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**National-Scale Rice Crop Mapping Using
Multi-Sensor Satellite Earth Observation Data**

2nd Indo Global Irrigation Summit
24-25 June 2026, New Delhi India

National-Scale Rice Crop Mapping Using Multi-Sensor Satellite Earth Observation Data

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National Remote Sensing Centre (NRSC)

Indian Space Research Organization (ISRO)

2nd Indo-Global Irrigation Summit

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Introduction

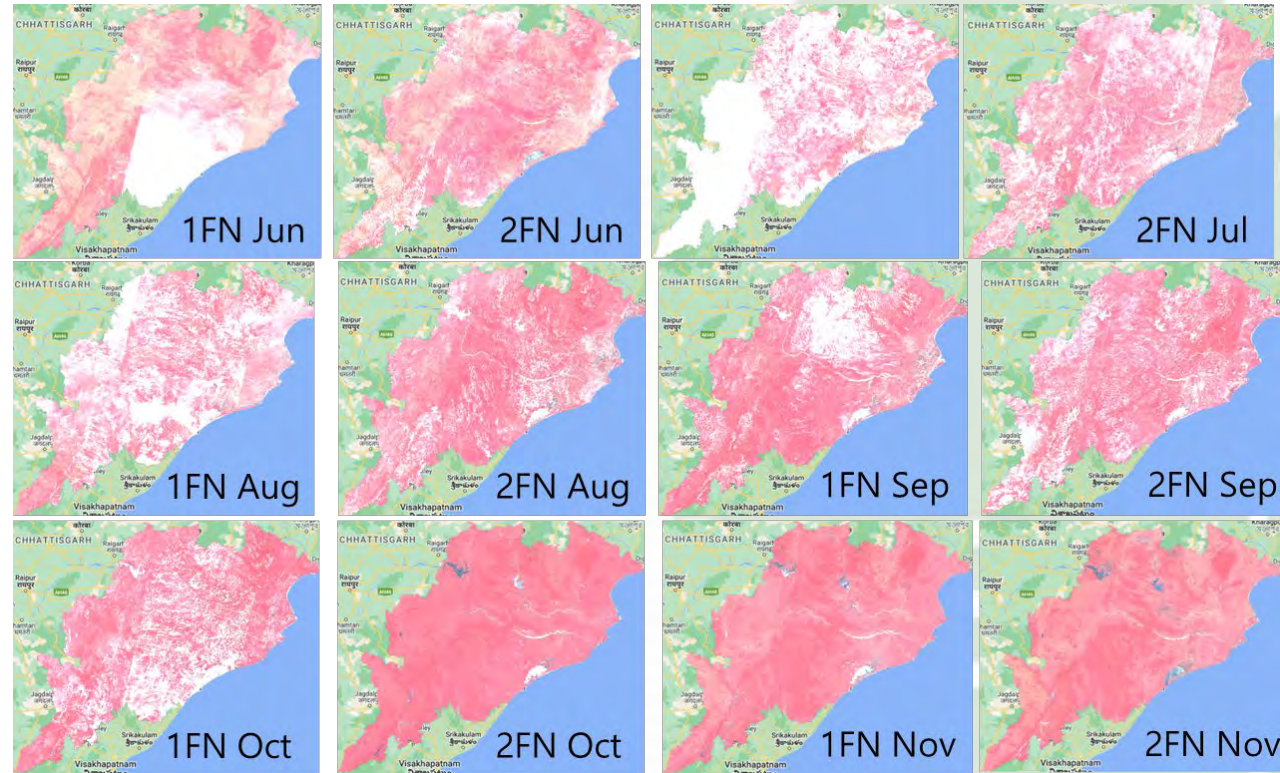
- ❑ Rice is one of the most important staple food crops, feeding more than half of the world's population.
- ❑ Rice is the largest consumer of irrigation water in many Asian countries.
- ❑ In countries such as India, rice plays a critical role in food security, rural livelihoods, and agricultural economies.
- ❑ Efficient irrigation management requires timely and accurate information on rice extent and cropping patterns-*Conventional surveys are difficult to implement consistently at national scales.*
- ❑ Satellite Earth Observation provides synoptic and repetitive observations for large-area agricultural monitoring.
- ❑ National-scale rice maps support irrigation planning, water allocation, crop assessment, and food security programs.

"Accurate and timely information on rice extent is fundamental for irrigation water management, crop production assessment, and national food security."

Why do we need SAR data for Agriculture?

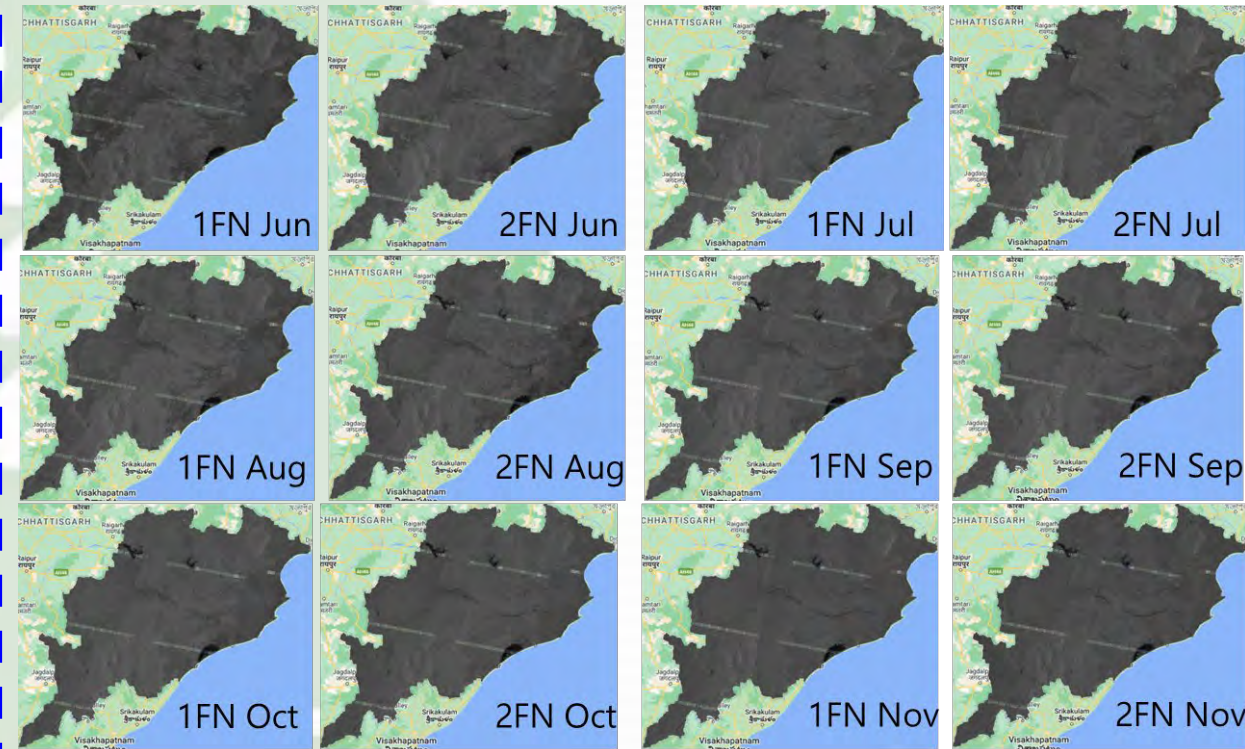
Unavailability of Cloud free optical data

