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CONSULTATIVE MEETINGS ON HIGH-LEVEL POLICY

ON SATELLITE MATTERS

THIRTEENTH SESSION

GENEVA, SWITZERLAND, 28-29 JANUARY 2016

FINAL REPORT

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1. ORGANIZATION OF THE SESSION

1.1 Opening of the session

D. Grimes, President of WMO, opened the meeting at 14.00 on 28 January 2016. He recalled the significant contribution of the satellite community to assist WMO Members and NMHSs in serving and warning citizens, in better understanding the implications of weather, climate and water-related impacts, and in coping with extreme events. There are strong benefits to the dialogue between the satellite agencies and WMO, since it helps positioning WMO and its Members in their approach to satellite data use.

2015 has been a special year for the United Nations in which the Sustainable Development Goals, the Sendai Framework for Disaster Risk Reduction 2015-2030, and the Paris Agreement under the Climate Change Convention were hallmarks of international collaboration. WMO needs to position itself in this regard, to assist Members in mitigating and adapting to environmental stressors. When Members implement solutions to address what has been agreed internationally in environmental conventions, WMO should be a major player in supporting such solutions.

For example, monitoring more comprehensively greenhouse gases is one example how to measure progress with the Paris Agreement, similar to measuring ozone concentrations in support of the Montreal Protocol. WMO Members provide key information services to support the adaptive capacity of nations, to cope with impacts of climate change and climate-induced extreme events. Satellite observations play a key role in this regard. Heads of State at UNFCCC COP-21 have stressed consistently that it is time to act now on tackling these challenges, since the solutions are at hand.

WMO will have to heed changes in the domain of Earth-observation satellites: scientific and technological progress, enabling more nations and actors in space; an increasing role of the private sector, identifying business opportunities and offering solutions. The relationship of public and private-sector activities in Earth observation needs to be discussed in the WMO context.

He raised some questions: How to position WMO in a world where “technological downscaling” leads to more satellites some of which may be small satellites? What are the implications of “Big Data” to the exploitation of Earth observation satellite data?

He then recalled the agenda of the session with the following topics:

(i) Development of a Vision for the WIGOS Space-based Component Systems in 2040.

The 2040 Vision of the WIGOS space-based component systems is intended to provide a shared, high-level goal to guide the efforts of WMO Member states in the evolution of satellite-based observing systems supporting all WMO application areas. Development of the Vision started in 2015; a first draft would be submitted to CBS-16 (2016), for ultimate endorsement by Cg-18 (2019).

(ii) Data exchange policies
This topic is receiving increasing attention in light of the potential prospect of basic meteorological space-based (and other) observing systems operated for commercial purposes. While WMO Resolution 40 remains in force, Cg-17 adopted Resolution 60 on the WMO policy for the international exchange of climate data and products to

support implementation of the GFCS. Practices of data exchange and sharing in the USA and Europe will be shared, for discussion.

(iii) Architecture for Climate Monitoring from Space.
This topic is of particular importance in the context of the Global Framework for Climate Services (GFCS), noting the increasing role of space-based observation in climate monitoring, and the need to ensure the sustained generation of satellite-based climate data records within the Architecture for Climate Monitoring from Space. The status of GFCS and GCOS requirements, and the new work plan of the CEOS-CGMS Working Group on Climate will be presented. This topic is even more important in a post-COP-21 environment.

For reference, the report from the 12th session of the CM held in 2014 is available here: http://www.wmo.int/pages/prog/sat/documents/CM-12_Final-Report.pdf

A tour-de-table followed.

In his opening remarks, P. Talaas, WMO Secretary-General, recalled the seven WMO strategic priorities for the 2016-2019 period:

- Disaster Risk Reduction
- Global Framework for Climate Services
- WMO Integrated Global Observing System
- Aviation meteorological services
- Polar and high mountain regions
- Capacity development
- Governance

He pointed out the importance of satellite contributions to climate services, WIGOS, and to monitor polar and high-mountain regions where surface observations are sparse. Capacity development is particularly important since many members are deficient in using satellite data. He illustrated the important satellite contribution to progress by ECMWF in forecasting the 500hPa anomaly, to sea-level rise monitoring, and to Arctic sea ice extent anomaly tracking.

