CEOS Tools and Data Services for Enhanced Access, Analysis and Interoperability of Climate Datasets

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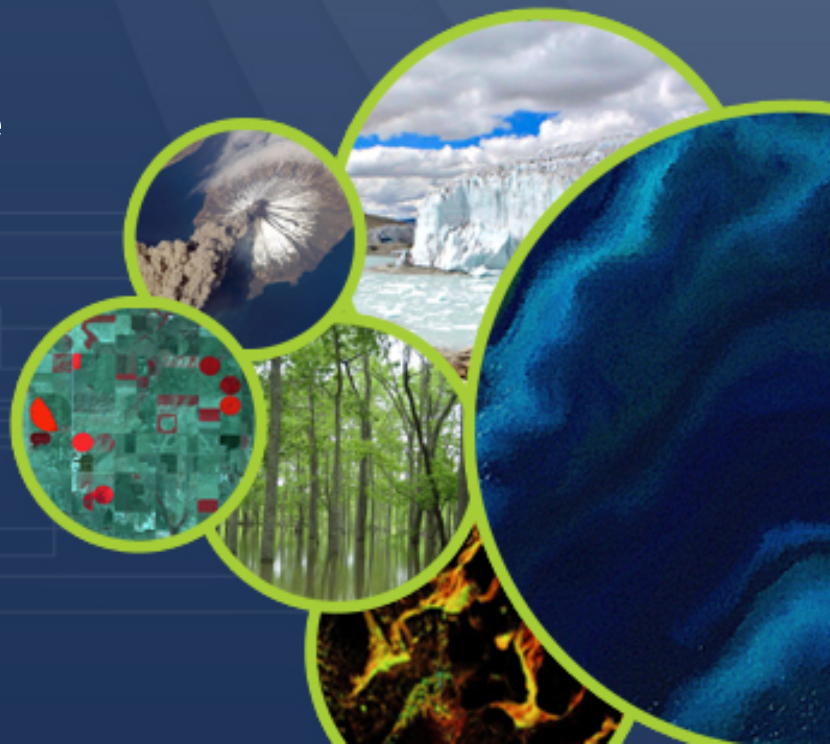
NASA

NOAA Climate Data Record Annual Meeting
August 5, 2015



www.ceos.org

Why CEOS?

www.ceos.org

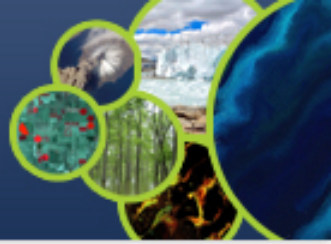
The Committee on Earth Observation Satellites (CEOS) serves as a focal point for international coordination and data exchange to optimize societal benefit from space-based Earth observations. CEOS represents 22 countries through its 31 space agencies and 24 associate members.

What is CEOS doing?

CEOS agencies collaborate on a variety of international projects that address key global issues ...

Data Access ... Promoting space data use
Agriculture ... Global Food Security (GEOGLAM, UN-FAO)
Deforestation ... Carbon and Deforestation (GFOI, UN-REDD)
Climate Change ... Global Climate Change (UNFCCC)
Disaster Management ... Floods, Earthquakes (UNISDR)

CEOS Tools and Data Services



Enhanced Access ...

- **CEOS Data Policy Portal** (**www.ceos-datapolicy.org**)
- CWIC Tool (**ceos.org/ourwork/workinggroups/wgiss/projects/cwic/**) Managed by the CEOS Working Group on Information Systems and Services (WGISS) ... common standards for searching satellite data collections

Enhanced Analysis ...

