

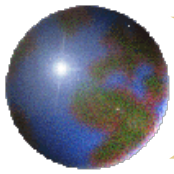
Frequency, persistence, and seasonality of atmospheric circulation types in European regions

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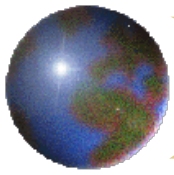
(1) Institute of Atmospheric Physics, Academy of Sciences of the Czech Republic

(2) Faculty of Science, Charles University, Prague



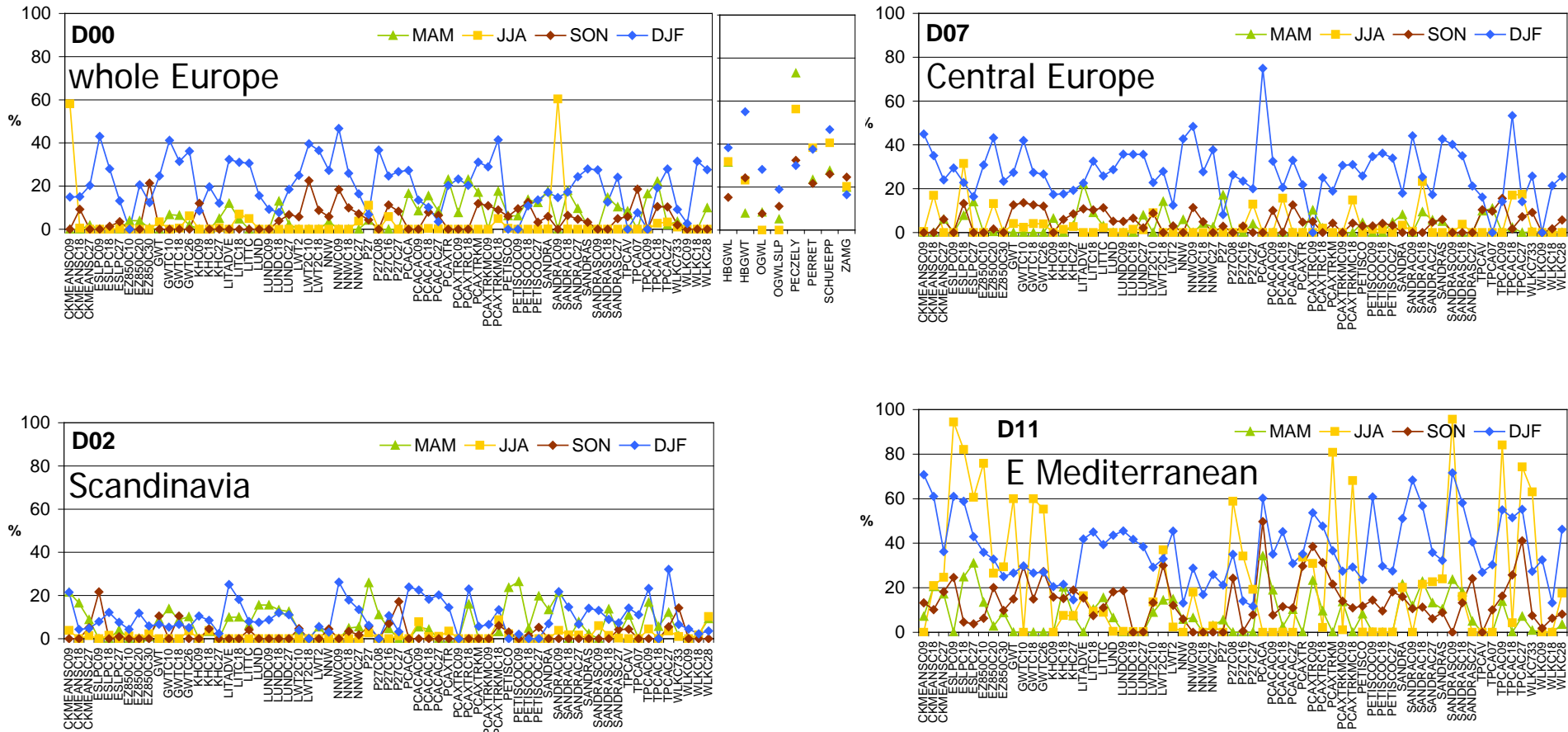
Frequency of CTs

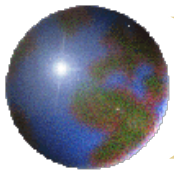
- ✦ we studied seasonal linear trends in the frequency of CTs in 1957-2002 in all catalogues from cat.1.2, all domains
- ✦ total number of CTs > 55,000
- ✦ comparison of objective and subjective catalogues
- ✦ related issues
 - ❖ different number of CTs in individual catalogues
 - ❖ in each catalogue, season, and domain, we were looking for the CTs with trends significant at the 95% level
 - ❖ different overall occurrence of individual CTs – how to compare the resulting trends?
 - ❖ thus we calculated the percentage of DAYS occupied by CTs with significant trends in frequency



