

Airborne measurements of the water cycle of arctic weather systems during the ISLAS2020 campaign

Harald Sodemann

Geophysical Institute, University of Bergen, Norway

with acknowledgements to the entire ISLAS team:

Andrew Seidl, Aina Johannessen, Alena Dekhtyareva, Iris Thurnherr, Marvin Kähnert, Marius Jonassen, Lars R. Hole, Paul Voss, Sander Løklingholm, David Chandler, Tim Carlsen, Robert David, Lukas Papritz, Marina Dütsch, Kivi Rigel, Patrick Chazette, Julien Totems, Julien Delanoë, Alfons Schwarzenboeck, Christoff Andermann, Franziska Hellmuth, Dominique Duchanoy, Guillaume Seurat, Trude Storelvmo, Franziska Aemisegger



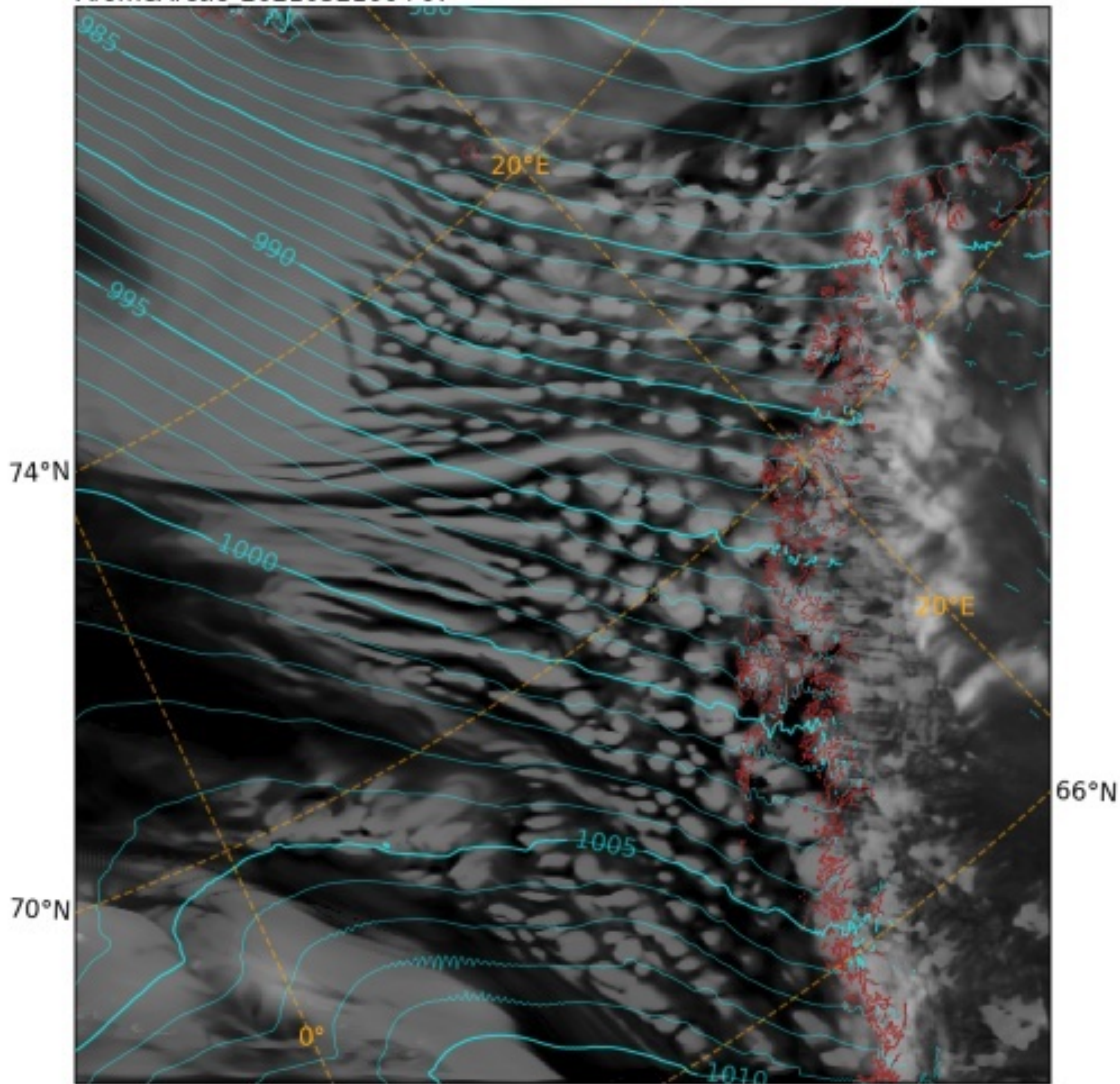
ISLAS



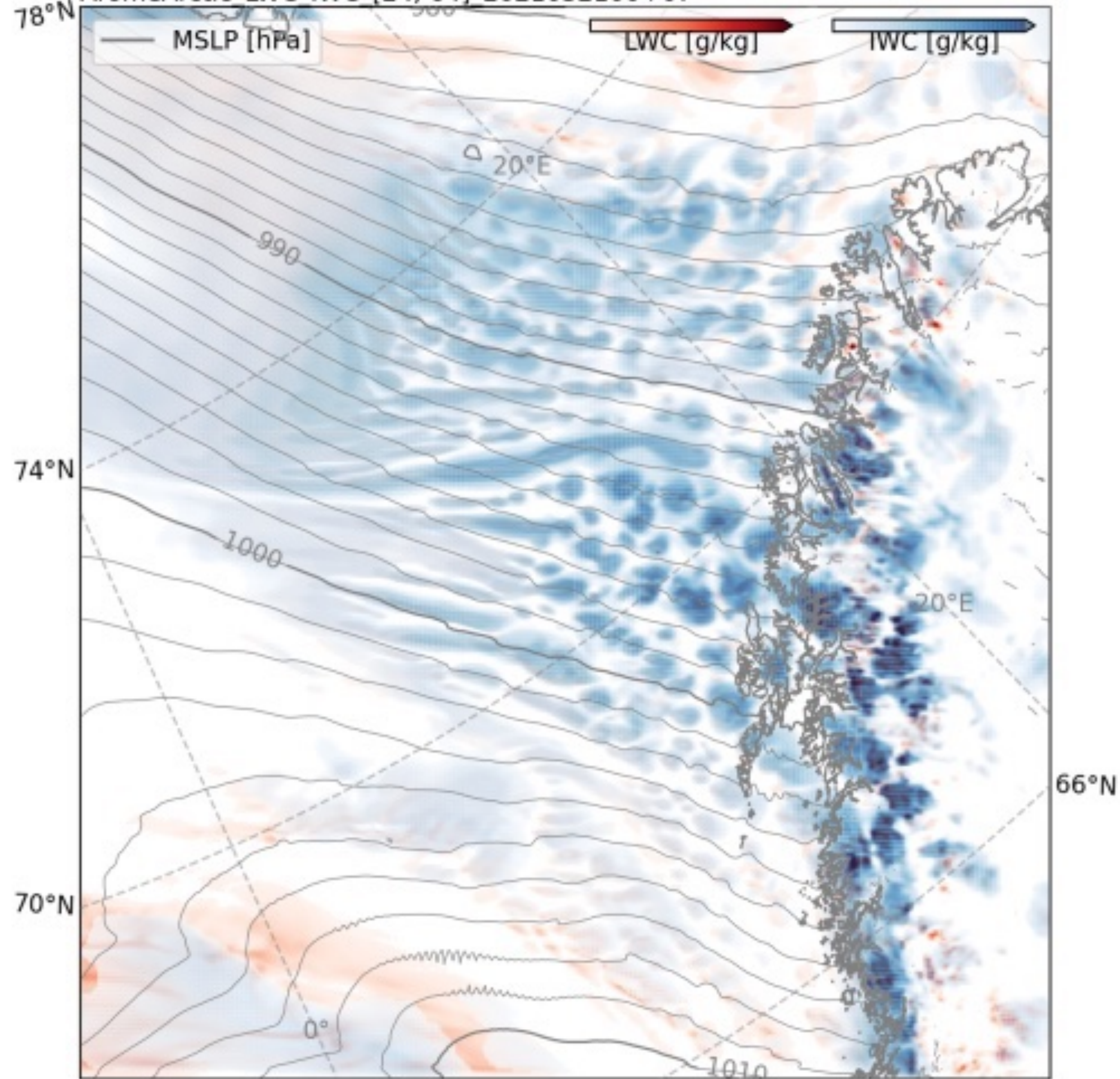
Funded by
The Research
Council of Norway

