

DEVELOP

2021 FALL PREVIEW



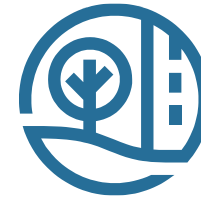
WATER
RESOURCES



HEALTH &
AIR QUALITY



ECOLOGICAL
FORECASTING



URBAN
DEVELOPMENT



DISASTERS



AGRICULTURE



CLIMATE



DEVELOP

2022 SPRING PORTFOLIO

*IMPACTS AND PARTNERS ARE TENTATIVE

ENGAGEMENT:

88



PARTICIPANTS

43



PARTNER ORGS

22



PROJECTS

TERM I: 19

TERM II: 3

TERM III: 0

IMPACT:

24

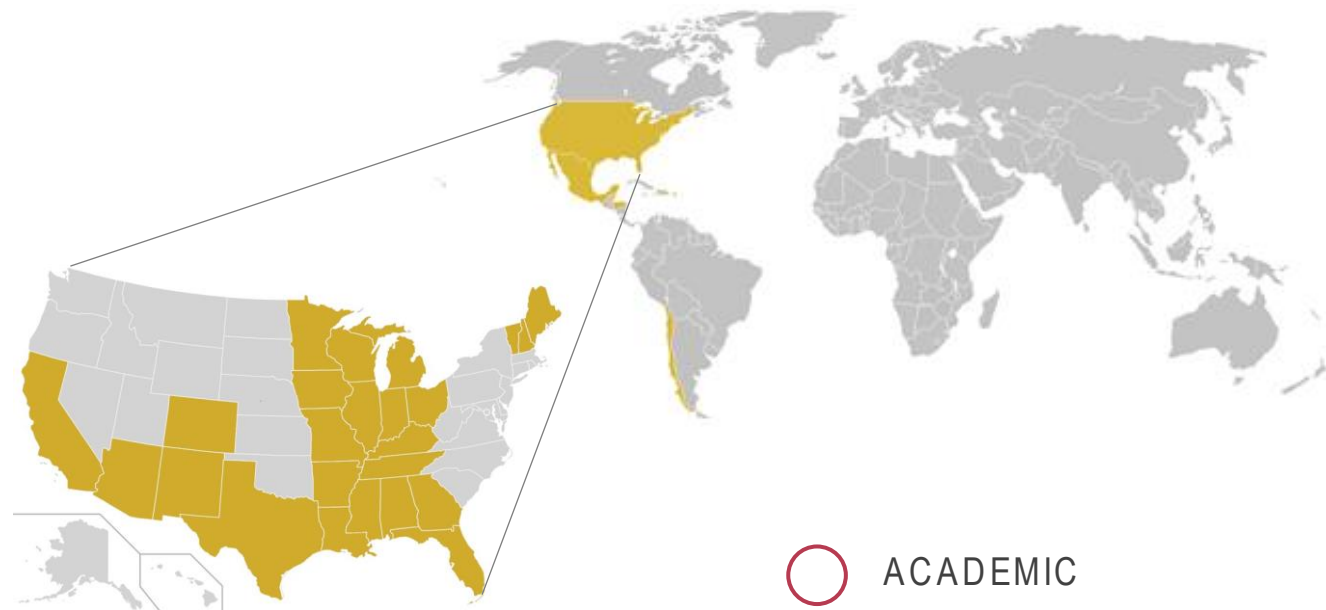
U.S. STATES

1

U.S. TERRITORY

6

COUNTRIES



DISASTERS



WILDFIRES



AGRICULTURE



ENERGY



ECOLOGICAL FORECASTING



WATER RESOURCES



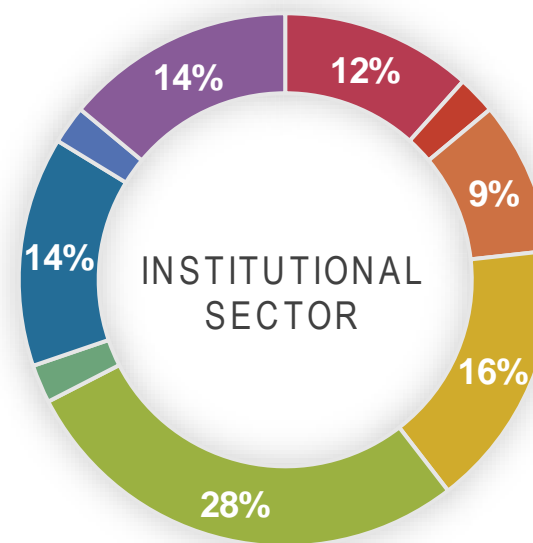
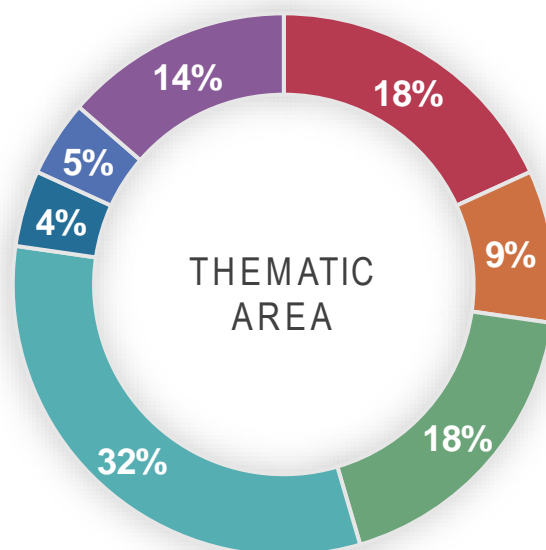
URBAN DEVELOPMENT



CLIMATE



HEALTH & AIR QUALITY



Tech Projects

Increase usability and accessibility of EO data and products through improvement of previous DEVELOP tools, deeper exploration of EO cloud (Jupyter notebooks, Google colab, datacubes), and exploration of AI and machine learning in DEVELOP work.

Listening Projects

Increase depth of engagement and expand DEVELOP work into new communities through an in-depth needs assessment process, including landscape analyses of organizations and communities working in specific areas, identifying key groups to engage, conducting interviews / a listening tour, and synthesizing findings and next steps for the program.

DEVELOP

2022 SPRING PARTICIPANTS

88



PARTICIPANTS

28 (32%)

