Geospatial for Water Resources Assessment and Mangement

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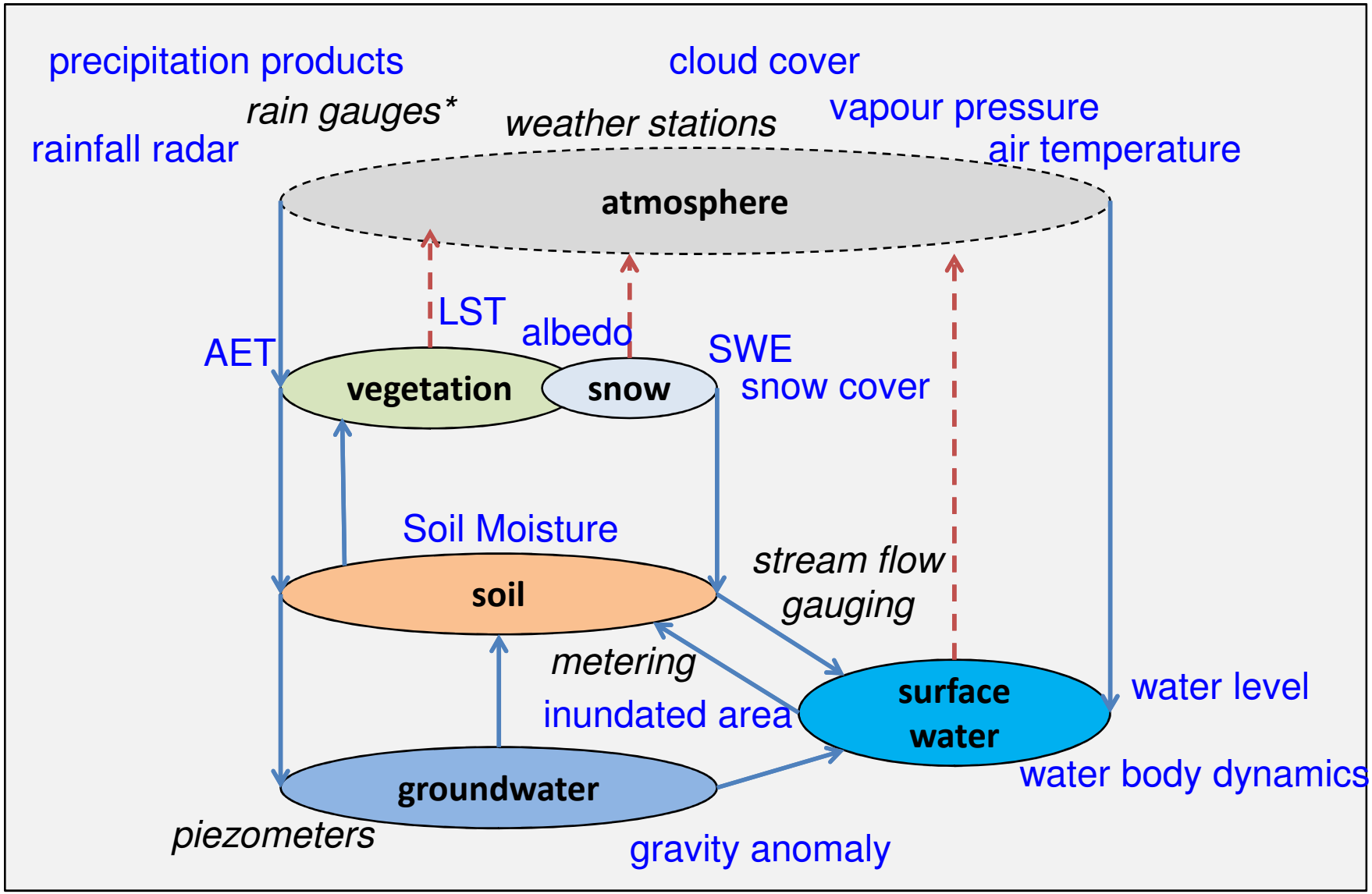
Information from Satellite Observations



* Conventional ground based observations shown in italics

Hydrologic Modeling for Water Resources Assessment and Flood Management

1. **Basin Level Water Resources Assessment Using Space Inputs (annual time-step)**

- Joint pilot study with CWC in Godavari, Brahmini & Baitarani River Basins
- Up scaled all 20 river basins : CWC will execute with the support of NRSC

2. **Snow melt Runoff forecasting in 5 Himalayan river basins (Seasonal, fortnightly)**
   -User : CWC

- Seasonal forecast modeling (April to June)
- Short term forecast modeling (16 daily)

3. **Grid based Water Balance Computations (daily time-step)**
   Godavari , Mahanadi, Brahmani-Baitarani,etc Basins @ 3 minx3min- extended to all basins soon

- National level @ 9minx9min

4. **Real-time flood forecasting in the Godavari Basin (sub-daily time-step)**

- A real-time application in collaboration **with CWC and IMD**
- FF Modeling in 6 Flood prone areas

5. **Glacier Lake hazard assessment (event based study)**

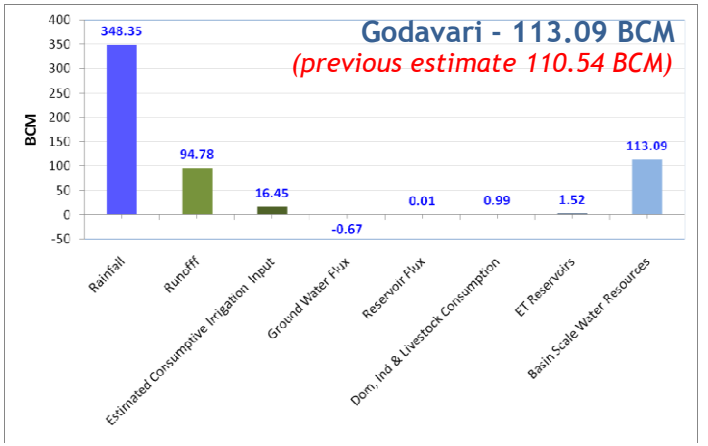
- South Lonak glacier Lake, Sikkim ,Lake in Nepal, Kedarnath etc..

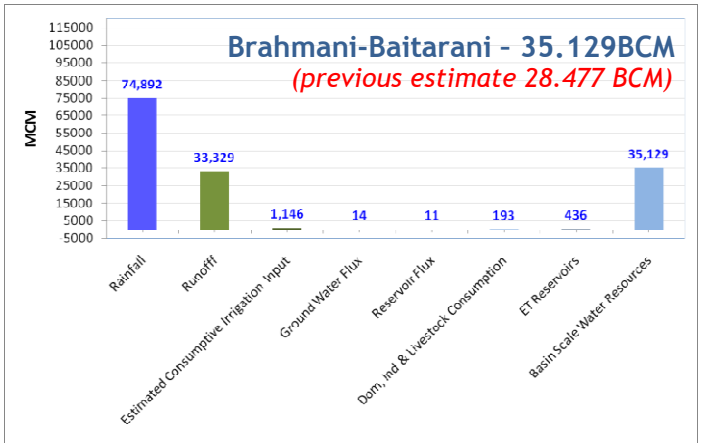
Basin-wise Mean Annual Water Resources Assessment using Space Based Geo-Spatial Data

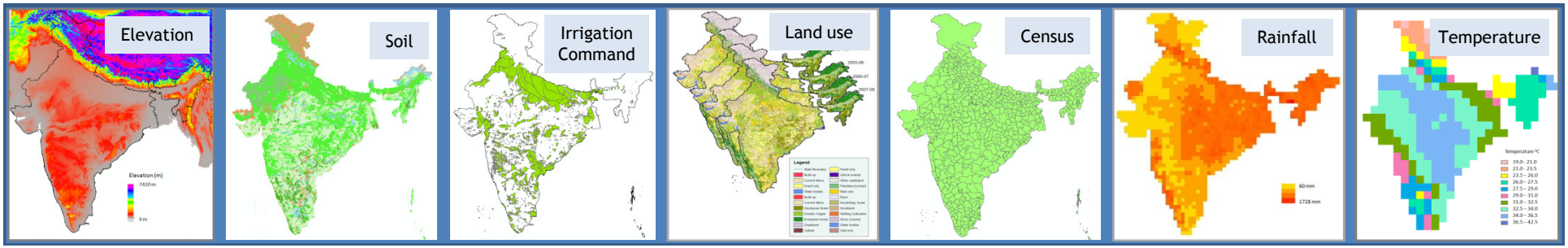
Implementation at National Level

- Currently used water resources potential estimates are old; Changes in land use /land cover, irrigation development, GW exploitation and varying rainfall/climate necessitated re-assessment
- NRSC and CWC jointly carried out pilot studies (Godavari and Brahmani-Baitarani river basins)
- Precipitation based Water balance approach; Thornthwaite-Mather Water Balance Model; Monthly time step
- Land Use/Land Cover, Soil, irrigation command, Climate are integrated at Hydrological Response Unit level to compute AET, Soil Moisture and runoff from precipitation
- Calibration of model runoff with field measured river discharge
- Water Resources availability is computed with model computed runoff and upstream abstractions (irrigation water use, evaporation losses, domestic, industrial and live stock consumptive use)
- Upscaled to all basins: CWC &NRSC -12FYP

Pilot Study Results







Water Resources Management

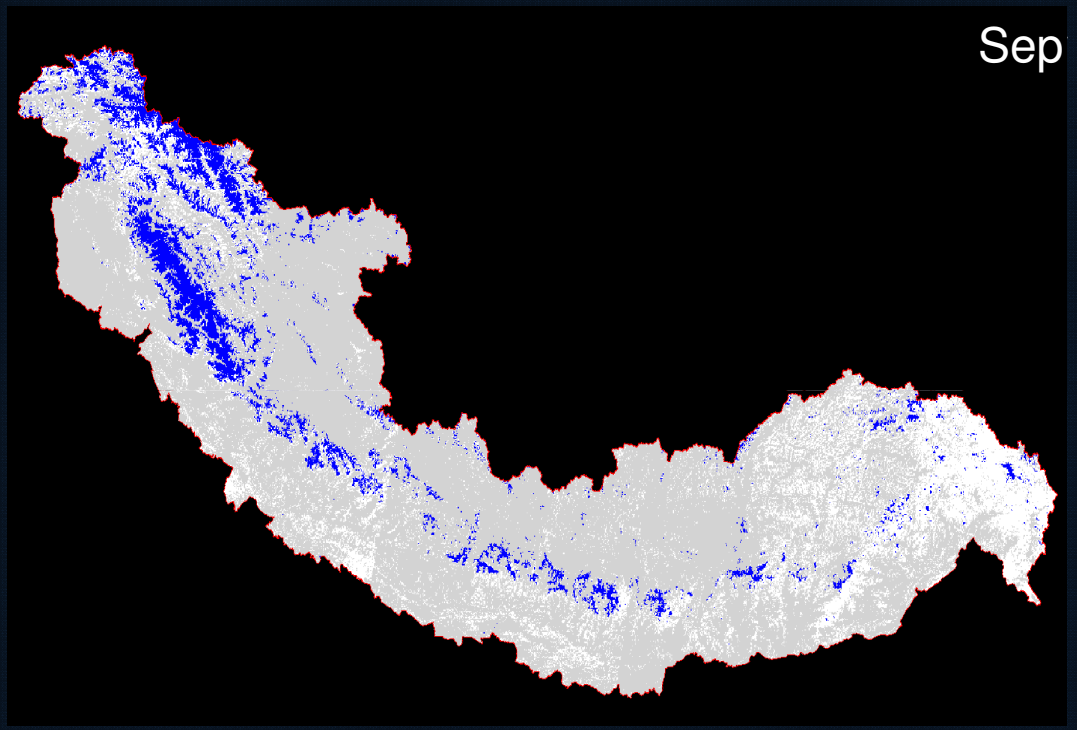
Snowmelt Runoff Modelling

- Estimation of runoff due to snowmelt during summer months using Remote sensing derived inputs adopting energy balance approach.
- Remote sensing is the only tool to capture snow cover dynamics for the inaccessible Himalayan region. Snow cover being highly dynamic, the spatial extent can be captured in cost effective manner on daily basis.
- Seasonal and short-term forecasts are provided.

- To plan the water allocations and sharing for drinking water, irrigation and hydel power generation during the summer period
- Central Water Commission, Ministry of Water Resources

- Chenab, Beas, Sutlej, Yamuna and Ganga basins
- IRS-P6 AWiFS and Terra Modis

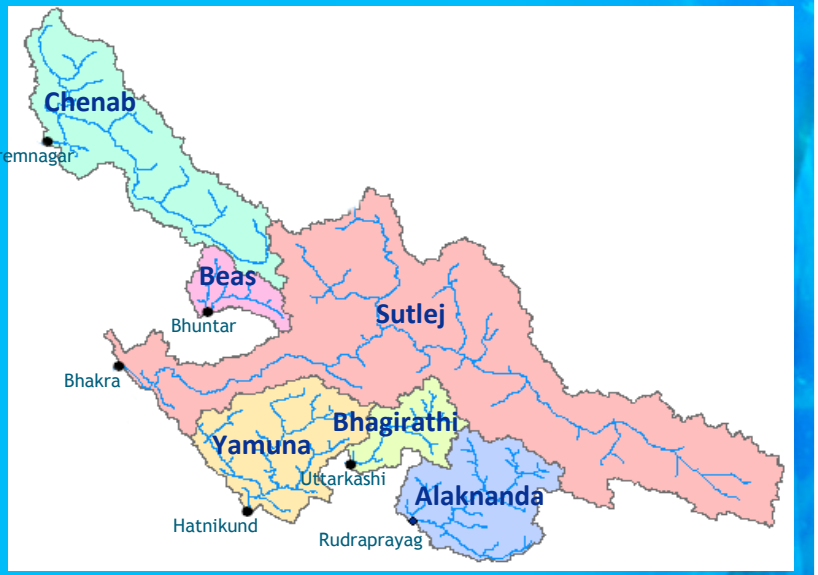
Snow Cover Dynamics



Snowmelt Runoff Forecasting in Himalayan basins using RS inputs

Using Energy Budget approach

Input data used	Source
Snow Cover Area	AWiFS / MODIS satellite data
Glacier Cover Area	AWiFS satellite data
Land Surface Temperature	MODIS satellite data (8-Day LST product MOD11A2)
Incoming Solar Radiation	f(elevation,slope,aspect,Julian day, lat., long.)
Net Longwave Radiation	f(LST) - (MODIS satellite data, 8-Day LST product MOD11A2)
Snow Albedo	MODIS satellite data (Daily SCA Product MOD10A1)
Land Cover	AWiFS satellite data
Snow persistence Index	MODIS satellite data (8-Day SCA Product MOD10A2)
DEM	Cartosat / SRTM data
Discharge, Rainfall data	CWC- Field data

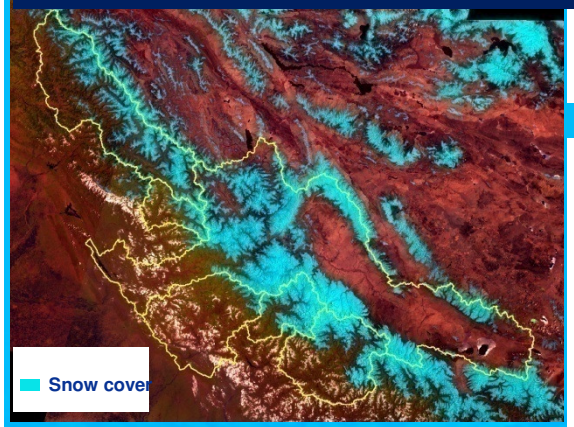


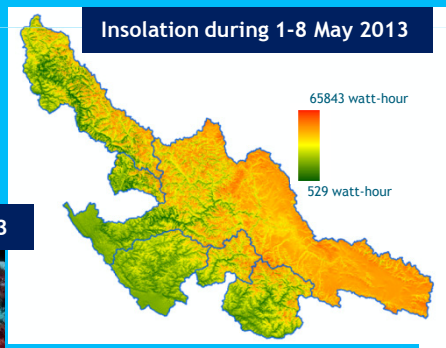
Seasonal Snowmelt Forecast issued for the period April-May-June 2013

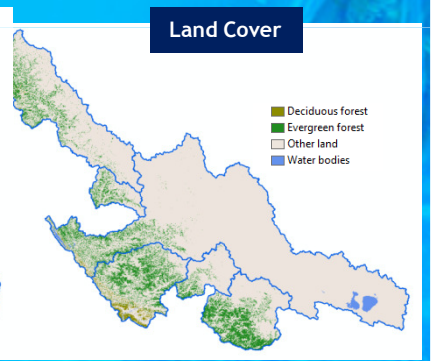
Basin	Seasonal Forecast Apr - Jun 2013 (MCM)
Alaknanda	2,320
Bhagirathi	1,040
Beas	800
Chenab	6,520
Sutlej	3,700
Yamuna	960

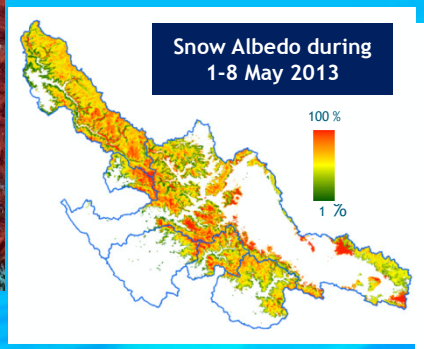
Forecast issued on 1st April

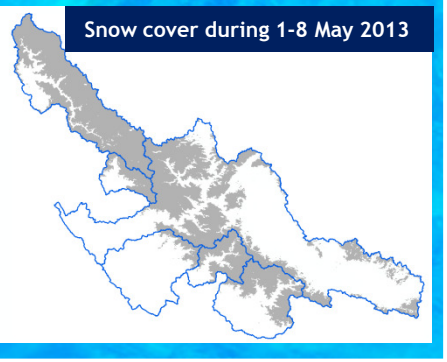
AWiFS data showing the snow cover area during 2013





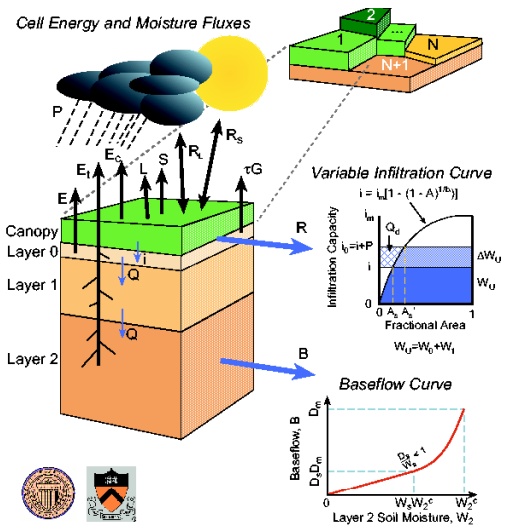


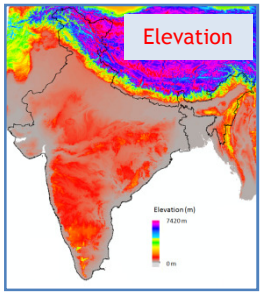


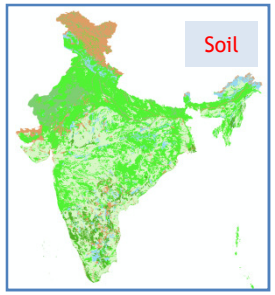


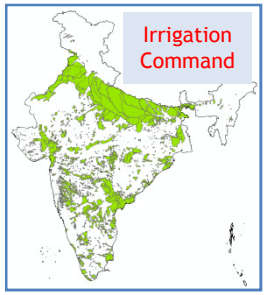
Land Surface Hydrological Modelling – Mahanadi River Basin

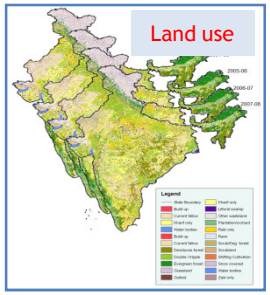
- Variable Infiltration Capacity Hydrological Model
  - *Open source; Grid-wise water and energy balance*
  - *Sub-grid heterogeneity of Land cover*
  - *Soil depth-wise hydrological response*
  - *Vegetation phenological changes*
  - *Daily / sub-daily time step*
- 9 min (~16.5km), 3 min (~ 5.5km) Grid-wise data base
- Geo-spatial data
  - *Terrain - Topographic, Soil (NBSSLUP), LULC (NRC-250k), LAI, Albedo, Irrigation*
  - *Meteorological – Rainfall, Temperature, … (CDAS/CPC)*
  - *Hydrological - River discharge, Reservoir Storage/Releases, GW levels, …*
- Calibration with river discharge data (India-WRIS)

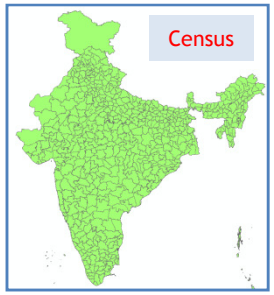


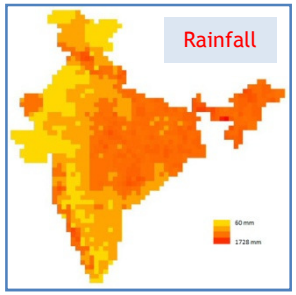


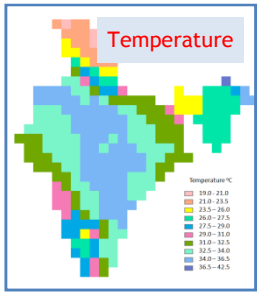




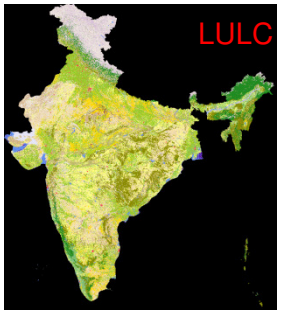








Land Use / Land Cover Parameterization



Legend

- Build up
- Kharif only
- Rabi only
- Zaid only
- Double / tripple
- Current fallow
- Plantation/orchard
- Evergreen forest
- Deciduous forest
- Scrub/Deg. forest
- Littoral swamp
- Grassland
- Other wasteland
- Gullied
- Scrubland
- Water bodies
- Snow covered
- Shifting Cultivation
- Rann