FCC of Sentinel-2



- Microwaves Penetrate Clouds, haze and moderate rain (more predominant in *kharif* season)
- Lower frequencies penetrate through crops

Sentinel-1 SAR



Odisha (Kharif 2022)

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- ✓ Day and night operation (independence of sun illumination)
- ✓ No effects of atmospheric constituents (multitemporal analysis)
- ✓ Sensitivity to dielectric properties (water content , biomass etc.)



- Multi-sensor remote sensing data from EOS-04 & Sentinel-1 (C-band SAR)) enables all-weather, high temporal resolution crop characterization
- Time-series analysis of SAR backscatter and spectral indices facilitates phenology-based classification and paddy extent delineation
- Automated processing frameworks (e.g., cloud platforms, ML/DL models) are critical for scalable, reproducible, and near real-time mapping

Indian SAR Mission: RISAT-1A (EOS-04)

- *Launched by ISRO on Feb 14 2022*
- *C-band SAR sensor acquiring the data in different modes (FRS, MRS and CRS)*
- *Capability of acquiring the data-in dual pol, full pol and hybrid pol.modes.*
- *Systematic coverage of India in MRS mode with 17 days interval*

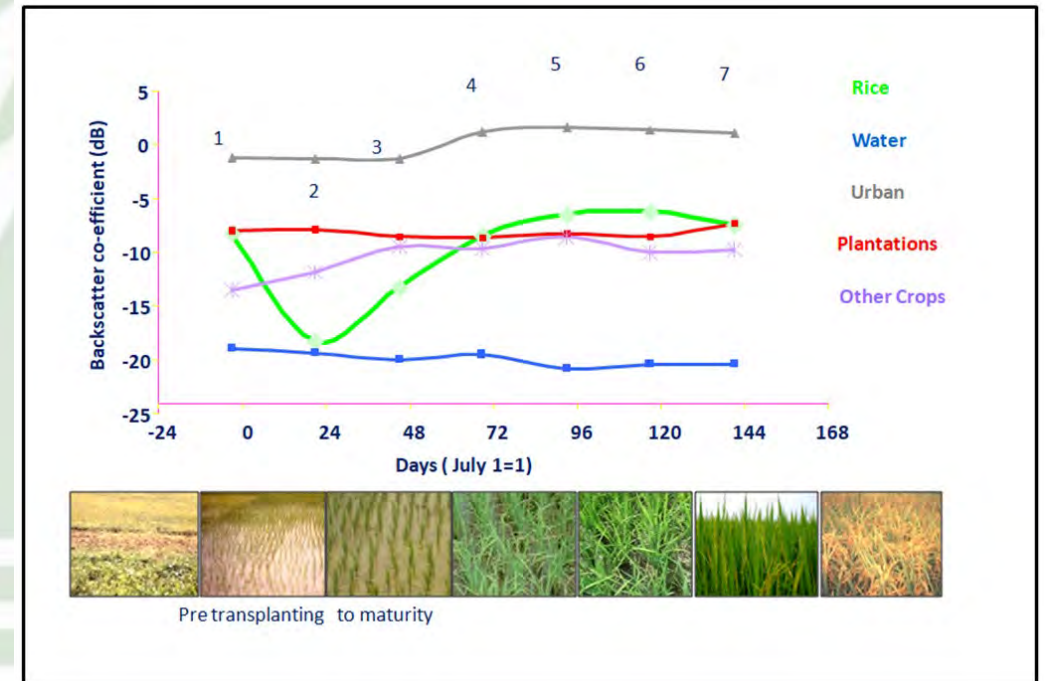
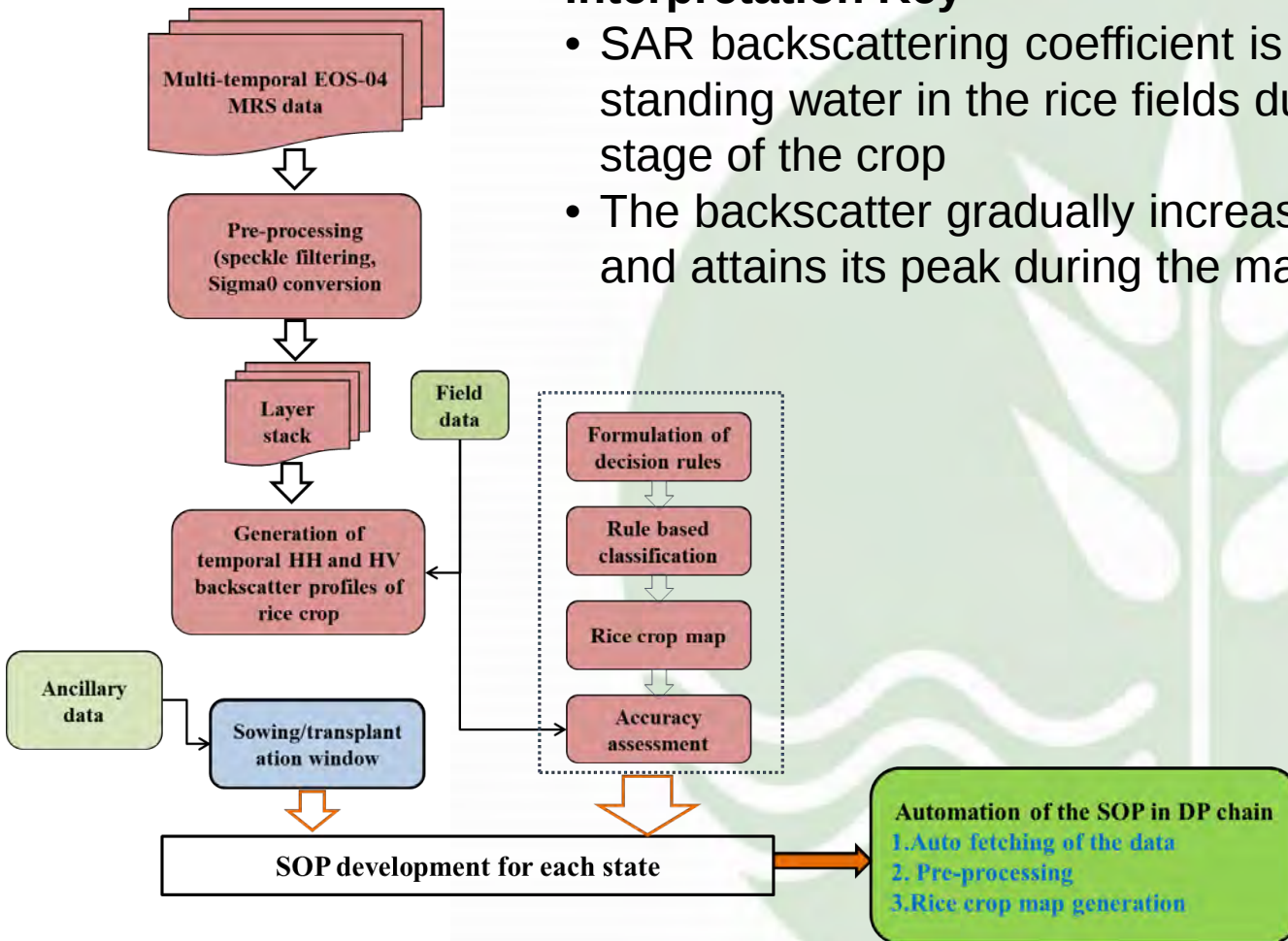
NRSC Initiatives – Rice mapping at National Scale