UNIVERSITY OF BERGEN

AromeArctic 2021032100+07



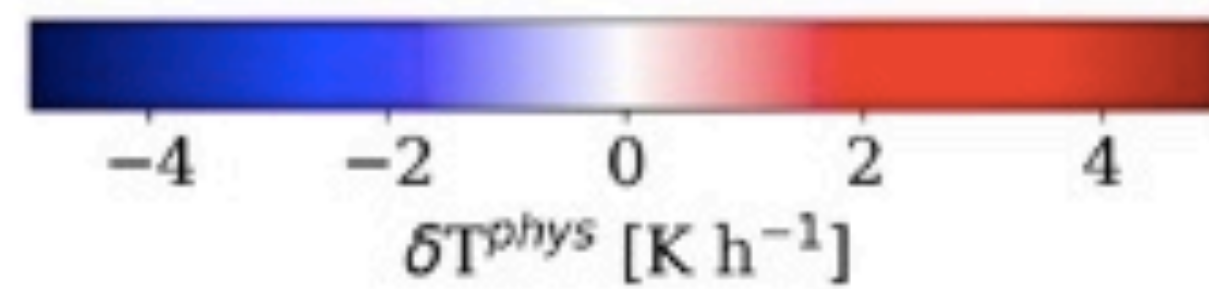
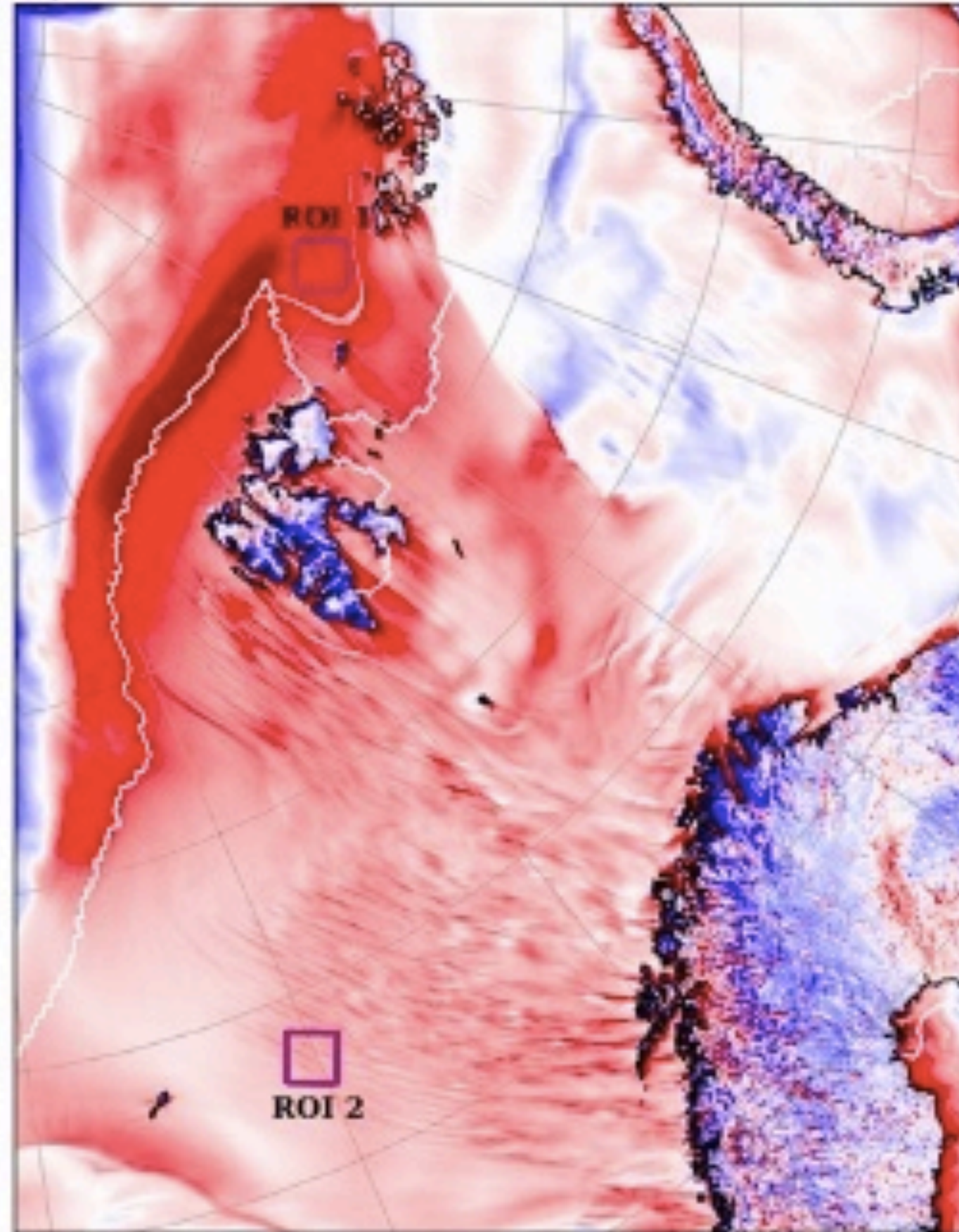
AromeArctic LWC IWC [24, 64] 2021032100+07



