P2.3 Short-term climate variability - Dynamics and Processes

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Detailed Research Results and Objectives of Phase 2

(A) Identification of the large-scale and synoptic-scale processes governing intra- and interannual atmospheric variability (e.g. NAO/NAM, blocking)

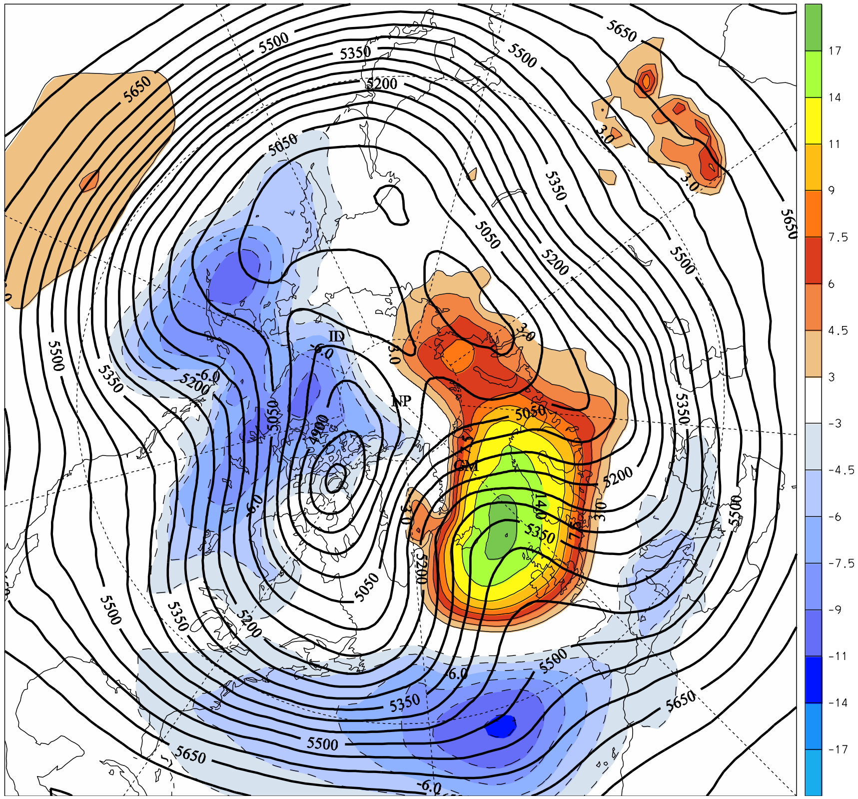
(B) Characterization of the climatological properties of intra-seasonal phenomena in past, current and putative future climate.

(C) Characterization of the properties of upper-level wave propagation and wave-breaking.

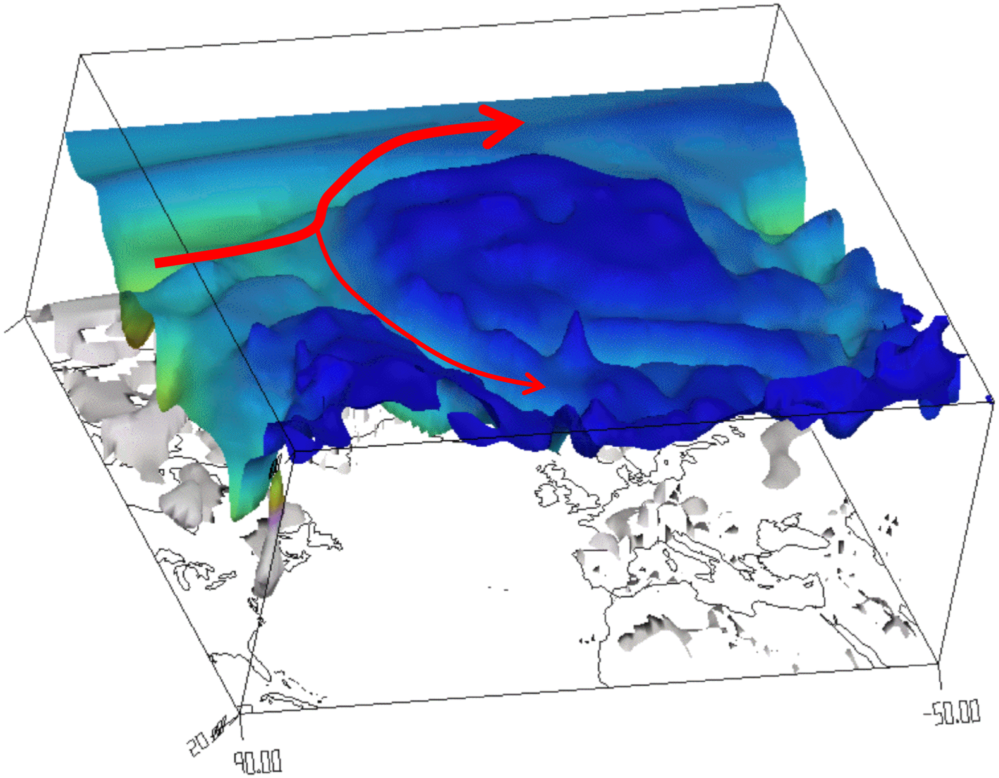
(D) Assessment of the key processes and the upstream conditioning of extreme events (EEs).

(E) tentative: Assessment of the predictablity of extant forecast tools in representing intra-seasonal phenomena and extreme events.

