

Satellite-derived sea ice export and its impact on Arctic ice mass balance

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Arctic sea ice export



Mar 06, 2010



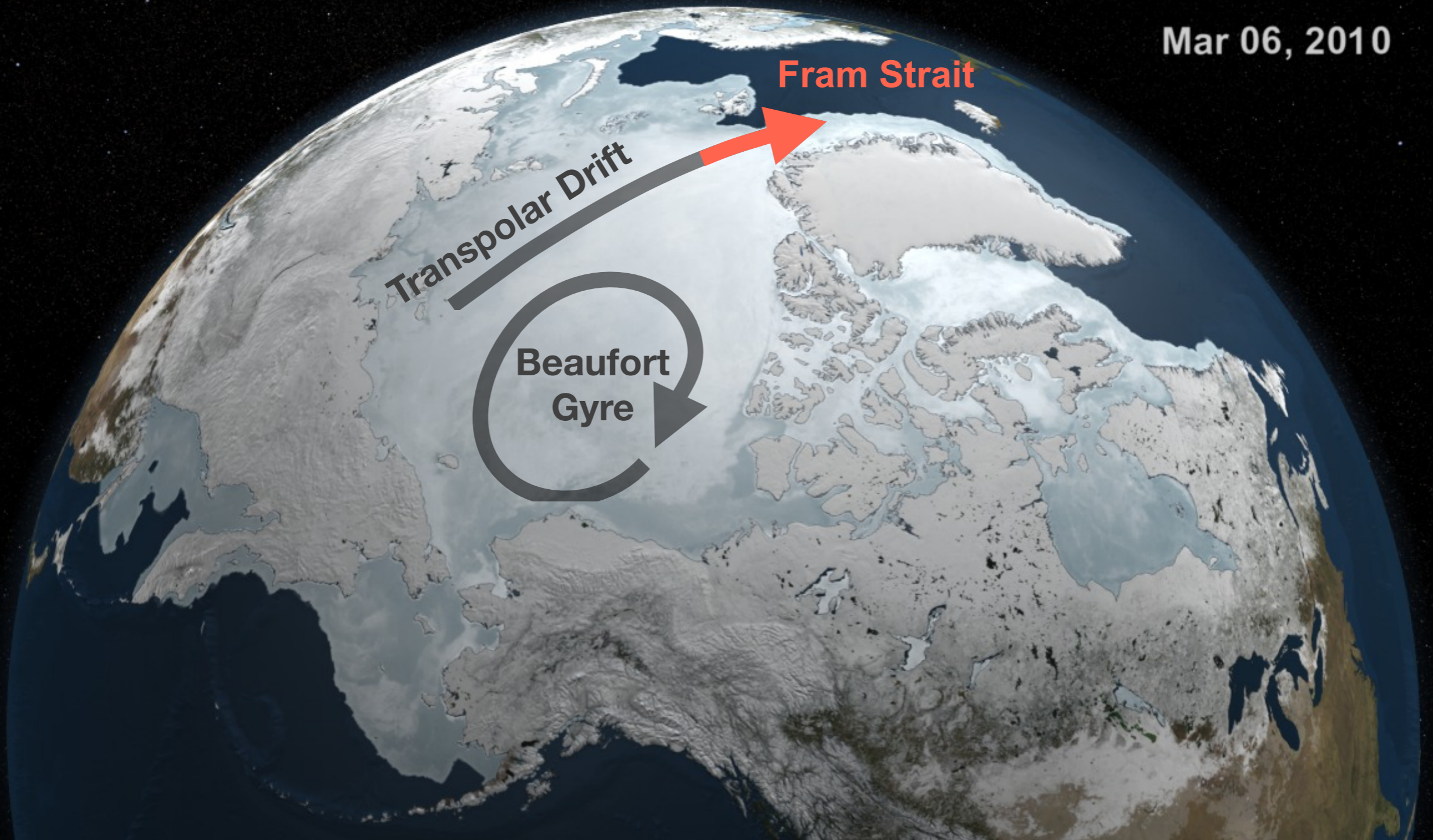
Transpolar Drift

Beaufort Gyre

Arctic sea ice export



Mar 06, 2010



Transpolar Drift

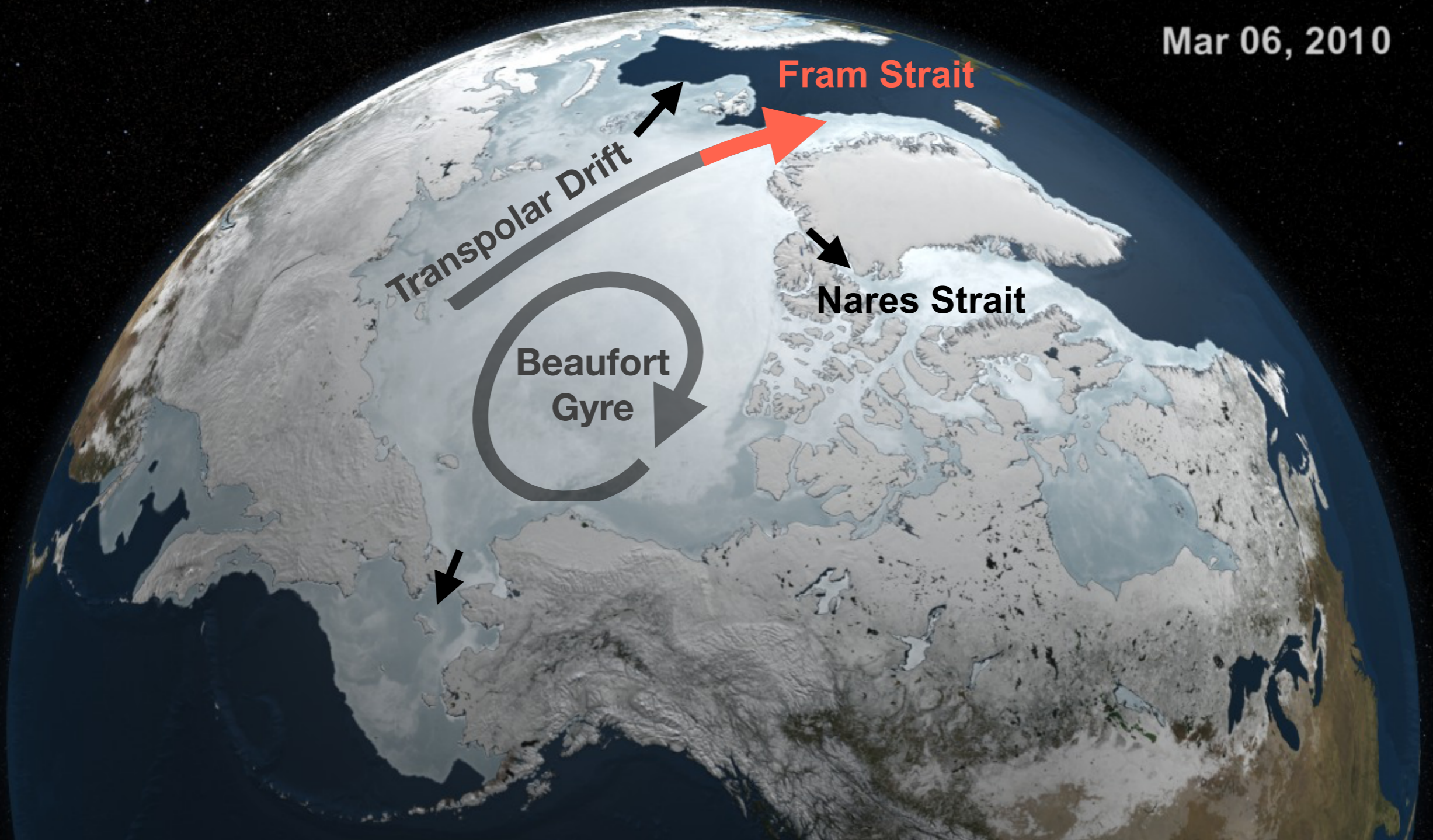
