GEOBENE

UNCCC Climate Change Talks, Accra, Ghana

IIASA - Side Event

IIASA Science for Global Insight www.iiasa.ac.at

REDD for Ecosystem Services

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Questions

1. Which Financial Resources are needed for REDD?
2. Is Permanence an issue?
3. Will REDD help to maintain ES?
   - How much?
   - Where?
4. Can REDD be implemented so that ES can be maximized?
5. Can baselines be determined to appropriately account for different National Circumstances

Which Financial Resources are needed for REDD?

- Strongly depends on the implementation mechanism (compensation for private or social opportunity costs)
- Efficiency of the implementation
- Baselines (incl. D or DD)

Domestic and international financial policy instruments targeting deforestation

	Incentives type	Tax type
International funding	• ODA funding support to national "avoided deforestation" policies • Carbon credits trading	• International agreements: payment above negotiated deforestation level
Domestic funding	• "avoided deforestation" policies financed through subsidies. • Redistributive budget schemes • Environmental services payment	• Land clearance tax • Timber sales tax • Non-renewable energy tax • Emission tax

Two Mechanisms for Avoided Deforestation

- **Deforestation Tax**
  - Assuming Monitoring System for D
  - Reinvested Tax revenues in Rural Development Schemes?!

- **Carbon Stock Rental Contract (series of tCERs types)**
  - Assuming fully operational Land Management Plans identifying Deforestation ex ante & working governance system.

2035 Scenario:
50% Deforestation

Incentive Scheme: tCER

- **$ 6/tC/5yr**

Tax Scheme

- $ 9/tC (all Slash-burn)
- **$12/tC (FAO HWP)**
- $25/tC (all HWP pool)

2035 Scenario:
50% Deforestation

Total Investment Required

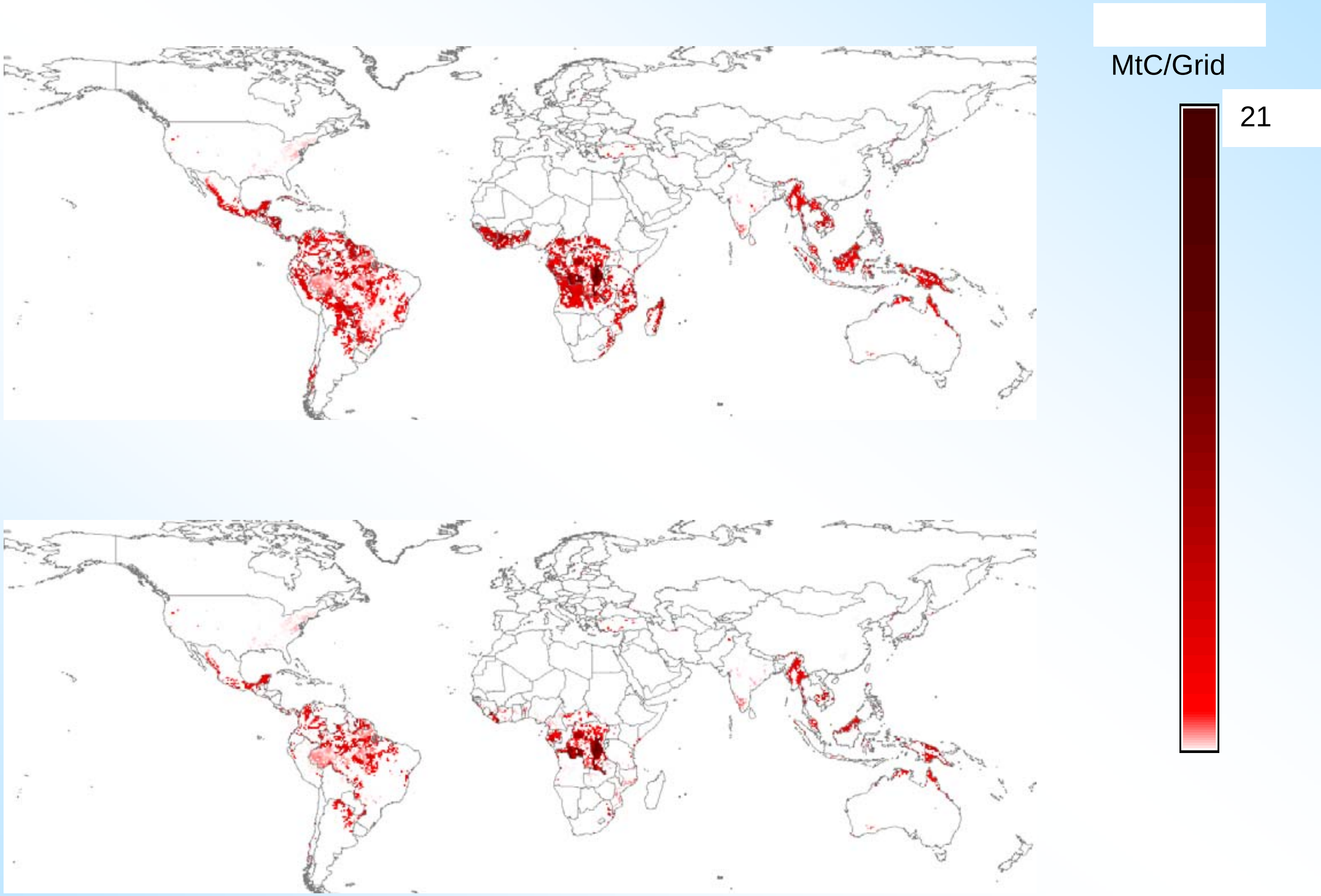
$33 Billion per Year

Manna from the Trees?

- 33 bn/year reduce deforestation by 50%

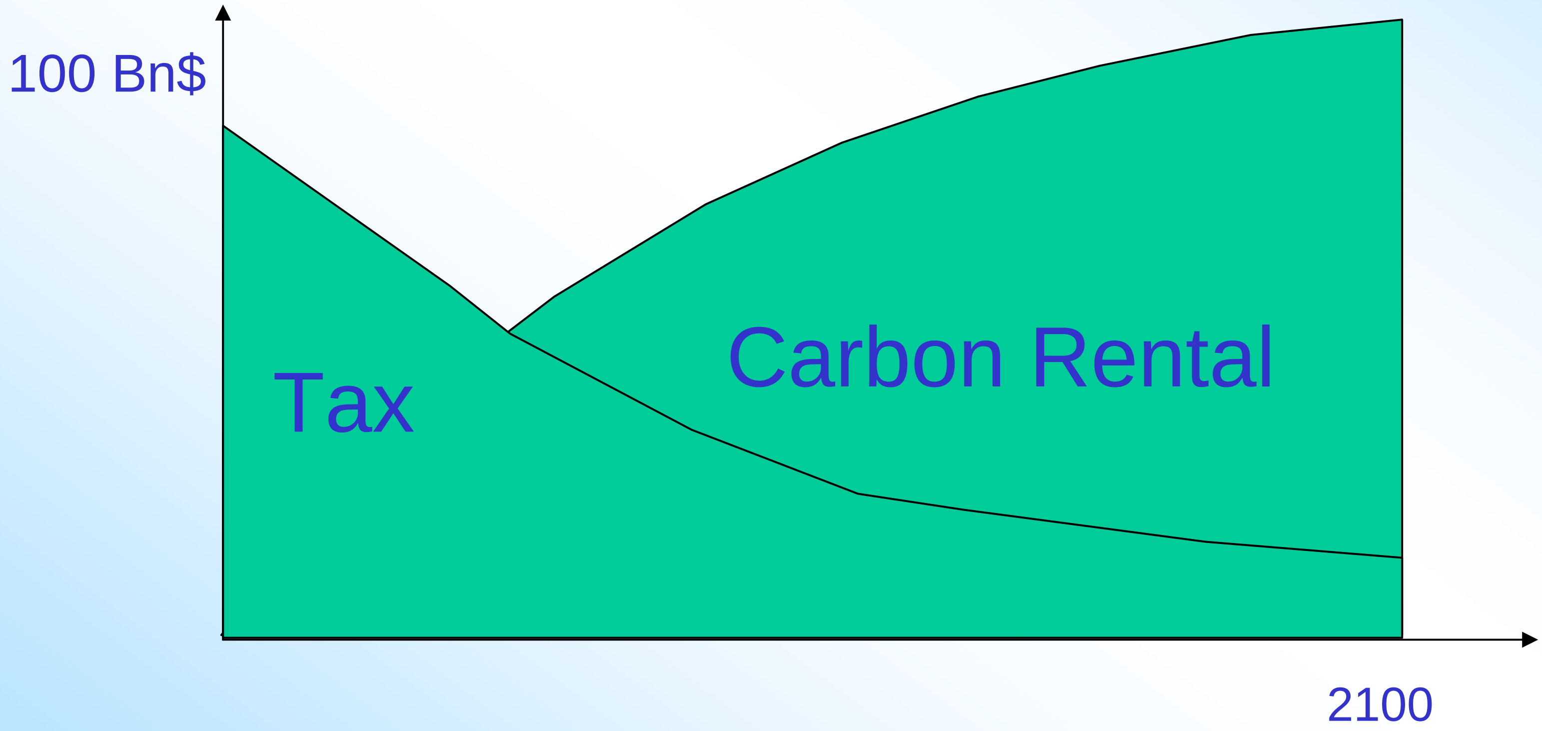
- 18 bn/year total investment in forestry
  - 600 million FDI (agri, hunting, fishing & for)
  - 564 million ODA to forestry

