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Evaluating modelled wetland methane emissions in Northern Europe

T. Aalto, A. Tsuruta, E. Burke, S. Chadburn, Y. Gao, V. Kangasaho, T. Kleinen, H. Lee, A. Leppänen, S. Lienert, T. Markkanen, P. Miller, J. Mueller, J. Mäkelä, D. Peano, O. Peltola, M. Raivonen, M. Tenkanen, D. Wårlind & S. Zaehle

Thanks to Global Carbon Project Team for sharing emission data

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Wetland methane emissions

- The region of Fennoscandia in Northern Europe is rich in wetlands
- Large monthly and year-to-year growing season differences in precipitation and temperature induce significant variation in regional CH4 emissions, which is challenging to reproduce by ecosystem models
- Here we compared temperature and precipitation responses of CRESCENDO model CH4 emissions to Global Carbon Project (GCP, Saunois et al., 2020) models, atmospheric inversions and upscaled flux observations (Peltola et al, 2019)

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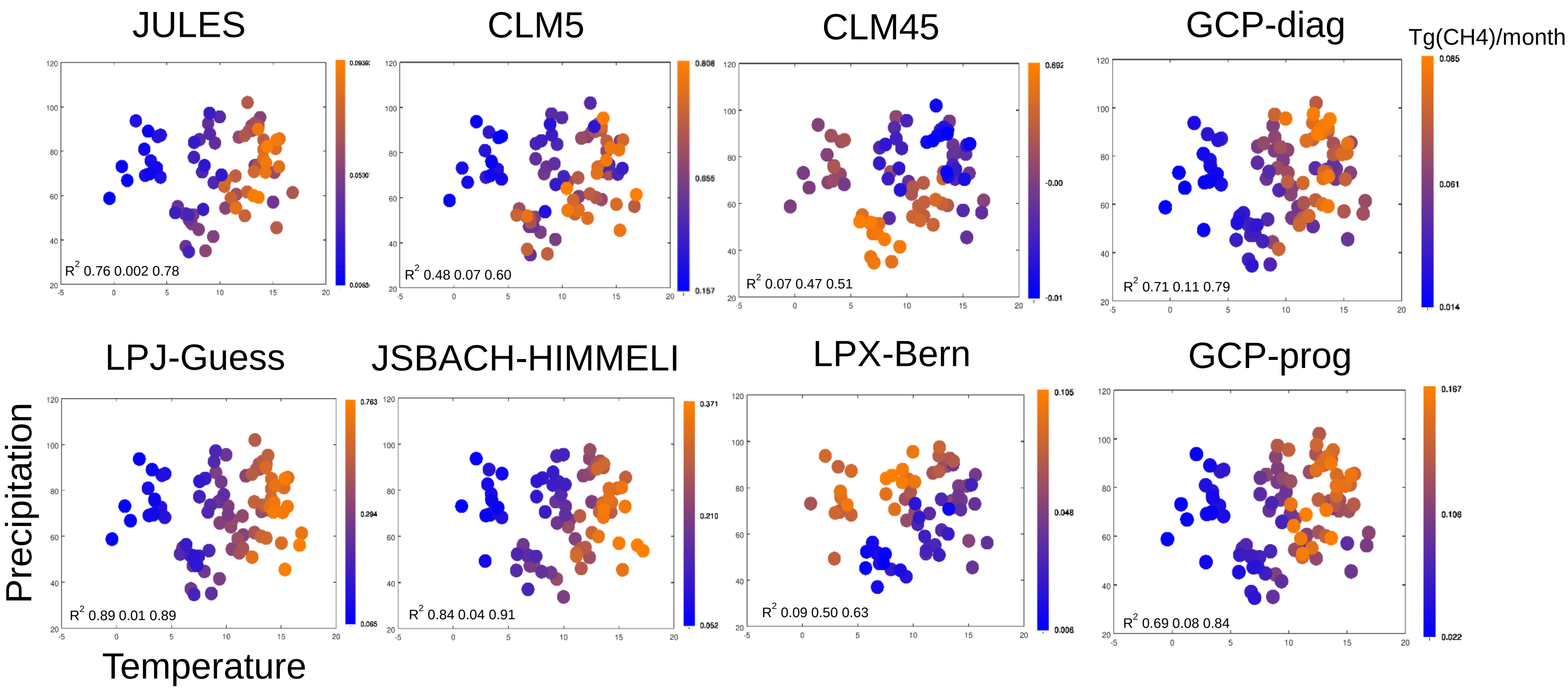
Ecosystem model CH4 emissions, precipitation and temperature



