

# Dzerdzevski's classification of non-tropical north-hemispheric atmospheric circulation patterns

**Concept, Pressure and Temperature Signals**  
*First results*

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# Structure

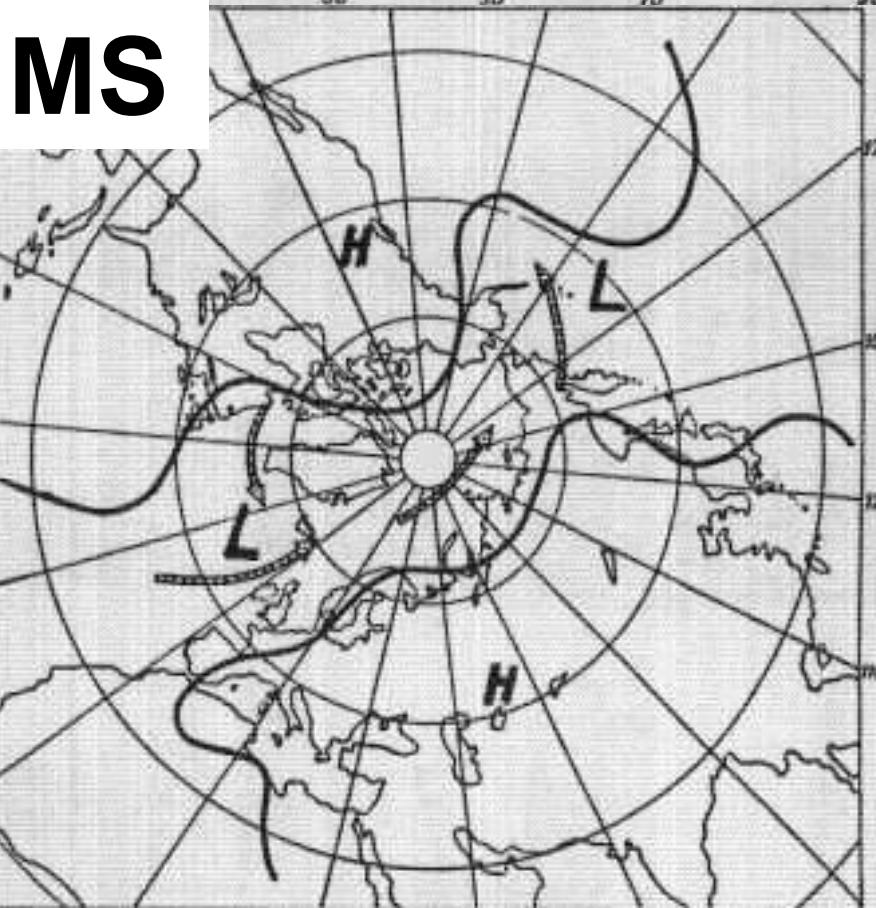
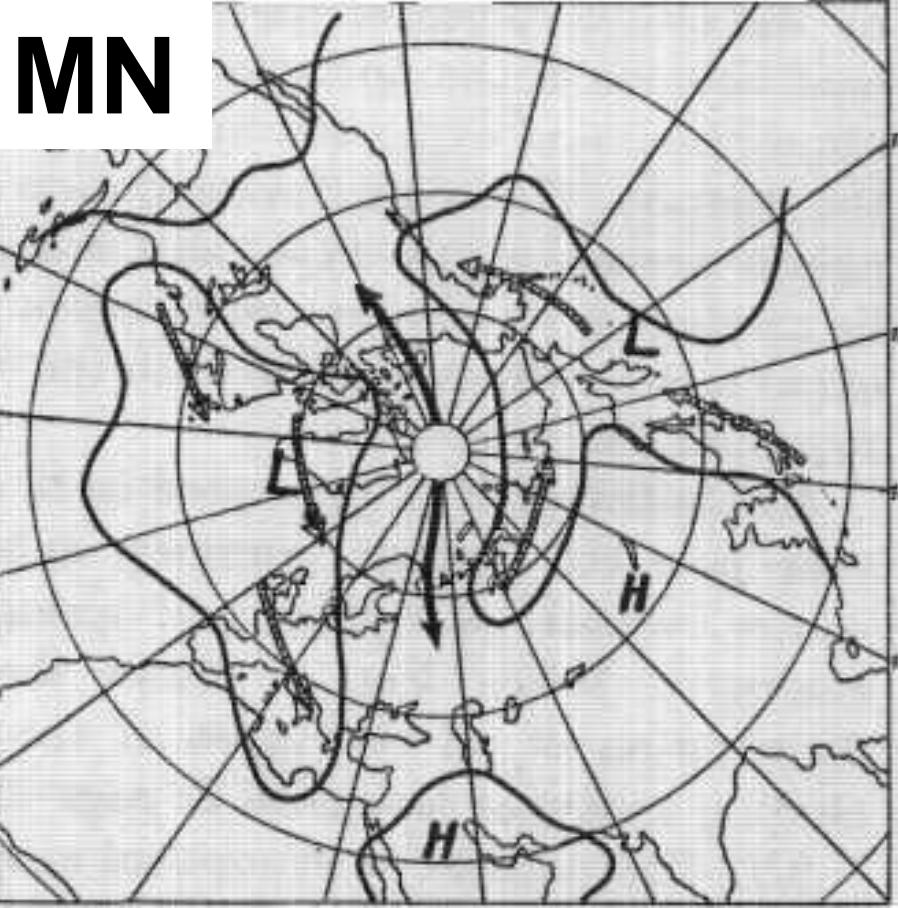
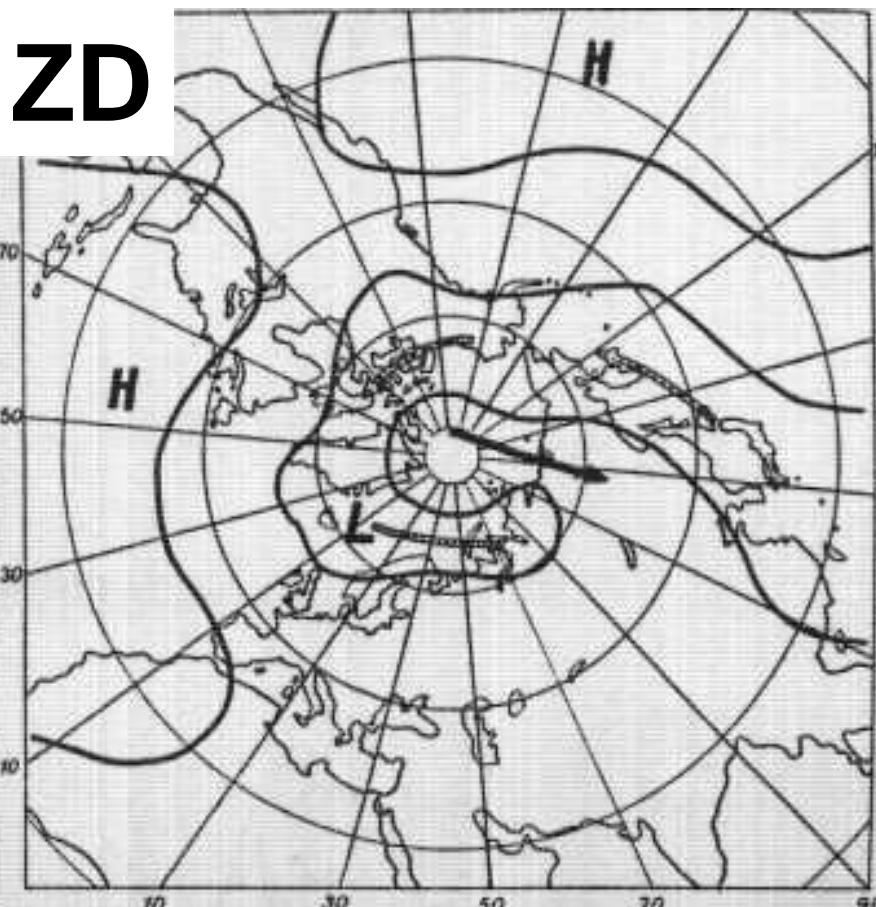
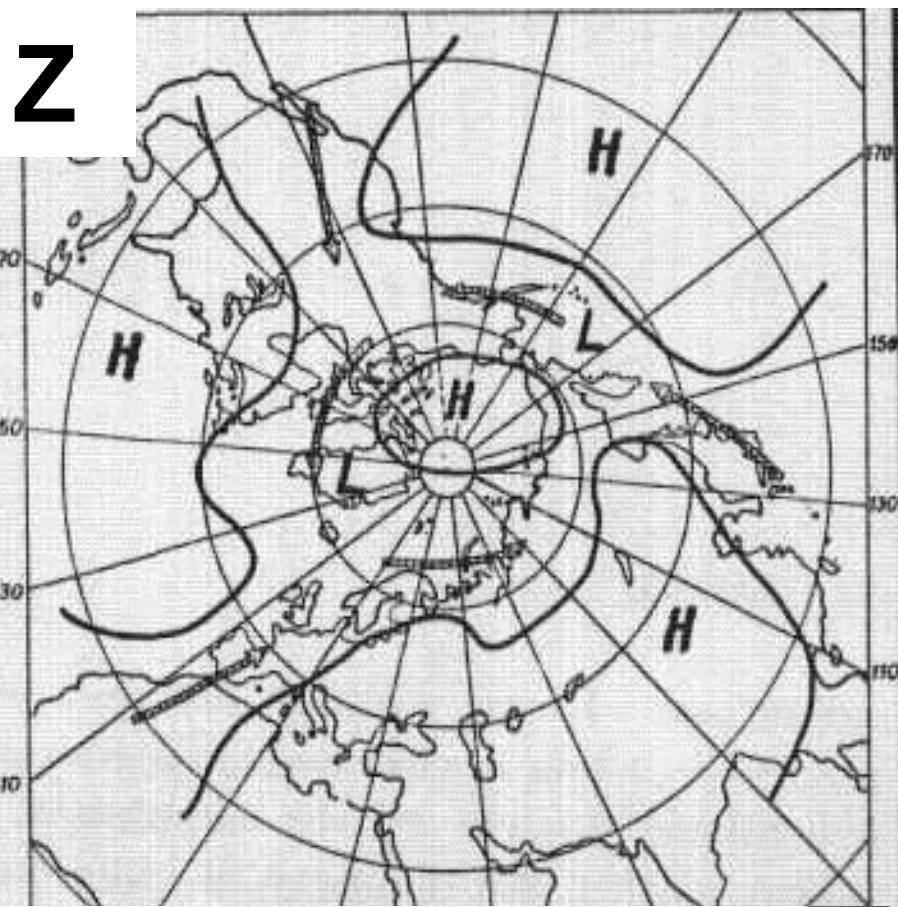
- Concept and data
- Preliminary results for discussion
- Monthly air pressure and temperature signals for circulation groups
- Details
  - Zonal (Z) circulation group
  - Zonal Disturbed (ZD) circulation group
  - Meridional North (MN) circulation group
  - Meridional South (MS) circulation group

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# Concept and Data

- Concept developed by B.L. Dzerdzevski: focus on “the big picture”
- Data taken from [www.atmospheric-circulation.ru](http://www.atmospheric-circulation.ru) (Nina Kononova, student of Dzerdzevski)
- Data available from 1899; used here from 1901 to 2010
- Classification of entire northern hemispheric atmospheric circulation conditions in non-tropical latitudes, based on the number of blockings and trajectories of cyclones/anticyclones and troughs/ridges
- 41 Elementary Circulation Mechanisms (ECM's), merged into 13 circulation types (CT's) and summarised by four circulation groups
  - **Zonal (Z)**: polar high pressure, no blocking, 5 ECM's in 2 CT's
  - **Zonal disturbed (ZD)**: polar high pressure, 1 blocking, 13 ECM's in 5 CT's
  - **Meridional north (MN)**: polar high pressure, 2-4 blockings, 21 ECM's in 5 CT's
  - **Meridional south (MS)**: polar low pressure, no blocking, 2 ECM's



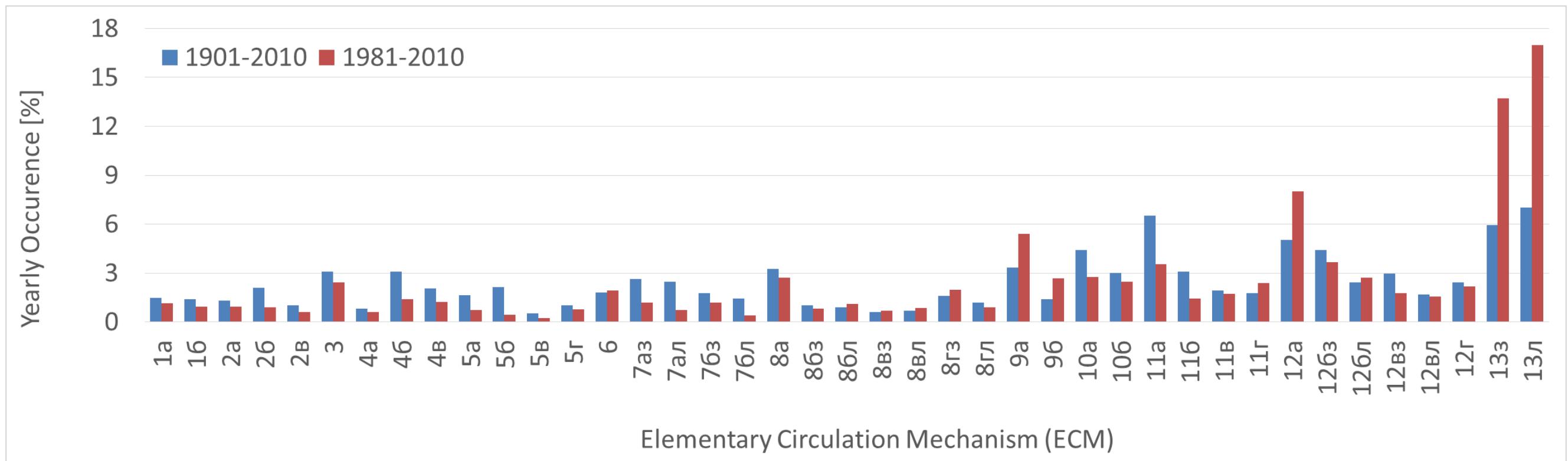
Circ. Group	Circ. Type	Circ. Subtype
Z Zonal	1	1а 1б
	2	2а 2б 2в
ZD Zonal Disturbed	3	3
	4	4а 4б 4в
MN Meridional North	5	5а 5б 5в
	6	6
MS Meridional South	7	7аз 7ал 7бз 7бл
	8	8а 8бз 8бл 8вз 8вл 8гз 8 гл
	9	9а 9б
	10	10а 10б
	11	11а 11б 11в 11г
	12	12а 12бз 12бл 12вз 12вл 12г
	13	13а 13б

# Structure

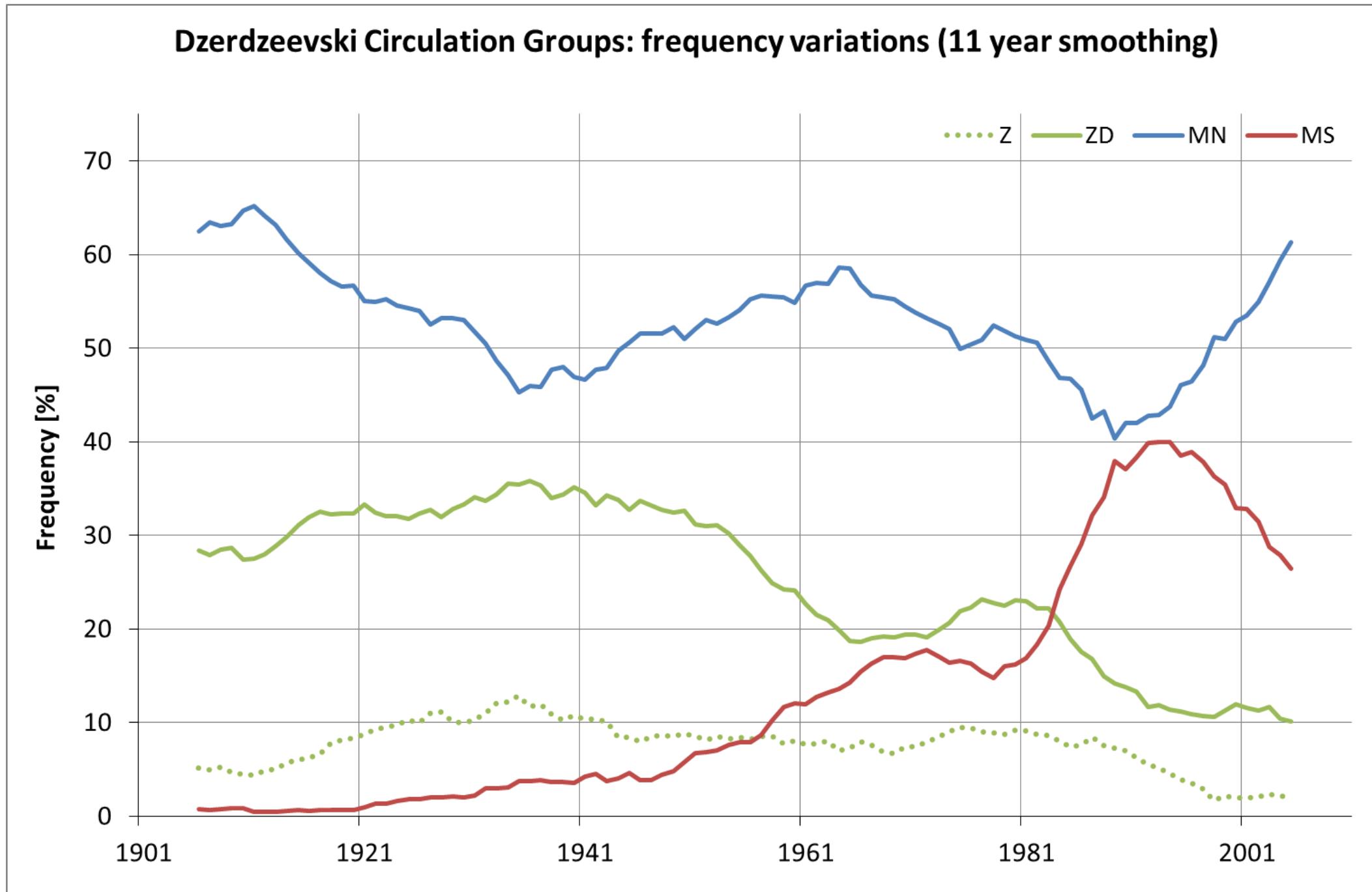
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# Frequency variations

- Very large fluctuations of circulation groups (and CT's/ECM's)
- Circulation epochs (next slide): how “real” are they (how homogenous is the time series) and how could they be verified (NAO, AO...)?
- Can the incredible strong increase of MS be real, and if yes – is it explainable by the decreasing Arctic ice shield? If so, why reverses the trend since the millennium?



# Frequency variations

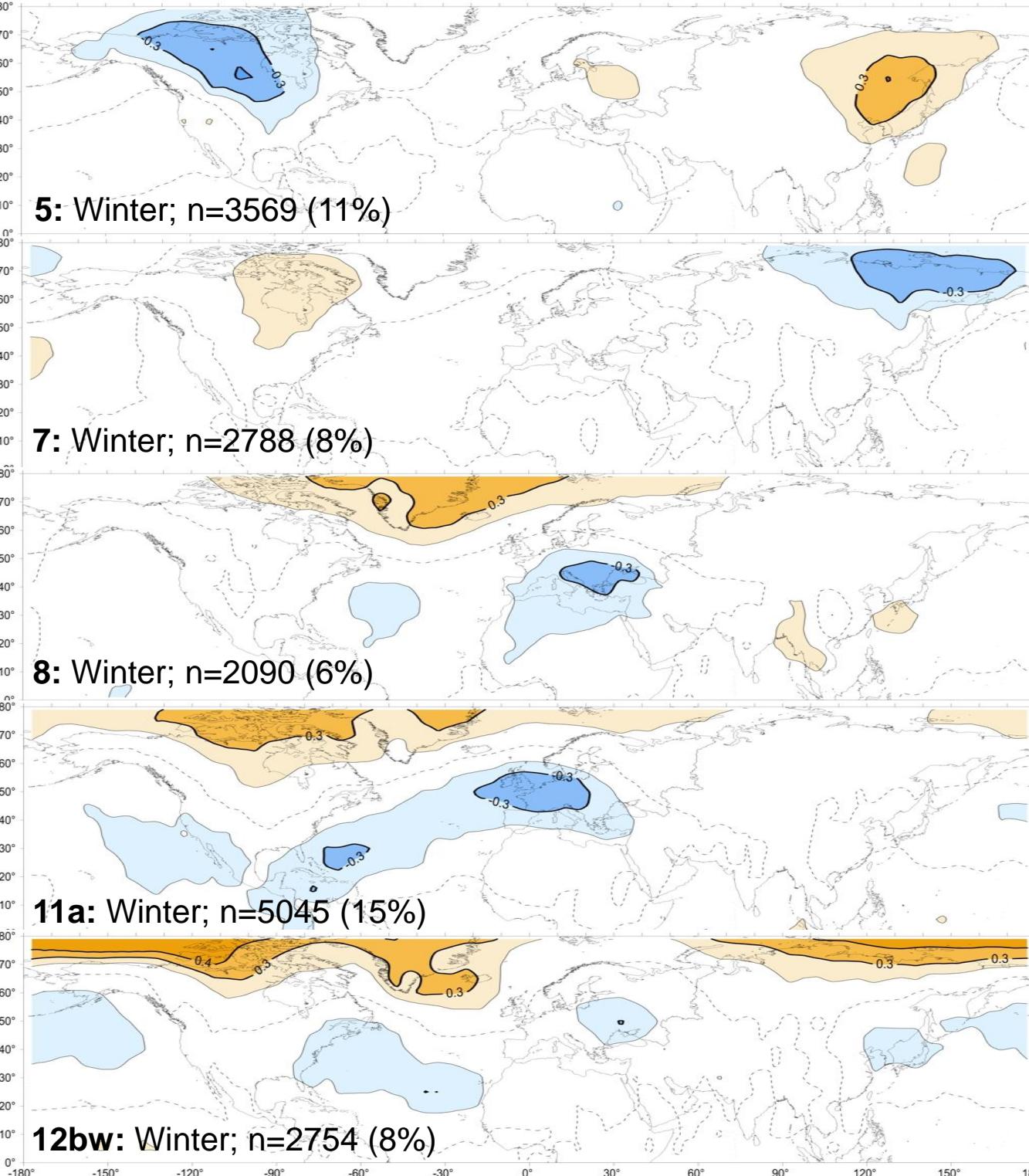


# Climate signals

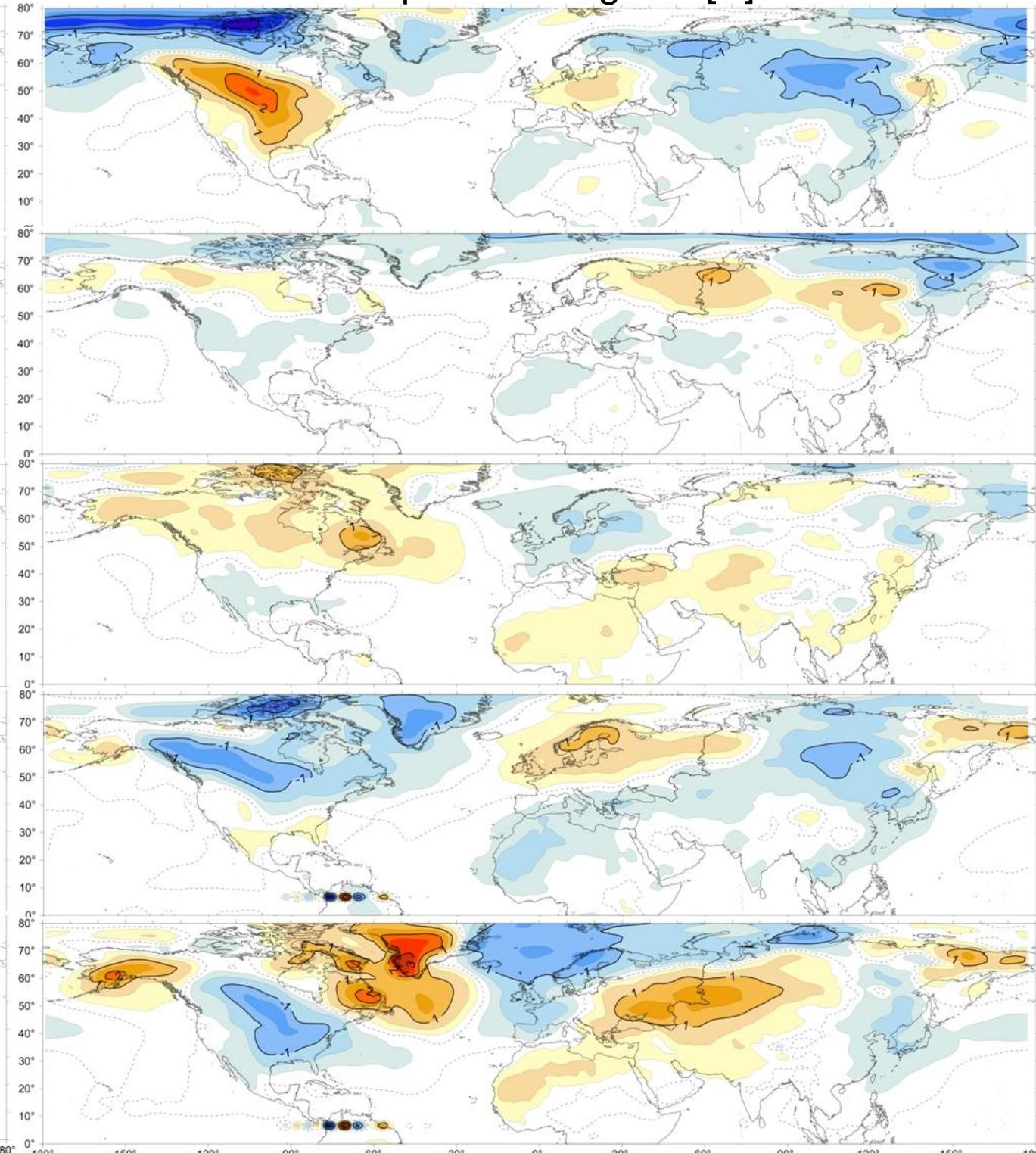
- Generally quite weak correlations between air pressure and circulation groups/types (in contrast to those of other, smaller-scale classifications like Vangengeim-Girs and Grosswetterlagen classification)
- Air temperature signals: for some CT's some useful results in specific regions, but generally below expectations
- Air pressure and temperature: often quite large changes of averages from one month to another (raises doubt of signal stability)
- Classification may still be useful to investigate temperature and other climate averages/extremes in a NH frame – *further research started*
- Better results by employing sectors? (6 sectors: Atlantic, European, Siberian, Far East, Pacific, American) – *so far not checked*
- Next slide: examples of visible air pressure signals and comparison with air temperature signatures (most pronounced in winter)

# Climate signals (selected CT's/ECM's)

Air Pressure Correlation Values



Air Temperature Signals [K]



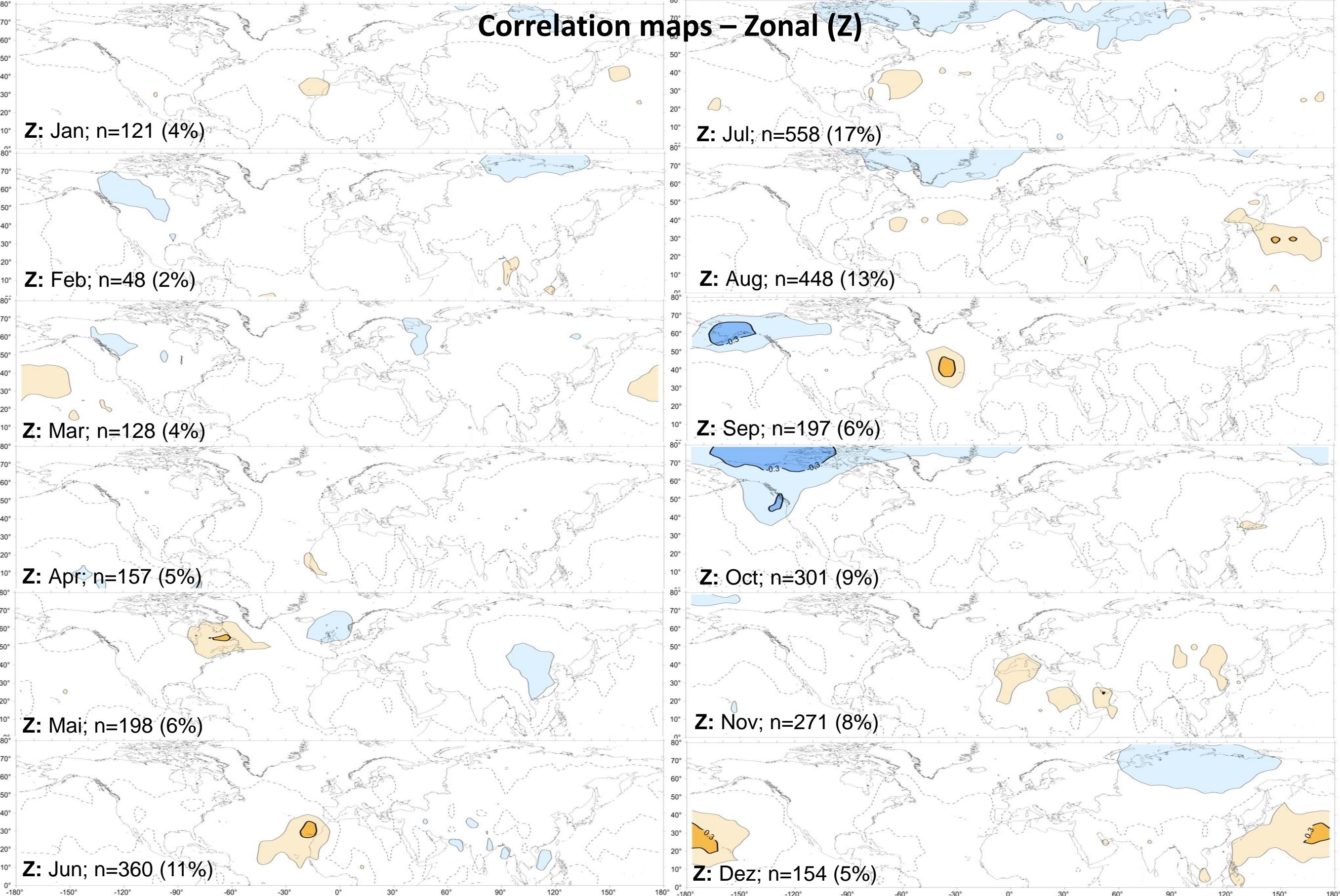
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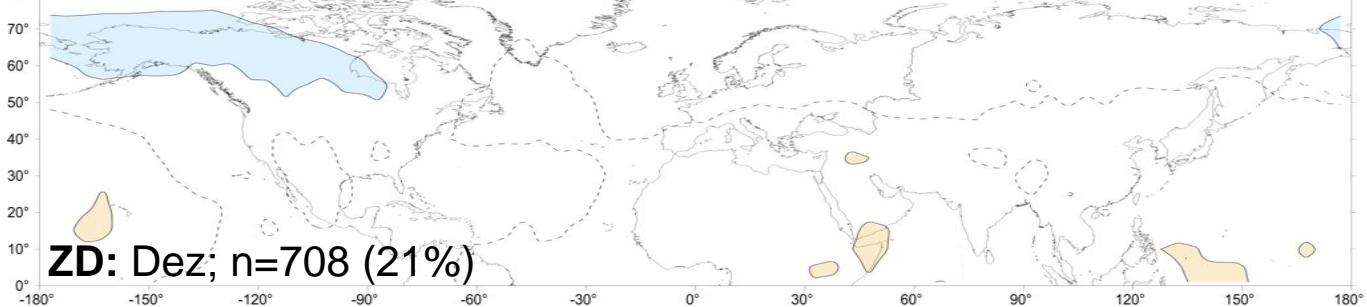
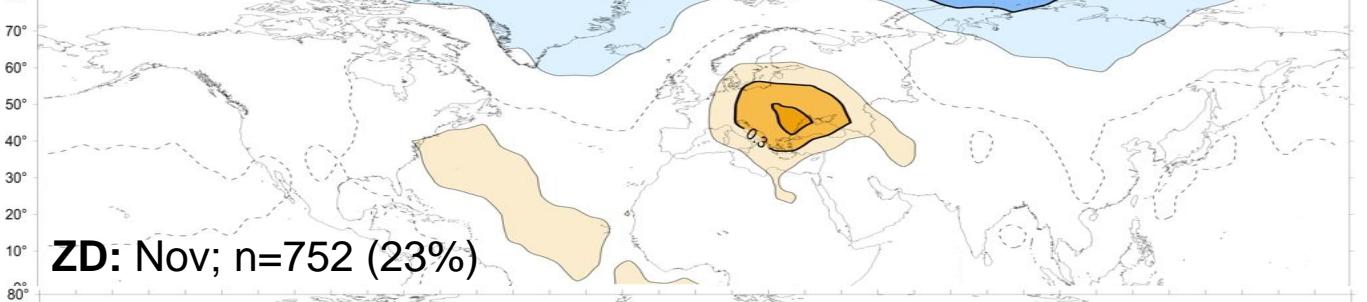
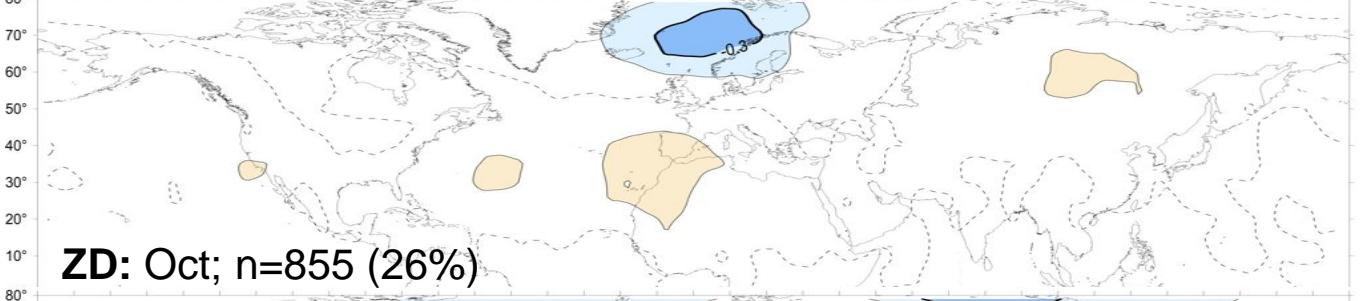
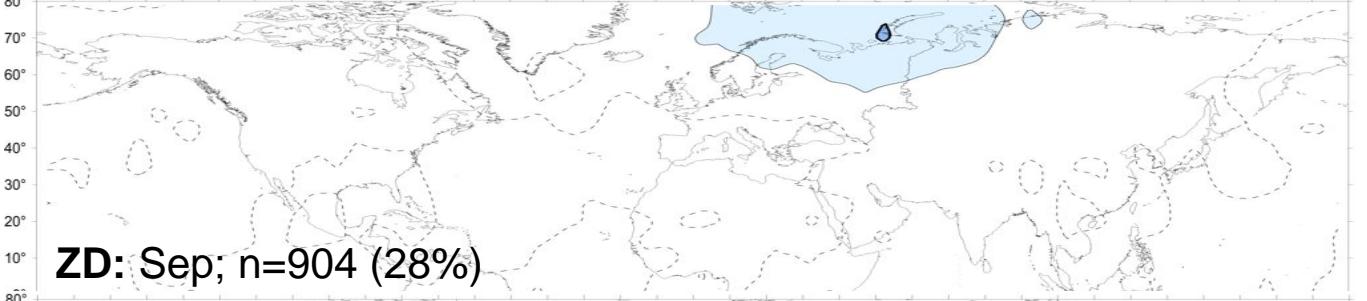
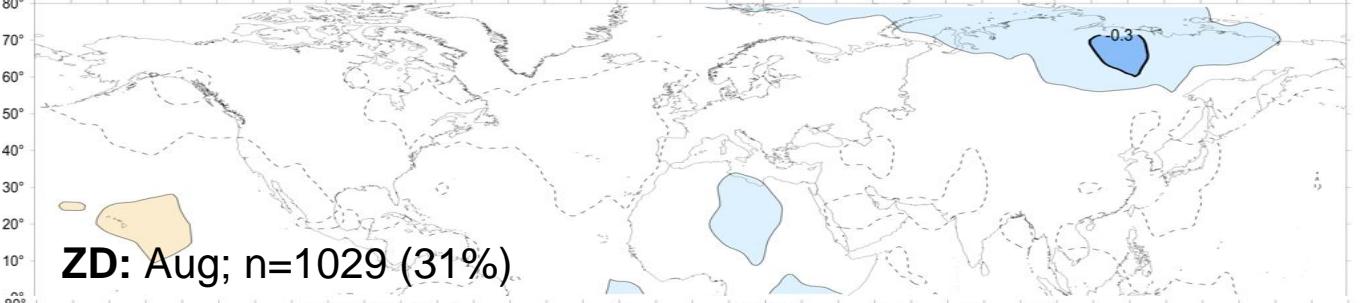
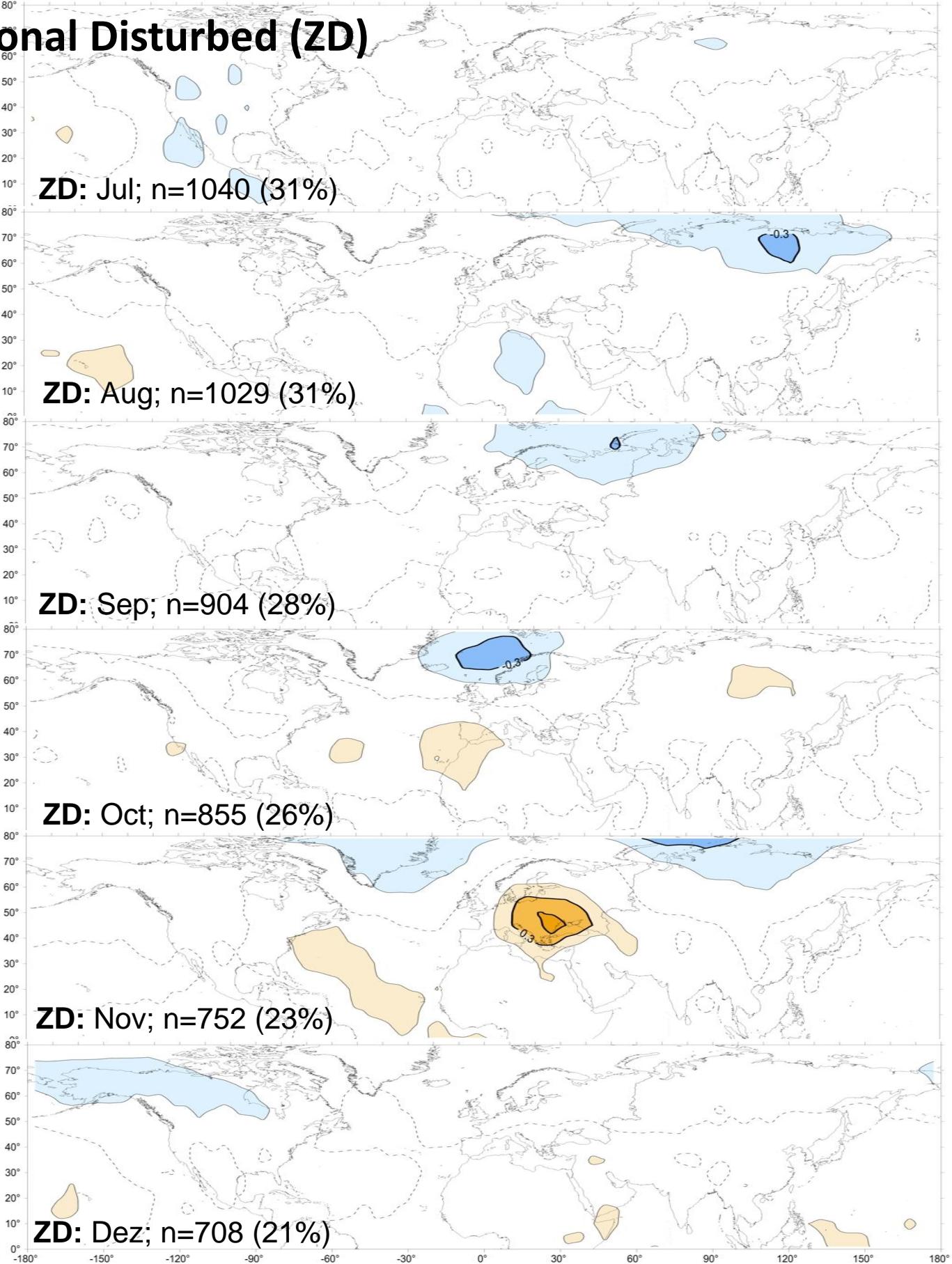
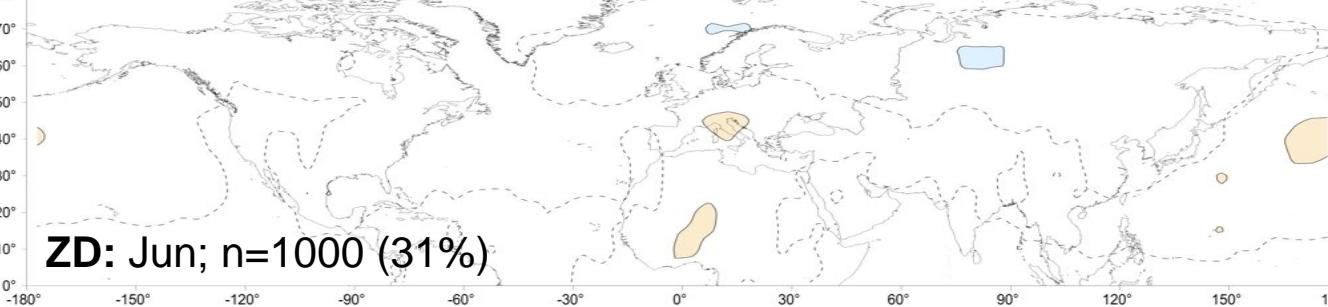
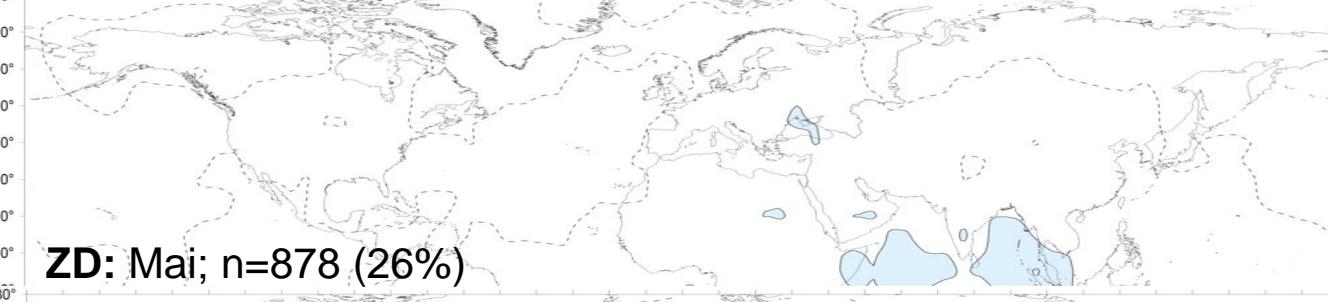
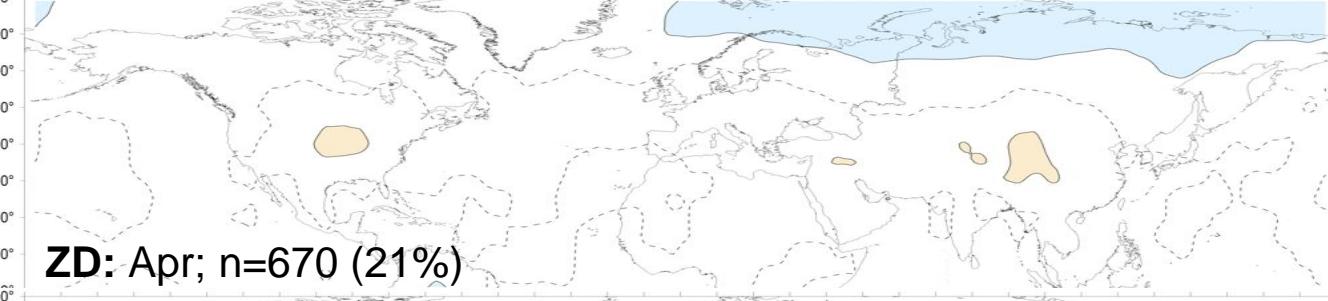
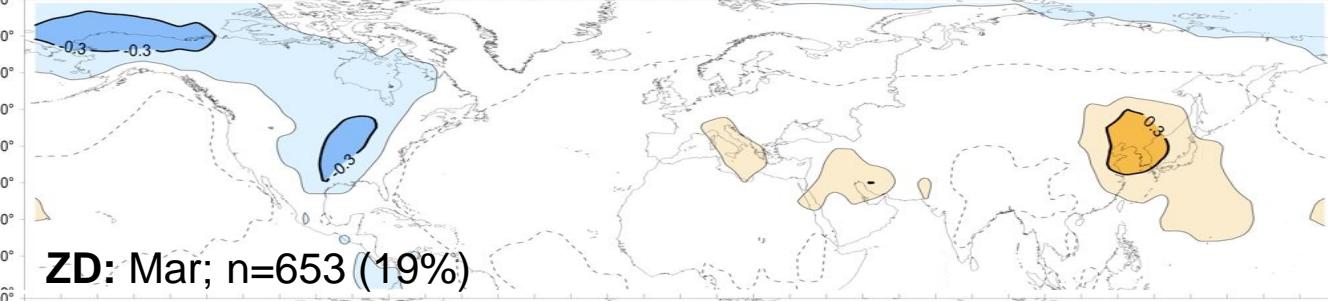
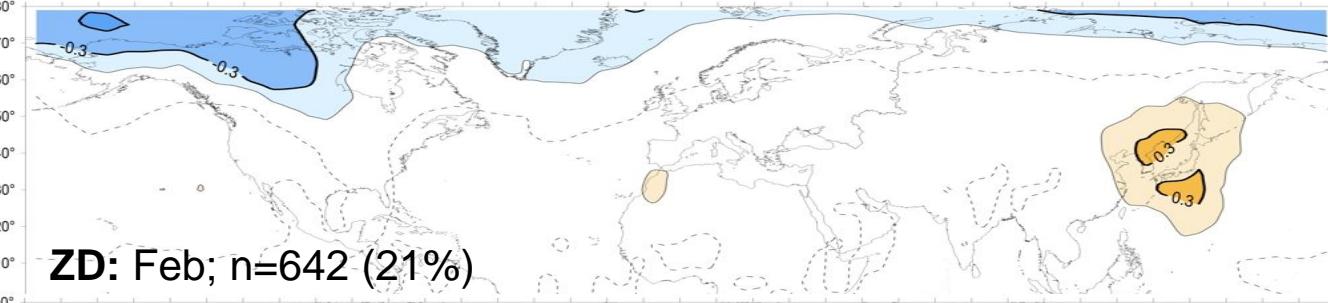
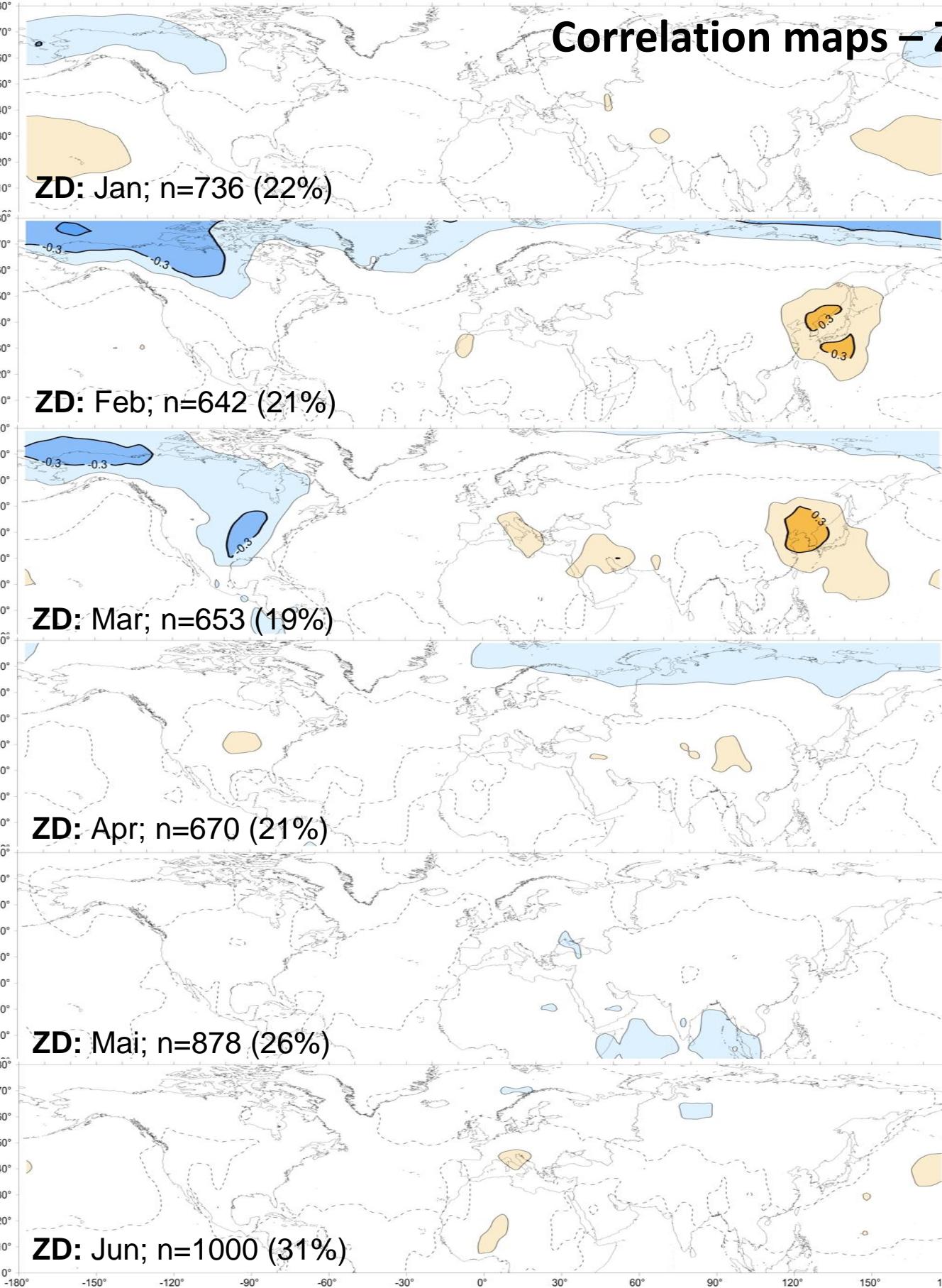
# Air pressure: correlation maps

- Data:
  - Sea level pressure: gridded set of monthly averages in  $5 \times 5^\circ$  worldwide resolution without gaps (HadSLP2r); Allan/ Ansell (2006), obtained via <http://hadobs.metoffice.com/hadslp2/data/download.html>
  - Dzerdzevski CG's/CT's/ECM's: number of days per month and type
- Methods:
  - Plots of monthly, seasonal, half yearly and yearly resolution
  - Linear de-trending of time series to reduce trend-originated correlations
  - Correlation of two time series, each, within 1901-2010 for every grid point
  - Level of significance:  $r=0,2$  ( $\alpha=0,02$ , 4% variance),  $r=0,3$  ( $\alpha=0,001$ , 9% v)
  - Mapping of NH for typical pattern and possible teleconnections (via mapping program SURFER)

