# Air Quality Forecasts and Distributed Pandora Sensors

Satellite Needs Working Group - Solution Fact Sheet

Effectively predicting key air quality parameters and their impact on human health require a combined approach leveraging models, ground-based data, and Earth observations. To meet these needs, the Satellite Needs Working Group (SNWG) supports an Air Quality Forecasts and Distributed Pandora Sensors solution. This 3-component solution will expand the Pandonia Global Network (PGN) of trace gas measurements and produce forecasts (including $PM_{2.5}$) for enhanced air quality monitoring:

- **Additional Pandora sites.** The PGN will be expanded to provide data in under-represented locations (10 in rural U.S. locations, and 10 at foreign U.S. embassies in regions with high levels of air pollution).

- **Air quality forecast products for Pandora locations.** NASA's Global Modeling and Assimilation Office (GMAO) will integrate Pandora observations with modeling output to obtain tailored air quality forecasts at Pandora locations.

- **$PM_{2.5}$ forecasts for cities worldwide.** The City Air quality foREcasting and analysis System (CARES) will use machine learning, ground-based observations, and NASA's Goddard Earth Observing System-forward processing (GEOS-FP) model output to provide consistent $PM_{2.5}$ forecasts at U.S. embassy locations and major global cities.
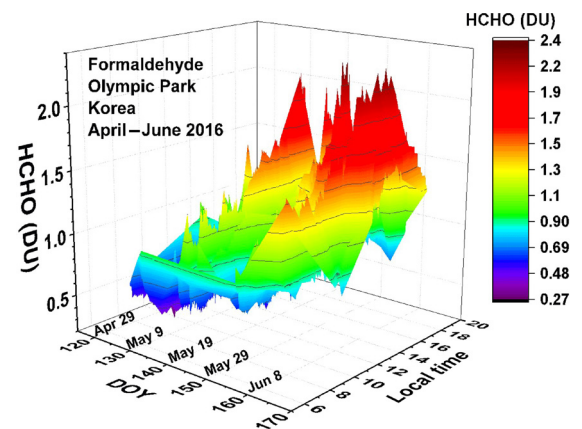
The figure (above) shows Pandora-measured formaldehyde amounts in Olympic Park, Korea from April to June 2016 at local times. Measurements of formaldehyde and other trace gasses will now be available in data-sparse regions as well as existing sites.
Credit: Jay Herman et al., 2018

Societal Benefit

- Support air quality monitoring for 20 additional locations in the rural U.S. and around the globe that currently lack ground observations

- Provide localized air quality forecasts at any Pandora site to better mitigate human exposure to harmful air pollution

- Initiate a long-term record of data collection at 20 new sites for historical analyses of trace gas concentrations

- Provide $PM_{2.5}$ forecasts, up to 72 hours in advance, to monitor and anticipate the amount of fine particulate matter near the surface

- Support validation for emissions and air quality monitoring satellite platforms at additional sites through the expansion of the Pandora network

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Air Quality Forecasts and Distributed Pandora Sensors

Solution Component	Pandora Sensors	GMAO Forecasts	PM$_{2.5}$ Forecasts
Input Source	Ground-based Pandora Spectrometer System	Ground-based Pandora Spectrometer System and GEOS Composition Forecast (GEOS-CF) model output	GEOS-FP, VIIRS, and available PM$_{2.5}$ measurements
Output Variables	• Total column ozone, nitrogen dioxide, formaldehyde • Tropospheric profiles of nitrogen dioxide and formaldehyde • Ground level concentrations of nitrogen dioxide and formaldehyde	Total column and surface ozone, nitrogen dioxide, formaldehyde	• Surface PM$_{2.5}$ concentration • U.S. EPA-defined Air Quality Index
Processing Level	2	4	4
Temporal Coverage	Dependent on sensor installation	January 2019 - TBD	May 2024 - present
Temporal Sampling	Hourly	Hourly	3-hour forecasts up to 72 hours in advance, updated daily
Latency	1 hour	Forecasts available NRT, historical data available with 24 hours latency	~2-4 hours (dependent on GEOS-FP latency)
Spatial Coverage	Select U.S. embassies (10) and agricultural sites (10)	Select U.S. embassies (10) and agricultural sites (10) with plans to scale to all operational Pandora Sensor locations	Select U.S. embassies (270) and cities (10,000+)
Spatial resolution	Point locations	Point locations	Point locations
Data format	Text files, HDF5	Text files, JSON files	ASCII (available via API)

How do I access this data?

Data for Pandora sensors in the PGN will be available through the PGN site. PM$_{2.5}$ forecasts for cities with a U.S. diplomatic mission are available through the U.S. State Department's ZephAir application. GMAO forecasts are not yet available.

Pandonia Global Network

ZephAir Air Quality Forecasts

Where can I find more information?

More information on Air Quality Forecasts and Distributed Pandora Sensors is available on this solution's webpage and the official Pandora Project website.

Air Quality/Pandora Webpage

Pandora Project

Background Image Credit: NASA Earth Observatory

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