Microwave Sensors Subgroup (MSSG) Report

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OUTLINE

- Missions and objectives
- Recent requirements and challenges
- Focuses and progresses
- 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
- Other related aspects:
  - ✧ GNSS and GNSS-Reflected signal applications
  - ✧ Spaceborne weather radars: Cloud and Precipitation Radars (e.g PR, CPR)
  - ✧ Ice sounders and GPR

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

Recent 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 on different spacecrafts and developed by different agencies;
- 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...

Many new techniques need to be developed for cal/val…

- High precision requirements:
  - ✧Brightness temperature: 0.1K
  - ✧Sea level: 1mm
  - ✧Backscattering coefficient: 0.1dB
- Cross-calibration/validation requirements:
  - ✧Traceable reference for processing or historical data
  - ✧Small shift of sensor parameters (frequency, bandwidth, on-board calibrators,…)
  - ✧Calibration models/algorithms for different sensors by different agencies

Priorities and focuses

- Level 1 data
  - ✧Brightness temperature for MW radiometer
  - ✧Backscattering coefficient for radar scatterometer
- Models and algorithms
- Radiometric standard for MW
  - ✧Noise source calibrator
  - ✧RAM calibrator
  - ✧Measurement and characterization

Current status and difficulty of the group

- No focused tasks and fixed active group members
- Activities constrained by non-technical factors
  - ✧Data access and exchange

Updates from WGCV-38

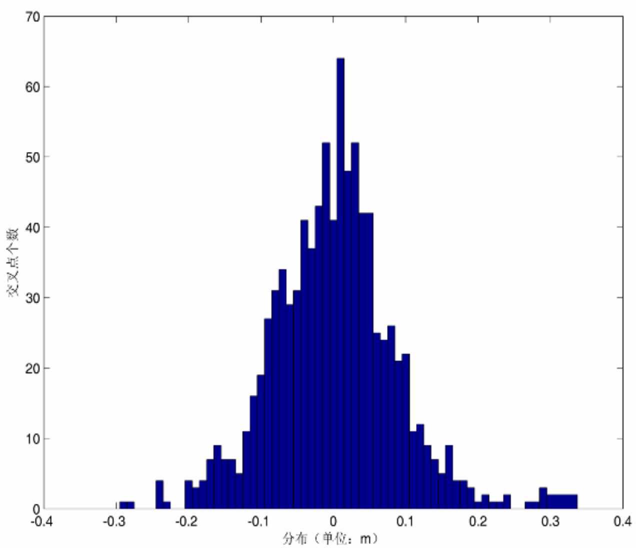
- Attend GSICS Microwave Subgroup tele-meeting (March 28)
- Attend International Ocean Surface Wind Vector (IOSWV) Science Team meeting (June 2-4)
- Organized invited sessions in IGARSS 2014, discussion with OSVW VC people (July 18)
- Progresses on calibration of altimeter
- Progresses on evaluation of wet tropspheric path delay
- Progresses on scatterometer

