Norwegian Meteorological Institute

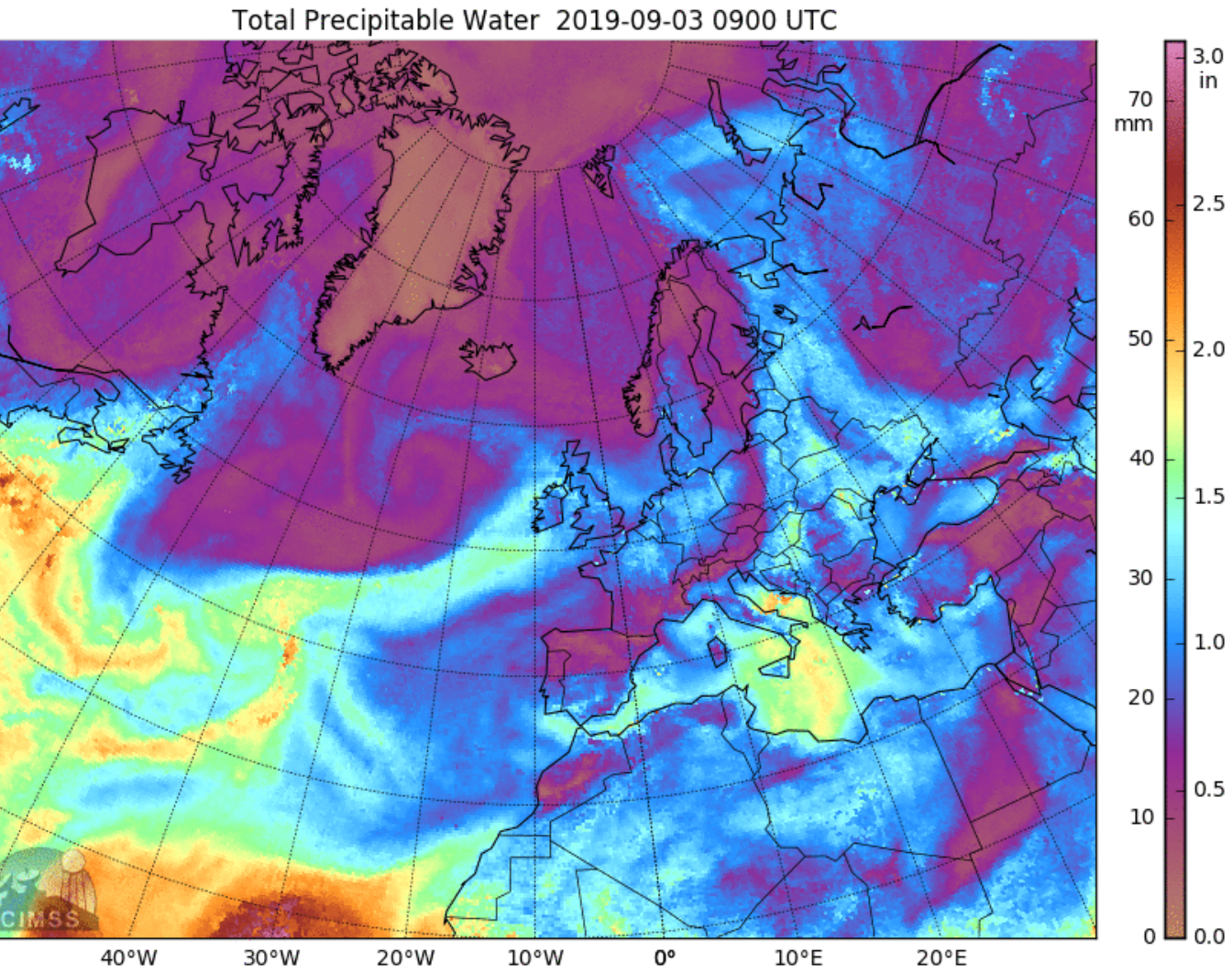
UiO : Universitetet i Oslo

Applying NWP-ensembles to identify different large scale setups for analyzing local extreme precipitation: A case study

Karianne Ødemark, Ole Einar Tveito, Malte Müller

Lillehammer, 17.9.2019

Extreme precipitation in Norway



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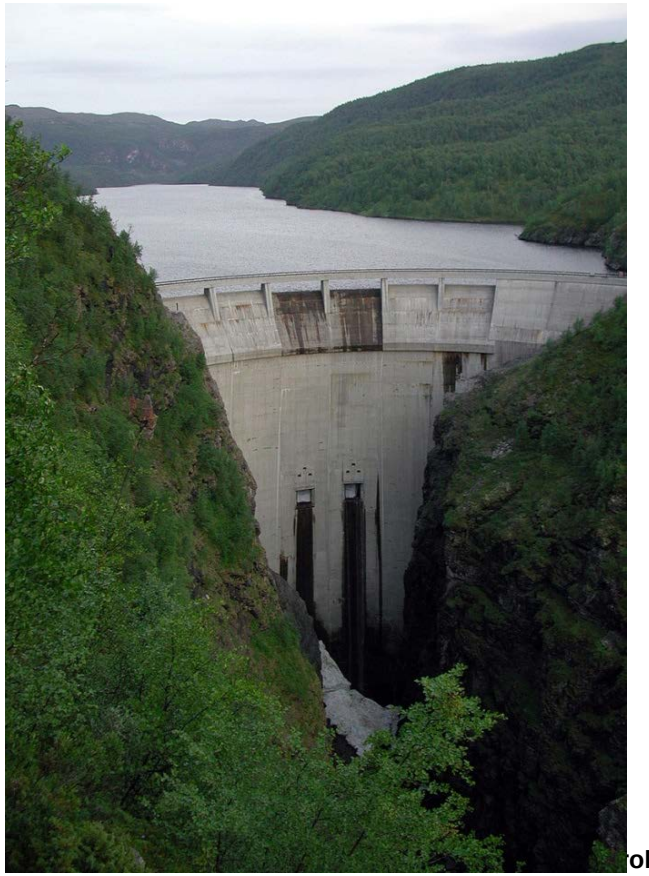
Probable maximum precipitation – PMP

PMP is the «theoretical maximum precipitation for a given duration under modern meteorological conditions» (WMO, 2009)



New method for estimating PMP

- PMP-estimate by traditional methodology is sensitive to subjective choices, and observation coverage.
- WMO recommend to calculate PMP in areas with orography using physics rather than statistics.
- There are efforts in different groups to develop a new method for estimating PMP

Maximize precipitation by shifting the boundary conditions in the model

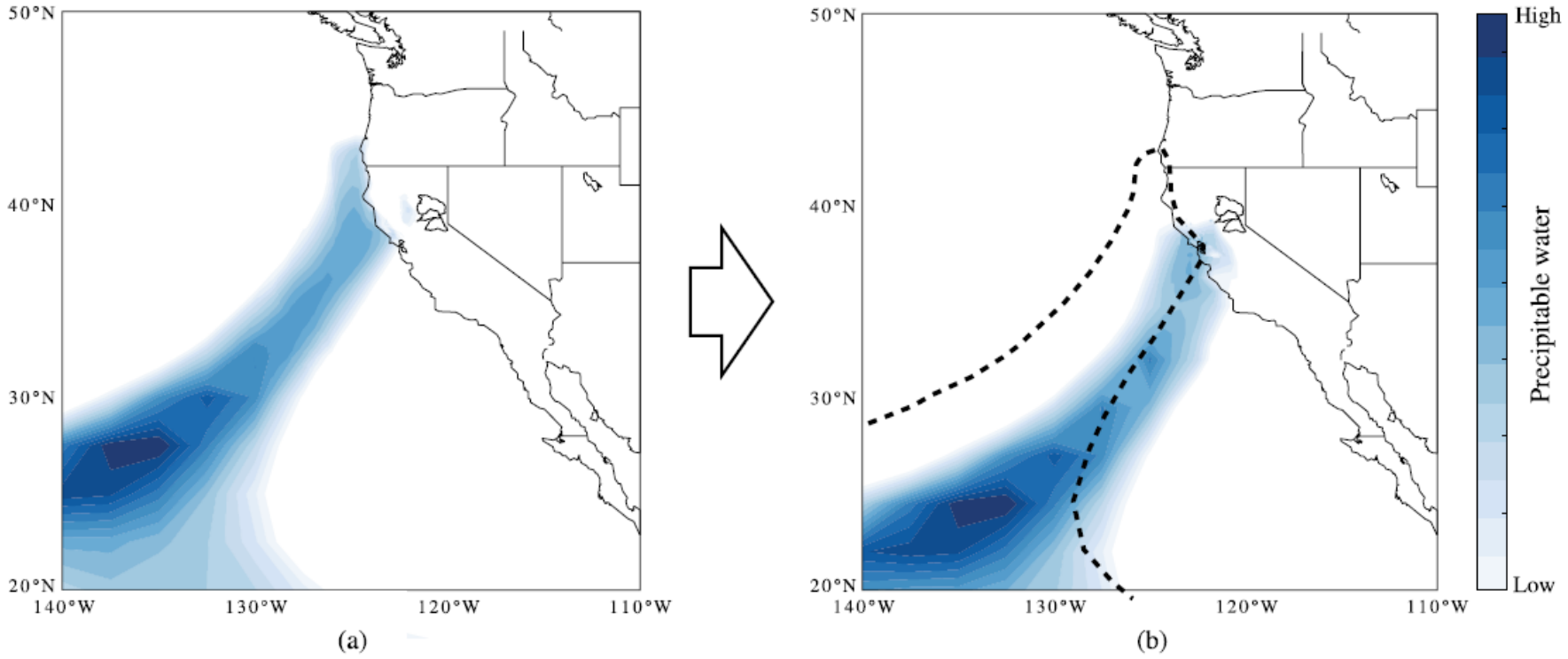


Fig. 2. Concept of atmospheric boundary condition shifting; positions of atmospheric river are based on precipitable water: (a) before shifting; (b) after shifting

Ishida et al 2014

Goals

- Is there a way to estimate maximum precipitation over catchments in Norway in a consistent and physical way?

Model chain: global – regional – catchment scale

10 ensemble members

Perturbation of intitial conditions

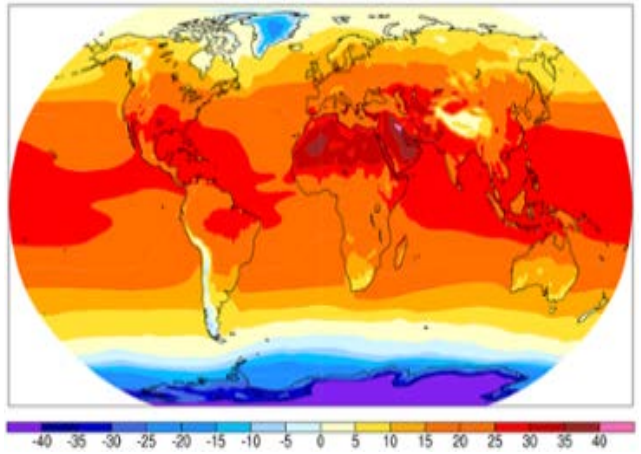
Detection of extreme event

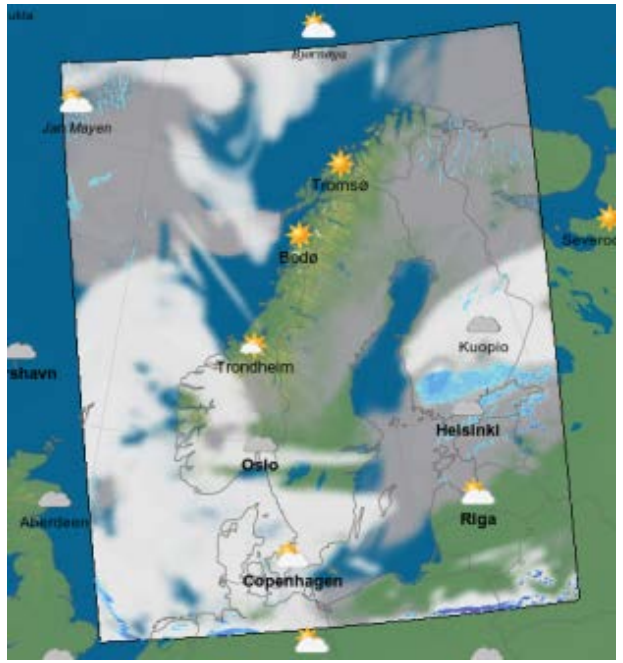
30 years EC-EARTH present climate

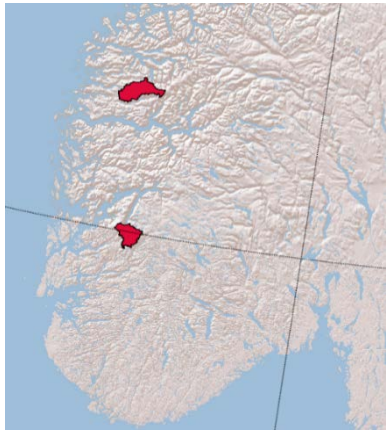
EC-Earth (global model)

