



# NASA-ISRO Synthetic Aperture Radar (NISAR) Mission Objectives and Perspective

## Key Scientific Objectives:

- Understand the response of ice sheets to climate change and the interaction of sea ice and climate
- Understand the dynamics of carbon storage and uptake in wooded, agricultural, wetland, and permafrost systems
- Determine the likelihood of earthquakes, volcanic eruptions, and landslides

## Key Applications Objectives:

- Understand societal impacts of dynamics of groundwater, hydrocarbon, and sequestered CO<sub>2</sub> reservoirs
- Provide agricultural monitoring capability in support of food security objectives
- Apply NISAR's unique data set to explore the potentials for urgent response and hazard mitigation

## Perspective:

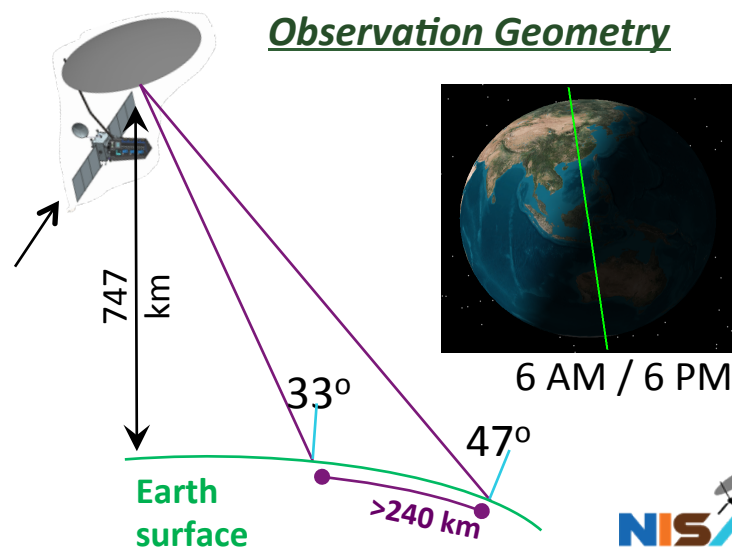
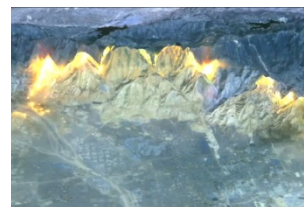
- Science community has consistently called for ubiquitous SAR coverage and sampling to make significant headway in Earth System Science (*e.g.* 2007 NRC decadal survey)
- Commercial systems have not been able to satisfy community needs, and perhaps cannot due to differences between scientific and typical commercial uses



# NISAR Science Observation Overview

NISAR Characteristic:	Would Enable:
L-band (24 cm wavelength)	Low temporal decorrelation and foliage penetration
S-band (12 cm wavelength)	Sensitivity to light vegetation
SweepSAR technique with Imaging Swath > 240 km	Global data collection
Polarimetry (Single/Dual/Quad)	Surface characterization and biomass estimation
12-day exact repeat	Rapid Sampling
3 – 10 meters mode-dependent SAR resolution	Small-scale observations
3 years science operations (5 years consumables)	Time-series analysis
Pointing control < 273 arcseconds	Deformation interferometry
Orbit control < 500 meters	Deformation interferometry
> 30% observation duty cycle	Complete land/ice coverage cycle
Left/Right pointing capability	Polar coverage, north and south

