BASQUE CENTRE
FOR CLIMATE CHANGE
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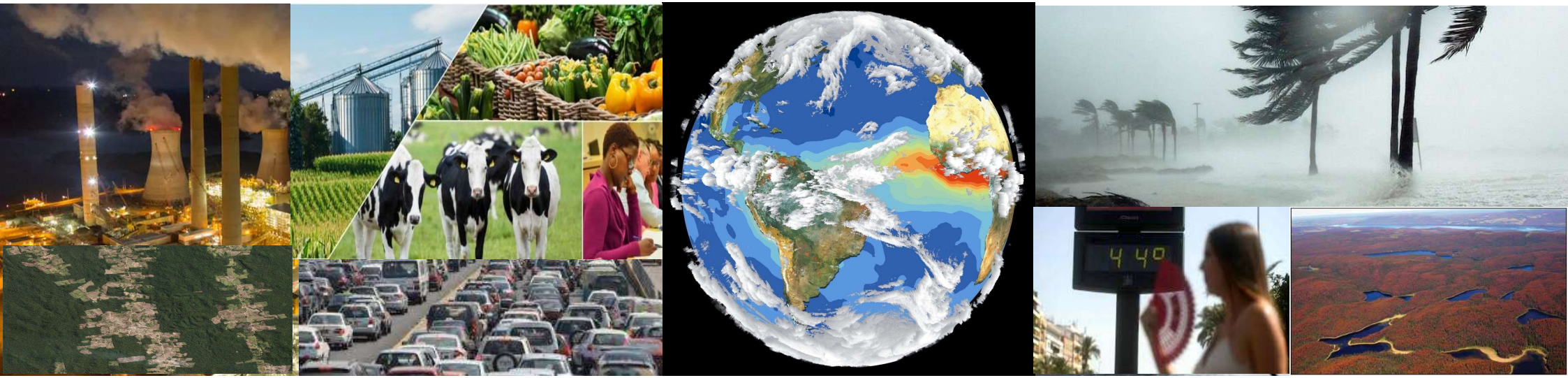
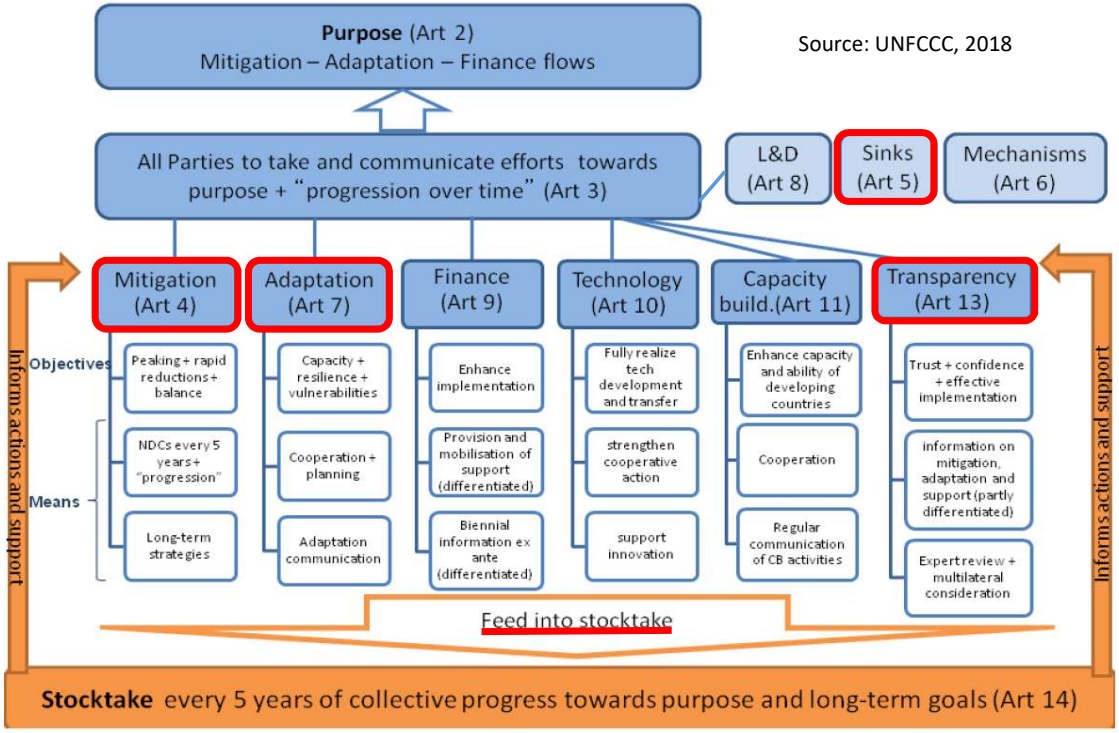
Knowledge gaps in climate change and land

M.J. Sanz Sánchez



Land use sector in the Paris Agreement context

- Land can contribute to mitigation, many future pathways largely relay on the sinks
- Sinks are very vulnerable to CC impacts (adaptation is key)
- Are specifically mentioned in Art. 5 (PA), including REDD+
- Difficult history under the UNFCCC GHG inv. Reporting (refined GHG IPCC GL) and KP Accounting (2CP Modalities)
- Some specificity on Sinks included in the Transparency FW Modalities Procedures and Guidelines (MPGs)



