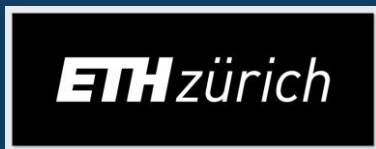


Arctic Amplification: a Rapid Response to Radiative Forcing

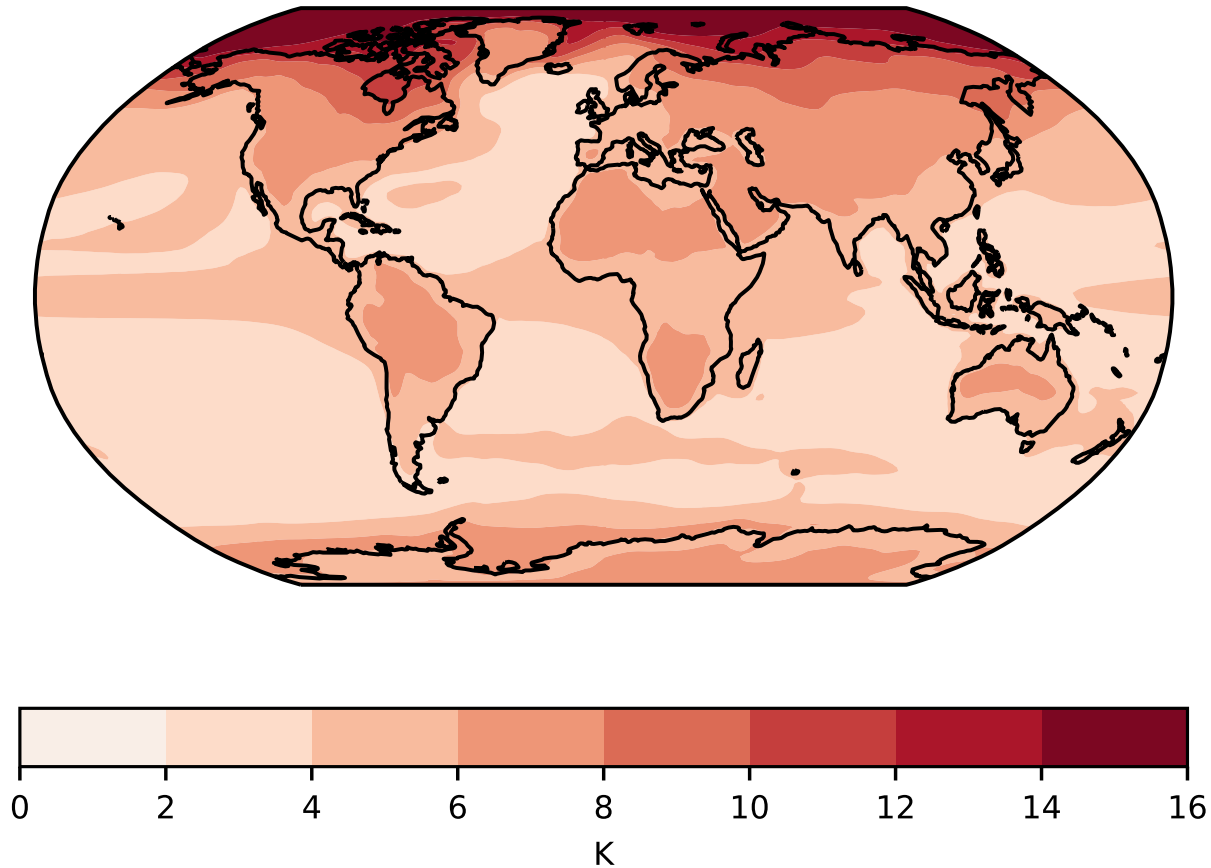
Tyler P. Janoski

Michael Previdi, Gabriel Chiodo,
Karen L. Smith, Lorenzo M. Polvani

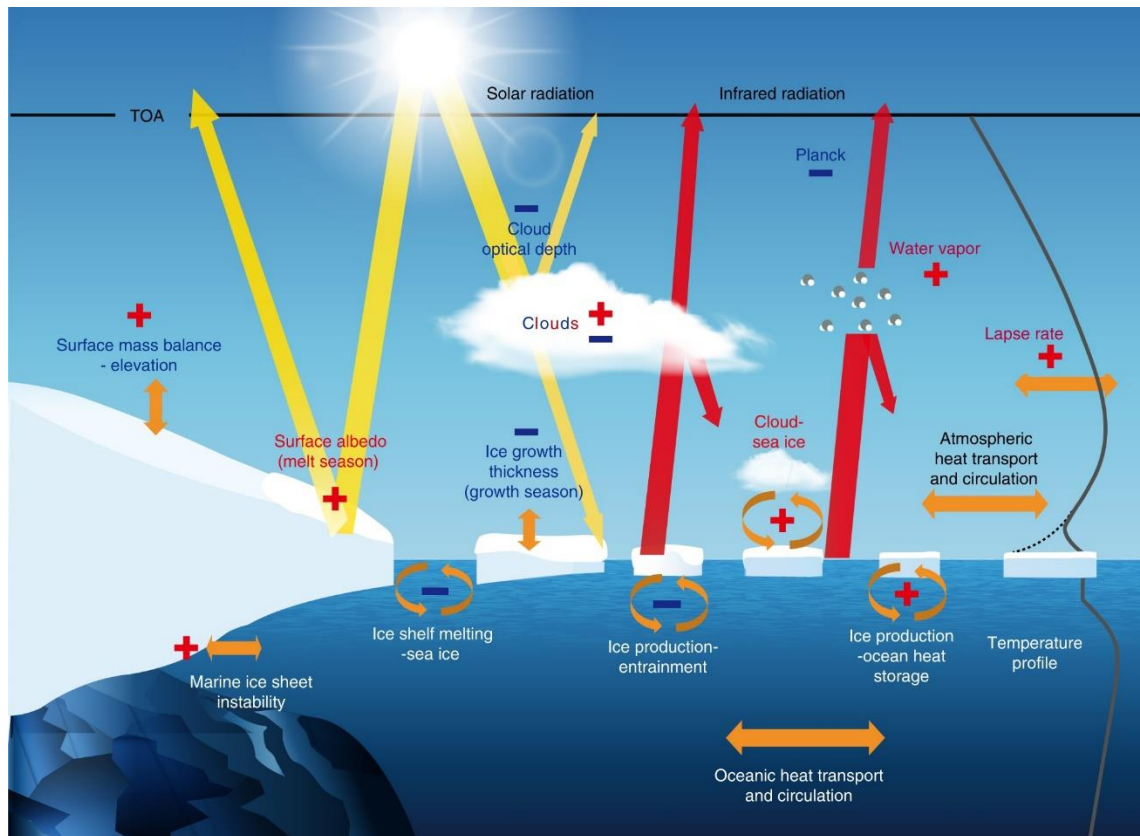


Arctic amplification (AA): enhanced Arctic surface warming

4xCO₂ Change in SAT, CMIP5



