



Advanced technologies using Data Science with APIs

Technical Session-V : Open EO data – Applications

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Outline

Four verticals of Geospatial Data at Bhuvan

Bhuvan Data Science

Two API based Applications

- Hot Spot Analysis using temporal LULC data
- Solar panels over India using satellite data

Future APIs

Four verticals of Geospatial Data at Bhuvan

Visualization datasets

Satellite Images: 0.3m - 50.0m

Thematic Services

"OGC Web Services (WMS, WMTS) towards interoperability"

Bhuvan-Thematic Services facilitate the users to select, browse and query the Thematic Datasets from this portal. Users can also consume these Thematic Datasets and integrate into their systems as 'OGC Web Services'.

- LULC - 50 K (2005-06, 2011-12, 2015-16)
- LULC - 250 K (14 Cycles : 2004-05 to 2018-19)
- LULC - 10 K (SIS-DP)
- Urban Land Use: 10K (NUIS)
- Wasteland: 50K (2008-09, 2015-16)
- Geomorphology:50K (2005-06) & Lineament: 50K
- Erosion :50K (2005-06)
- Salt Affected and Water Logged Area :50K (2005-06)
- Urban Sprawl
- Water bodies
- Flood Annual Layers (1998 to 2010) – Assam & Bihar
- Flood Hazard Layer (1998-2007) – Assam ,Bihar & Orissa
- Metadata NSDI 2.0
- Analysis, Statistics, Web services, View based Print, Add WMS Layer, Clip & Ship

Year	2020	
Products	Downloads	Unique Users
Indian Soil Datasets	3,355	696
Land Degradation	299	120
Mesoscale compatible inputs for: MMS	64	23
Mesoscale compatible inputs for: WRF	262	54

"LULC 250 K – 1459 requests cleared"

Thematic Services: 4k to 250k

Bhuvan – Point Data

Mobile Apps (70) & Crowd Sourcing (100 Million)

MGNREGA	61144034	Inventory, Monitoring – Before, During , After
PMAY-HFA	8452386	Monitoring – Direct Benefit Transfer
AP-Housing	6803541	Inventory, Repair Works
CDMA	1235143	Un Assessed, Under Assessed properties for taxation
IWMP	1218896	Monitoring and Impact Assessment
Health	1008745	Health Establishment Inventory – Public / Private
SISDP	752898	Asset Inventory for Gram Panchayat Dev Planning
PDMC	455067	Irrigation Infrastructure
RKVY	377290	Agriculture Dev Programs
Indian Post	179981	Inventory, Beat Mapping
Anganwadi	116172	Inventory and Optimal Planning

Projects	3 months	1 year
MGNREGA	32,52,293	1,47,67,112
PMAY-HFA	4,39,804	38,07,896
IWMP	26,677	2,80,297
RKVY	13,806	1,46,287

Poi Data ~ 100 Millions

ECVs- Environment and Climate Variables

Terrestrial Sciences, Ocean Sciences, Atmospheric Sciences

Model Derived Products, Cryospheric Products

Bhuvan – Disaster Services

"Disaster Management Information Support"

Disaster Management Support from space systems for strengthening the disaster management in the country.

- Flood (2008 onwards- 792 maps)
- Forest Fire (2008 onwards, MODIS, SNPP, JPSS)
- Drought (Spatial, meteorological indicators)
- Landslide
- Cyclone
- Earthquake (Magnitude GT 6)

Climate & Disaster Data

Bhuvan Data Science

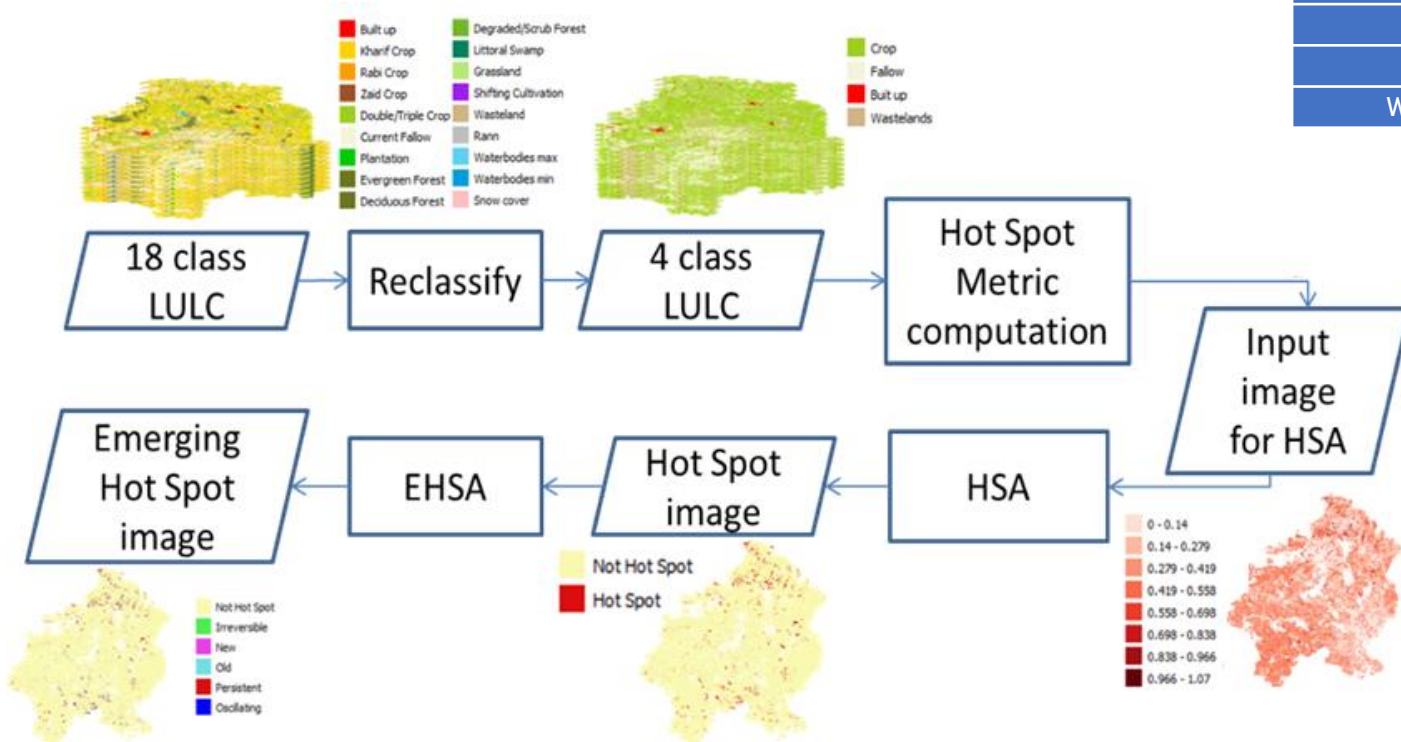
- Enrich Bhuvan with AI/ML analytics using the four verticals of Bhuvan Geospatial data
- Provide solutions for citizens and policy makers helping in decision making
- Two API based Applications
 - Hot Spot Analysis using temporal LULC data
 - Solar panels over India using satellite data

