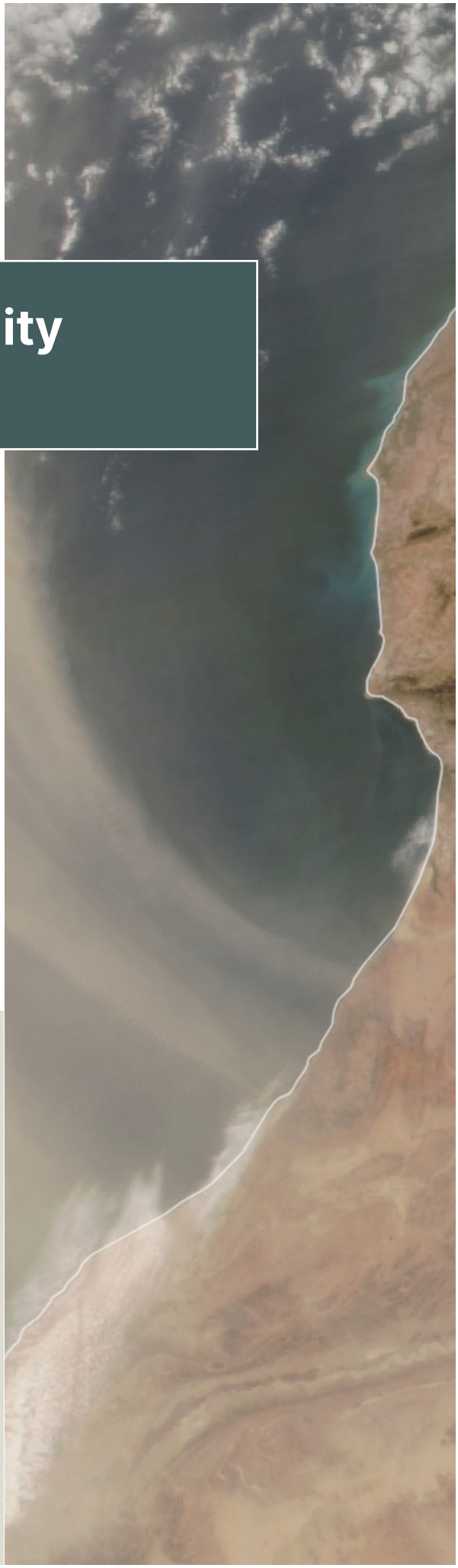
National Aeronautics and Space Administration

Training Resources: Air Quality Sensors and Forecasts



Summary

Air Quality Sensors and Forecasts is a Satellite Needs Working Group (SNWG) solution that aims to expand air quality networks, provide air quality forecast products for Pandora locations, and produce $PM_{2.5}$ forecasts for cities worldwide.

A number of training resources relevant to this solution are aggregated into five categories (specified below). For more information about this solution, visit the Air Quality Sensors and Forecasts webpage.

Table of Contents

Fundamentals of Remote Sensing

This category's resources provide an introduction to remote sensing techniques used to develop this solution.

What is Spectoscopy?	Article that provides an overview of spectroscopy, the measurement technique used by the solution's sensors: Pandora spectrometer system, AErosol RObotic NETwork (AERONET), and Clarity air quality sensors.
Spectroscopy and Remote Sensing (PDF download)	Learning module introducing the basic concepts in spectroscopy and remote sensing, for a better understanding of how the solution's sensors measure trace gases in the atmosphere to determine air quality.
Passive Instruments	The Pandora spectrometer and AERONET Sun photometers use passive remote sensing to measure trace gases and atmospheric aerosol properties respectively. This article provides an overview of passive remote sensors like these that are used to collect solution data.
Measuring Particulate Matter	Clarity sensors measure particulate matter concentration (e.g. $PM_{2.5}$) using laser light scattering. This article provides background information on particulate matter and how it is measured.

Missions and Instruments

This category's resources describe the missions and instruments used to develop this solution.

Pandora Project	The Pandora Project home page that provides links to other relevant resources including instrument hardware and geographical distribution, relevant research, and data product information and access.
Pandora Spectrometer System	NASA CASEI webpage for the Pandora Spectrometer System with details about the instrument, its airborne and field campaign involvement, and the data products generated from its campaign data collections.
AErosol RObotic NETwork (AERONET)	The home page for AERONET, a ground-based remote sensing aerosol network that is being expanded to additional locations in the U.S. and abroad as a part of this solution.
Clarity	Clarity $PM_{2.5}$ sensors will be co-located with Pandora sensors at select embassy locations. The Clarity home page provides access to more information about the company and their air quality monitoring technology.

