terrestrial

Biogenic Carbon Sequestration (tCDR): Multifunctionality for global resilience

Not considered here:

- *Enhanced carbon uptake of oceans (not terrestrial, see yesterdays session)*

Not Tracy Hester !

Convener: Rüdiger Grote
Institute of Meteorology and Climate Research (IMK-IFU, KIT), Garmisch-Partenkirchen
(Ruediger.Grote@kit.edu)

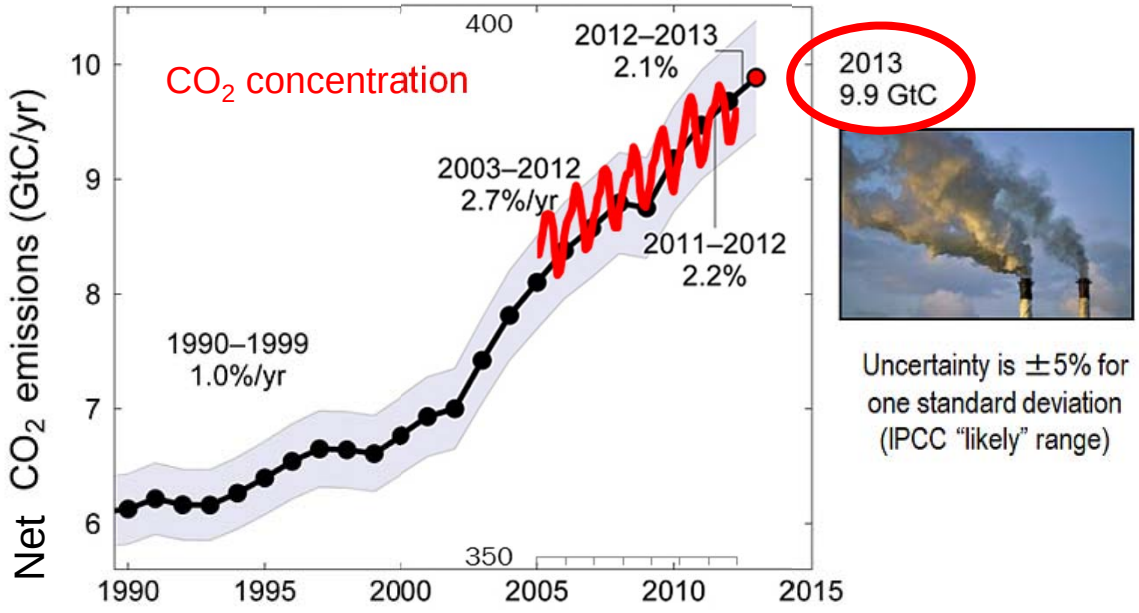
