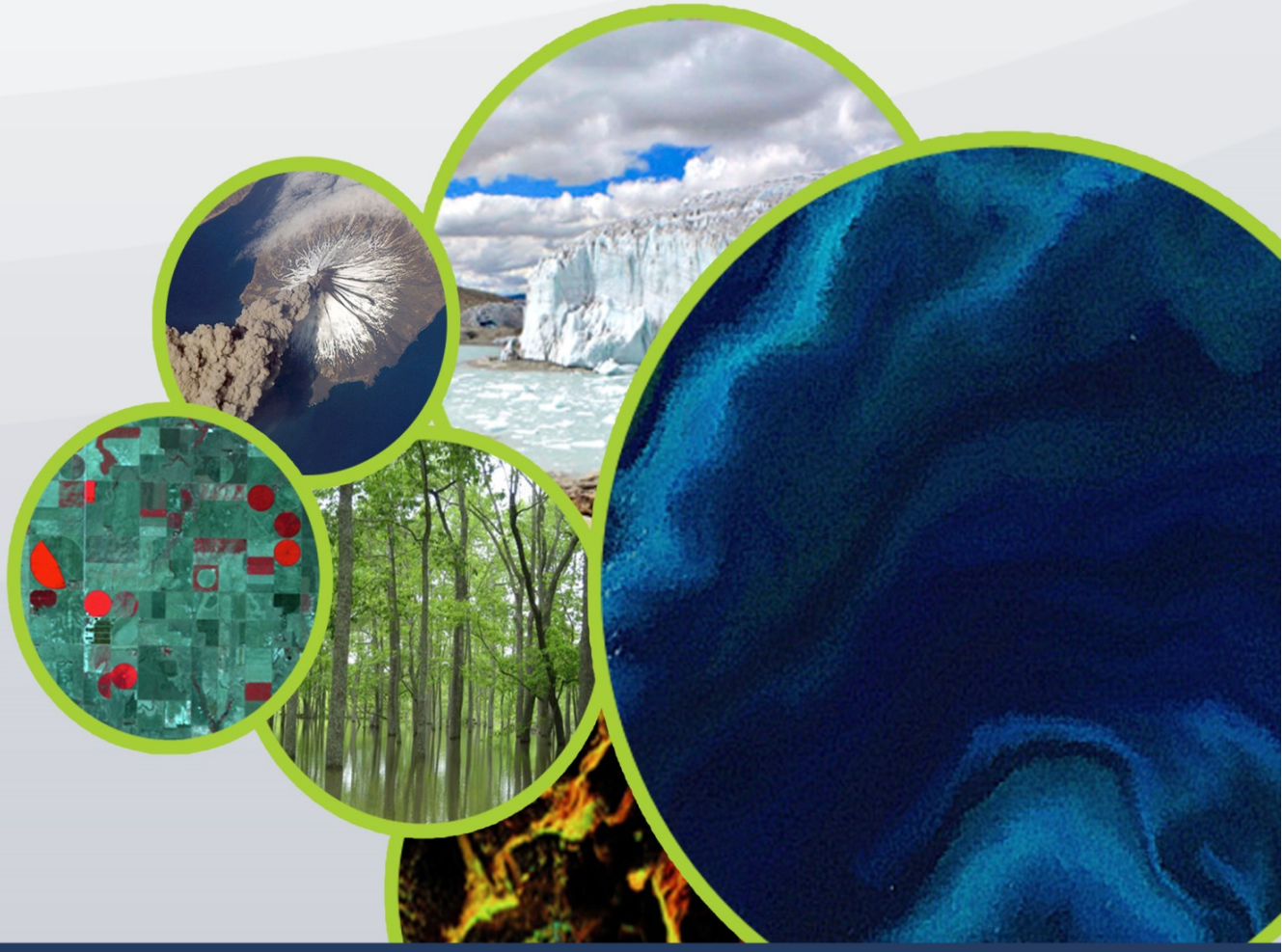
Committee on Earth Observation Satellites



Working Group on Calibration and Validation

CEOS WGCV #44 Minutes

Darmstadt, Germany - Hosted by EUMETSAT
Version 1.0 Sept 10th, 2018

Minutes for the WGCV-44 EUMETSAT, Darmstadt, Germany

Tuesday Aug 28

Following meeting opening and introductions, we began with an overview of EUMETSAT by our host.

Bojan Bojkov (EUMETSAT) –Welcome
Leads the remote sensing and products division that is responsible for the development, maintenance, and Cal/Val of all products.
No longer limited to meteorology, EUMETSAT is expanding, and their products have expanded to include both ocean and GHG.
An intergov'tal agency with 30 Member states that have extended beyond Europe, all of who have committed to long term programs and activities (on the order of 20-30y). EUM expects to expand further to include even more member states.

EUMETSAT exists primarily for weather forecasting, but they further contribute to operational climate monitoring, with a vision that is user driven. NWP performed by contributions from partner agencies with meteorological missions. ECMWF is a sister agency that focuses on weather forecasting and is the biggest user of EUM data.

In addition to serving member countries, EUM strives to achieve synergy with missions for benefit of member states.
Overview of current and future assets - Currently 11 satellites – 4 GEO (rapid repeat, 5-15 min), 3 LEO (global cov and NWP) - polar metop A,B - 4 joint satellites, Jason and Sentinel, MTG, EPS-SG

Supporting critical NWP
Copernicus
EUM satellite applications facilities (SAFs) are spread across Europe - 8 centers – EUM provides cooperation and oversight for these facilities that also distribute products.

Reviewed several satellite systems, providing optical, MW, and sounding sensors for various applications, and continuity planned for EPS 2nd gen beyond 2040. See slides for details.

KT: asked about freely available data
Central respository and SAFs distribute data. Data distribution to public isn't as smooth as NASA NOAA, but they are working on it.

Kurt Thome (NASA) – WGCV goals and overview
Develop collaborative activities.
WGISS is moving forward with ARD, we need to work with and support this effort.

We need to communicate key WGCV results to CEOS community – updating the web sites [both CEOS.org and ESA Cal/Val Portal (CVP)] to help us improve here.

Recognizes the need to update the Work Plan and close actions in preparation for Cindy take over.

Review of Agenda

Kurt Thome (NASA) - WGCV Chair's report
WGCV-43
Review of preparations for SIT tech workshop.

Review of WGCV presentation to SIT-33
Were asked about how we are progressing on Work Plan actions, particularly those related to ARD.
RadCalnet public release, ACIX report, Solar Irradiance Model, publication of LPV Supersites – were all major achievements
Synergies – CV-14, 17 18 19 each are moving forward in coordination with other groups.
Lots of activities and participation at meetings. Many people and institutions and countries represented.

Akihiko Kuze (JAXA) – JAXA report
Reviewed the JAXA satellite lineup.
Looking forward to GOSAT-2 launch
GCOM-C Since Dec 2017 – Greenland validation campaign
GCOM-W since 2012 featuring the AMSR-2 MW radiometer
GPM/DPR and GSMAP – showed hurricane activity and G-portal - new GPM web site

Planning for an AMSR-2 follow-on
ALOS-2 (L-SAR), products update ALOS-3 (optical) and ALOS-4 (L-SAR in development)

GOSAT- (2009-)
10 yr anniversary of RRV vicarious calibration campaign
Intercomparison of GOSAT and OCO-2 shows differences are small, variances are large. Differences noted in northern and southern part of the RRV site.

GOSAT-2 launch – shipped to Launch site Aug 20. Challenges of on-orbit calibration.

GS: re ALOS data availability.
Some is free and open, some is not, Kuze not sure.

Akihiko Kuze (JAXA) – Vice Chair goals
<u>Goals</u>
Share curiosity and understanding of the Earth from RS data
Fill gaps not filled by academia

<u>Actions</u>
Share cal/val, use airborne vert profile dynamics, on-board anomalies need to be captured from long term satellite missions, combining air Q and GHG obs w common techniques

<u>Challenge</u>
Val : GHG flux estimation w emission source & dynamics (wind is where we have the most uncertainty)
Contribution to understanding climate change: something only satellites can do

Kuze's experience includes 21-yrs w GOSAT
Int'l collaboration on cal/val – field and airborne, satellite intercomparison, cal/val @ RRV
Conquering non-linearity and anomaly on orbit for GOSAT – dealing w changes due to 3 shutdowns

MR: what working groups we would want to collaborate with going forward? - WG Climate

Steven Hosford (CEOS CEO – ESA) – CEOS work plan Status (remote presentation)
Updates/News
Priorities for 2018
A – Int'l CO2 and GHG emission monitoring
B – continue and progress our work w CEOS on data access and use
Both moving well

Leadership changes 2018 EC, 2019 Vietnam, WGCV Chair
Searching for Deputy CEOS EO
All CEOS chairs looking for replacement in 2020's

Discussed upcoming CEOS meetings – CEOS calendar

CEOS Work Plan – presented open Cal/Val deliverables
7-10 open to be completed this year, Updates due by Sep 30

2019-2021 Work Plan updated annually
November 9th requests will be made, deadline 14 Dec
1st version of plan by 25 Jan 2019
V1 released 20 Feb 2019
Asked members to please spend/allot time on inputs for Nov/Dec, and Jan/Feb
If linked to GEO Work Programme, please ID GEO WP items

Take away –
CEOS chair transition
CEOS SIT chair – NOAA until 2019, CSIRO/GA after that
CEOS work plan activities

MR: asking for more detail on the GEO identifier – Difficult to provide specific pointers to how to identify within the GEO Work Programme but can do this on a case by case basis.

Kurt Thome (NASA) – DEM update and discussion
DEM task team - Still open, not filled.
DEM differences will affect product intercomparisons

Terrain relief corrections needed, DEM required
Need a global product that is validated
Need to quantify geometric and radiometric implications for current and future EO sensors from the 10 to 30 to 90m DEMs

DEM task team objectives
Identified GMTED2010 (250m) - No others available that have been validated and are globally and freely available

NASA DEM (30m) available, but not validated
Lack of DEM experts willing and available to assess products

Need to add a cross reference of WGCV page for access to GMTED2010, will clear a WGCV-39 action

We continue to struggle to find someone to lead the DEM effort.
3 ideas

- Let the team fade away
- Recruit a non-expert lead and organize a DEM expert team
- DMIX – an exercise to define the impact of DEM choices rather than selecting the best DEM. Sentinel-2 study could be a model for this effort.

