MINUTES OF THE THIRD CEOS LAND SURFACE IMAGING VIRTUAL CONSTELLATION MEETING (LSI-VC-3)

20th – 21st March 2017
ESA ESRIN, Frascati, Italy

Monday – 20th March 2017

Welcome, Introduction, Objectives

Bianca Hoersch (ESA) welcomed everyone to the meeting and presented a logistics overview. Adam Lewis (GA) commended the team for their work over the past year, noting the excellent progress in a very short timeframe. Jenn Lacey (USGS) noted that LSI-VC is the glue joining numerous tasks ongoing within CEOS, such as the 2017 CEOS Chair Initiatives on Moderate Resolution Sensor Interoperability (MRI) and Future Data Architectures (FDA). The September joint meeting is a key milestone for LSI-VC, and the broader rationalisation of CEOS LSI requirements will see the team's responsibilities grow further.

Roundtable Introductions

Adam initiated a roundtable introduction session. The complete list of attendees is included in Appendix A.

LSI-VC-2 Actions Review

Matt Steventon (CEOS Chair Team) presented the status of actions from LSI-VC-2. There were 23 actions in total, with 18 completed as of LSI-VC-3. The statuses of five actions were reviewed, and the latest is summarised below.

LSI-VC-2-08	*Adam Lewis to coordinate LSI-VC action on 'CARB-08-02: Inclusion of IGCO continuity priorities in VC and WGClimate activities'. Brian to send Adam the IGCO document.*	**ON HOLD** *On hold pending the discussion with Mark Dowell during LSI-VC-3.*
LSI-VC-2-13	*Brian Killough, Jenn Lacey and Bianca Hoersch to initiate a plan for LSI-VC to establish the 'CEOS approach' to requirements/capability analysis – applying the procedures that have been developed in GEOGLAM and SDCG, in particular the 'requirements matrix'.*	**CLOSED** *Will be progressed during LSI-VC-3.*
LSI-VC-2-14	*Adam Lewis and Brian Killough to explore the possibility of setting up a small Data Cube over Australia for validation of the SEO's implementation of the WOfS algorithm by comparing the results to GA's.*	**Q3 2017** *The CEOS SEO team continues to work on this action, and should have results/a report to share by Q3 2017. This activity will compare WOfS results generated using USGS surface reflectance products (as used by the SEO) and GA-generated surface reflectance products (as used by GA).*
LSI-VC-2-20	*Adam Lewis to draft the task and potential membership of a radar team to progress the example specifications of SAR CARD4L. Membership should include JAXA, ESA (Bianca is POC), CSA (Paul Briand has confirmed), NASA, and UKSA. The team should start with the gamma-nought specification, and it was noted that the high-level definition is outside of scope.*	**CLOSED** *The SAR backscatter ARD Product Family Specification will be discussed during LSI-VC-3 and finalised following the meeting.*

LSI-VC-2-21	*Jenn Lacey to coordinate an update of the LSI-VC Implementation Plan ahead of CEOS Plenary.*	**CLOSED** *Will be progressed during LSI-VC-3 and finalised following the meeting.*

Agenda Review

Adam briefly reviewed the meeting agenda.

Review: Status of CEOS Landscape, Plenary Outcomes, and LSI-VC's Role

Jenn noted that the topic for this session is the revision of the LSI-VC Implementation Plan. She reviewed the tasks and the goal for this session: review the CEOS Work Plan and compile a list of 'Work Areas' and their respective milestones, to be used after LSI-VC-3 to update the LSI-VC Implementation Plan (via email).

Jonathon Ross (GA, CEO) presented an overview of CEOS to help set the stage, recalling the Kyoto Statement and the numerous global agendas that are relevant to CEOS and its agencies. He noted the CEOS Work Plan and the 2017 CEOS Chair Initiatives. The two chair initiatives bridge the gap between users and data. The FDA *ad-hoc* Team (FDA-AHT) is assessing the strategic direction for CEOS, and also progressing Pilot activities to inform the strategic decisions. Bottom-up activities on ARD are vital to the overall success of top-level FDA strategy discussions and other activities.

The work being undertaken by the FDA-AHT is broader than that of WGISS. In the longer term, each of the activities being undertaken by the FDA-AHT will need to find permanent homes in the CEOS structure.

LSI-VC Implementation Plan

In response to action LSI-VC-2-21, Jenn has taken responsibility for updating the LSI-VC Implementation Plan (IP). The IP is being revised so that it better reflects the current direction and priorities of the VC, and to ensure that it is consistent with the CEOS Work Plan 2017-2019. Jenn reviewed the document that she has marked-up with some suggested changes. The following points from the discussion were noted:

- Jenn noted the following aim from the IP: *"Promoting sustained and systematic collection of satellite-derived land surface imaging observations by sharing information on future mission development".*
  - It was agreed that it would be helpful to use the CEOS MIM Database (MIM DB) to generate some custom timelines for LSI-VC purposes.
  - Jeff Masek (NASA) noted that the gap identification potential of such timelines would be helpful – most importantly for SAR (as optical is already well covered globally). David Jarrett (NASA) supported the idea, stating that gap identification should be a priority.
  - Ivan Petiteville (ESA) stressed the importance of publicising any results.
  - Brian Killough (NASA) noted that ESA, the CEOS SEO, and the MIM Database team are working to add gap analysis capabilities to the MIM DB, although the approach and scope is still being discussed. Brian also noted that the COVE tool can be used to generate coverage maps, and periodic LSI-VC-specific maps could be auto-generated.

- Jonathon Ross (GA) suggested that if LSI-VC is not currently doing anything to address this aim then it should be a priority, as it comes down to CEOS agencies communicating their mission plans with each other.
- Adam suggested that the dot point be modified to also include current observation plans.

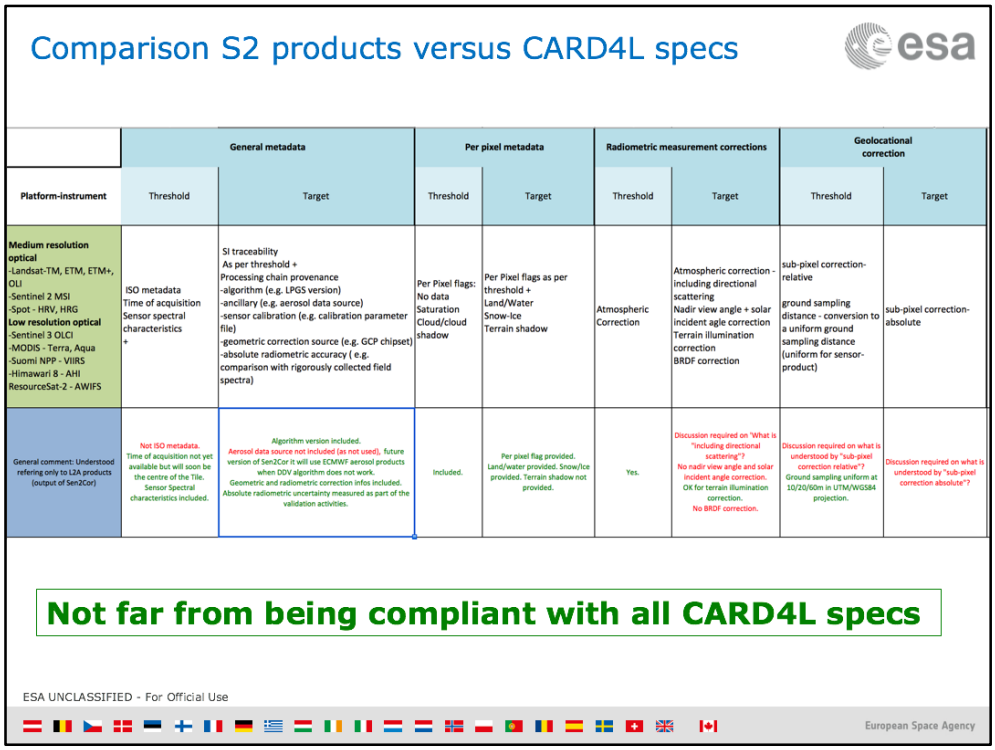
LSI-VC-3-01	*Jenn Lacey to coordinate LSI-VC mission timelines with the CEOS MIM Database team.*	**April 2017**
LSI-VC-3-02	*Brian Killough to investigate the possibility of automatically retrieving Sentinel-1 acquisition KMLs for COVE to allow future acquisition plans to be viewed in the tool.*	**May 2017**

- Jenn noted that the 3-year and 5-year horizons will need to be revised, and this could be done on a dedicated phone call.
- It was agreed that the first paragraph under the 3-year horizon goal for *Ground Segment and Information Systems* should be deleted. It was agreed that LSI-VC should focus on ARD and interoperability rather than data architectures – these will fall to the FDA-AHT and perhaps WGISS, in due course.
- Gene Fosnight (USGS) agreed to work with Jenn to elaborate the *Products and Services* row, due to its close relation to the Moderate Resolution Sensor Interoperability (MRI) Initiative. David noted that the wording in the 3-year horizon for *Products and Services* needs to be revised (one product from multiple sensors).
- Jenn will ensure that the FDA-4 CEOS Work Plan reference is elaborated in the next version of the LSI-VC IP.
- In regard to increasing the visibility of land surface imaging data holdings, the wording of the *Objective/Deliverable* should be revised to focus on gap analyses. The first paragraph under the *Description/Context* should be removed and the applicability of COVE should be mentioned in the remaining paragraph.
- It was suggested that the interoperability case study *Objective/Deliverable* be revised to include Sentinel-1, and that *'Moderate'* should be replaced with *'10-100m resolution'*.