The Problem

GLOBAL CARBON PROJECT

Fossil Fuel and Cement Emissions

Global fossil fuel and cement emissions: 9.7 ± 0.5 GtC in 2012, 58% over 1990

● Projection for 2013 : 9.9 ± 0.5 GtC, 61% over 1990

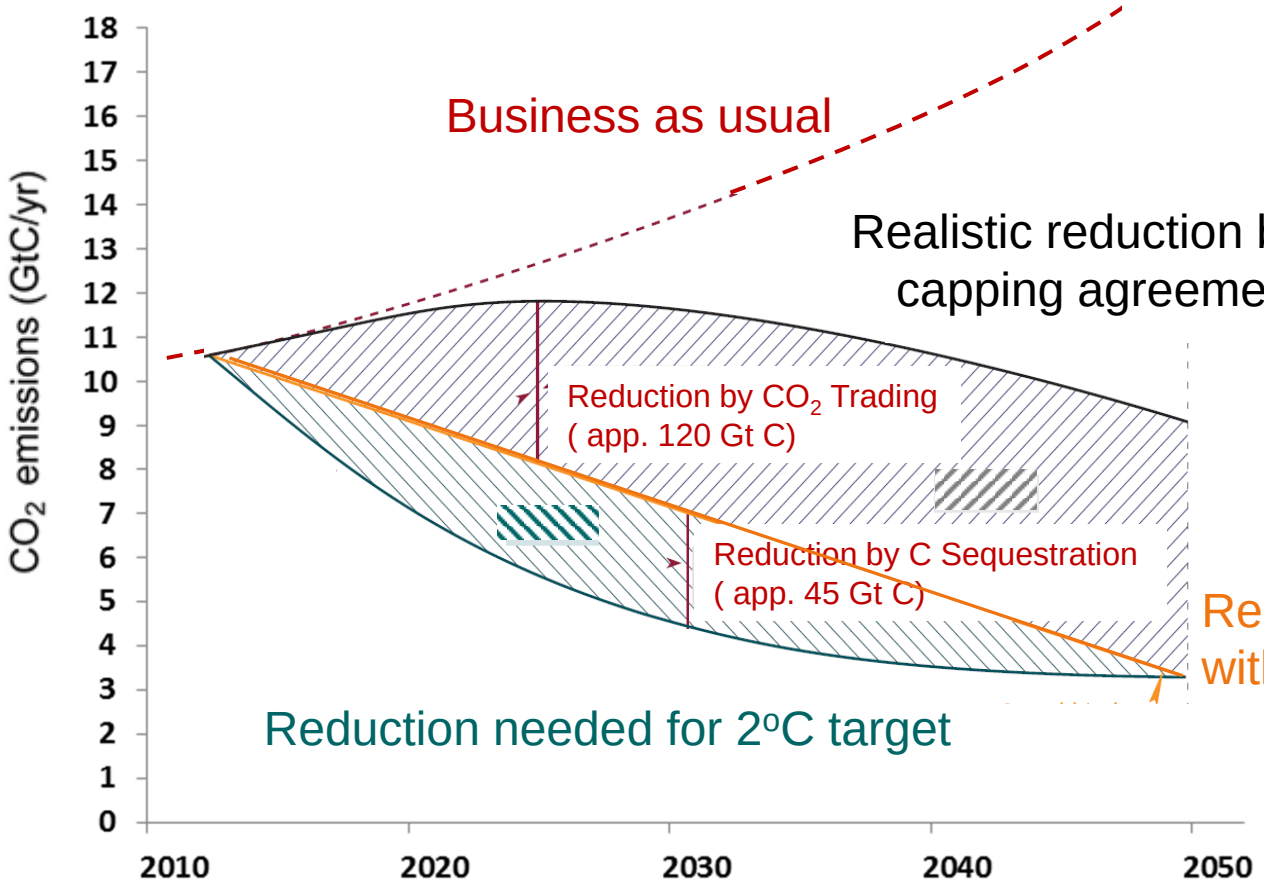


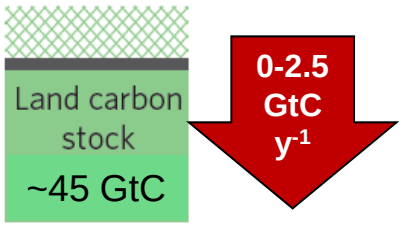
Uncertainty is ±5% for one standard deviation (IPCC "likely" range)