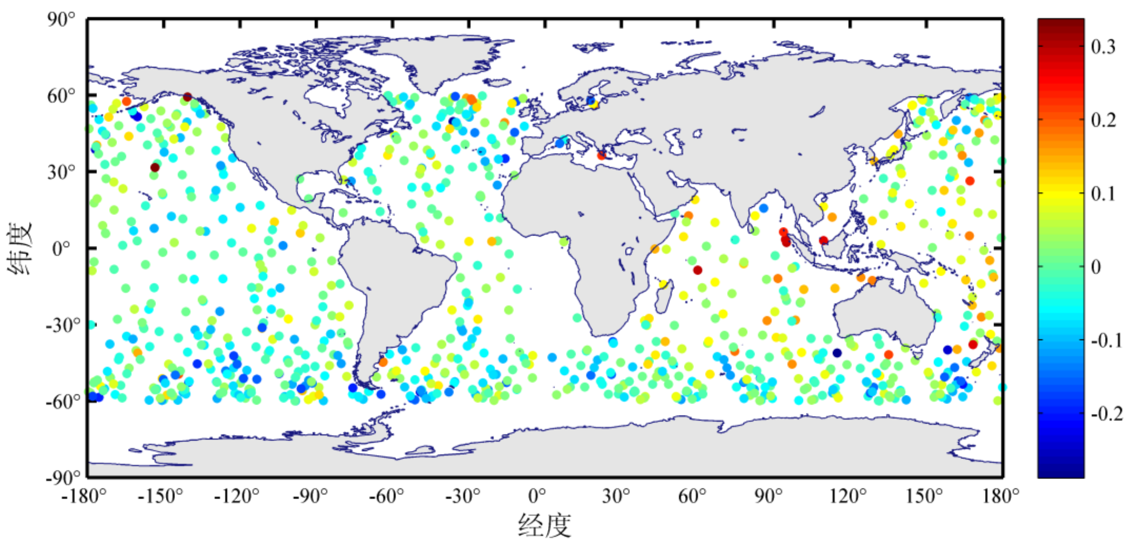
Cross-calibration of altimetry requirements and progresses

- Climate and global change research requires long-term data with continuance;
- Sea level products related to orbit and algorithms (corrections) and requires x-cal and val
- HY-2A altimeter with Jason-1/2 (NSOAS, CNES, ESA), cross comparison/calibration by NSOAS/SOA, CNES and ESA with very good encouraging results.
- Based on bilateral cooperation, no OST involvement.

Sea level

■ Cross-comparison: HY-2A with Janson-2





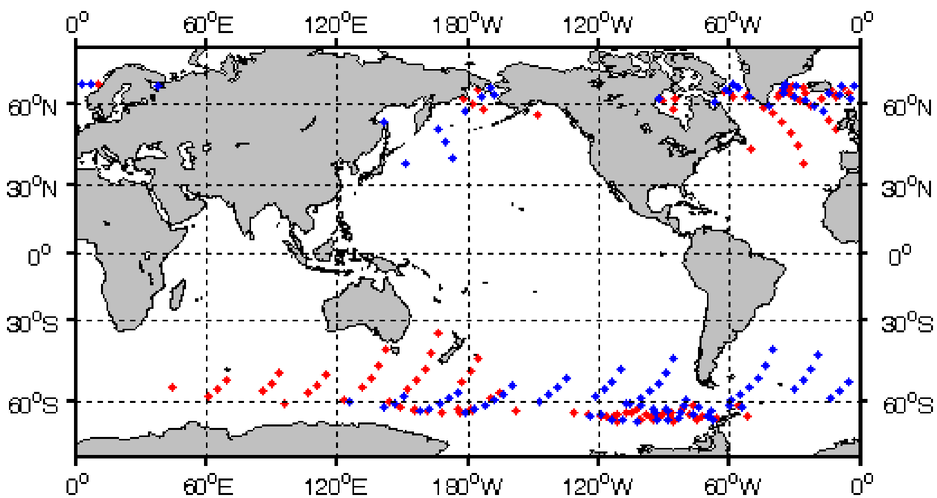
Statistics of coincidence locations

Absolute RMS deviation with average offset correction:

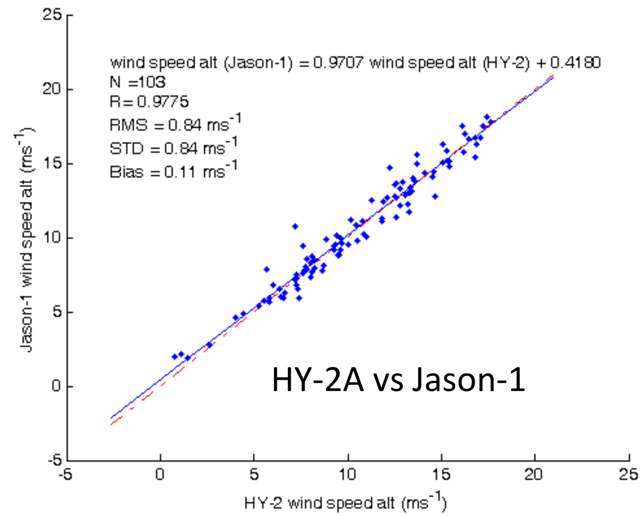
8.3cm, with correlation coefficient of 0.978.

