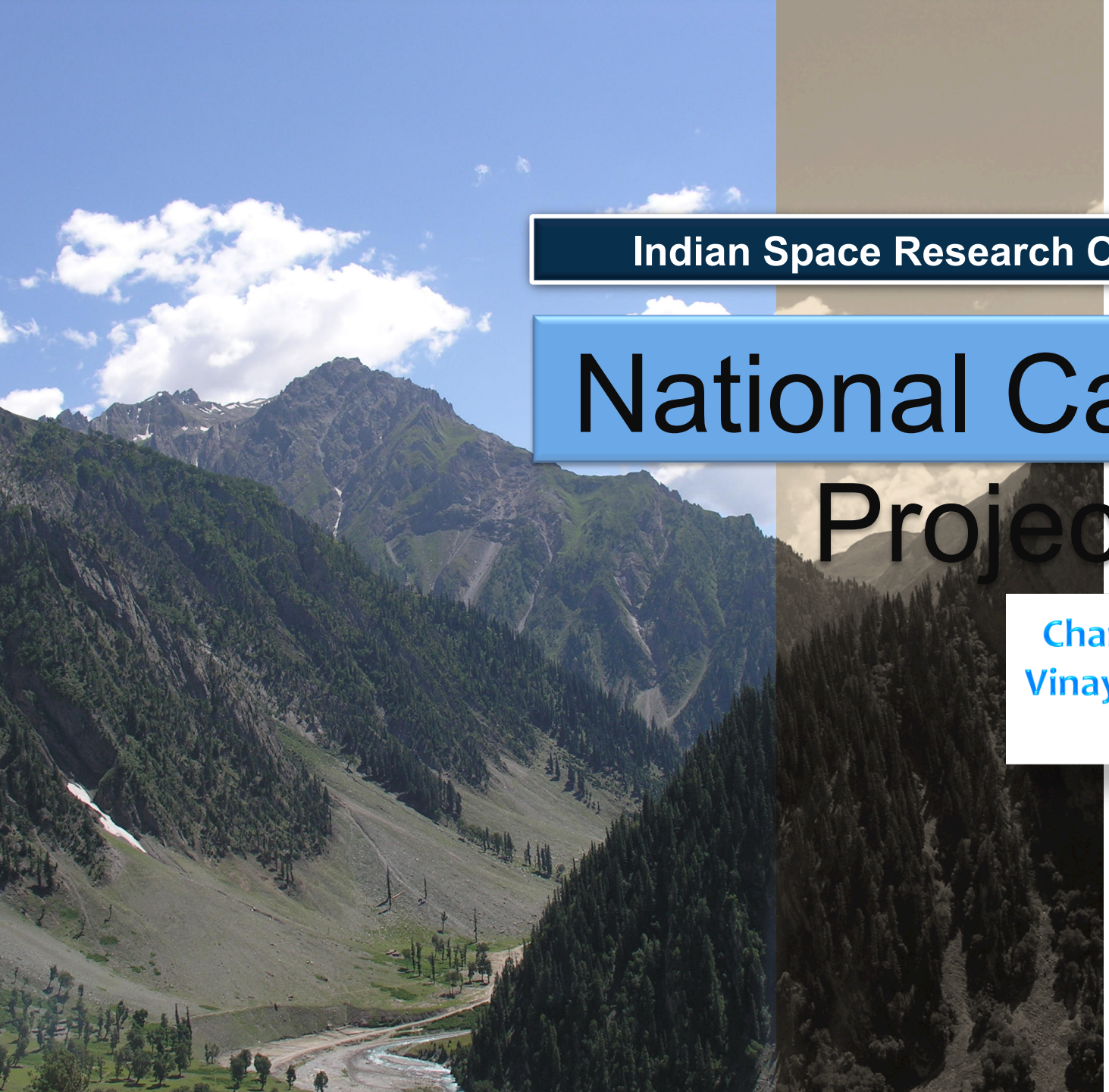


Overview

Indian Space Research Organization

National Carbon Project

Chandra Shekhar Jha
Vinay Kumar Dadhwal
& NCP Team

इसरो isro
nrsc

REDD+ in India

- Green India Mission is proposed as REDD+ mechanism by Govt of India
- GOI proposes strong support for PES (Payment for Ecological Services) under REDD+
- Implementation of cover increase and quality increase would be handled by Gram Sabhas (Village Councils) and Volunteer Foresters
- Village level spatial database preparation initiated by ISRO under SIS-DP for entire India which should act as key mechanism for MARV

Reduction in Deforestation and Degradation : Remote Sensing Capabilities

- **Indian Forest Cover Change Alert system initiated using - Resourcesat – 2 AWIFS**
- **Natural resource Census at 1:50000 scale using IRS Resourcesat for entire India initiated in its second cycle**
- **Forest fire alert generation and burnt area assessment studies using MODIS and IRS AWIFS sensor are being conducted**
- **World's first ever large scale retrospective sink CDM project in Khammam District, Andhra Pradesh , India.**

Carbon Inventory

National Carbon Project : Pools and Fluxes

- Vegetation Carbon pool studies
- Biomass surfaces
- SVAF - Flux tower network
- Atmospheric Carbon dynamics
- Geologic Carbon fluxes

Forest Cover Monitoring – Global and National Scenario

Global Scenario

14.6 Mha deforesration ,

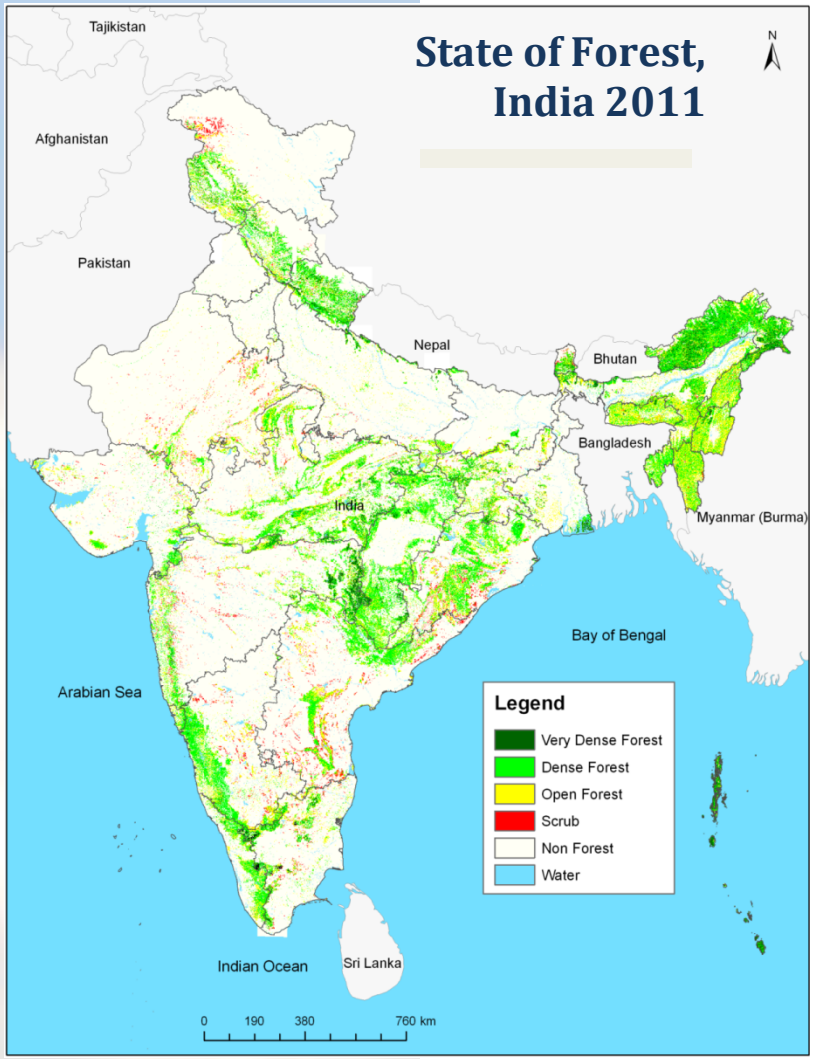
5.2 Mha plantations,

30% secondary formations

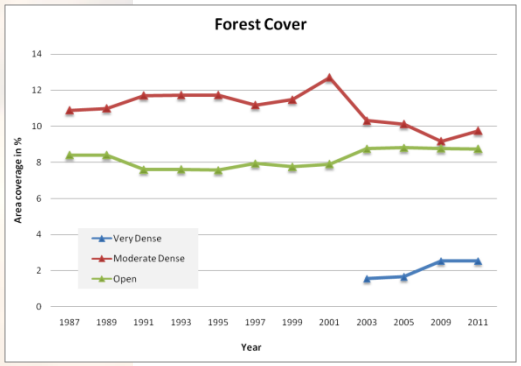
650 definitions,

National Scenario

- Periodical forest cover assessments in India since 1980 (XII reporting)
- Uses IRS satellite data
- 4 density classes delineated
- Report submitted to Indian Parliament