Google Maps

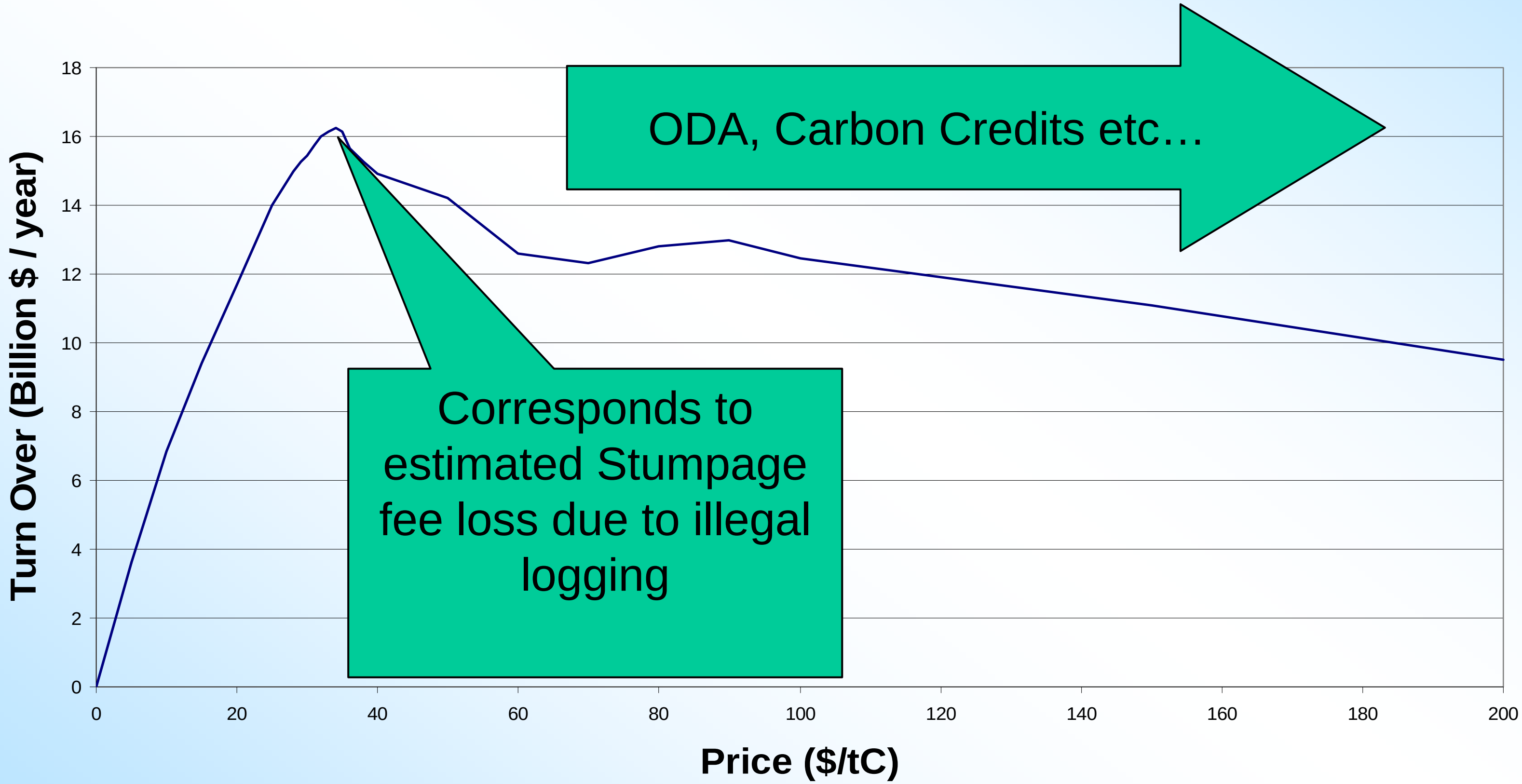


Source: Kindermann et al. 2006

Tax and Rental fee revenue streams

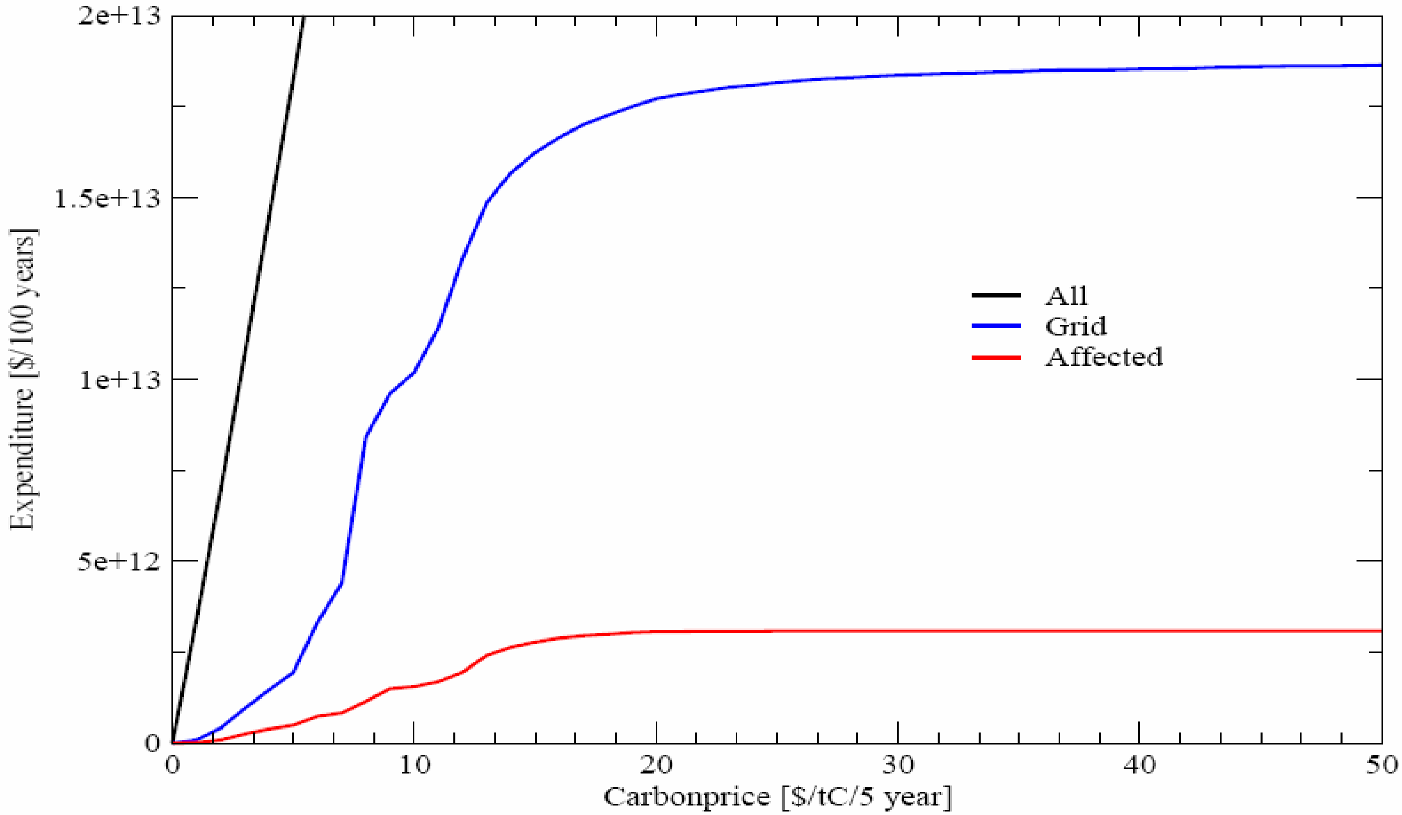


Tax and International Fungibility



Kindermann et al. 2006

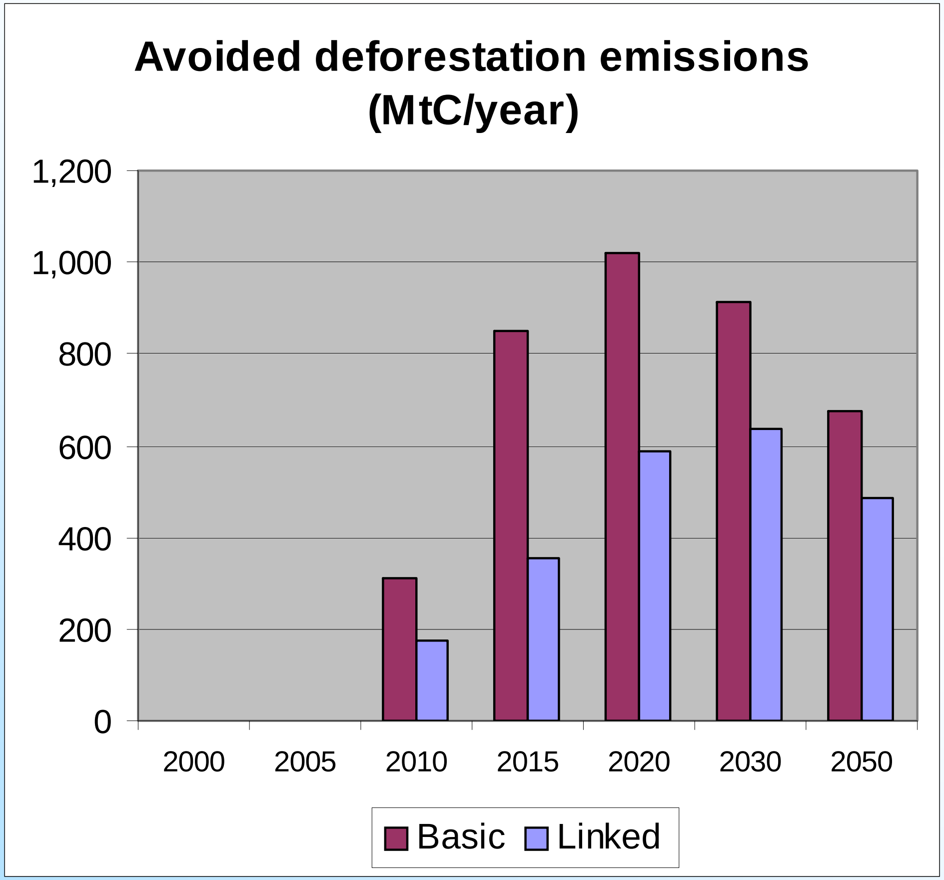
Costs of Incentive under Information Asymmetry

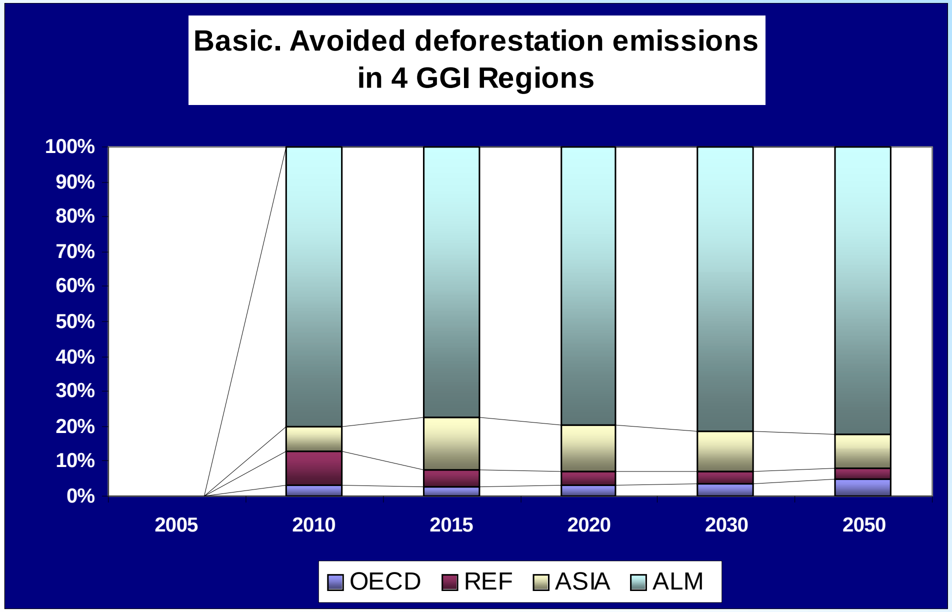


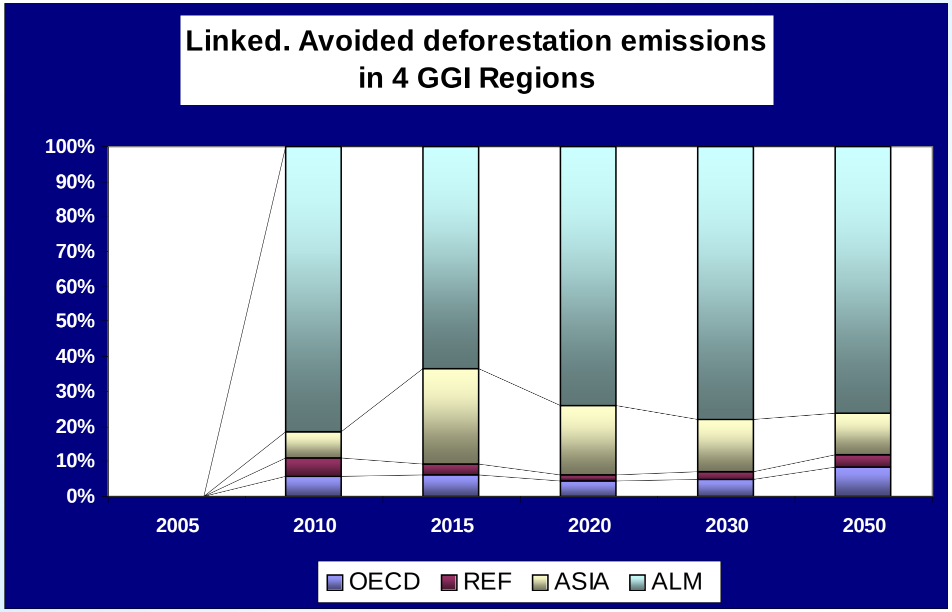
Costs f(System Bounderies)

- REDD as forest sector solution only
- REDD within a Full Land Use context
  - Competition over land
  - GHG leakage (e.g. N2O due to agricultural intensification)

Avoided deforestation emissions
at C price up to 100$/tC







Conclusion on Costs

- 10-60 Billion $ will need to be moved
- Implementation Mechanism crucial
- Information is valuable
- REDD needs to be costed out in a full LUCUF context

Is Permanence an Issue?

- With CCS fossil emissions are no longer permanent!
- Terrestrial and fossil carbon stocks can be renewed on a similar time scale!
- With BECCS we can even increase the fossil (litospheric) carbon pool.

=> Fungibility problem of two sectors with different capping mechanisms

Physical Permanence

Who wants to be eternal (permanent) in REDD if forests are subject to climate change (calamities, ecotone shift) and if you loose your land expansion option.

Conclusion

Permanence should **not** be viewed as a **physical problem**, but rather as a **mechanism design** problem which is not too difficult to be solved

Will REDD help to maintain ES?

- What are Ecosystem Services?
- History of the Ecosystem concept
- Ecosystems and biodiversity
- Co-benefits of avoided deforestation and ecosystem services
- How much and where?
  - Level of Ecosystem Services conserved (trillions)
  - Cheapest REDD max ES
  - Current uncertainties (GEO-BON)
  - GEO/GEOSS/GEOBON/GEOCARBONtask…..
  - Monitoring costs

What are Ecosystem Services?

