Long-Term Global Aerosol Products from NASA Reanalysis MERRA-2 Available at GES DISC

A31D-0095
AGU 2015 Fall
San Francisco, CA
December 14-18 2015

Description of Data Access Methods and Showcases of Aerosols from Volcanic Eruption, Dust Storm and Wildfire

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About MERRA-2 Aerosol Products

- **Aerosol Compositions:** Sulphur Dioxide (SO_2), Dust, Black Carbon (BC), Organic Carbon, Sea Salt, Sulfate (SO_4)
- **Aerosol Property:** mixing ratio, column mass density, emission, optical depth, deposition, sedimentation, etc.
- **Model:** GOCART (Goddard Chemistry Aerosol Radiation and Transport)
- **Assimilation Inputs:** AVHRR (pre-EOS period), MODIS, MISR, AERONET
- **Temporal Coverage:** 1980-present
- **Temporal Resolution:** hourly, 3-hourly, diurnal, monthly
- **Spatial Coverage:** Global
- **Spatial Resolution:** 0.5°x0.625°
- **Data Format:** NetCDF-4

Data Services

Finding Data: UUI

Subsetting: MERRA Subsetter

- ✓ Parameter, spatial, temporal subsetting
- ✓ Regridding (bilinear interpolation, nearest neighbor, distance-weighted average, ...)
- ✓ Resolution (gpcp2.5, cfsr1.0, ERA40, ...)
- ✓ Data Format (netCDF4, NetCDF4-classic)

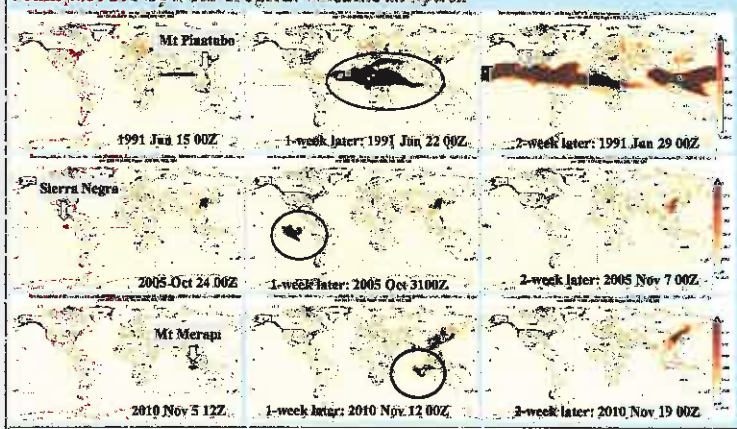
Visualization: Giovanni
http://giovanni.gsfc.nasa.gov/Giovanni/

Other Data Services:

- ✓ HTTP (for direct downloading)
- ✓ OPeNDAP
- ✓ GDS
- ✓ NASA centralized Earth Data search system
- ✓ Data Recipes (step-by-step instruction on reading data with varies data tools)

Products Description	Sample Parameters	Temporal Resolution	Product ShortName
Aerosol Diagnostics	SO_2 Column Mass Density Dust Surface Mass Concentration Dust Surface Mass Concentration -PM 2.5 Total Aerosol Extinction AOT at 550nm Total Aerosol Scattering AOT at 550nm	*Hourly* *Diurnal* *Monthly*	*M2T1NXAER (tavg1_2d_aer_Nx)* *M2TUNXAER (tavgU_2d_aer_Nx)* *M2TMNXAER (tavgM_2d_aer_Nx)*
Aerosol Diagnostics (extended)	Dust Dry/Wet Deposition Dust Emission Dust Sedimentation Black Carbon Biomass Burning Emissions SO_2 Biomass Burning Emissions	*Hourly,* *Diurnal* *Monthly*	*M2T1NXADG (tavg1_2d_adg_Nx)* *M2TUNXADG (tavgU_2d_adg_Nx)* *M2TMNXADG (tavgM_2d_adg_Nx)*
Aerosol Optical Depth Analysis	Aerosol Optical Depth Analysis Aerosol Optical Depth Analysis Increment	*3-hourly* *Diurnal* *Monthly*	*M2I3NXGAS (inst3_2d_gas_Nx)* *M2IUNXGAS (instU_2d_gas_Nx)* *M2IMNXGAS (instM_2d_gas_Nx)*
Aerosol Mixing Ratio (3D - L72)	Dust Mixing Ratio SO_2 Mixing ratio Hydrophilic /Hydrophobic Black Carbon Methanesulphonic acid	*3-hourly*	*M2I3NVAER (inst3_3d_aer_Nv)*
Aerosol Mixing Ratio Analysis Increments (3D - L72)	Dust Mixing Ratio Analysis Increments Sulfate Mixing Ratio Analysis Increments Black Carbon Mixing Ratio Analysis Increments	*3-hourly*	*M2I3NVGAS (inst3_3d_gas_Nv)*

