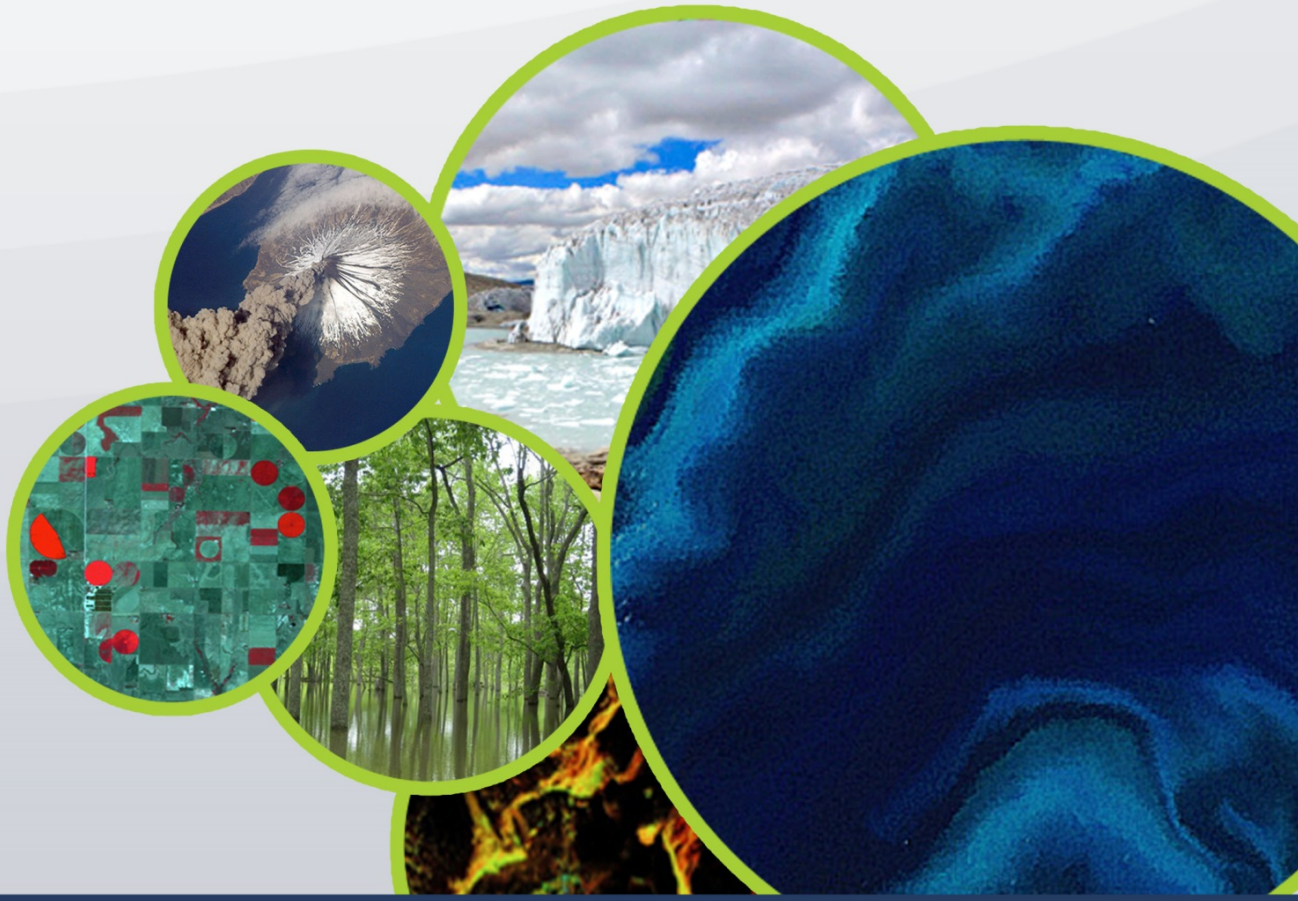
Committee on Earth Observation Satellites



Working Group on Calibration and Validation

CEOS WGCV Plenary #40 / Minutes

Version 1.0 (Final)
June 14th, 2016

Introduction

The minutes are taken along the original agenda which may be changed during the meeting in its order in some very rare cases. The minutes are extended by a separate list of the remaining open action items from this plenary and the plenaries before. Additionally, the list of participants and the adopted agenda is appended.

It shall be noted that in contrast to former meetings the current meeting minutes and those in the future shall concentrate on reporting results of discussions and presentations rather than providing lengthy, detailed transcriptions of the meeting over the course of the day. For that reason, some discussions were summarized, some topics (for example: status CEOS deliverables) were reported in total in one section. This approach had been selected to provide a result-oriented overview, especially for those, who could not participate in the plenary meeting.

Monday, March 14th, 2016

1 General Business I

1.1 Introduction/Welcome CEOS WGCV Plenary 40 (Chair / Host representative)

The CEOS WGCV Chair, Albrecht von Bargen (DLR) welcomed on behalf CEOS WGCV all attendants. Much appreciation was expressed to CSIRO and GA to host the meeting and to the audience for their attendance.
CEOS Chair Dr. Alex Held welcomed the attendants in Canberra of behalf of CSIRO.
The welcome was followed by a brief round table introduction of each attendee.

1.2 Adoption of Agenda (CEOS WGCV Chair and secretariat)

The Agenda version 1.01 was presented to the plenary. The agenda was unanimously adopted for the plenary session with slight correction noted in the attached version of the agenda. Note that due to the fact that some registered agencies did not attend some agenda items had been taken off the agenda.

1.3 Chair's Report (Albrecht von Bargen, DLR)

Albrecht von Bargen presented the Chair's report and went through the current CEOS WGCV challenges. This includes support of other CEOS work groups as well as the Carbon Action Items as well as interaction with virtual constellations. He informed about activities and meetings that had taken place in the last few months. Some of the chair's goals are to improve the communication channels of the CEOS WGCV to outreach to new members. The current membership is stable to growing as BoM and JAXA sent participants. The participation by AEGOS, ANGKASA, ASI, ISRO, and CNO were prevented due to administrative reasons. EUMETSAT is committed to its permanent participation. The new members will need to be integrated into existing activities and will be given opportunity to start their own initiatives.
There are monthly telephone-conferences with CEOS SEC to enhance information flow between CEOS SEC and CEOS WGCV. In addition, bi-annual teleconferences are held with the CEOS SIT team about CEOS WGCV activities. CEOS WGCV activities were presented during

CEOS plenary and the CEOS SIT workshop in Darmstadt in September last year. The current three year CEOS work plan is one of the drivers of CEOS WGCV activities. This includes further links to other CEOS bodies which will be partly discussed in the further proceedings of this meeting. A link to GSICS is established on the WGCV level and sub-group level by common meetings and invitations to workshops after identification of possible cooperation fields during the past.
A structural overview of the WGCV internal and external interactions and drivers demonstrated that the WGCV is driven more and more by external activities such as the Carbon and Water Activities. Awareness of these activities is needed to coordinate resources in an efficient fashion.
The meeting agenda has shifted emphasis from a simple reporting of agency activities to a topical session format. In order to maintain such a topical session format, it is advantageous if agenda items would be brought up well in advance of the meeting. Earlier agenda finalization will also help in attracting new members to participate.
Von Bargen came to the topic that it is important to make the results of WGCV available with WGCV branding to increase visibility.

1.4 Vice-Chair Nomination (Chair)

The Chair reminded on the Vice-chair nomination procedure and the fact that a Vice-chair shall be nominated during the CEOS WGCV # 41 plenary in September 2016. So far no agency announced its candidacy, but the chairs are confident that a nomination can be held during the coming CEOS WGCV plenary in Tokyo.
It is understood that sub-groups are currently not in the position to discuss any candidate in advance to CEOS WGCV 41, but a CV and short self-presentation shall be sent to sub-group chairs when available to allow sub-group vote coordination in advance of the Tokyo meeting.
In case no nominee comes forward, the current governance indicates that the current Vice-chair will become Chair according CEOS governance. The current Chair will then hold the Vice-chair position ad interim.

