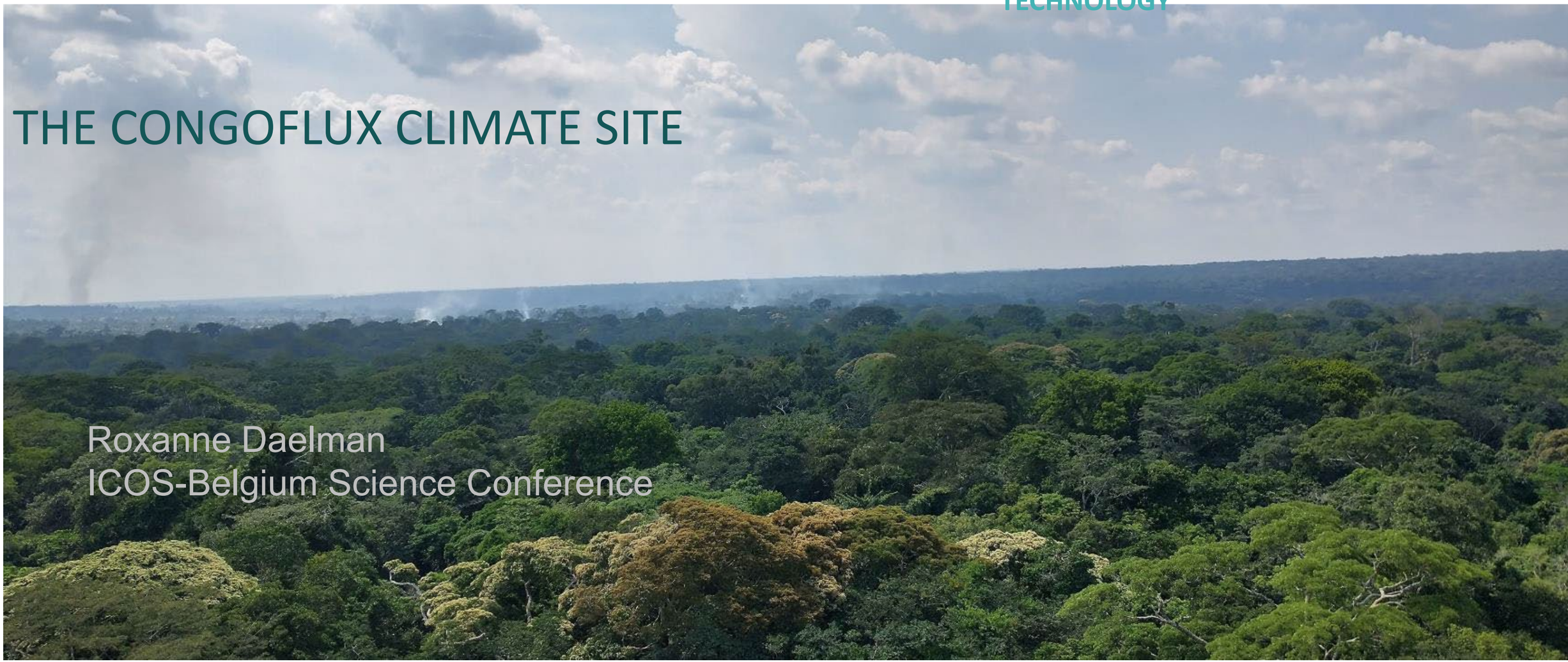
FACULTY OF BIOSCIENCE ENGINEERING

DEPARTMENT OF GREEN CHEMISTRY AND TECHNOLOGY

THE CONGOFLUX CLIMATE SITE



Roxanne Daelman

ICOS-Belgium Science Conference

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ISOFYS Isotope Bioscience Laboratory

CongoFlux

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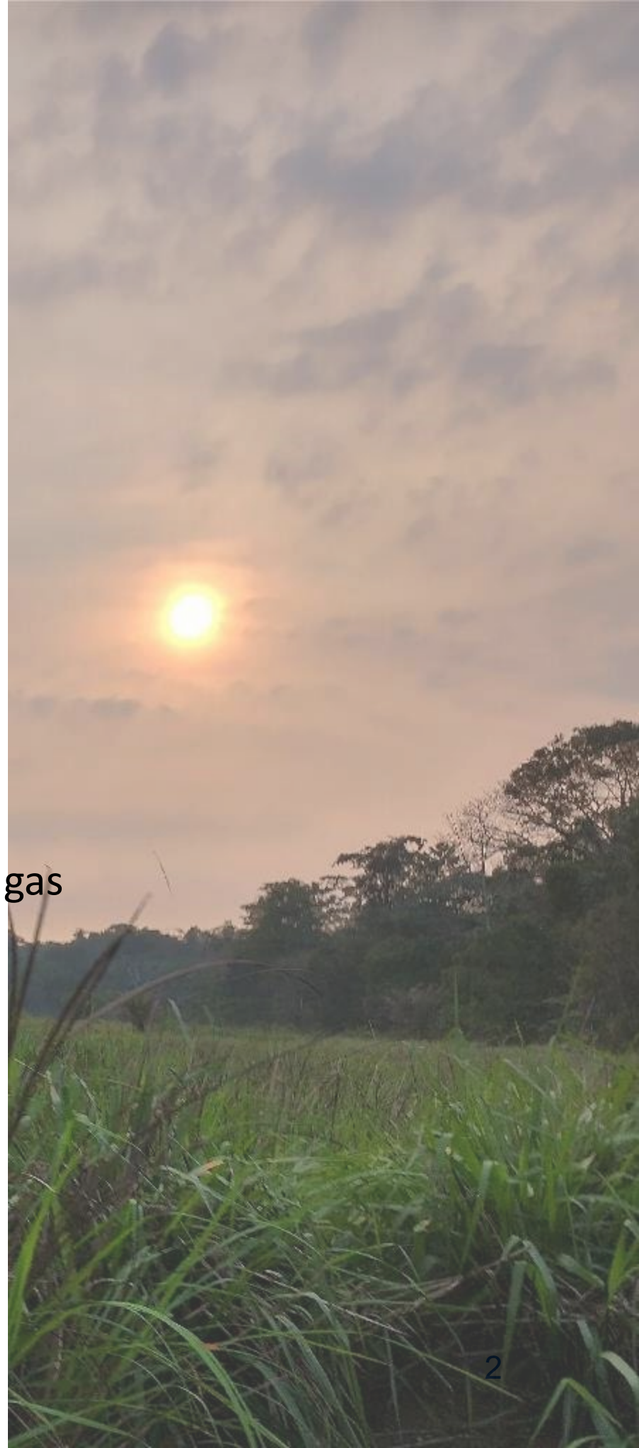
The Congo Basin