Objective: End-to-end automated solution to bring out the locations of major changes over the Decade in Land Use Land Cover using 1:250K
Main Emphasis on Agriculture

Class Mapping	
Kharif Crop, Rabi Crop, Zaid Crop, Double/Triple Crop, Plantation	Crop
Current Fallow	Fallow
Built up	Built up
Wasteland, Rann	Wasteland

Year 1	2	3	4	5	6	7	8	9	10
Crop	Crop	Crop	Fallow	Fallow	Fallow	Builtup	Builtup	Builtup	Builtup
Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow	Fallow

Change, Frequency and Latency



Transition matrix

From ↓ To →	Crop	Fallow	Builtup	Wasteland
Crop	1	2	3	4
Fallow	1/2	1	2	3
Builtup	1/3	1/2	1	2
Wasteland	1/4	1/3	1/2	1

Saaty's Weights

Eigen Weights
0.166
0.278
0.482
0.813

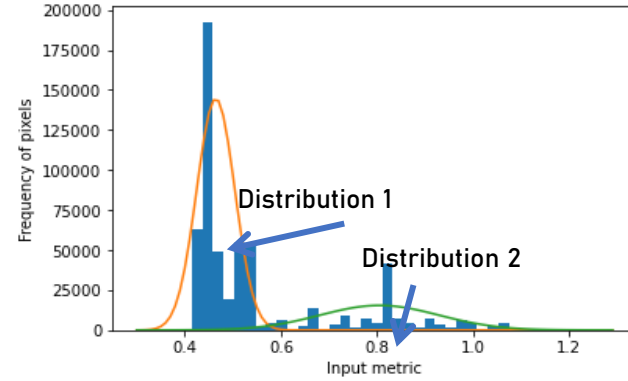
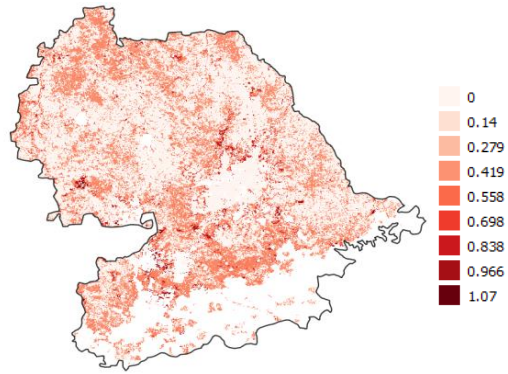
Comparison and New Approach

Approach	Transition Matrix	Saaty's weights	Novel Approach
CCCCCFFFFF	0.275	0.211172	0.486172
CCCCCCUUUU	0.3	0.292713	0.592713
FFFFWCCCCC	0.28125	0.275912	0.557162
FFFFWWWWWC	0.28125	0.534869	0.816119
CCCCCFFFW	0.325	0.275912	0.600912
FFFFWCCCCC	0.28125	0.275912	0.557162

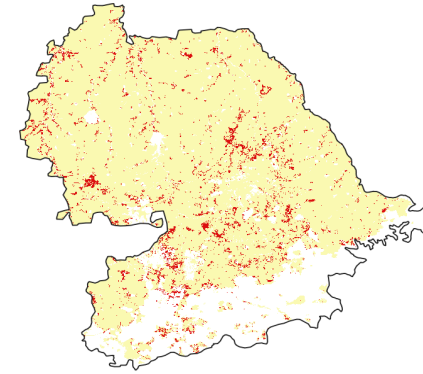
C - Crop, F - Fallow, U - Builtup, W - Wasteland