TM subgroup –

- Reorganize as Global DEM subgroup?
- Absorbed by another subgroup?
- Survey WGCV agencies for experts. If we do this, is this sufficient for a subgroup?
- Remember this can be led by a non-expert.

Finally – this is also an interoperability/ARD/data cube issue
Can we roll it into CARD4L efforts?

DEM Task team concept – keep or ??

PG: there is an ITT out for evaluating and providing DEM for Copernicus. Free and open DEM at 90m 30m, restricted, free and open in some regions (probaby EU). Would have to be purchased
SH: CARD4L and ARD interest – options also

- Restrict countries or agencies with access.
- Free and open 30m DEM – restrict users
- Do we need Agency buy in?

Role of WGCV is to evaluate the quality of available DEMs.
AVB: Focus on the impact of DEM choices.
MR: if we are going to procure such work, we will have to focus on the impact (and need)
NF: still need someone to lead the effort.
GS: this is a key interoperability issue.
AVB: need a concrete example of the benefit

Summary

- DEM is still vital and crucial to product accuracy (definition of free and open??)
- Path forward - Leverage Card4L/LSI-VC, how?
- Use the agencies involved with these

Will work with Greg to develop a plan relying on LSI-VC interactions to drive what areas of study make sense as a starting point for DEM Task Team

ACTION – Survey recent results from Surface Reflectance ARD efforts within LSI-VC to determine current DEMs being used.

ACTION – Draft an approach that could quantify the geometric and radiometric uncertainties from DEMs of varying spatial postings and vertical resolutions.

Albrecht von Bargen (DLR) – GHG validation
Current network TCCON - How to integrate WGCV into GHG validation
Additional activities

- COCON (KIT)
- EM-27
- COMET-1 campaign

Total carbon column observation network (TCCON)
Cal/Val reference for all GHG missions
RS of column GHG - GOSAT and OCO-2 (Total column CO2/CH4)
Network of ground FTIR stations, by diff groups w common standards, High-precision CO,CH4,
Column-averaged and in situ CO2 are hard to compare
Good distribution of the network in the N hemisphere, only a few in the south, need to extend this.

TCCON is not currently part of ICOS, ref for all GHG missions, cannot be filled by ground based obs.
Africa and S Amer not covered. Only a few stations are stable in the long term
All GHG missions plan to use TCCON. Thus a long-term solution is needed.
Still work to be done on calibration.
KT: Will current TCCON measurement approach suitable as an example for replication? –
Key is the investment in the network and other groups could join the network
BB: TCCON is currently the network for CO2 validation even though there are known issues with the approach with uncertainties. These taken into account through baseline measurements. Still best current with others possibly coming on line that will need to be evaluated.

Akihiko Kuze (JAXA) - GHG cal/val
Specs for Spectrometers
Why is calib of Spectrometers needed in GHG differential absorption spectroscopy?
We need to detect 1-2 ppm variation of 400 ppm of CO2 from space
Consider atmospheric absorbtion in radiance calibration
Non-linear correction, stray light inter-band registration matters
Larger footprint to correct photons
Vert profile. - There has been rapid instrument technical progress in the last 5 years

Discussed what is needed to validate each product. L1, L2/3, L4 - It is very difficult to validate.
Validation of vertical profiles. Usually from point sources.
Have data over RRV, but no profile data over mega-cities.

Validation of flux estimation
Regional and city level, still trying to find validation.
Wind speed and direction also difficult to validate, need for good validation data.

Challenges for Spectrometer calibration, Actions - Validation – FRM

What can WGCV do?
Upgrade existing CEOS sites
Intercomp GHG spectrometers, selection of sites
Dev list of databases for Cal, and useful web sites for Cal/Val

How to share cal data not on the web
Sharing field and airborne campaign info
Collaborate with Atmospheric Validation Data Center (AVDC) – see GHG white paper by D. Crisp
What is needed? Who will do it??

Multiple options for validation, but this should happen with in the ACSG.
An addition is needed for the work plan.
We may want to move from research to operations.
Look at the subgroup structure. How does this fit into the goals of the subgroups?

Discussion on how to make progress on the workplan item for GHG validation.

KT: summarized that this is for the Work Plan and that we are proposing that this effort can take place within the ACSG.
BB: raised that EUMETSAT supports the GHG validation initiative. Described how the work could take place in the ACSG and this was based on discussions previously with Thome, Kuze, Bojkov, and von Bargen. Subgroup activity allows involvement of non CEOS-agencies. Effort would need to determine changes in the ACSG structure would be needed. Goal would be to reorganize in the next couple of weeks
MR: offered up the experience of LPV and how it involves broader level of expertise and to do it in a strategic way and focused.
NF: raised the issue of where the boundaries are between the subgroups and issues related to where groups go for information
BB: was firm on response that it needs to start with ACSG because of the GHG
MR: suggested issue is not a large one because it depends on the definition of the products
Vigorous discussion on this and clearly need to keep track of how this is handled especially with the test sites
ACTION – ACSG Chair to provide a proposed reorganized structure to ACSG to accommodate the validation of GHGs as part of its effort

Akihiko Kuze (JAXA) – Cal/Val for GHG observation spectrometers
Recent GOSAT observations.
Can we get OCO-2 to target the Namibia, Bautou, and Dunhuang sites. (RadCalNet)

Decade long dataset and new research products
GHG trend viewer tool.
Plan for 2018, to create a long-term research product of partial column and AIF of selected targets: mega cities, calibration and validation, point source data

GHG satellite constellation - GOSAT, GoSAT2, OCO-2, Sentinel-5p
Plan for 2018 - matched up dataset

Flux estimation
GOSAT long term renewal of CH4
CH4 flux has large errors
Optimized observation pattern to detect various emission sectors of CO2 and CO4

Nigel Fox (NPL) - RadCalNet Status
Portal opened in July
Site open and providing data.
TOA nadir view
Provided a review of the web site, what is available, how to contribute a new site.
Operational - users are visiting, showed visitor stats.

- 16 new users in the last month and now a total of 179 users

Kurt Thome (NASA) – Sites and definitions
Would like to provide a global integrated network of calibration sites
Make test sites available. (available in what sense?)
Reviewed USGS test sites.

WGCV-42 – What to do with LandNet?
Not currently supported and useful.
Push for interoperability and ARD making them more important
The test site concept is changing.

Proposes a map and test sites listed w coordinates
Each site has a description/properties. Purpose1, purpose2, link to more information

Do we adopt site hierarchy that Nigel proposed? (needs amendments)
GS: pointed out that Landnet originally was to provide processes for using test data as well as to motivate teams to collect data at those sites
MR: commented that the historical nature of Landnet and the archive of imagery for those sites suggests maintaining connection to the data for those using older sensors
PG: raised the issue of the confusing nature of Landnet and what it refers to. The idea of having a set of sites that are used for land is useful though it becomes confusing as to how to incorporate non-land cases and this is one example of the issue with Landnet.
JN: asked whether the test sites need to be CEOS sites or whether they can be less formal.
A bit of discussion on the term supersite and the overuse of the term supersite
GS: suggested that a small group be gathered to create a list of WGCV test sites for WGCV-45 with the group creating an initial set of definitions for test sites.
NF: suggested a definition exists based on the IVOS/LPV communication on supersites
ACTION- A small group of WGCV membership (3 to 5) to be organized to propose a labeling and web hierarchy for WGCV test sites.

Kurt Thome (NASA) – CEOS terms and definitions
Suggested we start with a list of existing terms and augment.
Nigel will have Emma provide the terms she's working on.
Will be distributed and commented on by WGCV and agreed upon by all before adding to web site.
NF: pointed out IVOS activities on vocabulary and thesaurus
Several pointed out inconsistencies in how some terms are used
JN: suggested a small starting point of terms in order to start the process

Discussion led back to relying on IVOS to provide a subset of their thesaurus that could be used to develop a web interface to the terms as well as a way for the groups to evaluate and edit the terms and definitions.
PC: mentioned that doing a test bed web presence would be good and that it is straightforward to keep the test bed off line for testing.

Nigel Fox (NPL) – IVOS Subgroup report
Next subgroup meeting will be held in Perth, where they may visit some test sites.
Work Plan
Like focus areas in other subgroups, championed by individuals
Current activities

- CEOS reference, solar irradiance
- GeoSpatial image quality – MTF – good practices and community references, catalog moved to CVP
- GSICS and IVOS joint activity wrt to the Moon and MTF activity
- PICSCAR – joint with GSICS, understand PICS, how to better characterize the sites, comparisons, a web site for PICS. Starting with Libya-4
- Supporting CEOS SST-VC (FRM4STS.org) Ocean, Land and Ice – continuous Cal/Val
- Ocean Color OCR-VC IOCCG evaluating the validation equipment, multiple participants
- FRMSOC
- Irradiance and radiance comparisons
- Tested indoors before being deployed on the water
- Working on reducing variance – preliminary results

ESA project to measure lunar irradiance
Joint CEOS/GSICS workshop on calibration sensors.

3D radiance code – www.eradiate.eu
physically based radiative transfer code

Summary
Focus on impact – using examples – without cal/val we couldn't do X. Or X is not possible without cal/val. Linkages. Message, value of cal/val.

PG: asked for clarification of PICSCAR – Comparisons from standardized data and evaluating differences and then looking at different BRDF models, beginning with Libya-4 with idea to expand later – *Measurements of the sand are nearing completion and the data will be available to broader group*
GS: asked about examples that Nigel is looking for on impacts of calibration - Nigel wants examples that show the impact of cal/val (both good and bad) as related to economic factors and real-life impacts.

