

Committee on Earth Observation Satellites (CEOS) Systems Engineering Office (SEO)

CEOS Spacecraft Coverage Analysis Visualization Tool (COVE)

Presentation at the WGCV-30 Meeting

Brian Killough
NASA Langley Research Center
Brian.D.Killough@nasa.gov

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CEOS Organization

GEO (Group on Earth Observations)

77 member countries +
51 participating organizations

GEOSS = Global Earth Observation System of Systems



**Committee on Earth
Observation Satellites
(Plenary)**
Chair: GISTDA

**Strategic Implementation
Team (SIT)**
Chair: NOAA

**CEOS Executive Officer
(CEO): ESA**

**Systems Engineering
Office (SEO): NASA**

Secretariat
CEOS Chair, Past Chair, Future Chair,
ESA/EUMETSAT, MEXT/JAXA, NASA/NOAA

CEOS

28 space agencies +
20 participating organizations



**Working Group
on Information
Systems and
Services
(WGISS)**
Chair: NASA

**Working
Group on
Education,
Training, and
Capacity Building
(WGEdu)**
Chair:
EUMETSAT

**Working Group on
Calibration and
Validation (WGCV)**
Chair: NOAA

**CEOS Societal
Benefit Area
(SBA) Teams**
– Agriculture
– Biodiversity
– Climate
– Disasters
– Ecosystems
– Energy
– Health
– Water
– Weather

Virtual Constellations
– Land Surface Imaging
– Ocean Surface Topography
– Atmospheric Composition
– Precipitation
– Ocean Color Radiometry
– Ocean Surface Vector Wind

CEOS SEO

Funder: NASA HQ
Dr. Michael Freilich (Principal)



What is the SEO?

- The Committee on Earth Observation Satellites (CEOS) **Systems Engineering Office (SEO)** was established in April 2007 to facilitate the development of CEOS global space constellation plans.
- The SEO **vision** is to **enhance communication and collaboration** among global space agencies to improve efficiency and effectiveness of science and applications for societal benefit.
- The SEO **technical function** includes: requirements definition, gap assessments using a systems database, trade studies and **special projects**, and implementation architecture development.
- The SEO **management function** includes: fostering communication among CEOS partners by coordinating and participating in CEOS meetings, developing **web-based management tools**, and developing visualization products for educating the global Earth Observation community about CEOS.



How can SEO work with WGCV ?

- Update the WGCV website to the new CEOS format and improve its content and functionality.

The website status will be reported later in the WGCV agenda.

- Develop tools for space-based calibration and validation that enhance collaboration and communication among CEOS agencies.

The remaining part of this presentation will be focused on the visualization tool for WGCV.



Key SEO Website Links

www.ceos.org – SEO/Systems Database

CEOS Committee on Earth Observation Satellites

[Calendar](#) | [Actions and Documentation](#) | [GEO](#) | [EO Handbook](#)

SEO Menu

- [CEOS Home](#)
- [SEO Home](#)
- [Contacts](#)
- [Constellations](#)
- [Systems Database](#)
- [Studies & Assessments](#)
- [COVE Google Earth Tool](#)

SEO Systems Database

The SEO systems requirements database was designed to capture the space-based measurement requirements driven by decision-makers, applications and science to compare them with the measurement capabilities of CEOS. Resulting measurement and time gaps will help to identify potential collaborative opportunities for CEOS long-term strategic planning. Populated with data from ESA's EO Handbook and additional CEOS Constellation and GEO SBA content, the tool plans to include pre-defined and user-defined queries and reports using a [systems architecture](#). The SEO envisions this tool will support the GEO Communities of Practice, CEOS Constellations, CEOS SIT leadership, and CEOS agencies.

[Mission / Instrument / Measurement Summary](#)

An alphabetical list of CEOS assets by mission, instrument and measurement including additional details in each category.

NOTE: The data in the systems engineering database is considered "PRELIMINARY". Validation of measurement connections to instruments and missions has not been reviewed by every space agency. In addition, the SEO has added additional content that is not part of the current "CEOS Database of Missions and Instruments" on which the EO Handbook is based. The use of this data should be for "preliminary" studies or assessments. Future updates will aim to improve the accuracy of the data so that users can benefit from the data, determine potential measurement gaps, and develop improved long-term strategic plans.

