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GCOS Workshop on Observations for Climate Change Mitigation

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**Co-sponsored by the Land Cover Project Office of the Global
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Executive Summary

The Global Climate Observing System (GCOS) and the Global Observations for Forest Cover and Land Dynamics (GOFC-GOLD) held a joint workshop on Observations for Climate Change Mitigation at the Headquarters of the World Meteorological Organization (WMO) in Geneva, Switzerland, from 5-7 May 2014.

The goals of the workshop were: (1) develop a statement on the general adequacy of the observations coordinated by the GCOS to support climate change mitigation and identify of further work that may need to be undertaken in preparation for the next GCOS status report on the Global Observing Systems for Climate, (2) identify requirements needed for observations and their use in monitoring to support climate services addressing mitigation needs (especially in regard to the Agriculture, Forestry and other Land Uses (AFOLU) sector), (3) discuss strategic guidance on what steps both GCOS and GOFC-GOLD should take, and (4) provide guidance for technical communities, data producers and data users.

In her opening remarks, Carolin Richter (GCOS) outlined the need for improved observations to support mitigation, and anticipated that in future greater availability and higher resolution of observations would increase utility for mitigation purposes. Subsequent presentations and discussions addressed observational needs from different sectors, and regional perspectives. During deliberations, the Chairman Stephen Briggs highlighted the following mitigation issues that are likely to require the attention of the GCOS in future:

- review existing and consider new Essential Climate Variables (ECVs) that are related to climate change mitigation;
- identify and address gaps and requirements for observations to support their use in monitoring to support research into mitigation;
- provide guidance for technical communities to advise data producers (e.g., space agencies, observation networks) and data users (those involved in mitigation, and climate science community).

The meeting considered that GCOS and GOFC-GOLD should:

Action 1: consider the relationship between ECVs (especially those related to biomass, land cover, fire, and soil carbon) and the IPCC greenhouse gas inventory guidance AFOLU, and suggest any revision to the ECV list in time for the next Implementation Plan.

Action 2: consider how ECVs relate to the remote sensing product list identified by the Space Data Coordination Group to support the Global Forest Observations Initiative (GFOI), and make any suggestions to revise the ECV list.

Action 3: investigate the possibility of generating a full global map of land use changes, tracking reported emissions data under the IPCC land use categories. The first step could focus on forest land and forest land changes.

Action 4: better coordinate with information important for mitigation (not covered within the current ECV context) on:

- (i) land management within the land use categories of IPCC, especially forest, agriculture, and livestock.
- (ii) drivers and agents of change.
- (iii) economic indicators (e.g., infrastructure, settlements, GDP).

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All workshop presentations and associated background documents, and the concept note for the workshop are available under:

<http://www.wmo.int/pages/prog/gcos/index.php?name=ObservationsforMitigation>

The participant list and agenda for the workshop can be found as an annex to this report. The outcomes and recommendations of the workshop are summarized below.

1. Background

Long-term observation is fundamental to the provision of sound and accessible information needed for sustainable environmental resource management globally including mitigation of greenhouse gas emissions, and the adaptation to climate change that is already an inevitable consequence of past emissions. Opportunities to improve the quality of observations need to be pursued in order to strengthen information available for these purposes, on a global basis and in particular for least developed regions. The Global Climate Observing System (GCOS)¹ and Global Observations of Forest Cover and Land Dynamics (GOFC-GOLD)² aim to ensure that all users have access to those observations, data records, and additional information that they require to address climate-related concerns, particularly in supporting mitigation and adaptation. So far the monitoring of Essential Climate Variables (ECVs) identified by GCOS has focused mainly on the physical climate system, and the needs of climate modelers and others undertaking work assessed by IPCC Working Group I, with little attention paid to human activities and the needs and requirements of climate change mitigation.

Accordingly, GCOS and GOFC-GOLD organized an expert meeting, which took place from 5-7 May 2014 at WMO headquarters. The meeting considered observation requirements for mitigation, reviewed the ECVs and associated guidelines and their adequacy for mitigation, and how to address gaps and deficiencies identified. The meeting focused on land use to exemplify ideas and options to expand upon ECV observations because the AFOLU sector is currently the sector with the largest data gaps and user needs, and also the sector where the ECV concept seems to be most relevant to mitigation.

2. Essential Climate Variables (ECVs) in the UNFCCC and needs associated with land-based climate change mitigation

Countries report to the UNFCCC Conference of Parties (COP) on how they are addressing climate change. They do this by submitting National Communications (NCs). Amongst other things guidelines for the preparation of NCs by developed countries include requirements related to research and systematic observation. These say that Parties *...shall provide summary information on global climate observing system activities...*, and that to *...guide reporting... Parties should refer to the detailed guidance provided in the UNFCCC reporting guidelines on global climate observing systems*³...

UNFCCC guidelines on reporting on global observing systems for climate were most recently revised at the 13th COP⁴. They ask Parties to *...describe the status of their programmes for contributing observations of the essential climate variables (ECVs) to the international*

¹ Official GCOS website: <http://www.wmo.int/gcos>.

² Official GOFC-GOLD website: <http://www.fao.org/gtos/gofc-gold>.

³ Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications (UNFCCC 2000, doc FCCC/CP/1999/7).

⁴ Decision 11/CP.13 Reporting on Global Observing Systems for Climate Document FCCC/CP/2007/6/Add.2

community. Annex 1 lists ECVs most recently identified by GCOS⁵. This list updates (and therefore differs from) the list of ECVs included in the reporting guidelines adopted by COP13, but the UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA) encourages Parties *...when providing information ...[in] their national communications... to take into consideration the new requirements identified in the 2010 updated GCOS implementation plan, in particular the new Essential Climate Variables (ECVs)*. The SBSTA also notes that *...any future revision of relevant UNFCCC reporting guidelines, in particular those on global climate change observing systems, should take into account the new elements identified in that plan*⁶.

Historically, COP decisions have treated ECVs as providing observational data to improve understanding and monitoring of the climate system, for example through climate modeling, and data analysis and assimilation. In addition it is becoming increasingly apparent that there are potential benefits in linking between ECVs and anthropogenic emissions estimation, because:

- this will increase consistency between climate models and mitigation efforts, which will become important in assessing the effectiveness of a new climate agreement
- of increased consistency in emissions estimation between countries
- of potential efficiencies in joint acquisition of data for modeling and for emissions estimation, for example by rationalizing and increasing the functionality of observation networks.