AA caused by feedbacks and changes in heat transport



These physical processes operate on considerably **different timescales**

Goosse et al., 2018

AA in CMIP5 models under 4xCO₂

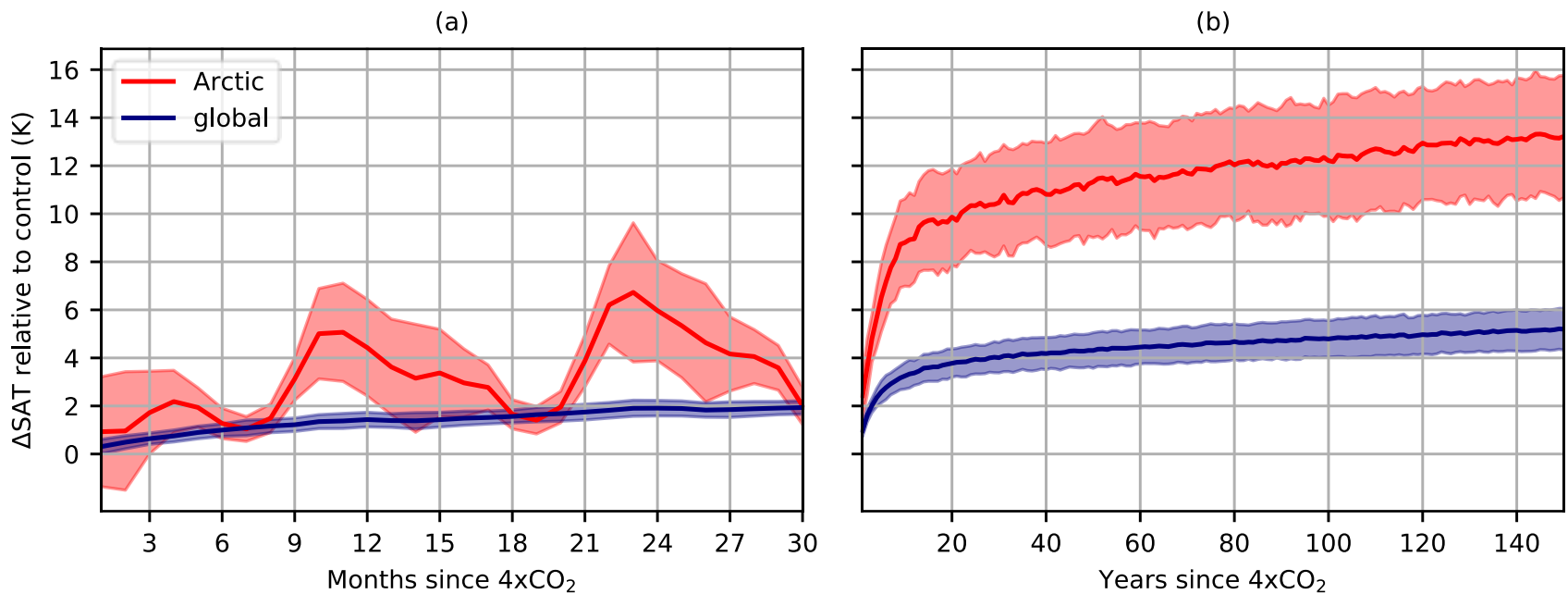
How fast does AA occur following 4xCO₂? Does the relative importance of AA mechanisms vary with time?

AA in CMIP5 models under 4xCO₂

How fast does AA occur following 4xCO₂? Does the relative importance of AA mechanisms vary with time?

- **Simulations from 21 CMIP5 models:**
 - Fully-coupled preindustrial control and abrupt 4xCO₂ runs
- **Feedbacks quantified using radiative kernel method**
 - Kernels from CESM-CAM5 (Pendergrass et al., 2018)
- **Arctic defined as 70°N-90°N**
- **Atmospheric and ocean mixed-layer heat convergence diagnosed from changes in column energy content**