Transport of SO_2 from Tropical Volcanic Eruption



Left: MERRA-2 assimilated column SO_2 mass density from volcano **Mount Pinatubo (Jun 1991), Sierra Negra (Oct 2005)** and **Mount Merapi (Nov 2010).** SO_2 from Mount Pinatubo travels westward with easterly wind, made a circle in about two weeks, which stayed in the atmosphere for over three months. In other two cases, SO_2 did not travel very far away, and stayed in the atmosphere for only a couple of weeks

Images are generated from Giovanni at NASA GES DISC

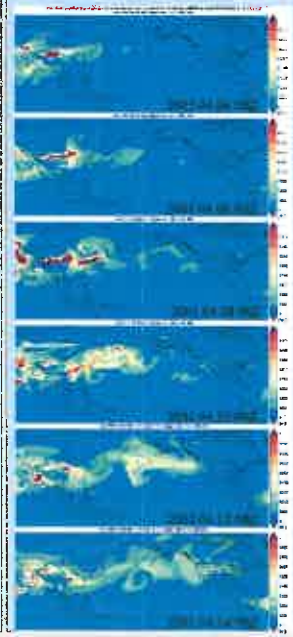
Satellite Measured SO_2

Name	Location (Lat, Lon)	Eruption Date	Mass (kt)	Observed Plume Altitude (km)
Mt Pinatubo	15.13, 120.35	1991.06.13 1991.06.15	140 20000	19 40
Mt Merapi	-7.54, 110.44	2010.11.05	300	17
Sierra_Negra	-0.83, -91.17	2005.10.23	2000	15

1 kilotons (kt) = 1000 metric tons

Data Source. SO_2 database derived from ultraviolet satellite measurements by Nickolay A. Krotkov (MEaSUREs 2012
http://disc.sci.gsfc.nasa.gov/datacollection/MSVOLSO2L4_V1.html

Travel of Dust from Asia to North America

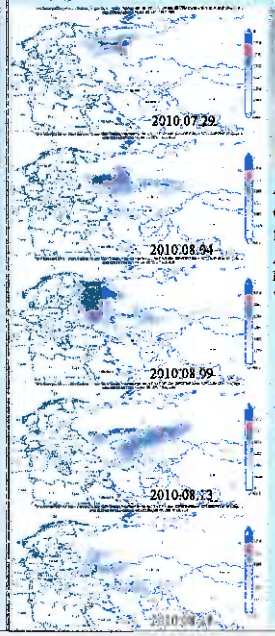


Above: True color image from MODIS, the famous **"Perfect Dust Storm" on April 7 2001** over Northeast China. Courtesy http://earthobservatory.nasa.gov/IOTD/view.php?id=8341

Left: MERRA-2 assimilated **column dust mass density,** the dust travels eastward from Asia across the Pacific reaching California and even Maryland in about 6-10 days

Images are generated from Giovanni at NASA GES DISC

Change of Black Carbon from 2010 Russian Wildfire



Above: MODIS captured dense plumes of smoke from **fires in western Russia** on August 4, 2010. Courtesy http://earthobservatory.nasa.gov/IOTD/view.php?id=45046

Left: MERRA-2 assimilated **black carbon (BC) Column Mass Density** from the **2010 Russian wildfires,** started in late July and lasted until early September 2010. The fires were associated with record-high temperatures and drought

Images are generated from Giovanni at NASA GES DISC

References:

Bosilovich, M. G., R. Lucchesi, and M. Suarez, 2015: **MERRA-2: File Specification.** *GMAO Office Note No. 9*, http://gmao.gsfc.nasa.gov/pubs/docs/Bosilovich785.pdf

Colarco, P., A. da Silva, M. Chin, and T. Diehl (2010), Online simulations of global aerosol distributions in the NASA GEOS-4 model and comparisons to satellite and ground-based aerosol optical depth, *J. Geophys. Res.*, 115, D14207, doi:10.1029/2009JD012820