Seasonal controls on regional methane and carbon dioxide exchange observed from a very tall eddy covariance tower in a wetland-rich landscape

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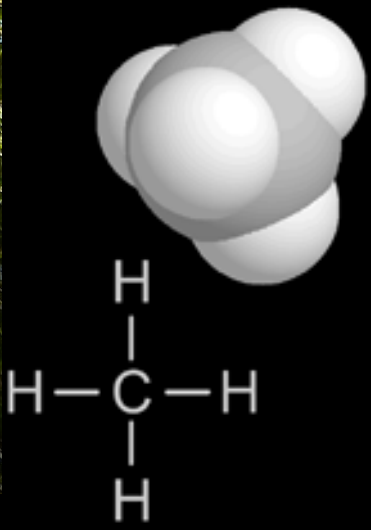
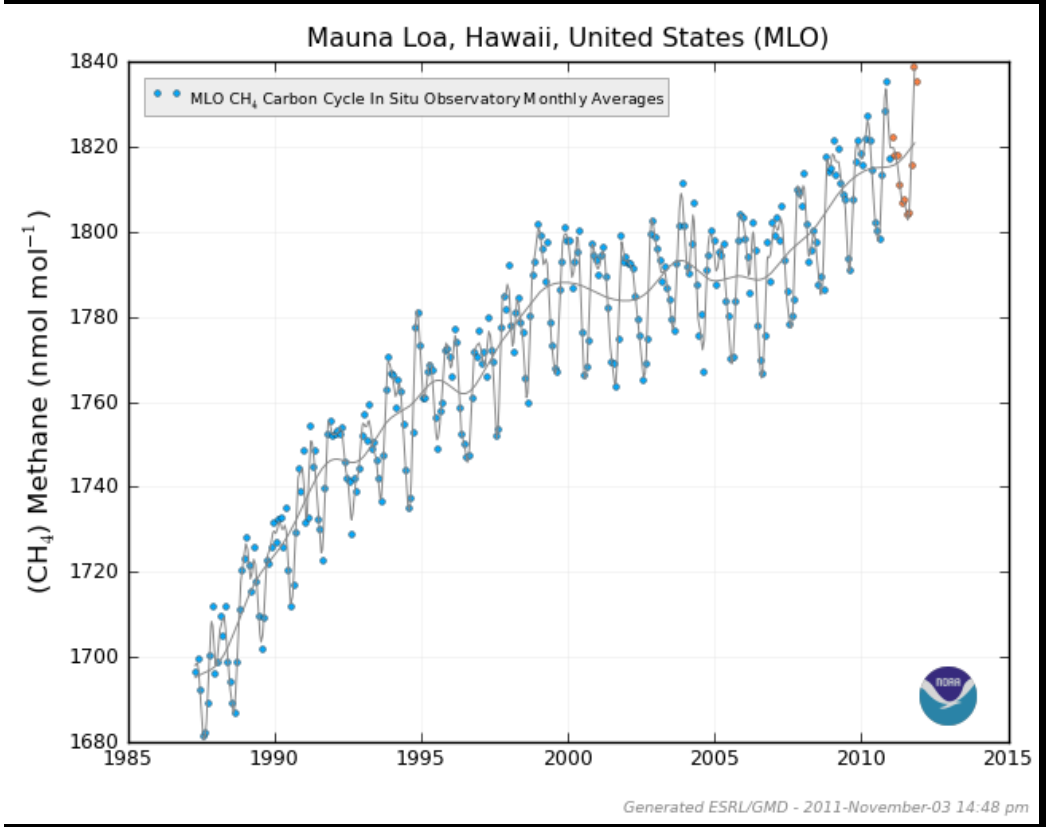
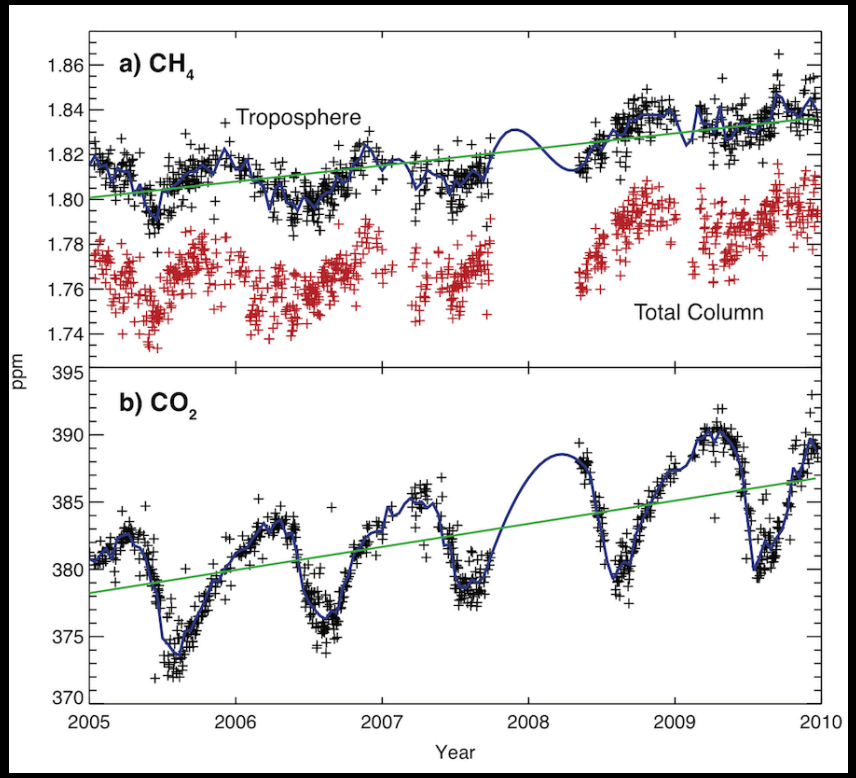


Methane concentrations continue to rise



Source: NOAA ESRL

Source: Park Falls TCCON (P. Wennberg)