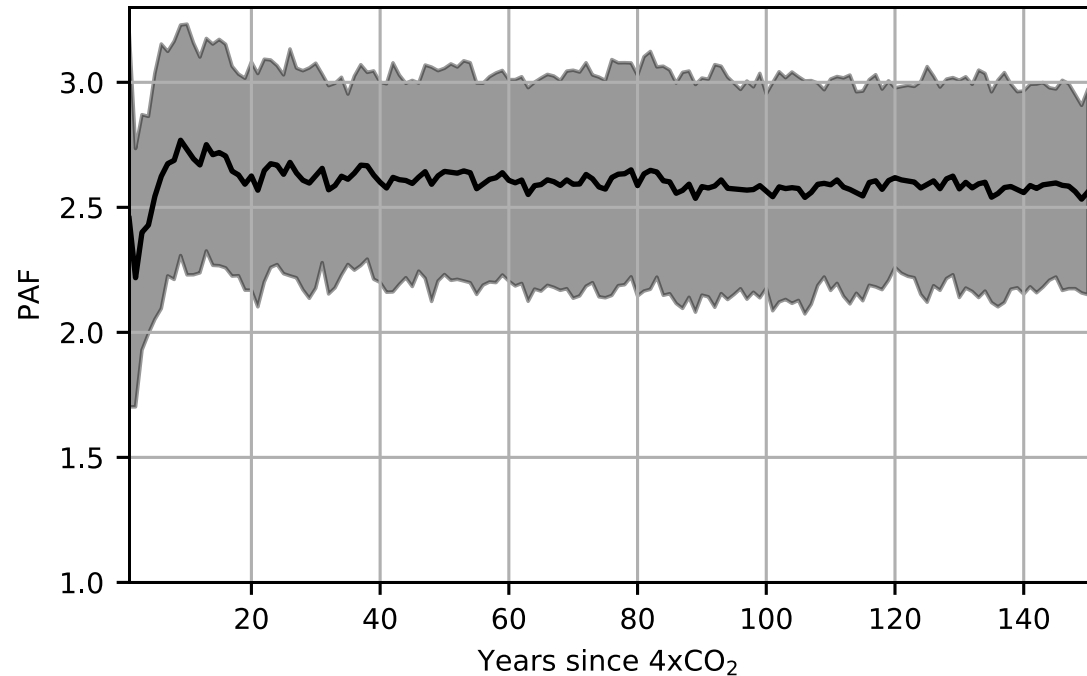
AA appears within months following 4xCO₂



Previdi et al., in review

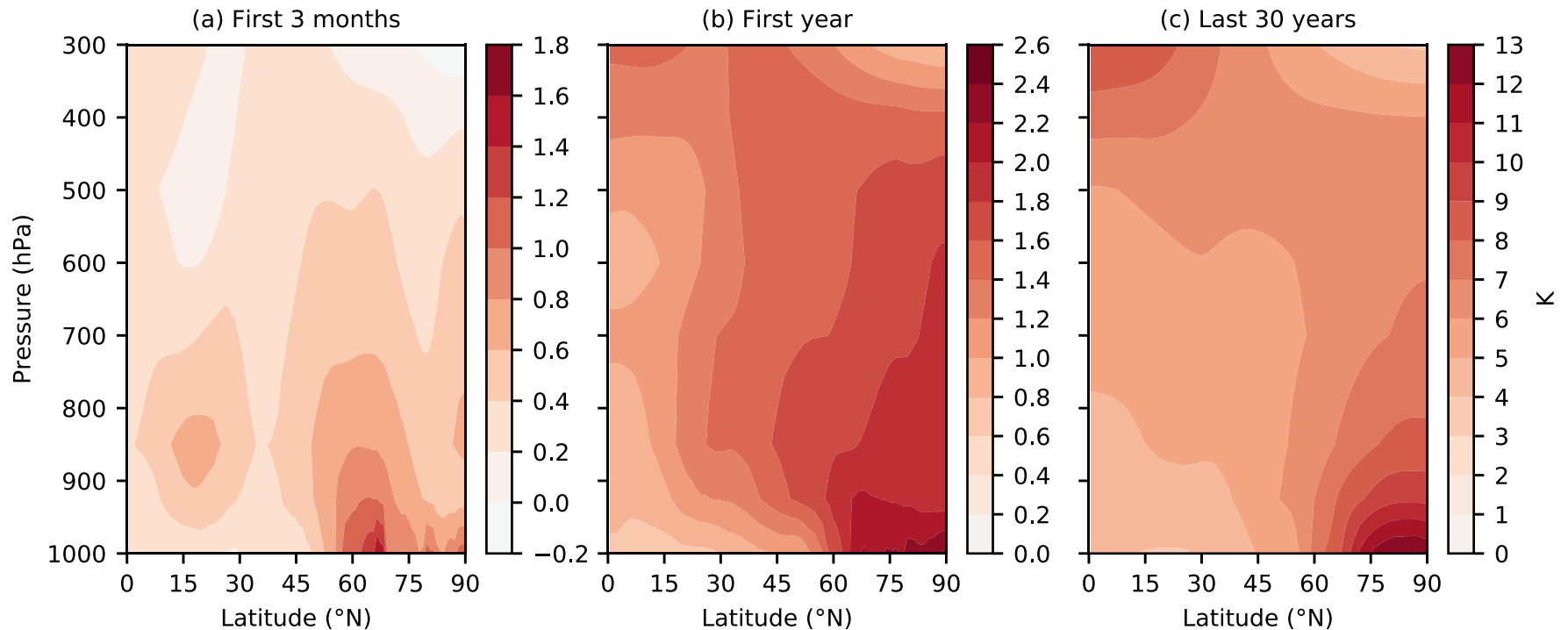
Time evolution of polar amplification factor