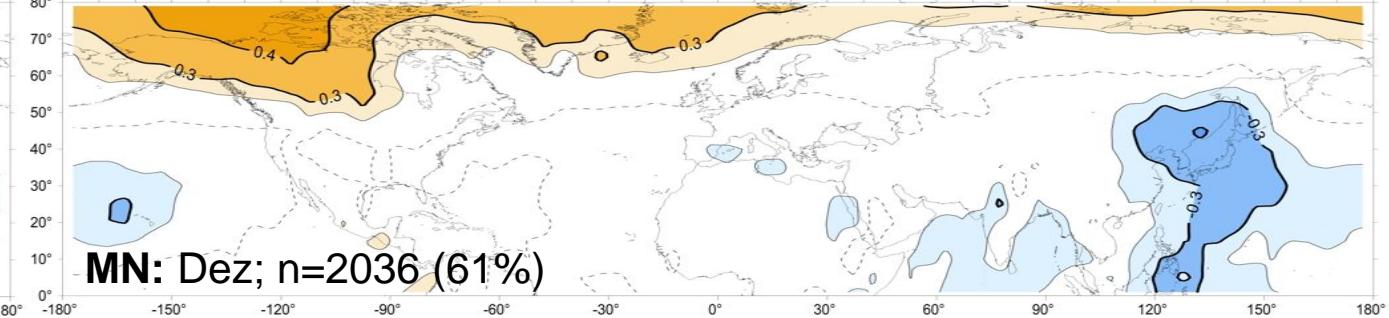
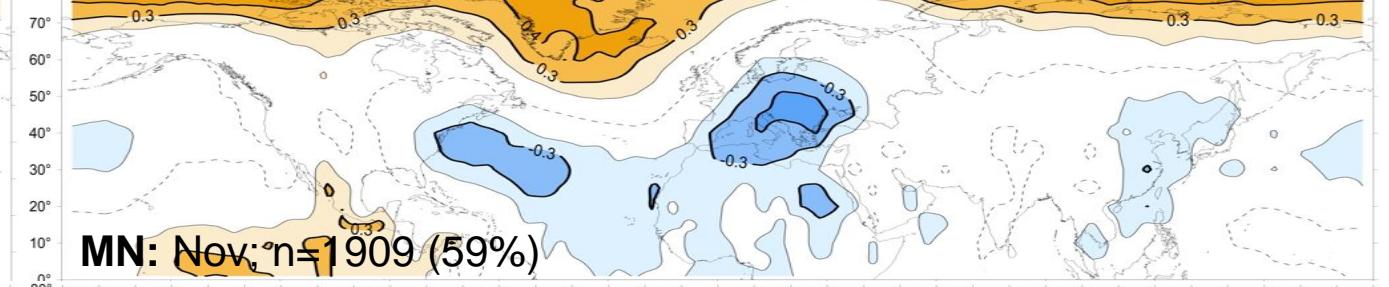
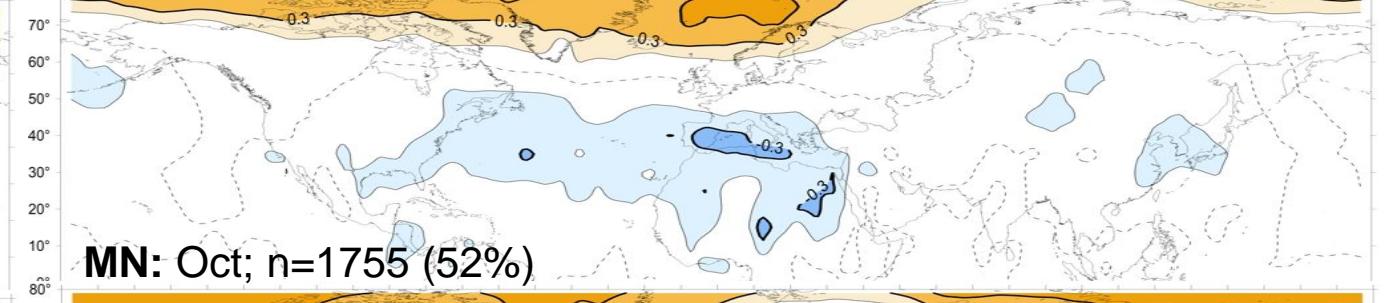
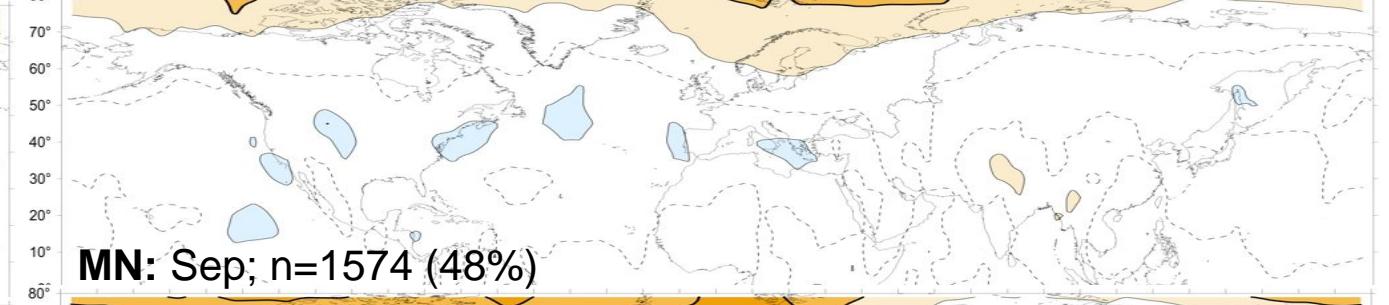
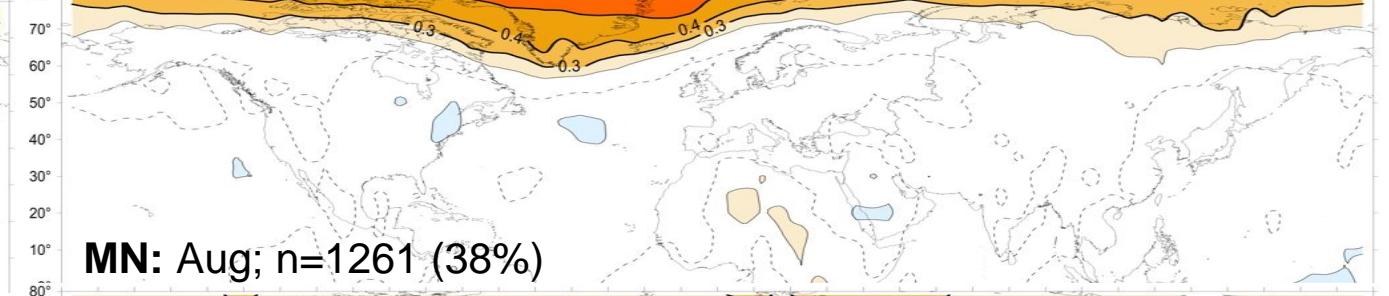
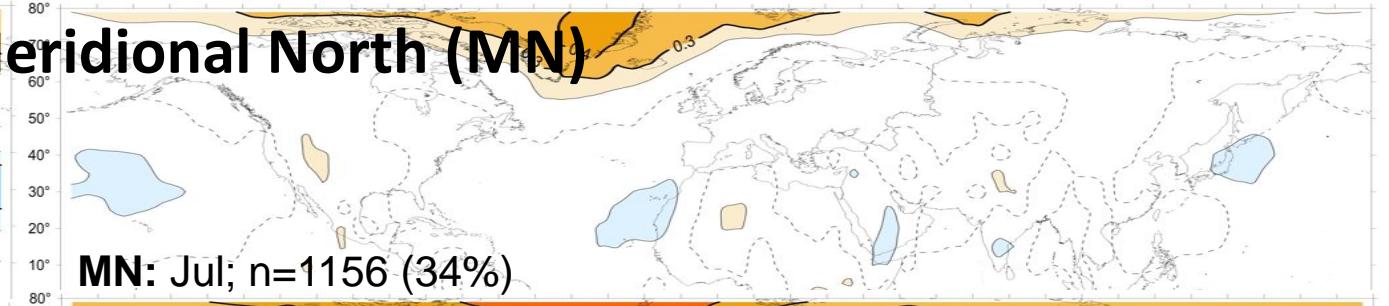
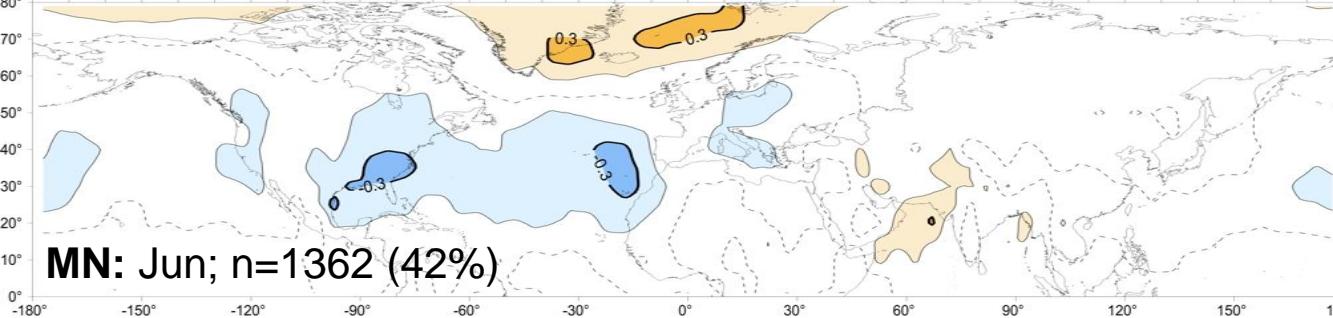
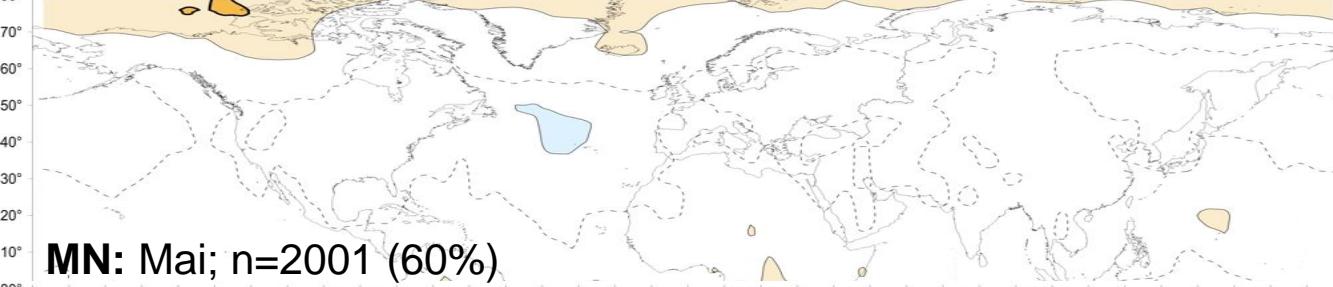
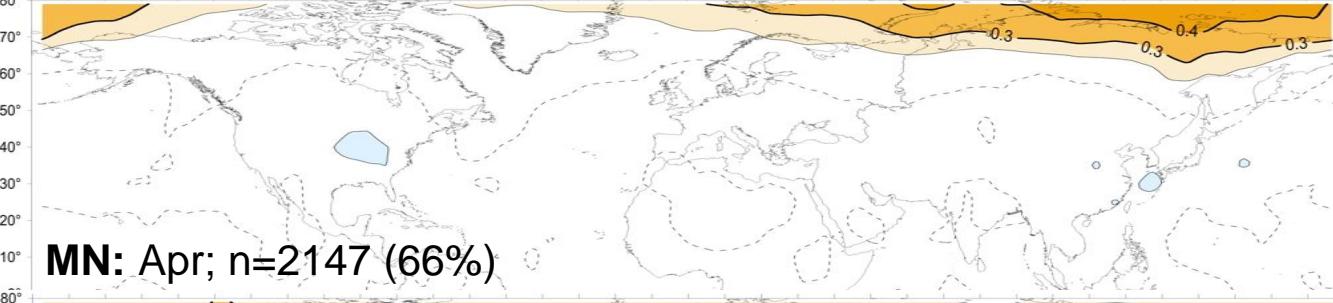
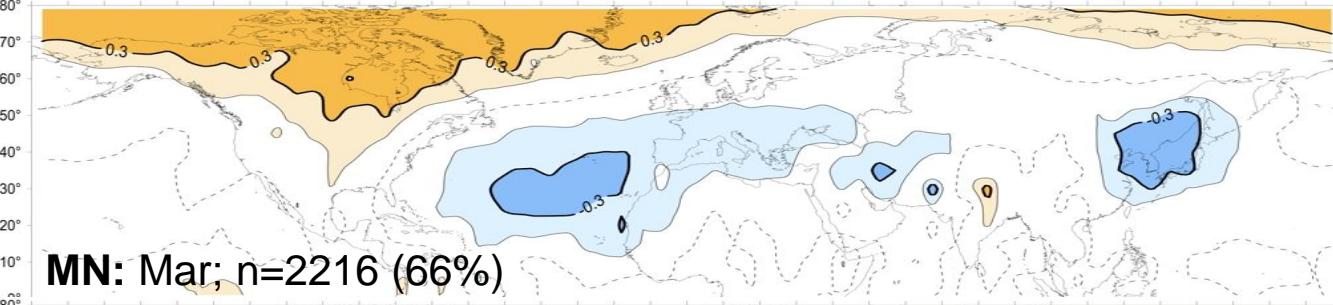
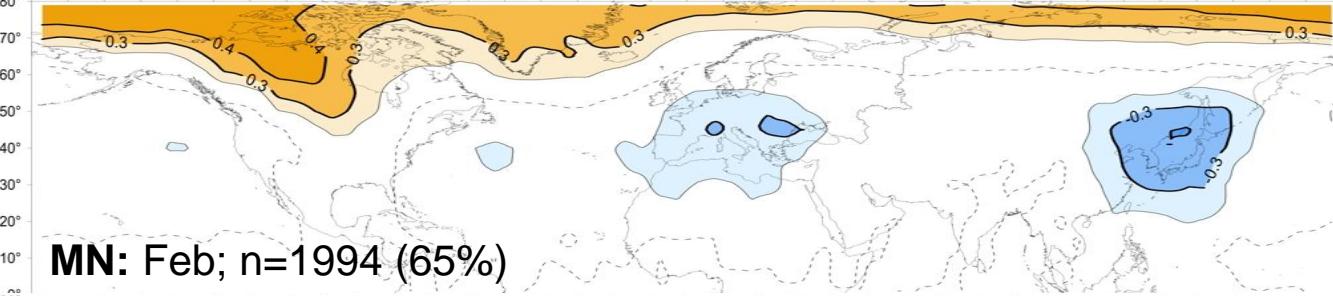
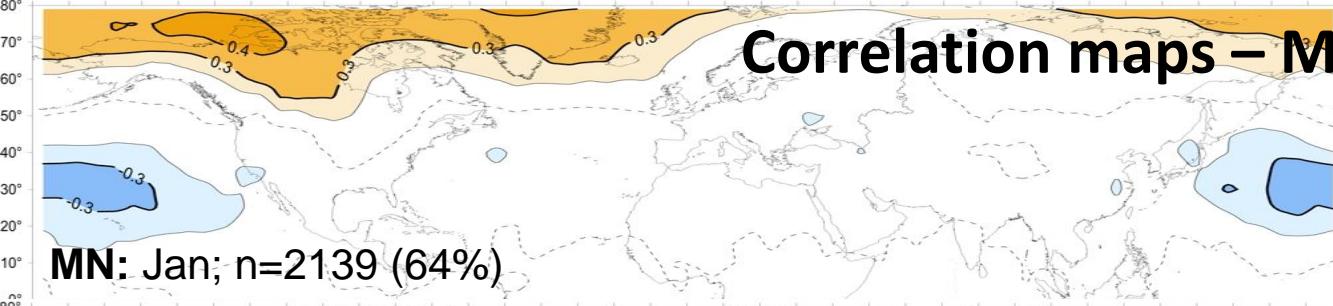
# Correlation maps – Zonal (Z)



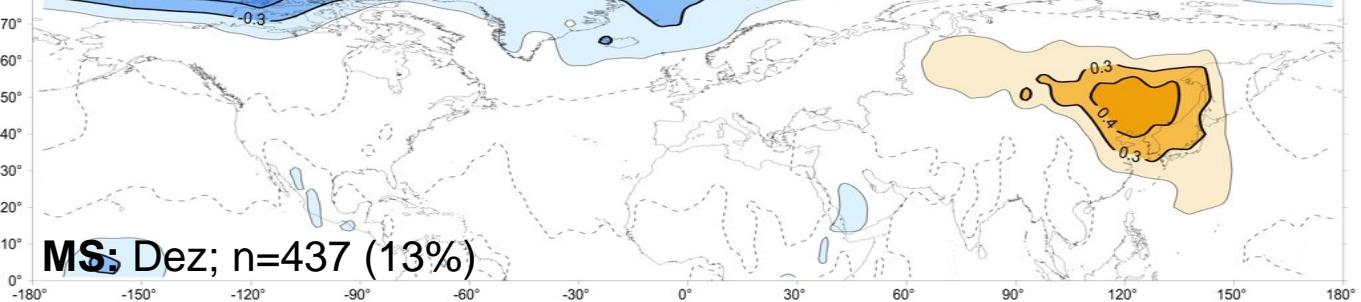
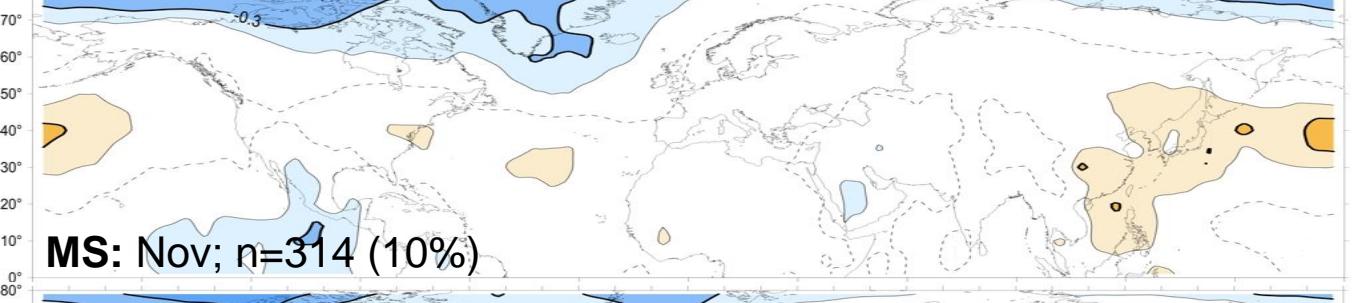
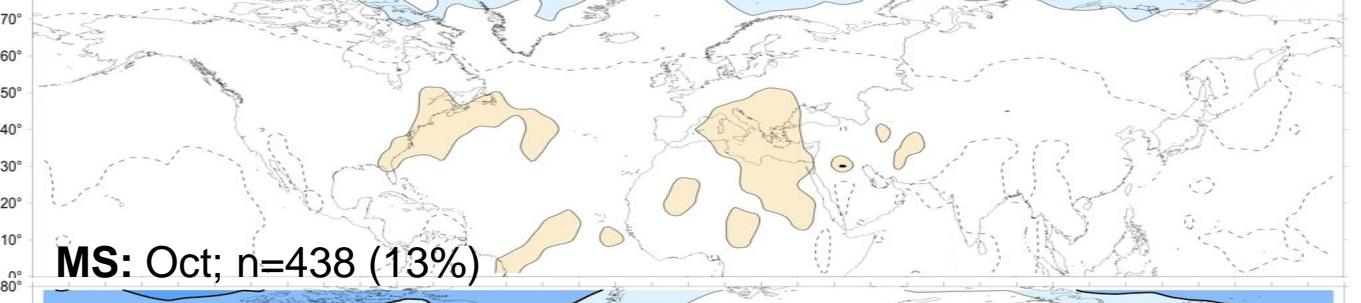
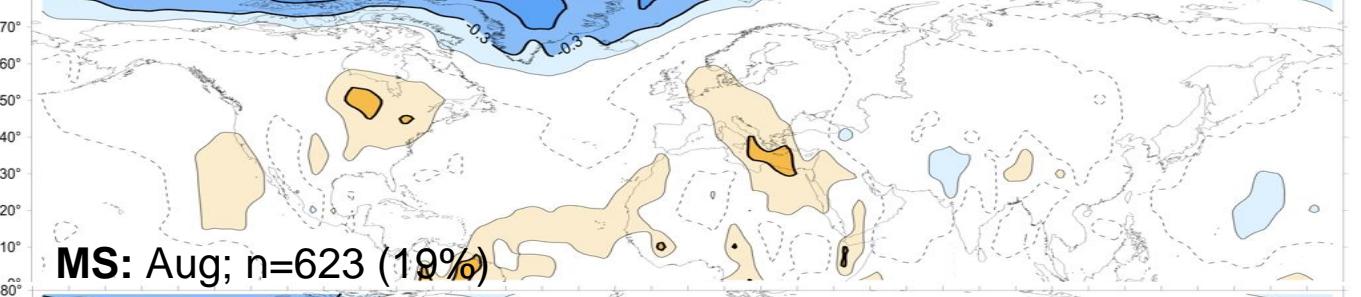
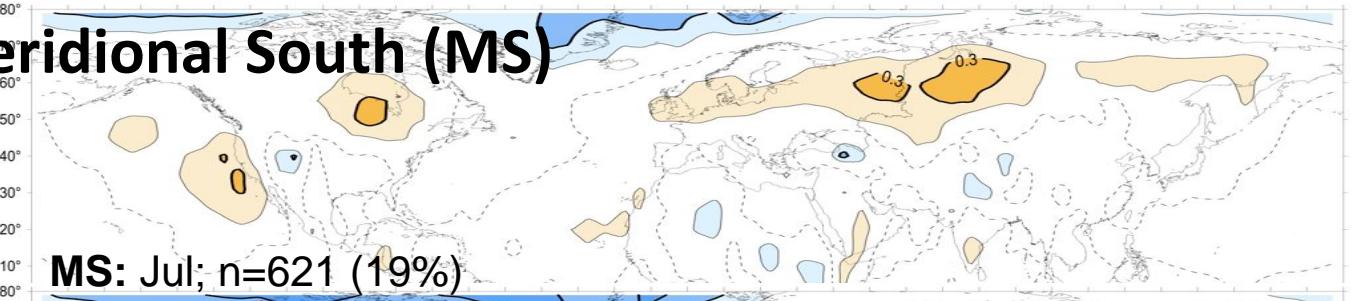
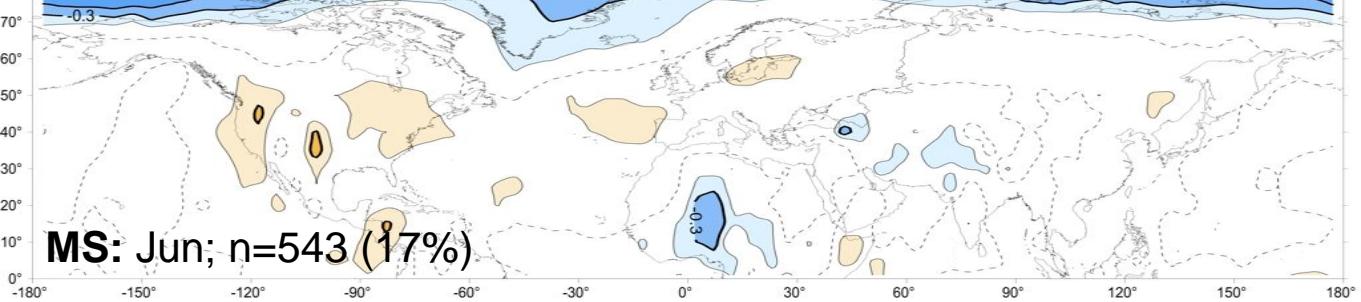
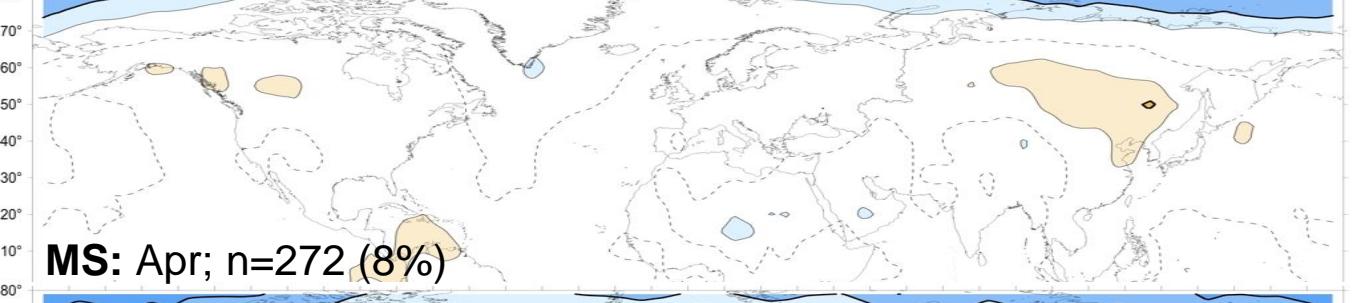
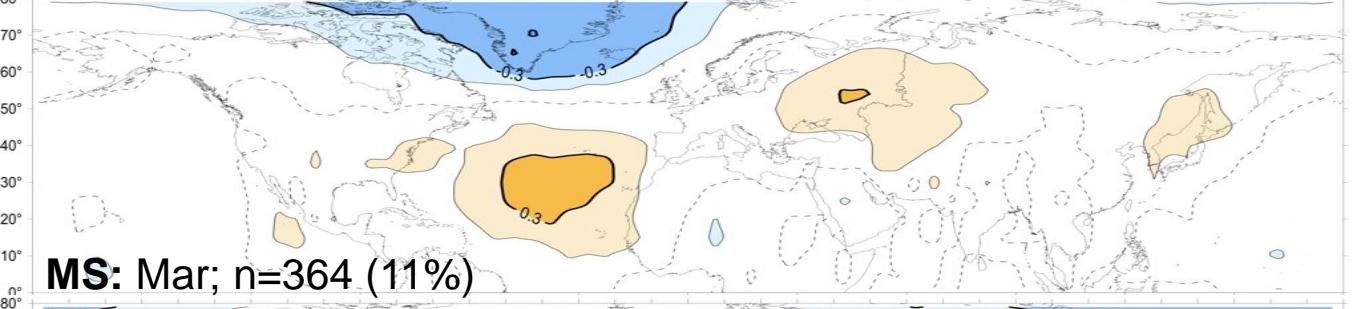
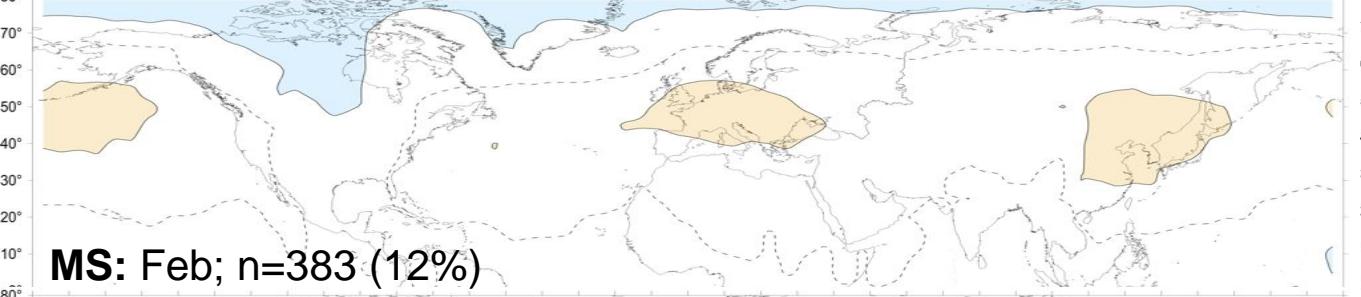
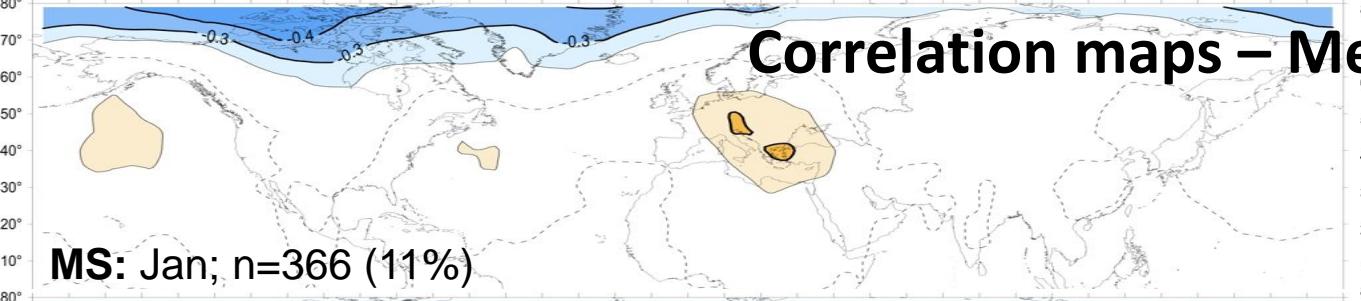
# Correlation maps – Zonal Disturbed (ZD)



# Correlation maps – Meridional North (MN)

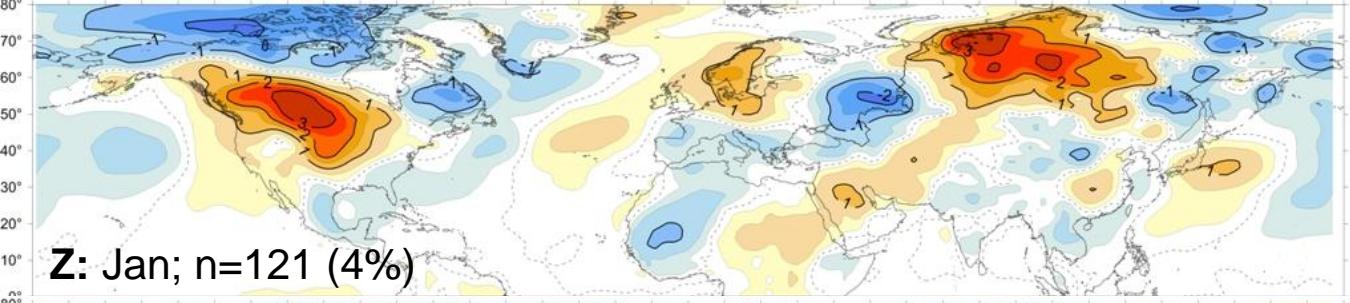


# Correlation maps – Meridional South (MS)

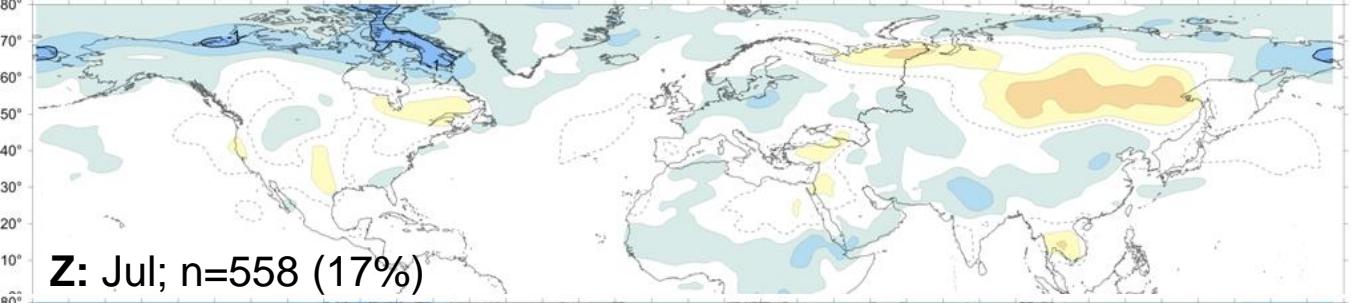


# Air temperature: signal maps

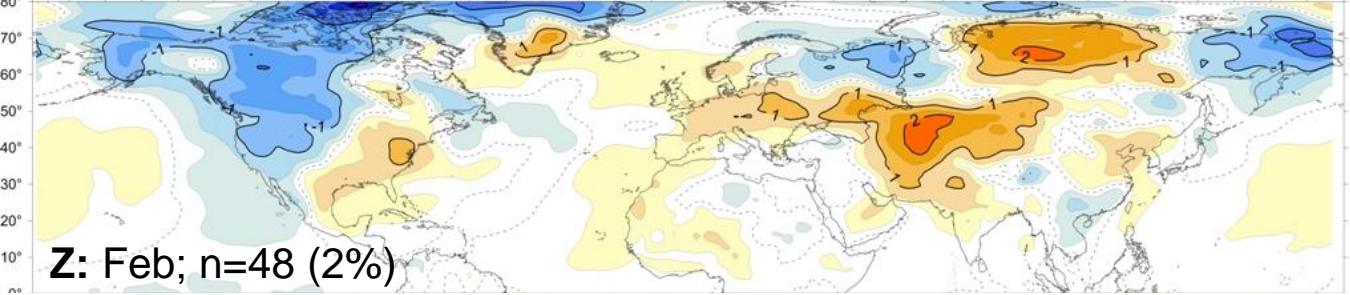
- Data:
  - Temperature data: gridded set of daily averages in  $\sim 1.9 \times 1.9^\circ$  worldwide resolution (Twentieth Century Global Reanalysis dataset – Compo et al. 2011), [www.esrl.noaa.gov/psd/data/gridded/data.20thC\\_ReanV2.html](http://www.esrl.noaa.gov/psd/data/gridded/data.20thC_ReanV2.html)
  - Dzerdzevski CG's/CT's/ECM's: daily data
- Methods:
  - Analysis of daily data (circulation types and air temperature)
  - Calculation of daily air temperature anomalies per grid point for 1901-2010; consideration of annual cycle)
  - Visualisation of average temperature anomaly fields per circulation type (via mapping program SURFER)
  - *Remark: in case of publication maps should be centred at the north pole instead of current visualisation*



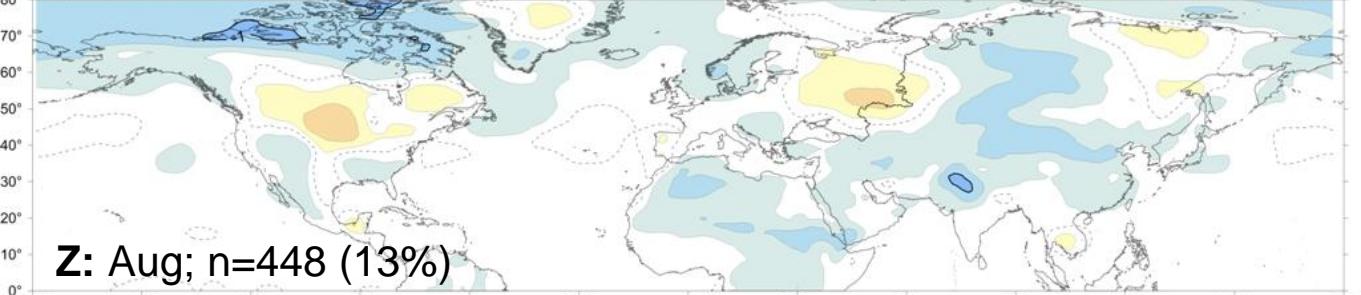
Z: Jan; n=121 (4%)



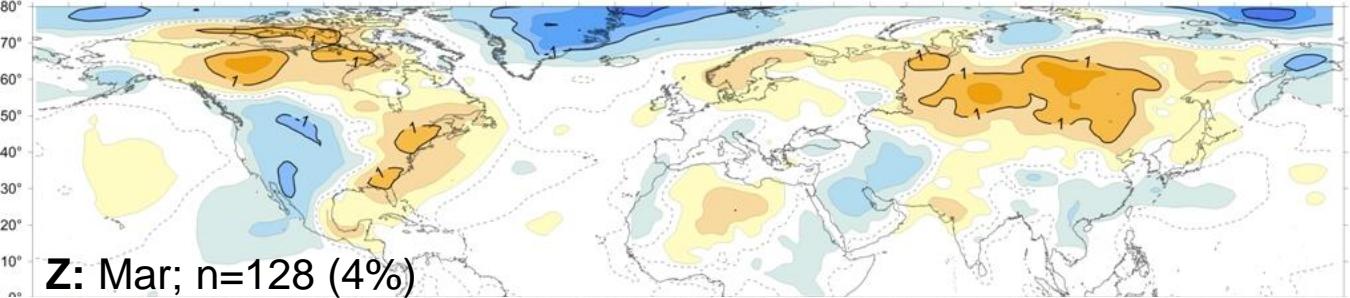
Z: Jul; n=558 (17%)



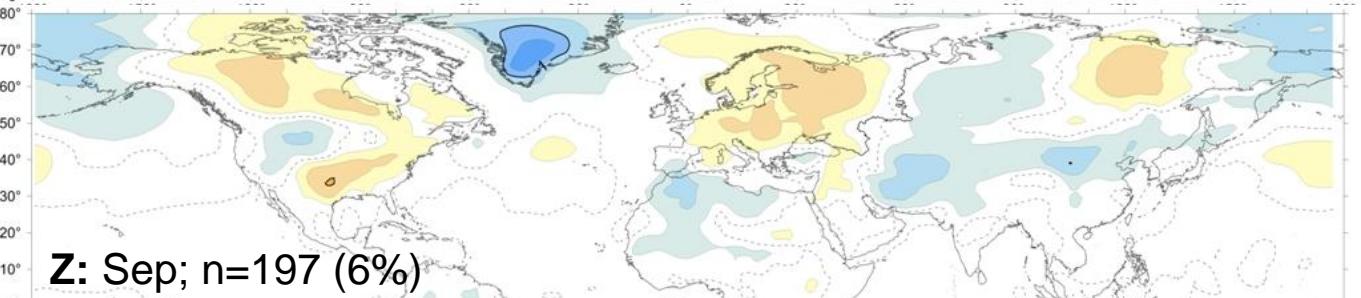
Z: Feb; n=48 (2%)



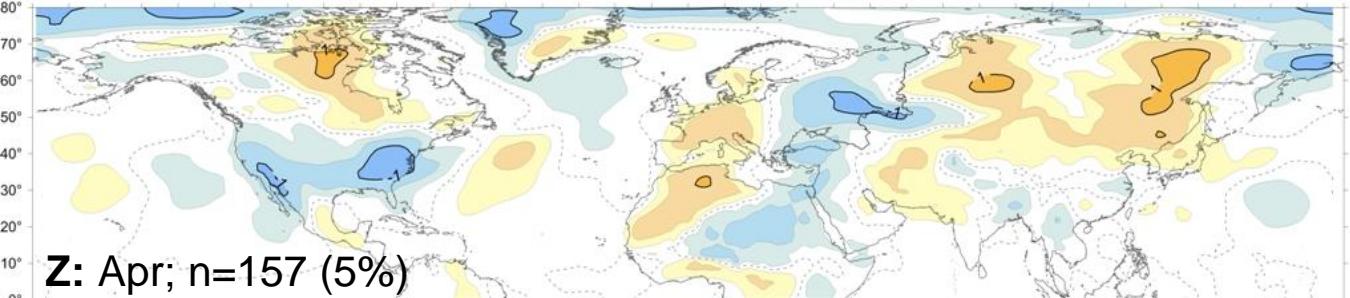
Z: Aug; n=448 (13%)



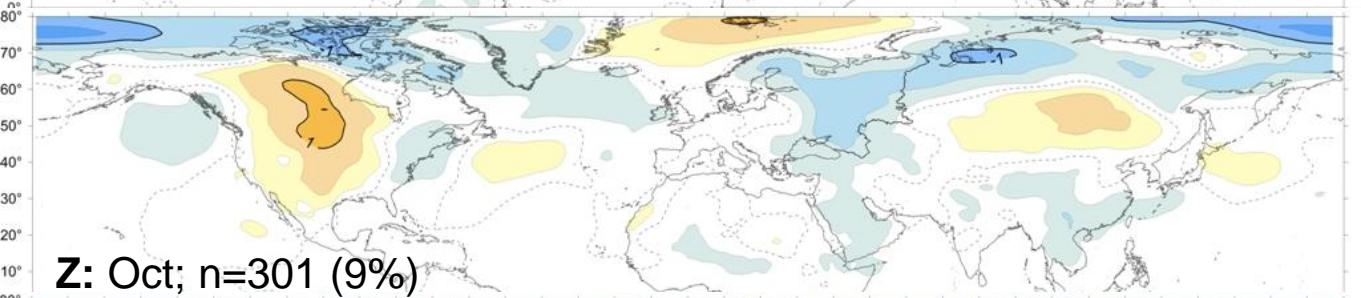
Z: Mar; n=128 (4%)



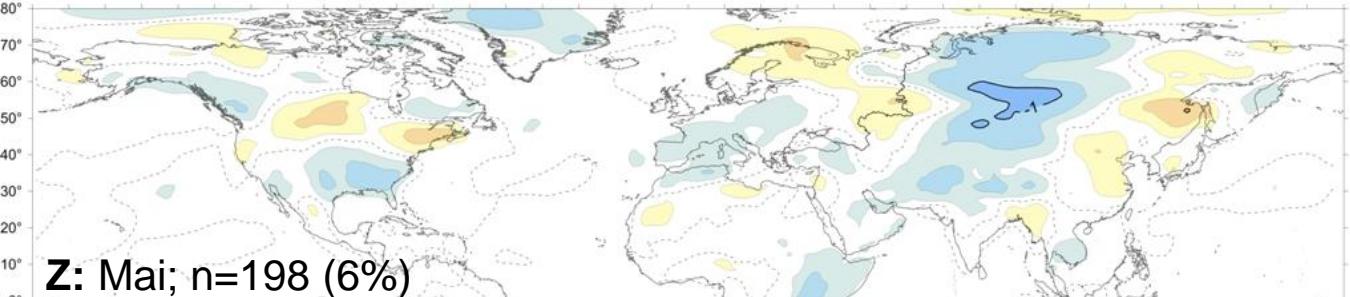
Z: Sep; n=197 (6%)



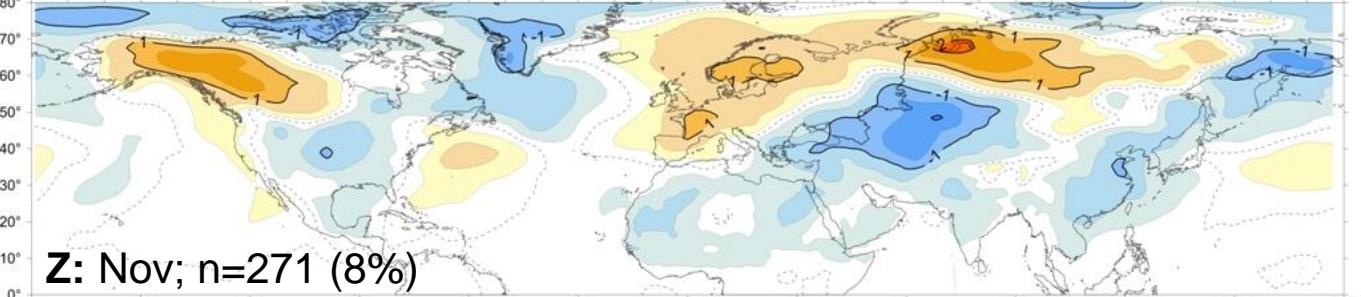
Z: Apr; n=157 (5%)



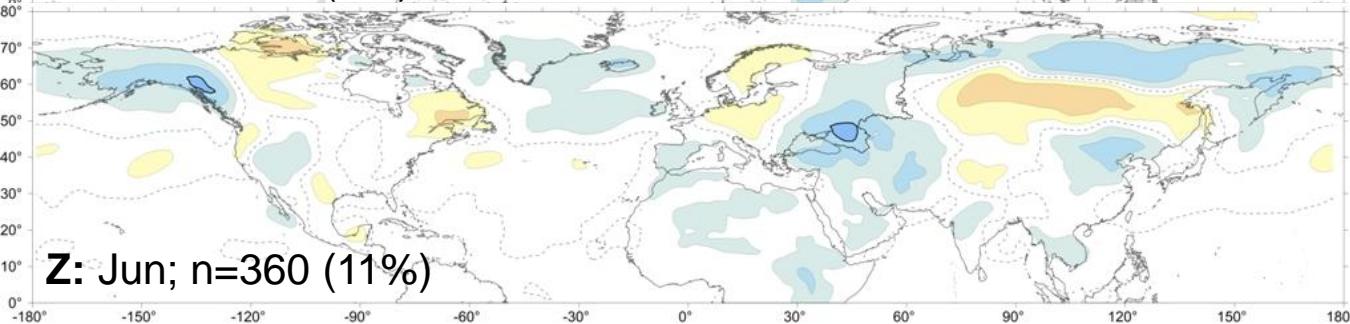
Z: Oct; n=301 (9%)



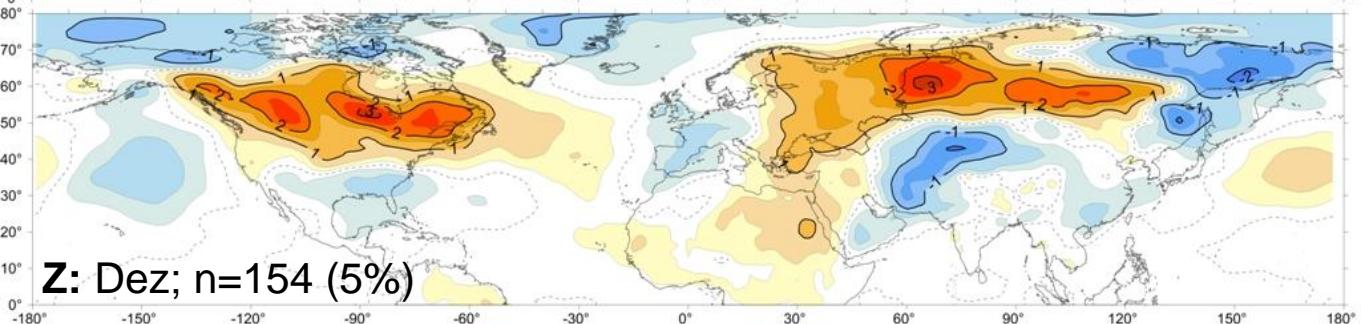
Z: Mai; n=198 (6%)



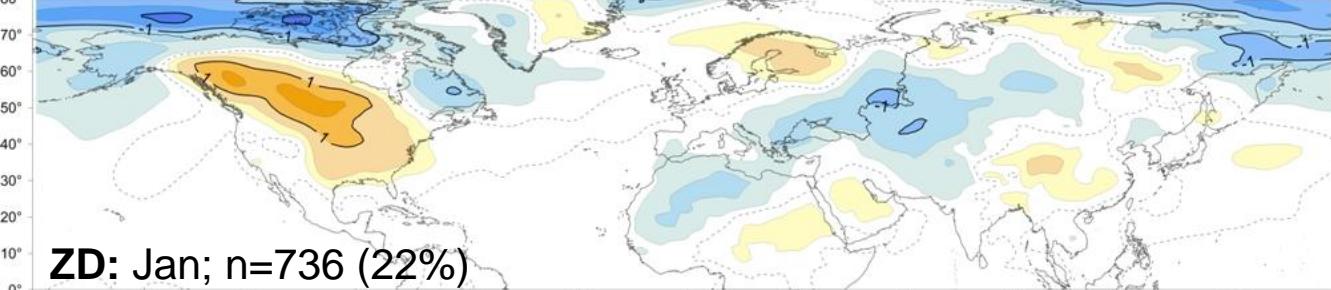
Z: Nov; n=271 (8%)



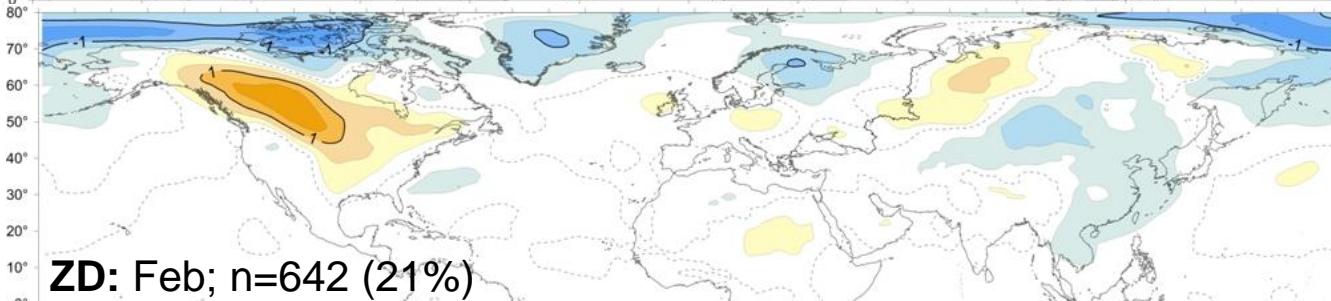
Z: Jun; n=360 (11%)



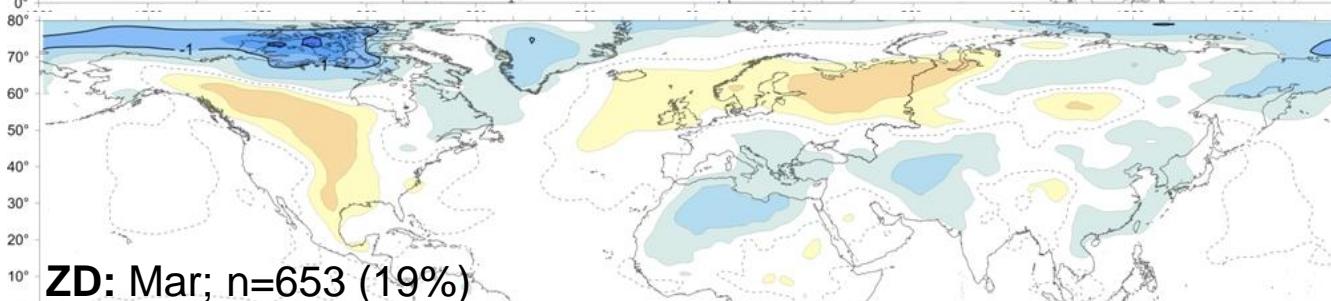
Z: Dez; n=154 (5%)



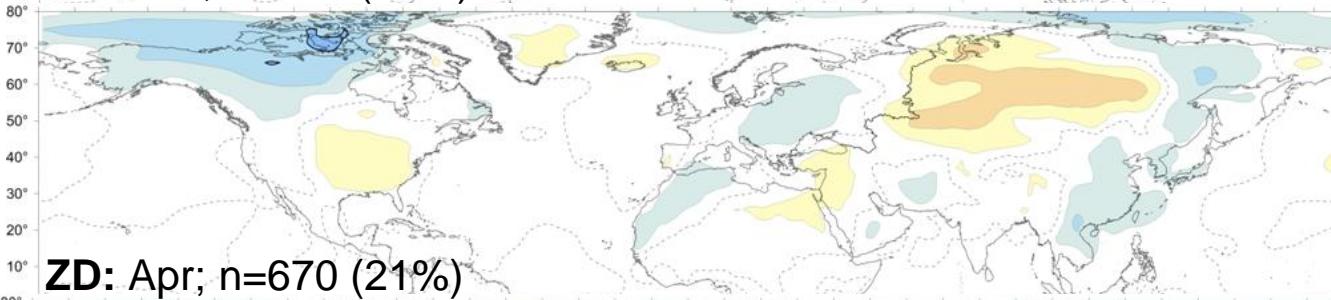
ZD: Jan; n=736 (22%)