- Second largest tropical rainforest of the world (550 Mha),
- Recognized as a biodiversity hotspot,
- Estimated to be the tropical region with the largest carbon uptake per unit of area,
- Estimated to have a net full GHG sink of 0,61 Gt CO_2eq yr^{-1}, which is six times stronger than the Amazon basin,
- Critical role in the regional water cycle, the global carbon cycle and the continental greenhouse gas balance,
- Has among the least environmental observations worldwide.



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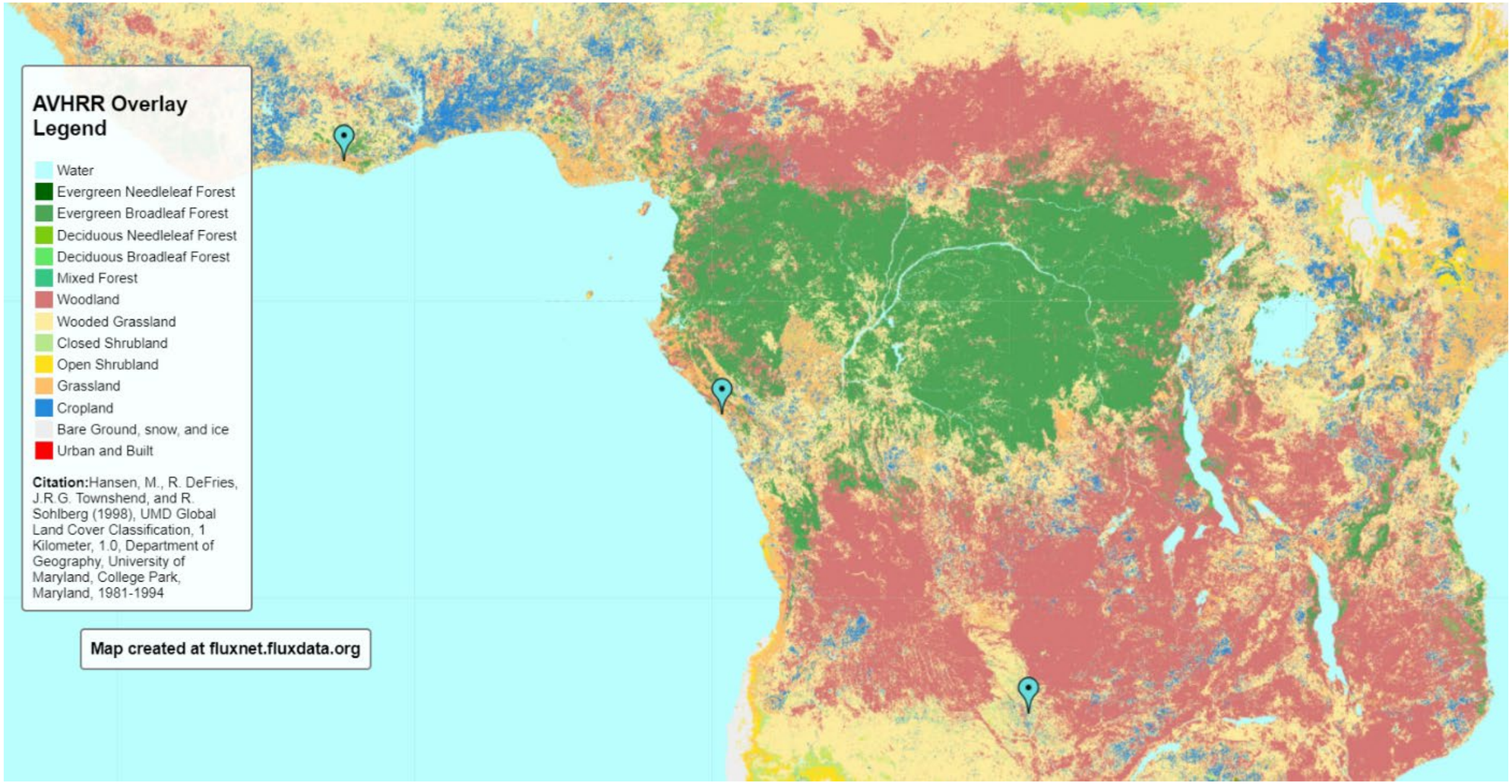
The Congo Basin: a blind spot