Fram Strait

Beaufort Gyre

Arctic sea ice export



Mar 06, 2010

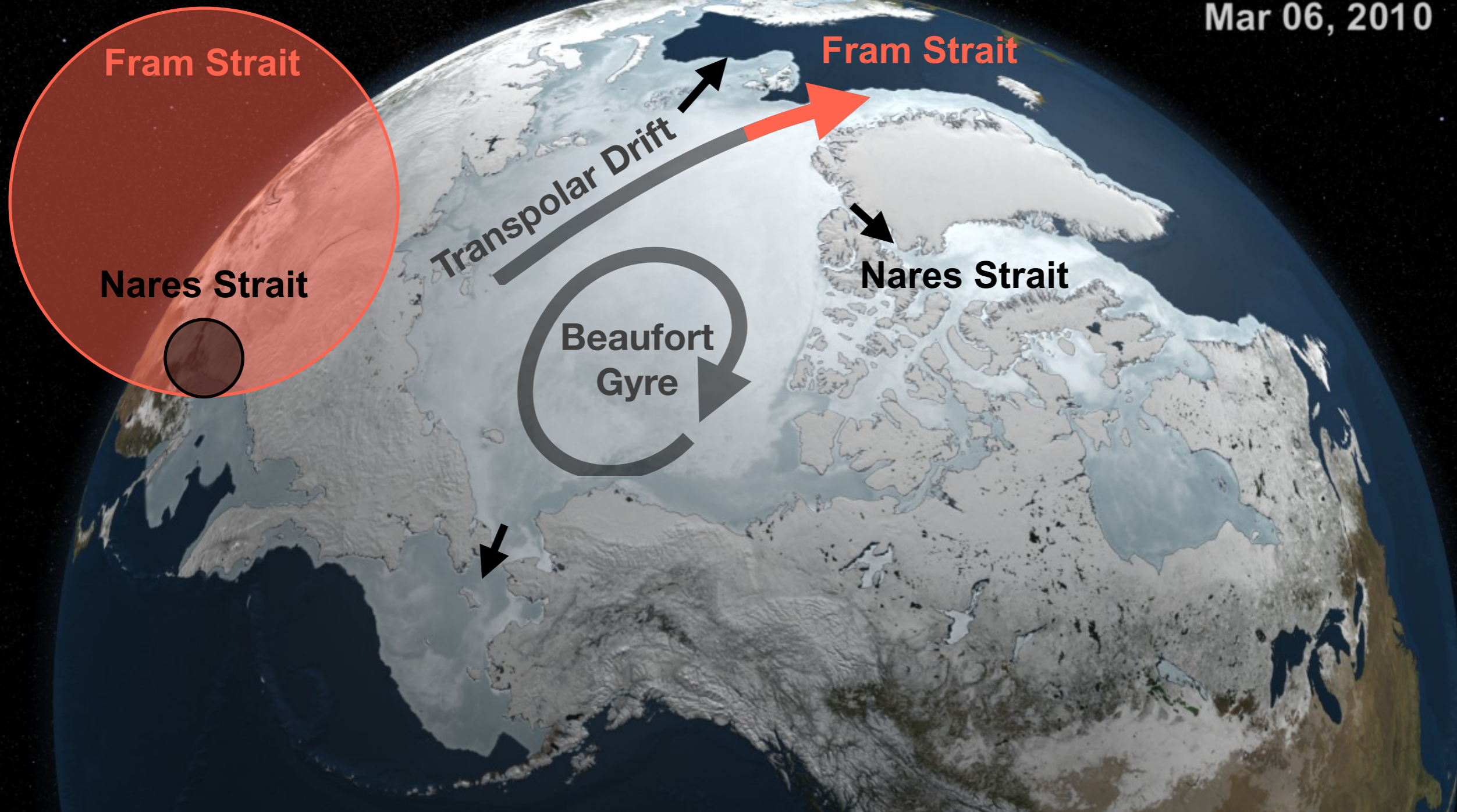


Arctic sea ice export



Ice Area Export

Mar 06, 2010

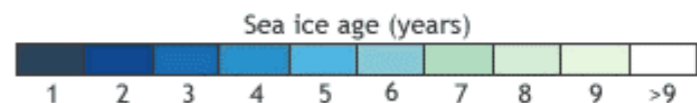
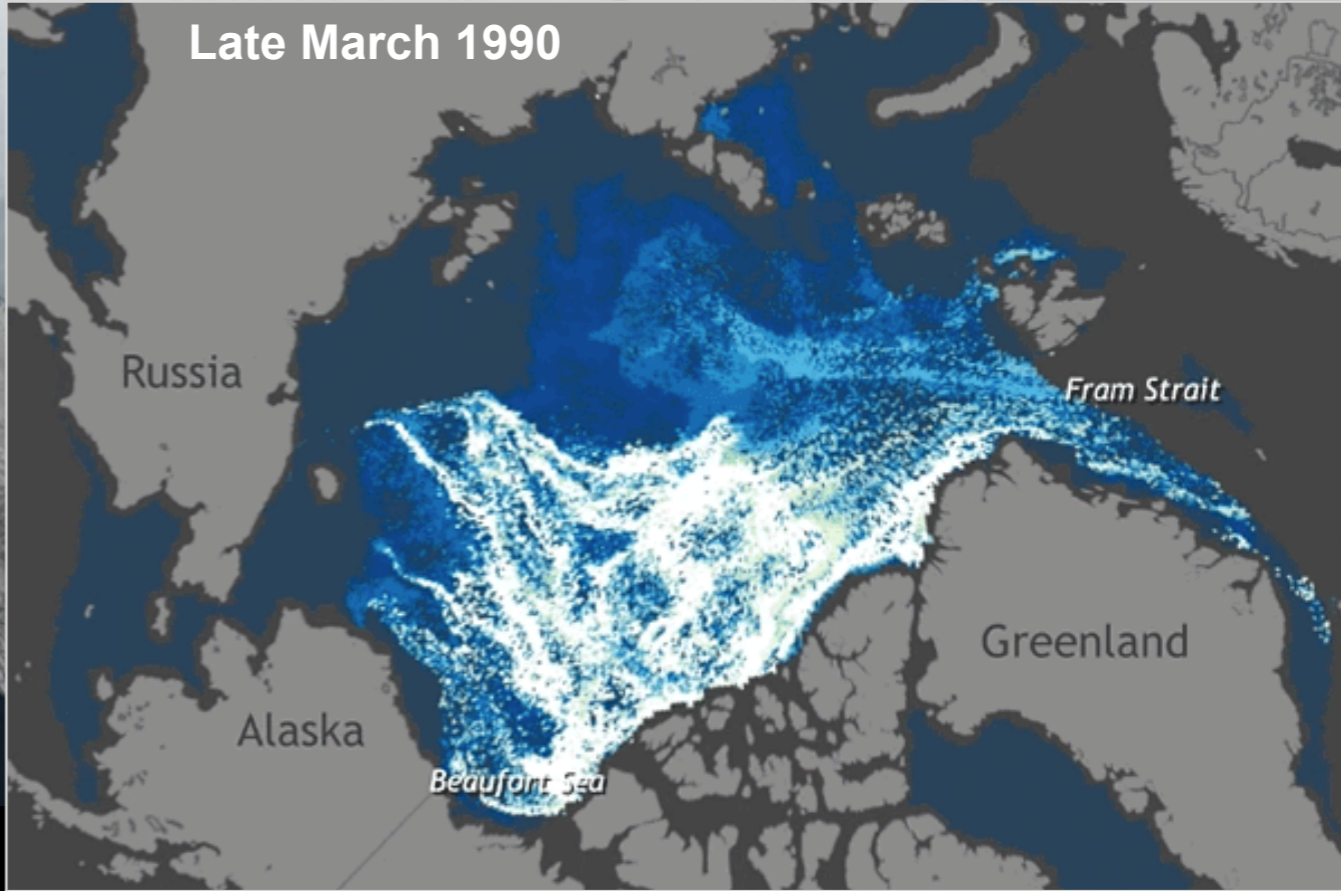
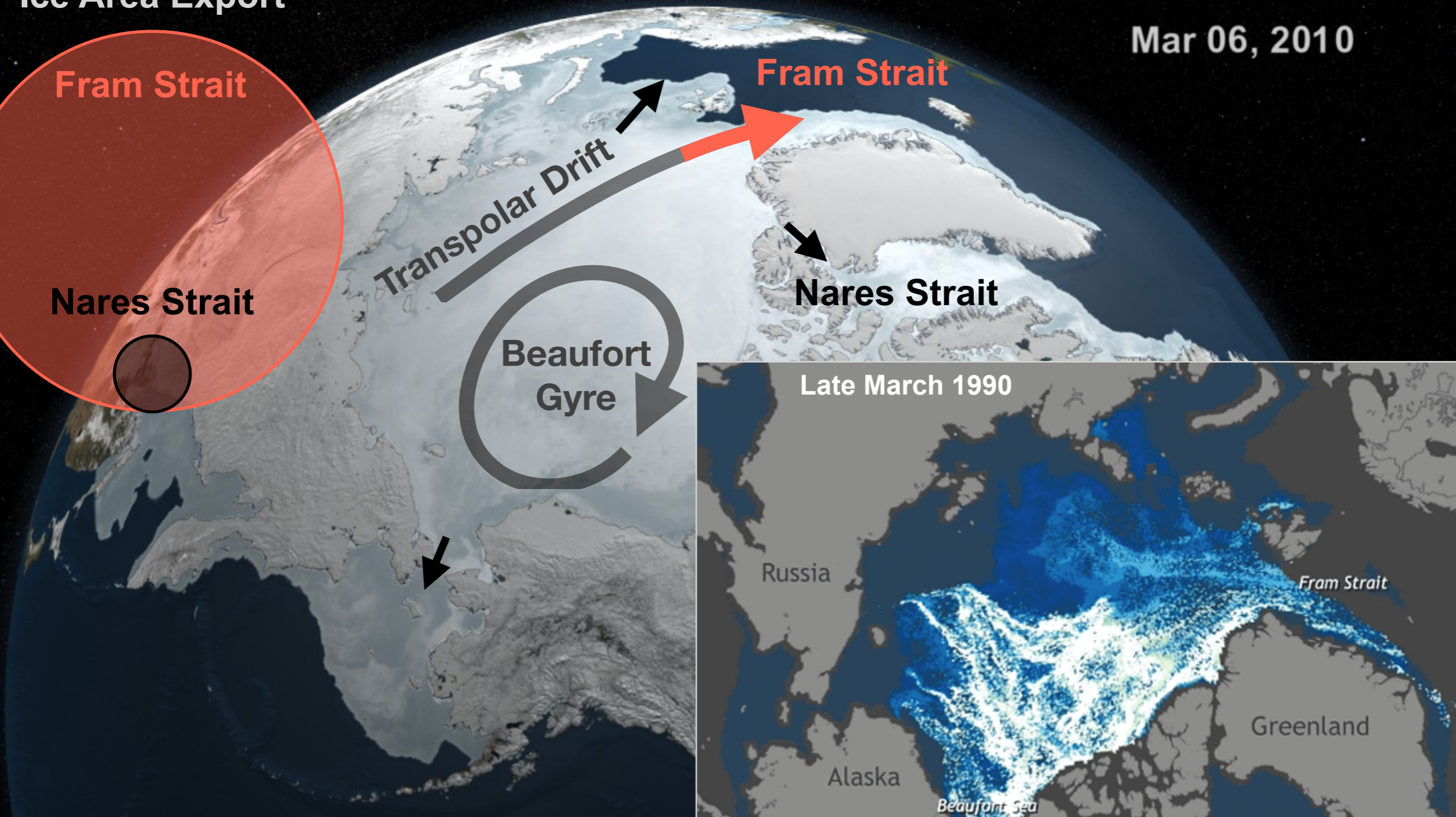
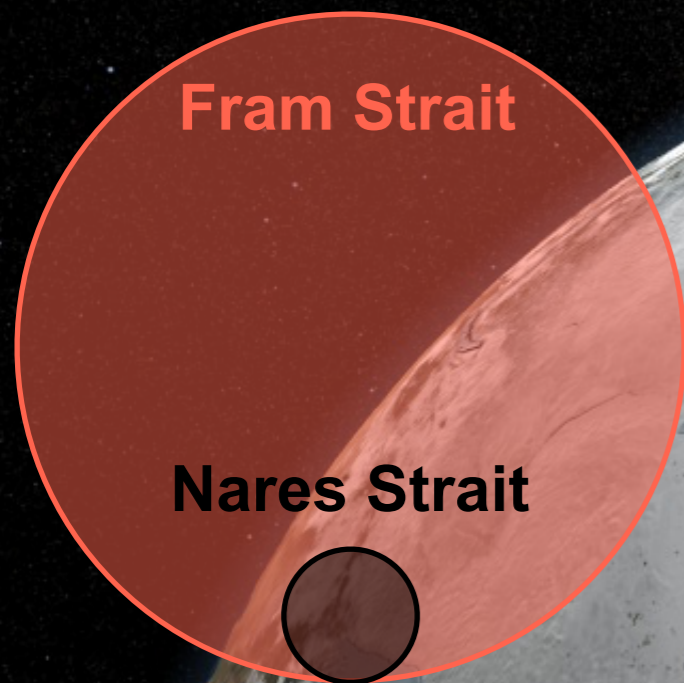