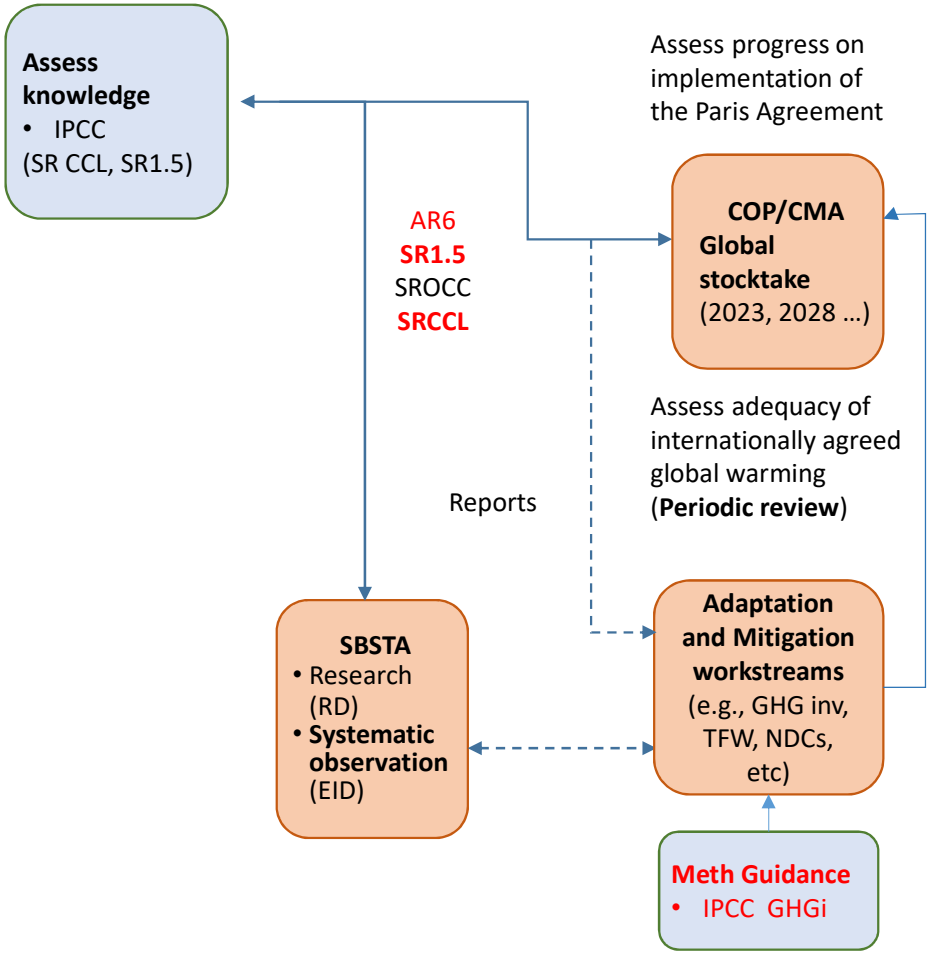
Source: UNFCCC, 2018

IMPORTAN TO NOTICE

Large discrepancies between top-down and bottom-up estimates !!!

Land use sector and science in the Paris Agreement context

- Land use and Sinks related science is contributing through IPCC assessment of knowledge (SR1.5, SRCCL, AR6)
- Science provides the bases for the methodological guidance by IPCC for countries to estimate their emissions and removals form the land use sector (1996 GL, 2003 GPG, 2006 GL, WL supplement, KP supplement, coming 2019 Refinement)
- Science contributes through IPCC or looking to align with
- There is a fundamental need to reconcile and make synergistic the top down and bottom up estimates, indicators etc.



IPCC SR Climate Change and Land (FD under preparation)

IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. A representation of the principal land challenges and land-climate system processes covered in this assessment report

Adopted ouline:

Summary for Policy Makers (~10 pages)

Technical Summary (consisting of chapter executive summaries with figures) (~20-30 pages)

Chapter 1: **Framing and Context** (~15 pages)

Chapter 2: **Land-Climate Interactions** (~50 pages)

Chapter 3: **Desertification** (~35-40 pages)

Chapter 4: **Land Degradation** (~40 pages)

Chapter 5: **Food Security** (~50 pages)

Chapter 6: **Interlinkages between desertification, land degradation, food security and GHG fluxes: Synergies, trade-offs and Integrated Response Options** (~40 pages)

Chapter 7: **Risk management and decision making in relation to sustainable development** (~40 pages)

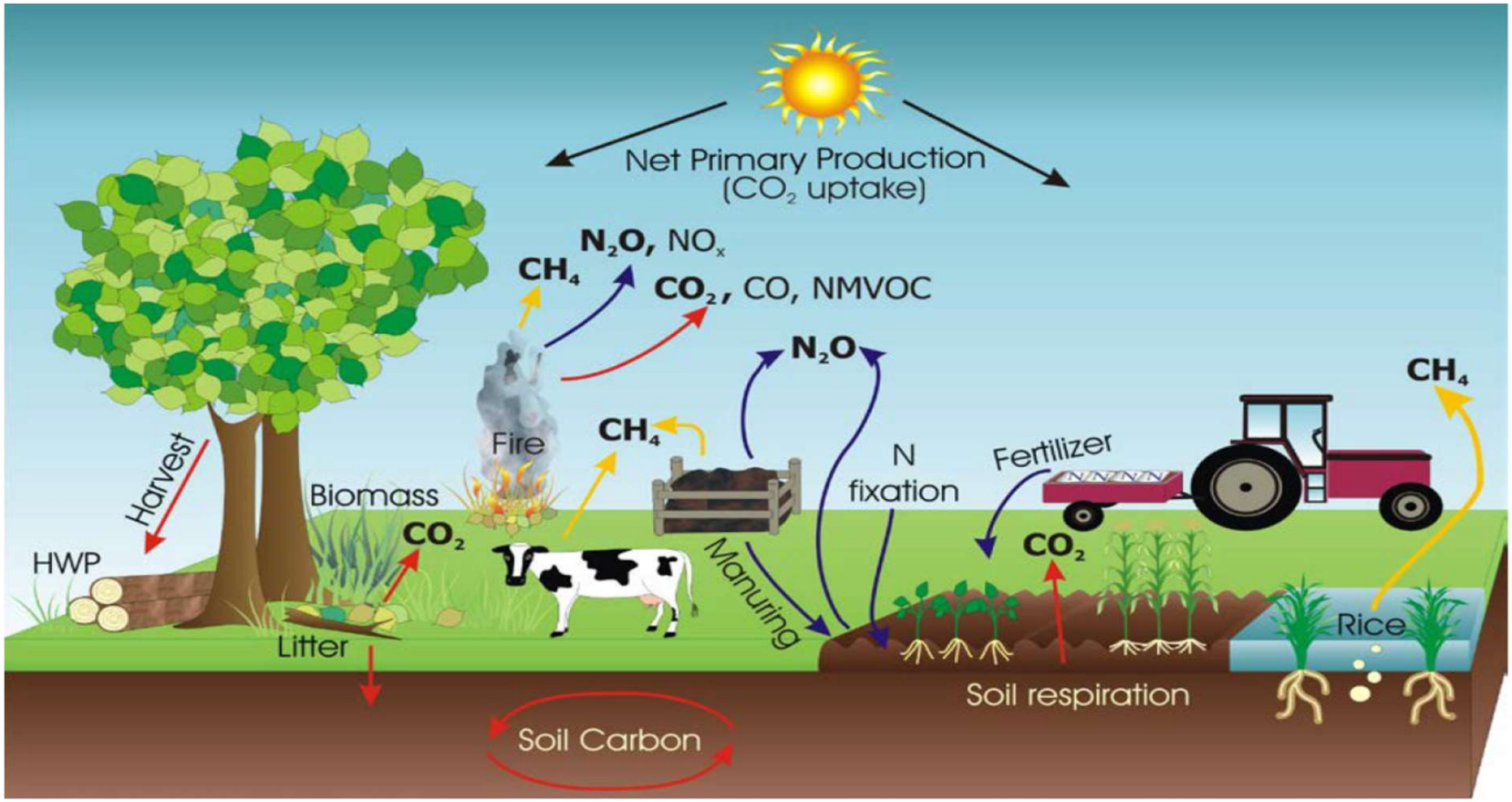
Boxes, Case Studies and FAQs (~up to 20 pages)

