National Wetlands Inventory: Integrating New Mapping Technologies

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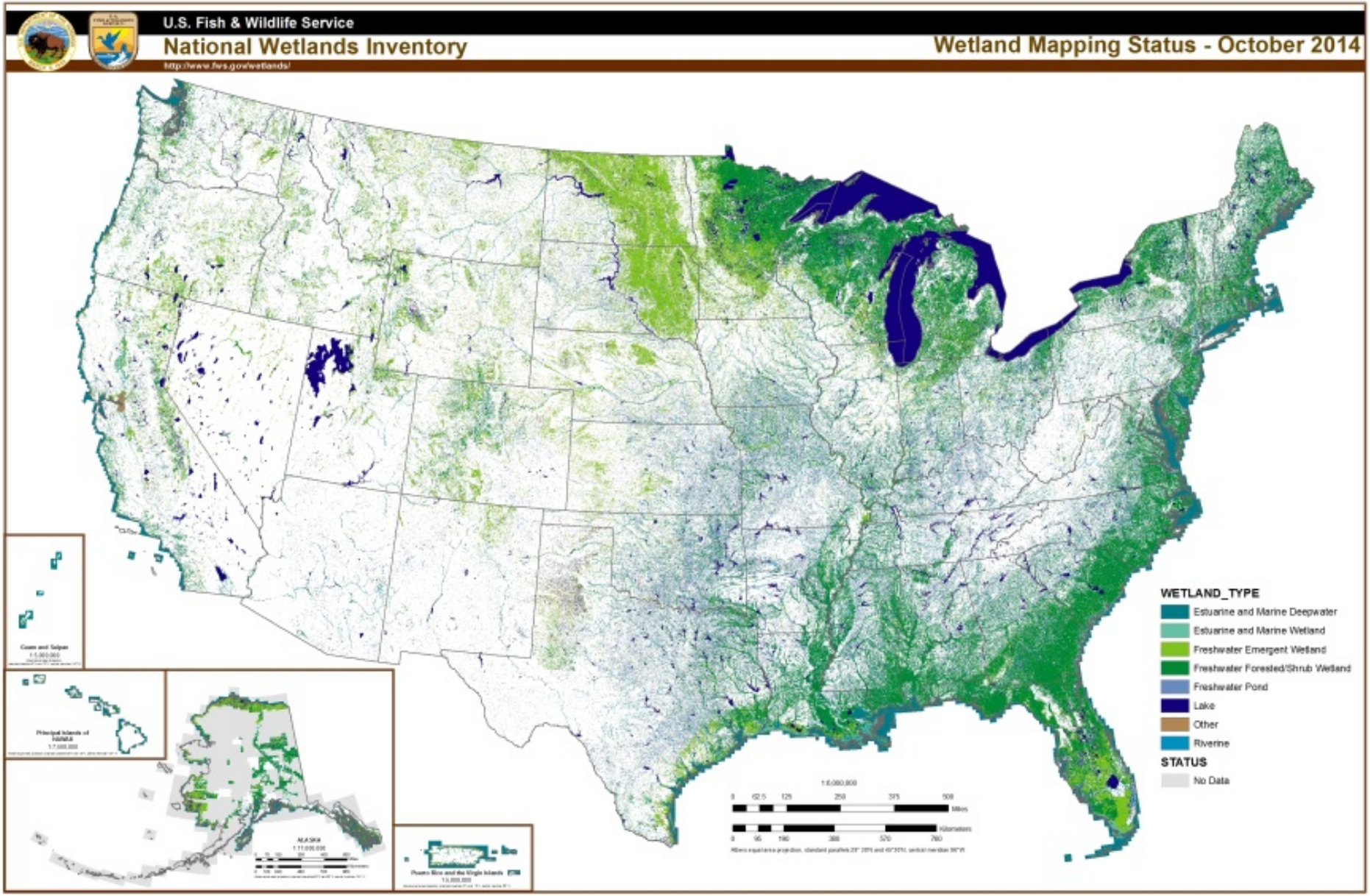
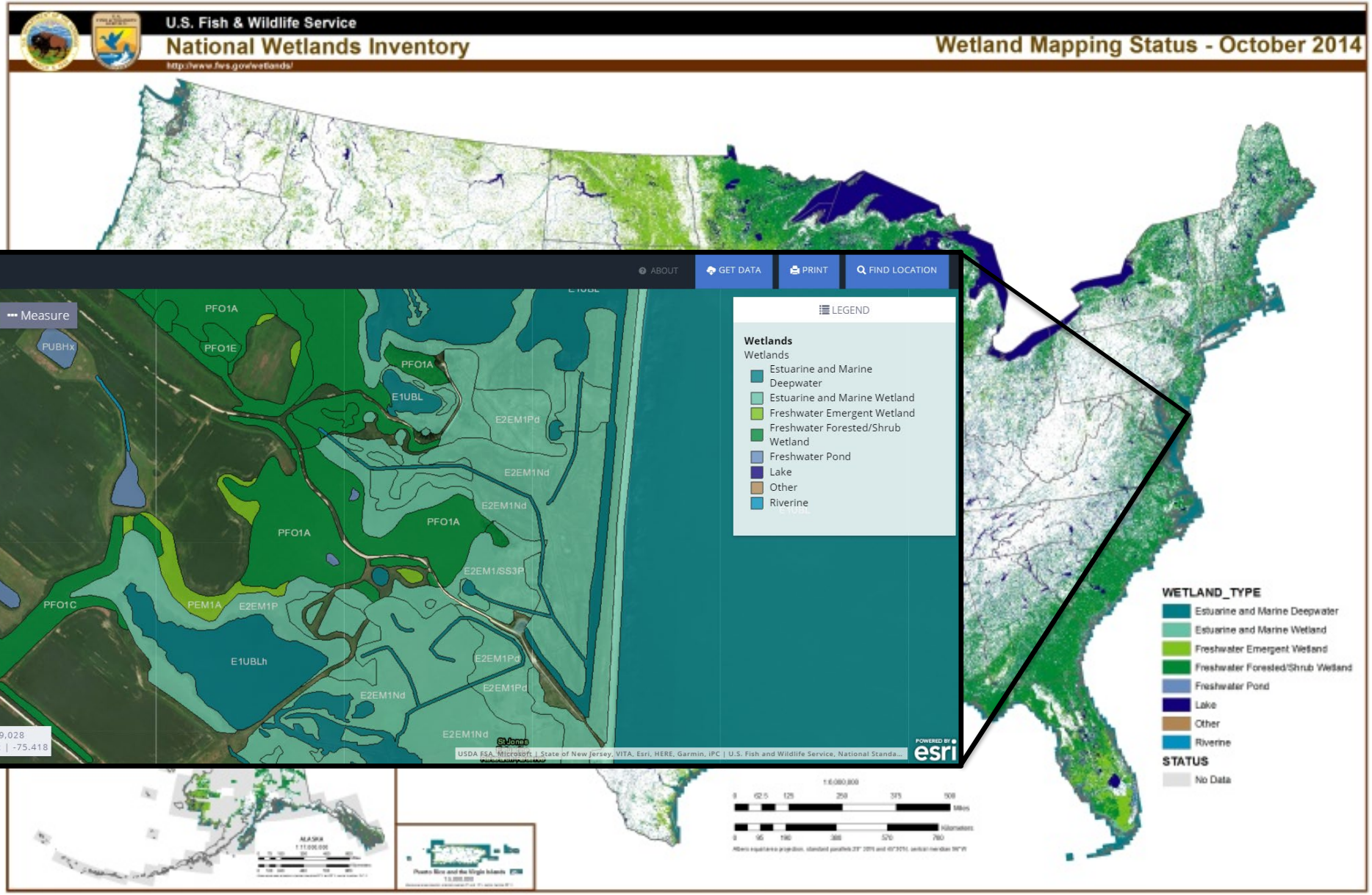
National Wetlands Inventory
U.S. Fish and Wildlife Service