LSI-VC-3-03	*Jenn Lacey to revise and circulate an updated LSI-VC Implementation Plan, which will be discussed further during the April or May LSI-VC teleconference.*	**May 2017**

ESA/Sentinel-2

Bianca Hoersch (ESA) presented an update on Sentinel-2, with a focus on the CARD4L compliance of Sentinel-2 products. The Sentinel-2 team performed an assessment on Sentinel-2 products and found that the L1C product is meeting the definition of CARD4L, and all other products are almost fully compliant.



Comparison S2 products versus CARD4L specs

	General metadata		Per pixel metadata		Radiometric measurement corrections		Geolocational correction	
Platform-instrument	Threshold	Target	Threshold	Target	Threshold	Target	Threshold	Target
Medium resolution optical -Landsat-TM, ETM, ETM+, OLI -Sentinel 2 MSI -Spot - HRV, HRG Low resolution optical -Sentinel 3 OLCI -MODIS - Terra, Aqua -Suomi NPP - VIIRS -Himawari 8 - AHI ResourceSat-2 - AWIFS	ISO metadata Time of acquisition Sensor spectral characteristics +	SI traceability As per threshold + Processing chain provenance -algorithm (e.g. LPGS version) -ancillary (e.g. aerosol data source) -sensor calibration (e.g. calibration parameter file) -geometric correction source (e.g. GCP chipset) -absolute radiometric accuracy (e.g. comparison with rigorously collected field spectra)	Per Pixel flags: No data Saturation Cloud/cloud shadow	Per Pixel flags as per threshold + Land/Water Snow-Ice Terrain shadow	Atmospheric Correction	Atmospheric correction - including directional scattering Nadir view angle + solar incident agle correction Terrain illumination correction BRDF correction	sub-pixel correction-relative ground sampling distance - conversion to a uniform ground sampling distance (uniform for sensor-product)	sub-pixel correction-absolute
General comment: Understood refering only to L2A products (output of Sen2Cor)	Not ISO metadata. Time of acquisition not yet available but will soon be the centre of the Tile. Sensor Spectral characteristics included.	Algorithm version included. Aerosol data source not included (as not used), future version of Sen2Cor it will use ECMWF aerosol products when DDV algorithm does not work. Geometric and radiometric correction infos included. Absolute radiometric uncertainty measured as part of the validation activities.	Included.	Per pixel flag provided. Land/water provided. Snow/Ice provided. Terrain shadow not provided.	Yes.	Discussion required on "What is "including directional scattering"? No nadir view angle and solar incident angle correction. OK for terrain illumination correction. No BRDF correction.	Discussion required on what is understood by "sub-pixel correction relative"? Ground sampling uniform at 10/20/60m in UTM/WGS84 projection.	Discussion required on what is understood by "sub-pixel correction absolute"?

Not far from being compliant with all CARD4L specs

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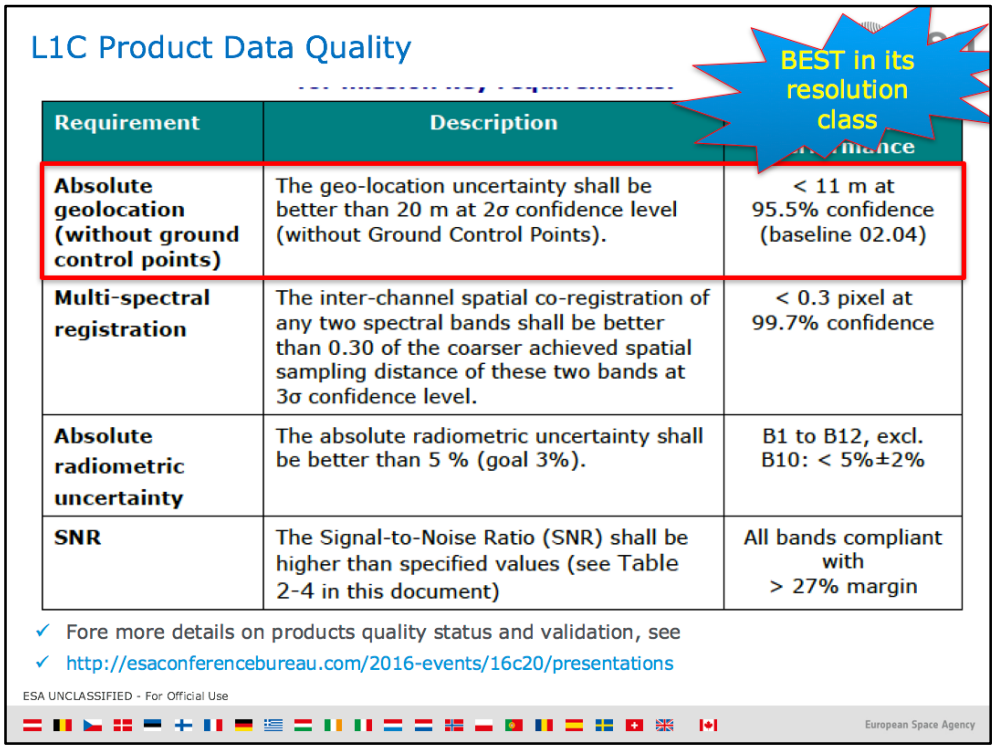
European Space Agency



L1C Product Data Quality

BEST in its resolution class

Requirement	Description	Performance
Absolute geolocation (without ground control points)	The geo-location uncertainty shall be better than 20 m at 2σ confidence level (without Ground Control Points).	< 11 m at 95.5% confidence (baseline 02.04)
Multi-spectral registration	The inter-channel spatial co-registration of any two spectral bands shall be better than 0.30 of the coarser achieved spatial sampling distance of these two bands at 3σ confidence level.	< 0.3 pixel at 99.7% confidence
Absolute radiometric uncertainty	The absolute radiometric uncertainty shall be better than 5 % (goal 3%).	B1 to B12, excl. B10: < 5%±2%
SNR	The Signal-to-Noise Ratio (SNR) shall be higher than specified values (see Table 2-4 in this document)	All bands compliant with > 27% margin

✓ Fore more details on products quality status and validation, see
✓ http://esaconferencebureau.com/2016-events/16c20/presentations

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Bianca asked Adam and Jonathon to clarify the CARD4L parameter on atmospheric correction directional scattering.

LSI-VC-3-04	*Jonathon Ross and Adam Lewis to revise the CARD4L definition wording around 'atmospheric correction directional scattering'.*	**April 2017**

Bianca noted that systematic Sentinel-2 L2A product generation is planned, and will start with a pilot for Europe in 2017. The results of the Atmospheric Correction Intercomparison eXercise (ACIX) will result in the selection of a single Atmospheric Correction (AC) algorithm for the systematic production, and will enable long-term, global L2A products. While a single algorithm will be selected for systematic production, multiple algorithms could be provided as part of the Sentinel Toolbox.

Jeff Masek (NASA) noted that ACIX will identify any systematic differences between AC algorithms. He added that there are two ways to retrieve atmospheric properties for AC: single date with ancillary atmospheric measurements, as well as time series analysis.

It's unknown when global Landsat Surface Reflectance (SR) products will be available systematically (as opposed to being processed on demand). LCMAP will produce products for the continental United States. Adam confirmed that Geoscience Australia (GA) are not producing Landsat SR products systematically.

The Sentinel-2 Global Reference Image (GRI) is expected by 2018, and it will be used to orthorectify all subsequent images to obtain the desired pixel accuracy.

Bianca noted that there are many Sentinel data hubs and portals emerging at an increasing rate. She asked whether LSI-VC should make an inventory of these portals and their capabilities in support of *"increasing the visibility of land surface imaging data holdings"*. There was some concern that we might not be able to keep up with the pace of development, which would undermine the utility.

LSI-VC-3-05	*Brian Killough to follow up with WGISS on the idea of producing an inventory of private sector Sentinel data hubs/portals and their capabilities.*	**April 2017**

Bianca closed by reviewing the timeline of future Sentinel-2 developments.