In practice this means evolving ECVs such as those related to land cover, soil carbon and biomass to help meet the data needs of the greenhouse gas emissions and removals estimation methodology developed by the Intergovernmental Panel on Climate Change and set out in the Good Practice Guidance of 2000 and 2003, and the 2006 Guidelines⁷. This is because COP decisions require anthropogenic emissions and removals of greenhouse gases, to be estimated and reported using the IPCC methodology, and therefore the effects of mitigation actions need to be quantifiable through the IPCC methodology if they are to count towards national emissions reduction targets agreed under the UNFCCC.

The main priorities for evolving ECVs in this direction are likely to include:

1. better identification of IPCC land categories (forest land, cropland, grassland, wetlands, settlements, other land) and changes between them.
2. identification of forestry and agricultural management practices or other human interventions within these categories.
3. association of carbon densities within sufficiently uniform strata corresponding to the subdivisions identified in 1) and 2) and covering the carbon pools identified by IPCC (namely above and below ground biomass, dead wood, litter and soil organic matter).
4. identification of extent of transportation and other human infrastructure in so far as these

⁵ Implementation Plan for the Global Observing System for Climate in support of the UNFCCC (2010 Update) GCOS-138 WMO 2010

⁶ Paragraph 44, Report of the Subsidiary Body for Scientific and Technological Advice on its thirty-third session, held in Cancun from 30 November to 4 December 2010. Document FCCC/SBSTA/2010/13

⁷ The IPCC guidance and guidelines on greenhouse gas emissions inventories is available at: <http://www.ipcc-nggip.iges.or.jp/public/2006gl/>.

affect stratification.

5. improved identification of disturbance areas, recurrence, and intensities and associated emission factors.
6. improved data on high carbon ecosystems (e.g., forests and non-forested peatlands) and associated disturbances.

GCOS anticipates that the benefits of doing this, particularly if ECVs could be linked to socio-economic data, would include better understanding of the relationship between drivers of emission trends and mitigation potential, and the importance of emerging activities such as agro-forestry. Clearly it will be important to link ECVs to emission factors and there needs to be sufficient attention to non-CO₂ GHG, particularly methane and nitrous oxide. The ability of developing countries to move to more disaggregated and representative (so-called Tier 2 and 3) IPCC methods is often limited by access to disaggregated activity and emission factor data. Because of their broad coverage, of ECVs are also likely to be suited to improving understanding of the links between mitigation and adaptation. GCOS recognizes that in order to broaden the application of ECVs it will need to work with other international organizations and initiatives, including notably FAO, IPCC, GOFC-GOLD and the Global Forest Observations Initiative (GFOI)⁸.

As a result GCOS expects that ECVs will in future:

- support a better understanding of the current and future interactions between land use and climate;
- improve knowledge of the impacts of land use and management decisions on mitigation, and the comparative advantages of different mitigation efforts for development;
- improve ex-post evaluation of implemented policies;
- help develop an integrated approach for consistent mitigation approaches and data comparability between countries and ecosystems.

2.1 IPCC Good Practice Guidance (GPG) and the ECVs

The requirements of emissions mitigation make it increasingly apparent that there are potential benefits in linking ECVs and anthropogenic emissions estimations. The agreed methodologies for reporting emissions to the UNFCCC is provided by the 2006 IPCC Guidelines for National Greenhouse Gas Inventories and the previous 2000 and 2003 IPCC Good Practice Guidance and the 1996 IPCC Guidelines, which set out how to estimate anthropogenic GHG inventories that neither over- nor under-estimate emissions as far as can be judged, with uncertainties reduced as far as practicable.

The IPCC framework provides guidance on how to produce emission estimates that are transparent, complete, consistent, comparable and accurate. The methodology is tiered, meaning that simpler or more complex methods are available depending on country capacity and data availability. Uncertainties are quantified at all Tiers. Higher Tier methods may be more disaggregated and better represent human activities and could offer a better link with ECVs (e.g. those related to biomass, soil carbon, fire, and climate). A more detailed view is presented in

⁸ The Global Forest Observations Initiative (GFOI) website: <http://gfoi.org/>

paragraph 4.1. Referring to the IPCC guidelines can help countries can better identify data gaps, data needs, and strategies for data improvement for both GHG emissions estimations and ECVs, which could increase effectiveness of mitigation initiatives consistency between climate models and mitigation efforts.

3. Recommendations and actions

3.1 Lines of action for GCOS and GOFC-GOLD

Existing ECVs are not intended to support land-based mitigation, but rather to provide observation-based evidence, mainly focused science and attribution of climate change at a global level. One goal of the workshop was to provide those interested in mitigation with the opportunity to influence the evolution of the ECVs. To this end the workshop recommended that GCOS and GOFC-GOLD should:

- Action 1:** consider the relationship between ECVs (especially those related to biomass, land cover, fire, and soil carbon) and the IPCC greenhouse gas inventory guidance for AFOLU, and suggest any revision to the ECV list in time for the next Implementation Plan.
- Action 2:** consider how ECVs relate to the remote sensing product list identified by the Space Data Coordination Group to support the Global Forest Observations Initiative (GFOI), and make any suggestions to revise the ECV list.
- Action 3:** investigate the possibility of generating a full global map of land use changes, tracking reported emissions data under the IPCC land use categories. The first step could focus on forest land and forest land changes.
- Action 4:** better coordinate with information important for mitigation (not covered within the current ECV context) on:
- (i) land management within the land use categories of IPCC, especially forest, agriculture, and livestock.
 - (ii) drivers and agents of change.
 - (iii) economic indicators (e.g., infrastructure, settlements, GDP).

Furthermore, GCOS should consider the needs of climate change mitigation in planning and prioritization, and in defining ECVs, which allow for continuous engagement with the climate change mitigation user communities and relevant panels such as GOFC-GOLD and GFOI.

3.2 Other recommendations

In addition to actions 1 to 4, there is a series of other recommendations aimed at increasing linkage between monitoring ECVs and the evolving needs for climate change mitigation:

The United Nations Framework Convention on Climate Change (UNFCCC)

UNFCCC should note the efforts by GCOS to increase the usefulness of ECVs for mitigation, and use available mechanisms to underpin this process by additional guidance and priorities, as appropriate, and as international climate negotiations evolve.

Mitigation science community

The mitigation science community needs robust, frequent, spatially extended and accurate data for integrated assessment modeling, and should better articulate its needs and priorities in a systematic way so they can be taken into account in developing ECV lists and guidance to support mitigation needs.

