QUARTERLY HAQ PROJECT HIGHLIGHT:
### SATELLITE-AIDED REGIONAL DUST FORECASTING FOR VALLEY FEVER SURVEILLANCE, HIGHWAY ACCIDENT PREVENTION, AND AIR QUALITY MANAGEMENT IN THE SW UNITED STATES

Supported through a 2017 HAQ grant, **Daniel Tong (George Mason Univ.)** and his team have developed new satellite data assimilation (DA) algorithms to improve the nation's dust forecasting. The system is built upon the FENGSHA dust emission module, which was originally developed by Tong for the EPA's Community Multiscale Air Quality modeling system and augmented by the team with new DA capabilities for several satellite products, including MODIS BRDF/Albedo, MODIS/VIIRS AOD, MODIS/VIIRS NDVI, and GOES-16 dust mask. A version of the dust model has been adopted and modified by the NOAA Air Resources Laboratory and promoted to the National Air Quality Forecast Capability (NAQFC) operational forecasting by the National Weather Service in July 2021. The team works closely with more than 30 stakeholders from local, state, federal and international agencies on air quality, health, and transportation safety, and has helped establish the Dust Alliance for North America (DANA), an international initiative to accelerate transitioning dust sciences into services.
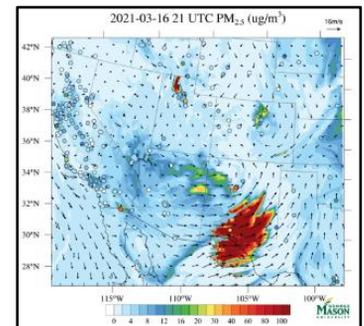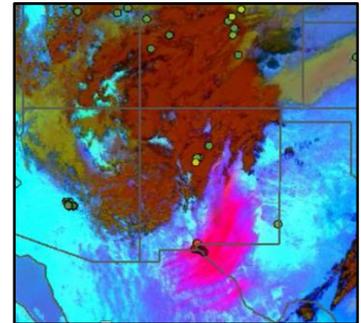
Dust mask (in pink) from GOES-16 (Top) and prediction of the March 16, 2022 dust storm in NM/TX (Bottom). Credits: NASA/D. Tong

NASA CELEBRATES EARTH DAY 2022: INVEST IN OUR PLANET

On April 22, 2022, the world celebrated the 52nd anniversary of **Earth Day**. NASA reflected on how the fleet of Earth-observing satellites examines our dynamic natural systems and effect of human activity on the planet's climate, atmosphere, land, and oceans. NASA invited the public to celebrate Earth Day by sharing connections to Earth through the social media campaign (#NASAEarthling), downloading Earth Day 2022 Posters in English and Spanish, participating in citizen science activities, and viewing Earth through NASA Worldview.
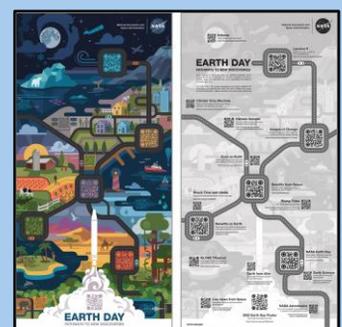
Credits: NASA

Earth Day 2022

HEALTH AND AIR QUALITY APPLICATIONS
APPLIED SCIENCES PROGRAM

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NATIONAL PUBLIC HEALTH WEEK 2022

In April 2022, **National Public Health Week (NPHW)**, which is supported by the American Public Health Association (APHA), highlighted the *Public Health is Where You Are* theme. The NASA HAQ and Communications Teams (**Aries Keck, Lia Poteet**) prepared a web feature, Monitoring Ozone and Tracking Red Tides, highlighting how NASA Earth observations can help inform local decision-making activities that protect community health. Project highlights included integrating US EPA (Air Quality System network) and NOAA (National Air Quality Forecast Capability) capabilities to enhance ozone mapping for city health (City Health Dashboard) (**Daniel Tong, George Mason Univ),** and incorporating Terra and Aqua data to develop algal bloom severity and respiratory irritation indices to offer insight to city managers on risk evaluation and interventions during algal blooms **(Richard Stumpf, NOAA)**.

