K&C Phase 4 – Final Report

Mapping Wetlands, Surface Structural Attributes, and Boreal Freeze/Thaw at Regional Scales with JAXA SAR Datasets

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Science Team meeting #25
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Mapping Wetlands, Surface Structural Attributes, and Boreal Freeze/Thaw at Regional Scales with JAXA SAR Datasets

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Science Team meeting #24
Tokyo, Japan, January 29-31, 2018
Project Objectives

Wetlands

Extension of on-going wetlands work
- 30-year record: JERS, PALSAR, PALSAR2
  
  **South America**, Alaska, Canada, Africa

Additional Regions

  **Chesapeake Bay** – Estuarine carbon, Land-ocean exchange

  New England, **Long Island Sound** – Land-ocean carbon exchange;

  Built environment and urbanization impacts

  River Deltas – Carbon & Conservation (Mekong, Indus, **South Asia**)

  **Boreal peatlands** – Canada, Alaska - Soil organic carbon influence on moisture and temperature controls to carbon flux and fire risk.
Project Objectives

Freeze/Thaw
Alaska, Canada, Northern Europe
  – Thermokarst studies
  – Permafrost carbon cycle

High Mountain Asia
- Snow and glacier melt links to climate
- Climate change links to economies (hydropower, fisheries)

Biodiversity and Surface Structure
Amazon and Brazilian Atlantic Coastal Forest
  – Biodiversity (relevance to Conservation)
  – Biome classification, landcover structure
Pacaya-Samiria National Reserve, Peru

- Most extensive tropical flooded forest in the Peruvian Amazon
- Spans area of more than 20,000 km²
- Hosts rich biodiversity
- Home to variety of wetland types, primarily palm swamp
Mapping of wetlands in Pacaya Samiria Reserve, Peru

Multi temporal SCANSAR

Seasonality of inundation patterns
Classification of PALSAR-2 Scansar Mosaics

Maximum Extent Classification

This classification delineates the maximum extent of inundatable areas observed in our PALSAR-2 time series.

- **Open Water**
- **Flooded Low Biomass Vegetation**
- **Flooded High Biomass Vegetation**
- **Never/rarely inundates**
- **Masked**

→ Can use this as a mask to classify individual mosaics
Land Cover Classification Based on Multi-temporal PALSAR 2 Pacaya Samiria National Reserve, Peru

- Permanent Open Water
- Intermittent Open Water / Flooded Low Vegetation
- Seasonally Flooded Forest
- Permanent Flooded Forest
- Never Flooded

Regions where Height Above Nearest Drainage (HAND) index > 20m masked out in white
GNSS Reflections: CYGNSS

DDM Peak SNR map for Jun 2017 CYGNSS data
GNSS-Reflectometry

- **Bistatic radar** concept takes advantage of GNSS transmitting satellites
- GNSS receivers receive surface-reflected **signals of opportunity**
- A GNSS-based sensor does not need to transmit signal
  - “Passive”, smaller, cheaper
  - This enables small platforms, **constellations**
  → Which increases spatio-temporal sampling at reasonable cost

- Operates at L-band
  - Penetrates 'all weather’ and some vegetation canopies over wetlands
Pacaya Samiria Classifications

PALSAR2 ScanSAR

GNSS Reflections
Amazon Inundation Monitoring
ALOS-2 PALSAR-2 ScanSAR

PALSAR Backscatter Statistics: Central Amazon

HH Mean

HH St Dev

HH Max – Min: Dynamic Range in dB

PALSAR 2 Time Series 2015-2017
Amazon Sub-Basins
PALSAR Classification: Central Amazon
Coastal Wetlands

- Regional wetlands processes driven by tides and river discharge
- Colored regions on maps depict wetland locations
Target Study Sites: Wheeler Marshes (low marsh end-member)

Red polygon contains *Phragmites* and *Scirpus* on edges, *Spartina patens* and *Distichlis* interior.

