

# The NASA-ISRO SAR (NISAR) Mission Concept

**Potentials for Water-  
related Monitoring and  
Research**

Artist's concept

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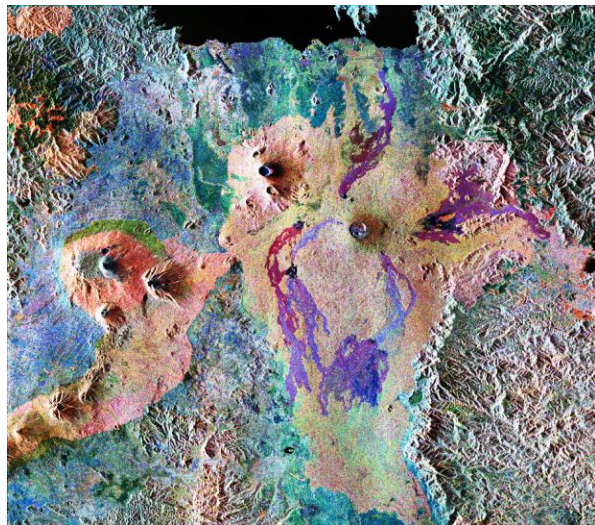
## NASA-ISRO SAR Mission Summary

- The Indian Space Research Organisation (ISRO) and NASA/JPL are jointly developing a SAR mission concept for launch in 2020, and to operate for at least 3 years
- Mission would directly benefit researchers and agencies interested in monitoring aquifers, water-related infrastructure, local soil moisture and surface water changes
- Would serve as a key element of SAR data continuity for applications programs relying on SAR data from the international constellation of satellites going back to 1992

# Synthetic Aperture Radar (SAR) Extends Imagery Beyond the Visible Spectrum

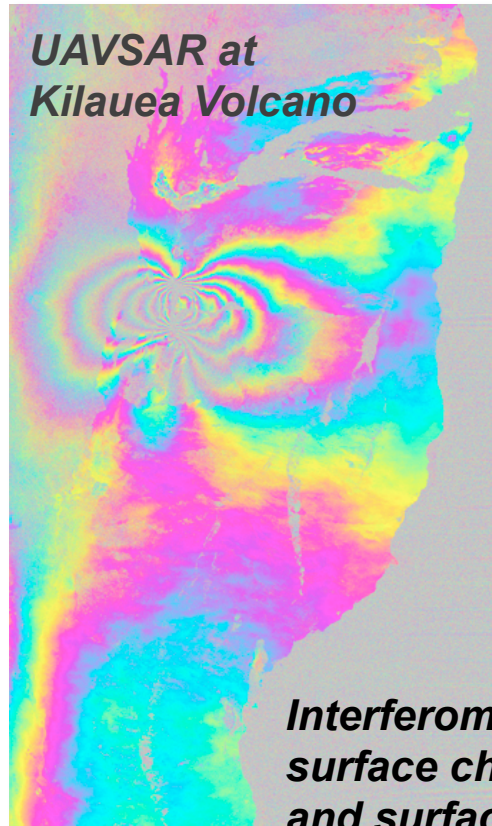
- Observations, methods, and insights pioneered at JPL starting in the 1970's
- SAR allow us to experience the Earth in a fundamentally different light, through clouds

