



What can we learn from a climate model-data comparison for the Last Interglacial period?

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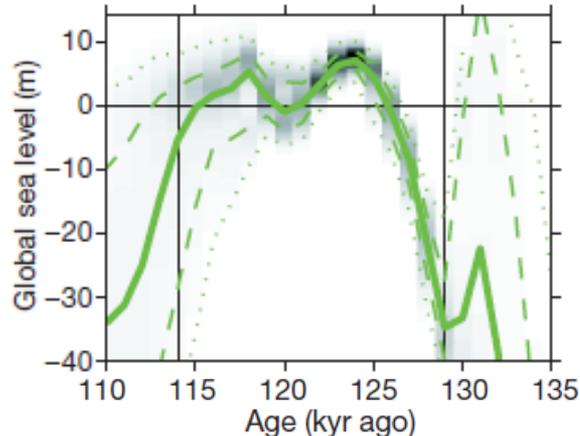
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Background

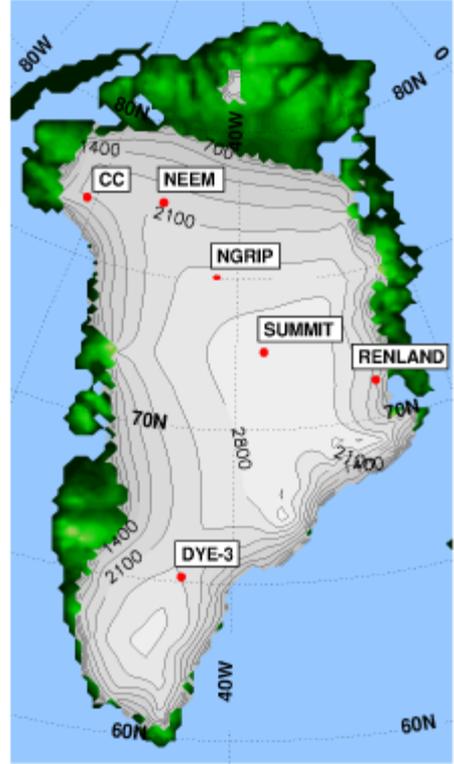
- Why the Last Interglacial?
- Why are we interested in the high latitudes?

LIG sea-level



(from Kopp et al. 2009)

Stone et al. (2013)



Background cont...

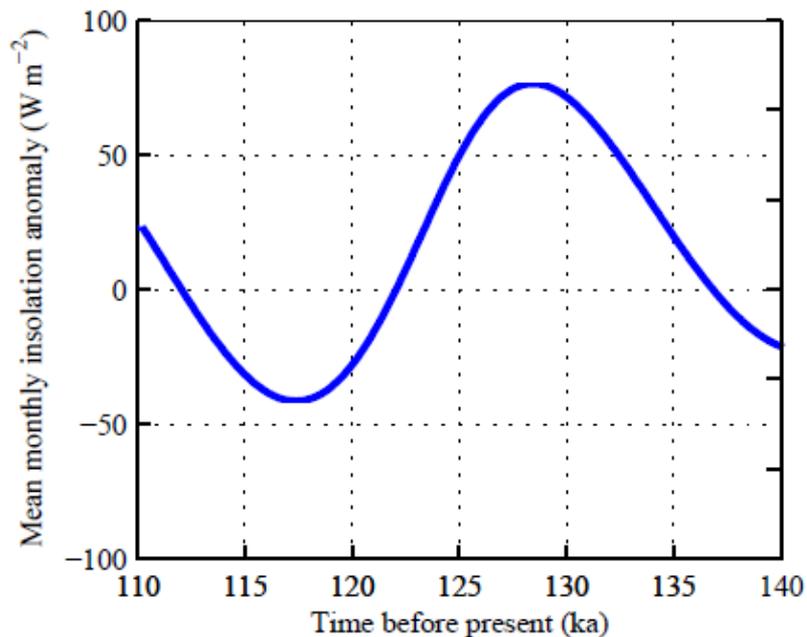
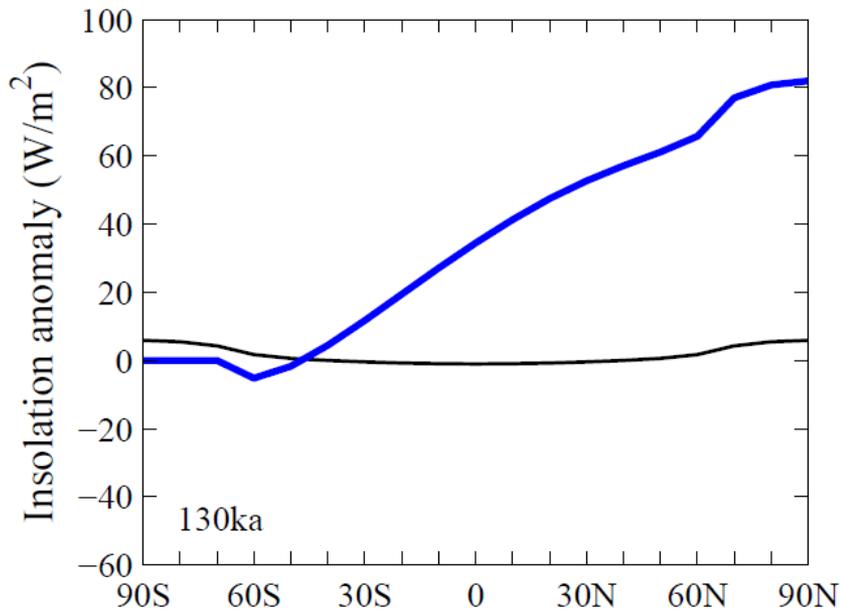
- Are patterns of temperature response coincident between the Northern and Southern Hemispheres in timing and magnitude?
- Can we replicate the patterns observed in the data record with a model?





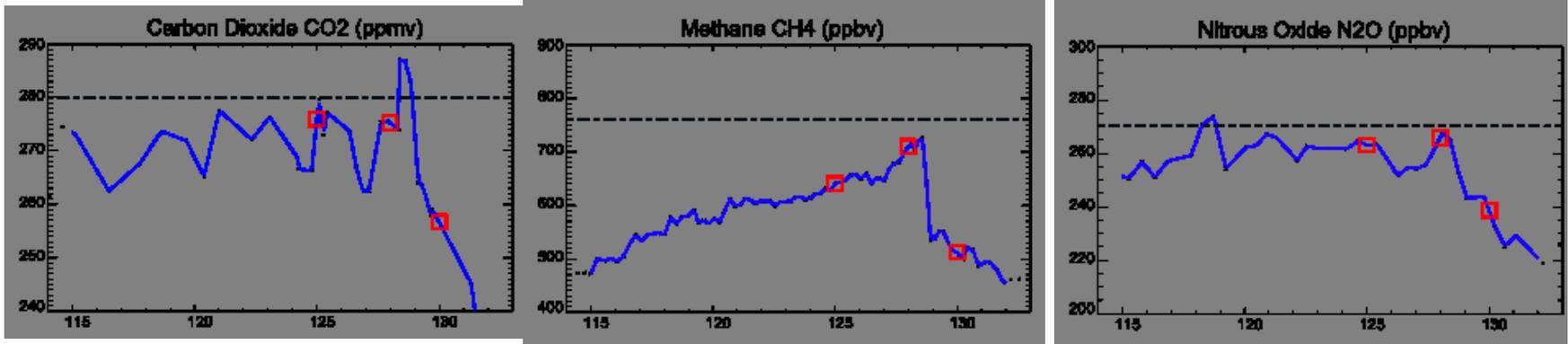
What causes the LIG warming?

Insolation changes

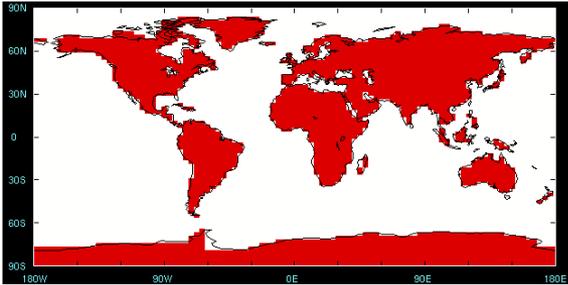
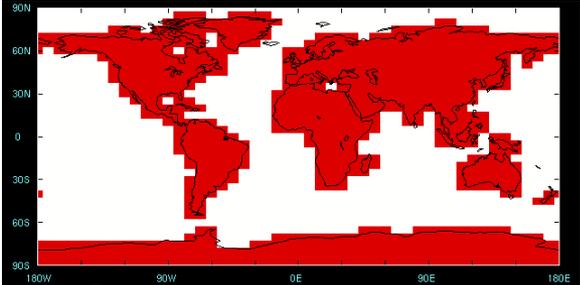


What causes the LIG warming?