NATIONAL MOSQUITO CONTROL AWARENESS WEEK 2022

In June 2022, the NASA HAQ and Communications **(Lia Poteet, Aries Keck, U.Group)** Teams prepared social media communications via NASA Earth Facebook/Twitter, to support the American Mosquito Control Association's National Mosquito Awareness Week 2022. Project highlights included monitoring and forecasting mosquito-transmitted diseases – chikungunya with CHIKRisk App globally **(Assaf Anyamba; USRA/NASA GSFC),** invasive mosquito species with VectorSurv in several US states **(Chris Barker, Univ. of California-Davis),** and West Nile virus with ArboMAP in South Dakota **(Michael Wimberly, Univ. of Oklahoma)** - and improving malaria decision support with DHIS2 **(John Beck, Univ. of Alabama in Huntsville).** Citizen science applications of GLOBE Program's Mosquito Habitat Mapper were showcased.

Credits: CDC

NASA HAQ INVESTIGATOR UPDATES

- ❑ **Susan Anenberg (George Washington Univ.):** She served as a panelist for the *Resources for Justice40, Equitable Deep Decarbonization, and Key Gaps* session at Advancing Energy Justice: Tools for Justice40 and Equitable Deep Decarbonization conference in May 2022.
- ❑ **Assaf Anyamba (UMBC/NASA GSFC):** He presented the talk, *Rift Valley Fever in East Africa: Modeling and Risk Prediction*, at the Exploring the Impact of Climate Change on the Global Food System meeting by the World Trade Organization in May 2022.
- ❑ **Helena Chapman (NASA HQ/BAH):** She served as a keynote, *Bridging Scientific Communities to Enhance Public Health Surveillance and Promote One Health Collaborations*, for the Univ. of Guelph's One Health and Development Symposium in May 2022.
- ❑ **Bryan Duncan, K. Emma Knowland, and Christopher Keller (NASA GSFC) and Kevin Cromar (NY Univ.):** They were interviewed for the NY Univ. article, To Breathe A Little Easier, Check the Air Quality Before Venturing Outside, in May 2022.
- ❑ **John Haynes (NASA HQ):** He presented an invited talk, *Monitoring Environmental Risks Using Earth Observations*, to 45 attendees of the Dust Alliance of North America (DANA) Webinar in May 2022.
- ❑ **Tracey Holloway (Univ. of Wisconsin-Madison), Yang Liu (Emory Univ.), Dan Goldberg (George Washington Univ.), and Laura Judd (NASA LaRC):** They presented on *Health Applications for Satellite-Derived Air Quality: Opportunities and Potential Pitfalls* workshops, organized by the Health Effects Institute.

NASA HAQ TEAM HOSTS SCIENTIFIC SESSION AT ATS 2022

At the American Thoracic Society (ATS) International Conference 2022, the NASA HAQ team coordinated a scientific session, *Integrating NASA Satellite Data in Cross-cutting Applications in Respiratory Health,* in San Francisco, CA. This session, moderated by **Helena Chapman (NASA HQ/BAH)** and **Laura Judd (NASA LaRC**), highlighted the NASA HAQ program, HAQAST team, and two NASA projects.

❑ Integrating Satellite Data to Examine Respiratory Health Risks: NASA Health and Air Quality Applications **(John Haynes, NASA HQ)**

❑ Satellite Data for Air Quality and Health **(Tracey Holloway, Univ. of Wisconsin-Madison)**

❑ From Space to the Street: Using Satellite Data to Address Inequities in Health Risks from Transportation-related Air Pollution **(Gaige Kerr, George Washington Univ.)**

❑ Experimental Air Quality Monitoring System for Saharan Dust to Improve Public Health in Puerto Rico **(Dan Otis, Univ. of South Florida)**
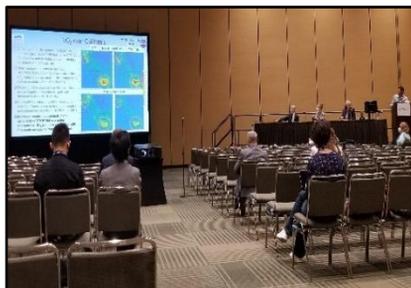
NASA session at ATS2023 (Left); A. Naeger (Middle) and A. Anyamba, M. Macmurdo, and H. Chapman (Right) present talks. Credits: ATS.

In complementary sessions, **Aaron Naeger (Univ. of Alabama in Huntsville)** presented the talk, *Can Satellite Data Help with the Assessment of Air Quality and COVID-19 Epidemiology?*, and **Assaf Anyamba (USRA/NASA Goddard)** offered insight with his *Modeling and Mapping Disease Risk* talk.