Mission / Measurement Timeline Tables

Virtual Constellations

- [Atmospheric Composition](#)
- [Land Surface Imaging](#)
- [Ocean Colour Radiometry](#)
- [Ocean Surface Topography](#)
- [Ocean Surface Vector Winds](#)
- [Global Precipitation](#)

GEO Societal Benefit Areas (SBA)

- [Disasters](#)
- [Health](#)
- [Energy](#)
- [Climate](#)
- [Water](#)
- [Weather](#)
- [Ecosystems](#)
- [Agriculture](#)
- [Biodiversity](#)

GCOS Essential Climate Variables (ECV)

- [Aerosol Properties](#)
- [Albedo](#)
- [Biomass](#)
- [Carbon Dioxide, Methane, and GHGs](#)
- [Cloud Properties](#)
- [Earth Radiation Budget](#)
- [FAPAR](#)
- [Fire Disturbance](#)
- [Glaciers, Ice Caps, and Ice Sheets](#)
- [LAI](#)
- [Lakes](#)
- [Land Cover](#)
- [Ocean Color](#)
- [Ocean Circulation](#)
- [Sea Level](#)
- [Sea Surface Temperature](#)
- [Soil Moisture](#)
- [Terrestrial Ecosystems](#)
- [Vegetation Index](#)
- [Wetland Ecosystems](#)
- [Wildfires](#)
- [Wind Speed and Direction](#)
- [Snow Cover](#)
- [Permafrost](#)
- [Ice Sheet Mass Balance](#)
- [Ice Sheet Velocity](#)
- [Ice Sheet Elevation](#)
- [Ice Sheet Thickness](#)
- [Ice Sheet Volume](#)
- [Ice Sheet Area](#)
- [Ice Sheet Perimeter](#)
- [Ice Sheet Shape](#)
- [Ice Sheet Position](#)
- [Ice Sheet Orientation](#)
- [Ice Sheet Slope](#)
- [Ice Sheet Aspect](#)
- [Ice Sheet Curvature](#)
- [Ice Sheet Roughness](#)
- [Ice Sheet Smoothness](#)
- [Ice Sheet Friction](#)
- [Ice Sheet Drag](#)
- [Ice Sheet Resistance](#)
- [Ice Sheet Inertia](#)
- [Ice Sheet Momentum](#)
- [Ice Sheet Energy](#)
- [Ice Sheet Power](#)
- [Ice Sheet Work](#)
- [Ice Sheet Heat](#)
- [Ice Sheet Mass](#)
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- [Ice Sheet Power](#)
- [Ice Sheet Work](#)
- [Ice Sheet Heat](#)
- [Ice Sheet Mass](#)

Mission Count tables by Constellation, SBA or ECV

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Atmospheric Composition																														
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Agriculture																														
Biodiversity																														

Recent News and Events

- [SatMagazine Article](#)
May 2009
- [CEOS Newsletter #32](#)
February 2009
- [CEOS Flyer for GEO-5](#)
November 2008
- [CEOS Brochure](#)
October 2008
- [CEOS Videos](#)

Visualization Tool

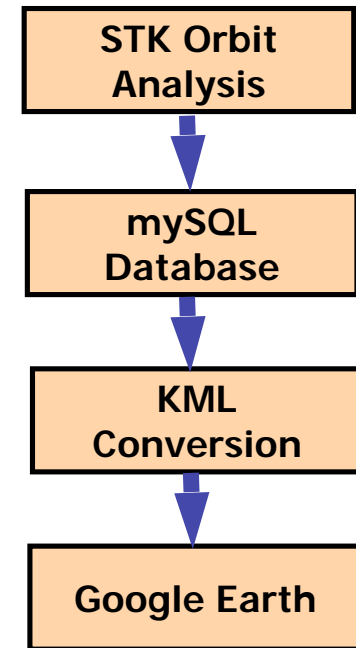
Alphabetical CEOS mission, instrument and measurement summary

