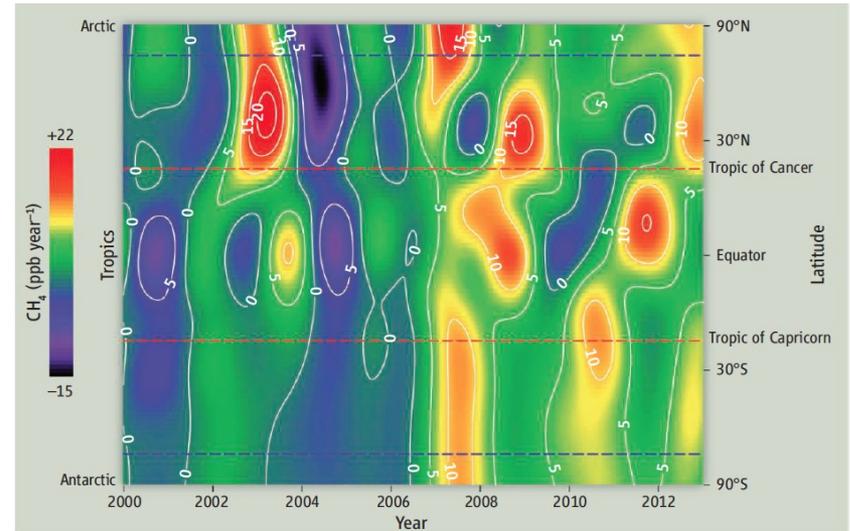
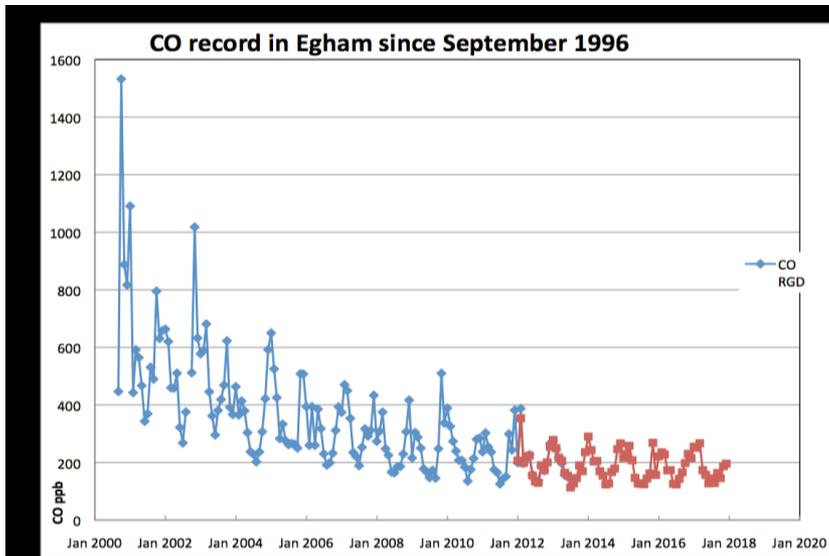


# Royal Holloway Greenhouse Gas group

EG Nisbet, D Lowry, RE Fisher, M Lanoisellé

1. *Equianos* network - Atlantic CO<sub>2</sub> & CH<sub>4</sub> ( [equianos.com](http://equianos.com) )
2. Arctic and Tropical methane emission budgets
3. Source campaigns - Arctic & Tropical wetlands, North Sea gas leaks, Aussie unconventional gas, Chinese coal, etc.
4. Lead European lab for  $\delta^{13}\text{C}$  in CH<sub>4</sub> (*EU-InGOS*) in ambient air
5. London CO<sub>2</sub>, CH<sub>4</sub>, CO, H<sub>2</sub> - mid 1990s to present



Methane growth rate by latitude. Contours of methane growth rate with sine of latitude. Plotting by sine of degree of latitude equally weights the results for surface area with latitude. Data from [www.esrl.noaa.gov/gmd/ccgg/mb/](http://www.esrl.noaa.gov/gmd/ccgg/mb/).

