Panel Discussion:

The Use of Models in National Greenhouse Gas Inventories

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Challenges and Opportunities in Implementing Higher Tiers in the National GHG Inventory

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Introduction

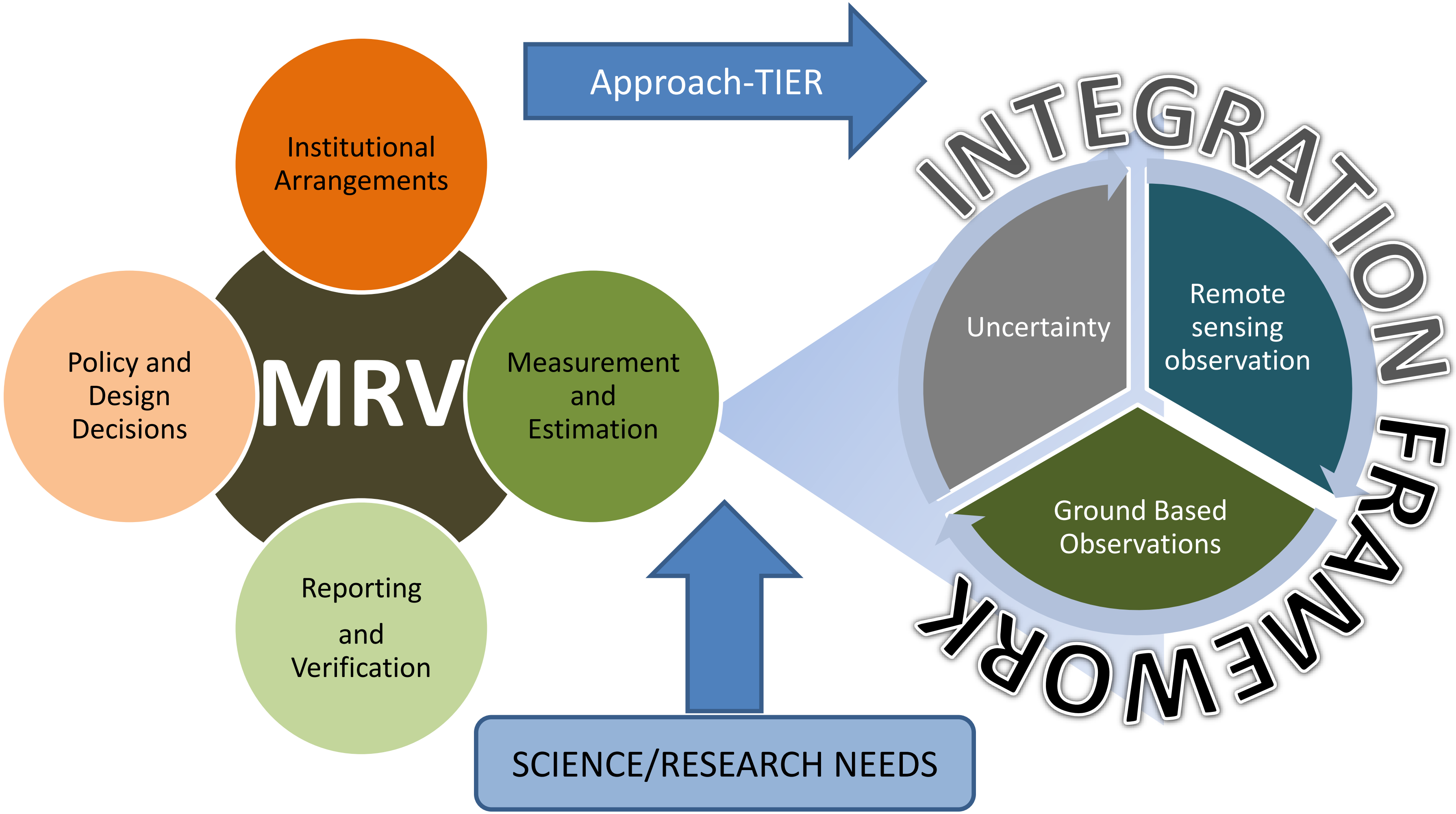
- Developing systems for GHG inventory and reporting GHG emissions and removals **requires combination of data from different sources →** this will need a **choice of integration method.**

