



Norwegian
Meteorological
Institute



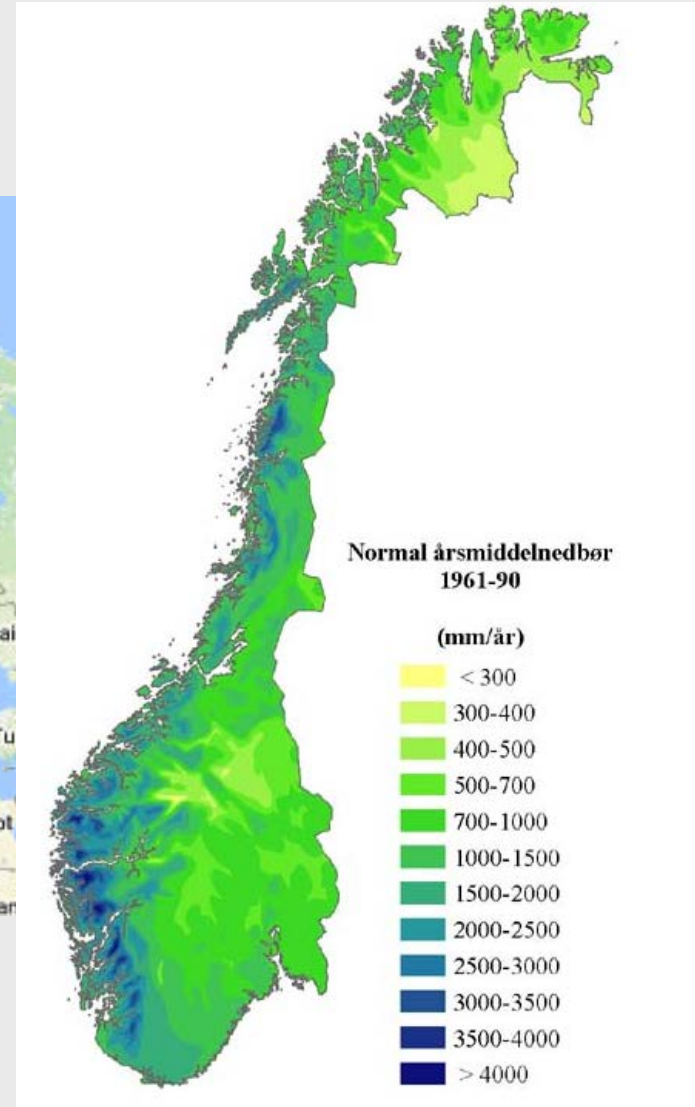
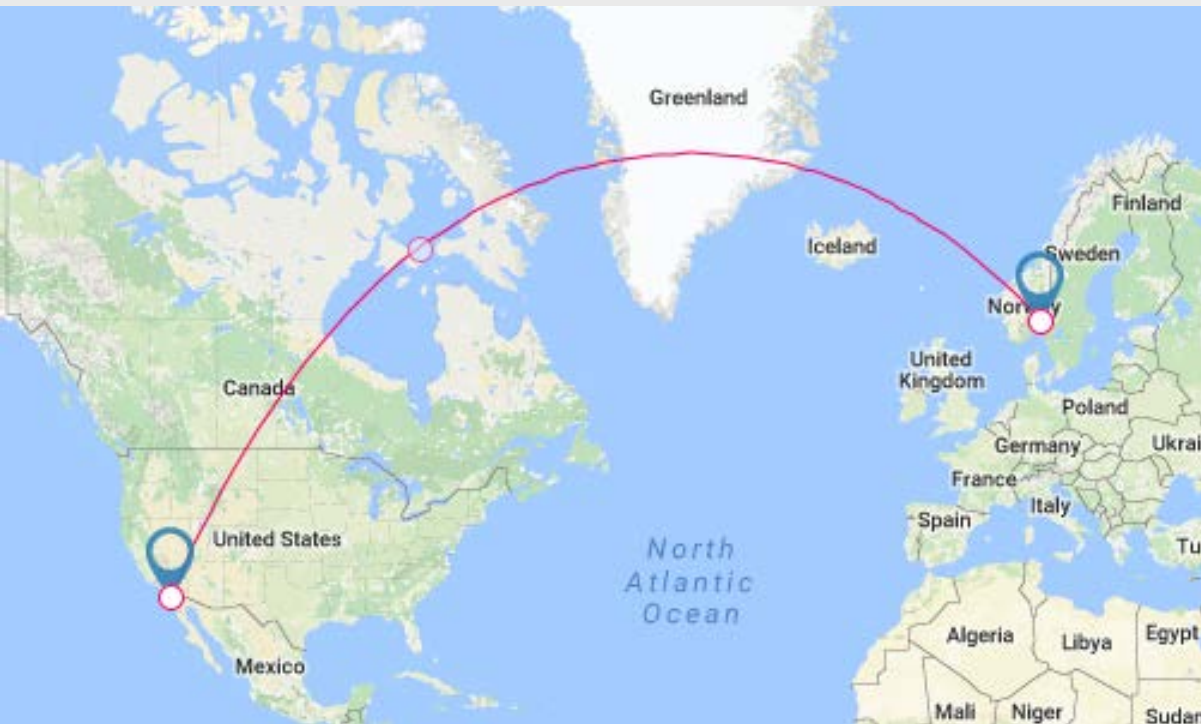
Extreme Precipitation in Norway and the connection to Atmospheric Rivers

Karianne Ødemark (MET/UiO)

