Arctic Pacific water dynamics from model intercomparison and observations

1. Introduction

- Pacific Water brings heat and fresh water from the Northern Pacific into the Arctic Ocean and can impact Arctic sea ice [1].
- Pathways and circulation of the Pacific Water in the Arctic Ocean are not fully known due to lack of observations [2].

2. Methods

- We analyse ocean models COCO, ECCO2, ICMMG, NAOSIM, NEMO-1°, 1/4° and 1/12° and OCCAM from the Forum for Arctic Ocean Modeling and Observational Synthesis (FAMOS) [2].
- We release Pacific tracer in Bering Strait in 1989-2007 (Fig. 1).
- We investigate changes in Pacific Water due to changes in wind, oceanic potential vorticity and Montgomery potential [3,4].

3. Results

- In the Beaufort Gyre wind stress curl is anti-cyclonic during the negative or neutral Arctic Oscillation (AO-) periods (1997-2007) vs. the cyclonic positive AO+ periods (1989-1996). The Ekman downwelling is stronger (Fig. 2), resulting in freshwater accumulation in the gyre during the negative / neutral AO- (Fig. 3).
- Stronger Ekman downwelling deepens the Pacific Water in the gyre, increases lateral density gradients and baroclinic response.
- This leads to a stronger vertical shear in the relative vorticity, thinning of the halocline and Pacific Water divergence (Fig. 4).
- Stronger Ekman downwelling in the Beaufort Gyre during the AO- results in Pacific water being pushed out of the centre of the gyre towards the Siberian shelves (Fig. 7).

4. Discussion and Summary

- We analyse Pacific Water tracer releases in the models from the Forum for Arctic Ocean Modeling project (FAMOS).
- Schematic for the Pacific water accumulation and release in the Beaufort Gyre is proposed as follows (Fig. 8).
- Changes in winds from the cyclonic AO+ to anti-cyclonic AO- periods increase Ekman downwelling in the gyre and pushes down halocline and Pacific Water.
- A stronger density gradient creates divergence of the Pacific Water towards the Beaufort Gyre periphery.
- Anti-cyclonic winds reduce Pacific Water content in the gyre.

References