



ARSET

Applied Remote Sensing Training

<http://arset.gsfc.nasa.gov>

 @NASAARSET

WHO PM_{2.5} Data Set Case Study Analysis

March 15-29, 2017

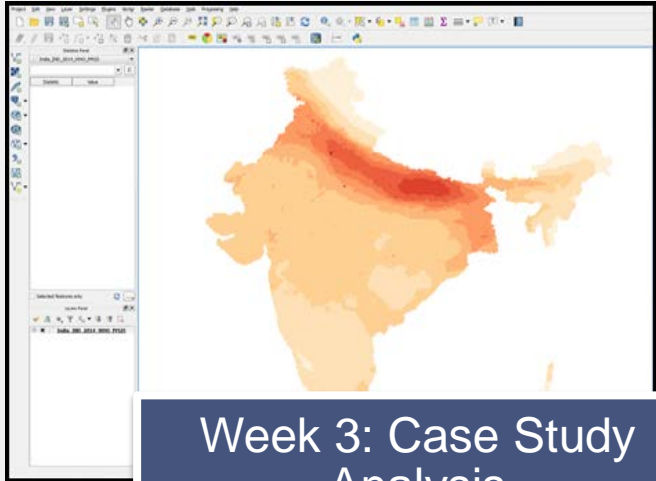
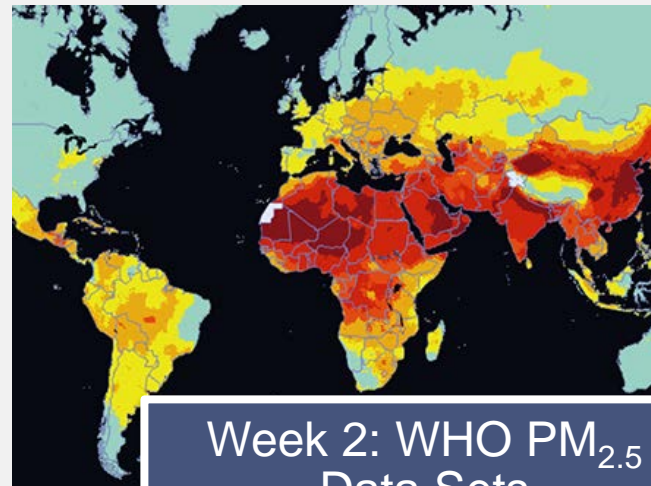
Melanie Follette-Cook, Pawan Gupta

Webinar Series Agenda



The image shows the 17 Sustainable Development Goals (SDGs) arranged in a grid. Each goal is represented by a colored square with a white icon and text. The goals are: 1. No Poverty, 2. Zero Hunger, 3. Good Health and Well-being, 4. Quality Education, 5. Gender Equality, 6. Clean Water and Sanitation, 7. Affordable and Clean Energy, 8. Decent Work and Economic Growth, 9. Industry, Innovation and Infrastructure, 10. Reduced Inequalities, 11. Sustainable Cities and Communities, 12. Responsible Consumption and Production, 13. Climate Action, 14. Life Below Water, 15. Life on Land, 16. Peace, Justice and Strong Institutions, and 17. Partnerships for the Goals. The text 'SUSTAINABLE DEVELOPMENT GOALS' is at the top.

Week 1: ARSET, Remote Sensing, and SDGs



A screenshot of a GIS application window. The main map area shows a map of India, color-coded in shades of orange and red, indicating high concentrations of PM_{2.5}. The application interface includes a toolbar at the top, a legend on the left, and a status bar at the bottom.

Week 3: Case Study Analysis

Session 3: Outline

1. Brief review of where to obtain data files
2. Viewing and analyzing the WHO estimates with the QGIS software
3. Reviewing other relevant data portals and websites

Today's Instructor: Melanie Follette-Cook, Ph.D.
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Today's Instructor: Pawan Gupta, Ph. D.
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<http://arset.gsfc.nasa.gov/people/pawan-gupta-0>

Learning Objectives

1. Learn how to obtain, display, and analyze the WHO PM_{2.5} estimates using the QGIS software
2. Learn about other data portals and informative websites

A world map with a semi-transparent white rectangular box overlaid on the center. The map uses a color scale from light yellow to dark red to represent different data points across the globe. The white box contains the text "Review of Sessions 1 & 2" in a black, sans-serif font, with a horizontal line underneath it.

Review of Sessions 1 & 2

UN Sustainable Development Goals (SDGs)

Transforming Our World: The 2030 Agenda for Sustainable Development



Text adapted from "[Transforming our world: the 2030 Agenda for Sustainable Development](#)"

UN Sustainable Development Goals (SDGs)

Transforming Our World: The 2030 Agenda for Sustainable Development

Target 3.9

By 2030, substantially reduce the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination



