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The atmospheric circulation as a driver of dry spell in Poland

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- ***Motivation***
- ***Data***
- ***Methods***
- ***Dry days selection***
- ***Selected circulation patterns***
- ***Blocking index***
- ***Summary***

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Motivation:

- ***tight water budget***
- ***scenarios indicating on a slight increase of annual totals with the highest increase during winter and high probability of slight decrease of summer totals***
- ***a significant increase of temperature, also during summer season causing significant increase of evapotranspiration***
- ***snow cover changes (lesser and shorter)***

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Data:

localization of measuring sities

- *daily totals from 24 meteorological stations in Poland from the period 1951-2015 (Source: IMWM-SRI)*
- *mean daily SLP from reanalysis NCEP/NCAR from the period 1951-2015 (Kalnay et al., 1996). Space resolution 2.5° x 2.5° region limited by parallels 30°N i 70°N and meridians: 60°W i 60°E.*
- *mean daily geopotential heights of the 500 hPa level in gridpoints located at parallels 40°N and 60°N between meridians 90°W and 90°E (source: reanalysis NCEP/NCAR in the period 1951-2015).*

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Methods: selection of dry days

- for each station the days belonging to at least 10-day long series of days with precipitation < 0.1 mm were selected
- from these days, those which were dry at least on 13 stations (> 50% stations) simultanously were selected
- the selected days were divided into four seasons (MAM, JJA, SON, DJF)

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Methods: Ward's k-mean

- ***To distinguish circulation types conducive to dry periods the Ward's k-mean method was used. Dry days serve as cases, pressure fields serve as variables. Types were distinguished separately in each season.***
- ***In distinguished types the mean pressure fields and their anomalies were calculated in each season separately.***

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Methods: blocking index

Blocking index was calculated using Lejenäs & Øakland (1983) equation:

$$BI(\lambda) = Z_{40^\circ N}(\lambda) - Z_{60^\circ N}(\lambda)$$

where λ means longitude, $Z_{40^\circ N}$ & $Z_{60^\circ N}$ are geopotential heights of 500 hPa level respectively at 40°N and 60°N parallels. To assess the relation between blocking and dry day appearance the anomalies of blocking index in selected days comparing to the seasonal average value.

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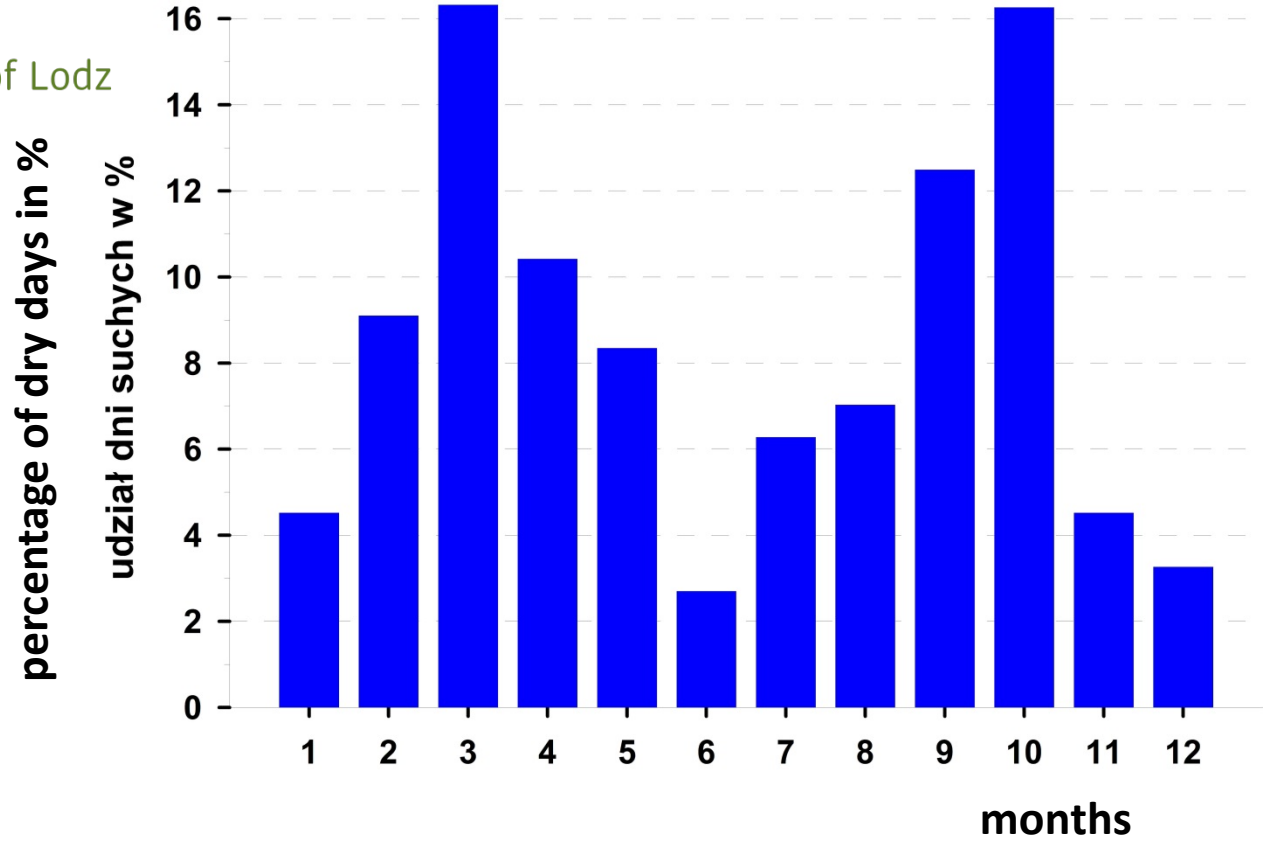
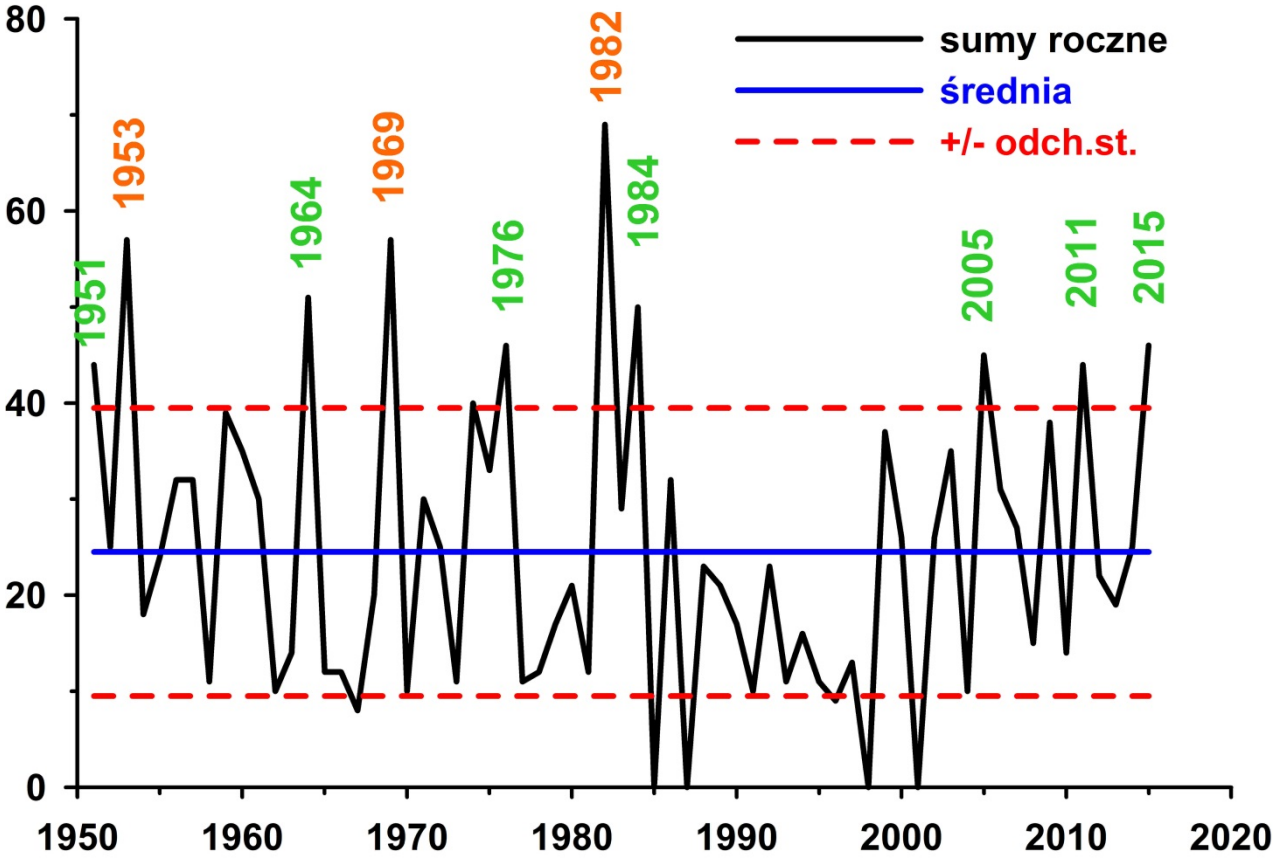


Annual course of very dry days.

