Vegetation Target for on orbit SAR data radiometric stability monitoring over Indian terrain

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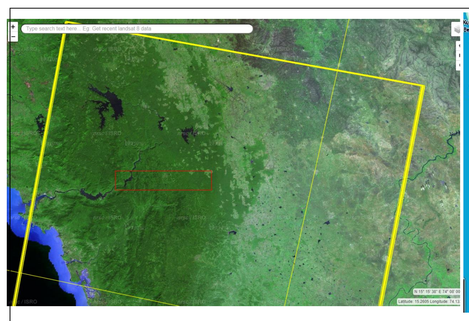
To Identify a radiometric vegetation target for ISRO SAR sensors like RISAT1A in augmentation with the globally identified 'Amazon Rain Forest' to have frequent opportunities due to systematic collection over Indian terrain.

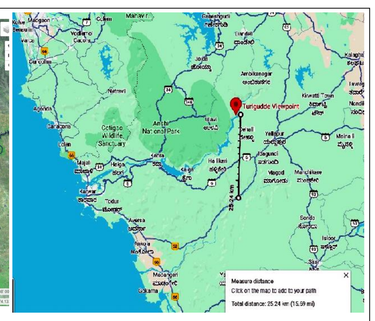
Studied Indian forest divisions and identified Yellapur Forest Division found to be promising by analyzing time series data of Resourcesat-2A ,RISAT2B,Sentinel1A,RISAT1A and NovaSAR.

Yellapur Forest Division is situated in the eastern part of Uttara Kannada district with Dharwad and Haveri districts in the east which is spread across over 1,68,986.66 hectares The division is drained by a number of rivers such as Kali, Bedti, Dharma, Tattihalla, etc.

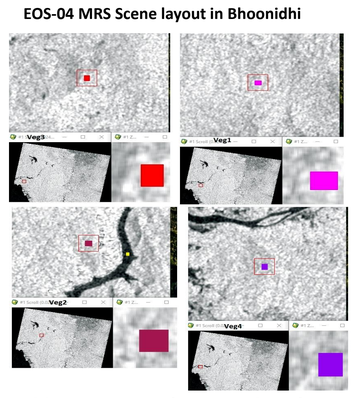
- **Five vegetation packets of the target site were identified based on the historical data and studied the radar backscatter coefficient for the available SAR Data.**



