**NASA DEVELOP National Program**

**2017 Spring Project Proposal**

**BLM at Idaho State University GIS TReC**

**Southeastern Idaho Water Resources II**

*Leveraging NASA Earth Observations to Identify Existing Surface Water Features to Improve Water Management and Resource Allocation in Southeast Idaho*

**Project Overview**

***Project Synopsis*:** Understanding water dynamics in southeastern Idaho is critical for water management best practices. Organizations that focus on water management, the Bureau of Land Management and Idaho Department of Water Resources, currently use data with known and suspected error to identify water bodies. This project will use Landsat 8 OLI, SRTM and Google Earth Engine to create a model that identifies and tracks water bodies within an assigned management area. The Surface Water Indicator Model (SWIM) tool will incorporate multiple water indices, topographic data, and a classifier into a single tool to accurately identify surface waters. This tool will be user-friendly and use the most current imagery to monitor temporal changes of surface water. The resulting maps produced by the SWIM tool will help natural resource managers with project planning, field assignments, and allocation of resources.

***Community Concern:*** Idaho has over 95,000 miles of rivers and streams and more than 100 lakes and reservoirs that supply water necessary for anthropic, economic, and ecological sustenance. These riparian areas also support numerous biota that can become candidates for sensitive species monitoring and wildfire protection. As a result, it is important to know the spatial extents of water sources and to understand their flow dynamics in order to improve management decisions.

***Source of Project Idea:*** A need for identifying surface water in a more efficient way to increase monitoring and management capacities was recognized during a meeting between DEVELOPer, Jenna Williams and the Bureau of Land Management representatives, Karen Kraus and Mike Kuyper.

***National Application Area Addressed:*** Water Resources

***Study Location:*** Southeastern Idaho (ID)

***Study Period:*** September 2015 to May 2016

***Advisors:*** Keith Weber (GIS Training and Research Center at Idaho State University), Charles Peterson (Idaho State University), Mark Carroll (NASA GSFC)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Bureau of Land Management (BLM) – Pocatello Field Office | Karen Kraus, Natural Resource Specialist | End-User | No |
| Idaho Department of Water Resources (IDWR) – State Office | Linda Davis, Senior GIS Analyst | End-User | No |
| NASA RECOVER Science Team | Keith Weber, GIS Director | Collaborator | Yes |

***End-User Overview***

***End-User’s Current Decision-Making Process:***Currently our end-users agencies (BLM or IDWR) are responsible for the management of surface waterbodies to meet both urban and rural water needs, and to manage resources for flora and fauna habitat. Neither of our end-users use satellite data to identify surface water features; instead they rely on the National Hydrological Database (NHD) and legacy non-spatial data to determine areas that require special management practices. End-users use the NHD combined with local knowledge and maps to identify water sources, because it is currently the best available dataset at the best resolution. Partners rely on this information about surface water bodies to manage water resources.

***End-User’s Capacity to Use NASA Earth Observations:***

Bureau of Land Management (BLM) - The Pocatello field office has been using GIS software for approximately 10 years. However, their use of satellite remote sensing data is limited and essentially constrained to viewing products produced for their use e.g., fire severity maps for the BLM are typically produced by USGS. BLM’s close working relationship with DEVELOP will help build their capacity to utilize NASA Earth observations particularly for water identification**.**

Idaho Department of Water Resources (IDWR) – The IDWR uses METRIC, a satellite-based surface energy balance model derived from Landsat imagery to administer Idaho’s water resources. METRIC estimates evapotranspiration as well as land use/land cover using Landsat imagery. These seasonal maps are then used to resolve water resource conflicts and agricultural water issues. The proposed DEVELOP project will build capacity for IDWR in regards to leveraging Earth observations and provide the most current information specifically regarding surface water sources***.***

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

NASA RECOVER Science Team –The science team will provide expert knowledge on techniques to leverage Earth observations to identify surface water features.

***Dissemination by Boundary Organizations*:**

NASA RECOVER Science Team – RECOVER is a fire-specific decision support system that automatically brings together, in a single analysis environment, all the information necessary for post-fire rehabilitation decision making. It currently uses national hydrologic data (NHD), wetlands data from USFWS, and watershed boundary polygons from USGS (Watershed Boundaries dataset (WBD)). None of these datasets adequately identify smaller surface water resources that are frequently the location of rare and endangered plants and animals. Once completed, these data layers can be made available to RECOVER end-users and partners through the RECOVER DSS to aid in post-fire planning.

***Project Communication & Transition Overview***

***In-Term Communication Plan*:** Communication between DEVELOPers and project partners will occur roughly every three weeks via teleconference or in-person meetings. Lines of communication will remain open if questions arise but these meetings will primarily involve project updates and high-level results. The center lead will be responsible for setting up the first project participant in-person meeting within the first two weeks of the term, and then the project lead will take over. There will also be bi-weekly project meetings between DEVELOPers and science advisors.

