CSE

Centre de Suivi Ecologique

Pour la gestion des ressources naturelles

ANSD

Agence Nationale de la Statistique et de la Démographie

The use of GIS and remote sensing for environment statistics

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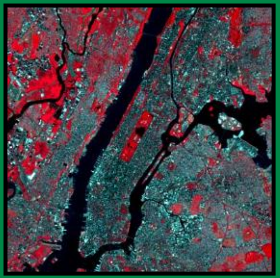
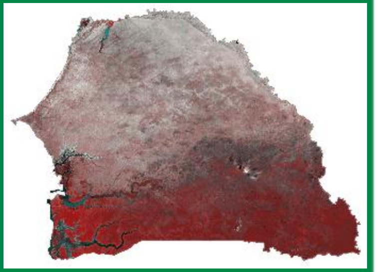
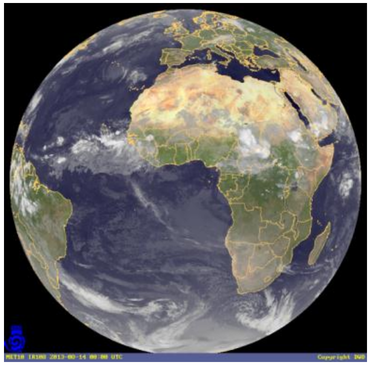
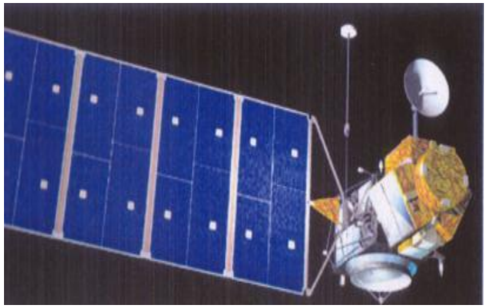
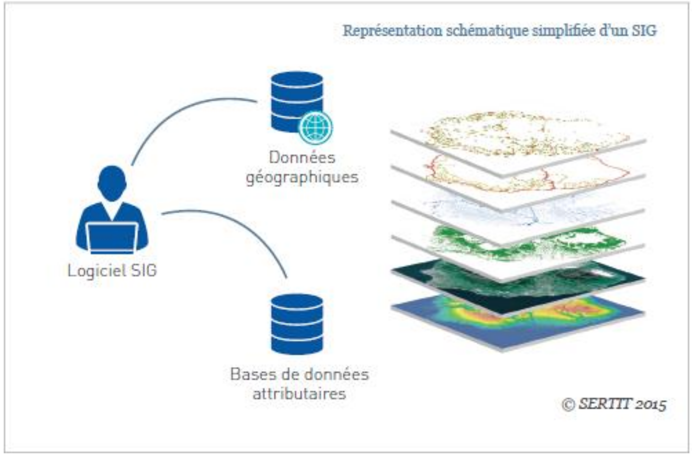




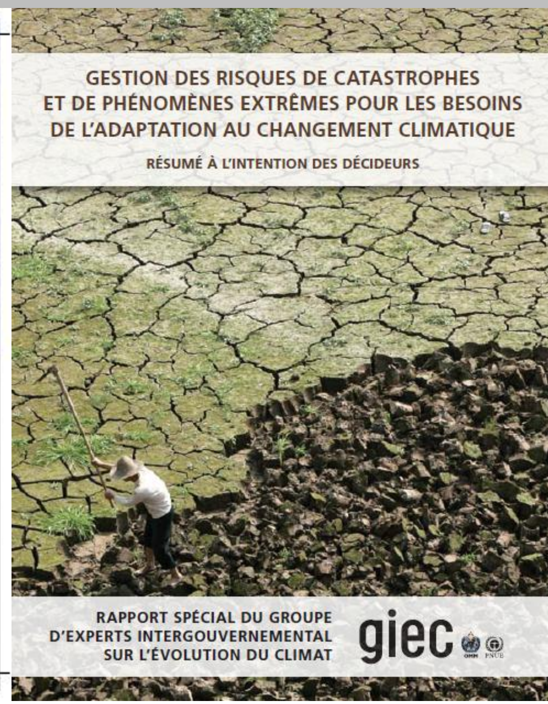
Outline

- **Introduction**
- **Concepts**
  - – Environment statistics
  - – Remote sensing
  - – GIS
- **Examples of using RS and GIS**
- **Conclusion**




Climate change should be added…



User have needs

How can I **survey**

We want to anticipate our

Ongoing dialogue between data demand and data supply…

alerted !

real time

Environment statistics

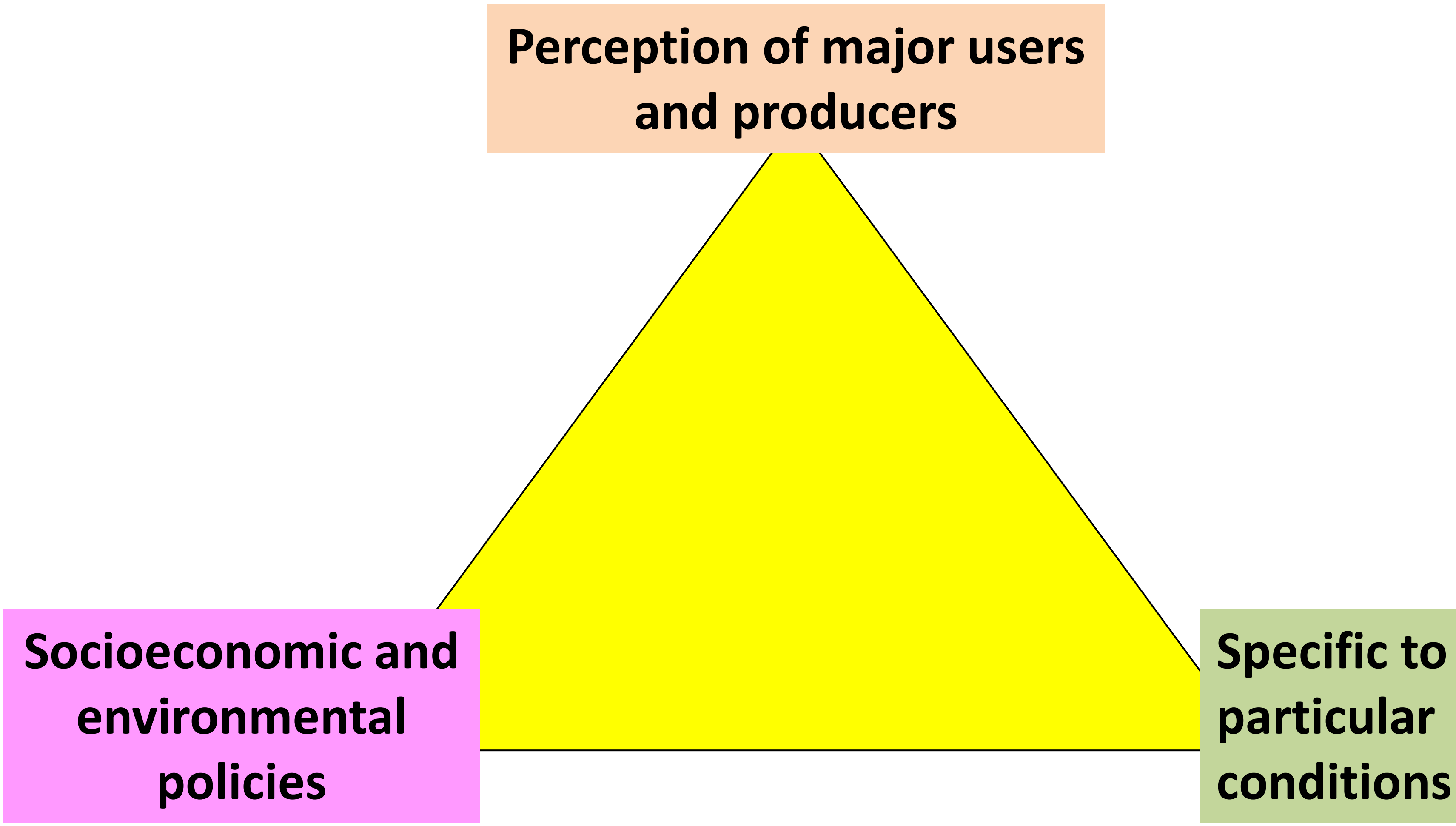
“Environment statistics are statistics that describe the state and trends of the environment

the media

Environment Statistics bring together:

- Human activities
- Natural events
- Impacts of activities and events on environment
- Social responses to impacts
- Quality and availability of natural assets

Environment statistics (2)
Scope of Environment Stats



Courtesy: Dozie Ezigbalike (UNECA)

Environment statistics (3)

The cha tatistics

- A F
  Env
- Con roaches
- Dev
- End
- Rel)
  info

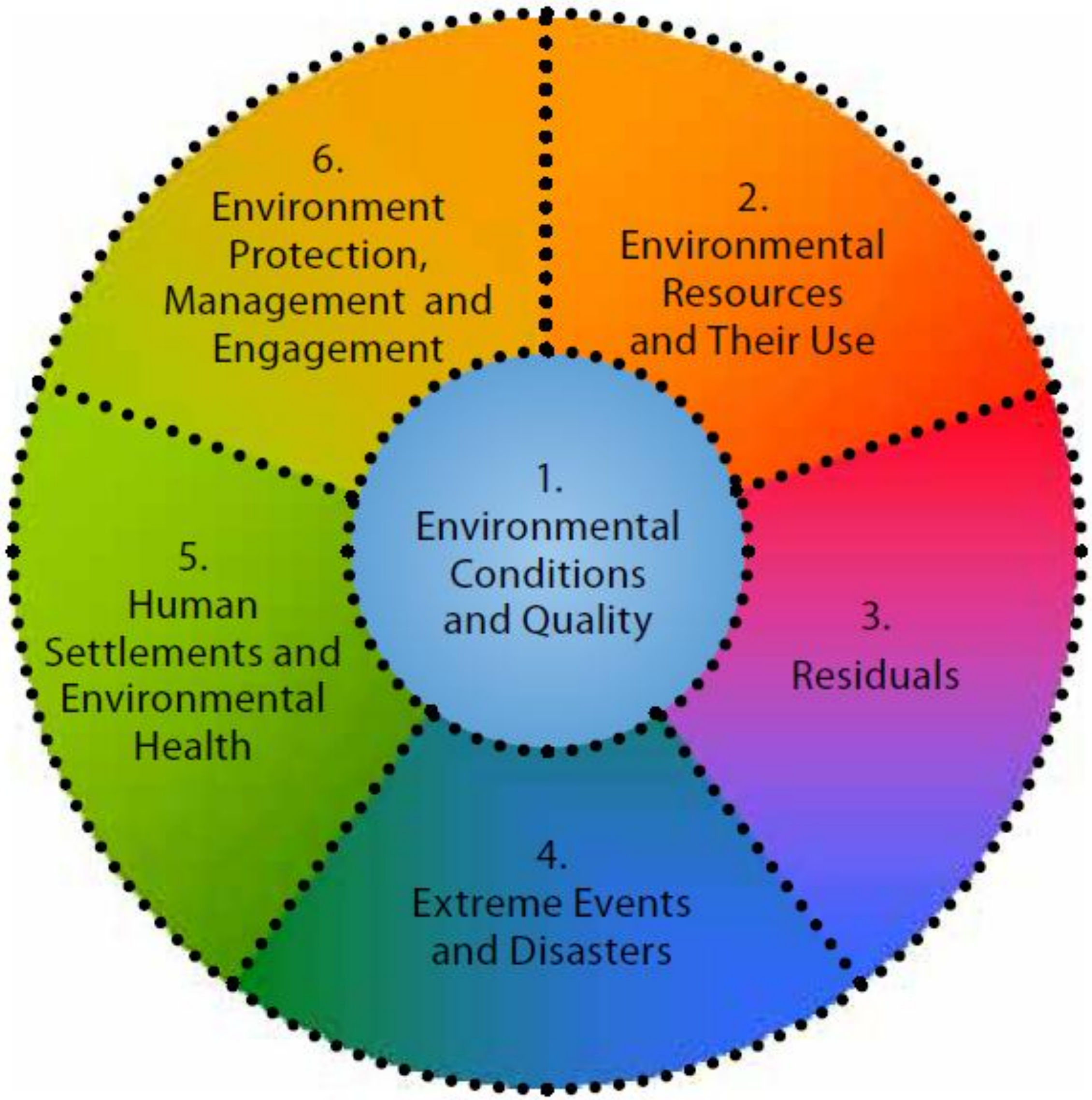


Figure 1. The FDES components

Courtesy: Dozie Ezigbalike (UNECA)