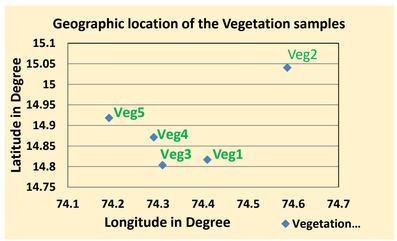
EOS-04 MRS Scene layout in Bhoonidhi



Google Map of the study Area

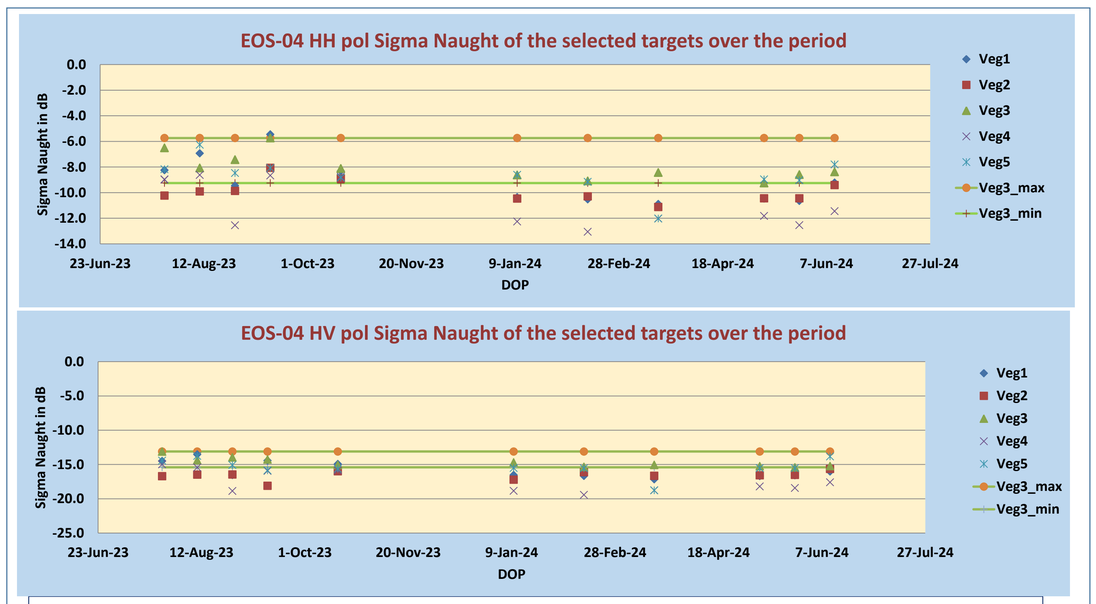


EOS-4 MRS Vegetation target Samples

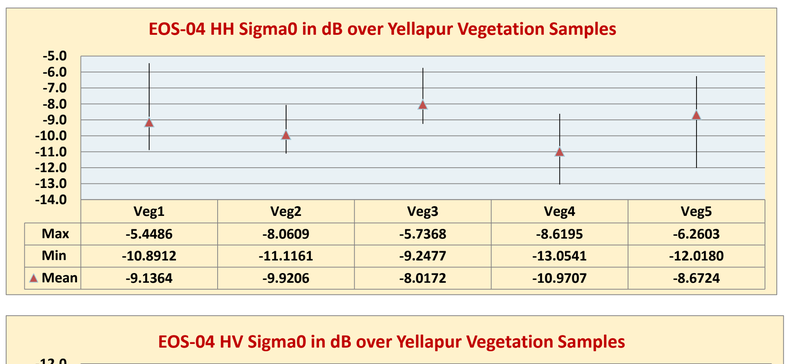


DOP	Inci.Ang	Altitude
24-Jul-23	37.86	528.45
10-Aug-23	37.86	528.50
27-Aug-23	37.87	528.46
13-Sep-23	37.87	528.59
17-Oct-23	37.89	528.42
10-Jan-24	37.90	528.63
13-Feb-24	37.94	528.51
18-Mar-24	37.94	528.46
8-May-24	37.94	528.19
25-May-24	37.95	528.03
11-Jun-24	37.94	528.33

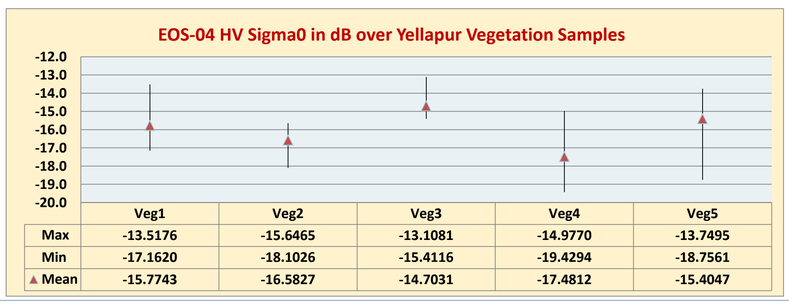
Data sets Analyzed



EOS-04 Vegetation response in HH and HV Polarizations MRS mode



	Veg1	Veg2	Veg3	Veg4	Veg5
Max	-5.4486	-8.0609	-5.7368	-8.6195	-6.2603
Min	-10.8912	-11.1161	-9.2477	-13.0541	-12.0180
Mean	-9.1364	-9.9206	-8.0172	-10.9707	-8.6724



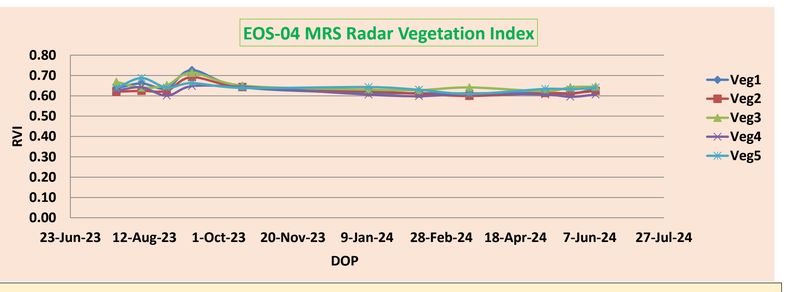
	Veg1	Veg2	Veg3	Veg4	Veg5
Max	-13.5176	-15.6465	-13.1081	-14.9770	-13.7495
Min	-17.1620	-18.1026	-15.4116	-19.4294	-18.7561
Mean	-15.7743	-16.5827	-14.7031	-17.4812	-15.4047

Radar Forest Degradation Index					
DOP	Veg1	Veg2	Veg3	Veg4	Veg5
24-Jul-23	0.27	0.24	0.34	0.25	0.28
10-Aug-23	0.32	0.25	0.28	0.28	0.37
27-Aug-23	0.27	0.25	0.31	0.20	0.28
13-Sep-23	0.45	0.38	0.43	0.30	0.33
17-Oct-23	0.28	0.29	0.30	0.29	0.28
10-Jan-24	0.23	0.24	0.26	0.21	0.29
13-Feb-24	0.23	0.22	0.26	0.20	0.26
18-Mar-24	0.22	0.20	0.28	0.22	0.22
8-May-24	0.23	0.23	0.25	0.21	0.27
25-May-24	0.22	0.23	0.28	0.19	0.26
11-Jun-24	0.27	0.25	0.29	0.21	0.28

Amazon Rain Forest Sigma0 values in dB		
EOS-04	FRS Mode	MRS Mode
HH	-7	-7
HV	-12	-11 to -14
Nova SAR		
HH	-7.5	
VV	-7.7	
RISAT2B	Spot Mode	
VV	-6	

Optical data from Resoucesat-2A Liss-3 Sensor

EOS-04_Mean	Veg1	Veg2	Veg3	Veg4	Veg5	Mean
RFDI	0.27	0.25	0.30	0.23	0.28	0.27
Ratio_HH/HV	0.58	0.60	0.55	0.63	0.56	0.58
RVI	0.64	0.63	0.65	0.62	0.64	0.63



Radar Vegetation Index is a ratio of cross polarization to total power from all polarization channels. In general ranges from 0 to 1, and it is a measure of scattering randomness.

