

WCRP REPORT

World Climate Research Programme



ICSU
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PROJECT REPORT

Report of the second session of the
WCRP Data Advisory Council (WDAC)

4-5 March 2013, Darmstadt, Germany

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Executive Summary

This report summarizes the discussions and outcomes of the second session of the WCRP Data Advisory Council. The meeting made progress on a number of core topics at the heart of WDAC's mandate, namely ECV inventories, data archives, data set quality assessments, data assimilation and reanalysis.

The WCRP Observation and Assimilation Panel (WOAP) workshop on the Evaluation of Satellite Related Global Climate Datasets held in Frascati in April 2011 identified the need for a one stop-shop inventory of satellite and in-situ ECV to help the user community discover and access climate data. Two major initiatives led respectively by GOSIC under GCOS, and the WG Climate under CEOS are relevant in this context, the later being more specific to satellite data. Activities are underway to identify their commonalities and plan for a way to merge these efforts. The CEOS led initiative appears to be best resourced to host this future capability, pending approval by the respective governing bodies.

Data inventories and archives raise the question of the required level of quality assessment/assurance of data sets being used by the scientific community for climate data assessment. Climate data set assessments are being conducted on a regular basis within the various WCRP core projects and activities, and sister programmes, but approaches, procedures and level of detail and quality vary a lot across these. The Council will compile existing best practices into a dedicated WDAC report as a reference by the community.

Reanalyses have become a fundamental tool in climate research. The WCRP 4th International Conference on Reanalysis identified the need to better understand their respective uncertainties. Observations are key in anchoring climate models simulations to measurements so as to produce optimal estimates of the climate. WDAC recognized the need to assess the respective impact of input observations, (and henceforth the cost-benefit of observing systems), in the quality of reanalyses. Plans are now underway to organize a dedicated workshop on this issue around end 2014. WDAC also considers developing a more systematic approach of assessing and intercomparing reanalyses, under some Reanalysis Intercomparison Project (RIP), which could be greatly facilitated through the ESGF ana4MIPs capabilities.

The Earth System Grid Federation (ESGF) is a major undertaking toward assembling climate model data into common format to support the WCRP Coupled Model Intercomparison Project (CMIP), itself being a major contribution to the IPCC AR5 and other climate assessment activities. The obs4MIPs, a JPL/NASA-PCMDI/DOE initiated activity, aims at identifying observational data sets having a one-to-one equivalence to climate model parameters so as to facilitate the subsequent evaluation of climate simulations against observations using the same format compliance and same grid technology. A similar initiative called ana4MIPs concerns reanalyses contributing to the ESGF and may be expanded to other quantities such as surface fluxes in the future. The expectation is now growing within the community, owing to the obvious potential for these capabilities to support and de-multiply the scientific activities within the program and it was decided to internationalize the current *ad-hoc* obs4MIPs working group by establishing an appropriate task group under WDAC to oversee these activities and help reaching out to the various networks who could contribute data to the obs4MIPs and ana4MIPs efforts.

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**WCRP Data Advisory Council
Session 2
4-5 March 2013
Darmstadt, Germany**

Present: Otis Brown (Chair), Toshio Koike (Vice-chair), Michael Bosilovich (Reanalysis), Mark Dowell (CEOS), Peter Gleckler (PCMDI), Eric Lindstrom (OOPC), Pierre-Philippe Mathieu (CLIVAR), Joerg Schulz (CGMS, GEWEX), Walter Meier (CliC), Adrian Simmons (AOPC), Jean-Noël Thépaut (WGNE), Brian Ward (SOLAS)

Apologies: Kaoru Sato (SPARC), Han Dolman (TOPC), David Schimel (IGBP)

Invitees: Christina J. de Groot-Lief (NCDC), Johannes Schmetz (Chief Scientist, EUMETSAT), Susann Tegtmeier (SPARC), Duane Waliser (obs4MIPs)

Staff: Michel Rixen (WCRP JPS)

1 Introduction

1a. Introduction - WDAC Chairs

The Chair, Otis Brown, welcomed all participants and thanked them for attending this first working WDAC meeting. This meeting was planned to address a number of core topics at the heart of WDAC's business: inventories, data archives, quality assessments, data assimilation and reanalysis. He also expressed his gratitude to EUMETSAT for hosting the meeting and for providing all the necessary facilities and support. A quick round table allowed everyone to introduce themselves to those who could not attend the first WDAC1 session and the invitees. He stressed that the agenda was quite busy and welcomed the assistance of everyone to stay within the allocated briefing time.

1b. Welcome address – Johannes Schmetz, Chief Scientist EUMETSAT

Johannes Schmetz welcomed all participants on behalf of Alain Ratier, Director General EUMETSAT. He recalled the main missions of this operational organization composed of 26 members, which are to procure satellites and to ensure a sustained real-time delivery of processed meteorological data to end-users, NWP centers in particular. He stressed that meteorological satellites were not initially designed to address climate issues

specifically, but the accumulation of decades of high quality satellite data have offered EUMETSAT a great opportunity to contribute to the climate agenda through its Climate Monitoring initiative. He noted that the new generation of scientists and engineers is now well aware of the benefits of weather satellites for climate applications. EUMETSAT is deeply involved in the generation of Climate Data Records and contributes substantially to the SCOPE-CM and GSICS initiatives.

1c. Meeting arrangements

Joerg Schulz welcomed all participants and provided some logistics details and arrangements for the group photo, catering, internet, etc.

1d. Adoption of agenda

The agenda was adopted without any change, except a switch of chairmanship on the 5 March in the morning.

1e. Review of WDAC1 actions

The Chair reviewed the actions of the WDAC1 meeting and noted that most of them were going to be discussed in-depth during the following two days of the meeting.

1f. WCRP update

Michel Rixen provided an update on the WCRP revised priorities following the OceanObs'09, the World Climate Conference and the ICSU Visioning process, now addressing the Global Framework for Climate Services, the Future Earth priorities (including observing and data systems cross-cutting themes) and the Framework for Ocean Observing. The revised WCRP structure includes the establishment of the WCRP Modeling Advisory Council and the WCRP Data Advisory Council and 6 Grand Challenges, identified as priority research themes for the 5-7 years to come. He stressed the importance of reanalysis for climate assessments, model-data comparisons and boundary conditions for regional downscaling, the central role of data archives such as obs4MIPs and ana4MIPs within the Earth System Grid Federation context and the growing expectation from the global and regional modeling community to facilitate their research. He observed that the "Climate from Space" week, 18-22 Feb 2013 held in Geneva 2 weeks before had addressed a number of topics (ECV inventories, metrics, assessments, obs4MIPs) directly relevant to the WDAC2 session. He stressed the importance of helping the community to discover climate data records through ECV inventories, the need to nail down uncertainties of data products, the unique position of WDAC to review best practices regarding data set quality

assessments within the program and the growing expectation of the community regarding data-driven scientific research through initiatives such as obs4MIPs and ana4MIPs.

Discussion: Mark Dowell raised some concerns regarding multi-disciplinary data such as those from the IGBP community, which are not yet an integral part of the implementation mechanisms. Adrian Simmons noted that GCOS faces similar challenges. Michel Rixen pointed out that the IGBP representative on WDAC could not attend this session unfortunately. He also noted the upcoming joint WGCM-AIMES (IGBP) meeting in September in Victoria which could address these issues.

2. Inventories, GOSIC

2a. NCDC, GOSIC

Christina Lief made a presentation on the Global Observing Systems Information Center (GOSIC). The GOSIC Portal can be accessed at <http://gosic.org> and was established by the Global Climate Observing System (GCOS) program as a way to provide better and more centralized access to an extremely diverse array of climate related datasets that cross atmospheric, oceanic, and terrestrial domains and are collected from non-satellite, in-situ, and satellite observing platforms. To aid in improving access to climate observing datasets, the GOSIC staff located at NOAA's National Climatic Data Center (NCDC) has developed an Essential Climate Variables (ECV) Data Access Matrix. The basic intent of the ECV matrix is to provide users with a centralized resource to access climate observing datasets from trusted sources for each of the defined atmospheric, oceanic, and terrestrial variables as well as metadata and reference documentation. The GOSIC staff is constantly adding new climate datasets identified by the global observing systems and the world data centers as the best available collection of data for a particular variable. Information on spatial and temporal coverage, data gaps, quality control, and additional data needs is also available in the matrix. The ECV Matrix is meant to be a "one-stop-shop" to access trusted ECV datasets and information. It can be accessed online at: <http://gosic.org/ios/MATRICES/ECV/ECV-matrix.htm>, and is continually updated to convey the latest ECV-related climate dataset information. The GOSIC develops unique value added products and assists in bringing the in-situ and satellite climate observing communities together to identify curated ECV data sets for the benefit of the entire climate community. In addition, the GOSIC, working with Data Centres, helped provide ECV data for the NOAA Climate Portal/Climate Change Dashboard (<http://www.climate.gov>).