- Integration methods rely on:
  - Data
  - Assumptions
  - Models

Role of science & research to support and improve

- Integration methods are able to:
  - facilitate the combination of data to generate estimates
  - simplify reporting by automatically assigning land uses and GHG emissions to the required classes based on rules consistent with national circumstances

Integration Framework



Methods of Integration and Estimation

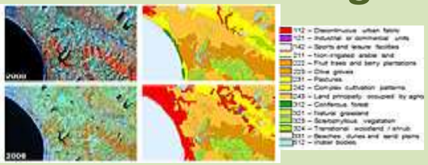
National GHG Inventory

Current integration method: Tier 2

- The activity data X emission/removal factor

Activity data

Dynamics of land use change

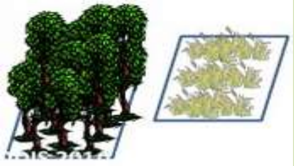


(ha/year)

X

Emission Factors

Dynamics of carbon change



(tCO_2/ha/year)

=

Emissions estimates

CO_2e

- In general, the method is **more suitable in landscapes with a few sequential changes** through time

Moving toward a higher tier (Tier 3)

- We have developed Indonesian National Carbon Accounting System (INCAS): **an integrating system for accounting GHG emissions and removals**, which can be used to support GHG inventory for land-based sector and MRV requirements for forests and peatlands.

http://incas.menlhk.go.id/

INCAS
Indonesian National Carbon Accounting System

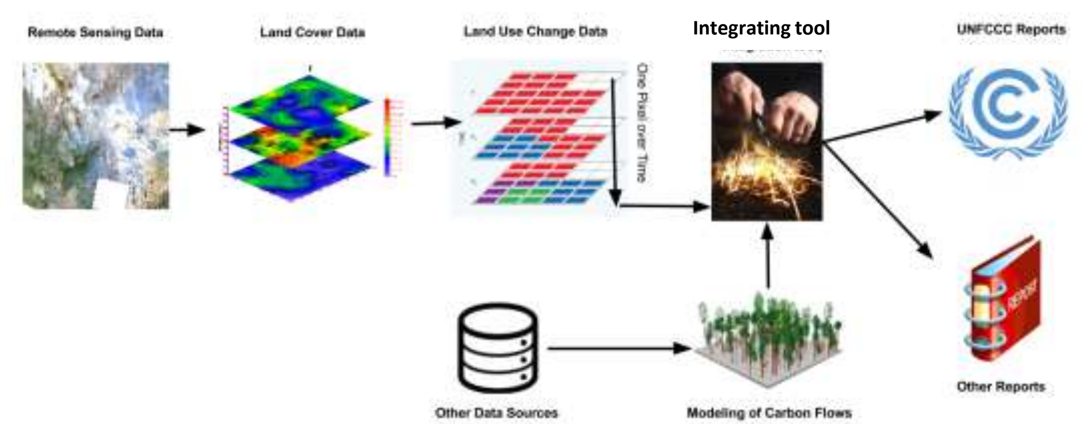
Motivated to develop a tier 3 system with key features:

- Nationally consistent GHG accounting system, with TACCC principles;
- Produces detailed estimates of both emissions and removals annually;
- Quantify historical, present & future emissions scenarios – support policy design, implementation and monitoring;
- Flexible approach to support multiple reporting requirements;
- Continuous improvement, use the best available data.

