



The LifeWatch ERIC Biodiversity
& Ecosystem eScience Conference
PLOVDIV, BULGARIA 7-10 JULY 2026

CO₂ fluxes responses to climate variables in the changing Arctic tundra

Presenter: Mariasilvia Giamberini

Main co-author: Silvana Beatriz Goiran

Institute of Geosciences, CNR, Italy

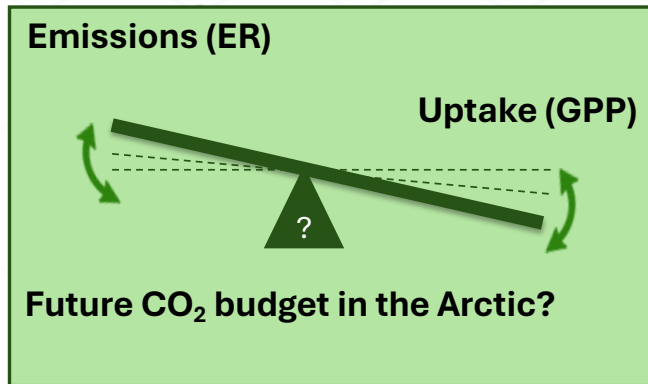


09 July 2026

The tundra: the life support system of Arctic terrestrial ecosystems



Climate and environmental drivers of CO₂ Fluxes

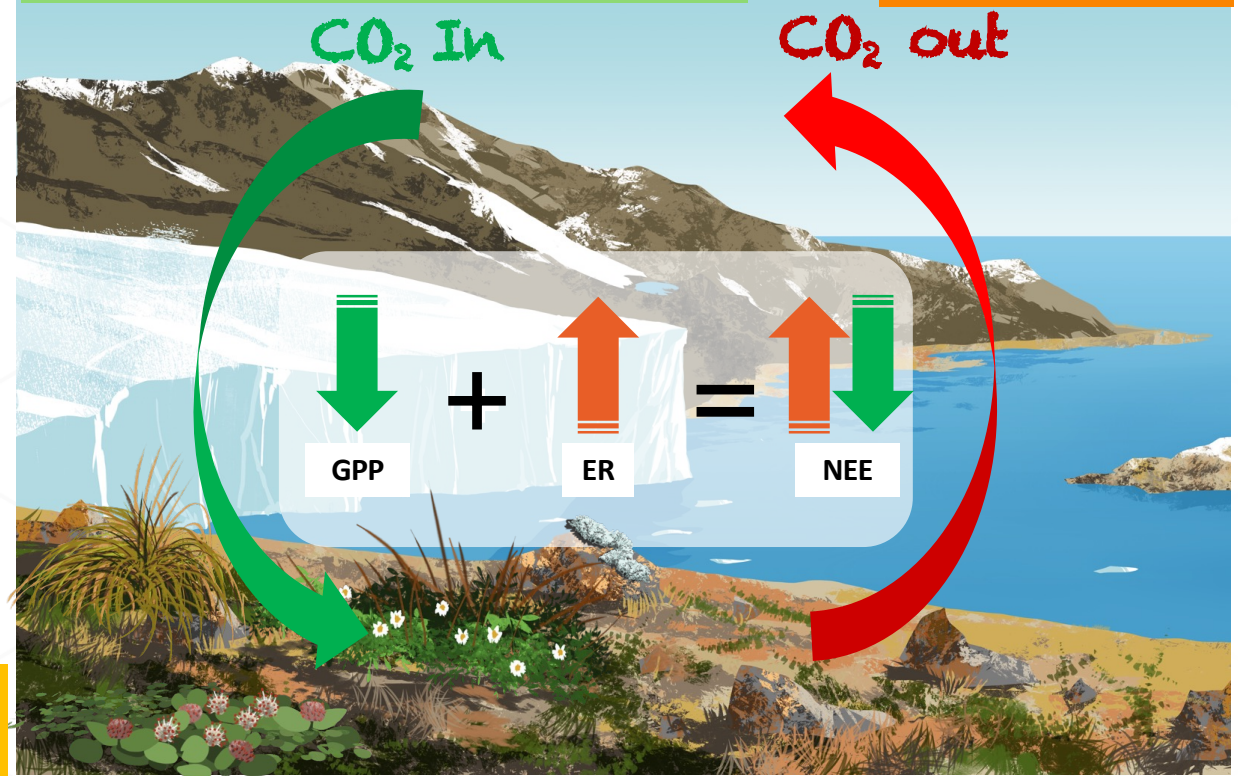


SINK ? SOURCE ?

