# DEVELOP 2020 Summer Preview



Health & Air Quality

Urban

Urban Development







Energy
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Transportation & Infrastructure

Water Resources



- Program-wide Software Carpentry workshop
   Topics: Unix Shell, Git, Programming in Python & R
- Remote access to a cloud computing environment for data processing
- Geoinformatics & graphic design participants
- NASA Bhutan STEM engagement
- Annual Earth Science Applications Showcase 'Applied Sciences Week'
   Dates: August 3<sup>rd</sup> 6<sup>th</sup>



# 2020 Summer Portfolio

### 13 States & 2 Countries Impacted

### 65 Participants 15 Projects

87% Domestic 13% International



### **Application Areas Addressed**



- Food Sec. & Ag
- Disasters
- Eco
- Energy
- Health & AQ
- Trans. & Infra.
- Urban Dev
- Water



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# DEVEL() 2020 Summer Projects



Health & Air Quality

Urban	

Development



Ecological Forecasting



Energy











Transportation & Infrastructure



### Pacific Northwest Health & Air Quality

California – Ames

**Community Concern:** There is mounting evidence that the threat of wildfires will increase under climate change, posing a public health hazard from increased wildfire smoke. Inhalation of wildfire smoke is associated with adverse health effects including coughing, wheezing, and worsening of lung conditions, which is a significant concern among community members and policy makers across Washington, Oregon, and the broader Pacific Northwest. In small communities east of the Cascade mountains, air quality monitoring stations are geographically sparse, which makes determining hazardous air quality levels difficult.

**Impact & Benefit:** This project will analyze wildfire impacts on air quality in the Pacific Northwest, with a focus on Washington state, to inform TNC's forest management practices and PSCAA's Clean Air targets. The project will also generate a web-based tool to visualize and analyze air quality in the region, which will provide supplemental air quality information where on-theground sensors are geographically sparse.



#### Partners:

- The Nature Conservancy, Washington Chapter
- Puget Sound Clean Air Agency

#### Earth Observations:

- Aqua MODIS
- Terra MODIS
- Suomi NPP VIIRS
- CALIPSO CALIOP
- ► NOAA-20 VIIRS
- ► Sentinel 5-P TROPOMI



### Cambridge Urban Development

Massachusetts – Boston

**Community Concern:** The urban heat island (UHI) effect is a phenomenon that makes urban areas significantly warmer than surrounding suburban or rural regions. As climate change advances, cities like Cambridge, MA expect to see serious impacts on residents' health, local environmental features, and infrastructure due to the UHI effect. The city is currently monitoring impervious surface area and canopy cover within the city limits, but has no way of tracking changes in urban albedo.

#### Partners:

City of Cambridge, Community Development Department
American Geophysical Union, Thriving Earth Exchange

**Impact & Benefit:** Currently, Cambridge is creating a Climate Change Preparedness and Resiliency plan to prepare for potential impacts, like the increased UHI effect. Overall, remote sensing products and NASA Earth observations will allow the partners to assess changes in albedo through time, albedo's influence on the UHI effect, and help the city adapt to future threats to public health and economic well-being.



#### Earth Observations:

- Terra MODIS
- Landsat 5 TM
- Landsat 8 OLI
- Landsat 8 TIRS
- Sentinel-2 MSI

### Huntsville Urban Development

Alabama – Marshall



#### Earth Observations:

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

#### ISS GEDI

**Community Concern:** An unchecked loss of trees in Huntsville could have negative effects on the environment and the local community. With the city's expansion, the effects of tree canopy loss could enhance an urban heat island effect. This could pose health risks to vulnerable populations within the city. It is important to understand how green infrastructure is changing and what effects this change could have. This research can help decision makers mitigate tree loss and analyze current urban heat island effects taking place within the city.

#### Partner:

City of Huntsville

**Impact & Benefit:** Huntsville, AL has a high percentage of PhDs per capita and is home to the second largest research park in the country. Its well-informed citizens want confirmation the city is doing what it can to protect tree canopy. The end products will facilitate greater collaboration between departments and improve public awareness for tree conservation. With the high costs of proprietary GIS software, the city GIS department has been limited from performing a study in-house. A comparable study for the city would be cost prohibitive to undertake without the support of the NASA DEVELOP Program.