Novel Approach --- Addresses all critical Hot Spot combinations

Indore District



Dist. Indore, Madhya Pradesh (3336 sqkm)
Hot Spot regions: **5.8% (194 sqkm)**



Not Hot Spot
Hot Spot

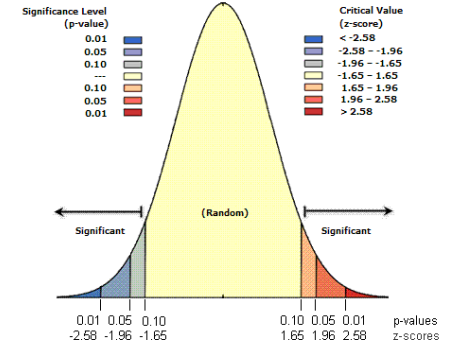
Input metric image

Bimodal distribution

Threshold

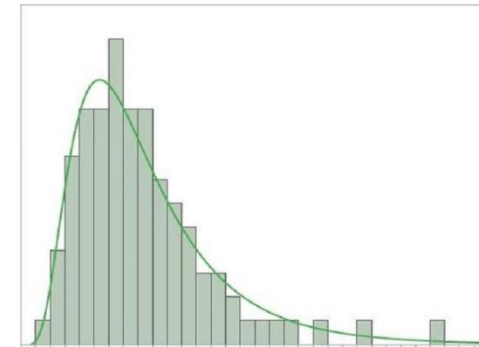
Hot Spot Image

Gaussian Distribution



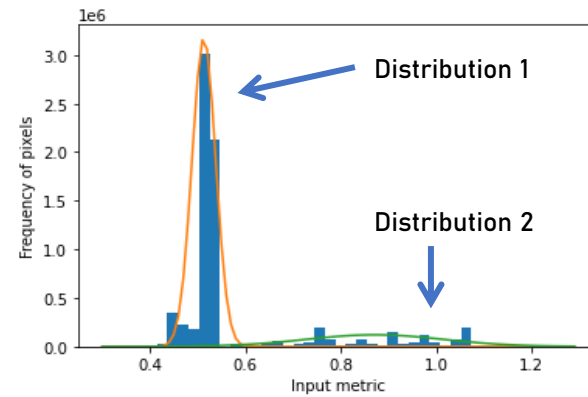
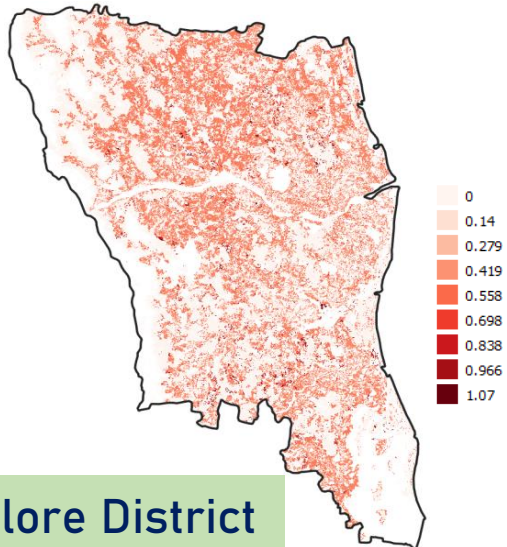
Getis-Ord G_i^* Metric