1.5 CEOS work plan 2015 (Chair)

The CEOS work plan has a schedule horizon of three years and is updated once every year at the beginning of the calendar year for the next year.
It is worth to note that out of 12 deliverables assigned to CEOS-WGCV, eight can be seen as completed. From the remaining four deliverables only two are delayed but with a high probability of being closed in the near future.
However, it shall also be kept in mind that a huge tableau of action items is hidden behind the deliverable Carbon-8. This is an item for its own agenda topic. (see below)

1.6 CEOS work plan 2016 (Chair)

As outlined above, the CEOS work plan is a rolling deliverable repository with annual renewal. New deliverables have recently been included. Those are related to the planned task teams “ACIX” (Atmospheric correction) ”cloud masking”. However, most of new deliverables are in Carbon-8 when the break-down in sub-task has been completed and those sub-tasks will become part of the WGCV work plan.

2 Subgroup Reports

2.1 SAR subgroup report (Albrecht von Bargen on behalf of Manfred Zink)

There was a calibration and validation workshop at ESTEC in Noordwijk. The meeting was very successful with 65 participants and 46 presentations in 11 sessions. There was a strong focus on Sentinel-1, but also papers on a variety of other satellites. All presentations are available from http://sarcv.ceos.org.
Bruce Chapman, who currently is the lead scientist for NISAR at NASA/JPL, was nominated as vice-chair for Manfred Zink. His nomination was unanimously approved by the CEOS-WGCV plenary.

2.2 ACSG report (Jean-Christopher Lambert)

Sub-group activities were focused on three small scale activities:

- The development and support of fiducial reference measurements, which will be presented in more detail tomorrow, were key of the discussions within ACSG.
- There was a workshop on WGCV cross-cutting activity selecting several limited 2-year studies.
- The Atmospheric Chemistry instrument calibration was brought forward in a CV-3 workshop and CV-5 meeting, as well as the definition of best practices for the calibration QA4EO.
- Further satellite validation best practices were examined, in particular for air quality, in cooperation with specialized groups such as NDACC EGs and WMO/GAW, ACTRIS-2, GEWEX, and other bodies.
- Transmission of WGCV experience to CDRs took place by, e.g., the pragmatic implementation in ENVISAT Phase F data evolution. Within the EU FP7 QA4ECV, a generic QA framework virtually applicable to all ECVS was developed.

Some possible areas of common interest with GSICS were identified which includes the UV-VIS aspects for the new CEOS WGCV solar spectrum recommendation. To avoid duplication of work between the bodies, best practices for the level 2 to level 1 feedback for calibration shall be developed. With respect of atmospheric characterization, forward calculations, radiative transfer calculations and fiducial reference measurements are of joint interest.
The subgroup wants to contribute to exchanges of best practices between the (semi-) automated validation servers present at various agencies. Data is taken from operational networks, being collected on a regular, e.g. daily basis. The modelling data, e.g. ECMWF CAMS, is taken, too, and automatically compared against the level 2 data from a satellite. This may be used either to validate models or to validate satellite products.

2.3 IVOS report (Nigel Fox)

IVOS 27 workshop was organized in Toulouse, France in November 2015. 50 attendees from 26 agencies/organizations were present. Next IVOS workshop will be hosted by CAS in July 2016 in the week after IGARSS 2016 in Beijing.
Topics discussed during IVOS 27 were briefly presented:

- MTF workshop: a rather new theme in IVOS, geospatial image quality is a topical issue interesting also industry bringing together 20 attendees. A prioritized “CEOS” list of MTF target sites shall be established and observed regularly. It was recommended from the audience (von Bargen, Ross) to make such a catalogue public

for CEOS WGCV as a very useful reference. Also, purely synthetic images are to be generated to also test MTF-evaluation software.
Two recommendations:
(a) establish reference dataset of CEOS recommended sites for MTF and to encourage agencies to collect data over these and to share results with the community
(b) IVOS recommends the establishment of a pilot project to carry out a comparison of inflight MTF retrieval methods through distribution of synthetic and real images.

- IVOS had reviewed the OCR white paper and IOCCG report 13 from a Cal/Val perspective. Both documents form a very good basis for the ocean color community, but some refinements are suggested. The comments had been forwarded to IOCCG for discussion. Currently, IVOS is awaiting the response to the comments.

AI WGCV-40-1
WGCV Chairs will clarify in accordance with the roles and responsibilities in cooperation with OCR-VC and IOCCG [after having received the answer from IOCCG with respect to the IVOS statements] (due date: WCGV plenary 42)

- Long term strategy is to provide a framework of tools to help assess/correct post launch radiometric gain of sensors. One of the conclusions was to have a web-telecon with GSICS on the convolution of spectral curves.
- PICS (pseudo invariant calibration sites) workshop had 30 attendees for a 1 day meeting. Significant progress on methods was made with respect to removal of seasonal effects, efforts to establish surface BRF and direct measurements of sand. A new 2-year project was established, led by P Henry (CNES) together with D Helder (SDSU) to focus on site characterization.

IVOS recommendations to CEOS WGCV are filed in the presentation. In terms of setting up a CEOS WGCV task team the procedure shall be followed and a proposal can be presented during the coming CEOS WGCV plenary for proposal.
In refinement to the presentation on request of T. Cecere (USGS), N. Fox detailed that the recommended database on radiometric gain corrections is intended to be a listing of comparison activities. Factors and detailed studies may be not publically available.
WGCV chair recommended the listing of different activities with the cooperation with other bodies inclined. He also advised to send the subgroup recommendations in advance of the plenary in order to be prepared for the discussion during plenary.
The chair asked on the status of the WGCV-37-2. Audience was informed that a teleconference is currently under organization.

2.4 MWSG report (Xioaolong Dong)

The mission of the Microwave Sensors subgroup is to foster high quality calibration and validation of microwave sensors for remote sensing purposes. These include both active and passive types, airborne and space-borne sensors.
The highlights of MWSG foci are filed in the presentation material. Emphasis was put on Challenges are posed by higher requirements for climate and global change applications and by cross-calibration efforts. No traceable standard is yet available for microwave sensors and several new sensor types have been developed. The objectives are the support of CDR from microwave, the support of CEOS VCs. As such the focus is on MWR and SCAT level 1 data, MWR & ALT standards as well as models and algorithms.

- A joint meeting of MWSG with GSICS Microwave subgroup is in preparation in July 2016 in Bejing before the IGARSS 2016 meeting hosted by CAS.
- Discussions and coordination with IOVWST and OSVW-VC are taking place with respect to a common work plan and calibration and cross-calibration for sigma 0 by NOC techniques and quality control standardization for sigma 0 and OVW products.
- A standard of calibration for microwave sounders and imagers shall be established. A global water vapor CDR from microwave radiometry shall be prepared. Cross comparison smf calibration efforts for L-band radiometry/scatterometry for soil moisture and ocean salinity are followed.
- With respect of calibration of MIR, the main activities are the sharing of calibration processing procedure and algorithms as well as the comparison and assessment of re-processed data.

In summary, foci were identified and accordingly focus groups were organized or in organization. Coordination and discussions with GSICS-GRWG/MWG, IOVWST, and the L-band focus area are established. In future, a standard of calibration of microwave sounder and imager shall be established. With respect to radar scatterometry, NOC for level 1 and level 2 data and OSWV data quality control guidelines are planned. Cross-calibration for radar altimetry, a GNSS-buoy reference, and a polar ice product are envisioned.

2.5 LPV report (M. Román)

The incoming chair of the sub-group provided a survey about the activities of the different focus areas. He briefly discussed a five-year road map for LPV including major activities with the driving agencies. It is worth to note that NASA is further willing to substantially support the activities especially with emphasis on those which are in contribution to Carbon activities. NASA is also sponsoring the LPV website which is well established since about 16 years. However, the chair clarified that significant resources must be spent for the resolution of the tasks yielding from CEOS Carbon action items. The CEOS/WGCV/Land product validation framework will be organized in order to improve the validation standardization in the coming three years. The global leaf area index product validation good practice document (http://dx.doi.org/10.5067/doc/ceoswgcv/lpv/lai.002) shall serve as a template for further products. A validation good practices document together with fiducial data sets and global satellite product subsets shall be combined in a server to provide (semi-) automatic comparison and validation. Finally, he outlined the MALIBU platform (Multi AngLe Imaging Bidirectional Reflectance Distribution Function UAS) which was built from scratch to provide optical land channels matching key land sensors for many current satellites. It may fly up to 400ft. The aim is to fly over any CEOS WGCV LPV core sites.

Tuesday, March 14th, 2016

Day 1 wrap-up

The chair provided in his presentation slide a short summary of the day before.