Build up
Kharif only
Rabi only
Zaid only
Double / triple
Current fallow
Plantation/orchard
Evergreen forest
Deciduous forest
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Littoral swamp
Grassland
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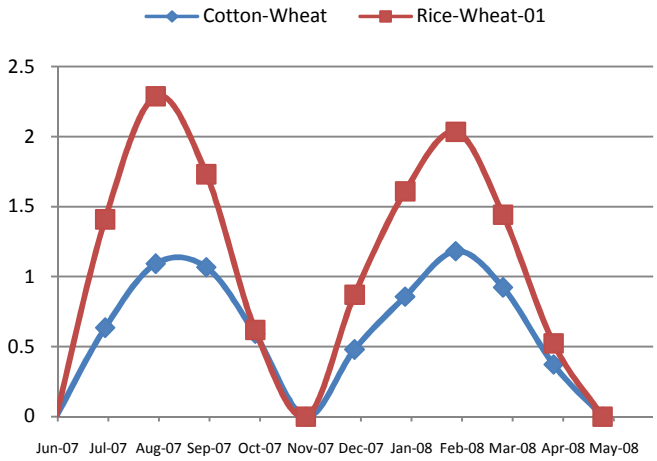
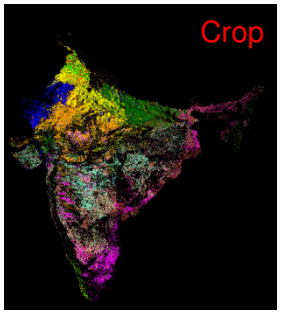
Water bodies
Snow covered
Shifting Cultivation
Rann

LAI Profile



13 Agriculture Classes

Cotton-Wheat
Rice-Wheat-01
Rice-Wheat-02
Rice-Rice
Rice-01
Maize-Bajra
Soybean
Rice-02
Bajra
Jowar
Coconut
Rice-03
Ragi
Plantation/Orchard
EG Forest
Deciduous Forest
Scrub/Deg. forest
Grassland
Scrubland
Gullied
Other Wasteland
Littoral Swamp
Build Up
Water Bodies
Snow covered
Rann

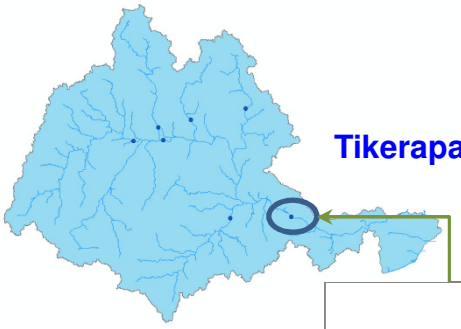


26 Vegetation Classes

Legend

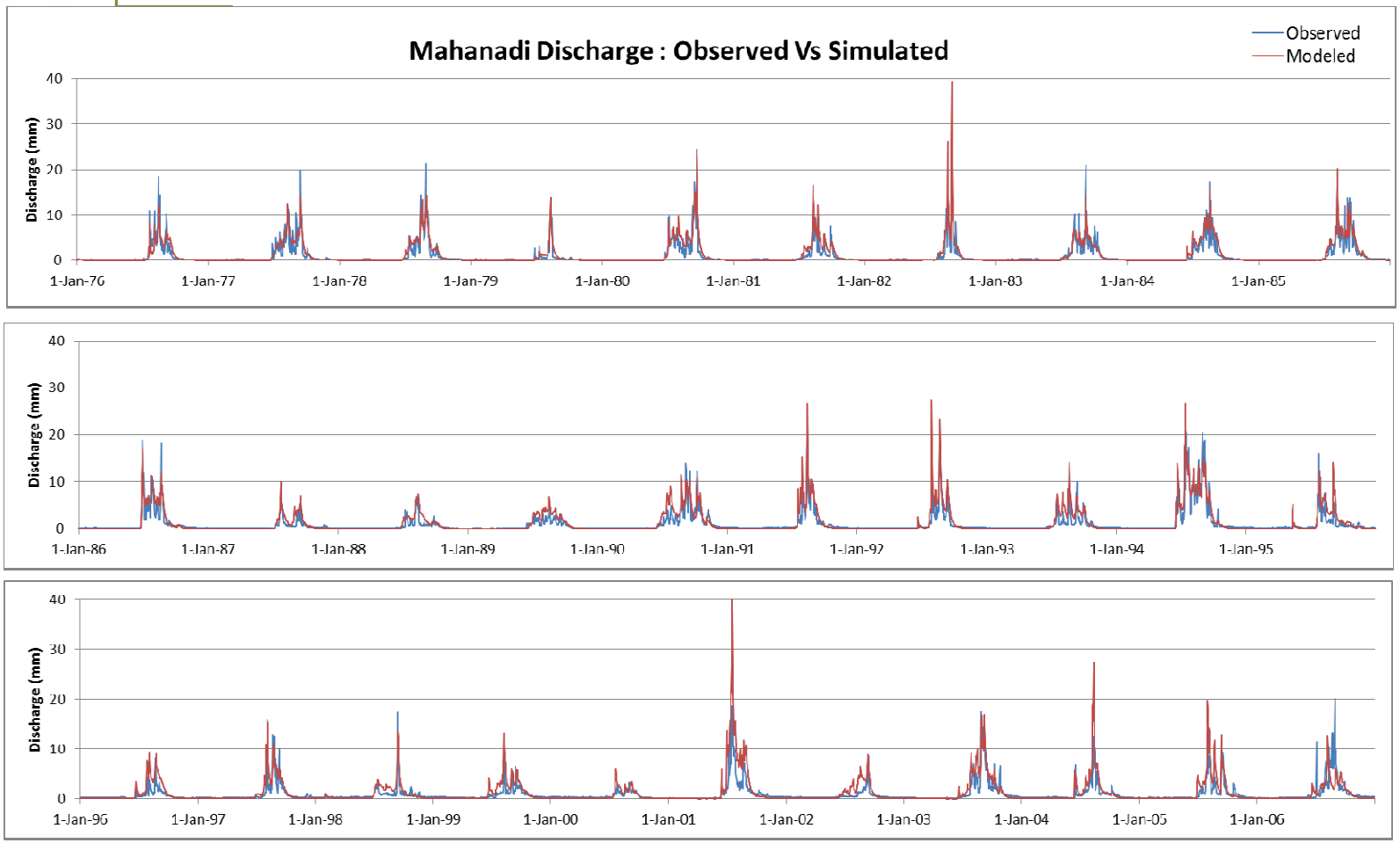
- Unclassified
- Cotton-Wheat
- Rice-Wheat(pnb)
- Rice-Wheat(UP)
- Rice-Rice
- Rice
- Maize/Bajra
- Soyabean
- Sugarcane-Wheat
- Rice Aman Paddy
- Bajra
- Jowar
- Coconut
- Rice(TN)
- Ragi

Calibration with River Discharge



Mahanadi Basin

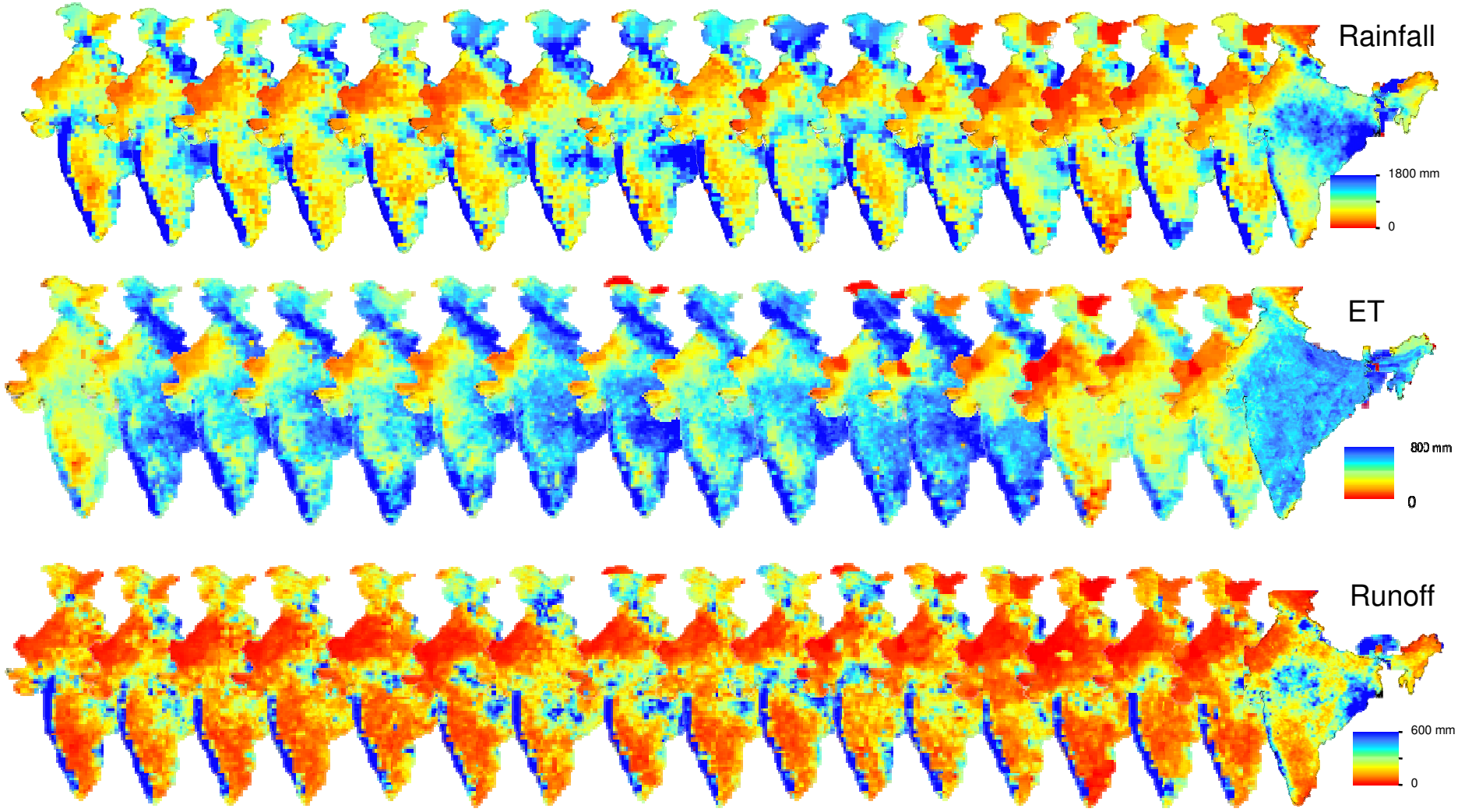
- Historic run time period – 31yrs (1976-2006)
- Gauge station - Tikerapara
- Nash Sutcliffe Coefficient – 0.70



Long Term Fluxes

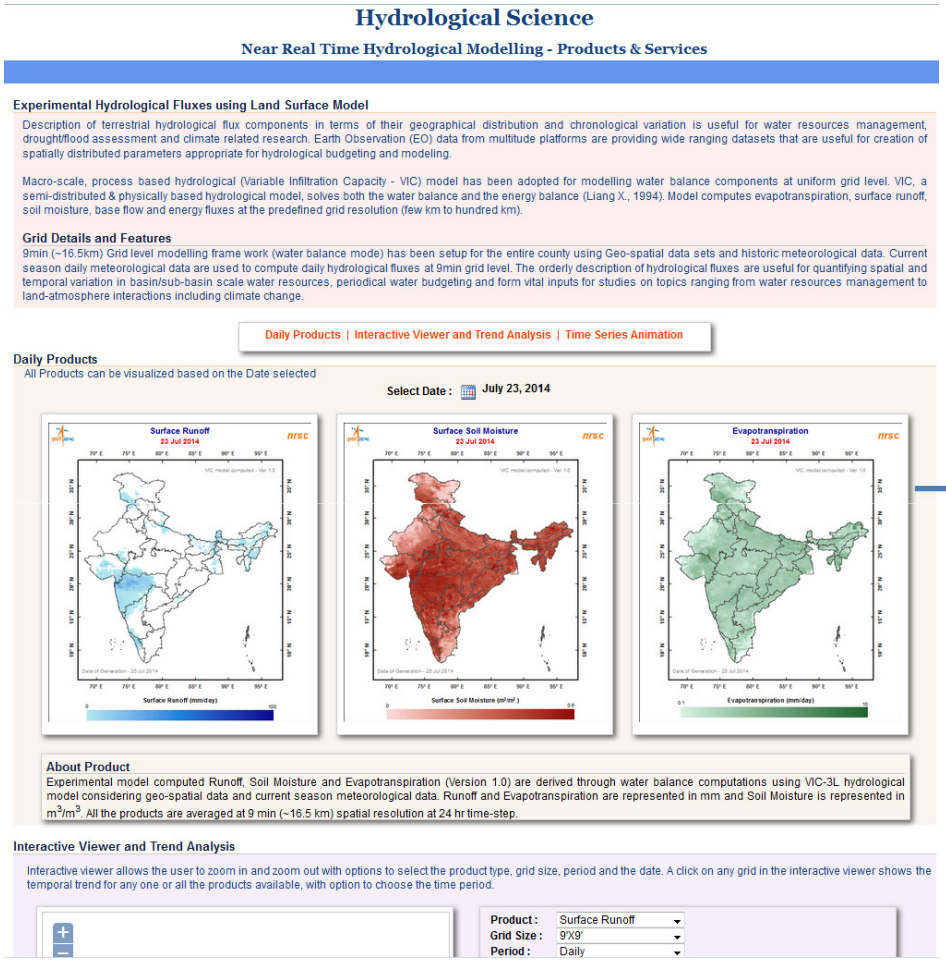
nrsc

1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2013(June-Oct)



Near Real Time Hydrological Modelling - Products & Services

National Remote Sensing Centre
Bhuvan



Source -- http://bhuvan.nrsc.gov.in/nices/

- Experimental model computed Runoff, Soil Moisture and Evapotranspiration (Version 1.0) are derived through water balance computations using VIC-3L hydrological model considering geo-spatial data and current season meteorological data using IMD Temperature point data with satellite based derived rainfall data of CPC & TRMM. All the products are averaged at 9 min (~16.5 km) spatial resolution at 24 hr. time-step.

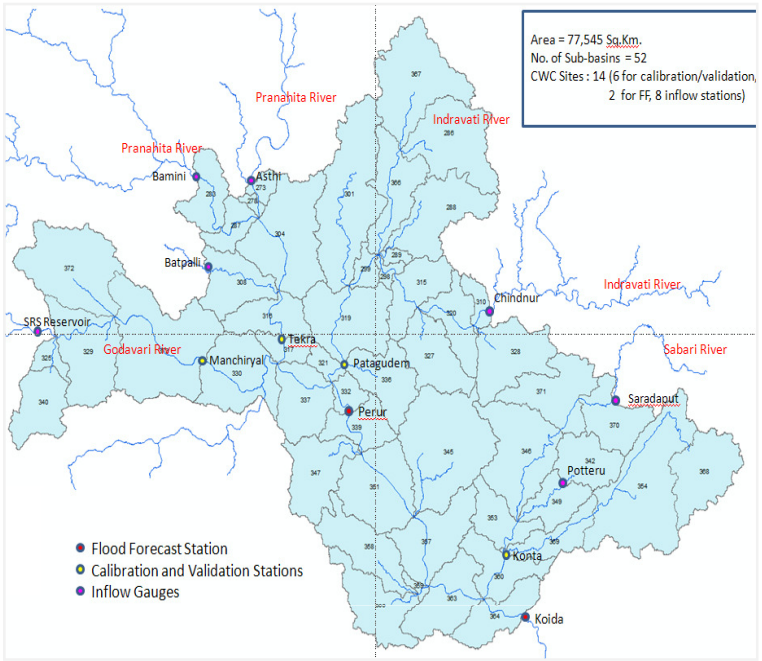
- Daily Hydrological fluxes are generated and uploaded to NRSC/Bhuvan in near real time with a lag of 2days.

Daily Products

Interactive Viewer & Trend Analysis

Time Series Animation

Flood Forecast Model for the Godavari Basin & Real-time Simulations



Static Data

- Landuse/landcover, Soil texture, DEM

Derived Parameters:

Topographic and Hydraulic Parameters of sub-basins and Channels

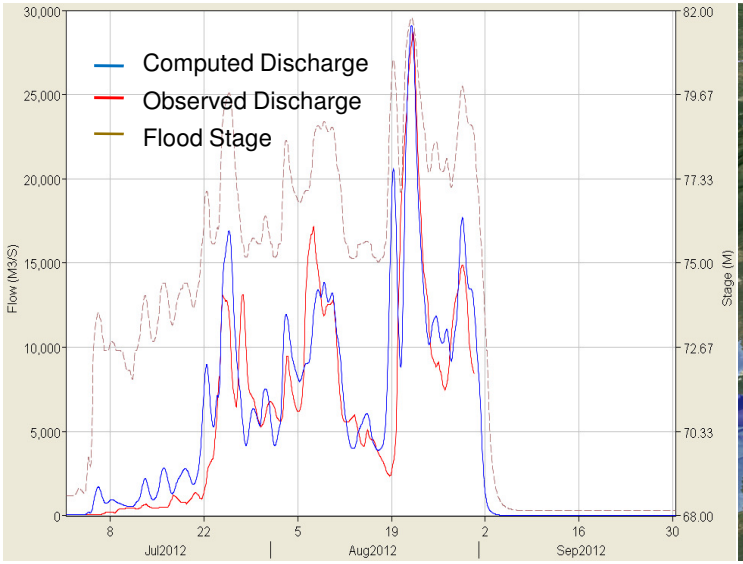
Dynamic Data

- Real-time 3 hr. Rainfall and discharge data (during 2010&11 from CWC)
- Daily Rainfall Data in near real-time from IMD of 2012.
- Rainfall forecast grids at 3 hr frequency from IMD, New Delhi

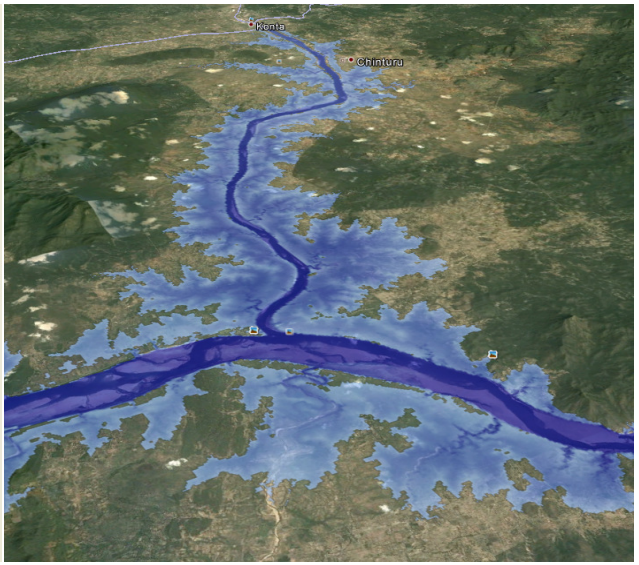
-Monthly ET data, and Rating curves

Real-time validation at CWC, Hyderabad

- The model was calibrated, validated and operationally used in 2010 and 2012 using real-time hydro- met. data obtained from CWC and IMD.
- Inundation simulations were done using ALTM DEM of Sabari Floodplains.



Flood Forecast Hydrograph at Perur



Inundation simulation in Sabari River using ALTM DEM (on Bhuvan)

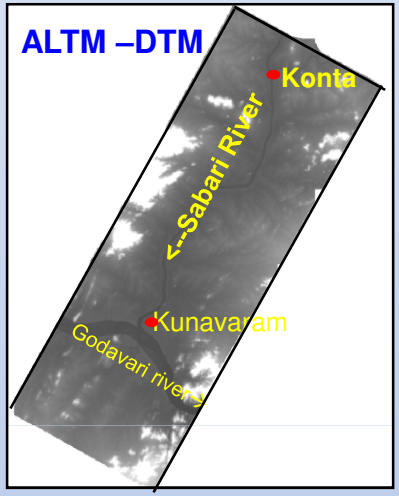
Modelling Environment:

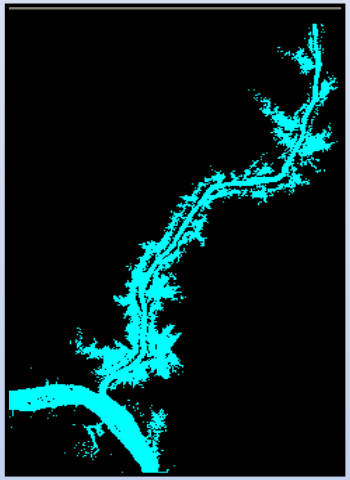
HEC-HMS, HEC-Geo HMS, HEC-RAS, HEC- Geao RAS

Development of similar models to other frequent flood prone rivers of the country.