## NISAR Would Uniquely Capture the Earth in Motion



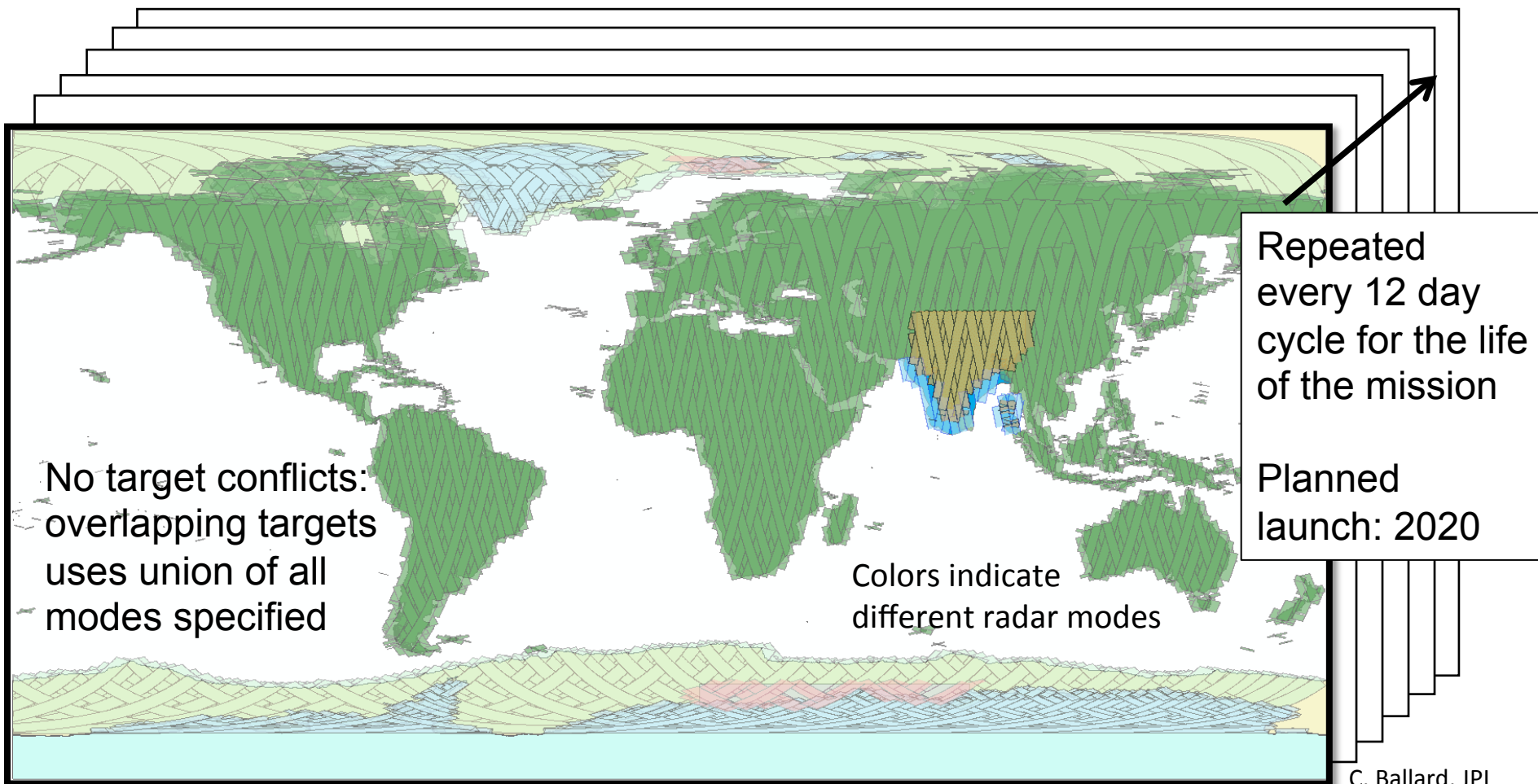


# Societal Challenges and What a NASA-ISRO SAR Could Contribute

Challenge	SAR Benefit Through Regular Monitoring of:
Global Food Security	<ul style="list-style-type: none"> <li>- Soil moisture and crop growth at agricultural scale</li> <li>- Desertification at regional scales</li> </ul>
Freshwater Availability	<ul style="list-style-type: none"> <li>- Aquifer use/extent regionally</li> <li>- Water-body extent changes</li> <li>- Glaciers serving as water sources</li> </ul>
Human Health	<ul style="list-style-type: none"> <li>- Moisture and vegetation as proxy for disease and infestation vectors</li> </ul>
Disaster Prediction & Hazard Response	<ul style="list-style-type: none"> <li>- Regional building damage and change assessment after earthquakes</li> <li>- Earthen dams and levees prone to weakening</li> <li>- Volcanoes, floods, fires, landslides</li> </ul>
Climate Risks and Adaptation	<ul style="list-style-type: none"> <li>- Ice sheet/sea-ice dynamics; response to climate change</li> <li>- Coastal erosion and shoreline migration</li> </ul>
Urban Management and Planning	<ul style="list-style-type: none"> <li>- Urban growth through coherent change detection</li> <li>- Building deformation and urban subsidence</li> </ul>
Human-activity Based Climate Change	<ul style="list-style-type: none"> <li>- Deforestation's influence on carbon flux</li> <li>- Oil and gas reservoirs</li> </ul>



# NISAR Systematic Observations

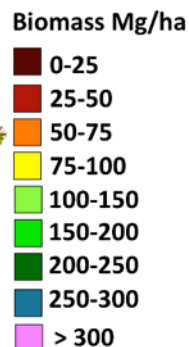
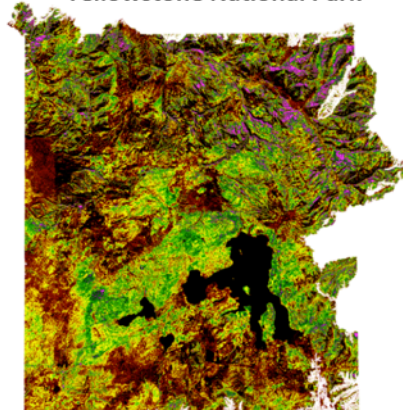