AROME MetCoOp (regional model)

Investigate precipitation extremes on catchment scale





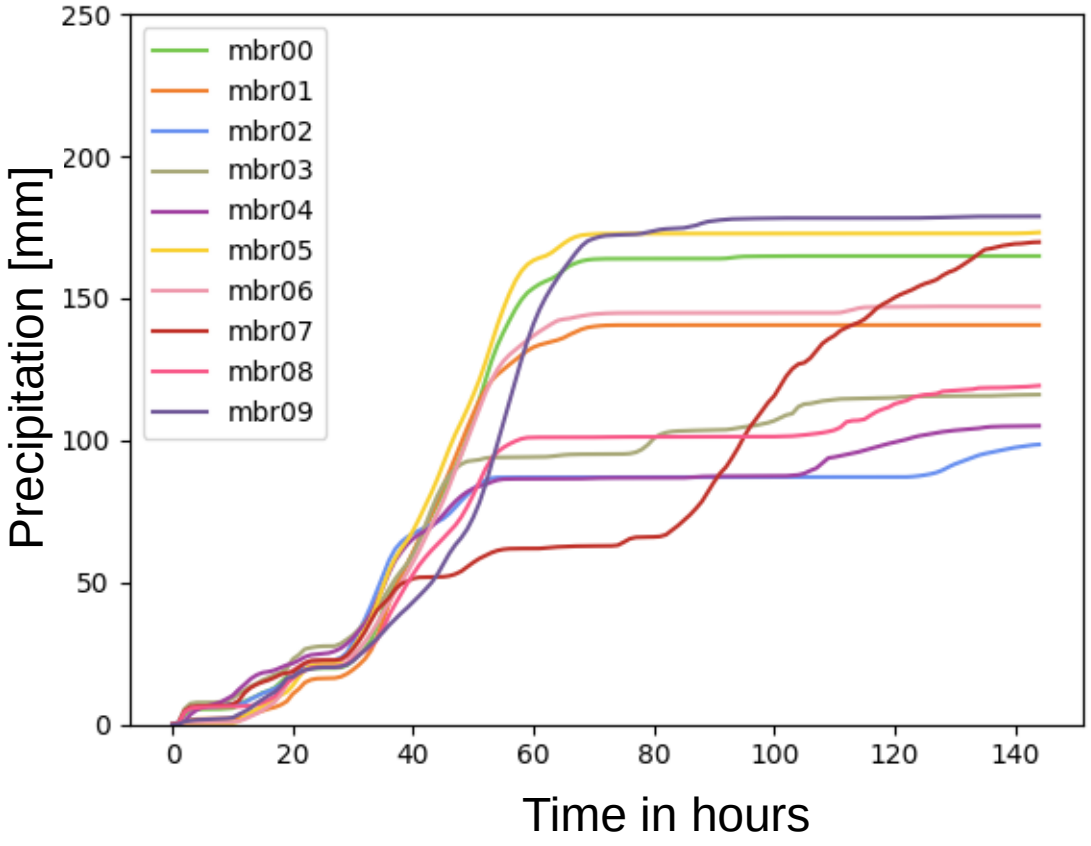



NORWAY


JØLSTRA
OPO

Accumulated precipitation in the two catchments

Jølstra



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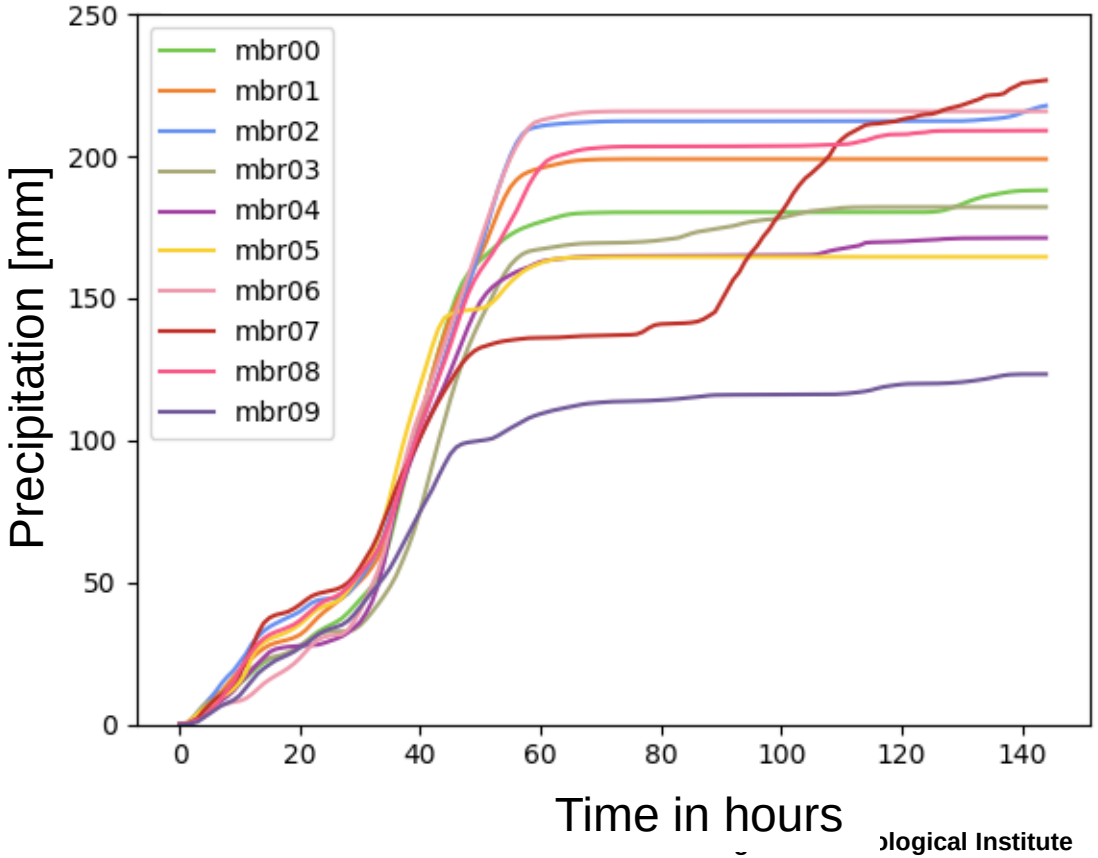
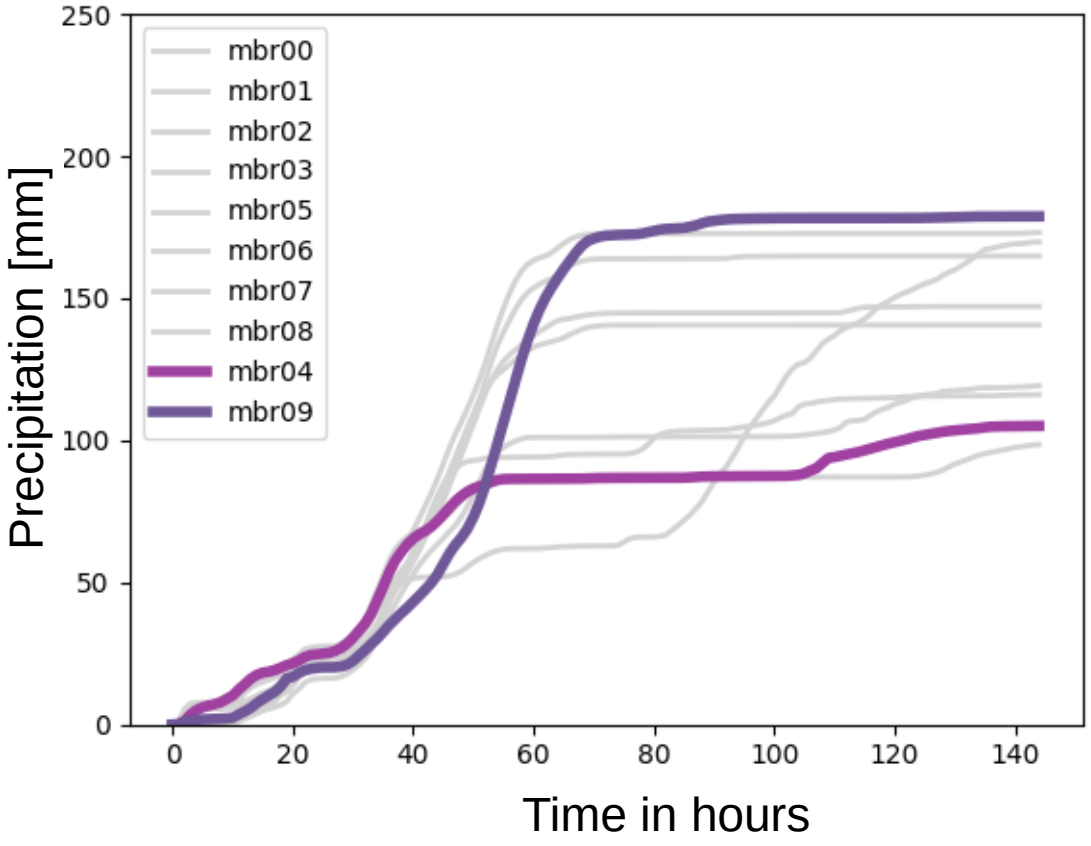