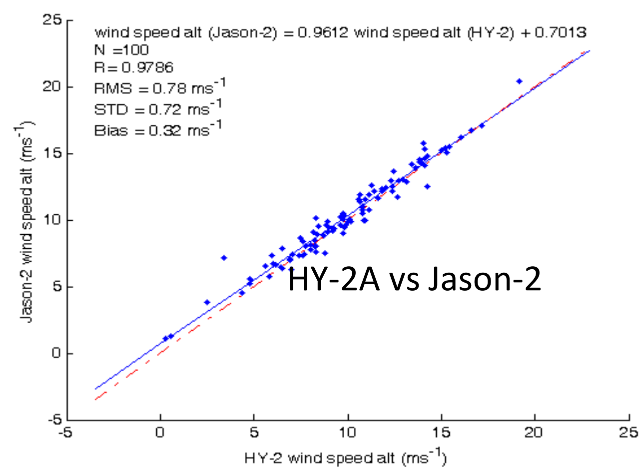
Wind speed

- Cross-comparison with Janson-1/2



Coincidence point distribution of HY-2A and Jason-1/2





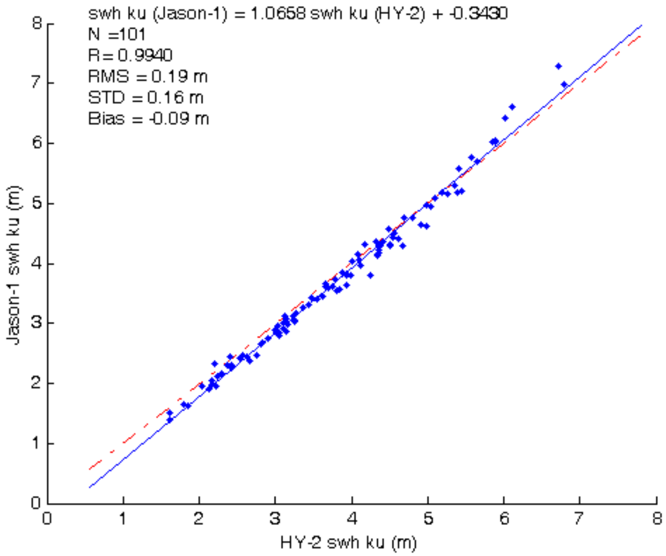
RMS deviation:

HY-2A vs Jason-1: 0.84m/s

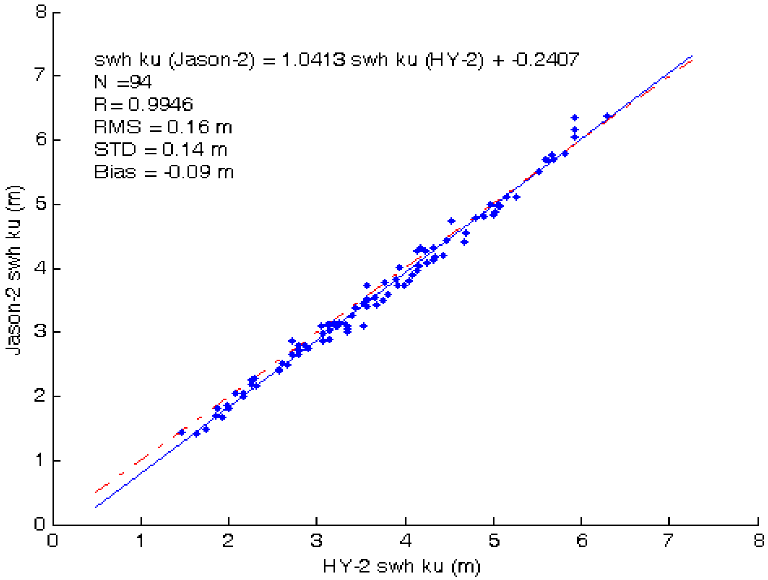
HY-2A vs Jason-2: 0.78m/s

Significant wave height

- Cross-comparison with Janson-1/2



HY-2A vs Janson-1

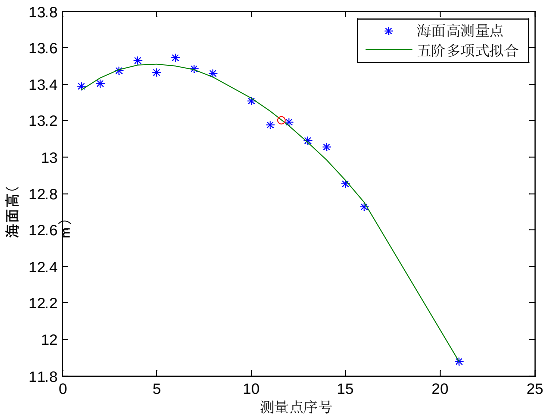


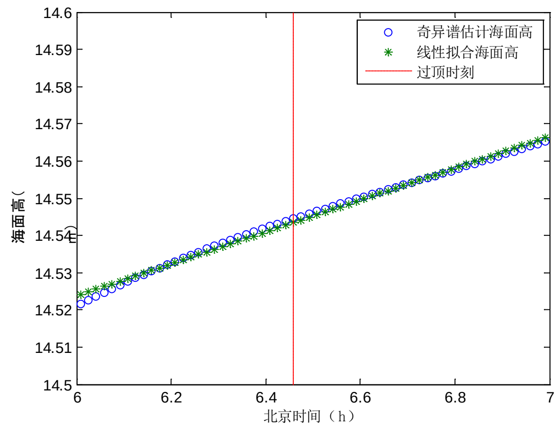
HY-2A vs Jason-2

RMS deviations: vs Jason-1: 0.19m; vs Jason-2: 0.16m

Altimetry calibration with GNSS buoy

- NSSC & NSOAS (China), TUC (Greece) & CNES
- Provide absolute reference for altimetry
- Model development ongoing



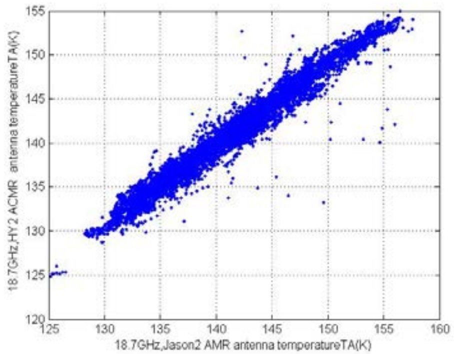


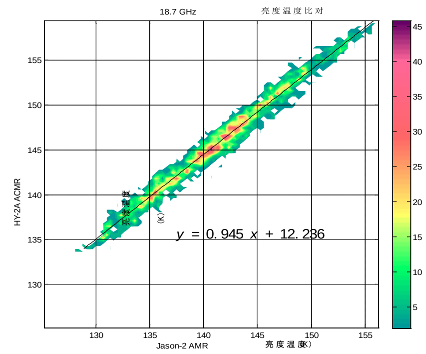
	HY-2 SSH	GNSS SSH	Bias
7月31日	14.639 m	14.543 m	0.096 m
8月3日	13.232 m	13.064 m	0.073 m

Cross-calibration/comparison for wet tropspheric path delay

- HY-2A ACMR and Jason-2 AMR
  - ✧ACMR: tri-frequency (18.7, 23.8, 37GHz)
  - ✧AMR: dual-frequency (18.7, 23.8, 34GHz)
- Cross comparisons
  - ✧Brightness temperature
  - ✧Path delay (ACMR vs AMR, ACMR vs ECMWF)