Miguel Román - LPV Subgroup report
CEOS LPV – history w the community
Validation Hierarchy – value of having long term definitions (16 years)
Albedo protocol – latest validation protocols about to be published

LPV Supersites – recognized by TERN (URL), Definition and web page for Super sites defined and used by LPV for multiple products.

CARB-16 – Biomass protocol effort, a draft of the protocol will be available by end of 2018, to coincide with the launch of GEDI to the space station

Miguel then launched into a discussion of cascading impacts of hurricane Maria on PR. Showed examples of his Black Marble high-resolution product and how RS data has and can be used for multiple purposes.
BB: asked whether Cuba studies had been done in addition to the Puerto Rico studies – Cuba has not been as impacted due to political forcing that caused it to have a more distributed power network.

Xiaolong Dong (NSSC) – MicroWave subgroup report
MWSG covers both passive and active
Updates
Focus group meeting held prior to the WGCV plenary.
Discussion focued on the cross validation of radar scatterometers
17 participants - 6 remotely
Objectives:
Requirement for calibration and cross calibration of scatterometers

Outcomes
Summary of current practices and recommendations
Cal/val of OSVW product
Summary of current practices and recommendations
Cal/Val for HY-2 scatterometers
Cal/Val of SCATSAT-1 scatterometer
Consideration of validation CFOSAT scatterometer
System Characteristics Design and Consideration of Cal/Val for Wind/Rad
Cal/Cross-Cal of scatterometer and ocean surface vector wind (OSVW) product at ICM-CSIC

Missions from different agencies
For NWP (precsion and accuracy, calibration) and CDR (consistency btw sensors, long term, stability methods, reference processing) applications

Priorities and road map (sharing data and processing for cal/val purposes)
<u>Future plans</u>
2nd meeting before OSVWST meeting in Portland ME
Invited sessions for IGARRS 2019
<u>Interaction w GSICS</u>
Organized a research group on calibration
Focus on GSICS-MW steering group and WGCV
GSICS MW inter calibration
<u>Future work</u>
Identify requirements for C/V of passive MW Sensors
Identify agency/focus group members
L-band radiometry calibration for global water cycle variables (SM, ocean salinity)

Rec WGCV44
Cal/Val of scatterometer for OSVW
Cal/val of passive mw sensors (w GSICS) – development of model and algorithm for PMW data for CDR

BB: suggests that GSICS and WGCV should have a joint meeting.
Two recommendations that need to be included in the minutes related to Ocean vector winds VC

Bruce Chapman (JPL) – SAR Subgroup report
Next meeting will be at CONAE in Buenos Aries
Soon after launch of SAOCOM 1A

Discussions and sessions on
- Joint cal/val sites
- SAR ARD PFS ([product family spec)
- Cal methodologies, val, and applications
- Innovative SAR concepts
- Future missions
- Other…

Currently reviewing ARD PFS for SAR products
Established a SAR ARD def team
Radar backscatter in final review
Questioning how useful these will be -
Draft form – do they fall in ARD category?
Geocoded SLC (draft)
Polarimetric decomposition (draft)
Polarimetric covariance. (draft)
INSAR line of sight (waiting)
INSAR coherence (waiting)

PG: asked whether the SAR ARD are part of CARD4L – it is
AVB: asked about the June meeting and how those results have been included in the SAR ARD discussions – June meeting was very productive and is providing guidance on what SAR products makes sense for ARD but the details remain to be figured out.
Paolo and Philippe and the SAR info is supposed to get to cal/val portal and Jaime followed up SAR subgroup working w Paulo on moving site to cal/val portal.

Wednesday Aug 29
Tuesday Summary - Kurt
Actions
WGCV-44-01
Survey recent results from Surf Refl ARD efforts with LSI-VC to determine current DEMs being used
Greg – WGCV-45

WGCV-44-02
Address uncertainty resulting from the use of various DEMs

Kurt

WGCV-44-03
ACSG chair to provide a proposed reorganization structure for the subgroup to accommodate the validation of GHG w/in the subgroup
ACSG chair - Provide draft before close of WGCG-44, and in time for SIT-33.

WGCV-44-04
Organize a labeling process for sites. WGCV membership will create a list of WGCV test sites.
Kurt will work with Paulo, and the WG leads to compile list of sites.

WGCV-44-05
Small subset of terms that will be a test bed for terms to use on Web site
Nigel, CVP, Jaime

Key points from Day 1
CEO report, DEM task team, GHG, RadCalNet, Test sites, Communication of terminology

PG: Action #1 should include a deliverable
GS: agreed to work with Thome on ensure Action 1 is properly phrased
Much discussion on Action#3. Bojkov wanted discussion to take place in order to develop the ACSG reorg.
NF: concerned that the work is cross-cutting enough that it should be a task team approach
KT: clarified that the formal task team process would be problematic for addressing CV-18.
AVB: agreed and described what the current problem would need and the experts that would need to be included within a task team approach to do it properly
BB: summarized how he viewed the process, emphasizing the initial work is to examine L2 .
NF: pointed to confusion resulted from Day1 chart indicating the L1 was part of the process
All agreed that the effort was Level 2 and on the ACSG draft reorg. Will be shown on Day 3.
Comments on test site action from Philippe was to include a shorter-term action to provide a test-bed input to the cal/val portal developer and leading to Action #6
KT: suggests Nigel and Jaime discuss possible collaborative efforts related to terminology

GSICS/WGCV interaction – Overview of Cal/Val activities at EUM

Jorge Akermann – Cal/Val activities at EUM

Compare in-orbit instrument performance in line w prelaunch calibration characteristics
Val L1 and L2 operational products to meet user requirement or to exceed these specs – for lifetime of mission
This is the basis for the tasks taken on by EUM – collecting ref data sets, dev/adapt cal/val software, maintain and extend processing facilities through updated algorithms and auxiliary data sets, iterate validation, with continuous monitoring of product quality.
Showed chart of the phases of this process, pre-launch planning, launch, commissioning, operations.
Formal process – product review board, declares status -Demonstration, pre-operational, operational.

Showed examples of Metop-B in orbit AMSU0A and MHS radiometric performance, IASI L1 Cal, Geolocational Assessment of Metop-A AVHRR/3, showed MetOP-B comparisons with NOAA
Use also of simultaneous nadir overpasses (SNO) – MHS L1 product validation using SNO results

Biases due to high space view correction factors. Also showed Metop-B HIRS using SNO's
Comparisons of MWTS on Metop-A and NOAA-19.
Example of Sentinel 3A/3B SLSTR L1 validation using SNOs with Metop-A IASI
Slides show S3B preliminary commissioning results
Comparison of Metop-B GOME-2 validation during commissioning – comparison with reference spectrum for L1, and between ozone profile and in situ measurements for L2.

Metop- GOME validation. AC SAF has developed a validation quality assessment – a monitoring tool, Showed samples of cross validation, monitoring, and comparisons

OSI SAF – analysis of Metop ASCAT L2 winds
Several more examples validation and assimilation efforts for MSG-4 products during commissioning efforts Metpo GRAS validation – compare w ECMWF tropospheric and atmospheric temperatures

MSG-4 and Meteosat-10 Assimilation of SEVIRI all sky radiance during MSG-4 commissioning

Recalibration of MSG VIS CDRs, and validation of re-calibrated radiance LST for CDRs
Example of GSICS IASI A and B intercomp using double differences, and multiple on-ground updates of instrument performance

GSICS IASI/Cris intercomparisons, Metop-A HIRS/4 performance changes due to instrument configuration, corrections for Meteosat IR channels (on GSICS server), and VIS channels
GSICS lunar cal system for Meteosat VIS - Runs in operational offline env't, intercal w/ MODIS/VIIRS

Outlook
Mission-integrated calibration monitoring and inter-calibration system (MICMICS)
Observing trends from individual calibration systems. Fully operational 2020.
Selected GRWG-UV subgroup baseline projects (NOAA and EUM). Ref solar spectrum, white paper, matchup and target sites, cross calibration below 300nm
Wrap up on EPS and EPS-SG, operational processors updated and tested, c/v tools in place, rehearsals

Kurt: intercomparisons btw multiple satellite sensors, what level of agreement can we achieve?
What are the limits from EUM perspective?

SNO limited to geographical area, best to compare instruments on same satellite
NWP – not needing co-location, they will map data to their common grid, but for pixel-to-pixel comparison, this is necessary.
Radiosonde data – still needed?
Are either biased? How to improve? Unknown.
BB: temperatures are good, but hygrometer measurements are questionable. One big concern, is the drop on sounder measurements, because the sat measurements have gotten so good. Numbers are of great concern, still need sondes!
KT: Reprocessing of IASI A and B? Yes for A, no need for processing of IASI-B.

Kurt Thome (NASA) – GSICS/WGCV linkages (GEO-CGMS/CEOS)
2 items
CV-15 L1 interoperability
CV-16 Ref solar spectrum

WGCV-39-08 (2014)
Move to close this based on interactions taking place already, at the subgroup level.
Intercomparison campaigns, intra system comparisons, geolocation

Moving forward – overlaps in personnel, joint meetings and telecons already happening, are there other interactions needed or is the status quo sufficient?
When interactions move to a conclusion, do we need to do more to make these efforts known?

T. Hewisen – ideas for further interactions. Most ongoing are sufficient, including 4 spectral SG
1 – pre-launch workshop
2 – lunar calibration workshops – suggests a 3rd in 2019 (GSICS/IVOS)
3 – MTF characterization, edge of GSICS interest, mostly they are radiometric, perhaps need more coverage for high res sensors
4 – solar spectrum – IR sounder
5 – SI workshop on hyperspectral sensors
6 – MW side?
KT: Good interactions, keep it up, and make others aware of your activities.