Vast majority of wetland is *Spartina alterniflora*
Inundation mapping with PALSAR HH imagery over Blackwater NWR

PALSAR High Tide (0.805 m)

PALSAR Low Tide (0.084 m)

Threshold-based classification (≤ -14 dB = inundated marsh)

Legend
- Ground Points
- Creek
- Marsh

- PALSAR Classified Inundation Wetland Classes
  - Open Water
  - High Tide Inundated Marsh
  - Non-inundated Marsh

- National Wetlands Inventory
  - Estuarine and Marine Wetland
  - Bishop's Head Tidal Gage
Inundation mapping with L-band PALSAR over Wheeler
- Using same thresholds from Blackwater NWR and integrating HV channel

Images below: PALSAR-1 Wetland Inundation Thresholding Classification: HH < -14 dB & HV < -23 dB
Blue pixels = inundation/open water, grey pixels = non-inundated land

Tidal height = 2.6 feet

Tidal height = 7.6 feet
Inundation mapping with PALSAR linking with DEM for volume estimates

PALSAR/PALSAR-2 HH Backscatter Imagery (ordered by increasing tidal stage)

HH < -14.0 & HV < -23.0 Classified as inundated and shown as colored pixels representing water depth
Inundation Product Validation

- Proposed validation with water level sensor grids

Wheeler Marshes (low marsh end-member)

Kirkpatrick Marsh (high marsh end-member)
Essential Biodiversity Variables

EBVs are defined as the derived measurements required to study, report, and manage biodiversity change, focusing on status and trend in elements of biodiversity.
EBV classes and candidates

There are 6 EBV classes and 22 EBV candidates. Click on each EBV class to get more detailed information about the candidates for each class.

<table>
<thead>
<tr>
<th>EBV class</th>
<th>EBV candidate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem structure</td>
<td>Habitat structure</td>
</tr>
<tr>
<td>Ecosystem extent and fragmentation</td>
<td>Ecosystem composition by functional type</td>
</tr>
</tbody>
</table>

show all EBV classes & candidates
Assessing Structural Variability with Imaging Radar Remote Sensing

PALSAR and PALSAR2 Yearly Backscatter Mosaics
Using the annual coefficient of variation, summary statistics were calculated. The color scale on the left (used for mean, max, and min coeff. of var.) indicates that a low covariance value is closer to blue, whereas, a high value is closer to red in color. The color scale on the right is for the standard deviation of the coeff. of var.
Coefficient of Variation with Different Window Sizes

Above are the coefficient of variation of PALSAR HV resampled 1km data for the year 2017, calculated at different neighborhood sizes over the Atlantic Forest region. Note the upper limit of the color scale is 0.75, instead of the previous 1.0, this to better illustrate coeff. of var. in this specific region.
Structural Mapping of White Sands Forest

- Lidar point-clouds from forest plots of white sands vegetation
- Detailed measurements of sub-canopy vegetation
- Collection contains traditional biometry measurements for comparative analysis
The value of biodiversity: where ecology, evolution, economy and sociology blend
The City College
of New York

Biodiversity

The Center for Biodiversity Under Environmental Change (C-BEC)
at The City College of New York
Global reach of CCNY Biodiversity research
YASUHIRO KUBOTA LAB.

WELCOME TO

BIODIVERSITY AND CONSERVATION BIOGEOGRAPHY JAPAN

UNIVERSITY OF THE RYUKYUS
Post-KC Efforts

Spatio-temporal heterogeneity in seasonal landscape processes controlling terrestrial carbon flux

- Carbon functional groups in Tropical forests
- Rangelands and Grassland Savannas
- Frost dynamics in cold soils
- Glacial landscape melt/thaw/freeze processes: Climate and Carbon in High Mountain Asia

Characterization of wetland distribution and inundation dynamics in coastal regions

- Eastern USA Coastal Wetlands
- South Asia Coastal Wetlands

Application of ALOS-2 datasets to assess seasonal wetlands inundation and vegetation structure of endemic ecosystems for the tropics and south Asia

- Biodiversity Monitoring
- Seasonally Inundated Tropical Wetlands and South Asia
- White Sands Vegetation Systems, South America