AWMA 2022 HIGHLIGHTS ENVIRONMENTAL JUSTICE APPLICATIONS

In June 2022, at the **Air & Waste Management Association (AWMA) Virtual Conference 2022**, the NASA HAQ Team coordinated the scientific session, *Satellite Perspectives on Environmental Justice)*, in San Francisco, CA. Moderated by **Laura Judd (NASA LaRC)** and **Helena Chapman (NASA HQ/BAH)**, **John Haynes (NASA HQ)**, **Qian Xiao (Univ. of Texas Health Sciences Center)**, **Gaige Kerr (George Washington Univ.)**, **Angelique Demetillo (Univ. of Virginia)**, and **Matthew Tejada (US EPA)** described examples of integrating satellite- and ground-based data for use in stakeholder activities related to quantifying environmental inequalities associated with artificial lights at night and

NASA session at AWMA2022. Credits: AWMA.

air pollution. Presenters highlighted knowledge gaps and presented the HAQAST Tiger Team on Environmental Justice and EPA Environmental Justice Screening and Mapping Tool to connect datasets with stakeholders' decision-making activities. More than 40 people attended this session. Also, **Aaron Naeger (Univ. of Alabama in Huntsville)** shared TEMPO updates, and **L. Judd (NASA LaRC)** presented on how column formaldehyde data can inform on ozone air quality using examples from field campaigns – both can enhance decision support applications related to air quality management.

NASA AIRATHON DATA CHALLENGE

In June 2022, the winners of the NASA Airathon: Predict Air Quality Challenge were announced! The Deputy Program Applications Leads of the NASA MAIA (**Abbey Nastan, Jet Propulsion Laboratory**) and TEMPO (**Aaron Naeger, Univ. of Alabama in Huntsville**) missions led the challenge, with collaboration from the U.S. Department of State, U.S. Environmental Protection Agency, and crowdsourcing platforms DrivenData and HeroX. The challenge drew more than 1,000 participants who used NASA satellite data, model outputs, and ground measurements to develop algorithms for estimating daily surface-level NO_2 and $PM_{2.5}$ at high spatial resolution. The successful challenge results will advance the science of estimating surface-level air pollutant concentrations using satellite data, with the overarching goal of guiding the development of more accurate air quality data products from the NASA MAIA and TEMPO missions.

Credits: NASA

EARLY ADOPTER ENGAGEMENT AT ANNUAL TEMPO MEETING

In June 2022, the TEMPO Mission Science Team and Early Adopters Program coordinated a three-day virtual meeting, which was attended by approximately 290 unique participants. Please visit the event webpage to view the recording and download the presentations.

❑ Day 1 focused on the TEMPO mission status, retrieval algorithm updates including novel ozone and aerosol algorithms, and the latest on the ground-breaking air pollution products from South Korea's GEMS mission.

❑ Day 2 covered validation planning, air quality modeling and forecasting, intensive field campaigns set for summer 2023 to complement TEMPO's on-orbit measurements, and in-flight operations of TEMPO with emphasis on the capabilities of special operations with rapid scans (e.g. ≤ 10 minutes) over portions of TEMPO's Field of Regard. Interactive poster sessions highlighted novel science applications (e.g., wildfire studies, emission characterization, canopy health, land and ocean characteristics) that will be enabled by TEMPO's observations.

❑ Day 3 consisted of panel and joint sessions with NASA HAQAST, with diverse groups of end-users and stakeholders to discuss how TEMPO data will advance air quality, health, and environmental justice applications, and further characterize data needs. Investigators discussed experiment ideas and needs for TEMPO's special operations, followed by a final session that provided details on TEMPO proxy data, download methods, and displaying data in ArcGIS.

TEMPO. Source: TEMPO website

GEO HEALTH COMMUNITY OF PRACTICE HOLDS MONTHLY TELECONS

The Group on Earth Observations (GEO) Health Community of Practice (CoP) – led by **John Haynes (NASA HQ)** and **Juli Trtanj (NOAA)** – continues to coordinate community teleconferences to leverage expertise across sectors and geographies and share Earth observation data and tools to support health decision-making. On average, 40 attendees participated in each telecon. Below is a synopsis of each meeting.

- ❑ April 2022: **Chandana Unnithan (UN COPUOS STSC Space and Global Health WG)** described a technology intervention that addressed the opioid crisis during the COVID-19 pandemic
- ❑ May 2022: **Krzysztof Knop (Wrocław Univ., Poland)** discussed his work on modeling the spread of avian influenza using geolocation data and machine learning techniques.
- ❑ June 2022: **Alex Schmid (LocationHealth, Switzerland)** highlighted LocationHealth, a GeoHealth startup that delivers spatial health information for real estate and travel. **Kamal Ramsingh (ZA SPACE, South Africa)** shared ongoing public-private partnerships to stimulate the development of small, medium, and micro-sized enterprises in the EO and Space Tech. **Juli Trtanj (NOAA)** and the **Heat Small Work Group** offered a debrief on the National Integrated Heat Health Information System (NIHHIS) National Meeting and shared ongoing activities of the Heat Small Work Group.