3 Agency reports I

3.1 NASA (K. Thome)

In addition to the presented slides some highlights are summarized:

- The second decadal survey is now underway by the National Research Council,
- The Sustainable Land Imaging Program together with USGS progresses;

- The development of SAGE-III/ISS, ECOSTRESS/ISS, GEDI/ISS, CYGNSS, TEMPO, GRACE-FO, ICESat-2, SWOT, NISAR, PACE continues.
- CLARREO mission (official start in Spring 2016 with launch in 2020) is now an instrument on the ISS based on a reduced budget which implies a trade-off whether both a reflected solar (RS) and an infrared (IR) spectrometer or only one of them can be established.
- NASA is investing a lot of effort for Sentinel 2/Landsat 8 cross-calibration. Radiometric results based on pre-launch gains look promising. Calibration with respect to land sites shows a good agreement between the two instruments that are smaller than the differences against ground measurements. This allows understanding the test sites simultaneously with the instruments. The plan is to have a harmonized data product including automated continuous validation.
- The NASA carbon monitoring system is following several carbon ecosystems, whereby one interesting activity is the ABOVE campaign using multiple instruments on ground, aircraft, and satellites to understand the vulnerable arctic environment.

F. Gascon (ESA) asked about the existing differences between Sentinel-2 and Landsat-8 which was responded in turn that it may still be due to the evolving characterization of Sentinel-2, which is still in its first year compared to Landsat being in its third.

3.2 BoM (I. Grant)

Chair welcomed the Australian Bureau of Meteorology for its prompt engagement after becoming associate CEOS member.

Ian Grant provided in his filed presentation a brief outline of BoM's activities with respect to calibration and validation derived from its general mandate:

- The offered satellite applications include weather and warnings, volcanic ash monitoring, NWP, ocean modelling, climate, but also environmental applications such as SST, solar radiation, or grassland curing (important for bush fires).
- For validation of satellites application, the processing is done in a unified way with proper software management implementing standard data formats such as NetCDF. The aim is the continuous monitoring of data product quality. There is also the basic idea to generate matching data sets by identifying co-located measurements and then put continuous monitoring with set drift thresholds and alarm levels in place.
- The bureau surface radiation network encompasses records from 31 stations with 14 being currently open. Three of these are BSRN standard station. Australia operates four Dobson spectrometers that provide a significant fraction of measurements at southern latitudes to the global Dobson network. In addition ozone balloon sondes are regularly launched.

3.3 CSIRO (T. Malthus)

Tim Malthus provided an update on the status from last meeting participation:

- A web presence was established (http://www.aeoccg.org.au/ascwg).
- A set of TERN guidelines were released.
- A second vicarious calibration site is under discussion, specifically for imaging spectroscopy missions. One candidate site was too vegetated and too heterogeneous, while another one didn't meet the 60% reflectance standard. While these two sites were suggested by Landsat data, the local condition, remoteness etc. are not ideal. Instead another area in WA, The Pinnacles, located only 250km from Perth is being evaluated, currently.

- Work on the Australian aerosol climatology progresses. Data is screened for quality and clouds. It shows significant harmonics, especially 4, 6, and 12 month cycles.

He asked for support by CEOS-WGCV for CSIRO Cal/Val activities because of the danger of significant reductions in funding from July 1st, 2016, onwards. Chair declared his willingness to write such a letter on behalf of CEOS WGCV. CSIRO representative shall send building blocks including clear cut arguments for the value of Cal/Val beyond the scientific community.
CEOS Chair emphasized that such arguments could also be used to draw further CEOS members into CEOS WGCV and finally in CEOS.
N. Fox and K. Thome clarified that for RadCalNet there is no specific requirement on the spectral reflectance of a site. ESA was looking for sites with high reflectance, and they may be more useful, but there is no formal requirement.

3.4 Geoscience Australia (M. Thankappan)

He reflected in his presentation that GA continues to implement the national Earth Observation from space infrastructure plan endorsed by the Government in 2013. An update was provided including:

- The Australian corner reflectors for SAR calibration site is up and running as an array of 40 CRS of 1.5/2/3.5m have been permanently installed in Queensland. Initial results of calibration are very promising, but there are some anomalies being investigated.
- A prominent part of GA work is the calibration of all Landsat data collections to Surface reflectance. A similar effort has begun with Sentinel-2 data including atmospheric correction, normalization to nadir view and terrain illumination correction.
- The national spectroscopy database is planned to be moved from the University of Woolongong to GA. GA also operates a field spectrometer for the support of field data collection.
- The Australian Geosciences Data cube offers transformation capability for data-intensive applications. This allows the analysis of 30 years of water surface data in about three hours, showing, for example, several lakes, which were previously thought to be non-perennial, are in fact perrenial. There are several other applications. For example, images from low tide/high tides are being analyzed to reveal the inter-tidal zone.
- There are a number of high level collaborations with EC/ESA, USGS, NASA, UKSA, GEO, and UNDP.
- A regional Copernicus Data hub is being set up for Sentinel data in the vicinity of Australia.

In reply to the request of M. Ross about the spatial resolution of the subsidence product, he responded that it should be in the cm scale.

3.5 NOAA (C. Cao)

The update of NOAA activities was briefly presented:

- The Jason3 satellite was recently launched.
- The Suomi-NPP is being continuously monitored. The signal-to-noise is pretty stable. Solar diffusor degradation is being monitored. Time series show the calibration to be very stable and accurate (that is better than the +- 2% specification). The only deviation seems to be the offset increasing due to age-induced dark current. An

active night light source for DNB calibration seems to be feasible. Reprocessing of Suomi-NPP data will compensate for many better understood instrument characteristics.

- There is a special issue on VIIRS Cal/Val and applications in Remote Sensing with 27 papers in preparation.
- There will be a GOES-R field campaign to support post-launch validation of level 1b and level 2 and higher products.

Replying the request of M. Roman about the implication of the worsening degradation of VIIRS, it was stated that this degradation is continuously monitored and corrected for by post-launch calibration.

3.6 USGS (G. Stensaas)

An update of Landsat 7 and 8 has been provided including the reception stations. Most instrument parameters are stable with seasonal variations, but the coherent noise component continues to increase. Most bands are stable within 0.3%. It still exceeds the requirements. Lunar calibration continues and follows other calibration methods. Regions of poor geolocation accuracy are being re-triangulated using Landsat 8 data; the first three phases of upgrade are complete, the 4th phase was added to make GLS control consistent with Sentinel-2.

In terms of the LSI-VC and the Landsat data products USGS requests to include CEOS WGCV for the refinement of the definition of Analysis Ready Data (ARD) which are base for data cubes and will be very important because Earth Observation is faced to Big Data. In reply the Chair pointed out that this discussion was held in LSI-VC and the "Future data architecture and access ad hoc team" of CEOS. In both, CEOS WGCV is represented and will hopefully able to outline its standpoint. However, CEOS WGCV observes a very difficult process of definition including some iteration results which are in contrast with existing and CEOS approved definitions from CEOS WGCV. This will be a tough iteration to come to a general solution. USGS will become CEOS chair in November 2016.

3.7 NSC (V. L. Barth)

A brief update was provided to the audience including

- Update on the Svalbard Integrated Arctic Observing System (SIOS), which is currently in the implementation phase. SIOS has started up with five positions at the SIOS Knowledge Centre in Longyearbyen. For the next three years, the development of SIOS will focus on the core services, data management, remote sensing, information services, open access and a dedicated web portal.
- MET and NILU are participating in the ESA aerosol Climate Change Initiative project lasting until 2017.
- Cryovex, a consortium formed by NPI and UiO are continuing their work at the field site on Austfonna, Svalbard. This site serve as a area for Cal/Val of ESA Earth Explorer mission CryoSat-2.
- With data from the Norwegian Young Sea ICE cruise which took place in 2015, the Universtity of Tromsoe has started a comparison study of SAR satellite data of different satellites including ALOS-2 Palsar, Radarsat-2, TerraSAR-X and Sentinel-1.

In reply to M. Ross request, it was responded that there were different ways of how the SAR data was gathered for this activity. For Radarsat-data, Norway has an agreement with Canada to order a certain amount of Radarsat-data for scientific and governmental use. For

ALOS-2 and TerreSAR-X, the data has been provided for research cooperation, and Sentinel-1 data is freely available through Copernicus.

