Seasonal cycle of the freshwater export through Fram Strait and CAA: How robust are model results?

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Part of an AOMIP article in preparation:

Arctic freshwater - How robust are model simulations?

A. Jahn, Y. Aksenov, B.A. de Cuevas, S. Häkkinen, E. Hansen, C. Herbaut, M.-N. Houssais, M. Karcher, C. Lique, A. Nguyen, P. Pemberton, L. de Steur, D. Worthen, J. Zhang

Objective

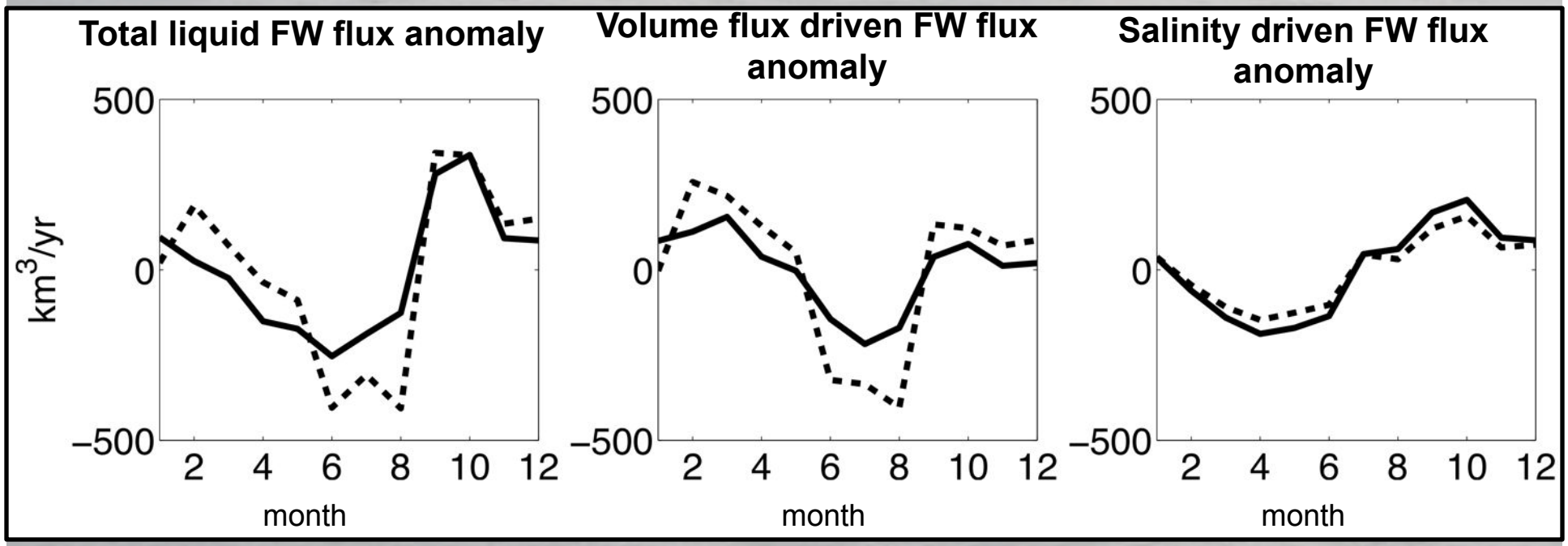
Objective: Determine how well models capture the seasonal cycle of the FW export through Fram Strait and the CAA

Which models?

	LOCEAN	UVic ESCM	OCCAM	ORCA 025	POM	ECCO2	PIOMAS	NAOSIM	RCO	POP-CICE
Period	1958-2001	1948-2007	1985-2006	1958-2004	1961-2008	1992-2008	1948-2008	1948-2008	1958-2008	1948-2007
Regional /global	R	G	G	G	R	R	R	R	R	G

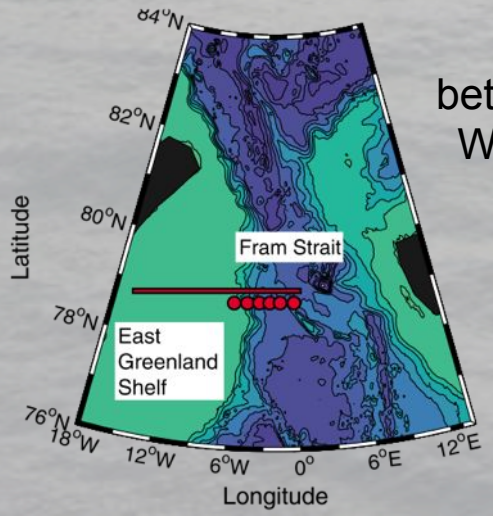
Period analyzed: 1991-2001

Fram Strait liquid FW export seasonal cycle: Observed (top 250m)



Dashed Line: as published in de Steur et al. (2009)