Target 11.6

By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management

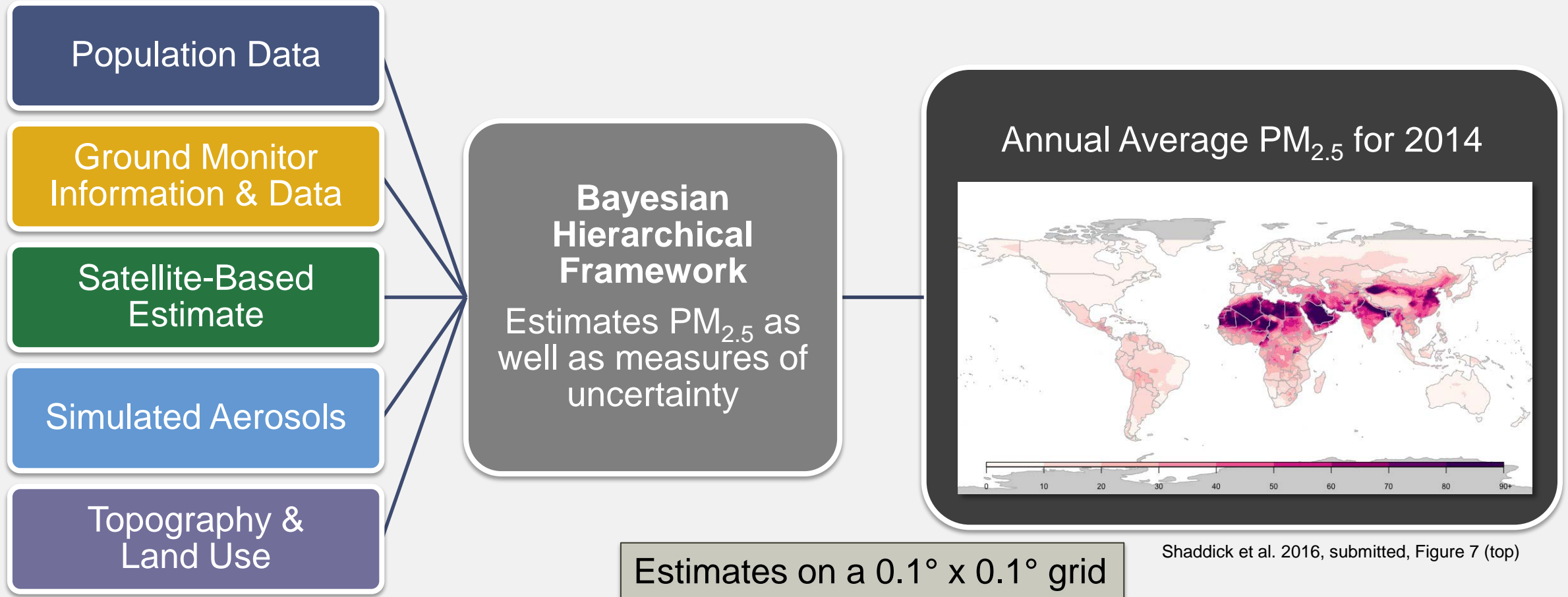
One indicator for both Targets is annual mean levels of fine particulate matter (PM_{2.5})

Text adapted from "[Transforming our world: the 2030 Agenda for Sustainable Development](#)"

Global PM_{2.5} estimates

- Van Donkelaar et al. 2016
 - Annual mean estimates of PM_{2.5} (1998-2012)
 - Available at: <http://sedac.ciesin.columbia.edu/data/set/sdei-global-annual-avg-pm2-5-modis-misr-seawifs-aod-1998-2012>
 - Or at: http://fizz.phys.dal.ca/~atmos/martin/?page_id=140
- WHO and the University of Bath - Data Integration Model for Air Quality (DIMAQ)
 - Model developed to estimate PM_{2.5} incorporating many sources of data
 - Estimates PM_{2.5} along with associated measures of uncertainty
 - Annual mean estimates of PM_{2.5} (2014 only)
 - Available at: http://www.who.int/phe/health_topics/outdoorair/databases/modelled-estimates/en/
 - Or by country at: http://avdc.gsfc.nasa.gov/pub/tmp/WHO_PM25_2014_COUNTRY_DATA/

Data Integration Model for Air Quality (DIMAQ)



WHO PM_{2.5} gridded data – By country

- http://avdc.gsfc.nasa.gov/pub/tmp/WHO_PM25_2014_COUNTRY_DATA/



The screenshot shows the NASA AVDC (Aurora Validation Data Center) website. The header includes the NASA logo, "GODDARD SPACE FLIGHT CENTER", and a login status "You are not logged in. Login Sign up". The main banner features a globe with a satellite and the text "Aurora validation data center". Below the banner is a navigation menu with tabs: OVERVIEW, DATA, TOOLS, DOCUMENTATION, LINKS, and EVENTS. The "OVERVIEW/ HOME" section displays a directory listing of WHO PM_{2.5} gridded data files for 2014, organized by country. The listing includes columns for Name, Last modified, and Size.