3.8 NRSCC (L. Ma)

The update was presented in a presentation and included

- TanSat will be launched in 2016.
- The technique of intensity correlation imaging is an extension of ghost imaging that offers improvements with respect to noise and super-resolution. The demonstrator functions well and offers a high resolution expect in the border area of the detector, where increased noise poses problems.
- The method of lunar calibration is compared against that of DCC (deep convective cloud) calibration. Hyperspectral measurements of lunar radiations were performed to improve models of lunar radiative models.
- On December 2015, the Baotou site became operational. It has been used for the calibration of 8 Chinese satellites. It has been enhanced by the installation of three automated radiometers. The retrieved spectral reflectances are being validated and further instruments to improve the characterization of the site are being developed.
- A Cal/Val project was proposed to the Dragon 4 program having contributions on optical, SAR, and microwave sensors.

3.9 JAXA (A. Kuze)

JAXA appreciated the opportunity to present its update to Cal/Val in CEOS WGCV after being absent for several years. The Chair enthusiastically welcomed the contributions of JAXA and its value to the community and especially to CEOS WGCV.
In his update, the following items were included:

- JAXA operates several non-optical Earth Observation instruments from space (AMSR-E, DPR, AMSR2, and ALOS-2).
- GOSAT was launched in 2009 and has operated continuously for seven years. The Fourier-transform spectrometer onboard offers several small bands covering CO_2 lines but includes also a broad part of the infrared regions. For on-ground validation JAXA makes use in cooperation with NASA/JPL of the site in Railroad Valley, Nevada (USA). Horizontal and vertical concentration of green-house gases are measured by a variety of stationary and airborne instruments. The long term stability is examined by a combination of vicarious calibration for absolute and backside solar diffuser for relative. Calibration sources are Sahara (with unknown AOT) and Lunar (with strong BRDF). The radiometric degradation derived from the Railroad Valley campaign data indicates a stable instrument for the last couple of years. As hot calibration target, a land target is used that required intense characterizations of reflectance and emissivity. Those data are also compared to NASA's OCO-2 mission.
- It is worth noting that JAXA derives numerous data products from JMA's Himawari 8 and 9, for example, the aerosol optical thickness, determined every 10 minutes.

In reply to M. Ross's request about any validation work with respect to the aerosol optical thickness product, A. Kuze stated that the derived data is consistent with MODIS data.

4 Metrics for Cal/Val

4.1 Background (Chair)

The Chair stated that validation metrics were discussed at several plenaries without any concrete final results. He also pointed to the very valuable work of LPV on concrete data products which had been taken as first input during the recent plenary. However, an action item was open related to some clarifications in the definition of validation metrics.
In addition to the definition of validation metrics, the future of calibration and performance characterization is increasing in importance because of the growing need of well-calibrated time series and compatible data products.

4.2 LPV Metrics Update (M. Román)

He provided an update of the LPV metrics and stated that they are currently in the phase of finalization meaning that the final results of the action item from the recent WGCV plenary cannot be discussed at the current time.In the discussion, reference was also made to the activities in the climate community including the FP-7 CORE-CLIMAX European Capacity Assessment for Climate Data Records. It turned out that those definitions need to be aligned together with the CEOS WGCV-LPV approach and the correct terminology that had been developed in CEOS WGCV the past several years. The chair pointed out that WGCV should start with satellite products and how CEOS WGCV will define the maturity of validation. This agrees with discussion during the most recent CEOS/CGMS WGClimate meeting that CEOS WGCV will provide a validation metrics starting along product validation to be discussed with this working group during ECV inventory update cycle 3 in order to set-up a proper overall metrics for climate applications.
Nigel Fox recommended that Level 1 also be included.
In terms of clarification of the terminology within CEOS WGCV and the participation of all sub-groups, an ad hoc team comprising of one out of LPV, ACSG, IVOS and the Chair of WGCV have been assigned the following action:

AI WGCV-40-2

An ad-hoc team comprising one member out of the subgroup LPV, IVOS and ACSG and the CEOS WGCV chair shall recap the terminology needed for validation metrics and formulate along the LPV validation metrics a coherent validation metrics for data products applicable in general with the starting point of individual satellite data products. This shall be developed such that the metrics can be extended in a follow-on step to the requirements of time series / climate data records. Due date shall be CEOS WGCV plenary 41.

5 Session on Atmospheric Remote Sensing

5.1 Session motivation (chair)

The chair opened the sessions with a broad introduction of near-future atmospheric satellite missions.

5.2 The FRM approach: Pandora and TCCON (B. Bojkov/A. von Bargen)

On behalf of B. Bojkov, A. von Bargen presented the introduction to the FRM approach. During the presentation some examples were given:

A network of Atmospheric composition FRMs including FTR (FRM4GHG) and DOAS (FRM4DOAS) instruments is in the pipeline for Sentinel 5P, MTG, etc. There is some dual use envisioned for use in validation of atmospheric data products as well as for atmospheric characterization for land products.
Another working example is the ESA Pandonia network with more than 30 instruments in the near future.
In response to the request of T. Schroeder, Nigel Fox pointed out that FRM distinguish themselves from normal in situ measurements because they go the extra mile to be traceable, well documented, etc.

5.3 Sentinel 5 Precursor Product Validation (F. Gascon)

F. Gascon (ESA) introduced the Sentinel 5 Precursor (S-5P) mission including the TROPOMI instrument and the current status of mission implementation. Launch date will be around End of October 2016. He presented also some insight into the pre-launch characterization campaign and emphasized also on the planned validation activities. The latter was the purpose of a dedicated workshop in September 2015. Currently, several validation activities are in implementation.

5.4 Sentinel 5 Precursor Product Validation (J.-C. Lambert)

The presenter provided insight into the planned validation activities of the Belgian community in cooperation with different other entities in Europe and the USA. He pointed out that validation requires the coverage of the full range of measured values and all conditions under which these may be measured at an appropriate sampling rate. There is a distinction between research mode validation and operational validation, where the latter requires near-real-time (NRT) and fully automated data in order to provide a quick feedback for correction measures.
One project uses data assimilation of level 2 products to compute backwards emission rates, partially to detect problems with the level 2 data.
Another effort is targeting the set up an operational validation flow with (semi-)automated reporting.

5.5 Sentinel 5 Precursor Product Validation (A. von Bargen)

A. von Bargen of DLR pointed out that DLR is organizing the German validation contributions in complement to ESA validation efforts. It ensures that there is a participation in the frame of FRM4GHG and FRM4DOAS. Germany will fund several proposals both for operational validation as well as research mode validation of different research entities in Germany.

5.6 ADM Mission and Cal/Val (F. Gascon)

Aeolus mission is to improve the quality of weather forecasts by providing information about the wind profile, primarily. It is a UV lidar with Mie and Rayleigh backscatter spectra to determine the wind speed along the line-of-sight direction. The primary level 2b product is the horizontally projected line-of-sight (HLOS) wind profile. Spin-off products (level 2a) are cloud and aerosol properties. Several Aeolus preparation campaigns made use of a demonstrator. A draft Cal/Val implementation plan is currently under review.

5.7 ADM/Aeolus preflight campaign (A. von Bargen)

Due to time restrictions, the presentation was limited but details can be found in the presentation file. It contains the overview and preliminary results of the Aeolus preparation

campaign carried out by DLR, ESA, and NASA. Instrumentation was provided and flown by DLR (ADM Aeolus test model) and NASA.

5.8 Airborne systems: IAGOS and GLORIA (J. Ungermann)

Jörn Ungermann of Research Center Jülich presented the compact measurement systems flown on an Airbus A 330/340 model by different carriers in the network IAGOS. This network includes also CNES, DLR, and others and provides continuous measurements of different trace gases along the flown trajectories for the past several years (and the coming years).
He also introduced the Limb profiler GLORIA which can be operated so that a tomographic profile of the atmosphere can be recorded. Such a tomographic view will provide new insights into the understanding of dynamics in the atmosphere. GLORIA will be used also during different campaigns onboard the research carriers GEOPHYSICA (Russia) and HALO (Germany) to validate S5P data products and later S5 data products.

