USING THE SOFTWARE OF ENVIRONMENTAL MANUAL AND GEOGRAPHIC INFORMATION SYSTEM FOR GREEN HOUSE GAS EMISSION AND ENVIRONMENTAL POLLUTION ABATEMENT

By
Tran Minh Y

Head, Dept. of Remote Sensing Technology,GIS, GPS

Space Technology Institute, VAST

Graz, 11-14/ 9 /2007

Purposes:

- To build database for environmental monitoring and management

- To carry out different analysis by mathematical modelling of spatial (in geographic information system software) and non-spatial (by environmental manual software) objects for climate change friendly, environmental pollution and green house gas emission abatement

Database for GHG inventory in Quang Ninh by GIS

- ***Energy***: database consist the follow fields: types, production or consumption, amount of GHG emission, forecast for year 2010
- ***Industry***: with some sectors give big amount of GHG emission as cement production and other construction material production. The data fields are: production, coal utilization amount, GHG emission, forecast for 2010
- ***Agriculture***: fields of data are: object, production, GHG emission
- ***Land use and forestry***: database consists of the fields of land use type, wood potential. The GHG emission present for forest clearing, CO2 originated from biomass growth and the total number of GHG emission
- ***Discharge***: there are 2 tables: table of GHG emission from household waste (Tab. 8) with fields: population, amount of waste, GHG emission; Other table is industrial waste (Tab. 9) with fields: types for productions, product, waste from production and GHG emission estimated.

Energy

Cod	Form	Types	1996 (tons)	Total CO_2 emission(Gg)
1.1	Energy	Petrol (Kt)	22.798	
1.2	Energy	Diesel and Mazut	128.81	
1.3	Energy	Gasoline	0.88	
1.4	Energy	Oil and grease	0.486	
1.5	Energy	LPG(Kt)	0.200	
1.6	Energy	Mineral pitch	1.048	
1		*General*		446.6
2.1	Energy	Fuel for residential purpose	296.698	509
3.1	Energy	Coal exploitation	8711.125	2104.4
3.2	Energy	Coal utilization	366.802	758

Industry

Type	Product (tons)	CO_2 emission amount (Gg)
Cement	5200	2.59
$CaCO_3$	34500	25.94

Source: Dept. of Industry in Quang Ninh

Agriculture

No	TYPES	UNITS	PRODUCT_96	GHG_EMISION_96 (Gg CH4)
I	Livestock breeding			
1	Pack of pigs	con	237516	1.42
1	Sows	con	16259	
2	Pack of buffalo	con	72944	0.15
3	Poultry	con	1599000	0.37
II-1	Area of paddy	Ha	45512	
II-2	Area of possible flooding due to rain	Ha	4000	28.22
II-3	Other area	Ha	70000	27.26
II-4	Regular flooding area	Ha	7000	14.12
II-5	Area of 50-100cm depth	Ha	5000	
	Savan Area	Ha	203900	CH_4: 0.219, CO: 5.753 N_2O: 0.003 NO_X: 0.0097
II-6	Rice yield	Tons	120160	CH_4: 0.2190
II-7	Yield of cereal crop	Tons	4938	CO: 5.753
	Yield of sweet potatoes	Tons	48300	N_2O: 0.003
II-8	Area of cereal cultivated	Ha	2723	NO_X:0.102
	Capacity	Tons/Ha	18	
	Area of sweet potato	Ha	8375	
	Capacity	Tons/Ha	58	
II-9	- Fertilize - K	Tons	6500	
	- Fertilize - N	Tons	10000	N2O:0.0166
	Excrement	Tons	200000	N2O: 0.0033

Source: Dept. of Agriculture and Rural Development

Land use and forestry

Type	CO_2	CH_4	CO	N_2O	NO_X
Amount of emission gas from deforestation (Gg)	564.113	0.65	5.2695	0.0447	1.05
CO_2 absorb amount by land of secondary forest (Gg)	-609.299				
CO_2 absorb by biomass growth (Gg)	-944.95				
Total amount of CO_2 emission (Gg)	-980,744				

Discharge

Districts	Population	Estimated Amount of refuse collected (Tons/year)	CH4 emission from solid waste (Gg)	Domestic waste water (liter/person /day)	Amount of CH4 emission from waste water (Gg)
HA LONG CITY	148601	12500	0.34	156	0.0279
CAM PHA	139384	7020	0.19	154	0.0209
UONG BI	86437	4300	0.11	126	0.0118
DONG TRIEU	23120	2970	0.08	96	0.0129
QUANG HA	72246	1740	0.06		
YEN HUNG	50611	1830	0.05	96	0.0117

	Total output (tons/year)	Water demand(millions liter)	Total amount of water (millions litter /year)	Amount of CH4 emission (Gg)
Beer	8000	60000	480.00	0.296
Fish Source	1596	15000	23.94	0.002
Margarine	6240	5000	31.20	0.011
Paper Production	500	340000	170.00	0.012
Slaughter of cattle	31440	5000	157.20	0.055

Using Environmental Manuel software for GHG abatement technologies selection

Three major aspects: (due to limitations of the database and existing process model of the software)

- Green house gas emission abatement technologies in the field of electricity utilization (with the application of Demand Side Management Technology (DSM)
- Improvement of fire - wood stoves
- Cement Production field

To build scenario in the field of electricity utilization with the application of DSM technology

According to the General Scheme of EVN for Vietnam electricity development, in the field of thermal power plants, during the period of 2000 -2010, Quang Ninh - based coal fired power plants are:

- **Uong Bi power plants**

Capacity: 110MW

Total efficiency: 25.4%

Operating time: 6250 hours per year

Material used: Vang Danh coal with heating capacity of 5050 kcal/kg

- **Uong Bi 2**:

Installed capacity: 80 MW

Total efficiency: 37%

Operating time: 6250 hours per year

Is the extended medium steam turbine of Uong Bi 1

- **Uong Bi 3**:

Installed capacity: 300 MW

Total efficiency: 38%

Operating time: 6250 hours per year

Grid Electrical power generated: 1.8 GWh

Self - use electrical power: 7.8%

Technology: Coal - steam turbine with electrostatic dust filter and sub – dry, desulfulization system FGD, limestone – used, efficiency: 70%

Investment capital: 270 millions USD

Three Uong Bi plants use Vang Danh coal.

- **Oxbow** (Quang Ninh) thermal power plant:

Installed capacity: phase 1(2005): 300MW; phase 2(2010): 600MW

Operating time: 6000hours/year

Total efficiency: 37.2%

Technology: Boiling system ACFB with electrical static dust filter EST and desulfulization FGD using limestone, efficiency 70%; open circulation - cooling system

Fuel for combustion: coal with low HHV of 3990 kcal/kg

Capital investment: 350 millions USD

Optional green house gas emission abatement technologies:

According to studies conducted by Energy Institute and Halger Bally Consulting Company, the most advantage technology is DSM one (which is calculated by top - down model of IPCC and UNEP). Using EM bottom - up model, we select three following technological types for approaching:

- Residential light
- Residential refrigerator
- Installation of new TOU

The whole mechanism of the program, estimated about 30% of the total value is belonged to coal fired power plants in Quang Ninh (in comparison with national thermal power plant).

In the field of residential lighting:

- Increase the number of fluorescent lamp. Planned technology: mostly fluorescent lamp (80 %), 20 % of which is 40W - lamp, and the rest: 20W

To increase the efficiency of residential refrigerator:

- In base scenario: 120W, 150 litter, 14 hour - per - day model; Measure to implement: improvement of compressor and increase insulation strength; projected effect: 15% energy conservation; added cost: 35 USD per unit.

For the installation of new TOU:

- The program will be applied for industrial or service - commerce bases, low monthly peak demand of which is from 65 - 75 kWh). Recommend technology: new TOU, which can measure power factor as well as measure simultaneously two figures - maximum capacity demand (kW) and electricity consumption in different daily time periods. Projected effect: through penalty (or bonus) for power factor transferred electricity price, electricity loss can be reduced by 180 KWh/year and 6% conservation of the total peak demand due to the installation of TOU.

The scenario put in EM model (for the year 2005 and 2010) can be divided into three levels for making comparison:

- Base scenario, which includes coal fired power plants should be built up as Master Plan of EVN, without DSM effect
- Improved Scenario with DSM effect on residential light and refrigerator, and the installation of new TOU
- Very improved scenario with DSM effect and entirely installation of new TOU.

The application of DSM technology in the field of electrical energy use enables us to abate a considerable green house gas emission, and much more significant reduction in SO2 emission as shown in the graph and calculation results.

- In base scenario, to assure consumption demand for electricity, plants must operate at full capacity, even exceed designed capacity.

- In improved scenario, power plants operating at designed capacity can meet energy demand with the application of DSM technology mainly in the field of lighting and residential refrigerators (for the year 2005) and partly installations of new TOU (for the year 2010). The amount of green house gas emission reduce from 6490 Gg of CO2 equivalent to 5982 Gg (for the year 2000) and from 8042 Gg to 7054 Gg (for the year 2010).

- In very improved scenario, wholly installation of new TOU, together with replacement of light and the increase in residential refrigerator capacity show a significant change. The amount of CO2 equivalent declines from 6490 Gg to 5452 Gg (by the year 2005) and 8042 Gg to 6685 Gg (by the year 2010). Another highlight point in the scenario is the entirely use of DSM technology, especially the installation of new TOU, thus the peak load power reached can meet energy demand and temporaly stop one steam turbine - Uong Bi 2.

These improvements lead to a remarkable abatement of air pollution of SO2 and CO2 as mentioned above, resulted from overloaded operation of those plants.

Scenario of GHG mitigation by DSM technology

Year 2010
Project: C:\EM11\DATA\vietnam
1/23/99 4:59:44 AM
Definition of Scenario Options

1. Option :	Base					
Electrical demand		1090.00		MW	24400.00	TJ
Supply processes						
# Process	power el. total	power th. total	operating time			
1 coal-ST-Oxbow2		300.00	MW		6017.78	h/a
1 coal-ST-Oxbow2		300.00	MW		6000.00	h/a
1 coal-ST-Uong_Bi_3-QN	300.00	MW			6250.00	h/a
1 coal-ST-Uong-Bi-2		80.00	MW		6250.00	h/a
1 coal-ST-Uong Bi-QN-VN	110.00	MW			7249.50	h/a
Demand and supply are balanced.						

2. Option :	Improved					
Electrical demand		1090.00		MW	24400.00	TJ
Supply processes						
# Process	power el. total	power th. total	operating time			
1 DSM-TOU-VN		70.00	MW		5000.00	h/a
1 DSM-Residential-light		40.00	MW		3000.00	h/a
1 coal-ST-Oxbow2		300.00	MW		4451.11	h/a
1 coal-ST-Oxbow2		300.00	MW		6000.00	h/a
1 coal-ST-Uong_Bi_3-QN	300.00	MW			6250.00	h/a
1 coal-ST-Uong-Bi-2		80.00	MW		6250.00	h/a
1 coal-ST-Uong Bi-QN-VN	110.00	MW			7249.50	h/a
Demand and supply are balanced.						