$$PAF = \frac{\Delta \bar{T}_{pole}}{\Delta \bar{T}_{global}}$$



Previdi et al., in review

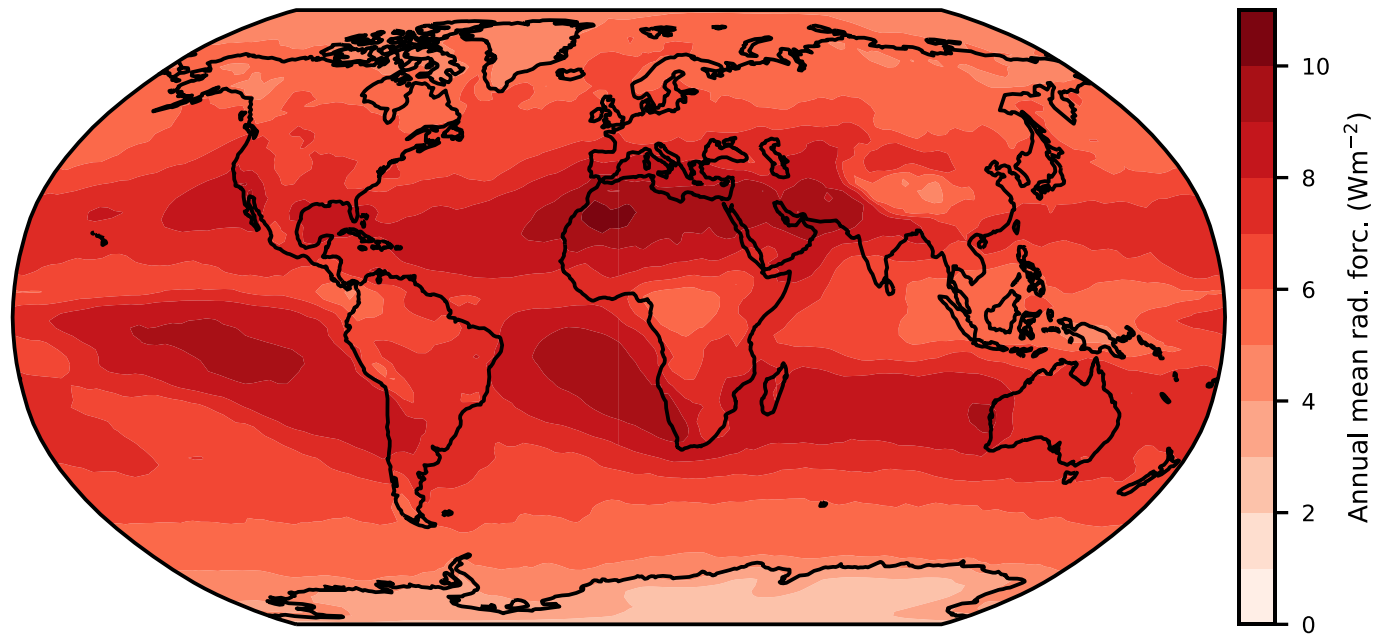
Vertical structure of warming after 4xCO₂