5.9 Andoya (V. Lonar Barth)

Ms Barth presented the Norwegian base in Andoya which includes also ALOMAR. ALOMAR uses several LIDARs to derive tropospheric aerosols, ozone, clouds, and water vapor. The Norwegian Institute for air-research (NILU), ALOMAR and the Norwegian Meteorological institute in Norway plan to validate data products from S-5P and ADM/AEOLUS. A brief update was given on these validation plans which also include methane in the Arctic.European Cal/Val Projects (J.-C. Lambert)
The QA4ECV is a project for the quality assurance for essential climate variables. The goal of GAIA-CLIM is to improve our ability to use ground-based observations to characterize satellite observations for several atmospheric ECVs. Some work packages are dedicated to the proper comparison of data gained by different measurement geometries and the feedback of data assimilation to level 2 quality.
An important question being treated on a QA4ECV Land-Atmosphere-Workshop was on the limitations applying to the inclusion of BRDF in RTMs and the impact of thermal infrared surface emissivity uncertainty on trace gas retrieval.

5.10 JAXA Atmospheric validation (A. Kuze)

For the validation of carbon products, an annual inter-comparison between GOSAT, carrying the sole Fourier-transform spectrometer, with OCO-2 is performed. The BRDF correction is the largest uncertainty in cross calibration. Thus only measurements with small BRDF differences are selected. Applying further corrections, the OCO-2 and GOSAT spectral radiances agree with better than 5%. Some interesting results of first steps towards emission inventory are the result that the US seems to emit 30% more methane than determined in the 2012 EPA report.

6 CEOS Chair's Initiatives

6.1 Future Data Access (T. Cecere)

No presentation was held, because the presenter's devices were corrupted during travel. Instead the following email was provided to the audience.

The report will consist of a description of the historical aspects of satellite agencies providing access to the data and the evolution of architectures and technology leading to the current situation.
The report will then explore what is changing and how organizations are starting to respond. The move/push for space agencies to provide Analysis Ready Data is one of the most significant developments - with respect to this we will explore commonalities and make recommendations as this applies to CEOS. We see strong ties to ARD and the work being done by the LPVSG.
Other areas to be explored in the report are being able to work with multiple modalities (various CEOS satellite data plus DEMs), and the ways that users will expect to be able to discover and access data in the future. We are also discussing the impact of Cal/Val and the timeliness of being able to provide ARD in near real time.

6.2 Non-meteorological Applications for Next Generation Geostationary Satellites (T. Schroeder)

An ad hoc team was established a few weeks ago and is envisioned to last for one year with reporting to the CEOS plenary. The team is supported by 14 CEOS agencies.
Several GEO/LEO located satellites offer comparable spectral bands in the VIS-IR spectral region offering the ability to look at ocean color. With Himawari 8/AHI, the full disk of earth is sampled every 10 minutes, with some special regions sampled even more often. There was already a Japanese-Australian workshop on this topic with more than 50 participants.
Several non-meteorological applications for Himawari-8 were identified.
This NMA study should eventually detail trends and outlooks for GEO/LEO satellite capabilities, an inventory of relevant non-met applications, benefits of synergistic use of GEO-LEO systems and recommend the way forward for CEOS and its agencies.

6.3 Non-meteorological Applications for Next Generation Geostationary Satellites (I. Grant)

GEO/LEO satellites have complementary observation characteristics. Data fusion could combine the LEO fine spatial resolution with the GEO fine temporal resolution. This obviously necessitates inter-calibration. The presenter provided an example of joint GEO/LEO retrieval of aerosol and surface BRDF from a CSIRO study which will be further developed in collaboration with JAXA.
In response to the request about GEO data availability, it was stated that all BoM GEO data are available in netCDF4 format.
Changyang Cao mentioned that there are some effects due to differences in orbit and angles that have been analyzed in GSICS.
M. Roman also mentioned that there is a problem with combining measurements of different spectral resolution with respect to their error budgets. This however is not necessarily a problem when combining LEO/GEO data, if their spectral resolution matches.

7 Carbon Action Items

7.1 Introduction

The chair provided an introduction to the genesis of the Carbon action items and their relation to CEOS WGCV. During the recent CEOS WGCV plenary a small ad hoc team had been formed to sort out the tasks related to the Carbon Action items for CEOS WGCV.

7.2 Status of Carbon Action Items

There are currently 14 actions from Carbon Strategy relevant to WGCV, which are not easily mapped on actual actions for WGCV. Instead the overall action items have been broken down into smaller sub-tasks, which could remove overlap and simplify work for the WGCV. Some of the sub-tasks could be delegated to WGCV subgroups.
The next steps would be to carry this process through for all WGCV action items. The question is, whether to have fewer action covering broader topics or more actions having specific topics.
The subtasks could also be used to achieve a win-win situation with the objectives of CEOS WGCV which will be highly appreciated on CEOS plenary level.
It was unanimously agreed by all attendants that the presented approach to break down the action items carefully into smaller sub-tasks and identifying coincident tasks in different action items shall be followed. It was also agreed that it is better to have a thorough and maybe more time-consuming analysis allowing then easy block-building instead of starting large tasks in different groups and teams.

8 Joint Meeting Preparation

The preparation of the joint meeting included summarizing the findings of the discussions which had taken place already. The update of the GEO work plan will be presented tomorrow by GEO. Currently, no dedicated activity can be found for CEOS WGCV but it may happen that CEOS WGCV will be involved indirectly in some of GEO tasks. This shall be identified during the joint WGCV/WGISS meeting. All other items had been summarized in slides which will be presented and discussed tomorrow during the meeting.

Wednesday, March 16th, 2016

9 Joint CEOS WGCV / WGISS Meeting

See separate minutes

Thursday, March 17th, 2016

10 Land Surface Remote Sensing

10.1 Introduction (Chair)

The session was started with the chair summarizing the activities of the last days and thanking the organizers for the perfect social event of the preceding evening. The vice-chair took over and introduced the following presentations.

10.2 FRM for Surface Radiation (N. Fox)

The aim of this ESA sponsored activity is to establish and maintain SI traceability of global Fiducial Reference Measurements (FRM) for satellite derived surface temperature product validation and help develop a case for their long term sustainability. The idea is to employ different radiometers to measure radiance under identical conditions both in the laboratory and in the field. A full uncertainty evaluation is to be provided.
The radiometers will be calibrated in the lab against standard blackbodies for a range of temperatures, and also employed blackbodies of the instruments will be calibrated against standard blackbodies. Outside the laboratory, the radiometers will be compared on ice

(Greenland), sea surface and different vegetation forms and surfaces in UK, and desert (Namibia).
To be considered "fiducial", participation in this activity is required. A workshop on the results will be held at NPL in UK in March, 2017, which will be announced through CEOS.
A question from the audience relating to how participants qualify for the workshop, was replied with the answer that a particpant's desire to take part and the ability to do so are all that are needed.
Action item WGCV-40-3:
Nigel Fox shall provide input regarding the workshop to the CEOS WGCV secretariat for the workshop announcement on the ceos.org website. Due date: CEOS WGCV plenary # 41.

10.3 RadCalNet Status (N. Fox)

RadCalNet is a new network of instrumented sites dedicated to the radiometric calibration of EO optical sensors. The RadCalNet objectives are to define the detailed architecture, to demonstrate an operational concept with the currently available infrastructure and resources, and to provide recommendations to CEOS/WGCV/IVOS and CEOS/WGCV for evolution of RadCalNet towards an operational network.
NASA (Railroad Valley Playa), CNES (La Crau) , and CAS-AOE (Baotou) have each offered a site, while ESA is currently identifying a fourth site to be operated jointly with CNES. This vision is that site owners are responsible to provide surface reflectance and atmosphere products that are delivered every 30 minutes to central database and disseminated by the RadCalNet portal. RadCalNet sites are required to provide data in 30 minute intervals, 9 am to 3 pm local standard time, nadir view only, and in 10-nm intervals at least between 400 nm and 1000 nm and possibly beyond (up to 2500 nm). The portal, operated by Magellium with support by NASA, exists but is not open for public, yet. In June 2016 a closed 6-month beta shall be started. Beta users will be limited to those having CEOS membership and operating a satellite sensor that is suitable for use with RadCalNet.
RadCalNet is intended to be an operational network. As such it is open to further member sites, but only if the specific requirements, e.g. of yearly review, are fulfilled. At this moment an inter-comparison is being done between Landsat-8/SPOT-5/Sentinel-2 to demonstrate the RadCalNet concept and identify differences between sites.
Grant: The site size of 50m might top-of-atmosphere not be very useful for instruments with a large footprint. ***Fox***: What is listed are the base requirements as a starting point. Sites may naturally surpass these requirements and offer larger sizes.
von Bargen: What about the long-term funding of the activity? ***Fox***: The continuation is obviously dependent on the good-will of agencies.
Gascon: Will all four sites be operational during the beta phase? ***Fox***: One site will open 1-2 month later.
Stensaas: Would a site fulfilling all the requirements be added? ***Fox***: Yes, absolutely, after the end of the beta phase. The purpose of the beta phase is more to check on the functionality of the processing chain and the portal.
The previously mentioned activity to locate a fourth RadCalNet site in Gobabeb, progresses. One needs to be careful when installing equipment on the ground to not impact the site homogeneity too much. After examining several candidate local site locations, the precise location of the future RadCalNet site was selected.