Arctic sea ice export



Ice Area Export

Mar 06, 2010



Credit: NASA

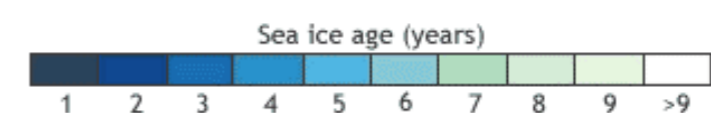
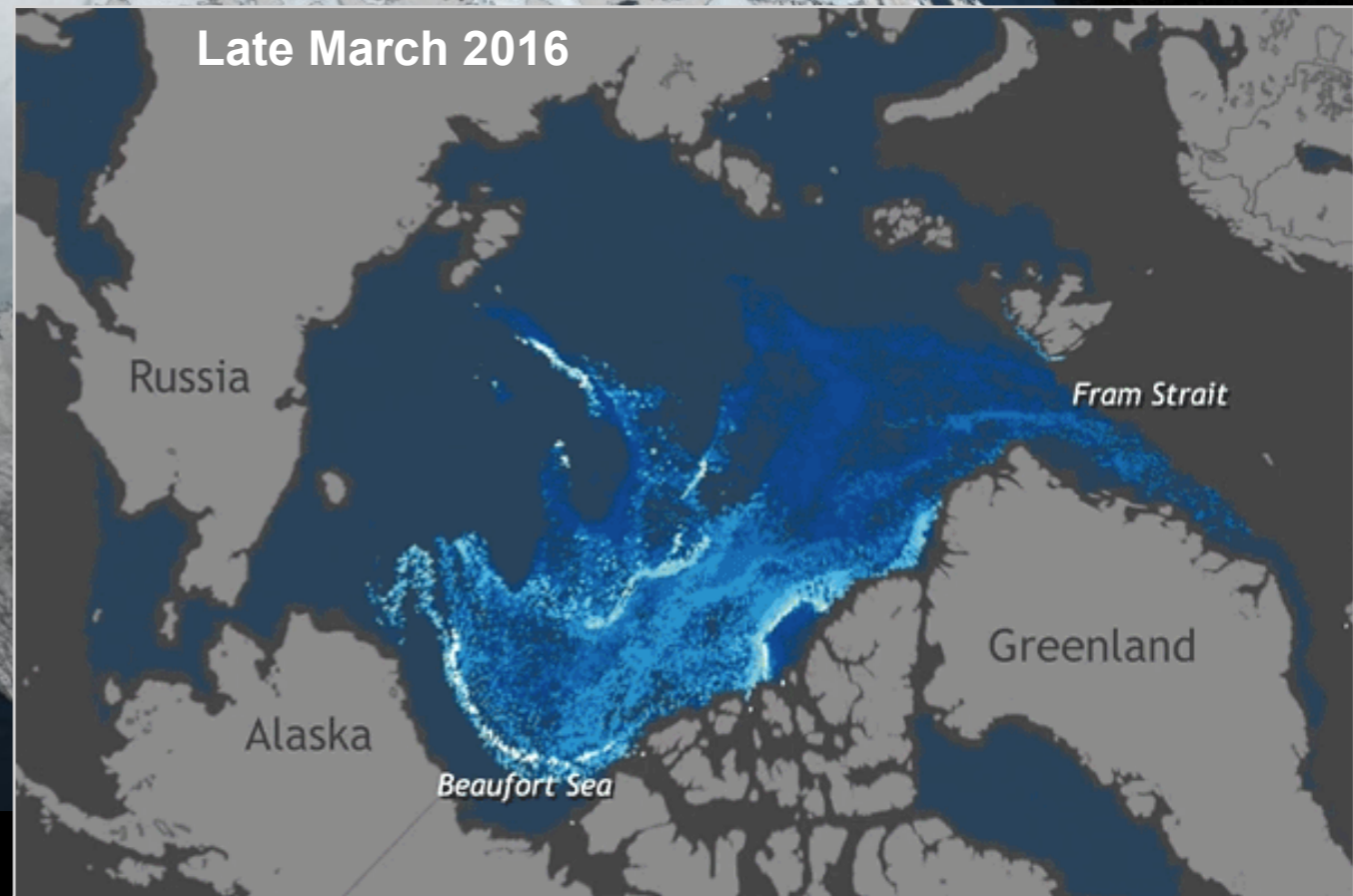
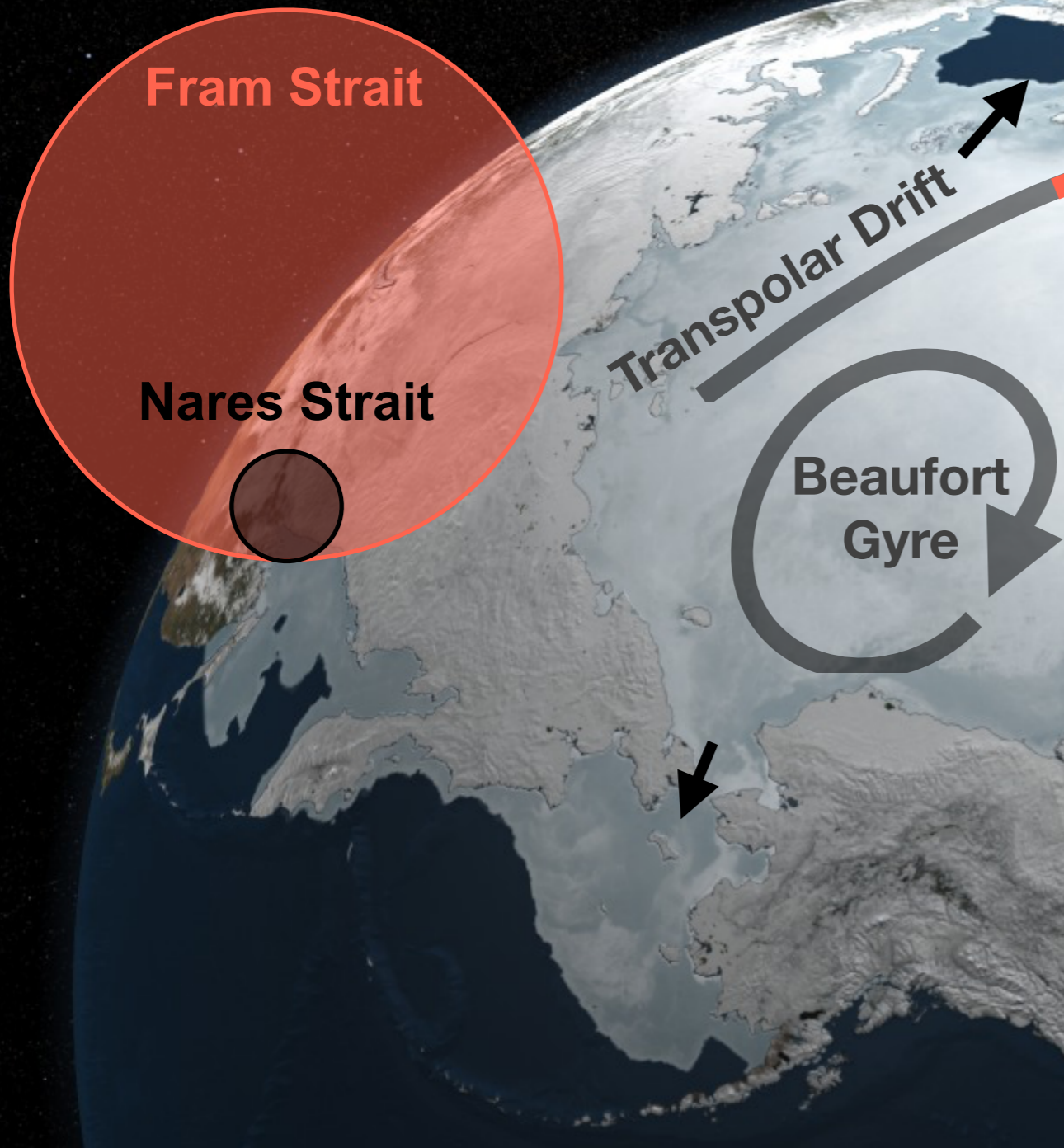
Credit: NOAA/Tschudi