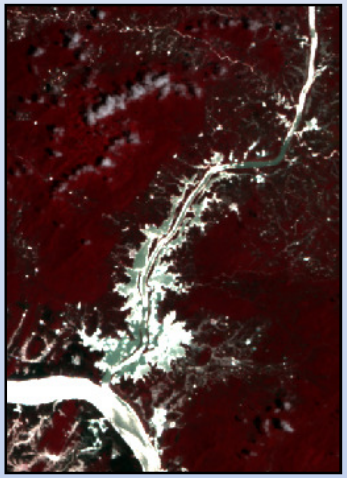
Mahanadi (completed
Brahmani-Baitarani,
Kosi, (in progress)
Gghagra (in progress)
Gandak, (in progress)and
Krishna River Basins

Flood Early Warning
Flood Inundation Modelling

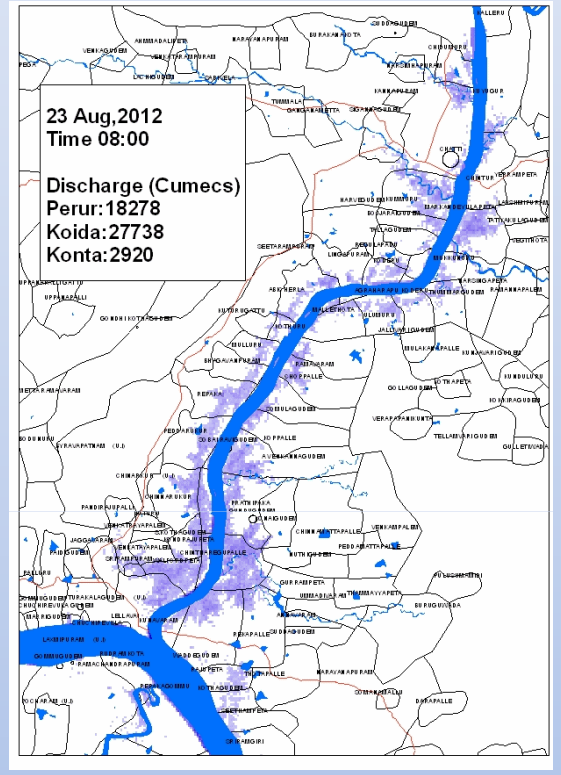




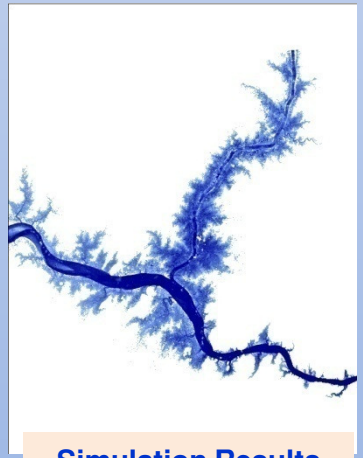
Simulation Results
23 Aug,2012
Time 06:00



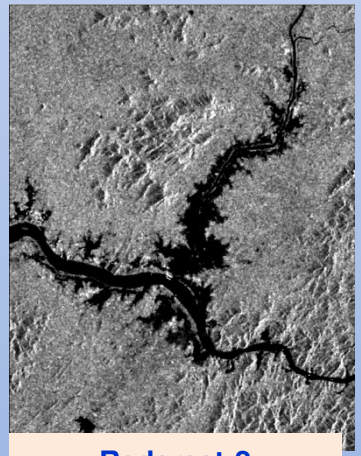
Resoursesat-2
23 Aug,2012
Time 10:30



>90% accuracy

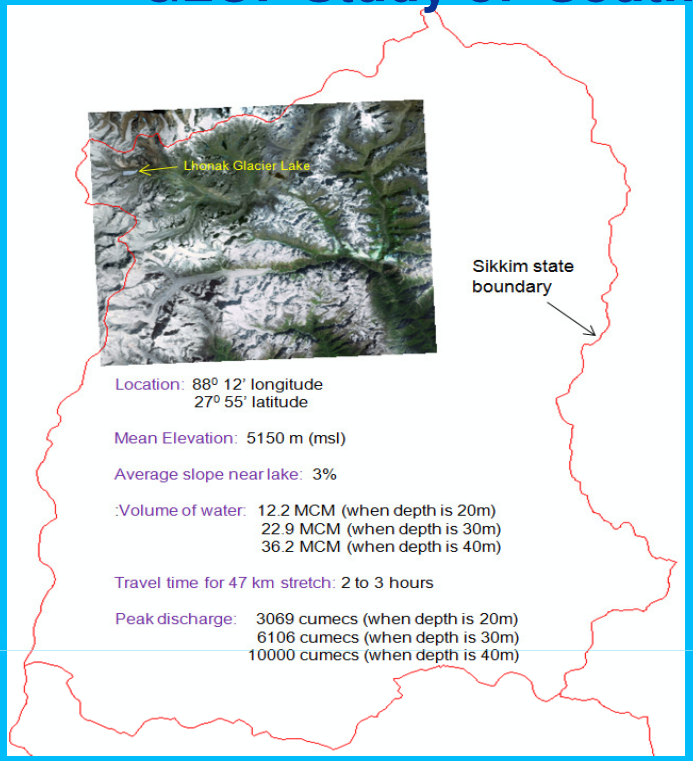


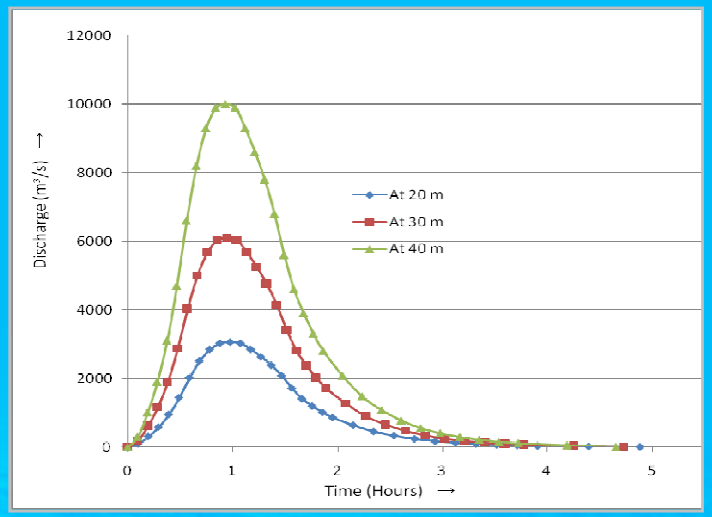
Simulation Results
06-Aug-2013
Time 06:00



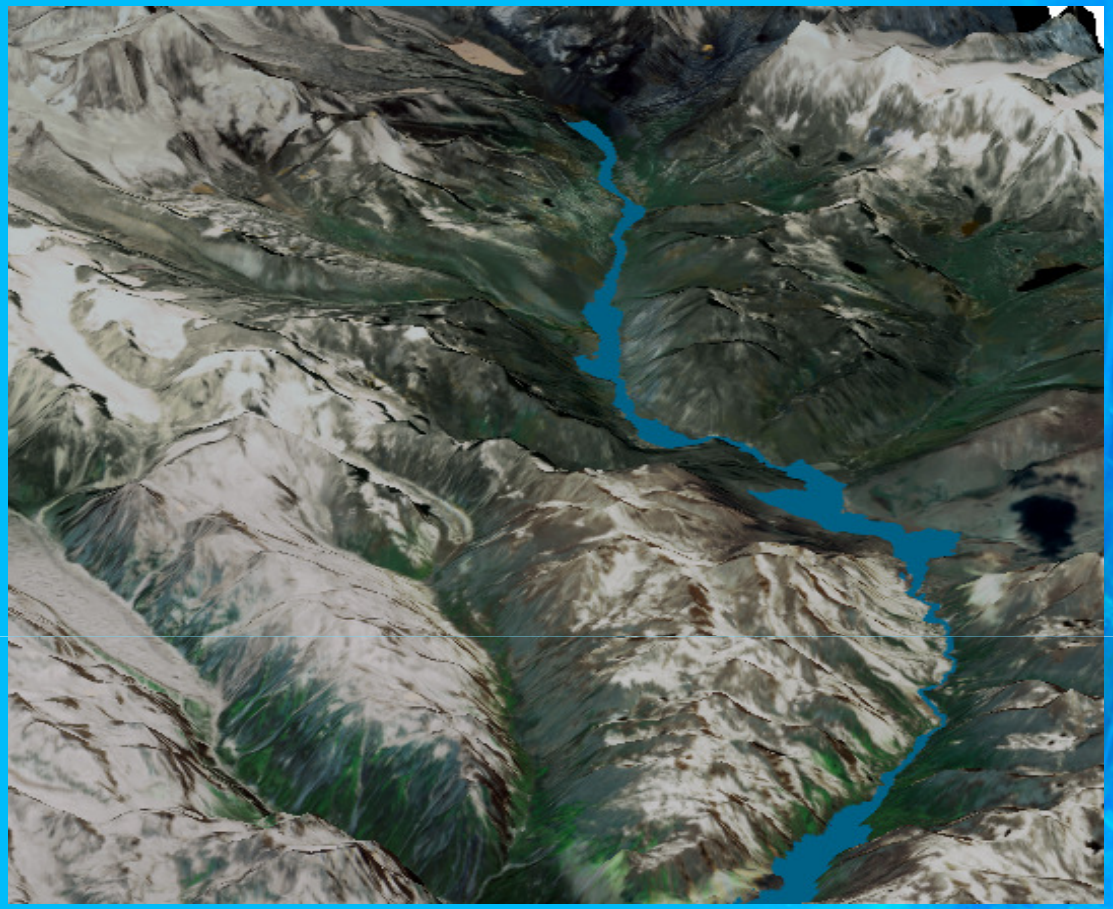
Radarsat-2
06-Aug-2013
Time 06:00

GLOF Study of South Lhonak Glacier lake in Sikkim Himalaya





Simulated flood hydrographs for different depths of water in the lake



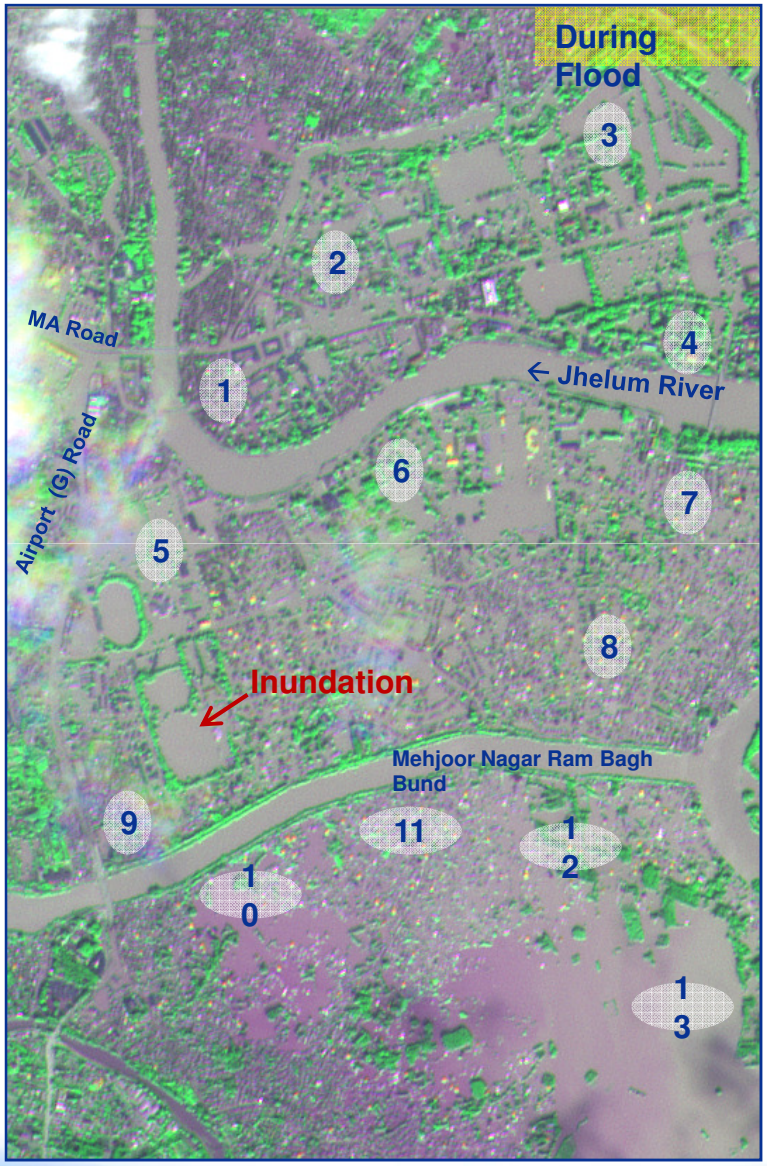
Possible flood inundation simulation in case of Sudden failure of the earthen dam (at 10000 m ^{3}/s)

- Depth of inundation varies from 3 to 5 m when the discharge is 10,000 m ^{3}/s

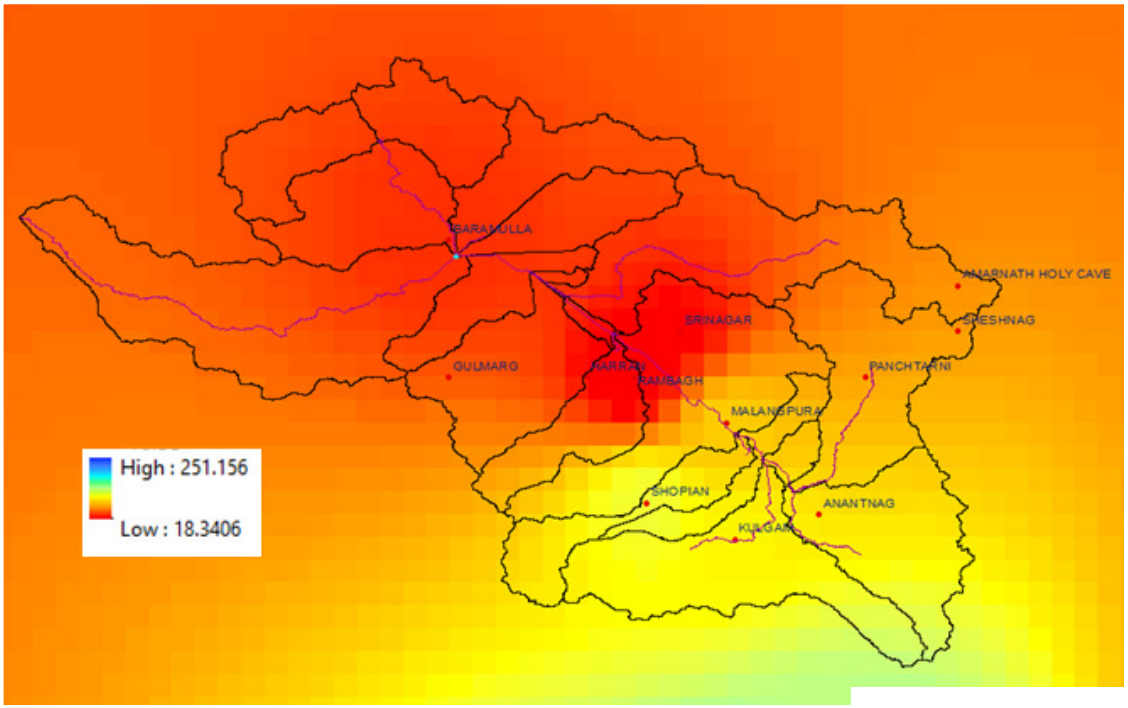
- Peak discharge will occur within one hour in case of sudden failure of the earthen dam.

-

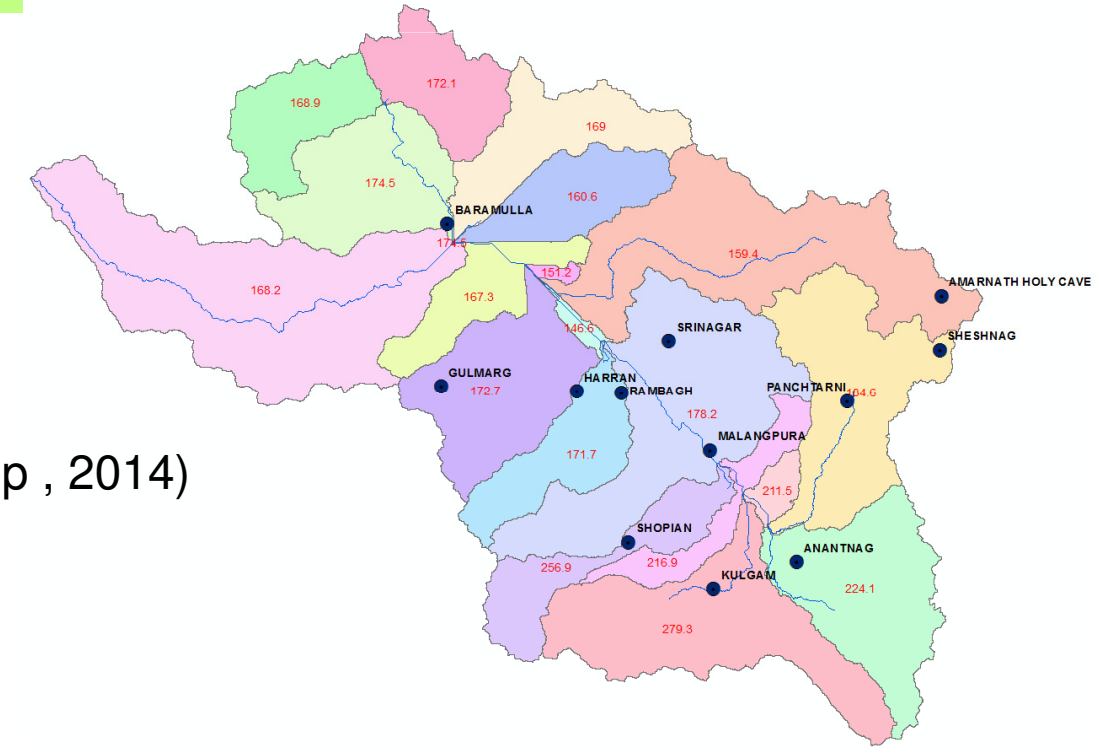
Flood Management



- Near Real time flood inundation mapping
- Flood hazard zonation : Assam (c),Bihar (c) & Orissa (p)
  - Web application is developed
- River configuration and bank erosion studies
  - Selected rivers stretches
- Flood control embankment mapping
  - Selected river stretches
- Flood Forecast Modeling
- Flood inundation simulation
- Geospatial services for flood relief management
  - Mobile based application for disaster relief management

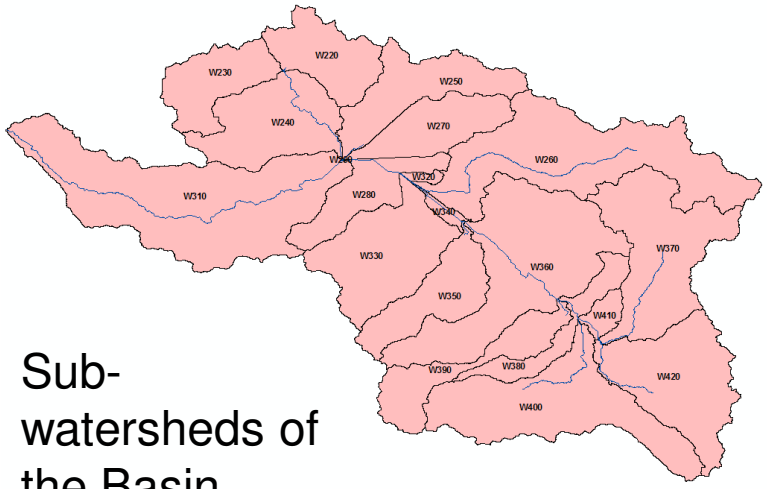


Spatial Variation of Rainfall on 5th Sep, 2014 in mm. (Point data Source: IMD)



Accumulated Rainfall (3rd to 5th Sep , 2014) in each sub-basin (in mm)

Jhelum (Srinagar) Floods-03-05 Sep.2014

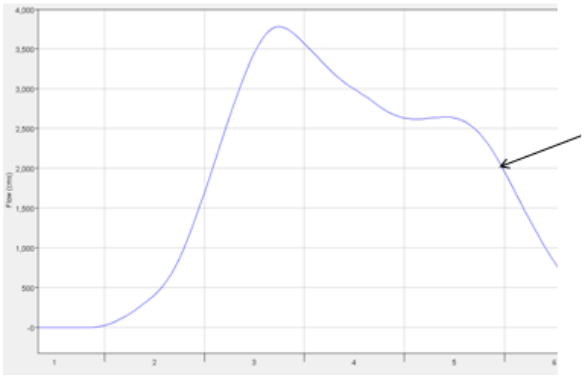


Sub-watersheds of the Basin

Rainfall varies 146 to 280 mm (Avg.188mm) from 3rd to 5th Sep, 2014

Peak Q @ outlet is 3782 m^3/sec and at @ Srinagar is 2728 m^3/sec.

Comparison of IMD, CPC, and TRMM Rainfall

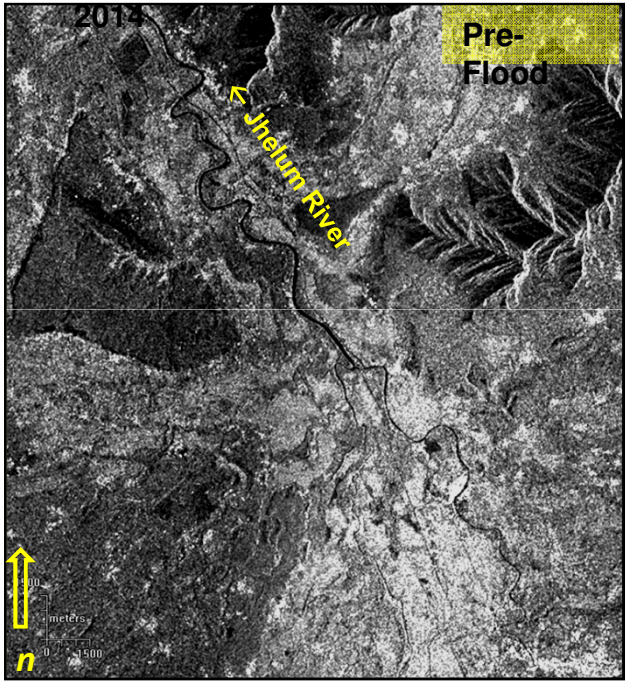


		Sep-03			Sep-04			Sep-05			Sum(3 TO 5 SEP)					
NAME	AREA(Sq.km)	CPC	TRMM	IMD	CPC	TRMM	IMD	CPC	TRMM	IMD	CPC	TRMM	IMD	CPC	TRMM	IMD
W220	522.6687	17.488	12.54	60.582	26.154	18.69	80.251	21.063	4.78	31.316	64.705	36.01	172.149	33819.3	18821.3	89976.9
W230	505.683	22.511	10.113	57.093	29.727	28.193	77.918	22.671	4.238	33.924	74.909	42.544	168.935	37880.2	21513.8	85427.6
W240	792.9009	33.834	15.936	62.125	26.725	45.731	81.913	26.553	5.314	30.452	87.112	66.981	174.49	69071.2	53109.3	138353
W250	647.757	30.465	22.652	59.477	17.196	27.651	77.747	16.534	8.146	31.782	64.195	58.449	169.006	41582.8	37860.7	109475
W260	1571.5782	21.305	32.114	51.261	62.757	98.861	69.413	100.572	11.966	38.739	184.634	142.941	159.413	290167	224643	250530
W270	503.091	37.148	22.268	57.406	25.065	33.299	71.804	25.459	8.197	31.376	87.672	63.764	160.586	44107	32079.1	80789.4
W280	446.0994	38.386	21.808	61.076	45.317	38.128	77.136	43.306	6.922	29.132	127.009	66.858	167.344	56658.6	29825.3	74652.1
W290	0.0648	33.834	15.936	62.125	26.725	45.731	81.913	26.553	5.314	30.452	87.112	66.981	174.49	5.64486	4.34037	11.307
W300	0.0486	36.121	15.601	54.569	56.195	56.51	76.716	39.554	8.495	36.876	131.87	80.606	168.161	6.40888	3.91745	8.17262
W310	2011.0437	36.121	15.601	54.569	56.195	56.51	76.716	39.554	8.495	36.876	131.87	80.606	168.161	265196	162102	338179
W320	30.0186	30.355	21.93	55.794	52.584	39.78	66.261	55.685	4.95	29.158	138.624	66.66	151.213	4161.3	2001.04	4539.2
W330	899.2377	47.213	27.156	57.838	97.185	51.65	78.63	68.805	10.719	36.242	213.203	89.525	172.71	191720	80504.3	155307
W340	49.5234	29.875	21.93	54.94	66.768	39.78	64.135	67.028	4.95	27.523	163.671	66.66	146.598	8105.54	3301.23	7260.03
W350	543.4209	49.15	32.076	55.438	111.728	56.181	77.188	90.181	15.637	39.086	251.059	103.894	171.712	136431	56458.2	93311.9
W360	1528.3728	30.096	26.921	56.979	77.883	58.816	78.371	106.598	14.135	42.836	214.577	99.872	178.186	327954	152642	272335
W370	1101.1545	15.816	35.954	46.362	72.359	110.189	86.063	155.236	30.474	52.126	243.411	176.617	184.551	268033	194483	203219
W380	321.3351	21.503	31.602	55.317	64.745	75.915	100.001	154.646	26.601	61.629	240.894	134.118	216.947	77407.7	43096.8	69712.7
W390	514.2123	51.282	34.84	63.321	119.011	63.306	120.092	137.15	22.984	73.525	307.443	121.13	256.938	158091	62286.5	132121
W400	1231.2	57.985	31.284	64.829	180.359	68.556	134.882	147.222	38.707	79.621	385.566	138.547	279.332	474709	170579	343914
W410	103.1535	28.172	31.44	42.34	75.554	67.65	104.715	150.539	28.74	64.439	254.265	127.83	211.494	26228.3	13186.1	21816.3
W420	965.4228	44.204	33.033	29.19	128.181	61.612	119.651	119.328	51.62	75.275	291.713	146.265	224.116	281626	141208	216367
	14287.9869													2792961	1499708	2687305
												WT.AVERAGE		195.476	104.963	188.081

