Arctic Climate Change

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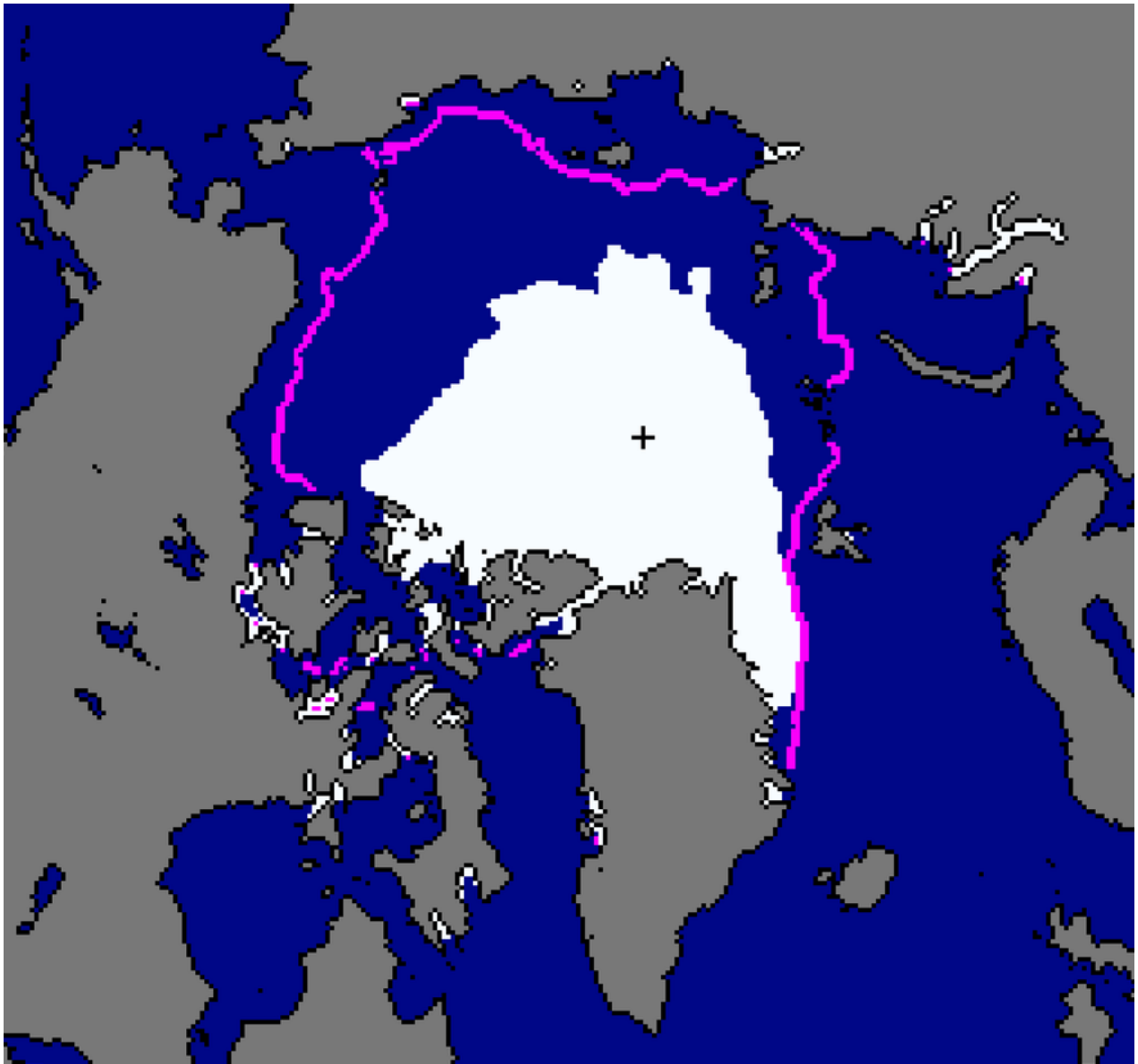
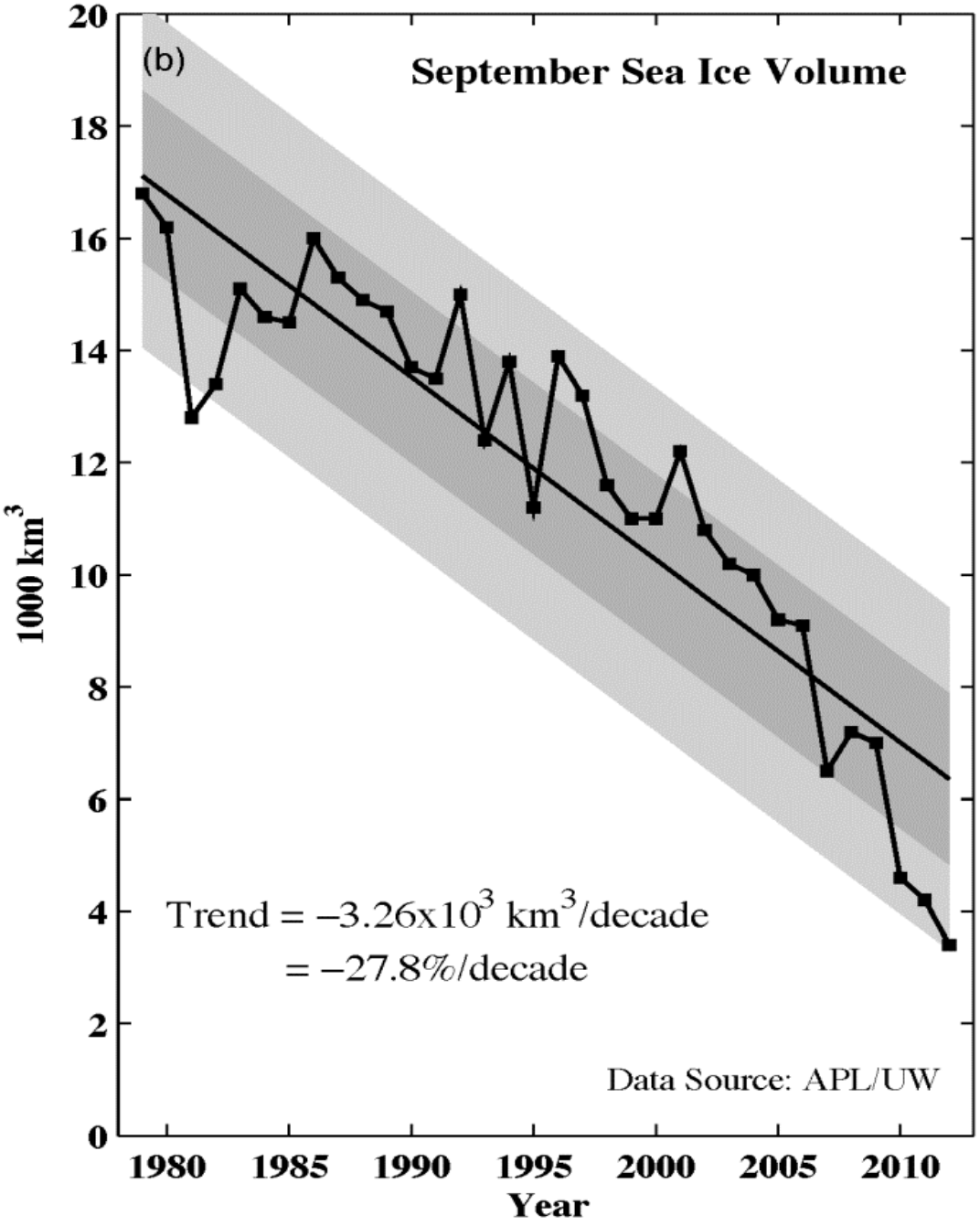
NOAA/Pacific Marine Environmental Laboratory