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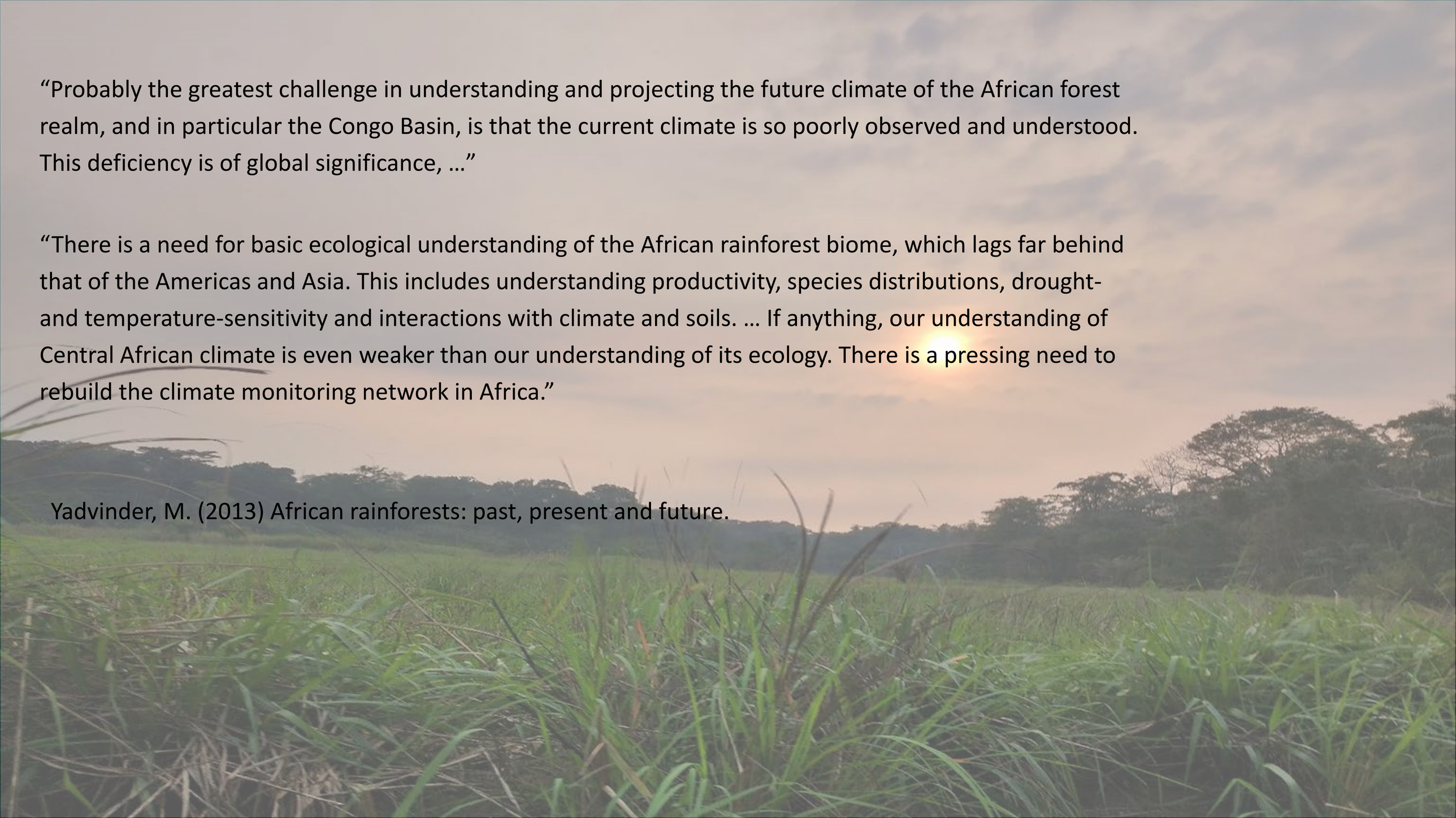

“Probably the greatest challenge in understanding and projecting the future climate of the African forest realm, and in particular the Congo Basin, is that the current climate is so poorly observed and understood. This deficiency is of global significance, …”

“There is a need for basic ecological understanding of the African rainforest biome, which lags far behind that of the Americas and Asia. This includes understanding productivity, species distributions, drought- and temperature-sensitivity and interactions with climate and soils. … If anything, our understanding of Central African climate is even weaker than our understanding of its ecology. There is a pressing need to rebuild the climate monitoring network in Africa.”

Yadvinder, M. (2013) African rainforests: past, present and future.