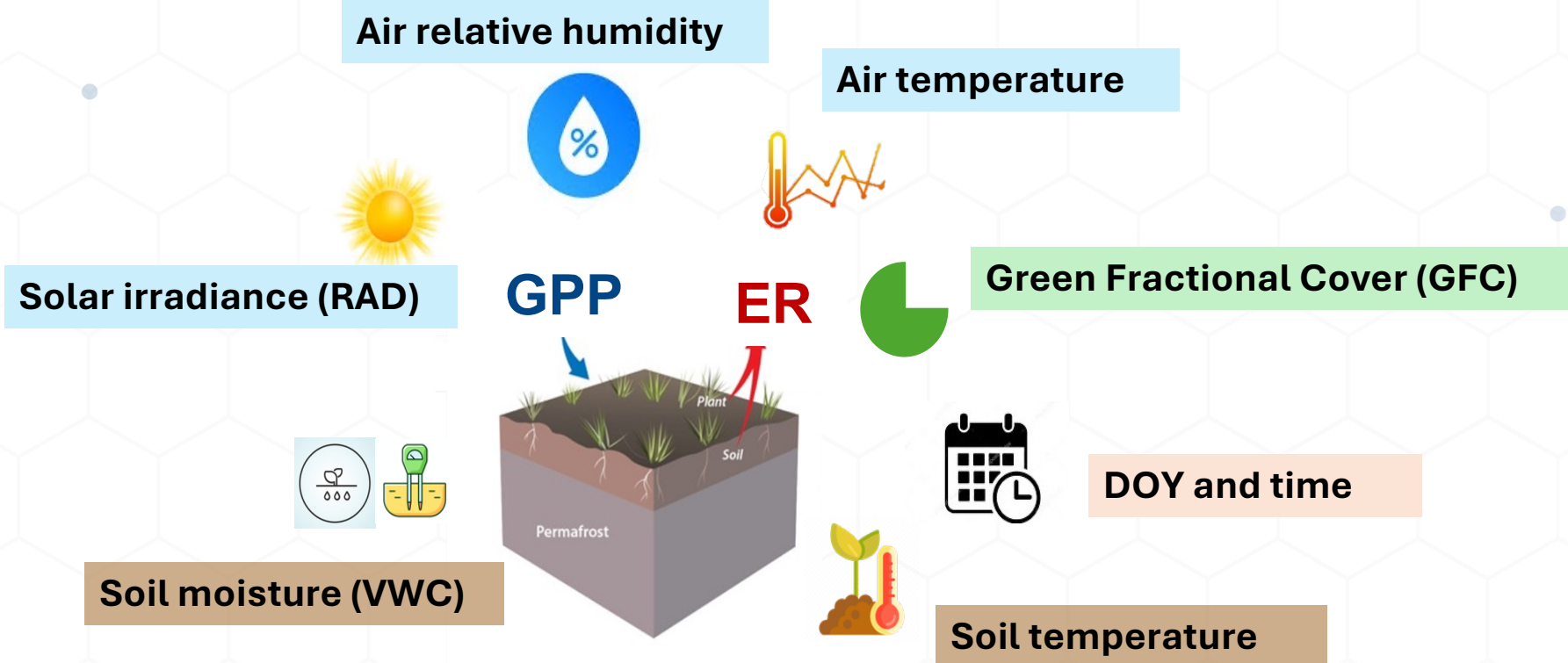
How will ER and GPP be affected by climate change?

