# NASA DEVELOP National Program 2018 Spring Project Proposal

## Colorado – Fort Collins

#### **Utah Water Resources**

Utilizing Landsat to Detect Ephemeral Water Sources in Support of a USGS Feasibility Assessment and Management Strategy of Equids

## **Project Overview**

**Project Synopsis:** This project will use Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI and SRTM v3.0 to provide partners at the United States Geological Survey (USGS) with maps of water resources for populations of free-roaming "wild" horses (*Equus ferus caballus*) and burros (*Equus asinus*) in Utah. Partners at the USGS will apply the end products produced through this project to more effectively enable targeted resource allocation, strategic ecological planning, as well as management efforts.

**Community Concern:** Since 1971, the Bureau of Land Management (BLM) in partnership with the United States Geological Survey (USGS) has managed free-roaming wild horses and burros on public lands with the aim to support healthy populations on rangelands as part of its multiple-use mission. The BLM and USGS are tasked with managing and maintaining appropriate population levels for each herd in 20 designated Herd Management Areas (HMA) in Utah. Currently, there is limited information regarding water resources for equids in semiarid ecosystems. Enacting informed and effective management decisions by the USGS and BLM has been challenging from this paucity of information regarding water resources.

**Source of Project Idea:** Dr. Kate Schoenecker was introduced to the DEVELOP program by another USGS staff member who had worked with the program successfully in the past. Recognizing that the geospatial capacity necessary to complete a portion of one of her current USGS projects was not currently available in her laboratory, Dr. Kate Schoenecker approached DEVELOP CO staff to learn more about the application of NASA Earth observations and to discuss project feasibility.

#### National Application Area Addressed: Water Resources Study Location: UT Study Period: June 2000 – January 2018

**Advisors:** Dr. Paul Evangelista (Colorado State University, Natural Resource Ecology Laboratory), Nicholas Young (Colorado State University, Natural Resource Ecology Laboratory), Tony Vorster (Colorado State University, Natural Resource Ecology Laboratory), and Brian Woodward (Colorado State University, Natural Resource Ecology Laboratory)

Pa	Partner Organization:				
	Organization	POC (Name, Position/Title)	Partner Type	Boundary Org?	
	USGS,	Dr. Kate Schoenecker, Ecologist	End User	Yes	
	Fort Collins Science Center,	~			
	<b>Ecosystem Dynamics Branch</b>				
	Bureau of Land Management,	Gus Warr, Program Manager	Collaborator	Yes	
	Utah State Office				

## **Partner Overview**

#### End-User Overview

**End User's Current Decision-Making Process:** The USGS, in accordance with the BLM, are responsible for monitoring and managing populations of free-roaming wild horses and burros on public lands. Currently the USGS and the BLM are cooperating on studies investigating the management of foaling rates in Utah. To achieve the goals of the study, the USGS utilizes both radio telemetry and field observation data to monitor the movement and habitat use of focal species to accurately assess herd counts in designated HMAs. Knowledge of the water resources will supply the USGS with a more informed prediction of potential equids movement, habitat use, and habitat selection. This information of water resources will aid the USGS in improving field monitoring tactics as well as creating more effective management strategies for both wild horses and burros.

#### End User's Capacity to Use NASA Earth Observations:

USGS, Fort Collins Science Center, Ecosystem Dynamics Branch – This federal organization encompasses a diverse network of academic researchers, federal agencies, industry leaders, and policy makers designed to disseminate research-based information. Our specific point of contact does not have experience using NASA Earth observations in research. This project will build capacity for both our specific point of contact as well as the USGS organization as a whole by showcasing the use and application of NASA Earth observations across disciplines.

#### Collaborator & Boundary Organization Overview

#### **Collaborator Support:**

Bureau of Land Management, Utah State Office – The BLM will provide wild horse and burro species movement datasets within HMAs in support of the project.

#### **Boundary Organization Dissemination:**

Bureau of Land Management, Utah State Office – This boundary organization is involved in the development of this project through close ties with the USGS. The BLM along with the USGS will provide focal species and first hand ecological field knowledge that will be utilized by the DEVELOP team. The BLM seeks to expand their stakeholder's knowledge of current and potential future impacts towards wild horses and burros. The BLM will share the results of this project widely through their program network, which looks to provide data and resources to land and resource management organizations throughout Utah through their website, workshops, and presentations.

