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Prepared by CGMSSEC
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WG I,II,III,IV + SWCG +
Plenary

Status of implementation of CGMS High Level Priority Plan (2019-2023)

The status of implementation of CGMS High Level Priority Plan (2019-2023) is presented. It incorporates inputs from:

- WG – I, II, III and IV chairs and rapporteurs
- International Science Working Group chairs and rapporteurs
- GSICS project
- SCOPE-CM project
- CEOS-CGMS Joint Working Group on Climate
- CGMS Space Weather Coordination Group

To guide the considerations of the working groups, the colour coding in the table indicates:

Green: Priority is reflected in ongoing CGMS actions
Yellow: Actions have been defined associated to the priority, but progress is limited
Red: No actions associated with the priority can be identified or major obstacles is hindering progress

Action/Recommendation proposed:

- WGs I, II, III and IV to consider and amend the status of implementation of the HLPP
- The WGs should in particular
    - identify priorities within their area of focus that can be considered achieved and should be removed from the HLPP.
    - Identify new or modified priorities, that should be considered by CGMS for inclusion in the revised HLPP. Some recommendations have already been identified during the preparation of this document and are reflected in the tables below
    - Consider whether priorities where no actions can be identified should be retained in the HLPP.

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This document presents the status of implementation of the CGMS High-Level Priority Plan (2019-2023), as agreed by CGMS at its 47th Plenary Session in Sochi, Russia in May 2019. The status is based on inputs primarily from chairs, co-chairs and rapporteurs from CGMS Plenary Working Groups I, II, III and IV as well as the CGMS Space Weather Task Team, gathered through the inter-sessional activities, as well as from International Science Working Groups (through WG-II), the joint CEOS-CGMS Working Group on Climate and other non-plenary working groups reporting to CGMS.

The table present the targets according to the logic of the CGMS end-to-end systems. A colour coding indicates the overall progress of achievement of the target:

ACHIEVED	Target has been achieved, will be proposed for removal from HLPP
	Priority is reflected in ongoing CGMS actions
	Actions have been defined associated to the priority, but progress is limited
	No actions associated with the priority can be identified or major obstacles is hindering progress

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
1	**Operational Continuity and Contingency Planning**	**WG-III**		
1.1	Mitigate the impact of identified degradation or loss of capabilities of the CGMS baseline and ensure appropriate contingency measures are in place, in particular to:		WG-III at its Risk Assessment Workshop in February 2020 identified mitigating actions to address loss of CGMS baseline capabilities. The outcome of the Risk Assessment was presented to WG II and IV. It was agreed to involve the WG II ISWGs, GSICS and JWGClimate to substantiate findings for the next assessment and to consider opportunities to mitigate identified risks. (Associated actions are recorded).	

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
1.1.1	Ensure continuity of passive microwave imager measurements		WG-III recognized the need for a long-term plan for ~6 GHz frequency microwave imaging in at least one LEO orbit for all weather sea surface temperatures. Recommended mitigating actions included ensuring data availability from HY-2B, continue to work towards having 6 GHz data from two orbits (consistent with section 1.2.2), and NOAA to provide an update on SSMI status and possible follow-on. It will be investigated whether the current and planned µwave constellation provides adequate support for precipitation measurements, as these measurements depend mainly on frequencies around 90 GHz.	
1.1.2	Ensure long-term continuity of the Early Morning orbit, in particular for IR/MW sounding		The official announcement of China's decision for FY-3E in EM orbit was made by CMA during the 17th WMO Congress. Following this official announcement, CGMS actions are being defined to ensure the full integration of the FY-3E satellite in the overall GOS. The long-term continuity in the EM is still to be confirmed. Korea is in the approval process for an EM programme, and the decision process in China is not yet completed.	

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1.2	Advance the response to the WIGOS 2040 vision for space, by the implementation of new capabilities beyond the CGMS baseline		CGMS agreed to extend its response to the WIGOS vision, and in particular to include a number of new measurements in the CGMS baseline: - Imaging from Highly Elliptical Orbits for Arctic observations - Short Wave IR Spectrometers for monitoring of Greenhouse Gases (CO2 and CH4) - Multi-viewing, multi-channel, multi- polarisation imaging for aerosols - UV limb sounding spectrometry for profiles of Ozone and trace gases	
1.2.1	Advance the new generation of GEO satellites, including advanced imaging, lightning mapping and IR and UV sounding for the whole geostationary ring		No progress reported.	
1.2.2	Work towards ensuring low frequency microwave imagery for all-weather SST and ice monitoring from at least 2 sun-synchronous orbits		Will be addressed in CGMS-47 plenary	

Commented [MR1]: Baseline as static?

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1.2.3	Increase geographical altimetry coverage, for example through wide-swath altimetry		ISRO will present plans for altimetry missions at CGMS-48	

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1.2.4	Advance the atmospheric Radio Occultation constellation, with the long-term goal of providing 20000 occultations per day on a sustained basis		IROWG recommends targeting 20,000 globally distributed observations per day with uniform spatial and local time coverage, noting that both the equatorial and polar components of the COSMIC-2 mission are required for operational NWP. Recent studies show that substantial increases in NWP accuracy and climate monitoring utility are obtained for increases in the number of RO profiles to at least 20,000/day (corresponding to around 4 M bending angles per day), and beyond, not approaching saturation at 20,000 per day. The status remains unchanged: the target number of occultations will not be met with existing operational missions or those in the implementation stage. Current estimates for operational missions, including the COSMIC-2 equatorial mission, are for approximately 12,000 occultation profiles per day starting in 2022 with the launch of EPS-SG. However, only 5,500 are from satellites providing global coverage (EPS, EPS-SG, Feng-Yun and JASON-CS/Sentinel-6). The COSMIC-2 mission profiles are all below about 40 degrees latitude. Source: WMO/OSCAR (courtesy of C. Marquardt, EUMETSAT). To mitigate the risk of a gap after COSMIC-2, all operators should consider flying RO instruments on any planned low-inclination mission. Target will be reviewed in the context of the 2020 revision of the CGMS baseline	

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			RO: Recommend operators to fly RO instruments for all missions in drifting orbits to mitigate the risk of gaps beyond the middle of the decade. Input from IROWG: The 20 000 target is well established and has already been endorsed by CGMS. And the assessment of the current and near future situation - with quite some gaps in coverage (especially in local time) at latitudes beyond 40° latitude - is still valid.	
1.2.5	Move towards an operational space weather monitoring capability from the Lagrangian Point L-5		The need to expand to the L-5 orbit has been established by NOAA's NSOSA study, which noted the benefit of off-Sun-Earth axis solar observations. Will be addressed further in the Space Weather cooperation between NOAA and ESA.	
1.3	Support satellite impact studies, including in particular impact of data latency and the impact of the Early Morning orbit;		The preparation process for the next WMO impact workshop in 2020 has started and CGMS will provide inputs to the science questions for the workshop, to ensure that impact of data latency is adequately addressed.	