10.4 RADCALNET in WGCV: Way forward (K. Thome)

Near term activities involve the inter-comparison of well-understood sensors (Landsat-7, Landsat-8 and SPOT-5) at given sites to evaluate key differences to determine site-related impacts. The uncertainties shall be characterized to determine the uncertainty on a day-to-day basis for atmospheric and viewing geometry conditions, so they can be assembled in look-up-tables for more exact characterization of acquired data. Before going public in the first quarter of 2017, the fourth site has to be completed, the documentation has to be consolidated and the portal has to be tested during the beta phase.
The process for adding new sites within the CEOS WGCV was proposed. A panel made up of five CEOS WGCV members shall collect the submissions and decide upon a recommendation to the CEOS WGCV plenary. It was pointed out that the membership in the panel shall be coupled to member's expertise and not to positions in a CEOS body.
The RadCalNet membership criteria were revisited. For example, for the desired parameters, no specific instrumentation is required, instead, just figures with sensible error bars needs to be supplied.
M. Ross commented to add further aerosol parameters such as particle size in order to complete the atmospheric correction validation if it relies on aerosol optical thickness only.

10.5 Baotou Validation Site (NRSSC)

The Batou site is located in Inner Mongolia, China, comprising a flat area of ~300km2 with a wide range of land covers in a cold, semi-arid climate. Several artificial targets were constructed by natural gravels of different spectral reflectance for the purpose of radiometric calibration and spatial performance assessment. A target also using also flat concrete plates for microwave and optical image resolution assessment is also available. 75 geometric control point targets are placed to determine positional accuracy.
The high-accuracy stepwise Cal/Val system aims to develop a chain that transfers the benchmark from laboratory to space-borne sensors. In order to obtain the "truth" of ground scenes and targets, the Stepwise Cal/Val system are integrated and some standard payloads are still under-development. An automated reflectance spectrum measurement system was established that automatically measures the surface reflected spectral radiance with a spectro-radiometer; after determining the TOA spectral radiance, the working status is adjusted according to weather conditions.
A series of scientific flight campaigns were carried out on Baotou site with more than 11 airborne and 12 spaceborne sensors.
In future, it is planned to continuously improve the capacity of automated radiometric calibration and contribute to the "global calibration" of EO through RADCALNET. Further, the capability of land product validation based on the infrastructure of Baotou Site shall be enhanced by more ground scenes, more measurement instruments and a better quality control. In 2016, an evaporation and soil moisture observation system will be installed also aimed at modeling activities.

10.6 TERENO network (J. Ungermann)

The presentation provided some insight into the TERENO network which provides validation data and material to interested user.

10.7 LSI Status (T. Cecere)

The LSI-VC has been newly founded with the task of furthering the use of LSI. T. Cecere presented the draft work plan task.

First, the visibility of land surface imaging data holdings shall be increased, e.g. by working together with WGISS to list relevant datasets to ensure visibility through CWIC. An equivalent to the GFOI Space Data Portal shall be established.
Second, gaps in/opportunities for acquisition planning in support of the CEOS Carbon Strategy shall be identified.
A third important task is to define intercomparable analysis ready data (ARD) products with the context of land surface imaging (e.g. according to USGS, an ARD product consists of Landsat Top of Atmosphere (TOA) Reflectance, Surface Reflectance, and Brightness Temperature). An example for such a product was given by showing the proposed future global data flow options for National Forest Monitoring Systems.
Fourth, an engagement in the implementation of trial data cubes is planned.

10.8 TERN (A. Held)

TERN's Vision is for an Australian ecosystem science community that has undergone transformational change - from one in which effort is frequently fragmented, duplicative and short-term, to one that is national, networked, and delivering for Australia's future.
The situation is similar to Europe, where users are confused by many different products with similar access procedures to level 3 type of products.
The original concept, "facility", consisted of a remote sensing data delivery backbone (solving issues of data form, interoperability, delivery), a data production network (nationally-consistent, including metadata, documentation …), and a ground validation program and instrumentation.
The activities are "glued" together by the AusCover Team and Network that aggregates all the data and institutions. Over 50 data products can be accessed by the data discovery portal.
There are several TERN Supersites and other validation sites for high-spatial resolution remote sensing data collection. It is actively worked on improving best practices for validation. Some experimental techniques cover DWEL laser scans at different wavelengths, determining the 3-D point cloud from UAVs, for example to determine fine-scale canopy height, multispectral UAV imaging of supersites, and UAV LiDARs.
Gascon: Some of the sites are interesting for being LPV core sites. ***Roman***: How far is AusCor with automated web services? This is important because if the data is only available through manual methods, it is not very useful. LPV can help with standard and open software. ***Held***: We try to make the data easy to access. We are interested in having as many people use it as possible.

11 Interaction with Other Entities

11.1 Cooperation with LSI / discussion

The LSI-VC had its first meeting in late February this year and the results have been summarized above. However, the discussion about interaction with LSI-VC was mainly driven by the definition of Analysis Ready Data (ARD).
During the discussion following points were raised:
ARD will come to fruition quickly due to ongoing activities with GA with respect to data cube applications for Landsat-8 and Sentinel-2 data
The term of ARD might be differently defined for different products, for example, for land surface different quantities are relevant than for ocean color.

The starting point of ARD is that the data volume of EO is now in the area of Big data. Product complexities are difficult for many users to handle; they just want easy access to data that do not require additional processing for their applications.
It was observed that some agencies use TOA brightness temperatures for estimation of extent of drought. This is something which should be discouraged – only downstream products should be used for.
However, it was concluded that the general definition of an ARD is not a direct objective of CEOS WGCV but CEOS WGCV can support if some input is needed with terminology consistency especially related to Cal/Val.

11.2 Ocean Color – Status

The status of the Ocean Color discussions had been reported during the IVOS subgroup report.

11.3 Interaction with WGClimate (A. von Bargen)

Von Bargen gave an overview on recent activities of the Climate working group. Current activities of WGClimate are an update of the ECV inventory in cycles (current cycle will be now #2), a gap analysis of the ECV inventory, and the Carbon Strategy implementation. There are two major points for interaction between WGClimate and WGCV: the support in the ECV gap analysis implementation and the provision of general support to the definition of the "quality/uncertainty column" of the maturity matrix recurring also for QA4ECV. This point has been widely discussed also during the agenda topic on validation metrics. The validation metrics have been broadly presented to WGClimate pointing out that a coherent definition in WGCV for the validation of individual level 2 data products will be first required before populating a maturity matrix in cooperation with WGClimate can be done during the ECV inventory update cycle # 3. For that reason the above action item (WGCV-40-2) had been introduced under agenda topic “validation metrics”.

12 Agency Reports II

12.1 BelSpo (J.-C. Lambert)

A short update on EO missions and validation activities was provided. This included also:
The Altius limb sounder on a PROBA platform was approved recently with phase B2 being imminent.
The SOLAR instrument on ISS/Columbus continues to provide solar irradiance spectra. A Workshop took place in Uccle in March with 30 participants.
A new NDACC/TCCON FTIR will be installed in Porto Velho, Brazil, due to is important with respect to biomass burning and carbon cycle in Amazon rainforest and due to the low data quality of in situ and satellite measurements in this region.
In addition he provided further information about validation activities, their publication and documentation. (see presentation)

12.2 DLR (A. von Bargen)

As largest contributor in Earth Observation programs of ESA and EUMETSAT, Germany understands its National Earth Observation Space Program as a complement and seeks to be supportive to the European programs.
The launch date updates for the future missions and missions under implementation can be taken from the slides. Further information about the data quality for TanDEM-X was

provided. TanDEM-X provides an absolute height error of 1.3m (90% LE). It greatly improves both coverage and accuracy of previously available data. Mission is in close operation, though not in tandem information anymore. 80% of data processed so far to be completed in mid-2016. As a demonstration of its capabilities, a temporal deforestation example was shown indicating that a more global data set is in preparation.