ological Institute

Accumulated precipitation in the two catchments

Jølstra



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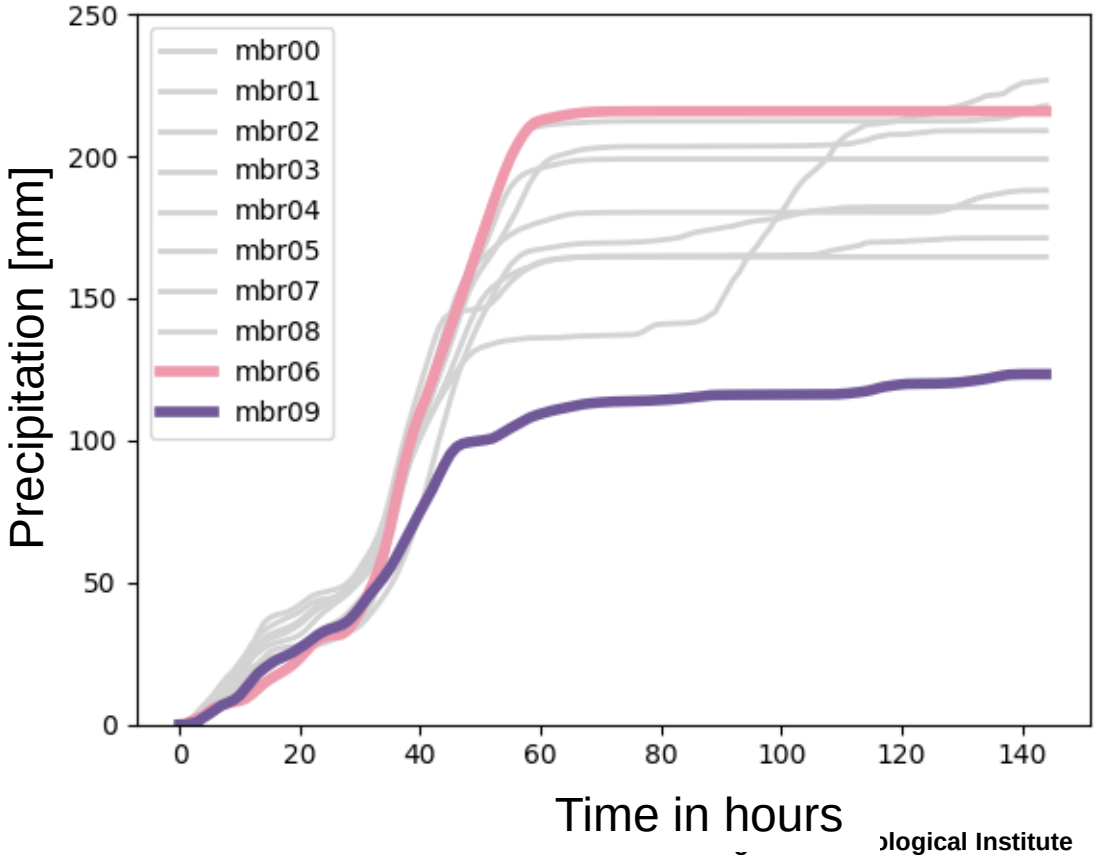
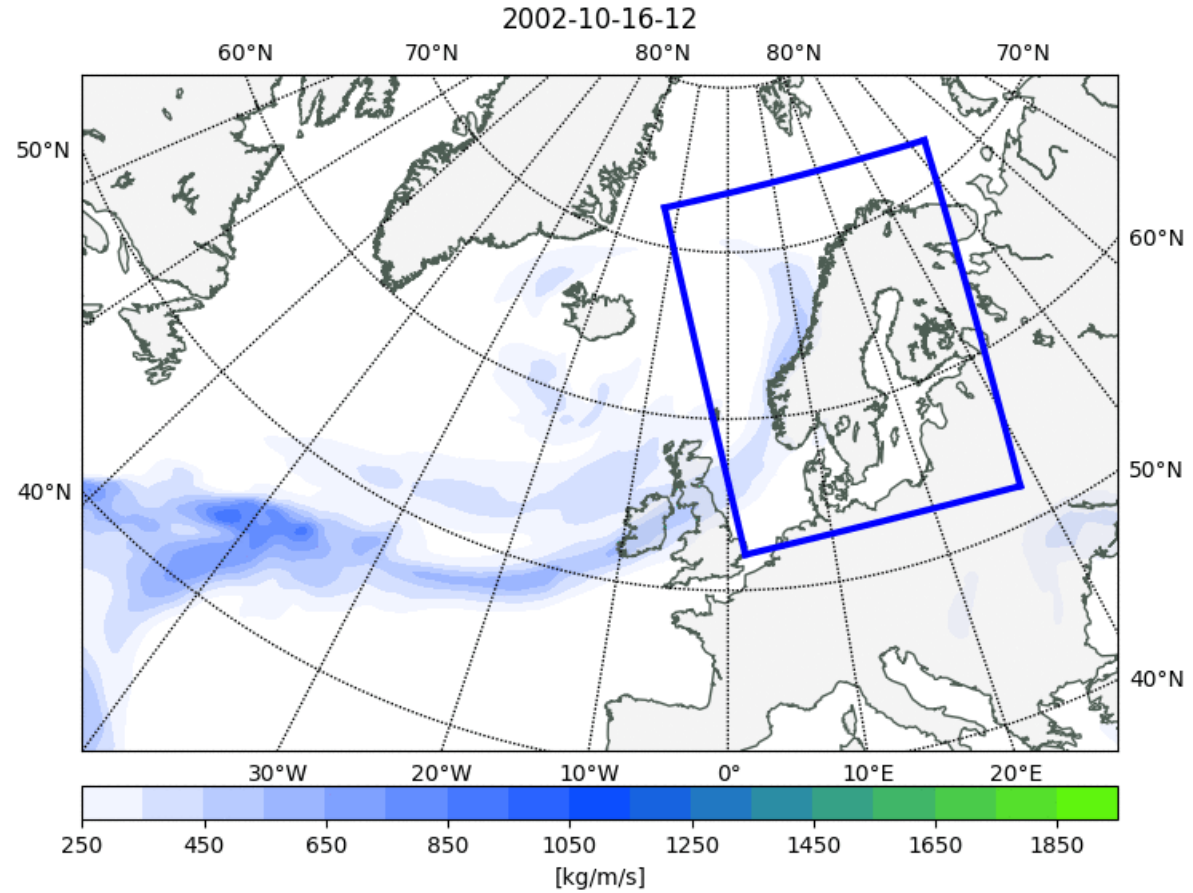


Integrated Water Vapour Transport (IVT) from EC-Earth

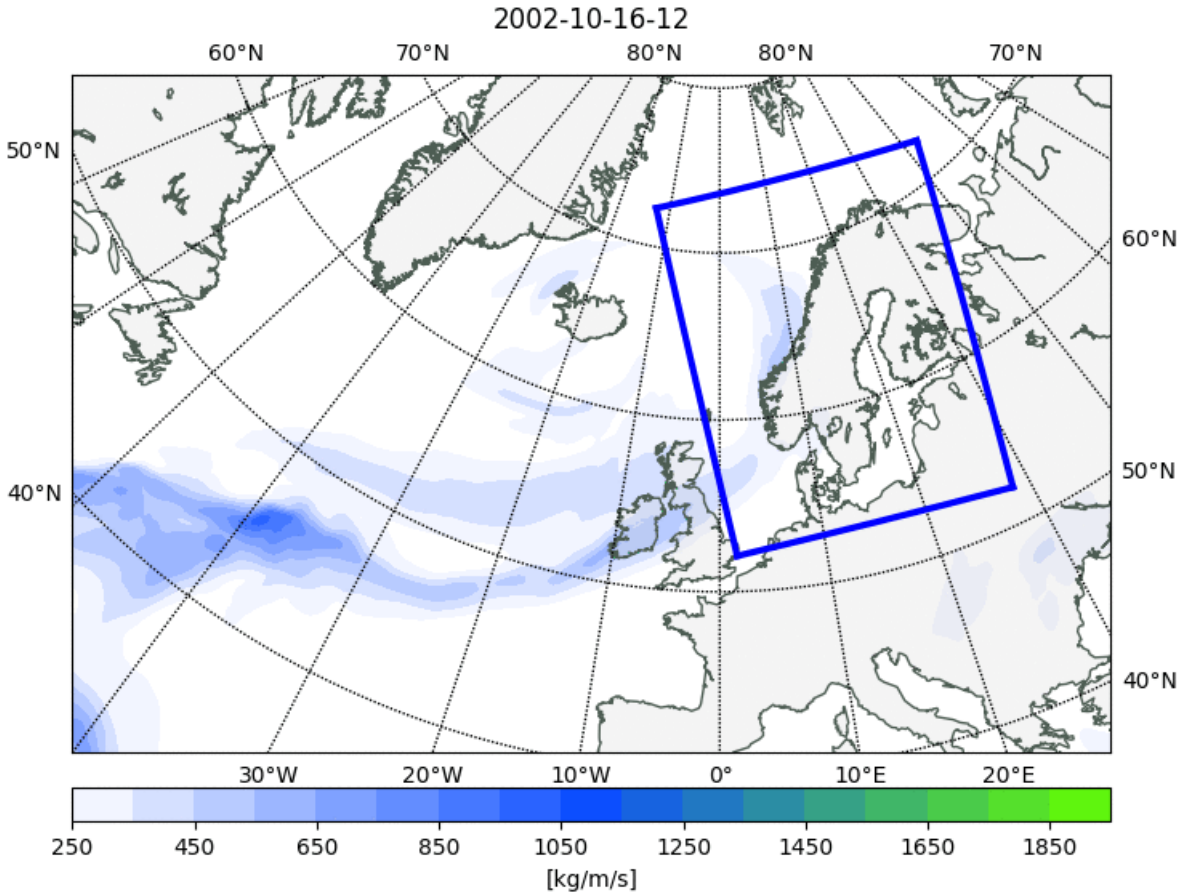
6 days – 6 houerly steps

Member 4: low Jølstra



[kg/m/s]

Member 9: high Jølstra



[kg/m/s]

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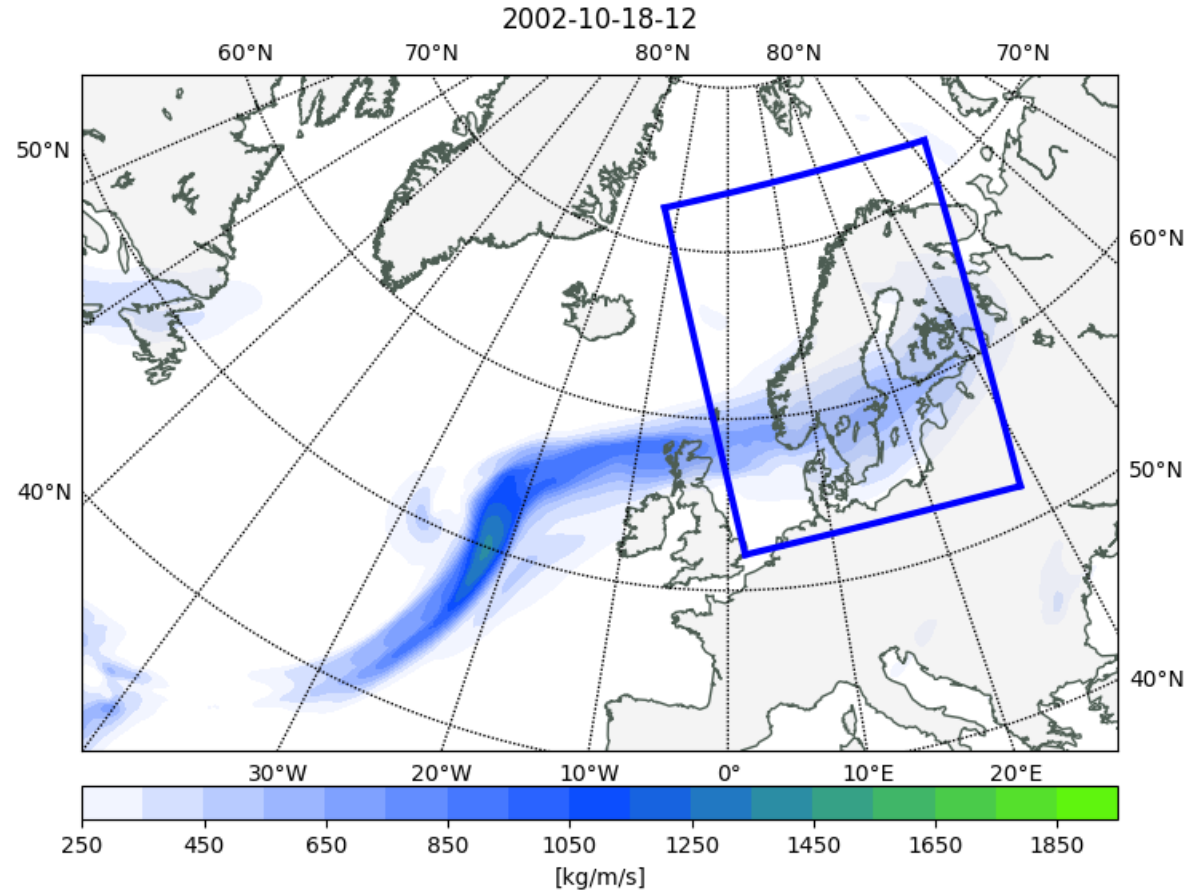

[kg/m/s]