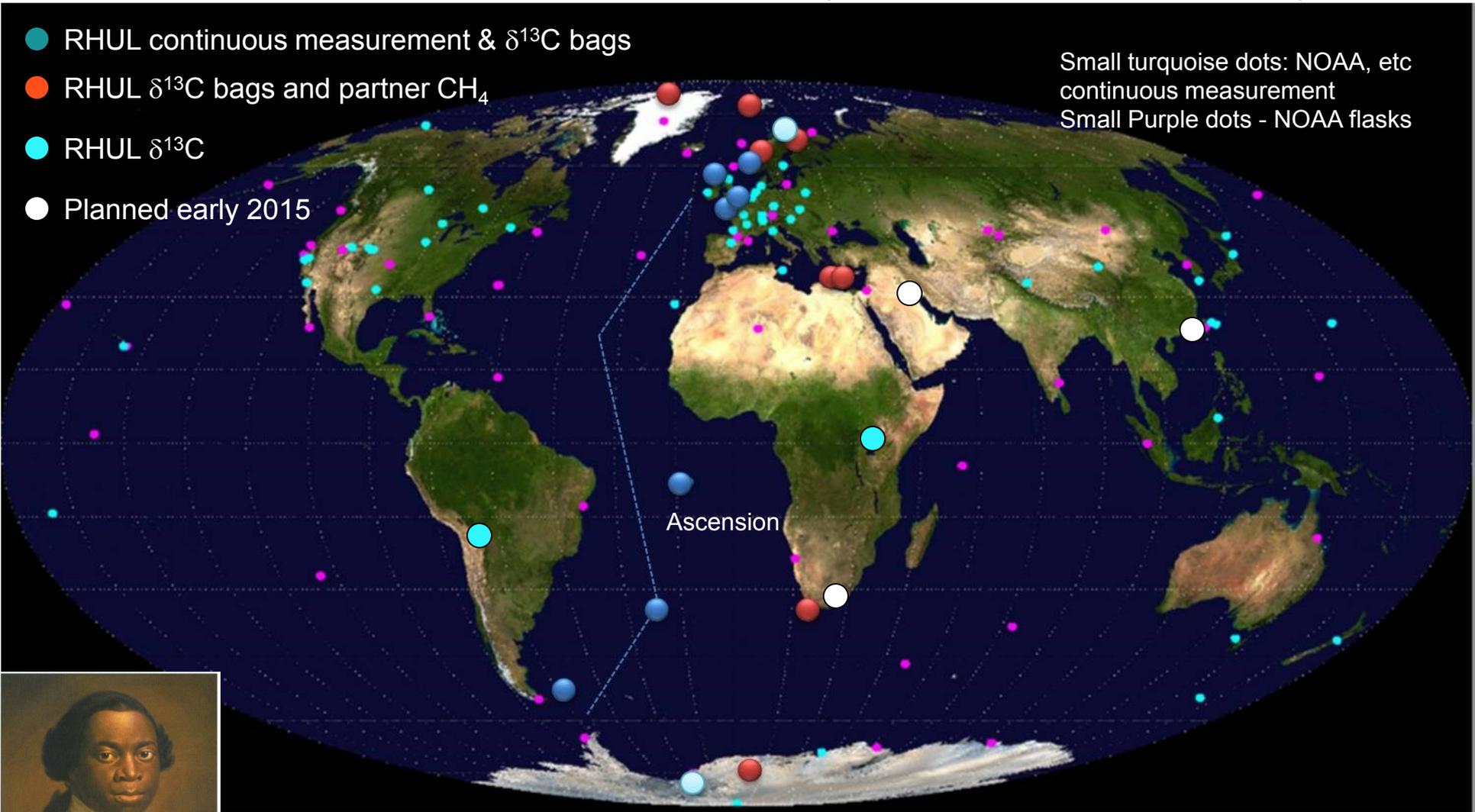
NOAA methane plot from:  
Nisbet, et al, *Science* **343**, 493-5, 2014