#### Project Communication & Transition Overview

**In-Term Communication Plan:** The team will communicate with partners at USGS on a biweekly basis. Since the partners of this project are based locally in Fort Collins, in-person meetings will be simple to plan and carry out. The Center Lead and Project Lead of this project will be the primary points of contact with both partner organizations.

**Transition Plan:** At the end of the term, the team will host a seminar to disseminate project results and hand off decision support tools. A short training workshop on the use of the data and tutorial will follow the seminar.

arth Observations:			
Platform & Sensor	Parameters	Use	
Landsat 5 TM	Surface reflectance, normalized difference vegetation index, normalized difference moisture index,	This dataset provides the temporal (16 days) and spatial (30 m) resolution needed for mapping water for equids.	

#### Earth Observations Overview

	tasseled cap	
	brightness, greenness,	
	and wetness	
	Surface reflectance,	
	normalized difference	
	vegetation index,	This dataset provides the temporal (16 days) and spatial
Landaat 7 FTM+	normalized difference	(30 m) resolution needed for mapping water for equids.
	moisture index,	Landsat 7 imagery will be used as an ancillary dataset to
	tasseled cap	Landsat 5 when cloud free imagery is not available.
	brightness, greenness,	
	and wetness	
	Surface reflectance,	
	normalized difference	
	vegetation index,	
Landaat 8 OLI	normalized difference	This dataset provides the temporal (16 days) and spatial
Lanusat o OLI	moisture index,	(30 m) resolution needed for mapping water for equids.
	tasseled cap	
	brightness, greenness,	
	and wetness	
	Elevation along	This dataset will be used to derive topographic indices
SPTM V3	espect and compound	to be used as predictors that could represent important
	topographic index	characteristics of hydrologic networks and water
	topographic index	collection depressions.

#### Ancillary Datasets:

USGS and BLM Equid Field Measurements - Species Habitat Usage

North American Land Data Assimilation System (NLDAS-2) Mosaic Precipitation, Soils, Surface Water – Environmental Predictor Variables Data

#### Modeling:

Random Forests (POC: Dr. Catherine Jarnevich, USGS Fort Collins Science Center) Support Vector Machines (POC: Dr. Catherine Jarnevich, USGS Fort Collins Science Center)

#### Software & Scripting:

Esri ArcGIS – Image processing, end product generation Exelis ENVI/IDL – Image calibration, LandTrendr coding R – Statistical analyses, raster processing Google Earth Engine API – Large scale image analysis

## **Decision Support Tool & End Product Overview**

### End Products:

End Products	Partner Use	Datasets & Analyses	Software Release Category
Water Detection Map	This product will help our partner pinpoint predicted areas of water resources in remote semiarid conditions.	This product will integrate NASA Earth observations remote sensing data and partner collected herd field data. This data will be employed to detect the water in Utah Herd Management Areas utilizing Google Earth	N/A

		Engine and Random Forests modeling techniques.	
Modeling Tutorial	The tutorial will enable end users to replicate this study in future years and for additional study locations.	The tutorial will cover data processing, fitting statistical models to the data, and interpretation as well as mapping of model output.	N/A

**End-User Benefit:** This project will save the USGS and BLM time and money by further refining monitoring and field survey efforts. The project also enables analysis across larger scales and new study sites that would not be possible without full utilization of NASA Earth observations. End products will be integrated in the USGS and BLM decision making and management processes to more effectively manage herd populations in semiarid ecosystems.

#### **Project Timeline & Previous Related Work**

Project Timeline: 1 Term: 2018 Spring

#### **Related DEVELOP Work:**

Spring 2014 (CO) – Colorado Water Resources: Utilizing Landsat 8 and MODIS for Mapping Extent, River Stage, and Impacts of the 2013 Colorado Floods

Spring 2014 (MSFC) – Southeast US Water Resources: Development of an Alternative Drought Monitoring System using NASA Earth Observation-Derived Drought Indices and Groundwater Storage Estimates for Improved Water Resource Monitoring in the Southeastern United States