ST/ESA/STAT/SER.M/78

STATISTICAL … IQUES Série M N° 78

Framework for the Development of Environment Statistics

A guide for the development and organization of environment statistics

The Framework for the Development of Environment Statistics (FDES) 2013, including the Core Set of Environment Statistics, as well as an Action Plan for putting the FDES to work, were endorsed by the 44th session of the Statistical Commission (New York, 26 February–1 March 2013)*

A F … FOF … ENV … POUR LE DÉVELOPPEMENT … TISTIQUES … IRONNEMENT

Environment statistics for policymaking

The demand for environment statistics is increasing in step with the continued environmental challenges faced by modern society. The recognition that human well-being depends on the environment has led to an increasing emphasis on environmental and sustainability concerns on which decisions and actions need to be taken. Paramount to these actions is the regular production of environment statistics of the highest possible quality to support evidence-based policymaking by enabling the identification of environmental policy issues and allowing their objective quantification.

Environment statistics portray key information about the state of the environment and its most relevant changes through space and time. They strengthen assessments through quantitative techniques, making analyses more robust, timely and progressively harmonized at the international level. Environment statistics are necessary for producing environmental assessments, state of the environment reports, environmental compendia, environmental indicators, indicators of sustainable development, as well as to facilitate environmental-economic accounting.

The member States of the United Nations have addressed this challenging area during the Rio+20 Conference in June 2012. The outcome document, "The Future We Want" contains various references that are relevant to the work of the United Nations Statistics Division (UNSD) in this regard. This document frequently mentions the importance of data, in particular, environmental data, as well as information and indicators. The Framework for the Development of Environment Statistics (FDES 2013), including the Core Set of Environment Statistics, provides an appropriate means for addressing these information needs as they relate to the environmental dimension of sustainable development. The FDES has been recognized by the 44th session of the Statistical Commission as a useful tool to adequately respond to the increasing demand for information in the follow-up to Rio+20 and the post-2015 development agenda (including Sustainable Development Goals).

The challenge of producing environment statistics

Environment statistics cover a wide range of information and are interdisciplinary in nature. Their sources are dispersed over a variety of data producers, and similarly numerous methods are applied in their compilation. To effectively produce environment statistics, specific statistical and environmental expertise, scientific knowledge, institutional development capabilities, and adequate resources are equally necessary. Many countries still require substantial technical assistance and capacity building. Environment statistics therefore require a proper framework to guide their development, coordination and organization at all levels.

UNITED … NIES

* The United Nations Statistical Commission is the apex entity of the global statistical system bringing together the Chief Statisticians from member states from around the world. It is the highest decision making body for international statistical activities especially the setting of statistical standards, the development of concepts and methods and their implementation at the national and international level.

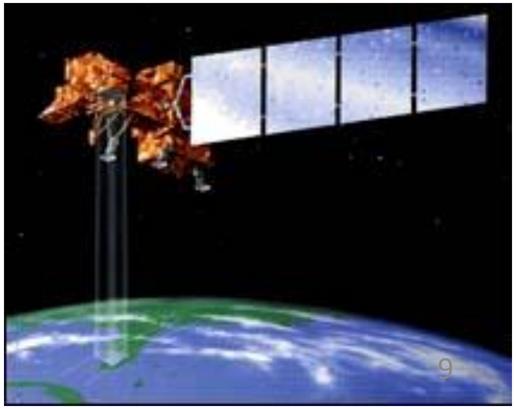
Remote sensing: definition

- **Remote sensing is the collection of information about an object without being in direct physical contact with the object.**

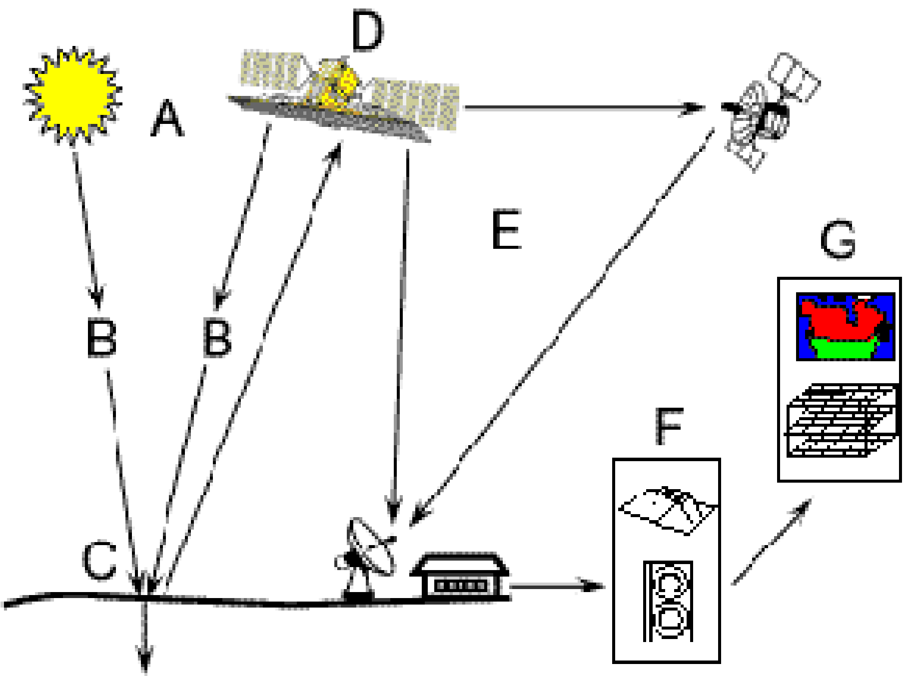
- *Remote Sensing is a technology for sampling electromagnetic radiation to acquire and interpret non-immediate geospatial data from which to extract information about features, objects, and classes on the Earth's land surface, oceans, and atmosphere.*

  - Dr. Nicholas Short

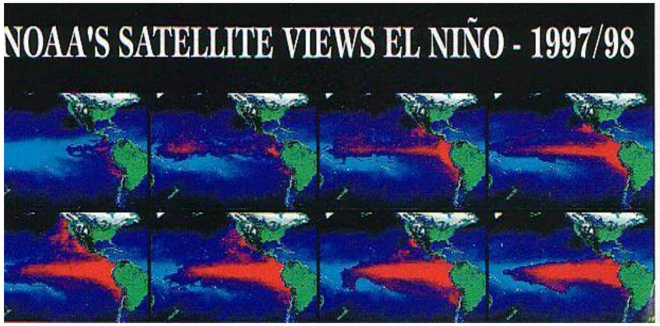
Courtesy: Dozie Ezigbalike (UNECA)



Elements involved in Remote sensing



1. Energy Source or Illumination (A)
2. Radiation and the Atmosphere (B)
3. Interaction with the Object (C)
4. Recording of Energy by the Sensor (D)
5. Transmission, Reception and Processing (E)
6. Interpretation and Analysis (F)
7. Application (G)



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Sat d or
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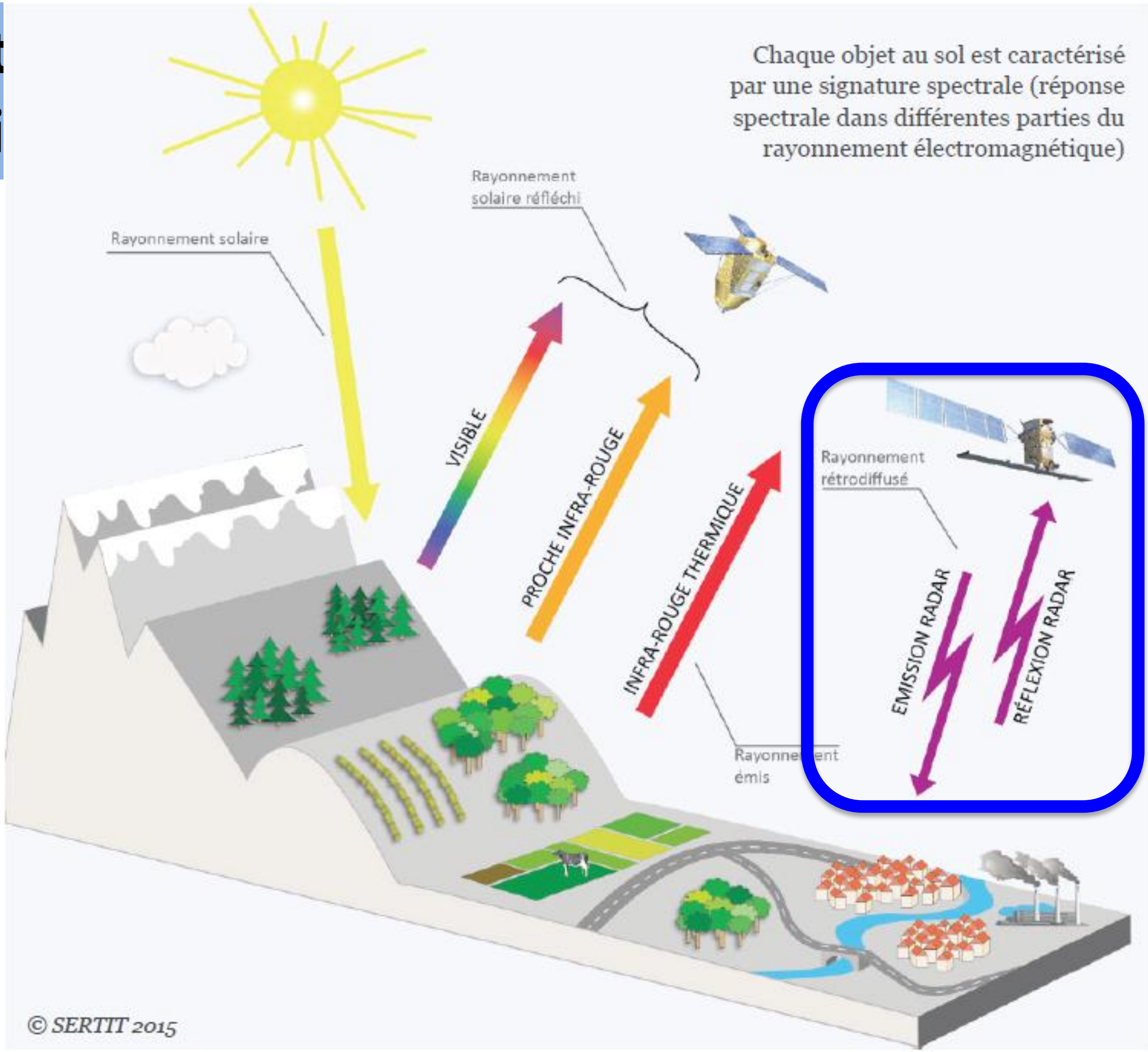


