AEROMMA:

Atmospheric Emissions and Reactions Observed from Megacities to Marine Areas

July 2023

A comprehensive study led by
NOAA's Chemical Sciences Laboratory
investigating anthropogenic and marine emissions that alter tropospheric composition and impact air quality and climate

The AEROMMA campaign brings together airborne, ground, and satellite observing systems, and state-of-the-art air quality and climate models, to investigate emerging research needs in:

- urban air quality
- marine emissions
- climate change
- atmospheric interactions at the marine-urban interface
- satellite-based observations of atmospheric composition

AEROMMA expands upon recent NOAA research findings to improve our understanding of air pollution in a changing environment

Anticipated outcomes:

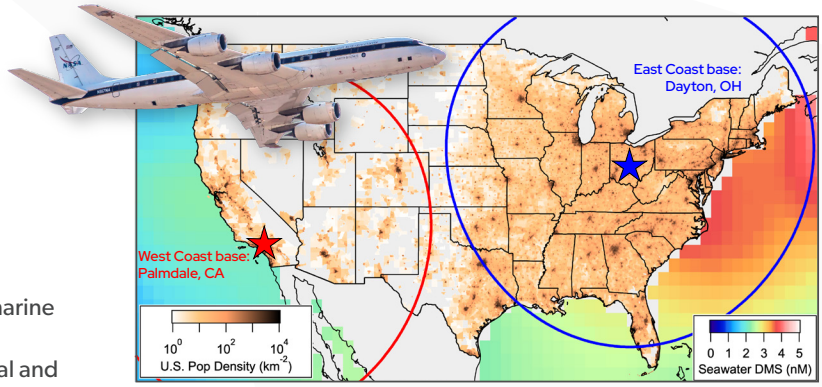
» Quantification of emissions (including VOCs and NO_x) that lead to ozone and fine particulates (PM2.5)

» Assessment of emissions recovery following the COVID-19 economic slowdown

» Reduction of uncertainties in global climate models due to marine aerosols formed by natural ocean sulfur emissions

» Improvement in the representation of emissions and chemical and physical processes in the next generation NOAA weather-chemistry and air quality forecasting models

» Comprehensive measurements for validating TEMPO and JPSS satellite observations and proof-of-concept testing for NOAA's planed next-gen GeoXO satellite



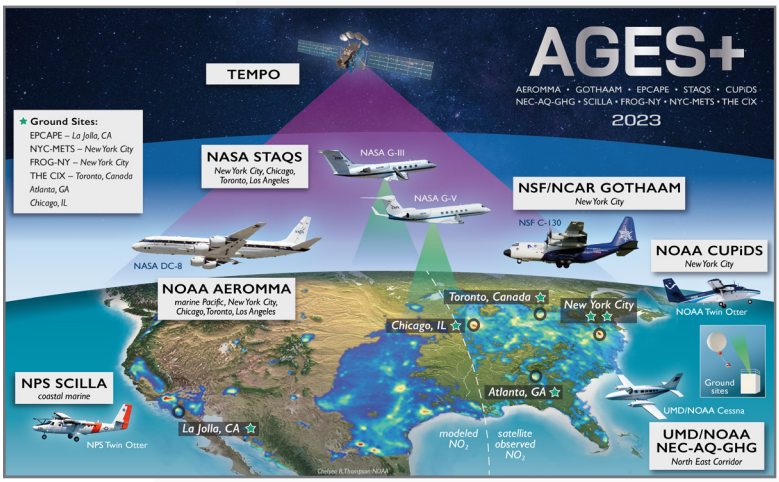
AEROMMA is using the extensively instrumented NASA DC-8 research aircraft for a series of flights in May – August 2023. The aircraft will base in California and Ohio to access several major coastal and inland cities and two ocean basins. The DC-8 flight range is indicated as rings on the above map. Oceans are colored by dimethyl sulfide (DMS), the primary sulfur compound emitted from oceans.

AGES+ Coordinating Activities

AEROMMA is NOAA's flagship field campaign within the greater AGES+ network of collaborative, coordinated projects occuring in the summer of 2023.

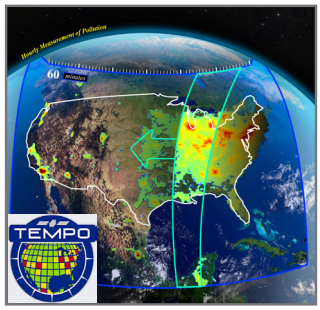
Collectively, the AGES+ campaigns represent the largest air quality-focused research campaign to date, spanning coast-to-coast, and encompassing hyperlocal ground-based observations, a network of instrumented ground sites, several NOAA and NASA research aircraft, and space-based observations from NOAA JPSS and the recently launched NASA TEMPO geostationary satellite.

