EGU22-13158

Terrestrial Carbon Dynamics through Time

insights from downcore compound-specific radiocarbon dating

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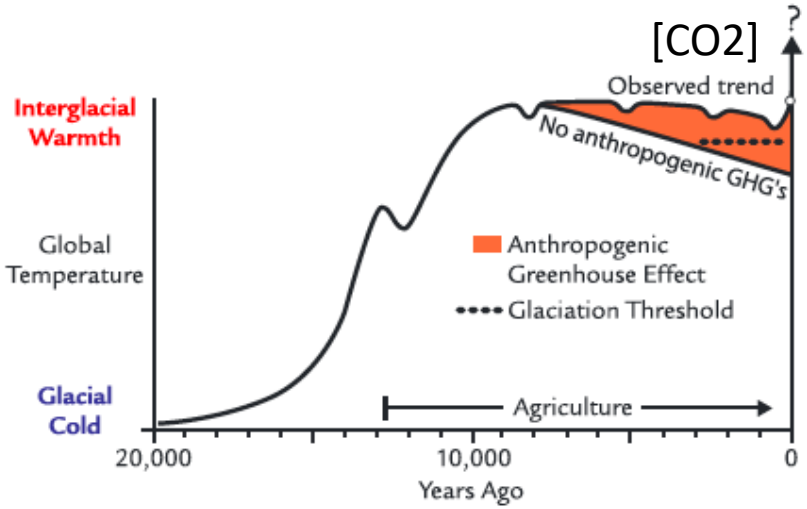
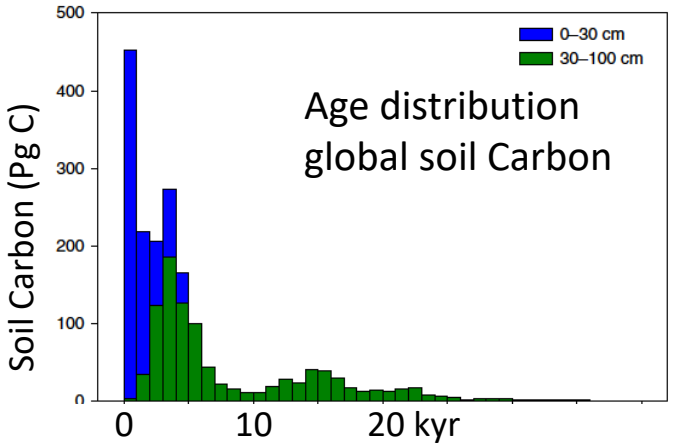


Ruddiman et al (2016) Rev. Geophysics

- How has the Terrestrial Carbon Stock changed since the LGM?
- Role of early humanity?
- Role of climate changes?



Shi et al (2020) Nat. Geosci.

