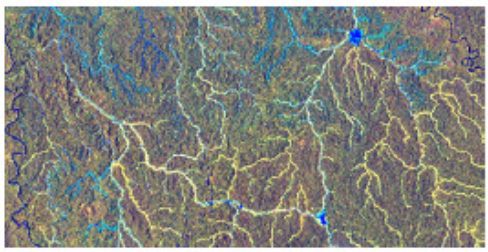
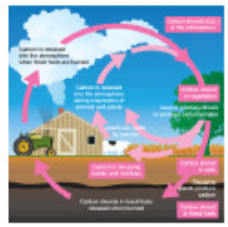
Reporting forest degradation under UNFCCC

Danilo Mollicone, FAO



CONTEXT

- Under UNFCCC: no forest definition and no forest degradation definition with a land based reporting approach



CONTEXT

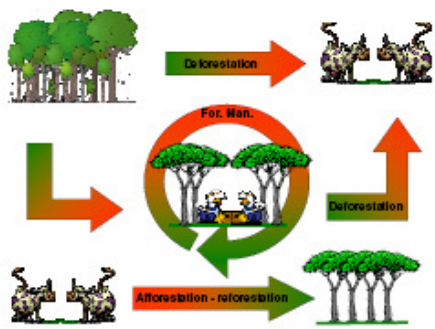
- Under the Kyoto Protocol: a framework forest definition and no forest degradation definition with an activity based approach

- Under the expected REDD mechanism: forest definition ? and forest degradation definition ? with an activity based approach

- In the context of UNFCCC there are no definitions that explain changes occuring within a land use category

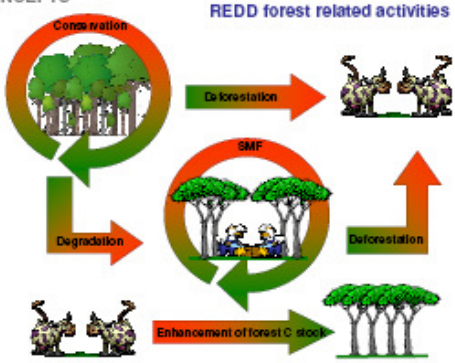
CONCEPTS

KP forest related activities



CONCEPTS

REDD forest related activities



IPCC methodology

KP and REDD activities	=	Forest sector (AFOLU / IPCC)
Deforestation	=	Forest land converted to other land
Forest management Degradation SMF Conservation	=	Forest land remaining forest land
Reforestation Afforestation Enhancement F C S	=	Other land converted to forest land

IPCC methodology

Carbon stock changes: five pools

- Above-ground biomass
- Below-ground biomass

} biomass

- Deadwood
- Litter

} dead organic matter

- Soil

} mineral / organic

$$\Delta C = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{DW} + \Delta C_{LI} + \Delta C_{SO}$$

IPCC methodology

„Stock Difference" method

$$\Delta C = C_2 - C_1$$

ΔC = change of carbon stock

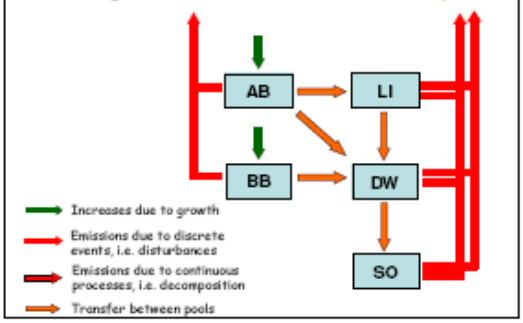
C_2 = carbon stock at **time 2**

C_1 = carbon stock at **time 1**

for one year: $\Delta C = (C_2 - C_1)/(t_2 - t_1)$

IPCC methodology

Changes = Gains – Losses (by pool)



Gain-Loss (default) method for Biomass

$$\Delta C_B = \Delta C_G - \Delta C_L$$

ΔC = change of carbon stocks in biomass

ΔC_G = increase due to biomass **growth**

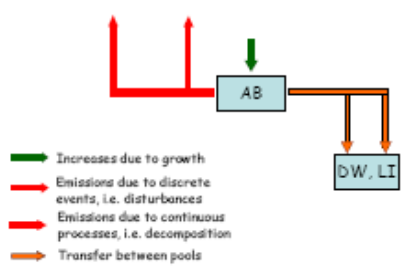
ΔC_L = decrease due to biomass **loss**

Gain-Loss, or default method: consider all processes

$$\Delta C_G = G_{growth}$$

$$\Delta C_L = L_{wood\text{-}removals} + L_{fuelwood} + L_{disturbances}$$

IPCC 2006GL



Integrating Forest Transects and Remote Sensing data to Quantify Carbon Loss due to Forest Degradation: a case study of the Brazilian Amazon

Technical meeting on Forest Degradation

FAO FOIM
8-10 September 2009
Rome, Italy

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Remote Sensing Detection of Forest Disturbances