100% means all very dry days

Longterm variability of the number of very dry days



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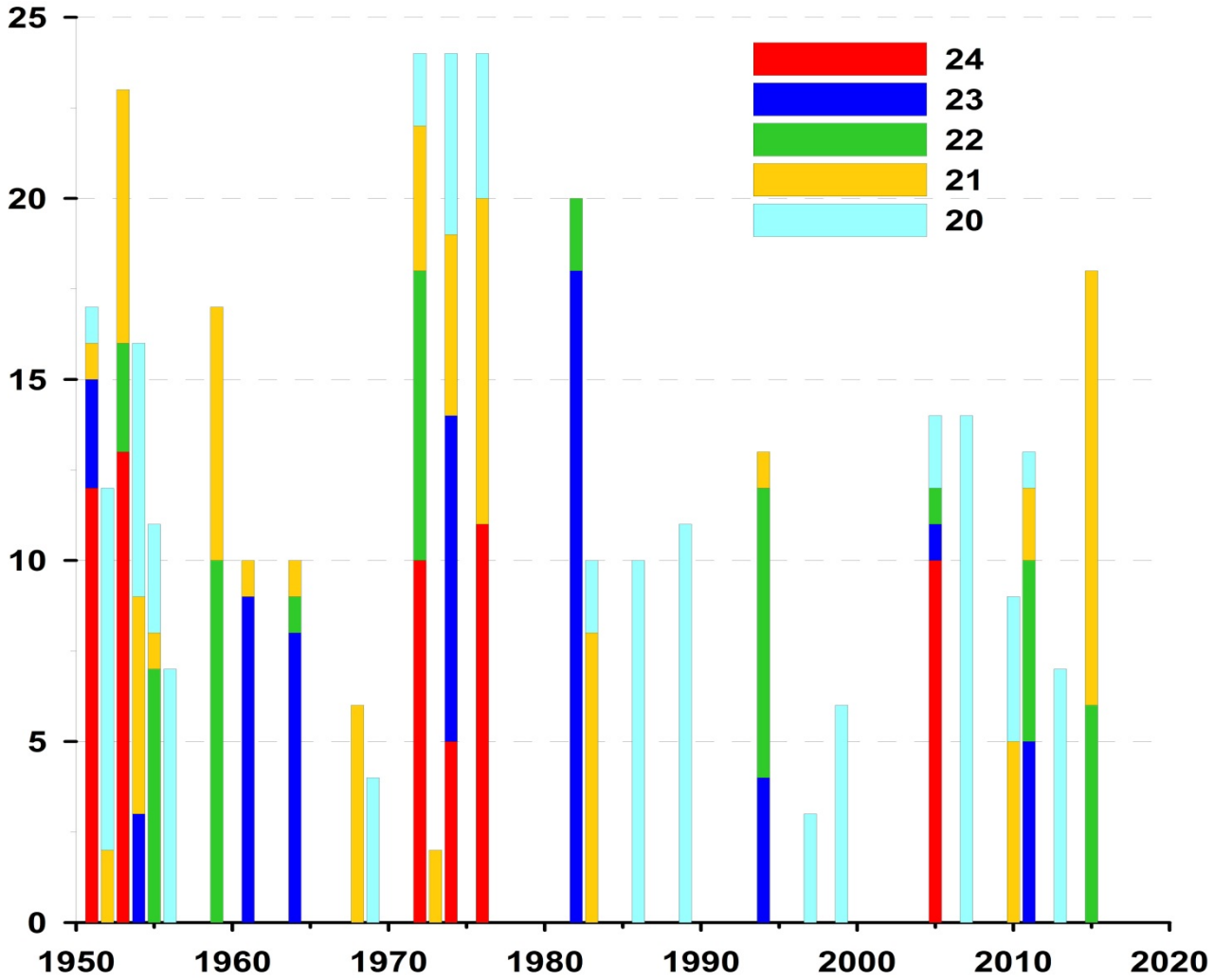
Longterm course of extremely dry days (dry on at least 20 stations)



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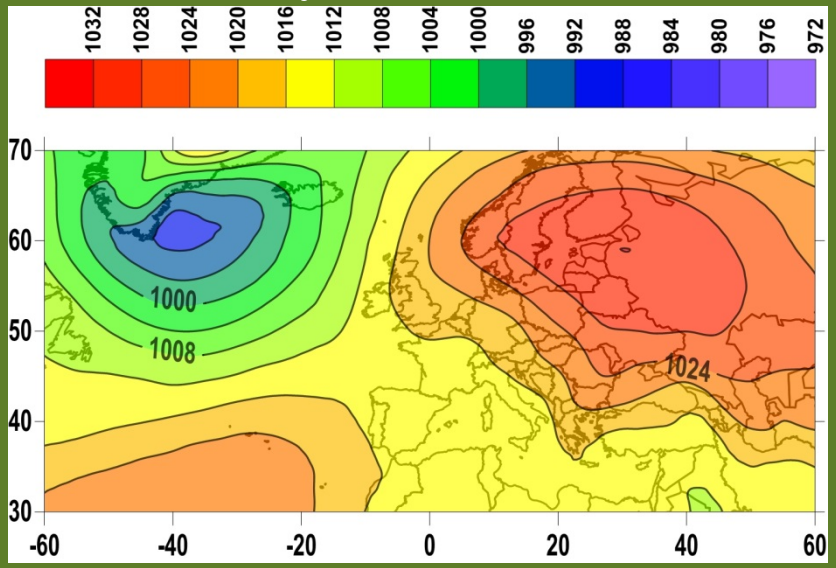
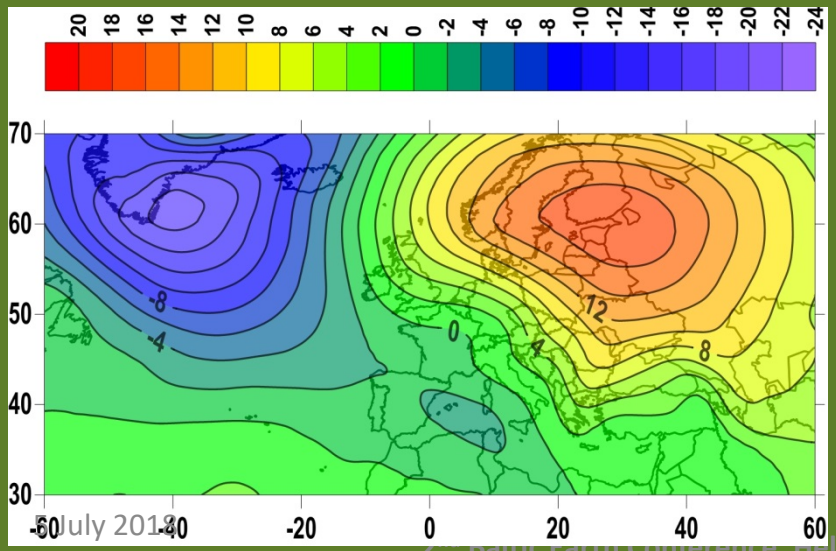
type 1, 99 days

Spring





*Upper map presents **mean SLP field**, on days in dry waves belonging to particular types*

*Lower map presents **SLP anomalies**, on days in dry waves belonging ti particular types comparing with seasonal averages*

