



# Large scale circulation patterns associated to seasonal dry and wet conditions over the Czech Republic

**C. BORONEANT<sup>1</sup>, V. POTOP<sup>2</sup>, M. MOZNÝ<sup>3</sup>, P. ŠTEPÁNEK<sup>3</sup>, P. SKALÁK<sup>3</sup>**

*<sup>1</sup>Center for Climate Change, Geography Dept., University Rovira I Virgili, Tortosa, Spain*

*<sup>2</sup>Czech University of Life Sciences Prague, Dept .of Agroecology and Biometeorology, Czech Republic*

*<sup>3</sup>Czech Hydrometeorological Institute, Prague, Czech Republic*



# Outline

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- **Motivation**
- **Objectives**
- **Data & Methods**
- **Results**
- **Summary & concluding remarks**



# Motivation

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- **Recent studies based on long term observations (1890-2009) point out on significant trends toward dry conditions in the Czech Republic (Trnka et al. 2009 and Brázdil et al. 2009). The intensity and frequency of drought in the region were shown to be due to changes in near surfaces temperature rather than changes in precipitation.**
- **To our knowledge, relatively few studies have dealt so far with the connection between drought in the Central Europe and its large scale driving factors.**
- **What are the large scale factors associated to seasonal moisture variability over the Czech Republic based on station observations?**



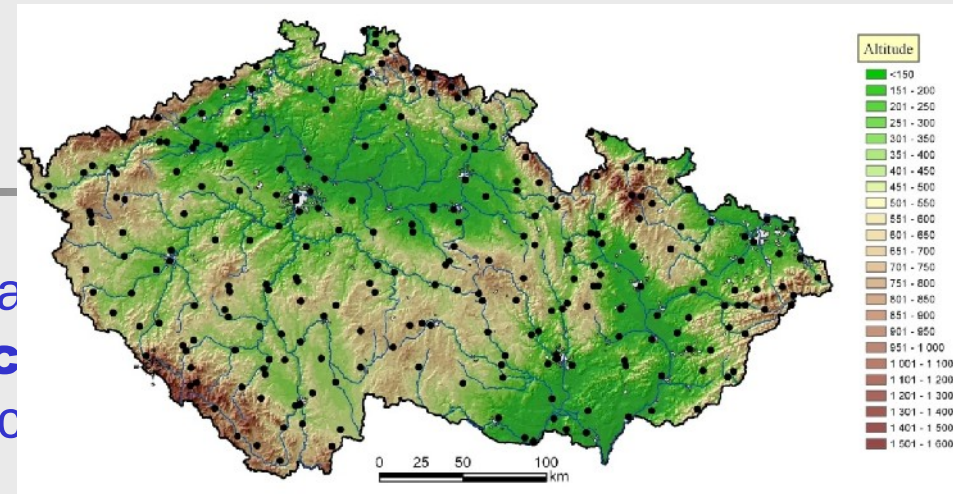
# Objectives

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- **To investigate the relationship between moisture indicators (SPEI drought index) and the large scale patterns (MSLP, PWC, SST) associated to seasonal dry and wet conditions in the Czech Republic**

# Data

- Monthly temperature means and total precipitation from **184 climatologic stations** uniformly covering the Czech Republic



## Global gridded data (2° x 2°)

- Monthly Sea Level Pressure (MSLP) and Precipitable water content (PWC)

[http://www.esrl.noaa.gov/psd/data/gridded/data.20thC\\_ReanV2.html](http://www.esrl.noaa.gov/psd/data/gridded/data.20thC_ReanV2.html)  
(Compo et al. 2006, 2011; Whitaker et al. 2004), and

- Sea Surface Temperature (SST) from NOAA Extended Reconstructed Sea Surface Temperature (SST) V3b

<http://www.esrl.noaa.gov/psd/data/gridded/data.noaa.ersst.html>.

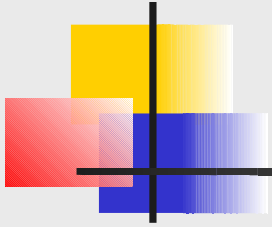
**Period of analysis: 1961-2010**

# Methods



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- **Standardized Precipitation-Evapotranspiration Index - SPEI (Vicente-Serrano, 2010)** <http://sac.csic.es/spei/index.html>
- **EOF Analysis (Preisendorfer 1988, von Storch 1995)**
- **Composite maps (MSLP, PWC, SST vs  $\pm 0.75$  stdv PC1 of seasonal SPEI 1 mo lag)**



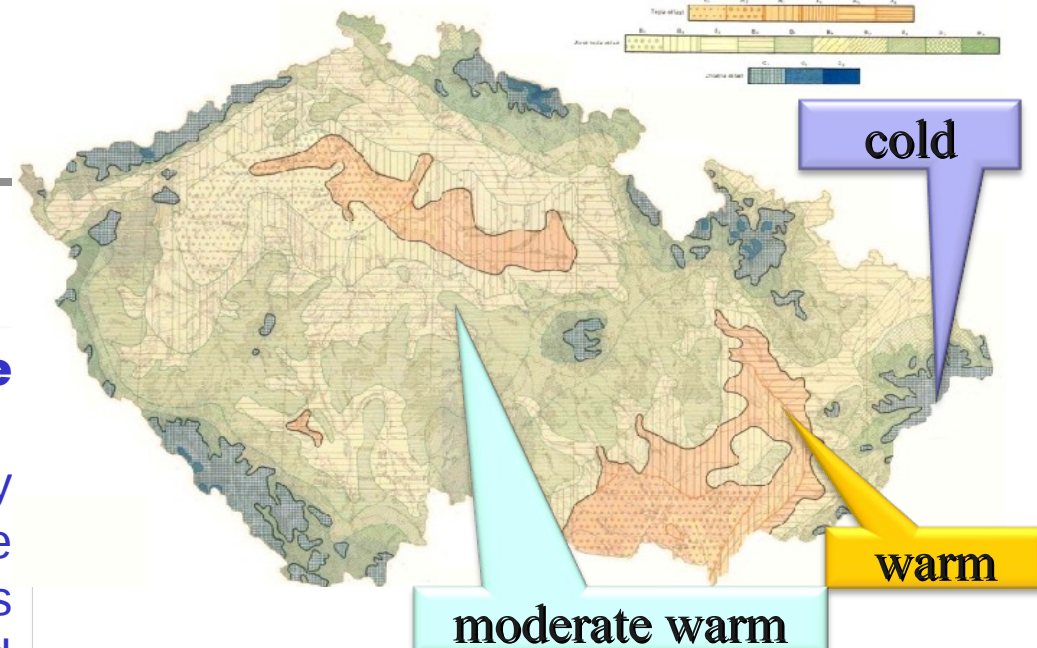
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# Results

# Climate of the Czech Republic

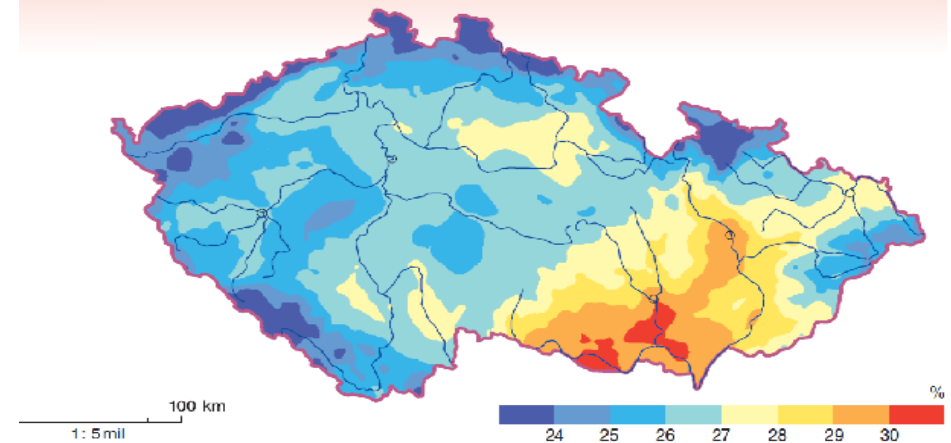
## Climatic classification according to Quitt (1971)