Greenhouse gas changes



The models

	HadCM3	FAMOUS
Ocean resolution	1.25° x 1.25°	2.5° x 3.75°
Atmosphere resolution	2.5° x 3.75°	5° x 7.5°
Vertical layers in the atmosphere	19	11
Atmospheric time step	30 min	1hour
Land-sea mask		



Experimental design

HadCM3 = SNAPSHOTS

➤ 4 simulations of 500 model years: 130, 128, 125 and 0 ka (BP)

FAMOUS = TRANSIENTS

➤ 132-115ka

Changed orbital parameters (insolation) ✓

Changed GHGs ✓

Changed ice sheet ✗

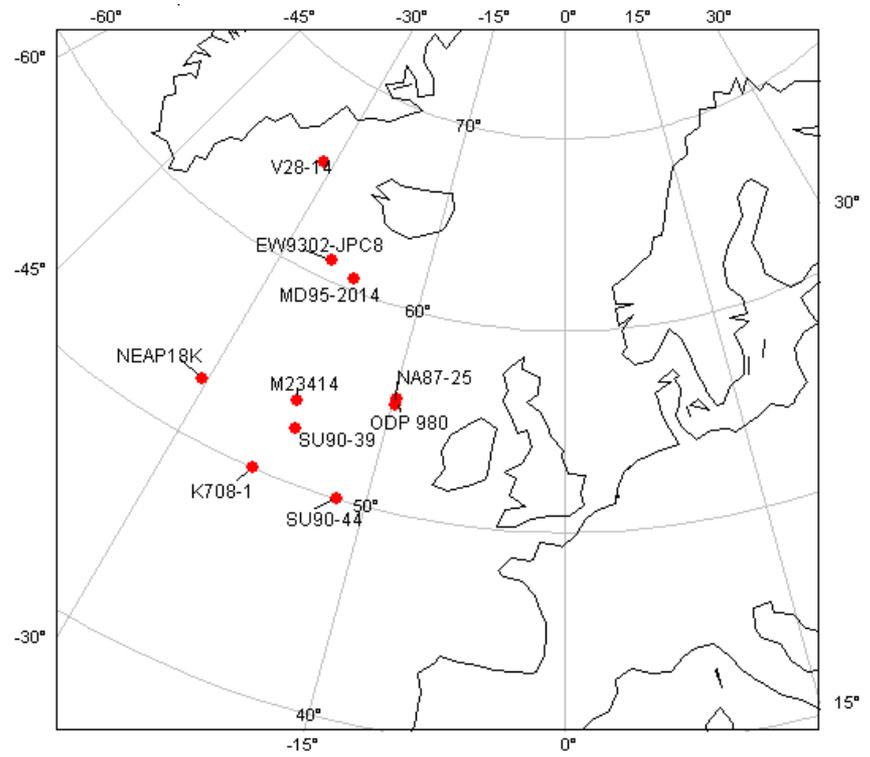
Vegetation feedbacks ✗

Freshwater forcing ✗





Temperature evolution in the North Atlantic



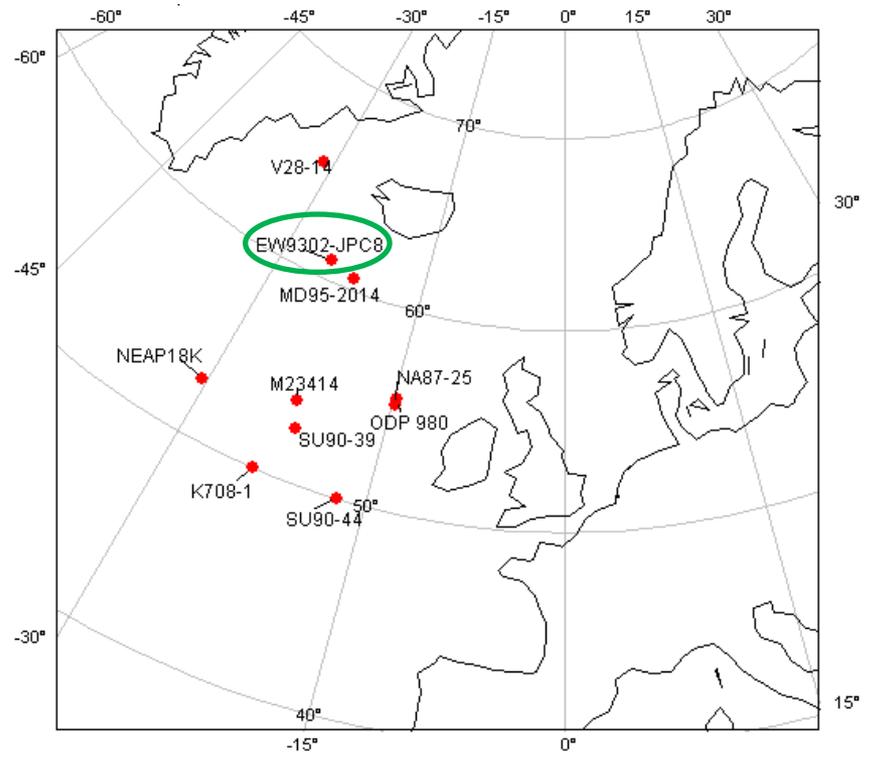
- Important since model comparison shows different behaviours of the thermohaline circulation during the LIG

- Proxy-based reconstructions of surface temperatures from the Norwegian Sea and the North Atlantic inconclusive on the timing of peak interglacial warmth



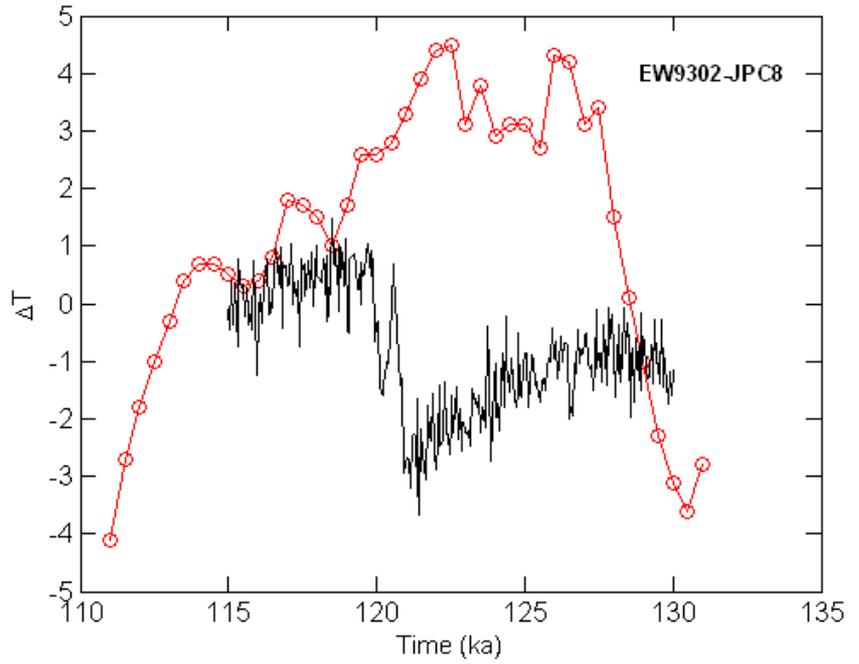
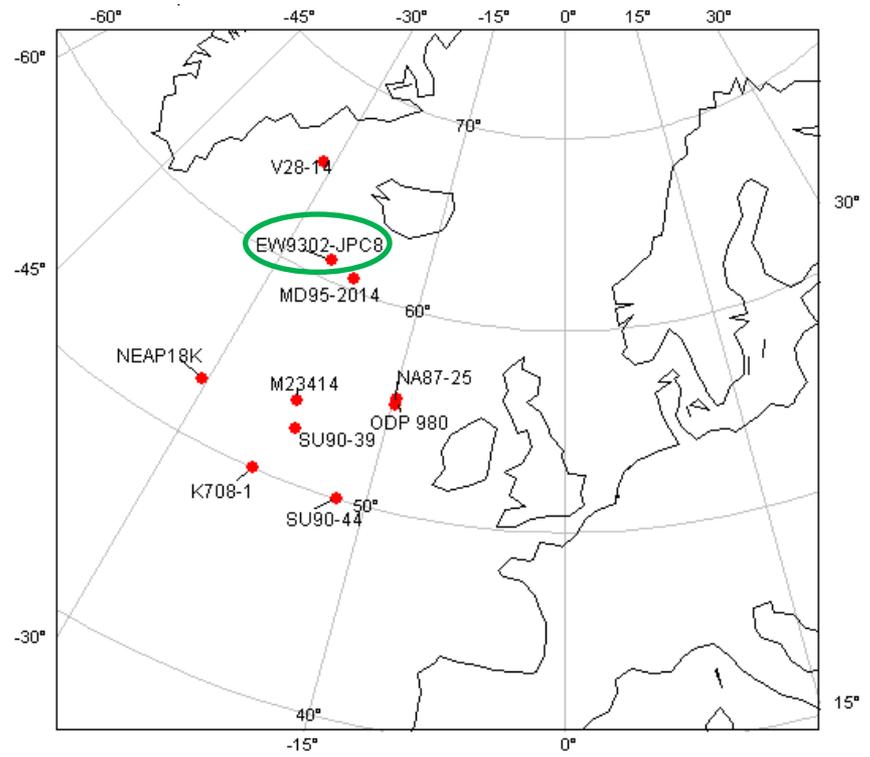


Temperature evolution in the North Atlantic





Temperature evolution in the North Atlantic

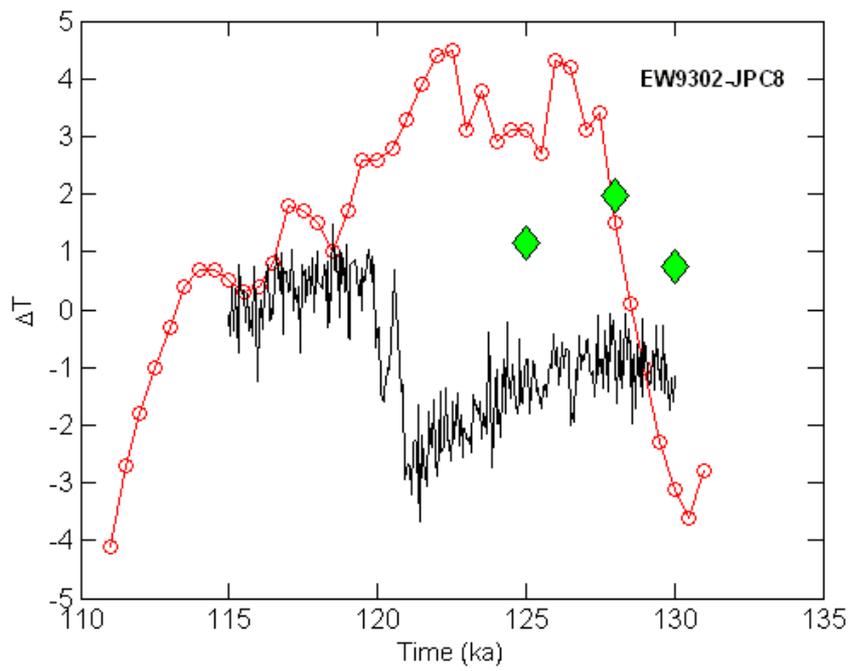
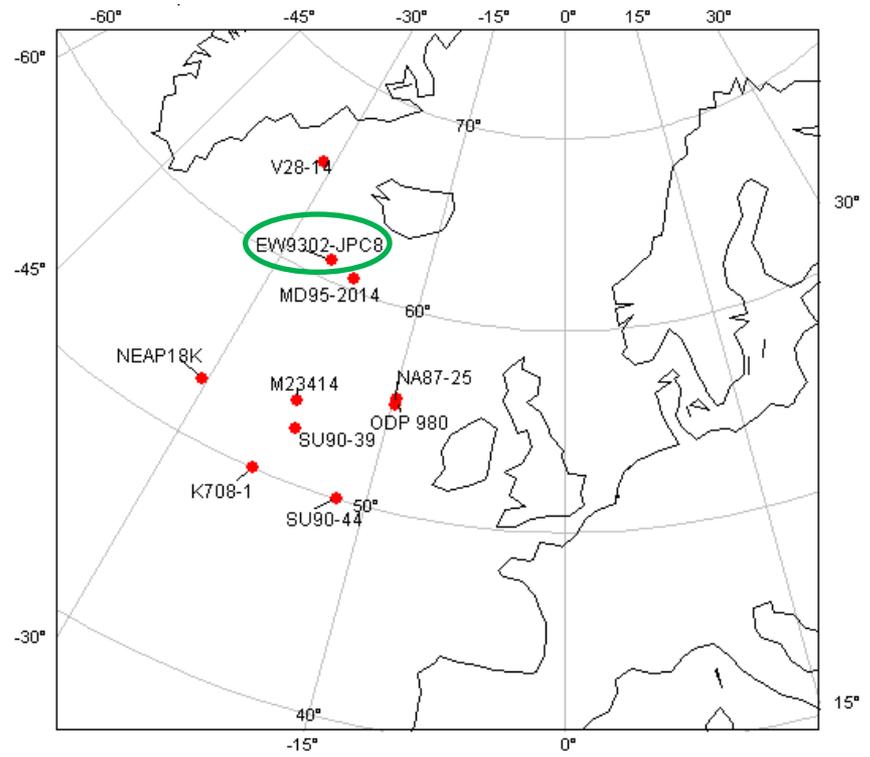


