What Can Tea Bags in Salt Marshes Tell Us About Climate Change?

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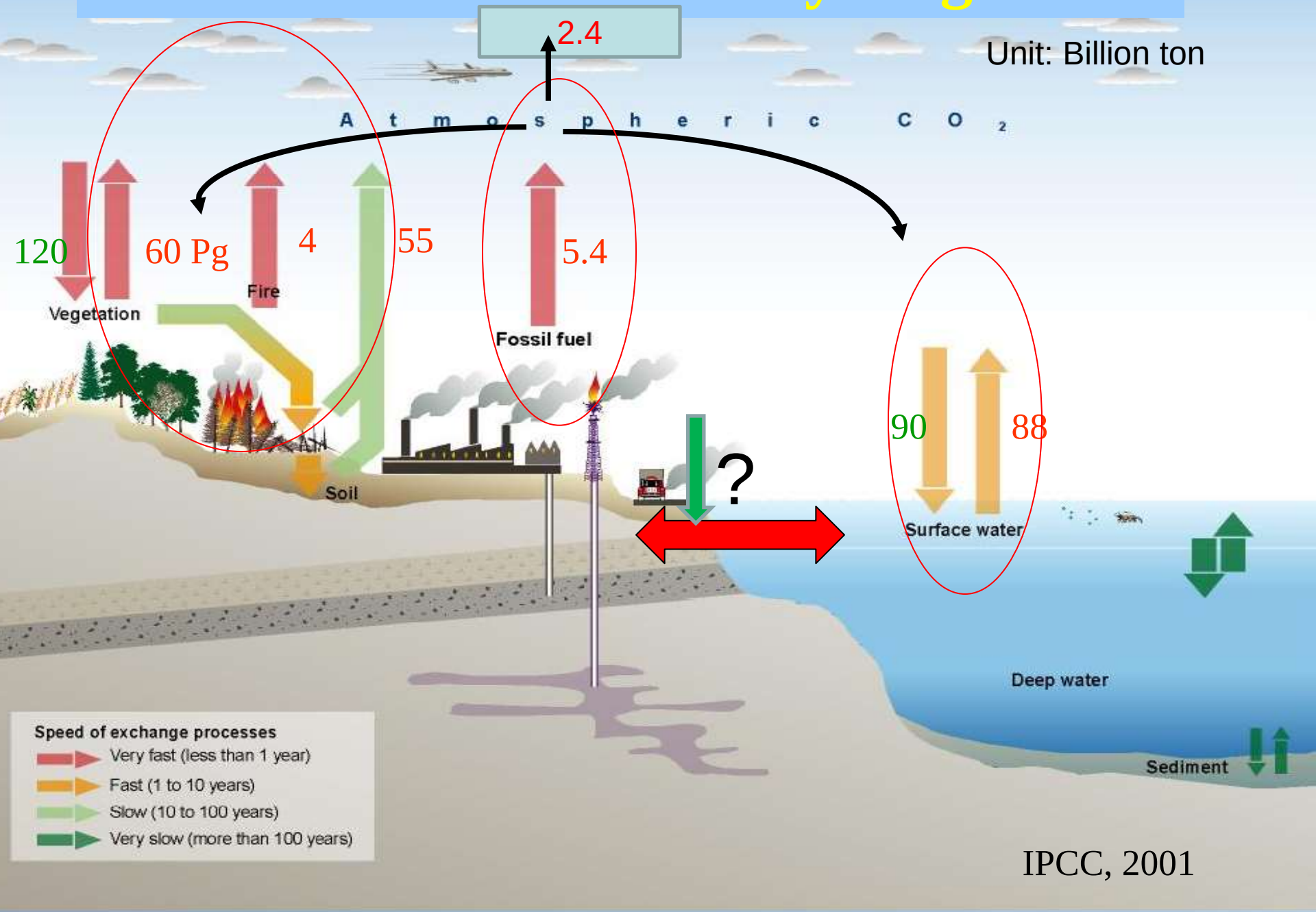
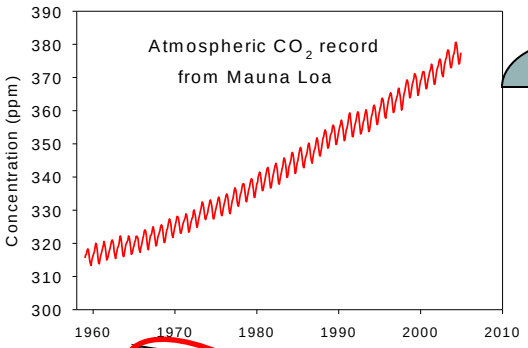
Global carbon cycling