Frequency of CTs

Percentage of days occupied by CTs with significant trend in frequency in selected domains



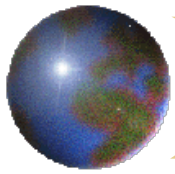


Frequency of CTs

Magnitude of significant trends in the frequency of CTs in GWTC10
(days per season in 1957-2002)

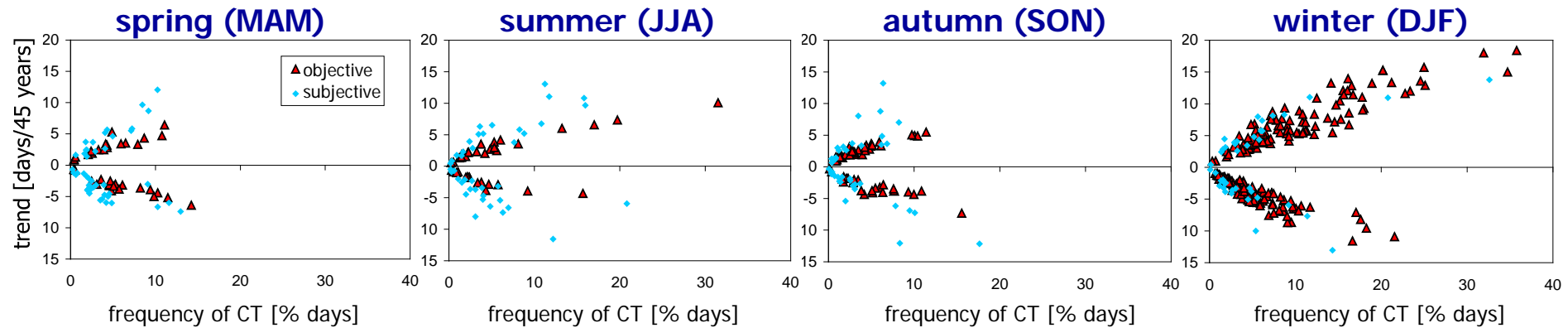
		W	SW	NW	C	A	N	NE	E	SE	S
spring	D00								-4		
	D01									-6	
	D02	5									
	D03								-5		
	D04										
	D05										
	D06										
	D07										
	D08			5							
	D09				2			-8			
	D10				-3						
	D11										
summer	D00										
	D01										
	D02										
	D03										
	D04		5								
	D05										
	D06				3						
	D07				-2						
	D08										
	D09						-6				
	D10				-2		-5	9			
	D11										

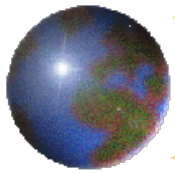
		W	SW	NW	C	A	N	NE	E	SE	S
autumn	D00										
	D01										-6
	D02										
	D03										
	D04										
	D05										
	D06										
	D07					-4	4				
	D08				2						
	D09										
	D10										
	D11						5		-7		
winter	D00	17			-11						
	D01										
	D02							-3			
	D03										
	D04		10								
	D05									-6	
	D06	8							-6		
	D07	16				-4					-7
	D08	14			-3				-9	-10	
	D09										
	D10			5	-3						-6
	D11							11			-8



Frequency of CTs

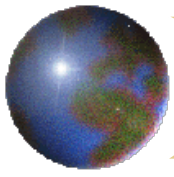
Seasonal frequency vs. magnitude of significant trends in frequency of CTs in Central Europe (D07)
Results from all objective and all subjective classifications