Space agencies

Governments supporting the main agencies in charge of space-based Earth Observation (EO) programmes have confirmed their commitment to ensure continuity of activities that will allow the provision of EO data for the next 20 years to support climate change monitoring and mitigation activities. We recommend space agencies further to develop their coordination of activities via the Committee on Earth Observation Satellites (CEOS), and to facilitate the access and the use of EO data, building on the example provided by the Space Data Coordination Group set up to meet the data needs of the GFOI.

The European Space Agency (ESA), and the National Aeronautics and Space Administration (NASA), in coordination with other national agencies and research institutes, have been engaging in the development of some terrestrial ECV datasets following the GCOS requirements. We recommend the space agencies to maintain their participation in these initiatives, to ensure the adequacy of future EO data and associated services consider the evolution of the priorities and needs for the ECVs discussed here.

Capacity development agencies

Several bilateral and multilateral initiatives exist to develop country capacities to monitor human-induced land cover change in the context of international conventions like the UNFCCC. We recommend relevant stakeholders (e.g., FAO, World Bank, UNEP, national agencies) to take note of the GCOS process, and develop the coordination of their respective actions to improve country capacities and towards global synthesis of impact of land-based mitigation actions across countries and regions.

4. Overview of data requirements

There are multiple users of data and information related to climate change mitigation. Their importance and requirements vary according to whether mitigation activities are planned, implemented or evaluated; and they vary in terms of the type of users (i.e. national governments, climate mitigation scientists, international negotiations, local mitigation implementers). This is further discussed in Annex II.

4.1 IPCC Guidelines for National Greenhouse Gas Inventories⁹

The IPCC has published guidance and guidelines providing methodologies to estimate national anthropogenic emissions and removals of greenhouse gases (hereafter collectively referred to as “IPCC Guidelines”). The Revised 1996 Guidelines for National Greenhouse Gas Inventories, together with the two volumes on inventory good practice guidance - the Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (GPG 2000) and the Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG-LULUCF) – have until now been used by Parties included in Annex I of the UNFCCC (Annex I Parties, developed countries). Developing countries (those not included in Annex I of the UNFCCC) use the 1996 Guidelines, and are encouraged to use the two volumes of good practice guidance. The latest version of the IPCC Guidelines is the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (2006 Guidelines), which Annex I Parties must use for their inventory submissions from 2015. The two supplementary guidance reports produced in 2013 – the 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement) and the 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement) will be also used by Annex I Parties as supplements to the 2006 Guidelines. Developing countries should use the good practice guidance as well as the 1996 Guidelines. Although there has been no UNFCCC decision requiring them to do so, some Non-Annex I Parties, have also started using the 2006 Guidelines, and more may do so in future.

Principles

Reference to anthropogenic emissions and removals means that greenhouse gas emissions and removals included in national inventories are a result of human activities. In the AFOLU Sector, emissions and removals on managed land are taken as a proxy for anthropogenic emissions and removals. Emissions and removals caused by natural disturbances are included in the national greenhouse gas inventories if they occur on managed land. For the purpose of the second commitment period under the Kyoto Protocol, emissions caused by natural disturbances may be excluded in accordance with conditions set out in relevant decisions by the COP/MOP.

The key greenhouse gases of concern in the AFOLU Sector are CO₂, N₂O and CH₄. Emissions of other nitrogenous gases including NO_x and NH₃, which can serve as a source of subsequent N₂O emissions (and hence referred to as indirect emission sources), are also considered in the IPCC Guidelines.

To promote the development of national greenhouse gas inventories that are consistent, comparable, complete, accurate and transparent, a collection of methodological principles, actions and procedures are defined and collectively referred to as good practice. Inventories consistent with good practice are those which contain neither over- nor under-estimates as far as can be judged, and in which uncertainties are reduced as far as practicable. The concept of good practice was introduced in the GPG 2000 and remains a key concept in the subsequent IPCC Guidelines including the 2006 Guidelines.

⁹ All the IPCC methodological guidance reports can be downloaded from the IPCC TFI website (<http://www.ipcc-nggip.iges.or.jp/>).

Categorization and stratification scheme for data collection

Land-use category

Categorization and stratification of land are important to ensure adequate data collection to produce complete and high quality estimation of land-based emissions and removals. Firstly, all lands within the national territory should be categorized into the six land-use categories described by IPCC, namely: Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land. Each land-use category is subdivided into land remaining in that category (e.g., Forest Land Remaining Forest Land) and land converted from one category to another (e.g., Forest Land converted to Cropland). There may be further stratification of each category by climate, soil type, ecological zones and management practices¹⁰.

Carbon pools

Within each land-use category and sub-category, carbon stock changes and emission/removal estimations can involve the five carbon pools (Above-ground biomass, Below-ground biomass, Dead wood, Litter and Soil organic matter). National circumstances may require modification of the pool definitions provided by IPCC. It is *good practice* to ensure consistent use of the definitions over time, and to demonstrate that pools are neither omitted nor double counted, consistent with the guidance. Methods are provided for estimating carbon stock changes associated with harvested wood products.

Others

Nitrous oxide emissions from managed soils are usually estimated from national level data on N supplied to soils, including N fertilizer usage or sales, crop residue management, organic amendments and land-use conversions that enhance mineralization of N in soil organic matter. Similarly, CO₂ emissions from liming and from urea application to managed soils are typically estimated using aggregate data.

Methods to estimate GHG emissions/removals

The most common approach is to combine information on the extent to which a human activity takes place (called activity data) with coefficients which quantify the emissions or removals per unit activity (called emission/removal factors). Although the dynamics of carbon pools introduces some additional complexities, the basic equation is therefore: Emissions = Activity Data x Emission Factor.

There are two approaches to estimation of carbon stock changes in any pool.

Gain-Loss Method: Carbon stock changes are estimated as a sum of gains and losses of carbon. Gains can be attributed to growth (increase of biomass) and to transfer of carbon from another pool. Losses can be attributed to transfers of carbon from one pool to another or emissions due to decay, harvest, burning, etc.

¹⁰ For 3.1 more details, refer to Section 3.1 "IPCC Stratification scheme for AFOLU data" in the Meeting Report of the IPCC – FAO – IFAD Expert Meeting on FAO Data for LULUCF/AFOLU Rome, Italy, 20-22 October, 2009 (IPCC 2010) which is available from the IPCC TFI website.
(http://www.ipcc-nggip.iges.or.jp/public/mtdocs/pdfiles/0910_FAO-IFAD-IPCC-Meetingreport.pdf)

Stock-Difference Method: Carbon stock changes are estimated as difference in carbon stocks measured at two points in time.

