**NASA DEVELOP National Program**

**** NASA Ames Research Center

*Spring 2017*

**Short Title: Chile Water Resources**

**Subtitle:** Integrating NASA Earth Observations into the Google Earth Engine Platform to Enhance Drought Monitoring in Chile

**VPS Title:** La Sequia: Monitoring Water Resources and Agriculture in Chile

**Project Team & Partners**

**Project Team:**

Garrett McGurk (Point of Contact), garrett.l.mcgurk@nasa.gov

Mariana Webb

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**Advisors & Mentors:**

Dr. Juan Torres-Perez (Bay Area Environmental Research Institute, NASA Ames Research Center)

Dr. Eduardo Bendek (NASA Ames Research Center)

**Partner Organizations:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| Ministerio de Agricultura (Chile) | Sr. Antonio Yaksic, Jefe Subdepartamento de Información, Monitoreo y Prevención para la Gestión Integral de Riesgos (Deputy Chief Department) | End-User | Yes |
| Oficina Agrícola de la Embajada de Chile en los Estados Unidos de América (Chile) | Sr. Javier Chaud, Especialista Agrícola (Agriculture specialist) | Collaborator | No |

**Project Details**

**Applied Sciences National Applications Addressed:** Water Resources, Agriculture

**Study Area:** Chile

**Study Period:** January 2001 – February 2017

**Earth Observations & Parameters:**

Soil Moisture Active Passive (SMAP) Radiometer – soil moisture

Terra, Moderate Resolution Imaging Spectroradiometer (MODIS) – snow cover

Aqua, Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) – snow water equivalent (SWE)

GCOM-W1, Advanced Microwave Scanning Radiometer 2 (AMSR2) – snow water equivalent (SWE)

**Ancillary Datasets Utilized:**

* Chile Ministry of Agriculture Climate Data Library – combined drought index, MODIS snow cover, precipitation stations

**Software Utilized:**

* Google Earth Engine API – data hosting, visualization and analysis
* Python – ingest and process satellite data to load into Google Earth Engine using API

**Project Overview**

**80-100 Word Objectives Overview:**

The objective of this project was to conduct a feasibility study on the usage of Google Earth Engine (GEE) as a platform for incorporating satellite-derived hydrologic data into the Chilean Ministry of Agriculture’s drought monitoring and decision making process. To evaluate the capabilities of GEE, the team integrated NASA Earth observations into the GEE platform documenting each step for the Chilean partners to replicate. Overall, the team seeks to enhance Chile’s capability to manage water resources by providing decision-makers and stakeholders improved access to data and analysis tools.

**Abstract:**

Chile is characterized by extreme climate variability ranging from the arid Atacama Desert, one of the driest places on earth, to the extremely wet Lake District that averages 2,535 mm of annual rainfall. In recent years, Chile has experienced abnormal climate conditions as record droughts and rapidly receding glaciers place an added strain on a historically limited water supply. With stakeholders from the water resources and agricultural communities relying on this limited reserve, the management of water in Chile has become increasingly important as the Ministry of Agriculture prepares for future climate variability. This project provided the Chilean Ministry of Agriculture with a case study evaluating the effectiveness of incorporating new NASA Earth observation datasets into the Google Earth Engine (GEE) platform to enhance drought-monitoring capabilities in Chile. To highlight the potential benefits of utilizing GEE to aid in drought monitoring and decision making, the team developed a tool within the GEE platform that aggregates data from the Soil Moisture Active Passive (SMAP) radiometer, the Moderate Resolution Imaging Spectroradiometer (MODIS), and the Advanced Microwave Scanning Radiometer for the Earth Observing System (AMSR-E) and the Advanced Microwave Scanning Radiometer 2 (AMSR2). Parameters derived from the remotely sensed data included soil moisture (SM), snow cover (SC), and snow water equivalent (SWE). The advantage of hosting this data in the GEE platform is that it is a collaborative cloud-based analysis tool, which allows users to share, store, and perform analysis on large volumes of data. GEE has the potential to transform the way in which geospatial information is studied and disseminated, improving upon the accessibility and breadth of the data currently available.

**Keywords:**

Google Earth Engine, SMAP, MODIS, AMSR-E, AMSR2, water resources, drought, agriculture, climate resilience

**Community Concerns:**

* Chile’s varied geography and west-flowing rivers result in disproportionate water resource distribution, with the highest domestic and agricultural demands coming from the arid and densely populated north-central regions of the country.
* The expansion of Chile’s agricultural economy has resulted in consumption of greater volumes of water, stressing already strained water resources.
* Anomalous global climate events have contributed to a trend of extended dry periods during the summer growing season. Coupled with more intense periods of precipitation in the winter months, these effects threaten agricultural yields and local livelihoods.
* Current drought monitoring tools don’t incorporate satellite-derived SM, SC, and SWE datasets.

**Current Management Practices & Policies**:

The Chilean Ministry of Agriculture currently uses the Climate Data Library (CDL), a data repository and analysis tool, for the dissemination of climate data relating to agricultural applications. The CDL’s Drought Monitor visualizes historic, current, and forecasted drought indicator data. Datasets available include precipitation, discharge, snow depth, reservoir levels, temperature, soil moisture, and the Combined Drought Index (CDI). While the CDL does host some SM, SC, and SWE datasets, the data is calculated using discontinuous *in situ* measurements.

**Decision Support Tools & Benefits:**

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| --- | --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** | **Software**  **Release** |
| Chile Drought Engine (CDE) | This GEE tool will incorporate data from SMAP, Terra MODIS, Aqua AMSR-E, and GCOM-W1 AMSR2. All data were hosted and processed by Google Earth Engine and ready for analysis by the Ministry of Agriculture. | Hosting NASA Earth observation data in the platform will enhance the Ministry of Agriculture’s current decision- making process by incorporating NASA Earth observation -derived soil moisture, snow cover, and snow water equivalent data. It will also serve as a case study for future implementation of drought monitoring in the GEE platform instead of the current CDL. | III |