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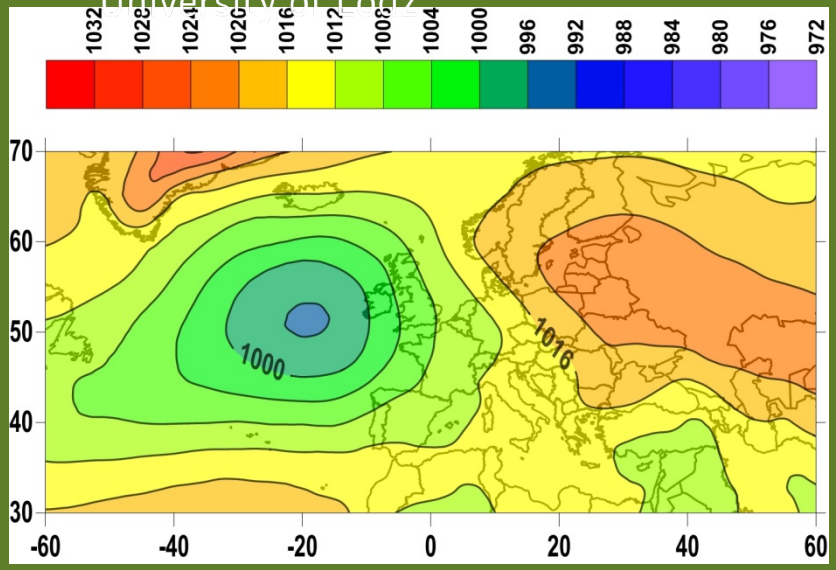
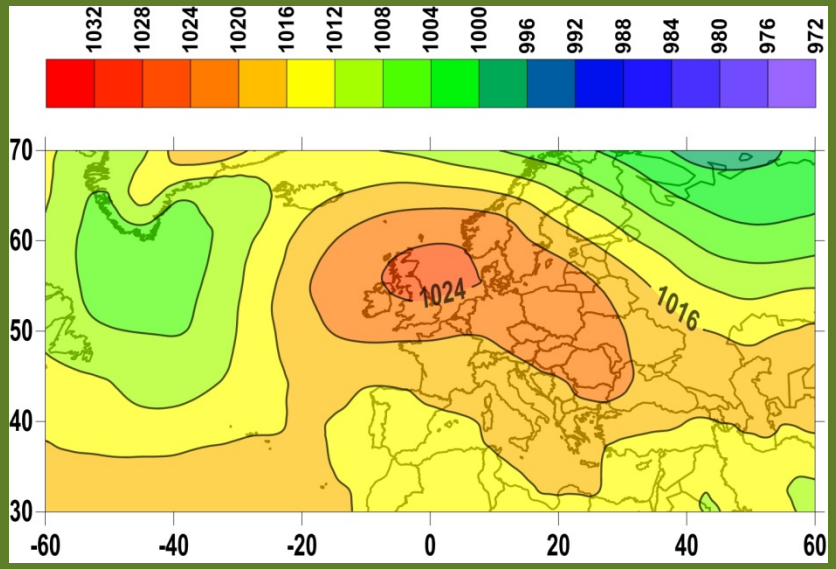
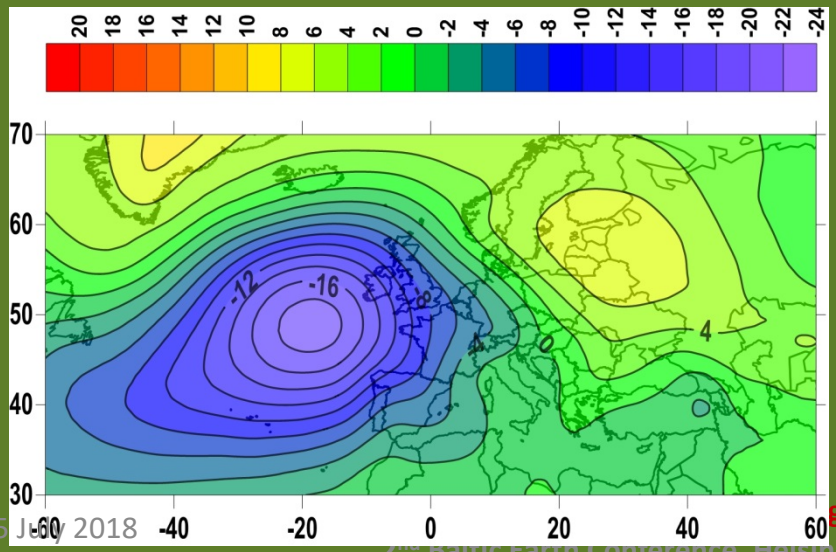
type 2, 130 days

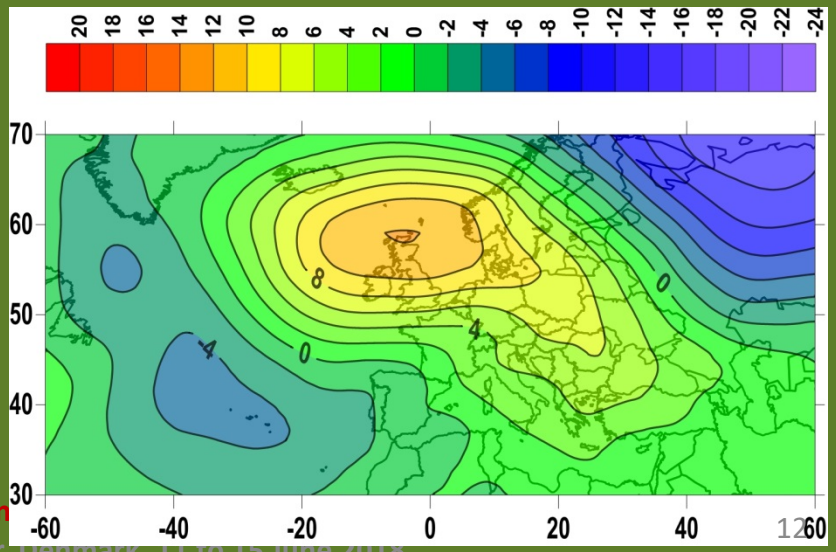
type 3, 106 days

Spring









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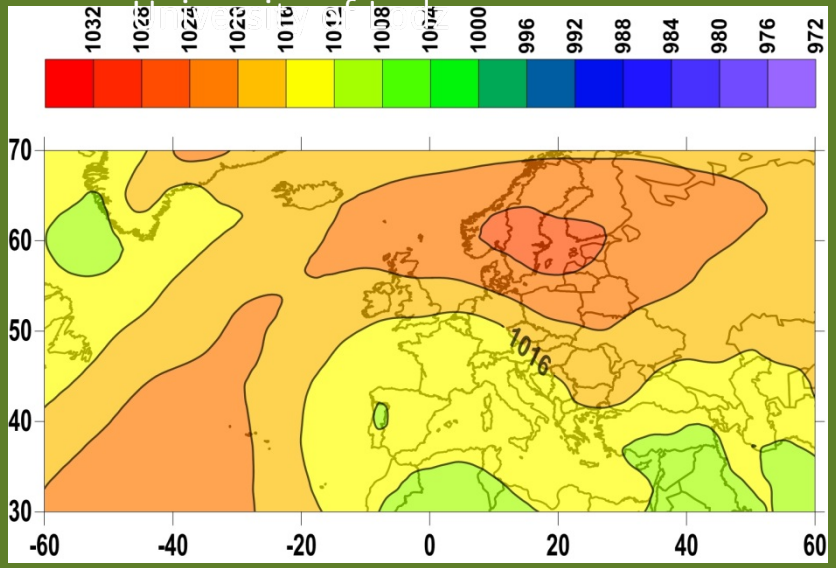
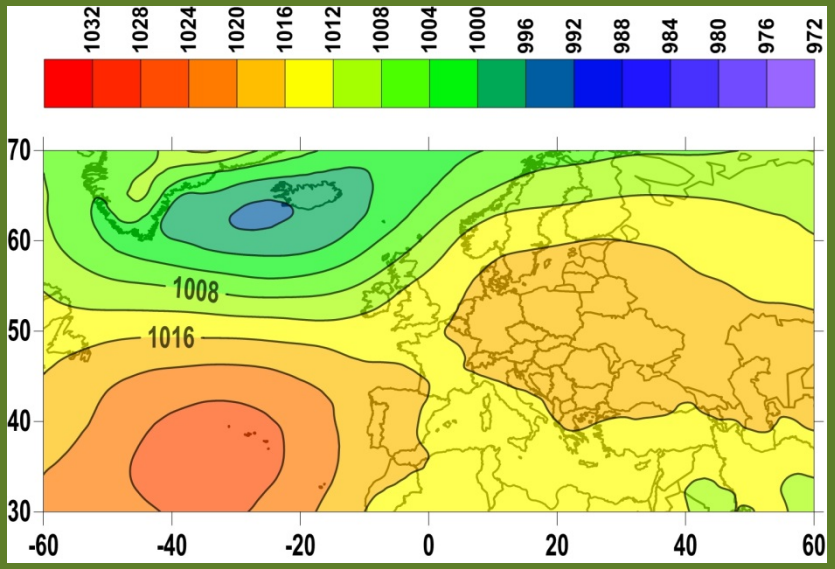
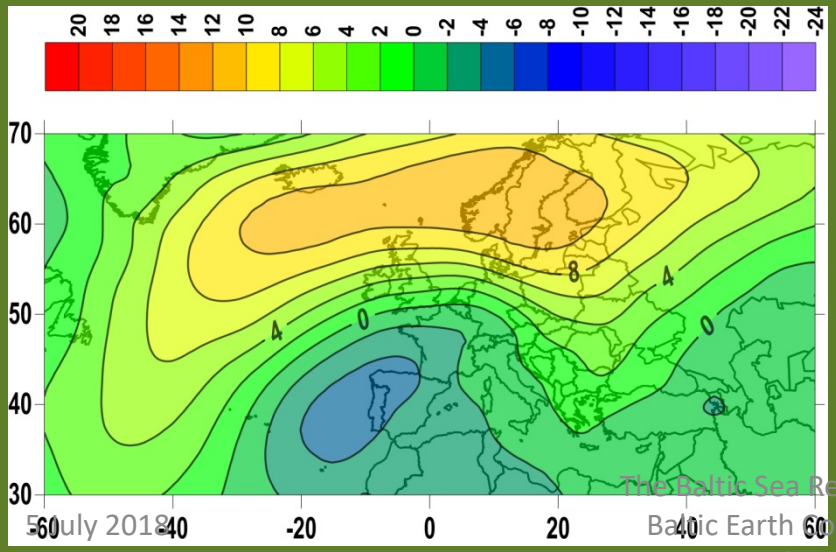
type 4, 80 days