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APPROACH

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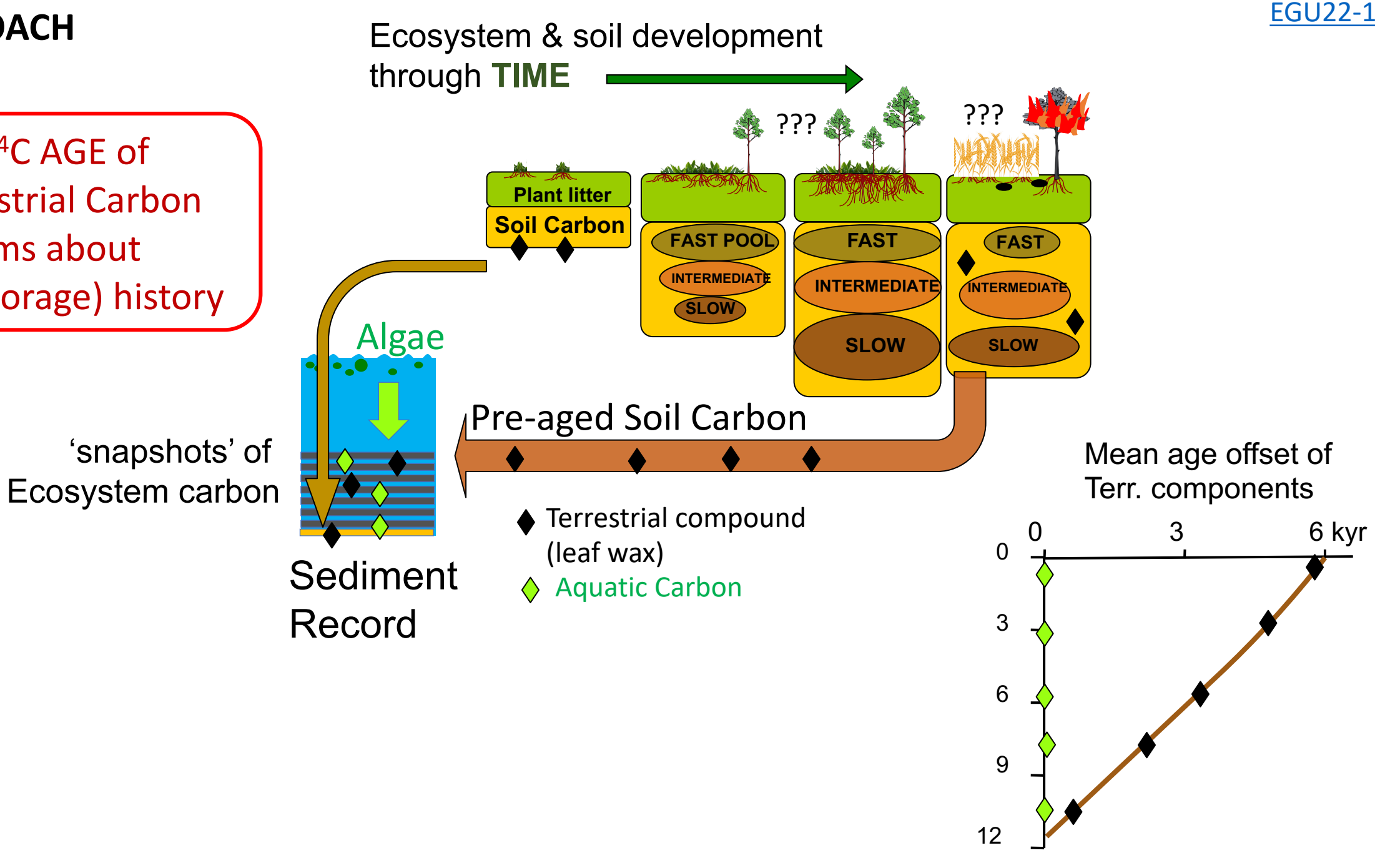
The ^{14}C AGE of Terrestrial Carbon informs about its (storage) history



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EXAMPLES FROM AROUND 10 DOWNCORE PROFILES

Smittenberg et al (2006) Science 314
Ongoing buildup *of refractory organic carbon in boreal soils during the Holocene*