Data Products and Descriptions

This category's resources describe the solution's resulting data products and provide other descriptive materials.

Air Quality Sensors and Forecasts: SNWG Solution Fact Sheet	SNWG solution fact sheet for the Air Quality Sensors and Forecasts solution that includes an overview of the solution, its scientific and societal benefit, and data specifications such as temporal coverage and spatial resolution.
Pandora Products	Webpage providing an overview of Pandora data products by retrieval type including NO_2, O_3, and HCHO.
Pandonia Global Network (PGN) Reports	Webpage providing technical documentation on data products, calibration and validation, instrument hardware, and more for the Pandonia Global Network (PGN), a network of Pandora sensors distributed globally to assist with satellite validation efforts.
GEOS-CF Model Data Access	Data access webpage for Goddard Earth Observing System Composition Forecast (GEOS-CF) datasets and documentation; data from distributed Pandora sensors will be integrated into this GEOS model as part of this solution.
GEOS-FP Data Products	Data access webpage for near real-time (NRT) data products from GEOS, conducted in a Forward Processing (FP) stream that generates forecasts and assimilation products using the most current system for NRT. GEOS-FP along with available $PM_{2.5}$ measurements will be used to provide consistent $PM_{2.5}$ forecasts at U.S. embassy locations and major global cities as part of this solution.

Data Access and Code Examples

This category's resources provide links to access the solution's data as well as open source code for using the data.

SNWG Air Quality Forecasts	Prototype for this solution's web portal where users can explore global air quality data by location and sensor type, providing forecasted air quality indices and daily averages.
PGN Pandora Data Visualizations	Interactive web portal with statistical data visualizations for PGN stations around the globe, selectable by date, trace gas (NO_2, O_3, SO_2, HCHO, H_2O), and measurement type (total column, tropospheric column, surface concentration). *Note: best viewed in Microsoft Edge, Mozilla Firefox, or Apple Safari*
PGN Data Portal	Data access portal for PGN Pandora station data where the data can be filtered by location, product type, and date.
AERONET Data Explorer	Data access portal for AERONET Sun photometer data, searchable by wavelength, site, processing time, and date via an interactive map.
Clarity OpenMap	Data access portal for Clarity sensor data where users can select a sensor site via an interactive map and view the U.S. air quality index for that location.

Use Case and Application Examples

This category's resources provide examples of the solution in-use as well as other potential scientific applications of the data.

Evaluating Sentinel-5P TROPOMI tropospheric NO_2 column densities with airborne and Pandora spectrometers near New York City and Long Island Sound	Publication describing the use of Pandora spectrometers to measure tropospheric column NO_2 for the evaluation of Sentinel-5P TROPOMI NO_2 products during the Long Island Sound Tropospheric Ozone Study (LISTOS).
The first evaluation of formaldehyde column observations by improved Pandora spectrometers during the KORUS-AQ field study	Publication describing the use of Pandora spectrometers for formaldehyde observations during the Korea–United States Air Quality Study (KORUS-AQ).
Using networked Pandora observations to capture spatiotemporal changes in total column ozone associated with stratosphere-to-troposphere transport	Publication describing the use of PGN Pandora systems for total column ozone observations.
Sulfur dioxide (SO_2) vertical column density measurements by Pandora spectrometer over the Canadian oil sands	Article describing the use and analysis of sulfur dioxide vertical column densities retrieved by the Pandora spectral Sun photometer in Fort McKay, Alberta, Canada, from 2013 to 2015.

Clarity Customer Stories	A series of air quality monitoring use cases involving Clarity sensors including the installation of air quality monitoring networks in Boulder, Colorado to protect residents from wildfire smoke, in Broward County, Florida to engage students in air quality research, and in London, England to improve air quality conditions throughout the city.
AERONET Publications	List of publications describing the use of AERONET sensor networks for atmospheric and environmental observations. Includes research on black and brown carbon in smoke, aerosol optical and physical properties in forest fires, and sea salt aerosols in marine atmospheres.

Contact Information

Need additional help using this solution? Let us know what gaps or questions still exist, what tools interest you, and/or how you want to apply this solution. We are happy to connect you with more information and ongoing efforts to fill those gaps. Contact us at info@snwg-impact.net.