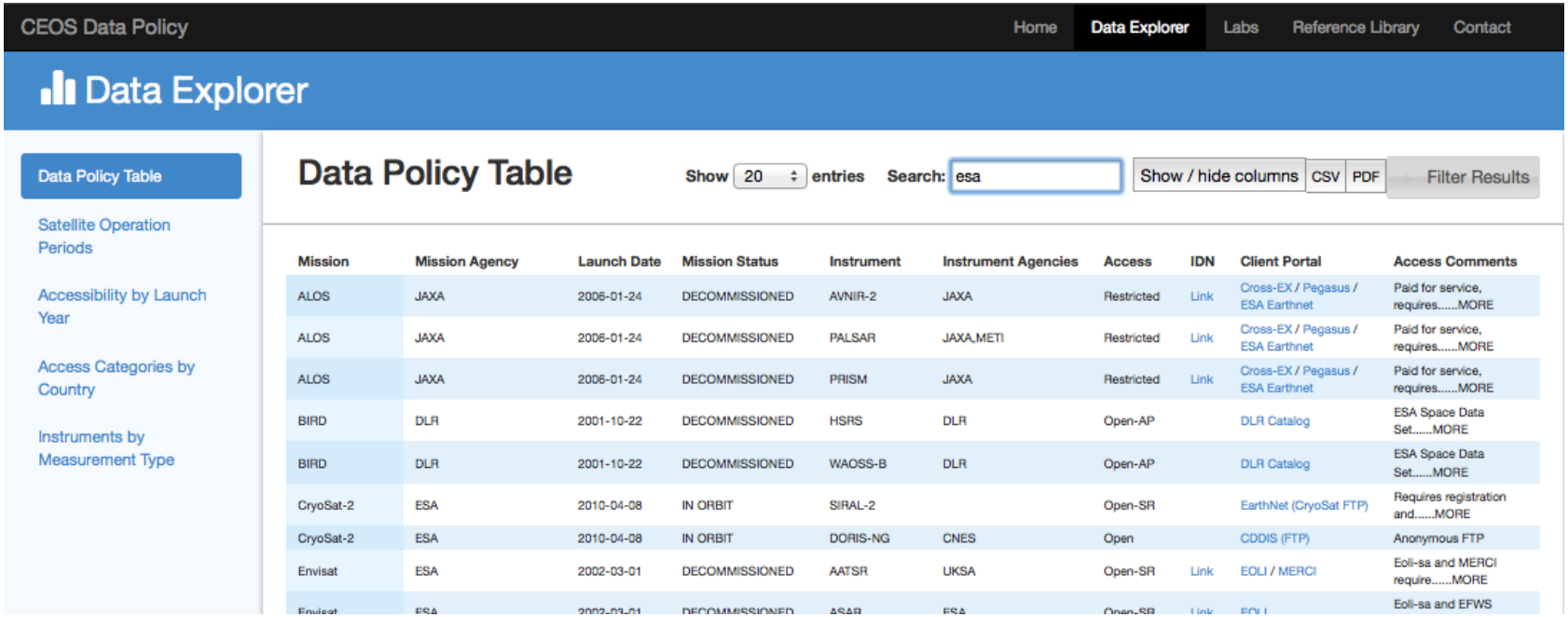
- **COVE Tool** (**www.ceos-cove.org**)
- MIM (Mission, Instrument and Measurement) Database (**www.eohandbook.com**) ... Managed by ESA with support from CEOS-SEO. Represents all CEOS agency current missions and future mission plans.

Enhanced Interoperability ...

- Essential Climate Variable (ECV) Inventory (**www.ecv-inventory.com**) Managed by the CEOS-CGMS Joint Working Group on Climate
- **CEOS Data Cube** (**www.ceos-cube.org**) ... NEW in July 2015

Data Policy Portal

www.ceos-datapolicy.org



Data Summary

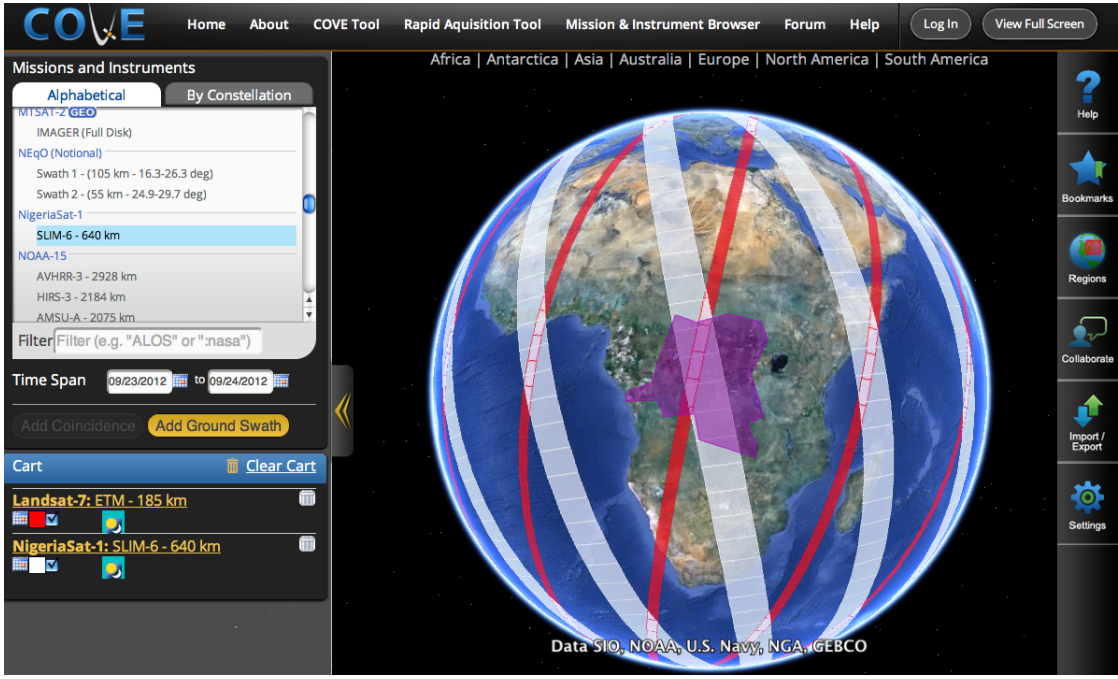
- **Open Access = 62%** , Restricted or Unknown = 38%
- CEOS Agencies are currently operating **134 missions**
- Database includes **352 missions** launched since 1990 and 650 mission-instrument combinations.
- Tool includes direct links to primary data portals.

