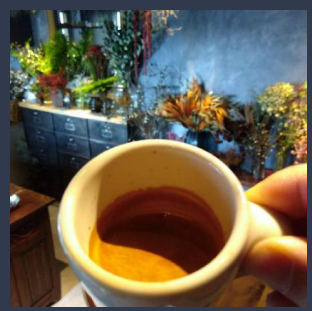




github.com/Eisbrenner
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linkedin.com/in/ezra-eisbrenner



Lagrangian properties of on-shelf satellite-geostrophy* between the North Atlantic and the North Sea

(*) satellite-geostrophy $\Rightarrow$ satellite-derived geostrophic velocity fields

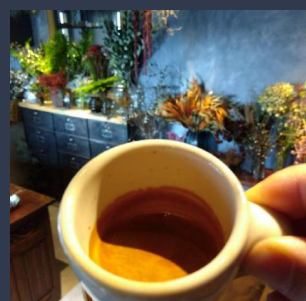
Ezra Eisbrenner^{1,2}, Léon Chafik^{1,2}, Kristofer Döös^{1,2}

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introduction

Between the North Atlantic and the North Sea

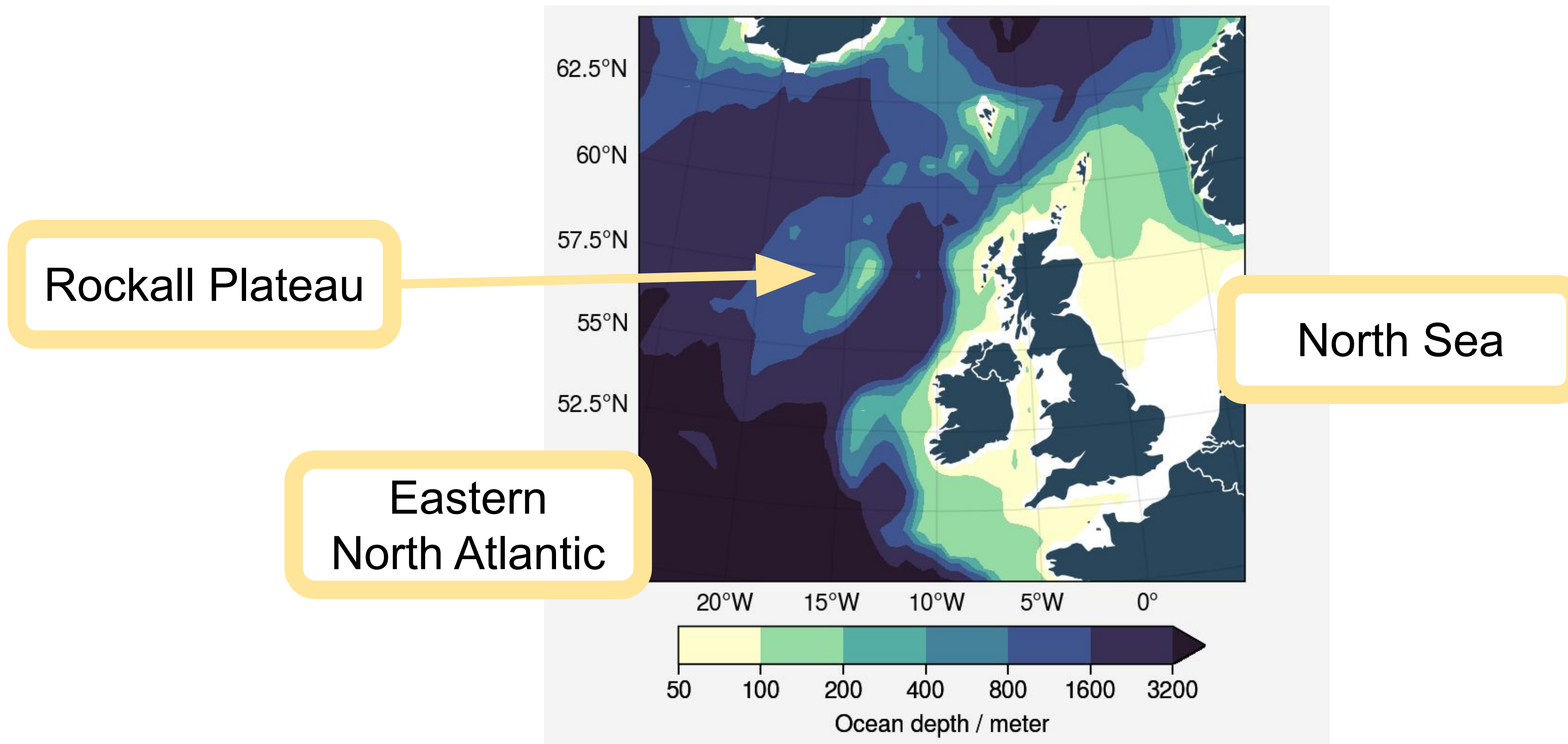
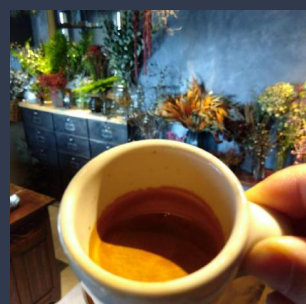
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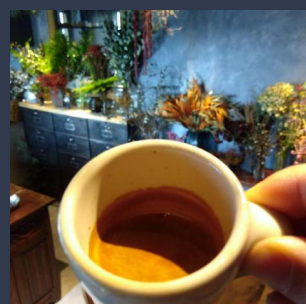
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Bathymetry around the British Isles

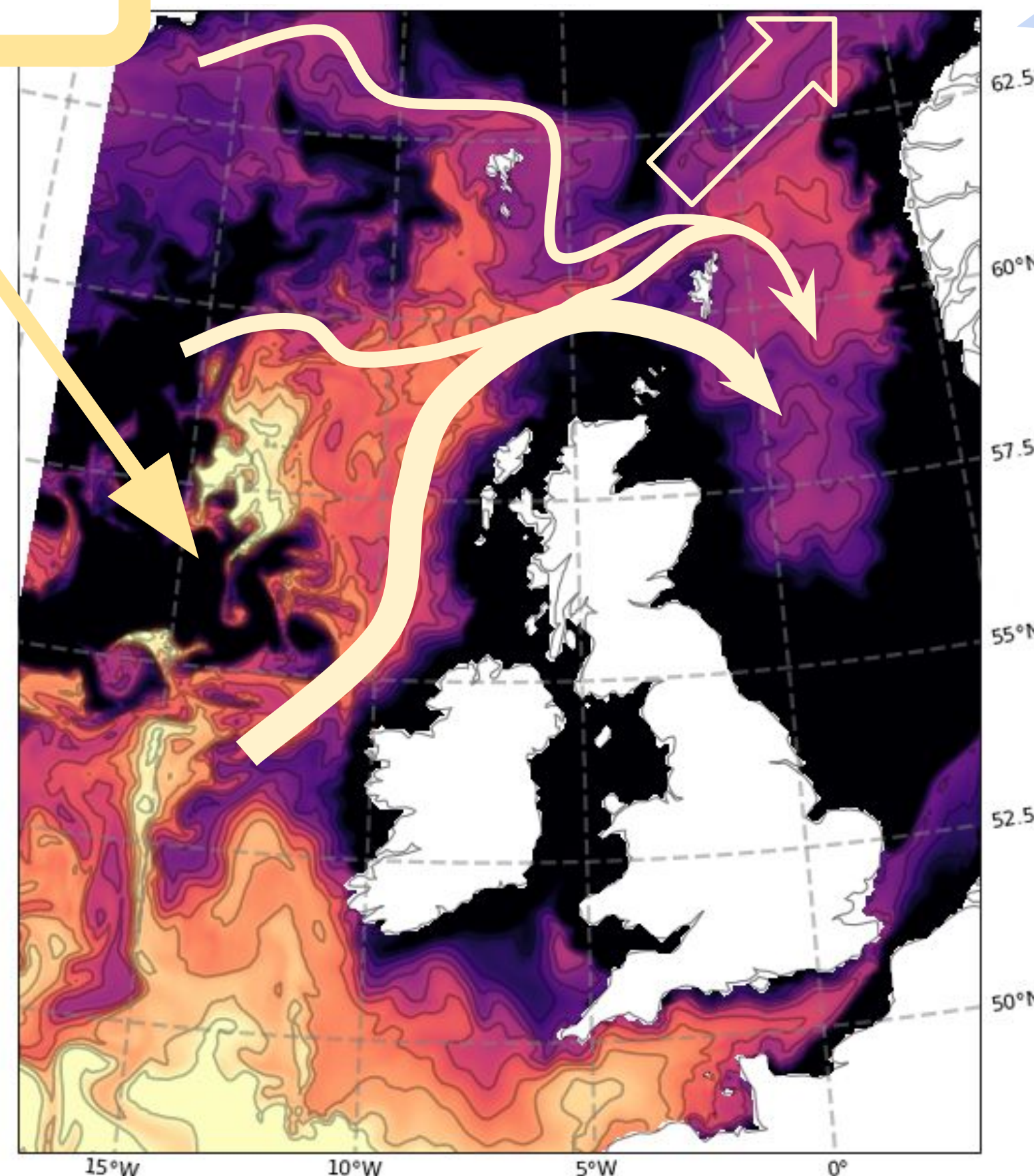
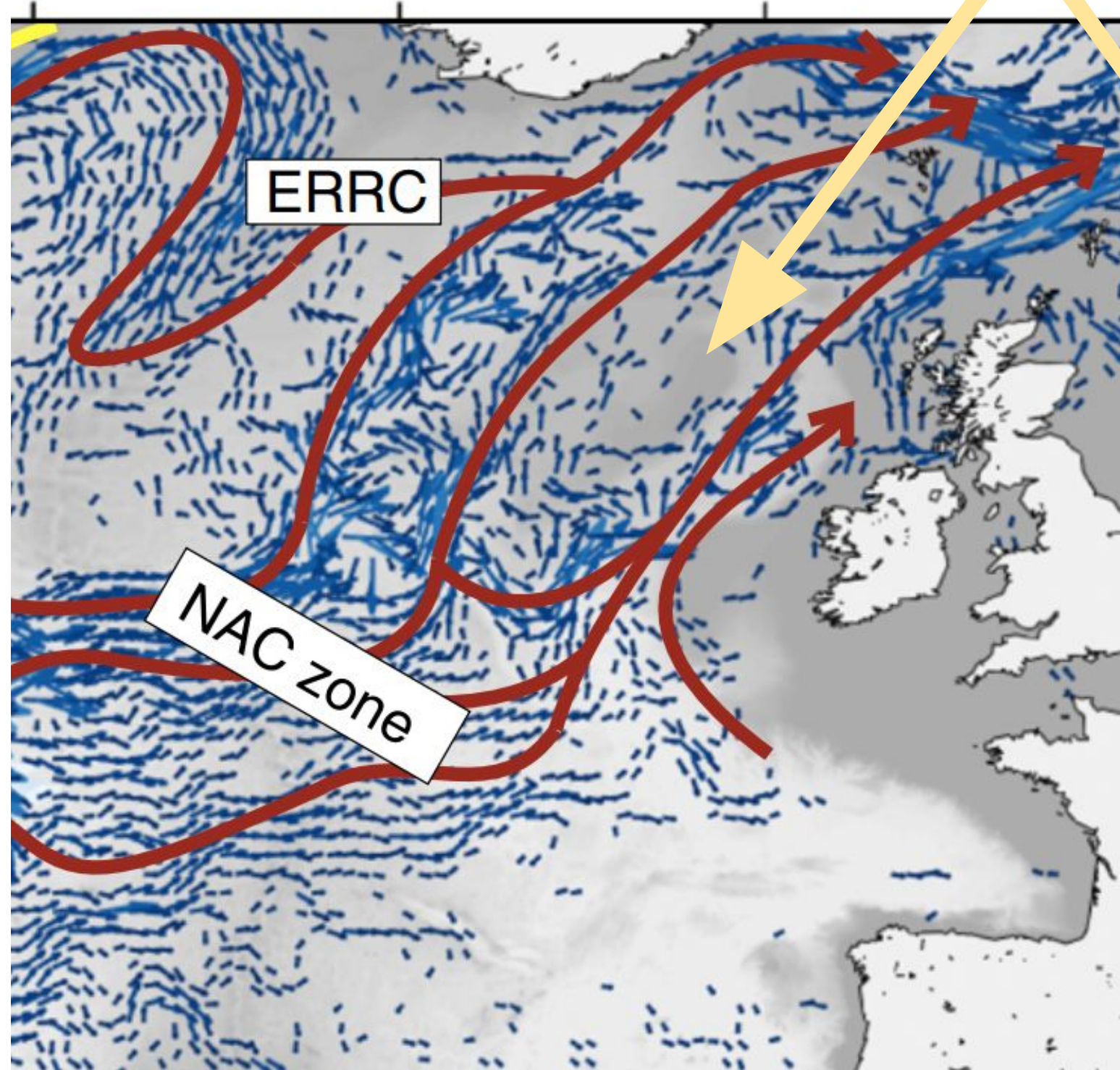
Bathymetry data by:
GEBCO Compilation Group (2020) GEBCO 2020 Grid
doi:10.5285/a29c5465-b138-234d-e053-6c86abc040b9



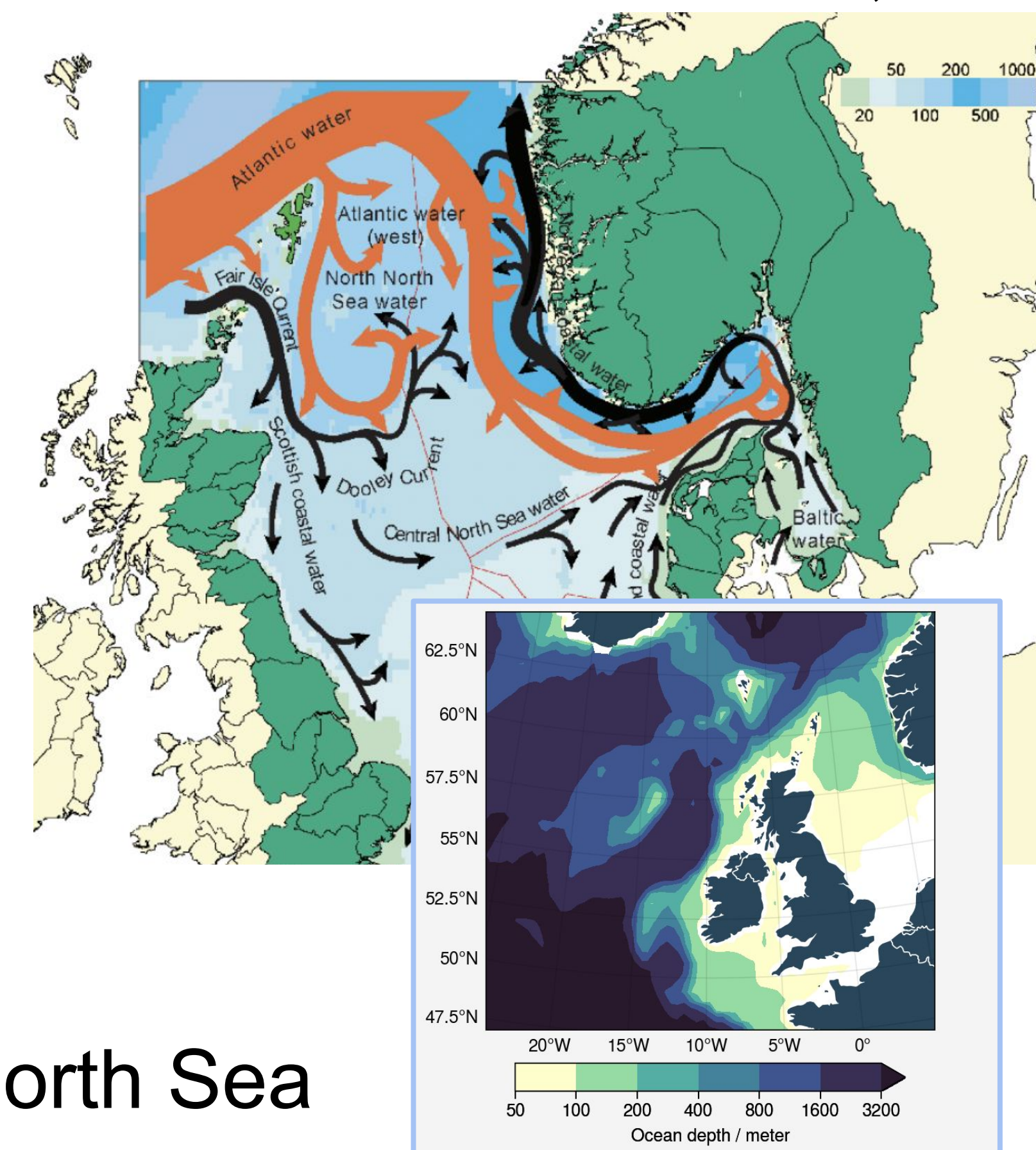
Rockall Plateau

Snapshot of surface salinity (using <https://doi.org/10.48670/moi-00052>)