Integration and Estimation

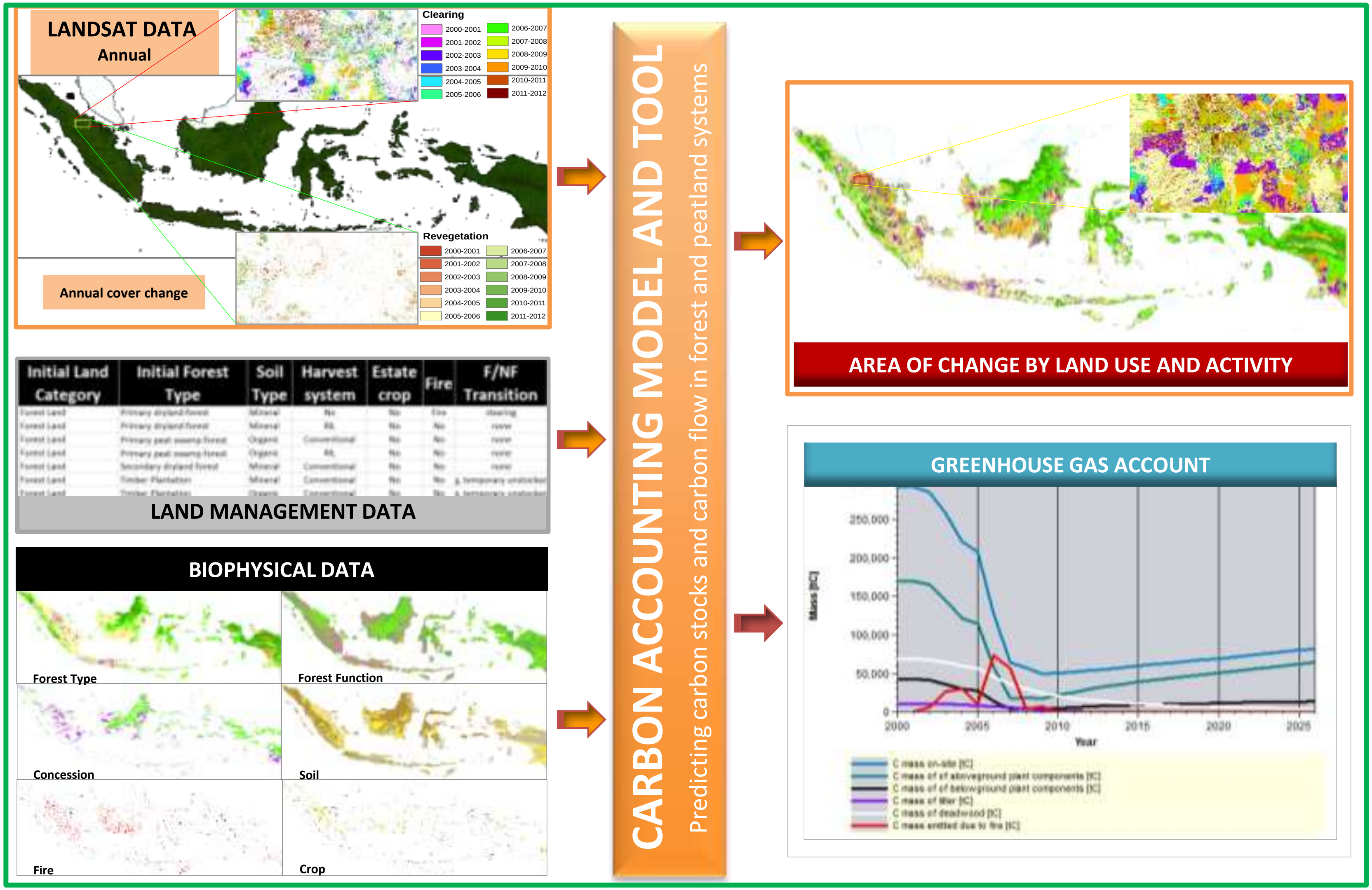
INCAS integration method: Tier 3

- Integrated frameworks, with spatially-referenced models (representative of Tier 3, Approach 2/3 methods); the spatially-explicit methods (representative of Tier 3, Approach 3 methods) which track individual units of land (polygons or pixels).



- In general, the method has a **greater ability to analyse the effects of management** on emissions and **can project emissions estimates** to enable scenario analyses.

