REQUEST FOR INFORMATION
Research That Falls in a Gap between current SMD Solicitations General Information:
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Applying Earth Science Data to Air Quality Management and Public Health Decisions

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Summary – NASA Interdivisional Applied Research Need

In response to the NASA Science Mission Directorate (SMD) solicitation on research that is aligned with the agency mission and SMD's Science Plan but falls in a gap between current solicitations, we present the following applied research activities to be executed as a Research Opportunities for Space and Earth Science (ROSES) project. Our team has tracked, responded to, and completed a number of ROSES elements over an extended period of time and do not see the integrated vision we propose here. The need for linking and integrating the Remote Sensing Community directly in an applied manner with Air Quality Regulatory Agencies has not been fully realized in the AQAST and HAQAST efforts; those were and are excellent programs to connect academic researchers with air quality regulators.

To improve and expand the use of remote sensing data by air quality regulatory agencies, more resources are needed for translating key scientific information from these datasets to the end user community. For 50 years, the regulatory agencies have been and continue to be required to employ an increasing suite of tools and data to assess air quality impacts and protect public health under the federal Clean Air Act and the states' authorities. Those routine and ongoing regulatory analyses are not integrated with remote sensing data in a manner that a typical regulatory agency can access and apply them. The current gap between remote sensing science data and air quality regulatory agencies will continue to grow due to the rapidly increasing complexity and size of new (e.g., GOES-16/17, TROPOMI, GLM, Pandora, TOLNet) and future (e.g., GEMS, TEMPO, MAIA, GeoCarb) remote sensing datasets. The advanced technology of these state-of-the-art instruments will permit high-quality measurements that can be confidently used in air quality management and planning decisions. To ensure that the enhanced capabilities of new remote sensing instruments are effectively utilized by air quality regulatory agencies, we need to design and combine training strategies and delivery systems familiar to regulatory agencies that integrate agencies' data with remote sensing data in usable formats and resolution, to better engage and enable these agencies for the large increase in volume of new science data. To date, significant resources have been provided for developing research to operations (R2O) / operations to research (O2R) infrastructures for the weather agencies, but a clear gap in infrastructure and applied integration continues to hinder the use of remote sensing data by air quality agencies.

The Three Elements of our Applied Research Project Design

1. Partnering Regulatory Agencies with Remote Sensing data for management and planning through application in existing and expanded web-based Data and Decision Support Systems.

   Existing Data and Decision Support Systems offer NASA a straightforward manner to integrate the immediately applicable Remote Sensing data addressing appropriate time/space/chemical species information in real-world applied air quality management and planning studies. As an example, WESTAR-WRAP leverages the CIRA Air Quality Data System at CSU to support and direct operations of the Technical Support System (TSS) and the Intermountain West Data Warehouse (IWDW). Those websites function to ingest, analyze, display, and re-distribute emissions and air quality data, at national and regional scales to support regulatory analysis by state, tribal, local and federal agencies' air quality management staff across the West. Similar structures to various degrees exist at the regional level in the Great Lakes, New England, Mid-Atlantic, and Southeastern U.S. regions. Regional and national subject matter experts from the regulatory agencies and other collaborators would be tasked thorough the TSS and IWDW, for example, to assist NASA and the Remote Sensing Community in understanding when and how completely Remote Sensing data, products, and knowledge, can be integrated into their required analysis processes, in the form of photochemical grid modeling platforms and associated data scenarios. A Regional Center approach enables efficient operations to tie together a variety of uses and regulatory planning heeds, and would return results usable for individual states and federal agencies, as we have done for more than a decade.