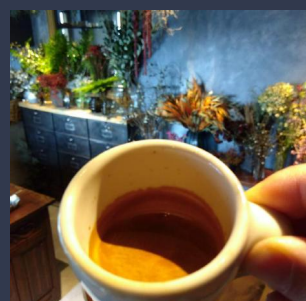
Holliday et al., 2020



Thomas et al., 2010



Current systems outside and into the North Sea



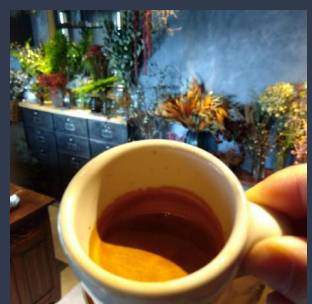
github.com/Eisbrenner
twitter.com/EzraEisbrenner
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method

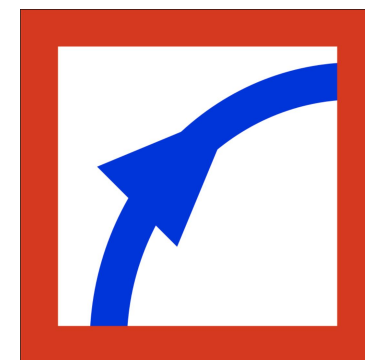
Lagrangian Trajectories





Lagrangian tracking

- code: **tracmass.org**

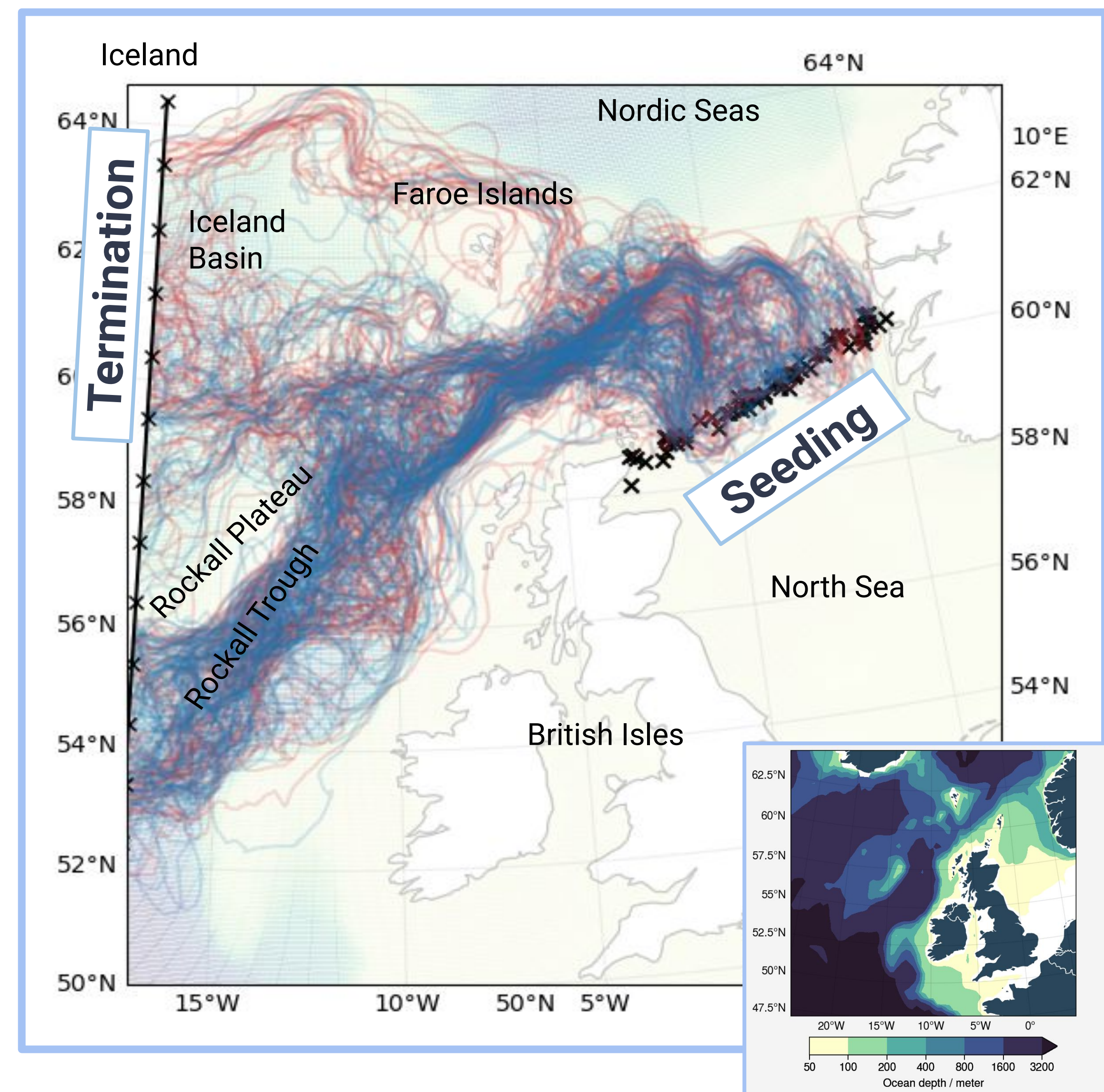


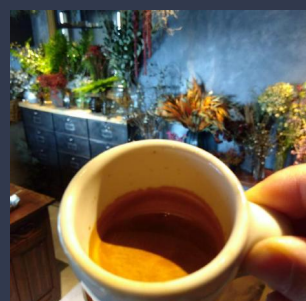
Parcels are

- continuously seeded [1994–2019]
- backtracked in time
- assigned an area transport [m^2 / s]

Trajectories are

- calculated using satellite-derived geostrophic velocity fields





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linkedin.com/in/ezra-eisbrenner



data

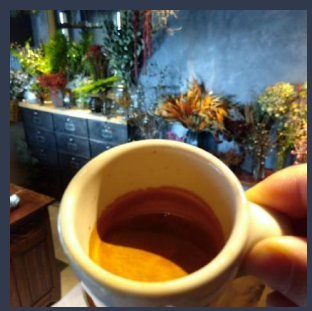
Satellite-Derived Geostrophic Velocity Fields

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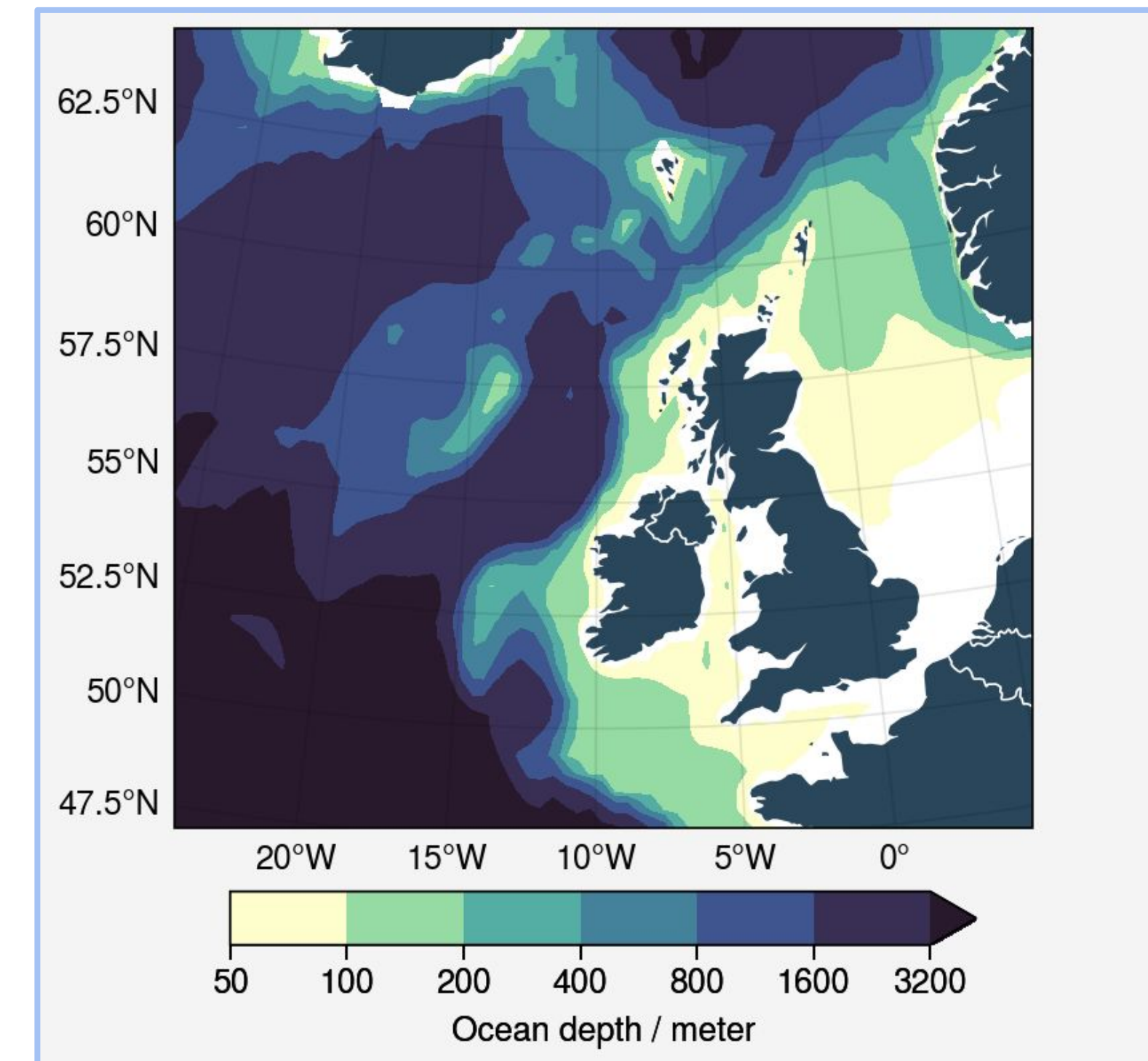


- We use satellite-derived geostrophic velocity field data
 - from January 1993 to December 2019

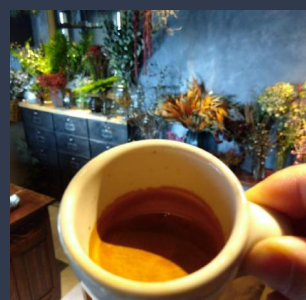
Geostrophic truncation

$$\rho \frac{D\mathbf{v}}{Dt} + \rho f \hat{\mathbf{e}} \times \mathbf{v} = -\rho \mathbf{g} - \nabla p + \mu \Delta \mathbf{v}$$

- Is geostrophy a **good approximation** for trajectories **in the shelf seas**?
 - **Probably not**
- Which limits the interpretability
 - but it still is an **interesting tracer for ocean dynamics**



Global ocean gridded L4 sea surface heights and derived variables reprocessed, SEALEVEL_GLO_PHY_L4_MY_008_047: <https://doi.org/10.48670/moi-00148>