- Develop a standardized, scalable SOP for *Kharif* rice crop mapping across major rice-growing states of India using multi-satellite SAR datasets (EOS-04 and Sentinel-1)
- Design and implement an automated processing framework for operational rice crop mapping at district to national scale, ensuring consistency, efficiency, and near real-time capability
- Retrieve rice transplantation phenology by exploiting multi-temporal SAR backscatter dynamics (e.g., Backscatter signatures and flooding–transplanting transitions), enabling high-resolution delineation of transplanting windows to support precision irrigation scheduling and water resource optimization

Methodology

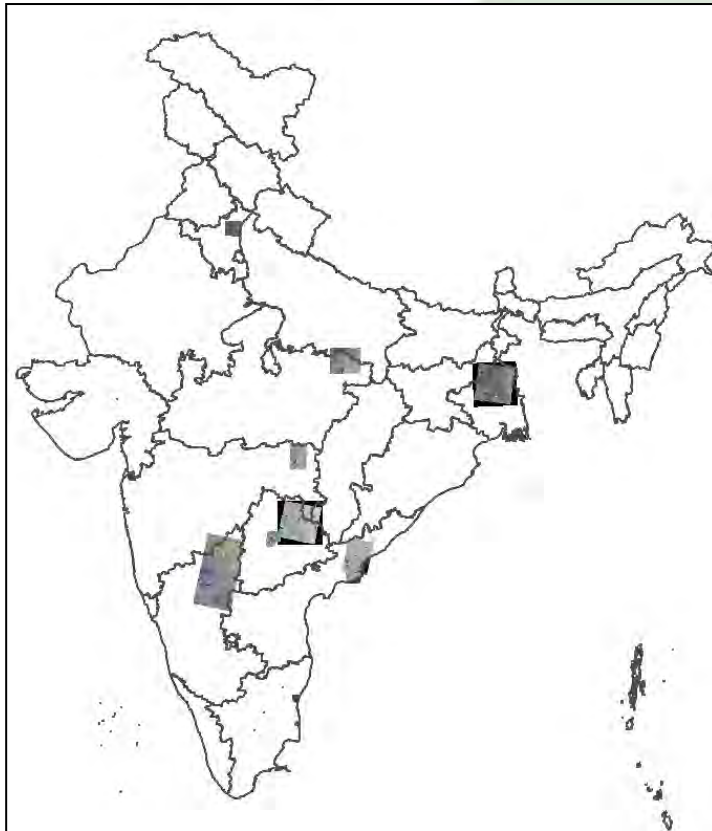
Interpretation Key

- SAR backscattering coefficient is found to be very low due to specular reflection by the standing water in the rice fields during the puddling (a tillage practice) or transplantation stage of the crop
- The backscatter gradually increases with an increase in the number of tillers and stems and attains its peak during the maximum vegetative growth stage of the crop

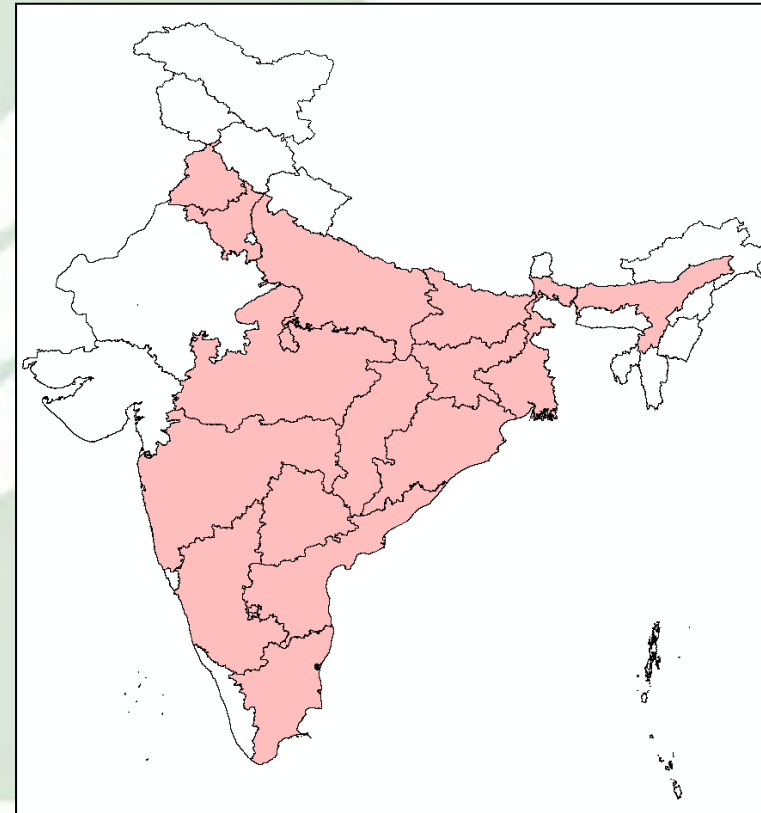


Temporal EOS-04 (RISAT-1A) MRS HH and HV polarization data acquired at every 17 days interval from June till October/November

