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Implementation and validation of a current model system in the greatest sound in the North East Atlantic archipelago of the Faroe Islands

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The location of the Faroe Islands on the Greenland-Scotland ridge puts the oceanography on the boundary of deep water and shelf and fjord dynamics. This placement in close proximity of the deep ocean currents, important for heat transport towards the Arctic, makes the Faroe Islands higly exposed to climate change. Therefore it is important to understand the interaction of deep water oceanography and fjord dynamics in general, to be able to predict potential impact, due to changes in ocean parameters.

The Faroe Islands consist of 18 islands. The topographic characteristics are typical for an ice sheet shaped land surface with long and slim islands, steep mountain sides divided by narrow and relatively deep fjords. This highly complex topography is greatly influenced by wind conditions.
Sundalagið separates the two largest islands: Streymoy and Eysturoy and has three fjordarms and two main basins. The northern part (SUN) is 15km long and 100m-1.6km wide. The sound is bound to the north by a 9m deep sill. Towards the south by a narrowing of a 100 meter wide and around four meter deep sill, depending on tidal conditions.
The southern part (SUS) is not as clearly constricted but contains three major basins with depths ranging from 70-100m (Hansen et al., 1990).

We have implemented a nested model system using high resolution bathymetry in the fjords and the entire shelf as well as the open-source hydrodynamical model ROMS (Regional Ocean Modeling System, http://myroms.org). The Faroe Islands model applications are using triply, one way nested grids with 800 $\rightarrow$ 160 $\rightarrow$ 32 meter resolutions in the horizontal. This gives us the opportunity to both simulate the deep water oceanography applying 800m resolution as well as the dynamics in the shallow regions using finer resolution models.

A particular interest in the area is the influence of the tidal regime. In SUN the tidal dynamics are quite limited due to the location of an amphidromeice point in the Nolsoy fjord (M2=10.4cm (www.dmi.dk)) whereas SUN is heavily dominated by tidal dynamics (M2=63.1cm). The general observation is a more pronounced stratification in SUN and higher vertical mixing in the water column in SUS (2016 CTD mesurements).

Our ROMS simulations are run for the year 2013 (only part of the year for the 32m resolution) and forced with high-resolution atmospheric conditions (WRF-1km), large-scale ocean fields (ROMS 4km) of currents, hydrography and sea level (Lien et al., 2014), global tides (TPXO7.2) and climatological freshwater discharges including the main rivers. In this study we validate the model simulations using in-situ data coverage (ACDP) in the local area.

A well-functioning dynamical model system is highly important for the Faroe Islands where aquaculture is by far the greatest industry. Linking this to a particle tracking module will further increase the understanding of climate impact in the Faroes in particular with regards to the changes for the biological cycle and mitigation of sea lice (a challenging parasite for the aquaculture) by temperature changes.