

Pathways of the Pacific Water in the Arctic Ocean: preliminary high-resolution modelling results

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Arctic Model Intercomparison Project

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Woods Hole Oceanographic Institution, MA, USA



Outline of the talk

- Motivation of the study and Methods
- Models (briefly)
- Transports: modelled and observed
- Tracer experiments
- Summary and future plans

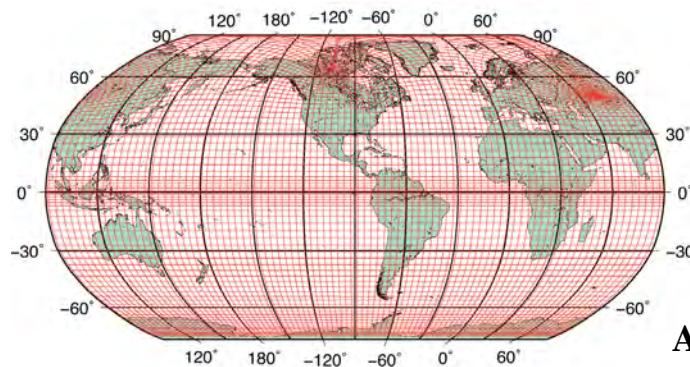
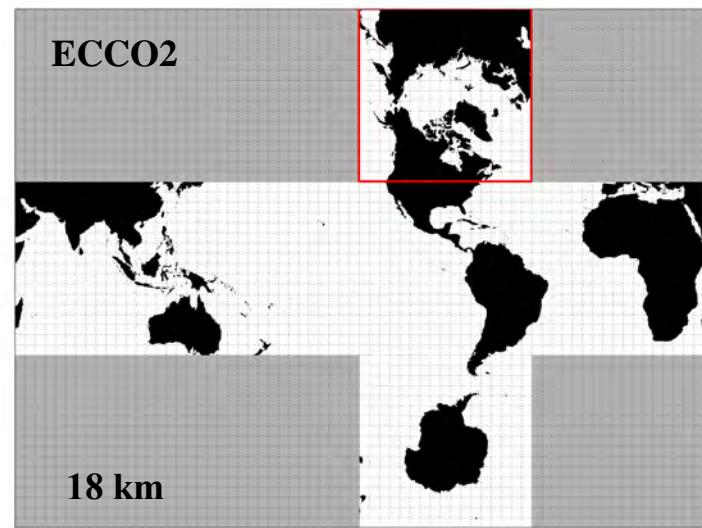
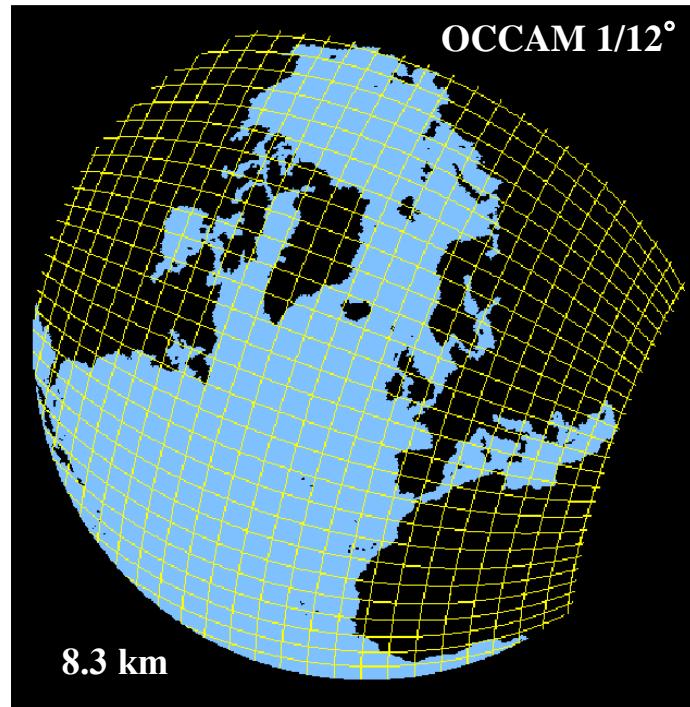


Motivation and Methods

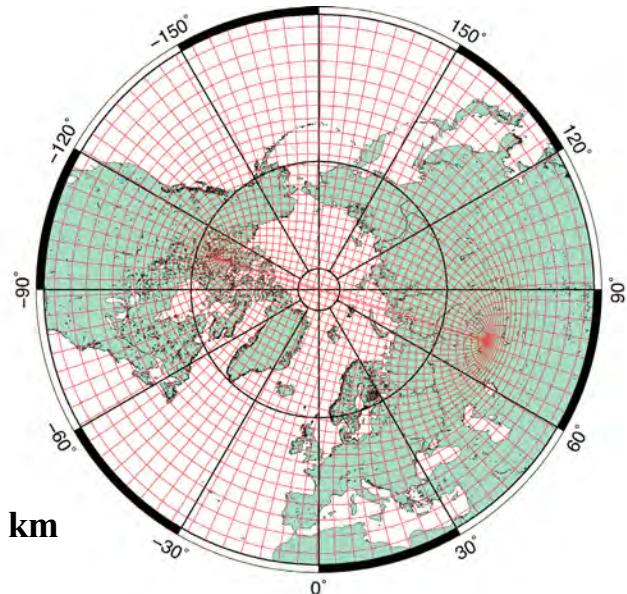
- Motivation: quantify Pacific water evolution in the Arctic and its outflow into the North Atlantic in the high-resolution models; understand the differences, analyse mechanisms and improve simulations
- Methods: analyse modelled transports and storage of Pacific Water utilizing TS classes and model tracers; compare to the observed.