Data – JJA
 Model – JJA





Temperature evolution in the North Atlantic

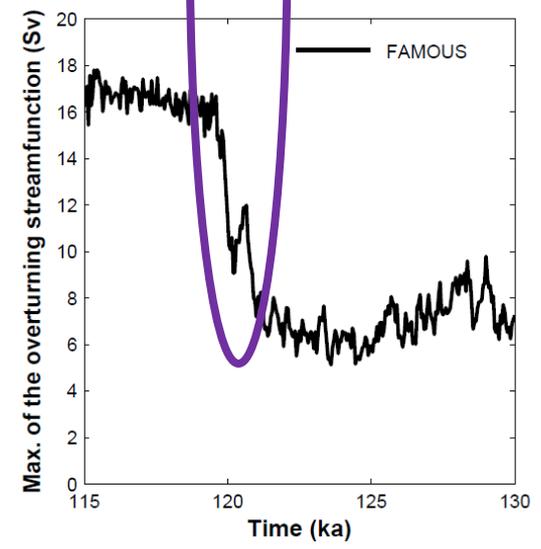
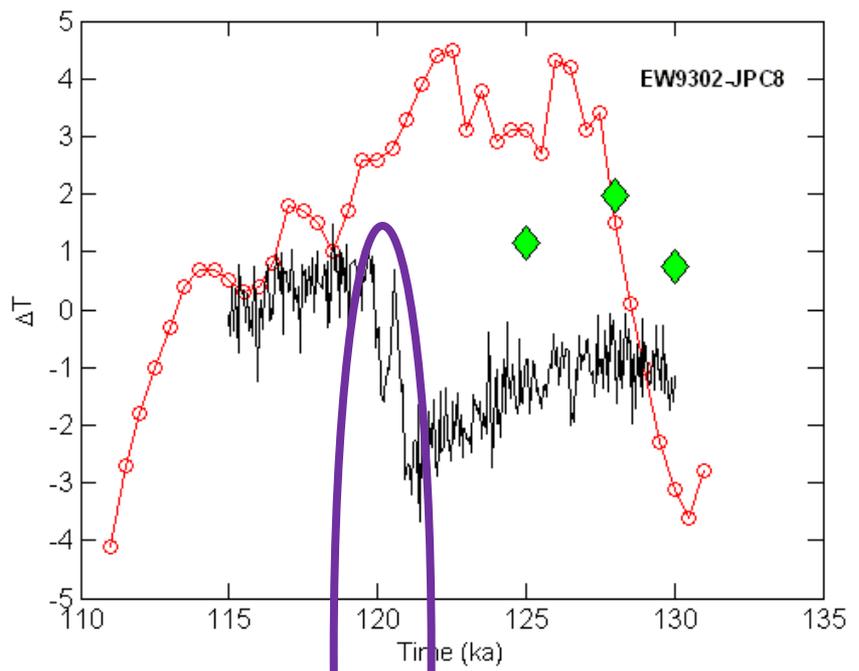
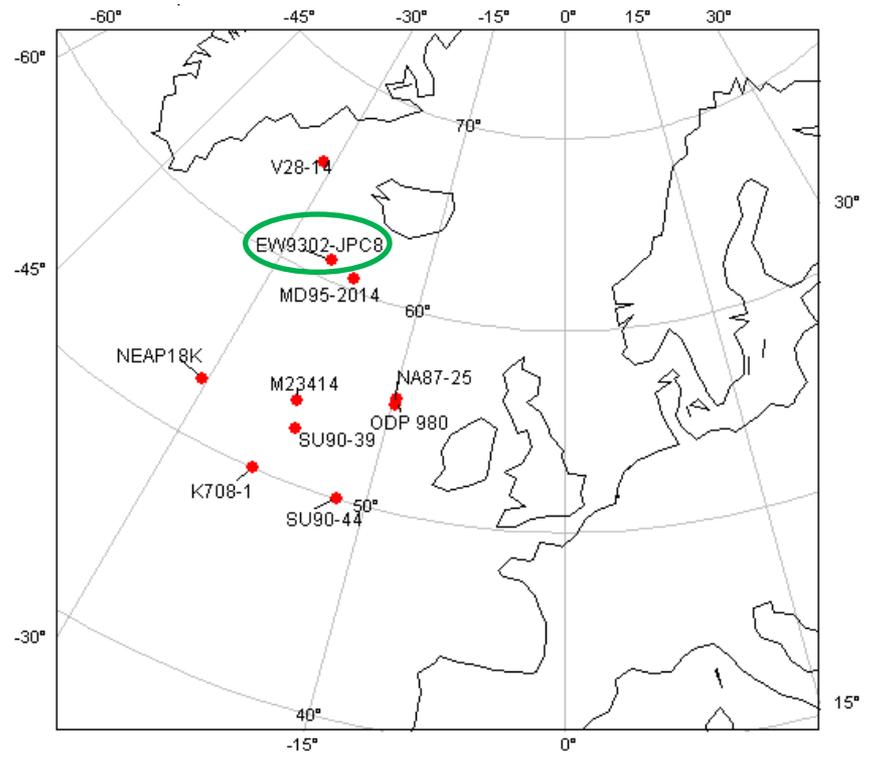