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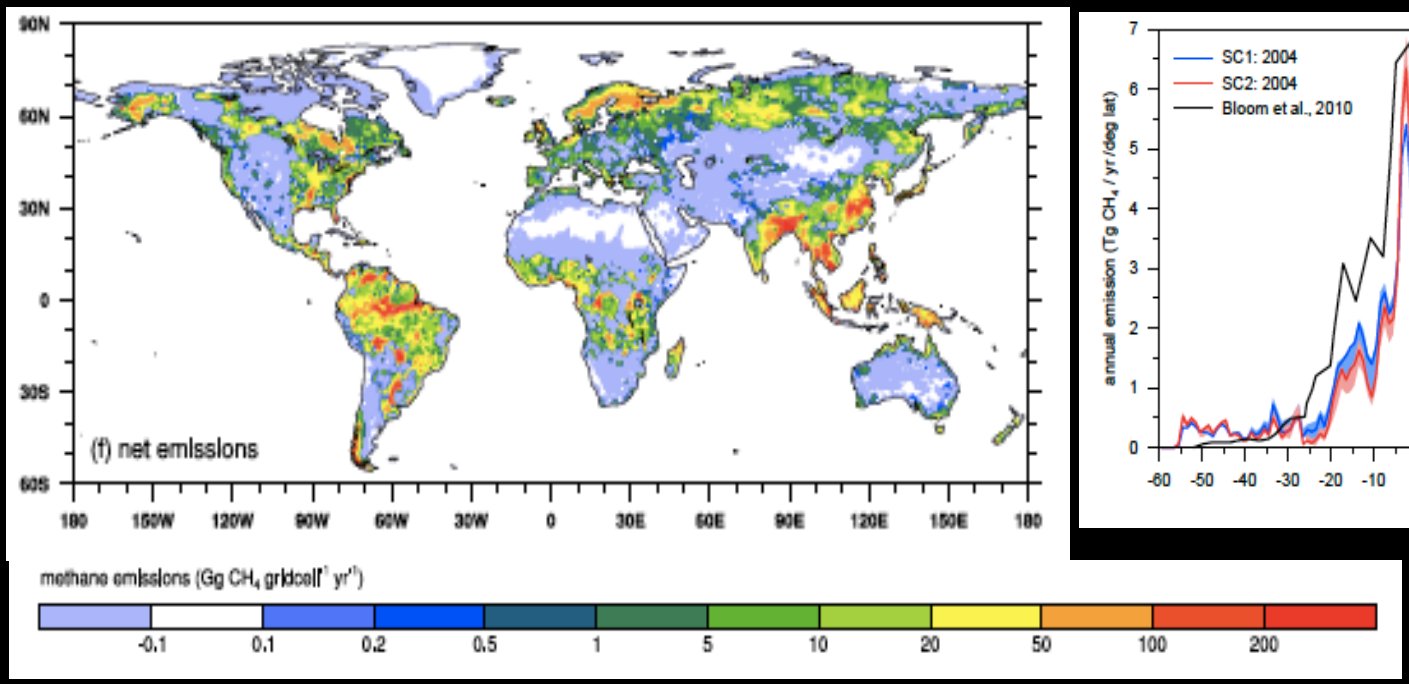
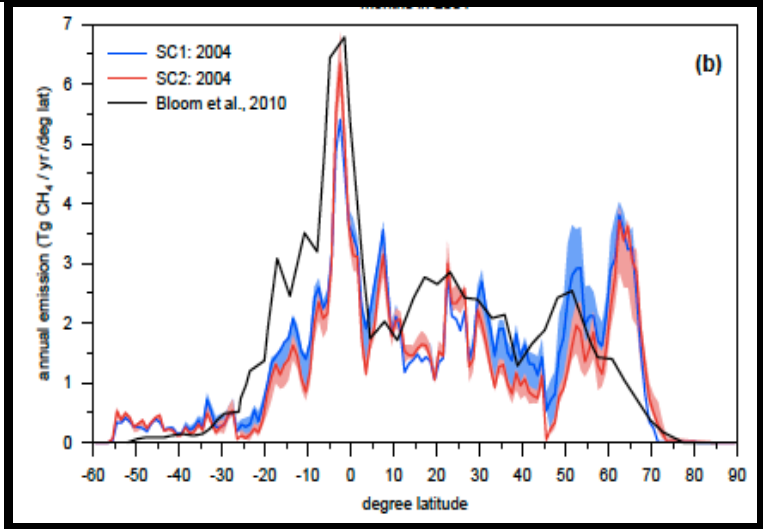
Sources and sinks of methane are not well quantified





Spahni et al. (2011) Biogeosciences

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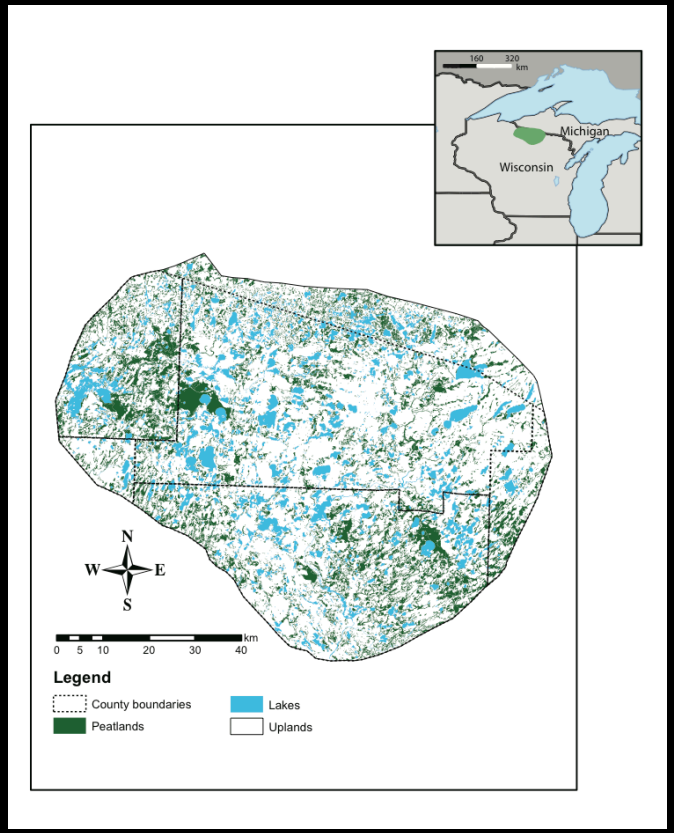
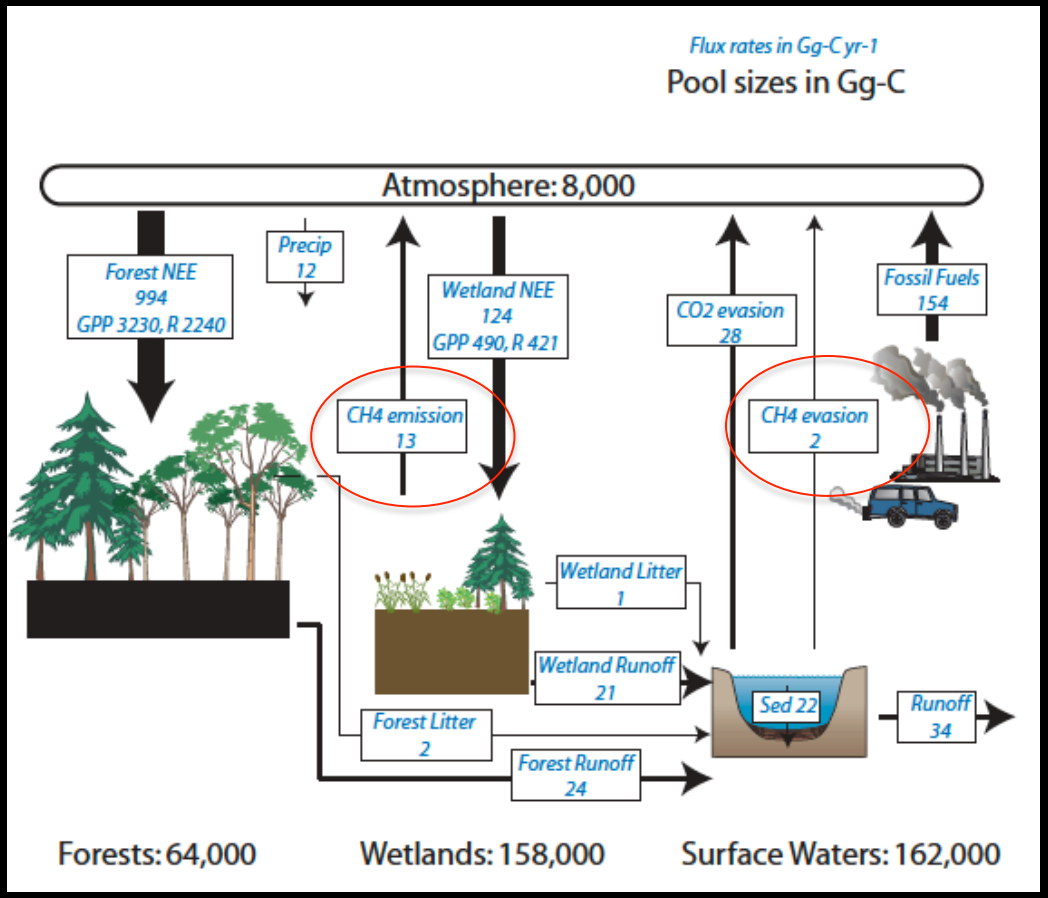
Wetlands are a primary source of methane emissions in temparate/boreal regions