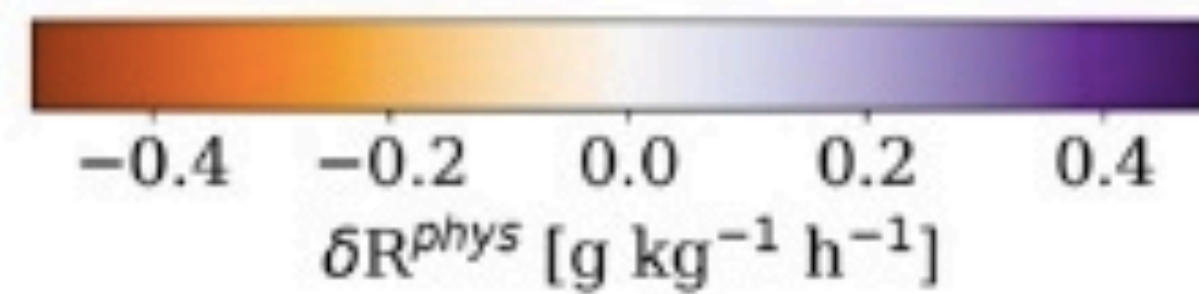
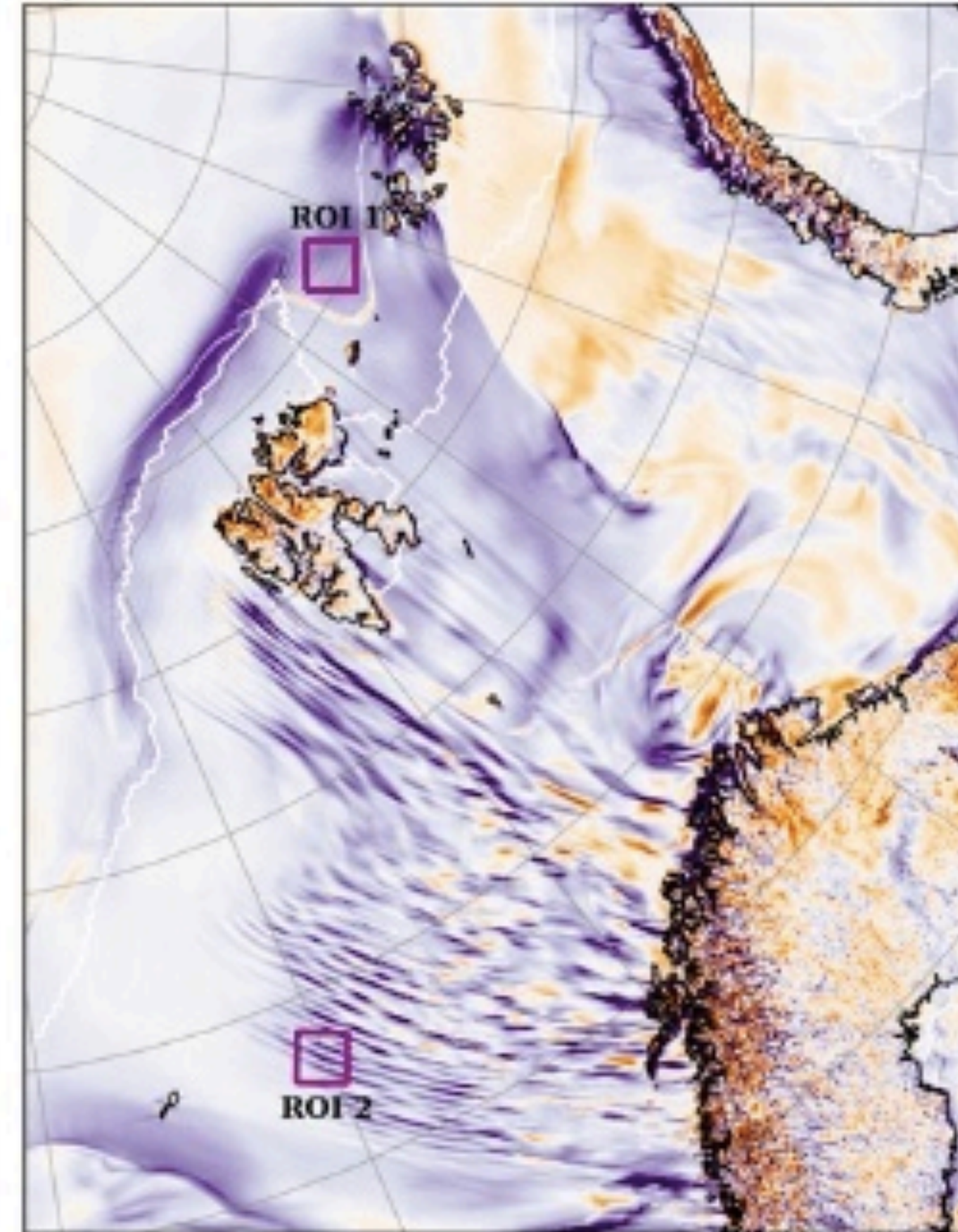
AROME Arctic forecast, 2.5x2.5km, 2021-03-21