U.S. Fish & Wildlife Service
National Wetlands Inventory
http://www.fws.gov/wetlands/
Wetland Mapping Status - October 2014
WETLAND_TYPE
Estuarine and Marine Deepwater
Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond
Lake
Other
Riverine
STATUS
No Data
Guam and Saipan
Principal Islands of HAWAII
ALASKA
Puerto Rico and the Virgin Islands
1:6,000,000
0 62.5 125 250 375 500
Miles
0 95 190 380 570 760
Kilometers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ABOUT
GET DATA
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PFO1A
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PUBHx
E1UBL
E2EM1Pd
E2EM1Nd
PFO1C
PEM1A
E2EM1P
E1UBLh
E2EM1/SS3P
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USDA FSA, Microsoft | State of New Jersey, VITA, Esri, HERE, Garmin, iPC | U.S. Fish and Wildlife Service, National Standa...
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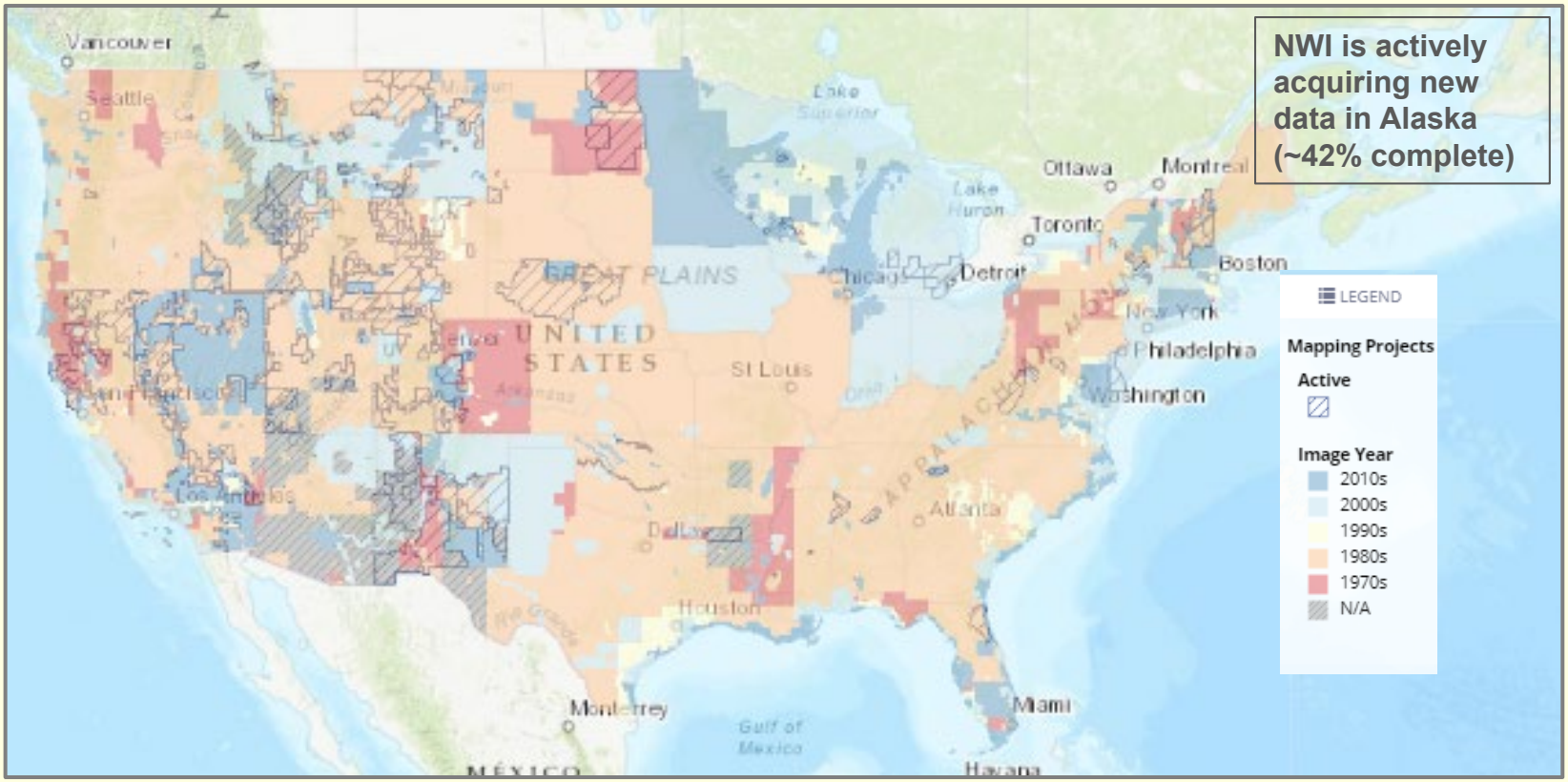
Dataset Production Methods

- Manual interpretation of fine spatial resolution (≤1-5m) optical images in a GIS, augmented by:
  - Ancillary data – DEMs, SSURGO, etc.
  - Limited automated classification techniques
- Highly detailed classification system (800 codes used)

	Lower 48 States, Hawaii, & Territories *	Estuarine & Lacustrine Deepwater **	Alaska (Including Deepwaters)
TMU	0.5 acres (0.2 ha)	1.0 acres (0.4 ha)	5.0 acres (2.0 ha)

For additional information please see: FGDC-STD-015-2009

NWI's Critical Challenge

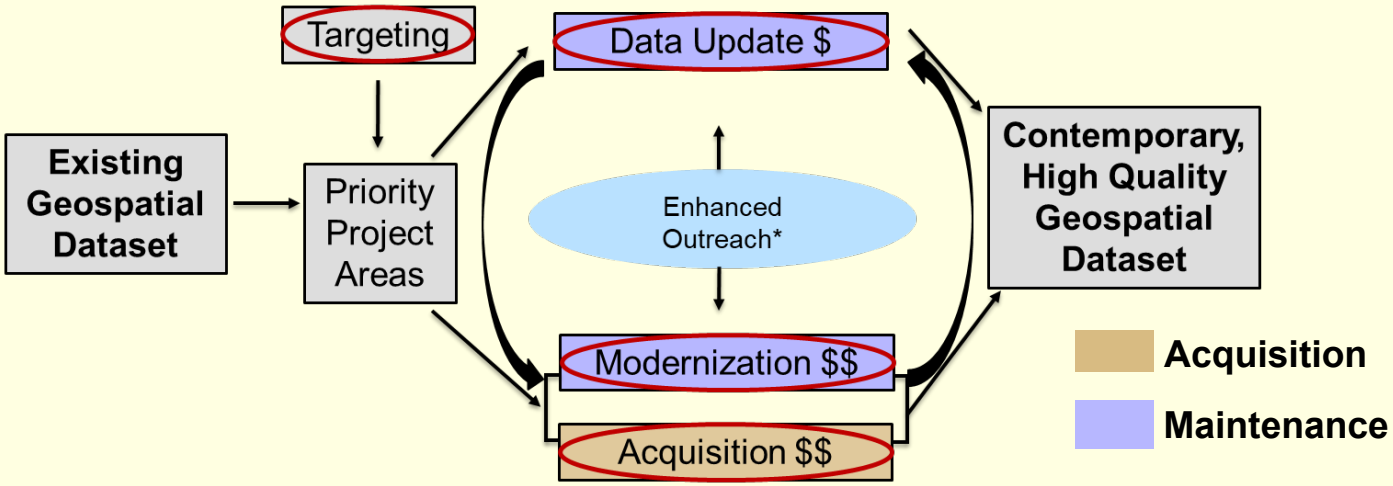


Acquisition and maintenance of a contemporary dataset that meets users' needs for accuracy, as well as detail.

Current State of Wetland Mapping

- Rapid technological development, but wetlands still very challenging to accurately (and cost-effectively) map
  - Especially at fine spatial scale, including hydroperiod
- **How do we address this challenge at a national scale?**

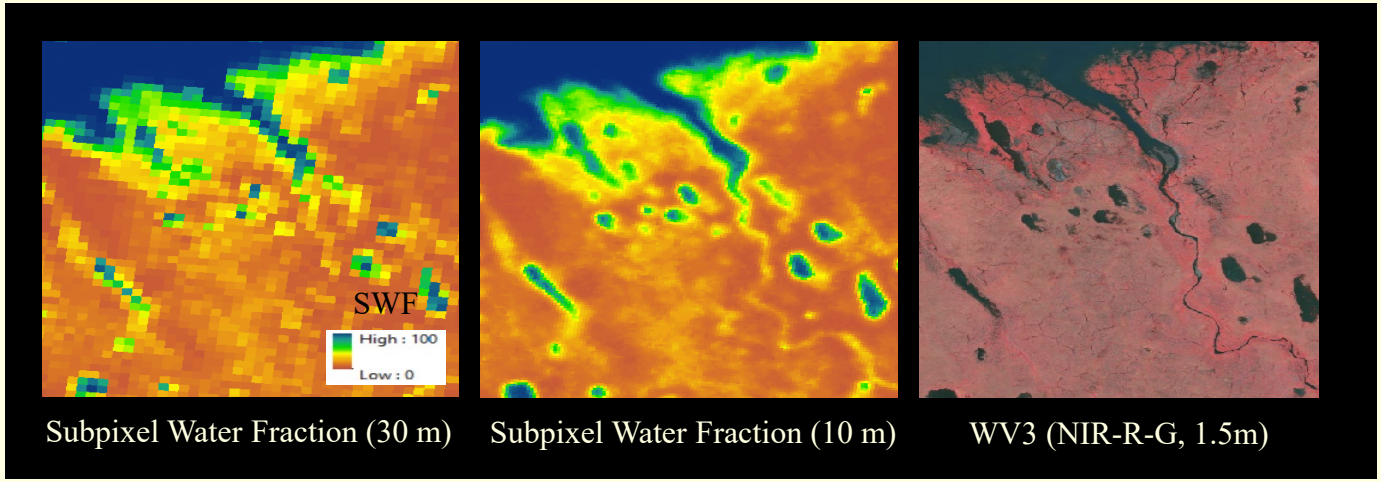
Future of NWI Mapping



- Adaptively manage NWI's targeting, acquisition and maintenance procedures to **leverage the best of all datasets and techniques/processes**
  - **Key**: A semi-automated approach – where automated processes are used to strategically improve efficiency and quality within a robust, time-tested manual foundation