Circles: monthly averages May – October, 2000-2018, Region: Fennoscandia

R2 values: Variation in emissions explained by T, P, or T&P together

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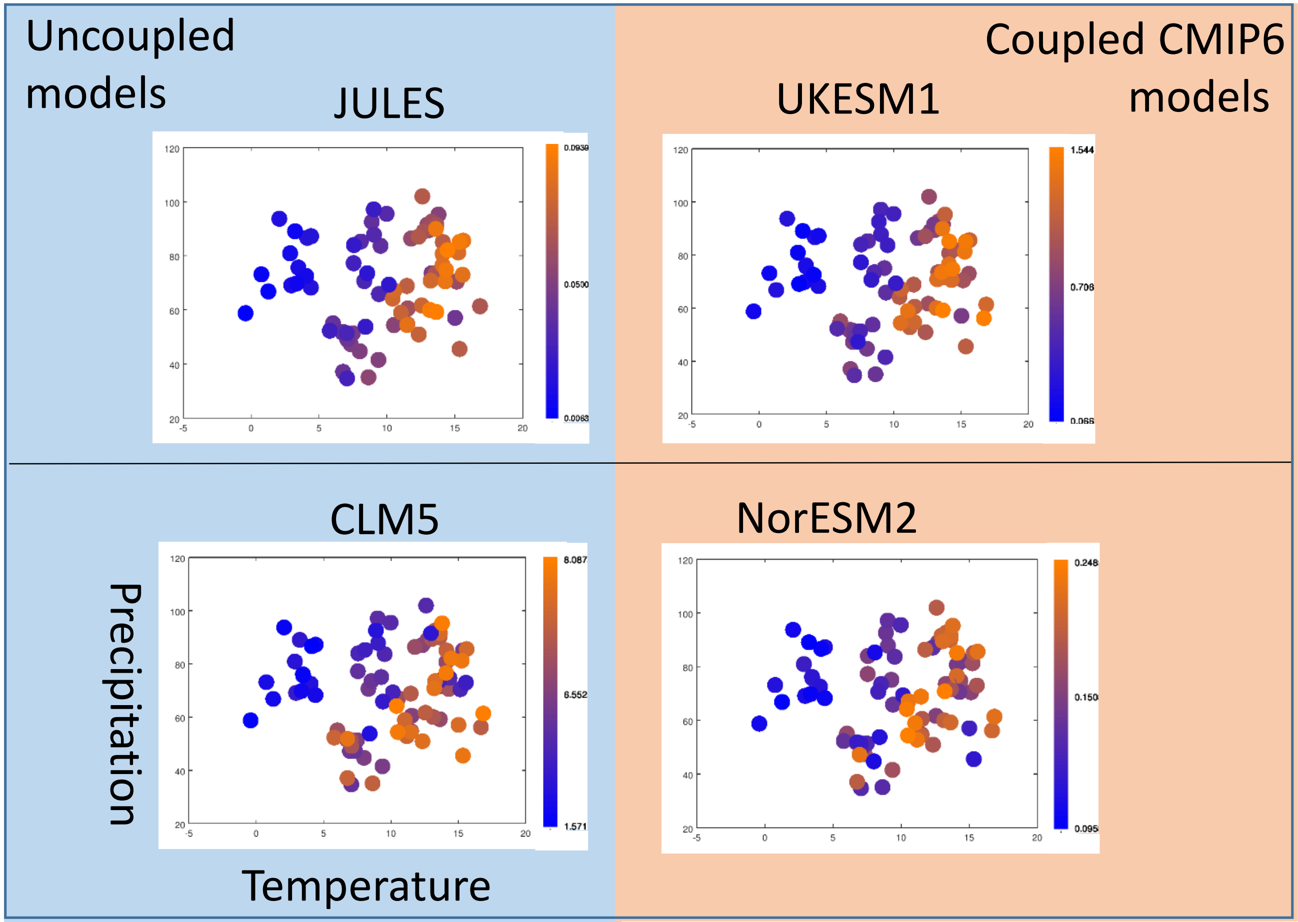
Ecosystem model CH_4 emissions, precipitation and temperature