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results

Principal Component Analysis of 1-Year-Origin Positions

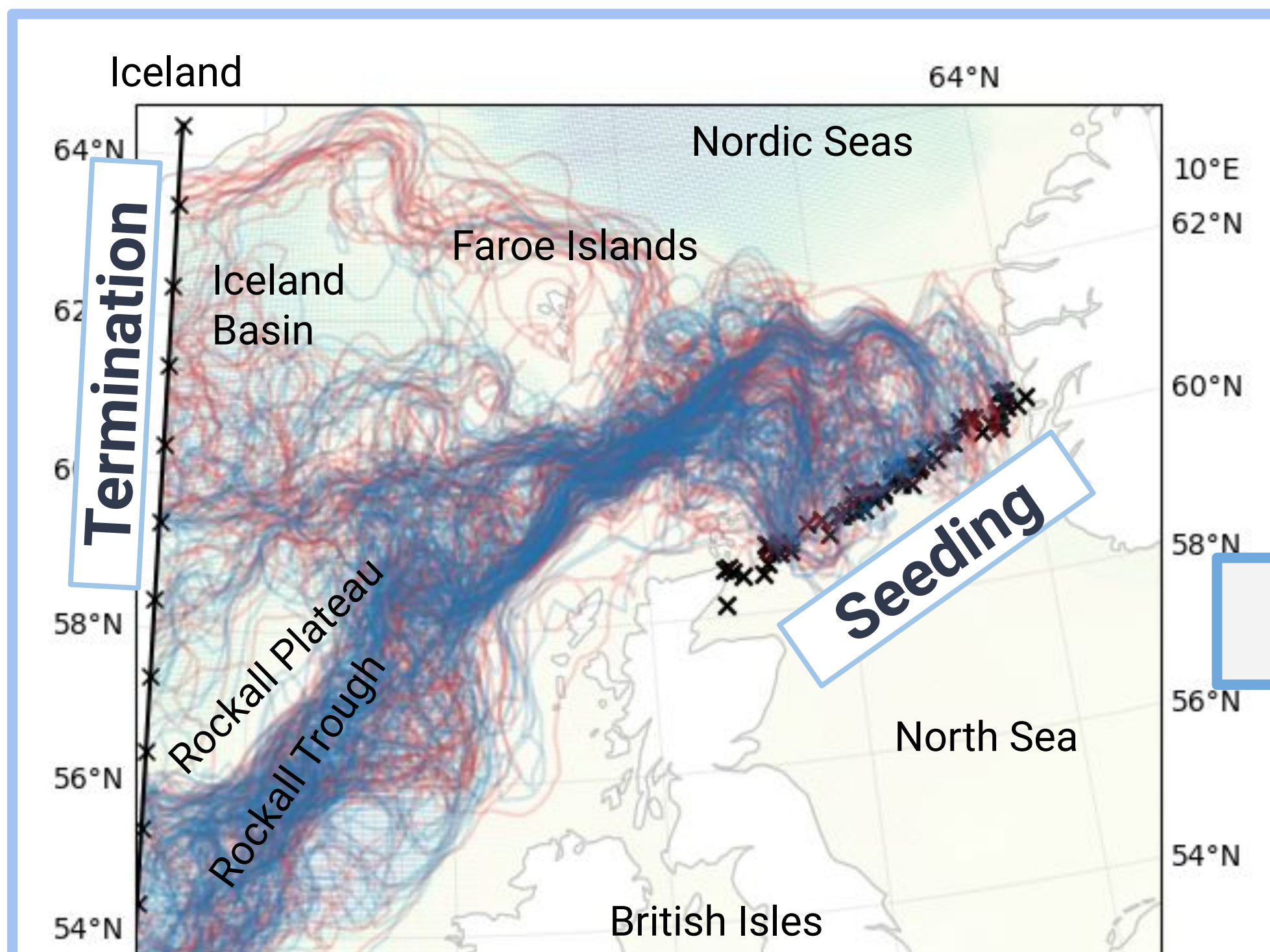
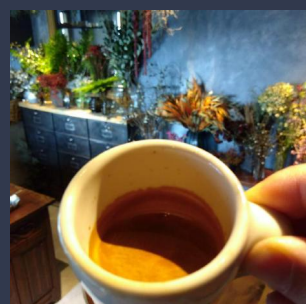
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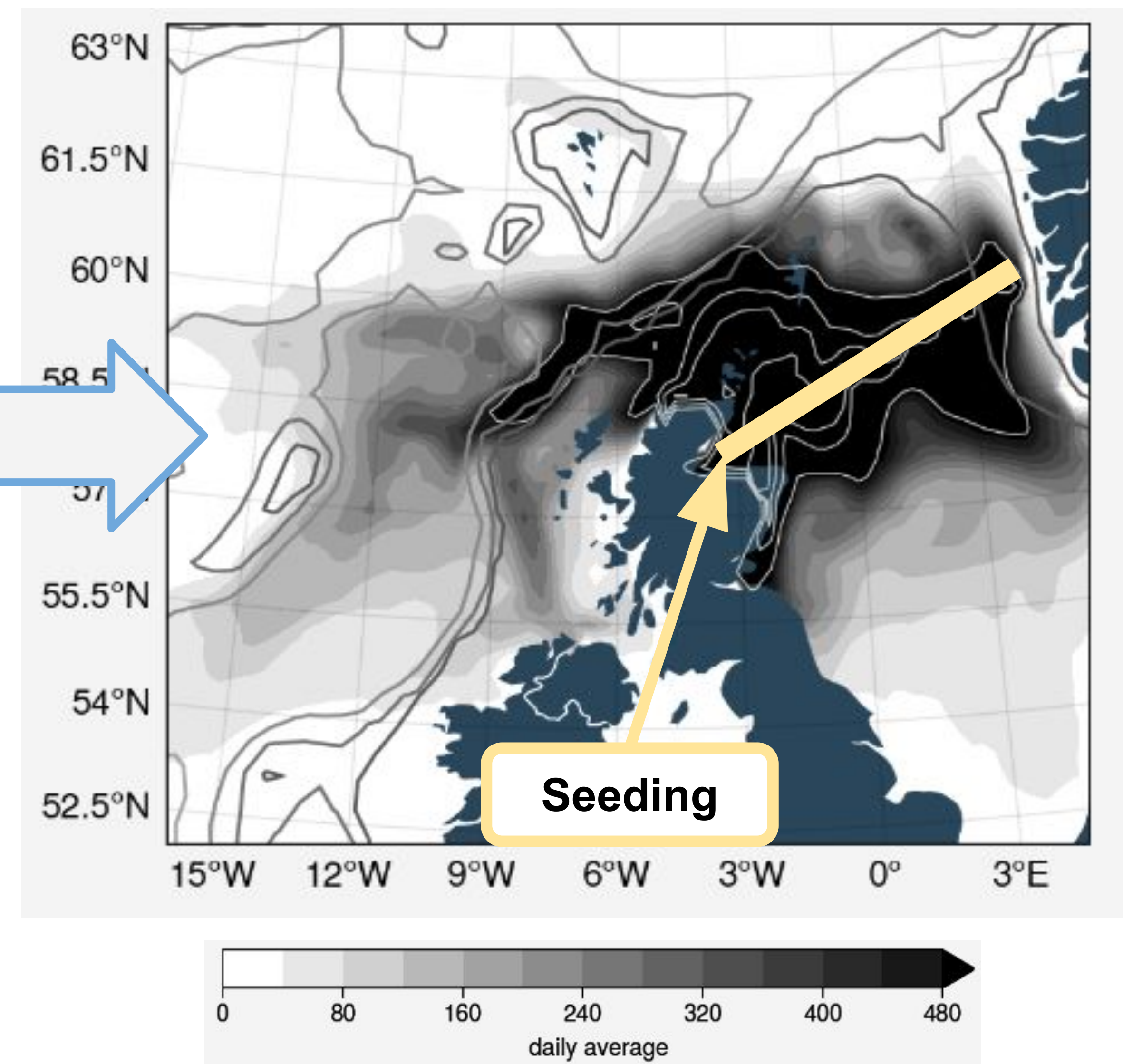
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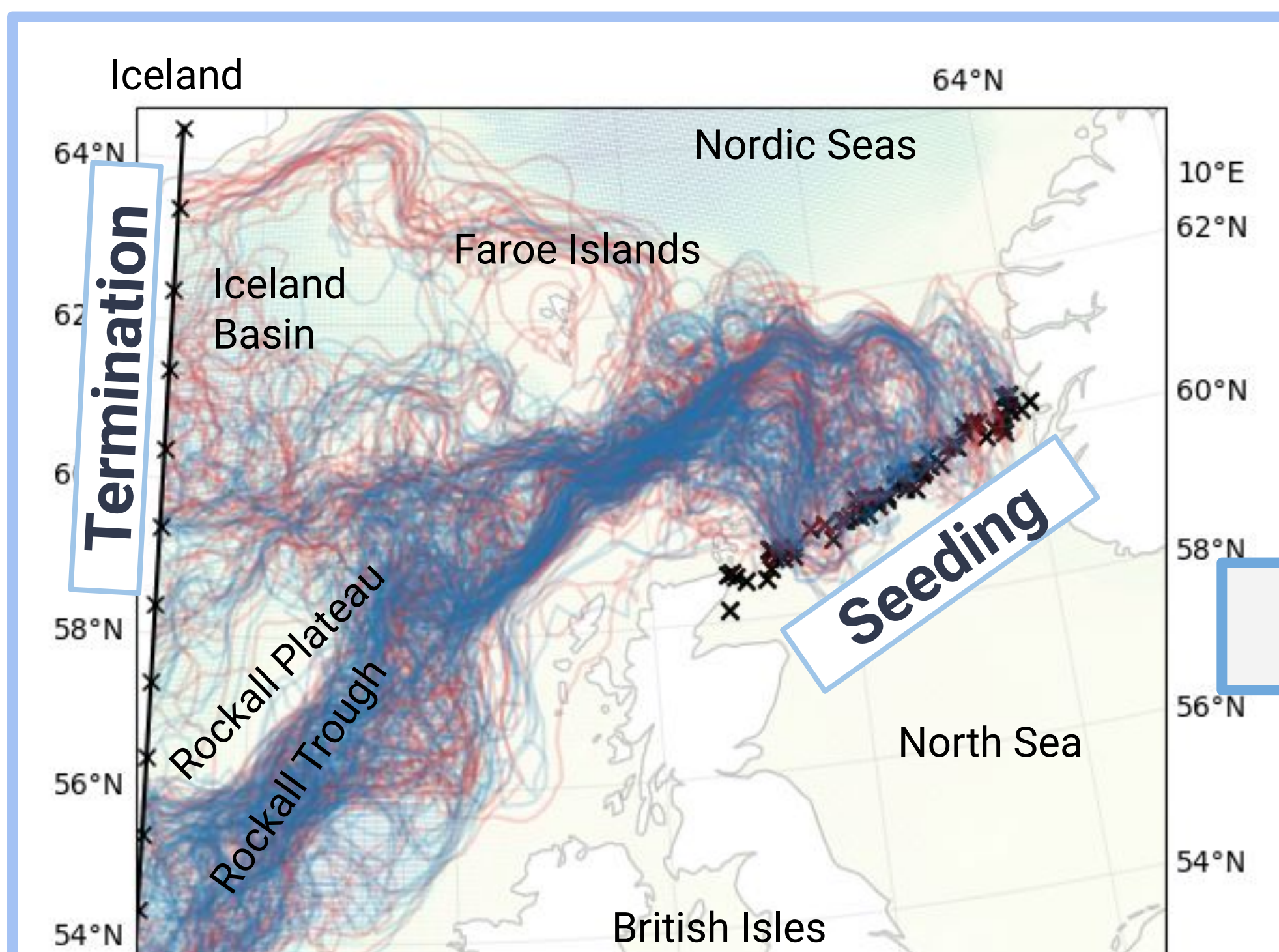
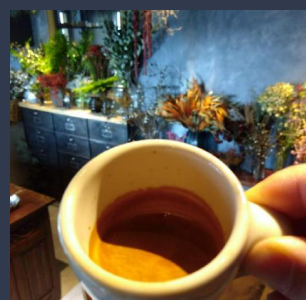
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Time-mean of binned unique trajectory positions.

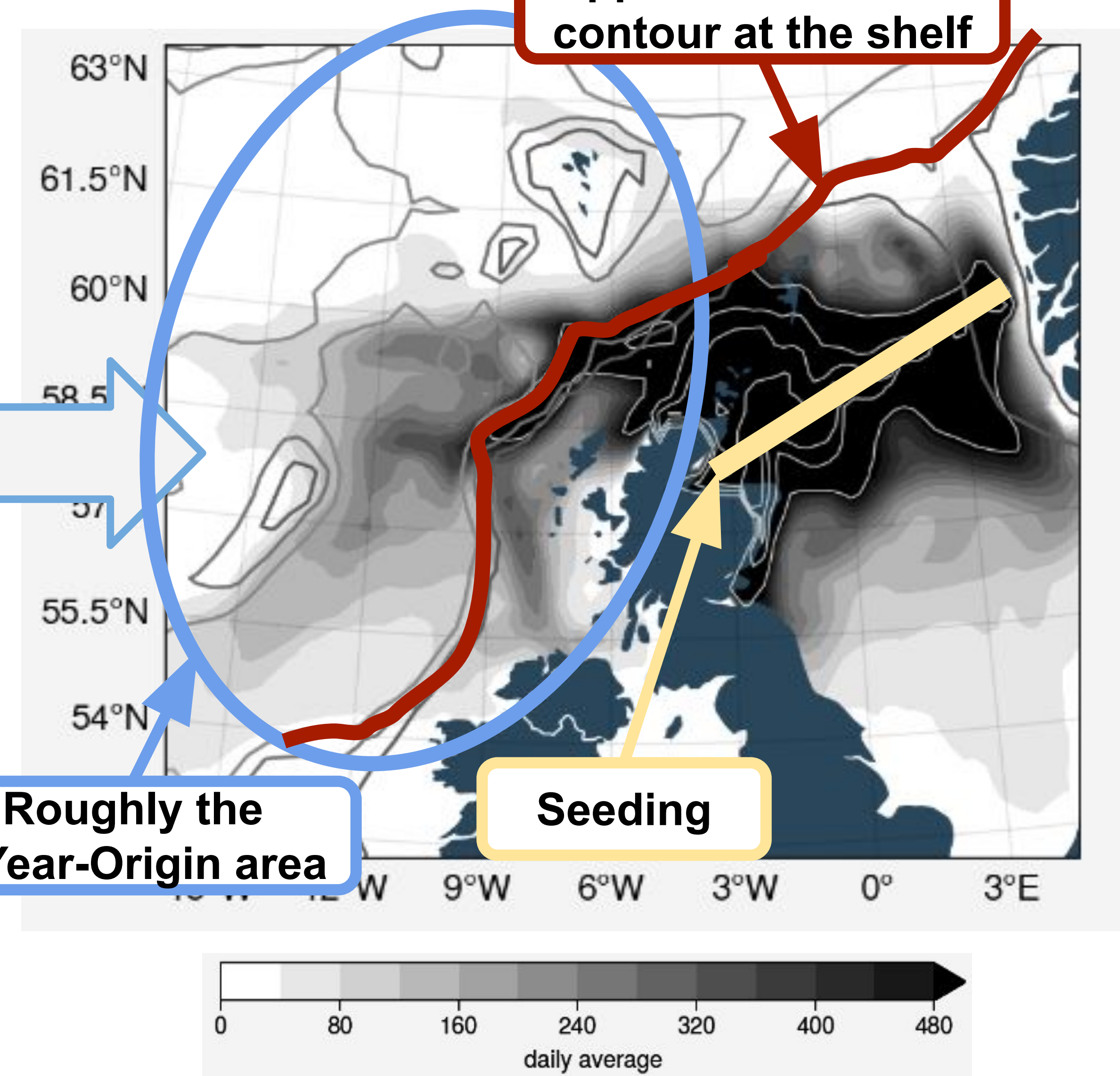
Weighted by each trajectory's area-transport at release.

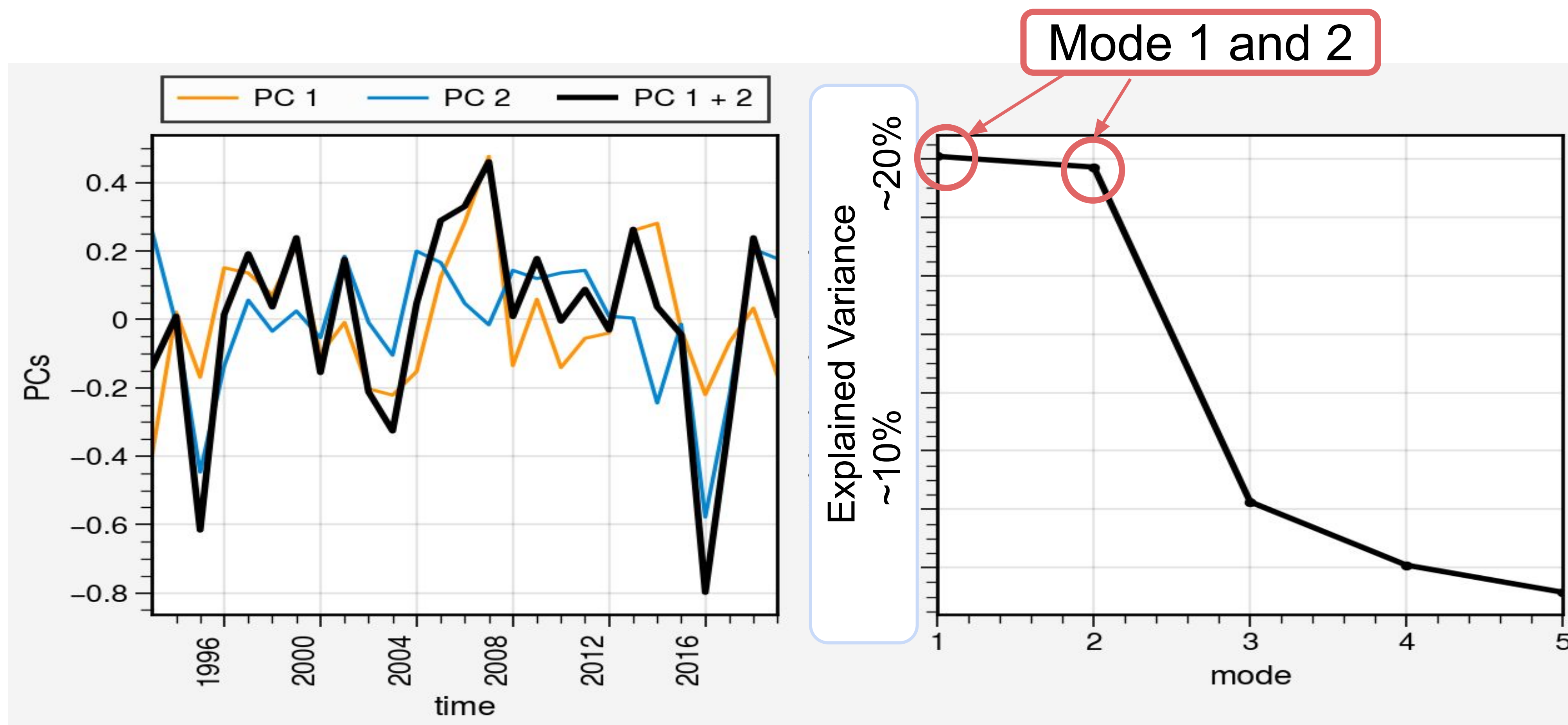
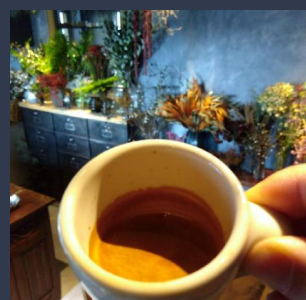




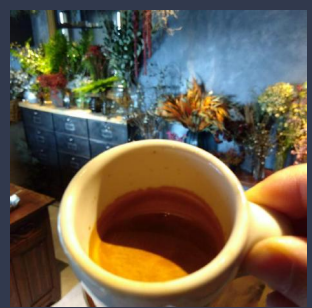
Time-mean of binned unique trajectory positions.

Weighted by each trajectory's area-transport at release.