With leap year adjustment: 2012 growth rate is 1.9% and 2013 is 2.4%

Source: Le Quéré et al 2013; CDIAC Data; Global Carbon Project 2013

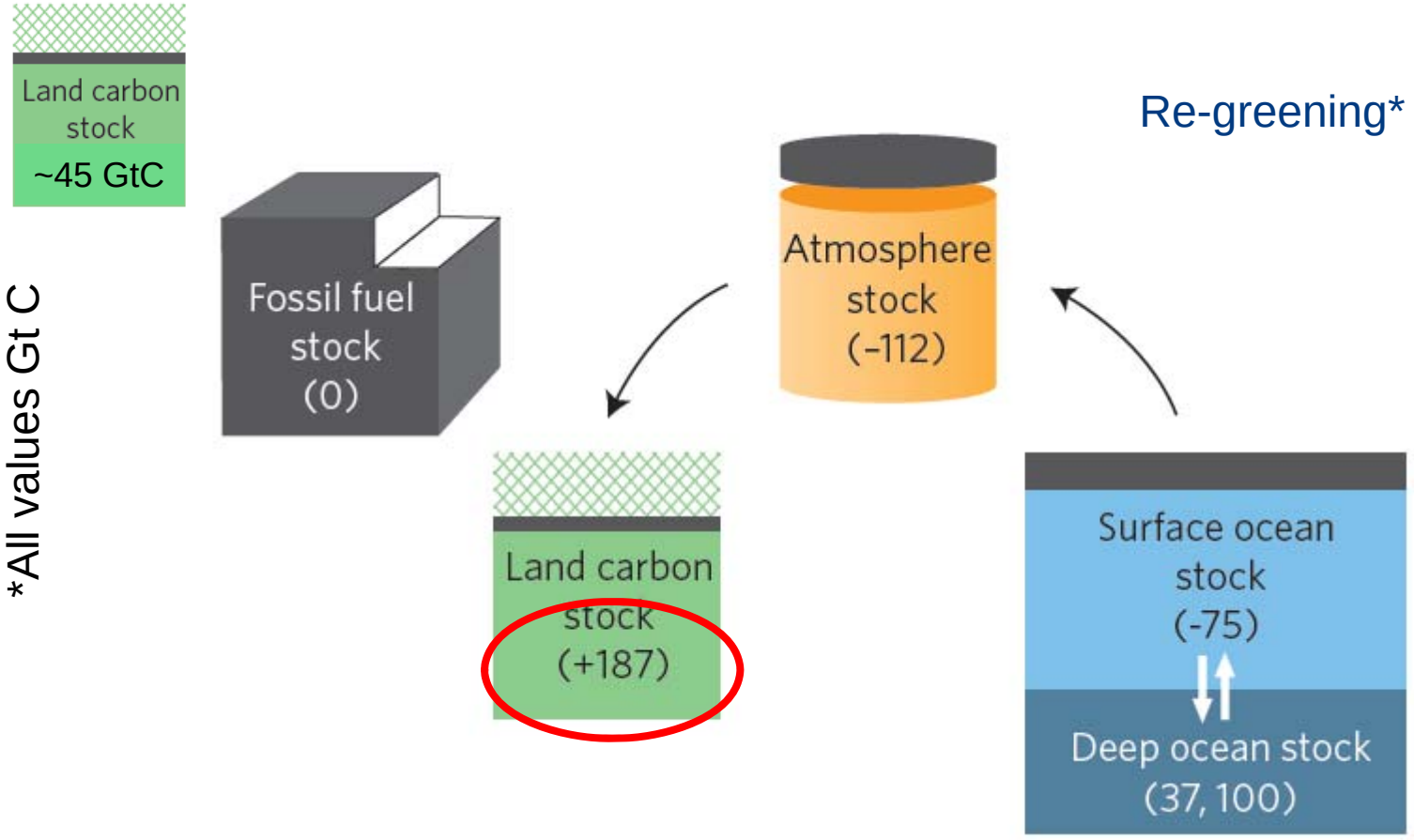
The Solution Plan





→ modified from Radermacher 2013 (GAIA)

Do we have enough storage space?

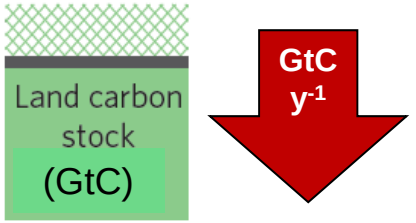


*All values Gt C

→ Mackey et al 2013 (Nature)

How can we possibly do it?

