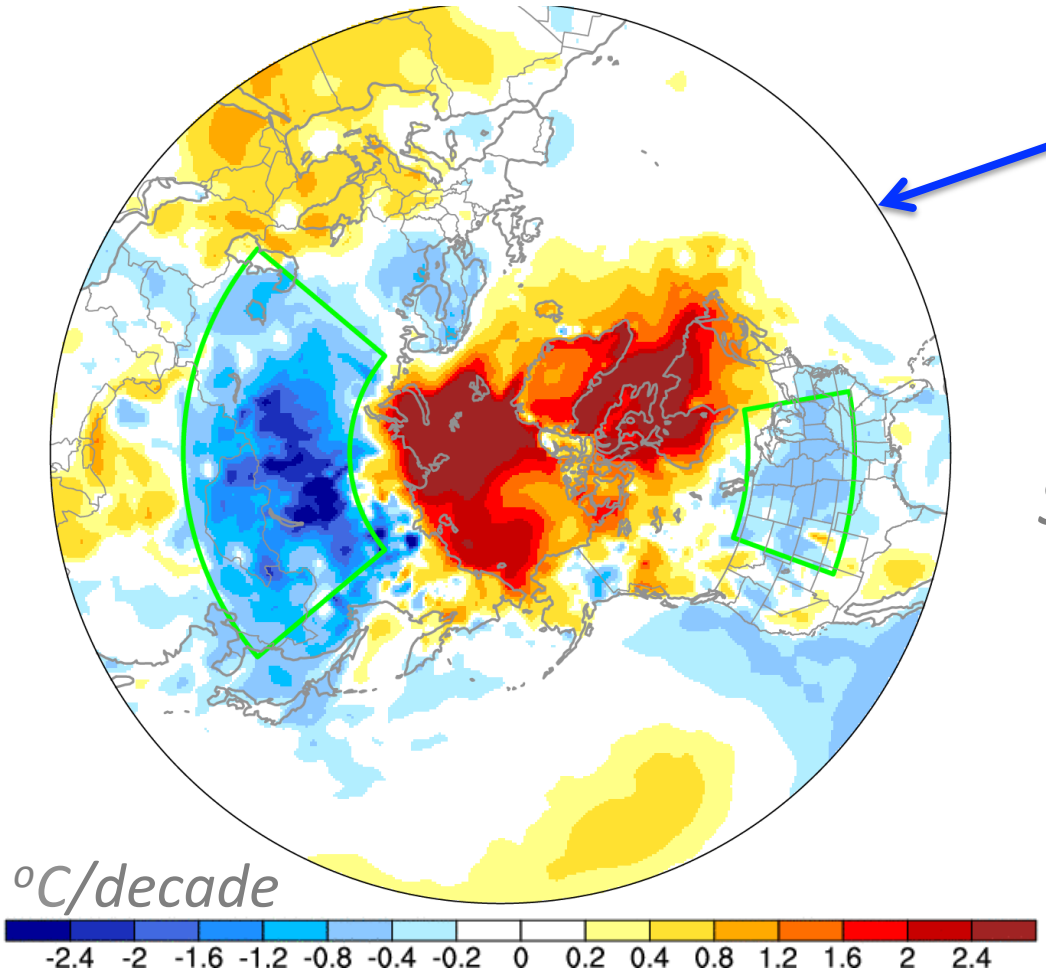
What Caused the Recent "Warm Arctic, Cold Continents" Trend Pattern in Winter Temperatures?

