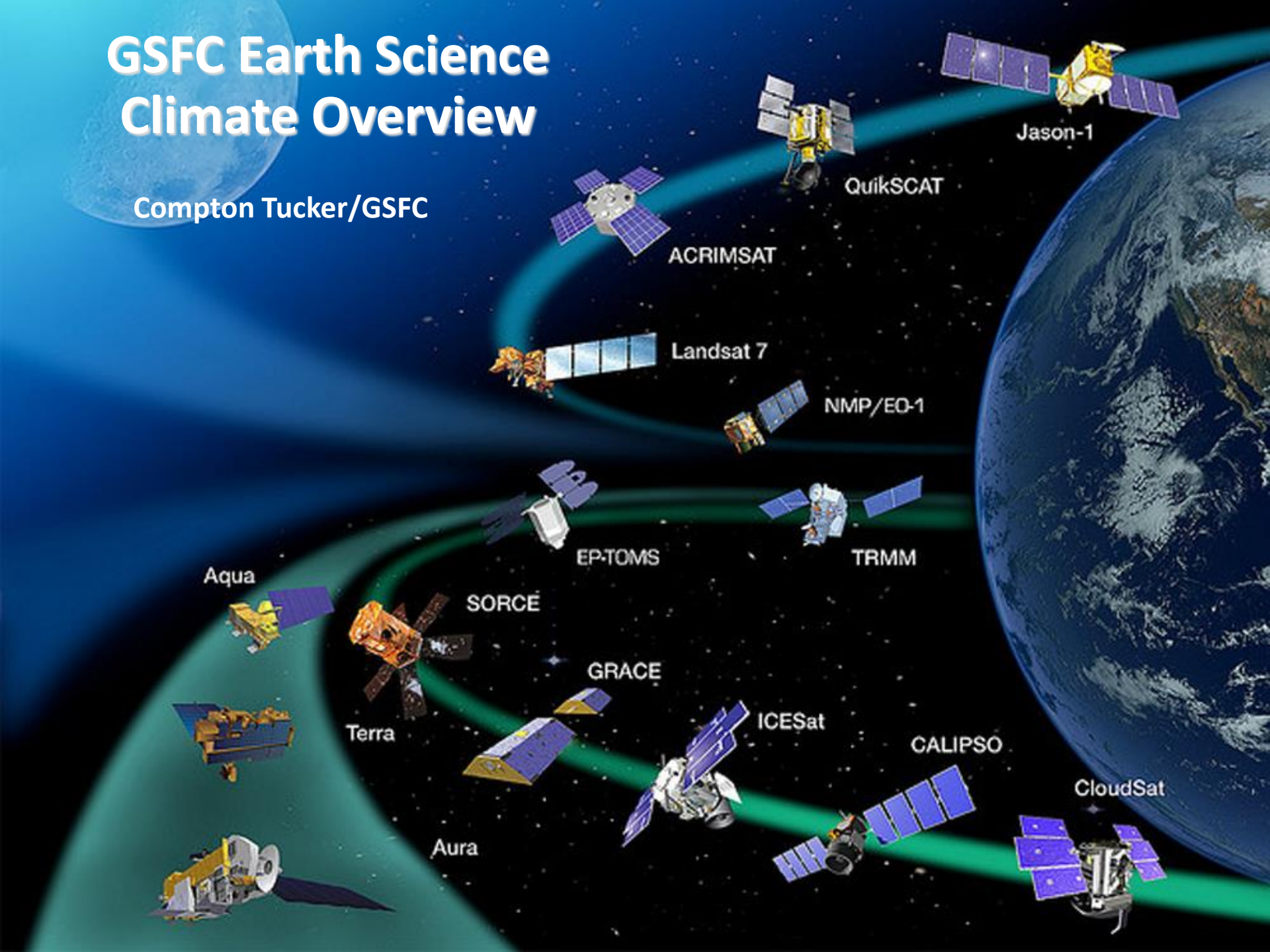
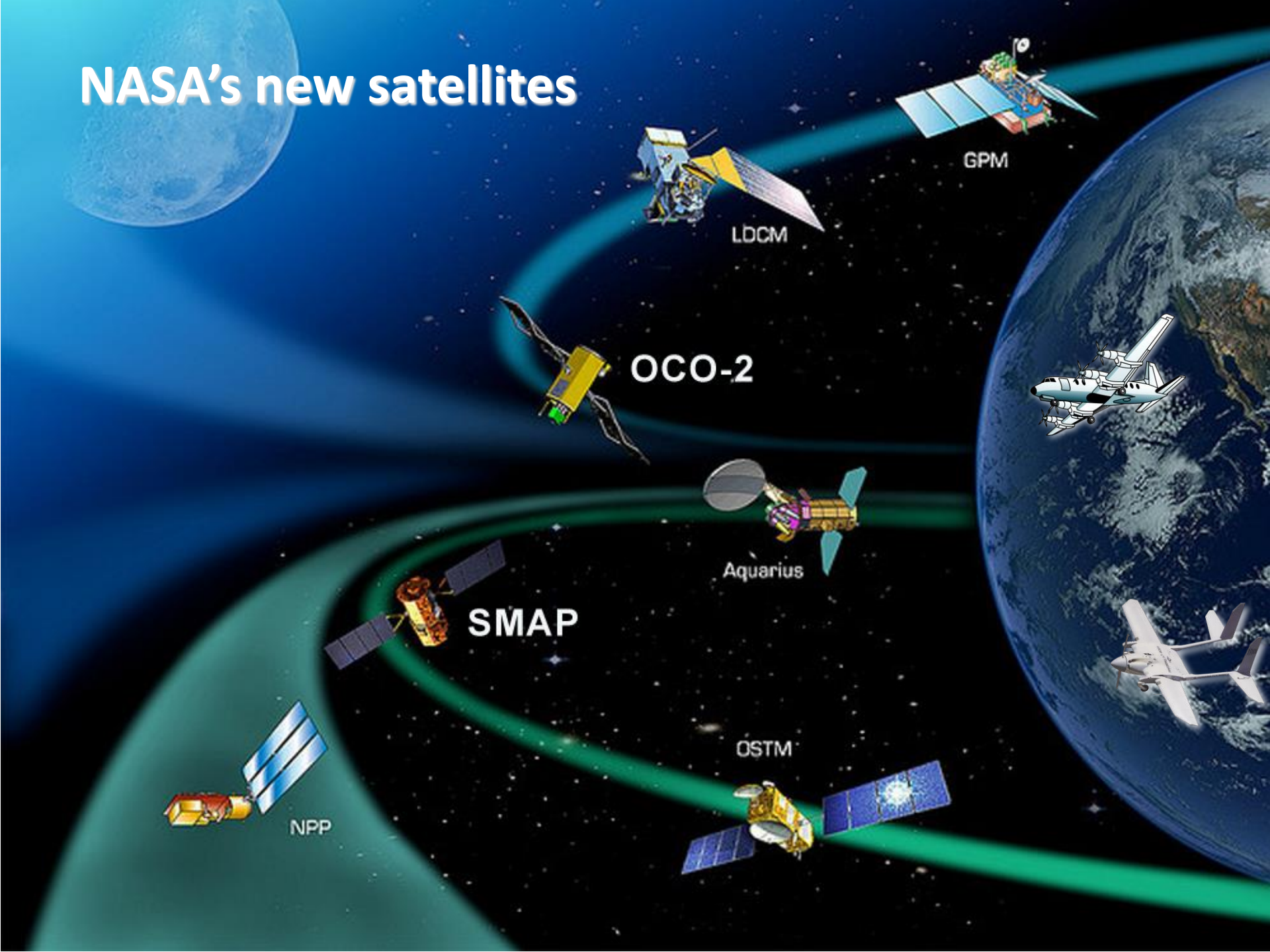
GSFC Earth Science Climate Overview

Compton Tucker/GSFC



NASA's new satellites

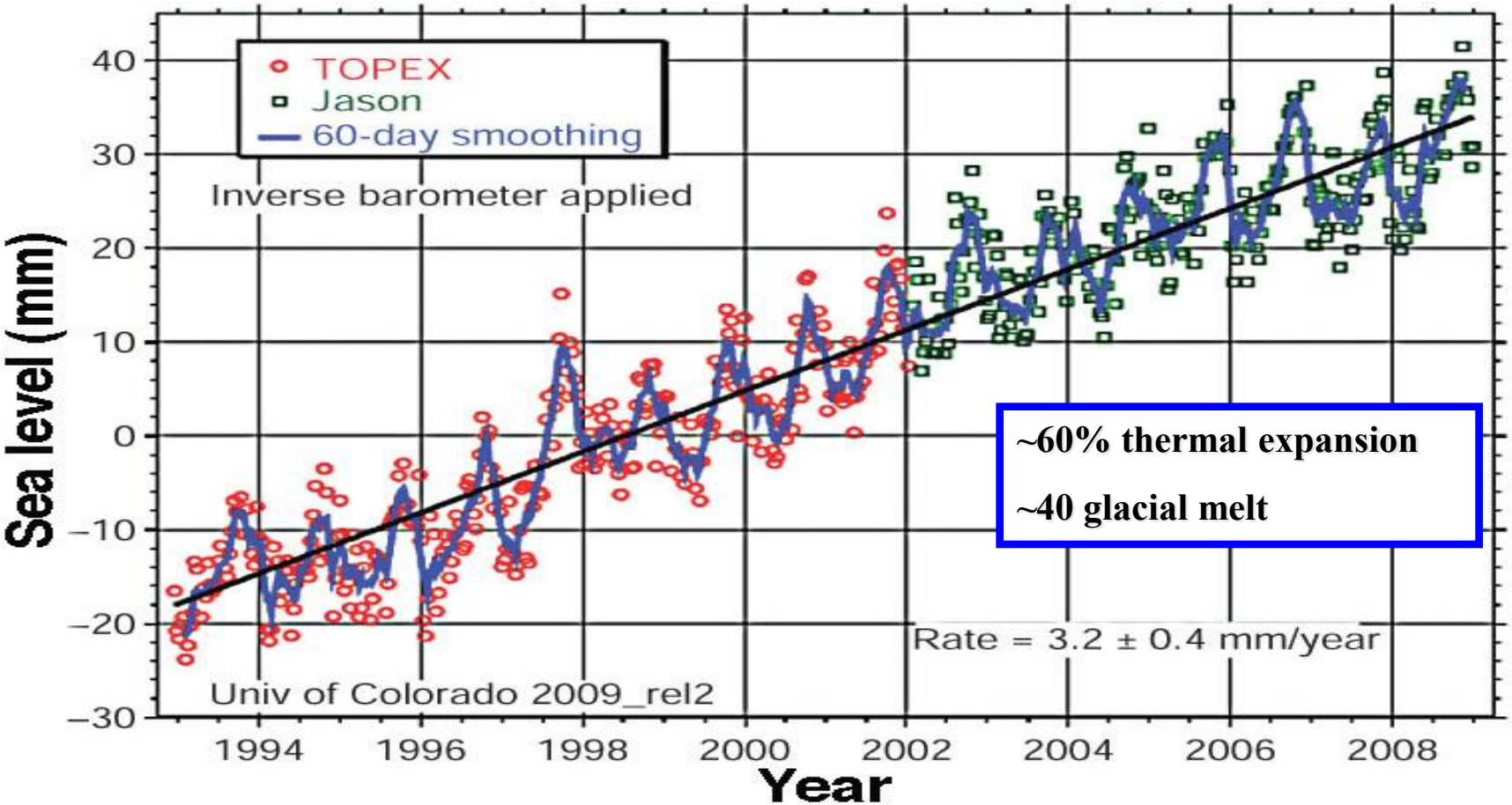


Is the Earth Warming?