22/137 developing countries have NO repeat inventories



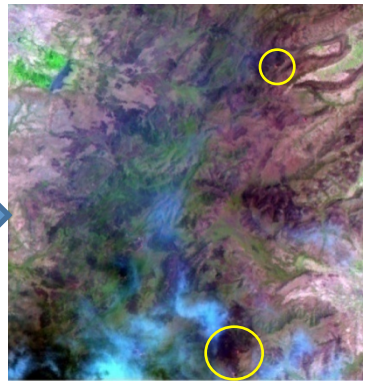
Daily Active Forest Fire Alerts During Feb-June Every Year based on TERRA/AQUA MODIS Data

Daily acquisition of TERRA/AQUA MODIS data

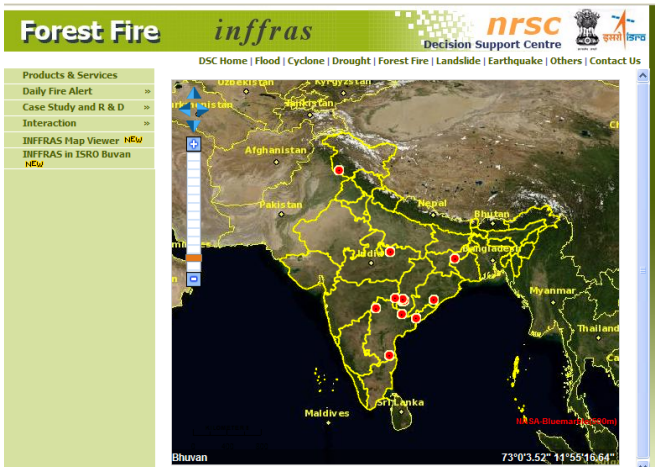
~4 daytime passes per day

Generation of 2 daily Active Fire Alerts

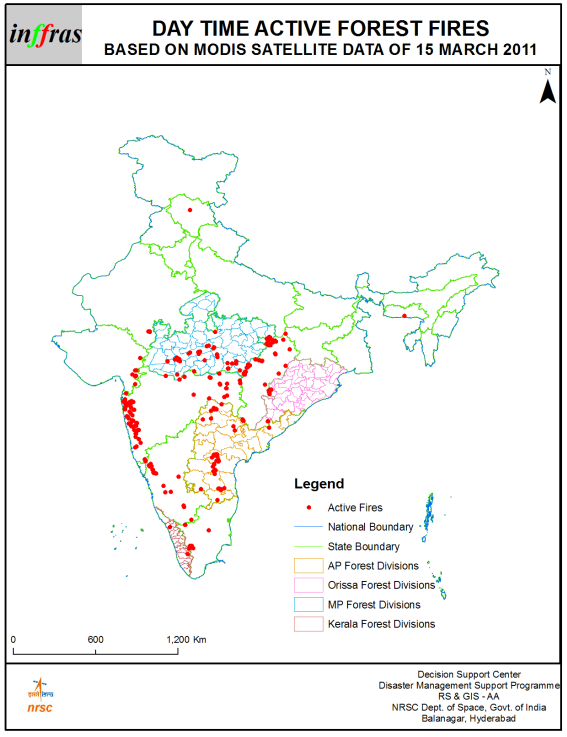
MODIS contextual Fire Algorithm- MOD14



Value additions
•Forest Mask
•Forest Admin. overlay



2D and 3D Visualization through BHUVAN



Disaster Management Support Programme

Decision Support Center

Indian Forest Fire Response and Assessment System (INFFRAS)

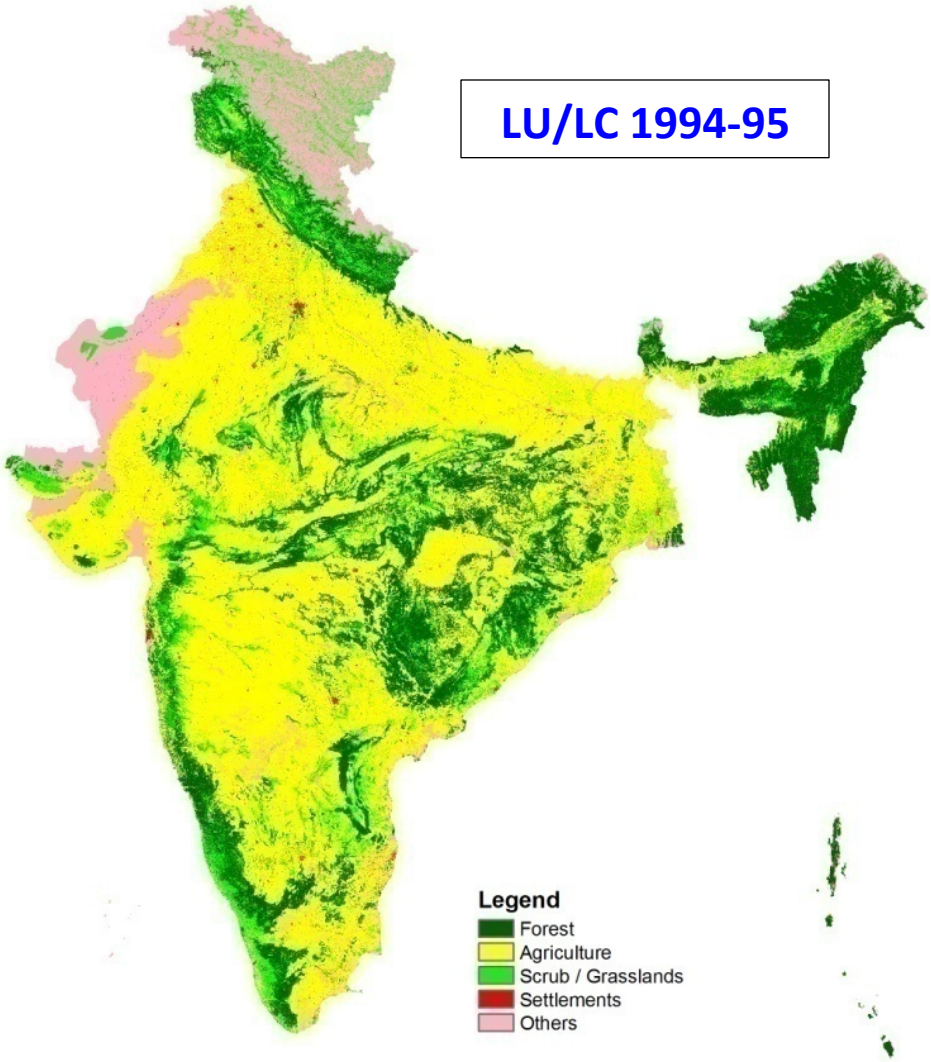
Feedback

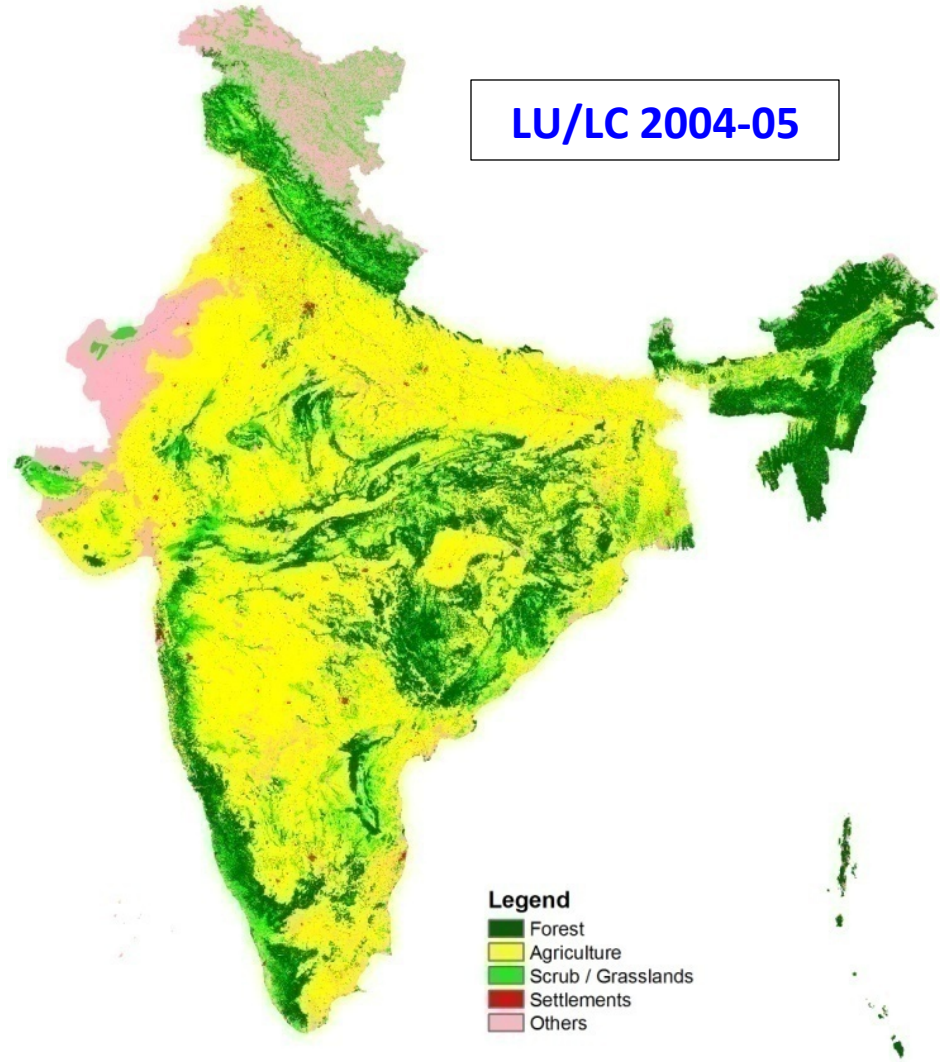
Information to ground personnel for fire mitigation