Persistent updated measurements of Earth

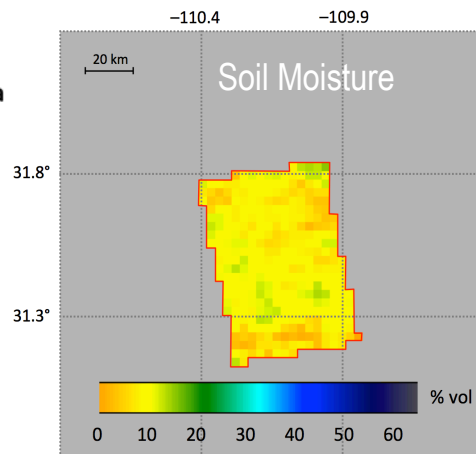


# AMS-relevant NISAR Applications Products

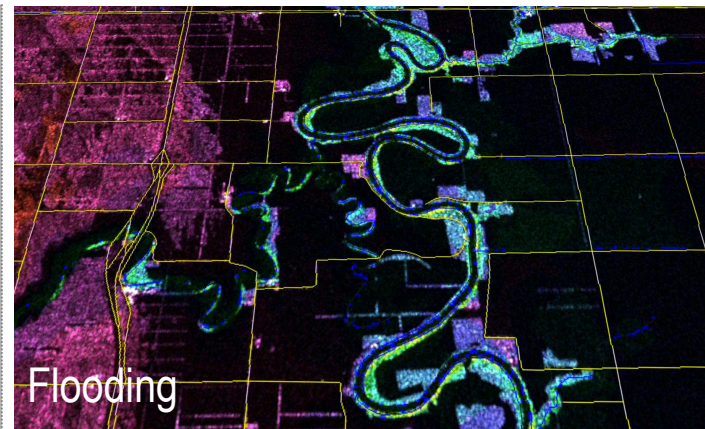
Forest Aboveground Biomass  
Yellowstone National Park



Courtesy: S. Saatchi

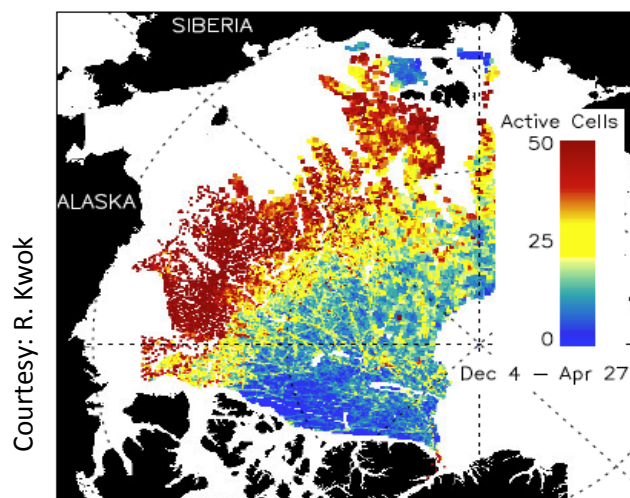


Courtesy: M. Lavalle



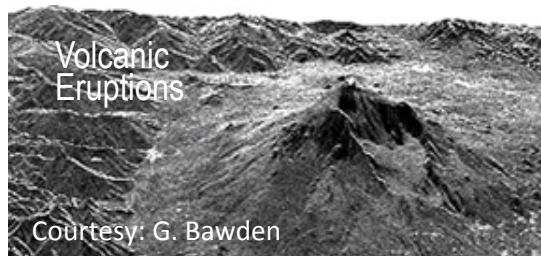
Courtesy: G. Breckenridge/S. Nghiem

Courtesy: S.-H. Yun

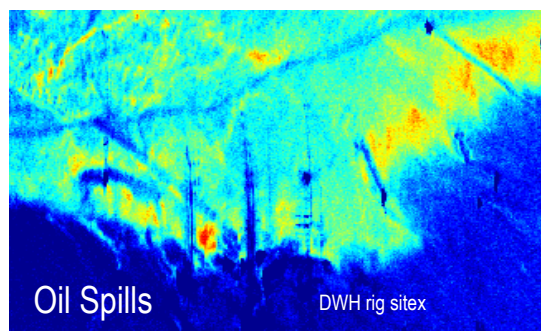


Courtesy: R. Kwok

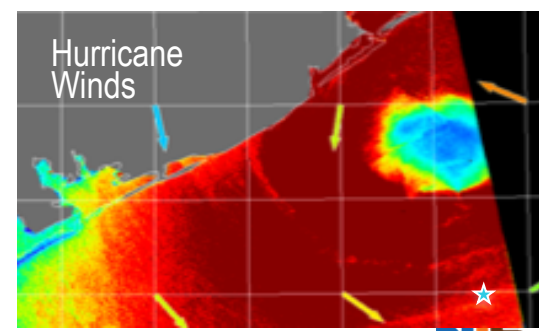
Sea Ice Extent/ Ice and Ship Tracking



Courtesy: G. Bawden



Courtesy: C. Jones



Courtesy: G. Bawden



## NISAR Outlook in January 2016

- NISAR will provide a rich time-series of *free and open* data globally for science and applications research
  - 12-day interferometric repeat, < 6-day sampling, polarimetric data covering all land, near-shore, and ice-covered areas
  - Day/Night, cloud-free radar imagery
- NISAR data can potentially support hydrological and meteorological monitoring services
  - The project is engaging other agencies and science communities through the NASA Applied Sciences program to explore special observational needs and products (e.g. low latency)
  - Scope of high-level products from project itself is limited – NASA relying on community to develop products as driven by need
- NISAR is progressing well toward PDR in June 2016, with planned launch in 2020