Rationalising CEOS LSI Activities

Stephen Ward (CEOS Chair Team) summarised the rationale behind the joint meeting of the SDCG for GFOI, CEOS-GEOGLAM *ad-hoc* Working Group, and the LSI-VC planned for 6-8 September 2017. The purpose of this trial meeting is to begin the process of rationalising CEOS LSI activities, resulting in both better coordination of LSI requirements and also travel efficiencies. The *ad-hoc* teams of SDCG for GFOI and CEOS-GEOGLAM were never intended to be permanent, and this meeting will explore how they might be incorporated under the LSI-VC umbrella. Jonathon Ross (GA) noted that there is also the hope that this will set a precedent for how new GEO Initiatives should be addressed by CEOS – providing a framework for the incorporation of new LSI requirements in the CEOS structure.

Gene Fosnight (USGS) welcomed the initiative, noting that it will bring user feedback into the LSI-VC, and that co-locating these meetings will expose LSI-VC to the user perspective. He stressed however that we must be careful not to lose what has made the SDCG for GFOI and CEOS-GEOGLAM *ad-hoc* WG successful – their identity and links to the user community – during any future transition.

Jenn Lacey (USGS) noted that the MRI Initiative would be another ideal topic for the joint meeting. Stephen agreed and will ensure that the concept note/week-at-a-glance/agenda are revised accordingly.

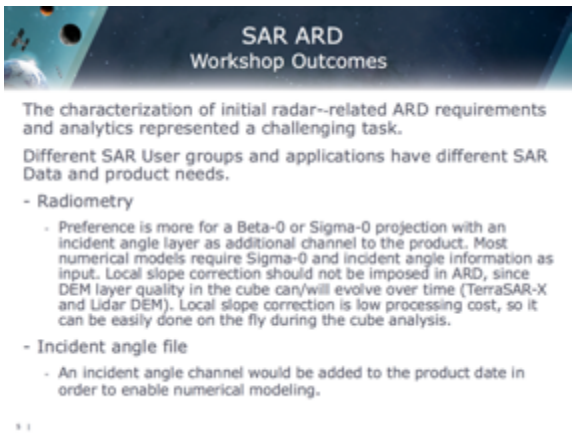
While the end goal is to incorporate the *ad-hoc* teams under LSI-VC, Stephen stressed that agency representatives on SDCG-GFOI and CEOS-GEOGLAM should not be recalled prematurely.

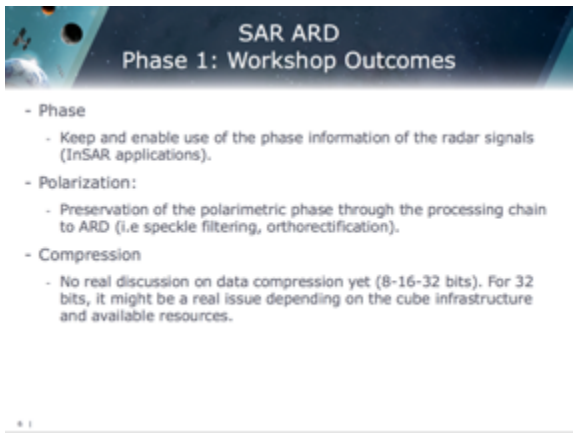
David Jarrett (NASA) questioned how the LSI-VC Implementation Plan and 'Joint Work Plan' would operate together, asking whether the joint plan would incorporate the LSI-VC Implementation Plan. It was agreed that the LSI-VC would likely maintain its own plan, while activities that are specifically cross-cutting would be covered in any future joint work plan.

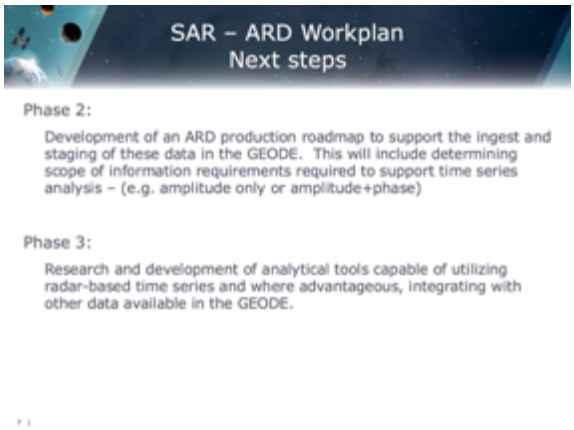
It was agreed that we should take a considered and conservative approach, holding the trial meeting before deciding the next steps.

CSA Report

Paul Briand (CSA) noted the efforts within Canada to establish five new initiatives to ensure the increased use of space-based EO data in the key policy areas of terrestrial monitoring, activities supporting climate change impacts, and ecosystem resilience. NRCan-CCMEO are developing a Big Geospatial Data Analytics (BGDA) system, referred to as the Geoanalytics Earth Observation Data Environment (GEODE), which will require definitions of SAR and Radarsat Constellation Mission (RCM) ARD for time series analytics. Phase 1 of the effort to define Radarsat ARD includes examining current SAR ARD standards/definitions under development (e.g., within CEOS/LSI-VC, Google Earth Engine) and the development of mini Data Cubes to support development, testing and demonstration. A workshop in January 2017 initiated the process:







Henri Laur (ESA) questioned the applicability and usefulness of SAR ARD, noting that many of the land domain users ESA is serving with Sentinel-1 data are using it for interferometry, and the overall user community is very diverse in their needs. He asked whether it is appropriate to treat the SAR user community in the same way as the optical user community. He added that interferometry time series are seldom used, and noted that there were big investments in the past with ERS that resulted in projects with few, if any, end users. Systematic production might not be feasible, however providing access to methods via the Sentinel Toolbox is a possibility.

Adam Lewis (GA) stressed that CARD4L is not meant to cover specialised users or interferometric applications, and the applicability of a SAR ARD product should not be dismissed. There are many new potential users for basic application of SAR, e.g., in forestry and agriculture (rice and cloudy area observations, in particular) that would benefit greatly from a basic product. We have seen this need communicated through consultations with users (e.g., via SDCG-GFOI, GEOGLAM).

Brian Killough (NASA/SEO) agreed with Adam's position, noting that we need to focus our definition to make it clear that interferometric SAR is not within scope. He supported Adam's statement regarding the emergence of entirely new user communities that want to use radar alongside optical data. Paul noted that many users in Canada do not wish to spend time doing pre-processing of SAR data, and an ARD product could be very useful for them.

ISRO

Bimal Bhattacharya (ISRO) presented the SACRS2 scheme for atmospheric correction of Resourcesat-2 AWiFS data, which is available via the MOSDAC site (http://mosdac.gov.in/) and IGIS Version 2. http://www.sciencedirect.com/science/article/pii/S0303243415000835

Adam Lewis (GA) asked whether there is any systematic way to process data, as the tool appears to be manual. Bimal confirmed that an automated script is available.

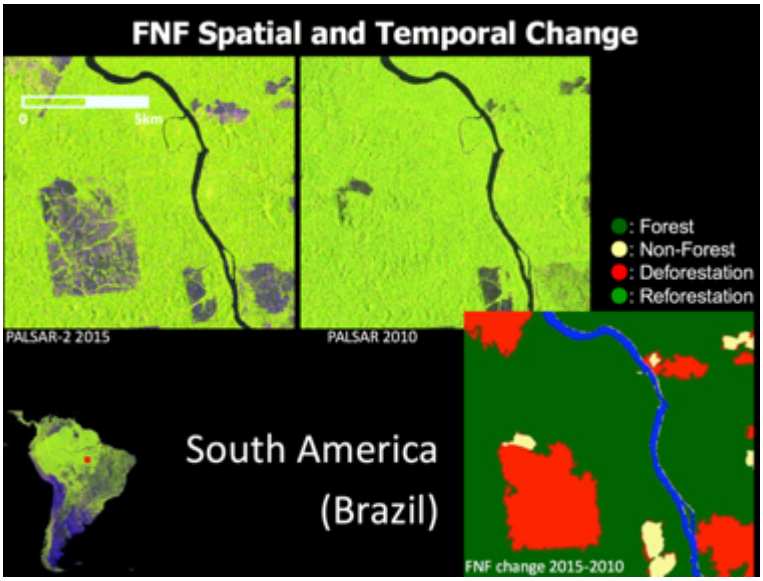
Bianca Hoersch (ESA) noted that ISRO has not been involved in ACIX to date, and she suggested Bimal join the April 11-12 ACIX workshop (at ESA ESRIN).