IPCC SR Climate Change and Land (FD under preparation)

SR CCL includes a proposal for integrated response options available to address the land challenges of climate change mitigation, climate change adaptation, desertification, land degradation and food security which correspond to chapters 2 to 5

Those respond to not only land management, but chain values and management of risk and governance

IPCC Methodological Report 2019 Refinement of 2006 GL for GHG inventories (FD out for review)



Estimations covered by GHG Inventories in the AFOLU Sector

IPCC Methodological Report 2019 Refinement of 2006 GL for GHG inventories (FD out for review)

Provision of New Guidance - Examples include the following:

Use of **allometric models and biomass density maps** for estimation of biomass carbon;

Use of Remote Sensing (RS) data (satellite data) and products in assessing changes in land areas and land use changes

Methods for estimating the **influence of inter-annual variability on greenhouse gas emissions and removals** and also

Natural disturbances such as fires, insects, ice storms

Mineral soils in croplands on Tier 2

Estimation of **emissions/removals for flooded lands**

Estimation of **carbon stock change from biochar amendments to mineral soils;**

On **livestock categories**

Provision of updated default emission factors - Examples include the following:

Values for biomass for forest land

Values for biomass for cropland

Values for Soil Carbon for cropland

Refinements to estimation of CH4 emissions from rice cultivation

Values for Soil Carbon for grassland

Values for livestock categories

Value for soil N_2O emissions

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Values for Soil Carbon for grassland

Values for livestock categories

Value for soil N_2O emissions

IPCC Methodological Report 2019 Refinement of 2006 GL for GHG inventories (FD out for review)

Provision of new default emission factors - Examples include the following:

New emission factors for livestock

More complete coverage of categories/sections – Examples include the following:

Guidance on **RS data, ground based data, and ancillary data integration** and use to derive consistent time series estimates of land use and land-use change

Guidance on the use of **Tier 3 methods**

Guidance on ensuring **methodological consistency of time series**

Guidance on **Tier 2 methods in the soil section for GL, CL and FL**

Guidance on **Tier 2 methods for direct soil N2O emissions**

For **HWP** maintaining the existing approaches in the 2006 IPCC Guidelines

Vulnerability / Adaptation

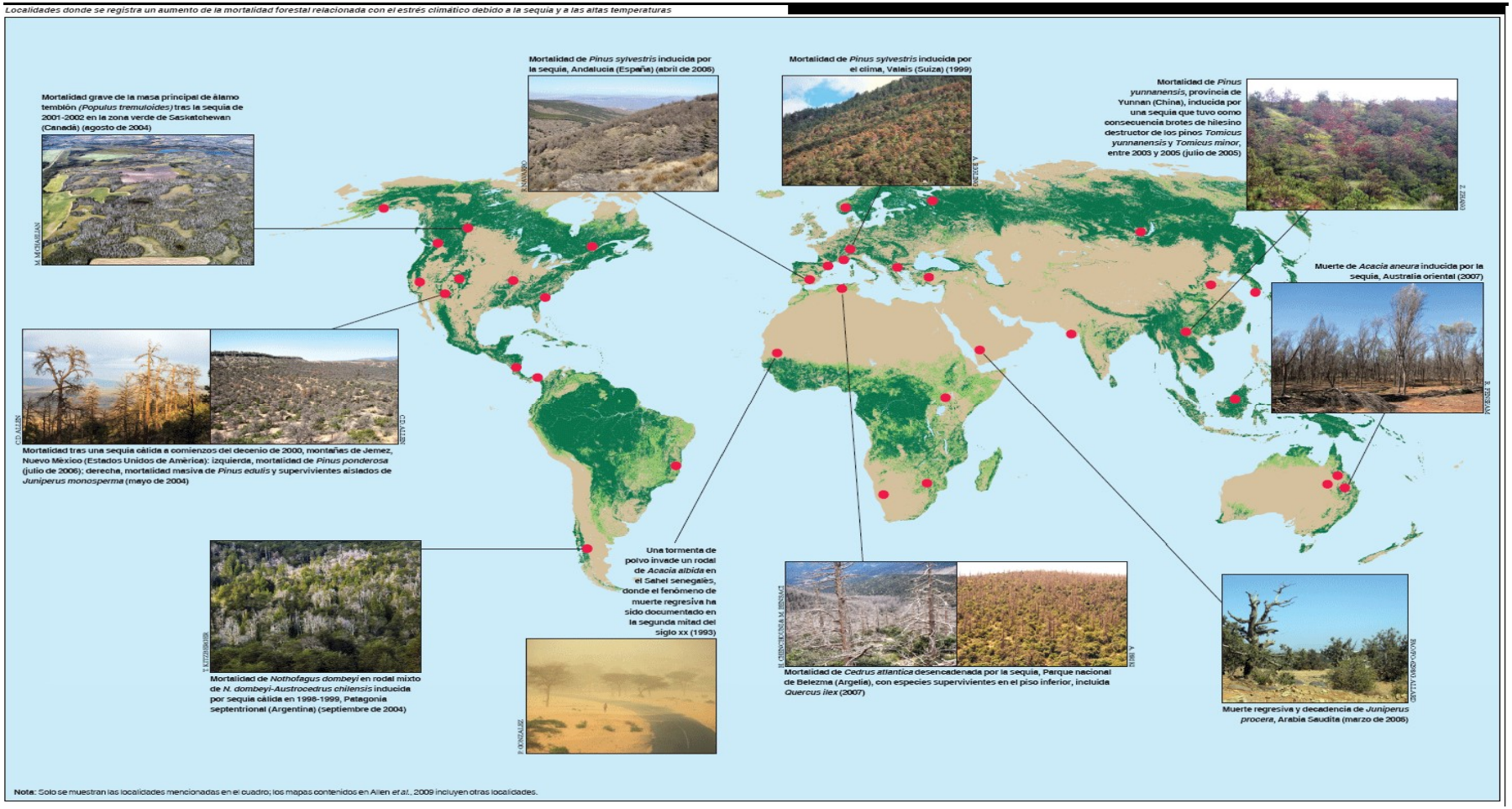
Recent literature / IPCC SRCCL




A global overview of drought and heat-induced tree mortality reveals emerging climate change risks for forests

