



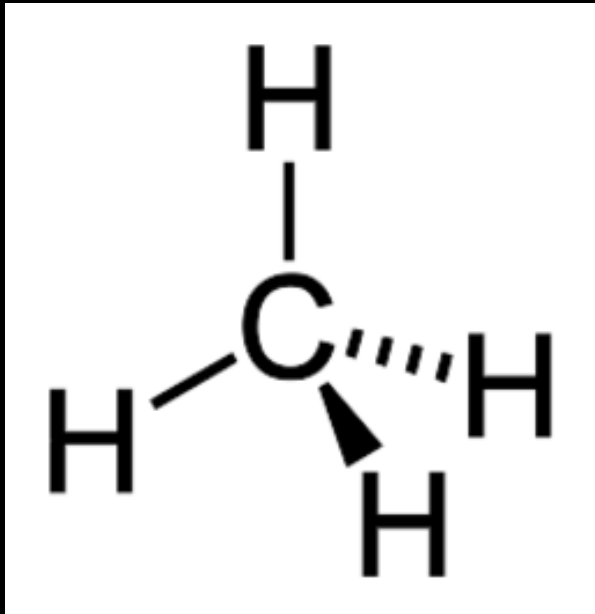
AHHHHH!

METHANE:

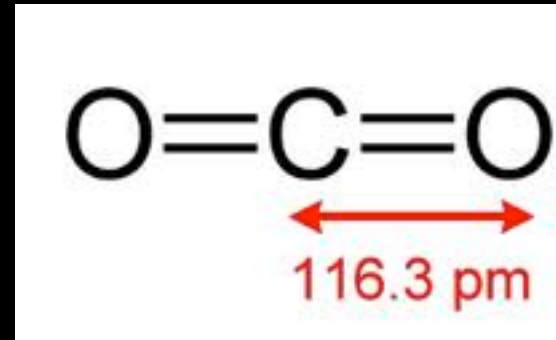
It's more than just cow farts

Ankur R Desai
Wisconsin Ecology
Fall 2012 Symposium

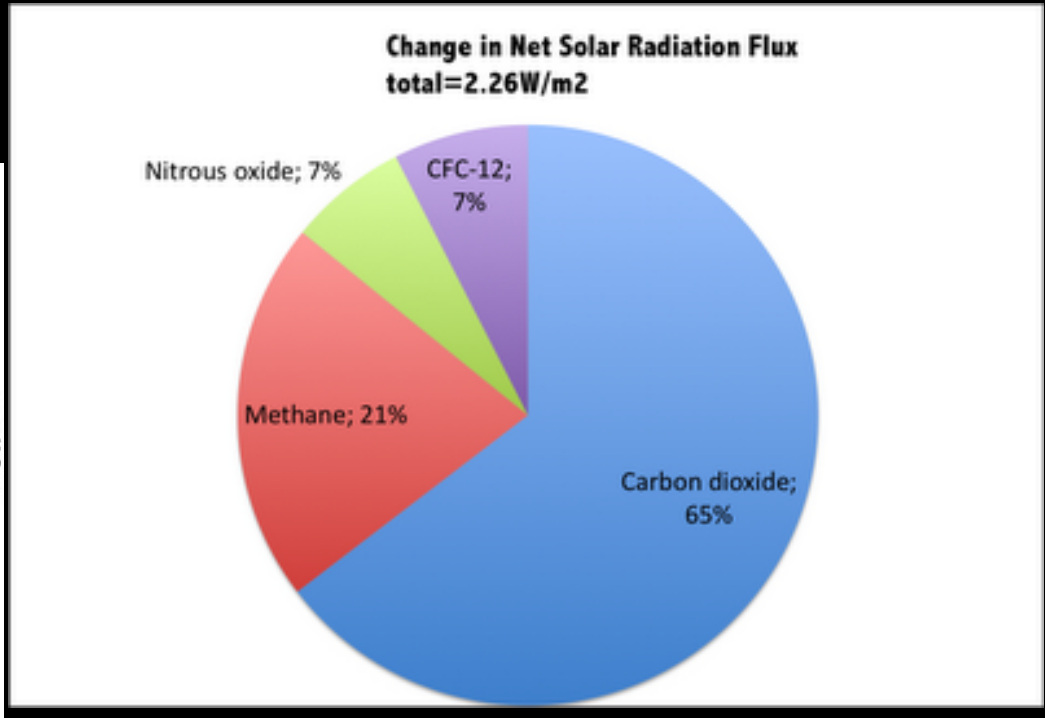
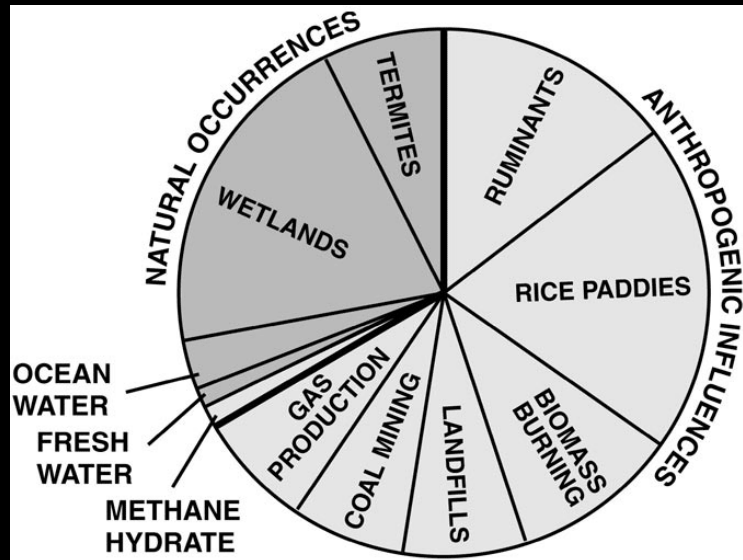
<http://purefixion.com/attention/2006/03/cow-farts.html>



Methane
1.8 ppm



Carbon Dioxide
393 ppm



Willow Creek - NetCam SC IR - Thu Sep 20 11:31:17 2012
Temperature: 36.0 °C internal, 9.0 °C outside
RH: 0%, Pressure: 944.0 millibars
Exposure: 400

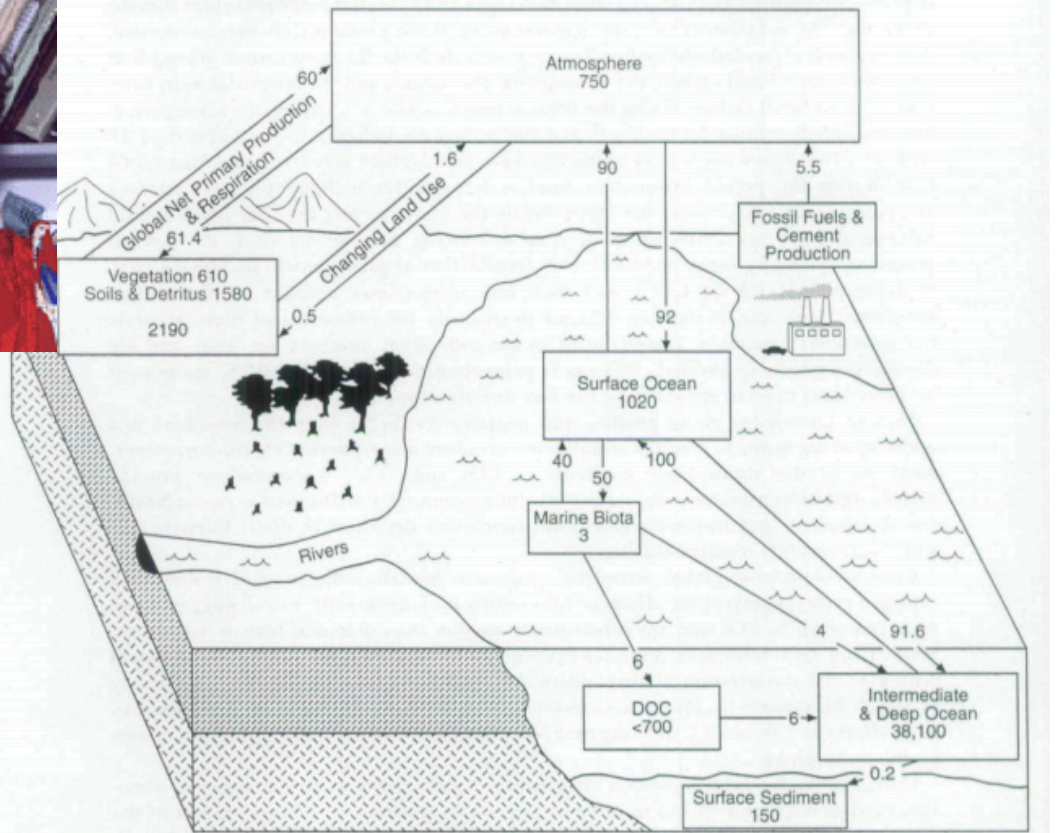
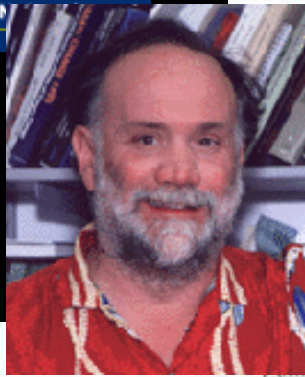
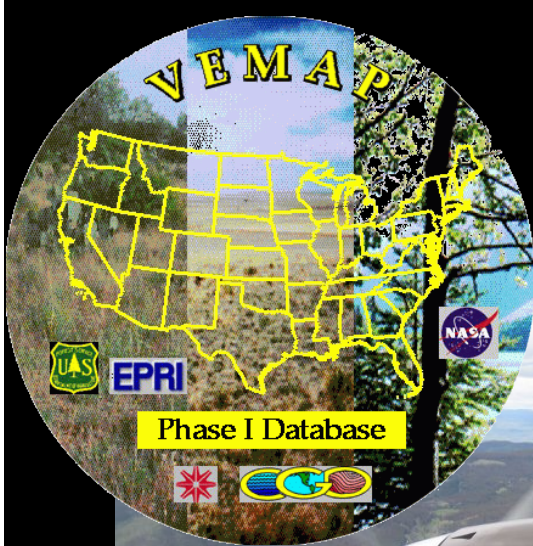
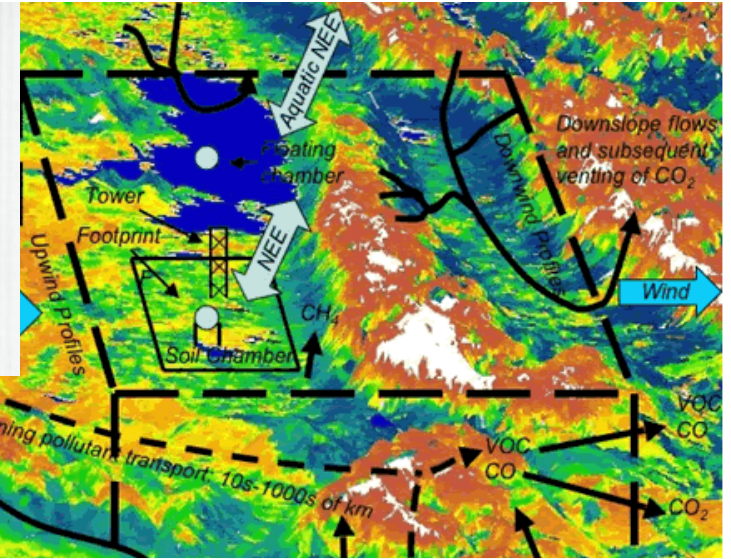


Global change ecology and biogeochemistry deal with the rapid rate of anthropogenic perturbation to ecosystems and its nutrient cycling