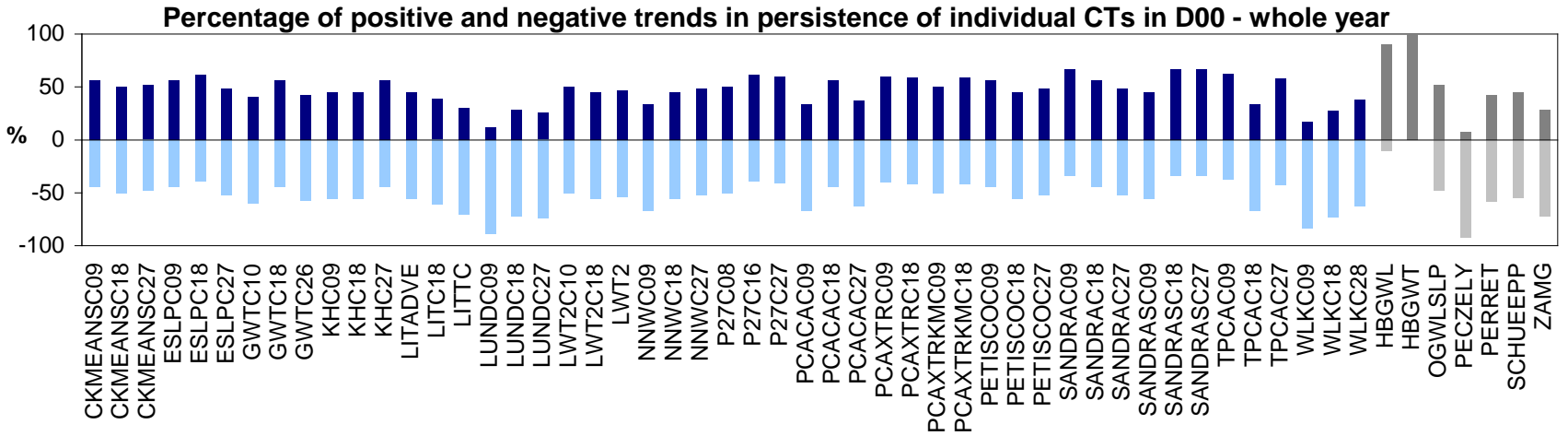
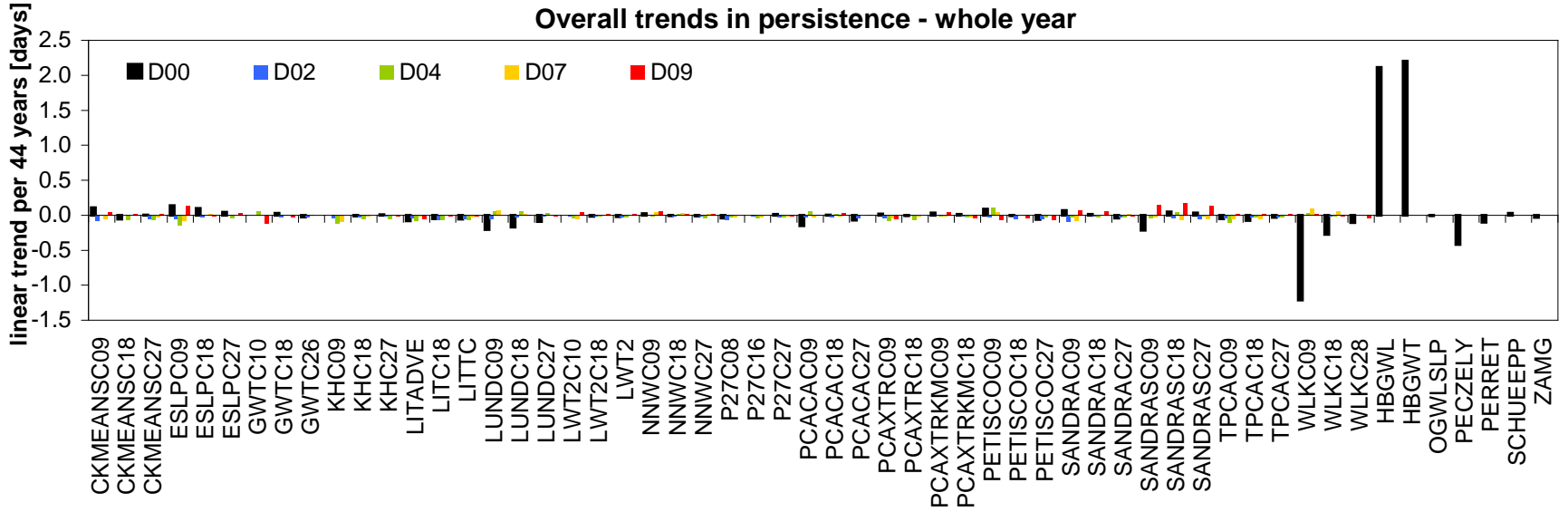