New Mapping Technology Project

- We are **increasing** our efforts to actively support the adoption of new mapping technologies.
  - **Goal:** Balance current financial and technical constraints, while making measurable strides towards better meeting demands for high quality, contemporary data



New Mapping Technology Project

- NMT Project supports a wide variety of efforts aimed at producing **cheaper, better, faster data**
  - Enhanced Leveraging of Partnerships
    - Increase dialogue between and among NWI and partners
    - Enhance leveraging of existing resources – e.g., ancillary data
  - Re-examination of mapping and agreement process
    - Evaluate mapping strategies/processes in order to better leverage partner skillsets and other resources
  - Strategic investment in research and development
    - Application of existing products – e.g., C-CAP HR and DSWE
    - **Development of new products**
      - **Foundational ancillary data**
      - **Improved targeting inputs/models**
      - **NWI Standard compliant data**

High Potential Technologies

- Enhanced Data
  - Lidar derived products
    - Potential wetness, vegetation height & flowlines
  - Analysis ready data (ARD)
  - Data fusion
  - Fine spatial resolution satellite imagery
    - Better geographic coverage
    - Finer temporal resolution
  - Longer wavelength SAR
- Advanced Analytical Capabilities
  - Artificial Intelligence
  - Cloud computing
  - Object based image analysis
  - Time series/trend analysis
- Better training data
  - Helicopters and UAS

Include - but are not limited to

Leveraging New Mapping Technologies to Advance NWI

Production of Foundational Ancillary Data in the Arctic National Wildlife Refuge

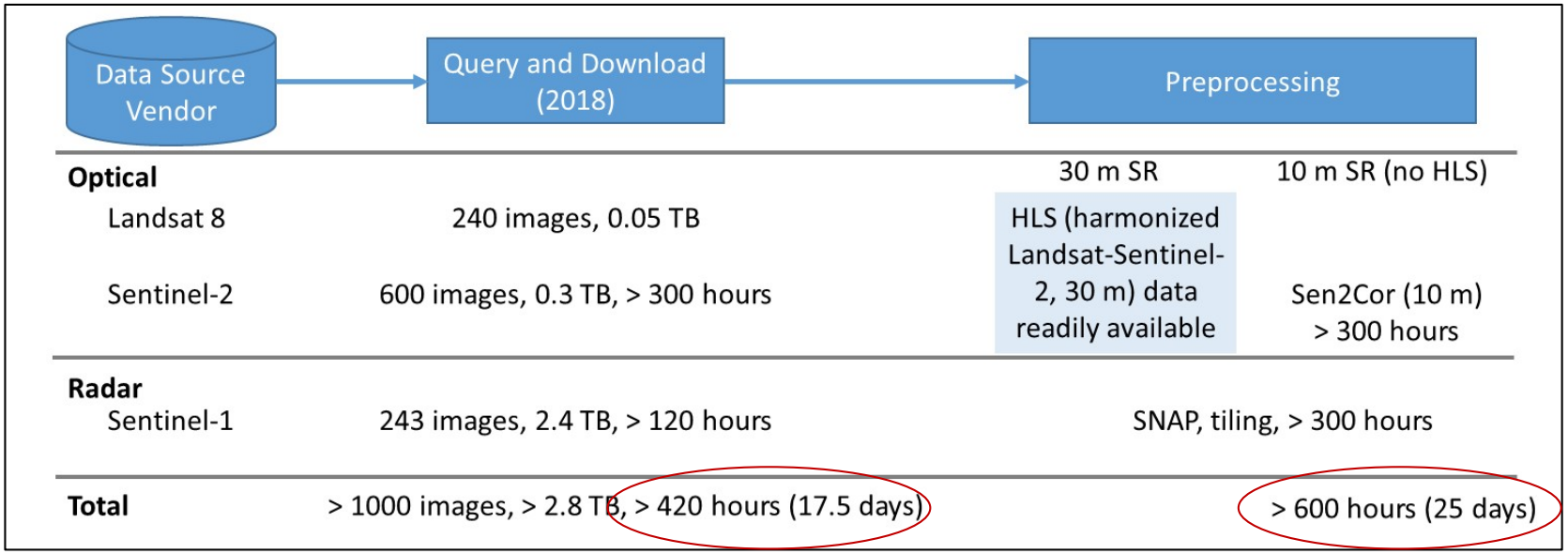
Project Background

- Over 40% of Alaska is wetland, as opposed to less than 5% of CONUS
- Most of America's wetlands are located in Alaska, but NWI covers only 42%
  - Over 31M acres of NWRS lands are not mapped

- NWI data needed to conserve waterfowl, salmon and big game
  - Essential for supporting economy and subsistence populations
- NWI data also critical for cost-effective, conservation oriented infrastructure development

Mapping Inundation within Alaska

- An ongoing project was designed to create foundational ancillary data to support more efficient/effective manual data production.
  - Protocol pulls in 100s to 1,000s of S-1/2 images to create monthly or probability based sub-pixel water fraction products

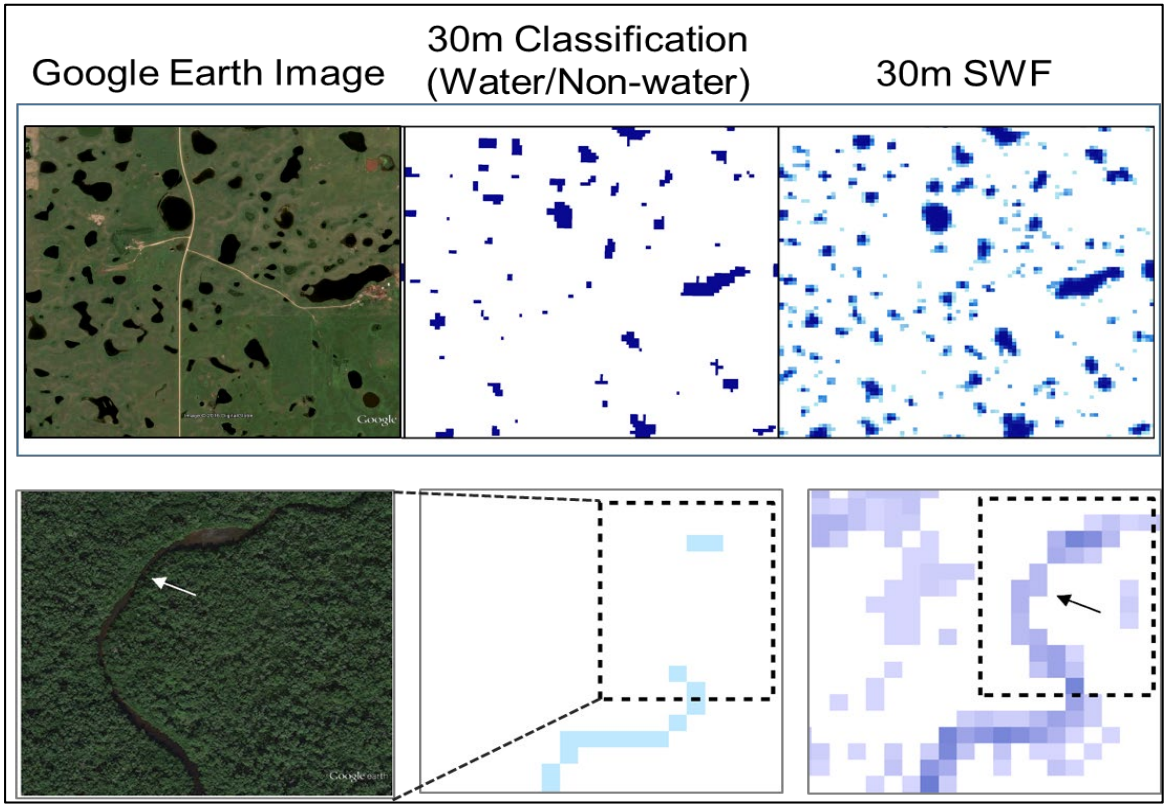


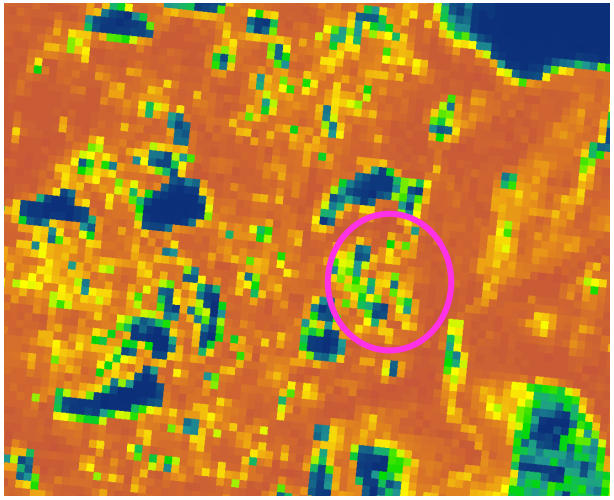
Collaborators: Chengquan Huang, Ben DeVries, and Zhenhua Zou (University of Maryland)

