Application of Synthetic TEMPO Products to Investigate Air Quality Impacts on Community-Level Public Health

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HAQAST5 meeting
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• Hourly daylight measurements from TEMPO will effectively monitor the air quality conditions over North America.

• Monitoring will be accomplished at sub-urban scales due to spatial resolution of 2.1 x 4.7 km.

• Multi-spectral capabilities (ultraviolet & visible channels) will help distinguish between BL, free tropospheric, and stratospheric O₃.
OMI vs TEMPO resolution

- Current spatial resolution of satellite sensors are too coarse for resolving emission source regions
- TEMPO’s high spatial resolution will lead to a drastic improvement in monitoring emission source regions

Valin et al. (ACP, 2011)
OMI vs TEMPO resolution

TEMPO’s high spatial resolution will allow it to resolve emission sources, including urban areas.

TEMPO will provide constraints on inventory emission magnitudes, spatial allocation, and possibly even sector partitioning.

Zhu et al. (Environ. Res. Lett., 2014)
• Quality of TEMPO data will be similar to GeoTASO, albeit with lower spatial resolution than the 250 x 250 m² pixel size of GeoTASO

• NO₂ slant columns from TEMPO data will be able to monitor the rapidly varying emissions from source regions across North America
• Synthetic TEMPO observations generated using simulated gaseous and aerosol composition from GEOS-NR
• GEOS-NR spatial resolution of \( \sim 12 \times 12 \text{ km}^2 \) spatiotemporally interpolated to finer TEMPO grid
• Profiles and vertical column amounts of species obtained from interpolation

Zhu et al. (ACP, 2016)
NO\textsubscript{2} columns modeled at approximate TEMPO resolution
NO$_2$ columns throughout the diurnal cycle
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NO$_2$ columns throughout the diurnal cycle
NO₂ columns throughout the diurnal cycle
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NO₂ columns throughout the diurnal cycle
NO$_2$ columns throughout the diurnal cycle

![Map showing NO$_2$ columns at 23 UTC]
• Utilize TEMPO synthetic data from a “dirty” and “clean” month for assessing the impact of AQ on health and hospital readmissions over northern Alabama.

• Regrid fine-scale TEMPO data onto a zip code level map for a direct comparison to the hospital data.

• Perform a statistical analysis between the hospital data and hourly NO$_2$, O$_3$, CH$_2$O, and AOD from TEMPO to understand significant relationships between the satellite and health data.

• Assess current operational satellite AQ data (OMI, OMPS, GOES-16, MODIS) to fully realize the benefits for using TEMPO data for health studies.
Smoke transport over North Alabama in Aug 2013

Clean conditions over North Alabama in Oct 2013

NASA Worldview
Over the past 15 years, SPoRT has successfully transitioned unique observations from more than 40 satellite datasets to operational end users.

Established research-to-operations/operations-to-research paradigm that engages in solving specific forecast problems.

SPoRT plans to use this successful approach to prepare the user community for TEMPO data.

Plan to host a TEMPO Early Adopters site.

[Diagram showing the cycle of consultation, sustain use in operations, identify forecast problem, match to research product, develop solution, provide training, integrate data, assess impact, revise product, and solve problem.]

[Website Link: https://weather.msfc.nasa.gov/sport/]

[SPoRT Logo]