Data – JJA
 Model – JJA
 Snapshots – JJA



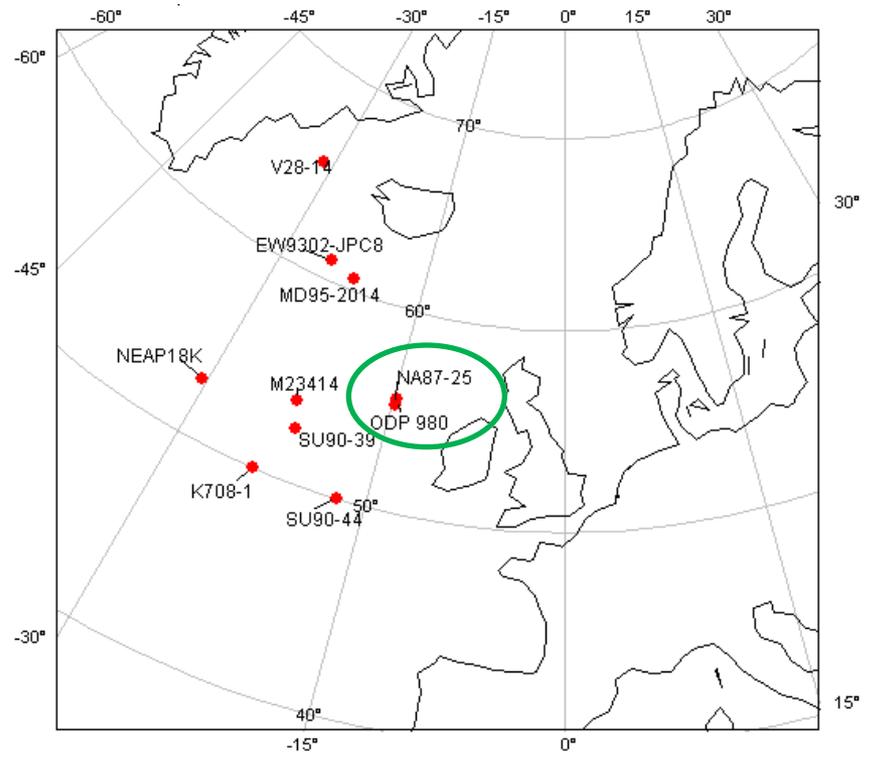


Temperature evolution in the North Atlantic



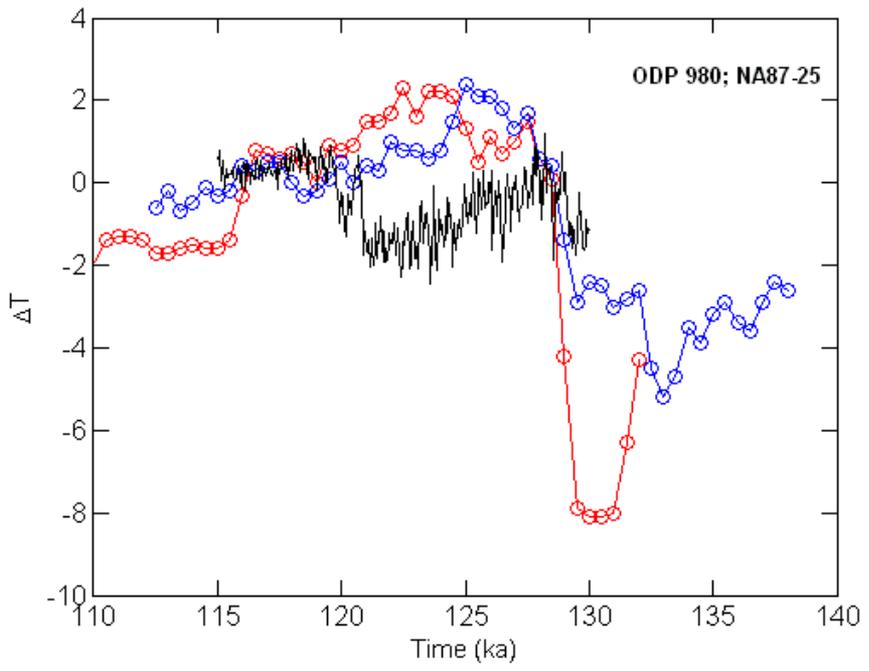
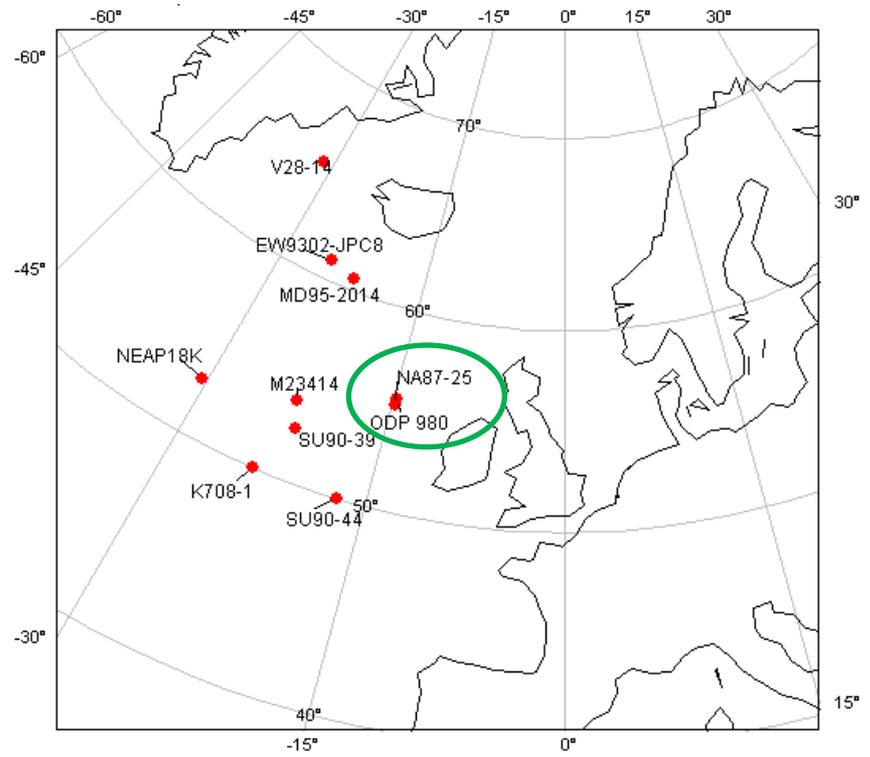


Temperature evolution in the North Atlantic





Temperature evolution in the North Atlantic

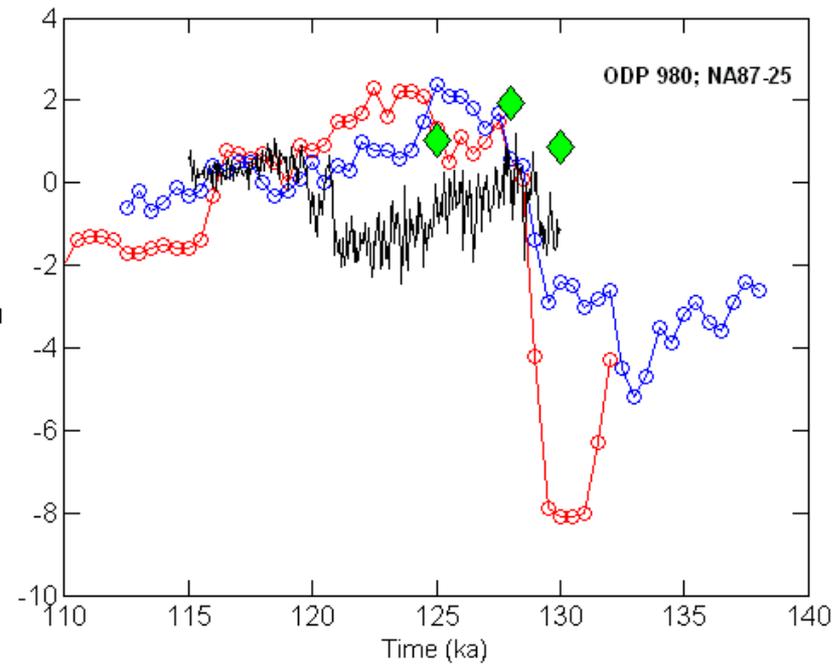
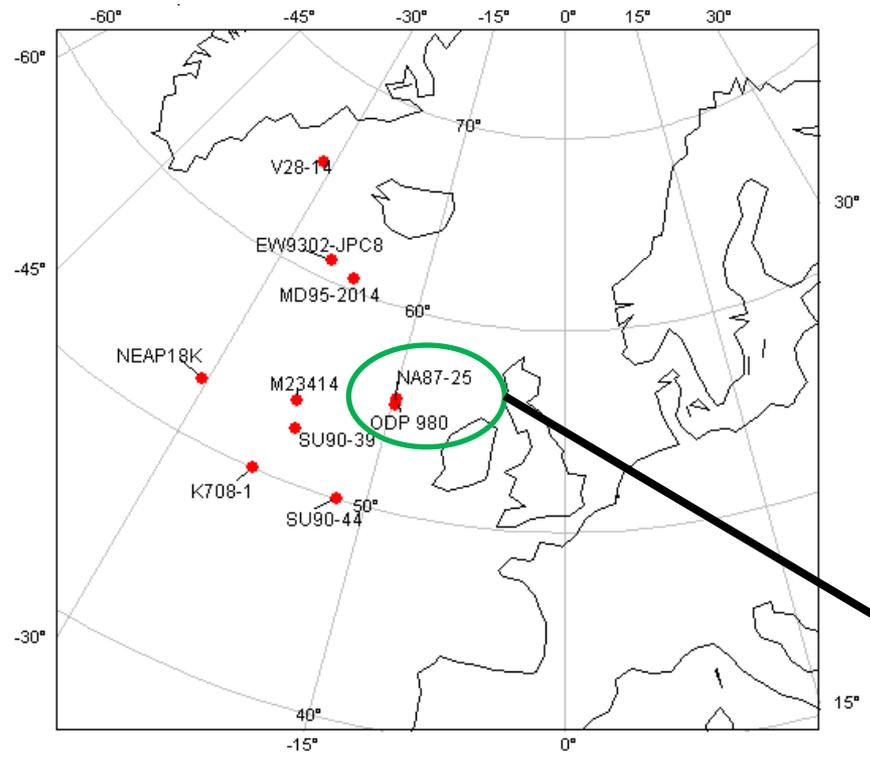


Data – JJA
 Data – JJA
 Model – JJA



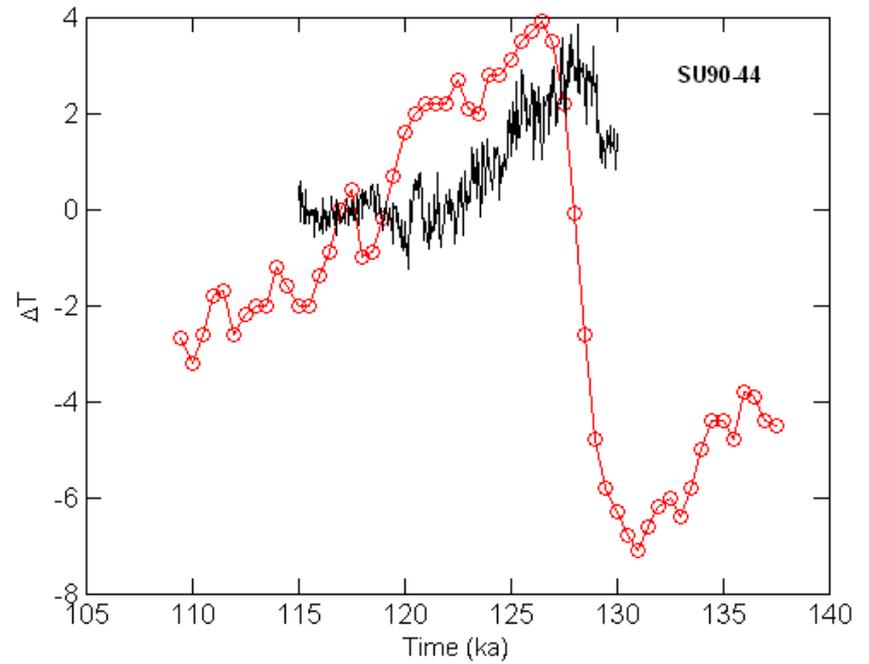
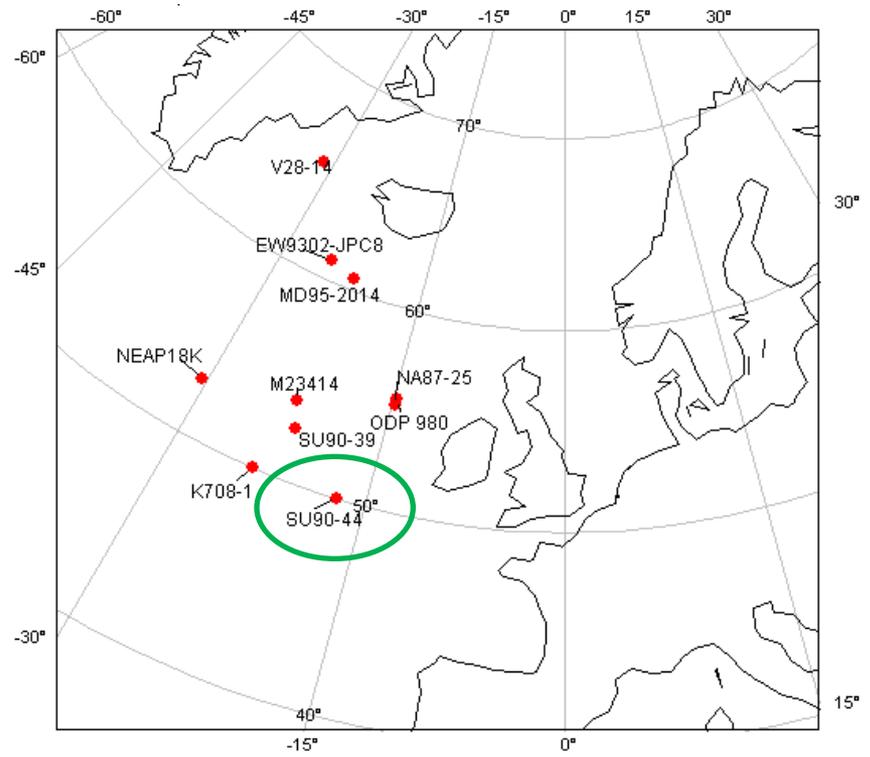