General modelling approach



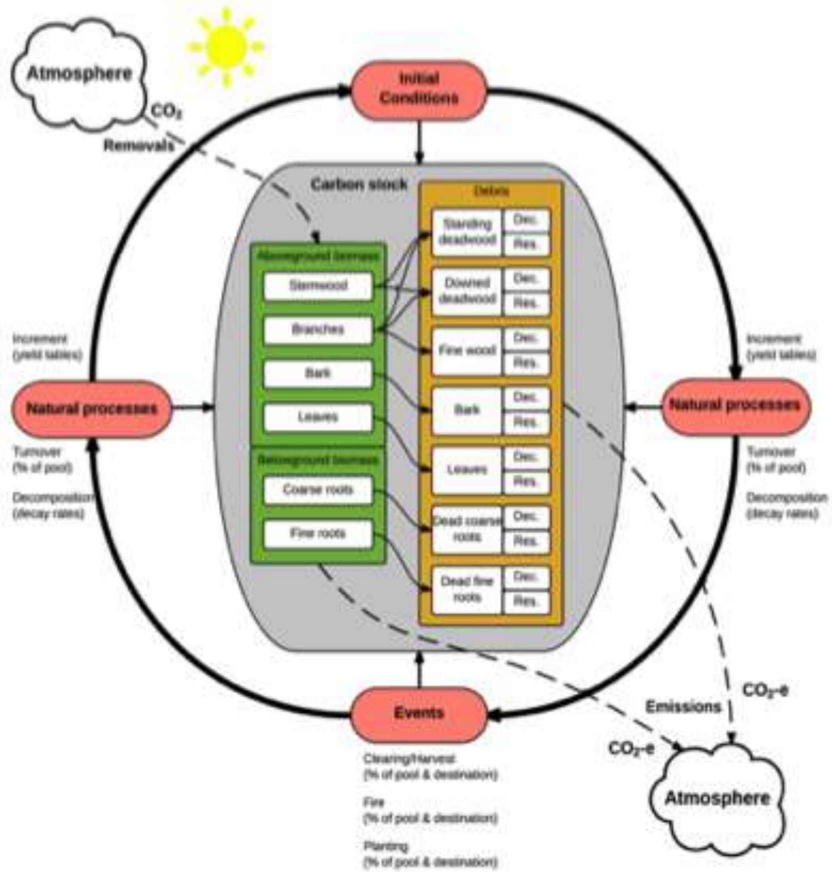
Source: Krisnawati et al (2015)

How to capture the transfers of carbon between the carbon pools

FullCAM
Full Carbon Accounting Model

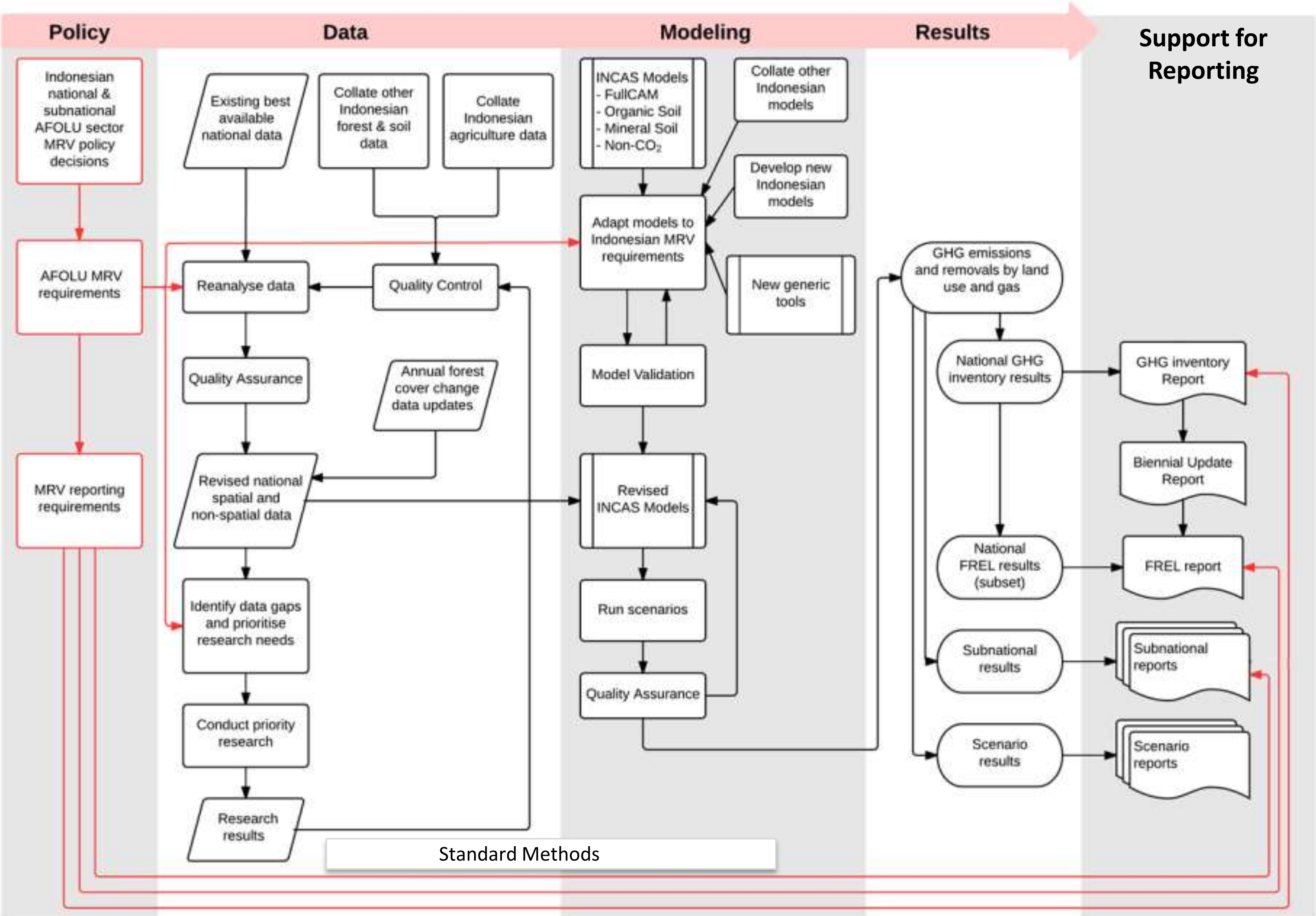
Input:
- Location of change
- Initial condition (C stock)
- Growth, *turnover*, decomposition
- Forest management events