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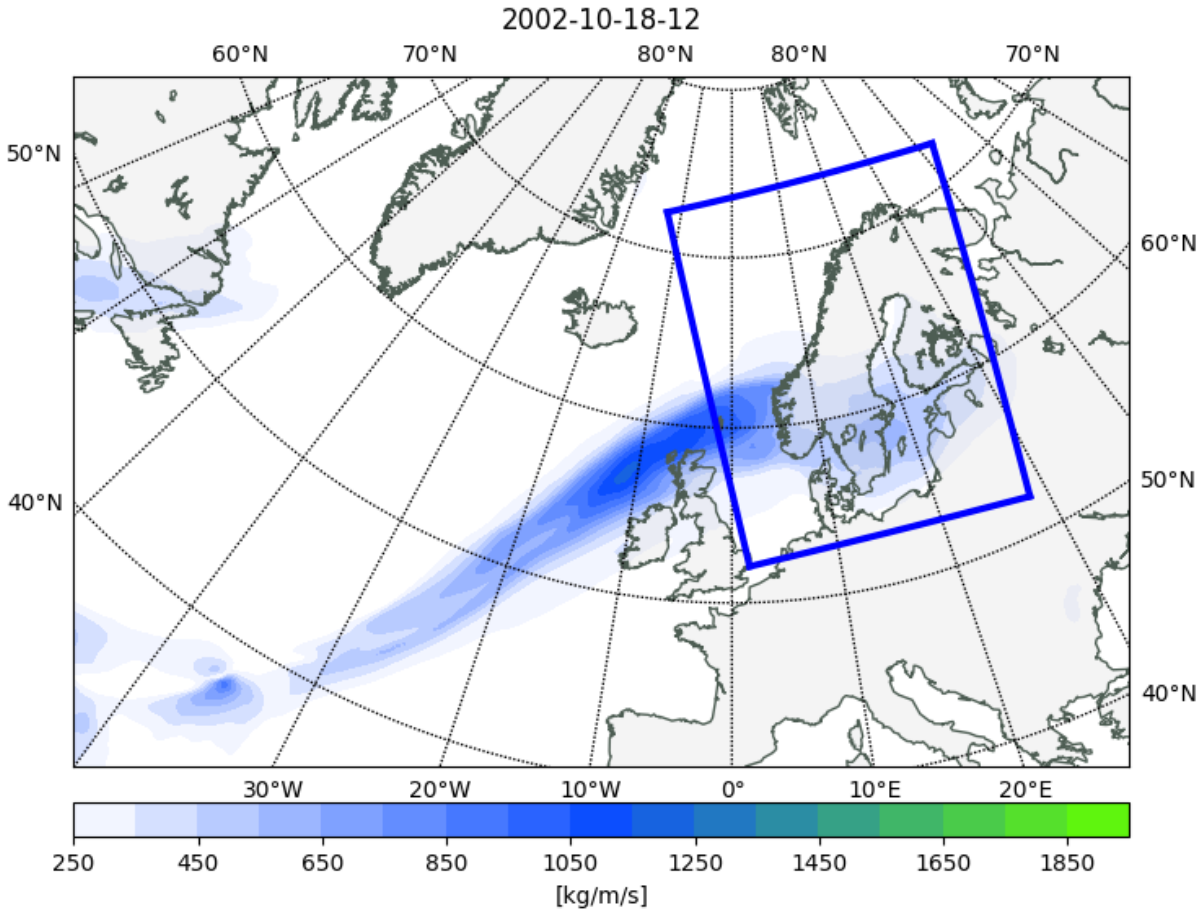
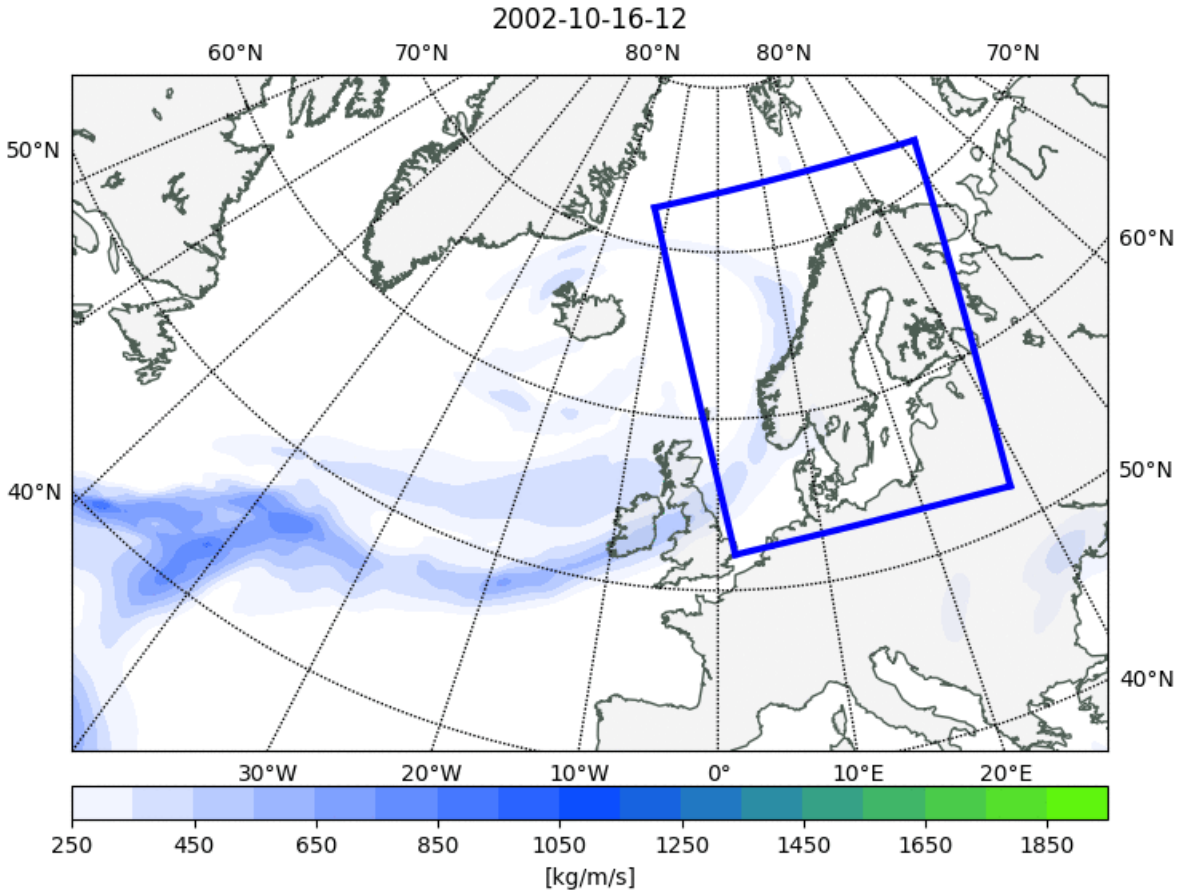


[kg/m/s]

Integrated Water Vapour Transport (IVT) from EC-Earth

Member 6: high Opo



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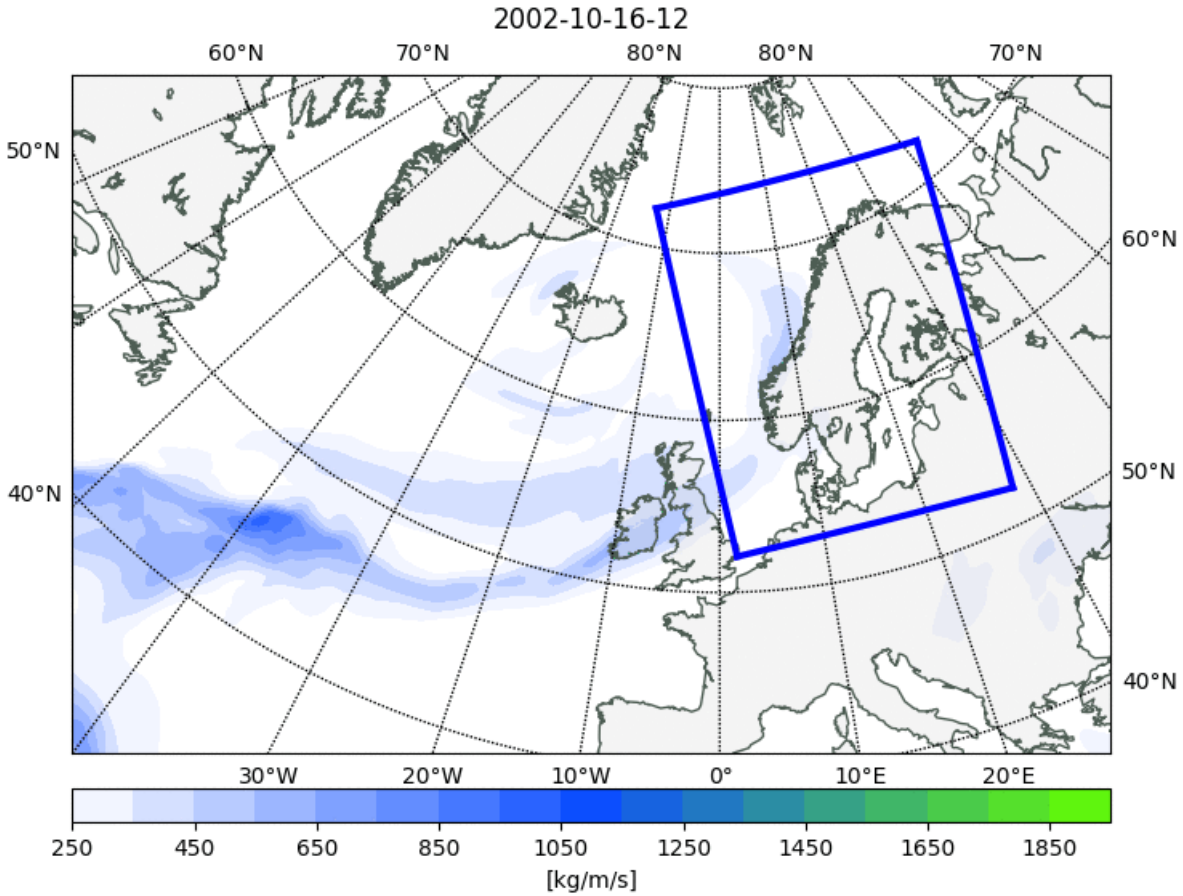