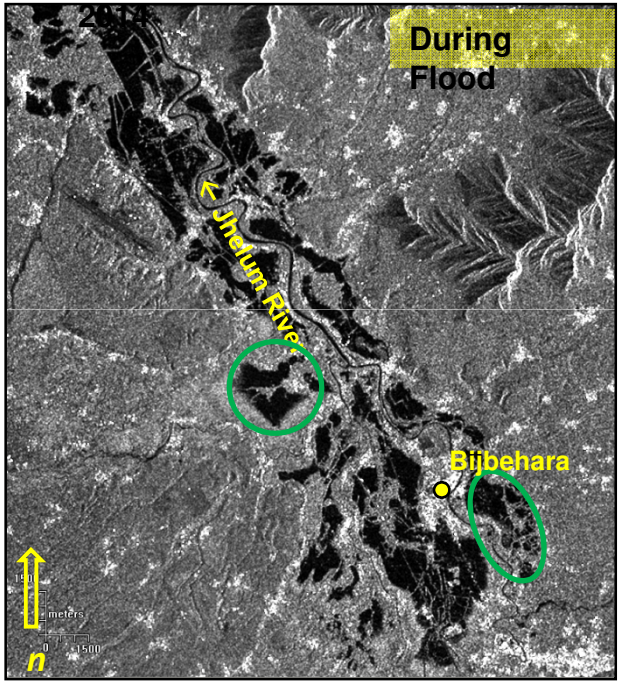
Floods in Jammu & Kashmir - 2014

Multi-temporal RISAT-1 images showing flood recession at Bijbehara near Anantnag, J&K

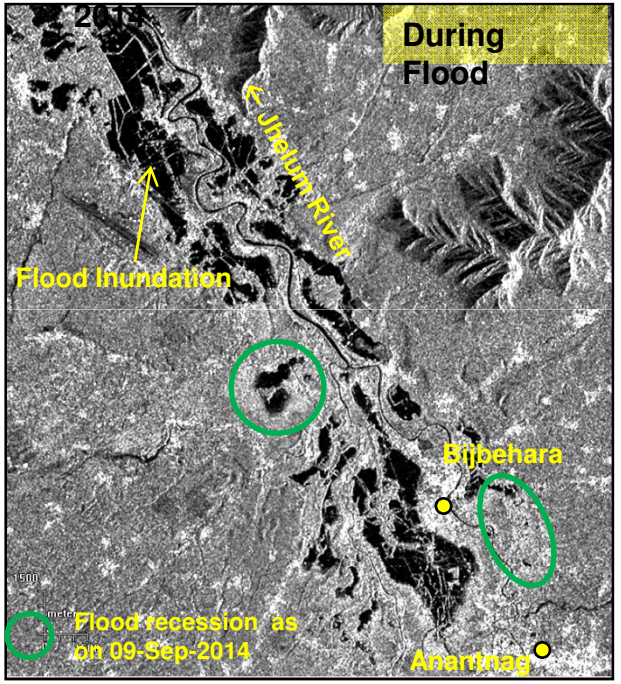
RISAT-1 image of 14-Aug-2014



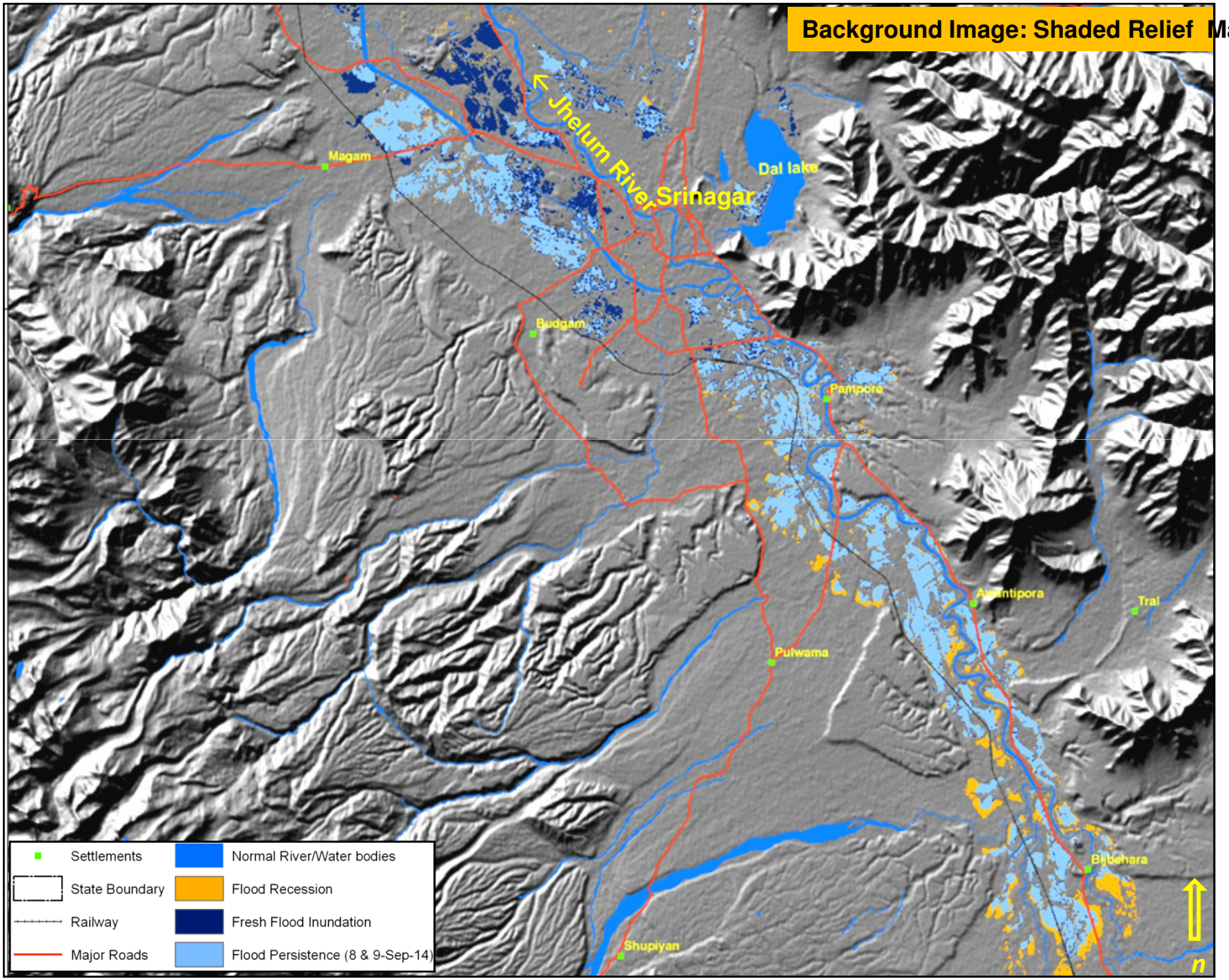
RISAT-1 image of 08-Sep-2014



RISAT-1 image of 09-Sep-2014



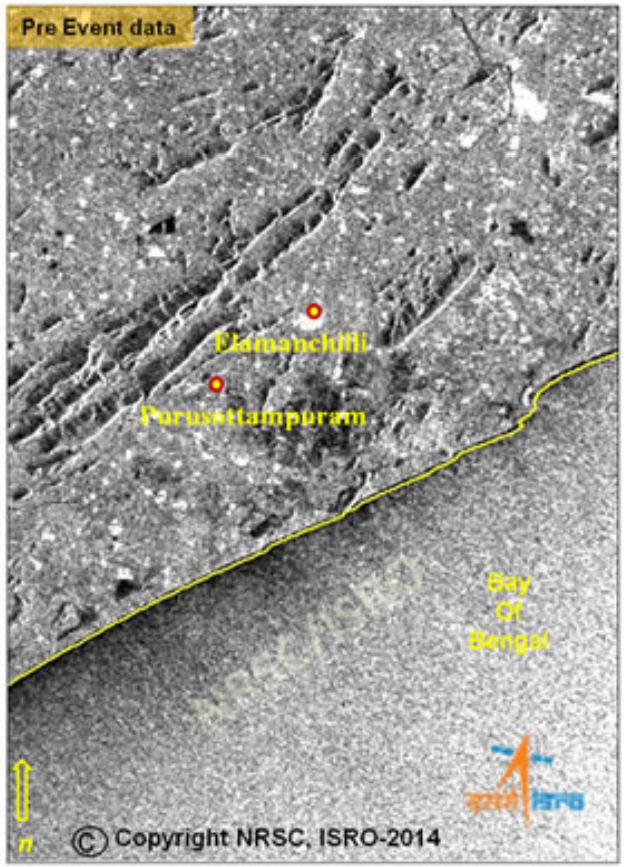
Flood progression and recession during 08-09, Sep 2014 in part of Jammu & Kashmir



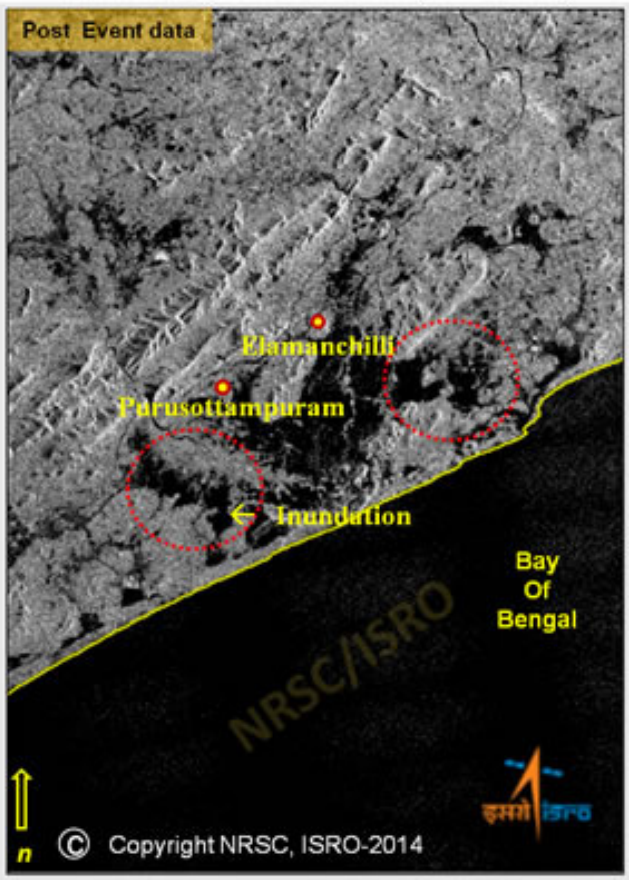
Cyclone HUDHUD - Response

1. Rapid Inundation Mapping
2. Flood Forecasting for Nagavali & Vamsadhara Rivers
3. Aerial Flying for damage assessment
4. Crowd Sourcing through Bhuvan

RADARSAT Image of 12-Oct-2014 (0600 hours IST)



RISAT-1 image of 12-Oct-2014 (1800 hrs IST)



Cyclone HUDHUD- 2014

Very Severe Cyclonic Storm "HUDHUD" on 12 Oct 2014 hit Vishakhapatnam, Andhra Pradesh between 1200 and 1300 hours IST.

Vishakhapatnam, Srikakulam, Vizainagram and East Godavari were severely affected due to strong gale winds and inundation.

ISRO/NRSC has carried out a close watch on the situation.

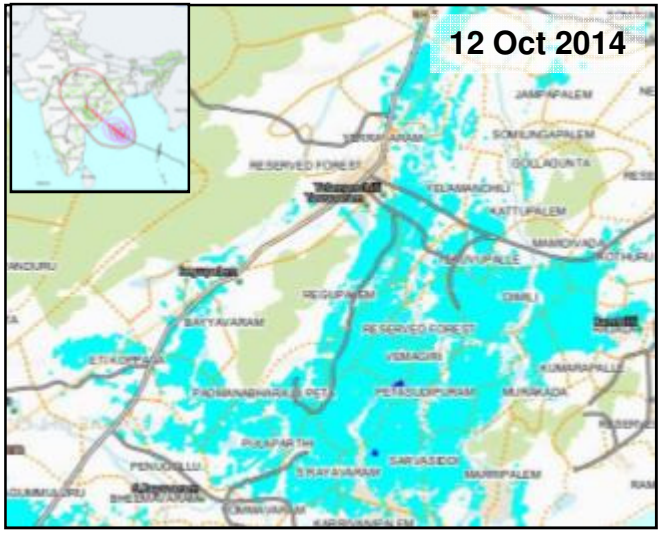
Aerial survey was carried out for detailed investigation.

Crowd sourcing was enabled to collect information from ground.

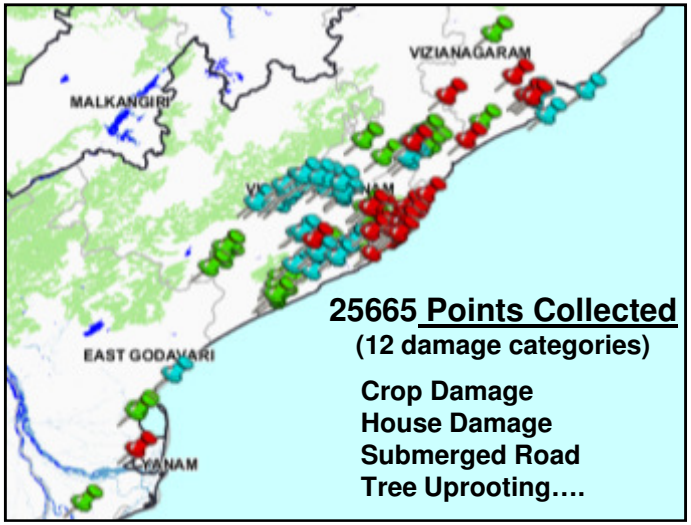
International Charter was also activated.

Inundation maps (about 22 in number) were provided in near real time to state Govt.

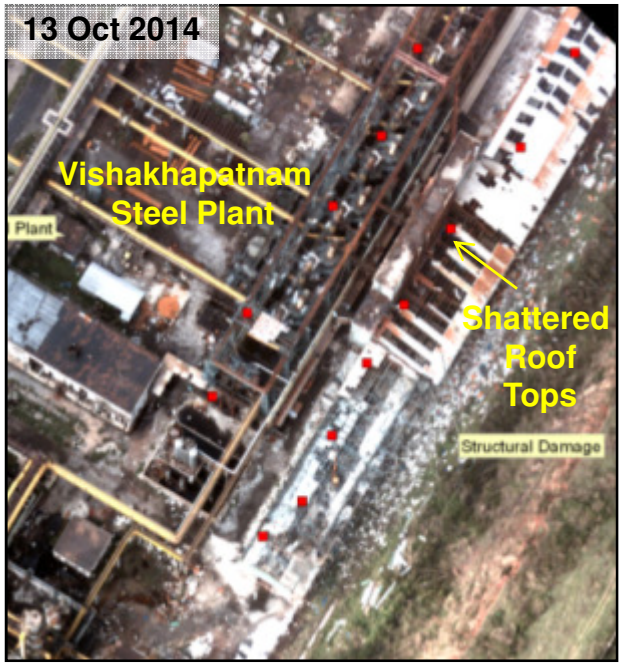
Inundation observed near Yelmanchalli

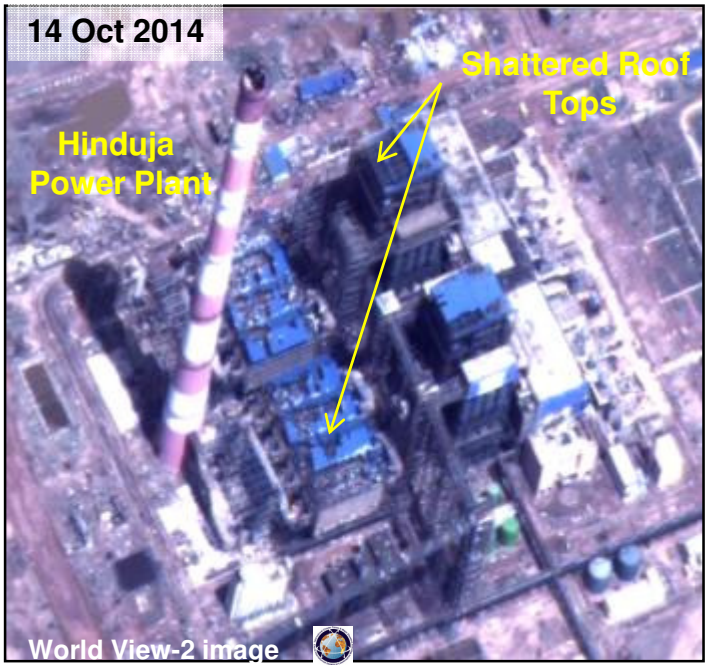


Crowd sourcing data uploaded to Bhuvan



Structural Damages (Shattered Roof Tops) Observed from Aerial & Satellite





Flood Mitigation

Satellite based Flood Extent (SaFE)

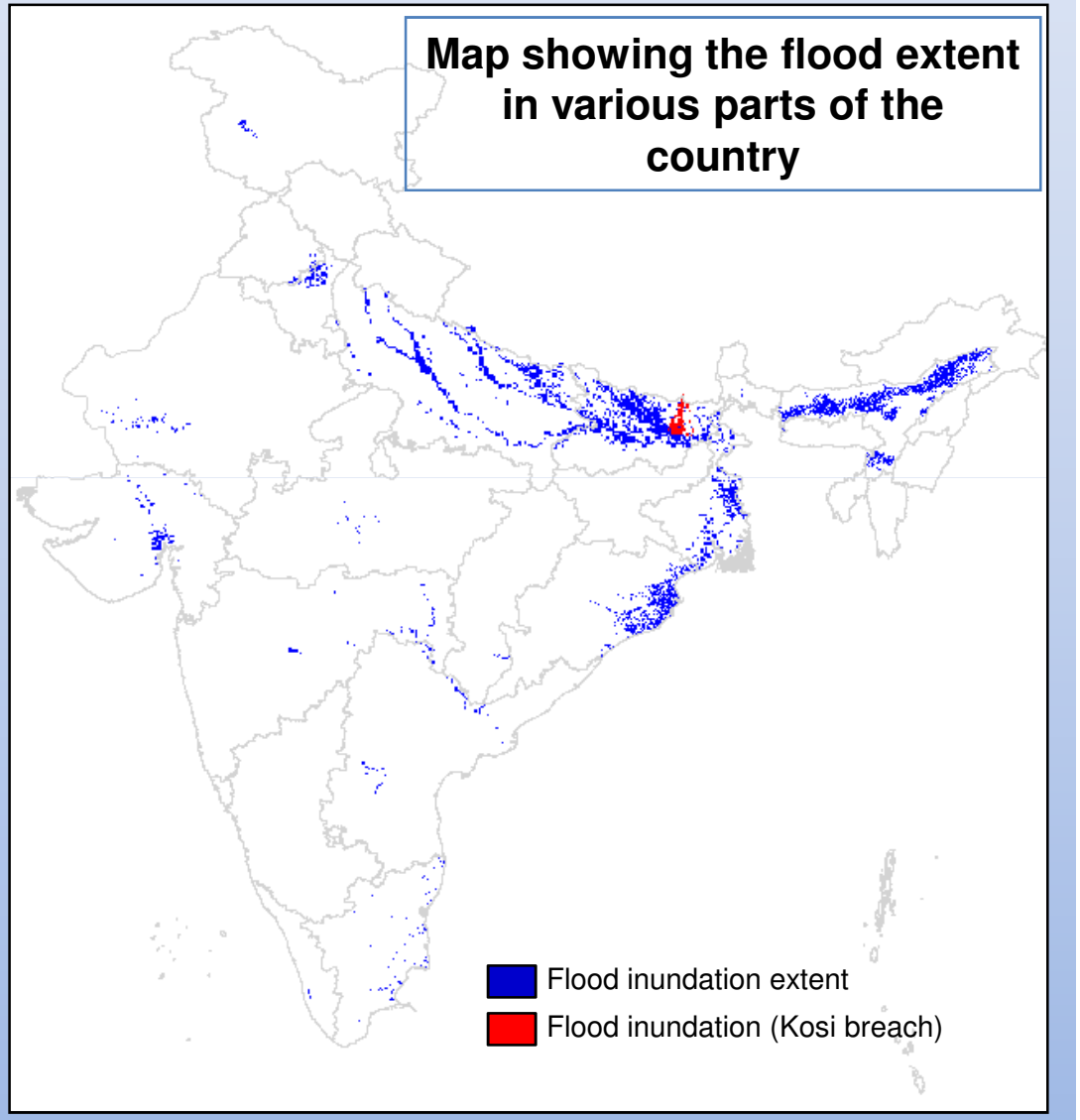
nrsc

Based on the analysis of satellite data acquired during selected major flood events in the country, generation of flood extent is initiated. This could be one of the important input for flood prone area assessment.

Selected events during 1988-2013 are considered for analysis.

Total satellite based maximum flood inundated area is about 10.934 mHa.

Hilly areas are not considered in this work. Work is in progress.