Soppensee

Lake Murten

Lake Lusvatnet*

Lake Ioannina

Saanich Inlet

Yukatan peninsula lakes

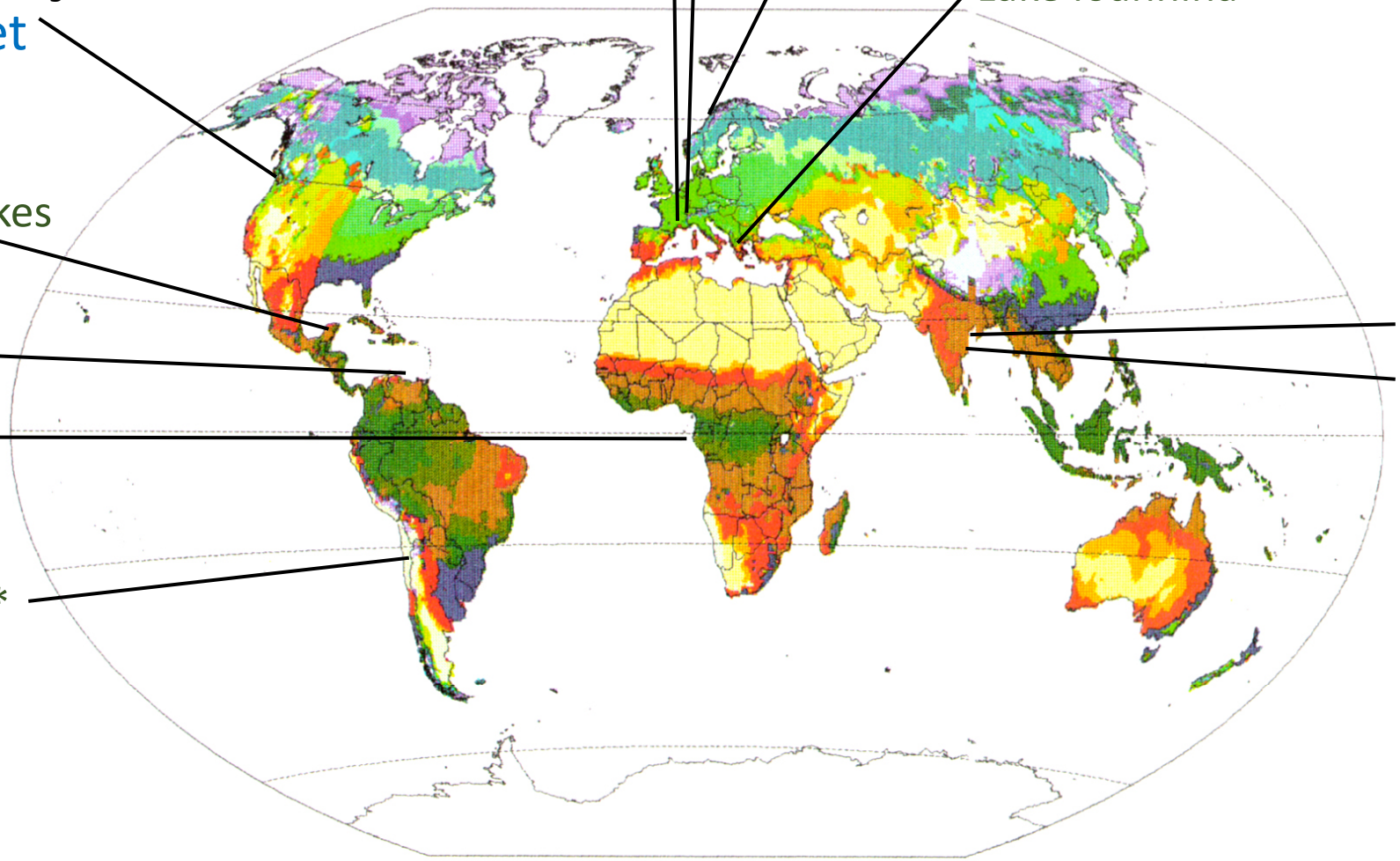
Cariaco Basin *

Congo basin

Lake Titicaca *

Brahmaputra