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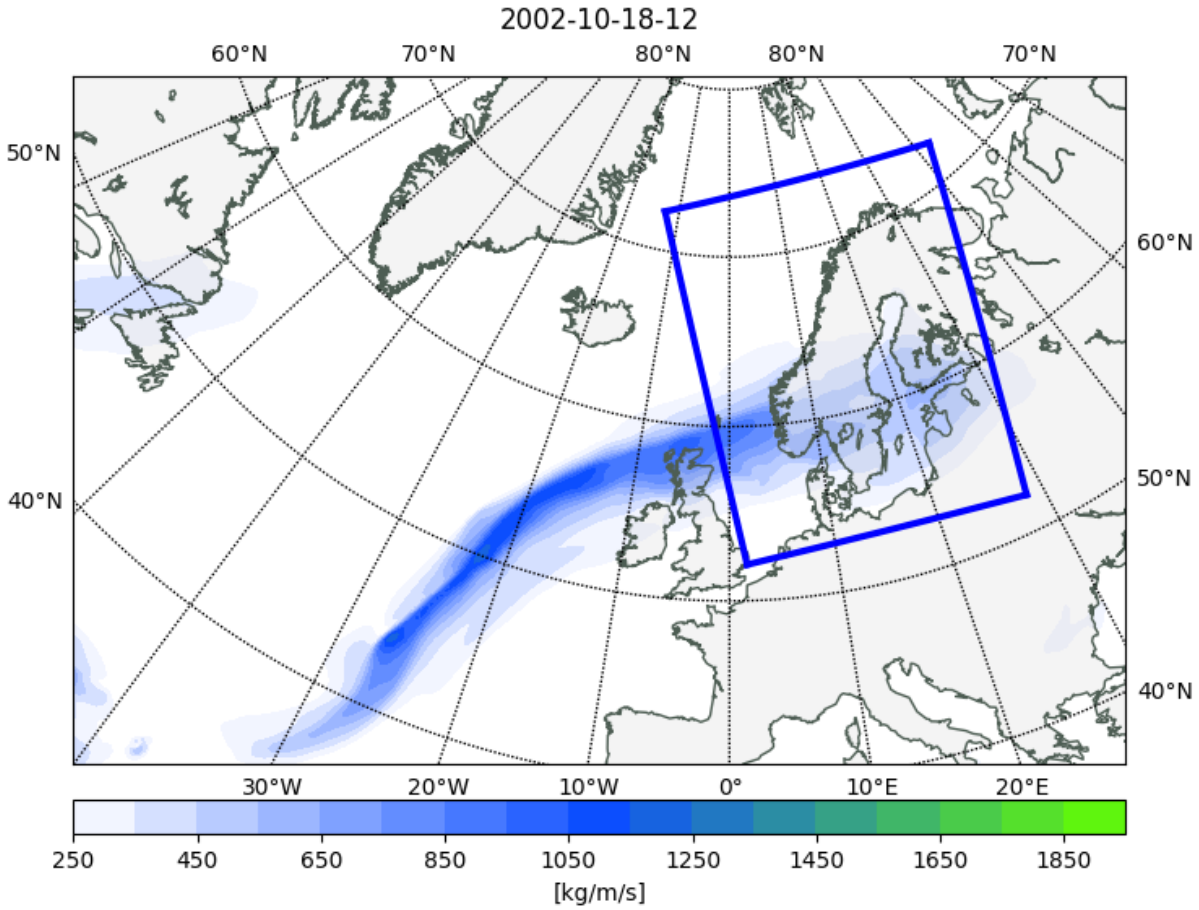
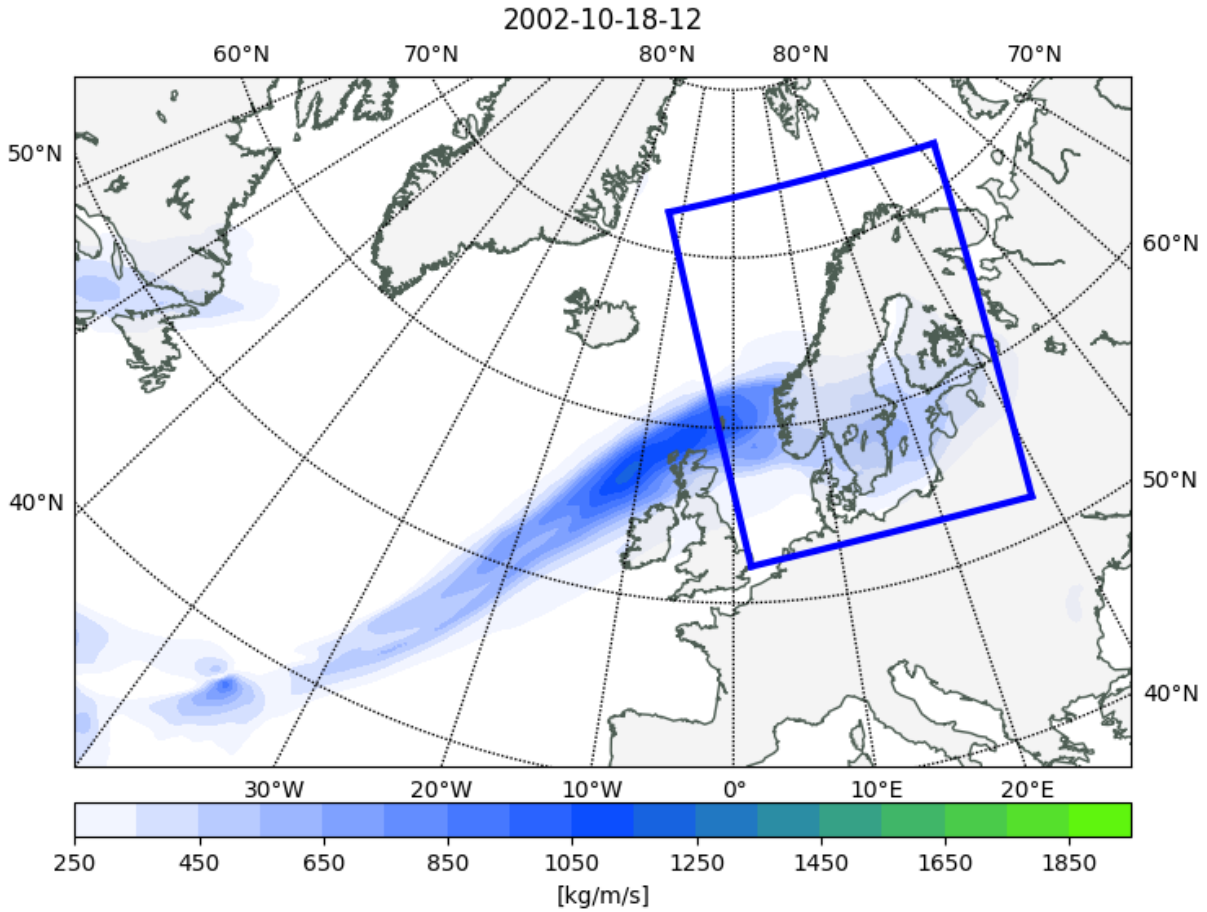
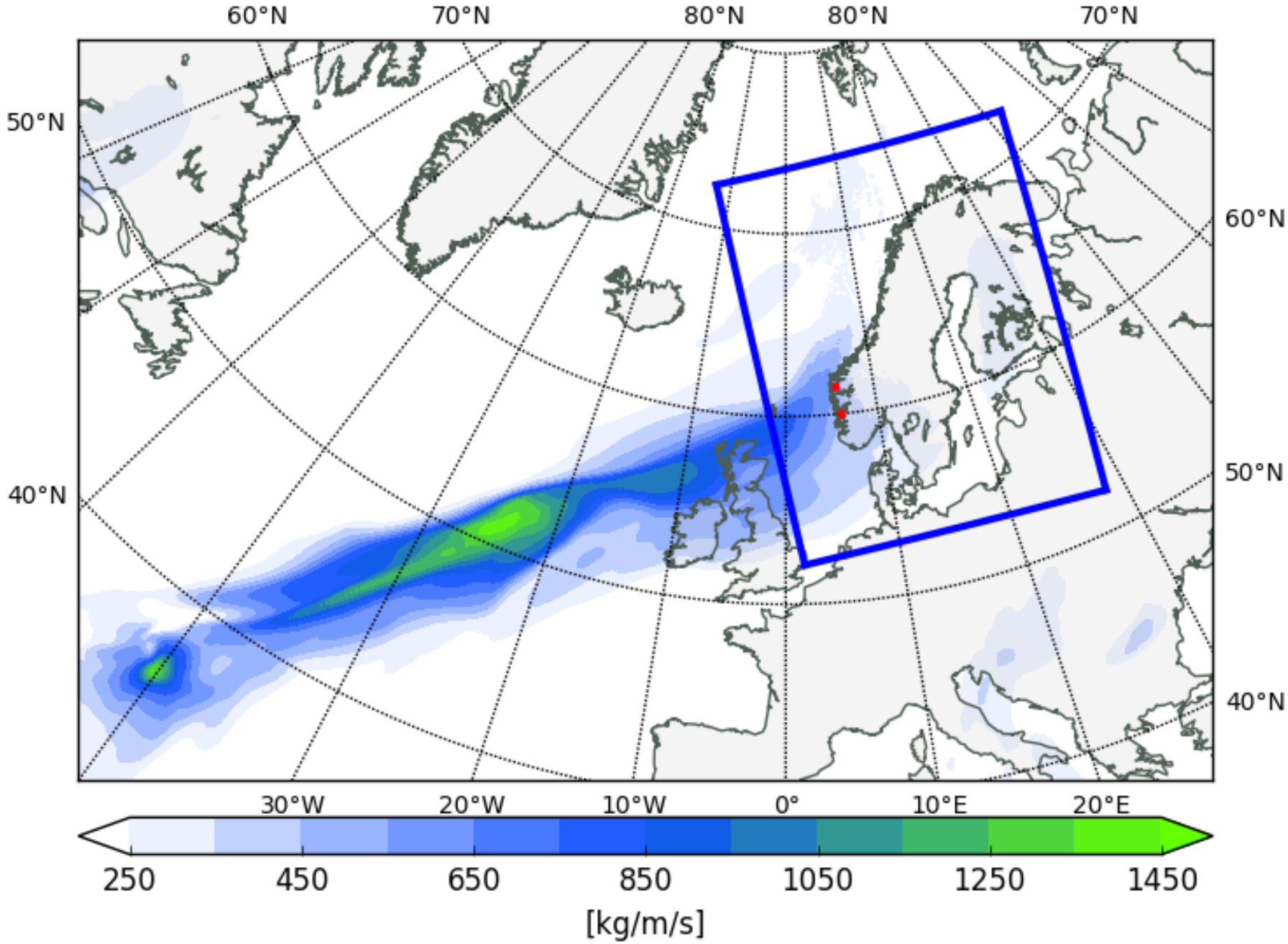


[kg/m/s]

Member 9: low Opo



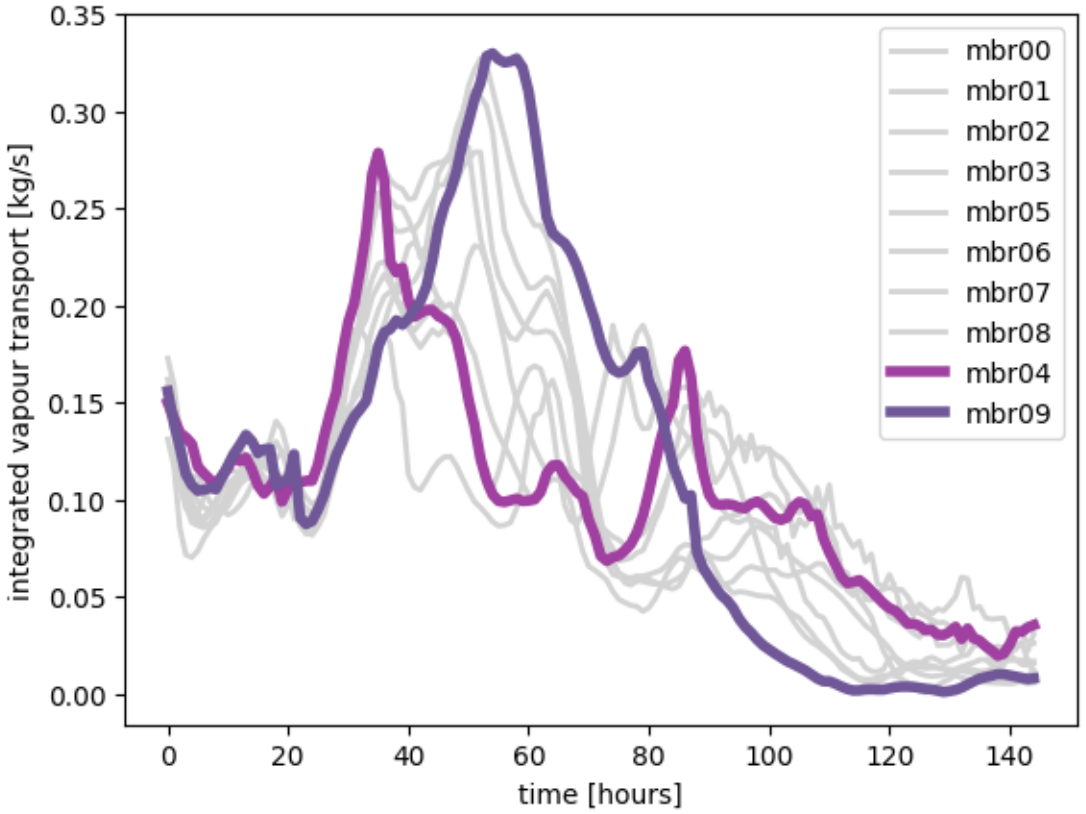
[kg/m/s]


60°N
70°N
80°N
80°N
70°N
50°N
40°N
60°N
50°N
40°N
30°W
20°W
10°W
0°
10°E
20°E
250
450
650
850
1050
1250
1450
[kg/m/s]

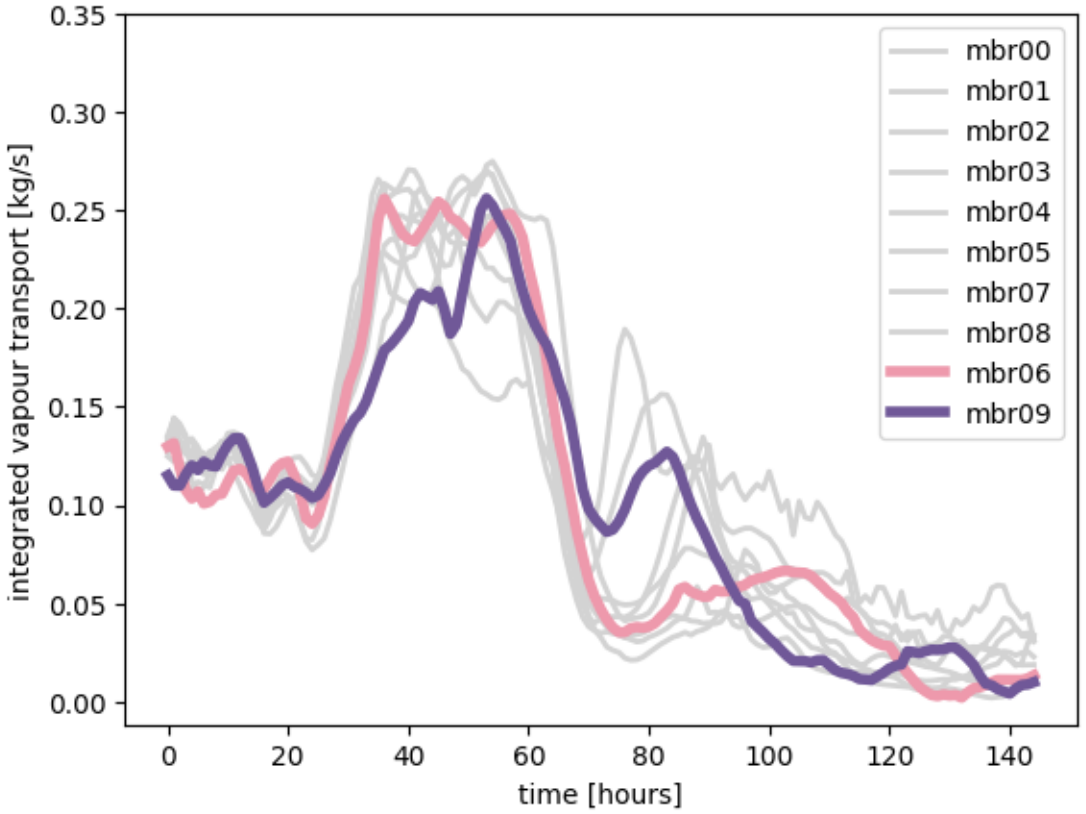
Cross-section upstream of the two catchments