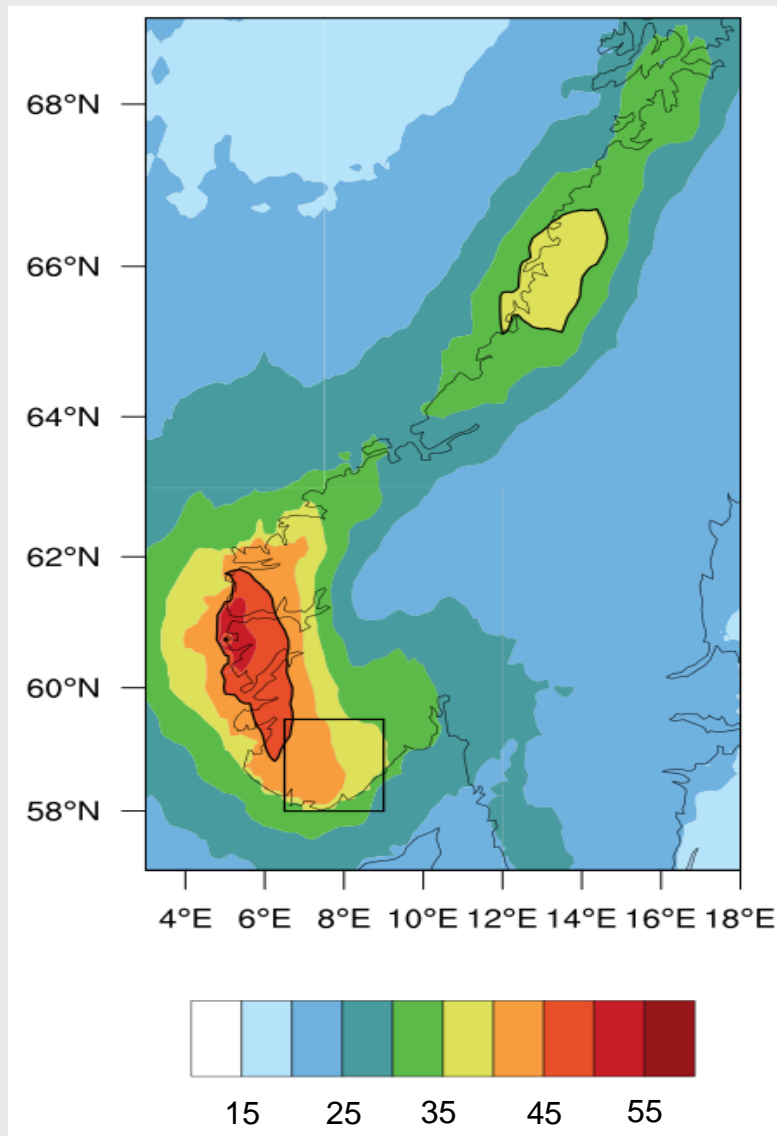
Richard Moore, Ole Einar Tveito, Terje Berntsen (MET/UiO, MET, UiO)

Imme Benedict (Wageningen University)

Precipitation in Norway

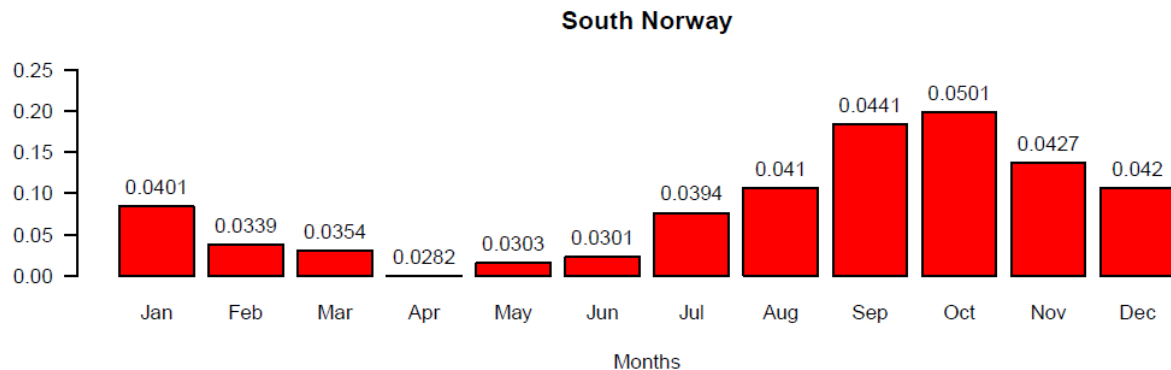
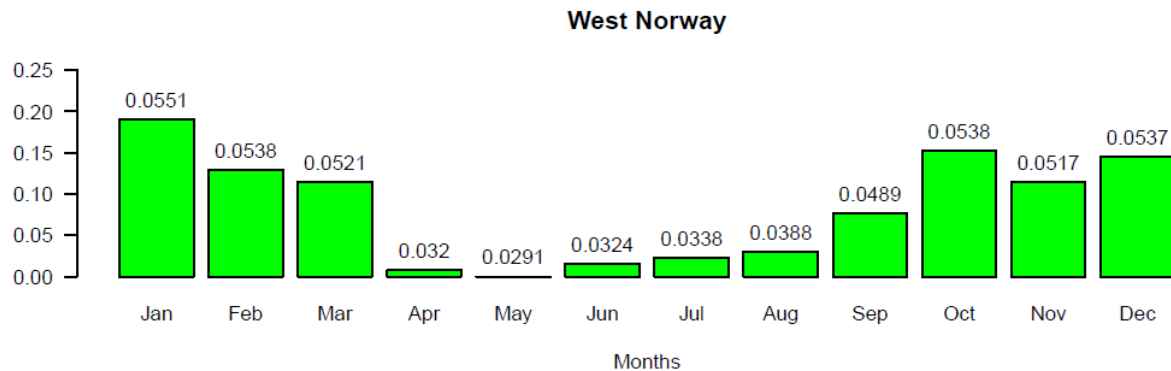
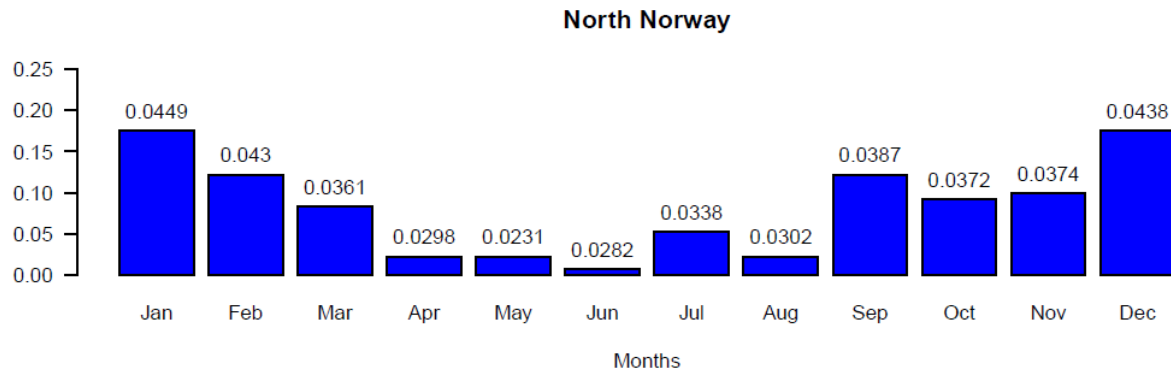