1. Re-/Afforestation

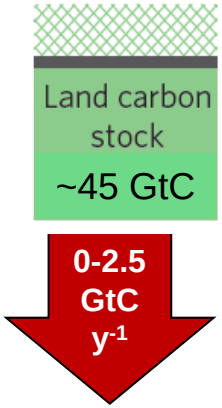


50-100	1-2	*Winjum 1992*
104	0.5-1.5	*Nilsson & Schopfhauser 1995*
120-240	1.3-2.6	*Arora & Montenegro 2011*

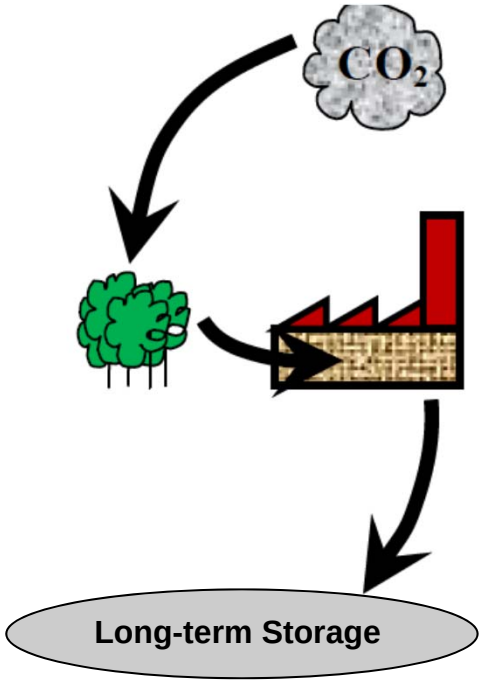
2. Agricultural practice (e.g. no tillage, residue and waste usage, agroforestry)

55	0.4-0.8	*Watson et al. 1996*
24-43	0.4-0.9	*Paustian et al. 1998*
21-51	0.4-1.2	*Lal 2004, 2014*

How can we possibly do it?



3. Bioenergy and carbon capture and storage (BECCS)



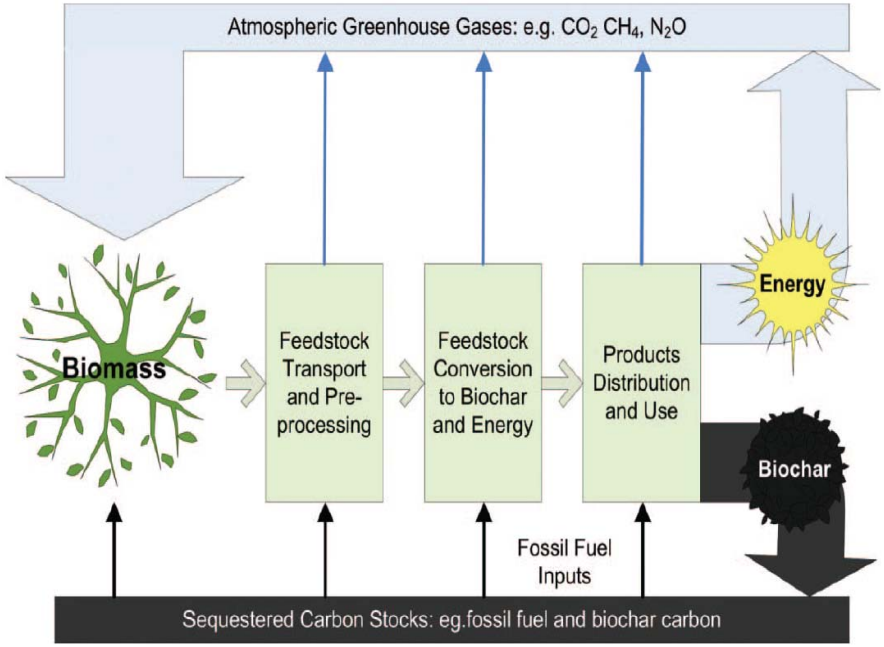
50-200	0.8-40	*Edmonds et al. 2013, Hoogwiik et al. 2003*
771	8-12	*Lenton & Vaughan 2009, Read 2008*
625	0-20	*Van Vuuren et al. 2013*

→ Gough & Upham 2010 (Tyndell Centre report)

How can we possibly do it?

0-2.5 GtC y^{-1}

4. (3b?) Biochar application



400	5.5-9.5	*Lehmann et al. 2006*
183	2.5	*Read 2008*
66-130	1.0-1.8	*Woolf et al. 2010*

→ Downie et al. 2011(Crit. Rev. Env.)