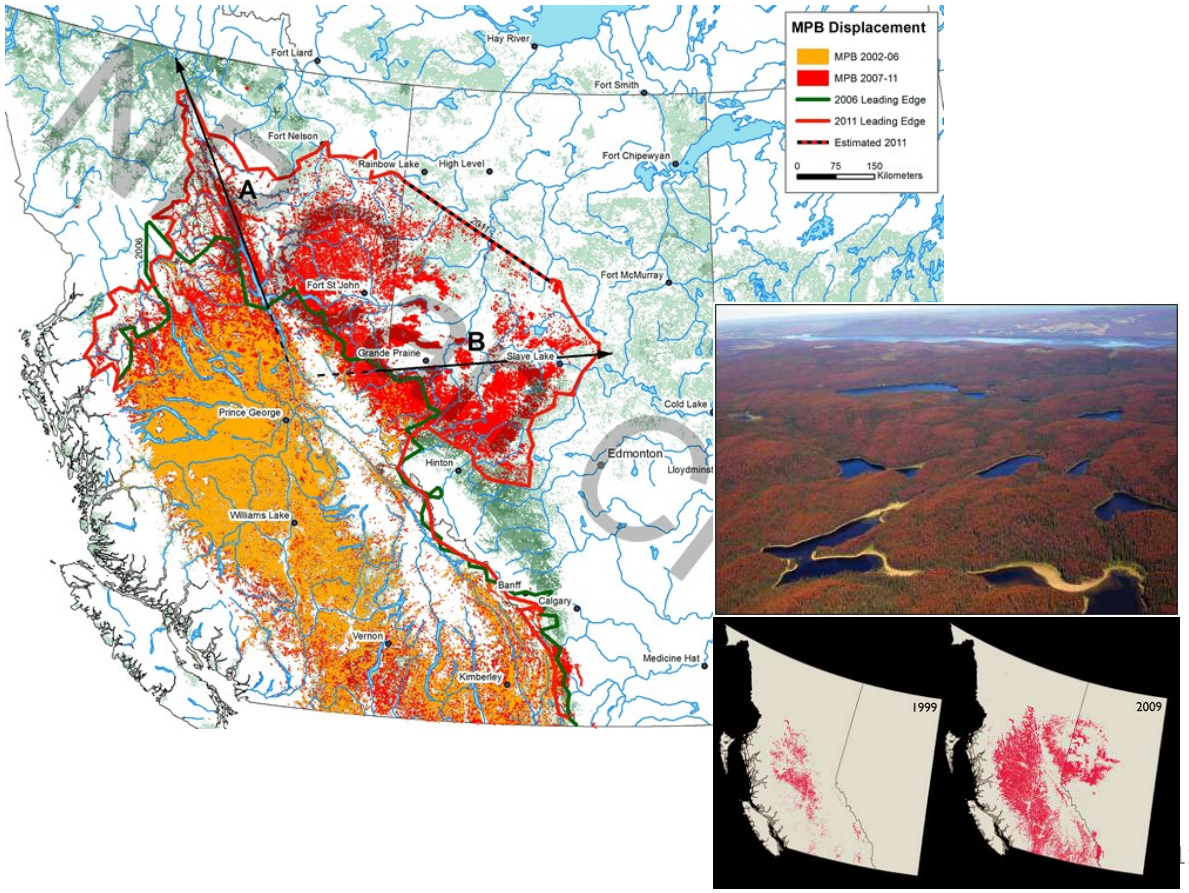
Craig D. Allen [a,*], Alison K. Macalady [b], Haroun Chenchouni [c], Dominique Bachelet [d], Nate McDowell [e], Michel Vennetier [f], Thomas Kitzberger [g], Andreas Rigling [h], David D. Breshears [i], E.H. (Ted) Hogg [j], Patrick Gonzalez [k], Rod Fensham [l], Zhen Zhang [m], Jorge Castro [n], Natalia Demidova [o], Jong-Hwan Lim [p], Gillian Allard [q], Steven W. Running [r], Akkin Semerci [s], Neil Cobb [t]

Forest are vulnerable!



Mountain pine beetle and forest carbon feedback to climate change - CANADA

- Cumulative impact of the beetle out-break in the affected region during 2000–2020 will be 270 Mt C over 374,000 km2 (Kurtz el al 2008)
- In the worst year, the impacts resulting from the beetle outbreak in British Columbia were equivalent to 75% of the average annual direct forest fire emissions from all of Canada during 1959–1999



Recent case of a disease (*Dothistroma pini*) in north Spain

Recent tree mortality… Basque Country

Pinus radiata
Monoculture (50% forest área)

Guipúzcoa (Spain)- January 2018 about 1.100 ha affected, six months later 16.000 of the 65.000 ha of pine forest in the province affected (mainly monocultures of *P. radiata*

During summer 2018 also detected in Vizcaya and Alava provinces. It will require extraction of the wood in the coming months

Importance of EO in the context of a changing climate

- The impacts of disturbances are increasing (i.e. diseases and pests, fires, windrows, unexplained decays, etc), and its effects on carbon dynamics, are generally poorly monitored and therefore ignored in modelling analyses and mitigation scenarios.
- EO therefore becomes critical:
  - Monitoring ecosystems natural variability and response to climate change and human management, understanding the processes behind
  - Establishing early warning systems for disturbance and damage early detection and assessment
  - Establishing relations between the above and the land planning and practices to address climate change (Adaptation and Mitigation) and the provision of other services