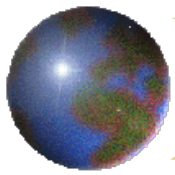
Persistence of CTs

- ✦ persistence = length of sequence of days classified with one CT
- ✦ Hess-Brezowsky: sudden increase in persistence in the mid-1980s – is it real or is it just an inhomogeneity?
- ✦ COST733 catalogue version 1.2, domains 00, 02, 04, 07, 09
- ✦ additional: OGWL with a minimum 3-day duration of CTs (...thanks to Paul James)
- ✦ applied statistics:
 - ❖ long-term persistence of individual types and all types combined
 - ❖ time series of annual persistence
 - ❖ linear trends of persistence
 - ❖ correlation of time series of persistence between pairs of classifications



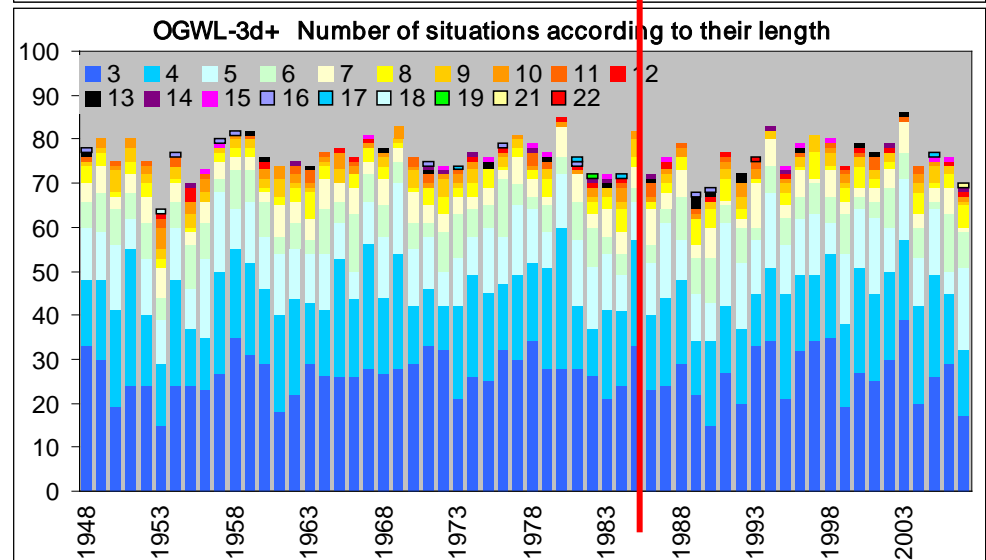
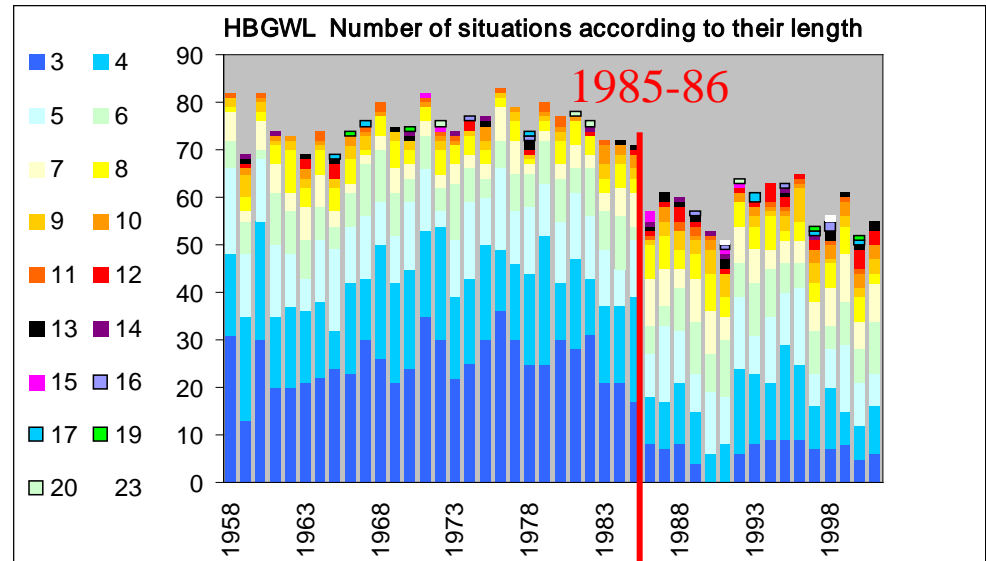
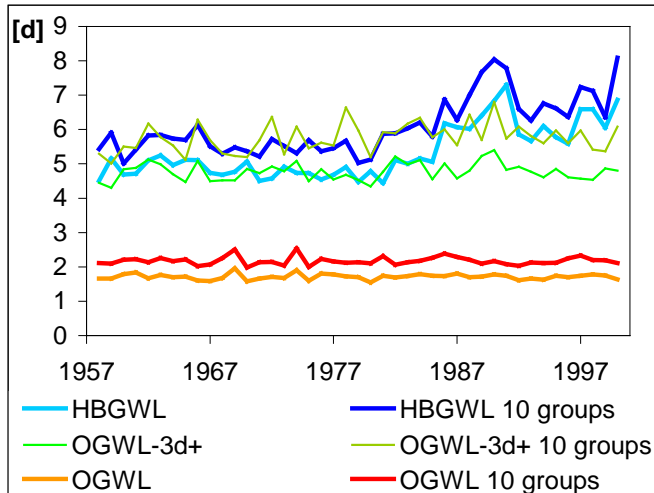
Persistence of CTs

