Report from WG II (Satellite data and products)

Ken Holmlund and JV Thomas
(Co-Chairs)
Paolo Ruti and Mitch Goldberg
(Rapporteurs)

Presented to CGMS-50 Plenary session, agenda item 4.5

Coordination Group for Meteorological Satellites

CGMS

WG II on "Satellite Data and Products"

WG II serves as important link between the annual CGMS meetings and the CGMS International Science Working Groups which provide regular reports and feedback to CGMS.

These are currently:

- International TOVS working group (ITWG)
- International Radio Occultation Working Group (IROWG)
- International Precipitation Working Group (IPWG)
- International Satellite Winds Working Group (IWWG)
- International Clouds Working Group (ICWG)
- Proposed International Earth Surface Working Group (IESWG)

WG II is also the primary interface between CGMS and other international initiatives, such as CEOS-CGMS Joint WG Climate, GSICS and SCOPE-CM and user communities, such as those organized in the areas of oceanography and marine meteorology, and atmospheric composition.

Coordination Group for Meteorological Satellites

CGMS

Overview of Session

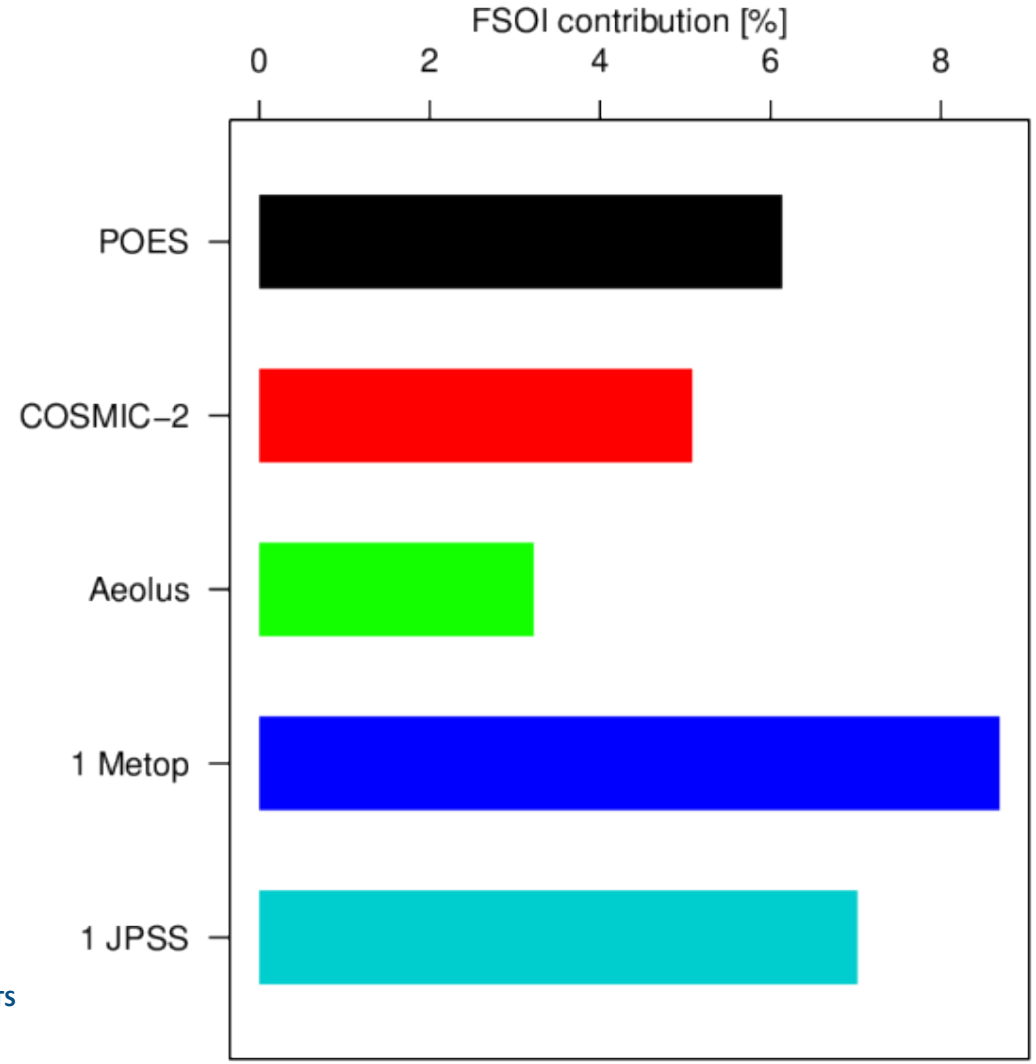
WGII/1: Welcome and opening
WGII/2: CGMS agency reports on highlights and issues in dataset and product generation 11 WPs
WGII/3: CGMS International Science Working Groups
(IWWG, IPWG, ITWG, ICWG, IROWG, GSICS) 6 WPs
WGII/4: Working papers on climate and GHGs 8 WPs
WGII/5: Working papers on ocean monitoring 2 WPs
WGII/6: Selected topics of high priority to members 7 WPs
WGII/7: Working papers responding to or raising CGMS actions 1 WP
WGII/8: Review and updating HLPP 2 WPs
WGII/9: AOB
WGII/10: Future CGMS plenary sessions
WGII/11: Review of actions/conclusions, preparation of WG report for plenary
Σ = 37 WPs (2021: 54; 2020: 49; 2019: 44; 2018: 41; 2017: 36; 2016: 37; 2015: 64; 2014: 50)

Virtual meeting
104 registrations
May 18-20
11:00 – 15:00 UTC

Plenary is requested to take note – Recommendations

Actionee	AGN Item	Action	Description	Deadline	Status	Priority Level
CGMS Space Agencies		WGIIR50.12	CGMS Space agencies are encouraged to maintain space-based assets beyond the design lifetime as long as they provide value added observations on a safe and affordable basis as determined by the operating agency			High Priority
CGMS Members		WGIIR50.04	(IROWG) All providers of RO observations are encouraged to classify RO data as core data in the sense of the WMO Unified Data Policy (Res. 1). Therefore, free, timely and unrestricted access shall be provided to NRT RO data and free and unrestricted access shall be provided to archived raw data (including auxiliary data)			High Priority
WMO and CGMS Members		WGIIR50.05	(IROWG) WMO and CGMS are encouraged to coordinate any GNSS-RO data purchases to ensure the current 20,000 daily target identified in HLPP is met with global and full local time coverage			High Priority

FSOI contributions from POES vs other selected observing systems



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Coordination Group for Meteorological Satellites

ECMWF

CGMS

Plenary is requested to endorse

Actionee	AGN Item	Action	Description	Deadline	Status	Priority Level
CGMS Plenary		WGIIA50.09	CGMS Plenary are requested to endorse the upcoming Third International Operational Satellite Oceanography Symposium (OSOS-3), planned for spring 2023 to be held in South Korea	CGMS-50	Open	High Priority

Plenary is requested to take note – Actions

Actionee	AGN Item	Action	Description	Deadline	Status	Priority Level
CGMSSEC & WMO		WGIIA50.01	CGMSSEC and WMO to consider if night-time light capabilities should be covered in HLPP, the CGMS Baseline, and should be reflected in the WMO Gap Analysis	CGMS-51	Open	High Priority
CGMS WGII Chairs and Rapporteurs		WGIIA50.06	CGMS WGII Chairs and Rapporteurs to propose a procedure for endorsement of new co-chair / rapporteurs for the International Science Working Groups to be presented to the CGMS Plenary for approval	CGMS-51	Open	High Priority
IESWG		WGIIA50.14	IESWG prepared a draft proposal on ToR for establishing a new CGMS International Science Working Group. Based on first outcomes, Working Group II proposes: • To finalize Terms of reference and circulate within CGMS in order to get feedback • To be presented at CGMS-51 Plenary or endorsed off-line • To engage IESWG in discussions on future priorities for CGMS Scientific Working Groups	CGMS-51	Open	High Priority