Blocking Detection and Indices



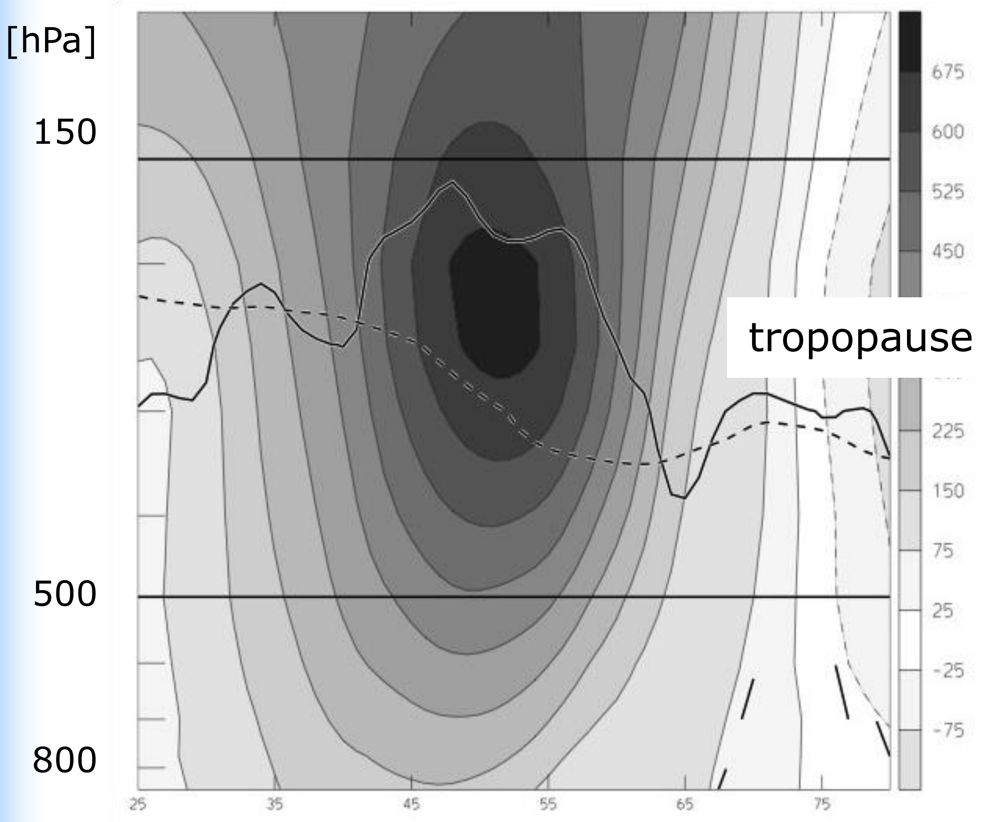
SLP anomaly dipole and Z500 ridge



Tropopause height anomaly

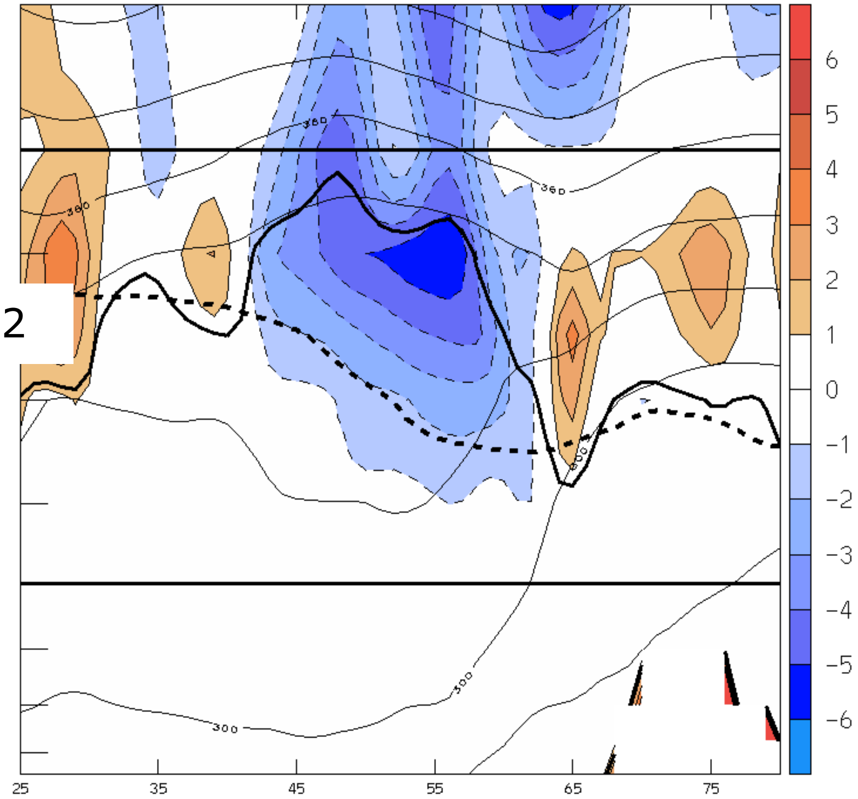
→ Definition of detection indices

Blocking Detection and Indices



Geopotential anomaly

tropopause PV=2



Potential Vorticity (PV) anomaly

→3dim PV-Index

Schwierz et al., 2004, GRL

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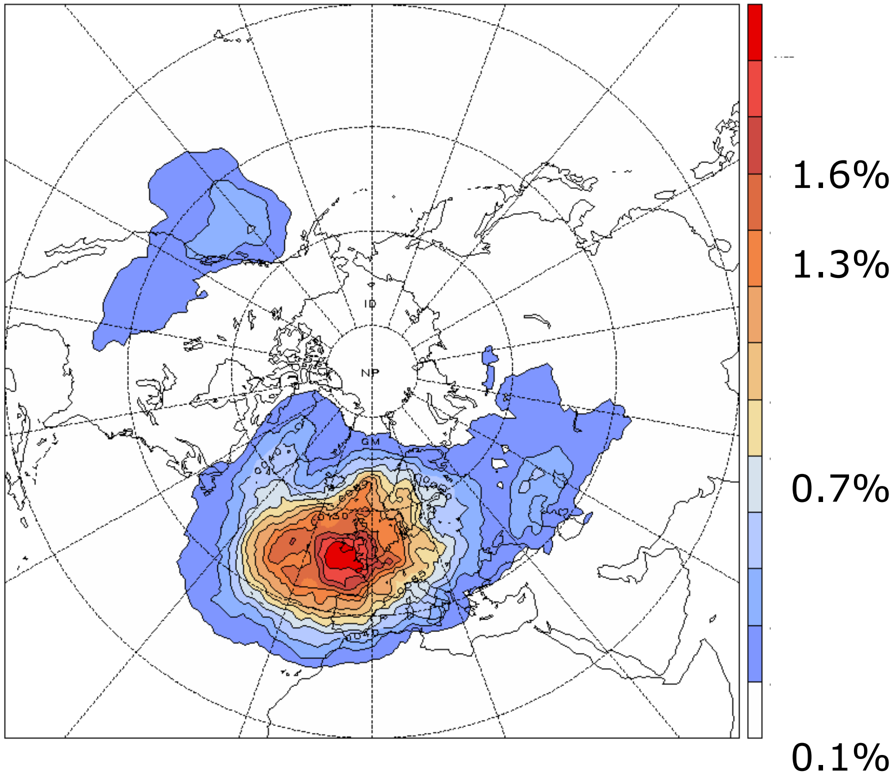
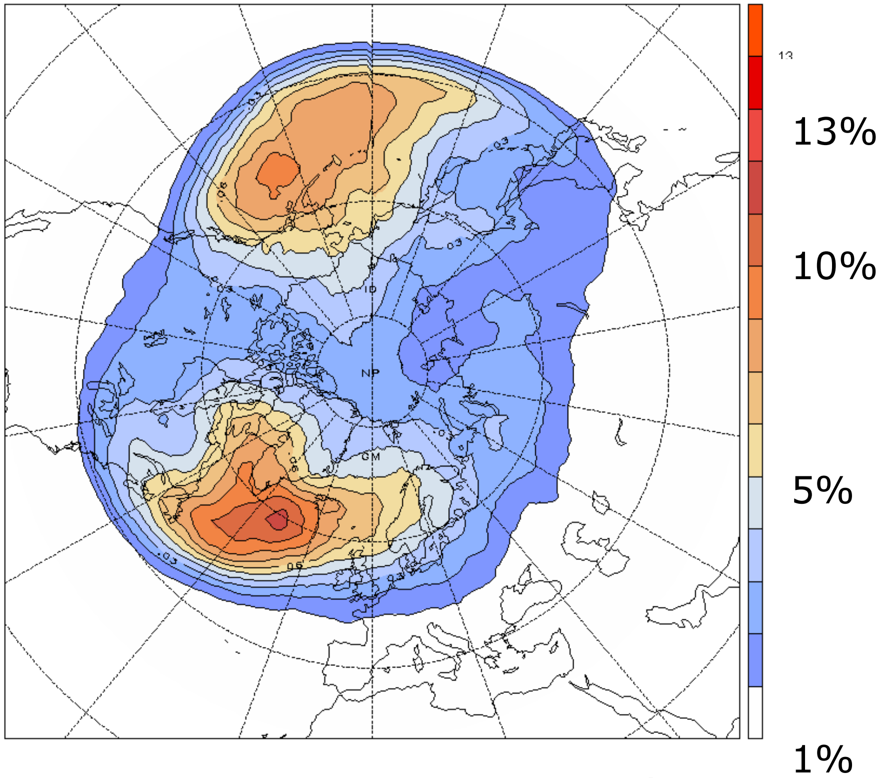
PV Blocking climatology DJF (ERA40)

APV



116 events → 0.9 per month

APV*



476 events → 3.5 per month

Schwierz et al., *GRL*, 2004
Scherrer et al., 2005, submitted
Maspoli et al., 2005, to be submitted