- Humans benefit from a plethora of resources and processes that are supplied by natural ecosystems
- Collectively these benefits are known as ecosystem services
- An ecosystem is a dynamic complex of plant, animal, and micro organism communities and the nonliving environment, interacting as a functional unit. Humans are an integral part of ecosystems
- Ecosystem services can be distinguished into 4 categories 1. Provisioning, 2. Regulating, 3.Supporting, 4.Cultural ecosystems

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Provisioning Services

Products obtained from ecosystems

- Food
- Fresh water
- Fuelwood
- Fiber
- Biochemicals
- Genetic resources

Regulating Services

Benefits obtained from regulation of ecosystem processes

- Climate regulation
- Disease regulation
- Water regulation
- Water purification
- Pollination

Cultural Services

Nonmaterial benefits obtained from ecosystems

- Spiritual and religious
- Recreation and ecotourism
- Aesthetic
- Inspirational
- Educational
- Sense of place
- Cultural heritage

Supporting Services

Services necessary for the production of all other ecosystem services

- Soil formation
- Nutrient cycling
- Primary production

Millennium Ecosystems Assessment, 2005

Short History of the concept of Ecosystems

- the notion of an ecosystem is ancient, however ecosystems became a unit of study less than a century ago,
- when Arthur Tansley provided an initial scientific conceptualization in 1935 (Tansley 1935) and Raymond Lindeman did the first quantitative study in an ecosystem context in the early 1940s (Lindeman 1942).
- First Textbook written by Eugene Odum, was published in 1953 (Odum 1953).
- a relatively new research and management approach, even though it is a central concept to understand the nature of live on earth

Millennium Ecosystems Assessment, 2005

Important issues/points

- It is common practice in economics both to refer to goods and services separately and to include the two concepts under the term services. Although “goods,” “services,” and “cultural services” are often treated separately for ease of understanding, for the MA all of these benefits were considered together as “ecosystem services”

- When people refer to “ecosystem goods and services,” cultural values and other intangible benefits are sometimes forgotten.

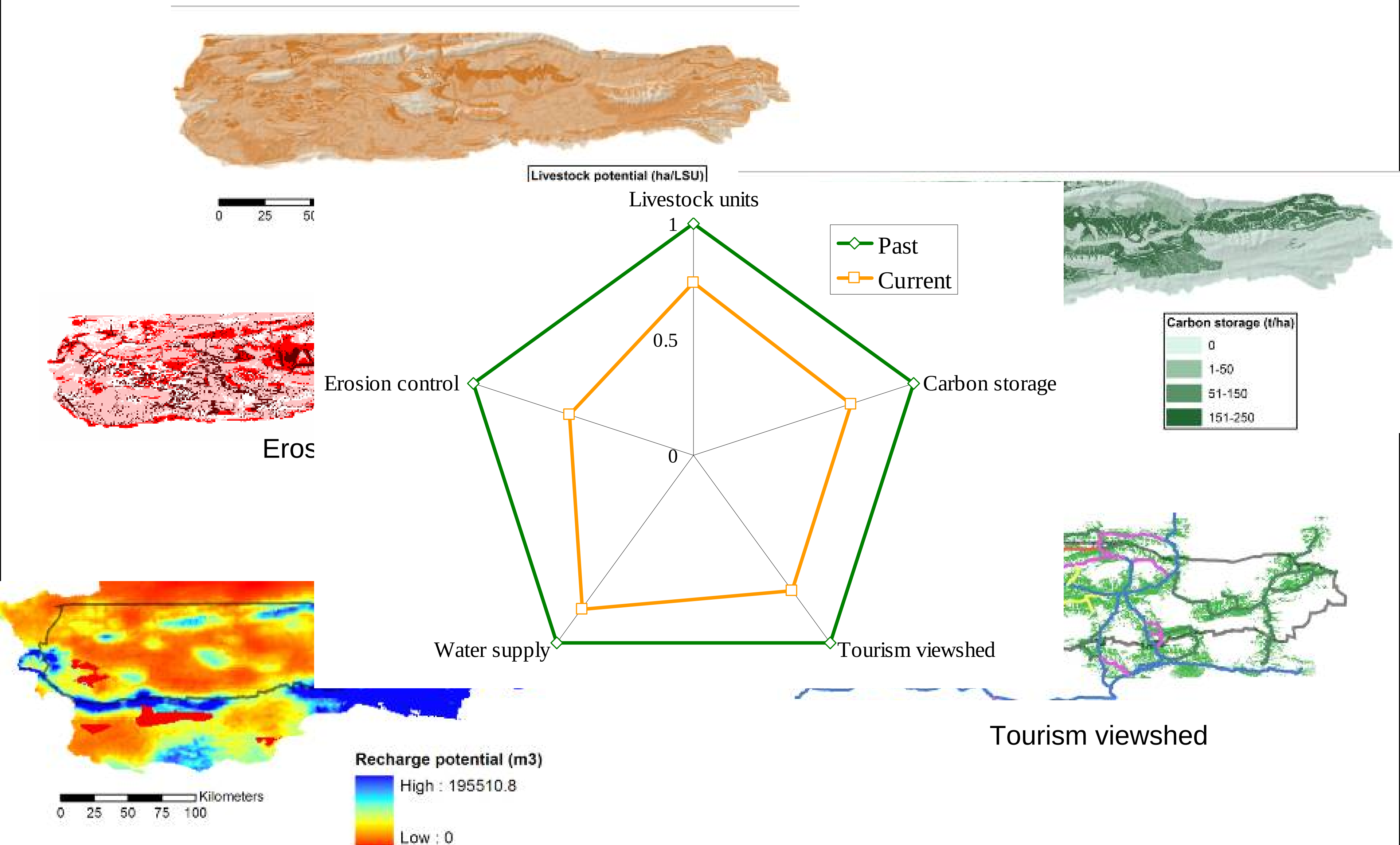
- People are considered part of the ecosystem. Traditional ecological knowledge needs to be considered, integrated, efforts from both sites are necessary

- Payment for ecosystem services are increasingly considered and valuation of these services might be required

Ecosystem services, Biodiversity, socio-economic effects, win- win solutions

- Efficiency of incentives to jointly increase carbon sequestration and species conservation on a landscape (Nelson et al, 2008, PNAS)
- Ecological and socioeconomic effects of China's policies for ecosystem services(Liu, 2008, PNAS)
  - systematic planning, diversified funding, effective compensation, integrated research and comprehensive monitoring

Monitoring Ecosystem Services



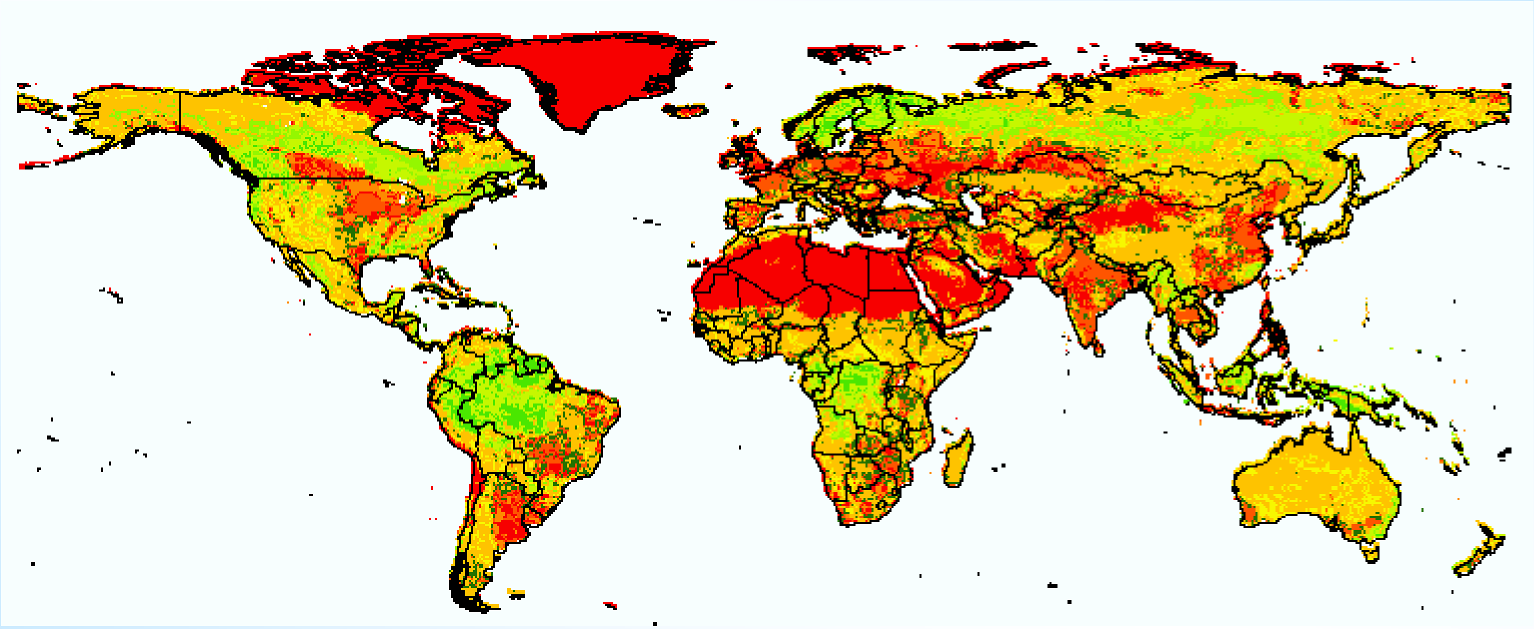
Reyers et al. In review

Different methods of valuation

- 1. avoided cost
- 2. replacement cost
- 3. factor income
- 4. travel cost
- 5. hedonic pricing
- 6. contingent valuation

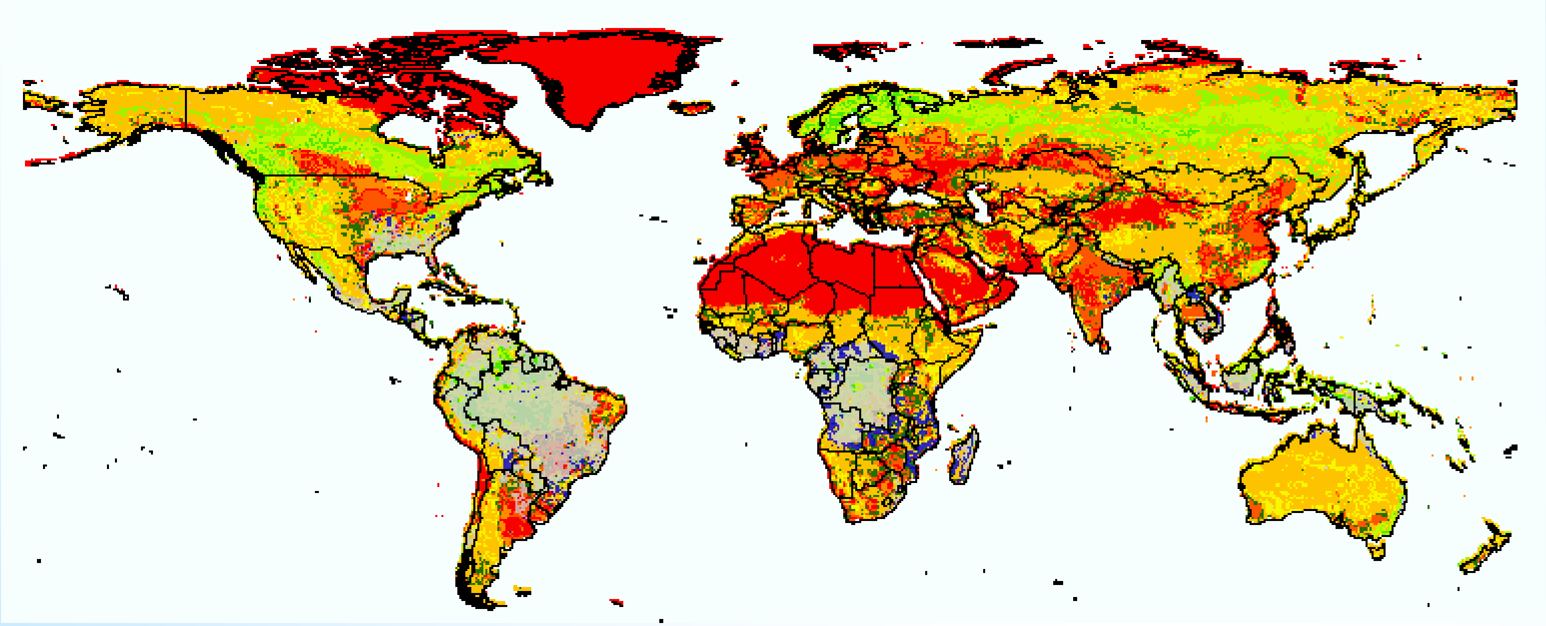
- Costanza, 1997, estimated that globally ecosystems are worth 33 trillion dollars, however critics say:
  - Not possible to put value on ES
  - Not possible to extrapolate
  - Big gaps in ecosystem valuation
- Millennium ecosystems assessment
  - Better valuation techniques since then
  - Taking increasingly people and livelihoods into account