### Fisher's Peak Eco Forecasting

Colorado – Fort Collins

**Community Concern:** Historically, this site has been privately owned with very little **anthropogenic disturbance**. As such, the property contains extraordinary **natural resources** that need to be **inventoried** and **assessed** during it's development into Colorado's second largest State Park.

#### Earth Observations: P

- Landsat 8 OLI
- Sentinel-2 MSI
- GEDI
- ► SRTM

#### Partners:

- The Nature Conservancy
- Colorado State
- Forest Service

**Impact & Benefit:** End-products will allow the partners to make **informed planning decisions** as they transition Fisher's Peak Ranch into a new State Park. A reliable map of the vegetation communities on the property, which is not currently available, will provide a critical baseline to support **planning**, **management**, and **long-term monitoring** of the unique area.





## Mark Twain National Forest Eco Forecasting

Idaho - Pocatello

**Community Concern:** Pine species have been heavily logged since the turn of the century, and restoration efforts are increasing to combat the lack of native species in an otherwise hardwood dominated forest. Land managers at the MTNF use pine stands as markers for shallow or exposed soil in the national forest to help generate maps of areas in need of restoration. Native pines also store carbon and influence groundwater stocks and slope erosion. If these trees are missing within areas of the forest, these factors can run unchecked and targeted restoration will be necessary. These concerns are the chief motivation for delineating between pine stands and other forest types on a landscape level throughout the forest.

**Impact & Benefit:** A cover type analysis of the forest canopy will allow forest managers to completely map the landcover types of the forest and will eventually assist managers in the creation of species level classifications. This map will then be forecasted out to the year 2040 to see changes in cover type while considering current management practices. This cover map will be integrated with elevation models on-hand so that forest managers can strategize their focus on restoring glade habitat across the 1.5 million acres of public land.



#### Earth Observations:

- Landsat 5 TM
- Landsat 8 OLI
- Sentinel-2 MSI

#### Partners:

- USDA, US Forest Service, Mark Twain National Forest
- USDA, US Forest Service, Geospatial Technology and Applications Center

# Southern Bhutan Eco Forecasting

Maryland – Goddard



#### Earth Observations:

### Partners:

- Landsat 8 OLI
- Landsat 7 ETM+
- SRTM

- Bhutan Foundation
- Bhutan Tiger Center

**Community Concern: :** The diverse landscapes of Bhutan host a rich biodiversity of animal and plant species. Elephants are a flagship species and environmental engineers whose conservation is essential for the functioning of the forest ecosystem. Despite this, the Asian elephant (*Elephas maximus*) faces threats of extinction throughout its range. Since 1986, the Asian elephant has been listed as Endangered on the IUCN Red List, as the population has declined by at least 50% over the last three generations. In planning and supporting wildlife corridors, there is an opportunity to use satellite data to inform conservation decisions and generate information that contributes to the protection of entire ecosystems.

**Impact & Benefit:** By generating habitat suitability maps and land cover classifications based on NASA EO, the project will highlight potential wildlife corridors, and will enhance the decision-making abilities of Bhutan Foundation and other stakeholders. This will not only help contribute to conservation efforts for the Asian Elephant, but will also build the partner's capacity to use remote sensing data to support and inform their projects.

### Georgia Energy III

Georgia – Athens

#### Earth Observations:

Landsat 8 OLI
Sentinel-2 MSI
NASA POWER

#### Partners:

 The Nature Conservancy, Georgia Chapter

 Georgia Department of Natural Resources **Community Concern:** While solar energy is a great alternative energy source, in Georgia many optimal locations for solar farms overlap with the habitat of the gopher tortoise (a keystone and vulnerable species) and the black bear (a recently recovered species). In 2018, building began for the largest solar site in the US in Twiggs County, which is also home to the largest growing black bear population. This has driven recent conservation conversations to save key flora and fauna in the state.