3. Option :	Very improved					
Electrical demand		1090.00		MW	24400.00	TJ
Supply processes						
# Process	power el. total	power th. total	operating time			
1 DSM-TOU-VN		70.00	MW		5000.00	h/a
1 DSM-TOU-VN		70.00	MW		6330.23	h/a
1 DSM-Residential-light		40.00	MW		3000.00	h/a
1 DSM-Refrigeration-Reside :	5.00	MW			5110.00	h/a
1 coal-ST-Oxbow2		300.00	MW		6000.00	h/a
1 coal-ST-Oxbow2		300.00	MW		6000.00	h/a
1 coal-ST-Uong_Bi_3-QN	300.00	MW			6250.00	h/a
1 coal-ST-Uong Bi-QN-VN	110.00	MW			3310.11	h/a

Air emissions

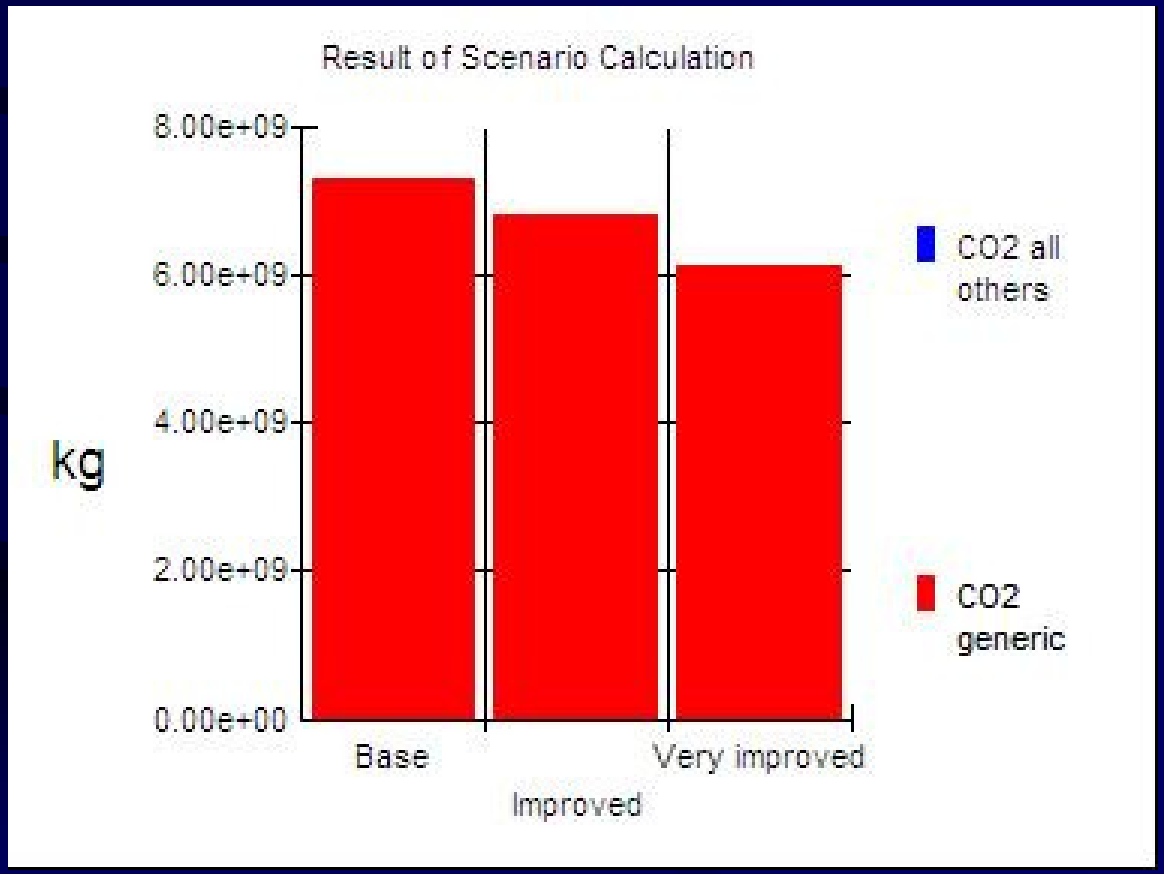
Pollutant [kg]

No	Scenario Option	SO2	NOx	HCl	HF	SO2-Equivalent
Only the processes of special interest :				generic		
1	Base	1.861E+7	2.932E+7	59941.89	5971.81	3.909E+7
2	Improved	1.821E+7	2.730E+7	56101.99	5579.77	3.728E+7
3	Very improved	9.619E+6	2.524E+7	45999.34	4567.22	2.724E+7
All other processes						
1	Base	0.00	0.00	0.00	0.00	0.00
2	Improved	0.00	0.00	0.00	0.00	0.00
3	Very improved	0.00	0.00	0.00	0.00	0.00
Total						
1	Base	1.861E+7	2.932E+7	59941.89	5971.81	3.909E+7
2	Improved	1.821E+7	2.730E+7	56101.99	5579.77	3.728E+7
3	Very improved	9.619E+6	2.524E+7	45999.34	4567.22	2.724E+7

Air emissions

		Pollutant [kg]				
No	Scenario Option	Particulates	CO	NMVOC	H2S	NH3
Only the processes of special interest : generic						
1	Base	5.072E+6	4.421E+6	5.103E+5	0.00	0.00
2	Improved	4.930E+6	4.154E+6	4.905E+5	0.00	0.00
3	Very improved	2.347E+6	3.619E+6	4.362E+5	0.00	0.00
All other processes						
1	Base	0.00	0.00	0.00	0.00	0.00
2	Improved	0.00	0.00	0.00	0.00	0.00
3	Very improved	0.00	0.00	0.00	0.00	0.00
Total						
1	Base	5.072E+6	4.421E+6	5.103E+5	0.00	0.00
2	Improved	4.930E+6	4.154E+6	4.905E+5	0.00	0.00
3	Very improved	2.347E+6	3.619E+6	4.362E+5	0.00	0.00

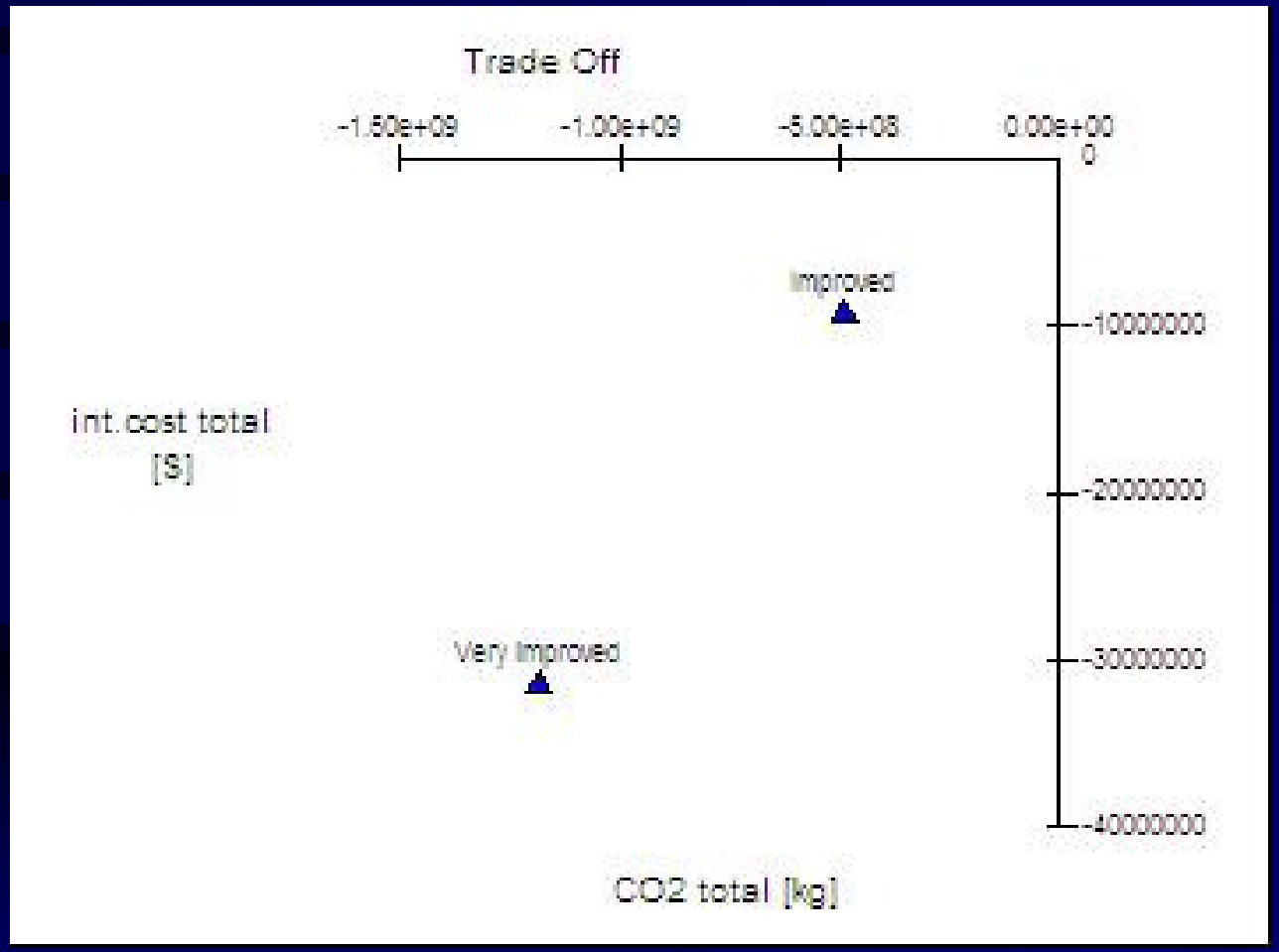
Amount of CO2 with application of DSM technology by year 2010



Investment costs: Results of calculation for base scenario is 758.6 millions; In improved scenario: 764 millions and in very improved: 650,4 millions. In terms of trade - off for CO2 emission, analysis figures for the year 2005 in EM software are 62.12 kg/USD in improved and 34.37 in very improved scenario respectively.

For the year 2010, investment cost for base scenario is 1119 millions USD, figures of improved and very improved are 1121 millions USD and 1011 millions USD respectively.

Trade off with application of DSM technology by 2010



To build comparative scenarios in the field of residential fire - wood stoves

The field surveys had been shown that, even living in coal - available areas, fire - wood and saw - dust stoves are still popular options due to low level of per capita income. These forms of cooking are not recommended in the future in order to prevent deforestation. However, we now consider some kinds of current wood fired stoves used in Vietnam, in comparison with those in other developed countries in order to reach full exploitation of refuse sources like sawdust or wood in low - income rural area of Vietnam.

In the rural area of Quang Ninh, the most popular form of stoves used is open 3 - feet stove, efficiency of which is quite low (8%), mostly not improved, except for some households' ones...

Scenario for EM of those can be grouped for following:

1. Open fired wood stove
2. Built up fired wood stove
3. Fired wood stove of developed countries

Scenario for stove-wood improvement in the “EM”

Definition of Scenario Options

1. Option : stove-wood

Thermal demand	0.00	MW	0.01	TJ

Supply processes

#	Process	power el. total	power th. total		operating time	
1	stove-wood		0.00	MW	744.72	h/a

Demand and supply are balanced.

2. Option : stove-wood-QN

Thermal demand	0.00	MW	0.01	TJ

Supply processes

#	Process	power el. total	power th. total		operating time	
1	stove-wood-QN		0.00	MW	899.97	h/a

Demand and supply are balanced.

