What has caused the improved ice thickness in HadGEM1?

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Introduction

- Preliminary results based on a suite of sensitivity experiments using HadGEM1
- Aim to determine how the new sea ice schemes have affected the sea ice
- Focus on ice thickness
- Compares well with observations and is an improvement on HadCM3

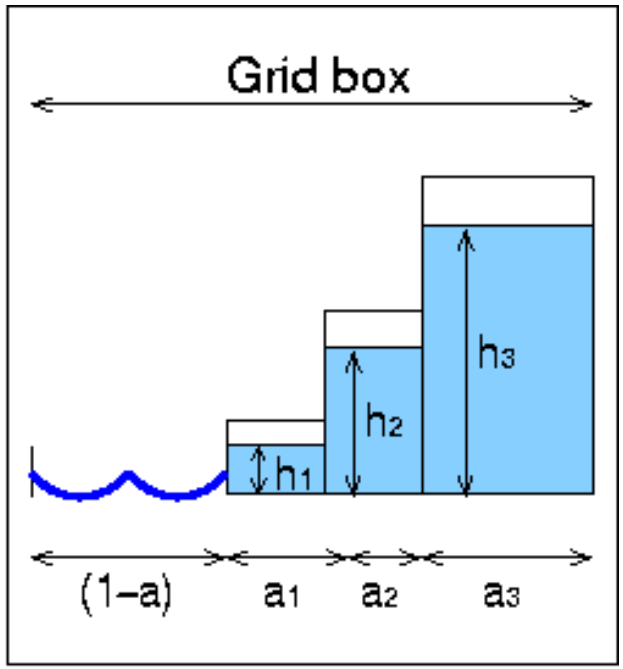
New scheme: EVP Dynamics

- Elastic-Viscous-Plastic dynamics (Hunke and Dukowicz (1997)

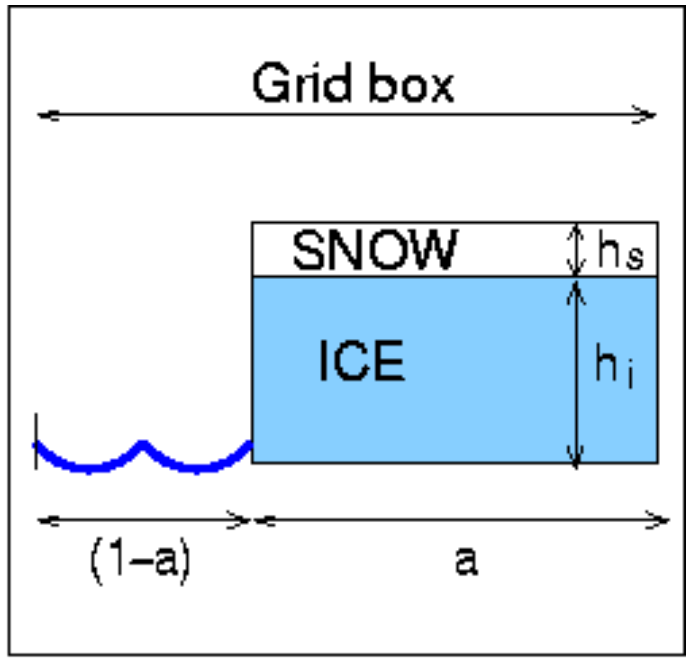
$$m\frac{\partial u}{\partial t} = \tau_a - \tau_w - Coriolis + \tau_i$$

- Ice rheology: diverge easily, but resist compression and shearing motion under convergence
- HadCM3: ice advected with surface ocean current. No advection if h > 4m and moving to thicker region

New scheme: Ice thickness distribution (ITD)



HadGEM1



HadCM3

- ITD with 1 category is scientifically different to the HadCM3 scheme, due to differences in thermodynamics and ridging schemes

Sensitivity experiments

	Atmos / Ocean	Thermo dynamics	Dynamics
Control	HadGEM1	HadGEM1 (ITD : 5 cats)	HadGEM1 (EVP)

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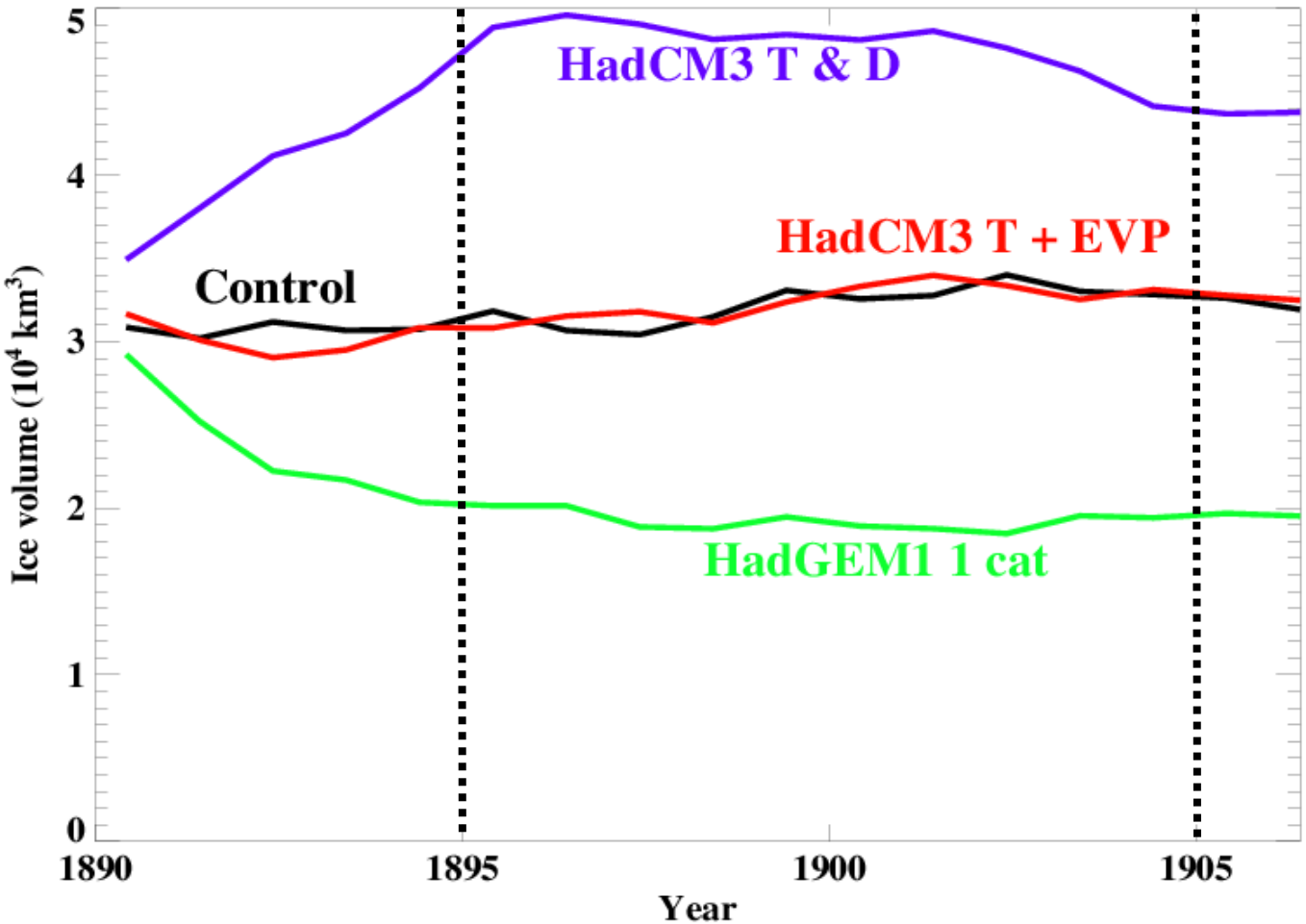
Control	HadGEM1	HadGEM1 (ITD : 5 cats)	HadGEM1 (EVP)
HadCM3 T & D	HadGEM1	HadCM3	HadCM3
HadCM3 T & EVP	HadGEM1	HadCM3	HadGEM1 (EVP)