A new statistical package (Piwik) was added to the GOSIC Portal beginning of 2013 to provide user statistics. For the period from January 25, 2013 to March 25, 2013 there were 4243 visits, 12810 page views, 429 downloads, 2063 outlinks and 406 max actions in one visit. (Definitions: Visitors/visits -

someone who comes to your Web site and looks around a bit. They may go to one page or they may go to 100 pages, but they're still only visiting once; Page views - how many pages were seen by visitors; Outlinks - external URLs that were clicked by visitors; Actions - includes viewing pages, file downloads, clicks on external website URLs, etc.)

Discussion: Otis Brown and Mark Dowell emphasized the need to identify commonalities of CEOS and GOSIC inventory platforms, even if at the end they may be reached through different access points. Otis Brown and Michael Bosilovich enquired about the possibility of data set identifiers and version tracking, which Christina J. de Groot-Lief confirmed. Mark Dowell recalled that the Architecture was designed to adhere to GCOS principles, which covers both in-situ and satellite data. Otis Brown noted the need to identify how the CEOS inventory, and potentially its associated database, can be adapted to address in-situ data holdings and attributes. Following a question by Toshio Koike, Christina J. de Groot-Lief confirmed the close coordination with GTOS, GCOS, GOOS and GEO to develop the new tools within the data access matrix. Eric Lindstrom raised concerns about the level of ambition on the inventory, which requires collecting systematic information. He felt that CEOS has more resources available to take the lead on this activity. The Council agreed that having sustained institutional support is necessary for the inventory process to be successful. Moreover, it will be necessary for GOSIC to be successful, as well.

2b. CEOS update, WG Climate

The Climate Monitoring Architecture is now seen as an overarching framework for much of the work of CEOS (and CGMS) in ensuring the production and assessment of ECVs. Since its inception (January 2011) this has been - and will continue to be - a joint activity CEOS, CGMS and WMO. In advancing the original roadmap defined in the report "Strategy Towards an Architecture for Climate Monitoring from Space" an activity was initiated in 2012 to populate an inventory of metadata on space-based ECVs. An initial call was released with CEOS MIM in May 2012 to both CEOS and CGMS agencies. Responses were originally due October 5th – extended to January 2013. The call for information was presented in a questionnaire form – through a web interface (<http://ecv-inventory.com/>) which included 45 total questions based on 5 topics (General, Usage, Stewardship, Properties, Access). Responses were requested at the ECV dataset level and addressed both existing/past missions and future/planned mission in two separate questionnaires.

In this initial call for agencies to submit dataset descriptions ~220 entries were provided with a good representation across domains. An initial quality control is underway which includes assessing completeness, consistency checks (incl. with MIM) and with domain experts making a broad initial assessment of the data entries received.

The space agencies believe there is an opportunity to consider a central “database” of ECV product metadata. At present the CEOS-CGMS-WMO may be the best “resourced” opportunity for this – but this should not negate the potential for multiple interfaces to this database itself. If this is to become of more general resource for ECVs, the CEOS-CGMS-WMO inventory needs to verify consistency of GCOS/WCRP questionnaire with ECV Inventory and to evaluate the feasibility of extending to in-situ data. If this appeared to be achievable, and if it is approved by CEOS and CGMS plenaries, the CEOS-CGMS-WMO could provide the infrastructure/database but GCOS/WCRP Panels and WMO would be ultimately responsible for soliciting in-situ contributions (i.e. handholding) and for the quality control of the resulting submissions.

In the following discussion, Mark Dowell clarified that CEOS encompasses both research and operations, whilst CGMS mainly deals with operational meteorological satellites.

2c. CGMS update

Jörg Schulz provided an update of climate relevant CGMS activities in 2012 when CGMS had its 40th anniversary. The list of climate relevant achievements over the 40 years of CGMS is fairly long but the most important was the establishment and maintenance of a global baseline for coverage from geostationary orbit. More recent achievements are the development of a coordinated approach to calibration and inter-calibration (GSICS), the promotion and development of a coordinated framework for generating climate data records from space observations (SCOPE-CM) and the facilitation towards a common approach to archiving of data and metadata which is essential for climate monitoring applications.

CGMS has developed a rolling 5 year High-Level Priority Plan (HLPP) for the years 2013-2017 that is part of a longer term perspective, in particular with respect to the new challenges raised by climate monitoring in the context of the implementation of the Global Framework for Climate Services (GFCS). This plan will also ensure proper interaction with other space agencies and their relevant constituencies, e.g., CEOS including its working groups and virtual constellations.

One top-level priority of the plan is the advancement of the architecture for climate monitoring from space, i.e., taking an active role in building up the architecture as a contribution to the GFCS. Major activities under this priority are to:

- evaluate the CGMS baseline against the logical view of the architecture
- extend GSICS and SCOPE-CM
- analyze long-term datasets and their impact on climate applications
- establish priorities for multi-decadal ECV products and contribute to the creation of key FCDRs supporting many ECVs
- ensure systematic contribution to the ECV inventory
- provide integrated access to climate data records provided by CGMS members
- develop a common approach to long-term data preservation.

One major activity of CGMS is to maintain the observation continuity and traceability, which are essential for climate observations and which require long-lead space segment planning. CGMS long-term plans for sustained observations are summarized in the “CGMS baseline” adopted at 39th CGMS and form the current (2012) CGMS response to the WMO Vision for 2025.

Jörg Schulz closed with the announcement of the next and 41st plenary meeting, CGMS-41 which will be hosted by JMA and JAXA in Japan from 8-12 July 2013.

Discussion: Mark Dowell stressed that after the CEOS Strategic Implementation Team (SIT) meeting, some longer term plan for CEOS-CGMS coordination on climate issues can be expected. Peter Gleckler noted the grassroots approach on development of the CF convention but was wondering how to promote this initiative at higher level. Michel Rixen asked about the process for ECV prioritization, which at EUMETSAT is based on resources, funding and CM-SAF support and complementarity with ESA CCI's effort. Jean-Noel Thepaut stressed the need for access to old archives from the 1960s and 1970s for reanalysis purposes. Eric Lindstrom suggested some dedicated projects on mission data sets as another approach. Mark Dowell pointed out that gap analyses might incentivize contributions to the CGMS/CEOS inventory efforts.

2d. GCOS and OOPC update

Adrian Simmons provided an update on the Global Climate Observing System (GCOS) programme. He recalled the basic nature and remit of GCOS. None of its three panels co-sponsored by WCRP had met since the opening meeting of WDAC in July, although the Terrestrial Observation Panel for Climate (TOPC) would meet later in the week and its atmospheric counterpart AOPC would meet early in April. Han Dolman would be stepping down as TOPC Chair and would be replaced by Koni Steffen. The GTOS secretariat remained non-functional, and this would be a topic for discussion by TOPC. Eric Lindstrom, outgoing Chair of the Ocean Observations Panel for Climate (OOPC) was attending the meeting, and he would speak further on new arrangements for OOPC.

The GCOS Steering Committee (SC) had met in September 2012, and recommended that the WDAC-endorsed dataset inventory project proposed by the outgoing WOAP Chair and NCDC go ahead, recognizing that this depended on availability of resources at NCDC. The SC endorsed actions identified by WDAC1 concerning harmonization with CEOS/CGMS/WMO activities on inventory, promotion and catering for inclusion of datasets based on *in situ* measurements, and linking with other initiatives such as obs4MIPs and reanalysis.org that would be considered later in this second session of WDAC. GCOS participated in the “Climate from Space” week to further this.

The GCOS program has started on the process of producing reports on progress and adequacy of climate observation scheduled for 2015 and a new Implementation Plan scheduled for 2016. The content would be based on inputs from a review of actions set out in 2010 Implementation Plan, including the CEOS response, a recent Workshop on Observations for Adaptation to Climate Variability and Change, the fifth IPCC Assessment process, through workshops that would include participation of lead authors from WG1 and WG2 and other experts, input from panel chairs and members, writing-team meetings, consultations and public review. GCOS looked forward to input from WCRP to this process; the recent workshop on SPARC data requirements, to be discussed later in this WDAC session, would be one important source.