In the IPCC methodology, a tier represents a level of methodological complexity.

- Tier 1 methods are the simplest, and equations and default parameter values (e.g., emission and stock change factors) are provided in the IPCC Guidelines. Country-specific activity data are needed, but for Tier 1 there are often globally available sources of activity data estimates (e.g., deforestation rates, agricultural production statistics, global land cover maps, fertilizer use, etc.), although these data may be spatially coarse.
- Tier 2 generally uses the same methodological approach as Tier 1 but applies emission and stock change factors that are based on country- or region-specific data, for the most important land-use categories. Country-defined emission factors are more appropriate for the climatic regions and land-use systems in that country. Higher temporal and spatial resolution and more disaggregated activity data are typically used in Tier 2 to correspond with country-defined coefficients for specific regions and specialized land-use or livestock categories.
- At Tier 3, more complex methods are used, including models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national level.

4.2 ECV interactions with greenhouse emissions estimates

Annex I lists the 50 Essential Climate Variables (ECVs) defined by GCOS to support the work of the UNFCCC and the IPCC. The ECVs are divided into atmospheric, oceanic and terrestrial groups. Most of ECVs in the current list are not relevant to land-based mitigation and only few observations are of potential use as data input to estimation and reporting using the IPCC GPG. Table 1 suggests how these could relate to the methodology.

Table 1: Relation between ECVs (terrestrial and atmospheric) that could potentially be used to support emissions estimates using the IPCC guidelines. Black cells indicate strong relationship between emission components and ECVs. Grey indicates some relationship, and white cells indicate no clear relationship.

ECVs IPCC	Activity data		Emission Factors			Bio-mass burning	Soil management	Live-stock	Rice
	Land Use & change	Land use	Bio-mass	Dead org. matter	Soil org. carbon				
Land cover	Black	Black	Black	Grey	Grey	Black	Black	White	Black
Above ground biomass	White	White	Black	Grey	Grey	Black	Grey	White	White
Soil Carbon	White	White	White	White	Black	Grey	Black	White	White
Fire disturbance	Grey	Grey	White	White	White	Black	Grey	White	White
Soil moisture	White	White	White	White	White	Grey	Black	White	Black
Water use	White	White	White	White	White	White	Black	White	Black
Leaf Area Index	Grey	Grey	White	White	White	Grey	White	White	White
Albedo	Black	White	White	White	White	Black	White	White	White
Temperature	White	Grey	White	White	White	Grey	White	Grey	White
Precipitation	White	Grey	White	White	White	Grey	White	Grey	Black
Methane	White	White	White	White	White	Grey	White	Black	Black
CO ₂	White	White	Black	Black	Black	Black	Grey	White	White
N ₂ O	White	White	White	White	White	Grey	Black	Black	Grey

4.3 Data needs for AFOLU sector mitigation activities

Forestry and agricultural activities, including changes in land use and land management, are a major source of GHGs. In the land use sector, drivers of emissions often interact – agricultural expansion or demands for biofuels or bioenergy will increase pressure on the forests as carbon sinks and stores. This reinforces the need for integrated emission assessments, which have recently been focused increasingly on these issues. Despite the uncertainties, the recently delivered AFOLU chapter under the IPCC 5th Assessment Report¹¹ (AR5, WGIII) offers a more comprehensive view of the different GHGs emitted by the land sector, in an integrated manner.

The AFOLU chapter¹² identifies AFOLU's key emission sources, which should help prioritize mitigation activities, and also navigate data needs and priorities. These include:

- (i) For the non-forest sectors: Enteric fermentation + soil management (70% of the agricultural emissions), rice emissions (9-11%), biomass burning (6-12%), and manure management (7-8%);
- (ii) For the forest sector: Deforestation and forest degradation (95% of emissions of the forest sector).

Examples of mitigation initiatives for the AFOLU sector include:

- Reductions in CH₄ or N₂O emissions from croplands, grazing lands, and livestock.
- Conservation of existing carbon stocks, e.g., conservation of forest biomass, peatlands, and soil carbon that would otherwise be lost.
- Reductions of carbon losses from biota and soils, e.g., through management changes within the same land use type (e.g., reducing soil carbon loss by switching from tillage to no-till cropping) or by reducing losses of carbon rich ecosystems, e.g., reduced deforestation, rewetting of drained peatlands.
- Enhancement of carbon sequestration in soils, biota, and long lived products through increases in the area of carbon rich ecosystems such as forests (afforestation, reforestation), increased carbon storage per unit area, e.g., increased stocking density in forests, carbon sequestration in soils, and wood use in construction activities.
- Changes in albedo resulting from land use and land land-cover change that increase reflection of visible light.

Table 2 summarizes data needs, in order to estimate emissions and elaborate mitigation policies, and suggests future steps for data improvement.

¹¹ The AR5 WGIII chapter on AFOLU can be found here: http://report.mitigation2014.org/drafts/final-draft-postplenary/ipcc_wg3_ar5_final-draft_postplenary_chapter11.pdf.

¹² The full AR5 WGIII report can be found here: http://report.mitigation2014.org/drafts/final-draft-postplenary/ipcc_wg3_ar5_final-draft_postplenary_chapter11.pdf.

Table 2 – Summary of data needs and next steps for the different users, in order to improve their emission reports and mitigation assessments.

