IPCC Methodologies for Forests

Nalin SRIVASTAVA
Task Force on National Greenhouse Gas Inventories

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Outline

- IPCC Guidelines for National Greenhouse Gas Inventories
- Forests in IPCC Guidelines
  - *1996 Guidelines*
  - *GPG & GPG-LULUCF*
  - *2006 IPCC Guidelines*
- Conclusions

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IPCC Guidelines for National Greenhouse Gas Inventories

- Revised 1996 Guidelines -Land-Use Change and Forestry (LUCF)
- 2000 Good Practice Guidance and Uncertainty Management (GPG2000)
- 2003 Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF)
- 2006 IPCC Guidelines for National Greenhouse Gas Inventories

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Evolution of IPCC Guidance on agriculture and land-use

1996 IPCC GLs

- Agriculture and Land Use and Change and Forestry (LUCF) separate sectors
- Only the most important activities resulting in GHG emissions/removals
- Implicit assumption about estimating emissions and removals only over lands subject to human intervention
- Only accounted for above-ground biomass and soil C pools

GPG & GPG-LULUCF

- Agriculture and Land Use, Land-use Change and Forestry (LULUCF) separate sectors
- Provides *good practice* and uncertainty management guidance
- Now includes all land use emissions/ removals split into six land-use categories from all pools
- Explicit Use of *managed* land as a proxy for anthropogenic emissions/removals

2006 IPCC Guidelines

- Agriculture and Land Use and Change and Forestry (LUCF) combined into a single sector Agriculture, Forestry and Other Land Use (AFOLU).
- Same approach as GPG-LULUCF
- Retained use of *managed* land
- Inclusion and consolidation of several previously optional categories
- Refinement of methods and improved defaults

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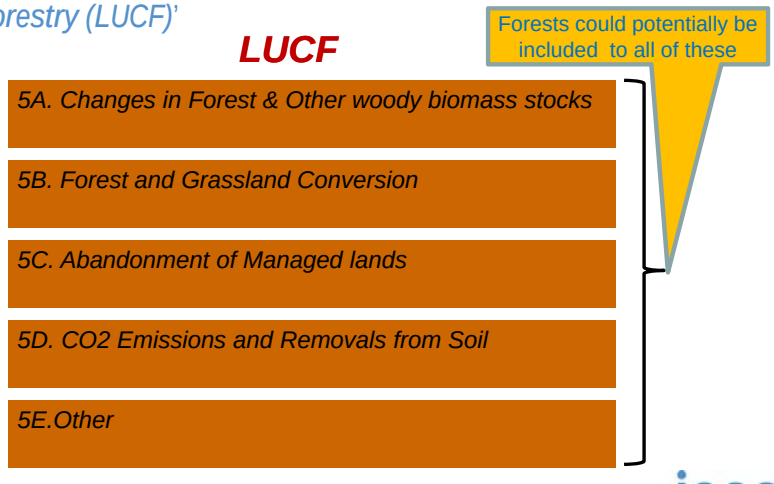
1996 IPCC Guidelines: Coverage

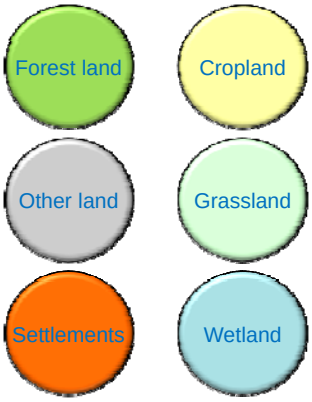
- Forests were covered under the sector '*Land Use Change and Forestry (LUCF)*'



GPG-LULUCF & 2006 IPCC Guidelines: important features

- *GPG & GPG-LULUCF* improve upon the *1996 IPCC Guidelines* through the introduction of concept of "*good practice*" and uncertainty management in national GHG inventories
  - Uncertainty Information and how to use it
  - Quality Assurance and Control
- *GPG-LULUCF* divide all managed land into six land use categories thereby ensuring the complete coverage of all managed land
  - The same approach was used in the *2006 IPCC Guidelines*