Subpixel water fraction (SWF) quantifies continuous (0-100) surface inundation:

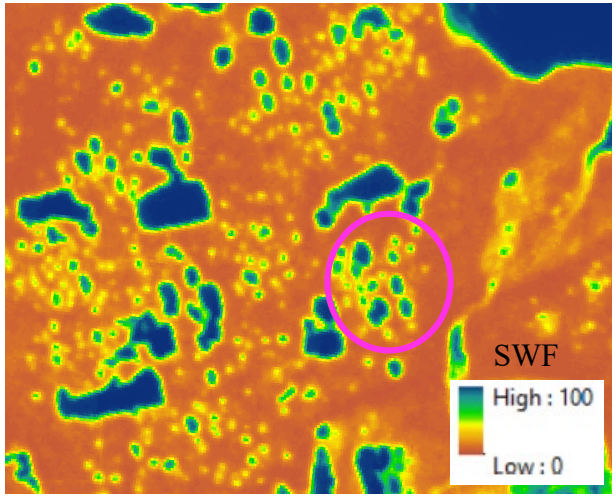
$$SWF = \frac{\text{Water area in pixel}}{\text{Total area of pixel}}$$

Small/narrow wetlands better detected using SWF





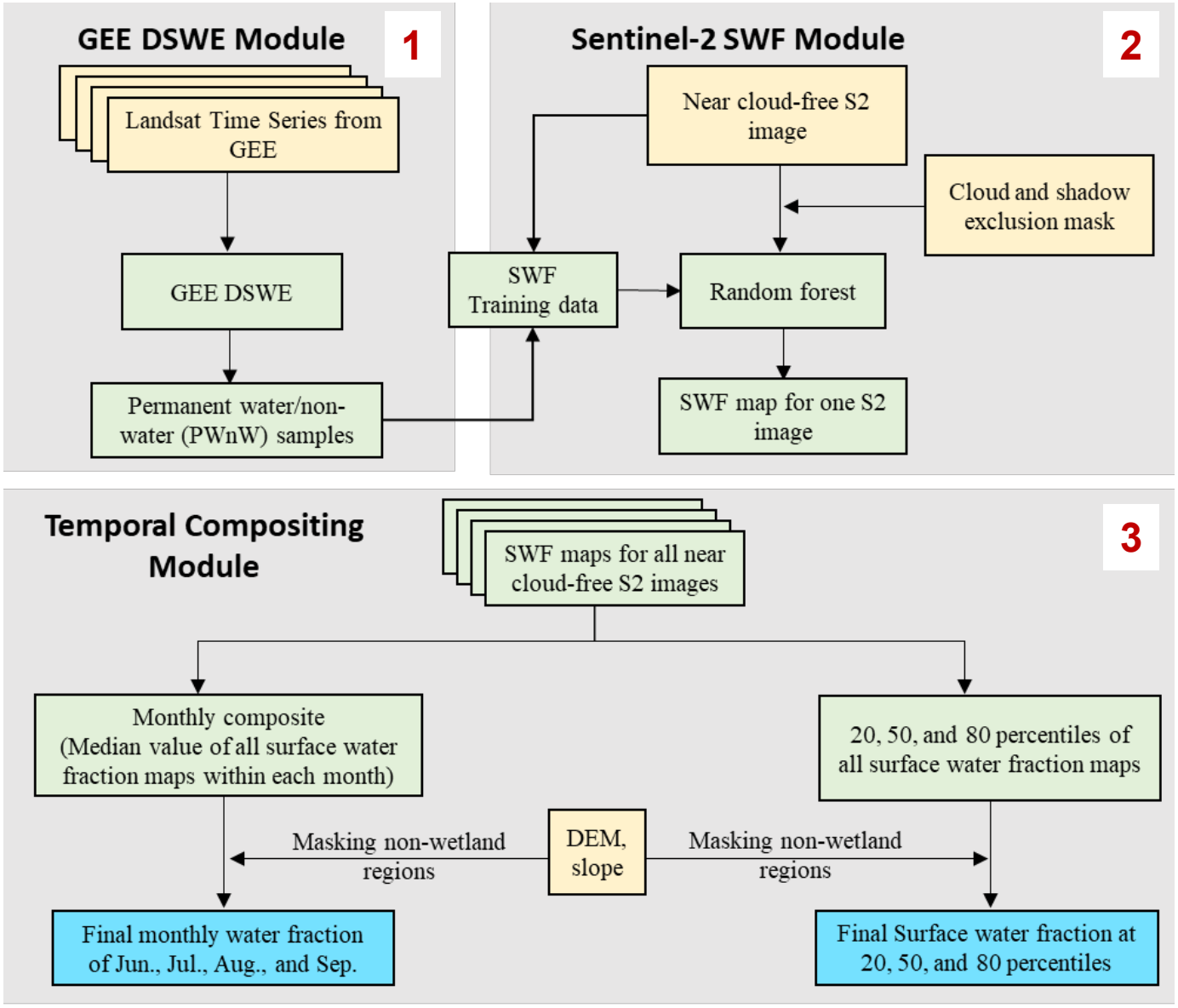
Subpixel Water Fraction (SWF, 30m)



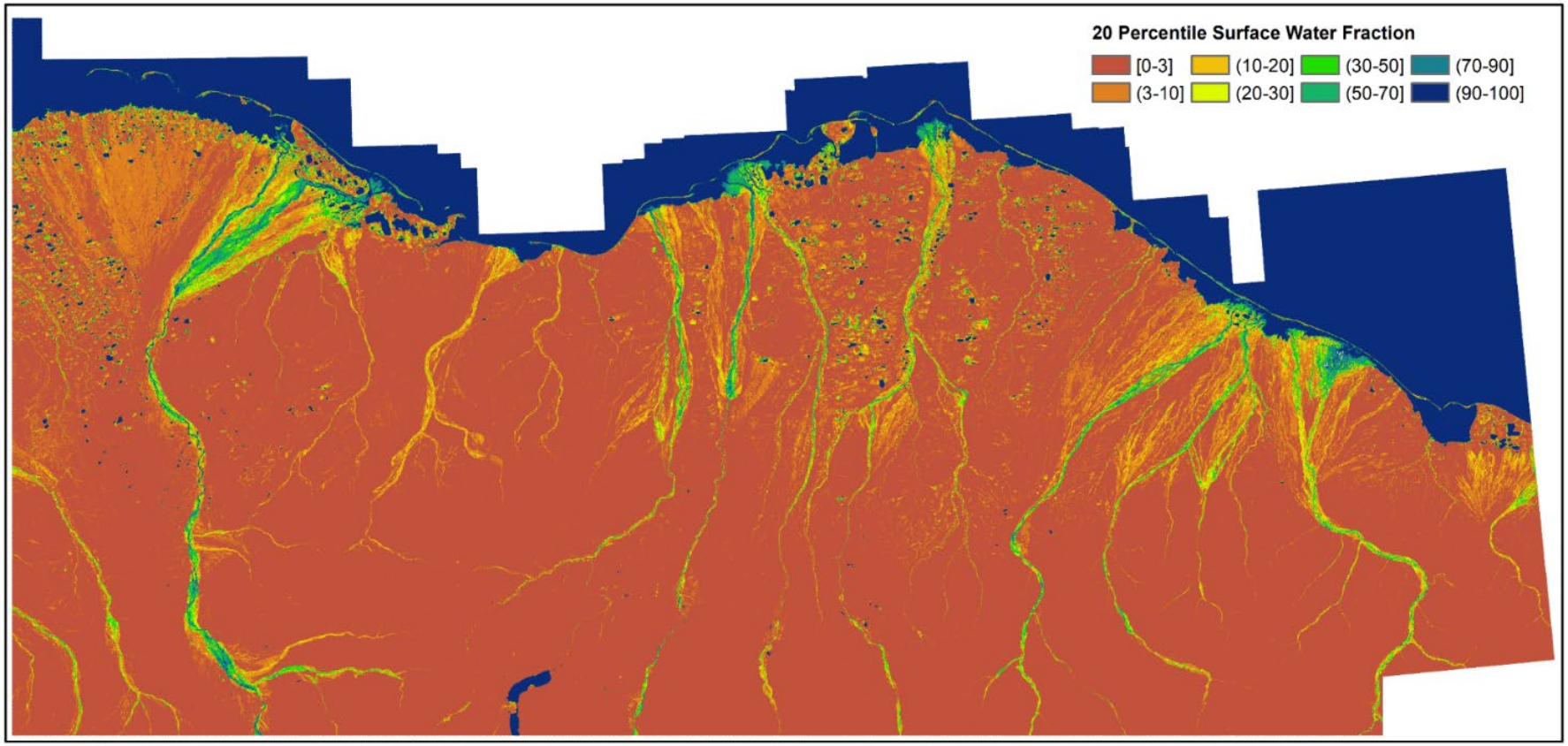
SWF(10m)

Digital Globe WV3 Image (1.5m)