Schéma représentant les principes de la télédétection passive et active

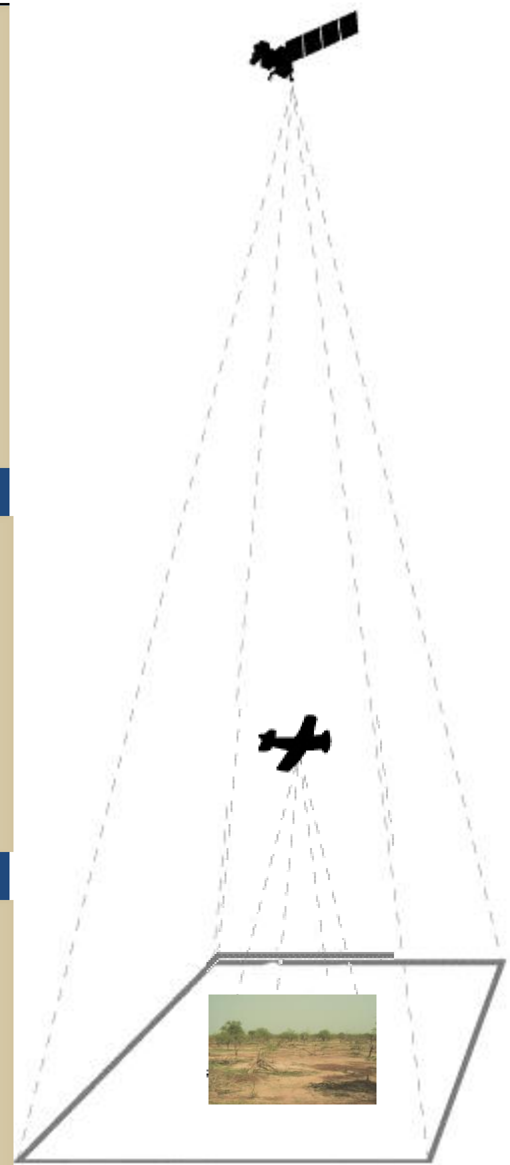
Sources de données

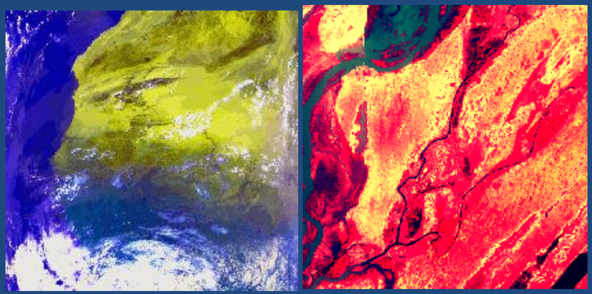
Niveau de collecte

- **Imagerie satellitaire**
  - Météosat, MODIS
  - NOAA
  - LANDSAT
  - SPOT
  - Corona
  - QuickBird…

- **Prises de vue aériennes**
  - Photographie aérienne
  - Vols systématiques de reconnaissance
  - Vidéographie aéroportée

- **Etudes de terrain**
  - Inventaires
  - Mesures GPS
  - Enquêtes

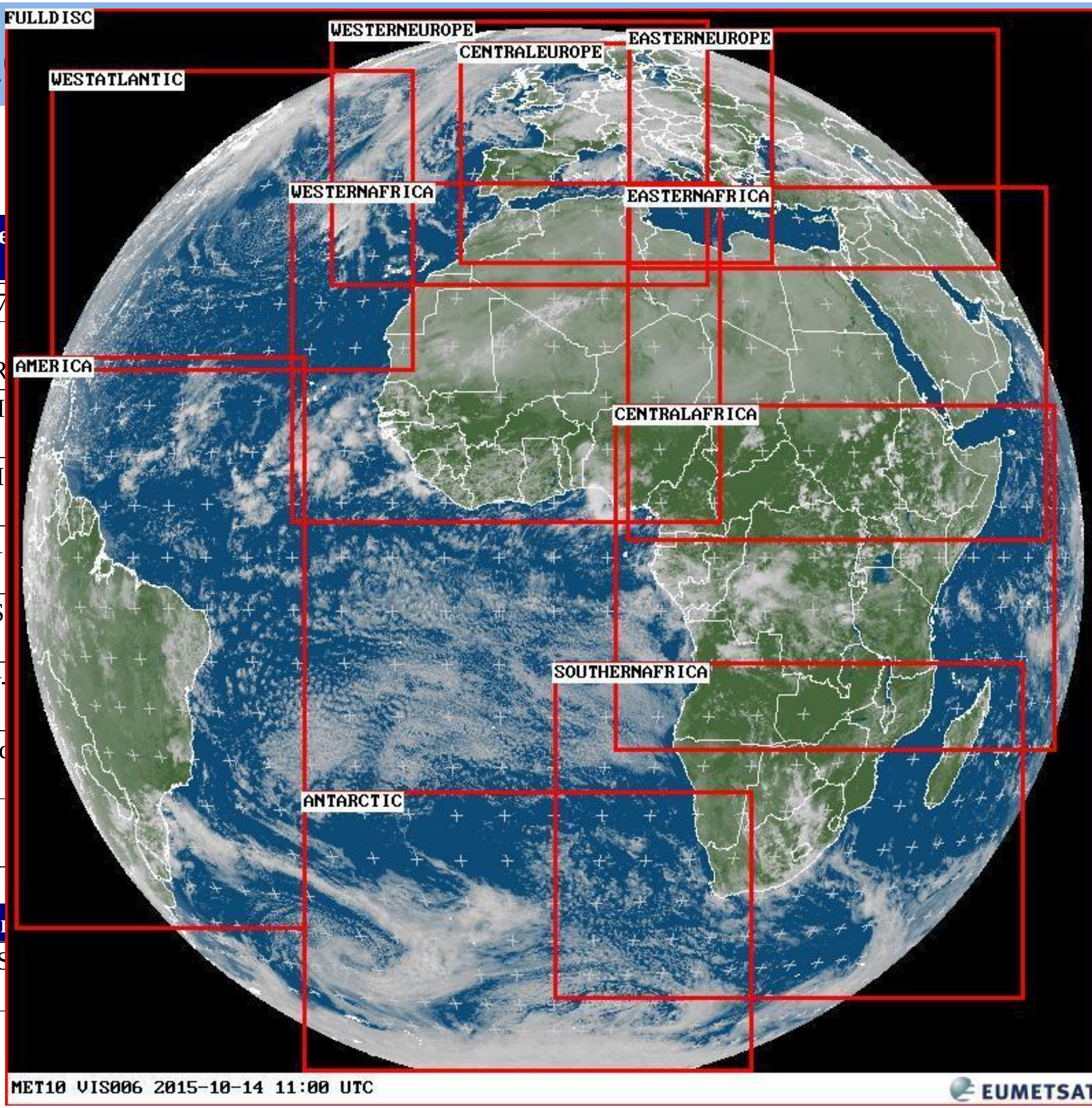




R… ts.

Se…
Landsat-7
IRS RESOUR…
LI…
LI…
IRS 1C/1…
IKONOS
OrbView-…
Quickbir…
Airborne

Ser…
RADARS…



Courtesy: Dickinson

Benefits from remote sensing data

- Very useful where areas are inaccessible or where the cost of collecting spatial data over extensive areas is prohibitive
- Provide good "pictures" for convi
participating in environmental as
- Provide data over large areas tha
- Are available on a repetitive basi
data for areas over a long time ba
- May be used to monitor the prog
- Faster extraction of GIS-ready dat

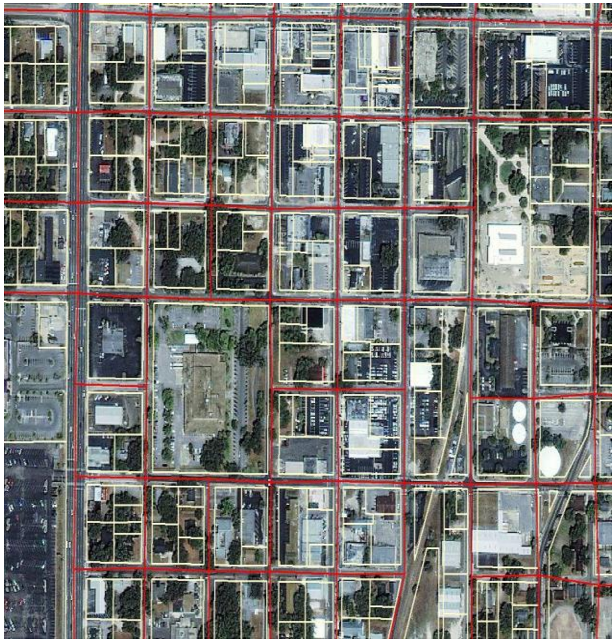
Disadvantages

- Needs ground verification
- Doesn't offer details
- Not the best tool for small areas
- Needs expert system to extract data

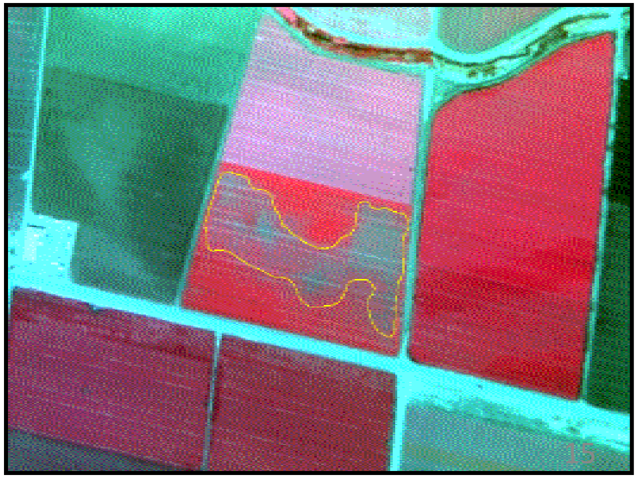



Application of Remote sensing

- **Urbanization & Transportation**
  - Updating road maps
  - Asphalt conditions
  - Wetland delineation



- **Agriculture**
  - Crop health analysis
  - Precision agriculture
  - Compliance mapping
  - Yield estimation



Courtesy: Bodruddoza Mia

Application of Remote sensing (2)