Study Area



Implementing states



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Test sites: 08

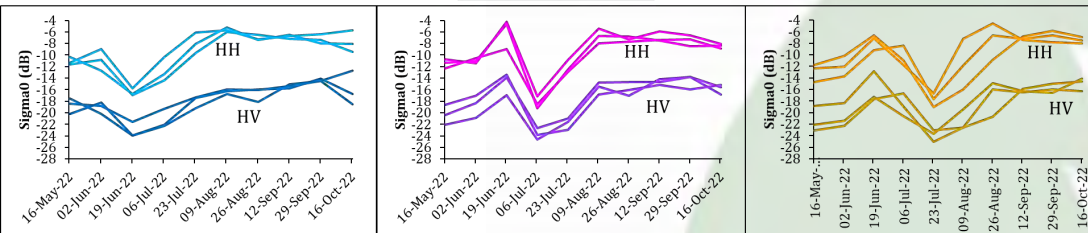
1. Karnal, Haryana
2. Rewa, MP
3. Bhandara, MH
4. Karimnagar, Telangana

5. Purba Bardaman, West Bengal
6. East Godavari, AP
7. Narayanpur, Karnataka
8. Siddipet, Telangana

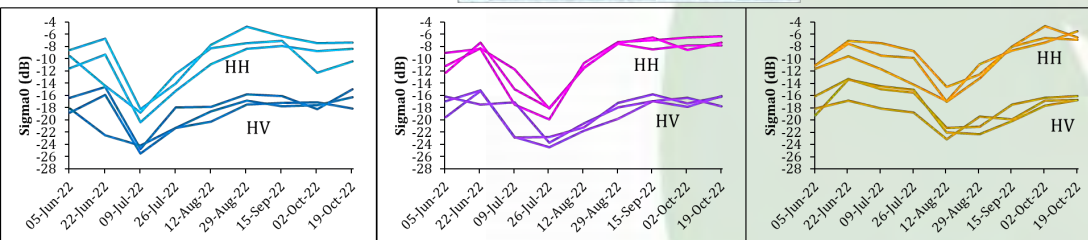