LSI-VC-3-06	*Bianca Hoersch to send Bimal Bhattacharya Webex details for the upcoming ACIX meeting (April 11-12).*	**24 March 2017**

LSI-VC-3-07	*Bimal Bhattacharya to share coverage maps that summarise the quantity and location of available AWiFS data.* *Jenn Lacey to share any related information obtained by USGS.*	**April 2017**

JAXA

Takeo Tadono (JAXA) reviewed JAXA's mission portfolio as well as the SAR ARD products generated from ALOS/JERS, namely the annual global mosaics and Forest/Non-Forest maps, which are released for free via JAXA's website:
http://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm



Tadono-san noted the plans for two future Japanese missions: an advanced optical satellite and an advanced SAR mission, both expected to launch in the 2020 timeframe. He closed by noting that optical ARD could be supplied in the form of global, orthorectified ALOS AVNIR-2 data, and JAXA will continue to explore and produce high-level products for public release.

In response to a question from Bianca Hoersch (ESA), Tadono-san confirmed that the aforementioned AVNIR-2 data is not a mosaic, and could possibly be released if requested by LSI-VC. An action was recorded to follow up with JAXA.

LSI-VC-3-08	*Jonathon Ross to coordinate LSI-VC action at SIT-32 to note the interest of the LSI/CEOS community in making the global, orthorectified AVNIR-2 dataset available as free-and-open CARD4L.*	**SIT-32**

Frank Martin Seifert (ESA), Brian Killough (NASA/SEO), and Jonathon Ross (GA) thanked JAXA for making the ALOS/JERS global mosaic datasets available, noting that they have great utility and that the CEOS SEO is working on integrating them into the Vietnam Data Cube pilot. Jonathon added that the FDA pilots are a cost-effective way to demonstrate the benefits of such datasets.

LSI-VC-3-09	*Takeo Tadono to share the download statistics for the ALOS/JERS global mosaics.*	**April 2017**
LSI-VC-3-10	*Takeo Tadono and Brian Killough to discuss ALOS/JERS Forest/Non-Forest global product validation.* *Takeo to share a paper on the validation/processing with Brian.*	**April 2017**

European Commission

Mark Dowell (EC/JRC) is the manager for the Copernicus Global Land Service. He spoke about a recent Request for Tender (released March 3) related to the production of global surface reflectance mosaics (10-day) using Sentinel-2 data. Products will be generated in multiple resolutions (10, 20, and 60 metres) and with various spectral variations. He indicated that there is scope for LSI-VC to direct the work over the coming years.

Jonathon Ross (GA) asked whether a Sentinel-1 global mosaic is being considered. Mark noted that there was some push to do a radar mosaic, however it was decided to only pursue this after further consultation with the user community. The possibility of releasing derived thematic products has also been discussed.

Sentinel-3

Susanne Mecklenburg (ESA), Sentinel-3 Mission Manager, presented an overview of the mission and some of its products, including those related to vegetation and LST. She noted that the synergy products are likely the most relevant to LSI-VC.

The phase shift between Sentinel-3A and -3B has recently changed from 180 to 140 degrees to improve interleaving for the altimetry mission, and will result in a slightly increased revisit time for ocean observations (from 2 to 3 days). Sample synergy and vegetation products are expected to be available by May 2017, with operational releases expected by mid-year. New products will be generated in response to requests from the EC – Aerosol Optical Depth (AOD) and Fire Radiative Power (FRP). The near-real-time FRP product will have a latency of 3 hours.

In response to Jeff Masek (NASA), Susanne confirmed that some radiometric intercomparisons (VIIRS, MODIS, PROBA-V, and Sentinel-3) have been performed by the Sentinel-3 validation team. Ferran Gascon (ESA) noted that there has also been some work done in the CEOS WGCV IVOS subgroup.

FDA Pilot Requirements

Brian Killough (NASA/SEO) presented an overview of the CEOS FDA Pilots (Colombia, Switzerland, Vietnam, USA, Europe, Australia) and the high-level results of a questionnaire carried out by the FDA *ad-hoc* Team. Two Data Cubes are being investigated for Vietnam – one hosted by VAST/VNSC and another by the NASA SERVIR Mekong Hub.

Jenn Lacey (USGS) asked whether the EC is represented on the FDA-AHT. Mark Dowell (EC/JRC) noted that the EC are interested in nominating someone for the FDA-AHT and there are potential candidates from both the JRC and Brussels office.

Brian reported that the newest FDA Pilot team from Switzerland have been making excellent progress in a short amount of time. During their efforts to populate a Data Cube, they have found that the USGS Landsat archive lacks a substantial amount of data for the period 1991-1998. Jenn agreed to follow up. Gene Fosnight (USGS) suggested that this gap might be due to the fact that the repatriated data has not been posted online due to it having accuracy issues related to PCD. Bianca noted that some of this data is available via the European EO Browser.

LSI-VC-3-11	*Jenn Lacey to investigate the missing Landsat data for Switzerland from 1991-1998.* *Brian Killough to check the European EO Browser for the missing data.*	**CLOSED** *Discussions continuing between ESA and USGS to make the data available via USGS processing systems.*

Brian noted the dependence that the FDA Pilots have on the CARD4L Product Family Specifications (PFS) and the availability of pilot CARD4L products. LSI-VC guidance is needed in regard to when the data will be available.

Brian also wants to ensure that the work of the MRI Initiative team benefits the FDA Pilots, and he will be working closely with Gene Fosnight (USGS) to coordinate some specific tasks that would be helpful.

Mark Dowell (EC/JRC) asked for clarification on the end goal of the FDA Pilots. Brian noted that it is unclear where the FDA work will ultimately end up in the CEOS structure – the FDA *ad-hoc* Team might be extended for another year (or more), or its activities could be distributed amongst various CEOS groups. By the 2017 Plenary, the FDA-AHT will summarise the lessons learned from the FDA Pilots to help guide future CEOS work around FDA. Gene suggested that these lessons learned should also be communicated to groups like the GFOI R&D Component. Paul Briand (CSA) noted the importance of not only having the capacity to establish the pilots, but also for their continued operation.

Brian closed by noting that the priorities for LSI-VC are shepherding the CARD4L Definition, Product Family Specifications, and Assessment Framework; and also the production and supply of CARD4L to the FDA Pilots. Jonathon noted that accessibility to CARD4L is key once it is being produced, and he suggested that LSI-VC keep this in mind as a possible topic for future work (around automated metadata, etc.)

The following actions were noted for the LSI-VC:

LSI-VC-3-12	*Adam Lewis (via Brian Killough) to provide the FDA Pilot teams with CARD4L Product Family Specifications (in draft and final form) as they become available (i.e., following LSI-VC-3 and SIT-32, respectively) including, as possible, associated guidance on interpretation, access, and use.*	**SIT-32**

LSI-VC-3-13	*Adam Lewis to work with the FDA-AHT at the 2017 SIT Technical Workshop (September) to ensure that lessons learned from the FDA Pilots are fed back into the work of the LSI-VC (i.e., in the areas of CARD4L and MRI).*	**2017 SIT Technical Workshop**

USGS/LCMAP Report

Gene Fosnight (USGS) spoke about Landsat collection management and noted the shift to the tiered system. Tier 1 data is data with less than 12m RMSE and is optimal for time series analysis. He noted that different algorithms are used to derive surface reflectance products from Landsat 4-7 and Landsat 8, and USGS are investigating methods for cross-comparing them. Gene suggested that it could be useful for the LSI-VC to hold discussions around coordinating global gridding systems.

Moderate Resolution Sensor Interoperability (MRI) Introduction

Gene Fosnight (USGS) is leading the 2017 CEOS Chair Initiative on Moderate Resolution Sensor Interoperability (MRI), and the activity is being undertaken by a subset of the LSI-VC team as well as representatives from other CEOS groups, including WGCV and WGISS.

MRI will draw upon the CARD4L definition and specifications, and use them to direct the effort on determining the interoperability of different sensors. CARD4L products allow interoperability both through time and with other datasets; the MRI Framework will detail the specifics around how the potential of CARD4L to support multi-sensor interoperability can be achieved for specific applications – drawing on lessons learned from a series of case studies (beginning with Landsat 8 and Sentinel-2) – and summarise recommendations and consequences. Gene confirmed that the case studies will produce both lessons learned and recommendations on best practices.

It was suggested that all nomenclature be well defined and consistent with other CEOS definitions (e.g., the use of 'moderate' when describing a sensor resolution).

MuSLI and HLS

Jeff Masek (NASA) presented a summary of two projects that are highly relevant to MRI: Multi-Source Land Imaging (MuSLI) and the Harmonized Landsat-Sentinel dataset.

MuSLI is a set of research projects, funded through the NASA Land-Cover and Land-Use Change (LCLUC) Program, that are working to advance the use of multi-source remote sensing data for land monitoring applications. Each project makes use of multiple, international datasets to achieve their goals, and an emphasis is placed on regional pilot projects and prototype products that can be scaled-up. A new solicitation for 2017 projects has been released, with an increased emphasis on continental-scale products.