Email Dissemination to ~400 nodal officers

Turn-around time of less than 1 hr from satellite overpass

NATCOM-II; Land Use/Land Cover change assessment 1994 & 2004





National Assessments – Approaches

- National level Forest areas and BEF
- RS based National level areas, Strata level BEF at National level
- State wise RS based areas & State wise, Strata wise BEF
- District wise areas, State wise, Strata wise BEF

National Carbon Project

GOALS

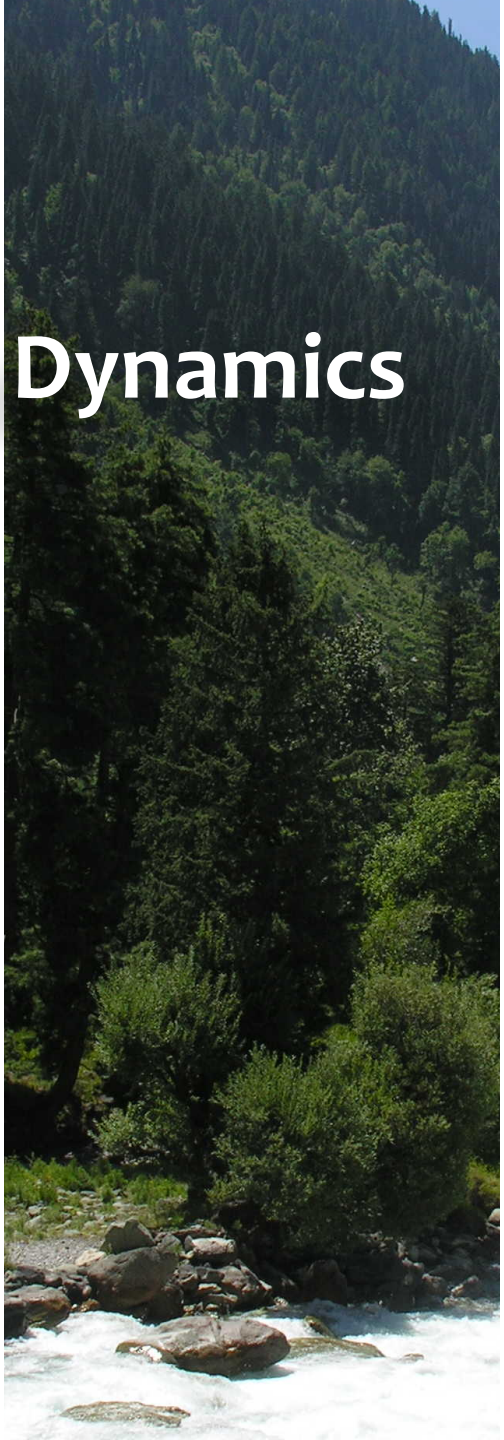
- **Assessment of Carbon Pools, Fluxes and Net Carbon balance for terrestrial biosphere in India**
- **To establish a observational network and remote sensing-based spatial databases for modeling and periodic assessment of carbon balance**
- **To provide support to national activity with respect to carbon balance under National Communication to UNFCCC**

Sub Projects

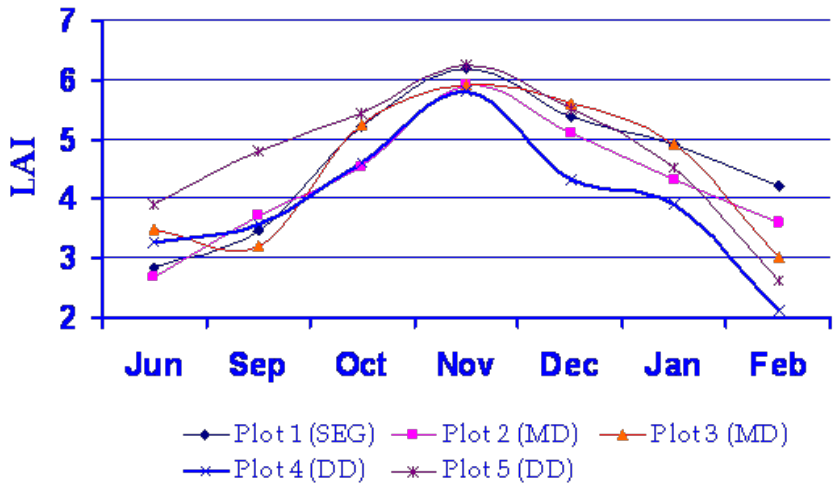
- Vegetation Carbon Pools
- Soil Carbon Pools
- Soil Vegetation Atmospheric Fluxes

Vegetation Carbon Pools and Dynamics

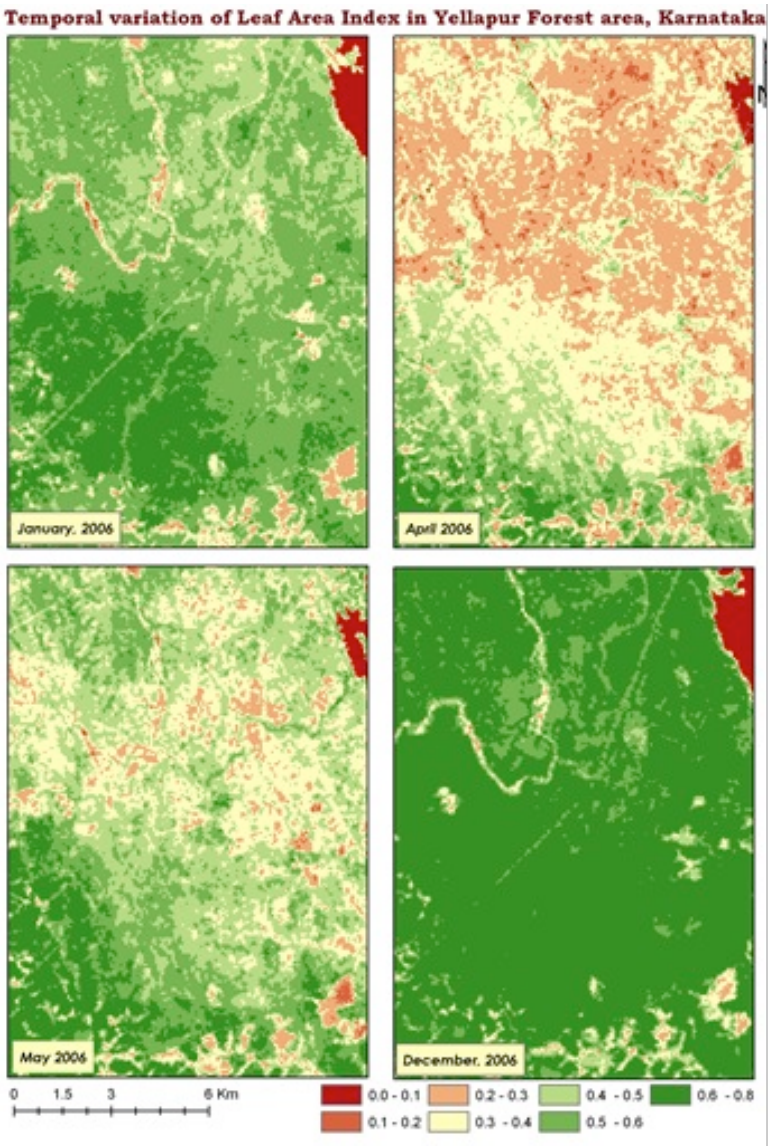
VCPD



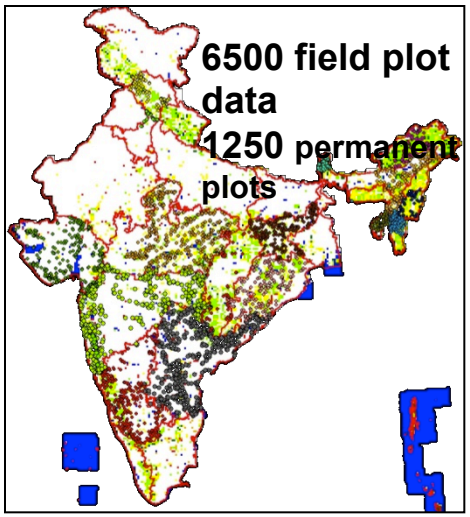
Tree level / Plot level Studies:

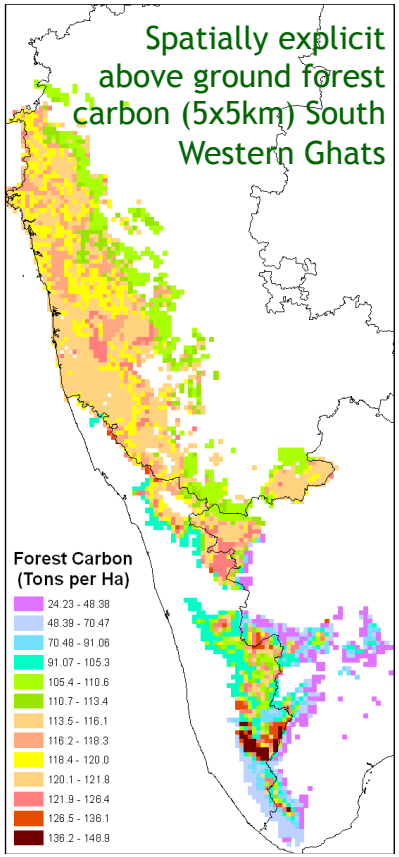


Month	Plot 1 (SEG)	Plot 2 (MD)	Plot 3 (MD)	Plot 4 (DD)	Plot 5 (DD)
Jun	2.84	2.67	3.47	3.27	3.9
Sep	3.46	3.71	3.19	3.57	4.79
Oct	5.22	4.55	5.25	4.6	5.43
Nov	6.19	5.91	5.91	5.8	6.25
Dec	5.39	5.11	5.61	4.31	5.52
Jan	4.9	4.31	4.91	3.89	4.52
Feb	4.2	3.6	3.01	2.11	2.61



Spectral Based LAI Changes in Yellapur Forest Area





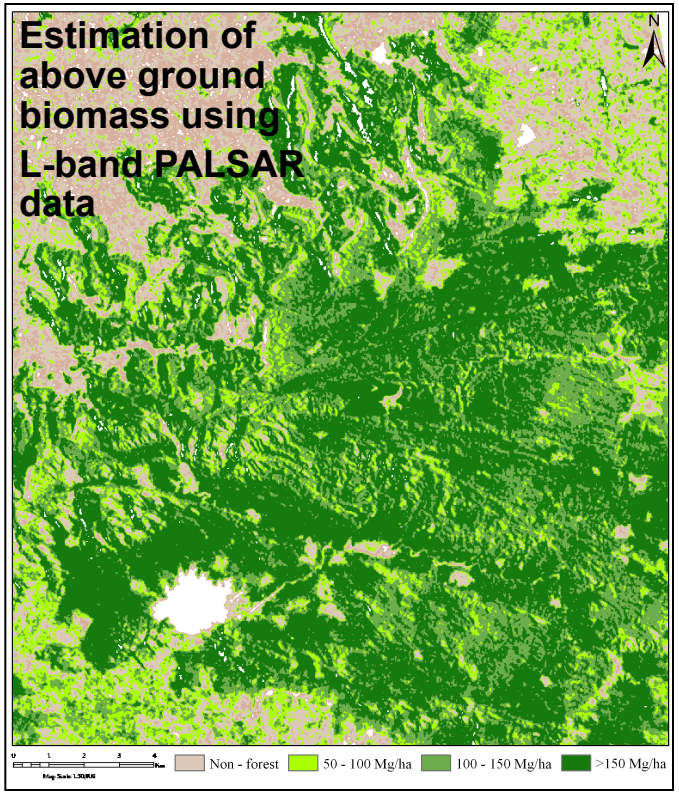
Stratification and extrapolation with RS data

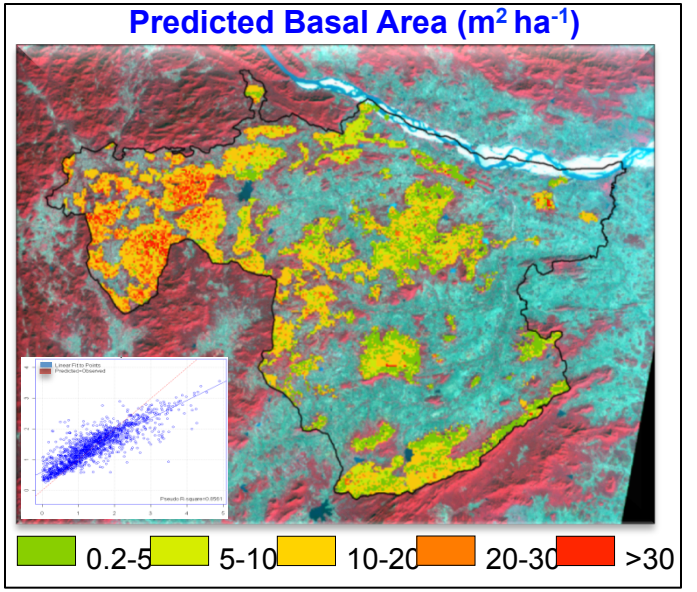
L-Band Microwave

Field Data/ Sampling Data

Optical RS & Modeling

Data Mining





National level Assessment of Trees Outside Forests using multi-resolution IRS data

Rationale :

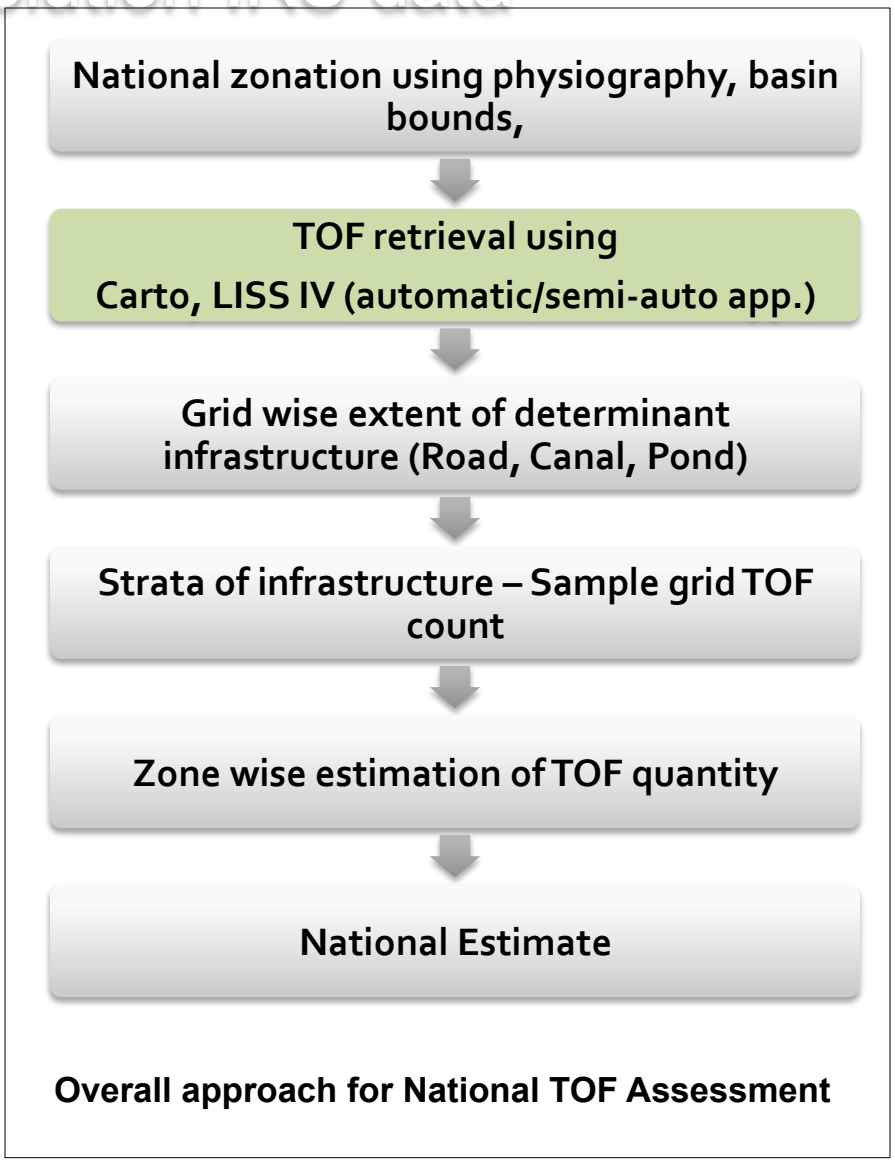
- Agroforestry gives livelihood support, Mitigation and Adaptation measure
- Trees Outside Forests increasing due to public and private initiatives
- IRS (Cartosat PAN/LISS IV) sensors are pivotal to provide parameterization on TOF