Temporal backscatter profiles of rice crop in HH and HV polarizations

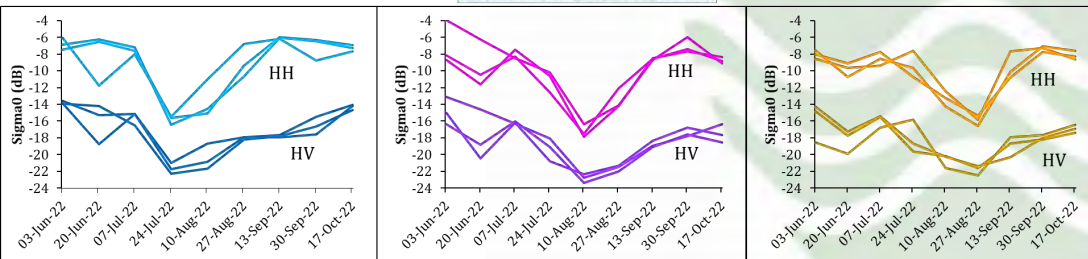
(a) Karnal, Haryana



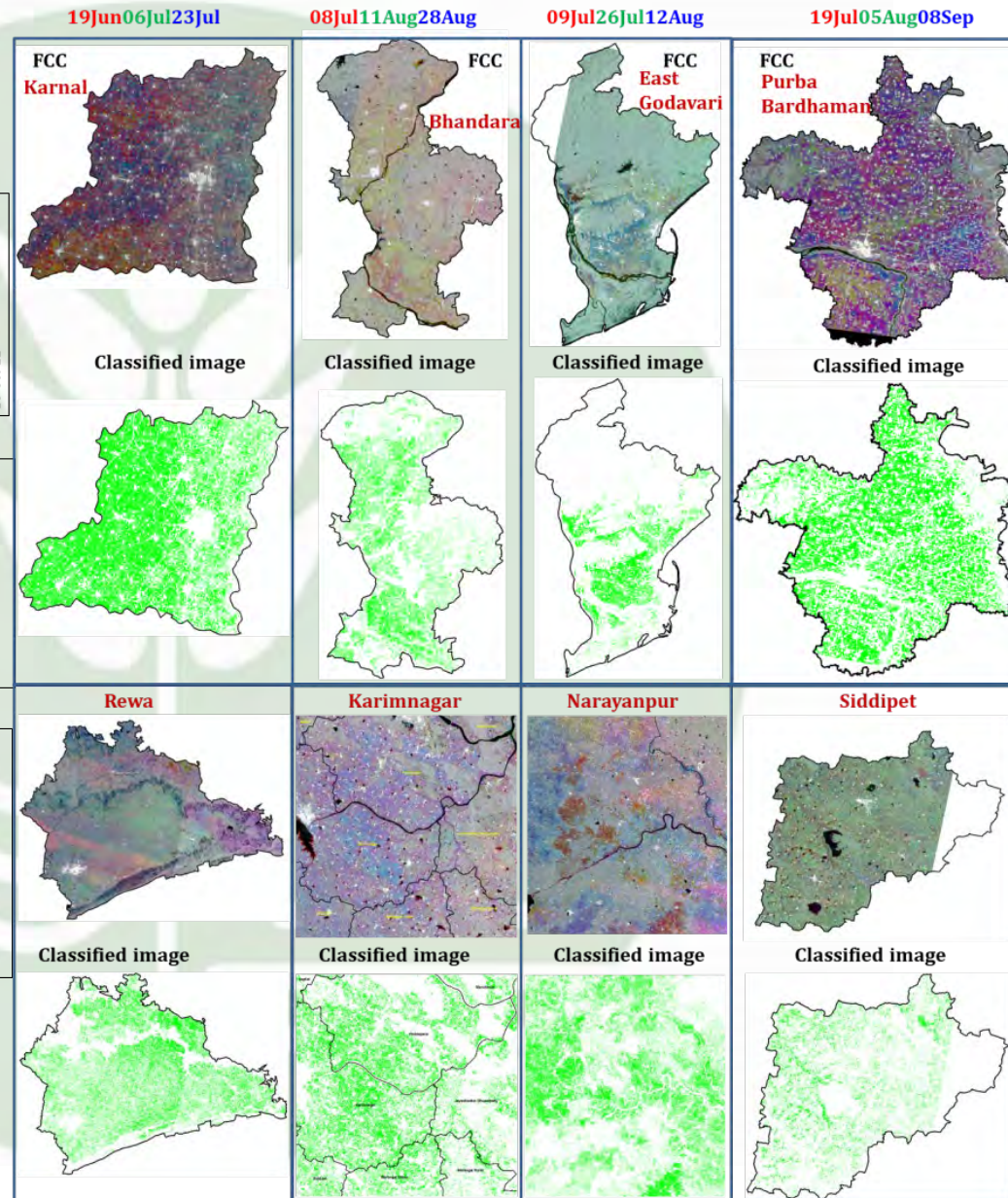
(b) East Godavari, Andhra Pradesh



(c) Narayanpur, Karnataka



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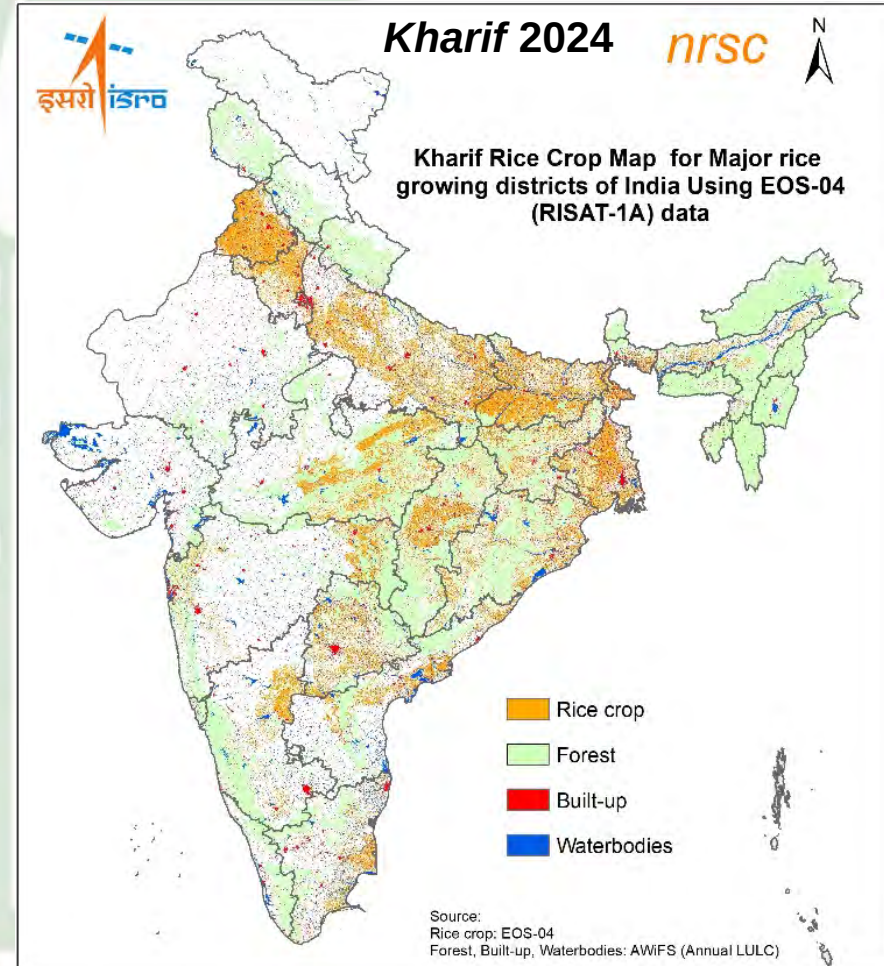
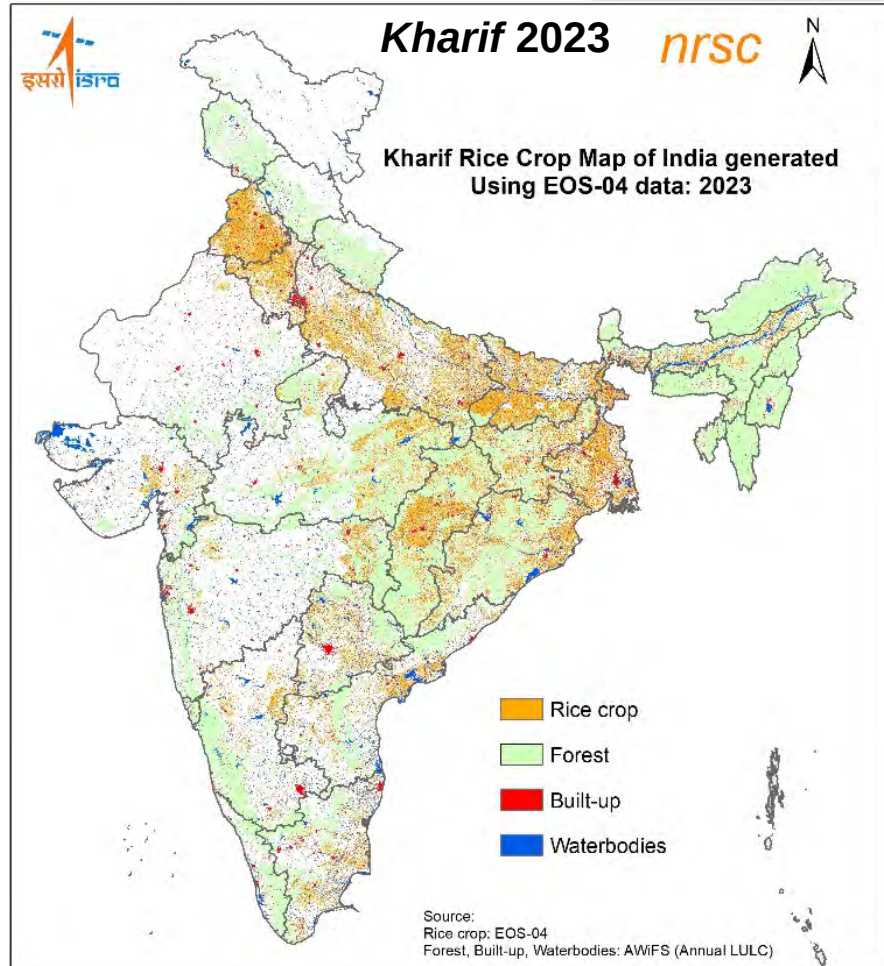