- on the **borderline** between **temperate continental and oceanic**;
- relatively hot summers and cold, cloudy and snowy winters. The temperature difference between summer and winter is relatively high, due to the landlocked geographical position
- **Continentality** increases from W to E and is greater in the lowlands than at higher locations



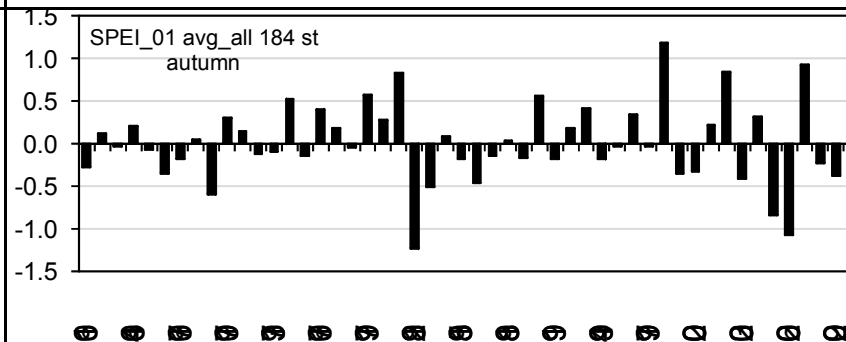
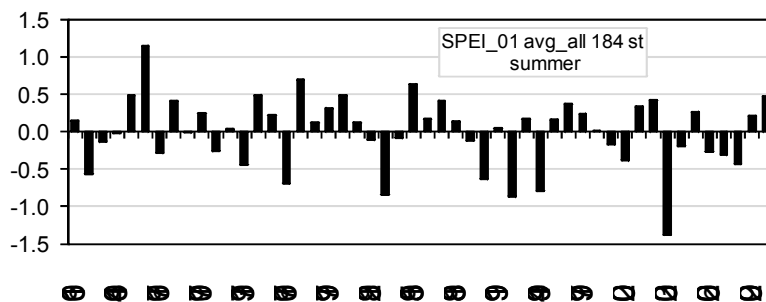
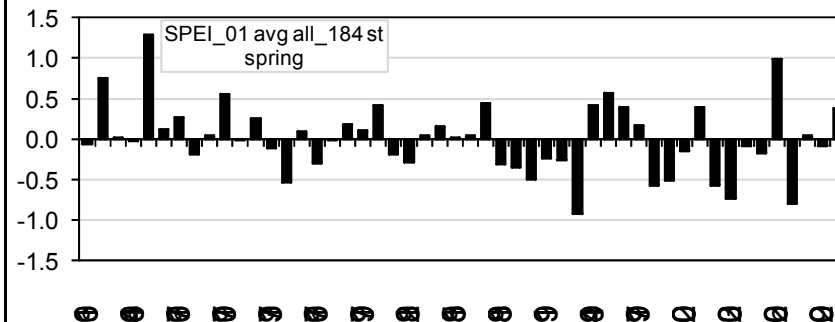
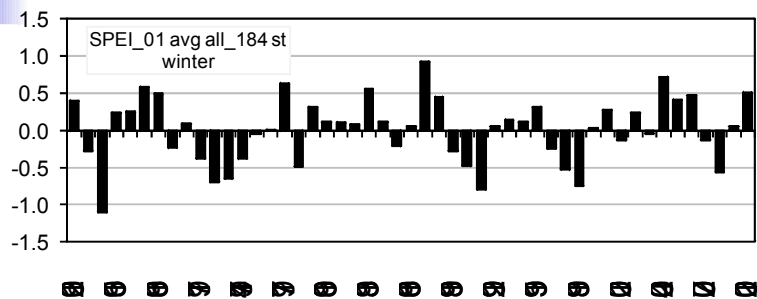
### Continentality

TERMICKÁ KONTINENTALITA PODNEBÍ PODLE GORCZYŃSKÉHO / THERMAL CONTINENTALITY ACCORDING TO GORCZYŃSKI





# Temporal evolution of seasonal SPEI at 1 month lag averaged over all 184 stations



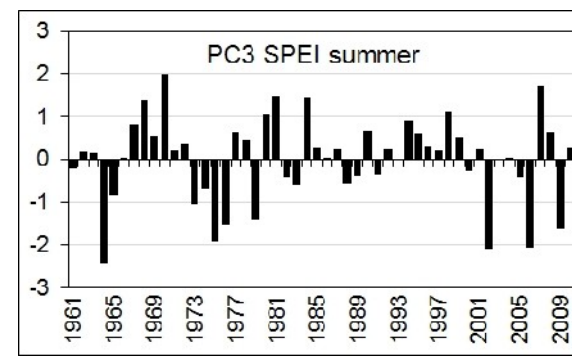
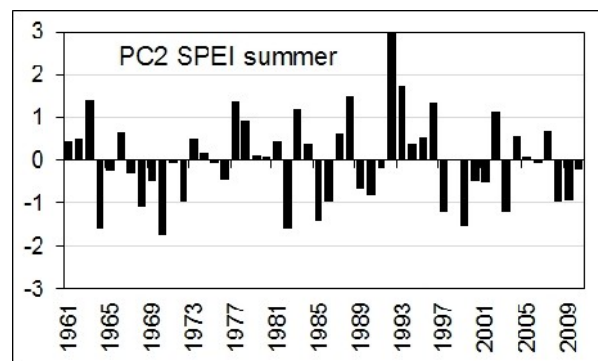
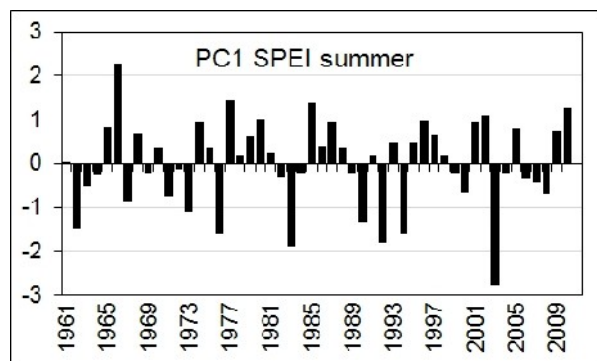
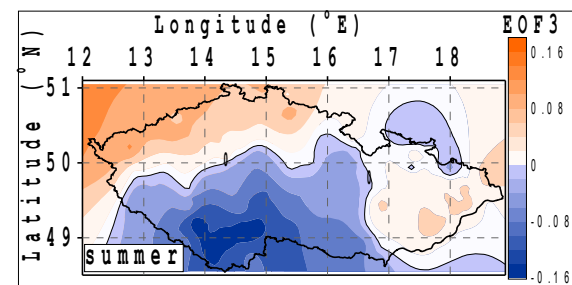
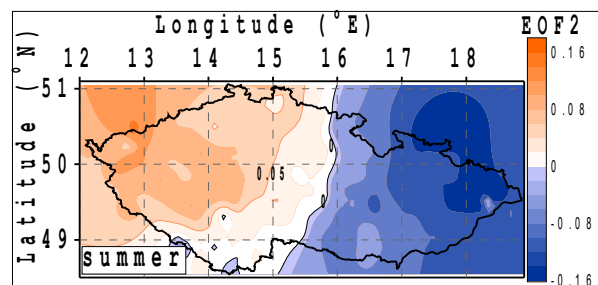
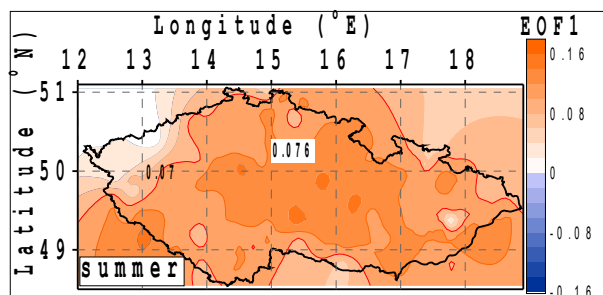



# The explained variance of the first three EOFs of seasonal SPEI at 1 month lag

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	<b>Explained variance (%)</b>			
	<b>wi</b>	<b>sp</b>	<b>su</b>	<b>au</b>
	<b>SPEI_01</b>			
<b>EOF1</b>	<b>57.81</b>	<b>61.30</b>	<b>58.83</b>	<b>65.81</b>
<b>EOF2</b>	<b>14.36</b>	<b>7.52</b>	<b>8.93</b>	<b>8.83</b>
<b>EOF3</b>	<b>6.08</b>	<b>5.69</b>	<b>4.92</b>	<b>5.61</b>

# The spatial patterns of the first three EOFs of summer SPEI at 1 month lag over the Czech Republic (upper panel) and the corresponding temporal PC series normalized by its standard deviation (lower panel).