Six Land Use Categories



- Reported Under Forests:
  - Degradation & Forest Management
    - Forest lands remaining Forest Lands
  - Afforestation & Reforestation
    - (Cropland/Grassland/Settlements etc.) converted to Forest Lands
- Reported under non-forest lands:
  - De-forestation
    - Forest Lands converted to (Cropland/Grassland/Settlements etc.)
- What is forest degradation?
  - TFI Special Report
  - Alternate definitions of degradation
    - criteria such as long term reduction of canopy cover, supply of benefits, C stocks
    - decided that no definition can be effectively operationalised

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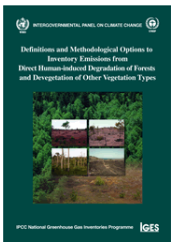
Definitions and Methodological Options to Inventory Emissions from Direct Human-induced Degradation of Forests and Devegetation of Other Vegetation Types



- Methodological options to estimate emissions from degradation
  - Area of degradation: remote sensing with ground-truthing, forest/vegetation sampling, activity reporting, or a combination of these methods
  - Carbon stock changes and non-CO_2 emissions are estimated using the methods in the *GPG-LULUCF*(or 2006 IPCC Guidelines)
  - Time series measurements may be needed to determine the occurrence of degradation
  - Low or small thresholds may require higher-resolution remote sensing with continuous spatial coverage, higher intensity sampling systems, or detailed and comprehensive activity reporting systems.
  - Approaches to reporting and documentation

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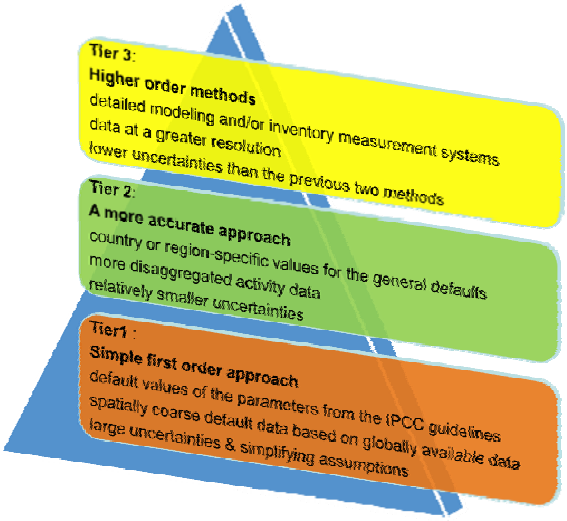
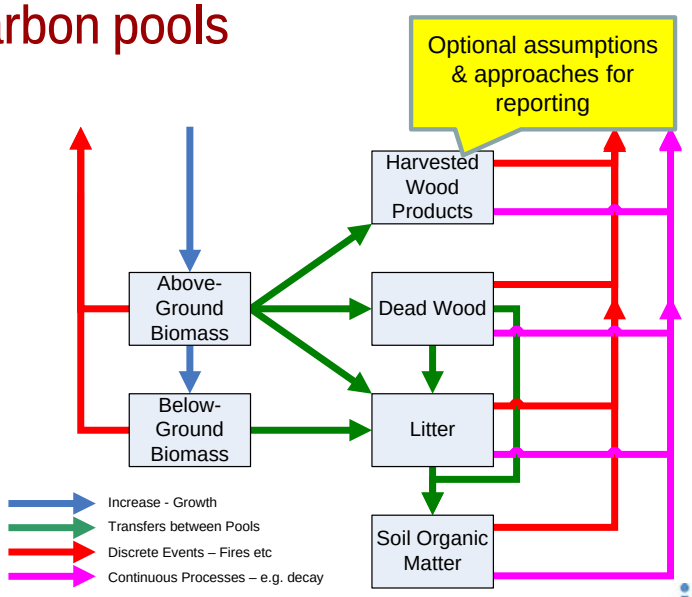
GPG-LULUCF & 2006 IPCC Guidelines: Guidance

- Both GPG-LULUCF and 2006 IPCC Guidelines contain essentially the same guidance on forests including:
  - Providing three approaches for representing land areas and area changes
  - providing three methodological tiers varying in complexity to be chosen on the basis of national circumstances
  - explicitly adopting *managed* land as a proxy for anthropogenic emissions and removals
  - addressing all the five carbon pools for Forest land
  - providing methods for estimating the significant non-CO_2 emissions from both existing and converted forests (e.g. non-CO_2 emissions from prescribed fires, N-fertilization etc.)