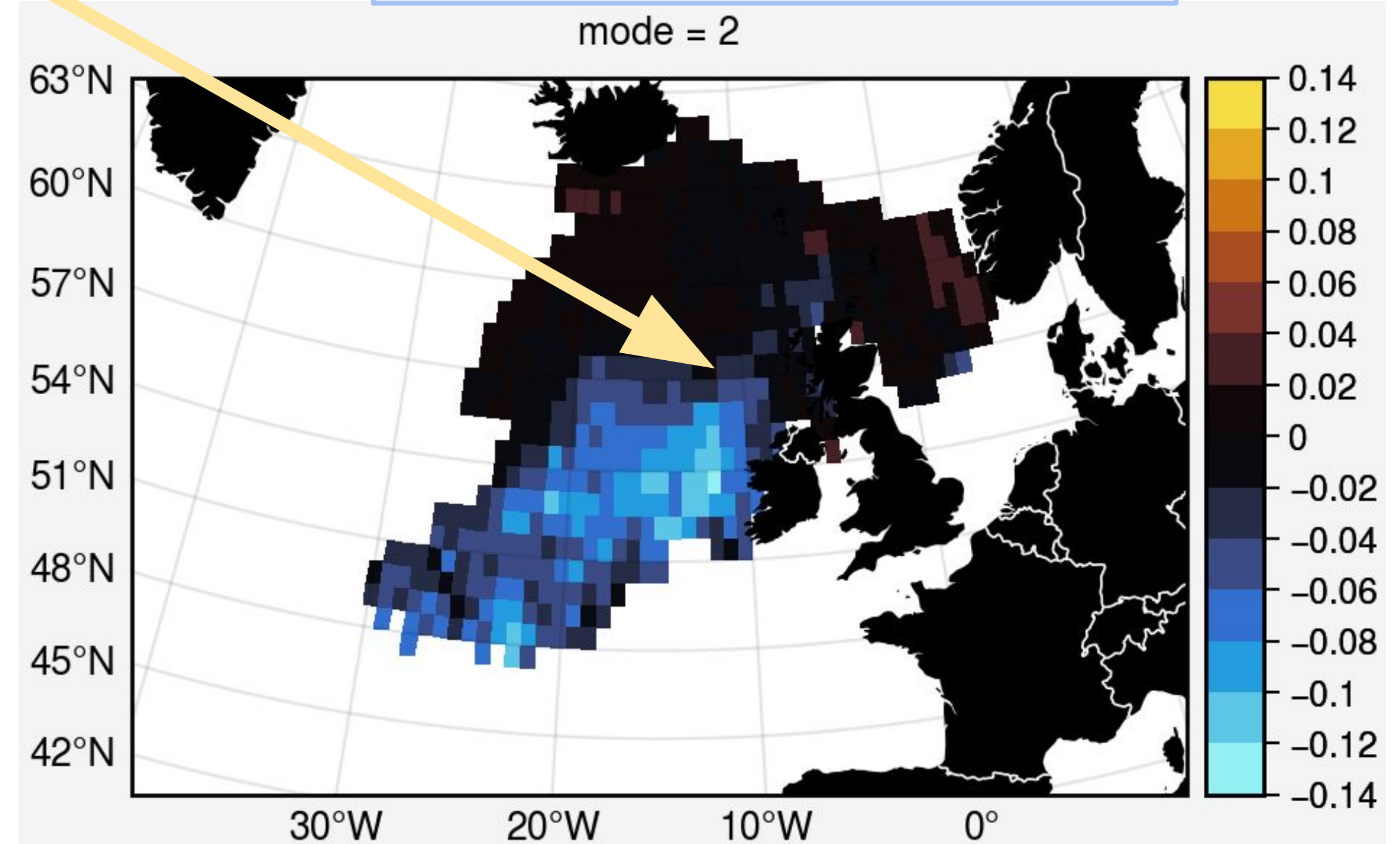
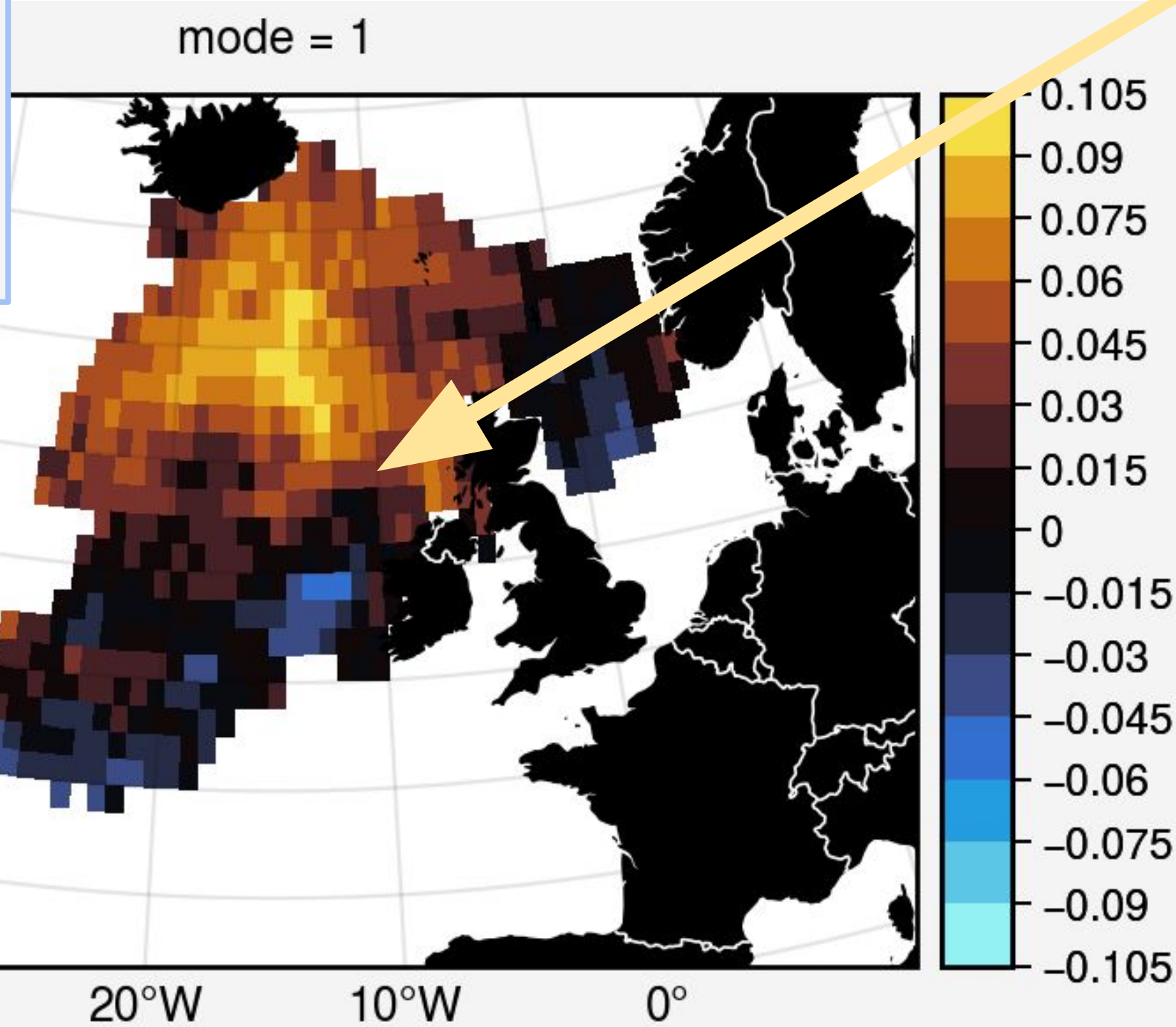
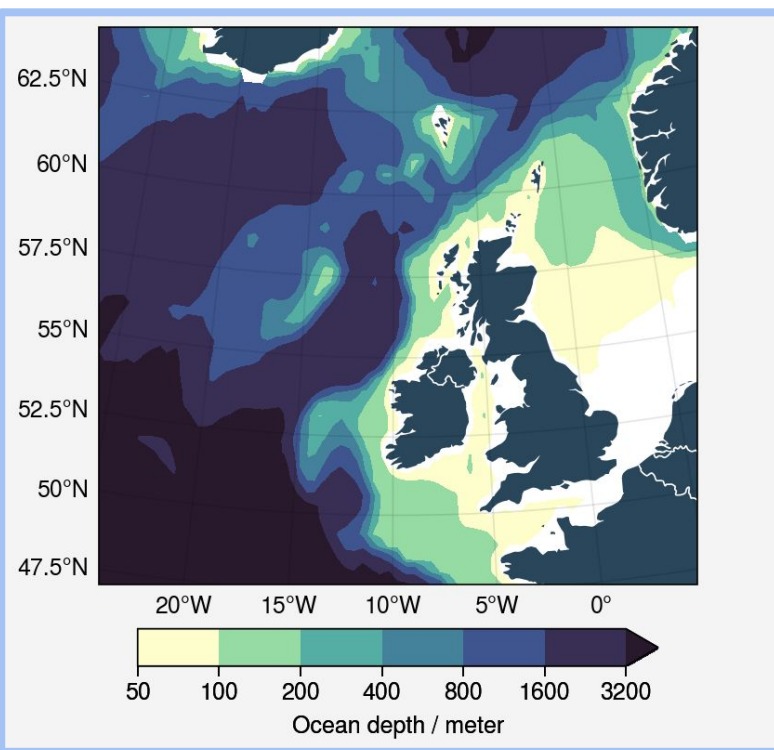
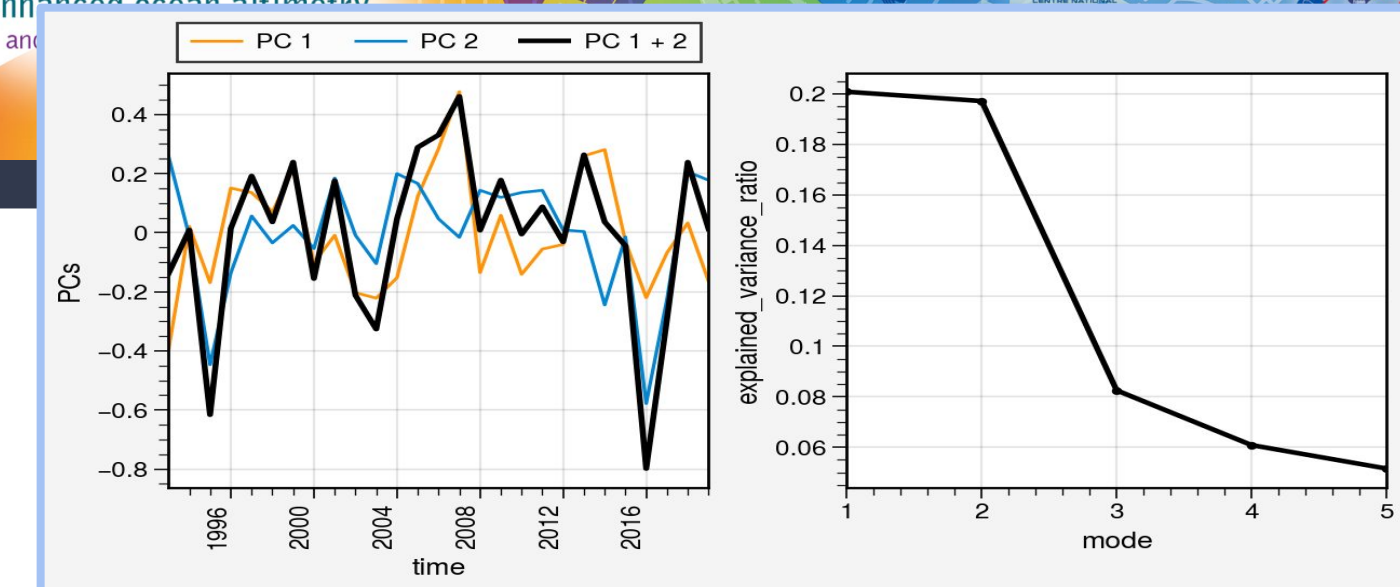




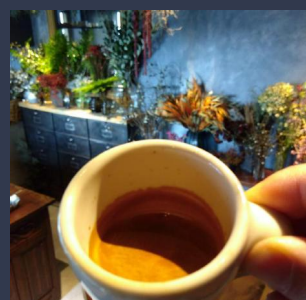
Principal components of modes 1 and 2



Rockall Plateau



Spatial patterns of modes 1 and 2 of a rotated EOF



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linkedin.com/in/ezra-eisbrenner



results

Relation to the Subpolar Gyre: the dominant regional ocean circulation pattern

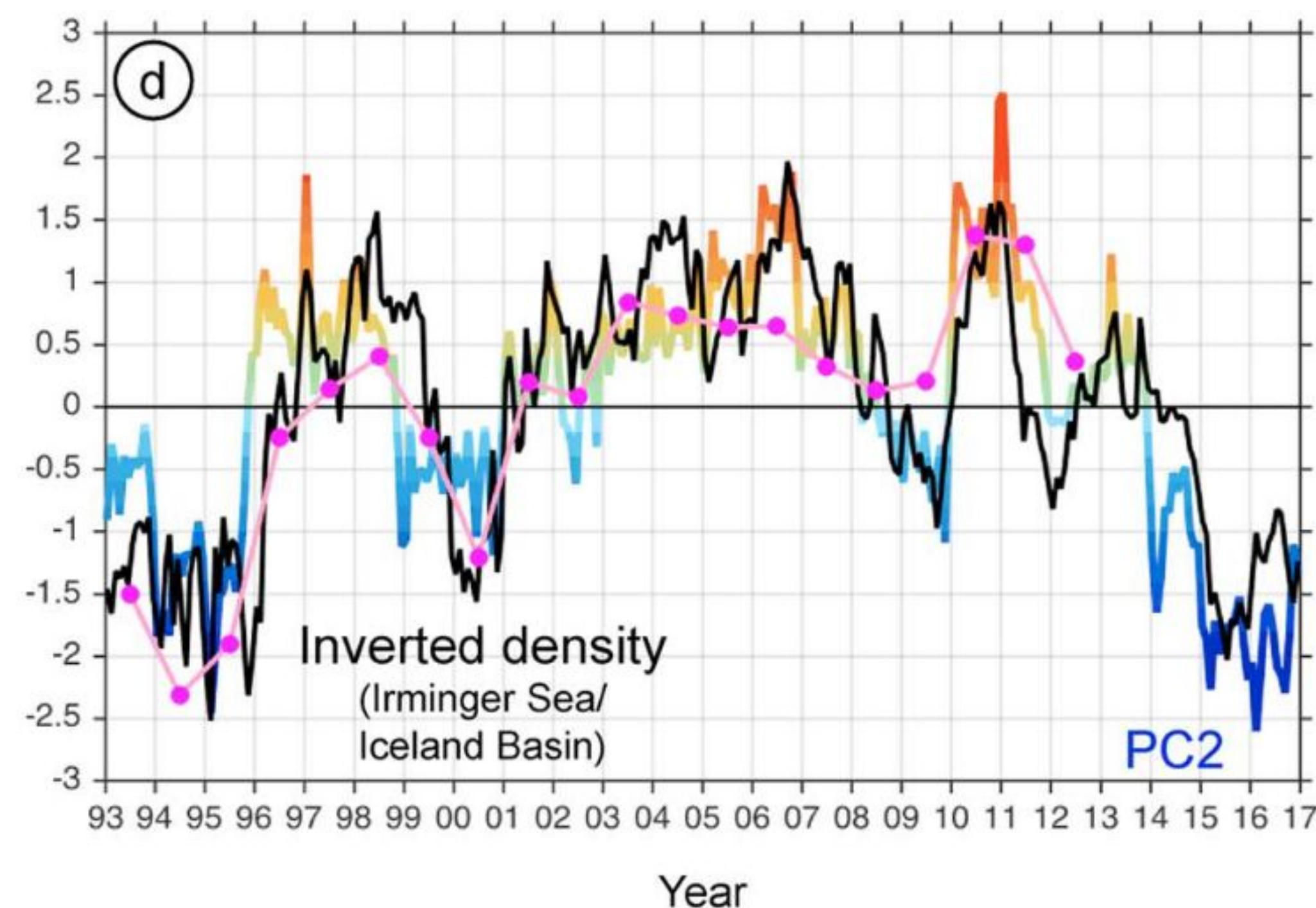
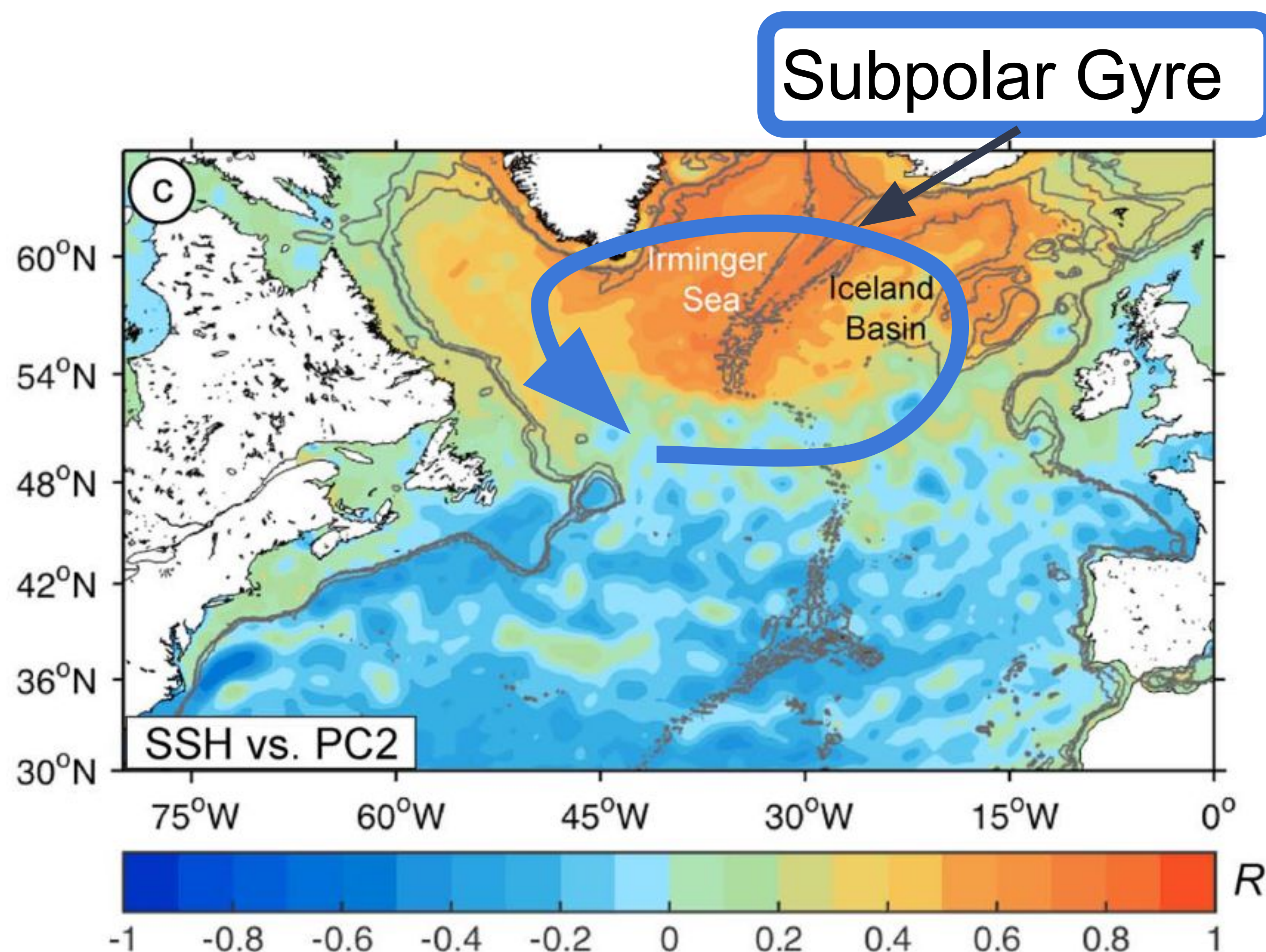
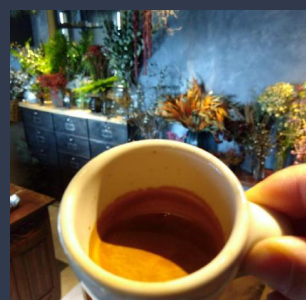
Ezra Eisbrenner^{1,2}, Léon Chafik^{1,2}, Kristofer Döös^{1,2}