Nigel Fox (NPL) – L1 interoperability project status – CV-15
Community agreed reference to L1 radiances and reflectance to understand biases – using common methodology.
What are the deliverables of such a system? Who wants it and why?
How do we create such a reference, and what is its uncertainty?
How to link sensor to the references and uncertainty. Communicating results to users, and how to review. Agreed to a pilot project w GSICS/GEO, understand user requirements
What are existing and future sensor comparisons? Develop and evaluate differences between methods
Consider how to combine results from the diff methods and assign uncertainties, how do we harmonize?
Lead to chain of comparisons by different methods. How to evaluate to post-launch domain?
Define and make available, the measurement equation.
What are the characteristics of a reference? List ref approaches and evaluation of approaches.
How to share results, a database of results?
In summary, for CV-15

- Workshop held; elements initiated; Spectral corrections (RT code, ACIX); SI in-flight (2019)
- Starting to think about how to combine results of elements (RadCalNet and PICS)

PG: What is objective of workshop? Are all the elements being addressed? V relevant right now.
BB: Short term goals? Go for low hanging fruit. Try to make it something operational. What will come out of it. Make the pieces smaller and start attacking them.
GS: There is a lot going on here. Lay out a strategy, who is doing what? An example we can provide for user for their sensor or products of interest. Create a document perhaps on this.
Kurt: GSICS has this, maybe not SI, but at least for a relative assessment
Might use this layout as an example for how to do GHG.

<u>WGCV Interactions w other CEOS-VCs</u>
Jean-Christopher - Recent activities of AC-VC
Our perspective related to AC-VC participation.

AC-VC-13 and 14 (Paris and College Park)
ACSG members are supporting cross agency harmonization in all AC-VC key topics

- Contributed to new data validation challenges.
- Geophys validation needs for GEO-AQ constellation
- Interaction on new AQ validation challenges
- Contribute to white paper on GHG constellation (requirements of current and future constellations)
- Advances in error assessment of Ozone trend estimates in SPARC, LOTUS and WMO ozone assessment 2018

College Park meeting – review of future missions – 25% of talks dealt w validation, rest on white paper
Day 2 – ozone – diff missions and new val challenges
Air Qual trace gas measurements. TROPOMI
Posters – retrieval and validation – good mix
Last day – OACC assimilation, validation advances, contributions

SPARC activities
LOTUS, OCTAV-UTLS and TUNER follow-on, SPARC/IO3C/IGACO-WMO/NDACC on changes in ozone profile trends
Stratosphere/troposphere interactions with climate
Those related to ACSG

- Harmonization of retrievals
- Calc on expression of uncertainty
- Issue of data comparisons
- Feedback on ref measurements
- Uncertainty on trend assessments – not just to science community
- Validation of L3 and higher level products

GAIA -CLIM EC
Gap analysis and impact document (GAID) http://www.gaia-clim.eu
Collaborative project - Many gaps identified, AC-VC community identified new gaps, doc still open.

MR: is gap analysis, is it within ECV?
No, didn't cover anything covered in QA4ECV. GHGs and others examined but tried to avoid overlap with other work, pioneer project addressed the validation gaps in the networks
AVB: can you clarify which parts that can be carried out by WGCV?
No formal proposals made for joint AC-VC and WGCV.
Is there a linkage, can we formalize the AC-VC and ACSG? - They know who to contact within the validation community without going through WGCV, go directly to the experts
BB: Noted several cases of FRM used interchangeably with in situ and ref data. FRM is fully characterized, for sat applications, and traced to SI, and thus clearly a separate entity.
MR: Protocols, process, an issue with FRM. (paper?).
Measurement protocol network vs FRM. Need to be consistent, what is traceable?

R. Scharroo – Ocean Surface Topography (OST) – VC
3 Sat Altimeter launches since 2016 – JASON 3, Sentinel 3A, 3B
25+ yr altimeter record
Jason C/V activities - In-orbit verification -By partner agencies (CNES, NASA, NOAA EUM)

Jason-2 end of life - Small group made recommendations, decision making by joint steering group

Sentinel-3 A/B - In orbit verification, cal and val by Partner agencies
S3VT and S3QWG (S-3 qual working group)
OSTST – starting to become a multi-mission altimeter working group
CEOS OST-VC highlight
At S3A launch it was planned to launch 3b straight into an interleaved orbit, no tandem
ESA and EUM with help of OST-VC recommended the tandem mission at outset
Common to previous altimeter missions, unique to optical, move already paying off

FRM4ALT
Int'l review workshop
- Review methodology C/V using ground-based measurements
- Define requirements, establish standards, provide recommendations and best practices for altimetry calibration such that sea level can be monitored to SI

Roadmap
- Est ref frame for ref measurements; Min set of obs; Harmonization approach; Reqs for in situ equip.

SAOO Phase 0 study, New swath Alt constellation
Requirement to resolv 50 km and 5 day res
Lead to 15+ 1D altimeters or 2-3 swath altimeters
Still req traditional 1-D alt for ref

Hope to expand this to a whilte paper on future alt constellation
Update req on spatio-temporal cov, accuracy, LT stability
Intended as OST-VC activity for 2 yrs

KT: Tandem? - Only 30 sec apart, allows for high level of comparison

A. O'Carroll - Ocean Sea Surface Temperature (SST)- VC Main activities
Main Activities
FRM4STS, HRRDB - High res drifting buoys, Felyx (https://hrdds.ifremer.fr)

Slide of FRM definition – from the S3 Val Team (S3VT)
Based on specif req, Linked to a mission c/v team, Build on existing capabilities, Fwd thinking and LT

FRM4STS - IVOS and SST-VC collaboration
Focusing on radiometers and their intercomparisons
Focused on bringing on new teams and new radiometers
Outcome was best practices and protocols
Legacy database to store the result

Look toward FRM from high res SST of drifting buoys.
Service of improved SST obs to the GTS - Need more access to better data.

Motivation came from GHRSST
Within DBCP-PP reinstated in 2018 to take up the new specification
Want to get the data on GTS so that others can take on the data and provide feedback.

FELYX – S3 validation is done with this, can be more widely used.

Summary – focus on FRM continues, identify community resources projects and tools for other CEOS VC/WG.

S. Linow - Ocean surface vector winds VC
Overview of OSVW-VC objectives and summary, link to terms of ref
Gave an overview of constellation status - Looking at constellation configuration
WMO obs cycle req 6h
Optimum (min) OSVW constellation
- At least 3 on orbit w obs every 6 hrs
- And something that drifts among the orbits so that we can measure diurnal cycle

Cross calibration of missions, c/v and data prod standards
Ongoing discussions on QA of product and wind retrievals w/in context of IOVWST
Geophys Model Function (GMF) development and val
Comparison of wind retrieval algorithms
Assessment of rain effects in tropics
Spatial scaling effects
QC wind ref data linking dropsondes/buoys/SFMR/SAR

Discussion
XD: comments on how Monday's MWSG meeting led to collaborative efforts between the two groups. - Looking at w/in the framework of WGCV MWSG - Also w/in GSICS?
KT: How do we maintain the WGCV MWSG interactions? - Take advantage of future science meetings to have splinter meetings. There will be upcoming opportunities over the next 12 months. Plan to meet before Int'l ST meeting (IOVWST).
PG: Aeolus, just launched, new laser technology, how to validate wind measurements.
It is very difficult to do direct wind measurements but it is done

E. Kwiatkovska - Ocean color radiometry VC
Charter to provide LT time series of OC meas from multiple satellites established by IOCCG
Goals
Ensure continuity of OC time series for climate, operational services, and marine ecosystem health - provide high quality datasets through interagency efforts, harmonization for CDRS, Cap Building, OR

INSITU-OCR white paper - recommendations
Space sensor radiometric calibration, characterization, and temporal stability
Develop and assess satellite products
In situ data/FRM measurements
Information mgmt. and support

On going C/V activities
System Vicarious cal coordinated among several cross-agency activities
Task Force on Sat Sensor Cal - Collab on space instrument accuracy and stability to maximize quality of OCR data records. Coordinate IOCS and WGCV/GSICS lunar model development.
Coord of in situ meas protocols - Geostationary OCR capabilities - Exploration of meas beyond passive

KT: lunar model topic and whether this is a good way to have collaboration – Nigel answered this is a good opportunity for IVOS GSICS and optical ocean VCs
BB: OC approaches are now accepted approaches and they are useful for providing insight both in the sensor calibration and the atmospheric correction, done within VCs.

Discussion of possible Collaborative efforts w WGCV
BB: Forcing collaboration is not the best approach and there are not necessarily overlaps and often the VCs exist because there is not a place for their expertise
SH: next time have presenter show activities that wouldn't exist if VC didn't exist, from a C/V view
BB: pointed out several examples of the VCs benefitting from the cal/val side
SH: the message is clear as to how the VCs are providing successes
BB: provided further examples and the importance of communicating properly
Further question as to how so many VCs formed

WGCV Interactions with other CEOS Virtual Constellations

Medhavey Thankappan (GA) – Cal/Val of SAR and refl ARD products
ARD – data been processed to a min set of reqs for it to be interop through time, ease user burden
Creates an opportunity for exploitation of EO data streams
Based on CEOS FDA report. Call by agencies to simplify data handling to increase uptake by the users.

CEOS ARD strategy
Thematic product families: CARD4L is the first
Reviewed the ARD outlook - Tech specs, Pilots and feedback, Promotion
A high level endorsement by CEOS for CARD4L – To help space agencies realize a return on investment

3 initial products - http://ceos.org/ard
Surf rad (optical) - Surf Temp (thermal) - Backscatter (SAR) - Future SAR: INSAR

Digital Earth Australia Initiative - A platform for data cube technology - Sig ($) gov't initiative

ARD products need validation
In situ meas must be a key focus of c/v community
Focus of validation is not how the corrections are made, but how effective the corrections are.
Accuracy assessment.
Australia took on the continental scale validation of Surf Refl.
Field data collection in coordination with CSIRO, in two phases, in near coincidence w sat overpasses.
Common protocols were used by multiple teams
Showed plots of results for L8 and Sentinel, and the uncertainty of ASD measurements.