Buffam et al (2011) Global Change Biology

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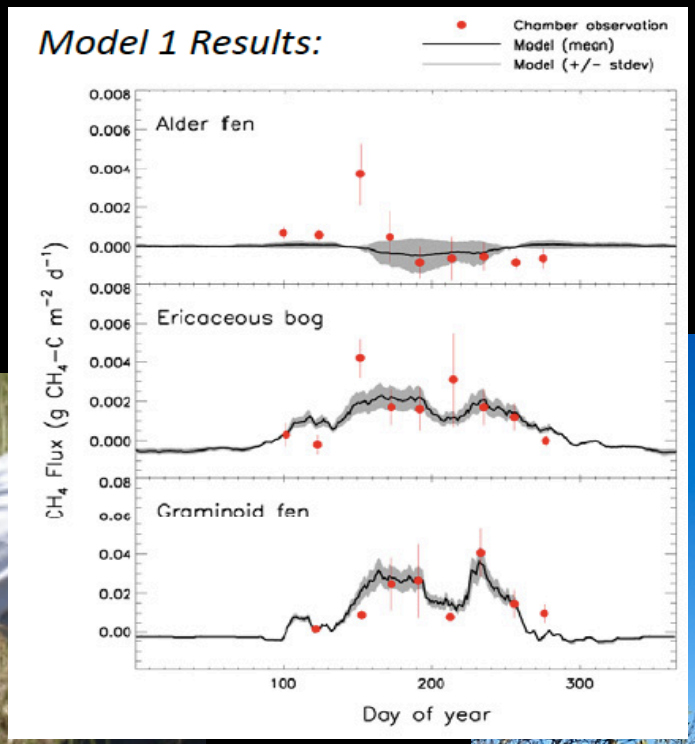
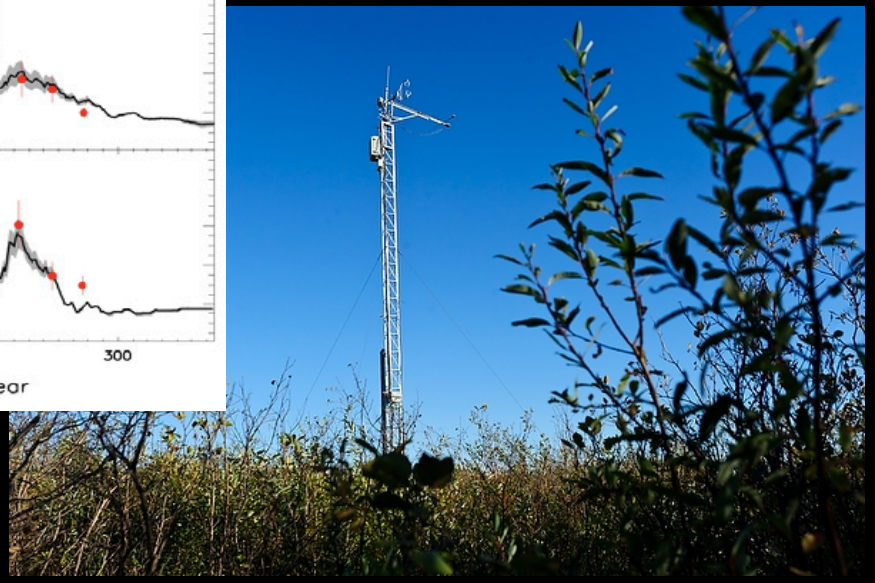
Evaluation of regional fluxes difficult with small towers and chambers



Source:
Cook et al (2008) AGU Poster

Credit: P. Weishampel



Credit: B. Rychter

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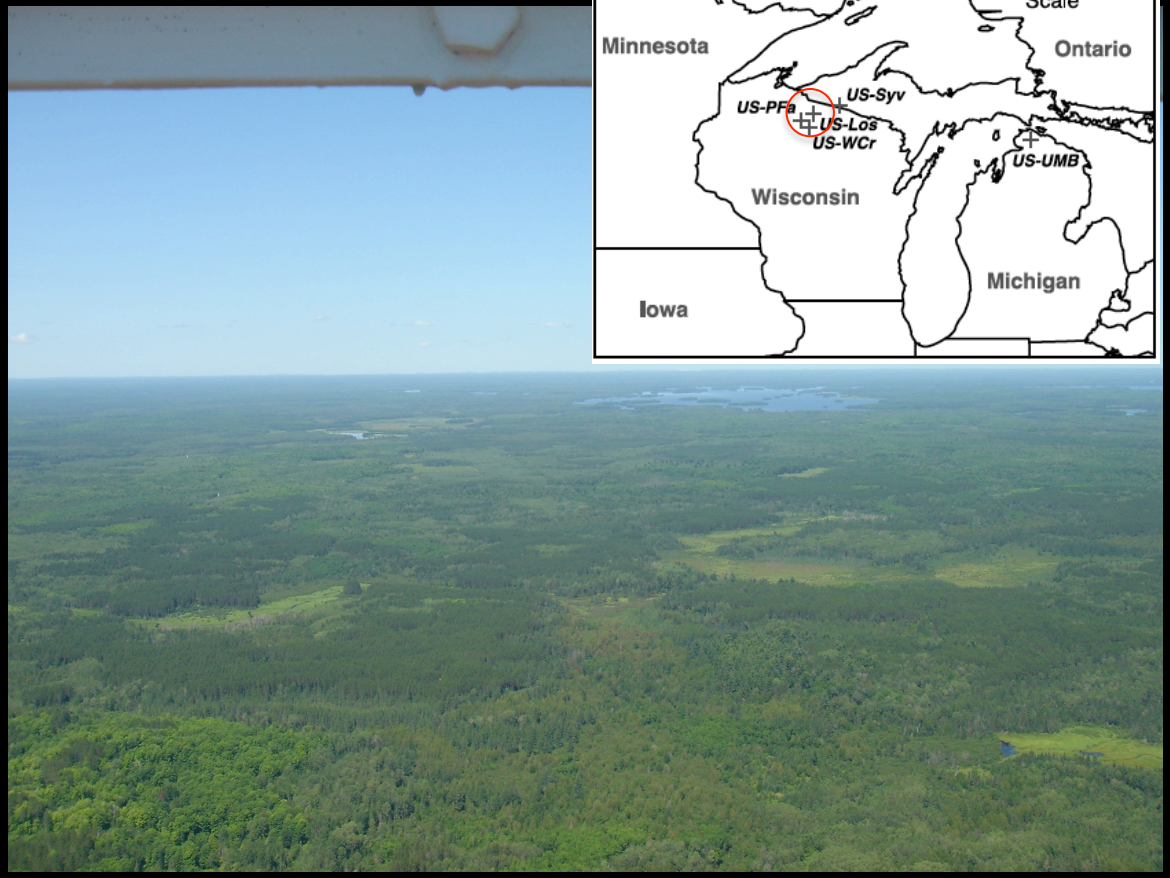
Tall towers offer novel approach to estimating regional fluxes