# Equianos partnership - Atlantic Greenhouse Gas measurements (large dots)

RHUL, NILU, FMI, UEA, S. Africa Weather, Jersey Met, British Antarctic Survey

- RHUL continuous measurement &  $\delta^{13}\text{C}$  bags
- RHUL  $\delta^{13}\text{C}$  bags and partner  $\text{CH}_4$
- RHUL  $\delta^{13}\text{C}$
- Planned early 2015

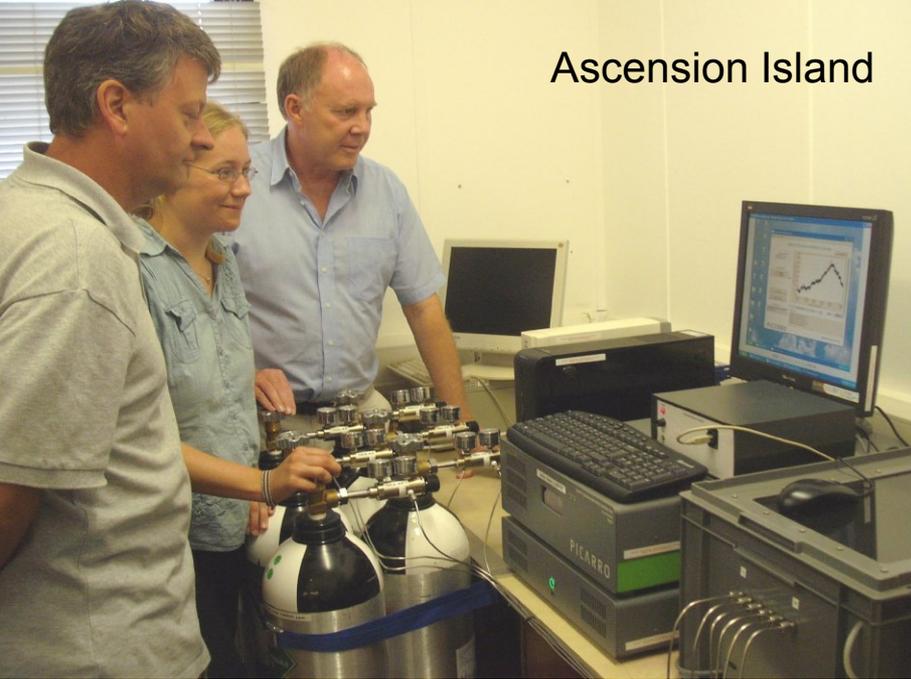
Small turquoise dots: NOAA, etc  
continuous measurement  
Small Purple dots - NOAA flasks



*Olaudah Equiano* **Equator-InterAtlantic-NOrth-South measurement**

18th century Cambridge Arctic scientist, partly responsible for Ascension settlement

Ascension Island



Ascension Island

Ascension Island  
Installed at Met Office, Wideawake airstrip.  
Wifi link, Met Office meteorology  
Steady SE Trades.