SAR cal/val - S1 corner reflector distribution
Plot showing the improvement of absolute location error, resurveyed corner reflectors.
Operational ARD processing or InSAR applications. Scaling up processing of S1 SAR ARD data in AU through a DEA InSAR project (digital Earth Aus)
Showed workflow of Victoria InSAR and animation of ground deformation.
Interactions with LSI-VC. Teleconferences/meetings on the topic, helping to define the InSAR ARD

Promotion of ARD
CEOS needs to promote ARD, needs to target data providers, data hosts and aggregators, and data users.
LSI-VC to create outreach flyers. L8/S3 uptake from user community is outpacing L1 data by 3:1.
ARD session at Living Planet.

PG: for the ARD of Surf Refl there is not an accuracy req, just geolocation req
MH: threshold and target reqs. We should voice concerns about ARD prod family specs.
PG: what is ARD? Confusion in community. Conclusion is that its level 2.
BB: first heard of ARD, is ARD something the providers come with at L2, fully defined? Or is there further transformation?
MH: removing the burden of preprocessing for data at a space and time.
BB: if the data are transformed to a grid, how this approach is done is going to be different for diff algorithms.

S. Hosford (ESA) – CARD4L Product Alignment Assessment
Context overview - CARD4L product alignment assessment steps
Role of WGCV - Peer review, what is involved, how can WGCV operationalize this assessment?
Reviewed the Product Family Specification content, and the CARD4L framework, which also includes a Product Alignment Assessment (PAA), process that a provider goes through to add their product to be considered for CARD4L. Involves self assessment (PFS), acceptance, and peer review (by WGCV).

CARD4L Framework, 3 parts
Define CARD4L
Product family specs (PFS) – Description, definition, requirements, each PFS doc has a guidance section
Product alignment assessment (PAA)
Provider decides if they want the product to be CARD4L, Contacts LSI-VC secretariat
LSI-VC will provide an SME contact who will guide them through process.
WGCV then provides a peer review of product.

Product alignment assessment burden is borne by LSI-VC
LSI-VC POC identified for each prod family spec - PFS POC interacts w Data provider and WGCV
1 – verify data provider product self assessment
2 – obtain feedback of WGCV

Is WGCV prepared to provide peer review?
What does Peer review entail? Level of detail (needs to be standardized)
Ensures a good practice was applied. Can that be operationalized? POC?

LSI-VC is asking WGCV to assist with CARD4L PAA
WGCV should
- Confirm willingness to contribute
- Estab what the contrib is
- Describe their interaction w the PAA process
- ID any necessary POCs

(2 pager covering these by end of Sept)

WGCV should continue to support LSI-VC/CARD4L on PFS to ensure improved interop (eg. detailing product uncertainties)

Self assessments – Were not as expected, need to have more specific requirements for self assessment.

AVB : PAA comment. L2, ARD, verify. Verify as ARD, validation is ongoing.
Provider, can be commercial, can be agency
PG: ortho rectified, surf refl product (specified algorithm?), cal/val?
Much discussion and confusion, Kurt interrupted, suggested that his presentation may clarify.

Kurt Thome (NASA) – Proposed WGCV CARD4L assessment process
PFS – POC interacts with data provider

Try to avoid getting bogged down in def of ARD, MRI, data cube
- ID key questions that lead to assessment of uncert in Surf REfl
- ID key Q leading to assess of Surf refl val

WGCV assessment role
Goal of LSI-VC to ensure – C/V process is employed and good practice is applied
WGCV needs to define the right level of detail
Define good practice -Includes how the assess the PFS metrics
Boundary betw doing the val and relying on the product providers results

Kurt suggests a process not unlike approval process used for RadCalNet sites.
Part of the process is done by LSI-VC and part by WGCV.
The product needs to meet specs, a target, which forces them to provide uncertainty.

Use the RadCalNet assessment process as a starting point for assessment process of CARD4L.
Slide 8 shows a proposed process that is detailed in slides 9-11

Much discussion ensued as to whether or not to accept this process, many were uncomfortable with it, many questions, many over the PFS as stated. The so called 'peer review' process is being construed as somehow a kind WGCV endorsement of the product.
Decided that they would approve it, given that WGCV could request LSI-VC to consider modifications to the PFS.

JC Lambert (BelSPO) – Agency Report
Provided an update of the EO missions for Atmosphere as well as Land/Oceans/Snow/Ice
Overview of ALTIUS mission – stratospheric ozone profiler - Launch 2022
Update on Validation data for Atmosphere, Marine and Solar obs, and agency contributions to monitoring networks.
Overview of several campaigns -
FRM4DOAS/GAIA-CLIM/QA4ECV CINDI-II campaign (http://uv-vis.aeronomie.be/groundbased/campaigns/CINDI2camp.php), S5P Validation Campaign 2019, APEX/BUMBA campaigns (Belgian urban NO2 monitoring), RAMOS campaigns
Updates on Validation methods and systems:
Multi-TASTE Expert Validation System – has been developed over a period of 25 yrs
EUM - CM SAF, CAMS NDACC validation server, QA4ECV atmosphere validation server, Sentinel-5p MPC VDAF – validation facility

MEP PROBA-V http://proba-v-mep.esa.int
2nd PROBA-V symposium at BelSPO

A. Meygret (CNES) – CNES agency report
Calibration monitoring of CNES in-flight missions
Prep for future missions, and working with CEOS WGCV
In flight Cal – PLEIADES 1A & 1B, IASI A & B, Megha-Topiques, IIR, SMOS

VENµS – Vegetation and Env'tal monitoring on a new µ satellite
Launched 2017 operations turned over in March 2018, Israel/France, tilting capability, 2-day revisit
5-10m spatial resolution, 12 narrow channels, 110 selected scientific sites
In commissioning phase focused on straylight issue, Image qual is good
Geometric performance – attitude refined, geometric performances are ok
Radiometric good, 3% for B3-B12
Data are freely available. Showed a 2018 time series.

CNES also provides partner calib support - SPOT 6&7, S-2&3, NASA exchanges for MODIS, Landsat 8

Theia: L2A Operational Production
MAJA - atmospheric correction software operationally used w/in THEIA ground seg (free standalone)
S2A 2B products, VENµS, Landsat 5/7/8 available within THEIA

SPOT world heritage – 15M scenes – processing to L1A for LT storage, up until Oct 2019
Looking into ARD – how to atmos correct data acquired in 1986…

Reviewed Future Mission preparations
IASI-C on Metop-C, IASI-NG, MERLIN – Methane RS LIDAR mission, MetroCarb – CO2

MAGIC Campaign contrib - Prepare the val of GHG products from Microcarb, IASI, MERLIN missions

SWOT – Surface Water and Ocean Topography Mission
CFOSAT – china France oceanography sensor, ocean surface winds
Trishna – TIR imaging Sate for high res N A
TARANIS - 2 optical instruments, Dedicated to lightening, photometers for irrad meas

CNES calibration Activities
Priorities - sounding and altimitery, also TIR and HyperSpec
Gap period for CNES imagery missions
Continue to support partners – radiometric cal database, methods development
CNES CEOS/WGCV involvement – internal review board recommends involvement in several targeted CEOS activities.

Philippe Goryl (ESA) – Agency Report
Currently have 12 ESA satellites, 4 heritage, 30+ partner missions
Copernicus – EO European leadership – Sentinels 1-6, with expansion to 7, 8, 9 planned
Provided an update on status of missions, as well as Landsat 8/S-2 harmonization, ARD

FRM4SOC and eRadiate Workshops
Other activities

- Systematic production of Surf REfl for Europe
- L1C absolute radiometric accuracy for 2A and 2B done by CNES
- Geolocation accuracy, geometric refinement with GRI (global ref image)
- Will help with compliance for CARD4L
- DEM – will be upgraded - ITT for DEM summarized in a table - 30m over Europe restricted

S3 - Commissioning phase, both radiometry & geometry good - SWIR issue, needs vicarious adj
Sentinel 5p – Atmospheric products - TROMPOMI
Just concluded commissioning phase, first products released in July. Staggered product release plan.

AEOLUS - Just launched last week – first UV doppler wind lidar
To improve weather forecasting and demonstrate technology, Cal/val planned, AO opened in March.

'Sen3Like' Initiatives - Harmonization of Sentinel 2 MSI and L8 OLI

ARD within ESA/DIAS infrastructure using CNES tool - Future: ARD on Demand?

eRadiate - Single RTM for all communities. Most appropriate identified method: 3D Monte Carlo RT (MCRT) to support cal/val activities

Thursday – Day 2 summary, Kurt
Key points from previous day
GSICS/WGCV links – where we can continue to work w GSICS
L1 interoperability effort – there are short term needs we need to address
VC – impressive array of EUM people in leadership roles w/in VCs
Reminder that natural collaborations happen, not to be forced
Keep the communication going with repeated presentations at our meetings
NEED a WGCV POC to LSI-VC, by the SIT meeting
CARD4L product assessment approval – first draft approved
Still can be revised

WGCV-44-08
A WGCV POC for the CARD4L process

WGCV-44-09
Will provided LSI-VC and the CEOS CEO w a 2-page description of our willingness to assist in completing the CARD4L PAA - Due Sept 12 2018 - We will comment on the specification as it is.

WGCV-44-10, we will comment on the product specification w/in 3 mos. There is a timeline for completing the PFS.
Kurt Thome (NASA) - WORK PLAN
Kurt presented a table of the open work items we are addressing.
FDA-12 Develop an inventory of current product formats used in CEOS agencies and ID recommendations to facilitate interop
Listed several actions and status of each. All being actively worked or already completed.

Next work plan, WGCV making good progress on is WP activities. Preparations beginning in Nov for next work plan.

