Editor’s Note

Even though this is the fourth-quarter-of-2018 issue of The Giovanni News, I’ll also take this opportunity to wish you a Happy New Year for 2019. This issue wraps up our coverage and commentary on topics from 2018, including abstracts relevant to Giovanni from the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) for the 2018 Fall Meeting of the American Geophysical Union. Also in this issue are a featured paper about nitrogen dioxide (NO₂) in Saudi Arabia, a note about our plans for the 2019 Gregory G. Leptoukh Online Giovanni workshop, an operational change to the Giovanni interface, and something else we think you’ll find interesting. So enjoy this issue and keep watching for more good Giovanni news!

Jim Acker
The Giovanni News Editor

FEATURED RESEARCH PAPER:


The introduction to this paper notes Saudi Arabia is the largest nation on the Arabian Peninsula. Although much of the country’s geography is dominated by the arid expanse of the desert, the country’s wealth means that its urban areas and industrial activities can influence regional atmospheric conditions. Based on this, the research group led by Dr. Zia ul-Haq investigated NO₂ concentrations in the atmosphere over Saudi Arabia for the period 2005-2014.

The researchers demonstrate that the NO₂ concentration pattern in Saudia Arabia is dominated by two ‘hotspots’: the capital city of Riyadh and the Mecca pilgrimage transportation hub of Jeddah. Industrial activities and vehicles are cited as the main causes of the hotspots. Industrial activities include cement production and sand crushing, in addition to oil production. The combination of these factors results in levels of pollution that “far exceed internationally acceptable standards.” Due to both higher temperatures and increased energy consumption, peak values were observed in summer and autumn.

In the paper, a figure generated by Giovanni shows the correlation between ozone (O₃) and NO₂. The correlation increases from south to north, toward areas with higher human population. A pixel with high correlation just south of the border with Jordan could be associated with nearby irrigated agriculture.
IN21B-35: The Advantages of Synergy – Quantitative Earth Science Data Visualization and Analysis with Giovanni, Panoply, and Excel

James G Acker, Gary T Alcott, Melanie Ventura, Jennifer C Wei, David J Meyer, and Giovanni Development Team

The NASA Giovanni data analysis system provides a multitude of basic analysis capabilities for numerous Earth science data products which are available in the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) archive, as well as for additional selected data products provided by other NASA Distributed Active Archive Center (DAAC) archives. In Giovanni, users can easily generate time-averaged data maps, area-averaged time-series, Latitude-Time and Longitude-Time Hovmöller diagrams, correlation maps, accumulation maps, and map animations (22 analysis options are available in total). While ASCII text output is available for time-series plots, it is not included as an option for data maps. In order to provide a quantitative, easy-to-use numerical output in ASCII text form, the NetCDF file output from a Giovanni visualization is downloaded and then opened with the free NASA visualization software package Panoply. Panoply provides the capability of translating the Giovanni file into comma-separated-variable (CSV) output. Panoply also provides additional visualization options, including the facile calculation of difference maps and quasi-anomaly maps using Giovanni output files. The CSV files from Panoply can then be imported into an Excel spreadsheet, where an Excel macro converts the CSV files. The output consists of latitude-longitude-data value triads in text form for maps, and either longitude-time-data value or latitude-time-data value triads in text form for Hovmöller diagrams. This presentation will explicate the basic procedure for the conversion, and then provide several examples where the procedure is applied to Giovanni output from different analysis options.
A recent study (Tong et al. 2017) shows a rapid intensification of dust storm activity over the southwestern United States in the past decades. For example, the frequency of windblown dust storms has increased 240% from 1990s to 2000s. Increasing dust storms can worsen air quality in the region. The study also finds that the intensification of dust events has a close connection with a fast-rising infectious disease (valley fever) caused by inhaling soil-dwelling fungi (*Coccidioides immitis* and *C. posadasii*) in the southwestern United States.

Hydrometeorological conditions play an important role in dust storm activity, including winds, precipitation, soil moisture, atmospheric boundary stability, land surface types, etc. In this presentation, we describe our preliminary results of linking the dust trends to variations of hydrometeorological conditions at regional and global scales, using a number of Earth observations, including products from NLDAS (North American Land Data Assimilation System), TRMM (Tropical Rainfall Measuring Mission), and MERRA (Modern Era Retrospective-analysis for Research and Applications) datasets, from NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC). The GES DISC, one of the 12 NASA data centers, is home to multidisciplinary data archives such as precipitation, hydrology, atmospheric chemistry, atmospheric dynamics, etc. We demonstrate that multidisciplinary datasets and services at GES DISC can be used for interdisciplinary investigation to understand the interactions of Earth system components from an observational perspective.