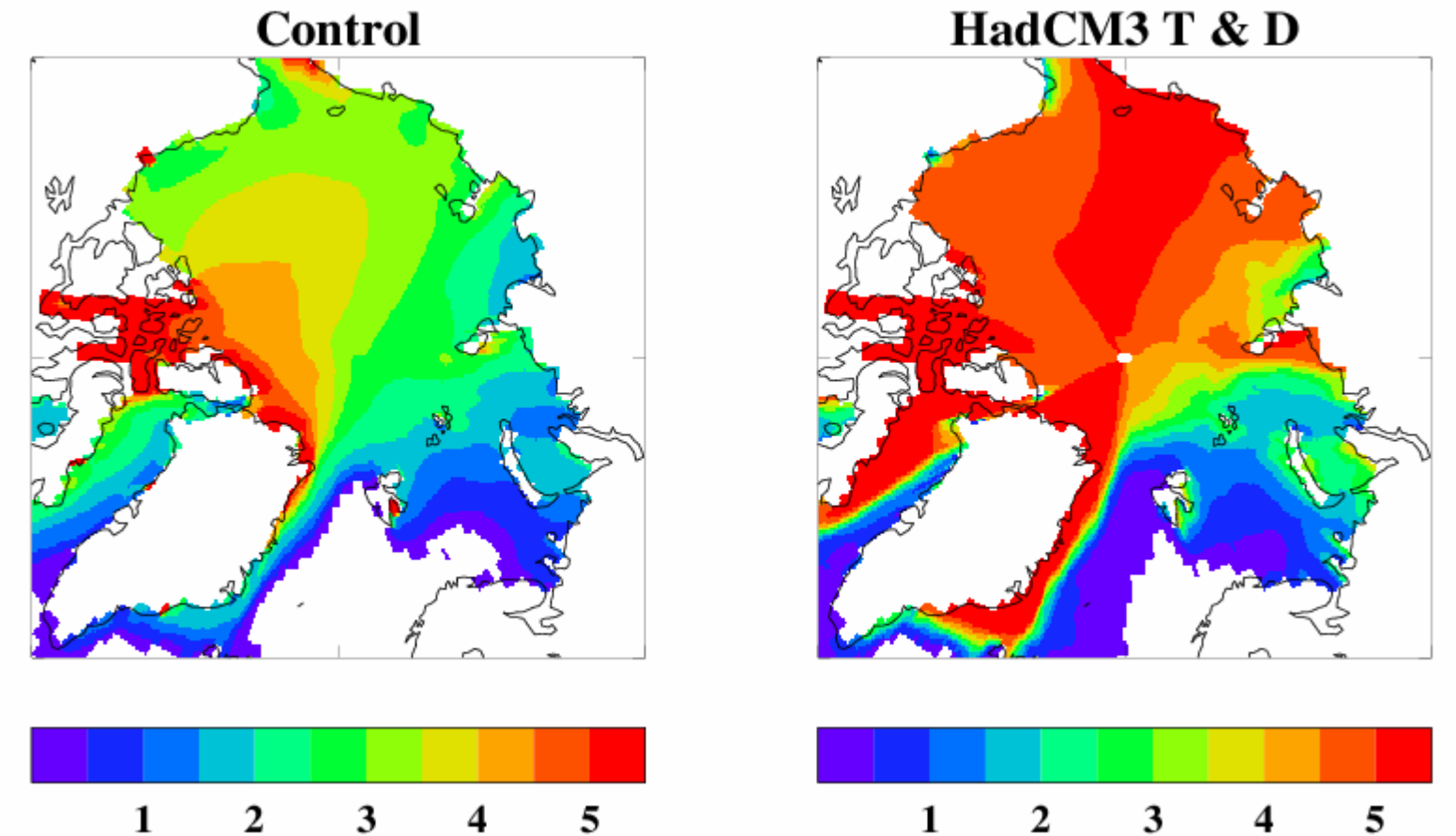
Sensitivity experiments

	Atmos / Ocean	Thermo dynamics	Dynamics
Control	HadGEM1	HadGEM1 (ITD : 5 cats)	HadGEM1 (EVP)
HadCM3 T & D	HadGEM1	HadCM3	HadCM3
HadCM3 T & EVP	HadGEM1	HadCM3	HadGEM1 (EVP)
HadGEM1 1 cat	HadGEM1	HadGEM1 (ITD : 1 cat)	HadGEM1 (EVP)

NH ice volume (10^4 km^3)



NH March ice thickness (m)