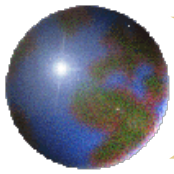




Persistence of CTs

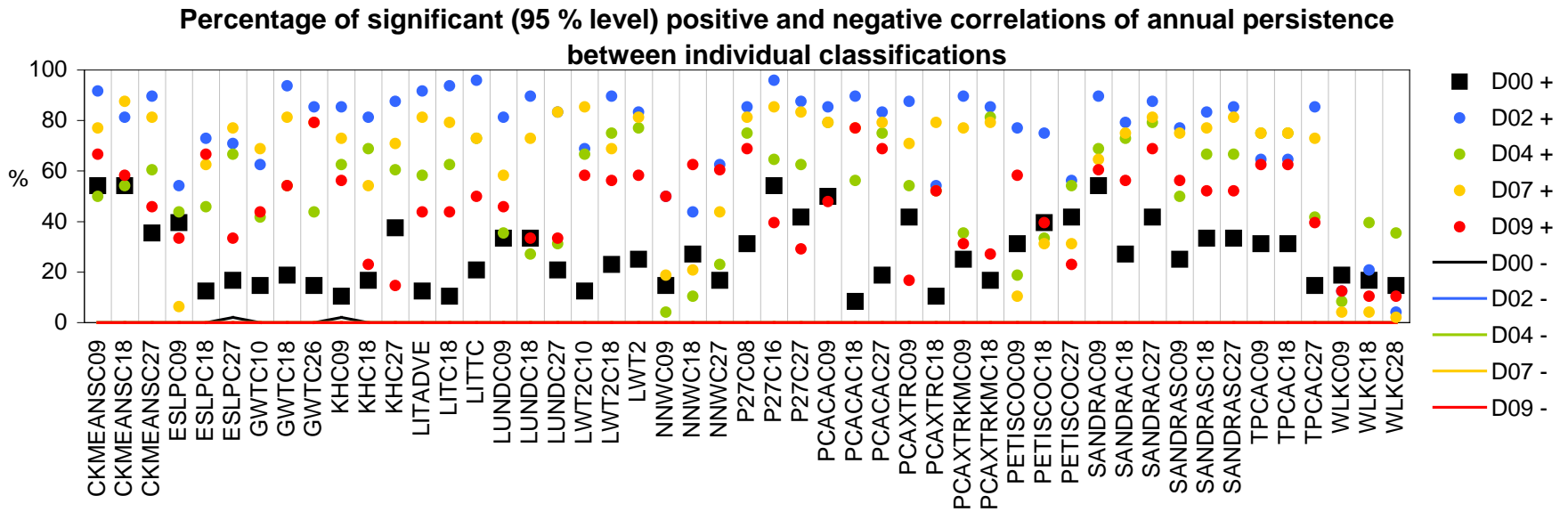
- the sudden increase in persistence in the Hess-Brezowsky in the mid-1980 is most probably an inhomogeneity
- it is caused by vanishing 3-day events