IN33C-0872: An Ensemble Metrics Analysis at GES DISC

Chung-Lin Shie, Guang-Dih Lei, Mary Greene, James G Acker, Gary T Alcott, Angela Li, Jennifer C Wei, Atheer F Al-Jazrawi, and David Meyer

At the NASA Goddard Earth Sciences Data and Information Service Center (GES DISC), we have archived and provided immense amounts of Earth science data, along with many developed pertinent services, to diverse research communities and the general public for decades. These Earth science data include more than 2,400 data products from different missions or projects containing more than 100 M data files/granules with a total volume size nearly 2 PB that broadly serve user needs in science areas such as Atmospheric Composition, Water & Energy Cycles and Climate Variability (but not limited to). Among the more than 70 developed services available to users, they involve useful tools such as Giovanni (23 services), SUBSET (13), etc. Since we are now facing the Big Data era with increasing archived data products in volume and variety, and thus increased data needs and service demands, we felt imperative to find out and have a better understanding on our users’ needs, characteristics and behaviors such as what instead of who (e.g., graduate students, but not their names) they are, and how or when and why they use our data products and services (i.e., the so-called “User Personae”) so that we would be able to address accordingly in the future and further improve our overall data and service supports. An “Ensemble” metrics analysis by integrating three different groups of metrics (see details as follows) for FY2010-FY2018 has thus been conducted. Our overall data products and services have shown constantly attracting numerous users from diverse background for performing various scientific studies and applications through this ensemble metrics analysis of “information mining” conducted by combining results from three unique and crucial metrics, i.e., 1) the daily/routine operational distribution metrics, i.e., tracking number of distinct users and distributed data files/granules, and size of distributed data volume for individual and overall data products and services, 2) the user publication records, i.e., collecting info of publications by users who have used Giovanni, and 3) information collected based on the Bugzilla User Assistance tickets that we have received from our users usually seeking help or contributing feedback. A detailed finding from this ensemble metrics analysis will be presented at the meeting.
Outbreaks of infectious diseases and health can be influenced by airborne and water-borne pollutants. Furthermore, air and water quality are associated with climate variability, industrialization, land use and land cover change, and water resource management. It is therefore crucial to understand environment-disease connections with existing long-term observed and modeled data, particularly for development of early warning systems for infectious disease outbreaks.

The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) (https://disc.gsfc.nasa.gov) archives large volumes of global environment data that are useful for research and applications regarding environmental factors and public health.

Examples of air quality measurements are:
- Daily satellite remotely sensed data, including Aerosol Index (AI), O₃, SO₂, CO, and NO₂ from Aura/OMI (October 2014 to present), and OMPS-NPP (January 2012 to present, currently research data products only);
- Hourly and monthly reanalysis modeled data, including PM2.5, O₃, CO, SO₂, BC, dust, AOD, and aerosol types from MERRA-2 (January 1980 to present);

Examples of surface meteorology and land surface measurements are:
- 3-hourly, daily, and monthly satellite precipitation from TRMM (December 1997 to March 2015);
- 30-minute and monthly satellite precipitation from GPM (March 2014 to present);
- Hourly and monthly modeled surface meteorology and land surface condition from MERRA-2 (January 1980 to present) and land surface assimilation models (January 1948 to present), including precipitation, surface temperature, relative humidity, wind, and soil moisture.

This presentation will give an overview of relevant environmental data at the NASA GES DISC. Through a number of use cases, such as dust events and active fires, we will introduce data services that assist in finding the right data, enable visualization and analysis of the data online, and allow downloading of data in user-preferred format.
IN43A-17: Challenges in Development of Online Visualization and Analysis Tools for Satellite Data
Zhong Liu, Mahabal Hegde, Angela Li, James G Acker, Jennifer C Wei, and David J Meyer

Over the years, various online visualization and analysis tools have been developed to facilitate satellite data access and help scientific users around the world to conduct research and develop applications (e.g., data product evaluation, what-if questions, etc.). For those who are new to satellite data products, using them can be a daunting task due to many obstacles in data processing such as data formats, complex data structures, special software packages, unfamiliar terminology, etc., especially when one is not sure whether a dataset is suitable for his/her research project. Even for experienced users, developing software for data processing and analysis can be a costly and time-consuming task.