The sponsors of GCOS have established a Review Board to assess the added value of the GCOS programme, and to review the mandate and terms of references of the programme. The Review would take into account developments since the current MoU was agreed to in 1998, such as the establishment of the Global Framework for Climate Services, the WMO Integrated Global Observing System and the GEO System of Systems, and also the general evolution of requirements for climate observations and derived products. The Board would hold its first meeting 26-27 March and the agenda included an item on views of partner programmes, including WCRP (and WDAC in particular).

Dr Simmons also reported some statistics of atmospheric observational coverage, illustrating some significant improvements in recent years, and showed maps of 2012 anomalies in near-surface conditions from different analyses.

The following discussion noted the possible role of WDAC and its members in supporting the GCOS review process.

Eric Lindstrom, outgoing chair of OOPC, reported on the status of OOPC, which activities were disrupted in 2012 by difficulties in resourcing the secretariat at IOC (Paris). The secretariat has been relocated to GCOS Office in Geneva and new personnel (Katy Hill) will now support OOPC.

OOPC did not meet during 2012 but several activities have carried forward. The Framework for Ocean Observing (<http://oceanobs09.net/foo>) was completed in May 2012 and led to the reorganization of GOOS. A pilot project to develop a Deep Ocean Observing Strategy has continued and is being transferred to the GOOS Steering Committee. A potential review of upper ocean thermal observations has yet to be initiated but may get started now that the secretariat has re-formed.

OOPC's role in GOOS has been changed. Its role in WCRP and GCOS remain unchanged. For GOOS it will now focus on both open-ocean and coastal-ocean. Two new GOOS panels (in parallel) will focus on biogeochemistry and biological observations, leaving OOPC to focus on physical observations of the ocean.

Eric Lindstrom is moving on from OOPC Chair to take up the co-chair role of the Steering Committee for the Global Ocean Observing System. New co-chairs of OOPC will be Mark Bourassa of Florida State University and Toshio Suga of JAMSTEC and Tohoku University.

Discussion: Mark Dowell asked about the interface between Essential Ocean Variables (EOV) and GCOS ECV and between physics and bio-chemistry efforts within the panel. Eric Lindstrom recalled that GOOS was divided into open and coastal ocean foci in the past, but assured the Council that OOPC's role with regard to GCOS has not changed.

2e. Discussion and way ahead

Otis Brown asked the Council to consider the next steps for a joint inventory process between CEOS and GOSIC. Specifically, what needed to happen and who has the responsibilities for the next actions. There is general agreement from the Council that expansion of the CEOS inventory process to accommodate in situ observations would probably be the most efficient and effective approach. Mark Dowell noted that this solution needs to be agreed upon by CEOS and CGMS. Multiple access to a unique repository could be considered and WCRP and GCOS could solicit inputs to the inventory and assess their quality.

3. Reanalyses and fluxes

3a. Reanalysis update, including reanalysis.org

Michael Bosilovich reported on the status of activities in the reanalysis community. Following up on the *WCRP 4th International Conference on Reanalyses*, he noted that the final conference report is now available on-line. Furthermore, a brief summary of the conference including its motivation and concluding statement was submitted to BAMS and accepted for publication (printing to be determined). The next international conference should be planned in the 2016-2017 timeframe, likely in the UK. The Council should revisit the timing and leadership for such conference at its next meeting.

A proposed workshop on input observations for reanalyses is being developed and led by ECMWF. Recent news that the EC proposal ERA received very high scores is encouraging for this workshop, but the timing is still to be determined. Another question was posed to the Council about connecting a technical developers workshop with the input observations workshop. This would be a small and specialized group to discuss recent progress and issues with data assimilation for reanalyses. Input is needed from the developing centres on this activity, and is part of the motivation for the development of a Reanalysis Task Team.

The major reanalysis centres all have continuing plans for reanalyses at this time. JRA-55 is underway, and expected to be released in the autumn of 2013. The JRA family of reanalyses will also consist of an AMIP ensemble experiment and a conventional data reanalysis as well. Likewise, the ERA suite of reanalyses is progressing, with an AMIP type 20th Century ensemble simulation completed, a surface-observation only reanalysis underway, to be followed by reanalyses covering the satellite era (see the ppt for detailed time tables). ECMWF will also provide offline Land assimilation counterparts to their reanalysis products. NCEP's reanalysis programme is a team effort, with Arun Kumar as PI, and includes ESRL, CIRES and NCDC partners. The suite of reanalyses will include AMIP, surface only, surface and upper air conventional data, as well as full satellite assimilation reanalyses. The GMAO is focusing on adding Earth system components to the assimilation system. Aerosols are already included and a major push for coupled land assimilation is underway leading up to an intermediate reanalysis, ahead of a fully Integrated Earth system reanalysis. These will permit deeper understanding for the reanalysis methods, but also, would represent a further increase in the number of viable reanalyses for research activities. While the increase in numbers can help explain the reanalyses, users will need to cope with a larger volume of data.

In separate efforts, the GMAO and ECMWF are making available the assimilated observations in reanalyses. For ECMWF, these are being processed during the production of their surface-observation only (ERA20C) reanalysis, while the GMAO has post processed the MERRA data from the Gridpoint Statistical Interpolation (GSI) diagnostics files. These data include the observation, forecast error and analysis error, and open several avenues of investigation. First, users of reanalyses can determine which observations are available within their domain of interest. Second, the data can be used to identify which observation systems are weighted higher in the analysis at any given time. Lastly, observational studies will be able to make use of the reanalyses quality assessment, in order to feedback to the observation data processing.

Reanalyses.org continues to thrive. Recently, the observation section has been expanded. User contributions have been made, including code to interpolate model levels to pressure levels. The project is grassroots, with general support from the reanalysis developers. More information and time would greatly improve the functionality of the site. Centres should encourage their reanalysis teams to support the effort. *Reanalyses.org*, along with *ana4mips* and *obs4mips*, can help improve the processing of this additional volume of data that comes along with increasing numbers of reanalyses products.

Discussion: Mike Bosilovich enquired on the need for a more formal reporting mechanism of reanalysis activities to WDAC, as there are several groups that have some reanalysis activities in WCRP. Peter Gleckler noted that funding has improved for these activities but still remains an issue on the long term.

Adrian Simmons pointed out that some products, such as SST, have now associated uncertainties. Joerg Schulz recommended reanalysis experts be formally involved in WCRP core projects. Jean-Noel Thépaut recalled the relevance of the THORPEX Data Assimilation and Observing System (DAOS) for reanalyses but also stressed the existence of a distinct research niche for the reanalysis community. Duane Waliser recommended distinguishing reanalysis assessments from the data platform.

3b. SOLAS update

Ocean-atmosphere exchange of energy, gases, particles and water at the air-sea interface is a critical component of the global climate system. In order to develop both a robust prediction mechanism, and a response to, future global environmental change, the ocean-atmosphere system needs to be better understood. The Surface Ocean - Lower Atmosphere Study (SOLAS) is a multidisciplinary and global-scale research programme whose overarching objective is to achieve quantitative understanding of the interactions and feedbacks between the ocean and the atmosphere, and how this coupled system affects, and is affected by, climate and environmental change SOLAS integrates the efforts of marine bio-geochemists, physical oceanographers, atmospheric chemists, meteorologists and climatologists, covering scales from the dissipative to global.

Brian Ward presented some recent results related to the oceanic uptake of CO₂ by the ocean, and highlighted the recent grassroots-developed Surface Ocean Carbon Atlas (SOCAT), which is providing global coverage of oceanic partial pressure of carbon dioxide to quantify the air-sea fluxes.

SOLAS has recently developed its mid-term strategy to focus on several key issues related to its objective:

- Air-sea gas fluxes at Eastern Boundary Upwelling Systems and Oxygen Minimum Zones
- Sea-ice biogeochemistry and their interaction with atmospheric chemistry
- Ocean-derived aerosols: production, evolution and impacts
- Atmospheric control of nutrient cycling and production in the surface ocean
- Impact of ship plumes on atmospheric chemistry, climate and nutrient supply to the oceans

Discussion: Mark Dowell enquired about the availability of collocated bio-geochemical data and re-emphasized the need to distinguish system metrics (the assessment with a small “a”) from physics assessment (Assessment with a big “A”). Brian Ward noted that SOCAT products are not gridded but scattered data, mainly collected via flow-thru systems during cruises. Michel

Rixen wondered about the possible inclusion of SOCAT in obs4MIPs by binning data on a regular grid and Peter Gleckler noted the great research potential using this data set. Joerg Schulz and Adrian Simmons noted the need for assessing the quality of data sets and the traceability of uncertainties.

