National Aeronautics and Space Administration

High-resolution mapping of wetland distribution and biomass with L-band radar

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1. INTRODUCTION

- Wetland marshes provide important ecosystem services such as carbon storage, coastal protection and biodiversity
- High resolution maps of extent and biomass are required for reporting to UN initiatives (e.g., Intergovernmental Panel on Climate Change (IPCC)) but are largely unavailable
- Anthropogenic pressures such as coastal development are causing the loss of wetland marshes and their associated ecosystem services

2. OBJECTIVE

- Map Louisiana wetland marsh extent and biomass within the St. Mary and Terrebonne parishes
  - Derive a high-resolution map of wetland marsh extent
  - Test the capacity for biomass mapping with JPL airborne radar

3. MAPPING WETLAND MARSH EXTENT

- Sentinel-2 optical satellite imagery acquired September 2017
- Object oriented classification using a Random Forests machine learning algorithm (Fig. 1)
- Trained with reference to high-resolution imagery and local base station (CRMS) data
- Accuracy 90.5%, kappa 0.86

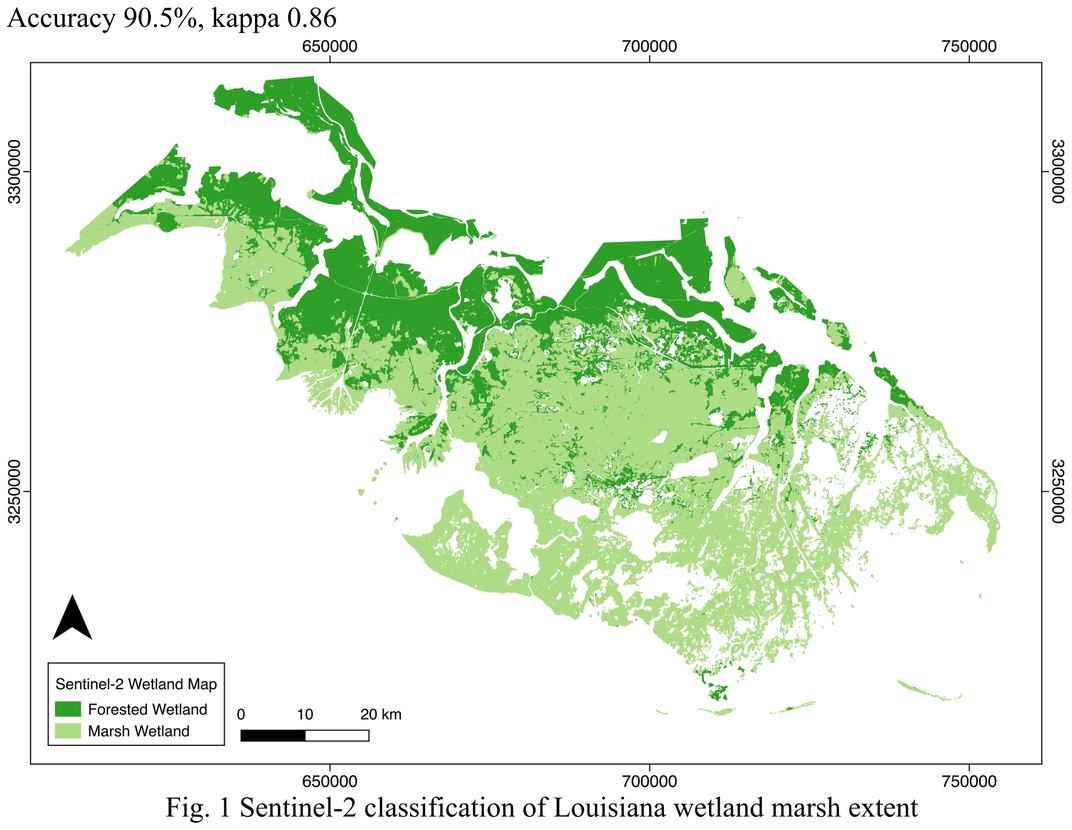

Fig. 1 Sentinel-2 classification of Louisiana wetland marsh extent

4. DIFFERENCE IN EXTENT

- Subclasses in NWI/C-CAP reclassified to match Sentinel-2 derived classes of marsh and forest
- Differences with Sentinel-2 map (Fig. 2, Table. 1) the result of marsh change, accuracy/coverage and spatial resolution

