

Does freshwater content of the East Greenland Current show imprints of increasing meltwater runoff?

Ilana Schiller-Weiss¹, Torge Martin¹, Johannes Karstensen¹, Arne Biastoch^{1,2}

¹ GEOMAR Helmholtz Center for Ocean Research Kiel

² Christian-Albrechts-Universität Kiel, Kiel, Germany

Freshwater Content and Methods

- East Greenland Current (EGC) system is a major conduit of freshwater from Arctic Ocean and Greenland Ice Sheet
- $$FWC = \iiint \frac{S_{ref} - S(t, z, y, x)}{S_{ref}} dz dy dx$$
- Reference salinity: $S_{ref} = 34.8$ psu
- We use output from a nested, eddy-rich ocean model and observational-assimilated reanalysis data:
- VIKING20X – 1/20° resolution, JRA55-do atmospheric forcing incl. inter-annually varying runoff¹
- GLORYS12V1 - 1/12° resolution, ERA-interim forcing, Greenland meltwater as a linear trend

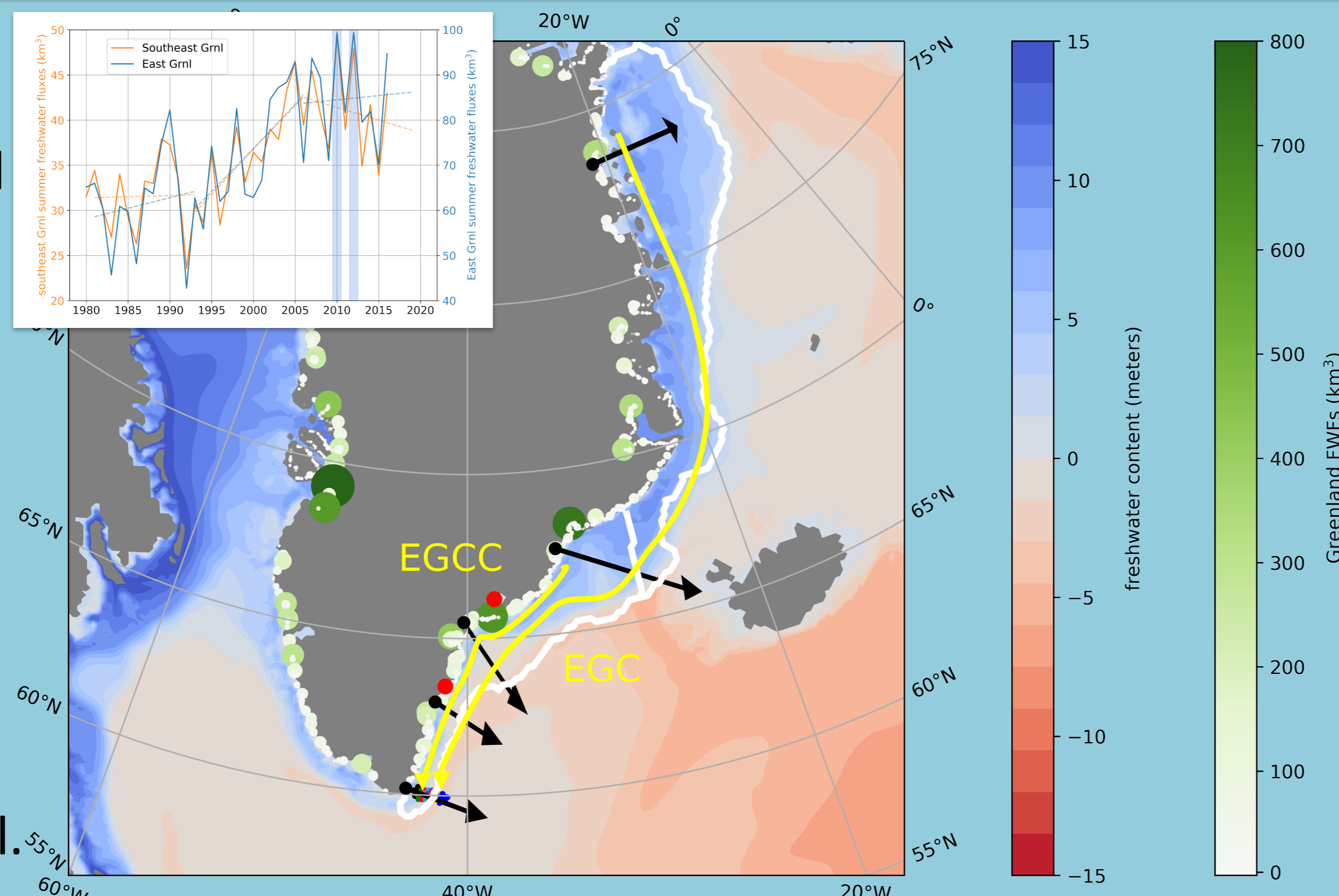


Figure 1: Map of mean FWC around Greenland, black vectors show cross sections. Time series of annual summer Greenland freshwater fluxes¹ along East and southeast Greenland