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1.4	Identifying partnership opportunities on space and ground segments and establish CGMS coordinated mechanisms;		Partnership on LEO ground segments being implemented by EUMETSAT and NOAA for Metop-SG and JPSS. It should be noted that this target applies strongly to the CGMS engagement in Space Weather.	
2	**COORDINATION OF SATELLITE SYSTEMS AND OPERATIONS**	**WG-I**		
2.1	**Coordination/Optimisation of data collection systems**			**2.1**
2.1.1	Assess Data Collection Service (DCS) status and evolutions including International channels, taking into account requirements of tsunami alert systems and in-situ ocean observations (e.g. buoys), and assess the utilisation of International DCS channels;		Considered work in progress noting the information in DCS Sub-Group status report. Status is considered to be “yellow” as the topic is dependent on the outcome of 2.1.2	2.1.1

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
2.1.2	Establish International DCP design standards taking into account requirements of tsunami alert systems and in-situ ocean observations (e.g. buoys) and lessons learned from the development of High Rate DCPs;		This is ongoing work by the WGI DCS sub group (some overlap with 2.2.1) The DCS Sub-Group are coordinating the elaboration of the user requirements, the technical specifications, and potential applications for a new DCP Standard including a section on DCP formats. The specification is initially based on ESA study. To be further elaborated at the DCS Sub-Group Meetings to be arranged after CGMS-48 Status is considered to be "yellow" as the topic to be further developed through dedicated working team and focused Inter-Sessional activities (2018-2021).	2.1.2
2.1.3	Establish Best Practices for Data Access, based on user requirements for sharing data/information delivered using DCS (outside the regional area) and evolve the mechanisms to share DCP data.		Considered work in progress. The DCS sub group propose an CGMS Best Practice on Data Access at CGMS-48 after comments received at CGMS-47 Proposed to be closed if BP endorsed at CGMS-48.	2.1.3
2.2	**Radio Frequency (RF) Protection**	**WG-I**		**2.2**

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2.2.1	Facilitate an effective preparation of national positions for the World Radio-communication Conference (WRC) 2023 favourable for the CGMS-related issues.		Considered well covered by the different working papers provided by the different WG-I members. This topic needs to be kept in the HLPP but updated to fit with the issues on the WRC-23 agenda for securing adequate information flow inside CGMS on national and regional level preparatory activities (as well as the dedicated report from SFCG activities provided by CGMS Liaison representative in SFCG) Noting that WRC-23 preparatory process has not really started given the COVID-19 situation:	2.2.1
2.3	**Direct Broadcast Systems and Data Processing**			2.3
2.3.1	To ensure the ease of use of data products, provide for dissemination of satellite-derived data and products in one of the four established formats (HRIT, BUFR/GRIB, NetCDF 4 and HDF 5). When a unique data format is used, use an open standard if possible or provide full documentation of the format to users along with the software to convert the data to one of the established formats;		Work has progressed, see the status report provided by EUMETSAT on dedicated paper for CGMS-48, containing also the outcome of specific work achieved by the WG-I participants through dedicated Inter-Sessional meetings. A dedicated CGMS "liaison officer" agreed at CGMS-47. The role is to coordinate with the CF community to concentrate efforts and views of the different CGMS members aiming at contributing to the evolution of these standards by actively participating in the related CF meetings. Topic is proposed to be further developed through dedicated and focused Inter-Sessional activities (2018-2021).	2.3.1

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
2.3.2	Develop efficient standardized data handling for high-resolution imaging and hyperspectral instruments, employing novel methods like dissemination of hyperspectral infrared data based on Principal Component Analysis;		Proposed to be addressed in WG-IV under the CGMS Task Force on Satellite Data Format and Standards (see CGMS-48-CGMS-WP-08).	2.3.2
2.3.3	Facilitate the transition to new LEO direct readout systems (JPSS, FY-3, Meteor-M, Metop-SG);		The initial nine Best Practices now published in *CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data* (CGMS/DOC/18/1008274) were introduced and endorsed through CGMS-44, CGMS-45 and CGMS-46. As a result of the ongoing work, supported by WG-I dedicated Inter-Sessional meetings, one new Best Practice, *BP.10 Monitoring of the Direct Broadcast Downlink* and an update to the existing BP.04 will be presented for endorsement at CGMS-48.	2.3.3

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2.3.4	Advance the implementation of the CGMS Agency Best Practices in support to Local and Regional Processing of LEO Direct Broadcast data for operational satellites with DB capability;		Maturity of the existing nine BPs considered achieved. To review and support the implementation of the BPs, WG-I has established a peer review process between the agencies operating LEO satellites with Direct Broadcast capability. The outcome of the peer review is reflected through the *Implementation of CGMS best practices for LEO direct broadcast data* documents prepared by each agency. These documents were exchanged and actively reviewed and discussed between CMA, NOAA and EUMETSAT prior to being published for the CGMS-48 WG-I meeting. The review covered not only the documents, but where relevant also a verification of the availability or content of resources listed in the document.	2.3.4
2.3.5	Support the evolution of the DBNet services to include new satellites and the extension to advanced sounders for at least half of the globe.		Implementation plan for inclusion of advanced sounders has been agreed by the DBNet Coordination Group. Implementation is ongoing, supported by all LEO satellite operators. Most significant change is that NOAA, in the context of its DBRTN system, has now replaced EUMETSAT as the provider of regional DB services from the USA	2.3.5
2.4	**Operational issues related to Space Weather**			
2.4.1	Evaluate existing operational space weather products and services in support of CGMS members' spacecraft operations and recommend additional services as appropriate		Will be addressed in intersessional work with SWCG	

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3	**COORDINATION OF DATA ACCESS AND END-USER SUPPORT**	**WG-IV**		
3.1	**Support the user-provider dialogue on regional/continental scales through regional coordination groups maintaining requirements for dissemination of satellite data and products through the various broadcast services;**		Regional coordination groups on data requirements are established in all WMO regions (RA I to RA VI), and those groups are very active. The report on the RAII WIGOS Project to Develop Support for NMHSs in Satellite Data, Products and Training in 2018-2019 demonstrates a good example of best use of satellite data information. Furthermore, a Survey on the Use of Satellite Data led to immediate reaction by JMA to enhance data access of GSMaP data to Asia and Pacific countries.	

