WCRP REPORT

World Climate Research Programme

Meeting Report

WCRP Observation and Assimilation Panel (WOAP)

Report from the Fourth WOAP Meeting (WOAP-4)
Hamburg, Germany, 29-31 March 2010

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WCRP OBSERVATION AND ASSIMILATION PANEL

Report from WOAP-IV
KlimaCampus, University of Hamburg
Hamburg, Germany
29-31 March 2010

SUMMARY OF MAJOR ISSUES

This was a good meeting with a wide ranging full discussion of a number of observationally-related issues and with a number of actions proposed.

Progress achieved during the last two years in relation to observations was reviewed and the following issues were addressed:

- GRUAN and interactions between GCOS and WCRP activities;
- Flux tower measurement exploitation and interactions with IGBP;
- Observations from space, including NPOESS developments, and interaction with CEOS;
- Reprocessing issues, including SCOPE-CM and discussion of a possible major reprocessing workshop;
- Interactions between GCOS and WCRP;
- Participation in GEOSS;
- The actions arising from JSC 31; and GCOS SC XVII.
- Assess the activities and results of the Task Group on Data Management and the Joint Working Group on Observational Data Sets for Reanalysis
- Datasets for evaluating models and other uses
- Discuss participation in the WCRP Open Science Conference in October 2011
- Consider datasets for evaluating models and the CMIP5;
- Discuss organization of the next international reanalysis conference; and
- Review the transition of WCRP projects and datasets beyond 2013.

SUMMARY OF ISSUES AND RECOMMENDATIONS

Issue – data activities

There is a need for datasets for evaluation of CMIP-5 and other model data. Concern was expressed about the JPL activity because there is no assessment of the datasets. A workshop was suggested where groups could come with an assessment of their own data as well as of that of other groups.

WOAP should help make observations as available and useable as possible. Observations are inherently more difficult to use than climate model output generated by CMIP. However, WOAP can help by providing encouragement and possibly a framework whereby the observations and climate modeling communities would interact to identify observation data sets useful in model evaluation, establishing guidelines for metadata that will facilitate search and discovery and formats and metadata that will facilitate analysis; and developing a strategy for making multiple datasets developed for model evaluation accessible in a way that parallels the CMIP model output archive.

A related issue is meta-data consistency across weather and climate communities. CMIP and CEOP have provided frameworks for access to model and observational datasets, including meta-data standards. The WMO has developed standards for meta-data for meteorological purposes which may not be fully aligned with those of CMIP.

Actions

- A proposal was made to draft two-page descriptions of products to be generated. Such descriptions would constitute the first bit of information needed to look at products and how they are documented. Although such 2-pagers are not really meant for scientists, they could still be a huge service to users.
- PCMDI is requested to liaise with the appropriate task group of WMO to optimize the treatment of meta-data for weather and climate model output.

Issue – Rigorous error analysis, documentation, product intercomparisons

The optimal use of satellite and in situ data depends upon a robust characterization of the data. Product documentation must include a complete discussion of uncertainties and biases. Intercomparisons of similar products are essential for determining and documenting advantages and disadvantages of each. More generally, while the community must continue to work to reduce uncertainties, it is appropriate to place more emphasis on the quantification of uncertainties. This is especially important for observed datasets, where structural errors are not always recognized.

Action

- WOAP encourages all groups to ensure that all model and observed datasets have their associated uncertainties quantified, with recognition of possible structural uncertainties.
- The JSC should encourage all WCRP programs to promote inter-comparison activities for groups that commit to continuing support for key climate datasets. Existing intercomparison activities, such as the GEWEX cloud climatology workshops and the CliC sea ice concentration product intercomparison, are examples of current efforts in this area. Support for such activities will most likely come from agencies that support reprocessing, e.g., NOAA, ESA, NASA, and JAXA.
- WOAP could help the science community and space agencies design the appropriate framework needed to maximize the value of satellite data for climate research, and to better interpret observations in a modeling context. In particular, WOAP should consider providing guidance to data providers on:
  - *Observational Priorities* of the WCRP research community, highlighting the critical ECVs needed to support climate modeling, their value, the current status of CDRs, and any associated issues, with a focus on satellite missions.
  - *Requirements for Data Exploitation Tools*, including a review of software and toolboxes, and what is needed to make full use of the data (e.g., web-based visualization and exploration tools such as Live Access data server, web mapping technology).
  - *Best Practices* for "iterative re-processing" of CDRs with particular focus on error budget analysis and traceability (e.g., instrumental error, structural error) including propagation of uncertainty along the processing chain.
  - *Data Stewardship Guidelines*, including guidance on formats, naming convention (along the lines of CMIP5), meta-data, and data policies needed to maximize access to data and associated algorithms.
  - *Data Assessment Guidelines*, with a focus on practical procedures needed to inter-compare different data sets, quantify their quality, strengths, weaknesses, validation data and limitations.

Such guidance from WOAP would be essential for helping steer funding towards the creation of the elements of an international climate *framework,* aiming to build long-term consistent climate data records with sufficient accuracy.

Issue – Recognition of WCRP and GCOS datasets and their assessment

The WCRP has always recognized the need for global datasets, and those activities became a major output of GEWEX leading to accessible and well-used datasets. GCOS has promoted of inter-comparisons between products to identify the sources of the differences between products and hence to reduce biases in all the products. The OOPC-AOPC working group on SST and sea ice was effective in promoting more consistency in global

SST products but similar success has not been achieved with sea ice, where there continue to be at least 8 independent products. Over the last decade, several groups have developed global dataset with slightly different approaches, which allows more rigorous estimates of the uncertainties and leads to continuing efforts to reduce the biases and random errors in the datasets. These advantages are realized only if there are the significant will and resources to establish the required international coordination and assessment of the results.

Actions

- The GEWEX and SPARC SSGs should continue to encourage the production of their key datasets, and their improvement, especially from ISCCP and GPCP, to serve the wide community of established users.
- WOAP should promote assessment activities involving all groups that prepare similar long-term datasets of ECVs and related variables.
- Other datasets under CLIVAR and CliC, such as SST, ocean heat content, sea level, sea ice, and so on, should also be considered.

Issues – Reprocessing and continuity of satellite data

WMO Integrated Global Observing System (WIGOS) is the WMO initiative to develop a more holistic approach to integrating WMO observing systems. The Global Space-Based Inter-Calibration System (GSICS) program has developed a number of calibration methods for satellite imagers and sounders. For climatological applications, inter-satellite calibration is critical. However, with some exceptions, GSICS calibration methods are not finding their way into reprocessing projects. All space agencies should develop plans to regularly reprocess data as new calibration and product generation methods become available, if these are not already in place. With SCOPE-CM, which promotes inter-comparison of global climate datasets of ECVs and related variables derived from satellite data through post-processing of the calibrated data produced under the GSICS process, and with ESA's new Climate Change Initiative (CCI), which aims to generate datasets of key ECVs and related variables derived from satellite data, there is a need for more comprehensive assessments.

Action

- It was noted that WCRP must become involved in pilot projects of WIGOS to increase their chance of succeeding.
- WOAP should ensure that the research community is involved with international assessments of global datasets. The SCOPE-CM provides a model of the process for international assessment, and it could be expanded to involve operational and research agencies as well as the research community.
- Agencies should support reprocessing of satellite data and their assessment. A letter to CEOS and CGMS could acknowledge participation in the GSICS project, and suggest continued cooperation programs in such as SCOPE-CM. SCOPE-CM could be expanded to include terrestrial or oceanic ECVs if agencies offer support.

***Issue* – Workshops to promote assessment of reprocessed datasets**

There was discussion of the merit of one or more WCRP workshops to assess reprocessed variables. One possibility is a large workshop that covers everything from energy and water variables (such as in GRP) to sea ice, snow cover (CliC), ozone, stratospheric water vapour, and temperature (SPARC), SST, ocean heat content, sea level, surface wind, relative humidity (CLIVAR), and so on. However there may be more merit in having a series of workshops to bring together inter-related variables but not all at once.

A key goal is a comprehensive assessment that better establishes uncertainties and error bars, what aspects are reliable, and what are not, and an informed commentary on the datasets. While part of such workshops may be a beauty contest and it may be possible to

choose a best product, this is unlikely, and more likely is that differences in choices will reveal different ways of proceeding. Once some level of maturity is established for a dataset, a doi[1] should be sought for datasets.

Action

- WOAP supports holding one or more workshops, perhaps led by GRP and ESA, to bring different teams together to assess algorithms and products
- Shortly after the WOAP meeting, ESA has indicated that it is willing to host such a workshop, and GRP is interested as well. Sponsorship is desirable from space agencies, in particular. Many participants at such workshops may be funded to attend through their team membership in producing a particular variable.

Issue – Future arrangements for the coordination of surface flux activities in WCRP

The terms of the members of the WCRP Working Group on Surface Fluxes have expired, and it is appropriate to consider the best organisational arrangement for the coordination of surface flux activities, bearing in mind the work in other WCRP programs.

Actions

- The CLIVAR SSG is requested to develop a strategy for coordinating current activities on surface fluxes across GCOS and WCRP projects and for ensuring that significant gaps are addressed.
- WOAP should consider focusing one proposed dataset assessment workshop on global surface fluxes, including physical and biogeochemical properties.

Issue – WCRP data management

Legacy datasets of WCRP need to be discoverable and recognised as WCRP contributions to international climate research. It is important for WCRP to have clear guidelines on data management practices.

Actions

- WCRP project offices should ensure that appropriate global datasets are registered in WIGOS and in the WCRP catalogue, in addition to meeting the basic requirements for data access and quality.
- WOAP accepts the offer by the CLIVAR IPO to update the web-based catalogue of WCRP datasets in consultation with projects. This should be posted on the WOAP web pages.
- The WOAP Task Group is asked to develop guidelines for data management practices across WCRP; this task should be completed over the next six months.
- A new chair of the Task Group is required as soon as possible.

Reanalysis

Issue – Joint Reanalysis Data Working Group

The working group should go forward with plans to develop a catalogue of input data for reanalysis. This should include information and references related to dataset versions and quality where possible, and should include datasets related to ocean, land and cryosphere as well as atmosphere (supporting disciplinary and integrated reanalyses).

Actions: Russell Vose (Chair of the Joint working group) will begin developing and implementing plans for the reanalysis data catalogue.

Issue – 4th International Reanalysis Conference

The recent release of several new data products has provided the impetus to begin planning for the fourth conference. Mike Bosilovich was asked, and agreed, to be the program chair.

[1] *doi is short for "digital object identifier". One is assigned to all published papers nowadays.*

This was originally envisaged for fall 2011, but to avoid overlap with the Open Science conference, the planned timing is being moved to April 2012. The proposed location is the Washington DC area, in close proximity to the resources of two of the latest reanalyses (CFSR and MERRA), and the United States is due in the venue rotation. The scope of the conference will include ocean, land, cryosphere and atmosphere reanalyses. Detlef Stammer, Russ Vose and Adrian Simmons have agreed to participate in the Program Committee. Members representing NCEP, ECMWF, ESRL, JMA, Land, Ice, Climate Variability, Data Assimilation, WCRP and likely WGNE are still being identified.
***Actions*:** Identify the Program Committee and Local Organizing Committee chair and begin planning, including garnering resources (Mike Bosilovich)

Issue – Atmospheric Reanalysis Proliferation
Given that four global atmospheric reanalyses have been released in the last year, as well as the planning for several regional reanalyses, the apparent proliferation of reanalysis data may cause problems with the user community. The multitude of reanalysis data sets is a result of diverse community needs. The community needs to be informed to be able to take advantage of these diverse data. It was noted that reanalysis should be a continuous, ongoing activity and is vital for climate services in multiple ways.
Actions

- It may facilitate comparisons to make the data available to PCMDI, and contribute to testing of present day climate models. The GMAO is planning making MERRA available through the Earth System Grid (ESG).
- Discussions following WOAP-4 (Gil Compo, Dick Dee and Mike Bosilovich) concluded that a Wikipedia type server for reanalysis comparisons and verification would be a good place for centers to share their knowledge that could also be used by individual investigators. Gil Compo has taken the initial implementation on.
- There is the need for funding for assessments to be adequate, and this should be a priority with program managers.
- Coordination and staggering of reanalyses remains a desirable goal. More sustained ongoing efforts are highly desirable, and should be part of climate services.

Issue – WCRP Reanalysis Pamphlet
WCRP should produce a reanalysis information pamphlet. This would cover basic information on each of the many available reanalyses in one place, including pointer to more information and likely the data itself. There will also be a www page also sponsored by WCRP.
Actions:
Mike Bosilovich will develop the first draft of a questionnaire for reanalysis developers. This will be refined and Ghassem Asrar will identify support personnel to develop the pamphlet and www page.

Observations

Issues –Gaps in, and sustainability of, space-based observations
There is a critical need for microwave SST data and better coverage by scatterometers. There is uncertainty in the future of climate-quality passive microwave and scatterometer instruments. There is also going to be a gap in limb sounding, which provides high vertical resolution profiles.
Action

- WOAP should consider sending a letter to CEOS and CGMS on behalf of WCRP and GCOS. However, because these issues are already considered in the 2010 GCOS Implementation Plan (IP-10), and given that CEOS is preparing a response to the IP, such a letter should carefully endorse and reinforce the GCOS plan, and the needs of the scientific community from the standpoint of the WCRP. It would be good to have an

exhaustive list of all gaps and indicate the criticality of each gap (e.g., consequences for science if the gap is not properly addressed in a timely manner).

The lifetime of current instruments (TMI and AMSR-E) should be estimated. If AMSR-E (Aqua) will continue to be operated after GCOM-W1/AMSR-2 launches, data continuity will be achieved and intercalibration between the two sensors will be possible. CEOS could be asked for their assessment of the likelihood of a gap in microwave SST coverage and their strategy for mitigating such a gap. The letter should also cover reprocessing issues (see below). Both CEOS and CGMS should be commended on their recent efforts to bring more attention to climate activities, and encourage more joint efforts.

Issue – Global reference sites

For the world oceans, there is a program supporting monitoring at about 150 sites and the OceanSITES program is a global reference network. Twenty sites are designated as air-sea flux reference sites, while others focus on biogeochemistry, geophysics and ocean transports. Over the land, many global networks, such as FluxNet and GSN, have been developed to support research and monitoring for specific purposes. There are a smaller number of global reference networks (such as CEOP, GRUAN, ARM, ICOS, BSRN) established for multi-variable observations. There are policy and scientific reasons for such reference sites to be collocated wherever feasible.

Action

- TOPC is asked to lead a dialogue with the relevant networks (including CEOP, GRUAN and ICOS) to develop a strategy to optimize and justify the distribution of multi-variable reference sites.

Issue – Improved measurement of solid precipitation

A significant fraction of regional precipitation falls as snow. New satellite missions are being developed to measure solid precipitation but the problem is far from solved.

Action

- CliC is asked to continue its dialogue with CIMO and other relevant groups to ensure that appropriate activities are being undertaken to improve the measurement of solid precipitation for research and monitoring purposes.

Issue – TOA radiation budget

The TOA radiation budget has not been adequate to provide physically reasonable imbalances without ad hoc adjustments.

Actions

- GEWEX is requested to investigate the feasibility of improving the accuracy of the TOA radiation budget, and whether adequate steps are being taken to address this issue.
- If such an improvement is feasible, then the JSC and GSC should encourage the relevant agencies to take the required actions

Issue – Co-ordination of ship-based observations should be enhanced

GO-SHIP is trying to facilitate the co-ordination of hydrographic section occupations to ensure resources are well spent. A more general effort for other types of shipboard measurements would also be valuable. A model for ensuring data quality in the absence of shipboard experts has been established and real-time data availability is encouraged. Although data management responsibility is likely to remain with national operators, a central access point to research vessel underway data should be established and the potential for comparison with model output, for example from SURFA, should be explored.

Action

- WOAP requests that the OOPC, in consultation with the AOPC as appropriate, considers the co-ordination of shipboard underway measurements at OOPC-15 including presentation from existing national programs. WOAP could also write a WCRP Newsletter article on the issue.

Other items

Issue – New chair for WOAP

There is a need for a new chair of WOAP as Trenberth had taken on chairmanship of the GEWEX SSG, and suggestion for appointment of a vice chair.

Actions

- Mike Manton has agreed to take on the chair and it is suggested that a vice chair should be appointed. There is a need for improved support for WOAP from JPS, such as a designated contact to help with matters arising.

REPORT OF THE MEETING

Session 1: Opening of the Meeting

Dr Kevin Trenberth, the Chair of the WCRP Observation and Assimilation Panel (WOAP), welcomed everyone and opened the meeting. On behalf of WOAP, he thanked Dr Detlef Stammer for hosting the meeting at the excellent facilities of the Climate Campus at the University of Hamburg.

The agenda for the meeting is given in Appendix 1, and the participants are listed in Appendix 2. Many documents for the meeting and presentations made at the meeting are given on the WOAP web site: http://wcrp.wmo.int/AP_WOAP4.html.

In introductory remarks, the Chair emphasized that WOAP is a cross-cutting activity representing observations and their use. WOAP is co-sponsored by both WCRP and GCOS. He observed that everyone at the meeting represents some other group, but, other than the Chair, no one has special responsibilities related to WOAP *per se*. It is therefore important that the representatives report back to their parent bodies in order to enhance coordination.

The Terms of Reference (TORs) for WOAP were briefly reviewed. Thus, WOAP was established to:

- Identify climate observational requirements;
- Help optimize observations;
- Act as a focal point for WCRP interactions with other groups;
- Promote and coordinate analysis, reprocessing, reanalysis, and assimilation; and
- Promote and coordinate information and data management activities, including web sites.