12.3 ESA (F. Gascon)

With respect to the Earth Explorer missions he reported that CryoSat-2, SMOS, SWARM are operating nominally while the ADM-Aeolus launch is planned for the third quarter of 2017, EarthCARE for 2018, BIOMASS for 2020, and FLEX for 2022.
Regarding the Sentinels, Sentinel-1A has been operating nominally the past two years. Sentinel-2A was launched on 22 June 2015 and is operating nominally. Sentinel-3A launch was successfully carried out on 16 February 2016 and is now in the commissioning phase. Further Sentinels are to be launched on 22 April 2016 (Sentinel-1B), in the fourth quarter of 2016 (Sentinel-5P), and the first quarter of 2017 (Sentinel-2B).
Activities regarding Fiducial Reference Measurements are currently carried out by Pandonia network and FRM4STS. Further FRM activities are in initiating phase: FRM4SOC (Radar), FRM4SAR (SAR), and FRM4ALT (Altimetry) activities.
With respect to Sentinel-2, the data quality is meeting or exceeding specifications. Global reference images for Europe and Australia are basically completed; work on other continents is ongoing.

12.4 Angkasa

Due to difficulties with the remote line the presentation could not be held. CEOS WGCV invites Angkasa for further participation.

12.5 ISRO (M. Arundhati)

A remote presentation gave an overview over the primary remote sensing missions of the last 20 years. There is a history of both non-imaging (with Scatsat as next launch) as well as imaging sensors including the joint NASA-Indian NISAR mission in 2020.
India operates a series of EO satellites, observing land and water, ocean, and weather. There are also several high-resolution mapping satellites.
Calibration and Validation for SAR activities, but also for other Indian satellites is performed. There is a clear feedback loop between the mission operator and the stakeholder in India. The primary purpose of ongoing calibration activities is to increase the accuracy and, thus, decrease uncertainty.
A CEOS qualified radiometric calibration reference site in Amazon rainforest is used as a large-scale distributed target. There are also calibration sites in India, where trihedral corner reflectors were placed. The scattering parameters of different plants are measured by ground based instruments and built into radiative transfer models and compared to satellite measurements data. Discrepancies are followed up. There is a Cal/Val Site in Kamarhatty with an ocean site that is well instrumented with several types of instruments. With respect to future SAR projects, there are several L and S band SAR campaigns in the nearest future. Indian validation sites had been identified. Finally, a quick overview about the ScatSat calibration activities was presented.

12.6 NSSC (X. Dong)

A brief overview of the history and organizational structure of the NSSC was given first.
There are four space science missions being launched in this and the last year.
He provided an overview about missions for Earth Observations which will be launched this year (TanSAT) and the coming year. Those are not only implemented by NSSC, but also by the Civil Space Infrastructure of China (CSIC).
The HY-2 series of satellites corrects for more errors (especially ionosphere) and is thus more accurate. Cross-calibration with JASON-2 shows a standard bias of less than 5.8cm. Further calibration experiments with GNSS-buoys for Radar altimetry calibration are performed. The Chinese Ocean Salinity Mission (HY-4) is estimated to launch in 2019 and will combined two microwave imagers to provide salinity, ocean surface roughness and Sea Surface Temperature. FY-3 is a series of microwave humidity sounder, where currently FY-3B is operational. Its performance is nominal and stable. CFOSAT combines a rotating fan-beam scatterometer with multiple beam radar. It is expected to be launched in 2018. FY-4A is a geostationary optical satellite to be launched in 2016. WCOM will carry an interferometic microwave imager, an polarimetric microwave imager and a dual-frequency polarized scatterometer to measure soil moisture, ocean salinity, snow water equivalent frozen-thaw, and ocean surface evapotranspiration to be launched in 2020.
It is worth noting that a microwave standard calibrator is under development.

Friday, March 18th, 2016

Day 4 wrap-up (chair)

Before the start on new topics, the chair presented an overview over the presentations and discussions of the preceding day. The CEOS chair who was in attendance, was thanked for being so available for discussion with the different working group chairs.

13 Internal Business

13.1 CEOS WGCV ToRs: Introduction / Motivation (Chair)

There are several changes within CEOS within the last five years that require adoption of new ways for the Working Groups, including WGCV, to document their methods.
During WGCV #39, it was found that the WGCV work plan is a mixture of terms of references (ToRs) and an actual high-level work plan. Thus, a split into a rather clear ToRs and an adaptable work plan is recommended. The ToRs were extracted by the chair from the work plan, adapted to the current state of affairs, with some changes for consistency and simplicity. The split ToR and work plan was discussed with the vice-chair as a pre-requisite for drafting. An advantage of this split is also that the work plan can be changed without involving the CEOS plenary in contrast to changing the ToRs. However, it should be also kept in mind that during last year a new working mechanism was introduced which shall be also included in the ToRs and the work plan.

13.2 CEOS WGCV ToRs discussion

The draft of the ToRs was then discussed intensively by carefully checking section for section the ToRs.
The following summarizes the discussion:

- The draft was mostly taken in parts from the former work plan with adding some edits, re-phrasing, and adding some new working mechanisms (task teams, ad hoc teams).
- The baseline for discussion was rephrased in some details by the Vice-chair without changing the original draft which was distributed before the plenary. (see draft 0.2)
- Some minor edits for clarity were introduced, for example Satellite-based Earth Observation instead Earth observation. The reporting was consistently clarified in section 2 regarding the chair and the sub-groups which includes also the communication of dates of meetings.
- A sentence will be added to ensure the transition of secretariat from one agency to the other.
- The vice-chair nomination had been clarified with respect to the governance of CEOS.
- Because the subgroup chairs are voting during the vice-chair nomination process in accordance with their subgroup members, the information flow about the candidates must be ensured. For that the subgroups shall be informed before nomination with relevant information about the candidate including CV. It was also clarified that the current Chair will become the future interim Vice-chair when no nominee can be found. The interim situation should be resolved until the coming WGCV plenary together with CEOS Chair and SEC.
- Because the current subgroup does have different internal structures it was agreed that instead of having as lead for a subgroup a chair and a vice-chair, the ToRs shall be re-formulated so that a subgroup is led by a chair with a vice-chair or with co-chairs.

It was discussed why GSICS had been explicitly mentioned in context of the relationship to external bodies. The Chair emphasized that this relationship is special because it points directly to an entity which is engaged in calibration of Satellite Earth Observation data as CEOS WGCV as well, and a special relationship had been established on different levels of cooperation. However, it shall be re-phrased to GSICS-GRWG instead GSICS, only. It is also worth noting this in the ToRs to emphasize this against the higher-level CEOS management. It was agreed that the Chair and Vice-chair will circulate the re-phrased updated draft to the audience until end of April 2016. Afterwards, the members of WGCV shall have the opportunity to comment for one month time. Chair and Vice-chair will clarify the comments together with the originators and circulate an update which becomes approved after two weeks, if no further objections against this update have been raised.

AI WGCV-40-4: CEOS WGCV Chair and Vice-chair shall circulate the meeting update of the draft ToR until end of April 2016

AI WGCV-40-5: CEOS WGCV members are requested to comment on the updated ToRs until end of May 2016. Comments are clarified with Chair and Vice-chair.

AI WGCV-40-6: CEOS WGCV Chair and Vice-chair circulate the final draft June 15th, 2016, which becomes finally approved by CEOS WGCV if no further objection is raised until June 30, 2016.

13.3 Outline Work Plan Structure (Chair)

After the discussion of the ToR, the outline of the work plan was discussed on basis of the given presentation. The WGCV unanimously agreed to follow this outline for the work plan.

Implementation of task teams (Chair)

The Chair introduced briefly the idea of task teams as it was also documented in the draft for the renewed ToRs

AI WGCV-40-7: CEOS WGCV secretariat is drafting a work plan until CEOS WGCV plenary 41.