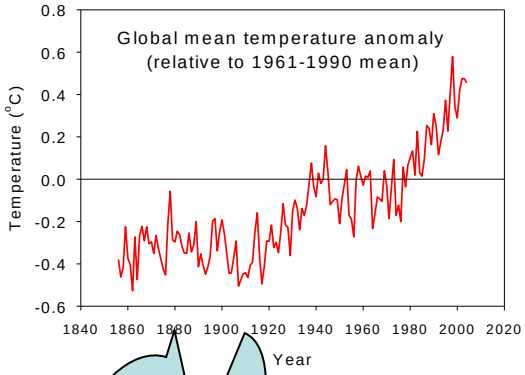


IPCC, 2001

Carbon-climate-ecosystems-Earth system

Carbon cycle



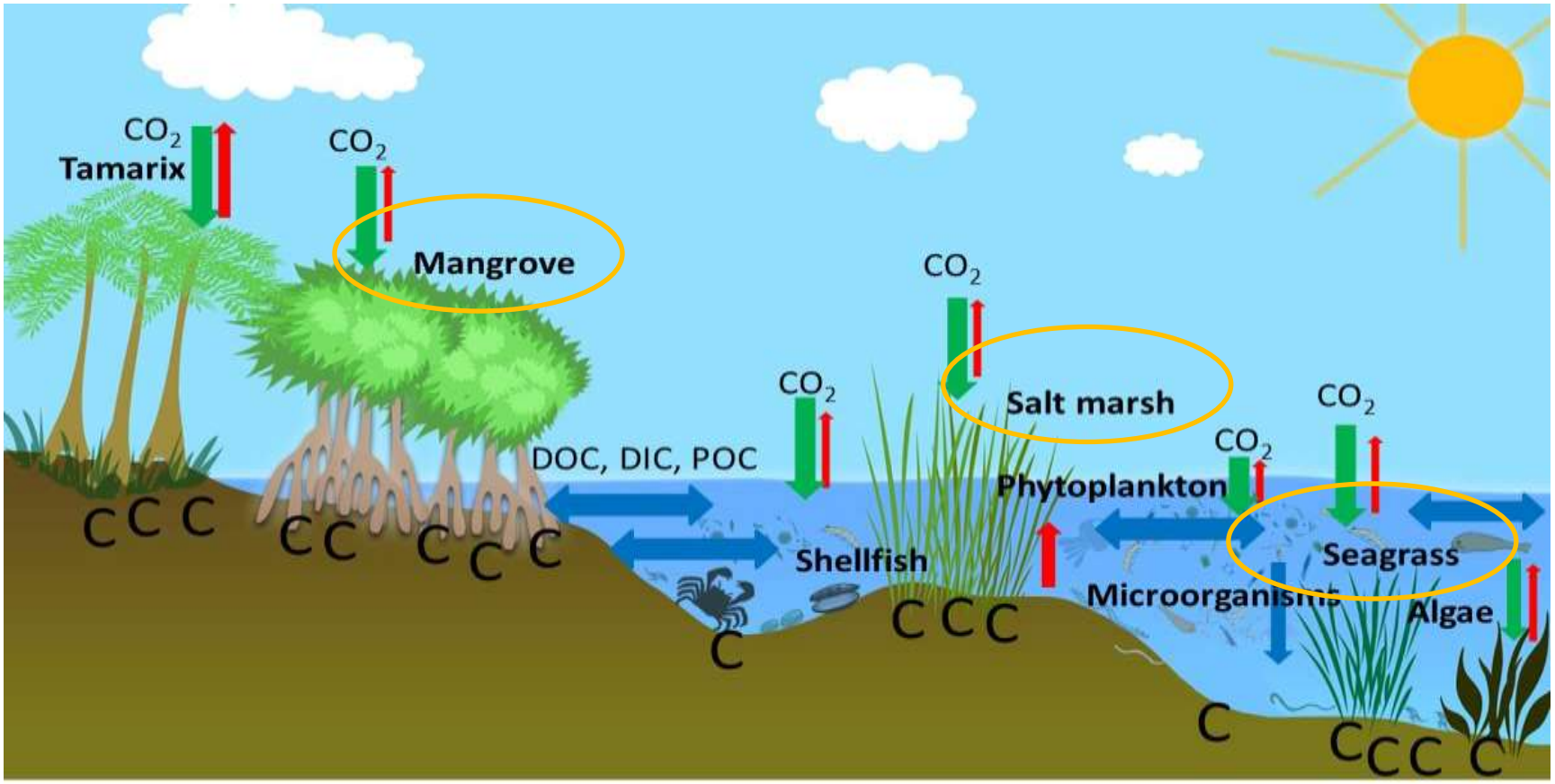


Climate change: warming, sea level, storms

Ecosystems

Earth system processes and modeling

Coastal blue carbon



Photosynthesis: $6CO_2 + 6H_2O + light \rightarrow C_6H_{12}O_6 + 6O_2$

Respiration : $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + heat$

Calcification: $Ca^{2+} + 2HCO_3^- \leftrightarrow CaCO_3 + H_2O + CO_2$

Tang et al. 2018.

Therefore,

- to understand and predict climate change, we need to understand the carbon cycle;
- to mitigate climate change, we need to increase carbon uptake (the negative carbon emissions), where coastal salt marsh plays an important role.

Negative Emissions Technologies (NET)

The National Academies of

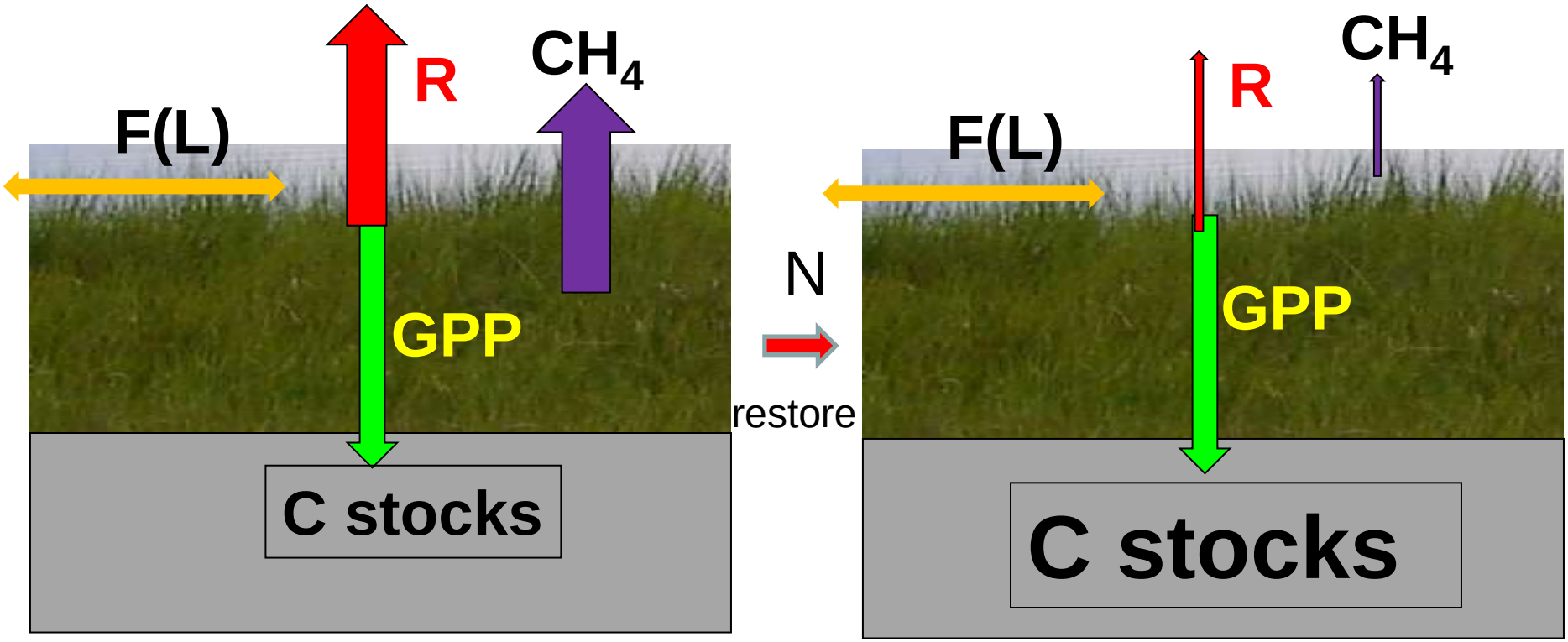
SCIENCES • ENGINEERING • MEDICINE

Developing a Research Agenda for Carbon Dioxide Removal and Reliable Sequestration