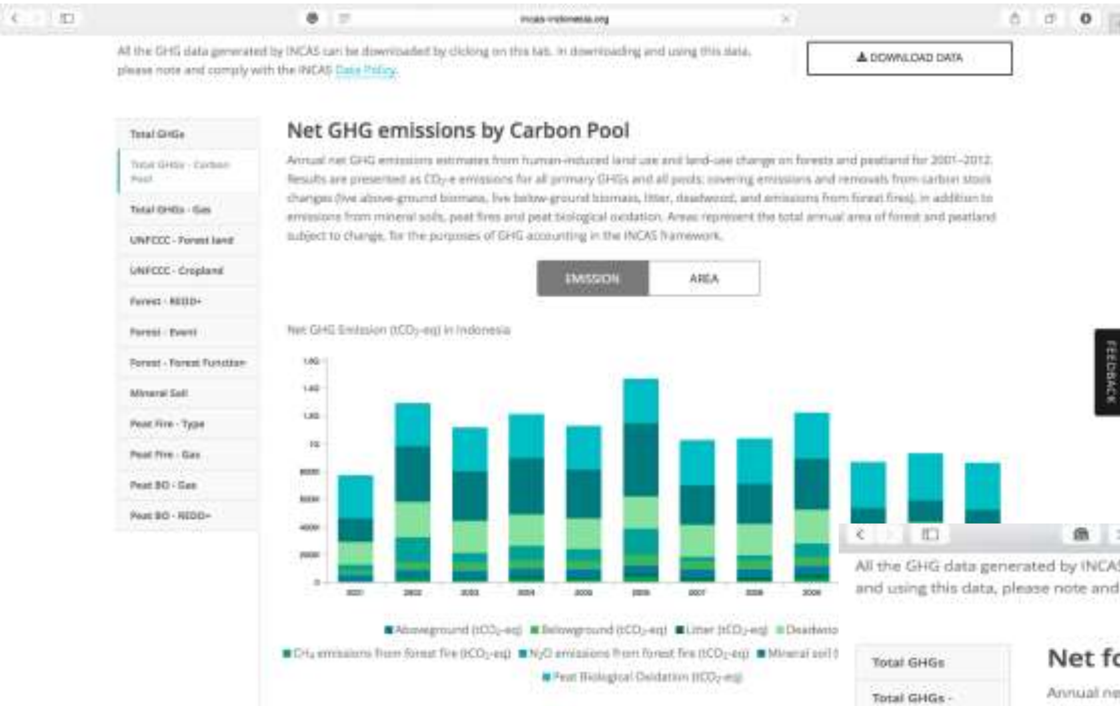
Output:
- Estimate of carbon flows between different carbon pools and ultimately emissions and removals.