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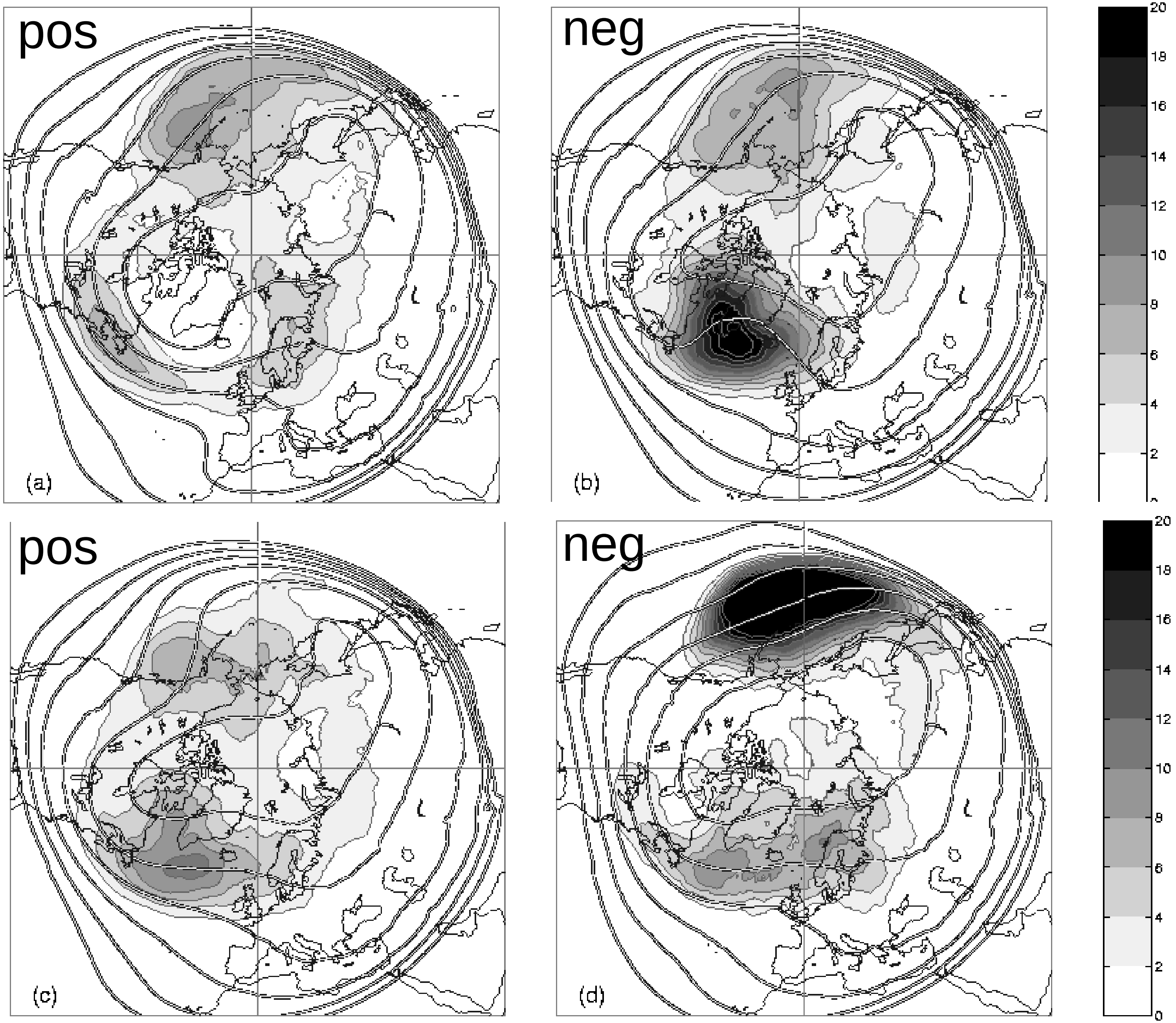
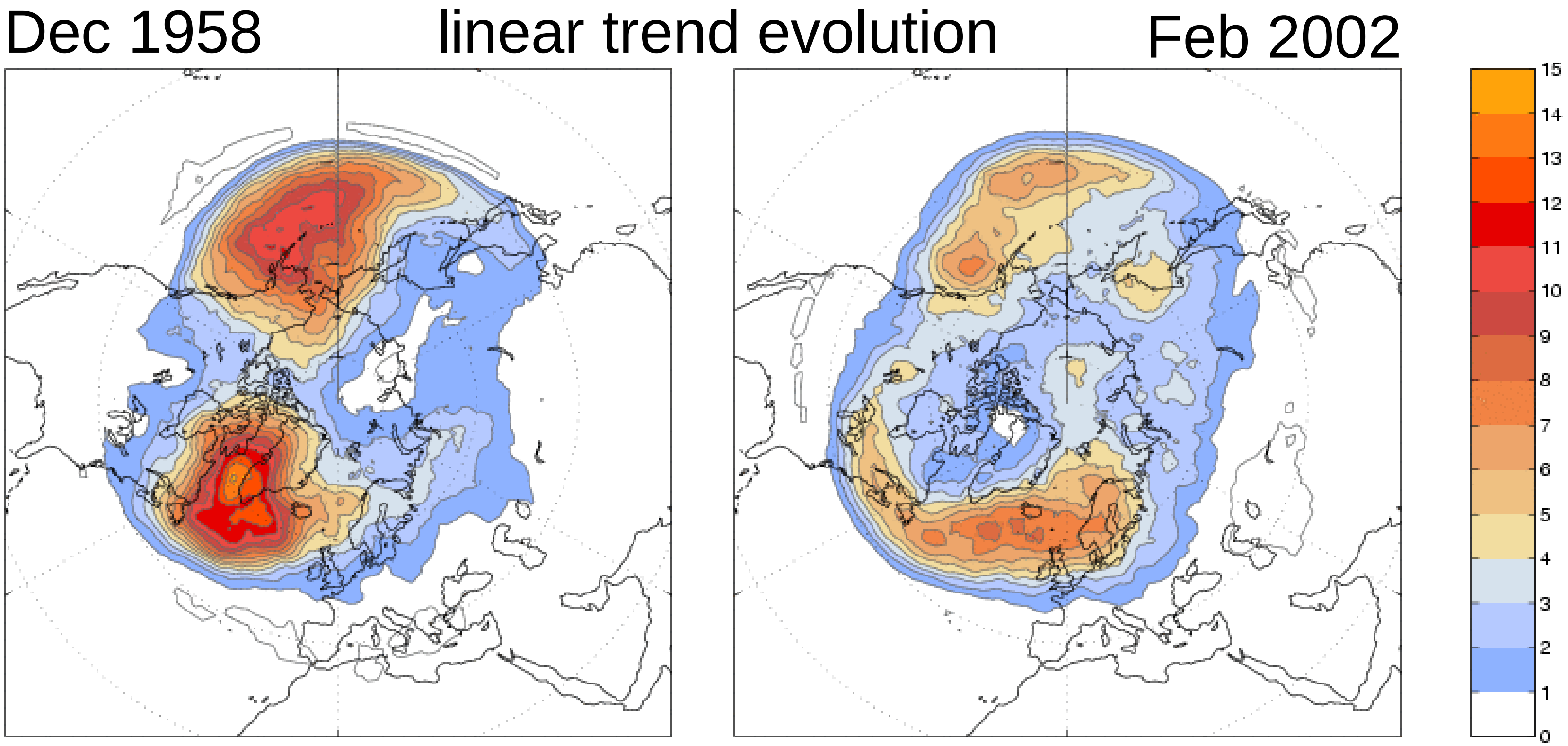
PV Blocking climatology DJF (ERA40)

NAO phases

PNA phases



Atmospheric Blocking Trend (ERA40)



Dec 1958 linear trend evolution Feb 2002

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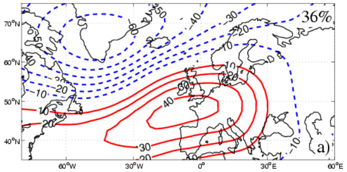
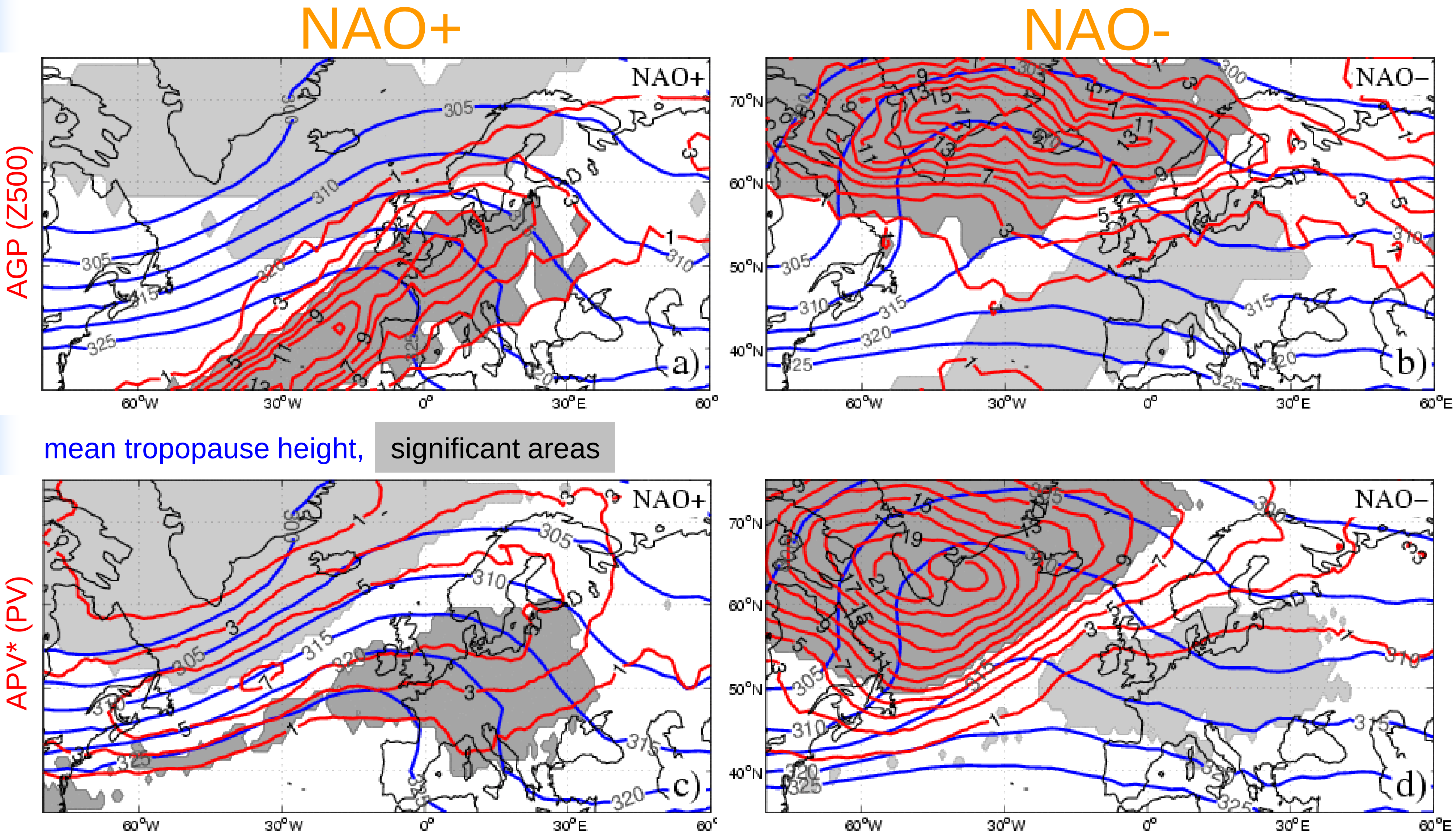
Atlantic Blocking and NAO phase