Terrestrial ecosystems and the carbon cycle

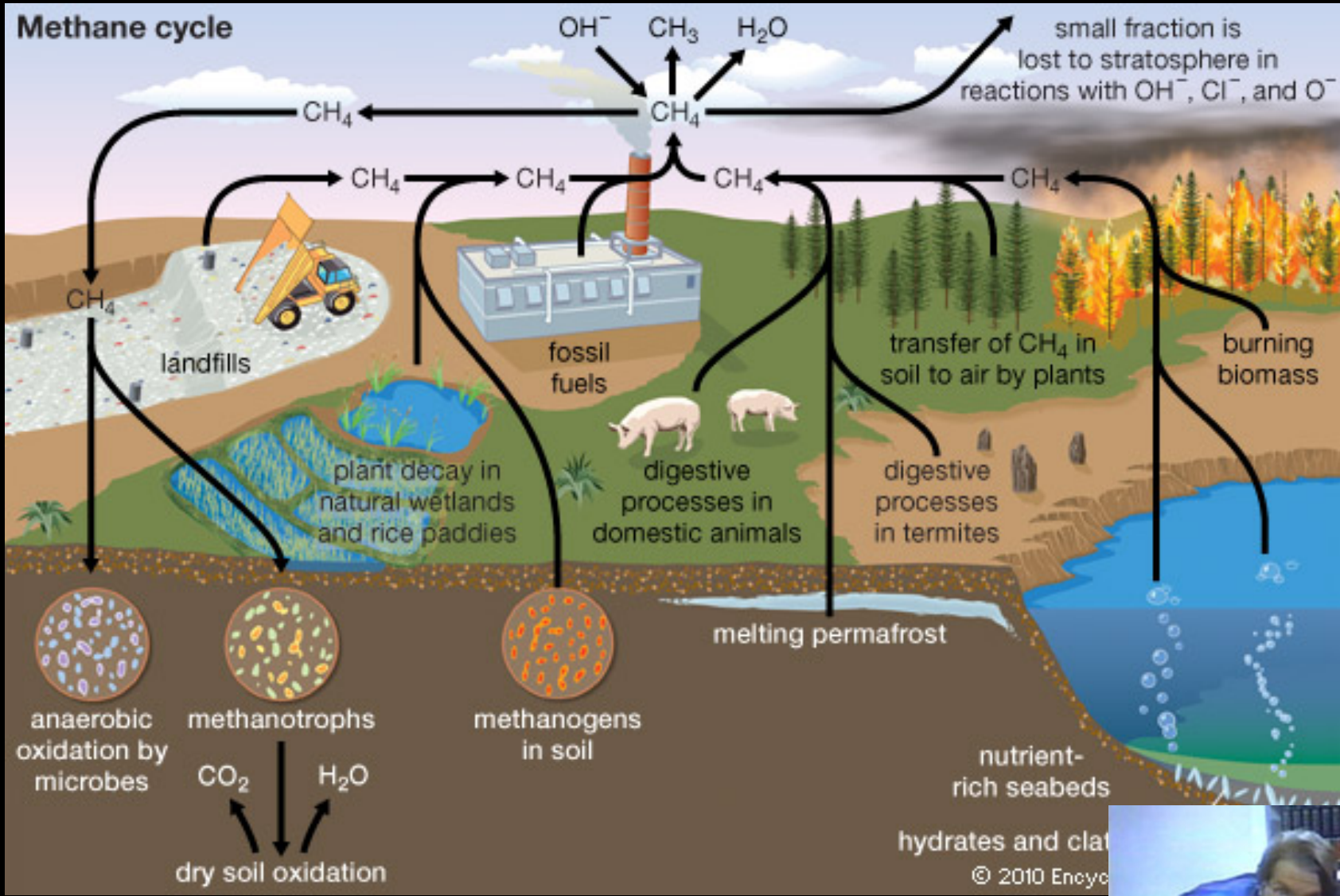
DAVID S. SCHIMMEL

National Center for Atmospheric Research, PO Box 3000 Boulder, CO 80307-3000, USA, and Natural Resource Ecology Laboratory, Colorado State University, Fort Collins, CO 80523, USA



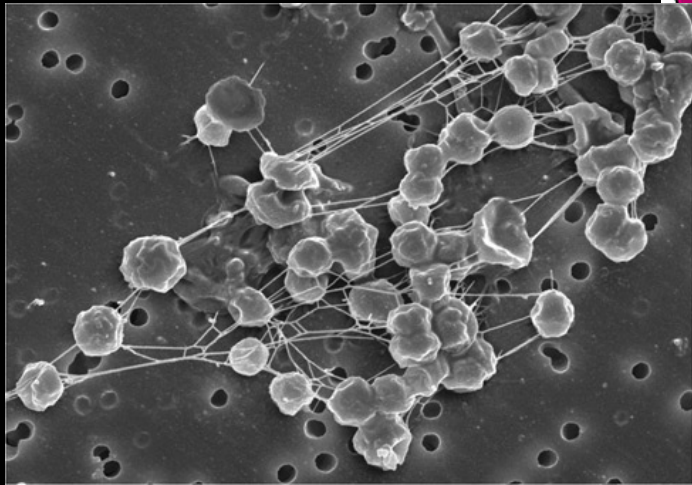
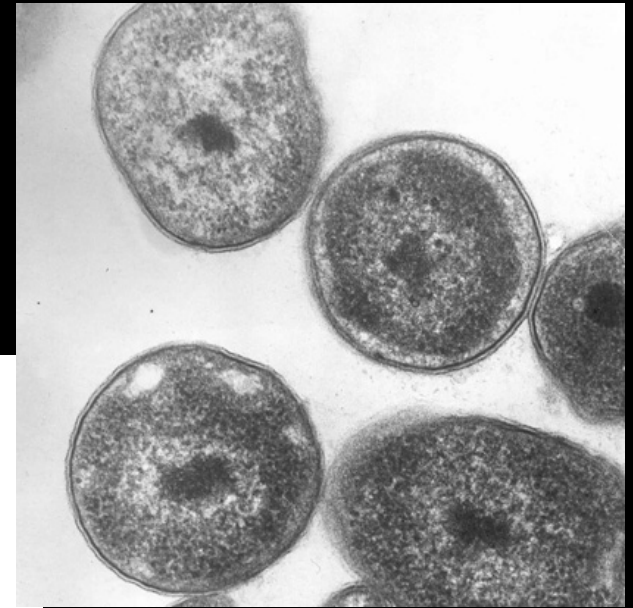
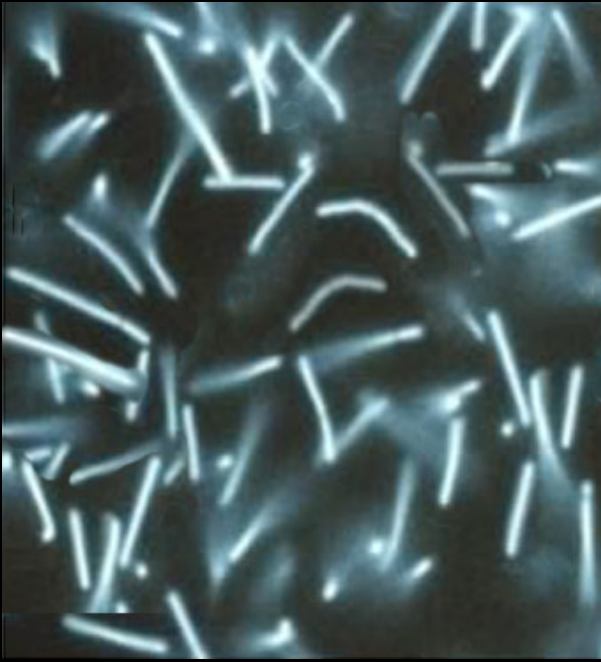