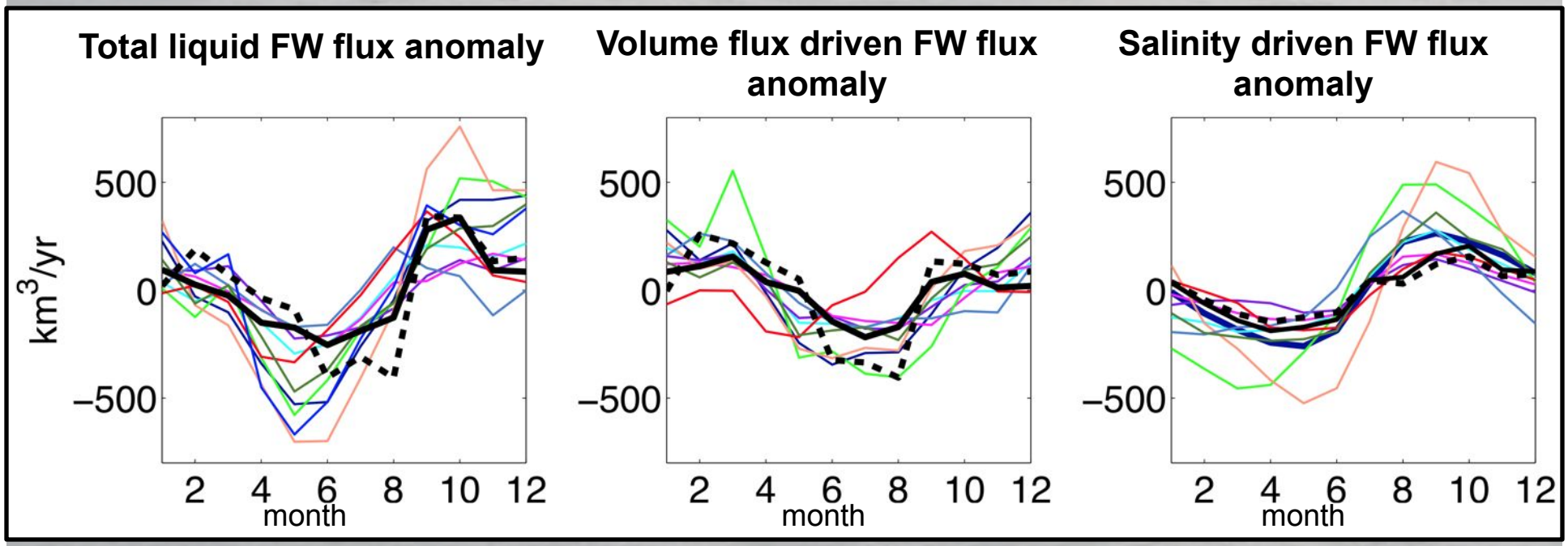
Solid Line: updated data, using regression to close-by instruments for missing velocity data and stronger nudging towards CTD data (de Steur et al., in preparation)



Mooring between 6°30' W and 0° W

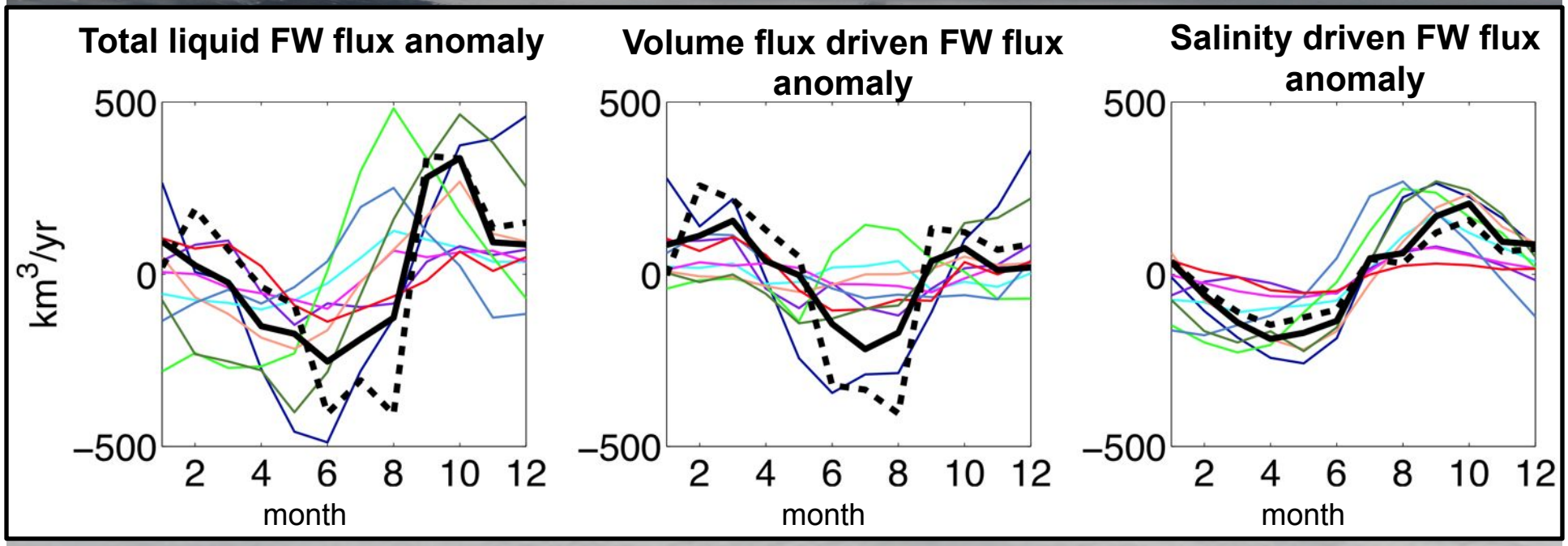
Illustration from de Steur et al. (2009)