The Harmonized Landsat-Sentinel (HLS) project is merging Sentinel-2 and Landsat 8 products at a radiometric level. Once scaled, this could provide global surface reflectance coverage every two to three days. Jeff noted that this is just one approach to harmonizing datasets, and only works when the sensors are fundamentally similar. Merging can also be done at the physical measurement level and through a process called orthogonal harmonization. It was suggested that this approach is more of a homogenization (i.e., making products look the

same) and we should be aware of the difference between homogenizing and harmonizing products.

In the future, HLS activities will be progressively scaled-up, with a complete North American product expected to be available during the 2017 calendar year (estimated at 137 TB/year). A 1-day best observation composite (M30 product) is also planned, and further interaction with the user community is a priority.

Jeff confirmed for Brian Killough (NASA/SEO) that HLS products could be stacked in a Data Cube environment.

Atmospheric Correction Intercomparison eXercise (ACIX)

Ferran Gascon (ESA) presented an overview of the ACIX project led by ESA and NASA. ACIX aims to perform an intercomparison of atmospheric correction algorithms. 12 different approaches are being tested by 13 different organisations/institutes/companies in 5 countries. The results of ACIX will point out the strengths and weaknesses of the different solutions, and highlight commonalities and differences between the approaches. The final analysis report is expected very soon – at the second workshop, to be held April 11-12 at ESA ESRIN. The focus is Landsat 8 and Sentinel-2 land surface measurements, and the results will influence the choice of the AC algorithm that will be used for the systematic production of Sentinel-2 surface reflectance products.

Tuesday – 21st March 2017

Day 1 Wrap-up

Adam Lewis (GA) summarised the discussions and reviewed the draft actions from Day 1. Some changes were made to the proposed actions.

University of Queensland (UQ) Update

Adam Lewis (GA) presented some updates on behalf of Stuart Phinn (UQ) and the Joint Remote Sensing Research Program (JRSRP). He noted in particular that the JRSRP have performed state-wide vegetation cover mapping for Queensland and also published a paper on an operational scheme for deriving standardised surface reflectance from Landsat TM/ETM+ and SPOT HRG for Eastern Australia. They are also generating their own surface reflectance from Sentinel-2 and the results correlate well with Landsat 8. Their cloud and water masking algorithms are now also running operationally.

GA ARD Status

Adam Lewis (GA) shared some GA perspectives on ARD, noting that demand is growing, including for SAR ARD. GA have estimated that 30% of analysis time could be saved with the systematic production of pre-processed ARD.

Adam noted the GA/UQ efforts to produce surface reflectance data, and reported that the corrections being applied to Landsat are also being applied successfully to Sentinel-2. As previously noted, SPOT-5 ARD is being progressed by Stuart Phinn/UQ, and they have been put in contact with Brian Killough (NASA/SEO) in support of the FDA Pilots.

Surface Brightness Temperature (SBT) is another (threshold) CARD4L Product Family Specification being proposed by GA and USGS, in addition to surface reflectance and SAR backscatter. With information on land surface emissivity, land surface temperature (target CARD4L) can also be derived.

CEOS SEO ARD

Brian Killough (NASA/SEO) presented an update on the procurement of ARD for the FDA Pilots. The CEOS Open Data Cube relies on ARD, and the ideal scenario would be for CEOS Agencies to generate and supply this data directly, however this is not always realistic and therefore in these cases an open source method for generating ARD is desired.

Brian presented a summary of the ARD processed and offered by the private sector, as well as a summary of the supply of ARD for Data Cubes:

Company	Dataset	Host	Processing Comments
Amazon	Landsat 8, TOA	AWS S3	Level-1 Top-of-Atmosphere with orthorectification
Amazon	Sentinel-2A, TOA	AWS S3	Level-1 Top-of-Atmosphere with orthorectification
Google	Landsat 5/7/8, TOA Landsat 5/7/8, SR	Earth Engine	Level-1 Top-of-Atmosphere with orthorectification and Level-2 processed Surface Reflectance (SR) using LEDAPS
Google	Sentinel-2A, TOA	Earth Engine	Level-1 Top-of-Atmosphere with orthorectification
Google	Sentinel-1A, GRD	Earth Engine	Level-2 processed with Sentinel Toolbox. Processing includes orthorectification, removing thermal noise, radiometric calibration and terrain correction using SRTM or ASTER.

Dataset	Definition	Availability	Comments
Landsat 5			ARD=SR. Products can be ordered thru USGS. Investigating enhanced ARD (solar and terrain illumination corrections, NBAR).
Landsat 7			ARD=SR. Products can be ordered thru USGS. Investigating enhanced ARD (solar and terrain illumination corrections, NBAR).
Landsat 8			ARD=SR. Products can be ordered thru USGS. Product is provisional
Sentinel-1			ARD=dB intensity. Definition and processing steps under review. Not available for download.
Sentinel-2			ARD=SR. Definition and processing steps under review. Not available for download. Uncertainty in atmospheric correction algorithm.
ALOS-PALSAR			ARD=dB intensity. Products are annual mosaics. Available through JAXA.
SPOT-5			ARD=SR. CNES product is TOA. Processing required to obtain SR. Methods for processing are under review.
SRTM DEM			ARD=height. NASA-NOAA product available for download. Only Feb 2000.
ASTER DEM			ARD=height. NASA-Japan product available for download. GDEM2 product is 2009-2011.
MODIS			ARD=Level-3. Multiple products available from NASA with Level-3 processing complete.
Harmonized Landsat-Sentinel-2 (HLS)			ARD=SR. Product under testing and evaluation by Landsat Science Team. Future downloads and data availability uncertain.

The CEOS SEO is producing its own Sentinel-1 ARD using the ESA SNAP tool and IW mode GRD data. By reviewing the work of CSIRO and GA researchers, as well as several advanced user communities (e.g., Google Earth Engine), Brian has identified 9 steps/options typically used when processing SAR data to an analysis-ready state. The steps applied vary between users – a summary is presented below – and Brian would like guidance from ESA on the best practice for producing SAR ARD that will satisfy the majority of non-expert users.

Step	Description	Google	CSIRO (Zhou)	GA (Lewis)
1	Orbit Updates	x	x	x
2	GRD Border Noise			x
3	Thermal Noise	x	x	
4	Radiometric Calibration	x	x	x
5	Multilooking		x	
6	Terrain Flattening	?	x	x
7	Speckle Filter		x	
8	Terrain Correction	x	x	x
9	dB Conversion	x	x	x

Pierre Potin (ESA, Sentinel-1 Mission Manager) stated that while the IW mode is the default for global land cover, SLC is now also being generated globally. It was intended to only be generated for areas where interferometry applications were anticipated, however due to strong demand from the interferometry community it is now produced globally. However, in

the FDA Pilot/CEOS Open Data Cube context, where users are new/non-experts, IW mode in the GRD format is the most appropriate dataset.

Nuno Miranda (ESA) is the Data Quality Manager for the Sentinel-1 mission. He stepped through the 9 processing options identified by Brian and provided feedback on each:

Orbit Updates	Precise orbital parameters are provided 20 days after acquisition. For most users, the corrections result in very minor differences, and these are mostly only relevant for interferometric users.
GRD Border Noise	GRD Border Noise is caused by acquisition width variations due to the curvature of the Earth, and is dependent on the length of the acquisition segment. Nuno confirmed that there should be no adverse effects caused by its removal.
Thermal Noise	Thermal noise is sensor-dependent (Sentinel-1 has a relatively poor noise floor) and dictates the point beyond which no measurements can be made, as sensor noise will be greater than the received backscatter. This affects measurements of low backscatter land cover types in particular, such as lakes, deserts, oceans, sea ice, etc. Thermal de-noising will remove these floor effects; however, the process is destructive and is not done in the GRD product. Thermal noise vectors will soon be provided in both azimuth and range, and a change in the data format is expected soon. Details will be made available ahead of the change (3 months or so) and any changes will only be rolled out once the SNAP tool supports the new format.
Radiometric Calibration	Should be applied.
Multilooking	Multilooking trades radiometric resolution for geometric resolution. It is up to the user to determine the amount of multilooking to be used, and is generally dependent on the window size. Multilooking is a speckle filter, so performing both is redundant.
Terrain Flattening	Critical for combining data from multiple sensors.
Speckle Filtering	Multilooking is a speckle filter, so performing both is redundant. The decision to use speckle filtering is dependent on the user/uses.
Terrain Correction	Standard procedure. “Terrain Correction” should be changed to: “Radiometric Terrain Correction” (i.e., using a DEM to account for slope, and performing orthorectification).

dB Conversion	Standard procedure. Joao Carreiras (NCEO/UKSA) stressed that for classification purposes, the original intensity scale must be used rather than the dB scale. Brian agreed, noting that SAR ARD should not include the dB conversion step, but rather provide users with the necessary conversions.