PA TFW - Adaptation information is becoming important, for both the definitions of NDCs and the provision of information

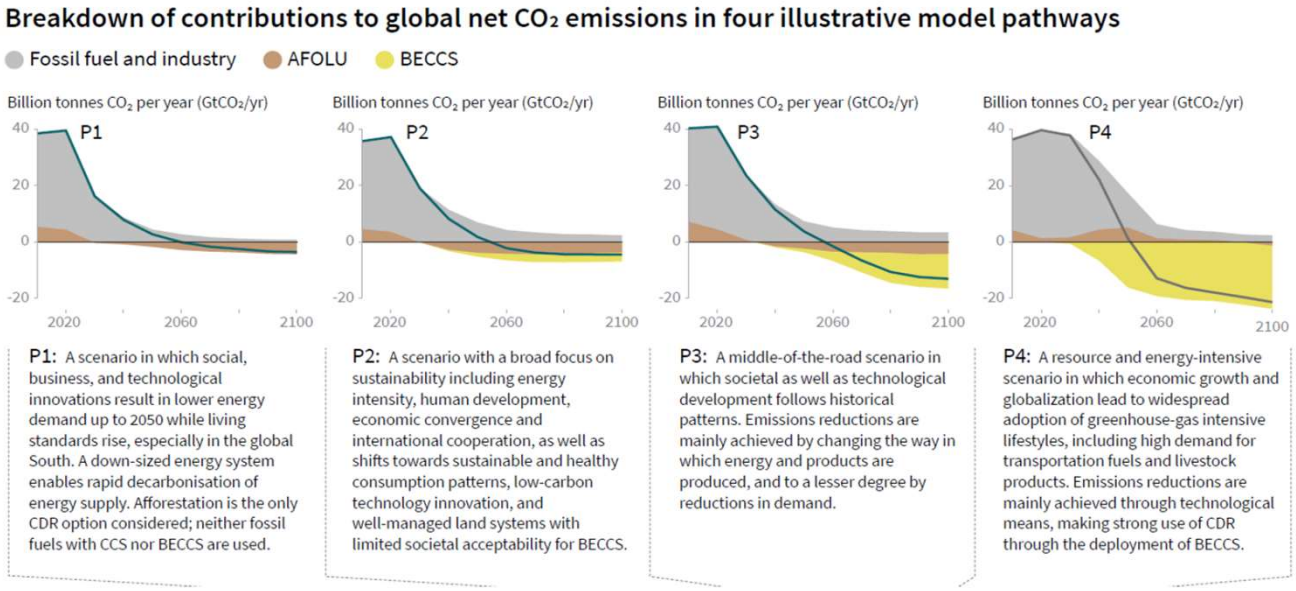
Mitigation

Recent literature / IPCC SR1.5, IPCC SRCCL, IPCC 2019 Refinement

1.5 IPCC SR: Characteristics of four illustrative model pathways

50–800 pasture and 0–500 of non-pasture agricultural land (food and feed crops) million Ha into 100–700 million Ha for energy crops