3. Option : stove-wood-improved_QN

Thermal demand	0.00	MW	0.01	TJ

Supply processes

#	Process	power el. total	power th. total		operating time	
1	stove-wood-improved-QN		0.00	MW	899.97	h/a

Demand and supply are balanced

Air emissions

No	Scenario Option	Pollutant [kg] SO2	NOx	HCl	HF	SO2-Equivalent
Only the processes of special interest :			generic			
1	stove-wood	1.54	3.03	0.00	0.00	3.65
2	stove-wood-QN	2.88	5.68	0.01	0.00	6.84
3	stove-wood-improved_QN	1.54	3.03	0.00	0.00	3.65
All other processes						
1	stove-wood	0.00	0.00	0.00	0.00	0.00
2	stove-wood-QN	0.00	0.00	0.00	0.00	0.00
3	stove-wood-improved_QN	0.00	0.00	0.00	0.00	0.00
Total						
1	stove-wood	1.54	3.03	0.00	0.00	3.65
2	stove-wood-QN	2.88	5.68	0.01	0.00	6.84
3	stove-wood-improved_QN	1.54	3.03	0.00	0.00	3.65

Air emissions

		Pollutant [kg]				
No	Scenario Option	Particulates	CO	NMVOC	H2S	NH3
Only the processes of special interest :			generic			
1	stove-wood	14.33	10.27	1.24	0.00	0.00
2	stove-wood-QN	26.87	19.26	2.32	0.00	0.00
3	stove-wood-improved_QN	14.33	10.27	1.24	0.00	0.00
All other processes						
1	stove-wood	0.00	0.00	0.00	0.00	0.00
2	stove-wood-QN	0.00	0.00	0.00	0.00	0.00
3	stove-wood-improved_QN	0.00	0.00	0.00	0.00	0.00
Total						
1	stove-wood	14.33	10.27	1.24	0.00	0.00
2	stove-wood-QN	26.87	19.26	2.32	0.00	0.00
3	stove-wood-improved_QN	14.33	10.27	1.24	0.00	0.00

Database of cement production in EM model and optional Scenario

There is one cement production factory in Lam Thach - Quang Ninh, with capacity of 88000 tones per year, using sub - dry technology and Chinese kiln lines. Hoan Cau, Lang Bang1 and Lang Bang 2 plants at Hoanh Bo, each of which is 1.5 million tones per year by the year 2005 and 3 million by the year 2010, will be come to operation.

Thus, by the year 2010, according to production planning of material construction sector, figures put in database are as follows:

- Plant capacity: 1.5 millions
- Initial Investment: 230 millions USD

Scenarios are built in two different forms, one of which is scenario by years and the other is comparative scenario between central cement production technology and local cement production technology, in terms of emission level of toxic gases, green house gas and different other dischages. The analysis scenario present us the picture of emission gas from cement production in the future

Scenario of Cement production by years: 2000,2005,2010

Definition of Demand

1. Option : Cement TW QN 2010
Energy Demand
Processheat-cement\coal-TW2005-QN : 8.410E+6 MWh
Sum : 8.410E+6 MWh

2. Option : Cement TW QN 2005
Energy Demand
Processheat-cement\coal-TW2005-QN : 5.443E+6 MWh
Sum : 5.443E+6 MWh

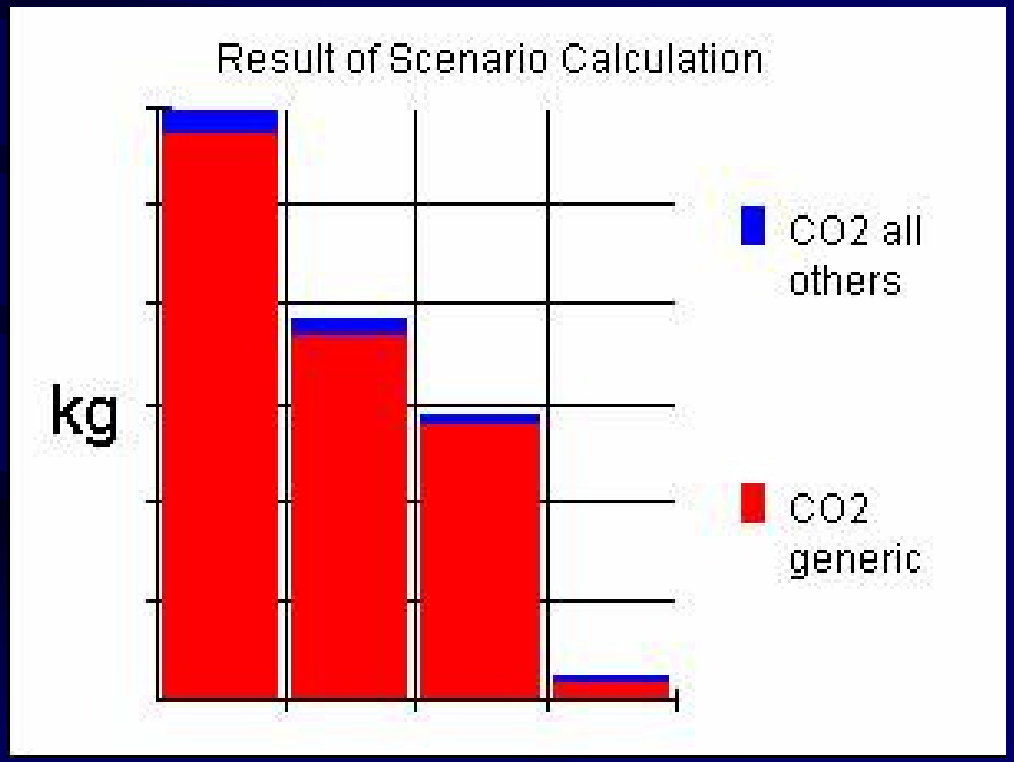
3. Option : Cement TW QN 2000
Energy Demand
Processheat-cement\coal-TWQN : 4.082E+6 MWh
Sum : 4.082E+6 MWh

4. Option : Cement DF QN 2000
Energy Demand
Processheat-cement\coal-QN : 2.947E+5 MWh
Sum : 2.947E+5 MWh

Air emissions

	Pollutant [kg]				
No Scenario Option	SO2	NOx	HCl	HF	SO2-Equivalent
Only the processes of special interest :		generic			
1 Cement TW QN 2010	1.227E+6	1.755E+7	0.00	0.00	1.345E+7
2 Cement TW QN 2005	7.943E+5	1.136E+7	0.00	0.00	8.702E+6
3 Cement TW QN 2000	5.957E+5	8.518E+6	0.00	0.00	6.526E+6
4 Cement DF QN 2000	43008.34	6.150E+5	0.00	0.00	4.712E+5
All other processes					
1 Cement TW QN 2010	2.350E+5	1.344E+5	9384.89	376.66	3.375E+5
2 Cement TW QN 2005	1.521E+5	87008.04	6073.71	243.77	2.184E+5
3 Cement TW QN 2000	1.141E+5	65258.24	4555.44	182.83	1.638E+5
4 Cement DF QN 2000	8235.69	4711.42	328.89	13.20	11826.08
Total					
1 Cement TW QN 2010	1.462E+6	1.768E+7	9384.90	376.66	1.378E+7
2 Cement TW QN 2005	9.463E+5	1.144E+7	6073.71	243.77	8.920E+6
3 Cement TW QN 2000	7.098E+5	8.583E+6	4555.44	182.83	6.690E+6
4 Cement DF QN 2000	51244.02	6.197E+5	328.89	13.20	4.830E+5

Graphic of GHG emission in the years 2010, 2005, 2000 and the last: local cement production



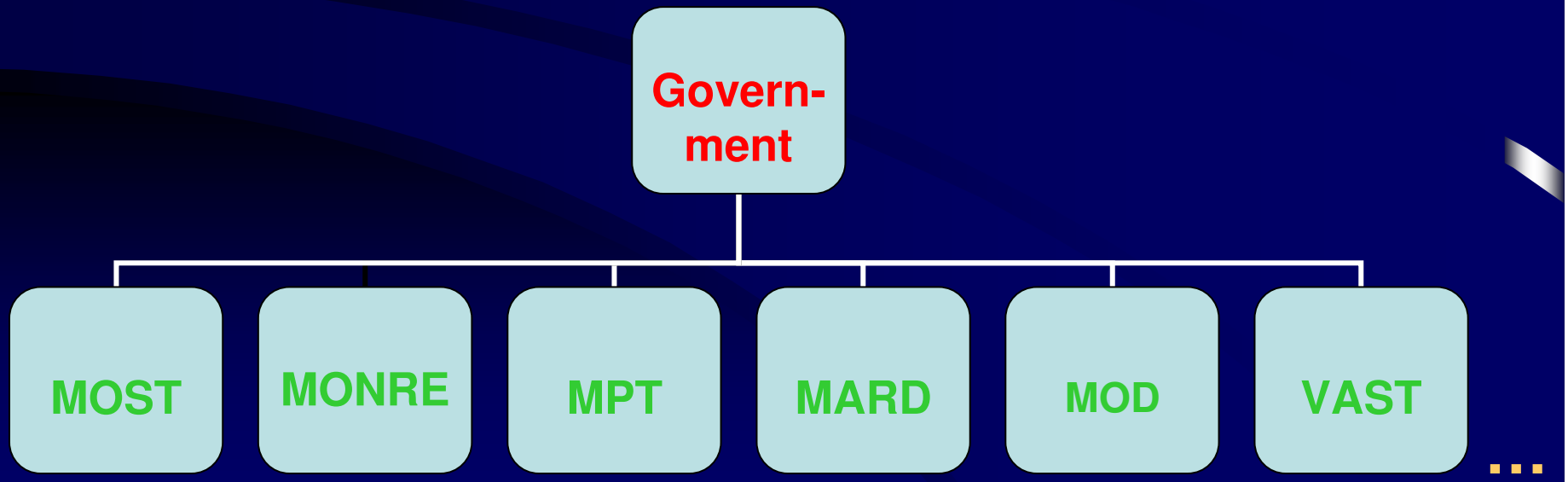
Space technology aproach for atmosphere monitoring and management

- In the recent years, Vietnamese government pays more attention to Space technology development: the investment had been given to many research laboratories for space technology in Vietnamese Academy of Science and technology (VAST).
- The Strategy for research and application of space technology until 2020 has been approved by the Prime Minister on June 14th 2006
- Space Technology Institute - VAST had been establish in Nov. 2006, and take a first place of responsibility on Space technology application in Vietnam as decision of the Government.

Chart of national organizational structure on space technology applications

The Government of Viet Nam consists of 26 ministries, and 13 organizations belonging to the Prime Ministry in which the following are much involved in space technology applications:

MOST – Ministry Of Science and Technology
MONRE- Ministry Of Natural Resources and Environment
MPT- Ministry of Post and Telecommunications
MARD- Ministry Agriculture and Rural Development
MOD – Ministry of Defence
VAST- Vietnamese Academy of Science and Technology



Functions of STI

- Research and development of Space Technology fields, aimed to expertise to build up small satellites (both in construction and management). Implementation of space technology in human life, provide other services in the field of space technology.

- Development of infrastructure for research and application of Space Technology: laboratories, earth observation satellite, ground station for satellite monitoring, management and respectively information receiving…

- Consultancy for government in the space technology development policy, basic legal for space application; play a role of main consultant agency to help National Space Research and Application Committee in Vietnam. Provide information about space technology development and application for different requirements of many production and service branches..