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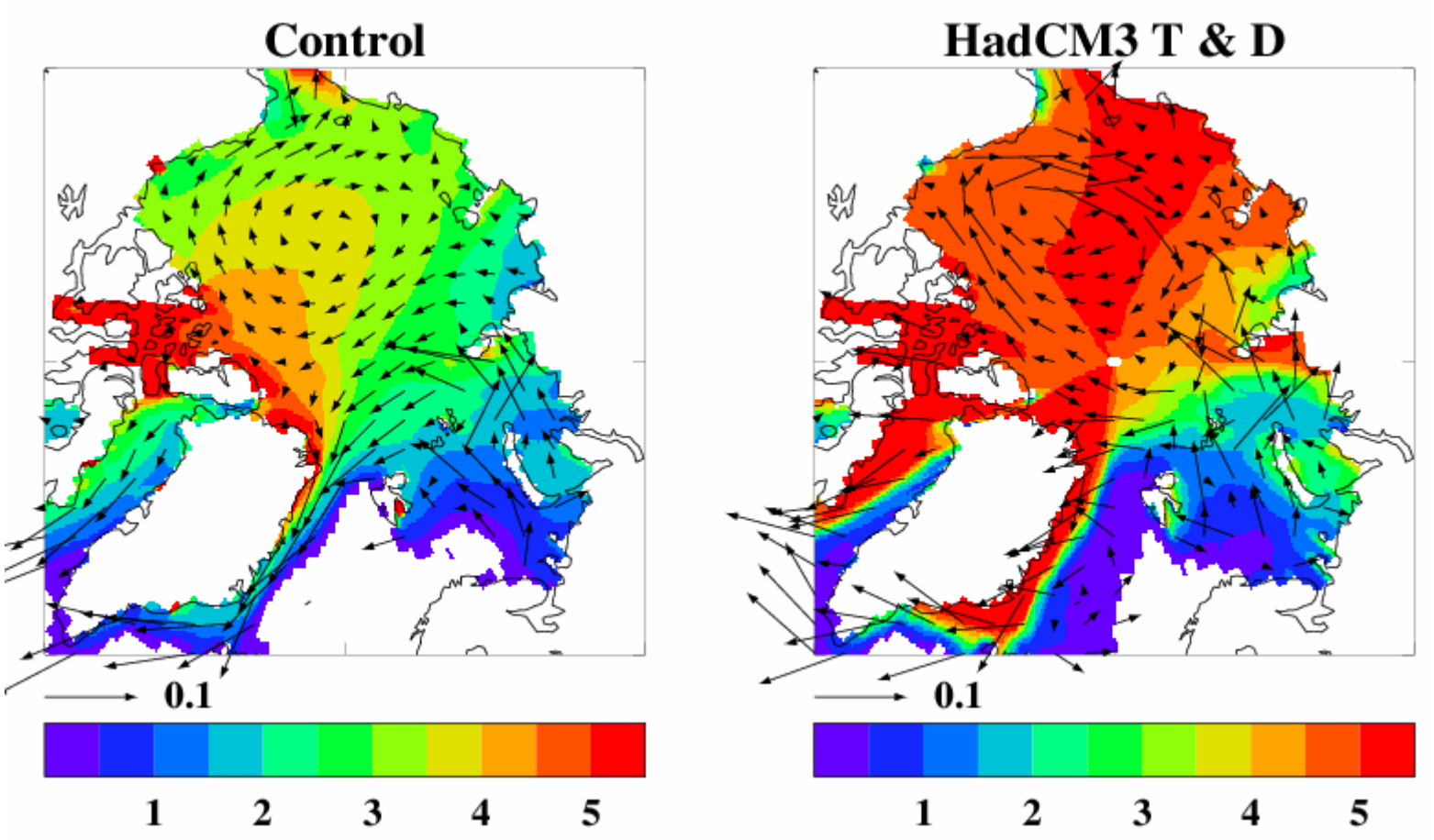

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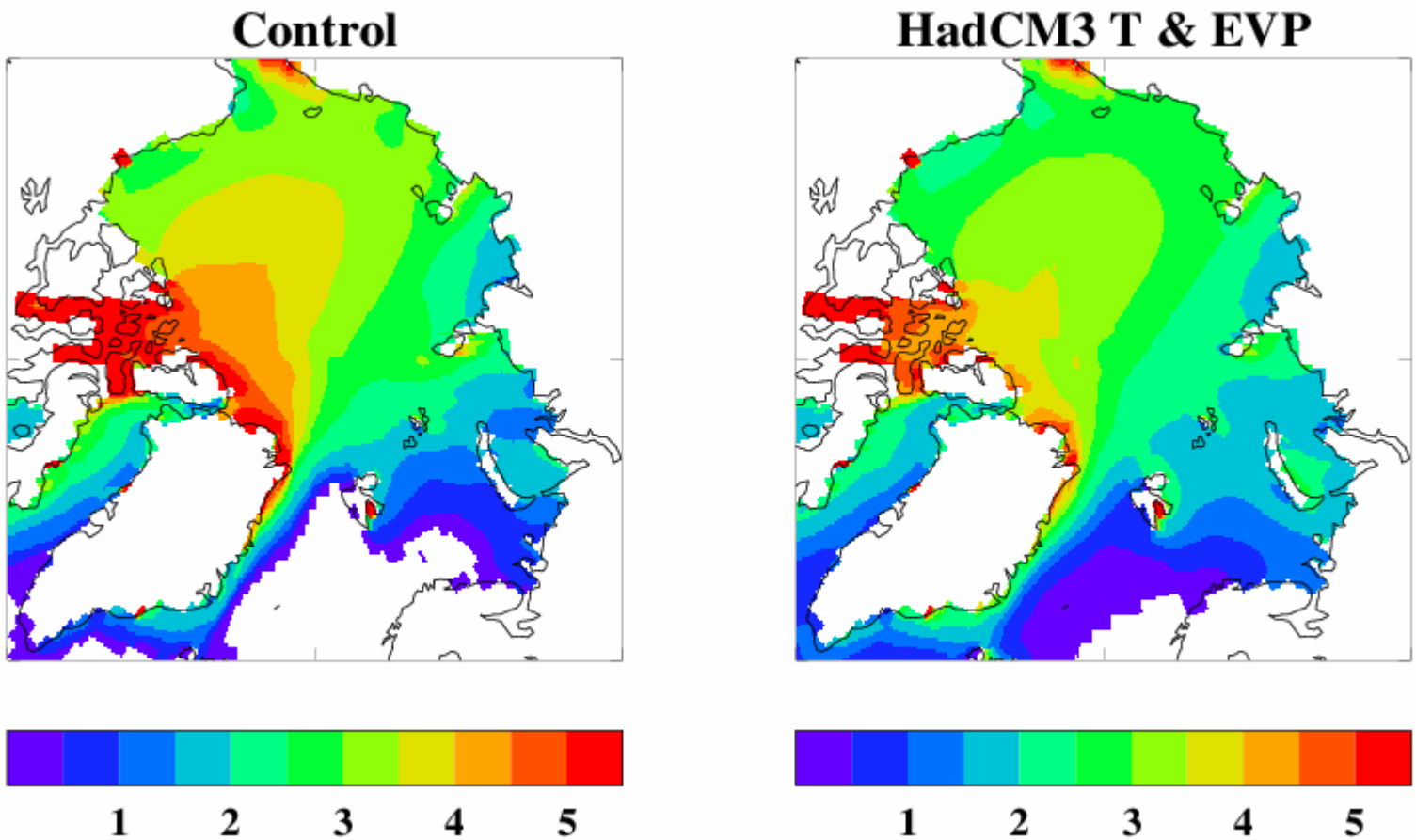