### E. Falkland Island (Stanley)

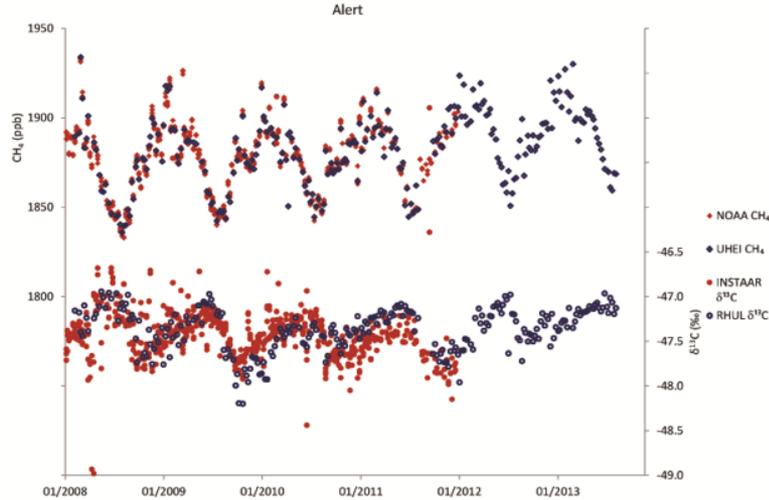
- Installed at the top of Sapper Hill, 2.5 km SW of Port Stanley, 25-29 Oct 2010
- Inlet at top of 12m communications mast
- WiFi link to the coast
- Gusts in excess of 15 m/s common during the installation and throughout the year



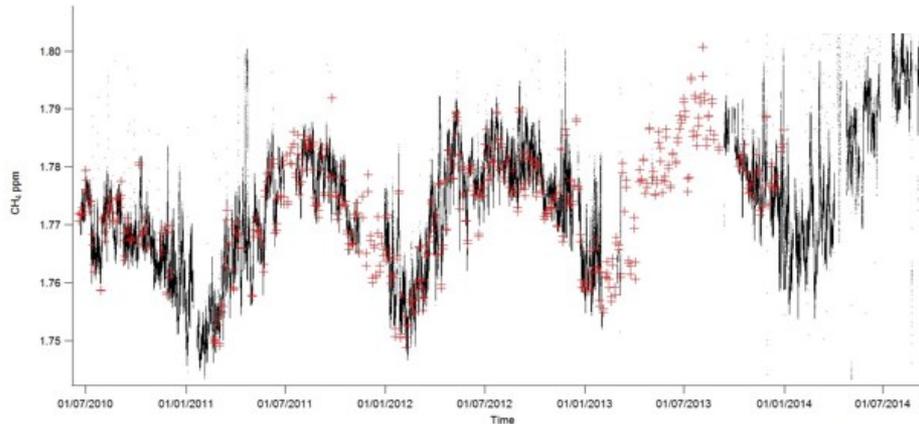
E. Falkland Island  
(Stanley)

# Alert and Ascension

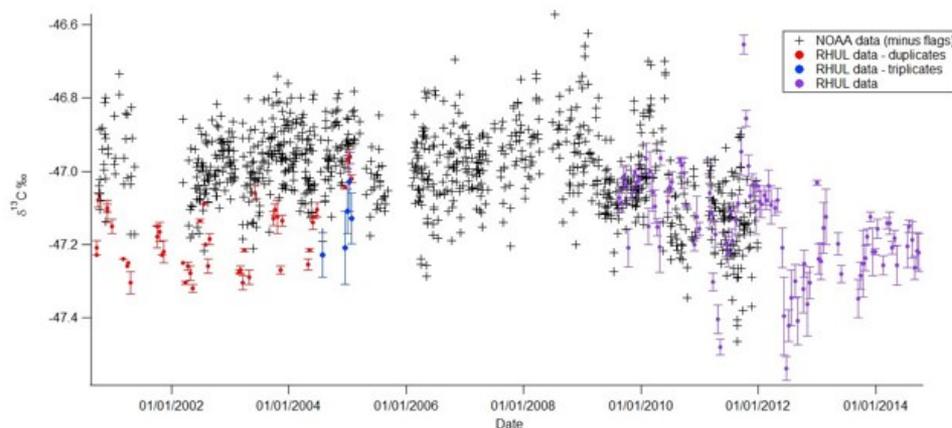
Arctic record - strong growth in 2007;  
shift to 'light'  $\delta^{13}\text{C}_{\text{CH}_4}$  in 2007 (wetlands)



Ascension record - sharp growth in  
2010-11 and recently.