Godavari *



* Unpublished data

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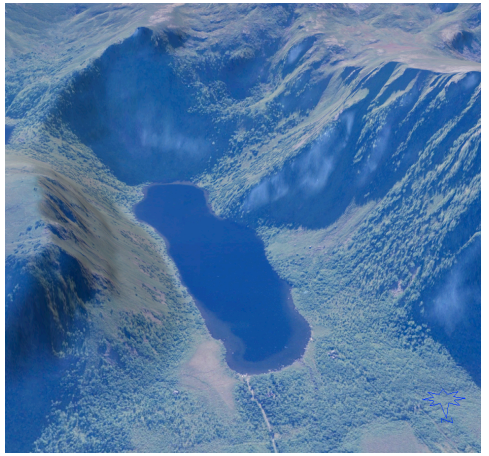
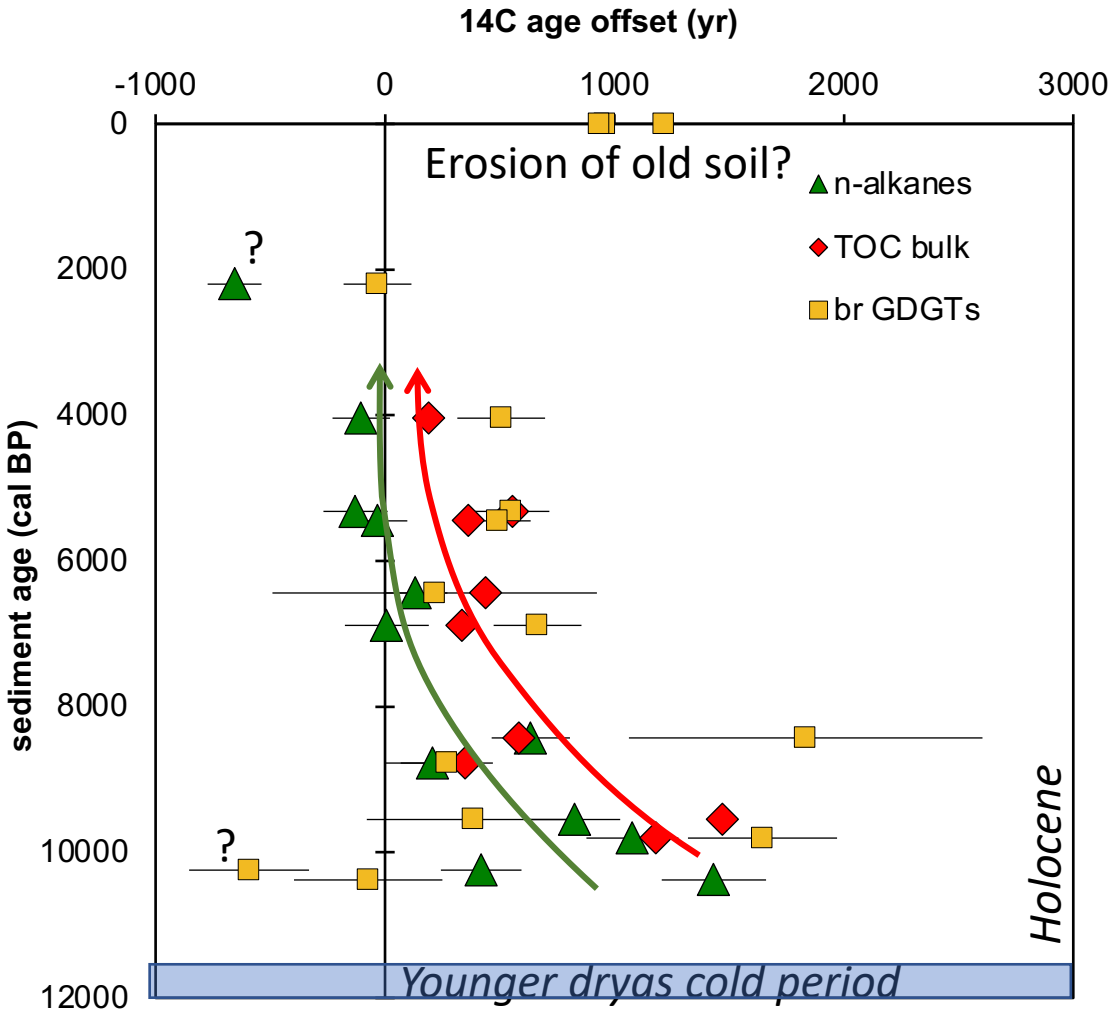
Lake Lusvatnet, Lofoten, Norway