Sectors for data needs	Mitigation-related report / research	Data periodicity	Data needs	Improving data: next steps
Countries	1. NAMAs	1. As required.	<p>Emissions of forests, agriculture, livestock, croplands, grasslands, wetlands, managed soils, rice, biomass burning and disaggregated land covers and management categories require data on:</p> <p>1. Emission factors through field measurements, census data, etc.;</p>	<p>Consideration of how observations relate to activity data used by countries.</p> <p>Data completeness, data gaps, data frequency.</p> <p>Appropriate data disaggregation levels taking into account needs of mitigation.</p> <p>Estimation of uncertainties in observations.</p>
UNFCCC country level	1. National Communications 2. National GHG Inventories (NIR + CRF) 3. BR, BURs 4. IAR, ICA 5. NAPAs	1. Periodical (for Annex I), non-fixed dates for non Annex I 2. Annual (Annex I), periodical (non Annex I) 3. Biennial 4. Biennial for Annex I countries, and determined by the frequency of biennial update reports for non Annex I	<p>2. Activity Data through remote sensing, large-scale surveys, etc. Field measurements, Census data, etc., for emission factor estimates.</p> <p>Mitigation alternatives also need socio-economic datasets for trend analysis and scenario development.</p>	<p>Improved data representativeness: satellite data at spatio-temporal scales relevant for decision-making.</p> <p>Improved data representativeness: disaggregated emission factors (spatially and temporally) based on country empirical research, and reduced uncertainties.</p>
Support to REDD+	REDD+ reporting National Forest Monitoring Systems	Biennial		<p>Reducing uncertainties of activity data of key land use changes (e.g. deforestation and forest degradation).</p> <p>Improved disaggregated forest</p>

				<p>activity data related to human disturbances within the same land use (e.g. forest degradation and drivers)</p> <p>Improved disaggregated forest activity data related to natural disturbances: Extent and location of forest disturbances due to fire, pest attack, and extreme weather.</p> <p>Improved activity data on project activities, relevant to CDM and REDD+ and sub-national or stakeholder interaction in general.</p> <p>Improved systems for assessing mitigation effectiveness of CDM, REDD+ and their relation to local livelihoods.</p> <p>Linking reference emission levels to sustainability of land use systems and social justification for various land systems.</p>
Climate modelling		Monthly, daily		Improved collection, processing and sharing of independently observed data.
Earth Systems modelling		Monthly, daily	<p>Same data as country level and UNFCCC process but at different aggregation levels</p> <p>Global climate datasets</p>	<p>Improved collection, processing and sharing of independently observed data (i.e. bottom-up ecosystem inventories of GHG emission or sequestration from land based fluxes).</p> <p>Consolidation of modelling outputs</p>

				<p>and integration of socio-economic information to biophysical data.</p> <p>Improved datasets (better disaggregation and reduced uncertainties) for model parameterization and model scaling-up processes.</p> <p>Improved global products for activity data (Forest maps produced internationally – e.g. by the University of Maryland)</p>
Integrated assessment models		Monthly, daily		Improved methods to assemble multi-source data, and reduced uncertainties.
Policy impact assessment and modelling	<p>1. Mitigation alternatives</p> <p>2. Sustainable consumption</p>	Annual, decadal	<p>1. Activity data, emission factors, socio-economic data, climate scenarios.</p> <p>2. Demands and supply trends</p>	<p>1. Improved matching of land information granularity with actionable policies.</p> <p>2. Improved data for assessment of supply chains. Improved coordination with data on commodity flows (MFA,LCA). Could feed in to consideration of the food-bioenergy sequestration nexus (not UNFCCC issue)</p>

Annex I – List of Essential Climate Variables

Domain	Essential Climate Variables
Atmospheric (over land, sea and ice)	<p><i>Surface</i>¹: Air temperature, Wind speed and direction, Water vapor, Pressure, Precipitation, Surface radiation budget</p> <p><i>Upper-air</i>²: Temperature, Wind speed and direction, Water vapor, Cloud properties, Earth radiation budget (including solar irradiance)</p> <p><i>Composition</i>: Carbon dioxide, Methane and other long-lived greenhouse gases³, Ozone and Aerosol supported by their precursors⁴</p>
Oceanic	<p><i>Surface</i>⁵: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean color, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton</p> <p><i>Sub-surface</i>: Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers</p>
Terrestrial	<p><i>Hydrological</i>: River discharge, Water use, Ground water, Lakes, Soil moisture</p> <p><i>Cryospheric</i>: Snow cover, Glaciers and ice caps, Ice sheets, Permafrost</p> <p><i>Biological/ Ecological/ Other</i>: Land cover, FAPAR, Leaf area index, Soil carbon, Albedo, Above ground biomass, Fire disturbance</p>

¹ Including measurements at standardized, but globally varying heights in close proximity to the surface.

² Up to the stratopause.

³ Including nitrous oxide (N₂O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF₆), and perfluorocarbons (PFCs).

⁴ In particular nitrogen dioxide (NO₂), sulphur dioxide (SO₂), formaldehyde (HCHO) and carbon monoxide (CO).

⁵ Including measurements within the surface mixed layer, usually within the upper 15m.

Annex II – Users of observations for climate change mitigation

Mitigation: planning, implementation, evaluation

Mitigation planning

Efficient and effective mitigation planning requires detailed assessments of both emissions data and mitigation options, so that what to reduce, where to reduce, when to reduce, how much and how to reduce, who needs to reduce and at what price can be answered. Better data help enable more strategic mitigation planning and investment, focused on the most important sources of greenhouse gases that need to be mitigated in order to avoid dangerous climate change, as required by the ultimate objective of the UNFCCC.

There appears to have been an increase in national and sub-national mitigation plans and strategies since the 4th Assessment Report (AR4). In 2012, 67% of global GHG emissions were subject to national legislation or strategies versus 45% in 2007 (5th Assessment Report Working Group III, AR5-WGIII)¹³. However, these plans and strategies are in their early stages of development and implementation in many countries, making it difficult to assess their aggregate impact on future global emissions and although there has been reported some evidence of reduction in the rate to growth of CO₂ emissions¹⁴ we have not yet seen a substantial deviation in global emissions from the past trend.



Figure 1 - Phases in the policy cycle (Source: Obersteiner, M. (2014)).

Emission data

Data on emissions support countries in identifying their mitigation options and can also help the countries seeking international support to access funding to help accomplish their development goals (Tubiello et al., 2013). Data action should therefore focus on gathering, assessing and improving data quality, with some key topics such as:

¹³ The IPCC AR5 WGIII Summary for Policy Makers can be found here:

<http://mitigation2014.org/report/summary-for-policy-makers>.

¹⁴ See *Trends in global CO₂ emissions – 2013 report*. PBL Netherlands Environmental Assessment Agency, The Hague, 2013. http://edgar.jrc.ec.europa.eu/news_docs/pbl-2013-trends-in-global-co2-emissions-2013-report-1148.

- i) data completeness,
- ii) provision of appropriate disaggregated data levels and assessments along supply chains (e.g., land use changes, emission factors at appropriate disaggregated levels),
- iii) provision of appropriate spatial and temporal data scales,
- iv) reduction of data uncertainties (particularly for key emission sources), and
- v) improved consistency and comparability.