Temperature evolution in the North Atlantic





Temperature evolution in the North Atlantic

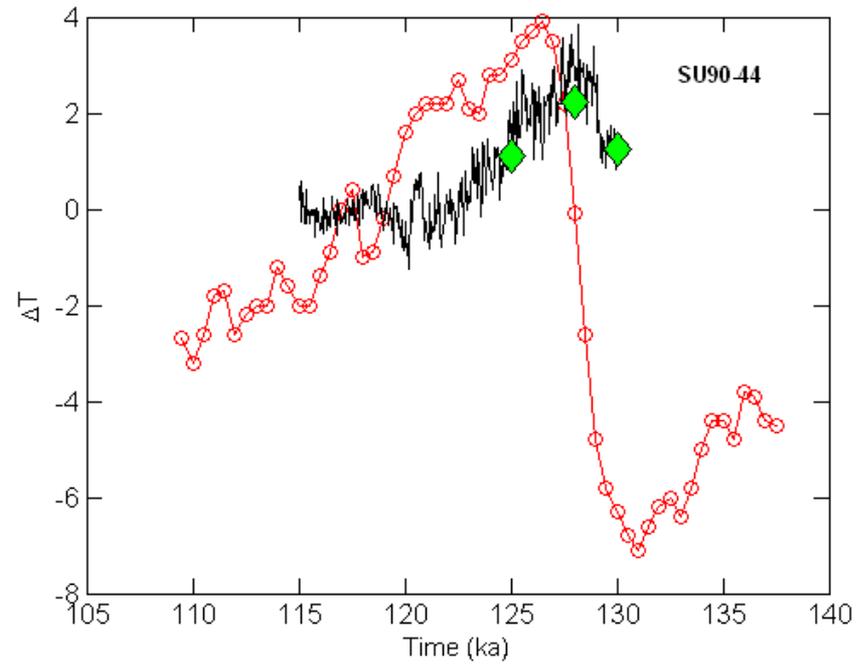
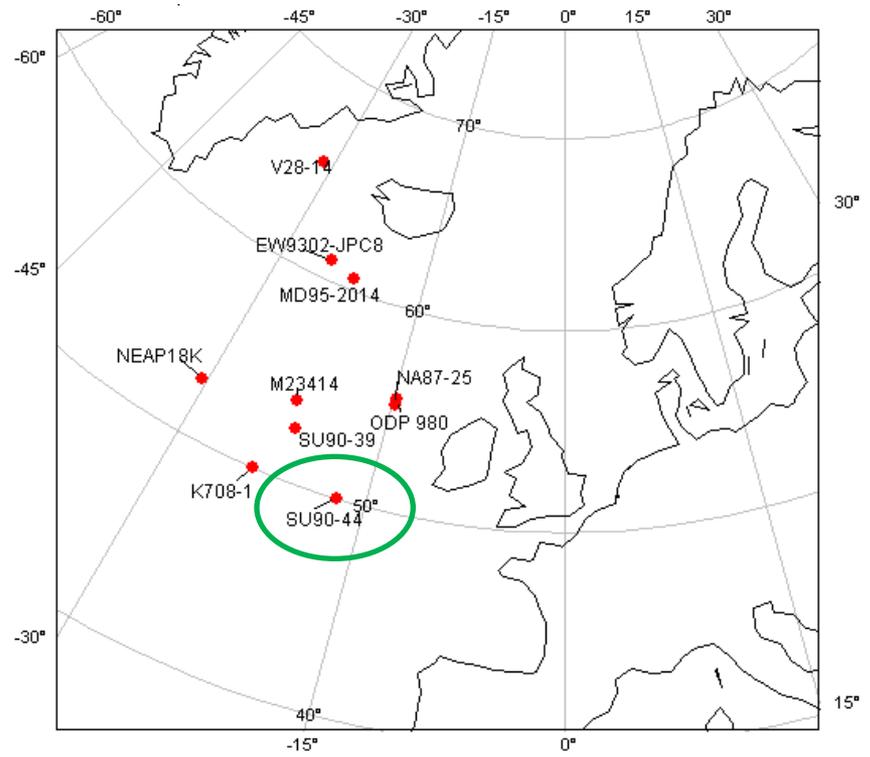


Data – JJA
 Model – JJA





Temperature evolution in the North Atlantic

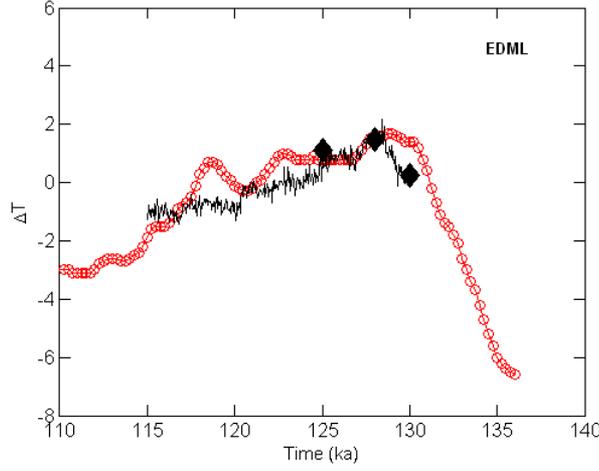
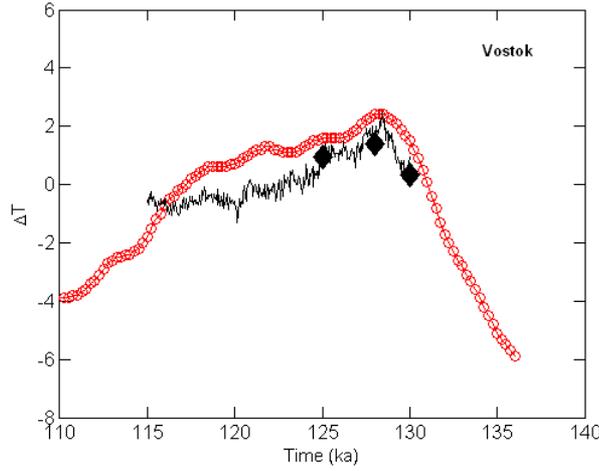
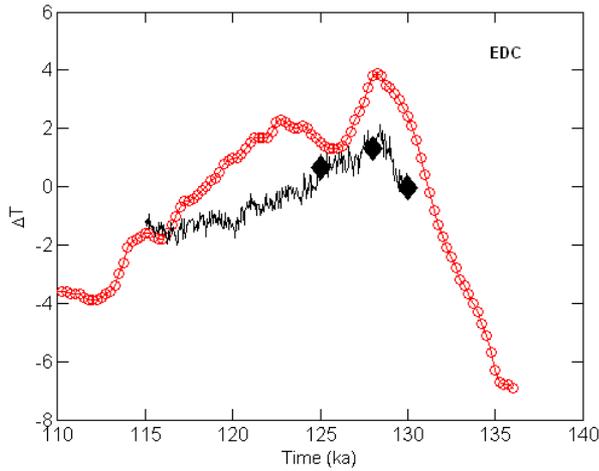
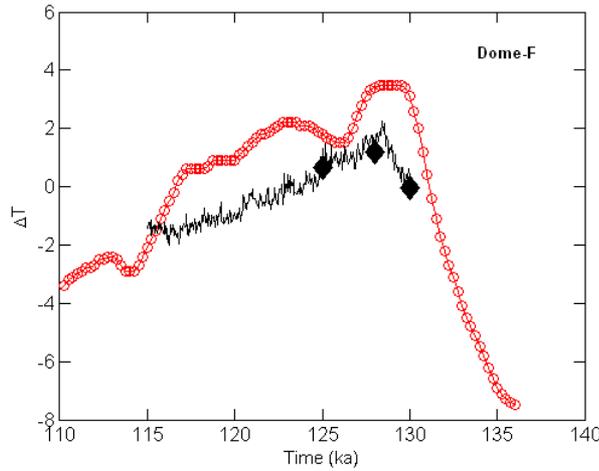
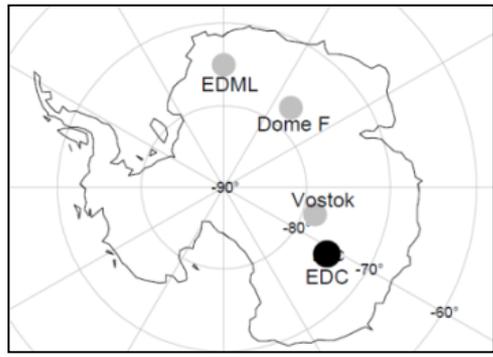