CEOS Systems Engineering Database

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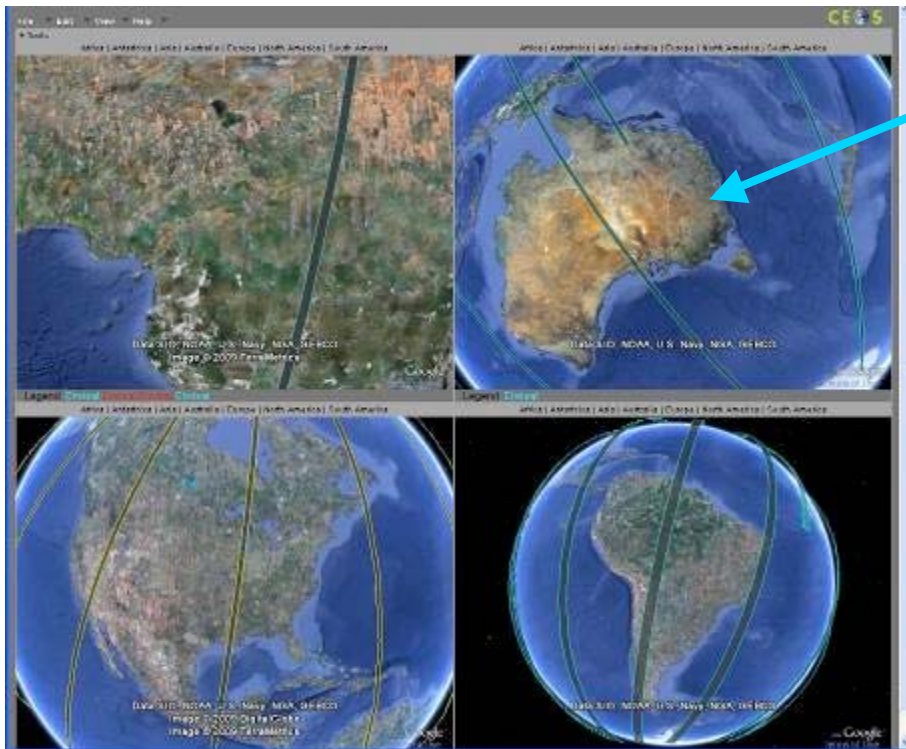
CEOS Systems Engineering Office (SEO)



- Display orbit and measurement coverage of CEOS missions on a Google-Earth map.
- Support evaluation of data availability for GEO Societal Benefit Areas (SBA) in any location.
- Support calibration (on-orbit and ground) opportunities for CEOS missions.
- Use for education and capacity building.

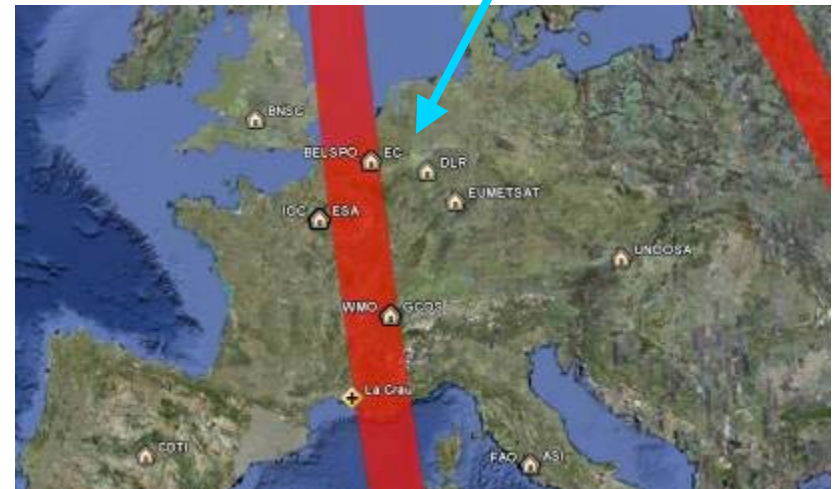


COVE Prototype Features



View multiple data sets on multiple viewports with zoom capability

Add background KML data such as CEOS agency locations or Cal-Val sites.