Accuracy table

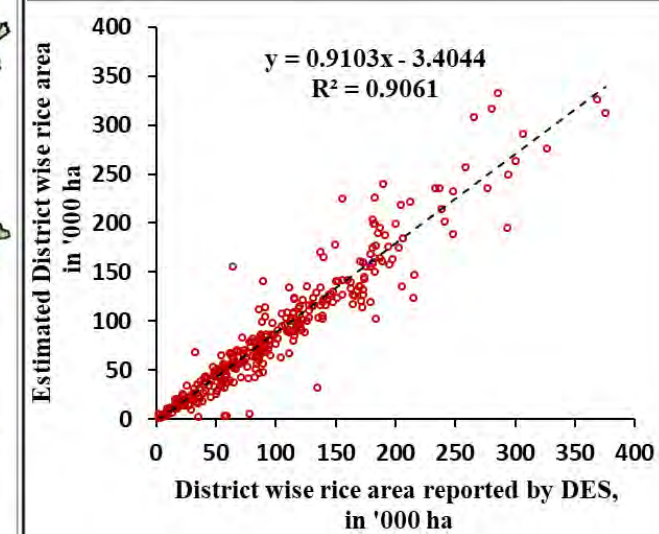
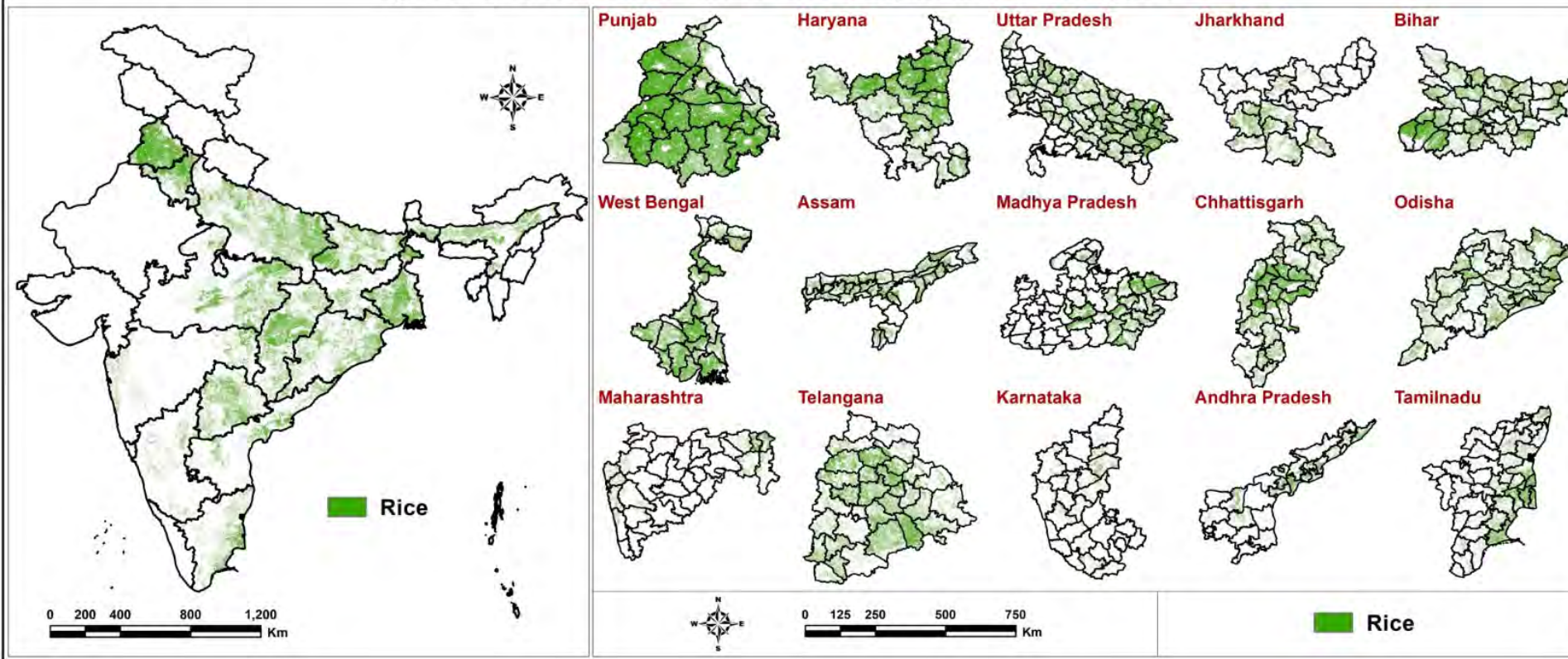
Sl.	Test Site	Accuracy
1	Karnal	94%
2	Rewa	88%
3	Bhandara	81%
4	Karimnagar	87%
5	Purba Bardhaman	96%
6	East Godavari	95 %
7	Narayanpur	83%
8	Siddipet	92%



Automated rice crop mapping using RISAT-1A (EOS-04) data at National Scale



Spatial Distribution of Kharif Rice Crop in India During 2024



- The classification results were further validated using ground truth (GT) points provided by MNFC and crowd-sourced data, confirming that the mapping accuracy remained above 80%.
- A comparison of district-wise rice area estimates with the Directorate of Economics and Statistics (DES) reported figures showed a strong correlation, with an R^2 value of 0.91.