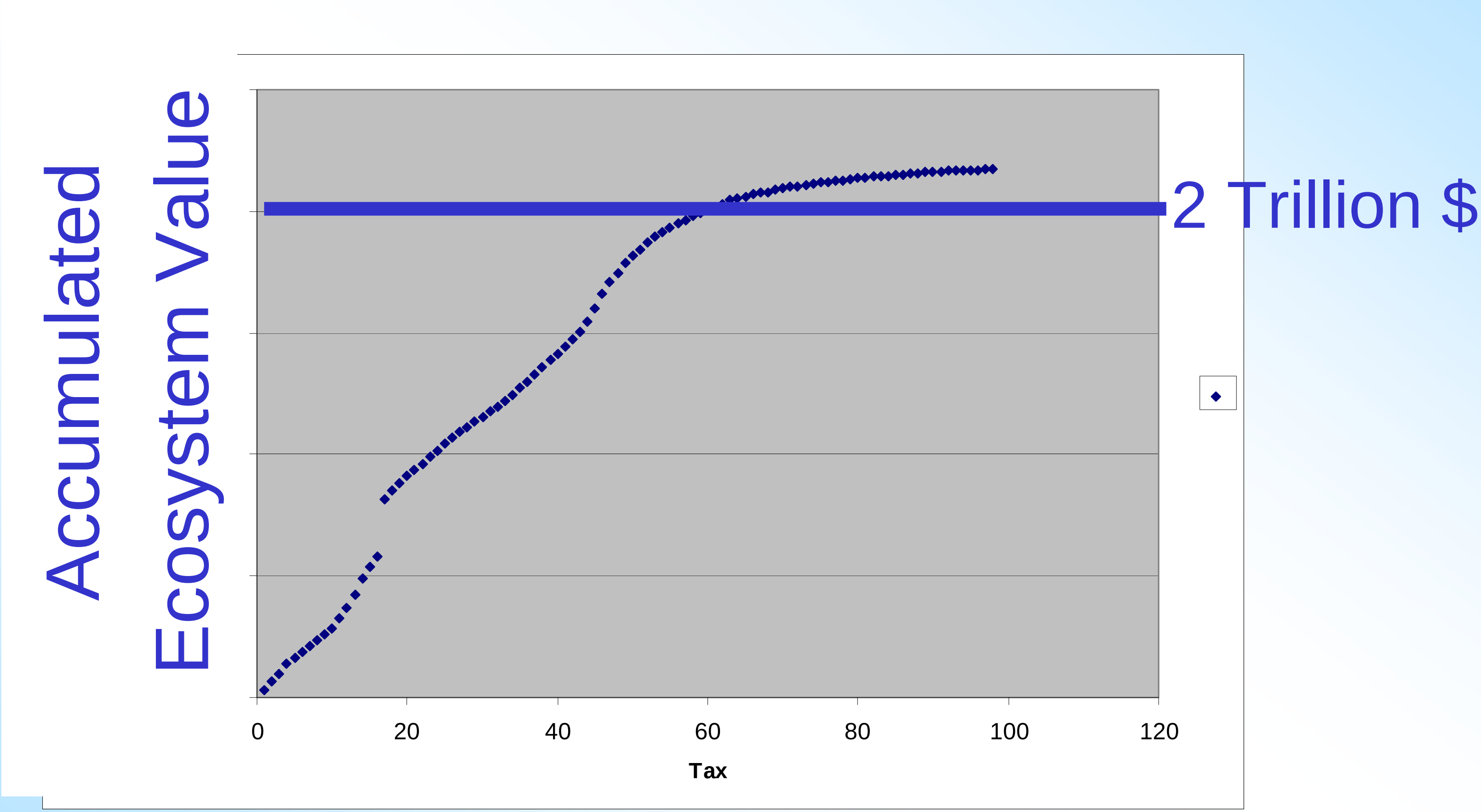
Ecosystem Value Map



Constanza, 1997

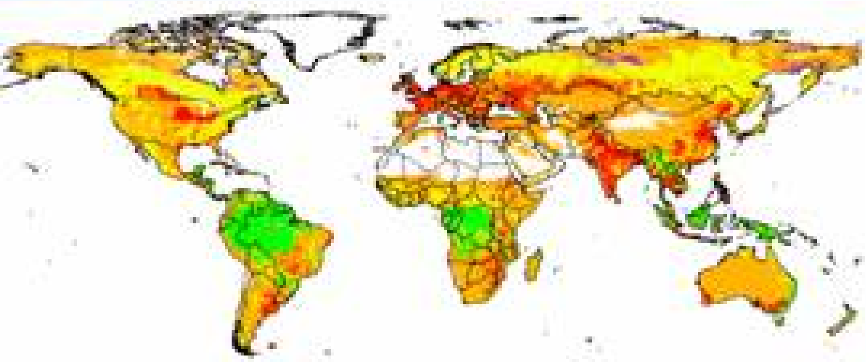
Ecosystem Value Map with Costs of REDD (12$/tC)

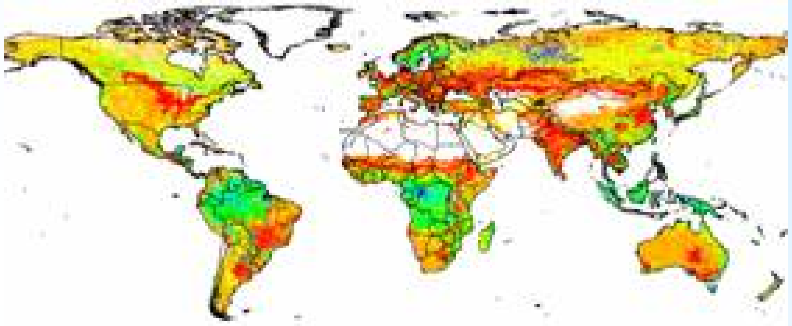




Accumulated Ecosystem Value
2 Trillion $
0
20
40
60
80
100
120
Tax

- Money spend for avoided deforestation versus the ecosystem value results in an order of magnitude of 1 to 100
- However, quite high uncertainty
- Recent trial to map ecosystem services Naidoo et al., PNAS, 2008
  - Conclusion, big data gaps