Current Assessment :

National level sampling by Forest Survey of India across 16 geo-blocks to provide state-wise statistics

Proposed Assessment :

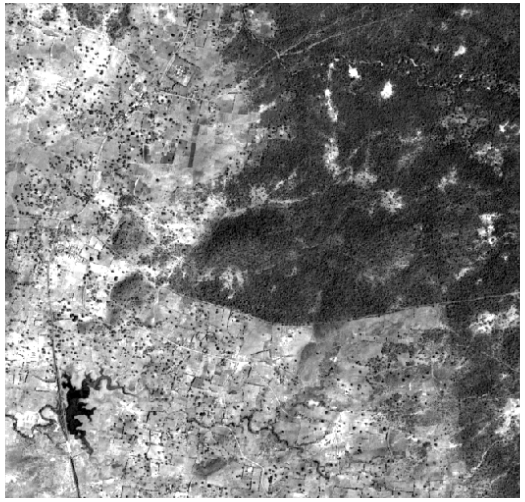
Geospatial sampling design integrating multi-resolution satellite data to provide district level statistics of TOF.



Overall approach for National TOF Assessment

Retrieval of TOF and Regional level factors

Image based retrieval : Semi-automatic method using Carto-1 and LISS IV data

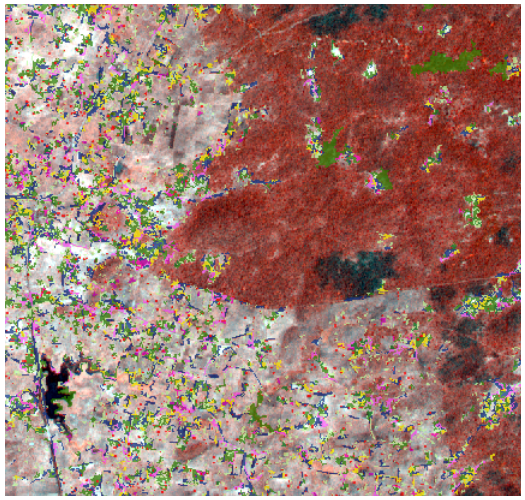


Per – pixel based approach

E .TOF – exterior TOF (agric. Lscape)

- Single crown
- Cluster (2-4)
- Line Dominated
- Meandering type
- Patch

I-TOF – Interior TOF(forest villages)

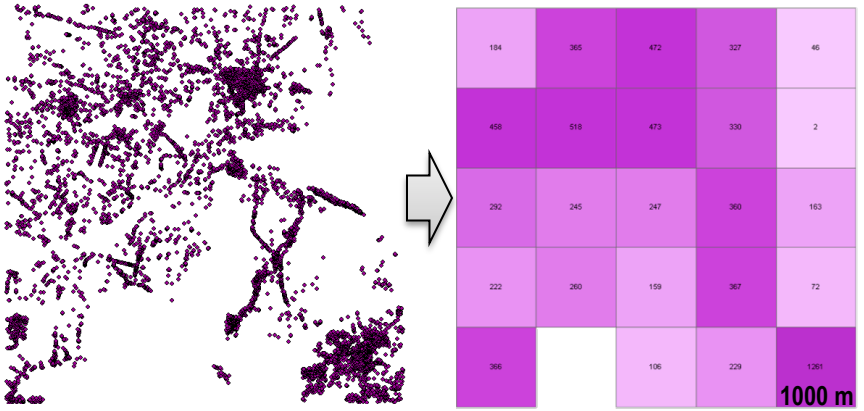


Object Based Image Analysis (OBIA)

Parts of Khammam, AP

- Single crown
- Cluster (2-4)
- Line Dominated
- Patch
- Scrub

TOF presence : Regional level aspects



TOF count – Grid (5X5 km)

Coarse Scale aggregation

TOF Occurrence

Patch	Indiv	Line
Plantn	Farms	Road
Lakes	Common	Rail
Settlmt	Settlmt	Canal
		Stream

Gridwise determinant > Factor

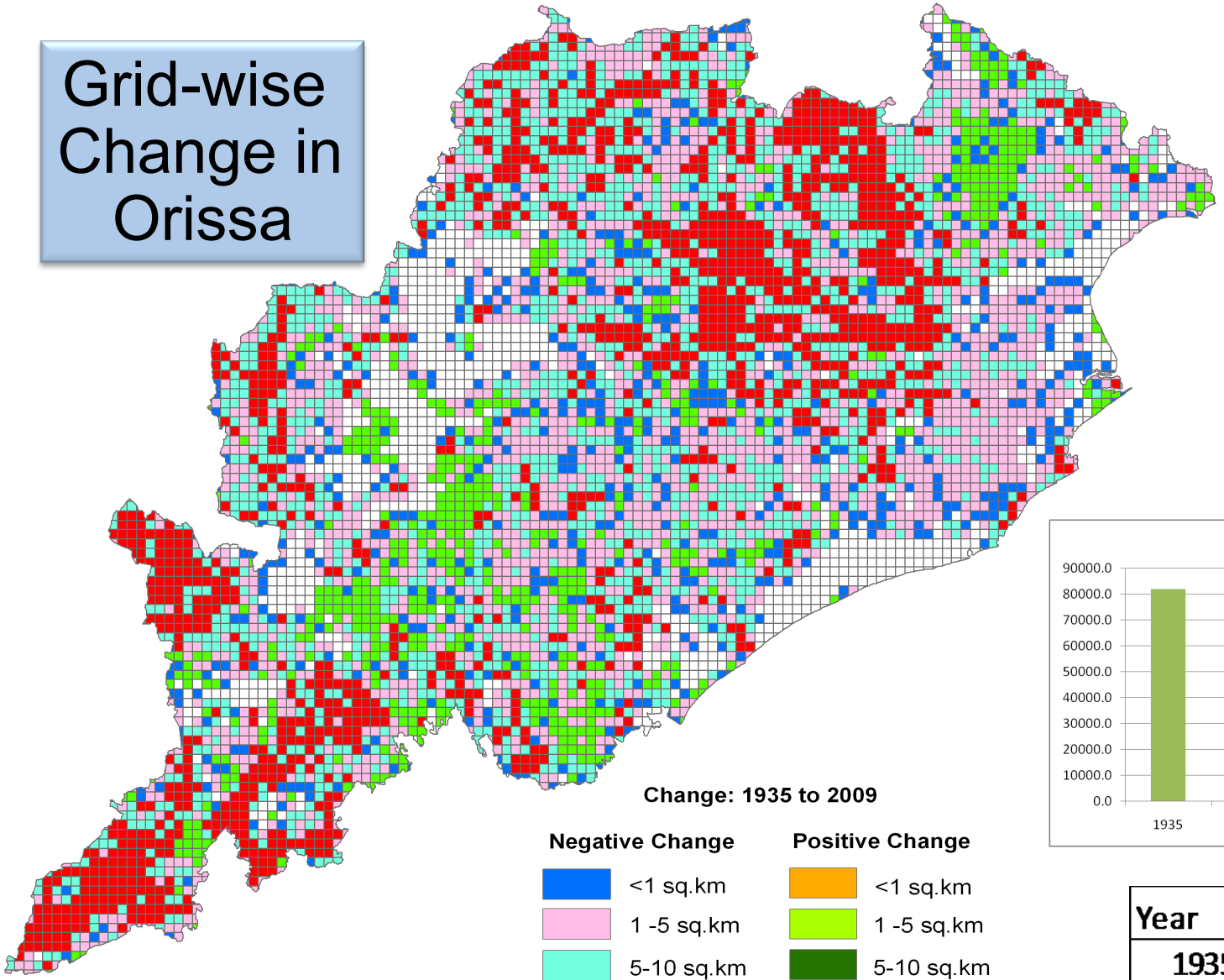
Sample > Estimate

Monitoring of Long Term Forest Cover Changes

Orissa

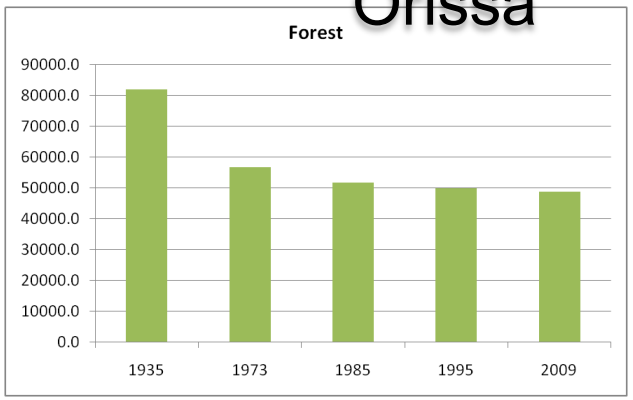
(1935-1975-1985-1995-2009)