Arctic sea ice export



Ice Area Export

Mar 06, 2010



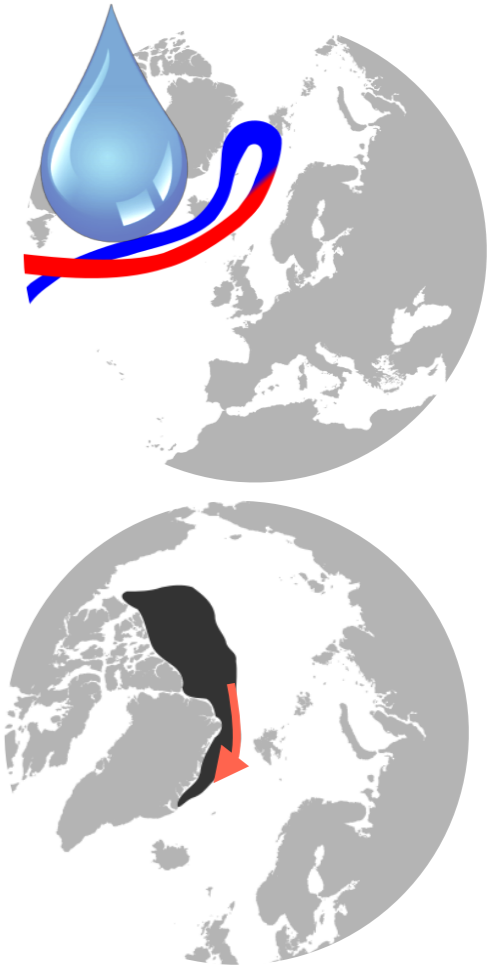
Credit: NASA

Credit: NOAA/Tschudi

Motivation and objectives



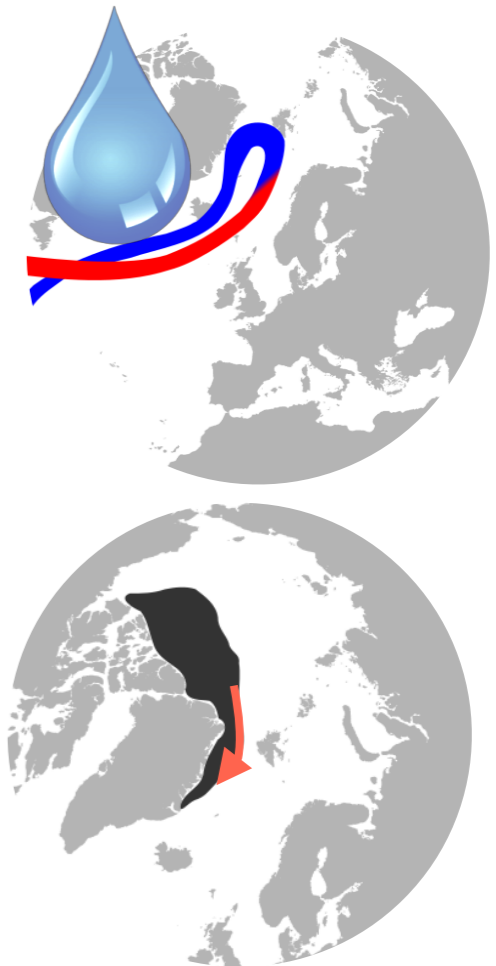
- Fram Strait ice export represents approximately 25% of the total **fresh water export** to the North Atlantic
- Changes in the export rates could affect the global ocean **thermohaline circulation**
- Impact of ice export on Arctic **sea ice mass balance**



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- Fram Strait ice export represents approximately 25% of the total **fresh water export** to the North Atlantic
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- **CryoSat-2 ice thickness data** are used to estimate winter sea ice export through Fram Strait over 7 years **between 2010 and 2017**
- We aim to examine the **variability of ice volume export**
- We quantify the impact of winter ice volume export on Arctic sea ice mass balance, considering Arctic net monthly ice volume changes

Calculating Arctic ice volume flux

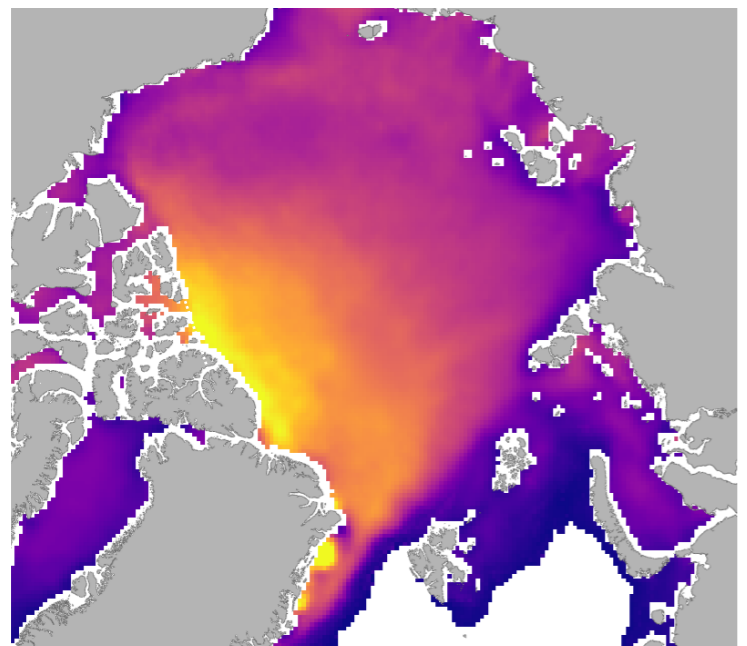


- Arctic-wide volume Flux (**V**) is derived by $V = G H D C$

Grid cell length ($G=25$ km)

Sea ice thickness (**H**)

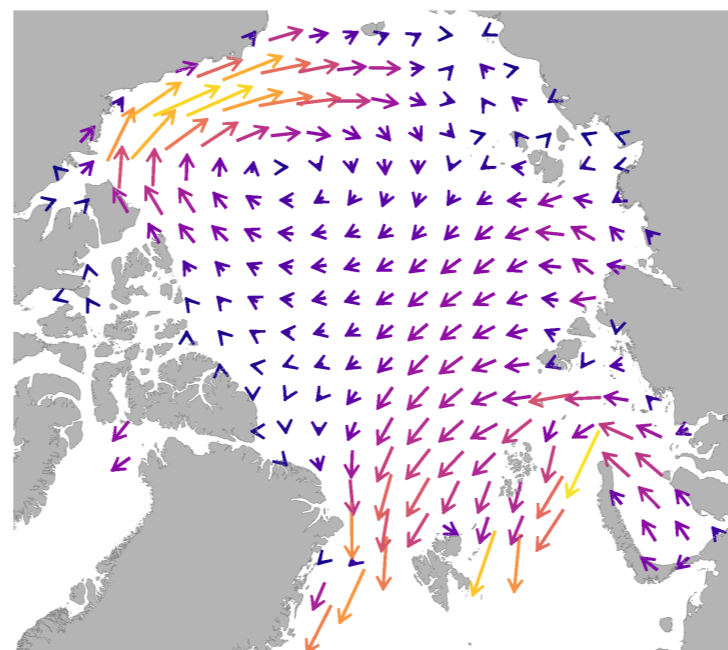
- monthly AWI
CryoSat-2 retrievals



0 1 2 3 4
Sea-Ice Thickness (m)

Sea ice drift (**D**)

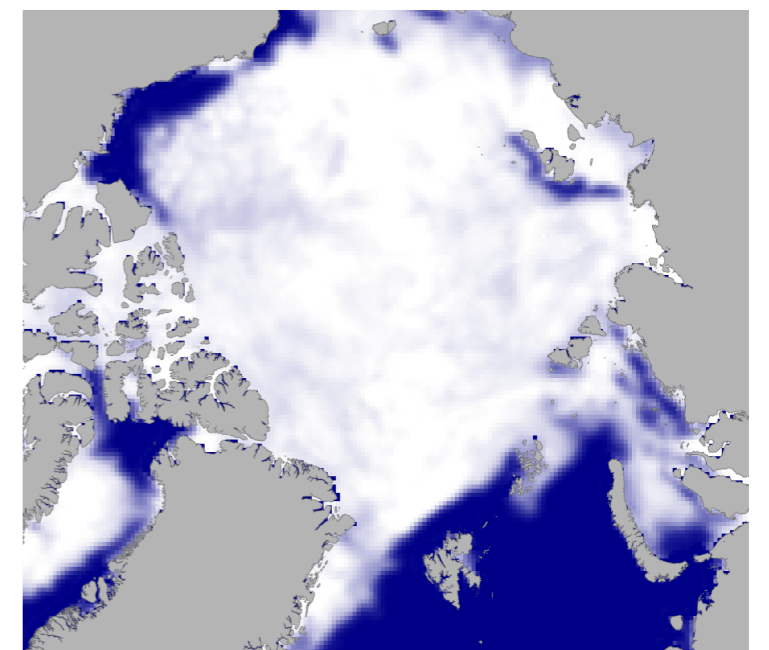
- low resolution ice drift
products IFREMER,
OSISAF, NSIDC



0 100 200 300 400
Ice Drift (km/month)

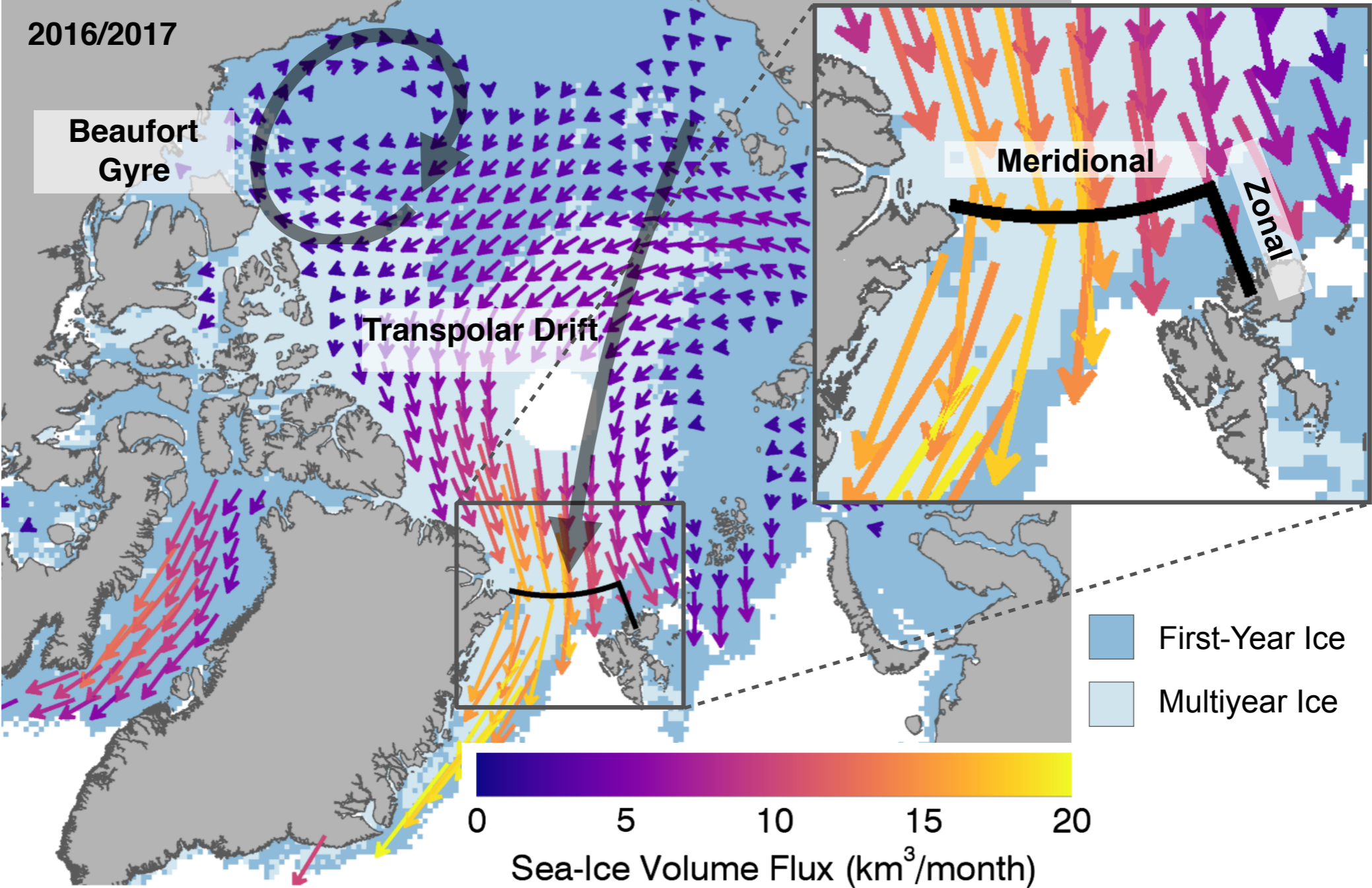
Sea ice concentration (**C**)