**SIR-C over Africa**

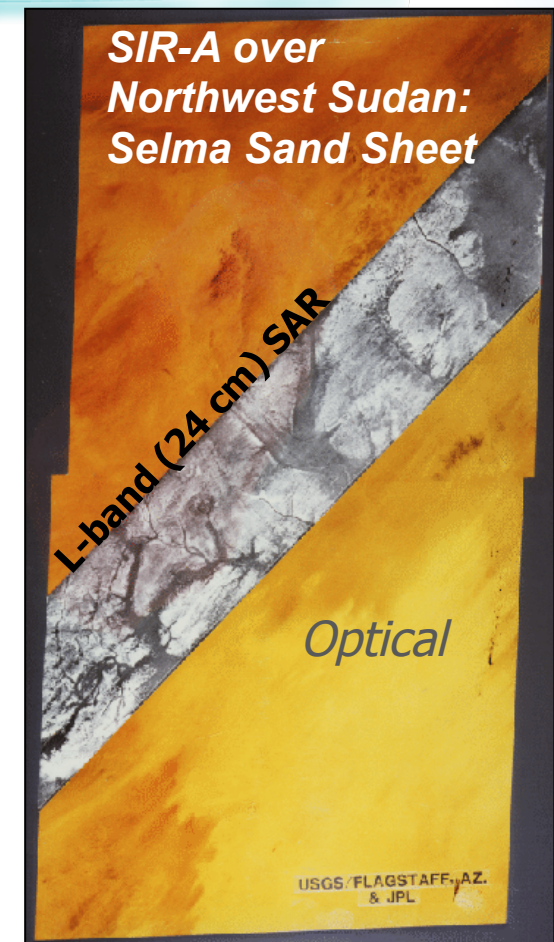


**Polarization and frequency diversity to characterize surfaces and measure moisture**

**UAVSAR at Kilauea Volcano**



**Interferometry to measure motion and surface change, including subsidence and surface water changes**



# 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>                                                                                             |

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

## Science:

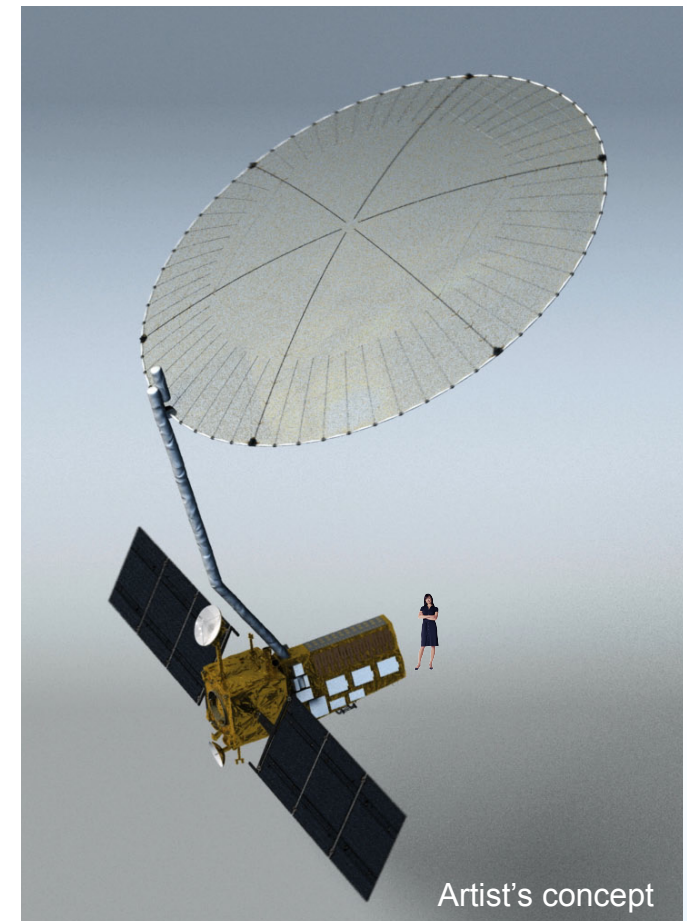
- Climate change impact on ice sheets and sea ice
- Carbon storage and uptake in wooded, agricultural, wetland, and permafrost
- Likelihood of earthquakes, volcanic eruptions, and landslides

## Decision Support:

- Groundwater, hydrocarbon, and sequestered CO<sub>2</sub> reservoirs
- Agricultural monitoring
- Natural hazard response and mitigation

# A NASA-ISRO SAR Mission Concept Inspired by the Decadal Survey

- Objectives consistent with 2007 Decadal Survey to the Tier 1 DESDynI Mission
- Objectives identified in NASA's Climate Architecture
- Many exciting “firsts”:
  - Major mission-level partnership with ISRO
  - Dual-Frequency (L- and S-band) radar
  - Unprecedented coverage, resolution, and sampling in time
  - New SAR technology
  - ISRO agreement to open data policy