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3.1.1	Consider the full range of user capabilities (ranging from advanced Short range NWP to more conventional nowcasting) when planning data utilisation, products generation and dissemination strategies, in particular for the new geostationary satellites;		Action pending to refine requirements from IPWG for access to GEO image data, progress in 2020 expected.	

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
3.1.2	Establish a sustained interaction with the operational nowcasting communities with a view to fully utilise the commonality of the future geostationary imagers and sounders.		The responsibility for the priority is between agencies and nowcasting communities, not between Agencies. However it is recognized that Agency interaction would facilitate further progress and some activities are happening here as well. Looking at some the key players with key current and future capabilities it seems this is progressing reasonably. Whilst some interactions exist, also in the context of the EUMETSAT MTG IRS Mission Advisory Group, a sustained regular interaction across all CGMS members planning to launch geo-satellites with hyperspectral infrared capabilities has not yet been established. Focus of SCOPE-Nowcasting Pilot Project 1 in RA II (Asia) and RA V (South-West Pacific) Working paper with updates on SCOPE-NOWCASTING will be discussed at CGMS-47 (CGMS-47-WMO-WP-10). To be further discussed at next SCOPE-NWC steering committee meeting. Activity to be coordinated with WGIV.	
3.2	**Prepare operational users for new generation of meteorological satellites through user readiness programmes, with coordinated contributions from CGMS members**			

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
3.2.1	Advance the implementation of the Best Practices for Achieving User Readiness for New Meteorological Satellites, in as far as they apply to CGMS operators;		The NOAA GOES-R and JPSS related user readiness work demonstrated the application of Best Practices. VLab plays an important role for Achieving User Readiness. The 5 year training strategy was endorsed.	
3.2.2	Provide up-to-date Information on these topics, to be synthesized and maintained by WMO in the SATURN portal, dynamically linked to resources of CGMS members, including the new generation of GEO satellites as well as new LEO satellites.		Continuous update of SATURN information to be included in Best Practice, by a to-be-established inter-sessional sub-group.	

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
3.3	**Support the coordination of the operational Digital Video Broadcast (DVB) satellite services for the Americas, Africa, Europe and the Asia Pacific regions;**		The communication satellite broadcast systems GEONETCast Americas, EUMETCast, CMACast and HimawariCast are well established and coordinated systems, and no significant issues are observed.	
3.4	**Increase access to, and use of, data from R&D and pre-operational missions, including space-weather missions;**		EUMETSAT, supported by CGMS members, is actively increasing access of such data to its member states, and to other CGMS members through bilateral arrangements. Examples are ISRO scatterometer missions and the China HY-2 mission. It should however be noted, that the bilateral agreements for R&D satellites do not always allow unrestricted re-distribution for operational use. Ongoing activities, no specific issues reported.	

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3.5	**Investigate the feasibility of utilizing existing dissemination systems for meteorological information in helping to mitigate disasters;**		EUMETSAT has implemented automatic retrieval of Value-Added Products from the Disaster Charter WEB site and re-dissemination on EUMETCast.	
3.6	**Increase operational access to data and products in support to the ocean user community;**		Ocean is addressed in the regional dialogues, but there is a need for a better dialogue with the global ocean community. It should be noted that J-COMM has now decided to re-establish the Task Team on Satellite Data requirements, which will enable a more structured dialogue between CGMS and the Ocean Community regarding data access. No progress so far.	

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3.7	**Utilise operationally the WIS infrastructure for satellite data provision and discovery;**		The overall WIS implementation is proceeding, but there is little evidence on the operational utilisation for satellite data. Most high-volume satellite data are still exchanged bilaterally outside the WIS context and are only to a limited extent discoverable in the WIS. Further actions are being taken in the CGMS Task Force on Metadata Implementation and also in the context of the CBS Expert Team on WIS Centres, in particular its Task Team on Data Centres. The WIS 2.0 implementation approach has been developed by the WMO, based on 11 principles underpinning the new functional architecture of WIS 2.0. Contributions from CGMS members were requested in form of participation with demonstration projects. Feedback expected in the context of cloud and big data services for the Joint WGI-WGIV session.	
3.8	**Provide coordinated CGMS inputs to WMO on satellite and instrument identifiers for data representation and metadata within the WIS**		Further progress on the activities performed by the CGMS Task Force on Metadata Implementation including creation of WIS metadata records for satellite data products. The CGMS Task Force on metadata invites Satellite Providers taking advantage of the Metadata Guidance documentation to create WIS discovery records in addition to the existing WIS documentation. A report on the status of the Task Force activities is foreseen at CGMS-48, agenda item 8.	

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3.9	**Harmonise the metadata (e.g. quality descriptors) and format of products to be exchanged, in adherence to the Service and Discovery metadata standards formulated in the context of WIGOS/WIS**			
3.9.1	Support WIGOS in the definition of harmonized product metadata for satellite data and implement for CGMS missions;		The CGMS Task Force on Metadata Implementation has worked on the WIGOS Standard Assessment. The recommendations available from CGMS-TFMI-WIGOS-Standard-Review were approved. An extension of the work plan regarding the assessment of the WIGOS Metadata Representation Format was endorsed.	
3.9.2	Promote the product metadata standards within ocean communities, such as on SST, ocean colour, ocean vector surface wind and ocean surface topography, to facilitate common data representation and near-real time exchange. This must be done in dialogue with the relevant CEOS Virtual Constellations.		No progress, will be discussed with Metadata Taskforce.	