Highly Detectable	Marginally Detectable	Almost Undetectable
· Deforestation · Forest fragmentation · Recent slash-and-burn agriculture · Major canopy fires · Major roads · Conversion to tree monocultures · Hydroelectric dams and other forms of flood disturbances · Large-scale mining	· Selective logging · Forest surface fires · A range of edge effects · Old-slash-and-burn agriculture · Small scale gold-mining · Unpaved secondary roads (8-20-m wide) · Selective thinning of canopy trees · Blowdowns	· Hunting and exploitation of animal products · Harvesting of most non-timber plants products · Old-mechanized selective logging · Narrow sub-canopy roads (<8-m wide) · Understorey thinning and and clear cutting · Invasion of exotic species · Spread of pathogens · Changes in net primary productivity · Community wide shifts in plant species composition · Other cryptic effects of climate changes · Most minor edge effects

Main Sources of Emissions:
- **Deforestation**
- **Selective Logging**
- **Forest fires**
- **Forest fragmentation**

Peres et al., (2006), TREE

Deforestation vs. Forest Degradation

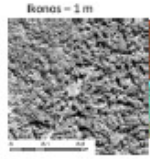
Selectively logged forest, Sinop-MT

Deforested area for plantation, Sinop-MT

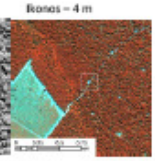
- Forest degradation has been defined as a type of land modification, which means that the original land cover structure and composition is temporarily or permanently changed, but it is not replaced by other type of land cover type (Lambin, 1999).
- For the purpose of REDD, we are interested in monitoring reduction of C stocks.

Monitoring Forest Degradation

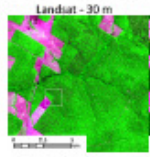
Ikonos – 1 m



Ikonos – 4 m



Landsat - 30 m



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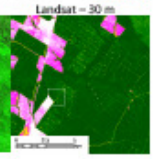


- More challenge than monitoring deforestation.
- There are several methods to detect and monitor forest degradation (GOFC-GOLD REDD Sourcebook).
- Methods:
  - Visual interpretation can easily detect canopy damage areas in very high spatial resolution imagery.
  - Spectral enhancement is required at lager pixel sizes.

Souza Jr. (2007)

Objetives

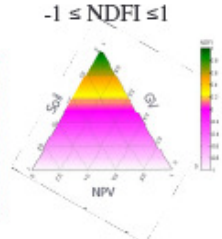
- Present a brief review of how remote sensing has been used to detect and map forest degradation.
- Show how carbon stocks of degraded forests can be characterized using rapid forest transect surveys.
- Demonstrate how field data of forest carbon stocks can be integrated with optical remotely sensed data to regionally characterize forest degradation.
- Discuss the challenges to integrating field-derived carbon estimates with remotely sensed data.

Normalized Difference Fraction Index - NDFI

$$NDFI = \frac{GV_{Shade} - (NPV + Soil)}{GV_{Shade} + NPV + Soil}$$

$$GV_{Shade} = \frac{GV}{100 - Shade}$$

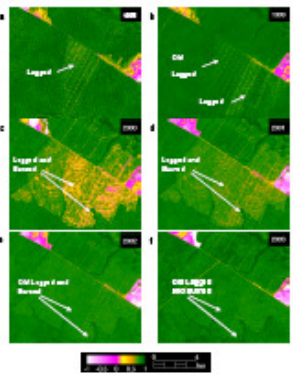
$$-1 \le NDFI \le 1$$



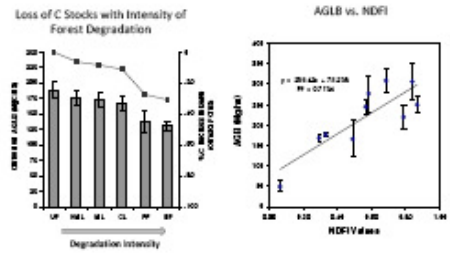
Souza Jr. et al. (2005)

Dynamic of Forest Degradation

- Degrataion signal changes fast.
- There is a synergism of forest degradation processes that can reduces more C stocks of degraded forests.
- Reccurrent forest degratation is expected and creates even more loss of C stocks.
- Annual monitoring is required to keep track of forest degrataion process.



C Stocks Change vs NDFI



Challenges to Monitor Forest Degradation and C Stock Changes

- Monitoring forest degradation requires well-documenting forest disturbance history, specifically recurrent degradation events and time since last disturbance.
- High spatial variability of forest biomass requires site-specific calibration of RS and AGLB.
- Monitoring degradation requires annual acquisition of satellite images because the rapid changes in degraded forests inhibit detection and mask out the intensity of the degradation after one year

Challenges to Monitor Forest Degradation and C Stock Changes

- Optical remote sensing techniques presented in this study cannot be applied in regions with intense cloudy conditions.
- Correlation of NDFI and AGLB of intact forest and forest degradation classes collapses after one year after the degradation event because the NDFI degradation signal disappear fast.