COVE Tool

www.ceos-cove.org

- **Free and Open** browser-based tool using **Google-Earth** to display satellite coverage swaths and calculate coincidence scene locations.
- Automated daily satellite position data from **CelesTrak**.
- Saved bookmarks and states, Google-Earth KML and Shapefile compatibility, collaborative sessions.
- Output: position, UTC time, viewing angles, solar angles, day/night, and EXCEL tables
- Large mission database: **254 missions, 692 Mission-Instrument** combinations

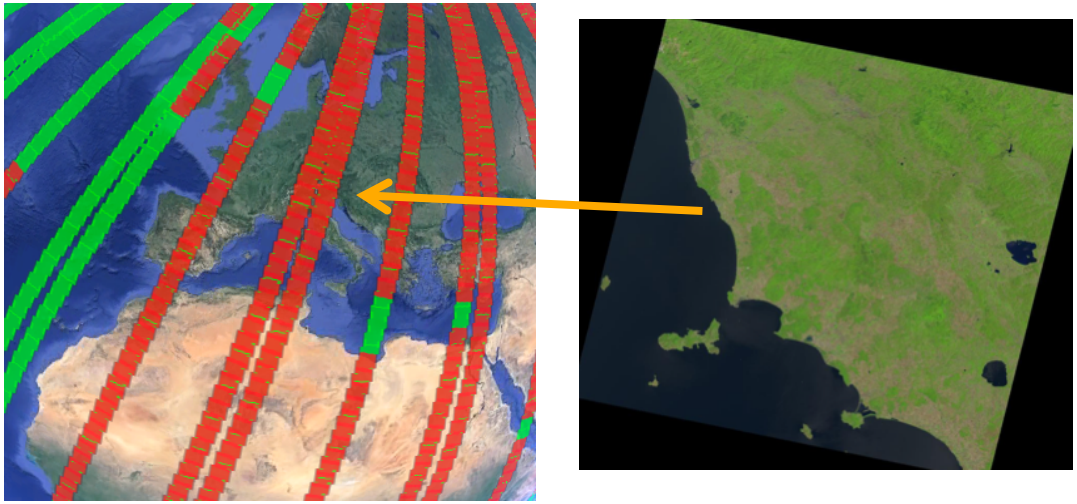
Calculate coincident satellite locations and past and future mission coverage.



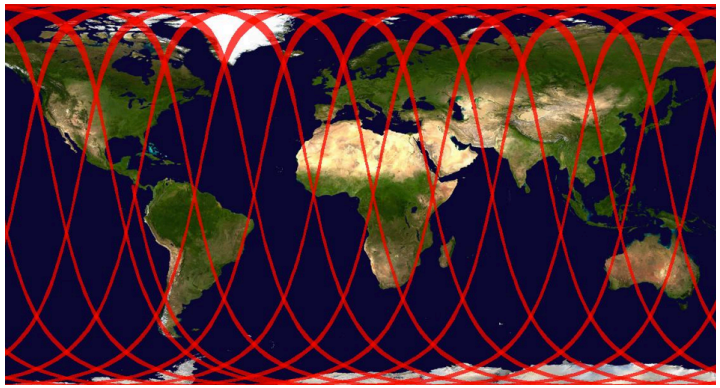
>20,000 unique users in 2014.