Mitigation options

Greenhouse gases can be reduced by supply-side mitigation options (i.e., by reducing GHG emissions per unit of land/animal, or per unit of product), or by demand-side options (e.g., by changing demand for food and fibre products, reducing waste). Better data could help provide more effective and efficient mitigation options by supporting:

- tools for analyzing the effectiveness of comprehensive mitigation interventions in the different sectors of AFOLU.
- assessment of the technical mitigation potential, ease of implementation, timescale for implementation and cost of implementation of the different alternatives.
- capacity development on these topics through regional and country-level activities around the globe.

Mitigation implementation

Implementation of mitigation activities requires a technical component and a policy component, and both will be shaped by public perception, which is important in determining the effectiveness and efficiency of governmental mitigation policies (Wollenberg and Tapio-Bistrom, 2012).

In the UNFCCC context, the implementation phase can be exemplified as follows:

1. Policy component: Parties to the UNFCCC have agreed to submit national reports on the implementation of the Convention, to the Conference of the Parties (COP). These reports include emission estimates as well as the country advances in mitigation policies and measures. The contents and level of detail in national reports differ between developed and developing country Parties, consistent with the principle of common but differentiated responsibilities and respective capabilities.

2. Technical component: Countries need robust, transparent monitoring systems to support national mitigation activities and their implementation, with different temporal scales that may cover:

- (i) long-term historical analyses of emissions to develop reference emission levels against which to contrast current trends,
- (ii) mid-term systems (e.g. annual assessments of land cover changes and land uses), and
- (iii) short term (e.g. monthly or bi-weekly assessments) to locate where emission sources are happening in near-real time and be able to act upon them.

3. Perception: Human perception is a fundamental to the success of mitigation implementation. Positive social perception of mitigation policies and contribution to implement them are frequently associated with:

- (i) synergistic association with other initiatives of societal importance (e.g., inclusion or not of sustainable development goals, inclusion of key stakeholder communities) (Wollenberg and Tapio-Bistrom, 2012);
- (ii) clarity of the mitigation negotiation framework (e.g., clarity regarding the architecture of the future international climate regime);
- (iii) clarity of the mitigation goals.

Negative social perception often relates to conflicting mitigation interests. Since AFOLU plays a central role for food security, human livelihoods, and sustainable development, the implementation and effectiveness of mitigation initiatives are constrained by concerns about competition between food and AFOLU outcomes, either because of an increasing use of land for biofuel plantations (Fargione et al., 2008; Alves-Finco and Doppler, 2010), or afforestation/reforestation (Mitchell et al., 2012), or by blocking the transformation of forest land into agricultural land (Harvey and Pilgrim, 2011).

Mitigation evaluation

Evaluation of mitigation actions relies on verification and review of the actions and of the associated greenhouse gas inventory data.

1. Evaluating the quality of reported emission data

Trust in international agreements to limit future greenhouse gas emissions will depend on the ability of each nation to make accurate estimates of its own emissions, monitor changes over time, and verify estimates with independent information. In this sense, and using the UNFCCC as an example, Parties have agreed to conduct "International Assessment and Review" (IAR) applicable to GHG emission data and information submitted by developed country Parties, and international consultation and analysis (ICA) for GHG emission data and information submitted by developing country Parties. IAR implies validation by international expert review teams (ERTs) following specific mandates included in COP decisions (e.g. Decision 2/CP.1). These verification processes of the reported emission data follows the reporting principles of the UNFCCC: accuracy, transparency, completeness, comparability and consistency.

2. Verifying mitigation effectiveness

Mitigation interventions are effective if they reduce emissions compared to what would have happened in the absence of the intervention. In the case of the land sector, a number of specific issues arise:

2.1. Additionality: Additionality is widely considered a core aspect of quality assurance of climate change mitigation activities. A project that claims carbon credits for mitigation needs to show that the same mitigation effect would not have taken place without the project.

2.2 Permanence/reversals: Reversals are the release of previously sequestered carbon, which negate some or all of the benefits from sequestration that has occurred in previous years. This issue is sometimes referred to as non-permanence (Smith, 2005). Various types of carbon sinks

(e.g., afforestation/reforestation, agricultural soil carbon) have a risk of future reversals. The reversibility of carbon removal from the atmosphere creates liability issues whenever integrating land use accounting systems that do not have long-term responsibility for carbon stocks.

2.3 Leakage/displacement: Displacement/leakage arises from a change in land use or land management that causes a positive or negative change in emissions elsewhere. This can occur within or across national boundaries, and the efficacy of mitigation practices must consider the leakage implications. If reducing emissions in one place leads to increased emissions elsewhere, no net reduction occurs; the emissions are simply displaced (Powlson et al., 2011). Global-scale verification assessments are thus important for assessing overall effectiveness of mitigation.

Mitigation needs for different users

The users and data requirements will vary on the planning, implementation and evaluation phases, but in general suggested mitigation needs and contributions for the different users can be found in Table 1.

Table 1 – Examples of common mitigation needs (reports/research) from different user groups.

Users	Mitigation-related report / research	Report/research periodicity
Countries	<ol style="list-style-type: none"> 1. Development of mitigation policies at national and sub-national scales (e.g., National Appropriate Mitigation Actions (NAMAs)). 2. Establishment of mitigation targets and mitigation policies. 3. Socioeconomic modelling of mitigation and adaptation alternatives for policy making. 	
UNFCCC country level	<ol style="list-style-type: none"> 1. Global mitigation negotiations (e.g., COPs). 2. Legally binding emission reduction commitments. 3. Global reporting through bottom up country contributions. <ol style="list-style-type: none"> 3.1 National Communications 3.2 National GHG Inventories (NIR + CRF) 3.3 BR, BURs 3.4 IAR,ICA 	<ol style="list-style-type: none"> 1. Variable, COPs: annual, quarterly. 2. Commitment periods are 4 years. <ol style="list-style-type: none"> 3.1 Periodically for Annex I, non-fixed dates for non Annex I. 3.2 Annual (Annex I), periodical (non Annex I). 3.3 Biennial. 3.4 Biennial for Annex I countries, and determined by the frequency of the submission of biennial update reports for non Annex I.
Support to REDD+ ¹⁵ (e.g., UNFCCC, UN-REDD, FCPF, GFOI)	Forest mitigation through REDD+ activities: <ol style="list-style-type: none"> 1. Reference levels. 2. MRV 3. Safeguards 4. NFMS 	<ol style="list-style-type: none"> 1. Historic period, country determined (e.g., 1990-2000, 2000-2010). Reported once. 2. Verification 3. Monitoring: annual; reporting: biennial, periodical. 4. Annual, quarterly.