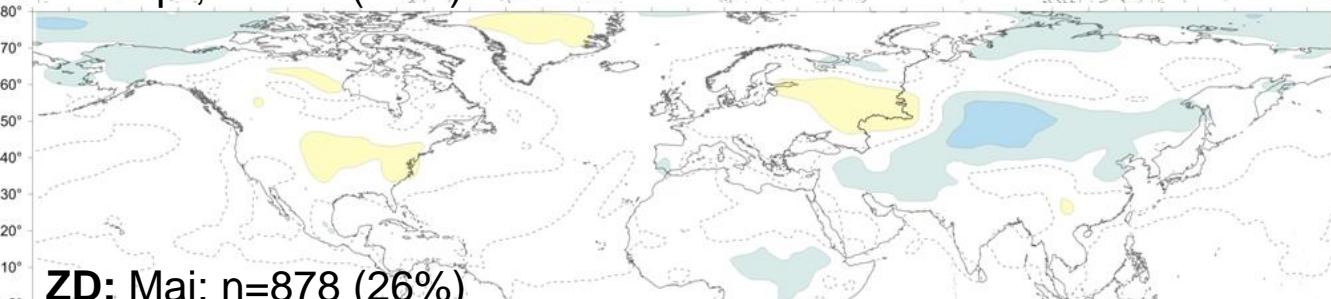
ZD: Feb; n=642 (21%)



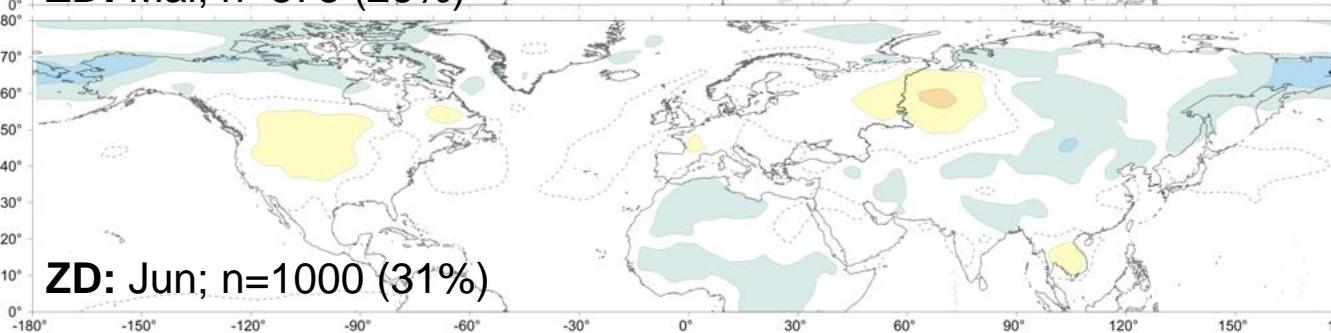
ZD: Mar; n=653 (19%)



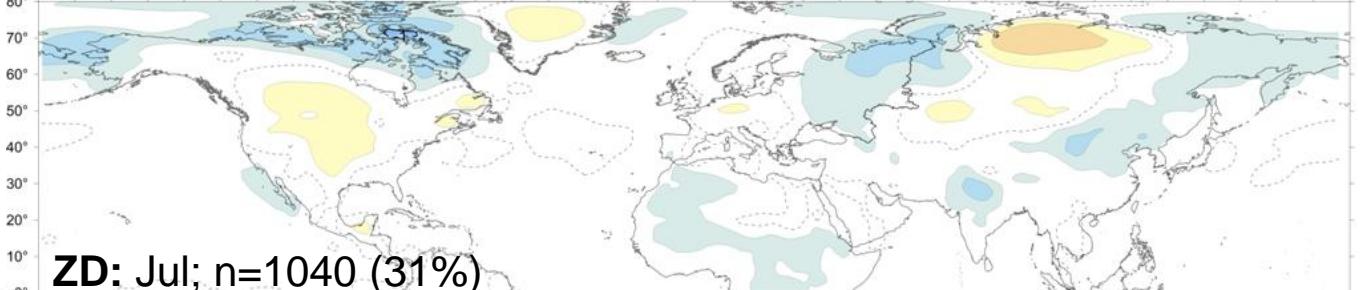
ZD: Apr; n=670 (21%)



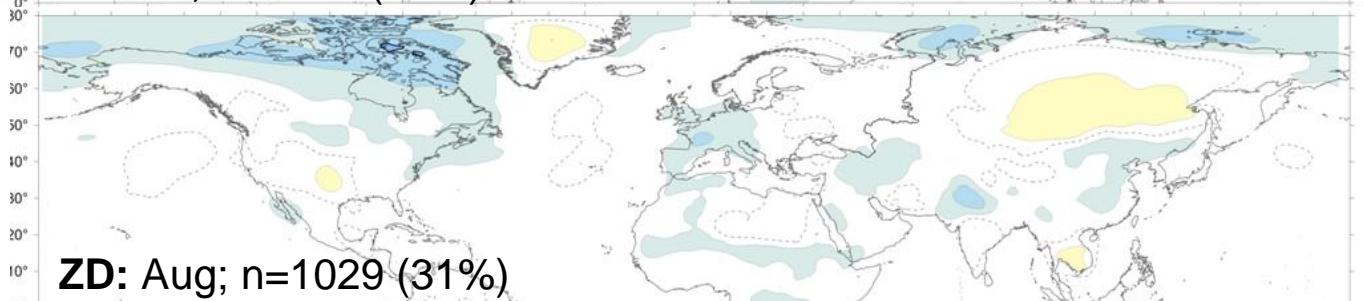
ZD: Mai; n=878 (26%)



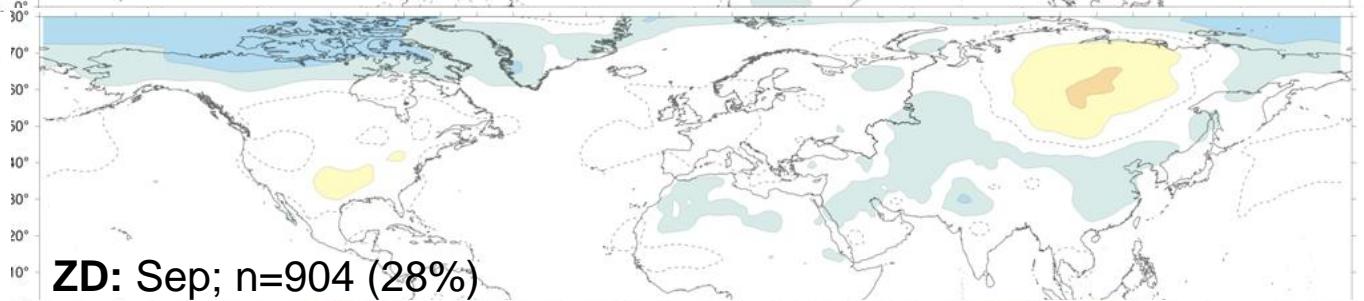
ZD: Jun; n=1000 (31%)



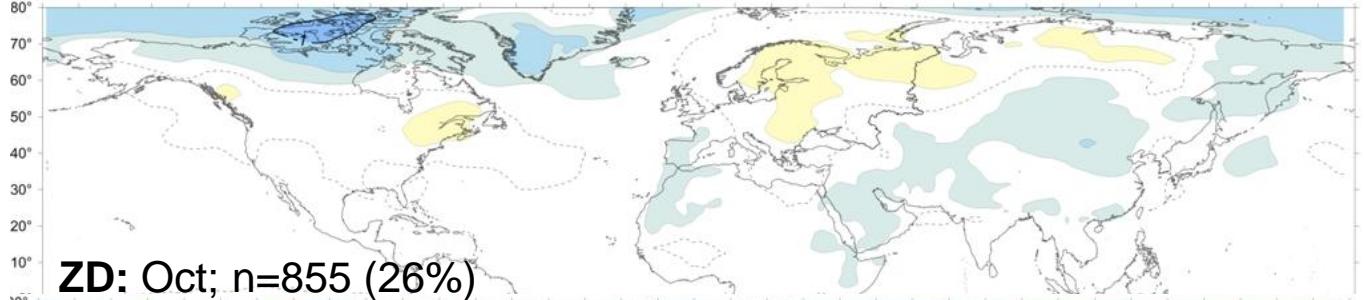
ZD: Jul; n=1040 (31%)



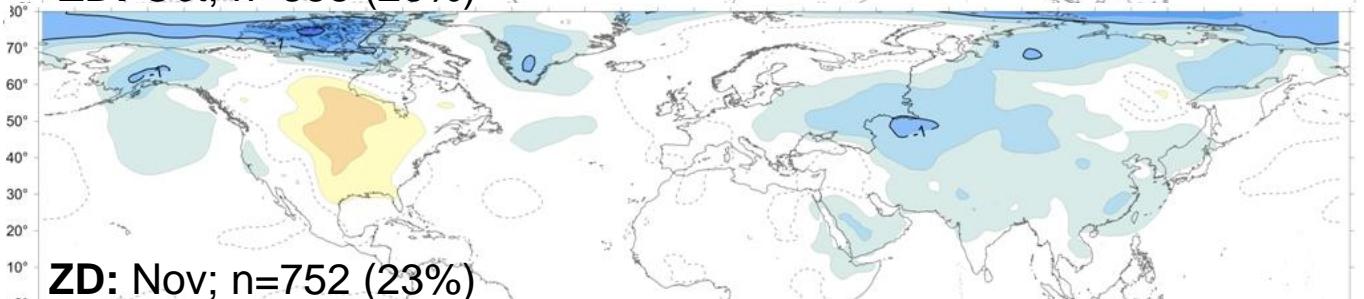
ZD: Aug; n=1029 (31%)



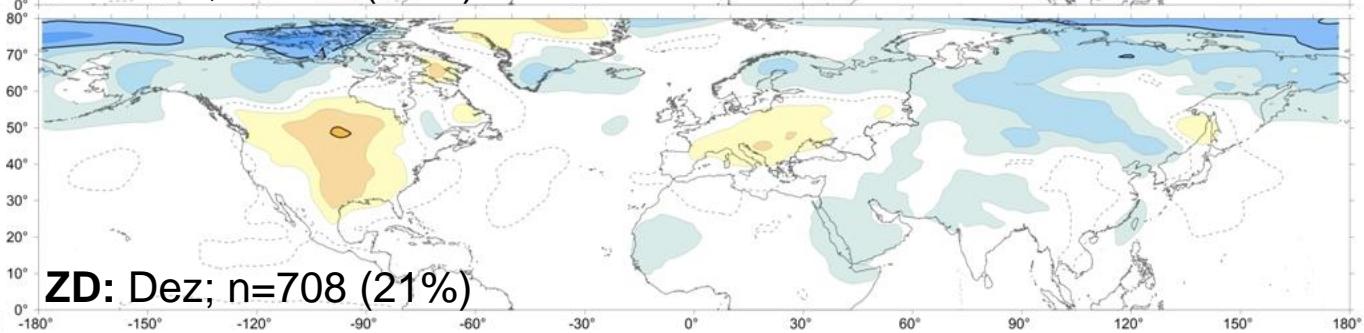
ZD: Sep; n=904 (28%)



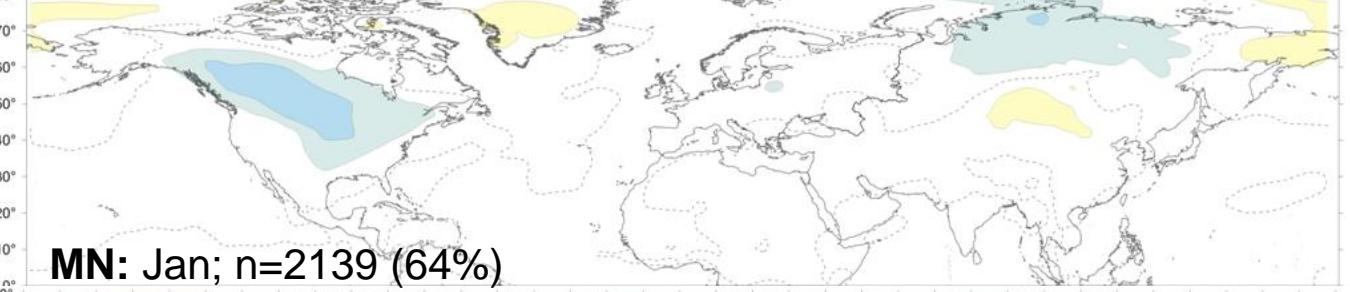
ZD: Oct; n=855 (26%)



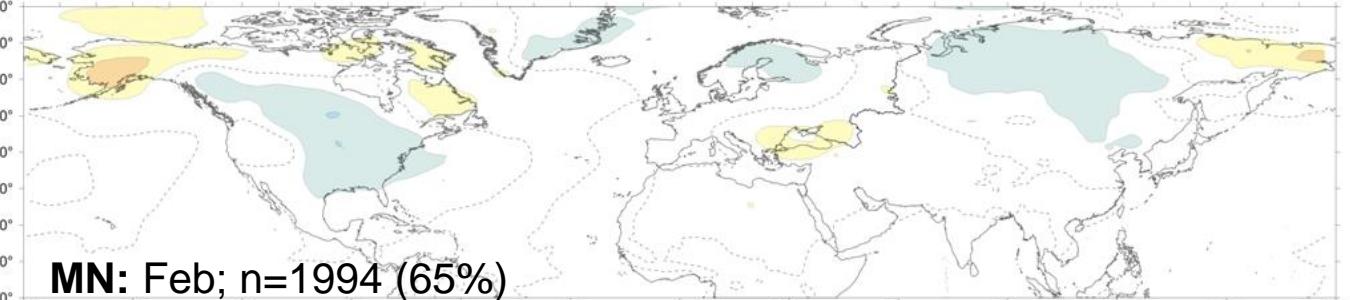
ZD: Nov; n=752 (23%)



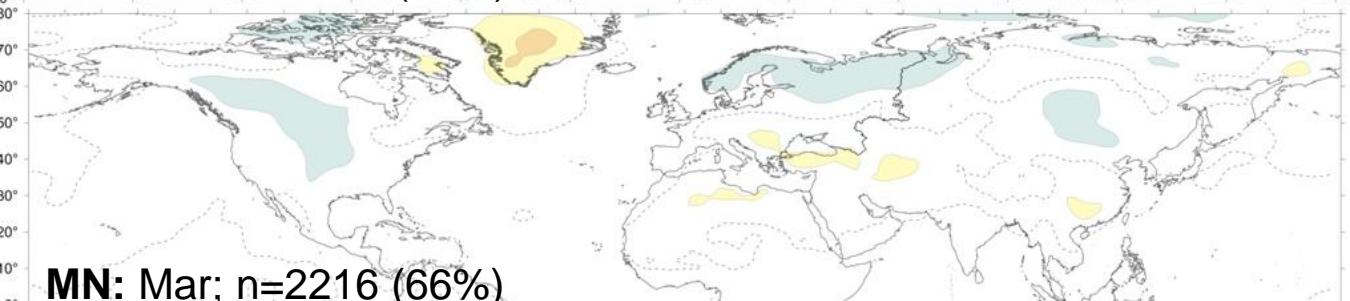
ZD: Dez; n=708 (21%)



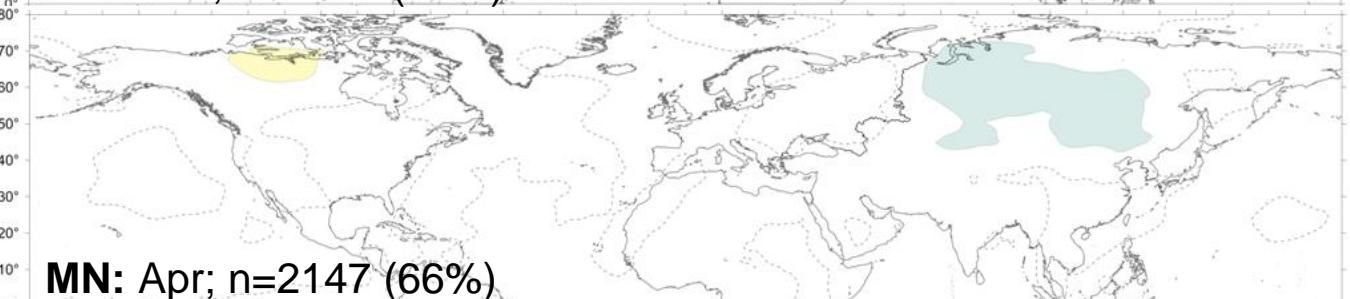
MN: Jan; n=2139 (64%)



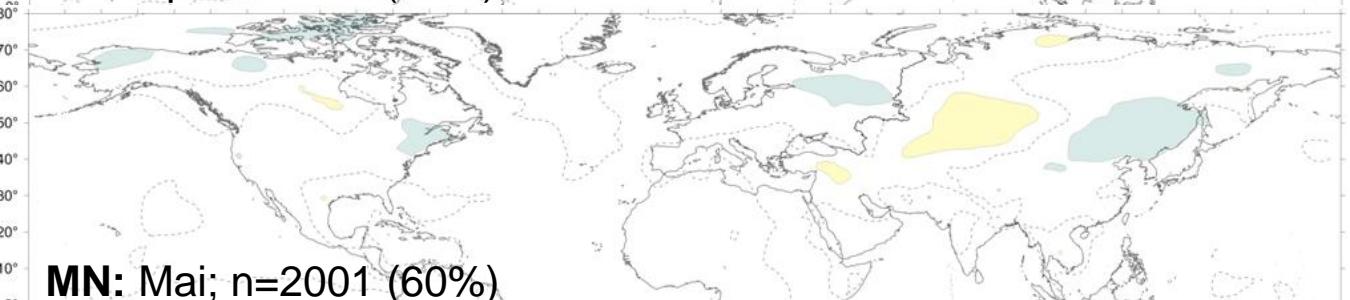
MN: Feb; n=1994 (65%)



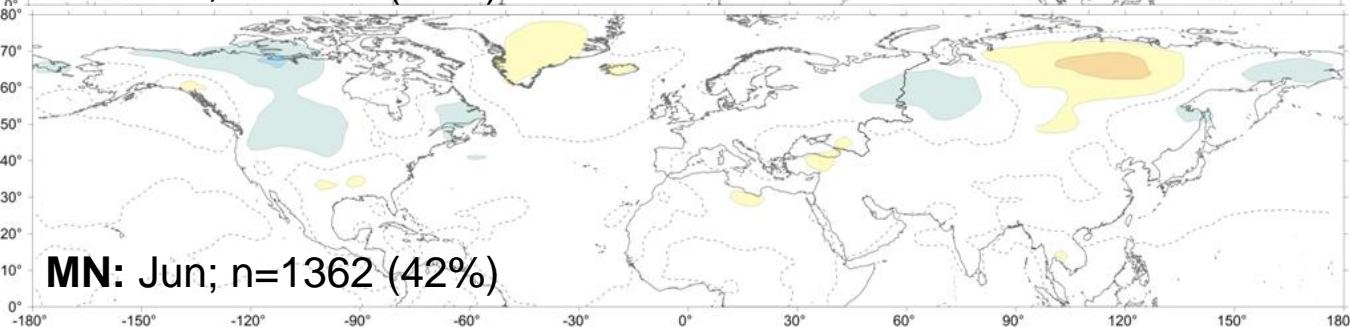
MN: Mar; n=2216 (66%)



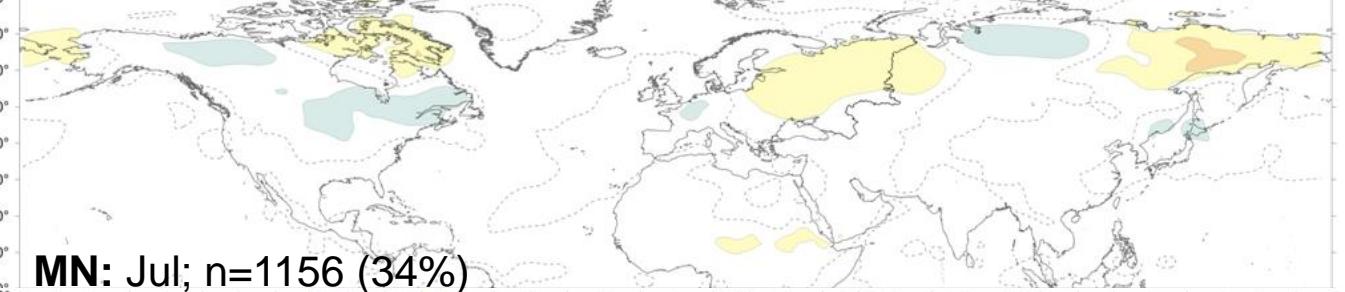
MN: Apr; n=2147 (66%)



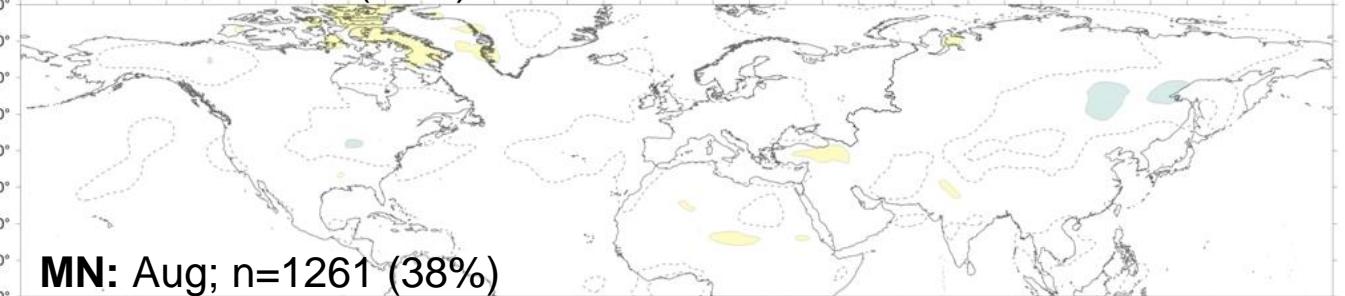
MN: Mai; n=2001 (60%)



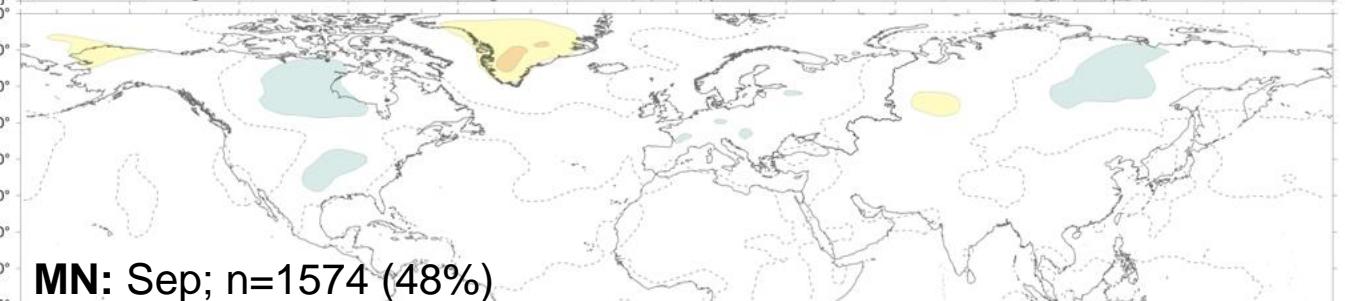
MN: Jun; n=1362 (42%)



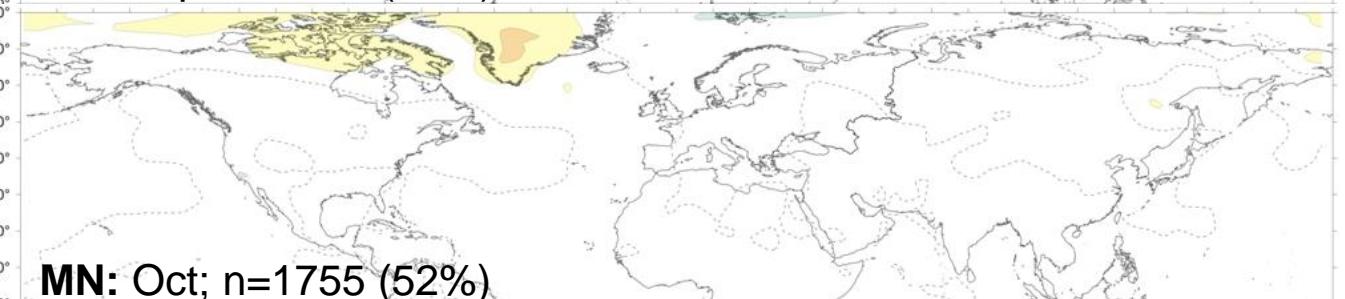
MN: Jul; n=1156 (34%)



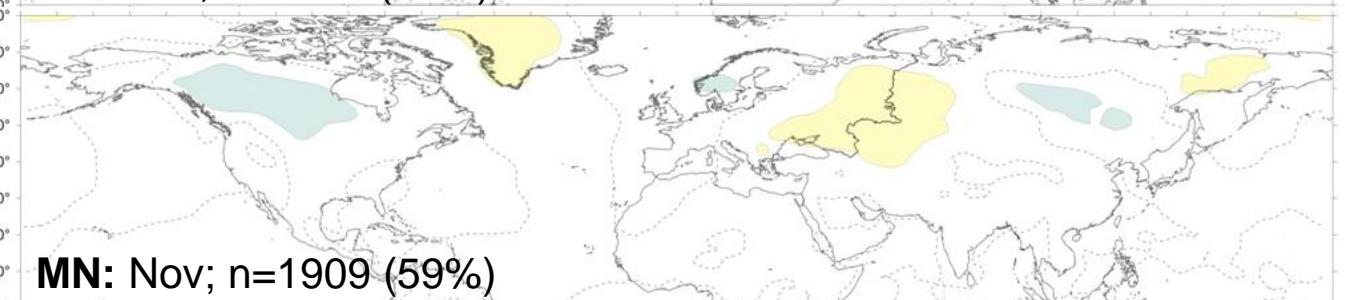
MN: Aug; n=1261 (38%)



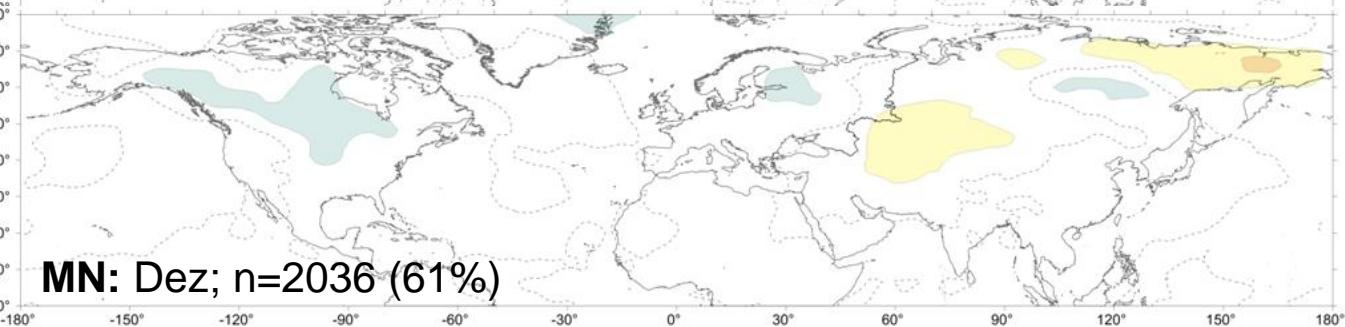
MN: Sep; n=1574 (48%)



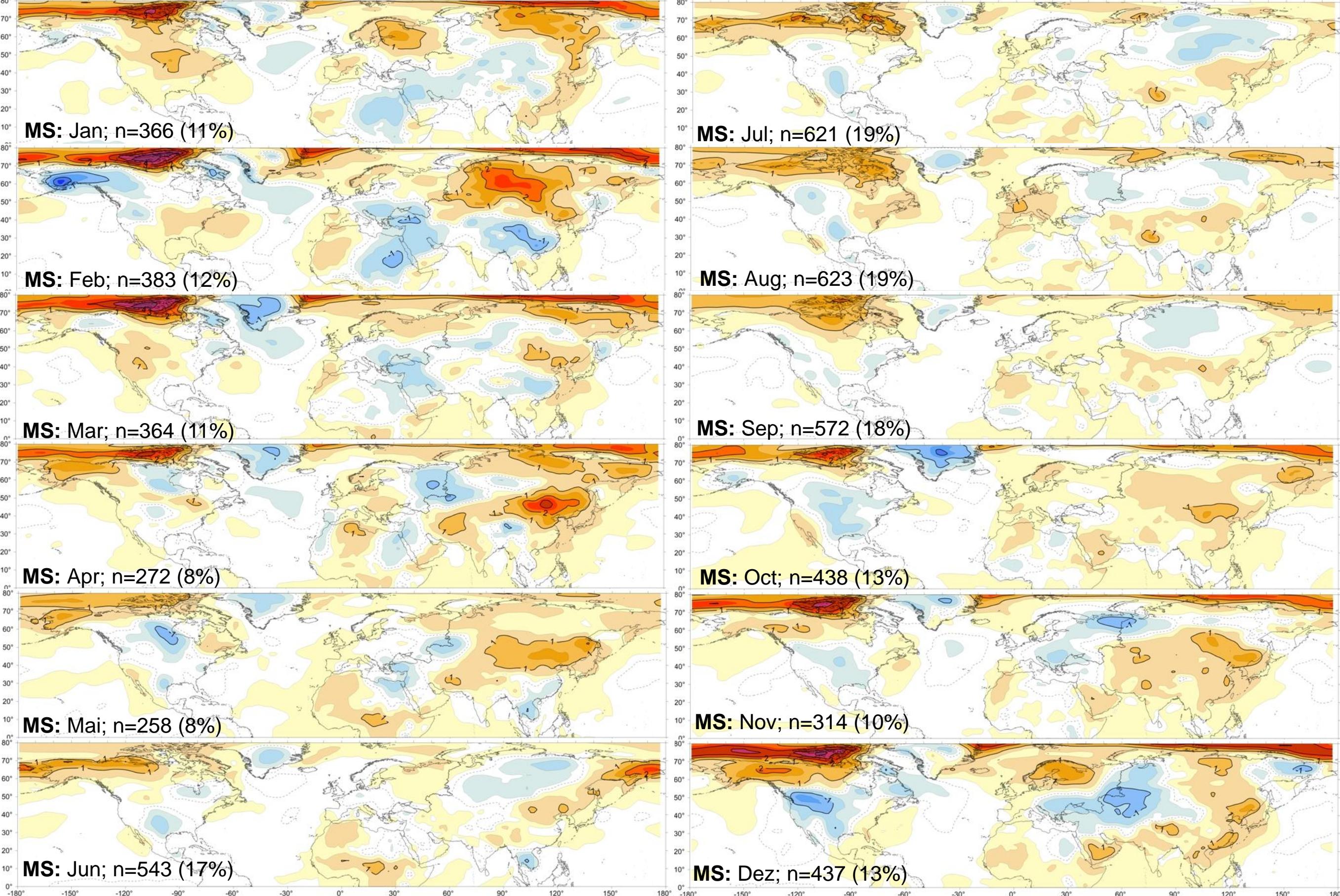
MN: Oct; n=1755 (52%)

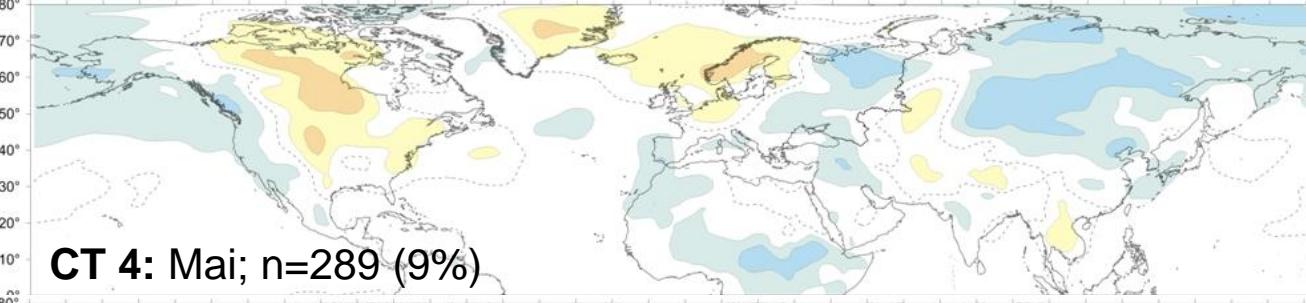


MN: Nov; n=1909 (59%)

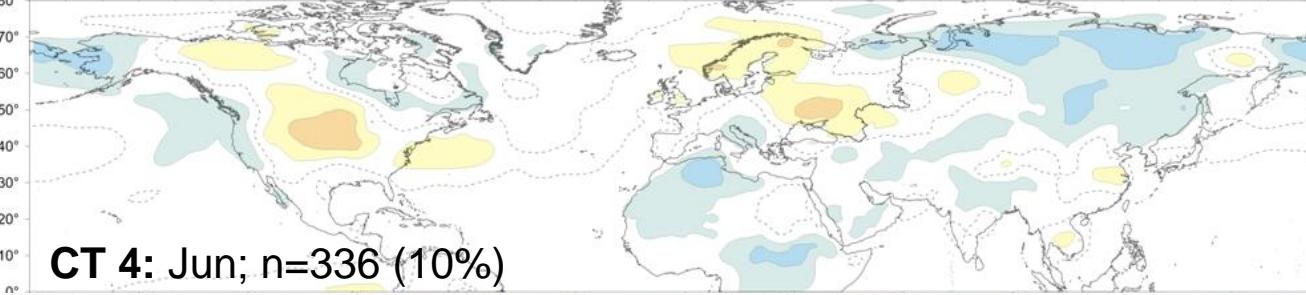


MN: Dez; n=2036 (61%)

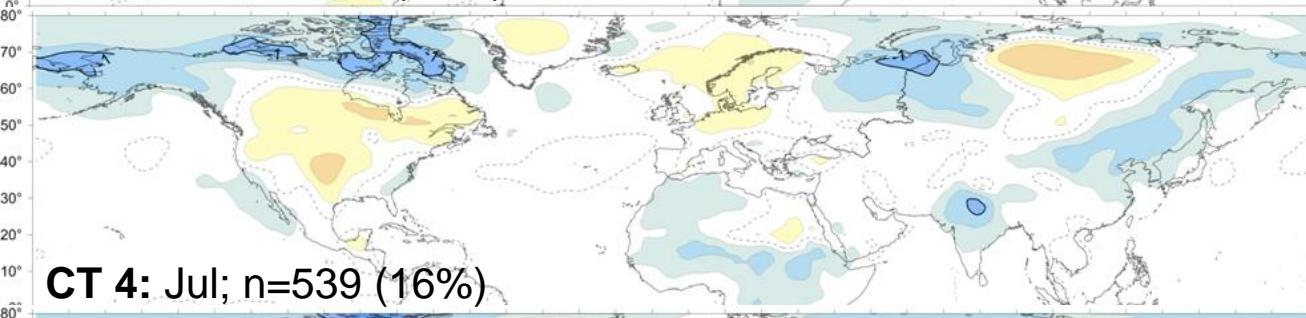




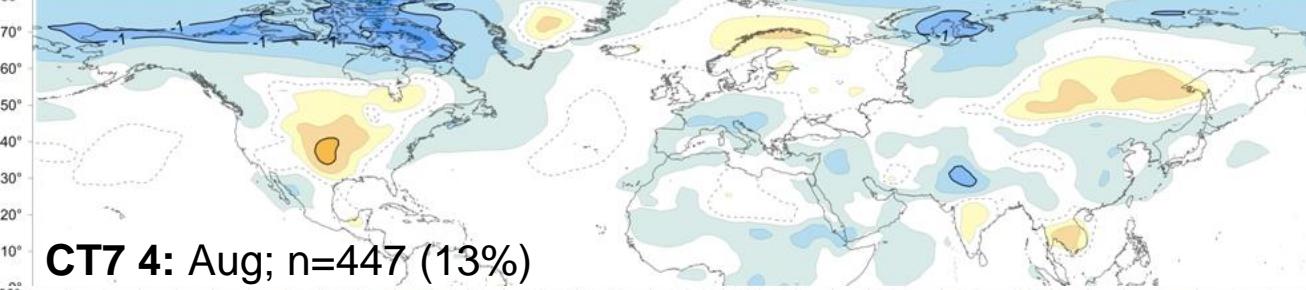
CT 4: Mai; n=289 (9%)



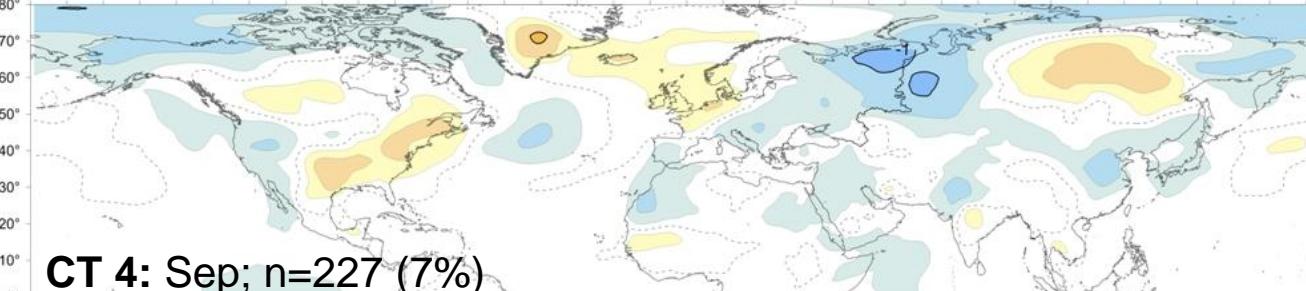
CT 4: Jun; n=336 (10%)



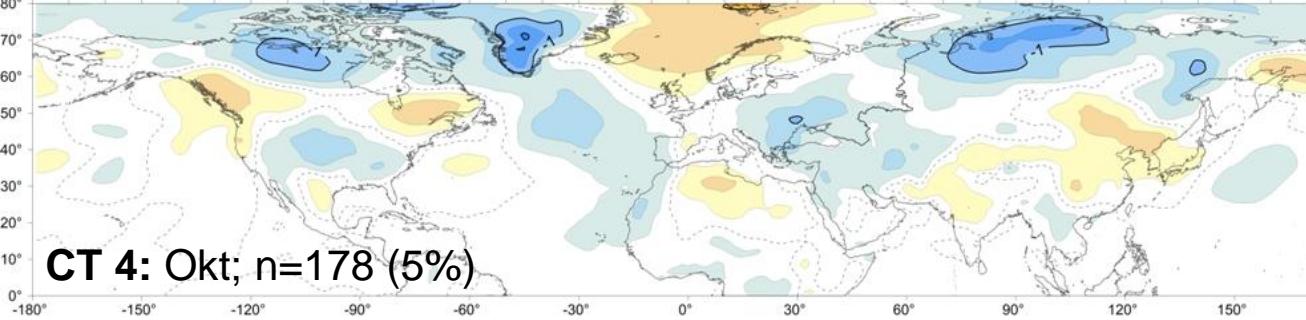
CT 4: Jul; n=539 (16%)



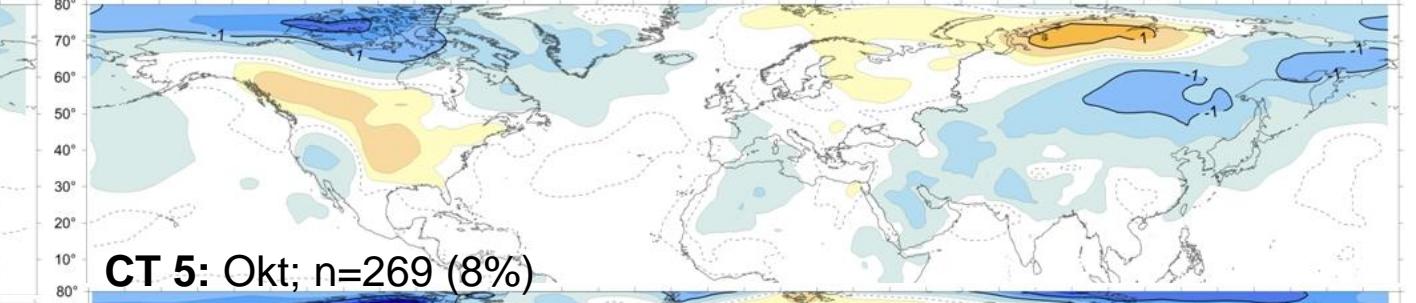
CT 7 4: Aug; n=447 (13%)



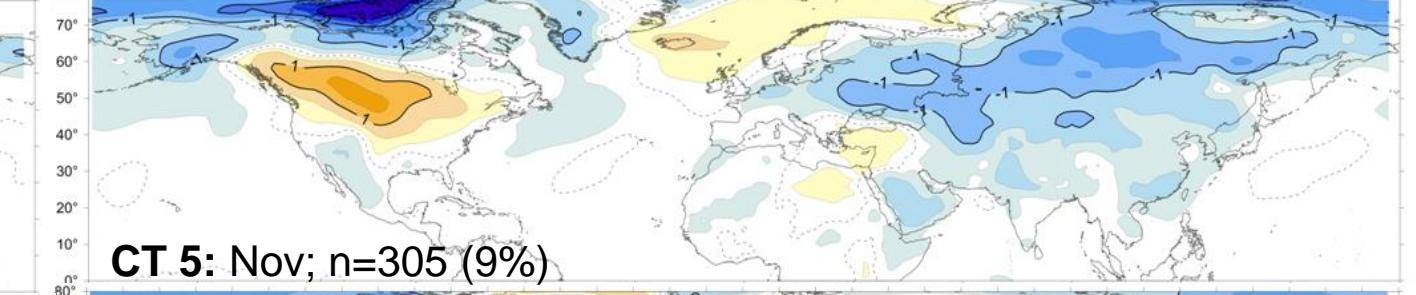
CT 4: Sep; n=227 (7%)



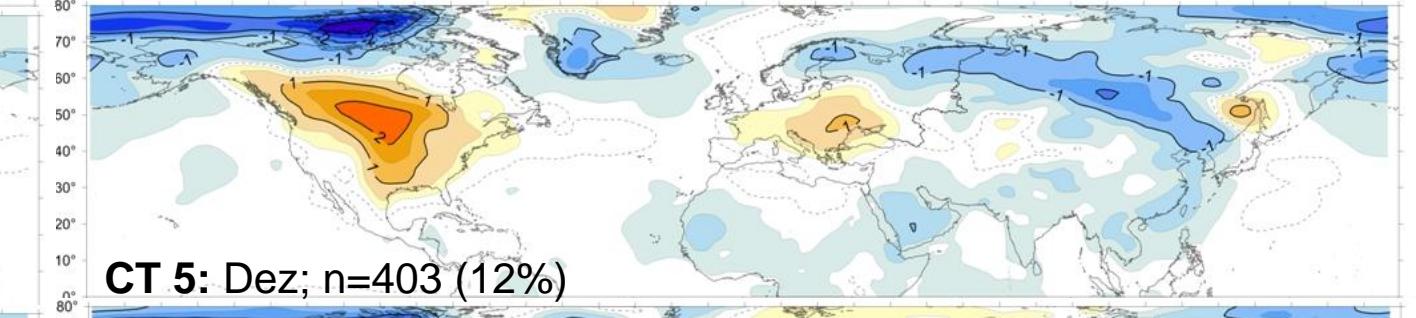
CT 4: Okt; n=178 (5%)



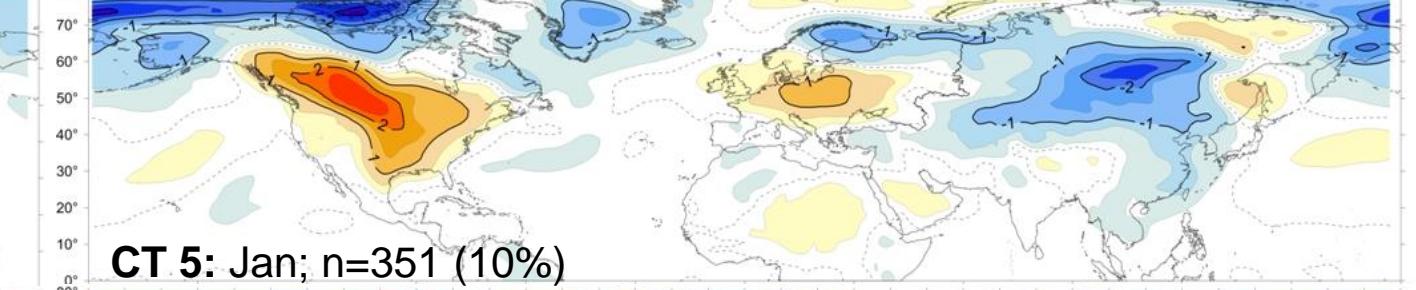
CT 5: Okt; n=269 (8%)



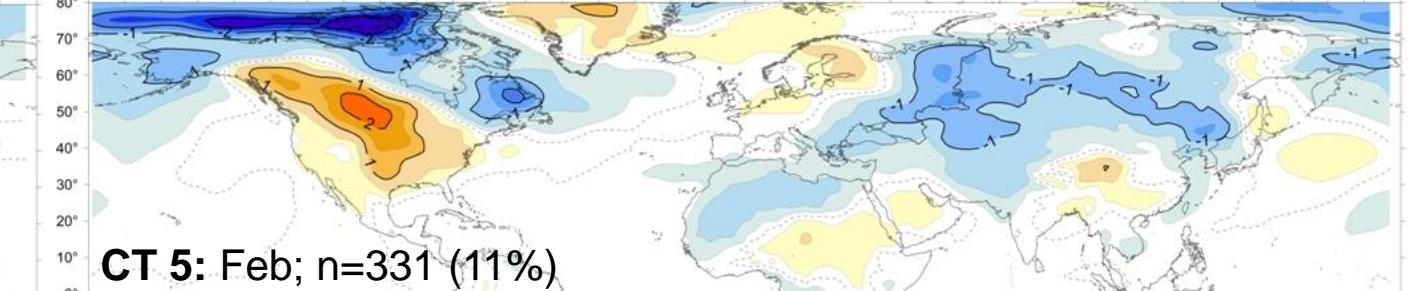
CT 5: Nov; n=305 (9%)



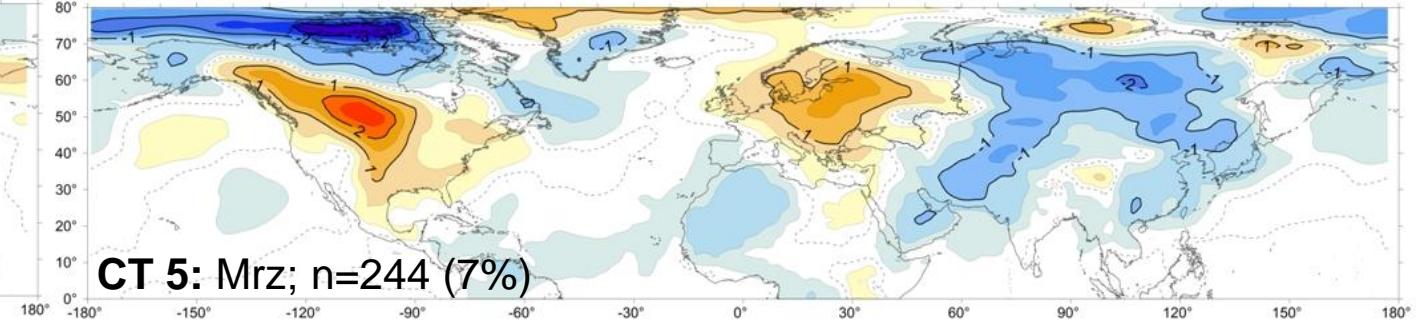
CT 5: Dez; n=403 (12%)



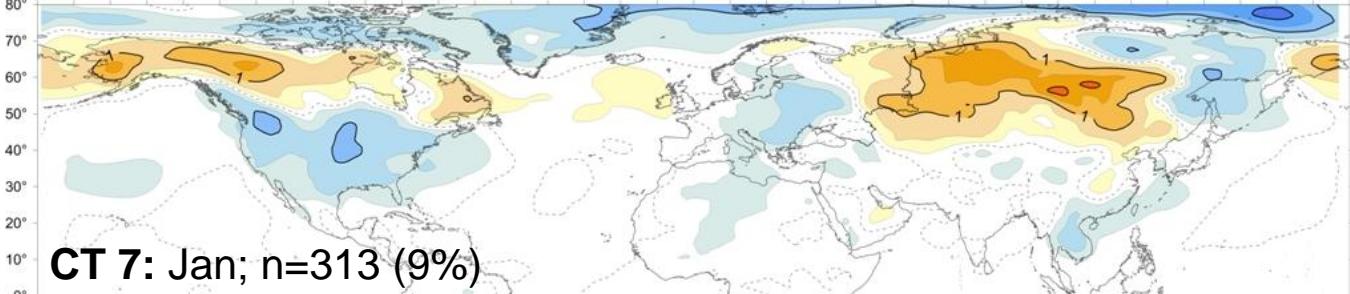
CT 5: Jan; n=351 (10%)



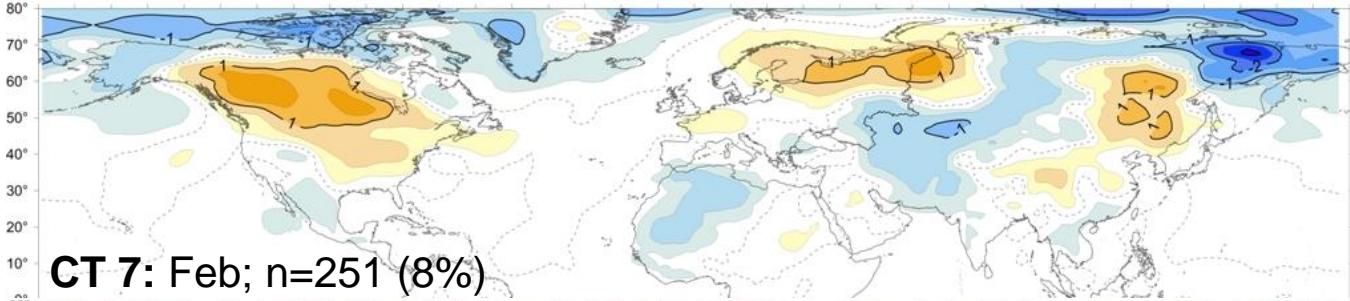
CT 5: Feb; n=331 (11%)



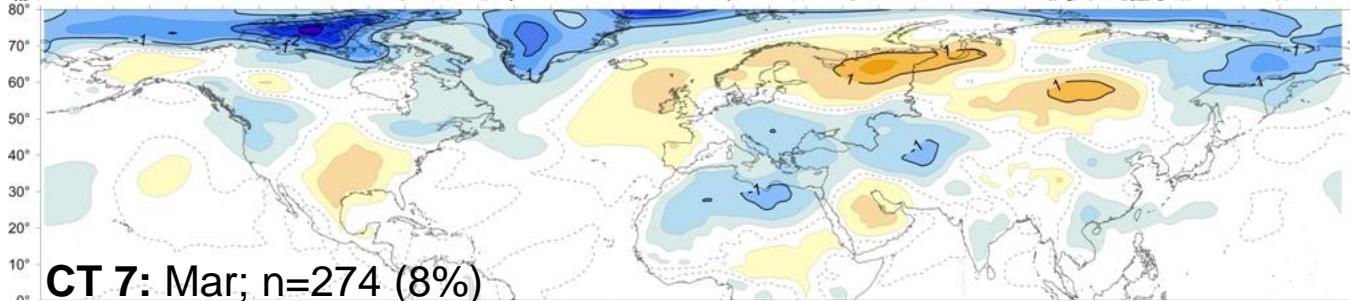
CT 5: Mrz; n=244 (7%)