3c. GSOP update: air-sea fluxes, ocean synthesis

Pierre-Philippe Mathieu summarized the outcome of the CLIVAR GSOP WHOI Workshop on Ocean Syntheses and Surface Flux Evaluation Woods Hole, Massachusetts, 27-30 November 2012, which brought more than 60 scientists from all disciplines, including surface fluxes, ocean observations (both in-situ and satellite), atmospheric reanalysis, and ocean synthesis communities.

The workshop focused on how to improve the quantification of air-sea fluxes by using heat budget constraints. This is a key research area that is critical for advancing our understanding of atmosphere-ocean interactions related to Earth's climate variability and change. This is also an important crosscutting area within WCRP that links the interests of different core projects including CLIVAR, GEWEX, as well as CliC for the high-latitude areas.

Large-scale air-sea fluxes products have been produced for a number of years based on satellite, in-situ and model data but in the absence of close physically based calibrations it has been difficult to determine their reliability. However there is now a real opportunity to improve our understanding and produce more reliable air-sea heat fluxes by bringing together a range of new atmosphere, ocean and satellite datasets for the first time. This would help to better understand the regional estimates of ocean heat content change.

The workshop has identified a series of recommendations to address the twin challenges of constraining global ocean heat and freshwater budgets using both models and observations, to improve surface forcing functions for ocean and coupled climate modeling purposes. There is a need for closer collaboration between the observation (both in-situ and remote sensing), modeling, and synthesis communities. There is also a need to extend the traditional concept of using point-wise *in-situ* measurements (through buoys/ships) for calibration of air-sea flux products to the use of suitable "Flux Ocean Regional References" to better constrain the products with ocean data in order to address the issues of regional variability and global imbalance which affect existing products. More information is available in the workshop report (Yu et al., 2012).

Discussion: Eric Lindstrom recalled the challenges in estimating heat fluxes, based on differences between large numbers of opposite signs, resulting in large uncertainties and observed that equal attention should be paid to fresh water and precipitation components. Toshio Koike commented on the involvement of GEWEX on these issues and Joerg Schulz stressed the GDAP collaboration with CLIVAR on these issues.

3d. Workshop on observations for reanalysis

Jean-Noel Thépaut briefed WDAC on the recent positive outcome of the EU proposal on reanalysis which will likely be able to support relevant reanalysis workshops and conferences, three of them being planned for the 2014-2016 time window. He also emphasized the interest of the community in coupled reanalysis and ensembles of reanalyses. Otis Brown and Michel Rixen recommended considering a coordinated planning of these events.

3e. Discussion

This session concluded with a broad discussions on whether the WDAC reanalysis effort would require a dedicated Task Team or not, which could be investigated more in detail at the next WDAC session.

4. Data requirements, assimilation, network design, OSSEs

4a. Data assimilation, OSSE

Michel Rixen enquired about the maturity of OSSE/OSE approaches to address issues such as the NOAA JPSS Mitigation Study. Jean-Noël Thépaut stressed that OSE already offer some relevant tools to support these questions but that there is currently a lack of support from space agencies to tackle the problem in a more systematic way. Michel Rixen pointed out that a full-fledged effort of 10 man years as proposed still represents a marginal investment compared to the cost of a satellite space and ground segment.

4b. NOAA JPSS Mitigation study

Otis Brown opened this discussion by briefing the Council on the current status of this study. He noted that there is a website soliciting options as well as providing an understanding of the highest ranked options (so far) – please see <http://www.osd.noaa.gov/jpssgap/>. This site provides overviews of Observation, Modeling, Assimilation and Other potential mitigation approaches as well as the process for evaluating ideas.

Brian Ward asked about the impact of current US funding sequestration. Otis Brown responded that a supplemental appropriation to address the impacts of Hurricane Sandy contains an additional ~\$100M to improve hurricane and severe weather forecasting capabilities. Jean-Noel Thépaut emphasized that impact for weather research may be different than for climate research.

4c. WMO Rolling Requirement Review

Michel Rixen presented the revised WCRP entries of the WMO Rolling Requirement Review (RRR) resulting from a consultation within the community, including WDAC and WMAC.

WDAC noted some concerns as to the use of such information to make important decisions on satellite mission needs as well as the adequacy of current surface observing networks. Whilst there was a general understanding that the RRR table was 'technology free', it was felt that the current table does not address the issues of stability of measurements, essential for climate research. Current accuracy values would also be helpful in that context. The naming of application areas currently using e.g. core project denomination, does not necessarily reflect general research activities within the programme and sister programmes. It was also suggested that more granularity could be provided by linking table entries to the Statement of Guidance documentation.

4d. SCOPE-CM Phase 2

Joerg Schulz provided an overview on the development of the Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) initiative and its current status. The essence of SCOPE-CM is to make big jumps with empty pockets, i.e., the coordination among space agencies on the generation of Climate Data Records is generating added value without increasing the resources but using them in a more intelligent way.

The aim of SCOPE-CM is to enable a network of facilities ensuring continuous and sustained provision of high-quality Climate Data Records (CDRs) from satellite observations. The foundation of SCOPE-CM is the network of relevant space agencies (currently CMA, EUMETSAT, JMA and NOAA) and other organizations (WMO, GCOS, CEOS, GEO, CGMS/GSICS, WCRP/GEWEX) with the aim to develop, extend and preserve the capabilities and skills of generating and re-generating CDRs.

The SCOPE-CM implementation started in 2008 with establishing the initial network and structure, agreeing on principles and standards, establishing the first pilot projects on selected subjects, assessing currently existing capabilities and establishing feedback mechanisms with users. This phase saw different pilot projects on the generation of CDRs that were testing different approaches of collaboration.

The lessons learned from the pilot projects led in 2012 to an updated SCOPE-CM implementation plan that detailed the implementation of the sustained production of CDRs in Phase 2 of SCOPE-CM. It will see the continuation of the establishment of a systematic approach to increase the sustainability (expressed through maturity) of CDR generation capabilities that includes the establishment of structures for sustainable generation of Fundamental CDRs, Thematic CDRs and Interim CDRs. Phase 2 has the goal to generate the first SCOPE-CM CDR products, to increase coverage of products in terms of ECVs, time and spatial dimension and to foster the extension of the network to additional partners.

The SCOPE-CM activities are organized in dedicated projects (SCM-Projects) with the objective to elevate a specific CDR capability to higher maturity. The projects are open for participation of member agencies but also to non-member agencies and research institutions. The only formal structure, the SCOPE-CM Executive Panel will use the Maturity Matrix approach to organize elements of the CDR life cycle and to assess the progress during the projects lifetime.

The first call for SCM-Projects was released in December 2012 and attracted ten SCOPE-CM project proposals that contain substantial FCDRs for geostationary satellite instruments and the AVHRR as well as continuation and extension of the projects on Atmospheric Motion Vectors and surface albedo. New is a project on the use of Radio Occultation data that facilitates collaboration of space agencies and research agencies worldwide to create a benchmark data set for atmospheric temperature trends. SCOPE-CM plans to release further calls for projects on annual basis.

5. Data sets, quality assessments and best practices

5a. GEWEX

Jörg Schulz provided a comprehensive overview on the assessment work done within the GEWEX Data and Assessment Panel (GDAP) and the lessons learnt from these assessments for current and future assessments. GDAP has finalized assessment activities for precipitation as well as cloud and radiation flux products and has ongoing activities for LandFlux and Seaflux and a new assessment activity on tropospheric water vapor. Assessment activities are not limited to datasets as also an assessment of satellite simulators has been initiated because it is likely that they will play a larger role in climate model evaluation in the future.

Recent years have shown that data set diversity can be confusing for users, and without the proper background information and understanding of the limitations of available data, there is a danger that these data may be incorrectly applied or misinterpreted. On the other hand users need to realize that it is often difficult to define a single best climate data source. Data sets are instead most often complementary in nature with varying strengths and weaknesses. It seems common understanding that essential elements that define the usefulness of a data set are certainly its accuracy and error characterization, but data products can be evaluated too favorably by the developers themselves in order to encourage data usage. Experience in GDAP has shown that assessments have benefits for science and applications as well as product providers.

It is the task of the assessments to conduct objective and independent evaluations and inter-comparisons. The basic goal is to point out differences and limitations and, if possible, to provide reasons for them. It helps to involve the scientists that created the data so that sufficient background information on instruments, applied methods, and underlying assumptions and limitations can be more fully understood and conveyed to the user. It has also been

observed that the involvement of product developers leads often to a tendency to broaden the goal of the assessment from its original intent of informing the user community to one of using the assessment itself as a diagnostic to help investigators improve their respective products. The second objective clearly requires broad participation from the data producers. GDAP has found that these two objectives are, in fact, compatible with one another but should always be kept distinct in the assessment.