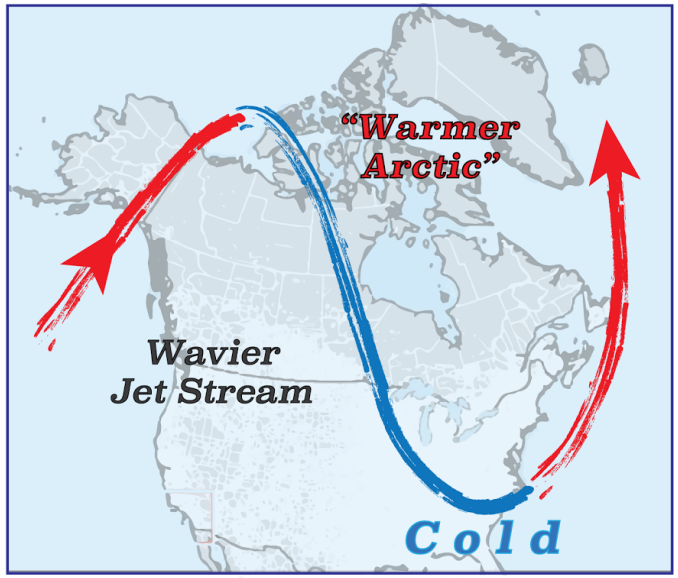


ERA-Interim
1990/91-2013/14
winter 2m-T trend

Sun, Perlwitz and Hoerling 2016, GRL

Lantao Sun, CU CIRES/NOAA ESRL PSD
US CLIVAR Webinar, July 13, 2016

Does recent Arctic change significantly affect the jet stream?



Francis and Vavrus (2012; 2015); Cohen et al. (2013); Honda et al. (2009); Overland et al. (2011; 2015); Liu et al. (2012); Tang et al. (2013); Overland and Wang, 2015; Kim et al. (2014); Mori et al. (2014); Nakamura et al. (2015; 2016); Kug et al. (2015) and others

Review paper: Cohen et al. (2014)

Barnes (2013); Screen and Simmonds (2013); Screen et al. (2013); Screen (2014); Barnes et al. (2014); Gerber et al. (2014); Sorokina et al. (2015); Hassanzadeh and Kuang (2014; 2015); Perlwitz et al. (2015); Li et al. (2015); McCusker et al. (2016) and others

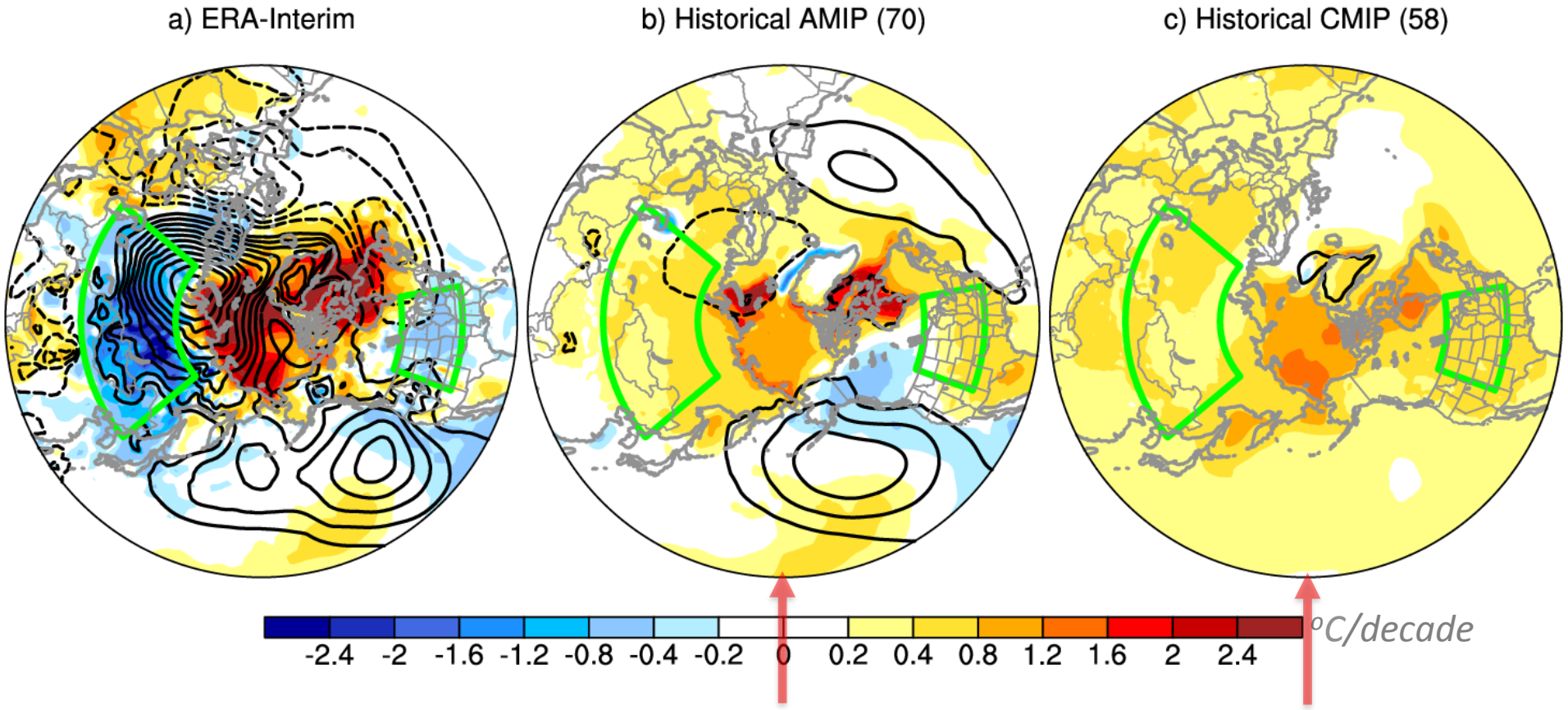
Review paper: Barnes and Screen (2015)

