

EGU24-14053, updated on 15 Aug 2024  
<https://doi.org/10.5194/egusphere-egu24-14053>  
EGU General Assembly 2024  
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## Overview of Airborne Field Campaigns under TEMPO for Calibration and Validation of Trace Gas and Aerosol Products

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The North American component of the Geo-Ring for Air Quality, the Tropospheric Emissions: Monitoring of Pollution (TEMPO) instrument, began collecting measurements on August 2, 2023. Multiple airborne field-intensives were conducted over the US during this TEMPO first-light period, including the NOAA Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas (AEROMMA) and Coastal Urban Plume Dynamics Study (CUPiDS) campaigns, coordinated with the NASA Synergistic TEMPO Air Quality Sciences (STAQS) campaign. The North American cities targeted included New York City, Los Angeles, Chicago, and Toronto. Here, we present an overview of the AEROMMA / CUPiDS collected summer 2023 datasets, relevant for calibration and validation activities of TEMPO, including for ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), formaldehyde (CH<sub>2</sub>O), sulfur dioxide (SO<sub>2</sub>), aerosol optical depth (AOD), and aerosol layer height (ALH). Ground-based lidar and airborne in-situ vertical profiling by the NASA DC-8 and NOAA Twin Otter aircraft are available for evaluating TEMPO Level 2 O<sub>3</sub> profile products (tropospheric and 0-2 km column retrievals). Airborne measurements of NO<sub>2</sub> (photolytic conversion of NO<sub>2</sub> into NO followed by laser-induced fluorescence, cavity enhanced spectroscopy, and multi-axis differential optical absorption spectroscopy (MAX-DOAS)) are available for evaluating TEMPO Level 2 NO<sub>2</sub> vertical column density products. Airborne measurements of formaldehyde and glyoxal (in-situ and MAX-DOAS remote sensing) can be evaluated similarly as other volatile organic compounds (VOCs). Lastly, a wide array of aircraft-based in-situ measurements of composition, size distribution, optical properties can be utilized to derive aerosol optical depth (AOD) and aerosol extinction profiles for evaluating TEMPO AOD and ALH products, along with TROPOMI and stereoscopic aerosol layer height products from GOES-16/18. Preliminary evaluation of TEMPO NO<sub>2</sub> will be presented as an initial calibration / validation test case, employing best practices to facilitate direct comparisons between airborne data with TEMPO Level 2 observations.

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