Chukchi Sea

September 30, 2009

SEA ICE SEPTEMBER 2012
~50 % Extent loss from climatology



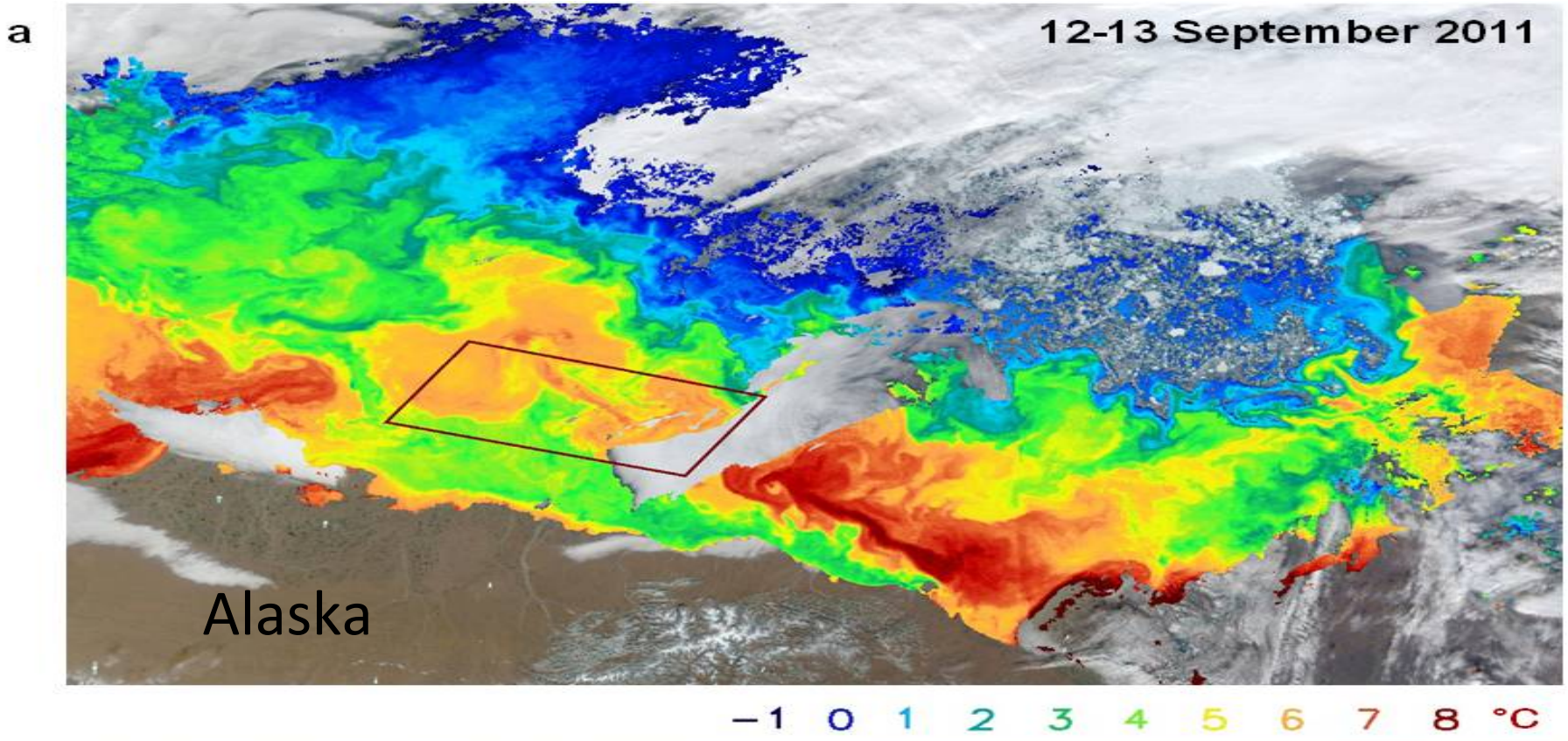


¾ Loss in Sea Ice Volume Since the 1980s

Sea Ice Reanalysis recently verified by satellite thickness estimates

Overland et al GRL 2013
Schweiger et al. 2011,
Maslowski et al. 2012
Laxon et al. 2013
Wadhams, 2012