Extreme precipitation in Norway



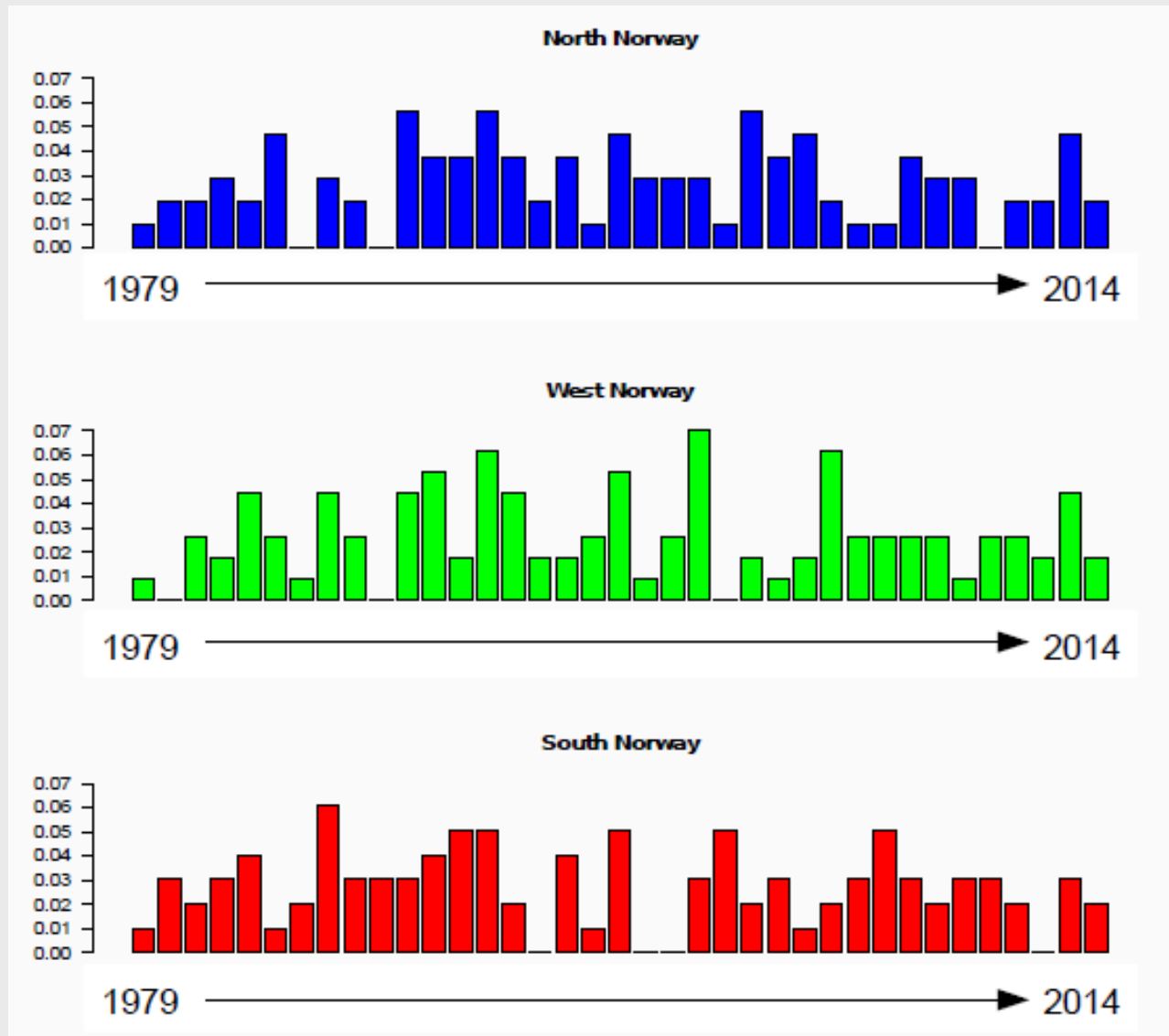
- Data from ERA-Interim
 - 1979 - 2014
- The 99th percentile of daily precipitation

Monthly climatology



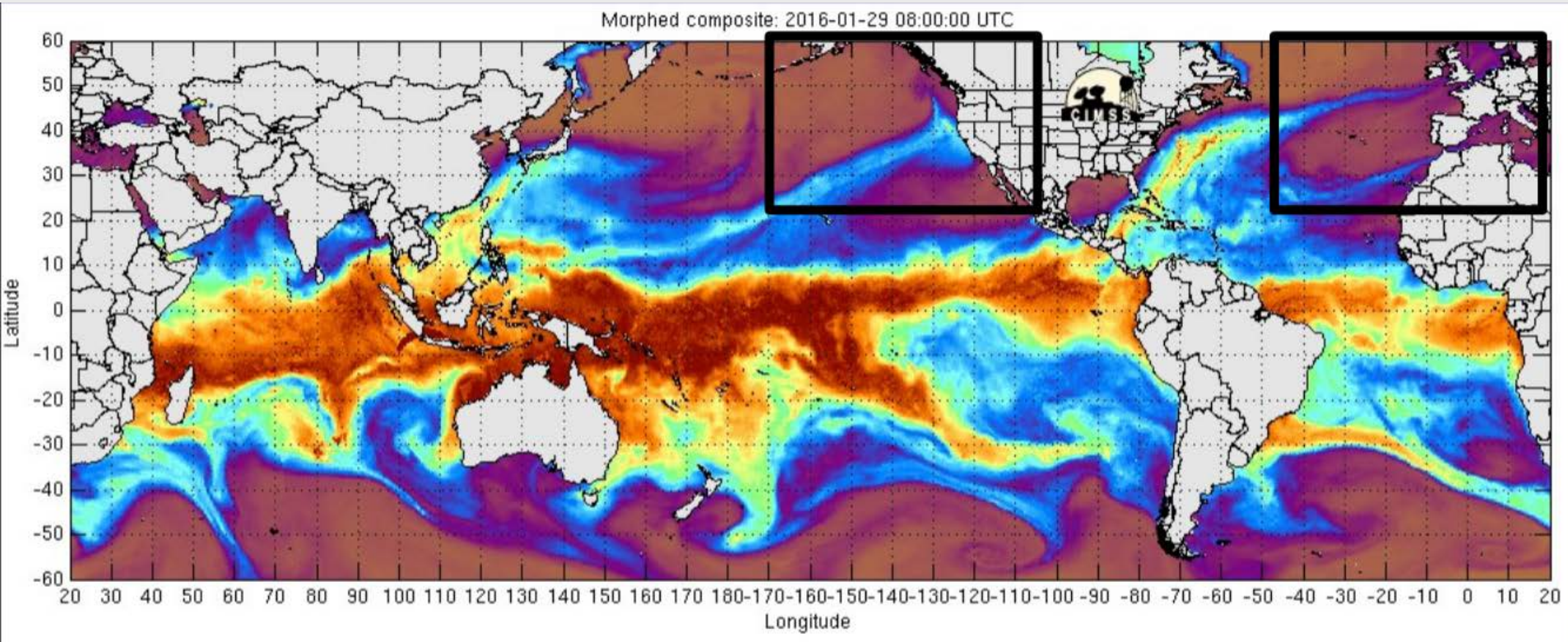
- Three regions
- The 99 percentile (Area average)
- For each month
- Fraction of events occurring in that month (to the total) on y-axis