SWF Processing Flow

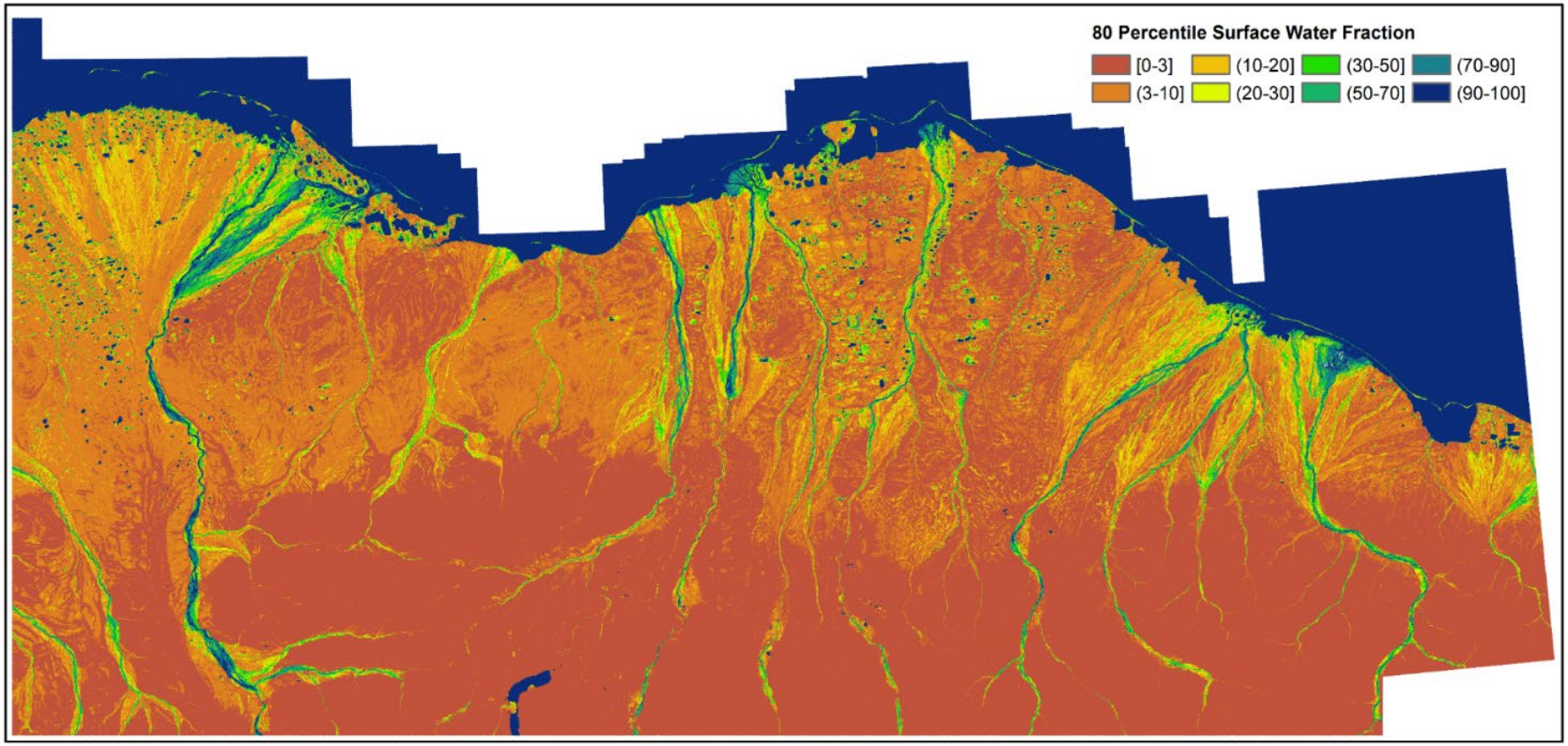


Twentieth Percentile SWF for 1002

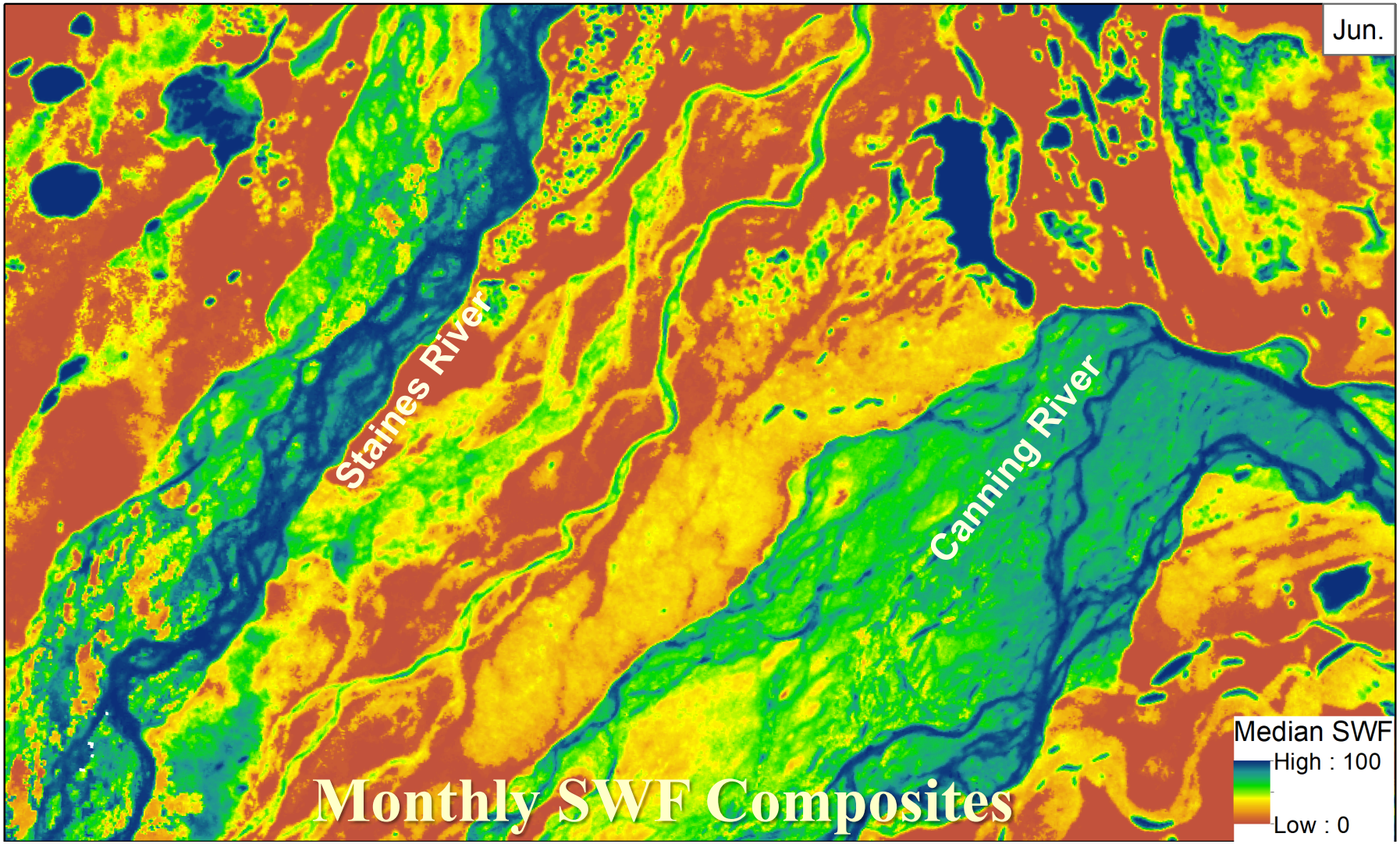


Annual Subpixel Water Fraction Composite Representing Low Water Levels

Eightieth Percentile SWF for 1002

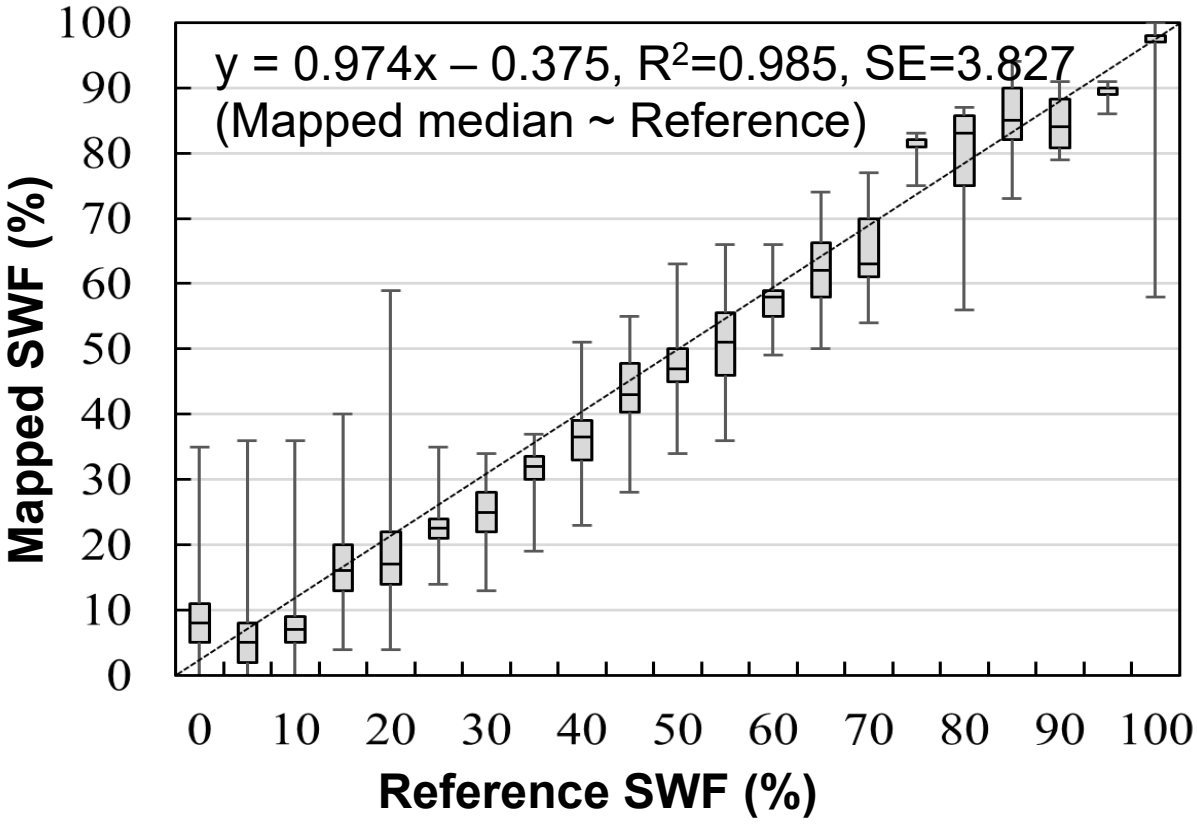


Annual Subpixel Water Fraction Composite Representing High Water Levels



Subpixel Water Fraction provides new information on intra-annual inundation dynamics that allows for more rapid and accurate determinations of wetland boundaries and NWI water regime modifiers. This information is especially critical in sensitive, rapidly developing areas that have lacked wetland information.