Plenary is requested to take note – Actions

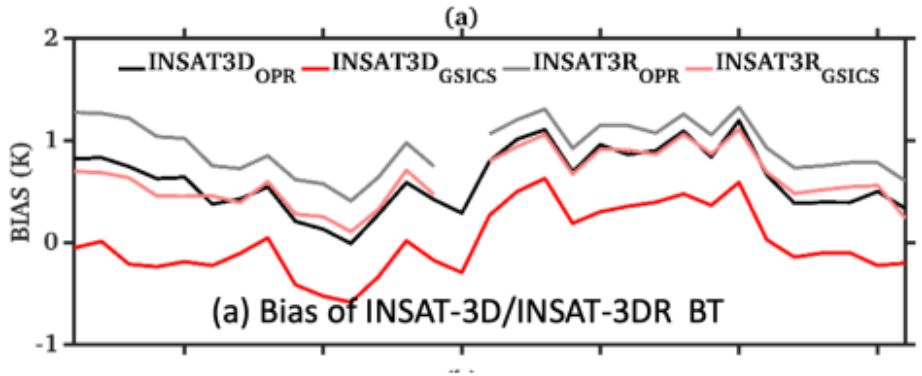
Actionee	AGN Item	Action	Description	Deadline	Status	Priority Level
CGMS WGII members		WGIIA50.02	CGMS WGII members are invited to nominate candidates for positions of Vice-Chairs for GSICS-EP and GRWG. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	OPEN	High Priority
CGMS WGII members		WGIIA50.03	CGMS WGII members are invited to nominate candidates for a Subgroup within GSICS on Space Weather Cal/Val and Intercalibration, which will be focused on providing intercalibration for Space Weather. Please provide nominations to cgmssec@eumetsat.int and mitch.goldberg@noaa.gov	Sept 2022	OPEN	High Priority

WGII/2: CGMS agency reports on highlights and issues in dataset and product generation

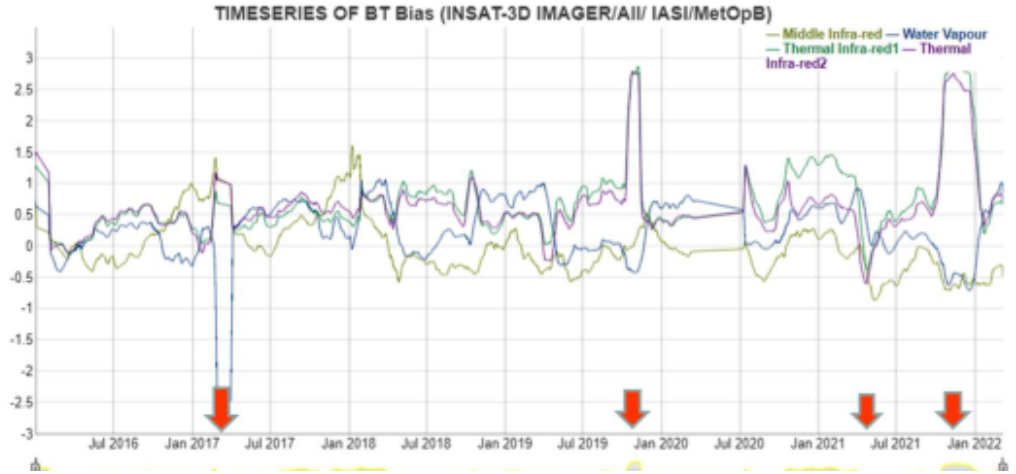
ISRO – Very active in GSICS

- INSAT-3D/3DR Imager GSICS coefficients for IR Channels are in demo phase
- 2016-2021 matchup data for visible and SWIR channels of INSAT-3D/3DR and MODIS is prepared using Ray-matching method.
- GEO-GEO inter-calibration of INSAT-3D and INSAT-3DR for all channels has been carried out.
- Bias monitoring using NWP forecast/ analysis for WV channel of INSAT-3D/3DR has been done for July 2018.
- Procedure to inter-calibrate INSAT-3D/3DR Imager IR channels using CrIS data is ready and in testing phase.

Error estimate of simulated BT using WRF 09 hr forecast from 1800 GMT with respect to INSAT-3D BT



Bias Monitoring: INSAT-3D Imager vs MetOp-B IASI *Demonstration*



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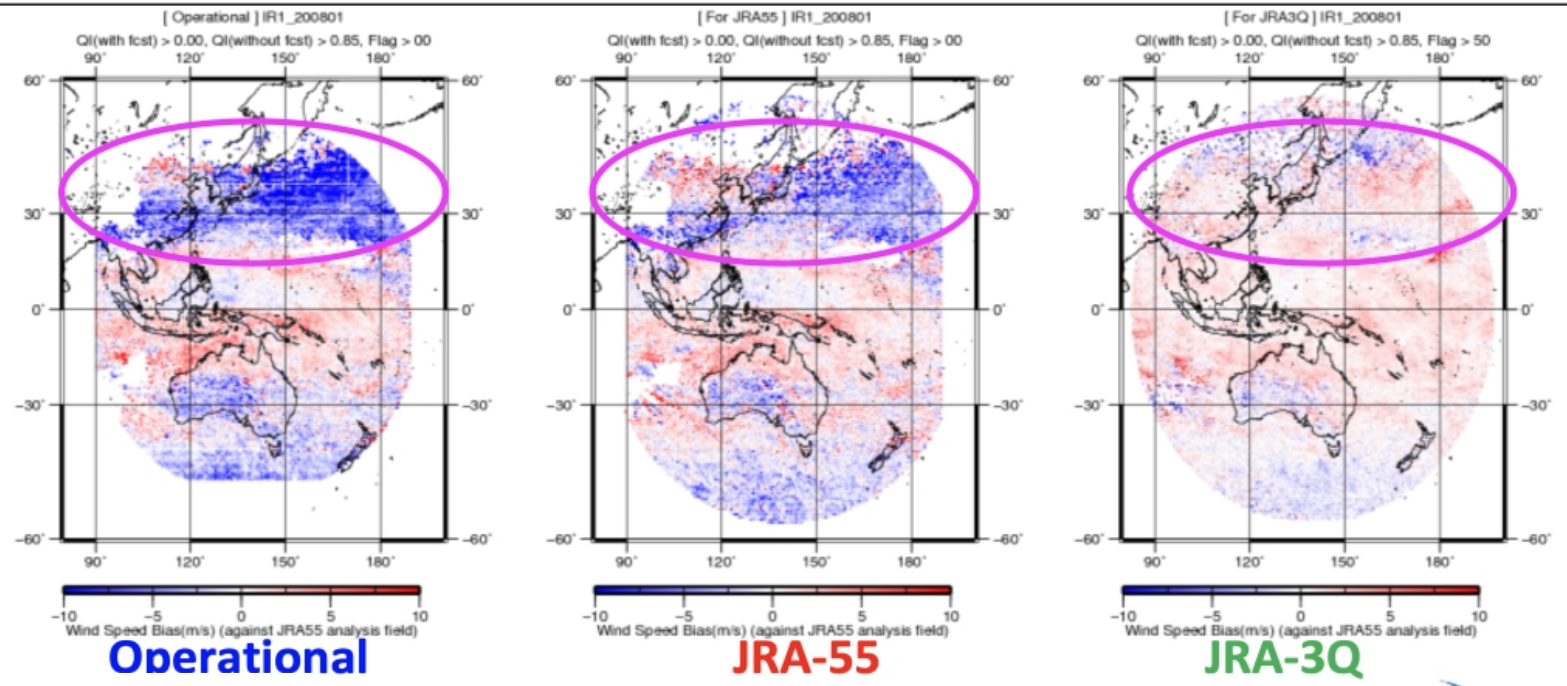
CGMS

JMA - Reprocessing of AMVs

The AMV datasets are re-produced using the latest derivation algorithm for Himawari-8 from GMS-5 to MTSAT-2 (1995-2015) for new JMA re-analysis (JRA-3Q). (As reported on the CGMS-49-JMA-WP-04)

This new reprocessed AMV dataset will be added to the ECV-Inventory.

