At what spatial and temporal scales do we gain useful information from stable water isotope observations?

Harald Sodemann
Geophysical Institute, University of Bergen and Bjerknes Centre for Climate Change, Bergen, Norway

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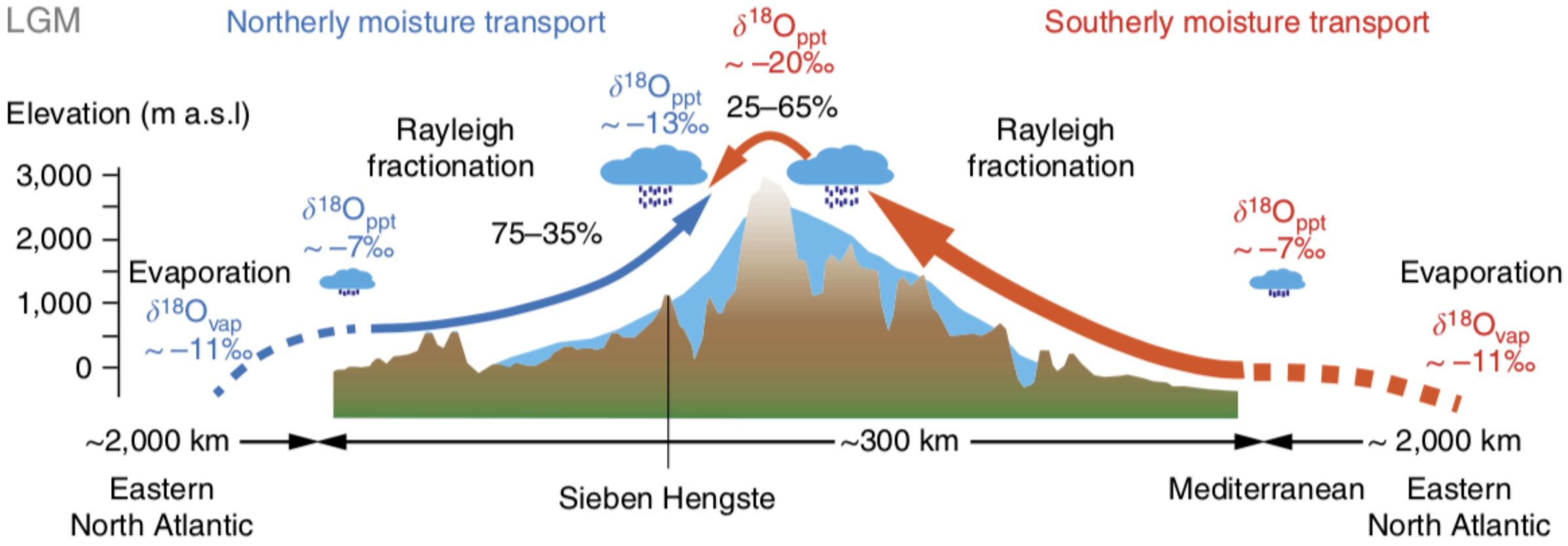
Revised and evolving concepts

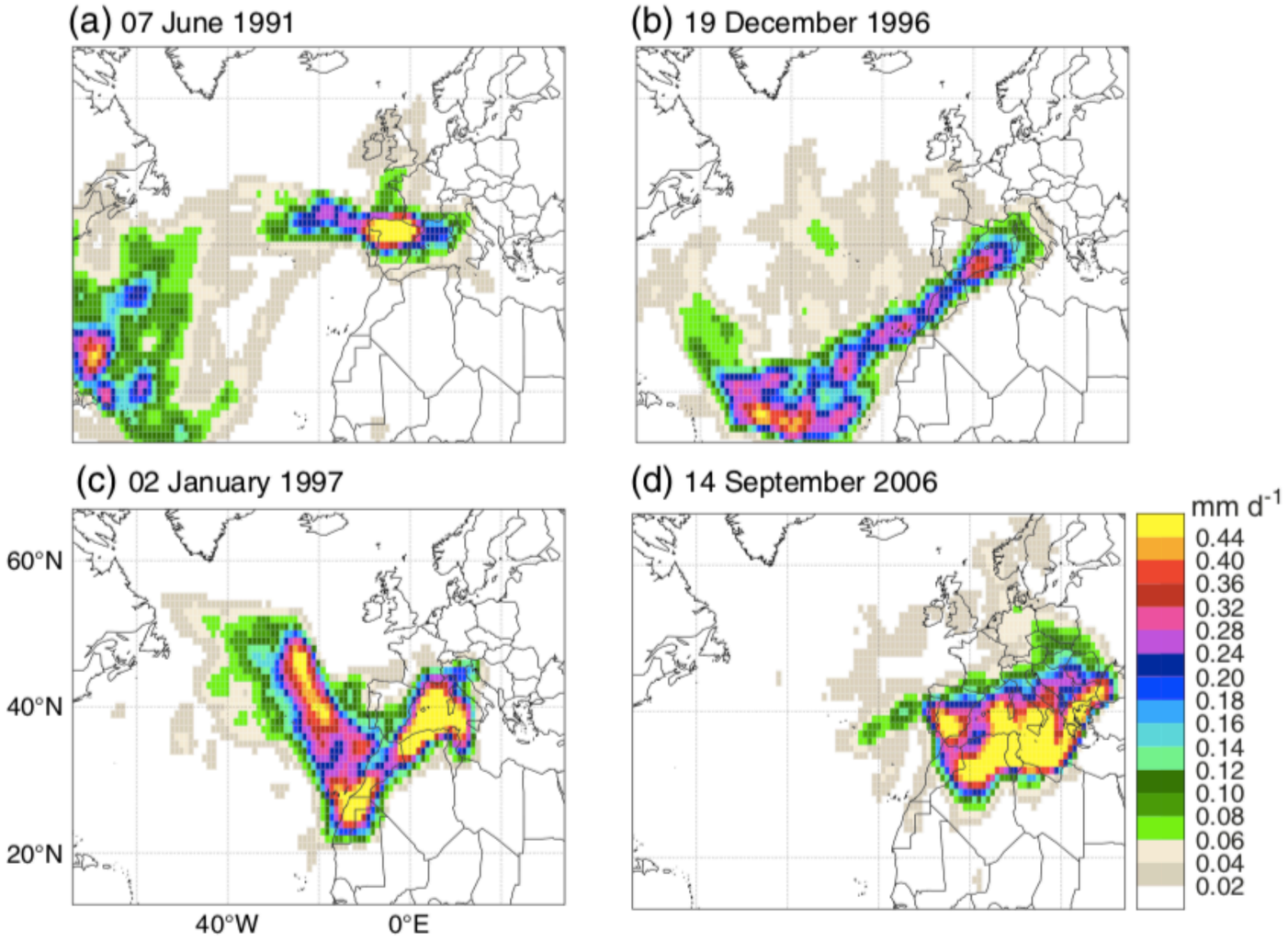
Towards a dynamic view on moisture transport