Small catchment steep slopes



3. Branched GDGTs ages (from soil microbes) reflect mostly bulk C but also show some enigmatic ages

2. Eroded Carbon reflects small catchment with fast C turnover

OR

Only release of young OC from soil surface (no erosion)

1. After Younger Dryas,
release of ancient (permafrost? Bølling-Allerød?) Carbon

Unpublished results

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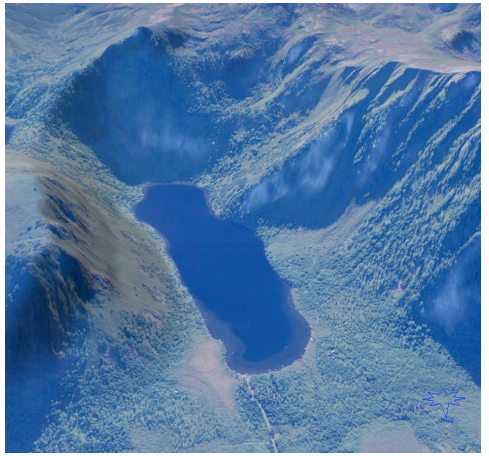
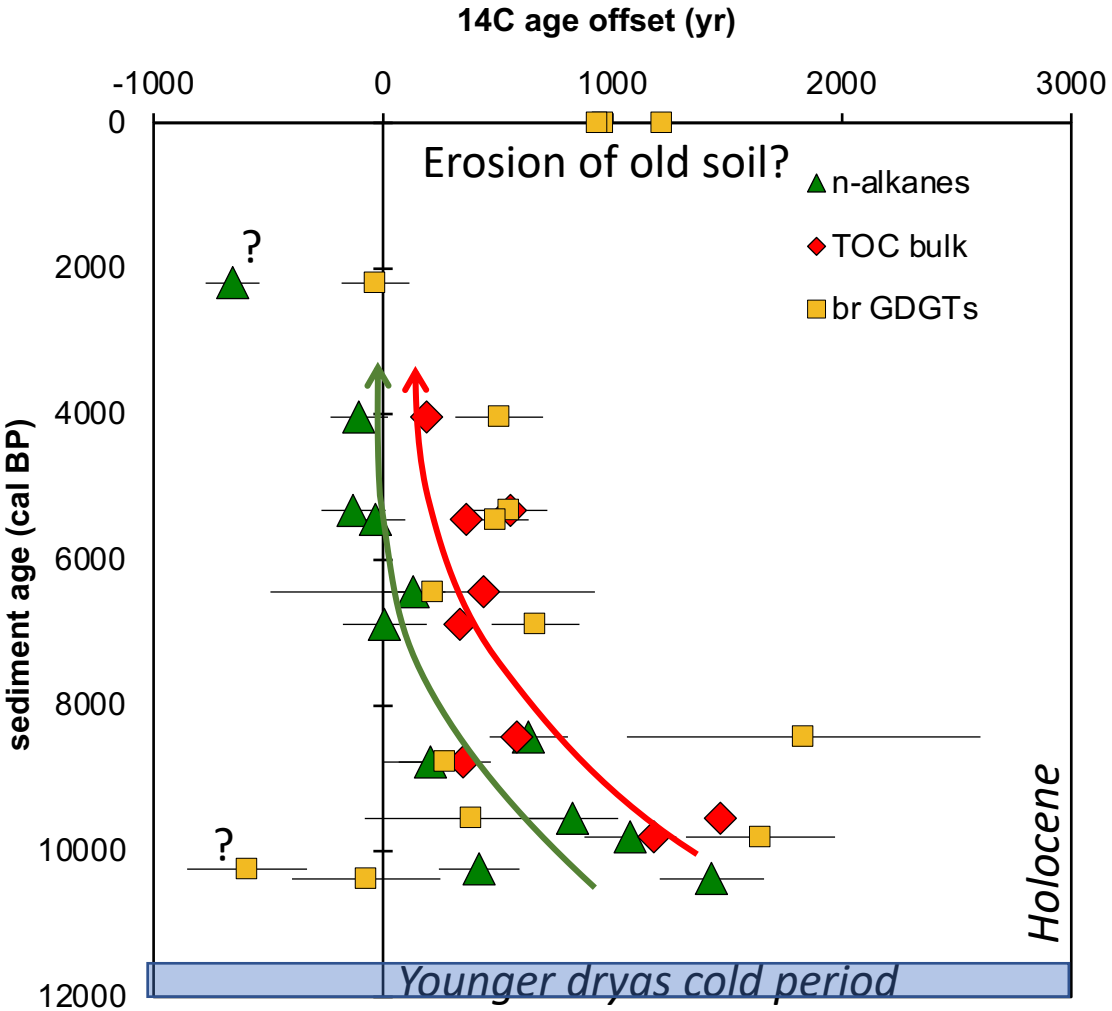
Lake Lusvatnet, Lofoten, Norway