- OSISAF

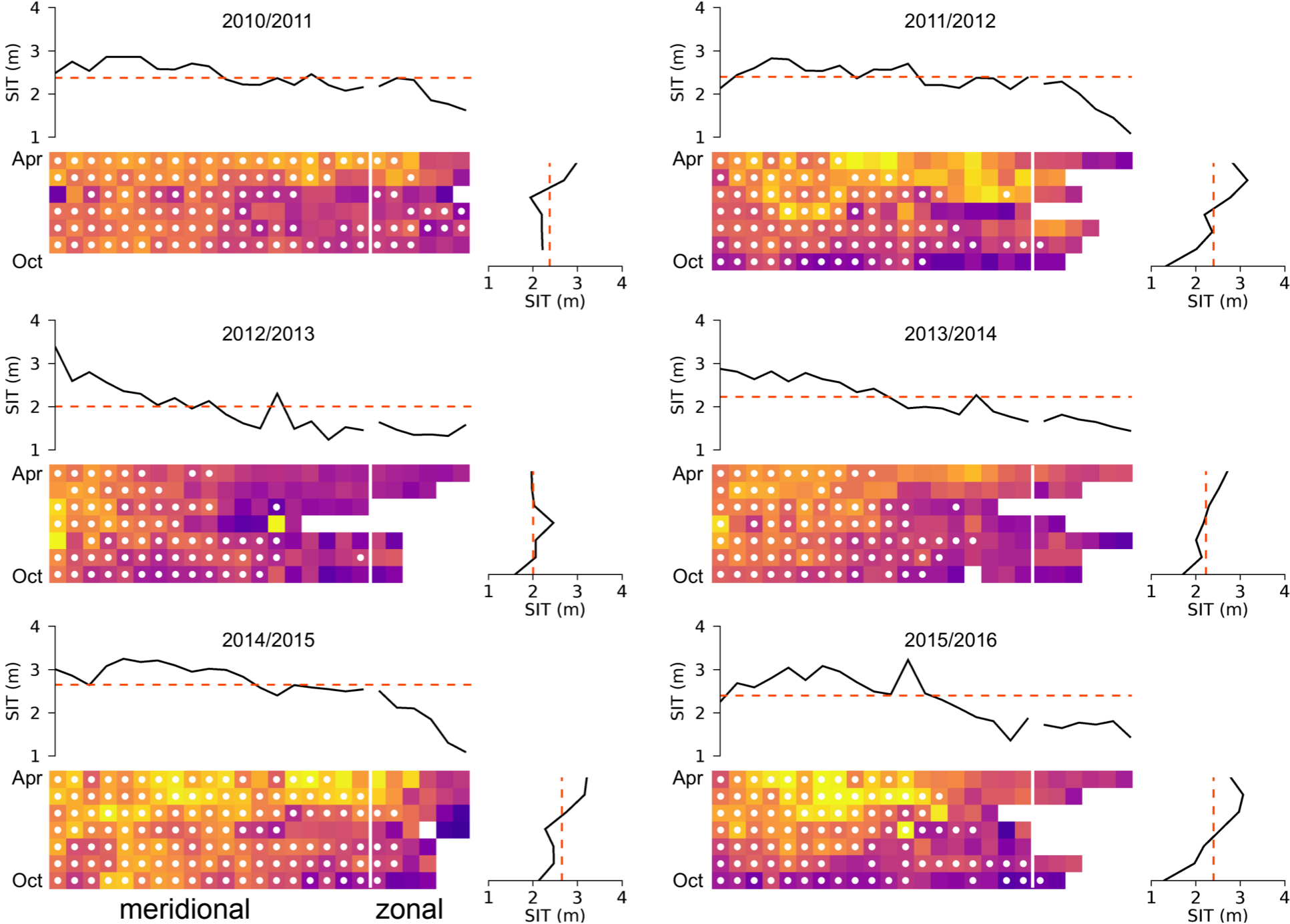
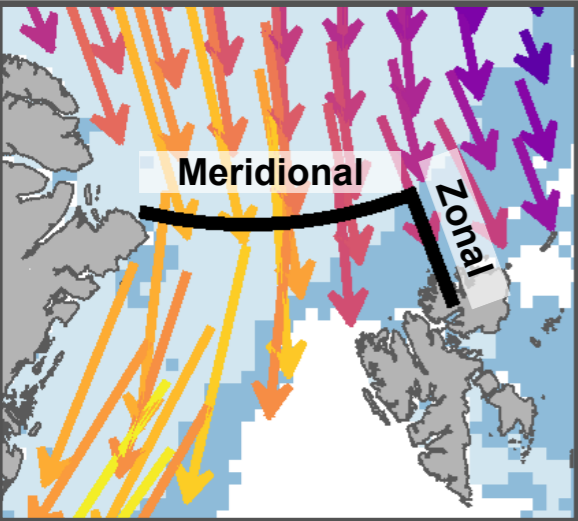


0 20 40 60 80 100
Ice Concentration (%)