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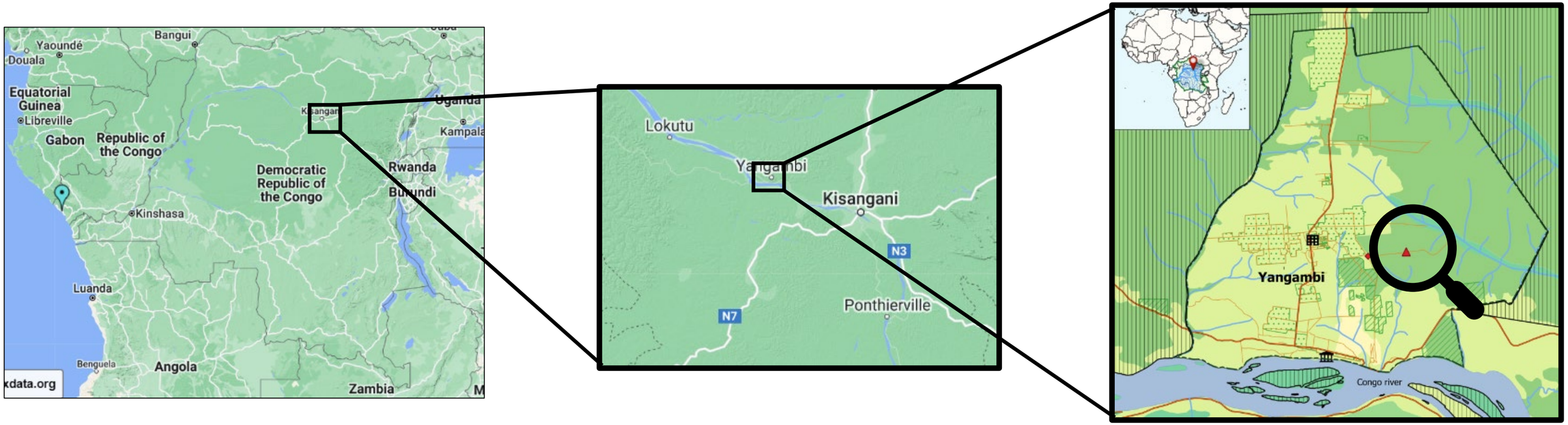
Tropicaux

The Yangambi research center



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MORE THAN EDDY COVARIANCE

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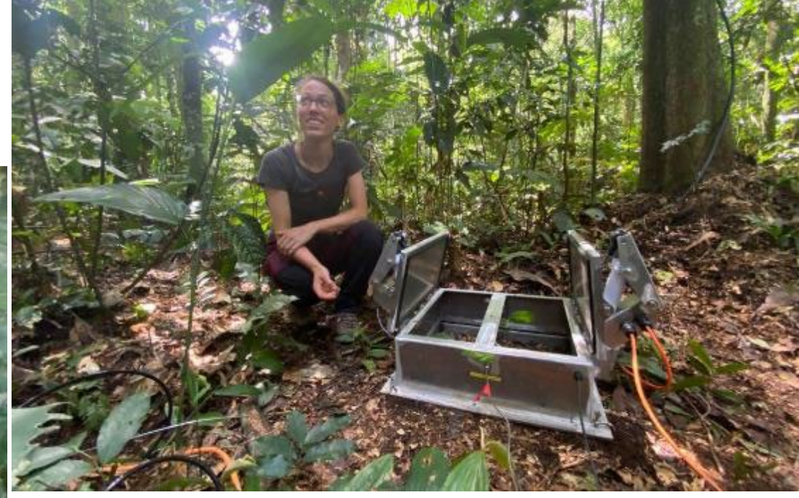
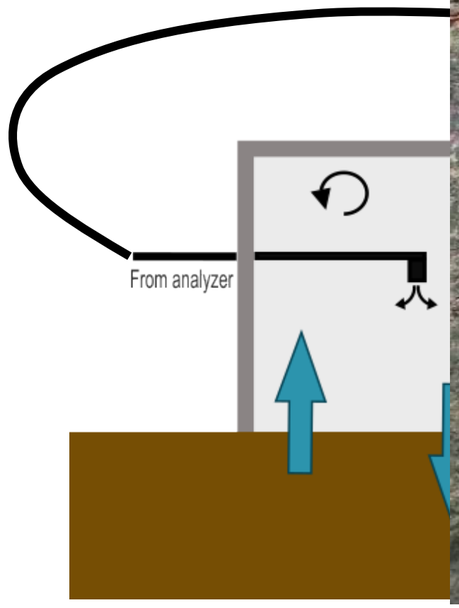
Soil fluxes



Stem fluxes

Stem chambers on living and dead trees measuring CO_2, N_2O and CH_4 stem fluxes



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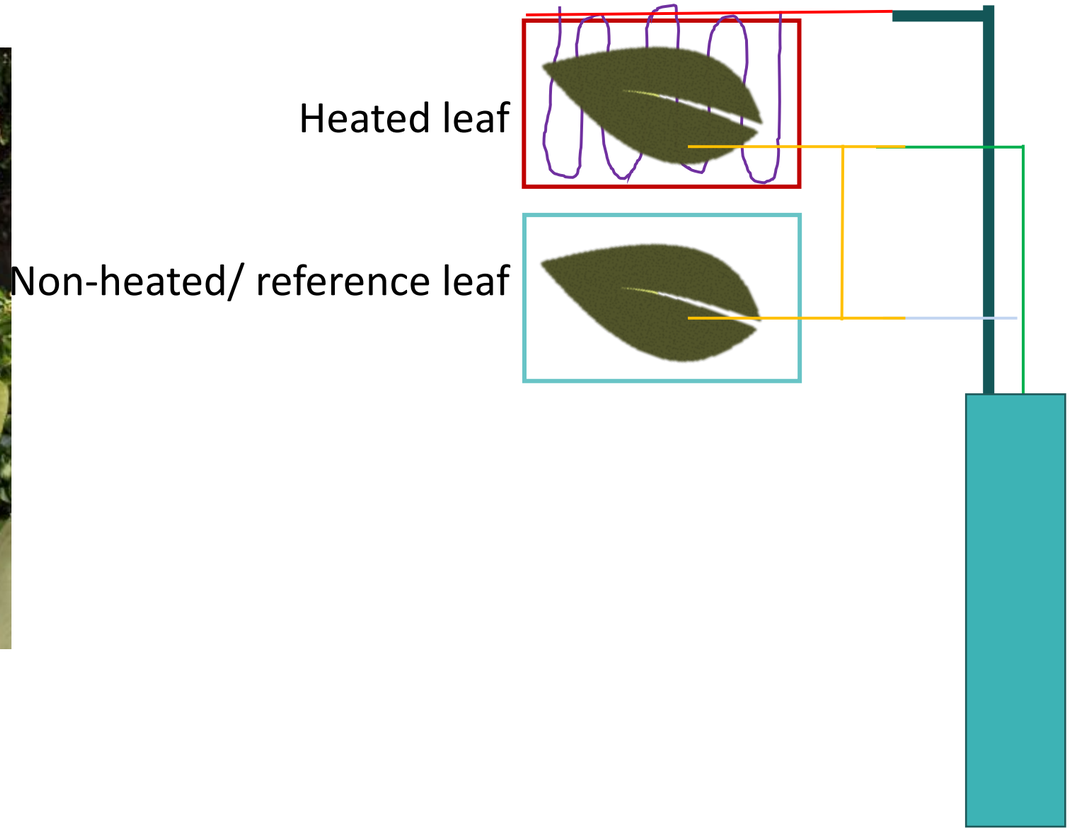
Pauline Hicter, Emmanuel