Model Inventory

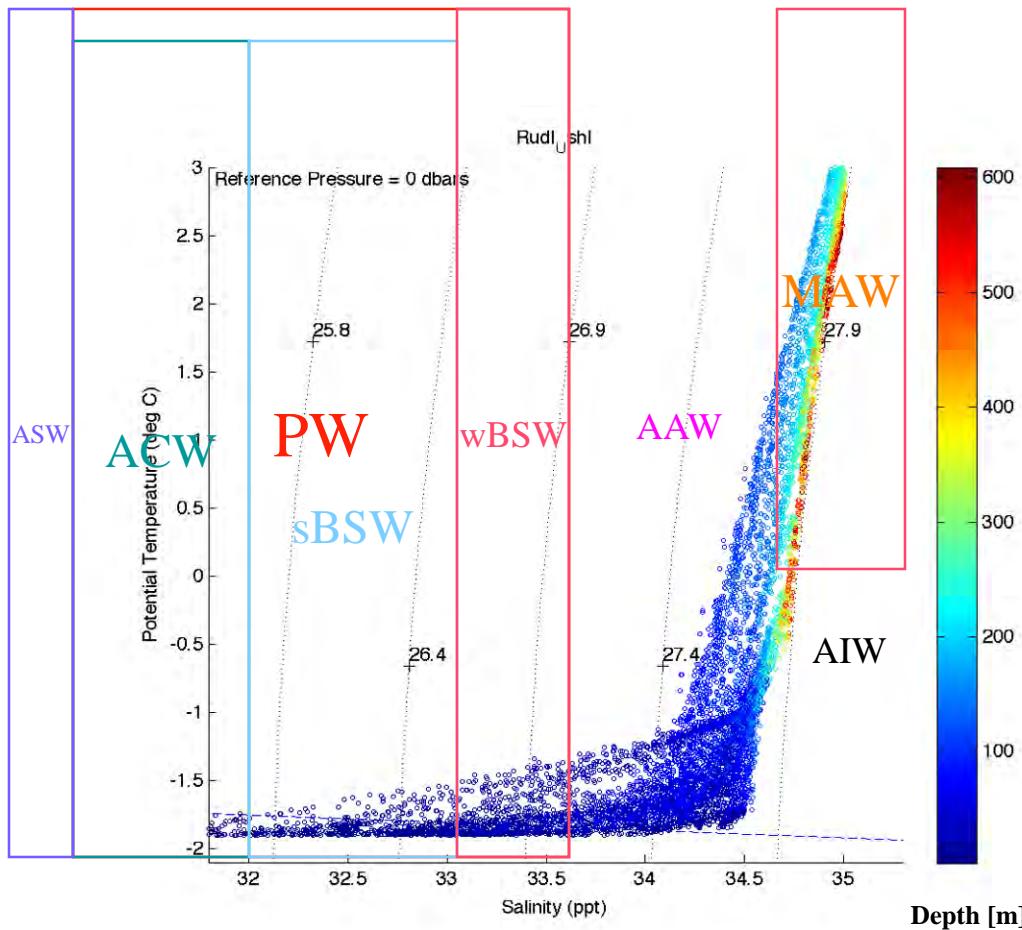
models	ORCA025	OCCAM	ECCO2	NAOSIM
Resolution In Arctic	6-15 km	8.3 km	18 km	28 km
Coverage	Global	Global	Global	Regional
Sea Ice	VP	EVP	VP	VP
Forcing	ERA-40 (6hr)	NCEP (6hr)	JRA25 (6hr)	NCEP (day)
Restoring	SSS (300 d/12d)	SSS (40 d)	no	SSS (180d)
Initial	DRAKKAR	WOA01/PHC	WOA01/PSC	PHC
Duration	1989-2001	1989-2006	1992-2009	1948-2008



Arctic Ocean: 6-9 km



Temperature-Salinity Classes used in the model diagnostics



‘Pacific Water’: $31.0 < S \leq 33.5$

‘Alaskan Coastal Water’: $31.0 \leq S \leq 32.0$

‘Summer Bering Sea Water’: $32.0 \leq S \leq 33.0$

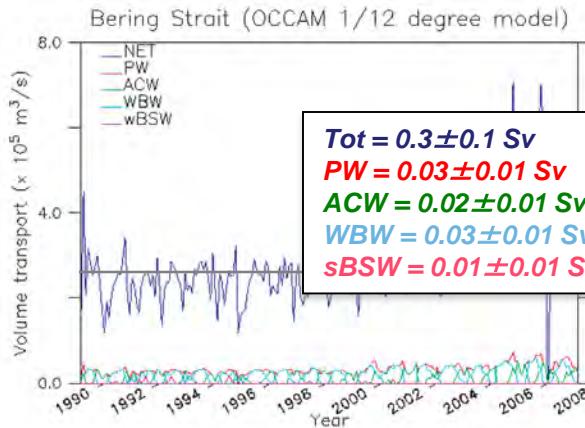
‘Winter Bering Sea Water’ $33.0 \leq S \leq 33.5$

Arctic Surface Water $S \leq 31.0$

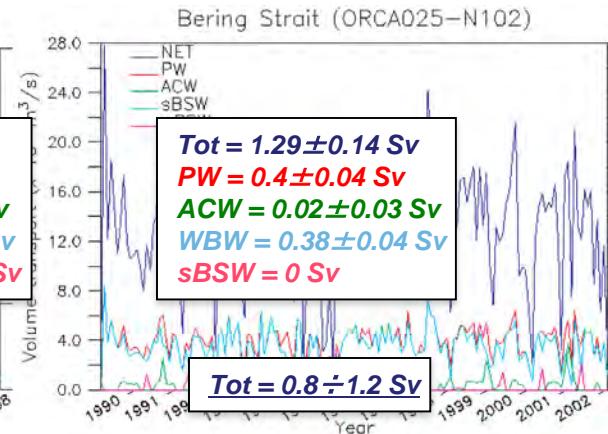
Modified Atlantic Water $T > 0^\circ \text{ C}$ $34.7 < S$