-100 to +1000 million Ha change in forest area by 2050 relative to 2010

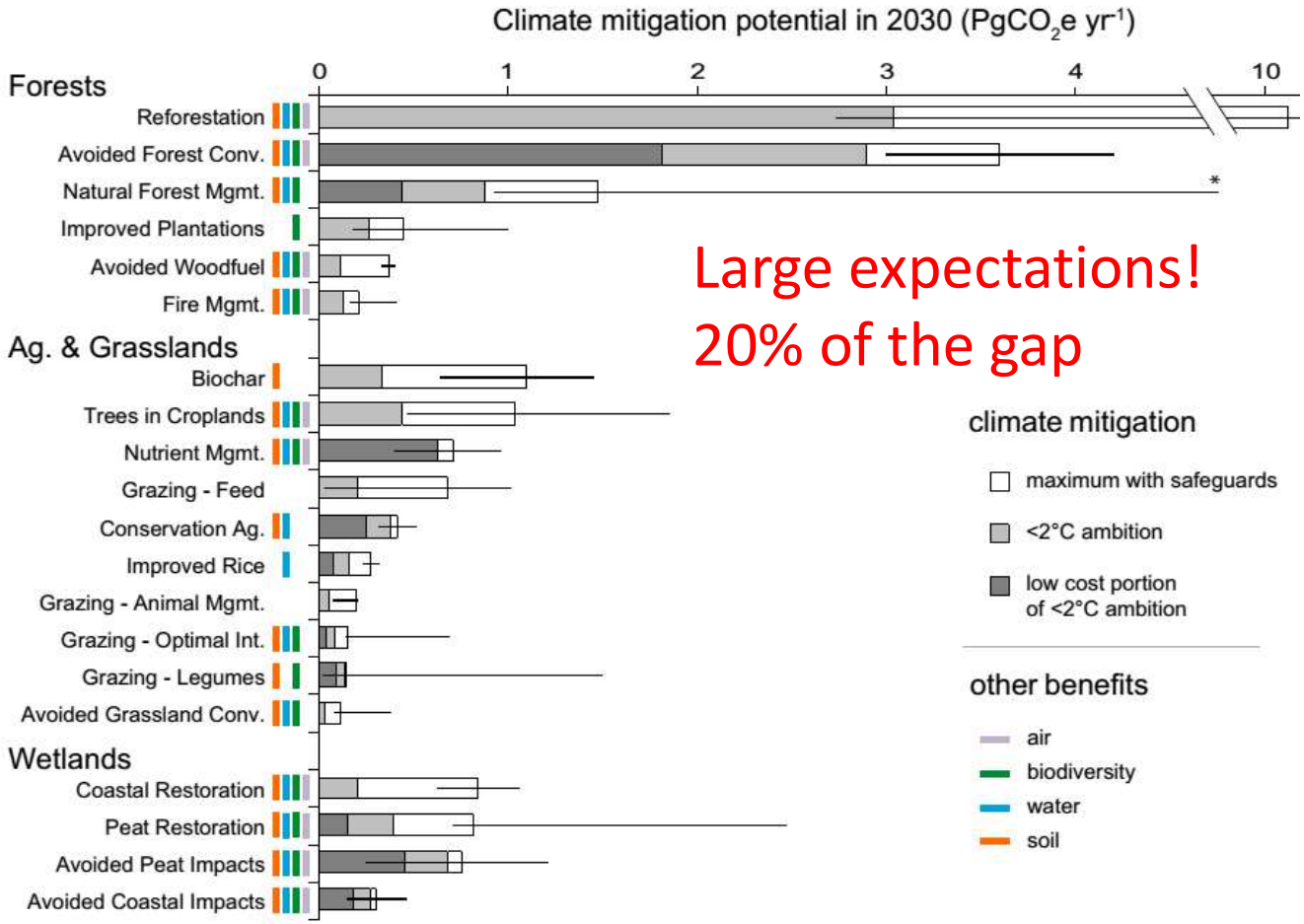


Cumulative CCS until 2100 ($GtCO_2$)	0	348	687	1218
↳ of which BECCS ($GtCO_2$)	0	151	414	1191
Land area of bioenergy crops in 2050 (million hectare)	22	93	283	724
Agricultural CH_4 emissions in 2030 (% rel to 2010)	-24	-48	1	14
in 2050 (% rel to 2010)	-33	-69	-23	2
Agricultural N_2O emissions in 2030 (% rel to 2010)	5	-26	15	3
in 2050 (% rel to 2010)	6	-26	0	39

Model pathways that limit global warming to 1.5°C with no or limited overshoot project

- Mitigation options **limiting the demand for land** include sustainable intensification of land use practices, ecosystem restoration and changes towards less resource-intensive diets (*high confidence*).
- The implementation of land-based mitigation options would **require overcoming socio-economic, institutional, technological, financing and environmental barriers that differ across regions** (*high confidence*).

Land Use role: Are potentials realistically calculated?

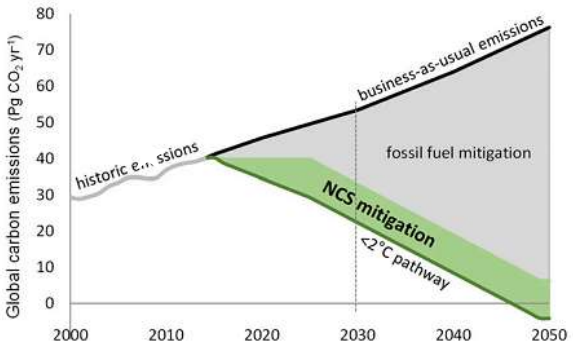


Large expectations!
20% of the gap

But huge uncertainty

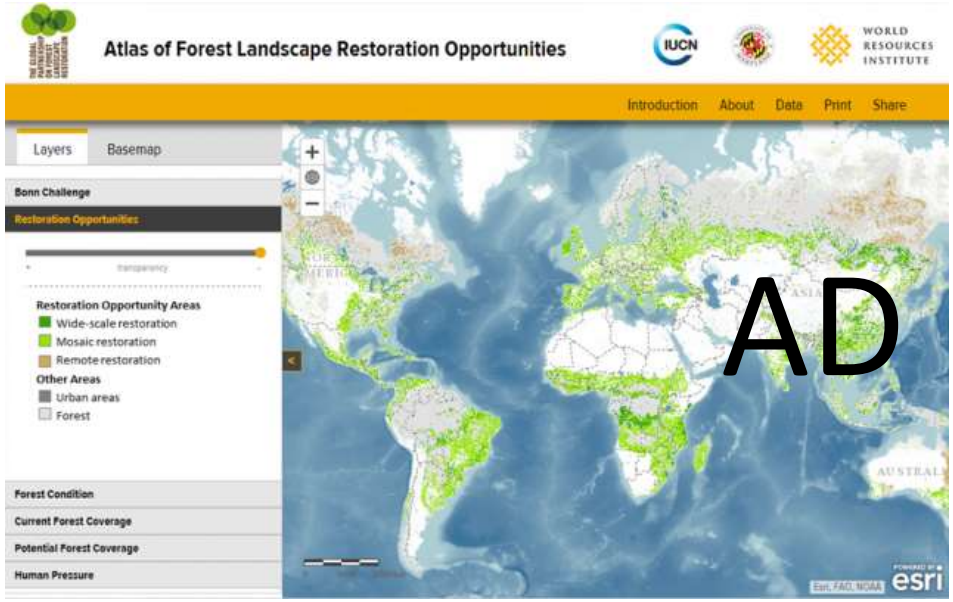
Are top down numbers right?

co-benefits?



Griscom et al 2017 (PNAS)

Land Use role: Are potentials realistically calculated? For example Reforestation



AD x EF

Griscom et al 2017 (PNAS)

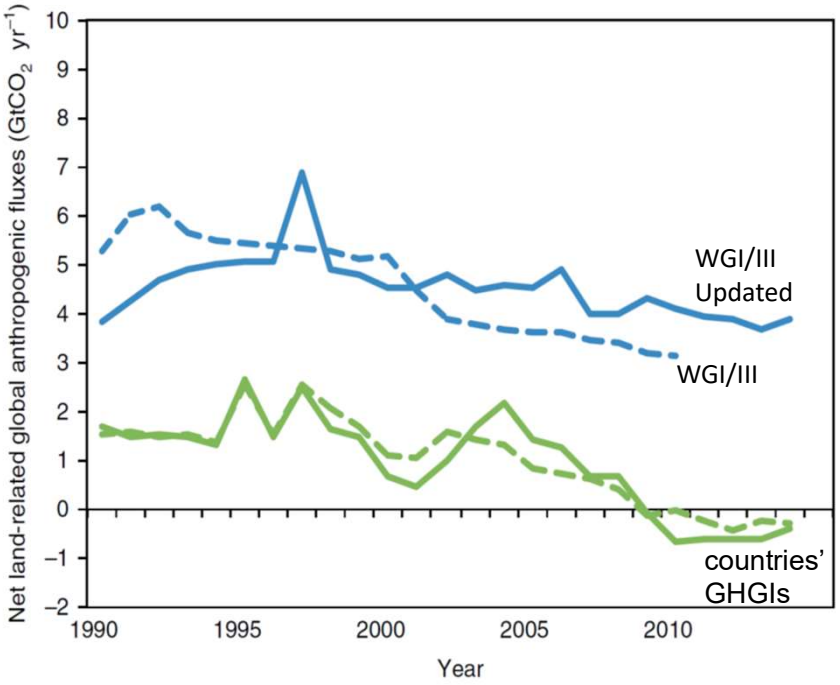
Country level maximum mitigation potential with safeguards for 8 NCS pathways. Units are $TgCO_2e\ yr^{-1}$ unless otherwise specified. "Ukn" refers to Unknown.