Parameterised model tendency output at high resolution in an mCAO

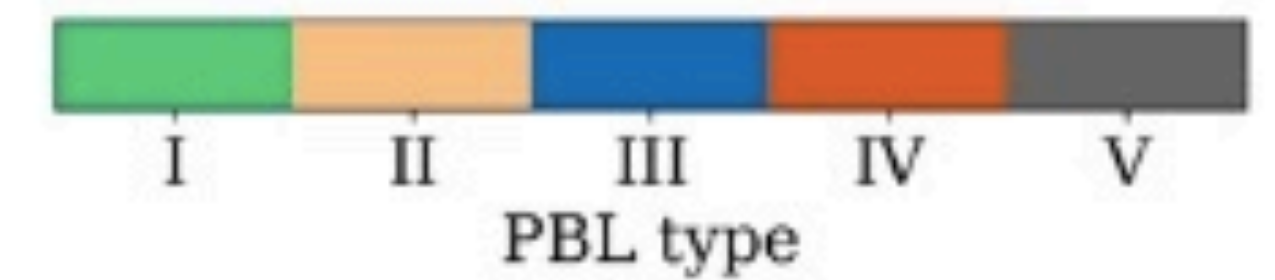
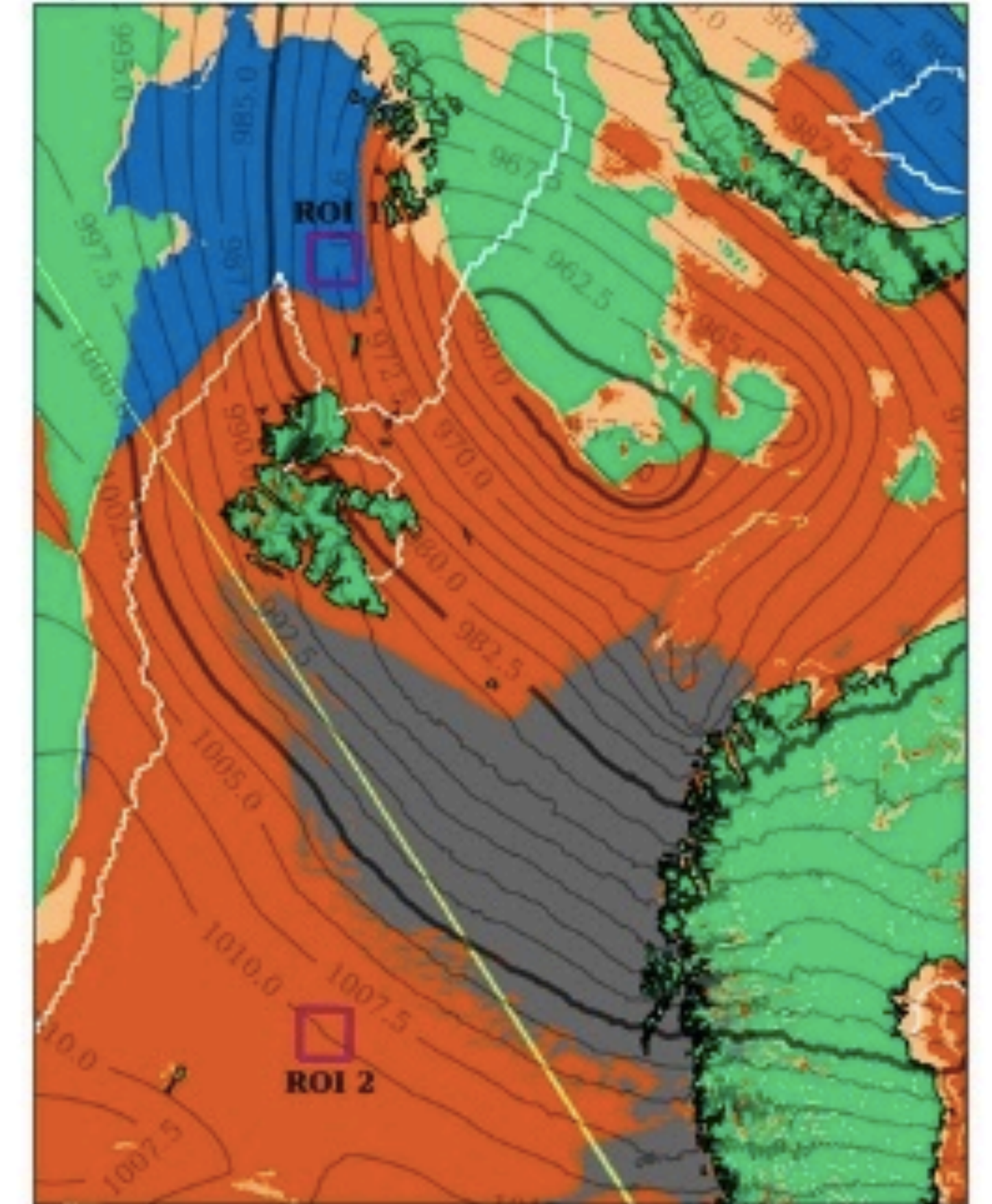
a) T tendency from physics



