**Applying Advanced Earth Science Data for Aiding Air Quality Forecasting and Management Decisions**

Over the next couple of years, a new era of advanced remote sensing instruments, including a constellation of geostationary spectrometers, will drastically increase our capabilities to monitor, forecast, and track trends of air pollutants across the globe. In an effort to prepare for the upcoming launch of the NASA Tropospheric Emissions: Monitoring of Pollution (TEMPO) spectrometer in 2022, which will observe hourly daytime trace gases and aerosols over Greater North America, a large increase in the number of NASA Pandora ground-based sites is expected across the U.S. The trace gas measurements from Pandora will complement the high-resolution ozone (O3) and aerosol profiles from the existing Tropospheric Ozone Lidar Network (TOLNet) at several locations across the U.S., and the thousands of long-term ground-based, EPA-certified reference or equivalent monitors operated by state, local, and tribal air quality agencies and reported to the national Air Quality System (AQS) and AirNow. These air quality agencies also prepare emission inventories used to assess trends and further regulate pollution; as well as assessing emission reduction targets and trends with photochemical grid modeling, usually for larger metropolitan areas, states, and at the western regional level. Although the research community is generally well-equipped to adapt to the new era of remote sensing data for aiding scientific studies, there exists a glaring gap between advanced Earth Science data and routine evaluation and application by air quality agencies in formats that facilitate use of the data in a reproducible fashion; which will continue to grow due to the complexity and size of new remote sensing datasets. However, it is critical that the new datasets are effectively utilized by air quality agencies as the high-quality observations can be used confidently in forecasting and management decisions under the federal Clean Air Act and the states’ authorities. This proposed project will employ a unique research to operations (R2O) / operations to research (O2R) paradigm for transitioning TEMPO, Pandora, and TOLNet data to key stakeholders in the western U.S. to improve air quality forecasting and management decisions.

During the pre-launch phase of the TEMPO mission, this project will focus on transitioning Pandora and TOLNet data along with pertinent trace gas and aerosol products from the European Space Agency’s (ESA) TROPOspheric Monitoring Instrument (TROPOMI). These data products will be incorporated into exceptional event analyses, including wildfires, prescribed fires, and stratospheric intrusions, and other air quality exceedance events involving multi-pollutant sources and complex chemistry to assess the benefit of applying advanced remote sensing data in decisions affecting the attainment or maintenance status for the air quality health standards of the area represented by the monitor under the Clean Air Act. We will also evaluate the use of the new data products on the forecast decision-making process by integrating the data into retrospective studies. This process will involve a critical assessment of the standard data files provided by accessible Pandora, TOLNet, and TROPOMI data interfaces. We will make necessary refinements to the files to ensure that the advanced data can be incorporated into the unique decision support systems of the end users. For the candidate air quality events, an assessment of synthetic TEMPO data products will be conducted to evaluate the potential advantages and limitations of future operational TEMPO data in the western region, which will provide the foundation for creating target product training. Based on end user feedback, we will also generate tailored synthetic TEMPO files to prepare end user systems for operational TEMPO data.

Once operational TEMPO data products become publicly available after launch in 2022, this project will focus on the immediate use of the suite of advanced remote sensing datasets (Pandora, TOLNet, and TROPOMI data) for assessing further improvements from the synthetic TEMPO data to improve air quality forecasting by a variety of users. Equally important, this project will set up and document the protocols, procedures, and identify the operational resources needed to facilitate routine use of the advanced remote sensing data in a reproducible fashion. This is not currently or consistently done, and is necessary to accomplish the full use of these advanced remote sensing data for the most robust regular analysis of all source impacts and the associated air quality evaluation and trend tracking in the western U.S region. The benefit of having a systematic stable platform designed to use advanced remote sensing data such as those from TEMPO in air quality trend tracking, exceedance and transport analyses, and forecasting will be closely evaluated for user value and operational resource support availability, which will include a robust product assessment and targeted training. We will also diagnose the added value of using high-time experimental TEMPO data in conjunction with available Pandora and TOLNet data for retrospective analyses and forecasting applications, such as monitoring pollution transport during upslope flows in areas of the Intermountain West.

**The goal of this project is to increase the Applications Readiness Level (ARL) of advanced remote sensing datasets in an effort to reduce the current gap between Earth Science data and air quality forecasting and regulatory agencies.**