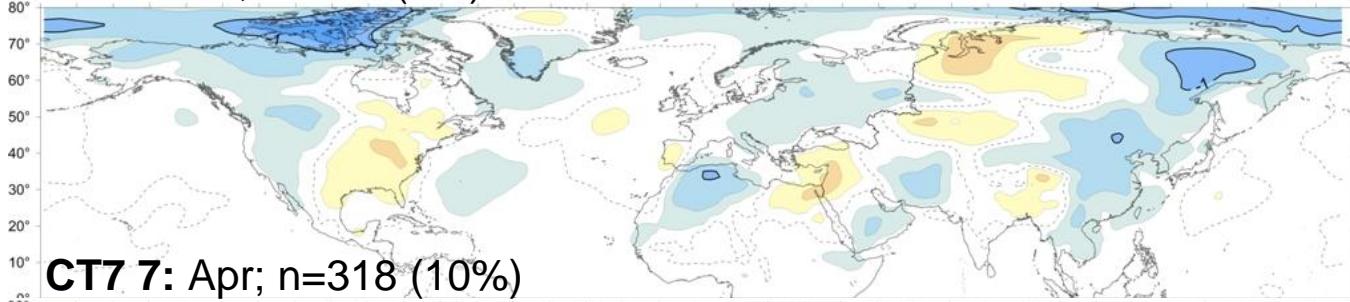
CT 7: Jan; n=313 (9%)



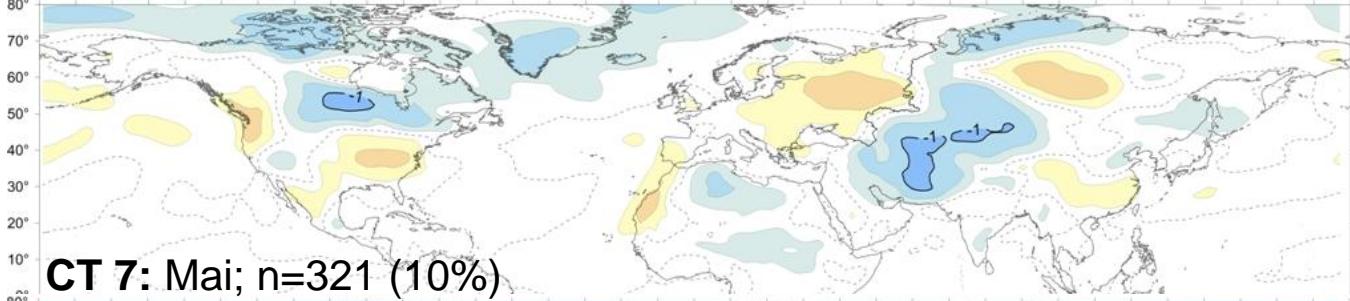
CT 7: Feb; n=251 (8%)



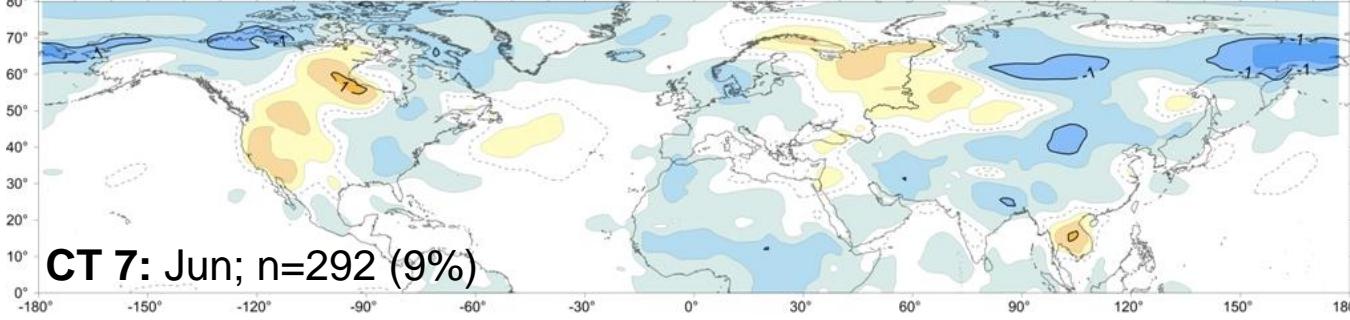
CT 7: Mar; n=274 (8%)



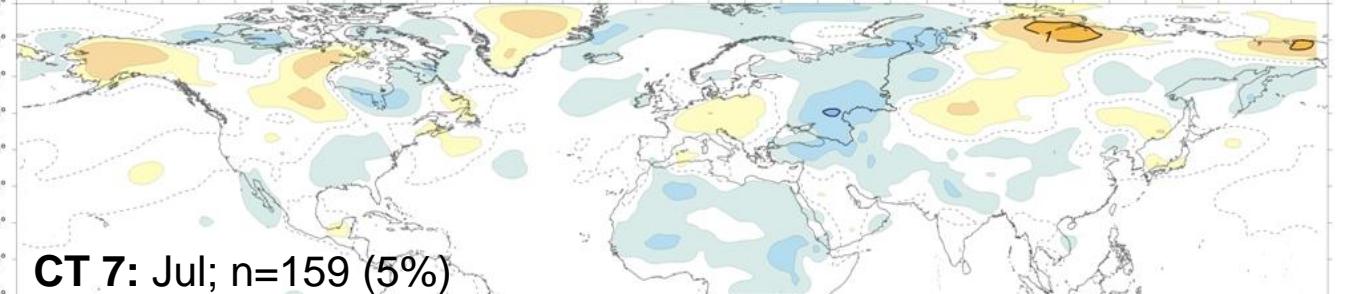
CT 7: Apr; n=318 (10%)



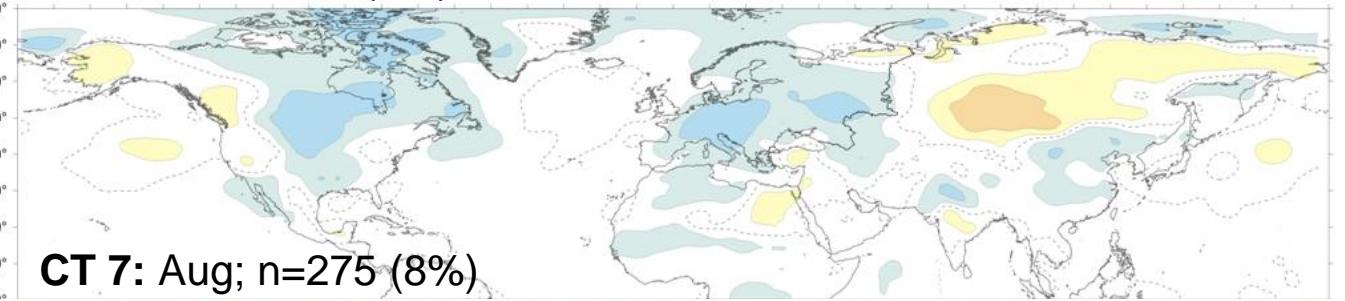
CT 7: Mai; n=321 (10%)



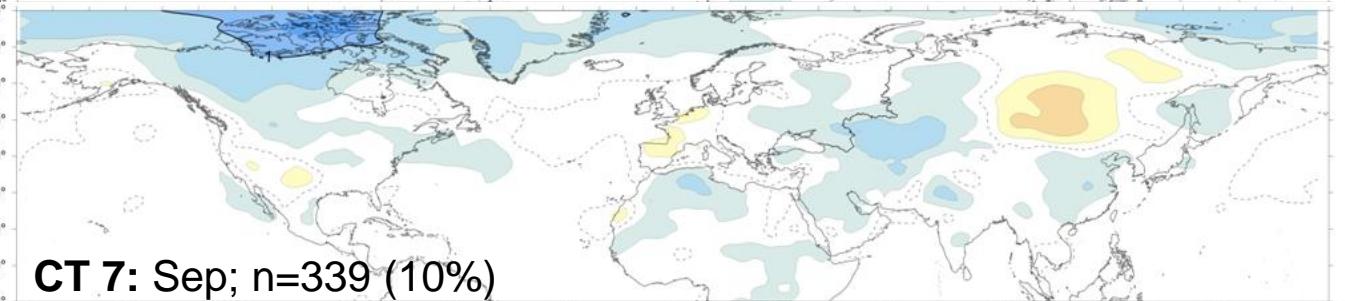
CT 7: Jun; n=292 (9%)



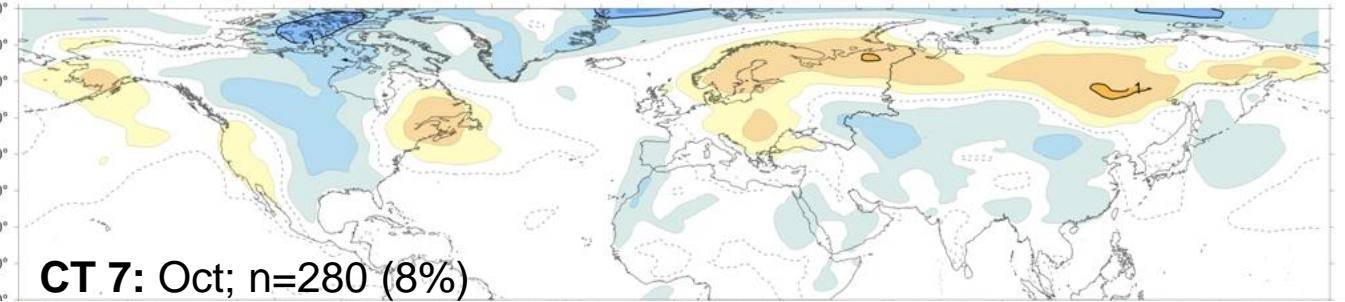
CT 7: Jul; n=159 (5%)



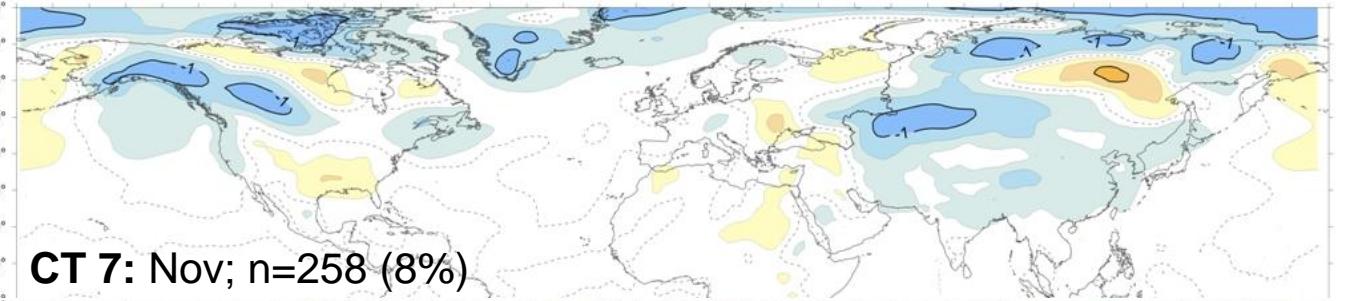
CT 7: Aug; n=275 (8%)



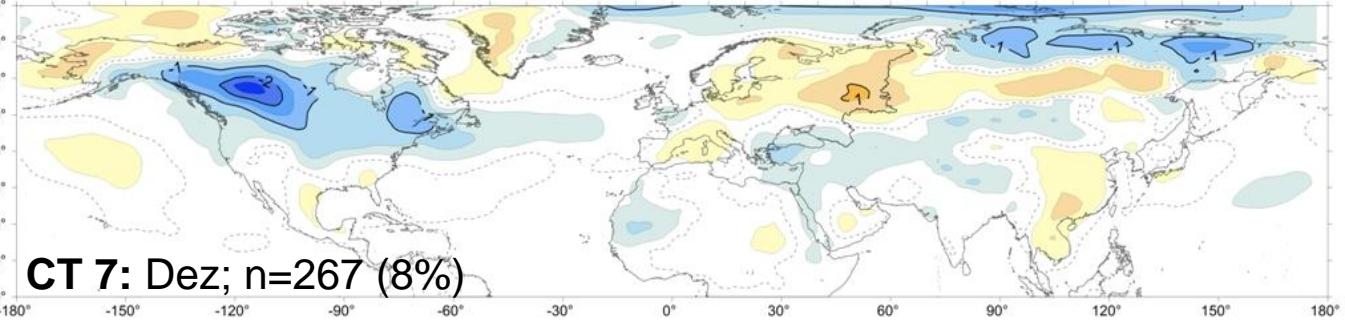
CT 7: Sep; n=339 (10%)



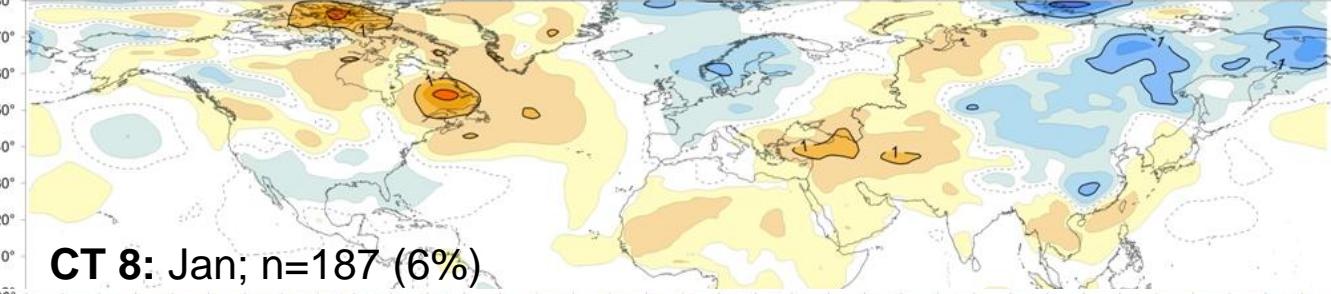
CT 7: Oct; n=280 (8%)



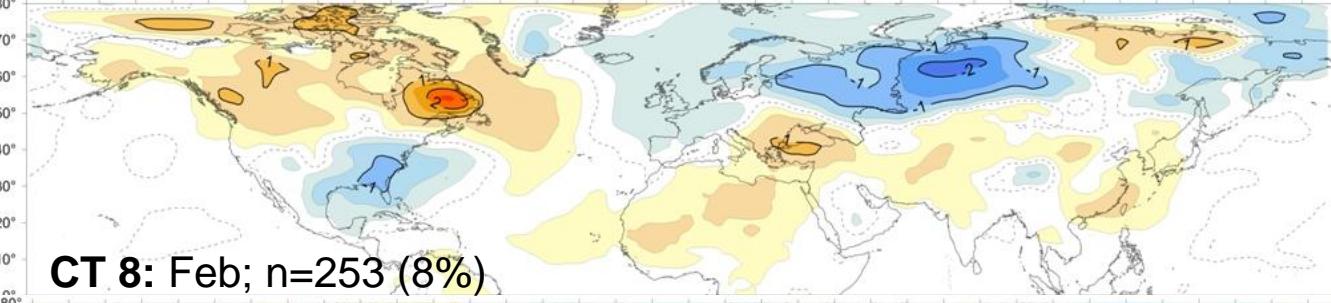
CT 7: Nov; n=258 (8%)



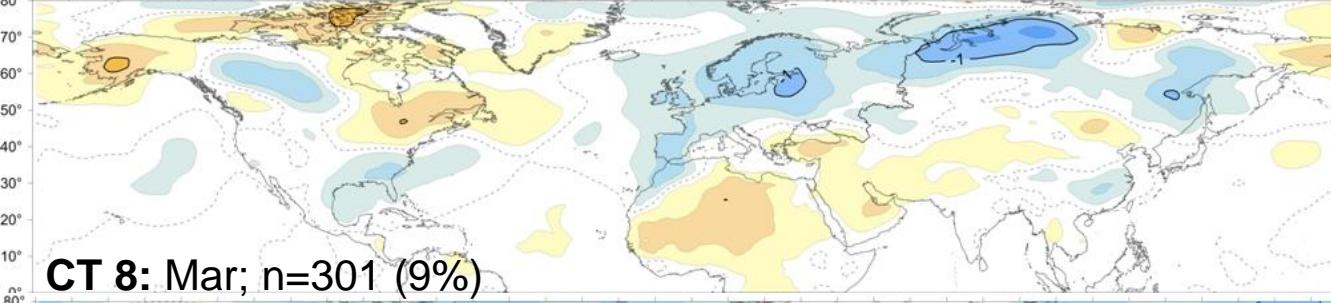
CT 7: Dez; n=267 (8%)



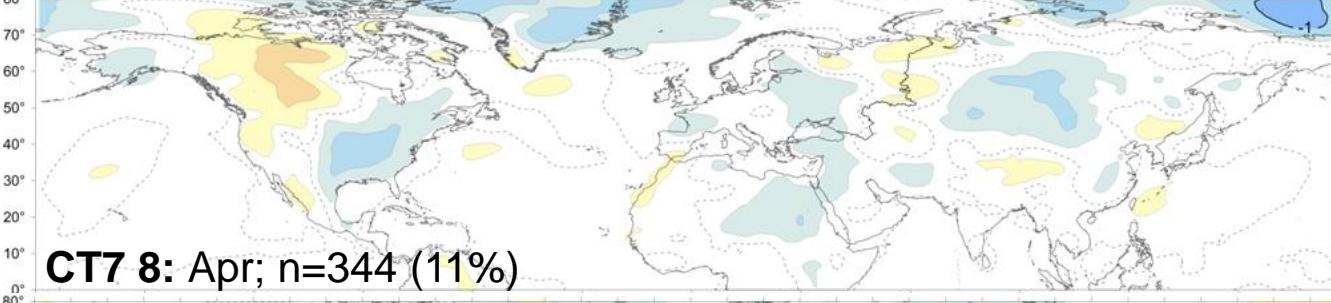
CT 8: Jan; n=187 (6%)



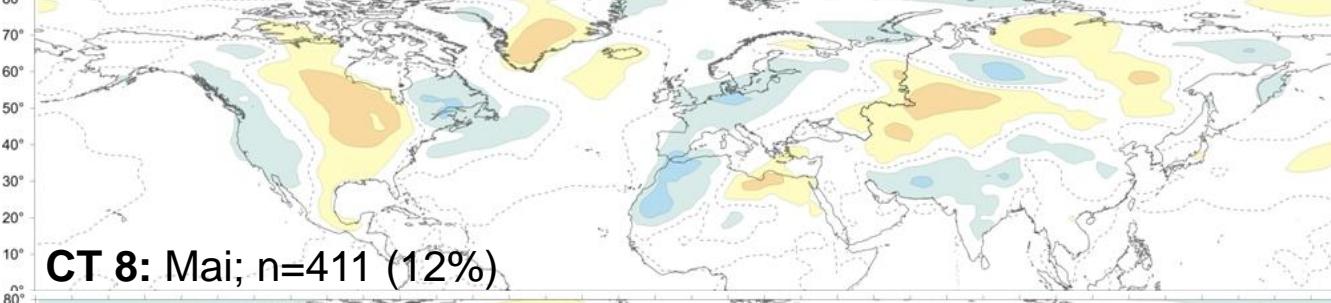
CT 8: Feb; n=253 (8%)



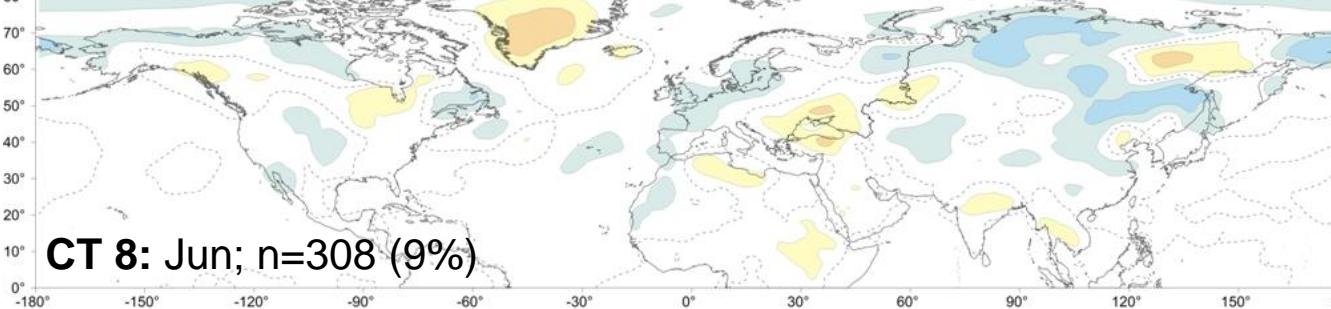
CT 8: Mar; n=301 (9%)



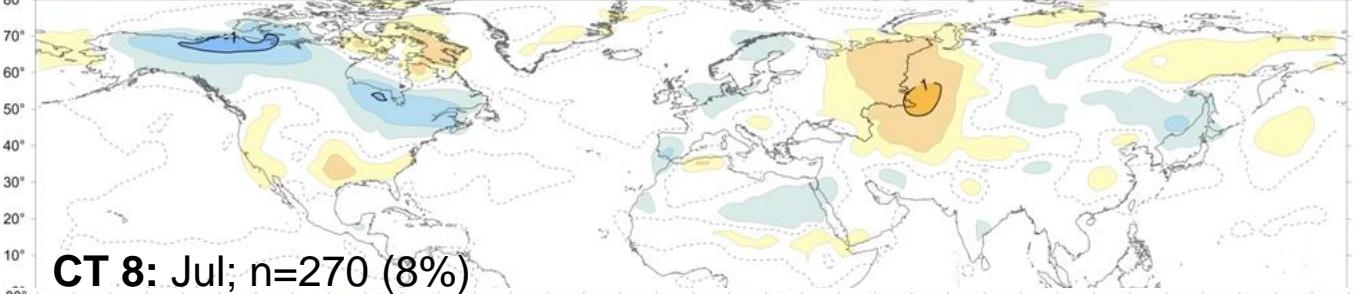
CT7 8: Apr; n=344 (11%)



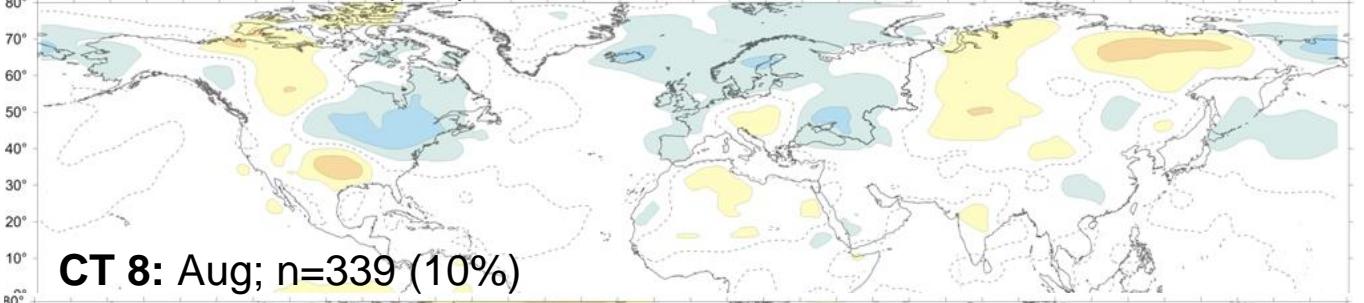
CT 8: Mai; n=411 (12%)



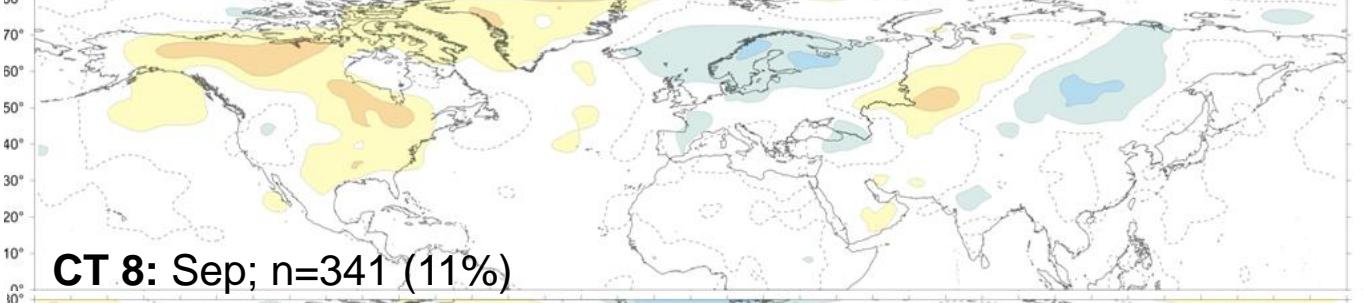
CT 8: Jun; n=308 (9%)



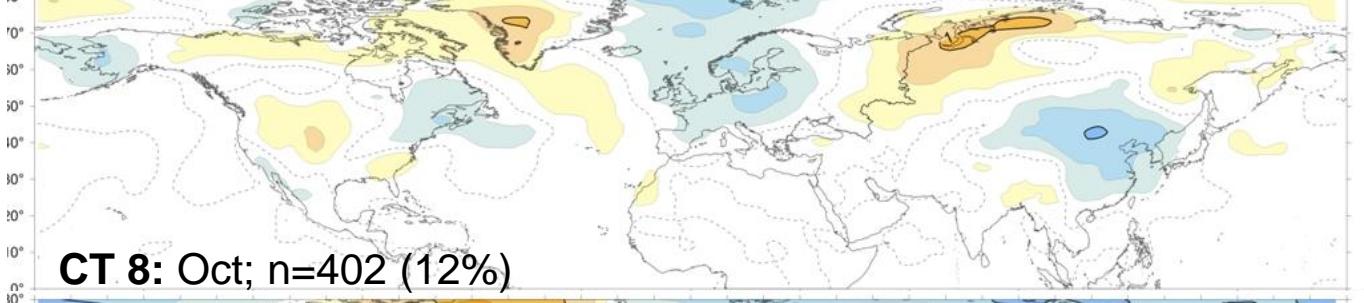
CT 8: Jul; n=270 (8%)



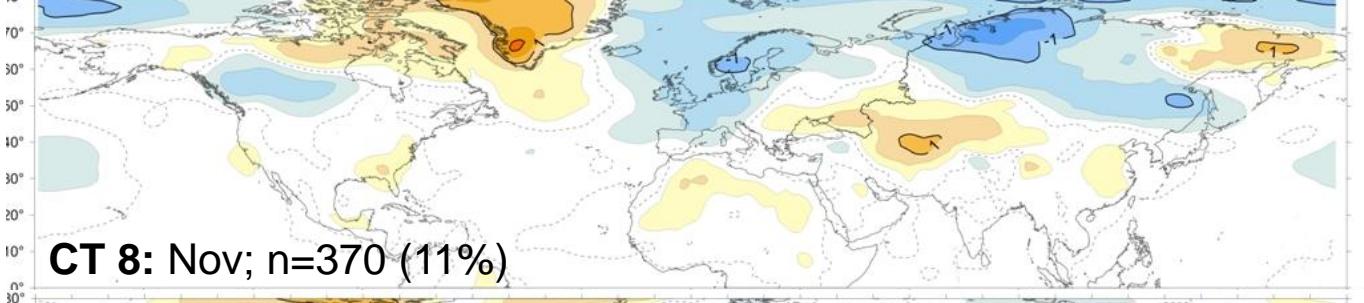
CT 8: Aug; n=339 (10%)



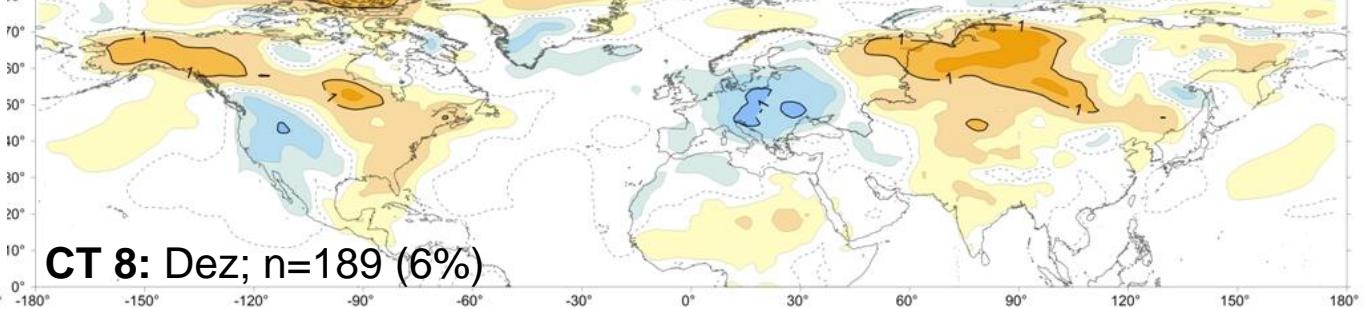
CT 8: Sep; n=341 (11%)



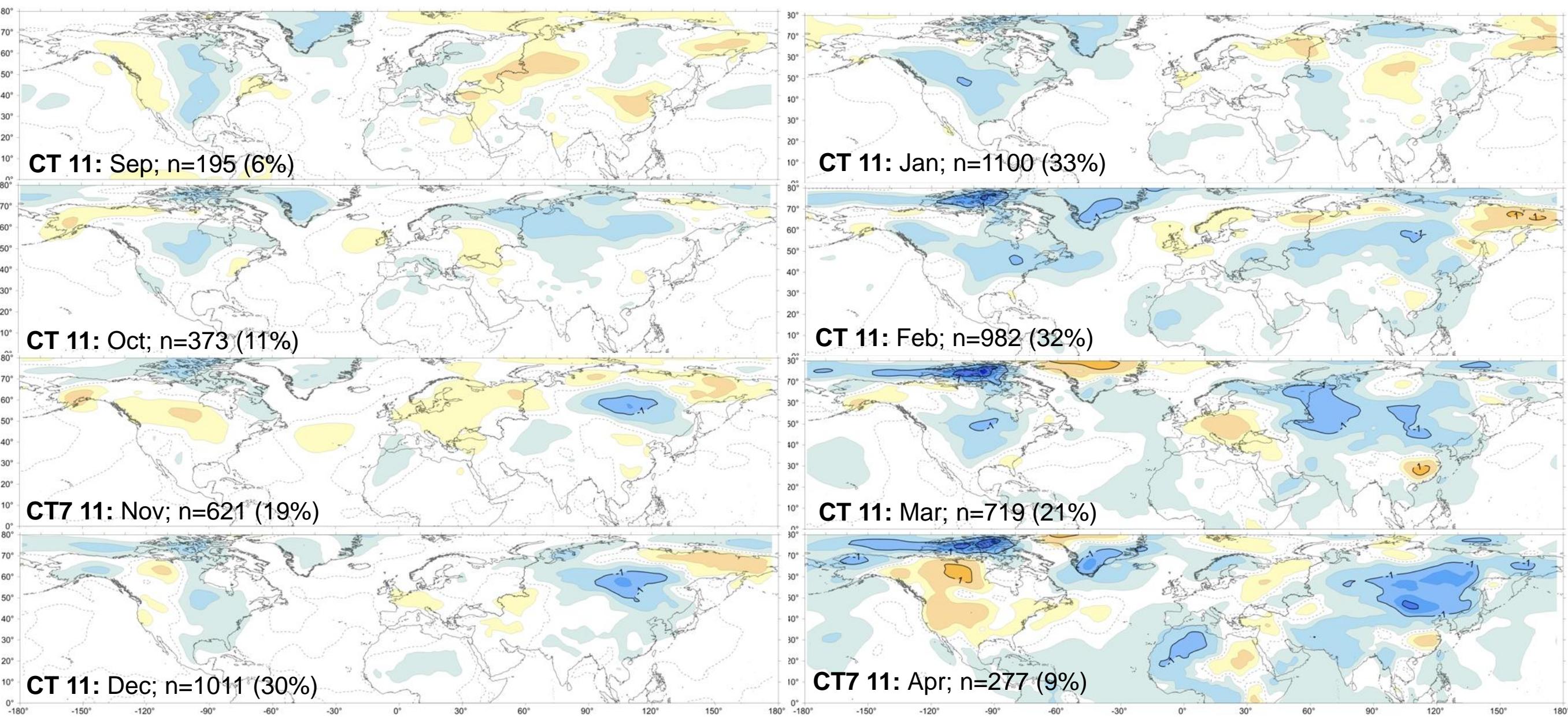
CT 8: Oct; n=402 (12%)

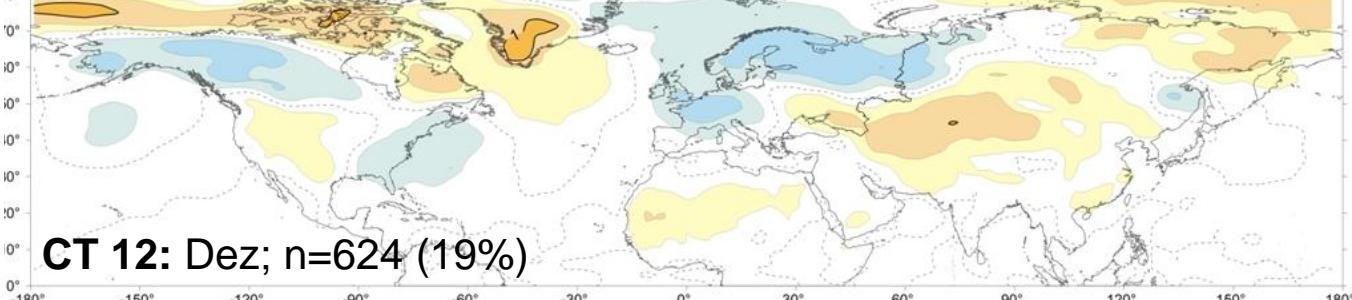
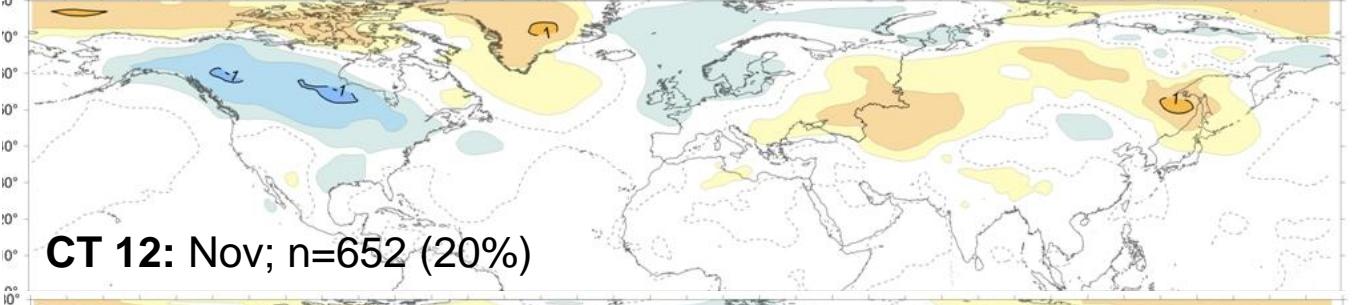
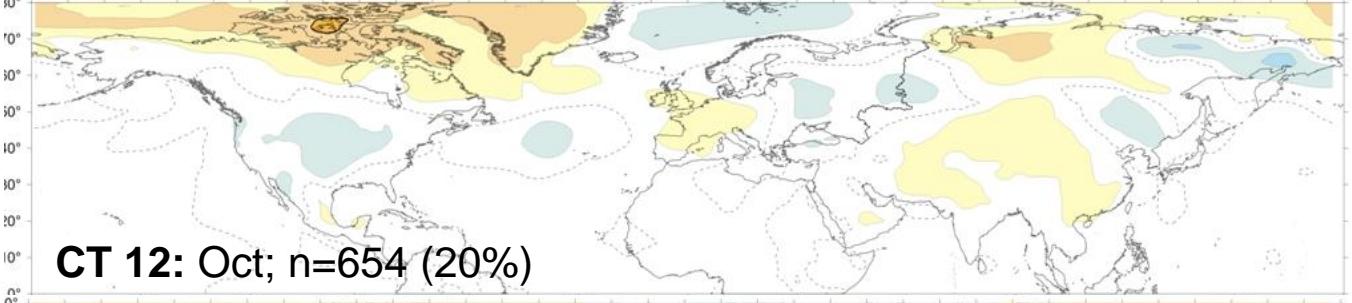
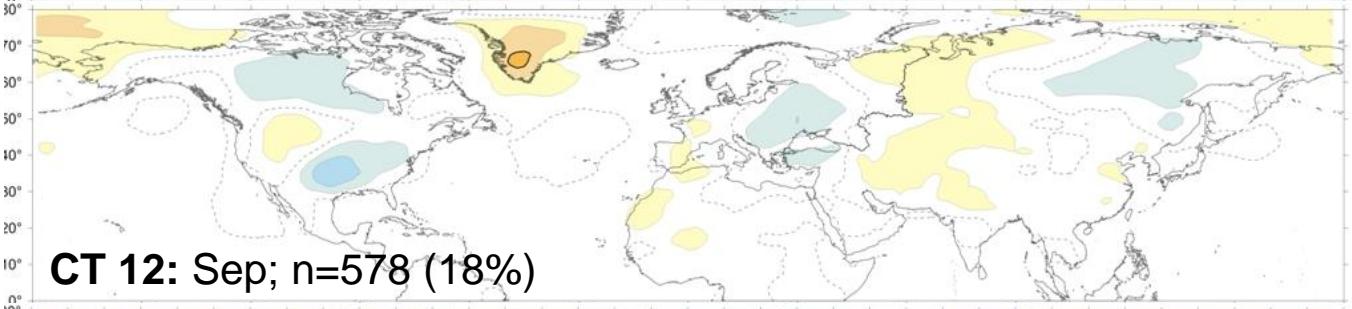
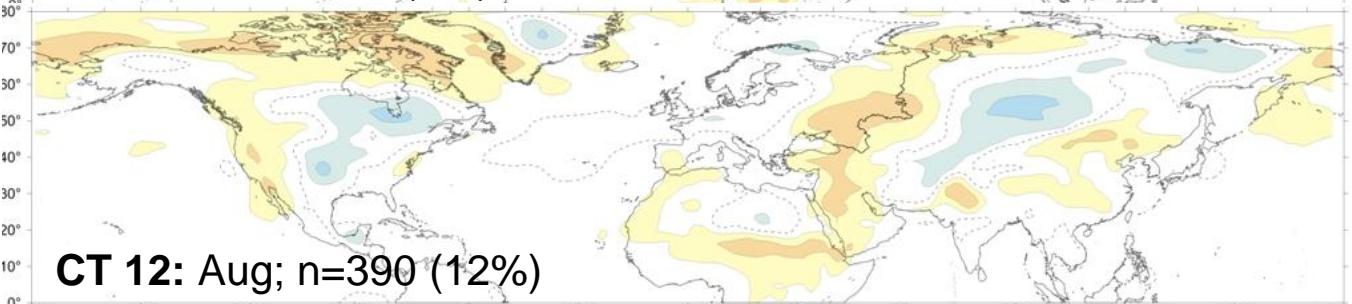
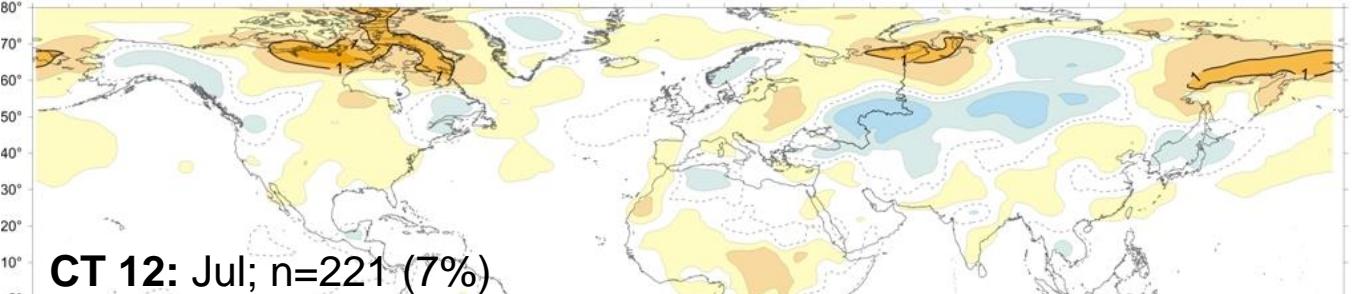
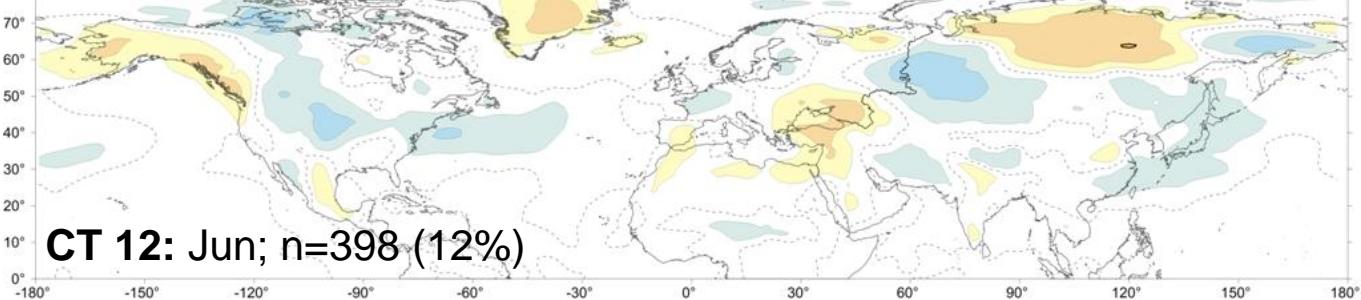
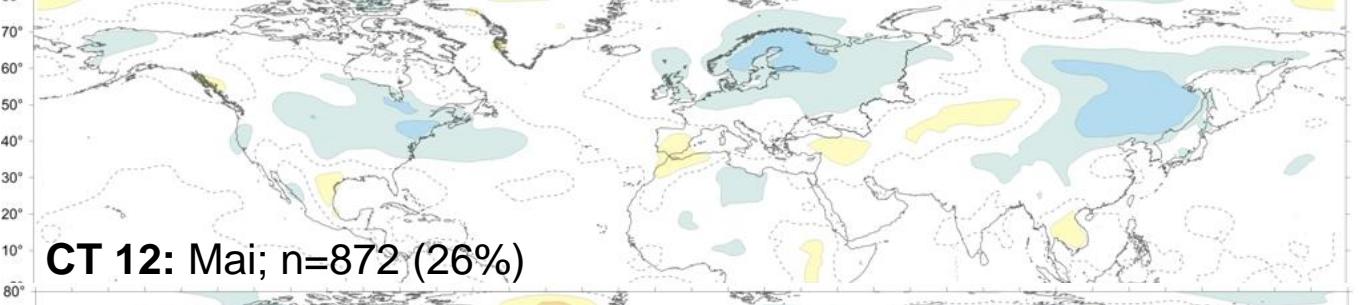
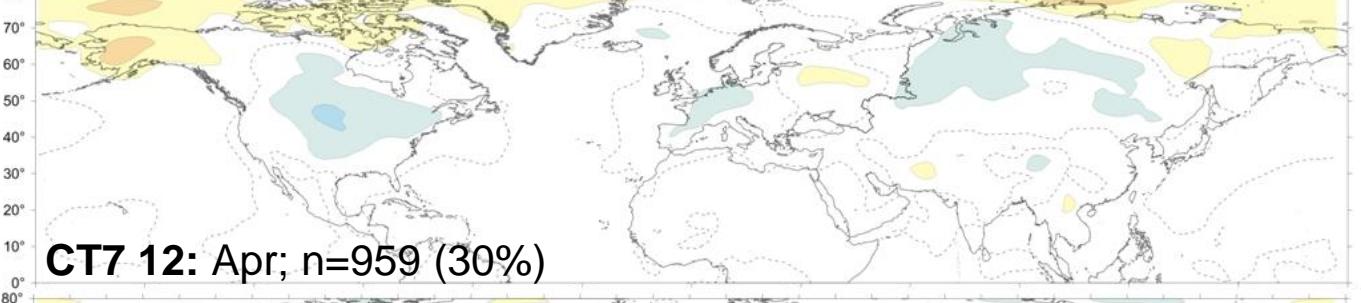
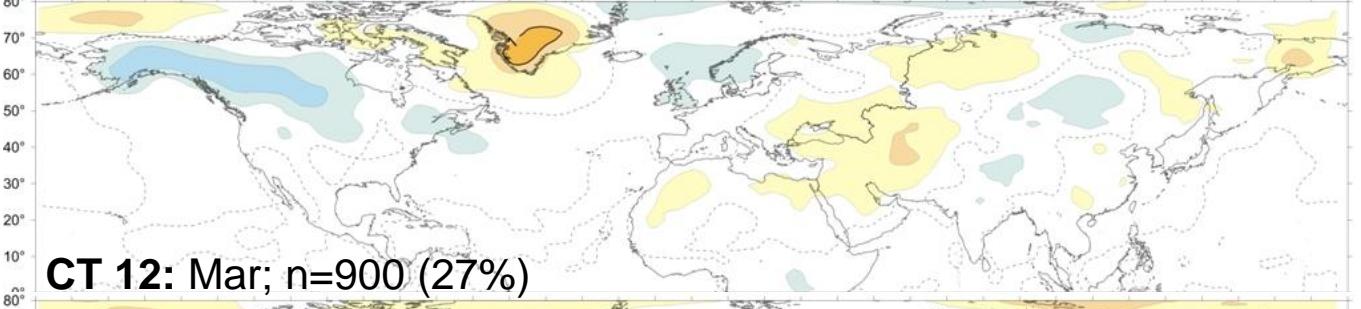
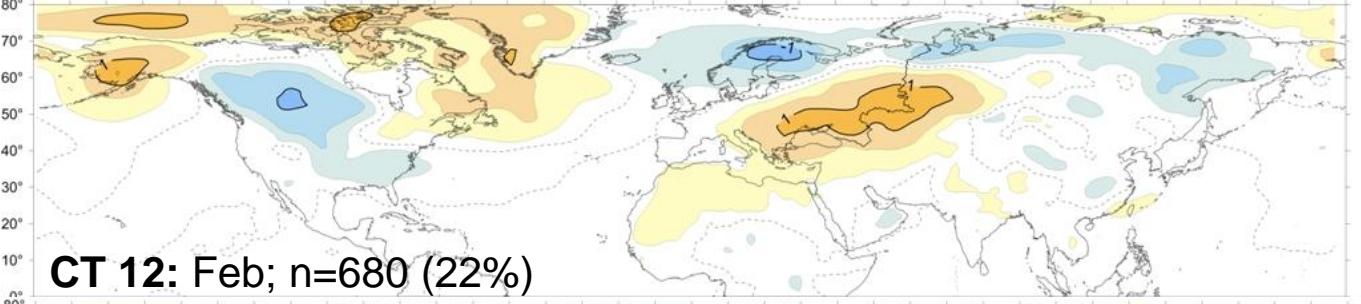
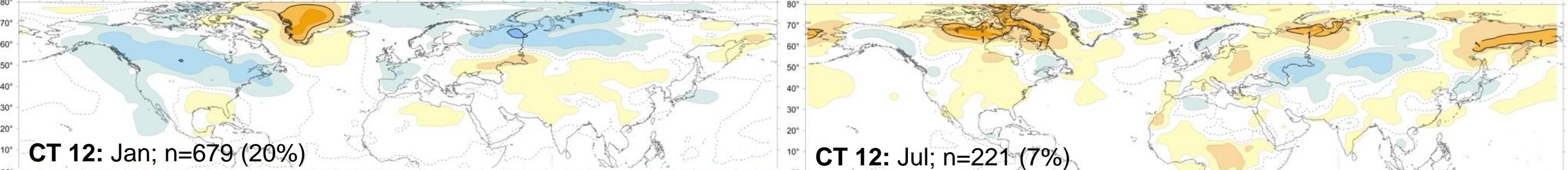


CT 8: Nov; n=370 (11%)



CT 8: Dez; n=189 (6%)

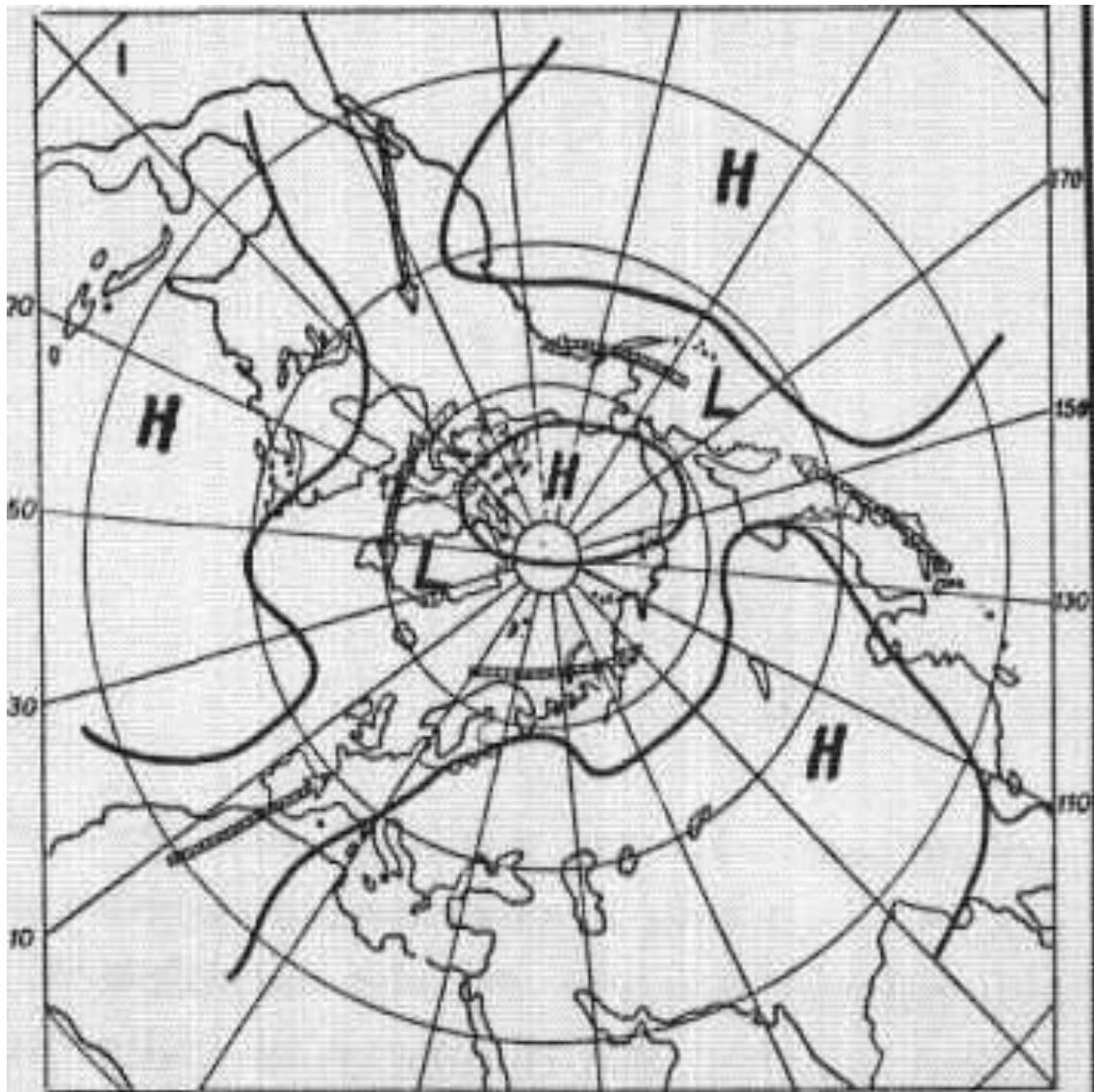




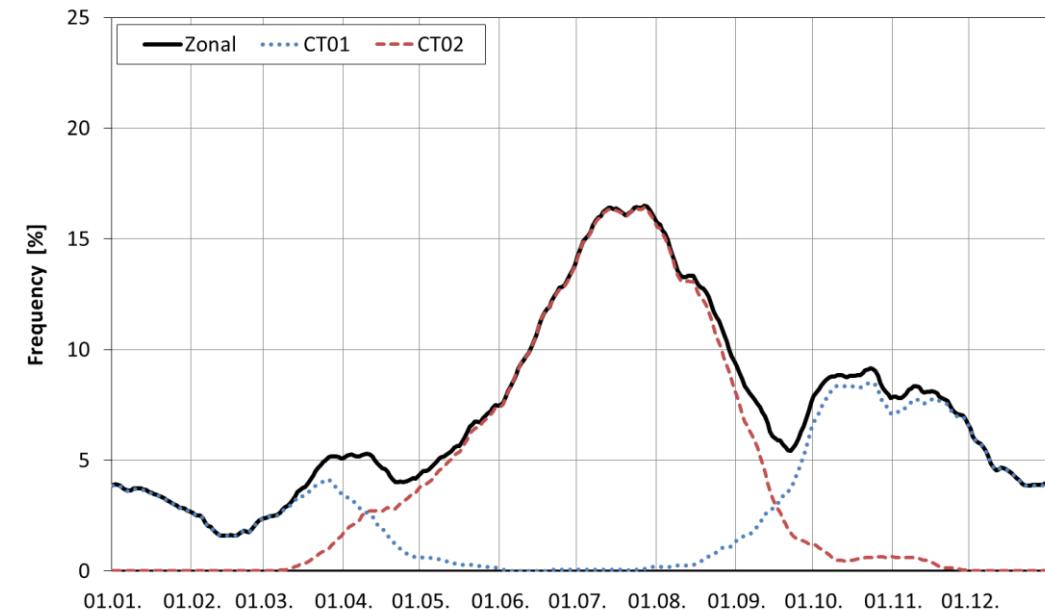
# Structure

- Concept and data
- Some results for discussion
- Monthly air pressure and temperature signals for circulation groups
- Details
  - Zonal (Z) circulation group
  - Zonal Disturbed (ZD) circulation group
  - Meridional North (MN) circulation group
  - Meridional South (MS) circulation group