Name	Last modified	Size
Parent Directory	-	-
Afghanistan_AFG_2014_WHO_PM25.csv	15-Feb-2017 10:32	220K
Albania_ALB_2014_WHO_PM25.csv	15-Feb-2017 10:32	11K
Algeria_DZA_2014_WHO_PM25.csv	15-Feb-2017 10:32	760K
Andorra_AND_2014_WHO_PM25.csv	15-Feb-2017 10:32	386
Angola_AGO_2014_WHO_PM25.csv	15-Feb-2017 10:32	375K
AntiguaandBarbuda_ATG_2014_WHO_PM25.csv	15-Feb-2017 10:32	761
Argentina_ARG_2014_WHO_PM25.csv	15-Feb-2017 10:32	1.0M
Armenia_ARM_2014_WHO_PM25.csv	15-Feb-2017 10:32	11K
Australia_AUS_2014_WHO_PM25.csv	15-Feb-2017 10:32	2.5M
Austria_AUT_2014_WHO_PM25.csv	15-Feb-2017 10:32	35K
Azerbaijan_AZE_2014_WHO_PM25.csv	15-Feb-2017 10:32	32K
Bahamas_BHS_2014_WHO_PM25.csv	15-Feb-2017 10:32	4.5K
Bahrain_BHR_2014_WHO_PM25.csv	15-Feb-2017 10:32	350
Bangladesh_BGD_2014_WHO_PM25.csv	15-Feb-2017 10:32	44K
Barbados_BRB_2014_WHO_PM25.csv	15-Feb-2017 10:32	317
Belarus_BLR_2014_WHO_PM25.csv	15-Feb-2017 10:32	99K
Belgium_BEL_2014_WHO_PM25.csv	15-Feb-2017 10:32	14K
Belize_BLZ_2014_WHO_PM25.csv	15-Feb-2017 10:32	6.8K
Benin_BEN_2014_WHO_PM25.csv	15-Feb-2017 10:32	34K
Bhutan_BTN_2014_WHO_PM25.csv	15-Feb-2017 10:32	13K

A world map with a semi-transparent white rectangular overlay box. The text 'QGIS' is written in black, bold, sans-serif font inside the box. Below the text is a solid black horizontal line. The map background shows a color-coded overlay, possibly representing elevation or climate, with colors ranging from light yellow to dark red. The overlay box covers the Americas, Europe, and parts of Africa and Asia.

QGIS

QGIS

- QGIS is an open source Geographic Information System (GIS) licensed under the GNU general public license
- This software offers many common GIS functions:
 - Visualize data
 - Create maps
 - Analyze, manage, export data
- For more information see: <https://www.qgis.org/en/site/about/>
- QGIS user guide for v2.14: <http://docs.qgis.org/2.14/en/docs/index.html>