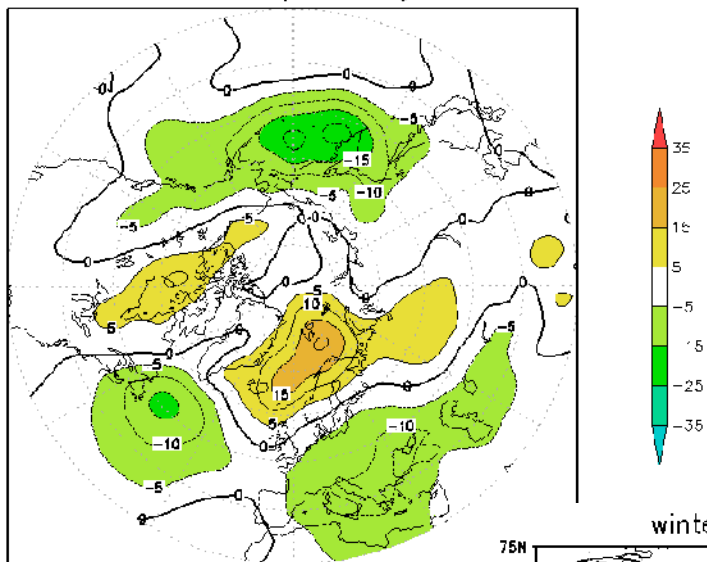


**The wettest and driest years  
(standardized amplitude of PC1 > 0.75 and < - 0.75,  
respectively)  
used to build the composite maps**

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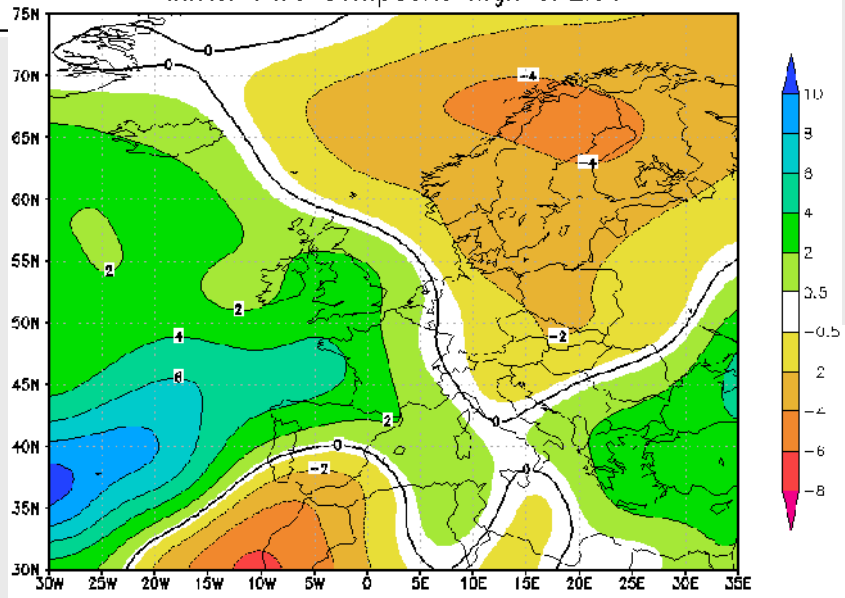
<b>Season</b>	<b>Winter</b>	<b>Spring</b>	<b>Summer</b>	<b>Autumn</b>
<b>Wet years</b>	1962, 1967, 1968, 1977, <b><u>1983</u></b> , 1987, 1988, 2004, 2005, 2006, <b><u>2010</u></b>	1962, <b><u>1965</u></b> , 1970, 1980, 1987, 1994, 1995, 1996, 2001, 2006, <b><u>2010</u></b>	<b><u>1965</u></b> , 1966, 1974, 1977, 1980, 1985, 1987, 1996, 2001, 2002, 2005, <b><u>2010</u></b>	1974, 1976, 1979, 1981, 1990, 1993, 1998, 2002, 2007
<b>Dry years</b>	1964, 1971, 1972, 1973, 1974, 1978, 1990, 1991, 1997, 1998, 2008	1968, 1974, 1976, 1989, 1990, 1993, 1998, 1999, 2002, <b><u>2003</u></b> , 2007	1962, 1967, 1973, 1976, 1983, 1990, 1992, 1994, <b><u>2003</u></b>	1969, 1982, <b><u>1983</u></b> , 1986, 1999, <b><u>2003</u></b> , 2005, 2006, 2009

winter MSLP composite high SPEI01

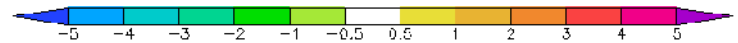
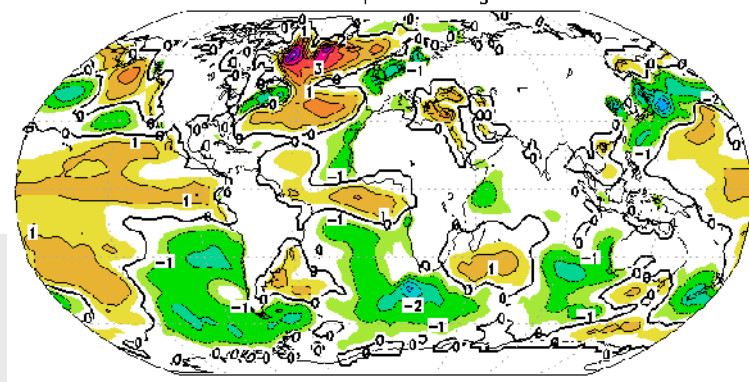


**Composite maps of anomalies  
(11 maps)  
Mean Sea Level Pressure  
Precipitable Water Content  
SST &  $>+ 0.75$  std of winter PC1  
SPEI\_01 mo**