Based on this feedback, Brian suggested that CEOS SAR ARD will likely use the following processing steps, and define 'Target' and 'Threshold' levels of compliance as per the following table. The final CARD4L product is backscatter intensity (unitless).

Step	Description	CEOS ARD
1	Orbit Updates	Threshold
2	GRD Border Noise	Target
3	Thermal Noise	TBD
4	Radiometric Calibration	Threshold
5	Multilooking	
6	Radiometric Terrain Correction	Threshold
7	Speckle Filter	TBD
8	Orthorectification	Threshold
9	dB Conversion	

Pierre directed Brian to the ESA Thematic Exploitation Platform (TEP) teams for further guidance on any thematic questions.

Brian noted that Sentinel-1 is currently in the COVE tool and Sentinel-2 will be added soon. Future Sentinel acquisitions could also be added using the publicly available acquisition segment KMLs provided by ESA. Brian is investigating how they might be automatically imported into COVE.

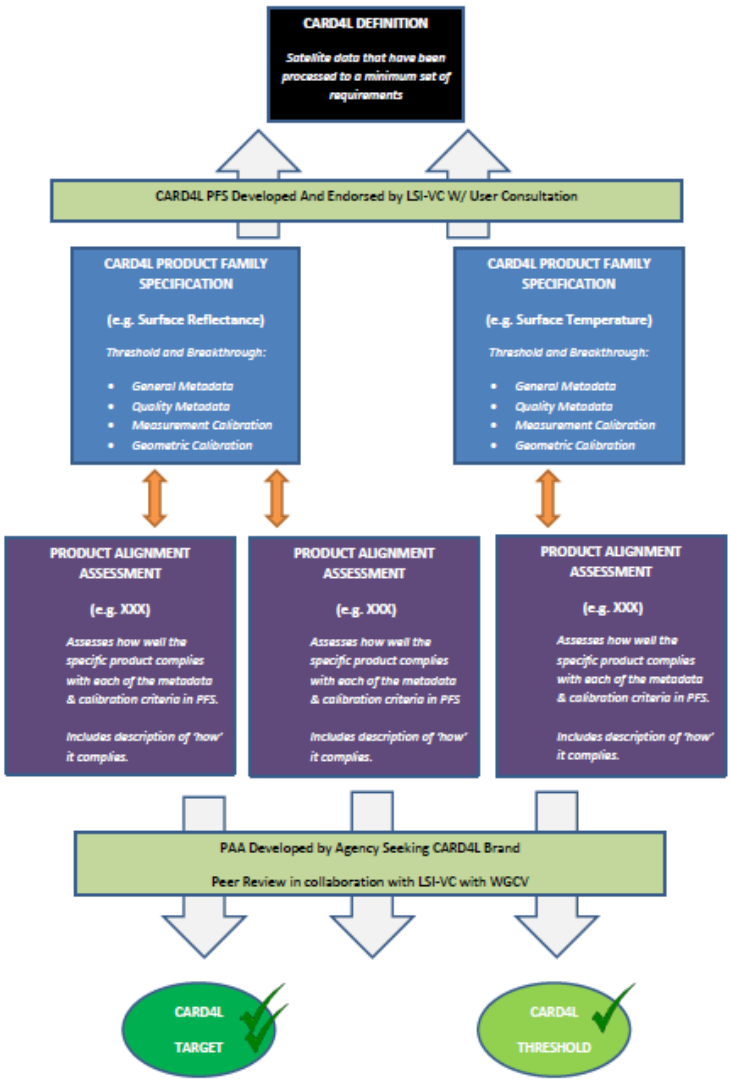
Pierre noted that there are currently no plans to generate Sentinel-1 ARD products systematically, however he is open to further collaboration with LSI-VC around ARD.

LSI-VC-3-14	*Brian Killough to reach out to Ake Rosenqvist and Heather McNairn (AAFC) for feedback on the specifics of the SAR ARD processing flow.*	**April 2017**
LSI-VC-3-15	*Adam Lewis to get Brian Killough a SPOT-5 surface reflectance Python script from Stuart Phinn for the CEOS Open Data Cube effort.*	**April 2017**
LSI-VC-3-16	*Paul Briand to explore the possibility of sharing a new Canadian SAR flood mapping algorithm with Brian Killough, in support of the Vietnam Data Cube pilot.*	**April 2017**

CARD4L Working Session

Adam Lewis (GA) presented an overview of the CARD4L Product Family Specifications (PFS) and Assessment Framework. He reported that the PFS are now formatted as standalone documents, and he reviewed an example for surface reflectance – making changes based on feedback received while walking through the draft. It was agreed that the PFS should not cover data discoverability/access, as they are about products rather than their delivery/discovery method.

A discussion followed on the target and threshold definitions. Brian Killough (NASA/SEO) questioned the definition for normalisation (data is normalised for solar-zenith angle (altitude)) – suggesting that it should be a threshold requirement. In response to David Jarrett (NASA), Adam clarified that while 'threshold' is acceptable, 'target' requirements are the desired level that will most likely increase data uptake and use. Gene Fosnight (USGS) suggested that the 'target' requirements need to be achievable and act as an encouragement for product improvement. Jenn Lacey (USGS) suggested that the targets should have some reference to interoperability enhancement. Mark Dowell (EC/JRC) noted that in the Climate Data Record context, the term 'target' is used to refer to improvements expected over a 5- to 10-year time horizon. Brian confirmed that half a pixel is a good threshold accuracy, while less than a third of a pixel is a suitable 'target' accuracy, as this ensures that AWiFS and AVNIR are covered by the PFS, for example. It was also agreed that to meet 'target' accuracy requirements, details of the reference grid used for geometric correction must be disclosed. It is still not clear how thermal noise should be handled in a SAR backscatter PFS, given that it is sensor dependent.



LSI-VC-3-17	*Adam Lewis to progress the surface reflectance Product Family Specification (PFS) through teleconferences and face-to-face at SIT-32.*	**SIT-32**
LSI-VC-3-18	*Adam Lewis to make a start on the SAR backscatter Product Family Specification (PFS), and set up a TIM to progress the specification with the team.*	**April 2017**

LSI-VC and Commercial Data Supply in Future Activities

Jonathon Ross (GA, CEO) recalled the driving force behind CARD4L: there is a group of non-expert users that are currently under-served, and we can work to provide data that best helps them. He noted that commercial data is also available and relevant, and many CEOS Agencies have close relationships with the private sector. Jonathon asked what role CEOS/LSI-VC could/should play in supporting easy access to and use of commercial data. He suggested the possibility of 'pixel renting' and observation gap filling, and he asked whether there is the possibility of commercial CARD4L offerings. Some questions were raised in regard to the possibility of commercial CARD4L:

- Must the dataset be fully free-and-open? Could the products be down-sampled versions of commercial datasets or perhaps global mosaics?
- Does the processing chain have to be open?
- How does CEOS deal with a commercial provider seeking CARD4L approval?
- How should the peer review of CARD4L compliance be coordinated?

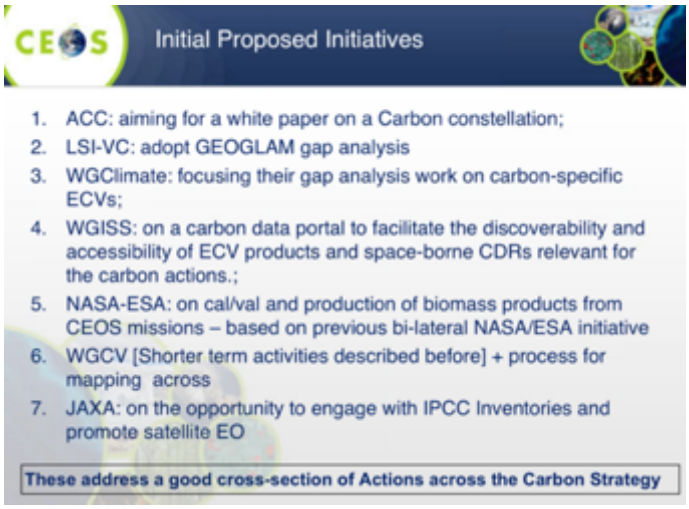
Kurt Thome (NASA, WGCV Chair) noted that commercial providers are not represented at the top-level of WGCV, however some of the WGCV subgroups include private sector representatives. Their involvement is purely instructive, focusing on protocols, methodologies, and best practices. Jenn Lacey (USGS) supported the WGCV approach to commercial engagement, suggesting that providing a CARD4L 'stamp' for private sector products might not be appropriate. Mark Dowell (EC/JRC) agreed, noting that such a situation could be complicated, especially if CARD4L were to end up having some monetary value. It was agreed that while we cannot stop companies self-assessing their products as CARD4L compliant, CEOS should not be doing assessments for the private sector.

