A High-Resolution Ocean-Ice Model of the Arctic
(Sensitivity to Surface Forcing)

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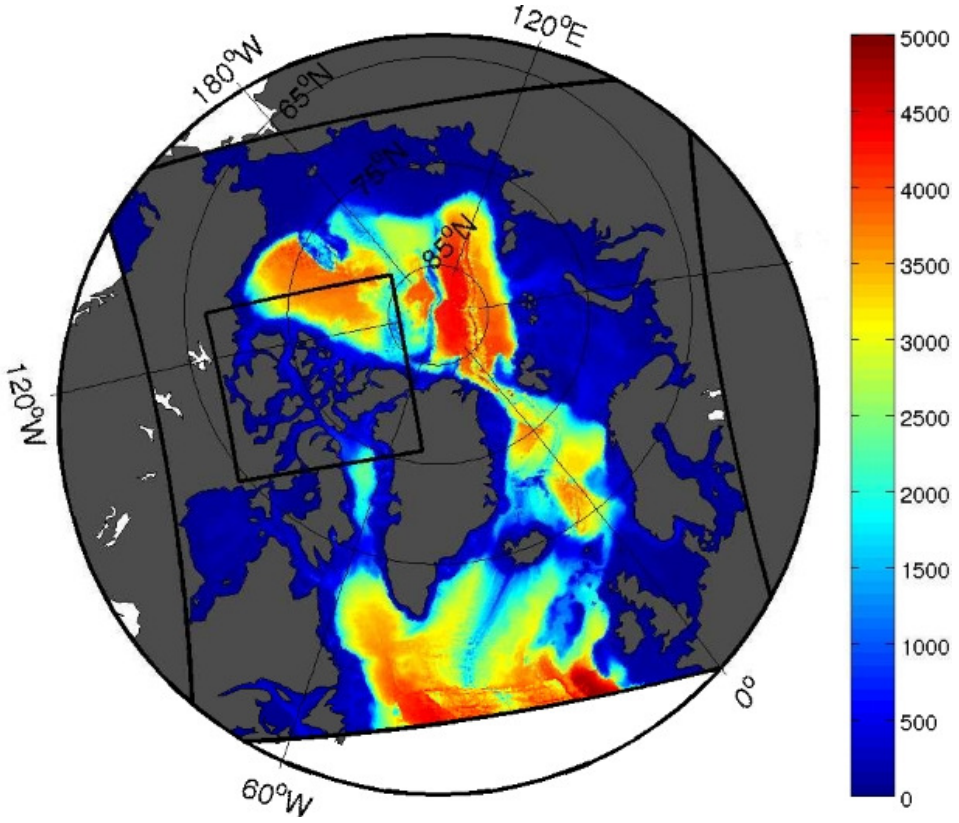
Objectives

- **Develop ice-ocean models based on NEMO, built on expertise developed from COMDA, CONCEPTS and GOAPP**
- **Use 2-way nesting technique (AGRIF): pan-Arctic model includes large-scale forcing; high-resolution sub-model for focused regions**
- **Use models to interpret observed changes in Arctic**
- **Serve applications in regional operational forecasting link to sea-ice and ocean data assimilation**
- **Serve future applications in coupled regional climate downscaling**

Model Configuration

- **Outer model for pan-Arctic, 18 km grid spacing, 348×364 grids**
- **Inner model for CAA and Beaufort Sea, 6 km grid spacing, 349×328 grids**
- **Maximum 46 z-levels in vertical with partial bottom cells**
- **Inner model will be extended to include McKenzie Delta and whole Beaufort Sea**