The Chair then introduced the objectives for the meeting, which broadly were to consider progress achieved since the last WOAP meeting almost two years ago with respect to:

- GRUAN and interactions between GCOS and WCRP activities;
- Flux tower measurement exploitation and interactions with IGBP;
- Observations from space, including NPOESS developments, and interaction with CEOS;
- Reprocessing issues, including SCOPE-CM and discussion of a possible major reprocessing workshop;
- Interactions between GCOS and WCRP;
- Participation in GEOSS;
- The actions arising from JSC 31; and
- Actions arising from GCOS SC XVII.

The Chair indicated that the WOAP session would also:

- Assess the activities and results of the Task Group on Data Management and the Joint Working Group on Observational Data Sets for Reanalysis
- Datasets for evaluating models and other uses
- Discuss participation in the WCRP Open Science Conference in October 2011
- Consider datasets for evaluating models and the CMIP5;
- Discuss organization of the next international reanalysis conference; and
- Review the transition of WCRP projects and datasets beyond 2013.

Before ending Session 1, the Chair established four Task Groups for the meeting. These Task Groups were charged with reporting to the final review session at the end of the meeting on recommendations and actions to be taken with respect to the principal issues

raised during the initial thirteen sessions. Task Group 1 will address data matters, including the dataset, data management, legacy, and reprocessing issues to be considered in Sessions 8, 9, and 11. Task Group two will consider current and future data, encompassing the space observation, *in situ*, and CEOS interaction issues to be discussed in Session 5. Task Group 3 was assigned reanalysis and attribution issues, including recommendations for follow-up actions, the joint Working Group with GCOS on data for reanalysis, and the next reanalysis conference. And, Task Group 4 was given the responsibility to consider GEO and GCOS issues. A short report and presentation should be delivered within a week of the meeting.

Session 2: WOAP Updates

2.1 Review of Activities since WOAP-III. The Chair's introductory presentation in Session 1 continued into Session 2 with a review of Panel activities since WOAP-III, held in Boulder in September 2008. Among other things, the Chair reviewed the outcomes of the most recent WCRP Joint Scientific Steering Committee session in February 2010. He provided an overview of the white paper on observations prepared for the JSC meeting (see website) and which is related to a white paper presented at World Climate Conference-3 (WCC-3), *Capabilities of Existing and Future Observing Systems*. In particular, he discussed of the role of WCRP in addressing the observing needs highlighted in that paper. The Chair concluded by reviewing future needs for observations and analysis, noting that needs existed for: both *in situ* and space observations that satisfy the climate observing principles; a performance tracking system; Climate Data Records (CDRs); the ingest, archival, and stewardship of data; data management; access to data; data processing and analysis; the analysis and reanalysis of observations and derivation of products; and data assimilation and model initialization.

In discussion, the Chair noted that the purpose of WOAP is not to take over things that are already being done well but to promote integration and synthesis, e.g., through reprocessing and reconciliation of different data sets.

There was a note for the need for a new chair of WOAP as Trenberth had taken on chairmanship of the GEWEX SSG, and suggestion for appointment of a vice chair.

2.2. Report from WCRP JSC. A report on WCRP developments was presented by Dr T. Busalacchi (Chair of the JSC). The major events of the last year in which WCRP has played an important role included WCC-3, OceanObs'09, and the ICSU Review and Visioning process. It was noted that the scientific progress made through WCRP and its associated activities was strongly recognized by WCC-3 and that the Conference called for major strengthening of observations and research. Both GCOS and WCRP were identified in the Expert Segment of WCC-3 as essential elements of the new Global Framework for Climate Services (GFCS) that is to be created. Other elements will include a climate services information system, a user interface mechanism, and a capacity building element. The high-level task force established to design the GFCS will deliver its recommendations and proposed steps for implementation to the WMO Congress in June 2011. OceanObs'09 was focused on strengthening and enhancing the international framework under GCOS, GOOS, WCRP, and IGBP and on supporting regional and national frameworks for sustained world ocean observing and information systems supporting various societal needs. The ICSU visioning activity noted the grand challenges in global sustainability, the most significant to WOAP of which is to develop the observing systems needed to manage global environmental change.

The JSC Chair concluded his presentation by noting some of the principal challenges ahead for WCRP. These included decadal variability and prediction, along with coupled data assimilation; projections of future precipitation; development of probability distributions for

future extreme events; public perception and trust of climate science, including the quantification of uncertainty; sea ice and ice sheet modeling and seasonal forecasting of the coupled Arctic; the global framework for climate services; aerosols; and geo-engineering.

A question arose as to whether the scope of WCRP should be expanded if prediction of the Earth System becomes important. The JSC Chair noted that this was probably premature but that WCRP would eventually need to incorporate human dimensions in its purview. The demand for human dimensions data is not there yet, but if WCRP helps to create this demand, then the role of WCRP may change.

The JSC Chair mentioned that he would like to see nominations for a new Chair and Vice-Chair for WOAP. WCRP is very supportive of WOAP, but it was noted that WOAP does not have a dedicated support person. This fact was lamented by the current WOAP Chair, who also pointed out that having dedicated support would help in recruiting the new Chair. The important issues are the need to maintain continuity of activity, especially when membership is somewhat volatile as members rotate off their parent committees, and to consider how to most effectively use the network of representatives of the sub-programmes sitting around the table.

Session 3: Reports from WCRP Groups

Session 3 heard reports from representatives of two WCRP Groups and from representatives of various WCRP projects.

3.1 Working Group on Numerical Experimentation (WGNE). P. Gauthier summarized the activities of this working group. Among other things, he noted several upcoming and/or potential workshops, including 1) a joint WGNE/WGCM meeting in 2011, possibly in Melbourne, Australia; 2) a Year of Tropical Convection workshop, to be scheduled; 3) a workshop, also to be scheduled, on the physics of Earth System models, which will involved both WCRP and WGNE; and 4) a possible workshop in 2010 on model uncertainties, the aim of which would be to bring together the community dealing with model uncertainty in ensemble predictions and data assimilation with the stochastic parameterization community. WGNE and WGCM have carried out a model development survey whose results are being processed.

To note: WGNE has been asked to form a position on delivery of climate services; WGNE will be involved in the organization of the WCRP Open Science Conference. A number of NWP centers have agreed to contribute high resolution simulations to the AMIP part of the CMIP archive. SPARC has requested to have a representative in the WGNE model development group. WGNE encourages members to contribute data to the satellite precipitation intercomparison, has expressed its concern about the lack of sustained funding of reanalysis efforts, and also notes the valuable role of Transpose AMIP for evaluating errors in climate models.

3.2 Working Group on Coupled Modeling (WGCM) and Modeling Issues for WOAP. K. Taylor summarized this topic. Current activities focus on understanding why model projections differ, on evaluating climate models over a wide range of scales and phenomena (from weather to paleo, from global to regional, and from individual physical processes to climate), and exploring how model formulation and present-day model performance translate to reliability of climate projections. CMIP is a central activity of the WGCM, and CMIP5 is intended to allow better understanding of robust and uncertain aspects of climate change, to enable more detailed quantification of strengths of major feedbacks, to include a carbon cycle component, to better meet the needs of the “impacts” community, to provide information needed to assess adaptation and mitigation strategies, and to better coordinate/integrate across the modeling community.

To note: The WGCM challenges WOAP to push to make observations as easily available and useable as the climate model output generated by CMIP. They endorsed the JPL initiative to be discussed in session 11. It would like to see WOAP: 1) provide encouragement and possibly a framework whereby the observations and climate modeling community would interact to identify observation data sets useful in model evaluation, 2) establish guidelines for metadata that will facilitate search and discovery and formats and metadata that will facilitate analysis; and 3) develop a strategy for making multiple datasets developed for model evaluation accessible in a way that parallels the CMIP model output archive.

3.3 Perspectives on WCRP Projects. A number of short presentations were made on WCRP projects, including CLIVAR, CliC, SPARC, CEOP, GEWEX, and on the Working Group on Surface Fluxes (WGSF). D. Stammer, representing the Climate Variability and Predictability (CLIVAR) Project, noted that CLIVAR planning is moving ahead without a sunset date in effect. CLIVAR imperatives were identified as: anthropogenic climate change; decadal variability, predictability and prediction, including the role of oceans, adequacy of the observing system, initialization, monsoons, and extremes; intraseasonal and seasonal predictability and prediction; data synthesis and analysis; the ocean observing system; and capacity building. The Global Synthesis and Observations Panel (GSOP) promotes ocean reanalysis and assessments of observations needed via experiments, such as observing system experiments.

J. Key discussed the Climate and Cryosphere (CliC) Project, noting, in particular some short-term activities for long-term objectives. These included: a review of passive microwave sea ice products and endorsements of a community "sea ice concentrations and ice extent product"; improvement of sea-ice parameterization for Arctic and Southern Oceans; support for a new Arctic System Reanalysis; extension of permafrost studies under the carbon and permafrost initiative (CAPER) in continental shelf areas; contribution to the development of observational coordinating bodies, particularly with regard to the IPY legacy; and development of more realistic ice-sheet models. Issues for WOAP included whether/how the use of snow and ice data could be used in reanalyses; development of a climatology of snow water equivalent (SWE); a desire for suggestions and/or support for continuing the WMO IPY Space Task Group, preparing for a Global Cryosphere Watch, and planning for an International Polar Decade. It was noted that CliC needed to work more closely with GCOS on snow and ice Essential Climate Variables (ECVs).

C. von Savigny introduced the Stratospheric Processes And their Role in Climate (SPARC) Project. SPARC science objectives to 2013 were categorized and discussed in three areas, chemistry and climate; detection, attribution and prediction of stratospheric changes; and stratosphere-troposphere dynamical coupling. It was noted that there will be no limb sounding of the atmosphere beyond the end of this decade, and, therefore, both GCOS and WCRP should say something about this.

T. Koike introduced four objectives of GEWEX that the Coordinated Energy and Water Cycle Observations (CEOP) Project will achieve. In reaching these objectives CEOP will: provide, by 2011-2012, a "state-of-the-art" suite of global energy and water cycle products complete with error bars for closing the global water and energy budgets for the period 1980 to 2010; improve understanding of the contributions of water and its highly coupled non-linear interactions in regulating feedbacks to the climate system; provide a final review of the success of GEWEX in improving parameterization at operational Numerical Weather Prediction (NWP) and climate modeling centers and its impact on the predictive capabilities for key energy and water cycle variables, including hydrological prediction; and demonstrate the benefits of improved hydrometeorological predictions for water resources.

C. Kummerow commented on the activities of the GEWEX Radiation Panel. The Panel supports the production of long-term global products consisting of available satellite and in-situ observations. These are always documented, and nothing is proprietary. The current plans of the Panel include: preparation for reprocessing of individual data sets using common ancillary information with other GRP products; production of first multi-product dataset to promote water and energy closure studies (LandFlux is making great strides); development of a roadmap for transition to operations of SCOPE-CM; fostering data stewardship via GSICS/NOAA SDS; development of a "robust" relationship among observed water and energy variables to help validate climate model processes; expansion of tools (e.g., ISCCP simulator) for broad use; and continued promotion of improvements in polar regions.

E. Kent presented a review of the activities of the Working Group on Surface Fluxes (WGSF). Unfortunately, this is a working group in which the terms of all members have now expired. Nevertheless, the recent activities of the Working Group have included participation in OceanObs'09 and contribution of a Community White Paper to that conference; participation in the Joint SEAFLUX/US CLIVAR Working Group on High Latitude Surface Fluxes Meeting in March 2010; involvement in the SURFA Project; work on solar flux calibration/intercomparison measurement meeting BSRN standards; and the imminent submission to the *Rev. Geophys.* of a review article on surface production of sea spray aerosols.

3.4 Discussion. It was noted by the WOAP Chair that there is a need to address the difficulties in funding assessments of data sets.

Session 4 Coordination with GCOS and GEO

4.1 Update on GCOS Activities. C. Richter, Director of the GCOS Secretariat, provided an update on GCOS activities. She emphasized the strong and important link the Secretariat has developed with the UNFCCC Secretariat and noted that the GCOS Secretariat submitted to the UNFCCC in August 2009 the *Progress Report on the Implementation of the Global Observing System for Climate in Support of the UNFCCC*. The Report indicates that good progress has been made in only about one quarter of the 131 actions contained in the original 2004 Implementation Plan (IP-04). Some progress has been made in most, but not all, of the other actions, but many gaps persist. An update of IP-04, which will be known as IP-10, will be delivered to COP16 in Mexico at the end of the year. An estimate of the costs of implementing the actions in IP-10 is included. Richter also highlighted the relationship between GCOS and the WMO Integrated Global Observing System (WIGOS), noting that the climate observation activities of WIGOS are carried out as part of the cross-domain GCOS, which WMO co-sponsors with UNEP, ICSU, and IOC. She also noted that GCOS is recognized as the climate component of GEOSS and that it is a Participating Organization in GEOSS. At the GEO-VI Plenary in Washington, DC in November 2009 a Strategic Target for climate observations was approved. Finally, she noted that Adrian Simmons will become the new Chair of the GCOS Steering Committee, replacing the retiring John Zillman, and thus a new AOPC chair will be selected (who will become a member of WOAP).

4.2 Atmospheric Observations Panel for Climate (AOPC). A. Simmons reviewed the activities of AOPC. He noted, in particular, that AOPC has led in development of 12 GCOS guidelines for the generation of datasets and products. Independent requests have been made for a dataset review mechanism, and WOAP was identified as a forum to consider this. On reanalysis, Simmons noted that datasets from several new reanalyses would soon be available and recommended that study groups be formed to inter-compare them. It would be useful to provide reports of intercomparisons to the next WCRP international reanalysis conference. Concerning atmospheric chemistry, AOPC has urged the GAW Secretariat to

strengthen support for common coding standards, near-real-time data supply, improved data management, and network integration for observations of atmospheric composition. In discussion, it was noted that reanalysis intercomparisons and making the next round of reanalysis better also require funding.

4.3 Ocean Observations Panel for Climate (OOPC). The focus of the OOPC presentation by E. Lindstrom was on the decisions and actions arising from OOPC-14, held in Miami, Florida in January 2010. In summary, these included: improvement of the societal relevance of OOPC ocean climate indices; maintaining the OOPC focus on the GCOS Implementation Plan (IP-10) but in the context of OOPC as part of an integrated framework for sustained ocean observations, including biogeochemistry and ecosystems; reviewing deep ocean observation requirements; reviewing ocean thermal observation requirements in 2011; understand regional *in situ* and satellite observing needs; develop a "story" on societal relevance of observations; developing a strategy for joint ECVs key for air-sea fluxes; encouraging an ongoing requirements review process through progress reports; encouraging data sharing; and, in the future, determine requirements for western boundary current monitoring. In discussion, it was determined that there was a need to consider development of ocean indices. There is an ongoing issue of availability of observations from Exclusive Economic Zones (EEZs).

In a second presentation, Lindstrom noted the formation of a Task Group at OceanObs'09 to develop an "Integrated Framework for Sustained Ocean Observations." The Task Group will recommend how best to take advantage of existing structures to "develop an enhanced global sustained ocean observing system over the next decade, integrating new physical, biogeochemical, biological observations while sustaining present observations."

4.4 Terrestrial Observations Panel for Climate (TOPC). H. Dolman noted that TOPC is a joint panel of GCOS and GTOS but that, to date, most directions for TOPC have come from GCOS. He reviewed progress implementing the terrestrial ECVs, noting there has been significant progress in defining internationally accepted standards for the terrestrial ECVs but that progress in establishing institutional support for *in situ* networks has been slow. The objective of creating a comprehensive and well coordinated reference network for *in situ* observations of the fullest possible range of terrestrial ECVs is a continuing, yet still largely unmet challenge. Also, the establishment of several Global Terrestrial Networks (GTNs), e.g., for hydrology, glaciers, and permafrost, where data collection takes place largely through *in situ* measurements, has significantly improved the coordination and global coverage of these observations. But other networks like river flow have declined. Outstanding actions include Action T3: Development of a subset of current LTER and FLUXNET sites into a global reference network for ecological monitoring sites with sustained funding perspective; and Action T33: Develop globally gridded estimates of terrestrial carbon flux from in situ observations and satellite products and assimilation/inversions models. Some questions were raised that are of special relevance to WOAP: Are ECV products tuned to climate models, and can they be used as input or benchmarks? How can we optimize their use? Does the TOPC-CliC link need to be stronger? And, can consistent production of ECV's across domains be done? Improved links with CEOP should be forged.

4.5 Cryosphere Observations. J. Key noted that the IGOS Cryosphere Theme assessment resulted in improved coverage of cryospheric elements in the GCOS Implementation Plan and contributed to the GCOS-CEOS plan for satellite-based products. He indicated that efforts have begun to ensure an IPY legacy through the GEO Work Plan. Also noted was the interaction between CliC and GCOS. GCOS lists the Global Cryosphere Watch (GCW) as an implementation agent, so CliC interaction with GCOS will be through GCW (if GCW is approved by WMO in 2011). The GCOS Implementation Plan, on which CliC has commented, contains numerous actions relevant to CliC.