Data – JJA
 Model – JJA





Temperature evolution in Antarctica

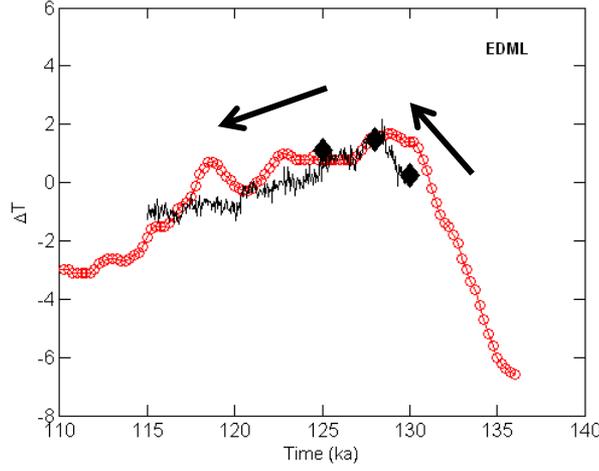
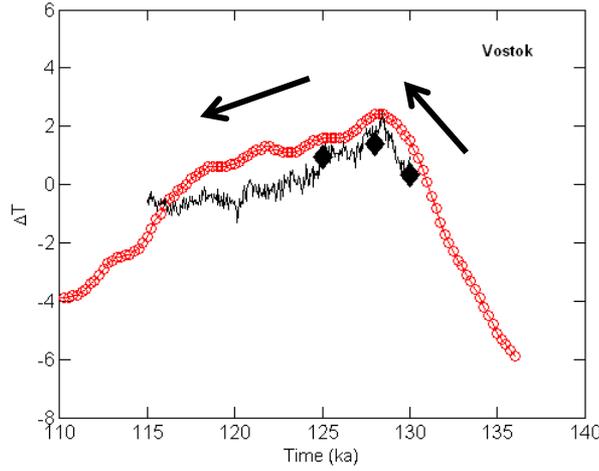
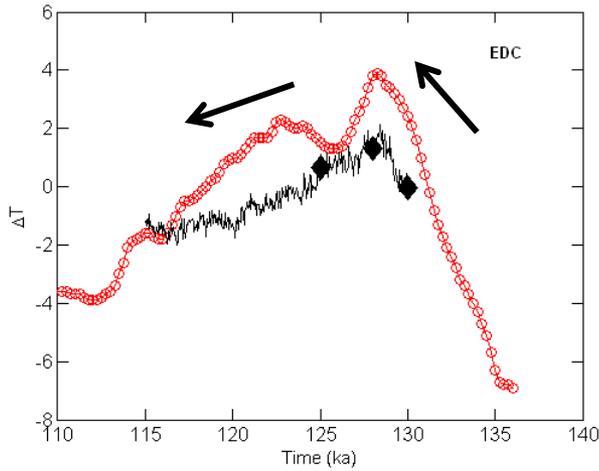
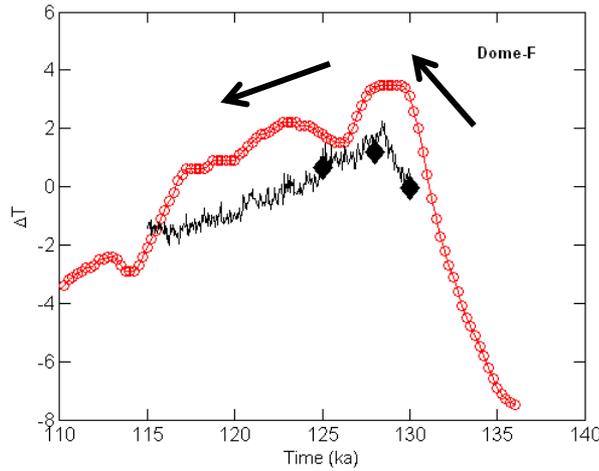
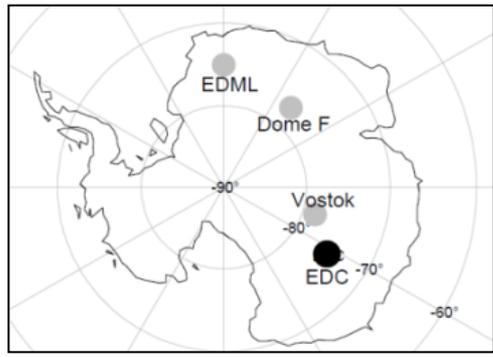


Data – annual
Model – annual





Temperature evolution in Antarctica

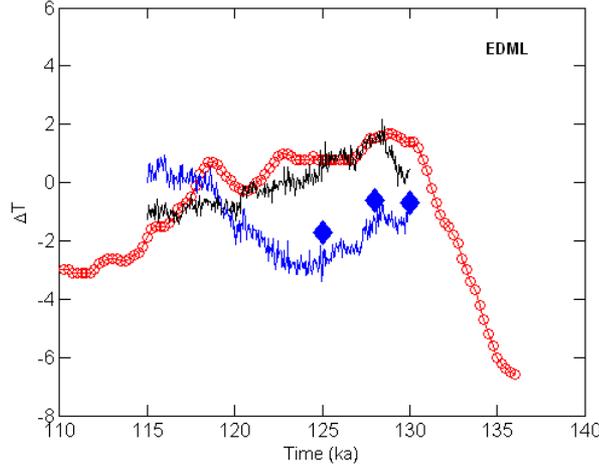
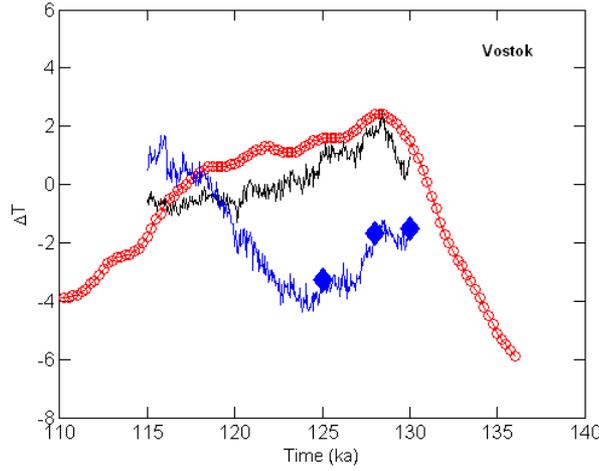
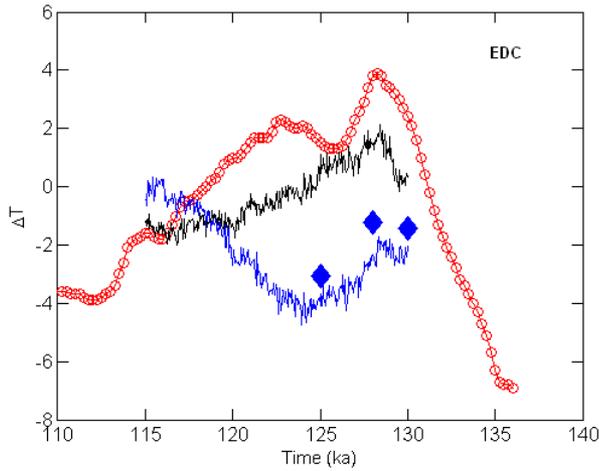
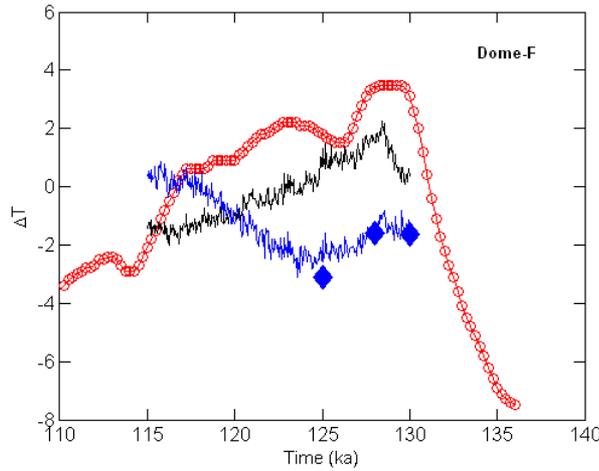
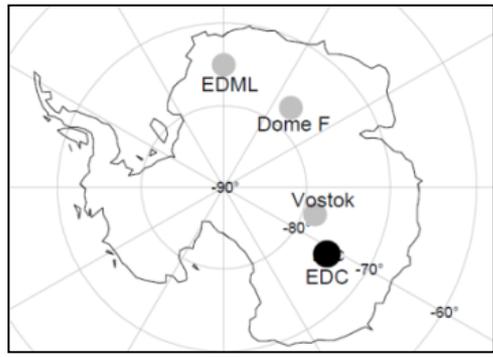


