**NASA DEVELOP National Program**

**Spring 2016 Project Proposal**

**NOAA National Centers for Environmental Information (NCEI)**

**Cascade and Sierra Nevada Mountains Water Resources**

An Inter-comparison of the PERSIANN and CMORPH Climate Data Records over the Cascade and Sierra Nevada Mountains

**Project Overview**

***Objectives:*** 1)To determine if the existing station data is representative of the true areal extent of precipitation by using PERSIANN and CMORPH as a comparison, 2) Enhance the understanding of the variability of precipitation and snow pack across the Cascades and Sierra Nevada, and 3) Provide water resource managers with monthly and seasonal maps to help with current forecasting efforts.

***Community Concern:*** Within the Western states, snowmelt from the mountains is responsible for the majority of the seasonal fresh water resources. *In situ* monitoring stations and sites within the Cascades and Sierra Nevada serve to measure snowpack and indicate future water supply. However, *in situ* monitoring stations are spatially limited in the region. Due to this limitation, it is difficult to determine future water availability. This proposed project will utilize two NOAA Climate Data Records (CDRs) and two NASA Earth observations to map and understand precipitation variability across the Cascade and Sierra Nevada Mountains.

***National Application Areas Addressed:*** Water Resources, Climate, and Weather

***Study Location:*** Cascade Mountain Range located in Washington, Oregon, and California.

Sierra Nevada Mountains located in California and Nevada.

***Study Period:*** January 1984 – December 2015

***Advisors:*** Michael Kruk (ERT, Inc.), Kevin Werner (NOAA Regional Climate Service Director)

***Source of Project Idea:*** This project idea resulted from the NOAA CDR meeting in August 2015 where DEVELOP summer projects were presented and discussed. Michael Kruk, the in-house science advisor to the Pacific Water Resources team, met with Kevin Werner, NOAA’s Regional Climate Services Director for the Western Region, and suggested this project.

**Partner Overview**

***Partner Organizations:***

Western Regional Climate Center (WRCC) (End-User; POC: Nina Oakley, Assistant Research Scientist)

National Weather Service (NWS) (Boundary Organization; POC: Andrea Bair, Physical Scientist)

***End-User Current Decision Making Process:***

Currently, station-based data and gridded datasets such as PRISM and NCEP-NCAR Reanalysis datasets are used to understand climate in the West. The Western Regional Climate Center (WRCC) provides climate information to their broad user base and incorporates it in their research. They do not currently use remote sensing data but are interested in incorporating it into their suite of climate products.

***NASA Earth Observations Capacity:***

Western Regional Climate Center – familiar with the NASA Earth observations suite. In 2012, WRCC was part of a NASA Experimental Program to Stimulate Competitive Research (EPSCoR) (project that designed and held a teacher workshop based on NASA Earth observations.

***Collaborator & Boundary Organization Support:***

National Weather Service – Support and advice will be given to the team concerning the final products of the project. The NWS POC will provide guidance on how to format and produce the final products. Additionally, the NWS POC will disseminate the final products and results with local weather resource managers and forecasters.

***Communication Plan & Transition Approach:***

The team will have weekly teleconferences with the science advisors and partners. Team will meet weekly with science advisor, Michael Kruk, to discuss progress. Additionally, the team will keep up communication with partners via email and teleconferences.

The transition approach to the end-user will be via email where the data, maps, and tech report will be shared. The product will be used to help monitor precipitation and snow pack throughout the winter to provide information to water resource managers and forecasters.

***End-User Benefit:***

The outcomes of this proposed project will help WRCC and NWS to more accurately communicate precipitation totals from individual storms in the Sierra and Cascades to relevant stakeholders. Additionally, this product would help monitor precipitation throughout the winter to provide information to water resource managers. Current gridded precipitation products are limited by station availability and often remove extreme values, so establishing confidence in a satellite-derived gridded precipitation dataset would be very useful in the West.