Interannual variability



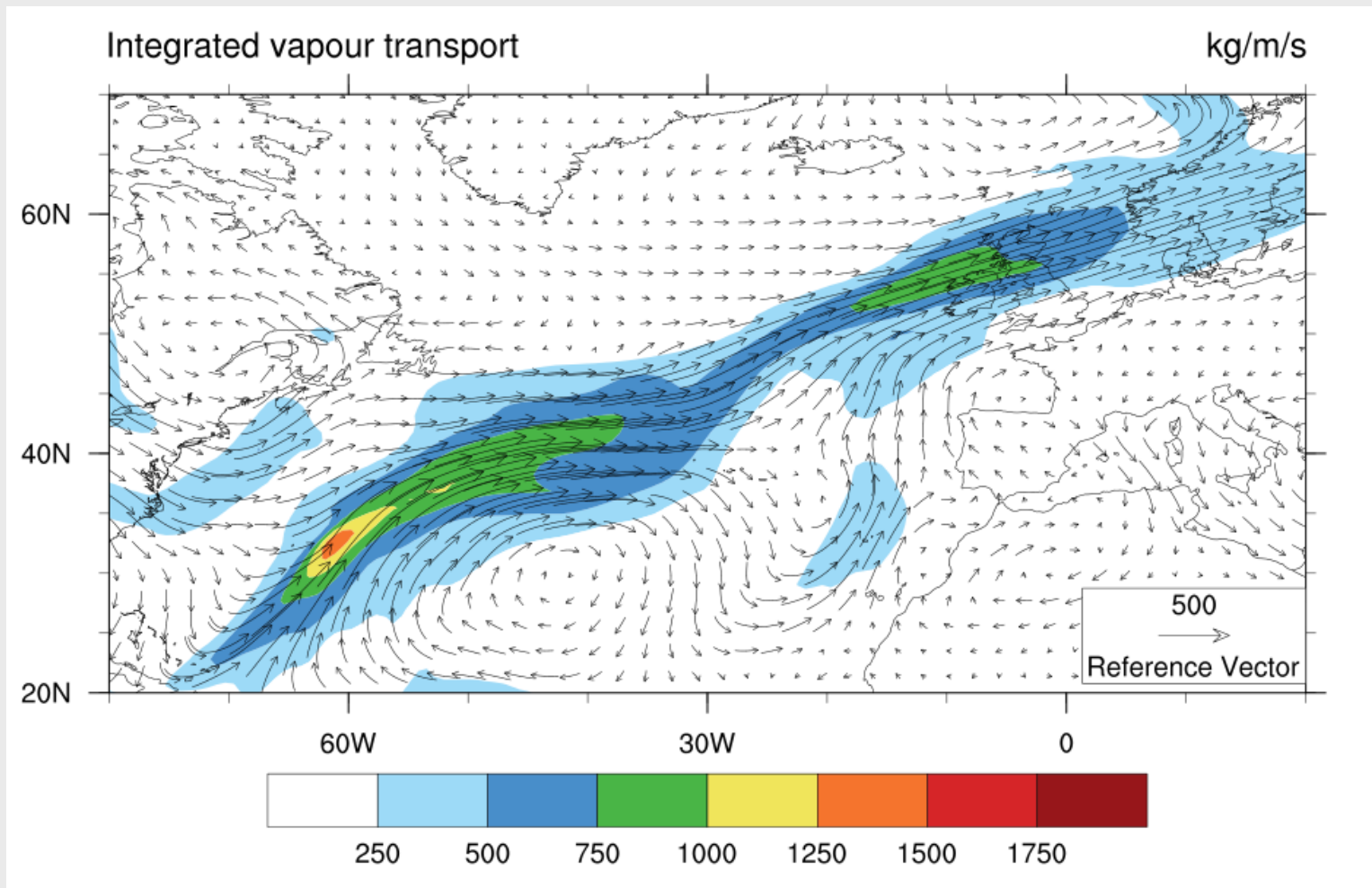
Are the events atmospheric rivers?

Similar 'settings' compared to West coast of America

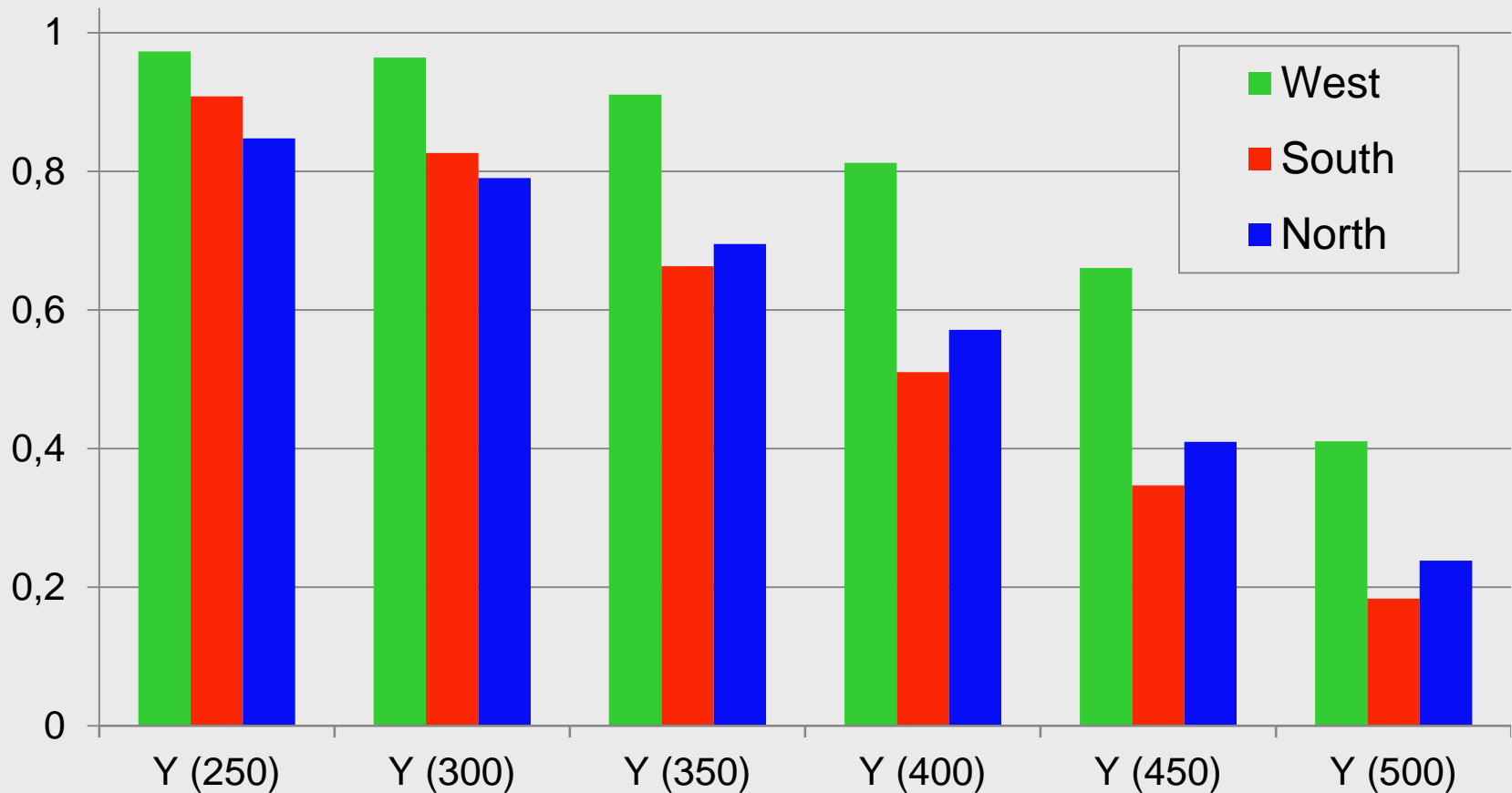


Are the events atmospheric rivers?

