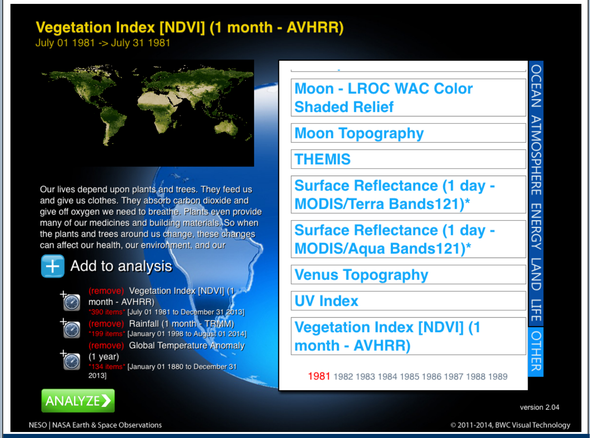
Examining our instrumented world for greater understanding: NESO provides access to NASA remote sensing data that describes our world and how it is changing

Maurice A. Henderson- NASA Goddard Space Flicht Center, Scott Muller-BWColor, Inc

NESO the Tool

NASA Earth and Space Observations (NESO) is an interactive map and measurements tool that fosters active sharing and discussion among dispersed learners and educators in both formal and informal settings. NESO provides access to timely and relevant remote sensing data which will enable novice or non-technical users to pursue a scientific inquiry process to reach conclusions about our changing world as scientists might do. Users can gain a working knowledge of how to ask questions of NASA data using the functionality and interactivity of our tool across three platforms; a webpage, an iPad app, and NOAA's Science on a Sphere (SOS). We use accessed data to create animations and time series over entire missions and allow the user to generate specific statistics and graphs.



NESO for K-12

Facilitates easy access to Remote Sensing data structures

- Access a familiar variable both locally and globally
- Look at change over time and over space
- Introduce color legends, graphing, and statistics from probing a single point to complex analysis.

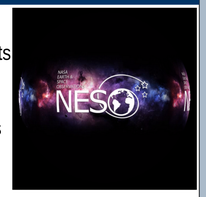
Supports learning across the curriculum, and scaffolds analyzing data and interpreting graphs

- Common Core State Standards- Math
  - Statistical Sampling in 7.SP.A, 8.SP.A, HSS.IC.A-B, HSS.ID.A-C
  - Scatter Plots, Histograms, Linear modeling, Box plots
  - Capture data with real relevance
  - Export data for further analysis and processing
  - Develop claims based on evidence
- Next Gen Science Standards
  - Engage learners in collaborative inquiry-based investigations
  - Examine change over time MS-ESS2-2, MS-ESS2-5
  - Examine interaction between processes, resources, and climate change HS-ESS3-1, -5, -6
- Common Core State Standards- ELA-LITERACY.W.6-12
  - Write arguments to support claims

Supporting three platforms

Science on a Sphere navigator

- Provides access to the full range of data sets
- Interactive experience for large audience
- Full access to sharing capability
- SOS navigator has been used for two years to define the process flows



Stand alone iPad app

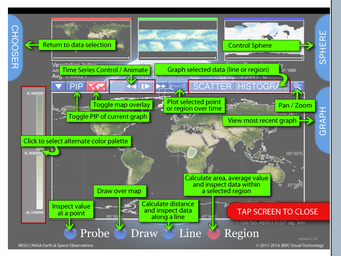
- Look and Feel from SOS experience
- Selected caching of analysis and animation

HTML5 based webpage

- iPad functionality except no caching

Hi-Def desktop navigator

- Eq. func. of iPad with UHD imagery



Key Features

- Analysis Widget: I need to expand on how this will be implemented
  - Sharing and Collaboration encouraged
  - Widget provides a jump start for further analysis
- "Find" Query to locate features and destinations
- Overlay and transparency between data sets
- Waypoint recording
- Animate data time series
- Statistical analysis of simple data sets and time series
- PDF analysis support
- Selectable Color tables
- Access to the full resolution of any data set
- Caching capability to support off-line analysis

Engaging Science and Engineering Practices

Start with simple questions about familiar variables

- What is the temperature of a single spot?
- How is a value represented by color?
- How does the temperature change over time?
- How do different color choices enhance the investigation?