Leaf warming

Leaf warming experiment looking into the long-term temperature response of photosynthesis

with 24 pairs of heated and non-heated leaves on 12 individual trees



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And more ….

- Cosmic ray neutron sensor
- Black carbon
- Ozone
- Quantify photosynthetic parameters of tropical species representative of the Congo Basin
- Sapflow sensor and dendrometers
- GEM-plots

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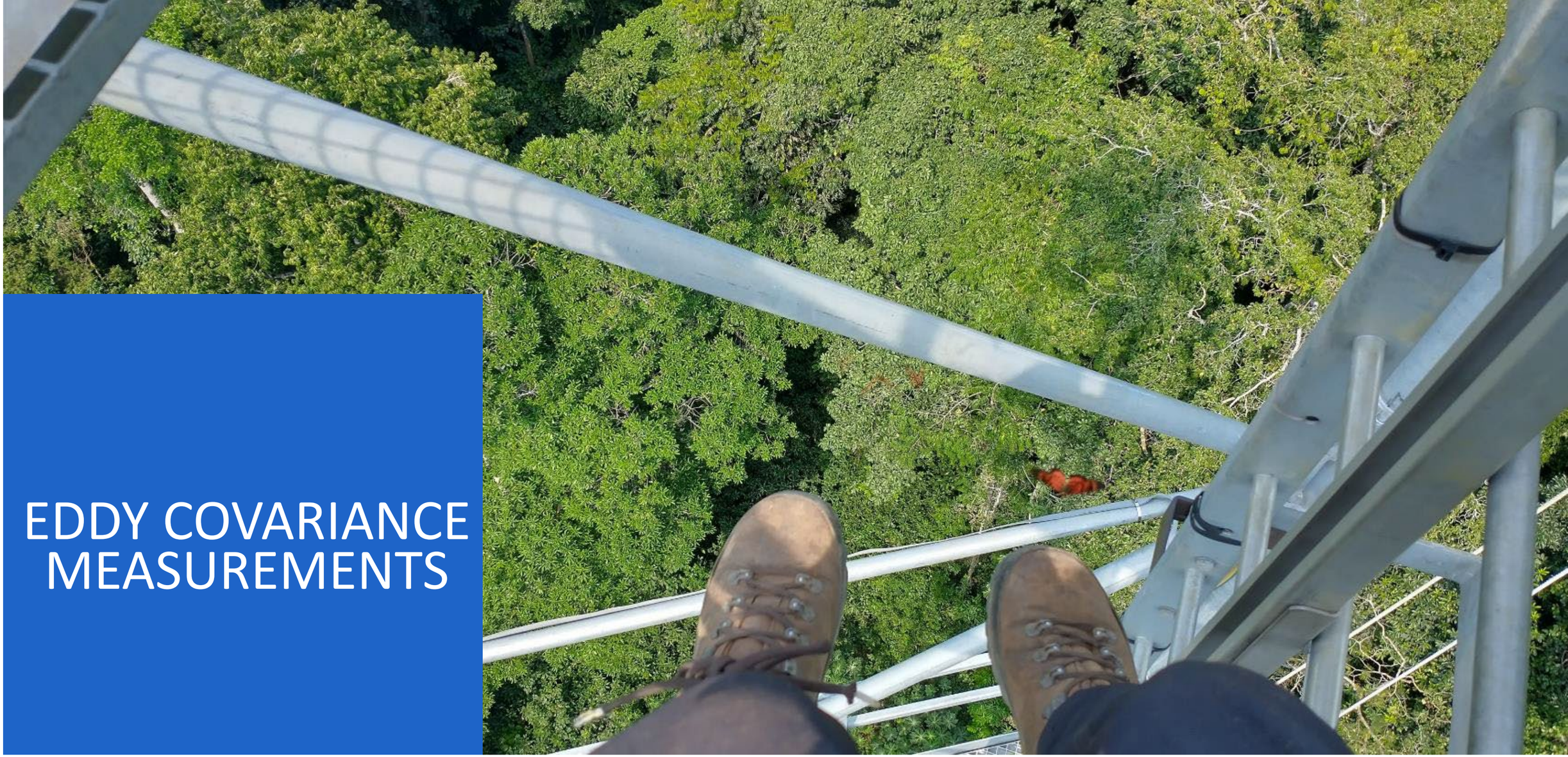
EDDY COVARIANCE MEASUREMENTS



