

## USGEO Program to Improve Air Quality Forecasts and Decision Support for Respiratory Health

### Description

Research and operational agencies in the United States, collaborating as members of the United States Group on Earth Observations (USGEO), are coordinating their actions and programs to related Earth observations technology to improve air quality forecasts that have respiratory health consequences. This contribution describes the early successes from this collaboration between NASA, EPA, NOAA, USGS, and CDC, among others.

The objective is to provide timely forecasts of severe environmental dust and aerosol episodes by assimilating Earth observations data into global weather models that currently do not include dust observations as part of the daily forecasts; and, to provide reliable two to three day forecasts of these episodes so public health authorities can intervene to reduce health affects that exacerbate respiratory and cardiovascular diseases. Another critical objective is to relate statistically the frequency and severity of air quality episodes with health outcomes from hospital records and patient complaints to better understand the epidemiology of human respiratory diseases. Methods include

1. retrieval of most recent satellite measurements of near-surface environmental conditions that control dust entrainment;
2. assimilating these measurements into dust forecast models embedded in operational weather models to replace earlier, outdated measurements of these properties; and
3. running the models with the refreshed data to obtain short-term forecasts of atmospheric dust loads and movements on time scales that are useful for public health actions.

Several types of surface and near-surface measurements are made routinely from satellites. Among the more useful for predicting dust entrainment in arid and semi-arid regions are the total area and distribution of dust sources as determined by the amount and distribution of vegetation cover; soil moisture at the surface; the timing, amounts, and patterns of rainfall; topography; and the speeds and directions of near surface wind. Results achieved from model runs indicate that replacing outdated land cover measurements with actual satellite observations of land cover improves the ability of the models to forecast when dust episodes will occur, and in some cases, the magnitude of the dust concentration. The impact of these early results has augmented the interest of local, regional, and national health authorities and air quality compliance agencies in the United States to include environmental conditions at the Earth's surface in daily weather forecasts. Moreover, it is expected that extending these forecast capabilities to include vertical profile measurements of smoke from fires and anthropogenic emissions from agricultural and industrial sources in the lower atmosphere will further improve air quality forecasts having health applications.

The program is executed through federally-funded research and applications projects. These include: Health & Environment Linked for Information Exchange (HELIX); Public Health Applications in Remote Sensing (PHAiRS); Geo-Medical Statistics (GeoMedStat); Public Health Air Surveillance Evaluation (PHASE); and the Environmental Public Health Tracking Network (EPHTN).

Specific health applications are aimed at understanding the epidemiology of asthma and myocardial infarction through tracking outcomes of populations at risk; improving decision support for health communities-of-practice; and linking exposures to health outcomes. To do this requires timely forecasts of aerosol and particulate concentrations as measured by satellite sensors and verified by in-situ monitoring networks.



## Added Value

GEO can aid these early achievements through its support of the Sand and Dust Storm Warning System being established by the UN World Meteorological Organization and by supporting the International Council for Science (ICSU) initiative on Science for Health and Well-being. To achieve this will require encouragement from GEO to stimulate interoperability among weather satellite data processing systems to achieve consistency and validity of forecasts. Improved forecasts of extreme dust and aerosol events will add to GEO's system-of-systems for both the air quality and human health Societal Benefit Areas. Finally, GEO can have a significant impact on the future of GEOSS abilities to identify and monitor major air quality events and the international transport of both dust and aerosols on a global scale.

National assets for in situ, airborne, and satellite sensor systems are synergized through multi-agency formalized in some cases with administrative memoranda of understandings. These are implemented in various ways by the funded projects to gain access to required data sets (e.g., EPA's AIRNow and Aeronet networks), processing algorithms (e.g., NASA sensor Science Team products), models (e.g., NOAA's NCEP and EPA's CMAQ), visualization technologies, and delivery mechanisms. Workshops are organized to bring air quality/public health project teams together to review cross-cutting developments, reinforce program goals and objectives, and reinforce communication between communities-of-practice. Sustainability is achieved by each agency's long term strategic plan, supported by the changing mix of projects awarded through competitive processes.

## Relevance to GEO

Early achievements demonstrate that timely forecasts of extreme dust events can be made for the American Southwest. The Northern Hemisphere is known, even if anecdotally, to be very dusty and polluted by a global, mid-latitude ring of unhealthy aerosols. In the 21st Century, the Northern Hemisphere is also being labeled as a breeding ground for emerging diseases. Some of these could begin as respiratory syndromes that if not monitored closely, could progress to pandemic status across the economically developed world. The threat of pandemics aside, the growing incidence of chronic respiratory diseases in any nation's general population takes its toll on the gross domestic product (GDP) and cost of rising health care needs. The evolving air quality/respiratory health system should be evaluated as a component of GEONETCast.

Contribution to 10-year plan:

- To be added

GEO Work Plan reference (SBA, Task, Target):

- SBA: Human health and well-being
- Task: HE-07-02 – Environment and Health Monitoring and Modeling

## Participants

Participating Organizations: USGEO (including NASA, EPA, NOAA, USGS, DOE); ISPRS (through working group participation on projects)

## Current Status and Next Steps

Long-term continuity depends on continued program funding as expressed in individual agencies' strategic plans; progress in developing products based on Earth observation inputs and modeling outputs; success in growing the communities of practice who will use the products; and demonstrated success linking air quality forecasts with related health outcomes, and socioeconomic benefits.

Gaps include missing data in satellite measurements, gaps in geographic coverage, sensor technology gaps, standards, and interoperability.