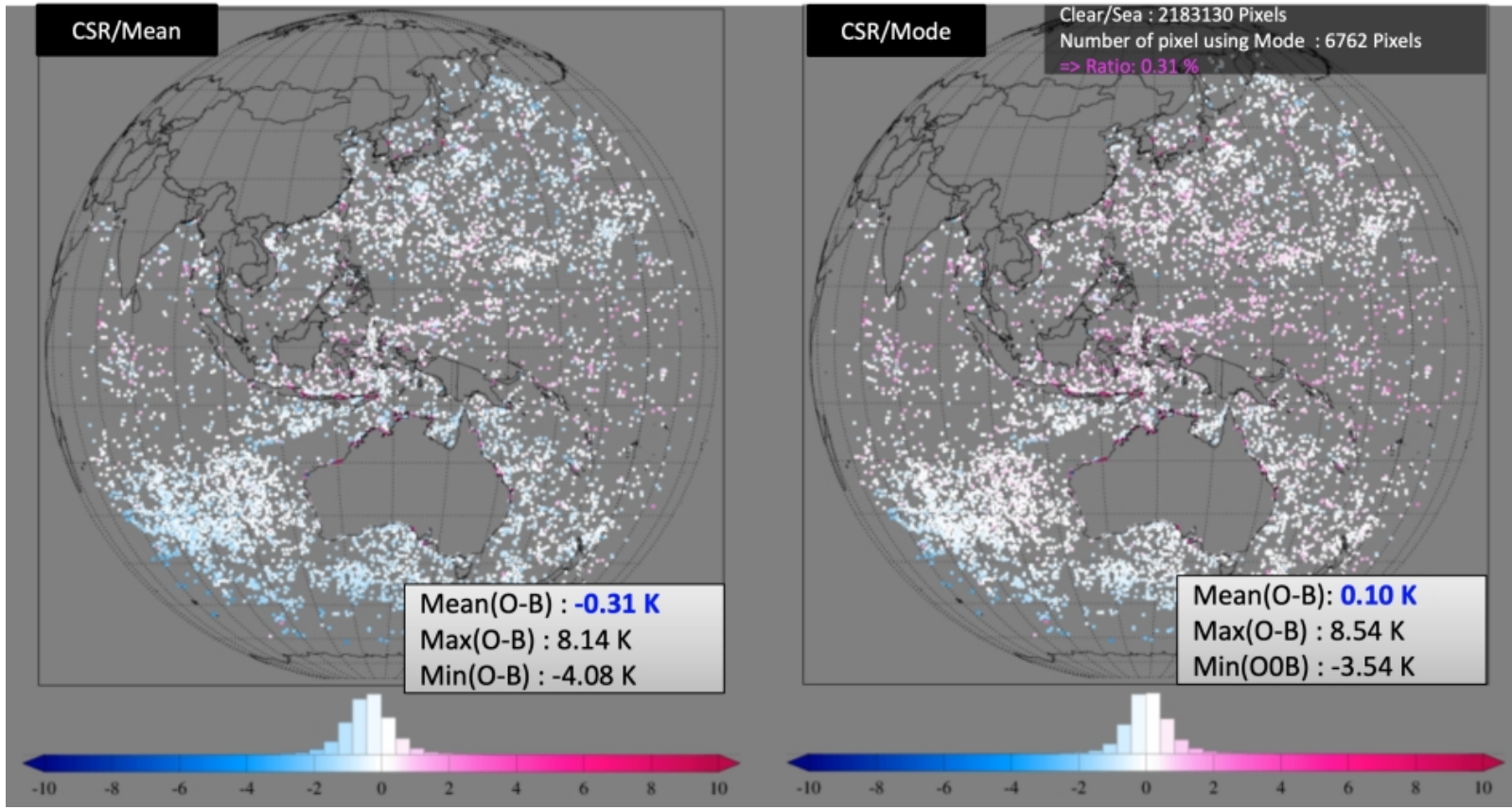
MTSAT-1R (**January** 2008), Upper Layer (< 400hPa), without forecast QI (>85), against JRA-55 analysis fields



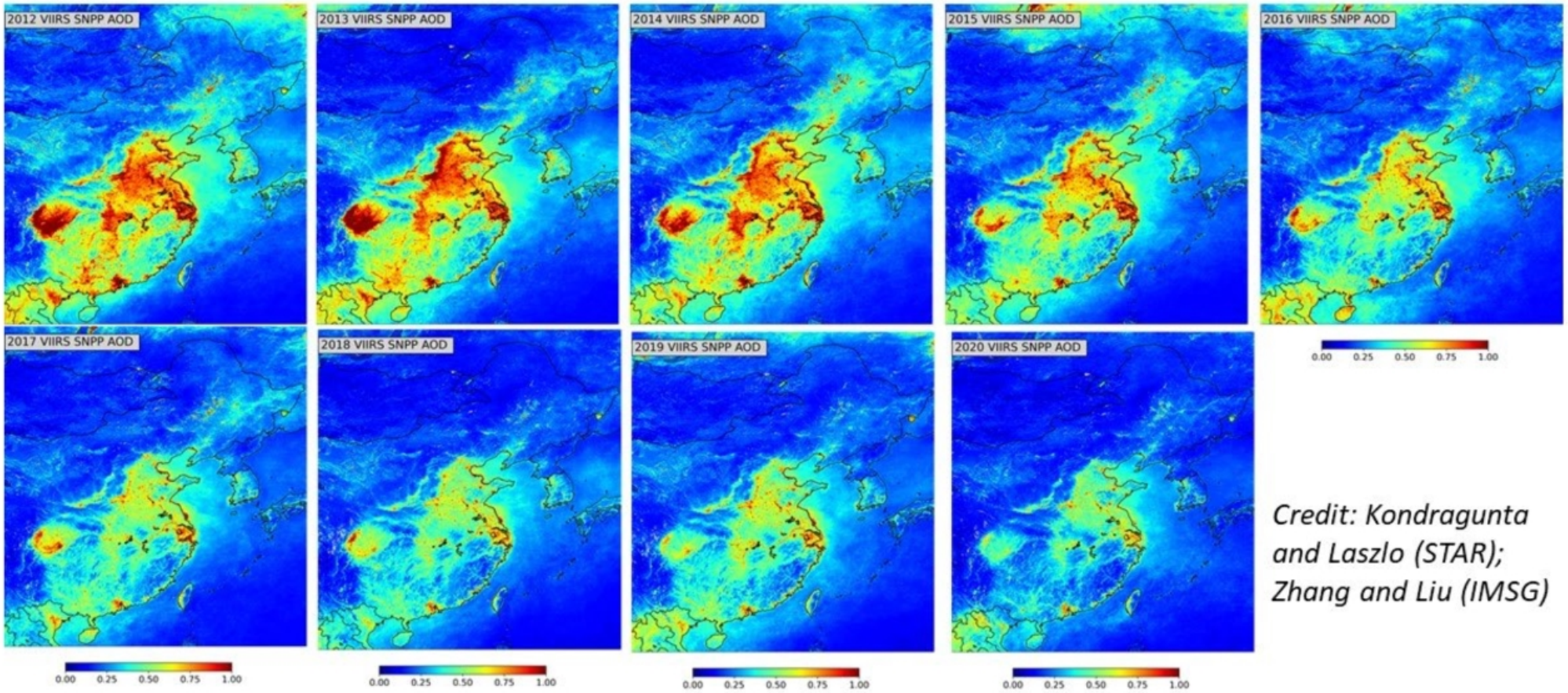
KMA

- Improvements in Geostationary Clear Sky Radiances procedures resulted in significant NWP impacts

- Implemented a new 2 -minute temporal forest fire detection system vs 10 minutes



NOAA



Credit: Kondragunta and Laszlo (STAR); Zhang and Liu (IMSG)

- As part of COVID-19 reprocessing on Cloud project, SNPP VIIRS AOD data were reprocessed using the Enterprise algorithm.
- Reprocessed SNPP annual mean VIIRS AOD data over China shows clear (known) decreasing trend in pollution. *Before we analyze 2020 impact of COVID-19 lockdown impact on aerosols we have to de-trend and de-seasonalize the data.*
- This reduction in particulate pollution as detected by VIIRS AOD is due to strict pollution control strategies (*chief among them phasing out old vehicles*) implemented in China after the 2013 "PM2.5 Crisis" (UNEP report, 2019).
- These findings are consistent with other published work (Sogachiva et al., 2020) that reported decreasing AOD trend in China from 2013 to 2017.