Climate Model Simulations

- Historical AMIP (70): atmosphere model simulation forced by observed radiative forcings, SSTs and sea ice concentrations.
- Historical CMIP (58): atmosphere-ocean coupled model simulation forced by observed radiative forcings.

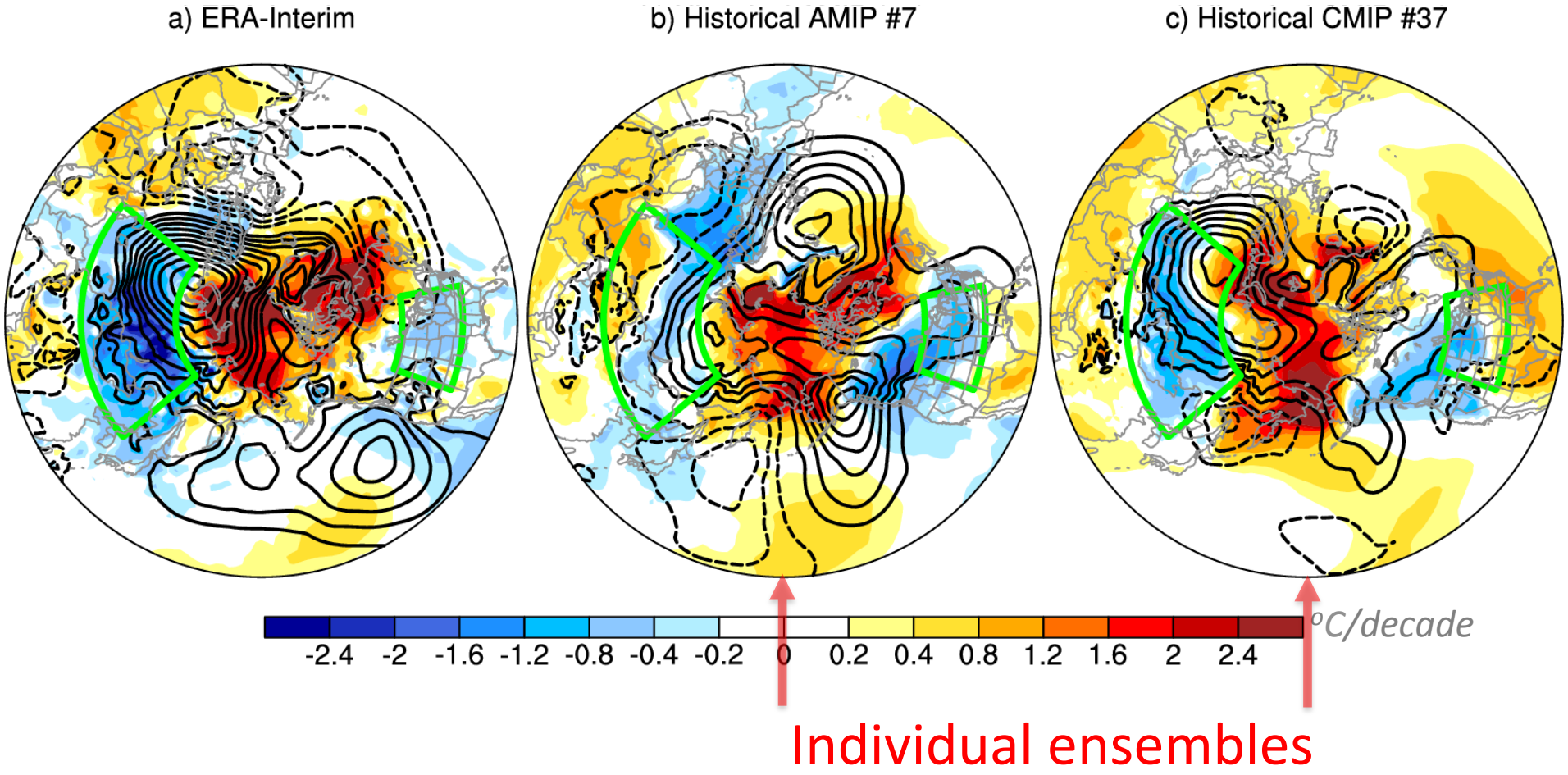
✧ *1990/91-2013/14 winter trends in sea-level pressure (SLP) and 2m-temperature*