Simulated ocean transports through Bering Strait

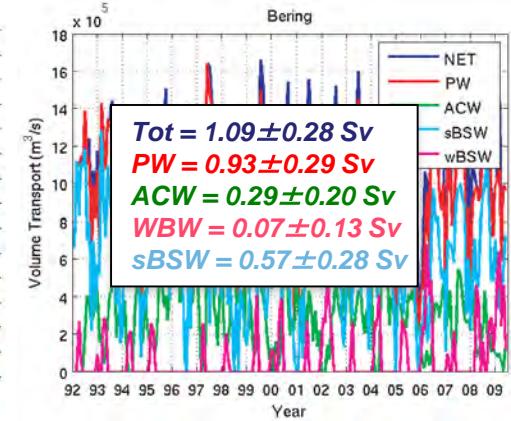
OCCAM 1/12°



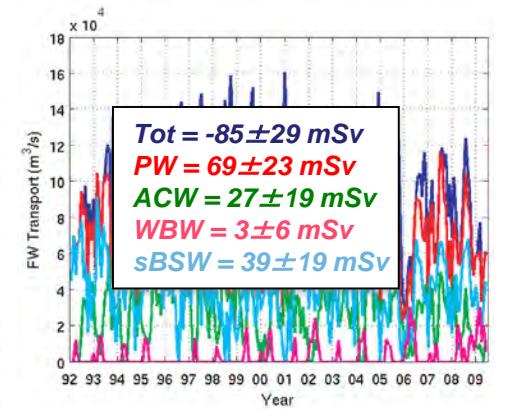
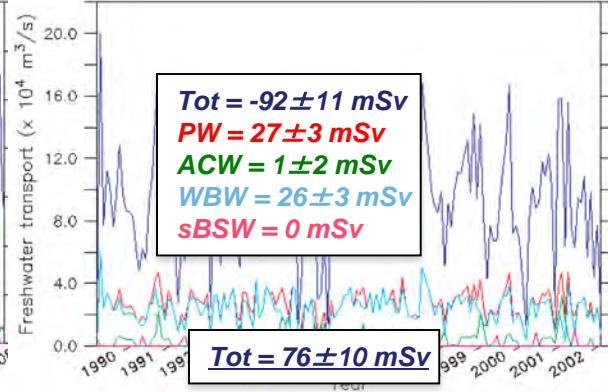
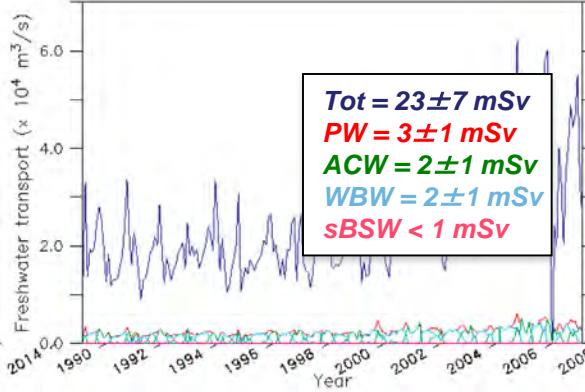
NEMO ORCA 1/4°



ECCO2



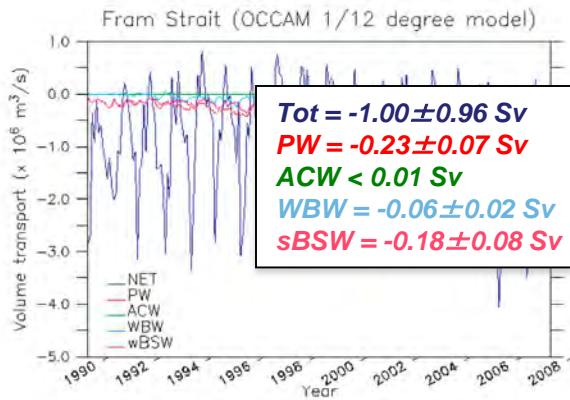
Volume Transports



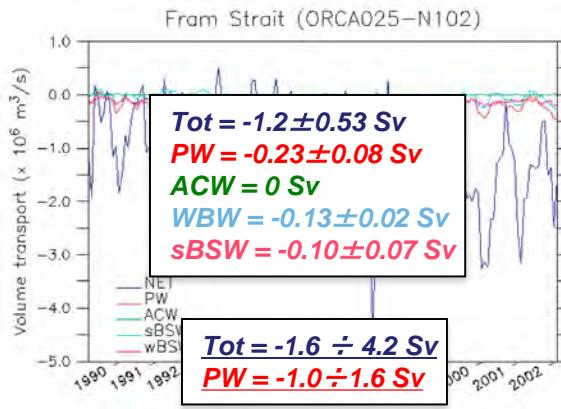
Freshwater Transports (Referenced to 34.8)