WGII/3: CGMS Internal Science Working Groups Reports

ITWG, ICWG have Plenary WG reports
IROWG has special report* to Plenary

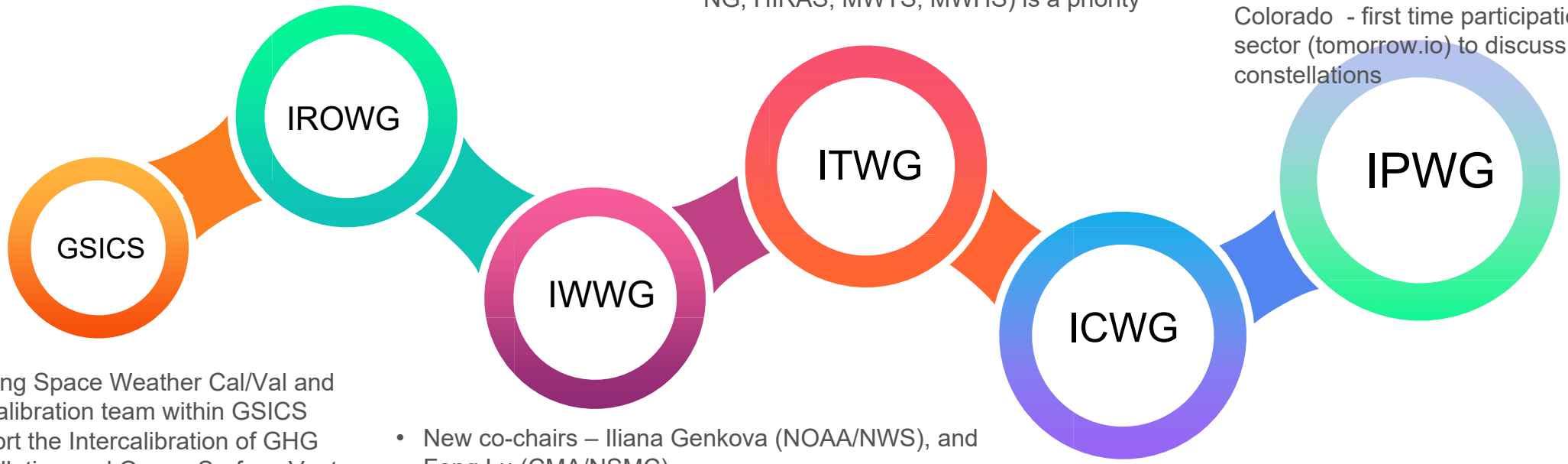
*Future GNSS radio occultation data needs

Coordination Group for Meteorological Satellites - CGMS

- The value of and need to open and free access to RO data, including archived raw data.
- September 2022, Austria with the 7th International Workshop on Occultations for Probing Atmosphere and Climate (OPAC)

- New emphasis on smallsat constellation architectures and impact assessments.
- Significant impacts for all-sky microwave data assimilations
- Impacts from new instruments (IRS, IASI-NG, HIRAS, MWTS, MWHS) is a priority

- Dr. Joe Turk (JPL/Caltech) is the new IPWG Rapporteur.
- Joint IPWG/GEWEX Precipitation Assessment has been published
- The Global Satellite Precipitation Constellation: Current Status and Future Requirements (AMS, Bull. Amer. Meteor. Soc.)
- IPWG-1 June 13-17, 2022 in Fort Collins, Colorado - first time participation from private sector (tomorrow.io) to discuss smallsat constellations



- Including Space Weather Cal/Val and InterCalibration team within GSICS
- Support the Intercalibration of GHG constellation and Ocean Surface Vector Winds
- Recommendation of “TSIS-1 HSRS” as the Solar Reference Dataset.
- GSICS State of the Observing System Report – included in upcoming GSICS Quarterlies

- New co-chairs – Iliana Genkova (NOAA/NWS), and Feng Lu (CMA/NSMC)
- Action 46.04: best AMV format for use in global and regional NWP models
- A46.07: IWWG to consider climate projects from AMVs and to report to CEOS/CGMS WGClimate with a potential project
- IWWG16 is scheduled Spring 2023 in Saint-Sauveur, Quebec, Canada hosted by Environment and Climate Change Canada (ECCC)

- Intercomparisons between current and new instruments (ABI, AMI, AHI, MERSI, AGRI, FCI, MetIMAGE, VIIRS, SLSTR, SGLI, GISAT, INSAT-3D, etc)
- ICWG in person meeting in 2023.

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International Earth Surface Working Group

- Working Group II has been working with IESWG on the definition of the Terms of Reference
- Good progress can be reported
- IESWG has demonstrated relevance to CGMS
- Broad CGMS engagement at the 4th IEWSG meeting (April 2022)
- Strong focus on operational relevance required

Working Group II proposes:

- To finalize Terms of reference and circulate within CGMS in order to get feedback
- To be presented at CGMS-51 Plenary or endorsed off-line
- To engage IESWG in discussions on future priorities for CGMS Scientific Working Groups

Use best practice and needs document to address recommendations from science working groups.

Examples

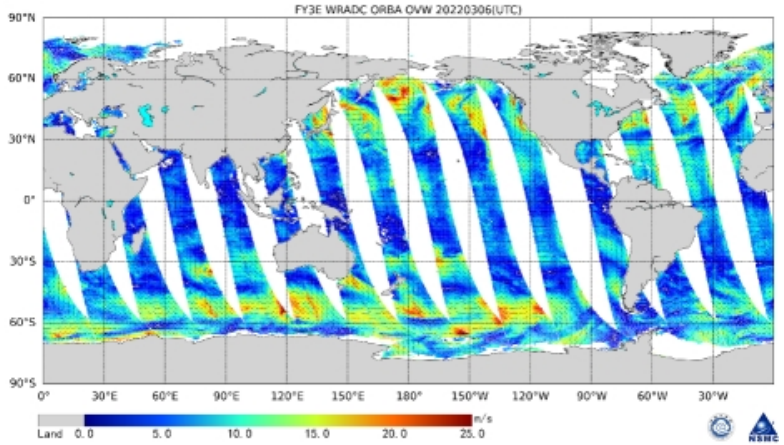
- R47.02: From ICWG: CGMS members to budget a baseline funding for intercomparison studies.
  - Best practice: Agencies should participate in CGMS endorsed and other relevant intercomparison studies as part of their documented and funded cal/val program requirements.

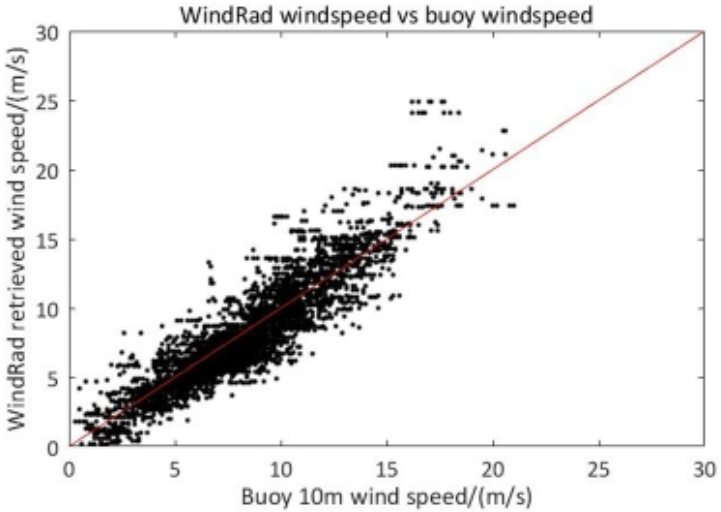
- ITWG Science Issue: Some inconsistencies have been observed in the retrieval of ozone profiles from IR and UV/Vis observations which could attributed to an inconsistency of the precision of the spectroscopic parameters between the 2 spectral ranges. Inconsistency problems have also been observed for SO2

- The science needs document can be provided to agencies with science funding opportunities.