Credit: Dave Moore

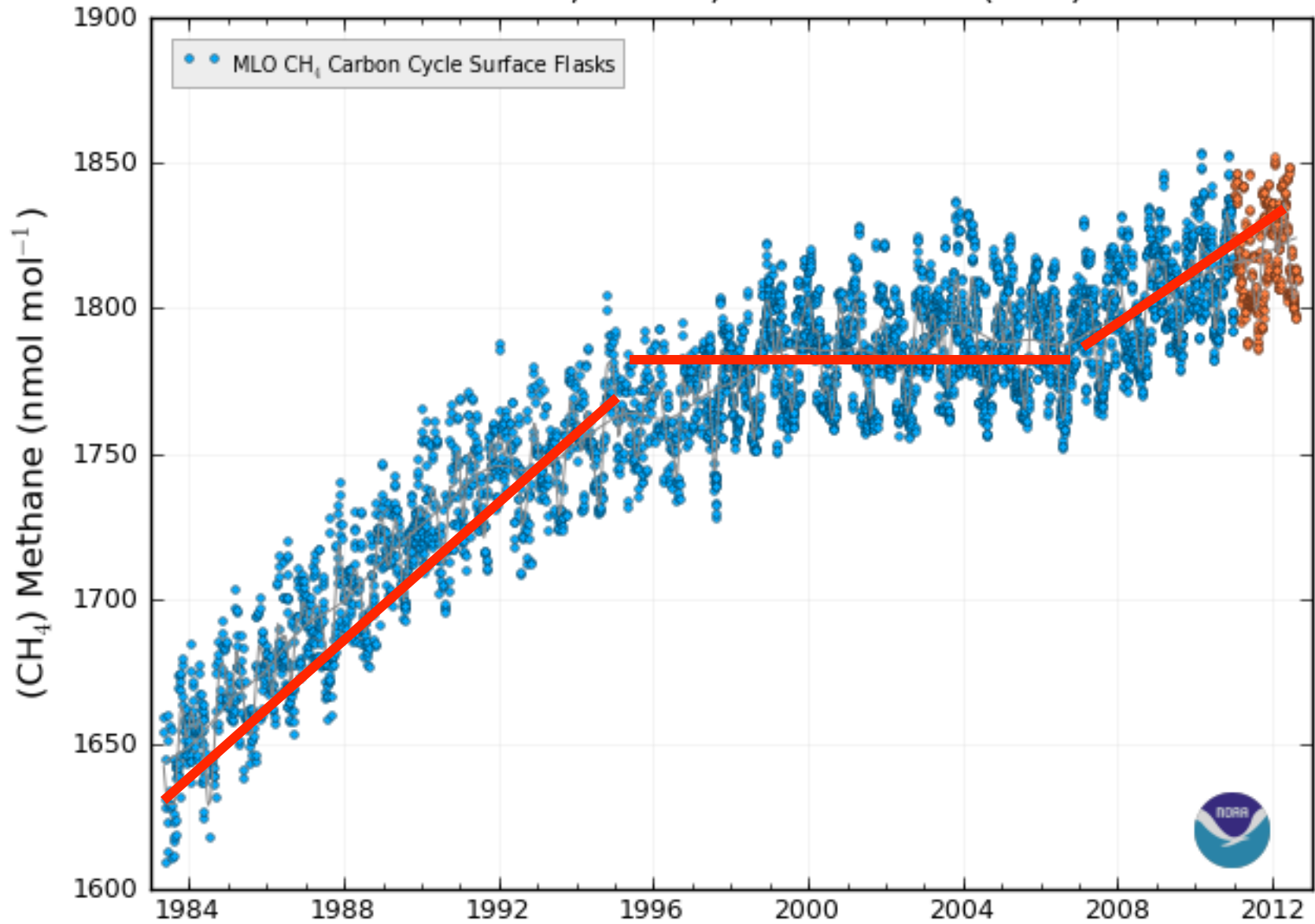


<http://media-1.web.britannica.com/eb-media/75/135075-004-105F7745.jpg>



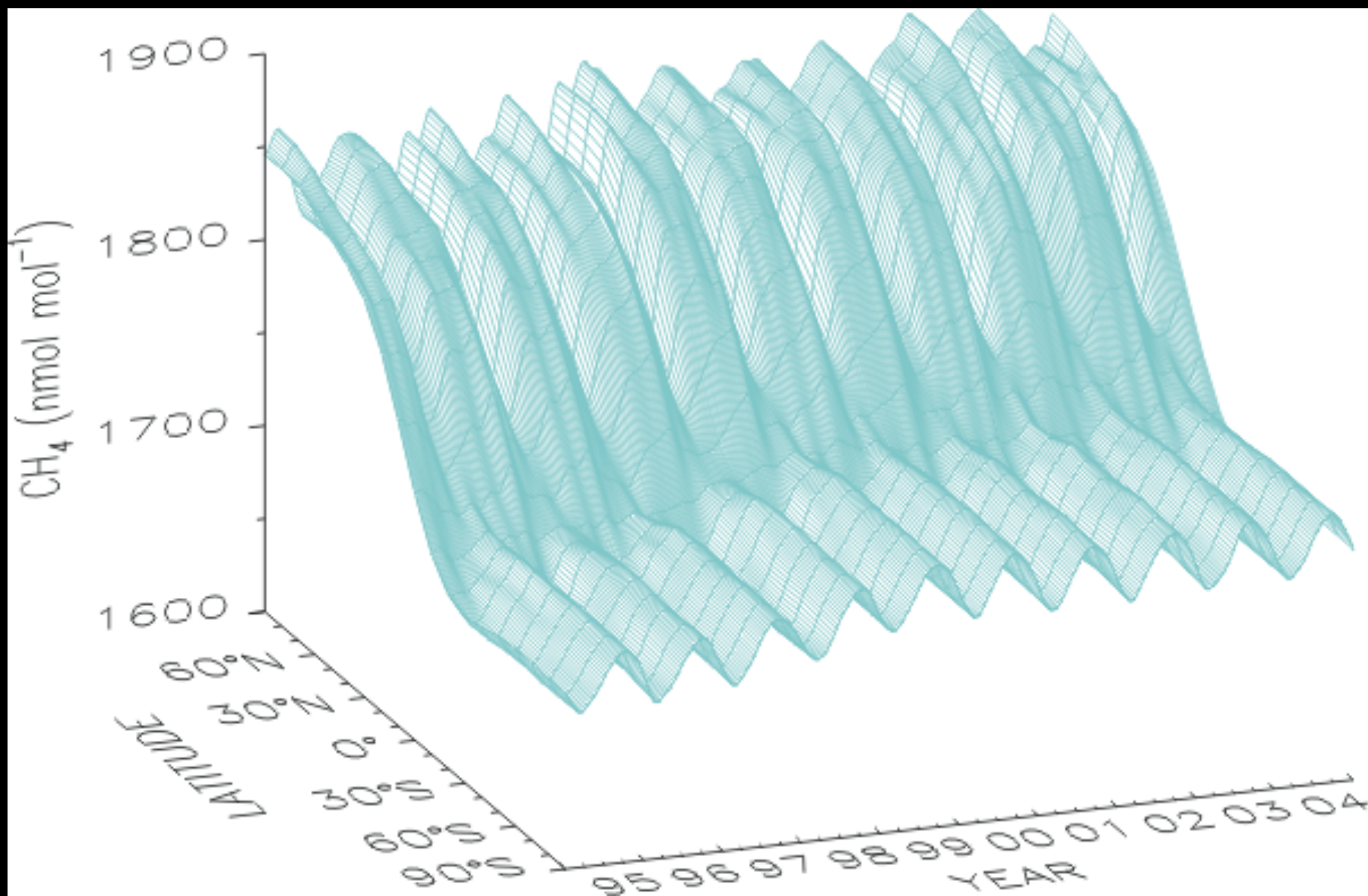


Mauna Loa, Hawaii, United States (MLO)



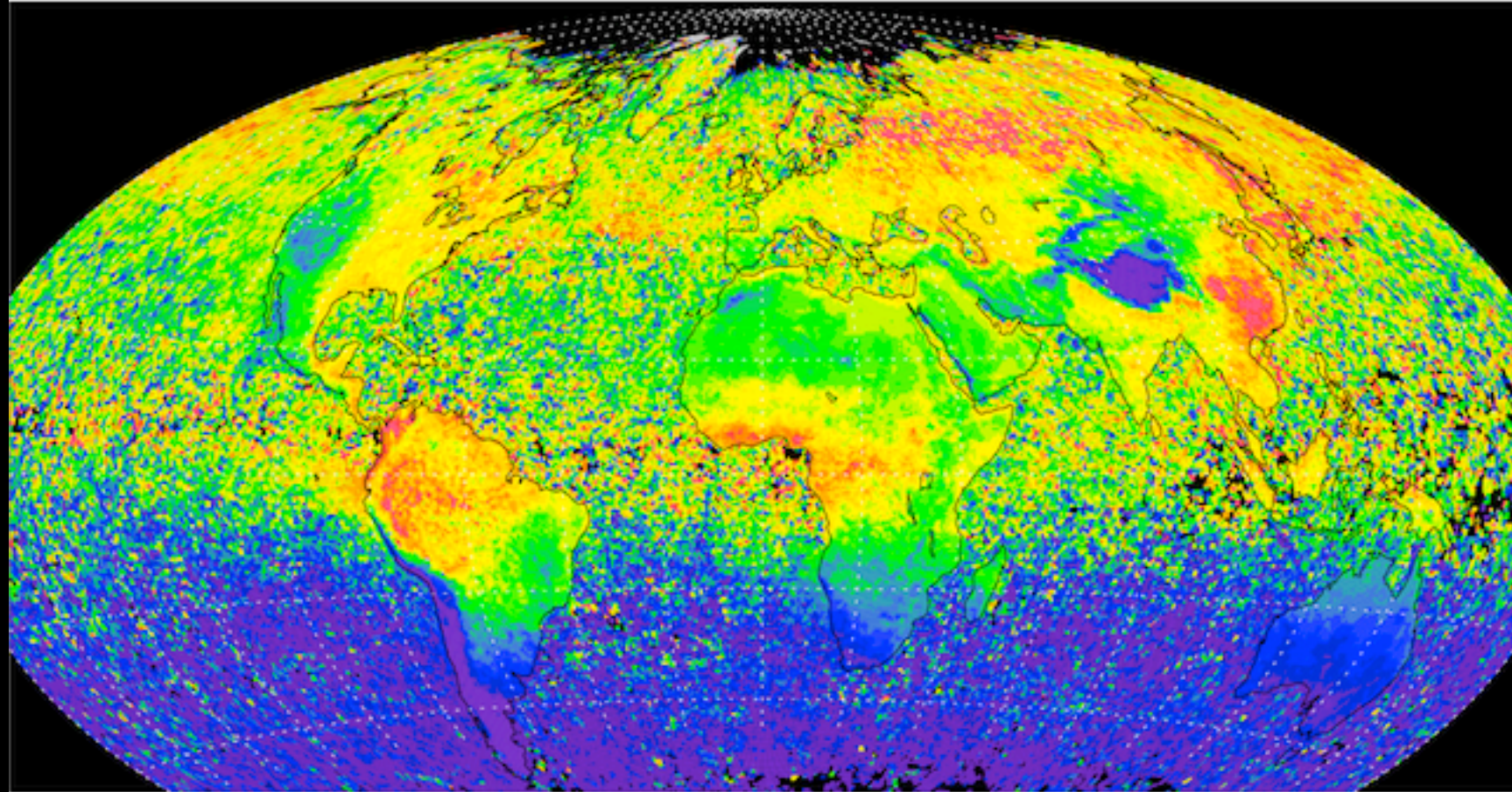
Source: NOAA ESRL

Graph created ESRL/GMD - 2012-September-15 04:50 am



Source: NOAA ESRL

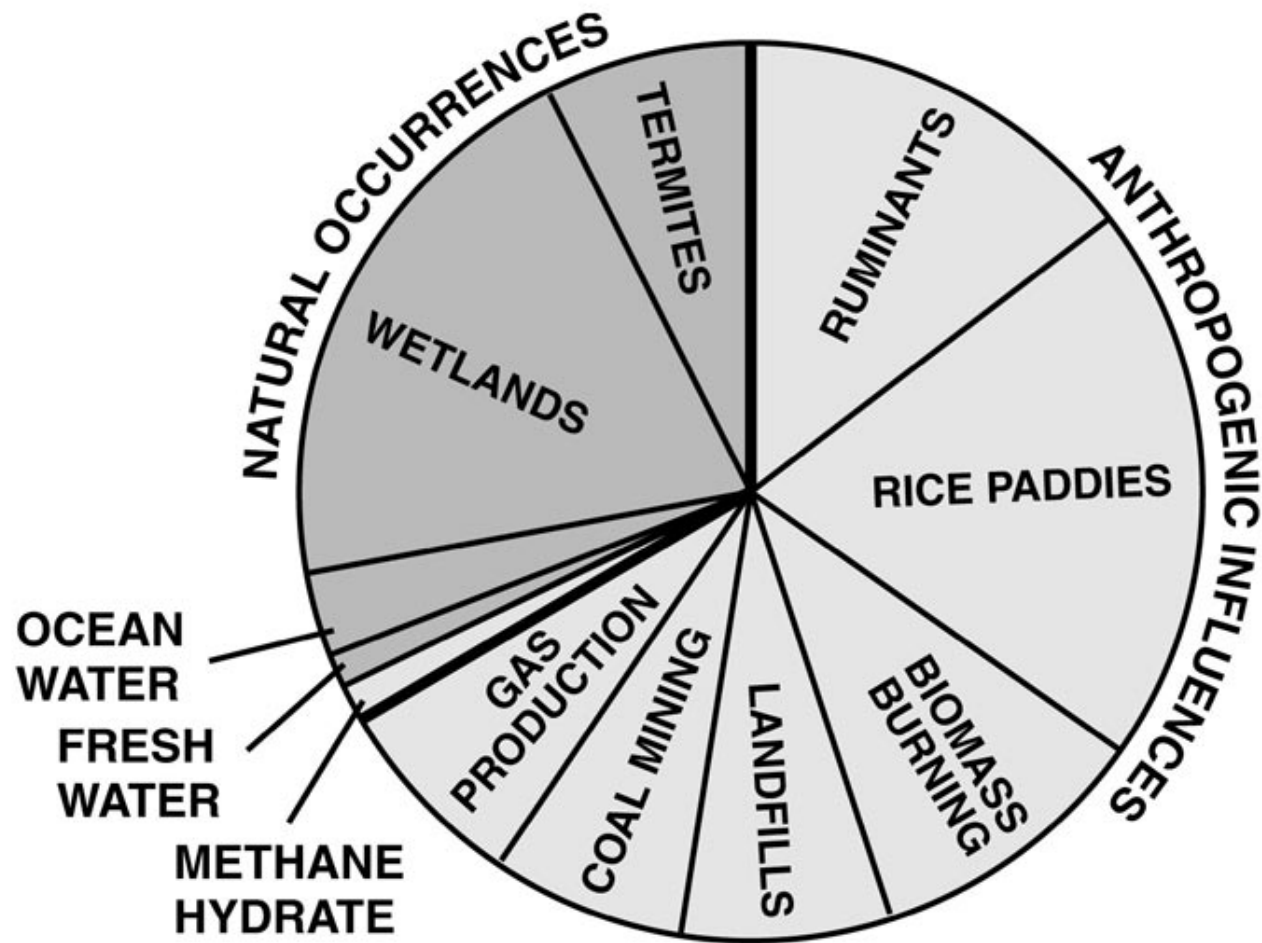
Methane SCIAMACHY/ENVISAT 2003-2005



CH₄ column-averaged mole fraction [ppb]