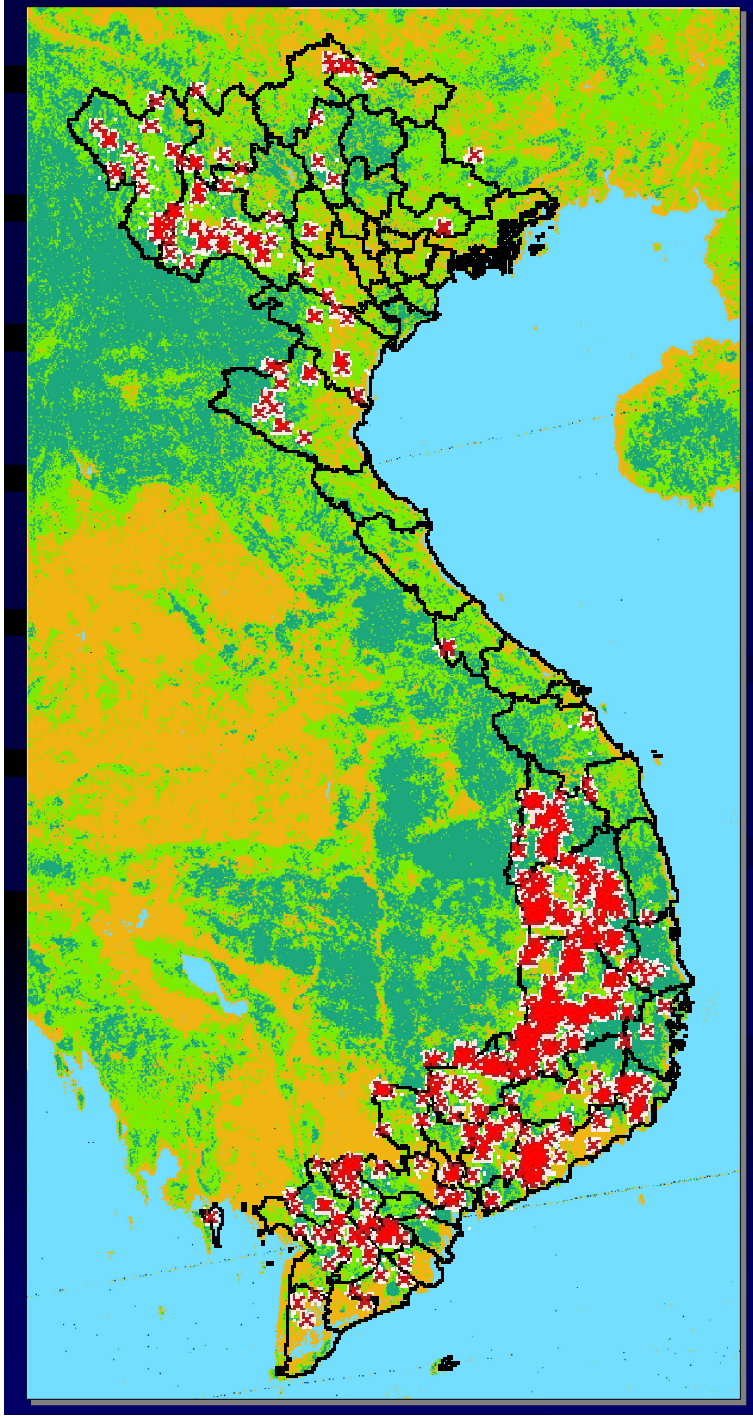
- Training for postgraduate programs, participate in education of graduate student in providing knowledges of space technology.

- International Relations development in the field of Space Sciences and technology

Major achievements

- Design and fabricate the high-resolution GMS/MT-SAT/FY2 satellite receiving system HRS-200.
- Use of remote sensing data for flood monitoring and mapping in Mekong River Delta and in the Central Part of Vietnam
- Use of satellite for forest fire forecasting.
- Analysis the influence of natural conditions to the distribution of rice cultivation in the Mekong River Delta using radar and optical image combining with GIS.
- Application of Satellite and GIS Data for change detection of Land-cover in coastal zone of Viet Nam.
- Application of Remote Sensing for study of landslide, soil erosion, drougth hazards …

FOREST FIRE MONITORING APPLICATION



NDVI and Forest Fire

•NDVI composite map, Feb-Mar, 2003. Composite using Fourier time series analysis

Fire points detected from Mar. 8 –19, 2003

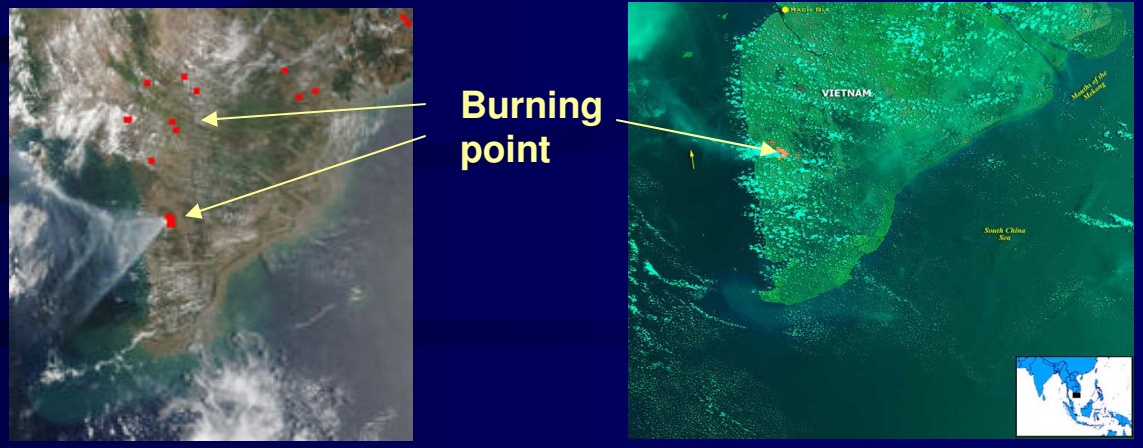
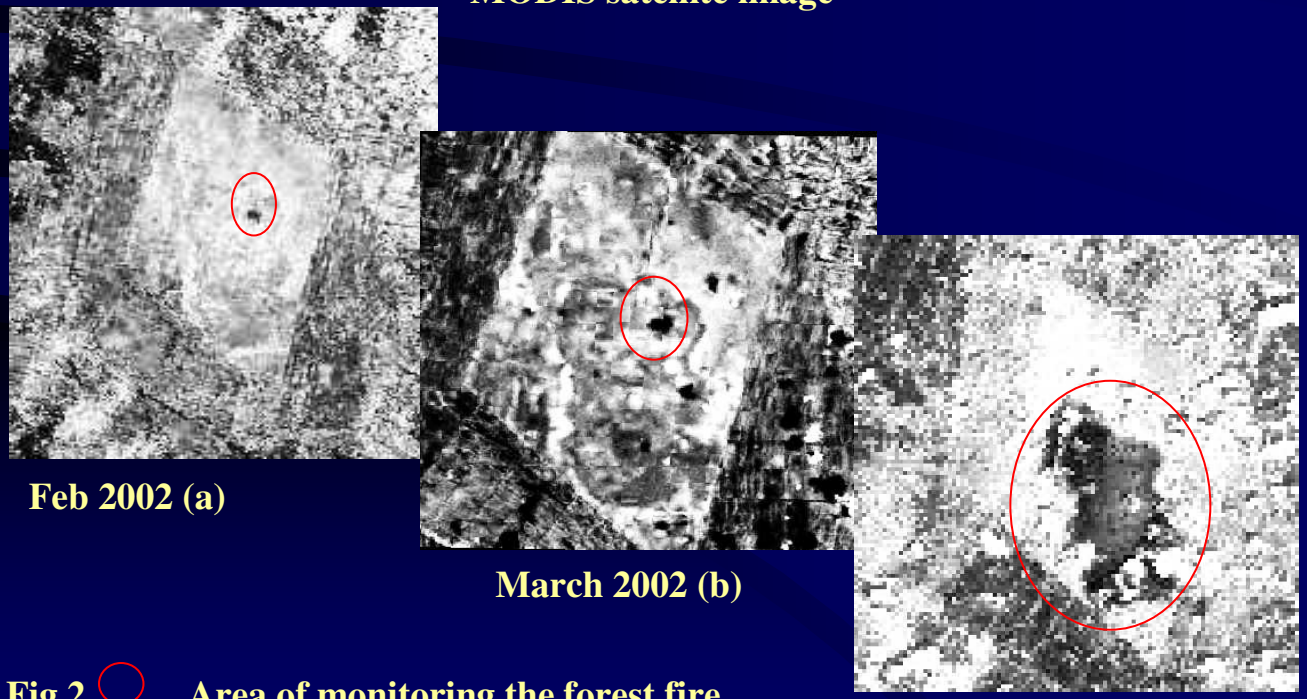


Fig 1. Fire detection in April 05th (a) and 18th (b) 2002 in the surrounding area of Uminh Thuong by MODIS satellite image



Feb 2002 (a)

March 2002 (b)

Sept 2002 (c)

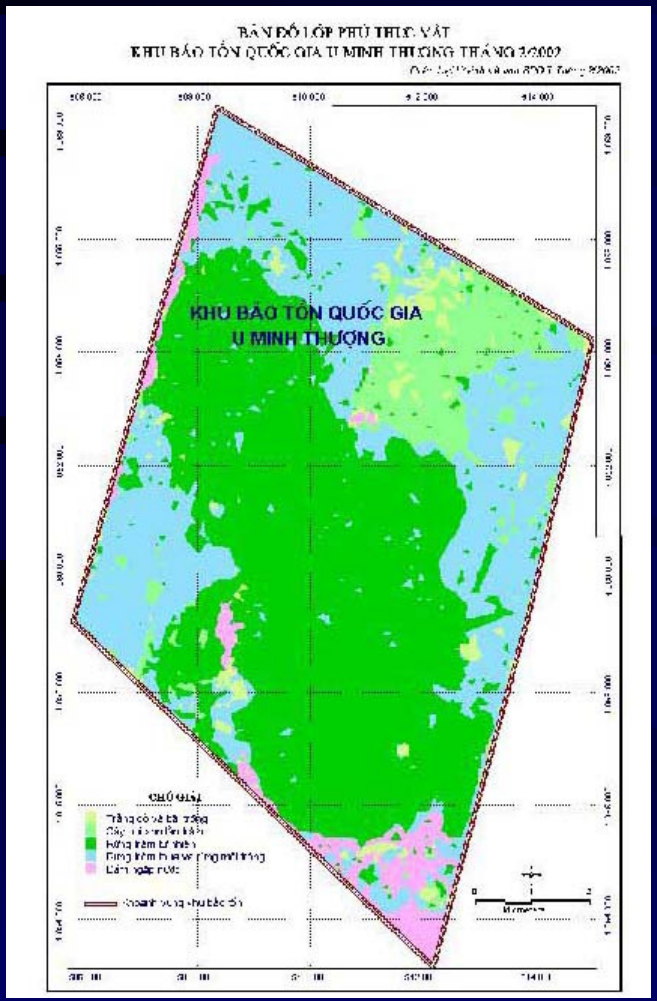
Fig 2. Area of monitoring the forest fire in the Uminh Thuong forest

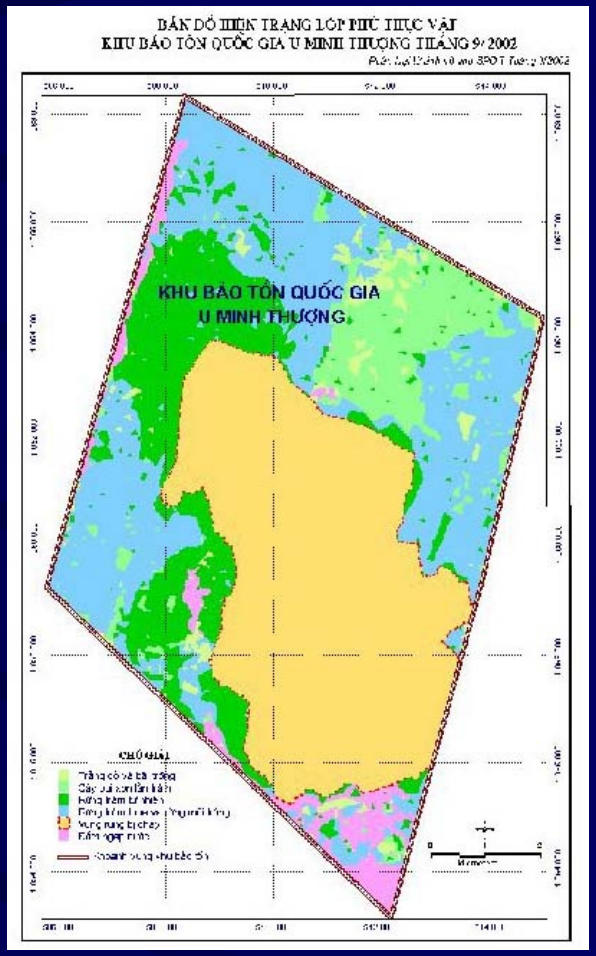
Forest fire at the National Park U Minh Thuong

SPOT image on 8/1/1995

SPOT image on 28/9/2002

Results of images processing





HABITAT	Area Burnt (ha)	%
Dense melaleuca forest	2551.94	32.1
Plantation melaleuca forest and scrubs	231.51	2.9
Swamp with grass	161.01	2.0
Paddy field	37.73	0.5

Drought disaster in Vietnam

Viet Nam lies in the tropical zone of the Northern-hemisphere, with a coastline of approximately 3,000km. The country is prone to almost all kinds of natural disasters, of which storms, floods and drought rank as the worst and most frequent

In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity

Types of drought

- ***Meteorological drought*** is usually associated with significant decrease in normal precipitation over an area and expressed solely on the basis of the degree of dryness (often in comparison to some normal or average amount) and the duration of the dry period.