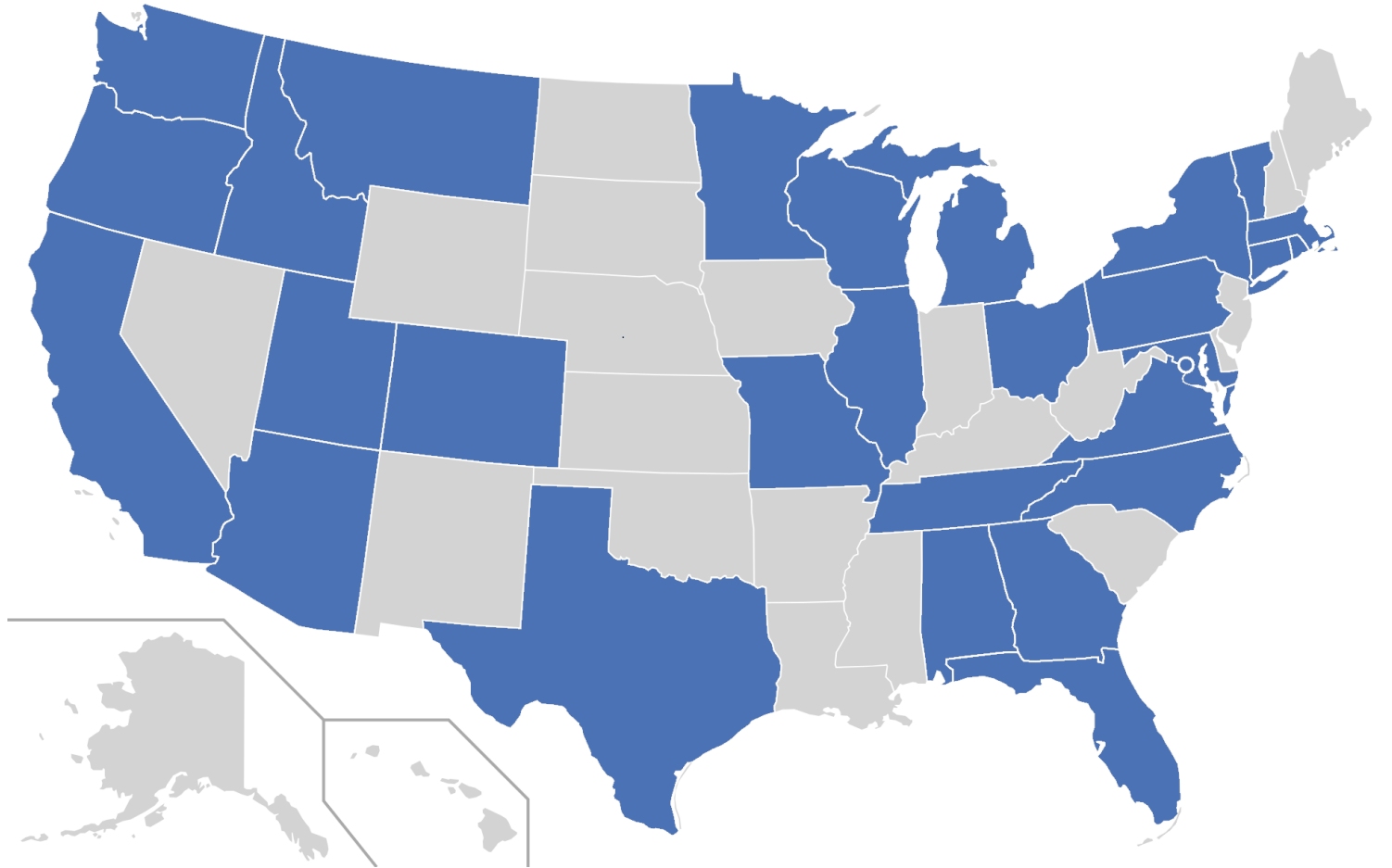
RETURNERS

60 (68%)

NEW
PARTICIPANTS

28

STATES +
WASHINGTON DC



Mississippi Embayment Water Resources

Community Concern: The Mississippi Embayment is a system that contains four aquifers spanning across seven states in the southeast, which is expected to get more water with climate change. As the region becomes more desirable and experiences new development, there is concern an increase in demand and decrease in recharge rates will result in groundwater depletion.

Partner:

- Protect Our Aquifer

Earth Observations:

- GPM IMERG
- ECOSTRESS
- Sentinel-2 MSI
- GRACE-FO

Impact: Partners will be able to better understand the relationship between landcover and recharge and identify at-risk areas to inform mitigation strategies, enhance monitoring, and evaluate the impact of development projects.



Image Credit: Jeff Futo



Okefenokee Water Resources

Community Concern: The Okefenokee Swamp is a unique ecosystem that stores carbon in its deep peatlands, protects biodiversity, and offers various recreational and economic opportunities for nearby residents. There are concerns that increased development and extractive industry activity surrounding the swamp could lead to lowered water levels and increased fire frequency. Several recent fires have damaged surrounding property and impacted local air quality.

Partners:

- Okefenokee Swamp Park
- US Fish and Wildlife Service, Okefenokee National Wildlife Refuge

Earth Observations:

- Landsat 5 TM
- Landsat 8 OLI
- Sentinel-1 C-SAR
- SMAP

Impact: This project will identify trends in fire location and frequency and track changes in the swamp's hydrology that could lead to increased fire risk. Mitigating fire risk will help protect the recreational, economic, and ecological services provided by maintaining the park's integrity.



Arizona Water Resources

Impact: Maps displaying the extent of pinyon-juniper die-off and assessment of mortality in relation to precipitation, soil moisture, elevation, and soil type have the potential to directly inform vegetation management, including prescribed burns, at Wupatki National Monument.

Partners:

- National Park Service
 - Flagstaff Area National Monuments

Earth Observations:

- Landsat 8 OLI
- Sentinel-2 MSI
- ISS GEDI
- GPM IMERG
- SRTM
- PlanetScope



Community Concern: In 2021, the National Park Service observed a dramatic die-off event of pinyon-juniper woodlands at the Wupatki National Monument and nearby Coconino National Forest in Flagstaff, Arizona. Pinyon-juniper woodlands produce juniper berries, an important food source for local birds, and serve as breeding grounds for wildlife.