¹⁵ A more detailed overview of the key players can be found in Annex III of this report.

	<ul style="list-style-type: none"> 5. Addressing drivers of deforestation 6. Institutional arrangements 7. REDD+ financing 	<ul style="list-style-type: none"> 5. Historical period and annual. 7. Annual.
Climate modelling	Research on climate scenarios in connection with mitigation needs.	Monthly, daily climate data requirements for multidecadal climatic scenarios.
Earth Systems modelling	Biogeochemical global cycles and associated GHG fluxes scenarios and their relation to mitigation scenarios	Monthly, daily data requirements for multidecadal biogeochemical and GHG flux estimation.
Integrated assessment models	Socioeconomic, climate, and biogeochemical integrated global scenarios	Monthly, daily data requirements for multidecadal integrated mitigation scenarios.
Policy impact assessment and modelling	<ul style="list-style-type: none"> 1. Mitigation alternatives and scenarios considering political, socioeconomic, climatic, and biogeochemical components. 2. Sustainable consumption 	Annual, decadal data requirements for multidecadal policy scenarios.

Annex III – Overview of actors supporting REDD+

UNFCCC process

After eight years of negotiations on methodological aspects of REDD+, COP19 decided on the “Warsaw Framework for REDD+” (COP19 in Warsaw, Poland, 11-23 November 2013, FCCC/CP/2013/10, Paragraph 44). It consists of seven elements related to both technical and financial aspects of international procedures for REDD+, and formalizes REDD+ as a policy process that has achieved an overall consensus among Parties. The decisions provide guidelines on finance, reference levels, measuring, reporting and verification (MRV), safeguards, national forest monitoring systems, institutional arrangements, and addressing drivers of forestation.

Support to REDD+

The **UN-REDD** Programme is the United Nations collaborative initiative on REDD+ in developing countries, established by the Food and Agriculture Organization (FAO), the United Nations Development Programme (UNDP), and the United Nations Environment Programme (UNEP). It supports nationally-led REDD+ processes and promotes the informed and meaningful involvement of all stakeholders, including indigenous peoples and other forest-dependent communities, in national and international REDD+ implementation.

The **Forest Carbon Partnership Facility** (FCPF) is a global partnership, housed within the World Bank’s Carbon Finance Unit. It provides technical assistance and supports developing countries with forest stocks in their efforts to develop national strategies and systems for REDD+. The FCPF further assists countries to test approaches that can demonstrate that REDD+ can work, and provides them with performance-based payments for emission reduction programmes. UN-REDD and FCPF are cooperating closely together, and recently conducted a common country needs assessment to complete their REDD+ readiness phases.

Through its **Global Forest Observation Initiative** (GFOI), the Group of Earth Observations (GEO), together with the Committee of Earth Observation Satellites (CEOS) and other key partners, is facilitating the supply and use of forest observations for countries interested in establishing forest monitoring systems. Following guidelines set by IPCC, and in accordance with UNFCCC, the GFOI will help to strengthen the provision of data, and support services best suited to the needs of national governments.

Annex IV – Participant list

Invited Experts

No.	Name	Institution	Location	Email
1	Dr Cheikh MBOW	World Agroforestry Centre (ICRAF)	Nairobi, Kenya	C.Mbow@cgiar.org
2	Dr Jim PENMAN	University College London	London, United Kingdom	j.penman@ucl.ac.uk
3	Dr Inge JONCKHEERE	Food and Agriculture Organization (FAO)	Rome, Italy	inge.jonckheere@fao.org
4	Dr Michael OBERSTEINER	Internat. Institute for Applied Systems Analysis (IIASA)	Laxenburg, Austria	michael.obersteiner@gmail.com
5	Prof. Adrian SIMMONS	ECMWF, University of Reading	Reading, United Kingdom	Adrian.Simmons@ecmwf.int
6	Dr Olivier ARINO	European Space Agency (ESA)	Frascati, Italy	olivier.arino@esa.int
7	Mr Frank-Martin SEIFERT	European Space Agency (ESA)	Frascati, Italy	Frank.Martin.Seifert@esa.int
8	Dr Florin VLADU	UN Framework Convention for Climate Change (UNFCCC)	Bonn, Germany	fvladu@unfccc.int
9	Dr Michael CHERLET	EC Joint Research Centre (JRC)	Ispira, Italy	Michael.cherlet@jrc.ec.europa.eu
10	Mr Filipe LUCIO	WMO/Global Framework for Climate Services (GFCS)	Geneva, Switzerland	flucio@wmo.int
11	Mr Kiyoto TANABE	IPCC/Task Force on National Greenhouse Gas Inventories (Technical Support Unit)	Kanagawa, Japan	tanabe@iges.or.jp
12	Dr Rosa Maria ROMAN-CUESTA	CIFOR-ICRAF Center for Geo-Information, Wageningen University	Wageningen, The Netherlands	Rosa.roman@wur.nl
13	Prof. Anthony JANETOS (from remote)	GOFC-GOLD Project Office	Boston, United States	ajanetos@bu.edu

Secretariat

No.	Name	Institution	Location	Email
14	Dr Stephen BRIGGS (Chair)	European Space Agency (ESA)	London, United Kingdom	stephen.briggs@esa.int
15	Dr Martin HEROLD	GOFC-GOLD Project Office	Wageningen, The Netherlands	Martin.herold@wur.nl
16	Dr Brice MORA	GOFC-GOLD Project Office	Wageningen, The Netherlands	Brice.mora@wur.nl
17	Dr Carolin RICHTER	Global Climate Observing System	Geneva, Switzerland	crichter@wmo.int
18	Ms Jessica HOLTERHOF	Global Climate Observing System	Geneva, Switzerland	jholterhof@wmo.int

Annex V – Workshop agenda

Joint GOFC-GOLD/GCOS Workshop on Observations for Climate Change Mitigation 5-7 May 2014

Press Room, WMO Headquarters,
7 bis Avenue de la Paix, CH-1211 Geneva, Switzerland

Day 1 - Monday 5 May 2014

09.30 Registration
Starting at 10 hrs.

10 00 hrs – 12 30 hrs
Session 1 - Setting the frame

10 00 hrs

Welcome from hosts: GCOS and GOFC-GOLD

Tour de Table

Chairman of workshop: Stephen Briggs (Chairman of GCOS Steering Committee)

Co-chairs: Carolin Richter (GCOS), Martin Herold (GOFC-GOLD Project Office)

10 20 hrs

Intro - Why this workshop?

