**NASA DEVELOP National Program**

****NASA Goddard Space Flight Center

**Spring 2016**

**Short Title: Great Lakes Ecological Forecasting**

**Subtitle:** Utilizing NASA Earth Observations to Monitor and Forecast the Spread of *Phragmites australis* in the Great Lakes Basin

**VPS Title:** Bogged down in Phragmites: Remotely Monitoring the Great Lakes Basin

**Project Team & Partners**

**Project Team:**

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**Advisors & Mentors:**

Laura Bourgeau-Chavez (Michigan Tech Research Institute)

**Partner Organizations:**

Great Lakes and St. Lawrence Cities Initiative (Collaborator), POC: Laura Bretheim; Boundary Organization

Michigan Technological University, Michigan Tech Research Institute (Collaborator), POC: Laura Bourgeau-Chavez

**Project Details**

**Applied Sciences National Applications Addressed:** Ecological Forecasting

**Study Area:** Great Lakes Basin: United States (MN, WI, MI, IL, IN, OH, PA, NY) and Canada (Ontario, Quebec)

**Study Period:** June 1985 – June 2020

**Earth Observations & Parameters:**

Landsat 5, TM - Land use/ land cover change

Landsat 7, ETM+ - Land use/ land cover change

Landsat 8, OLI - Land use/ land cover change

SRTM – Digital Elevation Model

Earth Observing-1, Hyperion - Vegetation indices

ALOS, PALSAR - Land use/ land cover change

ALOS-2, PALSAR-2 - Land use/ land cover change

**Ancillary Datasets Utilized:**

* USGS National Land Cover Dataset (NLCD) - land cover
* NOAA Coastal Change Analysis Program (C-CAP) - regional land cover

**Models Utilized:**

* Goddard Institute for Space Studies ModelE/Russell Model (GISS-E2-R)
* Clark Labs, TerrSet Land Change Modeler

**Software Utilized:**

ArcGIS - raster manipulation/analysis, image enhancement & map creation

QGIS - raster manipulation/analysis, image enhancement & map creation

ERDAS IMAGINE - raster manipulation/ analysis, land classification

TerrSet – forecast modeling of land change

**Project Overview**

**80-100 Word Objectives Overview:**

This project explored the capability of using Earth observations to monitor and forecast the extent of *Phragmites australis* in the Great Lakes Basin. The team used a combination of radar and optical imagery to map the extent of Phragmites from 1985 to 2015. Additionally, the team examined different environmental variables as drivers of change for Phragmites in the Great Lakes Basin. With a time series of land cover maps and environmental variables, the team forecast the extent of Phragmites in the Great Lakes Basin through the year 2020.

**Abstract:**

*Phragmites australis* is an invasive species that threatens wetland habitats in the Great Lakes and St. Lawrence River basin. Governance in both Canada and the United States recognize that Phragmites detection is a first line of defense in limiting the spread of this species. Left untreated, *Phragmites australis* will outcompete native regional wetland species, resulting in monotypic stands of invasive Phragmites. This creates unsuitable habitat for native fish or wildlife, increases fire risk, and increases elevation of the landscape, depriving wetlands of nutrients needed by native flora and fauna. Identifying the current extent of Phragmites, as well as forecasting their spread throughout the Great Lakes Basin, will help the Great Lakes and St. Lawrence Cities Initiative in its goal to distribute accurate Phragmites information to local policymakers in both the US and Canada. Utilizing Advanced Land Observing Satellite-2(ALOS-2)Phased Array type L-band Synthetic Aperture Radar(PALSAR-2) data, in combination with Landsat 8 Operational Land Imager (OLI) data, land use/land cover maps were created mapping the current extent of Phragmites in 2015. Using the TerrSet Land Change Modeler, Phragmites extents were forecast through the year 2020. Forecasting results will help local governments enact policy to plan for and mitigate the spread of *Phragmites australis*. Challenges and limitations included obtaining temporally and spatially comprehensive PALSAR-2 data for the Great Lakes Basin.

**Community Concerns:**

* *Phragmites australis* is an aggressive invasive freshwater or brackish-tidal wetland perennial grass.
* Phragmites easily outcompetes native plant species due to its ability to reproduce through seeds or underground rhizome clones.
* Phragmites can grow up to 15 ft. tall with up to 60 stems per sq. ft., displacing native marsh vegetation.
* Dense monotypic stands of Phragmites create unsuitable habitat for native fish or wildlife, increase fire risk, and increase elevation of the landscape.
* Once Phragmites are introduced in an area they are difficult to remove.

**Current Management Practices & Policies**:

The Great Lakes and St. Lawrence Cities Initiative (GLSLCI) does not currently involve remote sensing in their management decisions for the Great Lakes Basin, nor do they have a strong understanding of the current extent of *Phragmites australis* for the region. The GLSLCI also lacks understanding of how Phragmites extent will change in the future. Current policies are carried out through an intergovernmental collaborative across cities, municipalities, states, and provinces. The Great Lakes Phragmites Collaborative was established to facilitate communication among stakeholders across the region and serve as a resource center for information on Phragmites biology, management, and research. Current inventories of Phragmites extent involve funding field crews to collect field data of known areas of invasion. Current management practices to eradicate *Phragmites australis* involve the use of herbicides, mowing, prescribed burning, flooding, tarping, and grazing.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Land Use / Cover Time Series and Current Phragmites Extent Maps | Landsat 5 TM; Landsat 7 ETM+; Landsat 8 OLI; ALOS PALSAR; ALOS-2 PALSAR-2 | Land Use/Land Cover maps for multiple dates will provide the extent of *Phragmites australis* as a time series, showing where the species is spreading and its rate of dispersal throughout the Great Lakes Basin. This will allow city governments to plan and mitigate the impact of this invasive species within their jurisdiction. |
| Forecasted Phragmites Extent Maps | Landsat 5 TM; Landsat 7 ETM+; Landsat 8 OLI; ALOS PALSAR; ALOS-2 PALSAR-2; SRTM | Forecast maps for the year 2020 will help local and regional governments throughout the Great Lakes identify where *Phragmites australis* is likely to spread. This will allow city and regional governments to direct capital and resources in preventing the invasive species from establishing itself in these coastal areas. |

**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)

**Software Release Requirements**

What category do the tools your project is creating fall within? Category I