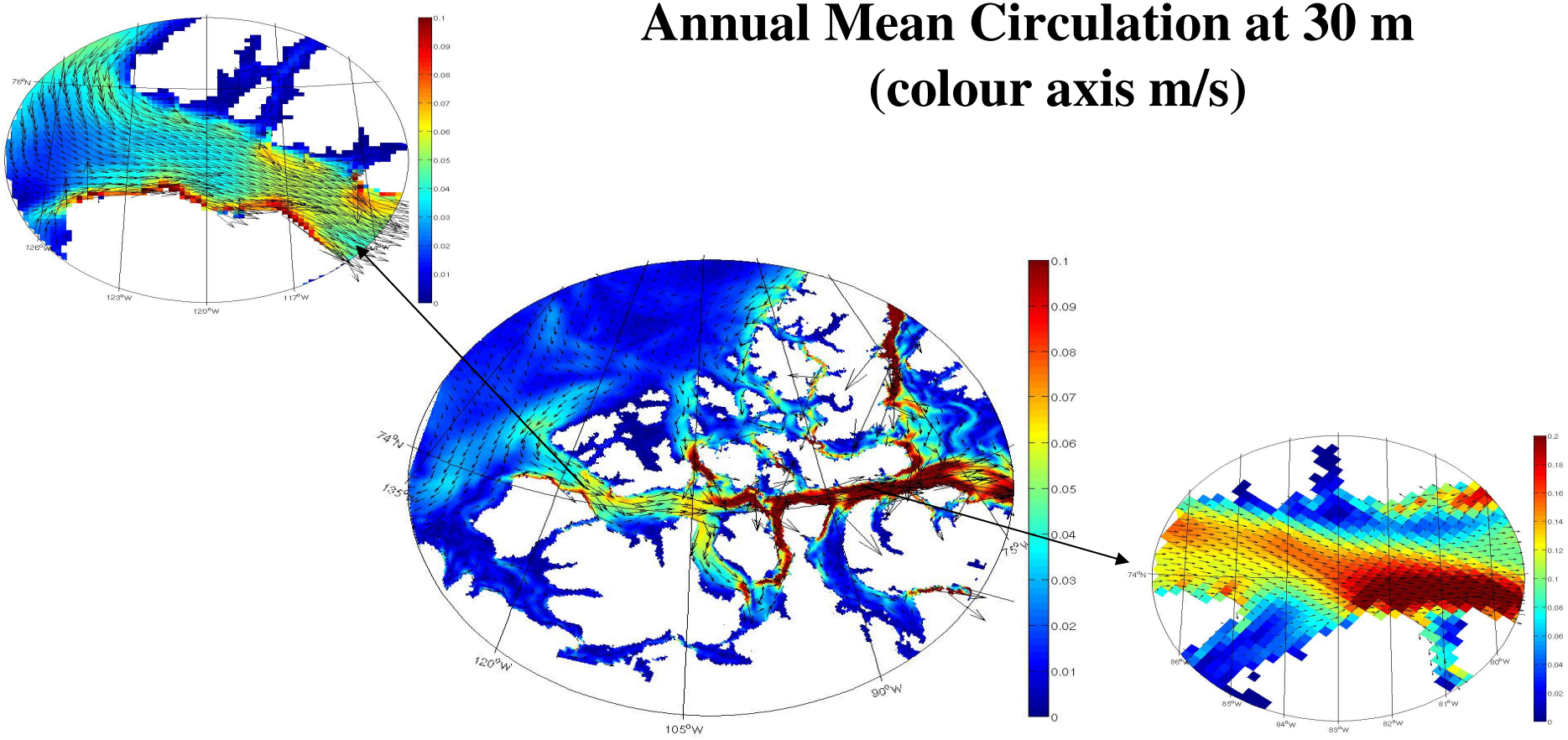


Model Setup

- **Base on GOAPP debugged NEMO 2.3, sea-ice module LIM2**
- **Initialization: January T-S from PHC v3.0; sea-ice properties from ORCA025 global simulations**
- **Open boundary conditions: monthly T, S, velocity and sea level from ORCA025 simulations (Flather radiation for barotropic velocity)**
- **Surface forcing: CORE Normal Year Forcing (NYF) for spin-up tests; OMIP forcing for sensitivity study**
- **Runoff climatology; SSS resorting**