Sharp shift to 'light'  $\delta^{13}\text{C}_{\text{CH}_4}$  begins in  
2012 (wetlands)



Growth is probably driven by  
meteorological change, not  
directly by human emissions

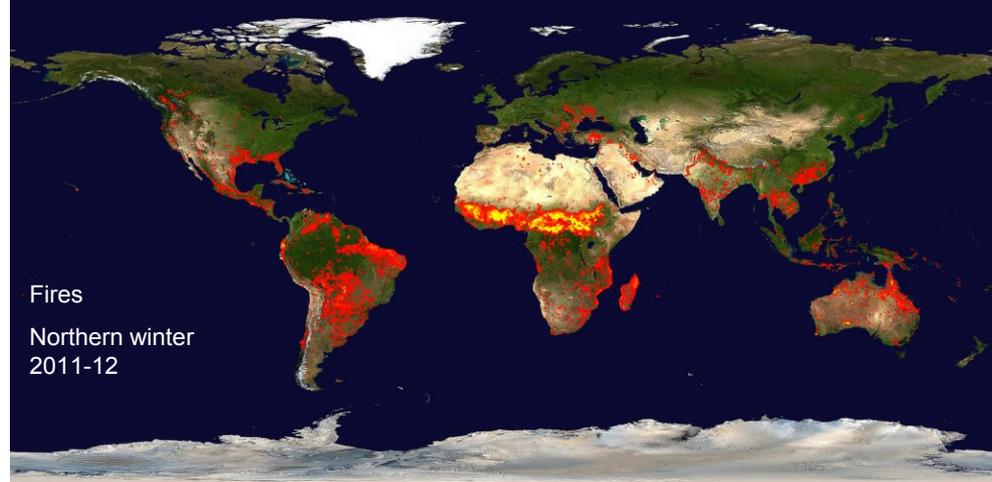


Papyrus swamp, Kajjansi airstrip, Uganda

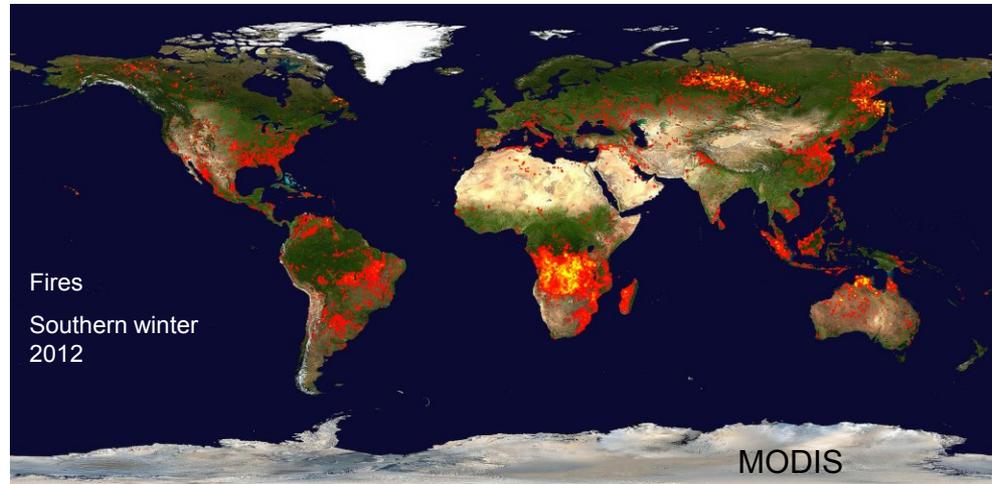
RHUL sampling to 3000m,  
Uganda and Ascension



Mission Aviation Fellowship  
Kajjansi, Uganda



Fires  
Northern winter  
2011-12



Fires  
Southern winter  
2012

MODIS

Tropical swamps; tropical  
grassfires, and the great *La Nina*  
of 2010-12

# The Arctic problem: isotopes show sources are wetlands in summer and gas in winter, **not** hydrate and permafrost emissions