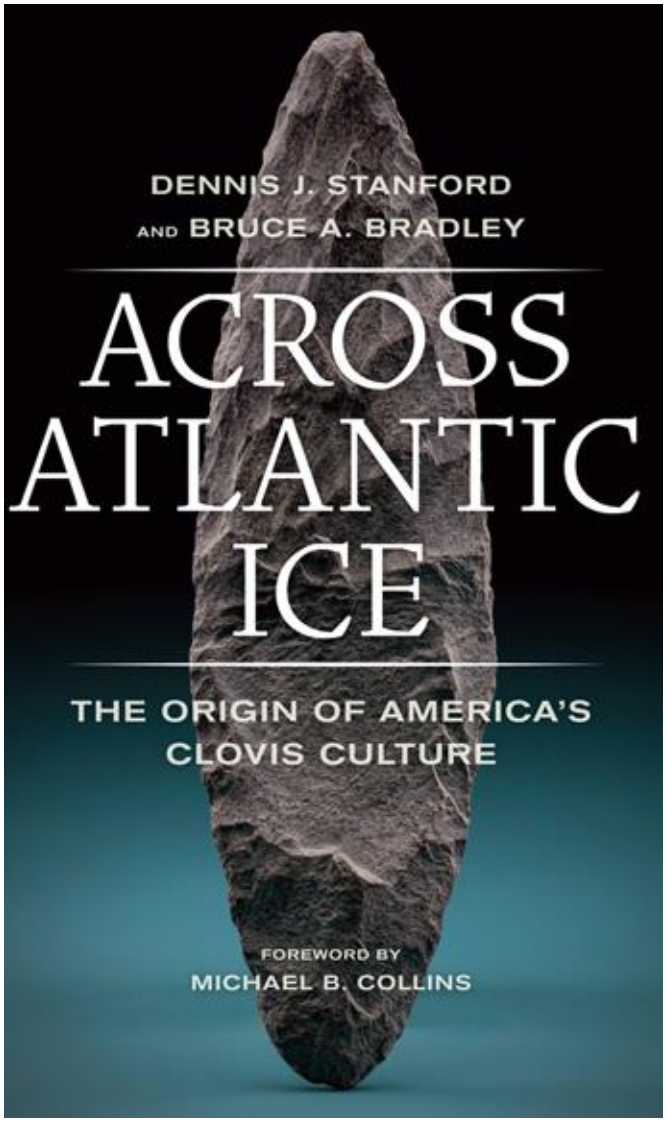
- Sea level — rising
- Sun — no change
- Ocean temperatures — increasing
- Glaciers — melting
- Sea Ice
- Surface thermometers — increasing
- Atmospheric temp. — increasing

Global Warming—Keep it Simple

- The Earth warms, sea level rises
- The Earth cools, sea level falls

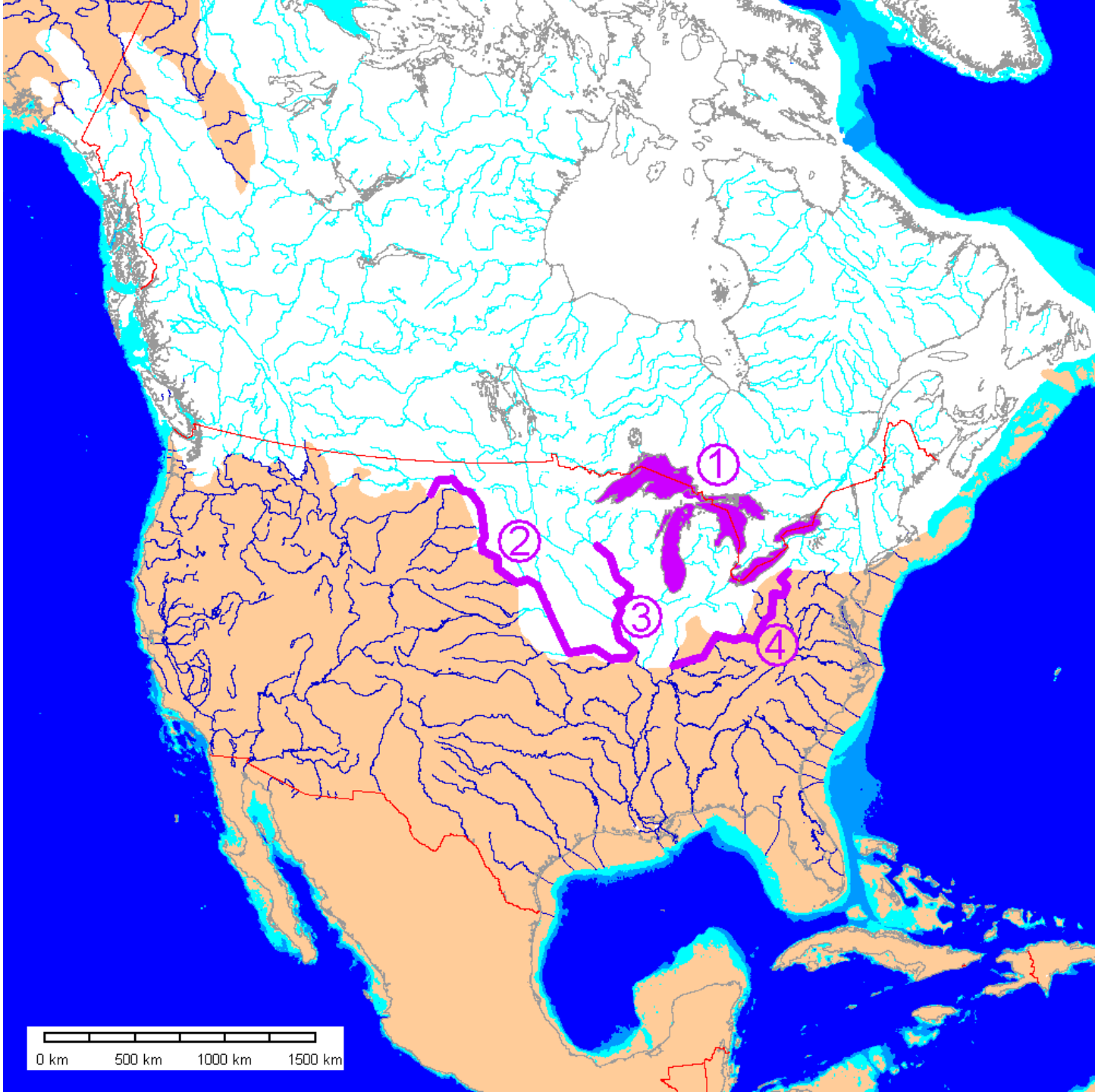


Global Warming—Keep it Simple
The Earth warms, sea level rises



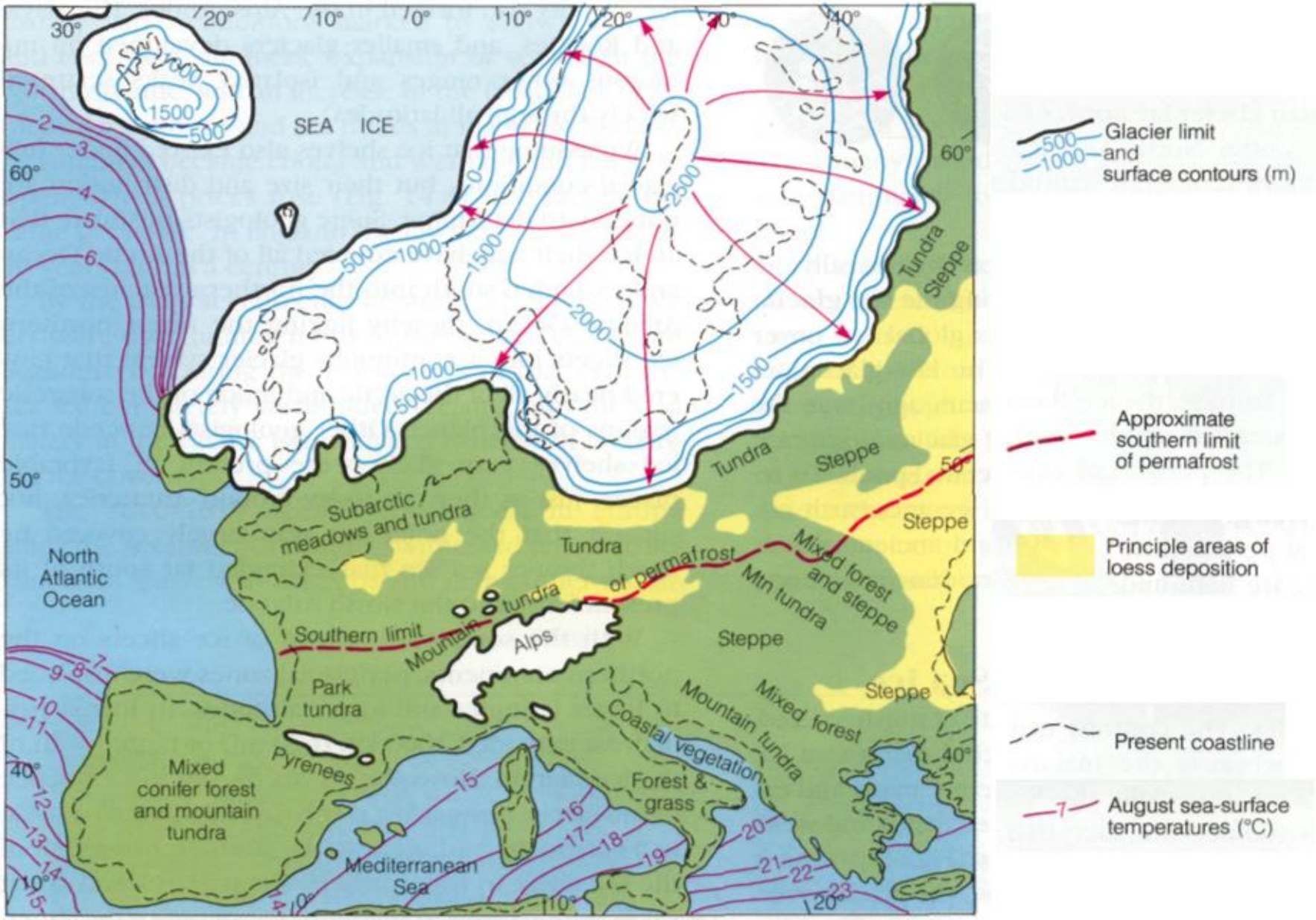
At the maximum extent of the last ice age, sea level was over 400 feet lower.