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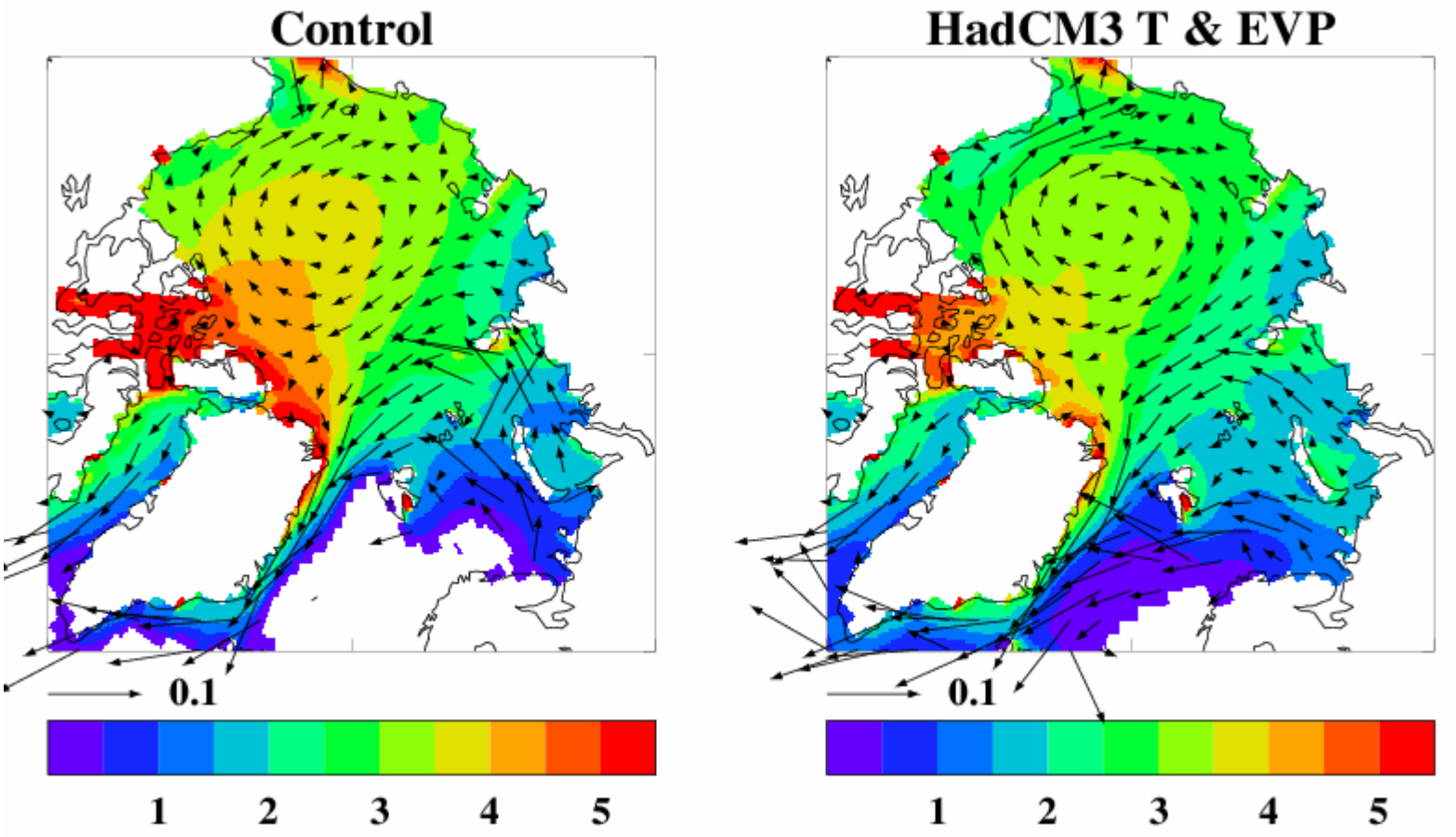