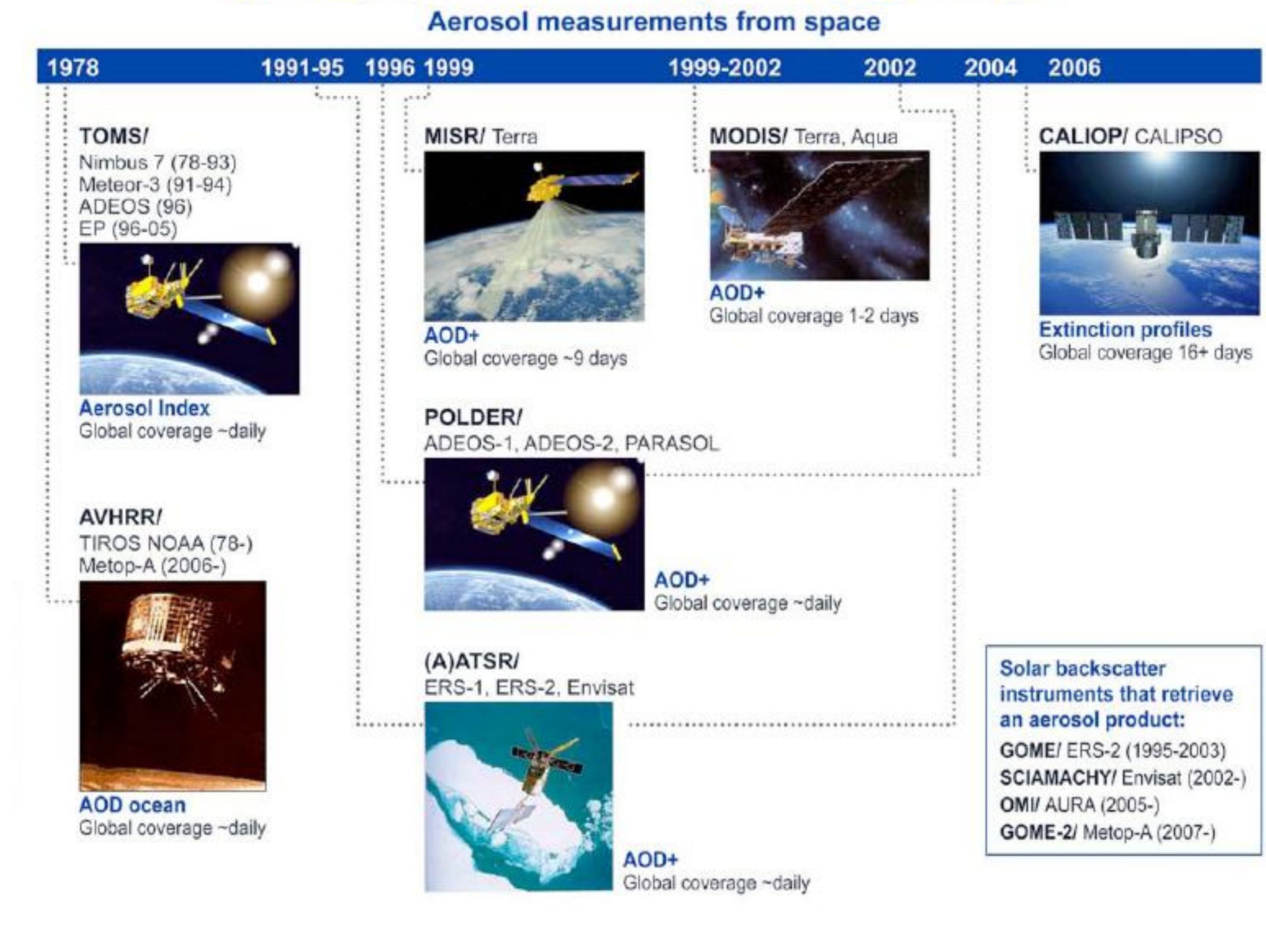
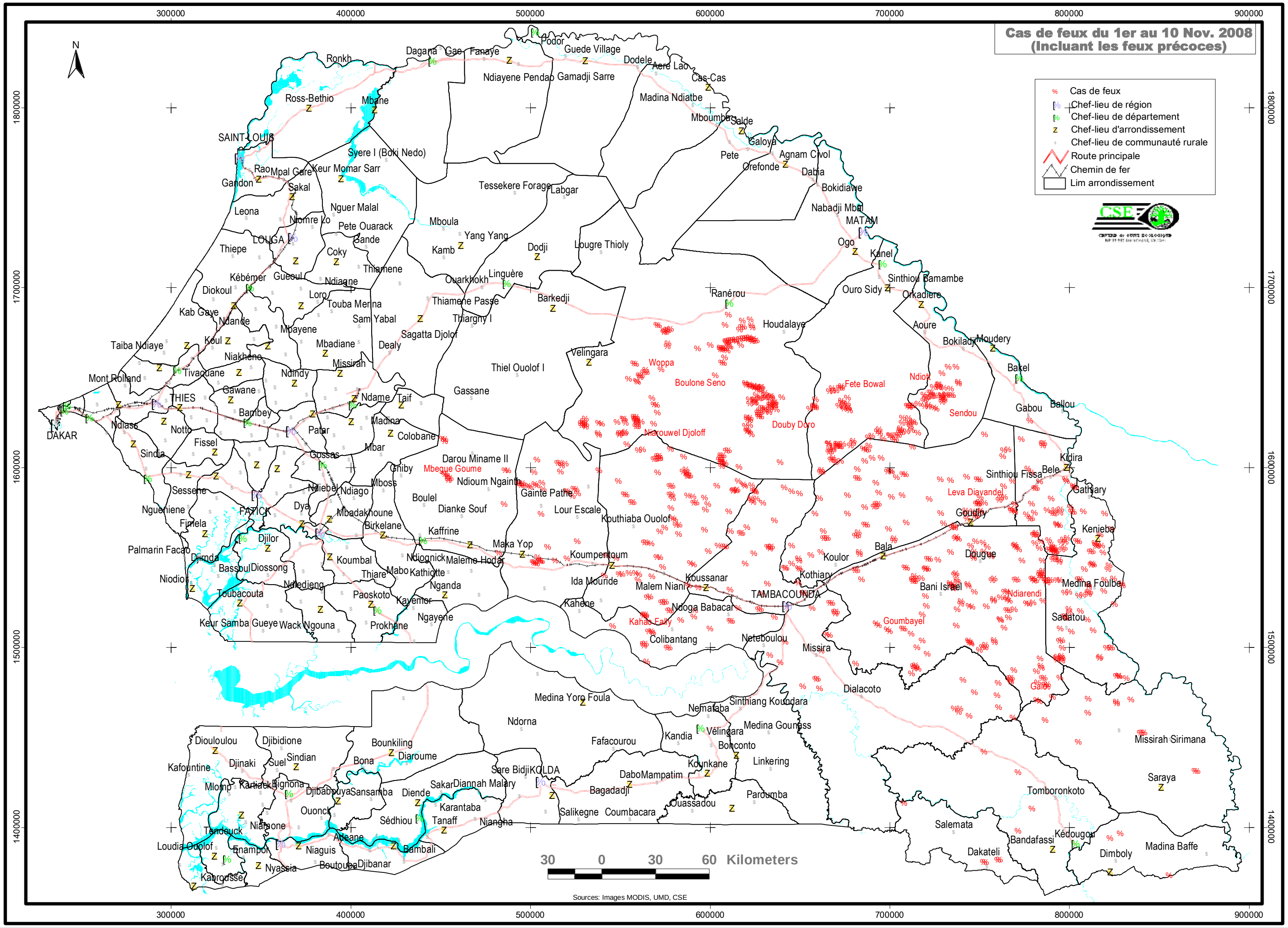


Figure 15 - Aerosol measurements from space

- N

Courte

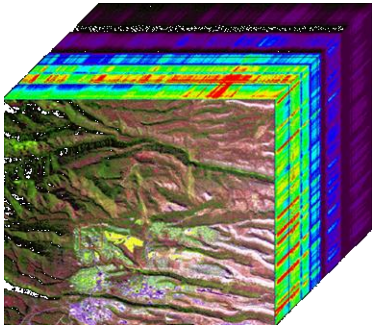
Applications sur le suivi des feux de brousse



Le traitement des données journalières de l'imagerie MODIS a permis de faire des **synthèses mensuelles et annuelles des statistiques concernant les feux de brousse**. Ces synthèses sont utilisées pour une meilleure compréhension des **évolutions temporelle et spatiale** du phénomène des feux de brousse.

Image Processing

- **Image Pre-Processing**
- Image Restoration
- Sensor Calibrations
- Atmospheric Corrections
- Solar Illumination Corrections
- Topographic Corrections
- Geometric Corrections

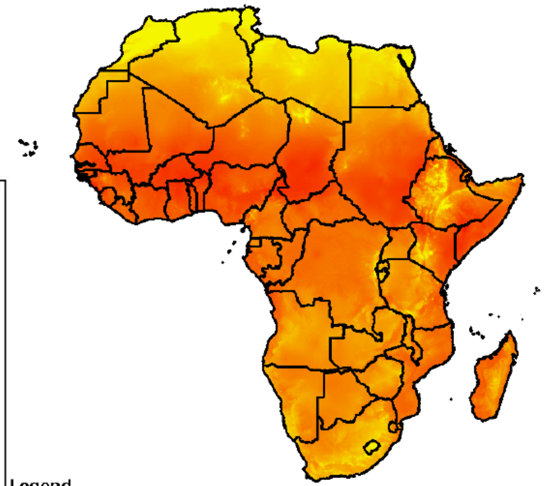


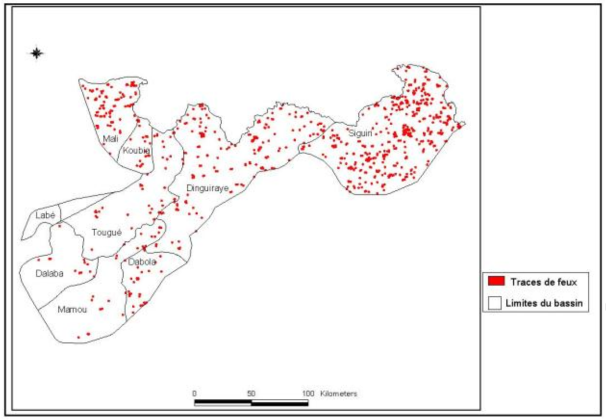
- **Image processing**
- Spatial enhancement
- Spectral enhancement
- Classification
- Feature Extraction

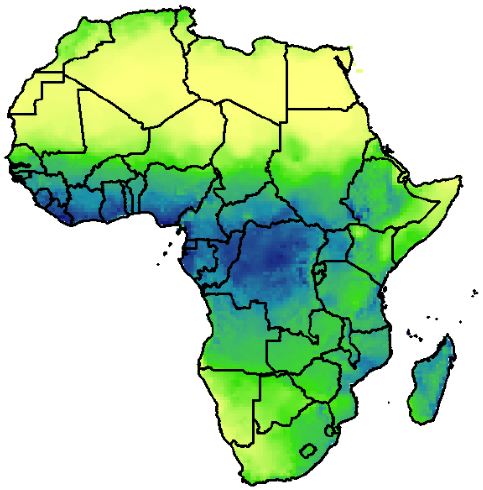
Courtesy: Bodruddoza Mia

Image Processing Software

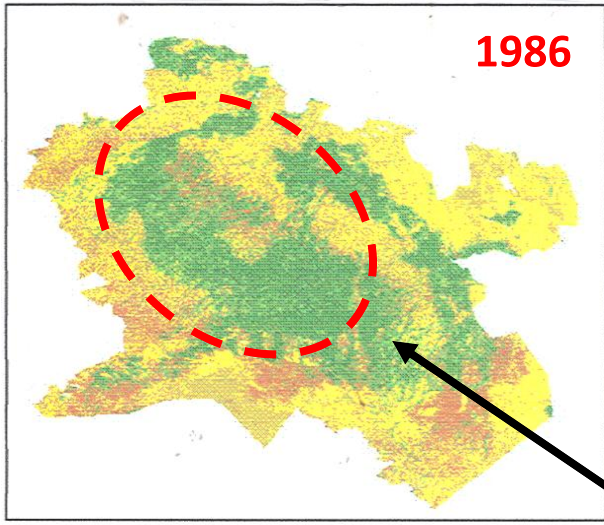
- ERDAS Imagine
- ENVI
- ILWIS
- ArcGIS
- PCI Geomatica