Skewed Distribution

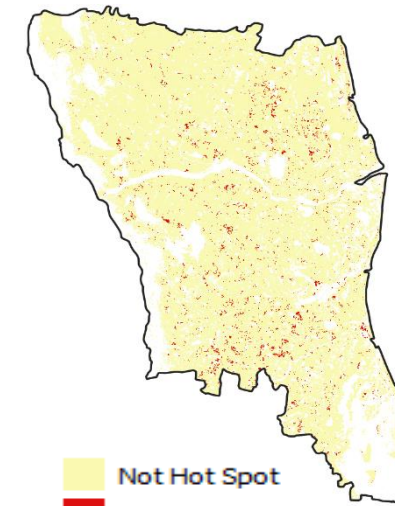


Box Plot Metric

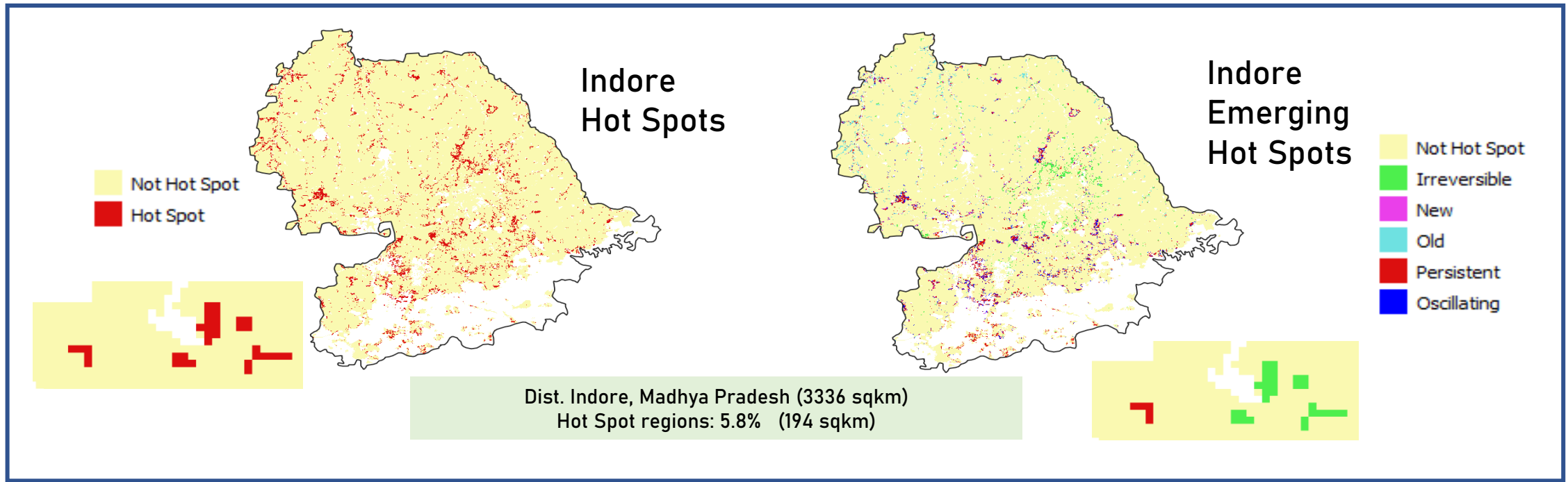
Nellore District



Dist. Nellore, Andhra Pradesh (9590 sqkm)
Hot Spot regions: **2.5% (247 sqkm)**

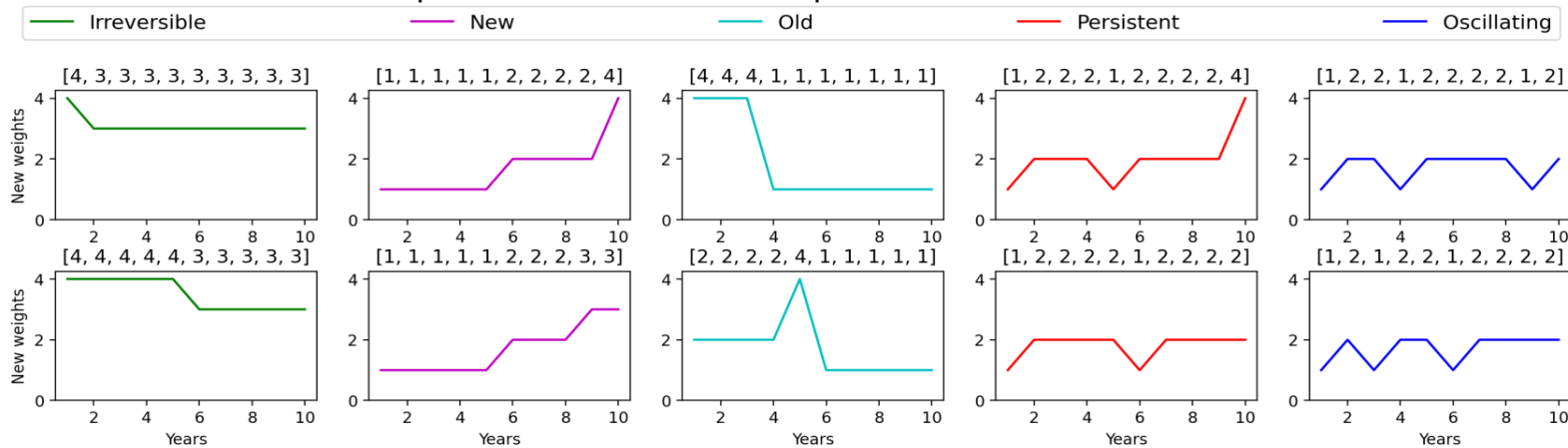


Not Hot Spot
Hot Spot