Credit: M. Rydzik



Source: B. Cook

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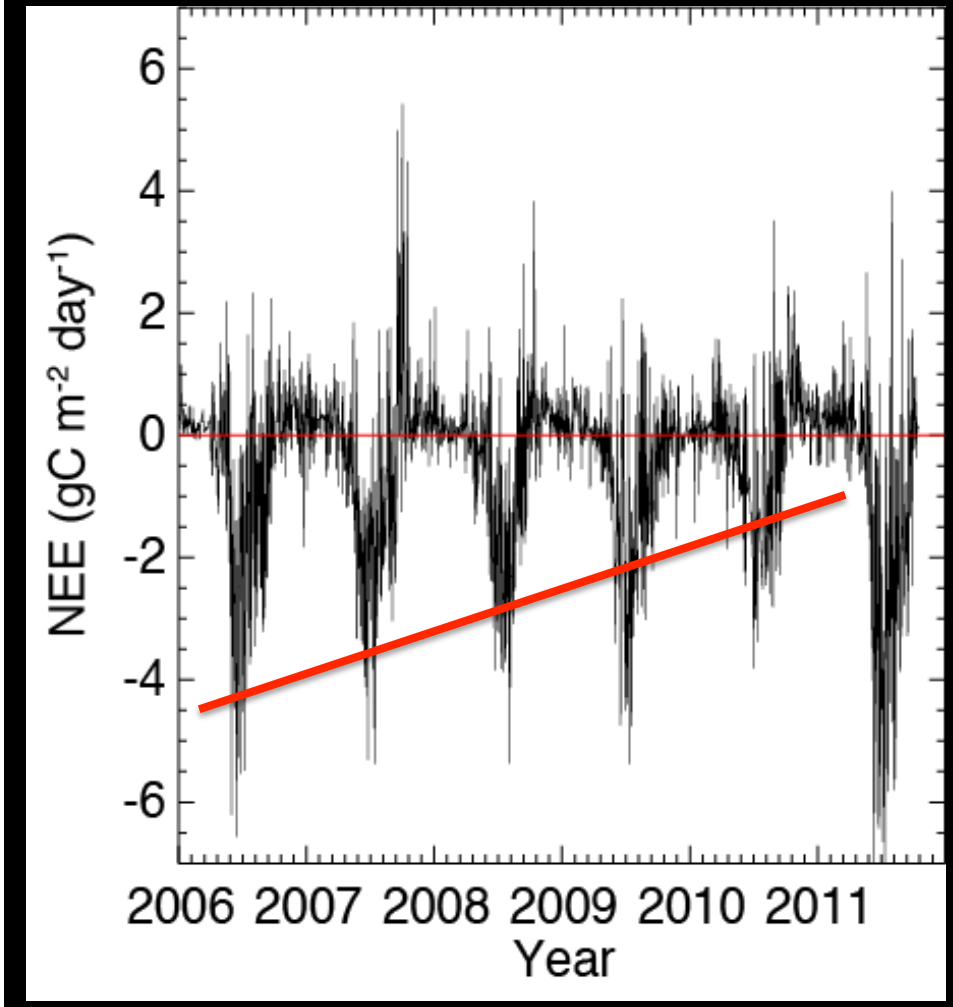
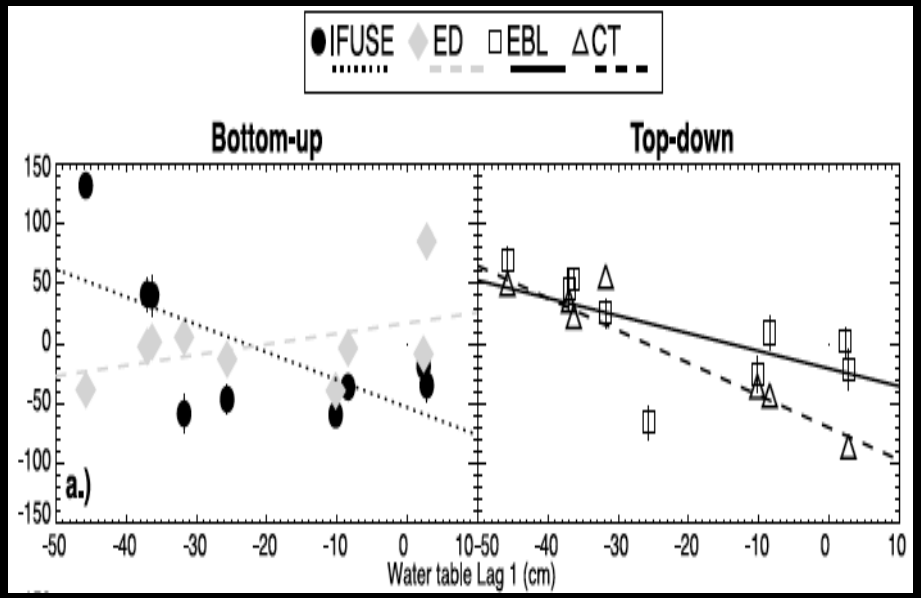
Long term CO_2 flux record reveals moisture controls on regional flux