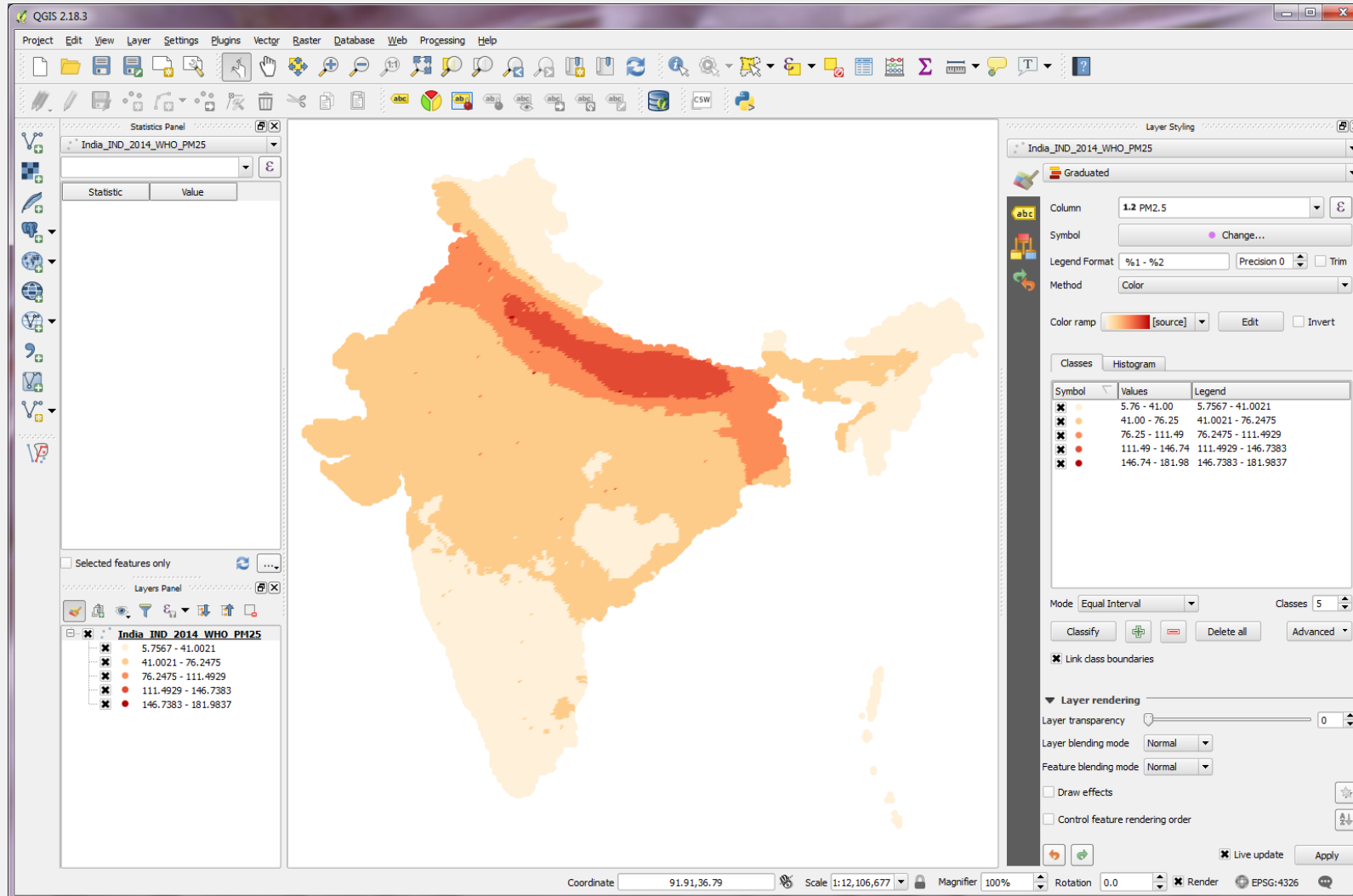
<https://www.qgis.org/en/site/about/>

QGIS

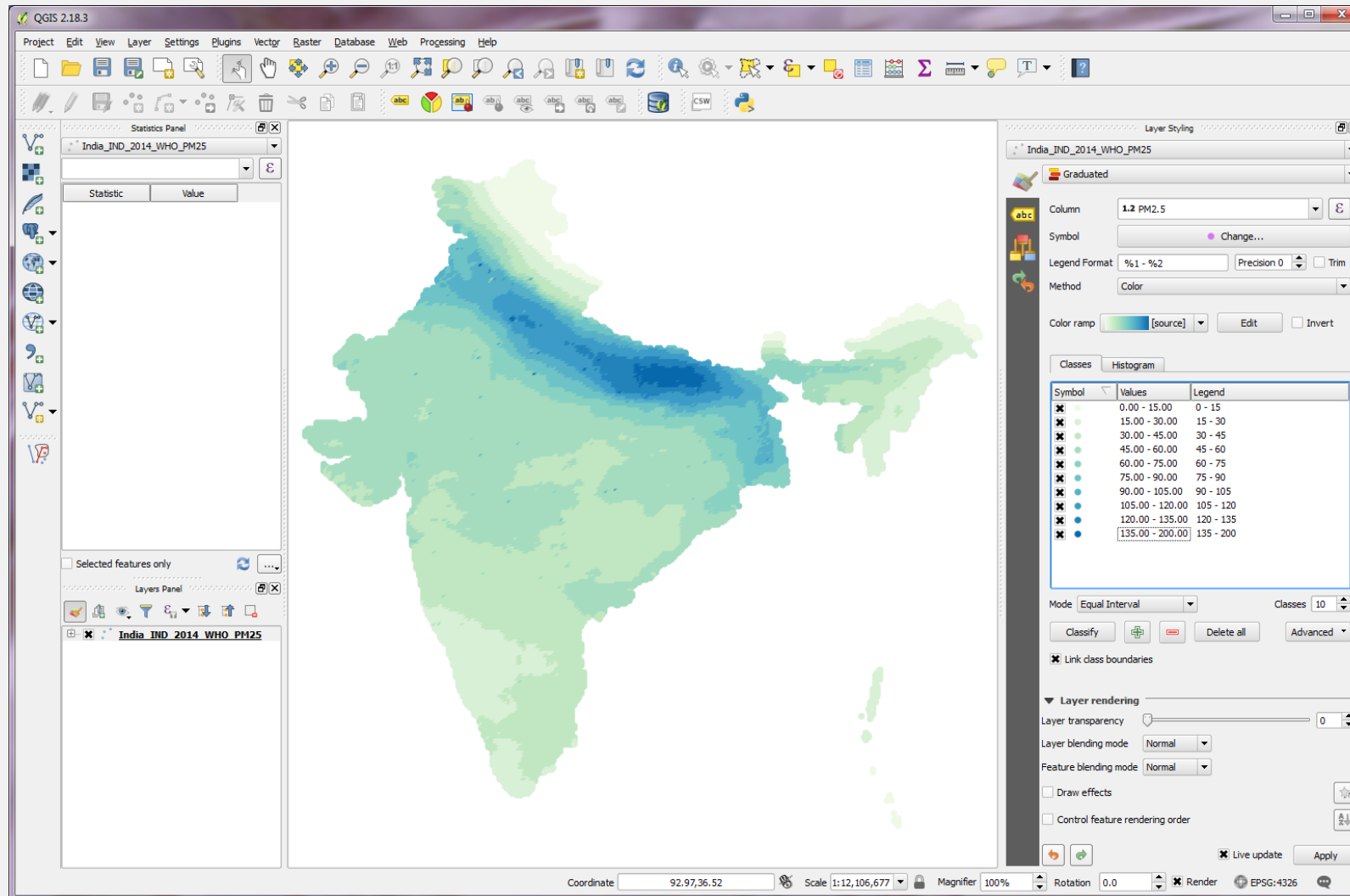


- By now you should have:
 - Downloaded and installed the QGIS software
 - Downloaded at least some or all of the individual country files
- In this section we will walk you through how to....