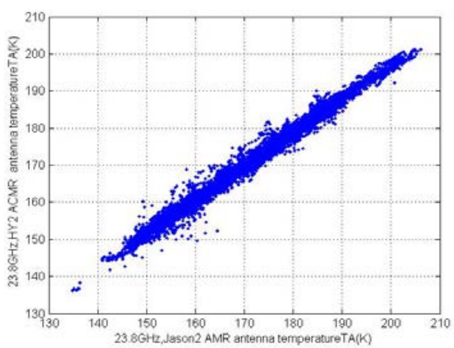
Brightness temperature

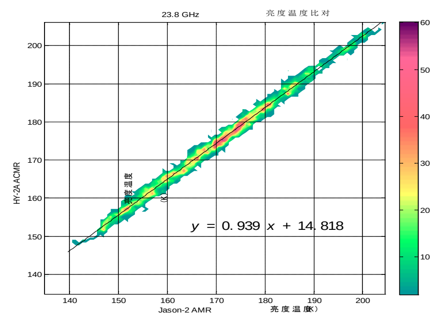




f=18.7GHz

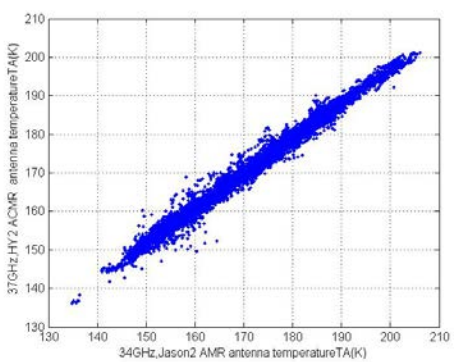
Std=1.17K,r=0.98

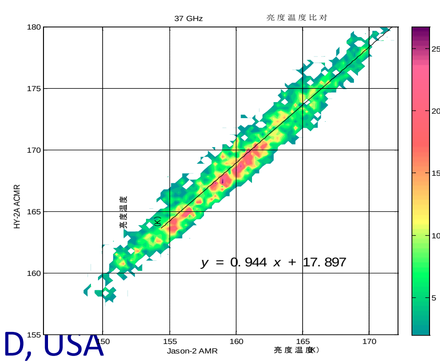




f=23.8GHz

Std=1.74K,r=0.93



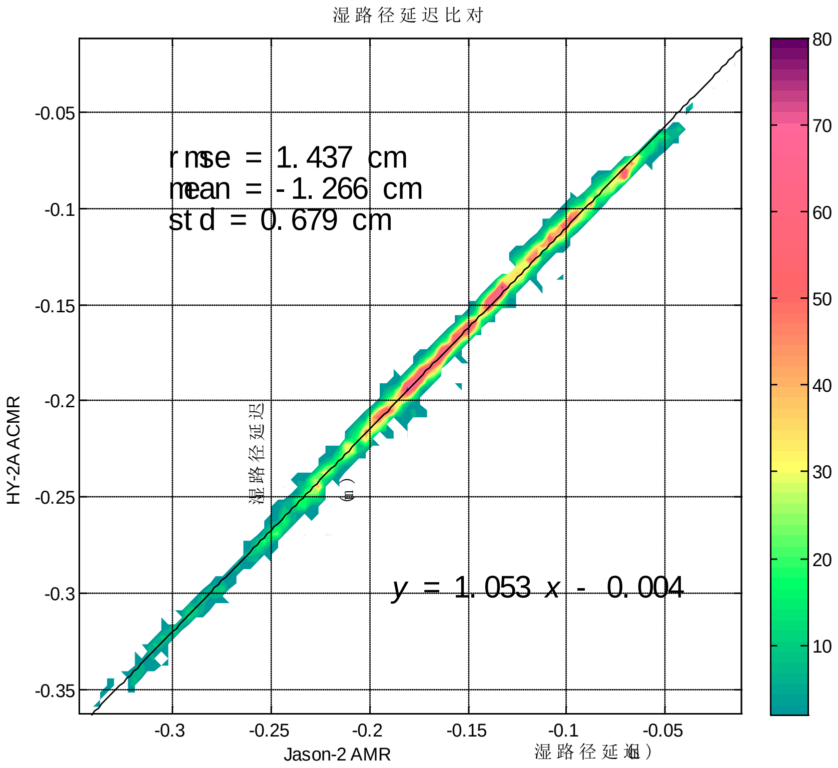


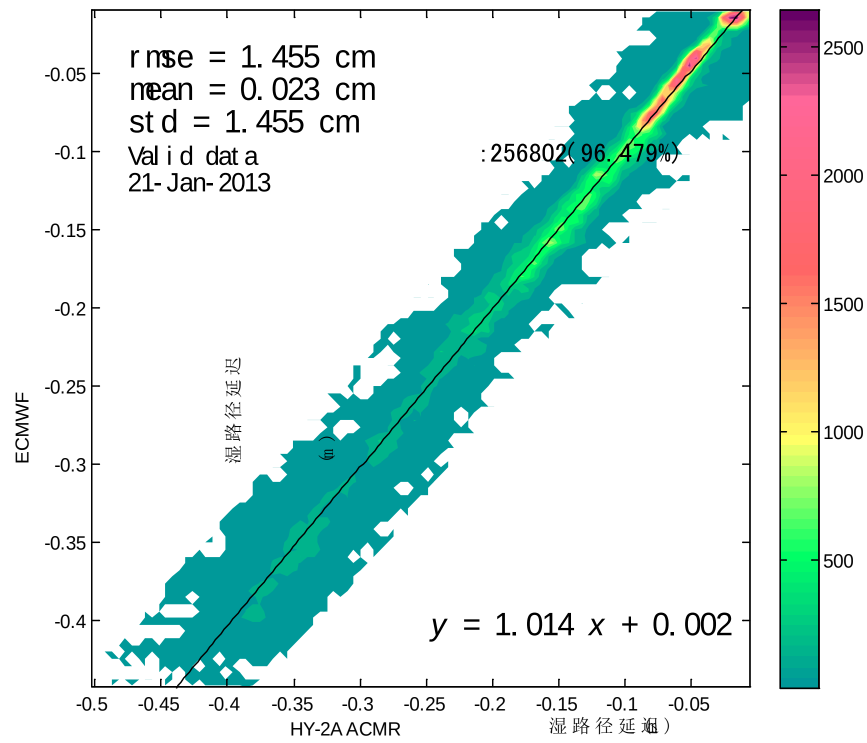
f=34GHz/37GHz

Std=1.56K,r=0.95

, MD, USA

Path delay:
ACMR vs AMR & ACMR vs ECMWF





Future works-MW radiometry

- MW radiometry
  - ✧ Formulate tasks on specific variables: water vapor by nadir-looking radiometer (ACMR, AMR, MWR) (ESA, NSSC/NSOAS, NOAA)
  - ✧ Validation of MW radiometer data with GNSS-Occultation
  - ✧ Coordination with GSICS Microwave Subgroup (cooperation to avoid duplicate work)
  - ✧ Coordination with VCs (P-VC and SST-VC) for demand of cal/val support
  - ✧ Information change on MW radiometric references (noise source and RAM) and standard radiometers (NSSC & BIRMM/China, NIST/US, FSUE «VNIIFTRI»/Russia, NPL/UK)

Future works-radar altimetry

- Radar altimetry
  - ✧Exchange cross-comparison
  - ✧Development of absolute validation (GNSS-buoy)
  - ✧Development of modeling for validation (satellite with in-situ data)
  - ✧Exchange of calibration site data
  - ✧Coordination with OST VC

Future works-scatterometer

- Radar scatterometer
  - ✧ Exchange of cross-comparison by global ocean calibration data
  - ✧ Continue to coordinate sigma 0 data cross-comparison for reference sites (Amazon, Antarctic, ocean)
  - ✧ Standards of quality control (participation)
  - ✧ Further support to OSVW-VC

Recommendations and proposals

- Agency support with L1 data for specific cross-calibration/comparison purpose, and improve calibration and validation.
- Encourage close collaboration between instrument teams and science/user community.

Thanks！