Small catchment steep slopes

Different to Saanich Inlet



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Soppensee, Switzerland

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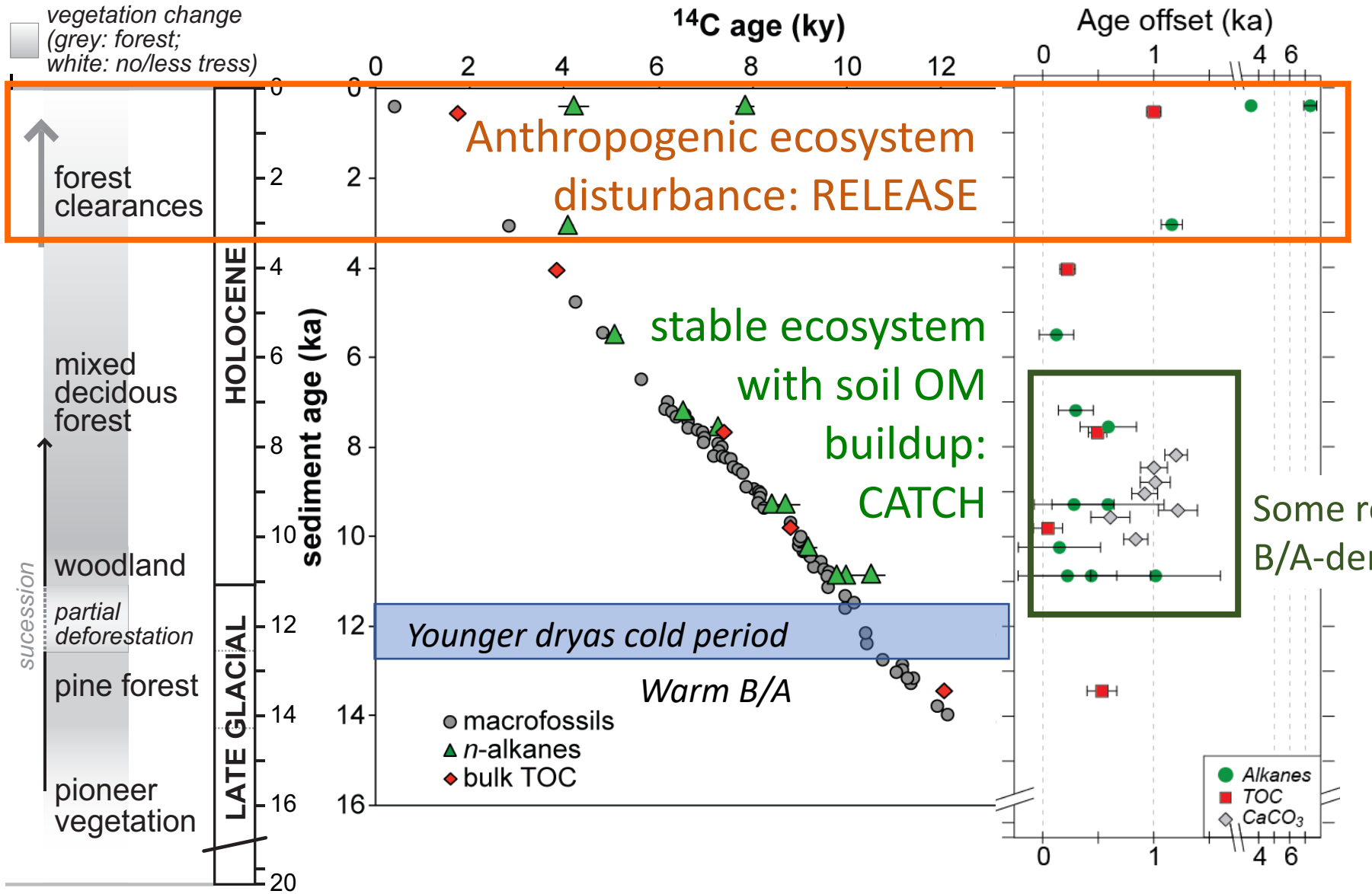
Catchment: small



Some release of pre-YD B/A-derived C?

Gierga et al (2016) QSR 144, p123 Long-stored soil carbon released by prehistoric land use: Evidence from compound-specific radiocarbon analysis on Soppensee lake sediments