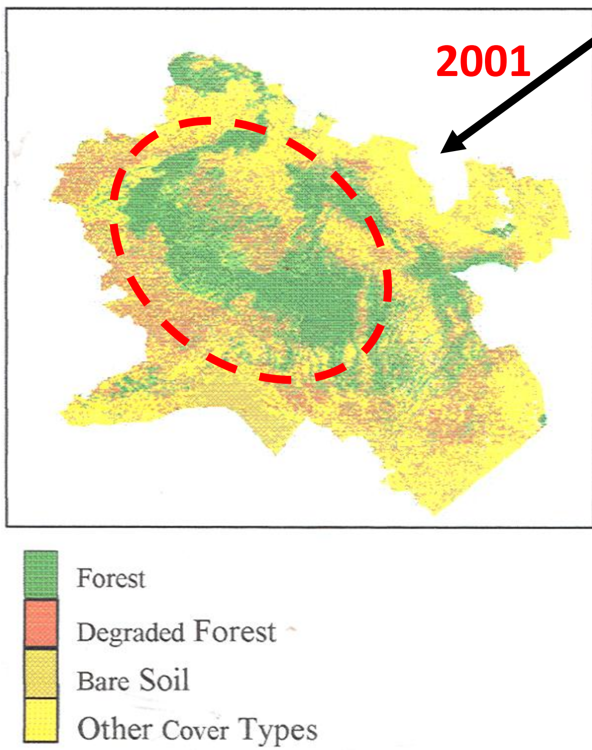


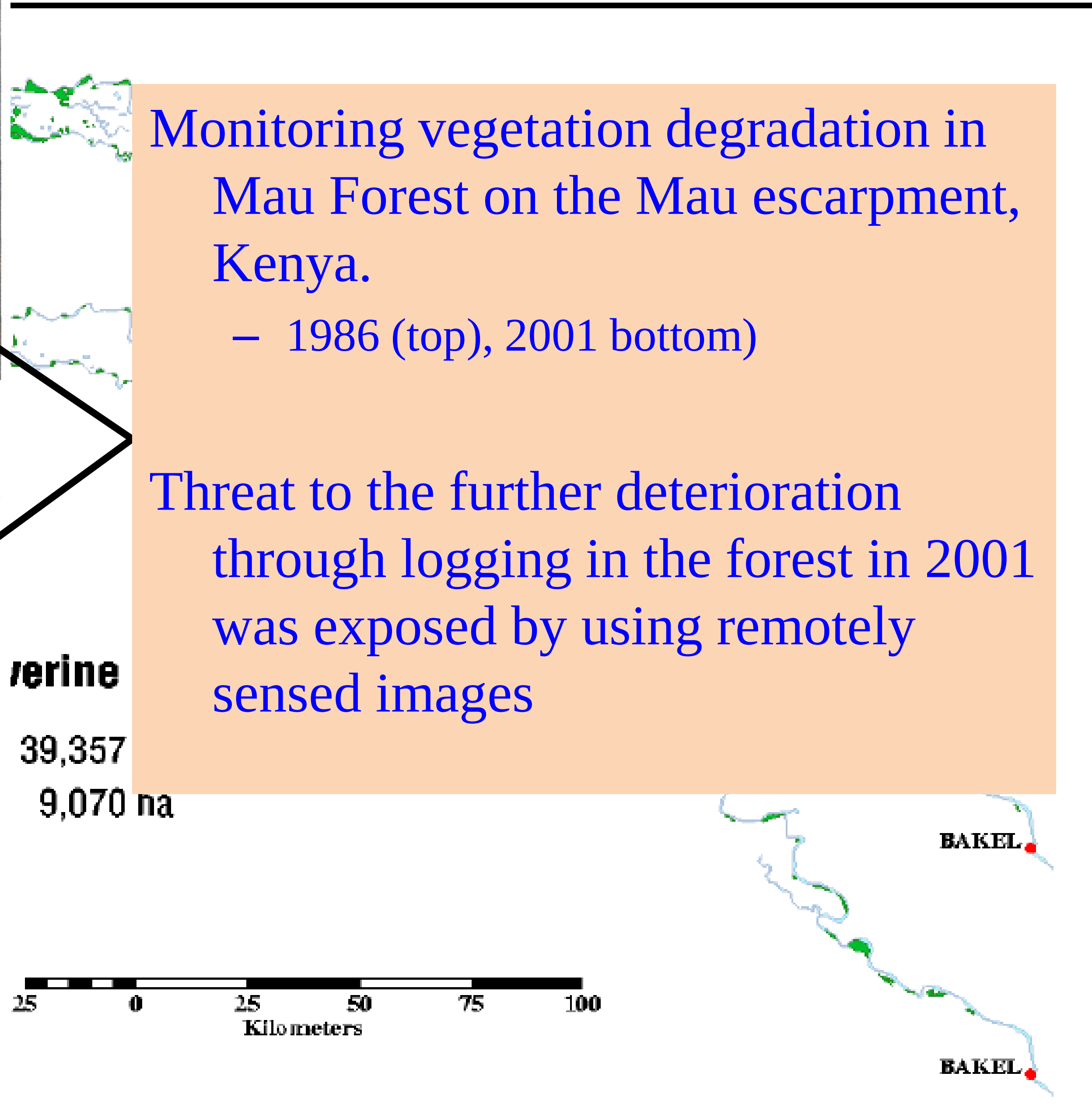


Courtesy: Bodruddoza Mia



Vegetation cover of Mau Forest, 1986 (*above*)
Vegetation cover of Mau Forest 2000 (*below*)





Monitoring vegetation degradation in Mau Forest on the Mau escarpment, Kenya.

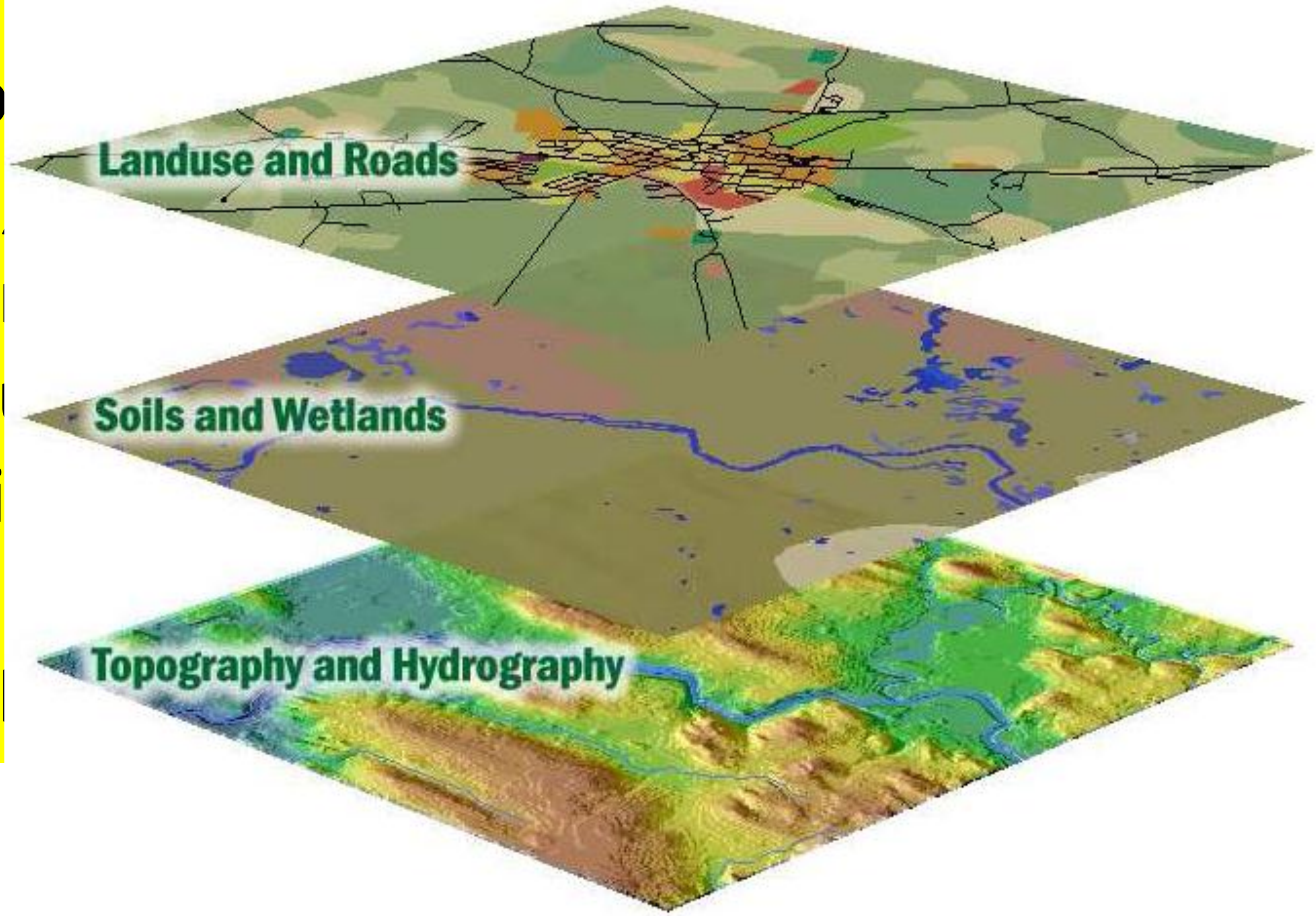
- 1986 (top), 2001 bottom)

Threat to the further deterioration through logging in the forest in 2001 was exposed by using remotely sensed images

GIS

✓ **GIS for Data combination**

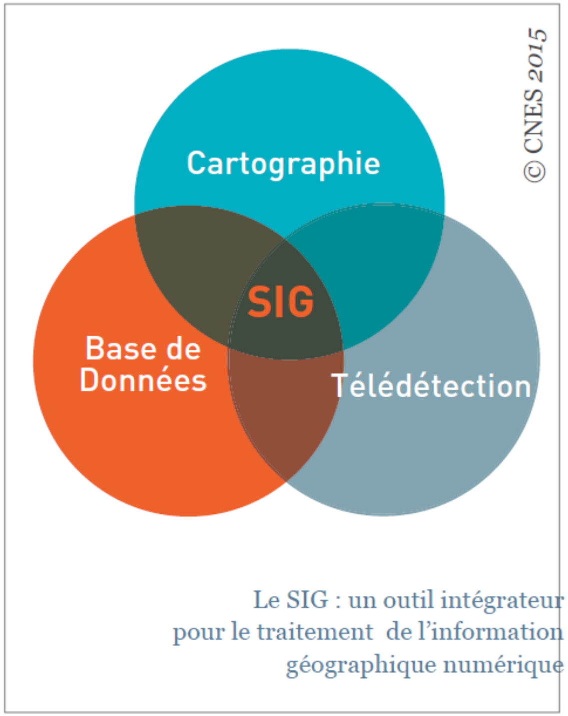
GIS (Geographic Information System) is used to input, store, retrieve, manipulate, analyze and outp eospatial data, king for plan , natural reso , urban facili



✓ **G**

Basic Functions of GIS

- Data Acquisition and prepossessing
- Database Management and Retrieval
- Spatial Measurement and Analysis
- Graphic output and Visualization



Courtesy: Bodruddoza Mia

Benefits of GIS

- Geospatial data are better maintained in a standard format.
- Revision and updating are easier.
- Geospatial data and information are easier to search, analysis and represent.
- More value added product.
- Geospatial data can be shared and exchanged freely.
- Productivity of the staff improved and more efficient.
- Time and money are saved.
- Better decision can be made.