Collaboration with P2.5





mean tropopause height, significant areas

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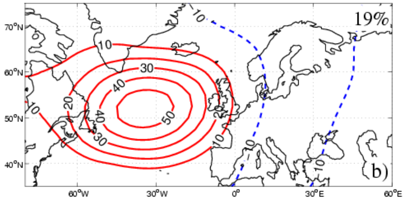
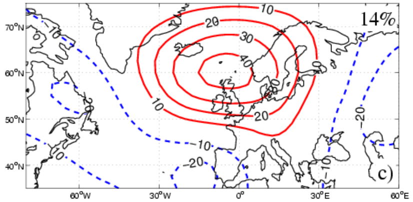
Blocking relation to

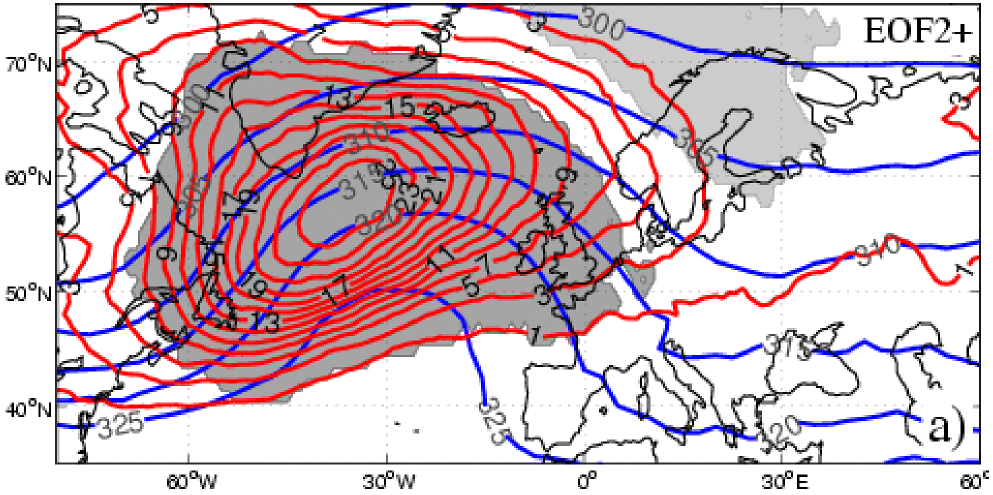


and

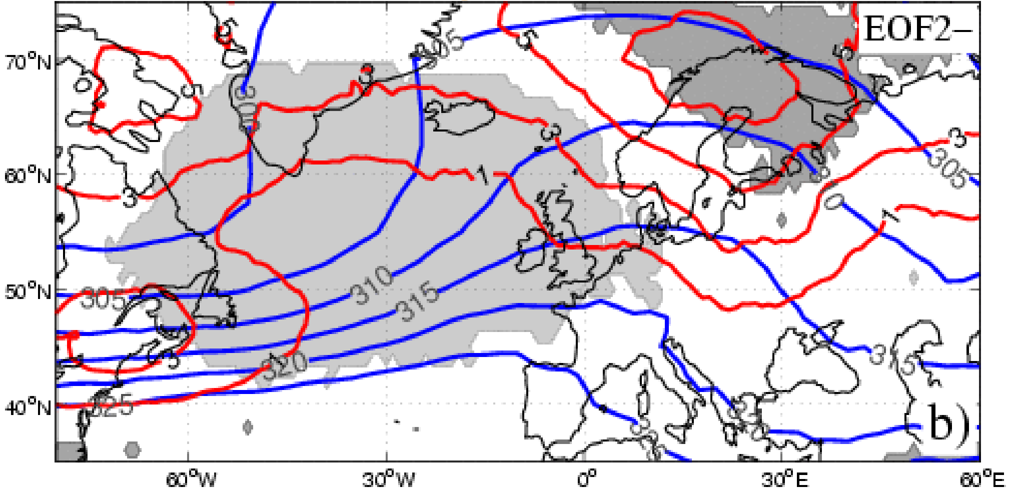


APV* (PV)

EOF2+



EOF2 -



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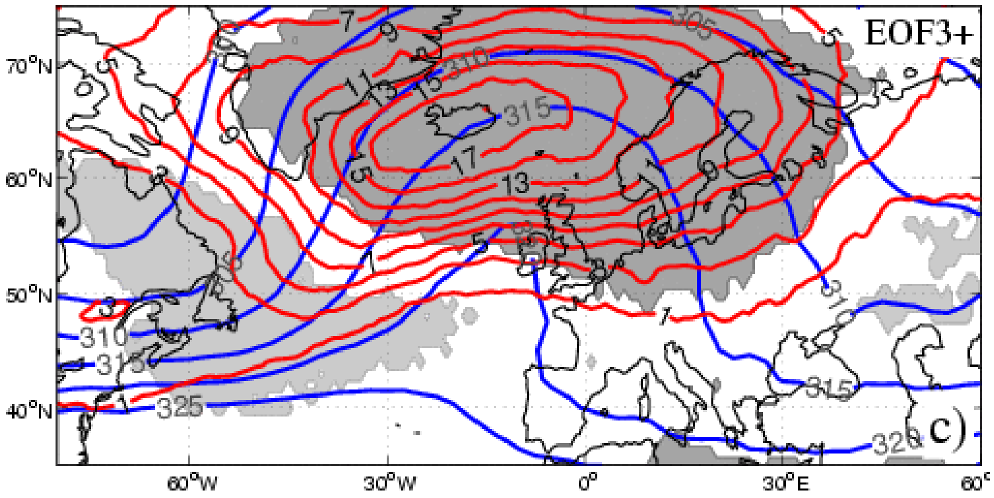