**Impact & Benefit:** Map products that show the evolution (2017-2020) of land conflict between key species habitat and optimal solar sites will help grasp the rate of conflict changes since TNC and GADNR began this focused conservation effort. A Solar Suitability Tool will give solar developers the ability to know key ecosystem locations and plan around them in their development.



### Satellite Beach Energy

Arizona – Tempe

**Community Concern:** In 2019 Satellite Beach adopted a resolution stating that "It is the goal and policy of the Satellite Beach City Council, in cooperation with other local governments, private organizations, and individuals, for <u>100% of all</u> <u>electricity consumed in the City of Satellite Beach</u> to come from renewable energy resources and associated technologies by the year 2050." It is not viable to utilize wind energy in this area, so the city is turning its attentions towards the potential of solar energy.





#### Partners:

 City of Satellite Beach (FL)
 City of Orlando, Fleet and Facilities Management Division (FL)

#### Earth Observations:

- ► NASA POWER
- Landsat 8 OLI/TIRS
- Aqua MODIS

**Impact & Benefit:** Solar energy potential estimates by building will provide invaluable information for decision making as Satellite Beach transitions to 100% clean energy. The team will also assess areas with excess stress on air conditioning use through greenness and land surface temperature analysis. The development of a reusable tool with known and adjustable assumptions will give the partners confidence in the reliability of the data on which they base their policy decisions for locally generated solar energy and energy use reduction initiatives. The partners plan to share this tool with other communities around Florida.

### Bhutan Water Resources

Alabama – Marshall



#### Earth Observations:

- NOAA AVHRR
- Aqua MODIS
- Terra MODIS
- Aqua AMSR-E
- GCOM-W1 ASMR-2

**Community Concern:** The Earth's climate has changed throughout history. In the last 650,000 years there have been seven cycles of glacial advance and retreat. The current warming trend is of particular significance as it can be likely attributed to human activity since the mid-20th century. It is important to understand how these impacts affect local communities in Bhutan. Bhutan has experienced increased warming and this has resulted in servere changes to its local climate. The Bhutan HEROES project employs a combination of weather data collection (through a network of weather stations) and citizen science to help understand climate change. Satellites have been collecting data about our planet and its climate on a global scale for decades and can supplement the HEROES project by providing timely, consistent, actionable data to mitigate and adapt to climate change.

#### Partners:

- Bhutan Foundation
- Ugyen Wangchuck Institute for Conservation and Environmental Research

**Impact & Benefit:** The benefit to the Bhutan Foundation and UWICER will be to bolster the efforts of the HEROES program in recognizing changes to phenology and climatology over the past 40 years. Earth observations provide objective, timely, spatially explicit information and can serve as another monitoring tool for promoting better understanding and appreciation of climate change and its impact on biodiversity in Bhutan.

### Cherokee Water Resources

North Carolina – NCEI

**Community Concern:** Persistent drought conditions in the fall of 2016 exacerbated forest fires for the counties intersecting the Qualla Boundary, the land trust of the Eastern Band of Cherokee Indians (EBCI). Forest management practices, such as prescribed burning, reduce dry fuel availability. Forest composition maps from multiple data sources can improve the effectiveness of these targeted management actions.

#### Partners:

- Eastern Band of Cherokee Indians, Natural Resources
- USDA Forest Service, Eastern Forest Environmental Threat Assessment Center

Earth Observations:

- ISS GEDI
- Landsat 5 TM
- Landsat 8 OLI
- Sentinel-2 MSI

**Impact & Benefit:** This project will leverage satellite-derived optical and LiDAR imagery to determine forest canopy fractional part (deciduous vs. coniferous) and year-to-year change in composition for the Qualla Boundary and surrounding counties. This information will help EBCI efforts to map forest structure and expand their resources for monitoring forest change in response to drought and other disturbances.



#### U.S. Drought Monitor – 22 Nov 2016



### Riley County Water Resources

Virginia – Langley

Community Concern: Recent repeated flooding of Wildcat Creek has caused extensive damage to businesses and residents of Manhattan, Kansas and their rural surroundings.