4.6 WMO Integrated Global Observing System (WIGOS). B. Ryan presented an overview of WIGOS, the WMO initiative to develop a more holistic approach to integrating WMO observing systems, including in particular GOS, GAW, and WHYCOS. WIGOS is intended to be a comprehensive, coordinated system for observing systems based on the requirements of all WMO Programmes. It is eventually intended to encompass the requirements for some 25 programmes and 120 geophysical parameters within atmospheric, oceanic, and terrestrial domains. Standardization will be pursued in three areas: measurements and observations, including homogeneity, interoperability, and compatibility of all observations; data exchange, discovery, access, and retrieval (DAR); and end-product quality management. Pilot and demonstration projects were discussed. It was noted that approval for full implementation of WIGOS would not be considered until the next WMO Congress in June 2011. It was noted that WCRP must become involved in pilot projects so as to increase their chance of succeeding.

4.7 Report from the Group on Earth Observations (GEO). M. Tanner reported on developments related to GEO. He noted that GEO now has some 81 members and 56 participating organizations. He noted that the upcoming GEO Ministerial in Beijing, China will showcase the climate community and stressed that engagement and cooperation with the Global Climate Community is fundamental to the success of the Global Earth Observing System of Systems (GEOSS) as a global environmental information system for society. The goal of GEOSS is to provide better information for decision making so as to achieve societal and economic benefits, a global coordinated network, and sustained and comprehensive observations. He stressed that scientific engagement is critical to the success of GEOSS and that a cross-cutting approach involving many communities is important. Tanner highlighted an upcoming GEO-IPCC workshop, to which GCOS and WCRP will also contribute, which will focus on how GEOSS can support IPCC assessments. The workshop has been postponed, but will probably take place in the early part of the second half of 2010. When asked what WOAP can do for GEOSS, Tanner noted that all need to keep doing what they are doing, as GEOSS is just a coordinating mechanism. For its part, GEO needs to help raise the visibility of various projects. Tanner noted also that oceans need higher visibility and thought it might be possible that oceans could become a tenth SBA. One WOAP participant encouraged GEO to focus on a small number of high-level policy issues and to report back on progress made on these.

Session 5 Space Matters and Relations with Space Agencies

The Chair noted that previously WOAP has drafted letters to CEOS on behalf of WCRP and GCOS. It has noted climate needs, and especially the needs for quality and continuity, and reinforced aspects of the GCOS Implementation plan. The letters applauded the CEOS plan, but expressed concern that it may not be implemented, and they sought reassurance that climate concerns would be a priority (which is now is). This session is intended to provide an update on funding and progress. There have been some separate interactions with M. Goldberg, and Dr Goldberg should probably be more involved with WOAP.

5.1 CEOS Activities on Climate. I. Petiteville reviewed the CEOS response to the GCOS Implementation Plan, noting significantly that 88 percent of the satellite-related actions in the plan have progressed at least moderately. SBSTA has encouraged CEOS to continue coordinating and supporting the implementation of the satellite component of GCOS and has invited CEOS to report at its 33rd session in November 2010 on progress made in its efforts to meet the relevant needs of the UNFCCC. SBSTA is also interested in the terrestrial domain, particularly forest carbon tracking, and CEOS is pursuing this through GEO Task CL-09-03b. CEOS will prepare a response to the GCOS IP-10 and will begin with the development of “actionable actions.” Of note is that CEOS is developing a climate diagnostic portal. This will provide visualizations that can be readily interpreted by decision makers and will include attributes for peered review papers and validation so users can

make their own assessment how to use the information. CEOS has formed a Climate Advisory Group with the mission of reviewing the generation of FCDRs and derived ECV satellite products by the CEOS Space Agencies, ensuring that a coherent implementation plan exists for each product and ensuring a proper coordination of climate product generation with other relevant international initiatives.

5.2 GCOS. A. Simmons, H. Dolman, and E. Lindstrom presented brief reviews of the satellite observation matters discussed in the GCOS scientific panels that each chairs, respectively AOPC, TOPC, and OOPC. Simmons noted that the space agencies have improved both mission continuity and observational capability and are increasingly meeting the identified needs for data reprocessing, product generation, and access. He stated that the need for continuity of satellite observations was stressed repeatedly in IP-10. He highlighted, with some concern, the lack of future provision for a limb-sounding mission. And he noted the need for a combination of *in situ* and satellite measurements for reference systems, precipitation, aerosols, CO2 and CH4, and solar irradiance and the Earth radiation budget. He further noted that GCOS expects to update the existing satellite supplement to IP-04. H. Dolman noted that there were no major issues related to satellite continuity but that the worry is about calibration/validation. E. Lindstrom pointed out that JASON-3 has been subscribed to now, so OOPC feels good about the continuity of the sea level record. He also noted good progress in operationalizing some ocean measurements from space. In discussion following the presentations, it was noted that we are in danger of losing the microwave SST capability. EUMETSAT, it was observed, might be able to take on this issue.

5.3 Introduction to Sustained Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM). B. Ryan introduced SCOPE-CM, noting that its aim was to address the requirements of GCOS in a cost-effective, coordinated manner, capitalizing on existing expertise and infrastructures, and that its objective was continuous and sustained provision of high-quality ECV satellite products on a global scale. She explained that SCOPE-CM will be implemented in three phases. Phase 1, which includes the establishment of the initial network and structure, is just getting underway. Phase 2, expected to be completed by the end of 2012, will establish structures for the sustainable generation of FCDRs and TCDRs. And Phase 3, which has no end point, will see the full deployment of the sustained system of product generation. A number of pilot projects have been initiated, although it was noted that NOAA is not putting any new funds into the reprocessing of geostationary winds. In stressing the way forward, Ryan noted that there is a need for more involvement from research agencies and/or those working on ECVs, that testing of the maturity model/matrix should be broadened, that concepts related to oceanic and terrestrial ECVs should be tested, and that dialogue between operational and research communities needs to be continually advanced.

5.4 ESA Climate Change Initiative (CCI). The objective of the CCI initiative, introduced by P. Mathieu, is to realize the full potential of the long-term global Earth Observation archives that ESA, together with its Member States, has established over the last thirty years, “as a significant and timely contribution to the ECV databases required by the UNFCCC.” ESA has allocated 75 million Euros to address about 20 ECVs through 11contracts to be tendered in this initiative. It gives GCOS substantial credit for enabling this activity to move ahead. A climate science advisory board for the initiative will be established. Mathieu noted that the initiative will undertake periodic reprocessing of data sets, will optimize observations by fostering exploitation and model evaluation (e.g., through CMIP5), and will engage with the user community (e.g., through dialogue with WOAP). It was noted that funding for reprocessing will be mainly for European teams.

5.5 NPOESS Developments. T. Busalacchi, in introducing NPOESS developments, emphasized that no advocacy group like GCOS exists for sustaining the satellite sensor

line. He indicated that, as a result of "Nunn-McCurdy Certification" in 2006, the planned acquisition of six spacecraft has been reduced to four, that the launch of the first NPOESS spacecraft has been delayed until 2013, and that several sensors have been canceled or downgraded. The NPOESS mission has been split in two: NOAA and NASA have responsibility for the p.m. satellites as the Joint Polar Satellite System likely using the NPP bus, while the Defense Department is responsible for the morning platforms, reactivating DMSP. President Obama's FY '09 budget, however, restores some of the climate capabilities on NPOESS spacecraft. Even so, Busalacchi noted that: 1) there are structural problems associated with the provision of climate-quality measurements from systems designed to meet national objectives more closely associated with the needs of the operational weather forecast community, and 2) there is a lack of clear agency responsibility for sustained research programs and the transitioning of proof-of-concept measurements into sustained measurement systems. As noted in the Decadal Survey, the elimination of the requirements for climate research-related measurements on NPOESS is the most recent example of the failure to sustain critical measurements. Busalacchi noted that there is a need for a strategy for sustained climate observations, for a national policy for provision of long-term climate measurements, and for clear agency roles and responsibilities.

5.6 JAXA's Earth Observation. T. Igarashi reviewed JAXA's long-term plan for Earth observations. He noted that JAXA expects to continue the operation of Advanced Land Observing Satellite (ALOS), Tropical Rainfall Measurement Mission (TRMM), and Advanced Microwave Scanning Radiometer for EOS (AMSR-E)/AQUA for next few years and that Greenhouse Gases Observation Satellite (GOSAT) will continue observation by TANSO-FTS and CAI as planned for five years. JAXA is planning to launch AMSR2/Global Change Observation Mission – Water (GCOM-W1) to follow up after AMSR-E/AQUA on the water cycle in 2011; Global Precipitation Mission (GPM) will follow TRMM in 2013 for precipitation; and Earth Cloud, Aerosol, Radiation and Energy (EarthCARE), to be launched in 2013, will measure cloud and aerosol 3D structure. Other satellites to be launched include ALOS-2, ALOS-3, Global Change Observation Mission – Climate (GCOM-C1) in 2014, and GOSAT-2. Igarashi discussed the concept for the Global Change Observation Mission (GCOM), noting that it aims to construct, use, and verify systems that will enable continuous global-scale observations of effective geophysical parameters for elucidating global climate change and water circulation mechanisms. Also, JAXA has been contributing to CEOP by providing dedicated satellite datasets, and JAXA/Earth Observation Research Center (EORC) has started cross-cutting activities in ecosystem, water cycle, and disaster mitigation measurements.

5.7 Discussion. In discussion, it was noted that climate change is now a high priority in JAXA but that JAXA's budget has been reduced in 2010. It was suggested that a recommendation be written to space agencies stressing the importance of sustained climate observations from space, from the view point of climate data user community. J. Key was proposed to initiate this task via his task group.

Session 6 German Perspectives on Observations and WOAP

6.1 German Perspectives on Observations and WOAP. M. Visbeck took some time to review the Global Framework for Climate Services (GFCS), which, following agreement at the World Climate Conference-3 (WCC-3), will be developed by a special high-level Task Force in the next 12 months or so. Visbeck noted that the GFCS is to have five components, including GCOS, WCRP, a service information system, a user interface mechanism, and a capacity building element. The experts at WCC-3 agreed that both GCOS and WCRP should be strengthened as part of the GFCS; the service information system and the user interface mechanism would be new elements. Visbeck also noted the calls for action emanating from OceanObs'09. His overview focused mainly on the German

role related to observations, and he noted that in general Germany is a good citizen when it comes to sustaining observations. He said Germany would like to have an integrated carbon observing system in place by 2014. He also mentioned the German role in capacity building and outreach, highlighting, in particular, support for the Cape Verde Ocean Observatory. Germany will continue to contribute to capacity building efforts where it can help, he stressed.

Session 7 Reanalysis

The Chair noted that WOAP initiated and led the program committee for the Third International Reanalysis Conference, held in January 2008 in Tokyo. It was sponsored by JMA, U Tokyo, and led in WOAP by T. Koike, with several other WOAP members heavily involved. This is a vibrant activity, desperately in need of coordination, and WOAP has played a key role. WOAP has a Working Group on reanalysis data from whom we will also hear and to which we need to provide advice.

7.1 Atmospheric Reanalyses: An Update. M. Bosilovich updated WOAP on the main atmospheric reanalyses that are current or underway, noting the proliferation of such analyses but perhaps not a redundancy. Despite such proliferation, Bosilovich stressed the uniqueness of recent reanalyses and discussed the motivation of the different agencies in producing them. Nevertheless, the discussion suggested that there may not be adequate capacity to vet and assess the reanalyses. He noted that changes in the observing system affect the climate of a reanalysis and that, despite assimilating much the same observations, uncertainty among reanalyses persists. Regional reanalyses, he observed, generally have the same principles as global ones, with benefits from higher spatial resolution, targeted physical processes, testing/development that focuses on regional priorities, and reliance on some global reanalysis for lateral boundary conditions. The North American Regional Reanalysis (NARR) was the first such reanalysis and is widely used, but others exist as well. Of special note was planning for the next global reanalysis conference, expected to be held in 2012. If ERA 75 stays on target, it will be near production in 2013.

Following this presentation, a brief intervention was made by T. Koike on behalf of Dr Takahashi on the status of the Japanese 55-year reanalysis project, JRA-55. This will be a 60-km resolution global climate data set. Phase 1 will include data from 1958-2012, and it will reanalyze past observations using a constant state-of-the-art data assimilation system. Phase 2 will provide regional downscaling over Japan. JRA-55 will be a notable improvement over JRA-25.

7.2 Ocean Reanalyses. This presentation, introduced by D. Stammer, addressed continued development of ocean synthesis products and reanalysis, coordinated by GSOP, noting that some are now global in scope, by including sea ice, and a new EU Arctic reanalysis effort just started. Stammer also discussed exploration of the use of syntheses for initialization, continuation of joint evaluation efforts and improvements, reprocessing of input data sets and prior error information, the eight Community White Papers contributed to OceanObs'09, and the first coupled assimilation efforts. He noted annual workshops for intercomparison of products from multiple groups to evaluate product quality and skill, identify strengths and weaknesses, and define climate-relevant indices and standards for assessment. Climate-oriented ocean data synthesis is needed, he stated, to improve understanding of variability and climate sensitivities, improve climate forecasts by merging coupled models with the climate data base, and to improve model skill. The next efforts of the GSOP were noted to be: implementation of OcenObs'09 outcome (jointly with OOPC), reanalysis of global historic hydrography, reanalysis of XBT data, analysis of global budgets and sea level, provision of initial conditions for seasonal to decadal predictions (EazyInit), improving initial conditions and initializations, and preparing for coupled data assimilation. The next workshop will be in September 2010 in Boulder.

7.3 Cryosphere Reanalyses. J. Key reminded WOAP that cryosphere variables included various properties of snow; lake and river ice; sea ice; glaciers, ice caps, and ice sheets; and permafrost and frozen ground. Many GCMs have ice models and predict ice extent and thickness. However, the only real cryosphere-specific reanalysis system is the Pan-Arctic Ice-Ocean Modeling and Assimilation System (PIOMAS), which, in fact, does a good job. Under development is the Arctic System Reanalysis (ASR) – a coupled ice-ocean, land surface and other model system. SNODAS combines all available data, including NWP model output, coupled with meteorological and snow observations, to generate a best estimate of gridded snow water equivalent in near real-time. It was noted that NOAA funds reprocessing of snow and ice products and that 8 different ice concentration products exist. Part of NOAA funding is used to evaluate and compare the products; some comparisons are occurring with the SAF in ESA. Other reprocessing efforts have been made as well.

7.4 Coupled Reanalyses/Assimilation of Atmosphere, Ocean, Sea-Ice, and Land Surface Data--"Seamless" Predictions. P. Gauthier addressed WOAP on data assimilation for validation of climate modeling systems. In drawing some conclusions, he noted 1) that data assimilation and reanalyses are often based on an adapted NWP suite for which model short-term forecasts have been thoroughly validated; 2) that using a climate model to do data assimilation (Transpose AMIP) provides detailed information about systematic departures from observations; 3) that examination of the physical tendencies associated with the first days of a forecast can indicate how imbalances in the physical processes may cause excessive model sensitivity, which can increase the uncertainty of climate predictions; and 4) that observation datasets used for reanalyses could be valuable for studies on climate model validation, including added value for the data prepared for reanalyses. He noted that for coupled systems, the complexity is increasing and that this approach is certainly to be encouraged. Finally, regarding parameter estimation with coupled models, it was necessary to adjust the parameters related to surface fluxes as well as a number of other parameterizations.

7.5 Report from the Working Group on Observational Data Sets for Reanalysis. R. Vose identified the terms of reference of this working group as: reviewing data center holdings worldwide; developing a plan for integrated data sets; overseeing progress of Implementing Centers; and reporting regularly to AOPC and WOAP. The Working Group has assembled surface and upper air inventories, augmented existing data sets, developed plans for improving specific data sets, focused on upcoming reanalyses, and served as a catalyst. It has not denoted official Implementing Centers or held many meetings (contact has been mainly through email and phone calls). A number of issues were raised for which feedback was sought. Thus, questions were raised on: 1) the desirability of a partnership with the Commission for Climatology (CCl), 2) the initiation of more dataset development work (including, e.g., the merging of holdings and the incorporation of metadata; 3) radiosonde temperature metadata, i.e., to give the assimilation systems more information or try to homogenize; 4) improving BUFR capability; 5) development of a regularly updated web-based catalog of datasets that can be used in reanalysis (could be hosted at NCDC); and 5) the idea of organizing a small, focused workshop on how our activities relate to and take advantage of current reanalyses. WOAP could help set priorities for this workshop. Discussions were initiated but were continued in the Task Group 3 meeting and are reported in session 14.

7.6 Planned Reanalysis Workshops. M. Bosilovich introduced this agenda item. He noted that workshops can be time consuming, e.g., in preparing examples, case studies and materials, and that some of these may not be ready at the time a workshop is held. Also, self defined data formats make data easily accessible and analyzable with most software. However, this can lead to a black box mentality, i.e., occasionally "reanalyses=obs." Attention was drawn to two workshops, in particular. The first is an invitation-only workshop hosted by the Global Modeling and Assimilation Office on 5-7 April 2010 at NASA/GFSC.

The objectives are to review the current status of reanalyses and the lessons learned and to identify the primary technical issues (from assimilation system and observation perspectives) that need to be addressed or that will be addressed in the next reanalyses. The second is a workshop sponsored by US CLIVAR to be held on 1-3 November 2010 in Baltimore, which will focus on new reanalysis systems (CFSR, 20thC, and MERRA), observations, and integrated Earth system analysis.

7.7 Next Reanalysis Conference. Planning for the next reanalysis conference will begin soon. If this Conference is held in 2012, rather than 2011, there may be some advantages, e.g., from standpoint of some users who will have been able to delve into it. A date in the Northern Hemisphere Spring (i.e., March, April, and May) could be considered. The Conference might be held in the Baltimore/Washington area so that NCEP and NASA people could be fully engaged. In discussion it was noted that there should be some discussion of data, and that it should definitely involve oceans, sea ice, land, etc., i.e., everything. The Conference should be different from more focused workshops. M. Bosilovich was endorsed as the Chair of organizing committee for the conference and also given the mandate to set up a local organizing committee and programme committee. Others that are expected to be on an advisory committee include R. Vose, A. Simmons, J. Key, and K. Trenberth.