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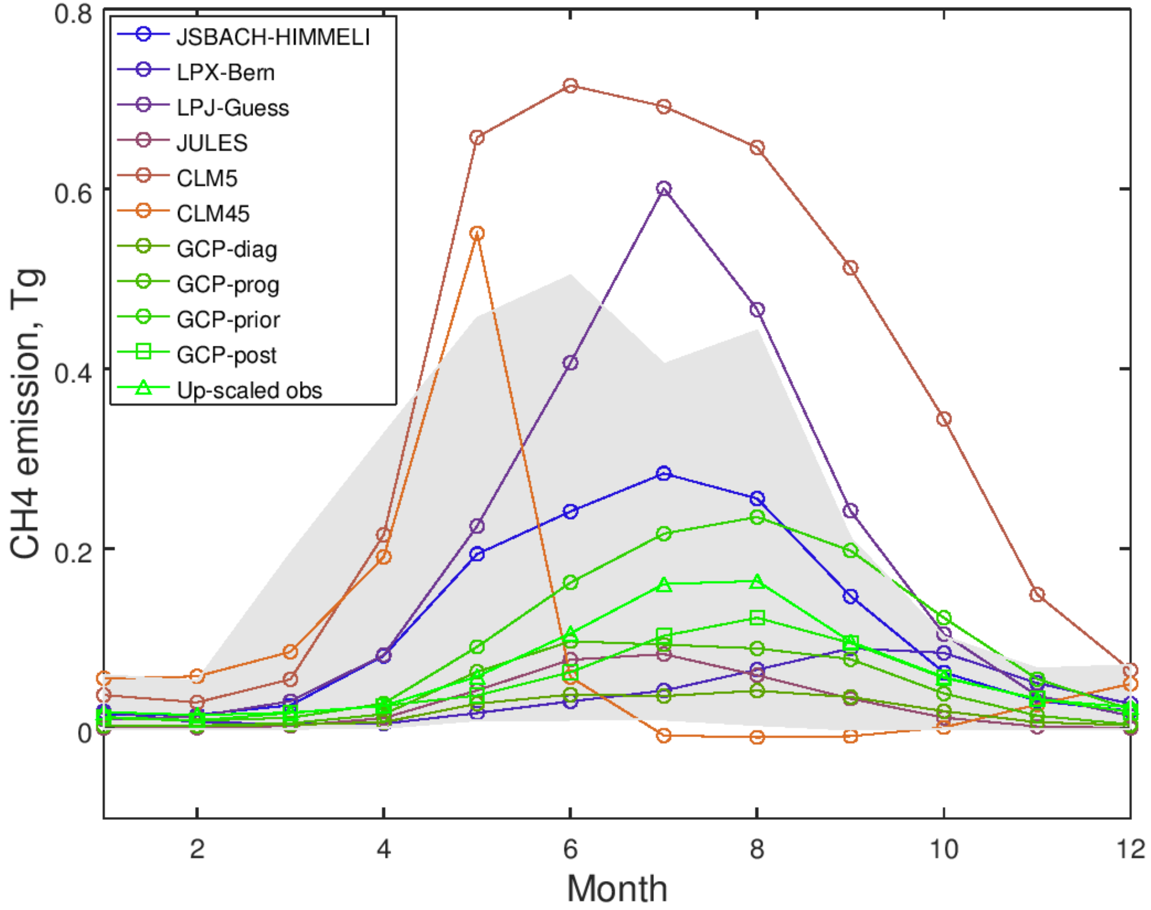
Seasonal cycle of CH4 emissions



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Ecosystem model CH_4 emissions

- High emissions were correlated with high temperature in JULES, LPJ-GUESS,JSBACH-HIMMELI and CLM5, and high precipitation in LPX-BERN