Padre Island Water Resources

Community Concern: A jetty system constructed in 1962 has impacted longshore currents and erosion patterns along Padre Island. Erosion is occasionally mitigated by dredging projects, but no long-term analysis has been completed to evaluate the effectiveness of this mitigation strategy.

Partners:

- National Park Service
 - Padre Island National Seashore
 - Water Resources Division

Earth Observations:

- Landsat 5 TM
- Landsat 7 ETM+
- Landsat 8 OLI
- Sentinel-2 MSI
- Commercial High-Resolution



Impact: The NPS is looking for products to inform their upcoming beach management plan where long-term decisions will be made for future nourishment projects. Shoreline change analysis and a timeseries of turbidity will help inform plans to protect Padre Island.



Midwest Water Resources II

Community Concern: Understanding the spatial and temporal variability of evapotranspiration is essential for climate informed decision making, however sparse *in situ* measurements and short periods of record limit the historical perspective of this variable.

Earth Observations:

- Terra MODIS
- Landsat 7 ETM+
- Landsat 5 TM
- Landsat 8 OLI/TIRS

Partners:

- USDA Midwest Climate Hub
- Minnesota Department of Agriculture, Pesticide and Fertilizer Management Division
- Michigan State University
- Illinois State Water Survey
- NOAA, National Integrated Drought Information System



Impact: The results of this project will demonstrate the suitability of satellite-derived evapotranspiration products for water resource monitoring and analyze spatiotemporal patterns of evapotranspiration to inform partner decisions regarding land management strategies, water resource allocation, and drought mitigation strategies.

Jobos Bay Water Resources II

Community Concern: Increased frequency of extreme events have escalated the vulnerability of Puerto Rico's coastlines to waves, storm surges, and sea level rise (SLR). SLR could cause seawater intrusion into freshwater catchments, migration of mangrove forests, and deepening of coastal reefs, which could reduce coastal protection of Jobos Bay.

Partners:

- Jobos Bay National Estuarine Research Reserve

Earth Observations:

- Landsat 8 OLI
- Landsat 7 ETM+
- Sentinel-2 MSI

Impact: Building on the last term's work, this project will provide end users with details on mangrove health and therefore shoreline stability and ecosystem health.



ORCAA Water Resources

Community Concern: The Optical Reef and Coastal Area Assessment (ORCAA) tool will be updated to include additional chlorophyll-a and aquatic vegetation monitoring indices and extend its temporal range by 29 years.

Earth Observations:

- Landsat 5 TM
- Landsat 7 ETM+
- Landsat 8 OLI
- Sentinel-2 MSI
- Aqua MODIS
- Terra MODIS



Image Credit: James Perkins

Partners:

- Secretaría de Recursos Naturales y Ambiente
- Coastal Zone Management Authority and Institute
- Central American Integration System, Central American Commission on Environment and Development
- Wildlife Conservation Society
- University of Puerto Rico, Department of Marine Sciences, Bio-optical Oceanography Laboratory

Impact: This tool will allow partners to expand the water quality monitoring and analysis efforts provided by the first version of ORCAA. They will be able to evaluate trends for more water quality indices over a higher temporal resolution to include in their coastal protection policy decision-making.



UHEAT Urban Development

Community Concern: With urbanization and climate change, the City of Tempe, Arizona has experience increasingly high air and surface temperatures. Extreme heat events pose a risk to the local community, thus driving the need for heat mitigation and adaptation practices.