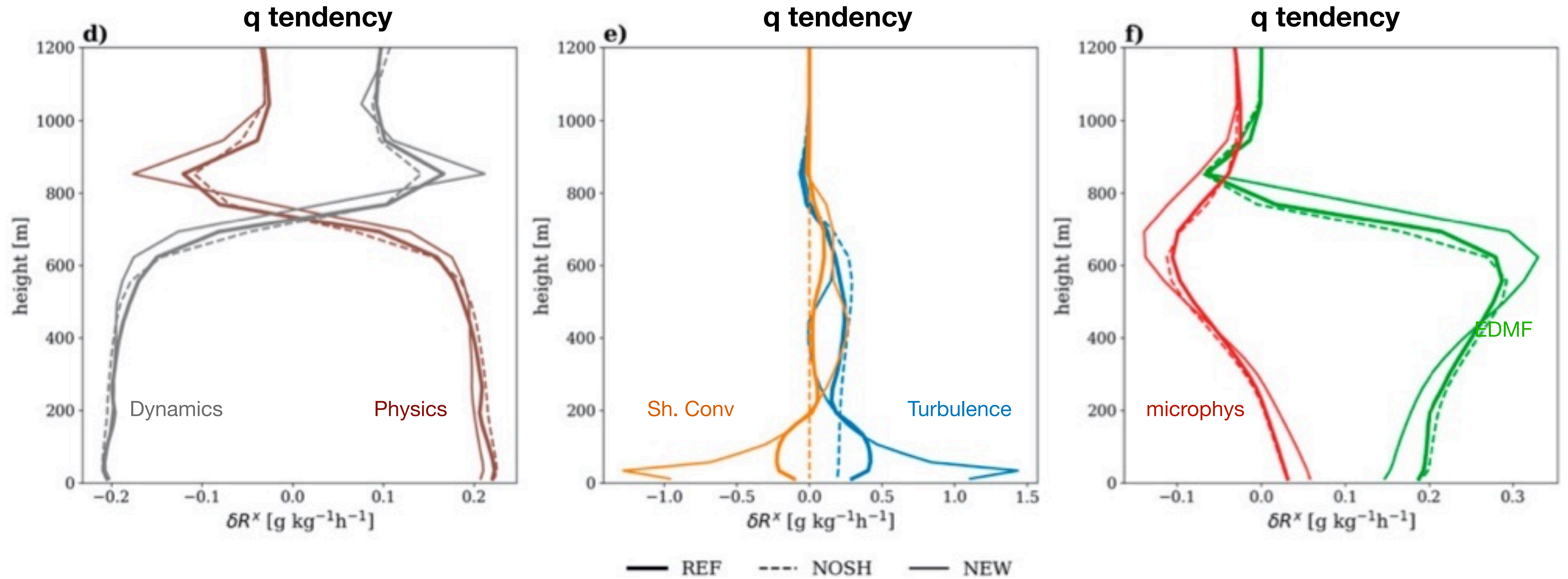
b) q tendency from physics



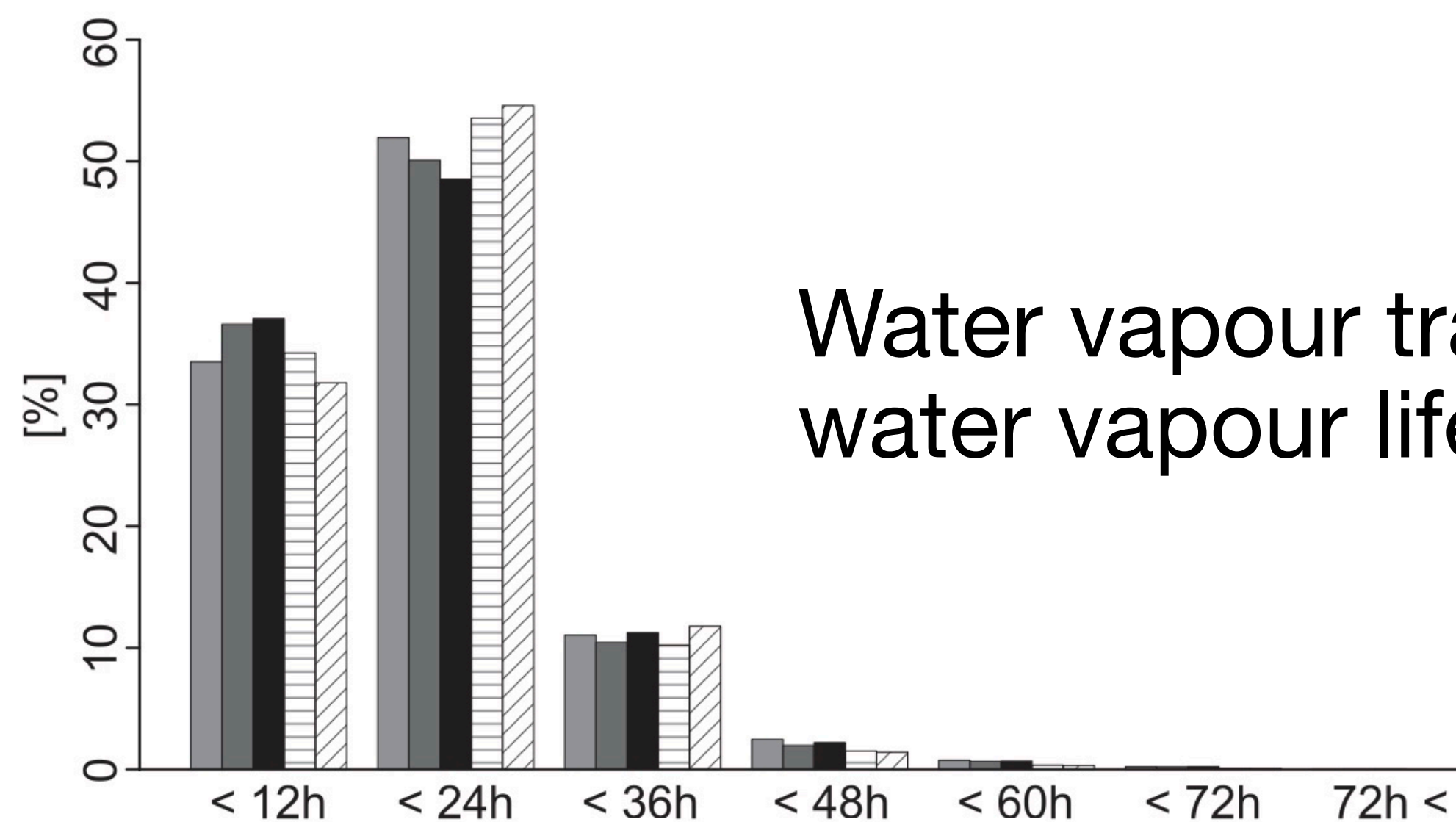
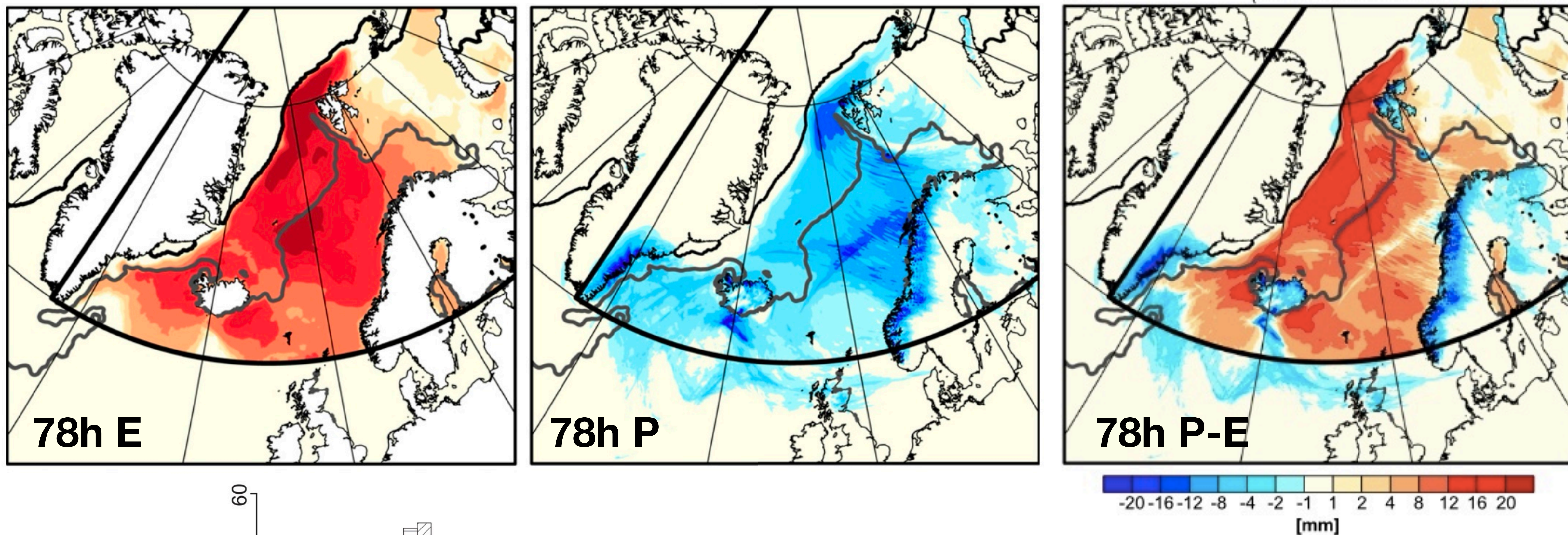
c) Boundary-layer type



Compensation of specific humidity tendencies (stratocumulus in a marine CAO)