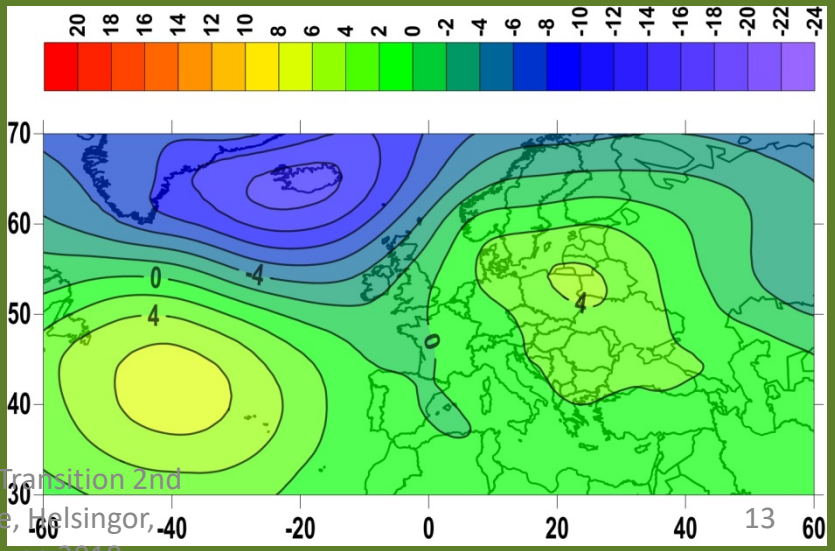
type 5, 124 days

Spring

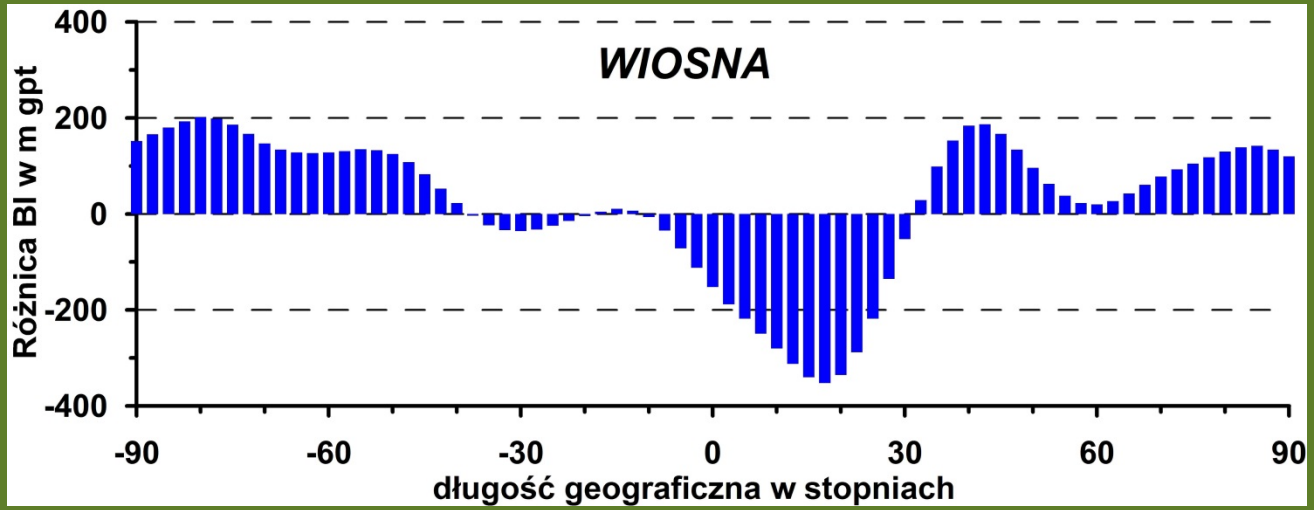








Spring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długość geograficzna w stopniach

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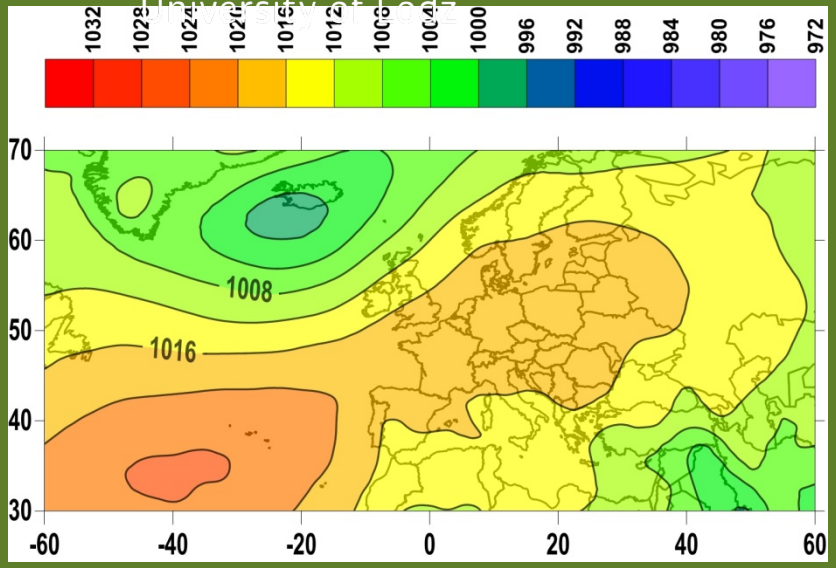
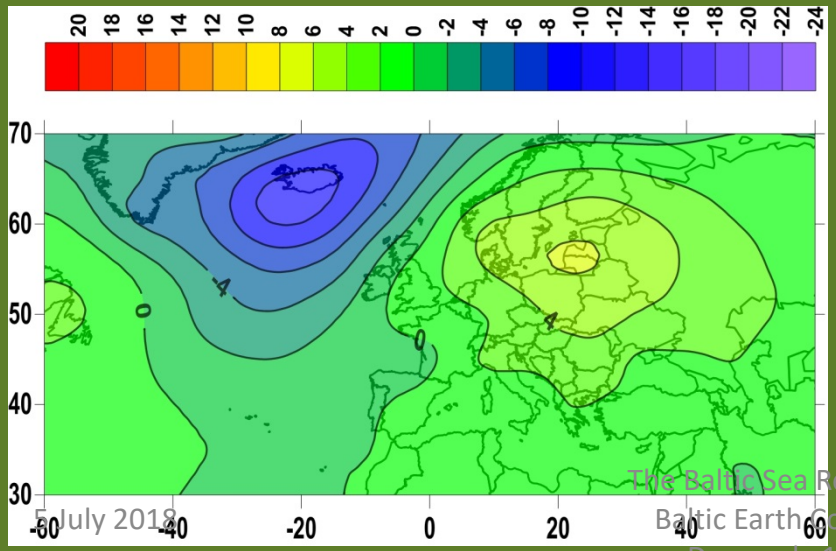
type 1, 90 days