Two-way Nested Model:
Results of High-Resolution Embedding

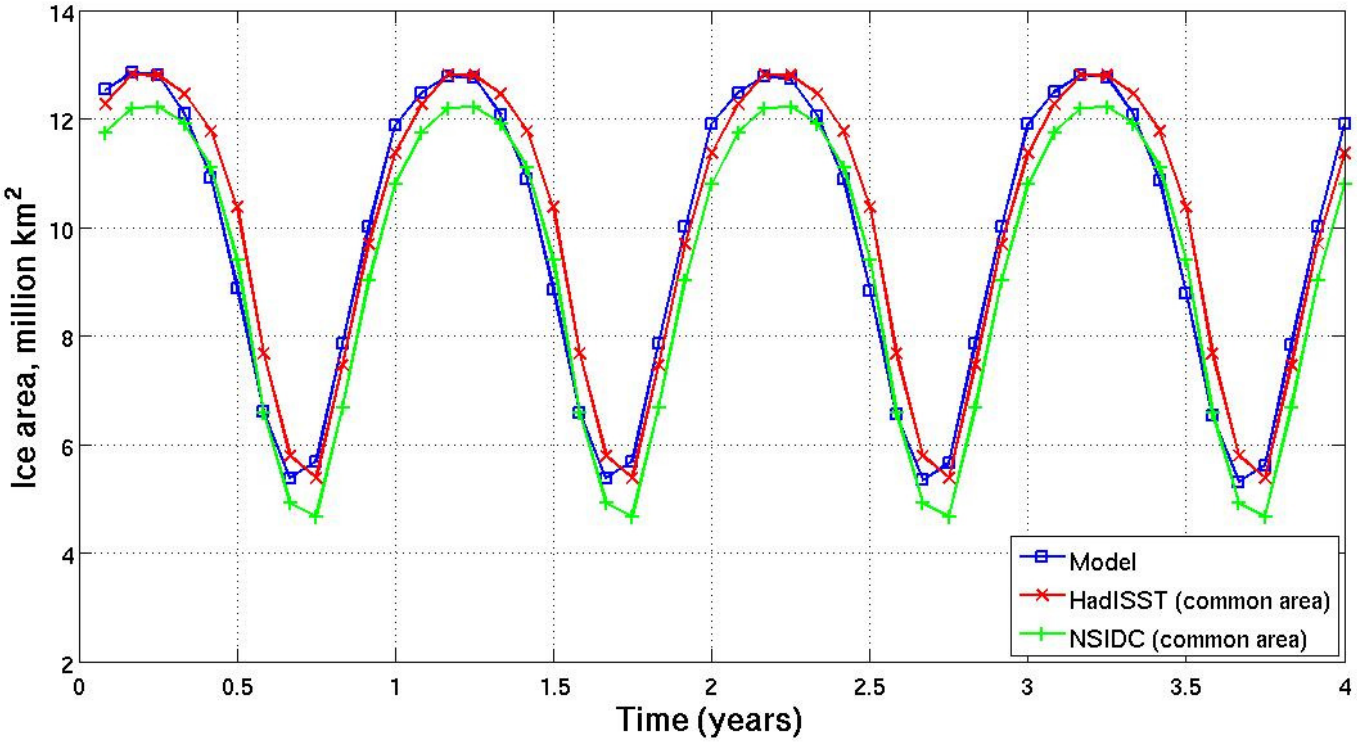
Annual Mean Circulation at 30 m
(colour axis m/s)