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3.10	**Document current data formats for space weather observations**		The space weather related actions for WGIV were superseded by the survey issued by the SWCG, which was aimed at data providers, formats, dissemination and latency issues. With this survey the existing actions could be closed.	
3.11	**Improve the near-real-time access to and global exchange of space weather data from instruments hosted on meteorological satellites**		NRT data access is not considered an issue. WG-IV will work closely with SWCG to follow up on data access.	
3.12	**Explore options for optimal data exchange of advanced data from new generation GEOs, in consultation with the global NWP centres through GODEX-NWP**		Currently no specific requirements from GODEX-NWP. Will be taken up in the future.	
4	**ENHANCE THE QUALITY OF SATELLITE-DERIVED DATA AND PRODUCTS**	**WG-II (Supported as appropriate by ISWGs and GSICS project)**	**Status below is provided based on information from the ISWGs that have met since last CGMS. A complete status of implementation of the proposed targets in the product area will be gradually established by WG-II, the ISWGs (during their cycle of meetings) and the GSICS project.**	

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
4.1	**Establish within GSICS a fully consistent calibration of relevant satellite instruments across CGMS agencies, recognising the importance of collaboration between operational and research CGMS agencies;**			
4.1.1	Establish a consistent inter-calibration for thermal IR channels using hyper-spectral sounders as reference. The implementation will be done successively by the individual satellite operators.	GSICS	Implemented and provides input to the annual GSICS. observing system report. Interoperability within GSICS framework ongoing. Regarding inter-calibration of passive microwave sensors, GSICS-EP should consider whether a specific target can be formulated at this point in time. GSICS-EP has considered this and proposed a formulation (4.1.4)	

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
4.1.2	Establish a consistent inter-calibration for solar channels using instruments with adequate in-orbit calibration and vicarious methods as reference. The implementation will be done successively by the individual satellite operators.	GSICS	The lunar irradiance and DCC (Deep Convective Cloud) have been suggested by GRWG as targets to transfer the NPP-VIIRS reference calibration for the solar reflective bands. The results have been demonstrated by most satellite agencies, the approach for implementation is still under discussion. It is imperative to stress the need to use the same solar spectrum for inter-comparing sensors based on radiance units. The MODIS, NPP-VIIRS, and N20-VIIRS sensors use the Neckel&Labs, MODTRAN 4.3, and Thuillier 2003 solar spectra, respectively. The GSICS-recommended NOAA NPP-VIIRS V2 calibration reference will use the Thuillier solar spectrum. This multiplicity is confusing. The GSICS VIS/NIR and UV groups have tasked the CU/LASP solar group to prepare a paper (contact: Peter Pilewskie peter.pilewskie@lasp.colorado.edu) to establish a high resolution solar reference spectrum anchored to the newly launched ISS/TSIS-1 sensor. This will be in coordination CEOS WGCV IVOS group.	

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4.1.3	Establish within GSICS a consistent calibration for reflective solar spectrometers by using instruments with stable orbits, good ground-based pre-launch calibration, adequate on-board degradation and wavelength scale characterization, and monitored records over PICS and ground-based atmospheric composition measurement sites with state of the art RT generation of radiance / irradiance ratios either absolute or relative constituent pattern differences	GSICS	NEW, should be shortened	
4.1.4	Establish a methodology to establish consistent calibration for microwave instruments. The implementation will be done successively by the individual satellite operators.	GSICS	NEW, formulation TBC	
4.2	**Establish commonality in the derivation of satellite products for global users where appropriate (e.g., through sharing of prototype algorithms);**			

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4.2.1	Establish commonality in the derivation of AMV products for global users where appropriate (e.g., through sharing of prototype algorithms) and consider backwards compatibility when designing AMV algorithms for the 16-channel imagers, so that present state-of-the-art algorithms can be applied to old imagery.	IWWG	The final results of the 3rd AMV intercomparison presented at IWW14 showed that the use of a Common QI by all the participants has real skill in filtering collocated AMVs for an improved statistical agreement. Working Group 1 on AMV methods produced two actions for the Common QI: 1) Place the software in a public repository for future collaborations and 2) All AMV producers to implement the software in their algorithms prior to IWW15. Working Group 2 on NWP data assimilation like the idea of the Common QI and encourage producers to provide it operationally. Action 1) is complete. The Common QI is located on GitHub at https://github.com/swanzong/IWWG.git. The owner of the site is Steve Wanzong (stevew@ssec.wisc.edu) and is freely available. Action 2) is partially complete. At the time of this CGMS48 (May 2020), EUMETSAT, KMA, JMA and the NWCSAF/HRW have included the Common QI into their algorithm repositories. NOAA has plans to complete their integration in the Fall of 2020. The IWWG co-chairs have started the organization of the 4th AMV Intercomparison. They will present the scope of the work at the upcoming IWW15, in September 2020. It is planned to work closely with the Aeolus, MISR, and the ICWG to find a common GOES-16 time period to share. Aeolus switched to a backup laser at the end of June, 2019. We expect to look for Aeolus data from August 2019 (or later) in the footprint of GOES-16. We also need to discuss ways to synchronize the IWWG golden day work with the ICWG. The ICWG performs their intercomparison in the same year it is introduced. The IWWG performs the work in between two meetings. This makes discussions difficult between the two groups.	

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4.2.2	Investigate the best configurations to be used by the AMV producers for use in global and regional NWP models respectively, and clearly define the appropriate requirements for each of them;	IWWG	With the advent of advanced imagers (Himawari AHI, GOES ABI, GEO-KOMPSAT AMI, INSAT-3D, -3DR, MTG FCI, FY4A/B AGRI), the upgraded sensors can be exploited to produce high resolution AMVs. These AMVs in high impact weather events (e.g. Tropical Cyclones) are needed to resolve some of the smaller scale flows and also be provided to mesoscale/hurricane NWP forecast/data assimilation systems. Mesoscale NWP is an advancing system that will demand AMVs at these scales. This topic has been discussed in a plenary session at IWW14 leading to the action A46.04. A46.04: NWP community to define the best configuration to be used by the AMV producers, for use in global and regional NWP models. MET Norway started to work on this topic using NWCSAF software. The study is still ongoing but preliminary results should be hopefully discussed at IWW15 in September. Both the MET Office and EUMETSAT started to investigate the use of surface correlation to improve the quality indicators associated with wind vectors. It should allow a clearer separation of the errors coming from tracking and the errors coming from the height assignment. Preliminary results will be presented at IWW15.	