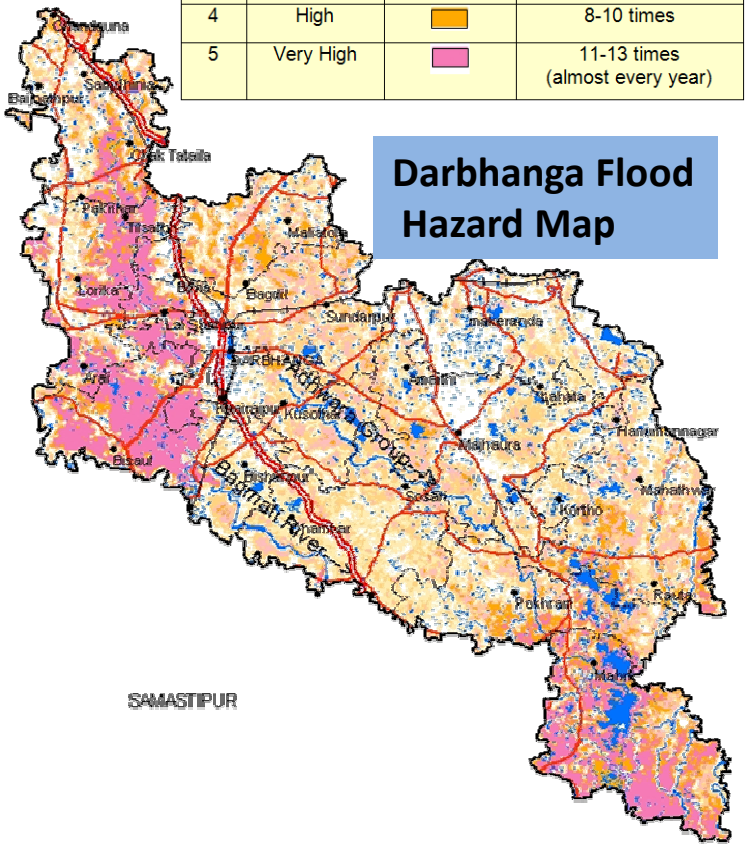
Data Used:

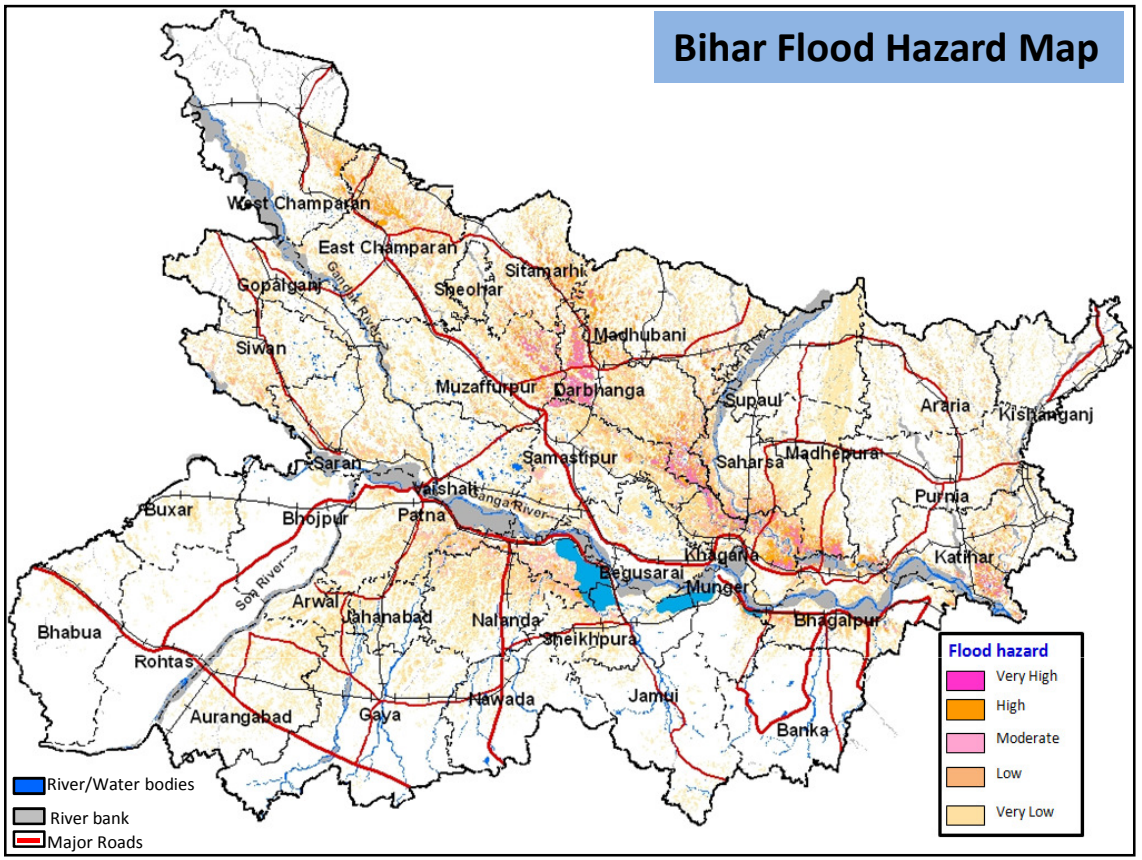
13 Years (1998-2010)- 128 satellite datasets.

Approach:

Based on Annual Frequency of Inundation and Intra Annual Flood Variations

Sl.No	Flood Hazard Classification	colour coding scheme	Number of times / years the area was subjected to flood inundation during 1998-2010
1	Very Low		1-2 times
2	Low		3-4 times
3	Moderate		5-7 times
4	High		8-10 times
5	Very High		11-13 times (almost every year)



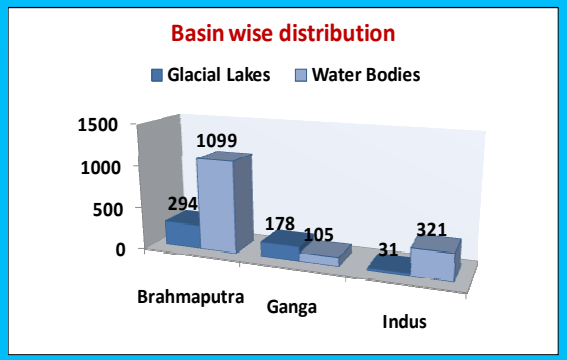


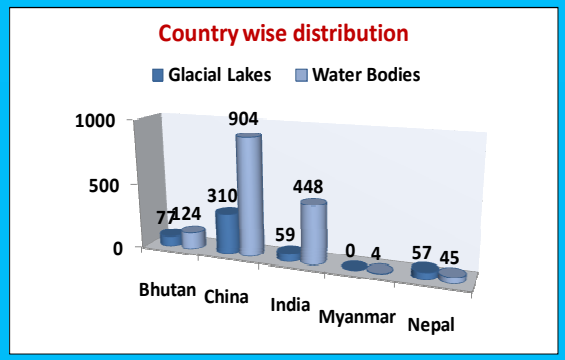
Sl No	Hazard Severity	Flood Hazard Area (ha)	% Flood Hazard (wrt State Geographic Area)	% Crop Area Under Different Flood Hazard Categories (wrt State Geographic Area)
1	Very High	83,280	0.88	0.43
2	High	1,22,905	1.31	0.78
3	Moderate	2,70,579	2.87	1.77
4	Low	5,24,862	5.57	3.60
5	Very Low	14,55,278	15.45	10.26
	TOTAL	24,56,904	26.09	16.83

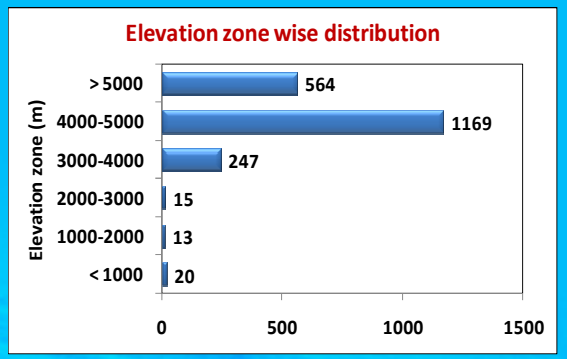
Inventory and monitoring of glacial lakes & water bodies in Himalayan region of Indian river basins

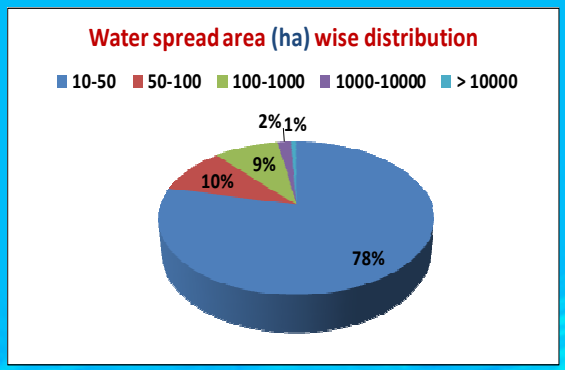
- Inventory of glacial lakes/water bodies in the Himalayan region of Indian River basins using satellite data (spatial extent > 10ha)
- Monitoring the spatial extent changes of the lakes/water bodies (> 50ha) on monthly basis during June to October months for 5 years, succeeding the inventorying year

Inventory of glacial lakes/water bodies - 2009
Using Resourcesat -1 AWiFS Data









2011

Month	No. of GL/WB monitored	Water Spread Area		
		Increase	Decrease	No Change
Jun	178	49	20	109
Jul	125	36	17	72
Aug	153	73	23	57
Sep	243	93	56	94
Oct	360	114	97	149
Jun-Oct	391	218	35	138

2012

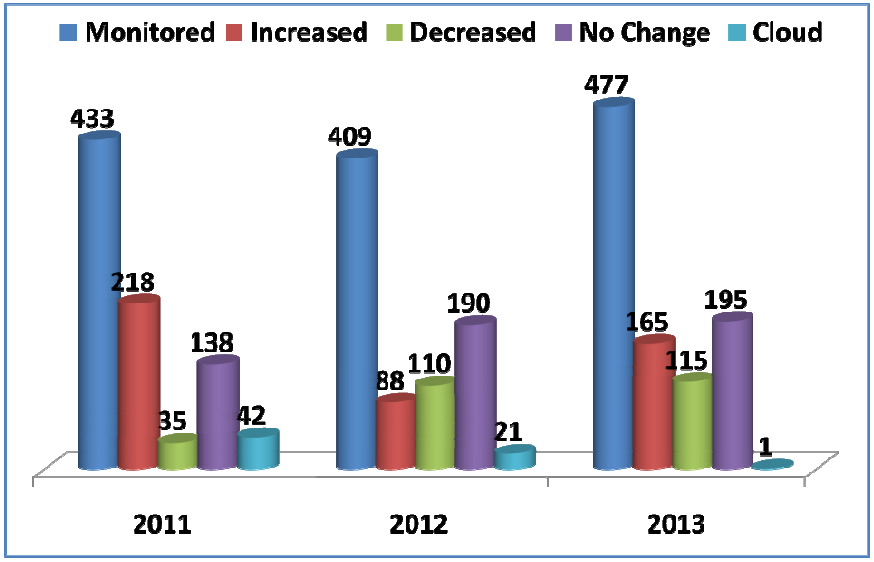
Month	No. of GL/WB monitored	Water Spread Area		
		Increase	Decrease	No Change
Jun	267	40	126	101
Jul	217	48	73	96
Aug	240	16	128	96
Sep	305	5	200	100
Oct	370	15	228	123
Jun-Oct	391	88	110	190

2013

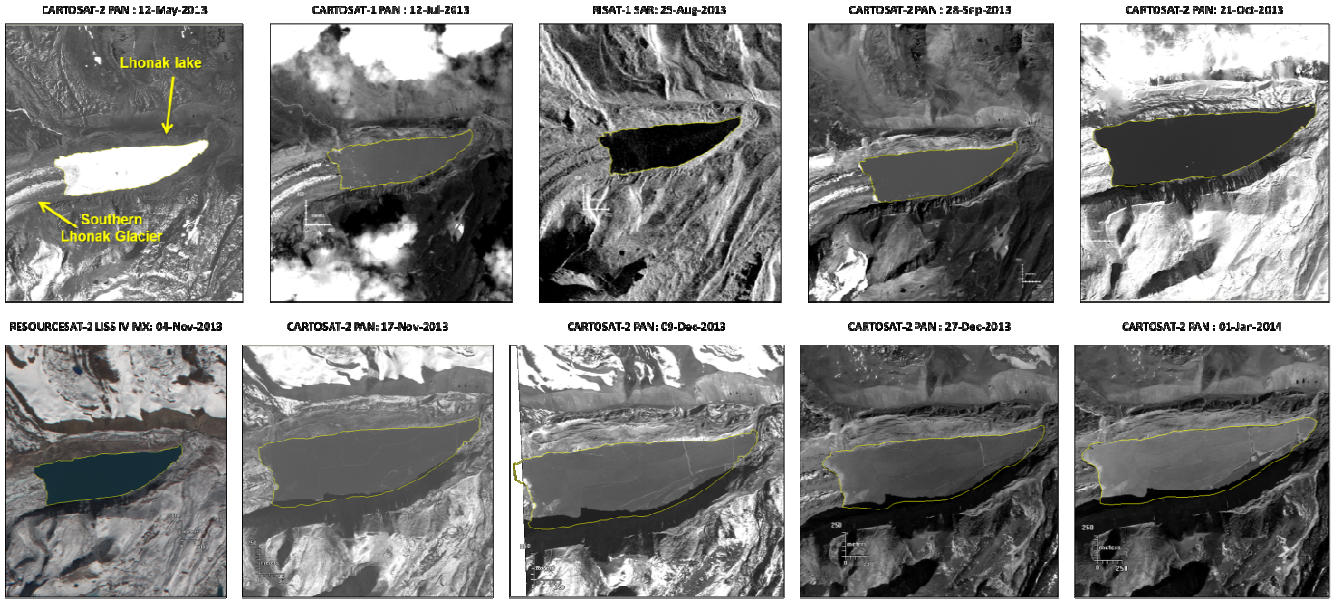
Month	No. of GL/WB monitored	Water Spread Area		
		Increase	Decrease	No Change
Jun	382	108	144	130
Jul				

Monitoring of Glacial Lakes/Water Bodies

- Glacial lakes / water bodies that are more than 50 ha were monitored using cloud free satellite of June to October during the years 2011, 2012 and 2013.
- Regular monitoring of two lakes (Lhonak lake in Sikkim and Pareechu lake) with high resolution satellite data is also being carried out during 2013.



South Lhonak Lake



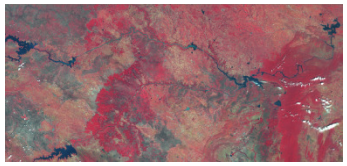
Date of Pass	Water Spread Area in ha (approx.)
12th May 2013	115
12th Jul 2013	125
25th Aug 2013	121
28th Sep 2013	120
21st Oct 2013	123
04th Nov 2013	125
17th Nov 2013	128
09th Dec 2013	129
27th Dec 2013	123
01st Jan 2014	122

Automated Satellite Data Processing

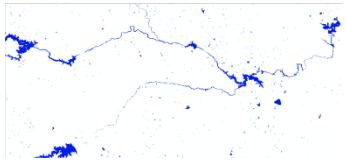
Geophysical Products : Water Bodies Fraction, Snow Cover Area

Resourcesat-2 AWiFS

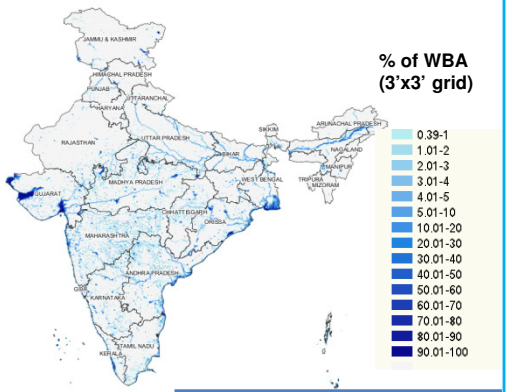
AWiFS Image

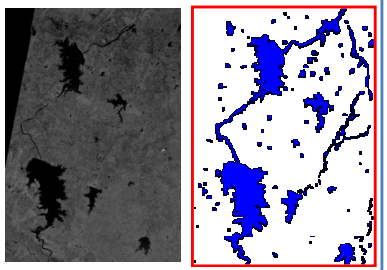


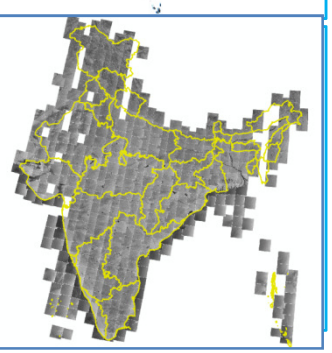
Water layer



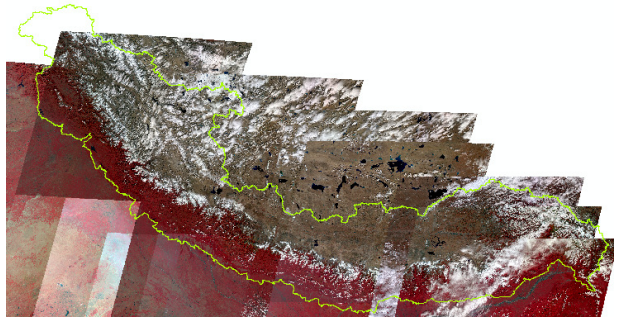
Water Bodie Fraction

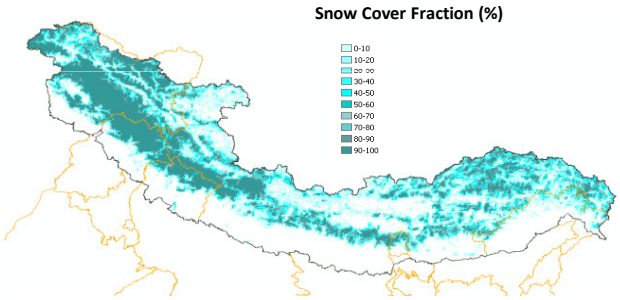






RISAT-1 MRS Microwave Data

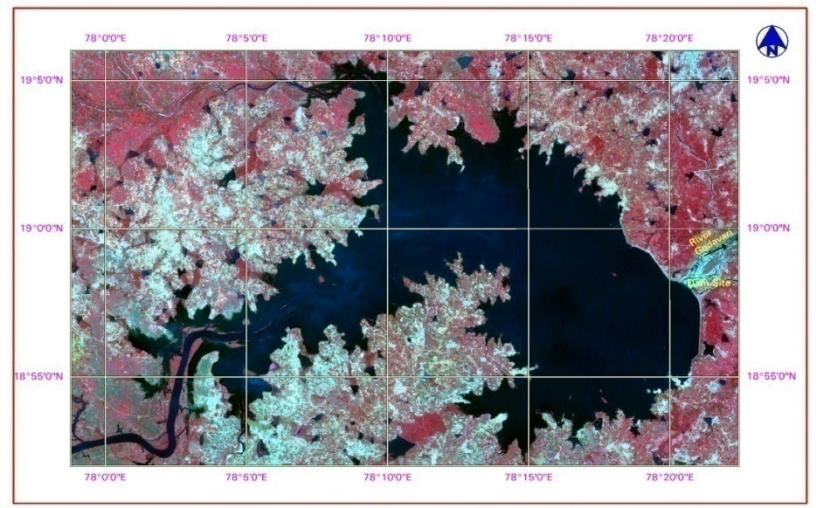




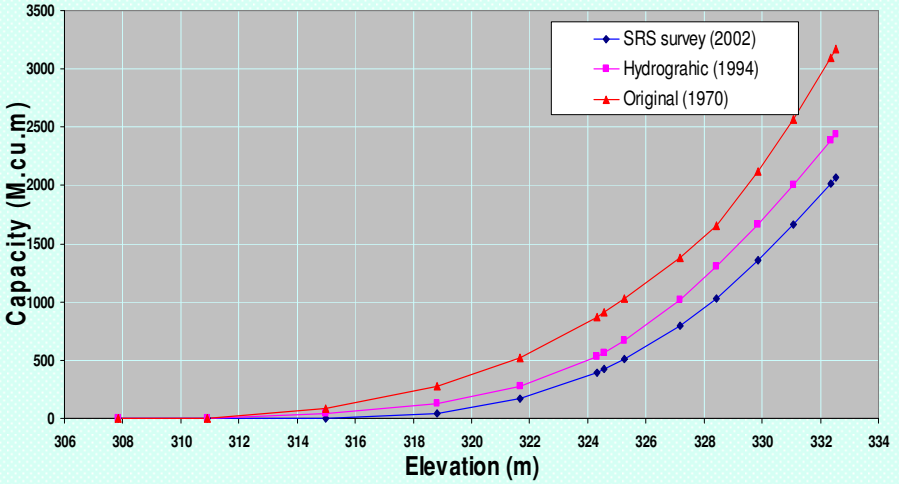
Satellite / Sensor	Frequency	Outputs
Resourcesat-2 AWiFS	15 Days	56m Water bodies Layer 3'x3' Grid Water bodies fraction
RISAT-1 MRS	Month	18m Water bodies Layer 3'x3' Grid Water bodies fraction
Resourcesat-2 AWiFS	15 Days	Snow cover fraction at 3'x3' Grid

RESERVOIR SEDIMENTATION ASSESSMENT USING REMOTE SENSING TECHNIQUE
SRI RAM SAGAR RESERVOIR, ANDHRA PRADESH

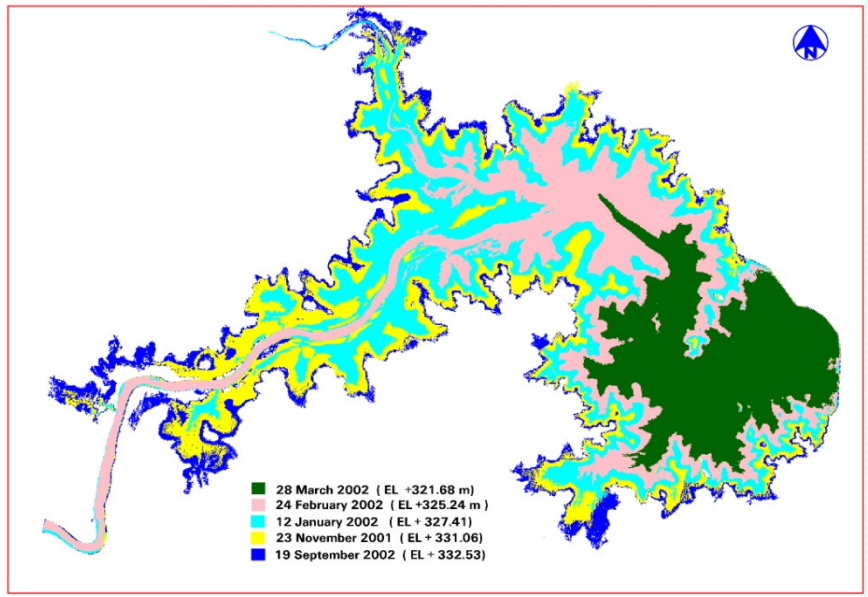
Satellite Image (FCC) of SRSP Reservoir



Elevation-Capacity curve of SRSP Reservoir



Waterspread area depletion pattern during 2001-02



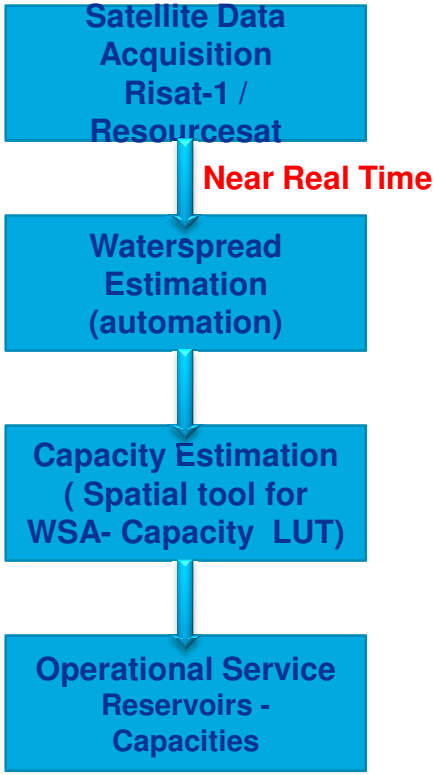
- Gross capacity assessed to be 2070.164 M.Cu.m. in year 2002

- 34.74 % capacity (1101.773 MCM) is lost since impoundment in 1970.