7.8 Discussion. The question arose as to whether proliferation of reanalyses is good or bad. In this context, it was noted that reanalysis should be a continuous, ongoing activity. This problem is how to fund such a continuing activity. A. Simmons noted that it could be funded as part of an operational climate service, which would include generating one's own operational reanalysis. K. Trenberth proposed that a letter be sent to reanalysis agencies pointing out the wisdom of having an ongoing activity. It was noted that the topic of reanalysis needs to be on the GFCS agenda because it is a climate service. It was also proposed that WCRP develop a brochure (or put information on a web page) that advertises the different reanalyses. G. Asrar emphasized three points: 1) that those responsible for designing the GFCS should consider reanalysis (this could be taken forward by A. Simmons and T. Busalacchi, who will be technical advisors to the high-level GFCS Task Force); 2) that advertising should be pursued, e.g., through the development of the brochure mentioned above; and 3) that a process needs to be developed to assess the strength and weaknesses of reanalyses so that it can be determined which product is useful for what purposes. Elaboration on these aspects is given in the Task Group 3 report in session 14.

Session 8 Reprocessing

8.1 GEWEX Radiation Panel (GRP) Report on Reprocessing. C. Kummerow provided a report of the status of GEWEX activities related to reprocessing, which included mention of the need for and readiness of variables suitable for reprocessing, of activities planned, and of funding and commitments already obtained or required. He noted that about 5 years are needed to do assessments and then to reprocess the data. The International Satellite Cloud Climatology Project (ISCCP), among others (e.g., SRB, water vapor, GPCP, SeaFlux, LandFlux), is now looking to do reprocessing, in this case some 28 years after the project started. The GEWEX aerosol climatology project is stuck at the moment because there is no funding, as it has been superseded by other missions. The GRP wishes to coordinate reprocessing of all products using the latest updates to code. A GRP product, it was noted, must "play by the rules," i.e., must have open data and agree to assessment and reprocessing. GEWEX claims that its process is an open one, but this is not always understood by the community (something that can be fixed). An objective was expressed to complete the reprocessing of GEWEX data sets by 2011.

8.2 Global Space-based Inter-calibration System (GSICS). In introducing GSICS, B. Ryan noted that applications require well-calibrated and inter-calibrated measurements, an expanding global observing system, and inter-calibration of instruments to achieve comparability of measurements from different instruments (see publication CGMS-34). GSICS was created to enhance and sustain calibration and validation of satellite observations, to intercalibrate critical components of the Global Observing System to climate quality benchmark observations and/or reference sites, and to provide corrected observations and/or correction algorithms to the user community for current and historical data. Ryan noted that many organizations contribute to GSICS, including WMO, NASA, NOAA, EUMETSAT, CNES, CMA, and JMA. JAXA and ESA are observers. The current focus is on the intercalibration of operational satellites and makes use of key research instruments like AIRS and MODIS as reference instruments. The current workplan for GSICS includes interagency collaboration on algorithms and data exchange and formats, product acceptance and documentation requirements (e.g., metadata standards, data formats, and website standards), routine intercalibration of all operational GEO infrared imagers, intercalibration of LEO instruments, traceability, and understanding root causes and corrections needed. Some desired GSICS outcomes include best practices/requirements for monitoring observing system performance (with CEOS WGCV), best practices/requirements for pre-launch characterization (with CEOS WGCV), and high quality radiances for weather, climate, and environmental applications.

8.3 Additional Comments by Project Representatives. No comments made.

8.4 Actions and Recommendations to Advance the Reprocessing Activity. It was considered that a mechanism may be needed to set priorities for reprocessing on an international basis. Reprocessing has become much more prevalent, but appears to be proceeding in an *ad hoc* fashion by individual teams reprocessing particular data streams. WOAP could address this issue in some fashion, for example, by promoting a much larger reprocessing workshop, perhaps in 2012, to involve all space-based and oceanographic variables and by getting space agencies on board to help fund it. It should perhaps be considered an assessment workshop and could be spilt into multiple workshops with more focus on a finite number of variables. WOAP has a set of principles for reprocessing, but they are hidden on the website and should probably be resurrected and reviewed, so that one goal of the workshop could be to come up with a set of guiding principles for reprocessing, e.g., which would provide advice on how reprocessed products could be reported in a way that is useful for the community. Also, it was suggested that a common algorithm be provided to enable differences in reprocessing to be better understood. It may be possible to get some of these results into the next IPCC report. It was considered important to highlight the importance of comparing the same product with different algorithms, e.g., to be able to point out differences between products and reduce uncertainty. A series of small workshops might be needed for this purpose. Discussion occurred about whether or not a letter should be sent to ESA, NASA, CEOS, and/or CGMS advocating this activity. The idea would be to use the workshop(s) to facilitate best practices. C. Kummerow would be willing to co-chair a workshop in the 2012 timeframe focusing on closure arguments and best practices. Also, ESA expressed interest in hosting such a workshop.

Session 9 *In Situ* Issues

9.1 Working Group on Surface Fluxes (WGSF). E. Kent summarized a number of issues of concern to the WGSF. She noted that: 1) OceanSITES should be expanded, with priorities in subpolar and high latitude regions and in regions with severe weather conditions; 2) More high quality routine flux measurements are needed, which in turn requires more coordination of activities, and with a focus on high variability regions and gaps in the OceanSITES network; 3) Voluntary Observing Ships should be maintained and enhanced as

a flux observation network; 4) Improved technology is needed, with increased power and bandwidth for moorings and more robust and capable platforms; 5) flux observing best practice should be followed; 6) flux parameterizations need improvement; 7) a range of independent, gridded flux datasets is needed; and 8) data stewardship should be improved, including ease of access and better metadata. A handbook on best practices in flux measurements exists, but is not well known and should be promoted. In discussion, it was noted that we are not now in a position to make measurements in very cold regions, so there is a need to plan for buoys in such regions. M. Manton noted that there is an obvious gap in air-sea fluxes and that it could be important for CLIVAR to figure out what the next steps/priorities should be. There is a need to link CliC and GEWEX, as this is a cross-cutting problem.

9.2 OceanObs'09. D. Stammer noted that OceanObs'09 was a huge success with over 600 attendees from some 36 nations. Some 99 community white papers were prepared for the Conference, which also included 47 plenary presentations. Stammer reviewed the several calls for action, including calls to nations and governments to: 1) fully implement by 2015 the initial physical and carbon global ocean observing system, and 2) to commit to the implementation and international coordination of systematic global biogeochemical and biological observations. The Conference also invited governments and organizations to embrace a framework for planning and moving forward with an enhanced global sustained ocean observing system over the next decade. A Task Team, to be co-chaired by E. Lindstrom and J. Gunn, was established to develop this framework. E. Lindstrom introduced the goals of the Task Team, noting that it will consider the outcomes and recommendations from the OceanObs'09 Conference and, in consultation with the international organizations and expert advice, shall: 1) recommend a framework for moving global sustained ocean observations forward in the next decade; integrating feasible new biogeochemical, ecosystem, and physical observations while sustaining present observations; and considering how best to take advantage of existing structures, 2) foster continuing interaction between organizations that contribute toward, and are in need of, sustained ocean observations, and, 3) report back to its sponsors and disband by 1 October 2010.

9.3 *In Situ* Data Matters Considered by AOPC. *In situ* data matters were considered by AOPC in the GCOS Progress Report. A. Simmons observed that we are seeing an upturn in performance measures, but that this has been mainly in developed countries. Long-term continuity, especially in oceans, is still a problem, and maybe for composition too. There has been some progress in developing countries, but not enough, and capacity building remains low. The revised GCOS Implementation Plan (IP-10) has increased emphasis on comprehensive surface networks for data on extremes and impacts/adaptation, on urban measurements, on high-resolution surface reanalysis for gap-filling, and on co-located measurements for the atmosphere and terrestrial domains. The last AOPC reviewed a number of matters requiring attention, including global exchange of snow-depth data in SYNOP reports, more prompt generation of World Weather Records, inclusion of additional ECV observations in these records, addition of sunshine data to CLIMAT messages, transition to use of BUFR encoding, and GTS routing of CLIMAT messages.

9.4 GCOS Reference Upper Air Network (GRUAN). A. Simmons, along with C. Richter, reviewed progress in GRUAN, the GCOS Reference Upper Air Network. They noted that the milestones achieved so far include: designation of a GRUAN Lead Centre at the Lindenberg Observatory in Germany, definition of major requirements for reference observations and of what will constitute a formal GRUAN measurement, appointment of initial GRUAN stations, publication of the GRUAN Implementation Plan 2009-2013 (GCOS-134), and annual Implementation-Coordination Meetings. The second Implementation-Coordination Meeting (ICM-2) was held in March 2010 in Payerne, Switzerland. A GRUAN Science Team and a Site Team were designated at this meeting, as well as five Task Teams. These included teams for radiosondes; global positioning system-

precipitable water (GPS-PW); measurement schedules and associated site requirements; site assessment, expansion and certification; and ancillary measurements. It was noted that WOAP participation in these Task Teams would be highly desirable. The first GRUAN-quality data is expected in 2010. In discussion, the issue of co-located measurements came up, as well as the relationship between GRUAN, BSRN, and CEOP sites. It was noted that these sites are all somewhat independent but that they could be "rationalized" to reduce costs. The desirability of as wide a range of atmospheric measurements as possible was noted. It was also pointed out that most of the sites seem to be in the Northern Hemisphere, and thus more are needed in Africa and South America.

9.5 TOPC *In Situ* Issues. A problem with most terrestrial sites, noted H. Dolman, is that most are run in research mode. Data access is sometimes also a problem. Furthermore, much hydrological and carbon data is created for economic purposes, and people are not keen to give this data away. Since the mid-1980s, we have seen a decline in hydrological stations. It is hard to get the message across that continuing these measurements for climate purposes is essential. It would help to have the GRDC more active in this context. On the other hand, permafrost and glacier network work well. The GMES global land group, which is chaired by Dolman, proposes to select a number of networks for participation in a fast track in situ effort. It was noted that a small task group will be created to discuss how to tackle commonalities between TOPC, Fluxnet, and CEOP. Having a number of sites with overlapping data would be desirable, but it is unlikely that, say, 35 sites could be established that do everything. In discussion, a point was made about the need to look at hydrological issues in a global way. In particular, a strategy is needed that will lead to open data sets. This may be a role for GEO. In any case, a policy is needed encouraging the data sets of countries to conform to international standards.

9.6 Flux Towers. In introducing this issue the Chair noted the following: Are the data being utilized adequately? Are the towers being exploited to the full with both physical and chemical variables and by taking full advantage of relationships? Can the towers be sustained? No doubt they are under funding pressure, and so the more they are used, with more users, the sounder is the basis for arguing for their continuity. So, can the towers be consolidated with other measurements, such as with CEOP reference sites or GRUAN? This may require some moves by one or the other but may be beneficial in long run. WOAP is a way to try to bring the various groups together to confront this issue and make some recommendations.

Following these preliminary comments M. Reichstein presented an overview of the flux tower network. Fluxnet is a recognized project within iLEAPS, which is within IGPB. It encompasses observation of CO_2, H_2O, and energy fluxes via eddy covariance; is a self-organized network of regional networks (and a few individual sites); contains sites mostly running in research mode; and, until 2007, was only loosely organized. Some challenges for Fluxnet include global standardization from the beginning, QC and filling of meteorological observations; selecting sites for data-assimilation; sustained funding for Fluxnet towers; going from research to monitoring mode; filling eco-climatological gaps (e.g., tropical savannahs/forests, high latitudes); and extension to isotopes and other trace gases. In discussion it was noted that Fluxnet sites are likely under funding pressure, so an argument to consolidate them in some way might be made. Some 250 of the 400 or so existing sites are likely to be redundant, but it is difficult to tell PIs to more or shut down individual sites. The challenge is to move research-driven sites to something more operational. A user workshop is planned for February 2011.

10.1 IPCC Schedule. The presentation by K. Trenberth focused on preparations for the IPCC Fifth Assessment Report (AR5). The selection of lead authors for the assessment will be made on 10 May 2010. The report of Working Group I will be delivered in September 2013. Everyone in WCRP should recognize the timetable, for instance if possible to include

new reprocessed data. It is hoped that the process for selecting lead authors does not become political. Concerns about this were voiced after learning that Fox News has obtained the author nomination list under the U.S. Freedom of Information Act. Also noted was an IPCC statement on the melting of Himalayan glaciers and the fact that an independent review of the IPCC process is being carried out by the Inter-Academy Council. This review is due in August 2010. Hopefully, the timing of its release will not be disruptive to the IPCC.

10.2 Possible Actions for WOAP on Items and Recommendations to WCRP and GCOS. This item is covered in the Session 14 Task Group reports.

10.3 Climate Service Center (CSC). I. Fischer-Bruns, representing the director of the new Climate Service Center, G. Brasseur, informed WOAP about the rationale, structure, and goals of this center. The Center was established in Hamburg by the German Federal Government as part of its "High-Tech" strategy to reduce vulnerability to climate change impacts. Located on the KlimaCampus of the University of Hamburg, the Center will eventually consist of 20 staff members. Six immediate goals of the center have been defined to include: 1) coordination and dissemination of user-friendly climate information produced by German institutions, 2) improved transfer of information from research to users and initiation of research activities to address users' requirements, 3) production of concrete climate-related information to fulfill the stated needs of the users/customers, 4) synthesis and evaluation of the latest outcomes of climate and environmental research; and 5) transfer of requests from users to the network of German research institutions. Longer-term goals were described as: 1) developing prediction systems for global, regional, and local prediction of climate change and its impacts on ecosystems, the hydrological system, air quality, and health in Germany and elsewhere, 2) development of effective strategies to reduce and adapt to climate impacts, and 3) contribution to the development of other Climate Services, e.g., in Africa, with emphasis on issues like drought, food availability, and forest management. The CSC will initiate activities at a national level, but eventually hopes to become more involved on an international scale.

10.4 Tour of the new DKRZ Building and Supercomputer. Following the formal presentations for Day 2 of the WOAP meeting, all had an enjoyable time visiting and learning about the DKRZ supercomputer, the 35th largest in the world. Some of the IPCC model runs for AR5 will be done on this computer.

The chair expressed great appreciation for both German speakers for taking time to brief WOAP and wished them well in their development of climate services.

Session 11 Data Activities

Action 27 of the XVIIth Session of the GCOS Steering Committee called for further elaboration of the issue of peer review of climate datasets with experts in WCRP, GOOS, and GTOS, noting that the next meeting of the WOAP would be an appropriate forum to consider this subject. The presentations in this Session broadly address this topic.

11.1 Report of the WOAP Task Group on Data Management (TGDM). This report, which also included agenda item 11.8 on the Revitalization of the Task Group on Data Management, was made by H. Cattle. He noted that membership is comprised of one person from each of the WCRP core projects. The Task Group has a mandate to review a) the current status and management of observational data and model output archives, including associated web sites within WCRP, and b) WCRP data policy. (Data issues have received increased attention following the release of the "climategate" emails). Activities to date include an initial survey of dataset archives and management practices within WCRP core projects, a review of data policies of WCRP sponsors and projects (where available),

leadership on development of the WCRP data policy statement (a copy of which is on the WOAP-4 web page), and development of a way forward (in a paper initiated by B. Keeley, also on the WOAP-4 web page). The survey clearly showed that WCRP projects are originators and/or custodians of archives of model output or observational datasets of key importance to the recent IPCC and ozone assessments. The TGDM proposed 12 individual actions addressing WCRP datasets, rationalizing names, managing data sets in the long-term and providing access to datasets. It was unclear, however, how these actions would be implemented. The future of this Task Group was raised in discussion, and it was noted that a new Chair will be needed for the next phase of its activities.

After some discussion, it was generally agreed that there is a continuing need for this Task Group. C. von Savigny volunteered to be responsible for some Task Group actions, but a Chair is still needed for it. G. Asrar noted that some data activities were started in an *ad hoc* fashion and asked what the principles should be for long-term data sets. The Task Group should consider developing WCRP-wide principles (perhaps building on the two big efforts already in place, CMIP and CEOP) and the ground rules for maintaining data sets. A focus should be on "big ticket" items, and lessons from the past should be incorporated. On historical data sets, it should be recognized that one size does not fit all. WCRP Project offices should ensure that appropriate global datasets are registered in WIGOS

11.2 CEOP. T. Koike introduced this agenda item. He noted that CEOP has well-organized data archive system. The Model Output Data Archiving Center is at the World Data Center for Climate at the Max-Planck Institute for Meteorology in Germany, *In-Situ* data is archived at the Data Archiving Center at the National Center for Atmospheric Research in the United States, and the Data Integrating/Archiving Center is at University of Tokyo and JAXA in Japan.

11.3 Data for Model Evaluations. K. Taylor noted that the Coupled Model Intercomparison Project (CMIP) has been a success, the reasons for this being because strict data standards were imposed building on the CF conventions (i.e., uniform format, uniform data structure, uniform metadata information, and adherence to the CF metadata conventions), modeling groups devoted substantial resources to rewriting output uniformly from all models, and because a broad community of scientists benefited. In summarizing data needs for model evaluation, Taylor noted that a collaborative effort between JPL/NASA and PCMDI is underway to provide the community of researchers that will access and evaluate the CMIP5 model results access to analogous sets of observational data. A number of NASA satellite data sets have been identified that have model equivalents. Thus far identified are AIRS, MLS, TES, QuikSCAT, CloudSat, Topex/Poseidon, CERES, TRMM, and AMSR-E. Plans have been developed for converting the data into CF-compliant format, documenting it for technical details for use/application in IPCC model assessment, and making them available via ESG and links from the PCMDI model access web portal. This activity is being carried out in coordination with the corresponding CMIP5 modeling entities and activities (e.g., WGCM and PCMDI). Model output will be served by federated centers around the world.