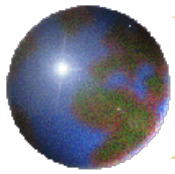




Persistence of CTs

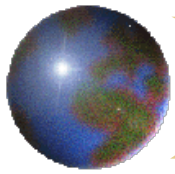
- Do individual classifications share a common long-term pattern of year-to-year changes in persistence?
- correlation of time series of annual persistence between pairs of classifications





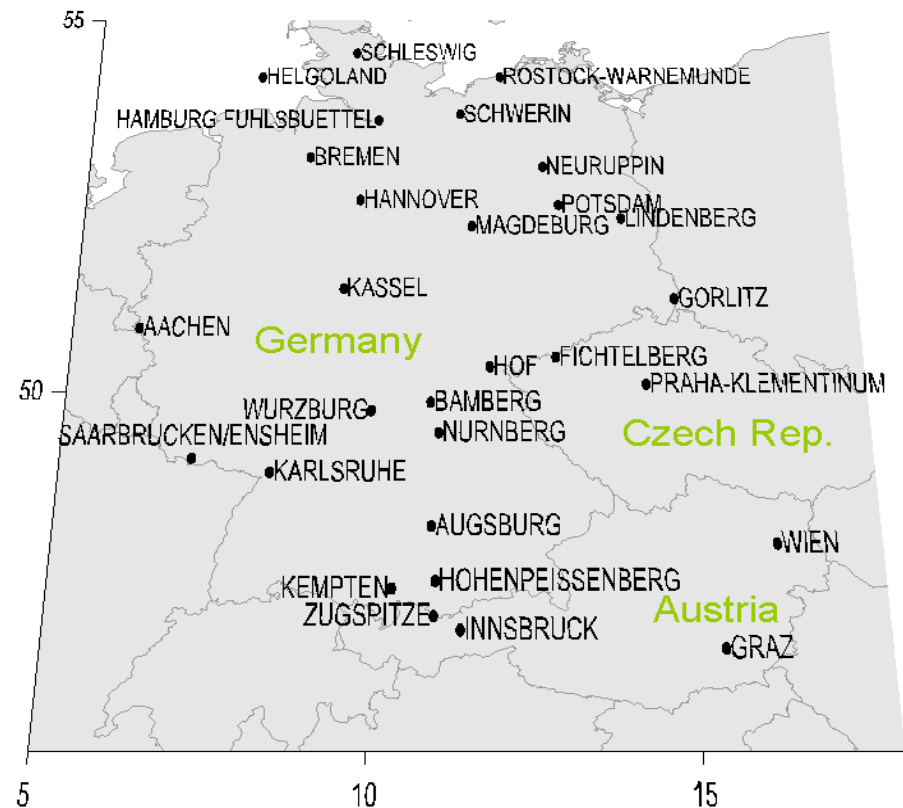
Persistence of CTs

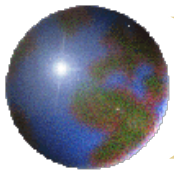
- ✦ Persistence vs. temperature anomalies: *Kyselý (2007)* and *Kyselý and Huth (2008)* found that persistent CTs are conducive to heat and cold spells, and hypothesized that the increase of persistence could lead to an increased severity of temperature extremes
- ✦ Now that we know that persistence is not rising, should we still be afraid of these extremes?
- ✦ We revisit the topic of warm CTs in summer in Central Europe, comparing the Hess-Brezowsky with its objectivized version OGWL3 in the period 1961-2000