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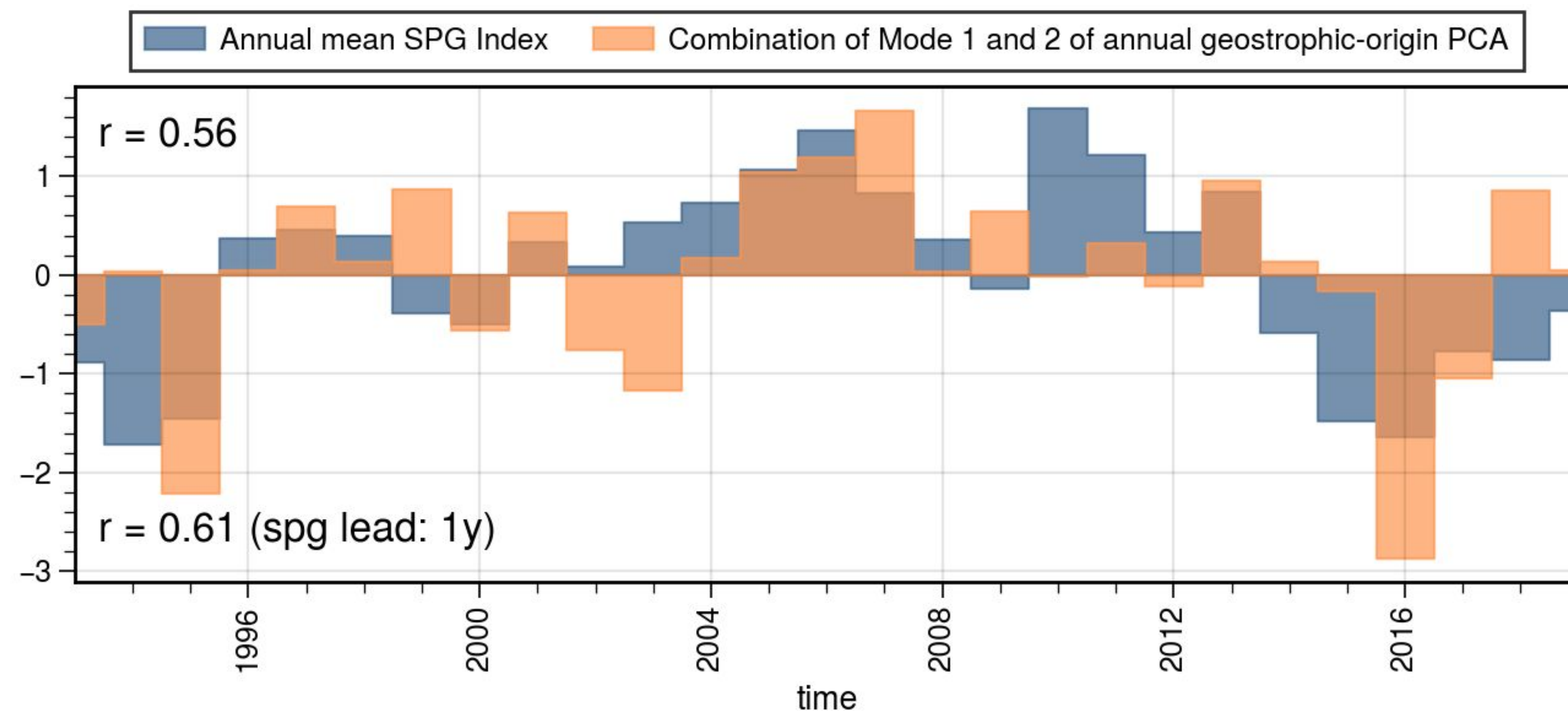
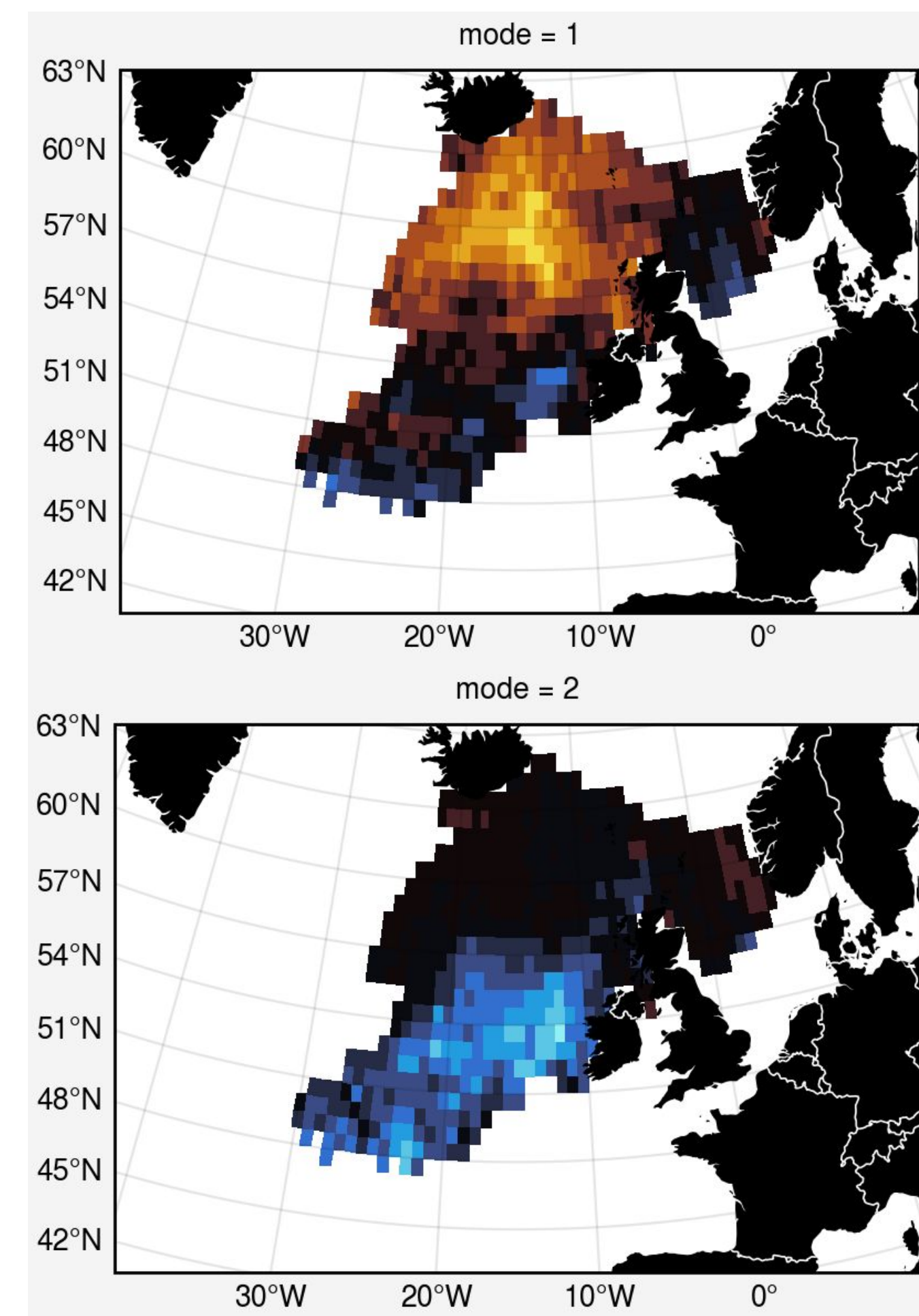
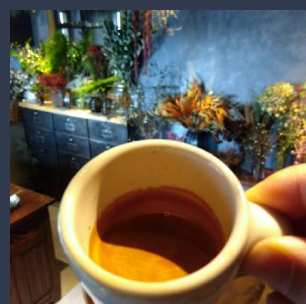


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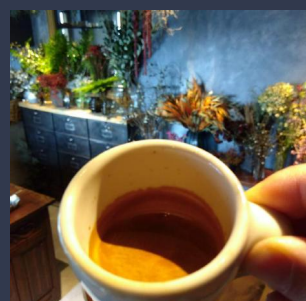
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Subpolar Gyre Strength Index by Hátún and Chafik, 2018



1-year-origin PC 1+2 vs. SPG strength index



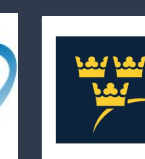
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linkedin.com/in/ezra-eisbrenner



Conclusions / Remarks

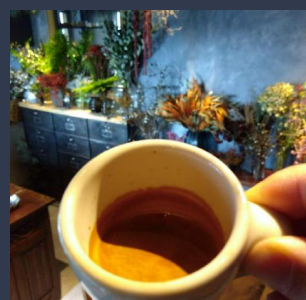
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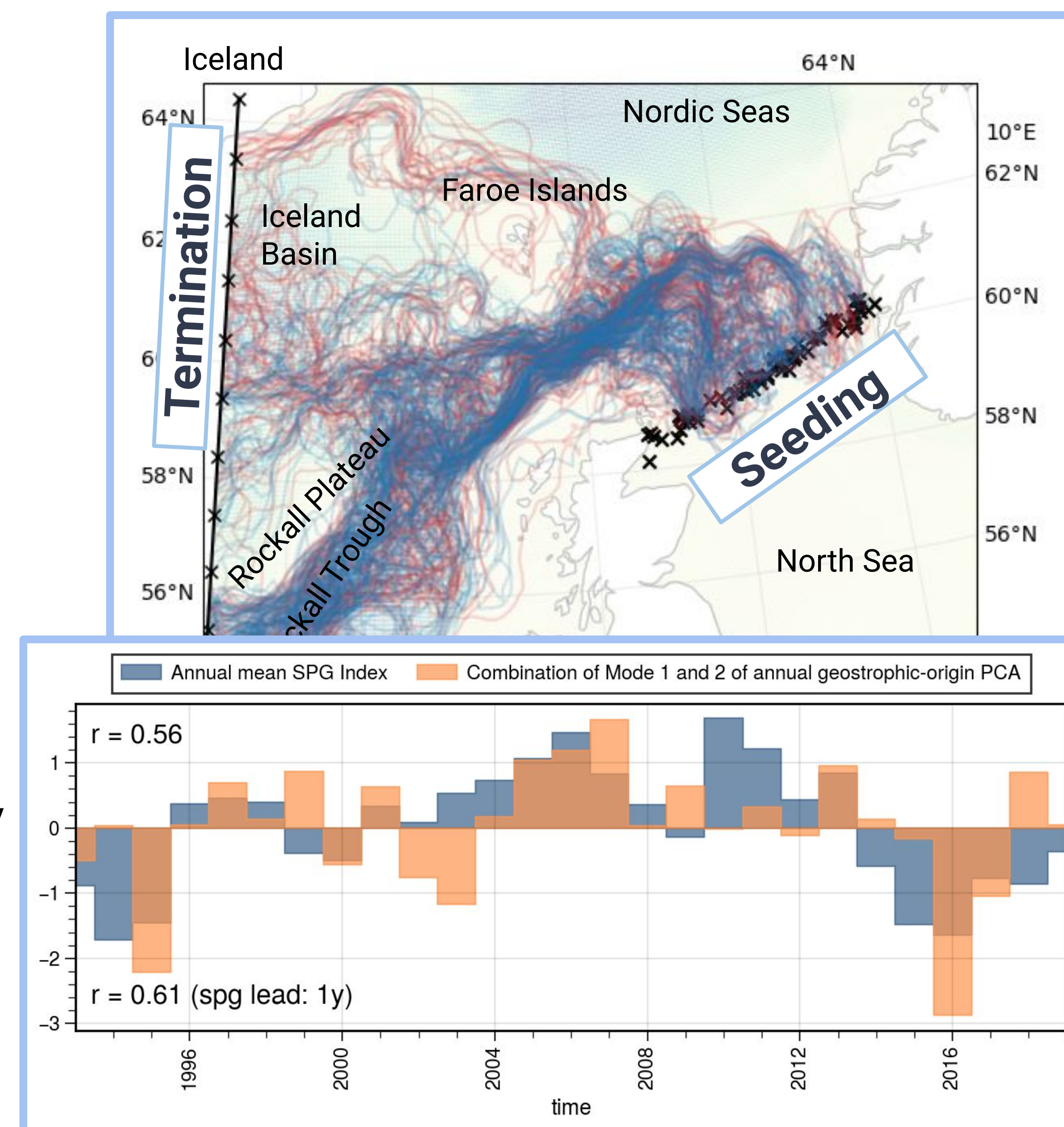


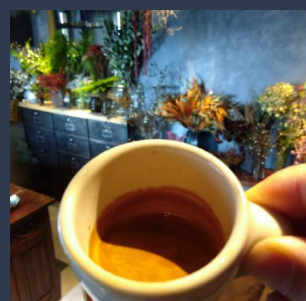
From Lagrangian tracking, utilizing satellite-derived velocities (which assume geostrophy)

- we create an indicator for ocean dynamics on the northern European shelf
- we see relations of this indicator to regional climate indices, foremost the SPG regimes

Caveat

- this ocean-dynamics indicator cannot directly be associated to water-mass transports or water-mass properties





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Thanks for listening!

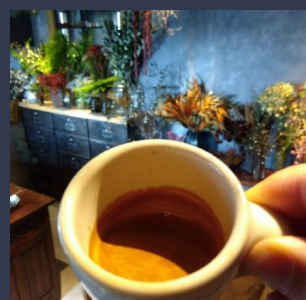
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Composites based on the SPG strength index from the complete trajectory position histogram timeseries