11.4 SPARC Data Initiative. In introducing this agenda item S. Tegtmeier observed that regarding the SPARC CCMVal project on model-measurement intercomparisons a variety of chemical observational data sets are available. However, it is not necessarily known which data set is most reliable for a particular application. Conflicting results are seen when comparing models to different data sets, so comparison is less meaningful. Therefore, there is a need for an assessment of the available data sets for chemical trace gases. The proposed assessment/report will offer guidance for the use of chemical trace gas observations from space-based instruments. It will establish a data portal for chemical observations in collaboration with the space agencies, compile climatologies of chemical trace gases (e.g., zonal means, variability, seasonal evolution, and annual means) in

collaboration with the instrument PIs, and detail inter-comparison of these climatologies. To be published as a SPARC report, it will also identify priorities for reprocessing data or enhanced validation efforts and identify measurement gaps, which could motivate and provide support for future missions. Some issues yet to be clarified include: How much of aircraft, balloon, and ground-based measurements should be included? Should water vapour and ozone be included? What about CO, short-lived species, aerosols, and PSCs? And, what about technical issues like trends in data sets and sampling biases? The issue of funding was raised in discussion. It will be needed, but at least some of the report will be undertaken by volunteers.

11.5 NOAA NCDC Data Initiative. From 9-10 March 2010, the NCDC conducted a Workshop on Ensuring Access and Trustworthiness of Climate Observations and Models for Society. R. Vose reported on the results of this workshop in this agenda item. The workshop was motivated by the fact that CMIP was a success for access to model output, and something was needed for observational data sets. It was designed to develop a process for facilitating access to observational data sets, to advance technical enhancements to standards for discovery, exchange, and use; and to identify needs for societal impact studies. A number of actions were identified to advance each of these desired activities. In addition, emerging technology to support a National Climate Services Infrastructure was considered. For this, the GCOS guidelines were helpful for observations metadata. A question arose as to how different data sets are assessed. This was seen to be a challenge, so the recommended approach was to pick out a few to "get the ball rolling." How to deal with certain "grey" data sets, which are good for some things but not others, was also an issue, albeit an unresolved one.

11.6 JCOMM Expert Team on Marine Climatology. E. Kent introduced this topic by beginning with a review of the Terms of Reference for the ETMC. These were to: determine procedures and principles for the development and management of global and regional oceanographic and marine meteorological climatological datasets; review and assess the climatological elements of the Commission, including the operation of the MCSS and the GCCs and the development of required oceanographic and marine meteorological products; review the GOOS and GCOS requirements for climatological datasets, taking account of the need for quality and integration; develop procedures and standards for data assembly and the creation of climatological datasets, including the establishment of dedicated facilities and centers; collaborate and liaise with other groups as needed to ensure access to expertise and ensure appropriate coordination; and keep under review and update, as necessary, relevant technical publications in the area of oceanographic and marine meteorological climatologies. A Task Team on Marine-Meteorological and Oceanographic Summaries (TT-MOCS) has been established with the mandate from JCOMM to consider what requirements exist now for climatological summary products. TT-MOCS is at an early stage in its work, but notes that climate change gives a possible application for summary products. In discussion it was observed that this initiative parallels the SPARC initiative and that recognizing CMIP-5 needs would be a key first step.

11.7 WMO Information System (WIS). B. Ryan introduced the WMO Information System, noting that WIS is necessary to ensure all WMO information is available to all WMO users and to ensure the long-term sustainability of all WMO information systems. The Global Telecommunications System (GTS) will remain an integral part of WIS and will continue to be improved as well as being made available to all WMO programs for the sharing of operational and time critical information. Ryan noted a number of ongoing activities related to the further development of WIS. A question arose as to the role that WIS could play for the data activities under discussion at WOAP. Ryan observed that there are references to a climate information system in the GFCS, so GFCS could be used as a primary mechanism before attempting to redesign a whole new system. WIS could also be

cast within the GEOSS structure so as to promote much more interoperability. It was noted that GMES products will soon be using WIS.

11.8 Revitalization of the Task Group on Data Management. See 11.1.

11.9 Summary Discussion of Session 11. K. Trenberth asked what WOAP should be doing regarding data activities, noting that WOAP can provide feedback to Karl Taylor, the JPL group, and the NOAA group on process. Concern was expressed about the JPL activity because there is no assessment of the datasets.

Trenberth used the NCAR Climate Analysis Section website as an example (http://www.cgd.ucar.edu/cas/catalog) where many datasets are documented and made available and a separate part of the catalog includes an "informed guide for users" that provides assessments and commentary of the usefulness and shortcomings of datasets. However, the project that generated these assessments is no longer funded.

It was generally thought that an assessment phase is essential. Perhaps an overview web site should be provided where alternative data sets are at least listed, even though they are not in a straightforward format. Activities, such as those of the GEWEX radiation panel and Climate Change Initiative of ESA should be encouraged, so that at some point, e.g., in a workshop a year or two from now, it might be possible to have a "showdown" and to encourage people to get together to compare and evaluate the data sets more thoroughly, assess them, and give them a higher level of maturity as a result.

D. Stammer noted that a first step would be to stimulate the community to use existing data. Everything else then becomes detail. It was noted that assessments can't be done at a single point in time but need to be undertaken on a more continuing basis. A workshop was suggested where groups could come with an assessment of their own data as well as of that of other groups. Some observed that it is getting to the point where broader, cross discipline assessments are needed. A proposal was made to draft two-page descriptions of products to be generated. Such descriptions would constitute the first bit of information needed to look at products and how they are documented. Although such 2-pagers are not really meant for scientists, they could still be a huge service to people.

Session 12 Climate Information

12.1 WCRP Open Science Conference. The WCRP Open Science Conference will be held from 24-28 October 2011 in Denver, Colorado, USA. See: www.wcrp-climate.org/conference2011. Planning for the Conference is already well along. The Open Science Conference will: appraise current state of climate science leading to AR5; identify the most urgent scientific issues and research challenges; ascertain how WCRP can best facilitate research and develop partnerships critical for progress; and facilitate growth of a future, diverse workforce. Tuesday, 25 October is devoted to Observation and Analysis of the Climate System. WOAP members should be heavily involved in helping to shape the agenda for this day and also in chairing sessions. The WOAP Chair encourages people to participate and to volunteer to help.

12.2 WCC-3 Repercussions. G. Asrar summarized the outcomes of the World Climate Conference-3 (WCC-3), in particular the decision to create a GFCS. He noted that an exciting effort is fast emerging to connect science with users. The action is on the top two layers of five layer model, i.e., how to translate science into useful information for various societal sectors. The challenge for us is that we are expected to continue with observations and science but also to assist with the translation of information to decision-makers. We are willing to help facilitate this but cannot take it on as a major effort. Other entities are already geared to do this, but we must find a way to understand each other's language and

communicate better. The user interface element to be elaborated is an important one, as it most directly relates to translation of the information for end users. GEO may have a role in this, but it depends on the entities belonging to GEO. Both GCOS and WCRP have been invited to provide information to the high level Task Force created to develop the GFCS, and some WOAP members will be invited to help us. This will be important as the Task Force members don't have a good appreciation of the science. It will take about a year for the Task Force report. Although the focus is more on services, the underpinning layers—GCOS and WCRP—need strengthening and support too. We need to become more oriented toward supporting services. Are there lessons to be learned from OceanObs'09? Yes. It was noted that although WMO has major strengths, it has difficulty viewing things in a broader context. Ocean services, for example, are much broader than WMO's mandate. IOC, among others, needs to have a seat at the table.

12.3 Transition of WCRP Projects beyond 2013.

12.3.1 CLIVAR. CLIVAR imperatives are seen to be anthropogenic climate change; decadal variability, predictability, and prediction; intraseasonal and seasonal predictability and prediction; improved atmosphere and ocean components of Earth System Models; data synthesis and analysis; the ocean observing system; and capacity building. A CLIVAR/GEWEX focused WCRP activity on drought is planned, as well as ocean model development and major plans for coupled modeling.

12.3.2 GEWEX. K. Trenberth has taken over as the new GEWEX Chair. Post 2013 the GEWEX mission will be to develop improved observational, diagnostic and modeling capabilities to measure and predict global and regional energy and water variations, trends, and extremes such as heat waves, floods and droughts; and to provide the science underpinning climate services. Imperatives deal with data, analysis, modeling, and applications. Planning for how to address these imperatives will take place at the Pan-GEWEX meeting in August 2010 in Seattle, Washington.

12.3.3 SPARC. Overarching activities to be maintained beyond 2013 include chemistry-climate model validation (CCMVal), assessment of key uncertainties in stratospheric and upper tropospheric measurements, and linking various scientific communities. The key science questions include quantification of the interaction between ozone recovery and climate change; investigation of air quality aspects of the troposphere-stratosphere system; quantification of the impact of solar variability (on all time scales) on climate; fostering stratospheric science in climate mitigation and adaptation; elucidating the role of polar regions in global climate; quantifying the effects of future stratospheric change on the global carbon cycle; and critical assessment of geoengineering. It was again noted that there is no other scheduled limb sounding mission after OMPS-Limb on NPP in 2011.

12.3.4 CliC. The primary long-term interests of CliC include sea level variability; understanding ice shelves; cryospheric observations and generation of data products; polar predictability, modeling and prediction of all cryospheric elements; encouraging and promoting regional activities, e.g., in South America; cryospheric contribution to water and carbon balance; and societal impact and mitigation. In the longer term CliC will be concerned with the viability of GCW, stronger presence in GEOSS, and with interaction with modelers on the use and treatment of ice properties.

12.3.5 WGSF. Future needs include: improved radiation measurement at sea, maintaining links to BSRN; coordinating precipitation measurement at sea; better coordination for physical flux process studies and parameterisation improvement; international coordination of routine measurement by research and selected commercial vessels; increased interaction with modelers; access to flux products; guidance on suitability of flux products not typically available; and aggregation of, and common access to, flux measurements.

12.3.6 Modeling Groups. Some important actions or activities include model intercomparison activity; enhanced links to process studies; increasing links to those outside the system. The WGCM can encourage a focus on uncertainty quantification; perturbed physics runs (i.e., perturbing various parameters to see what difference the perturbation makes), optimizing information that is coming from multi-modal ensembles; and developing standardized metrics for models to indicate where they have strengths and weaknesses. Model output should be formally referenceable, as there are calls for archiving model output so efforts can be reproduced.

Session 13. **Climate Information (continued)**

The topics of this Session, to a large degree, were covered in the introductory presentation of Session 2 and elsewhere, so after a few comments by the Chair, the meeting moved directly to Session 14. The Chair asked, "What and how are WCRP activities contributing towards developing a climate information system, with optimization of observations, analysis, attribution, diagnostics, and assessment?" The need to frame WCRP activities in new ways arose from JSC 29, which reviewed WCRP progress to date and decided that in order for WCRP to remain relevant and well-funded, there would need to be an evolution or "transition" in its activities that would reflect changing science priorities and societal needs. This program development was seen to take place on two time horizons, to 2013 and beyond. For the intermediate term perspective, the general consensus was that the strategy outlined in the so-called Coordinated Observation and Prediction of the Earth System (COPES) document is the desirable way forward. Consequently, the JSC recommended that in the near term, crosscuts should be fully integrated in the work of the projects. All aspects of WCRP work should be measured against the COPES strategy. To focus the way forward in terms of implementation of the COPES strategy for the intermediate term and to lead the way for planning post COPES, the JSC requested that the projects and modelling groups develop an implementation plan for the intermediate term. In this context, all core projects are asked to assess and identify what activities need to be further emphasized and which can be de-emphasized in the intermediate term.

Session 14. **Review and Task Group Reports**

The major part of Session 14 consisted of reports from the four Task Group leaders on the results of Task Group discussions. The reports focused on actions and recommendations for WOAP. The initial Task Group reports were circulated and modified to reflect all of WOAP views. The final versions appear below.

14.1 Reports by Task Groups Formed during the Meeting

14.1.1 WOAP Task Group 1 Report – Data matters from Sessions 8, 9 and 11

Contributors: H. Cattle, H. Dolman, E. Kent, J. Key, T. Koike, C. Kummerow, M. Manton (Chair), K. Taylor, C. von Savigny, and R. Vose

The task group identified the following issues as priorities for action for WOAP. The report briefly outlines the background associated with each issue, and lists recommended actions for the participating programs in WOAP. Detailed background on the issues is available from the meeting documents and presentations.

Issue – Future arrangements for the coordination of surface flux activities in WCRP

Background

The WCRP Working Group on Surface Fluxes has been functioning since 2004, and it has promoted work on improving the measurement and modelling of surface fluxes. The terms

of all the members of the Group have expired, and so it is appropriate to consider the best organisational arrangement for the coordination of surface flux activities, bearing in mind the work in other WCRP programs. Current activities of WCRP-related programs on surface fluxes include:

- WGSF has developed, *inter alia,* the Flux Handbook on observational best practice and the OceanObs09 paper on data requirements for fluxes.
- GEWEX has prepared a range of flux data sets, including SeaFlux, BSRN, LandFlux and SRB.
- CliC has a continuing program on fluxes in the cryosphere.
- US CLIVAR has a working group on high latitude surface fluxes.
- WGNE has the joint SURFA project with WGSF comparing collocated fluxes and related variables with NWP output.
- SOLAS aims to improve understanding of biogeochemical interactions and feedbacks between the ocean and the atmosphere.
- TOPC-AOPC Task Group is considering algorithms used in the preparation of ECVs at the land-atmosphere interface.
- TOPC has continuing work on carbon and related fluxes through the FluxNet program, and it is also establishing new activities on the estimation of global carbon fluxes.
- Real-time carbon fluxes are a component of the GEMS program.

Possible overlaps in current activities include work on air-sea fluxes in WGRF, GEWEX, SOLAS and CliC. Current activities of WGSF that should be continued include improvement in radiative flux and precipitation measurements at sea, flux process studies and their impact on parameterization, improved management of flux and flux-related data, and guidance on flux products.

Actions

- The CLIVAR SSG is requested to develop a strategy for coordinating current activities on surface fluxes across GCOS and WCRP projects and for ensuring that significant gaps are addressed.
- WOAP should consider focusing one proposed dataset assessment workshop on global surface fluxes, including physical and biogeochemical properties.

Issue – Recognition of WCRP and GCOS datasets

Background

The WCRP has always recognized the need for global datasets of ECVs and related variables. Such datasets are valuable as a basis for diagnostic studies and particularly for the evaluation of models. In the early days of WCRP, there was a concerted effort to encourage agencies to establish the infrastructure to prepare some specific datasets, and those activities became a major output of GEWEX leading to accessible and well-used datasets on variables such as surface albedo and water vapor. Some of the GEWEX datasets, such as those from GPCP and ISCCP, have a long history and must be continued (with occasional reprocessing) as they have very broad acceptance and usage in the modelling and diagnostics communities. Nonetheless, their low frequency trends are unreliable owing to changes in the observing system, and ongoing efforts are essential to address this as best as possible.

Over the last decade or so, it has been recognized that there are great advantages in having more than one group developing a global data set for a specific variable. The involvement of different teams in the development of a global product leads to slightly different approaches, which allows more rigorous estimates of the uncertainties in each version of the dataset. This process also leads to continuing efforts to reduce the biases and random errors in the datasets. These advantages are realized only if there are the significant will and resources

to establish the required international coordination and assessment between the different groups.

Action

- The GEWEX and SPARC SSGs should continue to encourage the production of their key datasets, and their improvement, especially from ISCCP and GPCP, to serve the wide community of established users. At the same time, WOAP should promote assessment activities involving all groups that prepare similar long-term datasets of ECVs and related variables.
- Other datasets under CLIVAR and CliC, such as SST, ocean heat content, sea level, sea ice, and so on, should also be considered; see also next issue.

Issue – Assessment of ECV and related variable datasets

Background

When first considering its role in the development of global datasets of ECVs and related variables, GCOS recognised that for several key variables there already were independent groups around the world generating state-of-the-art datasets. Cursory comparison between these products showed that there were significant differences between important aspects of the datasets, yet there was no clear 'best' product. Consequently GCOS saw its role as the promotion of inter-comparisons between the products in order to identify the sources of the differences between products and hence to reduce biases in all the products.

The OOPC-AOPC working group on SST and sea ice was effective for several years in promoting more consistency in global SST products. Similar success has not been achieved with sea ice, where there continue to be 8 independent products and little interaction between the producers. CliC has identified this issue as important to be resolved as soon as possible.

The WMO with a range of partners is establishing SCOPE-CM, which aims to promote inter-comparison of global climate datasets of ECVs and related variables derived from satellite data. The activity essentially provides post-processing of the calibrated data produced under the GSICS process. Pilot projects for SCOPE-CM have been identified involving two partner agencies for each dataset. The program of activities could provide a mechanism for the implementation of international inter-comparison of ECV datasets generated by independent agencies.

The ESA has established the Climate Change Initiative (CCI) which aims to generate datasets of key ECVs and related variables derived from satellite data. The process includes a user forum for engagement with the earth observation community. It is clear that the benefits from this major initiative would be increased by linking the user forum process with SCOPE-CM.