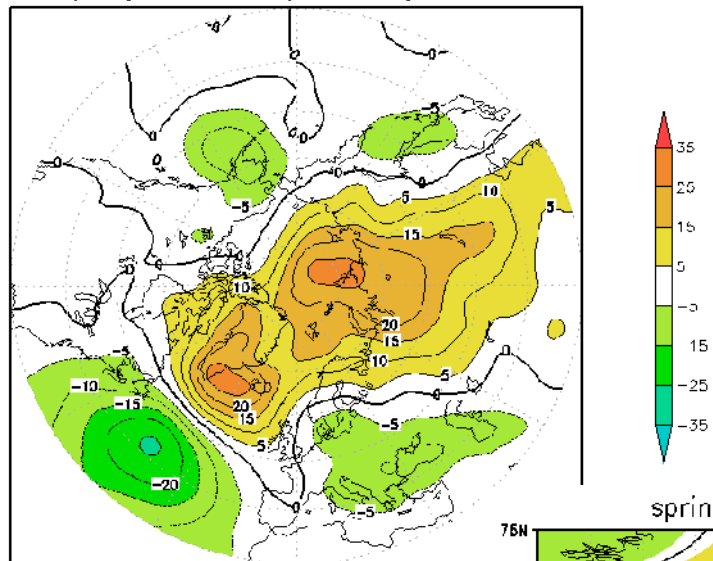
winter PWC composite high SPEI01



winter SST composite high SPEI01

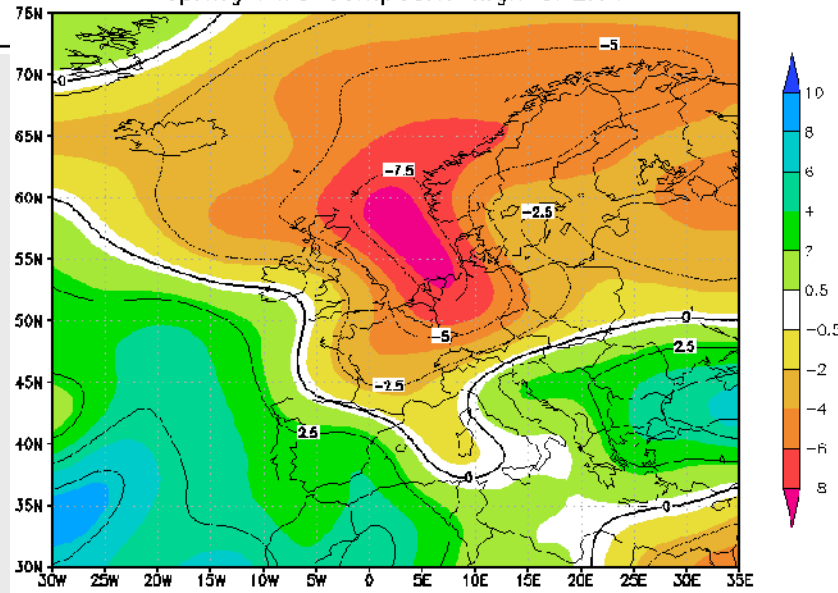


spring MSLP composite high SPEI01

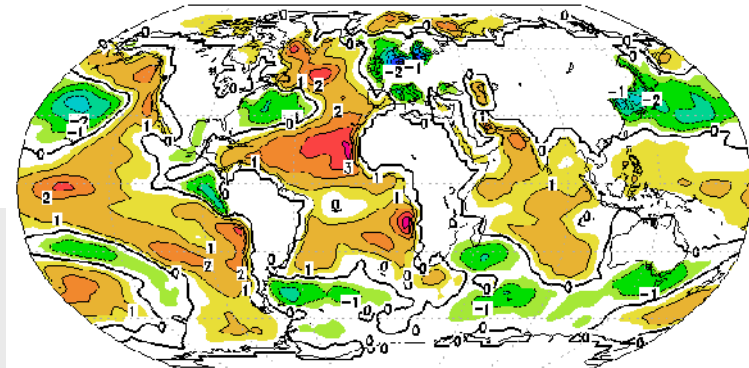


**Composite maps of anomalies  
(11 maps)  
Mean Sea Level Pressure  
Precipitable Water Content  
SST &  $> + 0.75$  std spring PC1  
SPEI\_01 mo**

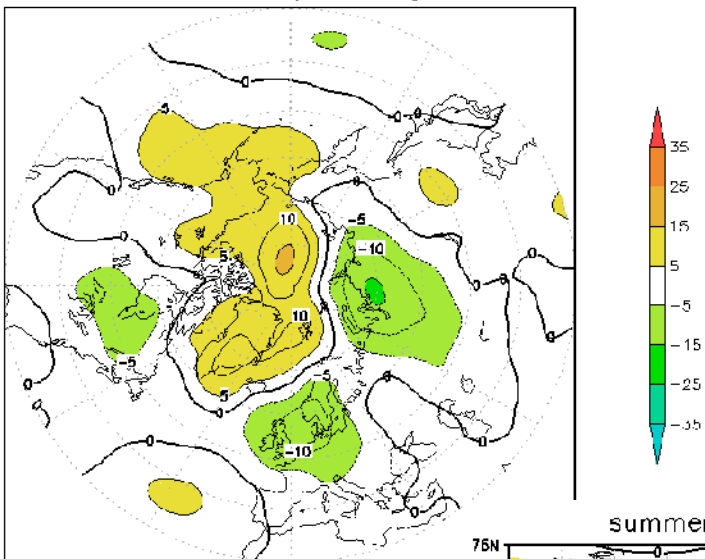
spring PWC composite high SPEI01



spring SST composite high SPEI01

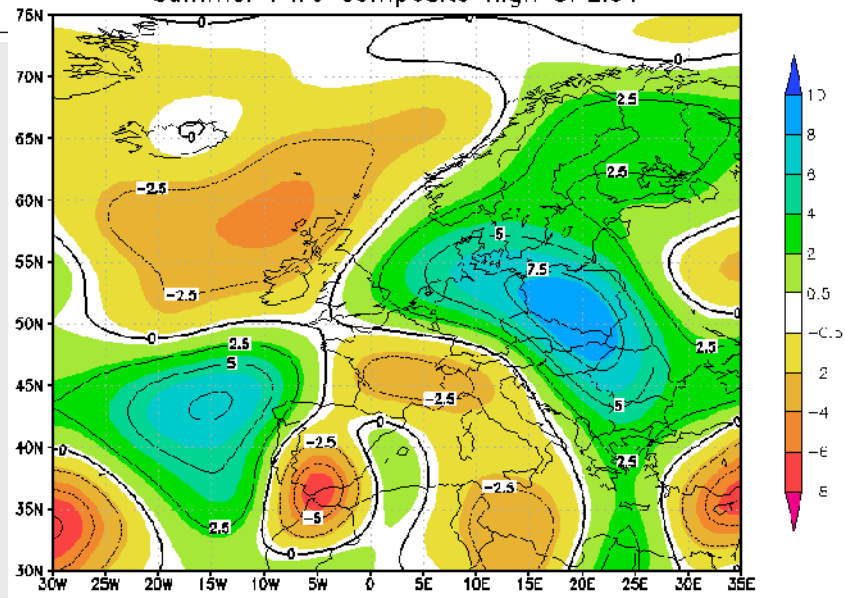


summer MSLP composite high SPEI01

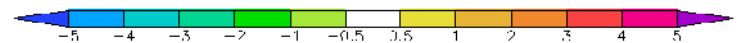
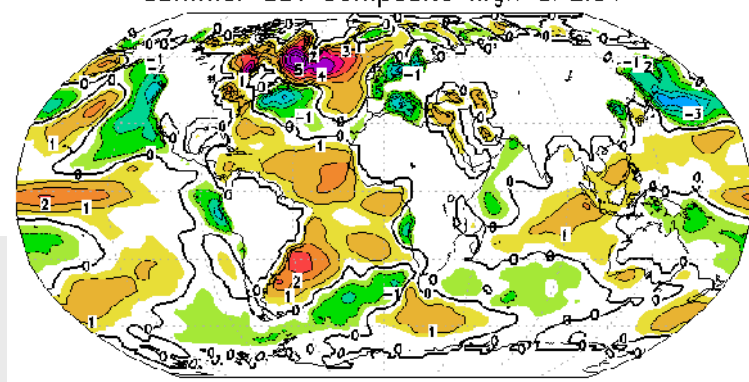


**Composite maps of anomalies  
(11 maps)  
Mean Sea Level Pressure  
Precipitable Water Content  
SST & >+ 0.75 std summer PC1  
SPEI\_01 mo**