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4.2.3	Assess the impact of Aeolus HLOS wind profiles on NWP, and investigate AMV height assignment issues using Aeolus data;	IWWG	Most of the European National Met Services presented early results of Aeolus data quality or impact on NWP at the first Aeolus NWP Impact workshop that was organised in Darmstadt on 12 September 2019. Other agencies such as NOAA, NASA, NIES, and ECCC also participated in the workshop. Although very preliminary and based only on the use of Laser-A, almost all regional and global NWP centres showed significant improvements from using Aeolus data in their data assimilation systems. The impacts were found to be largest in the S. Hemisphere extra-tropics, large in the tropics and less in the Northern Hemisphere extra-tropics. The main conclusion is that direct wind profile data provides valuable improvement of the general circulation in the forecasts. This improves the prediction of atmospheric dynamics, and the temperature and moisture fields by improved advection. All experimentation showed Rayleigh-clear winds (87 km horizontal averaging) provides more impact than Mie-cloudy, but Mie winds (10 km horizontal averaging) do provide a very valuable contribution. A second Workshop was planned for mid-March 2020, but it has been postponed to 26 November 2020 due to COVID19. New results of impact studies are expected, using the Aeolus data from Laser-B, which has been operational since July/August 2019. Laser B has better quality than Laser-A and the impact of Aeolus data on forecast scores should be even larger than the promising results shown during the first workshop. Several centers including NOAA, CIMSS, EUMETSAT, ESA, NCEP, ECMWF began comparisons of Aeolus winds against common AMVs extracted from passive satellite imagery. Such comparisons should help to	

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			understand the problems of height assignment errors common to all AMV producers, and to propose specific improvements.	
4.2.4	Establish a coherent development of volcanic ash products (notably from current and future geostationary imagers) utilising the JMA test-bed.	WG II	The Volcanic Ash Intercomparison Workshop was conducted in June-July 2015 in Madison US. Whilst there was progress and certainly activities are done under SCOPE-NWC Volcanic Ash project there has not been sufficient visibility to assess the overall progress. It also seems that there is a decrease in momentum in this field as time passes by since the Eyjafjaellajokull 2010 eruption. A second VASH intercomparison workshop has been conducted by SCOPE-NWC in 2018. WG II to review the Workshop report when it becomes available. WG II to consider way forward. Currently the JMA testbed is accessed only by a limited number of people and does not warrant maintaining/upgrading the infrastructure, JMA will close it down. There is therefore an **Action on WG II to consider alternatives.**	

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4.2.5	Develop best practices for retrieving cloud properties, using the converging capabilities of next-generation geostationary imagers	ICWG	ICWG attempts to establish references from comparisons that can be used as benchmarks to track the cloud product accuracies from CGMS agencies. In addition, the Cloud Heights for AMV Topical Group is addressing the need for standardized uncertainty and diagnostic metrics from cloud height producers to facilitate the optimal solution to the AMV height assignment problem. ICWG continued to run an intercomparison of cloud properties for the existing golden days (SEVIRI/AHI) and a new golden day for AHI chosen in collaboration with IWWG (July 21, 2016). Agencies submitted data ahead of the meeting and a standard analysis was conducted and discussed in the intercomparison group. The ICWG continues to support publicly available tools and data library hosted by the University of Lille. The ICWG/IWWG collaboration is also developing analyses relevant to the use of heights for the AMV application. The IWWG has chosen 21 September 2018 as a Golden Day for GOES-16 and Aeolus comparisons (preliminary). The ICWG intercomparison group is planning on automating data submission and analysis in the future. ICWG will participate in the comparison of techniques for generating the International Satellite Cloud Climatology Project Next Generation (ISCCP-NG) under the direction of the GEWEX Data and Analysis Panel.	

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			Update from ICWG: First we ask you to confirm that the formulation of this target is really correct. ICWG deals primarily with inter-comparison and validation activities which explains the previous name of this activity which was "Cloud Retrieval and Evaluation Workshop" – CREW. Thus, we don't think we have the mandate to "Develop best practices for retrieving cloud properties …" but rather to "Develop best practices for evaluation and validation of cloud properties". The latter formulation fits better to our Terms of Reference. We would like you to check whether this target has been incorrectly formulated. The previous two ICWG workshops (and preceding CREW workshops) were quite successful in reporting and discussing cloud retrieval evaluations and this was mainly explained by having dedicated staff leading and taking responsibility for common validation databases and evaluation methods. We are now seeking further funding support from CGMS for being able to continue this work (as expressed by recommendation WGII/R47.02) for the planned ICWG-3 meeting (23-25 September) and follow on meetings. The converging capabilities of next-generation geostationary satellites were explored at ICWG-2 and we expect them to be equally relevant or even intensified in studies presented at the next ICWG-3 meeting. For ICWG-3, studies will also be devoted to exploring data from both geostationary and polar orbiting satellites. A good example is the combined study of data from the GOES-16 imager and data from the AEOLUS mission based on a new Golden Day dataset. This study will be done in cooperation with IWWG and the work is already underway.	

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			Combined geostationary and polar data also play a key role in the upcoming ISCCP-NG project. The role of ICWG here has still to be defined but we see a potential for ICWG to be able to contribute in the evaluation of candidate algorithms for ISCCP-NG. In connection to this we can report that work has been initiated at NOAA in creating a global VIIRS dataset with a reduced resolution similar to that of the historic AVHRR GAC dataset.	

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4.2.6	Using current and future geostationary imagers and sounders, generate and disseminate consistent basic nowcasting products, initially in pilot areas, as identified in SCOPE-Nowcasting.	ICWG	ICWG had active discussions on nowcasting products as well as data collection and effective information generation. A scan strategy is recommended to include full disk imaging at least every 10 minutes when satellite and ground station capabilities allow. The group identified a need for inter-comparison studies from various satellite derived thunderstorm properties over the life cycle of several thunderstorms With the adoption of 10-minute full-disk scans by GOES-16 and GOES-17, all full-disk scans from all advanced geostationary imagers are available at 10 minutes. ICWG data submissions include full temporal resolution and this data is available to interrogate the use of cloud properties for nowcasting applications. ICWG welcomes the opportunity to collaborate with the community on use of the submitted cloud products for use with non-satellite information. ICWG weather applications group intends to compare products over severe weather including through the life-time of storms. Input from ICWG: The development of new Nowcasting products based on availability of new datasets and sensors is extensive. Many ideas were presented at ICWG-2 but it is still early to clearly identify mature operational tools. We hope that further advancements can be presented at ICWG-3, e.g., new applications combining satellite data and non-satellite information. Here, also applications based on new lightning sensors will be discussed in a dedicated session. These applications certainly have a capability to enhance Nowcasting tools and methods even further.	