13.4 Task team 1: ACIX (F. Gascon / all)

ACIX is an international collaborative initiative to inter-compare a set of atmospheric correction (AC) processors for high spatial resolution optical sensors with a focus on Landsat-8 and Sentinel-2.
The free and open data access policy to Landsat-8 and Sentinel-2 imagery has stimulated the development of several Atmospheric correction models and ACIX shall inter-compare these to identify strengths and weaknesses. The objective shall be achieved by first defining an inter-comparison protocol that will then be applied to the Atmospheric correction models. Last, the results shall be presented and discussed in a workshop with all participants.
Fox: In reply to the question of how specific will the input conditions for the models be specified, it was stated that ***t***he AC will be fed with satellite data plus any kind of ancillary data they require. The output will then be compared with each other and with FRM. It is required though that no image specific adjustments shall be made to the images.
The test sites are to be defined at the first workshop, whereby several candidates and requirements have been prepared. With respect to employed metrics, the first step in inter-comparison is the validation of aerosol optical thickness and water vapor products (which can be compared to AERONET data). Only then, the inter-comparison of surface reflectance is performed.
The first workshop will take place in June 2016 at the University of Maryland Research Park, the deadline for registration having already passed. The 2nd workshop, where the results are going to be presented, will take place approximately six month later.
The expected outcomes are a description of concept, protocols, and procedures for the inter-comparison, an assessment of the relative difference among the AC processors and FRMs, a definition of key sites and regions for the inter-comparison.
Comments:
Kurt Thome: (a) One should be careful to include test sites that will show a strong dependence on the Atmospheric correction. (b) Is the aerosol optical depth an input parameter for all the AC?
Answer Some processors still work purely empirical, e.g. by looking at the darkest pixel.
Jonathan Ross: Will this activity lead to an Atmosphere-corrected level 2A product?
Answer: First, the Atmospheric correction models shall be simply inter-compared. There is an Atmospheric correction model in the toolbox for users, but an official level 2A product requires in case of Sentinel-2A (a) a proper selection of an Atmospheric correction model and (b) a decision by the European Commission.
The task team implementation plan had been unanimously agreed so that the task team is approved by CEOS WGCV.

13.5 Task team 2 "Cloud masking" (B. Bojkov)

Unfortunately, the presentation did not arrive in time so that the presentation and approval of the task team had been move to CEOS WGCV plenary 41.

13.6 CEOS WGCV web page concept (Secretariat)

The chair provided an update about the different existing web-sites which represents the work of CEOS WGCV. He emphasized also the aspect of maintenance and sustained funding of each.

It turned out that the drafting of a concept is currently not ready because of the complexity of the task and the availability of the secretariat.
However it was recommended by the audience that a web page concept shall include a newsletter. This was discussed also under the aspect that it requires an editor and staff. News on a website can be generated much simpler, as only the news may be quickly published there**.** However, it**'s** a need to evaluate what would be the simplest way to disseminate our information to interested parties. It should be also taken into account that the website might be sufficient for CEOS WGCV, but for the people doing the work a newsletter might be more worthwhile.
The action item of WGCV 39 is further open but shall be refreshed by taking into account the opportunity of a newsletter to be included into the concept.

13.7 Action items (4) / status (Secretariat)

The status of action items will be checked off-line based on the discussions and the contents of the meeting and distributed with the minutes.
Meeting Close-out

13.8 CEOS WGCV Agenda plan (Chairs)

Chair emphasized that the agenda of the CEEOS WGCV is currently driven by setting up some internal means which allow demonstrating the output of the CEOS WGCV, the Carbon action items, and the cooperation with other CEOS entities on data quality topics beyond the emerging needs which are defined within the subgroups and task teams in terms of Cal/Val. There will be a more refined outlook in September during the coming CEOS WGCV plenary.

13.9 Date and Place of future meetings (Chair / Host)

The CEOS WGCV #41 meeting will be hosted by JAXA and take place from 5 September 2016 to 7 September 2016. The CEOS WGCV SAR Calibration & Validation sub-group Workshop will take place on the same site hosted also by JAXA from 7 September 2016 to 9 September 2016. The JAXA representative kindly presented the meeting place which is now well prepared to host the meeting. The Chair expressed the high appreciation of CEOS WGCV to host the coming plenary and the SAR subgroup meeting.

13.10 CEOS WGCV Summary (Chair)

The chair thanked everybody for such a fruitful meeting, especially the good collaboration with the WGISS. The vice-chair also remarked the productive atmosphere and the good progress on many of the discussed issues. Special focus will be given to allow more discussion if needed.
It was highly recommended to introduce to the plenary the other entities for the new members in CEOS. However, some source of information can be collected from the CEOS web portal.
The Chair also reminded the group that during the WGCV plenary the attendees had the opportunity to share the opinions of different other CEOS bodies during the sessions. This was possible, because many representatives of those entities were participants.

13.11 Concluding Remarks

The Chair thanked everyone for their attendance and also thanked CSIRO and GA for the very kind and smooth organization of the meeting. He expressed that it was a real pleasure to stay in Canberra.

With closing the meeting the members of CEOS WGCV are invited to attend the coming CEOS WGCV plenary at Denki University, Tokyo, Japan.

Appendix

List of Attendants

Given name	Surname	Entity	Role
Changyong	Cao	NOAA	
Thomas	Cecere	USGS	LSI-VC / FDHT
Arnold	Dekker	CSIRO	
Xiaolong	Dong	NSSC	
Nigel	Fox	NPL / UKSA	IVOS chair
Ferran	Gascon	ESA	
Ian	Grant	BoM	
Alex	Held	CSIRO	CEOS Chair
Hongyan	He	CAST	
Akihiko	Kuze	JAXA	
Jean-Christopher	Lambert	BelSpo	ACSG Vice-chair
Agnes	Lane	BoM	
Fuqin	Li	CSIRO	
Heguang	Liu	NSSC	
Vigdis	Lonar Barth	NSC	
Lingling	Ma	CAS / NRSSC	
Timothy	Malthus	CSIRO	
Arundhati	Misra	ISRO	remotely
Ross	Mitchell	CSIRO	
Cindy	Ong	CSIRO	
Miguel	Roman	NASA	LPV chair
Jonathan	Ross	GA	CEOS CEO
Thomas	Schroeder	CSIRO	NMA
Greg	Stensaas	USGS	
Matthew	Steventon	CSIRO	CEOS Chair team
Medhavy	Thankappan	GA	
Kurtis	Thome	NASA	CEOS WGCV Vice-chair
Matt	Tully	BoM	
Jörn	Ungermann	FZ Jülich	CEOS WGCV secretariat
Albrecht	von Bargen	DLR	CEOS WGCV Chair
Lan-Wie	Wang	CSIRO	
Xiaoxong	Xong	NASA	

Adopted Agenda

Action Item list CEOS WGCV plenary # 40

#	Action item	Assigned to	Due date
WGCV-40-1	WGCV Chairs will clarify in accordance with the roles and responsibilities in cooperation with OCR-VC and IOCCG [after having received the answer from IOCCG with respect to the IVOS statements]	CEOS WGCV Chair and Vice-chair	WCGV plenary 42
WGCV-40-2	An ad-hoc team comprising one member out of the subgroup LPV, IVOS and ACSG and the CEOS WGCV chair shall recap the terminology needed for validation metrics and formulate along the LPV validation metrics a coherent validation metrics for data products applicable in general with the starting point of individual satellite data products. This shall be developed such that the metrics can be extended in a follow-on step to the requirements of time series / climate data records.	CEOS WGCV Chair and subgroup chairs LPV, IVOS, and ACSG	WGCV plenary 41
WGCV-40-3	Nigel Fox shall provide input regarding the workshop to the CEOS WGCV secretariat for the workshop announcement on the ceos.org website.	Nigel Fox	WGCV plenary 41
WGCV-40-4	CEOS WGCV Chair and Vice-chair shall circulate the meeting update of the draft ToR until end of April 2016	CEOS WGCV Chair and ViceChair	April 30, 2016
WGCV-40-5	CEOS WGCV members are requested to comment on the updated ToRs until end of May 2016. Comments are clarified with Chair and Vice-chair.	CEOS WGCV members	May 31, 2016
WGCV-40-6	CEOS WGCV Chair and Vice-chair circulate the final draft June 15th, 2016, which becomes finally approved by CEOS WGCV if no further objection is raised until June 30, 2016.	CEOS WGCV Chair and ViceChair	June 15, 2016
WGCV-40-7	CEOS WGCV secretariat is drafting a WGCV work plan as outlined.	CEOS WGCV secretariat	WGCV plenary 41