Fram Strait liquid FW export seasonal cycle: Observed & Simulated



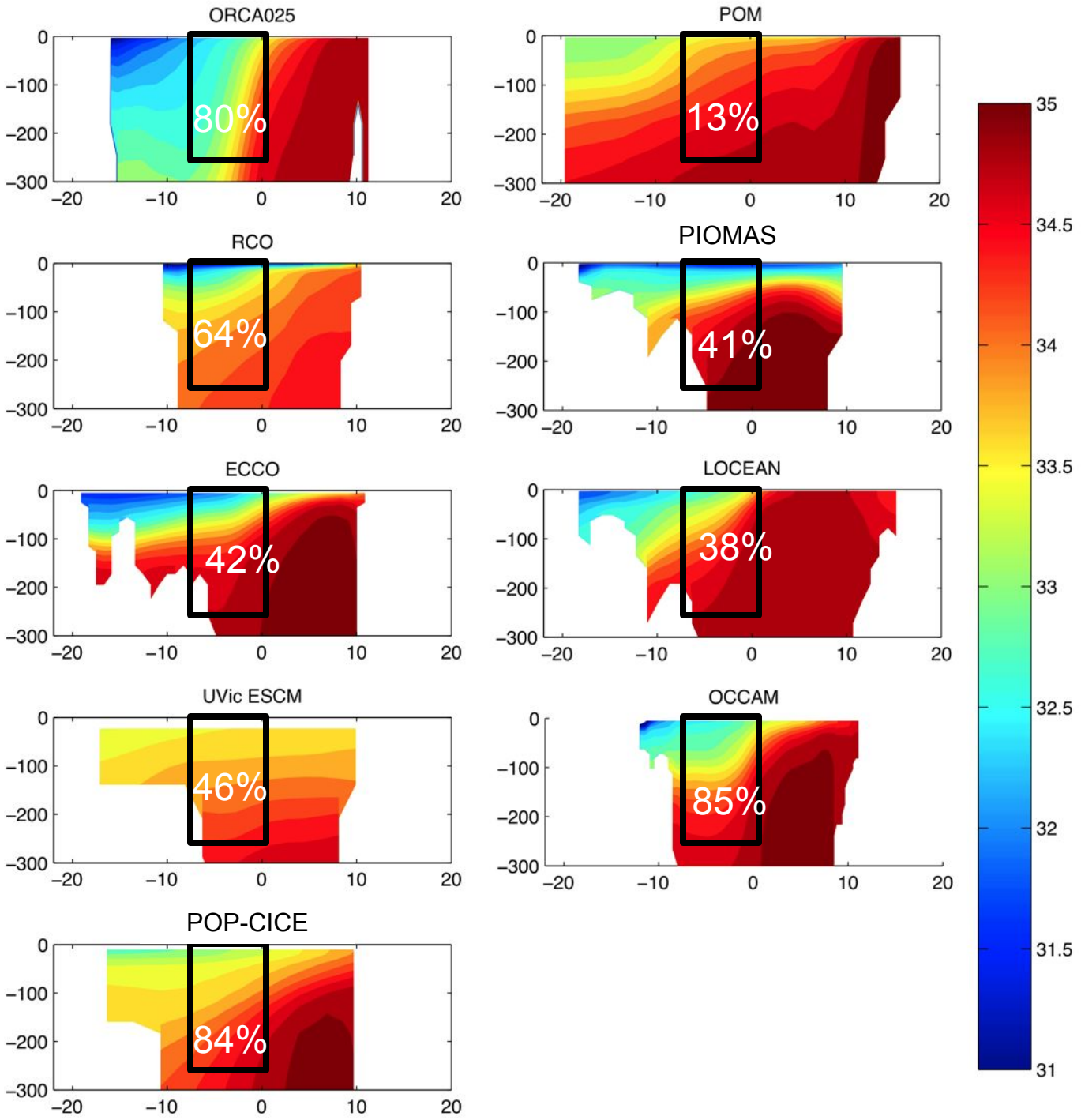
Models show a minimum one month before the new mooring data (and 1-3 before older mooring data), mainly due to an earlier decline of volume transport in the models compared to the mooring data

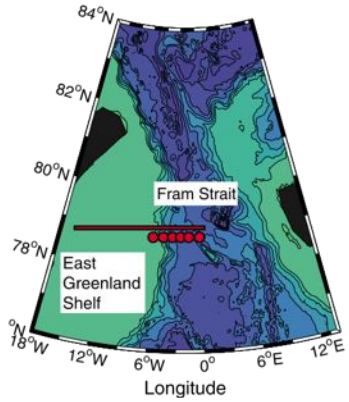
Fram Strait liquid FW export seasonal cycle: Observed & Simulated – only EGC



If models are limited to a similar region as covered by the moorings (6°W to 0°W):