Action

- WOAP should ensure that the research community is involved with international assessments of global datasets. The SCOPE-CM provides a model of the process for international assessment, and it could be expanded to involve operational and research agencies as well as the research community.

Issue – Meta-data consistency across weather and climate communities

Background

CMIP and CEOP have provided frameworks for access to model and observational datasets, including meta-data standards. The WMO has developed standards for meta-data for meteorological purposes. While these standards are consistent with those used in CEOP,

they may not be fully aligned with those of CMIP. There are advantages to ensuring that there is consistency in the treatment of meta-data for weather and climate model data.

Action

- PCMDI is requested to liaise with the appropriate task group of WMO to optimize the treatment of meta-data for weather and climate model output.

Issue – Global reference sites

Background

For the world oceans, there is a single program supporting monitoring at about 150 sites. The OceanSITES program is a global reference network that monitors dozens of variables over the full depth of the ocean from air-sea interactions down to 5,000 meters. Twenty sites are designated as air-sea flux reference sites, while others focus on biogeochemistry, geophysics and ocean transports.

Over the land, many global networks, such as FluxNet and GSN, have been developed to support research and monitoring for specific purposes. On the other hand, there are a smaller number of global reference networks (such as CEOP, GRUAN, ARM, ICOS, BSRN) that have been established for multi-variable observations. There are policy and scientific reasons for such reference sites to be collocated wherever feasible, bearing in mind that differences in purpose can lead to the selection of different geographical locations.

Action

- TOPC is asked to lead a dialogue with the relevant networks (including CEOP, GRUAN and ICOS) to develop a strategy to optimize and justify the distribution of multi-variable reference sites.

Issue – Improved measurement of solid precipitation

Background

A significant fraction of regional precipitation falls as snow. New satellite missions are being developed to measure solid precipitation. In the 1990s, WMO CIMO led a project to improve the measurement of snow. The project made significant advances, but further work is needed to refine and evaluate measurement techniques. It is understood that some work has commenced in CIMO to review the status of snow measurement, and CliC maintains effective links with the process. This topic is also of interest to GPCP.

Action

- CliC is asked to continue its dialogue with CIMO and other relevant groups to ensure that appropriate activities are being undertaken to improve the measurement of solid precipitation for research and monitoring purposes.

Issue – Quantification of uncertainties

Background

Uncertainties are now recognized by the community as an inherent aspect of model and observed datasets. The scientific community has been emphasizing the progress in reducing uncertainties. Given the inherent limits of models and observations, it may be more appropriate to place more emphasis on the quantification of uncertainties. This is especially important for observed datasets, where structural errors are not always recognized.

Action

- WOAP encourages all groups to ensure that all model and observed datasets have their associated uncertainties quantified, with recognition of possible structural uncertainties.

Issue – TOA radiation budget

Background

Global climate is determined by the TOA radiation budget, but the measurement of the components of this budget has not been adequate to provide physically reasonable imbalances without ad hoc adjustments. There remain uncertainties in the total solar irradiance, and CERES have worked extensively on the radiation budget, while CLARREO is designed to help calibrate satellite observations in the future. Questions arose about the feasibility of reducing the uncertainty.

Actions

- GEWEX is requested to investigate the feasibility of improving the accuracy of the TOA radiation budget, and whether adequate steps are being taken to address this issue.
- If such an improvement is feasible, then the JSC and GSC should encourage the relevant agencies to take the required actions.

Issue – WCRP data management

Background

CEOP and CMIP have provided modern frameworks for access to global model and observed research datasets. The WOAP Task Group on Data Management has reported on progress in developing a consistent approach to data management across WCRP programs, and they have provided some basic recommendations to improve the availability of legacy WCRP datasets. Most legacy datasets of WCRP need to be discoverable and recognised as WCRP contributions to international climate research. The significance of a legacy dataset can be demonstrated by the relevant project office taking the actions to ensure that the dataset is discoverable and recognised.

While most groups developing datasets in these times will naturally follow the recognised procedures for modern data management, it is important at least at a policy level for WCRP to have clear guidelines on data management practices.

Actions

- WCRP project offices should ensure that appropriate global datasets are registered in WIGOS and in the WCRP catalogue, in addition to meeting the basic requirements for data access and quality.
- WOAP accepts the offer by the CLIVAR IPO to update the web-based catalogue of WCRP datasets in consultation with projects.
- The WOAP Task Group is asked to develop guidelines for data management practices across WCRP; this task should be completed over the next six months.

14.1.2 WOAP Task Group 2 Report – Space and In Situ Observations from Session 5

Contributors: G. Asrar, T. Busalacchi, T. Igarashi, E. Kent, J. Key (Chair), E. Lindstrom, P. Mathieu, I. Petiteville, and B. Ryan

Purpose

The purpose of this task group was to identify major issues with (primarily) space-based and in situ observing of the earth system. This includes the analysis of past and current data,

potential gaps in future measurements and systems, and interactions with groups that coordinate space activities such as the Committee on Earth Observation Satellite (CEOS) and the Coordination Group for Meteorological Satellites (CGMS). The report describes only those issues that impact WCRP and that WOAP can potentially influence. A brief background and recommended actions are given for each issue.

Background

A number of international groups and activities have identified major needs in the space-based and in situ observing systems. The Global Climate Observing System (GCOS) Implementation Plan (*presented at WOAP-4 by Simmons, Lindstrom, and Dolman*) has been reviewed by CEOS (*presented by Petiteville*) and others with regard to satellite observations. Potential deficiencies in the future U.S. National Polar-Orbiting Operational Environmental Satellite System (NPOESS) - now the Joint Polar Satellite System (JPSS) - were identified by a US National Research Council study (*presented by Busalacchi*). Previous efforts such as the Integrated Global Observing Strategy (IGOS) have evaluated both in situ and satellite observations for the cryosphere, oceans, land, geohazards, and atmospheric chemistry, as has the WMO Space Task Group for the International Polar Year (*presented by Key*). An OceanObs'09 community white paper on surface fluxes identified observational needs, including satellite-derived quantities and in situ measurements (Fairall et al., OceanObs09; *presented at WOAP-4 by Kent*).

Not only are there needs in the types of observations that satellites provide, there are also concerns regarding the use of past and current data. The WMO Sustained, Co-Ordinated Processing of Environmental Satellite Data for Climate Monitoring (SCOPE-CM) project proposes to provide continuous, sustained, high-quality satellite products for various Essential Climate Variables (ECV) in response to GCOS requirements (*presented by Ryan*). The European Space Agency's (ESA) Climate Change Initiative (CCI) will also support reprocessing of some satellite data sets (*presented by Mathieu*), as will NOAA's Scientific Data Stewardship program (*presented by Key*). JAXA routinely reprocesses standard products from the beginning of the observation period using updated algorithms that reflect the latest results of calibration/validation activities, such as TRMM/PR and Aqua/AMSR-E, and will also support reprocessing of future JAXA satellite data (*presented by Igarashi*).

The issues that have been identified by this task group are:
Gaps in, and sustainability of, space-based observations:

1. There is a critical need for continuous microwave SST observations and better scatterometer coverage.
2. There will be no limb sounding capability after NPP.

Reprocessing and continuity of satellite data:

3. GSICS calibration methods are underutilized.
4. Reprocessing of global satellite data sets lacks support in some areas.
5. Rigorous error analysis, documentation, product intercomparisons are essential.

In situ observations:

6. Co-ordination of ship-based observations should be enhanced.

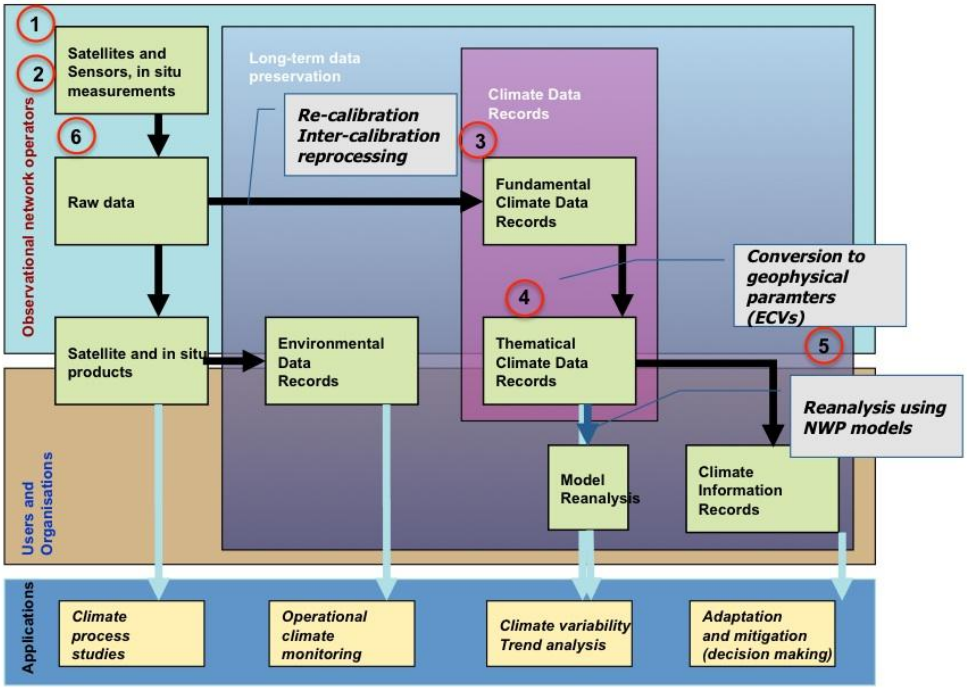

Figure 1. End-to-end processing flow for the generation and use of geophysical products. The major issues identified in this report are indicated by circled numbers (refer to the list of issues in the text).

These issues are mapped on the end-to-end processing flow diagram in Figure 1.

Issues – #1, 2: Gaps in, and sustainability of, space-based observations

Background

There is a critical need for microwave sea surface temperature (SST) data and better coverage by scatterometers. There is some uncertainty in the future of climate-quality passive microwave and scatterometer instruments. While infrared (IR) SST measurements will be available, microwave provides critical all-weather observations in cloudy regions. Accordingly, a microwave instrument capable of climate-quality SST measurements must be available on Joint Polar Satellite System (JPSS, a reorganization of the National Polar-orbiting Operational Environmental Satellite System, NPOESS). It is important for JAXA's GCOM-W1, 2, and 3 to proceed as planned, as these platforms will carry an AMSR microwave imager. However, while GCOM-W1/AMSR-2 is planned for launch in Japanese FY2011, plans for the subsequent satellites, and for NOAA JPSS are not clear.

Scatterometers provide surface winds over the oceans, a necessary component in the computation of air-sea fluxes. They also provide sea ice information. There is an operational, long-term scatterometer capability on Metop (ASCAT). India has a scatterometer on orbit that is still being calibrated and validated. China will soon have a similar capability. The Japanese GCOM series may include an advanced scatterometer (supplied by NOAA). Although scatterometers are not presently an "endangered species", there is some uncertainty in the overall coverage that will be obtained. Additionally, having a scatterometer on the same satellite as AMSR would improve precipitation detection and reduce the ambiguity in surface wind direction estimates during stormy conditions.

There is also going to be a gap in limb sounding, which provides high vertical resolution profiles. The Superconducting Submillimeter-Wave Limb-Emission Sounder (SMILES; JAXA and NICT) onboard ISS is in operation for global vertical profiling of O3, HCl, ClO, CH3CN, O3 isotope, HOCl, HNO3, HO2, and BrO. OMPS-Limb will be on the NPOESS Preparatory Project (NPP) satellite, but no OMPS limb sounder is scheduled for subsequent JPSS (NPOESS) satellites. There appears to be no other scheduled and funded limb sounding

mission. Possible solutions include ALTIUS (Belgium), PREMIER (ESA Earth Explorer candidate mission), CASS, and SAGE III.

Action

- WOAP should send a letter to CEOS and CGMS on behalf of WCRP and GCOS. However, before sending the letter to CEOS, it must first be determined if these gaps are already considered in the 2010 GCOS Implementation Plan (IP-10). If they are already in IP-10, the letter should refer to it, given that CEOS is preparing a response to the IP, and reinforce the need of the scientific community. It would be good to have an exhaustive list of all gaps and indicate the criticality of each gap (e.g., consequences for science if the gap is not properly addressed in a timely manner).

  The lifetime of current instruments (TMI and AMSR-E) should be estimated. If AMSR-E (Aqua) will continue to be operated after GCOM-W1/AMSR-2 launches, data continuity will be achieved and intercalibration between the two sensors will be possible. CEOS could be asked for their assessment of the likelihood of a gap in microwave SST coverage and their strategy for mitigating such a gap. The letter should also cover reprocessing issues (see below). Both CEOS and CGMS should be commended on their recent efforts to bring more attention to climate activities, and encourage more joint efforts.

Issues – #3, 4, 5: Reprocessing and continuity of satellite data

Background

The Global Space-Based Inter-Calibration System (GSICS) program has developed a number of calibration methods for satellite imagers and sounders. For climatological applications, inter-satellite calibration is critical. However, with some exceptions, GSICS calibration methods are not finding their way into reprocessing projects.

Furthermore, reprocessing of satellite data sets, both calibrated radiances and higher-level products, is not keeping up with the needs of scientists and reanalysis projects. The IPCC timeline should be kept in mind as targets for some reprocessing results. All space agencies should develop plans to regularly reprocess data as new calibration and product generation methods become available.

Action

- Agencies should support reprocessing of satellite data and their assessment. A letter to CEOS and CGMS could acknowledge participation in the GSICS project, and suggest continued cooperation programs in such as SCOPE-CM. SCOPE-CM could be expanded to include terrestrial or oceanic ECVs if agencies offer support.
- Because the calibration and intercomparison of several satellite sensors is not addressed by GSICS, it is recommended to increase the coordination between GSICS and CEOS WGCV and increase the coordination and coherency of the various projects aiming at producing FCDRs and satellite ECV products.

***Issue* – #5: Rigorous error analysis, documentation, product intercomparisons are essential**

Background

The optimal use of satellite and in situ data depends upon a robust characterization of the data. This is true whether the application is numerical weather prediction, climate reanalysis, or basic scientific studies. Errors may vary by season, by surface type (land v. ocean), or atmospheric conditions (clear v. cloudy, low v. high temperatures), so the error assessment

may be complex. Product documentation must include a complete discussion of uncertainties and biases.

Documentation should also detail the applications for which the product is best suited. This is particularly important if other similar products exist, i.e., products for the same geophysical parameter but generated with different algorithms. It is unrealistic to expect that any one product is the “best” for all applications, so users must have as much information as possible in order to use the data appropriately. Intercomparisons of similar products are therefore essential for determining and documenting advantages and disadvantages of each. Intercomparisons can be more fruitful if the different algorithms are applied to the same data, at least for case studies. In some cases it might be most efficient to share the software used in product generation.

Action

- The JSC should encourage all WCRP programs to promote inter-comparison activities for groups that commit to continuing support for key climate datasets. Existing intercomparison activities, such as the GEWEX cloud climatology workshops and the CliC sea ice concentration product intercomparison, are examples of current efforts in this area. Support for such activities will most likely come from agencies that support reprocessing, e.g., NOAA, ESA, NASA, and JAXA.

  WOAP could help the science community and space agencies design the appropriate framework needed to maximize the value of satellite data for climate research, and to better interpret observations in a modeling context. In particular, WOAP could provide guidance to data providers on:

  - *Observational Priorities* of the WCRP research community, highlighting the critical ECVs needed to support climate modeling, their value, the current status of CDRs, and any associated issues, with a focus on satellite missions.
  - *Requirements for Data Exploitation Tools*, including a review of software and toolboxes, and what is needed to make full use of the data (e.g., web-based visualization and exploration tools such as Live Access data server, web mapping technology).
  - *Best Practices* for “iterative re-processing” of CDRs with particular focus on error budget analysis and traceability (e.g., instrumental error, structural error) including propagation of uncertainty along the processing chain.
  - *Data Stewardship Guidelines*, including guidance on formats, naming convention (along the lines of CMIP5), meta-data, and data policies needed to maximize access to data and associated algorithms.
  - *Data Assessment Guidelines*, with a focus on practical procedures needed to inter-compare different data sets, quantify their quality, strengths, weaknesses, validation data and limitations.

  Such guidance from WOAP would be essential for helping steer funding towards the creation of the elements of an international climate *framework,* aiming to build long-term consistent climate data records with sufficient accuracy.

Issue – #6: Co-ordination of ship-based observations should be enhanced

Background

GO-SHIP is trying to facilitate the co-ordination of hydrographic section occupations to ensure resources are well spent. A more general effort for other types of shipboard measurements would also be valuable. Research vessels should take "underway" observations of mean meteorological and oceanographic parameters for the common good. A model for ensuring data quality in the absence of shipboard experts has been established

by national programs in the US, Australia and Germany. Real-time data availability is encouraged. Although data management responsibility is likely to remain with national operators, a central access point to research vessel underway data should be established and the potential for comparison with model output, for example from SURFA, should be explored.

Action

- WOAP can request that the OOPC, in consultation with the AOPC as appropriate, considers the co-ordination of shipboard underway measurements at OOPC-15 including presentation from existing national programs. WOAP could also write a WCRP Newsletter article on the issue.

