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Linking remote-sensing, ground observations and ecosystem models for improved GHG accounting in land systems

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Increasingly detailed GHG accounting is required for land-sector reporting under the UNFCCC and other instruments such as the Kyoto protocol. Reliable GHG accounting for the land is challenging because of the complex processes involved that result in high spatial and temporal variability in sources and sinks of GHGs. GHG accounting requires information on the area of managed land and how it changes over time, models for estimating GHG balances for each land unit, and a range of ground data that can be used for model calibration and testing, and as inputs to run models over space and time. The accounting framework must capture the following key components of the GHG balance, that apply at the scale of site (e.g. farm of forest management area), region or country:

• Change in the C stock in biomass (above and below-ground) and in dead organic matter above-ground.
• Emissions of non-CO2 GHGs from burning of above-ground biomass and dead organic matter.
• CO2 emissions from soils resulting from biological oxidation, or in the case of peat from combustion by fire.
• Emissions of non-CO2 GHGs from soils resulting from biological processes, or in the case of peat from combustion by fire.

Remotely-sensed data is critical for obtaining spatial and temporal information for specific units of land - this enables construction of disturbance histories, description of land condition (e.g. forest degradation in the tropics), estimation of patterns and rates of land use change, and inference of the nature of land management practices. All these markedly affect C stocks and GHG emissions.

Ground-based information can be wide-ranging and includes anything that can be used to facilitate the preparation of GHG accounts at a range of scales. The following are relevant to the formulation and testing of GHG accounting models, and as inputs to enable the models to be run spatially and to thus utilize remotely-sensed data:
• spatial maps of vegetation, land management, disturbance history, soil types and C content, land use, and spatialclimatic variables
• point measures of forest growth and equations for converting this to biomass, records of harvested wood, emission factors for C in biomass, dead organic matter and soils, emission factors for non-CO2 GHG emissions from soils and fire
• research data that can be used for the calibration and testing of models that can estimate components of ecosystem GHG balance

The above concepts will be illustrated using examples from the Australian National Carbon Accounting System, and from the international work being conducted by the Group on Earth Observations (GEO) Forest Carbon Tracking (FCT) task.