http://nas-sites.org/dels/studies/cdr/

US NAS 2018, Negative Emissions Technologies

Carbon cycling components

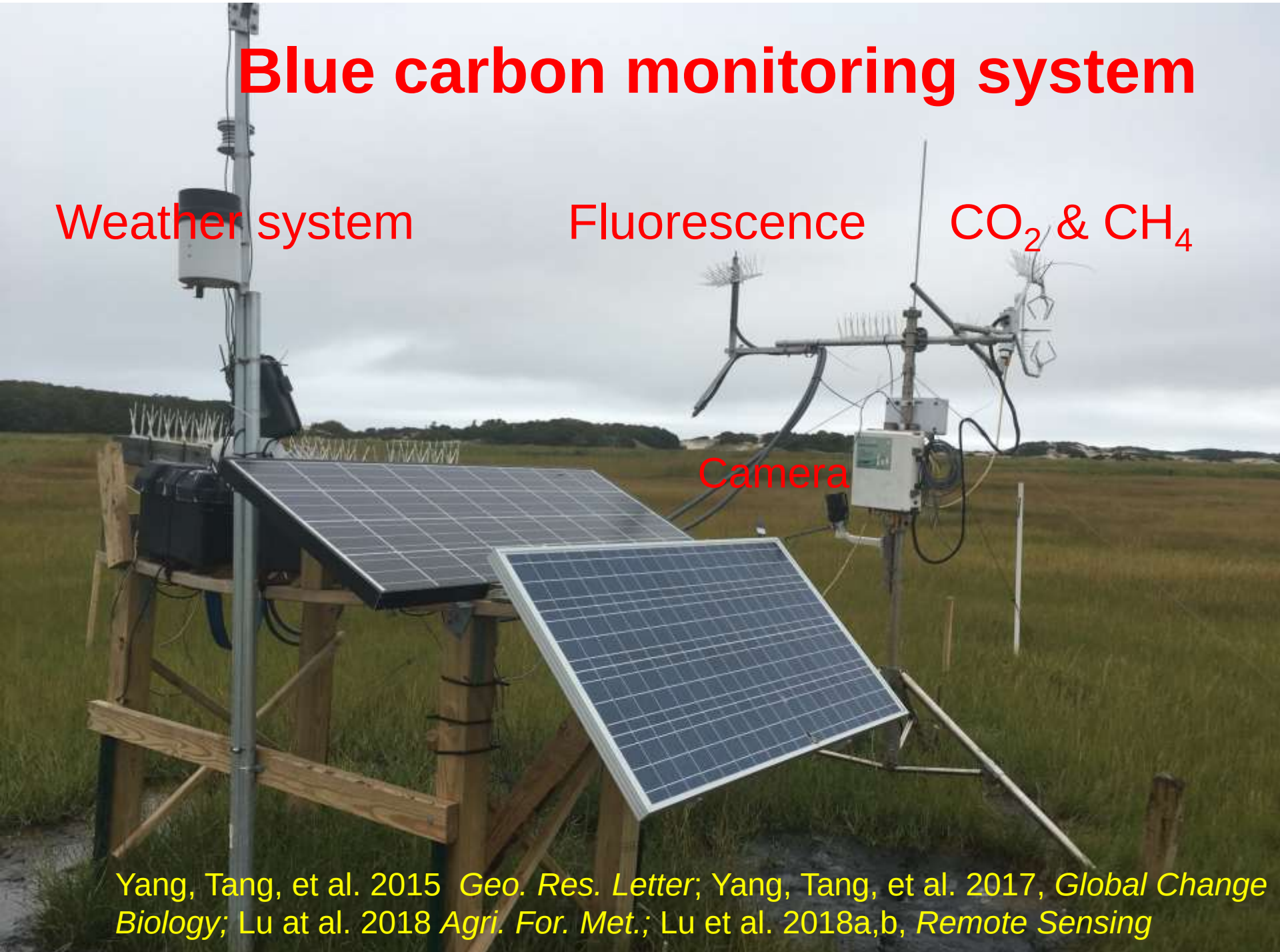


Tang et al. Unpublished

In-situ GHG Chamber flux measurement for salt marsh

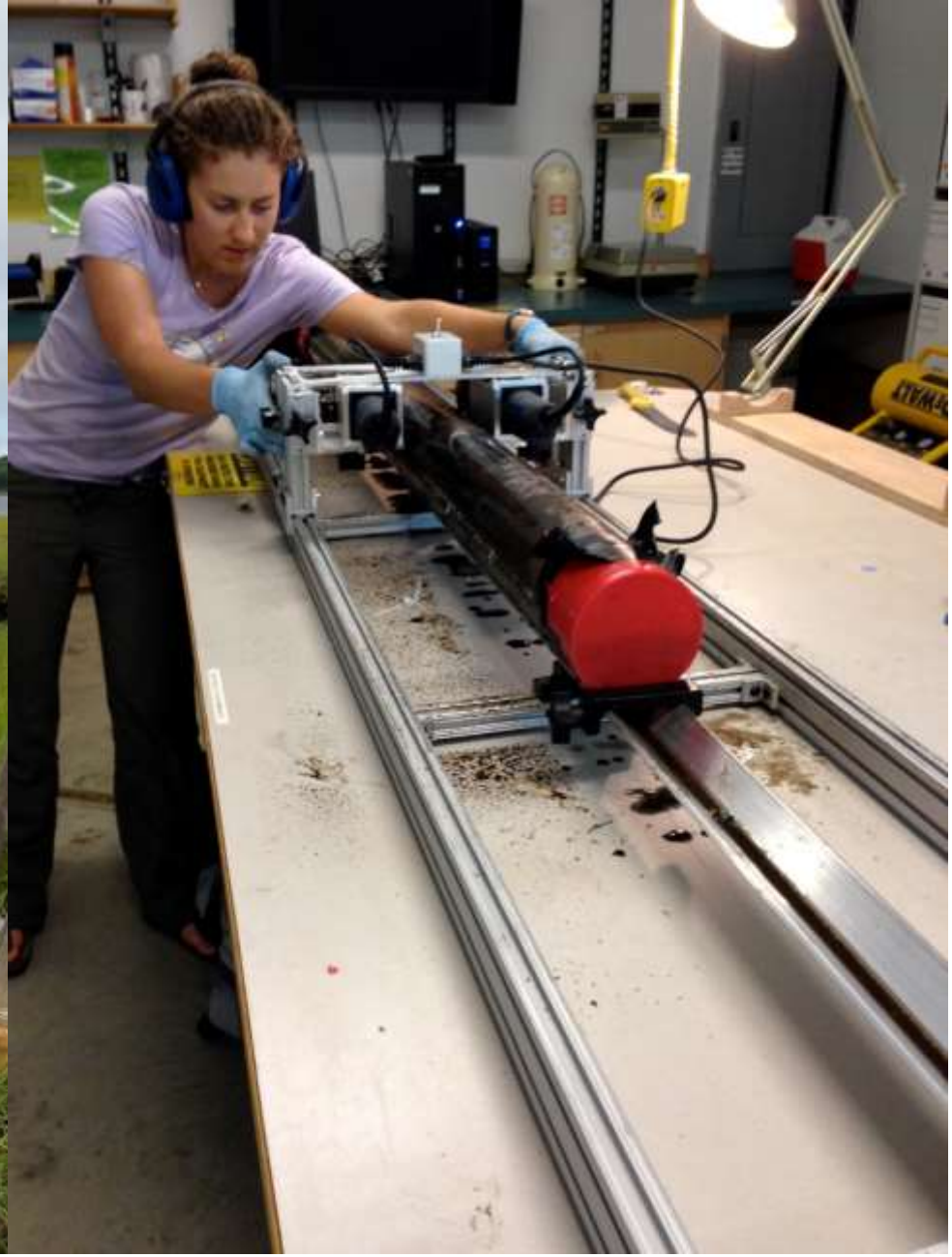
Flux measurement for Phragmites

Blue carbon monitoring system

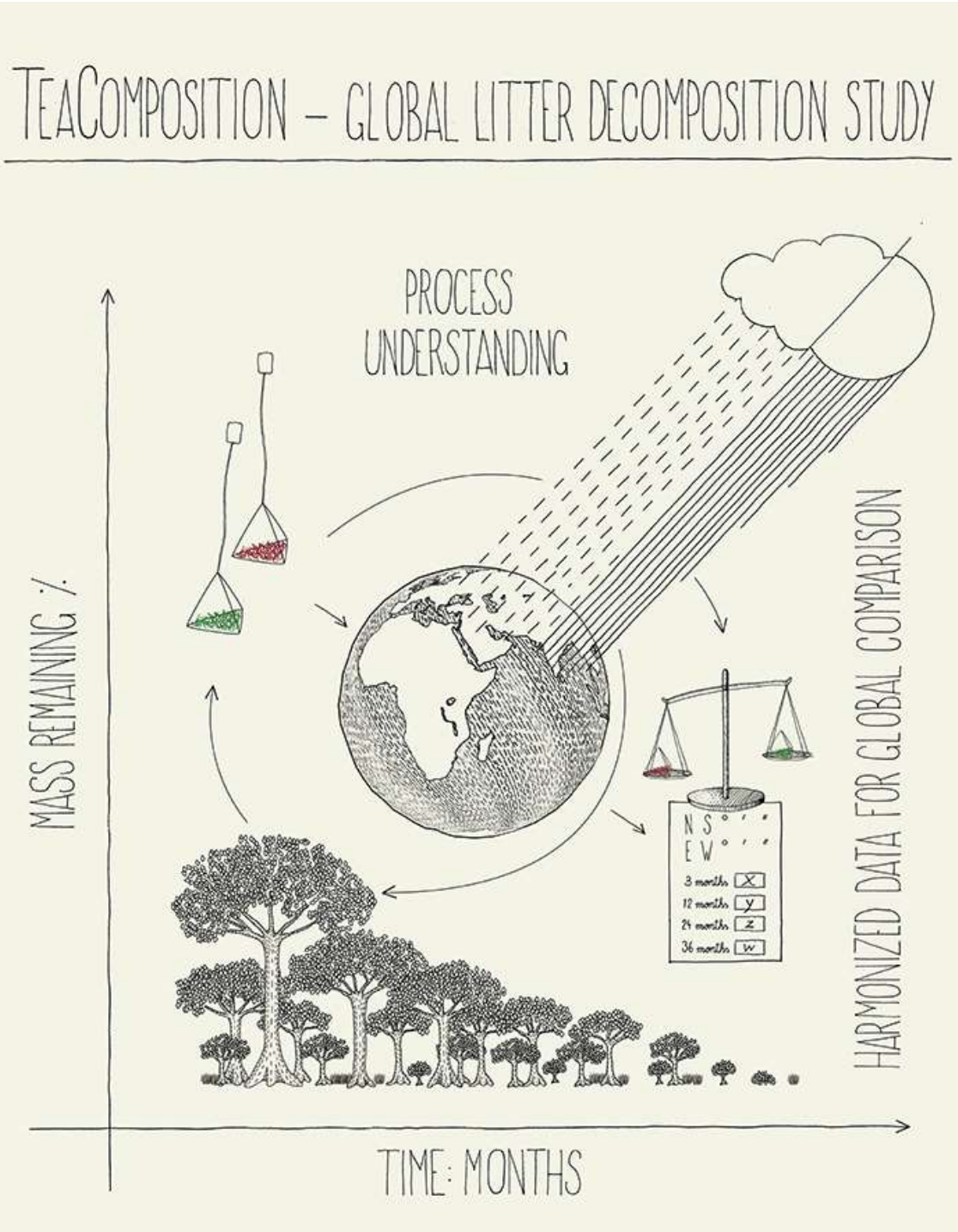