Luetscher et al., 2015

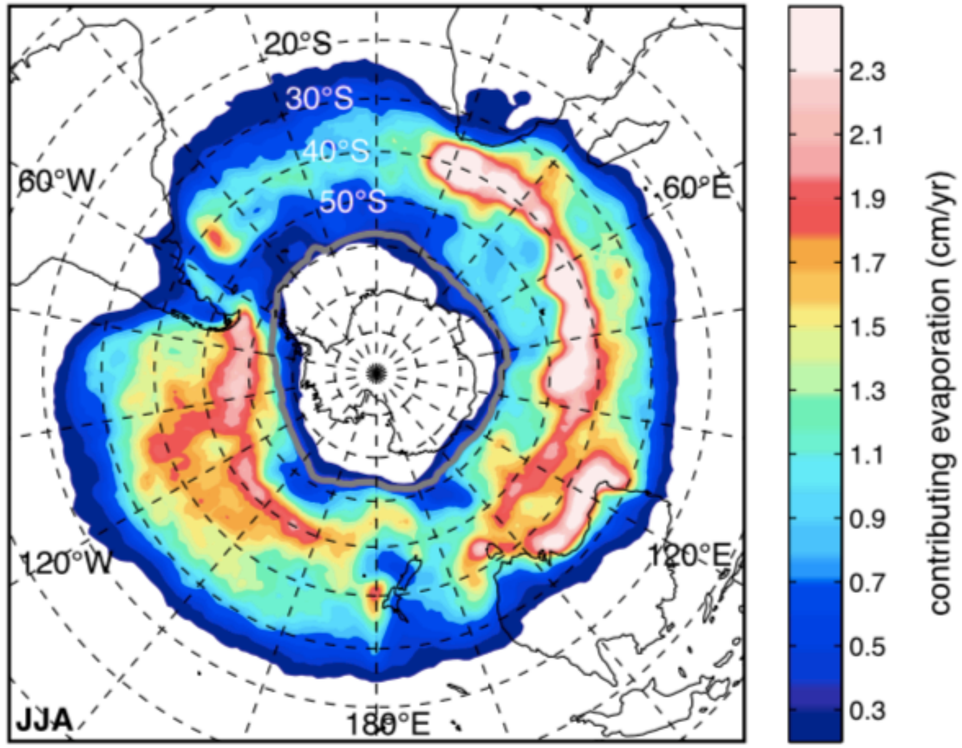
A weather system perspective

Mediterranean HPEs



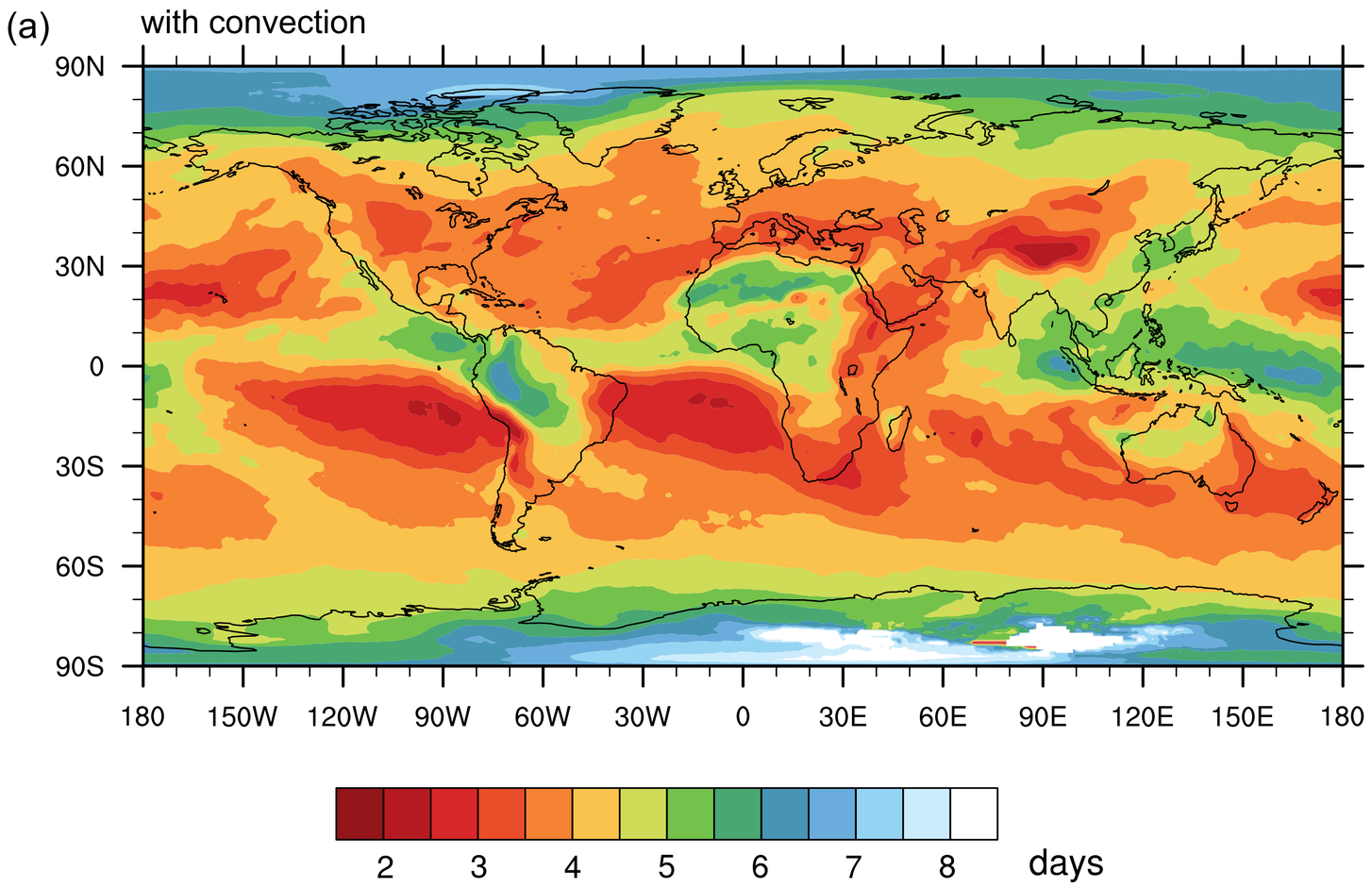
Winschall et al., 2014