IVT in AROME

Upstream Jølstra

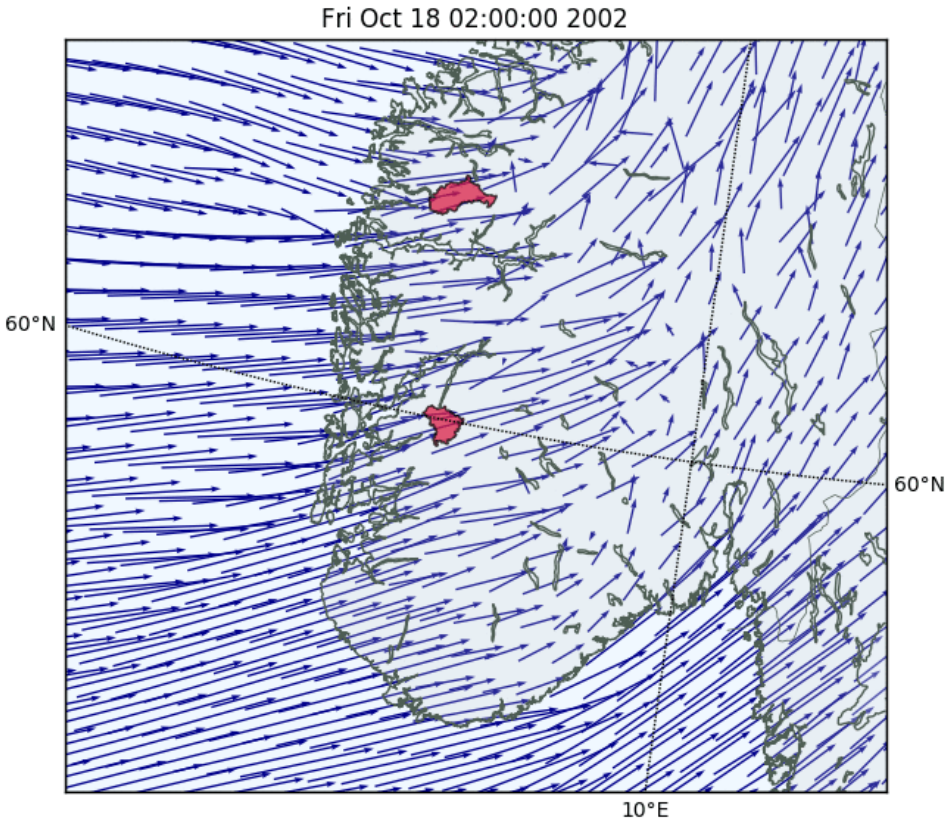


Upstream Opo



Surface wind AROME

Member 4
Low Jølstra



Member 6
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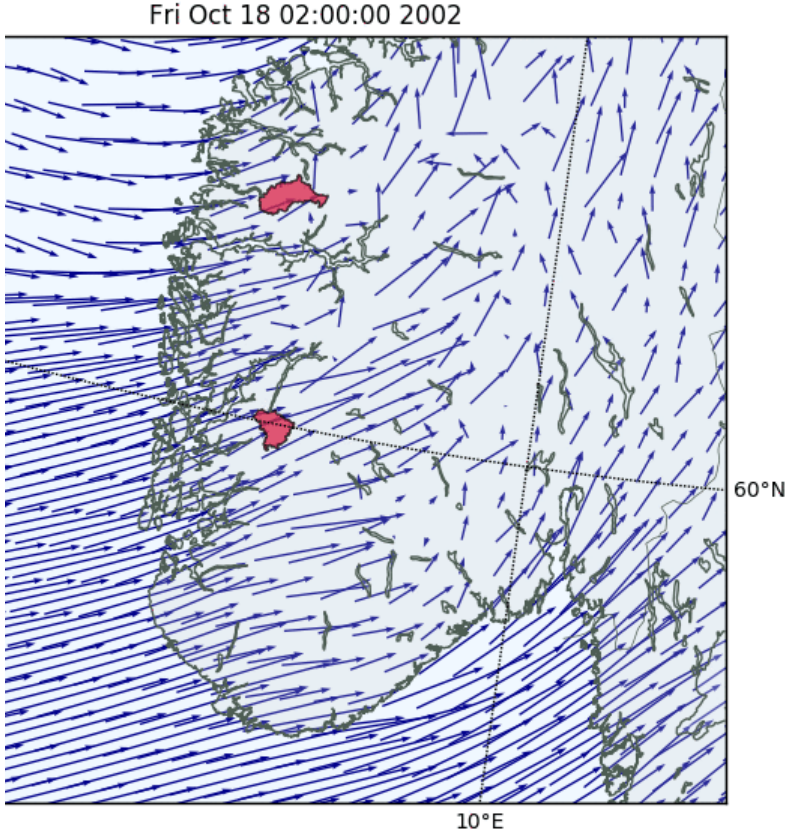

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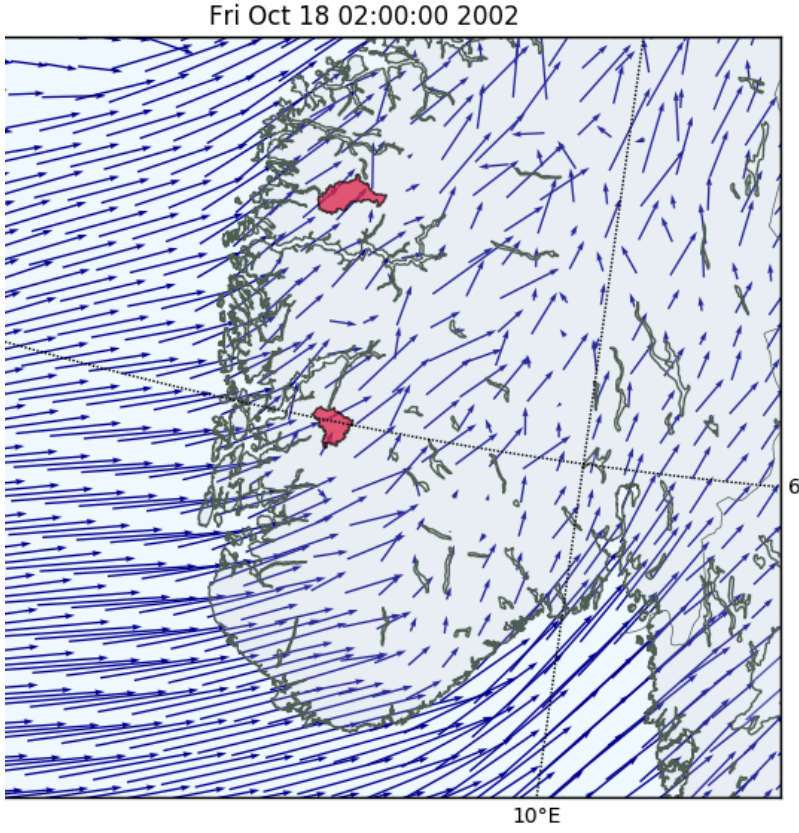
High Jølstra / low Opo



Surface wind AROME

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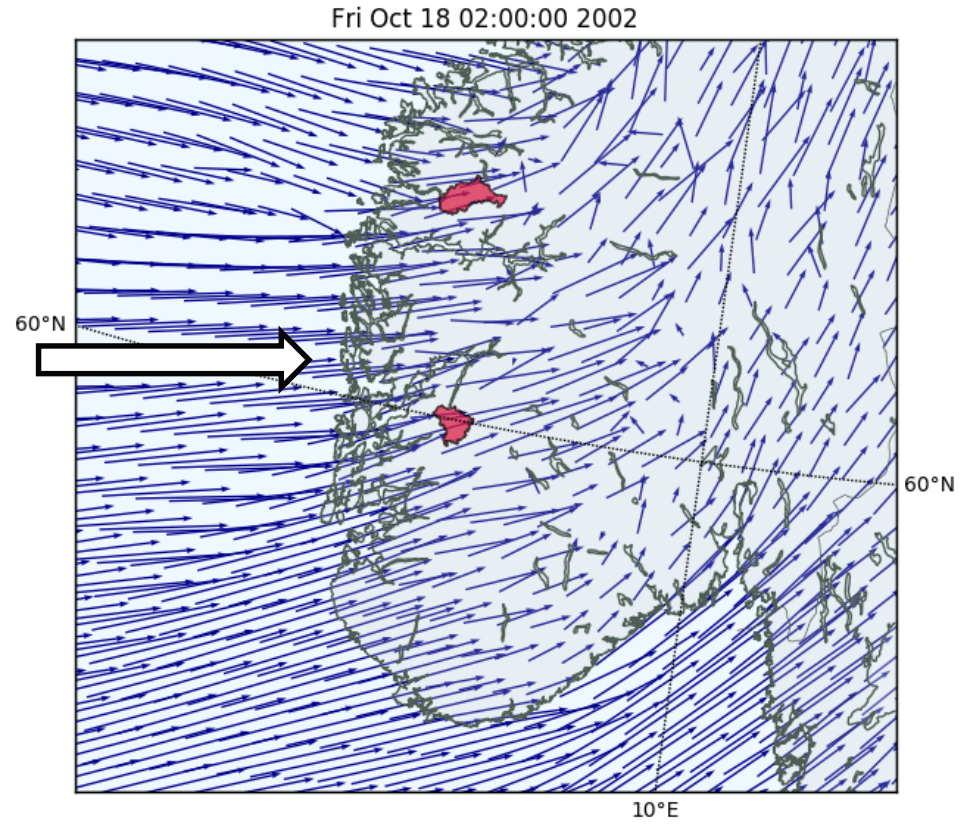
Low Jølstra



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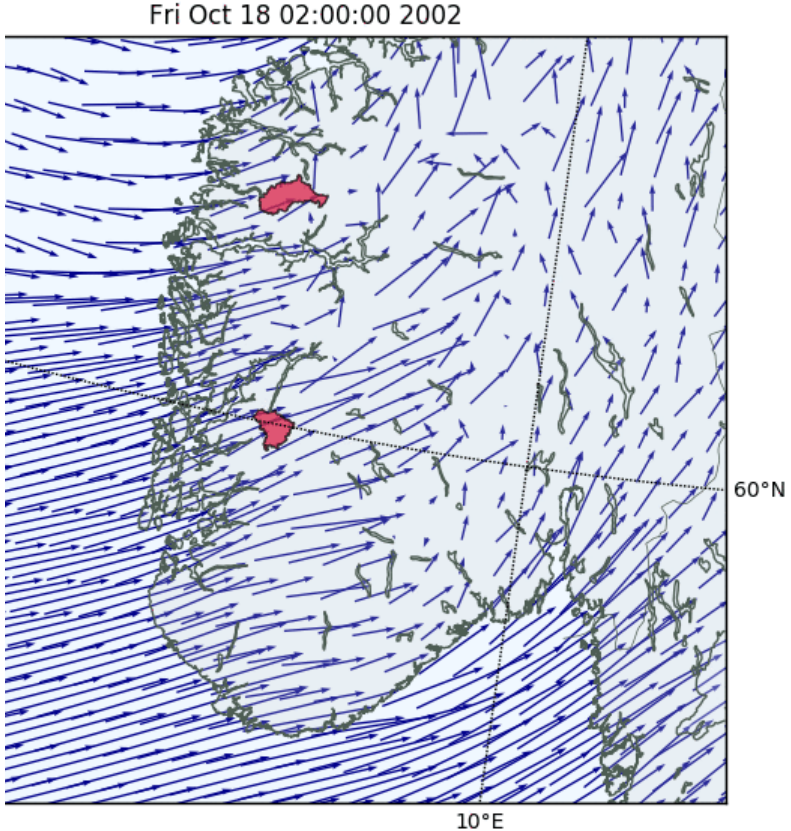

