**NASA DEVELOP National Program**

**2022 Spring Project Proposal**

**Virtual – Tech & Innovation**

**Mexico Disasters**

*Comparing Feasibility of Flood Detection Methods Using Google Earth Engine and Open Data Cube for Flood Mitigation in Mexico*

**Project Overview**

***Project Synopsis*:** This project is a contribution of NASA to the Committee on Earth Observation Satellites (CEOS) 2020-2022 Work Plan. It will partner with the CEOS Systems Engineering Office (SEO), the United Nation’s Regional Centre for Space Science and Technology Education for Latin American and the Caribbean (CRECTEALC), and Mexico’s National Institute of Statistics, Geography and Informatics (INEGI) to explore the use of Open Data Cube and HYRDAFloods for flood detection in Mexico. The team will use case studies of multiple flood events in the states of Hidalgo and Tabasco to understand differences between flood detection methods. These results will be shared with CRECTEALC and INEGI for enhanced flood monitoring and informed resource allocation.

***Study Location:*** States of Hidalgo & Tabasco, Mexico

***Study Period:*** January 2016 – December 2021

***Advisors:*** Dr. Brian Killough (NASA Langley Research Center), Dr. Kent Ross (NASA Langley Research Center)

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| **National Institute of Statistics, Geography and Informatics (INEGI)** | Paloma Merodio Gómez, Vice President | End User | No |
| **Regional Centre for Space Science and Technology Education for Latin American and the Caribbean (CRECTEALC)** | Sergio Camacho-Lara, Secretary General | Collaborator | No |
| **Commonwealth Scientific and Industrial Research Organization (CSIRO)** | Jonathan Hodge, Program Director | Collaborator | No |

***End User Overview***

***End User’s Current Decision-Making Process & Capacity to use Earth Observations:***INEGI is responsible for regulating and coordinating Mexico’s collection, processing, and distribution of statistical and geographic information to support decision-making. They are familiar with Earth observations and incorporate satellite imagery into their Geographic Information Generator. They are interested in the feasibility of creating an Open Data Cube for Mexico to conduct various analyses, including detection of flood events.

**Earth Observations Overview**

***Earth Observations:***

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| --- | --- | --- |
| **Platform & Sensor** | **Parameters** | **Use** |
| **Landsat 8 OLI** | Surface reflectance | Surface reflectance will be used within the ODC Sandbox and the HYDRAFloods model to calculate a time series water product to determine potential flooded areas. |
| **Sentinel-1 C-SAR** | SAR backscatter or decibels | Backscatter will be used within the HYDRAFloods model to calculate a time series water product to determine potential flooded areas. |
| **Sentinel-2 MSI** | Surface reflectance | Surface reflectance will be used within the HYDRAFloods model to calculate a time series water product to determine potential flooded areas. |
| **Suomi NPP VIIRS** | Surface reflectance | Surface reflectance will be used within the HYDRAFloods model to calculate a time series water product to determine potential flooded areas. |
| **Terra MODIS** | Surface reflectance | Surface reflectance will be used within the HYDRAFloods model to calculate a time series water product to determine potential flooded areas. |

***Ancillary Datasets:***

* SRTM – Elevation data for terrain correction analysis
* JRC Monthly Water History (Google Earth Engine) – Surface water data for comparison of ODC and HYDRAFloods
* Global Flood Database v1 (Google Earth Engine) – Surface water data for comparison of ODC and HYDRAFloods
* INEGI Basin Shapefile – Polygons of basins in Mexico

***Modeling:***

* Hydrologic Remote Sensing Analysis for Floods (HYDRAFloods) (POC: Kel Markert, NASA Marshall Space Flight Center) – create maps of flooded areas using radar and optical imagery

**Decision Support Tool & End Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| **ODC Flood Extent Maps** | These maps will identify areas of inundation (short-term surface water presence) based on algorithms implemented in ODC. | Landsat 8 OLI, Sentinel 1 SAR, Sentinel-2 MSI, MODIS (Terra and Aqua), and Suomi NPP VIIRS will be utilized in ODC to identify areas with presence of short-term surface water. | N/A |
| **HYDRAFloods Flood Extent Maps** | These maps will identify areas of inundation (short-term surface water presence) based on algorithms implemented in HYDRAFloods. | Landsat 8 OLI, Sentinel 1 SAR, Sentinel-2 MSI, MODIS (Terra and Aqua), and Suomi NPP VIIRS will be utilized in HYDRAFloods to identify areas with presence of short-term surface water. | N/A |
| **ODC & HYDRAFloods Comparison Analysis** | This analysis will compare ODC and HYDRAFloods products to each other and to third party inundation products like the JRC Surface Water products and the Dartmouth Global Flood Database. | Landsat 8 OLI, Sentinel 1 SAR, Sentinel-2 MSI, MODIS (Terra and Aqua), and Suomi NPP VIIRS will be utilized in HYDRAFloods to identify areas with presence of short-term surface water. | N/A |
| **Flood Detection Tutorial** | The tutorial will be a capacity building training that shows the partner how to use the code (already released) in ODC and how to apply the HYDRAFloods tool to the study region. | This tutorial will provide partners with training on how to run ODC and HYDRAFloods tool. Datasets include Landsat 8 OLI, Sentinel-1 SAR, Sentinel-2 MSI, MODIS (Terra and Aqua), and Suomi NPP VIIRS. | N/A |
| **ODC Flood Detection Algorithm** | This will be a narrative description of flood detection algorithm implemented in ODC. The algorithm will be described in sufficient detail to be easily replicated. Note: a coded version of the algorithm should not be expected unless the algorithm code has been released prior to project implementation | This algorithm will provide partners with sufficient information necessary for partners to replicate the algorithm in whatever environment they prefer. Datasets include Landsat 8 OLI, Sentinel-1 SAR, Sentinel-2 MSI, MODIS (Terra and Aqua), and Suomi NPP VIIRS. | IV |

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: Summer 2022

**Notes & References:**

***Notes*:** Open Data Cube Sandbox: <https://www.openearthalliance.org/sandbox>; Water detection notebook: [odc-colab/02.04.Colab\_Water\_WOFS\_L8.ipynb at master · ceos-seo/odc-colab · GitHub](https://github.com/ceos-seo/odc-colab/blob/master/notebooks/02.04.Colab_Water_WOFS_L8.ipynb)

HYDRAFloods open-source code repository: <https://github.com/Servir-Mekong/hydra-floods/>; documentation on how to use HYDRAFloods: <https://servir-mekong.github.io/hydra-floods/>

CEOS Deliverable: <http://deliverables.ceos.org/task_manager/deliverables/612/>

***References:***

Markert, K. N., Markert, A. M., Mayer, T., Nauman, C., Haag, A., Poortinga, A., Bhandari, B., Thwal, N. S.,

Kunlamai, T., Chishtie, F., Kwant, M., Phongsapan, K., Clinton, N., Towashiraporn, P., Saah, D. (2020). Comparing Sentinel-1 Surface Water Mapping Algorithms and Radiometric Terrain Correction Processing in Southeast Asia Utilizing Google Earth Engine. Remote Sensing, 12(15), 2469. Retrieved from https://www.mdpi.com/2072-4292/12/15/2469