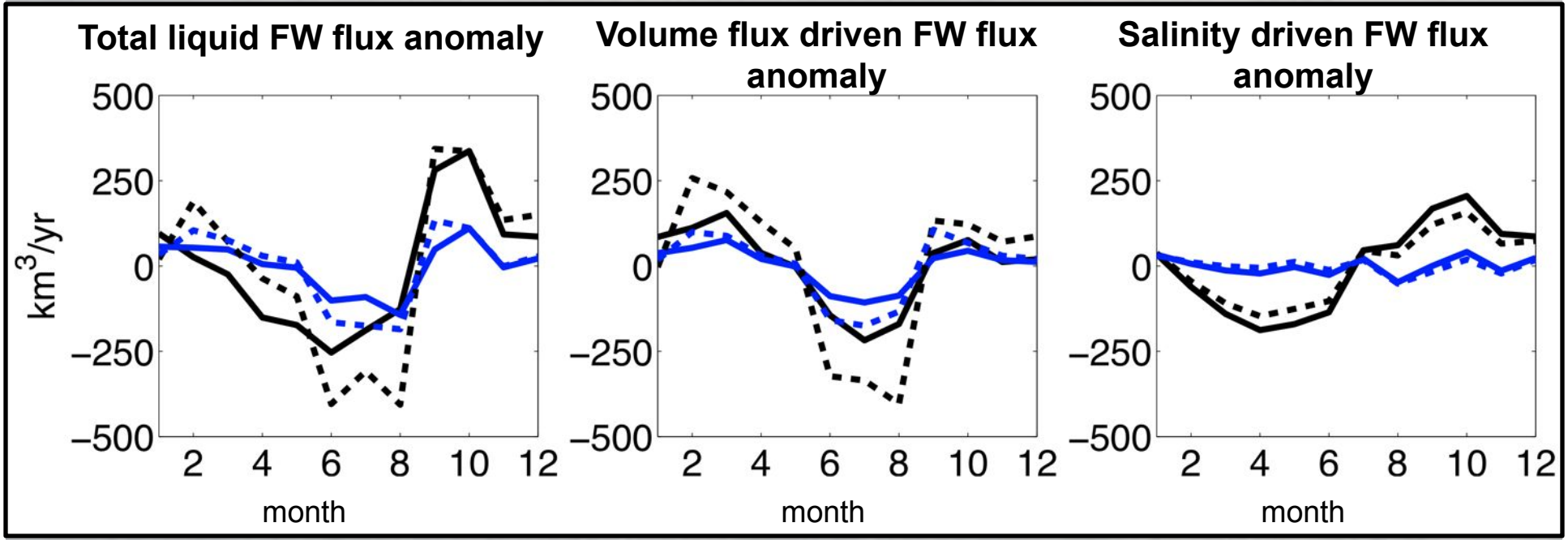
- The simulated seasonal cycle of the liquid FW export is much less consistent
- The simulated volume flux driven seasonal anomaly is much more inconsistent and generally too small
- The simulated salinity driven seasonal anomaly is reduced compared to all of Fram Strait





EGC not in the same location in all models!

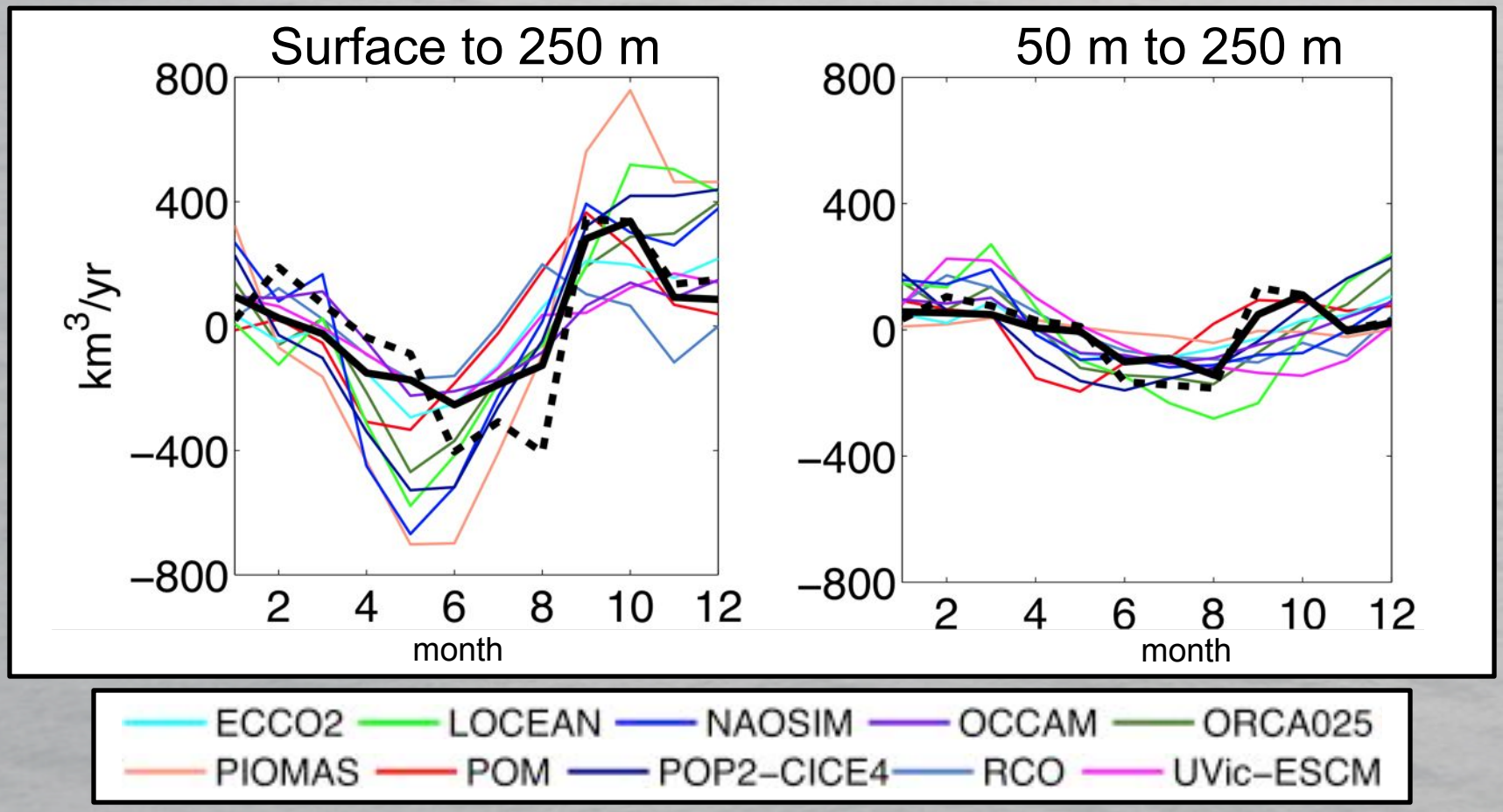
Fram Strait seasonal cycle: Observed – excluding top 50m