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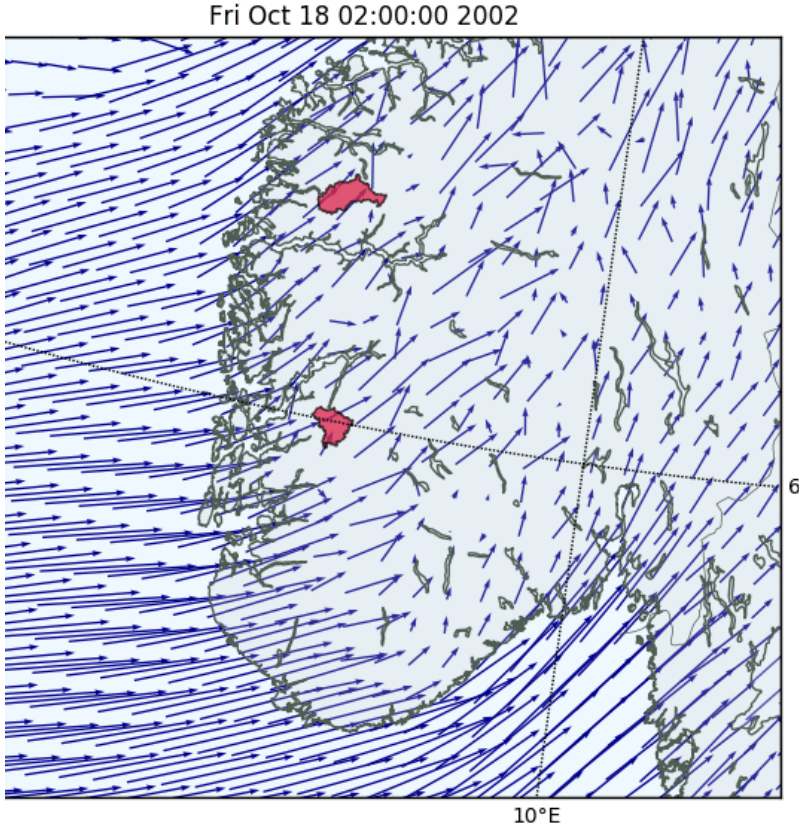

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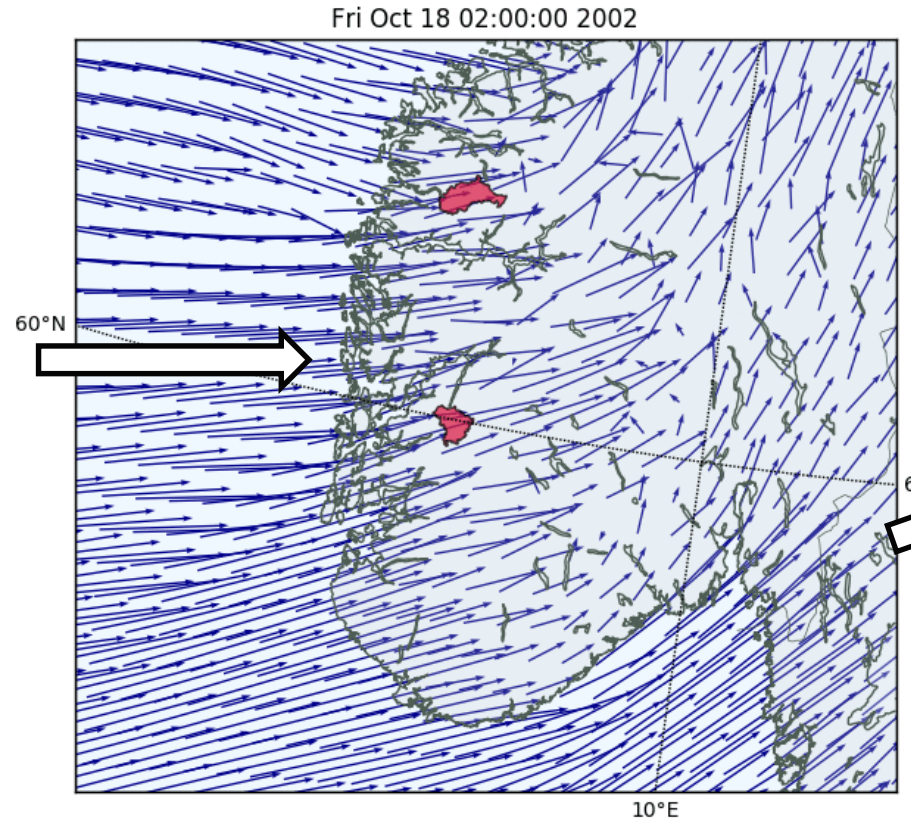

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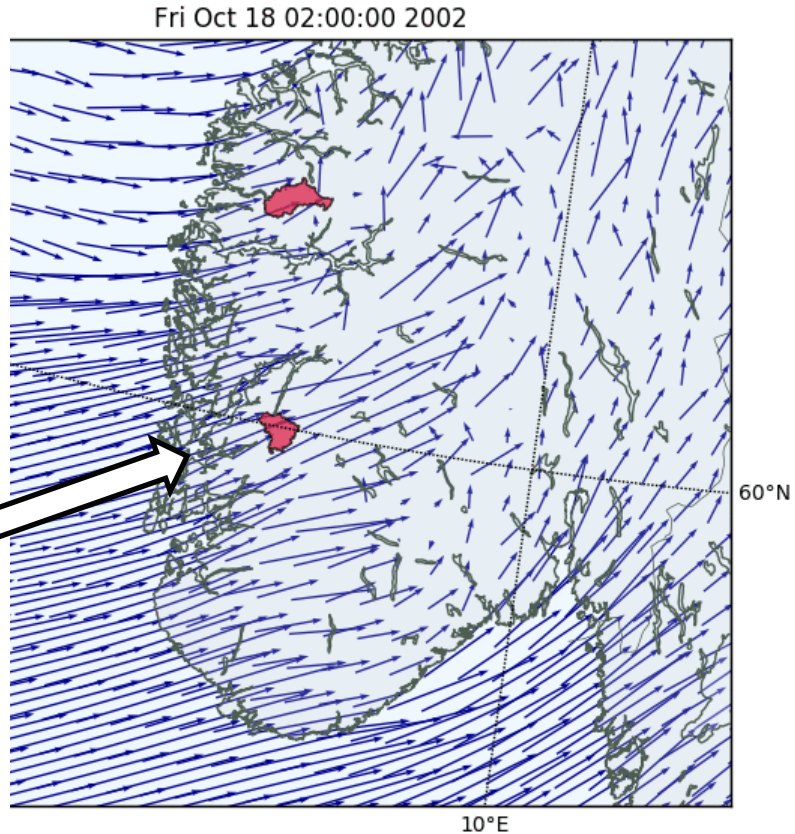

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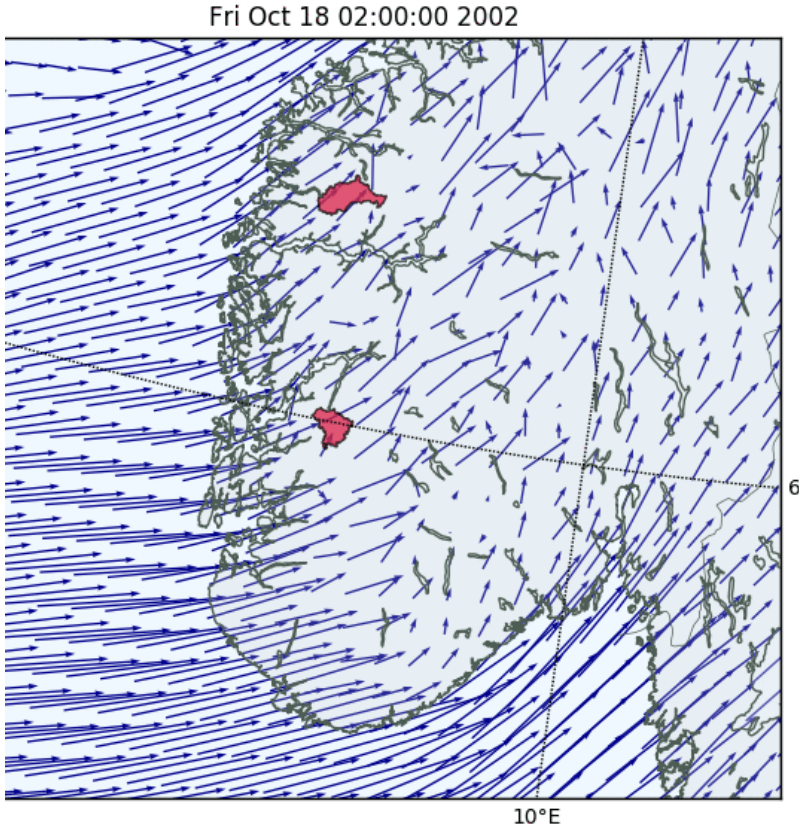

Surface wind AROME

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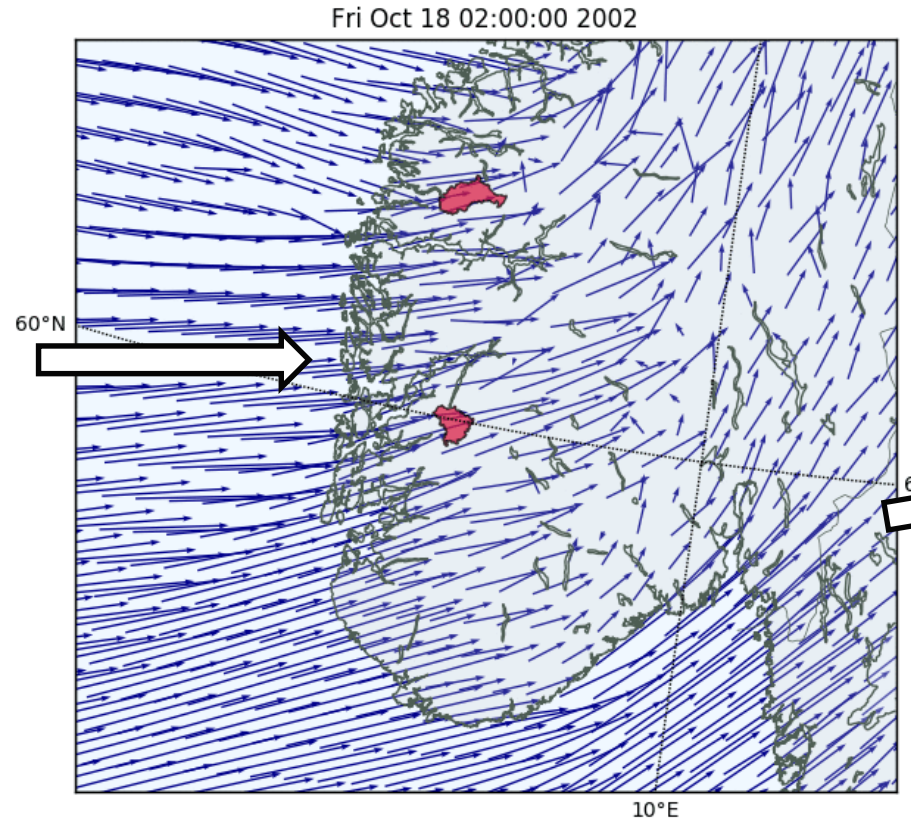