   The analysis needed to plan compliance with CAA health standards and welfare goals is necessarily multi-jurisdictional and broadly regional in nature, national analysis and solutions are often not applicable or possible. The regional assessment approach evaluates ground-based ambient air quality data, enables consistent and reproducible regulatory and scientific emissions inventories for all sectors, the transformation and analysis of the inventories to modeled emission fields, meteorological and other atmospheric data for modeling, and full-capacity regional photochemical models to provide one-atmosphere simulations of present and future air quality for management and planning purposes. The coincident alignment and resolution of data from the existing and emerging remote sensors, as well as how those data align with and confirm bottom-up data typically used by regulatory agencies, will be tested on regional basis. Feedback to remote sensing data delivery providers will then improve the content and format of data tiers and more fully implement those data. This approach would also allow staff from regulatory agencies to access and apply remote sensing data routinely to their specific agency's daily air pollution forecasting tools, exceptional events analyses, as well as the retrospective analyses with future projections studies required under the CAA. Our team is particularly interested in making TEMPO data work as the CAA requires of states with observed air quality problems, to mitigate with emissions controls and/or lessen or better manage exposure through improved forecasting.

2. Providing Support and Training to foster the interactions between the Remote Sensing Science Community and the data and tools used by Air Quality Regulatory Agency staff.

   As part of the regional center approach, the support and training activities would focus on the person on the air quality forecasting or analysis desk. Our team would develop materials and provide applied training of the real-world integrated bottom-up and remote sensing data. We

would build on the successful SPort paradigm discussed below with the delivery systems already provided by WESTAR-WRAP and other regional centers. Methodically this approach would involve, train, and push out regional analysis results for the thousands of people at regulatory agencies who touch and use air quality data every day. The proposed regional approach requires resources to build the structures needed to train users and integrate the universe of data from remote sensing, CAA analysis methods, and ground-based monitors. This work would bridge the NASA Divisions - Applied Sciences, Research and Analysis, and have strong interactions with and between NASA, NOAA, EPA offices, state and local air quality agencies, tribal organizations, federal land managers, and the remote sensing operations and data delivery groups.. This support and training effort would lower barriers, address problems and solutions, for NASA data processing to build and expand capacity beyond levels 2 and 3.

The NASA Short-term Prediction Research and Transition (SPoRT) Center developed a unique R2O / O2R paradigm for transitioning state-of-the-art satellite observations and research capabilities to end users to improve short-term forecasting and decision support. Since being established in 2002, the NASA SPoRT Center has successfully transitioned unique observations from more than 40 satellite datasets to operational end users. This paradigm emphasizes end user involvement and feedback through targeted assessments of data products, with the overarching goal of developing tailored data products and solutions based on forecast problems for sustained use in operations. The creation of focused training materials that address the advantages and limitations of data products is also key to the success of the paradigm. By actively engaging with end users, this paradigm has led to the introduction of experimental products in the operational environment, which has ultimately expanded the utility of NASA and NOAA satellite observations for decision-making. There is an immediate need to expand this type of R2O / O2R paradigm for effectively engaging with air quality agencies on how to best apply the new suite of remote sensing datasets for decision-making and planning activities. This must involve enhancing the relationships between the scientific community and tribal, local, state, and federal air quality management agencies in an effort to fully recognize pertinent air quality issues and data needs.

3. Developing a Healthcare Application that further integrates the data analysis results and tools from #1 and the relationships and research partners that emerge from #2.

The continuing exposure and health effects research results that suggest no safe level for health impacts from air pollution, even as the U.S. CAA regulations successfully and dramatically reduce emissions, requires the application of the data, tools, and relationships as described above. Our team would provide a healthcare application designed to engage a sector of potential users, to work with regulatory agencies to improve our understanding of the impact of airborne pollutants upon public health outcomes. The targeted engagement of this user group to access and use high spatiotemporal resolution data products in their applications, will promote interdisciplinary opportunities between traditional and applied research disciplines, and further expand use of geostationary remote sensing satellite products. To accomplish this objective, users will require that data be available at time and space scales suited for their research and clinical questions. Development of a computationally feasible platform, targeted for users with fewer resources and skillsets than those in traditional research and academic fields, with the capacity to quickly subset the data products by time/region/species would yield new understanding about the impacts of exceptional events and ambient air quality upon health in geographically discrete areas.