Simulated ocean transports through Fram Strait

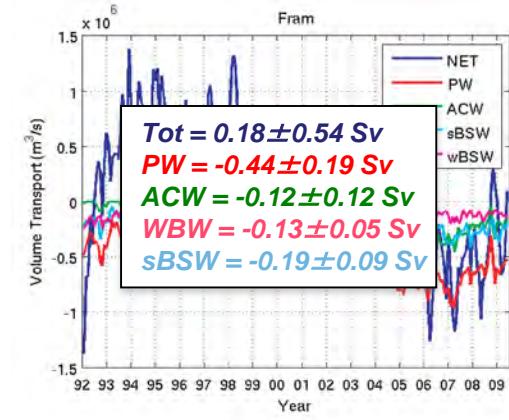
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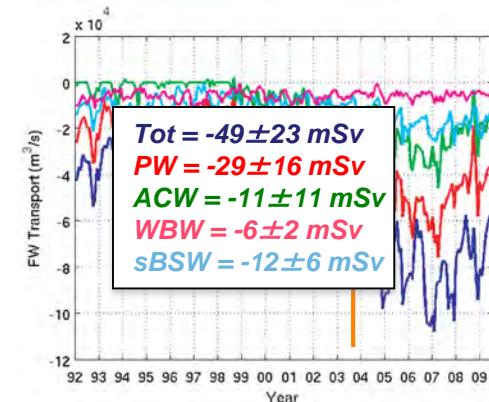
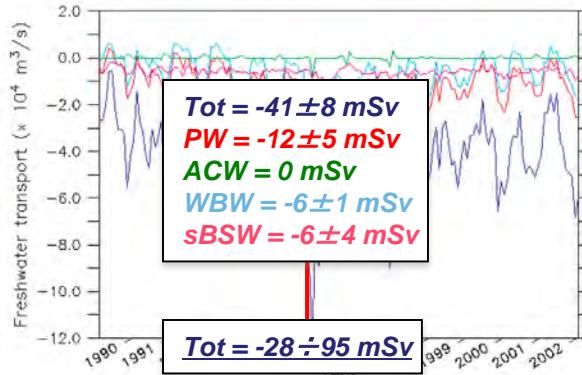
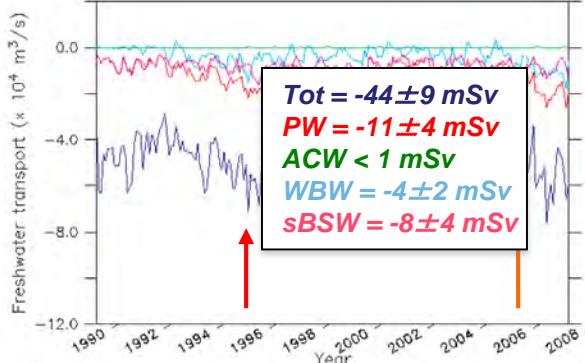
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Volume Transports

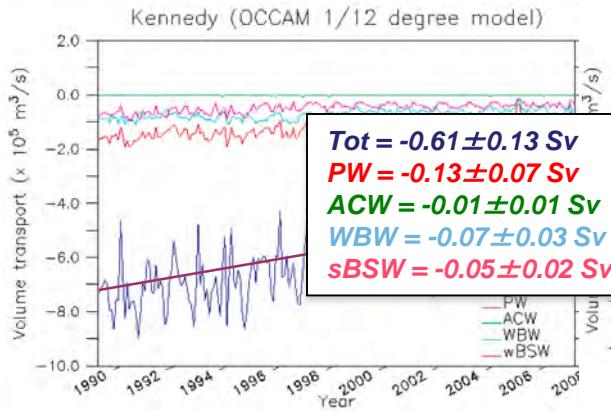


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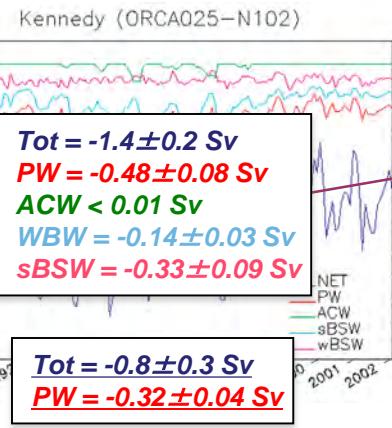


Simulated ocean transports through Kennedy (Nares) Strait

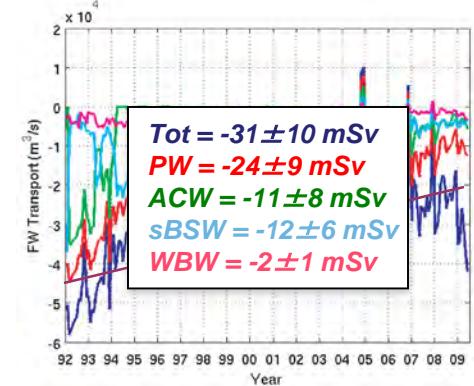
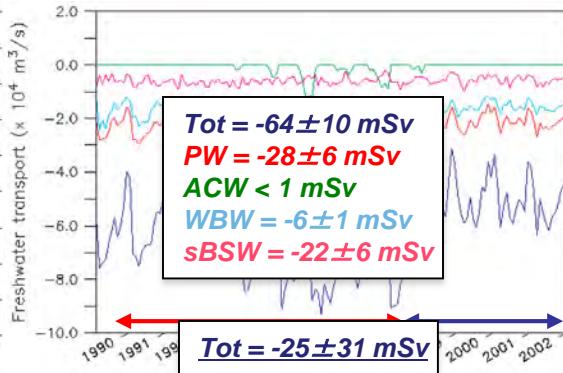
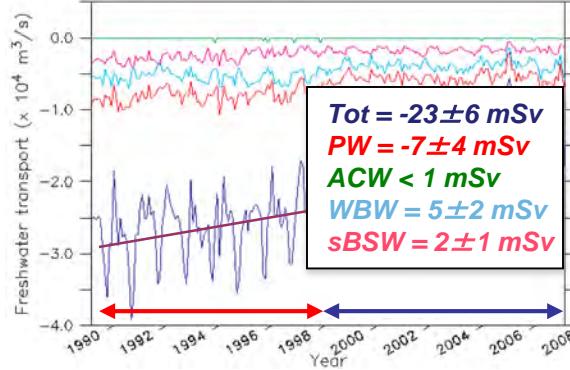
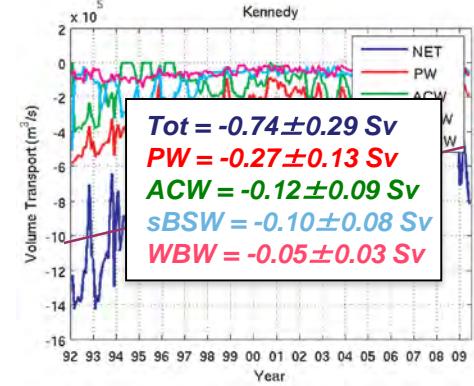
OCCAM 1/12°