Meltwater Runoff Extremes Detectable in EGC

- Cross sections taken along East Greenland south (downstream) of major fjord and glacier outlets and/or at mooring arrays
- Two freshwater extremes in 2010 and 2012 attributed to anomalous summer ice sheet melting observable in coastal (on shelf) cross-sections
- FWC trends differ near the shelf between VIKING20X and GLORYS12

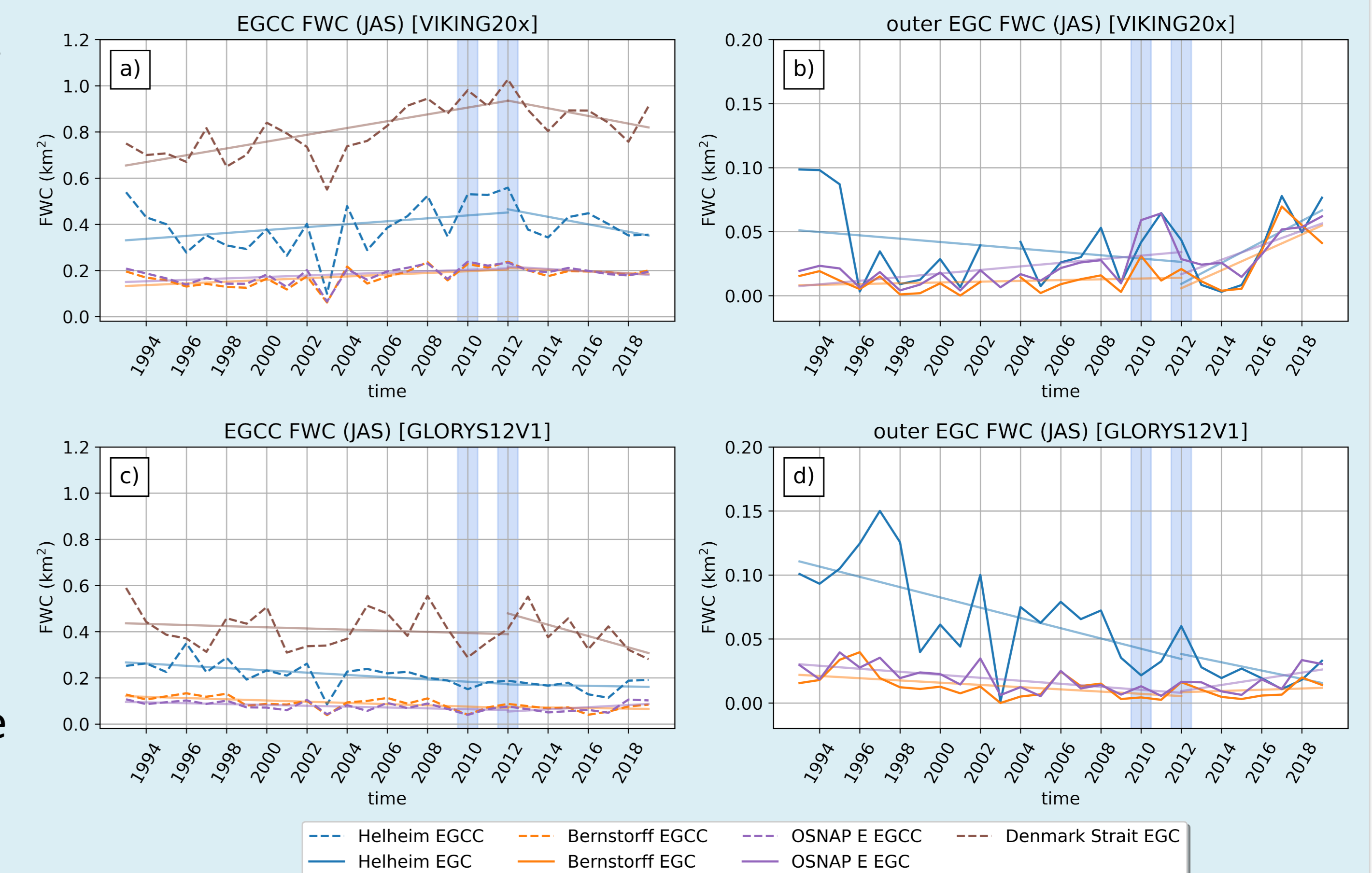


Figure 2: a, b) Annual summer freshwater content along the cross sections for the EGCC and EGC for VIKING20X. c, d) Same for GLORYS12