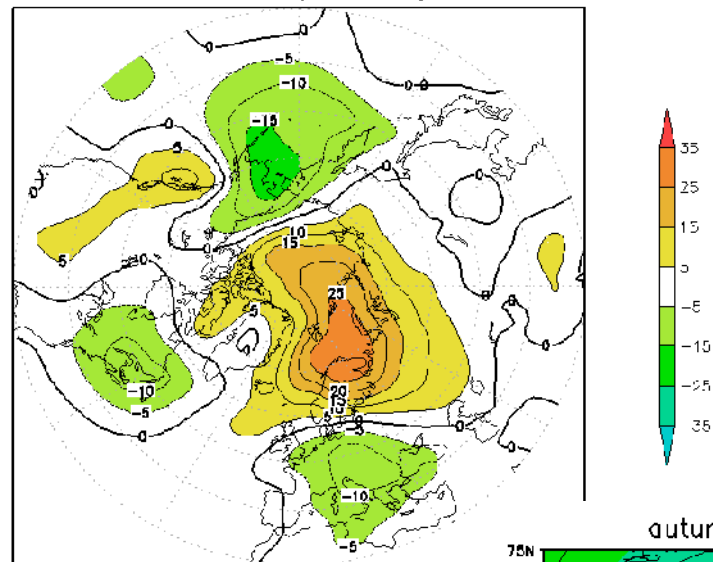
summer PWC composite high SPEI01



summer SST composite high SPEI01



autumn MSLP composite high SPEI01



## Composite maps of anomalies (9 maps)

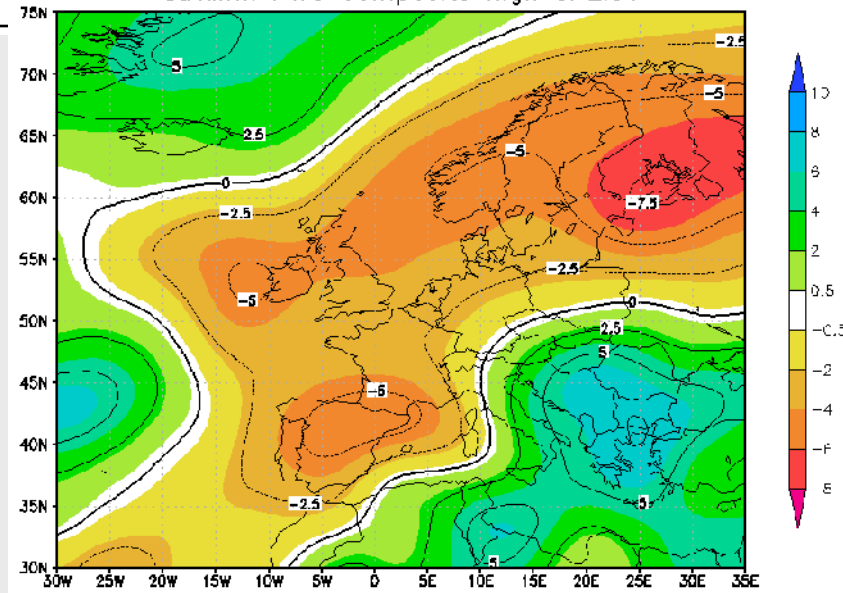
Mean Sea Level Pressure

Precipitable Water Content

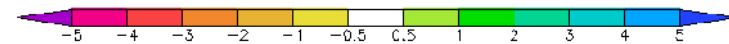
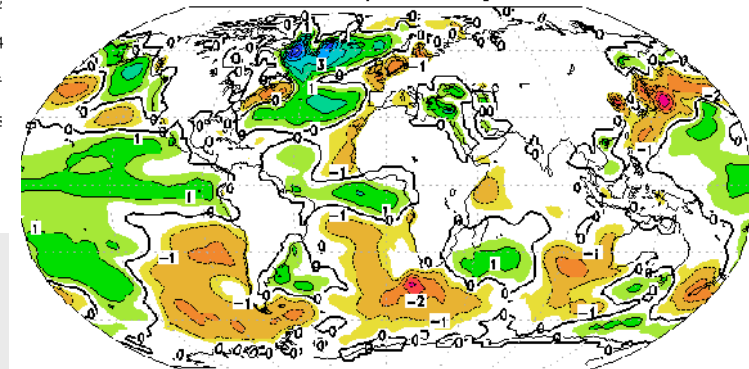
SST &  $>+ 0.75$  std autumn PC1

SPEI\_01 mo

autumn PWC composite high SPEI01

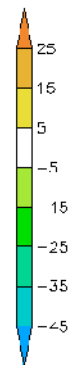
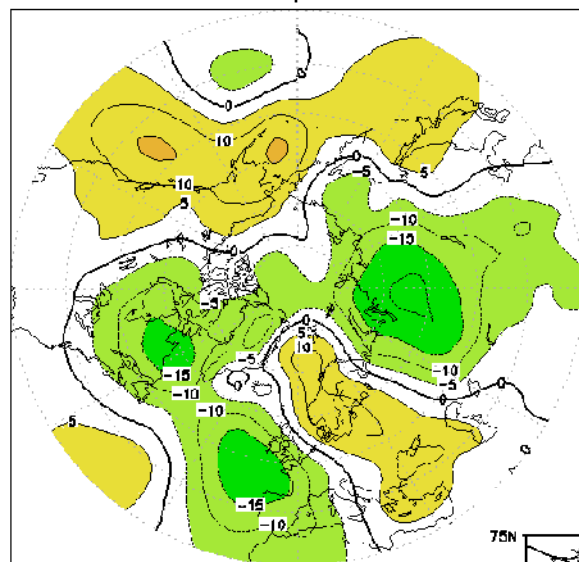


winter SST composite high SPEI01





winter MSLP composite low SPEI01



# Composite maps of anomalies (11 maps)

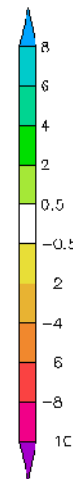
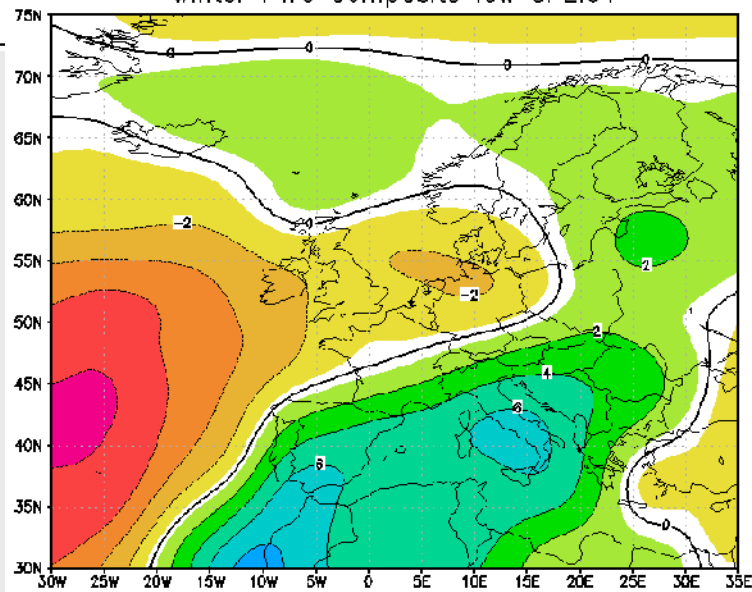
Mean sea Level pressure

Precipitable Water content

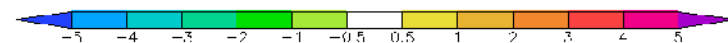
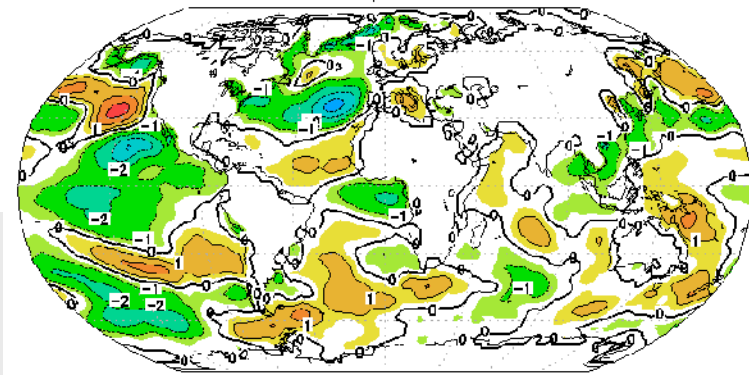
SST &  $< -0.75$ std winter PC1