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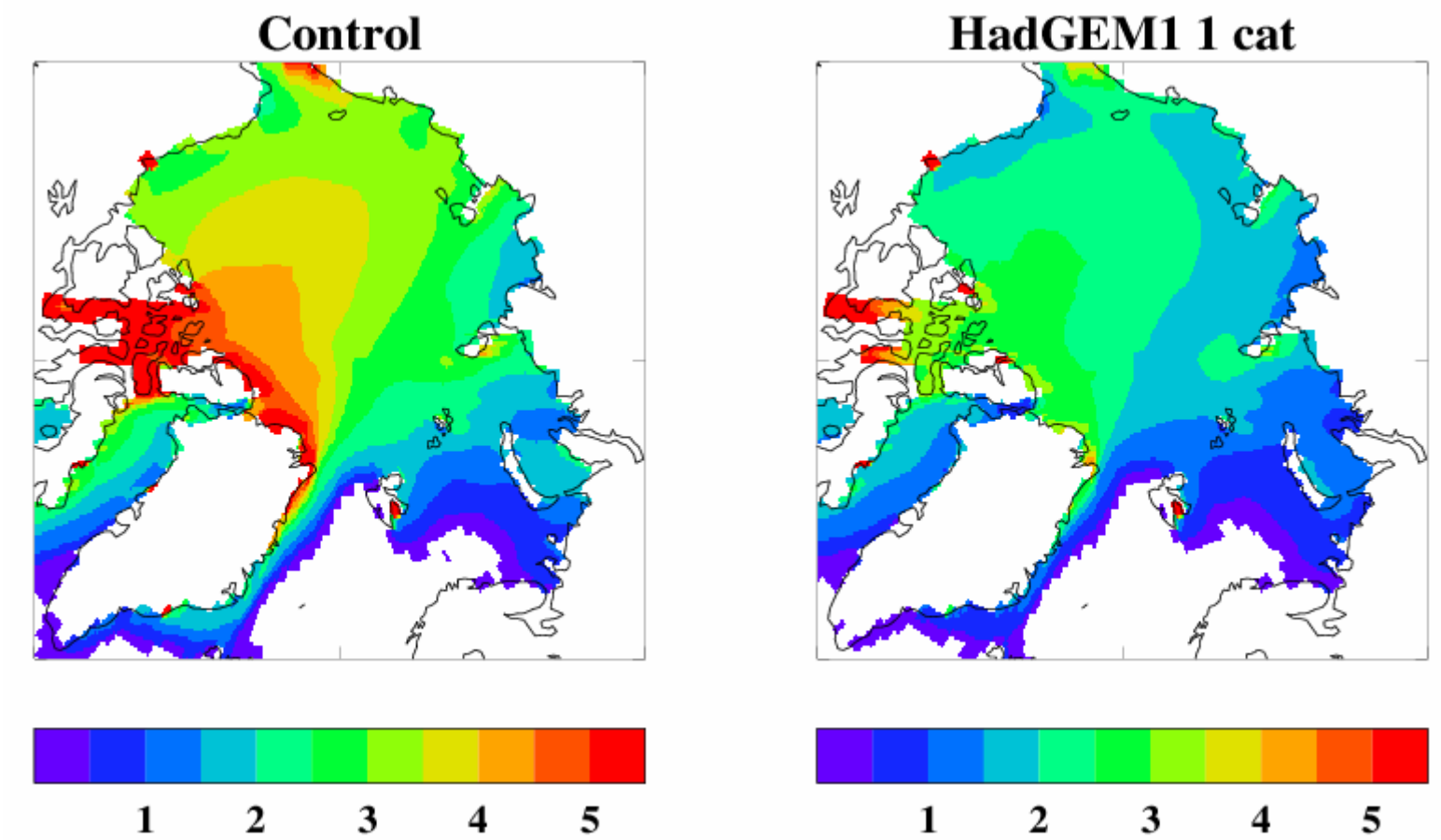
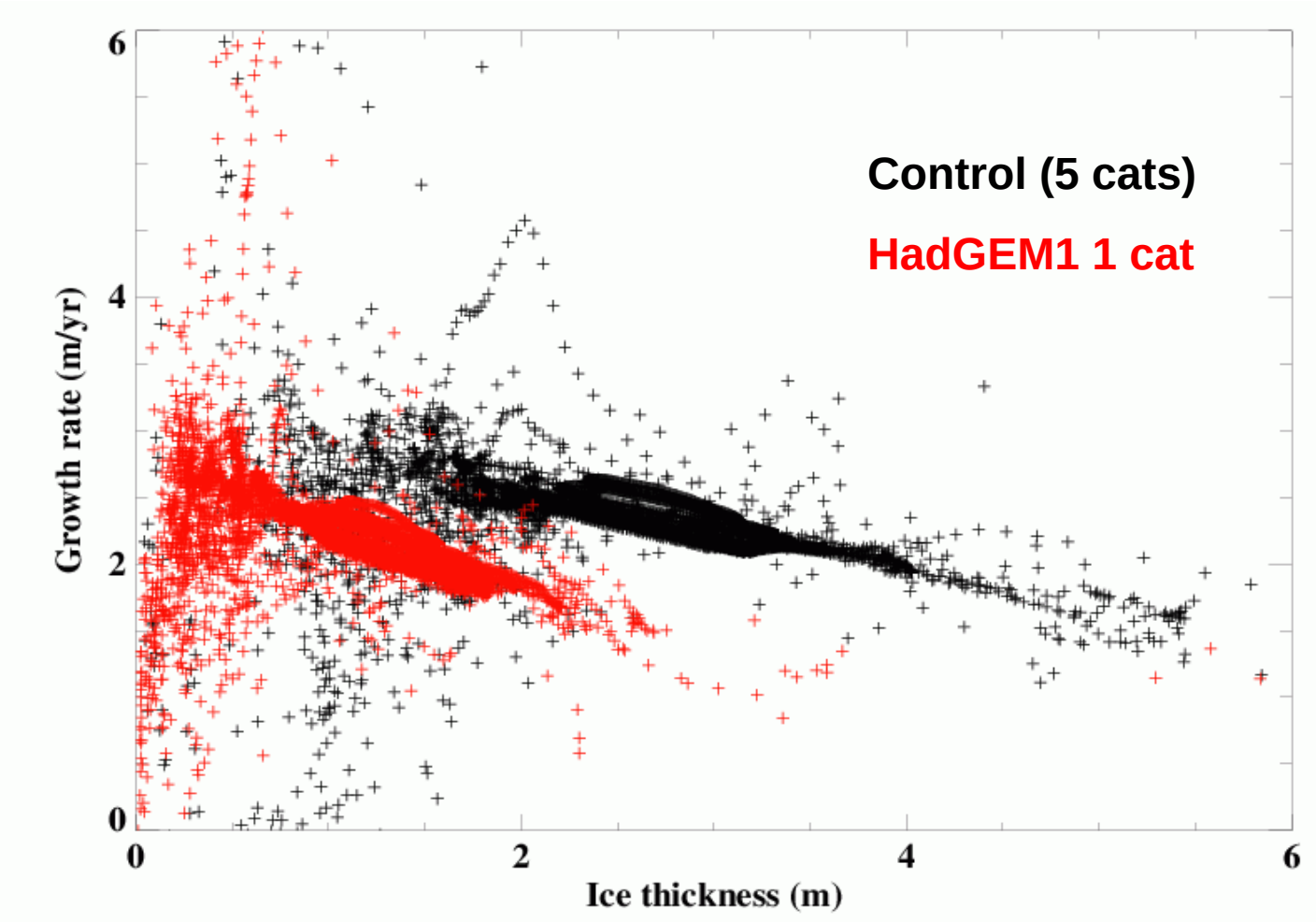
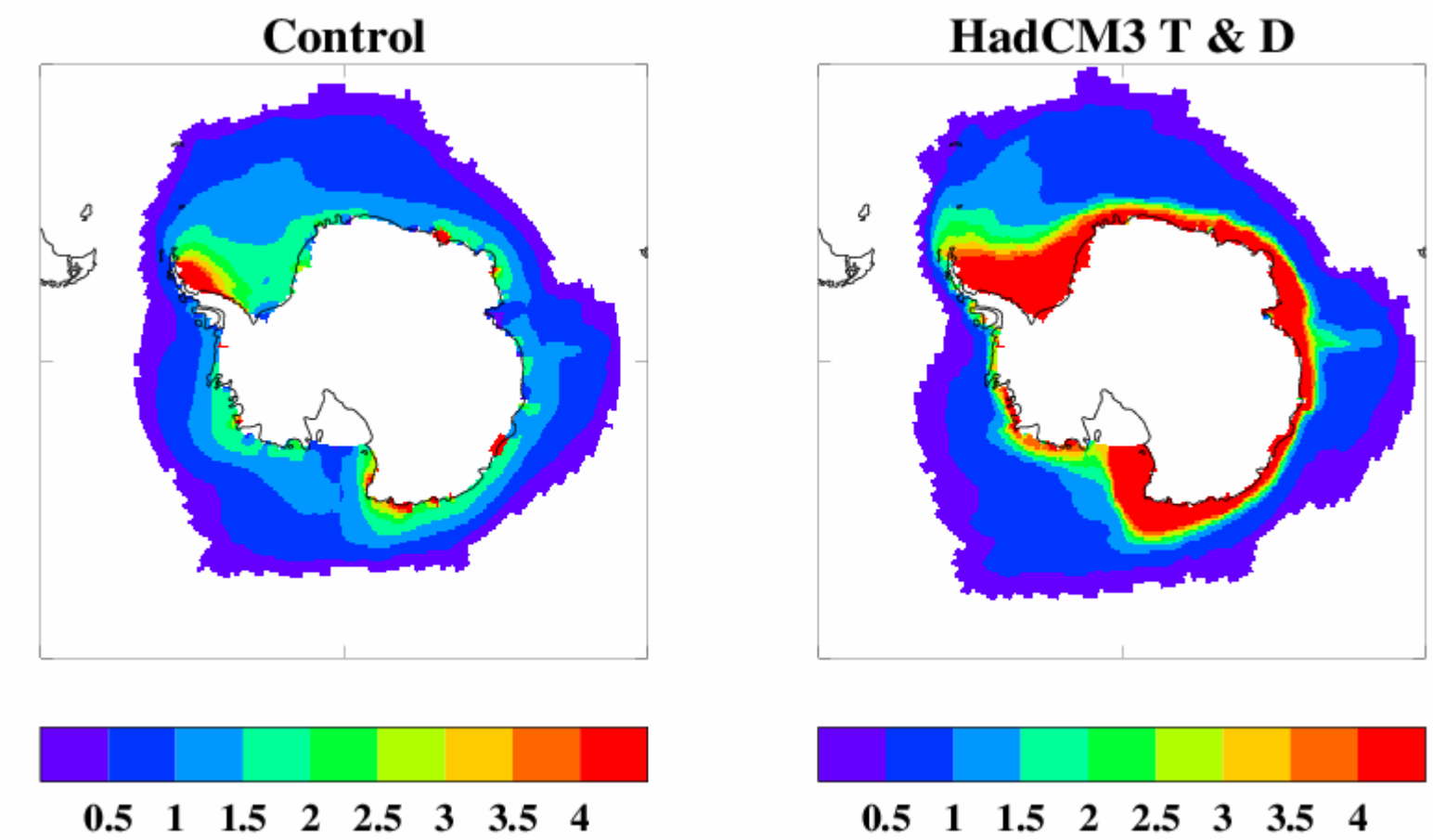