What else can happen?

Negative Feedbacks and Side-effects

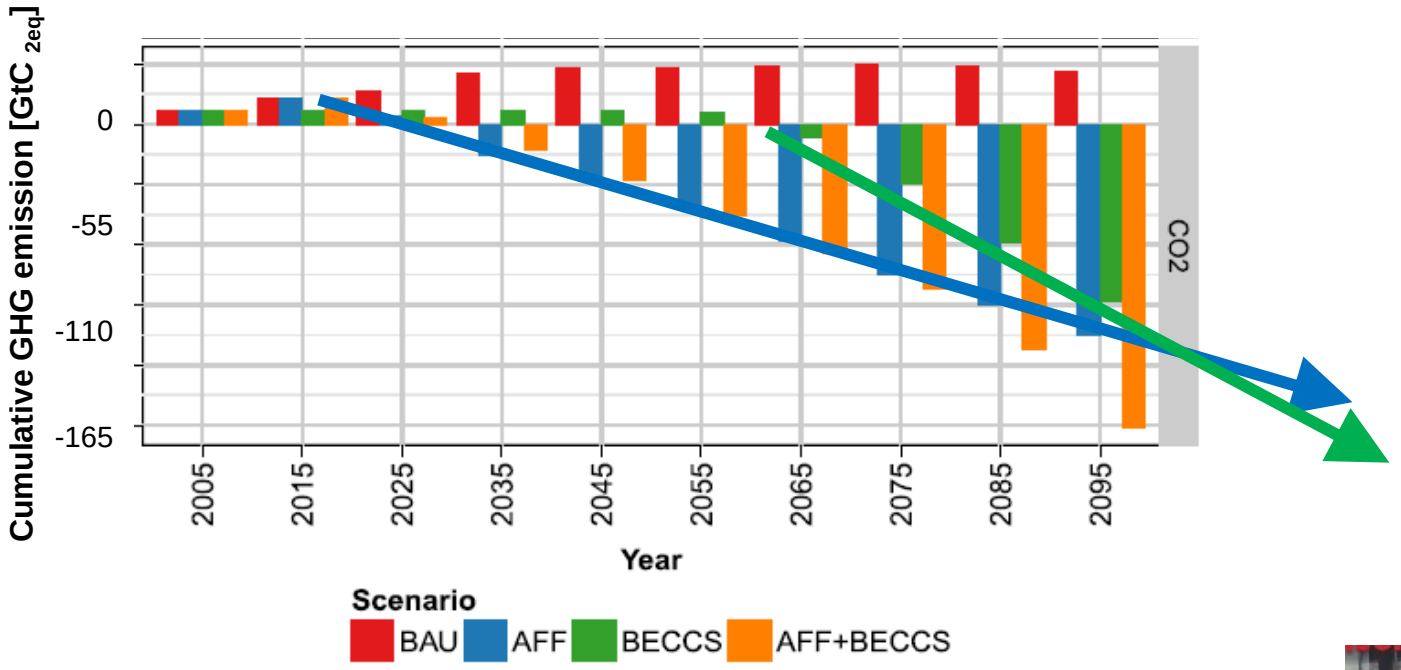
- Decreased albedo (climate warming) (Kirschbaum et al., 2011; Jackson & Masabathula, 2013, Betts et al. 2011)
- Less area available for food production (Beringer et al. 2011)
- Decreased water availability (Trabucco et al., 2008)
- Increased other greenhouse gas emission (with BECCS) (Humpenröder et al. 2014)

Positive Feedbacks and Side-effects

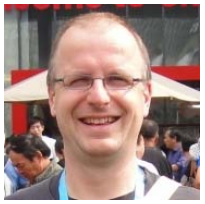
- Improved regional climate (Ornstein et al., 2009; Gálos et al., 2011)
- Improved ecosystem services (e.g. food, by-products, water quality, biodiversity) (Lal, 2004; Lal, 2014, Vihervaara et al., 2012, Downie et al., 2011; Kauffman et al., 2014)
- Possibly decreased N_2O emissions (with biochar) (Cayuela et al. 2013)

How to address the uncertainties ?