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The CongoFlux tower

- EC instrumentation at a height of 56.25m
  - Closed path gas analyzer (LI-7200 RS)
  - Ultrasonic anemometer (HS-50)
- CO_2, RH and Temp profile measured at 8 heights along the towe
- Supply of electricity from the solar park 2.4 km west
- More meteorological and hydrological data
  - Incoming and outgoing SW radiation
  - Incoming and outgoing LW radiation
  - PAR
  - Incoming diffuse light
  - Air pressure
  - Precipitation

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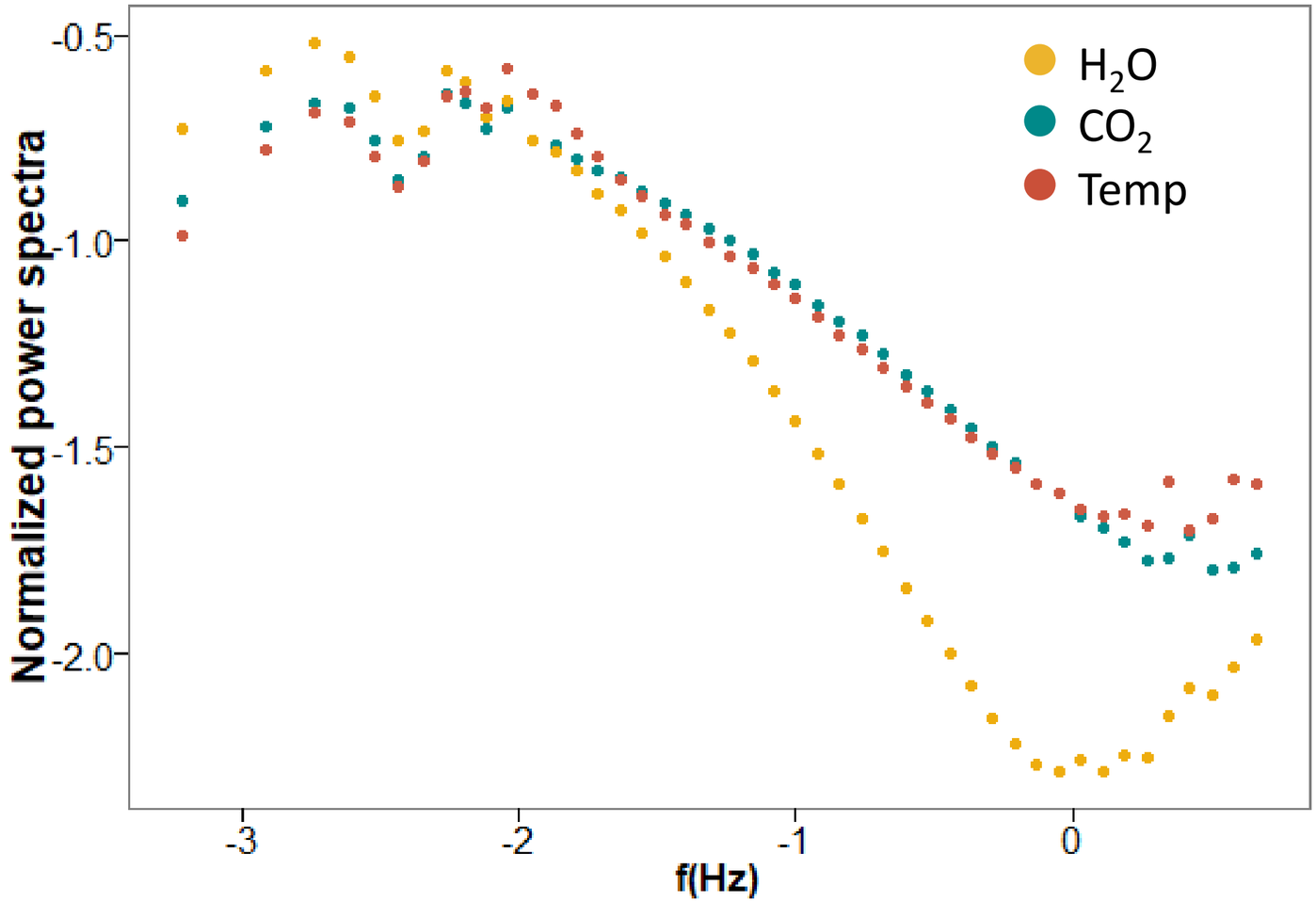
The challenges: Spectral corrections

Air passes through sampling lines which causes attenuation of CO_2 and water vapor fluctuations.