1990/91-2013/14 DJF 2m-T/SLP trend (CI: 0.5 hPa decade^{-1})



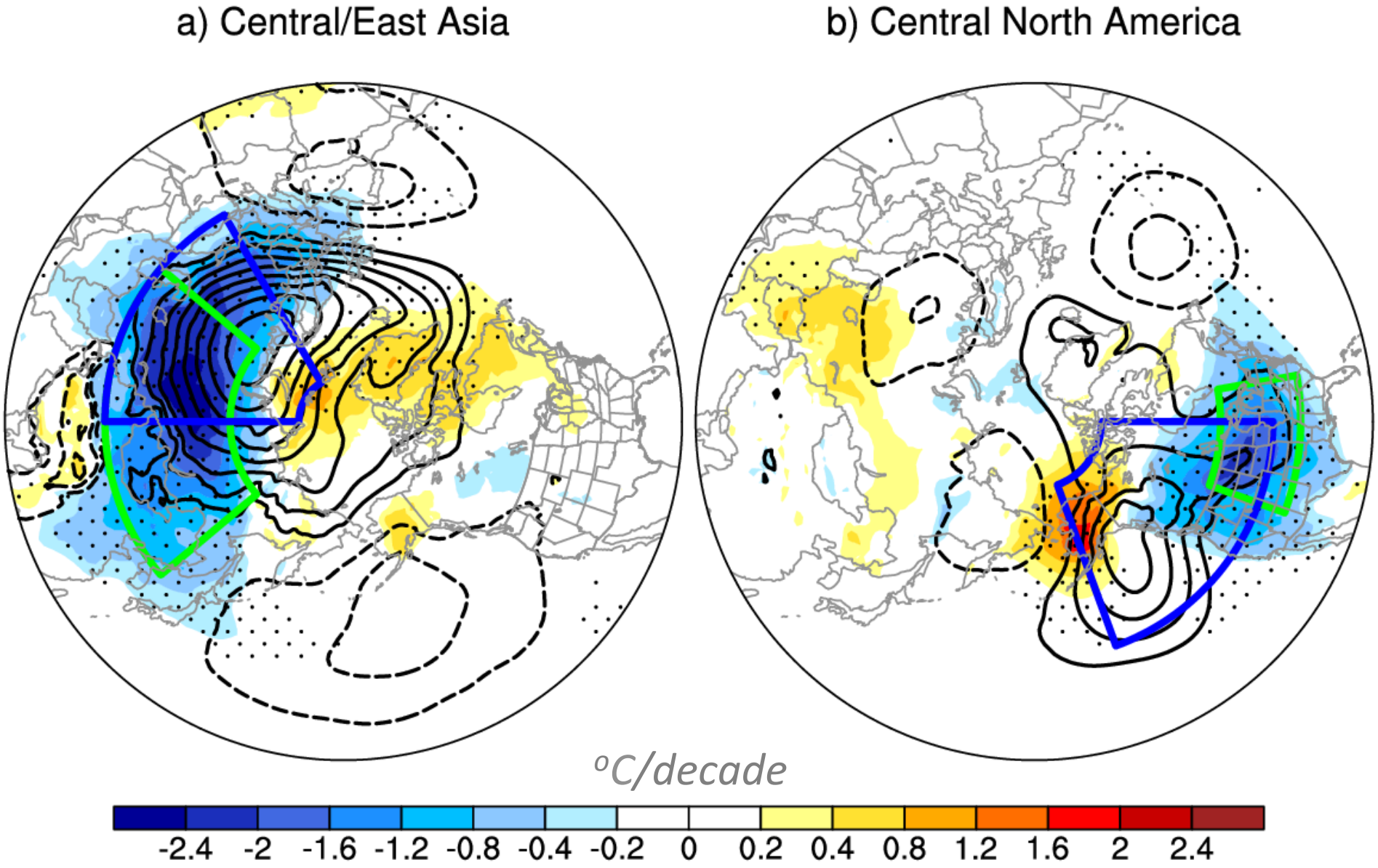
Recent mid-latitude cooling trend is not a forced response, either to GHG forcing, or the additive effects by SSTs and sea ice concentrations.