COVE Features

- **Data Overlays**: Landsat tiles, Sentinel-2 tiles, ASTER DEM, GlobCover, MODIS LCC.
- **Future Overlays**: Vegetation Phenology
- **Data Archive Links**: Landsat 7/8, SPOT 1-6, Pleaides-1A/1B, Radarsat-2, ALOS-1
- **Future Data Archive Links**: Envisat, ERS-1/2, Sentinel-1A/2A.
- 2D global output in JPEG format and KML output for Google Earth
- Spanish version available.



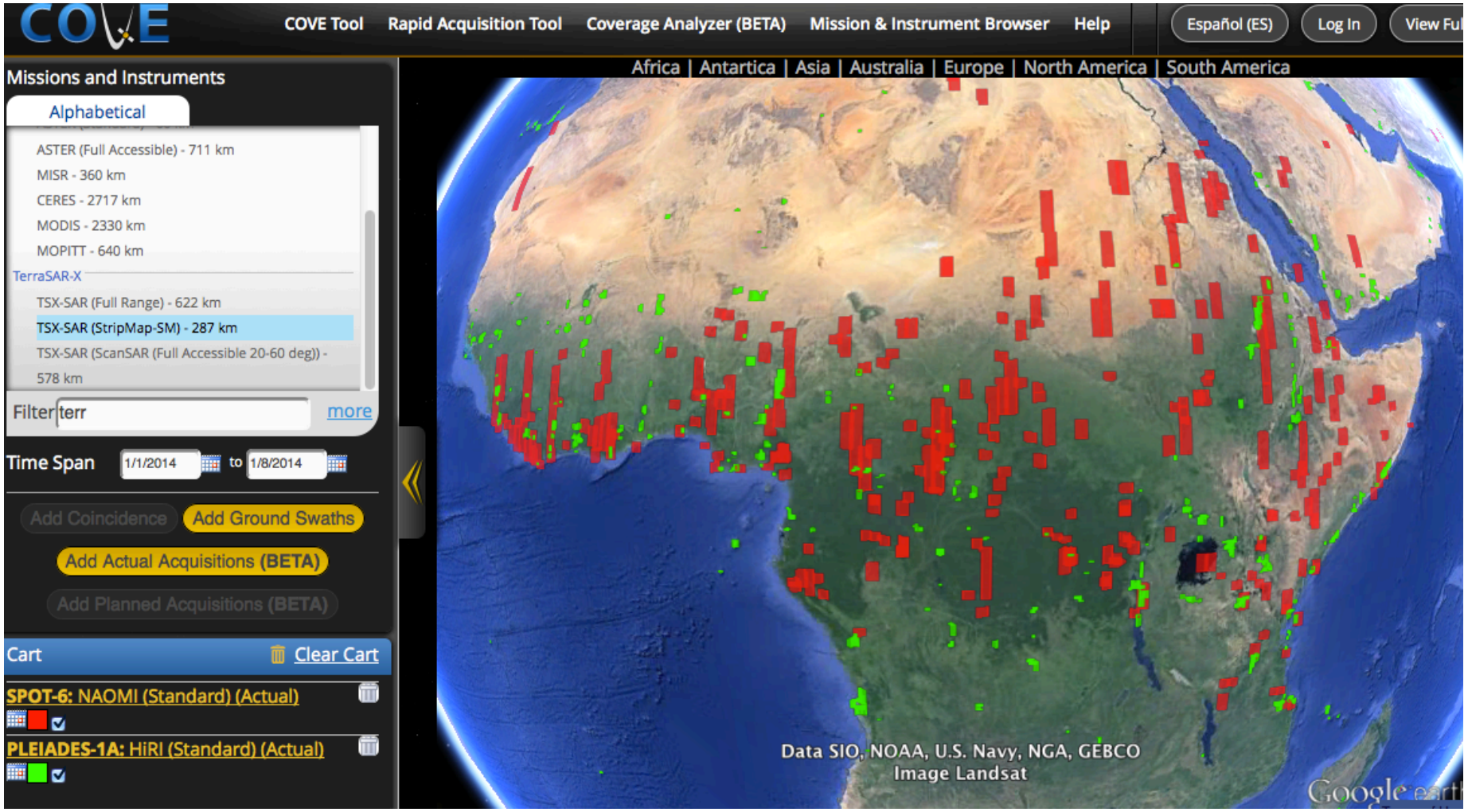
Landsat 8, Aug 1-3, 2013 over Europe
Green (potential), Red (actual)
Browse ... Northern Italy