WGII/5: Working papers on ocean monitoring

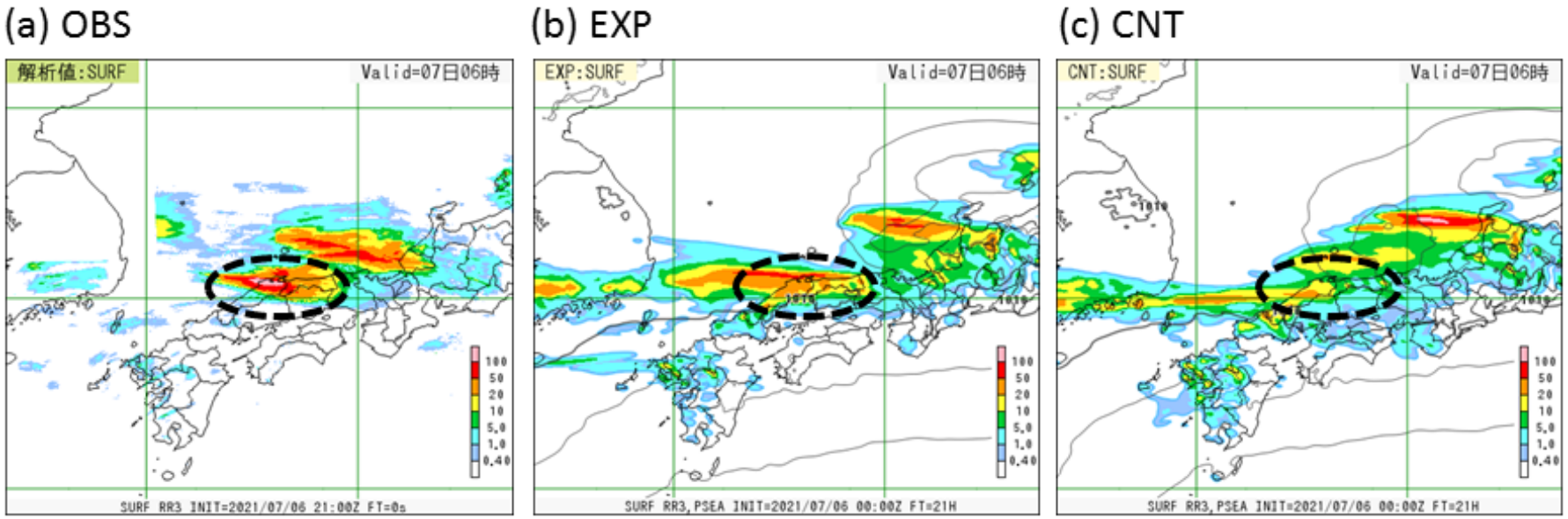
- Performance of ocean vector winds from FY3E WindRad
- Operational Satellite Oceanography Symposium Report





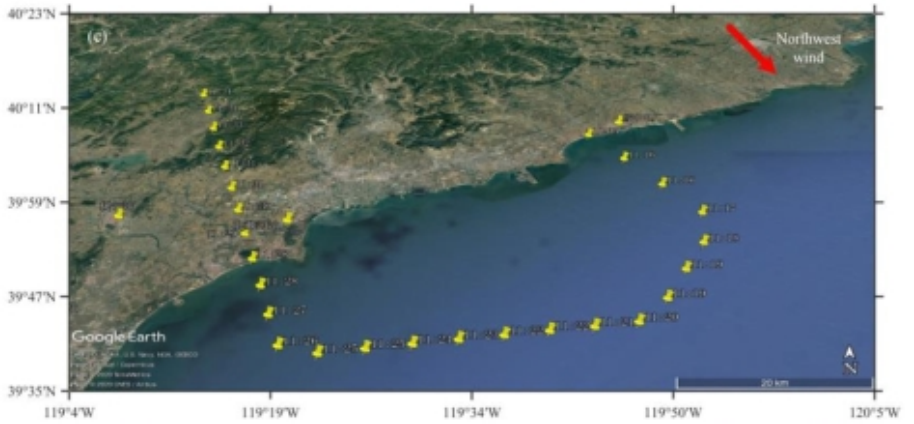
WGII/6: Working Papers on topics of high priority

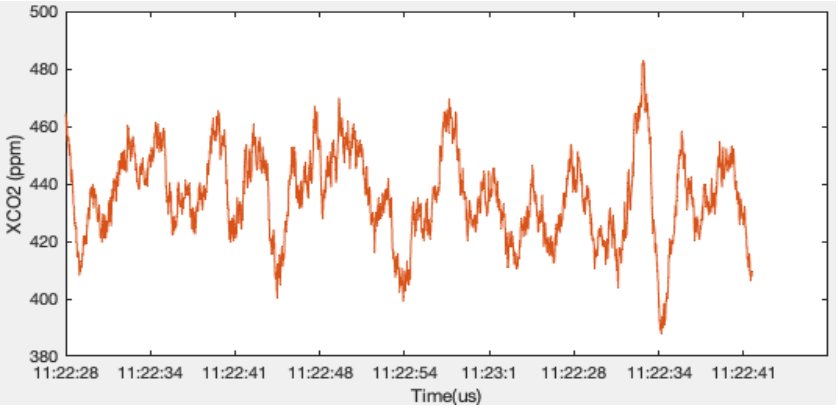
- CMA FY-4B Geosynchronous High-speed Imager
- JMA Enhanced Utilization of Himawari-8/9
- JMA OSSEs for geostationary hyperspectral soundings
- NOAA Next Generation Plans for LEO
- NOAA/NWS Nowcasting Application Drivers for LEO and GEO
- Status of WMO Core Satellite Data Activities



WGII/4: Working Papers on Climate and GHG gas initiatives

- CMA report on LIDAR CO2 measurements
  - DaQi-1 (DQ-1) satellite was launched in 16th April 2022.
  - A 1.57-μm airborne double-pulse integrated-path differential absorption (IPDA) light detection and ranging (LIDAR) for CO2 concentration measurement.
- EUMETSAT Contribution to Climate Science and Services
- JAXA's contribution to GHG Monitoring
- NOAA's contribution to GHG Monitoring
- GCOS Status Report
- WMO GHG Monitoring Activities
- WMO Space-based Weather and Climate Extremes Monitoring (SWCEM in SE Asia and Western Pacific Ocean





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Early Warning and Early Action

UN unveils ambitious target to adapt to climate change and more extreme weather

WMO SWCEM and CREWS are important contributors to new UN target "Early warning systems must protect everyone within five years"

WMO CGMS

SWCEM provides extreme weather information related to precipitation and droughts

Leverages JAXA and NOAA satellite-based precipitation products

NOAA is kindly requested to support the SWCEM by providing satellite precipitation estimates and derived products (Standardized Precip Index (SPI), VHI and soil moisture) from high resolution second generation CMORPH (CMORPH2) for monitoring drought and heavy precipitation events

JAXA is kindly requested to continue supporting the SWCEM by providing satellite precipitation estimates and derived products from new generation GSMaP

Coordination Group for Meteorological Satellites

What role should CGMS have?