Courtesy: Bodruddoza Mia

GIS Use

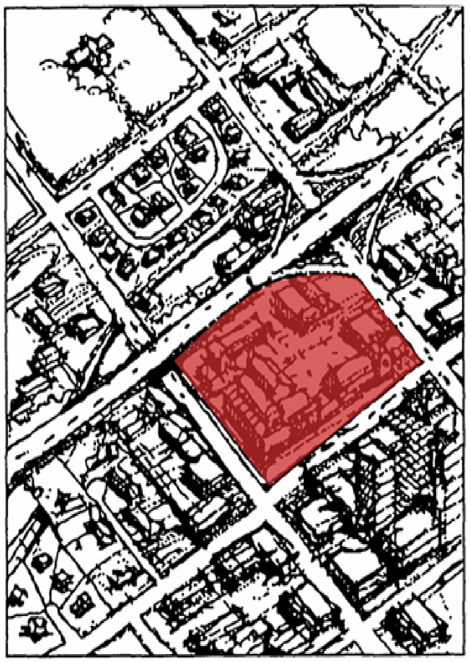
Locations - What is at….?

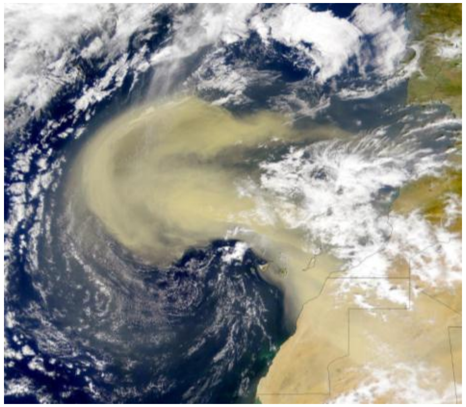
v Objects - Where is…?

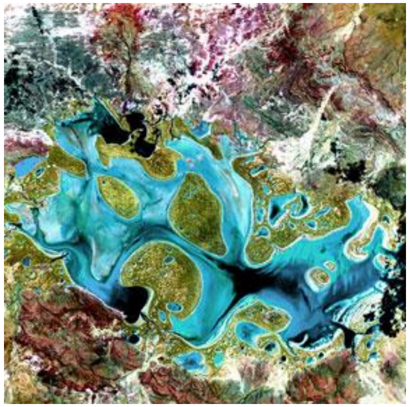
❖Patterns - Which things are related…?

v Models - What if…?

Trends - What has changed since…?







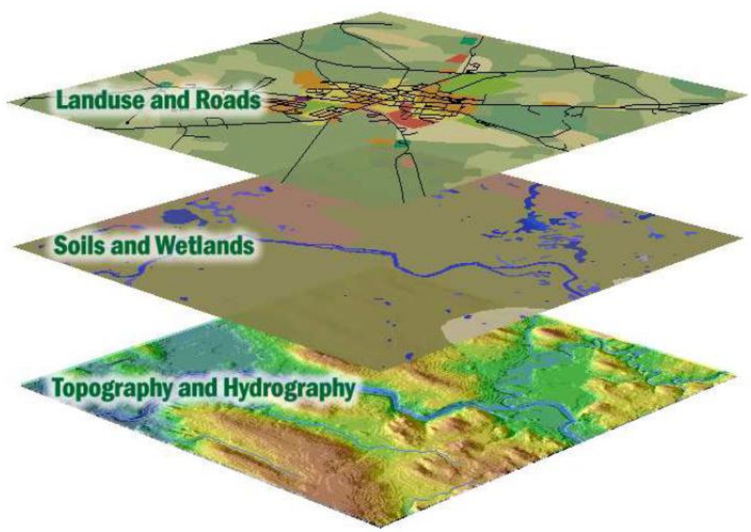
Courtesy: Bodruddoza Mia

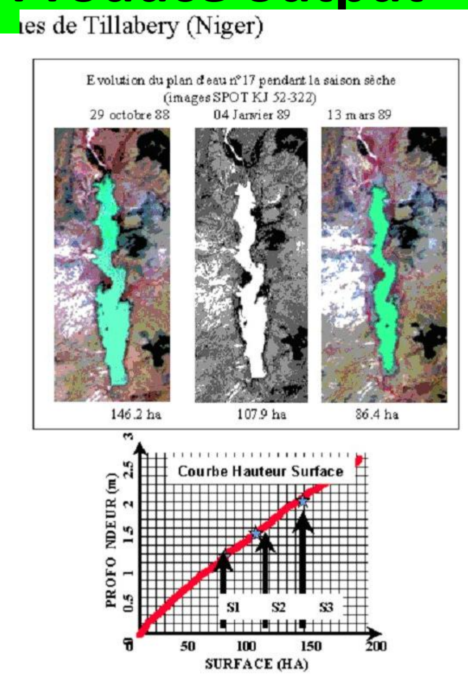
The basic elements of a GIS

- **A GIS is a 5-part system:**
  - People
  - Data
  - Hardware
  - Software
  - Procedures

Six Functions of a GIS:

- ✓ Capture data
- ✓ Store data
- ✓ Query data
- ✓ Analyze data
- ✓ Display data
- ✓ Produce output





Courtesy: Bodruddoza Mia

Application of GIS

Area	GIS Application
Facilities Management	Locating underground pipes & cables, planning facility maintenance, telecommunication network services
Environmental and Natural Resources Management	Environmental impact analysis, disaster management and mitigation
Street Network	Locating houses and streets, car navigation, transportation planning
Planning and Engineering	Urban planning, regional planning, development of public facilities
Land Information	Taxation, zoning of land use, land acquisition

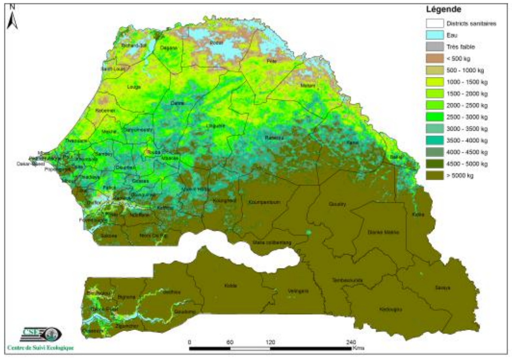
Courtesy: Bodruddoza Mia

Application of GIS (2)

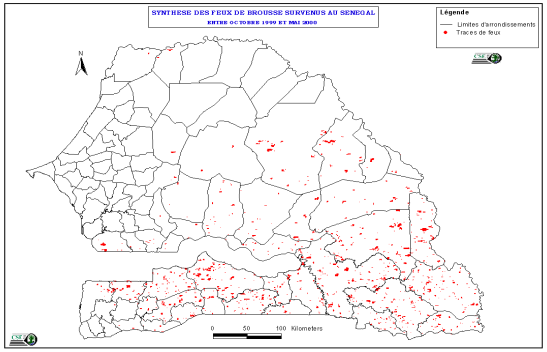
GIS can be found in most any field

… but generally can be grouped into four basic categories:

- **NATURAL RESOURCE MANAGEMENT**
  - » Forest & Wildlife
  - » Hydrological
  - » Minerals



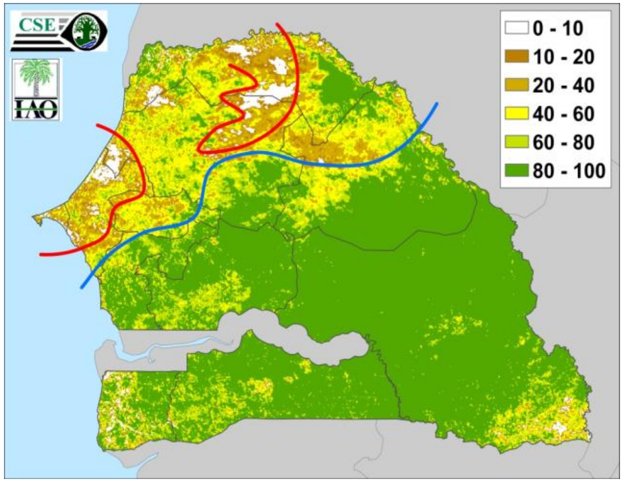
- **URBAN & REGSIONAL MANAGEMENT**
  - » Land Use Planning/Environmental Impact
  - » Public Works
  - » Emergency Response
  - » Legal Records

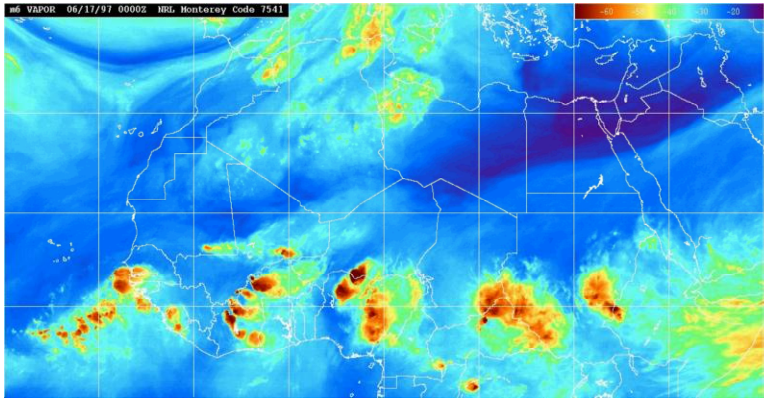


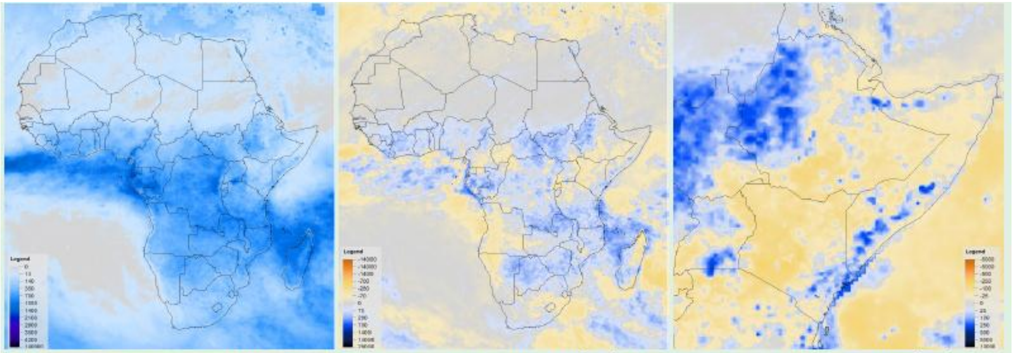
Courtesy: Bodruddoza Mia

Application of GIS (3)

- **COMMERCIAL**
  - » Market Area Analysis
  - » Site Selection
  - » Routing
- **AGRICULTURAL MANAGEMENT**
  - » Field Records
  - » Animal Management
  - » Climate Change / Human Impact







CARTE 2: PLUIES CUMULATIVES (JAN-MAI 2014)

CARTE 3: PLUIES COMPARÉES À LA NORMALE (JAN-MAI 2014)

CARTE 4: PLUIES COMPARÉES À LA NORMALE, AFRIQUE DE L'EST (AVR/MAI 2014)