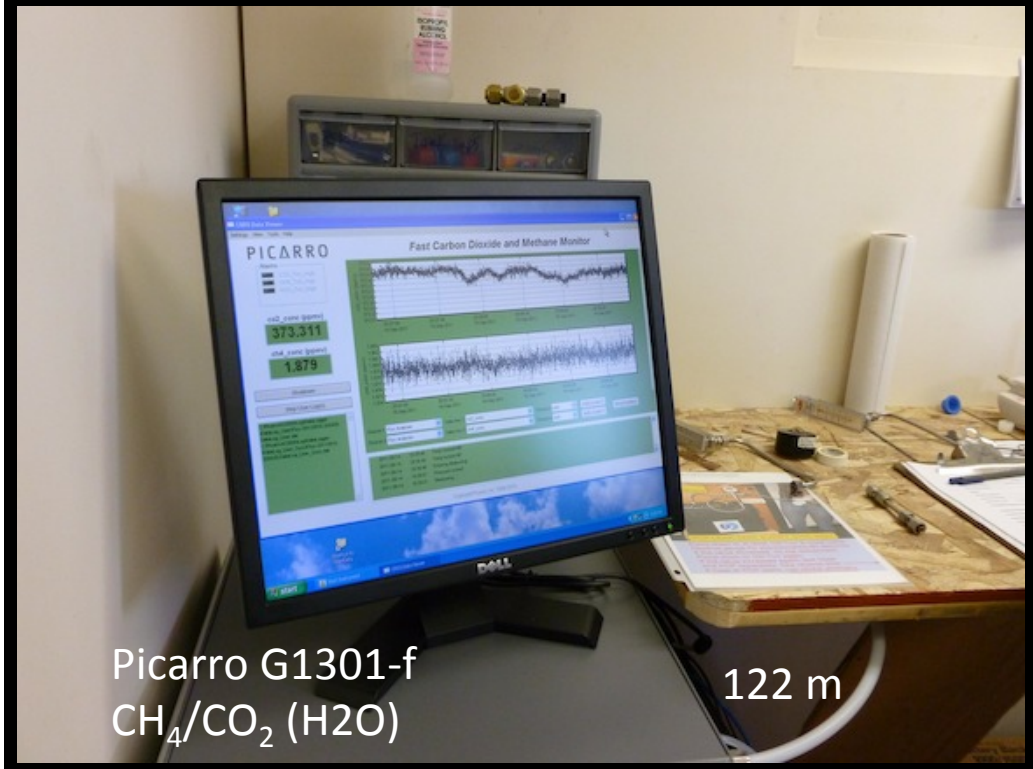




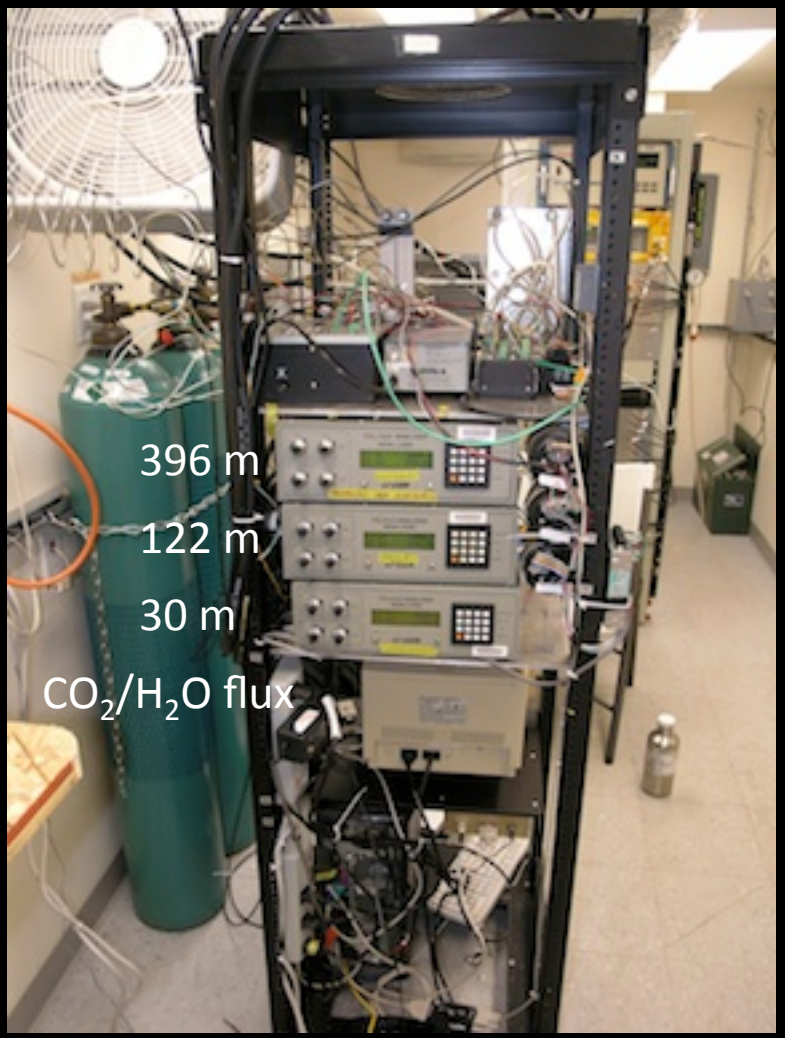
Desai et al (2010) JGR-G

AGU Fall 2011 B13J-03 (Desai)

Long-term continuous CH_4 eddy covariance is now feasible



Credit: M. Rydzik



Not shown: Los Gatos for CH_4 profile/storage flux
LI-7000 (NOAA) for CO2 profile/storage

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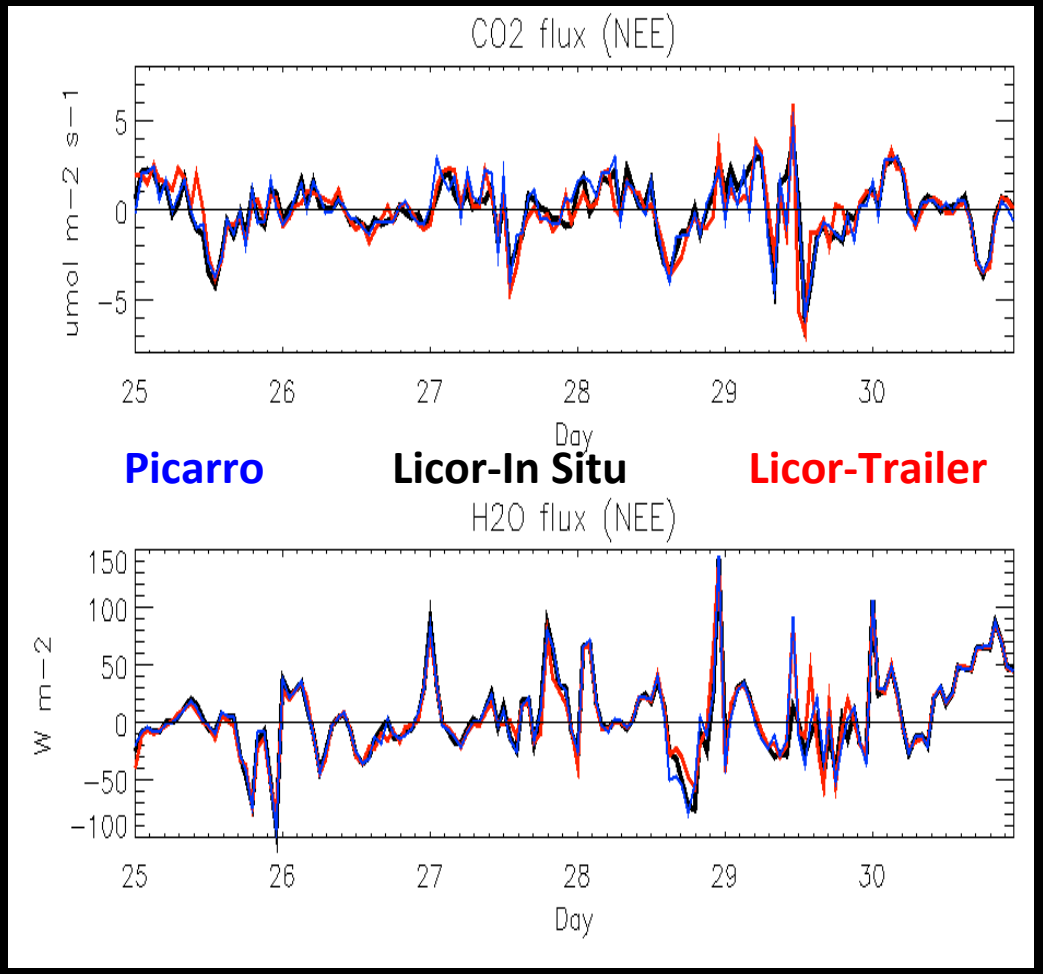
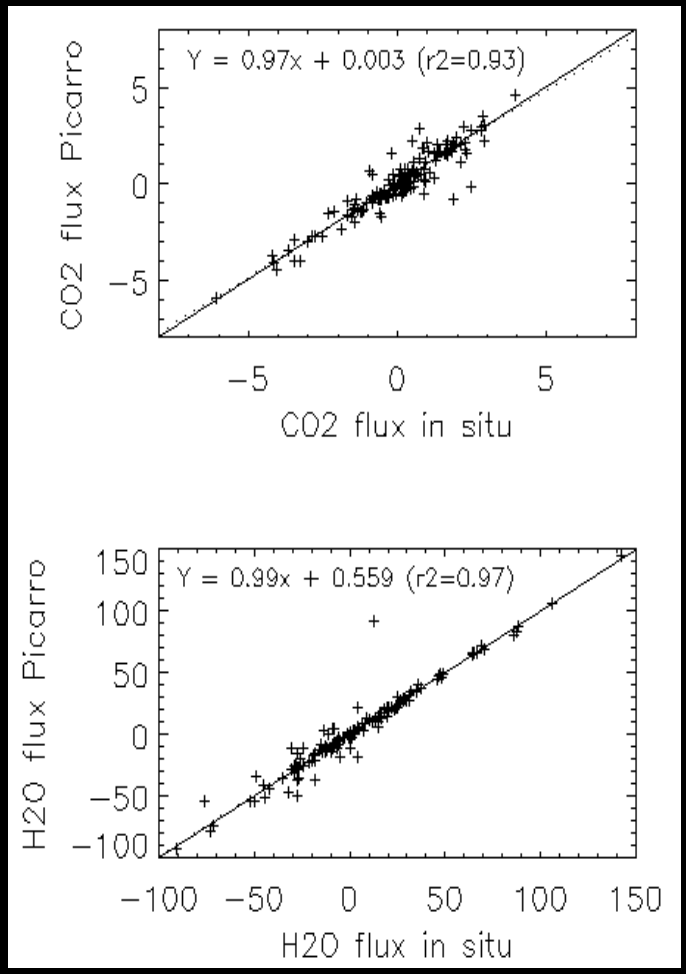
New instrument CO_2 and H_2O fluxes compare well to existing instruments