GDAP has found that assessment activities, like the products they assess, should not be viewed as static but rather as dynamic activities that may need to be repeated every 5-10 years depending upon the rate at which products are being added or modified within a given discipline. Even if the validation data, procedures and previously assessed data are archived for interim use by new product developers, comprehensive assessments are critical to move the field forward in a systematic way.

Currently, many assessments usually rely on voluntary efforts, which can take considerable time to finish and can collapse unless there is strong leadership.

Thus, assessments should include:

- A dedicated, motivated, and respected person to lead the effort
- Complementary assessment team members with specialized knowledge
- Regular team meetings – open and closed workshops
- A centralized data depot for data sets created specifically for the assessment (e.g., validation data or common gridded products) that can be used to facilitate assessments by new products or new versions of existing products
- Seed funding for some centralized activities to avoid collapse and/or very long duration.

Data set quality assessments are a general need across geophysical domains and should be performed throughout WCRP core projects. There is also great interest in assessments outside of WCRP by groups initiated by space agencies. It would be useful to establish some high-level best practices for assessments as outlined above that could be agreed within WCRP and then may become a standard for many more assessment activities.

Otis Brown recommended that we consider looking at commonalities between core projects with the goal of producing a blue-print on best practices regarding the assessment of climate data sets.

5b. CLIVAR

Pierre-Philippe Mathieu stated that CLIVAR will remain the ocean-atmosphere programme of the World Climate Research Programme. CLIVAR is in the process of refining its new set of research opportunities that will also contribute to the Grand Challenges of WCRP and the wider context of the oceans role in climate variability and change to the benefit of society and the environment in which we live. CLIVAR will retain its global and balanced approach based on observations, models and theory and their joint exploitation for climate assessment and climate prediction. CLIVAR will remain a strong supporter of the development of sustained climate and ocean

observations as well as targeted improvements to the ocean components of earth system models. CLIVAR will intensify its partnerships with the marine biogeochemistry and eco-system community as well as with a selected range of its user community. The transition to the new CLIVAR is well on its way and drafting teams for the new CLIVAR research opportunities have been established. Some adjustment to the advisory structure of the programme by aligning panels and working groups to the new strategy is expected for 2014. Below are draft statements of the key elements of the NEW CLIVAR reflecting the planning process in early 2013:

- the aim of CLIVAR “Climate variability and change in the atmosphere - ocean system” is to observe, understand and predict changes in Earth’s climate system with a focus on ocean-atmosphere interactions, enabling better understanding of climate variability, predictability and change, to the benefit of society and the environment in which we live.
- CLIVAR fosters international collaboration to (i) better understand the causes of climate variability on intra-seasonal to centennial time-scales through observations, analysis, and modeling, (ii) improve predictions of climate variability and change associated with both internal and external processes, and (iii) extend observational climate record through assembly of instrumental and where appropriate proxy data sets and their assimilation in ocean and climate models.
- CLIVAR builds on *key capabilities*, including improving ocean observing systems, improving ocean system models, ocean data, synthesis and information systems, support of global assessments, knowledge exchange with societal actors, education and capacity building especially by outreach to early career scientists.
- CLIVAR will put an emphasis on *new research opportunities*, including intraseasonal, seasonal and interannual variability and predictability of monsoon systems, decadal variability and predictability of ocean and climate variability, extreme events in the atmosphere-ocean system, marine biophysical interactions and dynamics of upwelling systems, and dynamics of regional sea level variability.

Michel Rixen recommended addressing data set assessments specifically at the next CLIVAR SSG meeting. Brian Ward offered for SOLAS to be involved in this process.

5c. SPARC, including ESA SPARC initiative

Susann Tegtmeier noted that within WCRP there is a growing emphasis on ensuring that observational data sets meet specific scientific needs. As a scientific user of observational data, SPARC has been going through a process of developing material on the kind and quality of measurements that are needed to support the individual SPARC activities. During the combined SPARC data requirements SPIN mid-term review workshop held at ESA/ESRIN, Frascati, Italy from 20-21 February 2013, this material has been discussed together with future SPARC measurement requirements. In particular questions regarding the scientific motivations for present and future

measurements, the estimated uncertainties and measurement network design have been addressed during the meeting. The material discussed and summarized at the workshop will help SPARC to synthesize the activity-level measurement requirements developed to date to produce an integrated document. Such a document will provide coordinated input to international bodies such as GCOS and CEOS, supporting requests from funding entities and stimulating greater use and improvement of observational products by SPARC activities. In parallel with this process, SPARC has been engaged in the ESA-funded SPIN project to develop long-term climate data records of stratospheric temperature, water vapor, ozone and aerosols as well as climatologies of short-lived species. The first phase of the SPIN activity focuses on the detailed analysis and maturation of ESA and third party mission satellite data sets. The second phase aims at merging ESA and third party mission data with historical records and at preparing future climate records. The recent end of SPIN phase one was reviewed by ESA during the above-mentioned SPARC data requirements SPIN mid-term review workshop where results from the various work packages were presented.

Discussion: Adrian Simmons recommended a closer collaboration between the ESA SPARC Initiative (SPIN) and the reanalysis community to identify appropriate satellite data studies. Joerg Schulz recalled the availability of Radio Occultation (RO) data, which may provide adequate resolution to address this.

5d. CliC, including data needs for seasonal ice outlooks initialization

Walter Meier briefed the Council on CliC and related polar science activities. The CliC Science Steering Group met 4-7 February 2013 in Potsdam, Germany. This was the first SSG meeting for new CliC Chair, Greg Flato of the University of Victoria. CliC will carry on previous working groups: ASPeCt, the Arctic Sea Ice Working Group and the Southern Ocean Panel. It will also propose to co-sponsor ISMASS with IASC and SCAR. However, it is also establishing two groups to address emerging key topics in polar climate: a "Sea Ice and Climate Modeling Forum" and a "Permafrost Modeling Forum". It is also creating four new targeted activities: (1) Antarctic ice-shelf and ocean coupled modeling, (2) Understanding linkages between cryosphere elements, (3) Coordination of cryosphere observations for model evaluation and initialization, and (4) Arctic freshwater synthesis.

CliC will also play an active role on several polar initiatives: International Polar Initiative, WMO Global Cryosphere Watch, WCRP Polar Climate Predictability Initiative, EC-PORS Global Integrated Polar Prediction System, and the WWRP-THORPEX Polar Prediction project. As can be seen, many of these projects focus on polar prediction. CliC will play a role in coordinating between these activities to maximize outcomes and will provide input and feedback. One aspect already underway is the ARCUS SEARCH Sea Ice Outlook, which began in 2008 and has been run in an ad hoc fashion with very little funding. More support is being sought to formalize the project, including

providing initialization data products, coordinated forecasts, and more rigorous metrics for forecast evaluation.

Another major focus in the cryosphere is on a better understanding of ice sheet dynamics and their role in sea level rise. This involves both a better assessment of the historical ice mass balance and better modeling and coupling with earth system models. Many initiatives have been undertaken, but more will be necessary as models develop and more data is obtained; CliC will be a platform to integrate these efforts.

Observational needs for models are another key focus area. On 17-18 February 2013, a workshop funded by the ESA CCI project and co-sponsored by CliC was held in Copenhagen, focusing on passive microwave sea ice estimates. Several different algorithms were presented and there was broad agreement that rigorous intercomparison is needed. A common validation data set is being prepared and will be distributed to interested parties. Another workshop, sponsored by the Arctic Sea Ice Working Group will be held on 5-7 June in Tromso, Norway. Connections between observations, modeling and observational needs for models will be one of the main themes for the workshop. CliC is interested in participating in observational data assessments and coordination of observations with models. These include obs4MIPs, CORDEX, and others.

Discussion: Brian Ward enquired on the status of the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) initiative, which initial planning is being supported by IASC and CliC. Walt Meier confirmed that the proposal was moving forward and that the science plan is being put together, addressing a.o. first-year ice.

5e. IGBP

N/A

5f. Discussion

Mark Dowell provided a short summary of the “Climate from Space Week”, 18-22 March held in Geneva about CEOS-WGClimate’s current thinking on assessments. Ensuring that an appropriate mechanism is put in place for the systematic assessment of GCOS ECVs as a fundamental component of WGClimate's efforts. CEOS sees the link to WCRP in general and specifically WDAC being an important part of this.

Specifically from their Terms of Reference WGClimate will "Review and assess, on behalf of CEOS, the generation of Fundamental Climate Data Records (FCDRs) and derived Essential Climate Variable (ECV) climate

products supported by Member space agencies, complementary with existing entities and roles".