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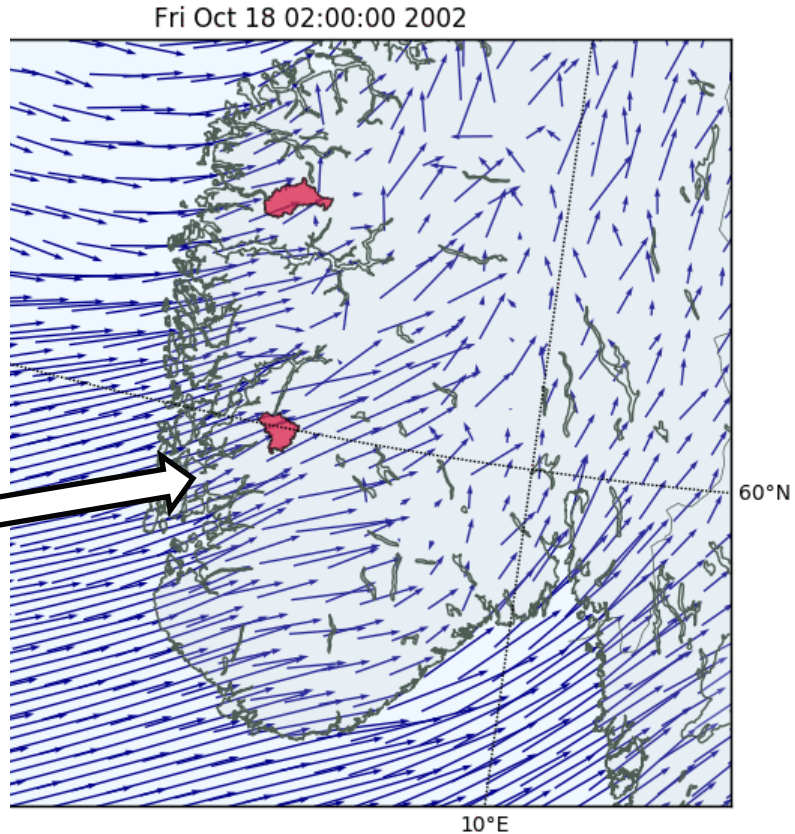

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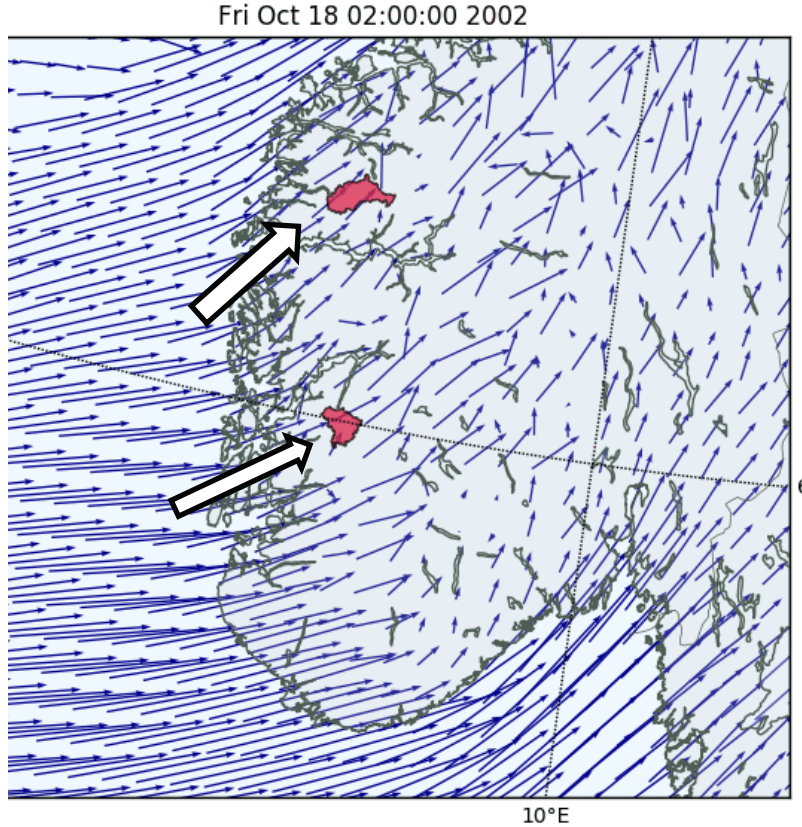
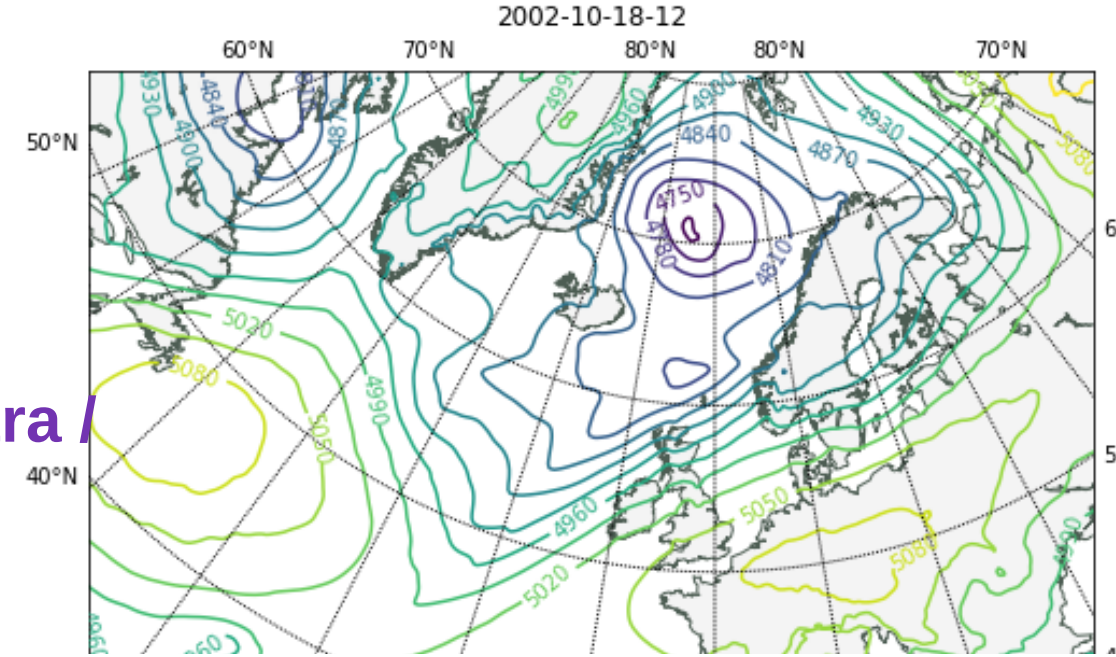


Geopotential height at 500 hPa

Member 9
High Jølstra / low Opo



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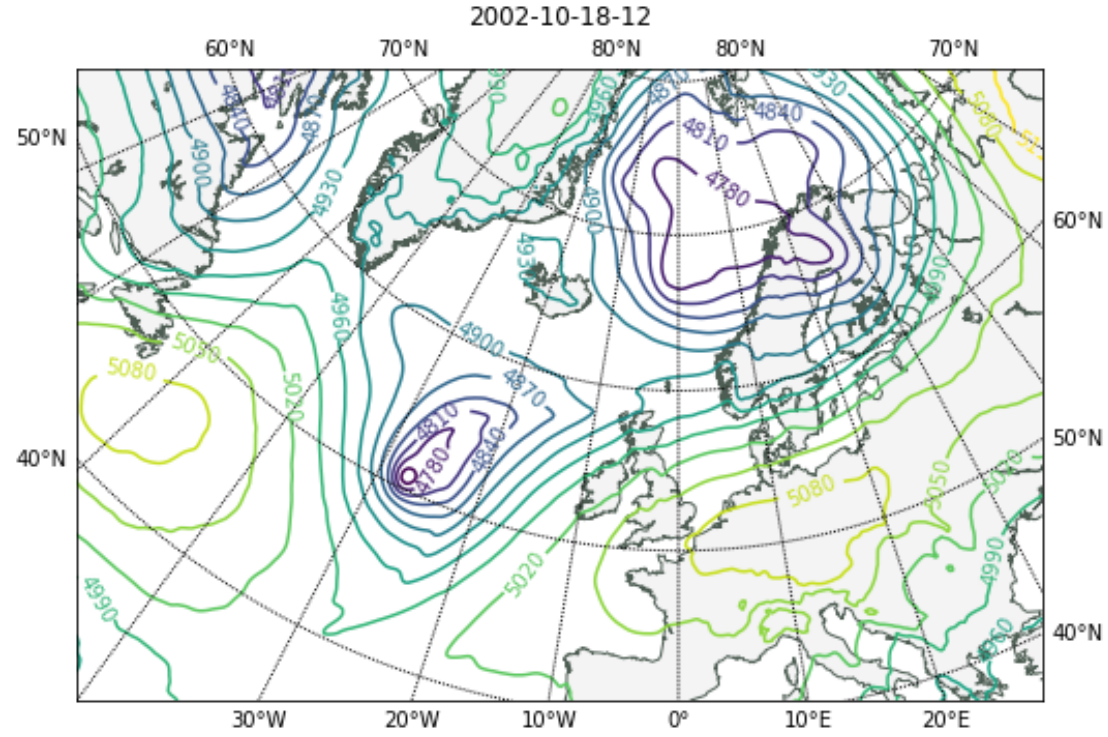
Low Jølstra



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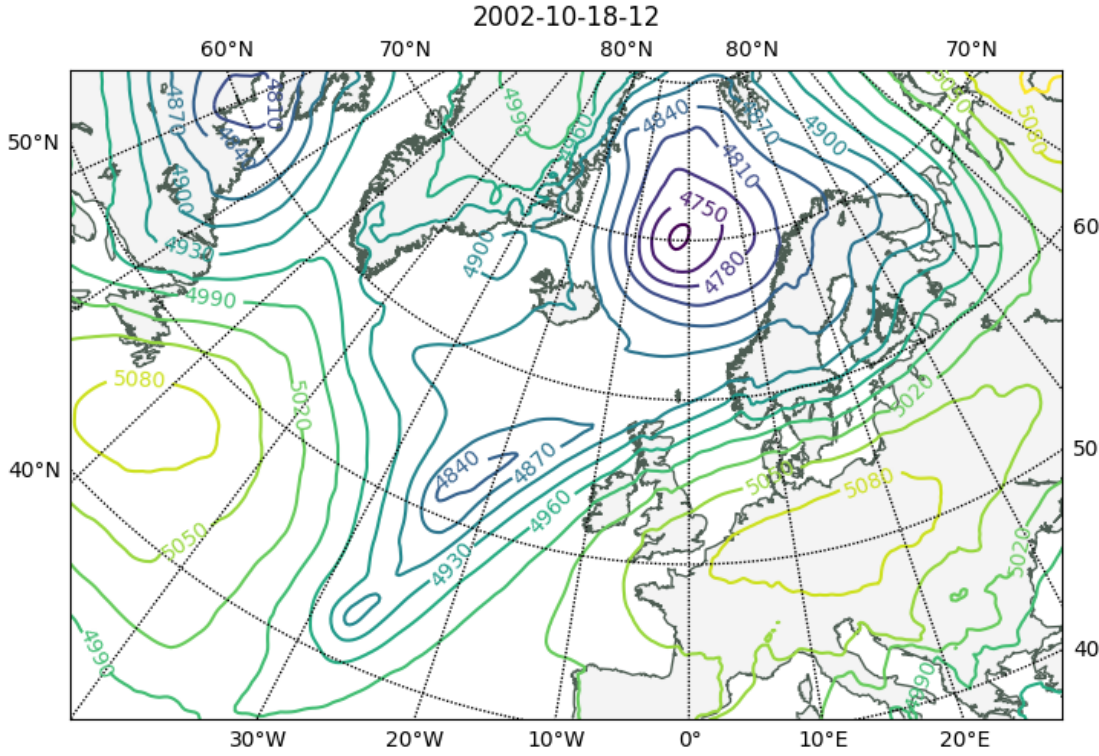

Conclusions

- To move moisture transport in space, does produce more precipitation in a selected catchment.
- This is done in a physically and dynamically consistent way by using a model chain
- Not yet at PMP values. Would need even more cases, doing the perturbation in another way?

Conclusions

- The case study provides knowledge on how different catchments are sensitive to small changes in moisture flow, wind, and ‘steering level’ patterns (geopotential height at 500 hPa-level)
- Ensemble studies are promising
  - Utilize other large ensembles