# Zonal Circulation Group (Z)



Anticyclonic conditions at Arctic region;  
2-4 southern cyclone outlets in 2-4 (of 6)  
sectors; no blocking



## Circulation Types (CT's)

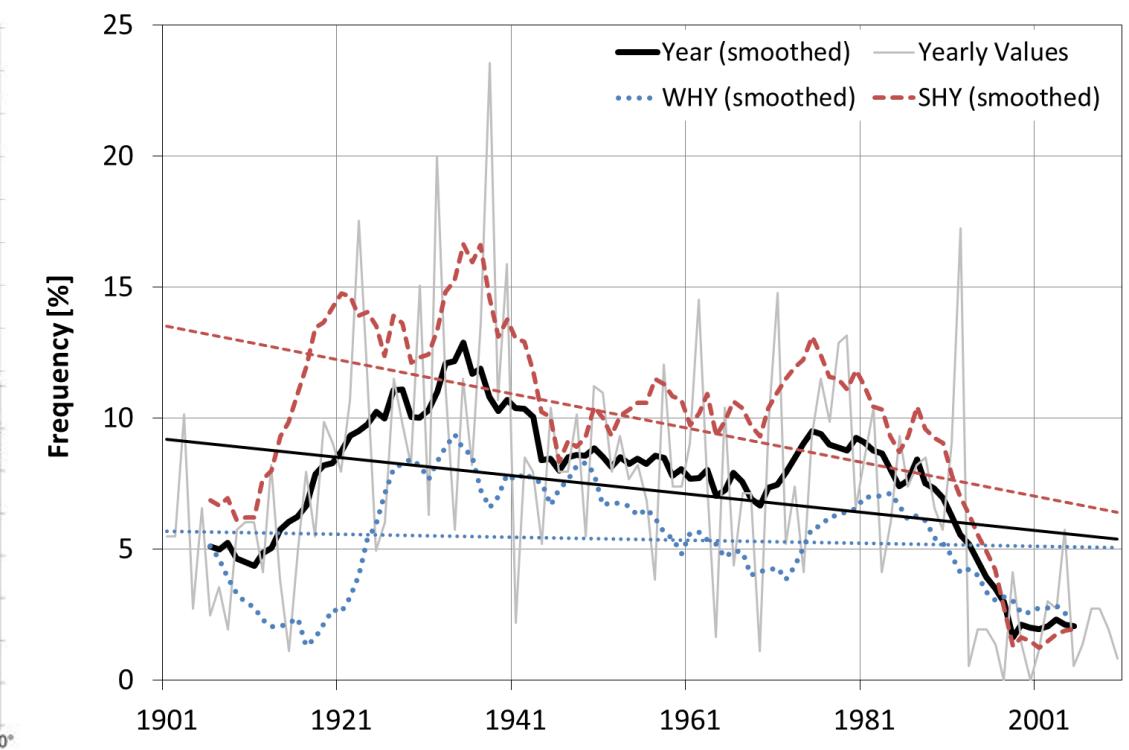
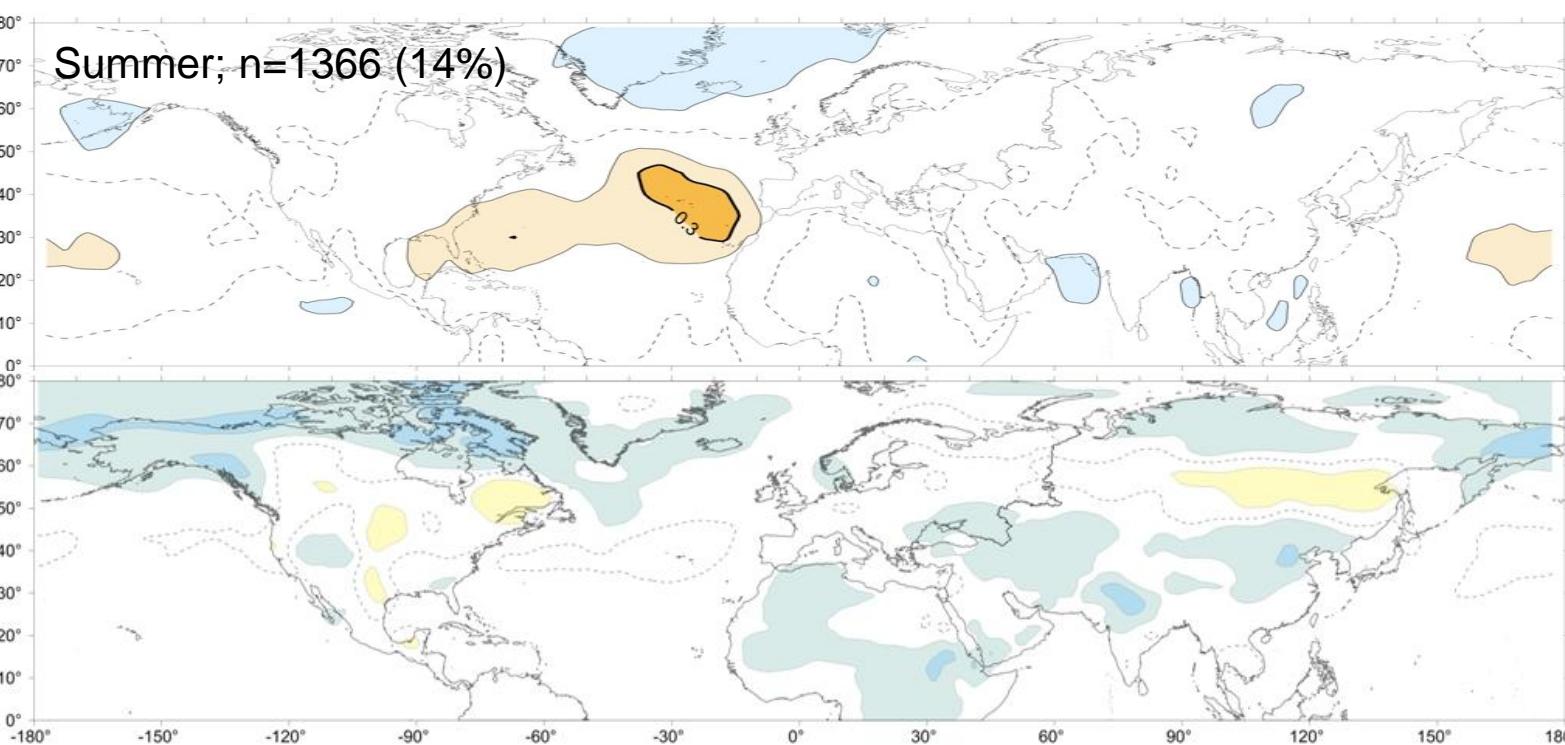
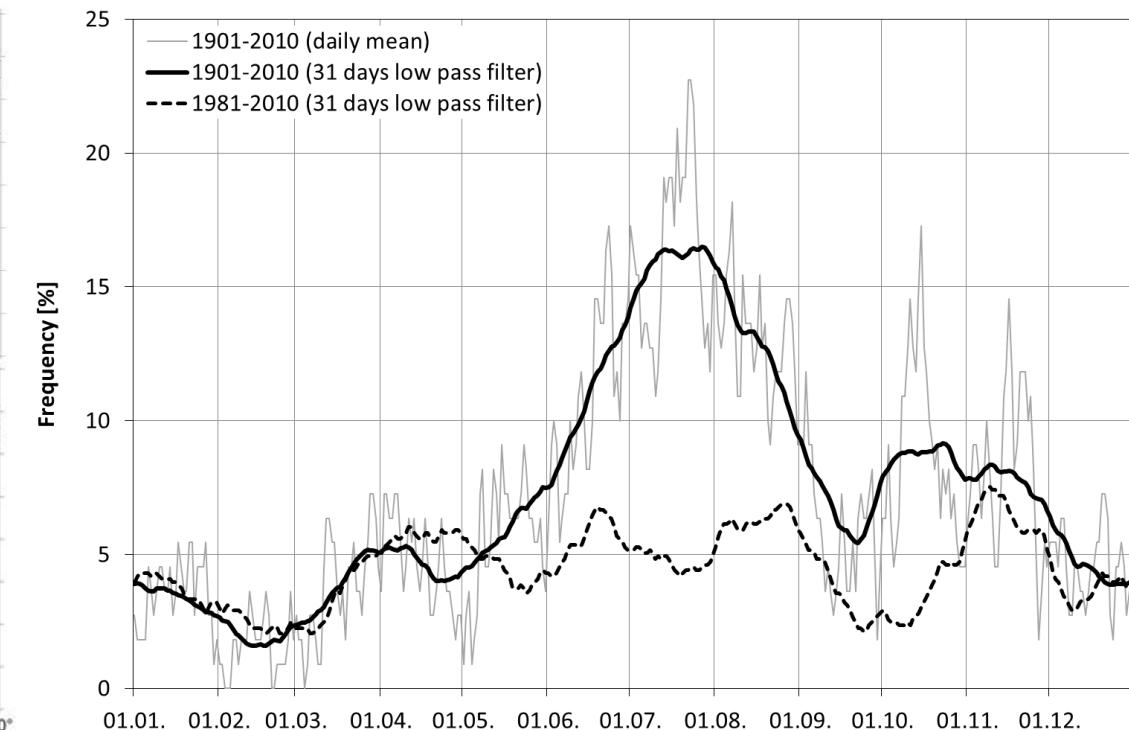
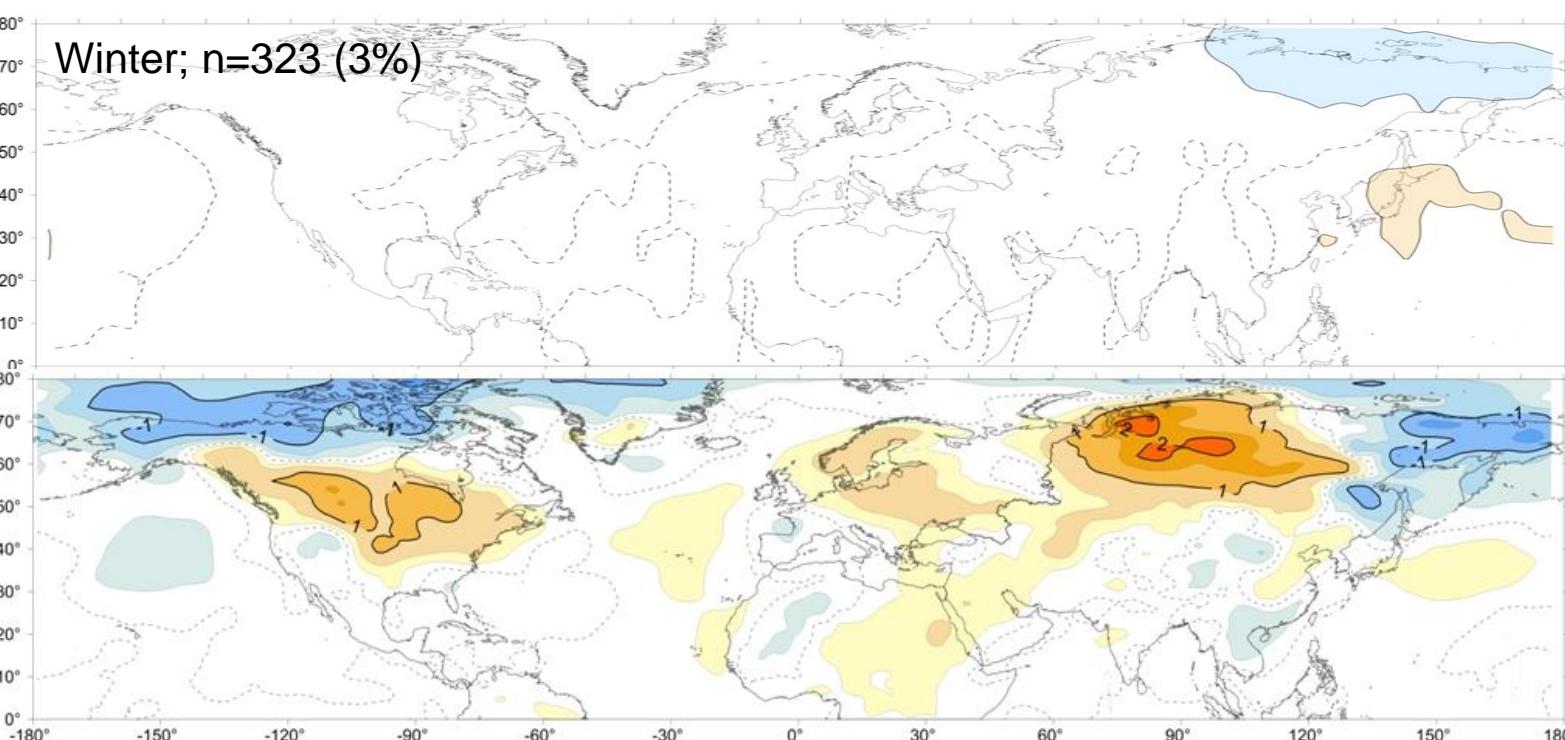
1	2,9%	WHY
2	4,3%	SHY

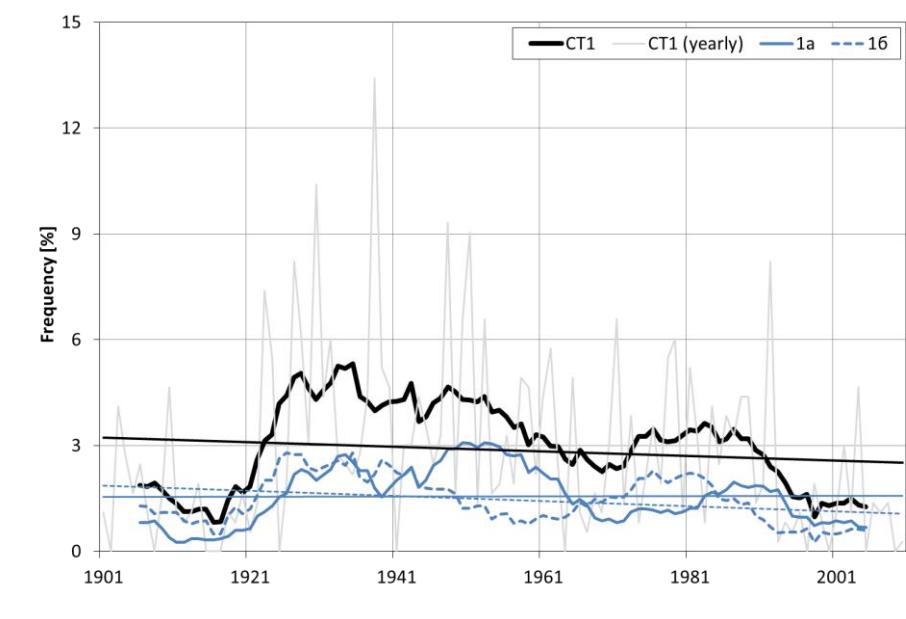
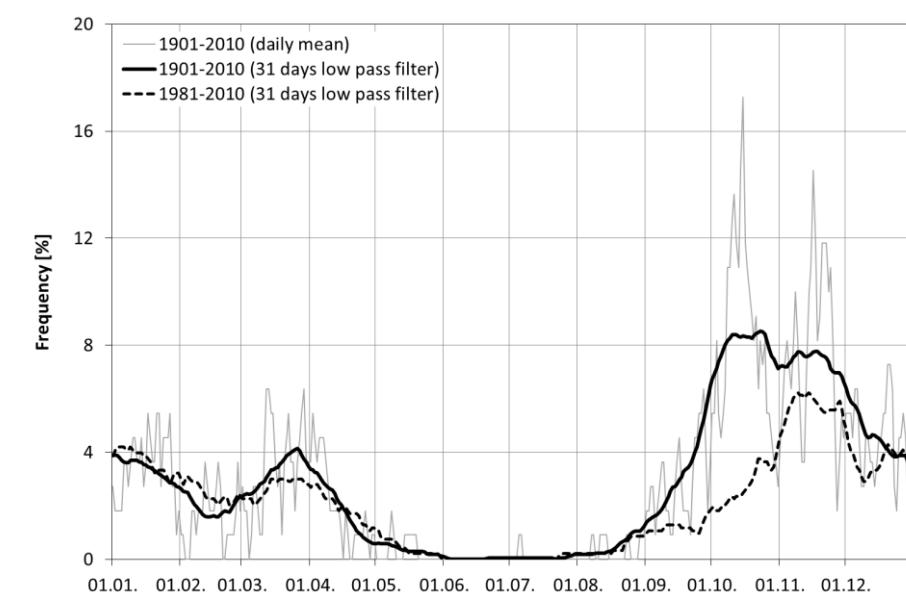
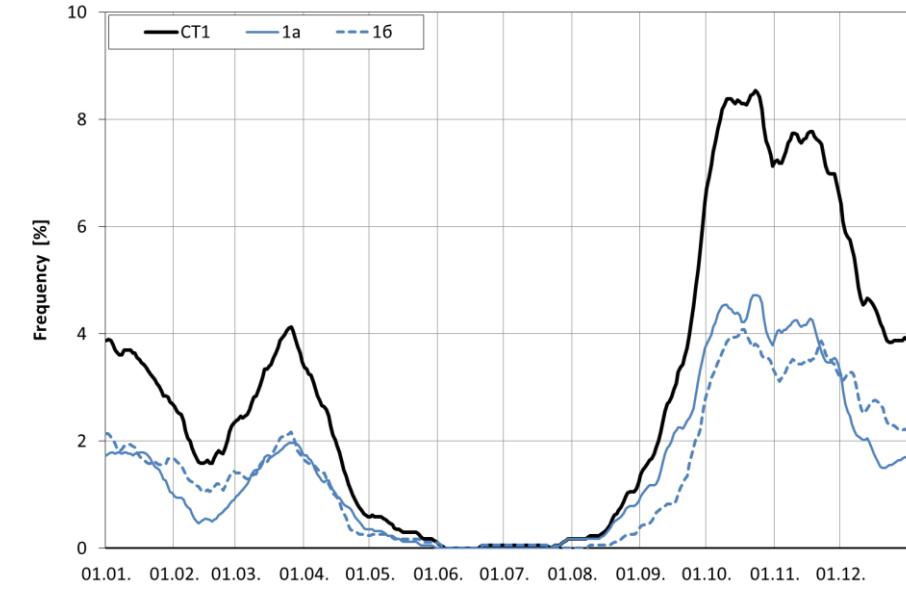
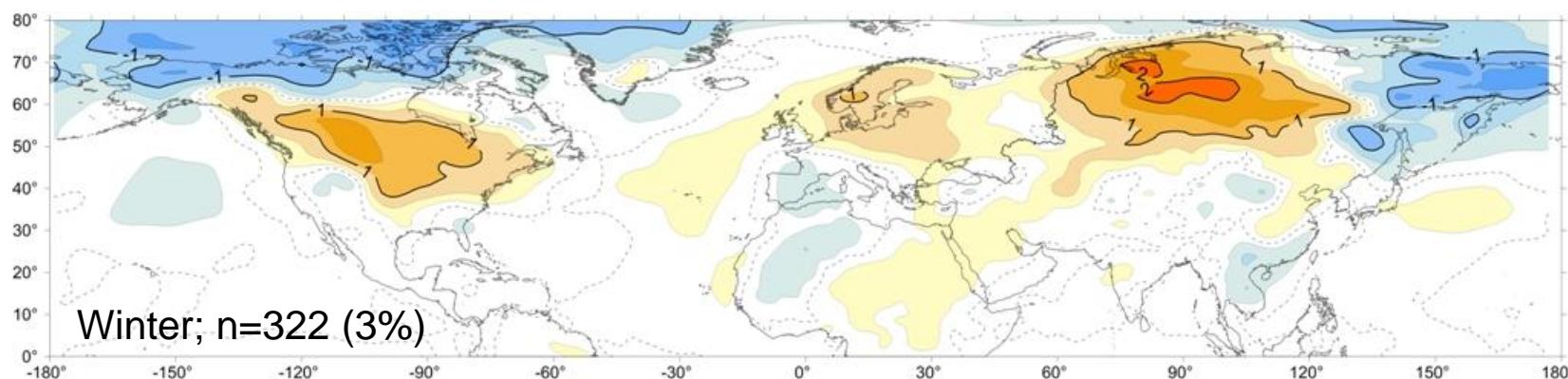
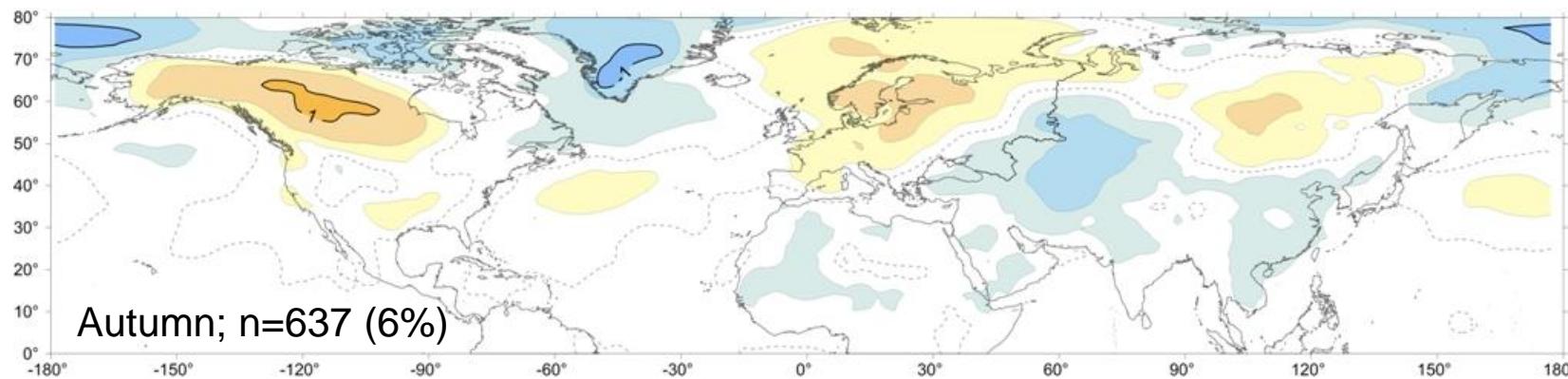
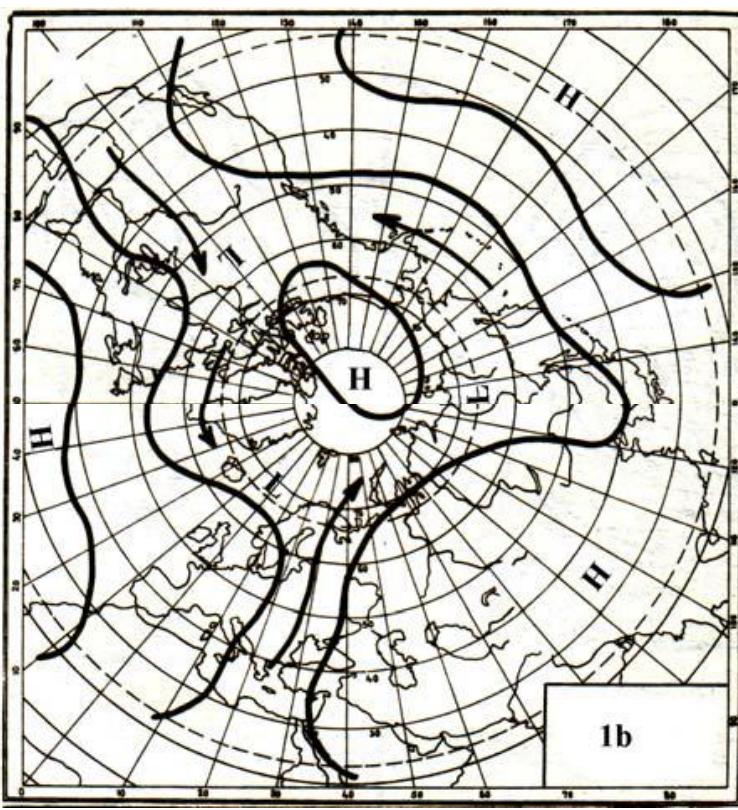
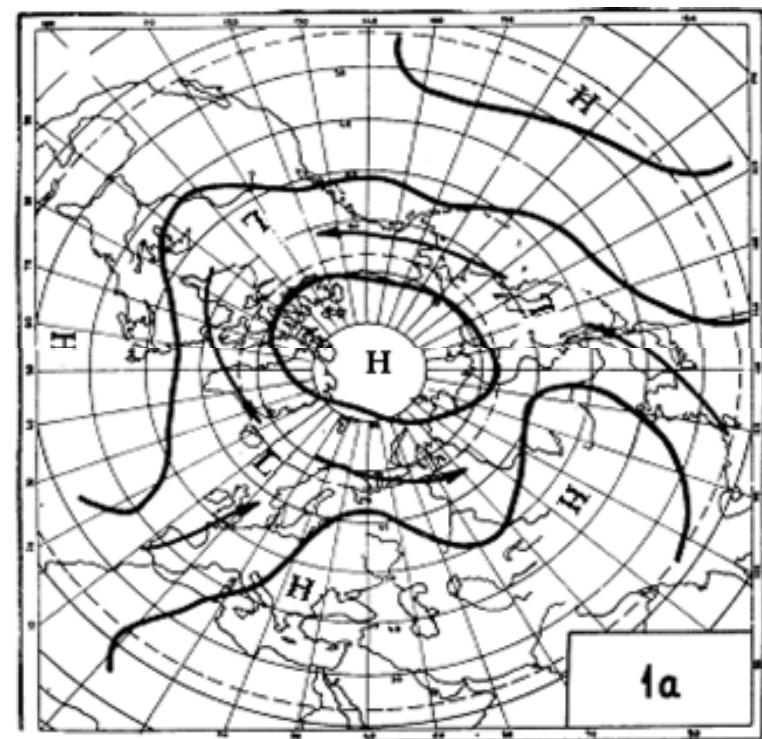
## Elementary Circulation Mechanisms (ECM's)

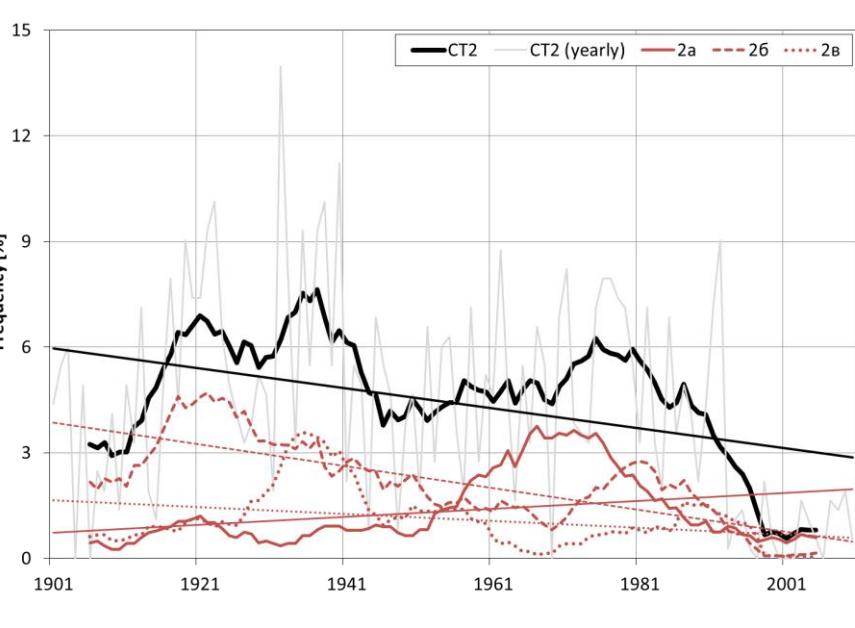
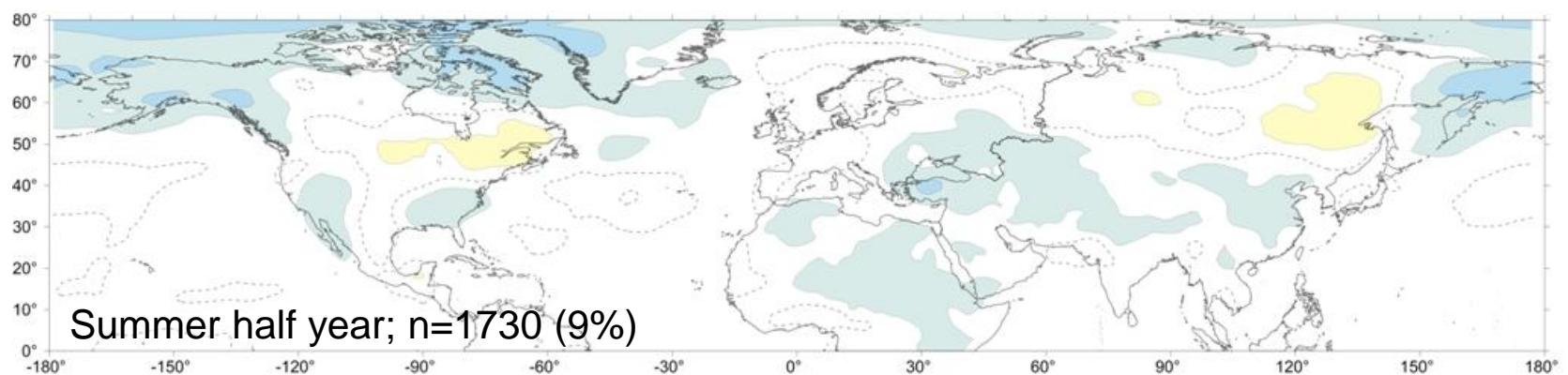
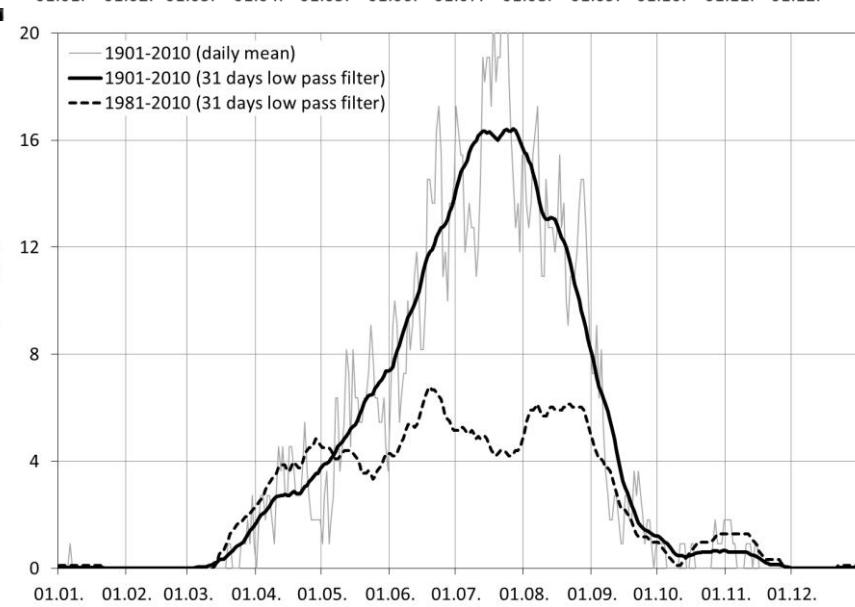
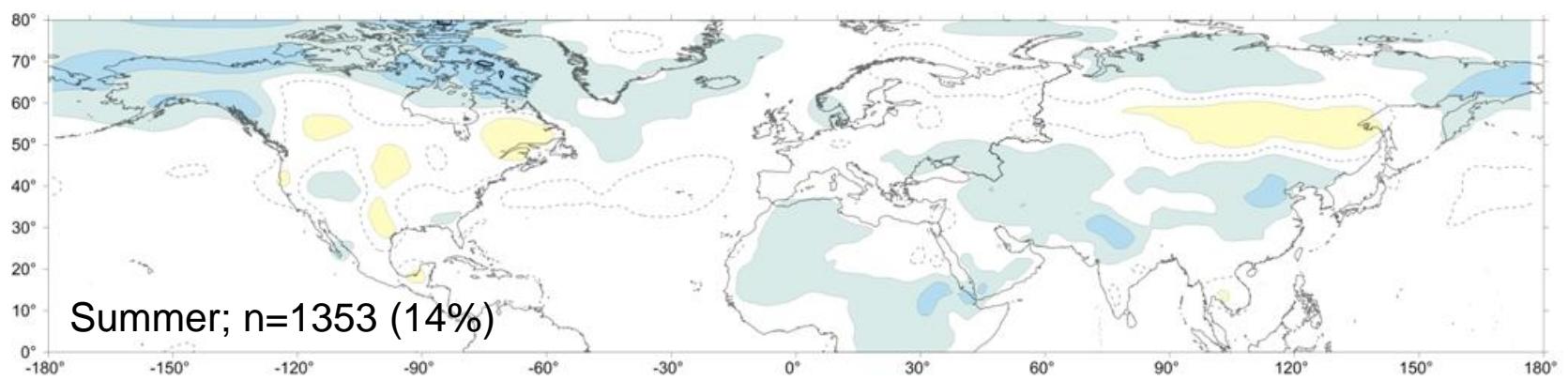
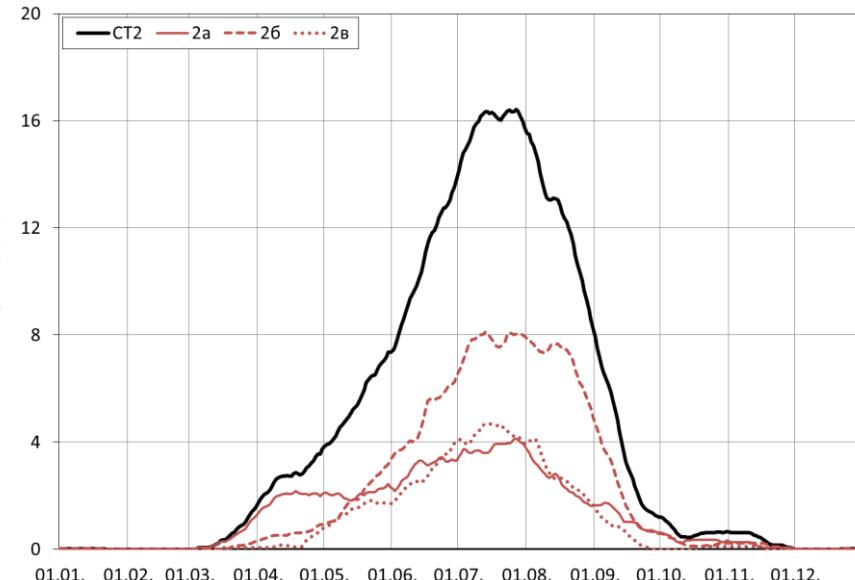
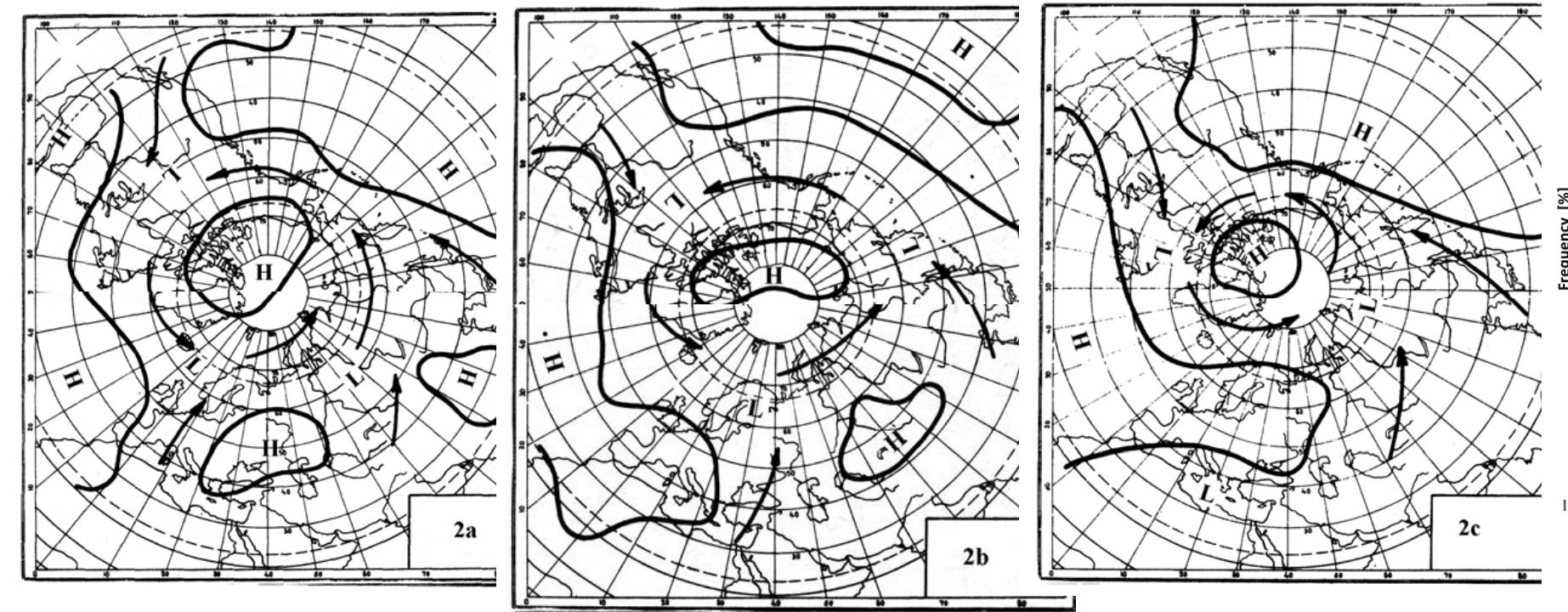
1a	1,5%	WHY
16	1,4%	WHY
2a	1,3%	SHY
26	2,0%	SHY
2B	1,0%	SHY

Third column describes main occurrence of CT's/ECM's;  
WHY = Winter half year; SHY = Summer half year

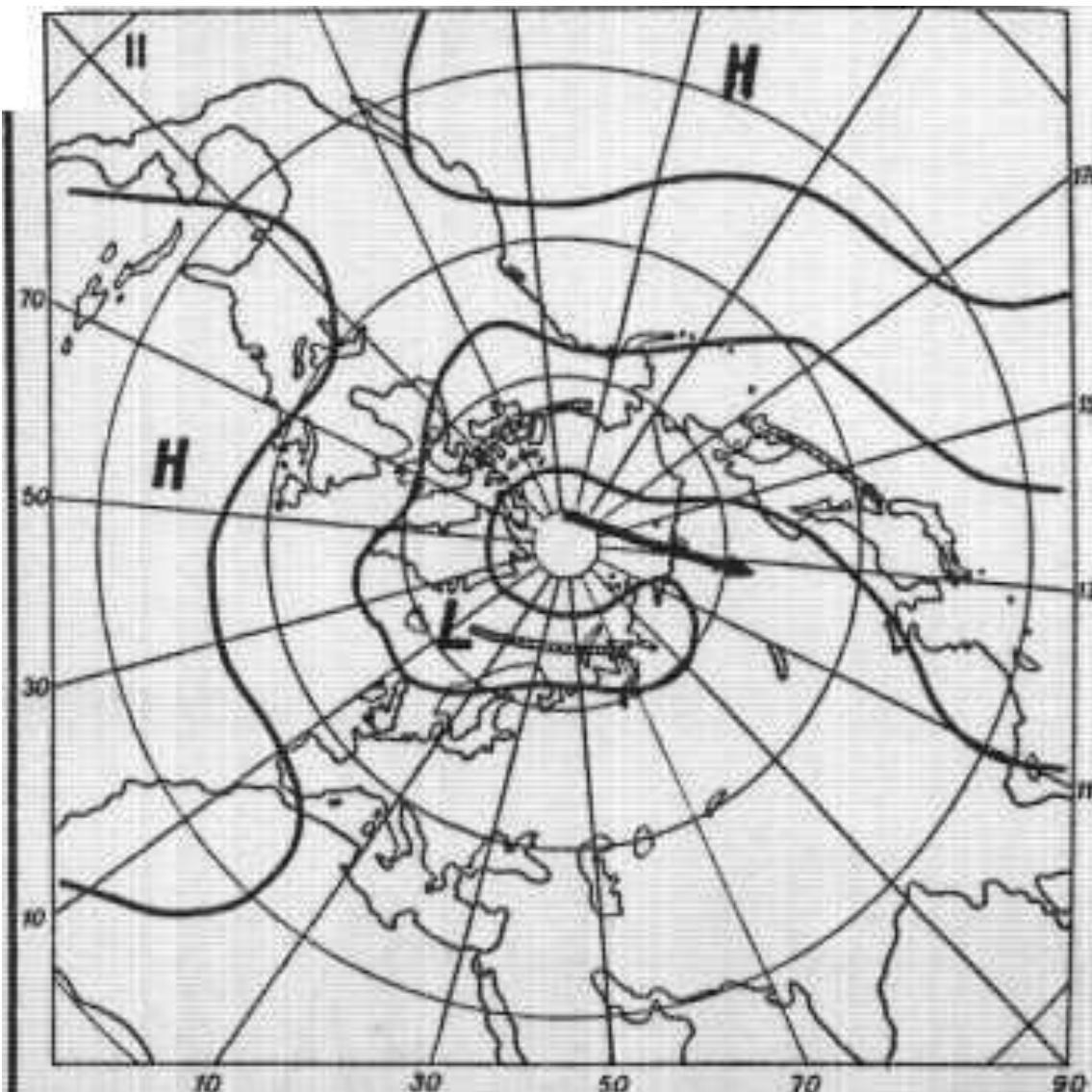
# Zonal Circulation Group (Z)



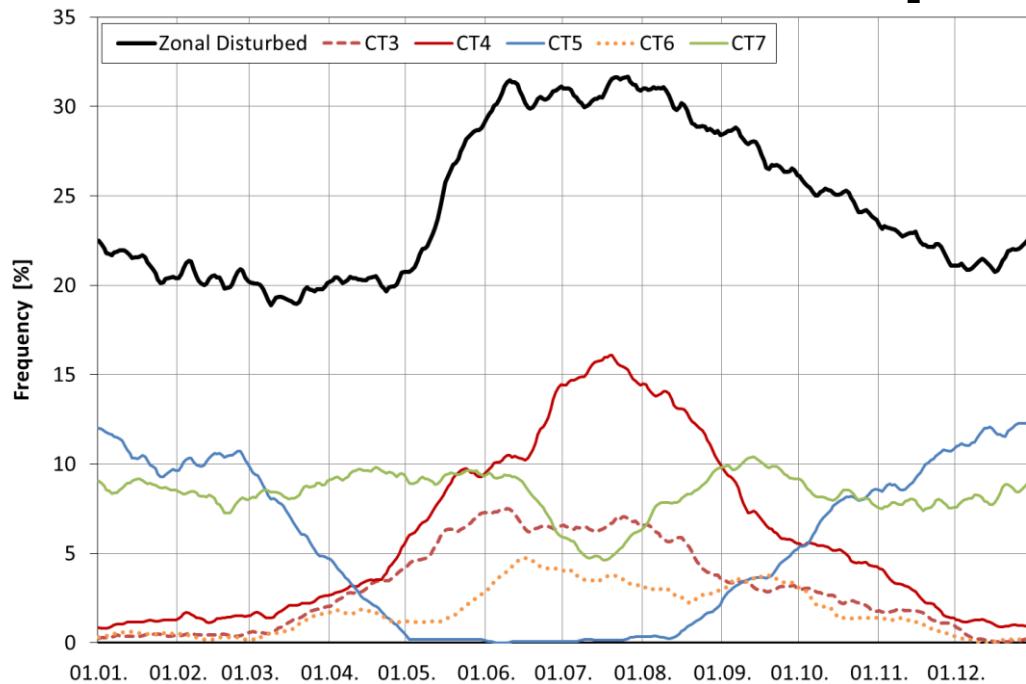




# Zonally Disturbed Circulation Group (ZD)



Anticyclonic conditions at Arctic region;  
2-4 southern cyclone outlets in 2-4 (of 6)  
sectors; one blocking over the  
hemisphere