Partners:

- City of Tempe
- Arizona State University, Urban Climate Research Center
- Arizona State University, School of Sustainability

Earth Observations:

- | | |
|-------------------|------------------|
| • Aqua MODIS | • Landsat 5 TM |
| • Suomi NPP VIIRS | • Landsat 7 ETM+ |
| • Landsat 4 TM | • Landsat 8 OLI |
| | • Landsat 8 TIRS |

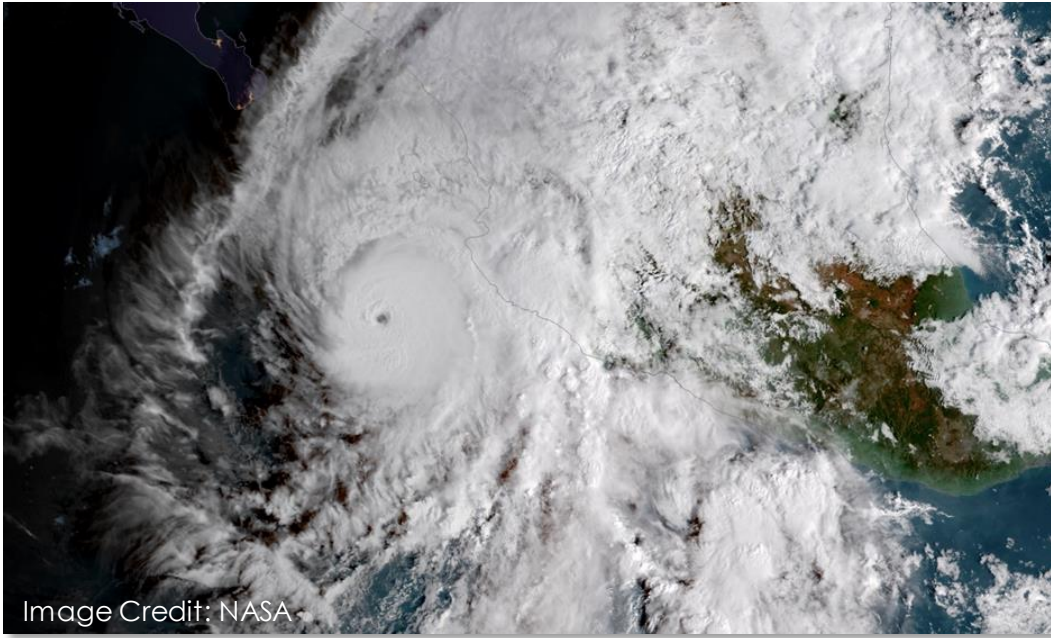


Impact: The Urban Heat Exposure Assessment for Tempe (UHEAT) 2.0 and user guide will help end users utilize an updated tool for heat exposure and risk analyses. The tool will also be expanded for use in other cities in Arizona as well as other regions in the United States.



Mexico Disasters

Community Concern: In Mexico, severe flood events are becoming more frequent due to extreme weather. Better understanding available tools and technologies will help mitigate the impacts of flooding to local communities.



Partners:

- National Institute of Statistics, Geography and Informatics (INEGI)
- Regional Centre for Space Science and Technology Education for Latin American and the Caribbean (CRECTEALC)

Earth Observations:

- Landsat 8 OLI
- Sentinel-1 C-SAR
- Sentinel-2 MSI
- Suomi NPP VIIRS
- Terra MODIS

Impact: This project will utilize an Open Data Cube Sandbox to detect flood extent in the region. A comprehensive tutorial will allow the partners to use this tool for future flood events.



Chile Disasters

Community Concern: Chile has experienced some of its worst fires in recent years, which has impacted residential communities. There are monitoring efforts in place, but they need to be enhanced to produce outputs faster and include difficult to reach locations.



Partners:

- Corporacion Nacional Forestal (CONAF)
- Embassy of Chile

Earth Observations:

- Landsat 8 OLI
- Sentinel-2 MSI
- Terra/Aqua MODIS
- SMAP
- GPM IMERG

Impact: This tool will automate processes used by CONAF for wildfire risk assessment, so that partners can produce outputs faster and more frequently. With enhanced monitoring, partners will be able to improve wildfire prevention and response time efforts.



Boulder County Disasters

Community Concern: On the Colorado Front Range, wildfires are becoming more prevalent and more severe. Boulder county residents and land-managers need to better understand management activities and their implications for forest carbon stock—something the county of Boulder is concerned and invested in.