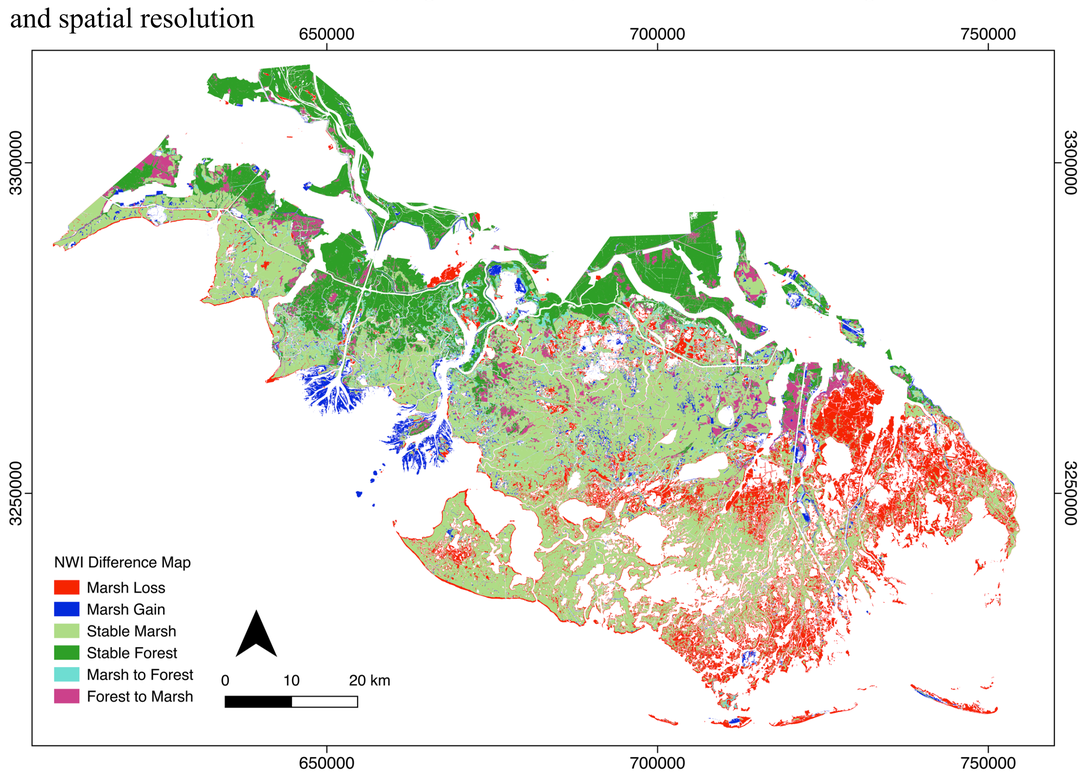

Fig. 2 Sentinel-2/NWI difference map

Table 1. Difference between Sentinel-2 and NWI/C-CAP extent maps

	Marsh Gain (km²)	Marsh Loss (km²)	Stable Marsh (km²)	Stable Forest (km²)	Marsh to Forest (km²)	Forest to Marsh (km²)
NWI	165.1	652	1567.5	797.7	141.7	238.3
C-CAP	109.5	526.1	1625.5	744	220.9	235.9

5. WETLAND MARSH BIOMASS

- NASA JPL Uninhabited Airborne Vehicle Synthetic Aperture Radar (UAVSAR)
- Scenes acquired October 2016
- Radiometric and geometric calibration using regionally specific vegetation model
- Field data acquired September 2015 (peak biomass)
- Relationship derived between UAVSAR HV polarized backscatter and field biomass data (Fig. 3)
- Backscatter increased with biomass until saturation occurred at high biomass values
- Biomass maps (Fig. 4) created by applying derived relationship to UAVSAR HV polarized mosaic