Key issues faced by WMO are: defining the use of international agreements for the benefit of NMHSs, addressing challenges at regional and national level (public sector expenditure cuts, the need to share know-how across nations), strengthening the dialogue with the private sector, as well as positioning NMHSs as national safety authorities. At EC-2016, a full day will be dedicated to discussing the relationship between commercial and public service providers.

He noted that the proposed Integrated Global Greenhouse Gas Information System (IG3IS) will be an important development, based on expanded networks, improved modelling, and satellite observations.

He emphasized the increasing importance of space-based observations for WMO, and stressed the value of CM for providing strategic guidance to its Space Programme. He gave his perspective on the three agenda items: (i) Vision of the space-based WIGOS components in 2040 – to serve as a shared, high-level goal to guide WMO members and satellite operators in supporting WMO application areas; data exchange policy – receiving increasing attention in light of the potential of meteorological space-based observing systems operated by private entities; climate and the Architecture for Climate Monitoring from Space – climate has never been higher on the environmental agenda, and is a priority for WMO. He stressed that the Four-Year work plan of the CEOS-CGMS Working Group on Climate will be critical to define the physical Architecture.

1.2 Adoption of the agenda

The session adopted the provisional agenda contained in Document 1.2 (1). All available working documents and reference documents were posted on the CM-13 document web page: http://www.wmo.int/pages/prog/sat/meetings/CM-13.php .

2. VISION OF THE WIGOS SPACE-BASED COMPONENT SYSTEMS in 2040

J. Kaye (NASA; Chair of the CBS Expert Team on Satellite Systems) presented the draft Vision of the WIGOS space-based components in 2040. WMO regularly reviews its Vision of future global observing systems to support weather, climate and related environmental applications. The 2040 Vision of the WIGOS space-based component systems is intended to provide a shared, high-level goal to guide the efforts of WMO Member states in the evolution of satellite-based observing systems. It is based on an attempted anticipation of user requirements in the WMO application areas, and technological capabilities, in 2040. This Vision addresses specifically the space segment because of the long lead times needed by space programmes to evolve from concept to reality. The Vision, to be developed and finalized by 2018 under CBS auspices, will be based on a broad consultation of user communities, WMO Technical Commissions, and space agencies.

The presentation included key results from a workshop held at WMO Secretariat on 18-20 November 2015, with participation by users, satellite agencies and technology experts.

He recalled the critical importance of satellite data for NWP, seasonal forecasting (ENSO anomaly), and the detection of Earth system trends. He described the background to developing the Vision, building on existing work (Visions for 2015, 2025). An evaluation of the Vision for 2025 shows an overall good response by space agencies, but also some missing elements where user requirements will be insufficiently addressed in 2025. He then described evolving user needs, trends in satellite technology, and expected changes in the community of satellite data providers (e.g., more space-faring nations, higher diversity of orbits and programme concepts, emergence of private actors, small and nanosatellites).

He noted that, in addition to proposing a space-based constellation in support of WMO applications, the Vision also discusses the need for data management to cope with increasing data volumes and user demands for short-latency access and long-term preservation (while recognizing that data management practices by 2040 cannot reasonably be anticipated today).

The elements of the draft Vision, structured along four tiers, strike a balance between providing specific guidance and being open to opportunities that cannot yet be anticipated. Generic consideration is given to the need for surface-based observations to complement space-based data and to provide independent calibration and validation.

The consultation period for the draft Vision is planned to end by mid-2018, by the time of 70th WMO Executive Council, before Cg-18.

A. Ratier expressed his appreciation for the draft Vision. He pointed out that the draft should not prescribe any particular data policy but focus on a resilient space-based observation architecture required for WMO applications in 2040. In relation to data, terms such as “essential” should be replaced by “critical” or “of high impact” where not explicitly referring to WMO Resolution 40. Classifying missions in Tiers should reflect their criticality to the overall architecture.

S. Briggs called for stronger involvement of the cryosphere community in the further development of the Vision.

V. Singh noted that technology pathways for data processing and management (such as based on cloud computing) should be captured.