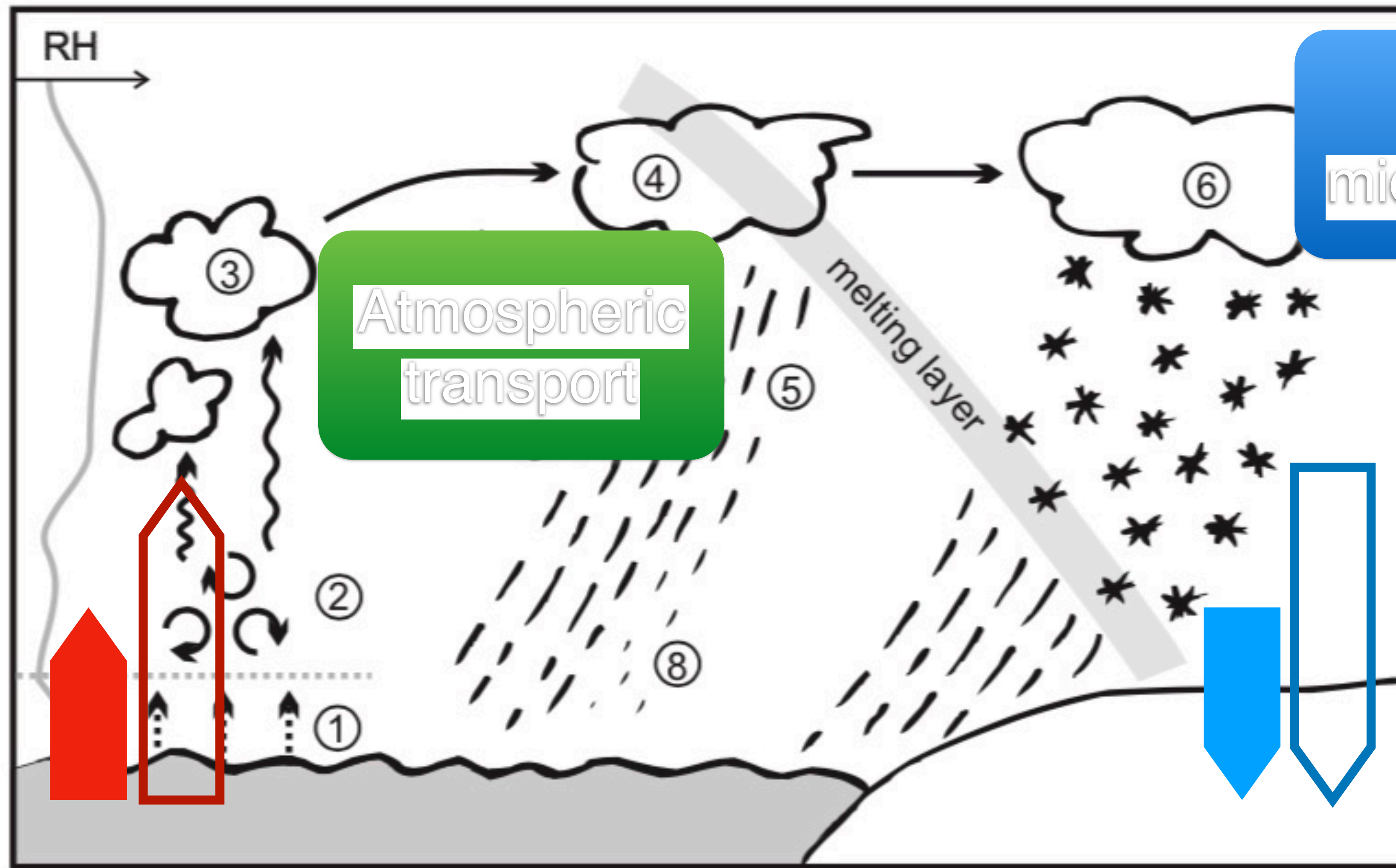


The local and intense water cycle of marine Cold Air Outbreaks



Water vapour tracer studies in CAOs show a water vapour life time of <24 h

Stable isotopes are an *integrating tracer* of the atmospheric water cycle



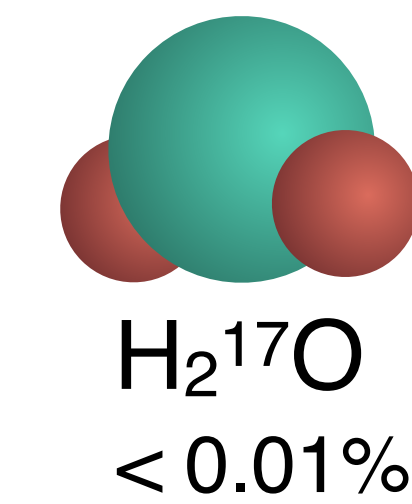
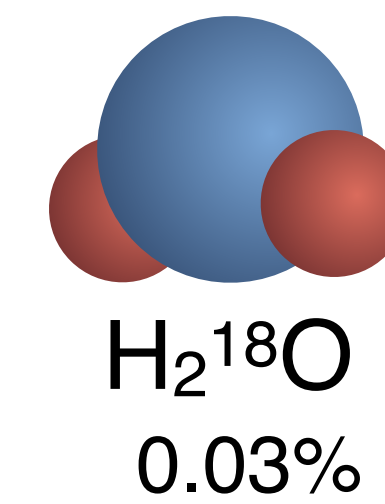
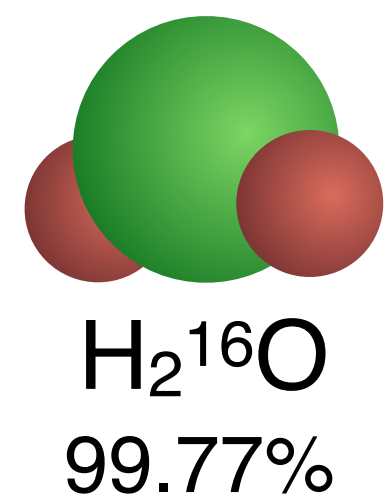
Cloud microphysics

Atmospheric transport

Surface evaporation

built-in tracer
sensitive to phase changes
identify error compensation?