Summer





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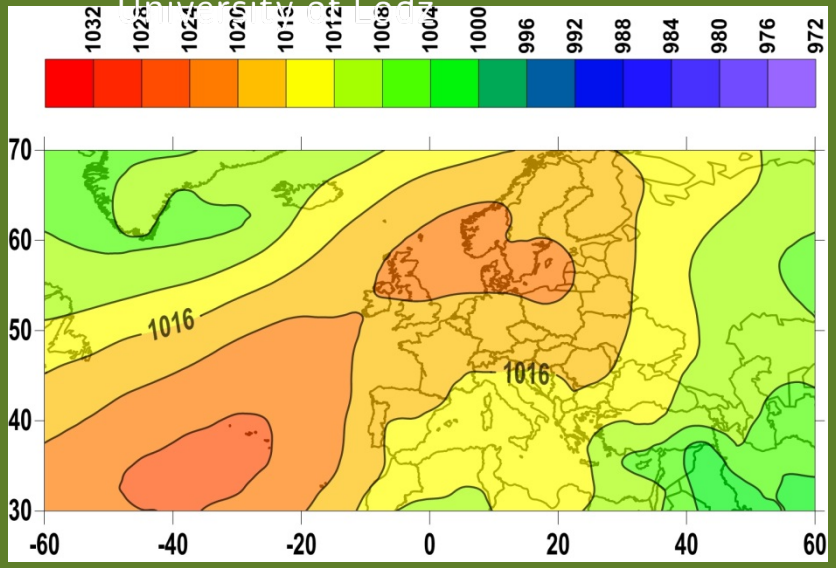
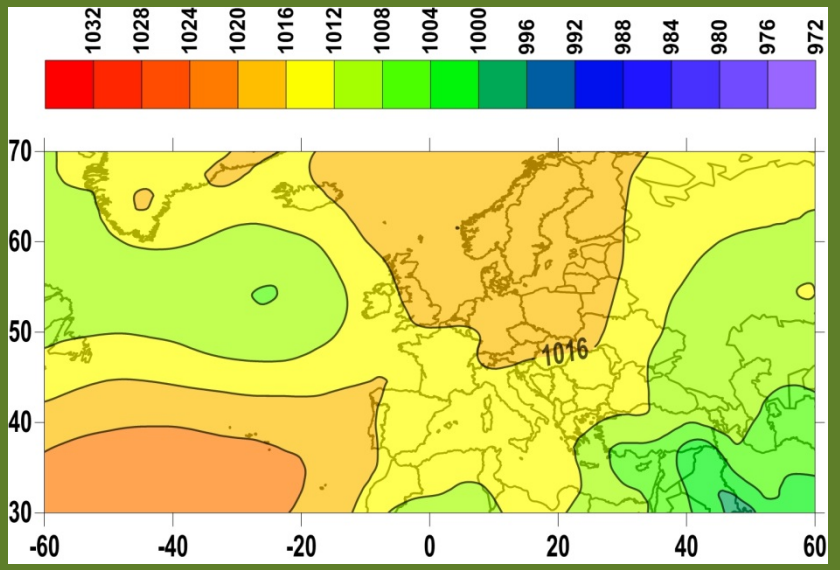
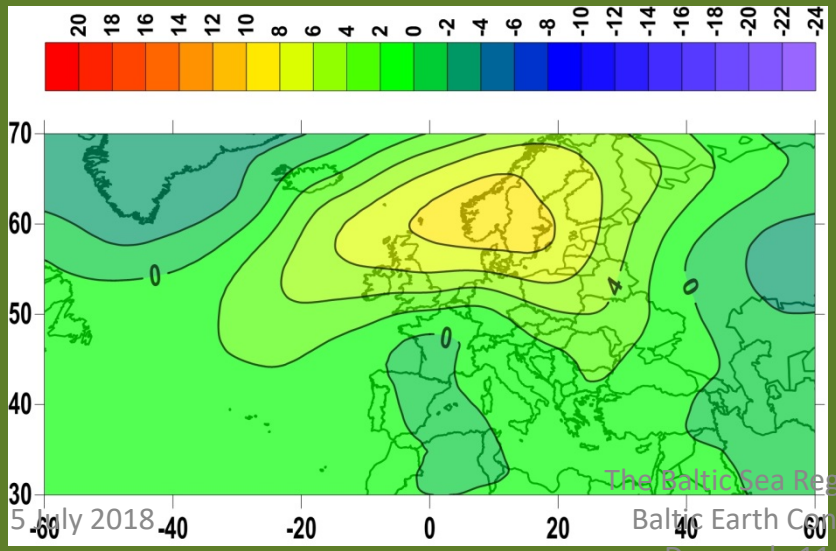
type 2, 96 days

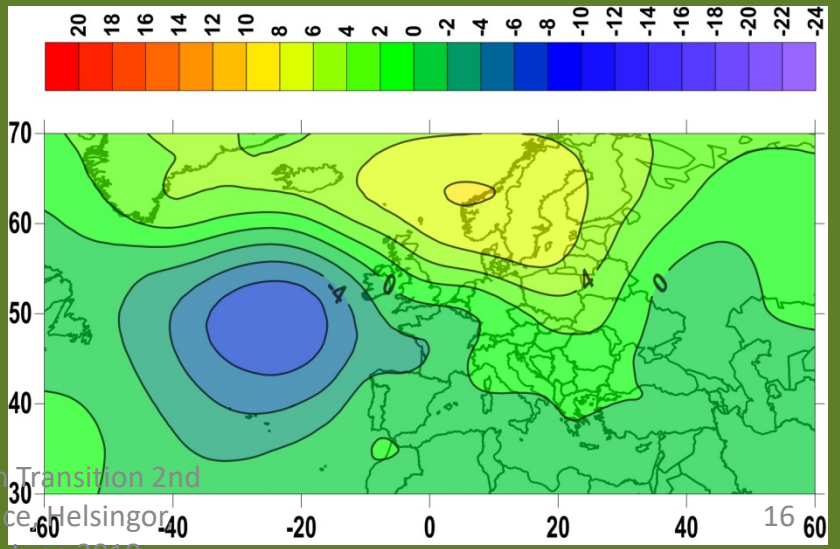


type 3, 69 days

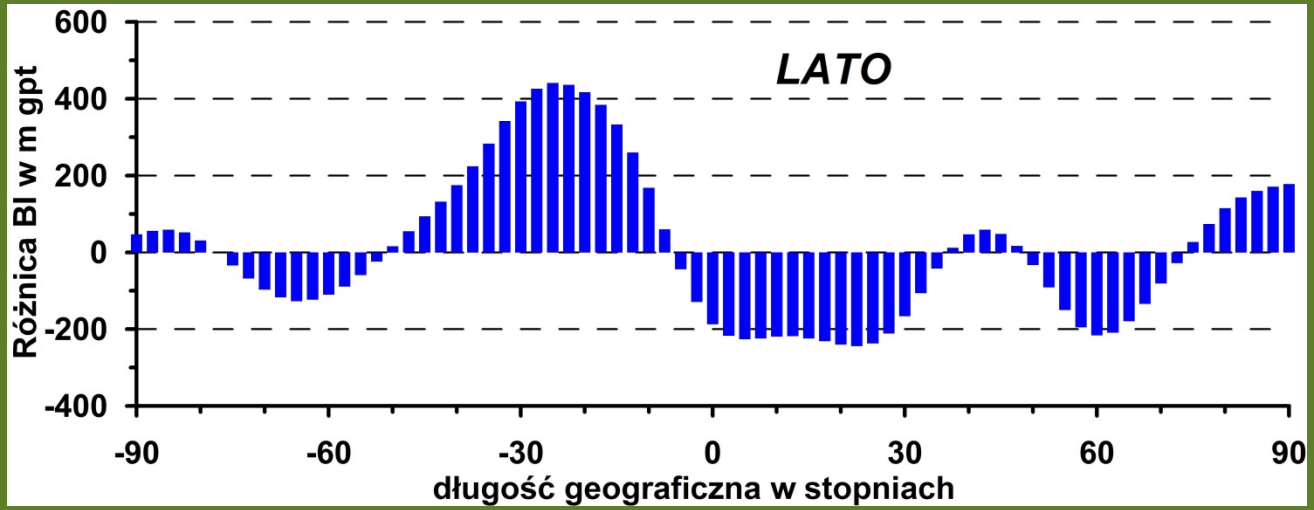


Summer





Summer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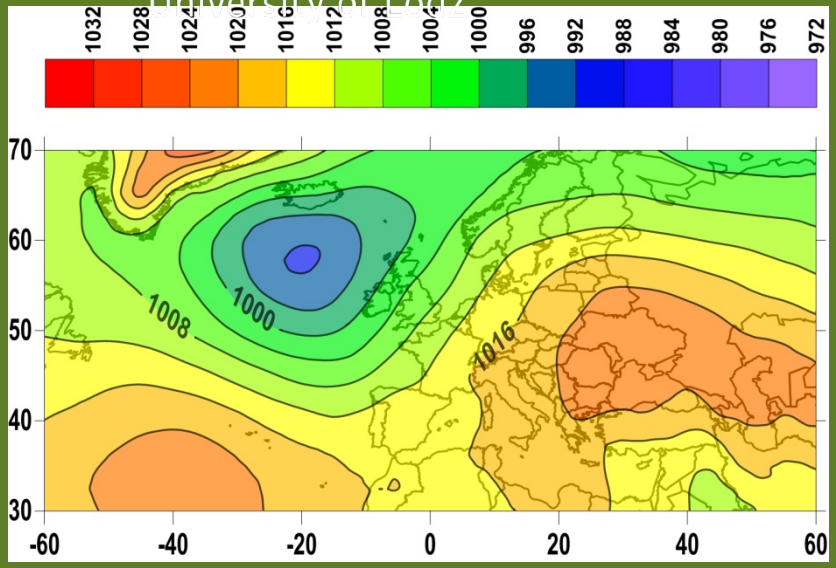
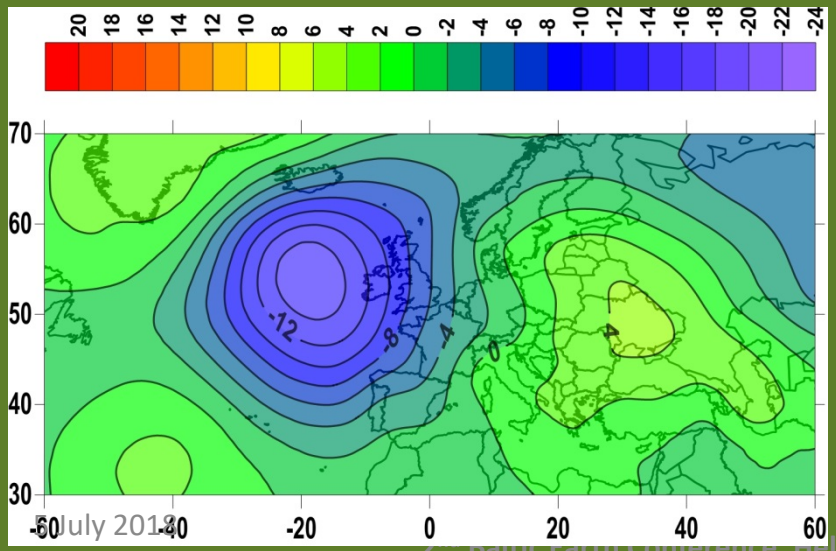
type 1, 96 days