NEMO ORCA 1/4°

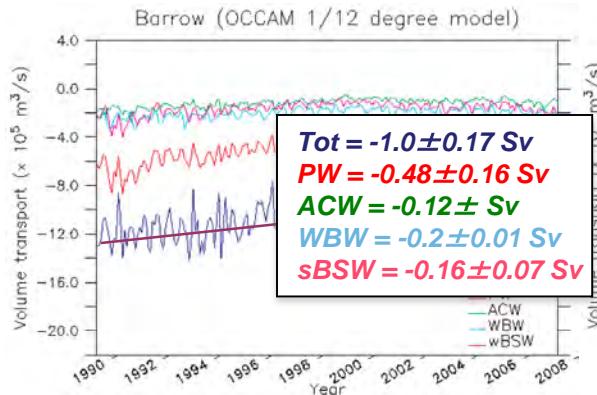


ECCO2

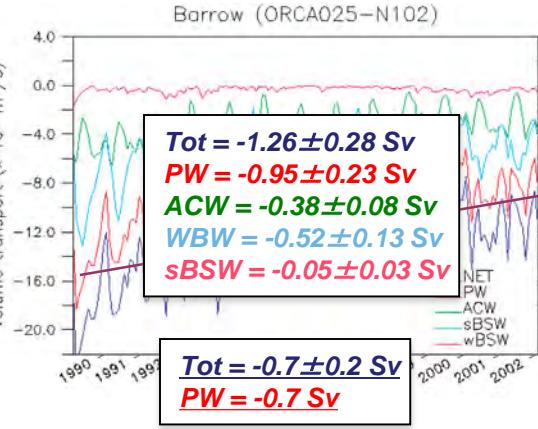


Simulated ocean transports through Barrow Strait

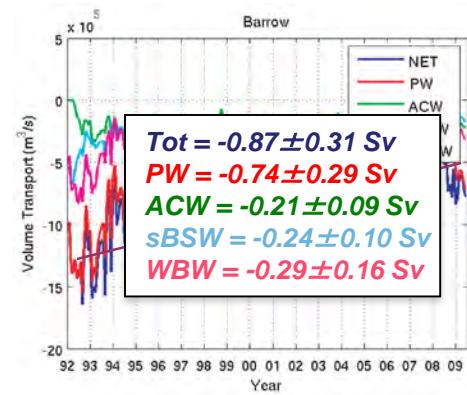
OCCAM 1/12°



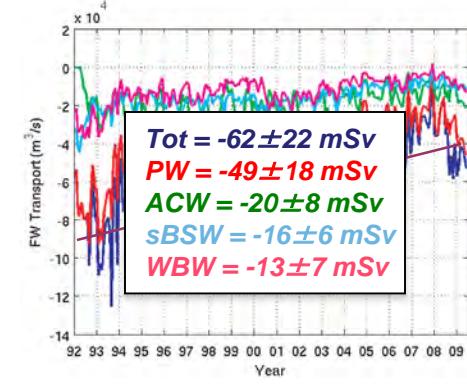
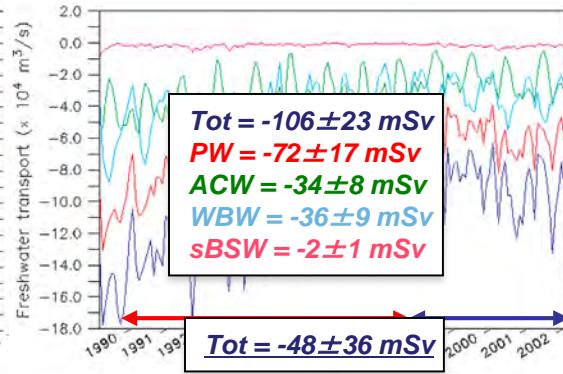
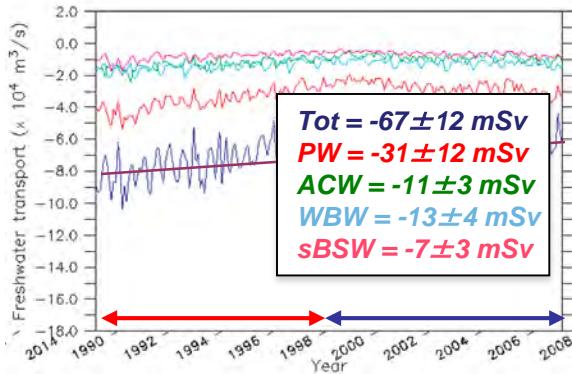
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Volume Transports

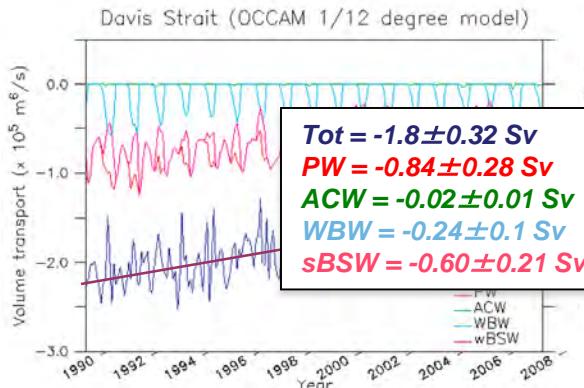


Freshwater Transports (Referenced to 34.8)