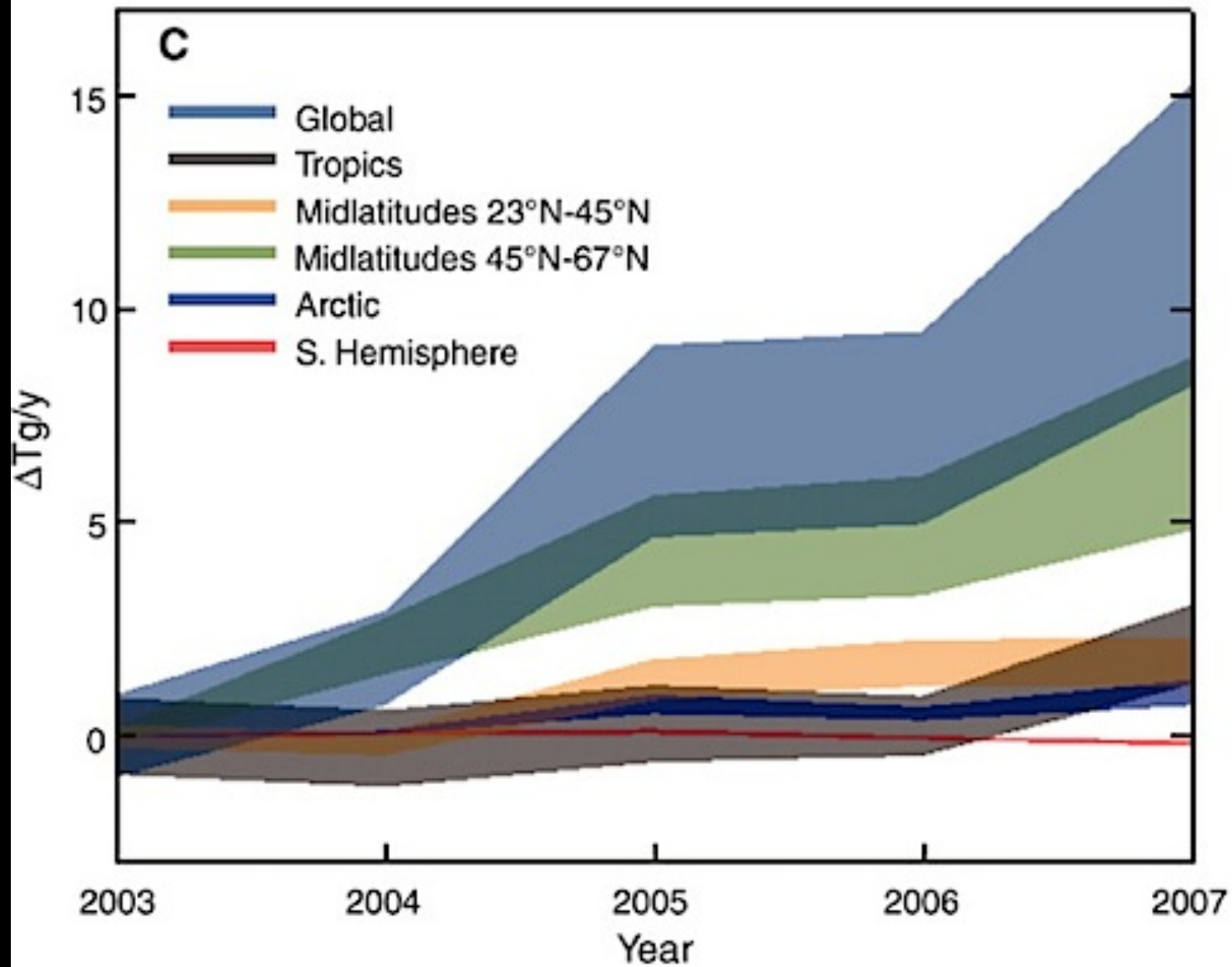


[http://www.iup.uni-bremen.de/sciamachy/
NIR_NADIR_WFM_DOAS/wfmd_image_gallery_ch4.html](http://www.iup.uni-bremen.de/sciamachy/NIR_NADIR_WFM_DOAS/wfmd_image_gallery_ch4.html)

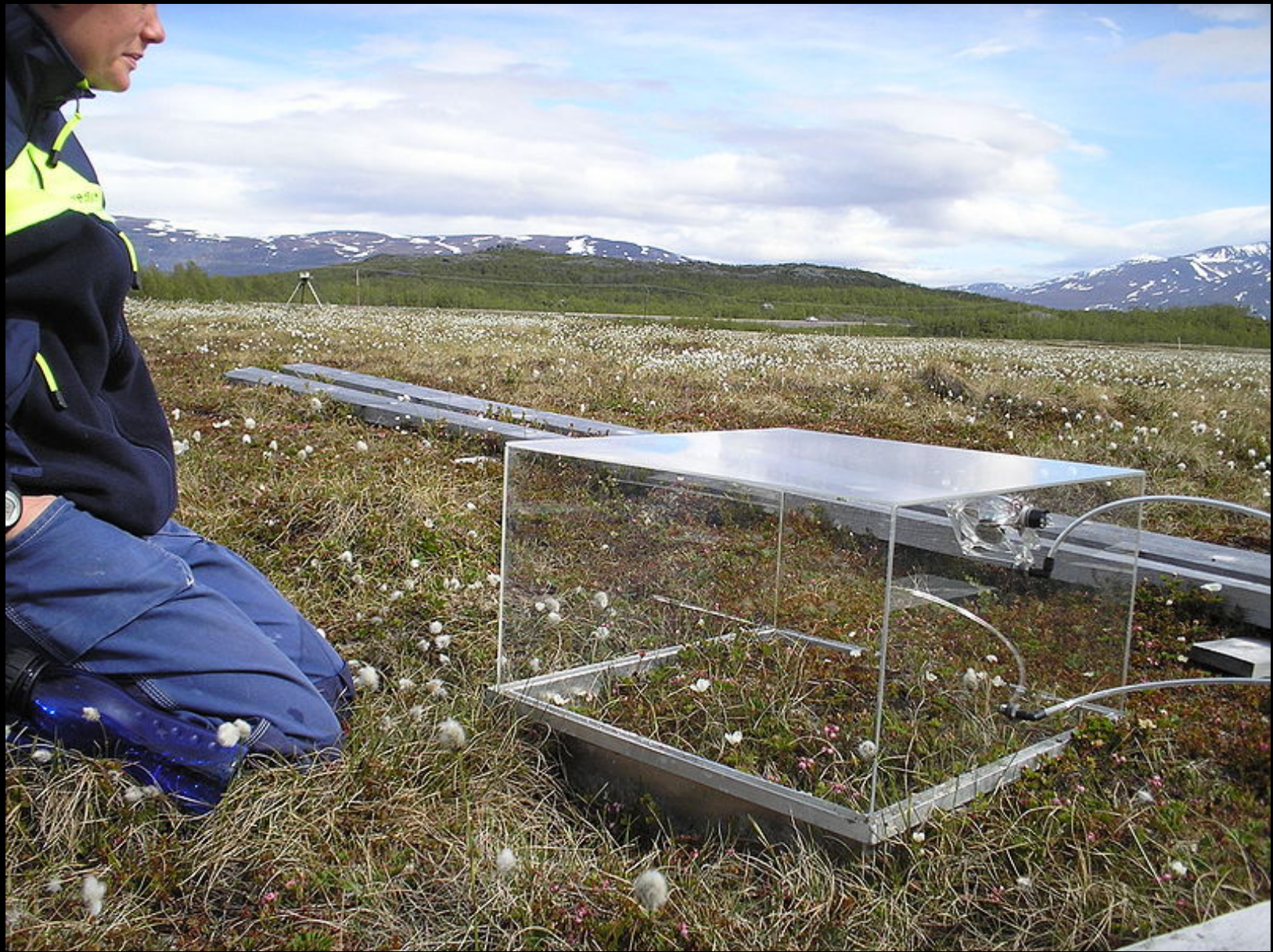


Source: U.S. Department of Energy
National Energy Technology
Laboratory

National Methane
Hydrate Program



<http://amanwithaphd.wordpress.com/2010/03/04/increasing-amounts-of-natural-methane-emissions/>



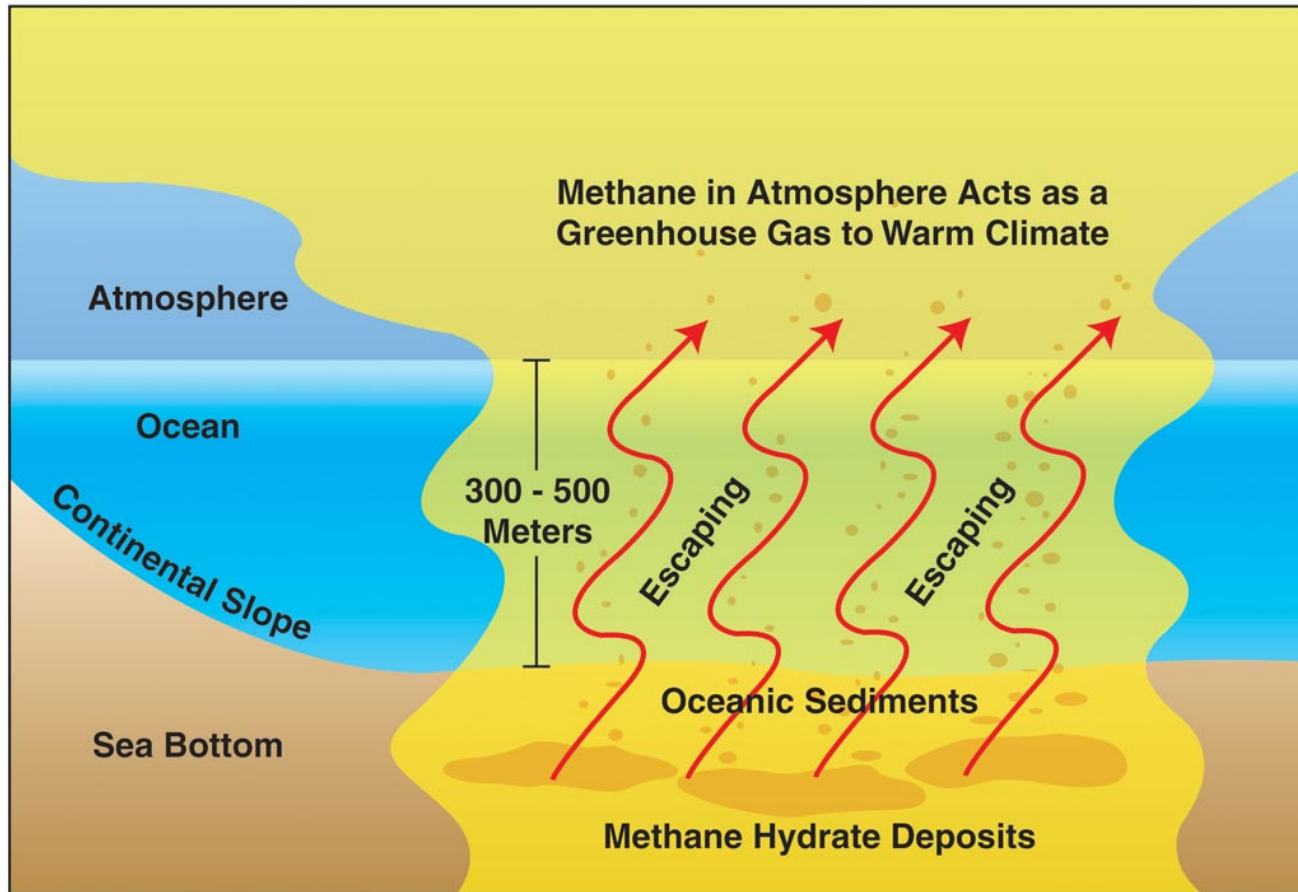


http://cdn.orkin.com/images/termites/termites_813x559.jpg



<http://environment.yale.edu/content/images/00002578/Flammable-gases-coming-out-of-oak-tree-browser.jpg?1344448836>