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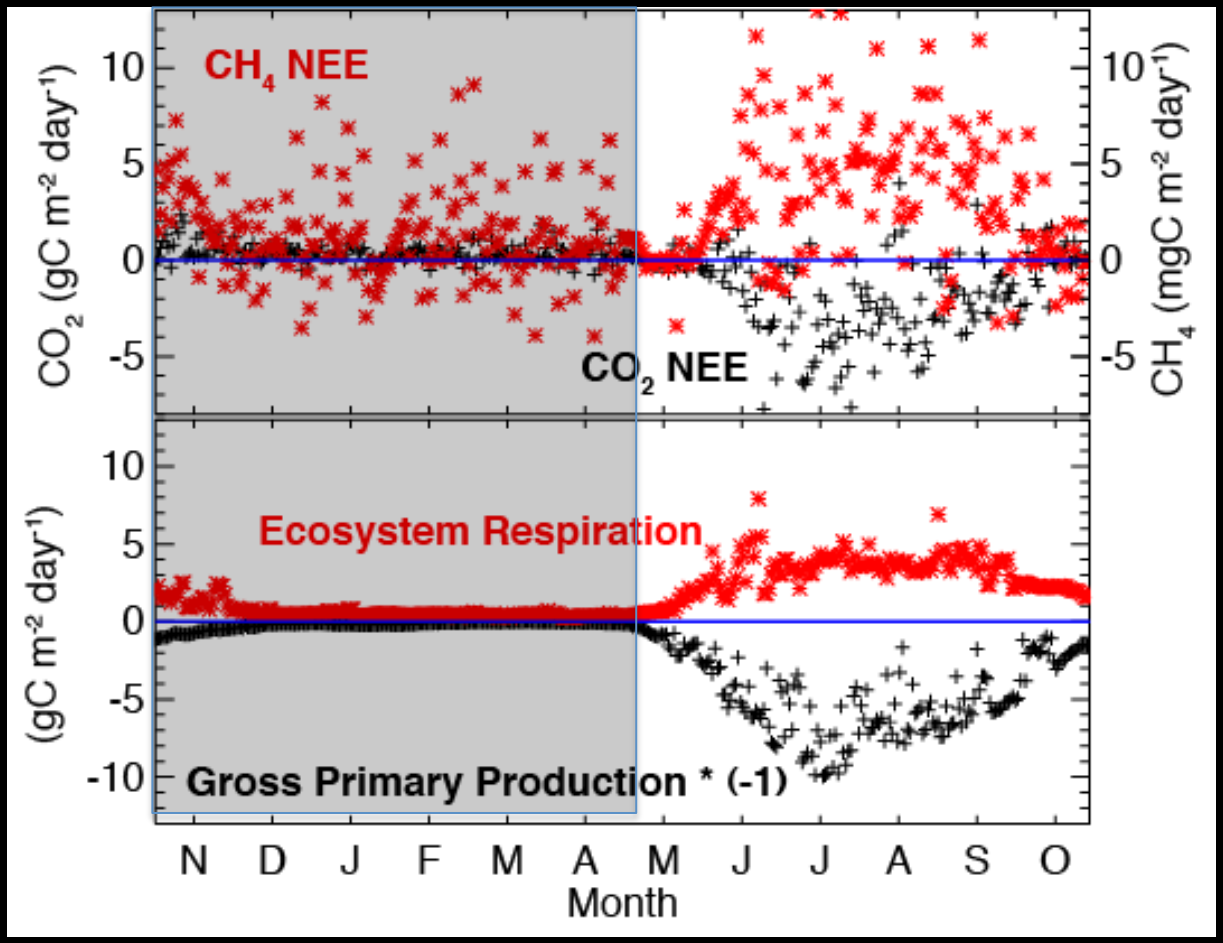
Comparison of CH_4 and CO_2 fluxes reveal stark differences by season

15 Oct 2010-
14 Oct 2011



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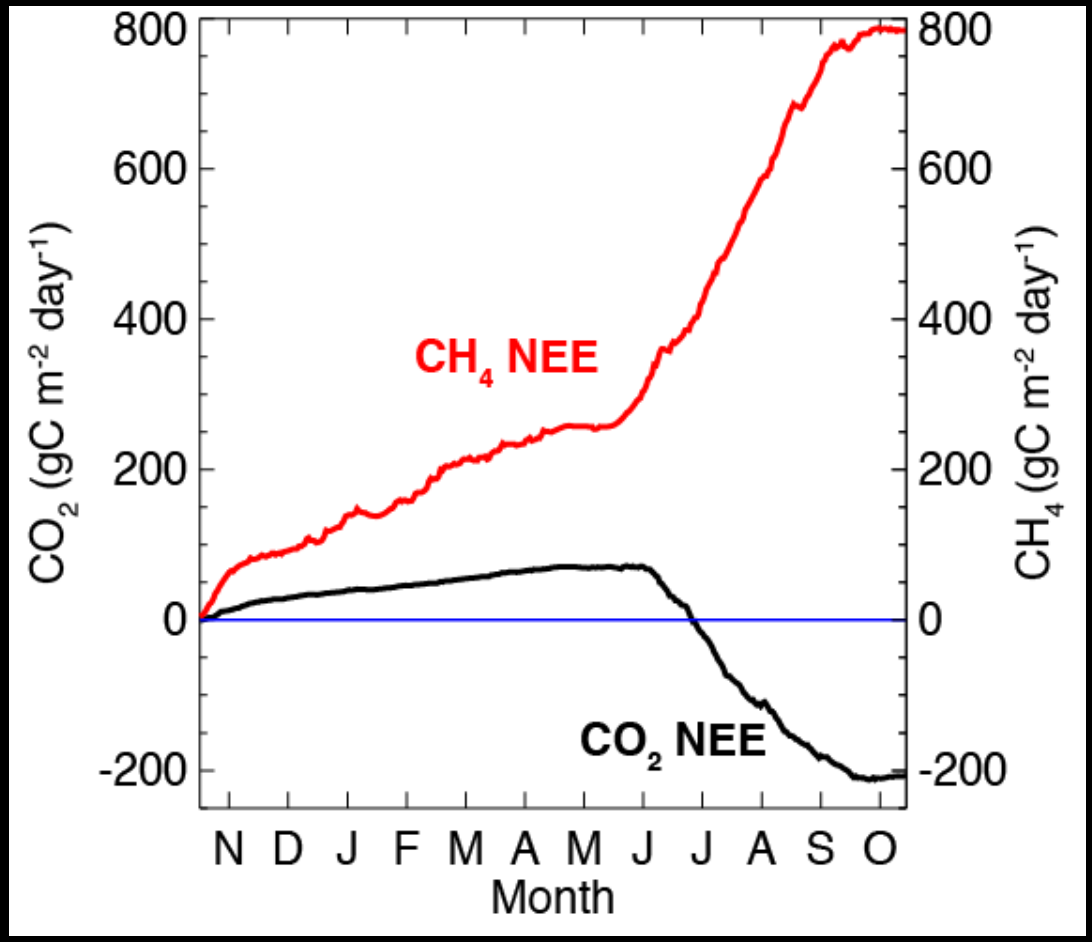
Large wintertime CH_4 emissions influence cumulative exchange