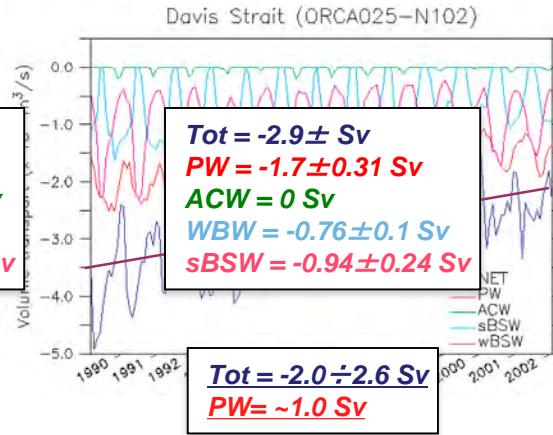


Simulated ocean transports through Davis Strait

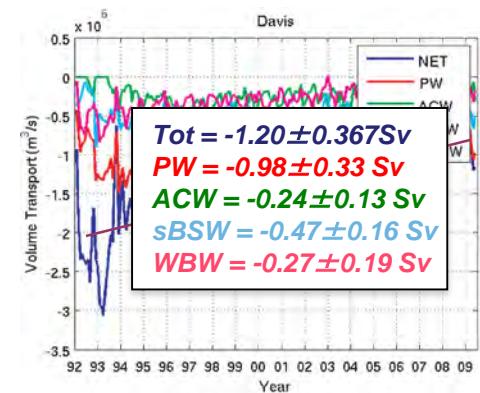
OCCAM 1/12°



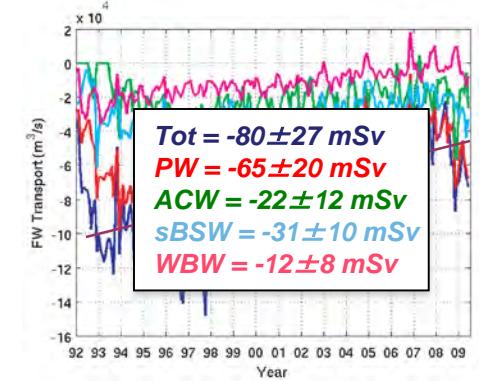
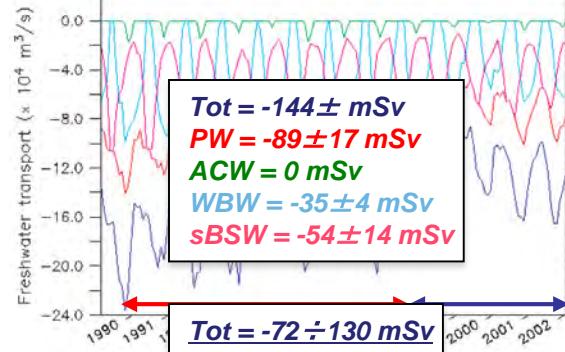
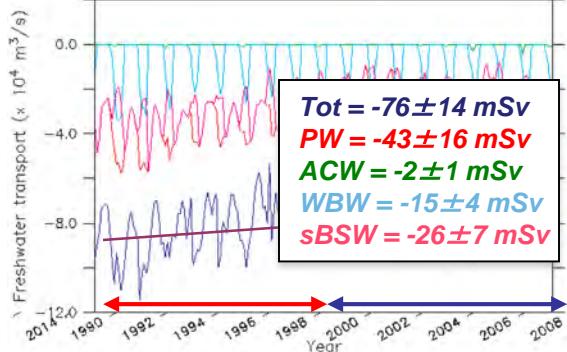
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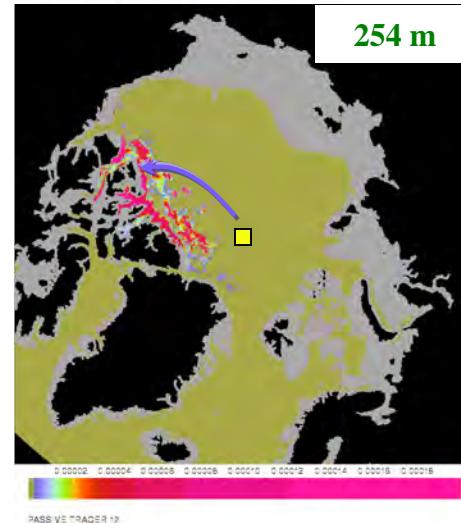
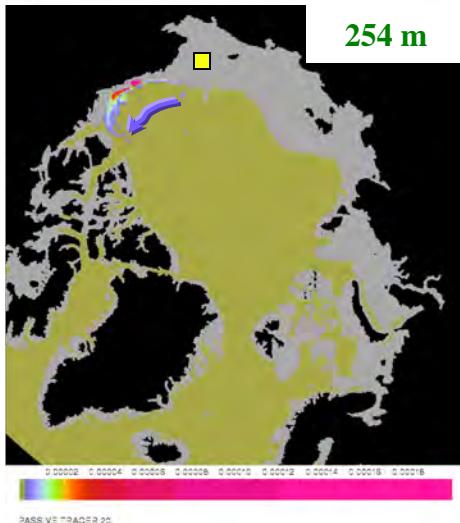
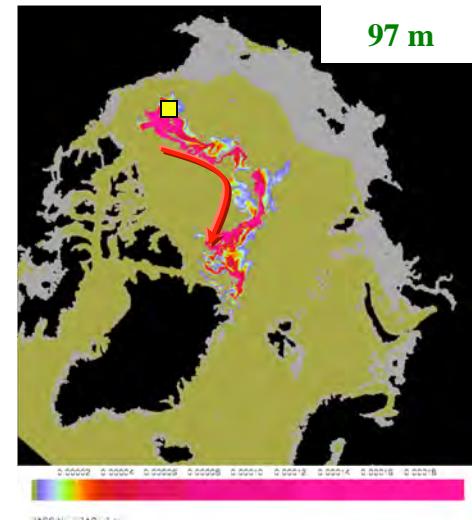
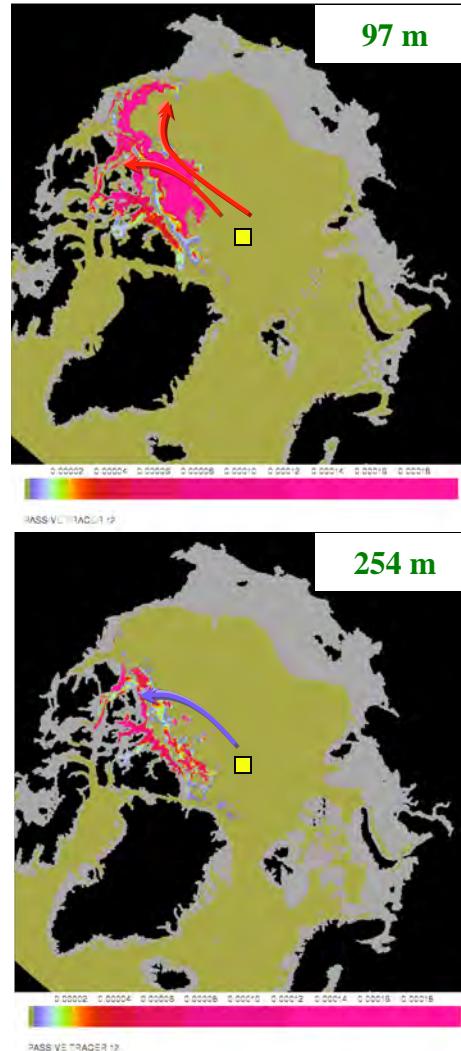
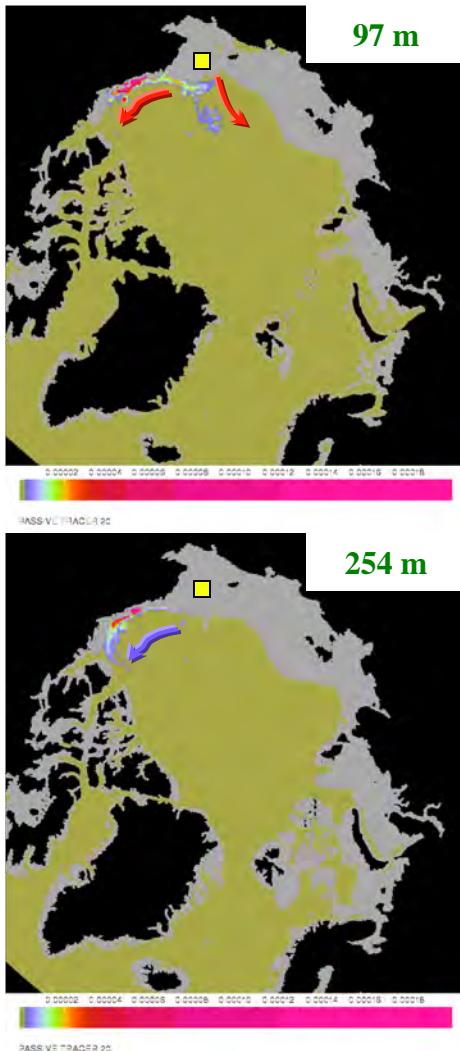