Grid-wise Change in Orissa



616 forest grids have no change in forest cover

Distribution of forest cover: Orissa

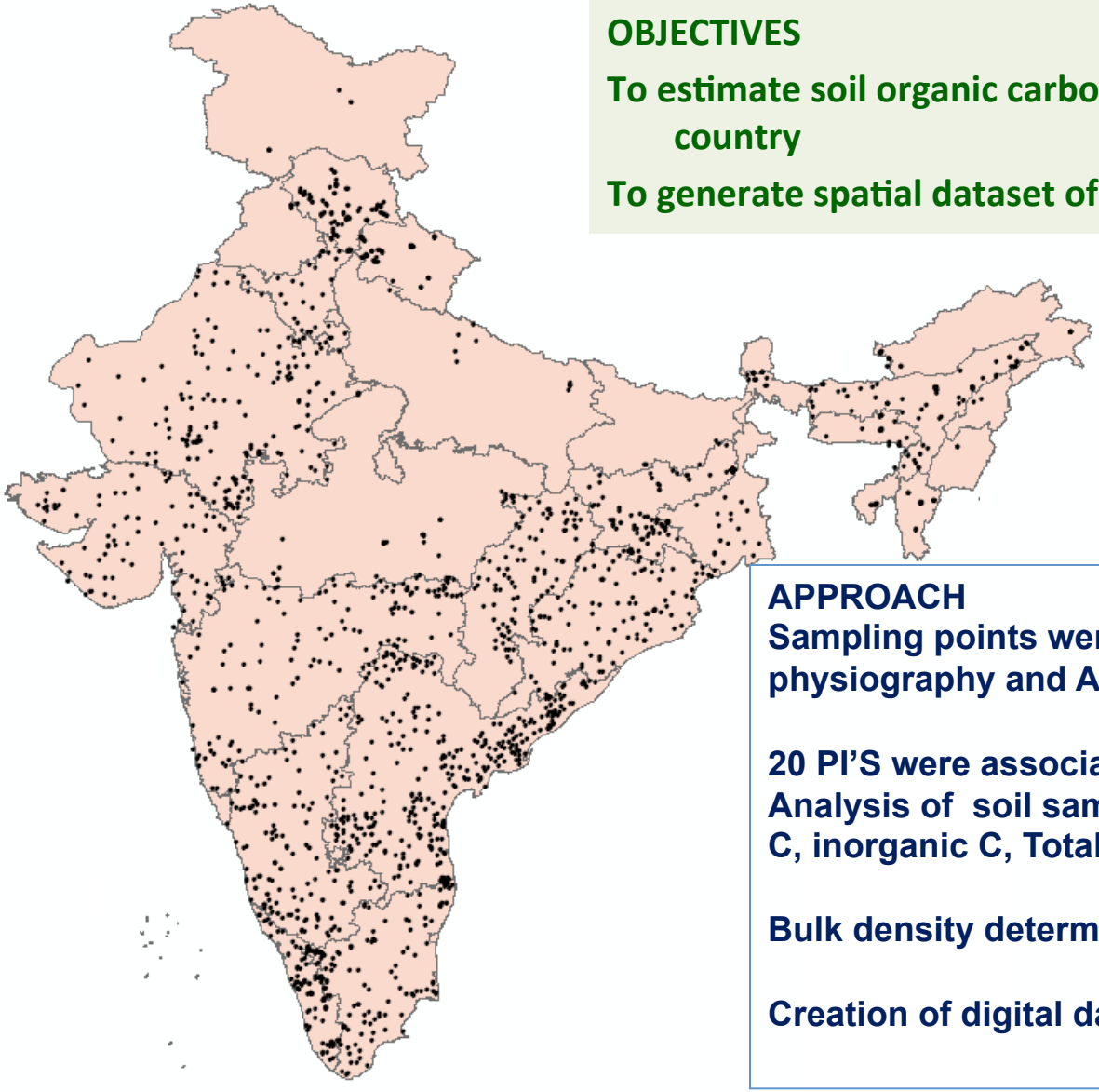


Year	Area (km^2)	% of TGA
1935	81785.6	52.5
1973	56661.1	36.4
1985	51642.3	33.2
1995	49773.0	32.0
2009	48669.4	31.3

Soil Carbon Pools and Dynamics

SCPD

NATIONAL CARBON PROJECT-SPATIAL ASSESSMENT OF SOIL CARBON POOL OF INDIA



OBJECTIVES

To estimate soil organic carbon and inorganic carbon stocks of the country

To generate spatial dataset of soil carbon stocks

APPROACH

Sampling points were identified based on land use, physiography and AESR

20 PI'S were associated in the collection of soil samples
Analysis of soil samples with CHN Analyser for organic C, inorganic C, Total C

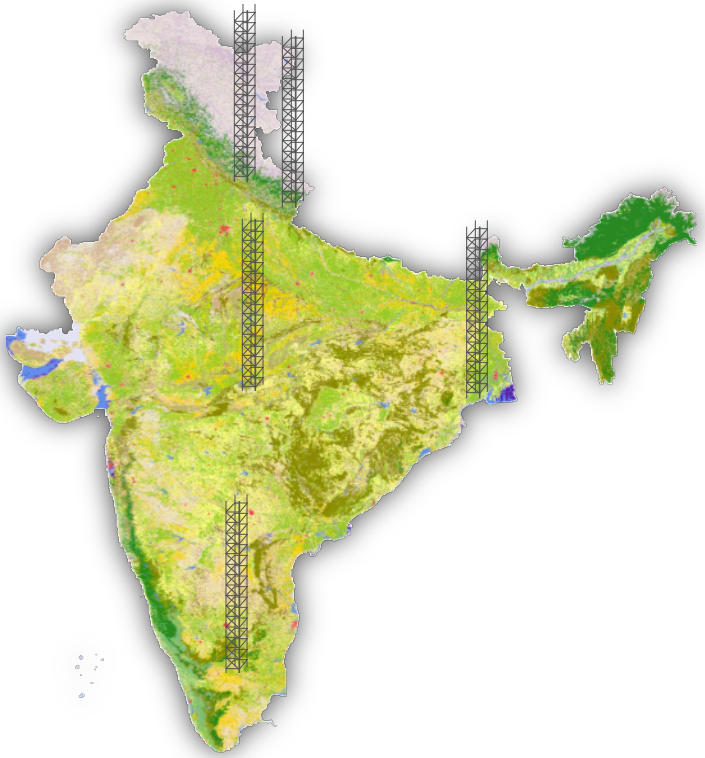
Bulk density determination using core or clod method

Creation of digital database

Soil Vegetation – Atmosphere Fluxes

SVAF

Soil Vegetation Atmosphere Fluxes
Establishment of Towers and Data Assimilation

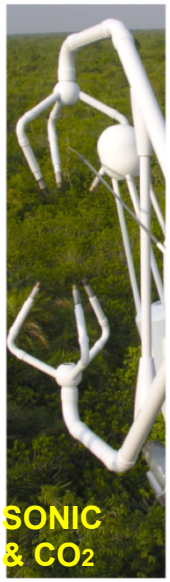


Status of Flux-Tower Operation

Sl no.		Site	Category
1	Opeartional	**Haldwani**	**Forest**
2		**Meerut**	**Agriculture**
3		**Barkot**	**Forest**
	Commissioned		
4		**Betul**	**Forest**
	Site Prepn. In Progress		
5		**Sundarbans**	**Forest**
	Sites Selected		
6		**Khurda**	**Forest**
		Dandeli/Tithimathi	**Forest**
	Proposed		
8		**Gujarat/Rajasthan**	**Grassland**
9		**Tamilnadu(Annamalai)**	**Forest**
10		**Maharashtra**	**Agriculture**
11		**Andhra Pradesh**	**Agriculture**