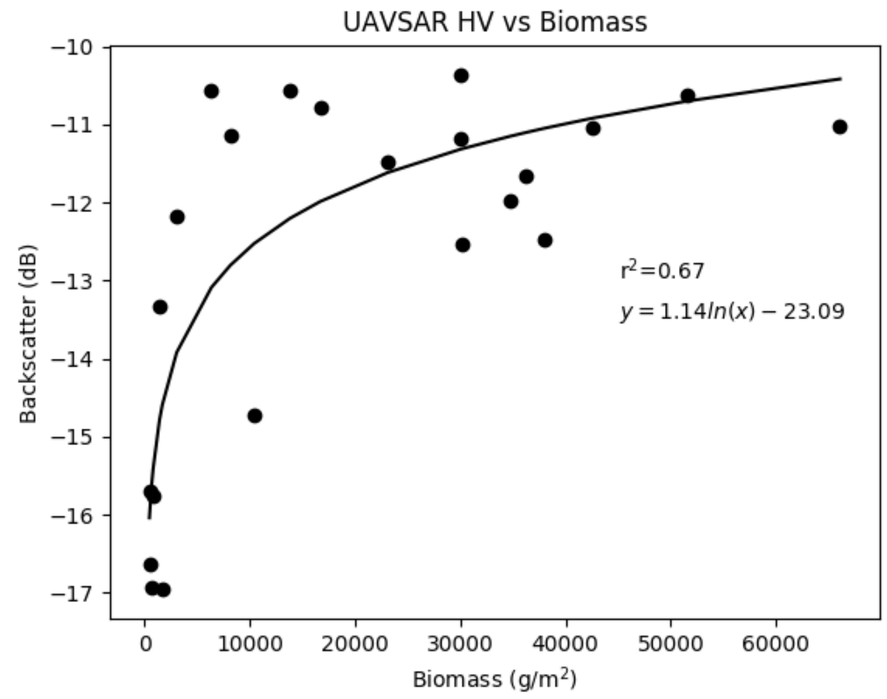

Fig. 3 Relationship between field biomass data and UAVSAR HV backscatter

6. BIOMASS MAPS

- UAVSAR coverage of 1440.8 km²
- Total forest biomass was estimated to be 18,348,766.17 t (mean=0.6 t, SD=0.92 t)
- Total marsh biomass was estimated to be 2,039,389.05 t (mean=0.03 t, SD=0.23 t)
- Biomass capped at 85202.4 g m² (field data max + field data SD)

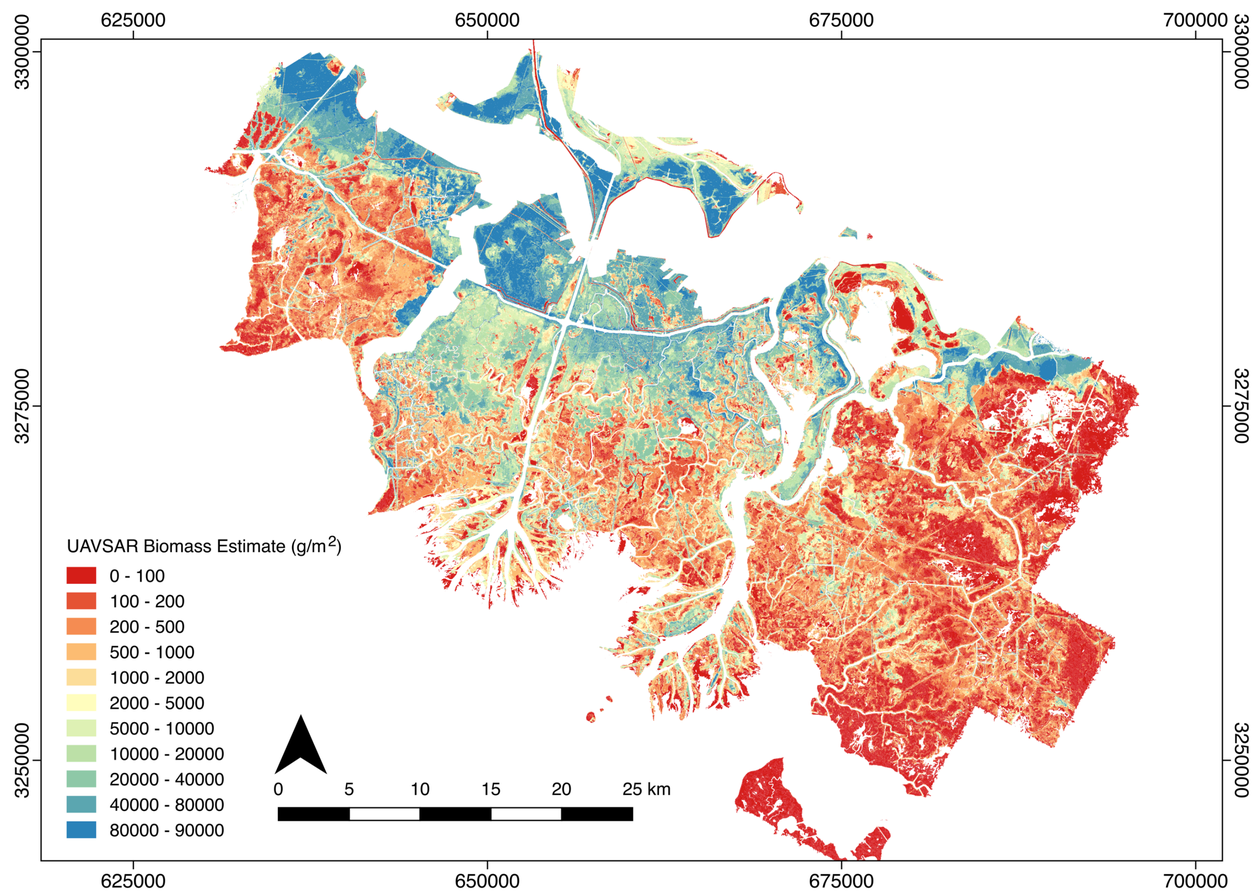

Fig 4. October 2016 biomass map derived from the relationship in Fig 3.

7. DELIVERABLES

- A novel map of Louisiana wetland marsh extent at high resolution, providing a new and up-to-date baseline
- Created previously unavailable very high resolution map of peak biomass as required for monitoring by the IPCC
- Successfully quantified biomass using JPL UAVSAR, demonstrating the sensor capability for biomass/ carbon accounting of coastal marsh ecosystems

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