Data – annual
Model – annual





Temperature evolution in Antarctica

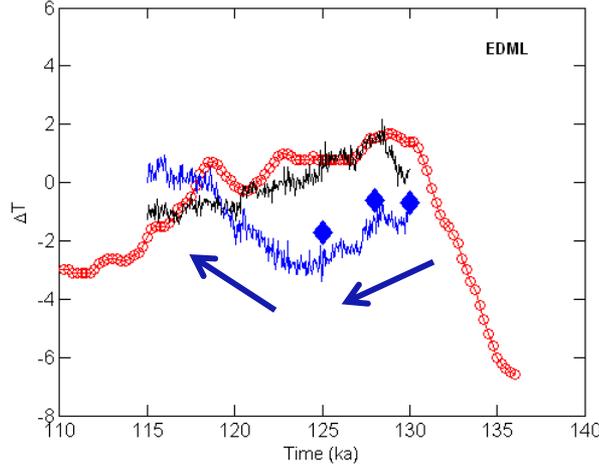
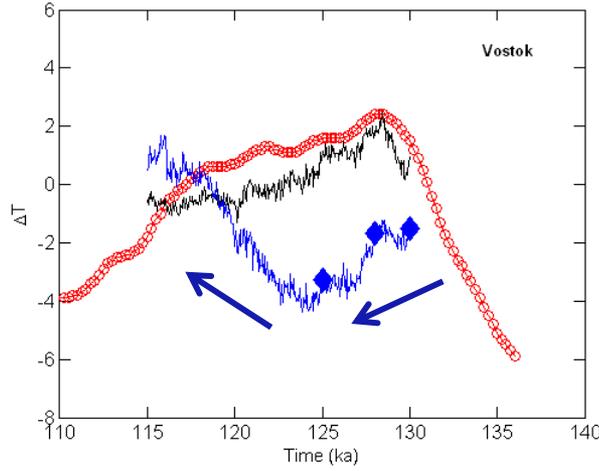
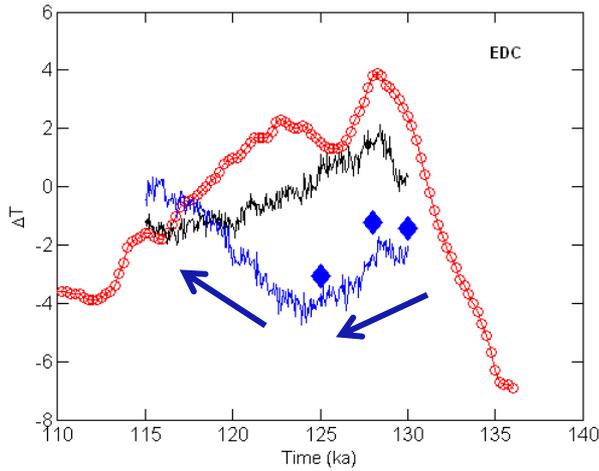
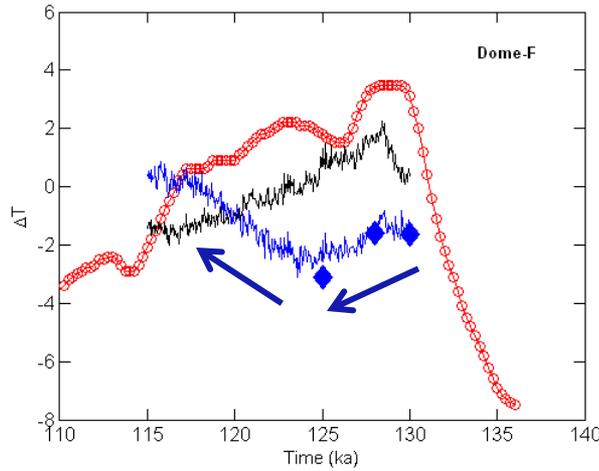
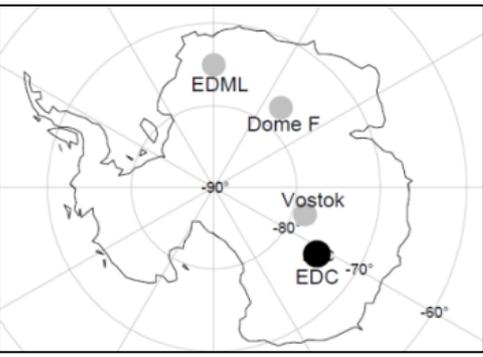


Data – annual
Model – annual
Model – DJF





Temperature evolution in Antarctica

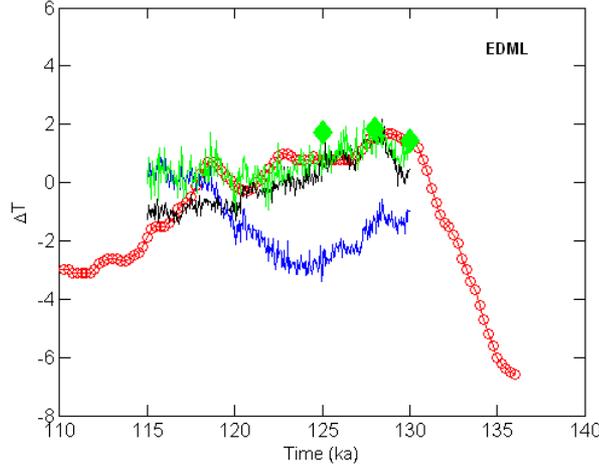
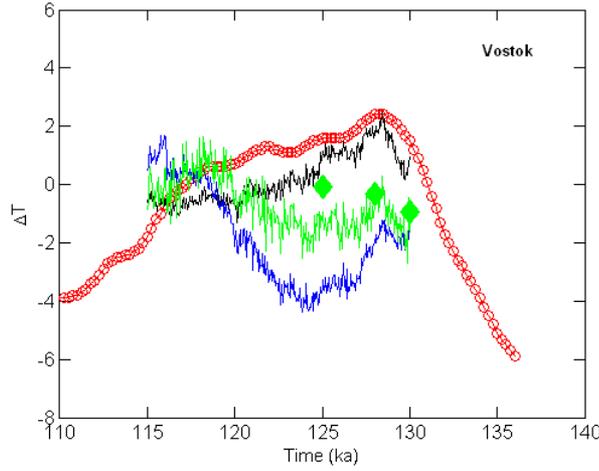
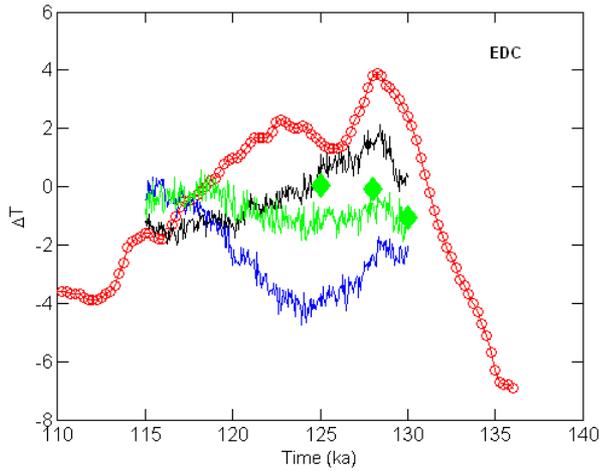
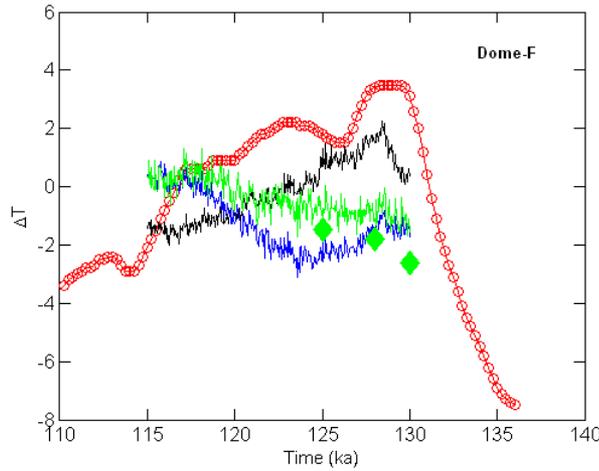
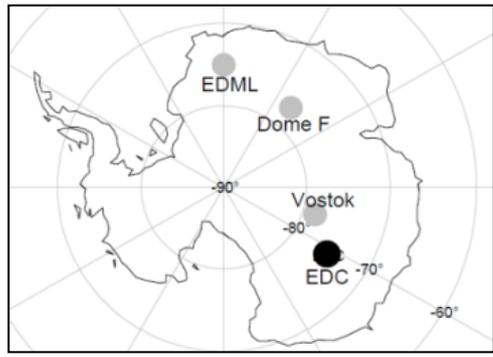


Data – annual
Model – annual
Model – DJF





Temperature evolution in Antarctica

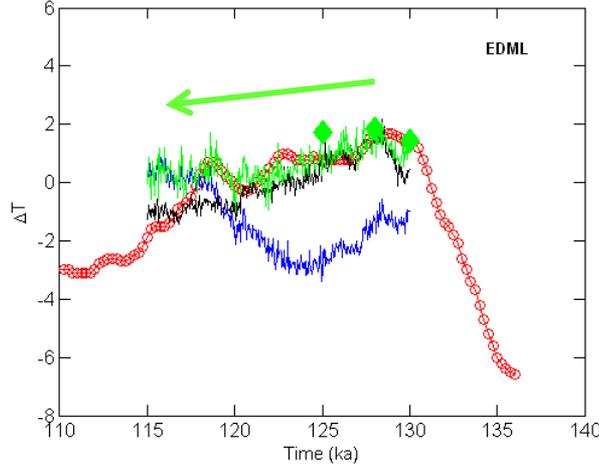
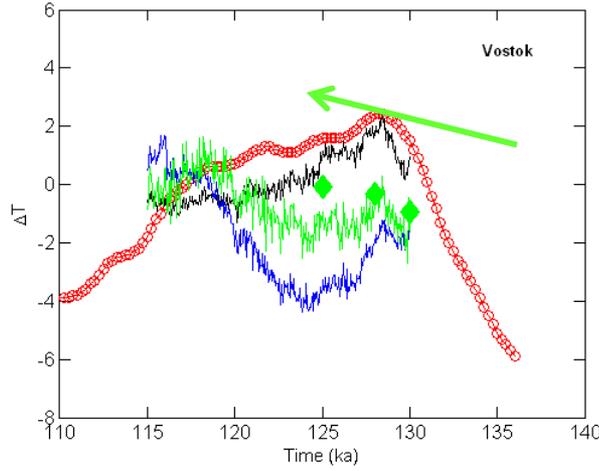
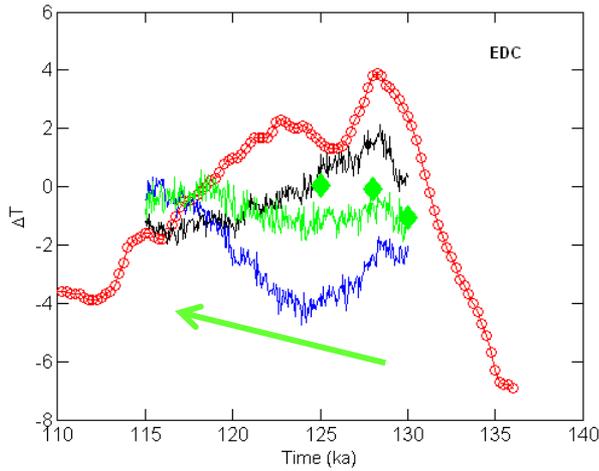
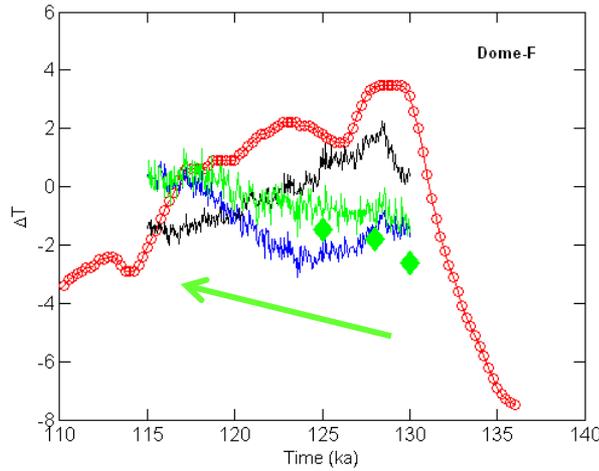
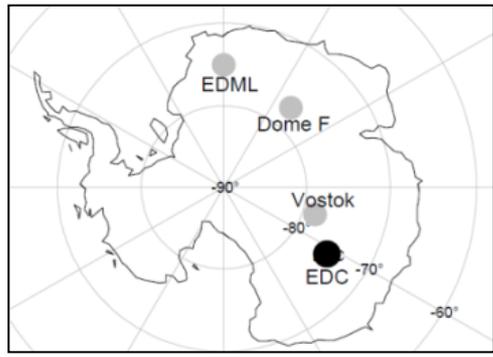


