**NASA DEVELOP National Program**

****NASA Jet Propulsion Laboratory

**Summer 2015**

**U.S. Disasters II**

**Subtitle:** Using GRACE-derived water and moisture products as a predictive tool for fire response in the contiguous United States

**VPS Title:** JT Reager and the Goblet of Wildfire

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Dr. John T. Reager (NASA Jet Propulsion Laboratory)

**Past or Other Contributors:**

Max Baldridge

**Partner Organizations**

USDA Forest Service Remote Sensing Applications Center (RSAC), End-User, POC: Brad

Quayle, Everett Hinkley

NASA Terrestrial Hydrology Program at Goddard Space Flight Center, Collaborator,

POC: Dr. Matt Rodell

**Project Details**

**Applied Sciences National Applications Addressed:**

Disasters, Climate

**Study Area:** Contiguous United States

**Study Period:** January 2003 – December 2013

**Earth Observations & Parameters**

GRACE – Surface soil moisture content, root zone moisture content, terrestrial water storage

Terra, MODIS – Enhanced Vegetation Index

**Ancillary Datasets Utilized**

* Oak Ridge National Laboratory Distributed Active Archive Center, Global Fire Emissions Database version 4 (GFED v4) – Burned area, Fuel consumption, Fire emissions
* USGS, National Land Cover Dataset (NLCD) - land cover

**Software Utilized**

Python – Data processing and analysis

ArcGIS – Land cover analysis and result visualization

**Project Overview**

**80-100 Word Objectives Overview**

Understanding the relationships between fire and regional climate conditions has previously faced great limitations in terms of the development of remote sensing applications. GRACE-derived terrestrial water data presents unique capabilities in terms of remote sensing applications in reference to fire. To that end, this project developed a programmatic methodology and algorithm using Python to analyze the relationships between fire, water content, vegetation index, and land cover datasets. This enabled the assessment of fire risk in the contiguous United States, which in turn provides a useful product for directing ground-response efforts during fire seasons.

**Abstract**

Understanding the relationship between fire severity and soil moisture in the United States has faced much difficulty, limiting the ability to determine areas that are at high risk. This is largely due to the complex environmental factors at play, especially as they relate to alternating periods of wet and dry conditions, and the lack of remotely-sensed products. Recent drought conditions and accompanying low Fuel Moisture Content (FMC) have led to disastrous wildfire outbreaks that cause economic loss, property damage, and environmental degradation. Thus, developing a programmed toolset to assess the relationship between soil moisture, which contributes greatly to FMC and fire severity can establish the framework for determining overall fire risk. To properly evaluate these parameters, assimilated data from the Gravity Recovery and Climate Experiment (GRACE) and the Global Fire Emissions Database (GFED) were used to determine the extent soil moisture correlates with fire severity. Analysis, including surface soil moisture content (SFMC) and GFED burned area data, produced correlation and regression maps at a coarse resolution of 0.25 degrees for the contiguous United States. These fire-risk products and toolsets proved the viability of this methodology, allowing for the future incorporation of more GRACE-derived water parameters, MODIS vegetation indices, and other environmental datasets to refine the model for fire risk. This will allow the Tactical Fire Remote Sensing Advisory Committee (TFRSAC) and the USDA Forest Service Remote Sensing Applications Center (RSAC) to assess national-scale early fire management and provide responders with a predictive tool to better employ early decision-support to areas of high risk during fire seasons.

**Community Concerns**

* One of the biggest contributing factors to fire danger is fuel moisture content (FMC). Low FMC means higher the risk, as well as a higher potential for fire severity.
* There is a lack of remote sensing applications concerning FMC, and GRACE-assimilated terrestrial water products offers promising results in filling that gap.
* Studies show that fuel accumulation occurs in wet years, so together both wet and dry years are needed in sequence for increased fire risk and increased potential fire severity.
* A remotely-sensed FMC product, combined with an analysis of yearly wet and dry patterns, could provide fire managers and responders with a powerful predictive tool for understanding fire risk and response.

**Current Management Practices & Policies**

Currently, the USDA Forest Service Remote Sensing Applications Center (RSAC) uses MODIS, Visible Infrared Imaging Radiometer Suite (VIIRS), and Advanced Very High Resolution Radiometer (AVHRR) data to monitor active fires in the conterminous United States. Through remote sensing, the USDA Forest Service RSAC also creates post-fire severity maps used to predict erosion and post-fire effects. RSAC GIS specialist Brad Quayle also works with the National Interagency Coordination Center to provide fire predictive services such as Fuels and Fire Behavior Advisories based on modeling and *in situ* measurements. However, there is currently no accurate remotely-sensed fuel moisture content product in use, so an FMC product would improve predictive risk-assessment capabilities.

**Decision Support Tools & Benefits**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Consolidated, modeled data inputted into an already created algorithm | GRACE, Terra MODIS | An assessment of 11 years of fire, water, and climate data to model fire risk and direct on-the-ground mitigation and response efforts |

**Project Imagery**

**[Insert image here]**

**Caption:** [Insert Caption Here. Max of 25 words.] Image Credit: [Insert project short title] Team.

**Image:** File Name (Please submit your image as a separate .jpeg as well as inserting it in this document)