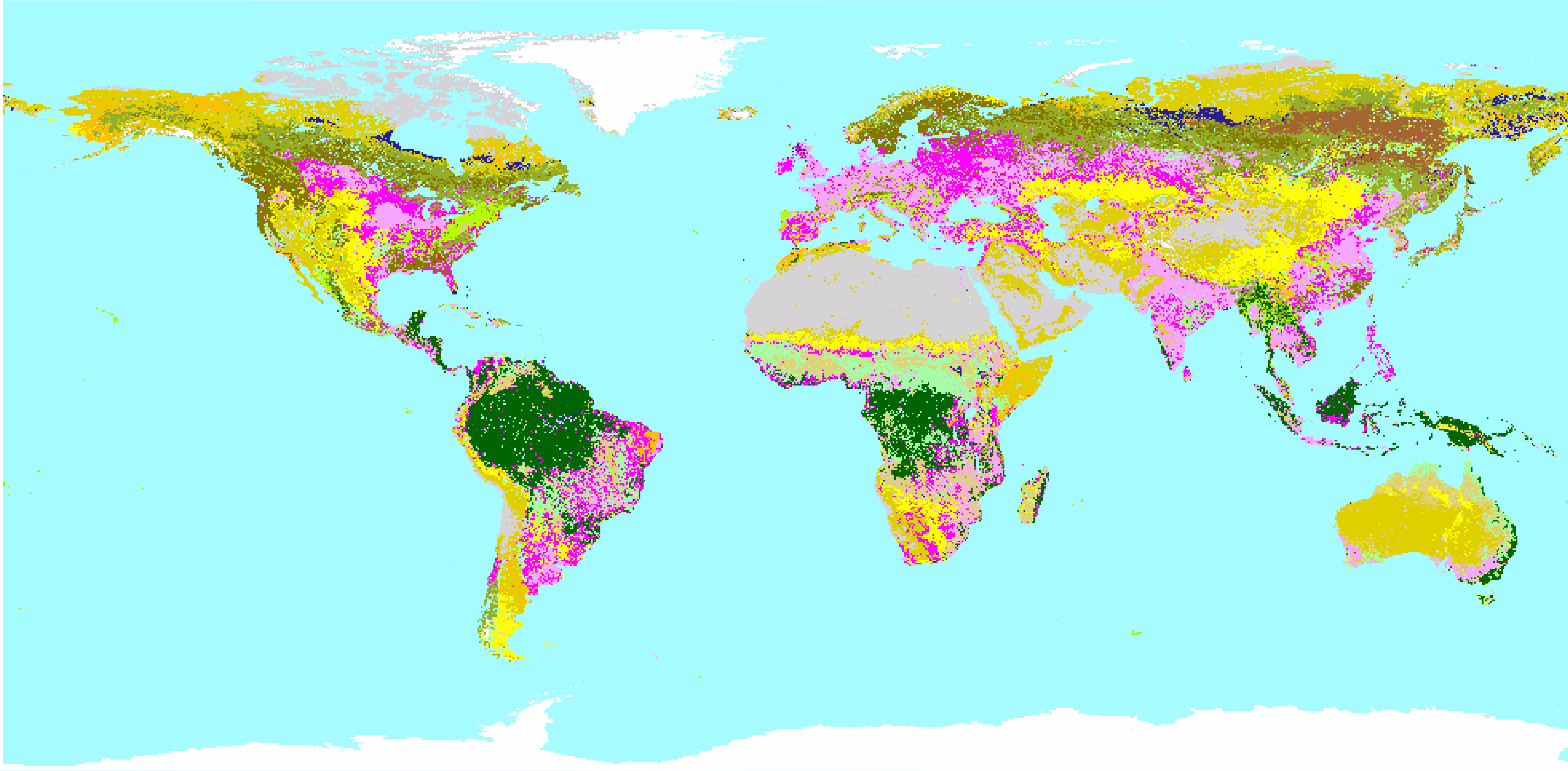




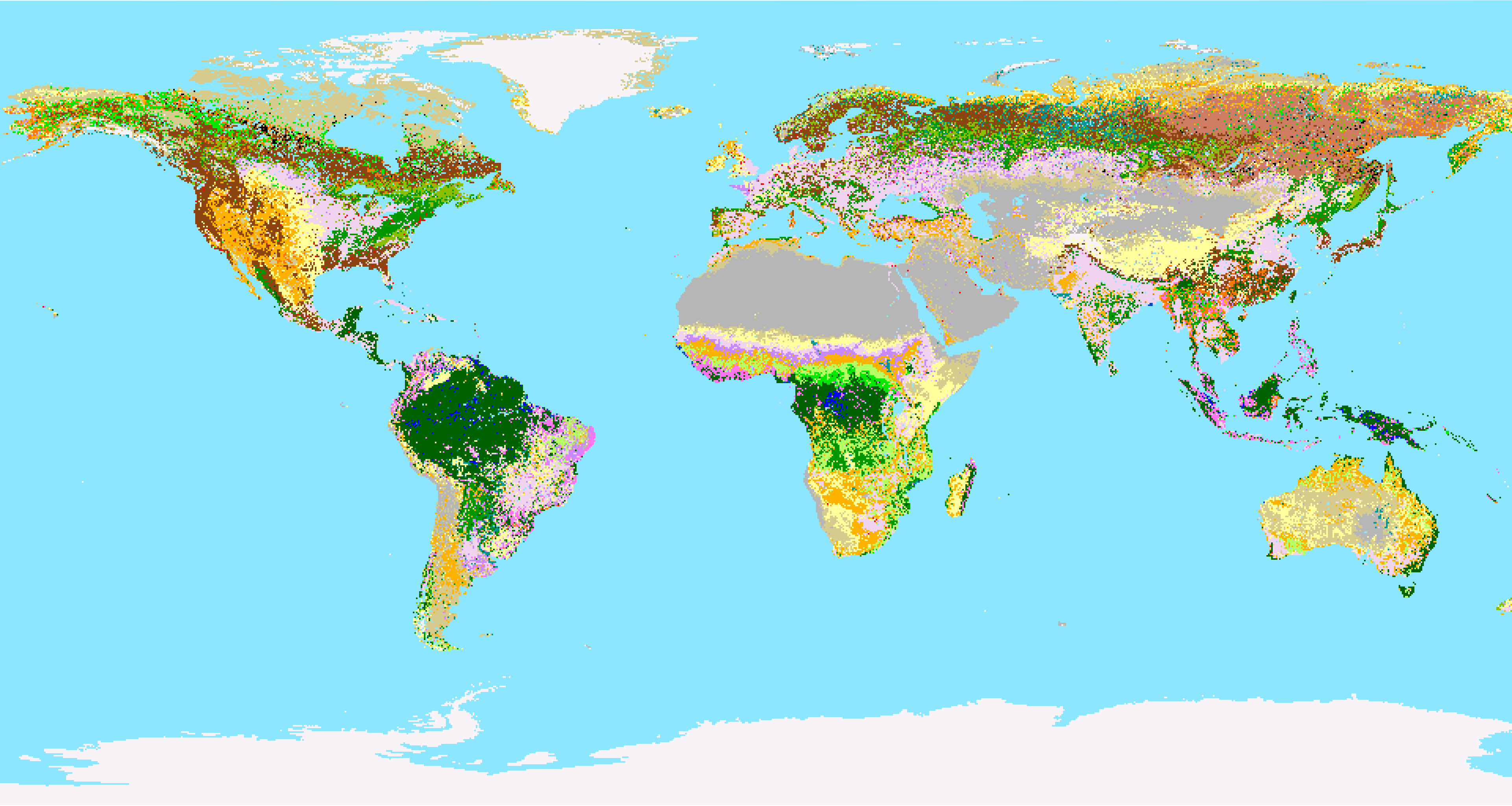
Costanza, 1997

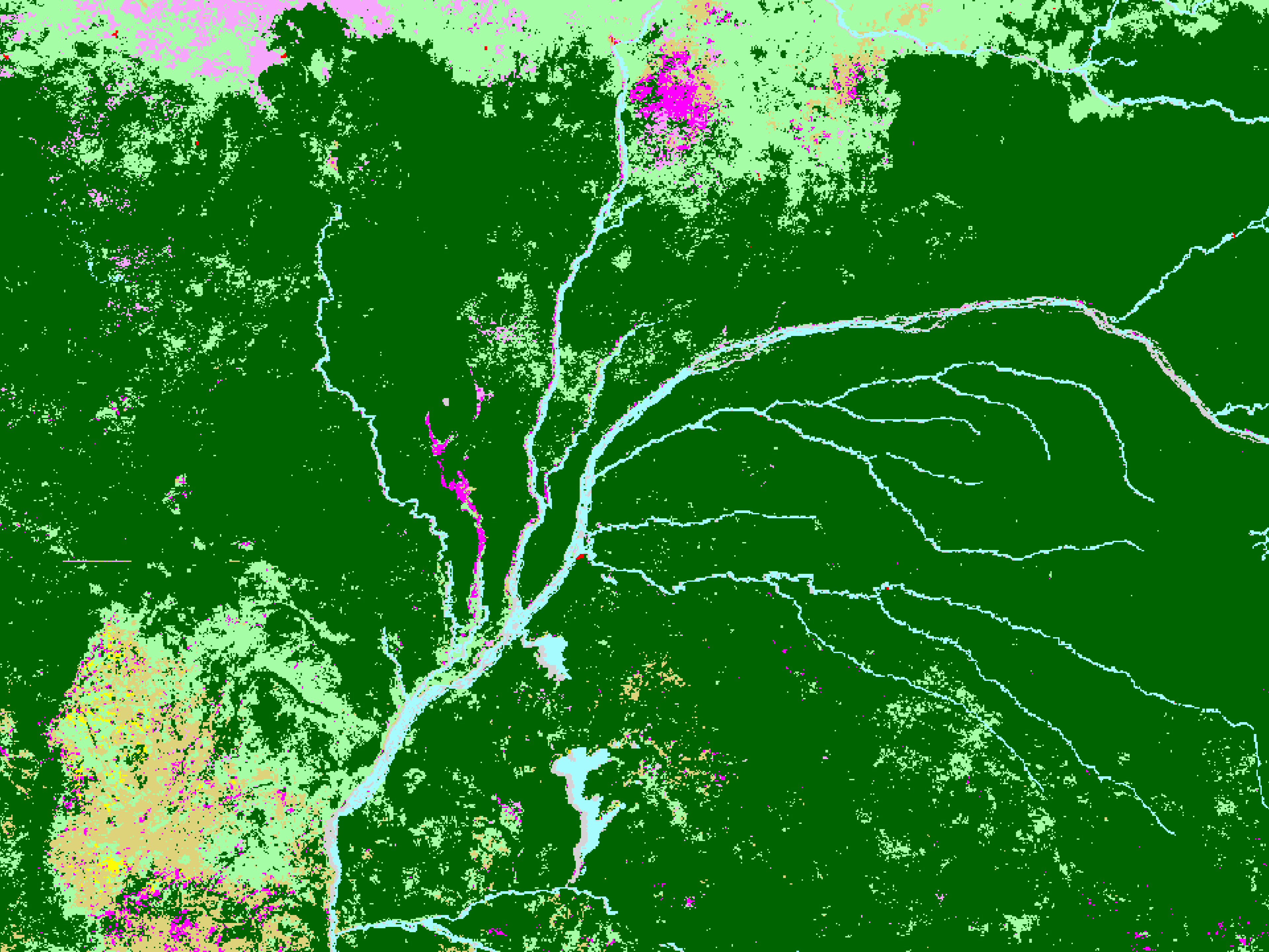
Recent activities to improve map of Costanza, 1997

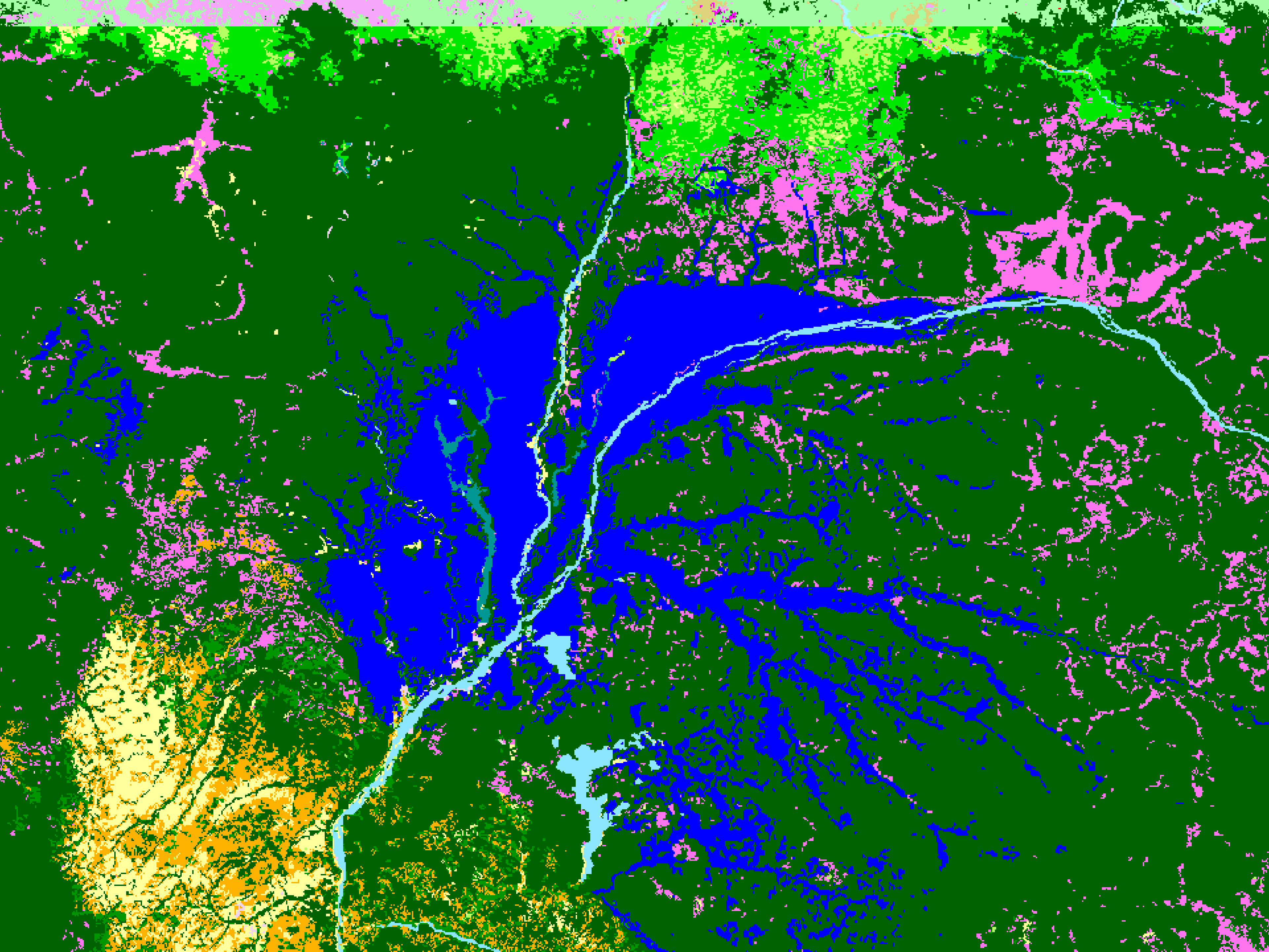
IGBP land cover



GLC-2000



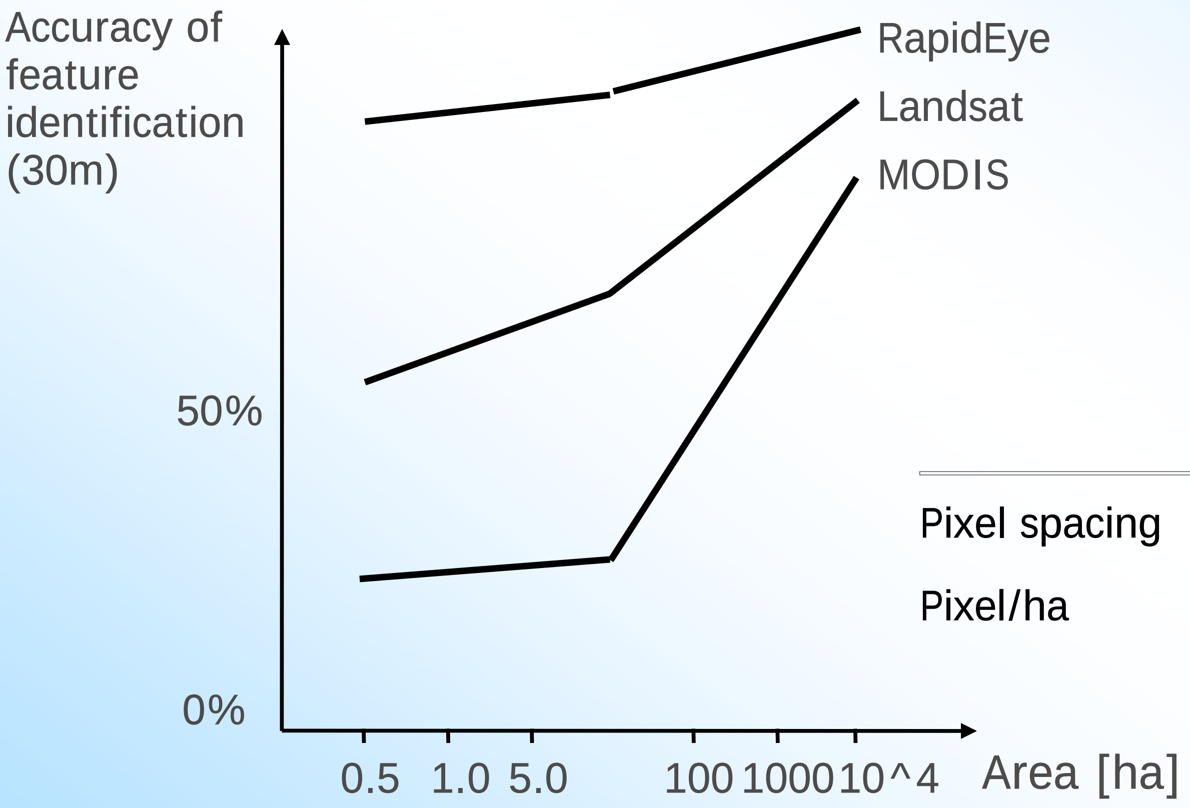




Current monitoring activities

- Geo/Geoss
- In 9 Societal Benefit areas (Climate, Weather, Agriculture, Biodiversity, Ecosystems, Water, Health, Energy, Disaster)
- Geo-Bon
- GeoCarbon

