**NASA DEVELOP National Program**

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

**Spring 2016**

**Short Title: Levant and Central American Climate I**

**Subtitle:** Monitoring Heavy Precipitation and Drought to Enhance U.S. Air Force Predictions and Decision-Making in the Levant and Central American Regions

**VPS Title:** Reverse the Thirst: Monitoring Heavy Precipitation and Drought

**Project Team & Partners**

**Project Team:**

Alec Courtright (Project Lead), alec.courtright@noaa.gov

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**Advisors & Mentors:**

Major Ryan Harris (14th Weather Squadron)

Raymond Kiess (14th Weather Squadron)

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Rob Blevins (Meteorological Connections, LLC)

**Partner Organizations:**

14th Weather Squadron (end-user), POC: Major Ryan Harris, Operations Officer; Boundary Organization

**Project Details**

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

**Study Area:** The Levant Region, made up of Syria, Lebanon, Israel, Iraq, and Jordan.

Central America, including Honduras, El Salvador, Guatemala, and Nicaragua.

**Study Period:** January 1981 - December 2015

**Earth Observations & Parameters:**

CMORPH-CDR, IR Band - Precipitation

PERSIANN-CDR, GridSat-B1 IR Window Channel - Precipitation

GPM, Merged Product - Precipitation

TRMM, TMI - Precipitation

Terra, MODIS - Normalized Difference Vegetation Index

NOAA-7,-9,-11,-14,-16,-17,-18, AVHRR - Normalized Difference Vegetation Index

GRACE - Groundwater

**Ancillary Datasets Utilized:**

* Global Historic Climate Network (GHCN) – Precipitation
* Integrated Surface Database (ISD) - Precipitation

**Models Utilized:**

* (USGS, USAID) Famine Early Warning Systems Network  (FEWS Net)

**Software Utilized:**

ArcGIS - raster manipulation/analysis, image enhancement & map creation of Landsat ETM+, NPP VIIRS, Aqua/Terra MODIS

GRASS GIS - raster manipulation/analysis, image enhancement & map creation of Landsat ETM+, NPP VIIRS, Aqua/Terra MODIS

R Statistical Program – statistical analysis and data processing

**Project Overview**

This project seeks to enhance the United States Air Force 14th Weather Squadron’s forecasting of heavy precipitation and drought in the Levant and Central America regions. Maps and climatologies will assist the Air Force with predicting areas within the study regions that are vulnerable to these climate extremes. Drought puts increased stress on the water supply and agricultural community. Heavy precipitation increases flooding and has many negative environmental consequences. The Levant and Central America’s unremitting sensitivities to drought and heavy precipitation create the need for better insight into the ties between conflict and incidences of severe climate variability.

**Abstract:**

The Levant region, comprising Syria, Lebanon, Jordan, Israel and Iraq, and countries along the Central American “Dry Corridor,” including Guatemala, El Salvador, Honduras, and Nicaragua, suffer from frequent drought and heavy precipitation events. Drought induces stress on water resources and the agricultural community and can serve as a catalyst to conflict as see in the Syrian civil war beginning in 2011 (Gleick 2014). Precipitation also has the potential to negatively affect communities through landslides and flooding. The United States Air Force 14th Weather Squadron uses authoritative climate data to inform military intelligence and planning in regions impacted by these extreme weather events. The 14th Weather Squadron is looking to expand their data analysis in both the Levant Region and Central America to monitor drought and heavy precipitation. Better understanding and a predictive monitoring tool can enhance military planning and intelligence in areas easily susceptible to conflict and where conflict is exacerbated due to drought or heavy precipitation. This project aims to utilize climate data from both NASA and NOAA Earth observations, climate data records (CDR’s) and other ancillary data to enhance the 14th Weather Squadron’s current drought and heavy precipitation monitoring systems in the Levant region and Central America.

**Community Concerns:**

* Heavy precipitation in the Levant and Central America is causing extreme flooding, water contamination, and landslides. These events put a strain on resources, cause significant loss of life, and isolate towns.
* Drought threatens the water supply and puts stress on agricultural communities.
* Recent severe droughts in both regions have resulted in crop failure and the die off of livestock. The high human and economic cost of these droughts has caused rural villagers to migrate to urban areas.
* In the Levant, mismanagement of water resources by the government and populations competing for resources in overcrowded cities has led to disaffection and civil conflict in Syria.
* Central America is classified by the United Nations as one of the regions of the world most heavily impacted by climate change. More consistent *in situ* monitoring and remote sensing is needed to prepare both regions for inevitable changes in their annual precipitation patterns.

**Current Management Practices & Policies**:

As part of the 2nd Weather Group, the 14th Weather Squadron collects, protects and exploits climate data to utilize in military operations and planning. The squadron monitors and analyzes several variables such as temperature and precipitation to improve predictive modeling and help the Department of Defense and other partner organizations plan for long-range climatic changes in all regions of the world. Currently, they use many remote sensing datasets as well as *in situ* data to examine a variety of parameters. They are constantly striving to provide higher resolution data over long periods of time. Their work aids in navigating societal challenges including globalization, coastal urbanization and population growth. Currently, the 14th Weather Squadron is focusing heavily on precipitation and drought to augment their findings with evapotranspiration and NDVI data in sensitive regions of the world.

**Decision Support Tools & Benefits:**

|  |  |  |
| --- | --- | --- |
| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Long-term climatology | CMORPH, Aqua satellite – precipitationPERSIANN – precipitationNOAA AVHRR – NDVIMODIS, Terra satellite - NDVI | Will give end-users (USAF, 14th Weather Squadron) historical patterns of precipitation and drought conditions to better understand seasonal and climatic trends |
| Drought and heavy precipitation monitoring tool | CMORPH, Aqua satellite – precipitation | Will identify areas of interest due to heavy precipitation or drought conditions based on regional stability concerns |
| Maps and Figures | CMORPH, Aqua satellite – precipitationPERSIANN – precipitationNOAA AVHRR – NDVIMODIS, Terra satellite - NDVI | Will provide end-users with communication resources and help the DEVELOP team communicate results |

**Project Imagery**

**[Insert image here]**

**Caption:**

**Image:**

**Software Release Requirements**

Category III – Software release unnecessary

**List the software or libraries used, under what license they were obtained, and the URL for the license in the table below:**

|  |  |  |
| --- | --- | --- |
| **Name** | **License** | **License URL** |
| R | Individual license  | https://cran.r-project.org/bin/windows/base/ |
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**Full Software Description and Plan**

**Introduction/Objective:**

What motivated the creation of this software, what problem does it address?

**Applications and Scope:**

Where and how will this software be used to influence decisions?

**Capabilities:**

What can it do better than what was previously available?

**Interfaces:**

How is one expected to use the software? For example, command line, GUI, script execution, etc.

**Assumptions, limitations, & Errors:**

What areas that the software could be improved upon in the future? This is where limitations of the theory, model, science, etc should be briefly documented. If the tools only work for a specific scenario, say so.

**Testing:**

What validation techniques and testing strategy will be used to build confidence in the software?