Partners:

- Boulder County Parks and Open Space
- University of Colorado Denver

Earth Observations:

- Landsat 8 OLI
- Sentinel-2 MSI
- SRTM



Impact: An analysis on forest treatment techniques, and their effect on forest carbon stock before and after wildfires, will allow our partners to better understand and manage the tradeoffs between fire mitigation and important ecosystem services like carbon storage.



EJ Disasters Listening Project

Community Concern: The increase in frequency and severity of disasters disproportionately impacts marginalized communities, often situated in areas where the implementation of environmental protection lags.

Initial Organizations to Engage With:

- NASA ASP Disasters Program
- EPA
- Groundwork USA
- Thriving Earth Exchange

Data:

- Identification of compatibility between geospatial data and socioeconomic data of varying scales



Impact: Synthesis of variety of geographies and acting organizations in the disasters landscape, culminating in a listening tour and needs assessment to support enhanced disaster management and risk reduction in marginalized communities. This synthesis serves as a pathway forward for DEVELOP and lays the groundwork for future collaboration with partners and standardization of EJ research within NASA Applied Sciences.



EJ Health & Air Quality Listening Project

Community Concern: The impact of poor health and air quality are often determined by communities' demographics and socioeconomic level. With limited means to address these issues, can geospatial analysis be used to aid community organizations in their search for environmental justice?

Initial Organizations to Engage With:

- NASA HAQAST – Satellite Data for Environmental Justice (SD4EJ) Tiger Team
- Groundwork USA
- Thriving Earth Exchange

Data:

- Identification of compatibility between geospatial data and socioeconomic data of varying scales



Image Credit: Ben Amstutz

Impact: Complete landscape analysis and needs assessment to support localized action planning and improved air quality.



Gulf of Mexico Health & Air Quality

Community Concern: A third of methane emissions come from oil & gas activity, but it is difficult to regularly monitor offshore activity at the spatial and temporal scale needed.

Partners:

- Bureau of Safety and Environmental Enforcement
- Bureau of Ocean Energy Management
- SkyTruth

Earth Observations:

- Suomi NPP VIIRS
- Sentinel-1 C-SAR



Impact: Enhance monitoring to evaluate venting & flaring activity at active wells, identify abandoned or leaking wells, enforce regulations, and identify sources to inform rulemaking. Also, this project will identify sources for targeted methane plume mapping in the future.



Delaware Basin Health & Air Quality

Community Concern: Carlsbad Caverns and Guadalupe Mountains National Parks have seen deteriorating air quality and visibility in recent years, which both impacts visitor experience and park resources.

Partners:

- National Park Service, Intermountain Region



Image Credit: Robert Thiemann on Unsplash



Image Credit: Brandon Frie on Unsplash

Impact: This work will provide end users with a spatial and temporal distribution of various atmospheric gases to inform critical management decisions that impact park lands and visitors.

Earth Observations:

- Sentinel 5-P TROPOMI
- GOES-16

Grand Valley Ecological Forecasting

Community Concern: Drought, beetle infestation, and more frequent and severe wildland fires are causing changes to the juniper-pinyon and sagebrush ecosystems of Grand Valley, CO.

Partners:

- National Park Service, Colorado National Monument
- Bureau of Land Management, McInnis Canyon and Dominguez-Escalante National Conservation Areas

Earth Observations:

- Landsat 5 TM
- Landsat 8 OLI
- Terra/Aqua MODIS
- SMAP
- SRTM



Impact: Time series maps of drought, beetle infestation, wildland fire impact, and fuels treatment impact will provide historical context and scientific grounding for wildland fire management in the region moving forward. Time series data will also be used as training inputs for forecasted maps in a second term of the project.



Grand Canyon Ecological Forecasting

Community Concern: Significant die-offs of Utah and one-seeded juniper are being observed across central and northern Arizona and are often attributed to drought. Partners at the National Park Service want to understand the current extent of these die-offs in Grand Canyon National Park and prepare for the future of rising temperatures and increased drought.



Partners:

- National Park Service, Grand Canyon National Park

Earth Observations:

- Landsat 8 OLI
- Sentinel-2 MSI
- SRTM

Impact: An analysis of mortality patterns in the region, and a risk map of areas most susceptible to drought, will give partners more insights on the conditions that are leading to juniper mortality, and allow them to make more informed treatment and restoration efforts.



