**Discussion Paper: A Future LSI-VC Implementation Plan**

**Introduction**

In accordance with the decision at CEOS-28, the LSI-VC is being refocused. Revised Terms of Reference have been prepared in accordance with the Plenary decision and the Virtual Constellations Process Paper. The purpose of the Implementation Plan is to identify the activities that the LSI-VC will undertake in the next few years to fulfill its Terms of Reference. The Terms of Reference provide the following high-level guidance on directions for the LSI-VC.

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|  | 3-Year Horizon | 5-Year Horizon |
| Space Segment | **Multiple sets of validated domain-specific requirements aggregated and analyzed to identify gaps and opportunities for optimization – supporting the implementation of interoperability and complementarity**  **Optimize and harmonize where feasible the global data collections provided by CEOS member agencies** | Acquisition plans across major international land surface imaging programs harmonized to best support validated domain-specific requirements |
| Ground Segment and Information Systems | Explore architectures for future distribution that would potentially enable analysis of very large land surface imaging data sets trialed across at least 3 nations/regions  **Stimulate an environment conducive to the creation of analysis ready data in support of enhanced usage and exploitation of the CEOS data portfolio for land surface imaging** | Establish the framework for an architecture network for analysis of very large land surface imaging data sets adopted |
| Products and Services | 1-2 compatible non-domain specific measurement products, derived from 1 sensor, being produced by multiple Agency systems | 4-5 compatible non-domain specific measurement products, derived from 3-4 sensors, being produced by multiple Agency systems |

The purpose of this discussion paper is to socialize the proposed implementation activities of LSI-VC for the next three years, working towards the 3-Year Horizon in the Terms of Reference.

In preparing this discussion paper consideration has been given to:

* The desire to address ‘pressing issues’ of strategic concern to CEOS and CEOS Agencies.
* The need to work with the resources that agencies can realistically provide.
* The need to re-build momentum by implementing solutions that work, thereby encouraging further agencies to buy-in and contribute.
* The desire, and need, to ensure strong linkages with other CEOS Entities. This builds on the linkages identified in the Terms of Reference.

**Proposed Focus**

It is proposed that LSI-VC effort be focused on developing and implementing coordinated solutions across the following four themes:

* Optimizing global data flows (with an ever increasing volume expected).
* Promoting analysis-ready data (with the goal to minimize the need for the end user to understand satellite/pass/sensor-specific processing).
* Exploring how new approaches to management/analysis of large data structures (e.g. Data Cubes) can be implemented and sustained.
* Addressing the actions identified for LSI-VC by the CSIST, as a pathfinder to broader approaches to analyzing land surface imaging requirements.

The LSI-VC will incorporate a phased approach where the outcomes from each phase will lay the groundwork for the subsequent phase.

Phase 1 Activities (–2015-2016)

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| Objective/Deliverable | Description / Context | Linkages |
| Identifying gaps/opportunities in acquisition planning in support of CEOS Carbon Strategy | In support of the CEOS Carbon Strategy, through this activity LSI-VC will analyze validated land carbon observation requirements, and identify the gaps and opportunities for optimization across CEOS agency missions. | SEO  WG Climate |
| Develop agreed definitions of intercomparable Analysis Ready Data (ARD) products in the context of land surface imaging | Analysis-Ready Data are data which can be used (for many purposes) without requiring a user to undertake instrument-specific, pass-specific, or space-craft-specific corrections. This greatly lowers the barriers to using land surface imaging data, and makes downstream chains more robust. ARD are ‘non-domain specific’, meaning it can be ‘provided once and used many times’. This is important given the volumes of data that exist in land surface imaging domain. This work will include identifying Fundamental Data Records that would form a foundation for ARD may include:   * Surface reflectance * Surface temperature * SAR gamma nought products | SEO  WGCV |
| Increase visibility of land surface imaging data holdings | Significant progress has already been made to improve the visibility of CEOS agency data through existing tools such as CEOS, CWIC and FedEO.  This activity will undertake a gap analysis of land surface imaging missions and datasets and work with LSI-VC agencies, and SEO and WGISS, to encourage increased visibility of existing and future land surface imaging data. Close partnerships with WGISS and the SEO will be critical to ensure this effort is complementary to existing activity. | WGISS  SEO  WGCapD |
| Engage with implementation of trial ‘data cubes’ | The ‘KenyaCube’ project being delivered by the SEO under the auspices of the SDCG-GFOI offers significant potential for lessons learned on future models for distributing and providing access to land surface imaging data. LSI-VC will provide information to this SEO-driven activity, and monitor progress, from the perspective of possible future operational implementation.  Other related systems, being implemented by other LSI-VC agencies such as GA, USGS and ESA will also be monitored. | WGISS  SEO |
| Perform a scoping study for global data flows for long time series land surface imaging data | Land surface imaging datasets are very large and, as noted above, shifting entire datasets to every end user is not technically feasible. However, relying on single global data centers may not be technically or financially feasible in the short term.  LSI-VC will support an SDCG for GFOI-led activity exploring how data flows can be optimized to minimize costs while maximizing data accessibility for end users, including exploring the potential for regional data hubs. LSI-VC will engage with this activity from the perspective of future architectures that will work most efficiently across domains.  This activity, combined with lessons learned from data cube implementations, is expected to provide ideas about future models for providing access to land surface imaging data. | SEO SDCG for GFOI |