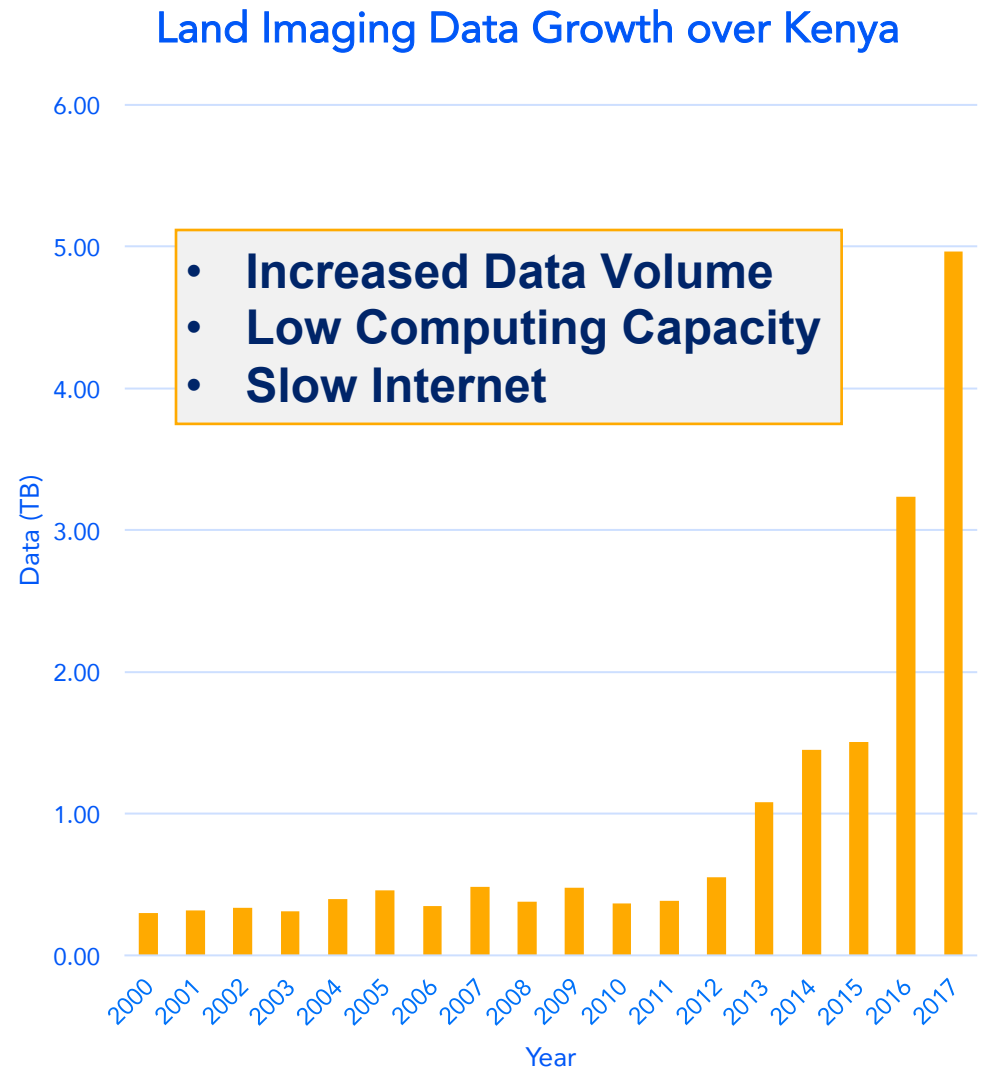
2D global map of Radarsat-2 on Aug 1,2013

SPOT and Pleaides in COVE

January 1-8, 2014 over Africa ... Data Acquisitions



We have a growing space data problem ...