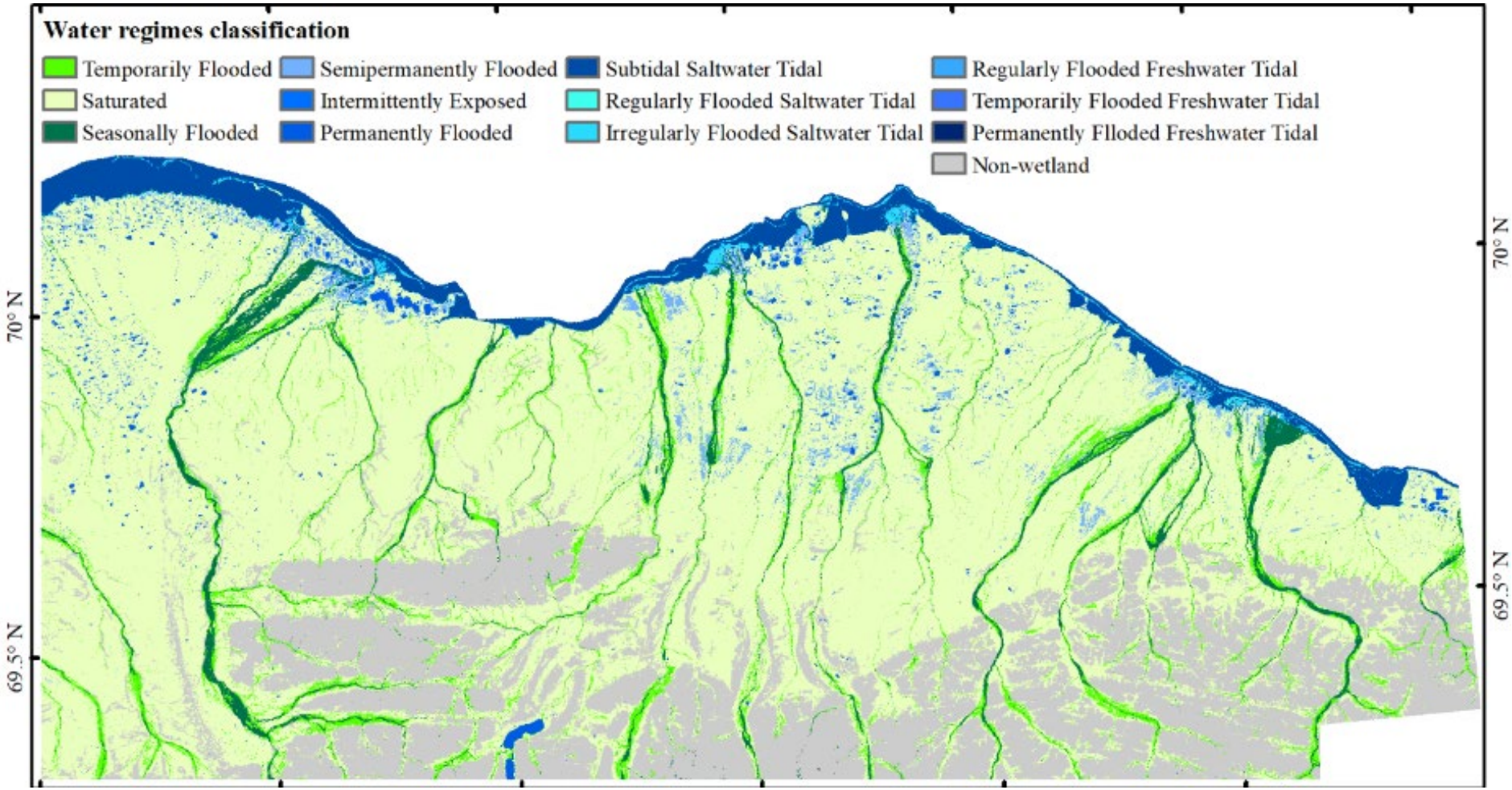
Pixel-Level Comparison of Mapped SWF with Reference Data



92% pixels had SWF values within 10% of reference data

Best available validation data: over 4,000 field photos collected at 300 locations used to validate SWF products. Photos collected from helicopter and the ground.

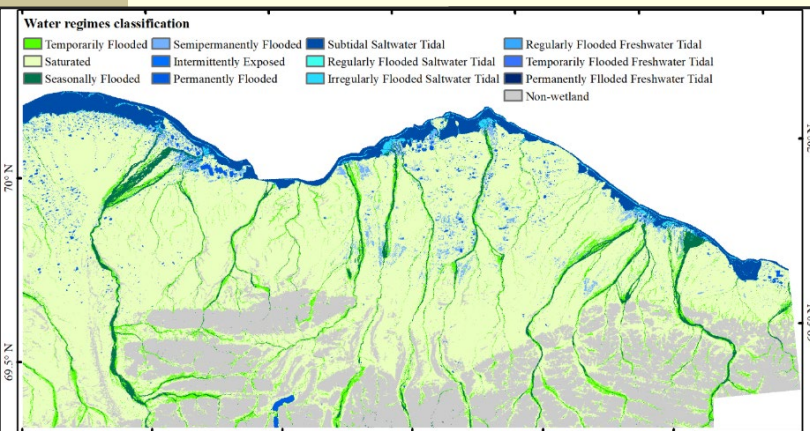
Water Regime for 1002

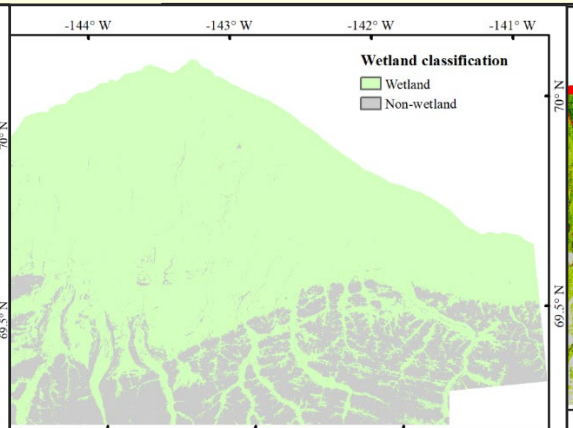


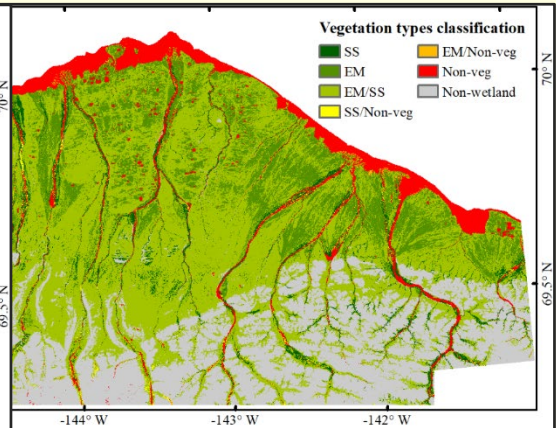
Monthly SWF composites for growing season and topographic metrics are used to produce water regime map for 1002 based on NWI water regime definitions