1990/91-2013/14 DJF 2m-T/SLP trend (CI: 0.5 hPa decade^{-1})

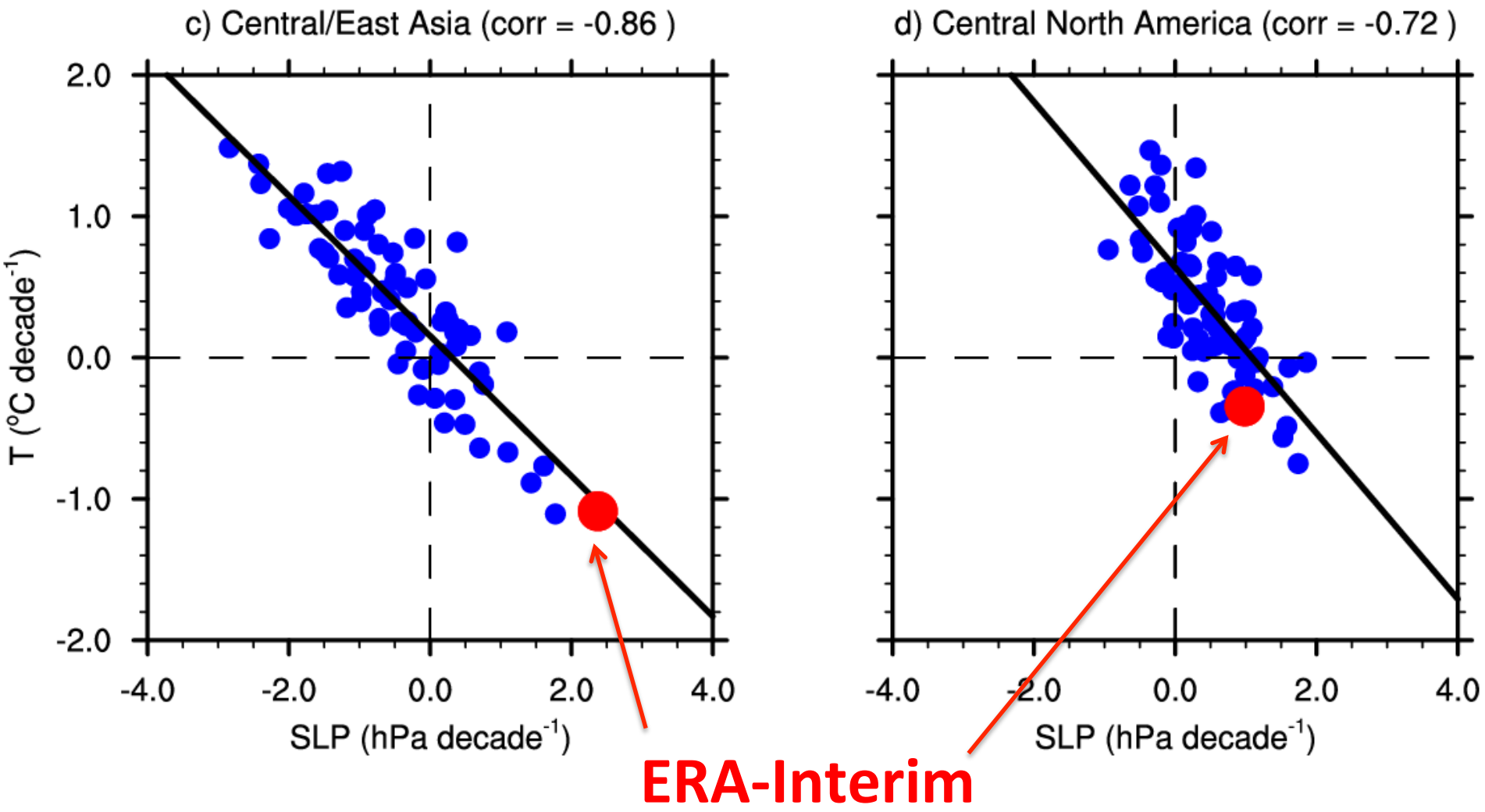


The observed cooling trend likely reflects the atmospheric internal variability.