Impact & Benefit: These analyses will inform future infrastructure investments and will be used to assess stream and watershed health.

#### Partners:

- City of Manhattan
- Riley County
- Department of Planning > SMAP L-band and Development
- Riley County Conservation District
- Kansas Forest Service
- Kansas Department of Health and Environment Kansas State University

#### Earth **Observations:**

- ► GPM IMERG
- Radiometer
- Landsat 5 TM
- ▶ Landsat 7 FTM+
- I andsat 8 OII



### South Carolina Water Resources

Virginia – Langley



### **Community Concern:** Increased rates of erosion in salt marshes due to sea level rise

#### Partners:

- South Carolina Department of Health and Environmental Control
- South Carolina Department of Natural Resources
- USGS Woods Hole Coastal and Marine Science Center

#### Earth Observations:

- Landsat 5 TM
- Landsat 7 ETM+
- Landsat 8 OLI
- Sentinel-1 C-SAR
- Sentinel-2 MSI



Impact & Benefit: UVVR will provide a meaningful measure of vulnerability that is less costly and labor-intensive to measure than a complete sediment budget evaluation.

# Ellicott City Disasters III

Maryland – Goddard

**Community Concern:** Over the past ten years, Ellicott City has been the victim of multiple detrimental flooding events, which have claimed human lives and caused infrastructural damage. While the town has grappled with these flooding issues for over 100 years, the local flooding dynamics are changing in both frequency and intensity. Accurate, timely, and detailed data reports are necessary to mitigate the effects of severe flooding in the region and inform early warning systems.

#### Partners:

- Howard County Government, Office of Emergency Management
- Howard County Government Storm Water Management
- NOAA, National Weather Service, Baltimore-Washington Weather Forecast Office



### Earth Observations:

- Aqua AMSR-E
- ► TRMM TMI
- SMAP L-band Radiometer

**Impact & Benefit:** The operational hazard matrix tool and spatially enhanced flood risk model will supplement the emergency management actions of the Howard County OEM by quantifying flood risk in real-time and demonstrating its spatial extent. These outputs can influence early warning decisions when potential flooding conditions are either present or predicted, allowing the OEM to better direct its resources where necessary.

## Rocky Mountain Disasters

Colorado – Fort Collins

#### **Community Concern:**

Communities along the Colorado Front Range have experienced several catastrophic wildfires in recent decades and are facing a future with increased fire frequency and severity. These fires have longlasting impacts on forest function and water quality. Understanding the impacts of severe fire on forest regeneration and water quality is critically important for communities across the western U.S. whose water originates in fire-prone, forested watersheds.

#### Earth Observations:

- ▶ Landsat 5 TM
- Landsat 8 OLI
- Aqua & Terra MODIS
- ► SRTM



Impact & Benefit: Maps characterizing vegetation recovery following fire and information about the drivers of these recovery patterns will benefit partners by evaluating relationships they have identified in their transect- and watershedscale work at larger scales and across multiple fires. The proposed products can help adapt and target latestage restoration treatments.

#### Partners:

 USDA Forest Service, Rocky Mountain Research Station



## Alaska Transportation & Infrastructure

California – JPL

**Community Concern:** Significant localized permafrost thaw is occurring in interior Alaska, especially in places where natural insulative vegetation has been removed. When icerich permafrost thaws, surface deformation and subsidence occur, posing a serious threat to Alaska's infrastructure by leading to decreased structural integrity of the ground and subsequent damage to roads and structures.

#### Partners:

- Army Corps of Engineers, Cold Regions Research and Engineering Laboratory
- Alaska Department of Transportation
- Alaska Department of Natural Resources
- Alaska Satellite Facility



Earth Observations: NASA Gulfstream III UAVSAR Sentinel-1 C-SAR

**Impact & Benefit:** End users will be able to incorporate NASA Earth observation-based methodologies into their decision-making processes involving permafrost deformation and land subsidence detection. Handing off a tool and script will enable end users to continue assessment of InSAR and LiDAR data as new data are released.