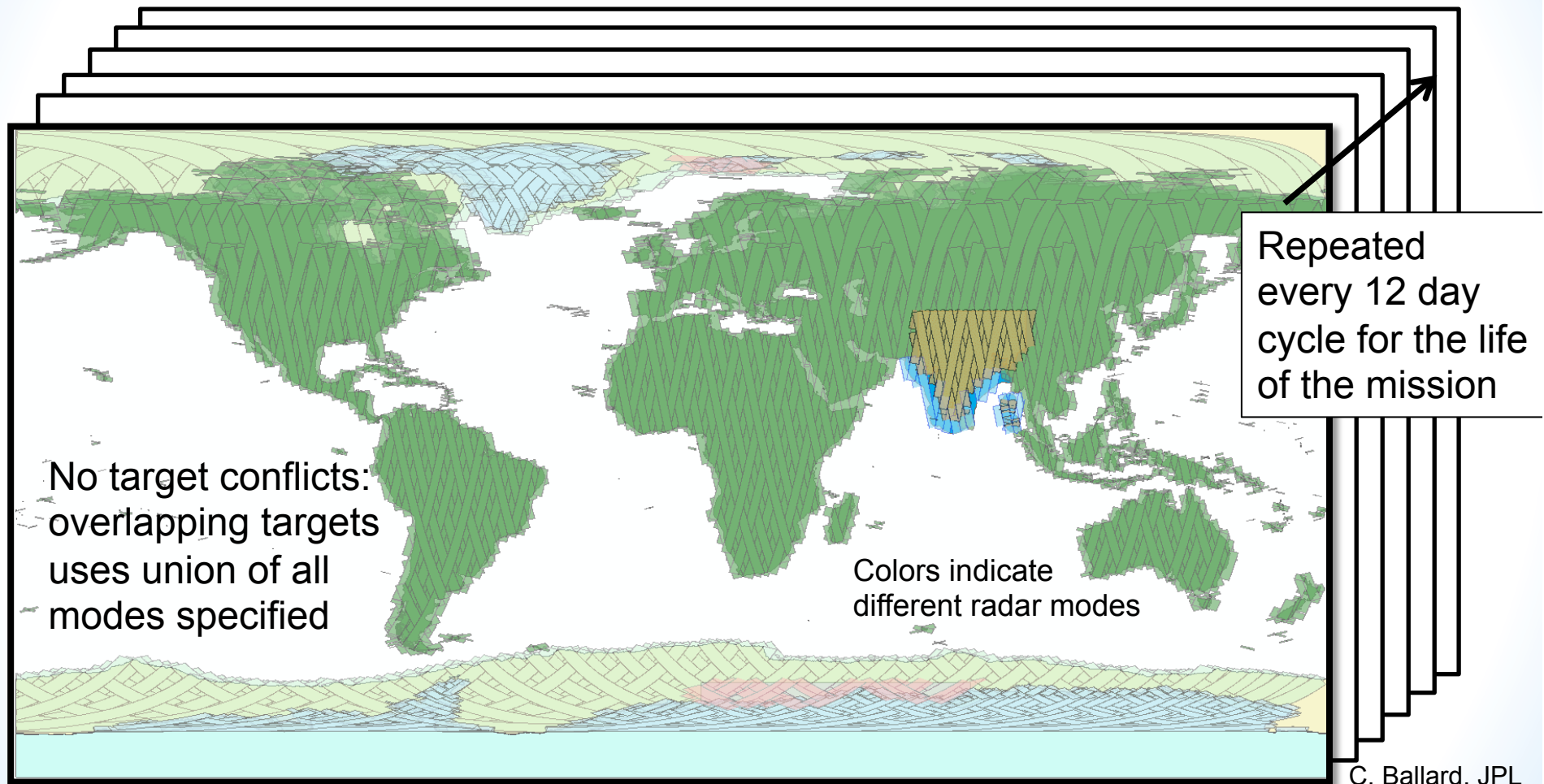


# The NISAR Mission Would Capture the Earth in Motion



- *Dense temporal and spatial sampling*
  - Reveals the mechanisms that drive poorly understood surface processes
    - Fast-transients on ice sheets and glaciers
    - Disturbance and recovery in forests
    - Tracking evolving hazards
- *Comprehensive global measurements*
  - Of ice to improve climate projection accuracy
  - Of ecosystems to reduce land carbon flux uncertainties
  - Of solid earth to improve disaster forecasting and risk assessments
- *Targeted regional measurements*
  - New science
  - New applications
  - Hazard response