- ***Hydrological drought*** refers to marked depletion of surface water (rivers, lakes, streams and reservoirs) and fall in water tables.

- ***Agricultural drought*** occurs when there is not enough soil moisture and rainfall inadequate to support crops

Establishing a drought monitoring system

In establishing a drought monitoring system, it should be based on simple information that non-technical observers can easily acquire and transmit, i.e., based on indicators. Among the normal indicators of the onset of a drought are:

- an unusual dry period;
- an increased number of wind storms;
- an increased number of dust storms (caused by loss of soil moisture);
- low air temperature and increased day time temperature;
- diminishing water supplies and reduced stream-flow conditions (lower reservoir level, surface water and ground water levels);
- an increase in the death rate of animals;
- changes in vegetation, especially the introduction of desert plants such as scrub brushes;
- unusual or unseasonal changes in the prevalence rates of specific communicable diseases associated with personal and environmental hygiene, indicating the diminished use of water for washing.
- In areas with a long history of drought occurrence, lower than normal precipitation can be taken as a potential drought sign.

Dry land in Vinh Phu province (North of Vietnam)

Space technology application for drought monitoring, assessment

Purpose:

- Identification of relationship between drought and vegetation cover.
- Drought assessment and recommendation for early warning system or measure for drought prevention.

Remote sensing data use:

- Mainly is LANDSAT-ETM for time period 2000 – 2003, practically:
- Nov. 2000; Jan. 2003; May 2003

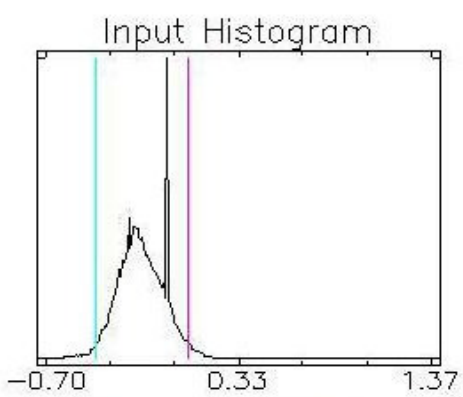
Other statistical data of time period 2000-2003 from Hydro-Meteo Service had been given: (as rainfall, temperature…)

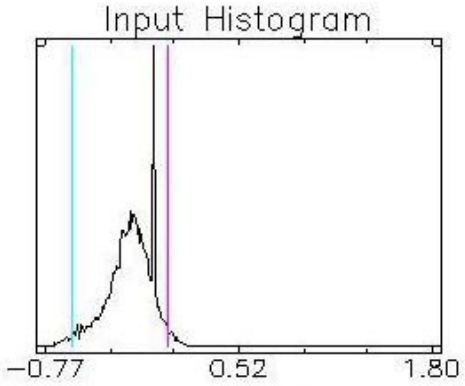
Rainfall: Nov. 2000: 8mm; Jan. 2003: 9mm; May 2003: 251mm

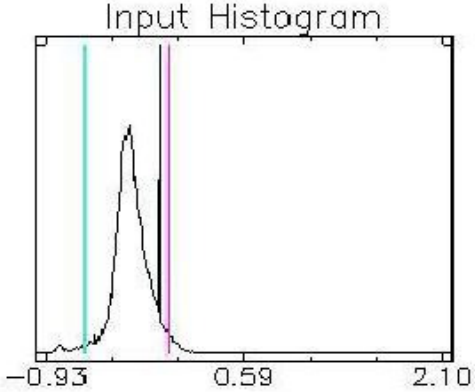
Temp. Nov.2000: 21,3oC; Jan. 2003:17,3oC; May 2003: 24,5oC