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			In ICWG-3, we promise to give time to (a) SCOPE-Nowcasting representative(s) to give us an update and seek collaboration.	

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4.2.7	To establish together with the user community a commonly agreed approach for retrieval of Principal Component scores and associated parameters from hyperspectral infrared data, minimizing information loss including the mutually acceptable update strategy for the principal component basis and to implement such an approach in a coordinated manner.	ITWG	The Data Assimilation/NWP working group at ITSC-20 recommended to da - If PC compression is used to disseminate hyperspectral IR observati approach should be taken in order to mitigate information loss (e.g., by reta principal components as possible). - A mutually acceptable update strategy should be devised and docum dissemination of PC products. - When using PC compression, noise normalisation should be perform noise covariance matrix. ITSC made further recommendations at CGMS-44, including: 1. To satellite agencies: If PC compression is used to disseminate hyper observations; a conservative approach should be taken in order to mitigate i by retaining as many principal components as possible). 2. To satellite agencies in dialogue with users: devise and document a mutually acceptable update strategy for the principal component basis when a principal component scores product is disseminated to users. Users are encouraged to monitor reconstructed radiances in parallel to operations so that the PC update strategy can be properly tested. PC scores are currently provided for IASI/EUMETSAT and according to feedback at ITSC-21 NOAA has developed a PC score products for CrIS	

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4.3	**Foster the continuous improvement of products through validation and inter-comparison through international working groups and SCOPE-type mechanisms;**			
4.3.1	Apply the IPWG validation protocol (as defined on its web page) to precipitation combination datasets generated using multiple satellite and in-situ data sources, and expand the number of participating agencies to broaden the validation domain	IPWG	Through the guidance of the IPWG validation working group, tremendous progress has been made with the Indian Meteorological Department (IMD) in the development of a satellite precipitation validation site over India that follows the IPWG validation protocol (see http://www.isac.cnr.it/~ipwg/calval.html). The web site is close to becoming operational. Despite best attempts, progress to develop a site over China has stalled. IPWG is pleased to report that Korea is highly interested in developing a site using there dense in-situ rain network and has developed a prototype. **Action on CMA to provide a PoC to progress on this activity in China**.	
4.3.2	Provide a SCOPE-CM Implementation Plan following the agreed new concept by 2020;	WG II	WP on SCOPE-CM phase III will be discussed at CGMS-47 (CGMS-47-SCOPE-CM-WP-01WGII). A small task team composed of representatives from NOAA, EUMETSAT and WMO have considered the way forward for SCOPE-CM and proposes to conclude all Phase-II activities and then adopt a new approach for SCOPE-CM, ie to focus on production of CDRs responding to gaps identified by JWGClimate. WG-II supported this proposal, which then will be detailed with updated strategy, Agenda and Terms of Reference for SCOPE-CM.	

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4.3.3	Conduct an inter-comparison study between the different methods to derive level 2 data from infrared hyperspectral sounders, recognising that there are several software packages available utilizing AIRS/IASI/CrIS data.	ITWG	A comparison of HSRTV and NUCAPS has been presented at ITSC-20 by Elisabeth Weisz, which included a description of the differences and similarities of the two systems. NOAA routinely intercompare soundings from NOAA and EUMETSAT operational level2 data using radiosondes. **ITSC-20 recommended that:** - Results of level 2 comparison studies should be published in the open literature and also presented at ITSC-2 - Level 2 algorithms should be implemented in direct readout packages to facilitate intercomparisons.	
4.4	**Maintain, enhance and improve the methods to describe the error characteristics of satellite data and products.**			
4.4.1	Establish a common vocabulary and methodology with appropriate error propagation to include the errors associated with validation data (e.g. radiosonde temperature, water vapour, precipitation and winds).	ITWG	FIDUCEO has established a framework doc that address errors associated with validation data. Will be provided to ITWG by Martin Burgdorf (University of Hamburg). ITWG (Christoforos Tsamalis) took action at ITSC-21 to provide input to CGMS , to be reviewed by the other ISWGs regarding new common vocabulary and methodology for the errors associated with validation data). To be considered in the ISWG Chairs intersessional.	

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4.4.2	Agree on standardized procedures to derive NedT estimates for microwave sounders, and include such estimates in the disseminated BUFR data.	ITWG	Nigel Atkinson (NWPSAF) has done an intercomparison of NeDT derivation methods. This will be considered by ITWG Working Group on Products and Software and WG on Data Assimilation and NWP. Regarding encoding into BUFR, two different methods are currently in use and the PSWG will analyse possible convergence.	
4.5	**Strengthen interaction with users in selected thematic areas by establishing a close relation with them as beta-testers and foster optimum use of satellite data.**			
4.5.2	Report on the progress within the Nowcasting community toward the use of hyperspectral sounders and work toward common products to serve the requirements of the global community.	WG II	The next opportunity for a wider discussion emerges in 2017 after the EUMETSAT Nowcasting workshop in Q1 2017 and the launch of the CMA FY-4A/GIIRS. A report on the value of hyperspectral sounders for nowcasting has been prepared in 2018 and updated in 2019 by Hazardous Weather Test Bed group.	

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4.5.3	Enhance the use of satellite precipitation datasets through an IPWG-led user workshop where training on visualization and analysis tools will be one of the topics.	IPWG	IPWG holds a training session as part of every IPWG. IPWG has been actively pursuing the WMO VLAB and has offered expertise for future VLAB lead training on precipitation. Way forward under discussion with VLAB. Update expected at CGMS-48. Update from IPWG: We have been in touch and coordinating with Vlab! We had planned on a training session at IPWG-10, however, we have had to postpone that meeting due to Coronavirus. We are likely to now hold IPWG-10 in June 2021 (still TBD). Vlab has also steered us to WMO training lead in Iran and we are hoping to provide support to a June 2020 training event (still TBD).	
4.5.3	Foster the coordinated development of novel products and applications of the new generation of geostationary imagers, initially for the areas of fire, aerosols and flood-mapping.	WG-II	Progress will be reviewed at CGMS-47. Good progress on flood mapping with NOAA ad CMA lead. Several case studies have been identified to gain local engagement beyond CMA and NOAA.GOFC-GOLD and AEROSAT meetings in 2018 were attended. The collaboration has in the past been general US-Europe, but it is open for other participation and CGMS agencies are encouraged to attend GOFC-GOLD and AEROSAT meetings (ACTION: I think we have one relevant, but need to check. If not we need a new one).	
4.6	**Foster and support research regarding enhanced radiative transfer capabilities, recognising the paramount importance of radiative transfer developments for satellite products**			