SPEI\_01 mo lag

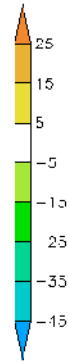
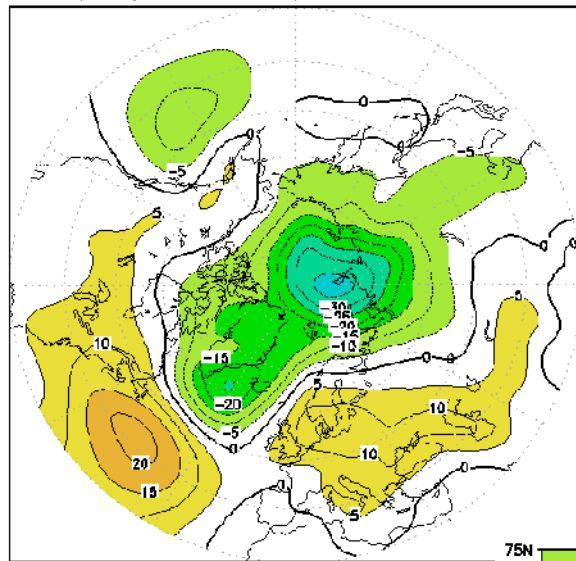
winter PWC composite low SPEI01



winter SST composite low SPEI01

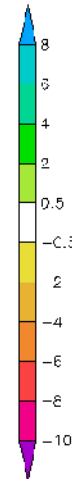
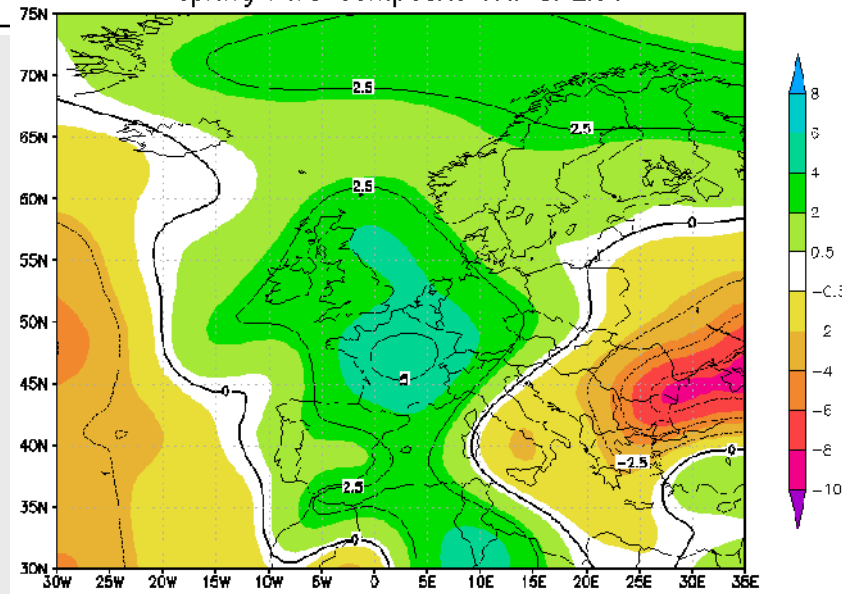


spring MSLP composite low SPEI01

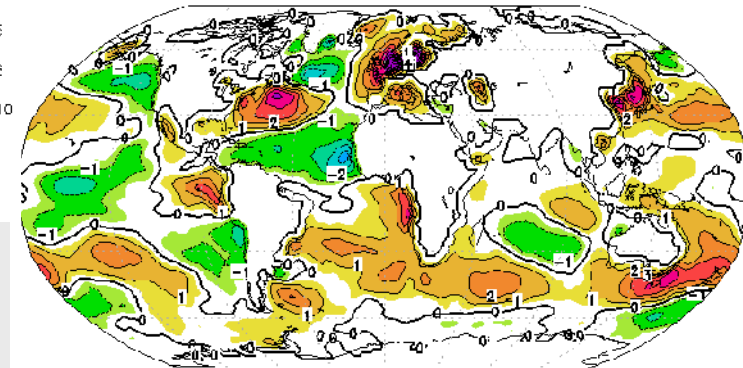


**Composite maps of anomalies (10 maps)**  
**Mean sea Level pressure**  
**Precipitable Water content**  
**SST &  $< -0.75$ std spring PC1**  
**SPEI\_01 mo lag**