Closing Thoughts and Next Steps

- Products are available, and GEE tool can be shared.
- Automated products are intended to be foundation of manual analysis – thus (hopefully) improving quality/cost-effectiveness while maintaining NWI standards
  - **Next step**: Assess the effect of integrating these automated data within NWI workflow





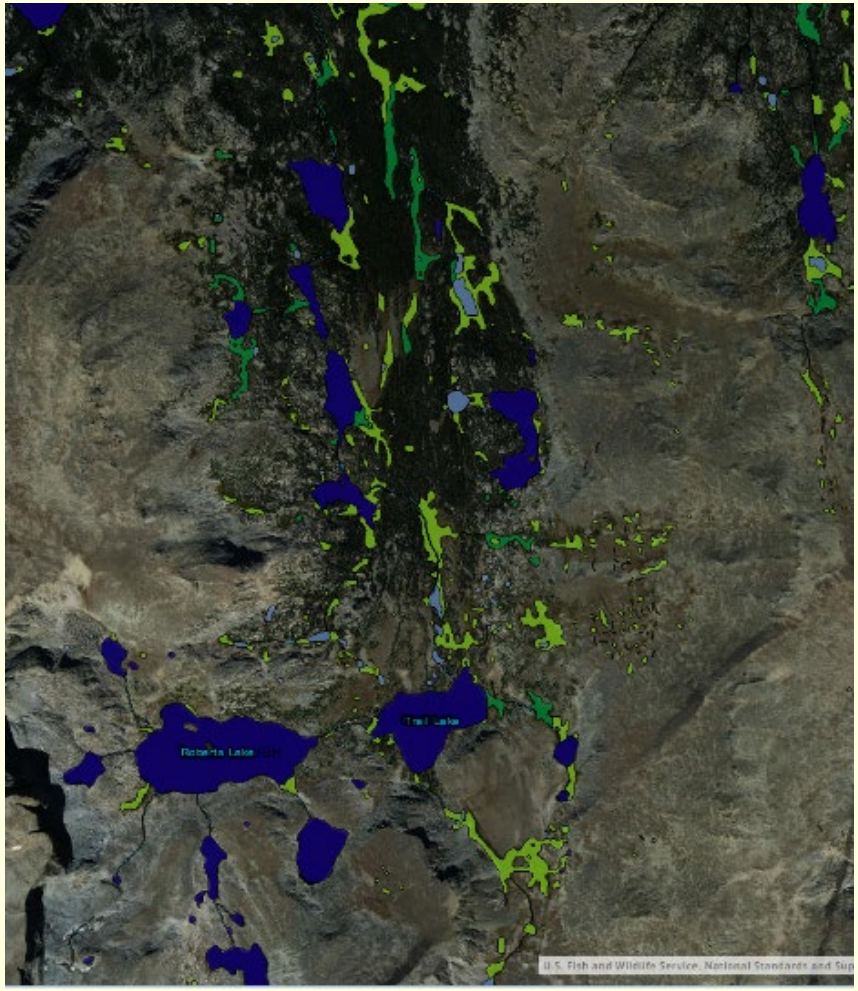


Leveraging New Mapping Technologies to Advance NWI

Improved Targeting of Updates in CONUS

Project Background

- Old data not always “bad”
  - Data are fine if land cover has not changed
- Need to identify areas in need of update
  - Strategically apply limited existing resources
  - Solicit new resources
  - Guide use of existing data
  - **Impact conservation**



Wyoming, 1983

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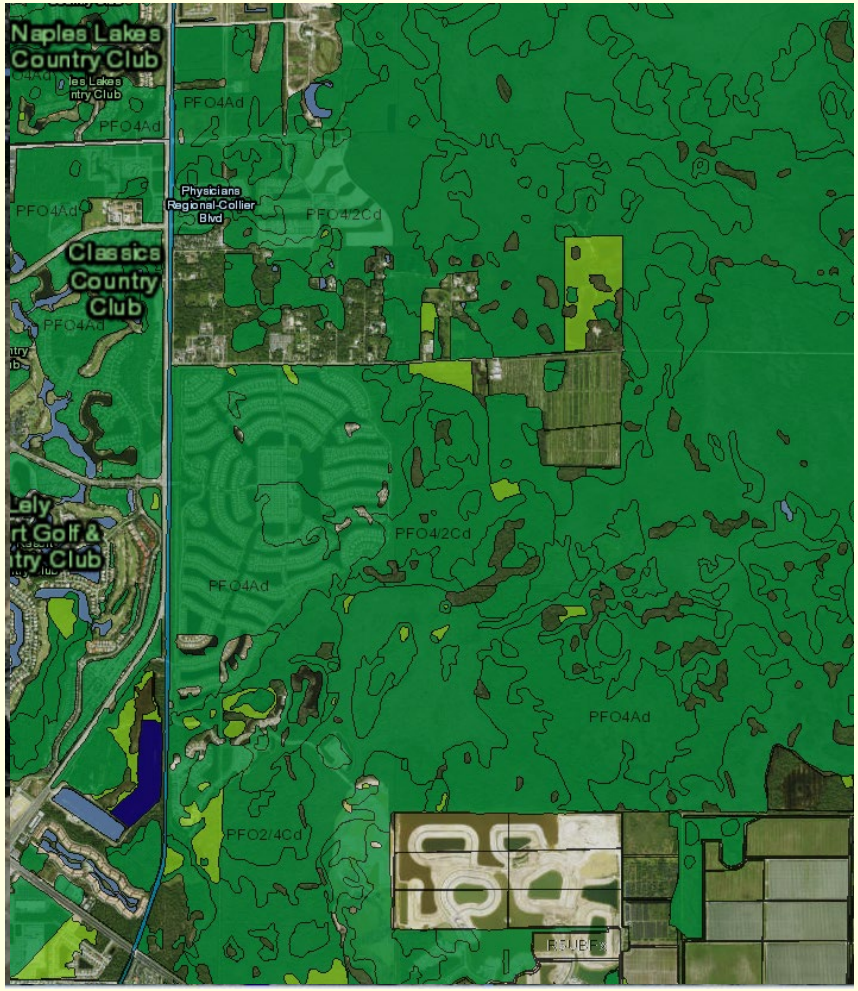
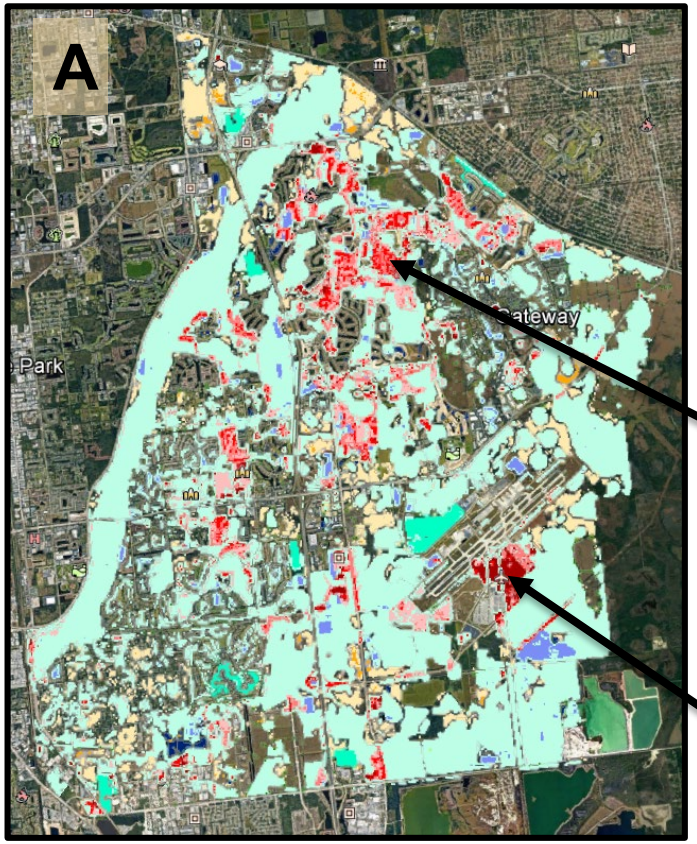
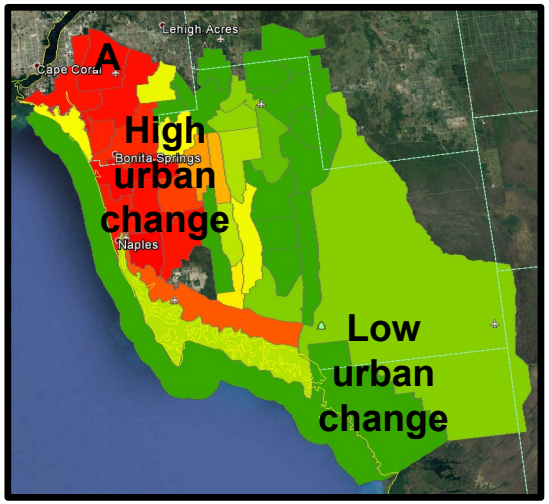