This effect gets stronger with higher relative hu

- ✓ Short inlet tube
- ✓ Heated inlet tube
- Spectral corrections



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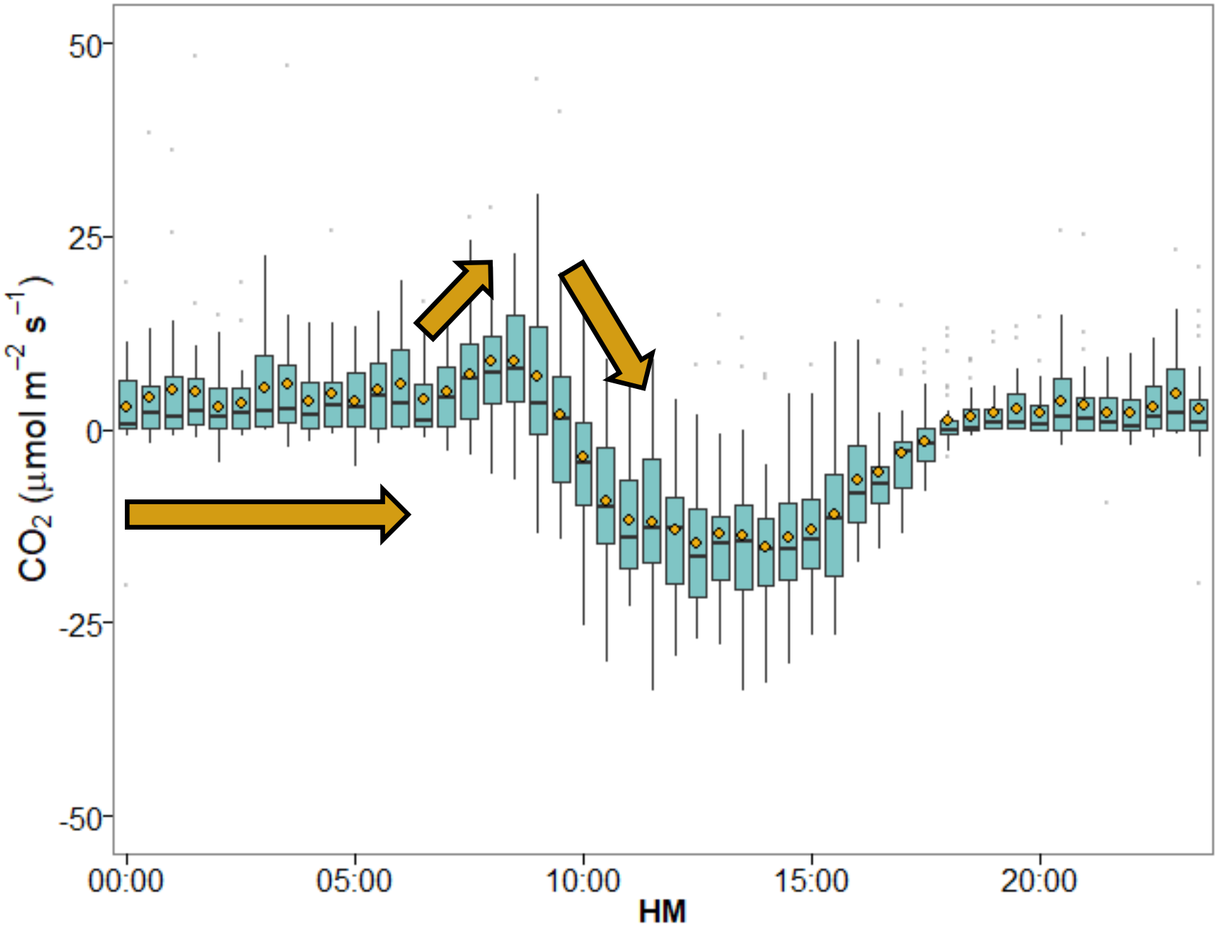
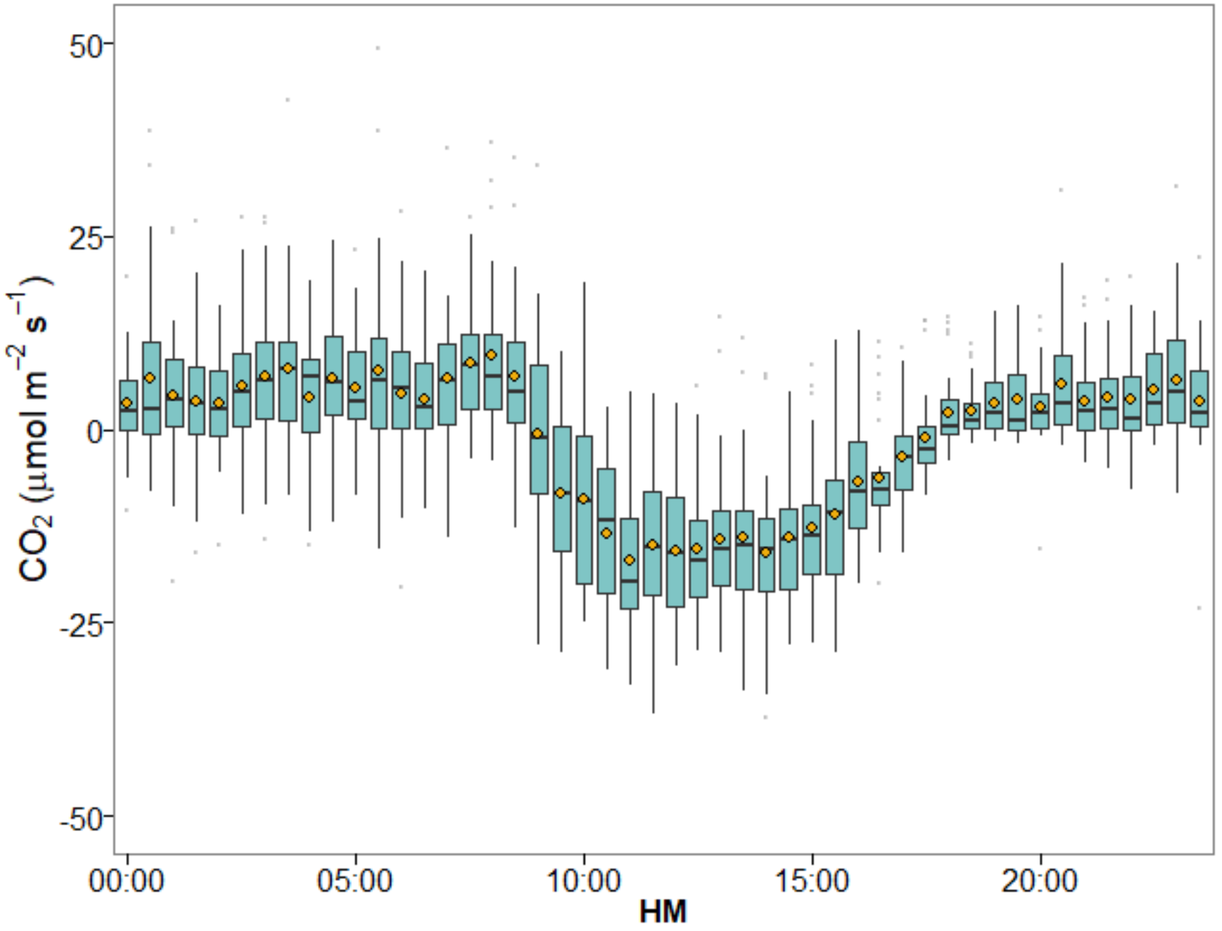
The challenges: Storage