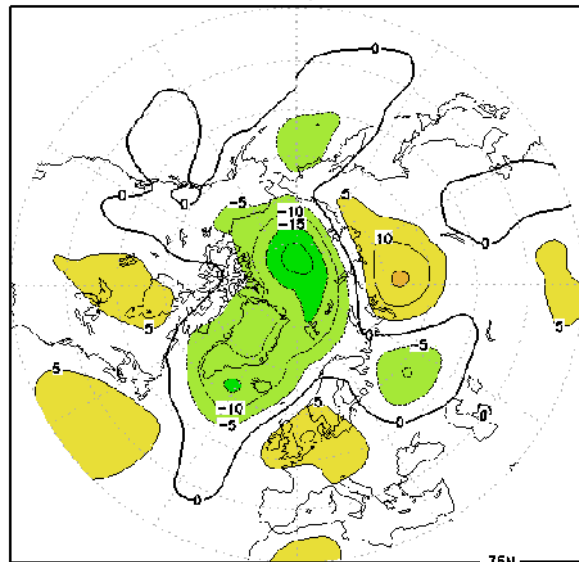
spring PWC composite low SPEI01



spring SST composite low SPEI01



summer MSLP composite low SPEI01



# Composite maps of anomalies (9 maps)

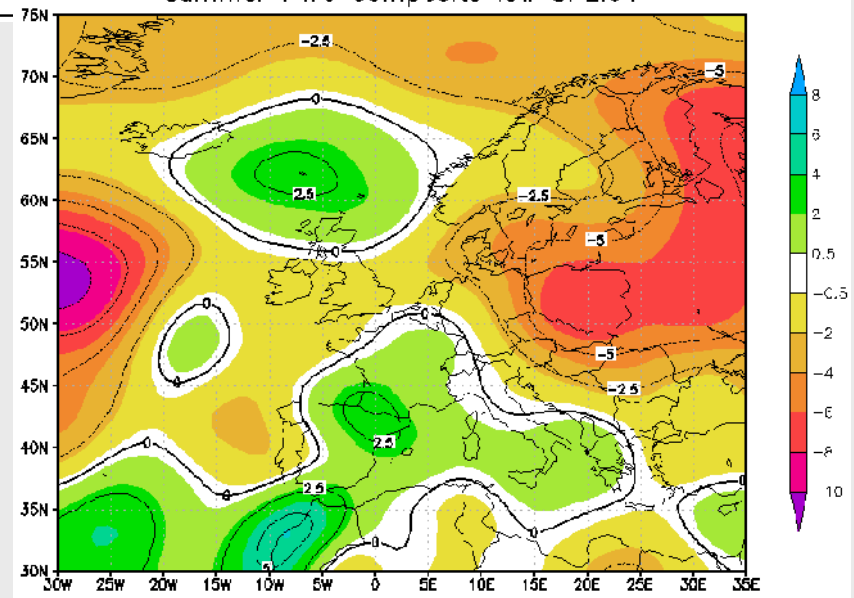
Mean sea Level pressure

Precipitable Water content

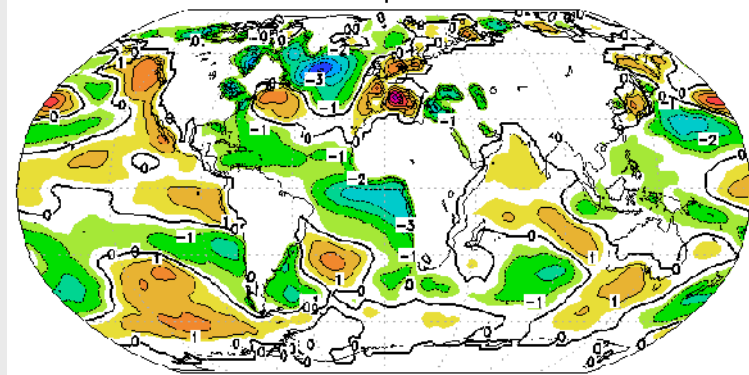
SST &  $\leftarrow$  0.75std summer PC1

SPEI\_01 mo lag

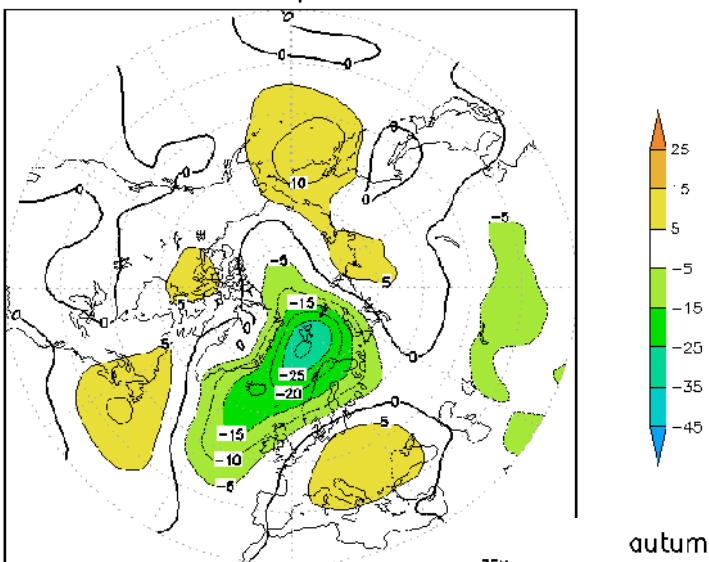
summer PWC composite low SPEI01



summer SST composite low SPEI01

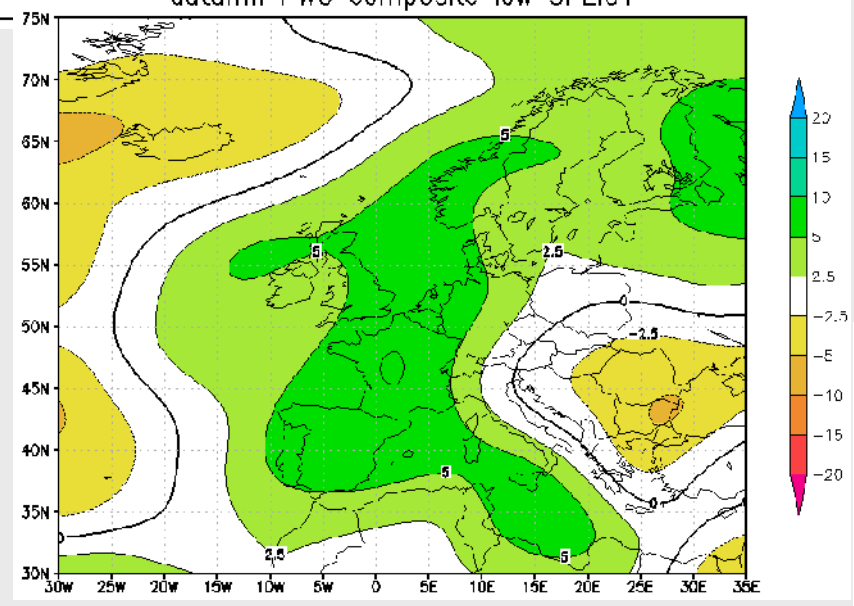


autumn MSLP composite low SPEI01

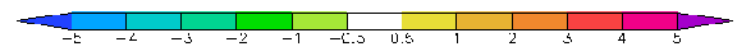
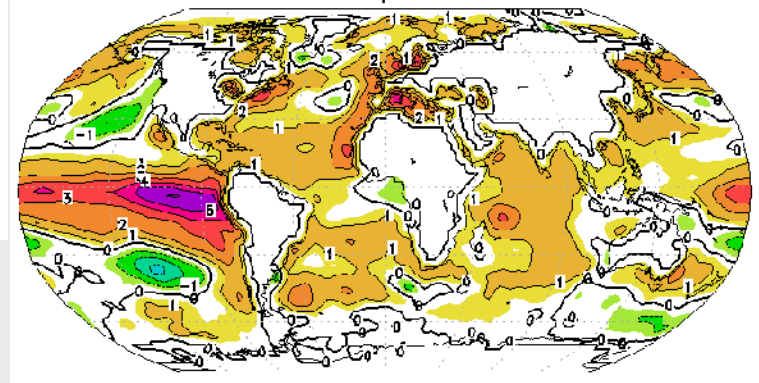


**Composite maps of anomalies (9 maps)**  
**Mean sea Level pressure**  
**Precipitable Water content**  
**SST & <- 0.75std autumn PC1**  
**SPEI\_01 mo lag**

autumn PWC composite low SPEI01



autumn SST composite low SPEI01





## **Summary & concluding remarks**

- **seasonal modes of variability of the SPEI at 1 mo lag at 184 stations of the Czech Republic have been analyzed**
- **the explained variance of EOF1 ranges between 58% (winter) and 66% (autumn); spatial coefficients have positive loadings at all stations; the EOF2 pattern point out on the climate influences (oceanic and continental)**
- **the seasonal composite maps of MSLP, PWC and SST anomalies built on selected standardized values of PC1 of SPEI-01 (higher/lover than  $\pm 0.75$  std of the series) point out on large scale driving mechanisms:**
  - **negative/positive AO phase associated with La Niña/El Niño years which may induce wet/dry conditions over the Czech Republic**



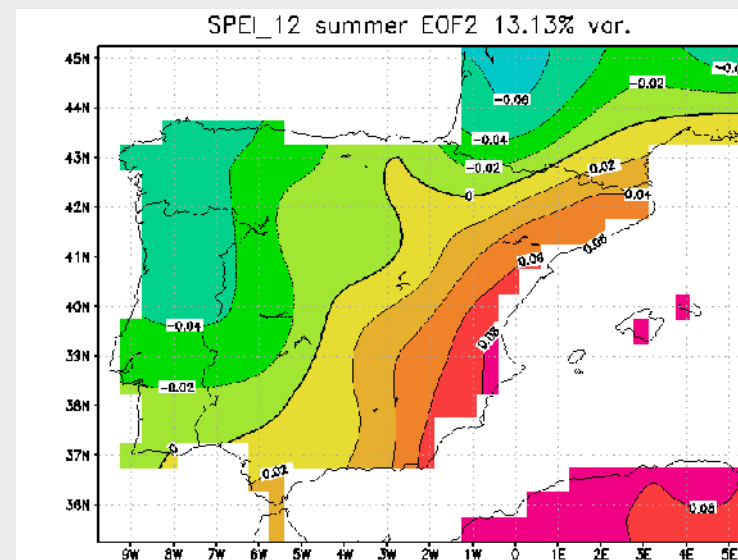
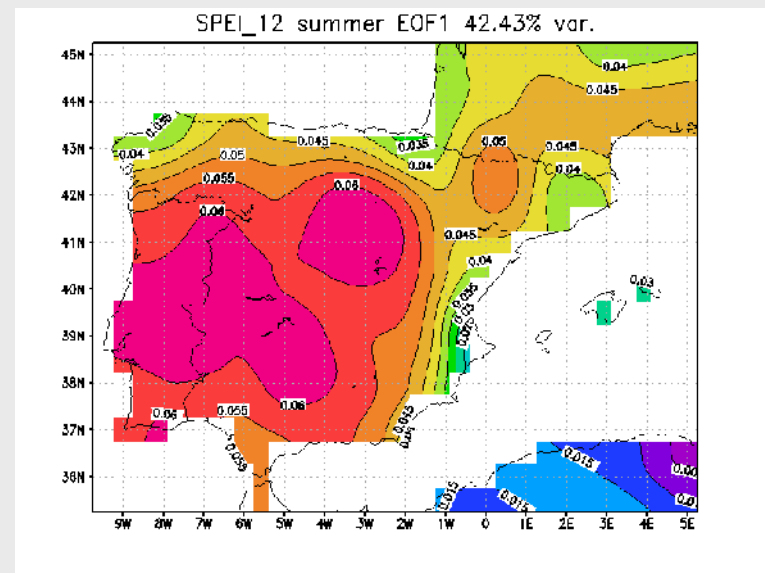
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**¡Gracias por su attention !**