Florida was about twice its current size

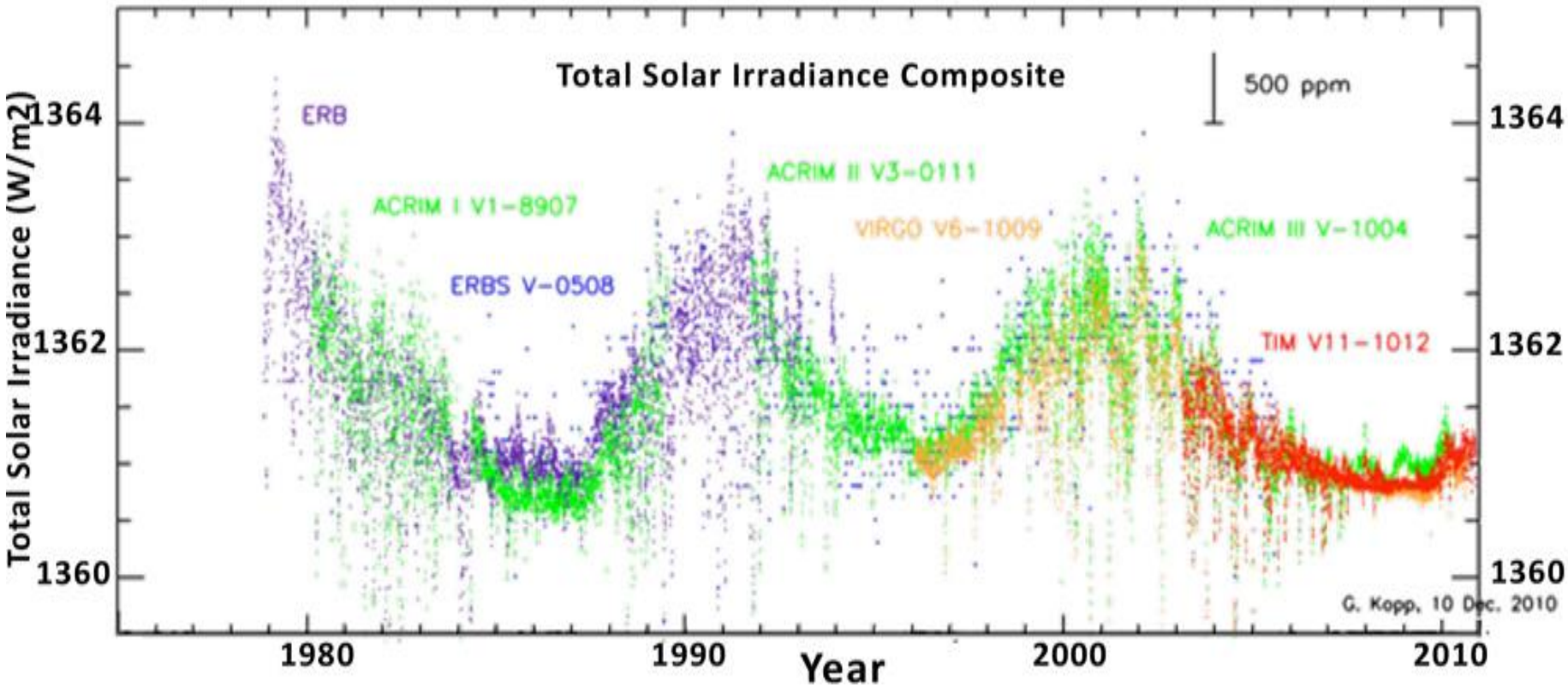


Global Warming—Keep it Simple
The Earth warms, sea level rises

Europe's Last Glacial Maximum 20,000 years ago

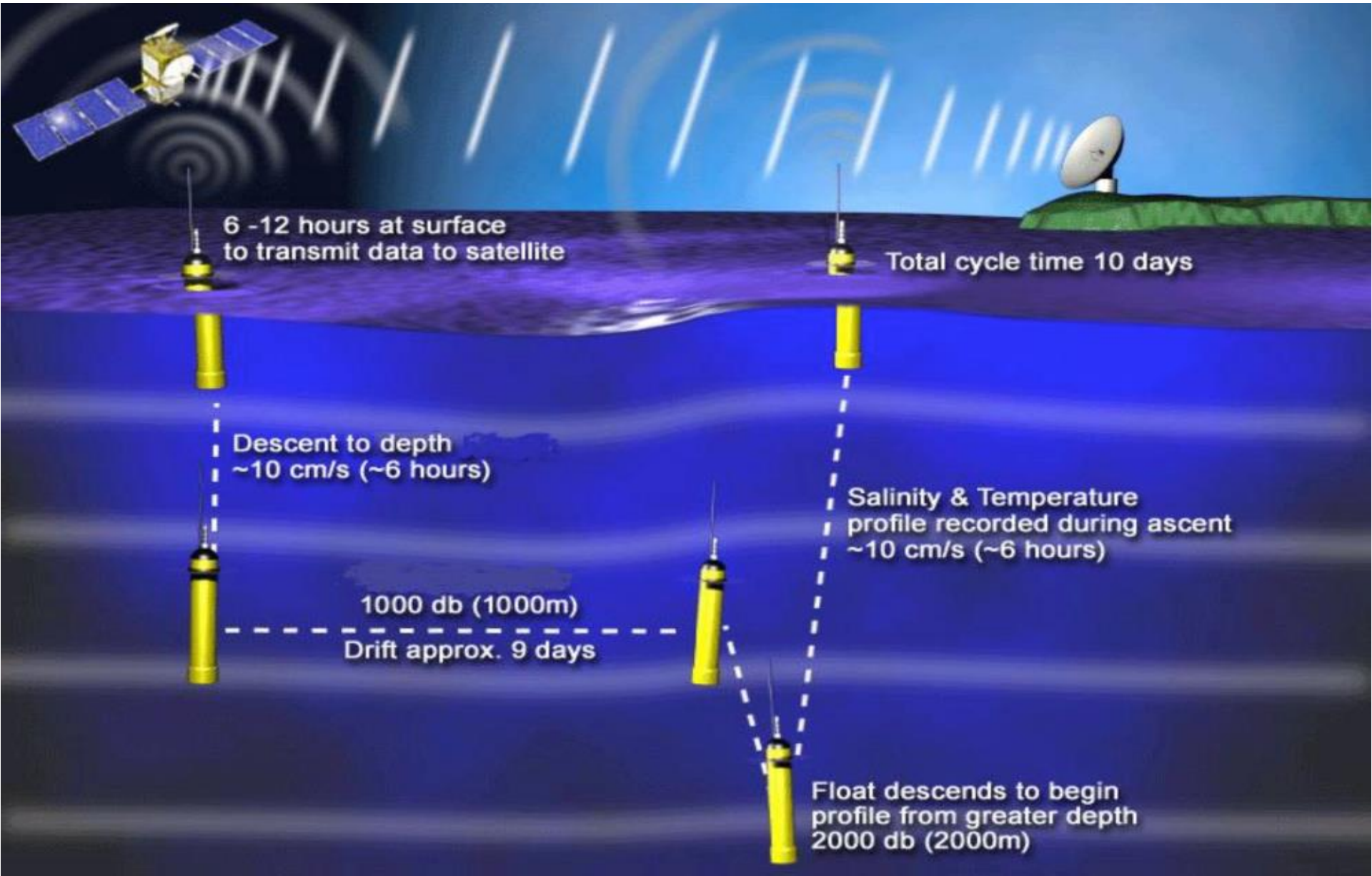


Total Solar Irradiance Record

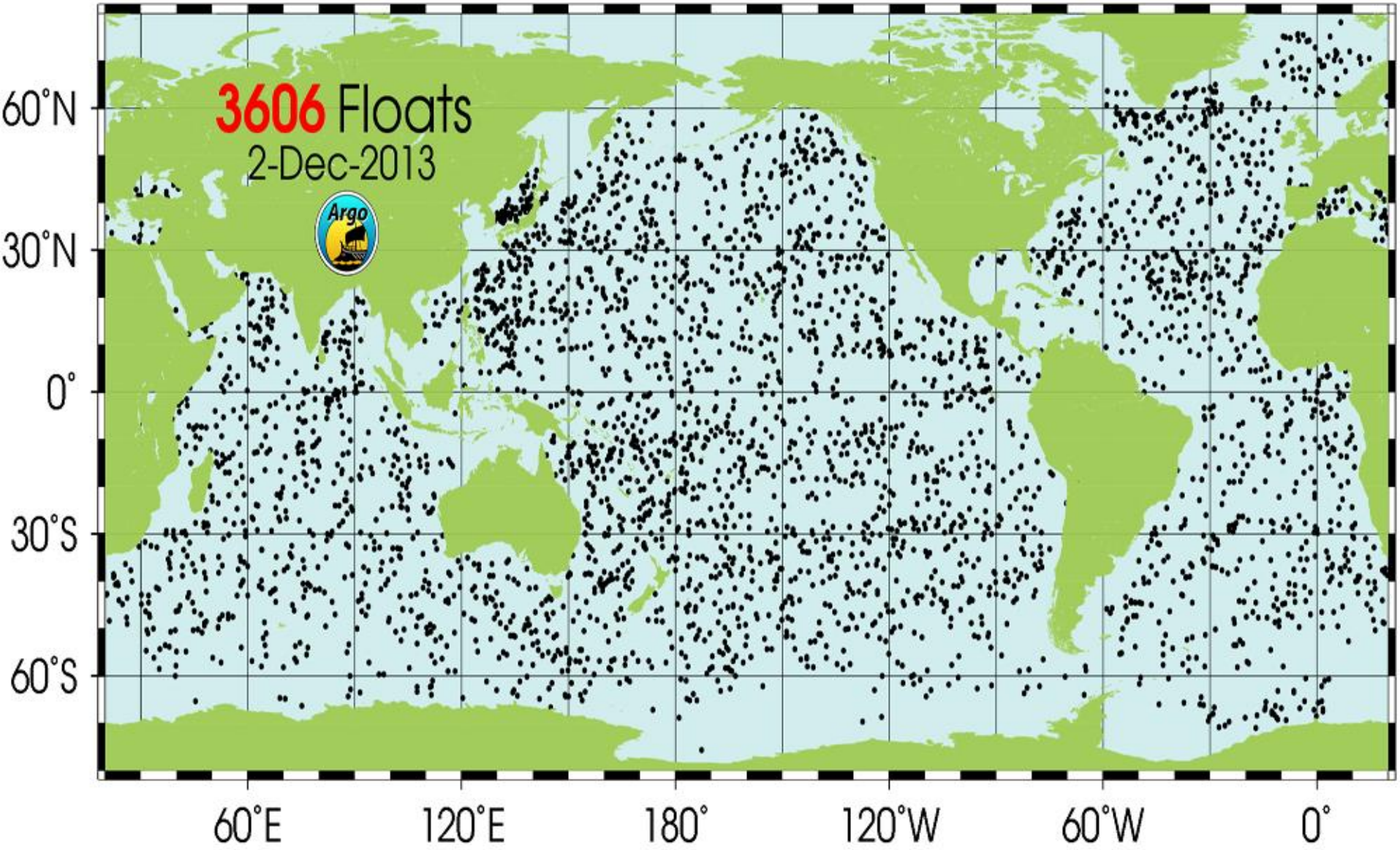


- In the satellite record, total solar irradiance varied by ~***one part in 500***
- ***ΔT ~ 0.1˚C***, nearly all associated with the ~11-year ***solar cycle***

Argo Float Ocean Temperature



Argo Float Ocean Temperature