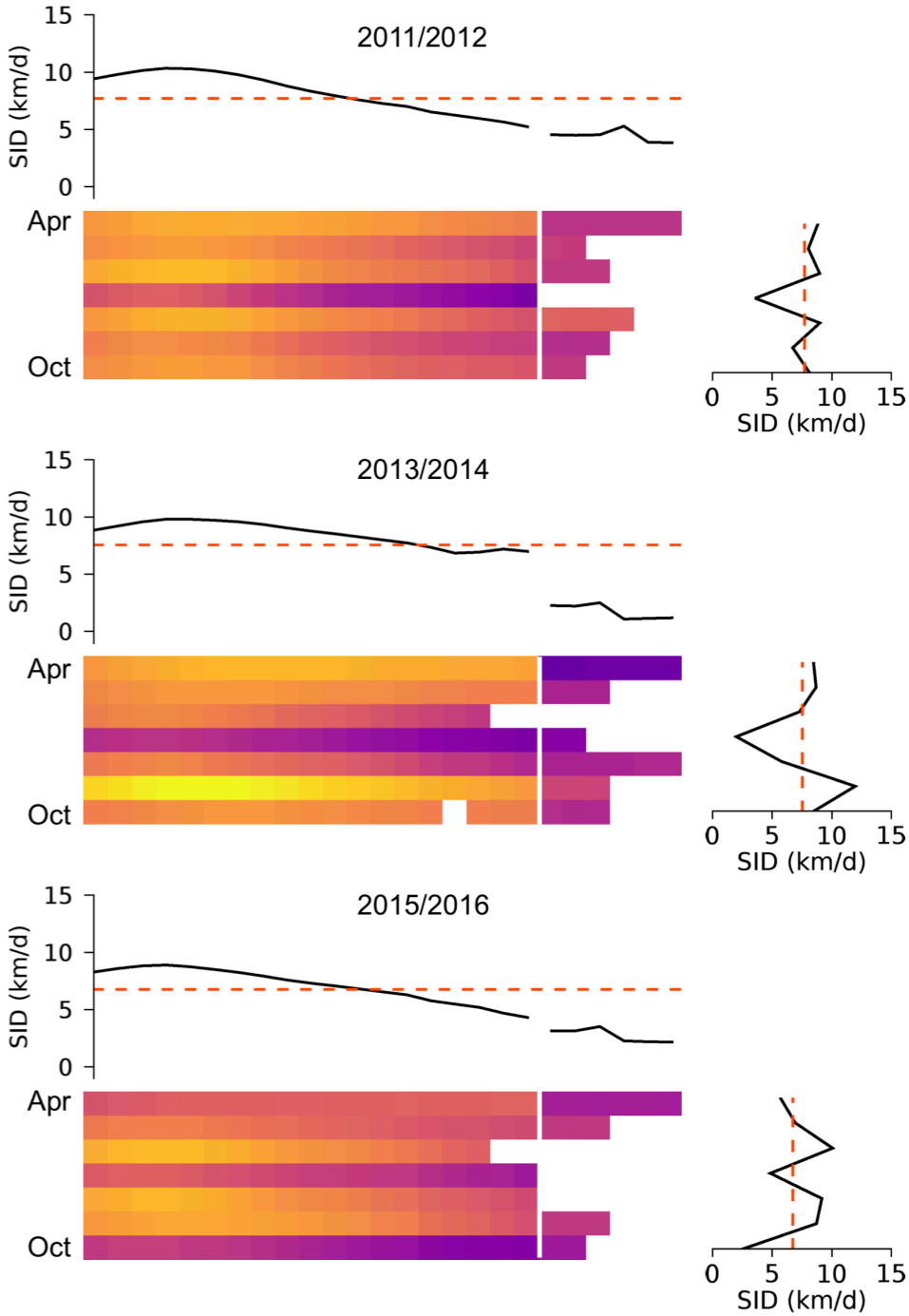
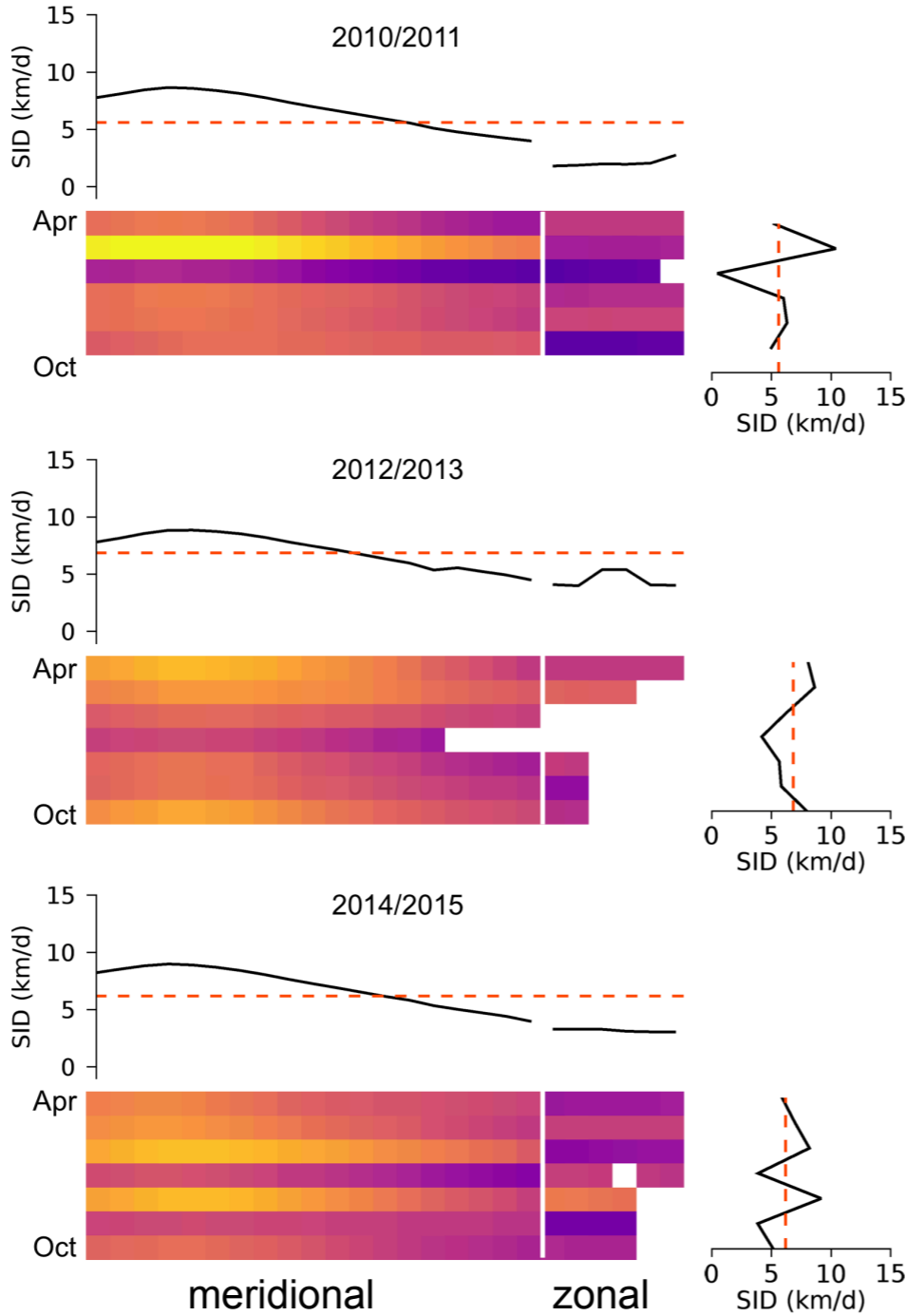
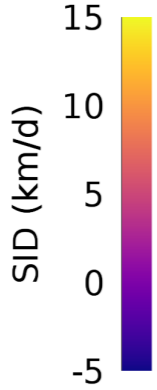
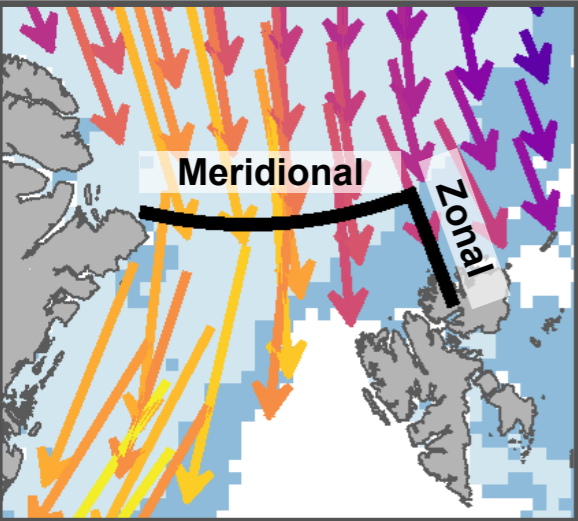
Calculating ice volume flux export



Sea ice thickness in the Fram Strait



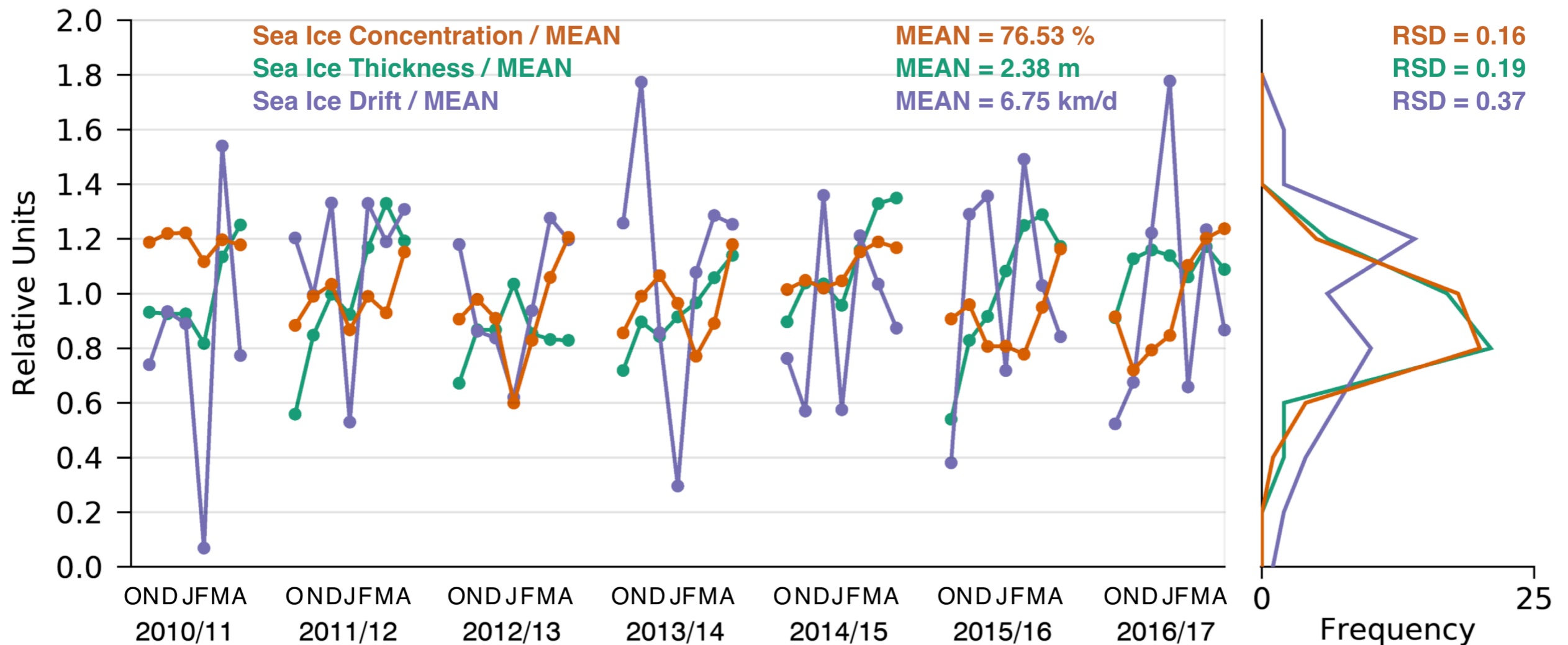
Sea ice drift in the Fram Strait



Variability of the input parameters



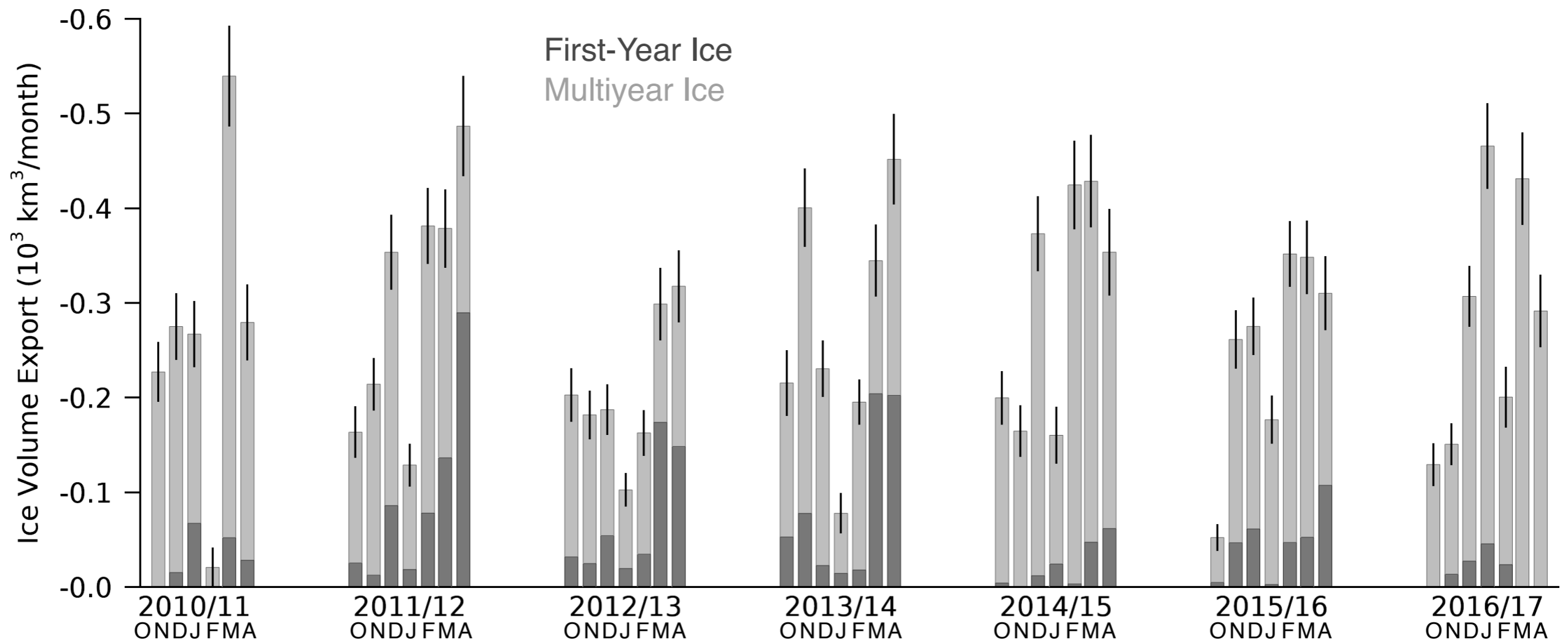
- We compare and quantify the extent of variability of the three parameters (**ice thickness, drift and concentration**).
- Their relative standard deviation (**RSD**) is the **ratio of the standard deviation to the mean**.