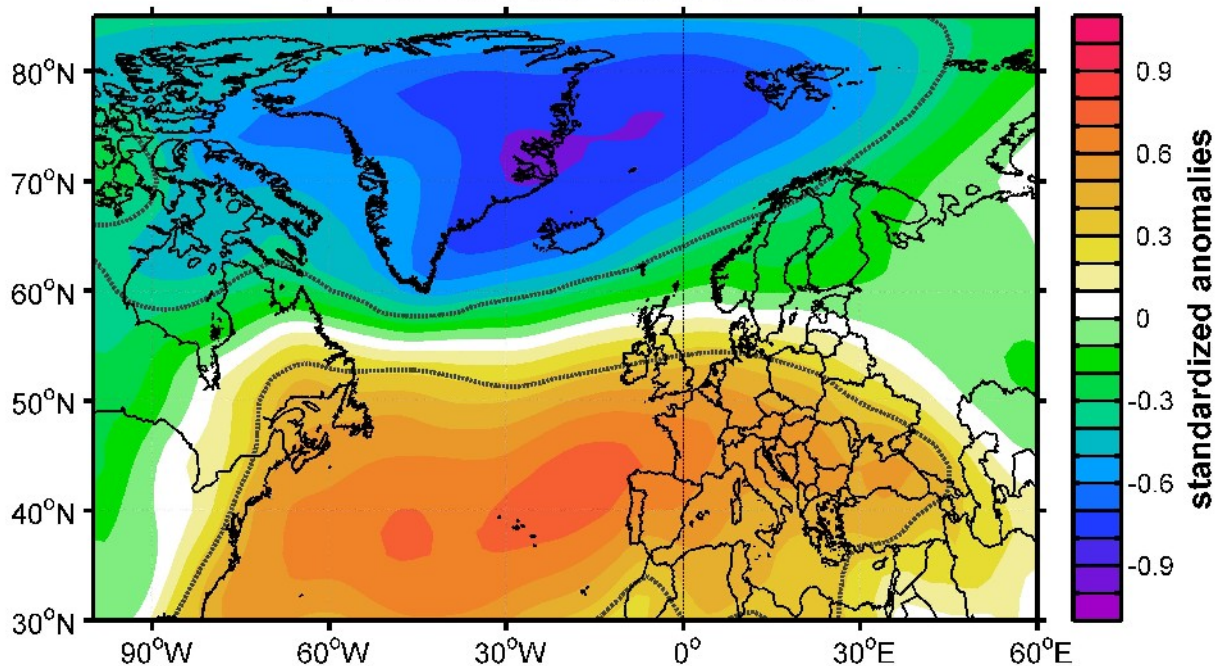
# Iberian Peninsula seasonal EOFs SPEI\_03\_06\_12\_24

## Explained variance & patterns

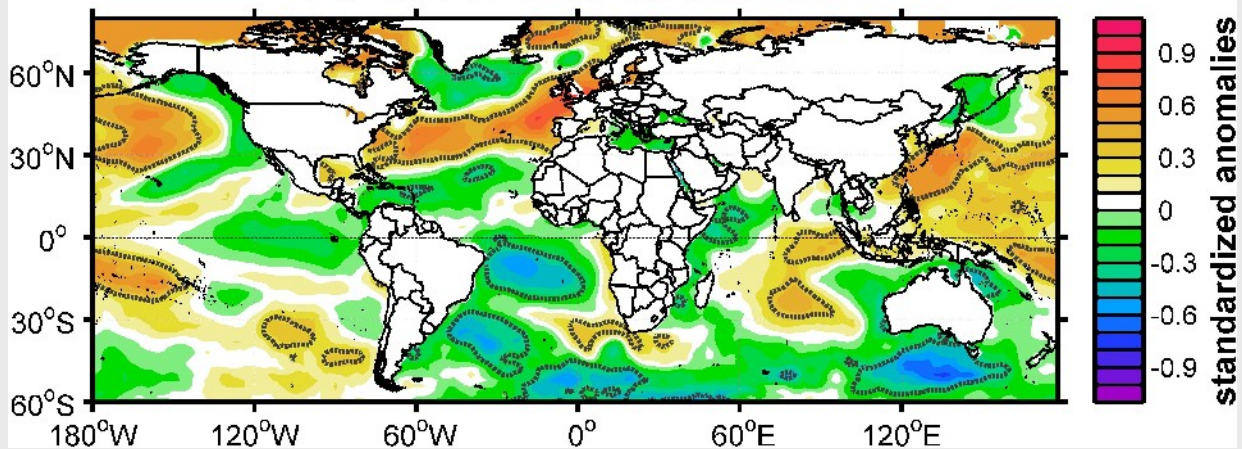
	SPEI_03	SPEI_06	SPEI_12	SPEI_24
wi_EOF1	43.75	40.43	40.75	40.35
wi_EOF2	13.06	13.34	13.20	13.30
wi_EOF3	12.08	11.17	10.47	10.82
sp_EOF1	48.65	45.80	42.65	41.01
sp_EOF2	14.93	12.84	11.82	13.08
sp_EOF3	9.81	10.25	10.22	10.56
su_EOF1	51.74	47.66	<u>42.43</u>	41.90
su_EOF2	11.82	13.92	<u>13.13</u>	13.70
su_EOF3	8.64	8.95	10.45	10.40
au_EOF1	43.68	43.06	42.77	42.09
au_EOF2	12.51	11.93	12.72	13.42
au_EOF3	10.60	10.13	10.21	10.61



**Low Composite Map  
PC1 SPEI12 DJF vs. SLP DJF**

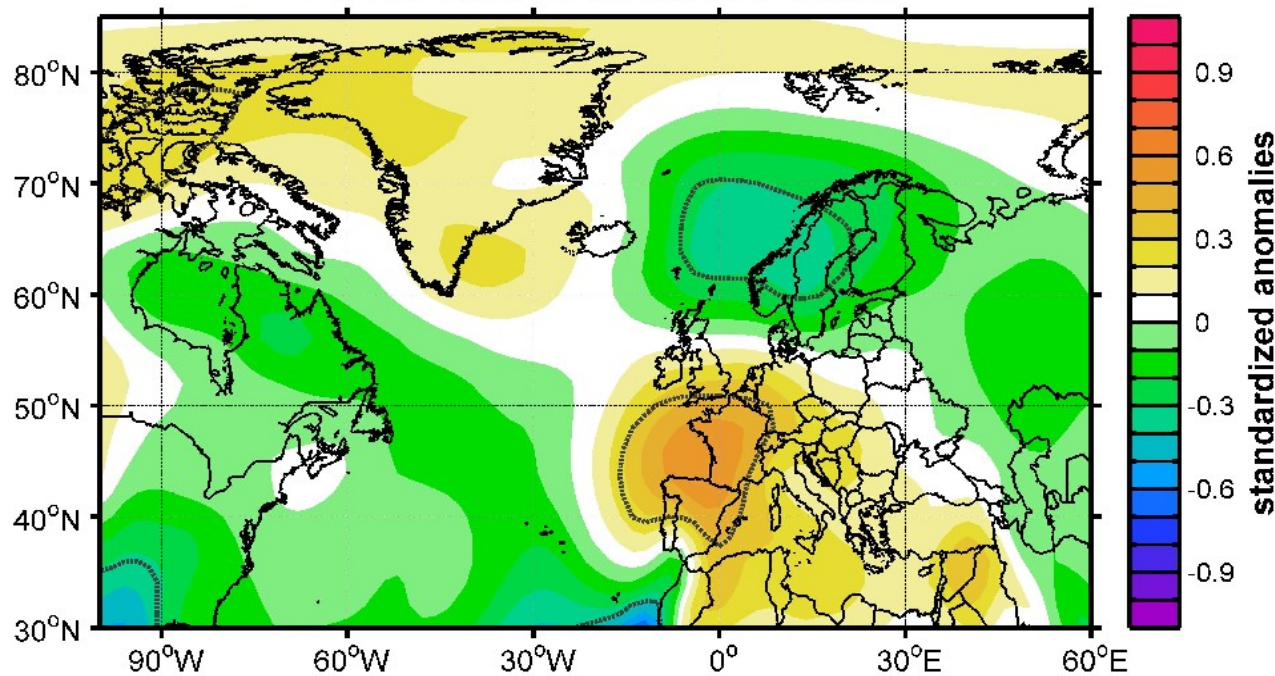


**Low Composite Map  
PC1 SPEI12 DJF vs. SST DJF**





**Low Composite Map  
PC1 SPEI12 MAM vs. SLP MAM**



**Low Composite Map  
PC1 SPEI12 MAM vs. SST MAM**