Down to 250 m
Without top 50 m

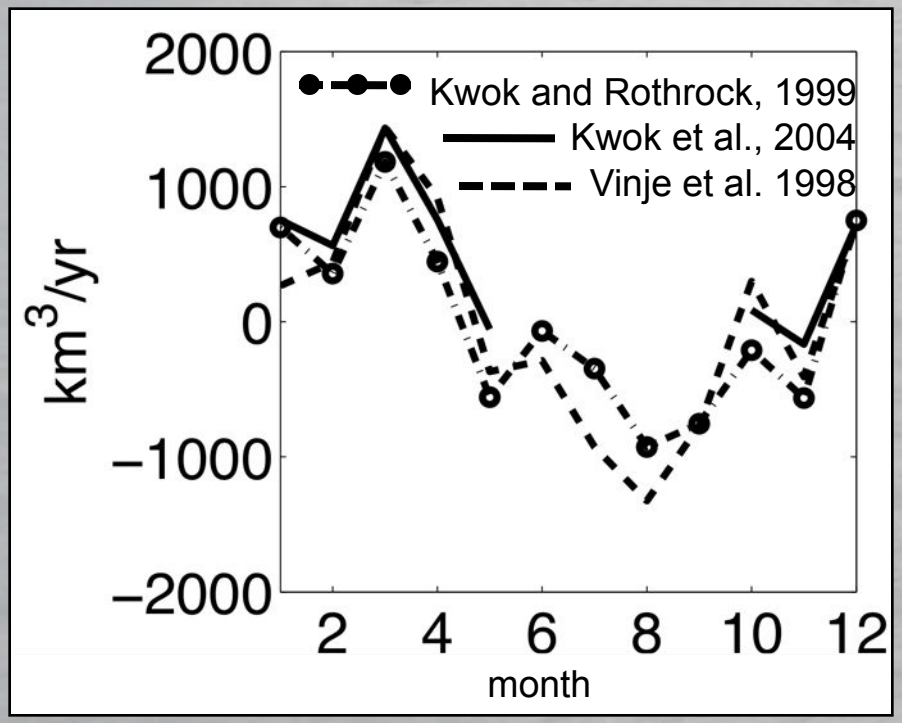
The seasonal cycle of the freshwater content below 50 m is very small and has almost no influence on the seasonal cycle of the FW export

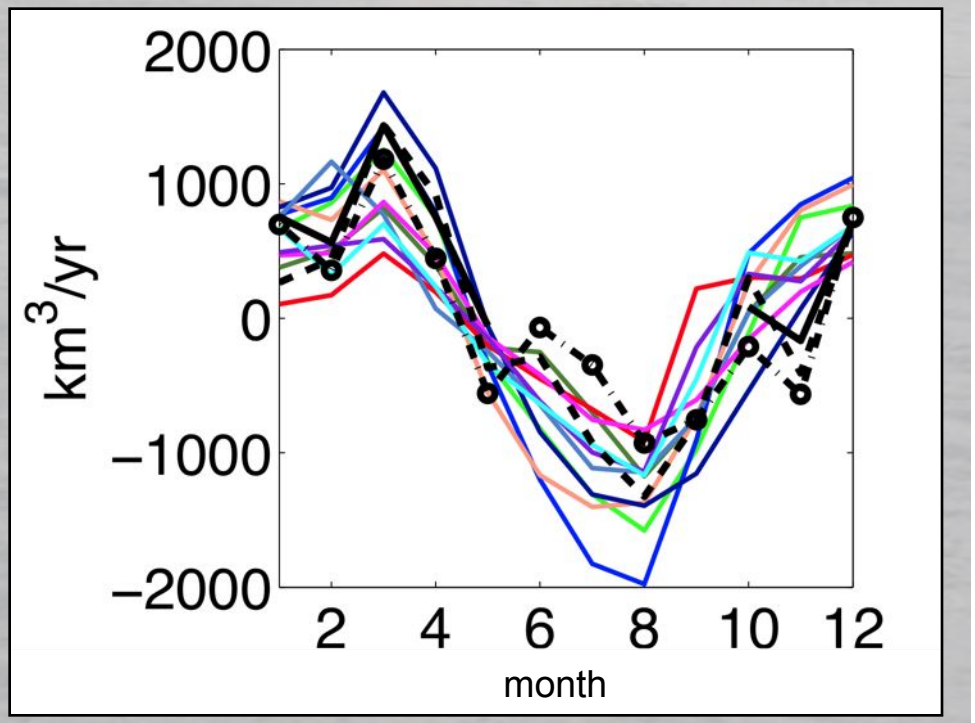
Fram Strait liquid FW export seasonal cycle: Observed & Simulated – excluding top 50m