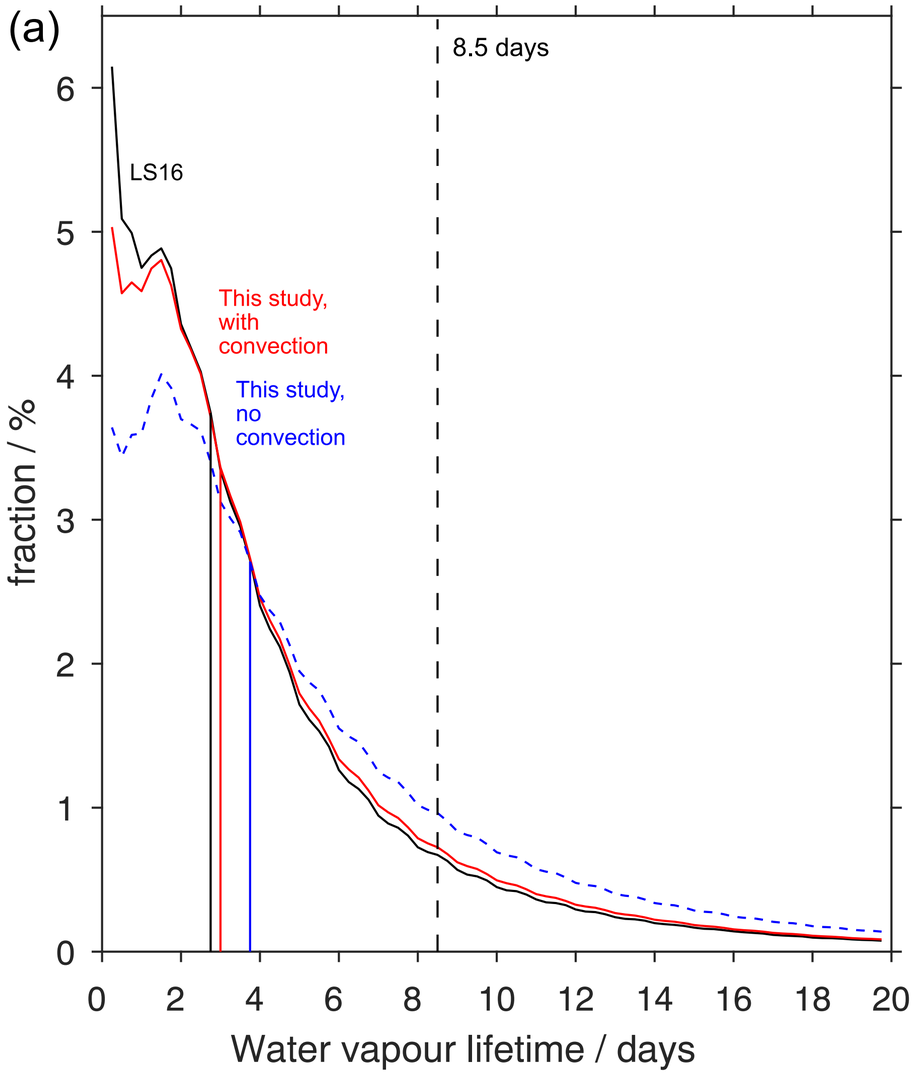
Antarctica, MAM



Sodemann and Stohl, 2009

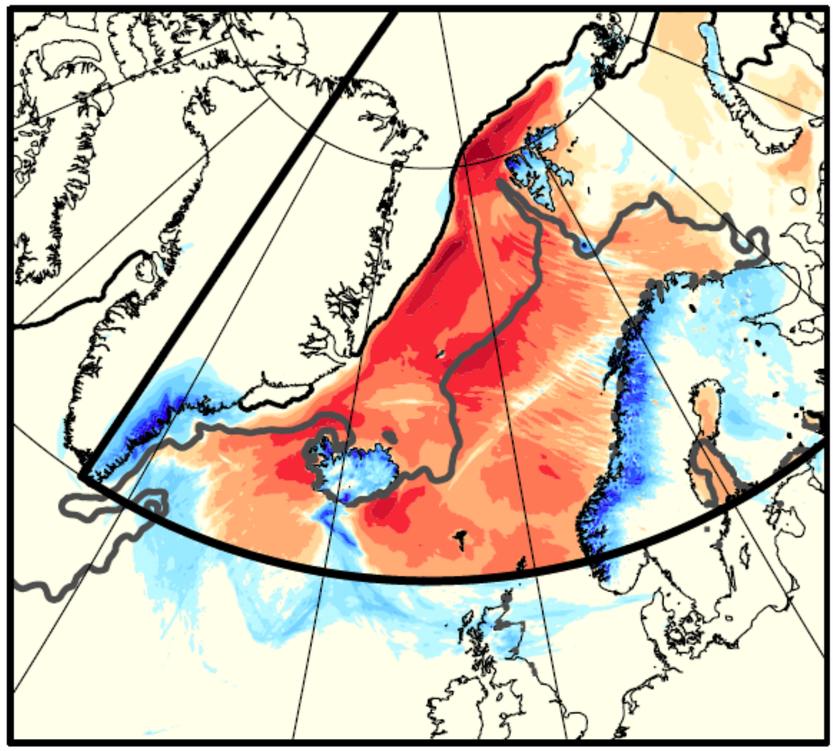
Moisture life time distributions