Central Arctic Autumn growth rate (m/yr)



SH September ice thickness (m)



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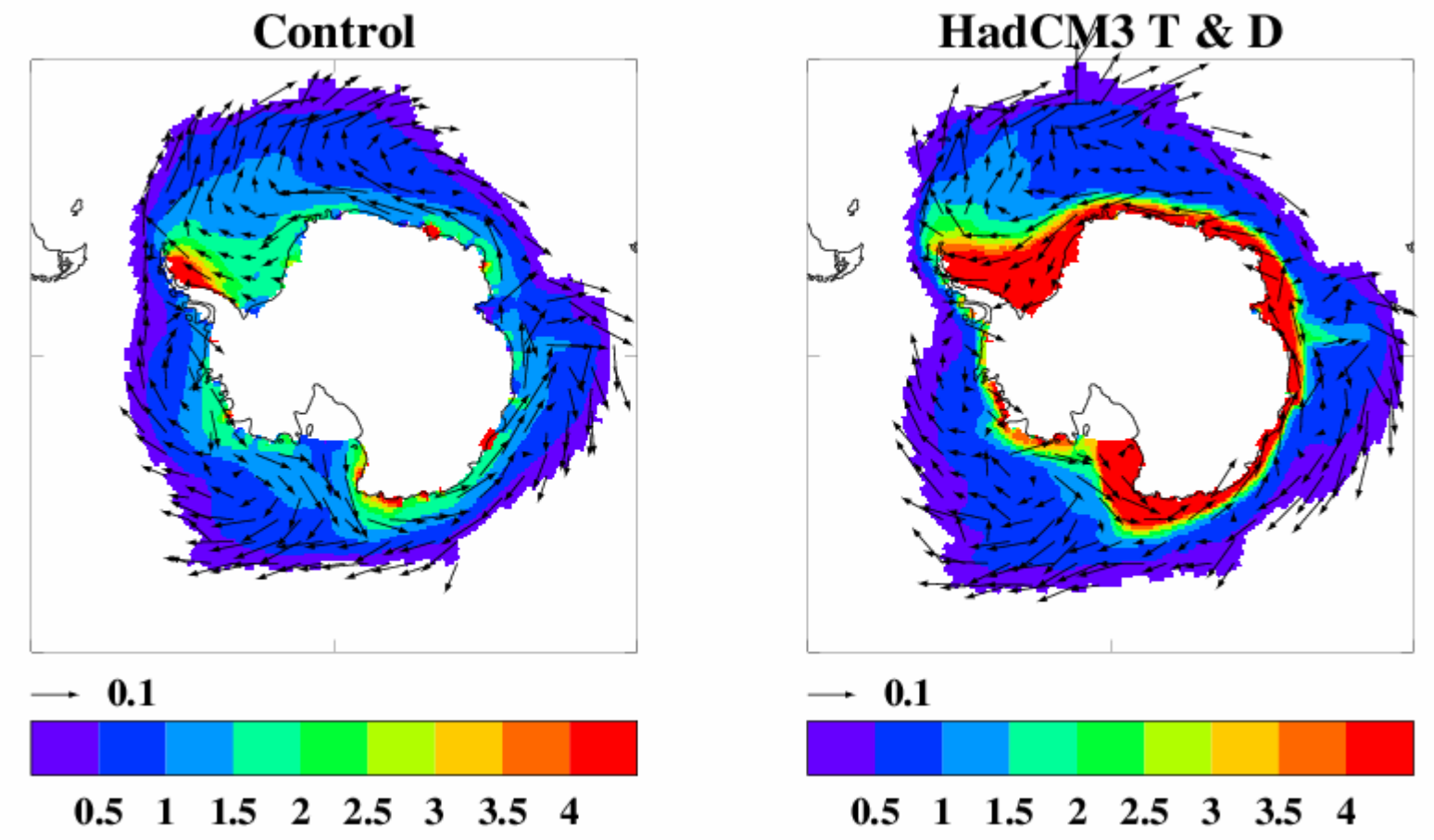