In the context of the discussions at the "Climate from Space" week, WGCimate agreed that the following general roles are required to put in place the required mechanism: identify domain specific expert groups (e.g. annex from WCRP/GCOS 2009 Letter), someone to define best practices (this would preferably not be led by Space Agencies), identify assessment teams on an ECV basis (this should probably include independent domain specific expert and space agency representatives i.e. from the Virtual Constellations), someone to ensure that these activities are adequately resourced and someone to provide a more general overview of assessments to verify consistency and applicability to GCOS requirements.

CEOS/WGClimate recognizes that ultimately the existence of an assessment should be indicated in the ECV Inventory but that the in depth material of the assessment itself would remain independent. This also underlines the need to also be clear on differences between system metrics (e.g. maturity matrix) and data assessments – these are seen as two orthogonal but intersecting axes.

Considering the general roles required, CEOS WGClimate proposes the following for advancing short term implementation:

- WCRP-WDAC (benefitting from experience with GEWEX, SPARC) would be best positioned to coordinate the definition of best practices for ECV Assessment.
- domain specific competence/scientific bodies (e.g. GHRSSST, IOCCG, OST-ST, OSVW-ST) together with CEOS VCs could undertake individual assessments.

A mapping of these bodies needs to be done systematically across ECVs. CEOS WGClimate to ensure assessment have resources, where appropriate thorough CEOS member agencies GCOS/WCRP Panels to provide review of assessments.

Discussion: Mark Dowell recalled that the CEOS WG Climate was essentially established as a response to the invitation sent out jointly by GCOS and WCRP to invite agencies to strengthen world-class science and sound decision making based on scientific analysis, comparison and review of climate data records. He recommended revisiting the letter and resulting achievement. Michel Rixen further suggested to write back to the agencies to acknowledge the effort made to respond to the GCOS-WCRP invitation and to encourage further engagement on these activities.

6. Earth System Grid, obs4MIPs, ana4MIPs

6a. Earth System Grid, CMIP5, metrics

Peter Gleckler presented an overview of the WCRP coordinated climate model intercomparison activities, and in particular the overarching Coupled Model Intercomparison Project (phase 5; CMIP5). A key to the success of now over 20 years of model intercomparisons has been the gradual grass roots development of conventions for climate model data and metadata. For CMIP5 and an increasing number of closely coordinated “MIPs”, a specified application of the CF metadata conventions has been adopted (<http://cf-pcmdi.llnl.gov>), with modeling groups transforming their data to meet these requirements via the Climate Model Output Rewriter (CMOR, <http://www2-pcmdi.llnl.gov/cmor>). To meet the rapidly expanding data volumes of climate model output, it has become necessary for a distributed approach to data accessibility, and this has been accomplished with the advent of the U.S. DOE led Earth System Grid Federation (ESGF). There are now several petabytes of CMIP5 model output being studied by hundreds of scientists, and it is expected that their research will form an important basis of the IPCC’s fifth assessment (AR5). At the most recent meeting of the WGCM, the members agreed to advocate the CMIP5 approach to data preparation and distribution for all climate model intercomparisons. In summary, the climate modeling and evaluation communities now rely on a well-established mechanism for organizing data and making it accessible for research. Obs4MIPs and related activities strive to further facilitate model evaluation by organizing observational products according to the same conventions and pathways used for climate model output.

Michel Rixen suggested expanding the WGNE/WGCM metrics panel to include WGSIP and CORDEX so as to span all time and spatial scales.

6b. obs4MIPs

Duane Waliser (JPL) presented obs4MIPs and outlined the motivation, guidelines, status, challenges and next steps. obs4MIPs was initiated via a JPL/NASA-PCMDI/DOE partnership about 3 years ago. Its objective is to facilitate the use of observation data specifically for model evaluation, and in particular for CMIPs. Initial focus has been on global satellite data sets. Key tenants of the activity include: 1) only observed variables that have a 1-1 mapping to the CMIP model output specifications are considered, 2) observation data is formatted in the same manner as the CMIP model output, 3) relatively simple documentation is produced, with particular consideration given to use of the data for model evaluation, and 4) the data are hosted side-by-side with the CMIP output on the ESGF. The initial effort has led to the identification and ESGF-publication of about 15 satellite data sets. Among these are ocean surface winds and sea level heights, precipitation, SST, ozone, temperature and moisture profiles, radiation budget quantities, etc. NASA has established an obs4MIPs Working Group, that includes representation from NOAA and PCMDI, in order to expand the holdings. Additional data sets being prepared include sea ice, aerosol, land/vegetation quantities. Expansion and partnership has been undertaken via ESA CMUG,

CEOS Climate Working Group, and a number of additional cloud data sets from CFMIP. To foster this expansion with the broader community, the Working Group has also helped establishing an initially agreed upon set of requirements for data inclusion in obs4MIPs, guidelines for the technical documentation, a data set recommendation form, file specifications, etc. These are all posted on the obs4MIPs wiki page. In addition, obs4MIPs has resulted in the initiation of an analogous effort, called ana4MIPs (see below), focused on a similar objective for reanalysis products. While the progress and impact of obs4MIPs has been good, considerations of judiciously expanding additional data sets, continued emphasis on quality control, interactions with ESGF, coordination with ana4MIPs, and planning for CMIP6 demands broader governance than can be provided by the NASA-initiated Working Group. A recommendation for a panel/task force under WDAC (with connections to WMAC) to provide this governance was made to the WDAC.

Discussion: Pierre-Philippe Mathieu noted that agencies might be able to produce outputs at specific resolution directly at the ground segment. Otis Brown suggested developing a proposed list of possible products.

6c. ana4MIPs

ana4mips is a follow on effort to obs4Mips, supporting the CMIP model intercomparison and validation exercise. There are a number of characteristics of ana4Mips that also apply to obs4mips, such as the goal for validating CMIP models, documentation and format that follows the CF convention. However, one key difference is that reanalyses have uncertainty related to the underlying model forecasts. That being said, dynamical state fields, such as temperature heights, wind and surface pressure, are typically close to the observation fields. This was demonstrated at the Council meeting by comparing eddy height for NCEP CFSR, MERRA and a single CMIP model era realization, where the differences between reanalyses is an order of magnitude smaller than the magnitude of the difference between the model and reanalysis. However, for quantities more dependent on model parameterizations, such as Outgoing Longwave Radiation, the differences between reanalyses and an observed reference data set are of the same order of magnitude and those between the observations and CMIP models. However, there are indications that an ensemble of reanalyses can be more reliable than any single contributor, and can help quantify the uncertainty of the reanalyses. While it is useful to have the reanalyses in the CMIP validation efforts, users need to be aware of the strengths and limitations. At this point, GMAO MERRA and NCEP CFSR are included in ana4mips. ESRL 20CR is being included at their ESGF node. ERA interim and JRA-25 are being incorporated by the GSFC Ana4Mips team. There are also a number of variables (tendencies and budgets, for example) that models need and which cannot be easily determined globally by observations. However, reanalyses can provide these data. It is hoped that, in the planning for a CMIP6, the standard model output could be coordinated with the reanalysis community as there may be additional reanalysis products that could be useful for model evaluation.

Michael Bosilovich stressed that there is a great opportunity for reanalysis to be part of the ESGF framework. He noted the specificity of ana4MIPs having usually model variables (very) similar to CMIP5 standards, as opposed to obs4MIPs. The inclusion of other reanalysis quantities (e.g. tendencies, forecast-observations differences, analysis-observations differences) was debated, despite not being a 1-1 connection to CMIP output, which would potentially diffuse the clarity of the goal versus keeping ana4mips more closely aligned with the 1-1 match to CMIP output. The RIP idea was considered as an equally interesting/valuable focused effort on reanalysis intercomparison. These two paths and the associated objectives might have implications regarding the governance of that group.

6d. ExArch

Otis Brown summarized the ExArch discussions in Windsor from their meeting last October 1-3, 2012 concerning international governance for the Earth System Grid Foundation (ESGF). The CF (Climate Forecast) convention, the exchange format standard used by the CMIP and other projects is currently overseen by the WGCM. The apparent outcome of the ExArch discussions is that WDAC does not need to consider taking on the responsibility as the WCRP oversight home for the ESGF.