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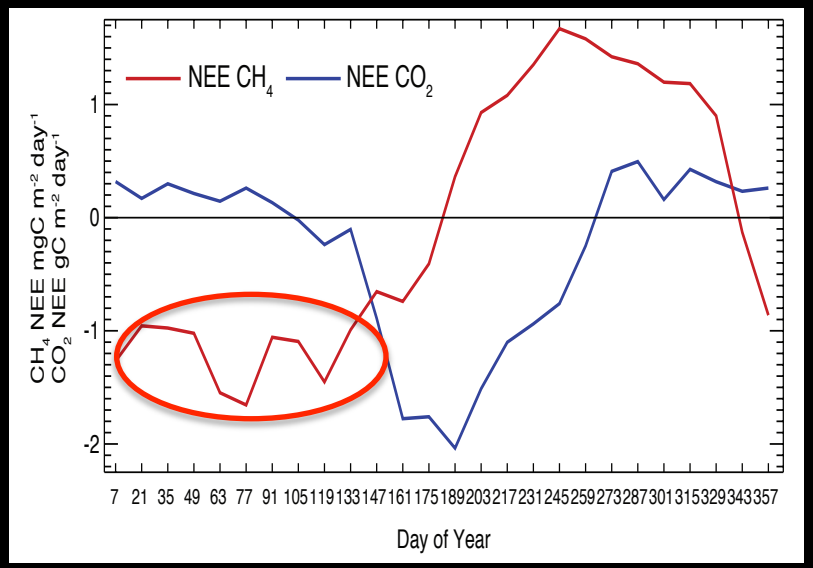
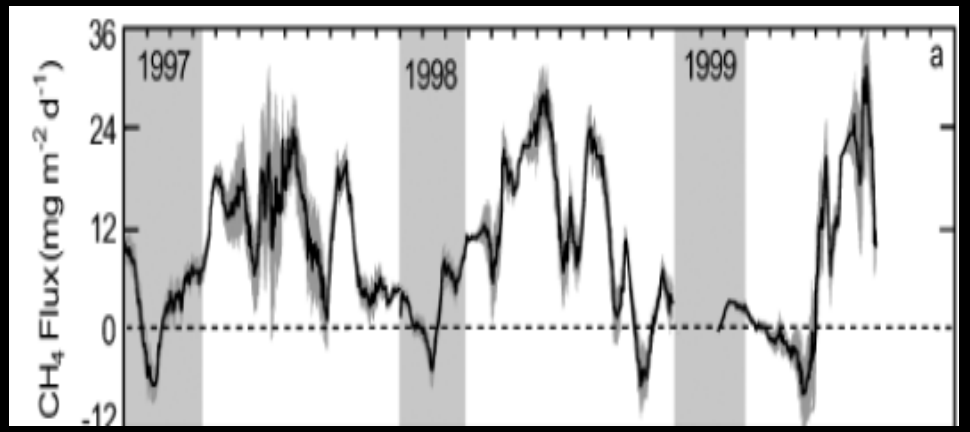
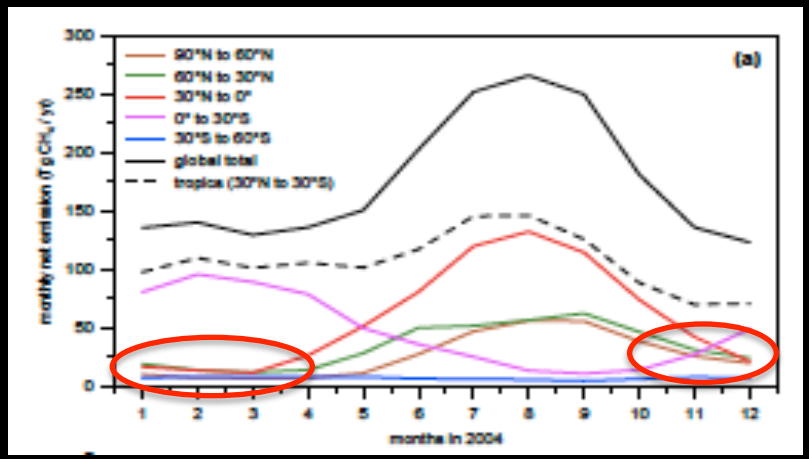
Modeled CH_4 fluxes for this region do not show these large emissions



Desai et al (2011) NACP Mtg.
Based on TCCON column observations



Werner et al (2003)
Based on tall tower flask/GC concentration gradient



Spahni et al. (2011) Biogeosciences
Modeled (LPJ) zonal seasonal cycles

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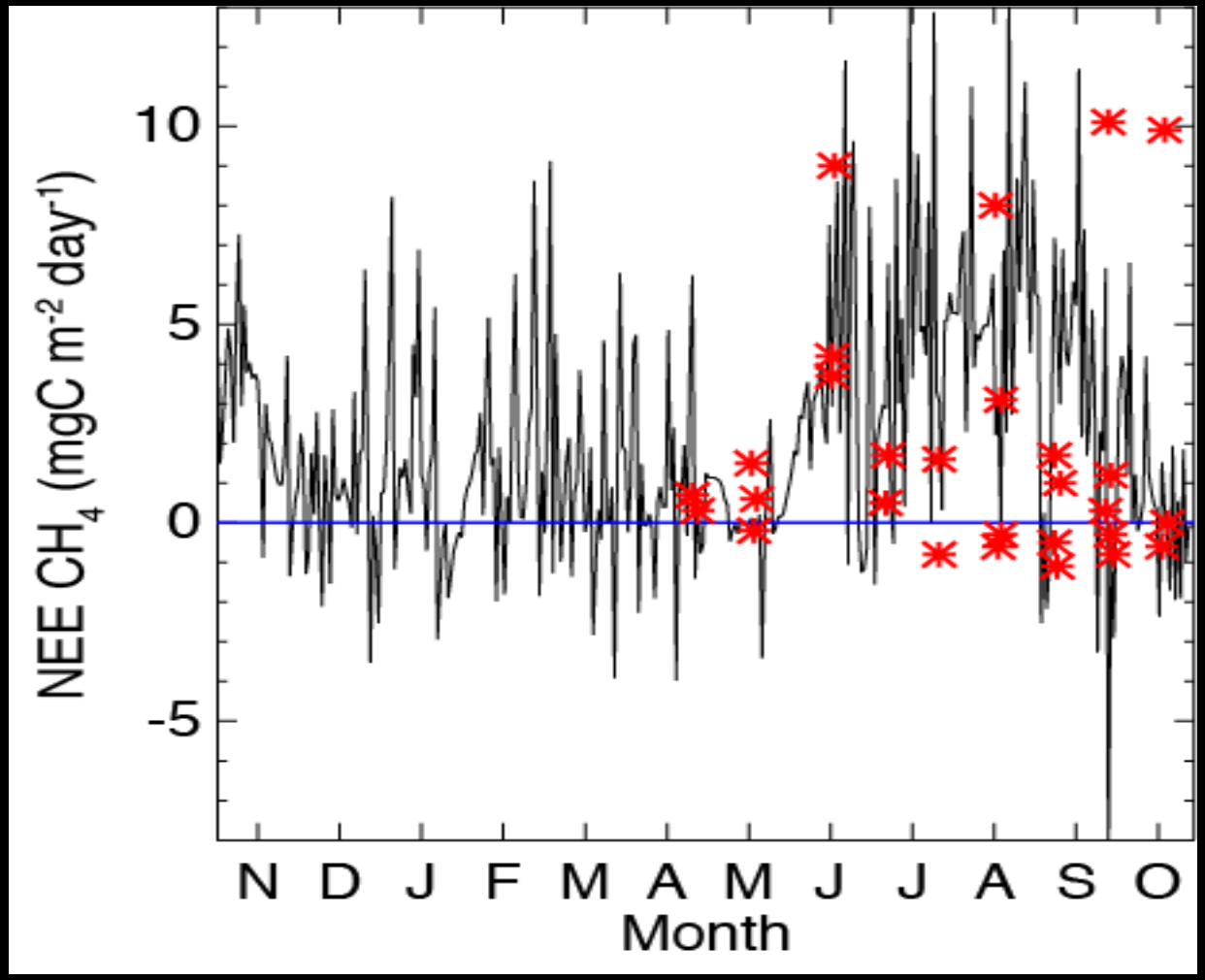
Flux magnitudes similar to chamber-based emissions made in nearby fens and bogs