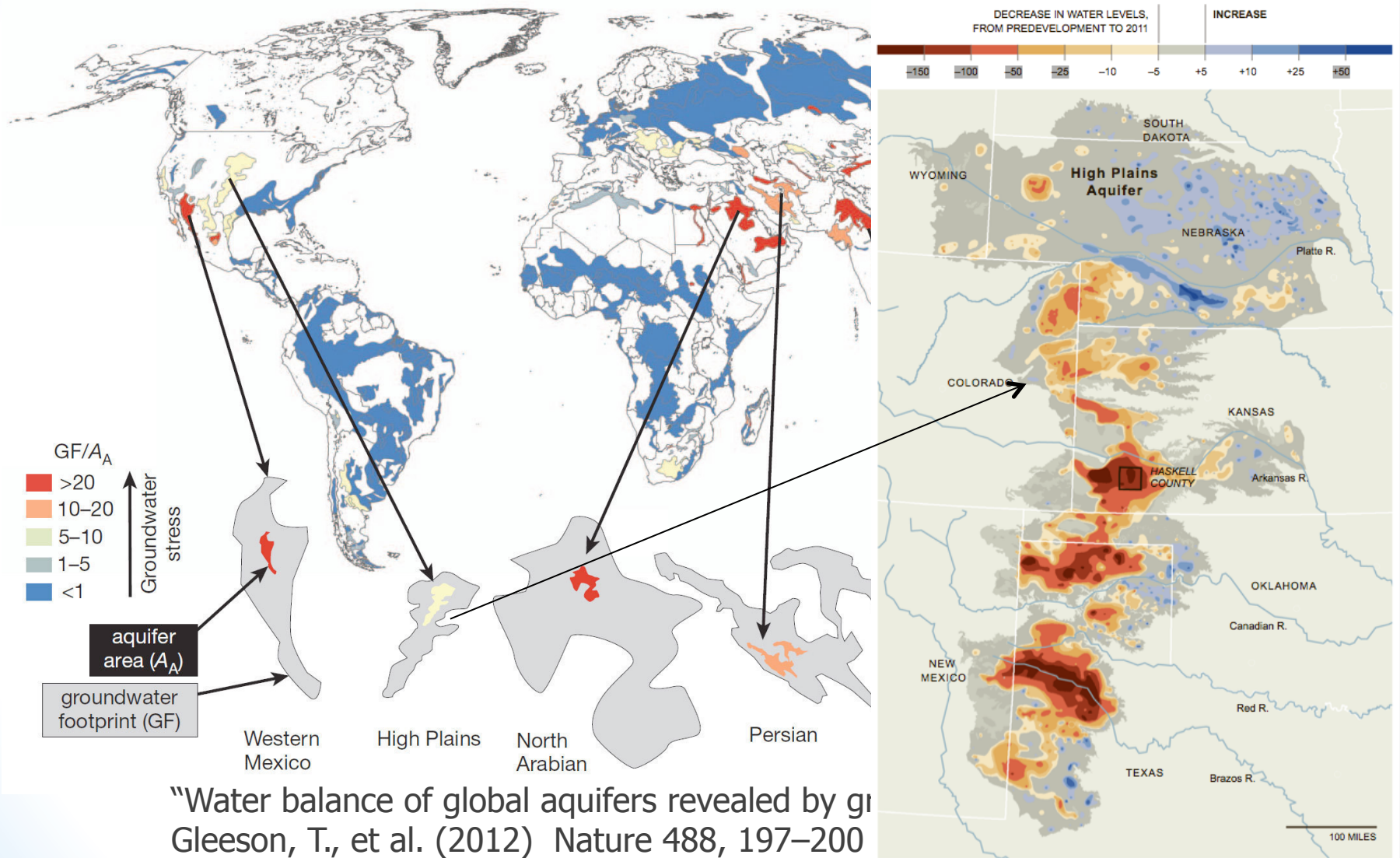
# NISAR Concept Systematic Observations



Radar and mission design concept optimized for persistent refresh of geodetic measurements of Earth, including aquifers and regions with surface water changes