6e. Discussion and way ahead – “obs4MIPs” white paper

Peter Gleckler and Duane Waliser suggested that WDAC would be the ideal home for an obs4MIPs task team or panel, with some relevant WMAC representation. On a question from Otis Brown about the requirements and assessment protocols for products to enter the archive, Peter Gleckler responded that there are alternatives, ranging from simply requiring adherence to the CF standards or a more ambitious path of ensuring some quality assurance as obs4MIPs strives to do. Michel Rixen further noted the need to have some consistency between model and data gating within the ESGF. Mark Dowell noted that the white paper does not refer to GCOS principles. Adrian Simmons welcomed the initiative but remarked that it will expose reanalysis products and that GCOS requirements were developed primarily for UNFCCC and not intended for model evaluation initially. Walt Meier asked about the consistency between different products such as sea-ice. Duane Waliser emphasized that different products can have multiple uses and hence varied strengths and weaknesses. Otis Brown and Eric Lindstrom asked which parameters would guide the choice of fields: would they be driven by specific model parameters or by ECVs? Pierre-Philippe Mathieu explained that there is a good interaction with the user community within ESA CCI, a lot of the products being used for model development requiring observations and reanalyses. Joerg Schulz observed that the point 5 in the white paper could be more explicit “on fostering assessments...” rather than just “seek community input and feedback...”. He also suggested mapping model variables against ECVs and EUMETSAT products against obs4MIPs variables. Otis Brown suggested they revisit the ToRs of the proposed panel

and develop a balanced topical and geographical membership to reflect the ToRs. Toshio Koike wondered about the governance link of this panel to the ESGF. Otis Brown suggested that the panel could be the WDAC's primary link to the Federation. Peter Gleckler noted that the ESGF is more focused on modeling support but some cross-representation could address this adequately. Eric Lindstrom expected the participating agencies to provide secretariat support into this initiative. Mark Dowell wondered whether the community would prefer liaising with individual agencies or through CEOS WG Climate on these matters. Michel Rixen observed that obs4MIPs data sets could have a specific entry on whether they are also ECV data sets. In conclusion, the WDAC members agreed that it was important to establish an oversight mechanism for the organization of observations on ESGF and that WDAC involvement was appropriate.

7. WDAC Business

7a. Review of planned meetings/events – gaps, duplicates, requirements

N/A

7b. WDAC – WMAC liaising

Otis Brown will attend the upcoming JSC34 in Brasilia 27-31 May, offering the opportunity for liaising with WMAC on cross-cutting issues.

7c. Next WDAC meeting – Date/Venue

Brian Ward kindly offered to hold the next meeting in Galway, Ireland. Dates TBD.

7d. AOB

N/A

7e. Review of Draft actions list

The chair proposed a list of actions agreed upon by all participants. The list was subsequently edited and is presented in Annex D. The Chair thanked all participants for their contributions and inputs and EUMETSAT for their great support in hosting the meeting.

Annex A – Agenda

<i>Time</i>	<i>Agenda Item</i>	<i>Docs</i>
<u>Monday 4 March 2013</u>		
1. Introduction – Chair O. Brown		
08h30	a. Introduction – WDAC Co-chairs	
08h45	b. Welcome address – EUMETSAT Chief Scientist - Johannes Schmetz	
09h00	c. Meeting arrangements – J. Schulz	
09h10	d. Adoption of agenda	1
09h20	e. Review of WDAC1 actions	3
09h40	f. WCRP Update, including Grand Challenges, Future Earth, CORDEX – M. Rixen	9
2. Inventories, GOSIC – Chair O. Brown		
10h00	a. NCDC, GOSIC – C. Lief, O. Brown	6,10
10h30	<i>Coffee break</i>	
11h00	b. CEOS update, WGClimate – M. Dowell	11, 12
11h20	c. CGMS update – J. Schulz	13
11h40	d. GCOS update – A. Simmons, H. Dolman, E. Lindstrom	14
12h30	e. Discussion and way ahead	
13h00	<i>Lunch</i>	
3. Reanalyses and fluxes – Chair T. Koike		
14h00	a. Reanalysis update, including Reanalysis.org – M. Bosilovich	7
14h20	b. SOLAS update, pCO ₂ ECV – B. Ward	15
14h40	c. GSOP update: air-sea fluxes, ocean synthesis – P.-P. Mathieu	8
15h00	d. Workshop on observations for reanalyses – J.-N. Thépaut	
15h10	e. Discussion - all	
15h30	<i>Coffee break</i>	

4. Data requirements, assimilation, network design, OSSEs – Chair O. Brown

16h00	a. Data assimilation, OSSE - J.N. Thépaut	
16h20	b. NOAA JPSS Mitigation Study – O. Brown	16
16h40	c. WMO Rolling Requirement Review – M. Rixen	5
17h00	d. SCOPE-CM Phase 2 – J. Schulz	
17h20	e. Discussion - all	
19h00	<i>Dinner</i>	

Tuesday 5 March 2013

5. Data sets, quality assessments and best practices – Chair T. Koike

08h30	a. GEWEX – J. Schulz	4,17,18
08h50	b. CLIVAR – P.-P. Mathieu	19
09h10	c. SPARC (including ESA SPARC initiative) – Susann Tegtmeier/K. Sato	20
09h30	d. CliC (including data needs for seasonal ice outlooks initialization) – W. Meier	21
09h50	e. IGBP – D. Schimel (TBC)	
10h10	f. Discussion - all	
10h30	<i>Coffee break</i>	

6. Earth System Grid, obs4MIPs, ana4MIPs – Chair O. Brown

11h00	a. Earth System Grid, CMIP5, metrics – P. Gleckler	22,23,24
11h30	b. obs4MIPs – D. Waliser	25
11h50	c. ana4MIPs – M. Bosilovich	
12h10	d. ExArch – O. Brown	26
12h30	e. Discussion and way ahead: governance, WMAC	
13h00	<i>Lunch</i>	

7. WDAC Business – Chair O. Brown

14h00	a. Review of planned meetings/events – gaps, duplicates, requirements	
14h15	b. WDAC – WMAC liaising	
14h30	c. Next WDAC Meeting – Date/Venue	

14h45	d. AOB	
15h00	e. Review of Draft actions list	
16h00	<i>Meeting ends</i>	

Annex B – WDAC Observations For Model Evaluation Panel

Oversight and Governance of Observational and Analysis Data Prepared for Model Evaluation

Prepared¹ for the WDAC
Draft V1.4
February 25, 2013

Summary:

Observational and reanalysis data are essential for climate model evaluation, and some products are already widely used for this purpose. The links between observational data experts and model developers/analysts are, however, often weak, and as a result, valuable data resources relevant to climate modeling research are underutilized by the modeling community or may be used naively or even incorrectly. Two pilot projects known as “obs4MIPs” and “ana4MIPs” have been launched with the intent to deliver observational baseline data sets for model evaluation. Obs4MIPs aims to apply to observational data the well-established model output standards adopted in CMIP and other projects (e.g. metadata and formatting) and to establish guidelines for documentation with particular relevance to model evaluation. Ana4MIPs strives to rewrite reanalysis products following the CMIP data requirements. By reprocessing these data products in this way, they can more easily be disseminated in like fashion with model output (e.g. through the ESGF). The pilot projects have already gained considerable attention and have reached sufficient maturity for consideration as an activity endorsed and overseen by the WCRP’s WDAC.

Background:

For over twenty years, the international climate modeling community has developed an increasingly coordinated approach to collaborative experimentation and analysis. Exemplified by model intercomparisons (MIPs), the resulting research has been central to each assessment report prepared by the IPCC. Increasingly, model intercomparison efforts are adopting a common set of standards for describing and organizing climate model output, which has made preparation of output less burdensome and has facilitated analysis of multi-model output by a broad community of researchers. A key aspect of the proposal below involves applying (with some refinements) these standards to certain observationally-based data sets to similarly facilitate their use in climate modeling research.

¹ This document was prepared by Robert Ferraro, Peter Gleckler, Renu Joseph, Tsendgar Lee, Jerry Potter, Karl Taylor, and Duane Waliser, who have all been actively engaged in obs4MIPs and/or ana4MIPs.

Obs4MIPs was begun in 2010 as a pilot activity launched by JPL² and PCMDI³, supported by NASA and the U.S. DOE. This inter-agency partnership combined NASA's expertise in a variety of climate relevant satellite products with PCMDI's experience in working with the international community via the design and implementation of MIPs.

Although obs4MIPs was initiated by a NASA-DOE partnership, the intent from the beginning was to attract contributions from a much broader observational community, which would eventually establish an observational data archive that the model evaluation community would find authoritative and easy to use. Following development of the obs4MIPs protocol, NASA has now prepared about 20 different observational products and is disseminating them via the ESGF. The identification of this initial set of data sets, the establishment of the obs4MIPs protocol, and the posting of obs4MIPs data sets on the ESGF were facilitated through two DOE & NASA sponsored community workshops (e.g. Gleckler et al., *EOS*, 92, 2011), scientific and IT collaborative work between JPL/NASA and PCMDI/DOE, and the establishment of and guidance from a NASA sponsored obs4MIPs Working Group.