14.1.3 WOAP Task Group 3 Report – Reanalysis from Session 7

Contributors: M. Bosilovich (Chair), P. Gauthier, A. Simmons, D. Stammer, and R. Vose

Reanalyses provide a key link between Earth system model development and observations. During WOAP-4, discussions generally revolved around several main topics. First, the Joint AOPC/WOAP working group on observational datasets for reanalysis needed guidance on continuing past and developing future activities. Recently (within the last year), four global atmospheric reanalyses have been released for use by the scientific community. This proliferation of reanalyses is unprecedented, given the difficulty of producing such data products, and may pose problems for the scientific community considering that each reanalysis has its own strengths, weaknesses and uncertainties. Lastly, WOAP is initiating the organization of the 4th WCRP International Conference on Reanalyses, and program committee formation is beginning along with scope and timing.

Issue – Joint Reanalysis Data Working Group

The joint working group was formed to collect information on the observations for reanalyses so that data can be traced and more easily improved as future reanalyses are produced. It was recommended that the working group go forward with plans to develop a catalogue of input data for reanalysis. This should include information and references related to dataset versions and quality where possible, and should include datasets related to ocean, land and cryosphere as well as atmosphere (supporting disciplinary and integrated reanalyses). The site should also link to reanalysis outputs where these provide observations and feedback that are accompanying MERRA and CFSR and are planned for ERA-CLIM. The catalogue should include reference links to satellite data sets, but the working group was recommended to concentrate on improvements to in-situ observational databases recognizing that satellite datasets generally have good stewardship arrangements in place.

Actions: Russell Vose (Chair of the Joint working group) will begin developing and implementing plans for the reanalysis data catalogue.

Issue – 4th International Reanalysis Conference

The first three Reanalysis conferences were very productive meetings for both the developers and users of reanalyses. They have been held at irregular intervals, the latest as recently as January 2008, but given the utility and diversity of reanalysis data, and the recent release of several new data products has provided the impetus to begin planning for the fourth conference. Mike Bosilovich was asked, and agreed, to be the program chair. This was originally envisaged for fall 2011, but WCRP will hold an Open Science Conference in October 2011. In order to avoid overlap with the Open Science conference, the planned timing is being moved to April 2012. The proposed location is the Washington DC area as it

is close proximity to the resources of two of the latest reanalyses (CFSR and MERRA), but also the United States is due in the venue rotation. These will be finalized once the program and local organizing committees are in place.

The scope of the conference will include ocean, land, cryosphere and atmosphere reanalyses. As such, the plan for the program committee is to have representation from the disciplinary reanalyses and representatives from the atmospheric reanalysis centers. At the WOAP-4 meeting, Detlef Stammer, Russ Vose and Adrian Simmons have agreed to participate in the Program Committee. Members representing NCEP, ECMWF, ESRL, JMA, Land, Ice, Climate Variability, Data Assimilation, WCRP and likely WGNE are still being identified.

The planned Washington workshop in November 2010 is supported by WOAP as a regional activity.

***Actions*:** Identify the Program Committee and Local Organizing Committee chair and begin planning, including garnering resources (Mike Bosilovich)

Issue – Atmospheric Reanalysis Proliferation

Given that four global atmospheric reanalyses have been released in the last year, as well as the planning for several regional reanalyses, the apparent proliferation of reanalysis data may cause problems with the user community. For example, without reasonable understanding of strengths and weaknesses of the different analyses it is difficult for a user to make the choice of which system to use, and reviewers may casually recommend that authors spend time and effort redoing work with more reanalyses. However, this proliferation is generally and scientifically good for the community, at this point in our understanding of reanalysis data. The multitude of reanalysis data sets is a result of diverse community needs and a sign of a strong growing community. The developers are in a position to take advantage of multiple data sets. This point will be raised at a Technical Developers Meeting (Apr 5-7, 2010, hosted by the GMAO).

At this point in time, the community needs to be informed to also be able to take advantage of these diverse data. It may facilitate comparisons to make the data available to PCMDI, and also then contribute to testing of present day climate models. The GMAO is already planning this, making MERRA available through the Earth System Grid (ESG). Discussions following WOAP-4 (Gil Compo, Dick Dee and Mike Bosilovich) concluded that a Wikipedia type server for reanalysis comparisons and verification would be a good place for centers to share their knowledge that could also be used by individual investigators. They are exploring the implementation of this Reanalysis Wikipedia (Gil Compo has taken the initial implementation on).

Related to this is the need for funding for assessments to be adequate, and this should be a priority with program managers. In the discussion it was noted that coordination and staggering of reanalyses remains a desirable goal. Further, the reanalysis are not sustained but tend to be a spasmodic research activity that can lead to disruption of teams, and loss of skills. Accordingly, planning is difficult. More sustained ongoing efforts are highly desirable.

Issue – WCRP Reanalysis Pamphlet

Ghassem Asrar offered support from WCRP to produce a reanalysis information pamphlet. This would cover basic information on each of the many available reanalyses in one place, including pointer to more information and likely the data itself. There will also be a www page also sponsored by WCRP. The task group supports this method of reaching out to the community.

Actions: Mike Bosilovich will develop the first draft of a questionnaire for reanalysis developers. This will be refined and Ghassem Asrar will identify support personnel to develop the pamphlet and www page.

14.1.4 WOAP Task Group 4 Report – GEO/GCOS from Session 4

Contributors: H. Dolman, E. Lindstrom, C. Richter, M. Tanner

The Group on Earth Observations (GEO) is an intergovernmental group leading a worldwide effort to build a Global Earth Observation System of Systems (GEOSS) over the next 10 years. GEO involves 81 countries, the European Commission, and 56 international organizations. The GEOSS vision, articulated in a 10-Year Implementation Plan, represents the consolidation of a global scientific and political consensus: the prediction and assessment of the state of the Earth requires continuous and coordinated observation* of our planet at all scales.

The GEOSS approach considers the Earth as an integrated system facing major common challenges, an intentional departure from earlier approaches looking at individual components of the Earth's system. Ultimately the objective of GEOSS is to develop the use of Earth observations by a broad range of users from both developed and developing countries and ranging from decision- and policy-makers to scientists, industry, international governmental, and non-governmental organizations.

GEOSS - Implemented by GEO Members for Society
Today, disparate and disconnected Earth observation systems are coordinated for limited purposes. Systems speak different languages, use different formats, produce different data accessible to different parties, and they have different reference frames. In one sense, the main idea about GEOSS is to make these observation systems interoperable and to bring them together into a single system to serve society across nine societal benefit areas:

- Disasters (Reducing loss of life and property from natural and human-induced disasters)
- Health (Understanding environmental factors affecting human health and well-being)
- Energy (Improving management of energy resources)
- Climate (Understanding, assessing, predicting, mitigating, and adapting to climate variability and change)
- Water (Improving water resource management through better understanding of the water cycle)
- Weather (Improving weather information, forecasting and warning)
- Ecosystems (Improving the management and protection of terrestrial, coastal and marine ecosystems)
- Agriculture (Supporting sustainable agriculture and combating desertification)
- Biodiversity (Understanding, monitoring and conserving biodiversity)

GEOSS will be implemented by GEO members and participating organizations which - while retaining existing mandates and governance arrangements - will benefit from the GEO high-level framework to (i) build inter-disciplinary partnerships; (ii) advocate observation priorities (e.g. the continuity and availability of data sets at Ministerial-level); and (iii) improve coordination, and reduce duplication, of planned or ongoing activities.

Climate Challenge
GEOSS will not be successful if it does not establish a global observation system that helps "improve our understanding of the Earth's climate system and the ability to predict climate change, and to mitigate and adapt to climate change and variability" (GEOSS 10-Year Implementation Plan Reference Document).

Climate:
• Enhance collaboration between observation, research and user communities
• Support the development of observational capabilities for Essential Climate Variables
• Identify climate products and information required for societal applications
• Develop and implement approaches responding to these requirements
• Facilitate access to climate data and models, particularly for developing countries
• Facilitate exchange of data and information across societal benefit areas
• Combine climate data with socio-economic information to better anticipate manifestations of climate change in areas such as Disasters, Health, Water, Ecosystems and Agriculture
• Develop a long-term strategy to improve observation capability, data assimilation and modelling
• Advance the monitoring and predictability of climate on seasonal, interannual and decadal time scales

Capacity Building
• Support national and international efforts in education, training, research, and communication
• Develop capacity building for (i) using Earth observation data and products; (ii) contributing to, accessing, and retrieving data from global data systems and networks; (iii) analyzing and interpreting data; (iv) integrating Earth observation data and products (with others); (v) improving infrastructure development in areas of poor observational coverage.

Role of the GCOS
The GCOS Implementation Plan represents a commonly agreed basis for GEO actions in the Climate area. Moreover considering the Targets above, the GCOS has an essential role to play in GEOSS implementation as it builds upon existing observing system e.g., WIGOS, GOOS and GTOS and represents something like a prototype for GEOSS only in the climate domain.

GCOS Contribution - Main Areas
1. Understanding Earth System phenomena related to Climate Change underpinning climate research (e.g. sea-level rise, change of convective weather patterns, change of frequency of extreme weather)
2. Connecting a multi-disciplinary range of sciences and addressing crosscutting issues
3. Developing Earth System modelling (e.g. from a seamless approach) and data assimilation schemes (integrating both space and in-situ data)
4. Fostering the development of user-driven socio-economic applications and related prediction systems
5. Enhancing capacity for using data & products
6. Producing and disseminating information relevant to decision makers (at all levels)
7. Improving the existing elements of a global observing system for climate in reviewing the products based on the ECVs.
8. Assessing the progress on the implementation of global observing system for climate.

GCOS Contribution - GEO Work Plan
The GCOS currently contributes to multiple GEO Work Plan Tasks.

Work Plan Tasks to which the GCOS currently contributes:
CL-06-02: Key Climate Data from Satellite Systems
CL-06-05: GEOSS IPY Contribution
CL-07-01: Seamless Weather and Climate Prediction System
WA-06-02: Forecast Models for Drought and Water Resource Management
WA-06-05: In-situ Water Cycle Monitoring
WA-06-07: Capacity Building Program for Water Resource Management
US-07-02: Millennium Development Goals

Work Plan Tasks for which the GCOS has expressed an interest:
WA-07-02: Satellite Water Quantity Measurements and Integration with In-situ Data
DA-07-06: Data Integration and Analysis System

Additional Work Plan Tasks that could be considered:
DI-07-01: Risk Management for Floods
HE-06-03: Forecast Health Hazards
EN-07-02: Energy Environmental Impact Monitoring
EN-07-03: Energy Policy Planning
DA-06-03: Ensemble-Technique Forecasting Demonstrations
CB-07-01: Capacity Building Strategy Implementation

Summary
The success of GEOSS - as a global environmental information system for society - will depend on engagement and cooperation throughout the global scientific community and throughout the Climate community in particular.

Annex I
CL-09-02: Accelerating the Implementation of the Global Climate Observing System
Accelerate the implementation of the Global Climate Observing System (GCOS) through enhanced support for the component systems of GCOS: The WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW), the IOC-led Global Ocean Observing System (GOOS), the FAO-led Global Terrestrial observing System (GTOS), and the global hydrological networks and all relevant satellite systems. Make relevant synergies with Task AR-09-03 “Advocating for Sustained Observing Systems”.

a) Key Observations for Climate

This sub-task is led by GCOS (crichter@wmo.int), GOOS, GTOS, WCRP and WMO
Strengthen the climate-related functions and activities of the Global Observing System (GOS), Global Atmosphere Watch (GAW) and Global Cryosphere Watch (GCW), the Global Ocean Observing System (GOOS) and Global Terrestrial observing System (GTOS). Support the Implementation Actions for the Atmospheric, Oceanic and Terrestrial domains identified in the “Implementation Plan for the Global Observing System for climate in Support of the UNFCCC” (GCOS-92).

b) Key Climate Data from Satellite Systems (former CL-06-01c]
This sub-task is led by USA (NASA, NOAA), CEOS (NOAA, mitch.goldberg@noaa.gov), CGMS, ESA, GCOS and WMO
Establish actions securing the provision of key data for climate studies and forecasting from satellite systems.

Key related Tasks in other SBAs include: CL-06-01 (A Climate Record for Assessing Variability and Change), CL-09-01 (Environmental Information for Decision-making, Risk Management and Adaptation), WA-06-02 (Droughts, Floods and Water Resource Management), WA-08-01 (Integrated Products for Water Resource Management and Research), WE-06-03 (TIGGE), WE-09-01 (Capacity Building for High-Impact Weather Prediction), EC-09-01 (Ecosystem Observation and Monitoring Network)

Appendix 1

Fourth WCRP Observations and Assimilation Panel (WOAP) Meeting

Date: 29-31 March 2009

Location: KlimaCampus, University of Hamburg
http://wcrp.wmo.int/AP_WOAP4.html

Logistics: http://wcrp.wmo.int/documents/1.1WOAP4_v3_logistics_participants.doc

Agenda of WOAP IV meeting (25 March 2010)

Session held under the auspices of the World Climate Research Programme (WCRP) and the Global Climate Observing System (GCOS).

Meeting Chair: Kevin Trenberth
Rapporteur (minutes): Bill Westermeyer

Meeting objectives:

- Progress achieved during the last two years in relation to observations
  - GRUAN
  - Flux tower measurement exploitation; IGBP
  - observations from space; CEOS; NPOESS developments
  - reprocessing; SCOPE-CM
  - interactions between GCOS and WCRP activities,
  - Participation in GEOSS.
- IPCC AR5 report and scoping
- Datasets for evaluating models
- Implications of WCC-3, COP-15 and OceanObs'09.
- Implications of the new GCOS implementation plan
- Implications of new WCRP implementation plan.
- Matters arising from JSC 31
- Matters arising from GCOS SC XVII meeting
- Assess the activities and results of Task Group on Data Management and the Joint Working Group on Observational Data Sets for Reanalysis
- Participation in WCRP conference, 23-29 October 2011, Denver CO.
- Organization of next International Reanalysis conference

WCRP Implementation Plan 2010-2015 -
http://wcrp.wmo.int/documents/WCRP_IP_2010_2015.pdf
WCRP Achievements Report - http://wcrp.wmo.int/documents/WCRP_AR_2008_2009.pdf
OceanObs'09 website: http://www.oceanobs09.net

Organization of meeting:
On day 1 the topics are organizationally oriented, but more generally the topics are ordered by subject rather than organization. Accordingly, groups who report on day 1 should review their activities but keep the items under each subject for the appropriate item on the agenda.

Presenters must leave time for discussion and adopt broad rather than detailed views. Please check your assignments and let me know if you can not do them.

Documents to be posted to the following web site
http://wcrp.wmo.int/AP_WOAP4.html (Note: times are for guidance only.)

Day 1: Monday, 29 March 2010

0830: Assemble

0850

Session 1: **Opening of meeting**

1.1	Welcome and logistics *(Trenberth)* *(Organize group dinner; Tuesday)*	*(5 mins)*
1.2	Opening remarks by local host	*(15 mins)*
1.3	Introduction: "Everyone represents a group"	(*10 mins*)
1.4	Purpose of the meeting and Adoption of the agenda *(Trenberth)* Main topics to be covered	*(20 mins)*
1.5	Conduct of meeting: Formation of Task groups (see Appendix)	*(5 mins)*

0945

Session 2: **WOAP updates**

2.1	Review of activities since WOAP-III *(Trenberth)*	*(20 mins)*
2.2	Report from WCRP JSC: role of WOAP within WCRP (*Asrar, Busalacchi)*	*(20 mins)*
2.3	Discussion	*(5 mins)*

Reference documents: WOAP whitepaper to JSC, Report to GCOS**
3/4 hour

1030- 1100 Break

1100

Session 3: **Reports from WCRP Groups**

(Focus on next 2 years; cf session 12.3 for post 2013):

3.1	WGNE *(Gauthier)*	*(10 mins)*
3.2	WGCM and modeling issues for WOAP *(Taylor)*	*(15 mins)*
3.3	Perspectives from WCRP Projects CLIVAR *(Stammer)* CliC *(Key)* SPARC (von *Savigny)* CEOP *(Koike)* GEWEX *(Kummerow)* WGSF *(Kent)*	*(up to 10 mins each)*
3.4	Discussion on future directions	*(10 mins)*

Reference papers: reports to JSC http://www.wmo.int/wcrpevent/jsc31/index.html*

1230- 1400 Lunch
1400

Session 4: **Coordination with GCOS and GEO**

		(about 15 mins each)
4.1	Update on GCOS Activities *(Richter)*	*(15 mins)*
4.2	AOPC *(Simmons)*	*(15 mins)*
4.3	OOPC *(Lindstrom)*	*(15 mins)*
4.4	TOPC *(Dolman)*	*(15 mins)*
4.5	Cryosphere observations *(Key)*	*(10 mins)*

4.6 WMO Integrated Global Observing Systems (WIGOS) (*Ryan*) *(10 mins)*
4.7 Report from GEO; GEO tasks *(Tanner)* *(10 mins)*
4.8 Discussion *(Manton) - see 10.2*

Reference papers: GCOS and Panels report to JSC, GCOS progress reports
http://www.wmo.ch/pages/prog/gcos/Publications/gcos-129.pdf
http://www.wmo.ch/pages/prog/gcos/Publications/gcos-137.pdf
1.5 hours

1530- 1600 Break
1600

***Session 5:* Space matters and relation with space agencies**

5.1 CEOS Activities on Climate *(Petiteville)* *(10 mins)*
5.2 GCOS *(Simmons, Lindstrom, Dolman)* *(10 mins)*
5.3 Intro to SCOPE-CM *(Ryan)* *(15 mins)*
5.4 ESA Climate Change Initiative (*Mathieu)* *(15 mins)*
5.5 NPOESS developments (*Busalacchi*) *(15 mins)*
5.6 JAXA Earth Observation, GCOM, GPM, Earth-CARE, GOSAT (*Igarashi*) (*15 mins)*
5.7 Discussion *(10 mins)*
Home Work (based on day's events)