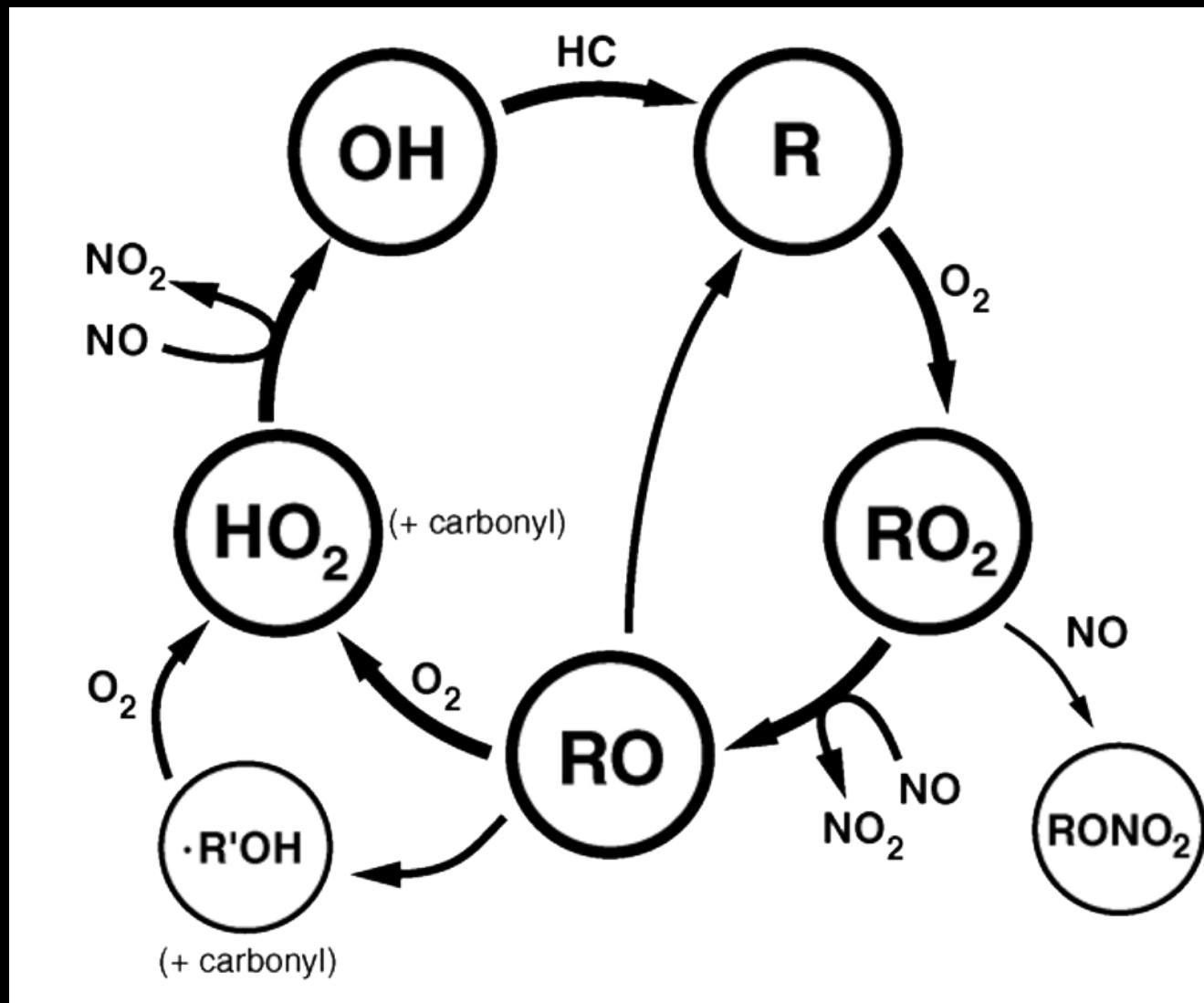
Methane Explosion Warmed Prehistoric Earth



http://www.giss.nasa.gov/research/news/20011210/methane_explosion.jpg

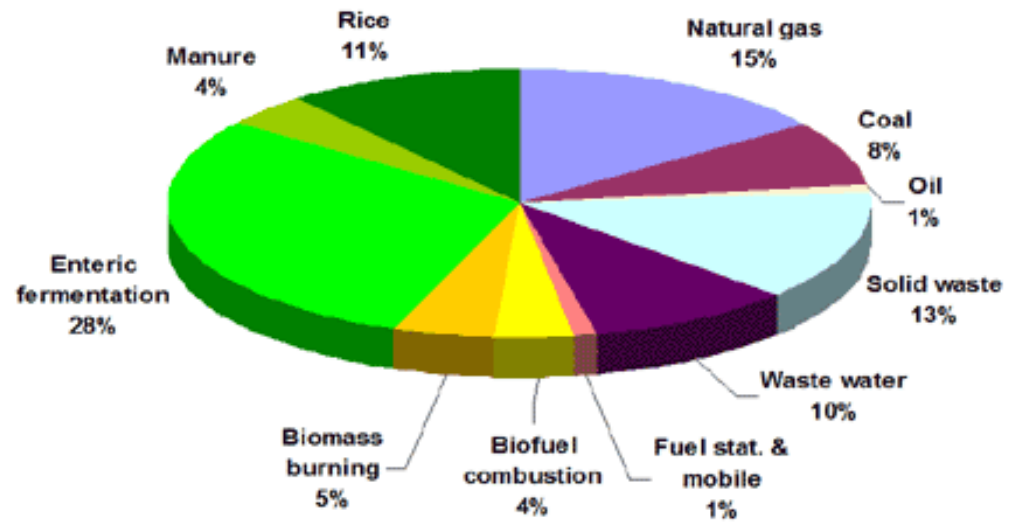


<http://www.treehugger.com/clean-technology/major-source-of-atmospheric-methane-identified-near-arctic-lakes.html>

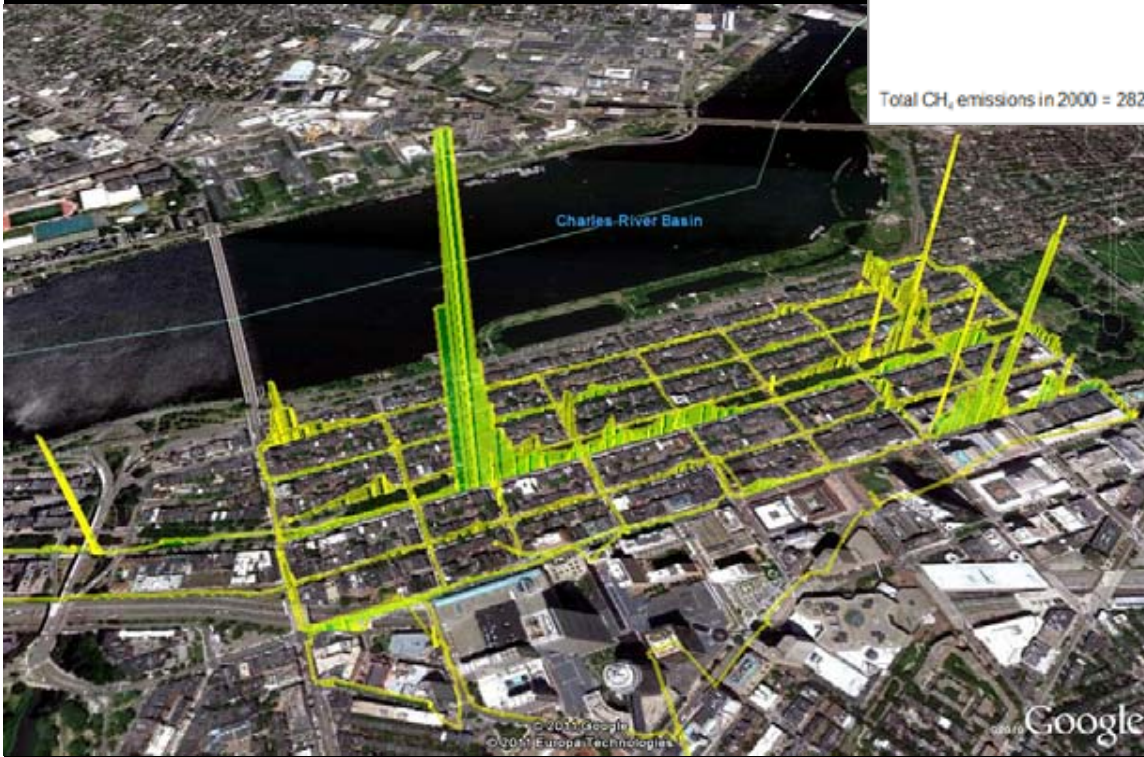


<http://ent.arp.harvard.edu/kinetics/sciobj/freerad/hoxcyc.html>

Global Anthropogenic CH₄ Budget by Source in 2000



Total CH₄ emissions in 2000 = 282.6 Tg CH₄



Source: Picarro, Inc. / Nathan Phillips, BU



<http://www.10dailythings.com/2009/12/23/u-s-to-capture-cow-farts-to-save-the-planet/>

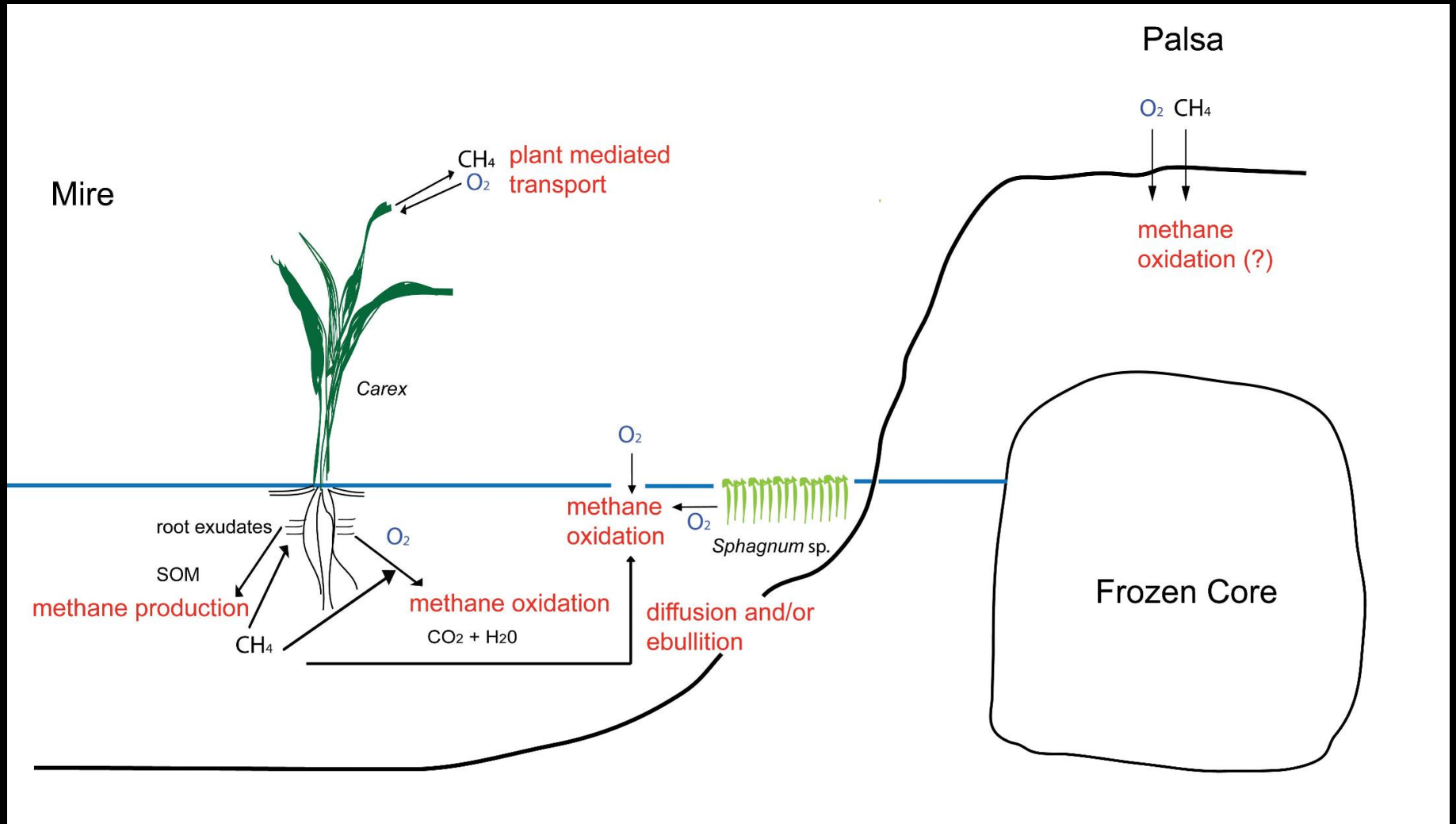
Letter

Nature **439**, 187-191 (12 January 2006) | doi:10.1038/nature04420; Received 14 July 2005; Accepted 3 November 2005

Methane emissions from terrestrial plants under aerobic conditions

Frank Keppler¹, John T. G. Hamilton², Marc Braß^{1,3} and Thomas Röckmann^{1,3}

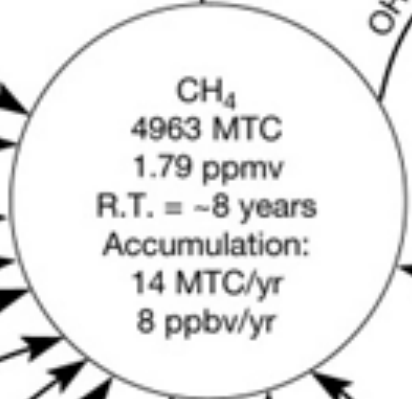
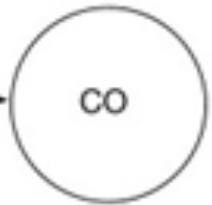