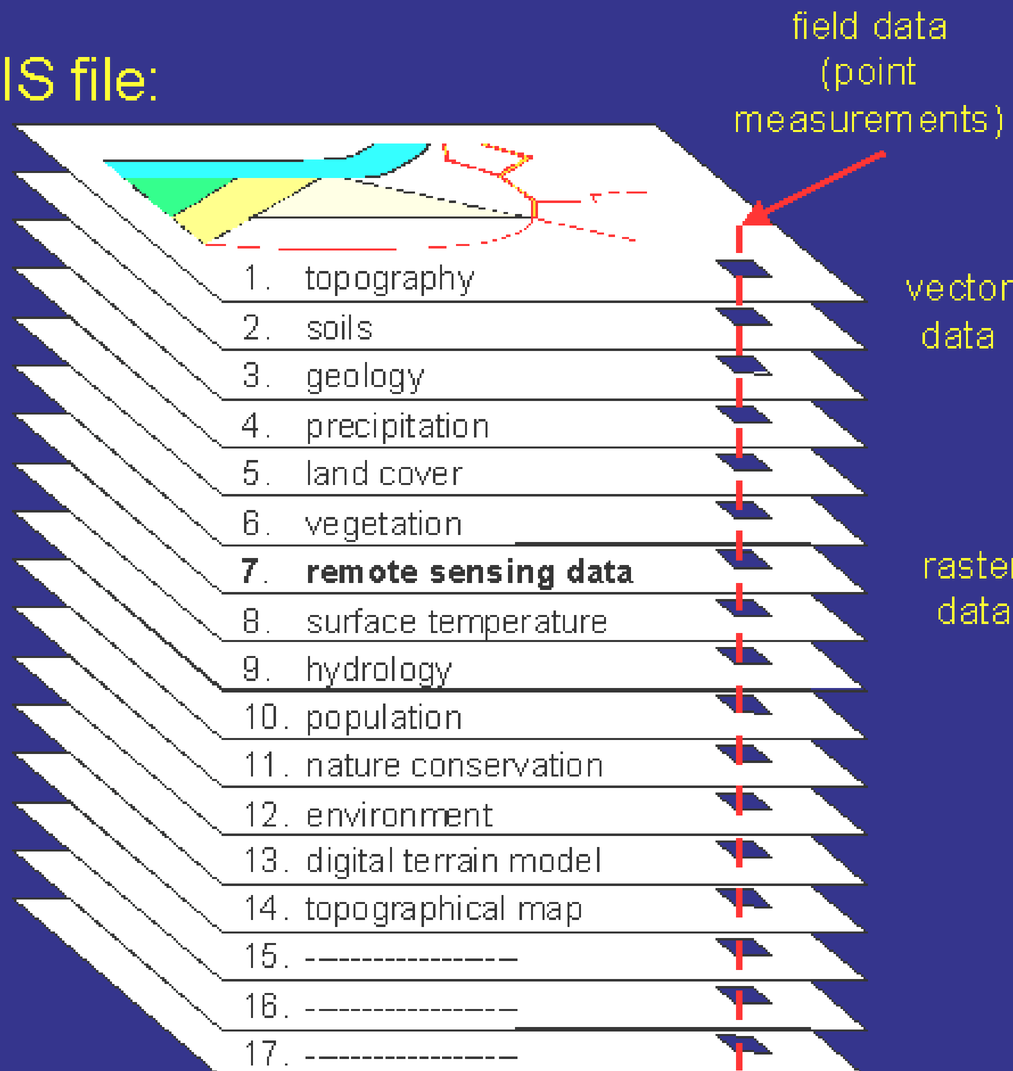
Courtesy: Bodruddoza Mia

GIS Geographical Information System

Well-considered combination of mutually referring **data sets** of various kinds of **position-bound thematic data** (database), software inclusive

Requirement:
the information layers match geometrically
==> OVERLAY STRUCTURE

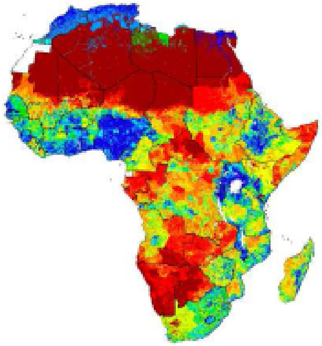
GIS file:



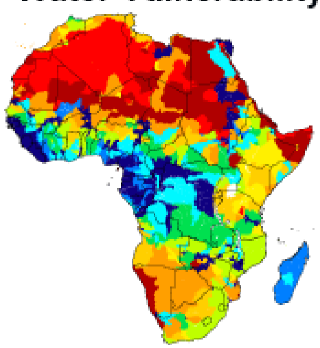
Food Security Modeling using Landcover

GeoCover LC Integrated into each model

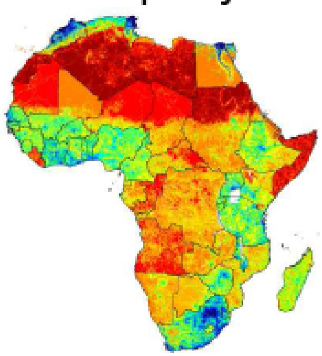
Total Potential Food Supply



Water Vulnerability



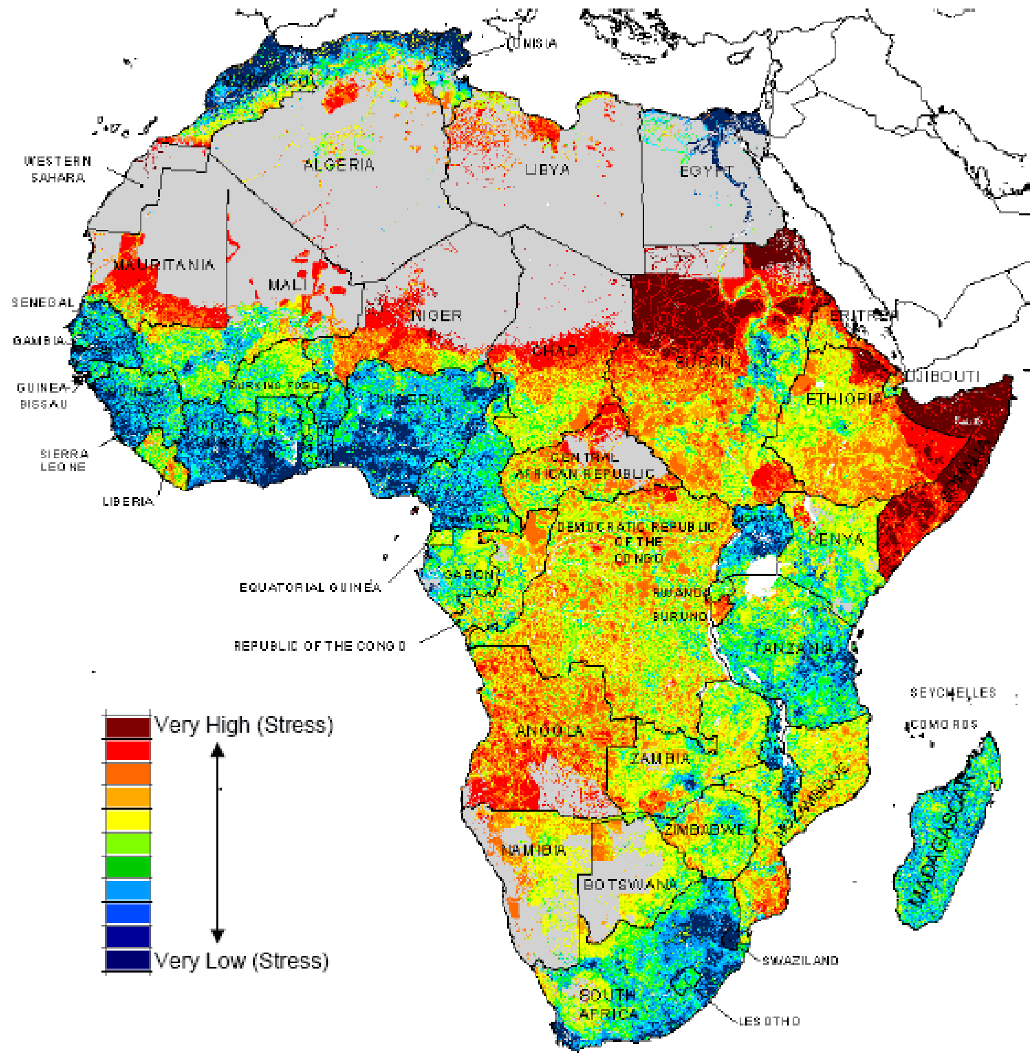
Capacity



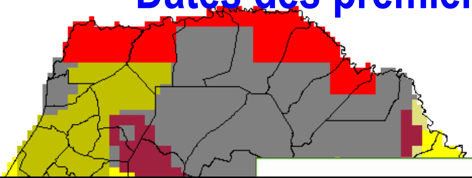
(food + water vulnerability) x (capacity)

Africa Geospatial I&W: Regions at Risk

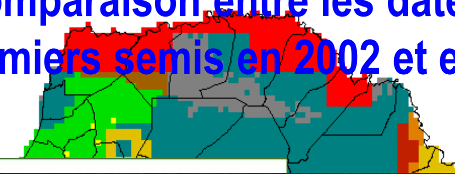
Population (Food-Water) Risk Surface



Dates des premiers semis



Comparaison entre les dates des premiers semis en 2002 et en 2001



Urbanisation of Cap Vert Peninsula: Dakar, Senegal

Like many West African cities, Senegal's capital city of Dakar has grown dramatically over the past several decades. Growth is expected to continue. While birth rates have begun to decline, natural growth still accounts for much of Dakar's expansion. In addition, Dakar experienced a large rural-to-urban migration beginning in the 1960s, when Senegal suffered from declining precipitation and periods of extreme drought. By 2005, Senegal's urban population exceeded its rural population. By 2030, two-thirds of the country's population is expected to be urban.

Roughly half of Senegal's urban population lives in the greater Dakar metropolitan area. Urban population growth has turned the Cap Vert Peninsula into a sprawling metropolis, where settlements reach ever-further inland and onto the prime farmland that has historically supported the city. Pikine, initially begun as a resettlement of urban slum dwellers 15 km west of Dakar, has grown to over one million people. Its location in the fertile Niayes region displaced large areas of urban and peri-urban agriculture that once provided livelihoods for a substantial portion of the population.

In the aerial photo mosaic from 1942, Dakar is concentrated at the southern tip of the peninsula, with only the airport and a few scattered roads and settlements to the north. The 2006/2007 image shows only a portion of the greater Dakar area, which currently stretches another 14 km to the city of Rufisque (not shown).