Volume Transports



Freshwater Transports (Referenced to 34.8)

Off-line ‘dye’ tracer after 5 yrs (1993-1997), OCCAM 1/12°

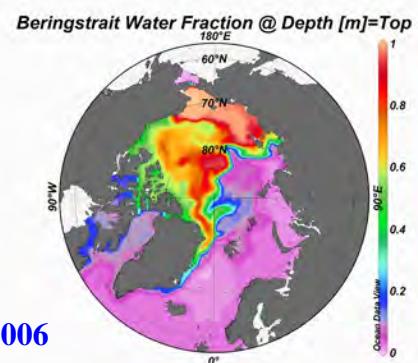
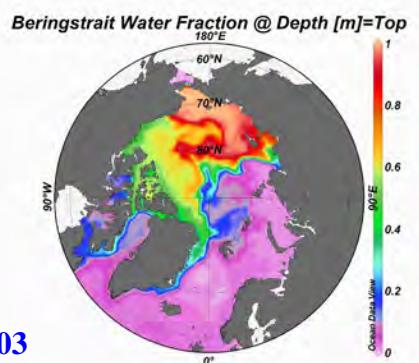
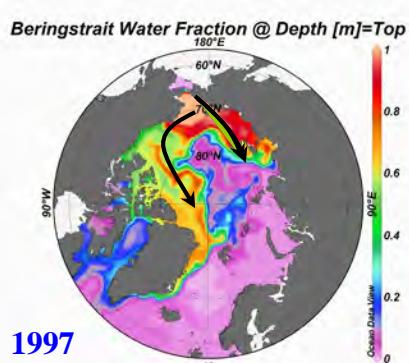


**Two routes for Pacific Water:
Alaskan and Transpolar**

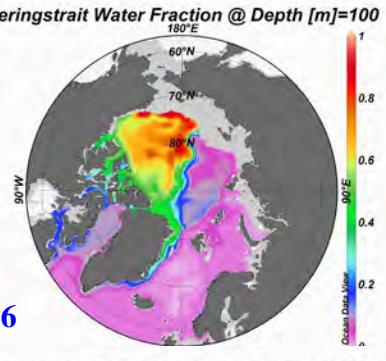
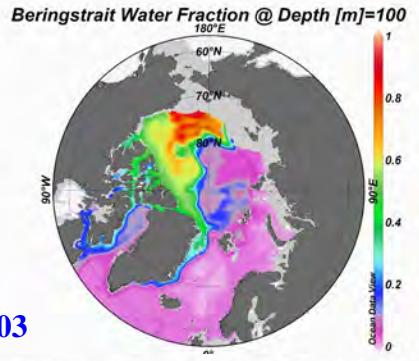
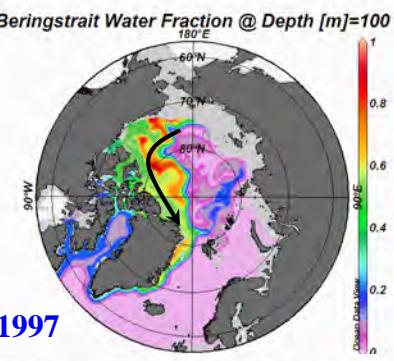
**Shallow flow goes both
directions, deeper flow goes
eastwards**