The New York City metropolitan area is a key nexus for the AGES+ projects. The Coastal Urban Plume Dynamics Study (CUPiDS) on-board the NOAA Twin Otter is using Long Island as an operating base, and several NOAA CPO-funded ground sites and NASA Pandora and TOLNet ground sites are situated around the region. Street-level measurements will also take place within NYC to assess disparities in exposure to air pollution.



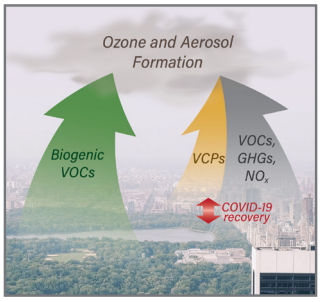
Project Sponsors

NOAA Chemical Sciences Laboratory (CSL)
NOAA National Environmental Satellite, Data, and Information Service (NESDIS)
NOAA Climate Program Office, Atmospheric Chemistry, Carbon Cycle, and Climate (AC4)
NOAA Earth's Radiation Budget
NOAA/CU Cooperative Institute for Research in Environmental Sciences (CIRES)
NASA Science Mission Directorate
EPA, NIST, and ECCC (ground sites)



AEROMMA observations validate new technology for space-based observations of atmospheric composition

AEROMMA provides observations for evaluating the NASA Tropospheric Emissions Monitoring of Pollution (TEMPO) and NOAA Joint Polar Satellite System (JPSS) trace gas and aerosol products, and informs the future NOAA Geostationary Extended Observations (GeoXO) constellation. AEROMMA observations evaluate NOAA's next generation weather-chemistry models and chemical data assimilation of atmospheric composition satellite data.

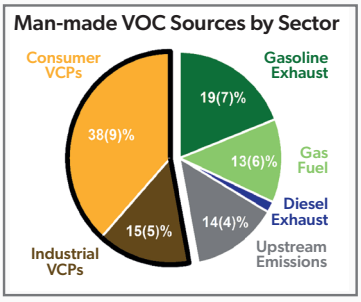


VOCs = volatile organic compounds
GHGs = greenhouse gases

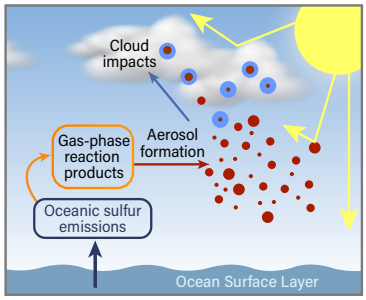
NOAA research identified volatile chemical products (VCPs) as a major source of man-made emissions in urban areas that contribute to ozone and PM2.5

Volatile chemical products (VCPs) include personal care products, cleaning agents, coatings and paints, adhesives, and insecticides. In some densely populated urban areas, VCPs are a larger source of volatile organic compounds (VOCs) than motor vehicle tailpipe exhaust.

VOCs (including VCPs) contribute to ground-level ozone and PM2.5, which are hazardous air pollutants that lead to 100,000+ premature deaths and $1T in damages annually in the U.S.



Data from Los Angeles. McDonald et al., 2018



A recent NOAA discovery redefined the marine sulfur cycle, prompting a renewed look at oceanic sulfur impacts on climate

Ocean-emitted sulfur, primarily dimethyl sulfide (DMS), reacts in the air to produce sulfate aerosol particles. These aerosols are important for global climate because they can act to form marine clouds and/or brighten existing marine clouds that reflect incoming sunlight. Oceanic sulfur is also an important natural source of sulfate aerosols to the stratosphere. Stratospheric sulfate aerosols reflect sunlight and have a cooling effect on the planet.

CSL's discovery of an additional DMS oxidation product (HPMTF) shows that the marine sulfur cycle in current climate models is incomplete *(Veres et al., 2020)*.

Resources for more information

NOAA CSL homepage

AEROMMA campaign homepage

AGES+ Coordinating Activities

Coastal Urban Plume Dynamics Study (CUPiDS)

NYC Air (Ine)Quality (NYC-AIQ)

NASA TEMPO instrument

NOAA's Operational Air Quality Forecasts

NOAA GeoXO Atmospheric Composition Instrument (ACX)

NOAA Joint Polar Satellite System (JPSS)

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