Standardized Precipitation Index SPI en fin juillet

Appui au suivi de la campagne agricole

Chan … tion

C. Mbow et al. / Global and Planetary Change 64 (2008) 210–221

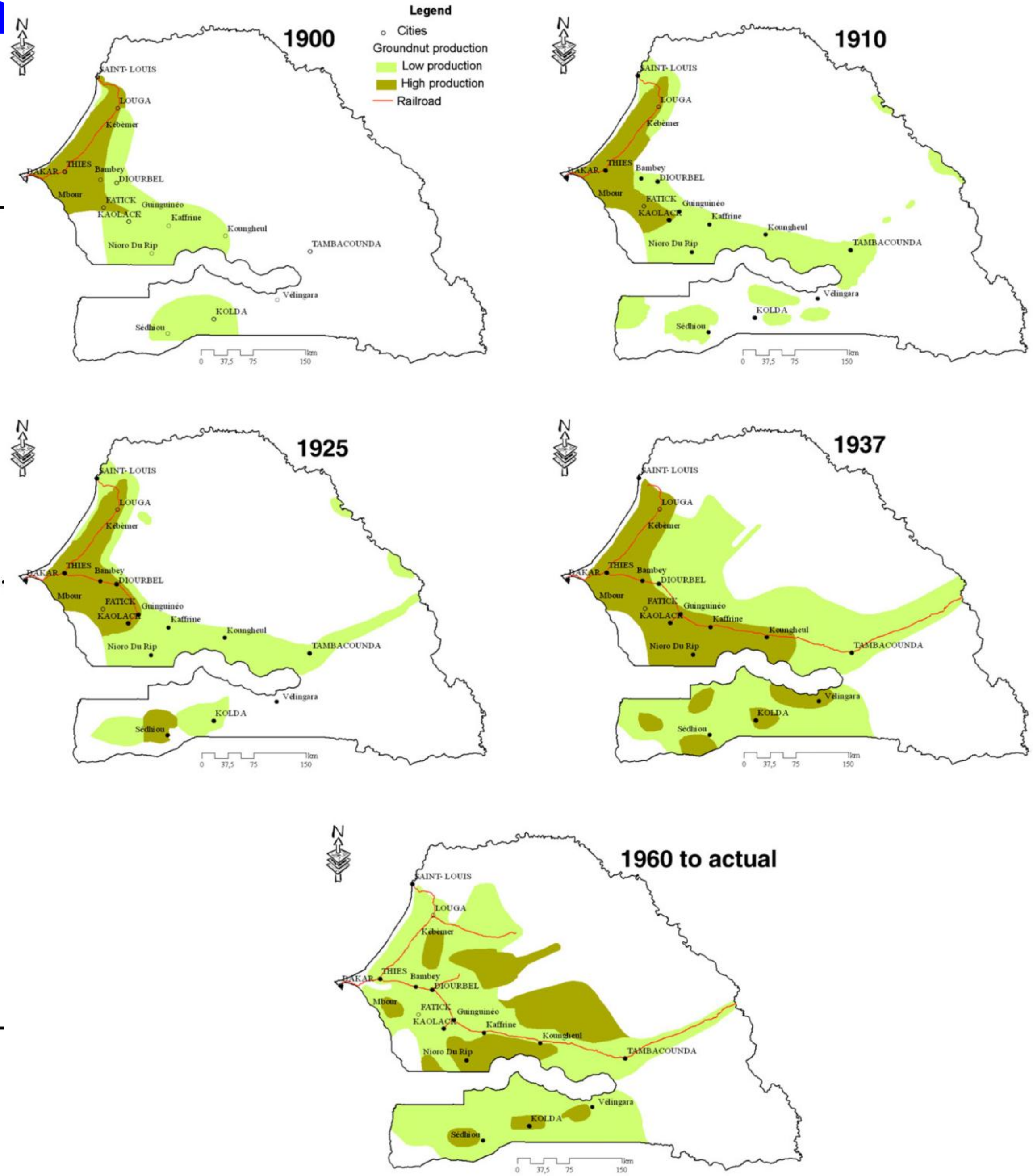
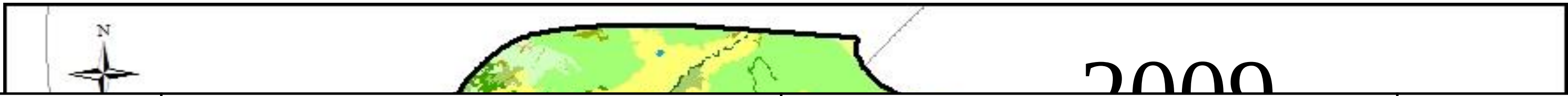


Fig. 2. Evolution of the "Peanut Basin" in Senegal—co-evolution of the railroad network (update of Porteres report, 1952).



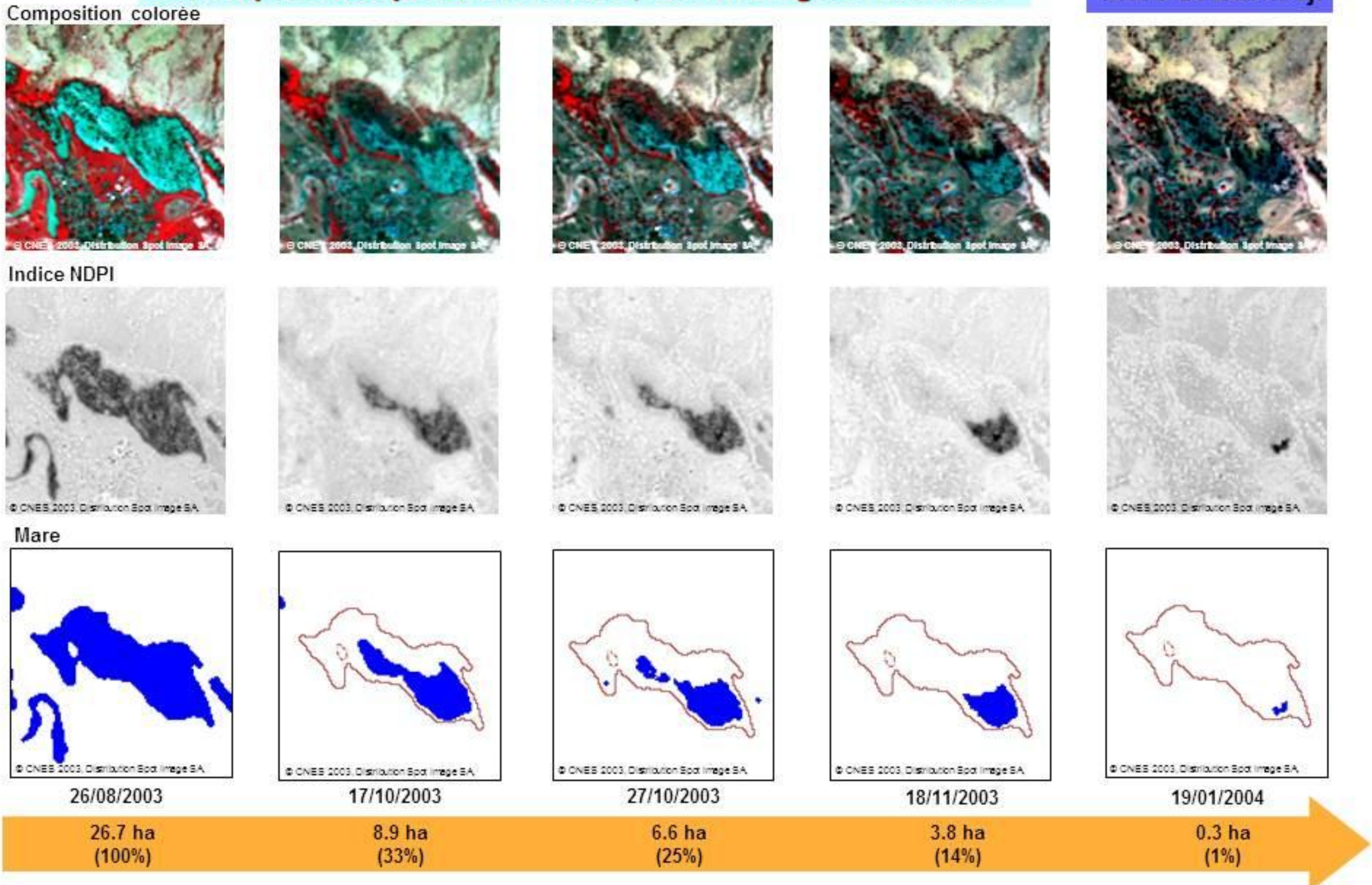
Classe	Superficie (ha)			Evolution des superficies			%
	1973	1987	2009	1987-1973	2009-1987	2009-1973	2009-1973
Savane boisée	6275,02	4162,57	397,36	-2112,45	-3765,21	-5877,66	-2,90
Savane arborée	44300,65	11606,49	13092,73	-32694,17	1486,24	-31207,92	-15,42
Savane arbustive à arborée	95550,42	85888,83	28762,20	-9661,58	-57126,63	-66788,22	-33,00
Savane arbustive	8686,51	11061,41	24227,33	2374,90	13165,92	15540,82	7,68
Steppe arbustive à arborée	19781,01	28296,15	63991,98	8515,15	35695,83	44210,98	21,84
Steppe arbustive	10293,18	14583,71	19184,04	4290,53	4600,33	8890,87	4,39
Culture/Jachère	15380,78	44676,35	50466,79	29295,57	5790,44	35086,01	17,34
Mare	613,18	579,81	541,37	-33,37	-38,44	-71,80	-0,04
Cuirasse	242,55	554,33	561,92	311,78	7,59	319,37	0,16
Sol nu	1146,63	834,25	1006,77	-312,38	172,52	-139,86	-0,07
Habitat	127,13	153,15	164,56	26,01	11,41	37,42	0,02

LU/LC in Barkedji region (BA, 2010; not to distributed!)

Un outil spatial adapté à la surveillance de la (FVR) -1

Suivi spatio-temporel des mares, donc des gîtes larvaires

Mare de Barkédji



Pond detection in Ferlo area (Senegal) using NPDI

SPOT 5 10m
26/08/2003

...bution Spot Image SA,
to...

...3 ha water bodies identified

SPOT-VEGETATION dekad... m
21/08...

100 ha (1 pixel) water bodies identified

The right data to tacle the issue at the correct scale!

Correct pond cartography

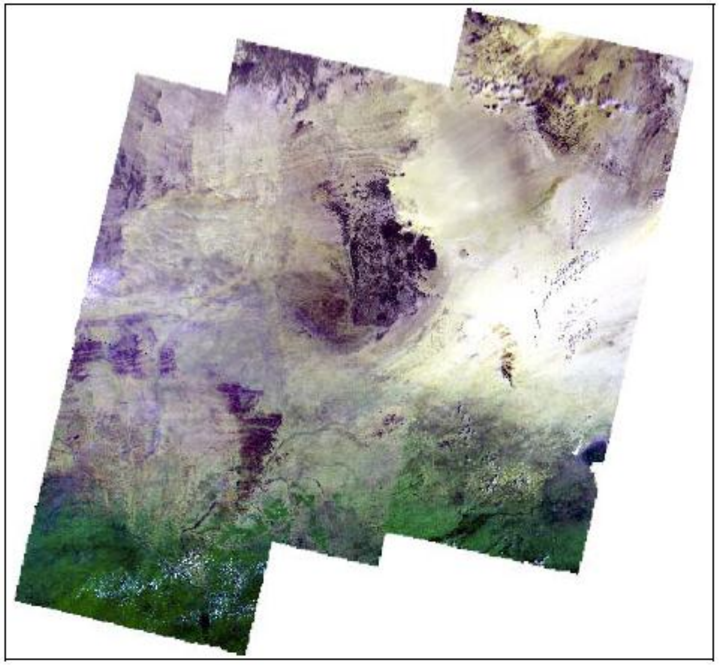
Breeding sites

Conclusion

- Remote sensing can be useful for applications reagrding to environment statistics

- Remote sensing allows the collection of detailed data about bio-physical characteristics that cannot be collected by questionnaires

Courtesy: Dozie Ezigbalike (UNECA)



Conclusion (2)

- **GIS allows the data, even questionnaire dat... visualized graphically**
- **GIS also provides for interpolati... spatial samples, and com... based on their locati...**

Strong need of capacity building regarding remote sensing data process, and GIS tools and softs

- ... gether:
- ... ivities and events on environment
- ... esponses to impacts
- ... uality and availability of natural assets

Courtesy: Dozie Ezigb... e (UNECA)

Aknowledgements

United Nations Nations Unies

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STATISTICS DIVISION (UNSD)

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Centre de Suivi Ecologique

ANSD
Agence Nationale de
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