Online visualization tools can overcome many of these difficulties and allow users to focus on scientific questions. For example, Giovanni (the Geospatial Interactive Online Visualization and Analysis Infrastructure, https://giovanni.gsfc.nasa.gov), developed by the NASA Goddard Earth Sciences Data and Information Services Center (GES DISC), allows access to over 1900 satellite and model variables in 82 measurement groups in 8 disciplines without downloading data and software. Main features include basic functions for data analysis and visualization, data provenance, output data in different formats (ASCII, NetCDF, GeoTIFF), and more. Over the years, ~1700 peer-reviewed publications in different disciplines have benefited from Giovanni in research activities (e.g. initial investigation, what-if questions, and product evaluation).

Despite the success of online visualization and analysis tools, challenges and new opportunities still exist, and more can be done with new requirements and technology. Examples are: a) how to increase the efficiency of dataset search by enhancing intuitive aspects; b) how to facilitate interdisciplinary research; c) how to provide data quality information; d) how to engage users to participate in data quality assessment; and more. NASA Earth Observing System Data and Information System (EOSDIS) satellite-based data products are processed at various levels ranging from Level 0 to Level 4. While most users use data products at higher levels (Level-3 and 4), products at lower levels are still important for case studies, algorithm development, ground validation, etc. In this presentation, we will use Giovanni as an example to present and discuss challenges and near-future opportunities for satellite data online visualization and analysis tools.
Examining Correlation Maps of OMI 500nm AOD and OMI Total Column NO\textsubscript{2} during the 2018 West Coast Fire Season

Giovanni’s ease of use enables it to be used to conduct preliminary research – and, of course, if we knew what the outcome was going to be, that would be a lab exercise and not actual research.

So, knowing nitrogen dioxide (NO\textsubscript{2}) is formed by combustion processes, and also that combustion processes produce smoke aerosols, it’s easy to surmise smoke and NO\textsubscript{2} generated by wildfires would be correlated (to some extent).

To research this, Giovanni’s correlation map analysis function can be utilized. Correlation maps of Ozone Monitoring Instrument (OMI) Aerosol Optical Depth (AOD) at 500nm (AOD\textsubscript{500}) and OMI NO\textsubscript{2} data were made with daily data averaged for the months of August, September, and November 2018, shown at left. A gradient blue color palette was used to make regional patterns easier to visualize.

The correlation maps show regions with higher correlation between NO\textsubscript{2} and AOD\textsubscript{500}, notably in British Columbia, in August and September. October (plot not shown) had lower correlations overall, as fire activity abated; but California suffered devastating wildfires in November, particularly the Camp Fire northeast of San Francisco. High correlations between NO\textsubscript{2} and AOD\textsubscript{500} are seen in the smoke plume regions for the Camp Fire and fires near Los Angeles, indicated by arrows. The image on the next page shows both smoke plumes on November 8, 2018. Also note the high correlation areas in southern Oregon, which aren’t associated with wildfire activity or urban areas (?) – this is research, after all.
Examining Correlation Maps of OMI 500nm AOD and OMI Total Column NO\textsubscript{2} during the 2018 West Coast Fire Season (continued)

The image at left shows two prominent smoke plumes from intense fires in California on November 9, 2018. To further investigate the correlation between NO\textsubscript{2} and AOD\textsubscript{500}, the Giovanni Interactive Scatter plot can be used. A small region offshore of San Francisco Bay was selected to generate the plot:

This is the resulting scatter plot. As might be predicted, there is a fairly good correlation between higher values of NO\textsubscript{2} and AOD\textsubscript{500}.

The Interactive Scatter Plot allows the location corresponding to a specific data point to be determined. So, e.g., for the plot at left, clicking on the red data point will show the location and the lat/lon coordinates, as shown below. The location of the point is shown by the green pin on the inset map.
In our next issue:

In the next issue of *The Giovanni News*, which will definitely reach you during the first quarter of calendar year 2019, we’ll cover the following topics:

- The next Giovanni release, which will have a modified access method requiring Earthdata login for full access to all data and services.
- A description of the upcoming Gregory G. Leptoukh Online Giovanni Workshop (Spring 2019), featuring innovative uses of Giovanni for undergraduate student research (and maybe a little graduate student research as well), and also the announcement of the next group of honorees for the Giovanni Image Hall of Fame!
- Featured research papers that used Giovanni from the July-December period of 2018 (and our final paper count for the year).

Yesterday? Last Week? Last Month? Last Year? Last DECADE?

Use Giovanni to research your own time period of interest with NASA Earth science data

[https://giovanni.gsfc.nasa.gov](https://giovanni.gsfc.nasa.gov)