Florida, 1999

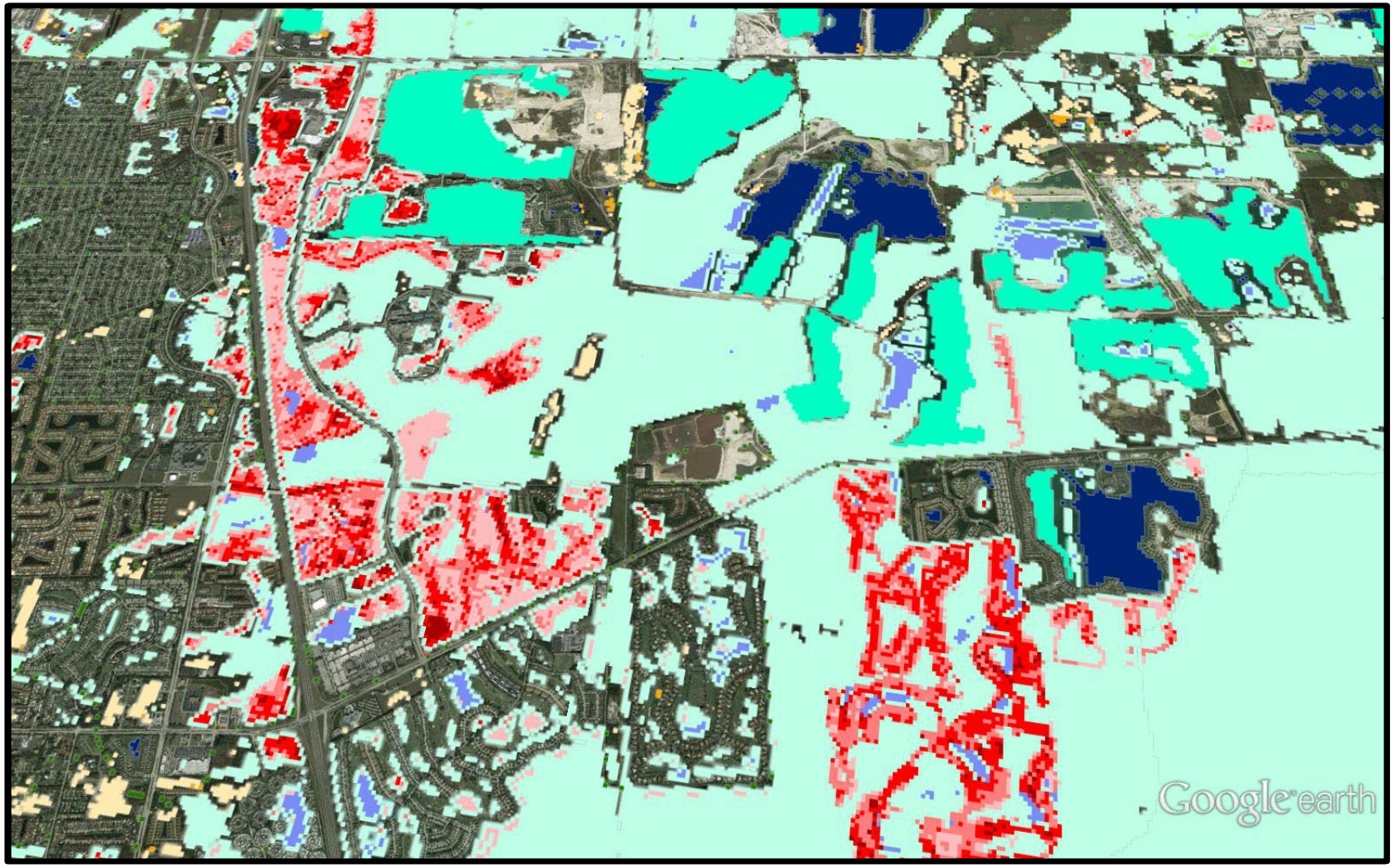


- NWI (T1) compared to NLCD 2016 (T2) at a 30 m scale to ID likely change areas, focusing on:
  - Areas that were NWI wetland or deepwater and are now medium or high intensity urban
  - Areas that were NWI upland and are now open water

- Change data are aggregated to the HUC-12 watershed scale across the CONUS
  - Several indices are created, including area, percent and normalized change area.



Collaborators: Chengquan Huang, Ben DeVries, and Zhenhua Zou



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- Wetland to NLCD Low intensity urban
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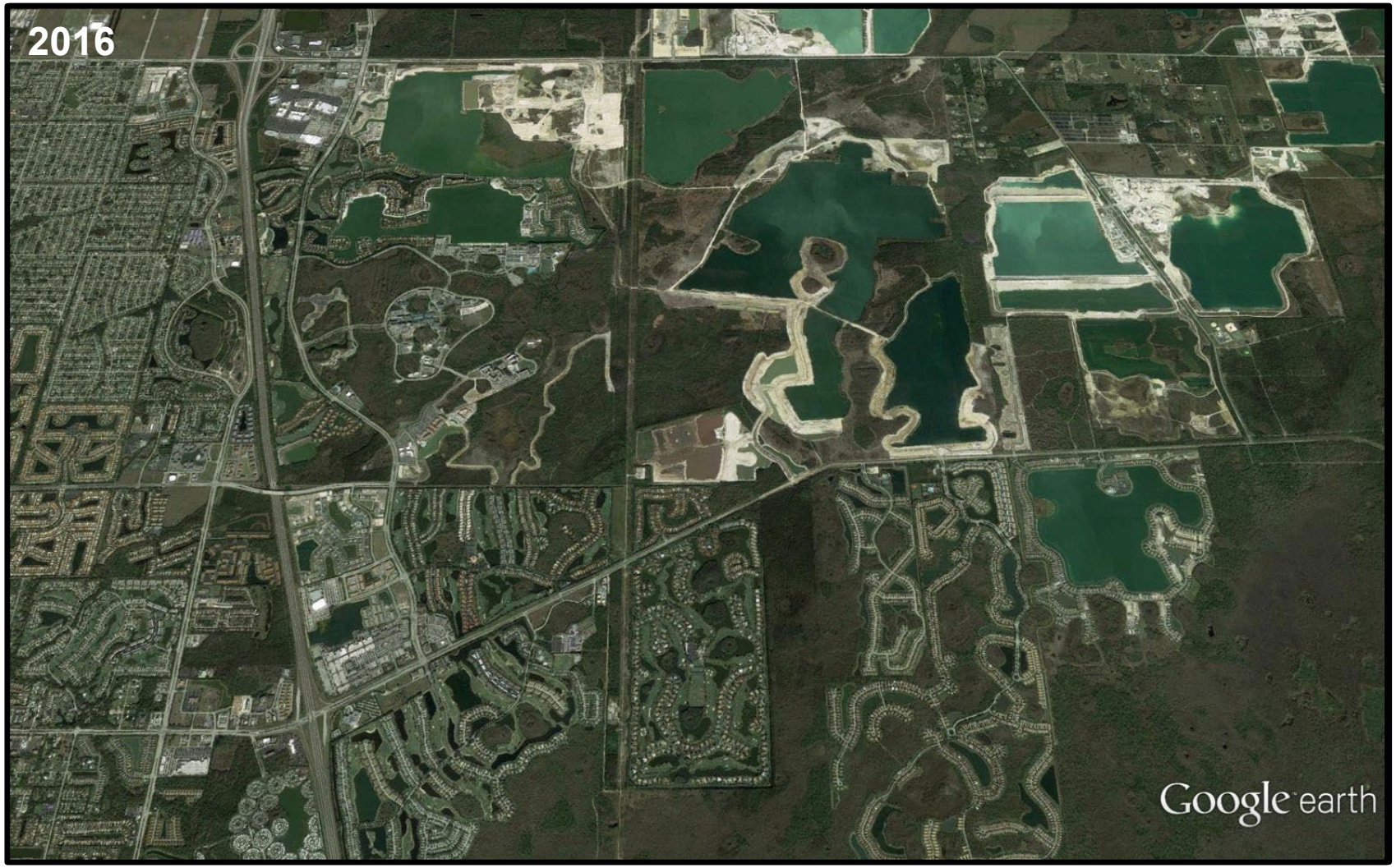

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Acres Wetland to Medium/High Intensity Urban per 10K Acres

- Recently developed HUC-12 change data will be used within NWI's Wetland Mapping Targeting Tool
  - Multiple data layers that can be used with a simple weighted algorithm to assess update priority
    - Land cover change, wetland density, base image quality, population metrics and location of stakeholder lands

General NMT Evaluation Criteria

- Before incorporating NMT NWI considers:
  - Needs of key stakeholders
  - Resource availability to implement technique
  - Effect of new technique on:
    - Uncertainty
    - Timeliness and cost
    - Consistency and feasibility – across the Nation
      - Might work someplace (sometime), but not everywhere
  - Not can; but instead should?
    - Cost/benefit of adaptation versus status quo

Closing Thoughts

- No easy button
  - If this were easy - we wouldn't be here!
- We don't expect automated processes to replace manual approaches in the foreseeable future
  - A dual manual-automated approach is needed to support NWI
- Progress will be incremental over time
- **We are in it for the long haul!**
- **Partnership is critical for success!**

The End