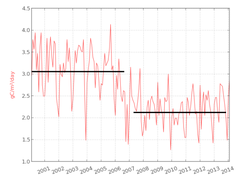
Compare different measurements of the same variable

- How do ground measurements differ from satellite?
- Compare the data that measure plant life in different ways.

Parallel the work of scientists and engineers

- Access similar data to reproduce a finding
- Make or identify a claim based on evidence and reasoning
- What were the challenges posed in making the measurements?

Using NESO to examine the satellite data for a forested region, we produced the graph to the right, duplicating a significant event reported by scientists.



Data Sources

NASA Earth Observatory (NEO)data produces image archive

- Typically tenth degree resolution images
- Record support full life of the mission

NASA Global Imagery Browse Services (GIBS) active archive [provided by EOSDIS to deliver global, full-resolution MODIS, AIRS, OMI and MLS imagery via a variety of standard services, such as Web Map Tile Services (WMTS), Tiled Web Map Service (TWMS) and KML]

Selected Earth and Space Science data products that have been reprocessed and are hosted by NESO

- Full spatial resolution is being supported
- Planetary data sets include true color and topography
- Astrophysics currently supported in optical and infrared

Procedures are in place to add Open Sourced Tile Servers to our catalog

Examples:

- AVHRR NDVI 1981-2013 monthly
- Global Surface Temperature 1880-2014 monthly
- Daily Modis True Color 250m
- WISE NIR Allsky map
- Mars, Venus, Lunar topography

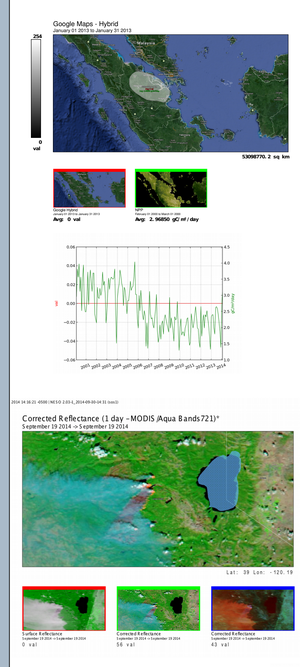
Uses Open Standards for Data Access handling

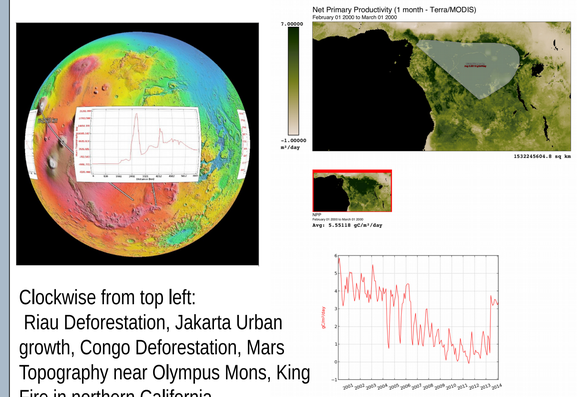
NESO interacts with GIS data through Open Geospatial Consortium (OGC) standards, the OpenLayers mapping library, and the Geospatial Data Abstraction Library (GDAL). This provides NESO with tremendous flexibility with regard to the types of data it can ingest and analyze, while using current industry standard programming interfaces. This layer of the software provides a means to view and select data for analysis. After data is selected, it is fed to various analysis engines. These are built using JavaScript and Python, but can be easily extendable by a user to include other language suites to provide desired analysis via a well defined API. An analysis engine consist of a program that takes the values of the points selected in the user interface and outputs a set of numbers that can be shown in graph form. Graphs are constructed using D3, a powerful JavaScript library for generating "Data-Driven Documents." This section of the software is also open to the possibility for users to create custom plots that further extend the capabilities of the NESO system.

Building Lesson Plans

The learning process for gathering and analyzing data is facilitated within the user interface for simple and complex analysis. Even activities that requires complex data gathering can be captured in the analysis widgets to insure consistency in the sampling process. Learning is the focus of each step in the data gathering and analysis process which is driven by the questions that the student is seeking to answer.

Examples of Analysis





Clockwise from top left:
Riau Deforestation, Jakarta Urban growth, Congo Deforestation, Mars Topography near Olympus Mons, King Fire in northern California

Contact information

Maurice A. Henderson
NASA Goddard Space Flight CEnter

8800 Greenbelt Rd
610HB
Greenbelt
Maryland 20771

T: 301-614-5672
E: maurice.henderson@nasa.gov