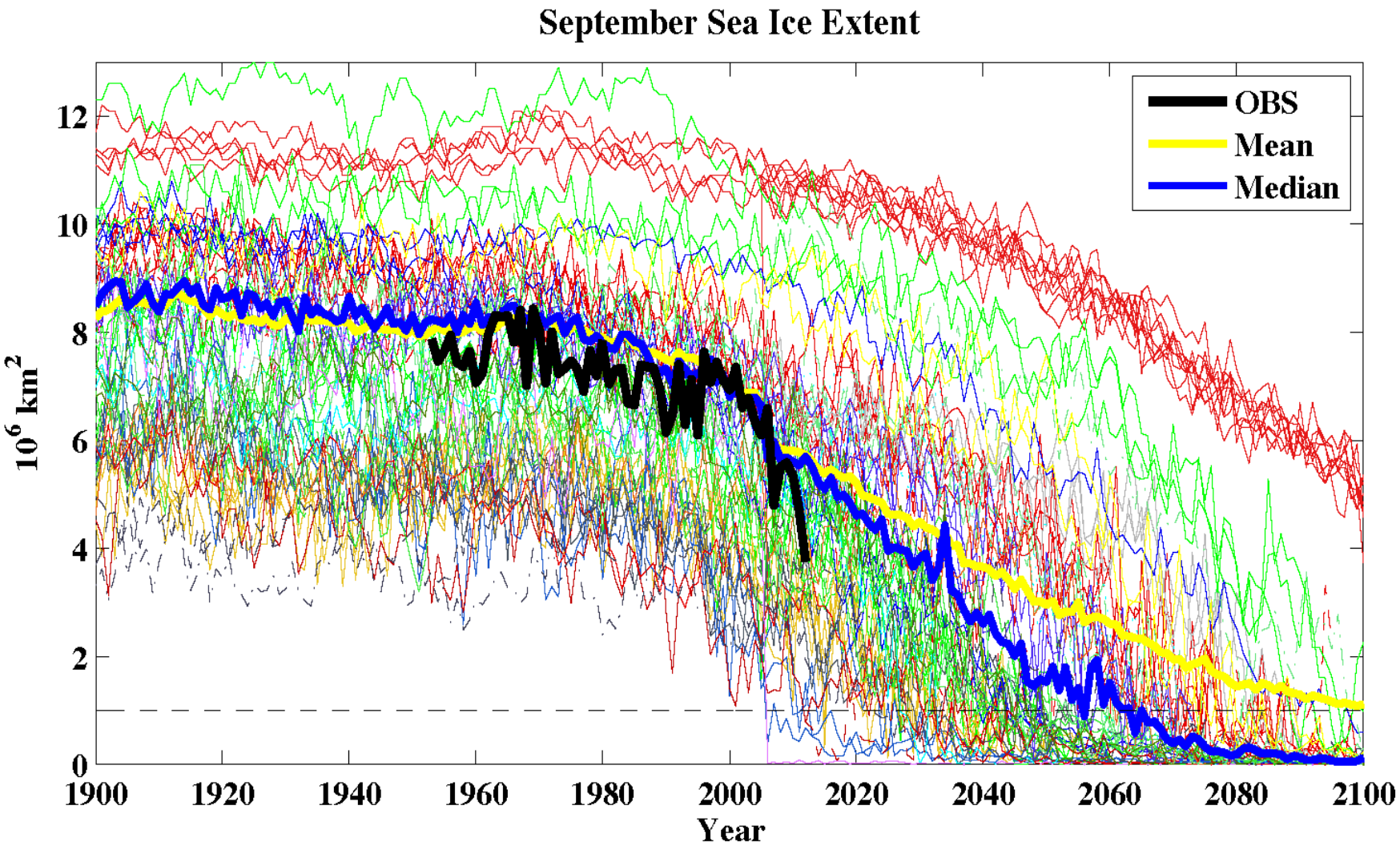
250 Miles of Open Water North of Alaska



Sea Surface Temperatures

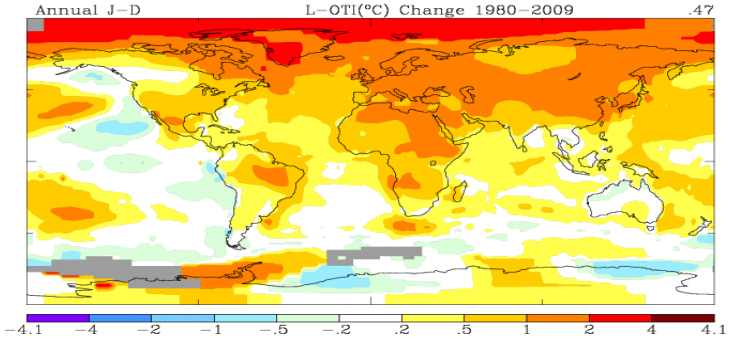
Wide Range of Climate Model Sea Ice Extent Hindcasts and Predictions

89 ensemble members from 36 CMIP5 models



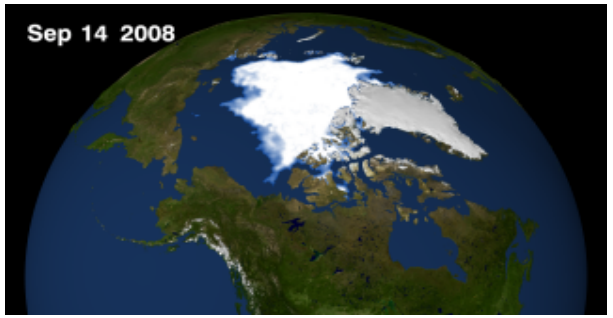
"Arctic Amplification": Global Warming +Multiple Feedbacks

Global Warming



Arctic amplification

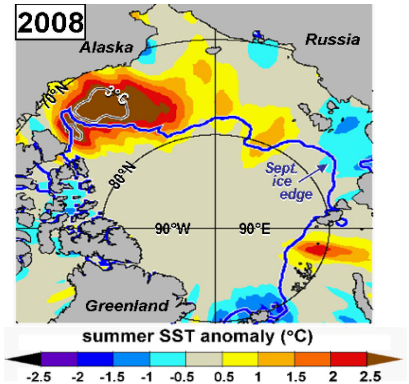
Reduction of Arctic sea Ice



Sept Sea Ice Extent

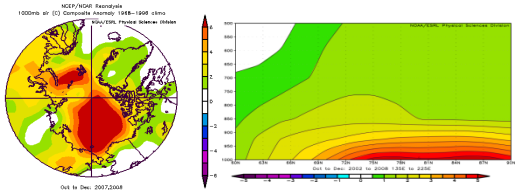
Surface albedo decrease

Ocean absorbs more heat



Heat releases to atmosphere in the fall.