Argo Float Ocean Temperature

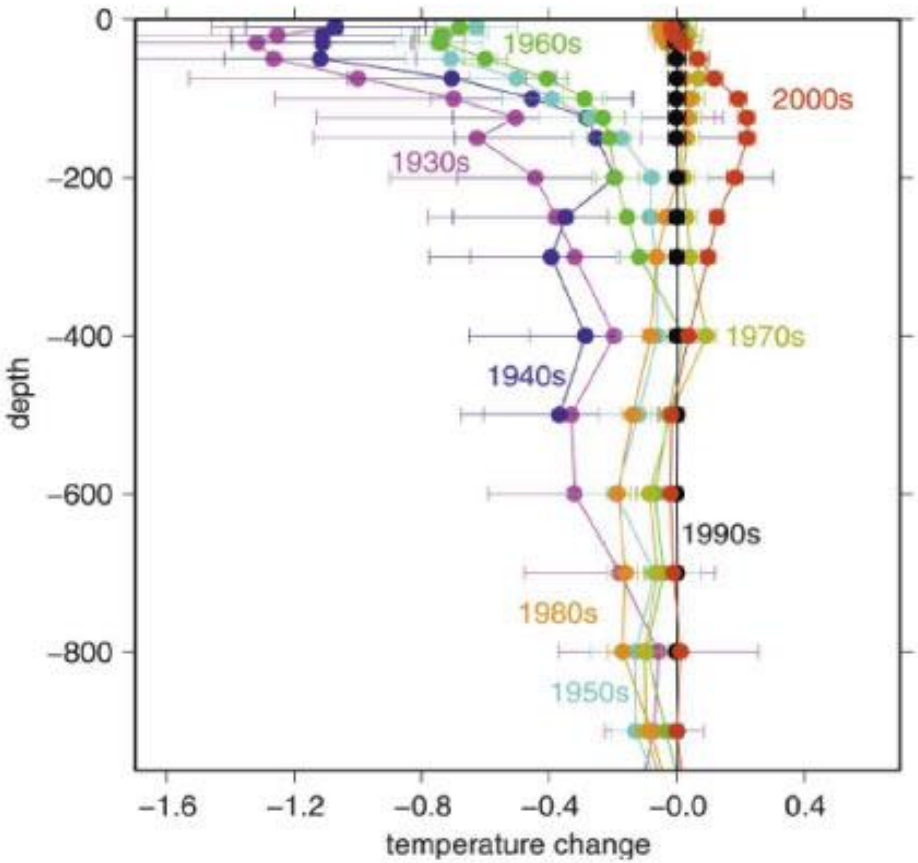
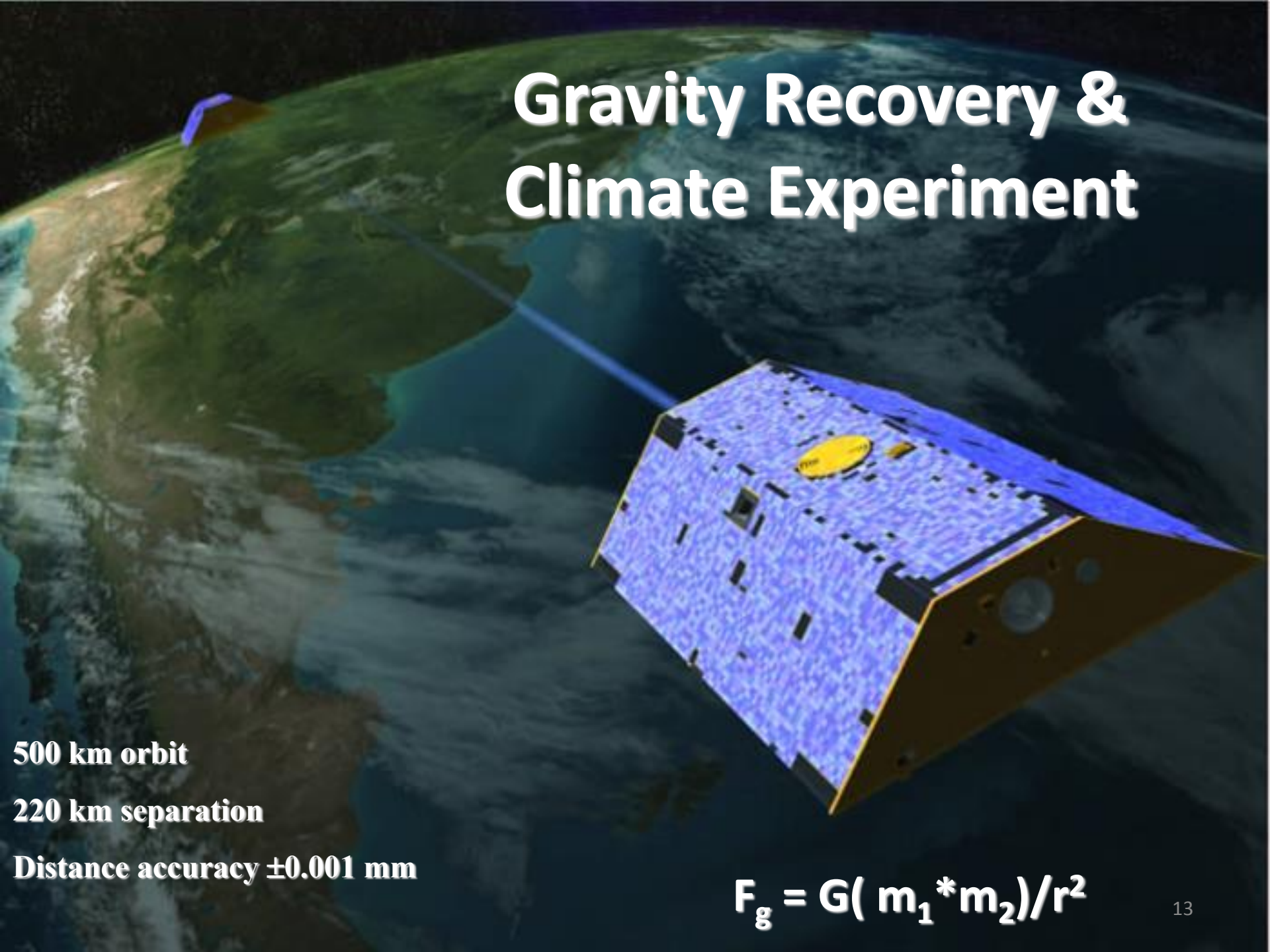


Fig. 5. Profiles of temperature difference between 1990s temperature profiles and hydrographic data sorted by decade. Differences are computed as 1990s reference temperatures minus historic temperature profiles sorted by decade, using the nearest neighbor method discussed in the text. Here results are presented for summer data (November through March), averaged first by latitude band.

Gille 2008.