Ice volume export through Fram Strait



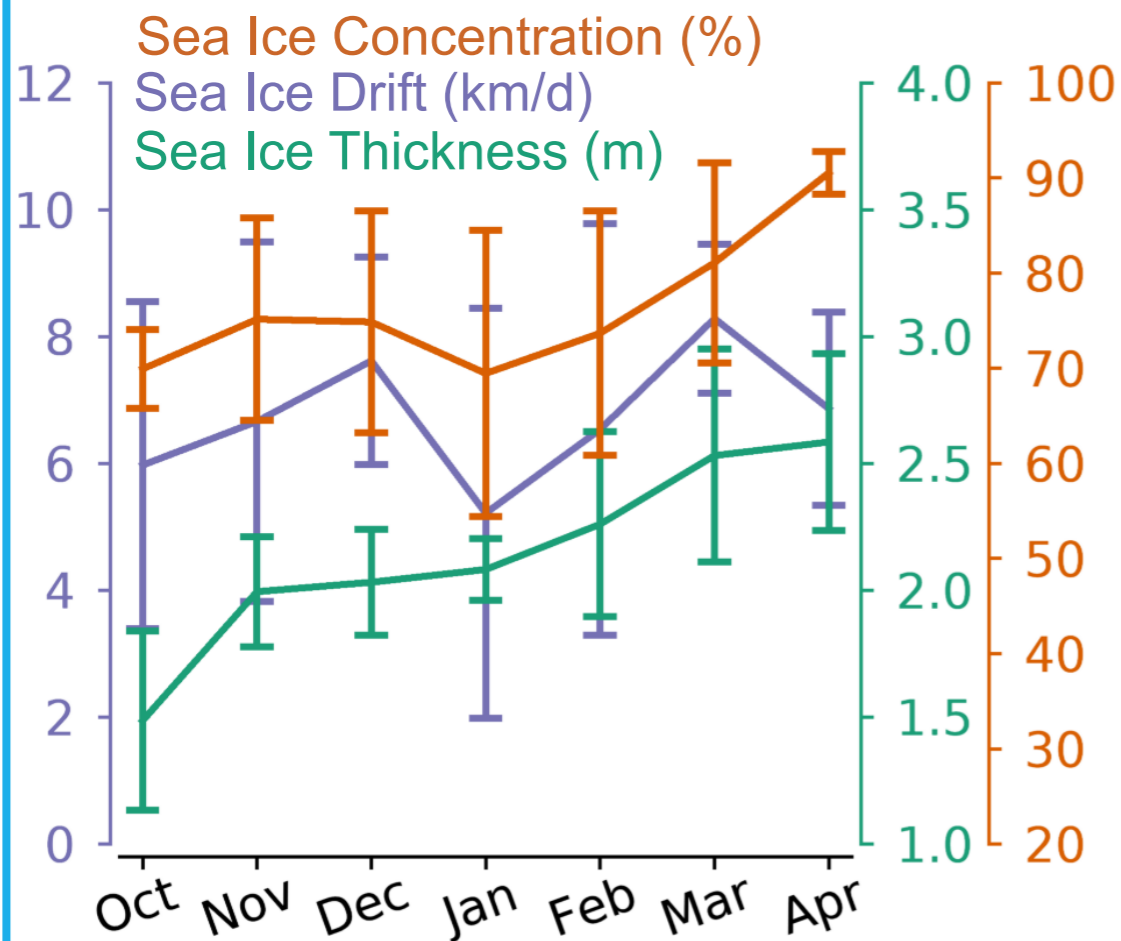
- Monthly sea-ice volume export through Fram Strait (October-April).



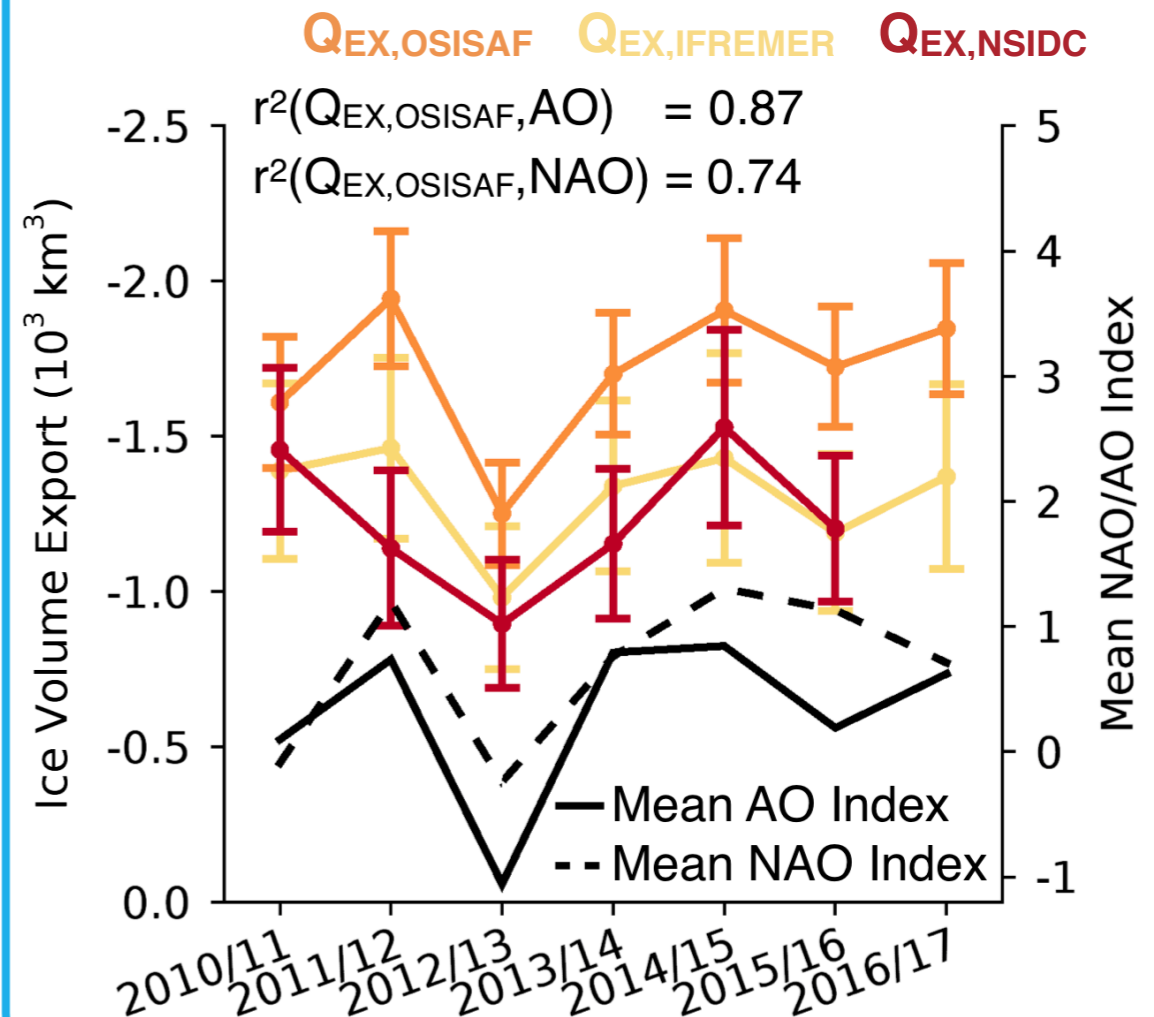
Seasonal and Interannual variations of ice volume export



- Ice drift is the main driver of seasonal and interannual variability of ice volume export.
- The seasonal trend of ice volume export is driven by ice thickness.