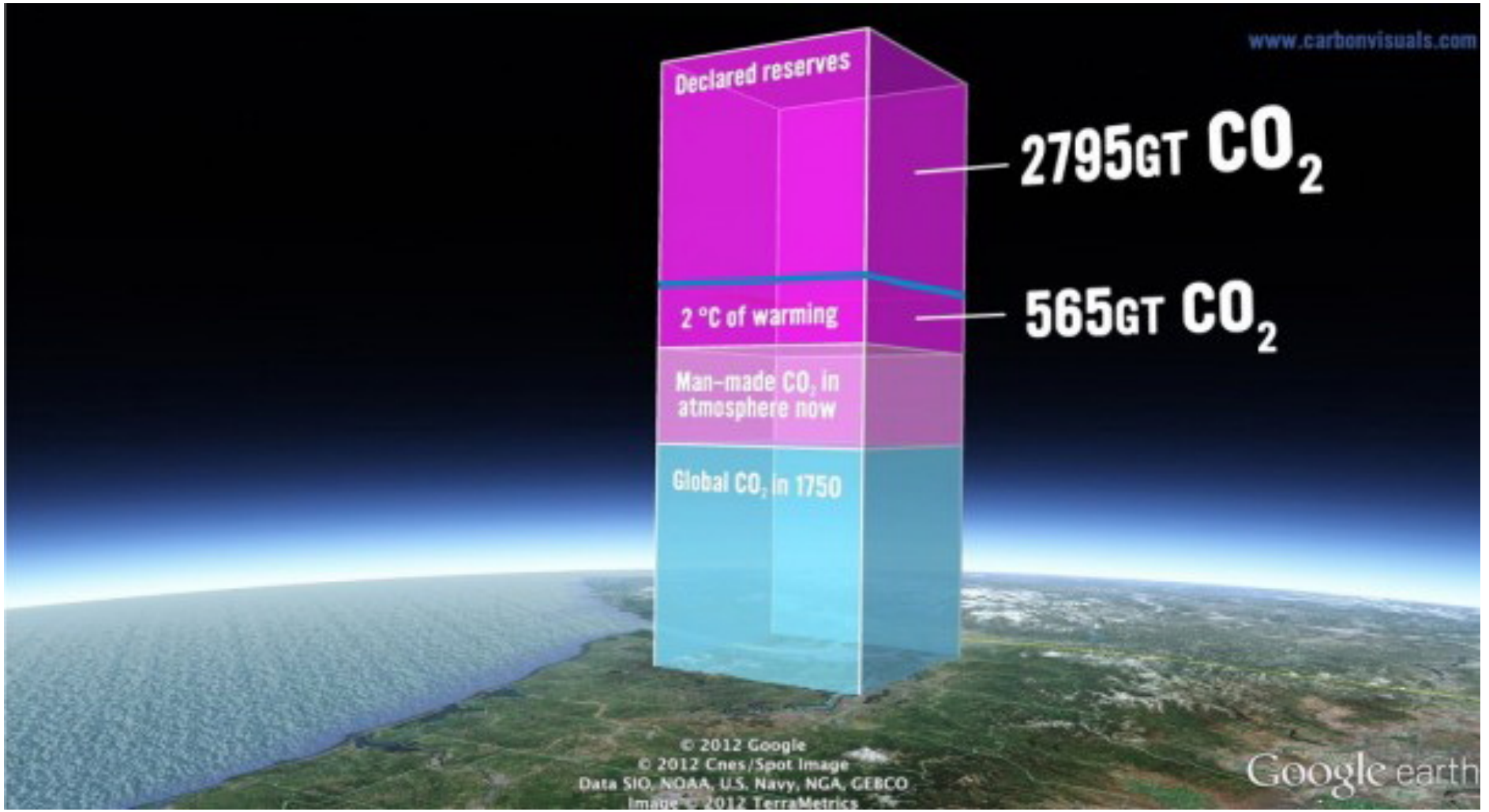
Atmosphere warming



OND Temp Anomaly

Teleconnection and circulation pattern change

Continued CO2 Increase



No Slow Down in Arctic Changes Before 2040

Added Ocean Heat Storage and Heat Flux from New Sea Ice Free Areas

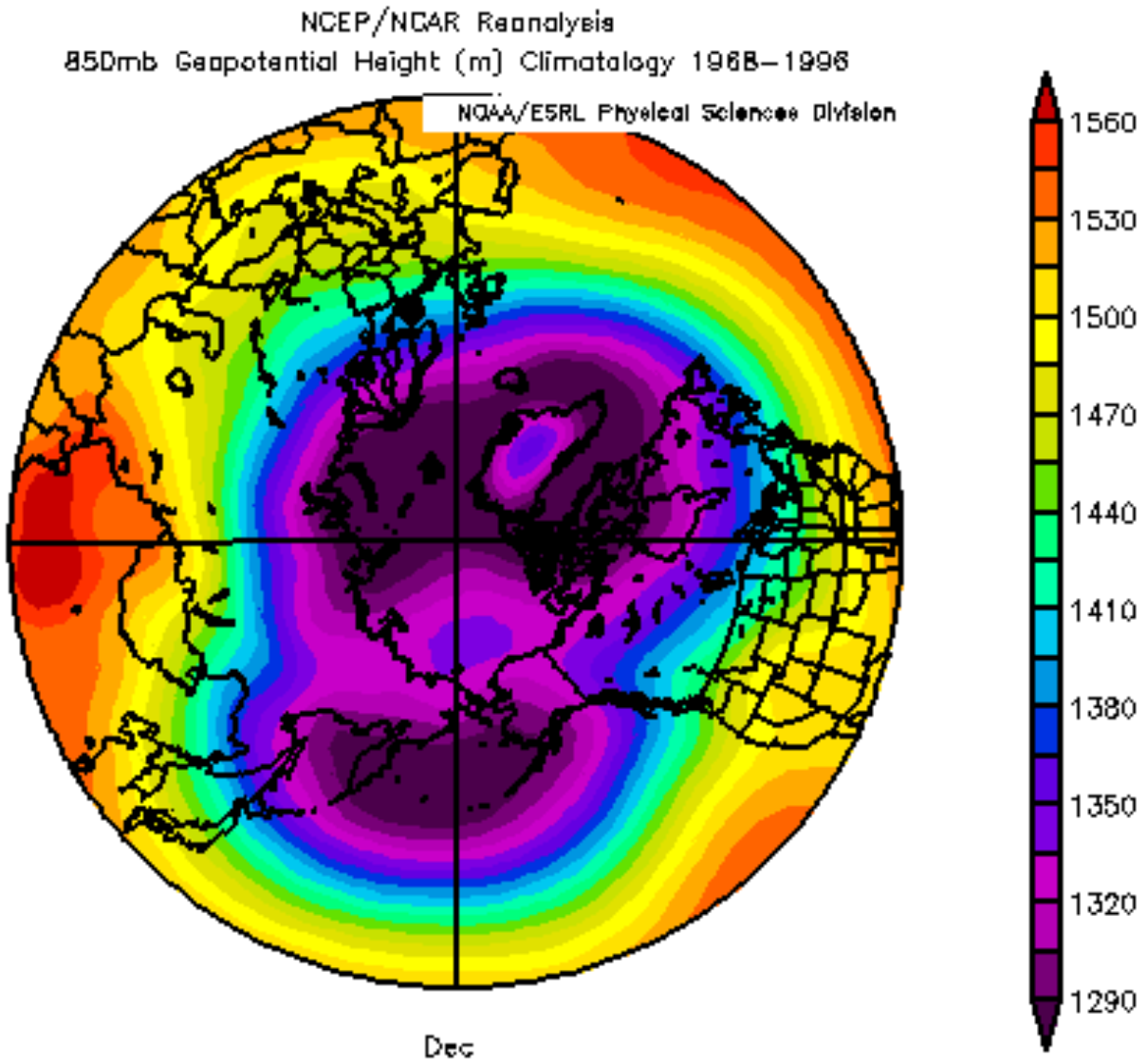
Will Arctic changes lead to more mid-latitude weather extremes in the coming decades?