In continuation with the NASA-RPI Student Engagement, supported by GEO Health CoP members – from **Rensselaer Polytechnic Institute (Thilanka Munasinghe)** and **NASA (Assaf Anyamba, Heidi Tubbs, Bhaskar Bishnoi)** – **Ethan Joseph (RPI)** led the paper publication, *Scraping Unstructured Data to Explore the Relationship between Rainfall Anomalies and Vector-Borne Disease Outbreaks*, in the *2021 IEEE International Conference on Big Data (Big Data)*.

Notably, the Managing Health Risks with Earth Observations article was published on the GEO blog, highlighting the recent launch of the *Earth Observation, Public Health and One Health: Activities, Challenges and Opportunities* textbook. This textbook was edited by **Stéphanie Brazeau and Nicholas Ogden (Public Health Agency of Canada, Canada)**, with contributions and support from **Guy Aubé (Canadian Space Agency)** and other international experts.

AIR QUALITY AWARENESS WEEK 2022

In May 2022, the NASA HAQ and Communications **(Marissa Kunerth, U.Group)** Teams prepared social media communications via NASA Earth and Atmosphere Facebook and Twitter threads, to support Air Quality Awareness Week 2022. Topics included: Wildfires and Smoke (Monday), Asthma and Your Health (Tuesday), Citizen Science and Sensors (Wednesday), Environmental Justice and Air Quality (Thursday), and Air Quality around the World (Friday).

Social media posts on NASA Earth Twitter.

NASA HAQAST TEXAS MEETING

In June 2022, the NASA Health and Air Quality Applied Sciences Team (HAQAST), led by **Tracey Holloway (U. of Wisconsin, Madison)**, held the HAQAST Texas Meeting with the 14 HAQAST Principal Investigators, researchers, and stakeholders. The meeting engaged stakeholders on uses of Earth science information for environmental health and air quality. This event addressed Gulf Coast air quality, climate risks, health impacts of heat and artificial lights at night, and more environmental health topics. Notably, it occurred in conjunction with the 2022 TEMPO Science Team Meeting, helping to advance the early adoption of upcoming TEMPO data for new applications related to air pollution, health, and environmental justice. Overall, this HAQAST meeting engaged 295 people – 55 in-person and 240 virtually. For more information, please view the recordings.

Attendees at HAQAST Texas Meeting (Left); J. Haynes presents his HAQ talk (Right). Credits: NASA

HAQ COMMUNITY ENGAGEMENT

The NASA HAQ team (**John Haynes, NASA HQ; Helena Chapman, NASA HQ/BAH)** conducted webinars that introduced the HAQ program and key examples of using Earth observations for public health applications.

❑ **Morehouse College:** J. Haynes and H. Chapman presented an overview of the HAQ program and selected projects to 30 public health students.
❑ **Princeton Univ.:** H. Chapman presented an overview of selected NASA projects to 15 undergraduate students in a global health seminar course.
❑ **Illinois High Schools:** H. Chapman shared a career talk in the health sciences to 20 high school students.
❑ **NASA Earth Science Division:** H. Chapman presented an overview of the HAQ program and selected projects as part of the webinar series for 10 interns of the High School Senior Experience.

PACE APPLICATIONS FOCUS SESSION

In May 2022, the NASA Plankton, Aerosol, Cloud, ocean Ecosystem (PACE) Applications team, led by **Erin Urquhart** and **Natasha Sadoff (SSAI/NASA GSFC)**, coordinated the Air Quality & Applied Atmospheric Sciences Focus Session. This event offered presentations and roundtable discussions on future uses of PACE satellite data products to support research and applied sciences in the context of air quality and applied atmospheric sciences. Notably, **John Haynes (NASA HQ)** provided an overview of the HAQ program. For more information, please view the session recording.

Credits: PACE webpage

LOOKING AHEAD

ARSET Training:
Satellite Remote Sensing for Measuring Urban Heat Islands and Constructing Heat Vulnerability Indices
August 2-11, 2022

Virtual and Hybrid Meetings:
MAIA-TEMPO Environmental Justice Workshop
August 5, 2022

Earth Science Applications Week
August 9-11, 2022

AmeriGEO Week
August 15-19, 2022
Asunción, Paraguay

RECENT COMMUNICATIONS

NASA
- ❑ **NASA to Launch 6 Small Satellites to Monitor, Study Tropical Cyclones** (Sofie Bates, NASA's Earth Science News Team)
- ❑ **Five Questions to Help You Understand Hurricanes and Climate Change** (Roberto Molar Candanosa, NASA's Earth Science News Team)
- ❑ **NASA's ECOSTRESS Detects 'Heat Islands' in Extreme Indian Heat Wave** (Jane Lee and Andrew Wang, Jet Propulsion Laboratory)
- ❑ **Introducing NASA's NEW Earth System Observatory**