**Water from BG flows into
Transpolar drift**

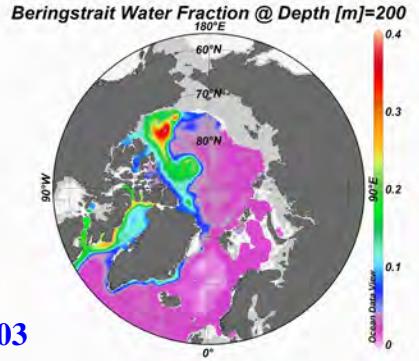
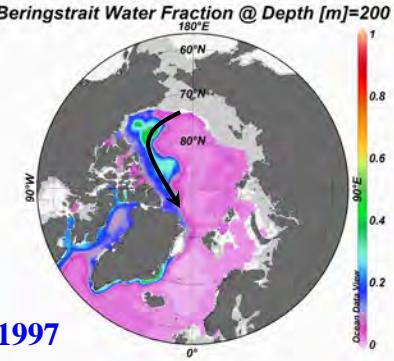
Pacific Water ‘colour’ tracer in the NAOSIM (AWI) model



Surface



100 m

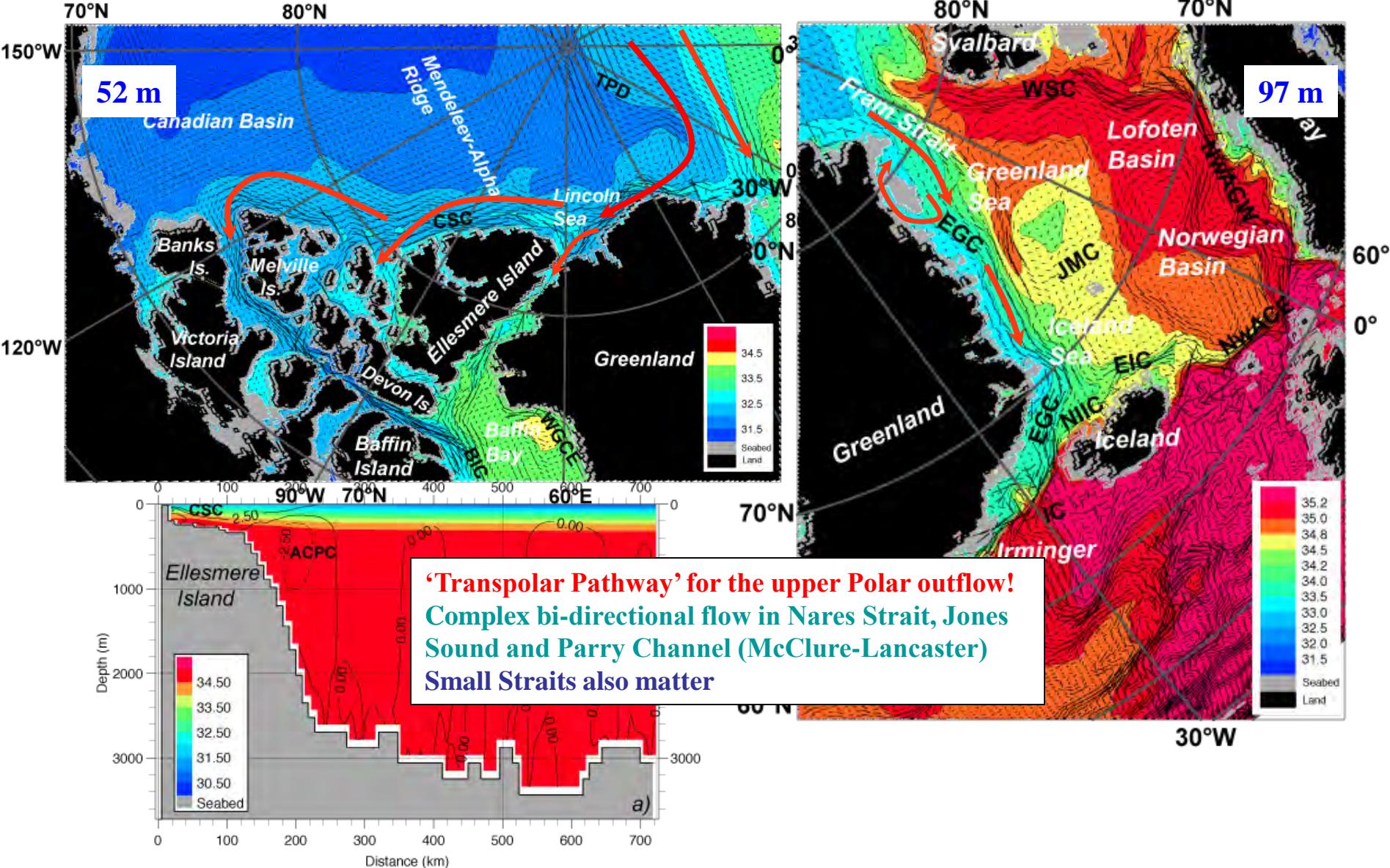


200 m

**Two routes for Pacific Water:
Surface fraction flows along
Siberian Shelf; deeper fraction
along the Alaskan Shelf**

**Interannual variations: switch
between Fram Strait and CAA
outflow (Falck 2005)**

Polar outflow 1989-2006 in OCCAM 1/12 °



Summary

- Volume and freshwater outflow timeseries for TS-classes for three high-resolution models: (1) inter-decadal variations are similar, (2) monthly and inter-annual variability is different, (3) Bering Strait inflow is different
- Compared to the observations (not many): reasonable match?
- Started tracer experiments: two pathways of the Pacific Water

Future plans

- Pacific Water storage and outflow through Fram and Davis straits from ‘colour’ tracer
- Mixing and ventilation
- Depletion of the Pacific halocline