National Action Plan for Sedimentation Assessment of 124 Reservoirs

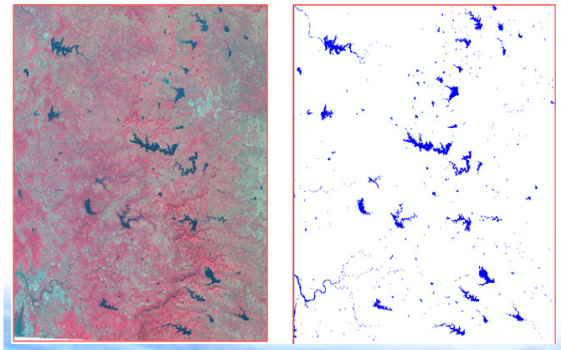
Estimation of Near Real Time Live storage Capacity of Reservoirs

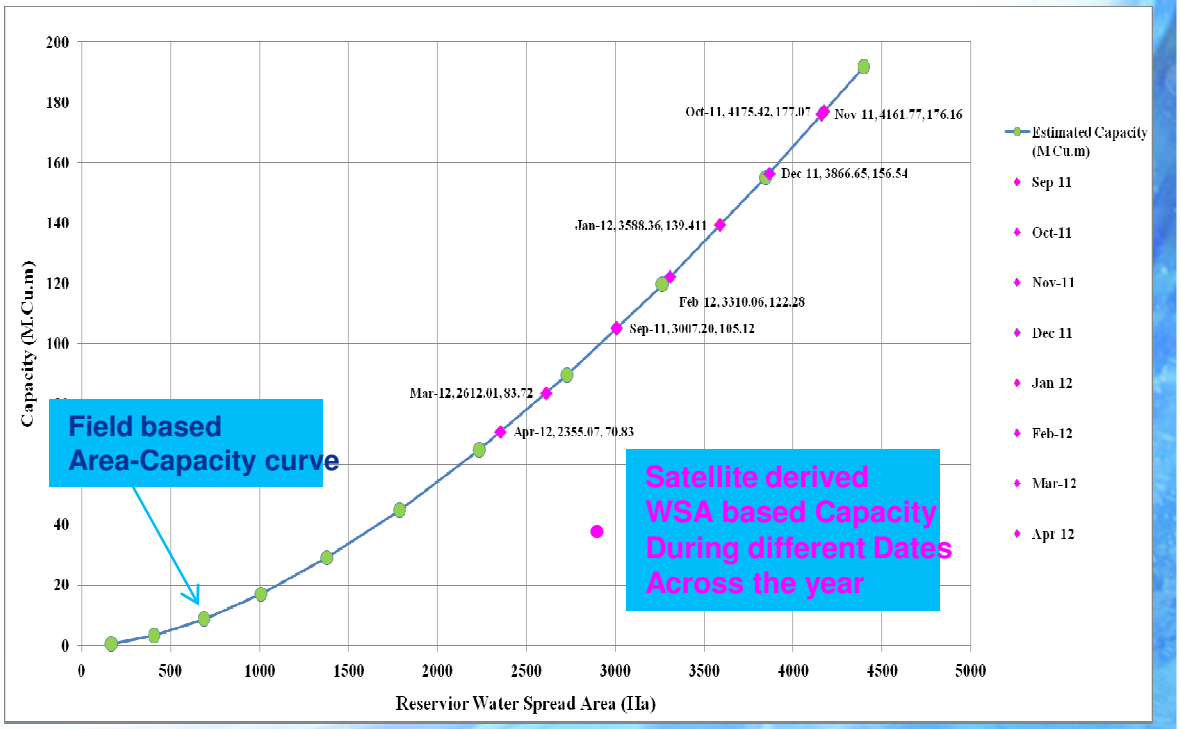
Utilisation of RISAT-1 + Resourcesat-2



Algorithms Developed and Evaluated for Waterspread Extraction ; As soon as the data is acquired , processing will be enabled through customized module

WSA-Capacity Curves : Look up Table

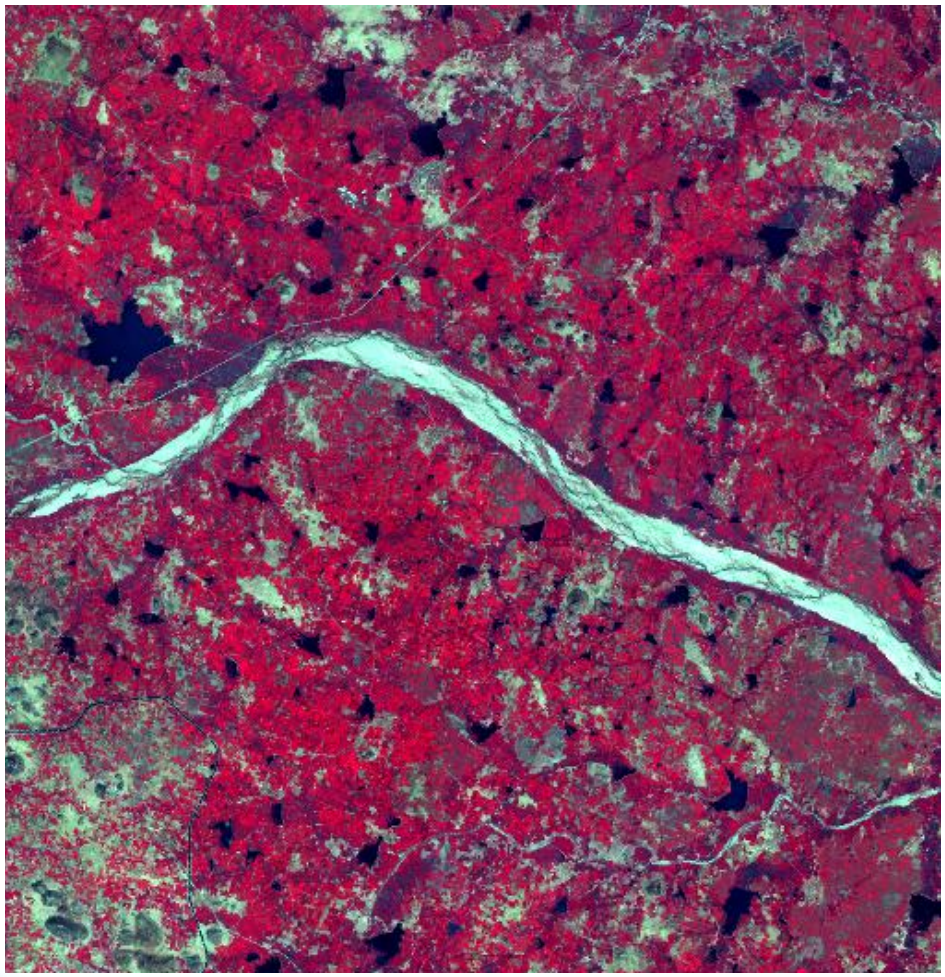




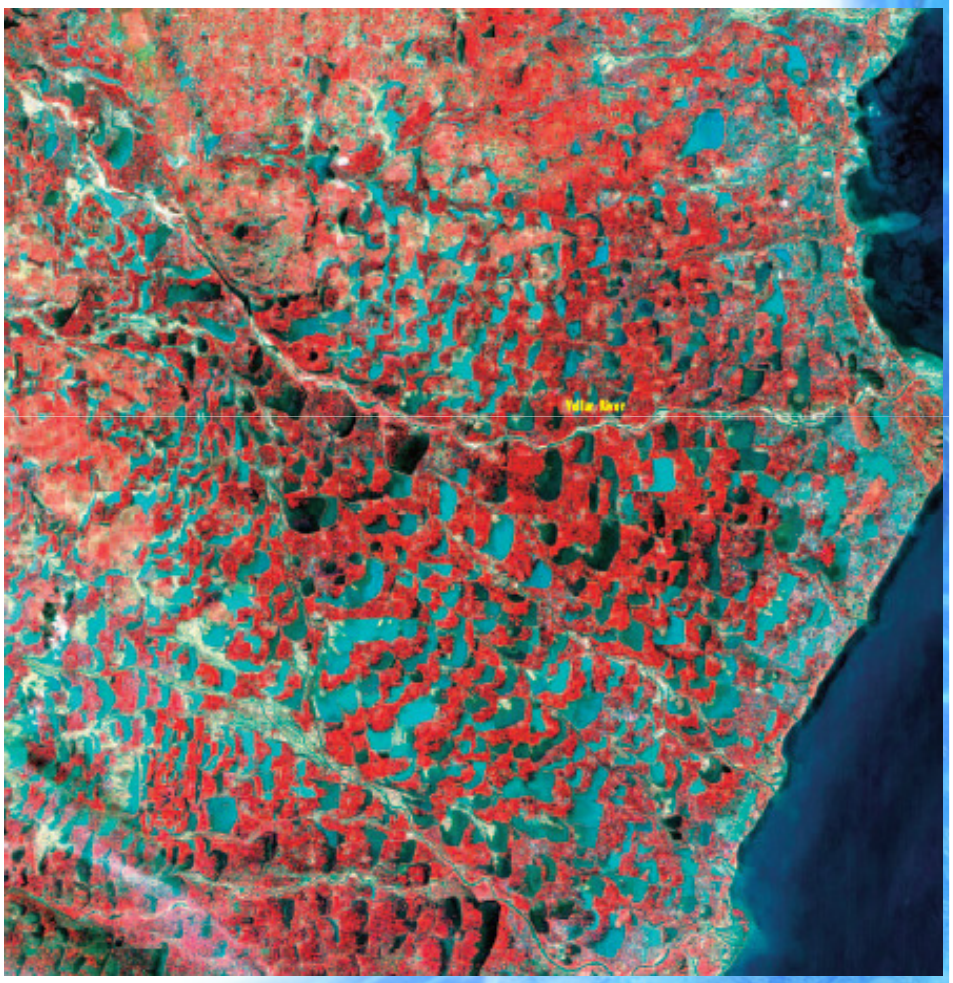
Tank Irrigation

Importance of tank irrigation

4.78 M.ha in 1962-63
3.07 M.ha 1985-86
1.97 M.ha 2008-09



Andhra Pradesh

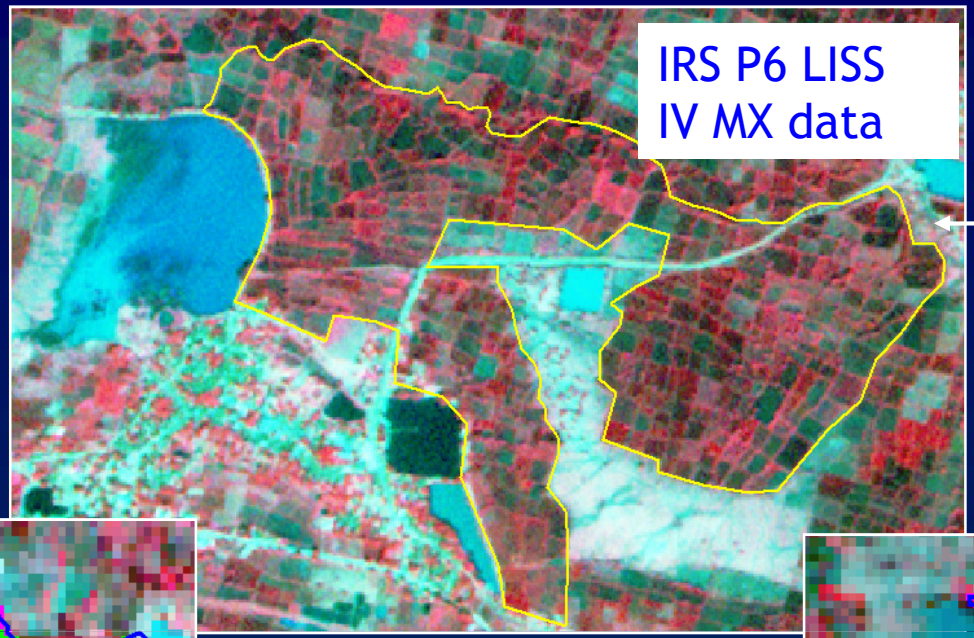


Tamil Nadu

Nakta Tank Command, Kabirdham District, Chattisgarh State

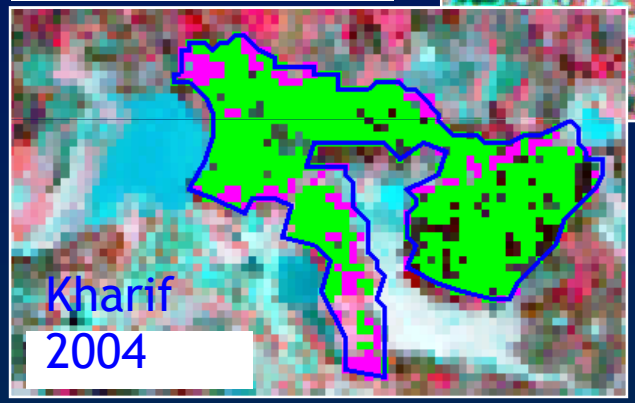
IP: 126 ha

Designed Irrigation: 81 ha



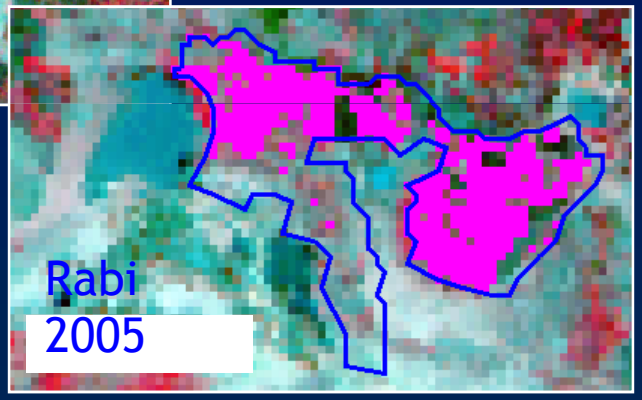
Tank command jurisdiction Idetnfied through field maps and LISS IV data)

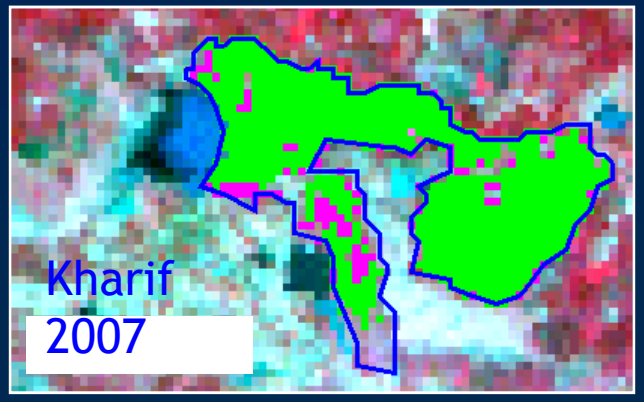
IRS P6 LISS III data



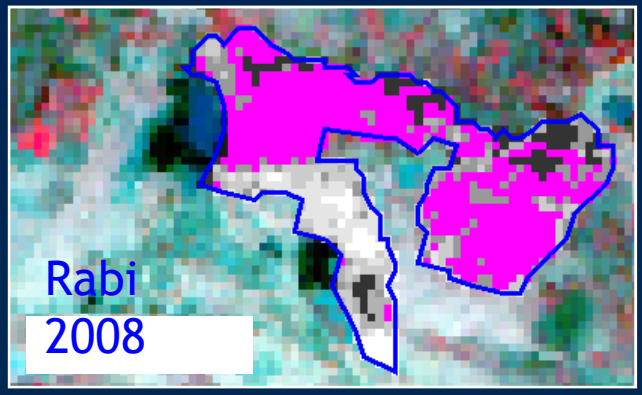
Year	Kharif		
	Paddy	Non Paddy	Total
2004-05	57.86	11.94	69.80
2007-08	66.61	8.16	74.77

IRS P6 LISS III data





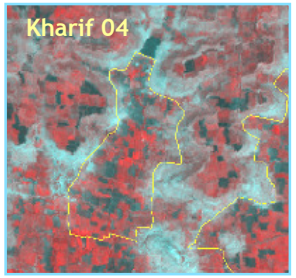
Year	Rabi		
	Paddy	Non Paddy	Total
2004-05	0.00	38.94	38.94
2007-08	0.00	42.97	42.97

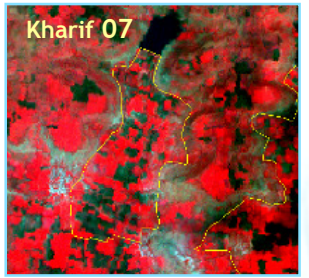


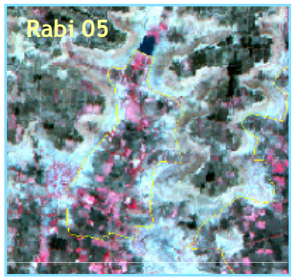
Tank / Minor Irrigation Water Management

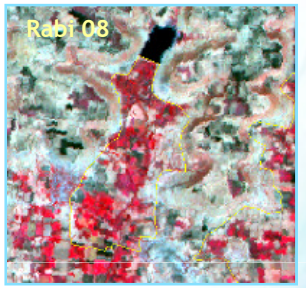
4.78 M.ha in 1962-63
3.07 M.ha 1985-86
1.97 M.ha 2008-09

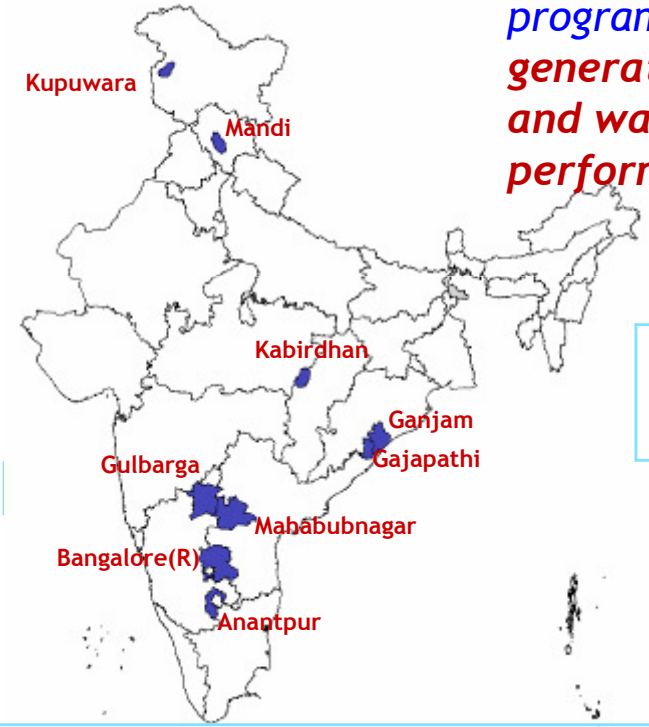
*Multi-year satellite data helps in evaluating impact of developmental programs - **through generation of agriculture and water related performance indicators***







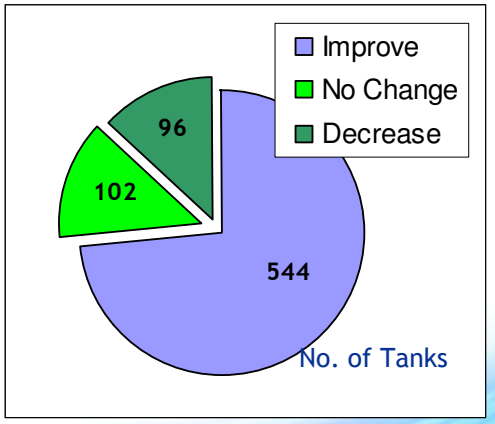


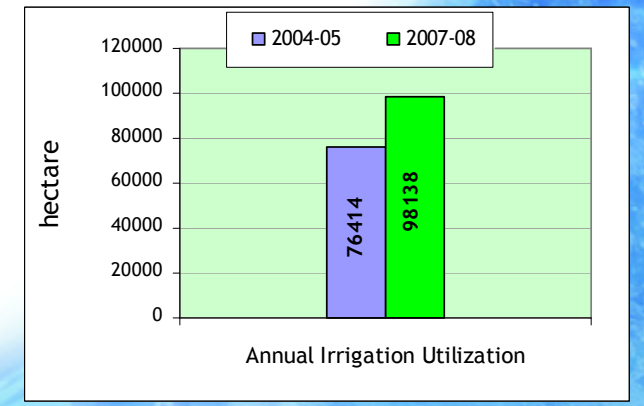


The satellite data based evaluation covered
742 Minor Irrigation schemes in 9 Districts spread over 6 States

- Total CCA covered - 1,01,788 hectare
- Two years of study
  2004-05 (Pre) and 2007-08 (Post)

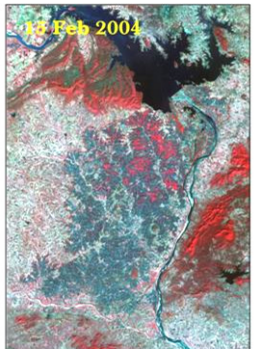
The satellite data based evaluation considers the temporal change (from 2004-05 to 2007-08) in Water spread area, Season-wise cropped area, Principal crop condition & Annual irrigation utilization

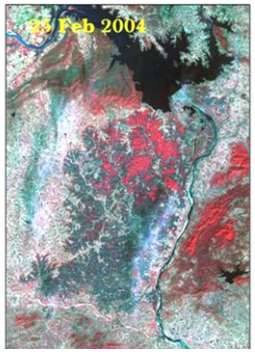


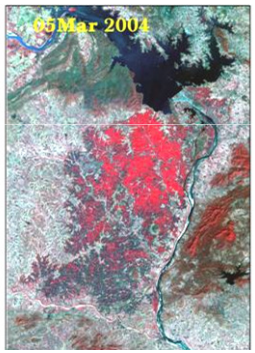


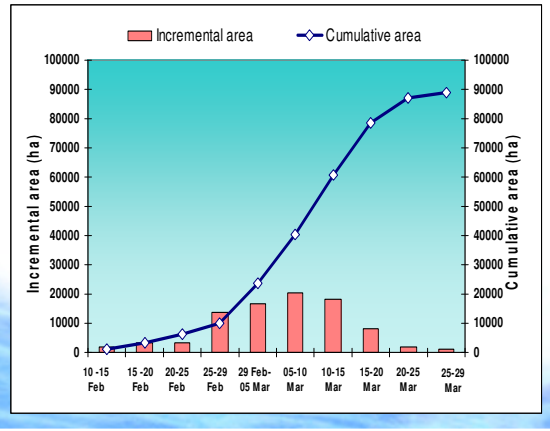
Overall Performance of 742 Tanks

Irrigation Water Management









Inventory of Irrigated Agriculture

- Cropping Pattern, Crop Condition

Performance Evaluation

- Irrigation Intensity ,Crop Productivity
- Water Utilisation Index, Water Use Efficiency

Monitoring Intervention Schemes

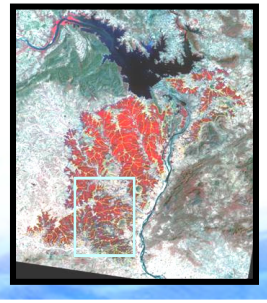
- Impact evaluation ,Sustenance of improvement