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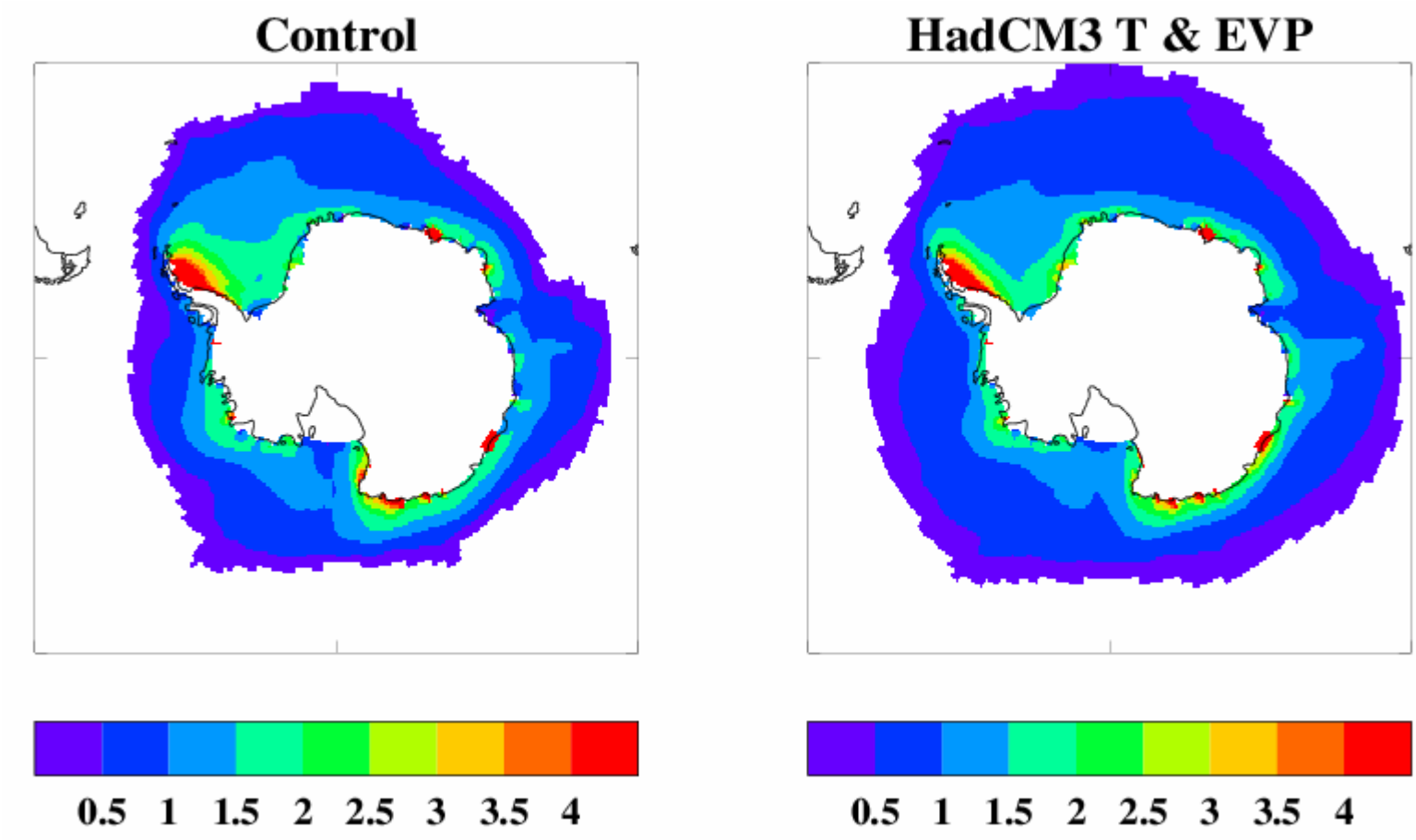

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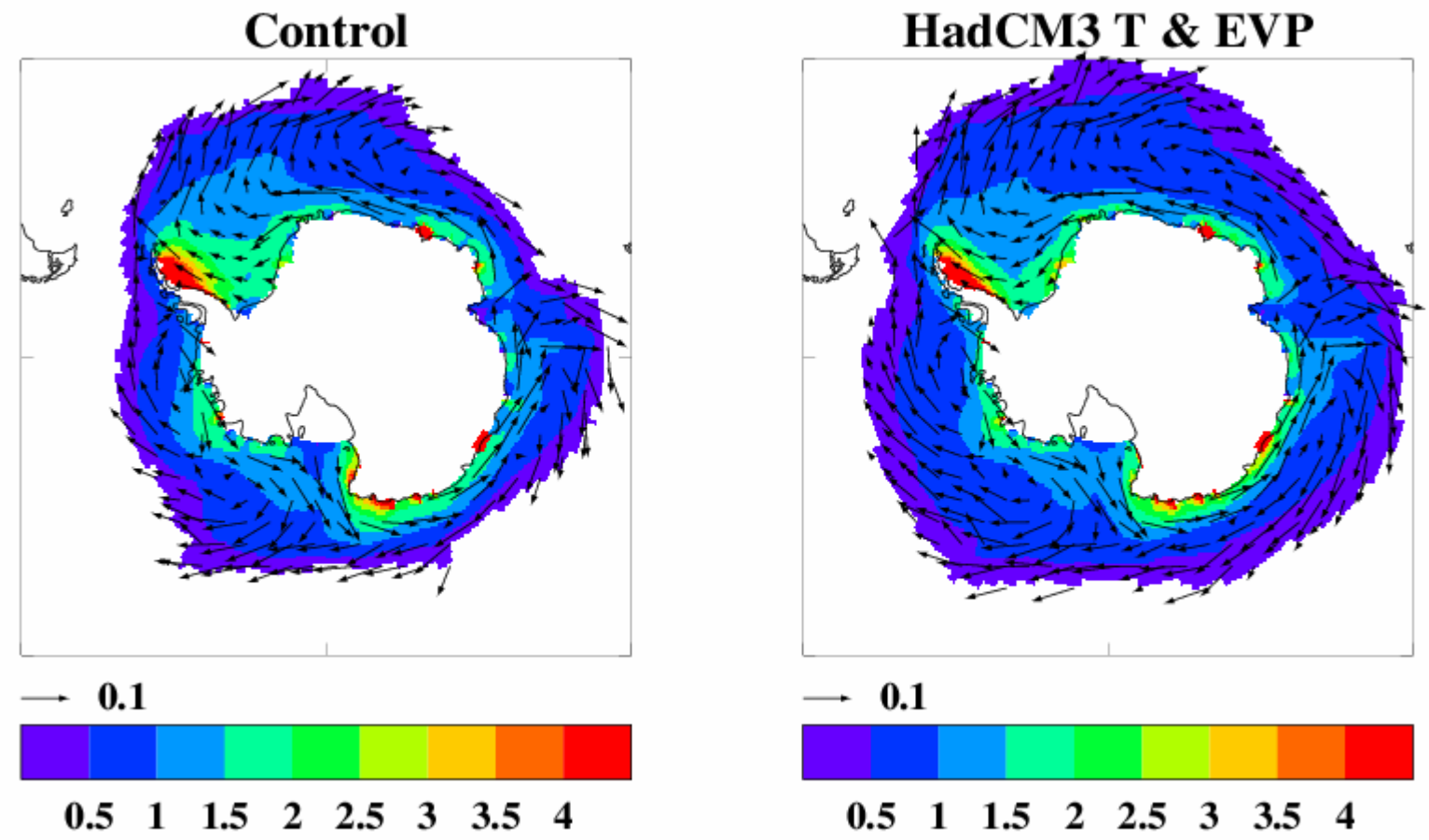