Surface evaporation



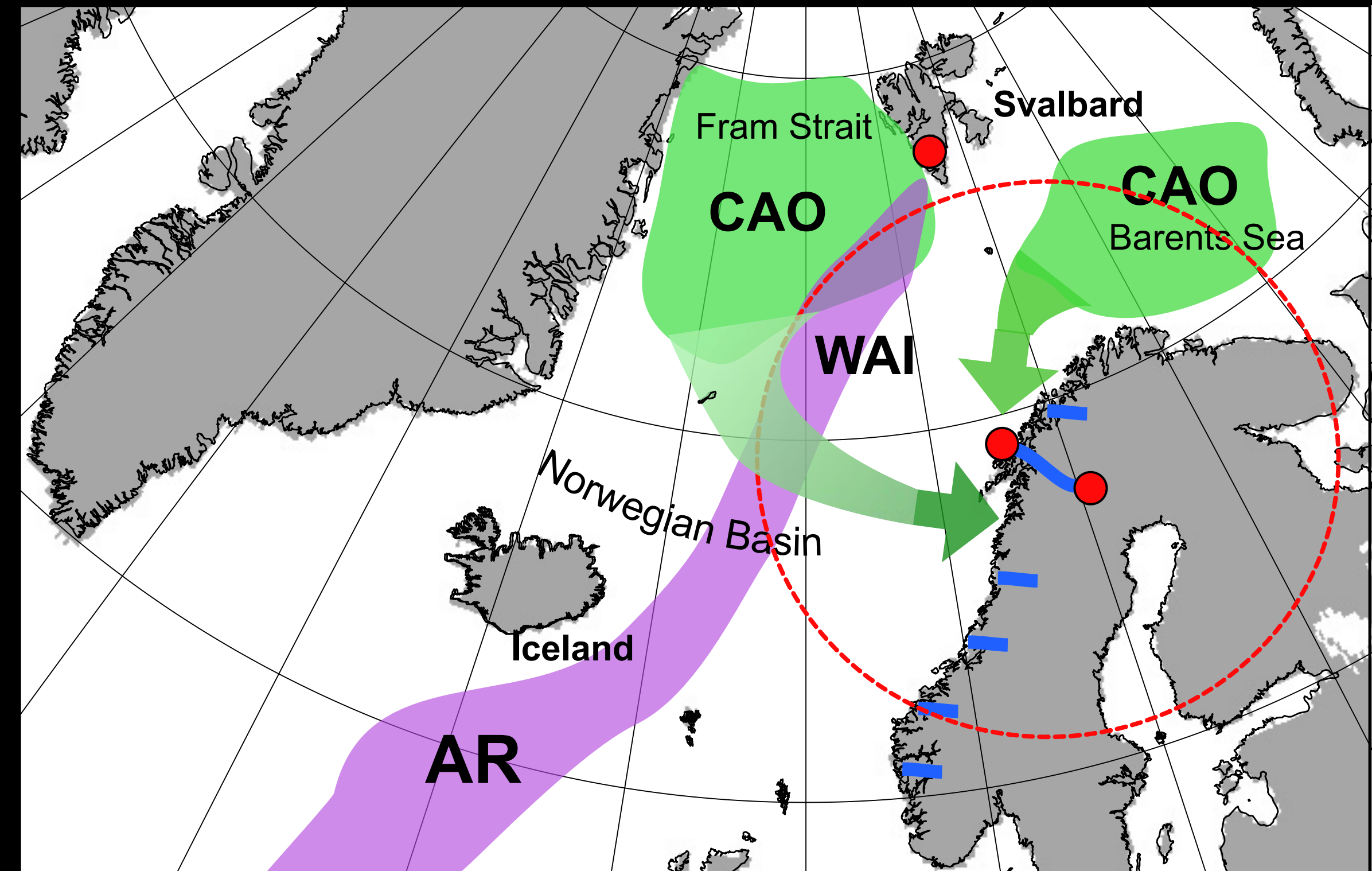
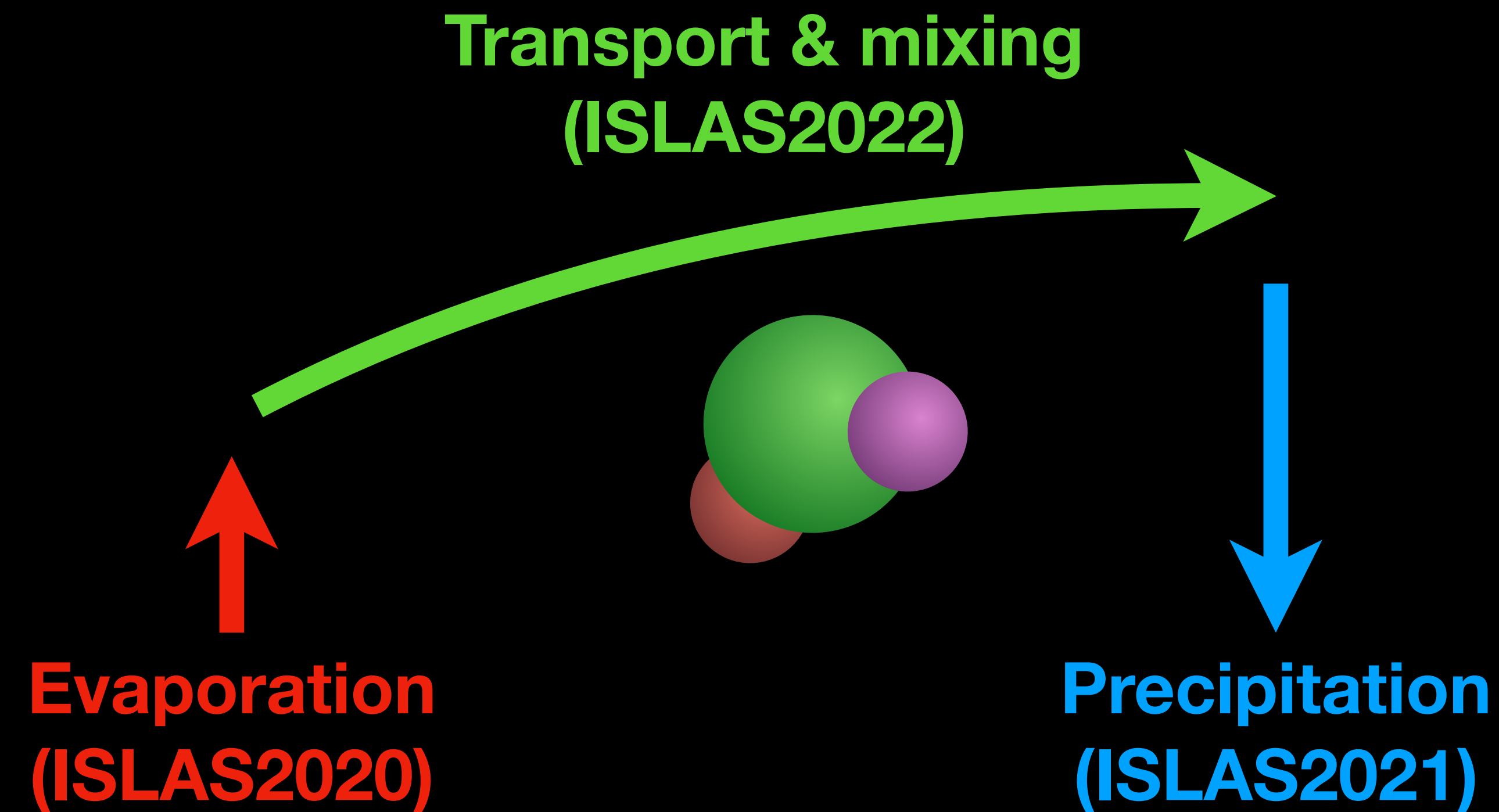
Airborne water vapour isotope measurements

Picarro CRDS analyzer L2130-i, 5 Hz

- Calibration
- Meas. artefacts
- Vapour & condensate



Local water cycles during marine CAOs as a testbed for using stable water isotopes





Feb/Mar 2020

ISLAS 2020

Seidl et al., AMT, 2023
Seidl et al., ESSD, 2026

Dekhtyareva et al., in prep.
Johannessen et al., in prep.



March 2021

ISLAS 2021

Dekhtyareva et al., ESSD, 2026
Steinslid et al., in prep.
Zwart and Sodemann, in prep.