Modelling



→ Humpenröder et al. 2014 (Environ. Res. Lett.)



Biogenic terrestrial Carbon Sequestration: Multifunctionality for global resilience

Constraints and benefits through afforestation in irrigated drylands
(Asia Khamzina, ZEF Bonn)

Options to enhance soil carbon sequestration on arable land
(Jürgen Kern, ATB Potsdam-Bornim)

Opportunities and challenges in modelling carbon sequestration and land-use change
(Martin Wattenbach, GFZ Potsdam)

Biogenic terrestrial Carbon Sequestration: Multifunctionality for global resilience

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Coffee break

Poster presentations

(Poster room, right side: "Mechanics and impacts of CDR and Biogenic Carbon Sequestration"):

- Can we store it all?
- Carbon sequestration potential and climatic effects of reforestation in and Earth
- Terrestrial carbon dioxide removal (tCDR): Opportunities for climate, challenges for agriculture
- Biogeochemical consequences of large-scale bioenergy plantations
- Climatic consequences of large-scale land-use change
- Sequestration of inorganic carbon via forestation
- Vegetation Carbon Pool Modelling through Remote Sensing and GIS
- Forest cover and land degradation mapping in Central Asia – Implications for carbon sequestration

Starting again at 4 pm (sharp!)

Biogenic terrestrial Carbon Sequestration: Multifunctionality for global resilience

terrestrial

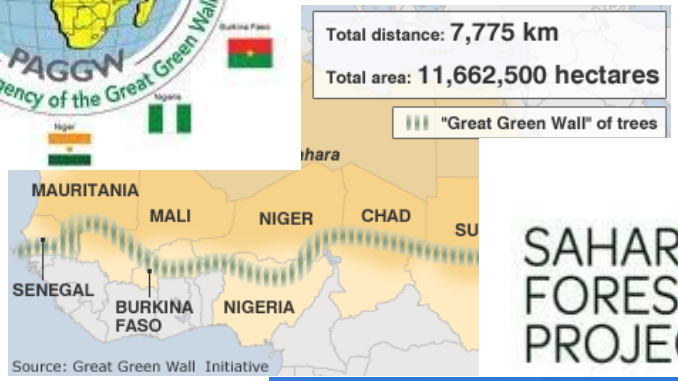
Biogenic Carbon Sequestration: Multifunctionality for global resilience

Panel Discussion

Moderator: Rüdiger Grote
Institute of Meteorology and Climate Research (IMK-IFU, KIT), Garmisch-Partenkirchen (Ruediger.Grote@kit.edu); Institute for Advanced Sustainability Studies, Potsdam

Biogenic terrestrial Carbon Sequestration: Multifunctionality for global resilience

Climate change mitigation

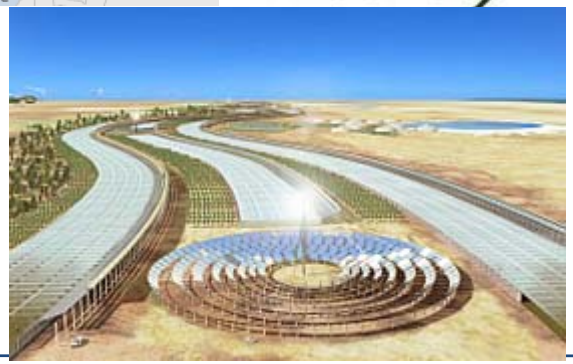


BioCarbon Fund | www.biocarbonfund.org

Kenya Sustainable Agricultural Land Management Project

First-ever agricultural land management project to issue carbon credits.
24,788 tons of CO_2 reduced, equivalent to taking 5,164 cars off the road for a year.
Increased **climate resilience** of farmers.

SAHARA FOREST PROJECT



+ food production
+ erosion protection
+ bioenergy
+ …

Biogenic terrestrial Carbon Sequestration: Multifunctionality for global resilience

Thinking into more than one dimension
… can carbon sequestration be handled as a by-product?