Mid-Latitude Attribution is Difficult and Controversial

We can say that loss of snow and sea ice adds additional heat to atmosphere that pushes toward a greater chance for a breakdown of the Polar Vortex

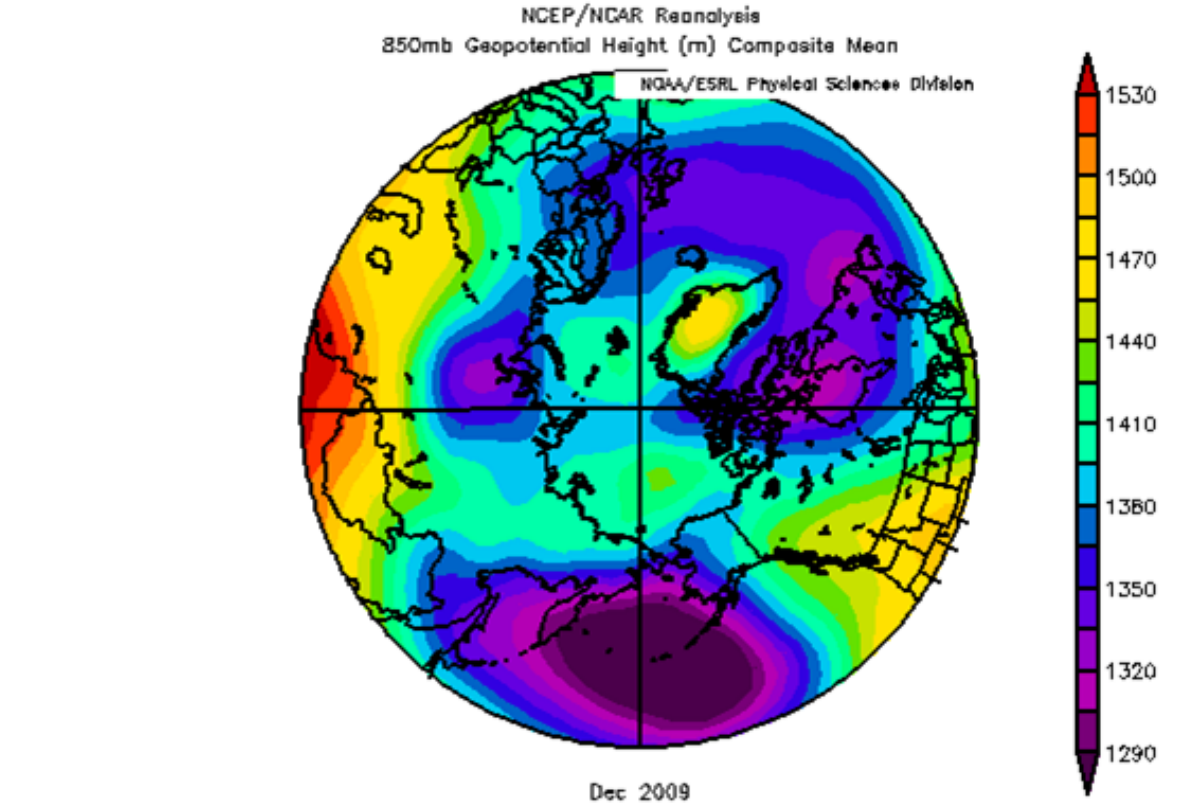
Normal “POLAR VORTEX” of west to east flowing winds traps cold air in the Arctic:

850 GEO HGT
DEC Climatology



December 2009 Impact

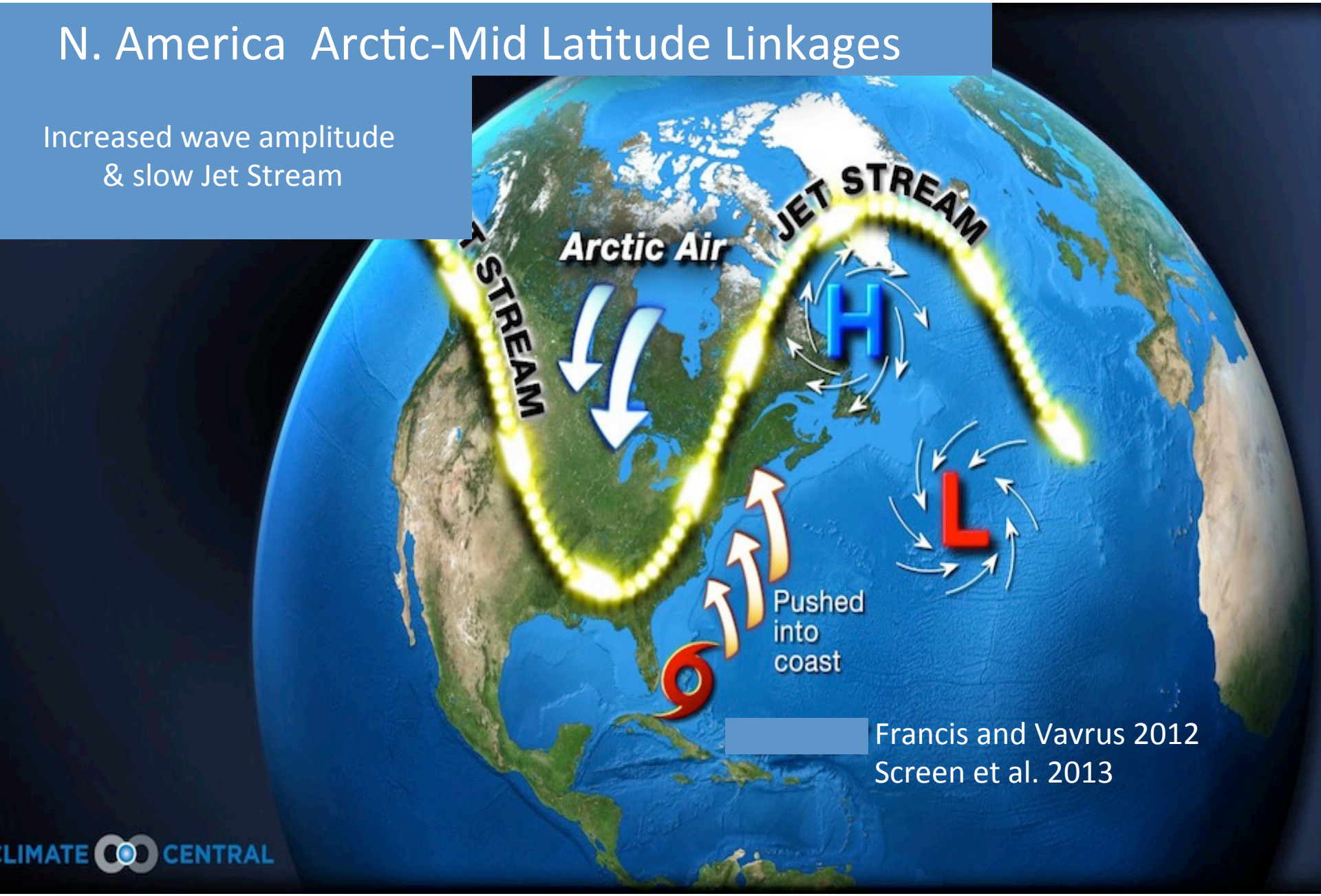
Record Negative Arctic Oscillation



850 Geopotential Heights

N. America Arctic-Mid Latitude Linkages

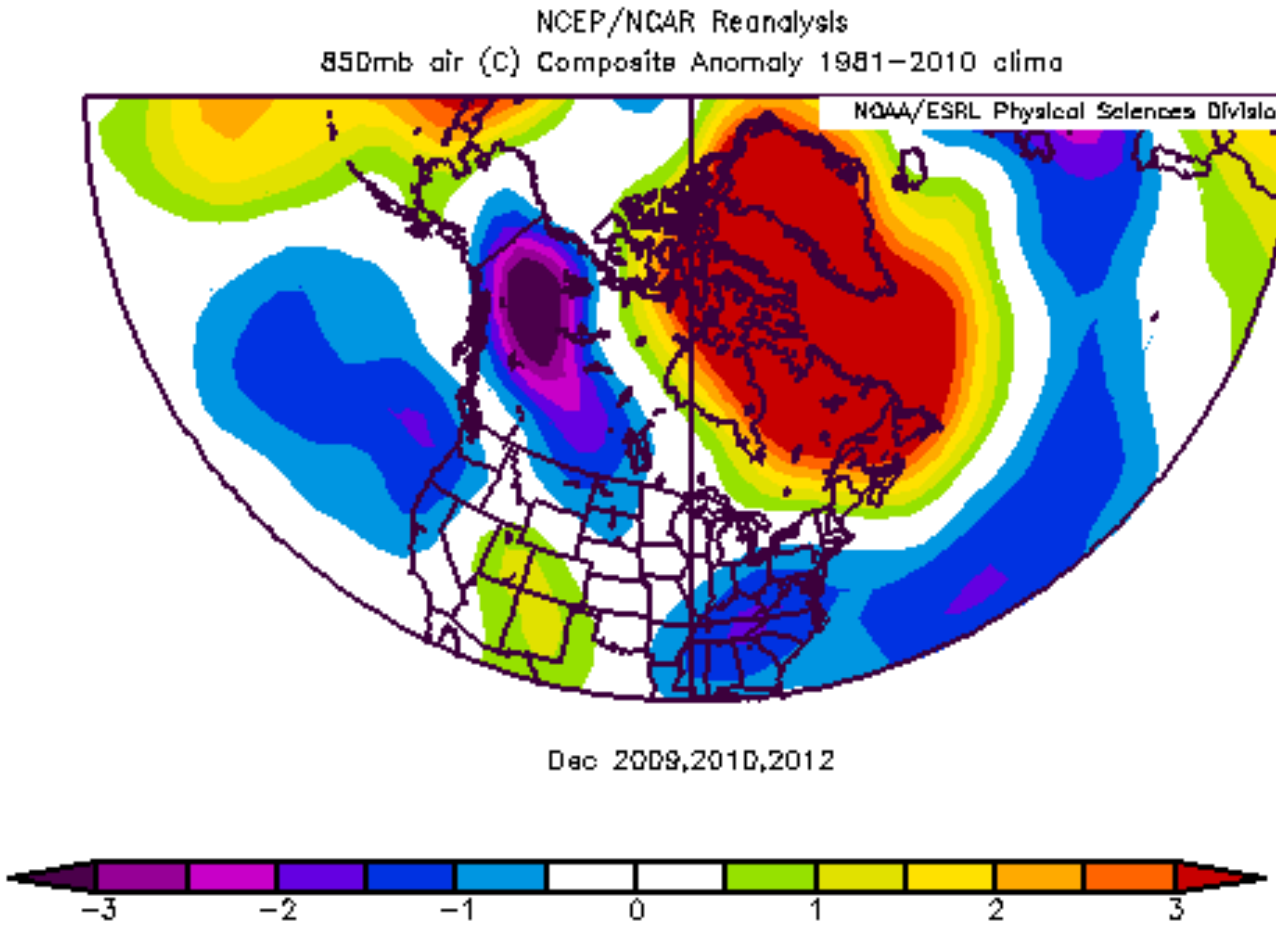
Increased wave amplitude
& slow Jet Stream