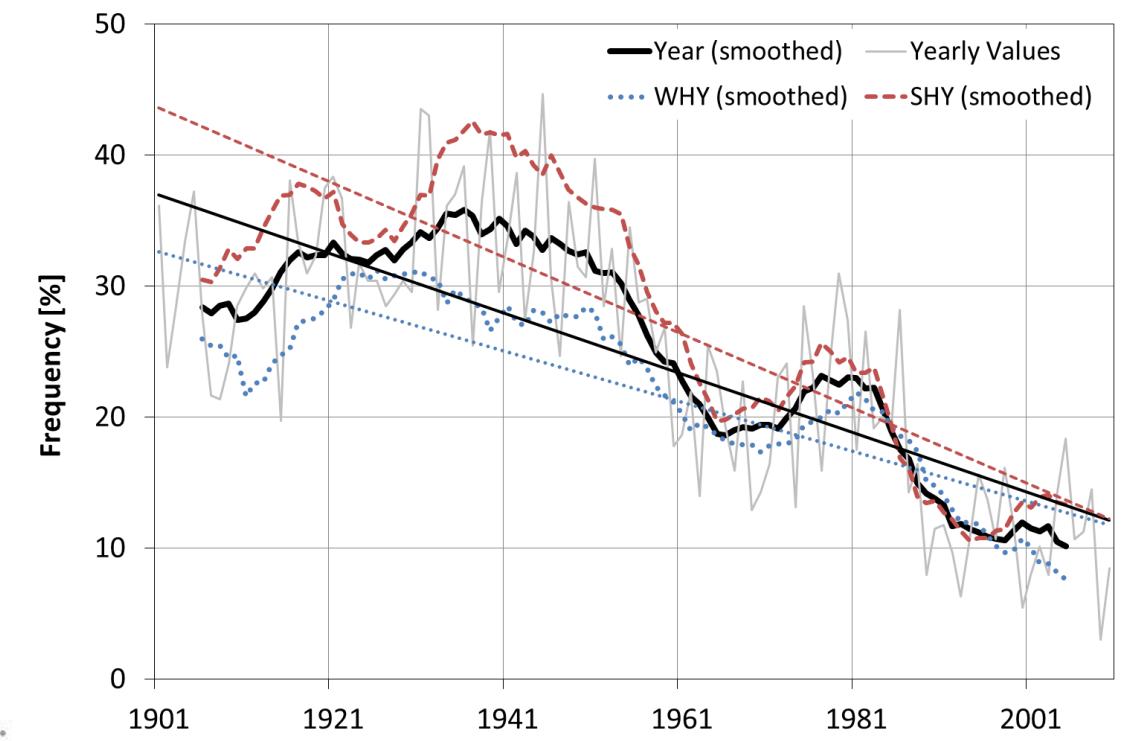
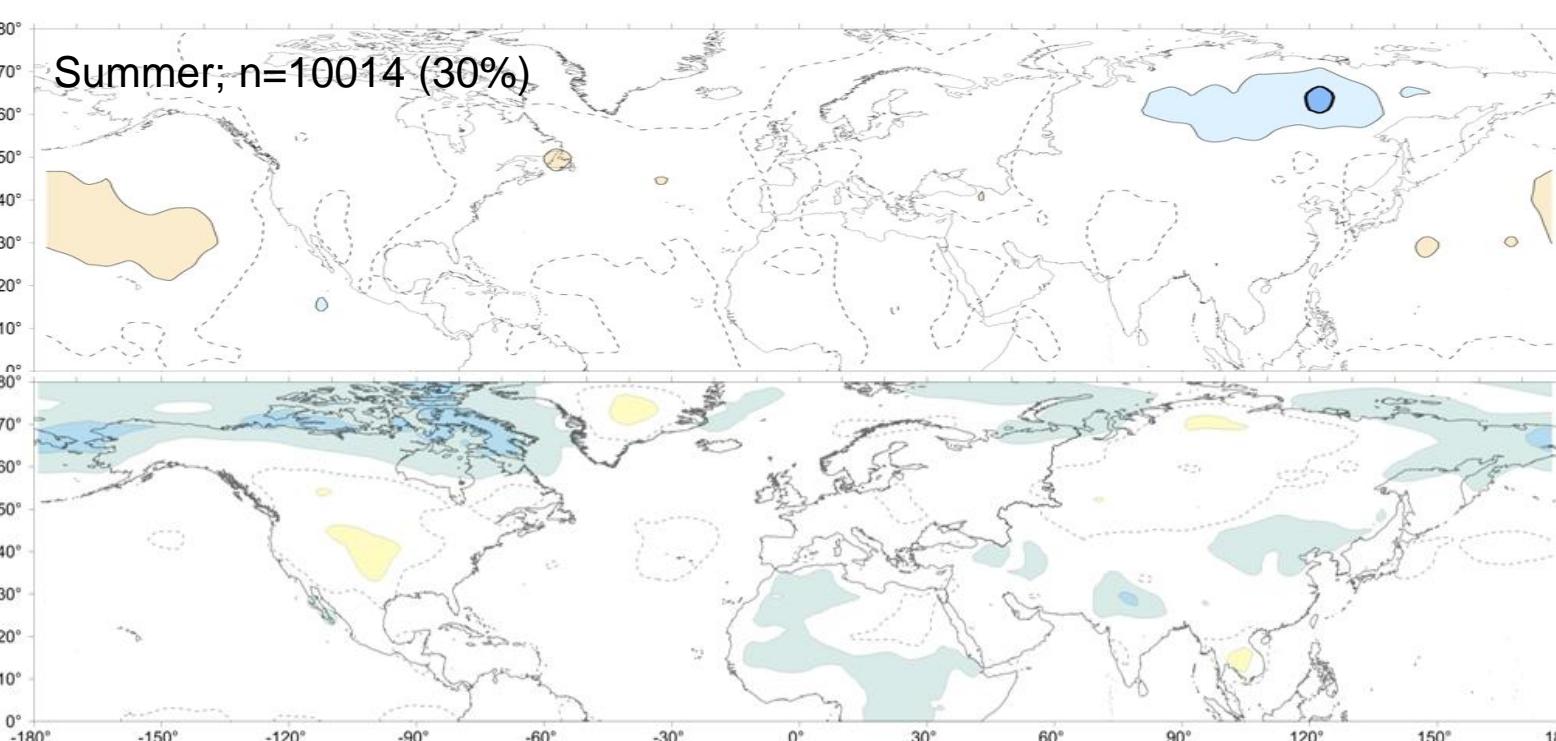
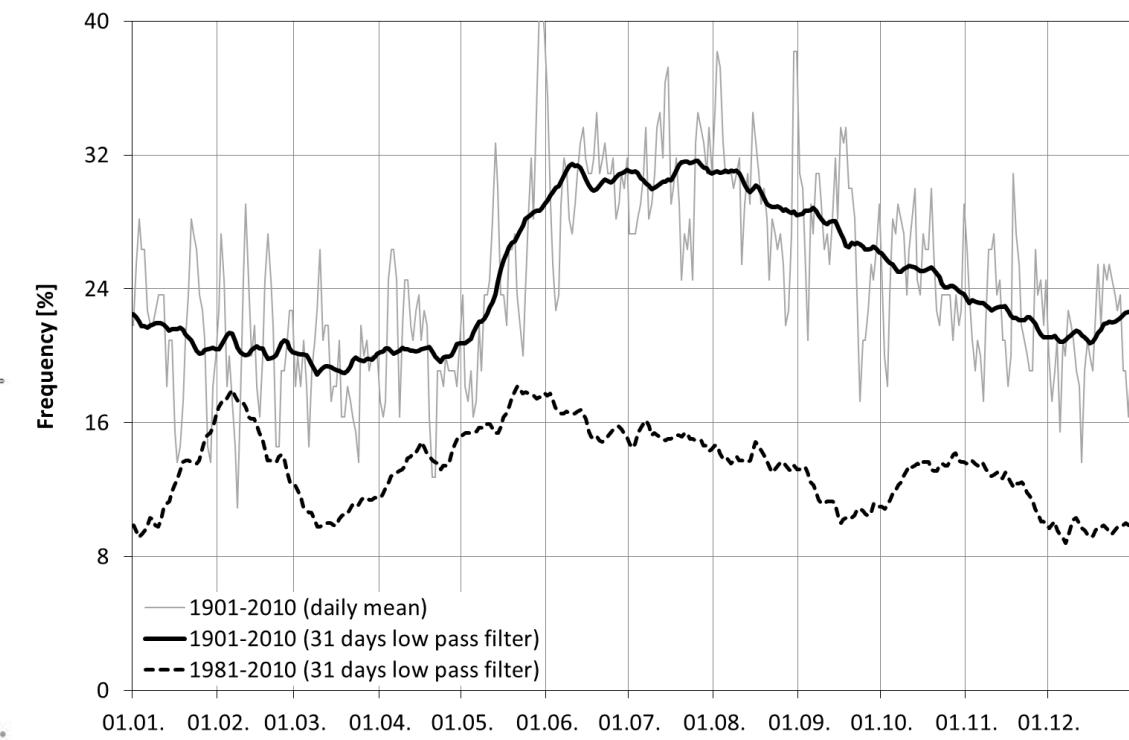
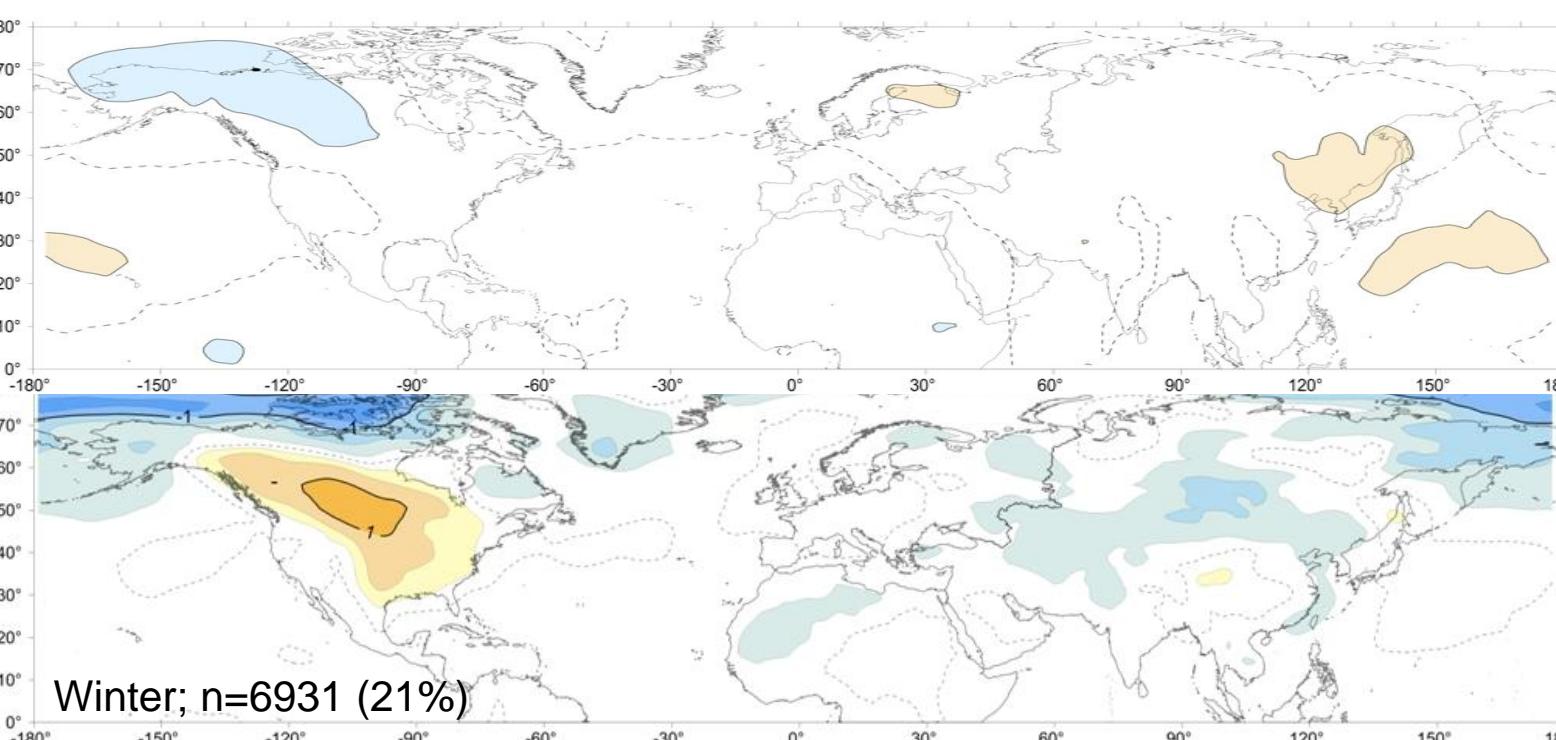
## Circulation Types (CT's)

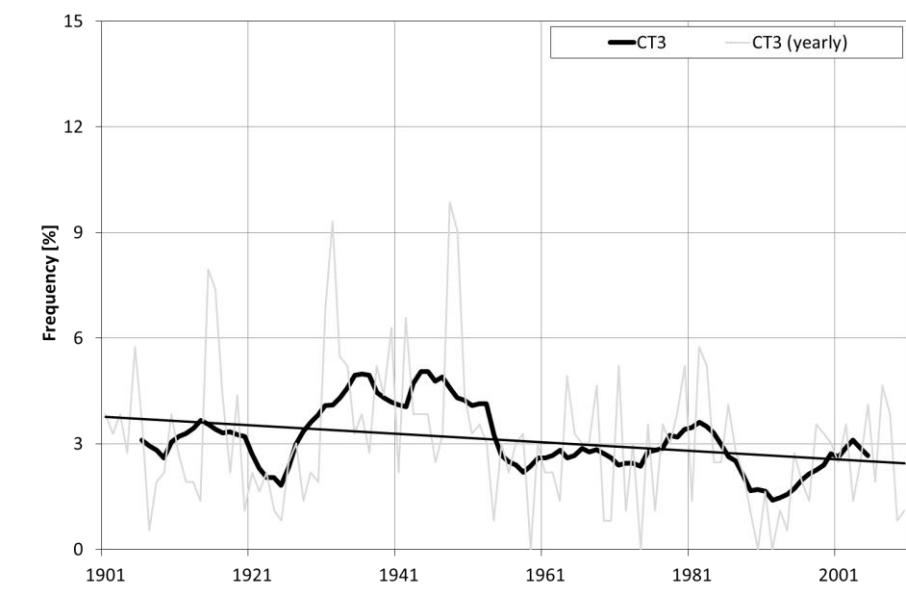
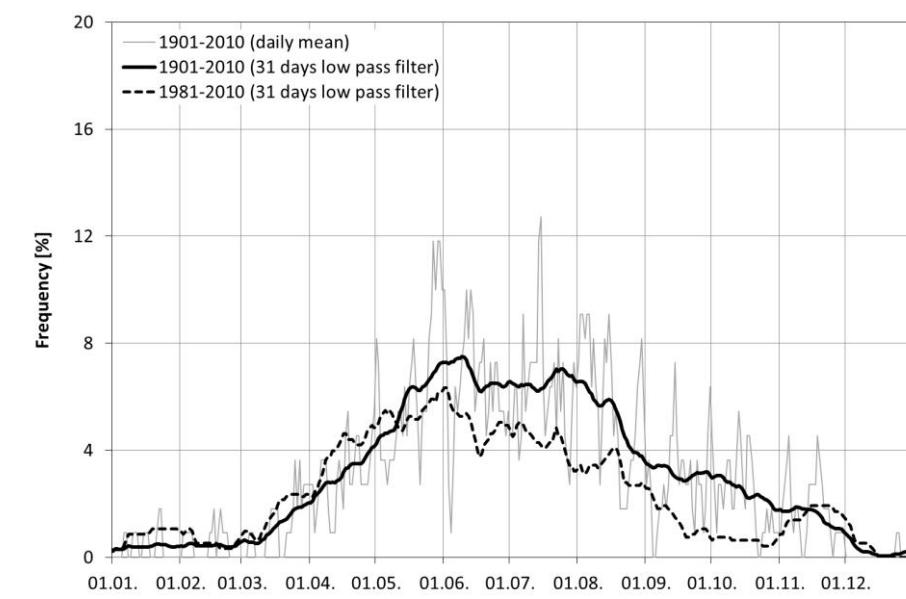
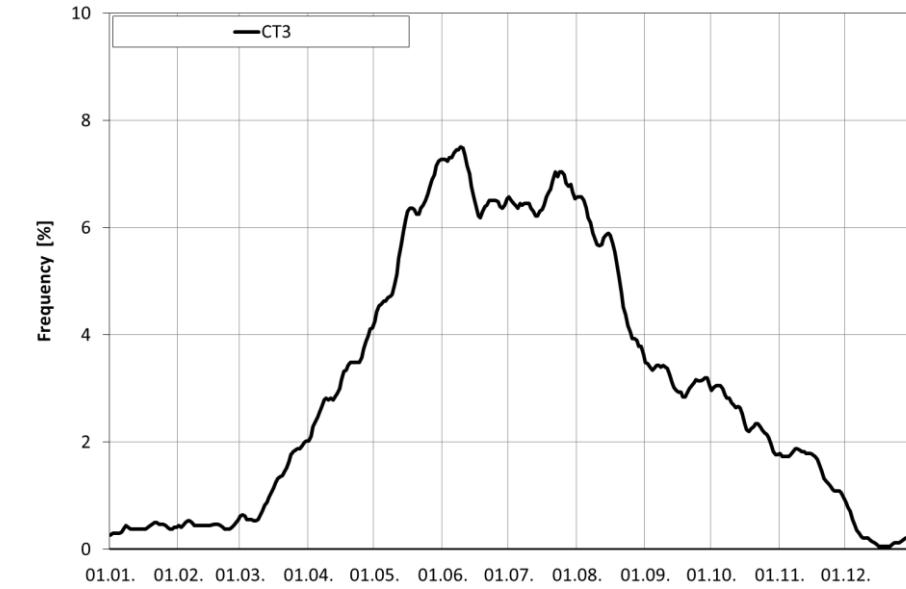
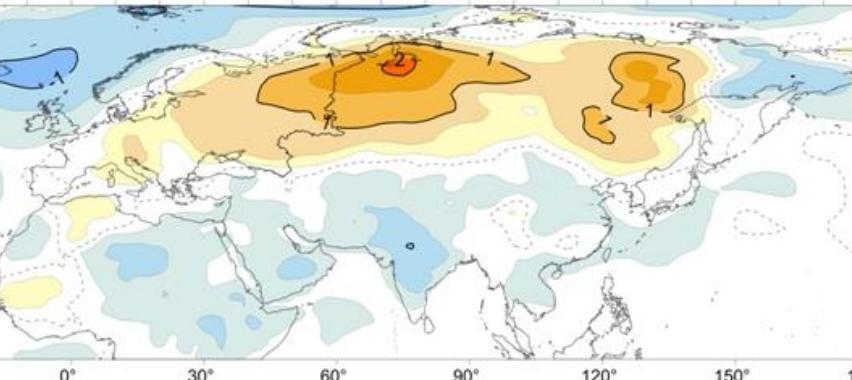
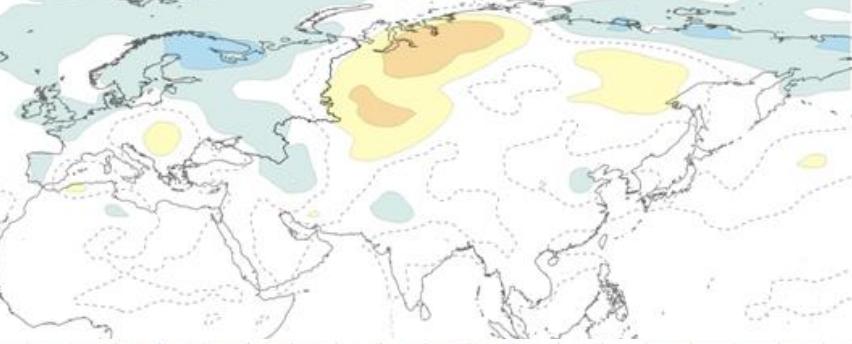
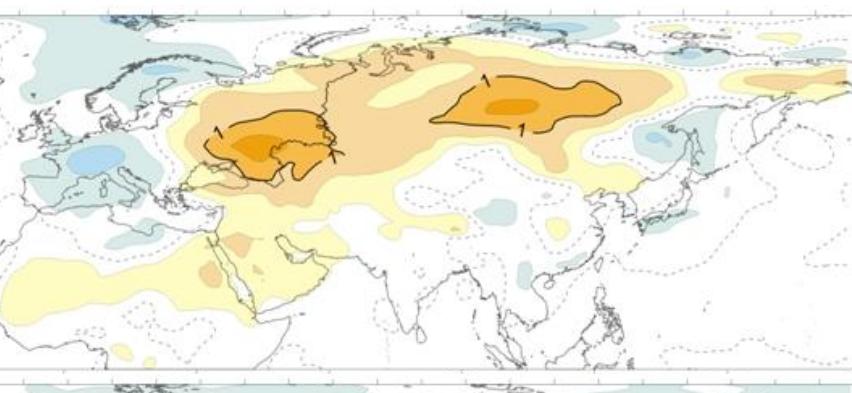
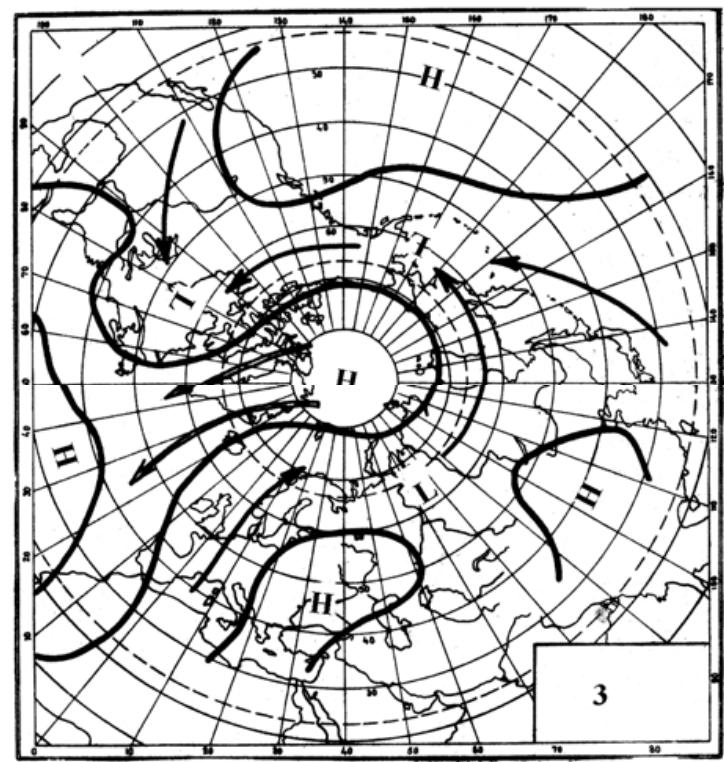
3	3,1%	SHY
4	6,0%	SHY
5	5,4%	WHY
6	1,9%	SHY
7	8,2%	Year

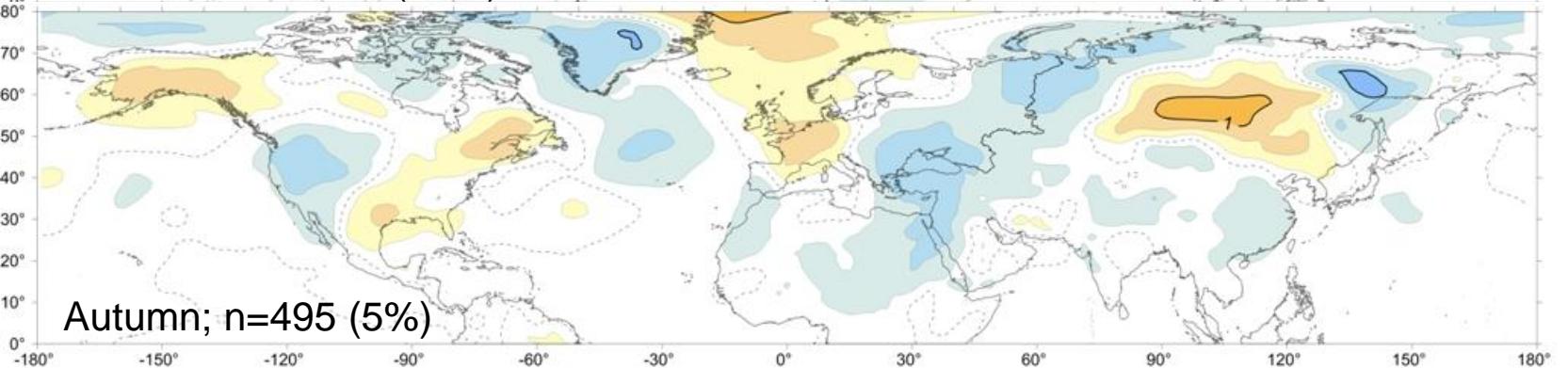
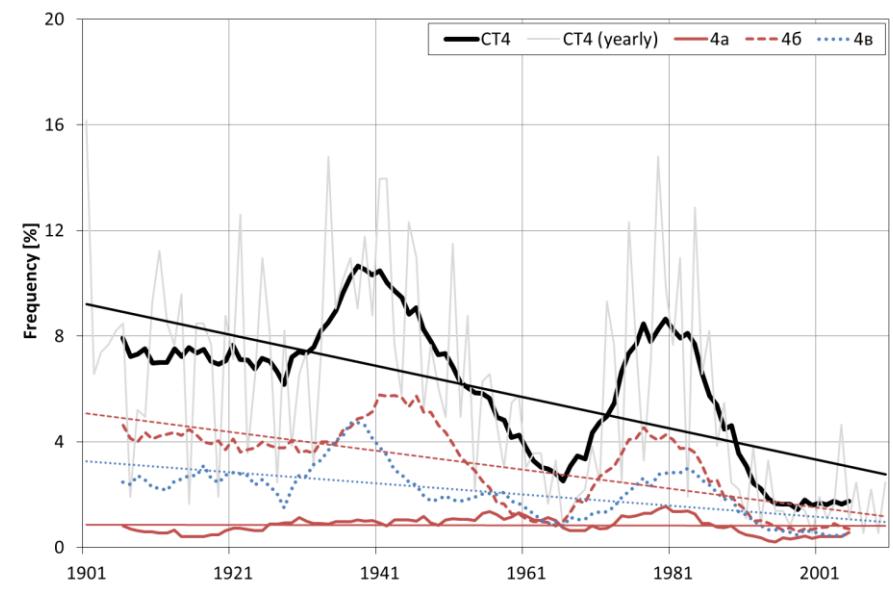
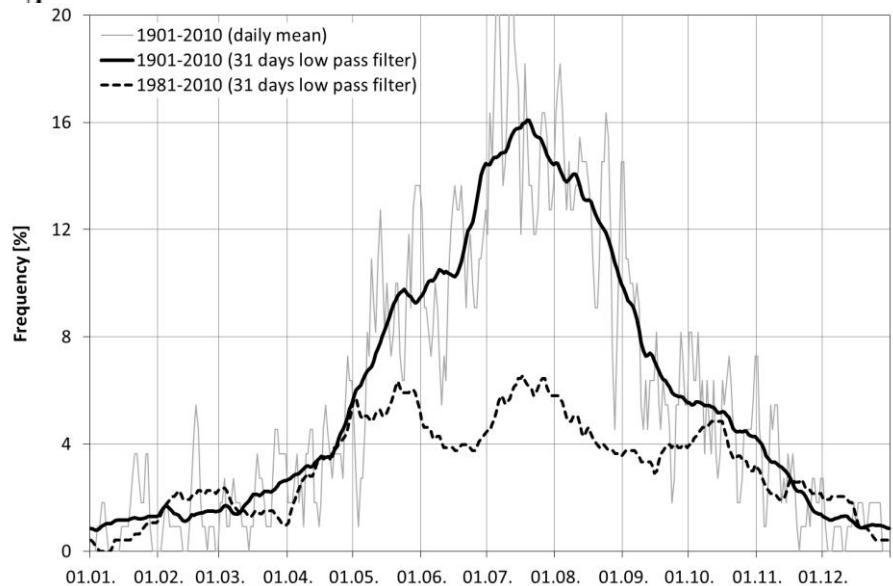
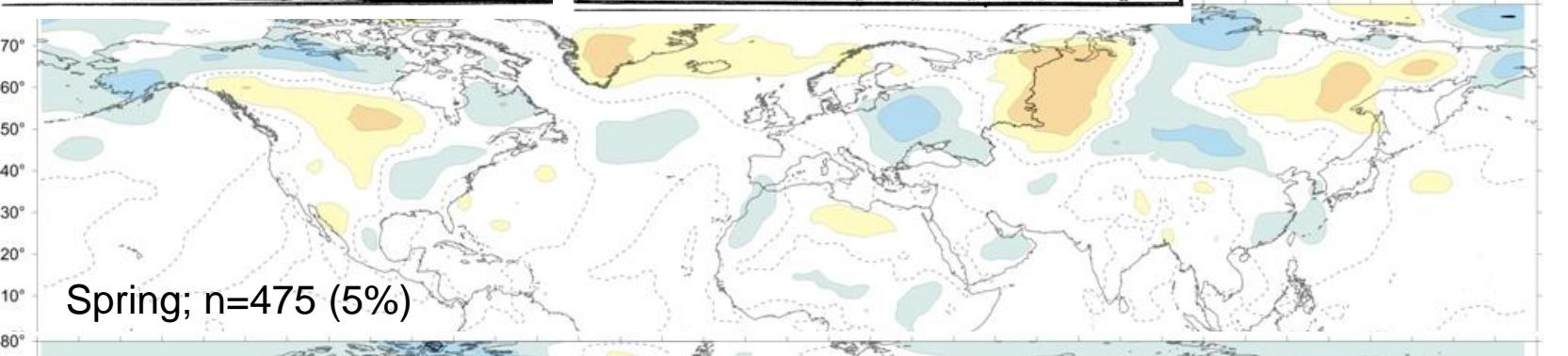
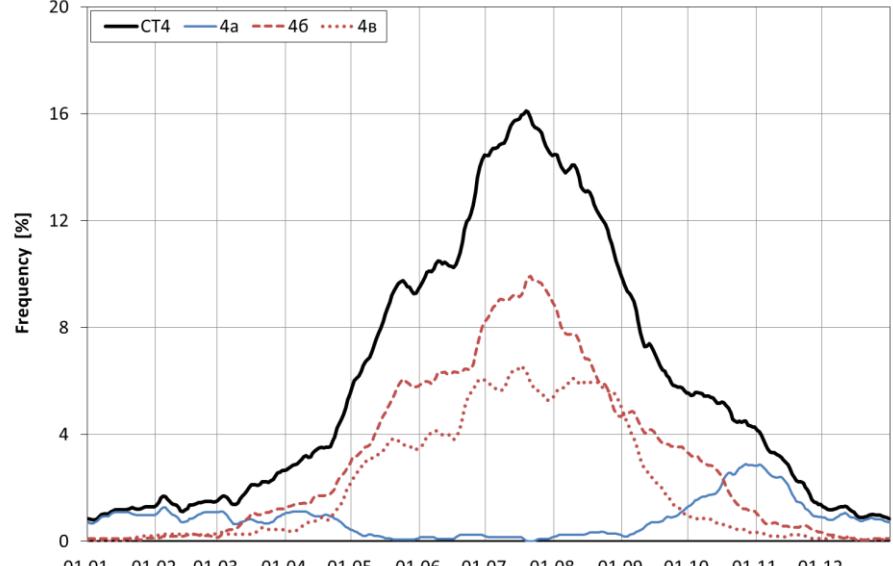
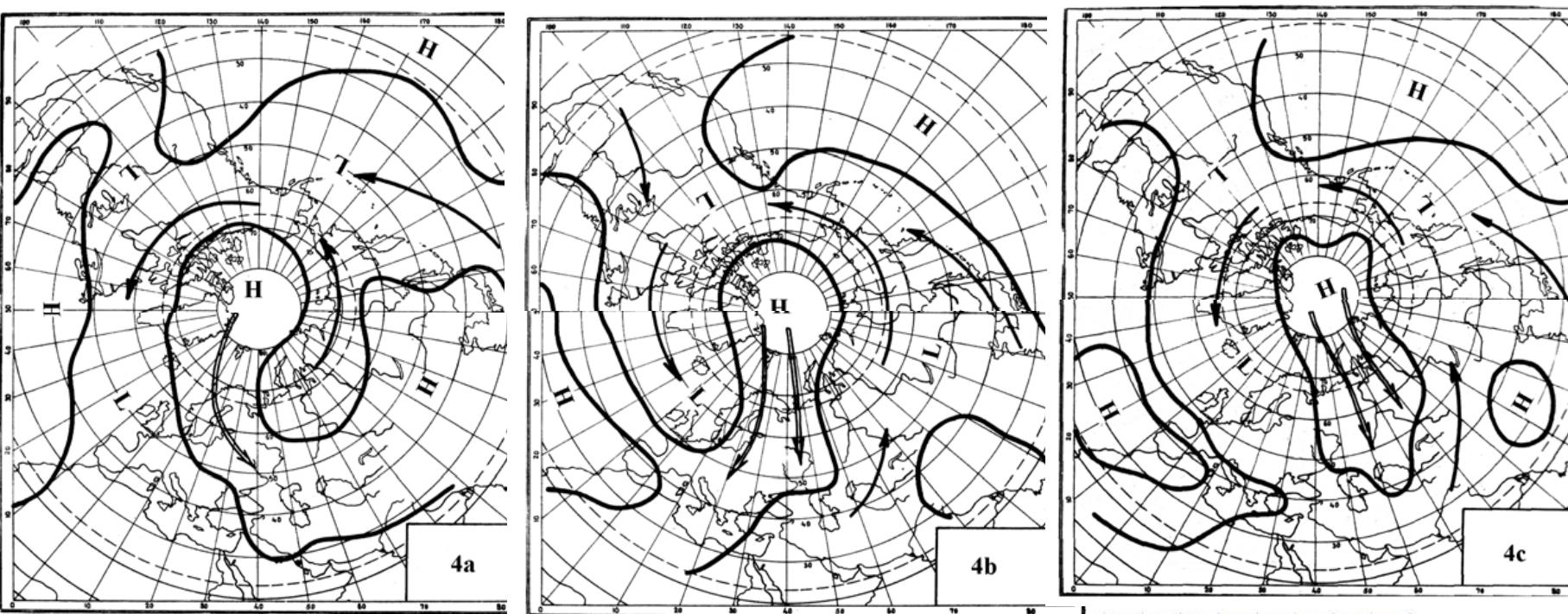
## Elementary Circulation Mechanisms (ECM's)

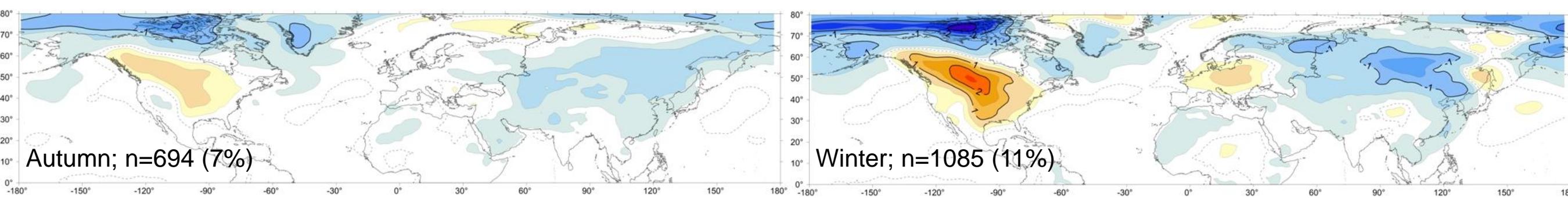
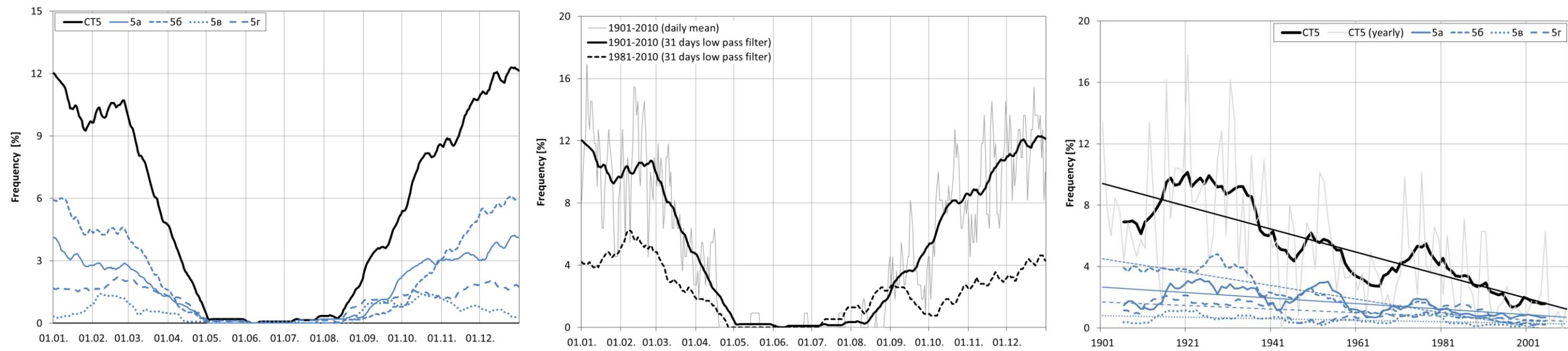
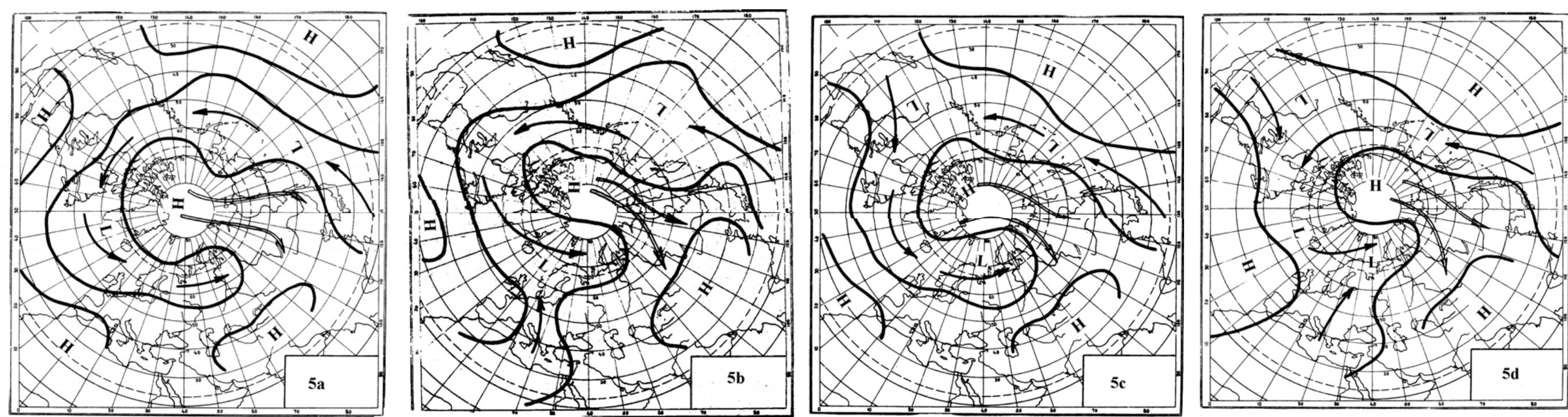
3	3,1%	SHY
4а	0,8%	WHY
4б	3,2%	SHY
4в	2,0%	SHY
5а	1,6%	WHY
5б	2,2%	WHY
5в	0,5%	WHY
5г	1,0%	WHY
6	1,9%	SHY
7аз	2,7%	WHY
7ал	2,4%	SHY
7бз	1,7%	WHY
7бл	1,4%	SHY

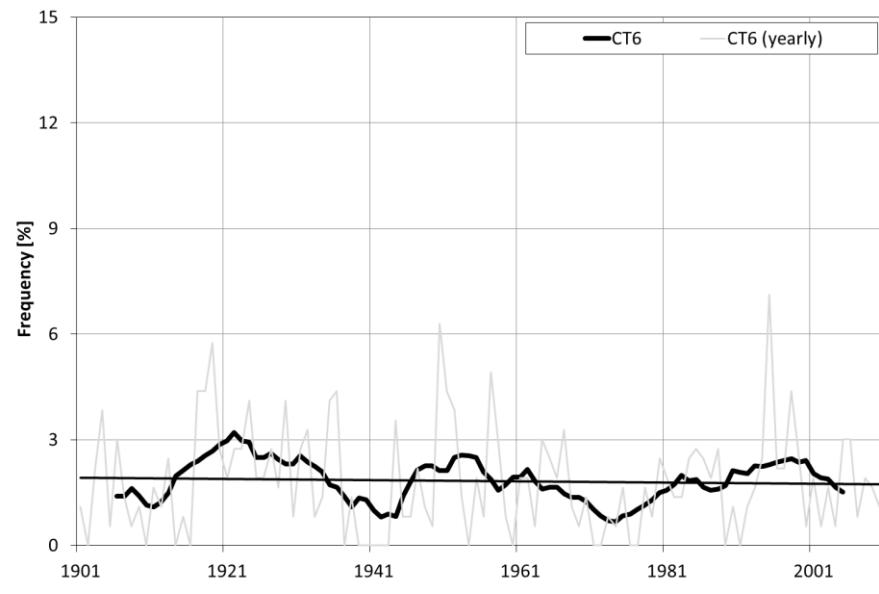
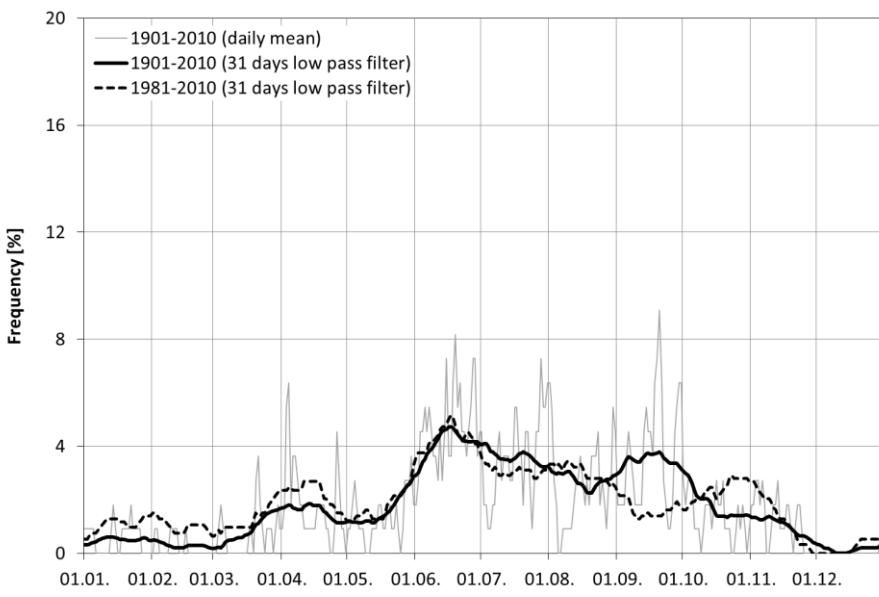
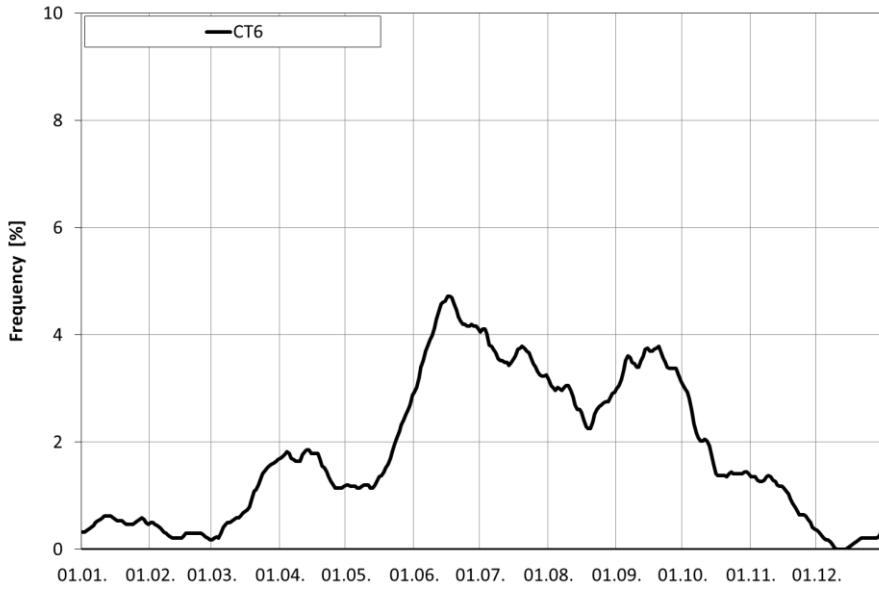
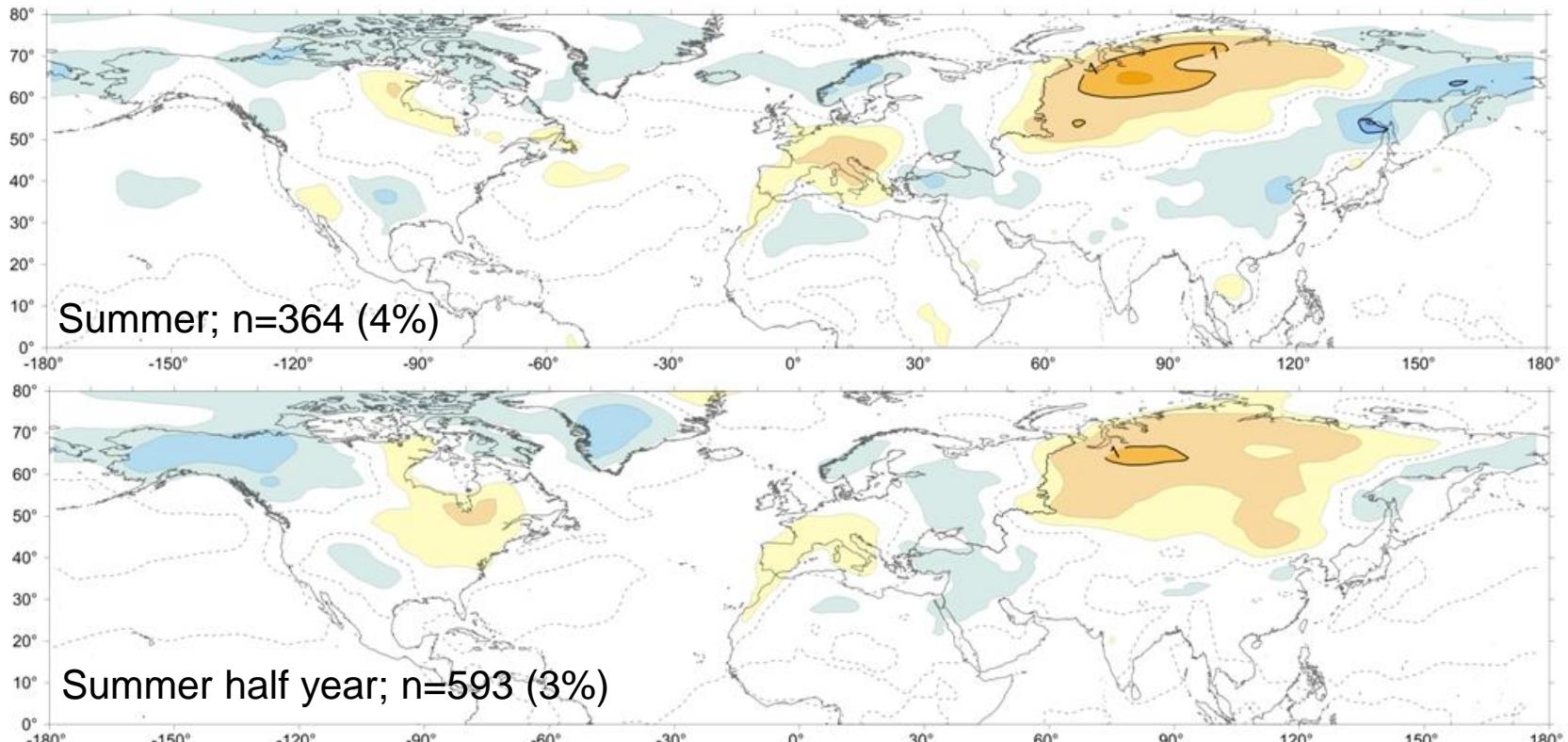
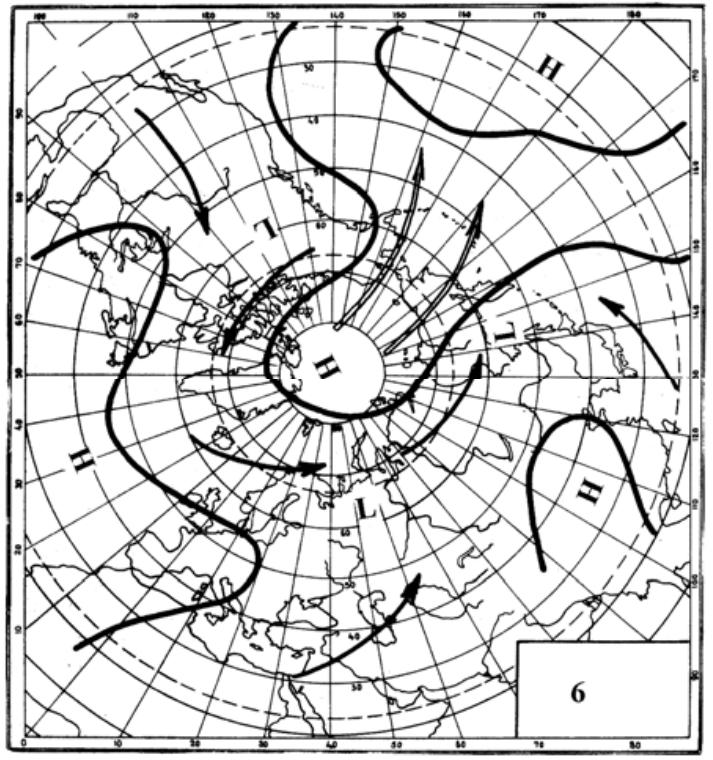
# Zonally Disturbed Circulation Group (ZD)

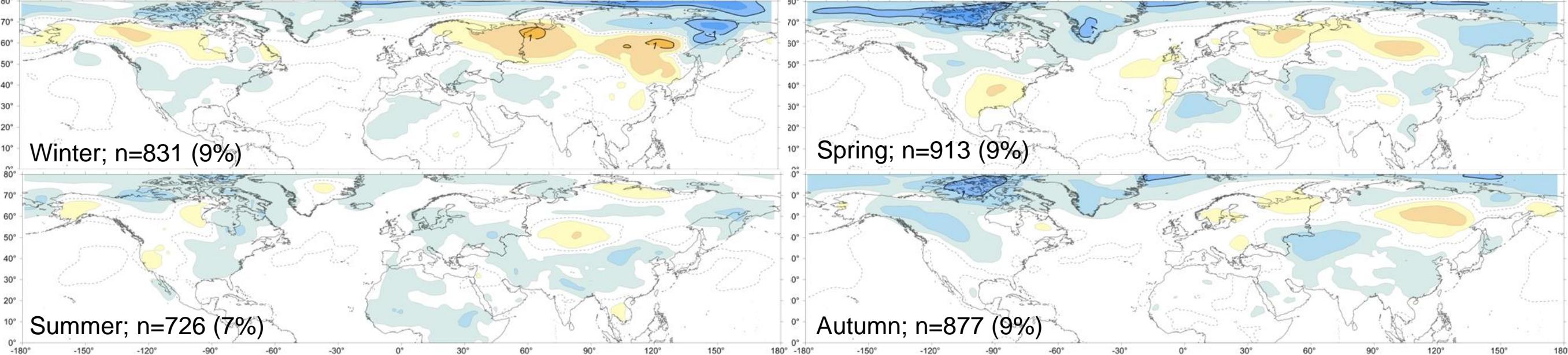
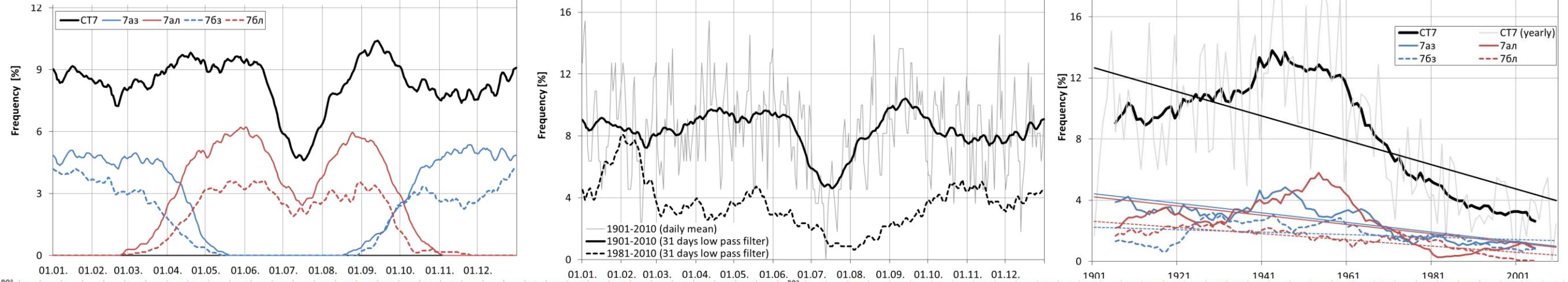
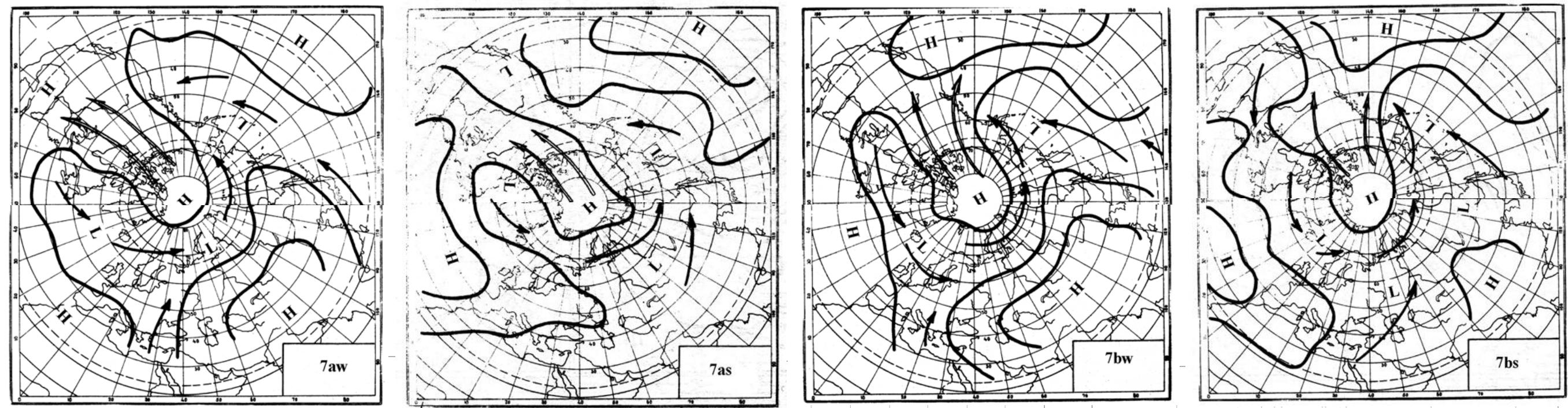