For Details see presentation by S. Nudds

Pan-Arctic Model Solutions:
Spin-up simulations with CORE NYF

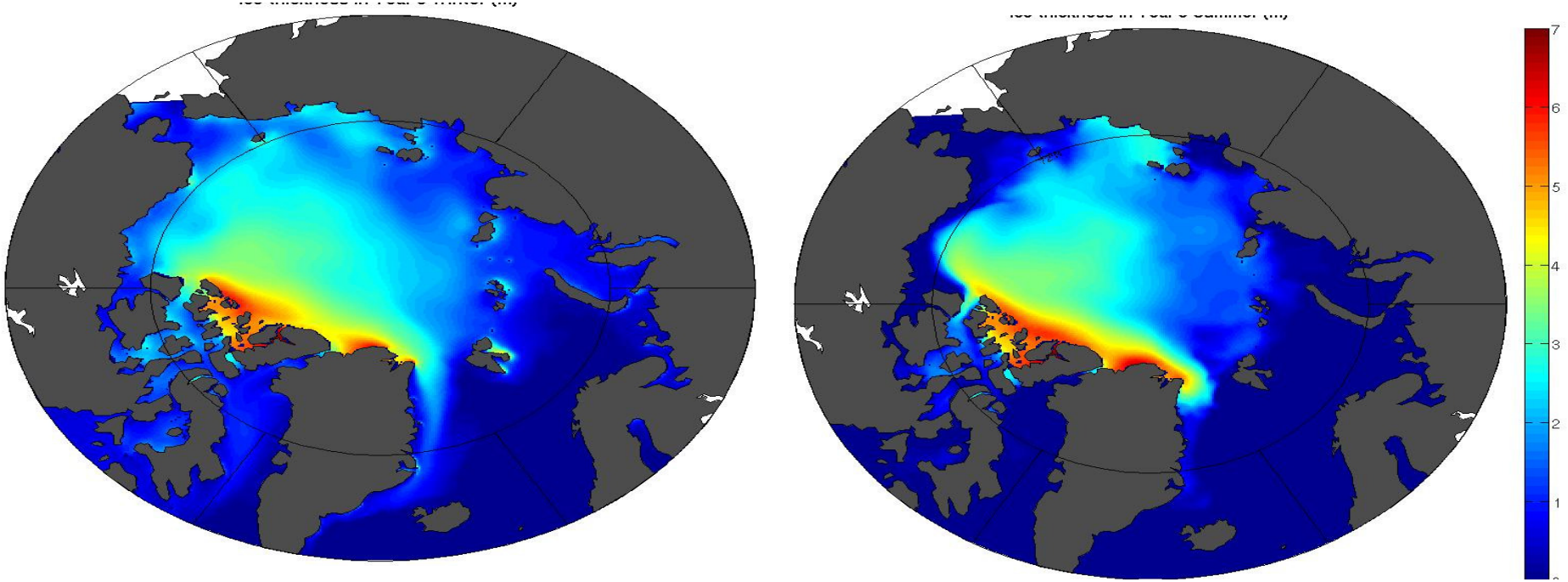
Total Ice Area