Excluding the top 50 m reduces the amplitude of the seasonal cycle of the liquid FW export and changes the shape of the seasonal cycle (except in POM)

Fram Strait solid FW export seasonal cycle: Observed & Simulated

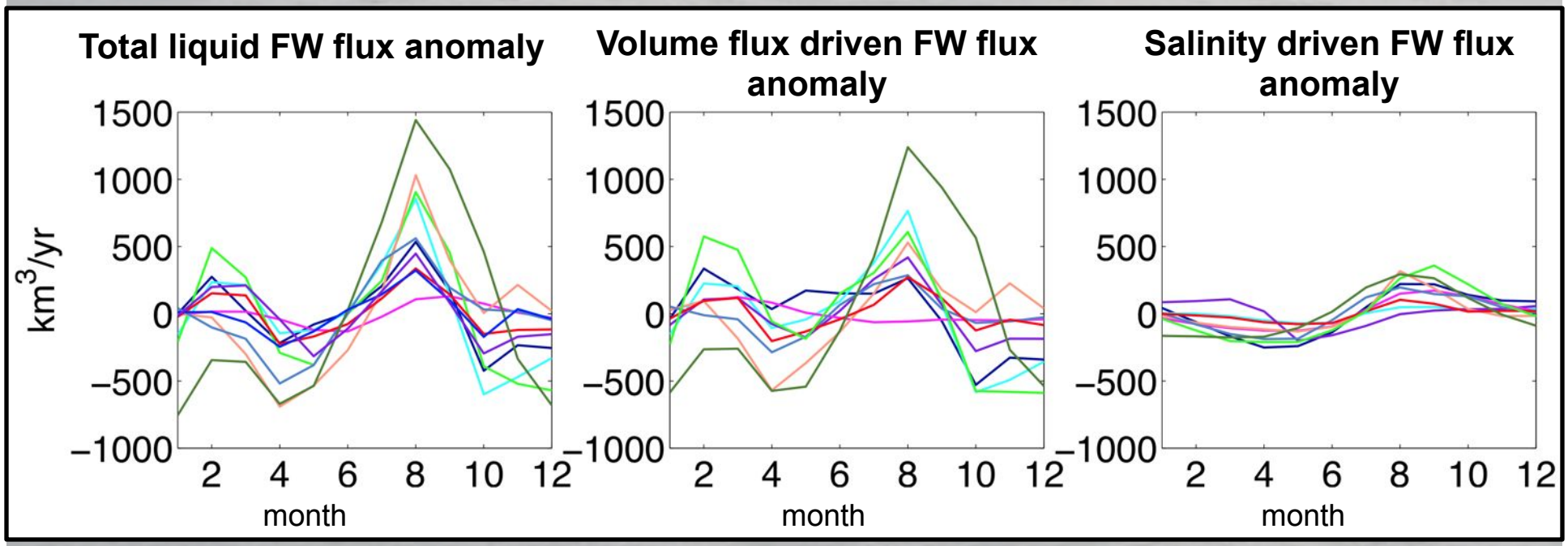




ECCO2 LOCEAN NAOSIM OCCAM ORCA025
PIOMAS POM POP2–CICE4 RCO UVic–ESCM

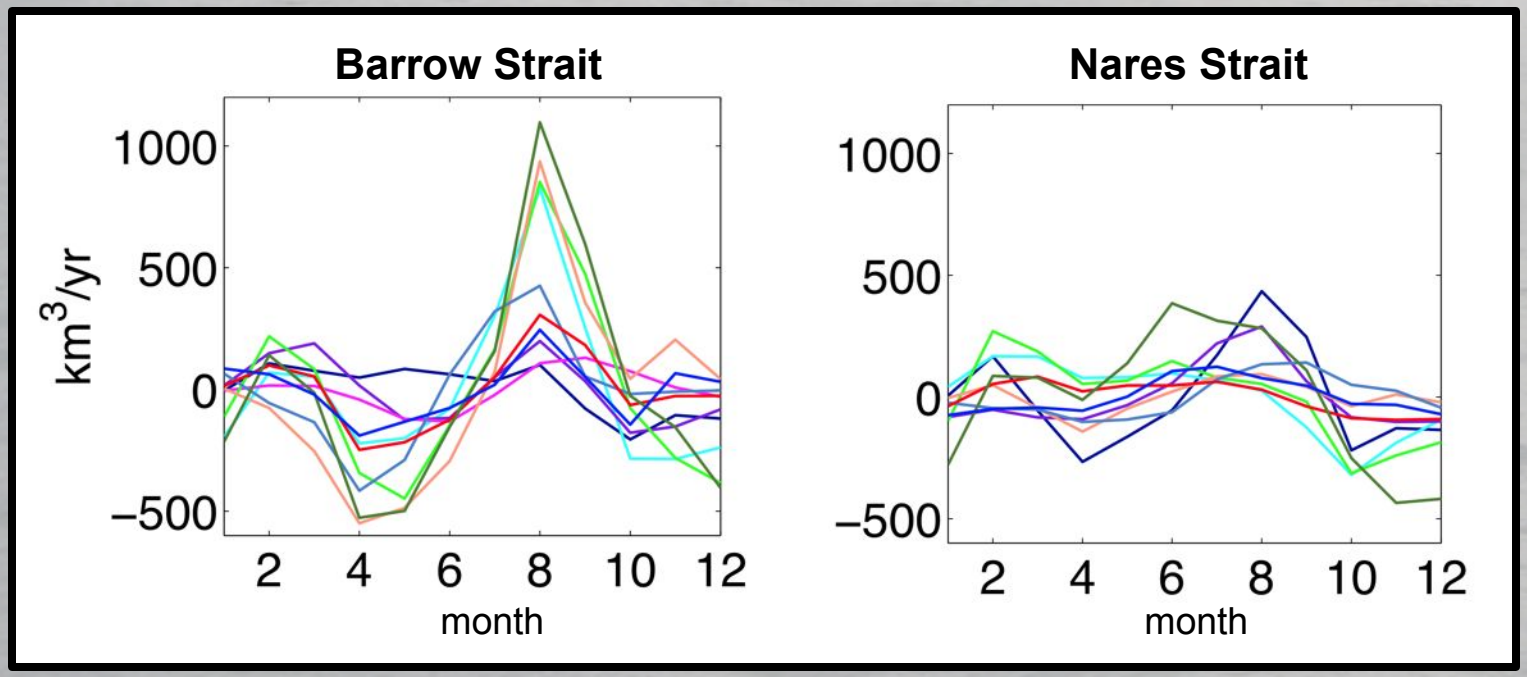
Good agreement of the models with the shape of the observed solid FW export seasonal cycle, with some models, potentially overestimating the magnitude

CAA liquid FW export seasonal cycle: Simulated