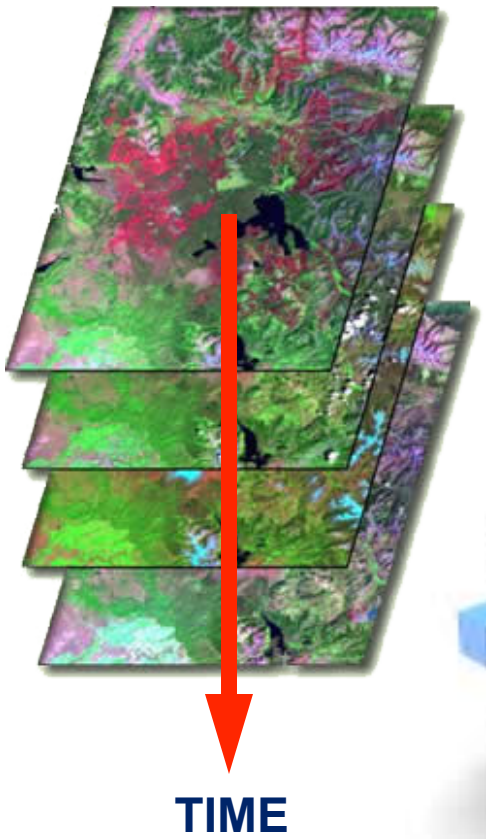
- A significant growth in land imagery data (optical and radar) from Landsat (NASA/USGS) and Sentinel (EC/ESA) will increase data volumes by >10 times in the next few years.
- Kenya could have 5TB of annual Landsat and Sentinel-2 data by 2017.
- **Recent testing** ... Processing a scene takes ~1 minute in U.S. and ~1 hour in Kenya. Downloading a scene takes ~6 seconds in U.S. and ~30 minutes in Kenya.
- Kenya says it spends 90% of its time getting the data and processing it.

We need a better solution ...

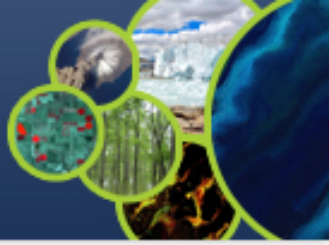
What is the solution?

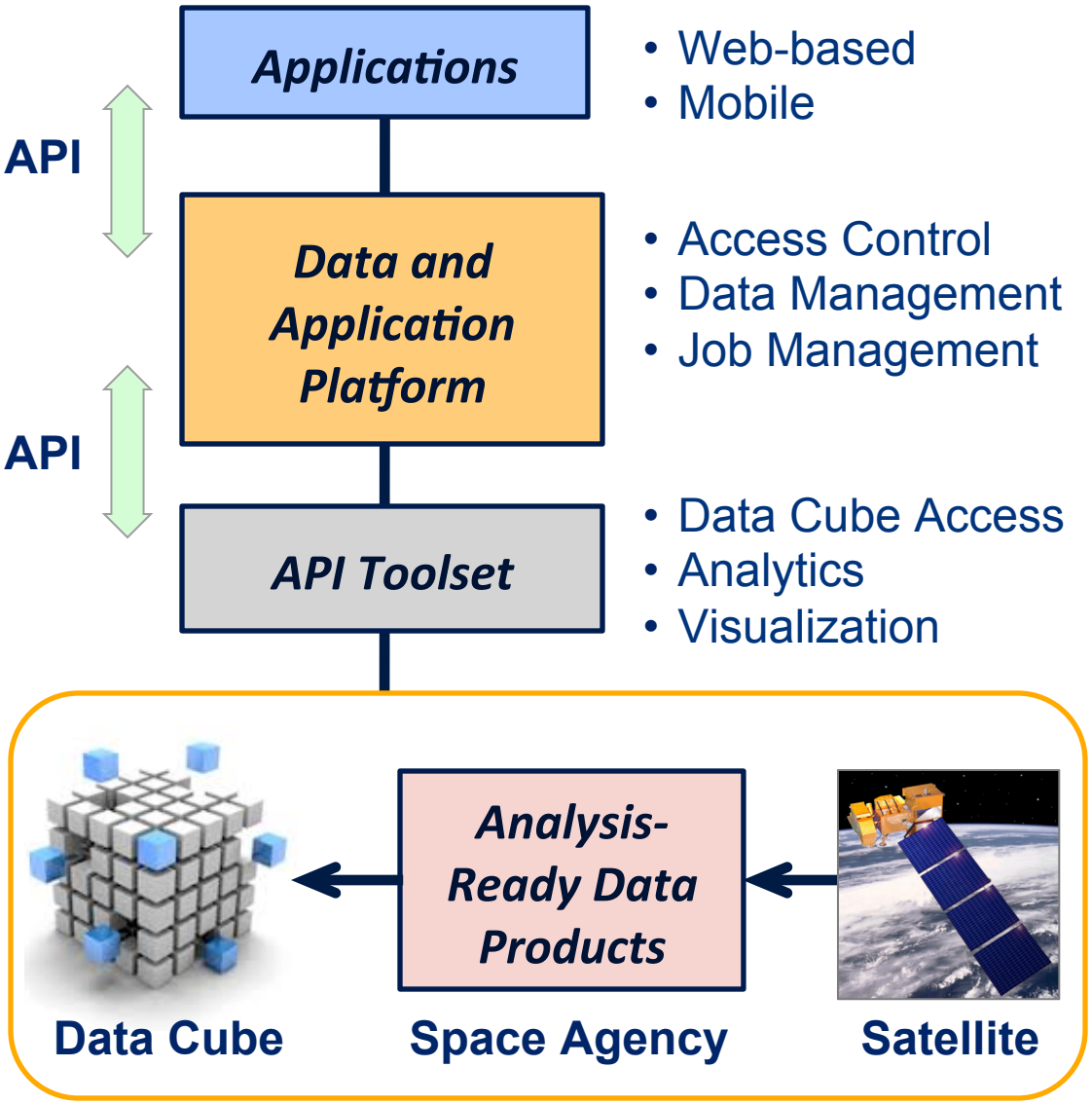
- Proven concept in Australia by Geoscience Australia and the Australian Space Agency (CSIRO).
- A multi-dimensional (space, time, data layers) **Data Cube** is an efficient and effective solution!
- **Shift in Paradigm** ... Pixels vs Scenes (no pixels lost)
- **Analysis Ready" Data** Products vs. Unprocessed Data (leave processing to the Space Agencies).
- **Data Cube** approach supports an infinite number of applications, makes it easier for users to access and use space-based data, and allows efficient time series analyses and data assimilation.