Sea Ice Melt Seasonality

- Sea ice melt persists during winter south of 66° N
- Timing of melt from Fram Strait to Denmark Strait coincides with runoff

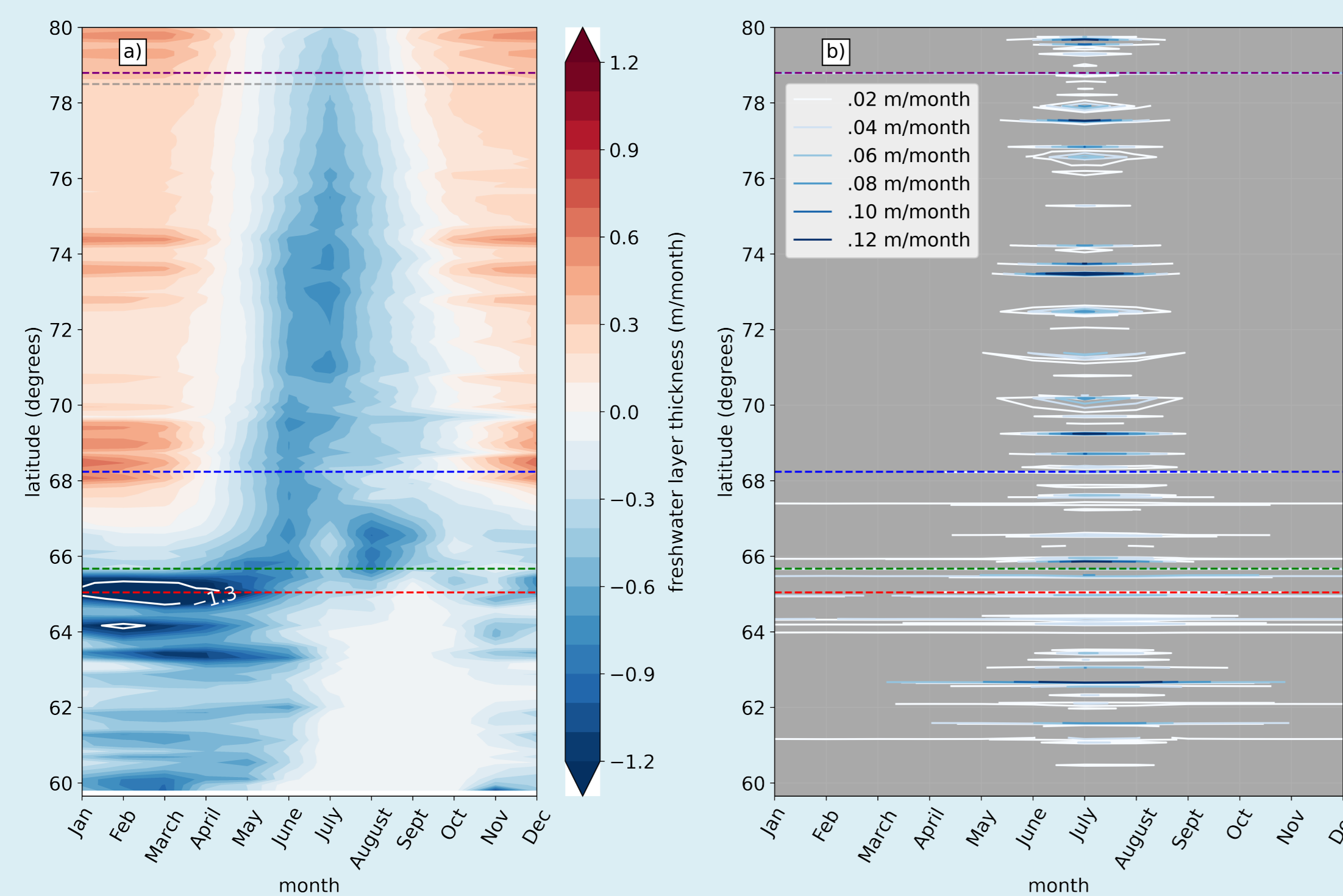


Figure 3: a) Hovmoeller of sea ice production climatology b) Greenland runoff climatology