Functionality

- Full Google-Earth tool capabilities (zoom, rotation, country labels).
- User friendly GUI interface for selecting missions, instruments and measurements.
- Upload capability for personalized KML files (i.e., CEOS agencies, WGCV ground sites)
- Prototype version includes 4 missions (GoSat, Envisat, Landsat-7, Sentinel-2)



COVE Prototype Access

- Access to the first COVE prototype tool is available on the CEOS website. This demo version was created for the March-2009 CEOS SIT-23 meeting.

- CEOS Website: www.ceos.org

Select: SEO - Systems Engineering Office / Systems Database / COVE Google Earth Tool

<http://saif-1.larc.nasa.gov>

Username: ceos

Password: ceos123

- Training videos ... [available online](#) (2 total)



Need for a coincident imaging tool

- Increasingly, data from multiple sensors are used to gain more complete understanding of Earth processes.
- Cross-calibration is the only viable solution to tie similar sensors and differing sensors onto a common radiometric scale, thus providing an important role in mission continuity, interoperability, data fusion
 - The information about near-simultaneous surface observations of Earth is NOT readily available to the Cal/Val community so that they can focus on the scientific analysis of the data
 - Instead, most standard cross-calibration exercises require substantial efforts by users to identify the image pairs
- Depending on the application scope, such efforts often accounts for a significant portion of the total effort and can result in substantially reduced amount of time available for conducting analysis the data
- Advantages include: ability to capture data from multiple international missions, simple and fast cross-calibration calculations, improvement and standardization over existing tools



Tool Objectives

- **Objective:** Develop a simple and intuitive Google-Earth application tool for the identification of coincident space mission cal/val opportunities to support the WGCV and CEOS agencies.
- **Programs:** Google-Earth (GUI maps), STK (mission orbit analysis), MySQL (database of mission information), C++ Code (or similar, for coincident scene calculation), YouTube (training videos).
- **Capabilities:** Utilize Google-Earth from a prior prototype development (multiple views, zooming and navigation). Import and export KML and KMZ files. Deploy over public internet and secure login.



Key Features and Capabilities

- User-defined evaluation period (start and end dates).
- User-defined region of interest (rectangular area).
 - Allow predefined geographical locations (CEOS reference standard test sites, continents, countries, etc) or a point search (specific latitude and longitude range).
- Identify coincident overpasses from two or more satellites.
 - Consider near-simultaneous crosses (within minutes) to longer time periods (lapse rate less than 30 days).
 - Allow real-time (minutes) or background calculations (~days).
- Display results of coincidences on a Google-Earth map.
- Output analysis results in a tabular format with sorting capability.
 - Include sortable column information for date, time, missions, location (lat/long), and lapse rate. Allow export capability to EXCEL.
- Add World Reference System (WRS) path and row information for scene ordering.



Schedule and Management

- The SEO will fund the development of this tool and release it to the WGCV for review and basic revisions.
 - Two releases are planned for Sept-2009 and Nov-2009.
 - Additional SEO funding and development will be determined at the end of this prototype period.
- The initial demonstration will use up to 10 CEOS land imaging missions to establish baseline STK cases for calculations and database population.
- Up to this point, the SEO has been working with Gyanesh Chander (SGT/USGS) to develop a plan for this project.

The SEO believes this project demonstrates the utility of a systems engineering tool with broad international appeal for enhanced communication and data evaluation opportunities among international CEOS agencies.



Questions

- How does the WGCV group view this tool and its potential utility to the CEOS community ?
- What other features and capabilities should be considered for the prototype development product ? Additional output products ?
- What missions should be included in the first demonstration products planned for Sept-2009 ?

Landsat-7 (ETM+)

CBERS-2B (CCD)

IRS-P6 (AWiFS)

Terra (MODIS)

Envisat (MERIS)



Contact Information

Brian D. Killough, PhD
Head, CEOS Systems Engineering Office

NASA Langley Research Center
Hampton, Virginia

Email: Brian.D.Killough@nasa.gov

Website: www.ceos.org (visit SEO link)

Office: 757-864-7047

Cell: 757-303-6277