Sodemann, 2019, revised

Targeting local water cycles



Papritz and Sodemann, MWR, 2018

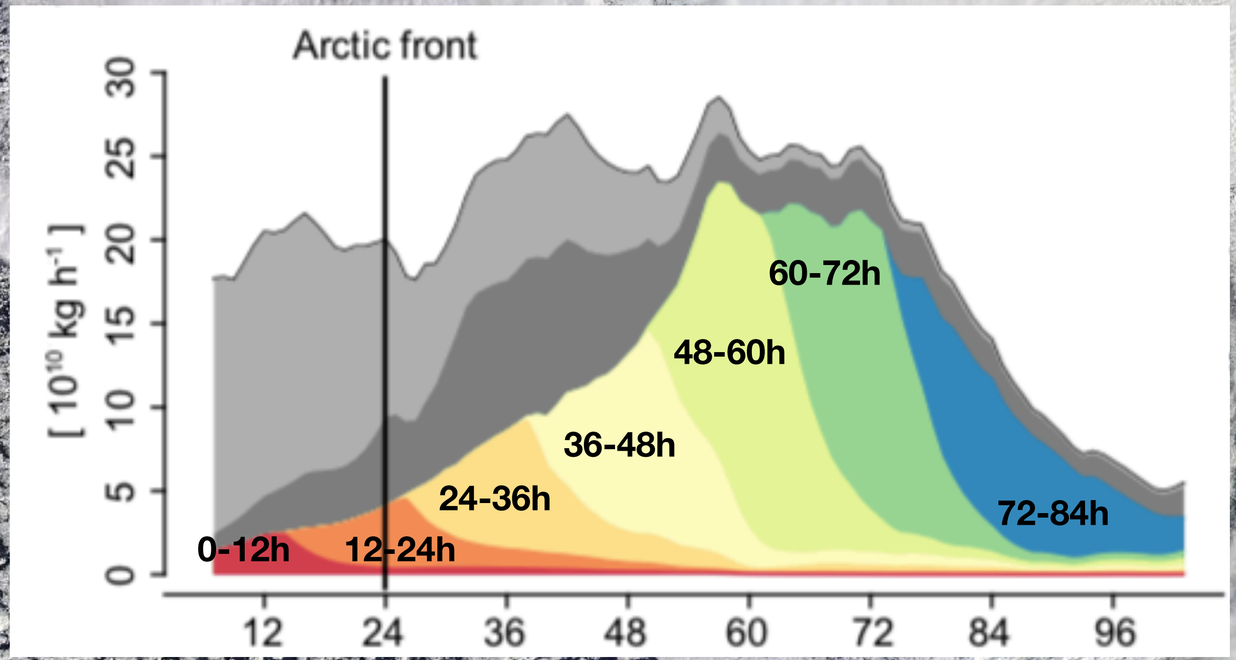
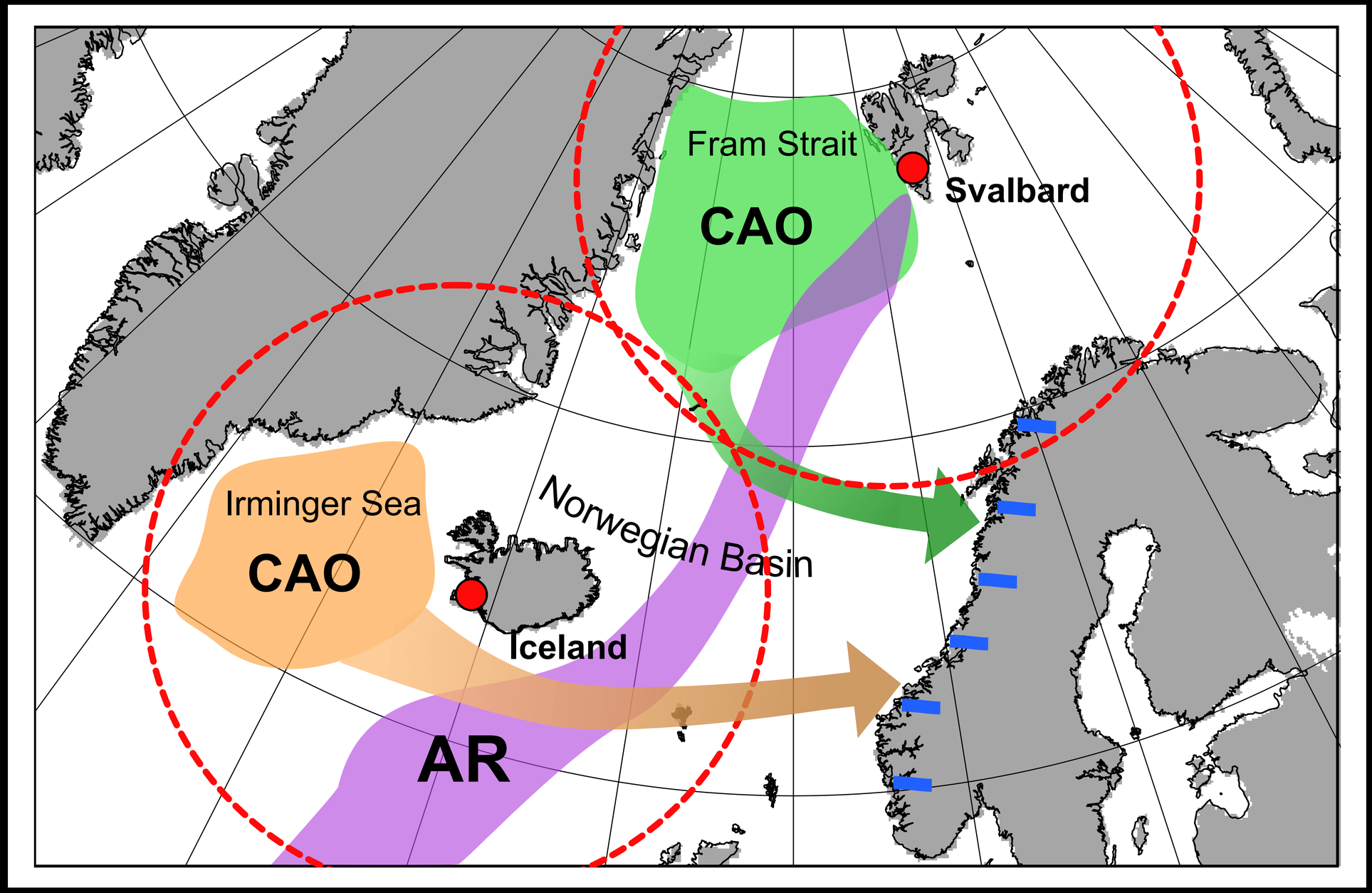