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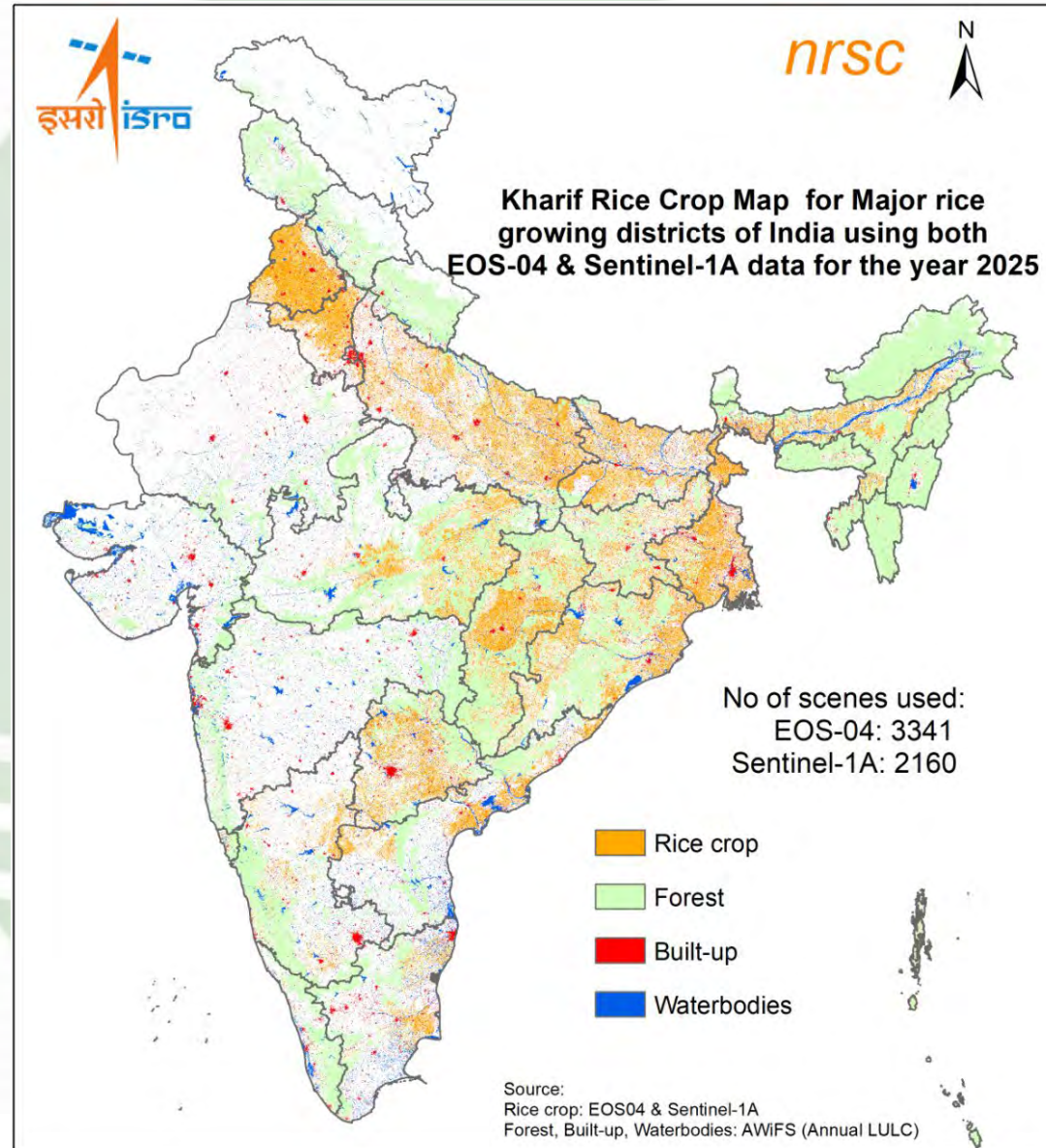
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Ref: P, S. et al. (2025) 'Strengthening food security through rice crop area monitoring in India using EOS-04 (RISAT-1A) SAR data', International Journal of Remote Sensing, 46(22), pp. 8878–8902.
doi: 10.1080/01431161.2025.2573244.



Synergistic use of EOS-04 & Sentinel-1 SAR data

The complementary use of EOS-04 and Sentinel-1 data helped overcome individual spatial and temporal coverage limitations.



Product-level integration of rice maps derived from both sensors resulted in a more comprehensive and reliable rice crop map.

Rice crop mapping-International

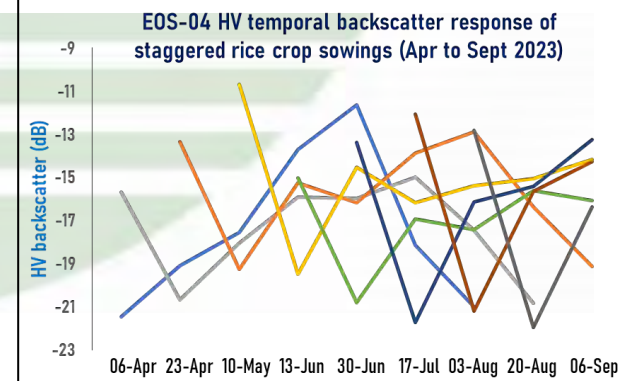
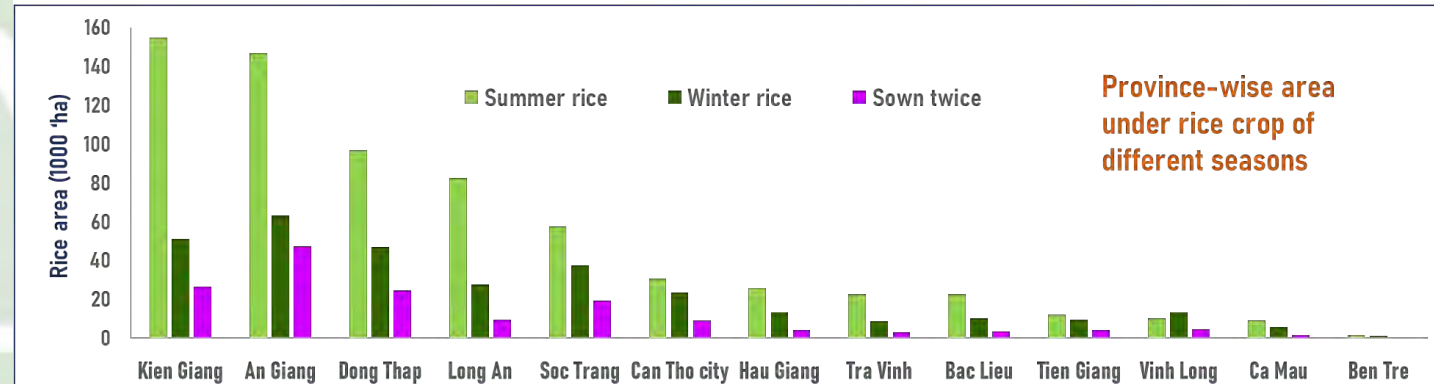
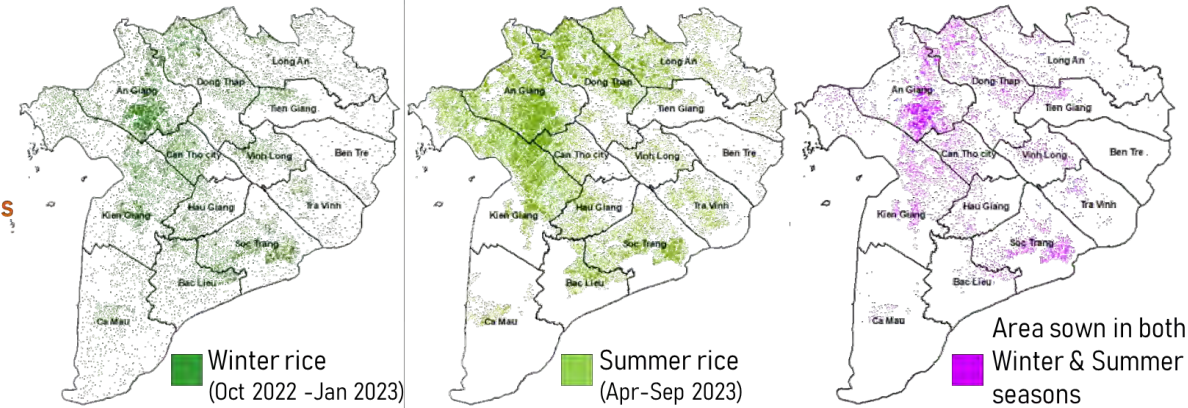
EOS-04 HV backscatter images and corresponding classified maps showing progression of summer rice sowings from May to Sept 2023