Three methodological Tiers



Carbon pools



GPG-LULUCF & 2006 IPCC Guidelines: Differences

- *2006 IPCC Guidelines* differ from *GPG-LULUCF* mainly in that they require the estimation of emissions from all disturbances (whether natural or anthropogenic) on managed forests
  - In GPG-LULUCF - disturbances can be ignored if subsequent re-growth is also ignored
- *2006 IPCC Guidelines* contain more detailed methods for including the HWP pool into national GHG inventories using any of the approaches under discussion in UNFCCC process
- *2006 IPCC Guidelines* includes previously optional categories

GPG-LULUCF & 2006 IPCC Guidelines: Activity data

- Some of the important data needs for forests in *GPG-LULUCF & 2006 IPCC Guidelines* are:
  - Areas of existing and converted managed forests
  - Areas of forests subject to disturbances
  - Areas of drained organic forest soils
  - Amount of organic and synthetic nitrogen fertilizer added to forest soils (or estimated nationally)

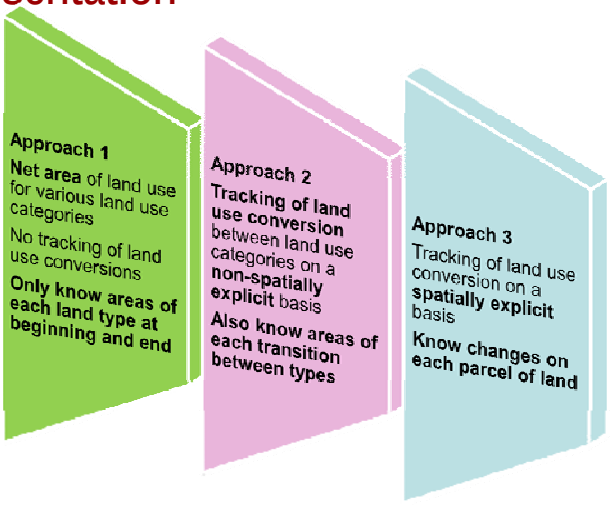
GPG-LULUCF & 2006 IPCC Guidelines: Emission factors and other parameters

- Total living biomass stocks
- Merchantable volume
- Average annual total biomass increment
- Average annual above ground biomass increment
- Average annual volume increment
- Biomass Expansion Factor(B.E.F.) for volume and volume increment
- Root-to-shoot ratios appropriate to increments
- Annual commercial harvest volume (round-wood)
- Annual volume for fuel-wood gathering
- Basic Wood Density(B.W.D.)
- Emission factor for CO_2 from drained organic forest soils
- Emission factor for N_2O emissions from N addition to forest soils

GPG-LULUCF & 2006 IPCC Guidelines: area representation and data collection

- *GPG-LULUCF* and *2006 IPCC* Guidelines provide detailed guidance to assist countries make the best use of the available data and reducing overlaps and omissions in reporting in the national GHG inventories
- Land use data should be *adequate*, *consistent*, *complete* and *transparent*
- Guidance is provided on the use of three generic approaches(*Approach 1, 2 & 3*) to be used for representing area and area changes in the GHG inventories and integration of land use area with data on management and C stocks for each approach

Three approaches for area change representation



GPG-LULUCF & 2006 IPCC Guidelines: guidance on area representation and data collection

- GPG-LULUCF and 2006 IPCC Guidelines describe the three potential sources of data for GHG inventories:
  - Databases prepared for other purposes
    - National datasets: e.g. forest inventories
    - International datasets: e.g. international land-use and land cover datasets
  - Data collection by sampling
  - Complete land inventory

Use of international databases

- International datasets on land-use and land cover can be used for:
  - Estimating spatial distribution of land-use categories to complement conventional inventories
  - Checks of existing land-use datasets by comparison between independent national and international datasets
- While using the international datasets, inventory compilers should consider:
  - Classification scheme
  - Spatial resolution
  - Classification accuracy and errors in geo-referencing
  - Interpolation and extrapolation