Data Cubes!



General CEOS Data Cube Architecture



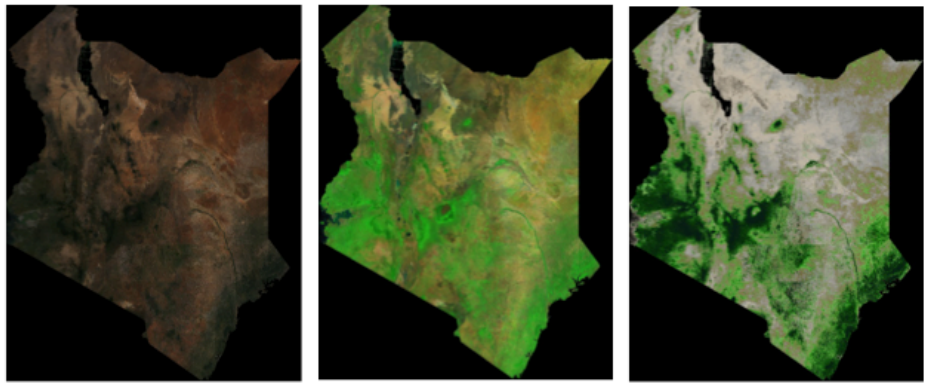


CEOS is developing ...
A flexible Data Cube architecture that supports infinite user applications, increasing and diverse datasets (space and in-situ), local or cloud-based deployment, and automated ingestion of new datasets.

Open Source software to allow free and open access, Advanced Programming Interface (API) access, future data and capability growth, and commercial opportunities.