Autumn





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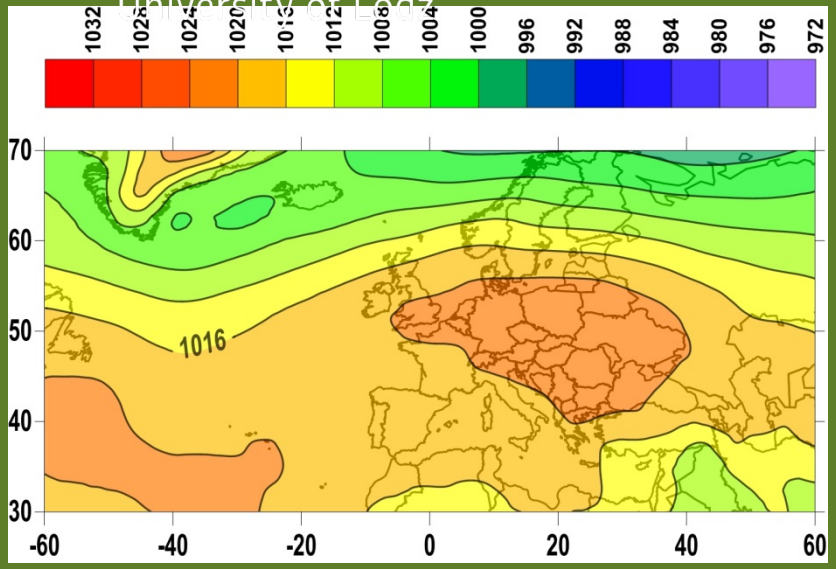
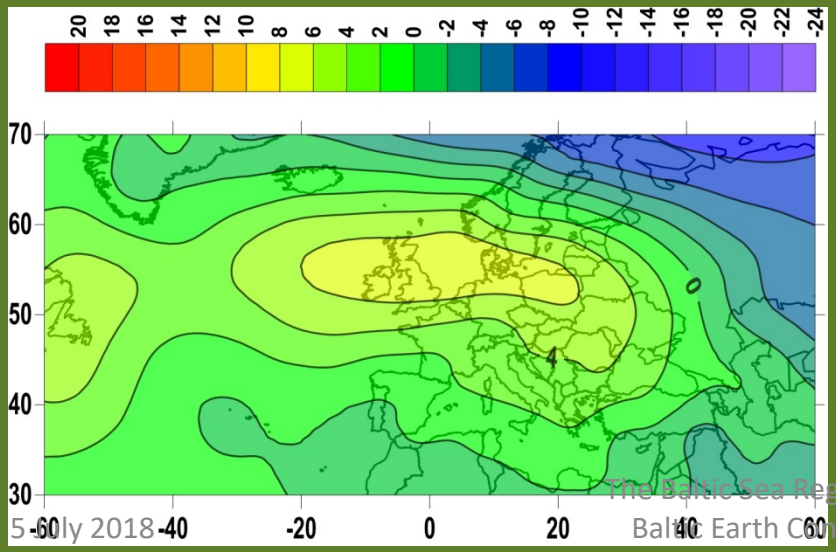
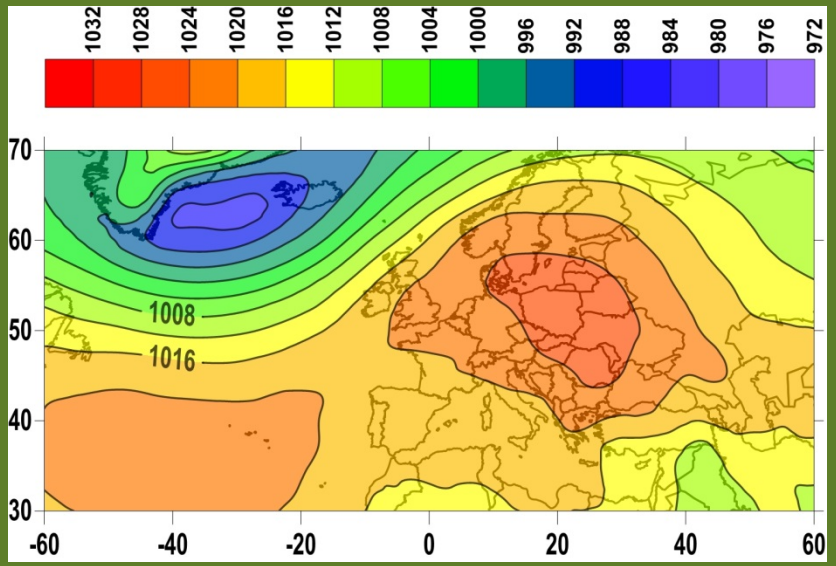
Autumn

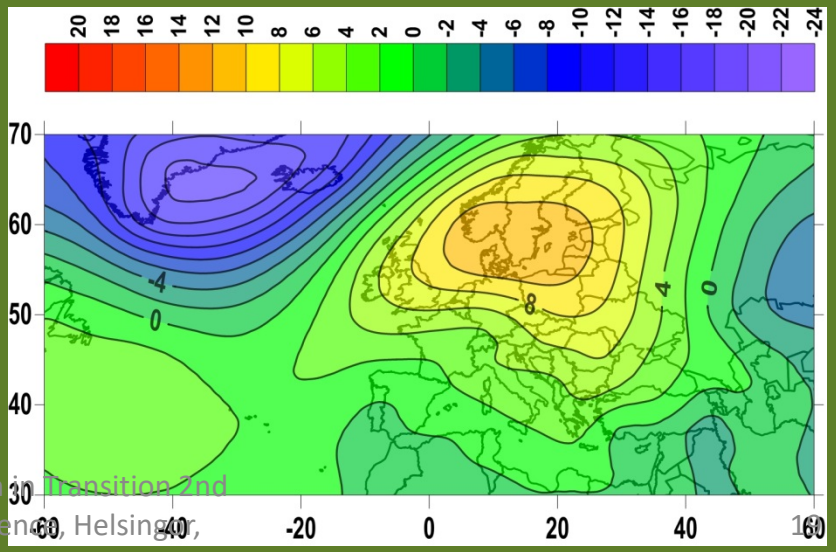
type 2, 116 days





type 3, 83 days





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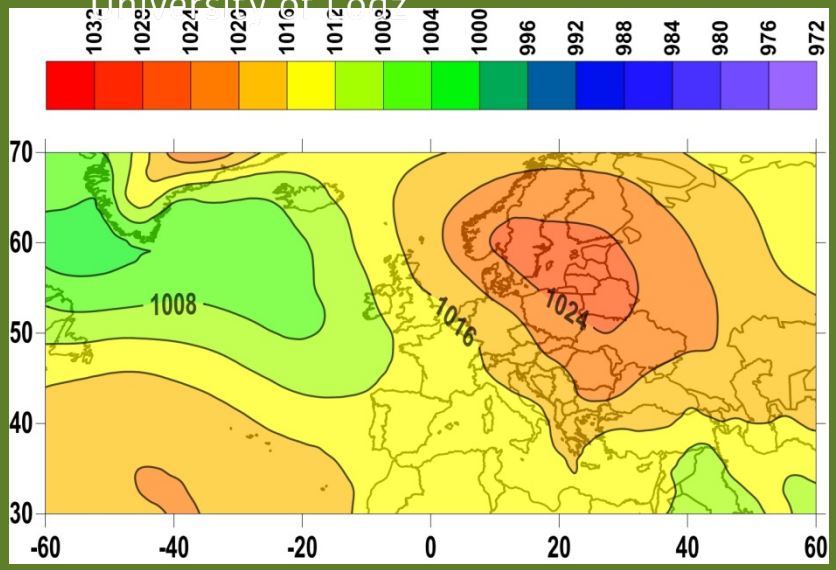
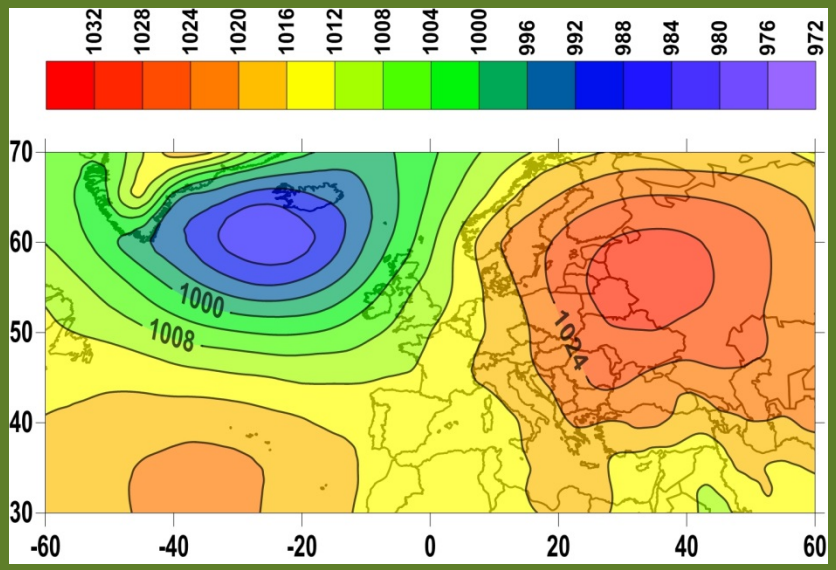
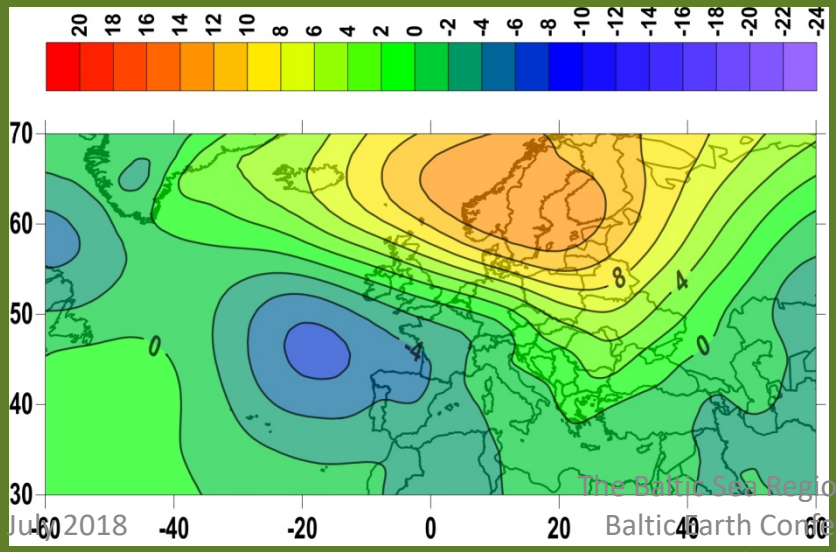
type 4, 156 days