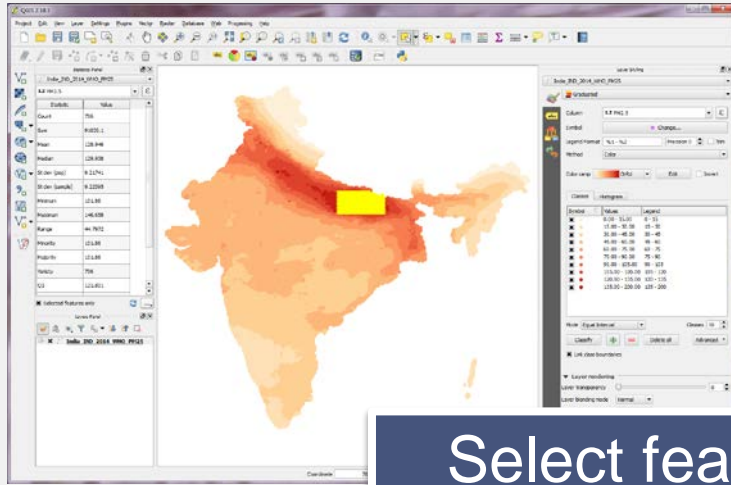
Upload and view the PM_{2.5} estimates



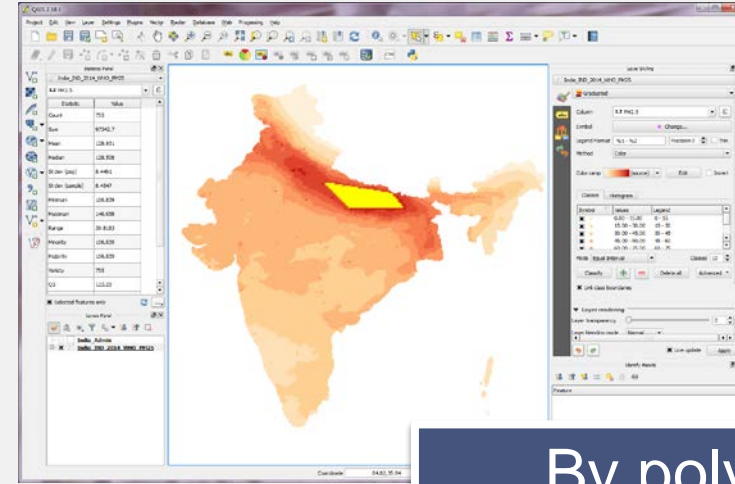
Change the color and color scale



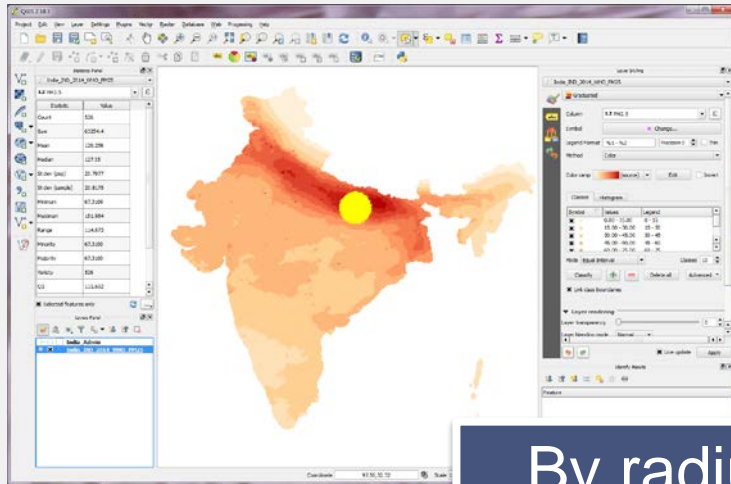
Create/Save a subset, and calculate basic statistics