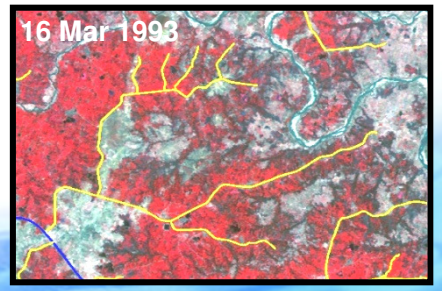
Near Real-Time Monitoring

- Irrigation Progress
- Intra-seasonal Irrigation Water Demand

Impact Assessment

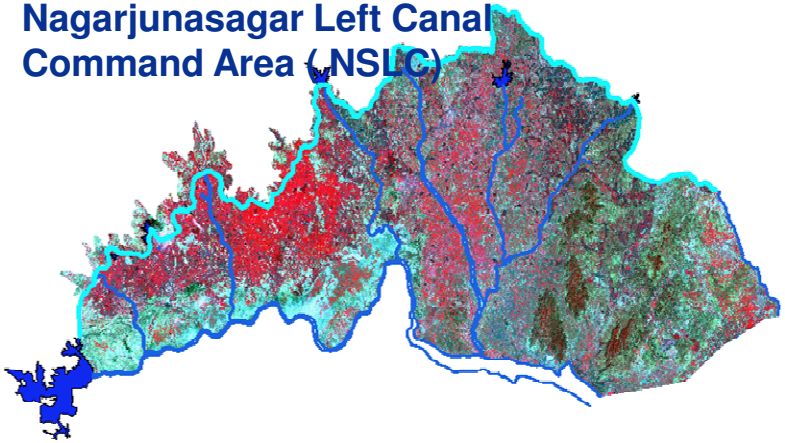
- Surface Water Logging, Soil Salinity/Alkalinity

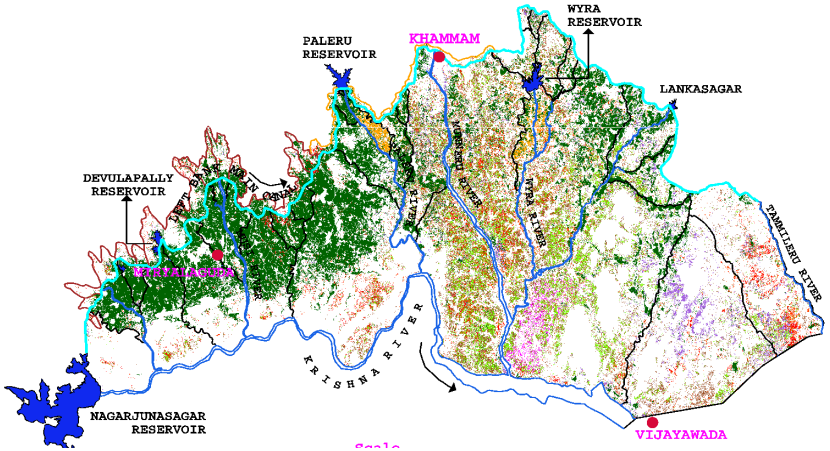


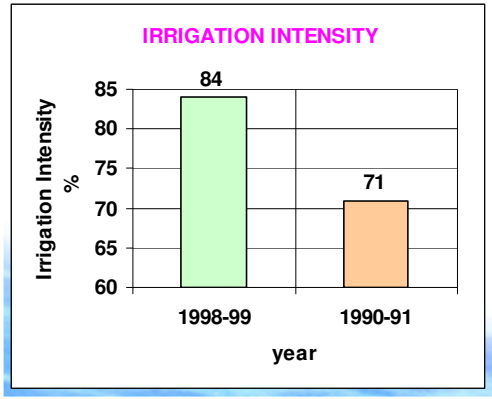


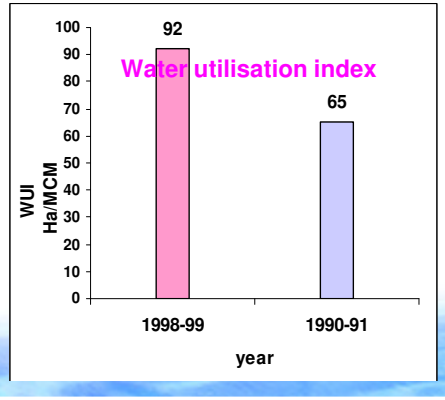
Performance Evaluation

Nagarjunasagar Left Canal
Command Area (NSLC)









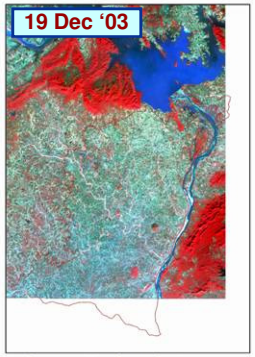
Performance indicators

+ Cropping Pattern
+ Area under crop
+ Irrigation potential utilized
+ Irrigation Intensity
+ Crop Production
+ Water Utilization Index
+ Water Use Efficiency

Identification of Canals with Differential / Poor Performance over Time and Space

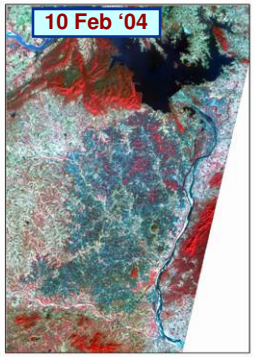
Decision Support For Intervention / Rehabilitation

Progression of 2003-04 Rabi Season Crop Area : RTDSS

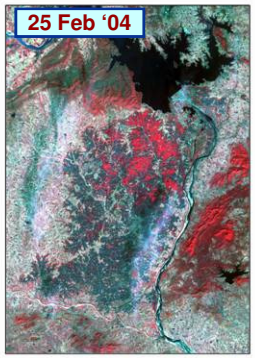


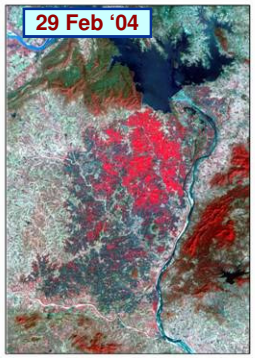
Prior to Irrigation

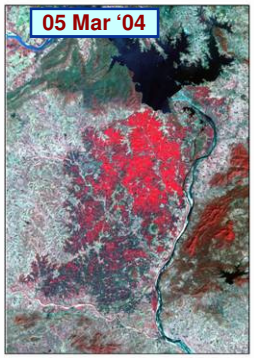
Irrigation Supplies Initiated



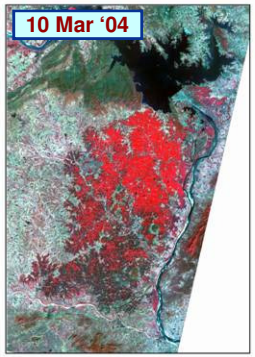
Field Preparation/ Rice Transplantation

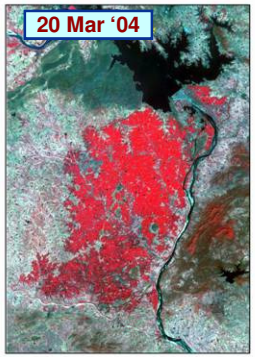




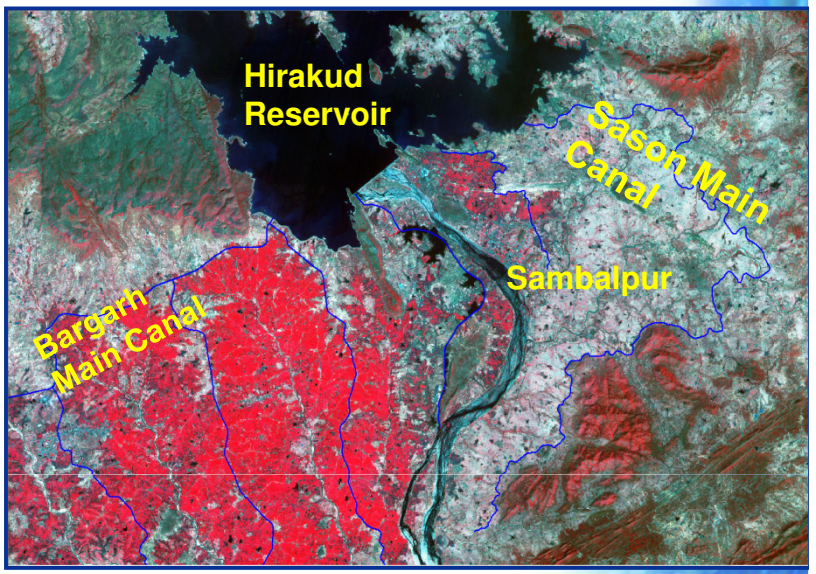


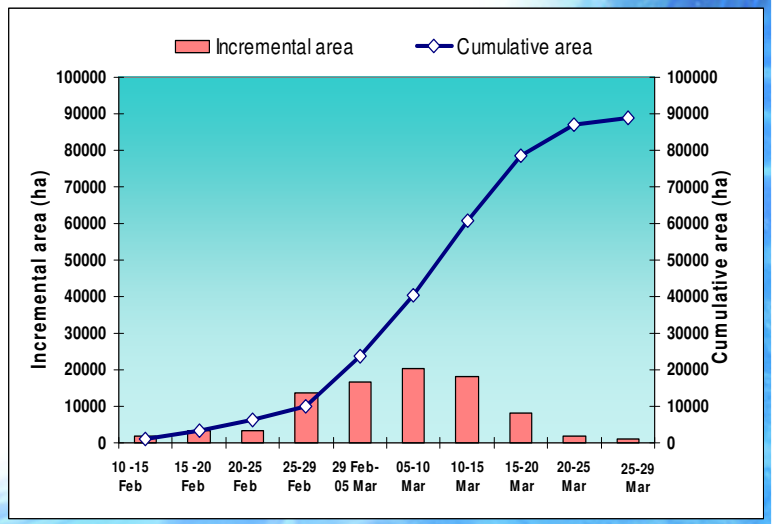
Rice Transplantation / Spectral Emergence / Active Tillering



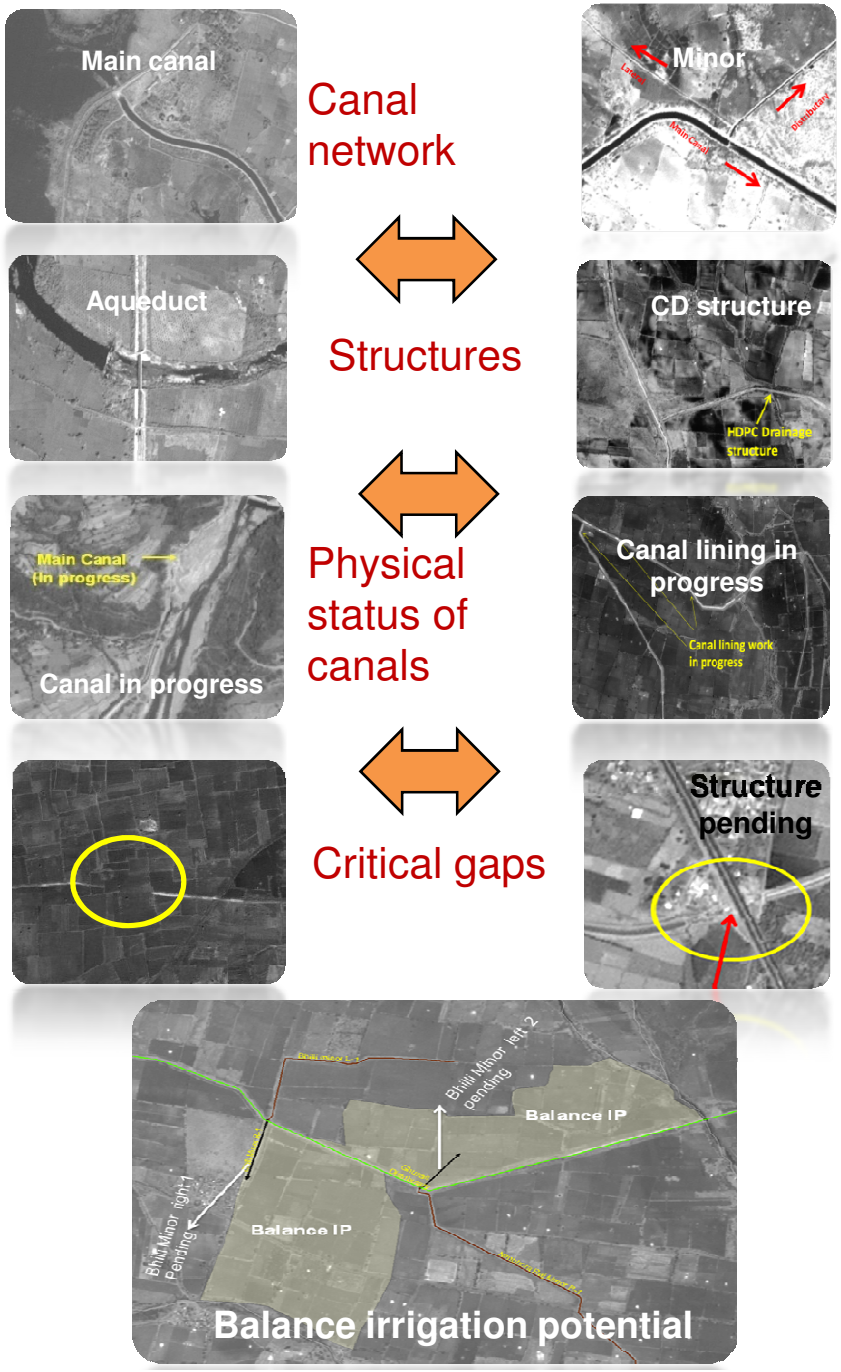


Spectral Emergence / Active Tillering / Heading

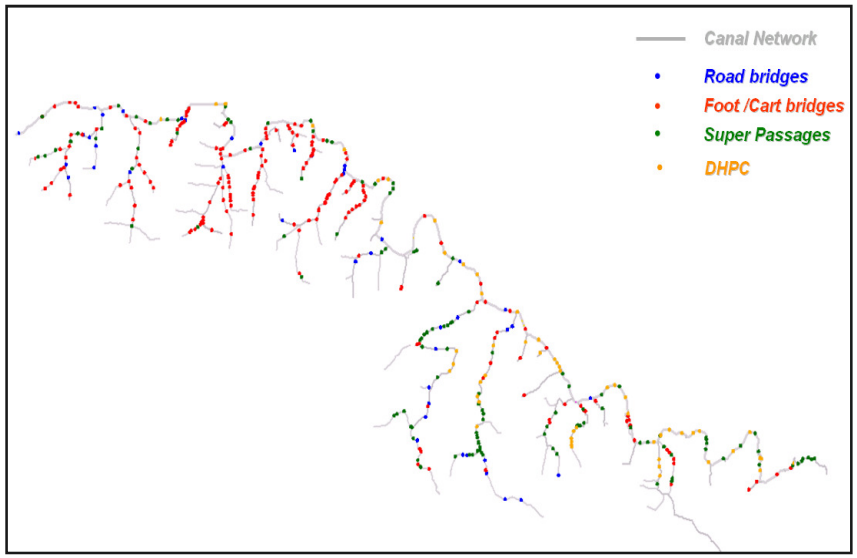




Inventory of Irrigation Infrastructure



Assessment of Irrigation Potential

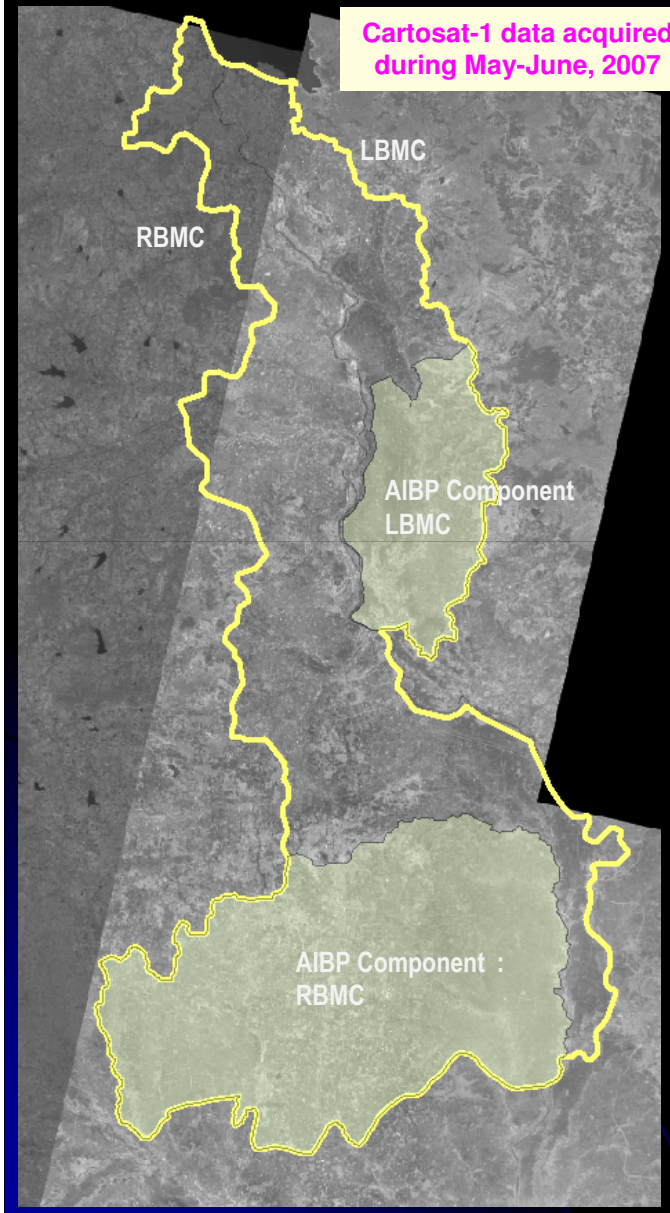


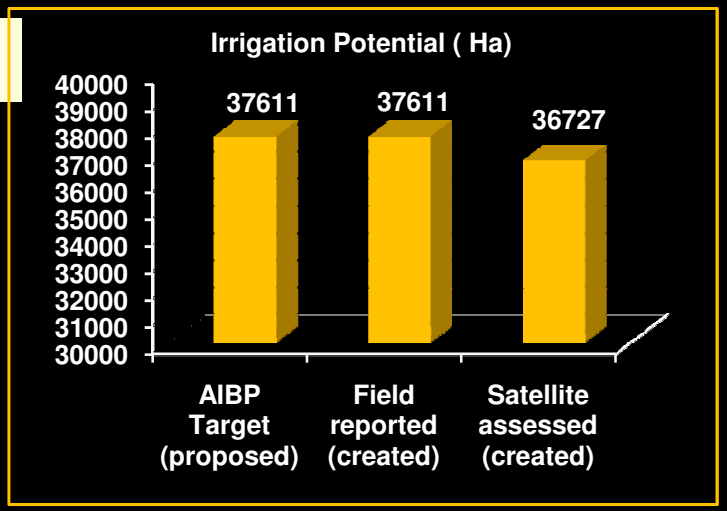
Assessment of Irrigation Potential created is estimated by comparing the canal network in terms of nos., lengths, its status together with information and status on irrigation and drainage structures with the planned / executed works

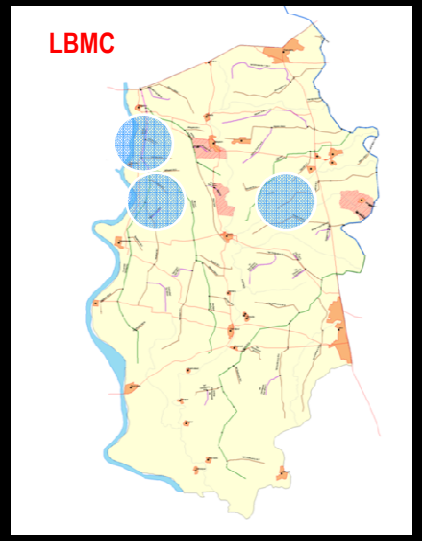
- **% physical progress**
- **Critical gap areas**
- **Irrig.potential created**

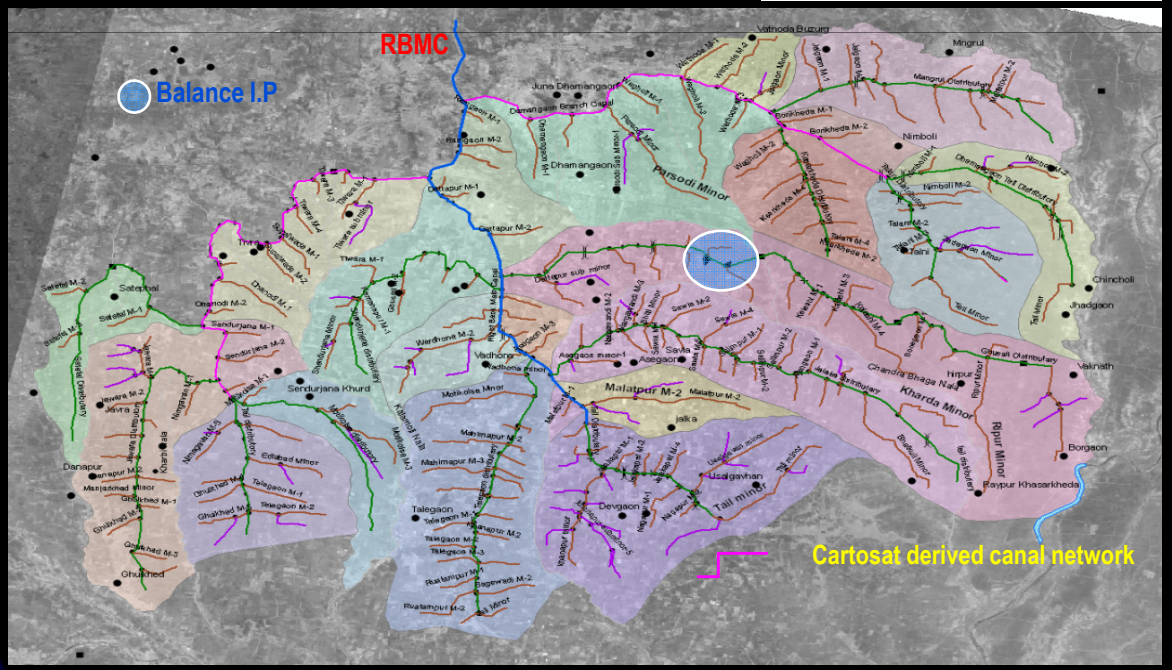
Assessment of Irrigation Potential Created in AIBP funded irrigation Projects in India