Vermont & New Hampshire Ecological Forecasting

Community Concern: Vermont is currently experiencing one of its worst *Lymantria dispar* outbreaks in recent history, and New Hampshire has suffered from defoliation events for several years. *Lymantria dispar* outbreaks cause mass defoliation events that impact tree health often resulting in tree mortality.

Partners:

- Forest Ecosystem Monitoring Cooperative
- Vermont Agency of Agriculture, Food and Markets
- University of New Hampshire Cooperative Extension
- New Hampshire Division of Forests and Lands, Forest Health Program

Earth Observations:

- Landsat 8 OLI
- Landsat 7 ETM+
- Sentinel-2 MSI
- PlanetScope



Image Credit: Bernard Dupont

Impact: End products visualizing the extent of defoliation events in New Hampshire and Vermont will provide historical context and a deeper understanding of hardwood tree health and resiliency over the study period.



Maine Ecological Forecasting II

Impact: Refined land cover maps forecasted to 2040 and timeseries analysis of climate throughout critical salmon habitat will inform salmon recovery initiatives that strive to improve habitat quality and increase the number of salmon that migrate to the ocean.



Image Credit: Downeast Salmon Federation

Earth Observations:

- Aqua MODIS
- Terra MODIS
- Landsat 5 TM
- Landsat 8 OLI
- GPM IMERG
- Sentinel-1 C-SAR
- Sentinel-2 MSI
- PlanetScope

Partners:

- Department of Marine Resources
- Downeast Salmon Federation

Community Concern: Shifting patterns in climate paired with changes in land cover have the potential to influence the dynamics of streams that Federally Endangered juvenile Atlantic salmon (*Salmo salar*) inhabit.



Phoenix Climate

Community Concern: The urban heat island effect (UHI) in Phoenix, AZ has contributed to extreme heat in certain areas of the city and is expected to intensify with projected climate changes and existing high temperatures. The UHI contributes to heat-related illness and mortality in response to hot weather and insufficient access to shade and water.

Partners:

- City of Phoenix, Office of Heat Response and Mitigation
- City of Phoenix, Office of Sustainability
- City of Phoenix, Streets Department
- Trees Matter
- Arizona Department of Health Services
- Arizona State University, Urban Climate Research Center

Impact: Utilizing NASA Earth observations paired with social data will enable end users to understand the cooling capacity and thermal comfort from proposed infrastructure while identifying and addressing environmental inequities through the City's Cool Corridor Initiative and Cool Pavement Pilot Program.



Image Credit: DPPed

Earth Observations:

- Landsat 8 OLI/TIRS
- Landsat 9 OLI-2/TIRS-2
- ISS ECOSTRESS
- Sentinel-2 MSI

California Agriculture

Community Concern: This project will assist the California Air Resources Board with agricultural carbon inventory assessments required within the Natural Working Lands Inventory by incorporating new remote sensing data analysis methods into an existing framework of landscape models and allometric equations for biomass estimation.

Partners:

- California Air Resources Board, Climate Change Program Evaluation Branch

Earth Observations:

- Landsat 8 OLI
- Landsat 7 ETM+
- Sentinel-2 MSI
- SRTM
- PlanetScope



Impact: The methods developed during this project will serve as the basis for future efforts to evaluate carbon stocks in other land cover types within California and in other states.



Haiti Agriculture

Community Concern: Haiti has lost a large portion of its primary and secondary forests which impacts local communities by depleting reliable resources that bolster the economy. This loss also impacts the global community by decreasing biodiversity and carbon sequestration. A way to address these community concerns is through reforestation.

Partners:

- Haiti Reforestation Partnership

Earth Observations:

- Landsat 5 TM
- Landsat 7 ETM+
- Landsat 8 OLI
- Sentinel-2 MSI
- PlanetScope & Rapid Eye
- GPM IMERG
- SMAP L-Band Radiometer
- ISS GEDI

Impact: A 30-year time-series of forest health and a habitat suitability analysis will inform the Haiti Reforestation Partnership's silvicultural decisions moving forward by providing historical context to present-day reforestation efforts.



Image Credit: USDA Forest Service, Diego Perez