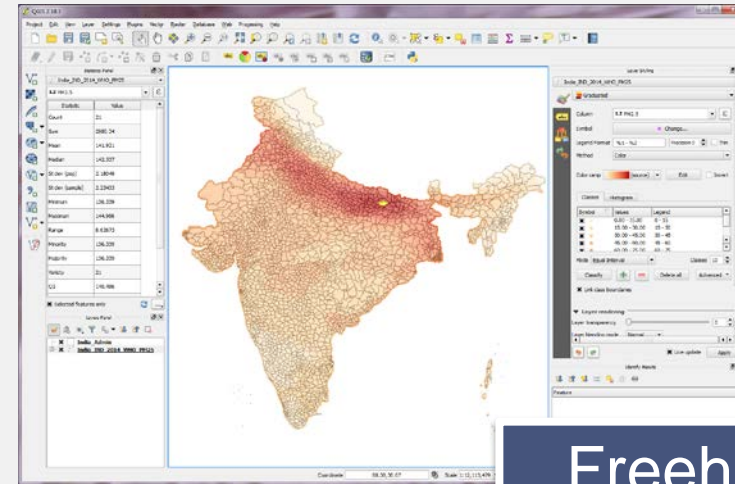
Select features



By polygon

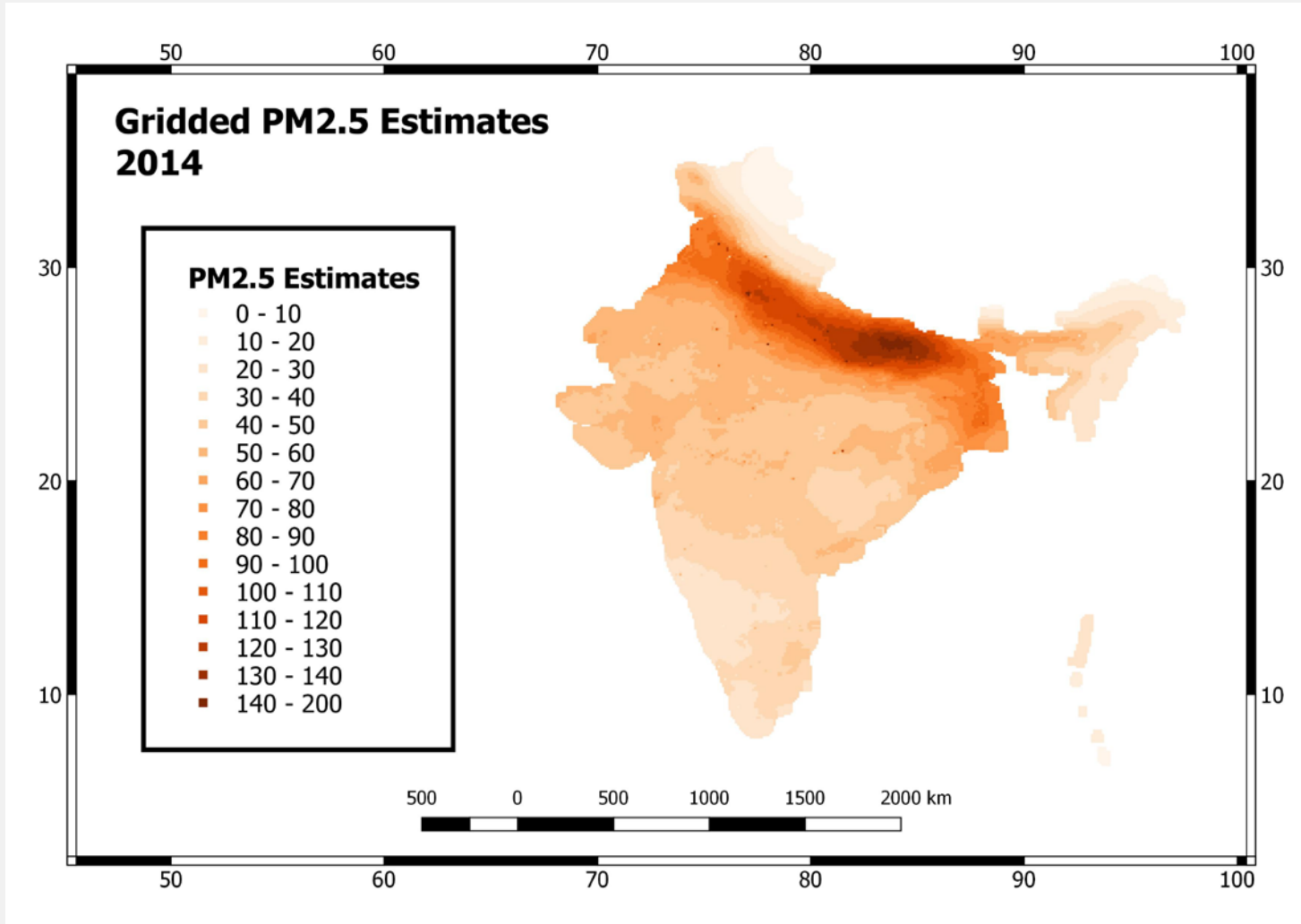


By radius




Freehand

Create a map



WHO PM_{2.5} gridded data – By country

- http://avdc.gsfc.nasa.gov/pub/tmp/WHO_PM25_2014_COUNTRY_DATA/



The screenshot shows the NASA AVDC (Aura Validation Data Center) website. The header includes the NASA logo, "GODDARD SPACE FLIGHT CENTER", and a login prompt: "You are not logged in. Login Sign up". The main banner features a globe with a satellite and the text "Aura validation data center". Below the banner is a navigation menu with tabs: OVERVIEW, DATA, TOOLS, DOCUMENTATION, LINKS, and EVENTS. The "OVERVIEW/ HOME" section displays a directory listing of CSV files for WHO PM_{2.5} data by country for 2014. The listing includes columns for Name, Last modified, and Size.