Biomass growth and carbon storage = gross primary productivity (GPP)

carbon release = respiration (ER)



Climate and environmental drivers of CO₂ Fluxes

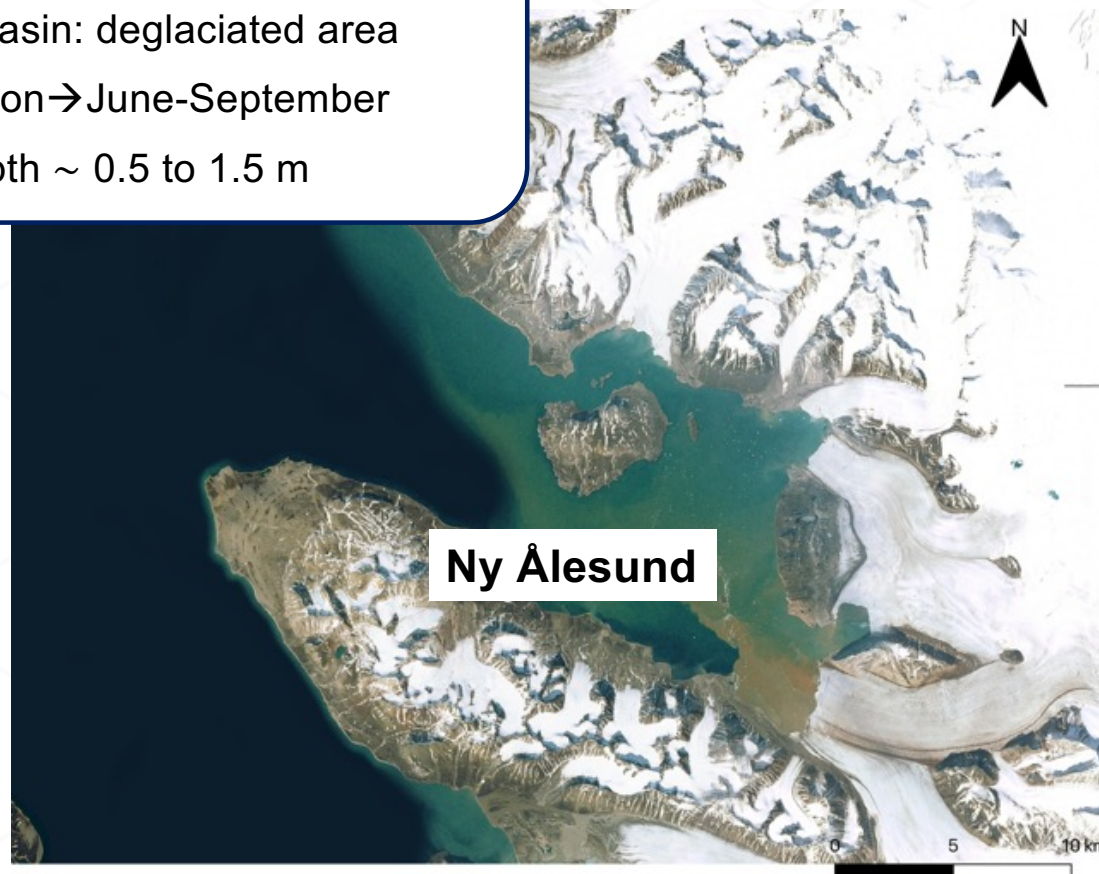
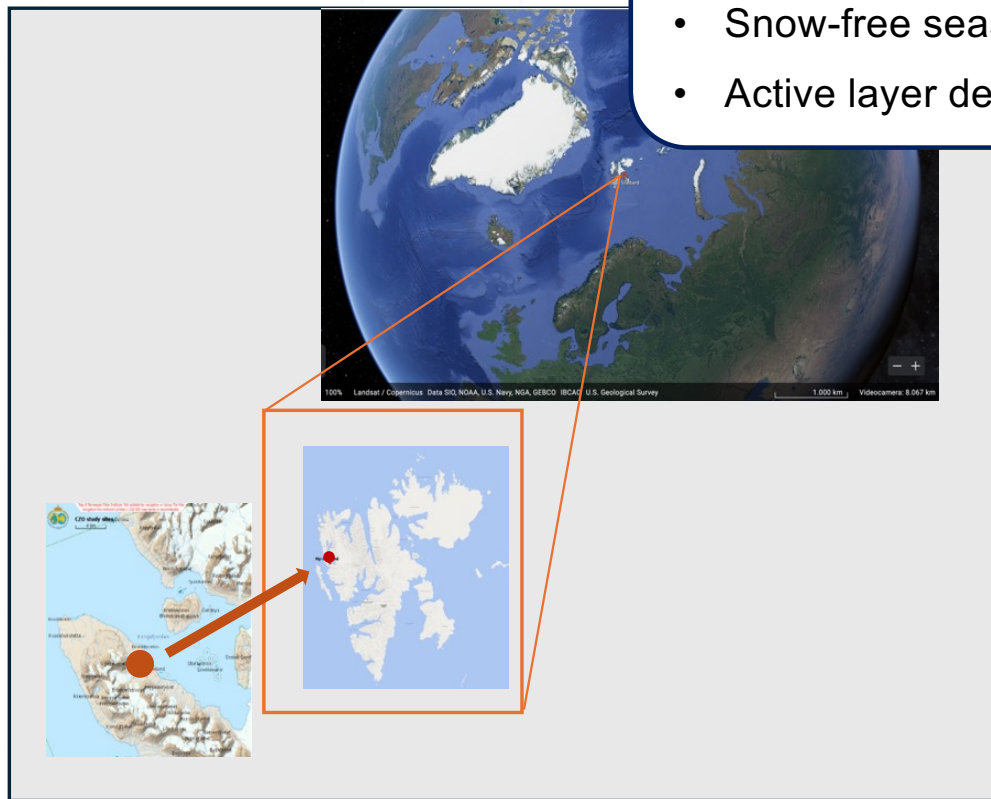