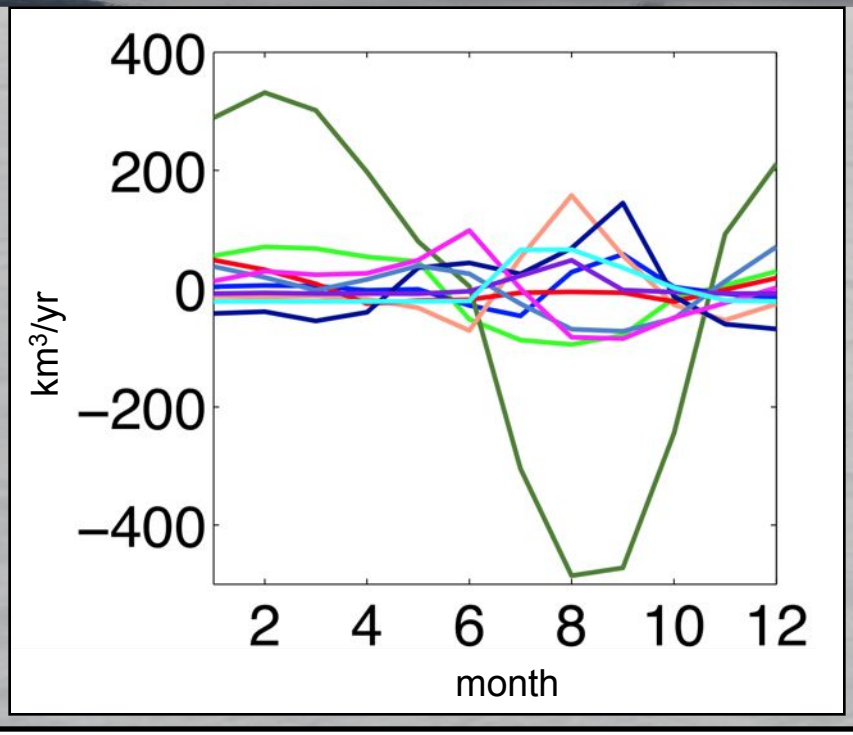
Good agreement with observational estimates of two-peak shape and little influence of salinity variability (Prinsenberg and Hamilton 2005; Muenchow and Melling 2008; Prinsenberg et al. 2009)

Barrow and Nares Strait liquid FW export seasonal cycle: Simulated



The simulated seasonal cycle of the liquid FW export is larger for Barrow Strait than for Nares Strait (except in POP-CIVE4), in agreement with observational estimates (Prinsenberg and Hamilton 2005; Muenchow and Melling 2008; Muenchow et al 2006)