Yang, Tang, et al. 2015 *Geo. Res. Letter*; Yang, Tang, et al. 2017, *Global Change Biology;* Lu at al. 2018 *Agri. For. Met.;* Lu et al. 2018a,b, *Remote Sensing*

Long sediment cores

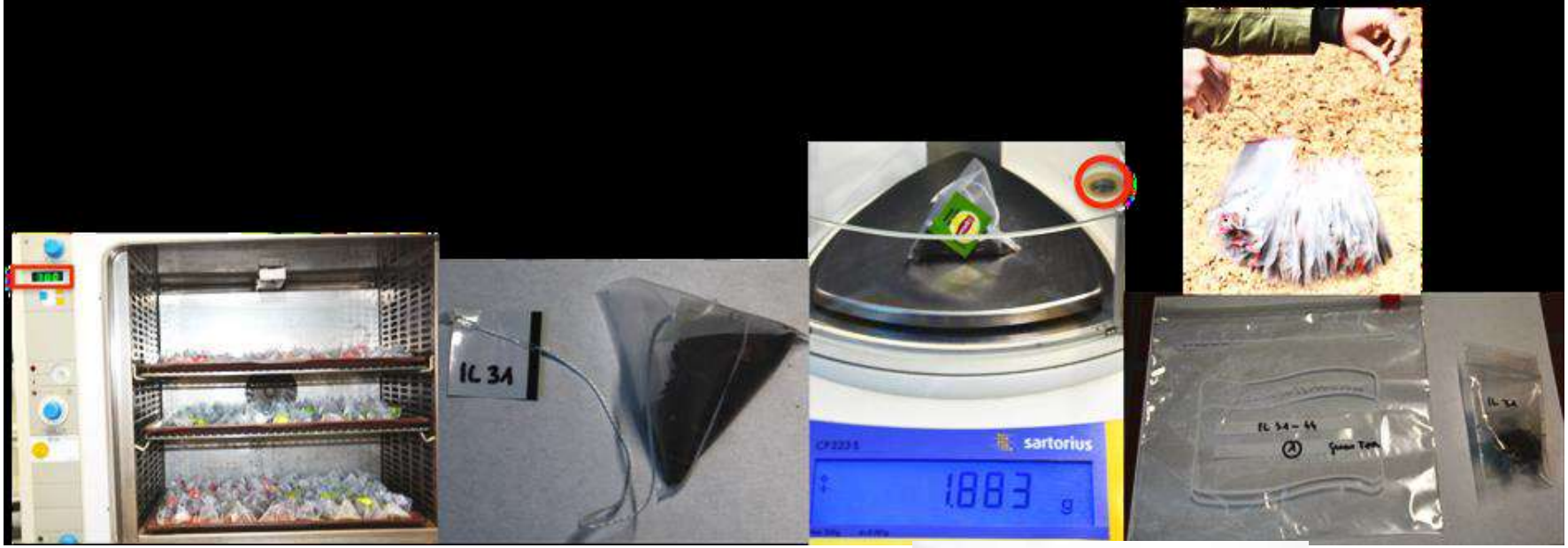


Use ^{210}Pb to date sediment cores (Gonneea et al.)



Tea decomposition experiment: to understand the decomposition rate of organic carbon