AR definition: IVT above 250 kg/m/s and length more than 2000 km (Rutz et al. 2014)



Are the events atmospheric rivers?



Large-scale dynamics

December 2006 (Sodemann & Stohl 2012)

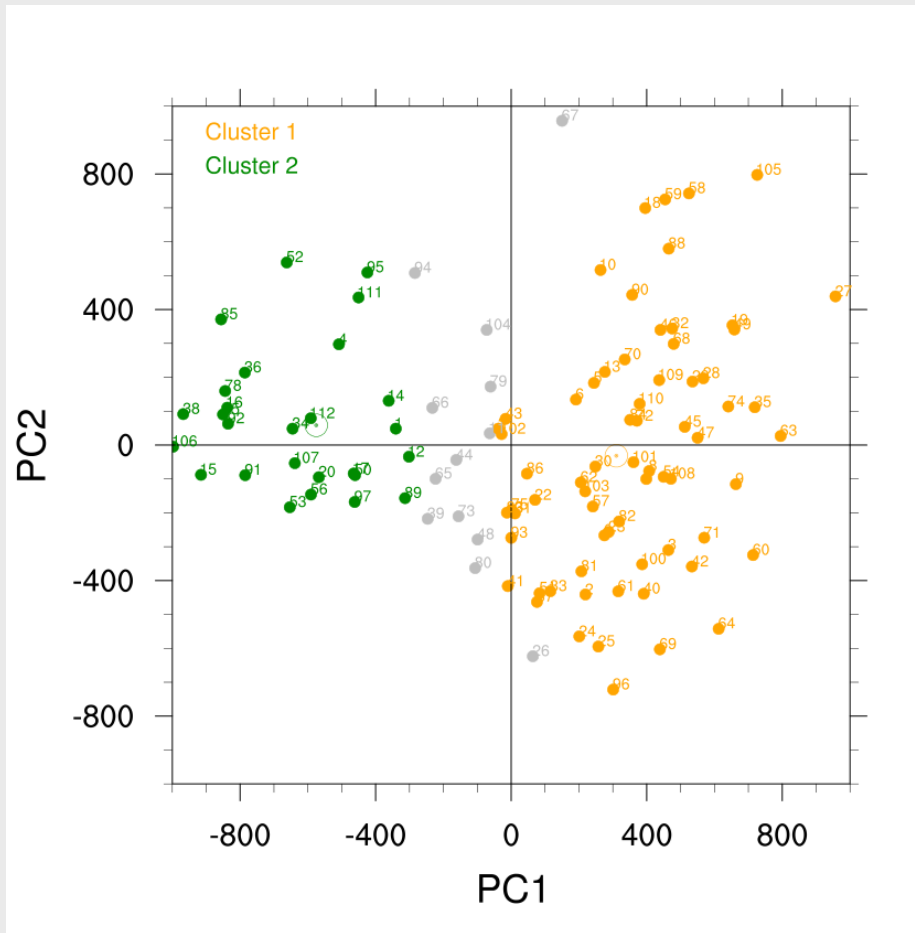


(1) Anti-cyclonic wave breaking + meridional upper-level jet



(2) Cyclonic wave breaking + zonal upper-level jet

Clustering analysis



West area, 120 h before the event

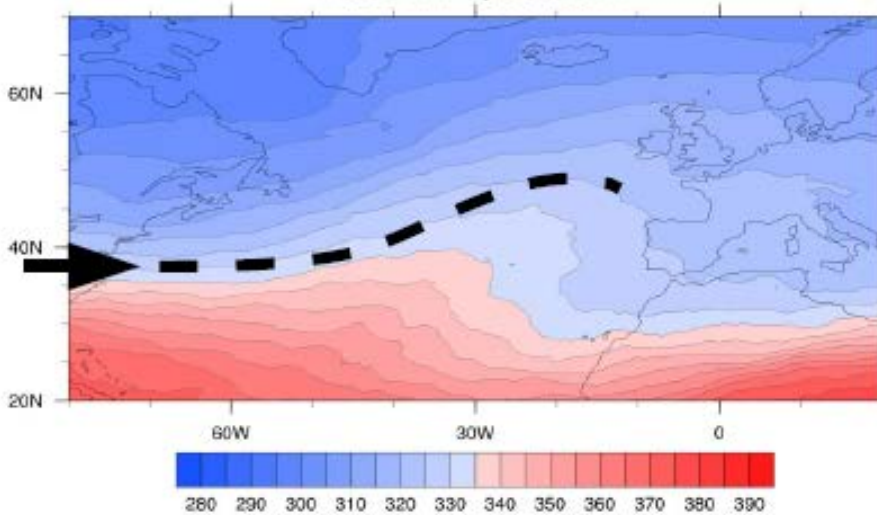
- Step 1) EOF analysis on the dynamic tropopause
- Step 2) Fuzzy clustering

Composites

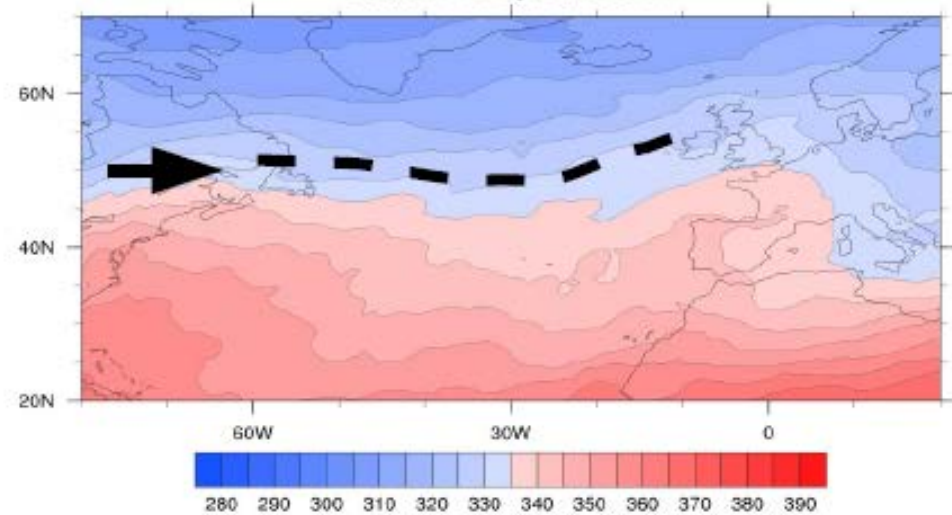
Cluster 1

Cluster 2

2000PV PT; Cluster 1



2000PV PT; Cluster 2



Potential temperature on the 2PVU surface
West area, 120 h before the event.