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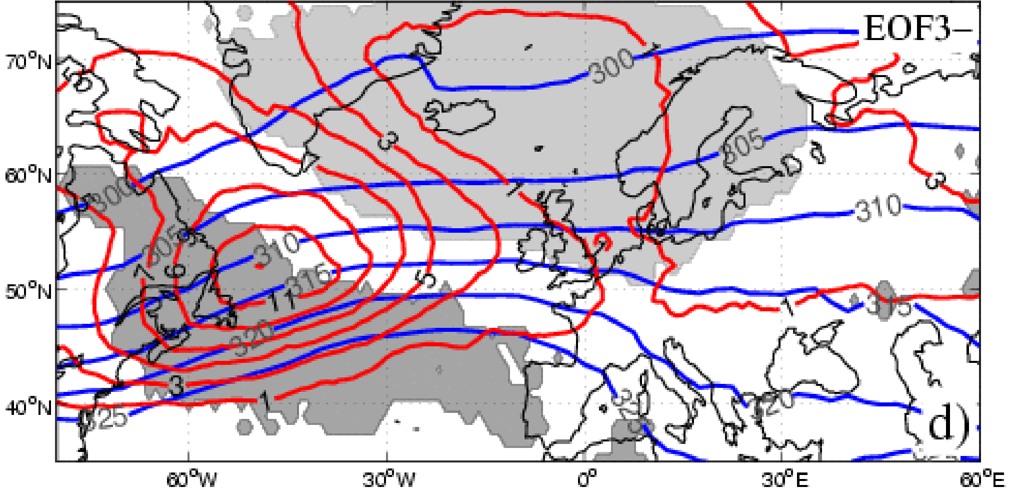
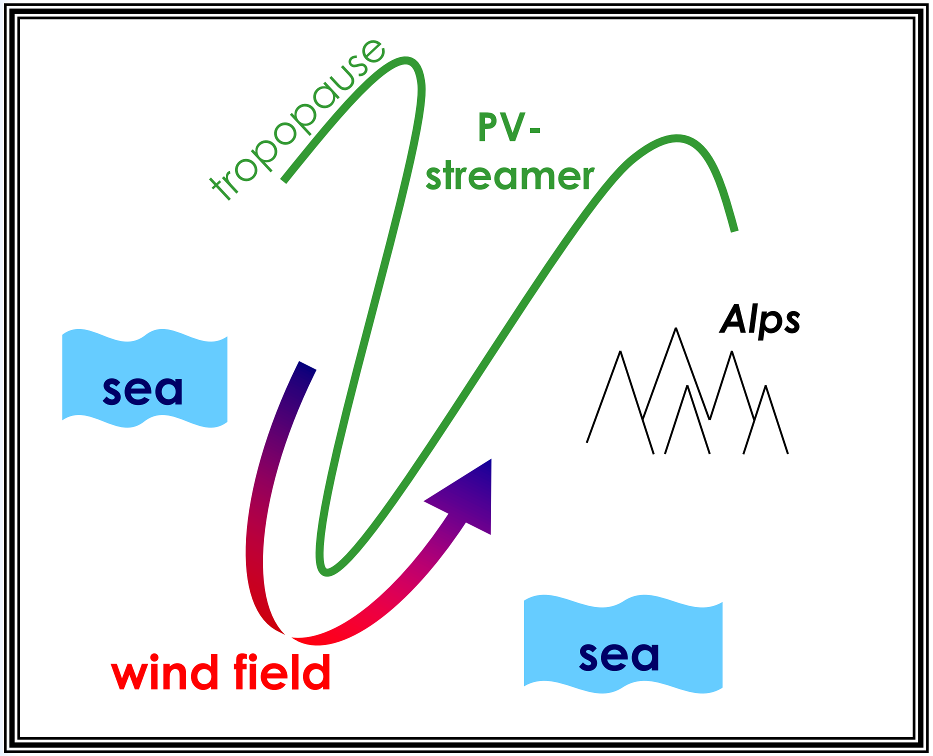


Heavy Alpine Precipitation

Case studies (e.g. Massacand et al., 1998):
PV streamers associated with heavy Alpine precipitation

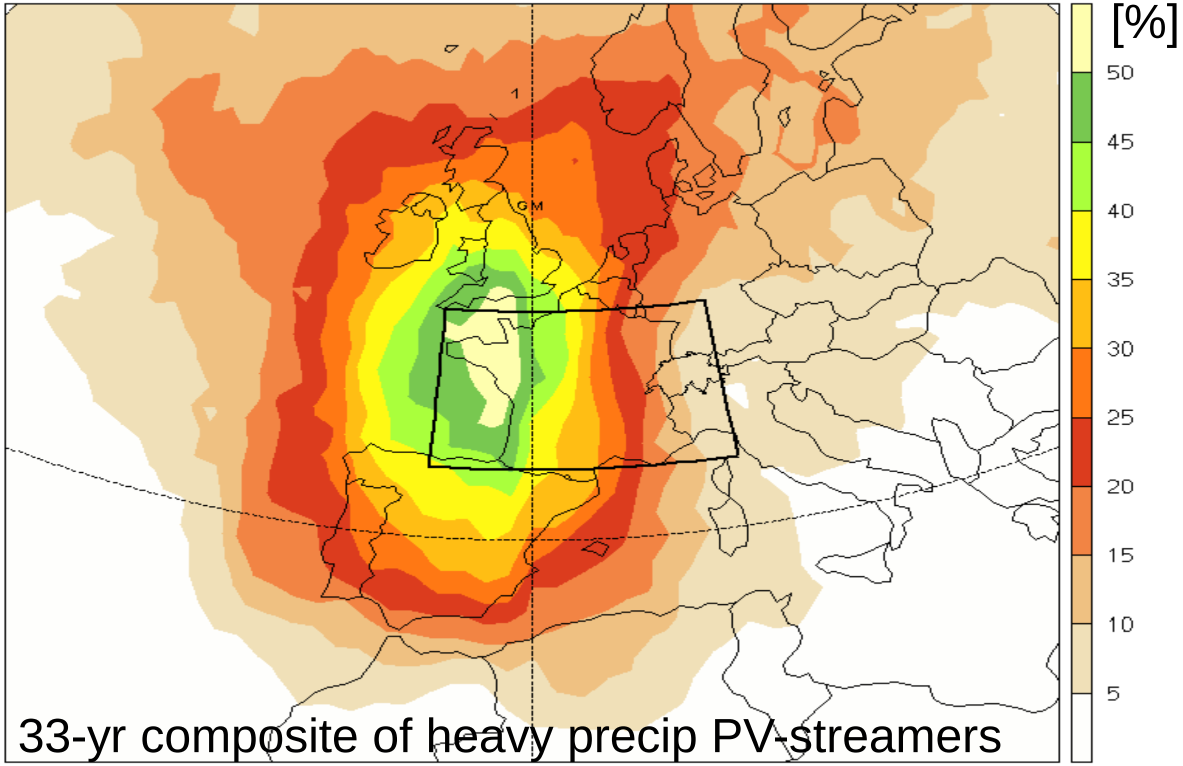


NCCR:
ERA40 streamer climatology and
1966-1999 rain obs climatology

Linkage of most extreme (1%) precipitation with PV streamers

→ Are there precursors for heavy precipitation ?

Climatological link between upper-level PV-streamers and heavy precipitation along the Alpine south-side (AS)



33-yr composite of heavy precip PV-streamers

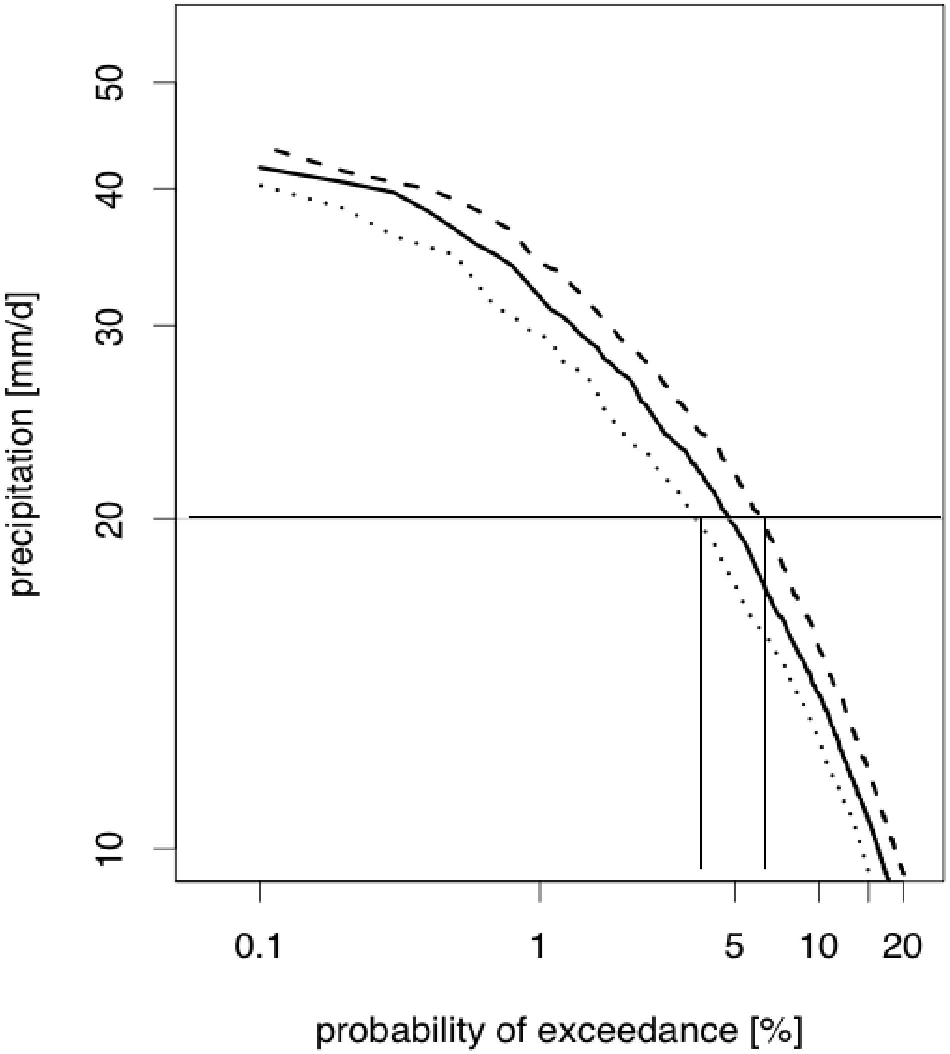
On 73% of the most extreme 1% AS-precipitation days,
a PV-streamer is present over western Europe
(85% for autumn events)