-CARD4L-branded specification documents
-Data product formats to facilitate interoperability
-Long-term plans for Moderate-Resolution Interoperability

Cindy Ong (CSIRO) – Agency Report

Vicarious calibration at Pinnacles desert site, a land calibration site N of Perth
Instrumentation – (similar to Namibia and La Crau) Cimel, Met station, static camera

Slides showing the site characterization, temporal variability in Winter 2018, 100x100 grid
Did a 10yr variability study of VNIR-SWIR from Landsat TM
Temporal Compositional Variation (FeOx) from ASTER and Hyperion, and the temporal composition variation in MgOH, Silica
Started on the uncertainty budget, varied the tilt on the spectralon panel,
Schedule for the site activity
CIMEL delivered, heritage survey, mast training, after which the Mast and CIMIL will arrive at site, after survey is finalized can begin to construct platform for mast.

Arhundati Misra (ISRO) – Agency Report

Topics – SAR/MW, AVIRIS, and InSAT3D

Work done on MW calibration

- Detachable corner reflector of 2m and testing using L band HH airborne data of SAC
- Study of Amrapur site in Gujarat region, potential Cal site
- Study the response of SAC-developed active radar calibrator
- Dev of Cal/Val network for SAR calibration across India, phase 1
- Design and dev of CR for deployment in Antarctica

International sites.
NAVIC installation – interferom SAR – showed data from MSL height and SD plot of NAVIC
Design and development of in situ soil sensor for val of satellite derived soil moisture products by SAC-ISRO, due to costly commercial Hydro Probe.
VNA based Ground Scatterometer: Design, Develop and test carried out.
GPR test site developed – why ground penetrating radar used, two layers w soils of diff delectric constants. Pipes of var thickness at diff depths us to carry out GPR measurements

AVIRIS NG c/v campaign at Jodhpur, March 2018
Deriving AOD from INSAT-3D, using AERONET to validate AOD product, used MODIS AOD as comparison. Showed imagery of InSAR AOD product. Temporal resolution is very good, but spatial resolution is not.
Fog product from InSAT 3D/3DR and its validation – generated since 2014, used by ground transportation and aviation.

Medhavy Thankappan (GA) – Agency Report

Digital Earth Australia – major Gov't investment, innovation and growth in digital economy and thus expect positive impacts on Aus economy

Example: Showed slides of Ord river irrigation - State/Fed developing irrigation in Kununurra area, changes due to dam wall raising. Area moving from rain fed cropping to irrigated cropping

Added Sentinel to the archive dominated by Landsat, delivered via the ARD work
Open Data Cube – a lot of interest in the Oceana region in the data cube
Have worked with Mexico and Cambodia on providing training on ODC usage.
Digital Earth Africa – helping GEO with this initiative

Continental scale val of surface refl has been a very large initiative - DEA validation phase 1

National Spectral Database - trying to maintain a database of all the data used, to archive for the long term, with the help of SPECCHIO

RADAR - Resurvey of Queensland CR array - 40 sites, will add new CR apex positions in 2019
help with NiSAR calibration
Setting up 2 new cal corner reflectors (CR) at Yarragaddee Geodedic Observatory
One of few fundamental geodetic stations that co-locates all 4 geodetic techniques
Showed images from TerraSAR X, Sentinel-1B
Geolocation analysis using TerraSAR - Values agree with CR sites collected elsewhere

Operational ARD processing capabilities for InSAR - looking to generate national deformation maps from SAR

Hosting ESA Pandora instruments – on GA building and Alice Springs – filling a gap

Broad Nat'l context for Cal/Val - Have a space agency, modest funding next 4 yrs – priorities include EO
Role of facilities in national infrastructure like TERN, IMOS, and AuScope
EO Australia and national coordination of cal/val https://www.eoa.org.au
Looking at how we develop a national cal/val plan going forward

Jack Xiong (NASA) – Agency Report
NASA Earth Science Missions slide - Slide showing missions through 2023
Slide showing 7 CubeSats in NASA's In-space validation of ES technologies (InVEST) program
Used to demonstrate and test constellation concept
ECOSTRESS – most recent instrument on space station, data provided w/in two weeks of launch
high res TIR instrument
PACE – ocean color instrument OCI, secondary 2 polarimeters for aerosol/cloud research (HARP2, SPEXone)
CLARREO Pathfinder – demonstrate on orbit high accuracy SI traceable Cal
LASP hyper spectral imager for climate science

NASA cal/val activities
Prelaunch focus on cal and characterization for a NASA ES missions and partner agencies
On orbit cal/val, Cal inter-comparisons – SNO, LEO-GEO
RadCalNet, Lunar Cal, Dev and app of new cal techniques and testing equip
Effort to address future demands and challenges - Fix of VIIRS DNB stray light problem

After 3 yrs of planning, Terra successfully executed a risky deep space Lunar maneuver to recalibrate the instrument. Also provided data for calibration of other sensors. Normalized to ROLO. RVS characterization results (MODIS RSB)

WGCV Interactions with other CEOS Working Groups

Albrecht von Bargen (DLR) (for J. Schulz) - CEOS/CGMS

Introduced in 2010 - Tasked to Coordinate and encourage collab activities
2011 global framework for Climate services
2013 Climate monitoring from space GCMS - CDR, Applications, Decision Making, Reanalysis
2015 working on enhancing use of CDRs, Relations to UNFCCC/GCOS
Direct link – our only opportunity to report for UNFCCC
2016 GCOS IP – Action G1 – review of CDRs, G2 – gap analysis
2017 comprehensive answer
2018 Resource for Coord Response - implement an ECV inventory – to be opened again
What next after gap analysis? Want to develop a white paper on what is needed for the val of CDRs including uncert and stability, sponsor a workshop on this topic - expect proposals for this soon
Conclude – focal point for space agencies to address GCOS req, single coord voice to UNFCCC
ECV inventory is a resource for community to use and create CDRs, WGclimate has the tools for effective analysis of data holdings and plans
JN: How often will this inventory be repeated? Annual – but this is a challenge
GS: GCOS provides ECV info, will uncertainty analysis lead back to WGCV? – There is not an uncertainty analysis really just reporting.
CO: Summer school workshop and whether this would cross-fertilize to WGCapD? – Depends on the real targets of the workshop and whether it is training or informative
CO: Does it make sense to put ECV inventory on cal/val portal – Is part of the WGClimate so a link would be suitable
J-C: Data level considerations and CEOS and CGMS are agencies with Level 1 but climate agencies are primarily Level 3 so does WGClimate include uncertainty analysis at Level 3 or is there a gap in going from the space agencies to the applications? – Most of the work is done at thematic levels using Level 2 and CDRs are at the Level 3/4 and this is a topic to discuss.

Kurt Thome (NASA) – WGISS/WGCV actions

1 data formats and interop in framework of FDA
2 qual indicators in discovery metadata
3 CEOS data cubes and CEOS test sites data access
4 standardization and best practices
Met at last Plenary – followed w a telecon 28Jun – update Telecon next week

Medhavy – 1 Data formats and interop in framework of FDA progress
WGISS call and met w Rob Woodcock
How might we make field site data available via data cubes, start w field data, move to subsets
Using L8 and S-2 as development datasets

Next steps
Review USGS land prod char web site for further use case
Develop base architecture diagram to define MVP
Work with WGISS connected data assets team for ARD data cube on demand

Tools for Intercomparing different products
JN: What is the tool? - Existing tool w/in GA
PG: Availability of tool? - Free and open.

Nigel – 2 Qual indicators in metadata
Obj – Ensure quality and uncertainty info is available (at discover and access) for users
On a per pixel, uncert may be too large to handle - Not easy to describe for the user

Decided after Brazil that SST would be a good test case to demonstrate what could be done
Is it a good candidate and the VC and GHRSST available to help with this.
Will evaluate the QI for the test case in discovery metadata searchable by end users
Review current reported metadata on SST and how QI info made accessible/viewable
Consider how to enhance/embed/report QA for users
AVB: suggests a link to the ATBD in metadata
PG: *what is the meaning of traceability from L1* – SST is a product thus it includes the L1 uncertainties and into the SST

Greg – 3 CEOS data cubes and CEOS test sites data access
Obj – Data Cubes (stackable data) test cases
How do we make these data more available to users, use work done w LPCS
Need MW and SAR sites

Test site catalog
Add test sites to IDN, what does this do? What is 'quick' tool?
Need to establish and update key test sites.
NF: we need to make it clear on what sites are endorsed within the list that we create

Cindy – Standardization and best practices
Contribution on CEOS best practice white paper on guidelines for the metadata for ARD to ensure the information needed is in the metadata
Support best practices on SAR - Leland Pierce is helping to contribute to developing standard metadata for SAR.

White paper discussion
Revisit and update WGISS-41/WGCV-40
Will review WGISS data management and Stewardship Maturity Matrix, which PG commented is very complex and doesn't see how we can work into.
GS: comment on how metadata are tracked within ISO but things are still not readily usable in a machine readable environment.
PG: need a way to make the results more widely available and sooner
AVB: pointed out that there are a limited amount of people providing input

Calibration/Validation Updates

X. Hu – Overview of FY-3D commissioning test overview
FY-3 is the Chinese second gen LEO met sat
4 on orbit and 4 more planned
10 instruments 5 successive, 2 improvements, 3 new
Launched 2017, commissioning almost done

FY-3D imager: MERSI->MERSI-II - Showed imagery of AOD, Fire monitoring,
HIRAS (similar to CRiS)
New in FY-3, WAI wide angle aurora imagery - Formal operations and data release Oct 2018

Function and performances have met reqs
Field campaigns took place in March, Apr, and Aug
All 10 instru have finished the 3 round tests for key performance
Trial sounding data were sent to ECWMF, Met Office, Wisc

Validation continuity
Operational Inst performance monitoring for LT base OBC complete telemetry
GSICS SNO monitoring
MERSI-2 cal trend monitoring using PICS
Integ cal system combines earth and moon targets with DCC and RT simulation

Tansat – CO2 sensor - data are open to world users
Comparisons w OCO-2, Showed a global Tansat CO2 image

Q. LU – C/V for FY-3C MW Sensors for NWP
Evolution of FY-3 for NWP – Showed the diff instrument suites
6 instruments of particular interest for NWP
4 Sounders and a wind scaterometer, and MW radiation imager