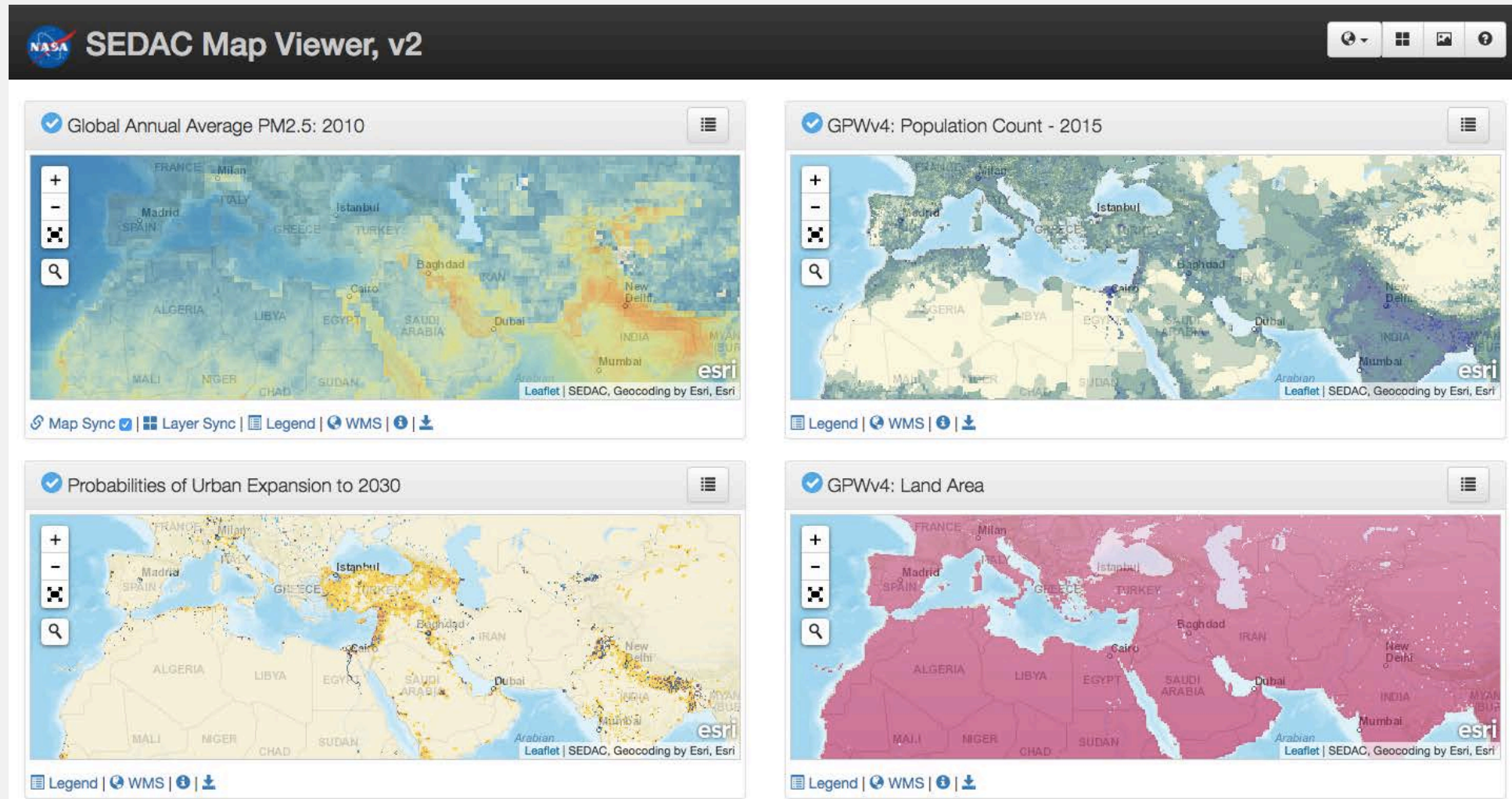
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A world map with a semi-transparent white rectangular box overlaid on the center. The map uses a color scale from light yellow to dark red, with a white outline of country borders. The white box contains the text "Other relevant data portals and websites" in a black, sans-serif font. A thin black horizontal line is positioned below the text, extending from the left edge of the box to the right edge of the text.

Other relevant data portals and websites

Socioeconomic Data and Applications Center (SEDAC)

<http://sedac.ciesin.columbia.edu/mapping/viewer/#>



Satellite Derived Surface PM_{2.5} Data Sets

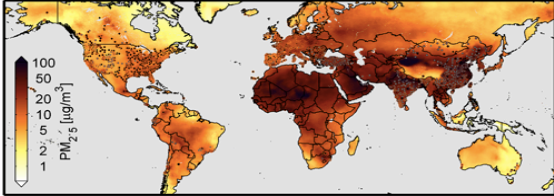
http://fizz.phys.dal.ca/~atmos/martin/?page_id=140

Atmospheric Composition Analysis Group

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Surface PM_{2.5}

Global Estimates:



We estimate ground-level fine particulate matter (PM_{2.5}) by combining Aerosol Optical Depth (AOD) retrievals from the NASA MODIS, MISR, and SeaWiFS instruments with the GEOS-Chem chemical transport model, and subsequently calibrated to global ground-based observations of PM_{2.5} using Geographically Weighted Regression (GWR) as detailed in the below reference.

References:
van Donkelaar, A., R.V. Martin, M. Brauer, N. C. Hsu, R. A. Kahn, R. C. Levy, A. Lyapustin, A. M. Sayer, and D. M. Winker, **Global Estimates of Fine Particulate Matter using a Combined Geophysical-Statistical Method with Information from Satellites, Models, and Monitors**, *Environ. Sci. Technol.*, doi: 10.1021/acs.est.5b05833, 2016. [\[Link\]](#)

Scientific Datasets:
Global resolved datasets are provided in ArcGIS-compatible NetCDF [.nc] or zipped ASCII [.asc.zip] file. Note that the unzipped ASCII files can be cumbersome. Gridded files use the WGS84 projection. The 0.01° × 0.01° grid contains 12500 latitude coordinates, with centres from 54.995°S to 69.995°N, and 36000 longitude coordinates, with centres from 179.995°W to 179.995°E. The 0.1° × 0.1° grid contains 1250 latitude coordinates, with centres from 54.95°S to 69.95°N, and 3600 longitude coordinates, with centres from 179.95°W to 179.95°E. Corresponding files for Google Earth are also provided [.kmz]. Country means are also provided in a comma separated ascii (.csv) format. Dust and Sea-Salt Removed PM_{2.5} estimates apply simulated compositional information to our full-composition values, following van Donkelaar et al., EHP, 2015. Other extractions can often be produced upon request. Please contact Aaron van Donkelaar (Aaron.van.Donkelaar@dal.ca) for further information.