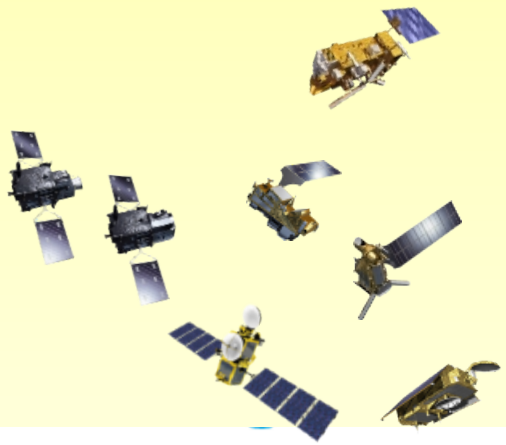
CGMS

Development of Climate Data Products and Usages

Sensing

EUMETSAT

- Long term satellite programs
- Patrimonial archive (decades)
- Data rescue (go back in time as far as possible)
- Expansion of product portfolio

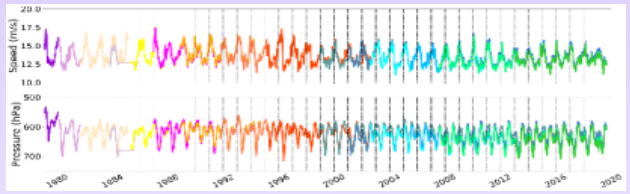


Climate Records

EUMETSAT

EUMETSAT SAF
SATELLITE APPLICATION FACILITY NETWORK

- Consistent calibration
- Geophysical parameters
- Uncertainty
- Data Access
- Cooperation with users
- Training



Applications

National Climate Service providers

Research

WCRP World Climate Research Programme

International Science Council

IAMC

Copernicus Europe's eyes on Earth

Climate Change

Assessment

ipcc Intergovernmental Panel on Climate Change

- Climate variability, trends
- Climate extremes, changes in extremes
- Climate processes and cycles (energy, water, carbon)
- Climate model initialisation, evaluation, …

Decision Making

Policy

United Nations Framework Convention on Climate Change

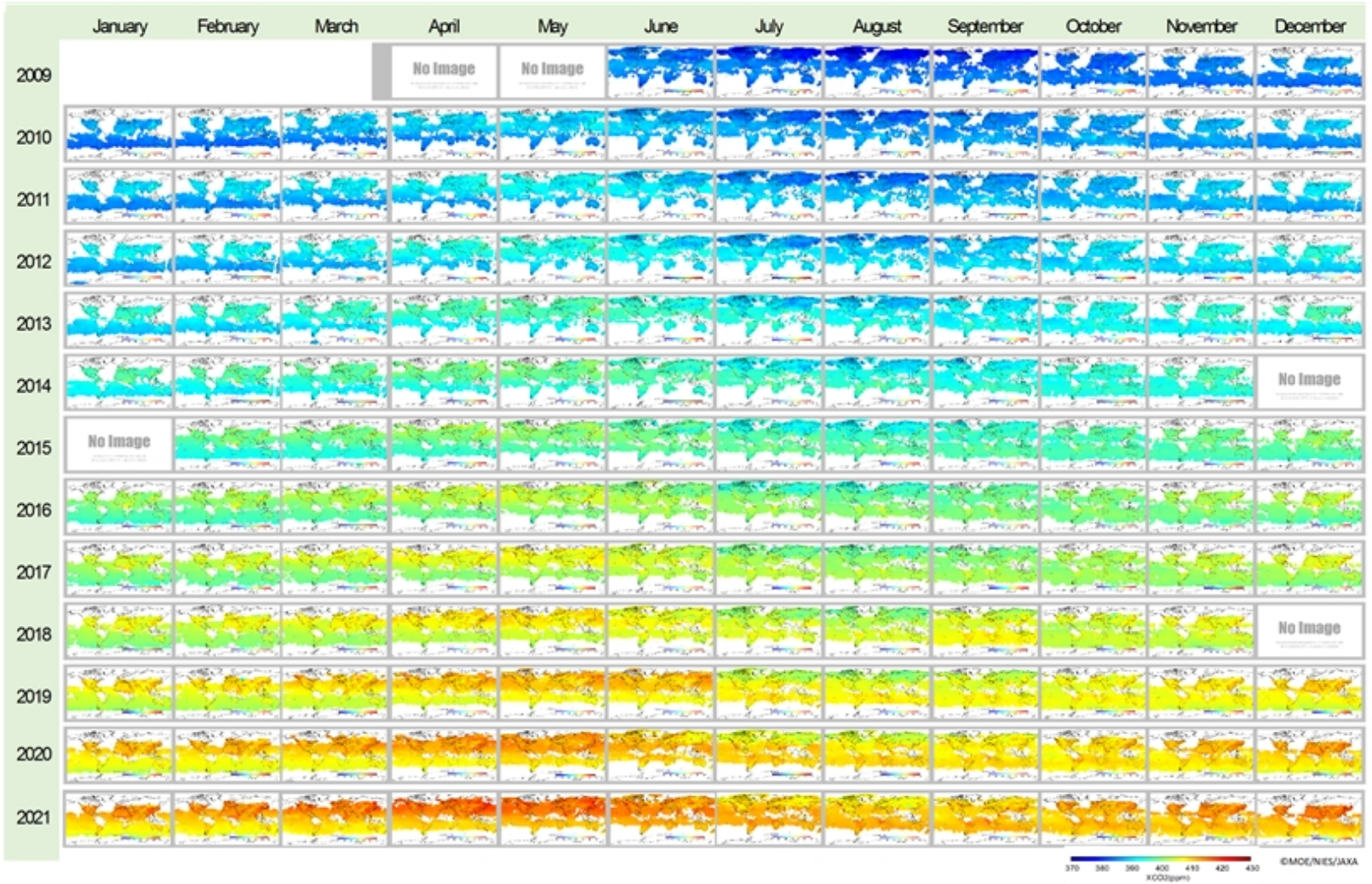
PARTIES

SBSTA / SBI
COP/ CMA/ CMP

- Mitigation
- Adaptation
- Infrastructure
- Energy
- Agriculture
- Fisheries
- Water
- Health
- Tourism

Decade long GOSAT observation

GOSAT data presents decade long global CO_2 density and its global changes from 2009 to 2021



Coordination Group for Meteorological Satellites

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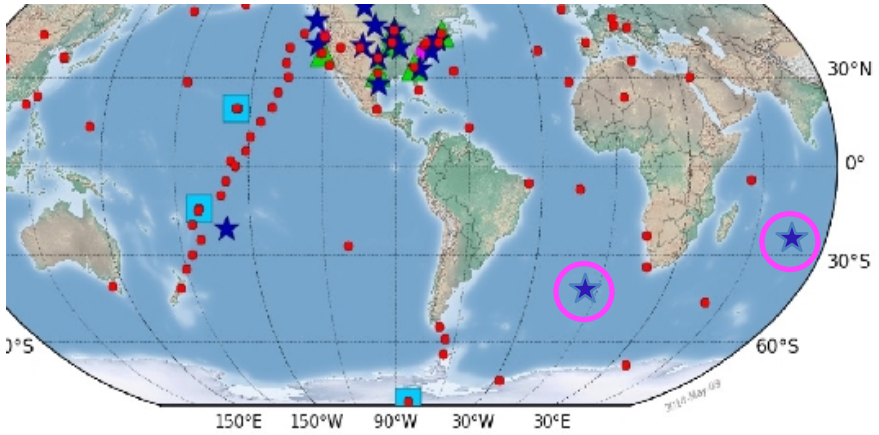
NOAA's Global Greenhouse Gas Reference Network

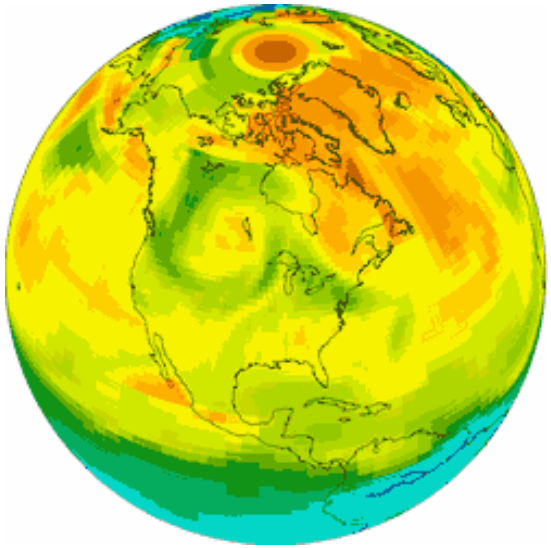


- Aircraft
- Mountain
- Tower
- Observatory
- Weekly Surface Whole Air Sampling

- NOAA's Global Greenhouse Gas Reference Network provides extremely precise and uniquely valuable measurements of CO_2, CH_4, N_2O and many other GHGs and process tracers.
- Data from NOAA's GGGRN and WMO Global Atmosphere Watch partners anchor and complement satellite GHG datasets.