Data – annual
 Model – annual
 Model – DJF
 Model – ppt-weighted





Temperature evolution in Antarctica

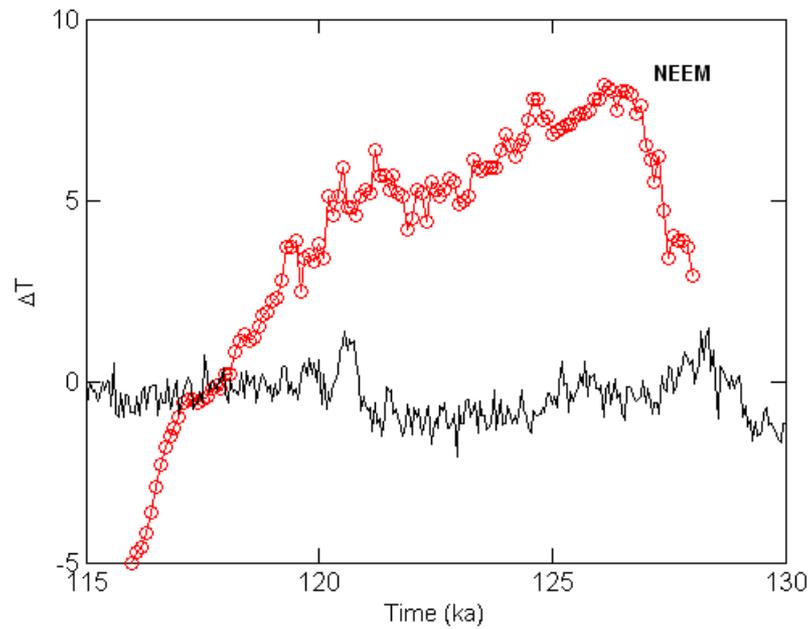


Data – annual
 Model – annual
 Model – DJF
 Model – ppt-weighted





Temperature evolution over Greenland

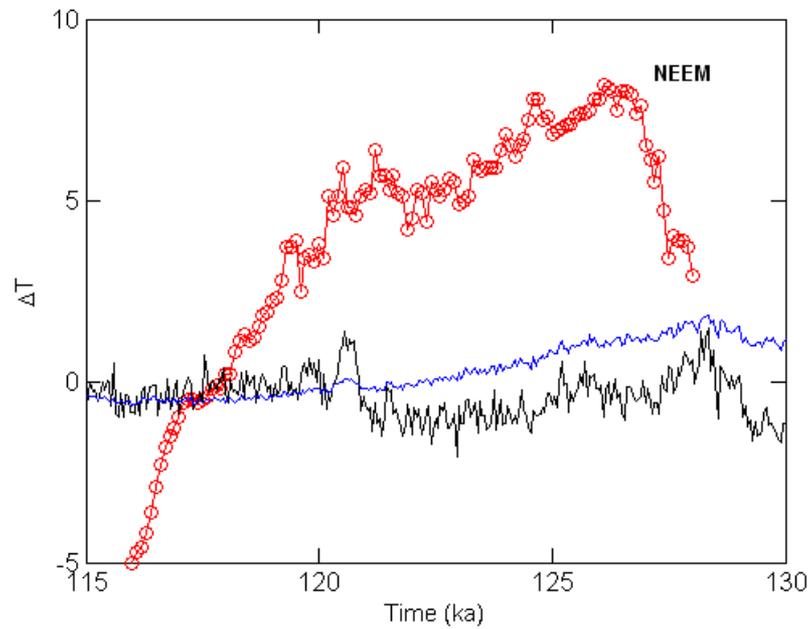


Data – annual
 Model – annual





Temperature evolution over Greenland

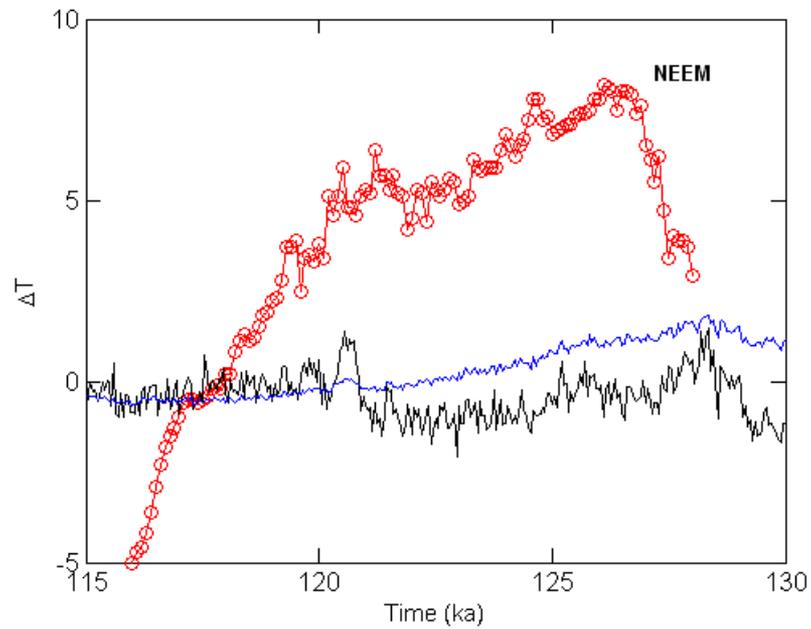


Data – annual
 Model – annual
 Model – JJA





Temperature evolution over Greenland



Model peak temperature precedes peak warmth from data

Model cannot replicate the magnitude of warmth



Concluding remarks and next steps

North Atlantic

- Peak LIG warmth out of phase between model and data at several locations
- Model changes related to THC slow down
 - Multi-model comparisons with palaeo-data required
- Variability between locations
 - Should we be averaging over a region instead of comparing at specific locations?
 - Consideration of sites to be chosen for more data acquisition

Antarctica

- Good agreement between *annual* model temperatures and data
- Out of phase when compared with model peak warmth (DJF)
- Precipitation-weighted temperatures dominated by DJF temperatures (when most precipitation falls in the model)

Concluding remarks and next steps

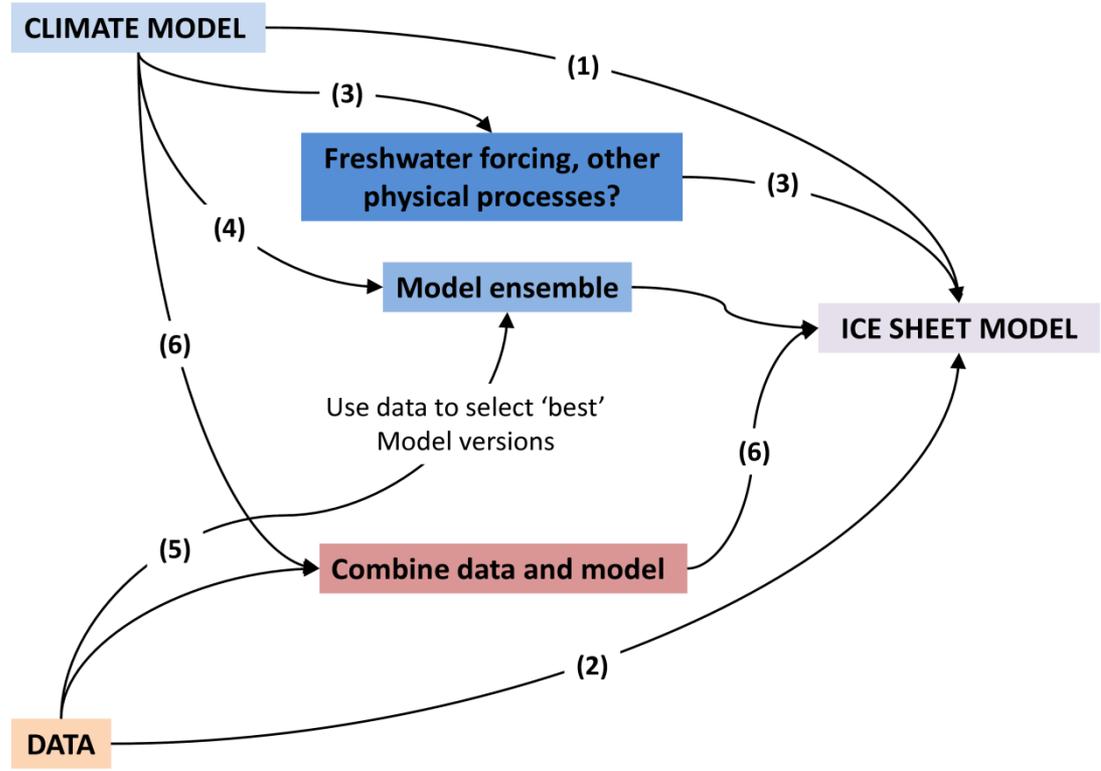
Greenland

- Earlier warmth shown in model compared with data
- Model cannot replicate the $\sim 8^{\circ}\text{C}$ warmth observed in the data
 - Missing feedbacks?
- **Warming occurs first in Northern Hemisphere then Southern Hemisphere in contradiction with the data**
 - Could be due to representation of physical processes in the model?
 - Lack of freshwater forcing? Timing needs to be considered. Bern3D model included freshwater hosing from remnant ice sheets resulting in delayed peak warmth.



Concluding remarks and next steps

- Possible next directions.....



Thank you

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