Mark Dowell (EC/JRC) asked whether CEOS Agencies have had success working with the private sector to release down-sampled/higher-level products derived from commercial datasets. The JAXA ALOS/JERS global mosaics were noted, and Paul Briand (CSA) agreed to share some examples from Canada. Ivan Petiteville (ESA) noted the example of WGDisasters, which uses commercial data for pilot activities. In this case, non-redistributable data is provided by companies to specific users for particular applications, and they generally consider it an opportunity to promote their paid products.

LSI-VC-3-19	*Paul Briand to share some Canadian examples of work done with the private sector to release down-sampled/higher-level products derived from commercial datasets.*	**April 2017**

CEOS Strategy for Carbon Observations from Space

Mark Dowell (EC/JRC) presented an overview of the *CEOS Strategy for Carbon Observations from Space*, its history, and the approach agreed at the 2016 CEOS Plenary to address the 42 actions identified therein. Seven core WG and VC initiatives, in addition to some other short term actions, have been identified as first steps.

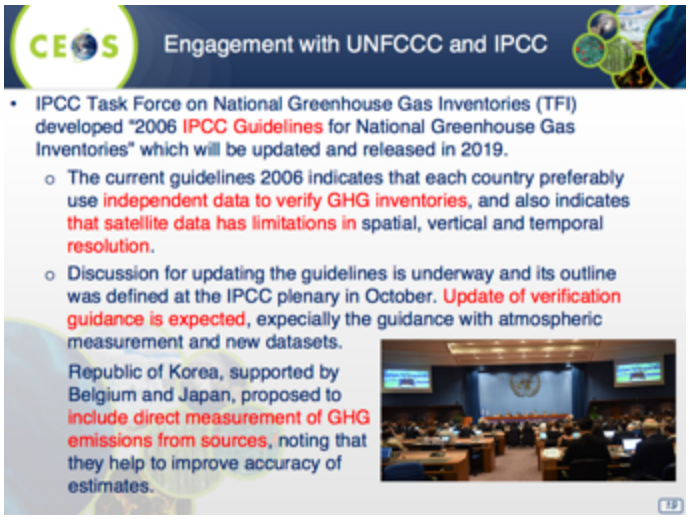


Mark acknowledged the work undertaken by the CEOS SEO to address CARB-08-03 and CARB-08-04 on behalf of the LSI-VC, and he thanked Brian Killough (NASA/SEO) for this contribution. A follow-up action related to promoting the accomplishment was recorded.

LSI-VC-3-20	*Mark Dowell and Brian Killough to revisit CARB-08-03/-04, document the process, and publish the results publicly as a CEOS Carbon Strategy outcome.*	**May 2017**

Mark reviewed some of the activities being undertaken by other groups in support of the CEOS Carbon Strategy:

- WGClimate will use the ECV Inventory to produce a subset of ECV records related to the Carbon Strategy.
- WGISS has developed a standard set of tools for carbon dataset discoverability, by applying existing tools to a thematic subset (carbon). WGISS are also working on a carbon portal, which will expose datasets in a common way across all CEOS Agencies.
- CEOS is contributing to the GEO Carbon and GHG Initiative by advancing data access and availability, optimising observation networks, and supporting carbon budget calculation consistency with broad observations.
- Japan is taking a lead role in the update of the IPCC Guidelines for National Greenhouse Gas Inventories, in particular on updating its verification guidance, and JAXA is involved in regard to EO.



Ivan Petiteville (ESA) asked whether JAXA will engage CEOS on the effort to influence the IPCC Guidelines for National Greenhouse Gas Inventories. Mark confirmed their intention to work with CEOS. Ivan suggested that they be asked to say something around this at SIT-32.

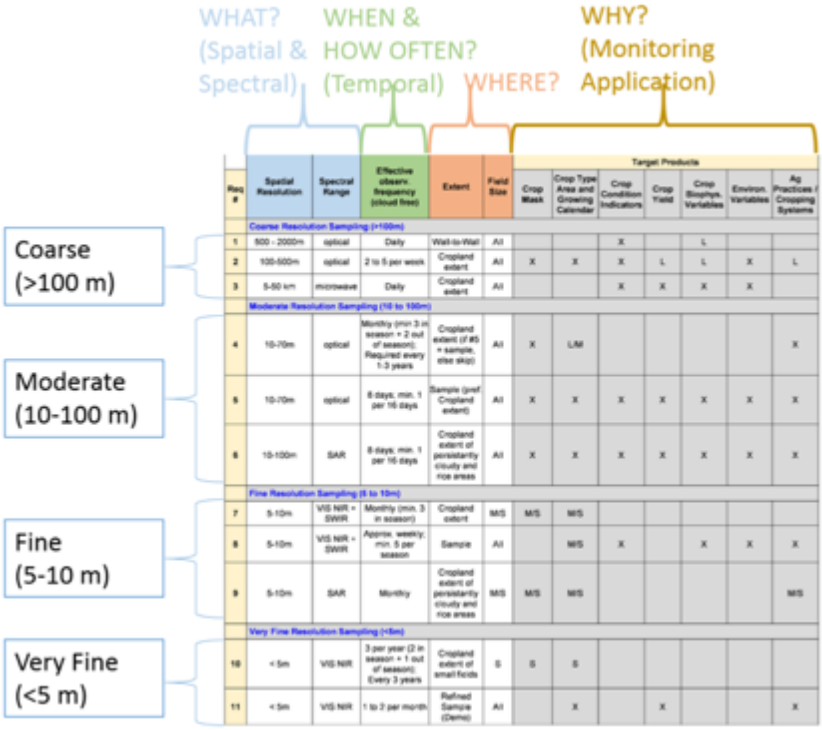
LSI-VC-3-21	*Mark Dowell to coordinate with JAXA and the ESA SIT Chair Team regarding raising the IPCC Guidelines for National Greenhouse Gas Inventories topic at SIT-32.*	**SIT-32**

Mark noted that the traceability of the CEOS Carbon Strategy requirements is currently lacking, and he supports the GEOGLAM approach being advocated by LSI-VC. He added that some of the products referenced in the Strategy are not yet being produced by agencies (e.g., there are many products that must themselves be derived from derived products) and he suggested that LSI-VC could promote their generation.

Mark noted that there are large discrepancies between the products in the CEOS MIM Database and the products that are actually produced by missions/instruments. The ECV Inventory is the complete record of (climate) products, and looking at the Inventory it would clearly be a large job to make the MIM match. Closer links between the two could help.

GEOGLAM Requirements Process

Jenn Lacey (USGS) presented an overview of the GEOGLAM requirements analysis process and the table used by the CEOS-GEOGLAM *ad-hoc* WG to assess user requirements.



LSI-VC plans to use this approach to assess the requirements of the CEOS Carbon Strategy. The first step is to define the target products ("WHY? Monitoring Application" above). A discussion followed on the best way to define these target products. Suggestions included the parameters from the CEOS MIM Database, the CEOS Carbon Strategy, and the GCOS IP. Mark suggested referencing the GCOS IP, as the parameters have quantitative values tied to them.

Brian Killough (NASA/SEO) requested clarification on the end goal – what will be done once the table is filled out? If this is a gap analysis, will we be identifying measurement gaps, coverage gaps, etc.? What do we do with the gap information? It was suggested that the information could be compiled and presented to CEOS as a series of findings and recommendations, in an attempt to influence future mission/instrument development, as with the ECV Inventory gap analysis.

It was agreed that filling out the table will be a large task, and will require expert knowledge. Mark suggested that once complete, the template be provided to the GEO Carbon and GHG Initiative team to fill out, as this is in line with GEO's responsibilities. Alyssa Whitcraft (GEOGLAM Secretariat) agreed, noting that compiling the requirements is the key step, and with GEOGLAM, for example, this took a very long time (2-3 years). Leaning on GEO/the carbon community is a necessity. The job for CEOS/LSI-VC should be restricted to mapping missions and instruments to the received requirements.

Mark and Alyssa noted that they are not sure if all of the rows currently presented in the table are applicable to carbon. Brian took an action to investigate further.

LSI-VC-3-22	*CEOS SEO to look at the terrestrial chapter of the CEOS Strategy for Carbon Observations from Space, constrain the rows currently in the requirements matrix, and assess what high-level requirements exist.* *Mark Dowell to reach out to Stephen Plummer for guidance.*	**June 2017**
LSI-VC-3-23	*Mark Dowell to reach out to GEO regarding having GEO Carbon and GHG Initiative experts fill out any carbon requirements template supplied by LSI-VC/CEOS.*	**May 2017**

Mark suggested that it would be good to identify a Data Cube activity around a specific carbon requirement (e.g., something that requires a long time series analysis) – perhaps related to water in developing countries. Brian agreed with the suggestion.