Image ©: MODIS on Aqua, NASA Worldview

Measurement opportunities: going in-situ



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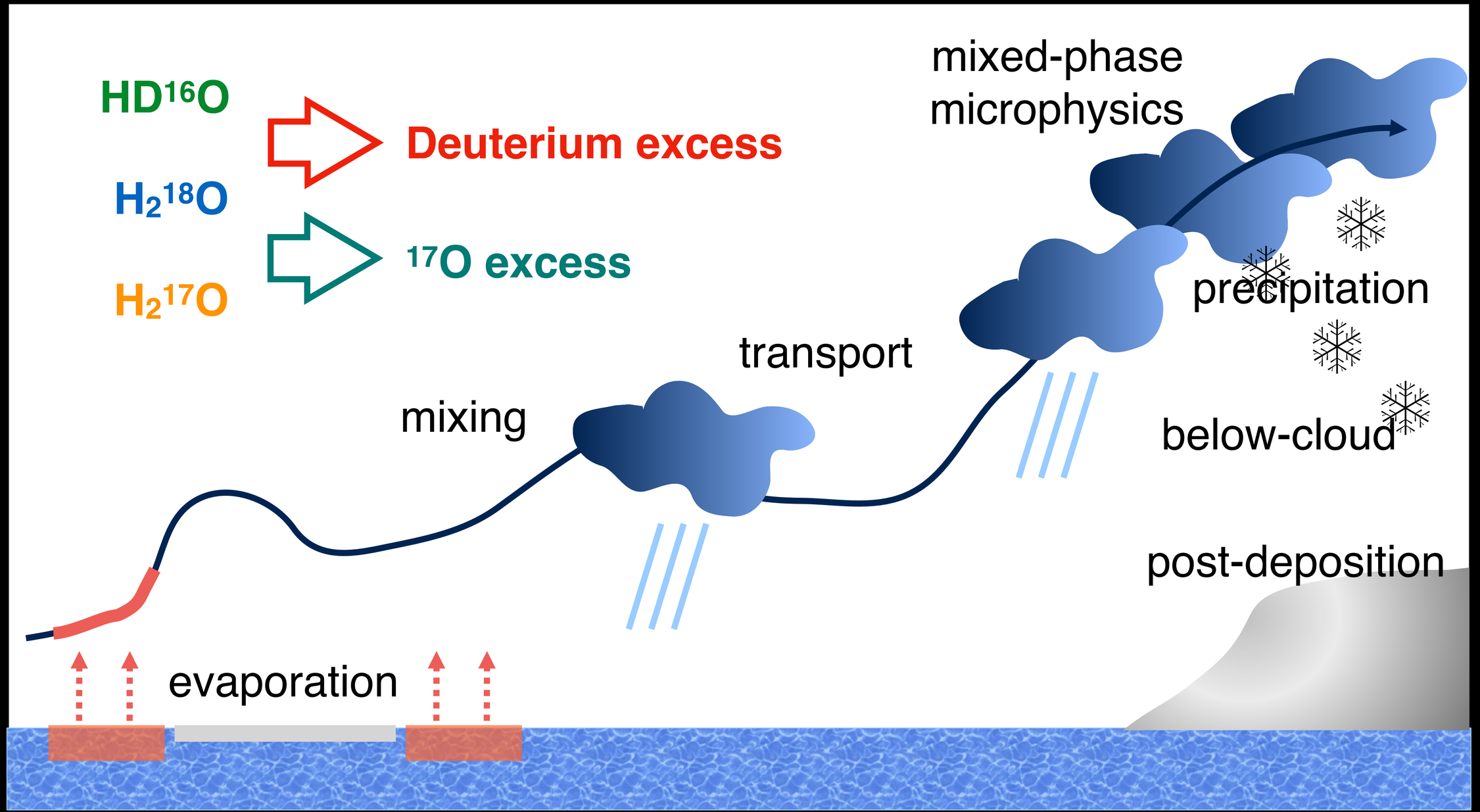
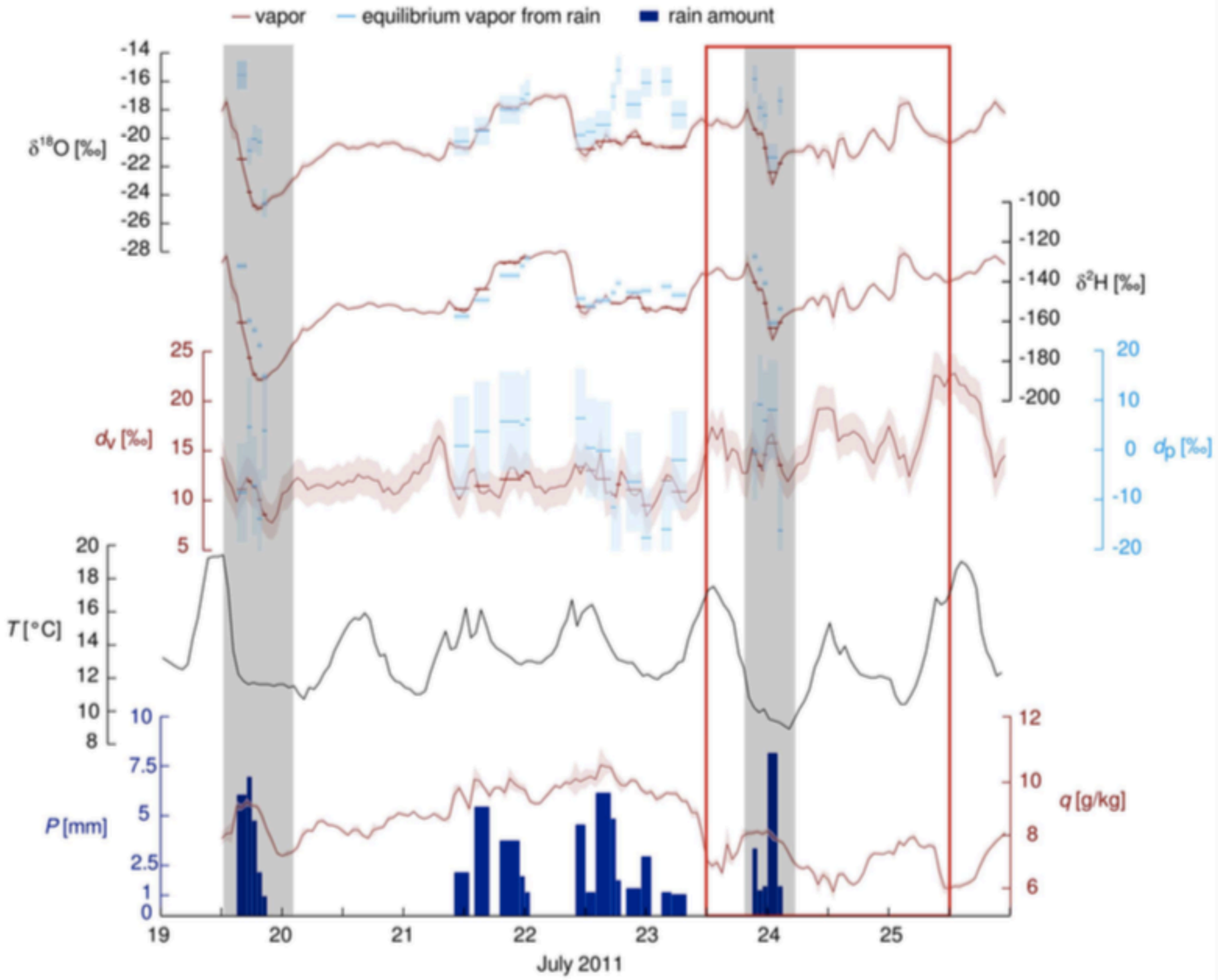
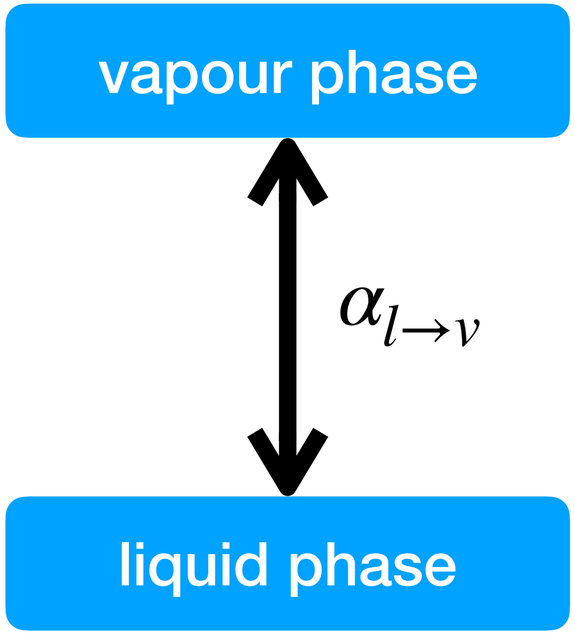
Disentangling different processes from measurements and modelling