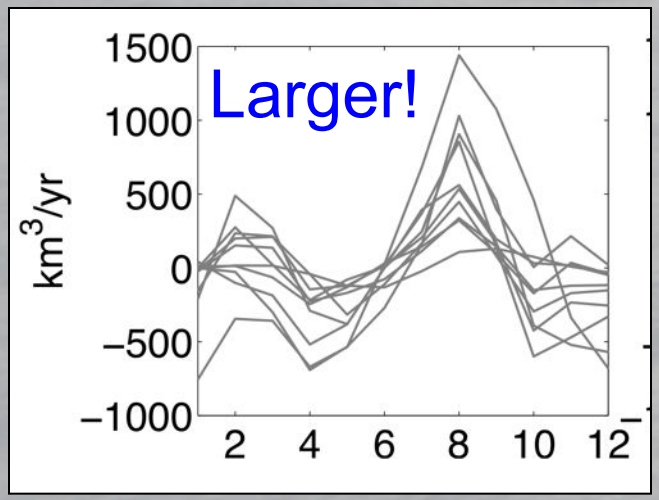
CAA solid FW export seasonal cycle: Simulated



Small seasonal cycle of the solid CAA FW export (except ORCA025), in agreement with observations, which show a peak after the summer break-up of landfast sea ice (Kwok 2005; Prinsenberg and Hamilton 2005)

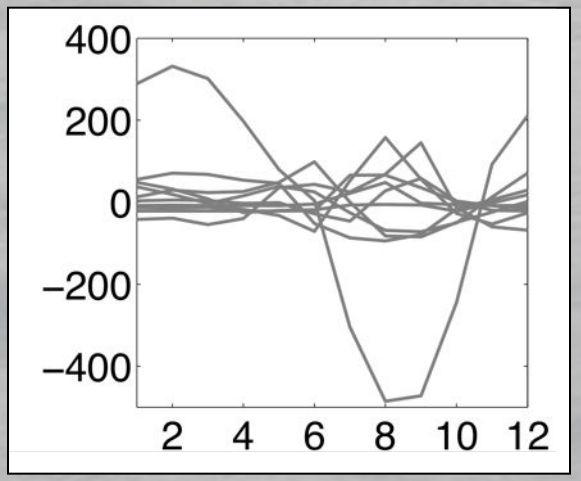
Summary:

- **CAA:** The models agree that:
  - The seasonal cycle of the liquid FW export through has a two-peak shape
  - The seasonal cycle of the solid FW export is small
  - The seasonal cycle of the liquid FW is larger in Barrow than in Nares Strait

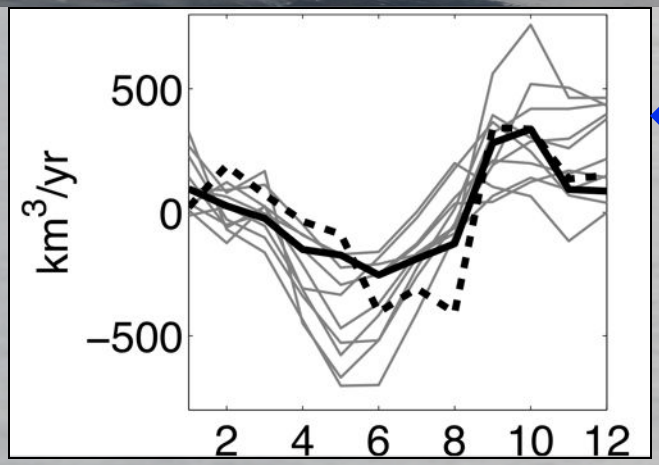


Liquid FW

Solid FW

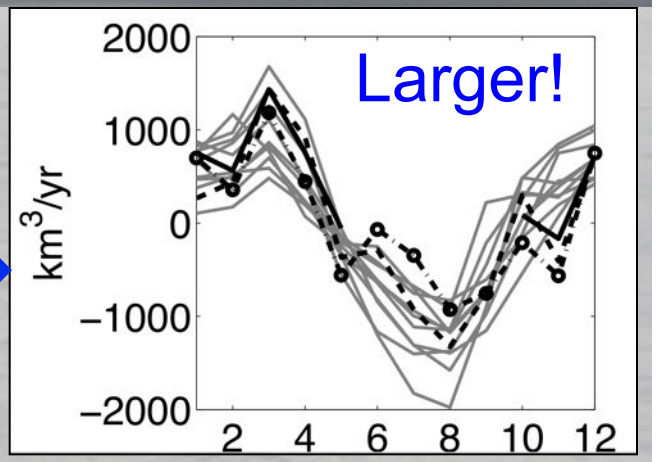


Summary:



Liquid FW

Solid FW



- **Fram Strait:** The models agree that:
  - The seasonal cycle of the liquid FW export has a peak in fall and a minimum in spring (but models show the minimum one moth earlier than observations)
  - The seasonal cycle of the solid FW export is larger than the seasonal cycle of the liquid FW export
  - Both seasonal salinity and volume flux changes contribute to the seasonal cycle of the liquid FW export

Summary:

- **CAA:** The models agree that:
  - The seasonal cycle of the liquid FW export through has a two-peak shape
  - The seasonal cycle of the liquid FW is larger in Barrow than in Nares Strait
  - The seasonal cycle of the solid FW export is small
- **Fram Strait:** The models agree that:
  - Both seasonal salinity and volume flux changes contribute to the seasonal cycle of the liquid FW export
  - The seasonal cycle of the liquid FW export has a peak in late summer and a minimum in spring (but models show the minimum one moth earlier than observations)
  - The seasonal cycle of the solid FW export is larger than the seasonal cycle of the liquid FW export
- **Overall, the models agree much more on the seasonal cycle of the FW export from the Arctic than on its interannual variability**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Questions?
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