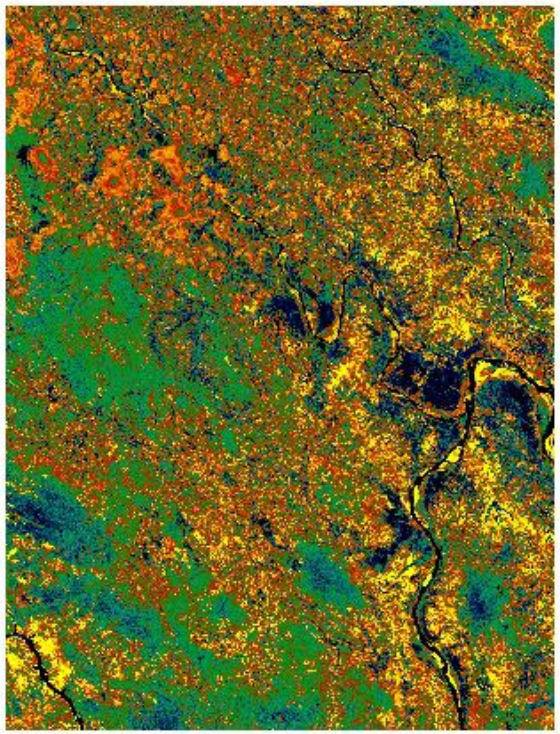
Normalised Difference Soil Index

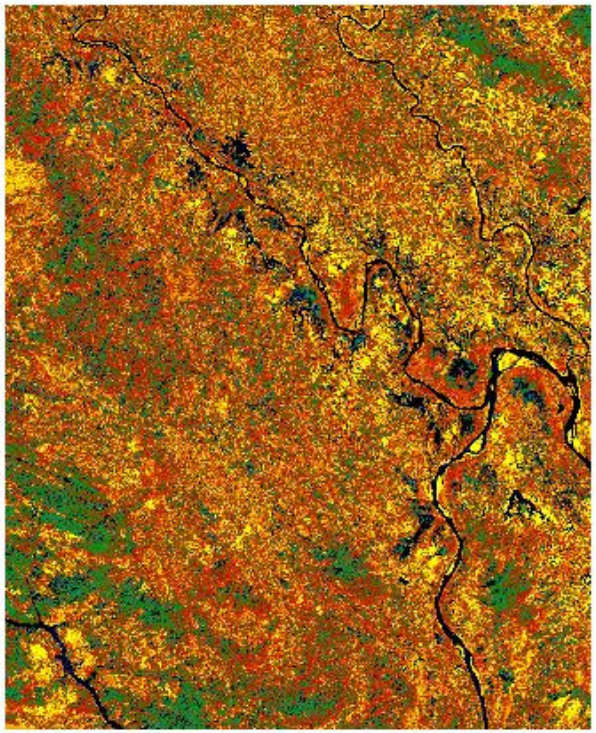
NDSI = SWIR – NIR / SWIR + NIR

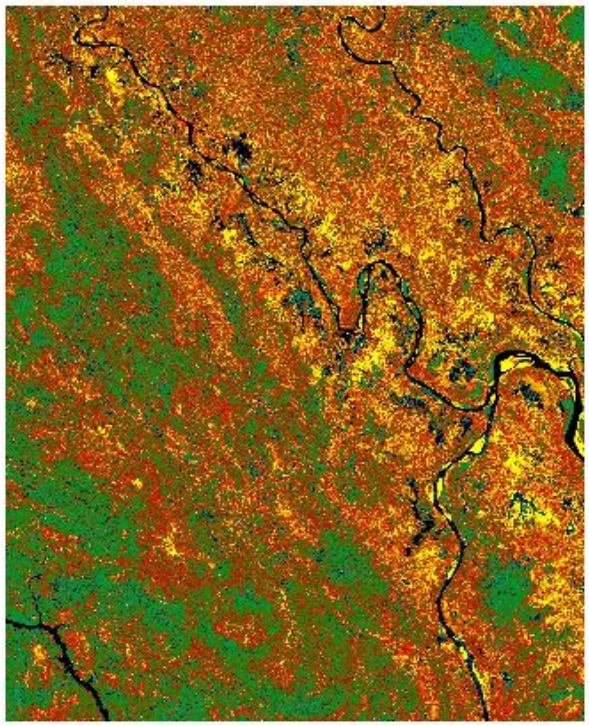






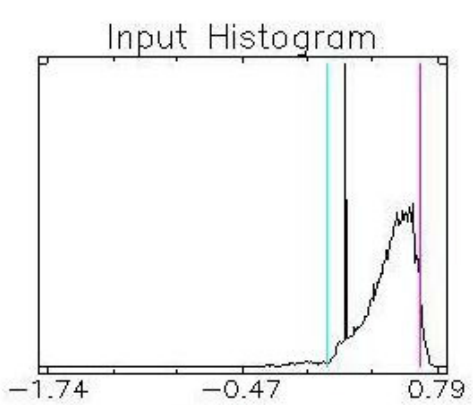


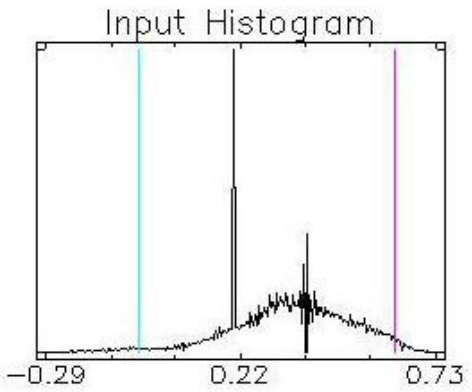


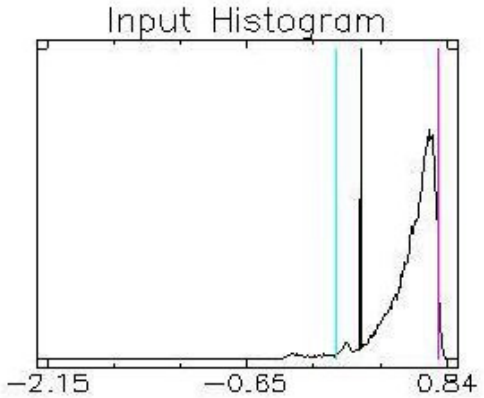


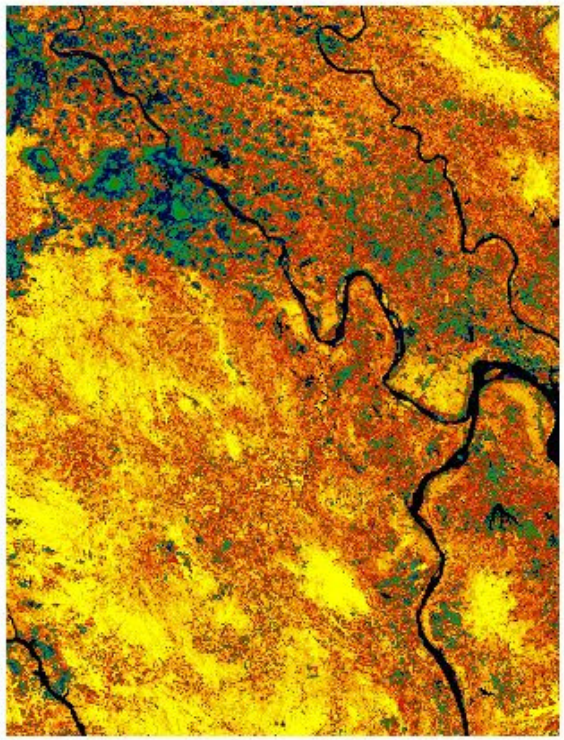
Normalised Difference Vegetation Index

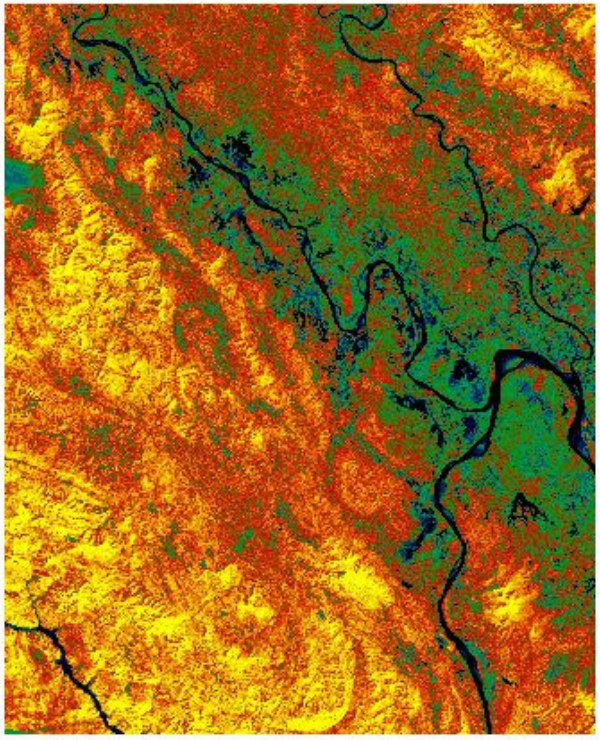
NDVI = NIR - RED / NIR + RED

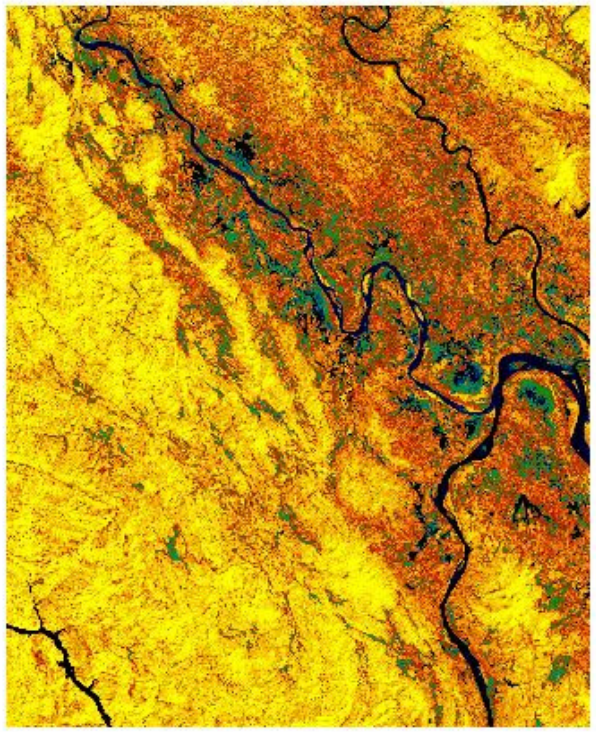






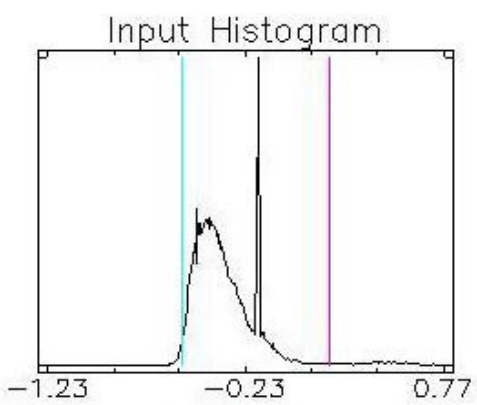


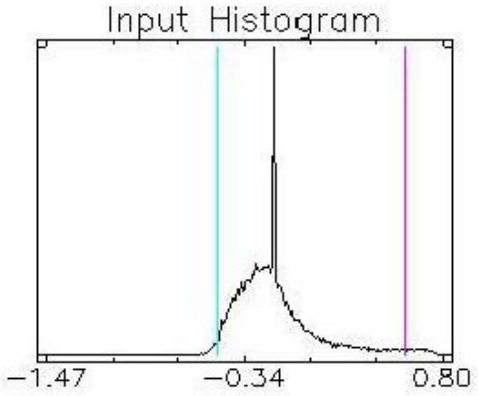


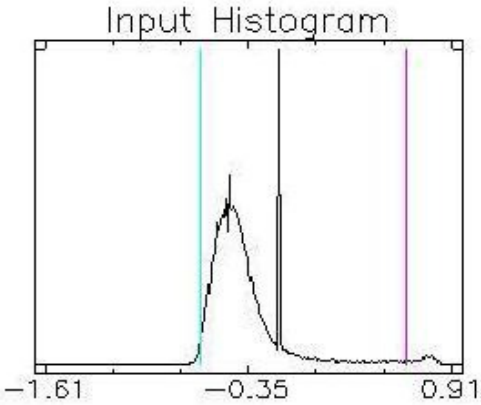


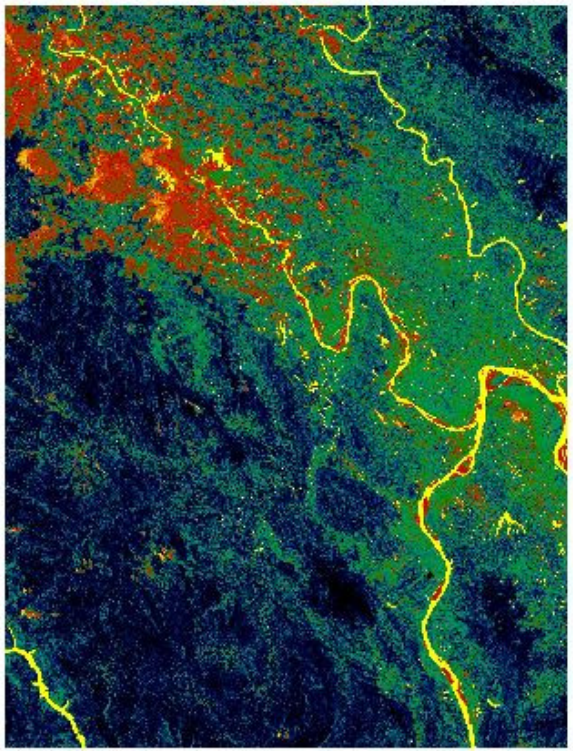
Normalised Difference Water Index

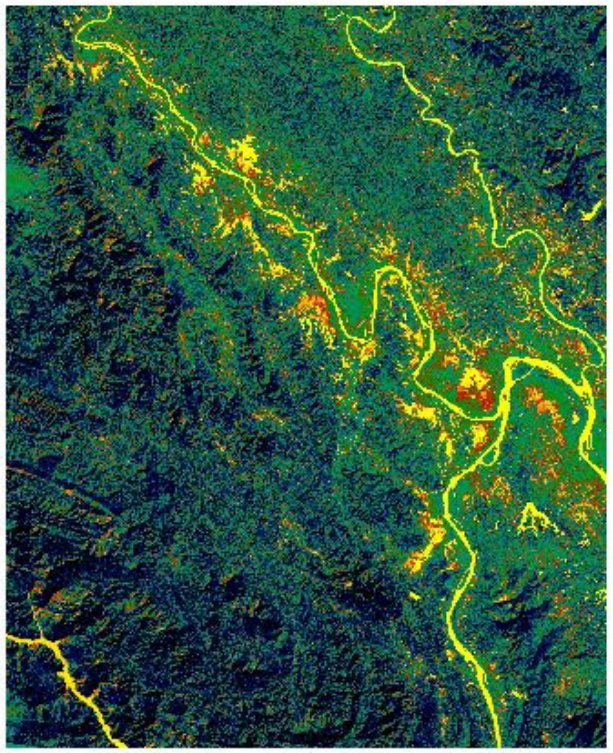
NDWI = RED - SWIR / RED + SWIR

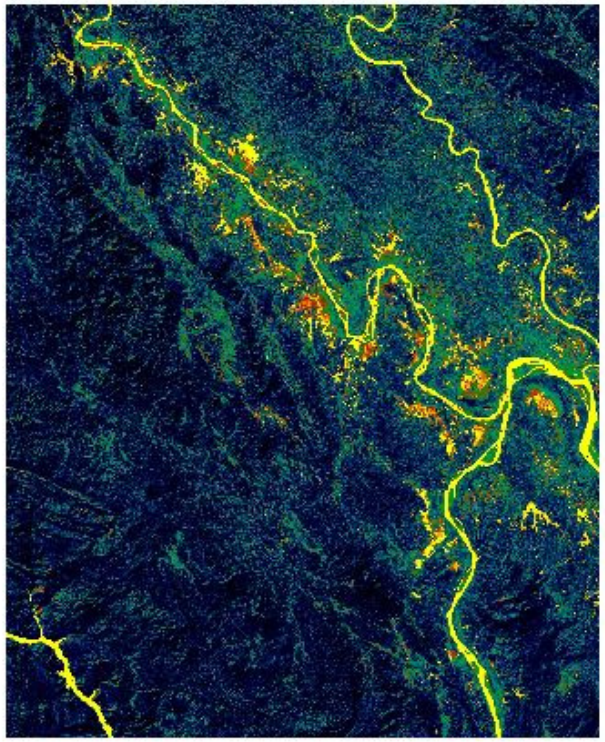






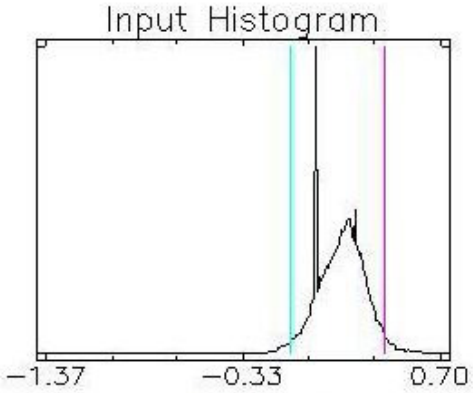


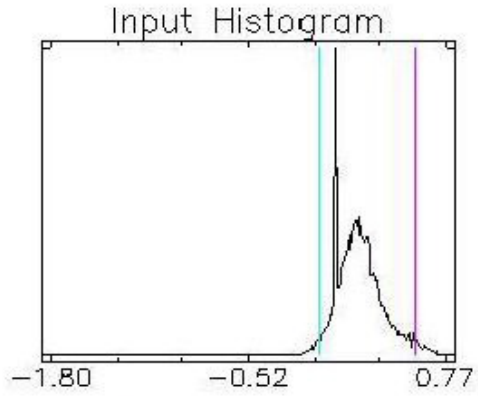


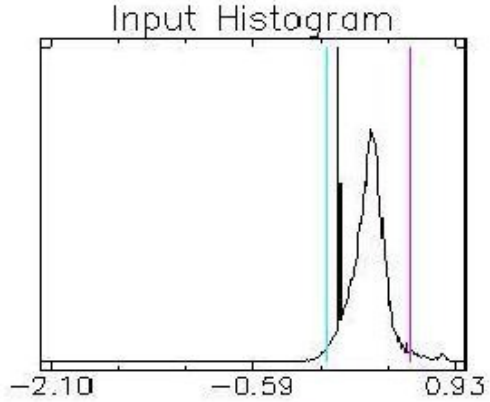


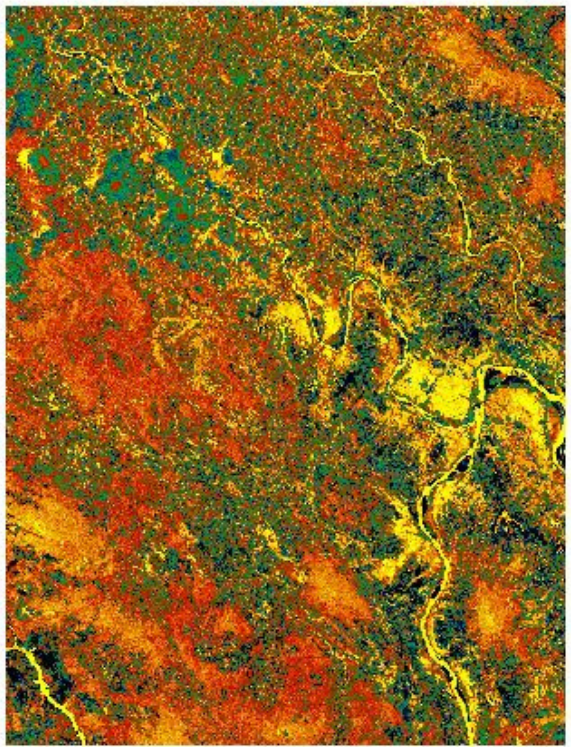
Normalised Difference Moisture Index

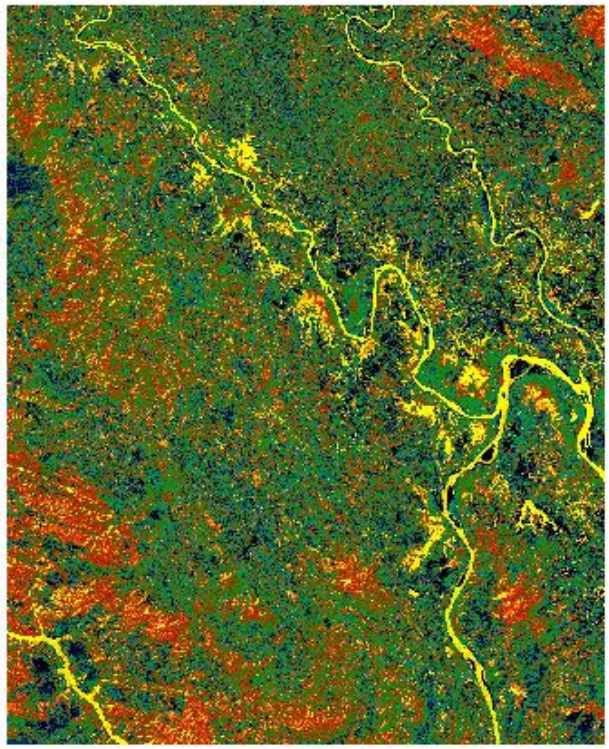