Anomaly maps generated from satellite data will help end-users determine which areas received above or below normal precipitation. Additionally, difference maps will be provided that show where the PERSIANN and CMORPH agree and disagree. The difference maps will highlight areas that would benefit the most from these supplemental data. Ability to generate more accurate maps of precipitation in the West will provide insight for water resource management and decision-making, as well as climate monitoring. Results from this work could also be applied to research on extreme precipitation in other parts of the state.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform** | **Sensor** | **Geophysical Parameter** |
| **TRMM** | TMI | Precipitation Estimate |
| **CMORPH-CDR** | IR Band | Precipitation Estimate |
| **PERSIANN-CDR** | GridSat-B1 IR Window Channel  | Precipitation Estimate  |
| **GPM** | Merged Product | Precipitation Estimate |
| **Suomi NPP** | VIIRS | Snow Cover |

***NASA Earth Observations Use:***

TRMM – This satellite product will provide precipitation estimates from 1997 to 2015 at 0.25 degree resolution.

GPM – This merged product will provide precipitation estimates at a high temporal (30 minute) and spatial resolution (0.1 degree). Unfortunately, data is limited to March, 2014 to present.

Suomi NPP – This collaborative NASA and NOAA product will provide snow cover estimates. This is a new product so the maps produced will only represent present conditions.

***NOAA Climate Data Records Use:***

CMORPH-CDR – This 8km product will provide daily high resolution precipitation for the region. It will be the highest resolution precipitation product used in the research and can offer near-real time precipitation if proves valuable.

PERSIANN-CDR – This is a 0.25 degree daily precipitation product that extends from 1984 until present. This long temporal timeframe will provide a 30 year climatology for the study regions.

***Ancillary Datasets:***

California Snow Survey – The Natural Resources Conservation Service of California Snow Survey Program provides mountain snowpack data and streamflow forecasts for the western United States. Common applications of snow survey products include water supply management, flood control, climate modeling, recreation, and conservation planning.

8-station and 5-station index –These indices are the average of 8 and 5 precipitation stations respectively that provide a representative sample of the region’s major watersheds which produce inflow to some of California’s largest reservoirs providing much of the state’s potable water.

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

|  |  |  |
| --- | --- | --- |
| **Proposed End Products** | **Decision to be Impacted** | **Current Partner Tool/Method** |
| Anomaly Maps | Help water resource managers determine which areas receive more or less than normal precipitation.  | Only use station data to determine precipitation  |
| Product Difference Maps | Show the areas in which the satellite products agree and disagree  | No current tool to show the difference in these products for this region  |
| Spatial Difference Maps  | Give researchers more information about how precipitation varies over areas | No current tool to show spatial variation of precipitation except station data |
| Benefits Map | Help researchers and water resource managers determine where satellite data can best fill existing gaps in station network  | None |

*Anomaly Maps –* Maps will be made for all the precipitation products to show areas that have above and below normal precipitation. These will be used to help water resource managers better understand precipitation patterns and variation.

*Product Difference Maps –* Maps showing the areas where the derived precipitation and snowfall agree and disagree with each other. These maps will be very useful to researchers so they can determine which products should be incorporated into models.

*Spatial Difference Maps –* Maps showing the spatial variation in the derived precipitation and snowfall over the domain and documenting those differences.

Benefits Map – A map showing the locations that will benefit most from using satellite data in concert with existing station data to fill spatial and temporal data gaps. This is akin to a Venn diagram where the overlap of the satellite data and the station data are maximized.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2016 Spring

***Previous Related DEVELOP Work:***

2015 Summer (NOAA NCEI) – Pacific Water Resources: Using NOAA CDRs and Satellite Data to Connect Phases of the El Niño Southern Oscillation (ENSO) with Precipitation across Hawaii and the U.S. Affiliated Pacific Islands (USAPI)

2014 Fall (NOAA NCDC) - Southwest US Climate: Utilizing Climate Data Records (CDRs) to Assess Likelihood of Extreme Precipitation in the Southwest United States

2014 Summer (Langley/NCDC) - Southern California Climate: Improving Methods of Predicting Extreme Weather Events or Drought Conditions for Water Resource Managers in Southern California

**Project Needs/Requests**

***Participants Requested:*** 3 participants

***Software & Scripting:***

R - downloading/statistical analysis

ArcGIS – data visualization and final maps