- The annual maximum was most often in July or August, but varied from May to September

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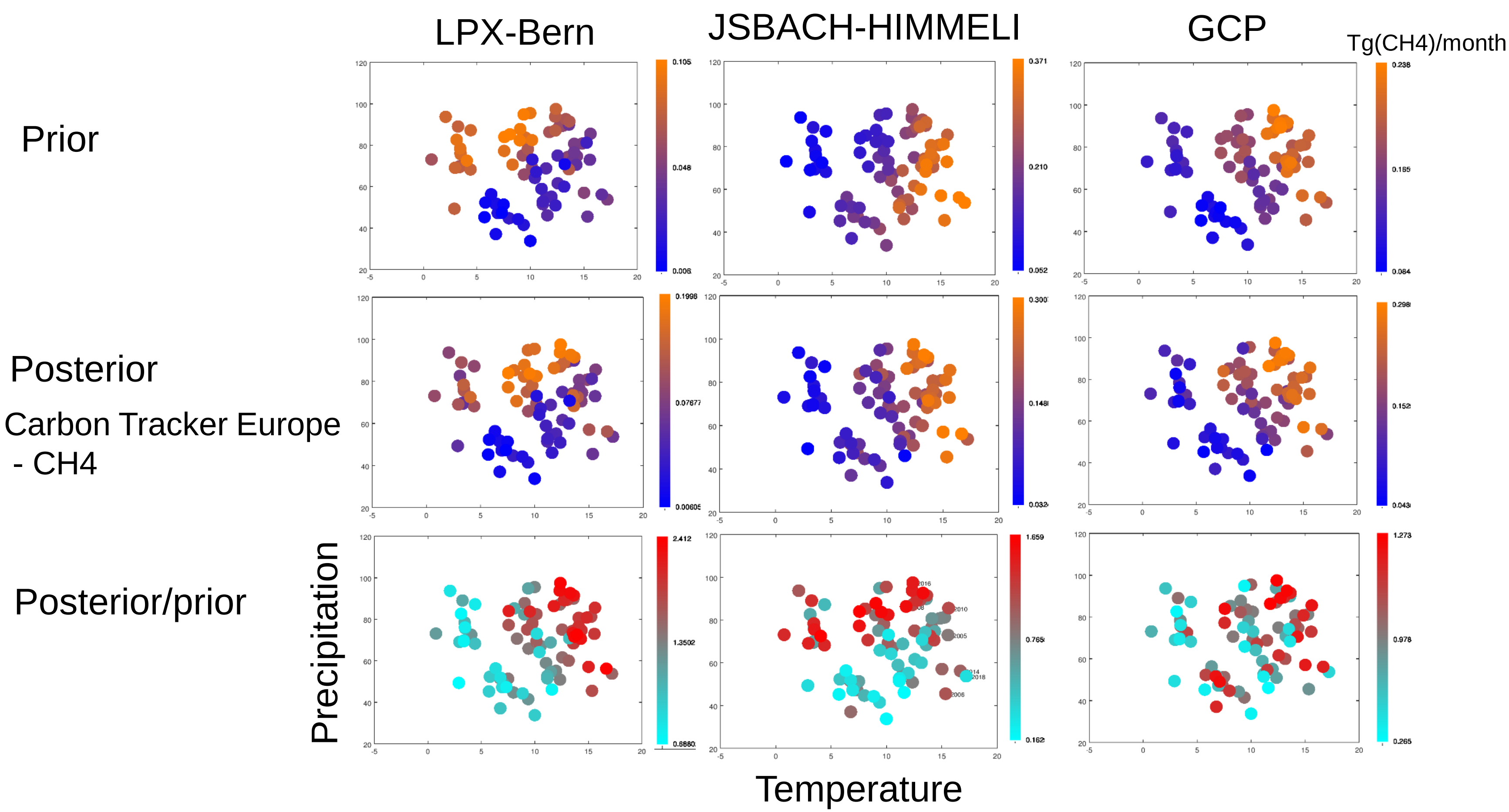
Atmospheric inverse modelling of CH4 emissions with different priors