Previdi et al., in review

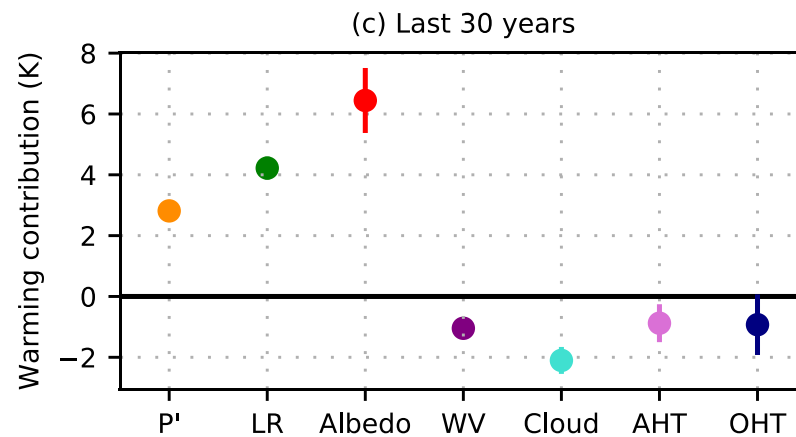
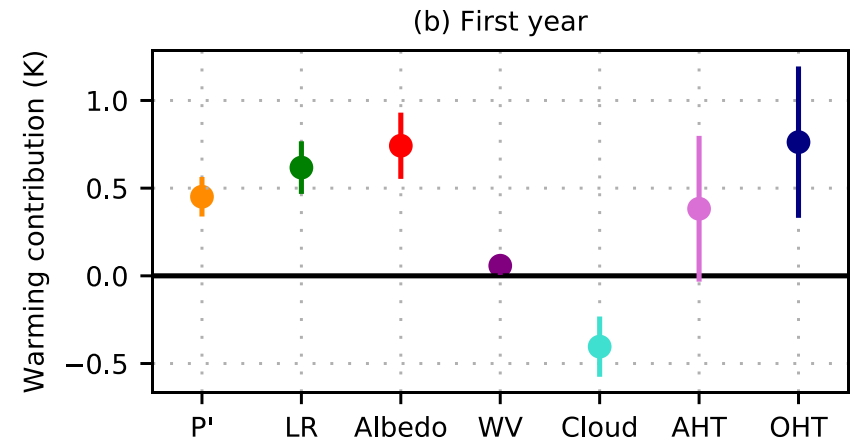
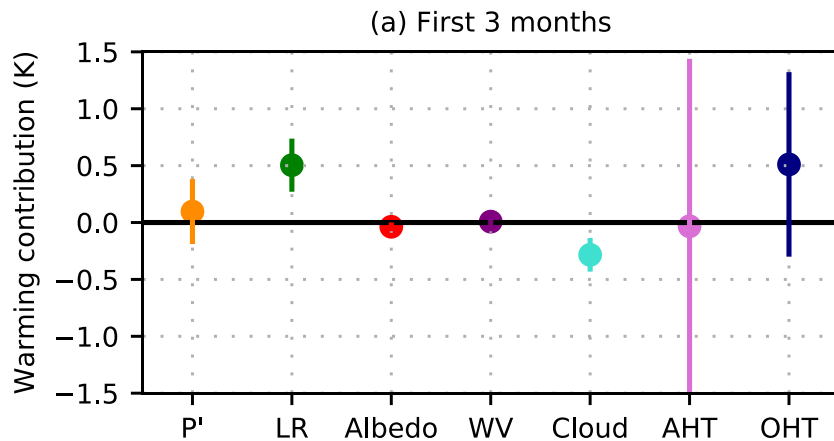
What is contributing to this response?