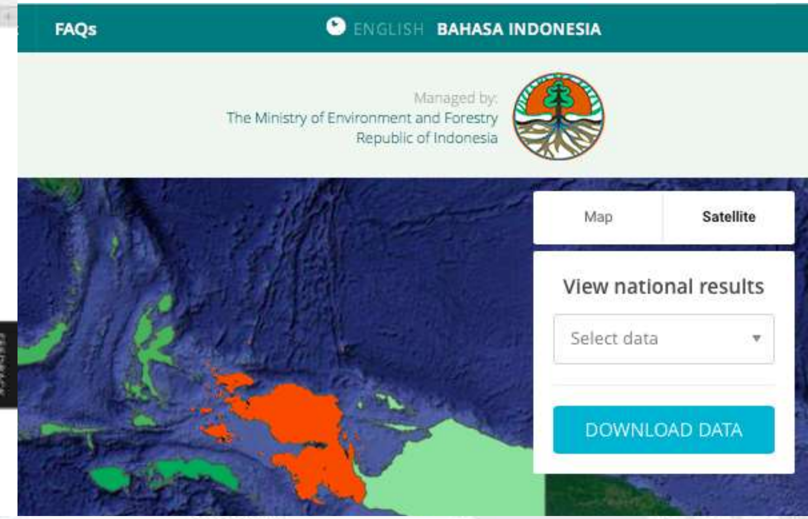


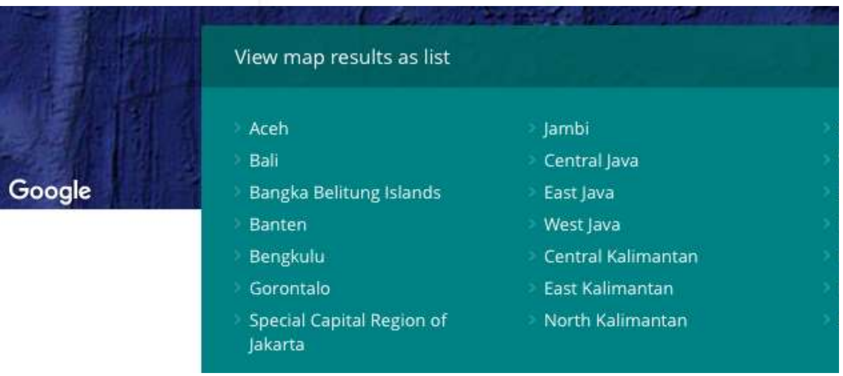
Source: Krisnawati et al (2015)