Circles: monthly averages June – September, 2004 - 2018, Region: Fennoscandia

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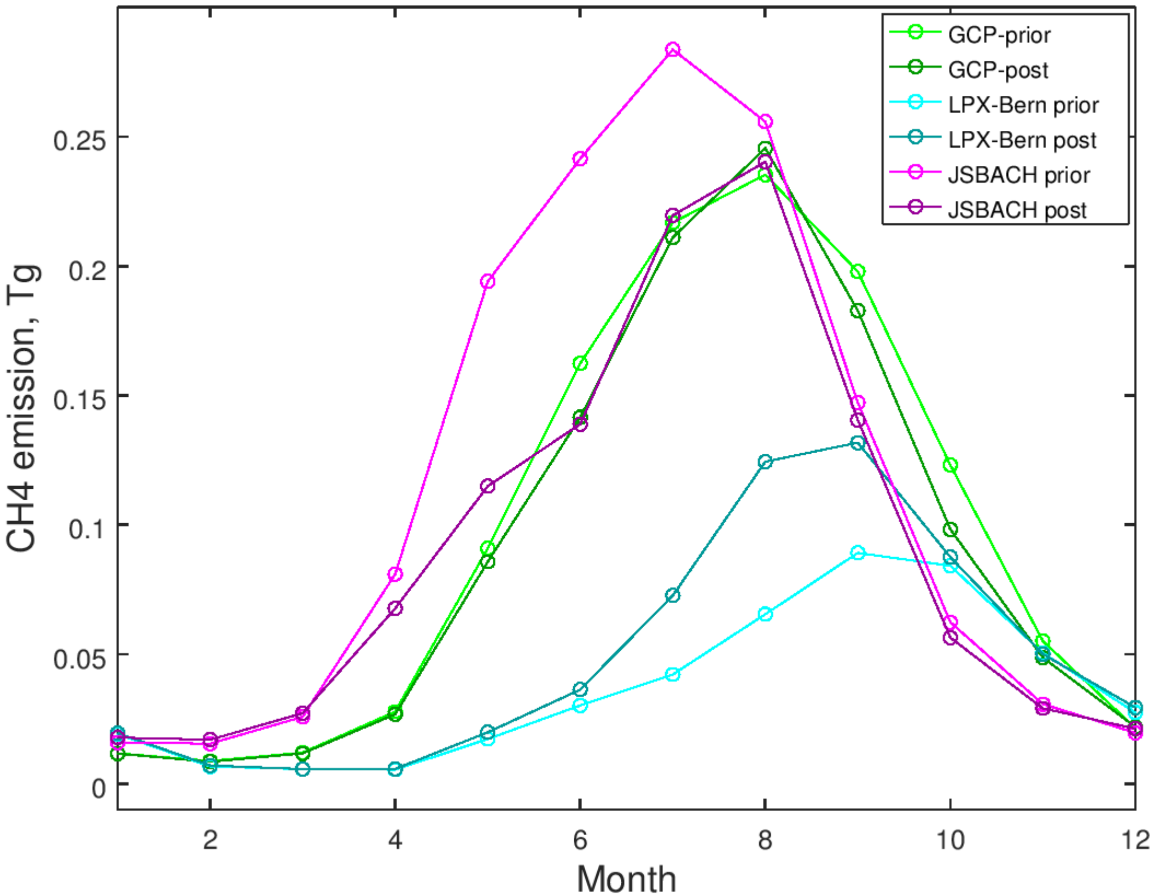
Prior and posterior seasonal cycles



Posterior simulations with
Carbon Tracker Europe - CH4 atmospheric inversion model

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Conclusions

- Ecosystem model CH_4 emissions were either temperature-driven or precipitation-driven, and inversions attempted to move the strongest responses towards co-limitation.
- The shape and maximum month of the annual emission cycle varied among ecosystem models, while inversions, GCP model ensembles and up-scaled flux observations suggested July-August as maximum
- Attention should be paid to the role of the individual emission components (peatlands, mineral lands), their magnitude and annual cycle

… checklist: soil moisture, water table levels, wetland area, peatland maps, soil carbon content and respiration, vegetation types and phenology, methane formation, oxidation and transport processes….

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