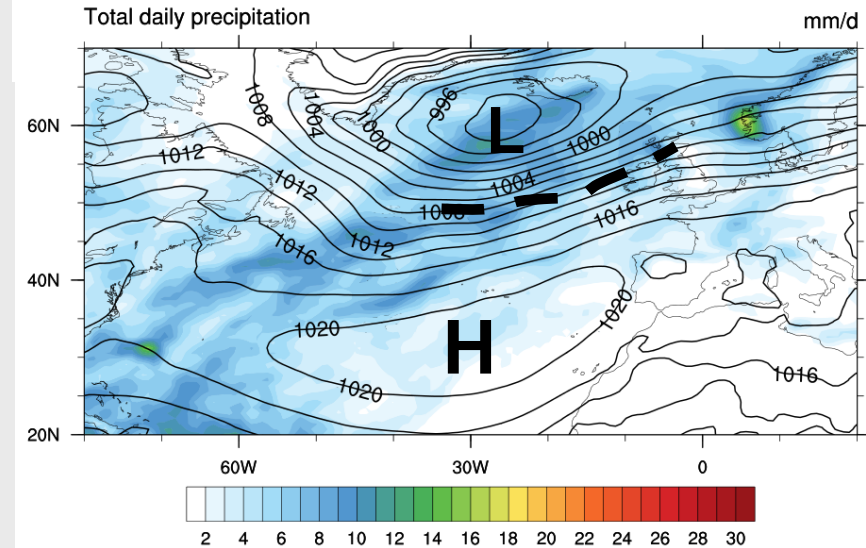
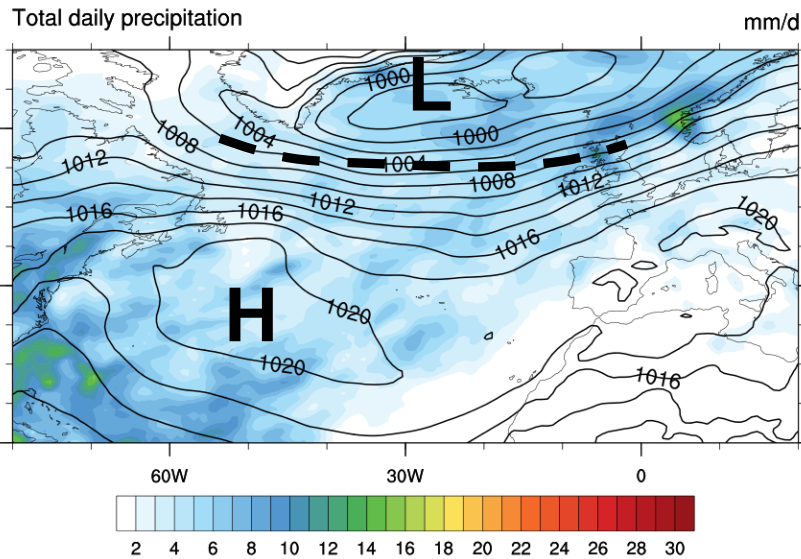
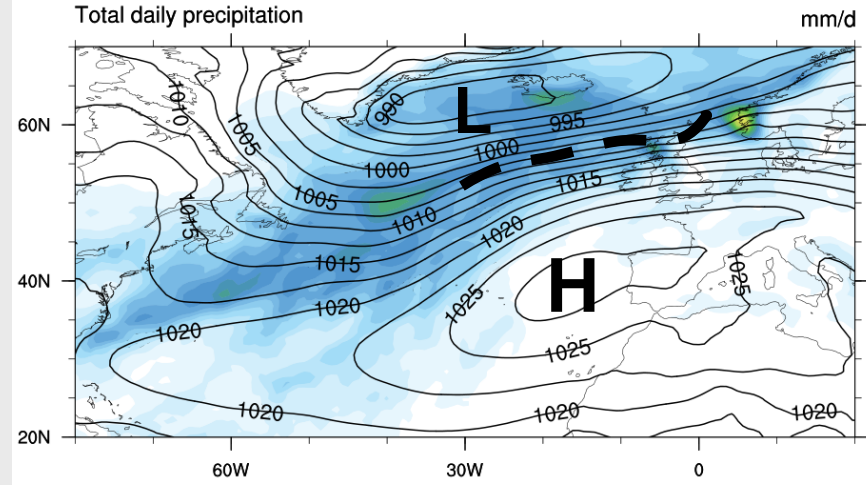
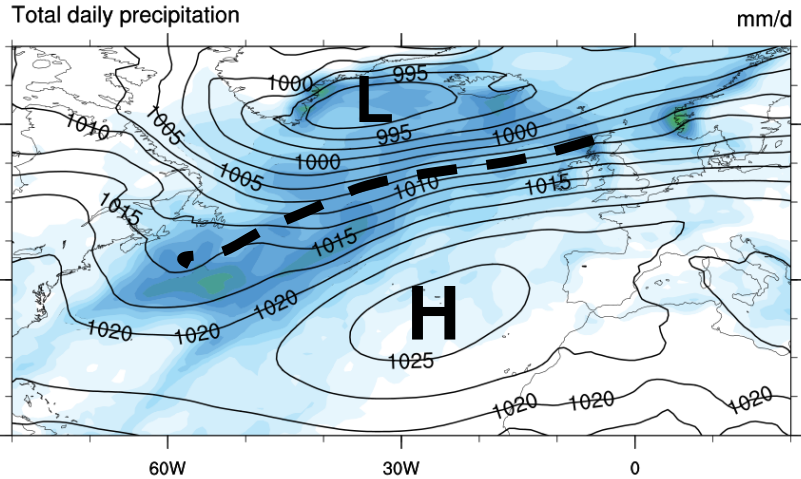
West