Martius et al., 2005, submitted

Presence of a streamer influences the precipitation probability distribution

Intensity of rainfall likely to be higher in presence of an upper-level streamer:
e.g. relative increase of probability for 20mm/d by 70%

solid:
climatological precipitation distribution
dashed:
precipitation on streamer days
dotted:
precipitation on no-streamer days



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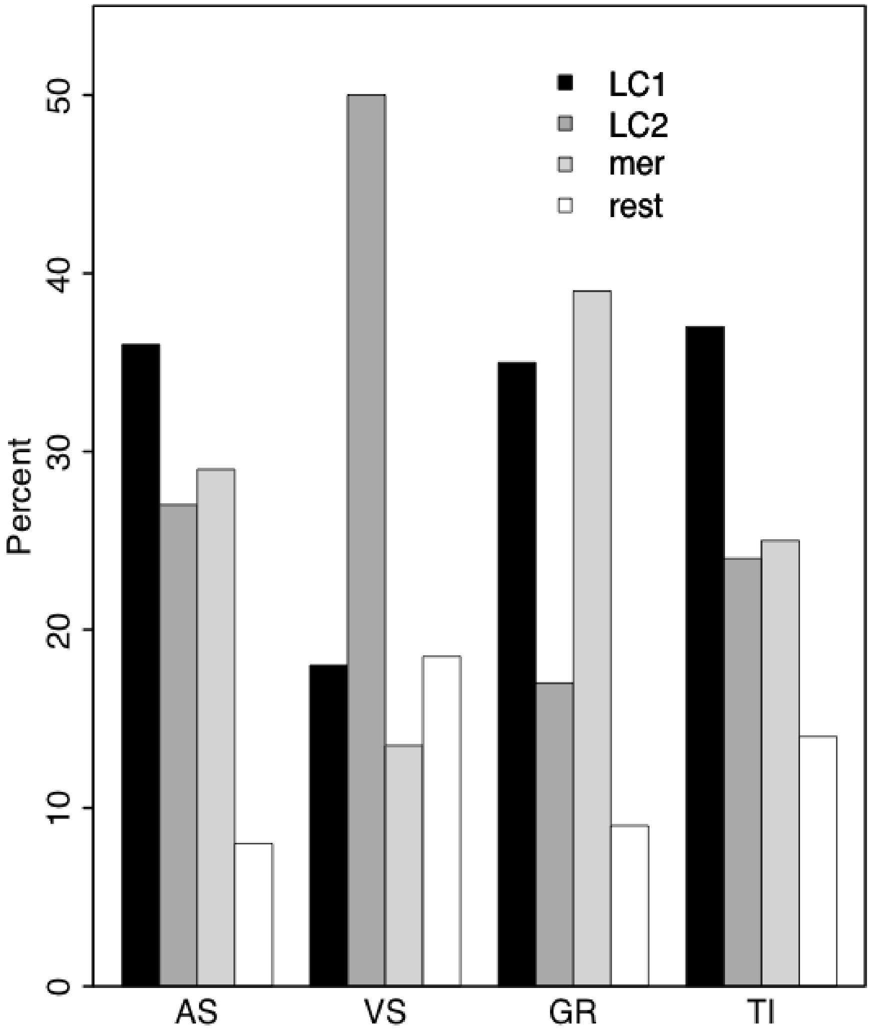
Streamer orientation and precipitation in Swiss valleys

Streamers associated with extreme rain in the different subregions have a distinct location and orientation:

Ticino: LC1
Grisons: LC1, meridional
Valais: LC2



LC1: anti-cyclonic orientation
LC2:cyclonic orientation
Mer: meridional orientation
Rest: no distinct orientation determinable

NFS NCCR climate

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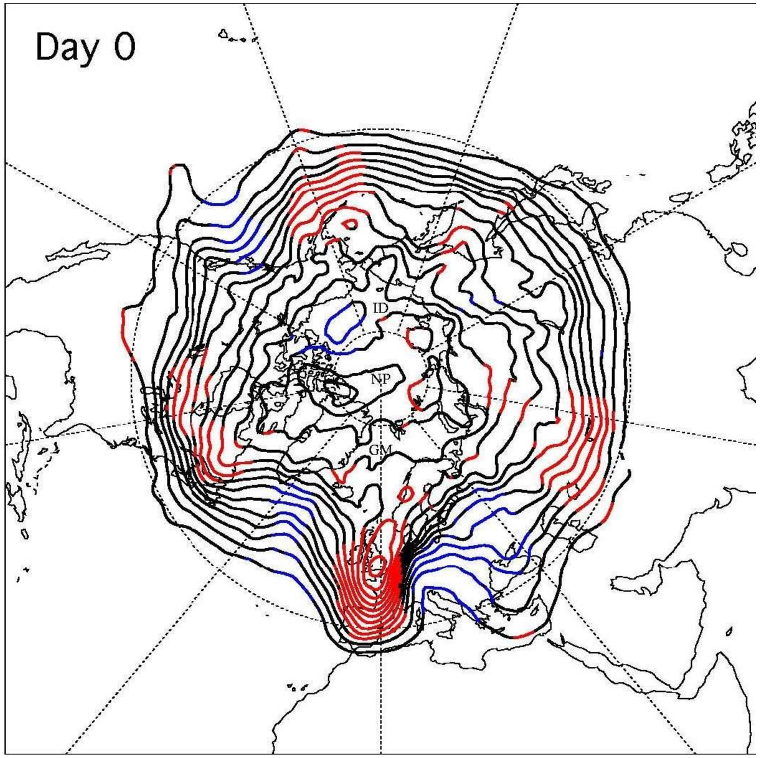
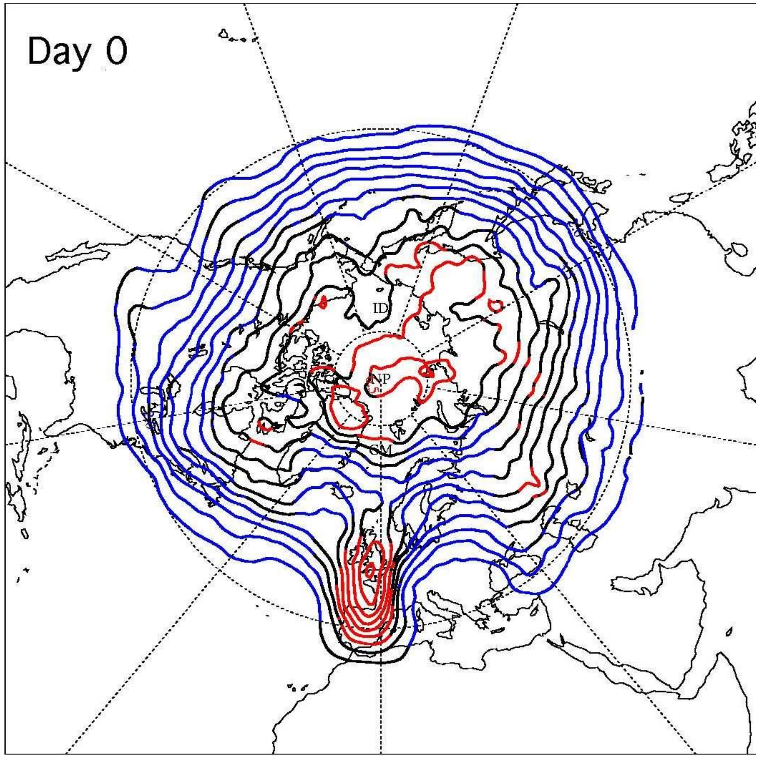
Anomalous hemispheric isentropic PV distribution on heavy precipitation days