Congo Basin, Africa

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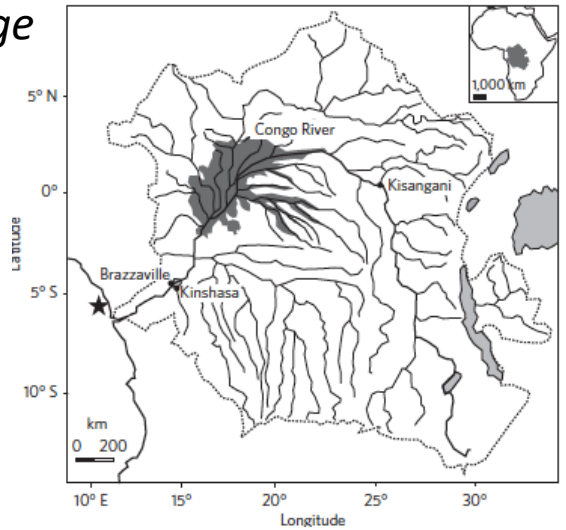
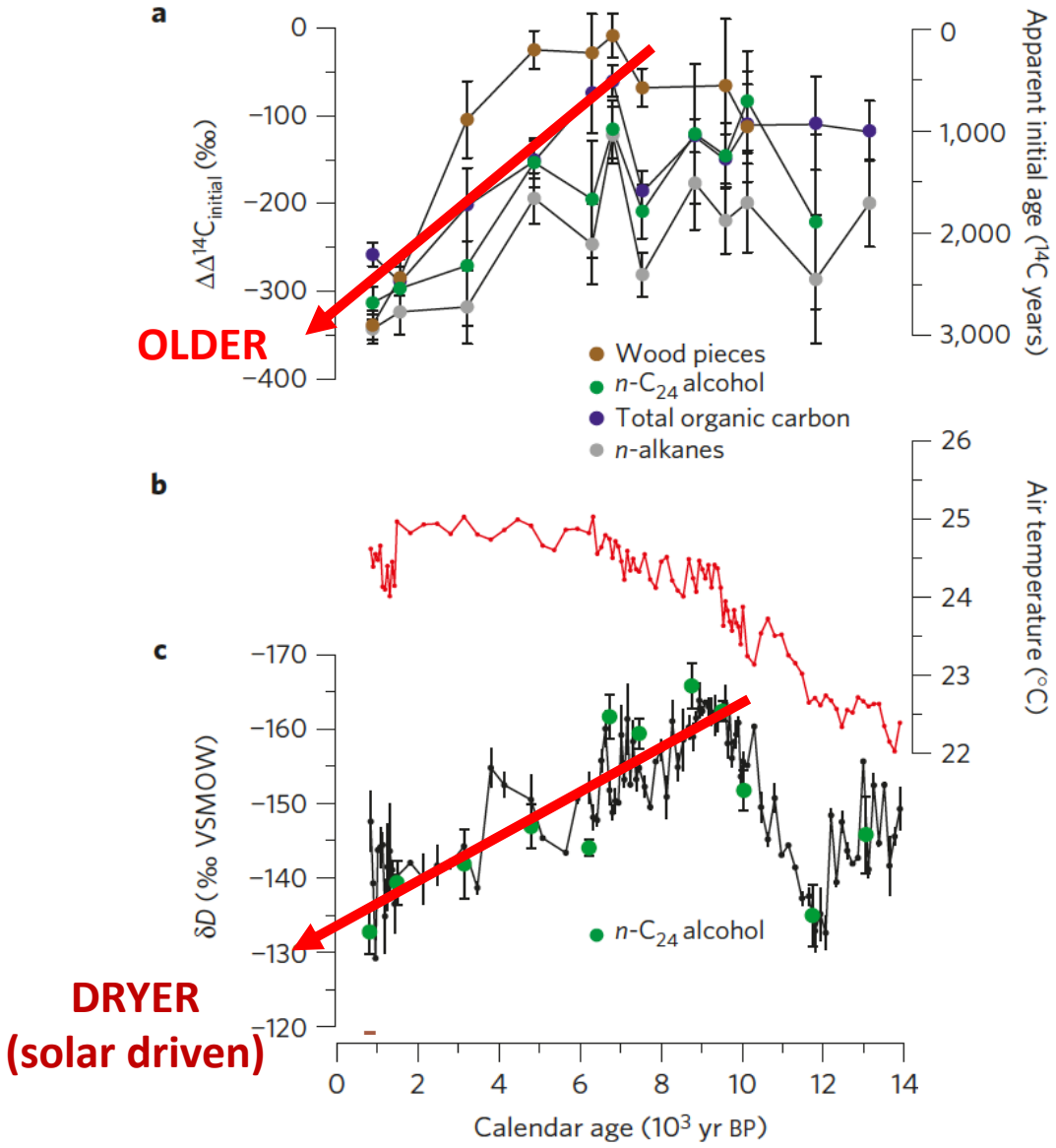
Catchment: very large





Schefuss et al (2016) Nat Geosci 2778 hydrological control of carbon cycling and aged carbon discharge in the Congo Rive Basin