Seasonal Ice Thickness

Winter

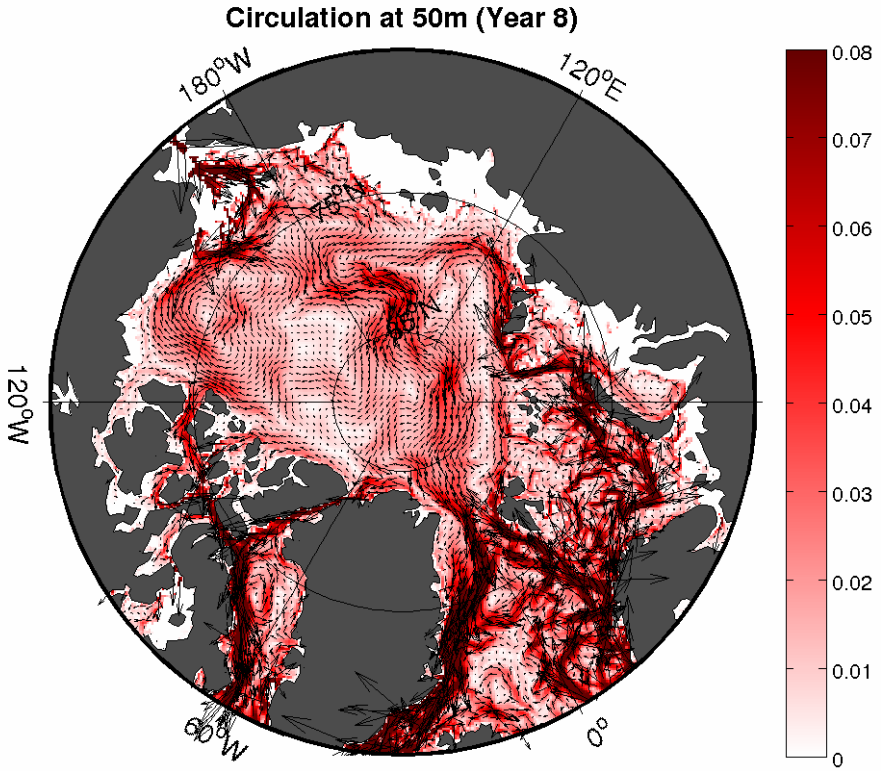
Summer



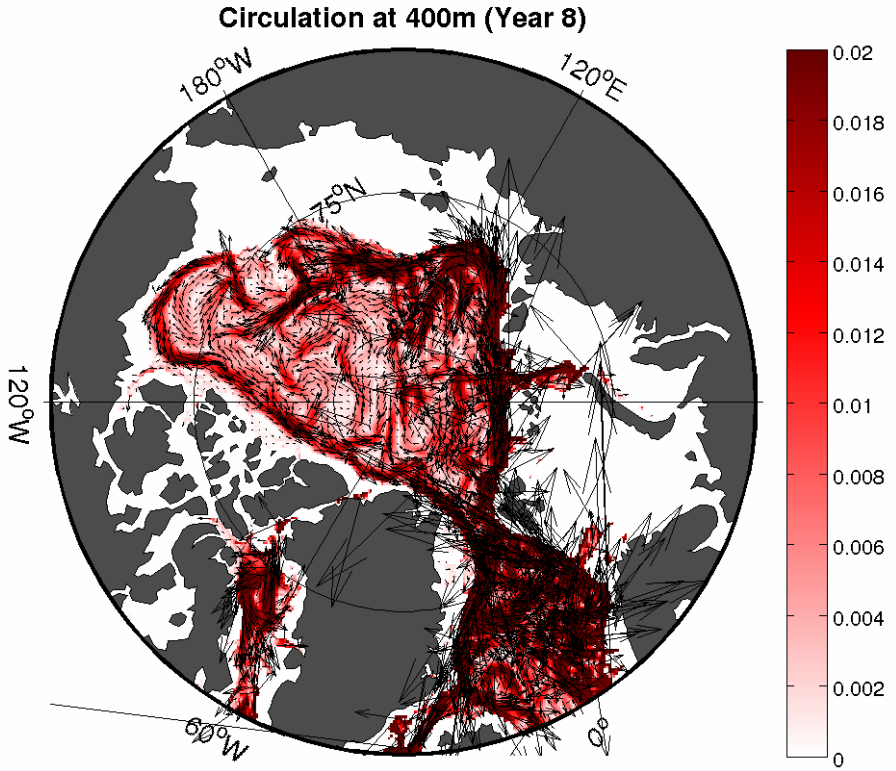
Annual-Mean Circulation

(colour axis m/s)