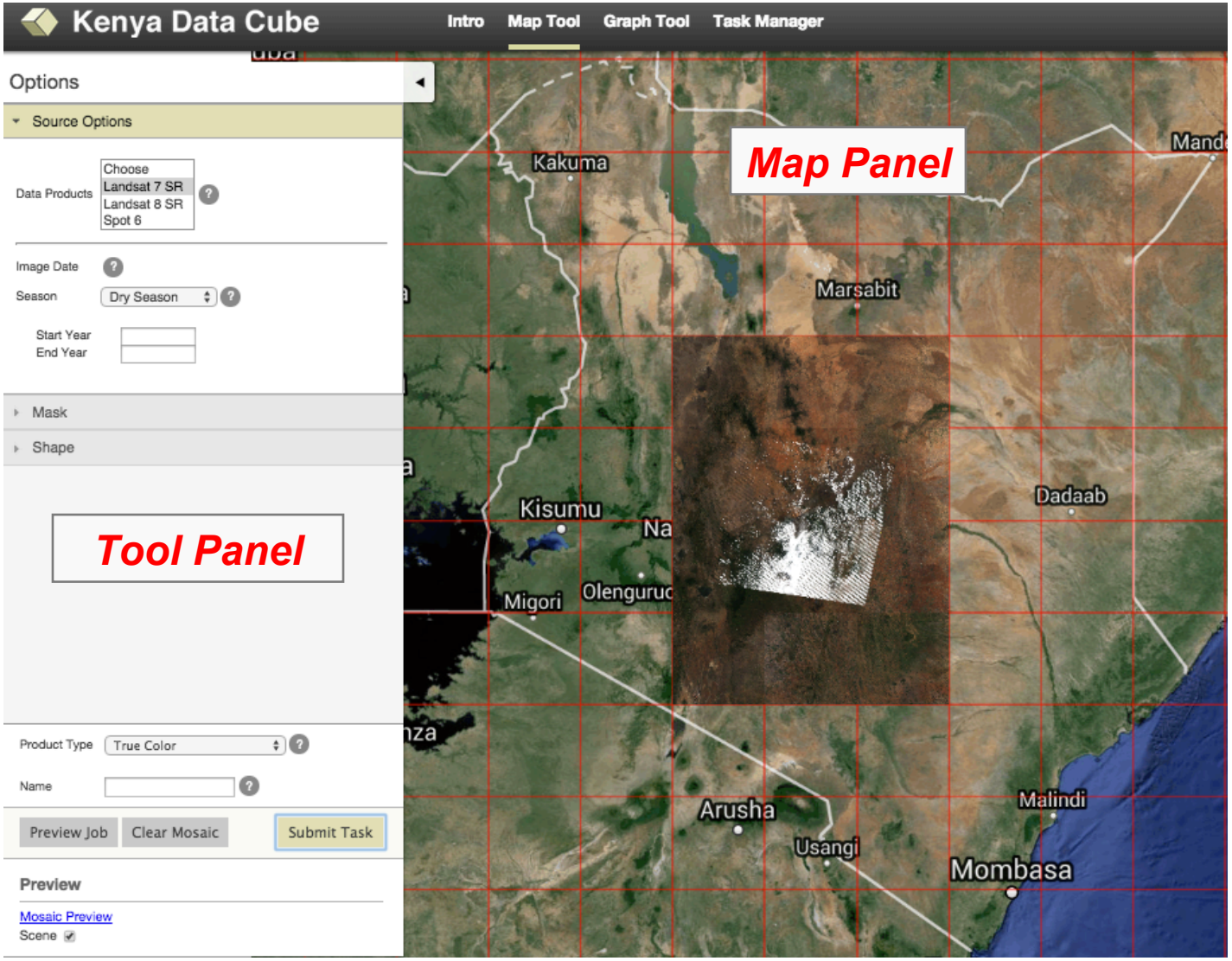
Kenya Data Cube Prototype Progress - July 2015

- We have created **two operating versions of the Kenya Data Cube**. One is deployed on the Amazon Cloud and one is deployed on a local computer.
- Historic Landsat-7/8 data (**7500+ scenes**) from 2000 to 2014 was obtained from USGS (11.5TB uncompressed, SR products). Pixel information was extracted and compressed into a 3.6TB Data Cube. The Data Cube uses 1/3 less storage to gain access to the same pixel information. Application algorithms can be run directly on the compressed Data Cube.
- We have demonstrated a reference a user interface that can generate a cloud-free mosaic and run simple algorithms (e.g., Tasseled Cap Index, NDVI)
- The team continues to improve the data ingestor software, the data analysis software and user interface. Following NASA internal approval of Open Source release, the tools will be available to anyone (for free) to develop their own data cube and user interface.



Natural Color | False Color (7,4,2) | NDVI

Kenya Data Cube User Interface Demo



- Selectable data products could include **BOTH space and in-situ data layers**
- Interface will create cloud-filtered mosaics and create custom analysis products
- Output will be JPEG or GEOTIFF files for input into the user workflow
- Data Cube content and User Interface is customizable using Open Source Software

GEO Plenary 2015
"In Situ" Side Meeting

- A "Non Space-based Observations Coordination Side Meeting" is planned for November 10, 2015 (TBD) at the GEO Plenary meeting in Mexico City, Mexico.
  YOU ARE INVITED … Open Meeting
- There is no global group responsible for non space-based coordination, such as CEOS for space. The European community (mostly EEA and Copernicus) have been the leaders.
- A new GEO Foundational task (GD5) is proposed for "Non Space-based Observation Resources" Previously, this task was included in the GEO Infrastructure (IN-01) task, "Earth Observations", led by Brian Killough (NASA, CEOS). It is now proposed to separate space and non-space coordination in the new GEO Foundational Task plan to allow the community to become more organized, focused and achieve greater success.
- **Meeting Objectives**: CEOS has agreed to work with GEO to develop a detailed task plan for the new non space-based foundational task (GD5, GEOSS non Space-based Earth Observation Resources) and complete a report to define the state of global coordination and recommendations for the future.

GROUP ON EARTH OBSERVATIONS