Summary

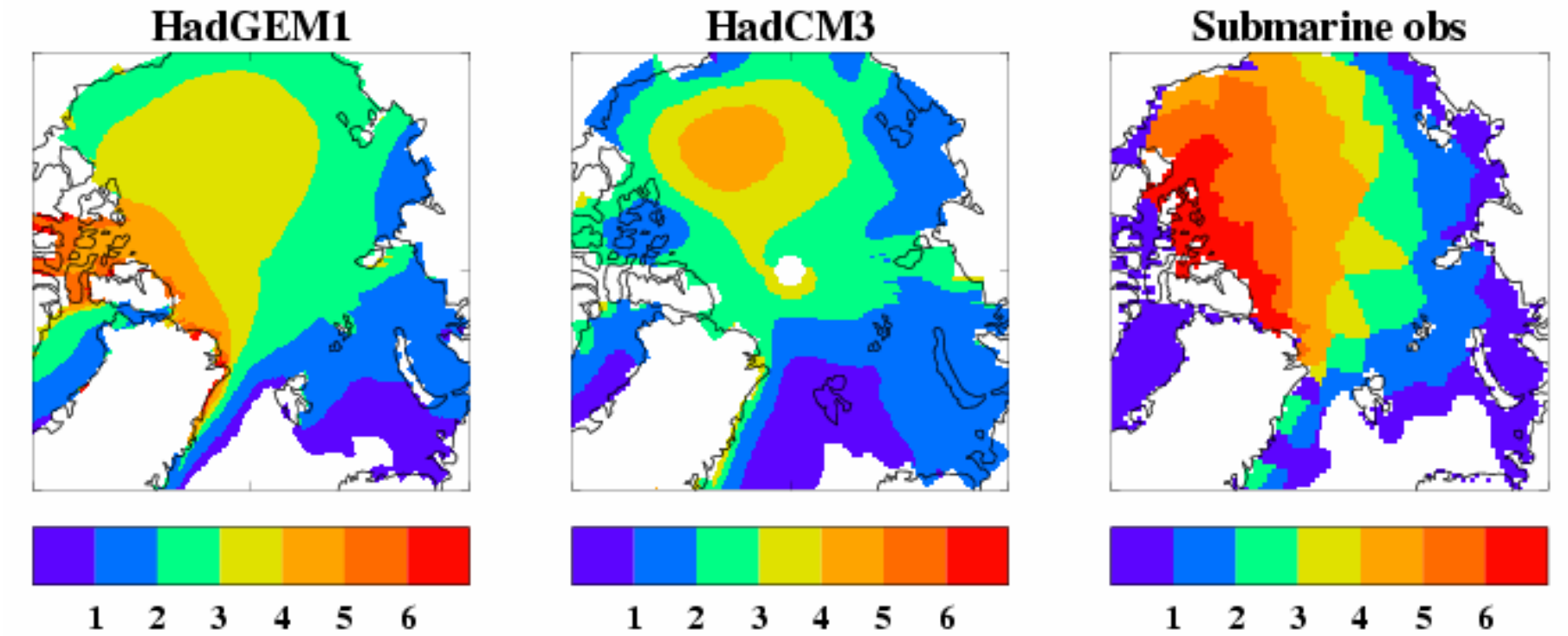
- Preliminary results based on a suite of sensitivity experiments using HadGEM1
- EVP improves the spatial pattern of ice thickness in both hemispheres
- ITD increases ice thickness due to increased growth rates, improving ice thickness particularly in NH

Future work

- Extend analysis to look at other sea ice properties e.g. ice concentration
- Impact of the new schemes on the atmosphere and ocean

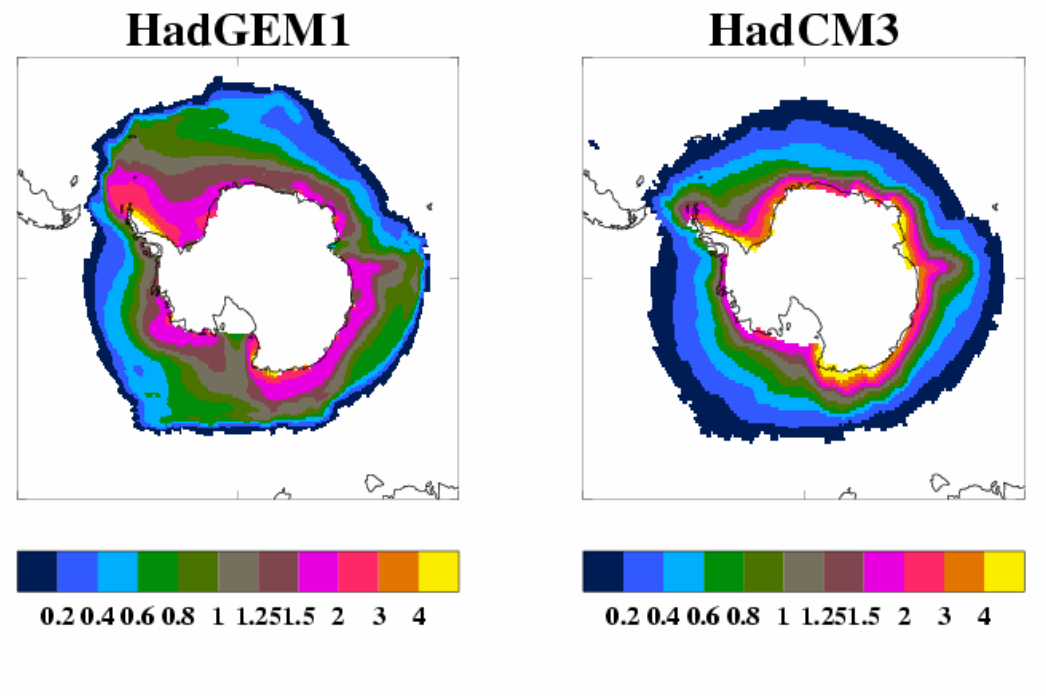
End

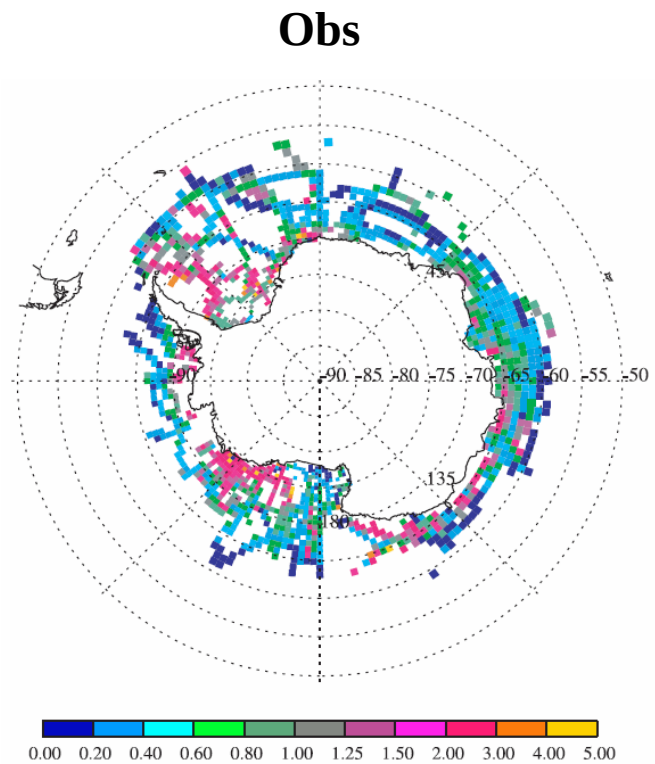
Winter ice thickness (m)



- 17 sub cruises (1960-1982)
- HadGEM1 mean = 2.6m, sub mean = 2.9m (north of 65°N)

Annual mean ice thickness (m)





- Timmerman et al. (2004)