Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument is a NASA mission with an expected launch date of 2020 or 2021.

To be hosted on geostationary communications satellite to maintain constant view of North America.

East to West scan over Field of regard (FoR) will be completed every daily hour.

Grating spectrometer will measure backscattered radiance in UV (290-490 nm) and visible (540-740 nm) with spectral resolution of 0.6 and 0.2 nm.

Capability to retrieve aerosol/cloud parameters and major elements in O3 chemistry cycle (O3, NOx, SO2, H2O, OH, CO, CH4, O3), plus H2O and UVB.

Multi-spectral capabilities will help distinguish between boundary layer and free tropospheric and stratospheric O3.

Air-quality monitoring at sub-urban scales due to high spatial resolution (2.1 km in N-S, 4.7 km in E-W at center of FoR).

Unprecedented capabilities of TEMPO will help effectively monitor the rapidly varying emissions and chemistry that governs our air-quality conditions.

Data Products and Display

- O3 profiles, tropospheric O3 based on eXel optimal-estimation method used for GOME and OMI.
- Method may be extended to SO2, especially volcanic SO2.
- TOMS-type O3 retrieval included for heritage.
- OMI heritage aerosol/cloud products: AOD, AAD, Aerosol Index, Cloud Top Fraction, Cloud Top Pressure.
- Development of advanced/improved aerosol/cloud products.
- Research products: UVB (OMI heritage) and city lights.
- TEMPO will use EPA’s Remote Sensing Information Gateway (RSIG) for subsetting, visualization, and product distribution.

TEMPO benefits:

- High spatial resolution will allow evaluation of temporal variations, spatial mapping, and sector-specific emissions.
- Ability to resolve urban emissions and chemistry and monitor these complex source regions.
- Characterization of emissions from evolving sources, such as oil, natural-gas basins, and fires.
- Much improved emission inventories, which will help assess control strategies.
- Internationally integrated observatory strategy employing complementary approaches between geostationary spectrometers will help improve emission estimates at common confidence levels over the Northern Hemisphere and air quality assimilation systems and forecasts.

TEMPO Early Adopters in Air-Quality Forecasting, Planning and Assessment, Pollution Emissions, Health, Agriculture, and Environmental Impacts: Applications and Decision Support

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Background

Air Quality Forecasting

- Previous research has shown large, positive impact of assimilating aerosol information from geostationary sensors.
- Surface concentrations, especially O3, NOx, and PM2.5, and emissions at high spatial resolution from TEMPO will be very beneficial for air-quality forecasting.
- The suite of hourly aerosol and atmospheric composition data products from TEMPO will help resolve the large data gap issues in ground-based networks in the U.S.
- High spatial and temporal resolution of TEMPO will be valuable for regions of complex meteorological flows (i.e., mountain/valley flows, lake/sea breeze circulations.)
- Synergy between TEMPO and GOES-R will be critical for wildfires, lightning NOx, volcanic ash, and aerosol/cloud interaction forecasting.

Pollution Emissions

- TEMPO measurements will significantly improve the estimations of background air quality levels, which have been increasingly focused due to the more stringent ambient air standards.
- The unique TEMPO measurements will enhance our ability to capture the diurnal changes in air quality concentrations, improve our understanding of the weekday and weekend differences in NOx columns, and help better identify and define exceptional events.
- TEMPO data can be used for rigorous model evaluation activities, and for improving data assimilation and air-quality forecasting.

The aircraft measurements clearly reveal the poor performance of the CMAC model during this high NOx transport event. The availability of TEMPO NOx will allow for similar model evaluation practices with nearly continuous measurements.

Planning and Assessment

- TEMPO data will provide detailed information about air quality and health effects.
- The high temporal resolution, expected accuracy, and spatial coverage of TEMPO data will benefit acute health-effect studies (e.g., asthma events linked to pollution) of PM2.5, O3, and NOx.
- TEMPO’s expected life is too limited to be appropriate for studying chronic effects (e.g., heart attacks linked to long-term exposure).
- TEMPO’s spatial resolution is not adequate for studying the acute health effects of NO2 – need oversampling methods to improve its spatial resolution.
- TEMPO retrievals must be converted to ground concentrations for studying the acute health effects from pollutants.

Agriculture and Environment

- TEMPO data will help quantitative understanding of local crop yield losses, along with spatial and inter-annual variability in losses, and for identifying regions where use of O3 resistant cultivars is valuable.
- TEMPO NOx measurements can be used to characterize emissions from fertilizer applied to agricultural fields, which will facilitate assessments of the potential benefits of improved nitrogen use efficiency in fertilizer application for surface O3 concentrations.

Health

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TOLEn, an international (USA and Canada) and interagency (NASA, NOAA, university) ozone- lidar observation network, provides highly time-resolved (few minutes) tropospheric-ozone vertical profiles for TEMPO validation and science.

Credit: Jim Szykman (EPA).

Gold: TEMPO’s NOx column in the morning a hour after 2 August 2014 over the Denver/Boulder areas. Preliminary data: C. Nowlan, SAO.

Approximate coverage of geostationary spectrometers with expected launch dates of 2018-2020.

Mike Newchurch: mike@nsstc.uah.edu Poster# PA33B-2240, Wednesday, 14 December 2016 13:40 - 18:00 Moscone South-Poster Hall, AGU Fall Meeting, 12-16 December 2016, San Francisco, CA, USA.