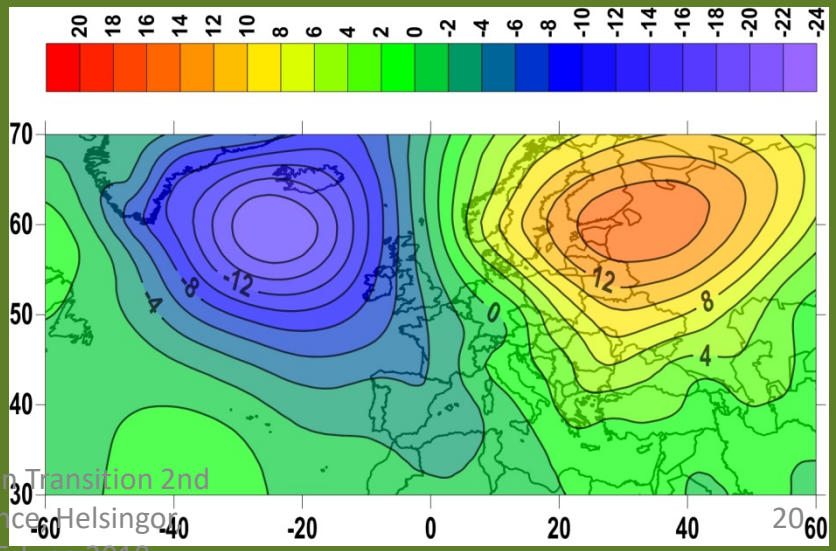
type 5, 79 days

Autumn

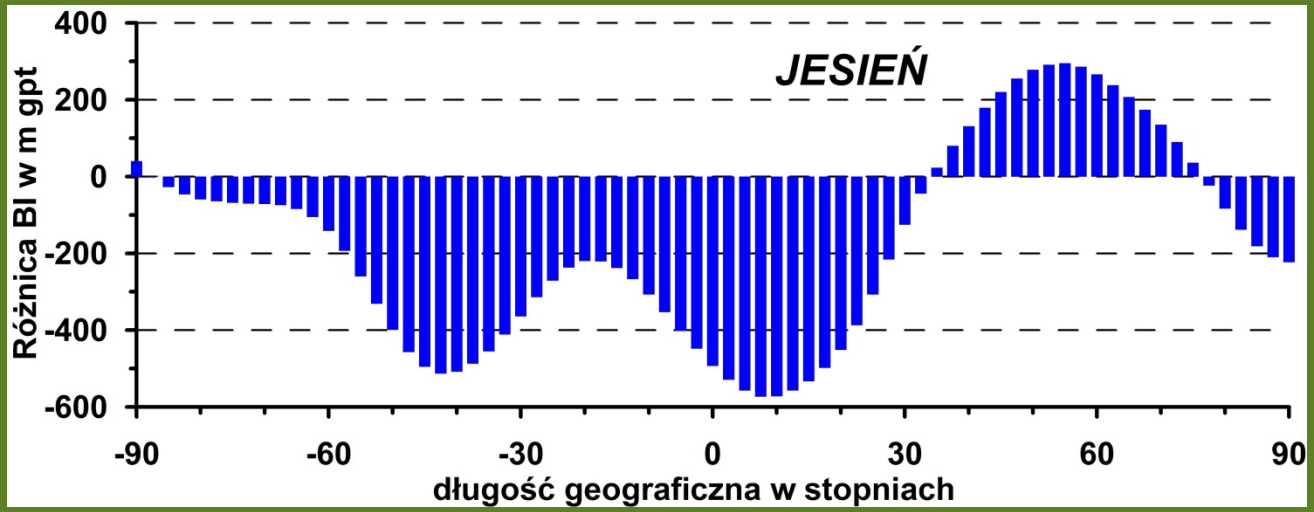








Autumn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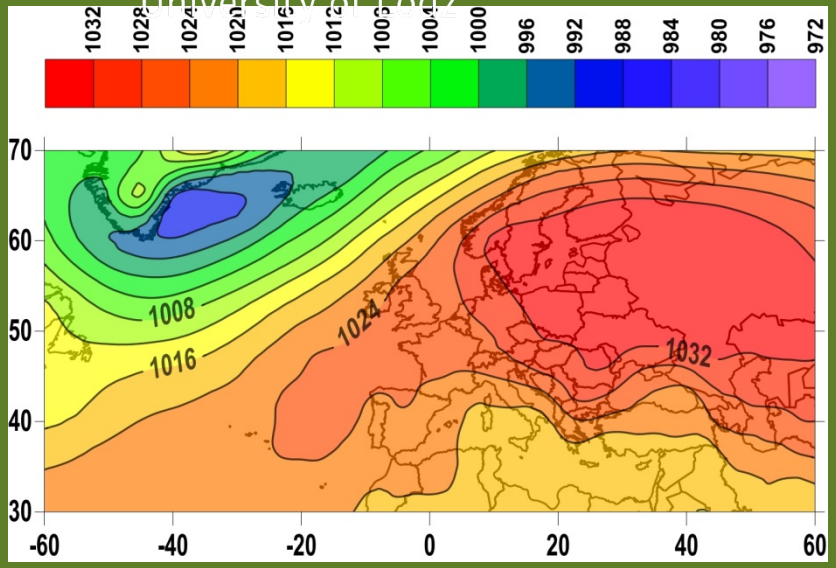
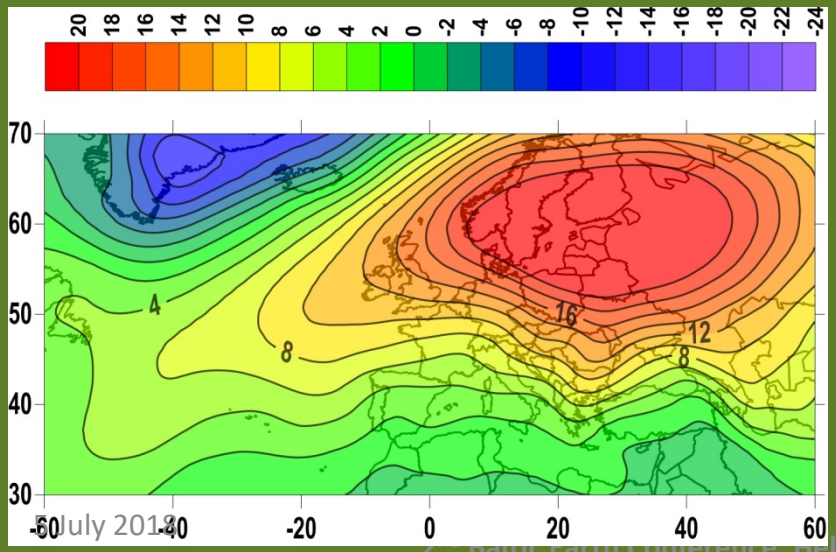
type 1, 65 days

Winter





Upper map presents mean SLP field, on days in dry waves belonging to particular types

Lower map presents SLP anomalies, on days in dry waves belonging ti particular types comparing with seasonal averages