Gravity Recovery & Climate Experiment



500 km orbit

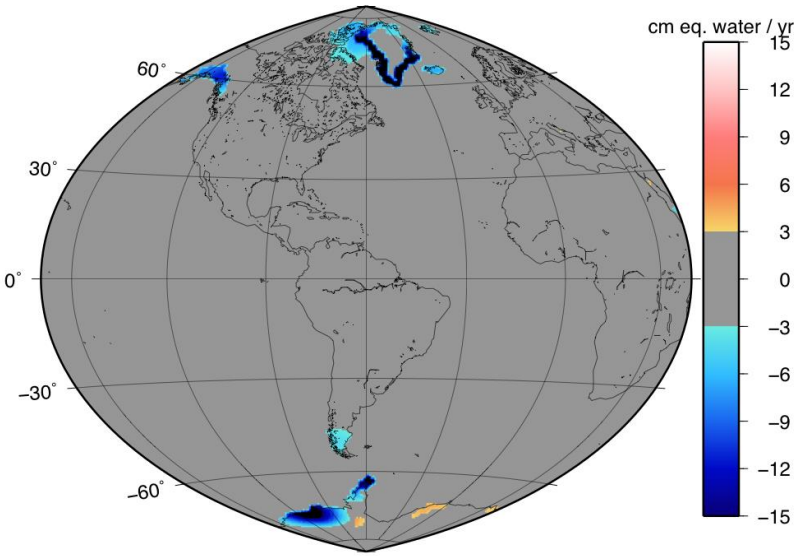
220 km separation

Distance accuracy ±0.001 mm

$$F_g = G(m_1 * m_2)/r^2$$

Summary from:
Land ice evolution from a new iterated GRACE global mascon solution

S. B. Luthcke (1), B.D. Loomis (2), T.J. Sabaka (1),
A.A. Arendt (3), D. D. Rowlands (1)



(1) NASA GSFC, Greenbelt, MD, USA,
(2) SGT Inc. @ NASA GSFC, Greenbelt, MD, USA,
(3) University of Alaska, Fairbanks, USA

G43C-04, Fall AGU, December 6, 2012

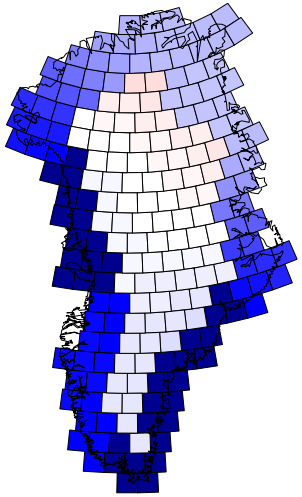
Luthcke, S.B. T.J. Sabaka, B. Loomis, A.A. Arendt, J.J. McCarthy, J.Camp (2013), Antarctica, Greenland and Gulf of Alaska land ice evolution from an iterated GRACE global mascon solution, *J. Glac.*, In Press..

GSFC mascon solution summary (2003.12 to 2010.12)