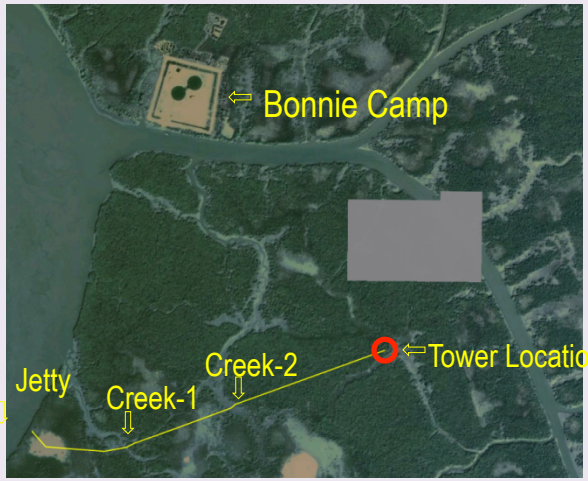
Progress at Sunderban and Betul Towers

Access Path for tower in tiger habitat swamps

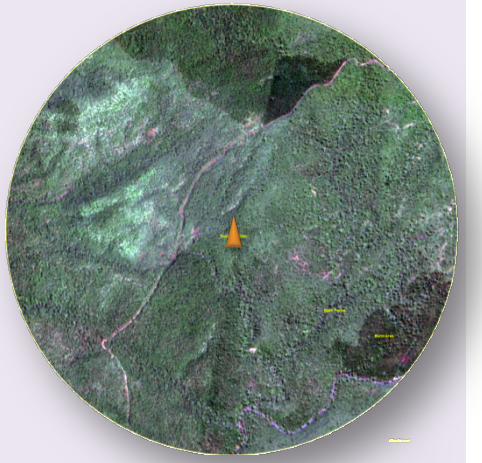


Sunderaban Tower, Sensors shown on different levels

Betul Tower ,Sonic anemometer , IRGA CO_2/H_2O analyser , (Fast sensors) ; Hygrometer and anemometer ,(Slow sensors) at the lowest height



Sunderban Tower

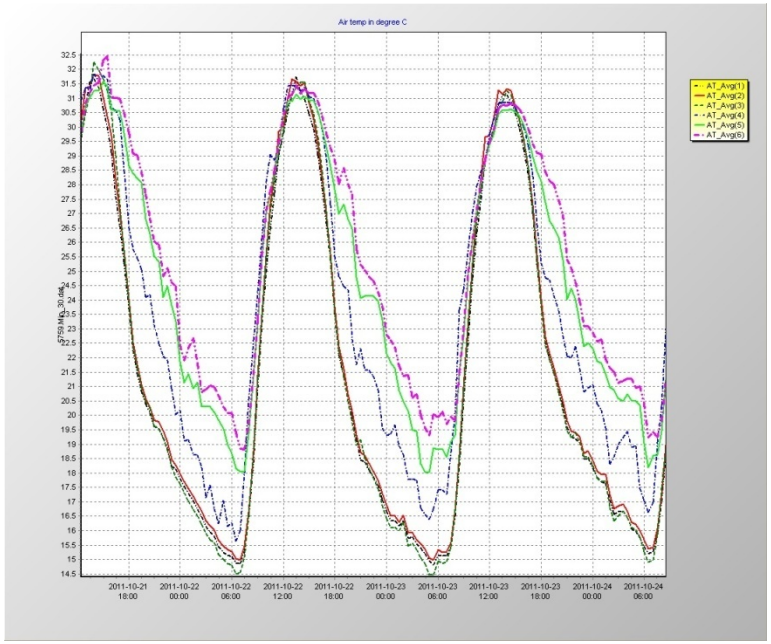


Betul Tower

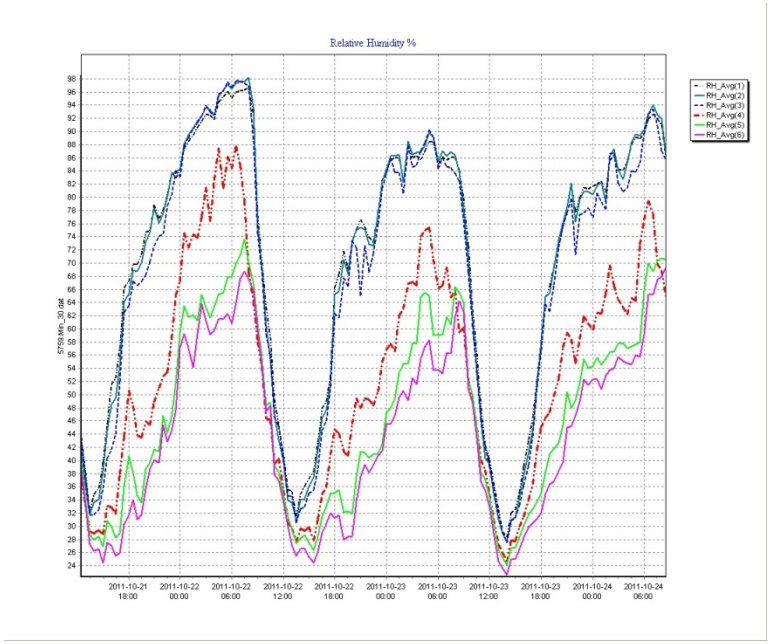
Positions on IRS Carto + LISS IV natural color merge

Initial Flux Tower Observations from Slow and Fast Sensors from Betul Flux Tower

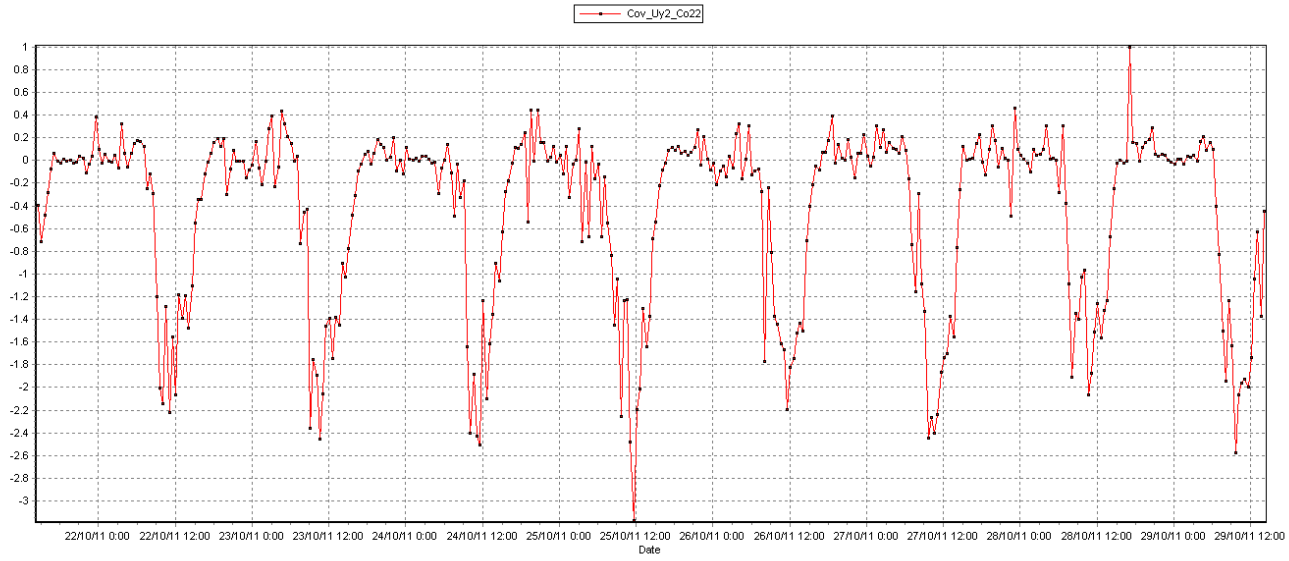
Diurnal Variations in Air Temperature



Diurnal Variations in Relative Humidity



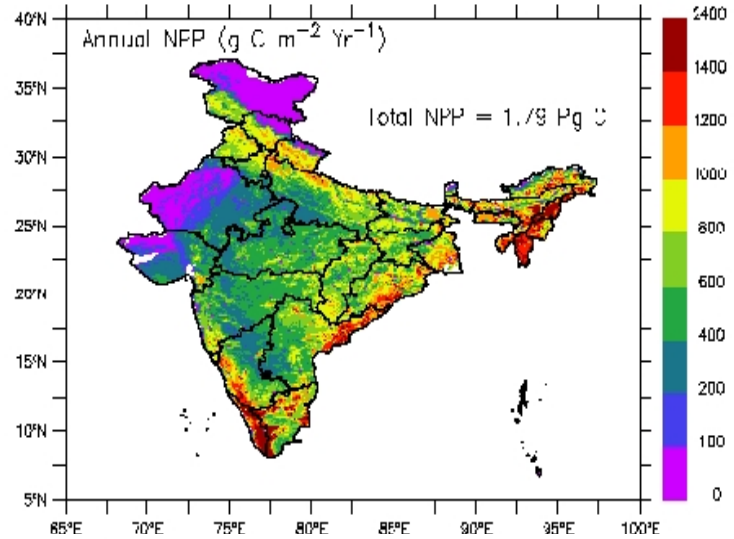
Diurnal Variations in CO_2 – 22nd Oct 2011 to 29th Oct 2011