Djukic et al. 2018


IL 31
sartorius
1.883 g


India
sartorius
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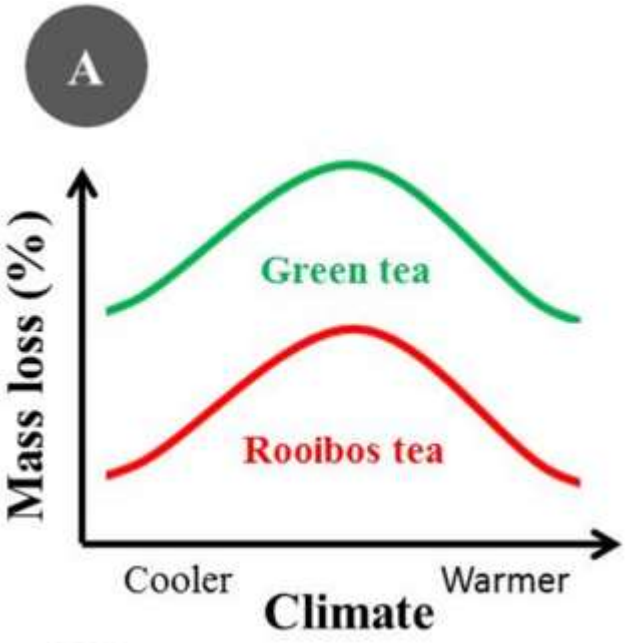
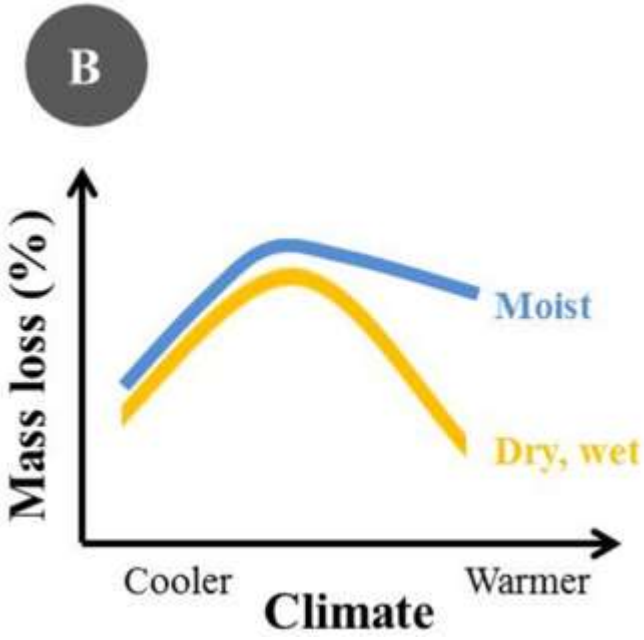
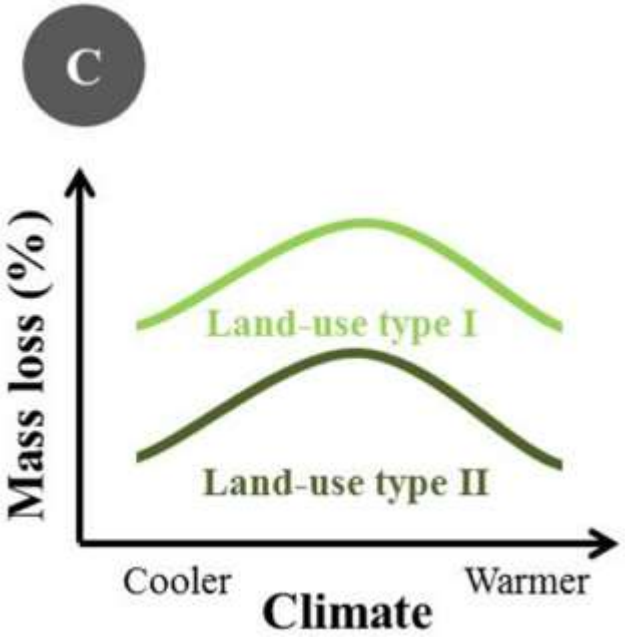
TARE
TARE



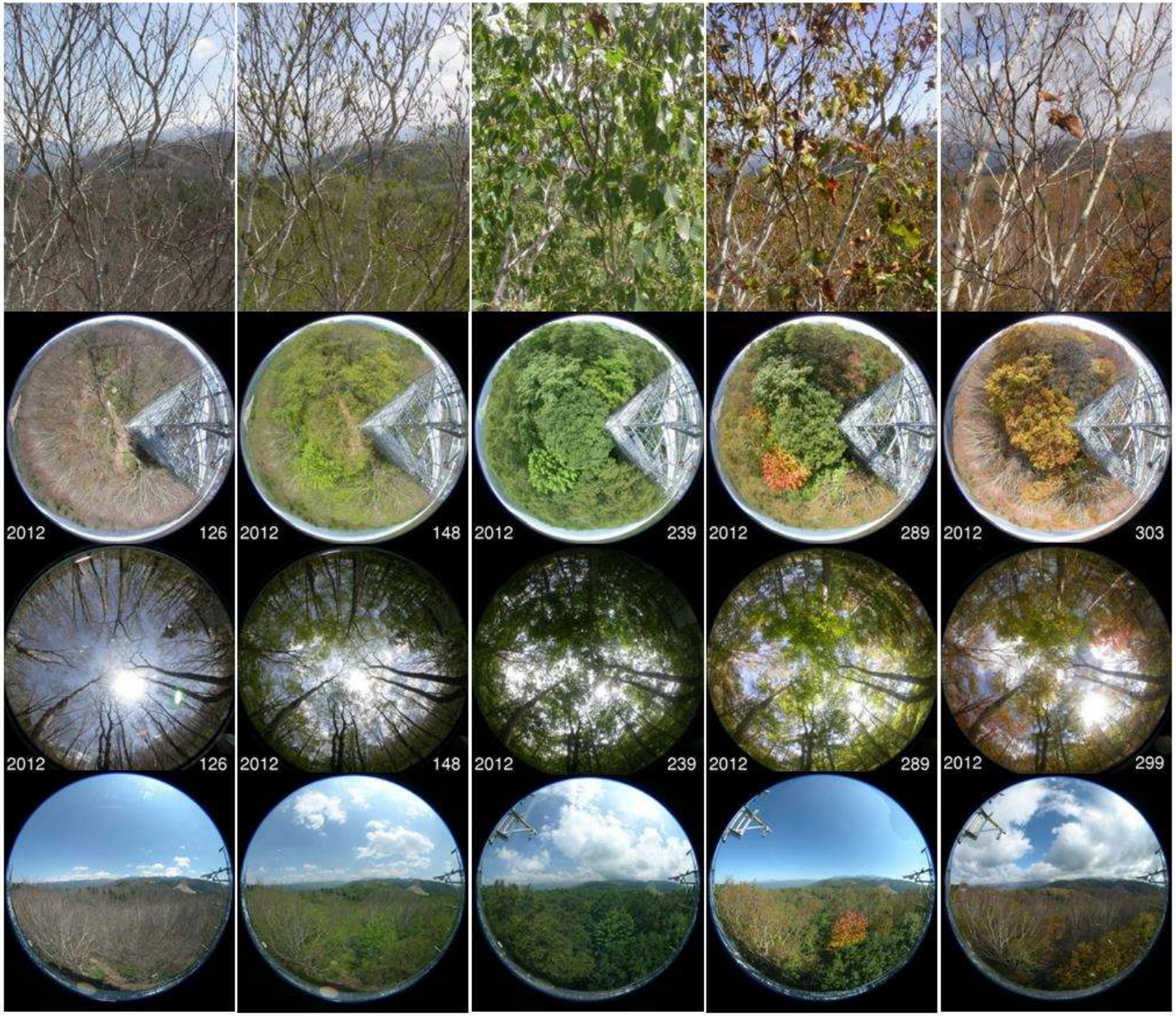
(a) Green tee will decompose faster than Rooibos tea due to different litter quality
(b) Initial litter decomposition will be determined by temperature in the cold biomes and precipitation in warm biomes
(c) Decomposition will differ between different land-use types (e.g. forest versus grassland) due to changes in microclimatic conditions