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
4.6.1	Continue support for line-by-line (LBL) reference model development and enhanced characterization of spectroscopy to ensure that product development teams and users of level 1 data have access to the latest updates in LBL forward modelling and the uncertainties involved.	ITWG	**Not enough support to spectroscopy or LBL. There is an issue with funding but also a generation change within the community, or rather, no successors to take over. (Expertise is often today already in their retirement age. WGII has agreed to set up an expert team or task team to further analyse the situation)** The Radiative Transfer and Surface Properties (RTSP) working group at ITSC-20 recommended the continued support of LBL model development and validation, both the forward model science/software and the measurements/calculations to improve the spectroscopy in all spectral regions covered by fast RTMs. *Characterising RTM error covariance* The group discussed the possible use of ensemble techniques for characterizing RTM error covariances, in particular for line-by-line (LBL) models. The group expressed the view that it is not an intractable problem but is still a very difficult one. It was felt the group should pursue the more classical approach of using colocated datasets for validation at this point. *Absorption line profile charcterisation* It was noted that there is recent research about a reformulation of the absorption line shape profile – other than a Voigt line shape – used in LBL models. The rationale being that the simplified assumptions on which the Voigt profile is based (e.g. the collisional parameters are independent from the velocity of the absorber) can negatively affect the accuracy of the simulated spectra. The use of a new line shape would have an impact on not just the current LBL model implementations but also on the spectroscopic databases. There are many suggested models for	

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			the new line profile. Recently, the IUPAC task group recommended the adoption of the Hartmann-Tran profile. Implementation of a new line shape formulation is already being tested in 4A/STRANSAC at LMD. There are currently no plans to include this reformulation in the Community Line-by-Line (CLBL) model at NOAA/JCSDA. RTSP recommended to include the potential reformulation of the absorption line shape profile into other LBL model development plans (CLBL mentioned specifically, but applies to any LBL model) ITSC-21 noted a need for more work on LBL spectroscopic uncertainty and a unified model for describing the shape of the relevant atmospheric water vapour lines from the microwave (MW) to the visible. This should include the thermal (TIR) and shortwave infrared (SWIR) regions.	
4.6.2	Perform validation and intercomparison of LBL models/spectroscopy to assess the impact of spectroscopic uncertainties and the differences between line-by-line and fast radiative transfer models.	ITWG	**Not enough support to spectroscopy or LBL. There is an issue with funding but also a generation change within the community, or rather, no successors to take over. (Expertise is often today already in their retirement age. WGII has agreed to set up an expert team or task team to further analyse the situation)** See details in ISTC-20 Radiative Transfer and Surface Properties Working Group report.	

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4.6.3	Through coordination between IPWG, ITWG and ICWG, continue to improve microwave radiative transfer models to include complex surfaces (e.g., snow, desert, etc.) and scattering atmospheres (e.g., frozen hydrometeors) to support improved algorithm development for current and future sensors.	WG II	EUMETSAT is planning a related study for which the results could be presented to CGMS members in due time. IPWG: This is always an ongoing topic and challenge but we are pleased to report some headway this year. Although there are several common topics between IPWG, ITWG and ICWG (and potentially IWWG and IRWG), the only true way to improve collaborations amongst the groups is for attendance at relevant meetings. The outgoing and incoming co-chairs feel that a greater financial commitment is needed by CGMS in order to allow for their attendance at these meetings; because of the growing size of IPWG, the resources provided are generally needed to support those meetings. During the past year, IPWG was able to identify "champions" to represent the precipitation community within ICWG and ITWG because of mutual interests in the focus topics such as radiative transfer and land surface modelling. For the next two years, we expect that Dr. Benjamin Johnson (NOAA/Joint Center for Satellite Data Assimilation) will provide IPWG linkage to ICWG and Dr. Philippe Chambon, incoming co-chair, linkage to ITWG.	
4.7	**Stimulate trade-off analyses for the development of future passive sounding instruments**			

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
4.7.1	Conduct studies to investigate the technical feasibility to reduce the field of view sizes for future microwave sounders without compromising noise performance to keep in line with the spatial resolution expected for future global NWP models.	WG II	For EPS-SG, EUMETSAT has concluded that no major improvements for MWS can be anticipated (over current microwave state-of-the-art sounders) within known technical limitations. For next generation microwave sounders, NOAA will study possible improvements. It should also be noted, that for ongoing considerations of microwave constellations and miniaturisation of microwave instruments, the continued trade-off studies are essential.	
5	**OUTREACH AND TRAINING**			
5.1	**Impact and benefit of CGMS satellite missions**	**Plenary**		

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
5.1.1	Develop capacity to assess and communicate socio-economic benefits of CGMS satellite missions	**SETT**	The SETT chaired by NOAA, has held three workshops and produced a guidance document for CGMS Members. The SETT is now working on a case study Socioeconomic Benefit (SEB) that will serve to highlight best practices and lessons learned. TT members include CMA, Environment Canada, CSA, EUMETSAT, JAXA, JMA, KMA, NASA, NOAA, and WMO. SETT achievements: • Completed literature review and identified relevant socio-economic expertise • Developed Guidance Document: Valuing Meteorological Satellite Programs: Guidelines for Socioeconomic Benefit Studies • Conducted 4 workshops Upcoming: • Completing pilot socioeconomic benefits study • Workshop on Study Findings • Develop Guidance Document v.2 incorporating results of pilot study • Monitoring activities of members and related organizations	

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5.1.2	Engage in communication and outreach activities to promote EO and Space Weather observations benefits		No specific progress	
5.2	**Training**	**Plenary /VLab**		
5.2.1	Continue to foster optimum use of satellite data for weather forecasting, climate applications, and environmental assessments including hazardous events such as volcanic ash and flooding;		New 4-year strategy for the Vlab project to be endorsed at CGMS-47.	
5.2.2	Update and develop new training material where necessary, and in collaboration with partner organisations such as Collaboration among Education and Training Programmes (COMET), Committee on Space Research (COSPAR) and the CEOS-CGMS Joint Working Group on Climate; disseminating such material through the VLab;		Significant progress in the training material provided by the VLAB.	