- *While there are many mitigation activities that require measuring, monitoring and reporting, an emphasis on **land use (agriculture) and forests** as initial focus area needs to be proposed to exemplify ideas and options to expand upon ECV observations to support climate change mitigation.*
- GCOS assessment cycle, ECVs, adaptation (20 min) – Carolin Richter (GCOS)
- Why this community of experts: focus on forest and agriculture (20 min) – Martin Herold (GOFC-GOLD)
- GFCS Implementation Plan, Observations and Monitoring Annex (20 min) – Filipe Lucio (WMO/GFCS)

11 20 hrs

Session 2 – Evolving needs from Mitigation Policy and Mitigation Activities

Rationale for Session 2

- *Land cover and land use changes act as both a cause and a consequence of climate change.*
- *Land and forest related mitigation activities are a priority in the UNFCCC political agenda in terms of post-Kyoto (LULUCF¹⁶/AFOLU¹⁷) and in developing countries (REDD+) that require proper monitoring, including the need to assess the collective impact of national actions globally.*

¹⁶ LULUCF = Land Use, Land Use Change and Forestry

¹⁷ AFOLU = Agriculture, Forestry and other Land Uses

Talks on Climate Change Mitigation Policy:

- Perspectives from the climate policy and mitigation under UNFCCC, LULUCF, AFOLU (20 min) – Florin Vladu (UNFCCC)
- Perspectives REDD+ and NAMAs (20 min) – Jim Penman
- Perspectives from FAO:
 - 1) Evolving data needs for agriculture (15 min) – Inge Jonckheere for Francesco Tubiello (FAO)
 - 2) Evolving data needs for forest observations (15 min) – Inge Jonckheere (FAO)

12 30 hrs – 13 30 hrs**Lunch Break****13 30 hrs****Talks on Mitigation Activities and Hotspots and related observation data needs:**

- Results and evolving data needs from climate change mitigation: an overview (20 min) – Anthony Janetos (GOFC-GOLD) (from remote)
- Results of the recent IPCC assessment: priorities of the IPCC WG III and related data gaps and data needs (20 min) – Cheikh Mbow (ICRAF)
- Evolving observational data needs from mitigation and integrated assessments (20 min) – Michael Obersteiner (IIASA)
- Evolving needs from developing country perspective (20 min) – Cheik Mbow (ICRAF)
- Evolving needs from Forest sector (20 min) – Simon Egglestone/Stephen Briggs (GFOI, ESA)
- Needs and requirements to integrate land management in climate and vegetation models (ISSI, Terrabites) (20 min) – Martin Herold on behalf of Han Dolman (UvA)

15 30 hrs – 16 00 hrs**Coffee Break**

16 00 hrs

Talks on Best Practices

- TSU IPCC Task Force on National Green House Gas Inventories (IPCC) (20 min) – Kiyoto Tanabe (IPCC TF GGI)

Discussion and Wrap-up: Summary of Sessions

- Who are the users of mitigation observations?
- Which are the countries/regions in particular need?
- What is the relevance and expectations from the Kyoto protocol or the post-Kyoto process?

Adjourn Day 1 at 18 00 hrs

19 30 hrs**Group Dinner****Day 2 - Tuesday 6 May 2014**

09 00 hrs – 12 00 hrs

Rationale for Session 3 (Observations and Research)

- There is important progress in the related monitoring field with new data and information becoming available on recent, historic and expected land cover and land use change.

Session 3 – Observations for Mitigation

- What are current relevant scope and initiatives?
- What ECVs are useful for this assessment? Where are the important gaps, and what are the missing ECVs?
- What mitigation measures do not exist yet?

Talks on Space-based observations:

- land cover (forests and agriculture) (20 min) – Brice Mora (GOFC-GOLD)/Frank-Martin Seifert (ESA)
- fire (20 min) – Olivier Arino (ESA)
- biomass (forests) (20 min) – Martin Herold (GOFC-GOLD)

Talks on In-situ observing networks:

- Forests (NFIs etc.) (20 min) – Inge Jonckheere (FAO)

Summary and synthesis discussions: charge for breakout groups – Stephen Briggs

12 15 hrs – 13 15 hrs

Lunch Break

Session 4 – Break out groups

13 15 – 16 00 hrs

Discussion items:

Break out group 1:

(Chair: Jim Penman, Rapporteur: Michael Obersteiner)

- (a) Evolving requirements for mitigation (climate policy, regional hotspots, etc.)
- (b) Defining existing data gaps from scientific assessments and modeling exercises (IPCC WGIII, etc.)

Break out group 2: Current status of ECVs vs. evolving data needs for mitigation

(Chair: Martin Herold, Rapporteur: Inge Jonckheere/Jessica Holterhof)

- (c) Strategies on how GCOS and its panels can help (what to include in the next GCOS IP, etc.?)
- (d) Strategies on how GOFC-GOLD can help

16 00 hrs – 16 30 hrs

Coffee Break

16 30 – 18 00 Presentation from breakout groups and discussions

Report of Break out group 1

Group 1 – Identification of data gaps and uncertainties, road map for the upcoming years on what is needed for observation to support climate change mitigation.

Report of Break out group 2

Group 2 - Recommendations to both GCOS and GOFC-GOLD on how to start developing better guidance and assessments to support data producers, (i.e. space agencies and observation networks) and users (climate science, mitigation stakeholders).

Day 3 - Wednesday 7 May 2014

09 00 – 10.30 00 hrs

Session 5 - Recap day 1 and discussion of next steps/action plan

- 1. What kinds of data are required and/or available to improve mitigation design, implementation and impact assessment globally in the forest and agriculture sector?**
- 2. What are adequacy and potential gaps of related ECV observations to support climate change mitigation?**
- 3. How can the GCOS process help with systematic observations for mitigation?**

11 00 – 12.30 00 hrs

Session 6 - Workshop Statement and Findings/Closing Panel

12.30 – 13.30 hrs

Lunch

13 30 hrs

Reassemble (if needed)

Further discuss draft statements and finalise workshop statement

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WWW

IPCC Fourth Assessment Report (AR4):

http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

IPCC Fifth Assessment Report (AR5):

<http://www.ipcc.ch/report/ar5/>

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