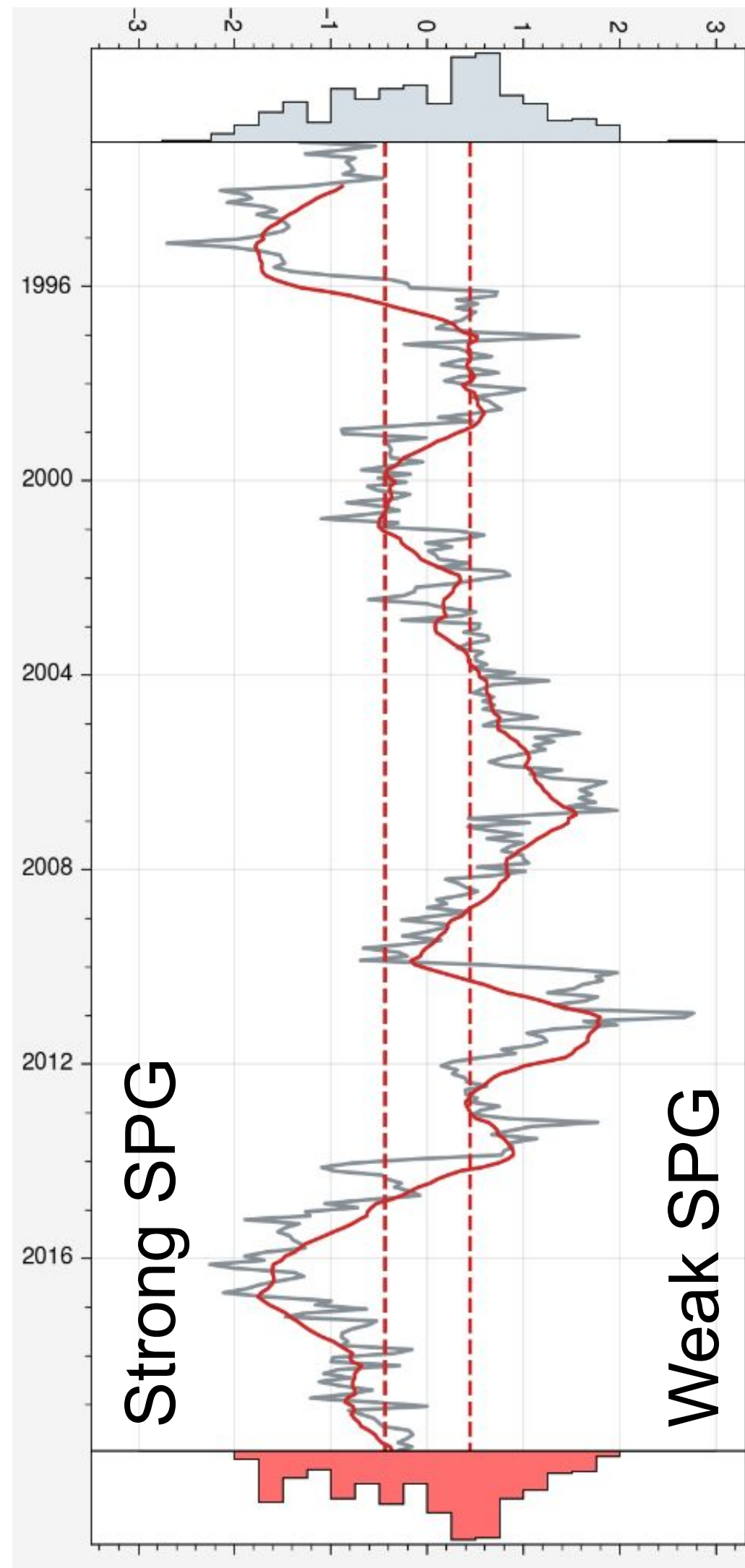
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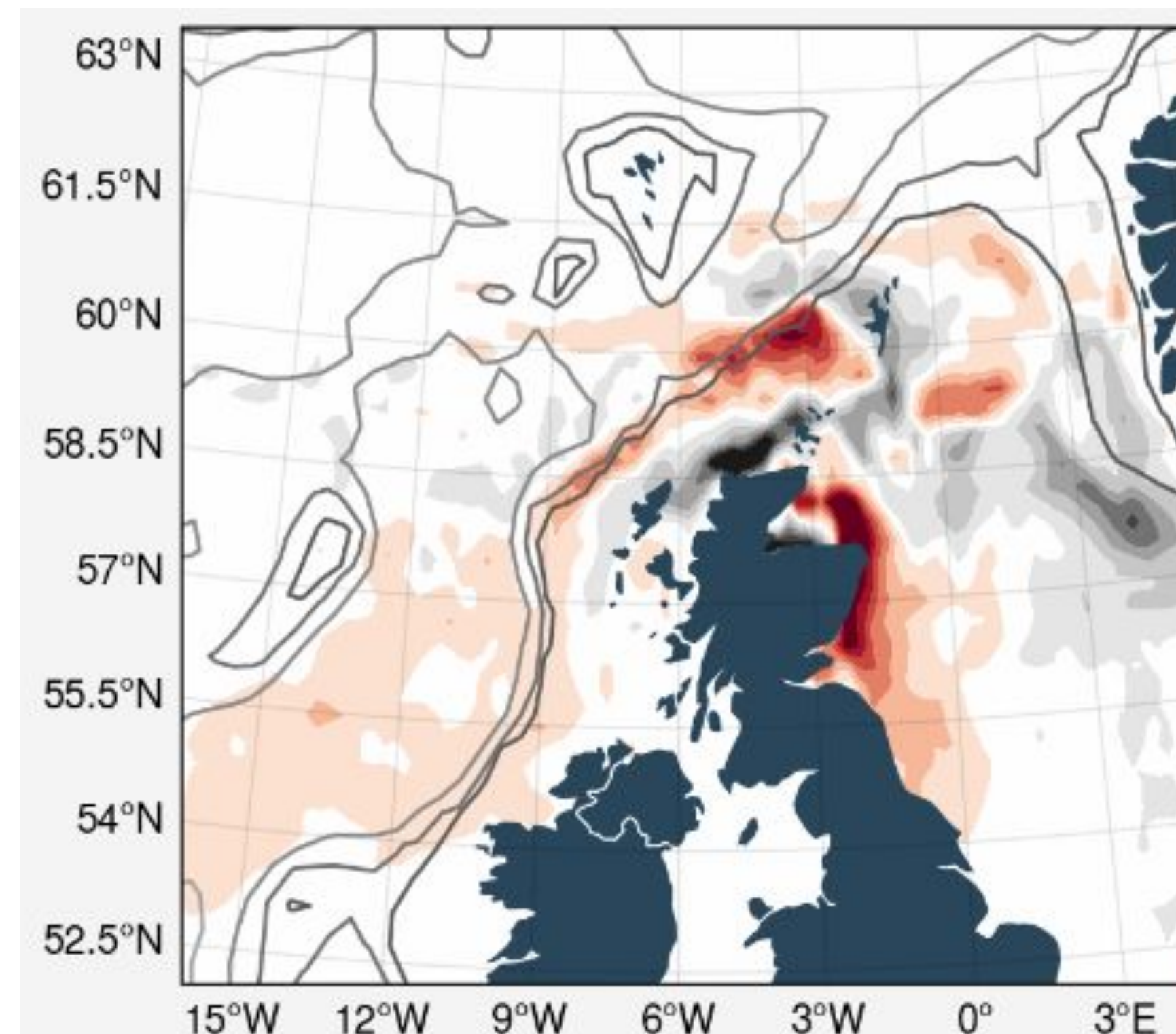


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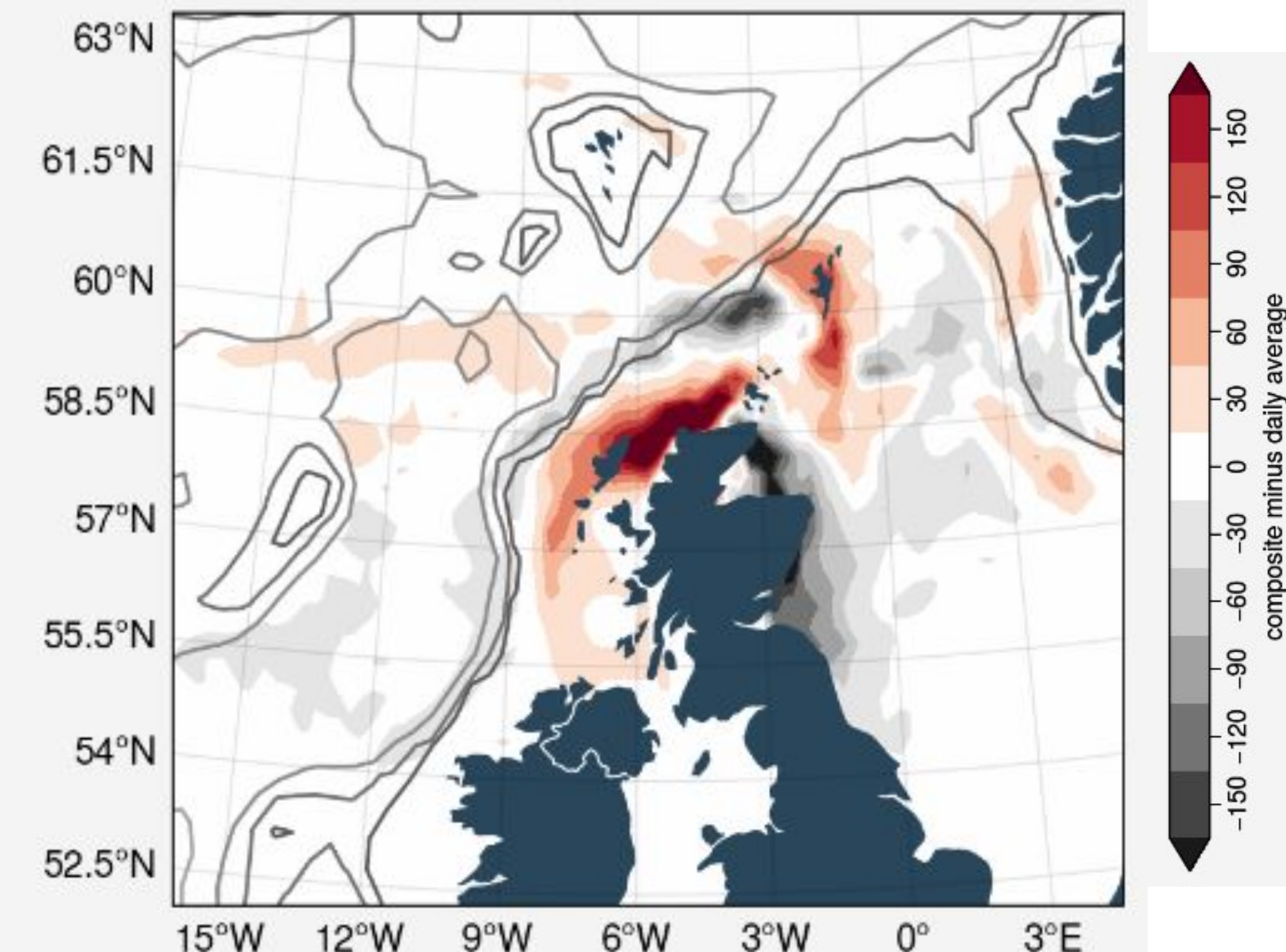
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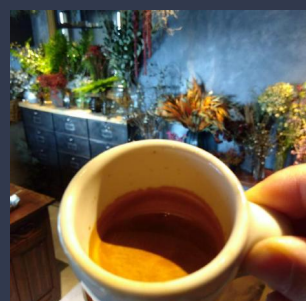
Strong SPG



Weak SPG



Decomposition based on the SPG strength index
but from the unfiltered trajectory positions



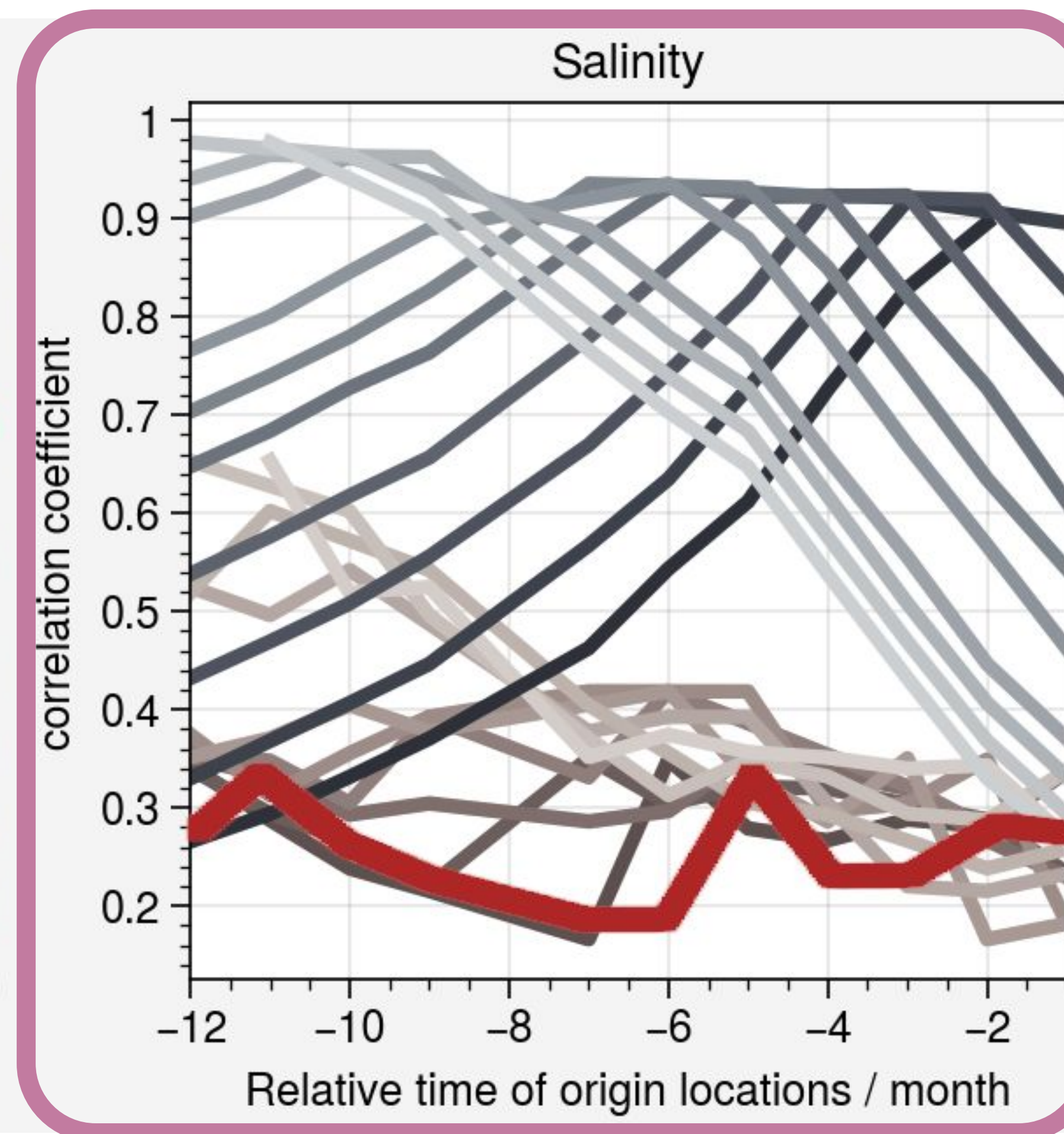
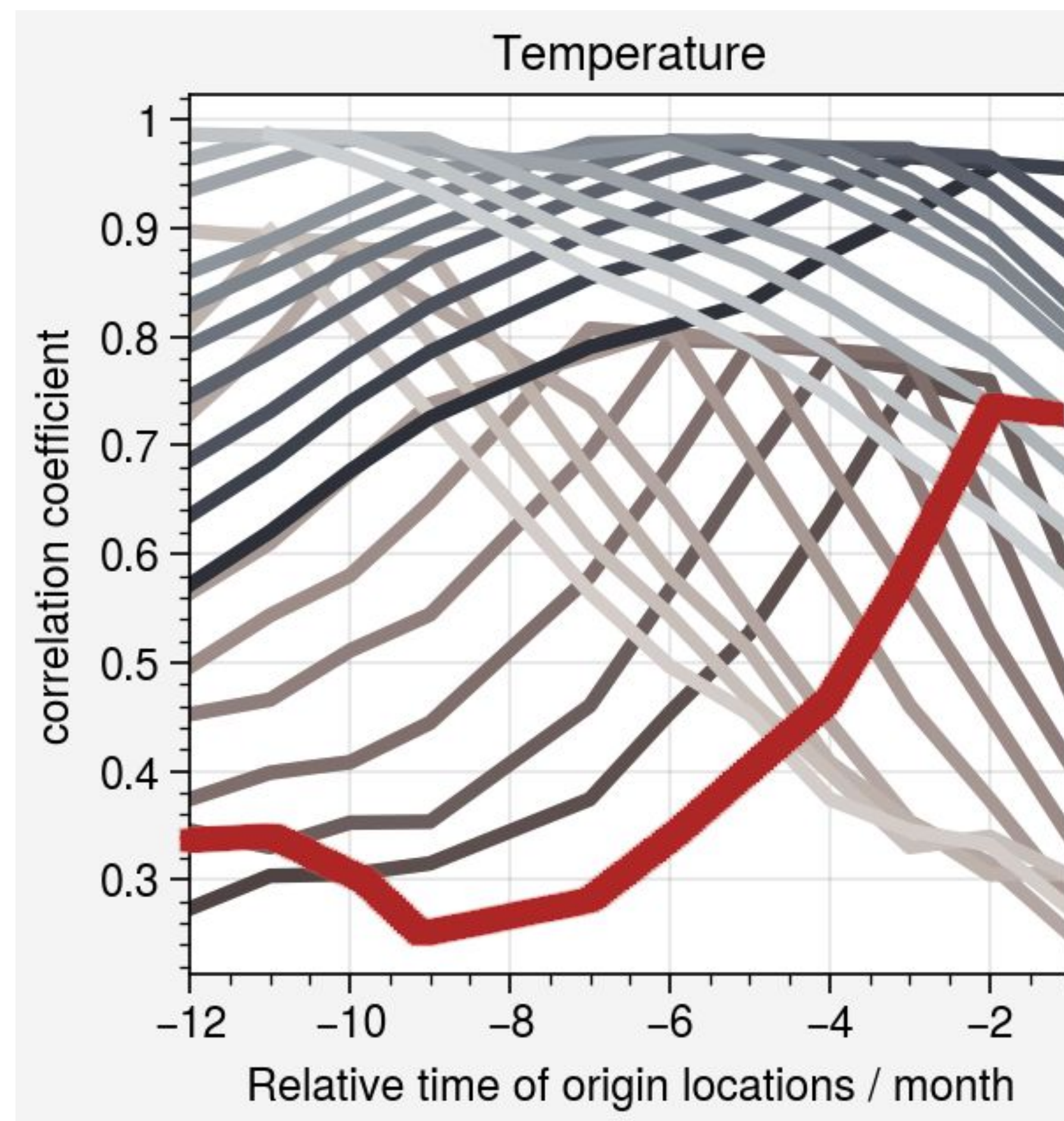
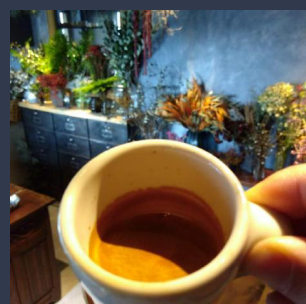
github.com/Eisbrenner
twitter.com/EzraEisbrenner
researchgate.net/profile/Ezra-Eisbrenner
linkedin.com/in/ezra-eisbrenner