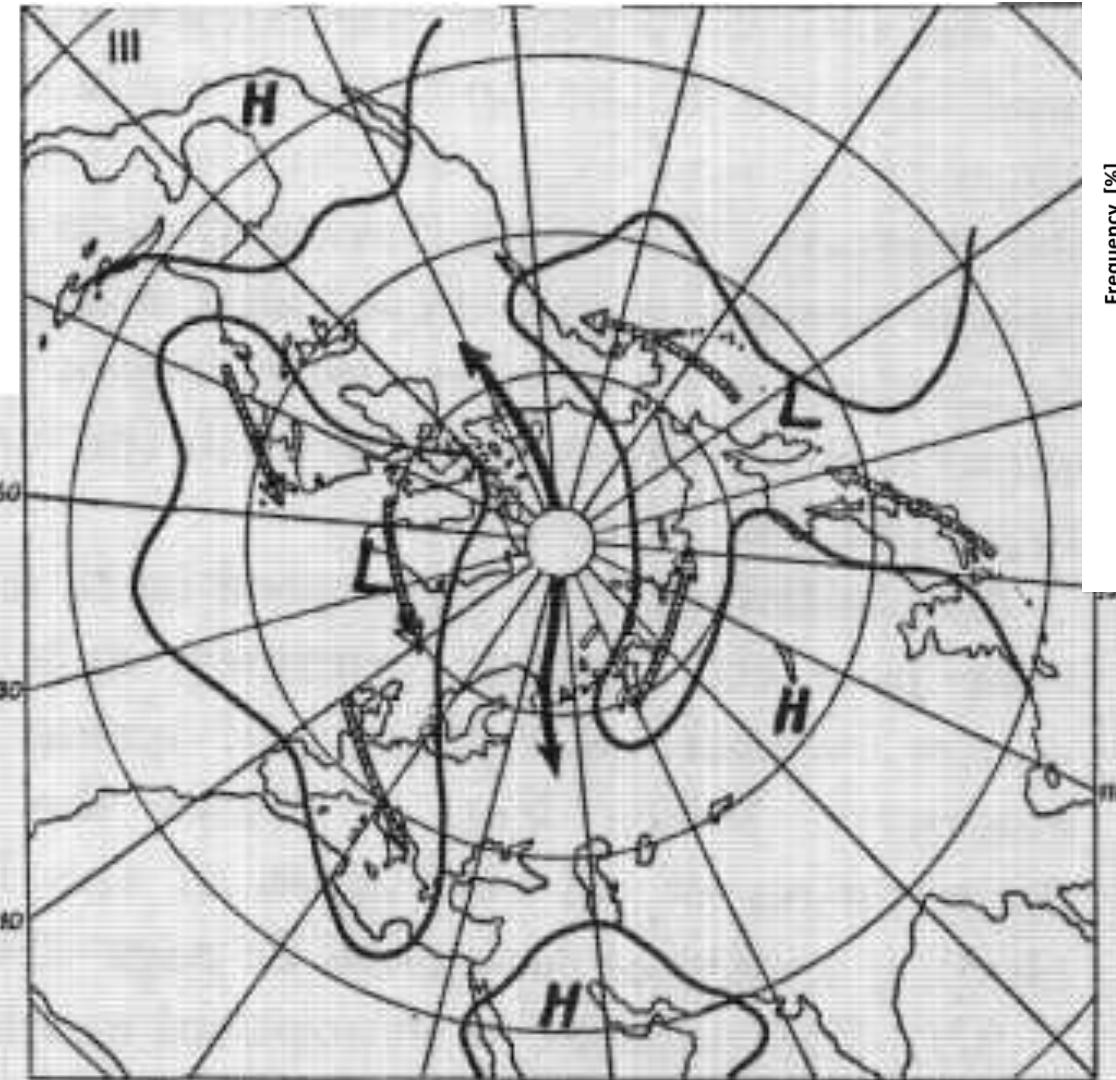




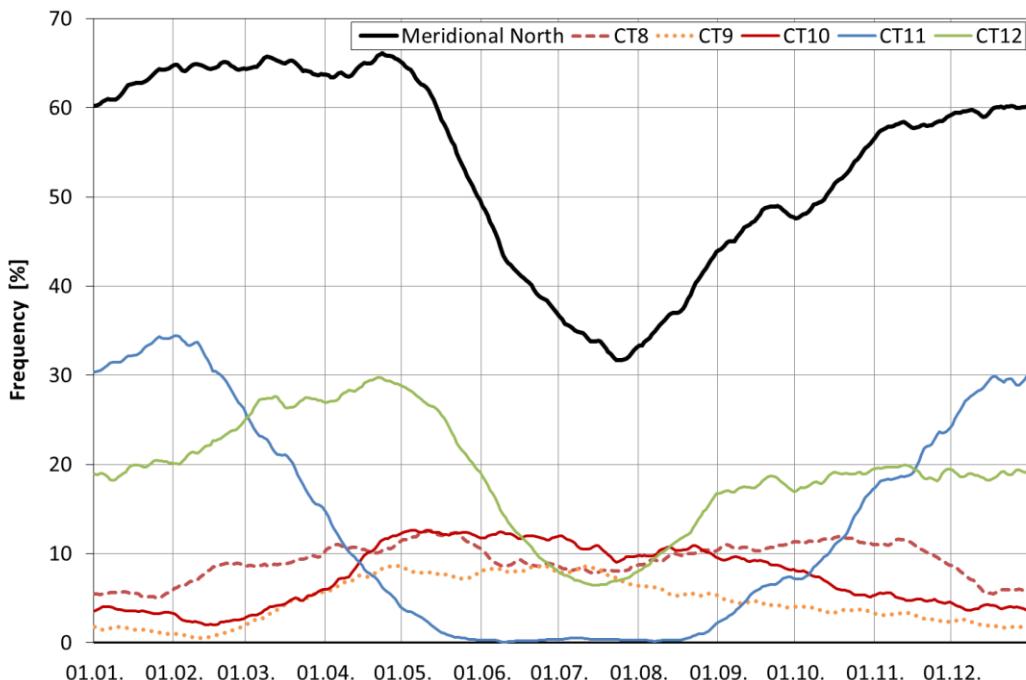




# Meridional North Circulation Group (MN)



Anticyclonic conditions at Arctic region;  
2-4 southern cyclone outlets in 2-4 (of 6)  
sectors; two to four blockings over the  
hemisphere



## Circulation Types (CT's)

8	9,3%	Year
9	4,8%	(SHY)
10	7,3%	(SHY)
11	13,2%	WHY
12	19,3%	Year

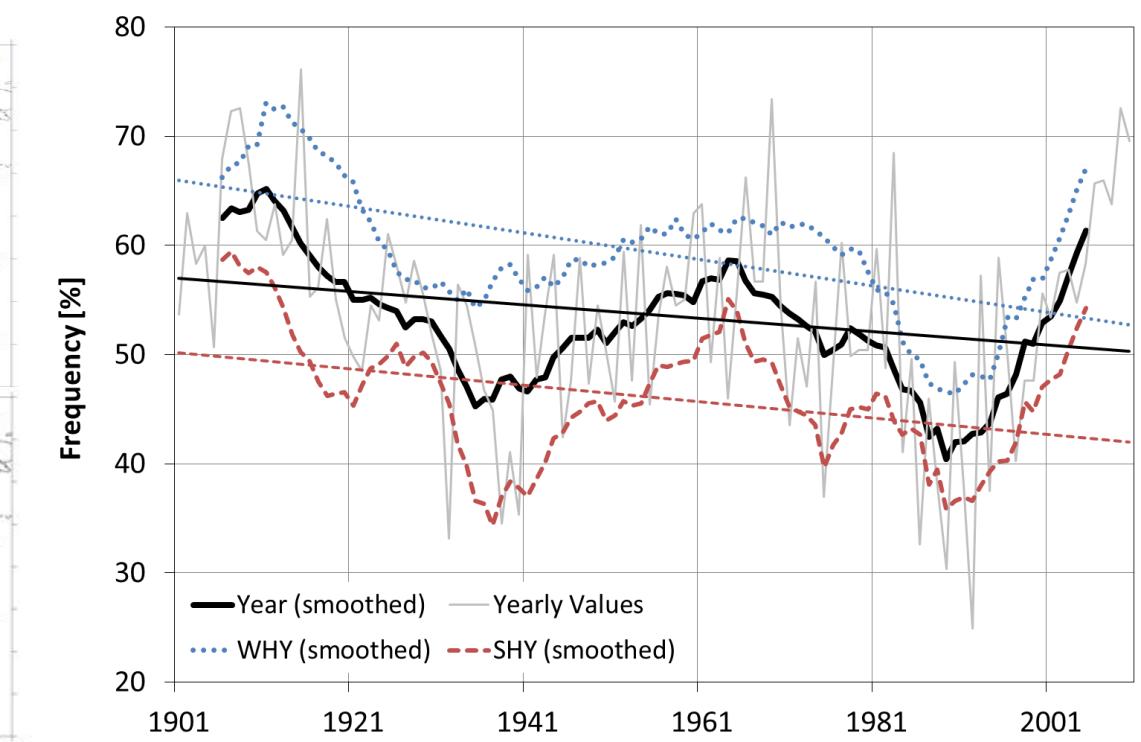
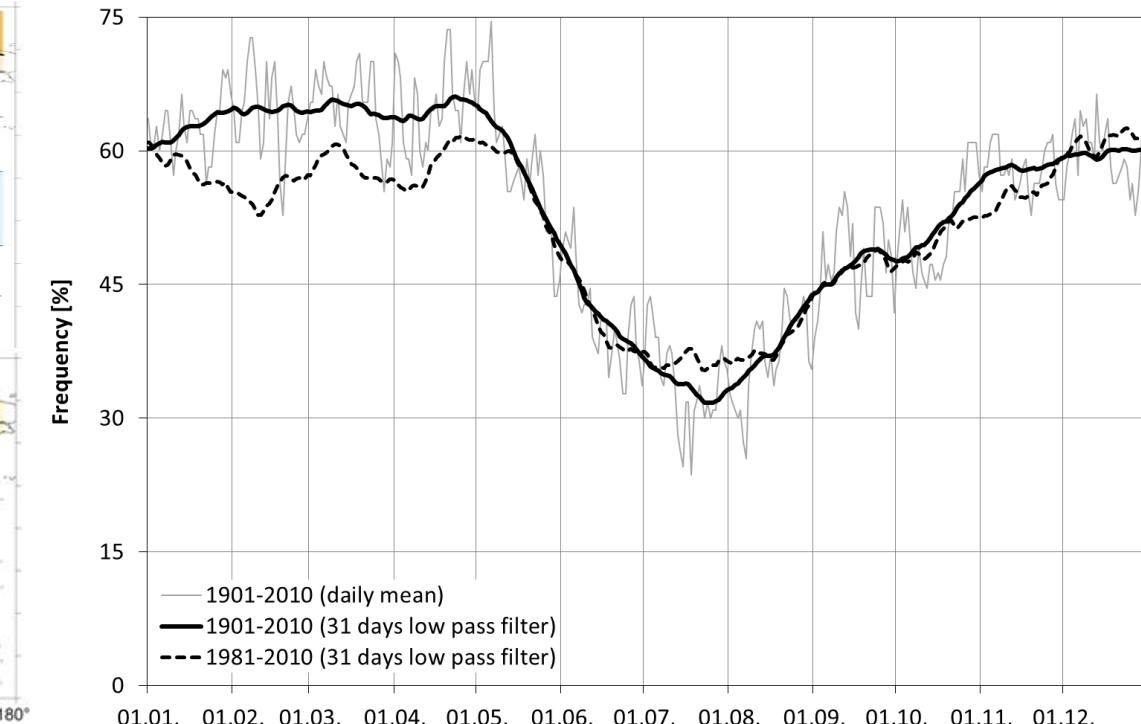
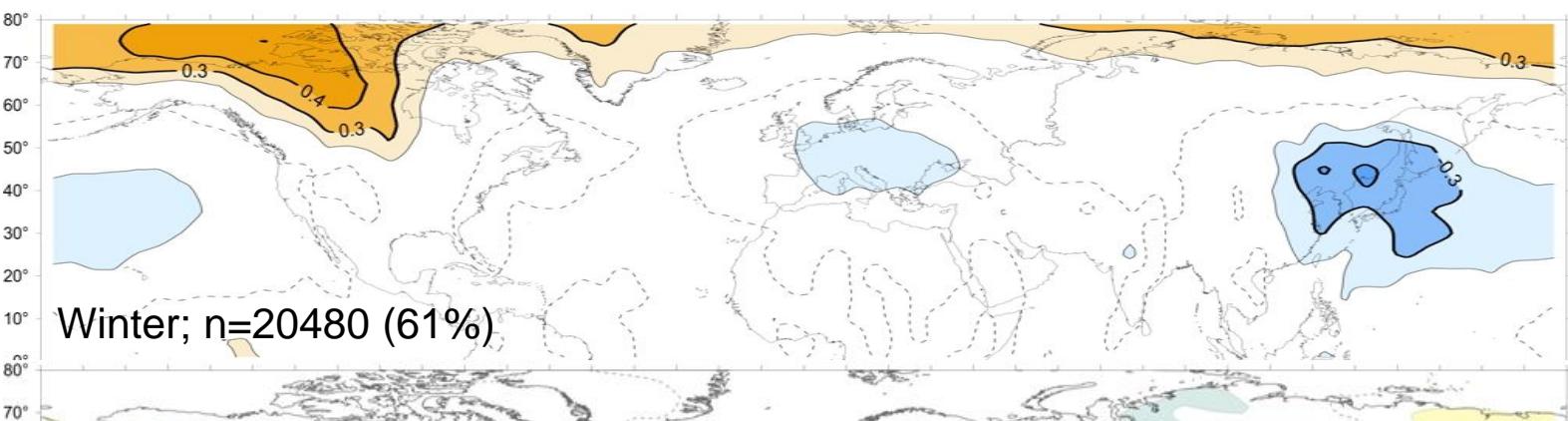
## Elementary Circulation Mechanisms (ECM's)

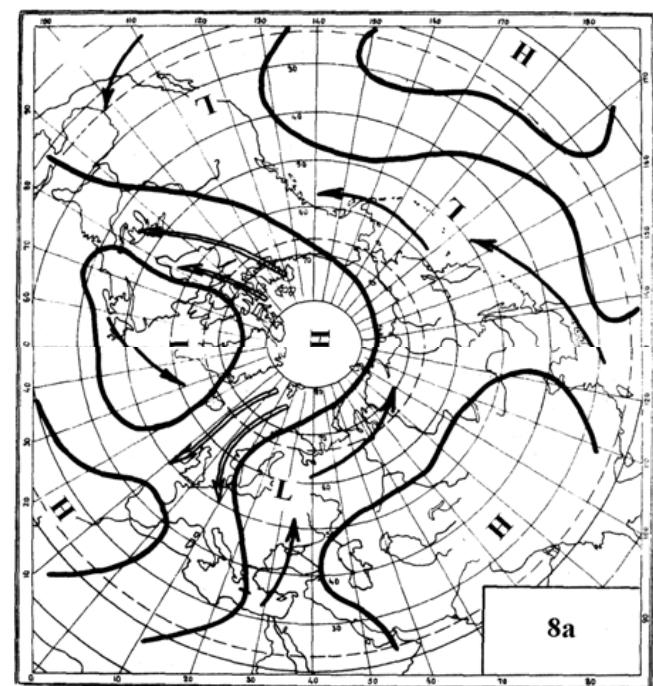
8а	3,3%	
8бз	1,0%	
8бл	0,9%	
8вз	0,6%	
8вл	0,7%	
8гз	1,6%	
8гл	1,2%	
9а	3,4%	SHY
9б	1,4%	Year
10а	4,3%	Year
10б	3,0%	SHY

## Elementary Circulation Mechanisms (ECM's)

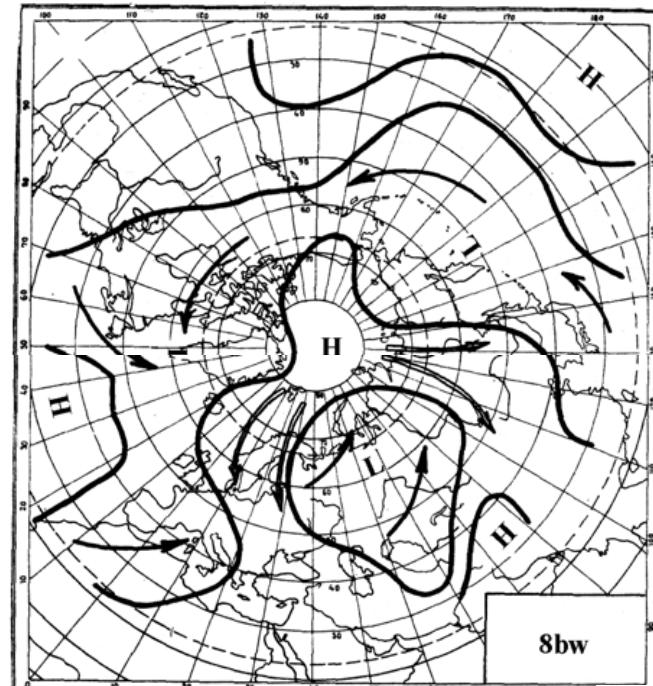
11а	6,6%	WHY
11б	3,0%	WHY
11в	1,9%	WHY
11г	1,7%	WHY
12а	5,4%	
12бз	4,5%	
12бл	2,4%	
12вз	2,9%	
12вл	1,7%	
12г	2,4%	

# Meridional North Circulation Group (MN)

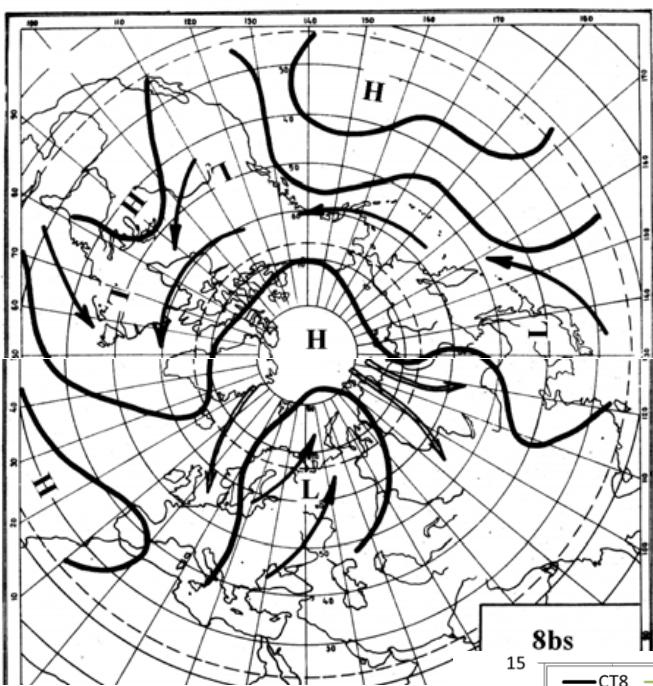




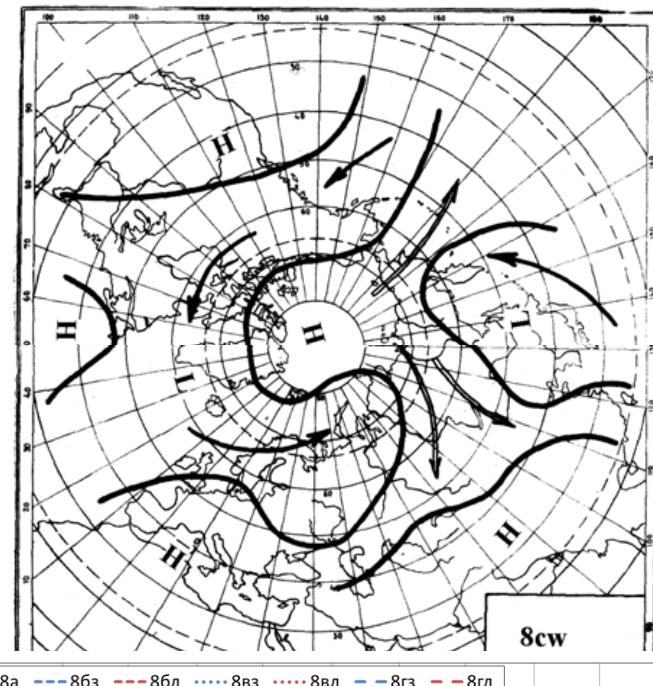
8a



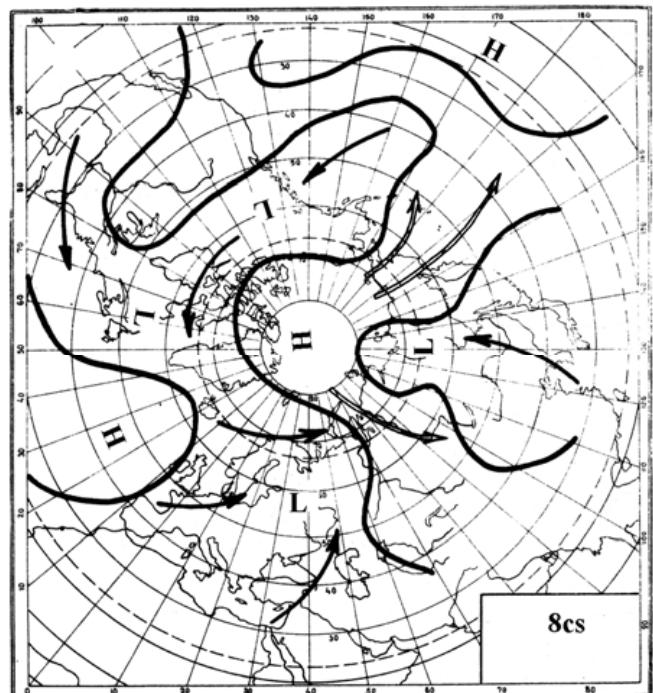
8bw



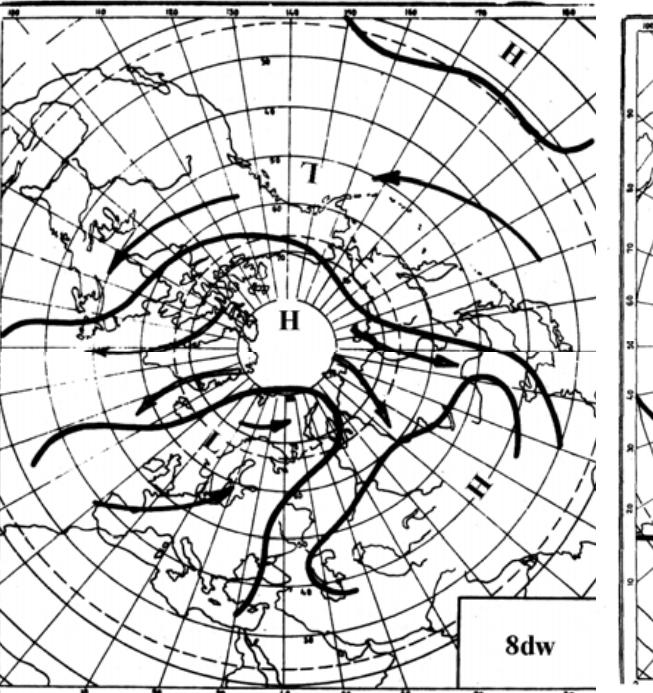
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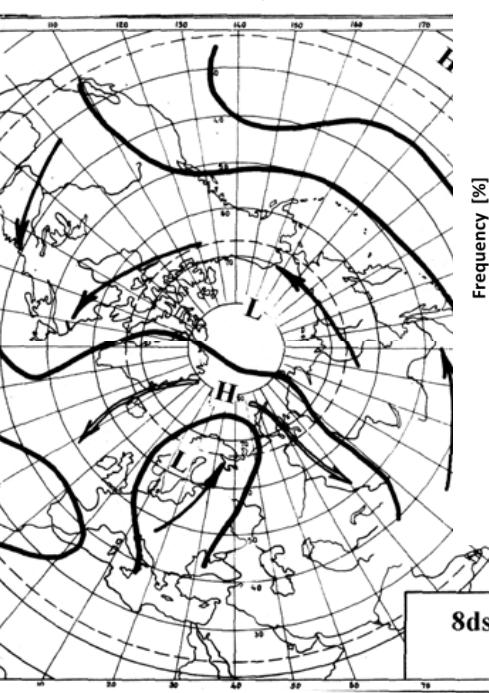
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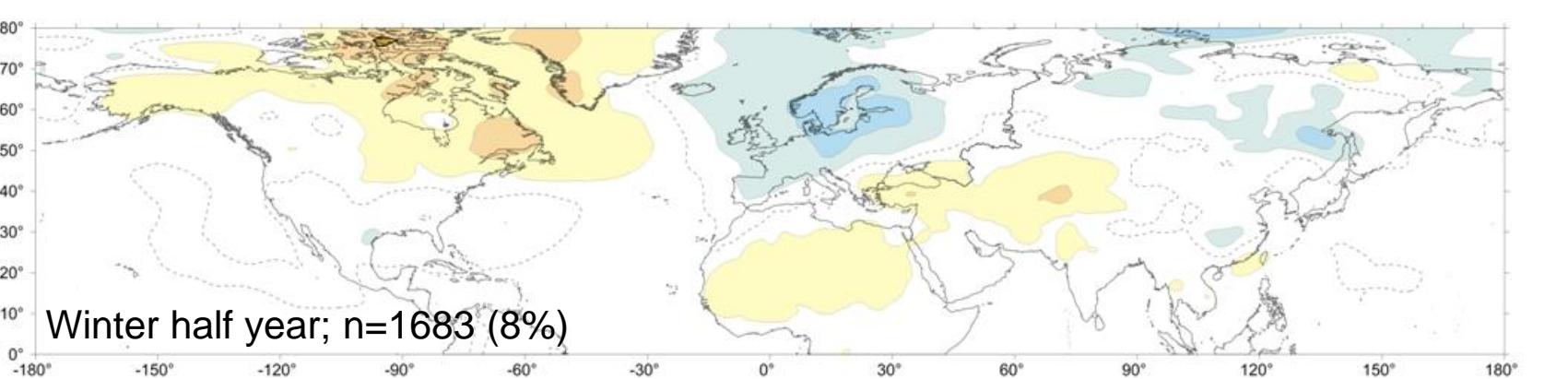
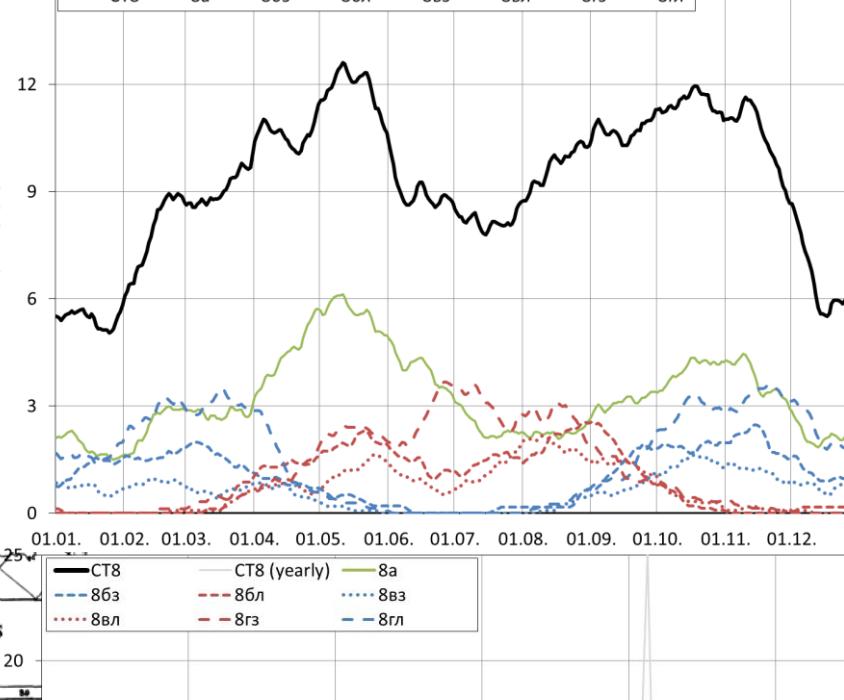
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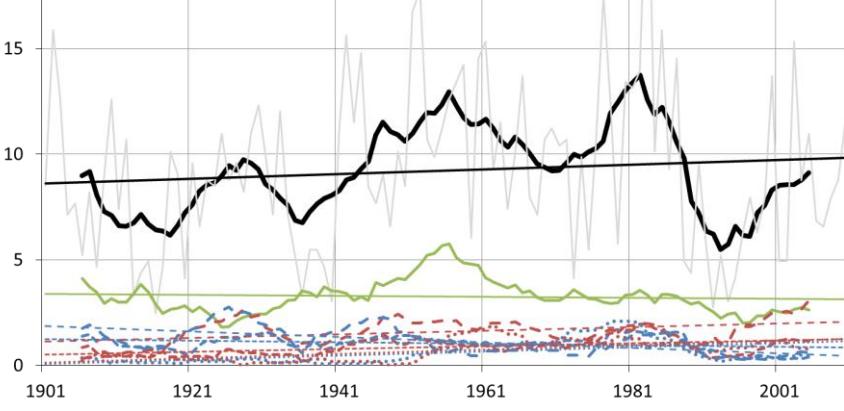
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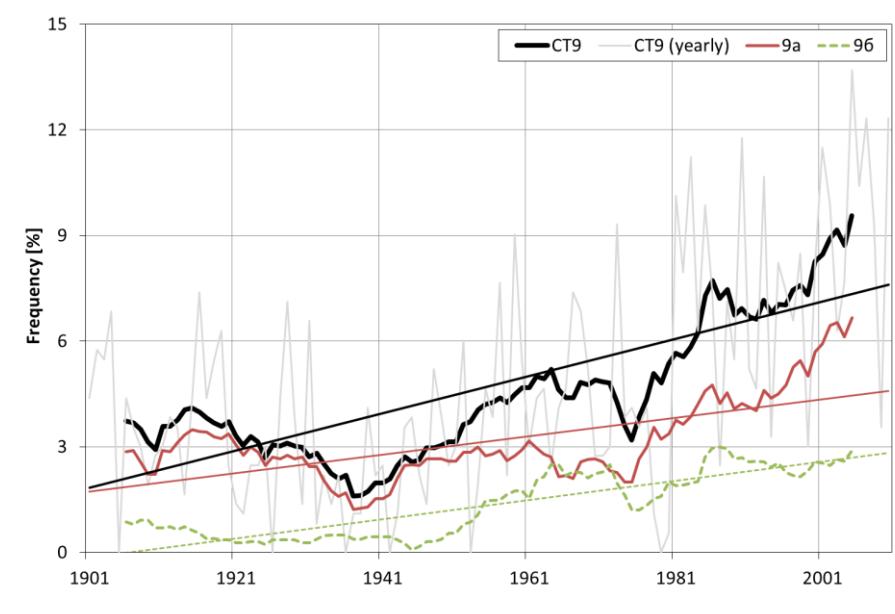
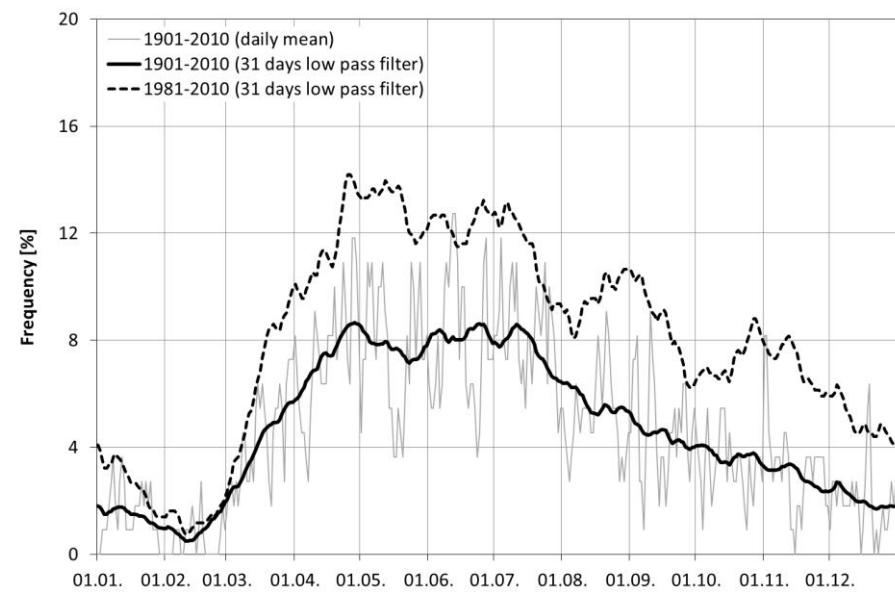
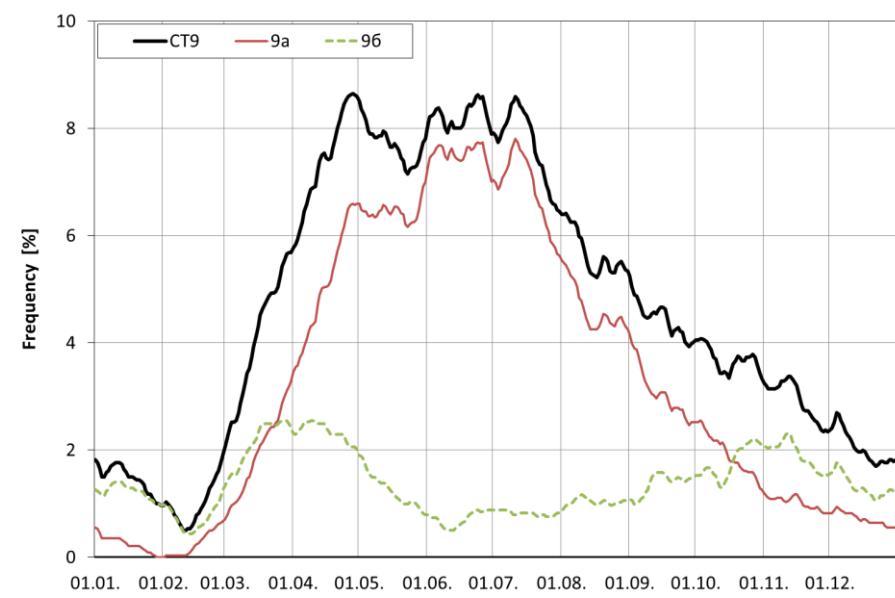
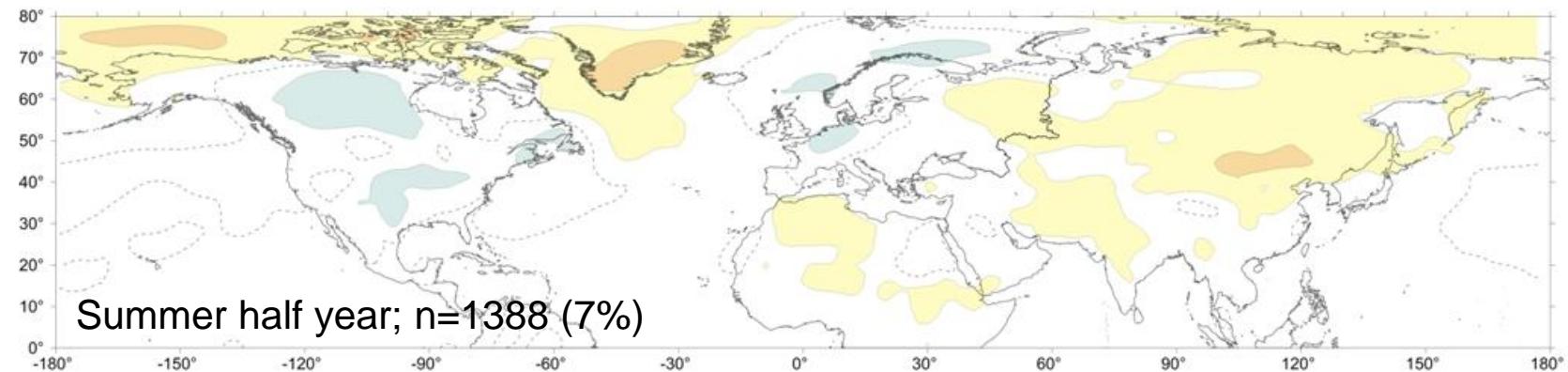
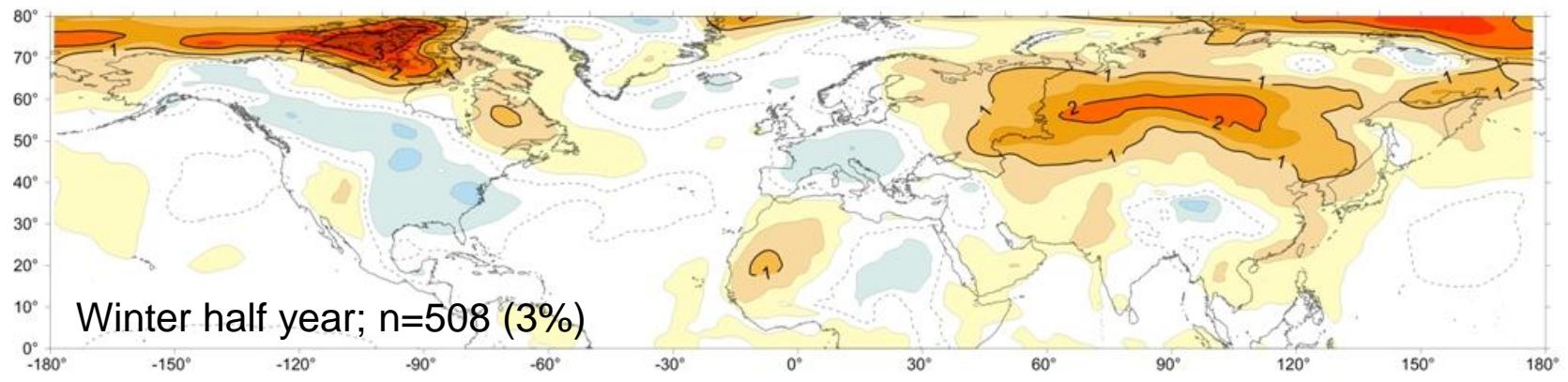
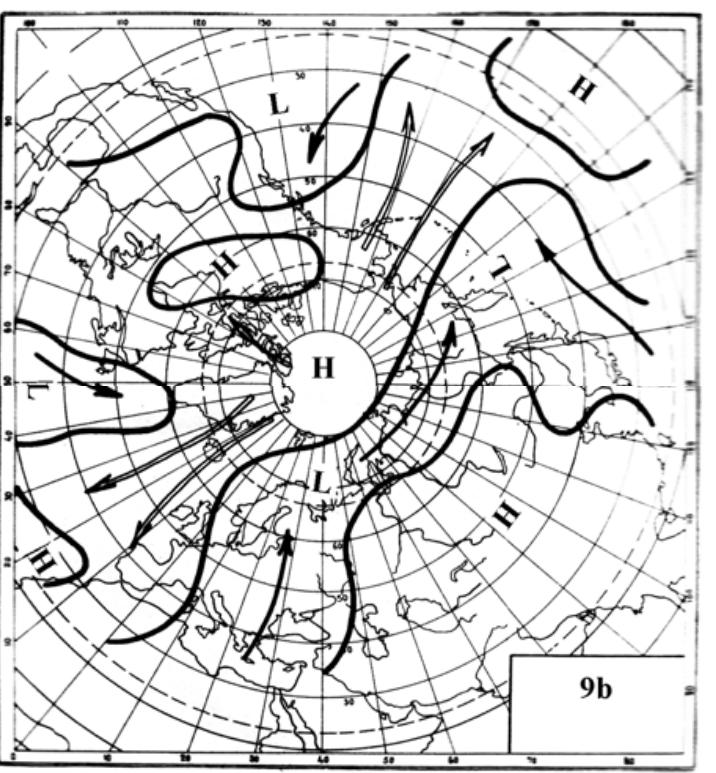
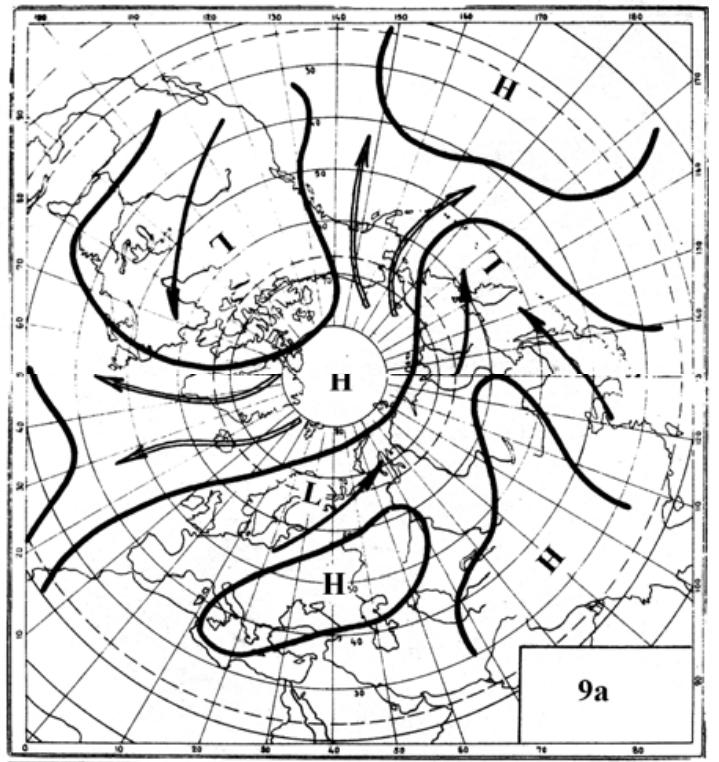


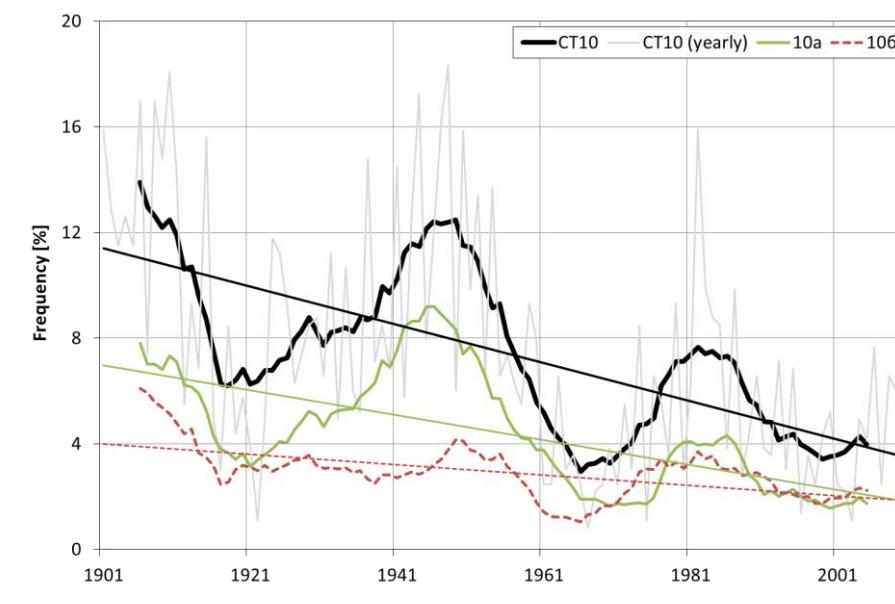
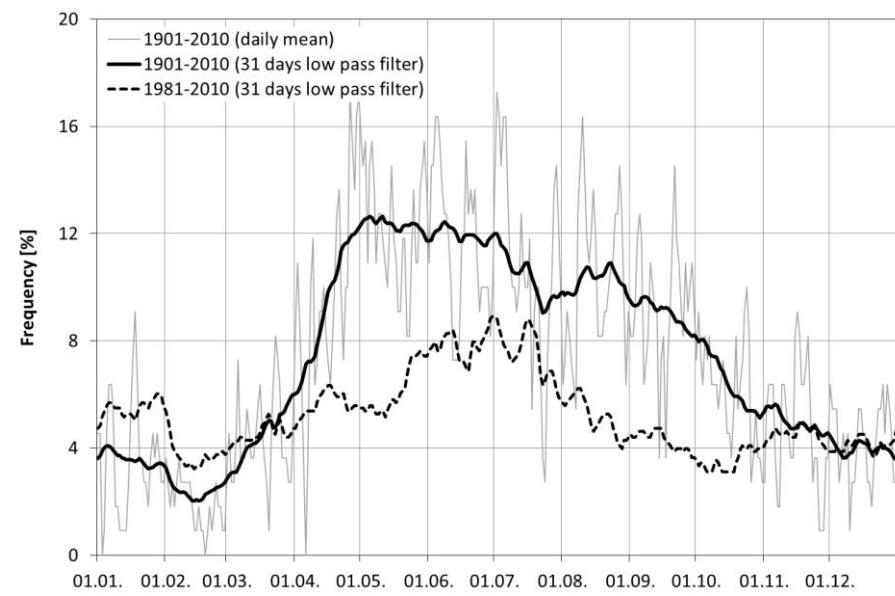
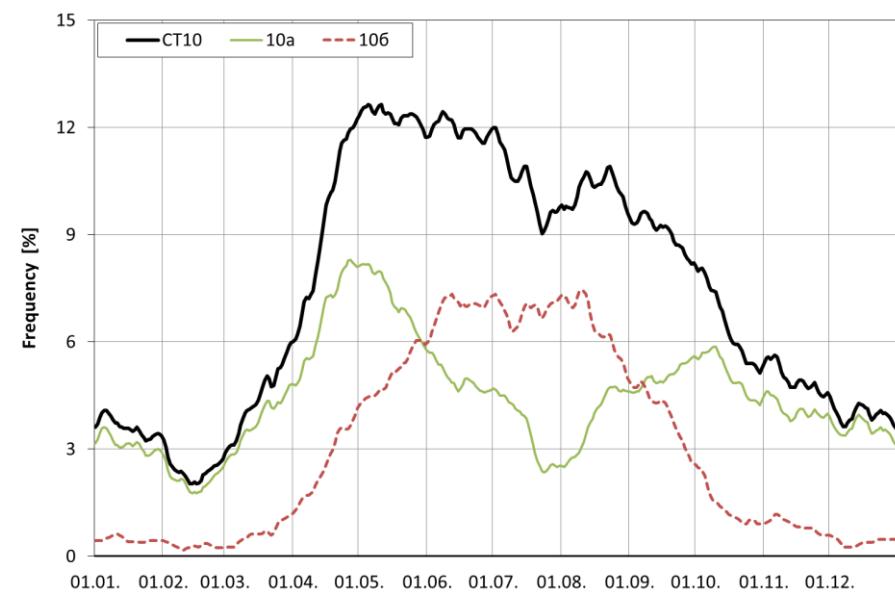
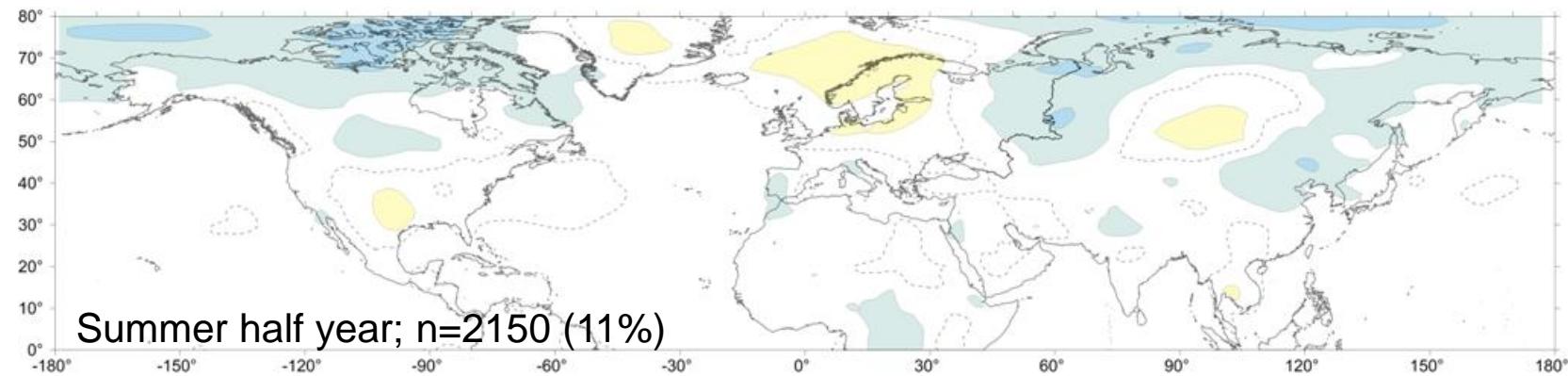
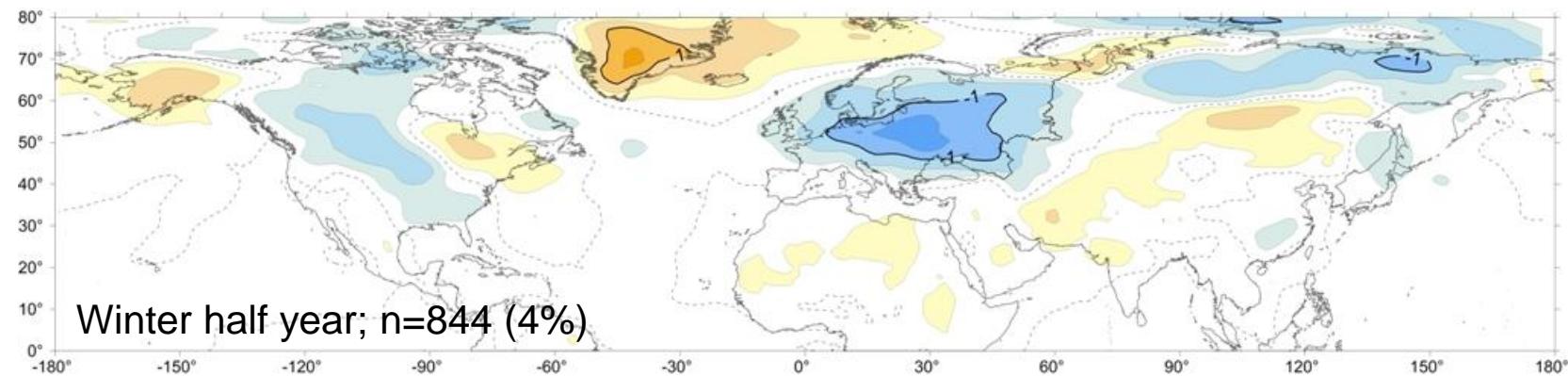
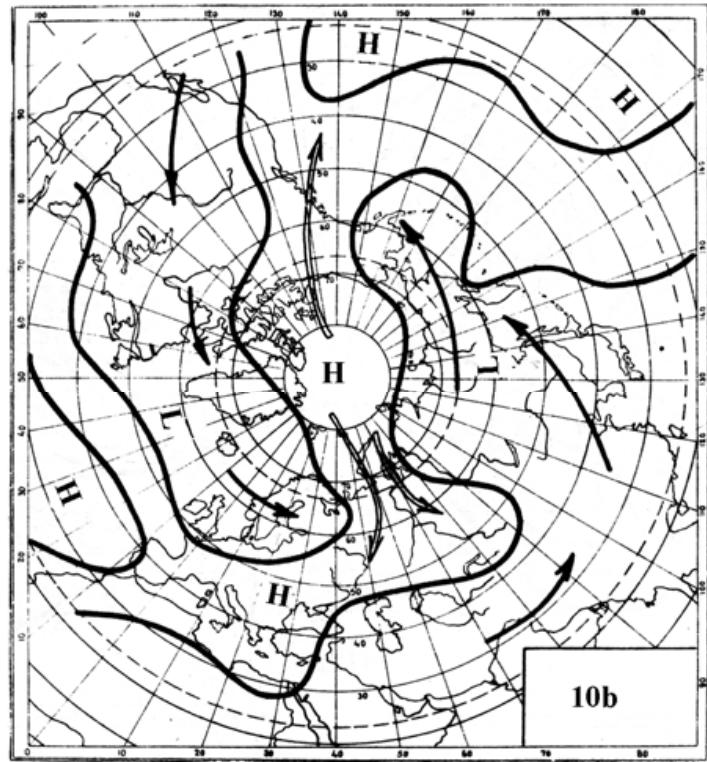
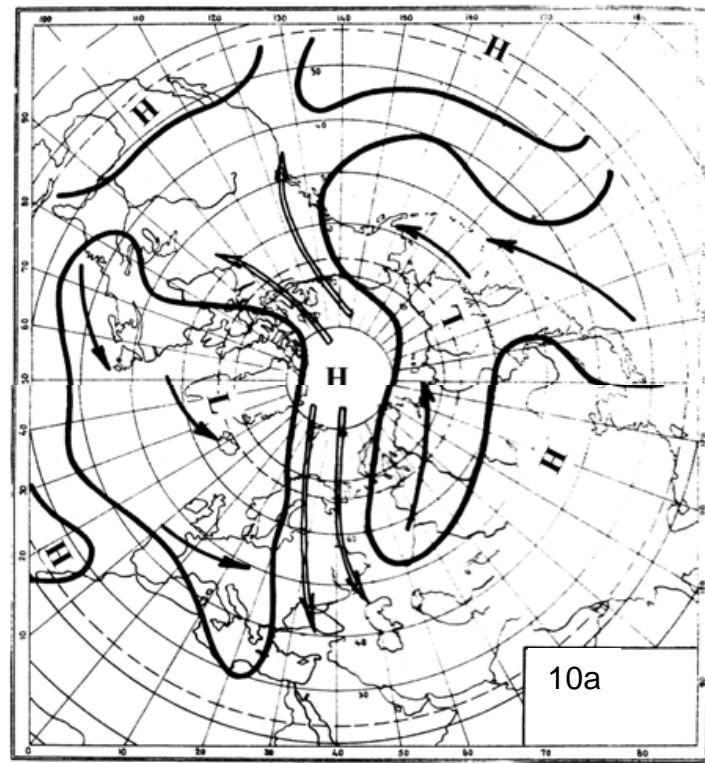
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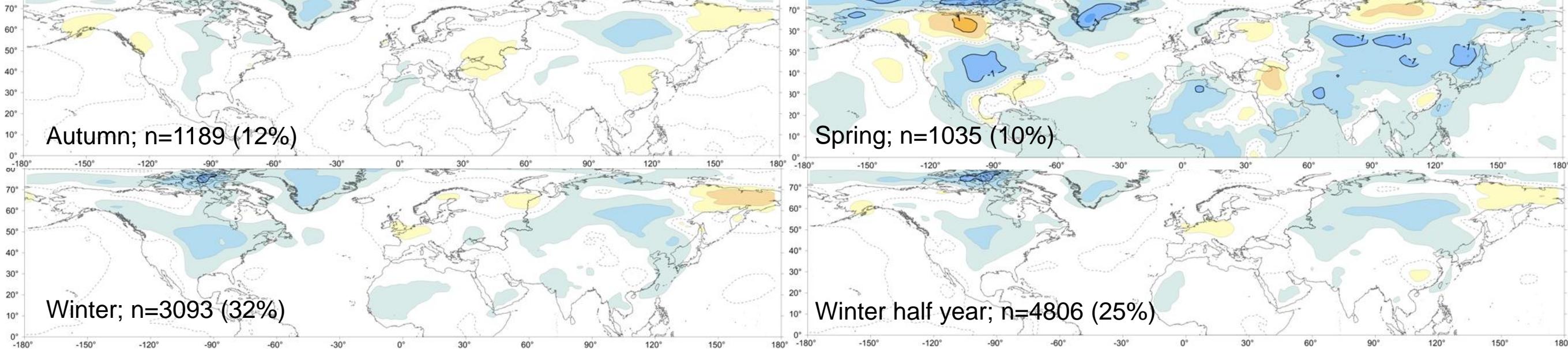
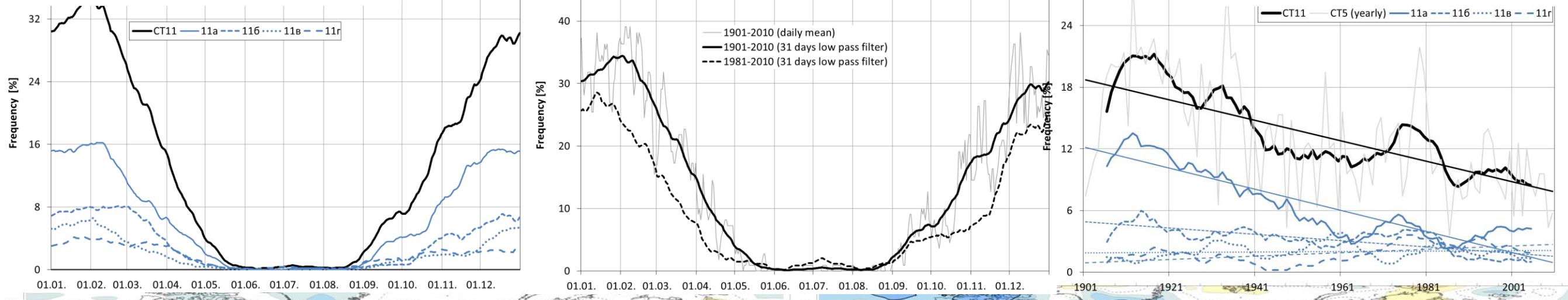
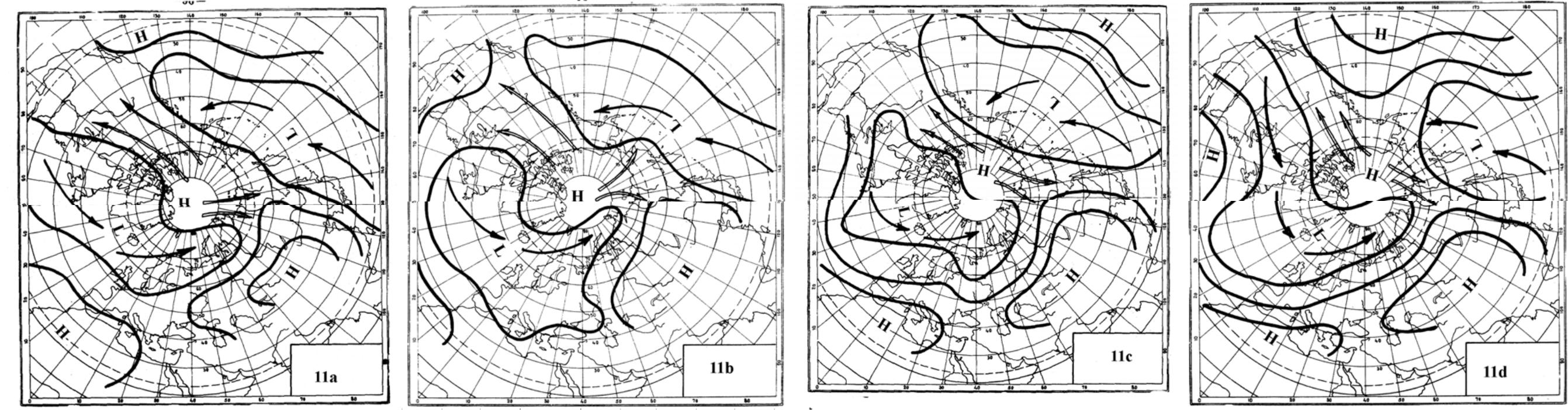