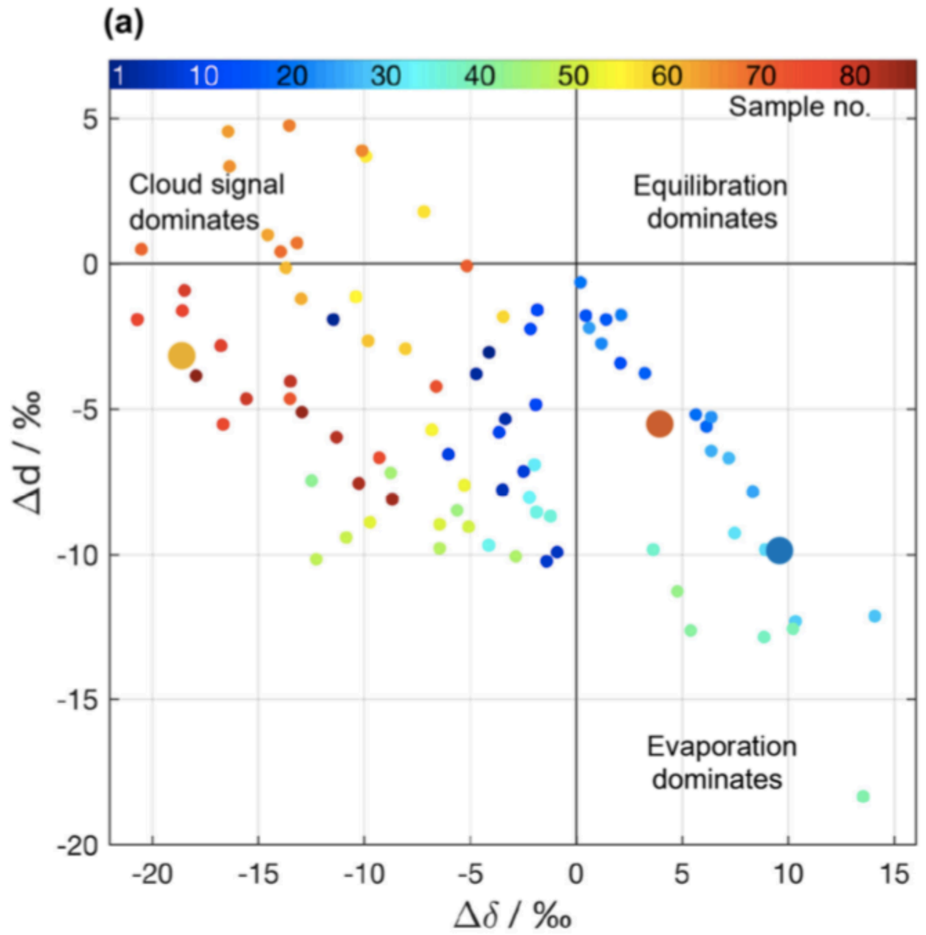
Interpretation framework: equilibrium vapour