Congo Basin, Africa

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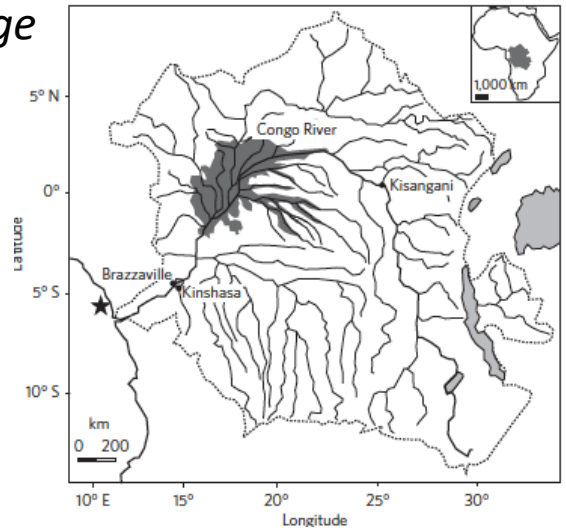
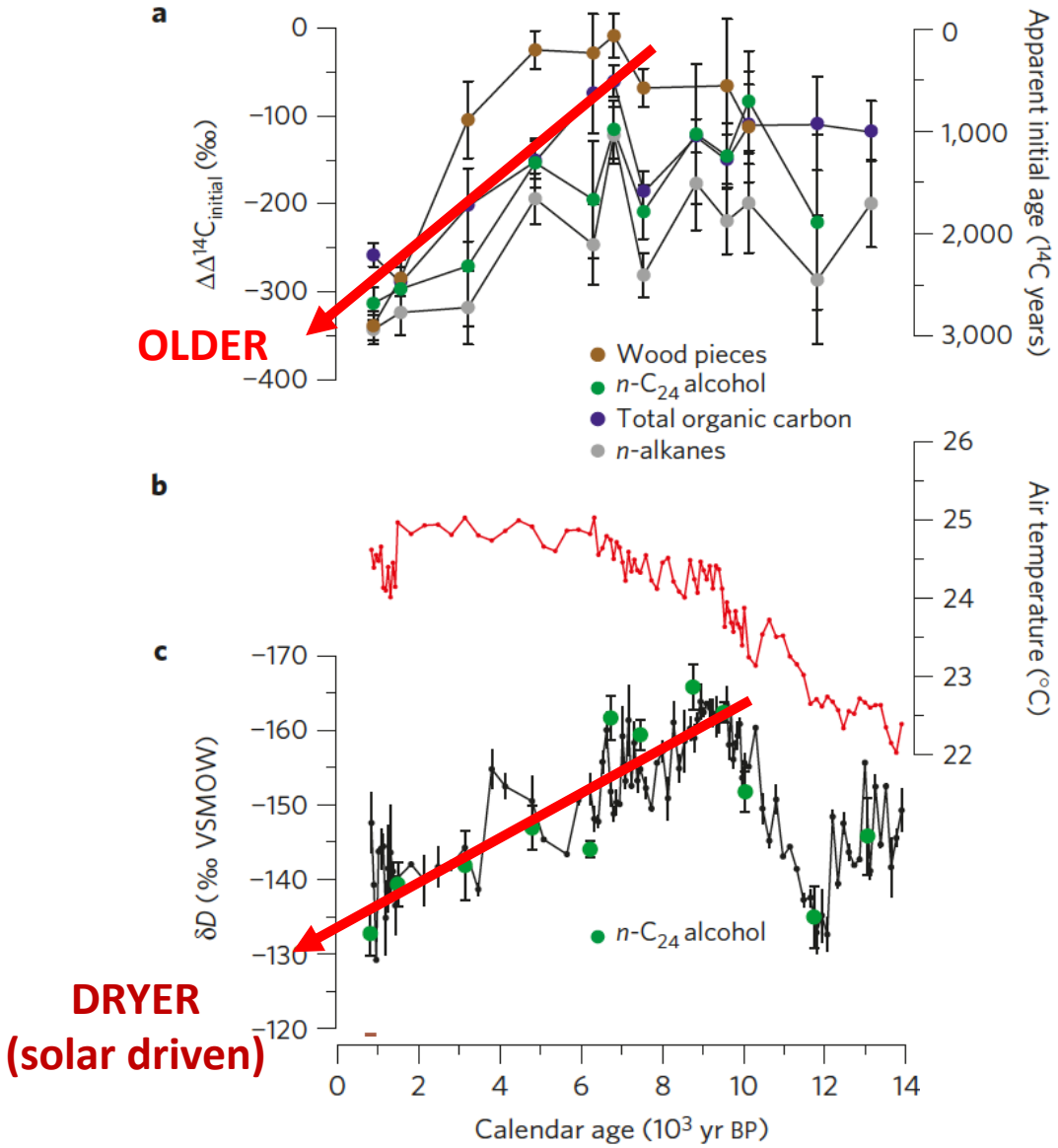
Catchment: very large





Explanations:

1. *Buildup* of old carbon and 'sampling' of this in sed. record ('Saanich' type)?
2. Dryer = *degradation* (drying) of old wetland peats → Export of old Carbon

2b. Human perturbance? ('Soppensee' type)

Schefuss et al (2016) Nat Geosci 2778 hydrological control of carbon cycling and aged carbon discharge in the Congo Rive Basin

Conclusions

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1. Cold, high latitudes: ongoing buildup of Carbon (long-term sink)
2. Mid-low latitudes: dynamic steady state ruled by long-term (hydro)climate

   * Wet (stable) conditions tend to give a '**young' signal** in sediment:

     = **ecosystem stabilization (Catch)**, with only surface export ('Soppensee style')

     or

     = more export & higher soil carbon turnover

   * (seasonal) dryness tends to give an **'old' signal**:

     = **erosion of old C stocks (Release)**

     or

     = less export (runoff) and thus **build-up** of C stock (**Catch**, 'Saanich style')

Disentangling these opposing mechanisms is a challenge

3. Long-stored Carbon is being (has already been) eroded away
   a) **because of human perturbance**
   b) due to climatic variability (drying / erosion)

SEE ALSO THE DISPLAY MATERIAL