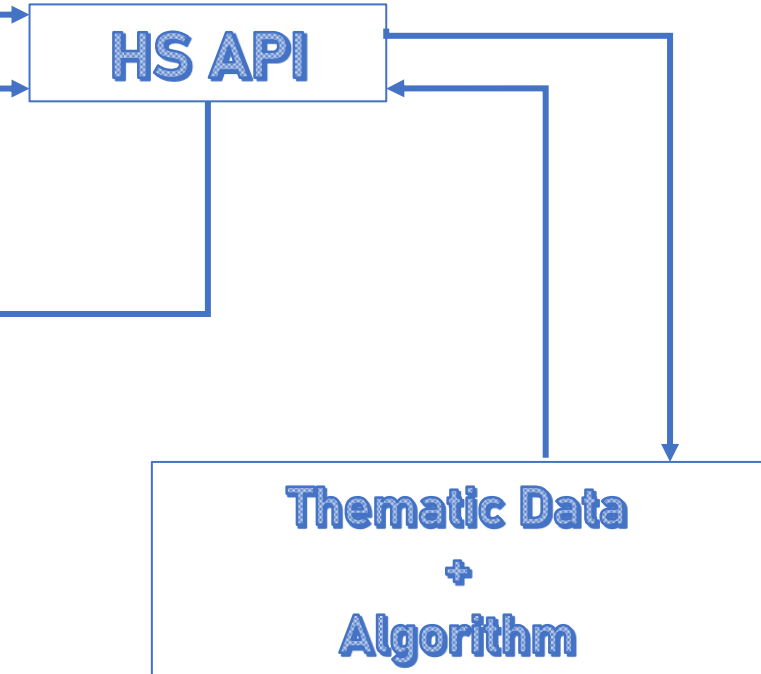
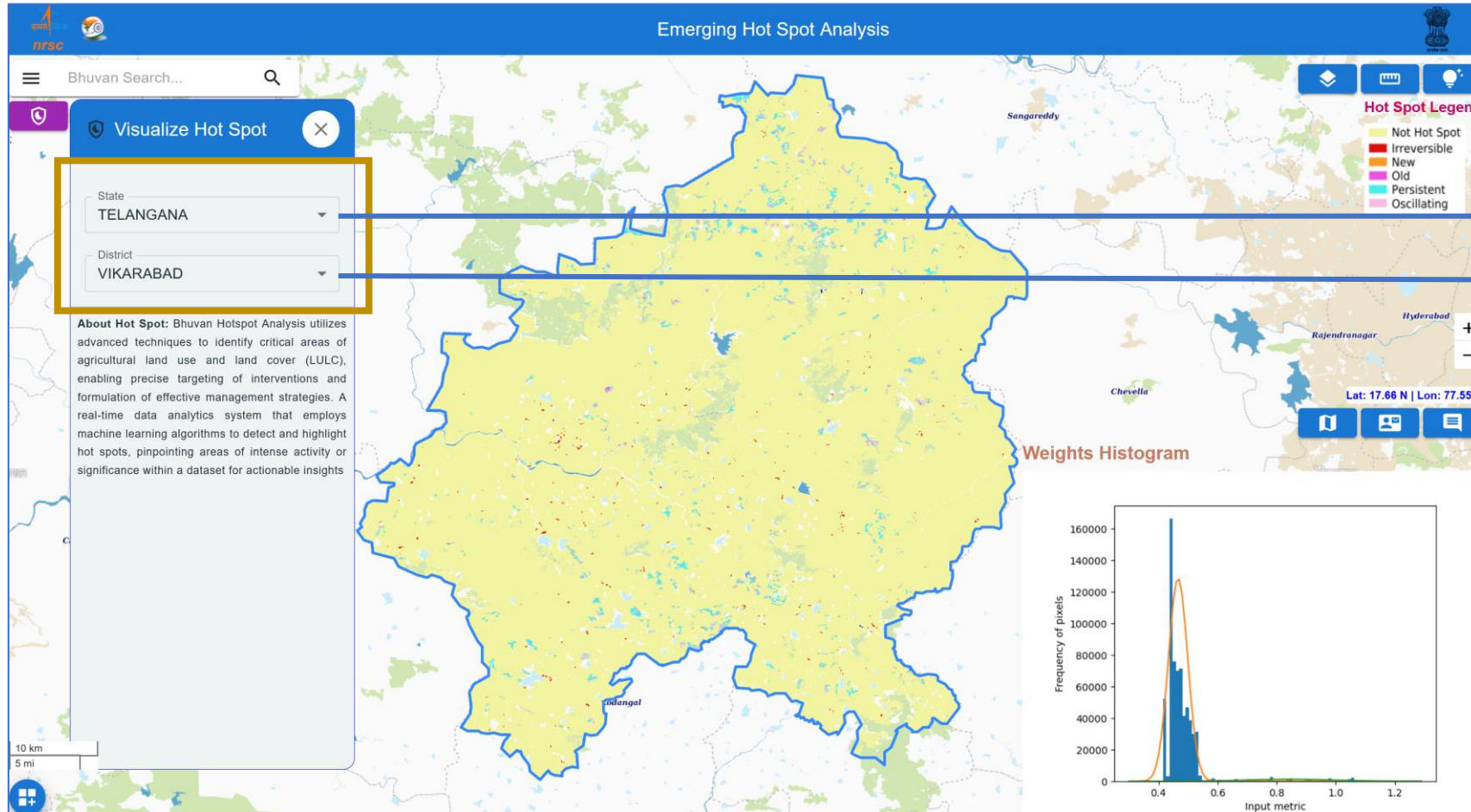


LULC classes for different categories of Emerging Hot Spot Analysis

1 : Crop 2 : Fallow 3 : Builtup 4 : Wastelands

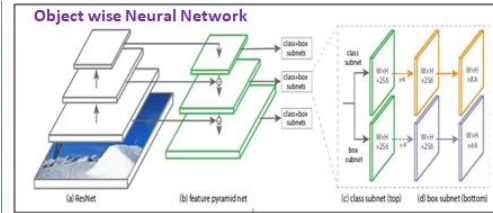
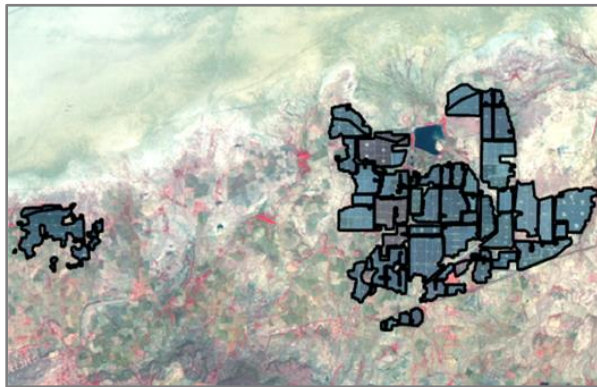
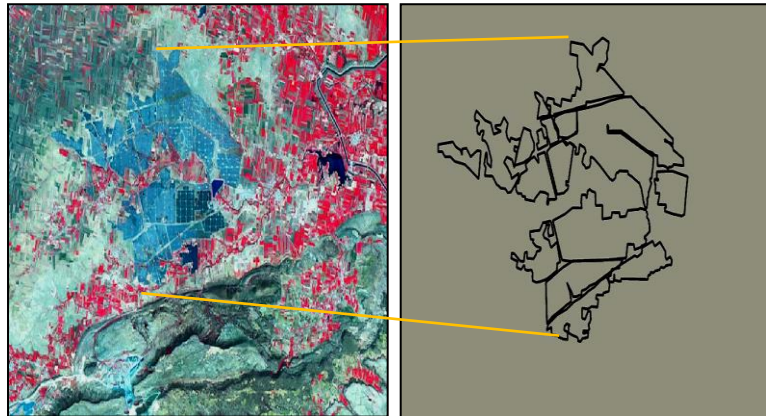