*"There are known knowns....." D. Rumsfeld*

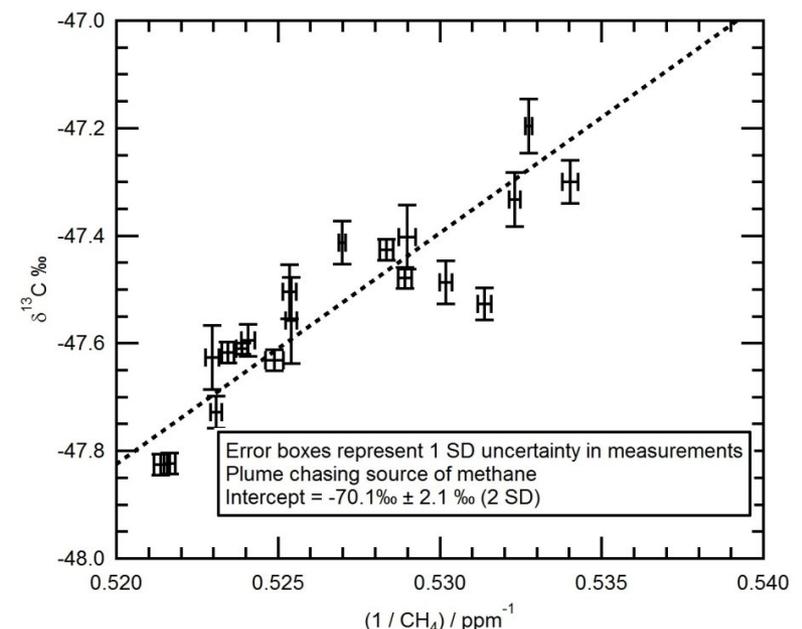
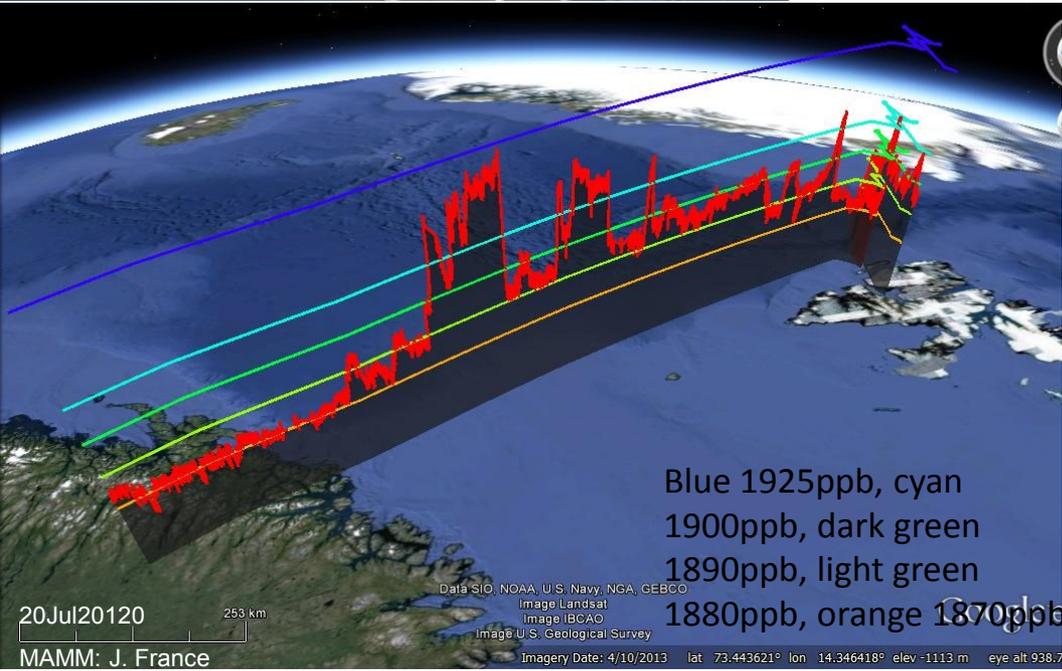
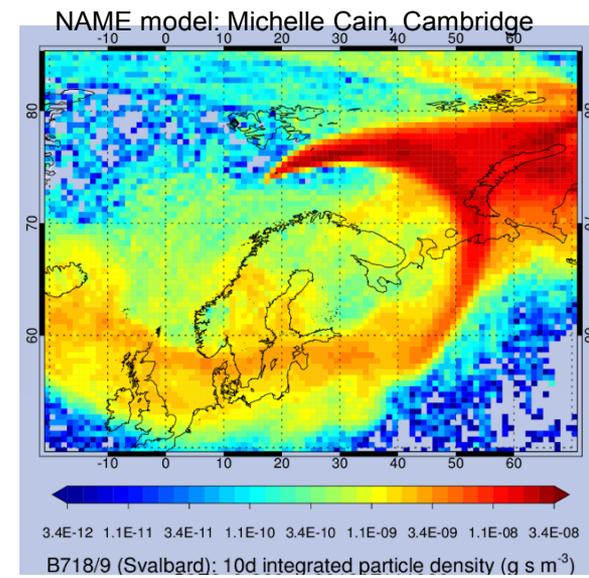