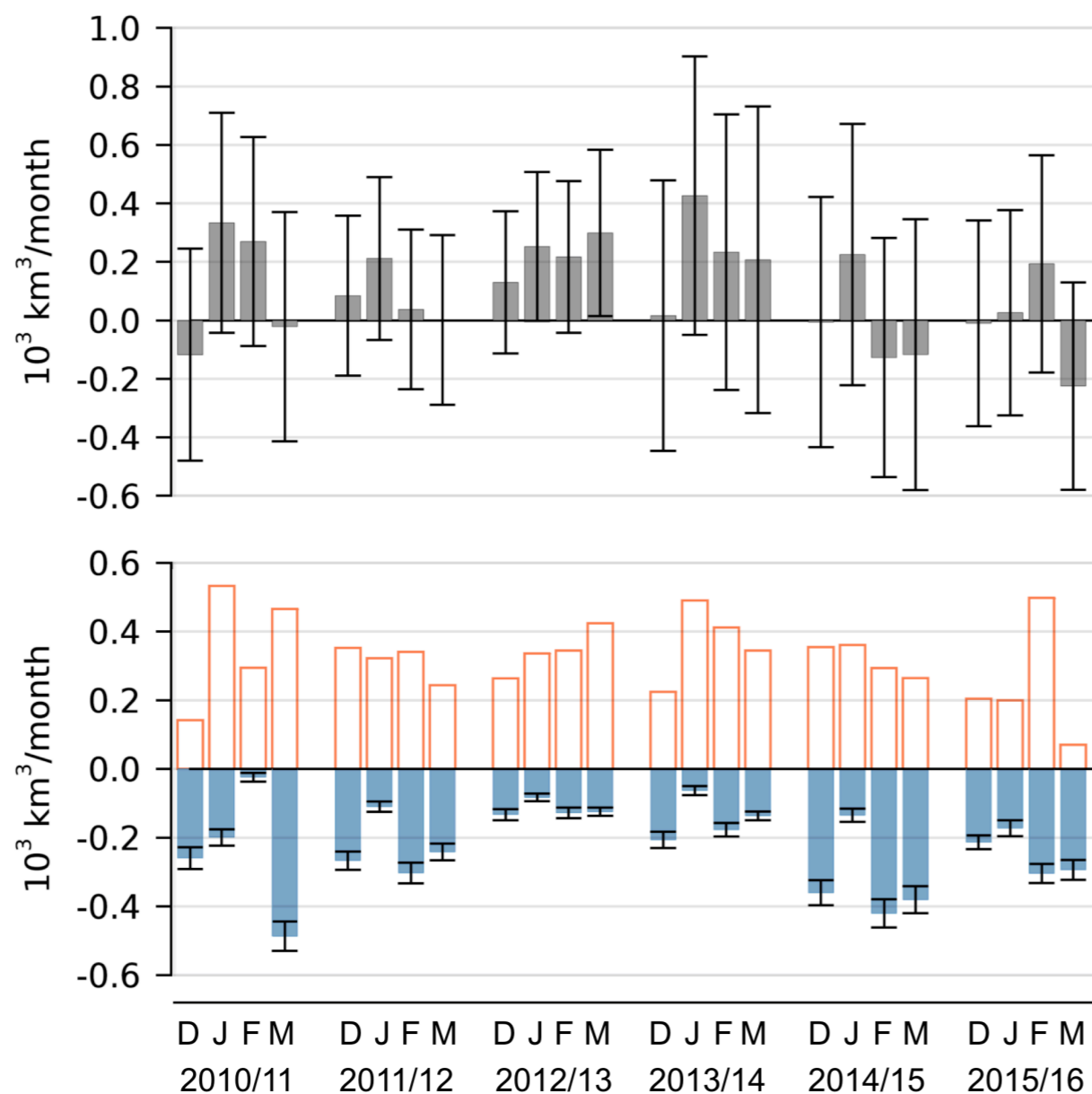
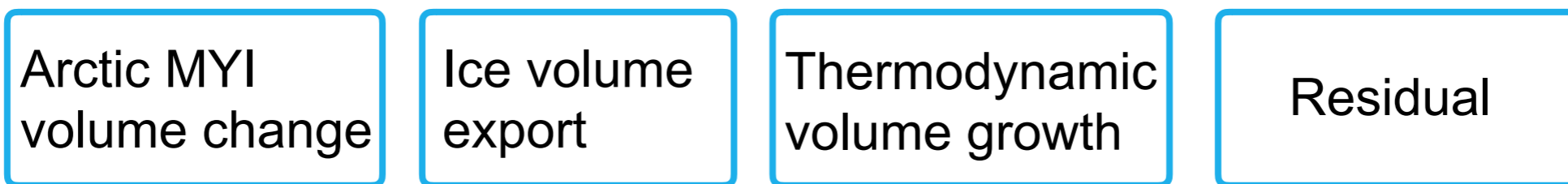
- **Seasonal** means of ice volume export are linked to Arctic Oscillation (AO) and North Atlantic Oscillation (NAO)



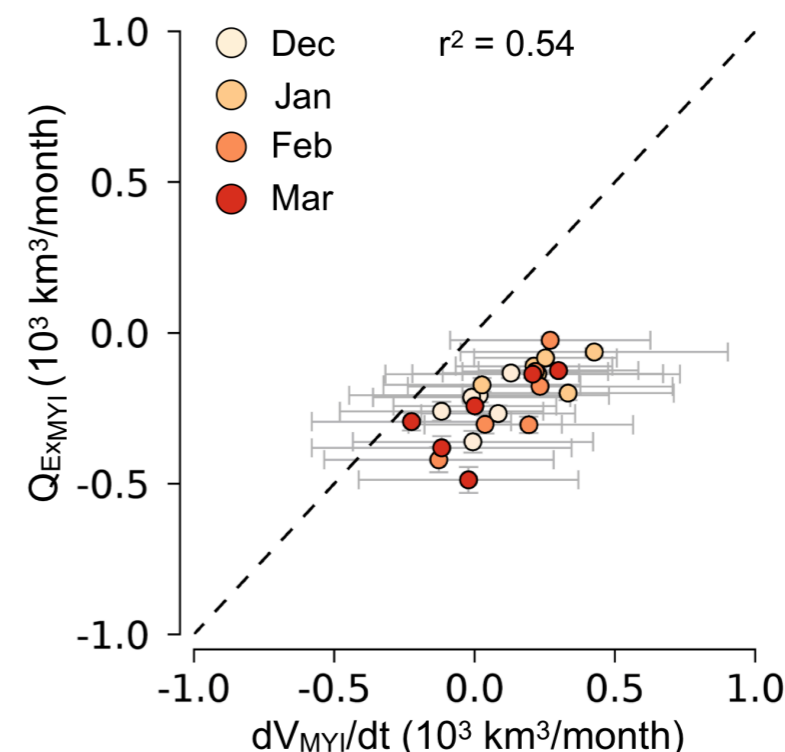
The impact of ice volume export on Arctic multiyear ice (MYI) mass balance



$$dV_{MYI}/dt = Q_{ExMYI} + (dV_{therm, MYI}/dt + dV_{resid, MYI}/dt)$$



dV_{MYI}/dt (observed)
 Q_{ExMYI} (observed)
 $dV_{MYI}/dt - Q_{ExMYI}$



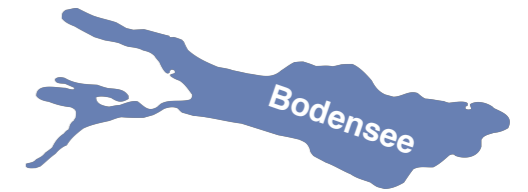
Summary & Conclusions

An aerial photograph of a vast desert landscape featuring numerous sand dunes. The dunes are illuminated by the warm, golden light of a low sun, creating a rhythmic pattern of light and shadow across the terrain. The colors range from deep blues in the shadows to bright oranges and yellows on the sunlit peaks.

Summary & Conclusions

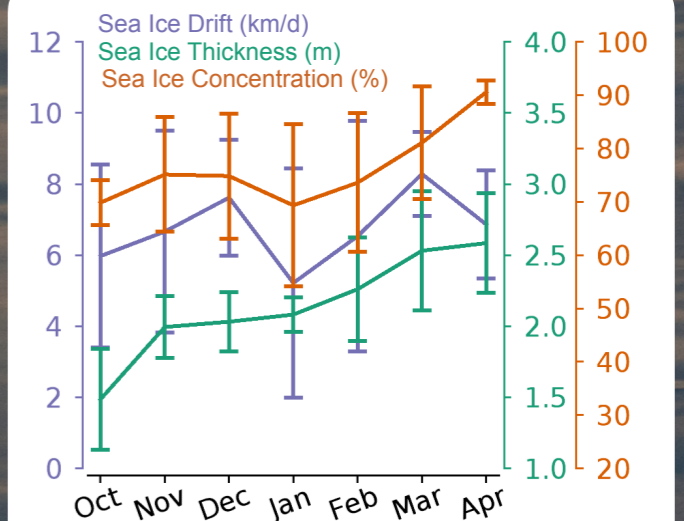
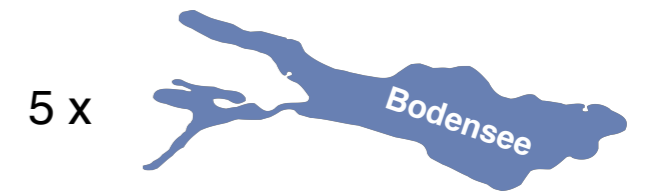
- Sea-ice volume export through Fram Strait shows a seasonal mean of $230 \text{ km}^3/\text{month}$.

5 x



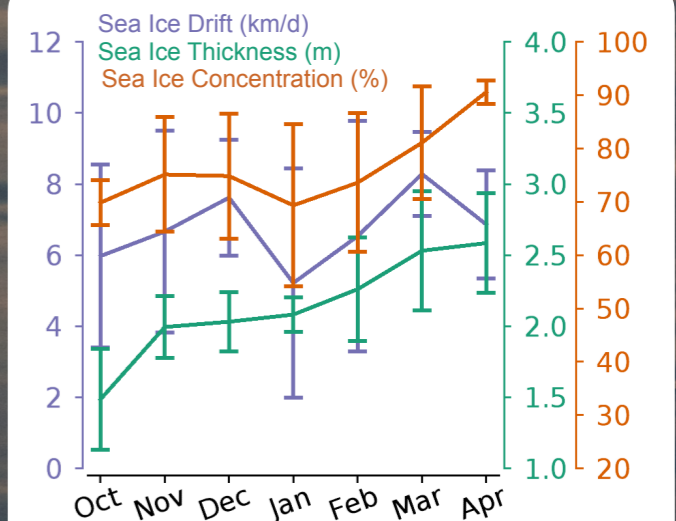
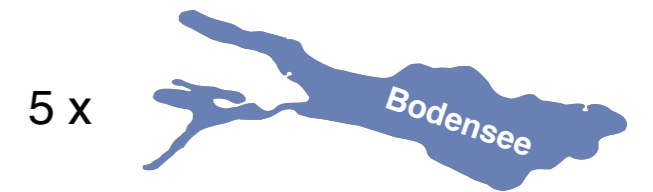
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- Interannual variations of ice volume export can be explained by large scale variability of the atmospheric circulation captured by the Arctic Oscillation and North Atlantic Oscillation indices.



Summary & Conclusions

- Sea-ice volume export through Fram Strait shows a seasonal mean of $230 \text{ km}^3/\text{month}$.
- Ice drift is the main driver of seasonal and interannual variability of ice volume export.
- Interannual variations of ice volume export can be explained by large scale variability of the atmospheric circulation captured by the Arctic Oscillation and North Atlantic Oscillation indices.
- 54 % of the variability of Arctic MYI volume over the December-March period can be explained by ice volume export through the Fram Strait.