GIS Trend

All = -230 ± 12 Gt a^{-1}

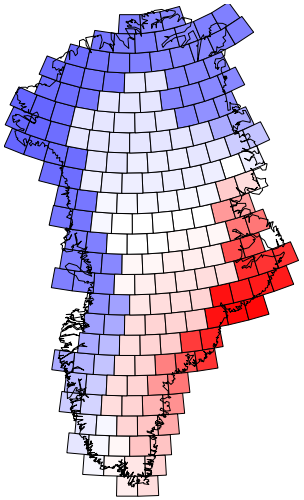
< 2000 m = -224 ± 20 Gt a^{-1}



GIS Accel

All = -10 ± 6 Gt a^{-2}

< 2000 m = -11 ± 7 Gt a^{-2}



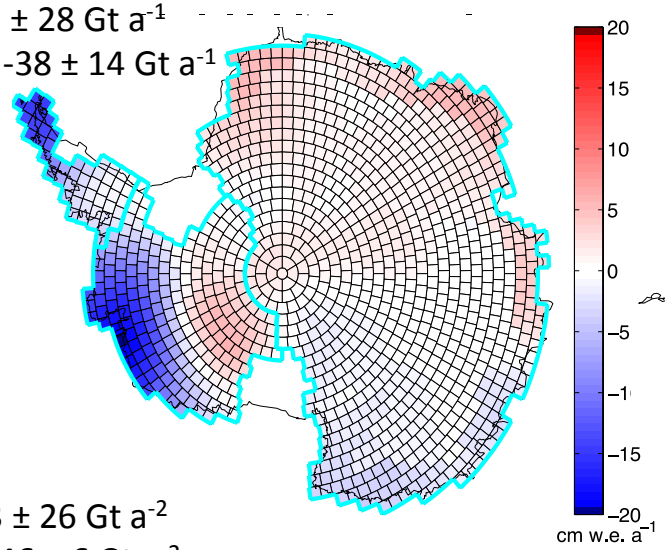
AIS Trend

AIS = -81 ± 26 Gt a^{-1}

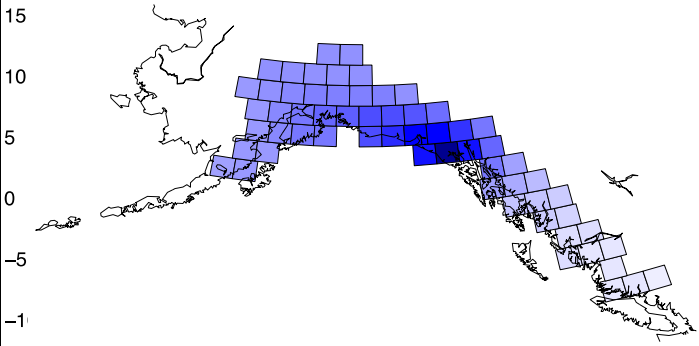
WAIS = -106 ± 16 Gt a^{-1}

EAIS = 63 ± 28 Gt a^{-1}

AISPen = -38 ± 14 Gt a^{-1}



GoA Trend = -69 ± 11 Gt a^{-1}



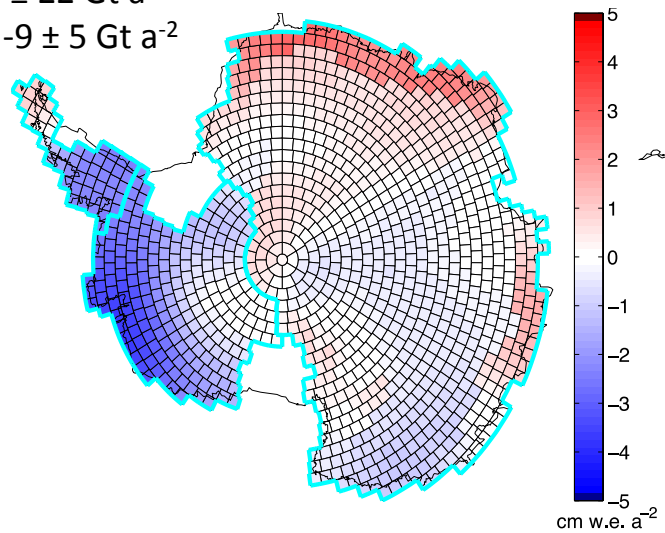
AIS Accel

AIS = -33 ± 26 Gt a^{-2}

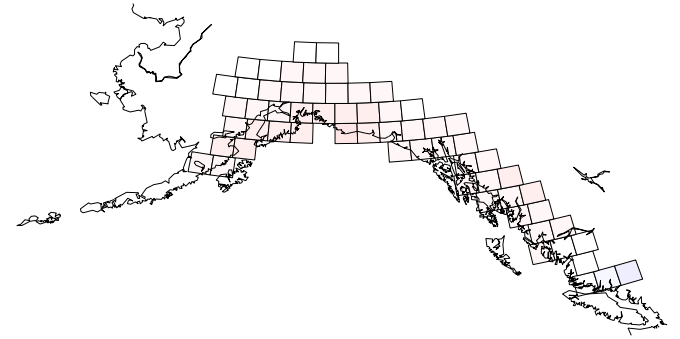
WAIS = -46 ± 6 Gt a^{-2}

EAIS = 22 ± 22 Gt a^{-2}