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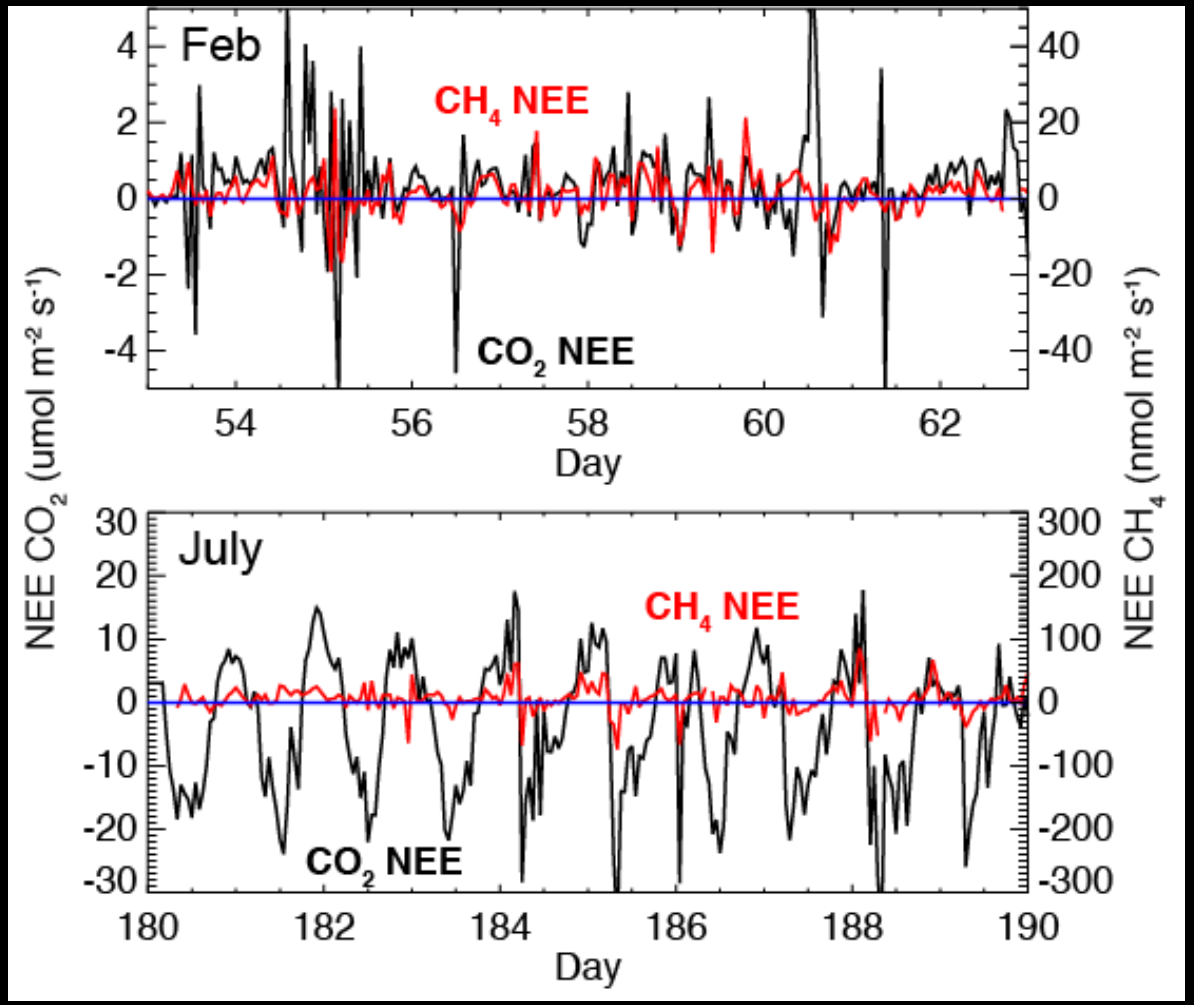
Similarity seen in diurnal cycles of hourly NEE but CO_2/CH_4 NEE ratio increases from winter to summer



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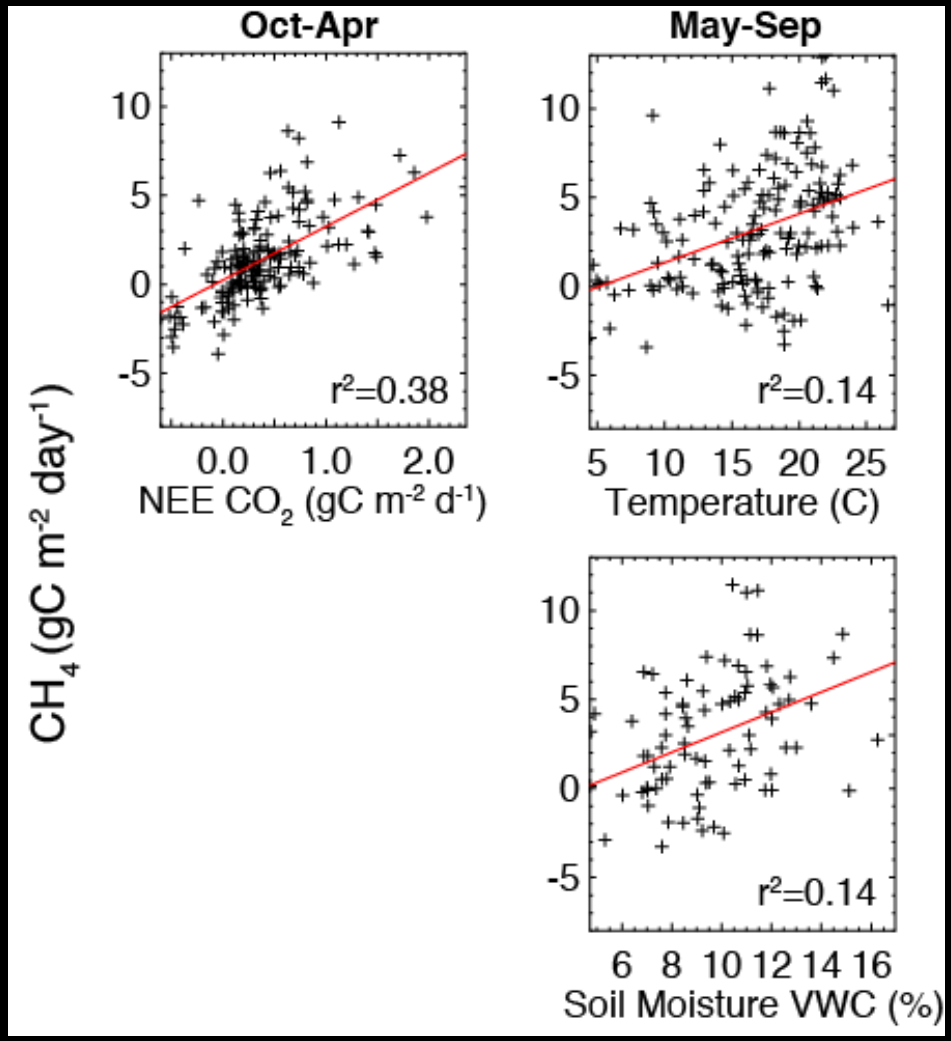
Environmental controls of CH_4 fluxes vary by season

- Correlated daily CH_4 flux to:
  - Air temperature
  - Incoming PAR
  - Precipitation (summer only)
  - NEE CO_2
  - ER and GPP
  - COSMOS regional soil moisture (summer only)
- Strongest fits shown on right



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Clearly, more investigation is needed on wintertime CH4 emissions

- Need to assess flux computation, correction and gap-filling routines for CH_4 flux
  - Small methane fluxes require tests on limits of detection, spectral loss
- Spatial scale likely has a large influence on observed or modeled flux
- Chamber flux campaign experiments need to be made in late fall/winter on role of under snow CO_2 and CH_4 emissions

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Thank you!

- NSF CAREER DEB #0845166
- WLEF/ Park Falls (US-PFa) tall tower research partners: NOAA ESRL (A. Andrews, J. Kofler), USFS NRS (M. Kubiske, D. Baumann), Penn State (K. Davis), Cal Tech (P. Wennberg), COSMOS (M. Zreda), NASA GSFC (B. Cook), WI ECB (J. Ayers) , Ameriflux
- Desai lab at UW: J. Thom, K. Jimenez, B. Brooks

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