Country	Reforestation	Natural Forest Mgmt.	Grazing - Optimal Intensity	Grazing - Legumes	Improved Rice Cult.	Avoided Coastal Impacts - Mangroves	Avoided Peatland Impacts	Peatland Restoration
Spain	188.73	12.13	1.05	3.72	0.20	0.03	0.03	0.06

Forest definition: Crown cover trehshold 25% / EF single one – corresponding to a semitropical forest for all Spain

Land Use role: large discrepancies among and between models and with GHGinv?

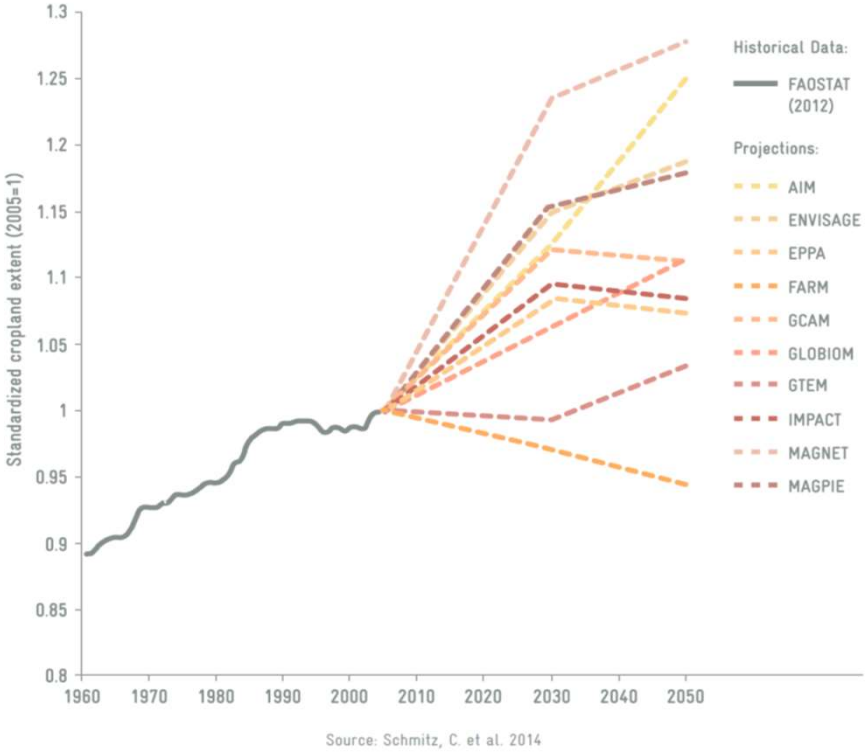
Comparison of the global net anthropogenic land-related CO2 fluxes estimated by AR5 / countries' GHGIs



Source: Grassi et al 2018

The gap between the updated estimates is about 4 $GtCO_2\,yr^{-1}$ for the period 2005–2014.

Comparison of different models on their proyections for the increase of croplands 2012-2050



Source: Schmitz, C. et al. 2014

The range goes from -5% to +30% .

How forest emissions are estimated by different communities

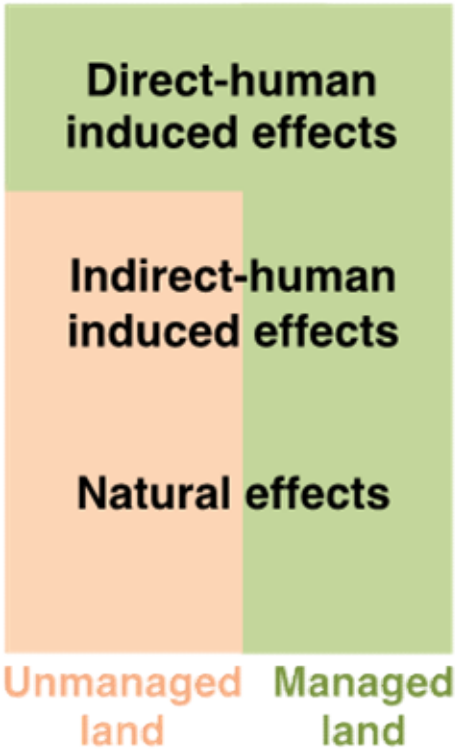
a) Effects of various factors on the forest CO_2 fluxes

Direct-human induced effects
- Land use change
- Harvest and other management

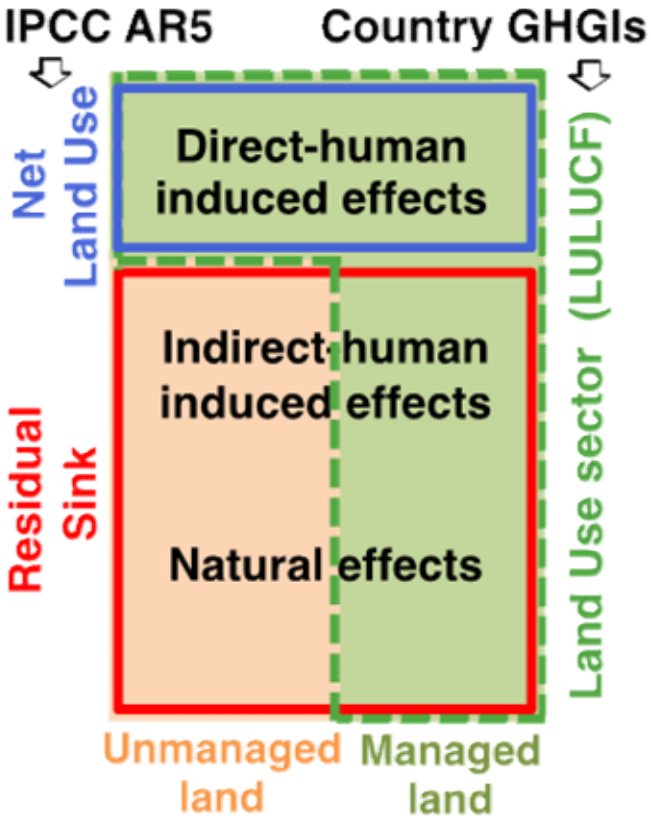
Indirect-human induced effects
- Climate change induced change in T°, precipitation, length of growing season
- Human-induced CO_2 and N fertilisation
- Impact of air pollution
- Changes in natural disturbances regime

Natural effects
- Natural interannual variability
- Natural disturbances

b) Where these effects occur



c) How these effects are captured in:



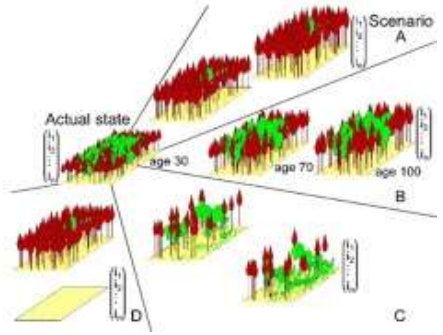
Relevant for the Global Stock Take!