Phase 2 Activities (2016-2017)

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| Objective/Deliverable | Description / Context | Linkages |
| Pilot approaches to undertaking integrated assessments of gaps/opportunities in asset usage | Building on the work for land carbon, develop and pilot an approach to analyze multiple sets of domain-specific requirements, allow for the identification of gaps and opportunities for optimization.  This pilot effort will integrates forestry, carbon, climate and agriculture validated requirements. Identify any potential continuity issues for land surface observations from space with CEOS member agency assets. | SEO  SDCG for GEOGLAM  WG Disasters |
| Develop a roadmap for routine production of intercomparable ARD | Building on agreed definitions of ARD from phase 1, this activity will develop a roadmap for interested CEOS member agency missions/programs to start processing land surface imaging data with an eye toward geometrically/radiometrically intercomparable surface reflectance, surface temperature and potentially equivalent RADAR products. | SEO  WGCV |
| Assess lessons learned from Data Cube implementations (including Kenya pilot, Australian Geoscience Data Cube, etc) and global data flows studies | Land surface imaging data volumes are significant, and applications increasingly require the ability to work iteratively with full continental (or greater) scale archives.  Traditional approaches to distribution and preparation of land surface imaging data do not address these challenges; the data are too big to move once, let alone multiple times.  This activity will review lessons learned from a number of initiatives to identify pathways forward, including a ‘Best Practice’ document for consideration by land surface imaging agencies in future systems design. | WGISS SEO  SDCG-for-GFOI |
| Pilot large data set distribution covering three regions | Implementation is to be determined based on the findings from the previous two phases. | SEO  WGISS |
| Establishing enhanced collaboration on wetlands and inland water way monitoring | Initial steps will be taken to identify and coordinate efforts by CEOS member agencies with interests/mandates for developing (or harmonizing) satellites to observe wetlands and inland waterways, and developing wetland and inland waterway data products.  This activity is in support of the CEOS Carbon Strategy, and will establish ongoing communication between agencies. | WGCV  SEO |

Phase 3 Activities (2017-2018)

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| Objective/Deliverable | Description / Context | Linkages |
| Continue to expand approaches to undertaking integrated assessments of gaps/opportunities in asset usage | Building on the phase 2 pilot, implement a broader approach to analyze multiple sets of domain-specific requirements, allow for the identification of gaps and opportunities for optimization.  Identify any potential continuity issues for land surface observations from space with CEOS member agency assets. | SEO  SDCG for GFOI  SDCG for GEOGLAM  WG Climate  WG Disasters |
| Begin implementing steps toward routine production of intercomparable ARD | Utilizing the roadmap developed in phase 2, interested CEOS member agency missions/programs will start processing land surface imaging data with an eye toward ARD. Where procedures are well-defined and mature a pilot activity may be undertaken to implement the roadmap with a goal of intercomparable data products being routinely produced across multiple CEOS agency systems. | SEO  WGCV |
| Establishing enhanced collaboration on wetlands and inland water way monitoring | Continue to identify and coordinate efforts by CEOS member agencies with interests/mandates for developing (or harmonizing) satellites to observe wetlands and inland waterways, and developing wetland and inland waterway data products.  This activity is in support of the CEOS Carbon Strategy, and will establish ongoing communication between agencies. | WGCV  SEO |