Following inception of obs4MIPs, a similar effort specifically focusing on reanalysis products was begun and became known as "ana4MIPs". The goal of ana4MIPs is to prepare reanalysis products following the CMIP5 data standards to facilitate climate model evaluation. At the recent WCRP reanalysis workshop, representatives from all the major reanalysis efforts agreed to have their data reformatted and distributed through ESGF, as is being done for obs4MIPs.

As is evidenced by the obs4MIPs data currently accessible via ESGF, the initial NASA products strictly adhere to the obs4MIPs protocol. Other groups are now also beginning to contribute selected data sets, and the expectation is that they also will be made to be fully compliant with the obs4MIPs standards (e.g., data from the Cloud Feedback Model Intercomparison Project observational holdings, CFMIP-OBS).

An essential criterion of obs4MIPs is that each data set corresponds to a field that is output in one or more of the CMIP5 experiments⁴. This technical alignment of observational products with climate model output facilitates model data comparisons and also retains a very specific programmatic focus for the activity. To help researchers use the data products (especially for purposes of model evaluation), requirements have been developed for documentation of obs4MIPs data sets⁵. And finally, in compliance with the data specification of CMIP5, obs4MIPs data is being served using the same mechanism as climate model output, namely the Earth System Grid Federation (ESGF)⁶. To summarize, products available via obs4MIPs are:

² NASA Jet Propulsion Laboratory, Pasadena, USA

³ Program for Climate Model Diagnosis and Intercomparison, Lawrence Livermore National Lab, Livermore, USA

⁴ http://cmip-pcmdi.llnl.gov/cmip5/data_description.html

⁵ <http://obs4mips.llnl.gov:8080/wiki/requirements>

⁶ <http://esgf.org>

- Directly comparable to a model output field defined as part of CMIP5
- Well established in the peer reviewed literature with demonstrated value for model evaluation
- Open to contributions from data producers meeting obs4MIPs requirements
- Documented for their use in model evaluation, with product version traceability
- Served through ESGF

Although obs4MIPs/ana4MIPs currently target only CMIP5 output fields, as other model intercomparisons adhering to the CMIP5 data standards emerge (e.g. the Atmospheric Chemistry and Climate Model Intercomparison Project), the list of variables should expand.

Key challenges and the need for oversight:

While the establishment of the NASA obs4MIPs Working Group has been valuable in helping to shepherd the initial phases of obs4MIPs and will continue to be relevant in addressing issues associated with NASA products, a body with a broader purview and vision needs to be established to comprehensively guide this activity. An oversight committee will need to address a variety of issues in setting a course that will enable obs4MIPs/ana4MIPs to flourish yet retain focus and high standards. Scientific vision, attention to details, and strategic decision-making will all be required, carried out with an awareness of international and inter-agency sensitivities. Among the obs4MIPs/ana4MIPs challenges that should be addressed by an oversight committee are the following:

- Considering the plethora of data sets potentially relevant to model evaluation, careful organization and, where necessary, filtering of candidate data sets needs to be done so that the user community can be guided to the most appropriate data sets available and is not confused by datasets that are largely duplicative or of demonstrably inferior quality. An oversight committee with guidance from the WDAC and input from outside experts could establish and arbitrate quality standards for data sets considered for inclusion in obs4MIPs/ana4MIPs.
- The intersection of observations and reanalysis with model output from protocols like CMIP5 is smaller than it could be. Increasing the intersection between future observational products and routinely saved model output is a goal of obs4MIPs/ana4MIPs, and reaching that goal will in part require coordination among WGCM model intercomparisons, the Climate Metrics Panel, other groups within the WCRP (e.g. WMAC, WGNE), and the satellite agencies.
- So far, obs4MIPs has dealt mainly with satellite data products, although some initial work has been done to treat site data from the Atmospheric Radiation Program (ARM). Guidance and strategy regarding the inclusion of in-situ measurements is needed. In general, strategic guidance

regarding the evolution of obs4MIPs is needed, including the evolution of the protocols and requirements.

- As observational scientists become aware of obs4MIPs/ana4MIPs, it is expected that they will show increasing interest in reworking their datasets to conform them to standards. Technical assistance will be requested and tools and documentation to facilitate this will be demanded, and so there will be a need for advocacy to raise resources for this effort.
- There will be a need to negotiate the metadata standards and to coordinate with data systems. A high-level strategy and guiding principles will be needed to enable the coordination and negotiation between different communities.
- Coordination is needed between obs4MIPs, ana4MIPs, CFMIP-OBS, IS-ENES, CMUG, ACCMIP, and other efforts.

Proposed oversight and guidance:

WDAC, in coordination with WMAC, is ideally suited to oversee obs4MIPs and ana4MIPs. One option for governance would follow the approach taken by the WGCM, which created a modeling panel to oversee CMIP. The WDAC could establish an “Observations for Model Evaluation Panel”, ideally one with members from the WDAC and WMAC being prepared to serve along with appointed experts from the broader community. A list of suggested nominations for initial panel membership can be provided, although it is envisaged that the WDAC will constitute the panel.

The WDAC Observations for Model Evaluation Panel would report regularly to the WDAC and WMAC, and obs4MIPs would be reviewed at sessions of both advisory councils. The panel’s charge would be to provide coordination, oversight, and guidance for obs4MIPs and ana4MIPs, and it would address the challenges discussed in the section above. The panel members would further serve as contact points and ambassadors for the obs4MIPs/ana4MIPs efforts.

Among the panel’s early objectives would be the following:

- Review existing obs4MIPs/ana4MIPs protocols and contributions. Adopt these or revise as appropriate to establish the obs4MIPs baseline.
- Define a protocol for accepting contributed data sets – this includes the mechanics of how and what is considered, and the process for accepting rejecting, or deferring a data set.
- Coordinate within the AR6 timeframe a workshop (perhaps with WCRP backing) to recommend modifications for the next round of MIPs and observational products so that there is greater overlap.

- Consider all components of earth system modeling, identify high priority candidate data sets especially useful for model evaluation, and encourage work to bring them in conformance with the obs4MIPs/ana4MIPs data standards.
- Enhance visibility of obs4MIPs/ana4MIPs within the WCRP and initiate coordination with other relevant sub-panels.

A draft “terms of reference” is included below as an Appendix. It is the fervent hope of the authors of this document that with due speed the WDAC establish an oversight panel along the lines suggested above and endorse the obs4MIPs and ana4MIPs efforts as the foundation for a WCRP activity to promote development of observational data sets for model evaluation.

**Terms of Reference for the
WDAC Observations for Model Evaluation Panel
(DRAFT)**

1. Establish standards for creating observational and reanalysis data sets that can be readily used to evaluate earth system models and promote development of conforming data sets.
2. Ensure that whenever sensible, the standards are made consistent with data standards used in major climate model intercomparison efforts like CMIP.
3. Coordinate activities with major climate model intercomparison efforts (e.g., CMIP) and liaise with other related WCRP bodies, such as WMAC.
4. Encourage development of, compose content for, and oversee a website providing information on observational data sets for model evaluation.
5. Seek community input and feedback on the value of products developed in conformance with obs4MIPs standards and evolve and tighten, if necessary, the standards to meet any additional needs.
6. Report to the WDAC, WMAC, and brief other relevant WCRP committees and panels (e.g., the WGCM) on progress, status, and plans for activities overseen by the panel.

Annex C – List of contacts

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Annex D – List of actions

	Action	POC	Date
1	WCRP/GCOS follow-up letter to agencies – recognition and further engagement	<u>Rixen</u> , GCOS Secretariat	May 2013
2	Inventory, investigate commonalities and elaborate joint inventory tool	<u>CEOS</u> , <u>GOSIC</u>	April 2013
3	Inventory, stimulate inputs from community	<u>WCRP core programs</u> , <u>GCOS panels</u> , <u>WMO</u>	WDAC3
4	Reanalysis, fluxes, task team to plan the “Observations for reanalysis” workshop	<u>Simmons</u> , Thépaut, Bosilovich	July 2013
5	WMO rolling requirement review: provide concerns to WMO SAT on suitability of database for climate applications	<u>Rixen</u> , Lindstrom, Simmons, WMO Space Programme	March 2013
6	Data set quality assessment: blue print on best practices	<u>Schulz</u> , with inputs from WDAC members	June 2013
7	obs4MIPs-ana4MIPs: establishment of task team/panel to promote contributions to the ESGF with observational and reanalysis data sets. ToRs and membership to be refined	<u>Gleckler</u> , Waliser, Bosilovich, Ward	June 2013