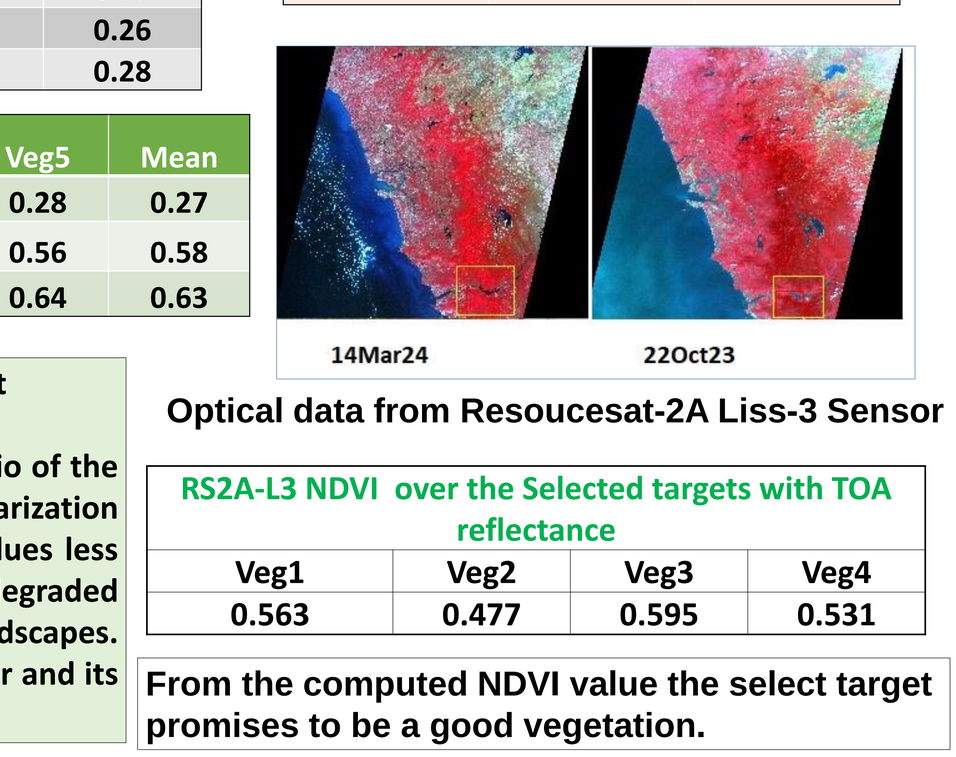
EOS-04 selected vegetation samples - Radar Forest Degradation Index and Vegetation Indices

The Radar Forest Degradation Index (RFDI) is a ratio of the normalized difference between co- and cross-polarization powers, with values ranging from 0 to 1. RFDI values less the 0.3 for dense forest, between 04 and 0.6 for degraded forests and greater than 0.6 for deforested landscapes. RFDI can be used to detect both loss of forest cover and its recovery after a disturbance.

RS2A-L3 NDVI over the Selected targets with TOA reflectance			
Veg1	Veg2	Veg3	Veg4
0.563	0.477	0.595	0.531

From the computed NDVI value the select target promises to be a good vegetation.

Sigma Naught Comparison in dB						
Co_pol	Veg1	Veg2	Veg3	Veg4	Veg5	Mean
S1A_VV	-5.86	-6.73	-5.46	-7.56	-4.87	-6.10
Novasar_VV	-8.07	-6.85	-7.27	-8.91	-6.45	-7.51
Novasar_HH	-7.40	-6.98	-6.91	-9.23	-6.37	-7.38
EOS-04_HH	-9.14	-9.92	-8.02	-10.97	-8.67	-9.34
R2B	-5.44	-8.26	-5.84	-5.88	-6.16	-5.22
Cross_pol						
S1A_VH	-12.19	-12.87	-11.83	-13.43	-11.46	-12.36
EOS-04_HV	-15.77	-16.58	-14.70	-17.48	-15.40	-15.99
Novasar_HV	-13.33	-13.15	-12.09	-14.47	-11.53	-12.91



From the computed average RVI and RFDI values promises the selected site is rich in vegetation throughout the calendar year.

Planned to continue the study

- for EOS4 Full Pol data using all modes.
- post launch NISAR L and S Band data for all modes .

From the study the selected site is suitable for vegetation target in systematic SAR coverage over Indian Terrain.