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5.2.3	Provide shared, regular support to funding the VLab Technical Support Officer function through the WMO VLab Trust Fund, and to the VLab Centres of Excellence as per agreed expectations.		Funding is still secured for the TSO only on an ad-hoc, non-sustained basis. WMO still seeking additional voluntary contributions from CGSM members:	
5.3	**User Conferences**	**Plenary**		
5.3.1	Conduct regional satellite users conferences to (i) share experience and foster the exchange of ideas; (ii) promote better access, and improve the utilisation of, existing satellite data and products; (iii) prepare the user community on new satellite systems' data products and services; (iv) engage young people entering the field; (v) other items as appropriate.		Series of Asia-Oceanic conferences and NOAA satellite users' conferences are continuing. A proposal for a new structure for securing the sustainability of the Asia-Oceanic conference is under pending endorsement by the regional partners.	
6	**CROSS CUTTING ISSUES AND NEW CHALLENGES**			

Ref	Target	Primary responsible for target in CGMS	Summary/highlights of progress as reported for CGMS-47	Overall Status
6.1	**Advancing the architecture for climate monitoring from space (through the joint CEOS-CGMS Working Group on Climate)**	**Joint CEOS-CGMS Working Group Climate (WG Climate)**		
6.1.1	Update ECV Inventory (with traceability to satellite CDR holdings), Gap Analysis and Action Plan of JWG Climate and report on status of JWG actions (This target is cyclic and all three parts are covered every year including endorsement by CEOS and CGMS).		Updates of the ECV Inventory will be done annually, the next version 3.0 was closed off on 28 February 2019. Generic parts of gap analysis will be repeated every year to monitor progress, specific ECV analysis will be for selected ECVs each year. Selection depends on existing known gaps and topics of specific interest for CGMS and CEOS agencies. WGClimate #10 has selected ECVs for 2019 gap analysis. Gap analysis report will be presented in October 2019 for endorsement. Status of implementation of Coordinated Actions is presented in CGMS-47-JWGCLIM-WP-03.	
6.1.2	Report to UNFCCC Subsidiary Body for Scientific and Technological Advice – Research and Systematic Observation (SBSTA-RSO). (This target is also part of the cyclic regular annual reporting);		A dedicated statement on progress of space agencies in climate monitoring including GHG monitoring capability development was delivered by WGClimate chair to SBSTA-49 in December 2018. A new statement will be prepared for SBSTA-50 for endorsement at CGMS-47 and then for SBSTA-51 in October 2019.	

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6.1.3	Respond (via CEOS) to the GCOS IP after new versions of it issued by GCOS. Provide mid-term assessment on progress in time for GCOS status report;		JWGClimate plans to update GCOS on status of space agency activities in 2022 in time for the next GCOS adequacy report.	
6.1.4	Foster the implementation of the architecture for climate monitoring from space by strengthening the analysis of use cases for climate data records to increase uptake by users		WGClimate #10 meeting has agreed a way forward for further case studies. WMO Space Programme has indicated to lead this activities and specific proposals wil be discussed at WGClimate #11, 4-6 September 2019, Anchorage, Alaska, USA. Resolution 6.1(5)/1 (Cg-18) „Implementation of the Architecture for Climate Monitoring from Space", which has been drafted with the input of WGClimate, will be considered by WMO Members at the 18th World Meteorological Congress in June 2019. The resolution describes the progress with implementation of the Architecture for Climate Monitoring from Space (also see CGMS-47-WMO-WP-04).	
6.2	**Space Weather**	**SWCG**		
6.2.1	Coordinate CGMS activities and align priorities with the space weather user community, in particular the ICAO Space Weather Centres, ISES, WMO IPT-SWeISS and the UNCOPUOS Space Weather Expert Group;		Will be addressed further at CGMS-47, including the future relationship to ISES and ICAO. **Target will be reworded to reflect the work with ICAO SW centres**	

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6.2.2	Investigate feasibility of a consistent inter-calibration for energetic particle measurements using instruments with adequate in-orbit calibration and vicarious methods, using GSICS methodology as reference.		Based on an action item raised in CGMS-46, a task group on inter-calibration of high energy particle sensor has been formed. Kick-off teleconference was held on Feb. 19, 2019. Results were presented at GSICS-EP-20 and a white paper describing the current instruments and their calibration activities and proposing a way forward on SWx instrument calibration is under preparation and supported by GSICS.	
6.2.3	Advance the integration of Space Weather coordination activities into the relevant CGMS working groups;			

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6.2.4	In coordination with IROWG establish requirements for and recommend an implementation of an optimised system for radio occultation observations for ionosphere monitoring.		The IROWG considers that this matter is progressing well. The Coordination workshop in 2014 and its follow-on were successful. Activities at different processing centers and by radio occultation scientists are addressing synergies between ionospheric and atmospheric retrieval processing, including a new algorithm that reduces residual effects of the ionosphere on atmospheric retrievals. The CGMS-46 WGII recommendation R44.13 that "CGMS agencies to ensure that the RO receiver design includes sufficient software/firmware flexibility to allow changes in the signal processing including processing of new GNSS signals/constellations, including ionospheric measurements" addresses how current and future satellites should comprise a system that addresses ionospheric monitoring. Current and future receivers are being designed with both atmospheric and ionospheric measurement capabilities, and acquiring both types of occultations simultaneously where feasible. Input from IROWG Co-Chair: There is certainly progress in the development of advanced methods to reduce residual effects of the ionosphere on atmospheric retrievals. My impression is, that more and more receivers are able to collect ionospheric data, so I would say that this recommendation was already successful. (E.g. the MetOp Series was/is not able to collect ionospheric data, but the second generation will.)	

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6.3	**Greenhouse Gas and Carbon monitoring from space**	**Joint CEOS-CGMS Working Group Climate (WG Climate)**		
6.3.1	Engage with the implementation of a global GHG monitoring system using the CEOS/CGMS whitepaper on a constellation architecture for monitoring atmospheric CO2 and CH4 concentrations and their natural and anthropogenic fluxes from space to support climate policy as reference;		The GHG roadmap will be presented to CEOS 33rd Plenary in October 2019 and made available to CGMS for endorsement.	
6.3.2	JWGClimate to coordinate the specific CGMS contributions to the GHG constellation, covering activities on mission coordination, inter-calibration, product prototyping, data distribution, exchange, formatting, and on training and outreach.		CGMS contributions to the roadmap will be implemented with oversight provided by JWGClimate. It is the intention that the roadmap will have specific work packages that then include the necessary groups for implementing them.	