4xCO₂ radiative forcing opposes AA



Previdi et al., in review

Arctic – global warming contributions

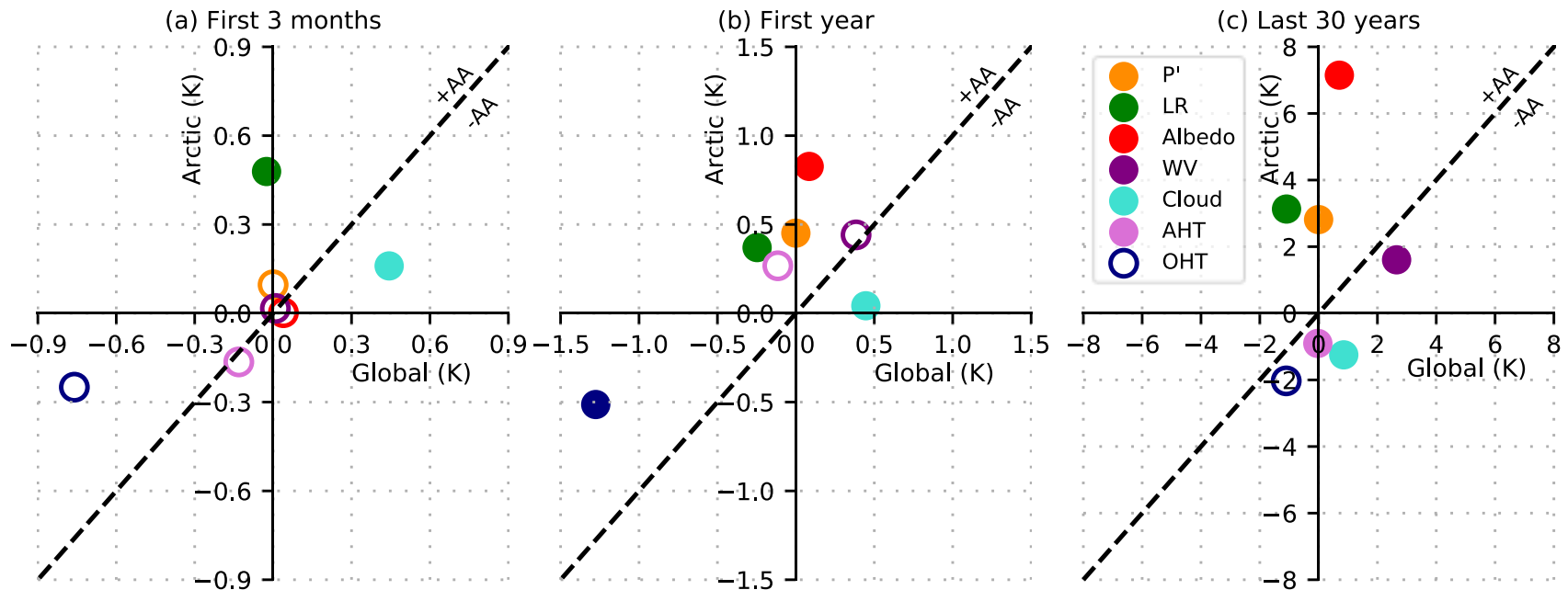


Previdi et al., in review

Conclusions

- Arctic amplification occurs rapidly (within a few months) in response to radiative forcing and is likely to be driven largely by atmospheric processes on this timescale
- Lapse rate feedback drives AA in first three months
- Albedo, lapse rate, and Planck feedbacks main contributors in quasi-equilibrium response, and are already most important feedbacks in first year
- The inherently fast timescales of AA suggest the potential for near-term mitigation of Arctic warming following a reduction in anthropogenic forcing

Warming contributions from feedbacks and transports



Previdi et al., in review