Australian Government
Department of Climate Change

# Linking Forest Carbon Budget Models and Remote Sensing of Climate Change

## Policy implications for Monitoring, Reporting and Verification

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# What sets MRV requirements?

- The for international inventory reporting answer lies in analysis of:
  - The **policy frameworks** that have
  - **accounting rules** which is supported by
  - guidelines for **estimation methods** that produce
  - **reporting formats**.
- Science questions and applications are not driven by these same processes – they do not have accounting structures

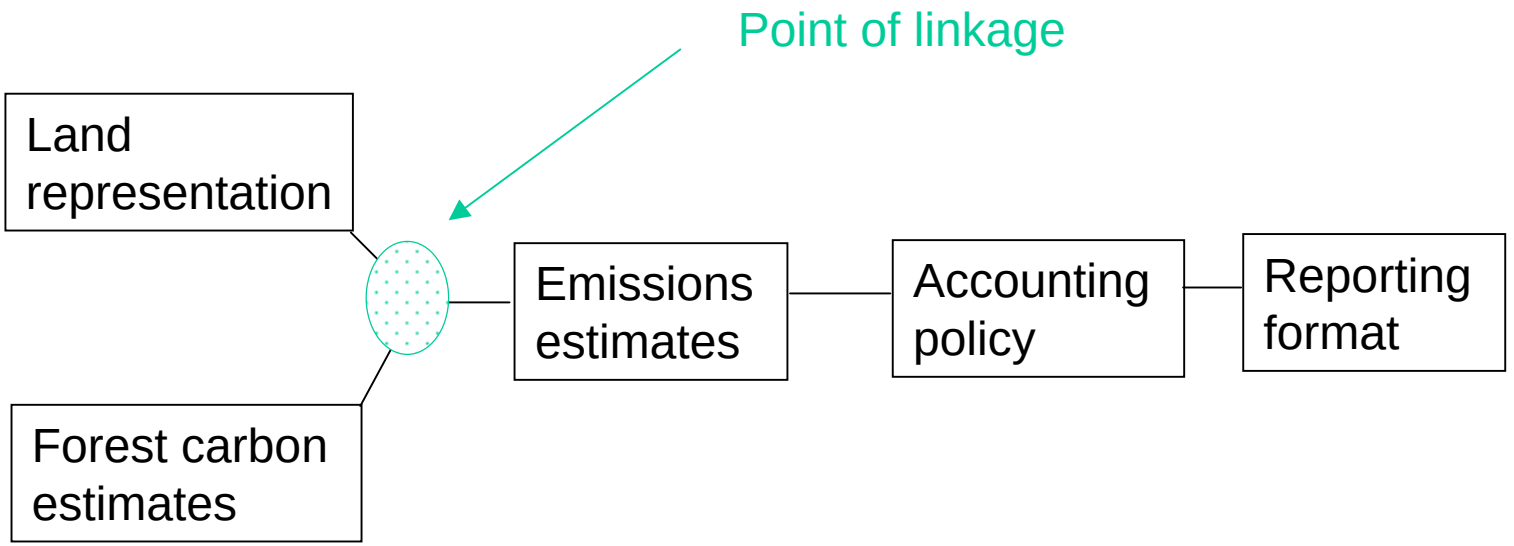
# What are the policy frameworks?

- The UNFCCC, the Kyoto Protocol, and various national and scheme specific offset rules
- For international reporting, the UNFCCC and Kyoto Protocol set the **policy frameworks**
- For the Kyoto Protocol, the Marrakech Accords set the **accounting rules**
- The IPCC guidelines set the **estimation methods**
- The parties agree the **common reporting formats**

# Is linkage necessary in estimation methods (IPCC)

- For inventory reporting, linkage of carbon budgets and remote sensing is not mandated
- Various methods of determining areas of land uses (land representation) are accepted
- Linkage of remote sensing and carbon estimates by models or repeat measurement is envisaged as a potential method

# The reporting process



# Lands and Emissions methods

- Lands
  - **Approach 1:** areas of different land use at different times (blind to land substitution and transition)
  - **Approach 2:** a land conversion matrix by area to identify land substitution, but not spatially explicit
  - **Approach 3:** spatially explicit (wall-to-wall time-series monitoring of land use change
- Emissions
  - **Tier 1**: emissions factors using global defaults
  - **Tier 2**: emissions factors using local defaults
  - **Tier 3**: emissions estimated by direct measurement or model

# Matrix of method combinations

| | Land Representation (Approach) | | |
|---|---|---|---|
| Emissions Estimation (Tier) | Approach 1 Tier 1 (UNFCCC) | Approach 2 Tier 1 (UNFCCC) | Approach 3 Tier 1 (UNFCCC) |
| | Approach 1 Tier 2 (UNFCCC) | Approach 2 Tier 2 (UNFCCC, Kyoto?) | Approach 3 Tier 2 (UNFCCC, Kyoto, **Project/Entity**?) |
| | Approach 1 Tier 3 (UNFCCC) | Approach 2 Tier 3 (UNFCCC, Kyoto) | Approach 3 Tier 3 (UNFCCC, Kyoto, **Project/Entity**) |

# Linking methods

- Presuming that wall-to-wall remote sensing is used, linkage to carbon budgets can be by:
  1. Forest inventory derived using fixed grid or random sample of permanent or sample plots
  2. Linked to ecosystem models or
  3. Direct measurement by remote sensing
- The choice of method should be determined by country circumstance (data capacity and reporting need)

# Policy questions determining monitoring need

- Baselines (references scenarios)
- Projections (future scenarios)
- Additionality (additional to BAU)
- Leakage (displacement rather than mitigation)
- Permanence (persistence of gains)
- Transparency
- Verifiability

# Benefits of wall-to-wall remote sensing

- Remote sensing aids in addressing each of the previous key policy issues
  - For each of the policy issues, times-series, wall-to-wall remote sensing provides a sound method for land representation
  - The choice of sensor must be matched to country circumstance and performance needs

# Linking method implication

- Each of the three options
  1. ground inventory
  2. modelling
  3. direct satellite measurement

  are appropriate, however:
  - for projections that include climate scenarios only ecosystems models apply (this is particularly important if climate feedbacks are to be considered)

# Applications beyond inventory reporting

- Cross cutting issues:
  - carbon budgets are affected by climate variability and natural disasters as well as human management and ecosystem models can represent these combined impacts
  - land surface feedbacks to the climate system can be derived from ecosystem models
  - carbon cycles cannot be separated from water and nutrient cycles – ecosystem models represent the combined effects of these cycles

# Conclusion

- The linkage of time series, wall-to-wall remote sensing linked to ecosystem models is one of several approaches to deriving carbon inventories, however it is;
  - it is the method that gives the highest order of policy response and flexibility in reporting
  - provides a basis for projections under anticipated climate change, and
  - supports land surface feedback to climate modelling