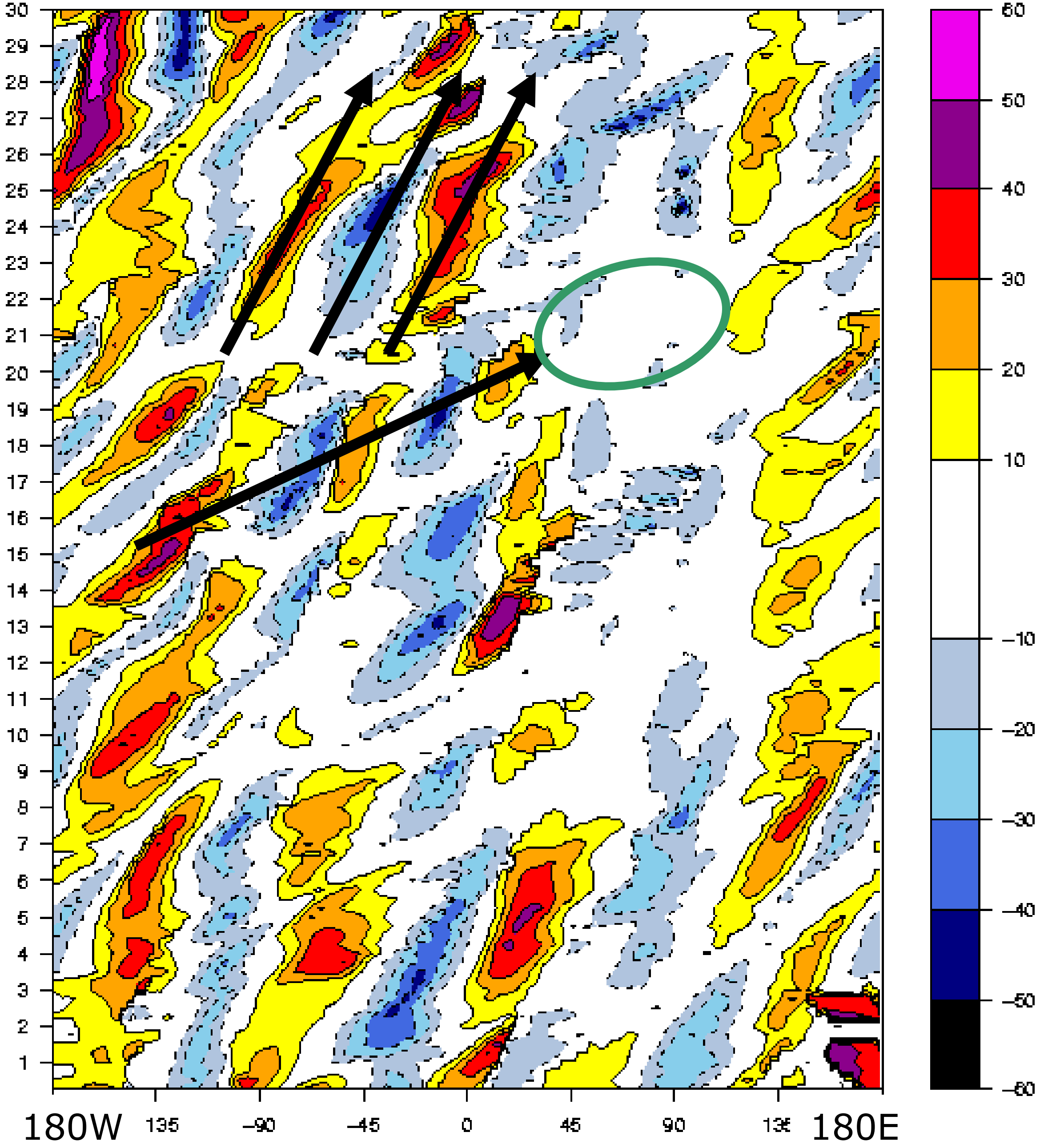
Summer (Apr – Sept)



Winter (Oct - Mar)



ERA40 climatology of Rossby waves

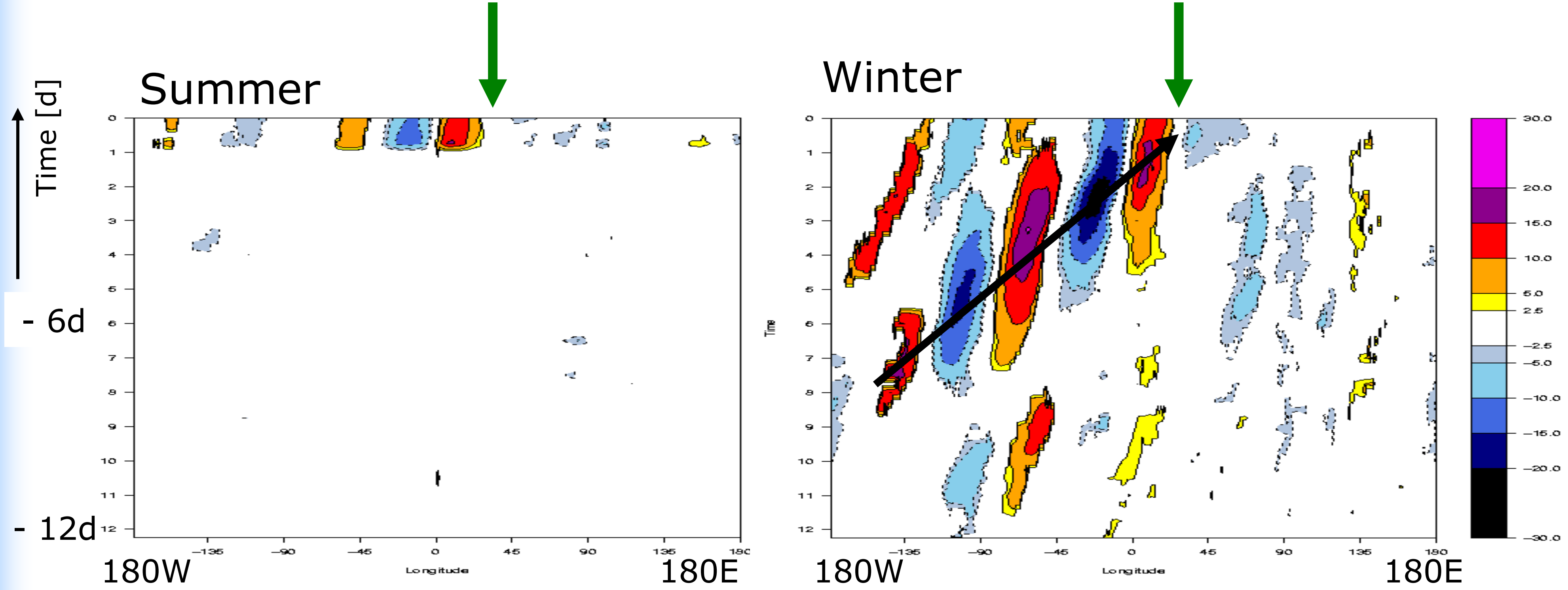


- ☐ Phase velocities
- ☐ Group velocities
- ☐ Wave lengths
- ☐ Wave train extension

Wave breaking linked to PV streamers and often causes heavy weather

→ Climatological use of Hovmöller evaluations

Wave composites – HP precursors (95% sig.)



- background: wave anomaly (k~5)
- precursor RW short
- no coherent phasing before D=-1