Alyssa suggested that the 'WHEN' column will need to be changed for carbon, as the observational frequency requirements are likely very different to agriculture. She added that linking the measurements to the decisions that can be made is an important step for generating political support.

Alyssa closed the session by noting that GEOGLAM is currently rebooting their requirements process. Both space-based and *in-situ* measurements are being included in the reboot. GEOGLAM is also looking at producing Methods & Guidance Documentation (MGD) along the lines of that produced by the GFOI.

Joint LSI-VC–GEOGLAM–SDCG for GFOI Meeting

Following up the presentation from Stephen Ward (CEOS Chair Team) on Monday, Jonathon Ross (GA, CEO) presented his views on the rationalisation of CEOS LSI activities and the joint meeting planned for September:

- The need for both 'domain-specific' and 'cross-cutting' activities will likely endure for a while. We want to ensure we are addressing both of these aspects, in a way that is sustainable for agencies, and recognises that ultimately the 'call' is often on the same assets.
- The first joint meeting is a step towards this – getting the different perspectives together and then talking to identify common issues/objectives.
- It should be noted that the need for domain engagement may 'scale up' in some domains for a while before scaling back, but it is not a link that we want to lose.
- Desired outcomes from an LSI-VC perspective:
    - How can we improve the flow of 'requirements' from GFOI and GEOGLAM to LSI-VC, and the responsiveness of LSI-VC in terms of 'cross-cutting' analyses?
        - In terms of requirements from existing sensors.
        - Insights into key future priorities.

- Gather information about applications for use in communications/promotion activities?
- Gather feedback on where ARD is headed, for example through the pilots, but also 'theoretical' perspectives. Perhaps gain some insights in terms of specification refinement prior to Plenary?
- Gain insights into how a 'scalable' and adaptable model can be established, in terms of user engagement, processing/products, and data distribution approaches?
- Opportunities to establish capability in domain communities, and procedures/materials/templates, so domains become more self-sufficient.

Jonathon closed by suggesting that the LSI-VC strategy for the meeting should revolve around benefits for the domains from initiatives like CARD4L, gap analyses, etc. and also capacity building for domain-specific communities.

LSI-VC-3-24	*Jonathon Ross to coordinate LSI-VC input on the formulation of the joint LSI-VC–GEOGLAM–SDCG for GFOI meeting planned for early September (agenda, objectives, etc.).*	**July 2017**

Wrap-up, Action Review, and Closing Remarks

Matt Steventon (CEOS Chair Team) reviewed the actions noted during LSI-VC-3, and some collaborative edits were made to the record. A further action was noted during the closing session:

LSI-VC-3-25	*Kevin Gallo to present an update on GOES-R surface reflectance products at the next LSI-VC team teleconference.*	**April 2017**

The LSI-VC Co-Leads thanked everyone for attending and closed the meeting.

APPENDIX A

LSI-VC-3 Attendees

Organisation	Name
CEOS Chair Team	Matt Steventon
CSA	Paul Briand
EC	Zoltan Szantoi
EC/JRC	Mark Dowell
ESA	Bianca Hoersch
ESA	Enrico Cadau
ESA	Ferran Gascon
ESA	Frank Martin Seifert
ESA	Henri Laur
ESA	Ivan Petiteville
ESA	Nuno Miranda
ESA	Pierre Potin
ESA	Susanne Mecklenburg
GA	Adam Lewis
GA	Jonathon Ross
GEOGLAM Secretariat	Alyssa Whitcraft*
ISRO	Bimal Bhattacharya*
JAXA	Takeo Tadono
NASA	David Jarrett
NASA	Jeff Masek
NASA/WGCV	Kurt Thome
NASA/SEO	Brian Killough
NCEO/UKSA	Joao Carreiras
NOAA	Kevin Gallo*
USGS EROS	Gene Fosnight
USGS EROS	Jenn Lacey

* Remote participant

APPENDIX B

Action Summary

No.	Description	Due Date
LSI-VC-3-01	*Jenn Lacey to coordinate LSI-VC mission timelines with the CEOS MIM Database team.*	**April 2017**
LSI-VC-3-02	*Brian Killough to investigate the possibility of automatically retrieving Sentinel-1 acquisition KMLs for COVE to allow future acquisition plans to be viewed in the tool.*	**May 2017**
LSI-VC-3-03	*Jenn Lacey to revise and circulate an updated LSI-VC Implementation Plan, which will be discussed further during the April or May LSI-VC teleconference.*	**May 2017**
LSI-VC-3-04	*Jonathon Ross and Adam Lewis to revise the CARD4L definition wording around 'atmospheric correction directional scattering'.*	**April 2017**
LSI-VC-3-05	*Brian Killough to follow up with WGISS on the idea of producing an inventory of private sector Sentinel data hubs/portals and their capabilities.*	**April 2017**
LSI-VC-3-06	*Bianca Hoersch to send Bimal Bhattacharya Webex details for the upcoming ACIX meeting (April 11-12).*	**24 March 2017**
LSI-VC-3-07	*Bimal Bhattacharya to share coverage maps that summarise the quantity and location of available AWiFS data.* *Jenn Lacey to share any related information obtained by USGS.*	**April 2017**
LSI-VC-3-08	*Jonathon Ross to coordinate LSI-VC action at SIT-32 to note the interest of the LSI/CEOS community in making the global, orthorectified AVNIR-2 dataset available as free-and-open CARD4L.*	**SIT-32**
LSI-VC-3-09	*Takeo Tadono to share the download statistics for the ALOS/JERS global mosaics.*	**April 2017**

LSI-VC-3-10	*Takeo Tadono and Brian Killough to discuss ALOS/JERS Forest/Non-Forest global product validation.* *Takeo to share a paper on the validation/processing with Brian.*	**April 2017**
LSI-VC-3-11	*Jenn Lacey to investigate the missing Landsat data for Switzerland from 1991-1998.* *Brian Killough to check the European EO Browser for the missing data.*	**CLOSED** *Discussions continuing between ESA and USGS to make the data available via USGS processing systems.*
LSI-VC-3-12	*Adam Lewis (via Brian Killough) to provide the FDA Pilot teams with CARD4L Product Family Specifications (in draft and final form) as they become available (i.e., following LSI-VC-3 and SIT-32, respectively) including, as possible, associated guidance on interpretation, access, and use.*	**SIT-32**
LSI-VC-3-13	*Adam Lewis to work with the FDA-AHT at the 2017 SIT Technical Workshop (September) to ensure that lessons learned from the FDA Pilots are fed back into the work of the LSI-VC (i.e., in the areas of CARD4L and MRI).*	**2017 SIT Technical Workshop**
LSI-VC-3-14	*Brian Killough to reach out to Ake Rosenqvist and Heather McNairn (AAFC) for feedback on the specifics of the SAR ARD processing flow.*	**April 2017**
LSI-VC-3-15	*Adam Lewis to get Brian Killough a SPOT-5 surface reflectance Python script from Stuart Phinn for the CEOS Open Data Cube effort.*	**April 2017**
LSI-VC-3-16	*Paul Briand to explore the possibility of sharing a new Canadian SAR flood mapping algorithm with Brian Killough, in support of the Vietnam Data Cube pilot.*	**April 2017**
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LSI-VC-3-18	*Adam Lewis to make a start on the SAR backscatter Product Family Specification (PFS), and set up a TIM to progress the specification with the team.*	**April 2017**
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LSI-VC-3-20	*Mark Dowell and Brian Killough to revisit CARB-08-03/-04, document the process, and publish the results publicly as a CEOS Carbon Strategy outcome.*	**May 2017**
LSI-VC-3-21	*Mark Dowell to coordinate with JAXA and the ESA SIT Chair Team regarding raising the IPCC Guidelines for National Greenhouse Gas Inventories topic at SIT-32.*	**SIT-32**
LSI-VC-3-22	*CEOS SEO to look at the terrestrial chapter of the CEOS Strategy for Carbon Observations from Space, constrain the rows currently in the requirements matrix, and assess what high-level requirements exist.* *Mark Dowell to reach out to Stephen Plummer for guidance.*	**June 2017**
LSI-VC-3-23	*Mark Dowell to reach out to GEO regarding having GEO Carbon and GHG Initiative experts fill out any carbon requirements template supplied by LSI-VC/CEOS.*	**May 2017**
LSI-VC-3-24	*Jonathon Ross to coordinate LSI-VC input on the formulation of the joint LSI-VC–GEOGLAM–SDCG for GFOI meeting planned for early September (agenda, objectives, etc.).*	**July 2017**
LSI-VC-3-25	*Kevin Gallo to present an update on GOES-R surface reflectance products at the next LSI-VC team teleconference.*	**April 2017**