AMIP SLP trend pattern associated with mid-latitude cooling

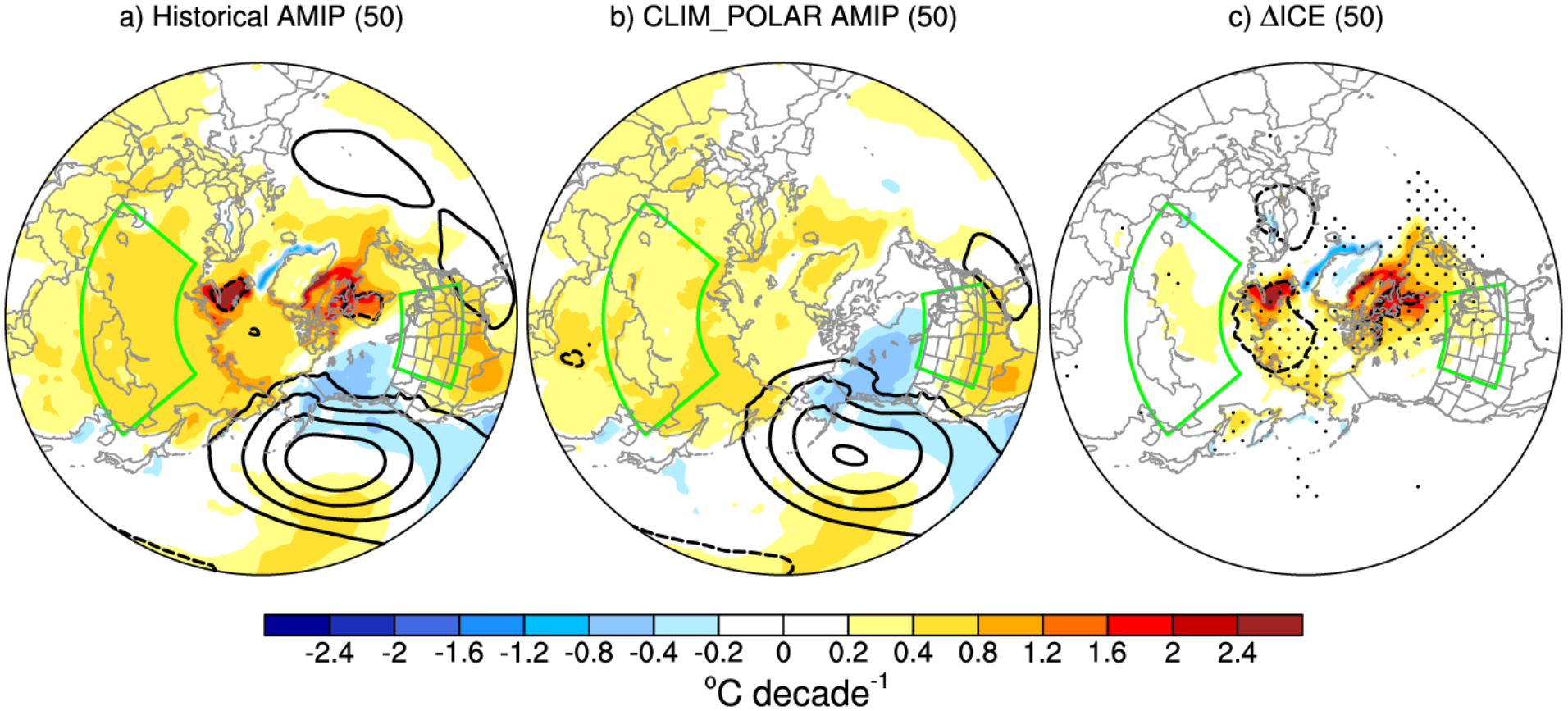


2m-T/SLP trend for individual ensembles



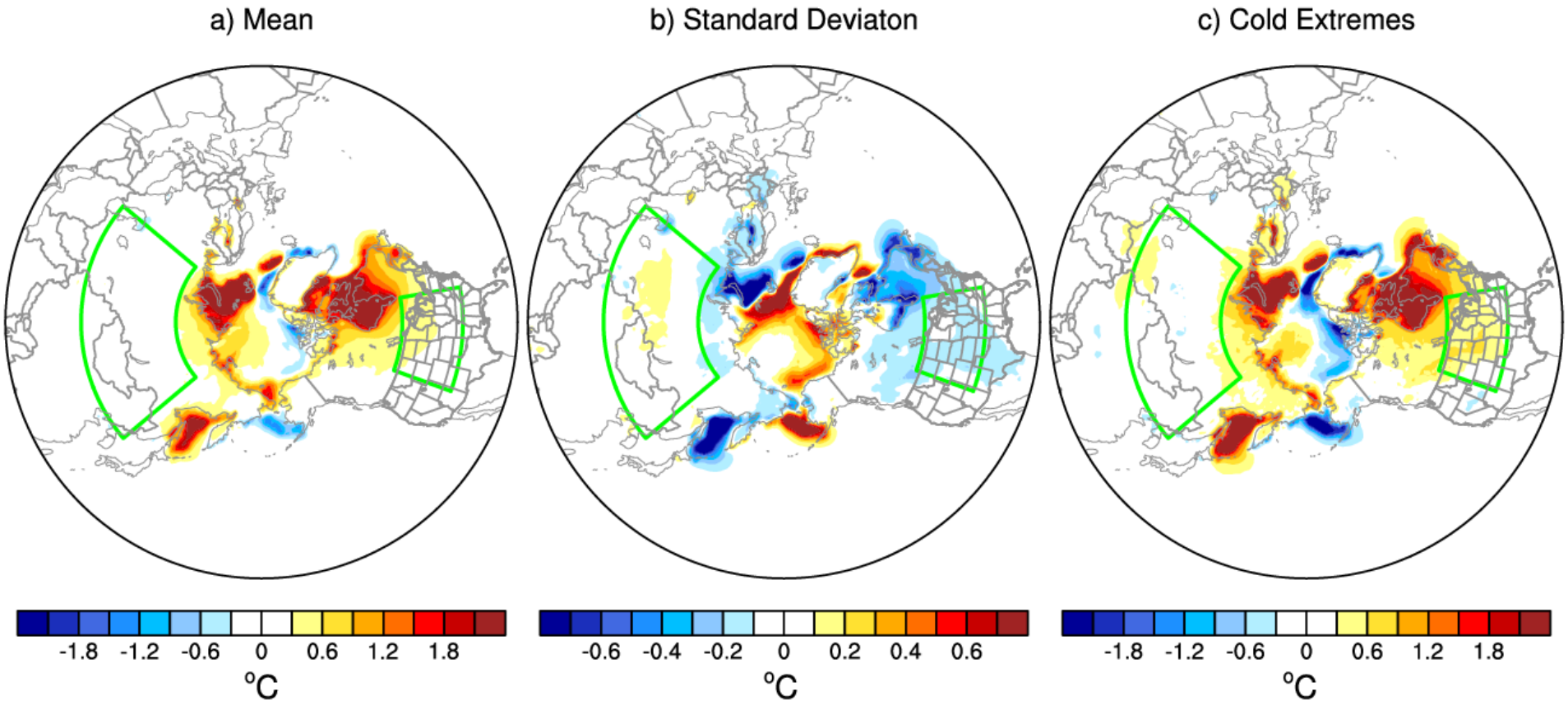
1990/91-2013/14 DJF 2m-T/SLP trend (CI: 0.5 hPa decade^{-1})

- **Historical AMIP**: observed GHGs, SST and sea ice conditions.
- **CLIM_POLAR AMIP**: observed SST, GHGs and sea ice 1979-1989 climatology
- **ΔICE = Historical AMIP – CLIM_POLAR AMIP**



Recent sea ice loss contributed to the warming in the Arctic, but not cooling in the mid-latitude continents.

DJF 2m-T Response to Arctic sea ice loss: 2004/05-2013/14 average



Arctic sea ice loss reduces daily temperature variability and reduces cold extremes.

Summary

1. Observed recent cooling trend in central/east Asia and central North America is not a forced response.
2. Recent sea ice loss contributed to the warming in the Arctic, but not to the cooling over mid-latitude continents.
3. Arctic amplification *does* affect mid-latitude weather, however by *reducing* daily variability and *reducing* cold extremes.