results

Decorrelation

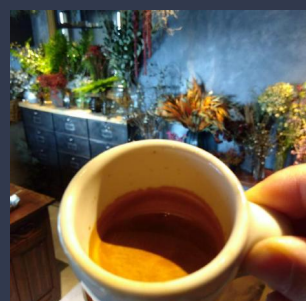




Stationary autocorrelation

Advective autocorrelation

Correlation along pathways of geostrophic advection yields nothing



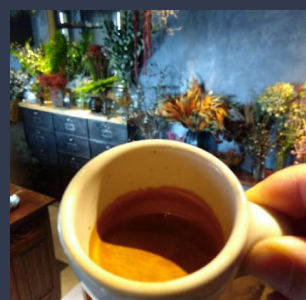
github.com/Eisbrenner
twitter.com/EzraEisbrenner
researchgate.net/profile/Ezra-Eisbrenner
linkedin.com/in/ezra-eisbrenner



results

Seasonal Cycle





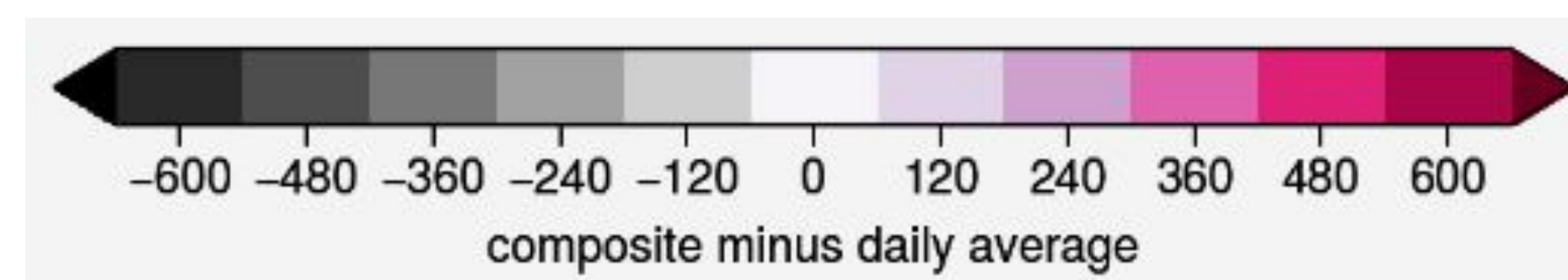
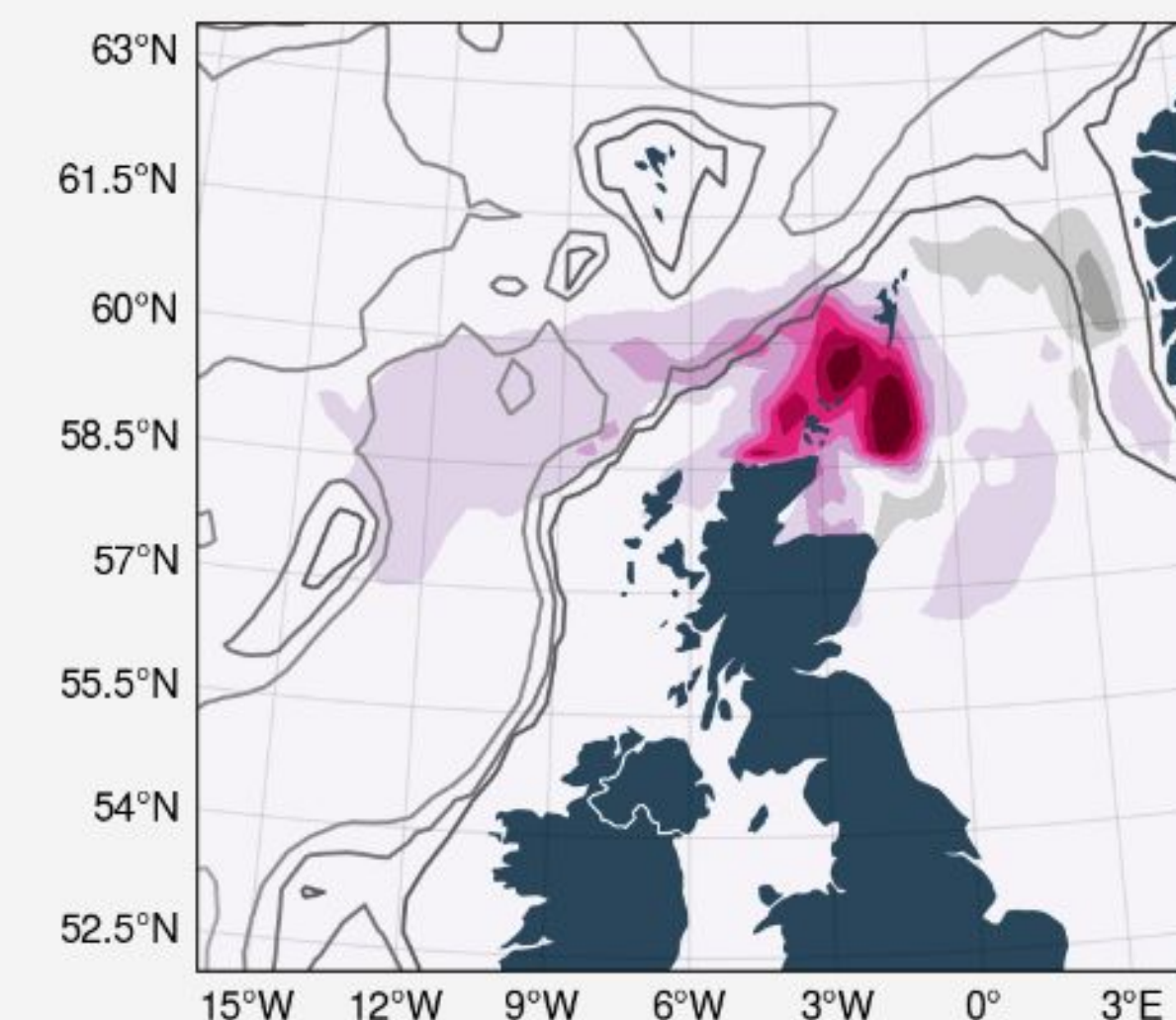
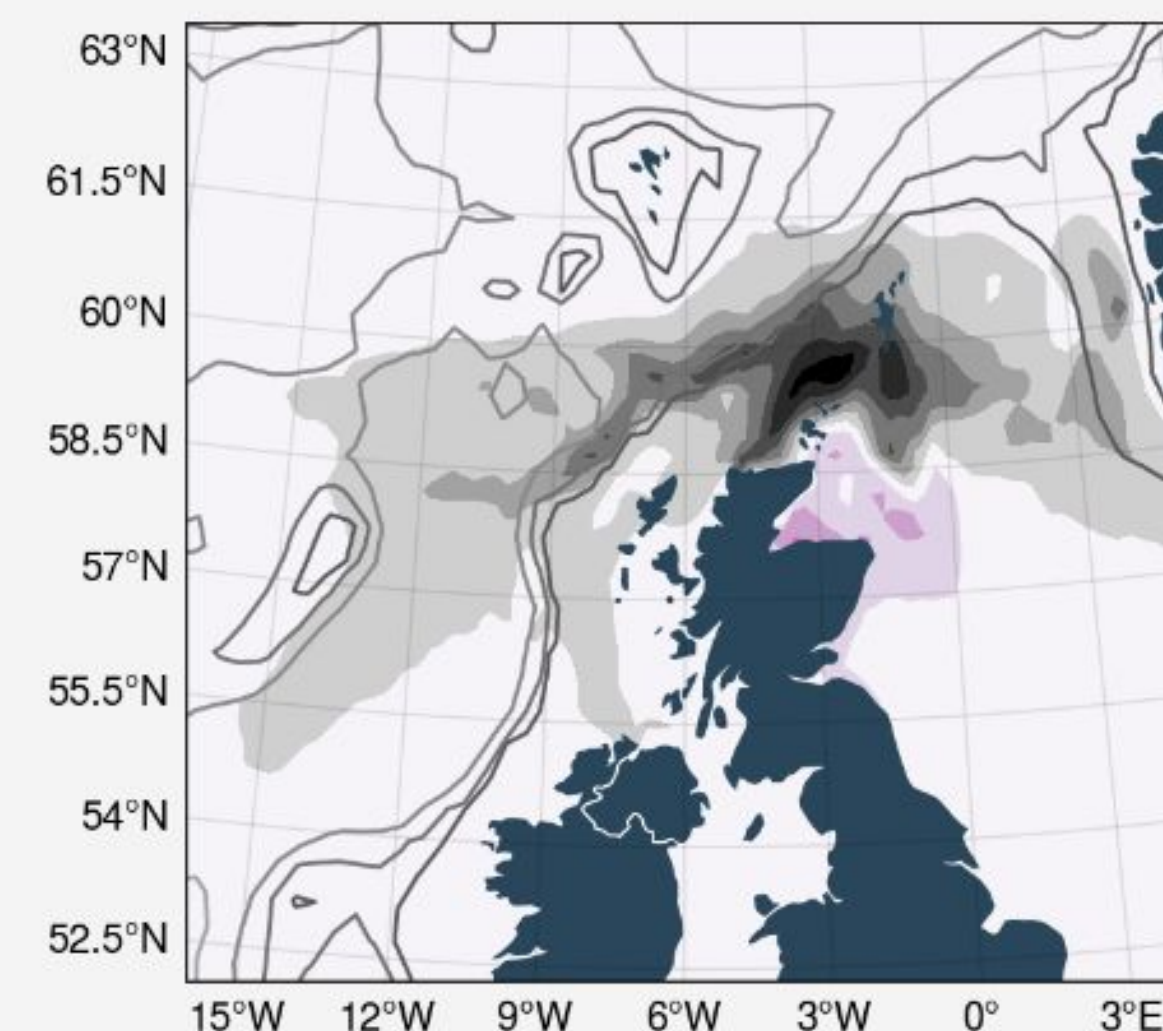
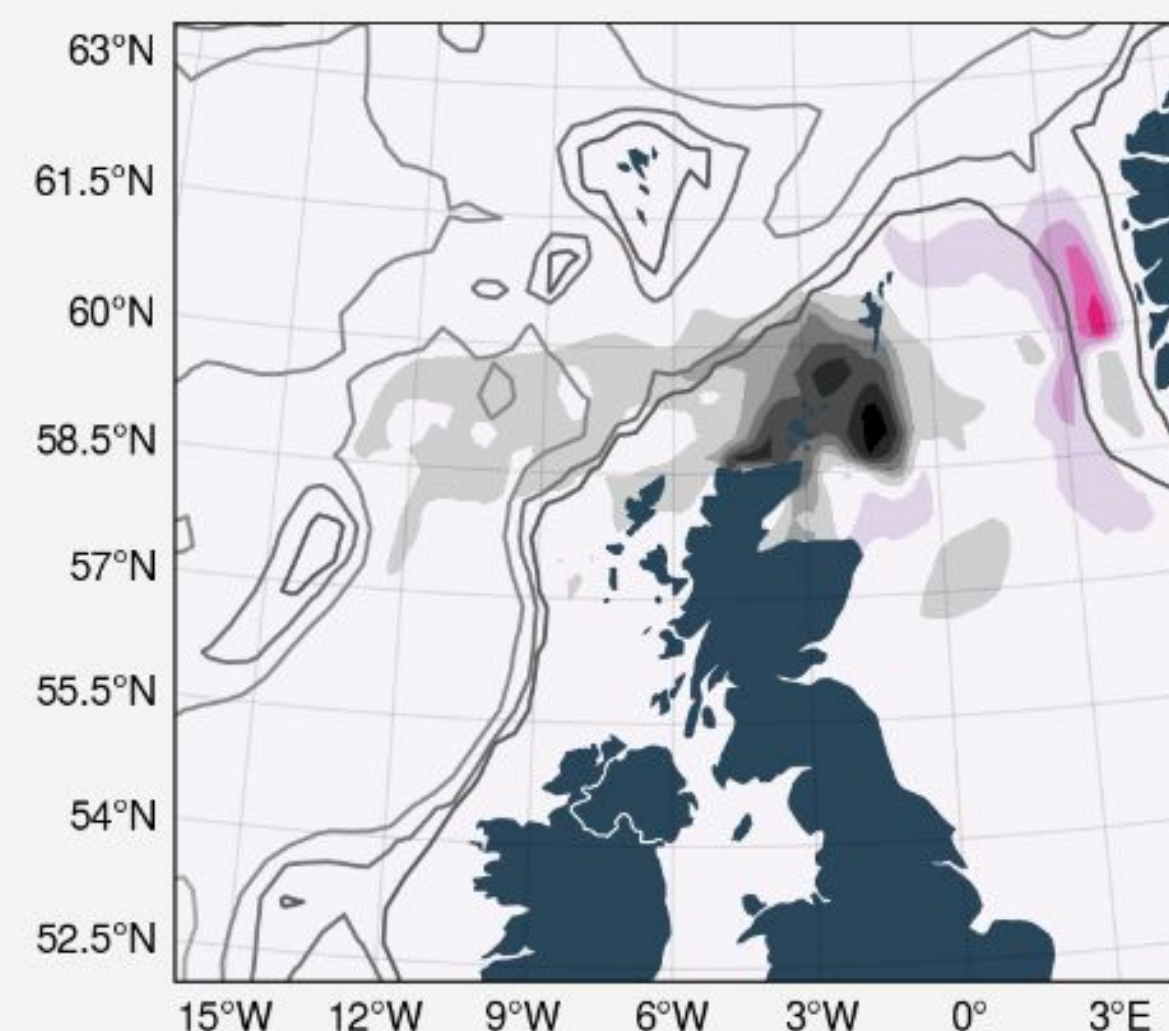
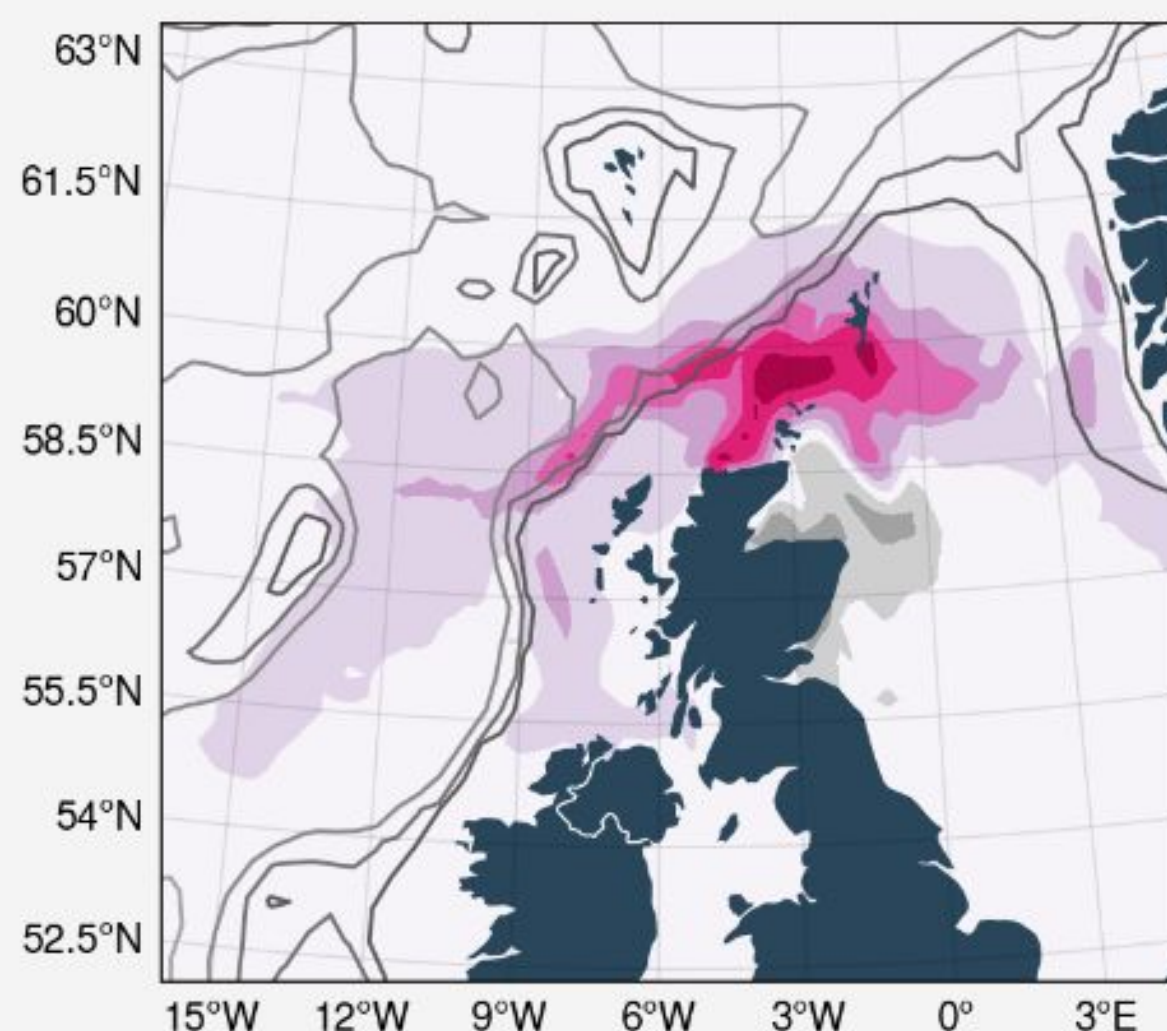
Time of particle seeding