Causes of EGC freshening

- Seasonal timing: Greenland runoff occurs primarily in summer, sea ice melt and alongshore winds accelerate in winter
- Reduced onshore Ekman transport results in a relaxation of the shelf current, further freshening the boundary

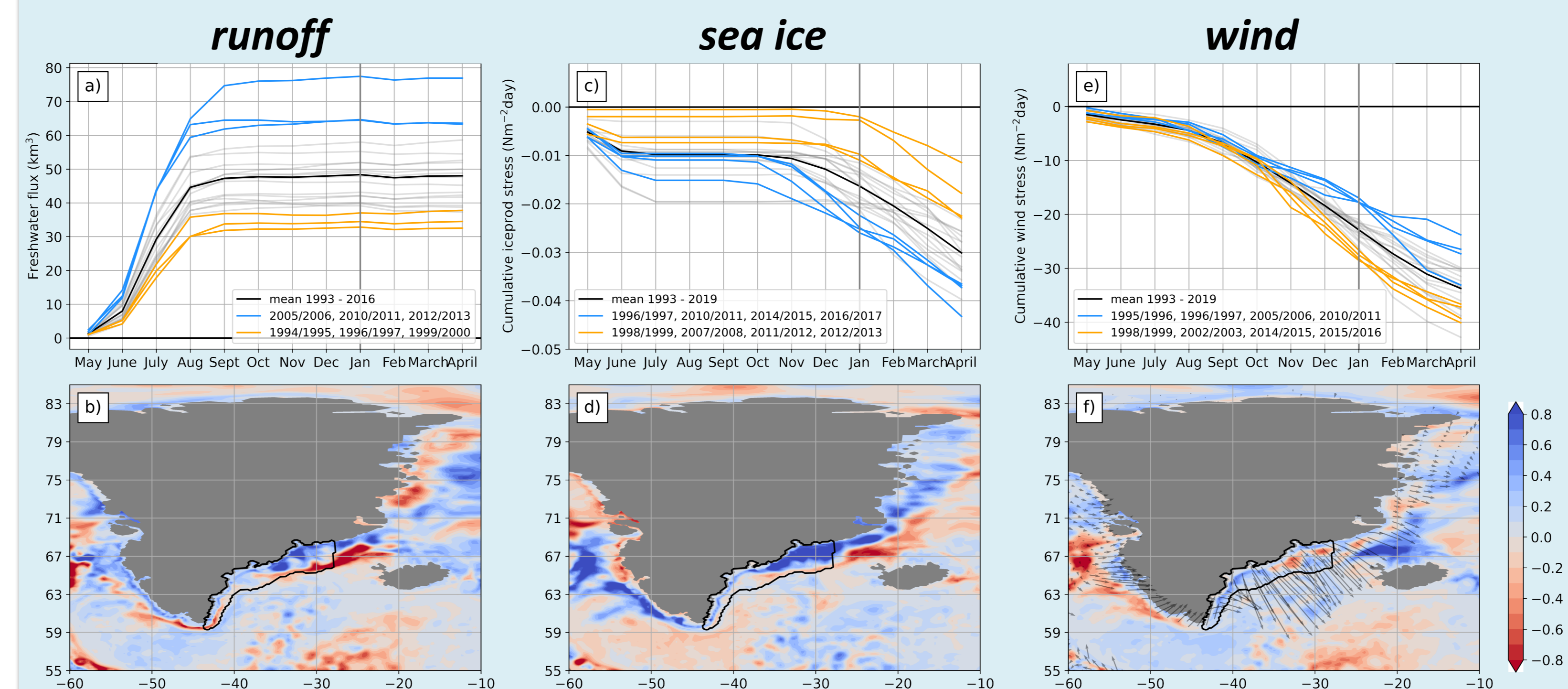


Figure 4: a, c, e) Cumulative sum of Greenland FWFs, sea ice production, alongshore wind stress. b, d, f) January FWC composite anomalies

Summary and Outlook

- Overlapping seasonal timing of sea ice melt north of 65° N and runoff potentially masks imprints of the latter
- Reduced wintertime alongshore winds result in weaker onshore Ekman transport causing salinity anomalies of comparable magnitude as runoff
- Low salinity waters near the shelf are well represented in VIKING20X suggesting improved boundary conditions and near-shelf observations to improve model simulations of Greenland meltwater impacts

Further questions:

1. Is there an impact in the subpolar North Atlantic due to Greenland freshwater increases?
2. How do wind patterns shape the imprint of meltwater in years with extreme runoff?