M. Lanoisellé

The Arctic has large potential methane sources from hydrate and thermokarst.

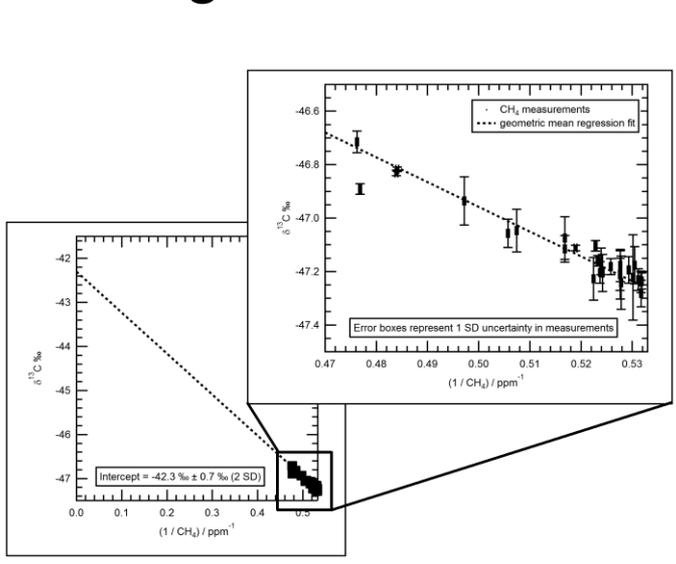
**Isotopic data suggest -70% source implying hydrate emissions to air are small**

But there may be future sustained moderate release of CH<sub>4</sub> as the sea warms and permafrost decays.



Source Keeling plot - aircraft samples NERC-MAMM 8

# Gas leaks - isotopic identification of the Total-Elgin leak's source (and flux).



**TABLE 1**  
*CH<sub>4</sub> mass fluxes and isotopic ratios from the Total Elgin gas leak.*

Date	Calculated flux (kg s <sup>-1</sup> ) (direct integration (White et al. 1976))	Calculated flux (kg s <sup>-1</sup> ) (2D Gaussian model (Turner, 1994))	$\delta^{13}C_{CH_4}$ (‰) ±2σ error
30 March 2012	1.3±0.2	0.8 to 1.4	-43.0 ± 0.5
03 April 2012	0.4±0.2	Not applied	-41.9 ± 1.0
Both Flights			-42.3±0.7 ‰