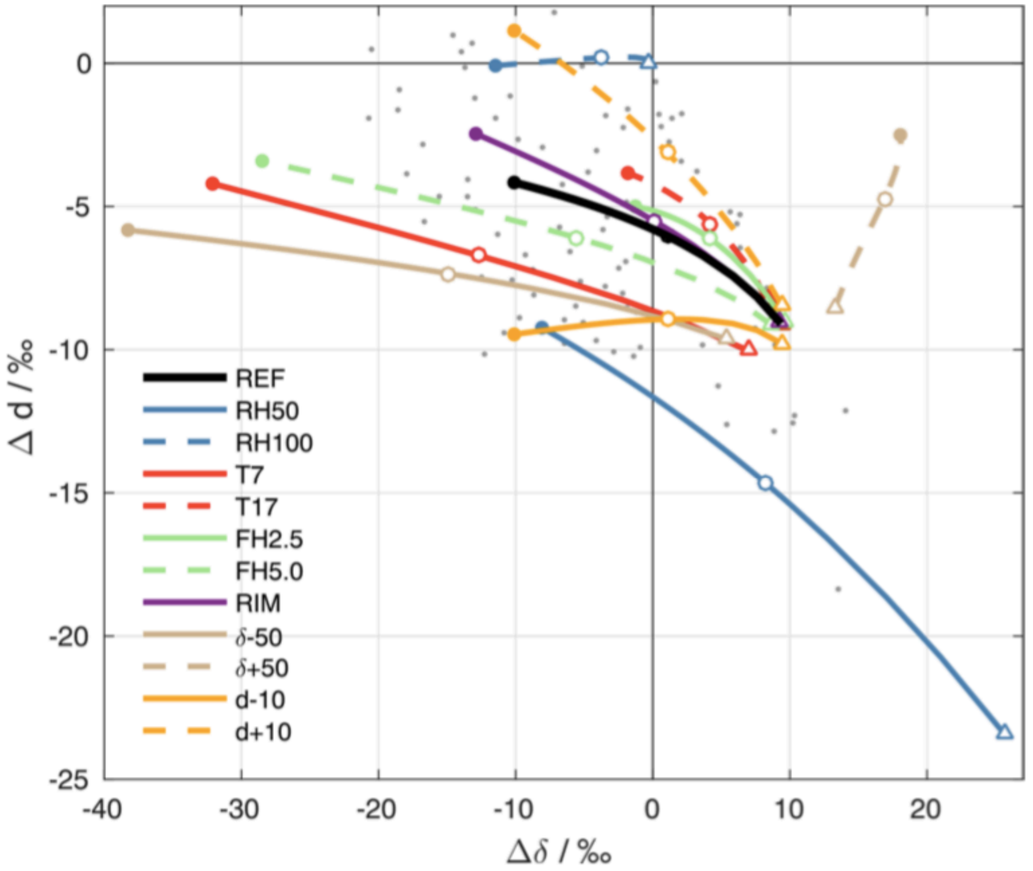




Aemisegger et al., GRL, 2015

Interpretation framework: $\Delta\delta - \Delta d$ diagram





Graf et al., ACP, 2019

Isotope measurement platforms and procedures

Ultralight Aircraft

Icebreaker KV Svalbard

Laboratory

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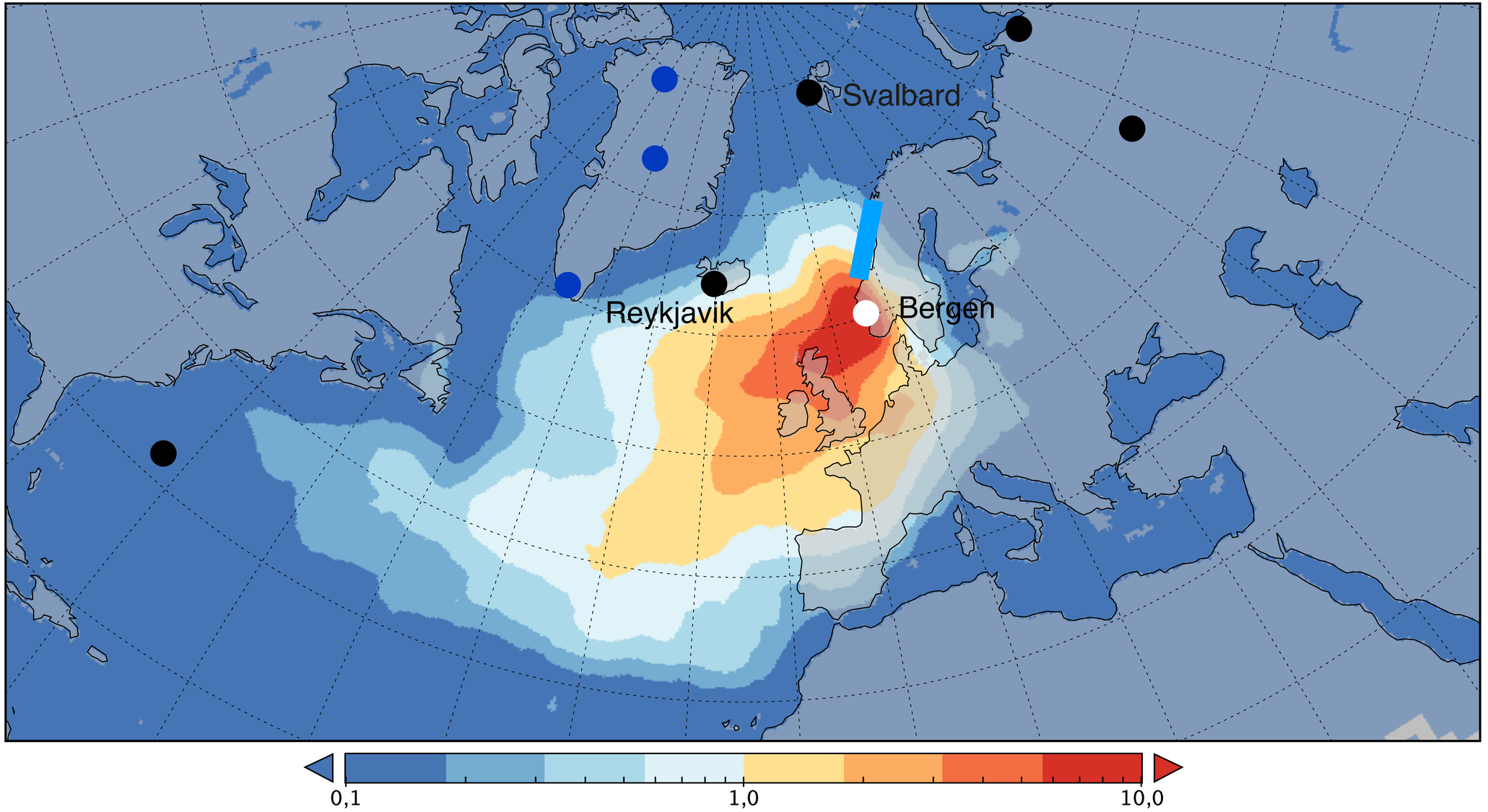
Reliability and intercalibration
Sharing tools and routines

A citizen science campaign with sample return

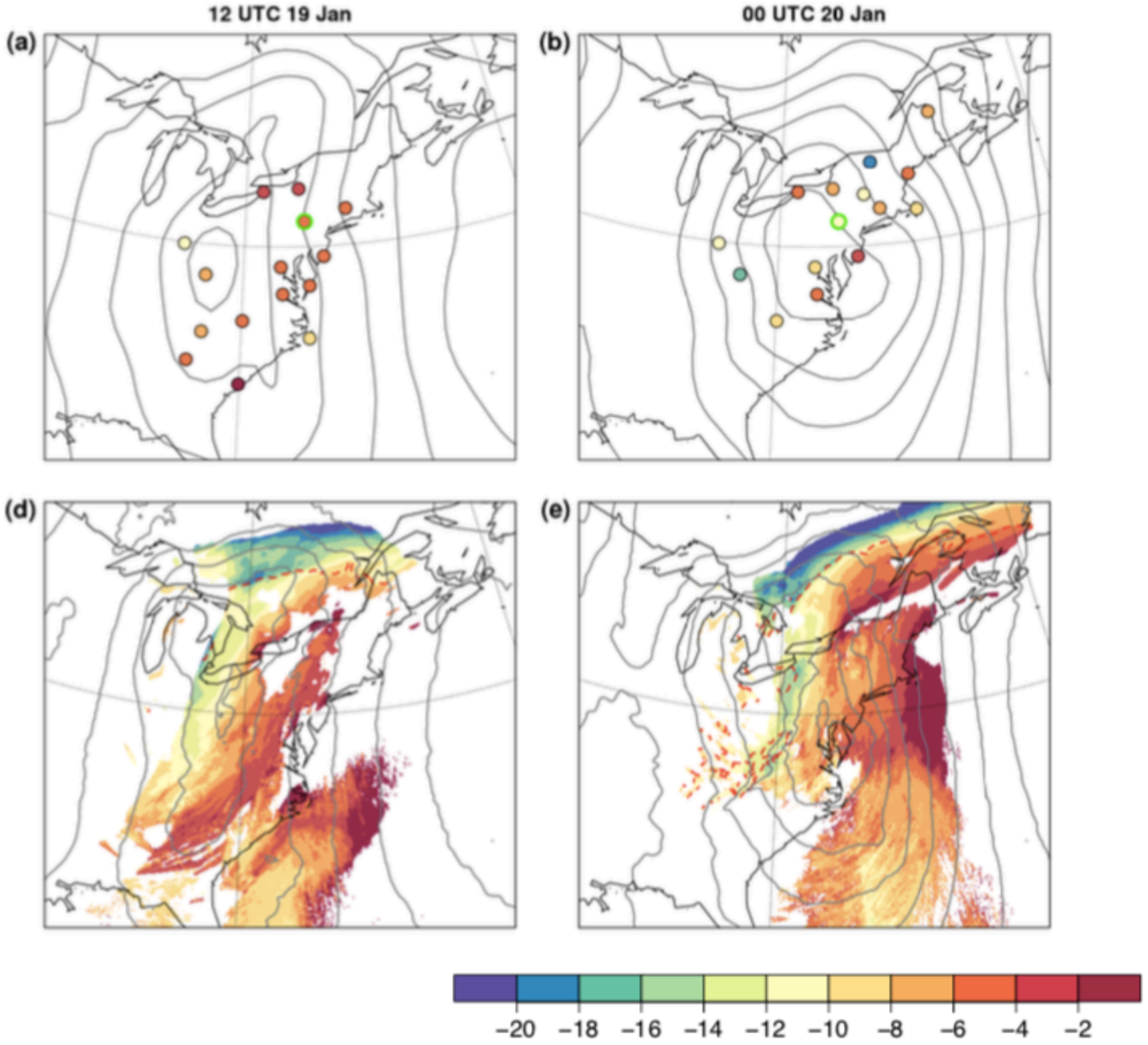
- Information
- Preparing snow kits
- Sample kit distribution
- Distributing snow kits
- Arranging sample return
- Analysis and interpretation
- Communication