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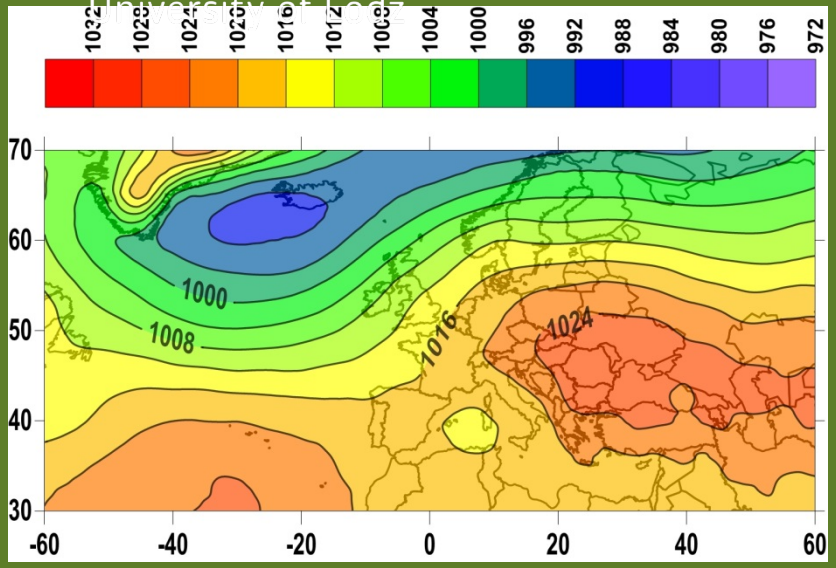
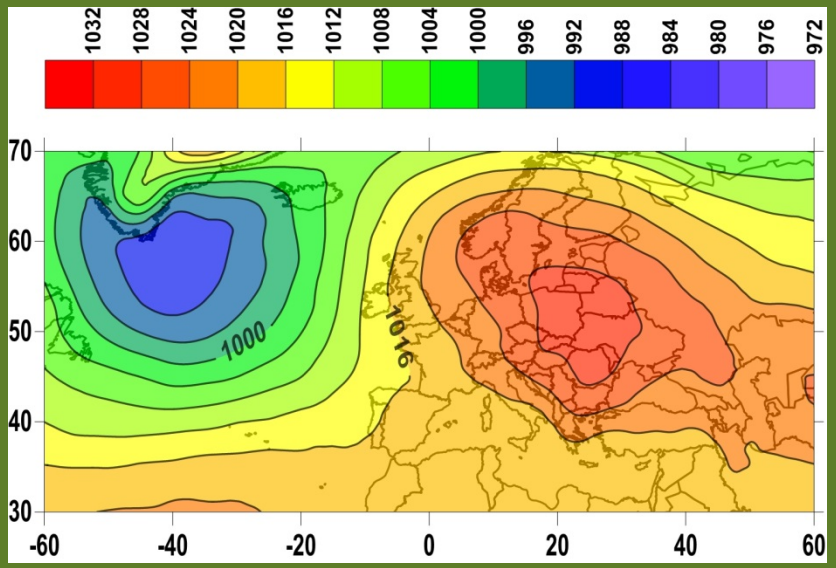
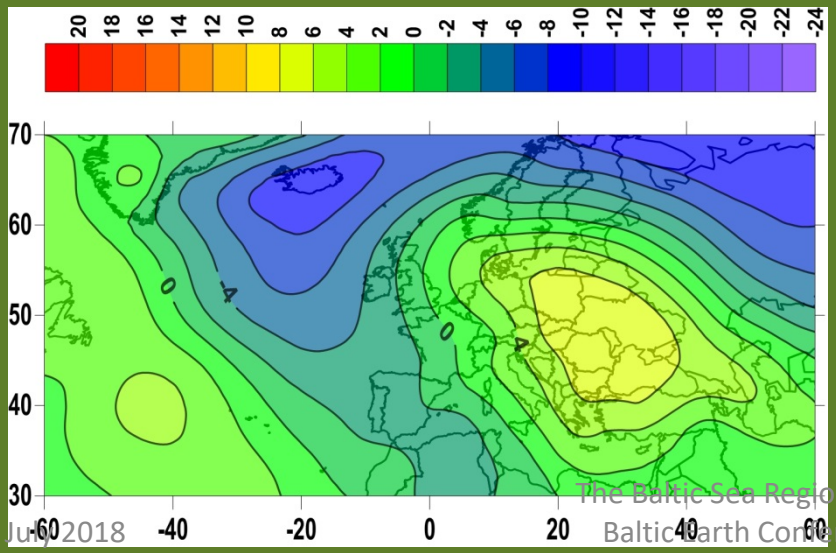
type 2, 75 days

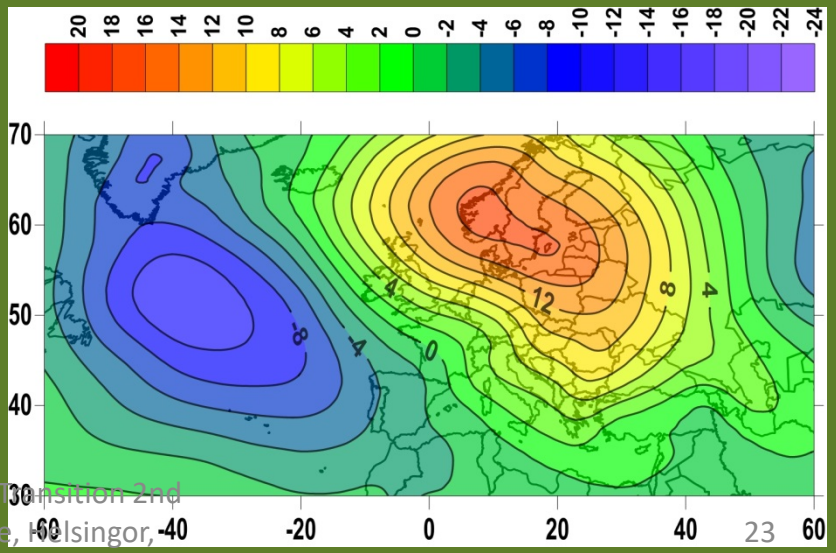
type 3, 129 days

Winter

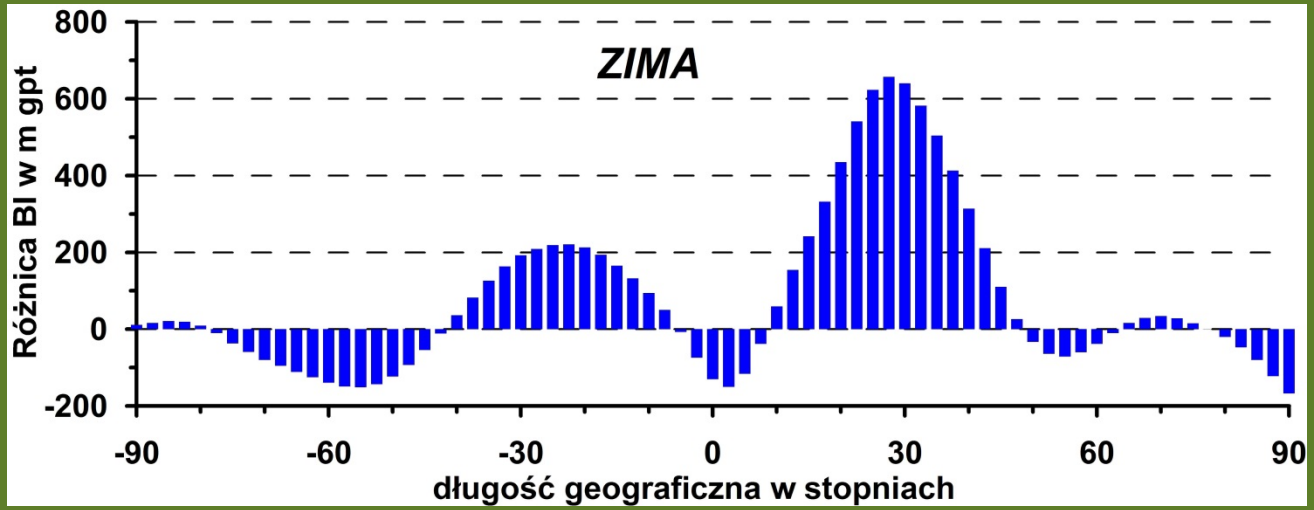








Winter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Summary:

- *In intraannual course of very dry days there are two maxima: a spring one in March and an autumn one in October,and two minima: asummer one in June andawinter one in December.*
- *There is no longterm trend of dry days frequency, but the period of lower frequency lasted from mid 80- ties to the beginning of the 21st century.*
- *The highest number of dry days were observed in 1982, 1953 and 1969*

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Summary:

- ***Dry days are accompanied by higher than usually pressure over the area of Poland***
- ***Dry days are more frequent during transient seasons: spring and autumn.***
- ***In all seasons dry days appear during blocking events with high pressure over Central Europe and low pressure over the northern part of the North Atlantic. The Azorian High is usually well developed with ridge of high pressure stretching to the north east and well developed high pressure system over Scandinavia.***