Note new tropical aircraft profiling sites over Africa and Amazonia

NOAA's CarbonTracker Data Assimilation System



- CarbonTracker estimates of CO_2 and CH_4 emissions and removals are currently driven by in situ measurement.
- Capability for assimilating satellite retrievals has been demonstrated.
- Multi-platform, multi-sensor data assimilation methods are needed to leverage complementary constraints and to reliably identify and correct systematic errors in retrievals.
- CarbonTracker includes regional and global implementations for diverse applications.

Coordination Group for Meteorological Satellites

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WGII – High Level Priority Plan

Working Group II discussed the HLPP and provided updates as relevant

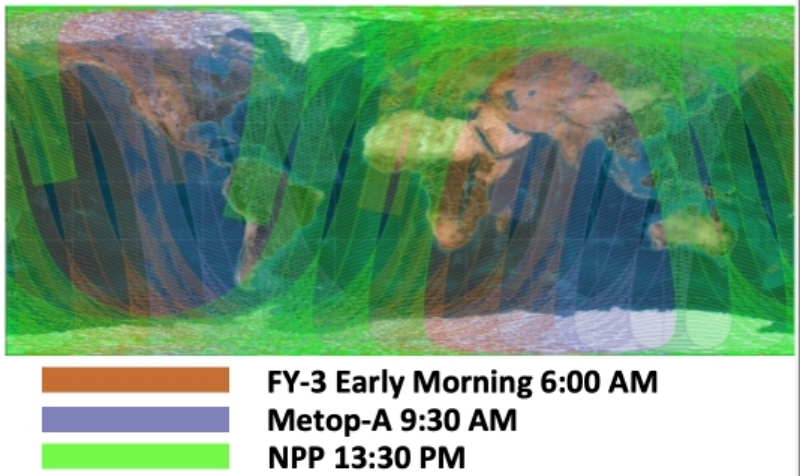
Will be presented under Plenary Agenda item 9
(CGMS-50-CGMS-WP-26)

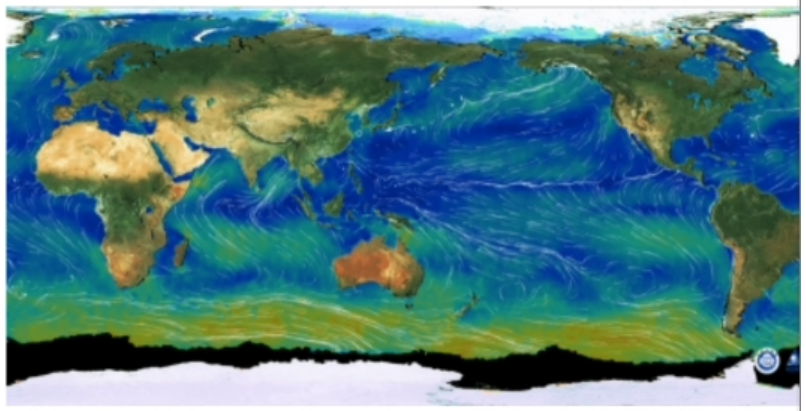
*Future GNSS radio occultation data needs

Thank you

CMA

- The first civil meteorological satellite in the 6 AM early morning orbit, launched on July 5, 2021
  - Ocean vector winds (OVWs) and Sea Ice from FY-3E scatterometer WindRAD
  - Hyperspectral Sounder (HIRAS)
  - Sea Surface Wind Speed from GNOS-II Reflectometery
  - Bending angle, refractivity, T&H profiles from GNOS-II RO
  - Microwave T&H soundings (MWTS & MWHS)
  - MERSI-LL Night Time Lights and Atmospheric Winds





FY-3E Monthly Mean Ocean Wind (September 2021)

IMD – Utilization of Upcoming Satellites

OCEANSAT-3 (2022)

- OceanSat is configured to cover global oceans and provide continuity of ocean colour data with global wind vector and characterization of lower atmosphere and ionosphere.
  - An 13-band Ocean Colour Monitor (OCM) in VNIR (400-1010 nm range) with 360 m spatial resolution and 1400 km swath for ocean Colour monitoring
  - 2-band Long Wave Infra Red (LWIR) around 11 and 12 µm for Sea Surface Temperature (thermal channels) at 1080 m resolution.
  - A Ku-Band Pencil beam SCATTEROMETER with a ground resolution of 50 km × 50 km for Continuity of wind vector data for cyclone forecasting and numerical weather modelling
- The mission objectives are to provide continuity of ocean colour data with improvements to continue and enhance operational services like potential fishery zone and primary productivity. Continuity of wind vector data through repeat of Scatterometer for cyclone forecasting and numerical weather modelling.

GISAT (2022)

- GISAT is configured to facilitate continuous observation of Indian sub-continent, quick monitoring of natural hazards and disaster.

Band	Channels	Ground Resolution(m)	Range(µm)
MX-(VNIR)	6	42	0.45 – 0.875
HyS-(VNIR)	158	318	0.375 – 1.0
HyS- (SWIR)	256	191	0.9 – 2.5

- GISAT will be be useful in Tropical Cyclone Monitoring, Dust monitoring, Day Time Monitoring, Value added Agromet Products, and mintoring of Extreme events such as cloud burst and thunderstorm.

Coordination Group for Meteorological Satellites

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JAXA

- JAXA Mission Definition Review (MDR) for the next generation Precipitation Radar satellite was completed in August 2021. The review board confirmed that the JAXA mission with a spacecraft carrying Ku-band Doppler radar is valuable as a successor of GPM/DPR.

- The IPWG report and the letter by CGMS, supported by CGMS members last year, was well received as requirements from international precipitation communities in the MDR. JAXA appreciates the efforts by CGMS and IPWG to support the new mission.

- In December 2021, Implementation Plan of the “Basic Plan on Space Policy” noted the Precipitation Radar Satellite Phase A activity.

- In January 2022, Precipitation Measuring Mission (PMM) Pre-Project Team was established on for the JAXA Spacecraft carrying the Ku-band Doppler Precipitation Radar.

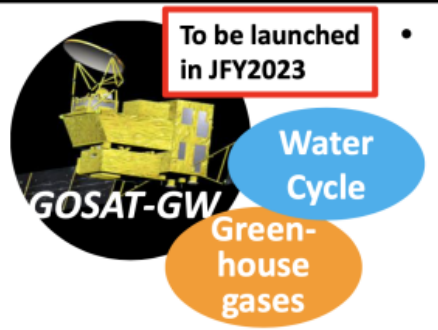
- Currently, JAXA is conducting conceptual study, and the System Requirements Review (SRR) is now scheduled in June 2022.

JAXA

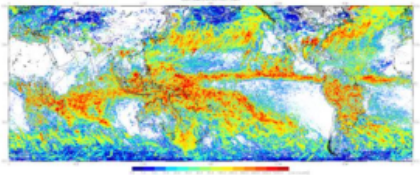
Future Missions for Climate & Water: EarthCARE (2022) & GOSAT-GW (2023)

- Europe-Japan joint mission
- 3 dimensional global distributions of cloud and aerosol to contribute to precise understanding of climate change
- JAXA and NICT provides world's first satellite-based cloud vertical motion by the Clod Profiling Radar (CPR) with 94 GHz with Doppler Capability at 0.8 km spatial resolution.