A. Makarau held that although the scope of the Vision was global, contributions from region-based space programmes and region-specific needs (such as of applications in Polar Regions) should be recognized in the Vision.

A. Ratier noted the difficulty to forecast data processing and management in 25 years and called for a careful statement in the Vision (“need to evolve with technology”).

P. Zhang considered that not only basic weather and climate user needs should be reflected in the Vision, but also wider user needs in the climate and environmental domains.

S. Barrell informed that CBS was looking at a complete Vision for the WIGOS in 2040, including the surface-based components. It should put a focus on complementary changes in surface and space-based systems and on where space-based systems may deliver what is currently provided at the surface.

M. Paese stressed the importance of protecting the radiofrequency spectrum for sensing meteorological phenomena, to be reflected in the Vision. NOAA will look at the Vision for user requirements when developing its own plans. He supported the comment on data terminology (“essential”, “critical” data).

RECOMMENDATION 1: In further developing the Vision for the WIGOS space-based component in 2040, attention should be to (i) clarify terminology (“essential”, “critical”), (ii) introduce the notion of a resilient observing system, (iii) better explain the difference between the Tiers, (iv) stress the complementary value of space-based and surface-based observing systems.

3. DATA EXCHANGE POLICIES

3.1 WMO Data Policy (Resolutions 40, 60) and Update on CBS Discussions

C. Blondin (WMO) introduced this item. The prospect of private-sector operators of basic satellite systems has triggered renewed attention to the issue of data access for global WMO applications, in particular for near real-time applications. Private entities are proposing models of data commercialization and utilization whereby they plan to sell data under use licenses. There may be value in exploiting data from private operators of basic observation systems, however, there are potential risks, such as loss of transparency of the observation and processing chain and thus of data quality and integrity, limitations to data access, and challenges to international coordination of satellite missions.

The WMO Resolutions 40 and 60[1] were recalled, as well as current work by CBS on this matter. WMO Resolution 40 adopted policy and practice on the international exchange of meteorological and related data and products. C. Blondin stressed that Resolution 40 has played a major role in ensuring availability and quality of data for WMO Members. It has helped that different data access and distribution policies could co-exist among WMO Members. He also pointed out that the satellite-specific provisions in the Resolution reflected the technical reality of the mid-1990 when the main use of satellite data was imagery for nowcasting.

He noted that progress over the past 20 years in using satellite data for WMO applications has been critically dependent on international satellite data exchange, and stressed that it will be an important objective of WMO to ensure that there is no regression in the quality of meteorological services in the future.

The session was invited to discuss a WMO position on the potential implications of private sector-based provision of basic satellite data on access to and quality of such data for WMO applications. Such a position should focus on how to achieve the best value from satellite data for WMO Members.

3.2 U.S. Open Data Sharing Policy

M. Paese (NOAA/NESDIS) showed evidence for the value of open data sharing, citing socio-economic benefits to the U.S. weather enterprise. The U.S. supports the WMO Resolutions, the GEO Data Sharing Principles, and other international commitments. Currently, work on open data principles is underway (including that data generated by the U.S. government should be: public, accessible, described, reusable, complete, timely, managed post-release). This is part of the Open Government Partnership (National Action Plan for the U.S.). He cited the NOAA policies to increase public access to data, and the NOAA Commercial Space Policy.

The NOAA Commercial Space Policy is intended to be high-level, overarching. It established a portal office, an open and transparent marketplace, guiding principles and strategic plans for commercial data buys, and demonstration projects. The intent is to preserve the quality of service in the U.S. or by international partners, while supporting and upholding the international data sharing commitments upon which NOAA depends for global data and products.

The NOAA Big Data Partnership includes private companies such as amazon, Google, IBM, Microsoft, as well as the Open Cloud Consortium and the University of Chicago. Its purpose is to address the question “How to gain more value from NOAA data?” (https://data-alliance.noaa.gov). No company will have exclusive access to the data; users must have equal access to the data. The NEXRAD 1991-2015 archive is the first example for a large dataset made available via the Partnership.

In the discussion, it was clarified that the Big Data Partnership addresses data generated by NOAA.