METHANE
(Fluxes = MTC/yr)



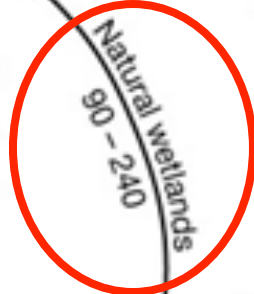
Climate sensitivity
0.3°C/doubling CH₄
18% greenhouse



To stratosphere
40 - 46

OH, O(D), NO₃ depletion
450 - 510

Ocean
10 - 15



Ruminants
90 - 115

Soil uptake
10 - 40

CH₄ hydrate
01 - 5

Rice paddies
50 - 100

Landfills
40 - 70

Termites
20

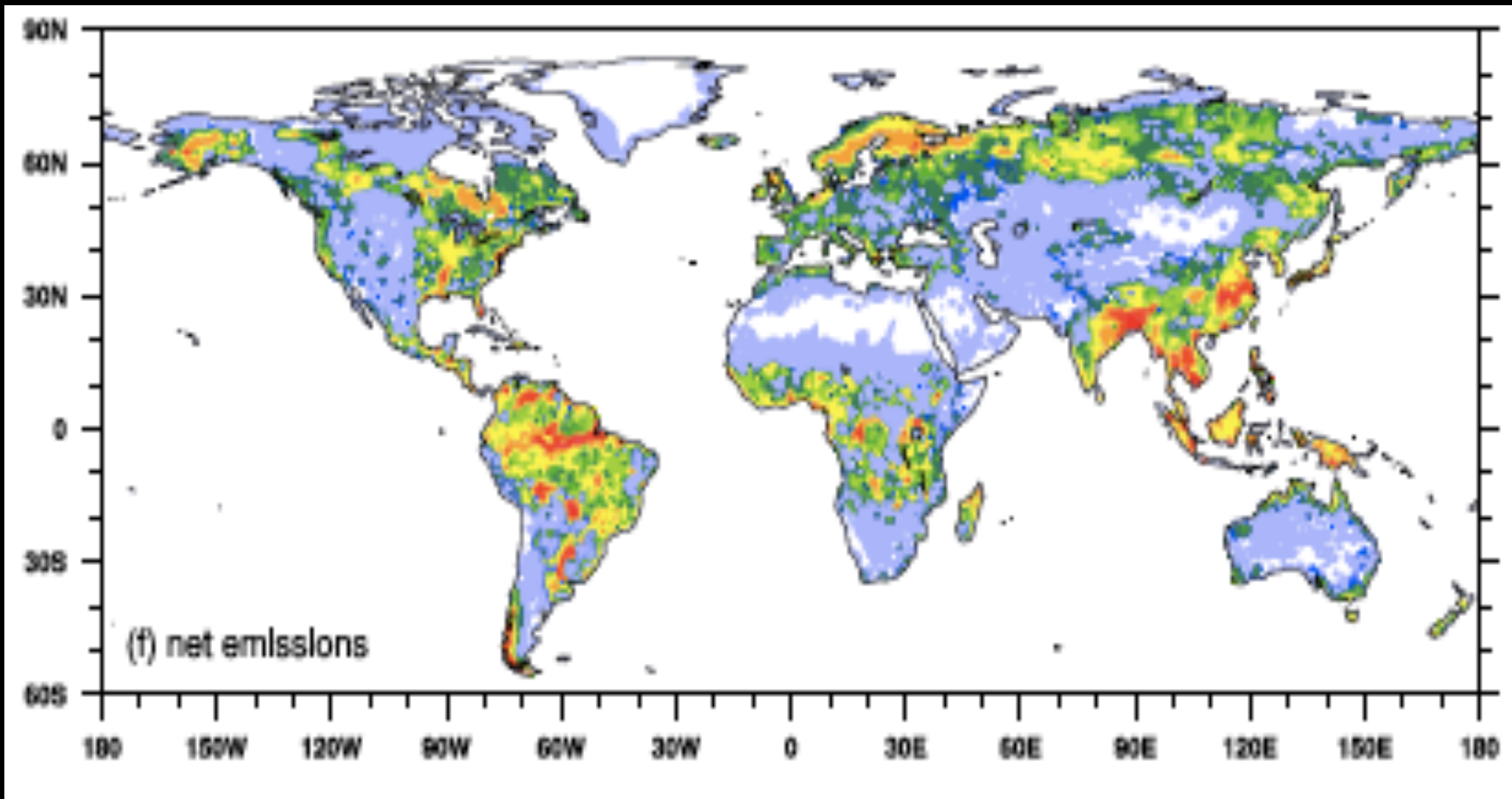
Biomass burning
20 - 55

Energy
75 - 110

Waste treatment
14 - 25

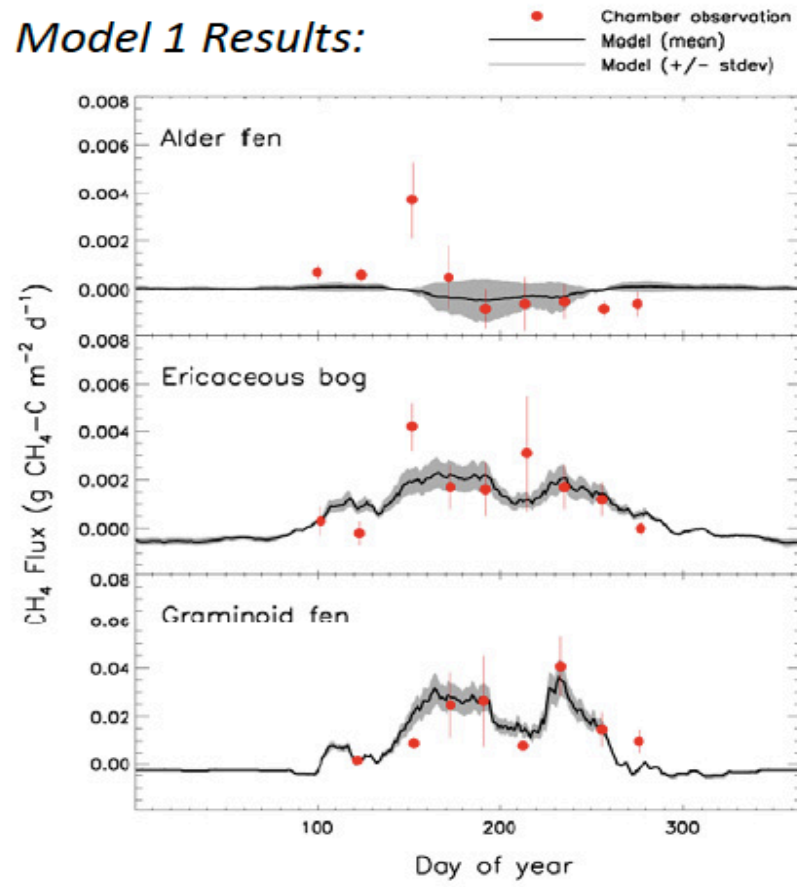
Land

Ocean

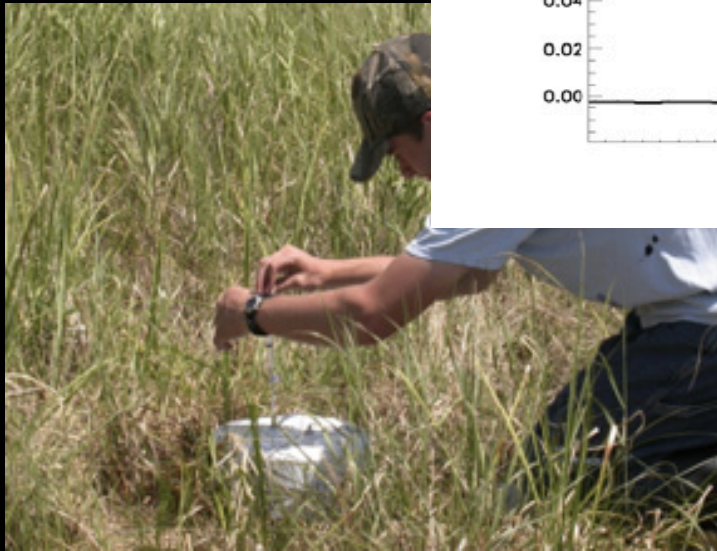


Spahni et al. (2011) Biogeosciences

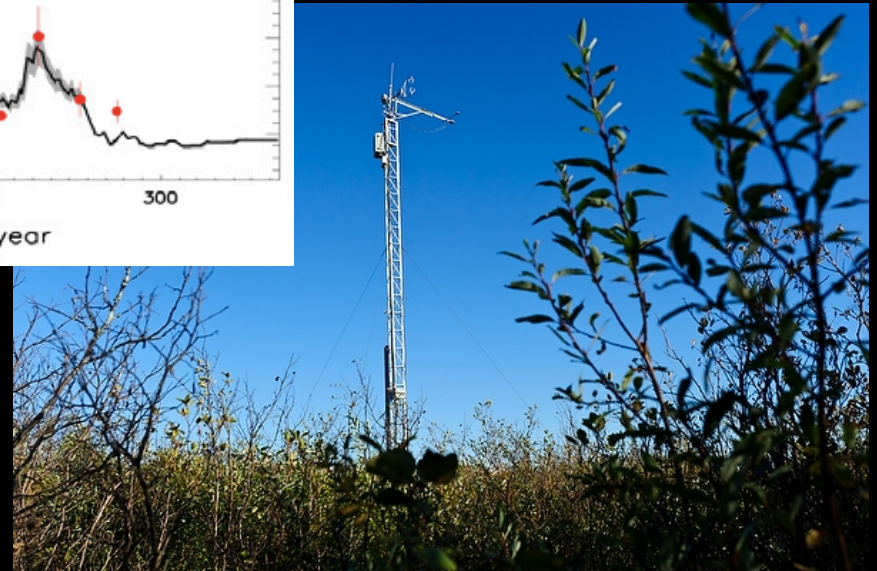
Model 1 Results:



Source:
Cook et al (2008)
AGU Poster



Credit: P. Weishampel

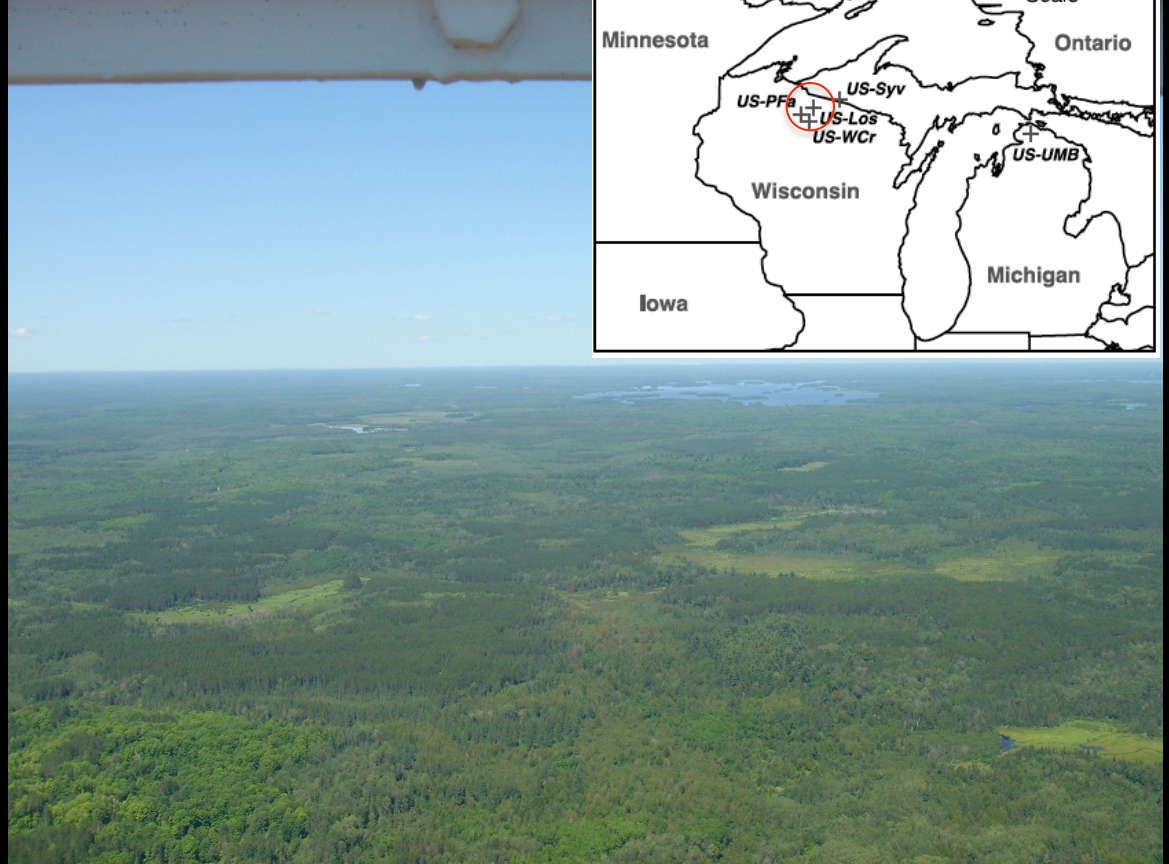


Credit: B. Rychter

Tall towers offer novel approach to estimating regional fluxes



Credit: M. Rydzik



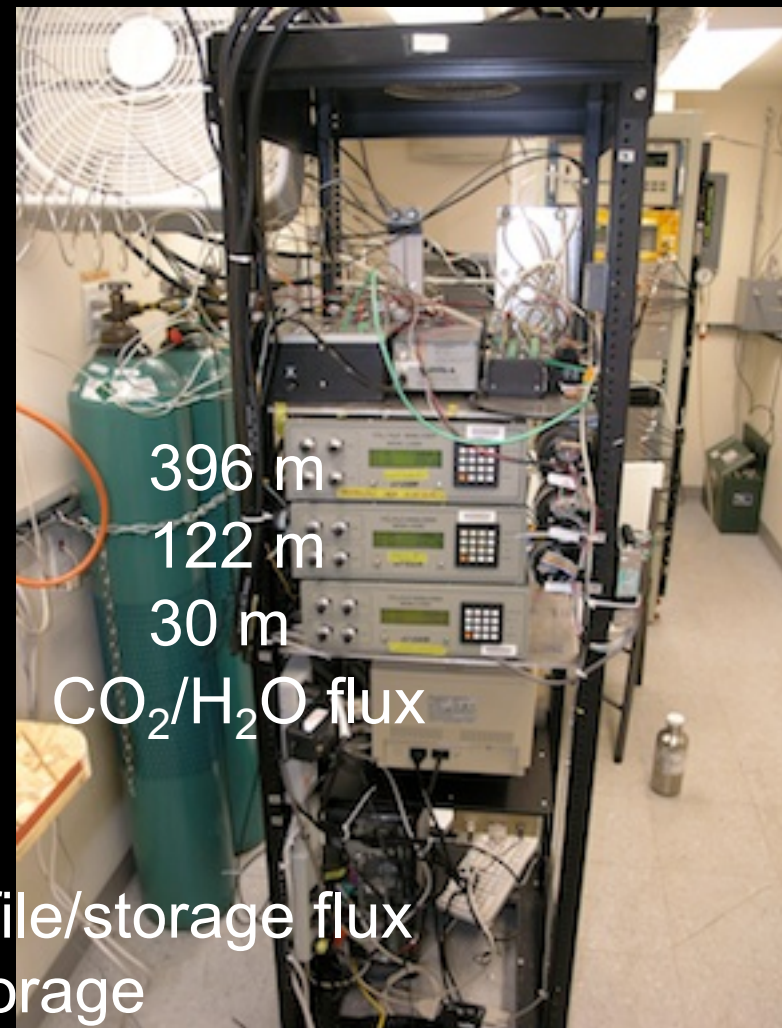
Source: B. Cook

Long-term continuous CH₄ eddy covariance is now feasible



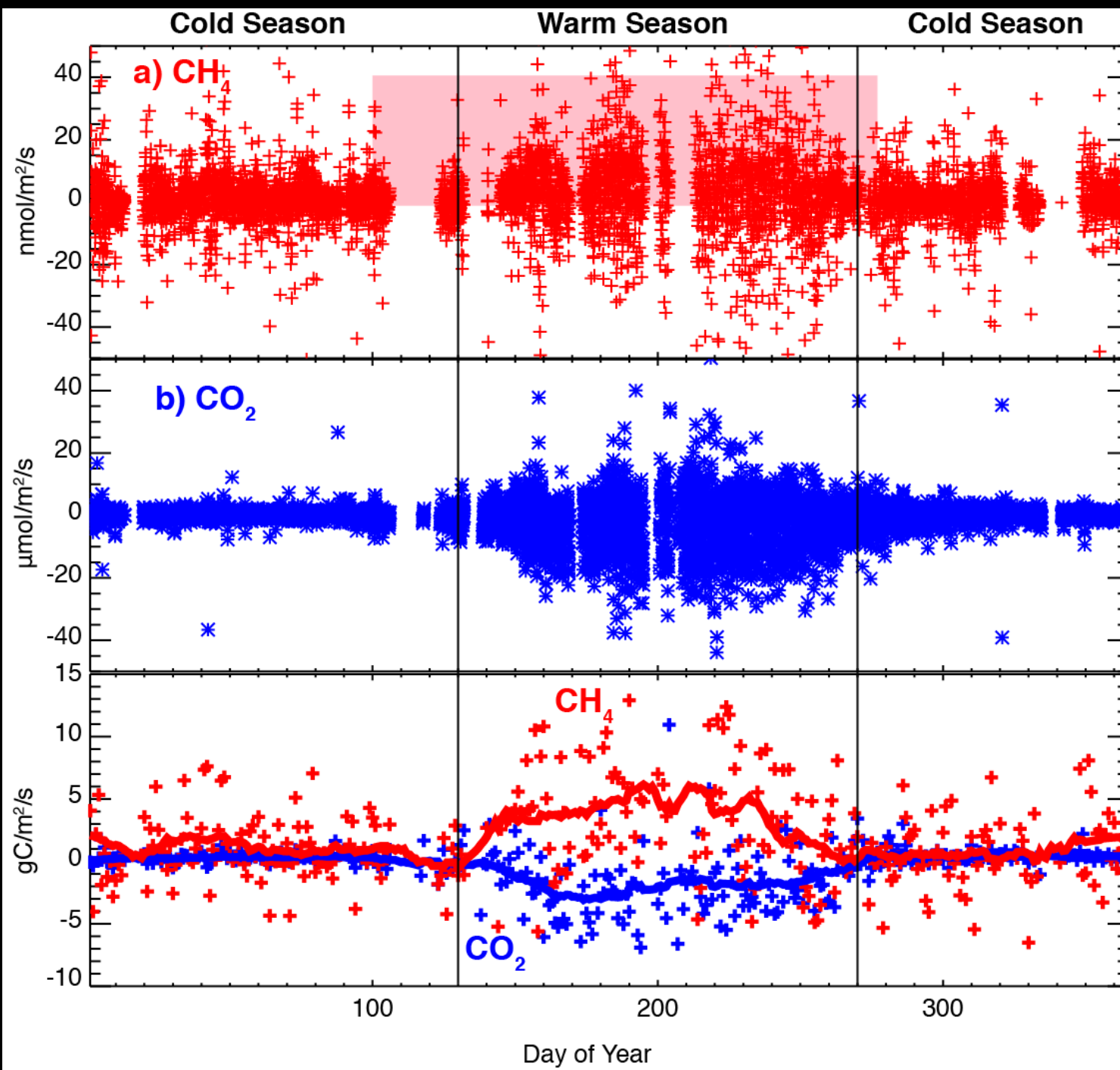
Picarro G1301-f 122 m
CH₄/CO₂ (H₂O)