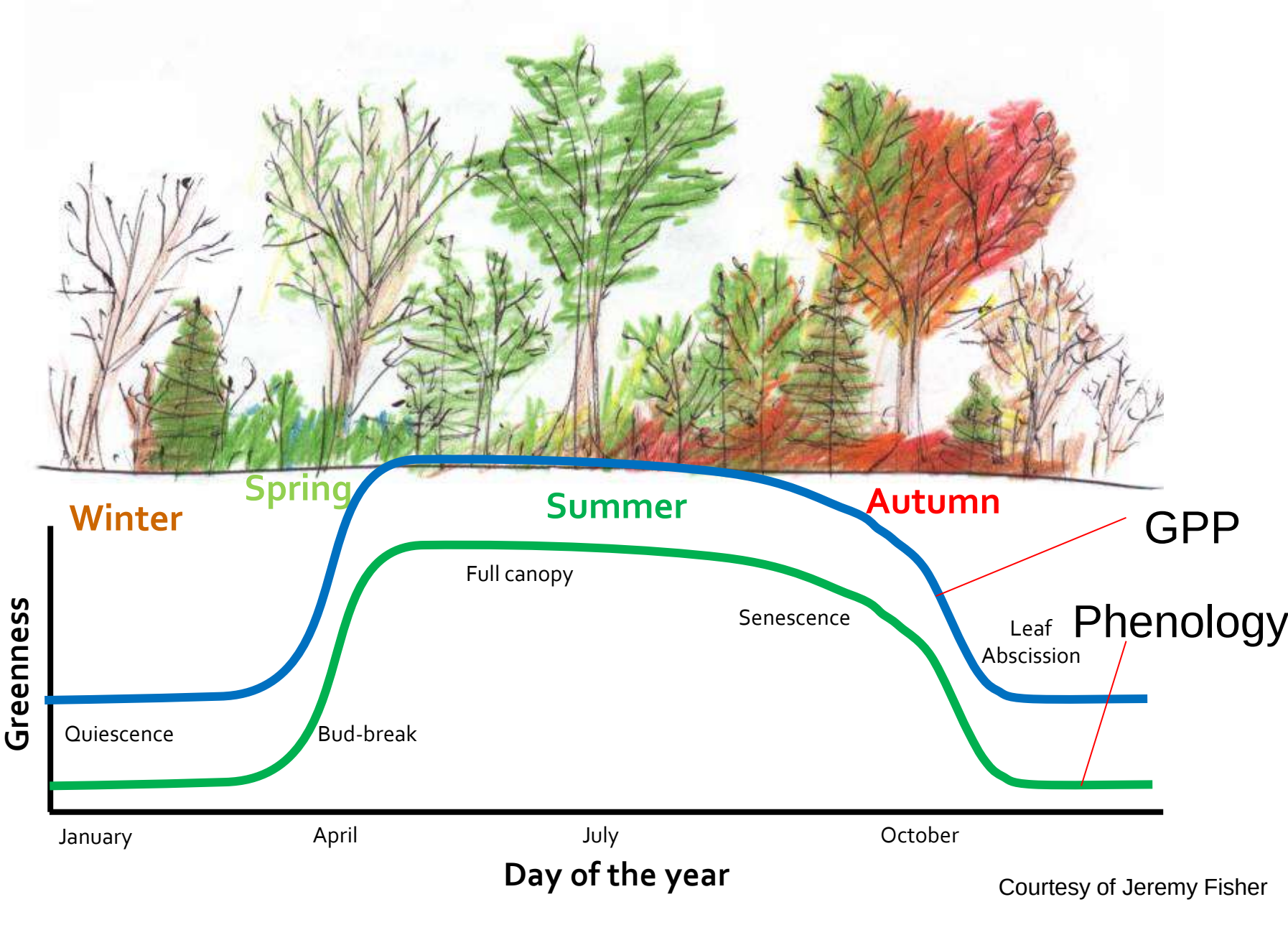
Djukic et al. 2018

Using Cameras to record leaf phenology



Tang et al. 2016
Ecosphere

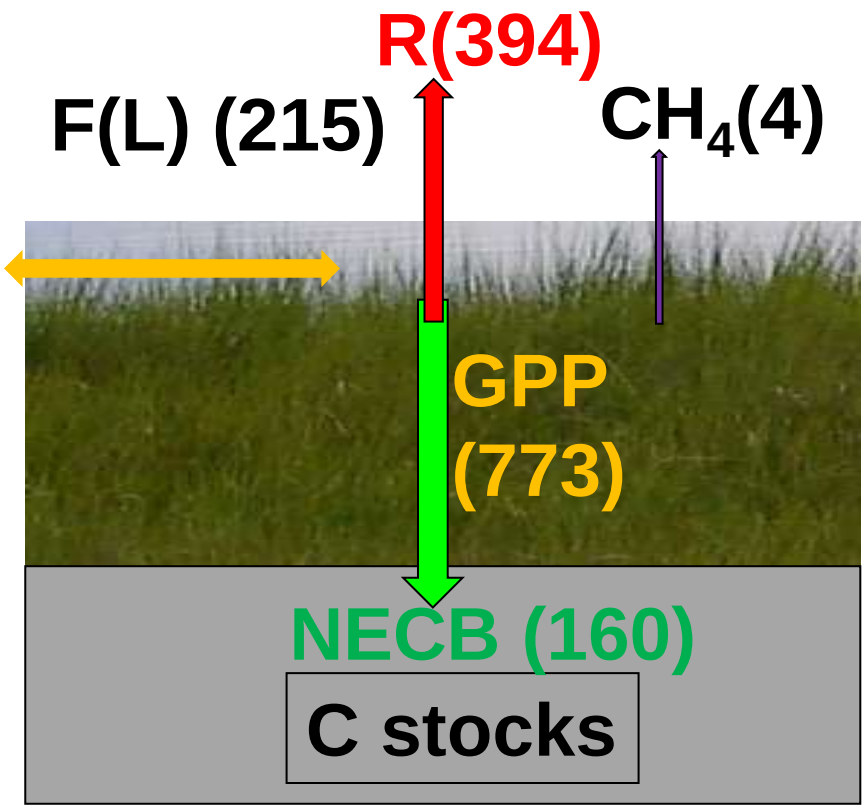
Leaf phenology vs. carbon (i.e. GPP)