S. Briggs noted that it was important to clarify the definition of “private data” and, for each case, data ownership and conditions on use.

[1] *WMO Resolution 60 (Cg-17): WMO Policy for the International Exchange of Climate Data and Products to Support the Implementation of the GFCS;* http://library.wmo.int/pmb_ged/wmo_1157_en.pdf#557

3.3 European Commission Copernicus Data Policy *(Daniel Quintart, EC DG GROW)*

Daniel Quintart (European Commission, DG GROW) informed on the European Copernicus data policy. Copernicus is the European Union Earth observation and monitoring programme. Copernicus services are structured around six thematic areas: land monitoring, marine environment monitoring, atmosphere monitoring, emergency management, security, and climate change. Sentinel satellite data and Copernicus service information are available on a free and open basis. This is the case even though some of the input data to the Copernicus services (from Contributing Missions, in-situ data sources) may be subject to other data policies, as defined by the owners of the Contributing Missions (such as ESA, EUMETSAT), or in-situ data sources (such as NMHSs). Free access is provided under pre-defined technical conditions through Copernicus dissemination platforms. Discovering and viewing data is possible without registration, whereas downloading data requires user registration.

3.4 Discussion and Conclusions

The following points were raised during the discussion:

S. Turner identified risks and opportunities associated with the prospect of commercial-based satellite data providers. Data currently used for NMHS operations are entirely secured by governments or groups of governments; this is a long-term underpinning and a necessary condition for high-quality, secure service provision, and in his view, it is not clear whether the private sector will ever be able to guarantee such long-term commitments. He advocated a gradual increase of the portion of data owned by governments that is free and openly available; involvement of private operators poses the risk that this portion may decrease in the future.

C. Blondin pointed out that some entity needed to cover the cost of infrastructure for generating observational data, and some form of cost recovery was needed. A. Ratier noted that two issues needed to be addressed: data policies for the re-use of public data (upon which public institutions needed to decide), and public use of private data (if the public is the primary user, WMO Resolution 40 should apply).

P. Zhang suggested that WMO should maintain the baseline for data exchange under Resolution 40. Commercialization should not affect data exchange under Resolution 40.

M. Paese stressed the distinction between regional and global data in terms of data exchange policy. NOAA today purchases some regional data for operational purposes, e.g., from commercially-operated lightning detector networks. For global data exchange, NOAA heeds WMO Resolution 40 and would freely distribute data that it may buy once.

D. Grimes noted that the evolving paradigm for the Global Forecast System (based on ensemble models across multiple global NWP centres) could be undermined if access to global data was not equitable. The President questioned whether WMO Resolution 40 was adequate to support the public good interests in the weather and climate domains, and to provide a more predictable environment for the private sector. He suggested that a strong policy statement from WMO on the global public good could provide leverage for Members in dealings with policy makers and commercial suppliers.

RECOMMENDATION 2: WMO should consider the adequacy of its current data policy with regard to stable, predictable provision of satellite data to support WMO Members'

services. The role of the private sector in data provision should be included in such a consideration.

B. Ryan informed about the GEO paper on the Value of Open Data Sharing, made available as background to the session. She described the order-of-magnitude stronger uptake of data once they were made available in a free and open manner, as compared to commercial distribution of the data. She held that the data policies by WMO and the European Commission did not go far enough in this regard.

C. Richter highlighted that there were still issues with data exchange for climate applications especially for many terrestrial observations.

4. ARCHITECTURE FOR CLIMATE MONITORING FROM SPACE

The Architecture for Climate Monitoring from Space[2] aims to provide a structured and comprehensive view of what GCOS Essential Climate Variable (ECV) Climate Data Records (CDRs) are available from Earth Observation satellites, to create the conditions for delivering further CDRs through best use of existing data holdings, and to optimize the planning of future satellite missions and constellations in order to expand existing and planned CDRs and address possible gaps. The Architecture spans end-to-end over several “pillars”, from remote sensing to climate data record creation and preservation and to climate applications in support of decision-making. The Architecture also provides a foundation for the Observations and Monitoring pillar of the Global Framework for Climate Services (GFCS).