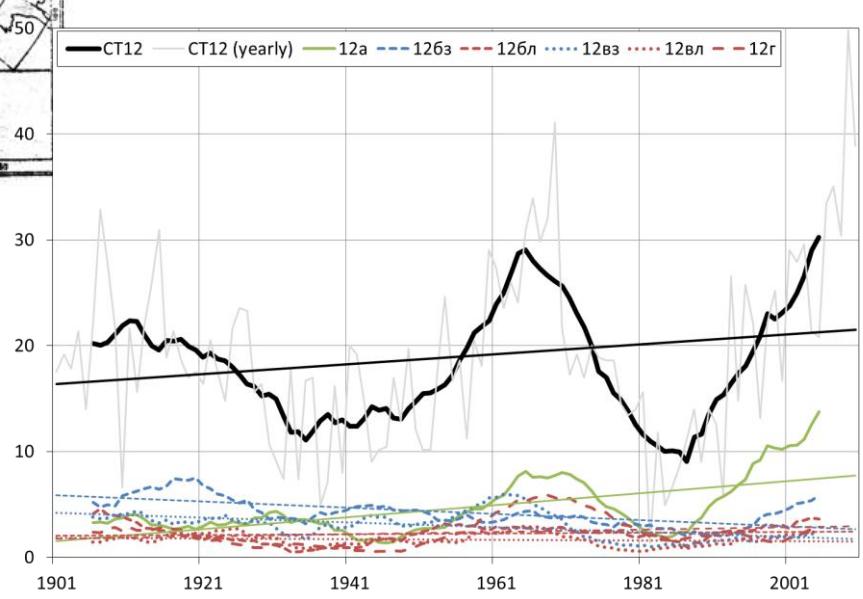
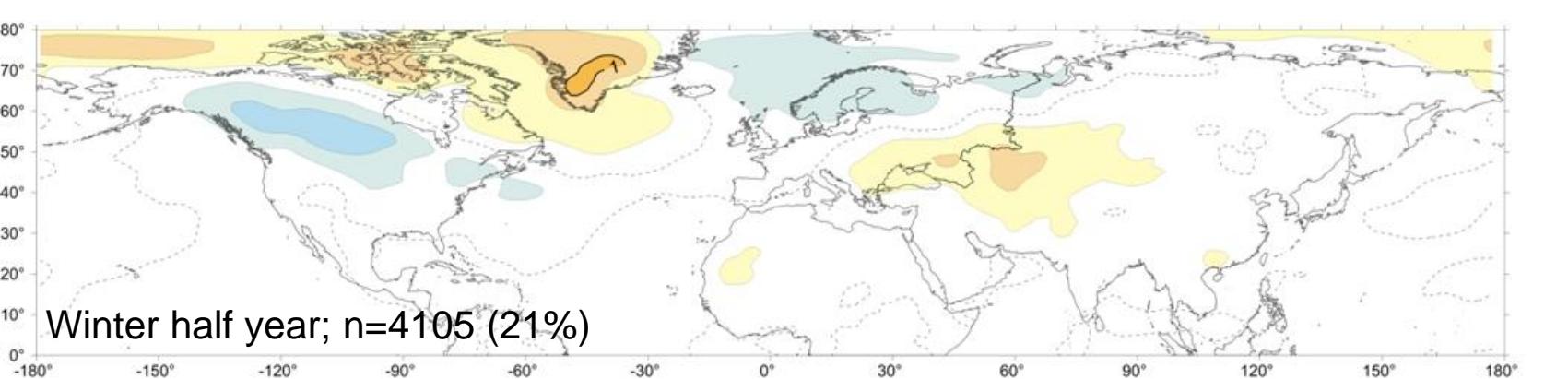
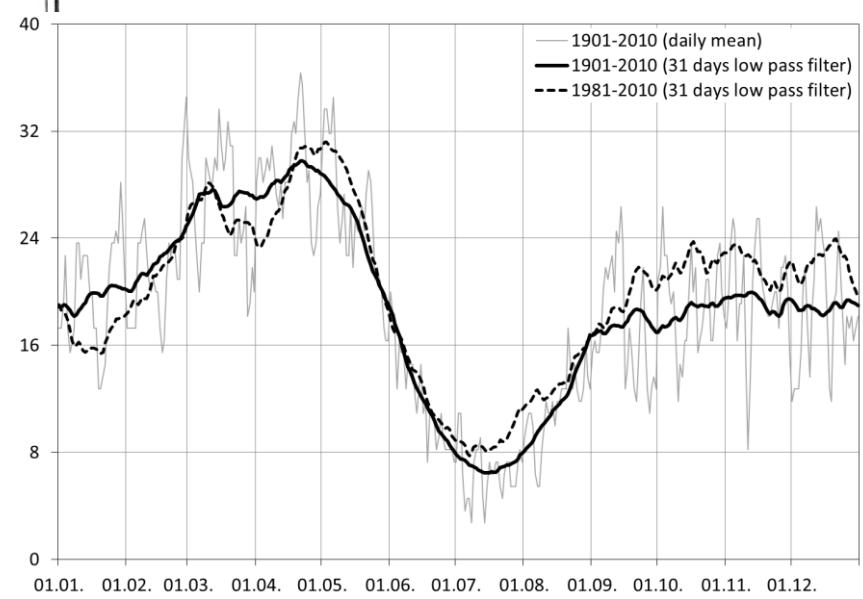
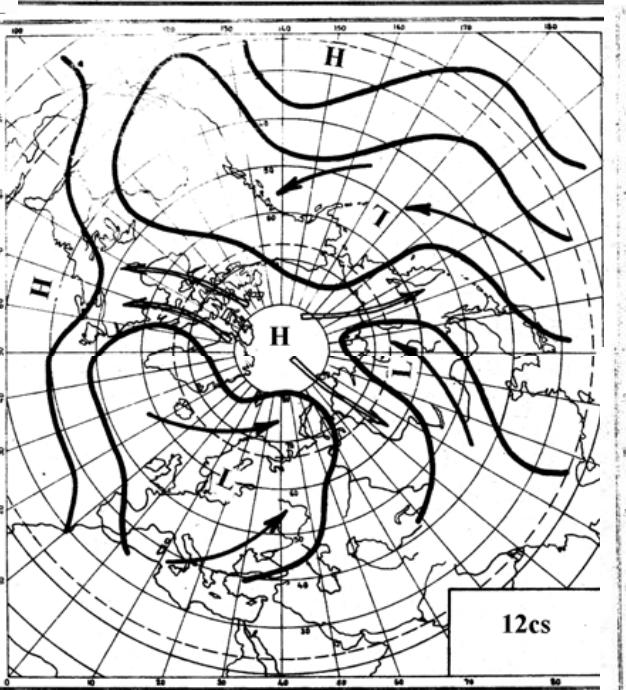
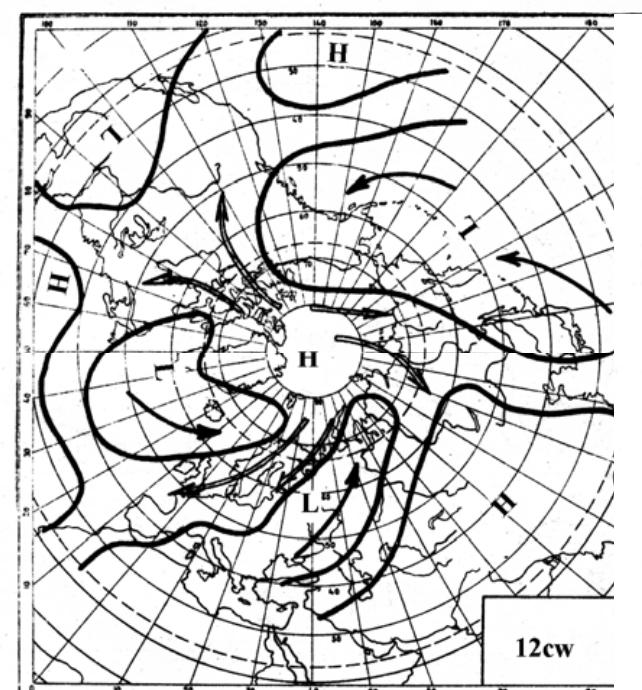
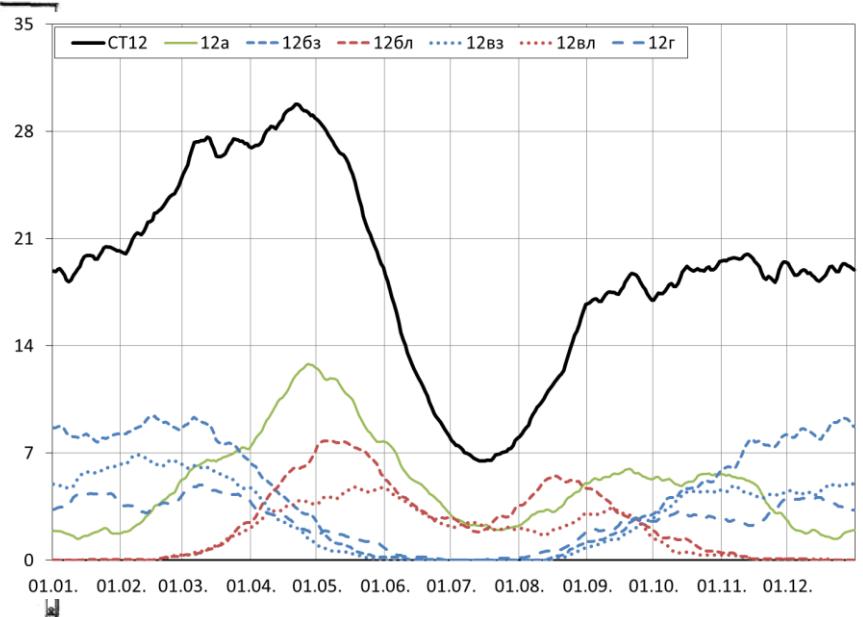
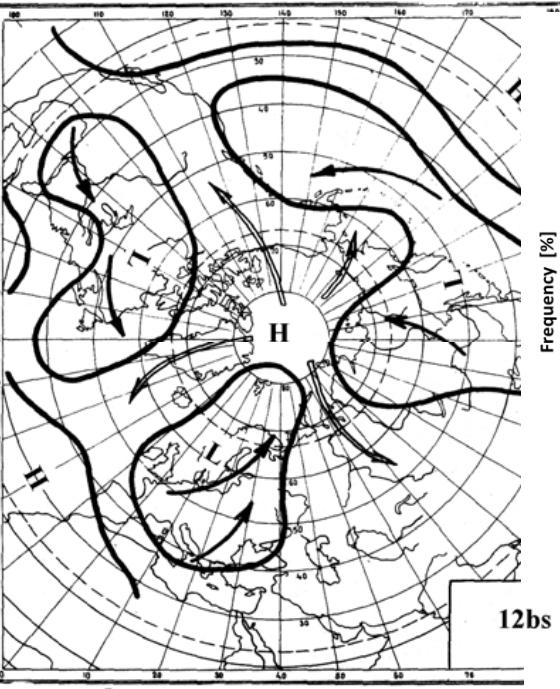
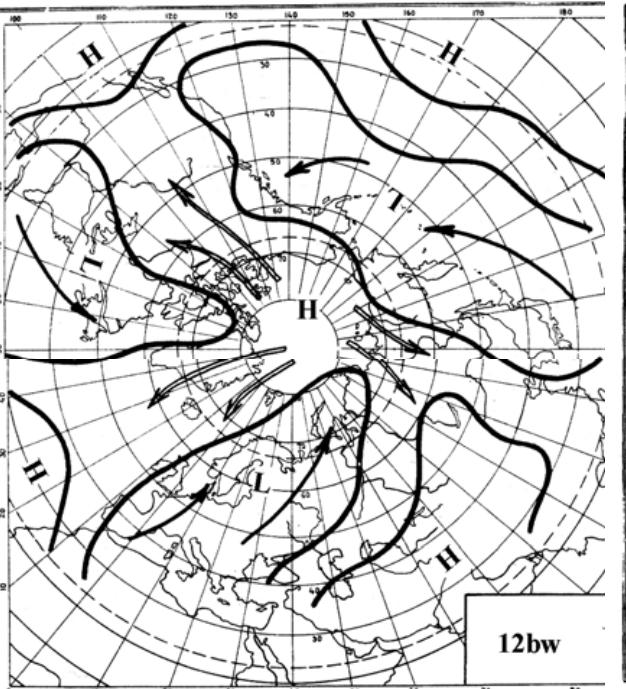
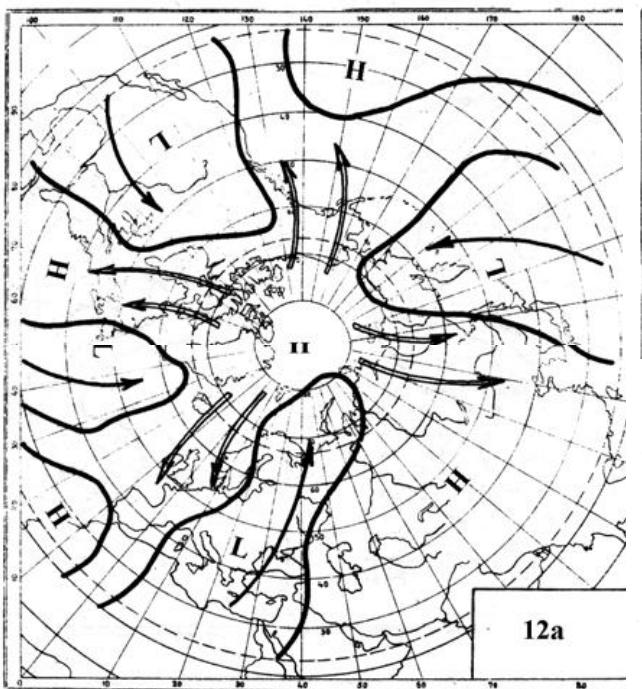
Winter half year; n=1683 (8%)



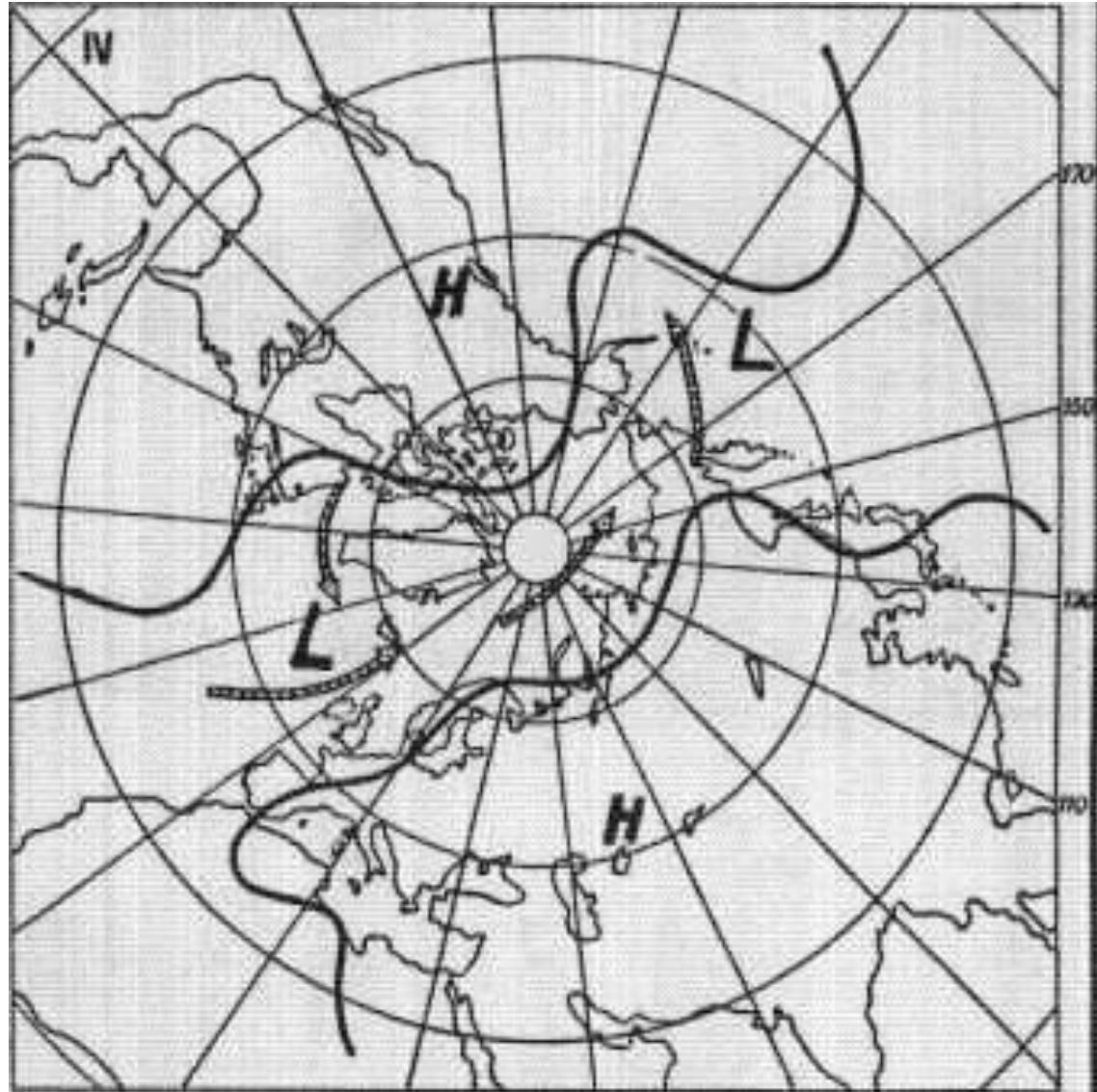




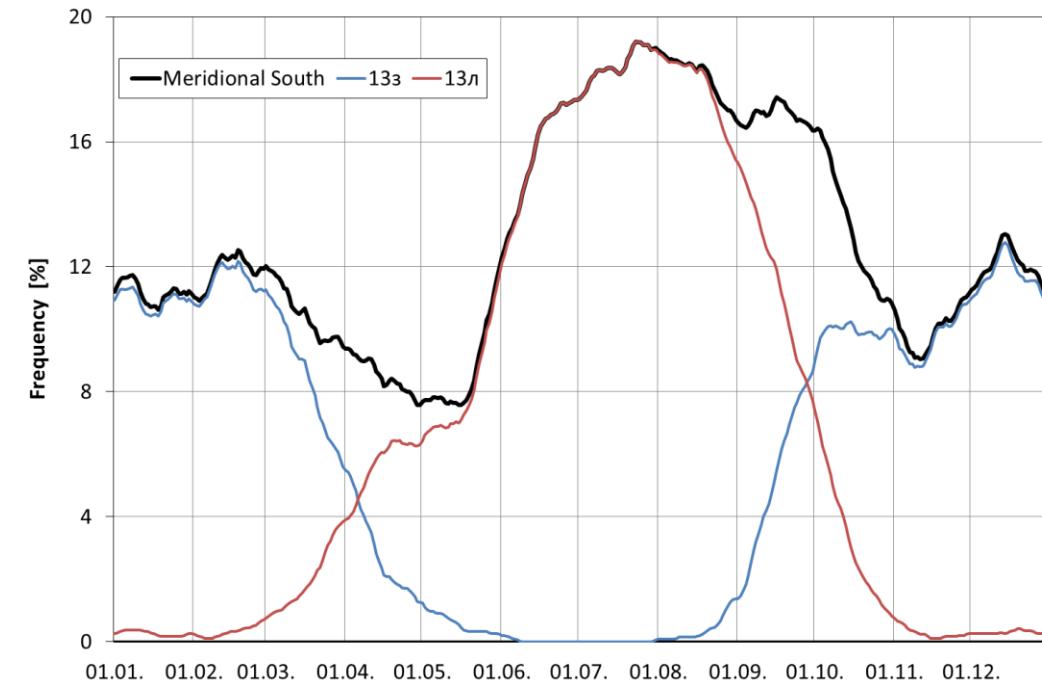




# Meridional South Circulation Group (MS)



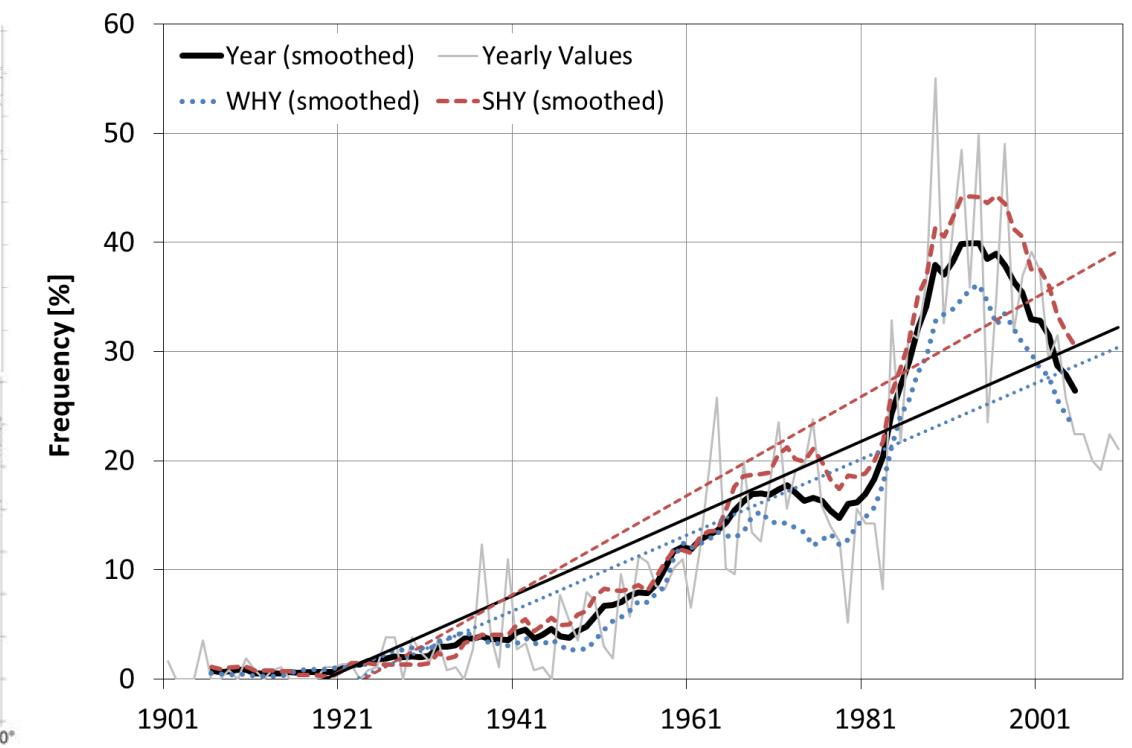
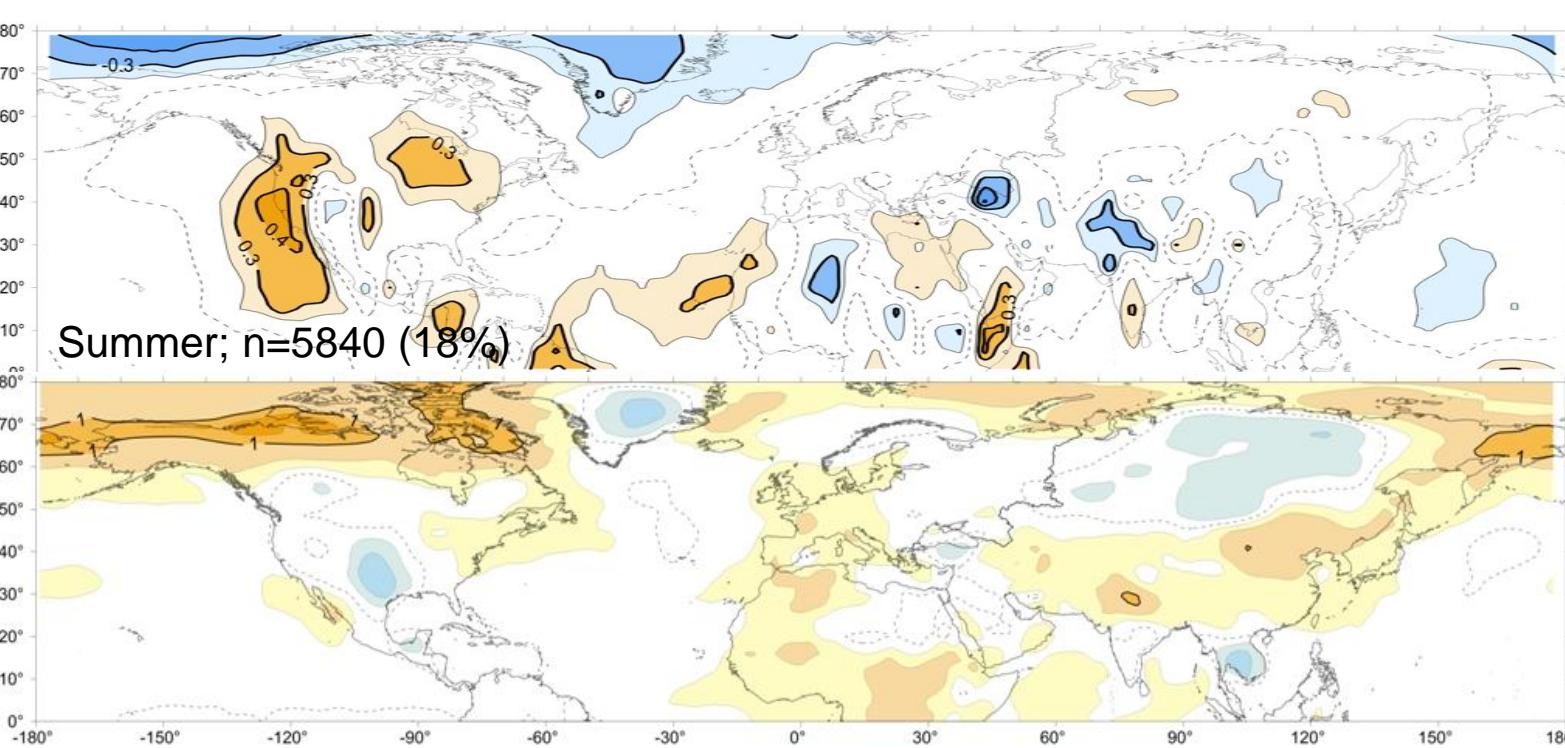
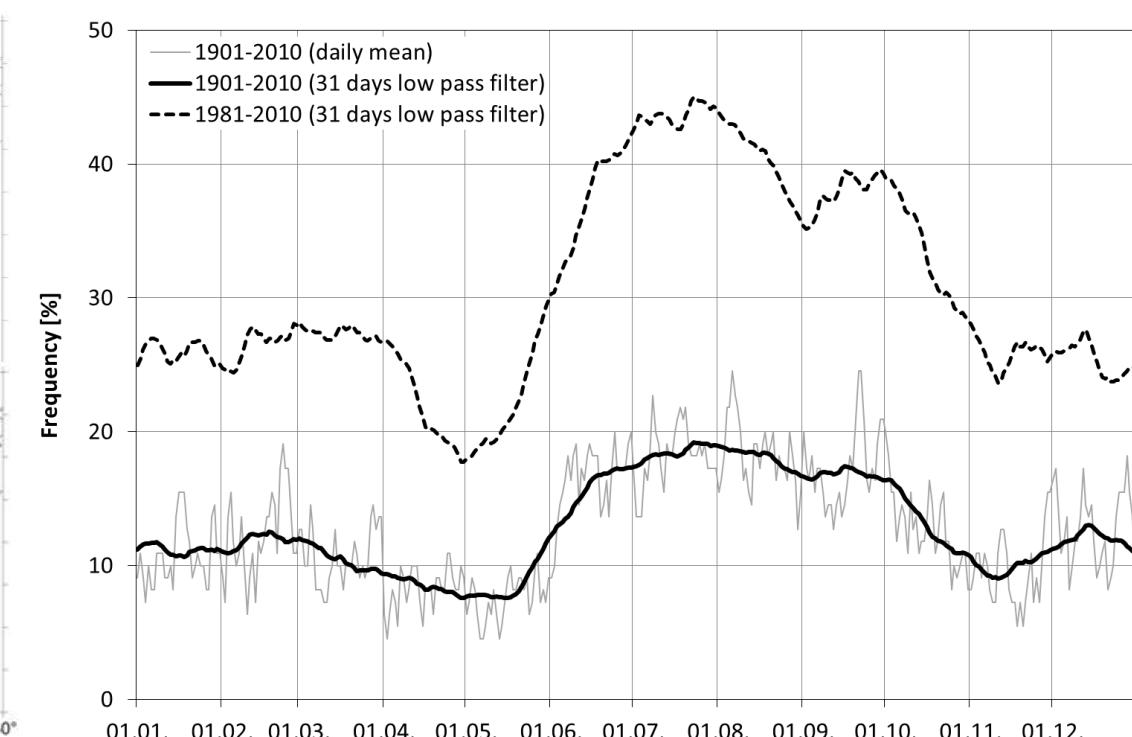
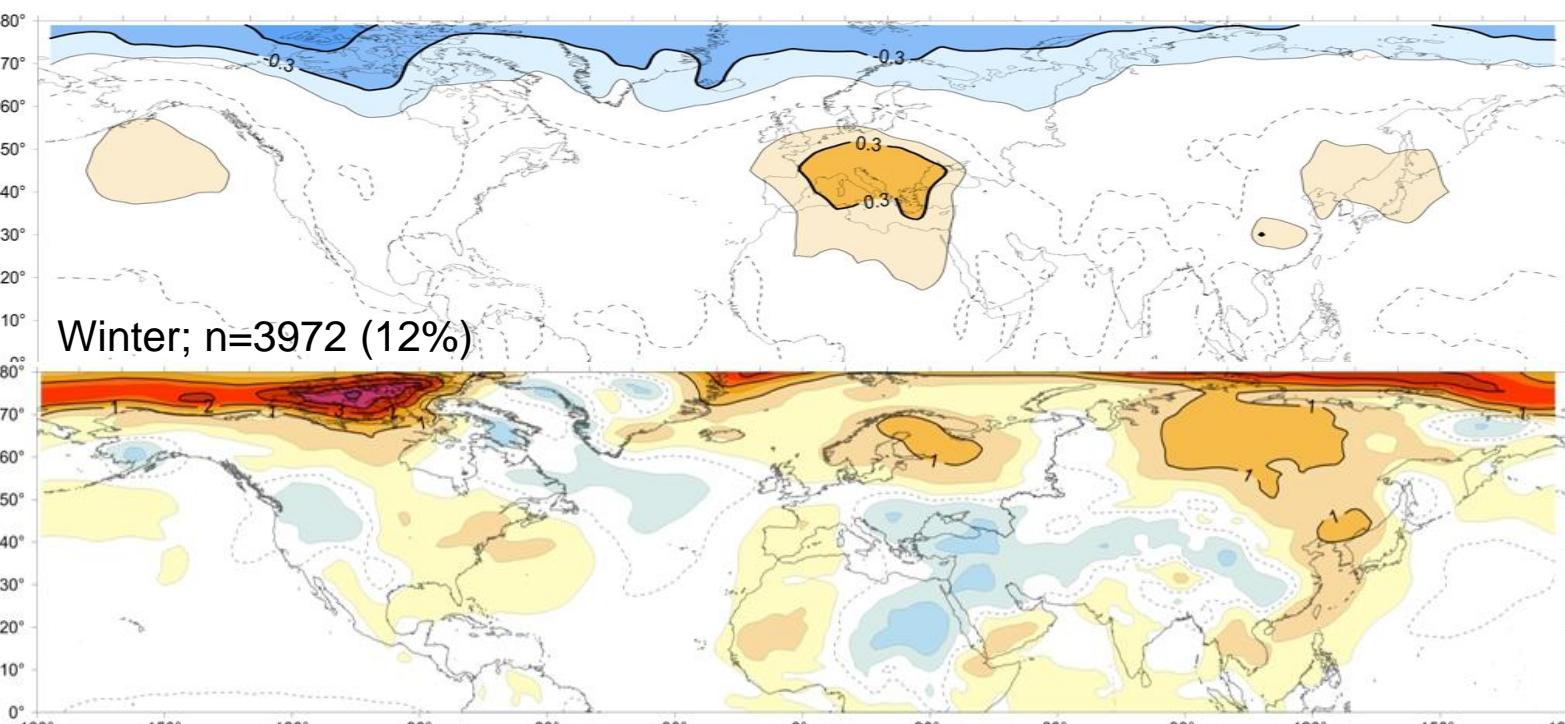
Anticyclonic conditions at Arctic region;  
3-4 southern cyclone outlets in 3-4 (of 6)  
sectors; no blocking

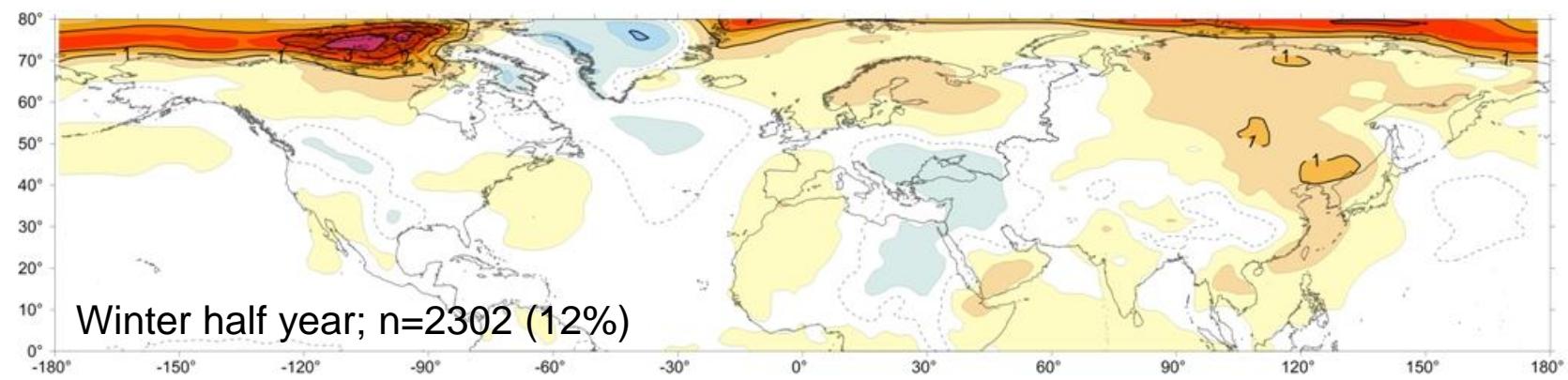
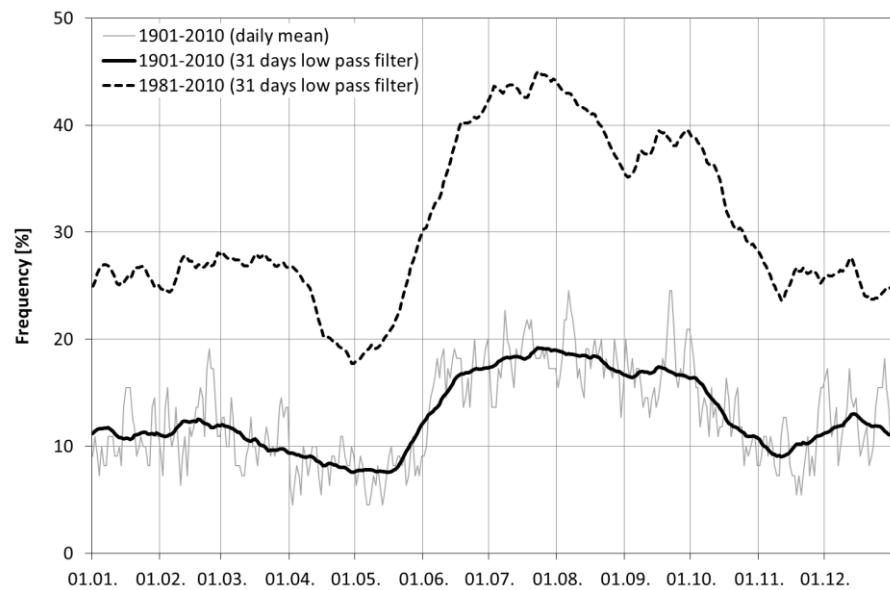
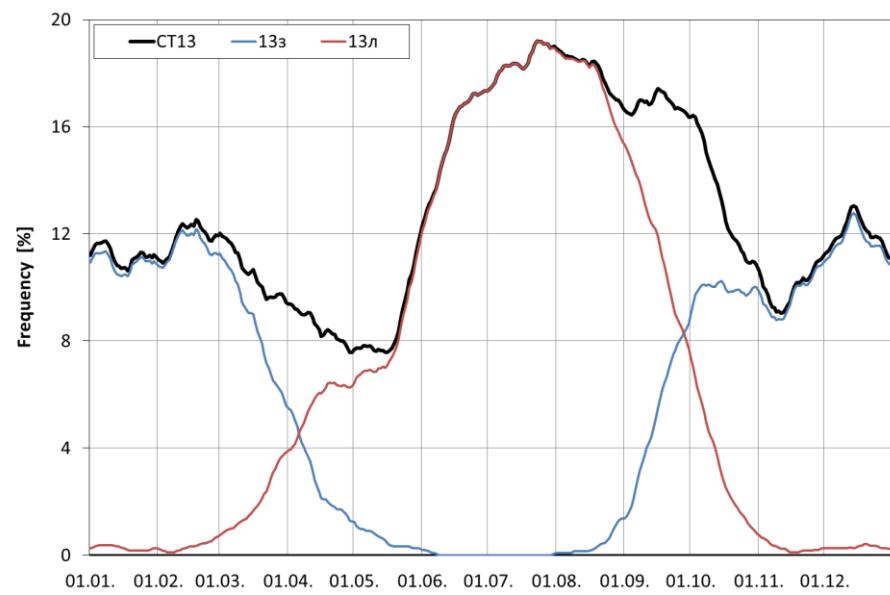
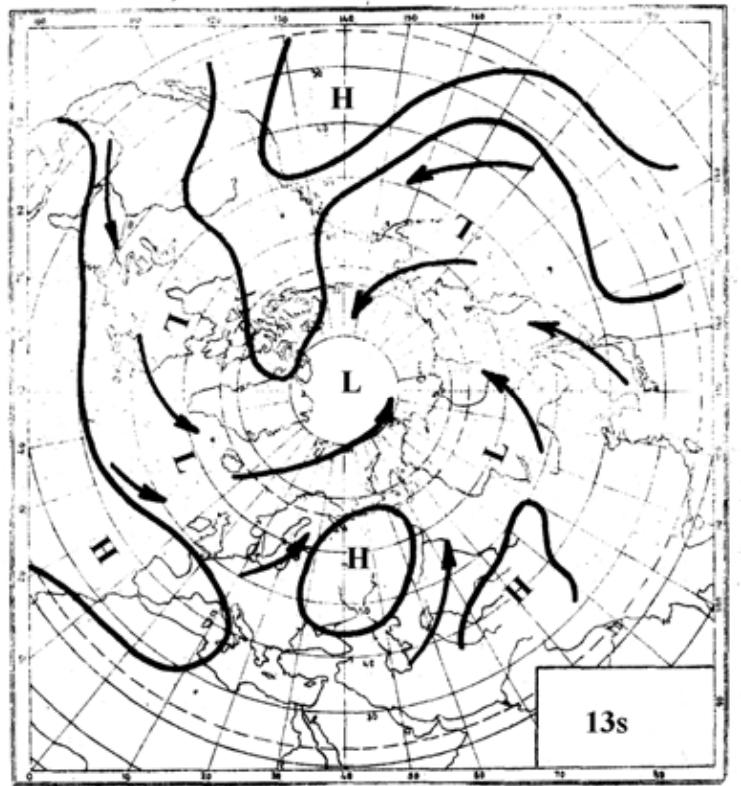
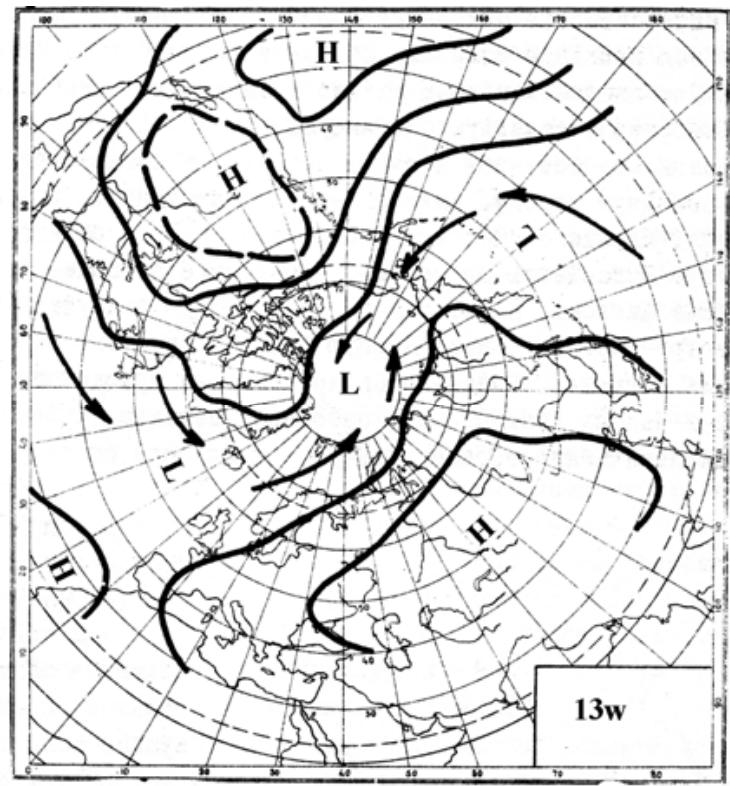


## Elementary Circulation Mechanisms (ECM's)

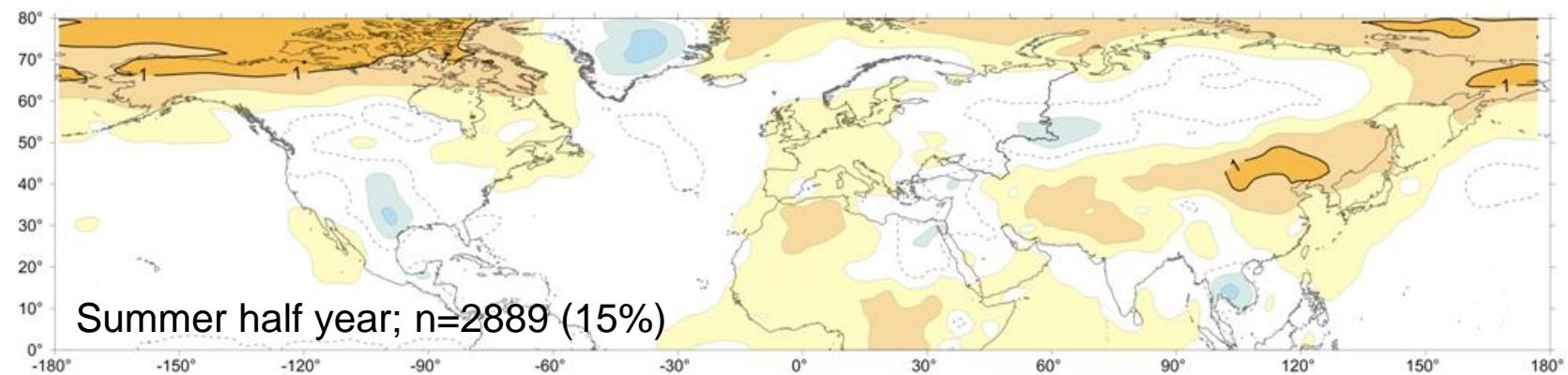
133	5,9%	WHY
13л	6,9%	SHY

# Meridional South Circulation Group (MS)

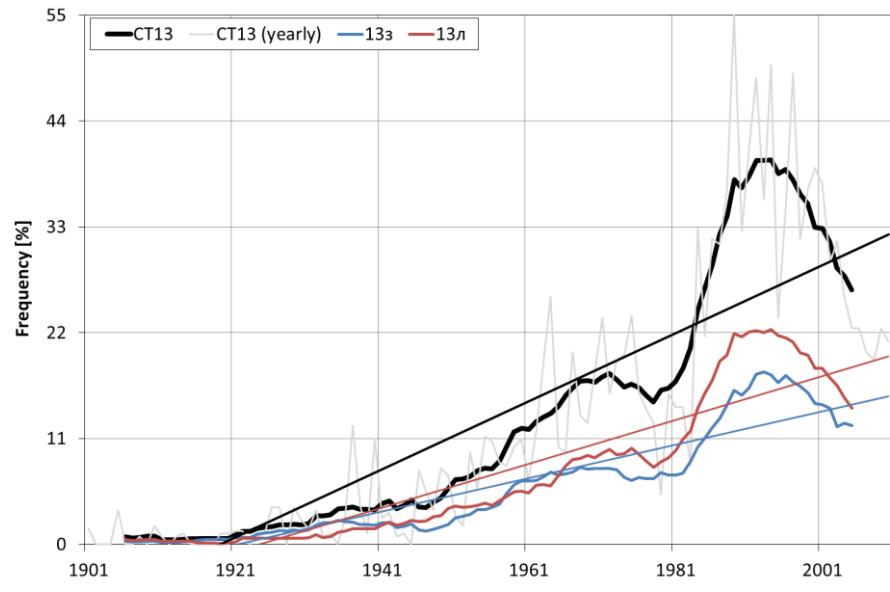




Winter half year; n=2302 (12%)



Summer half year; n=2889 (15%)



# Discussion

For further discussion please contact  
[andreas.hoy@ioez.tu-freiberg.de](mailto:andreas.hoy@ioez.tu-freiberg.de)