Source: Grassi et al 2018, and Lee & Sanz 2017

Land use sector in the Paris Agreement context: LU additional specificities TFW (COP24)

Assumptions and methodological approaches for estimating and accounting for anthropogenic greenhouse gas emissions and removals:

- Approach to addressing emissions and subsequent removals from natural disturbances on managed lands
- Approach used to account for emissions and removals from harvested wood products
- Approach used to address the effects of age-class structure in forests



Information to facilitate clarity, transparency and understanding of nationally determined contributions, referred to in decision 1/CP.21, paragraph 28

Land use sector estimates reporting under the UNFCCC

- Land use categories (FL, CL, GL, WL, SL, OL) and its conversions emissions and removals are reported by all Parties on the GHGinv* (BRs and BURs, GHGinv)
- KP Parties with commitments report emissions and removals from ADR, FM and CM, GM and revegetation if elected (supplementary information)
- Developing countries that want to benefit form REDD+ RBPs are providing FREL/FRLs and reporting REDD+ results from their selected activities

*Developing countries where reporting activities as per IPCC 1996 GL, but moving towards land use base reporting

- Land use categories (FL, CL, GL, WL, SL, OL) and its conversions emissions and removals are reported by all Parties on the GHGinv* (BTRs, GHGinv)
- KP Parties with commitments report emissions and removals from ADR, FM and CM, GM and revegetation if elected (supplementary information)
- Developing countries that want to benefit form REDD+ RBPs are providing FREL/FRLs and reporting REDD+ results from their selected activities (Art.5, BTRs Annex and FREL/FRLs

Information and reporting from different user groups in relation to mitigation

Users	Mitigation-related report / research	Report/research periodicity
Country user	Development of mitigation policies at national and subnational scales Establishment of mitigation targets and mitigation policies. Socioeconomic modelling of mitigation and adaptation alternatives for policy making	
UNFCCC at National level	Global mitigation negotiations Legally binding emission reduction commitments Global reporting through bottom up country contributions National Communications National GHG Inventories (NIR + CRF) BR, BURs -> BTRs IAR, IAC ->	KP (1 to 5 yr). GHG inv for Annex I annual Biennial – BRs and BURs -> BTRs
Support to REDD+ (e.g., UNFCCC, UNREDD, FCPF, GFOI)	Forest mitigation through REDD+ activities: Reference levels / MRV / Safeguards / NFMS Addressing drivers of deforestation Institutional arrangements REDD+ financing	Historic period, country determined, reported once Verification Results estimates annual; reporting biennial (voluntary)
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 Multi decadal 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	Mitigation alternatives and scenarios considering political, socioeconomic, climatic, and biogeochemical components Consumption of commodities, land footprint, trade	Annual, decadal data requirements for multidecadal policy scenarios

Adapted from GCOS 185 (2014)

DATA NEEDS on land use from different user groups

User	Data needs	Data gaps
Country	Emission factors through field measurements, census data, remote sensing (optical, LIDAR, etc), etc Activity Data through remote sensing, large-scale surveys, etc. Mitigation alternatives also need socioeconomic datasets for trend analysis and scenario development (projections).	How observations relate to activity data used by countries Data completeness, data frequency Appropriate data disaggregation levels taking into account needs and level of implementation Estimation of uncertainties
UNFCCC reporting		Satellite data at spatio-temporal scales relevant for decision making. Disaggregated emission factors (spatially and temporally) Reduced uncertainties and improve accuracy
Support to REDD+ (e.g., UNFCCC, UNREDD, FCPF, GFOI)		Reducing uncertainties of activity data of key activities Improved disaggregated forest activity data related to human and natural disturbances within the same land use (e.g. forest degradation) Improved activity data on project activities Improved systems for assessing mitigation effectiveness Linking the changes in practices to the results
Climate modelling		Improved collection, processing and sharing of independently observed data
Earth Systems modelling	Same data as country level and UNFCCC process but at different aggregation levels Global climate datasets	Improved collection, processing and sharing of independently observed data (i.e. bottom-up ecosystem inventories of GHG emission) Consolidation of modelling outputs information to biophysical data Improved datasets (better disaggregation and reduced uncertainties) for model parameterization and model scaling-up processes Improved global products for activity data that are transparent and can be disaggregated to compare with contry products
Integrated assessment models		Improved transparency and methods to assemble multi-source data, and reduced uncertainties.
Policy impact assessment and modelling	Activity data, emission factors, socioeconomic data, climate scenarios. Demands and supply trends	Improved matching of land information granularity with actionable policies Improved data for assessment of supply chains Improved coordination with data on commodity flows (MFA,LCA) Improve the consideration of co-benefits and trade offs

Adapted from GCOS 185 (2014)

What we learnt in GFOI that could be relevant for EO

- Inter-panel work makes sense but is hard to do in practice - so priorities should be found and the workshop can help here
- Coordinated observations of both space and in-situ data is critical and not very well developed in the terrestrial domain (much better in ocean and atmosphere) – for example recent update of the IPCC defaults
- The issue of resolving differences in estimates is critical for the global stocktake.
- Besides inventories and models, taking on-board several data sources that are evolving from space, i.e. land change, biomass, fire, biophysical variables, wetlands/peatlands, land management etc. – most of them are also covered by the ECVs
- GFOI work has the clear focus on countries needs but also mechanisms to assess (CALM) and make use of evolving space-based estimations (R&D, expert synthesis) and help countries to do so (MGD, CB)

Thank you for your attention