Status of the FY3 data in the NWP
Since 2008 MWTS has been used in CMA GRAPES model
Since 2009 four FY3 instru have been implemented w/in ECMWF IFS
FY-3 MW sounders are well characterized, recognized by WMO.
After 3 yrs monitoring MWHS quality

The OMB comparison btw FY-3A MWTS w MetOp/AMSU-A
Optimizer of Satellite Instrument parameters on orbit (OSIPOn)
The comparable data qual of FY-3C sounding instruments to its counterparts.
Looking at stability of the instrument, Monitoring OMB against the instrument parameter
MWRI aerosol - Trying to improve accuracy and stability,
Improve and evaluate the data quality and its impact on NWP

C. Qi – CMA FY-3D/HIRAS cal/val
HIRAS High spectral IR atmospheric sounder
It is a fourier transform interferometer w high spectral res, low noise and high radiometric accuracy.
Launched in Nov 2017, 3 mo outgassing. Turned on Mar 2018, aligned interferometer fixed mirror, April cooled detector. Mar-Jun in-orbit tests.
Displayed Instrument Monitoring system
Raw BB and Cal ES spectra – before and after optical alignment
Global BT - Noise performance is meeting requirements

L1 products - overview and status

3 bands LW, MW and SW - Spectral accuracy validation results
HIRAS OBS compared w LBLRTM simulation in clear ocean condition
Clear pixel filtering: Using MERSI cloud mask production
Radiometric calibration validation
SNO pairing method – LW bias better thans 0.5K, MW BT bias less than .7K
Comparison of HIRAS w MRSI
Summary
HRAS commission test with 17 items results were promising
Ground process system is running smooth gen L1 data in RT
HIRAS is great improvement to Chinese satellite IR

N. Xu – FY-3D/MERSI-II commission test
FY-3A/3B/3C
Like MODIS and VIIRS there are several VIS and IR channels some with 250 m res and some with 1km
Bands on MERSI-II have increased to 25, have added more bevel on edge of instrument to reduce stray light, On board BB calibrator – improved with warm up and cool down function, much improved from MERSI-I, New feature for Moon observation maneuver.
Visible on-board calibrator – lamps and shutter door alternative opening periodically, 4 radiance level lamps

Inflight calibration and val of RSBs
Multiple methods used, visible onboard calibrator, multiple-vicarious calib methods
OBCBB for cal multi-VC for cal/val
Moon, scheduled. Used for interband, absolute, and degradation monitoring.
Multi-site – stable Earth targets used
SNO – use MODIS, CRiS, GOME-2
Integrated vicarious calibration shows sensor is very consistent
Long term degvvvvradation targeting
CRCS ground based validation at Dunhuang and Qinghai Lake
Displayed automated ground long term monitoring on Donhuang site.
Summary – sig improvement from MERSI-I and II. SNR

Lingling Ma – Post launch Cal and Data QA of Chinese High Res Sat
Sensor overview
More than 20 HR satellites on orbit - 6 kinds, with each w a series versions
Pan, MS, and hyperspectral – vis to SWIR
GF01 first HR EO sat series - 800 km swath - 3 launched this year.

SV-1 China's first commercial satellite. Daily revisit and resolution of .5 m possible.

GF-5 Operational by Dec
Launch in May. The advanced hyper spectrum imager (AHSI) main sensor.
Vis to SWIR, w 5 nm spectral res, and 10 nm for SW, pointable
51 day revisit w not pointing or side-looking - 330 bands, 60 km swath, still in test phase
Planning continuous launch of hi res hyperspectral

Post launch cal req – Radiometric, spectral, geometric
Imaging performance assesessment

Baotou cal/val site in Mongolia
Single site with various types of surfaces natural and non for spectral/radiometric and spatial targets.
Knife edge targets, fan shaped
Automated calibration for various Chinese HR satellites using Baotou

Future
Construct China calibration sites
Cross cal thorugh spaceborne radiometric benchmark sensors
Consider using stable targets (PICS and moon), and adding RadCalNet sites

J-C Lambert (BelSPO) – Sentinel-5p Mission Performance Ctr - operational val facility
Started deliverying product to Copernicus, since July
Tropomi validation plan
3 components- SSP validation teams S5PVT, FRM providers, User Community and Int'l forum

S5P mission performance centre – Val Data Analysis Facility (VDAF)
QC, LT monitoring - Automated, routine comparisons, generation of 5P val database
Auto gen of online quick Look reports

Val data streams
L2 prod requirements - ESA FRM and WMO GAW contributing networks
Need to implement QC metrics
Can query the data qual on a map in real time
Awaiting ESA FRM4GHG, other data streams are quite delayed (TCCOM) (mentioned it took a year to get this data)
State of the art val chain, co-locators, comparators
Detailed processing model for QA4ECV for Atmos ECV precursors

Fully traceable, ENVISAT –> expanding to all S5P products

First release of S5P CO column data
Validation facility web site, articles available - Product details and quality reports

MPC operates an automated val server built on heritage systems, with long term support from BelSPO, EC, ESA, …

Valuable synergies Copernicus space and CAMS/C3S
Underlying systems are mature, but ad hoc support needed (moving val to operational, set up, tools, uncert and error budget, access to FRM)
Automated or not data val (L1-4) always req substantial interpretation by (human) scientific experts.

Paulo Castracane (ESA) – WGCV Cal/Val portal (CVP)
Showed old CVP web site, many of the links point to information that hasn't been updated in YEARS.
Have a 2 year contract for maintenance and evolution of the site.
Showed plans for a new home page and showed a proposed reshaping of the site.
Has reviewed the site and have created a number of actions, a preliminary mock-up is available for people to provide feedback.
Needed: content for IVOS, SAR, and MW subgroup content!

AVB: raised the previous WGCV effort on the CEOS web site. Also, there is supposed to be a location on the site for the work plan and the action items.
CO: asked who is the audience for cal/val portal
How do we update and track and decide whether the portal is needed and should be supported into the future?
How do we get the content input from WGCV? Highlight model of monthly subgroup results
Back to who the audience is, what is our goal? We need a way to get our info out there and easy to discover/access. Much discussion on the content and way forward
ACTION: Open the redesigned page for comment until March 31, 2018 and reviewers should keep in mind that
ACTION: Cal/Val Portal developers will contact specific users to obtain inputs to the redesign
ACTION: Cal/Val Portal developers will contact WGCV membership for information leading to an end of year telecon to assess the progress

Andrea Della Vecchia (ESA) – WGCV Cal/Val portal (CVP)
Collaborative environments for CalVal
Move the user to the data - Thematic exploitation platform – TEP
Ecosystem of interconnected thematic expeditions
Mission Exploitation Platform (MEP) that exists close to the processing system
Go to the MEP and access and exploit the data – a ulti-mission – federated exploitation system
NISAR GEDI BIOMASS
Aim is for all the data to integrated into a common virtual working environment
Allows users to access up to date data and algorithms for biomass estimation
Supported by a common ontology - Centralize Distribution
ESA Catalog 2d map viewer, ESA earth online, ESA gateway and collection catalog
Reprojections performed on the fly
ESA pilot with existing available collections
Data subsetting - extract a single pixel of data from one or more datasets, over a time period, extract, using an API. Showed examples of how the users can use the WCS query examples.

Greg Stensaas (USGS) - USGS Agency report
Landsat 7 mission set to be aligned w L9 and then 7 will be decommissioned. Dec 2020 launch
Restore-L mission to refuel Landsat7
Working on requirements doc for ARD
Planet Interoperabilty workshop – people trying to use L8 and Sentinel data in the cloud
Common DEM - Commercial side of the house would like to get access to better image chips.
L7 geodedic accuracy is mostly stable, OLI is even better.
L7 radiometry – doing well no sig degradation
Radiometric char of S-2 data – cross compared with OLI, published
L8 radiometry – extremely stable
Landsat 9 - OLI TIRS On track, moving forward
Developing a QA of RS data best practices document
MTF and geometry analysis of Planet data – will be presented at JACIE
Radiometry at 4 sites – Planet data vs L8 OLI TOA reflectance
LPCS – subsetting and reprojection, product intercomparison
Landsat-9 Follow-on planning, new sensor planned

C. Li (AOE) – Agency Report
Academy of Opto-Electronics, CAS
Balloons, OptoElectornics, EO Tech Appl (ETA), Satellite Nav Technology
Prof Li's lab is the ETA – ground sys eng, mech and appl of new sensors, data qual monitoring
Key Laboratory leading CAS name Quant RS info tech (QRSIT) – 57 staff, 22 students
International cooperation (Finland, Australia, WGCV, ESA (Dragon program), Int'l innov team)

RS acquisition - 3D imaging system based on Active & Passive payloads, Mini UAV lidar
QC for RS - RS calibration site (RadCalNet) Baotou, improving automated calibration system
Uncertainty analysis of the standardized rad cal product
Validation of VIIRS/DNB
Standardization of RS – establish a RS standard system for China
RS Information Service
Landslide detection with time series data
National poppy illegal cultivation monitoring and early warning system
Emergency response of RS disaster reduction
Cross-cal through spaceborne radiometric benchmark sensors and ground based validation

Xiaolong Dong (NSSC) – Agency Report
National Space Science Center – 2 labs
Space science planning dev and operation
Research and devl of Space science and frontier technology

NSSC contributions to Ocean and Meteorology satellites
Mission update – FY-3D, CFOSAT SCAT, HY-2B, COSM
Payload Cal & processing, Re cal & re processing of MW data, New cal techniques & test facilities
Sea Surf Level anomaly by HY-2A and Jason-2, Ice height in Antarctic and Greenland
HY-2B ACMR update - Thermal vac, Good pre-launch cal

Prep of CFOSAT calibration
FY-3 GNOS - Val w ECMWF, applications, GNOS-2
FY-3 TOU - first daily global total ozone, TOU follow-ons
Development of MWR references and measurement techniques
Cal Targets and techniques for MW, polarimetric MWR, emissivity testing current and future missions,
Cal facility w Temp control