Gjelsvik et al., 2025

PhD Marie Eichholz
PhD Angel Ignatious
PhD Christoffer Høvås

ISLAS 2022



April 2022

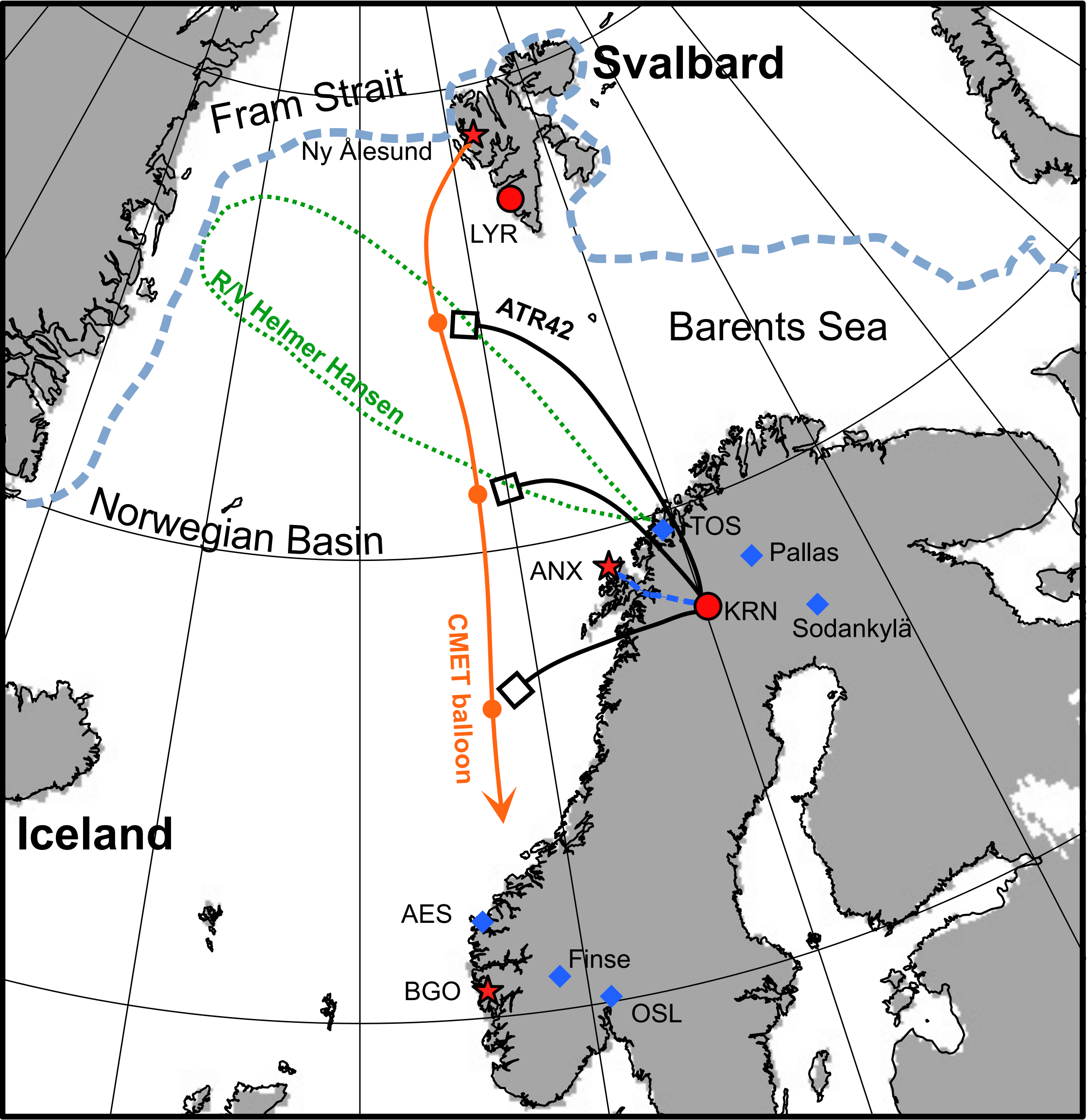
Watch the ISLAS 2022 movie here ->



Løklingholm et al., submitted
Sodemann et al., in prep.
Steinslid et al., in prep.

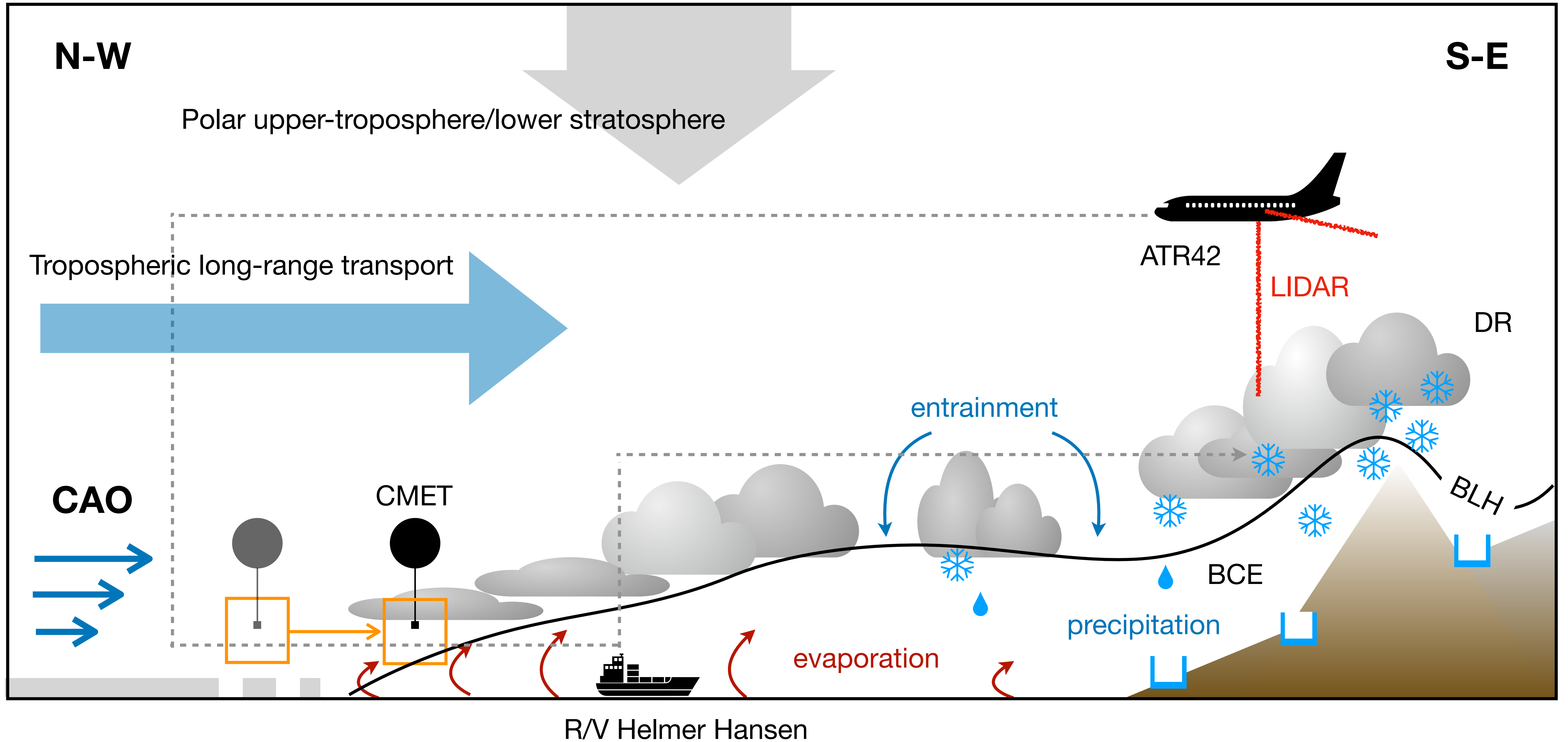
Larsgård et al., submitted
Steinslid et al., in prep.

ISLAS2022 science objectives



Science aim	Priority
In-situ fractionation from (quasi-) Lagrangian airmass sampling	1
Evaporation signature of water isotopes in water vapour	1
Mixing of the BL vapour and entrainment of free-troposphere air	1
Isotope fractionation during mixed-phase cloud processes	1
Conservation of second-order isotope parameters	1
Spatial representativeness of stable isotope measurements	2
Isotope signal of warm-air intrusions from mid-latitudes	3

ISLAS2022 measurement strategy



17 March
to 8 April
2022