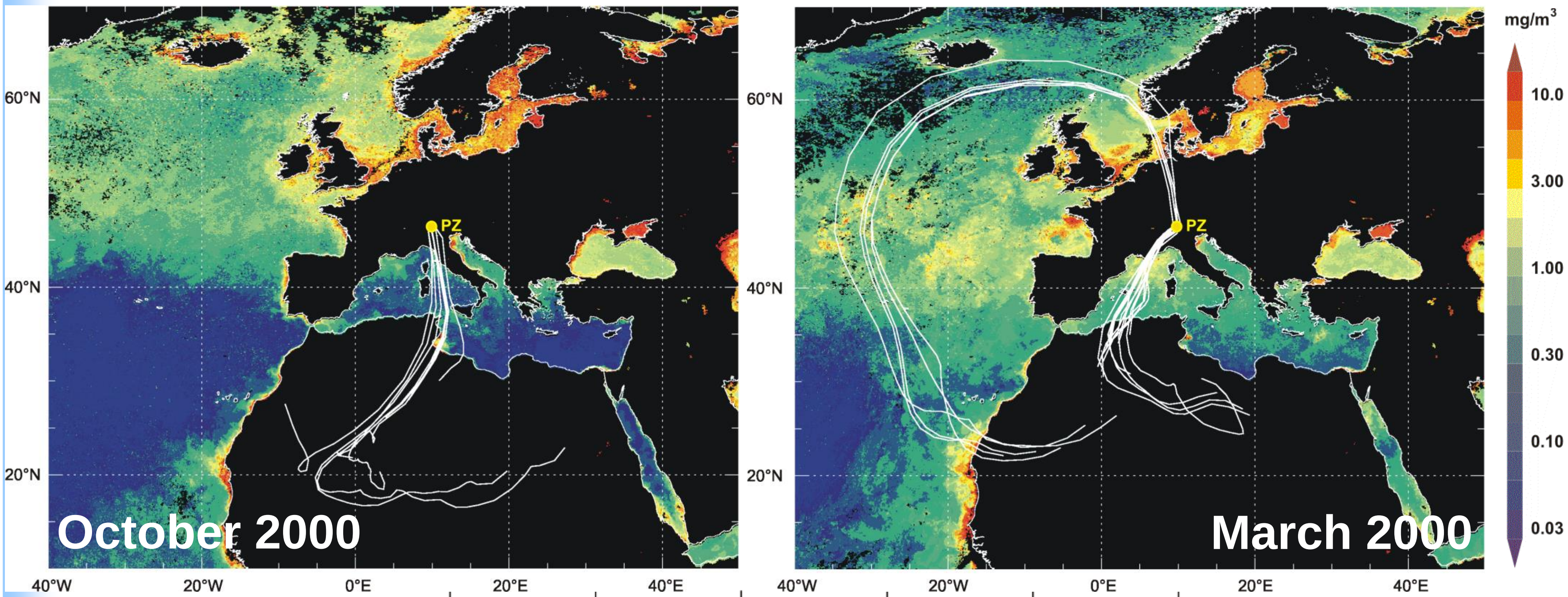
→ „in-situ“ streamer development

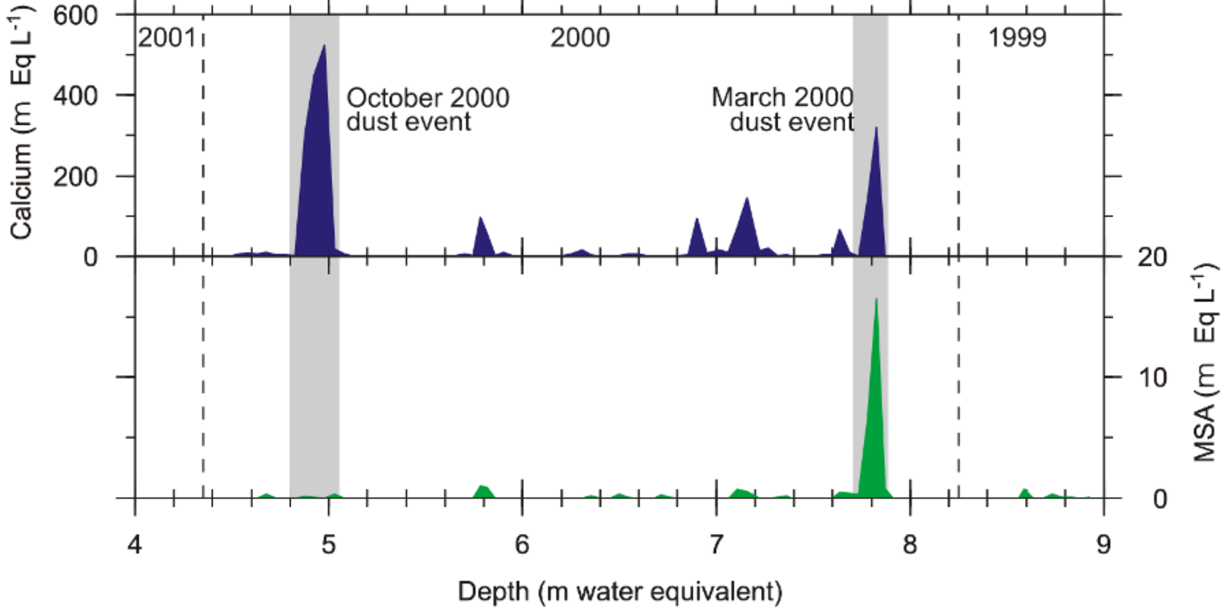
- steepened PV gradient
- precursor RW longer
- coherent phasing until D=-8

→Upstream wave precursor

Saharan dust in an ice core

Collaboration with WP1
Sodemann et al., *ACPD*, 2005, submitted



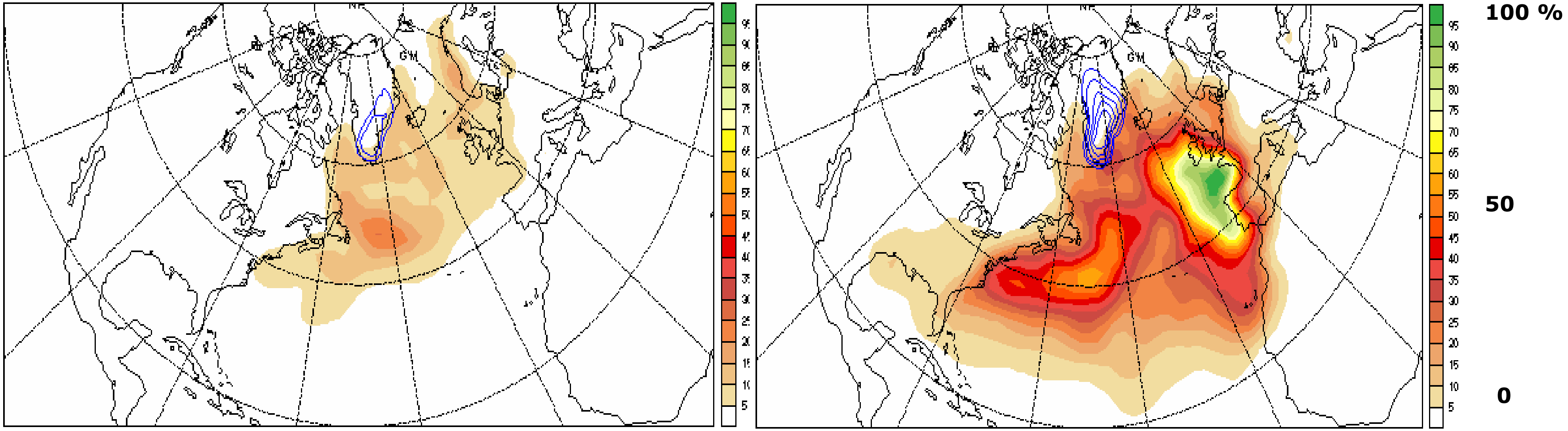


P2.3

Moisture uptake regions

NAO +

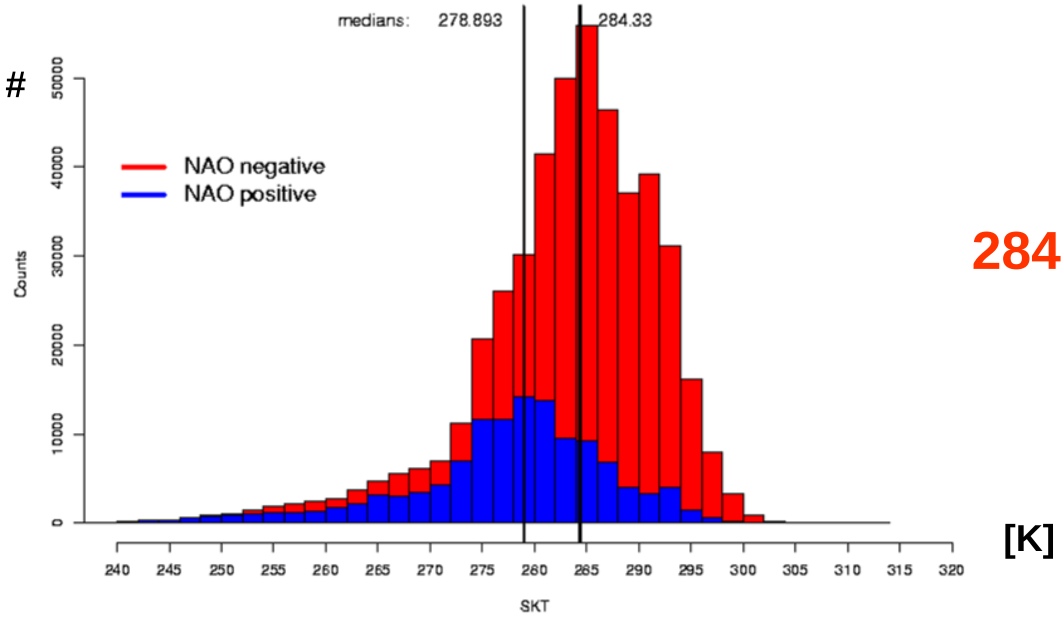
NAO -



Precipitation (contours: 10, 20, 40, 60, 80 %)

SST uptakes

NAO+ 278.89K



284.33K NAO-

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