NASA Applied Sciences Program
- ❑ **NASA Earth Science Mission Applications Programs**
- ❑ **NASA Makes 'FireSense'** (Aries Keck, U.Group)
- ❑ **Enter the World of Earth Science through the Applications Guidebook** (Marissa Kunerth, U.Group)

NASA Earth Observatory
- ❑ **Early Season Heat Waves Strike India** (Sara Pratt)
- ❑ **Wildfires Scorch Northern New Mexico** (Michael Carlowicz)
- ❑ **Measuring War's Effect on a Global Breadbasket** (Adam Voiland)
- ❑ **Tracking Night Lights in Ukraine** (Michael Carlowicz)
- ❑ **How Aerosols Helped Untangle Carbon Monoxide Trends** (Adam Voiland)
- ❑ **A Global Decline in Carbon Monoxide** (Adam Voiland)

HAQ ANNUAL SUMMARY 2021

In April 2022, the NASA Applied Sciences Program disseminated the **NASA Health and Air Quality Applications Annual Summary 2021**. This report summarized major accomplishments, project portfolio milestones, community leadership, and international activities. It highlighted the achievements of the Health and Air Quality Applied Sciences Team (HAQAST) and four ongoing Earth Observations for Health (EO4HEALTH) projects of the GEO Work Programme 2020–2022.
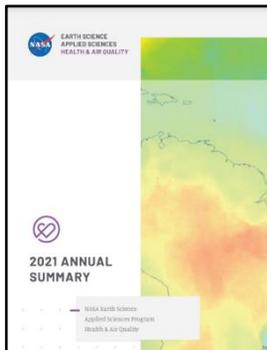
Credit: NASA

PAST

Meetings:

American Thoracic Society International Conference
May 12-18, 2022
San Francisco, CA

NASA HAQAST Texas
June 1-2, 2022
Houston, TX

Air & Waste Management Association's Annual Conference & Exposition
June 27-30, 2022
San Francisco, CA

ONE HEALTH IN THE NEWS

In March 2022, the One Health High-Level Expert Panel (OHHLEP) – with members of the Food and Agriculture Organization of the United Nations, World Organisation for Animal Health, the United Nations Environment Programme, and World Health Organization – published a summary of activities and accomplishments in the OHHLEP Annual Report 2021. In June 2022, they shared the new operational definition of One Health in *PLoS Pathogens*, which highlighted the Joint Tripartite Statement from December 2021.

PUBLICATIONS

Eyeing Visibility from Space: The Upcoming Multi-Angle Imager for Aerosols (MAIA) Investigation. *A&WMA EM Magazine*. (**A. Nastan**)

Cloud-based Applications for Accessing Satellite Earth Observations to Support Malaria Early Warning. *Scientific Data*. (**M.C. Wimberly**, D.M. Nekorchuk, R.R. Kankanala)

Are Opportunities to Apply Airborne Dust Research Being Missed? *Bulletin of the American Meteorological Society*. (W.A. Sprigg, T.E. Gill, **D.Q. Tong**, J. Li, L. Ren, R.S. Van Pelt)

Estimates of Ozone Concentrations and Attributable Mortality in Urban, Peri-urban and Rural Areas Worldwide in 2019. *Environmental Research Letters*. (D.A. Malashock, M.N. DeLang, J.S. Becker, M.L. Serre, J.J. West, K-L Chang, O.R Cooper, **S.C. Anenberg**)

Future PM2.5 Emissions from Metal Production to Meet Renewable Energy Demand. *Environmental Research Letters.* (S.D. Rathod, T.C. Bond, Z. Klimont, **J.R. Pierce**, et al)

Ambient Formaldehyde over the United States from Ground-Based (AQS) and Satellite (OMI) Observations. *Remote Sensing*. (P. Wang, **T. Holloway**, M. Bindl, et al)

The Association of Indoor Heat Exposure with Diabetes and Respiratory 9-1-1 Calls through Emergency Medical Dispatch and Services Documentation. *Environmental Research.* (**C.K. Uejio**, A. Patel Joiner, E. Gonsoroski, et al)

Can Column Formaldehyde Observations Inform Air Quality Monitoring Strategies for Ozone and Related Photochemical Oxidants? *JGR Atmospheres*. (K.R. Travis, **L.M. Judd**, J.H. Crawford, et al)