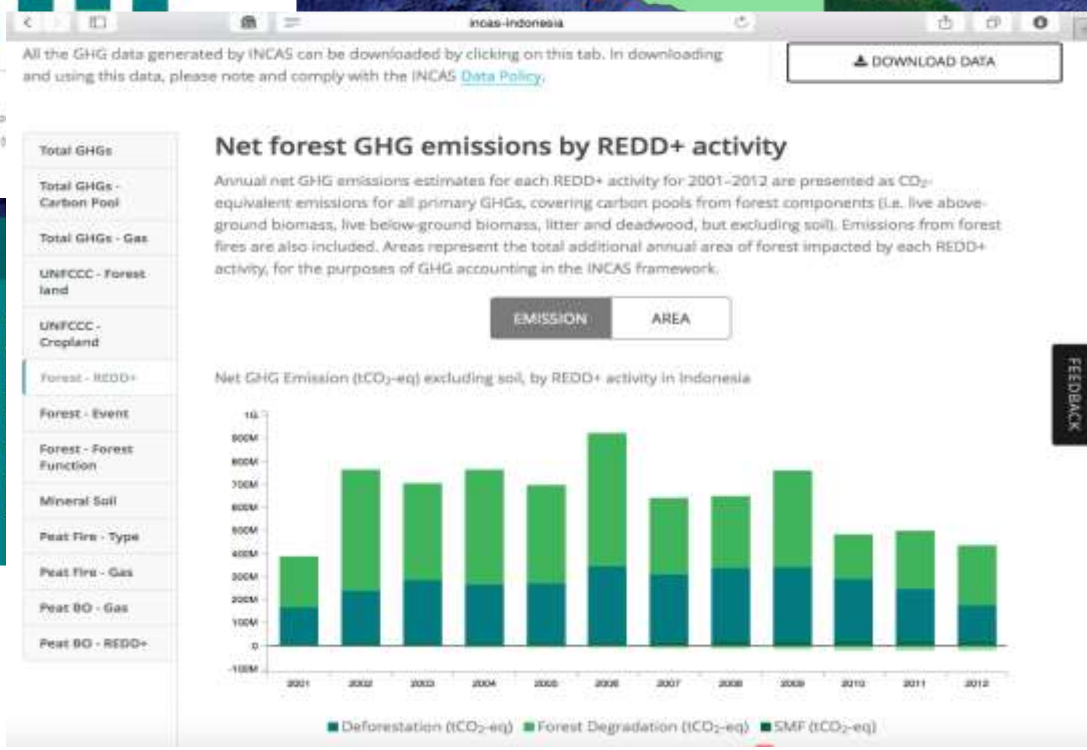
INCAS Framework











More detailed outputs can be generated

The models' outputs are verifiable

– VERIFICATION

- Transparency is built into the modeling and reporting system to facilitate quality control (QC) and quality assurance (QA), and external verification of results. This includes transparent summary of the methodology, data inputs, definitions, assumptions, results and any limitations of the analysis.
- Description of the data and results are documented and compiled in databases

Appendix 1. List of INCAS Database

No	Name of Database	Description
1	FullCAM Database	The database contains information on parameter, value, assumptions and references/source of the data used as inputs in FullCAM. It includes: • Initial condition of trees (AGB, stem, branch, bark, leaves, coarse root, fine roots) • Initial condition of debris (deadwood decomposable, deadwood resistant, bark litter decomposable, bark litter resistant, leaf litter decomposable, leaf litter resistant, coarse dead root decomposable, coarse dead root resistant, fine dead root decomposable, fine dead root resistant) • Carbon % of (dry) trees (stem, branch, bark, leaves, coarse root, fine roots) • stem density (kgdm/m3) • Turnover % of branch, bark, leaves, coarse root, fine roots • Resistant % of trees (stem, branch, bark, leaves, coarse root, fine roots) • Breakdown % of debris (deadwood decomposable, deadwood resistant, bark litter decomposable, bark litter resistant, leaf litter decomposable, leaf litter resistant, coarse dead root decomposable, coarse dead root resistant, fine dead root decomposable, fine dead root resistant) • Atmospheric % of debris breakdown (deadwood decomposable, deadwood resistant, bark litter decomposable, bark litter resistant, leaf litter decomposable, leaf litter resistant, coarse dead root decomposable, coarse dead root resistant, fine dead root decomposable, fine dead root resistant)
2	Event_ FullCAM Database	The database contains information on the events modelled in each type of forest (e.g. land clearing, clearing duw to illegal harvesting, selective harvesting with conventional technique, selective harvesting with RIL tehnique, Intense fire, moderate fire, Planting). Information available on each event for each forest type includes parameters used for FullCAM, value, assumption and reference used
3	Growth Database	The database contains information on the growth from 48 species and forest condition including data and references used, process employed in model development to obtain CAI values as inputs for FullCAM
4	Suite_Regime Database	The database contains information on 1152 regimes (land management) at certain suite that have been generated based on a combination of F/NF Class, Initial Land Category, Initial Forest Type, Forest Function, Soil Type, Harvest system, Estate crop, Fire, F/NF Transition and Subsequent Land Category. Suite represents a specific area with a a specific regime that will be modelled in

Advantages of using models

- Capability to capture more detailed spatial variations and detail emissions.
- Full carbon accounting model – could track the flow of carbon between different carbon pool.
- Full spatial modeling – could track the change on individual units of land.
- A higher tier integrated system has a greater ability to analyse the effects of management on emissions and can project emissions estimates → could be used as a guidance for implementation of the integrated monitoring and reporting system.

1) Reduce uncertainty and improve accuracy of estimates in the national inventory;
2) Improve spatial and temporal resolution of data and further disaggregating data categories;
3) Improve potential to correctly estimate impacts of mitigation on national inventories

Challenges:
Selecting an integration method/model requires consideration of practical and scientific issues:

- National and international reporting requirements;
- Data availability;
- Technical means and capacity;
- Standards by which the system and its outputs will be assessed;
- Availability of integration tools and the expertise to implement this;
- Flexibility and scalability;
- Cost effectiveness.

Thank you

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