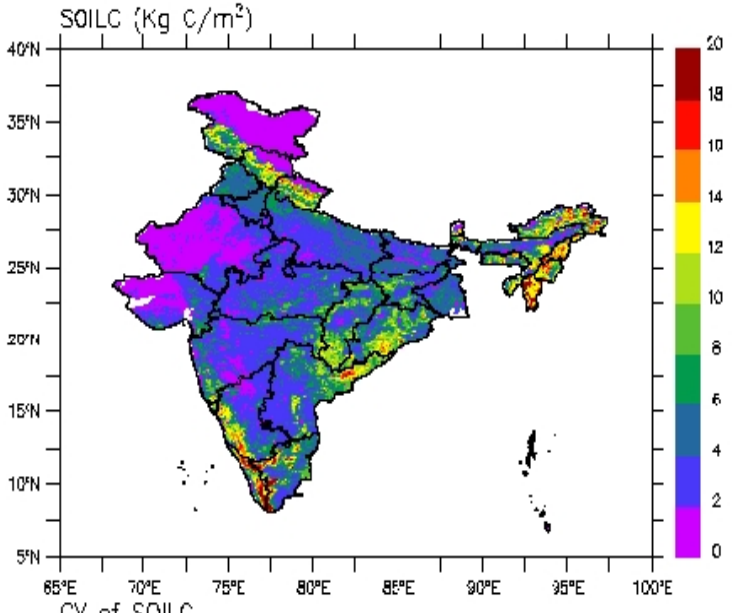


Initital Analysis – Eddy Covariance (10Hz) CO_2 Flux Computations; units of CO_2 in $mg/m^2/s$

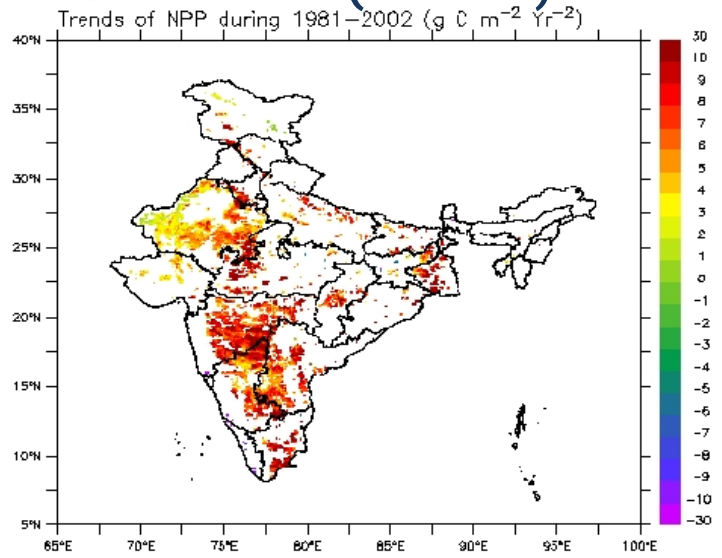
Mean and trends in NPP and SOC (CASA, NOAA-AVHRR 1981-2003)

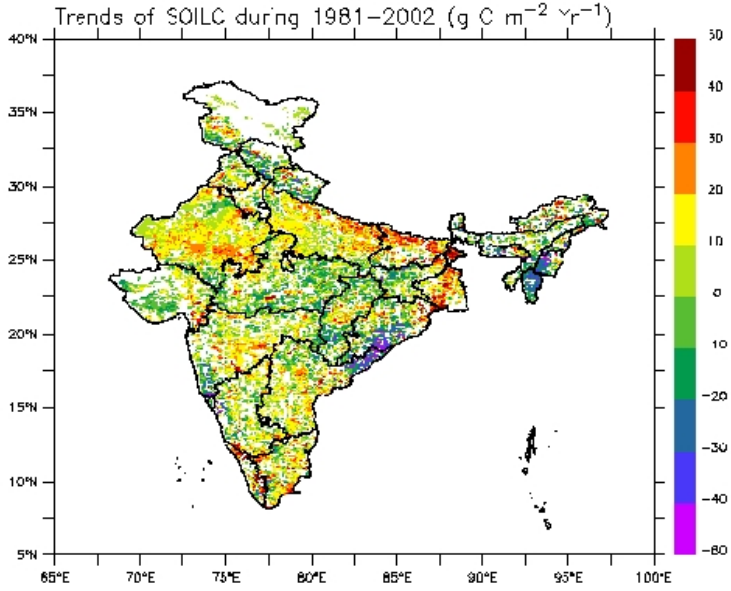
Annual Climatology of NPP and SOC



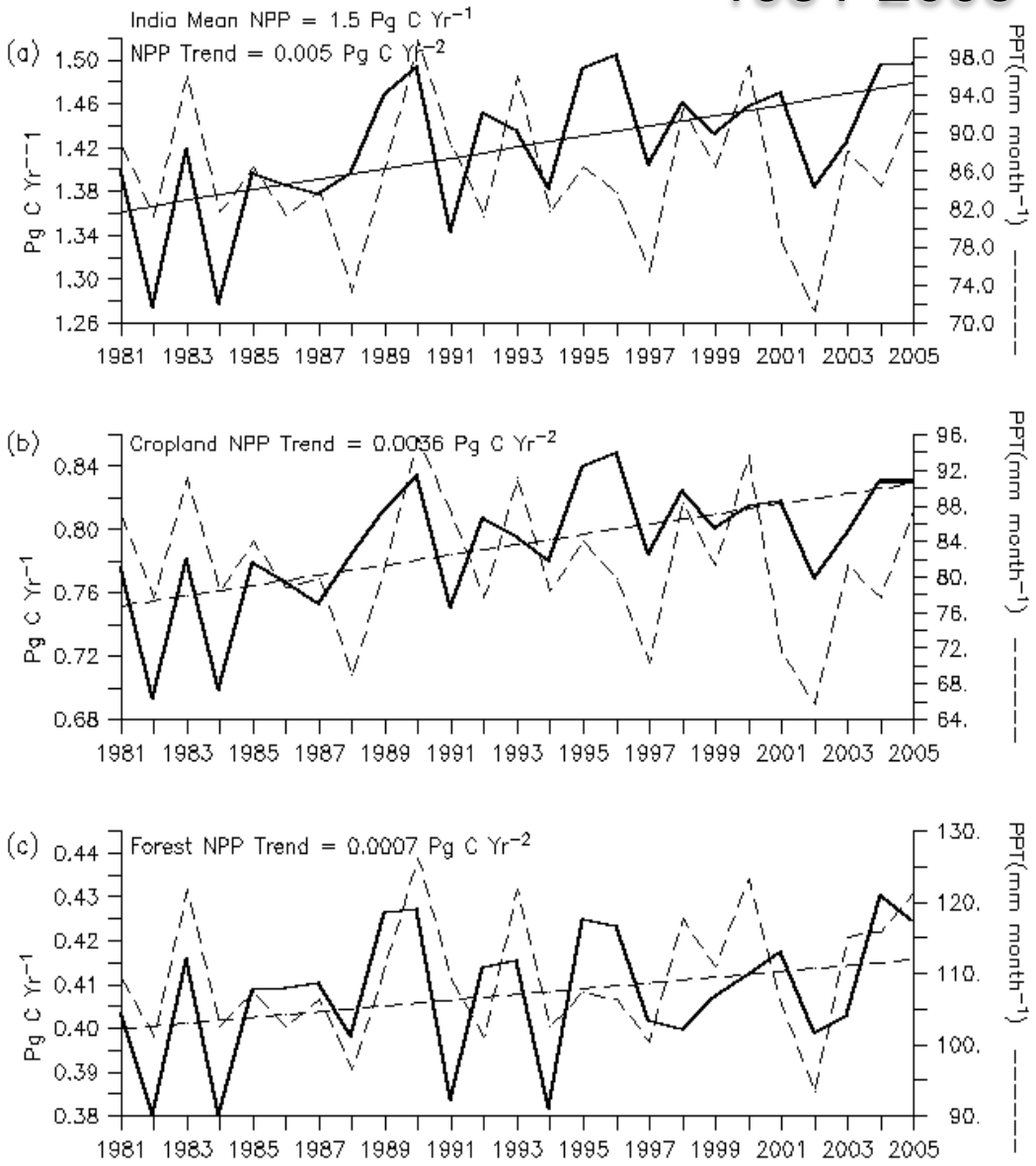


Trends (P > 0.10)





Long Term NPP Trends using CASA based simulations: 1981-2005



- Average annual NPP 1.5 Pg C Yr-1
- Increasing at the rate of 0.005 Pg C Yr-2
- Trend is equivalent to 8.5%

On an average India is the region of net sink of atmospheric CO2 with total annual uptake of 9.5 Tg C yr-1.

Thank You !