Hot Spot Analysis using temporal LULC data – prototype web application

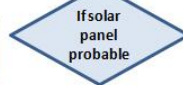


Solar Farm Inventory of India from Space

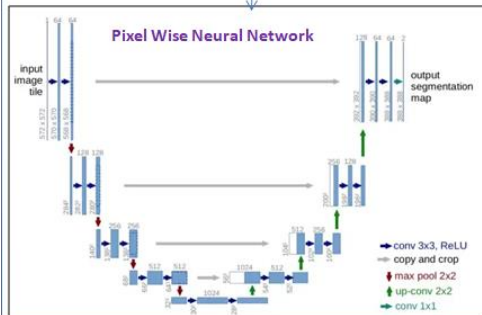
- Smart geospatial solar farm inventory by extracting solar farms from LISS III sensor data.
- State, district wise statistics of solar farms.



Hybrid Model

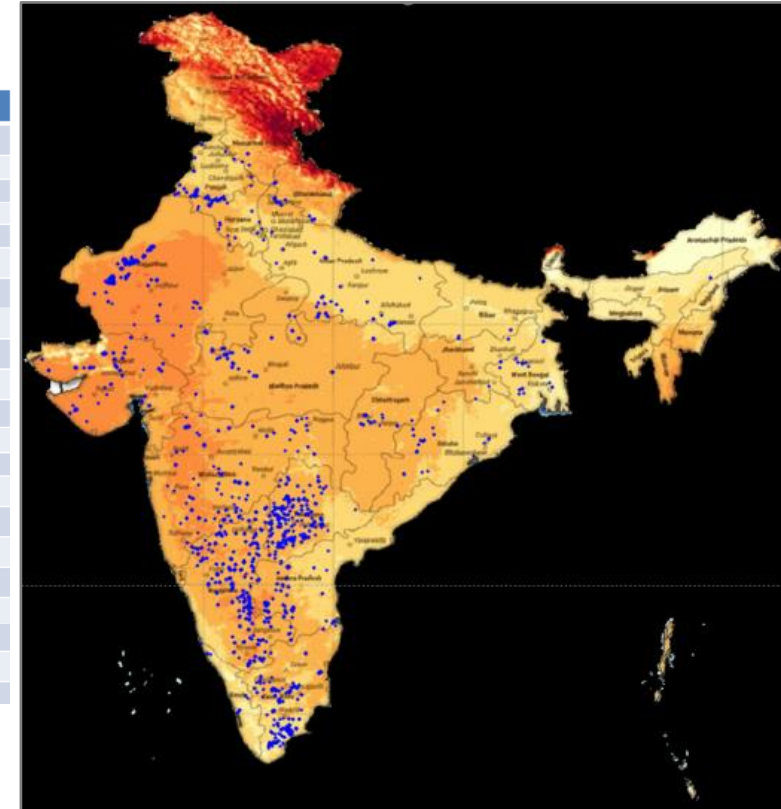


- With Reduced TAT
- Improved Accuracy



• Positional Accuracy 95%, Boundary Accuracy 90%
• Model Accuracy 97%*

State	Area (Ha)
Andhra Pradesh	11883
Assam	118
Bihar	178
Chhattisgarh	771
Delhi	20
Gujarat	7206
Haryana	178
Himachal Pradesh	52
Jharkhand	90
Karnataka	15884
Madhya Pradesh	7695
Maharashtra	3289
Orissa	829
Punjab	3088
Rajasthan	28767
Telangana	10709
Uttaranchal	680
Uttar Pradesh	3078
West Bengal	256
Tamil Nadu	3964
Kerala	96