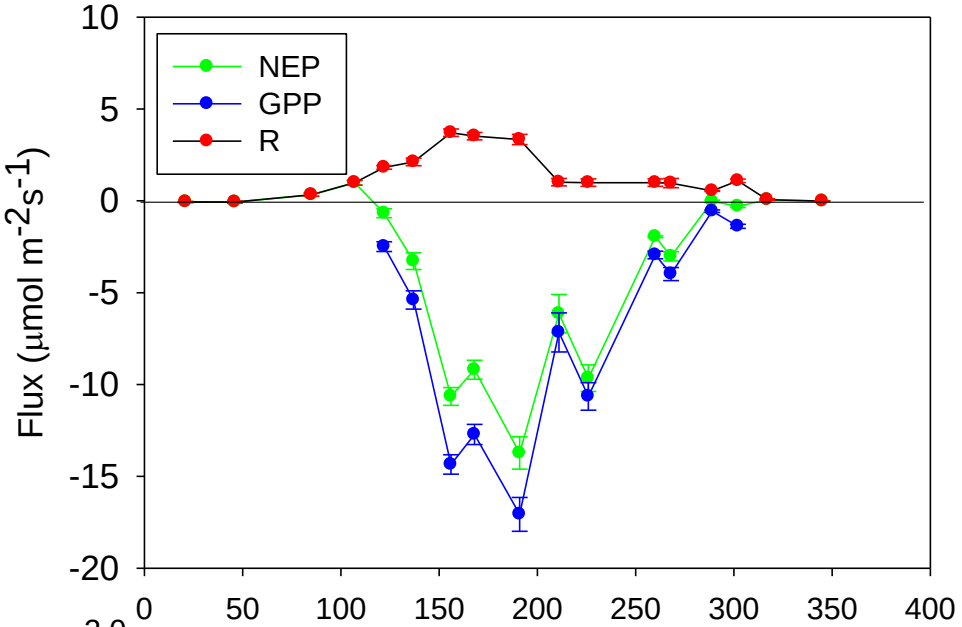


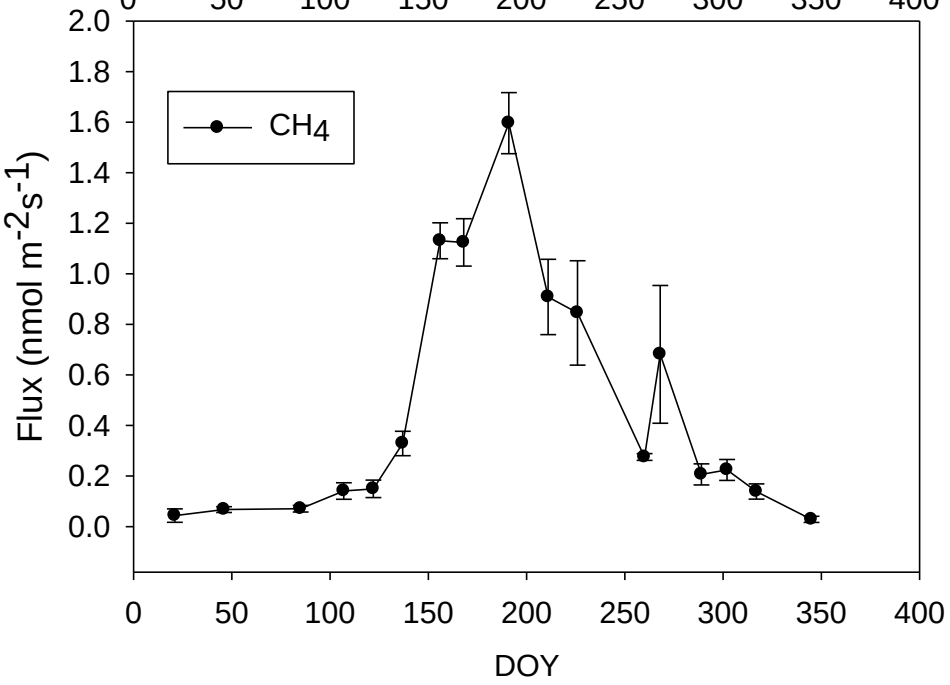
Courtesy of Jeremy Fisher

CO_2 and CH_4 fluxes in the pristine site

(gC $m^{-2}y^{-1}$)