**What are the main drivers of ER and GPP?
How do they control the carbon budget?**



A long term experiment relating climate and soil variables to GPP and ER by building empirical models

- Brøgger peninsula, Svalbard, Norway
- Bayelva river basin: deglaciated area
- Snow-free season → June-September
- Active layer depth ~ 0.5 to 1.5 m



The CNR CO₂ fluxes observatory in Ny Ålesund, Svalbard (NO)





Measurements in the field: The Flux Chambers

July–August 2019 – 2025: field campaigns: 2000+ sample points measured

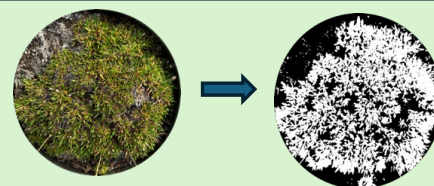
NEE, ER: IRGA (Licor) + Flux Chamber



Air T, RH, Atm. Pressure, Solar Irradiance:
portable meteo station

Soil T, Soil Water Content: Pt100
temperature probe + conductometer

Vegetation classification and Green Fractional Cover:
RGB pictures [Liu et al. (2010)]



Multiple years GPP and ER models (2019-2025): RESULTS

LINEAR and NON LINEAR models

$$GPP = \frac{\alpha_0 Rad}{1 + \alpha_0 Rad / F_{max}} (1 + A_1 GFC) + \varepsilon$$

$$ER = (a_0 + a_1 VWC + a_2 GFC) \exp(b_0 T_s) + \varepsilon^{[1]}$$

$$GPP = \beta_0 + \beta_1 Rad + \beta_2 VWC + \beta_3 GFC + \varepsilon$$

$$ER = b_0 + b_1 SoilT + b_2 VWC + b_3 GFC$$

explained variance = 0.67 (non-linear) and 0.59 (linear)

explained variance = 0.54 (both models)

MAIN DRIVERS

PRIMARY
PRODUCTIVITY:

Solar Irradiance

Green Fractional Cover

Soil Moisture

+

RESPIRATION:

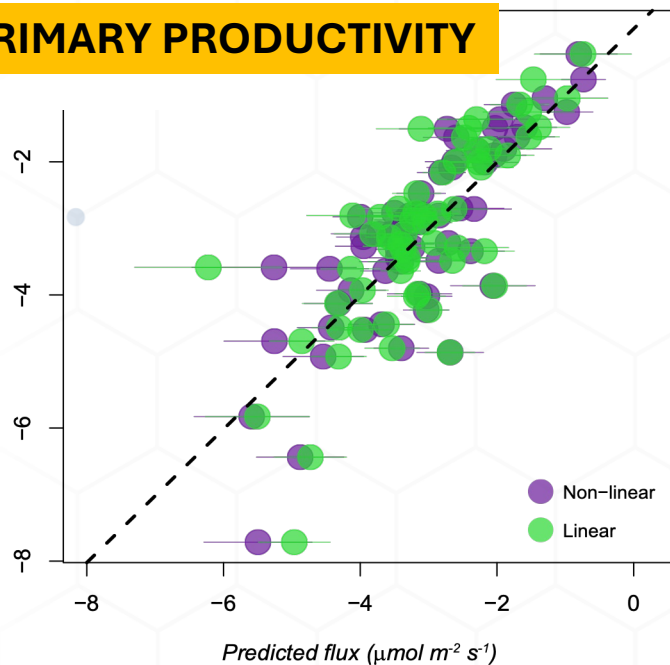
Soil Temperature

Multiple years GPP and ER models (2019-2025): RESULTS

LINEAR and NON LINEAR models

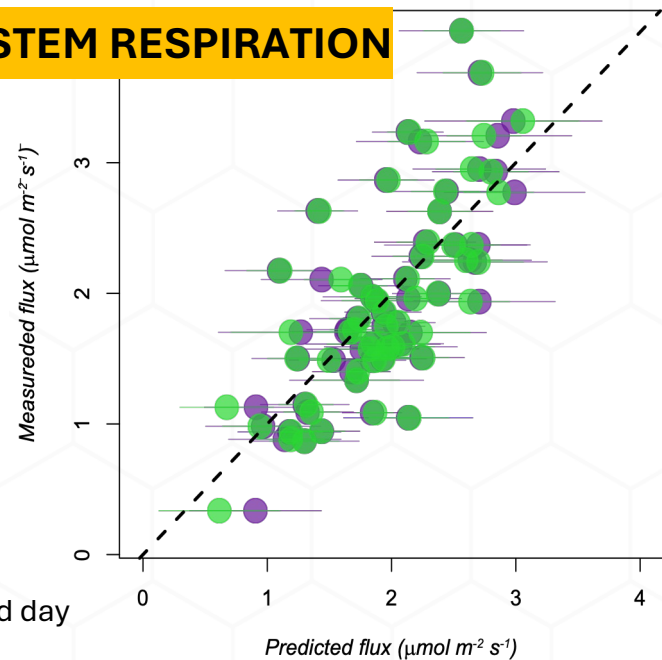
explained variance = 0.67 (non-linear) and 0.59 (linear)

PRIMARY PRODUCTIVITY



explained variance = 0.54 (both models)

ECOSYSTEM RESPIRATION



Data averaged per site and day

Linear and non-linear models provide similar results

Are ER and GPP drivers species-specific?

 Carex
 Dryas
 Salix
 Silene



Salix polaris (SL)



Carex Spp. (CX)



Silene acaulis (SI)



Dryas octopetala (DR)

work in progress

Are ER and GPP drivers species-specific?

This second part of the presentation shows preliminary results not published yet and therefore has been omitted.

If you need information about this part of our work, please contact
mariasilvia.giamberini@cnr.it

Thanks for your understanding

What's next?

Species-specific modelling

NON- LINEAR MODELLING

ROLE OF SPECIES PHENOLOGY



Widening the modelling perspective

PROCESS BASED MODELS: NUTRIENTS, MICROBIOLOGY, ALT

SPATIALLY EXPLICIT MODELLING: SPECTRAL
IMAGING, DRONES, REMOTE SENSING

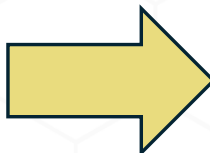


WHERE ARE THE DATA?

From data portals...



<https://zenodo.org/communities/igg-cnr-czo>



...To virtual research environments!



<https://data.iadc.cnr.it/>





Authors:

***Mariasilvia Giamberini
Silvana Goiran***

***Francesca Avogadro di Valdengo
Paola Forni
Marta Magnani
Silvio Marta
Antonello Provenzale***

THANK YOU!

Questions?

mariasilvia.giamberini@cnr.it