Friday Summary - Kurt
Work plan summary
Good progress toward actions for WGCV44
WG Climate summary, WGISS interactions, cal/val updates from CVP – 3 actions as outcome

WGCV-44-10
Access to new portal, visit and give opinion
WGCV-44-11
Design input

WGCV-44-12
Ask for content
Telecon will take place prior to end of 2018
WGCV-44-13
Comments from CARD4L PFS

Kurt Thome (NASA) - Carbon Actions related to Biomass
Reminder that many of our LPV related CA are related to the CEOS work plan CARB-16

WGCV-CA-17
We could request that this be closed based on what is on the LPV web site. These came about partly from S. Plummer who wanted to bring attention to the activities going on within LPV

WGCV-CA-19
Also covers several WGCV carbon actions
WGCV_CA 5 and 11 – Carbon 31, 7, 9

WGCV-CA-01
Develop list of completed and planned intercomp exercises

2018 CEOS Work Plan related actions for GHGs

Albrecht von Bargen (DLR) – CEOS GHG Validation workshop
German Space programme heritage
SCIAMACHY on ENVISAT - First space obs of GHG

National Mission Study (CarbMon) -Passive RS (spectrometry) of CO2 and methane
To understand sources and sinks on reg and local scale (ESA earth explorer 8 candidate CarbonSAT)

Common French/German cabinet decision (2010) - Bi national effort – MERLIN
Highly accurate spaceborne detection of spatial and tempal var of atm CH4 flux (emissions)

CoMet
Airborne mission for CO2 and CH4 with lidar and passive RS and in situ techniques
Goals of this Multi-aircraft, multi-sensor mission
- Airborne data regional inverse modeling
- Id local and regional GHG sources
- Improve regional est of GHG
- Val sat measurements
- Using innovative airborne

Albrecht von Bargen (DLR) – Agency Report
National RS validation workshop (May 2018)
Agency perspective - Satellite sensors -> data products -> validation
Validation community perspective - Instrumentation -> scientific validation –> data management
Val needs - Why is val so difficult
German val infrastructure (TCCON and TERENO network and val activities, ENVRI Plus activities)

4 Discussion blocks -

- Aims and needs for sat val
- Characterization of meas sites
- FRM
- Linking Sat and meas communities

Discussion on and along cross cutting topics
Summarized many Take away messages for all discussion block summaries - see slides.

Science Networks available but –
Many points wrt networks - Commitments… Standards applied?

Overall Take away
Transparent communication of validation requirements
Validation in Germany based on scientific entities: how to incl in research plans?
LT availability and continuity in data acq is not secured
Characterization and methods are a point of disc in many details
Challenge in SOP and QA
Dicussion on Research infrastructures

Albrecht von Bargen (DLR) – Pre-Launch Calibration workshop Update
Provided an outline of the agreed upon content
Spring 2014 discussed need for a workshop to bridge the gap between cal/on ground char and operational calibration
Driven by multiple subgroups

Outline
1st dedicated to optical imagers
Intensive discussion on clear defined topics - Programme driven by inivited orals

Preparation team: Nigel Albrecht Philippe Jack
3 day mtg - Instrument providers
B-team for 1st workshop
Balancing US EU Asia, but has to be limited
Programme team nominated by agencies - Expect 50-100 max could be more

Schedule
Prepared a flyer
Instrument/sensor providers in consultation w agencies, contact to nominate candidates for program committee
Finalize flyer and announce by end of Oct
Presentation registration 2019, Selection of presentations
Internal WGCV organization and General Programme committee

ACTION- Chair needs to contact GSICS about formal interaction on this workshop and whether GSICS and WGCV chair will invite
Committee will be Albrecht, Jack, Nigel, Tim H., and Rose Munro

Bojan Bojkov (EUMETSAT) – ACSG
ACSG Mission on web site
Perhaps add that the framework/comparison/best practices in AC val exists for nearly 30 yrs
Network for detection of GHG – does not have a subgroup
There were no formal subgroup meeting but that there were many meetings w members
Numerous meetings w members though the year (se also AC-VC report)
Members participated AVSG related meetings incl ACC GSICS NDACC SEROSST IO3CS etc.

Specific thematic meetings
Cloud mask for med res sensors
AQ FRM coordination @AGU
CEOS/CGMS MW imager gap task group – impacts SST Ice and MW time series – good outcome
Ground-based AQ FRM gap analysis – what is covered and not
German C/V Symposium involving WGCV SG members

Considerations
-Participation/interest in ACSG has always been a challenge – focus changing from research missions to operational missions for AQ, GHG, and down-stream services
Going to sub groups may make more sense because there is so much to address
-GSICS-UVSG address many activities for the operation AC missions
Should divide work among GSICS and ACSG
-GHG mission interop is critical esp. in the future as operational missions are launched

Way forward on GHG - CV-18 GHG ref standards to interop
Short term
1 Address WP action wrt CO2, CH4 - Post L1
2 ID short comings and gaps in GHG C/V. - What are issues and what has to be addressed?
3 prepare a position/way forward paper on closing CV-18
Have a draft by next WGCV

Longer Term (5-10)
1 Based on the expected outcome of ST (way forward paper), propose improvements in gaps in cal of sensors and L2 val infrastructure, alg intercomp on ground based instrum, Geog/geophys gaps for FRM
2 Id LT val needs and also ID potential process study needs (aircraft campaigns to characterize sources, challenging geophys conditions). In EU, need to cooperation/coordinate/synchronize
3 Work toward an operational reporting of the qual of space-borne GHG measurements and the underlying C/V infrastructure. Char individ sites, what is working what is not, so we can answer/address questions from sceptics as to why things don't agree

Need changes in ACSG to accomplish this. Reconstitute ACSG, specifically address GHG cal/val also bring in new members.
New GHG participants from BIRA-IASB, CAS CMA CNES DLR ESA EUM JAXA NDACC (tbc EC NASA NIES)
New ACSG ToR are to be prepared prior to WGCV-45

1st SG meeting on GHG to be held in second half of Nov at EUM

GSICS-UVSG to cover the operational L1-L2 issues
AVSG asks the WGCV to support the proposed way forward for CV-18 and GHG.
Organize AQ community – sites, data collection methods/standards

NDAC – forum to coordinate diff networks, Sat WG?? Coordinating the Sat and ground network community (NDAC)
NDAC – WG on FTIR – TCON, COCON – make sure we get the people from this WG
AQ has moved from research to operational and high profile – level of maturity is very high
To focus on GHG on ACSG will bring together aspects of what WGCV is trying to do

J-C: addressing the technical issues of the field efforts learned from air quality and having that included. Need a way to include the results and experience from the networks and the groups already doing cal/val incorporated into the effort. There are many active groups within the satellite and ground-measurement communities that can be leveraged – Effort will be to engage the groups doing the work within these broader organizations. Material presented was the minimum to include and there exist opportunities to have broader inclusion. Air quality has moved to near operational validation and the maturity is very high and having this example will be useful for taking GHG validation forward and doing it sooner than later.
NF: wants to understand why the membership is specifically listed – Short term timeline is what is leading to the targeted list

Philippe Goryl (ESA) – CMIX/ACIX
Action to summarize the ACIX report done by Brockmann, will put on the web site.
Comment made on the summary was in the mention of ARD, as ARD was not mentioned in the activity being summarized. Should move the ARD mention out of summary and perhaps in introduction of ACIX summary. Conclusion of exercise, close of action. Learned from exercise, know what can be done better, which is to be covered in ACIX2.
Cloud mask intercomparison exercise will be done in a similar way, and is associated with ACIX, and thus will be done concurrently.
ACIX-2 will be performed and split into two intercomparisons done for both water and land, with leaders of each identified from ESA/NASA. For the CMIX exercise the leaders have also been identified.
Schedules and deadlines set and underway.
Today we have 23 AC and or CM processors
18 Space agencies, institutes, Univ, Commercial
7 countries

Medhavey Thankappan (GA) – Continental Scale Surface Reflectance validation
Many participants and thanks to reviewers
3 sensors L8 S2A,B
Hope to manage the data collected as a national data collection archive
Characterize the products in terms of uncertainty
Impact on downstream products

Phase 1
Used existing protocols, incl QA4EO, TERN in the development of their own protocols
Evaluate multitemopral data collects from Phase 1 at a national workshop in Aug 2018

Report result from Phase 1 sites to rec from workshop in prop for Phase 2
Continue multi-temporal field data collection for nominated sites through Dec 2018
Data collection included instances of tandem meas of 2 teams doing meas at same time to understand level of bias introduced by teams and diff instruments
Collected direct and diffuse measurements
Attempted to standardize the workflow – incl QA/QC – developed QA/QC tools
Showed plots of S2 and L8 for tandem overpasses
Compared also the meas of ASD on the ground from two teams during the coincident overpasses

Then showed all the sites and the Sat vs Ground measurement plots

Drone based validation where they couldn't get field ASD, synchronized to S2 collect, flown at 50m

Phase 2
Will address sites that were not homog or easy to access
Review multitemporal collects from P1
Use more automation (drones)
Guided by workshop
Progress work on access and mgmt. of field spectra
National Spectral Database – SPECCIO
Field spectral data will be archived – made avail to the EO community – DOI?

Next
Help/feedback on protocols
Phase 2 action - Site selection
Deploy national spectral db on the AWS for routine operation
Progress on uncertainties – IVOS happy to contribute and help on uncertainty.

Move toward building the validation effort to something that can be applied to something global
Action to work w LPV to align SR effort with existing LPV processes leading to CEOS endorsed pub

Phase 2 to start next year.

MR: suggests timing is important and when all come together. FRM4Veg – SR, LAI, Fpar

Kurt Thome (NASA) - Closure of WGCV actions (CV-01, CV-09, CV-13, CV-16)
Send out Actions (where to put, stage, keep actions?)
CVP
RadCalNet
ACIX
GSICS/CEOS Ref Solar Spectrum

Vice Chair nomination and voting, A. Kuze will take over V. Chair after C. Ong takes on Chairmanship at next CEOS Plenary.