t=120

t=48

C1

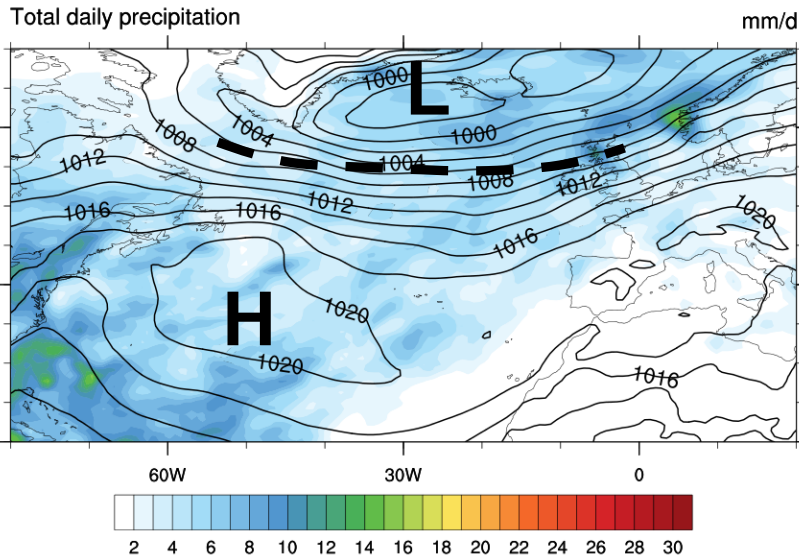
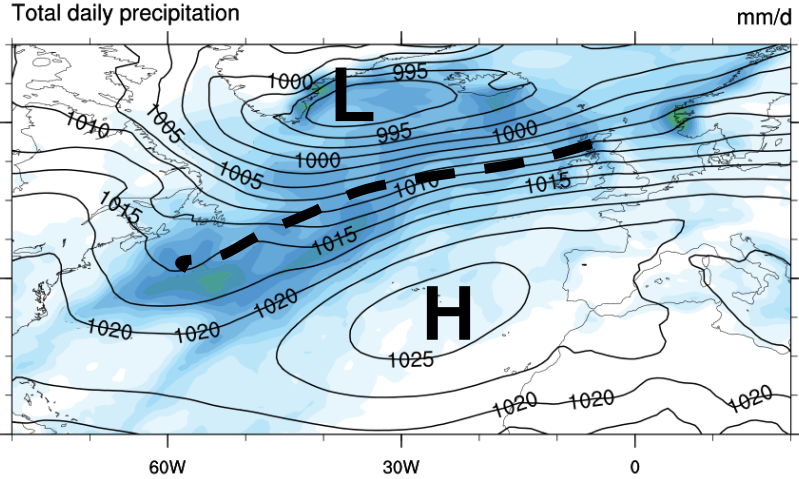
C2



Contours: sea level pressure at 12 UTC
Shading: 24-hour accumulated precipitation [mm/day]

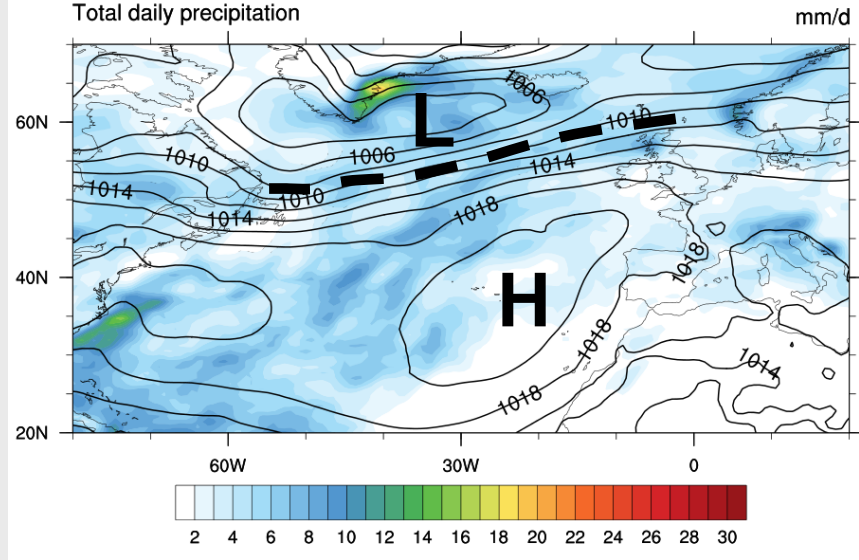
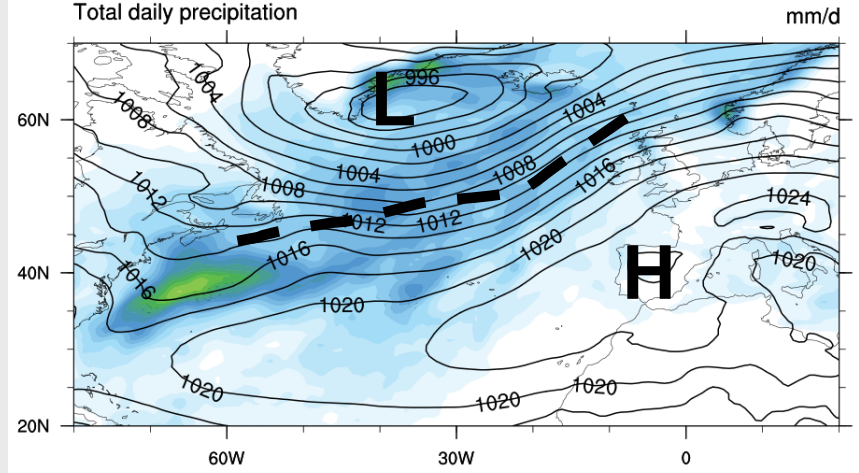
West