Orbit	Sun-synchronous sub-recurrent orbit Altitude: approx. 400km Inclination angle: 97.05° Local Sun Time at Desc.: 14:00 Revisit time: 25 days
Instruments	- Cloud Profiling Radar (CPR) by NICT & JAXA - Atmospheric Lidar (ATLID) by ESA - Multi-Spectral Imager (MSI) by ESA) - Broad-Band Radiometer (BBR) by ESA
Mass	Approx. 2.2 tons at launch
Designed lifetime	3 years



AMSR3 for both snow & rain



- Carrying two instruments, AMSR3 and TANSO-3.
  - AMSR3 (JAXA) will succeed AMSR series observations with adding new high frequency channels (166 & 183 GHz) for snow fall retrievals and water vapor analysis for numerical weather prediction.
  - TANSO-3 (led by Ministry of Environment in Japan) uses imaging spectrometer technology to measure CO2, CH4 and NO2 globally with medium and locally with high spatial resolution.

Orbit	Sun-synchronous sub-recurrent orbit Altitude: approx. 666km Inclination angle: 98.06° Local Sun Time at Desc.: 1:30 +/- 15 min Revisit time: 3 days
Instruments	- Advanced Microwave Scanning Radiometer 3 (AMSR3) - Total Anthropogenic and Natural emissions mapping SpectrOmeter-3 (TANSO-3) (for Ministry of Environment in Japan (MOE))
Mass	Approx. 2.6 tons at launch
Designed lifetime	7 years

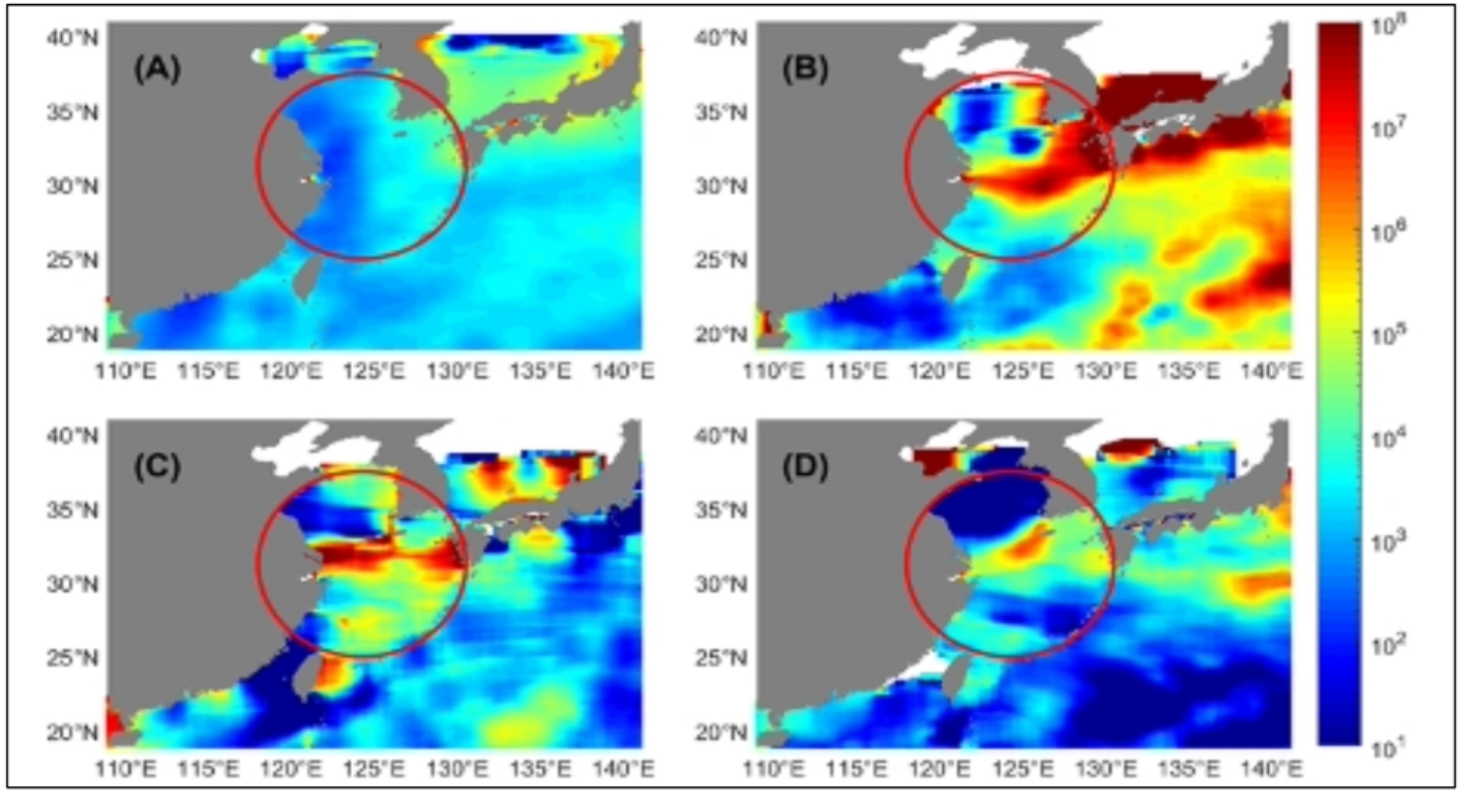
NASA

CYGNSS MICROPLASTICS CONCENTRATION DATA PRODUCT

Evans and Ruf (2021) presented a new method for detecting and imaging the global distribution of ocean microplastics from space. The method uses CYGNSS measurements of ocean surface roughness and relies on a reduction in responsiveness to wind-driven roughening caused by surfactants that act as tracers for microplastics near the surface.

Panel (A) shows the average microplastic concentration number density (#/km2) over an entire year. It serves as a background reference.

Individual one-week averages within that year are shown in Panels (B) 22–28 Jun 2017, (C) 27 Oct – 2 Nov 2017, and (D) 2 –8 Dec 2017. They reveal short lived bursts of high microplastic concentration emerging from the Yangtze River mouth (highlighted by red circles) and dispersing into the East China Sea



https://podaac.jpl.nasa.gov/announcements/2021-11-24-CYGNSS-Ocean-Microplastic-Concentration-V1.0-Release

International Earth Surface Working Group

- ***The Main Objectives of the IESWG as currently noted in the draft Terms of reference are:***
  - Use of EO data for modelling the Earth surface using both active and passive remote sensing data relevant to study processes and the surface-atmosphere interactions characterized for the purposes of improvement of Earth surface models for NWP and reanalysis;
  - Defining the key gaps and charting required advances in **land/surface data assimilation systems**, including (but not limited to) improving the observability of land surface models and DA systems, defining observational needs and model process improvements, embracing technology advances such as machine learning, and enabling strongly coupled DA environments;
  - Use of EO-data for NWP and others surface model parameter optimization including surface temperature, albedo, vegetation state, soil moisture, snow water equivalent, water-body extent, canopy parameters, vegetation water content, etc. and the resulting surface emissivity/reflectance/(solar induced fluorescence) spectra;
  - Charting the state of the operational Earth Surface and Land Data Assimilation Systems (LDASs); sensitivity studies of surface model parameters to remotely sensed data; outcomes of assimilating sensors such as SMOS, SMAP, ASCAT, and GPM and the follow-on missions building from this heritage; along with, their combination with higher resolution sensors such as MODIS/VIIRS, AMSR-2 and Sentinel-3-OLCI;
  - Advancing radiative transfer and emissivity/reflectivity/scattering-emission model development for VIS/IR/MW over land and snow covered surfaces. Review current parameterization for forward modelling of the surface boundary; description of available land emissivity databases/atlases; intercomparison and validation of physical models and retrieved emissivity (including land and snow surfaces);
  - Characterize product retrievals of surface parameters, their performances, stability, and evolution. Products include: surface temperature, albedo, vegetation state, soil moisture, snow water equivalent, inland water-body extent, canopy parameters, vegetation water content, etc. and the resulting surface emissivity/reflectance spectra;