Mekong river delta area, Vietnam

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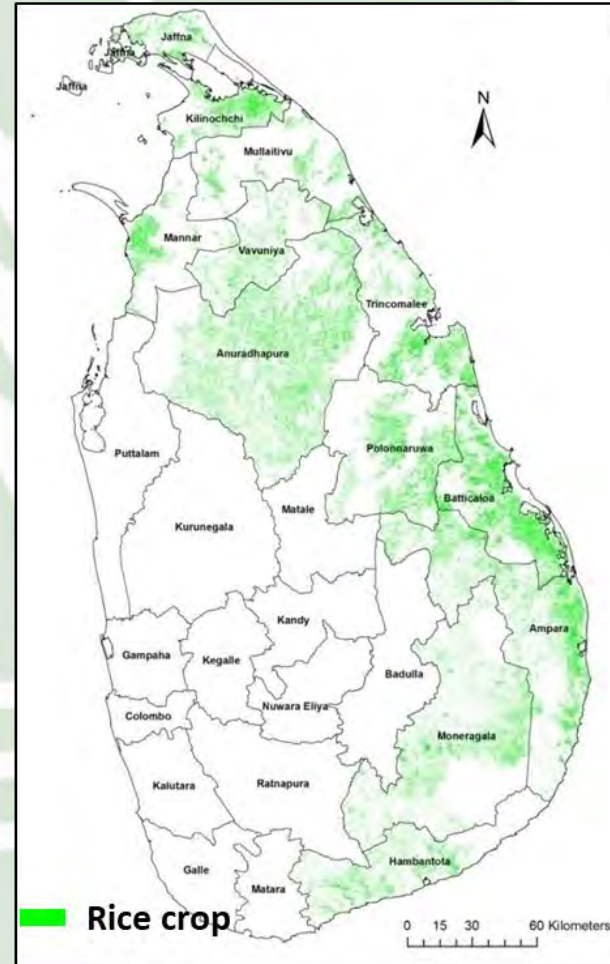
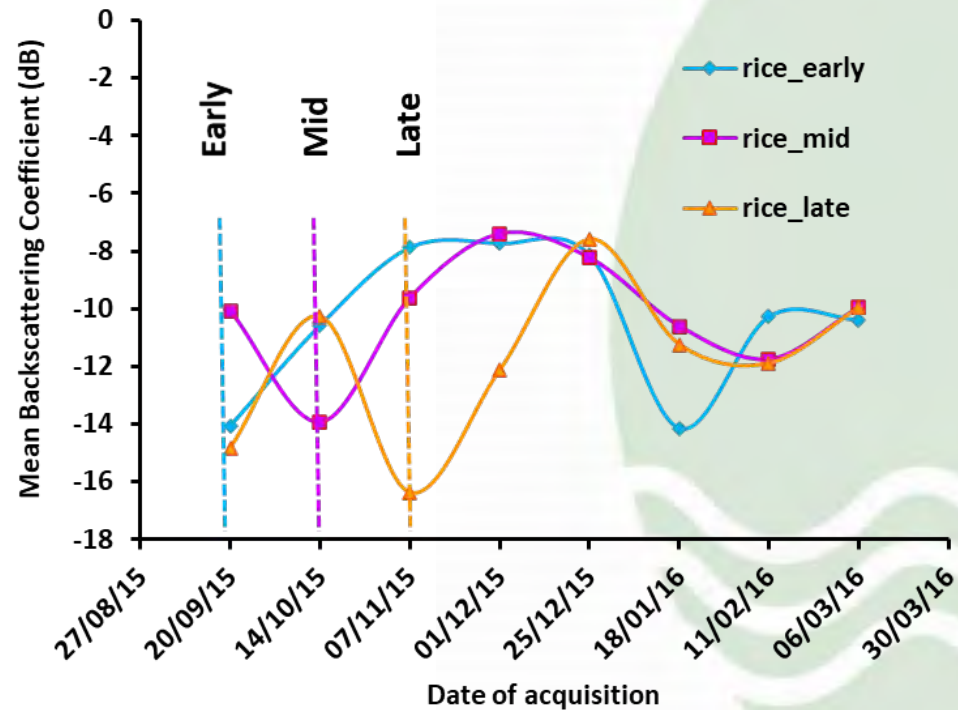
Rice maps of Winter and Summer seasons in Mekong River Delta



Rice crop mapping-International

Spatial distribution of the rice cropped area in 12 districts of Sri Lanka

Temporal backscatter profile of rice crop in Sri Lanka (VV-Polarization)



Delineated the rice cropped area in 12 major rice growing districts of Sri Lanka using temporal Sentinel-1A data for the 2015-16 Maha Season



Thank You

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