t=120



North

t=120



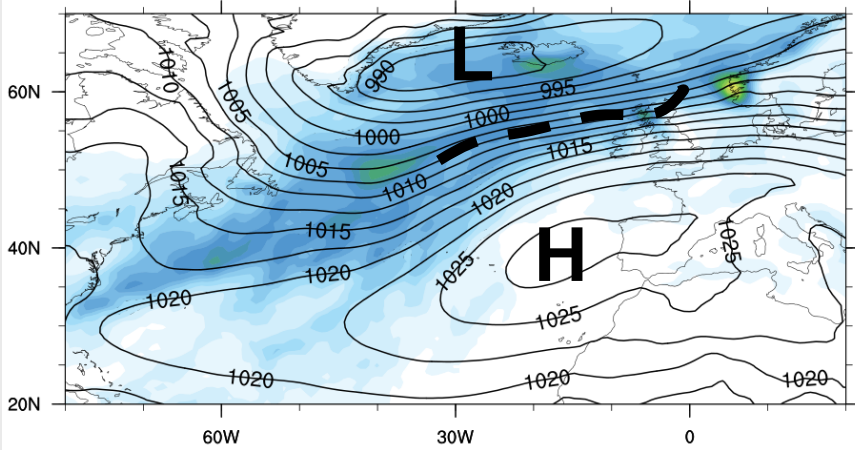
C1

C2

West

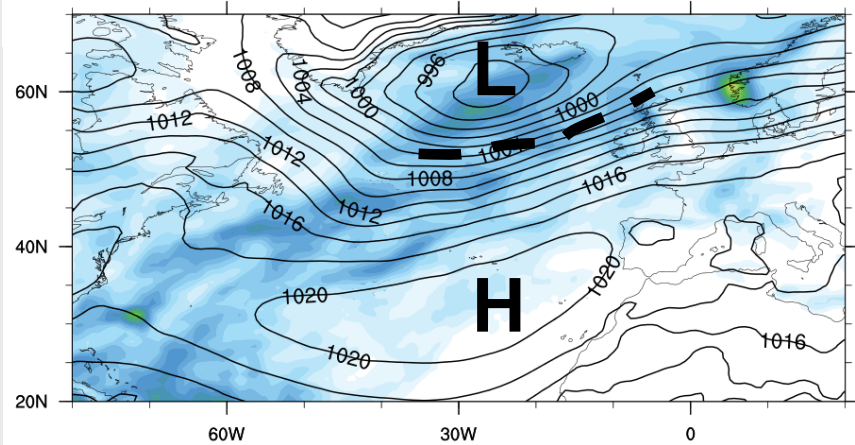
t=48

Total daily precipitation mm/d



C1

Total daily precipitation mm/d

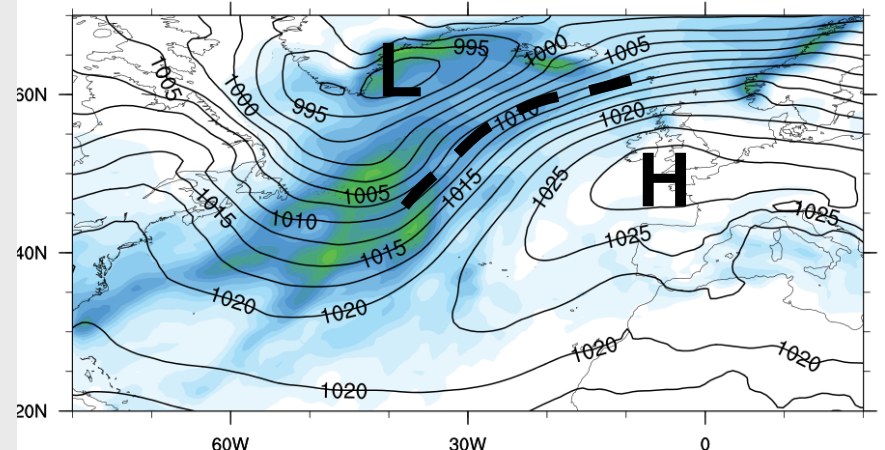


C2

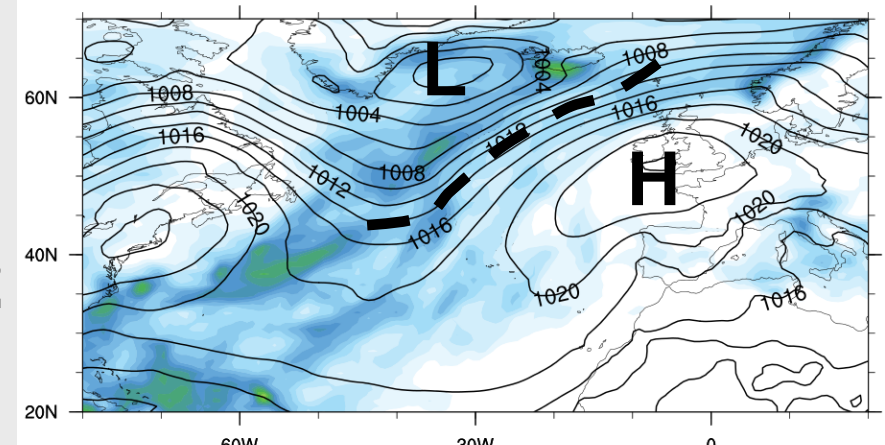
North

t=48

Total daily precipitation mm/d



Total daily precipitation mm/d



Difference in large-scale dynamics

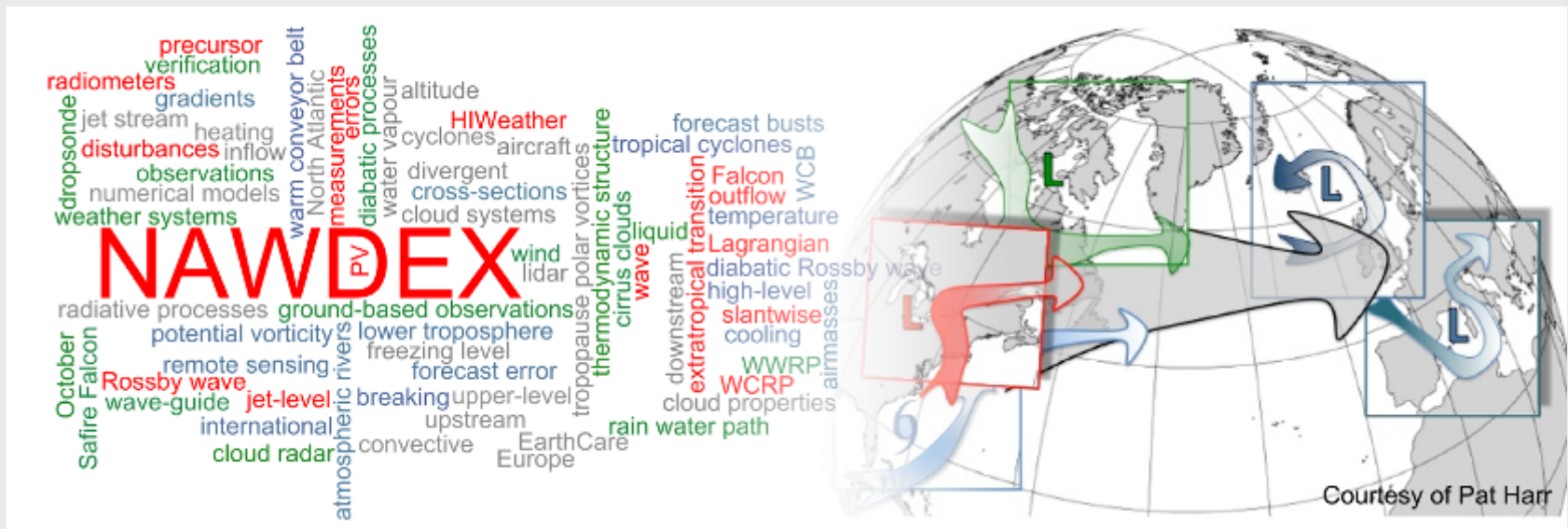
	<u>Intra</u> Between clusters in one region	<u>Inter</u> Between clusters of different regions
Long term	Large	Small
Short term	Small	Large

Upcoming

The North Atlantic Waveguide and Downstream Impact Experiment NAWDEX

+

The Norwegian Mesoscale Ensemble and Atmospheric River Experiment NEAREX – will provide the first aircraft measurements of an AR in the eastern Atlantic





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