The CEOS-CGMS Working Group on Climate, in which WMO is a member, has the task to advance the physical Architecture. Under this item, the satellite-specific observation needs of GFCS and GCOS were recalled, and the 4-year 2015-2018 work plan of the Working Group presented. The session was invited to discuss progress in implementing the Architecture.

4.1 Climate Service Needs

F. Lucio explained the pillars of the Global Framework for Climate Services (GFCS). For the observations and monitoring pillar, GCOS provides the foundation to identify user needs for observing ECVs. In addition, climate services will require socio-economic data and other data types that are not necessarily covered by the ECVs.

Climate information needs for decision-making include the following categories (left column) and climate research frontiers that determine progress towards meeting these information needs (right column).

Climate information needs	Climate research frontier
1. Strategic ahead-of-season planning (1-12 months lead time), relying on seasonal prediction	Improving seasonal prediction
2. Risk monitoring and management for intra-season operations (1 week to 40 days range)	Sub-seasonal prediction

[2] *WMO Resolution 19 (Cg-XVI) - Development of an Architecture for Climate Monitoring from Space*

3. Longer-term strategic planning/policy (5-10 years)	Decadal prediction
4. Climate change adaptation policy (next 50 years)	Climate change scenarios
5. Vulnerability assessment based on history of climate events	Observation database development
6. Decision-making at local scales	Downscaling
7. Estimating impacts of climate change and variability	Modelling and applications to improve understanding of impacts
8. Mainstreaming climate services for all timescales	Communication and climate service provider-user interaction

Furthermore, he made reference to the October 2015 status report of the global observing system for climate and reflected on whether socio-economic or other environmental or ecosystem ECVs were needed. As decided by Cg-17 and the GFCS Intergovernmental Board on Climate Services (IBCS), a Task Team will be established to look at data-specific requirements of the GFCS. Coordination of this Team with GCOS, in particular in developing its new Implementation Plan, will be essential.

T. Nakajima asked whether the ECV concept had been accepted by GEO. It was clarified that the GCOS IP was considered a key contribution to the GEO Climate SBA; it is expected to be recognized as a cross-cutting theme in the new GEO work plan.

B. Ryan pointed out that the development of Essential Biodiversity Variables (EBV) under the GEOBON initiative, and user requirements identified related to the UN Sustainable Development Goals (SDG), should be considered by the Task Team.

4.2 Requirements for Climate Observation from Space

S. Briggs briefed on the status of implementation of global climate observing systems. A 2015 status report[3] was produced, showing overall good progress with the actions identified in the 2010 GCOS implementation plan. The next Satellite Supplement may be developed as an Annex to the next GCOS IP 2016, or as a separate document, as rapidly as possible in conjunction with the Plan. He recalled principal findings for the domain-based and space-based components. Through the Copernicus programme, there is for the first time a 2030s perspective on the sustained provision of space-based environmental observations.

He showed the timetable for developing the 2016 Implementation Plan. The new plan is envisaged to broaden its scope to global Earth's environmental cycles and, inter alia, take into account the SDGs. Some 169 targets related to the 17 SDGs have been developed, and a recent draft of indicators to measure progress against these targets shows that these focus mostly on economic indicators. He advocated that these indicators should have a stronger connection to environmental monitoring.

He showed the key considerations for developing the next Plan. An increased effort is needed on communication, for example through developing policy and public awareness-relevant climate indicators that are more illustrative than surface temperature, for example.

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[3] *Status of the Global Observing System for Climate (GCOS-195)*, http://www.wmo.int/pages/prog/gcos/Publications/GCOS-195_en.pdf

He stressed the importance of defining the scope of GCOS: as a programme, it cannot be all-encompassing but needs to be aware of, and define the interfaces with, partners and other actors and systems. A trade-off between feasibility and comprehensiveness needs to be struck.

Regarding the Copernicus Climate Change Service, S. Briggs clarified that this Service plans to take responsibility to generate climate data records using ESA, EUMETSAT and Sentinel data.