AISPen = -9 ± 5 Gt a^{-2}



GoA Accel = 2 ± 7 Gt a^{-2}



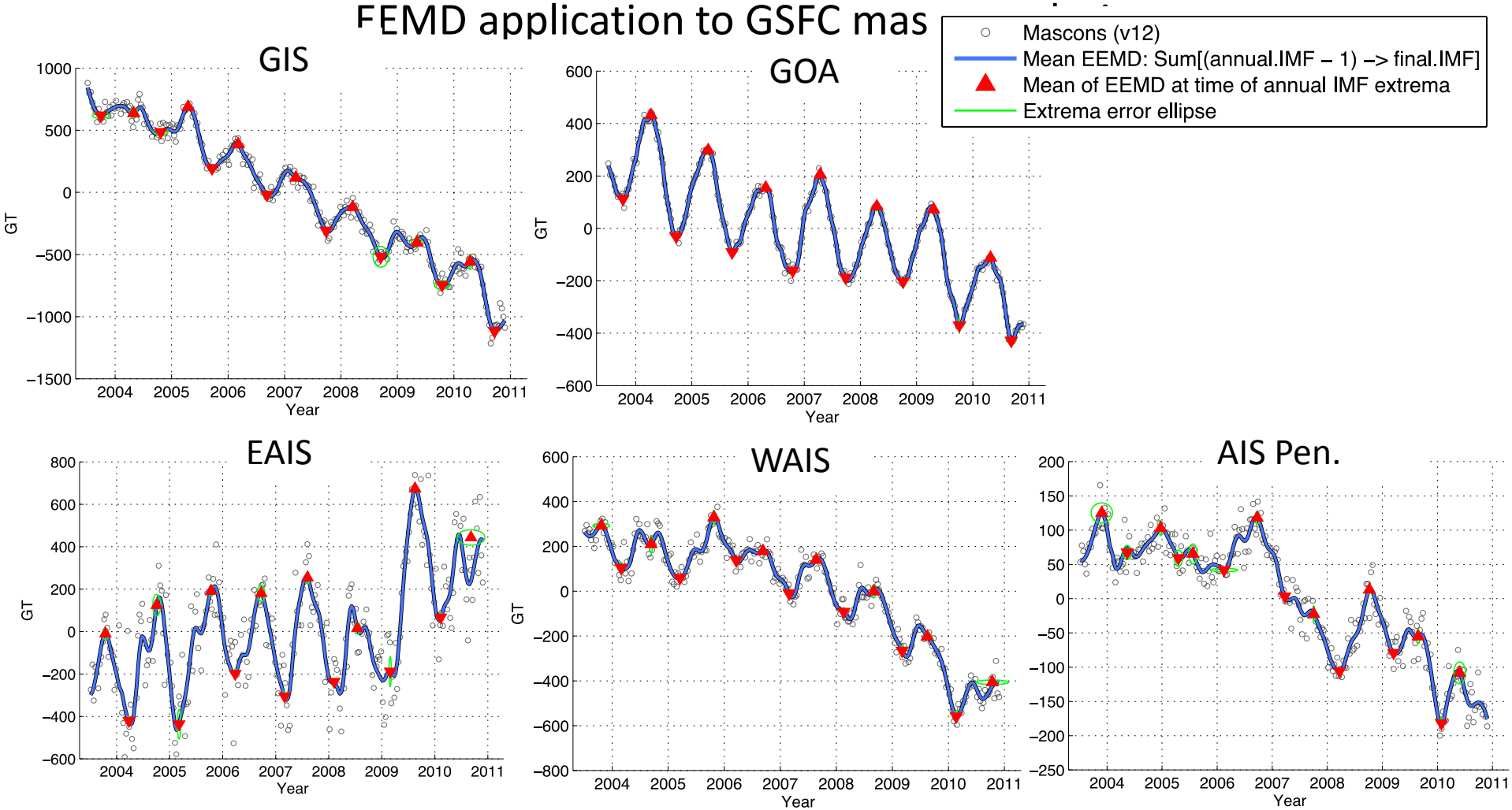
ICE5G Paulson GIA for GIS and GoA

Larsen LIA for GoA

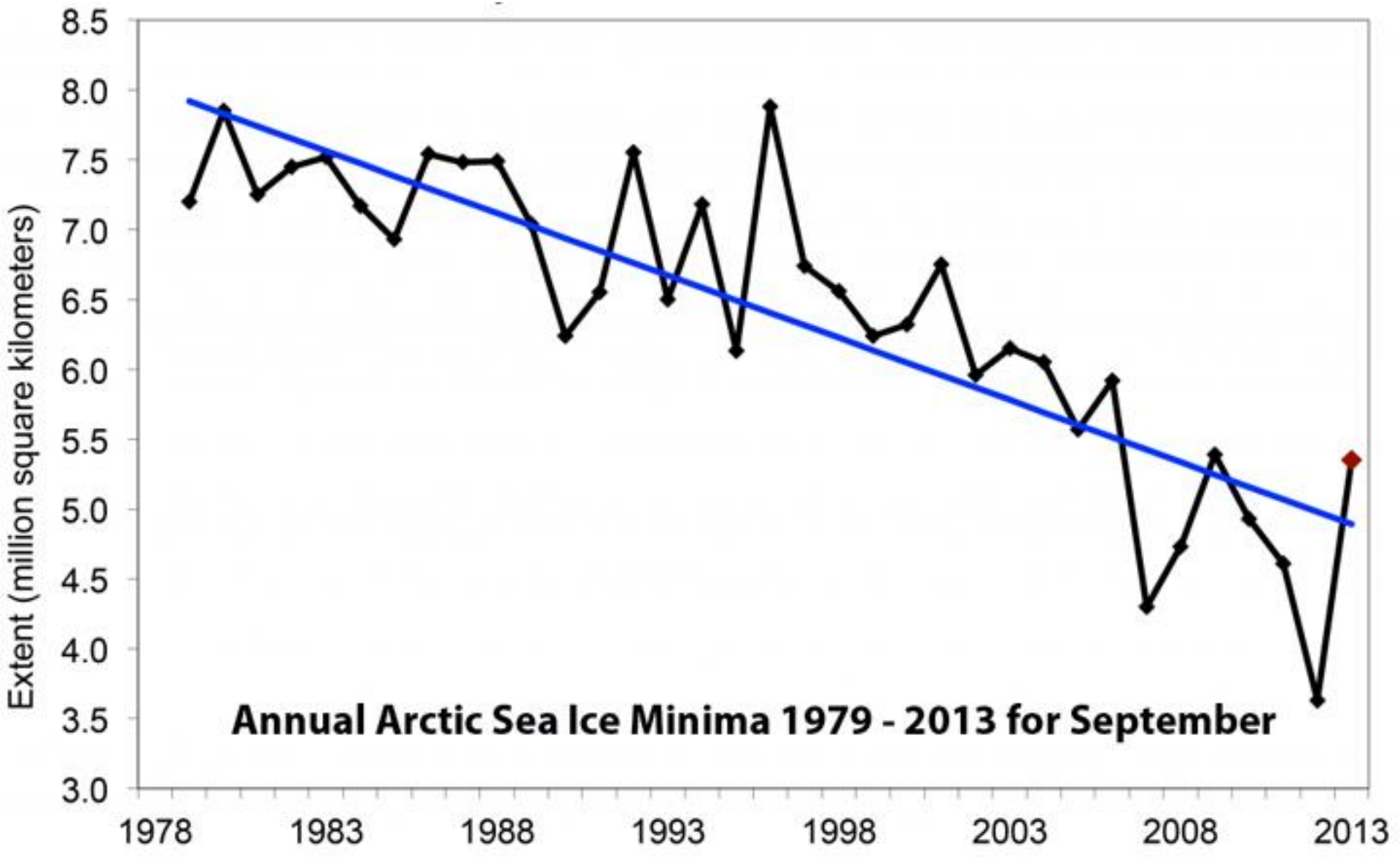
IJ05_R2 GIA for AIS

Mass time series and balance season timing from

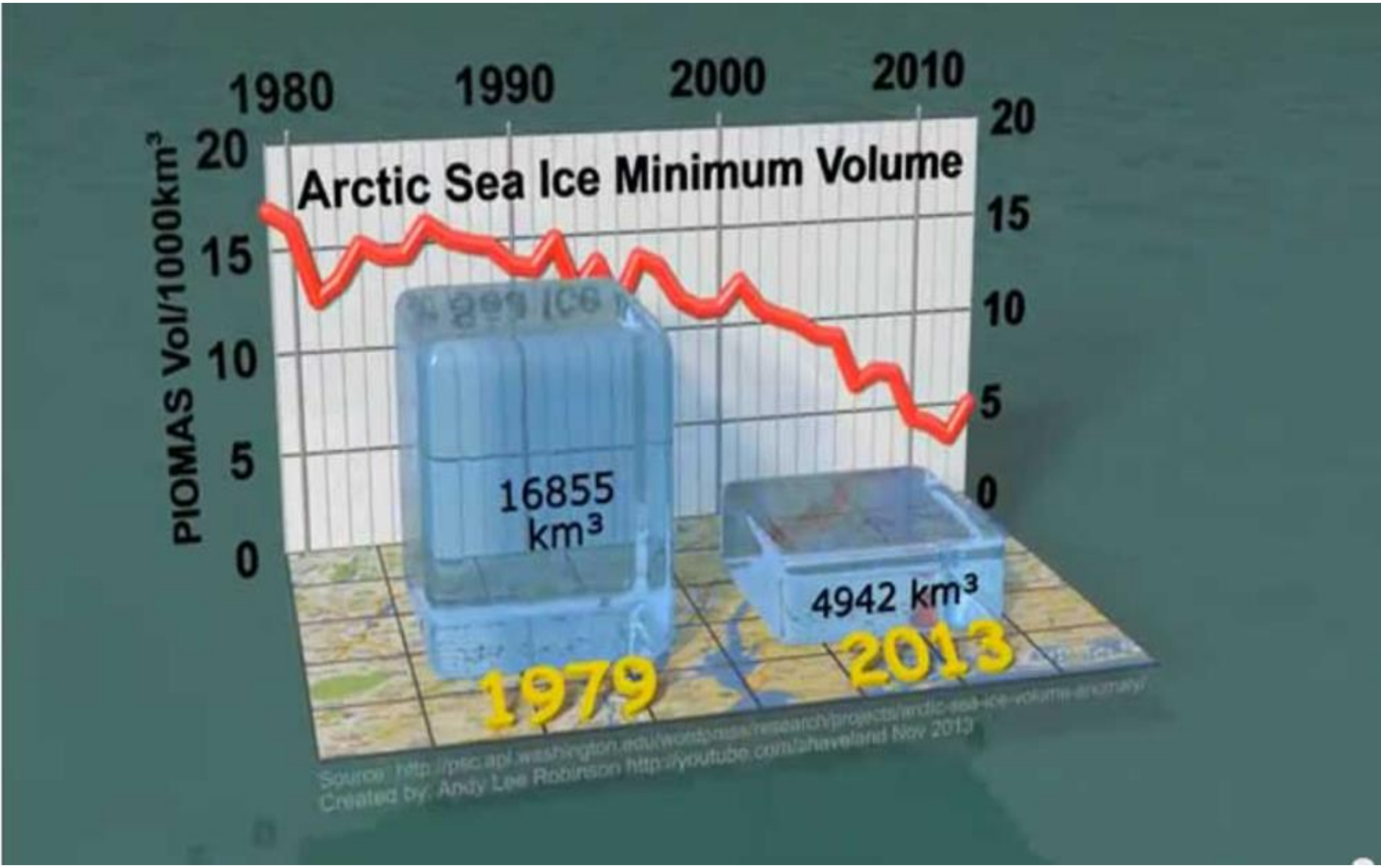
FEMD application to GSFC mas



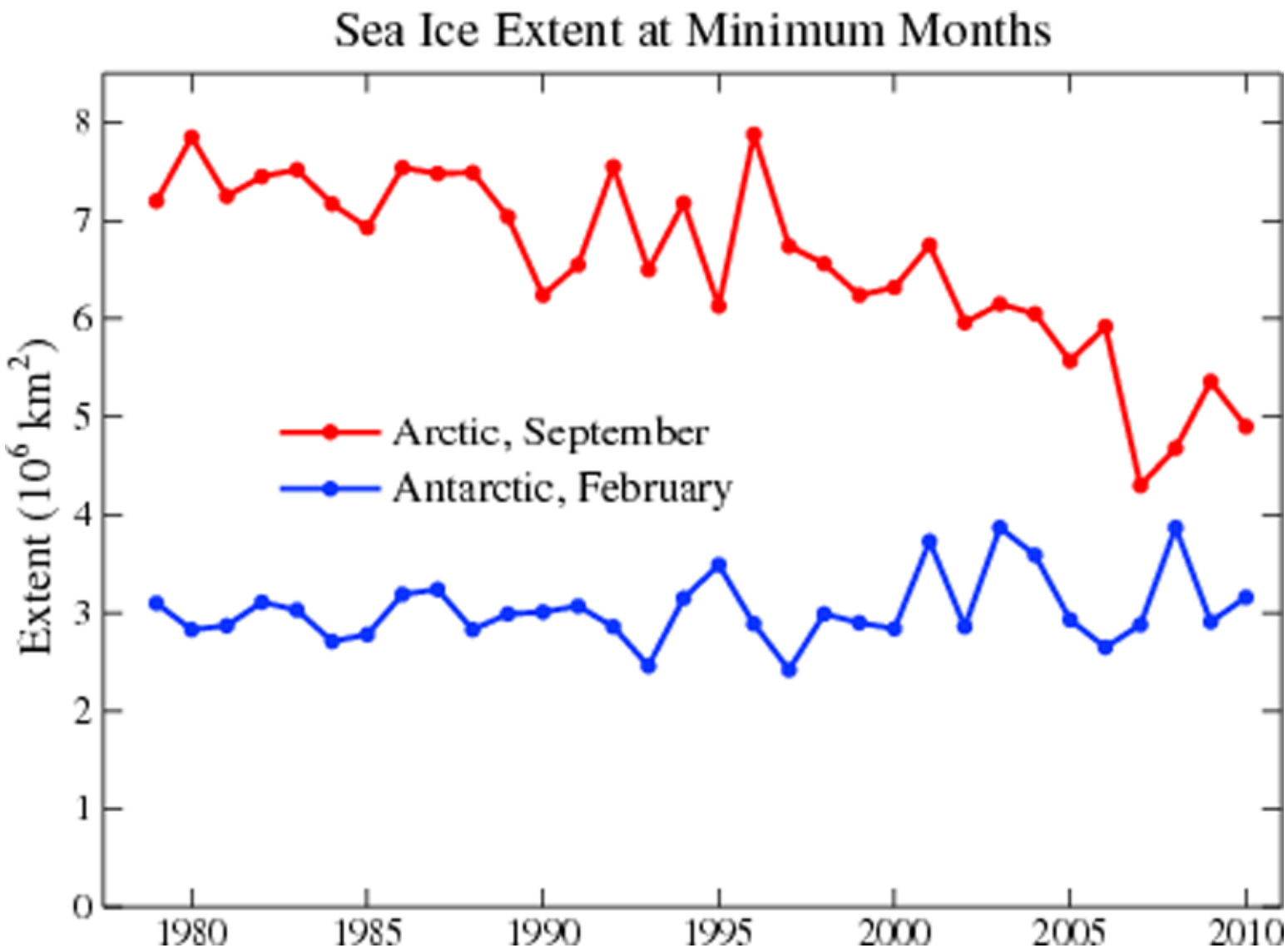
Arctic Sea Ice Minimum Update



Arctic Sea Ice Minimum Update

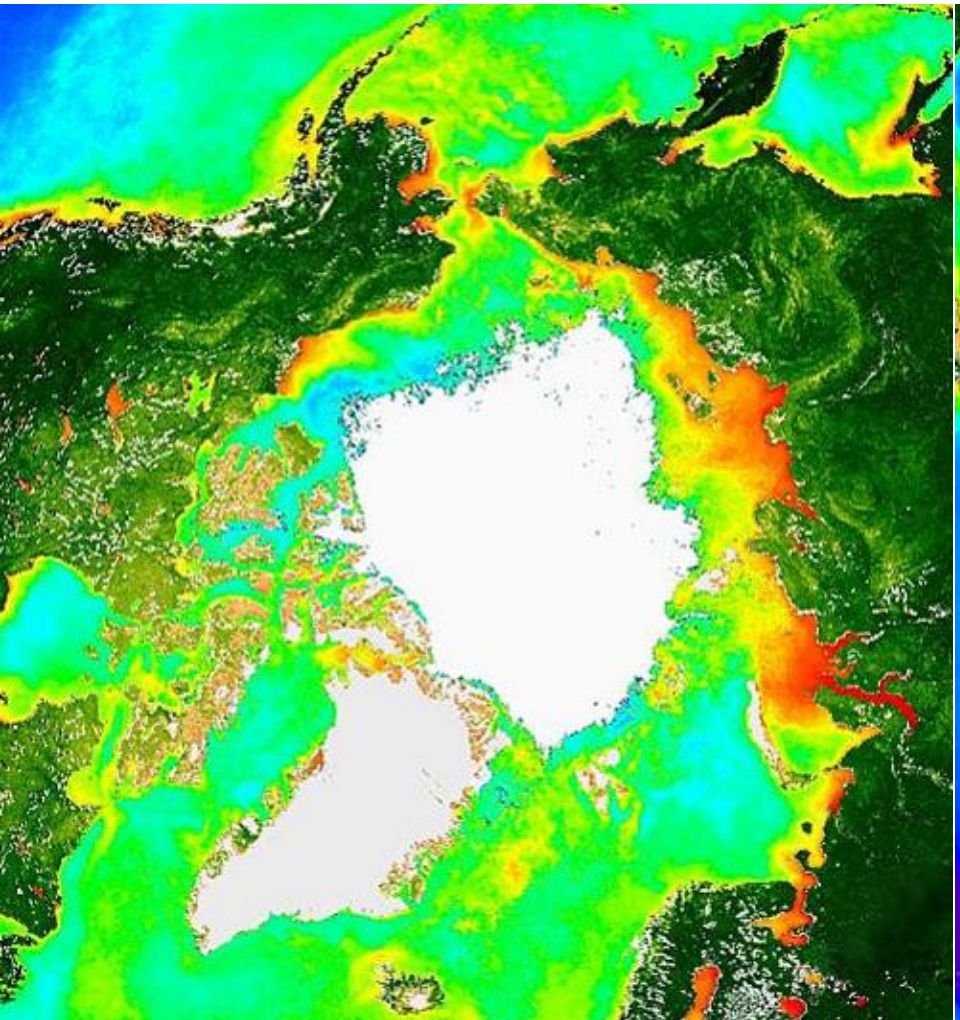


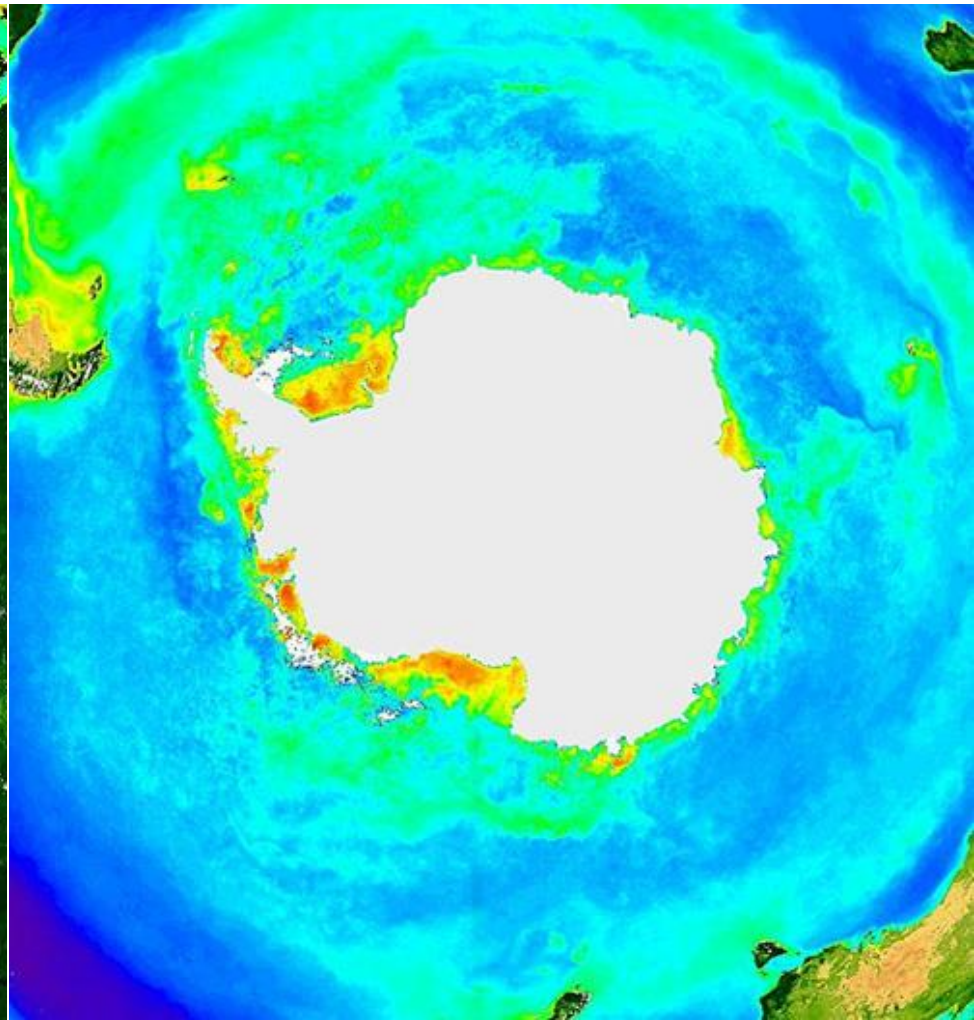
Arctic &Antarctic Sea Ice Minima



Are the Arctic & Antarctic Different?