Use of sampling methods for data collection

- Sampling methods should allow for consistent and unbiased estimation and result in precise estimates
- Sampling for areas repeated at successive occasions can be used to derive land use conversion matrices
- Sampling techniques can provide estimates of sampling errors and confidence intervals
- *GPG-LULUCF* and *2006 IPCC Guidelines* contain guidance on:
  - Use of auxiliary data and stratification
  - Systematic sampling
  - Permanent sample plots and time series data

Use of permanent sample plots and time series data

- Repeated sampling on relevant time intervals can help generate the time series data on area and C stocks to assess changes over time
- Three common sampling designs for repeated sampling are:
  - Permanent sampling plots
  - Temporary sampling plots
  - Sampling with partial replacement
- Permanent plot and sampling with partial replacement can be used for land use conversion estimation
- Temporary plots cannot generate land use conversion information unless used with auxiliary data

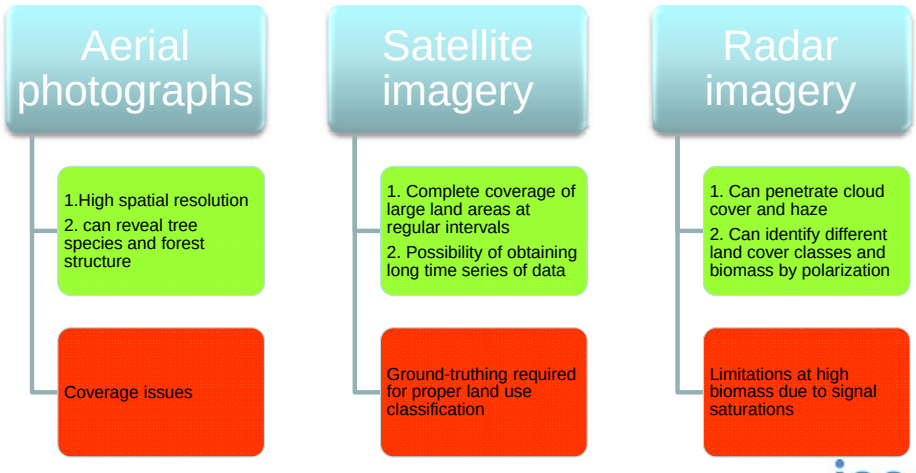
Use of remote sensing in forest GHG inventories

- Aerial or satellite based remote sensing (optical, radar and lidar) combined with ground-truthing can provide spatially explicit information on land cover and land use with repeated coverage
- Archived RS data can be used to reconstruct past time-series of land cover and land use
- It can be a useful tool in the identification of homogeneous areas for selection of sampling schemes and no. of samples
- However it has limitations such as presence of atmospheric haze and cloud cover and change of systems over the time-series among others

Use of remote sensing in forest GHG inventories (2)

- The important criteria for selecting remote sensing data and products as given in the *2006 IPCC Guidelines* are:
  - Adequate land use categorization scheme
  - Appropriate spatial resolution
  - Appropriate temporal resolution
  - Availability of accuracy statement
  - Transparent methods applied in data processing and acquisition
  - Consistency and availability over time

Remote Sensing systems in 2006 IPCC Guidelines



Combination of Remote Sensing with ground reference data

- 2006 Guidelines mention it as *good practice* to complement the remotely sensed data with the ground reference data
- Ground reference data can either be obtained independently or taken from the forest inventories
- Rapidly changing land uses or those having vegetation cover known to be easily misclassified should be more intensively ground-truthed

Conclusions

- ✓ IPCC Guidance on forest inventories has evolved from the coverage of a few important activities to a comprehensive scheme covering all emissions and removals from managed forests
- ✓ The *GPG-LULUCF* and *2006 IPCC Guidelines* use the same approaches
- ✓ While the Guidelines include internationally applicable default data, more detailed accurate forest inventories will need higher tier methods that require more accurate country-specific data
- ✓ The guidelines provide some limited guidance on the use of different data sources including remote sensing, ground based inventories and their combination.

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Thank you

IPCC Guidelines in all UN languages are available for download from the IPCC TFI website:

www.ipcc-nggip.iges.or.jp

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