Upperwardha Project, Maharashtra State









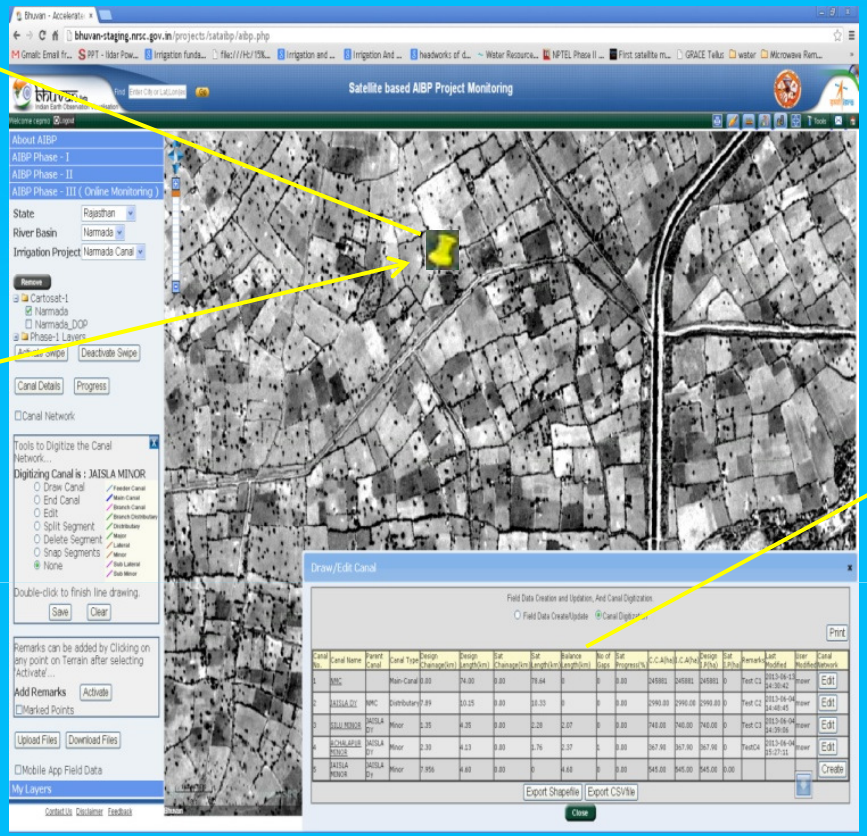
Satellite assessed Irrigation Potential created is slightly lower than field reported

Satellite based Online Monitoring of AIBP projects using BHUVAN Web services

Field photo

Internet

Posting of field photo / info through Mobile Application

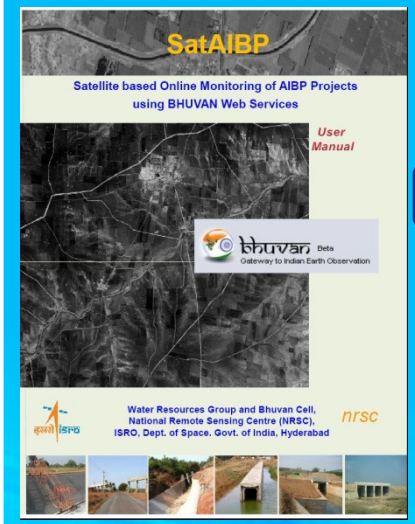


Posting of location specific comments

Sat Length(km)	Balance Length(km)	No of Gaps	Sat Progress(%)
78.64	0	0	0.00
10.33	0	0	0.00
2.28	2.07	0	0.00
1.76	2.37	1	0.00
0	4.60	0	0.00

Canal network status

Technical guidance by NRSC through online discussion forum



User Manual

Online Reporting of Physical and Financial progress

Physical Progress Financial Progress

PHYSICAL PROGRAMME OF AIBP COMPONENTS

S.No	Item of AIBP	Estimated Qt	Quantity Exe	Balance	Programme	Year	Q1-Progra	Q2-Progra	Q3-Progra	Q4-Progra	SpillOver
1	Item1	10	5	5	P1	2012-2013	2	1	1	1	5
2	item2	15	8	7	P2	2012-2013	5	2	3	2	5

Page 1 of 1 10 View 1 - 2 of 2

Physical Progress Financial Progress

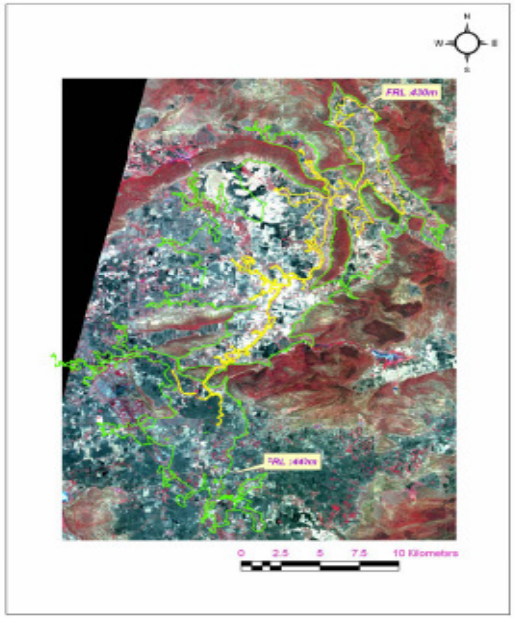
IAL PROGRAMME AND PROGRESS OF AIBP COMPONENTS

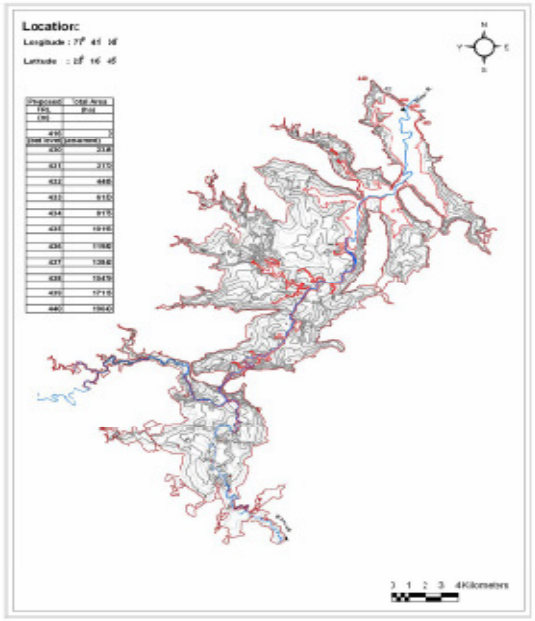
Item of AIBP	Latest Est. Q	Expenditure	Balance	Outlay	Year	Q1-Outlay(lal	Q1-Exp(lakh)	Q2-Outlay	Q2-Exp	Q3-Outlay	Q3-Exp	Q4-Outlay	Q4-Exp	Cum Exp(
Item1	5.00	8.00	6.00	4.00	2012-2013	10.00	5.00	2.00	5.00	5.00	5.00	5.00	5.00	20.00
Item2	9	6	3	17	2013-13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

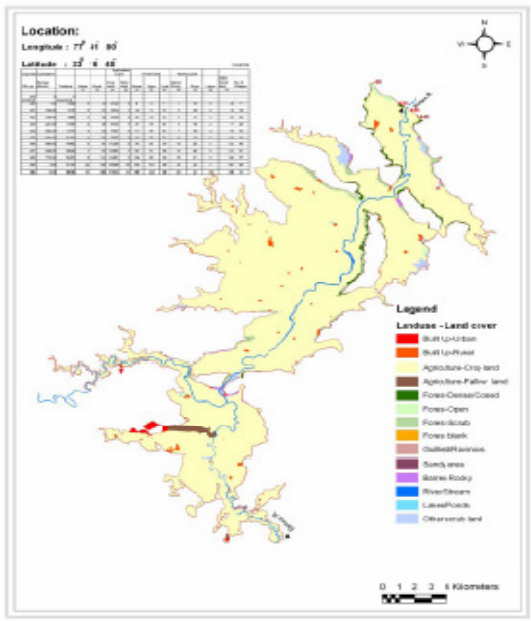
Page 1 of 1 10 View 1 - 2 of 2

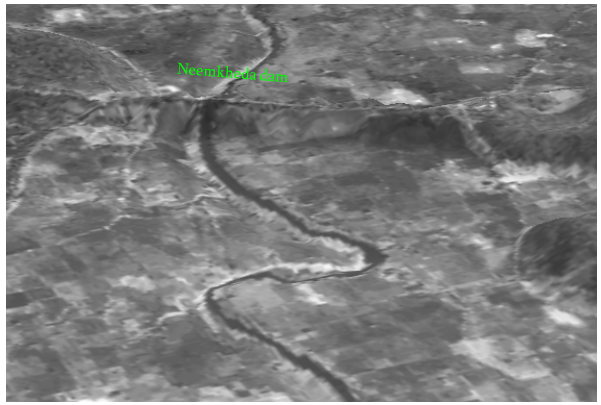
Neemkheda Dam - Submergence area analysis

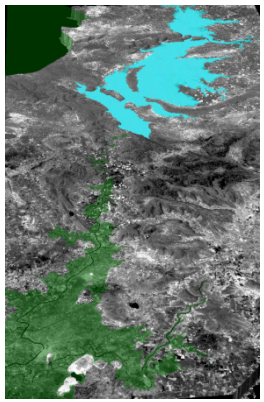
Location : 77 º 41’ 00” ; Latitude : 23 º 16’ 45”











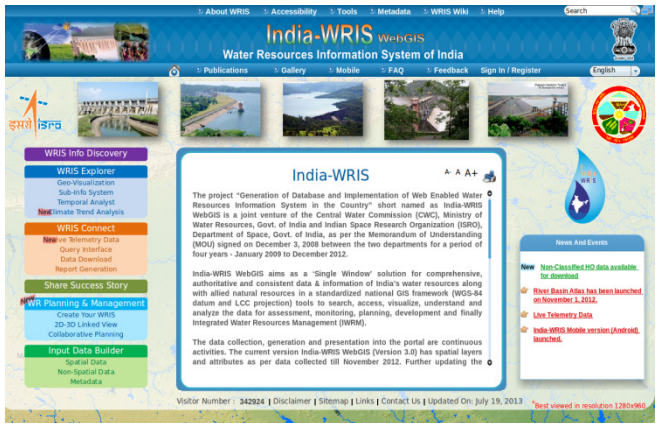
India-Water Resources Information System (India-WRIS)

"Generation of Database & Implementation of Web enabled Water Resources Information System in the Country (India-WRIS)"

A joint venture of NRSC/ISRO and CWC

A 'Single Window solution' for comprehensive, authoritative and consistent data & information of India's water resources in a standardized national GIS framework for planning, development and management of water resources in the country.

GUI of India-WRIS V 4.0



http://www.india-wris.nrsc.gov.in

6 modules - WRIS Info Discovery, WRIS Explorer, WRIS Connect, Share Success Story, Water Resources Planning & Management and Input Data Builder

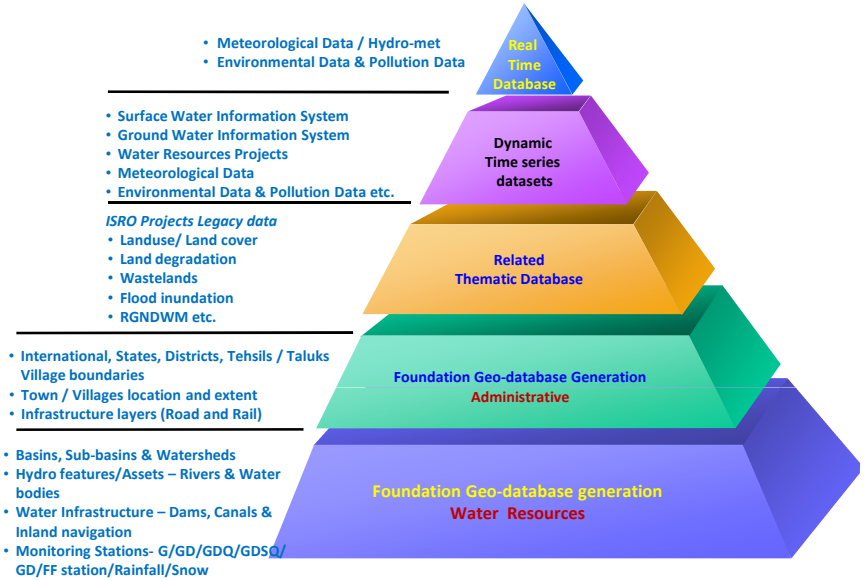
12 Main information systems and **36 Sub-information systems**

95 Spatial layers with more than **700 attributes, 5-100 years data**

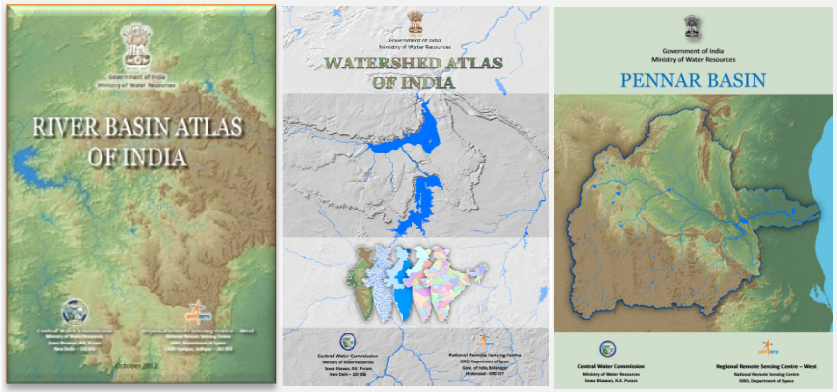
12 Main Information Systems

1. **Base Data Info Systems**
   1. Administrative
   2. Region
   3. Infrastructure
   4. Terrain
2. **Surface Water Info Systems**
   5. Water Resource Division
   6. Basin
   7. Watershed
   8. River
   9. Surface Water Body
   10. Water Resources Projects
   11. Command Area
   12. Minor Irrigation
   13. Canal
3. **Ground Water Info Systems**
   14. Aquifer / Litholog
   15. Ground Water Level
   16. Ground Water Potential (RSDWM)
4. **Hydro - Met Info Systems**
   17. Meteorological
   18. Climate
   19. Hydro - Observation
   20. Flood Forecasting
5. **Water Quality Info Systems**
   21. Surface Water Quality
   22. Ground Water Quality
6. **Snow Cover / Glacier Info Systems**
   23. Snow Cover / Glacier
7. **Inland Navigation Waterways Info Systems**
   24. Inland Navigation Waterways
8. **Inter - Basin Transfer Links Info Systems**
   25. Inter - Basin Transfer Links
9. **Hydro - Met Extremes**
   26. Flood
   27. Drought
   28. Extreme Events
10. **Land Resources Info Systems**
    29. Land Use / Land Cover
    30. Land Degradation
    31. Wasteland
    32. Soil
11. **Water Tourism Info Systems**
    33. Water Tourism
12. **Socio Economic Info Systems**
    34. Rural
    35. Urban

Data types & Designing information System



India-WRIS Publications



User Tracking Statistics

- Total **510552 hits** as on 12 June, 2014 across **147 countries**
- Per day **700 hits** on an average
- Total **15434 downloads** across 10 different sub-information systems as on 12 June, 2014

Thank You

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Major Information System and Sub-Info System

Main Information System – 12, Sub information System – 35, Layers – 95, and Attributes - > 4500, 5-100 years data

Sl. No.	Main & Sub Information System
I.	**BASE DATA INFO SYSTEM**
	1. Administrative Info System 2. Infrastructure Info System 3. Terrain (DEM) Info System 4. Region Info System
II.	**SURFACE WATER INFO SYSTEM**
	5. Water Resource Region Info System 6. Basin Info System 7. Watershed Info System 8. River Info System 9. Surface Water Body Info System 10. Water Resources Projects Info System 11. Command Area Info System 12. Minor Irrigation Info System 13. Canal Info System
III.	**GROUND WATER INFO SYSTEM**
	14. Aquifer / Litholog Info System 15. Ground Water Level Info System 16. Ground Water Potential Info System
IV.	**HYDRO – MET INFO SYSTEM**
	17. Meteorological Info System 18. Climate Info System 19. Hydro-Observation Info System 20. Flood-forecasting Info System
V.	**WATER QUALITY INFO SYSTEM**
	21. Surface Water Quality Info System 22. Ground Water Quality Info System

Sl. No.	Main & Sub Information System
VI.	**SNOW COVER / GLACIER INFO SYSTEM**
	23. Snow Cover/Glacier Info System
VII.	**INLAND NAVIGATION WATERWAYS INFO SYSTEM**
	24. Inland Navigation Waterways Info System
VIII.	**INTER-BASIN TRANSFER LINKS INFO SYSTEM**
	25. Inter-basin Transfer Links Info System
IX.	**HYDROLOGICAL EXTREMES INFO SYSTEM**
	26. Flood Info System 27. Drought Info System 28. Extreme Events Info System
X.	**LAND RESOURCES INFO SYSTEM**
	29. Land Use / Land Cover Info System 30. Land Degradation Info System 31. Wasteland Info System 32. Soil Info System
XI.	**WATER TOURISM INFO SYSTEM**
	33. Water Tourism Info System
XII.	**SOCIO – ECONOMIC INFO SYSTEM**
	34. Rural Info System 35. Urban Info System

Water Resources Assets of the Country

Spatial Layer Details	Number/ Area	No. of Attributes
WATER RESOURCES PROJECTS		
• No. of Major & Medium Irrigation Projects	1747	55
• No. of Lift irrigation Schemes	352	15
• No. of ERM Projects	131	50
• No. of Hydro Electric projects	222	17
• No. of Powerhouses	293	39
• No. of Dams	4575	34
• No. of Barrages/Weir/Anicuts	540	51
• No. of Reservoirs	4517	38
• Total Length of Canal	324600 km	3
• No. of Hydro-Structures	114709	6
• Waterlogged Areas in Major & Medium Command	17192.79 Sq.km	5
• Salt Affected Areas in Major & Medium Command	10345.41 Sq.km	5
• No. of Surface Water bodies	798909	5
• Area under Surface Water bodies	48379.89 Sq.km	-
• No. of Inter Basin Transfer Links	30	8
• No. of Inland Navigation Waterways	6 (4487 km)	15

ENVIRONMENTAL DATA		
• No. of Hydrological Observation Stations (CWC)	953	68
• No. of Surface Water Quality Stations (CWC)	419	2
• No. of Flood Forecasting Stations (CWC)	175	20
• No. of Meteorological Stations (CWC)	851	23

WATERSHED ATLAS	
• No. of Water Resource Regions	6
• No. of Basins	27
• No. of Sub-basins	101
• No. of Watersheds	4707
• Total Length of River (Line)	3617662 km
• Total Length of River (Polygon)	627726 km

ADMINISTRATIVE LAYERS	
• Total Length of Roads	2702136.38 km
• Total Length of Railway line	69023.46 km
• No. of Water Tourism locations	1328

India - WRIS WebGIS

A 'Single Window solution'
for comprehensive, authoritative and consistent data & information of India's water resources in a standardized national GIS framework for IWRM in the country.

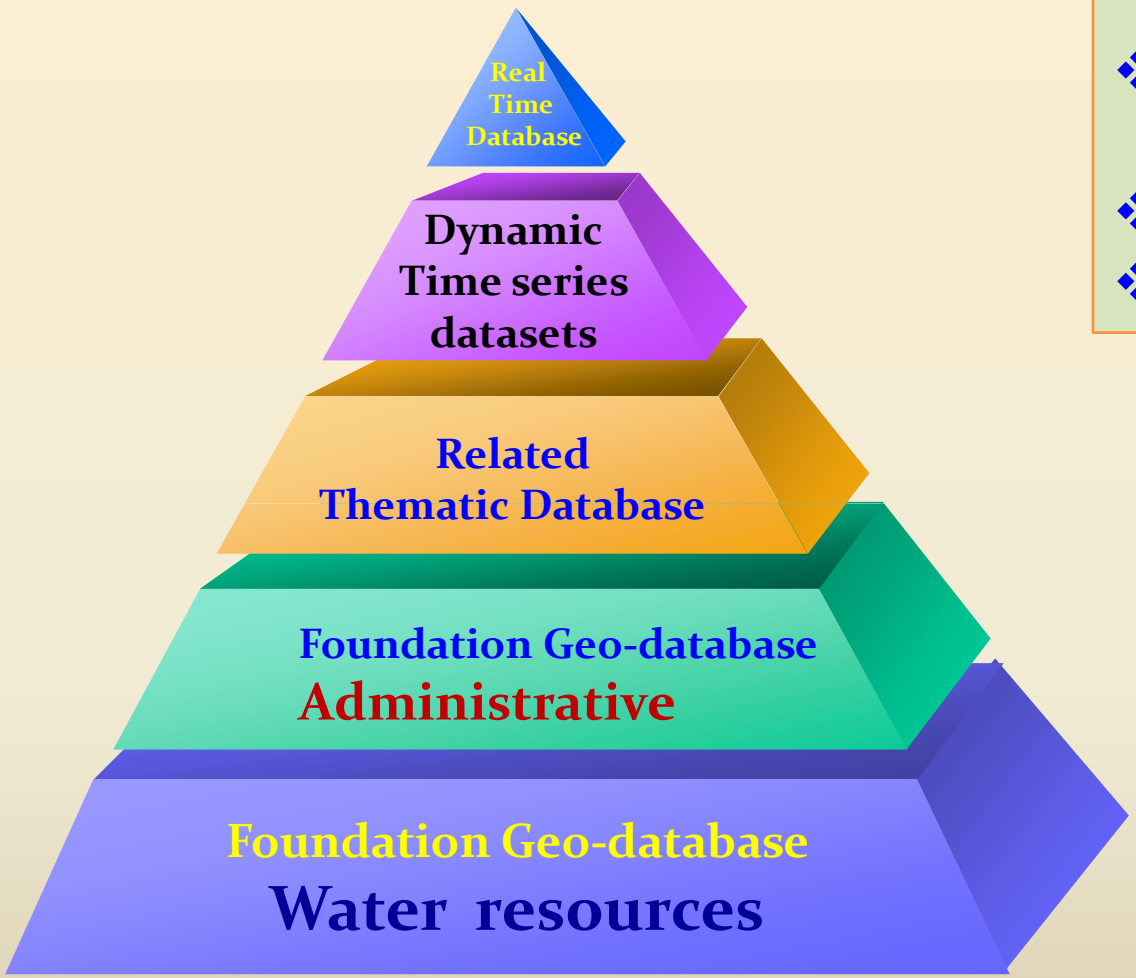
- **Accurate, adequate and contemporary information on the state of water resources is must in public domain for involvement in IWRM.**
- **Increasing public awareness elevates the importance of water information & enlightened public involvement in water management / decisions**

Project duration & cost : 5 years & Rs. 783.2 Million
Website & WebGIS Portal Launch in Public domain
India-WRIS WebGIS Version 1.0 launch - 7th December, 2010 & Version 4.0 launch - 19th January, 2014

Total Visits: 653,840
Visitors from India: 5,82,326
Visitors from other countries : 71,514
Total Downloads: 20,192
153 countries

http://www.india-wris.nrsc.gov.in/

Data types & Designing information system



Features of the Portal:

- Web portal for all sections of society
- Map policy, data policy, and CWC guidelines
- Scalable database
- Mobile Version

System has three categories of users and datasets:

- All General users
- Premium users
- CWC Intranet users

Data collection, standardization & organization

- More than 332,000 Softcopy files in different formats
- More than 5160 Hard copy reports