Article 7c (Adaption) of the Paris Agreement calls for strengthening research and systematic observation of the climate system and early-warning systems. In this context, GCOS should consider observational requirements to monitoring emissions and emission reduction; observational needs for loss and damage assessment, and adaptation; data needs for public awareness (indicators etc.); and capacity development.

4.3 Report on the Four-Year Work Plan of the Joint CEOS-CGMS Working Group on Climate

P. Lecomte (ESA; Chair of the CEOS-CGMS Working Group on Climate) referred to the report on the Strategy towards an Architecture for Climate Monitoring from Space, and the ECV inventory, as the basis for the Architecture. Gap analyses of climate data records will lead to identifying actions to close these in the future. The WG Climate is the key body to implement the Architecture, although it will not cover the entire end-to-end value chain (case studies were recently completed on the Architecture's downstream elements[4]). Progress of the Group over the past two years has been less than expected; to remedy this, more resources will be invested in the ECV inventory, mainly through EUMETSAT. Over the next two years, the Group's priority will be to complete a first assessment cycle based on the ECV inventory.

He explained the interaction between the Working Group, users of climate data records (including the UNFCCC) and GCOS which maintains consolidated user requirements. He noted the diversity of climate requirements for ECV records, for example whether investigating the carbon or the water cycle.

Other activities of the Working Group include reporting to CEOS, CGMS and the UNFCCC SBSTA, and maintaining an interface to GCOS, for example in supporting the development of the 2016 GCOS IP, or in developing the CEOS response to the GCOS IP. There is a CGMS action on developing an FCDR inventory, and interoperability standards. Currently, there is no SBSTA action on CEOS to report again at SBSTA-44.

The following points were raised during the discussion:

T. Mohr recognized the importance of WG Climate work for WMO. He noted that the space-based component of WIGOS was currently mainly designed for weather services. Discussions related to the first pillar of the Architecture will help define the climate component of WIGOS.

A. Ratier queried the interaction of the Architecture with the GFCS. He suggested that WMO should play a role (i) in helping the interaction between GFCS, GCOS and space agencies, and (ii) in assisting how GFCS identifies requirements. He stressed that space agencies do

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[4] *Satellites for Climate Services : Case studies for establishing an Architecture for Climate Monitoring from Space (WMO-No. 1162)* http://library.wmo.int/pmb_ged/wmo_1162_en.pdf

not cover the applications and decision-making elements of the Architecture – these should be addressed by the GFCS.

B. Ryan acknowledged the high importance of collaboration between CEOS and CGMS within WG Climate.

S. Briggs noted that GCOS has been mainly responding to IPCC WG I needs; it aspires to address WG II and III needs as well, and to this end, workshops have been organized with these communities. Regional and local data needed for adaptation largely not (yet) in the remit of GCOS.

P. Zhang noted that the gap analysis to be undertaken by the Working Group on Climate should identify the way toward an operational space-based climate monitoring system.

D. Grimes recognized the important role of the climate research community to define the ECVs. He added that WMO needed to clarify its internal structure for the definition of climate requirements for observing system coordination that respond to these requirements, and for better defining the interfaces to GCOS and GFCS. The WIGOS component systems should address climate requirements, now and towards 2040.

S. Briggs described the World Bank approach to structure their fields of activity into 14 global practices; some include physical domains such as water, energy, agriculture; climate is separate in this structure, underpinning everything else. This is recognizing the complex relationship between climate and other areas of society. GEO has taken a similar approach in its new work plan. GEO should put more emphasis on identifying requirements in each SBA.

5. ANY OTHER BUSINESS

No other business was raised.

6. CLOSURE OF THE SESSION

The President closed the session on 29 January 2016 at 11.00.

<u>Recommendations from the CM-13 session:</u>

RECOMMENDATION 1: In further developing the Vision for the WIGOS space-based component in 2040, attention should be to (i) clarify terminology (“essential”, “critical”), (ii) introduce the notion of a resilient observing system, (iii) better explain the difference between the Tiers, (iv) stress the complementary value of space-based and surface-based observing systems.

RECOMMENDATION 2: WMO should consider the adequacy of its current data policy with regard to stable, predictable provision of satellite data to support WMO Members’ services. The role of the private sector in data provision should be included in such a consideration.

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ANNEX:

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