All Composition PM_{2.5}:

Satellite-Derived PM_{2.5}, 2008, at 35% RH [ug/m3]
0.1° × 0.1° [.nc] [.asc.zip] [.kmz] [.csv]
0.1° × 0.1° w GWR adjustment [.nc] [.asc.zip] [.kmz] [.csv]
0.01° × 0.01° w GWR adjustment [.nc] [.asc.zip] [.kmz] [.csv]

Satellite-Derived PM_{2.5}, 2009, at 35% RH [ug/m3]
0.1° × 0.1° [.nc] [.asc.zip] [.kmz] [.csv]

State of Global Air

<https://www.stateofglobalair.org/>

The screenshot shows the top navigation bar of the State of Global Air website. It includes the logo 'STATE OF GLOBAL AIR' and a '+ Share' button. The main navigation menu contains links for 'HOW CLEAN IS YOUR AIR?', 'IMPACT ON YOUR HEALTH', 'EXPLORE THE DATA', and 'READ THE REPORT'. A secondary menu below it includes 'EXPLORE THE DATA', 'HOW TO', 'METHODS', and 'WHAT'S NEXT?'. The 'EXPLORE THE DATA' section is highlighted, with a sub-header 'Explore the Data' and a paragraph explaining the site's functionality: 'Here you can compare air quality or health impacts across countries, create global maps of air quality and health impacts, plot their trends over time, and view or download images and tables with air quality and health impact data. Please refer to the How To page and the Glossary for guidance. You can also find background information on how the air quality and health data are developed in Methods and see plans for future updates in What's Next. Tell us about your experience with the site, your analyses with the data, and what you'd like to see. We'd like to hear from you!' Below this, the interface is split into two main sections: 'AIR QUALITY' (Population-weighted concentration) and 'HEALTH IMPACT' (Burden on your health). The 'AIR QUALITY' section has a 'Select Pollutant' dropdown set to 'Ambient particulate matter pollution', a 'Choose a country' dropdown set to 'Afghanistan', and 'Compare to other regions' options including 'Select comparison region' (set to 'GBD Regions') and 'Select comparison sub-region' (set to 'North Africa and Middle East'). The 'HEALTH IMPACT' section features a 'Plots' tab with sub-options for 'Plots', 'Maps', and 'Tables'. Two line graphs are displayed: 'Average Annual Population-Weighted PM_{2.5} in Afghanistan' and 'Average Annual Population-Weighted PM_{2.5}'. Both graphs show data from 1990 to 2015. The Afghanistan graph shows a single line with a red dot at 2005. The second graph shows multiple lines for different regions, with a red dot at 2005. A legend at the bottom left of the graphs says 'Add global means'. At the bottom right, there is a small text block: 'State of Global Air 2017. HEI, 2017. www.stateofglobalair.org. Data source: Global Burden of Disease Study 2015. IHME, 2016. (Accessed 02/21/2017). Materials produced by HEI are freely available for downloading, printing, and distribution without alteration, provided that HEI is credited as the source.'

NASA Air Quality

<https://airquality.gsfc.nasa.gov/>

The screenshot shows the NASA Air Quality website interface. At the top right, there are links for "AURA", "EOS Project", and "OZONE HOLE WATCH". The main header features the NASA logo and the text "Air Quality Observations from Space". A search bar is located on the right side of the header. Below the header is a navigation menu with tabs for "Home", "Data", "News", "Maps", "Publications", and "Resources". The main content area is titled "AIR QUALITY FROM SPACE" and contains a welcome message, a paragraph about nitrogen dioxide (NO₂), and a link to "Data". Below this is a section titled "Before and After: World Nitrogen Dioxide Levels, 2005-2014" with two world maps showing data. On the right side, there are two sidebar widgets: "Air Quality Data on the Top 20 US Cities" and "Air Quality for 195 World Cities", each with a map and a description.

AURA EOS Project OZONE HOLE WATCH

NASA Air Quality
Observations from Space

Search this site

Home Data News Maps Publications Resources

AIR QUALITY FROM SPACE

Welcome to the website! Currently, the website is devoted to one air pollutant, nitrogen dioxide (NO₂), which is unhealthy to breathe and a necessary ingredient for the formation of unhealthy levels of surface ozone, another important pollutant. Our intended audience is health and air quality managers, but there is a lot of content that will be of interest to many people, including plots of data for almost 200 world cities!

What is the air quality like in your city and country? Just click on the "Data" tab above and then "World Regions" to see.

Before and After: World Nitrogen Dioxide Levels, 2005-2014

The two world maps show nitrogen dioxide levels. The left map represents 2005 and the right map represents 2014. Both maps use a color scale from blue (low) to red (high). A double-headed arrow is positioned between the two maps, indicating a comparison or transition between the two time periods.

Air Quality Data on the Top 20 US Cities

Click above to quickly find recent data products and imagery for the Top 20 US Cities.

Air Quality for 195 World Cities

Click above to quickly find recent data products and imagery for the Top 195 World Cities.

NASA H-AQAST

<https://haqast.org>



NASA HEALTH AND AIR QUALITY APPLIED SCIENCES TEAM

Connecting NASA Data and Tools with Health and Air Quality Stakeholders

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RESOURCES ▾

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HAQAST 2

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applications.

Feb 27-Mar 1

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