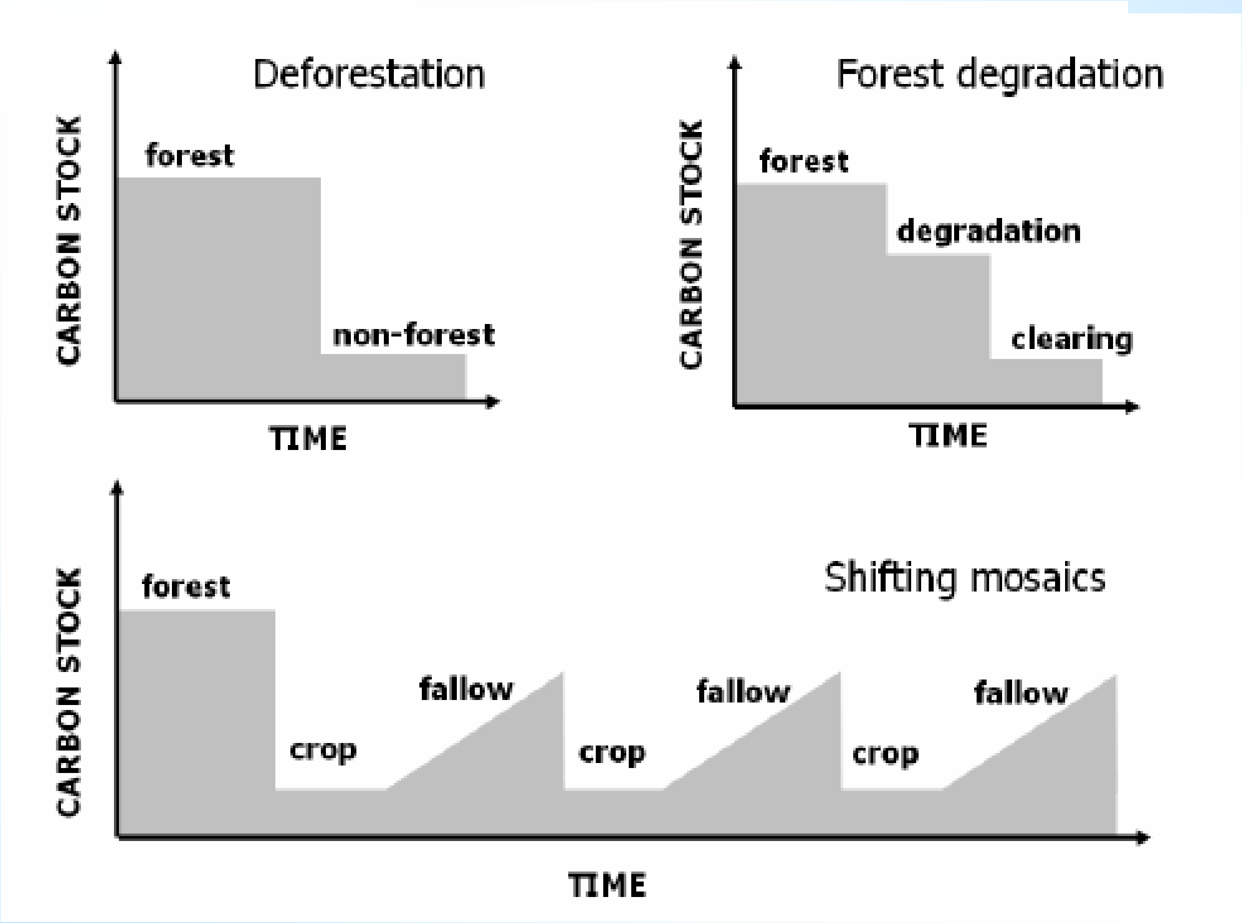
Accuracy of Forest vs. Non-Forest/Forest degradation assessments highly depends on the resolution (pixel spacing) of satellite imagery.



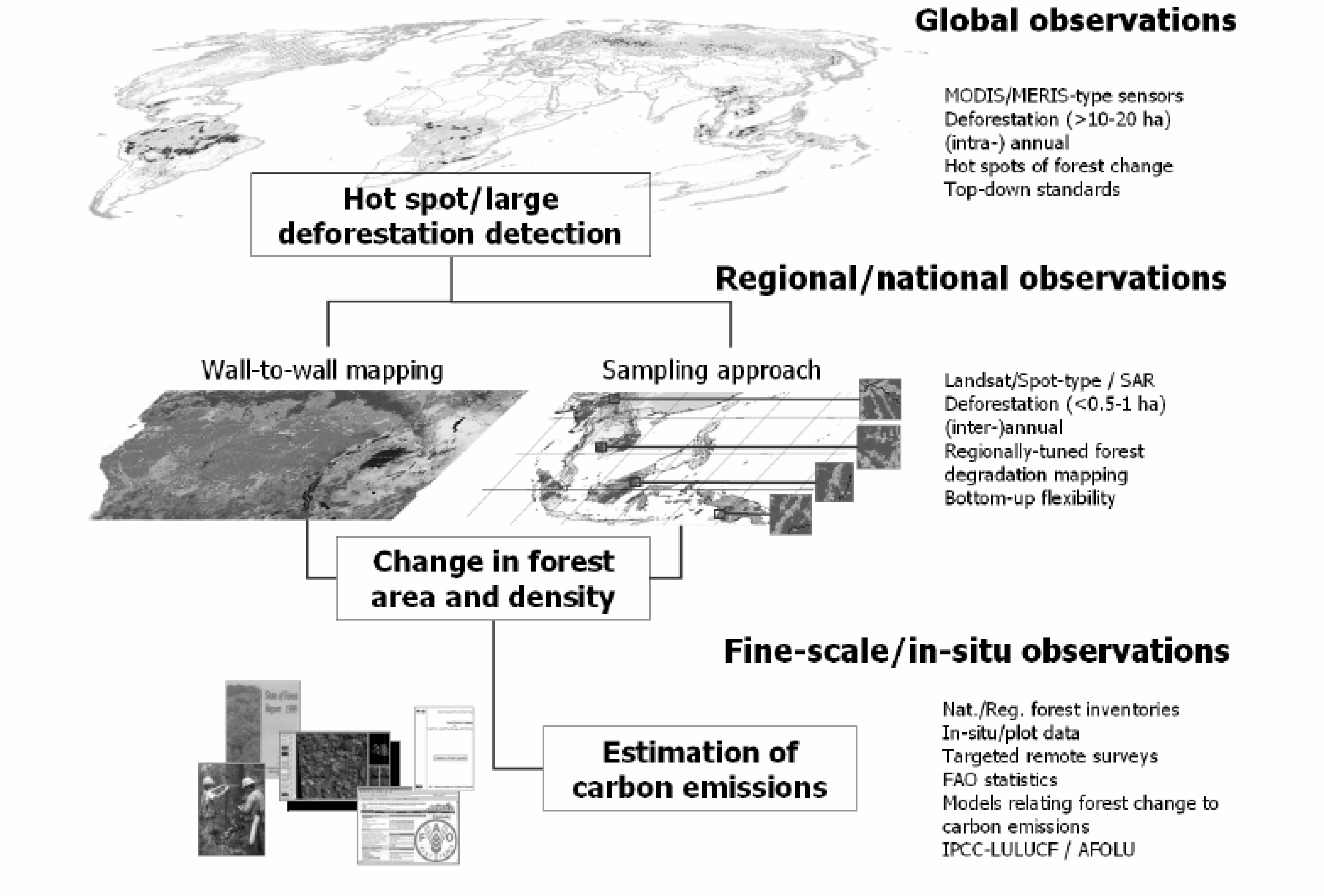
	RapidEye	Landsat	MODIS
Pixel spacing	5m	30m	250m
Pixel/ha	400	11	0.16

Carbon Stock Assessment Effort

- Biome classifications and average figures for ecosystem biomasses
  - No additional costs
- Sample Plots:
  - 300m² sample plot: Species/Height/BHD or biomass volumes: approx. 2 man-hours
  - Costs vary considerably (Austria:)
  - Few sample plots/100km² representing each land cover/ecosystem/forest formation
- LiDAR Scanning
  - approx. 7.50 $/ha (1-2 points/m²)
  - For boreal, temperate and open tropical forest stands
  - Not applicable in dense tropical forests
  - Representative areas of each land cover/ecosystem/forest formation



GOFC-GOLD, Report 26, August 2006

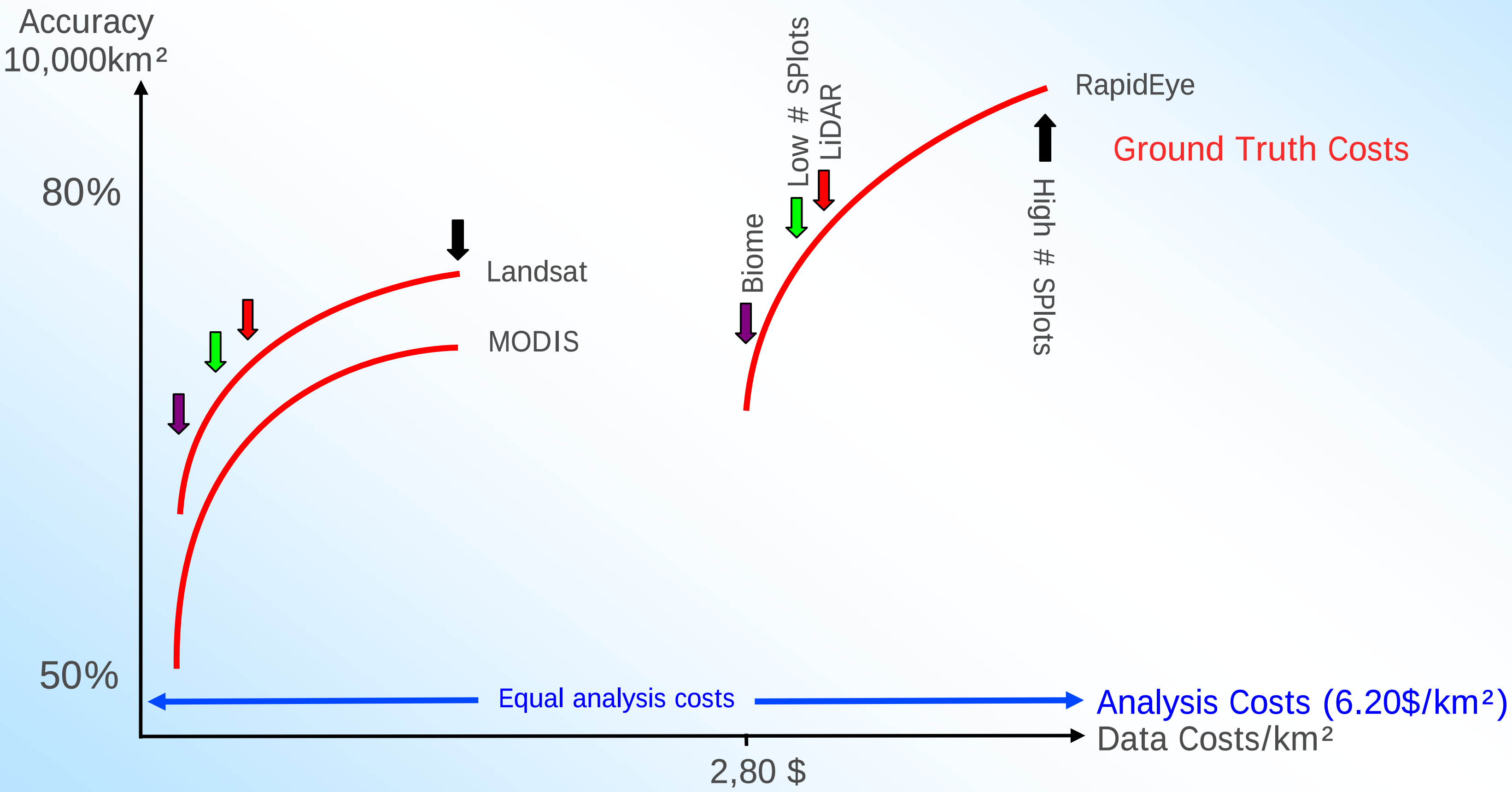


GOFC-GOLD, Report 26, August 2006

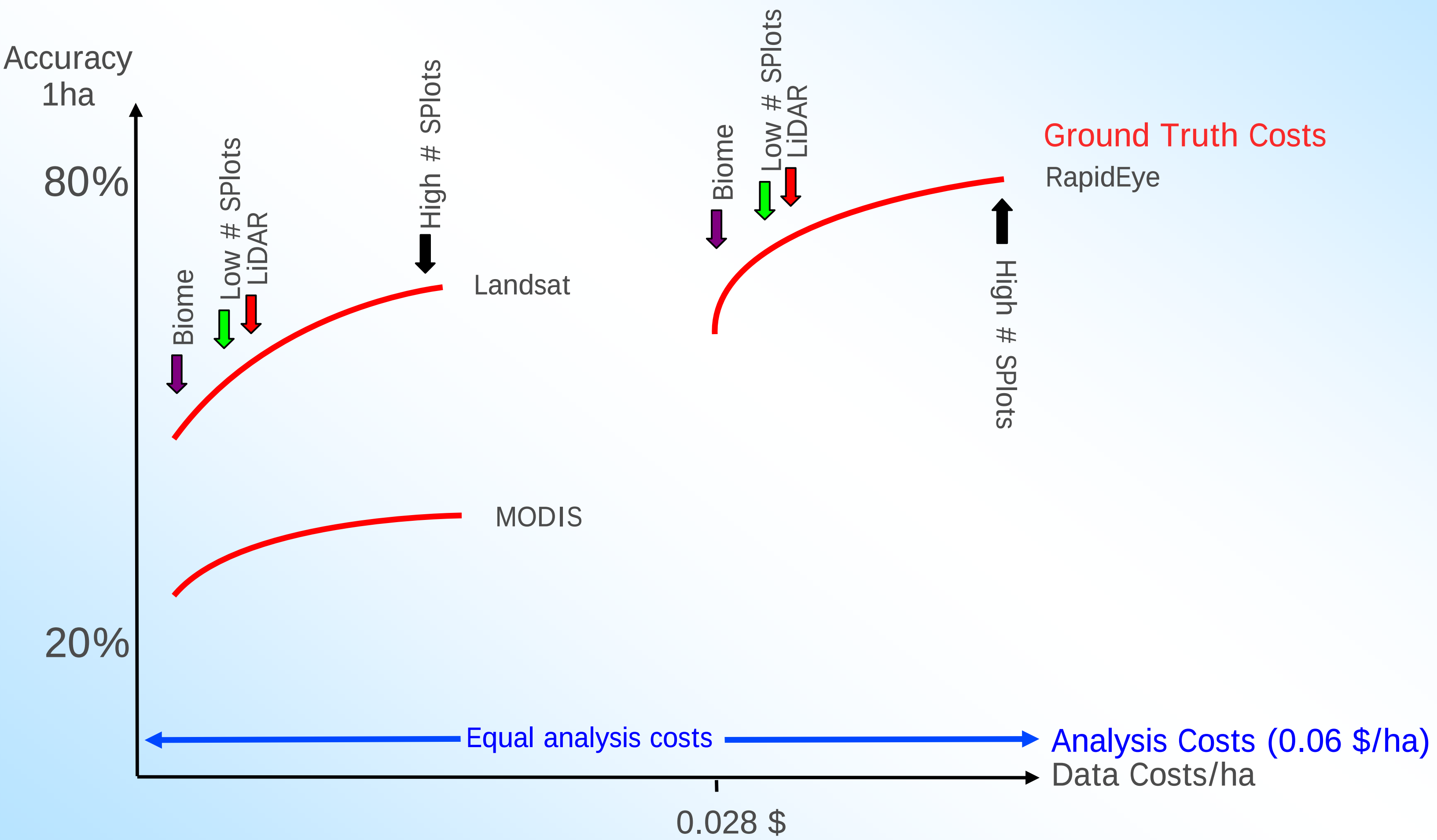
Monitoring Pathways

Origin of satellite data	MODIS	Landsat		RapidEye
Origin of ground data	Biome averages	Low # of sample plots	High # of sample plots	LiDAR
Description	Biomass estimations based on existing investigations/models	Low sampling density covering all major ecosystems	High sampling density covering all forest formation and	LiDAR scanning flight campaign covering representative areas