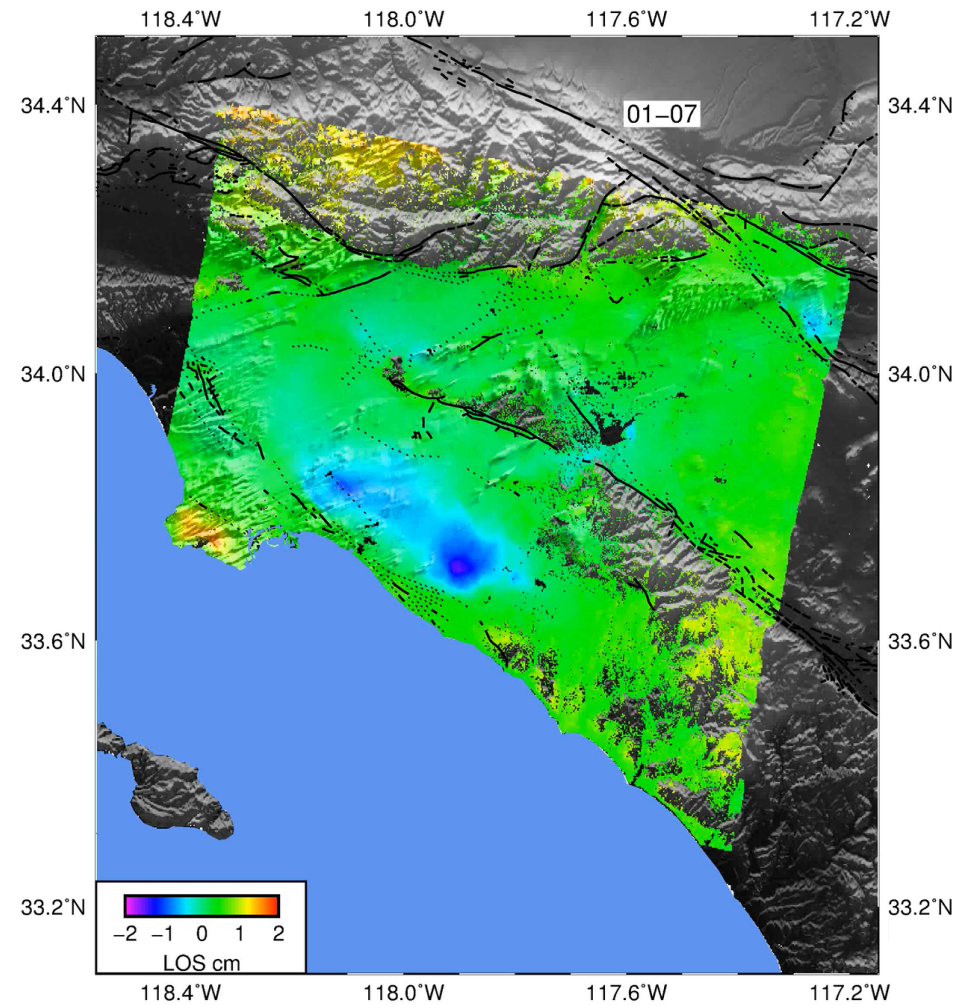
## Locations of the World's Aquifers



"Water balance of global aquifers revealed by gr  
Gleeson, T., et al. (2012) Nature 488, 197–200



# Delineating LA Basin Aquifers with InSAR Time Series



# NISAR Potential Contribution Summary

- NISAR would provide two SAR views of surface and ground water sources over the globe every 12 days at 10-100 m spatial resolution for a period of 3 years (primary mission) or greater.
- These data would allow dense time-series analysis to create regional products of
  - Aquifer use/extent regionally
  - Water-body extent changes
  - Soil moisture variability
  - Crop extent and variability
- Tailoring for specific needs will be coordinated through yearly Applications Workshops
  - First to take place October 28-29, 2014 at USGS HQ in Reston VA
  - <http://nisar.jpl.nasa.gov/applications/2014appwsagenda/>