Dynamical and thermodynamical contributions to the mid-latitude atmospheric response to Arctic sea ice decline

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Outline

1) Sea ice albedo reduction,

ocean/atmosphere coupled experiments,

strong & idealised sea ice loss,

CNRM-CM6 model

(PRIMAVERA project)

2) PAMIP atmosphere-only experiments,

pdSST-futArcSIC vs. pdSST-pdSIC,

forcing +2°C compared to pre-ind. period,

3 models:

CNRM-CM6, CESM2, CESM1-WACCM-SC

Dynamical and thermodynamical decomposition

$$\Delta T_{tot} = \Delta T_{dynamical} + \Delta T_{thermodynamical}$$

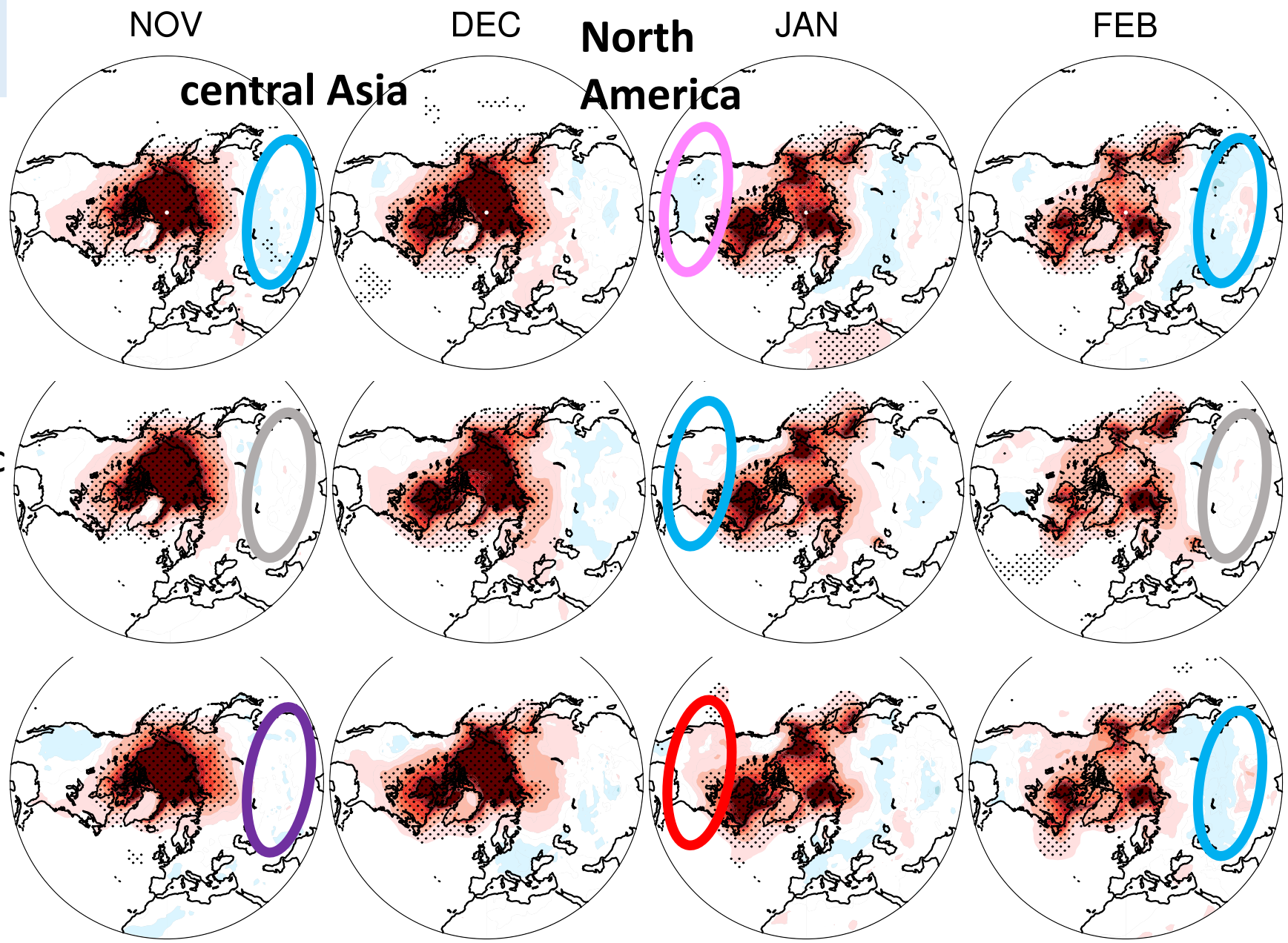
→ Dynamical adjustment method,
based on a regional reconstruction of circulation analogs (Deser, Terray & Phillips 2016)

PAMIP atmosphere-only experiments

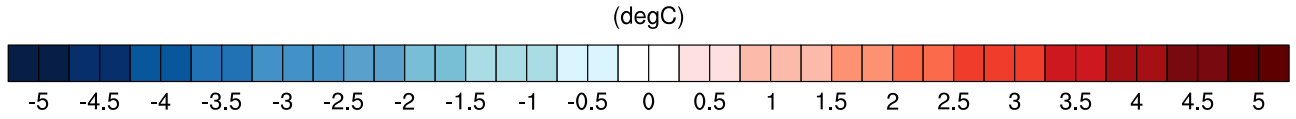
pdSST-futArcSIC vs. pdSST-pdSIC

Explained by:

- Dynamical component
- Thermodynamical component
- Both
- Both components offset each other
- Both components are weak



SAT +2m



Summary

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→ **The large-scale circulation & mid-latitude SAT response to Arctic sea ice decline is significant with an idealized forcing (albedo experiment, strong sea ice loss) with CNRM-CM6 but hardly significant in the PAMIP atmosphere-only experiments with CNRM-CM6, CESM2 and CESM1-WACCM-SC**

→ **Strong variability of the response in the PAMIP atmosphere-only experiments with CNRM-CM6 (between different subsets of 100 members)**

→ **In the albedo experiments, the SAT response is first mainly explained by thermodynamical changes when sea ice loss is the strongest in November (i.e. advection of warmer oceanic air masses and/or changes in local surface energy budget) and the next months the cooling found over central Asia is explained by an intensification of the Siberian High** (Chripko et al, in rev)

Questions

1. Are 100 members enough to detect a robust atmospheric response to Arctic sea ice loss associated with a warming of +2°C ?

2. Are the roles of the dynamical and thermodynamical changes over the mid-latitudes (on the mean **and** extreme **SAT) consistent across models ? Can they explain the regional differences among the PAMIP models ?**

3. Do the models agree on a dynamically-induced Eurasian cooling ? What are the implications for the detectability of the WACE pattern in future observations ?