Credit: M. Rydzik

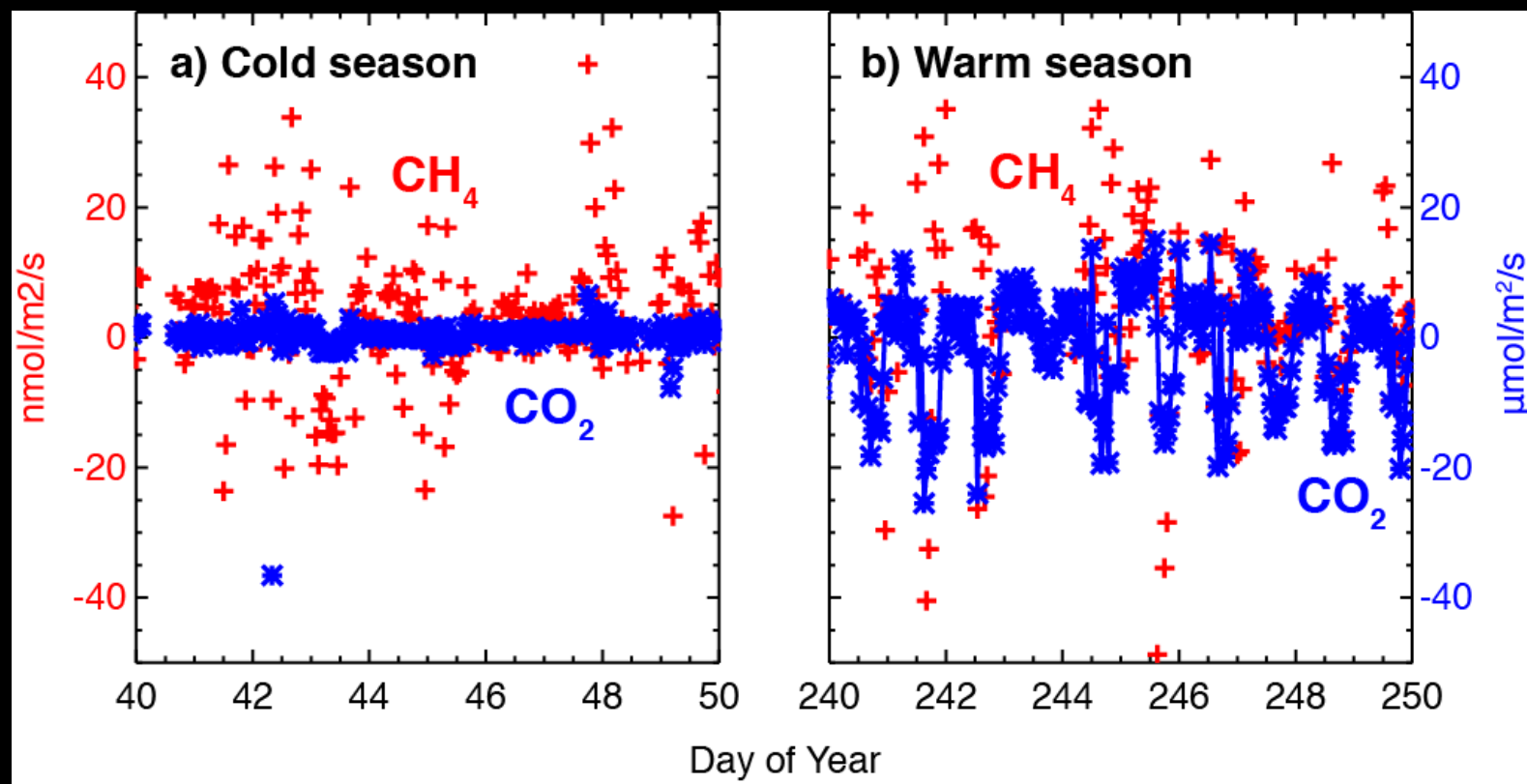


396 m
122 m
30 m
CO₂/H₂O flux

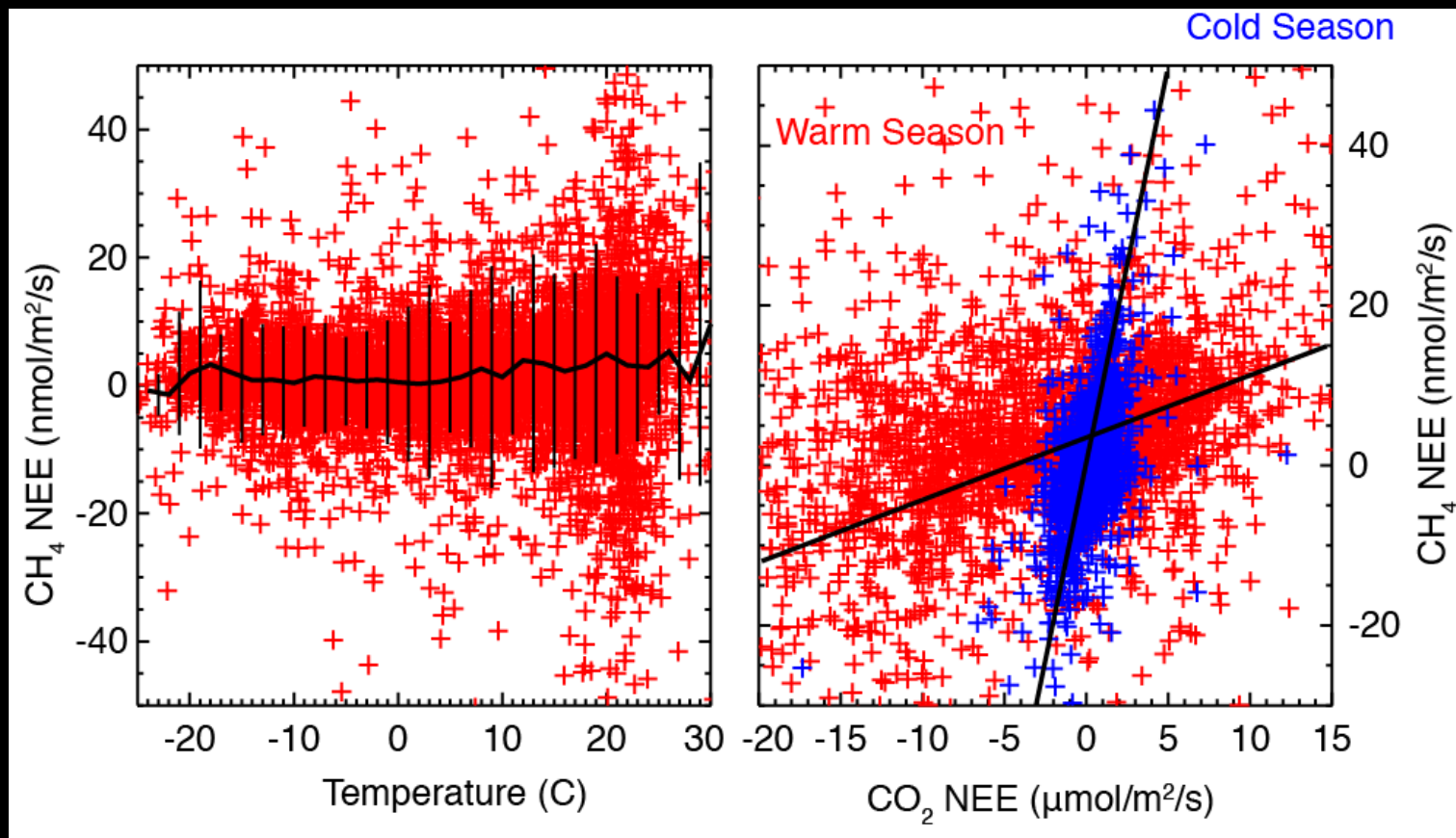
Not shown: Los Gatos for CH₄ profile/storage flux
LI-7000 (NOAA) for CO₂ profile/storage

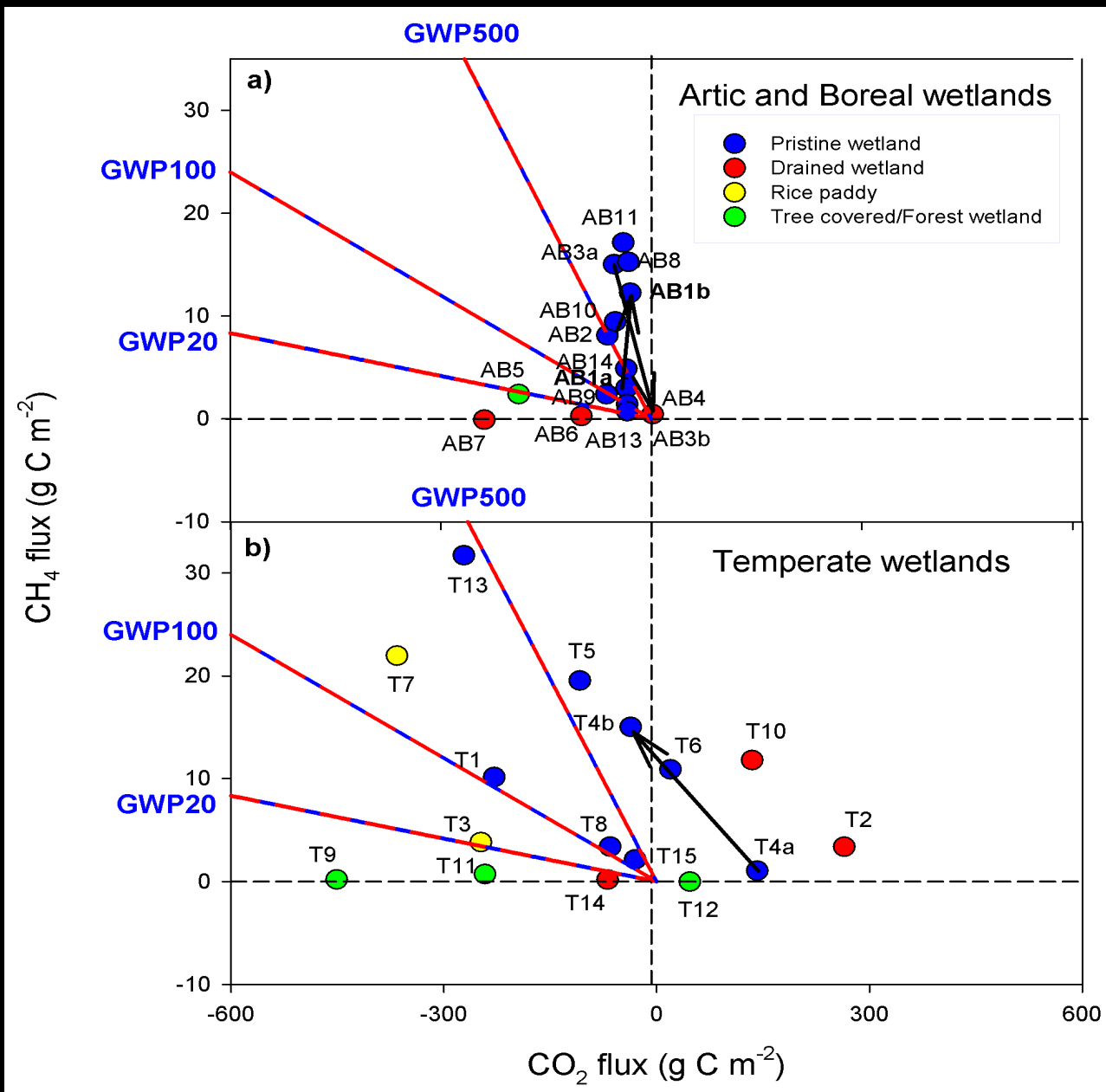


- Methane flux magnitudes do not change in magnitude from winter to growing season, but do change in quality.



- CH₄ emissions regionally are only weakly correlated to temperature, unlike at plot scale. Winter CH₄ fluxes strongly correlated to small magnitude CO₂ fluxes.





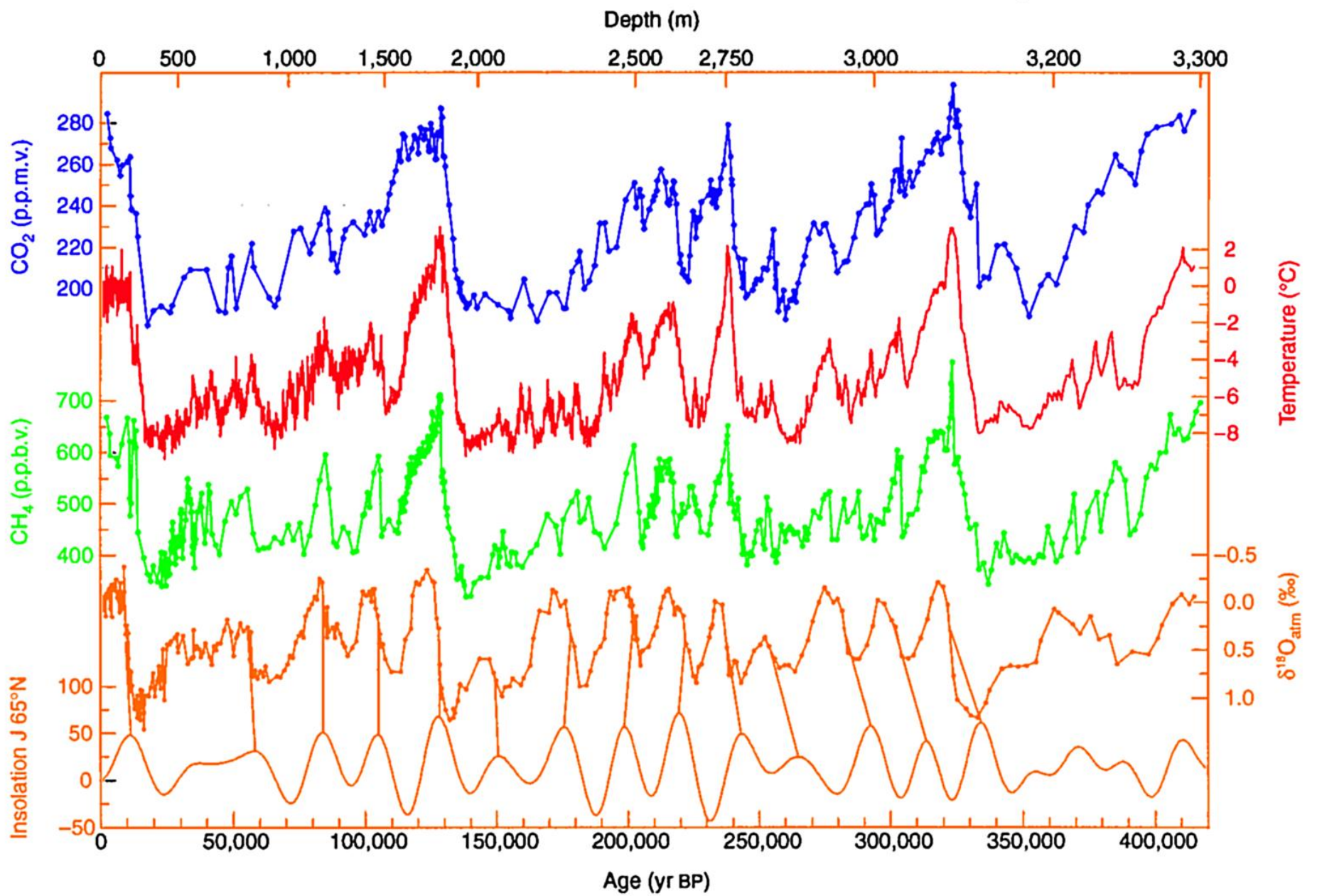
Petrescu et al (in prep)

Quiz: Who said this?

- “I am not a scientist myself, but my best assessment of the data is that the world is getting warmer, that human activity contributes to that warming, and that policymakers should therefore consider the risk of negative consequences.”
– Sept. 2012



<http://www.sciencedebate.org/debate12/>



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 Xu, and others
 - <http://flux.aos.wisc.edu>
 - desai@aos.wisc.edu
 - 608-218-4208