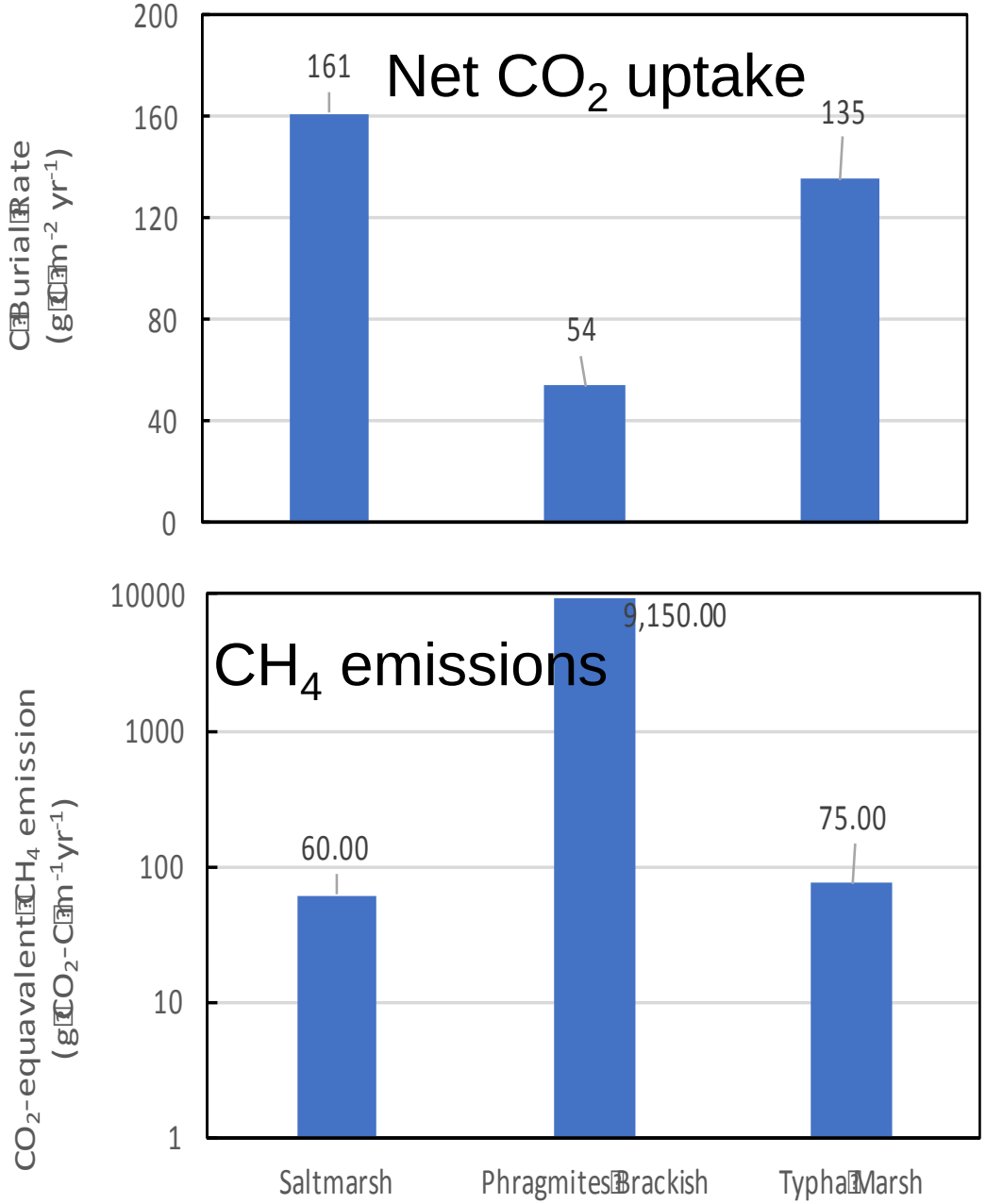






Tang et al. unpublished

Case study: Herring River wetland restoration project

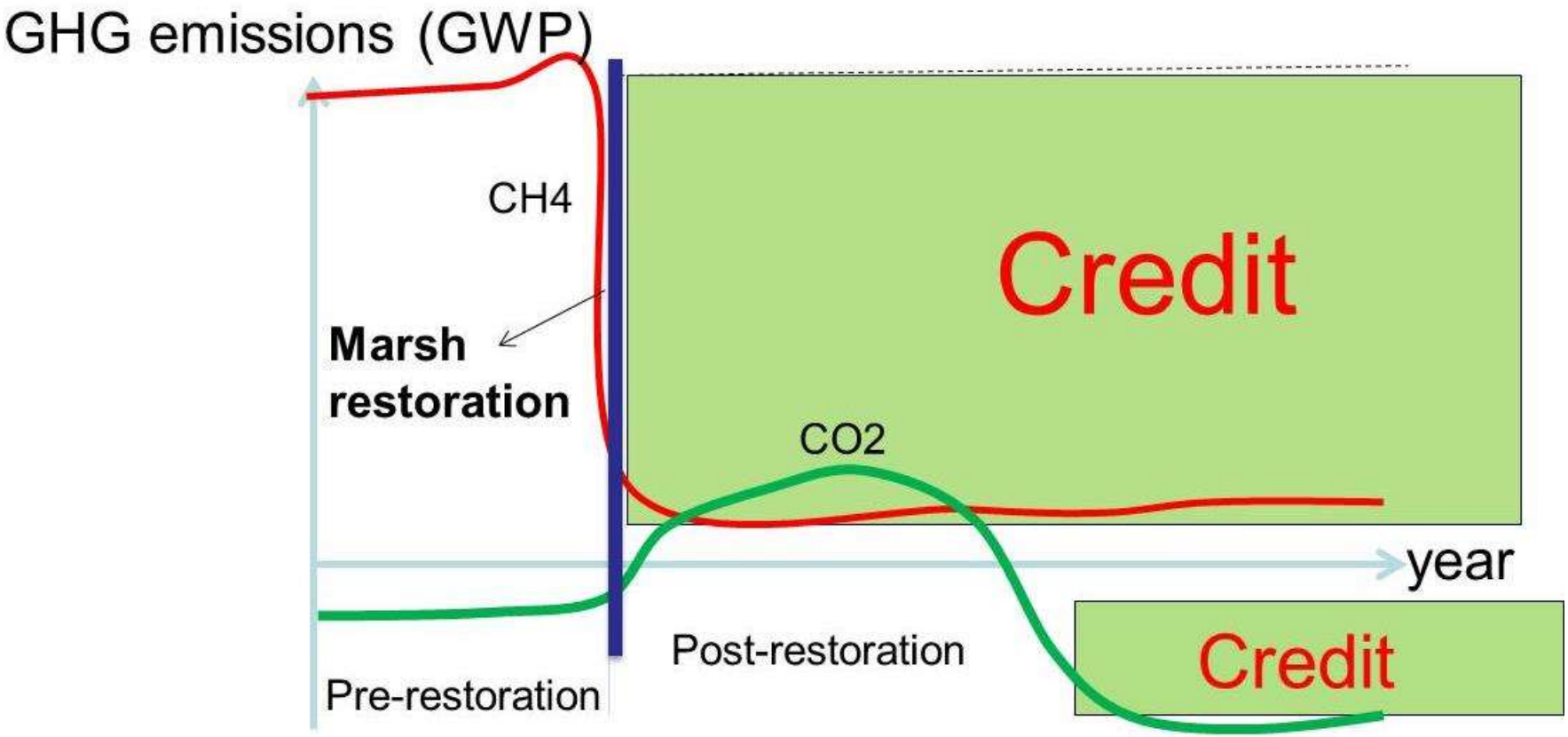


C from different ecosystems

Salt marsh: 100-200 gC $m^{-2}y^{-1}$)

Wang et al. in review

Carbon credit for salt marsh restoration



Blue Carbon Credit

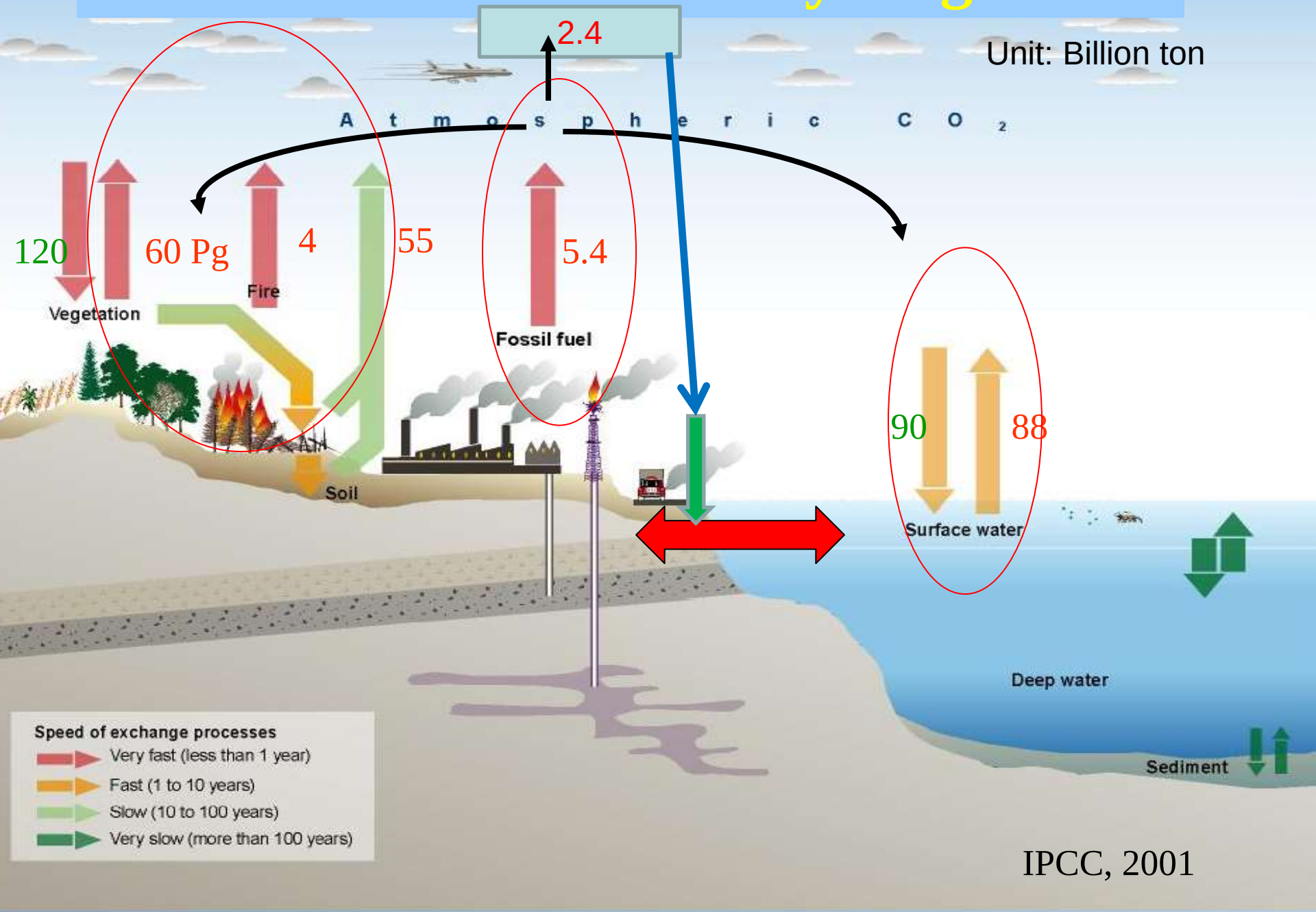
Carbon credit =

Carbon storage after human intervention - Carbon storage baseline

Conclusions

- We use gas analyzers, cameras, and tea bag experiments to understand the carbon cycle.
- We found that the coastal wetland is a significant carbon sink (blue carbon).
- Restoration increased carbon sequestration and decreased CH_4 fluxes.

Global carbon cycling



IPCC, 2001