Networks of stable isotope measurement stations



Moisture sources for Bergen during 2013 (10^{-3} mm day^{-1})

Isotope-enabled regional models as "gold standard"



Pfahl et al., 2012

COSMOiso
MAR
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AROME
…

Parameterisations
Error compensation
Observations
Representativeness

Better global models due to stable isotopes

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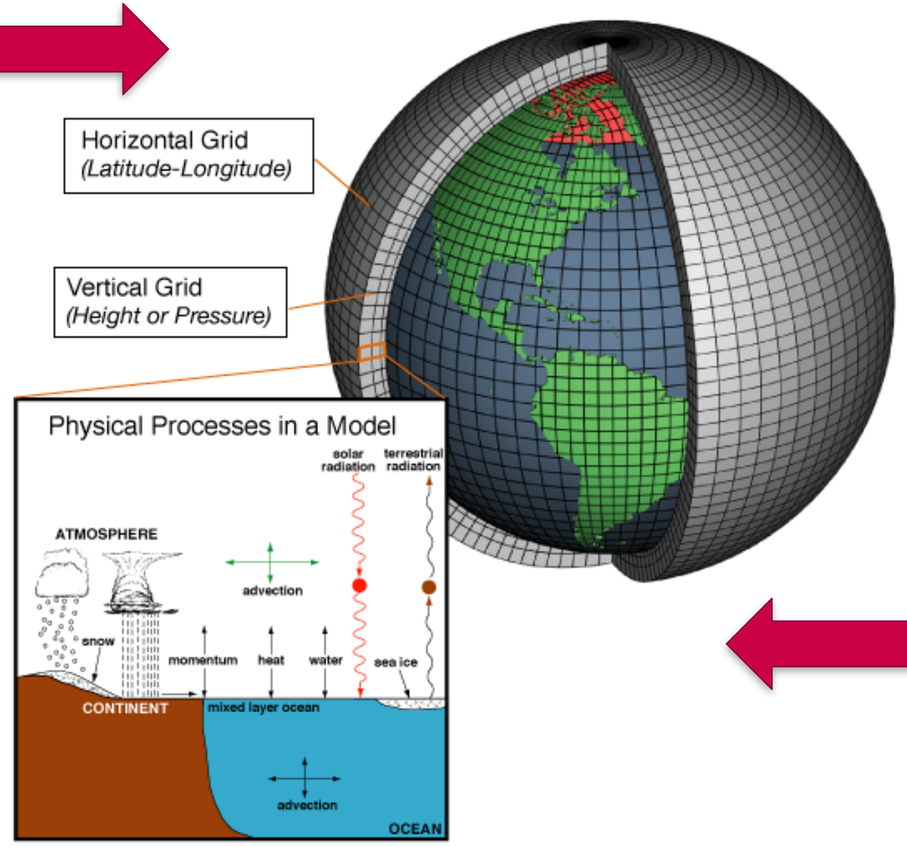
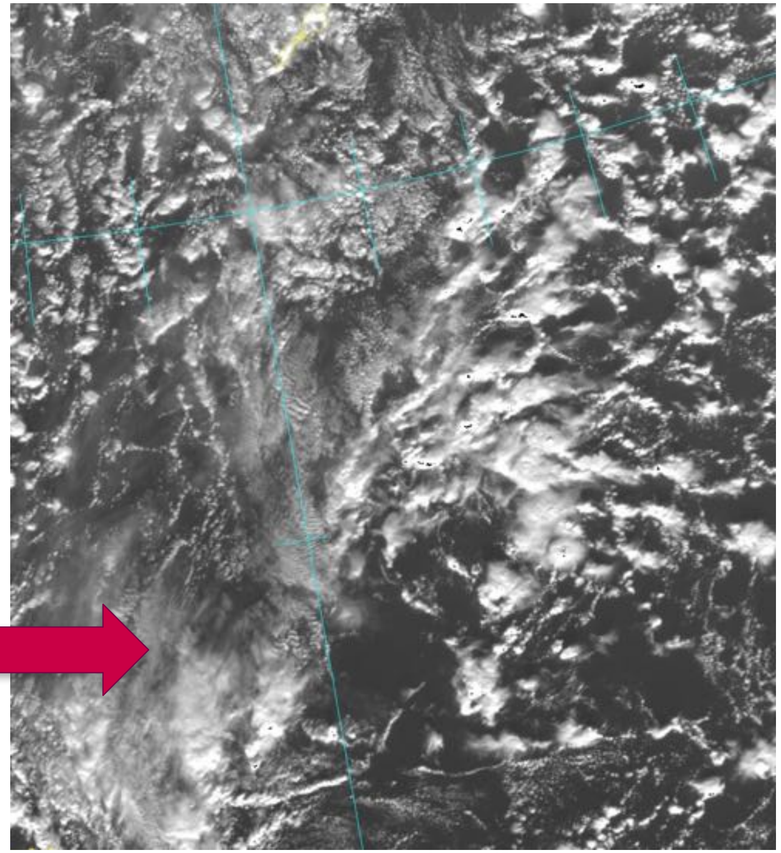
BCCR subgroup "Water cycle and water isotopes"

Massflux conservation within CAM5/NorESM
NorESM with stable water isotopes
Stable water isotope coupling across components





Conclusions

Perspectives on the water cycle are evolving
- moisture sources vary with weather systems
- the lifetime of precipitation has a highly skewed distribution

Spatial representativeness is a prerequisite for model-observation comparisons.

Information contained at short time scales for precipitaiton

Intercomparison of measurements and sharing of methods is key

Forthcoming campaigns will allow to consider the coupling between the components of the water cycle

Regional and global models constrained by stable isotope observations can act as gold standard and progress into operational reach

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