***Transition Plan*:** Our end-users will have access to the data via the ISU GIS TReC Spatial Data Library. A link will be provided to them along with the final draft of the technical paper and VPS. Final images and maps will be handed off during closeout and an e-mail containing the same data will be sent so the end products and data can be used for planning purposes as soon as possible. Currently, software release is under way which should allow the tool script to become available with the completion of the second term of the project.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 8 OLI** | Spectral classification | Examine spatial resolution and its capability to classify surface water bodies and land cover |
| **SRTM Version 2** | Identify water bodies | Input for classification of larger water bodies and use as secondary information for identifying streams |

***Ancillary Datasets:***

NASA – NASA Modern-Era Retrospective analysis for Research and Applications (MERRA) Reanalysis Model – Inform the estimation of seasonal variation on intermediate and ephemeral streams

USGS – National Hydrography Dataset (NHD) – Identify currently defined surface water. A current copy of these data already exists at the GIS TReC and is in active use as part of the NASA RECOVER DSS.

USGS – National Elevation Dataset (NED) – 10 m DEM; A current copy of these data already exists at the GIS TReC and is in active use as part of the NASA RECOVER DSS.

USGS – National GAP Analysis Program (GAP) – Land cover classification for agriculture

Sandia National Laboratory – Energy and Water Data – Provide data on availability, cost, and use of water

USDA National Agriculture Imagery Program (NAIP) – NAIP Digital CIR 2015 – Source for point classification of observable water sources.

***Software & Scripting:***

ESRI ArcGIS– Image analysis and classification

IDRISI TerrSet – Imagery processing, Image analysis

Google Earth Engine – Model building, scripting, and data processing

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Surface Water Map and Water Geodatabase | This product will be used to update the current NHD for the study area. The initial results will help our project partners focus resources in areas known to hold water and thereby eliminating data that does not reflect current ground conditions. The geodatabase will include a classification for discerning intermediate versus perennial water bodies. | The datasets will be compiled and analyzed to provide a comprehensive map of surface water in the study area using Landsat 8. These maps will be analyzed and compared with the most current NHD and BLM’s current knowledge of water body locations  Landsat 8 OLI, NHD, NED, GAP, NAIP, SRTM, GPM, [USGS Dynamic Surface Water Extent](http://remotesensing.usgs.gov/ecv/SWE_overview.php) | N/A |
| Surface Water Body Identification Comparison Map | This product will allow end-users to compare USGS Dynamic Surface Water Extent products to our own products produced with SWIM | Landsat 8 OLI, NHD, NED, GAP, NAIP, SRTM, GPM, [USGS Dynamic Surface Water Extent](http://remotesensing.usgs.gov/ecv/SWE_overview.php) | N/A |
| Surface Water Identification Model (SWIM) | This model will give our partners the ability to compile their own water indication map from the latest Landsat data, and compare current and historical water extents. | This model will be developed within Google Earth Engine using the support vector machine (SVM) classifier and within ArcMap using the random trees classifier.  Landsat 8 OLI, NHD, NED, GAP, NAIP, SRTM, GPM, [USGS Dynamic Surface Water Extent](http://remotesensing.usgs.gov/ecv/SWE_overview.php) | III |
| Tutorial | This will give partners the ability to apply project methodologies to other study areas, or time frames. | N/A | N/A |

***End-User Benefit*:** Developing a method that will use Earth observations to identify surface water features will benefit our project partners in a number of ways. The frequency of Earth observations in combination with the results from this project will provide end-users the most up to date information on surface water spatial extents. IDWR and BLM use the NHD combined with local knowledge and maps to identify water sources, because it is currently the best available dataset at the best resolution. For both partners, the ability to improve datasets related to water and water availability is desired because important decisions rely on accurate data

**Project Timeline & Previous Related Work**

***Project Timeline:*** 2 Terms: 2016 Fall (Start) to 2017 Spring (Completion)

***Multi-Term Objectives:***

* **Term 1:** 2016 Fall (ID) – Southeastern Idaho Water Resources
  + This term developed methods to accurately identify current surface water sources while initiating the creation of an end-user tool. However, the identification of surface water bodies is not enough to meet partner needs, since a simple identification method could include ephemeral water bodies while excluding intermediate water bodies. Therefore, this project is proposed to continue in the spring 2017 term. During project close out, the team presented first term findings and discussed the second term of this project.
* **Term 2 (Proposed Term):** 2017 Spring (ID) – Southeastern Idaho Water Resources II
  + The second term will use the methods developed in the first term to discern between intermediate and perennial surface water areas, while excluding ephemeral bodies, and enhancing tool development to handle the particular variables needed for discernment. Partner interaction will continue to develop through this term with in-person meetings scheduled as needed to determine the best way to implement and deliver project techniques and methods. The project handoff will take place in person after a closeout event at ISU GIS TReC.

***Previous Terms:***

2016 Fall (ID) – Southeastern Idaho Water Resources

***Related DEVELOP Work:***

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

2014 Fall (MCHD) – Mississippi Water Resources: Mapping the Extent of Critical and Endangered Mississippi Watersheds to Assist Restoration Efforts and Conservation Planning Using NASA Earth Observations

2015 Fall (MCHD) – Natchez Trace Ecological Forecasting: Utilizing NASA Earth Observations to Assess Current and Historic Wetland Extent along the Natchez Trace Parkway