Assessment of Large Areas (>1Mill ha)



Assessment of Small Areas (1 ha)



Cost Comparison

	Min $/ha	Max $/ha
Opportunity costs	2	2705
Administration	4	15
Transaction costs	18	450
Monitoring costs	2	8
Data	-	0.03
Analysis Costs	0.06	0.06
• Basic Land Cover Classification		
• Forest Mask (Forest – Non-Forest)		
• Biomass / Volume Estimations		
• Change Detection		
Carbon stock estimation/Ground truthing	2	7.50

Conclusion

- It makes a lot of sense to look at avoided deforestation and ecosystem services together
- Forest people are part of the ecosystem service and their traditional environmental knowledge needs to be integrated
- The global analysis reveals that low taxes for avoided deforestation coincide with high ecosystem values
- More global efforts are needed to close observation gaps and to be able to better quantify ecosystem services
- Remote sensing can help to be able to better quantify ecosystem services as well as monitoring deforestation
- All elements of ecosystem services need to be considered and possibly quantified, more ecosystem valuation studies are required
- Monitoring costs are relatively low compared to other costs

Can REDD be implemented so that ES are maximized?

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Interim Report IR-01-011

Cap Management for LULUCF Options:

An economic mechanism design to preserve the environmental and social integrity of forest related LULUCF activities under the Kyoto Protocol

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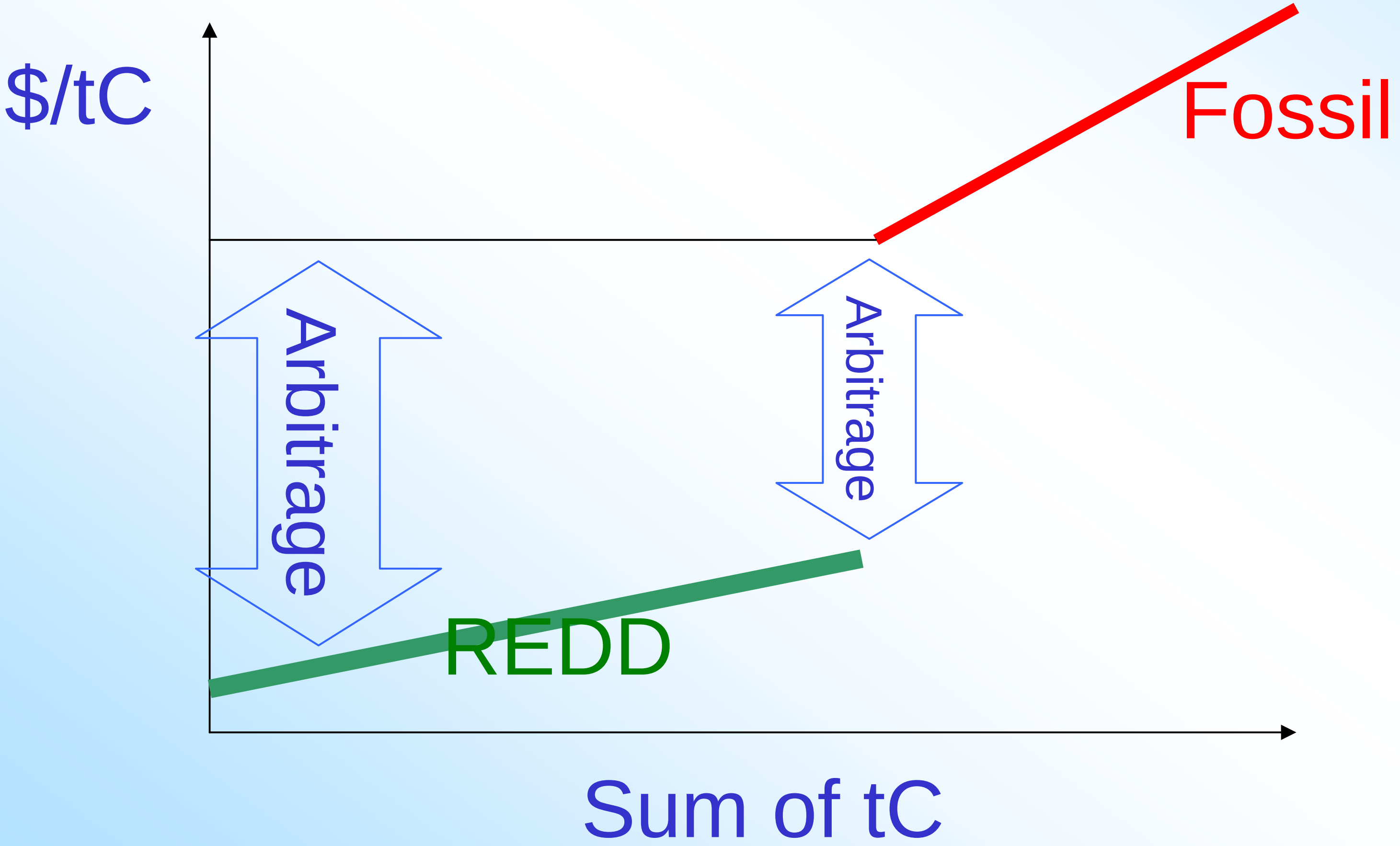
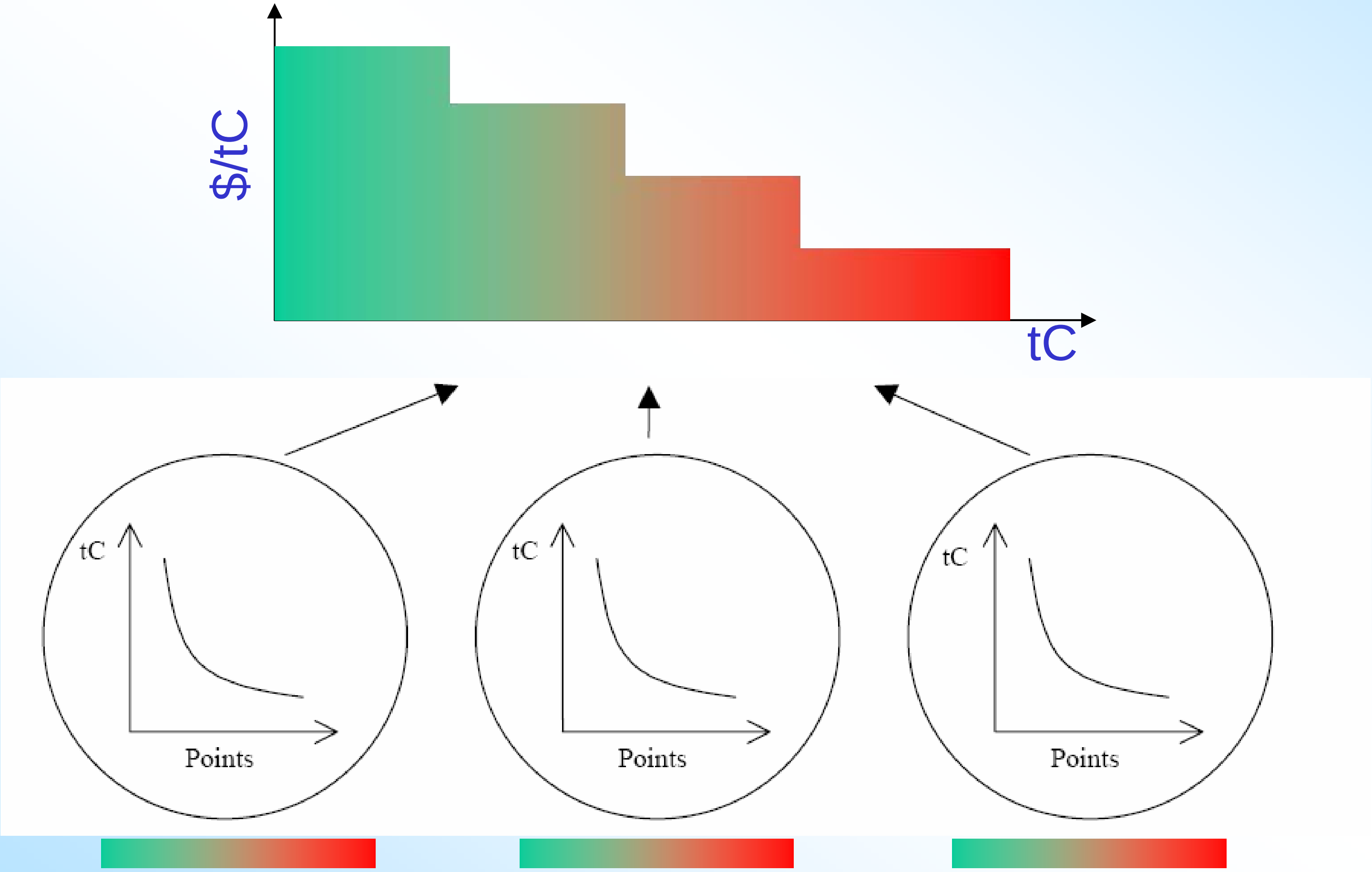
The Arbitrage Gap

Profits without effort



Dutch Tender Auction



Competitive Traits

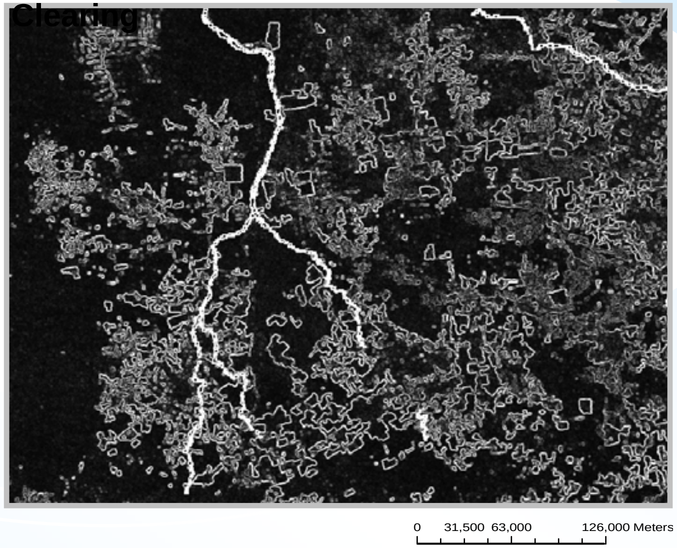
- ***Sustainability points*** given tC avoided
- ***tC avoided / tC credited*** given minimum Sustainability as entry condition

Can baselines be determined to appropriately accounting for different National Circumstances?