NDMI = NIR - SWIR / NIR + SWIR

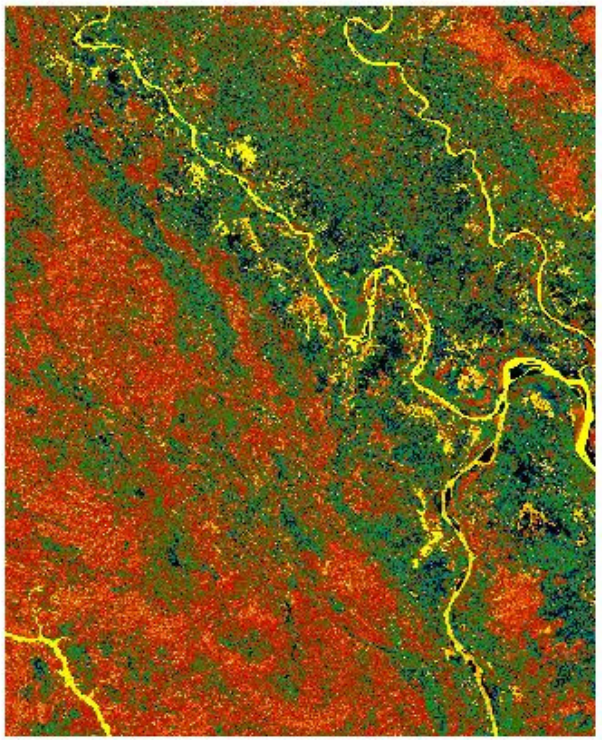




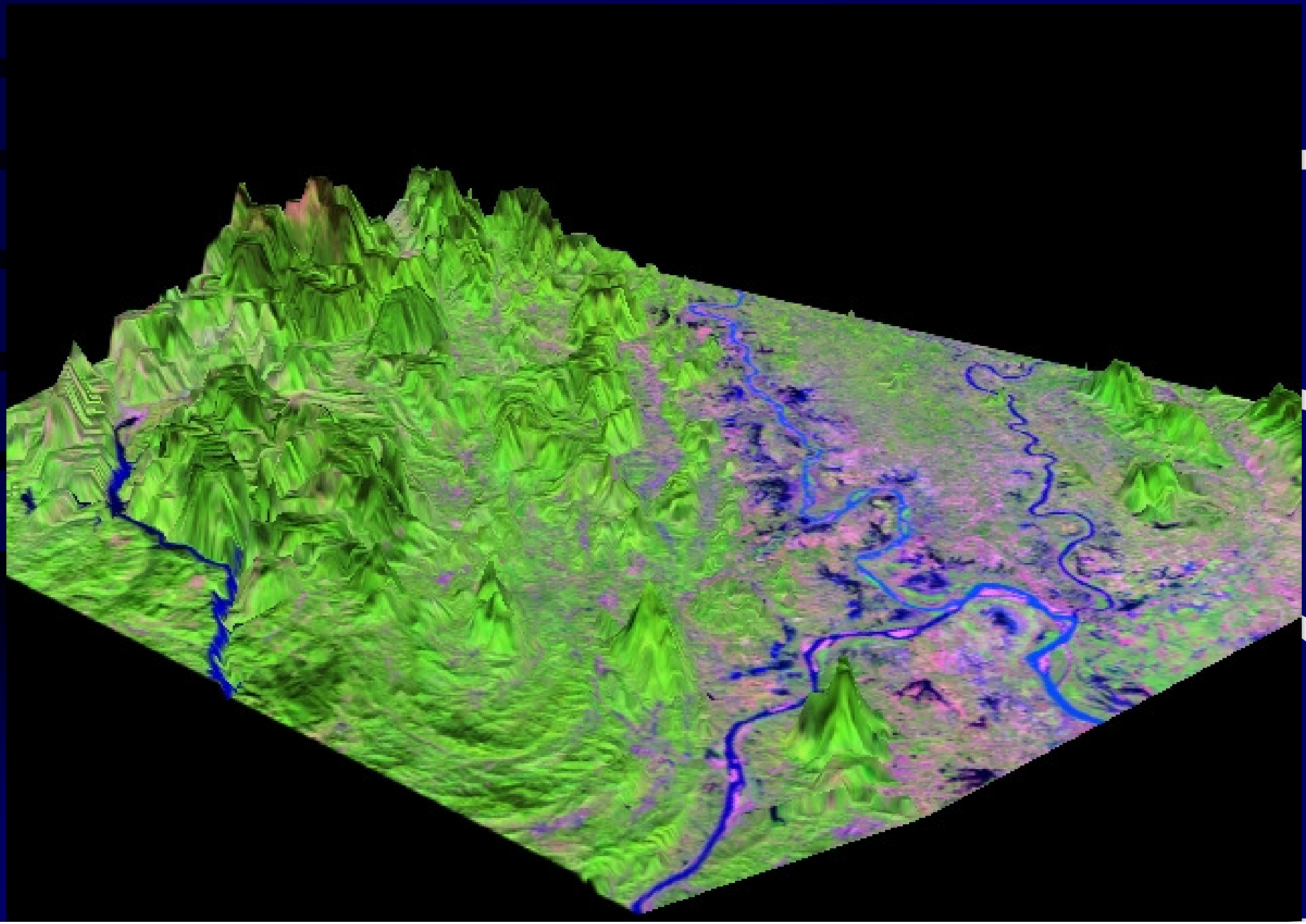




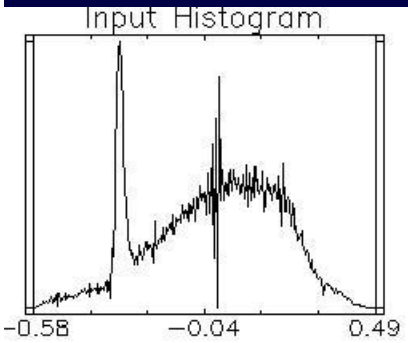


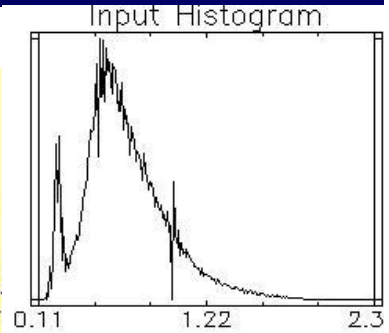


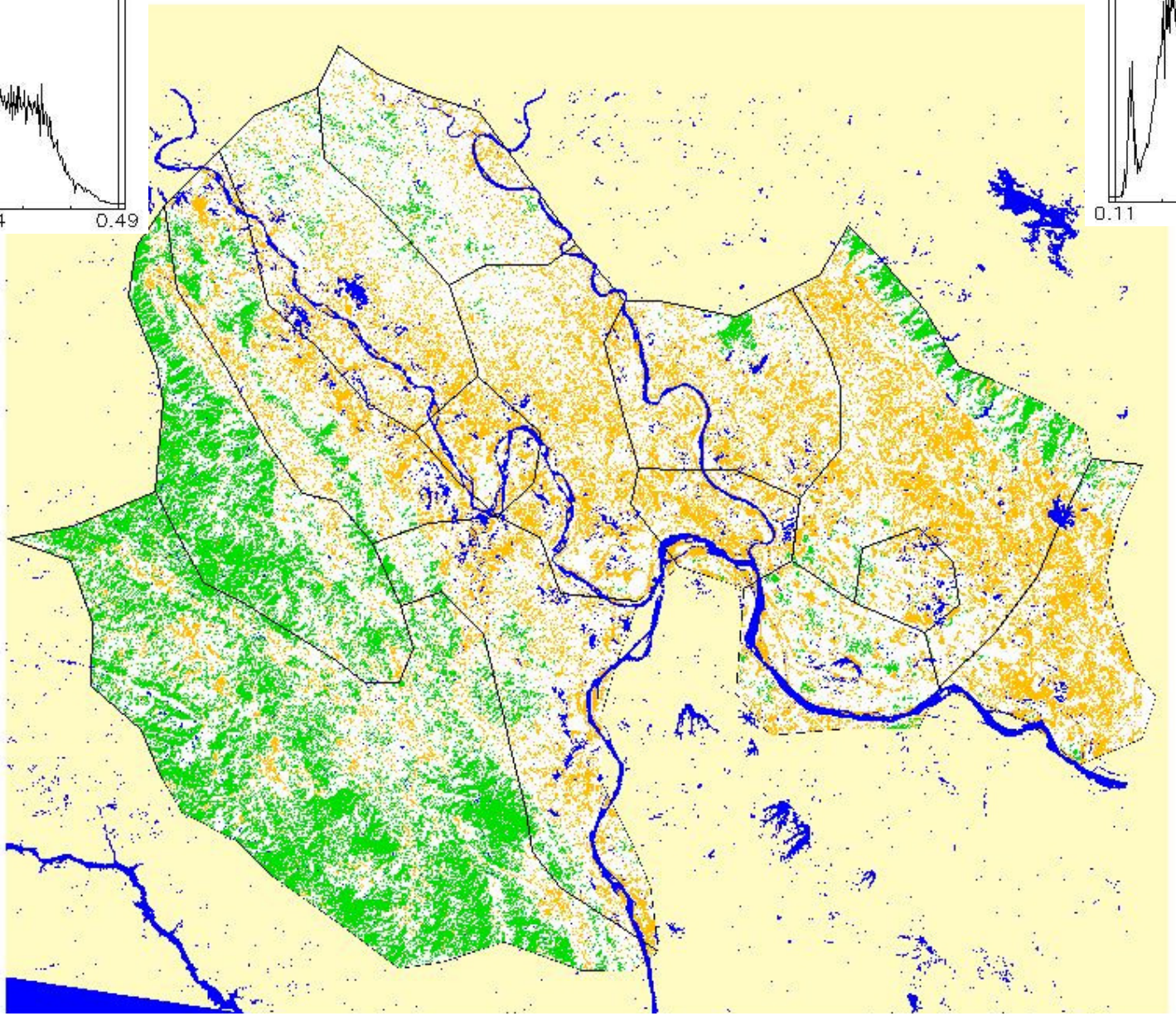
3D model of study area



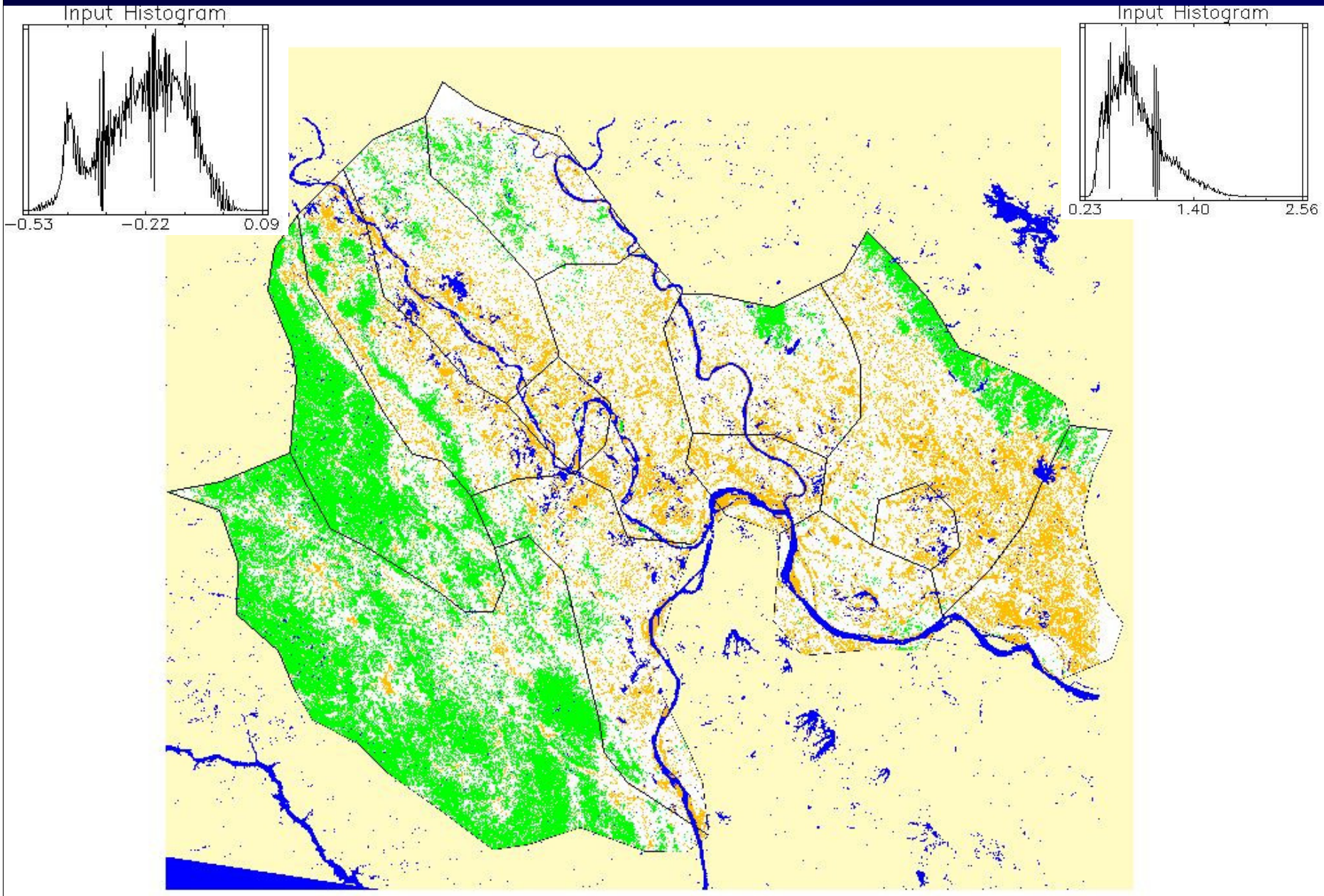
NDVI ver. Drought index in November 2000



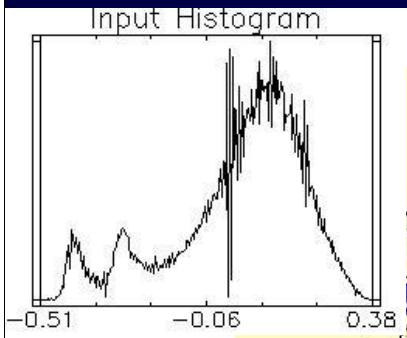


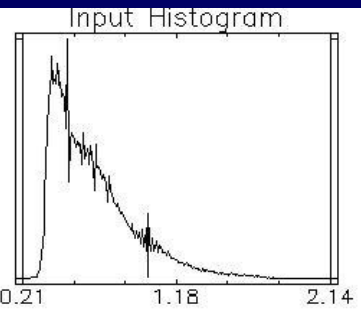


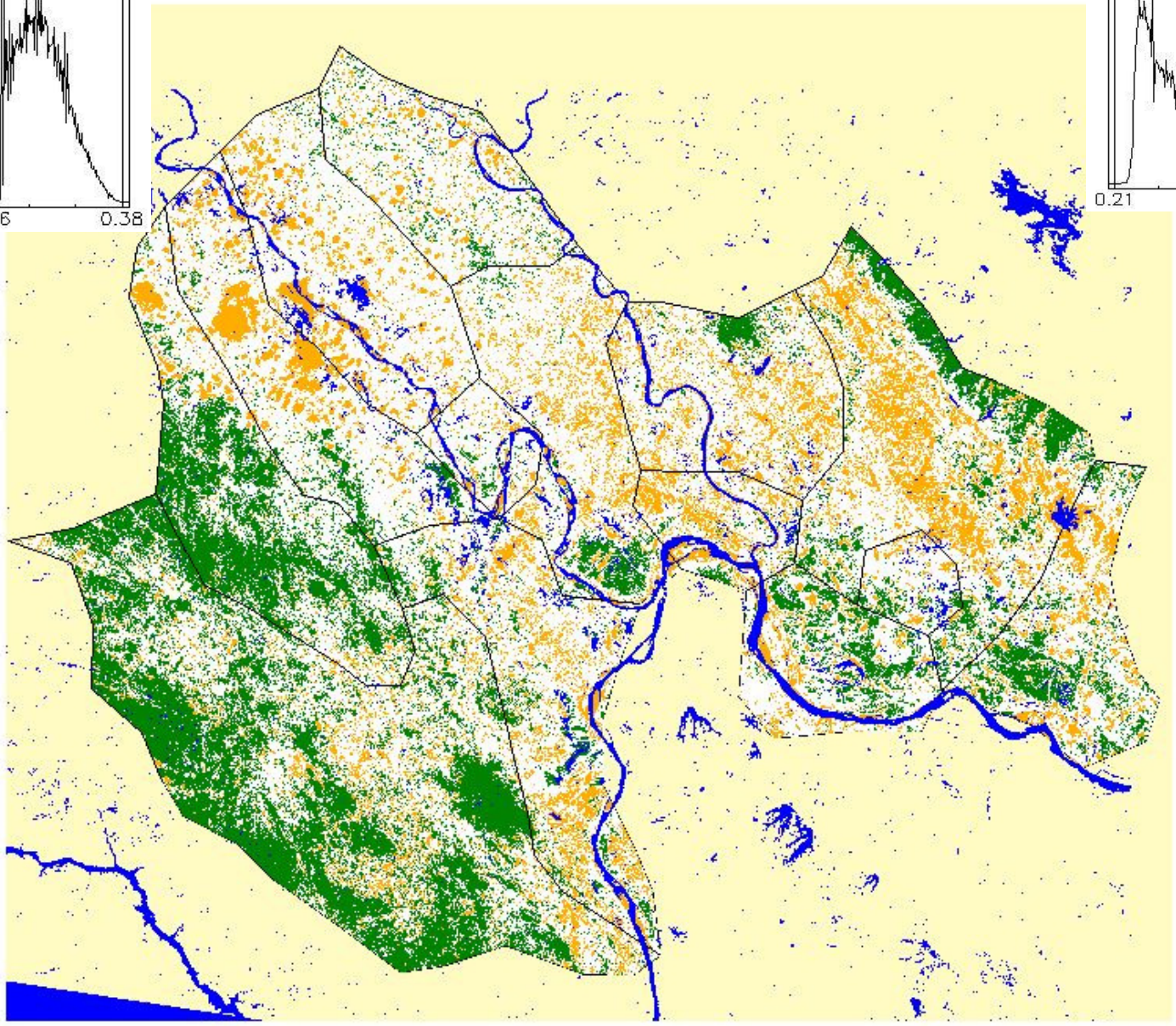
NDVI ver. Drought index in January 2003



NDVI ver. Drought index in May 2003







Conclusion

Regarding to the obtained result, we have conclusion that the environmental monitoring and management require the development of database for data storage and analysis. For the objective to present the actual environmental status, at the same time to give the attributes for option new technology aimed to environmental pollution and GHG emission mitigation, the application both GIS and EM is the effective tool

It is quite necessary to improve environmental monitoring and management technology in order to meet various assessment requirements. GIS software is capable of displaying and analyzing spatial database in relationship form between graphics and different attribute tables, while EM software helps to analyze and choose optimal technological process, which is economically and environmentally beneficial in the field of energy. The EM software is more specialized on storage and analysis for elaboration and selection of appropriate technological measures which environment friendly by Demand Side Management and Emission Control techniques

Conclusion (cont.)

- Space technology is effective tool for land use, land cover change detection and analysis
- The vegetation cover at different seasons having much relation with drought hazard: as much density area of forest and scrubs, as less drought hazard in dry season.
- The topography also much influence to drought too, and the Digital terrain model (DTM) with satellite image help us to identify the area with water shortage problem
- Forest fire can de detected by remote sensing effectively, and space technology much support for early warning of fire.

THANK YOU

FOR ATTENTION