Reference papers:
http://www.esa.int/esaEO/SEMUX6NKRGF_index_0.html
http://earth.esa.int/workshops/esa_cci/intro.html
http://www.wmo.ch/pages/prog/wcrp/documents/NPOESS_Decision_Fact_Sheet.pdf
1.5 hour

1730
Session 6:

6.1 German perspective on observations and WOAP (*Martin Visbeck*) (*25+5 mins*)
30 mins

1800 END of DAY 1 *Reception*

Day 2: Tuesday, 30 March 2010
0830

***Session 7:* Reanalyses**
7.1 Atmospheric reanalyses: an update *(Bosilovich)* *(15 mins)*
7.1.1 JRA55 *(Koike)* *(10 mins)*
7.2 Ocean reanalyses *(Stammer)* *(15 mins)*
7.3 Cryosphere reanalyses *(Key)* *(10 mins)*
7.4 Coupled reanalyses/assimilation of atmosphere, ocean, sea-ice, and land surface data, "seamless" predictions *(Gauthier)* *(15 mins)*
7.5 Report from Reanalyses WG and discussion of follow-up actions *(Vose)* *(25 mins)*
7.6 Planned reanalysis workshops *(Bosilovich)* *(15 mins)*
7.7 Next reanalysis conference: org committee (*Trenberth*) (*15 mins*)
7.8 Discussion *(5 mins)*
Reference papers: see update on atmospheric reanalyses at
http://www.oceanobs09.net/blog/?p=136

1030- 1100 Break

Session 8: Reprocessing

8.1 Report from GEWEX on progress summarizing the status with regard to activities related to reprocessing, including variables suitable for reprocessing (need, readiness), activities definitely planned, and funding and commitments already obtained and required. *(Kummerow)* *(30 mins)*
8.2 GSICS (*Ryan*) *(15 mins)*
8.3 Additional comments by project reps *(20 mins)*
8.4 Actions and recommendations to advance this activity *(25 mins)*
1.5 hours
http://wcrp.wmo.int/documents/5.1SCOPE_CM_SEP02_PilotProgress.pdf
http://wcrp.wmo.int/documents/5.1SCOPE-CM-PaperGuidelineGCOS_021009.pdf

1230-1400 LUNCH
Task groups lunch together

Session 9: **In situ issues**

9.1 Working Group on Surface Fluxes (WGSF) (*Kent)* *(15 mins)*
9.2 Ocean Obs '09 (*Stammer*, *Lindstrom*) *(25 mins)*
9.3 AOPC (*Simmons*) *(10 mins)*
9.4 GRUAN (meeting 2-4 March 2010) (*Westermeyer, Richter*) *(10 mins)*
9.5 TOPC (*Dolman*) *(10 mins)*
9.6 Flux towers (IGBP: *Reichstein*) *(25 mins)*
9.7 Discussion, other issues *(5 mins)*
Reference papers:
1.5 hours

1540- 1600 BREAK

Session 10 Misc, Review of action items; Host Country (Germany/EU) Activities

10.1 IPCC schedule (*Trenberth*) *(10 mins)*
http://www.ipcc.ch/activities/activities.htm#1
10.2 Possible actions for WOAP on items and recommendations to WCRP and GCOS: discussion (*M. Manton to lead)* *(30 mins)*
1645
10.3 Climate Service Center (*Guy Brasseur*) *(25 mins)*
1715
10.4 Tour of DKRZ new building/computer/climate center (5 min walk)

Documents:
2 hours total

18.00 END of DAY 2

19:00 Group Dinner

Day 3: Wednesday, 31 March 2010

0830
Session 11: **Data activities**

GCOS –SC Action 27. Peer Review of Climate Data Sets. The SC called for further elaboration of the issue of peer review of climate datasets with experts in WCRP, GOOS, and GTOS, noting that the next meeting of the WOAP would be an appropriate forum to consider this subject.

11.1	Report from Task Group on Data Management *(Cattle)*	*(30 mins)*
11.2	CEOP perspectives (*Koike*)	*(15 mins)*
11.3	Data for model evaluations (*Taylor, Teixeira*)	(*20 mins)*
11.4	SPARC Data Initiative (*Tegtmeier*)	*(15 mins)*
11.5	NOAA NCDC Data initiative, results from March workshop (*Vose*)	*(20 mins)*
11.6	JCOMM Expert Team on Marine Climatology (Kent)	*(10 mins)*
11.7	WMO Information System (*Ryan*)	*(10 mins)*
11.8	Revitalization of TG on Data Management	*(10 mins)*

2.00 hours, continued in session 13.

http://wcrp.wmo.int/documents/11.3Datasets4CMIP.pdf
http://www.wmo.ch/pages/prog/gcos/Publications/gcos-137.pdf

1030- 11.00 BREAK

Session 12: **Climate Information**

12.1	WCRP open science conference (*Trenberth/Asrar*) http://www.wcrp-climate.org/conference2011	*(10 mins)*
12.2	WCC-3 repercussions *(Asrar)* http://www.wmo.int/wcc3/page_en.php	*(10 mins)*
12.3	Transition of WCRP Projects beyond 2013: legacy, issues arising	*(10mins each)*
	12.3.1 CLIVAR *(Stammer)*	
	12.3.2 GEWEX *(Trenberth/Kummerow)*	
	12.3.3 SPARC *(von Savigny)*	
	12.3.4 CliC *(Key)*	
	12.3.5 WGSF *(Kent)*	
	12.3.6 Modeling groups *(Taylor)*	

1.5 hour

http://wcrp.wmo.int/documents/WCRPobservations09v3.doc

1230-1400 LUNCH Tasks groups lunch together

Session 13: Climate information (cont)

13.1	WCRP observations, datasets, and analysis strategy	*(30 mins)*
13.2	Recommendations, actions	*(15 mins)*
13.3	Future directions	
13.4	Discussion	

1500

Session 14: Review

14.1 Reports by task groups formed during meeting *(write up required)*
1/ Data matters: (sessions 8, 9, 11) *Manton*
2/ Current and future data: (session 5) *Key*

3/ Reanalyses (session 7) *Bosilovich*
4/ GEO/GCOS (session 4) *Tanner*

14.2 Review of action items *Westermeyer, Trenberth*

14.3 Other Business
- New chair
- Next meeting
- Intra-session activities
- New members

Close of the meeting: by 1630

PROPOSAL FOR TASK GROUPS for this meeting

These should act as rapporteurs on topics and lead discussion of the future directions, with short documents due shortly after the meeting. Suggest meetings at lunch.

1/ Data matters: datasets, data management, legacy, reprocessing (sessions 8, 9, 11)
Manton (chair), Vose, Cattle, Koike, Kummerow, von Savigny

2/ Current and future data: space observations, CEOS interactions, in situ (session 5)
Key (chair), Kent, Petiteville, Asrar, Busalacchi, Igarashi. Lindstrom

3/ Reanalyses and attribution: recommendations for follow-on actions, joint WG with GCOS on data for reanalysis, conference (Session 7)
Bosilovich, Simmons, Stammer, Gauthier, Vose

4/ GEO/GCOS items (session 4)
Tanner, Dolman, Richter, Lindstrom

List of participants

Appendix 2

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Appendix 3

Acronyms

AIRS	**ATMOSPHERIC INFRARED SOUNDER**
ALOS	**ADVANCED LAND OBSERVING SATELLITE**
AMIP	**ATMOSPHERIC MODEL INTERCOMPARISON PROJECT**
AMSR	**ADVANCED MICROWAVE SCANNING RADIOMETER (JAXA)**
AOPC	**ATMOSPHERIC OBSERVATION PANEL FOR CLIMATE**
AR5	**IPCC FIFTH ASSESSMENT REPORT (TO COME IN 2013)**
ARM	**ATMOSPHERIC RADIATION MEASUREMENT (DOE)**
ASR	**ARCTIC SYSTEM REANALYSIS**
BSRN	**BASELINE SURFACE RADIATION NETWORK**
BUFR	**BINARY UNIVERSAL FORM FOR THE REPRESENTATION OF METEOROLOGICAL DATA**
CAPER	**CARBON AND PERMAFROST INITIATIVE**
CCI	**CLIMATE CHANGE INITIATIVE (ESA)**
CCMVAL	**CHEMISTRY-CLIMATE MODEL VALIDATION**
CDR	**CLIMATE DATA RECORD**
CEOP	**COORDINATED ENERGY AND WATER CYCLE OBSERVATIONS PROJECT**
CEOS	**COMMITTEE ON EARTH OBSERVATION SATELLITES**
CERES	**CLOUDS AND THE EARTH'S RADIANT ENERGY SYSTEM**
CFSR	**CLIMATE FORECASTING SYSTEM REANALYSIS**
CGMS	**COORDINATION GROUP FOR METEOROLOGICAL SATELLITES**
CLARREO	**CLIMATE ABSOLUTE RADIANCE AND REFRACTIVITY OBSERVATORY**
CliC	**CLIMATE AND CRYOSPHERE PROJECT (WCRP)**
CLIVAR	**CLIMATE VARIABILITY AND PREDICTABILITY PROJECT (WCRP)**
CMA	**CHINA METEOROLOGICAL ADMINISTRATION**
CMIP	**COUPLED MODEL INTERCOMPARISON PROJECT**
CNES	**CENTRE NATIONAL D'ETUDES SPATIALES**
COP	**CONFERENCE OF THE PARTIES (TO UNFCCC)**
COPES	**COORDINATED OBSERVATION AND PREDICTION OF THE EARTH SYSTEM (WCRP)**
CSC	**CLIMATE SERVICE CENTER**
DMSP	**DEFENSE METEOROLOGICAL SATELLITE PROGRAM (USA)**
EARTHCARE	**EARTH CLOUD, AEROSOL, RADIATION AND ENERGY**
ECMWF	**EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS**
ECV	**ESSENTIAL CLIMATE VARIABLE (AS DEFINED BY GCOS-82)**
EEZ	**EXCLUSIVE ECONOMIC ZONE**
EORC	**EARTH OBSERVATION RESEARCH CENTER (JAXA)**
ERA	**ECMWF RE-ANALYSIS PROJECT**
ESA	**EUROPEAN SPACE AGENCY**
ESG	**EARTH SYSTEM GRID**
ESRL	**EARTH SYSTEM RESEARCH LABORATORY (NOAA)**
EUMETSAT	**EUROPEAN ORGANISATION FOR THE EXPLOITATION OF METEOROLOGICAL SATELLITES**
FCDR	**FUNDAMENTAL CLIMATE DATA RECORD**
GCM	**GENERAL CIRCULATION MODEL**
GCOM	**GLOBAL CHANGE OBSERVATION MISSION (JAXA)**
GCOS	**GLOBAL CLIMATE OBSERVING SYSTEM**
GCW	**GLOBAL CRYOSPHERE WATCH**
GEO	**GROUP ON EARTH OBSERVATIONS**
GEOSS	**GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS**
GEWEX	**GLOBAL ENERGY AND WATER CYCLE EXPERIMENT (WCRP)**
GFCS	**GLOBAL FRAMEWORK FOR CLIMATE SERVICES**
GFSC	**GODDARD SPACE FLIGHT CENTER (NASA)**
GMAO	**GLOBAL MODELING AND ASSIMILATION OFFICE**
GMES	**GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY**
GOOS	**GLOBAL OCEAN OBSERVING SYSTEM**
GOSAT	**GREENHOUSE GASES OBSERVATION SATELLITE (JAXA)**

GPCP	**GLOBAL PRECIPITATION CLIMATOLOGY PROJECT**
GPM	**GLOBAL PRECIPITATION MISSION**
GRDC	**GLOBAL RUNOFF DATA CENTRE**
GRP	**GEWEX RADIATION PANEL**
GRUAN	**GCOS REFERENCE UPPER-AIR NETWORK**
GSC	**GCOS STEERING COMMITTEE**
GSICS	**GLOBAL SPACE-BASED INTERCALIBRATION SYSTEM**
GSOP	**GLOBAL OBSERVATIONS AND SYNTHESIS PANEL (WCRP CLIVAR)**
GTOS	**GLOBAL TERRESTRIAL OBSERVING SYSTEM**
GTS	**GLOBAL TELECOMMUNICATION SYSTEM**
ICOS	**INTEGRATED CARBON OBSERVING SYSTEM**
ICSU	**INTERNATIONAL COUNCIL FOR SCIENCE**
IGBP	**INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME**
IGOS	**INTEGRATED GLOBAL OBSERVING STRATEGY**
ILEAPS	**INTEGRATED LAND ECOSYSTEM - ATMOSPHERE PROCESS STUDY**
IPCC	**INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE**
IP-04	**GCOS IMPLEMENTATION PLAN (2004)**
IP-10	**GCOS IMPLEMENTATION PLAN (2010)**
IPO	**INTERNATIONAL PROJECT OFFICE (CLIVAR)**
ISCCP	**INTERNATIONAL SATELLITE CLOUD CLIMATOLOGY PROJECT**
JAXA	**JAPAN AEROSPACE EXPLORATION AGENCY**
JCOMM	**JOINT WMO-IOC TECHNICAL COMMISSION ON OCEANOGRAPHY AND MARINE METEOROLOGY.**
JMA	**JAPANESE METEOROLOGICAL AGENCY**
JRA	**JAPANESE RE-ANALYSIS PROJECT**
JSC	**JOINT SCIENTIFIC COMMITTEE (WCRP)**
LEO	**LOW EARTH ORBIT**
MERRA	**MODERN ERA RETROSPECTIVE-ANALYSIS FOR RESEARCH AND APPLICATIONS (NASA)**
MLS	**MICROWAVE LIMB SOUNDER (NASA)**
MODIS	**MODERATE RESOLUTION IMAGING SPECTRORADIOMETER (NASA)**
NASA	**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (USA)**
NCAR	**NATIONAL CENTER FOR ATMOSPHERIC RESEARCH**
NCDC	**NATIONAL CLIMATIC DATA CENTER (NOAA)**
NCEP	**NATIONAL CENTERS FOR ENVIRONMENTAL PREDICTION (NOAA)**
NESDIS	**NATIONAL ENVIRONMENTAL SATELLITE, DATA, AND INFORMATION SERVICE (NOAA)**
NOAA	**NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (USA)**
NPOESS	**NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM**
NPP	**NPOESS PREPARATORY PROJECT**
NSIDC	**NATIONAL SNOW AND ICE DATA CENTER (USA)**
NWP	**NUMERICAL WEATHER PREDICTION**
OMPS	**OZONE MAPPPING and PROFILING SUITE**
OOPC	**OCEAN OBSERVATIONS PANEL FOR CLIMATE**
PCMDI	**PROGRAM FOR CLIMATE MODEL DIAGNOSIS AND INTERCOMPARISON**
PIOMAS	**PAN-ARCTIC ICE-OCEAN MODELING AND ASSIMILATION SYSTEM**
SAF	**SATELLITE APPLICATION FACILITY**
SBSTA	**SUBSIDIARY BODY FOR SCIENTIFIC AND TECHNOLOGICAL ADVICE (UNFCCC/COP)**
SCOPE-CM	**SUSTAINED CO-ORDINATED PROCESSING OF ENVIRONMENTAL SATELLITE DATA FOR CLIMATE MONITORING**
SDS	**SCIENTIFIC DATA STEWARDSHIP (NOAA/NESDIS)**
SNODAS	**SNOW DATA ASSIMILATION SYSTEM SPARC STRATOSPHERIC PROCESSES AND THEIR ROLE IN CLIMATE CHANGE (WCRP)**
SRB	**SURFACE RADIATION BUDGET**
SSG	**SCIENTIFIC STEERING GROUP**
SST	**SEA-SURFACE TEMPERATURE**
SURFA	**SURFACE FLUX ANALYSIS PROJECT**
SWE	**SNOW WATER EQUIVALENT**

TGDM	**TASK GROUP ON DATA MANGEMENT (WOAP)**
THORPEX	**THE OBSERVING SYSTEM RESEARCH AND PREDICTABILITY EXPERIMENT**
TIGGE	**THORPEX INTERACTIVE GRAND GLOBAL ENSEMBLE**
TMI	**TRMM MICROWAVE IMAGER**
TOA	**TOP OF ATMOSPHERE**
TOPC	**TERRESTRIAL OBSERVATION PANEL FOR CLIMATE**
TRMM	**TROPICAL RAINFALL MEASURMENT MISSION**
TT-MOCS	**TASK TEAM ON MARINE, METEOROLOGICAL, AND OCEANOGRAPHIC SUMMARIES**
UNFCCC	**UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE**
WCC-3	**WORLD CLIMATE CONFERENCE-3**
WCRP	**WORLD CLIMATE RESEARCH PROGRAMME**
WHYCOS	**WORLD HYDROLOGICAL CYCLE OBSERVING SYSTEM**
WG	**WORKING GROUP**
WGCM	**WORKING GROUP ON COUPLED MODELING (WCRP)**
WGCV	**WORKING GROUP ON ??**
WGNE	**WORKING GROUP ON NUMERICAL EXPERIMENTATION**
WGSF	**WORKING GROUP ON SURGACE FLUXES (WCRP)**
WIGOS	**WMO INTEGRATED GLOBAL OBSERVING SYSTEMS**
WIS	**WMO INFORMATION SYSTEM**
WMO	**WORLD METEOROLOGICAL ORGANIZATION**
WOAP	**WCRP OBSERVATION AND ASSIMILATION PANEL**