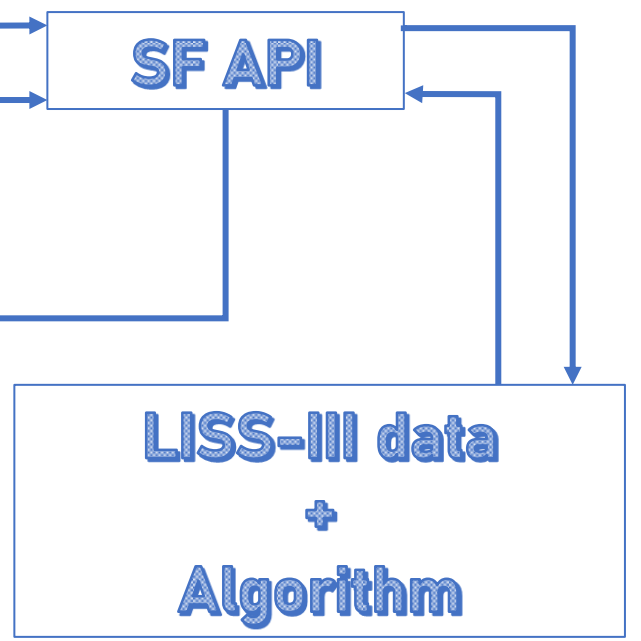
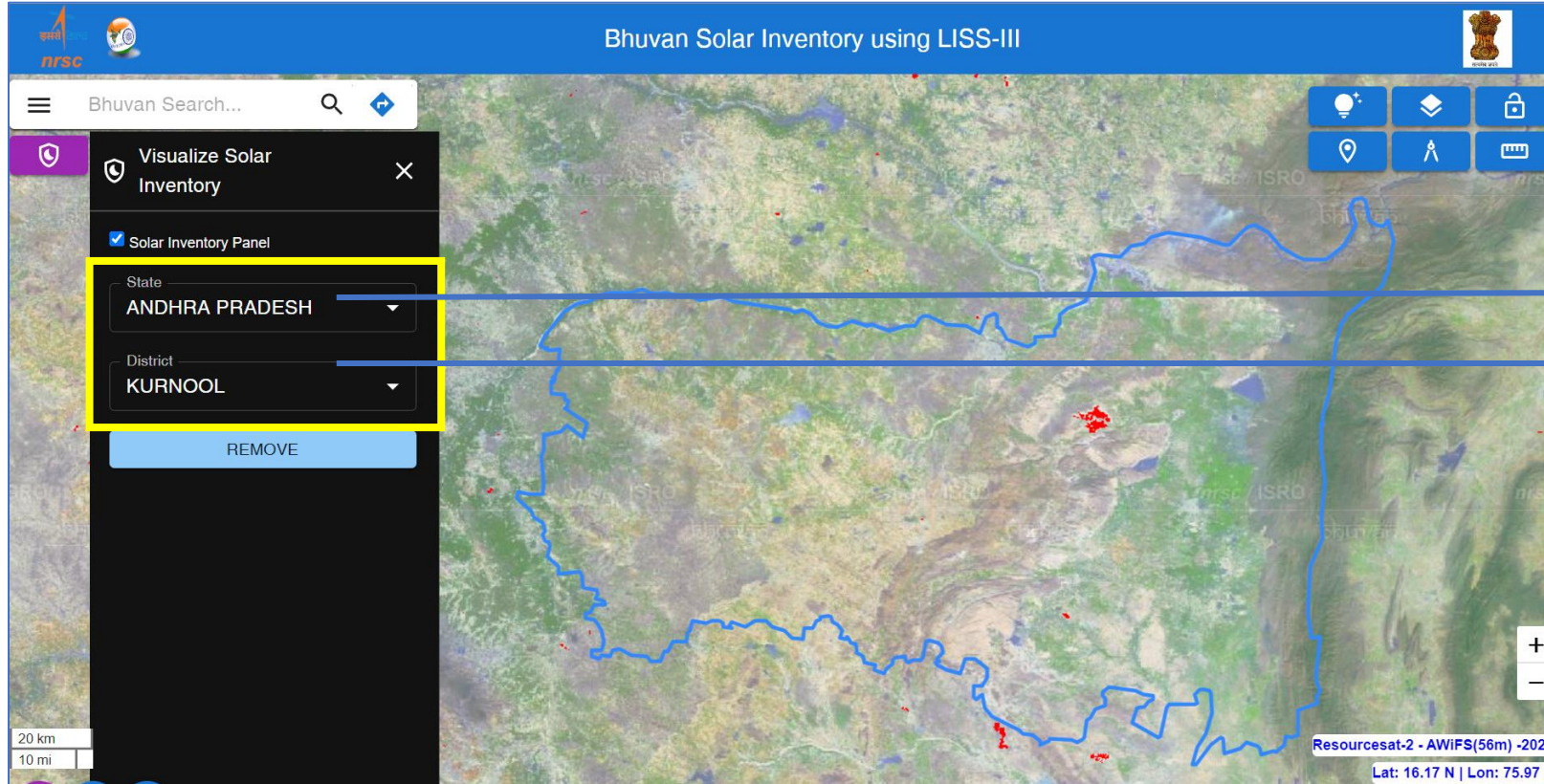


- Threshold area of Solar farms : ≥ 10 ha
- Total Solar Farms Area: 98831 ha
- No. of Solar Farm clusters: 2976
- Average area per cluster: 33.21 ha

- Object wise detection followed by pixel wise segmentation.
- Focal loss to handle class imbalance
- ResNet-34 used as backbone model for RetinaNet & Unet.