During the night CO_2 gets stored in the canopy and flushed out in the morning.

Need for profile measurements of CO_2 and H_2O for storage correction





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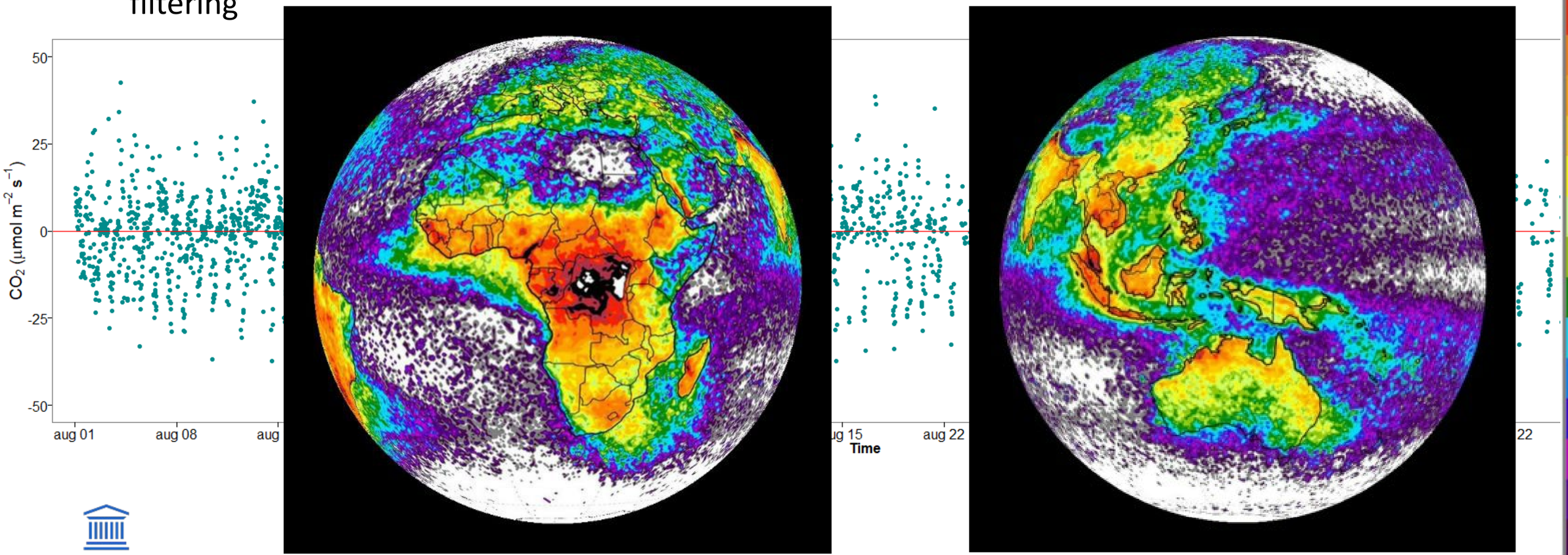
The challenges: Gap filling

- 40% of the data has flag 2
- another 40% gets filtered out by U* filtering
- Data gaps due to
  - Harsh conditions
  - Power issues



NASA LIS/OTD Science Team & NASA MSFC

Lightning flash frequency per year per squared kilometer

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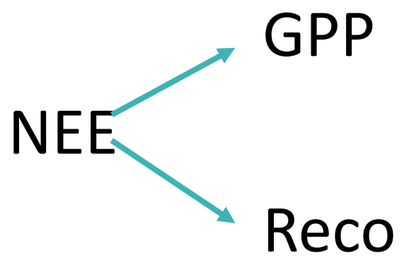
The challenges: Flux partitioning



Nighttime approach (Reichstein et al. 2005)

Respiration in function of temperature, fitted with nighttime data

Daytime approach (Lasslop et al. 2010) and moddified daytime approach (Keenan et al. 2019)

GPP in function of global incoming radiation using light response functions and respiration in function of temperature, fitted with nighttime data

Others

light response curve with VPD limitation

neural networks

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Tower data → GPP and Reco

instrumentation issues

corrections

filtering

gap filling

flux partitioning

…

Every step along the process influences the end result.

It takes someone who knows the tower and the site to process the data.

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Thank you

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