Q1: JFM

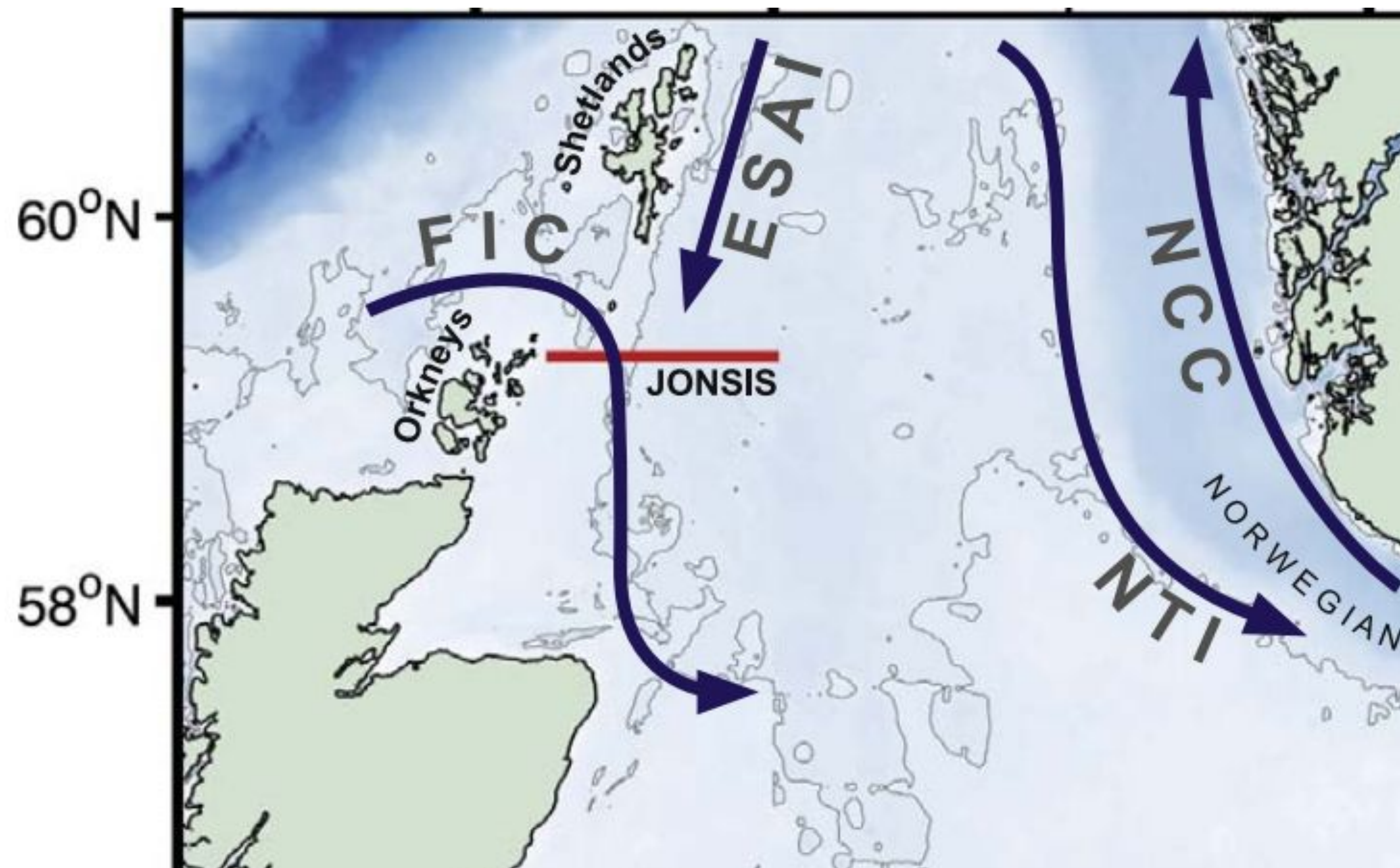
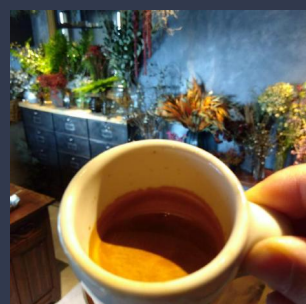
Q2: AMJ

Q3: JAS

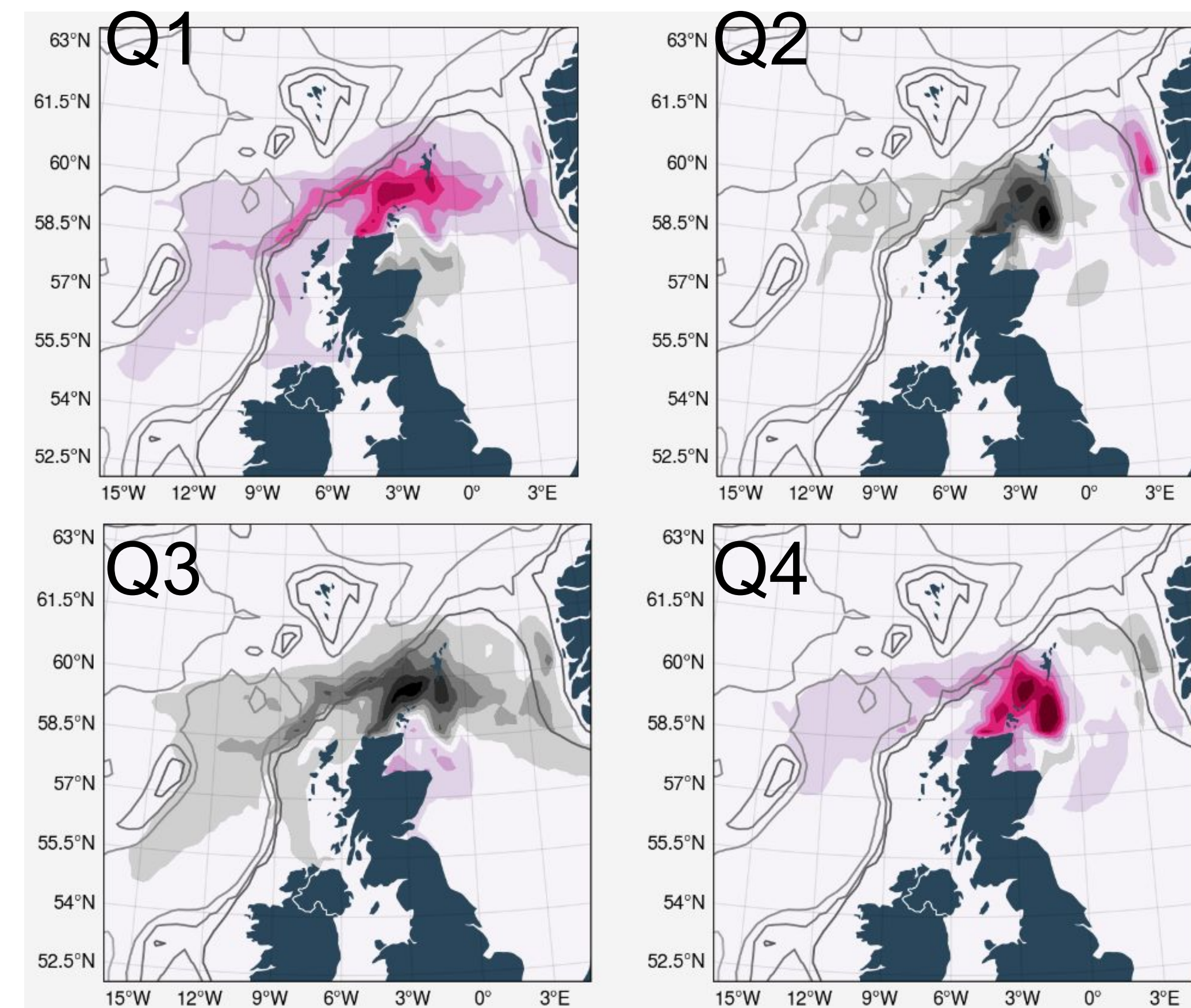
Q4: OND



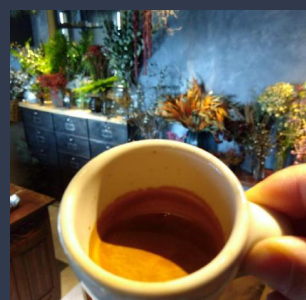
Difference of time-mean and quarterly time-means



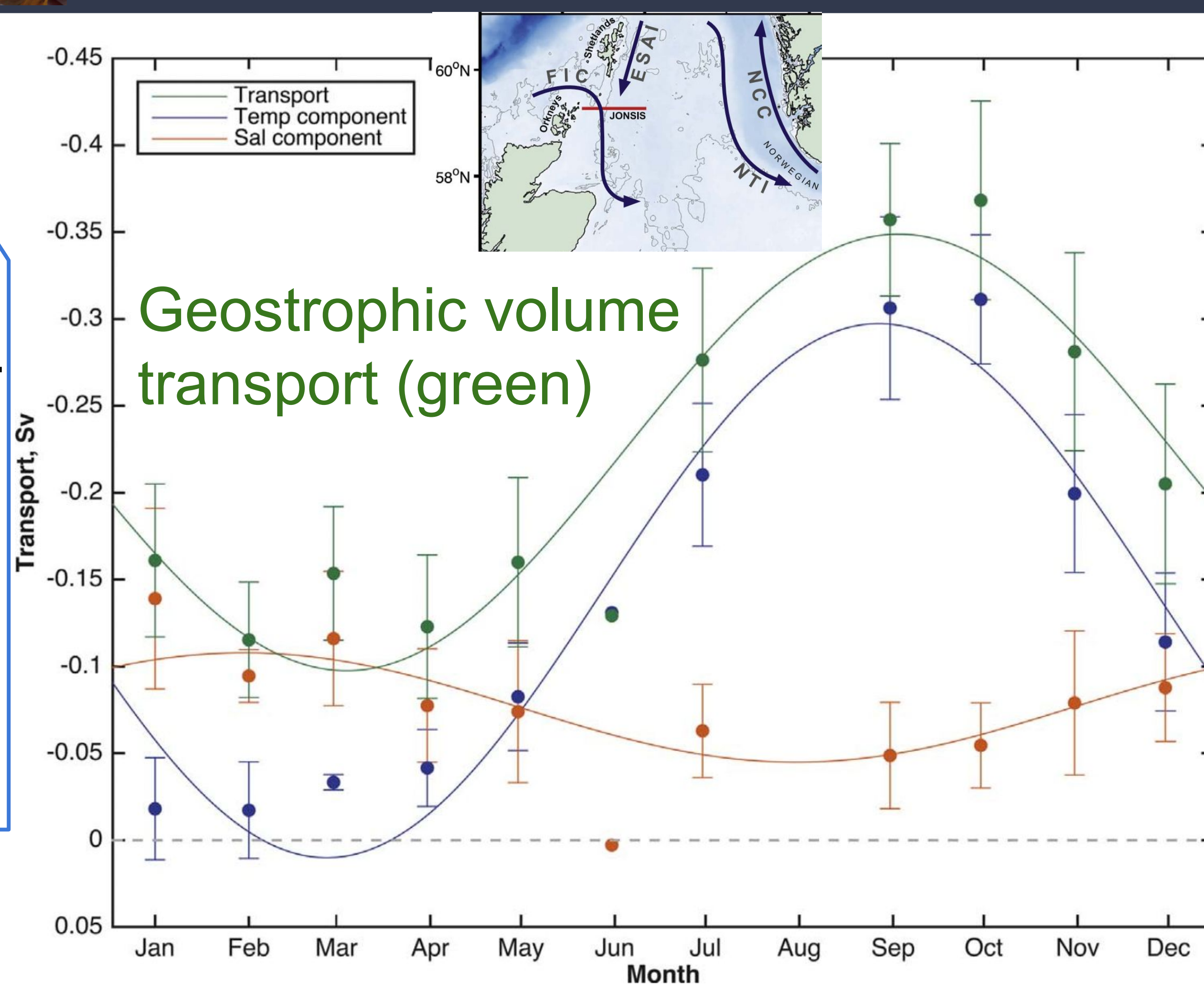
Time of particle seeding



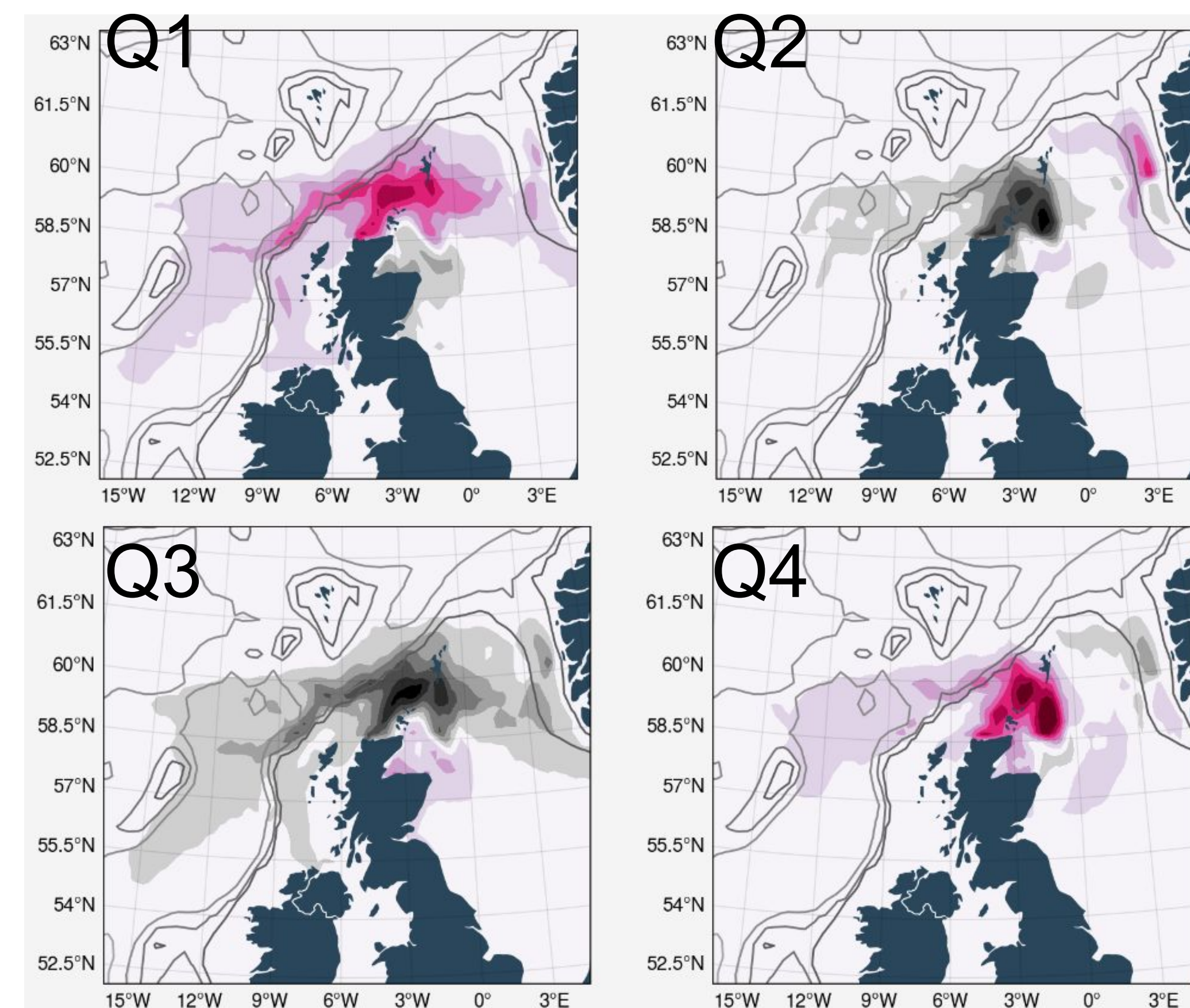
Seasonal cycle at JONSSIS (Sheehan et al., 2017)



Southward transport



Time of particle seeding



Seasonal cycle at JONSSIS (Sheehan et al., 2017)