Francis and Vavrus 2012
Screen et al. 2013

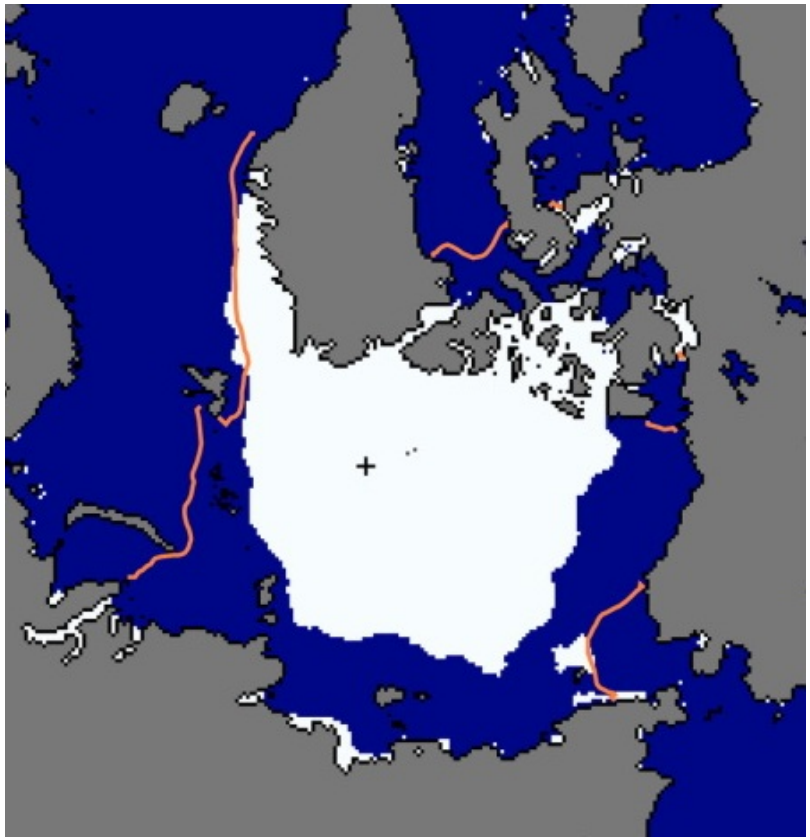
Warm Arctic - Cold Continents

850 mb Air Temperature Anomalies December 2009, 2010, 2012

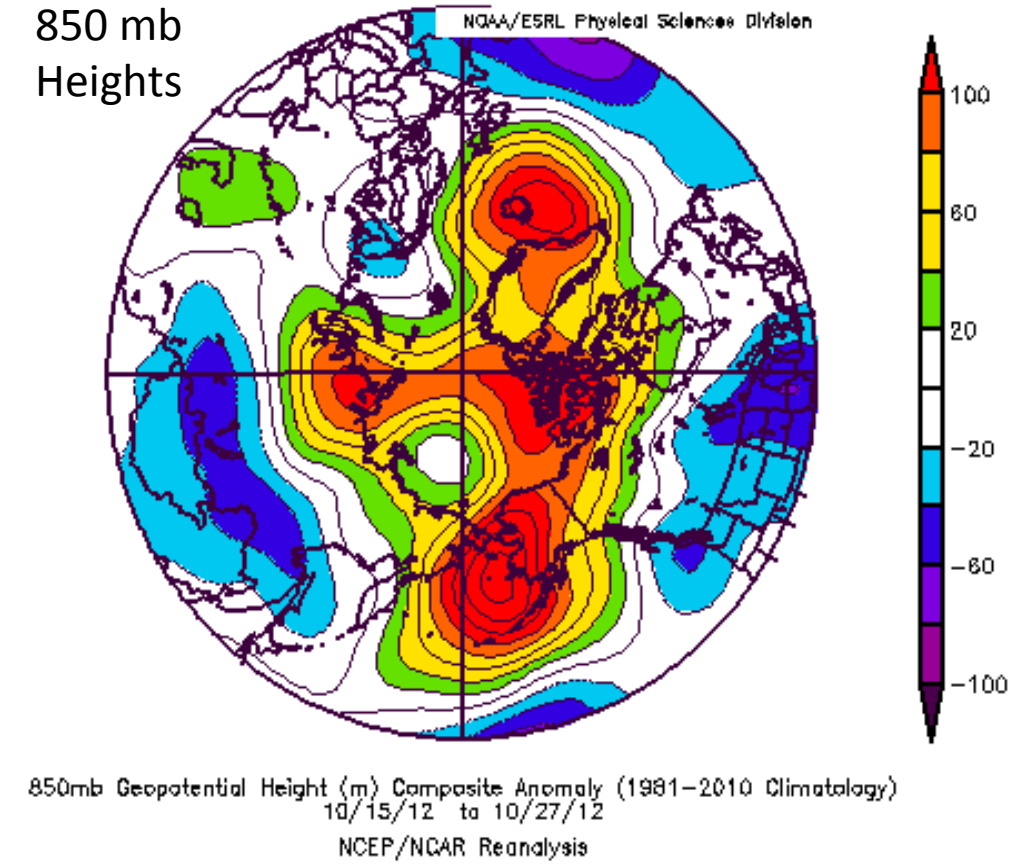


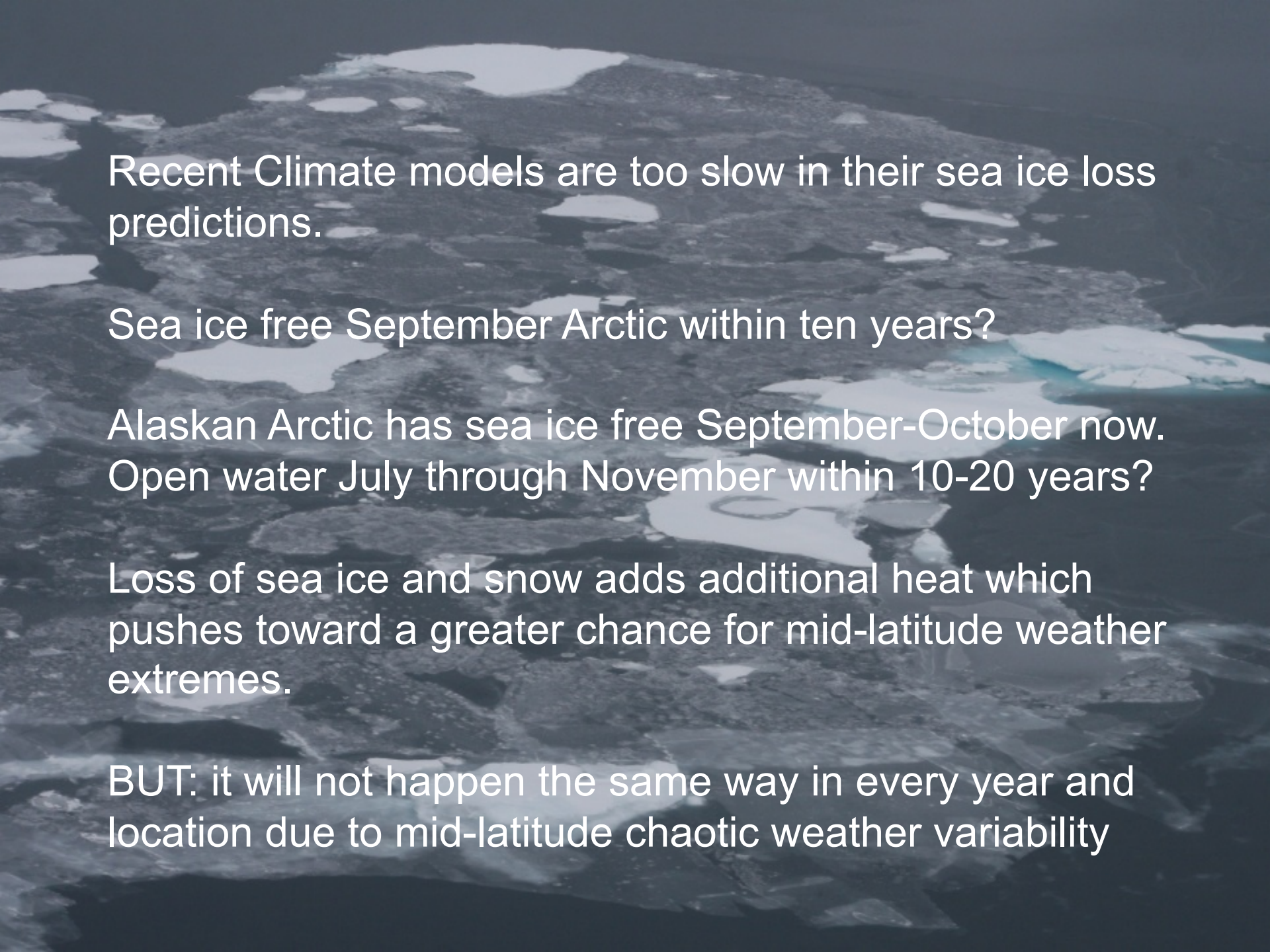
Hurricane Sandy:
2 Standard Deviation Negative NAO and AO

Oct 15
2012



850 mb
Heights





Recent Climate models are too slow in their sea ice loss predictions.

Sea ice free September Arctic within ten years?

Alaskan Arctic has sea ice free September-October now. Open water July through November within 10-20 years?

Loss of sea ice and snow adds additional heat which pushes toward a greater chance for mid-latitude weather extremes.

BUT: it will not happen the same way in every year and location due to mid-latitude chaotic weather variability