-40

- Joint meeting with GSICS-MW subgroup and recommendations for WV guidelines
- Group meeting on scatterometry & OSVW CDR and recommendations for scatterometry guidelines
- L-band WG meeting & potential WGCV initiative on L-band radiometry/scatterometry for SM and OS

Joint meeting with GSICS-MW subgroup

- Date and Place:
  - July 6, NSSC, Beijing
  - Same date as Dragon-4 meeting in Wuhan and a major planning meeting of CMA
- Participants (12)
  - NOAA NESDIS: Fuzhong Weng & Cheng-Zhi Zou
  - NSMC/CMA: Qifeng LU and 2
  - NOTC: Xiaoqi Huang
  - NSOAS: Hailong Peng
  - BIRMM; Chunyue Cheng
  - SIO/SOA: Gang Zheng
  - LAGEO/IAP: Wengying He
  - ITUN: Lilong Zhao
  - NSSC: Xiaolong Dong etc

- Topics
  - Status of calibration/inter-calibration algorithms and products at GSICS MWG
  - Status of calibration/inter-calibration algorithms and products at WGCV MWSG
  - Discussions and recommendations for standards/guidelines of calibration of MW sounder/imager
- Talks and Discussions
  - Instruments: pre- and in-orbit calibrations
  - Inter-comparison and inter-calibration
  - CDR requirements and re-calibration for CDR
  - Microwave radiometric standards

Requirements from GSICS-MW community (from C-Z Zou)

- Mapping time series of similar sensors but from vastly different heritage (e.g., SSMT2 to AMSU-B) together is of low priority
- More precise, longer latency correction are preferred
- It does appear most users would look at time series for global trends (most likely the O_2 & H_2O bands) and use to derive geophysical parameters (most likely window & H_2O bands)
- The average desired accuracy of the corrections was on the order of 0.4 K (slightly less for the O_2 bands)

- How the pre-launch calibration & mission planning can support climate applications.
- Some of the inter-satellite re-analysis/re-calibration algorithm can be recommended.

Recommendations for MWR benchmarks and guidelines (F-Z Weng)

- Suomi NPP ATMS is well calibrated and its performance in orbit meets the specification
- ATMS geolocation accuracy is assessed using the coastline gradient and cross-correlation methods. Its cross-track and along-track errors are well within the specification.
- ATMS TDR/SDR bias with respect to NWP background is illustrated and the sources of biases can attributed to NWP background bias, antenna side-lobe, and polarization spill-over, etc.
- ATMS and AMSU-A inter-sensor biases are well characterized and ATMS TDR data are now within AMSU-A family
- Noise characterization procedure is standardized using the Allan deviation for both microwave and infrared sounding instruments
- The ATMS overlapping data can be resampled to construct the high resolution data and to match the resolution made by other instruments such as CrIS and AMSU.
- Suomi NPP ATMS radiances or brightness temperatures show a striping pattern in O-B and a preprocessor is developed for destriping the data. After destriping, the noise can be reduced significantly
- The new algorithm is developed to include the antenna reflector emission in calibration and it is used for computing the total radiation from cold and warm calibration targets
- Many of ATMS instrument calibration and SDR science advances have been published through peer-reviewed process

- Further discussions to be done with CMA, EUMETSAT for how to extend to inter-agency and inter-satellite;
- Prepare and propose initiative on guidelines for characterizing and calibration.

Group meeting on scatterometry & OSVW CDR and recommendations for scatterometry guidelines

- July 11 at IGARSS 2016
- Participants: 8
  - NOAA-NEDIS: 2
  - KNMI/EUMETSAT: 1
  - CSIC-ICM: 2
  - U. Florida: 1
  - NSSC: 2
- Topics:
  - Status of OSVW and surface stress for NWP and CDR
  - Guidelines on inter-comparison/calibration

Identification of calibration uncertainty and bias of MWR for CDR

- Requirements from CDR
  - ✧ Long-term stability
  - ✧ Consistency between different instruments
  - ✧ Precision requirements
- Focuses
  - ✧ Procedure and processing of calibration
  - ✧ Stability and characterization of On-board calibrators
  - ✧ Prelaunch calibration requirements
- Progresses
  - ✧ Requirements discussed with GSICS-MWG
  - ✧ Key topics identified
    - ➢ Antenna characterization
    - ➢ On-board calibrator characterization
    - ➢ Near-field characterization for emission and effect from satellite body structure

Status for ECV (1)

- Ocean surface wind vector and wind stress are Essential Climate Variables (CEOS). However, a manifold of calibration procedures exists for scatterometers and radiometers, both on the level of the microwave measurements (L1) and winds (L2) or higher level products.
- Different producers use different procedures and standardization is far from optimal. This results in inhomogeneous Climate Data Records (CDR) to the detriment of climate applications, where the CDRs are used for climate analyses.
- While satellite agencies are applauded for planning new scatterometer missions, they may moreover support the establishment of uniform CDRs.
- It would be a main step forward, when CDR producers could easily interchange their calibration procedures, data and results, as well as the processors for L1 and L2 production to establish a higher level of communication between experts.

Status for ECV (2)

- To establish such intense collaboration, resources would need to be made available, in particular by the agencies participating in CEOS.
- Such action would in particular support the goals of the CEOS Ocean Surface Vector Winds Virtual Constellation (OSVW VC).
- In line with these CEOS VC objectives, the International Ocean Vector Wind Science Team (IOVWST) set up a working group on CDR generation among different wind data producers and scientists.
- However, while these producers are funded by the diverse satellite agencies to establish CDRs, they are usually not funded to standardize and intercalibrate their products, but which would be much for their user's convenience and the global users of the constellation data.

Recommendations

- CEOS to take action to provide resources for capacity building to develop standards for intercomparison and intercalibration of surface wind vector and surface stress CDRs in order to meet the user requirements for OSVW and surface stress ECV from scatterometry.

L-band WG meeting

- July 12 at IGARSS 2016
- Participants: NASA/Aquarius & SMAP, ESA/SMOS, NSSC/COSM
- Topics:
  - ✧ Inter-calibration/comparison of L-band radiometry data
  - ✧ Future workshop planned from discussion of data continuity to workplan.

Future workplan and recommendations

- MW radiometer
  - ✧ Recommend guideline for calibration and re-calibrations
  - ✧ Collaboration on mission data
- MW scatterometer
  - ✧ Assessment and recommendation of guidelines
  - ✧ Coordinates resources for inter-comparison/calibration guidelines