- Validation carried out in 4-stages using HR data.
- Model Trained on 1.5TB Data; Accuracy – 97%

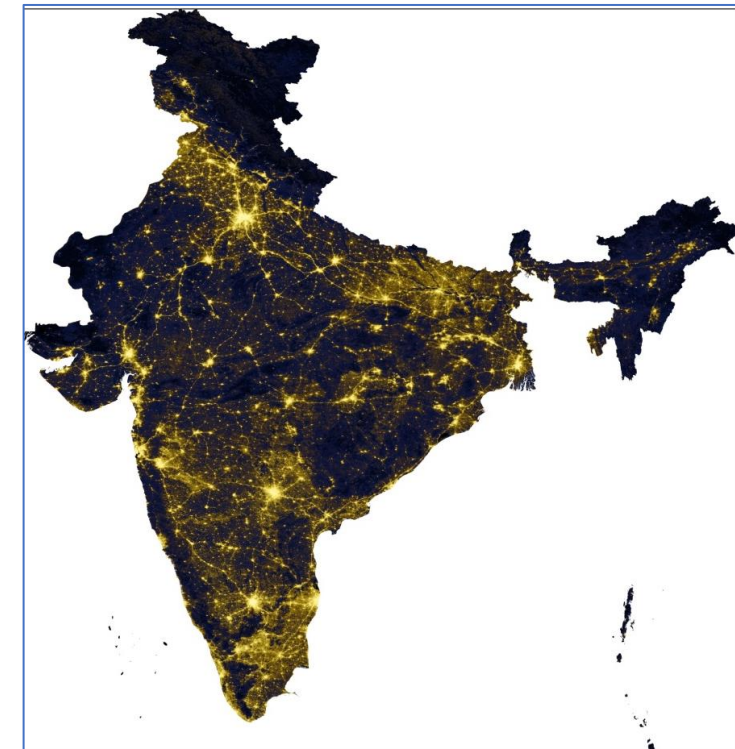
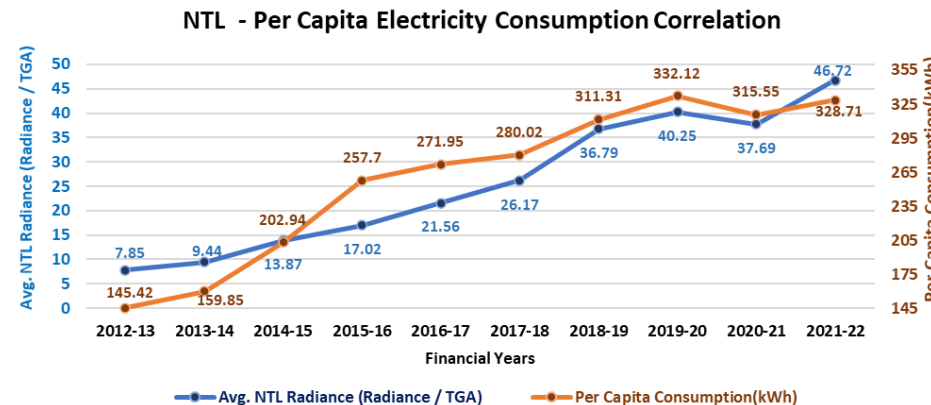
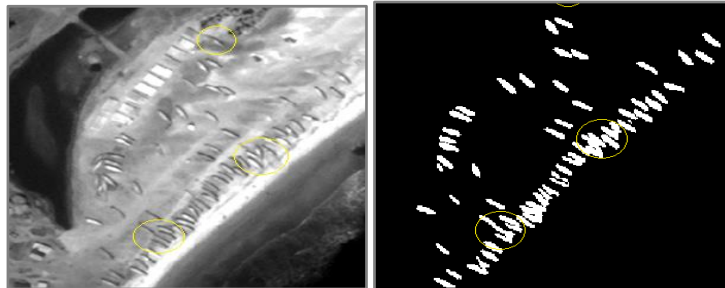
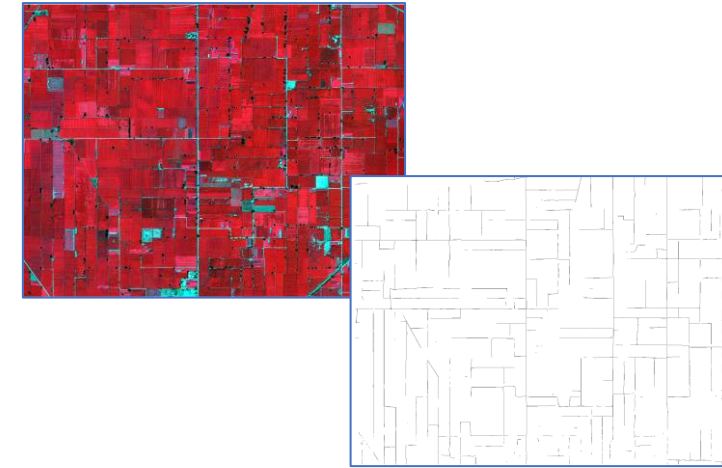
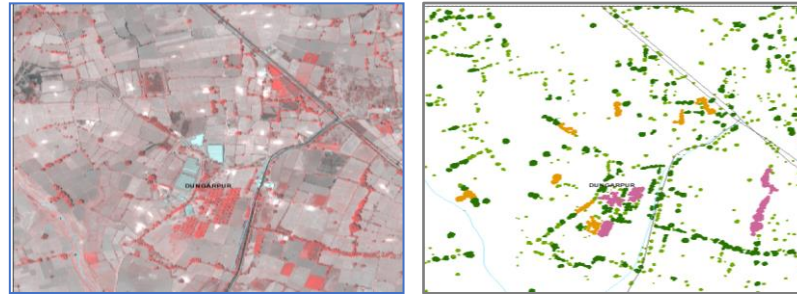
Solar Farm Inventory of India from Space – prototype web application



*under development

Ongoing and Future activities

- Tree Outside Forest
- Farm Bunds
- Fishing Boat Detection
- NTL Regression and Time Series analysis
- Many more...
- User owned data as input





Thank You

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