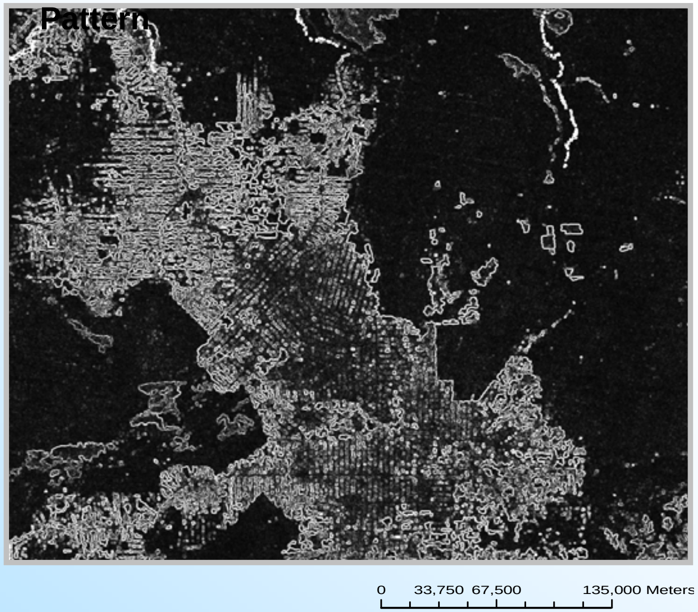
Exploring the Data

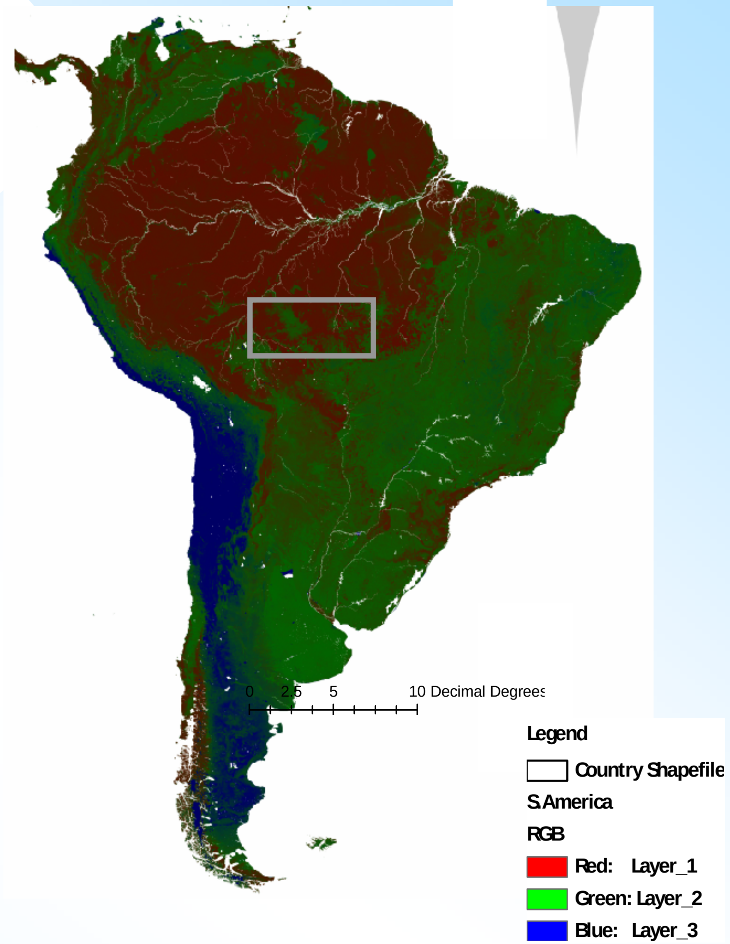
Mertens and Lambin (1997, as cited in Geist and Lambin 2001) identified key patterns in the landscape which can be attributed to deforestation. Large geometric patterns are suggested to be the work of large scale clearings for modern sector activities such as mining or more commonly ranches. Fishbone clearings on the other hand were explained as being involved in government resettlement schemes where small settlements were given strips of land to cultivate alongside road networks. Each of these patterns is supposedly easily identifiable across large landscapes with the appropriate resolution. The analysis of which can be enhanced greatly through the use of Non-Directional Edge in ERDAS Imagine software.

Non-Directional Edge Map of Large Scale Clearing

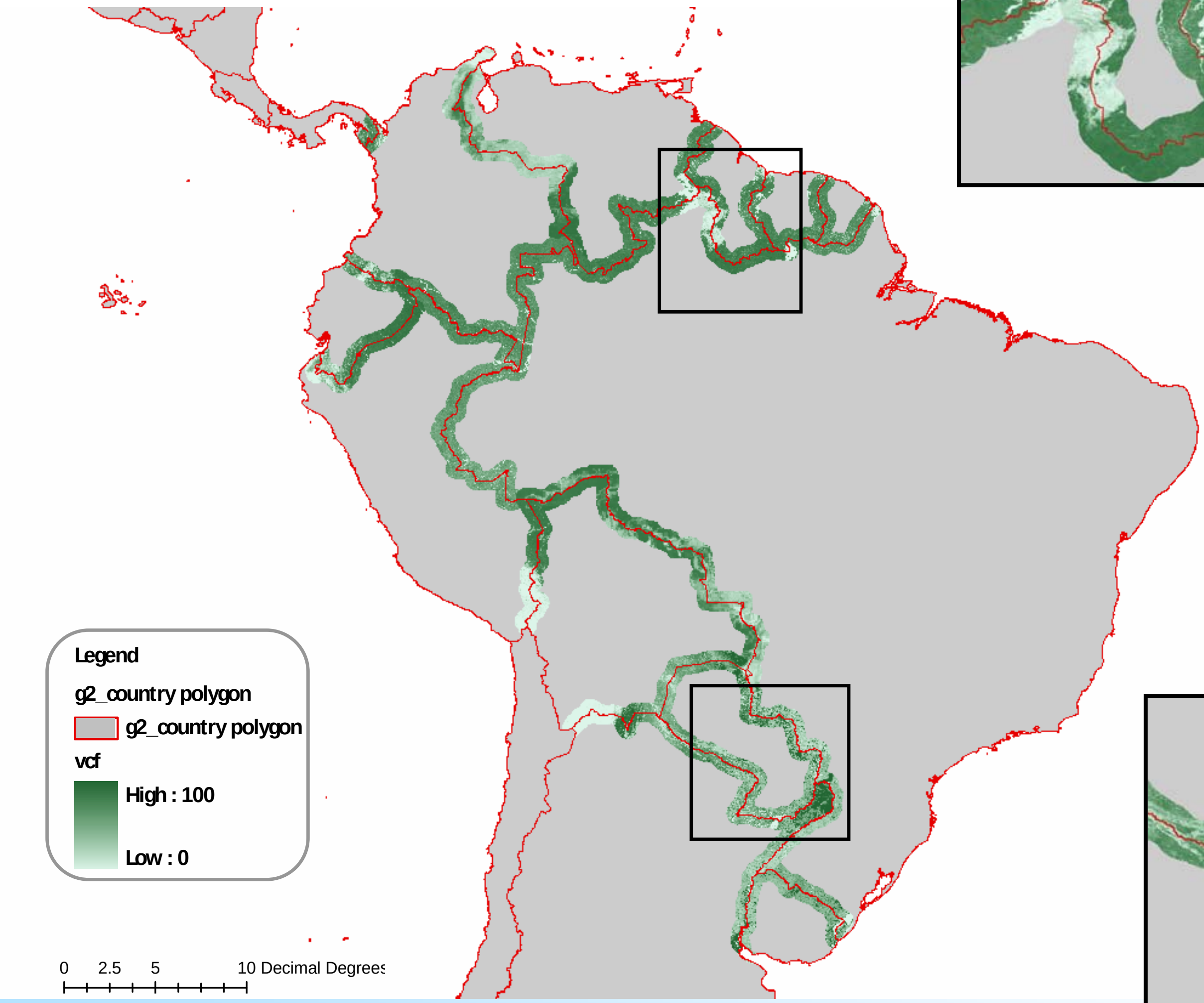


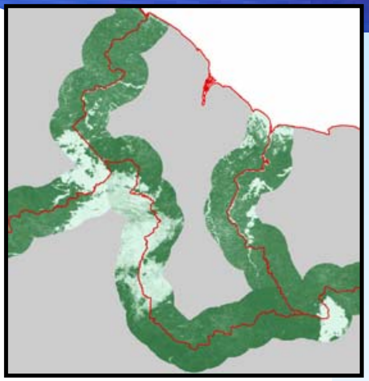
Non-Directional Edge Map of Fishbone Pattern

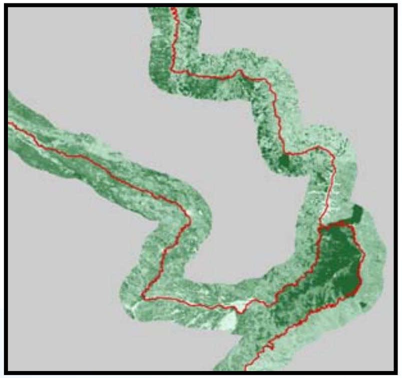




Results





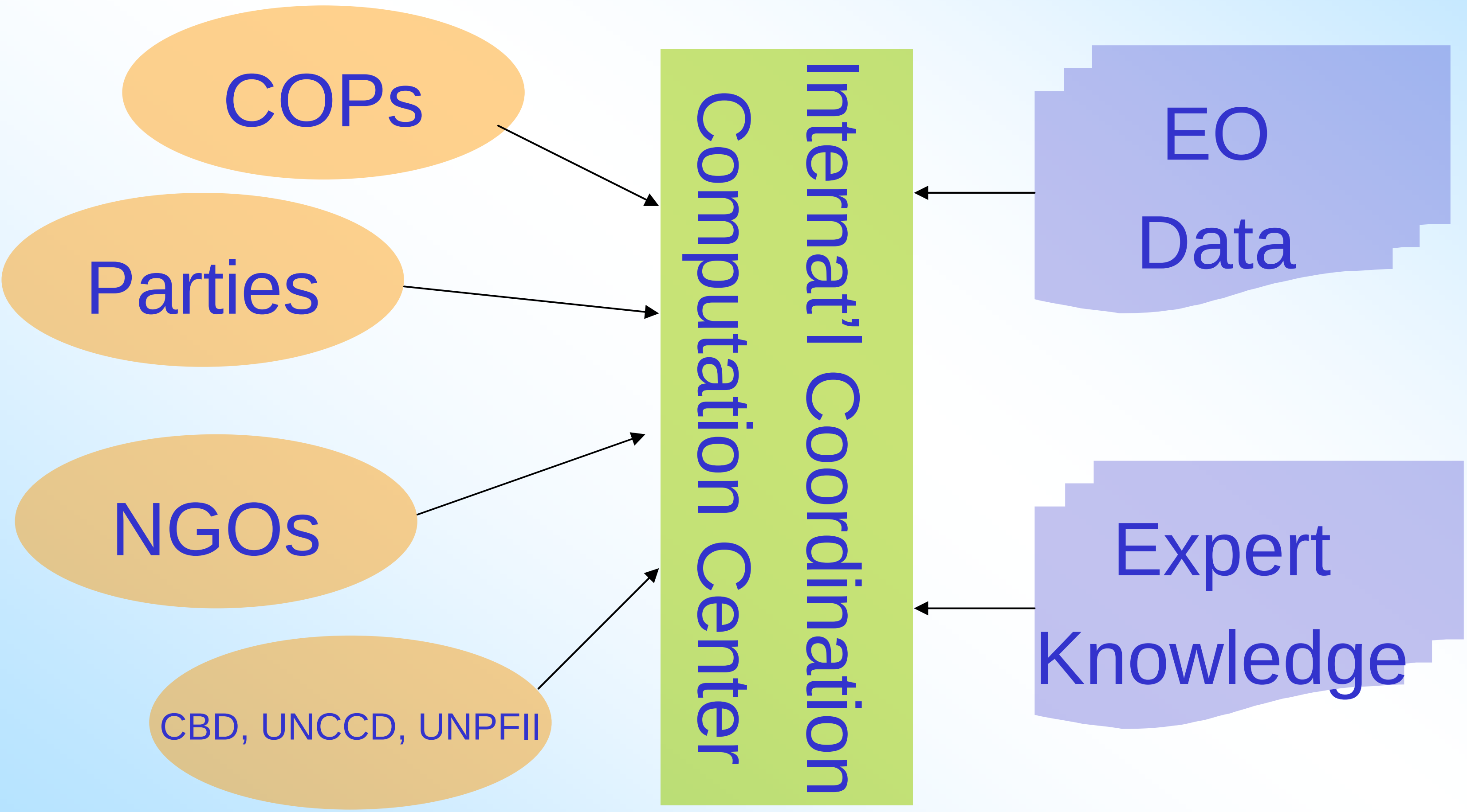


This image illustrates the study areas that were extracted from the VCF data. The two examples show where there is a visible cross border variation, depicted by the darker greens on one side of the border compared to the other. Therefore the index should replicate this large variation in a statistical format.

“Wrong” Baselines

- Example DRC
  - Historical baseline
    - Low baseline emissions
    - High Costs and low potential for REDD
  - Expected Market&Governance Scenario
    - How baseline emissions
    - Low costs and large potential for REDD

Institutional Map of Baseline Determination



Conclusion on Baseline

Modelling could turn out to be a way to determine FAIR & WORKABLE baselines against which REDD countries can be compensated.

Conclusion

1. REDD is cost effective and is a MUST to reach ambitious climate targets
2. REDD will consider ecosystem services and put mechanisms in place to monitor and value ecosystem services. Remote sensing together with in-situ monitoring offers those monitoring tools required.
3. Ecosystem services can be incorporated in REDD implementation mechanisms.
4. Use models for baseline determination.

…..time is running….

Contact

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