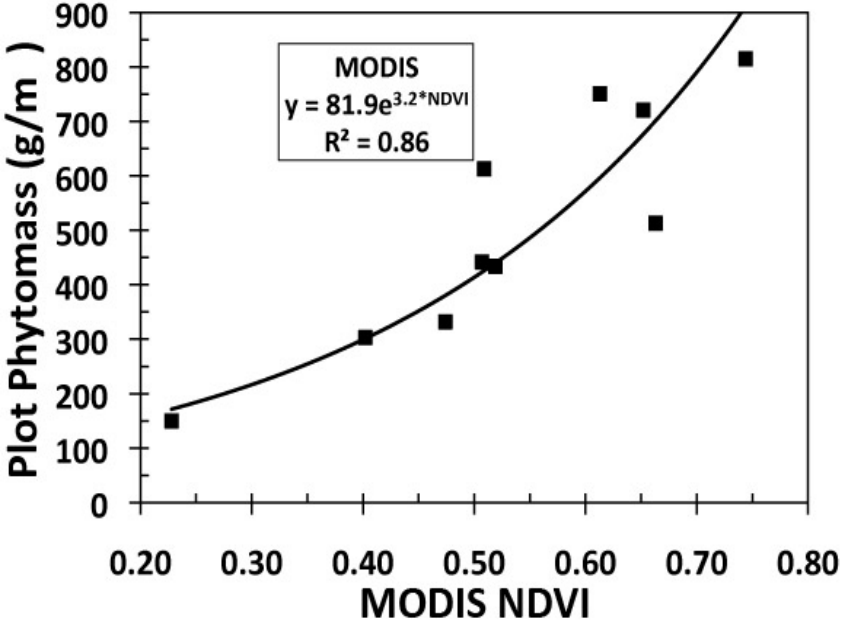
One is surrounded by land the other by ocean

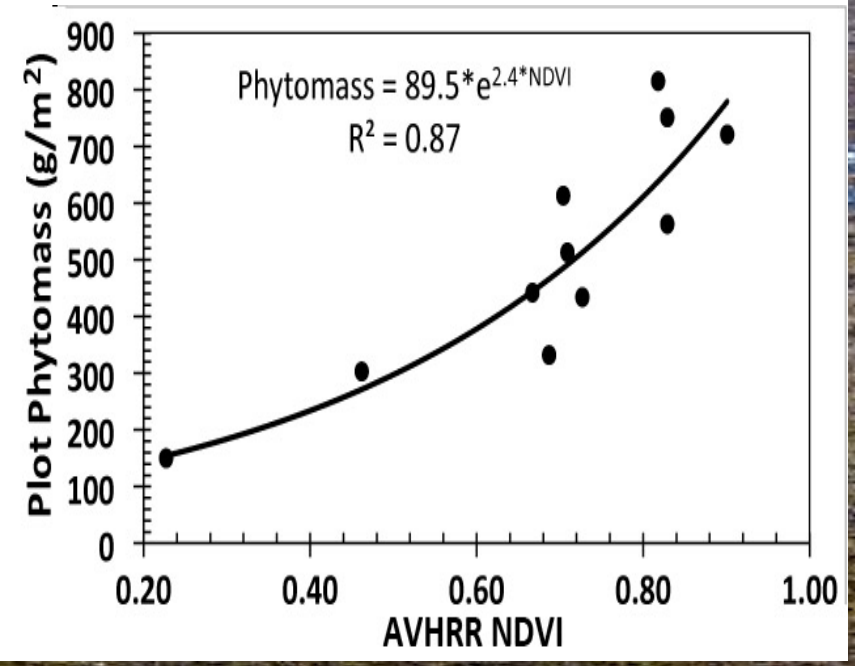




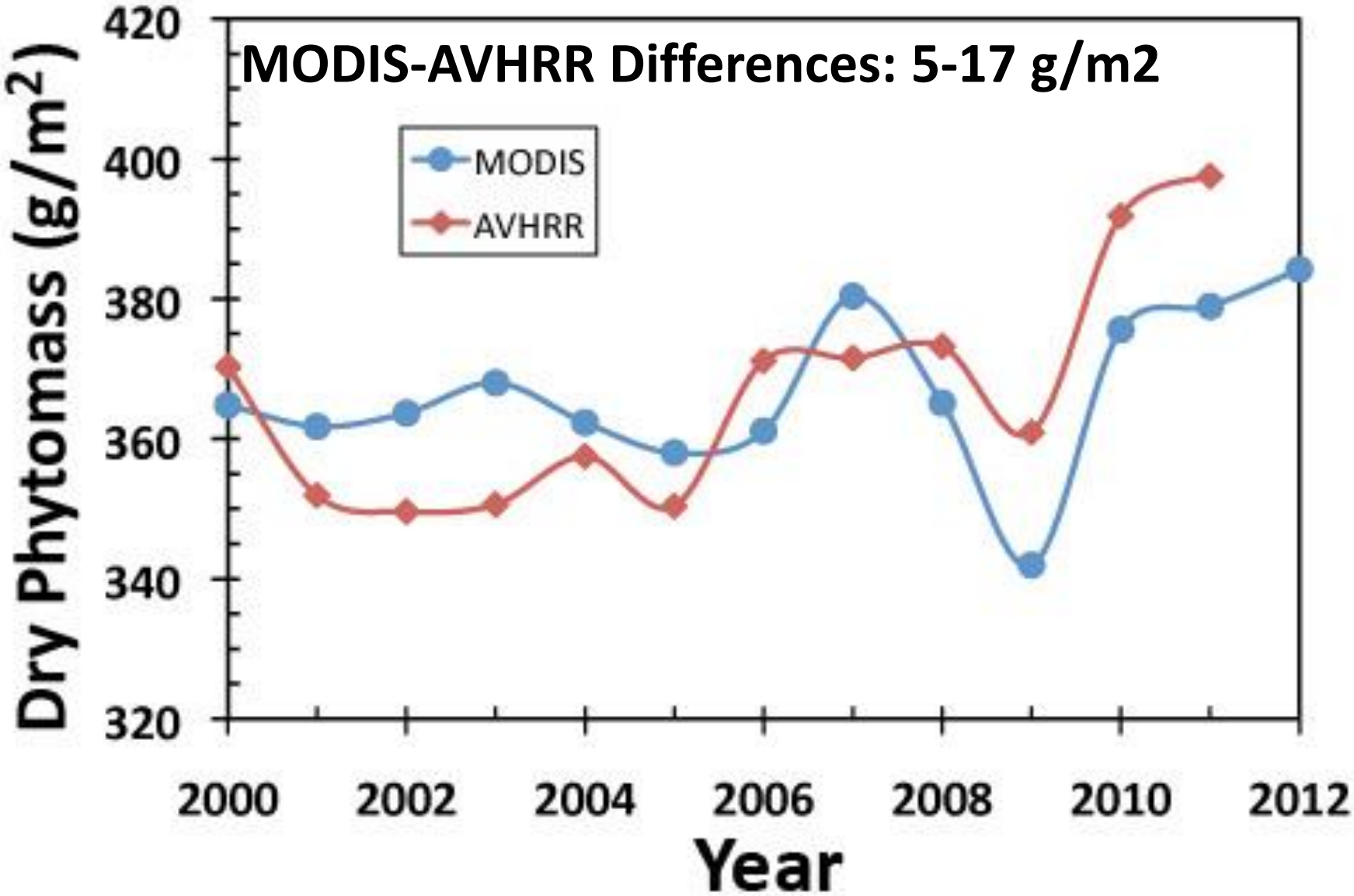
Arctic Tundra Biomass Work

Arctic Tundra Biomass

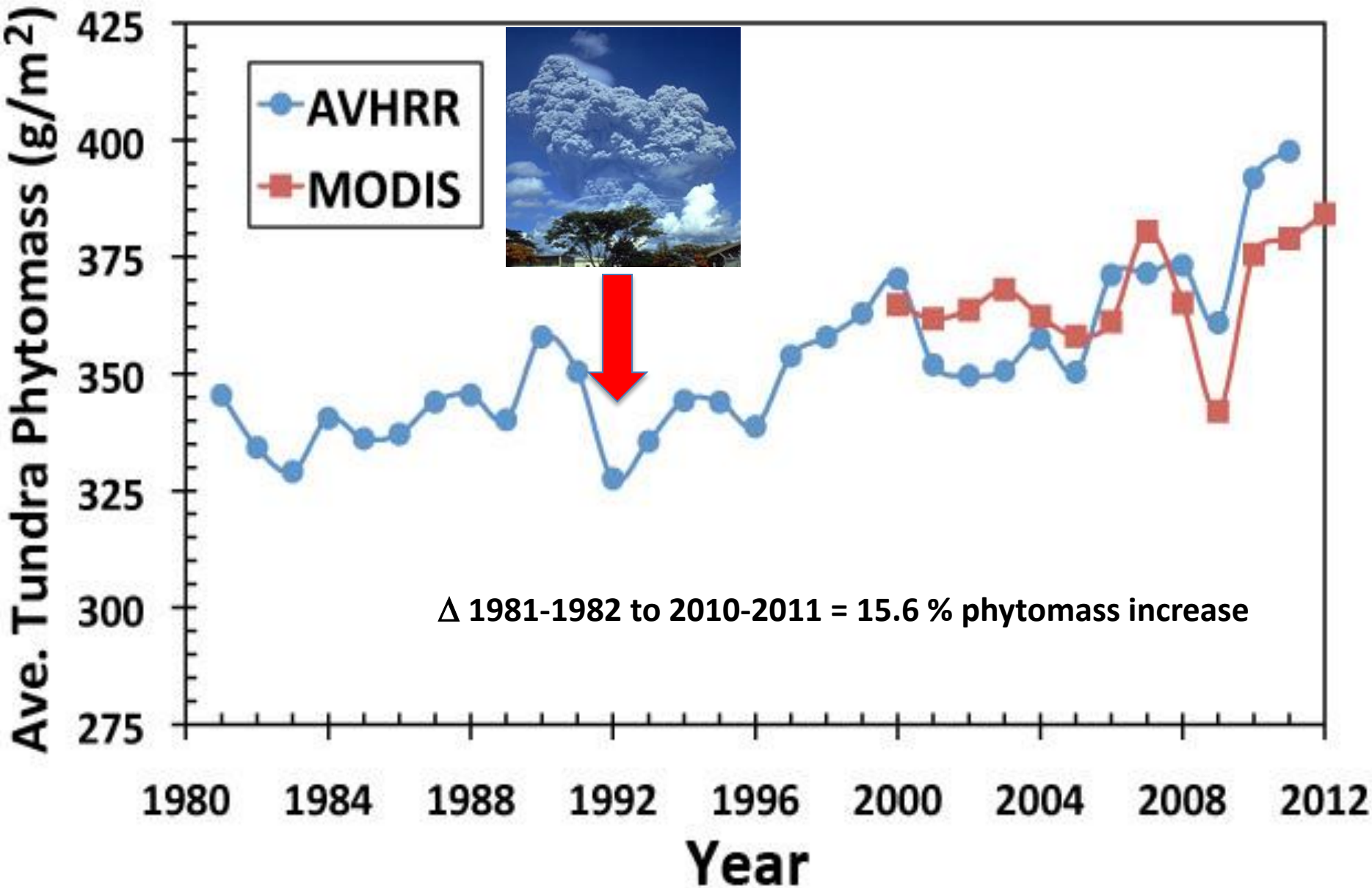




Total Tundra Average AVHRR & MODIS



Tundra Average AVHRR & MODIS



Questions?

P-3 at Sunrise; Thule, Greenland

- Michael Studinger