50 m depth

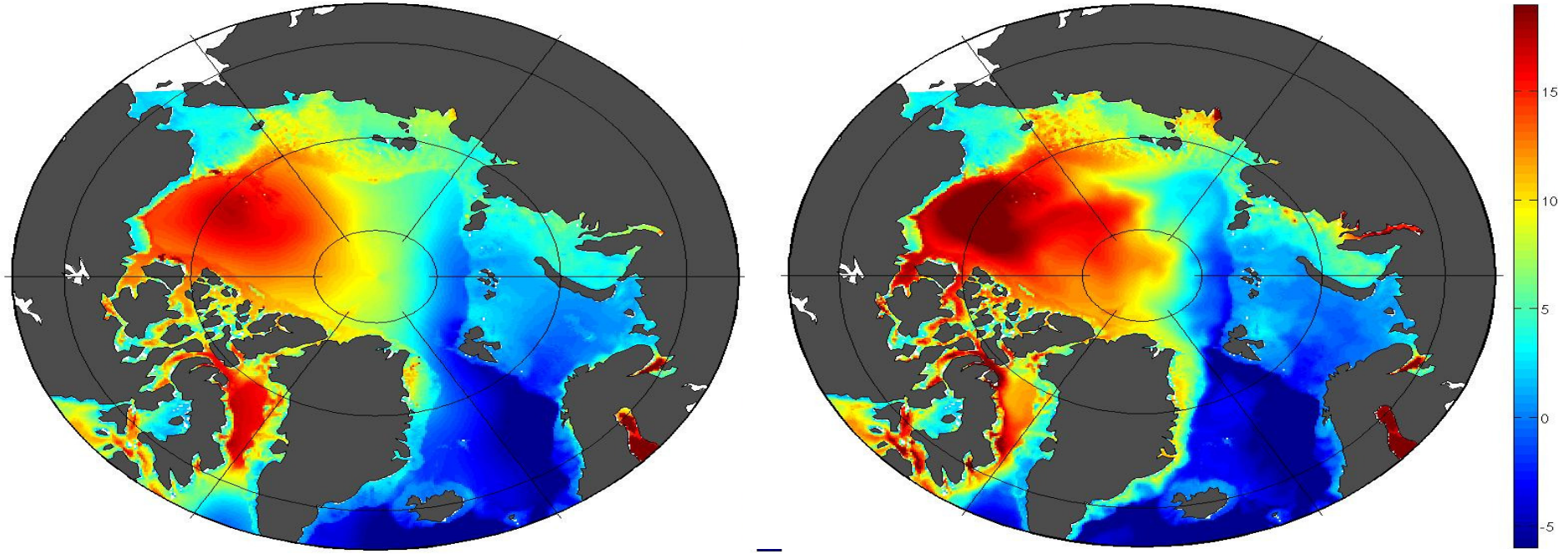


400 m depth



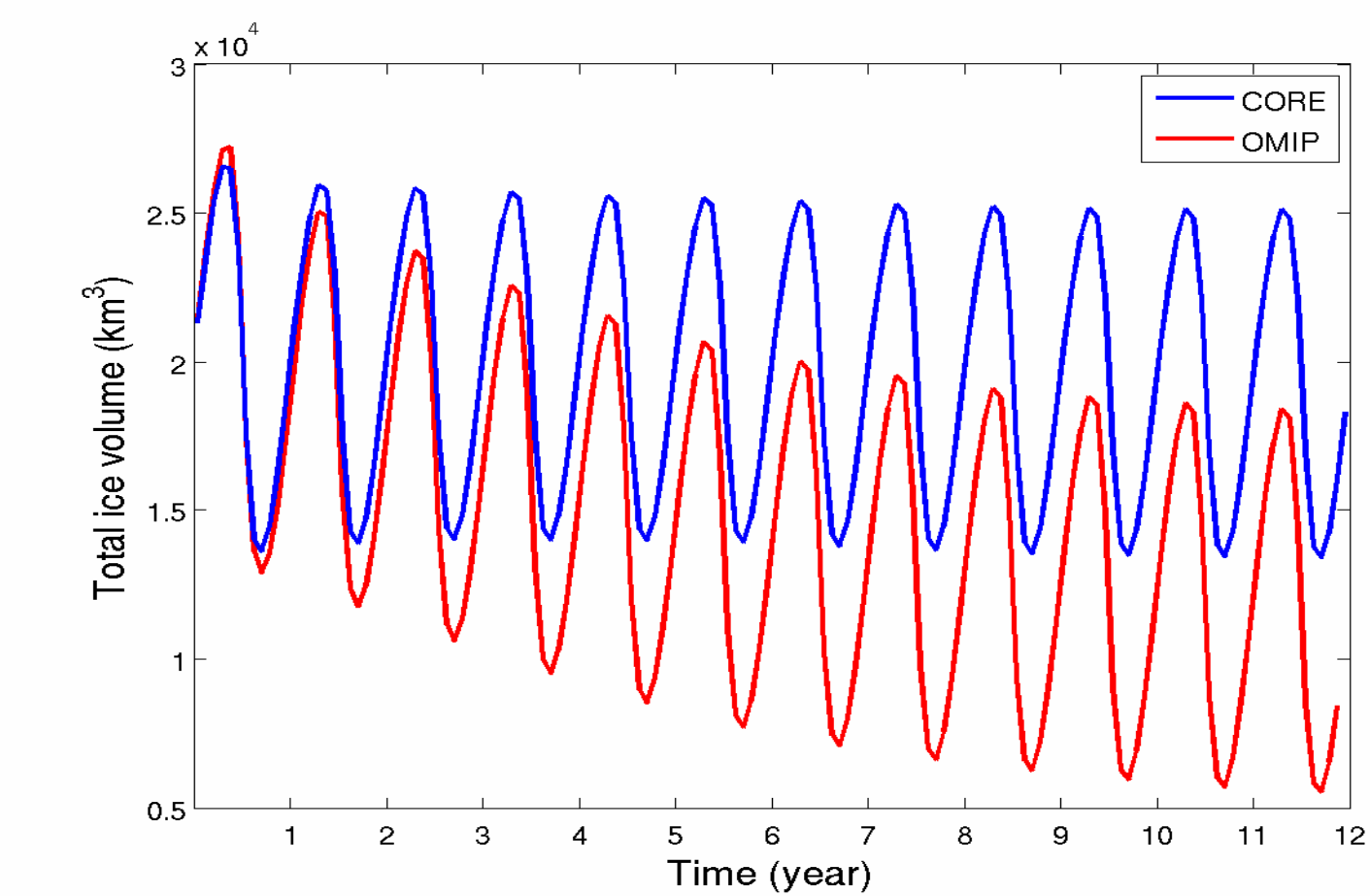
Annual-Mean Freshwater Content (upper 1000 m, colour axis m)

PHC Climatology **Model**



Pan-Arctic Model:
Different Solutions Using CORE & OMIP Forcing

Total Ice Volume



Pan-Arctic Model: Sensitivity Experiments

Experiments	Sea-Ice Drifting	400 m Cyclonic Circulation
All CORE	No	Yes
All OMIP	Yes	Yes
OMPI but CORE long &short wave radiation	Yes	Yes
OMIP but CORE precip, snow	No	No
OMIP but CORE precip, snow, wind	Yes	Yes

Understanding Sea-Ice Drifting in OMIP Run

- **Drifting with CORE radiation heat fluxes**
- **No drifting with CORE precipitation & snow**
- **Drifting with CORE precipitation, snow & wind**

Hypotheses

- **Difference in total precipitation causes difference in incoming Atlantic water?**
- **Or: snow changes ice insulation?**
- **Roles of difference in wind need further study: turbulent heat fluxes vs circulation?**

Further Work

- **Complete assessment of forcing climatologies, and model dependence on accuracy of forcing**
- **Spin-up => Simulations with inter-annually varying forcing (including boundary forcing from global models)**
- **Validation with satellite and in situ observations**

- **Add tides**
- **Upgrading ice and ocean model; new ice model (LIM3); LIM3-CICE4 inter-comparison(?)**

- **Develop forecasting capacity (sea-ice and ocean data assimilation, M. Buhner & G. Smith)**
- **Regional climate applications**