Persistence of CTs

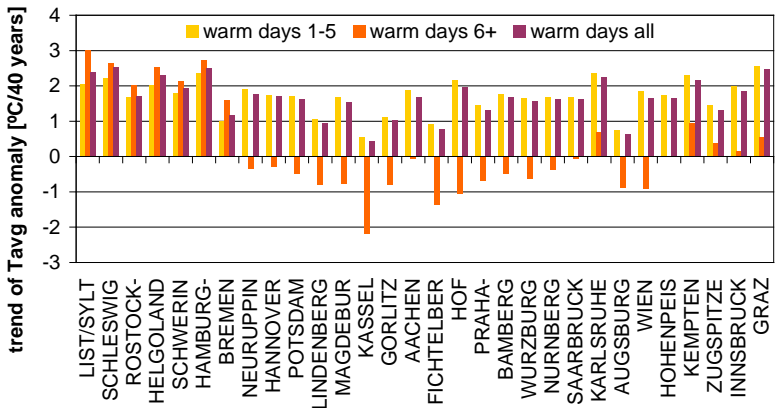
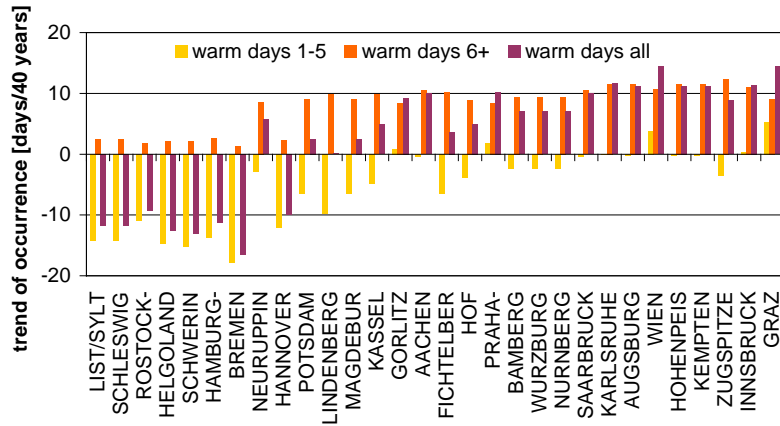
- ✦ Warm CT: mean Tavg anomaly > 1 deg.C
- ✦ Trends in frequency and temperature anomaly of early stages (days 1-5) and late stages (days 6+) of CTs
- ✦ We found major differences between HBGWL and OGWL3
- ✦ Most of the warm CTs are warmer during their late stages
- ✦ Different individual CTs act as “warm CTs” in different parts of the study area



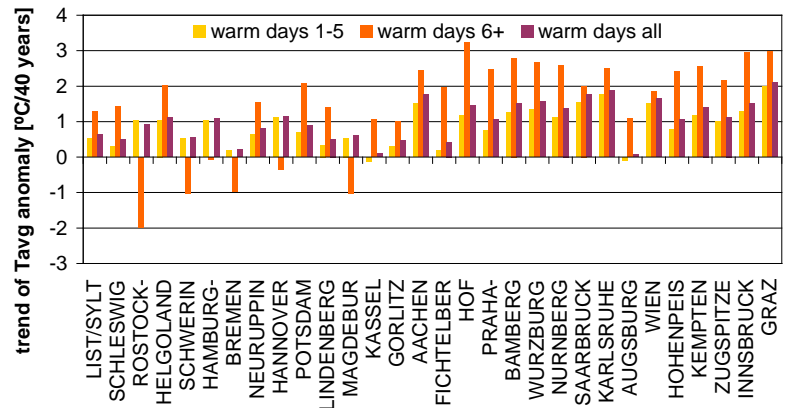
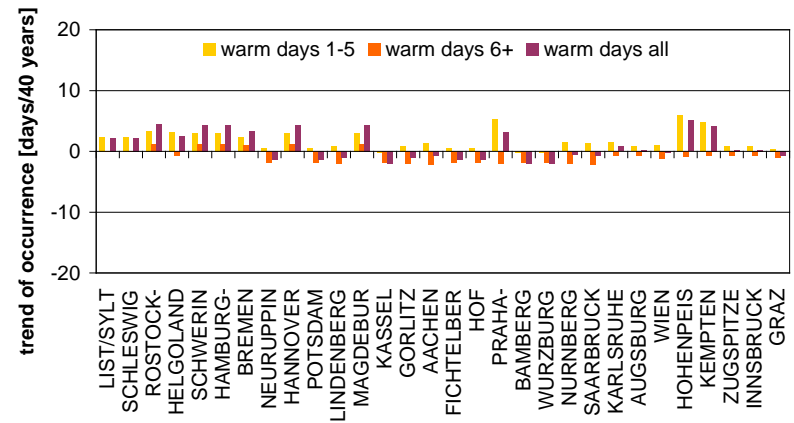


Persistence of CTs

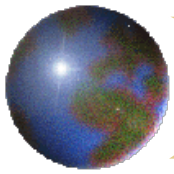
HBGWL



OGWL3



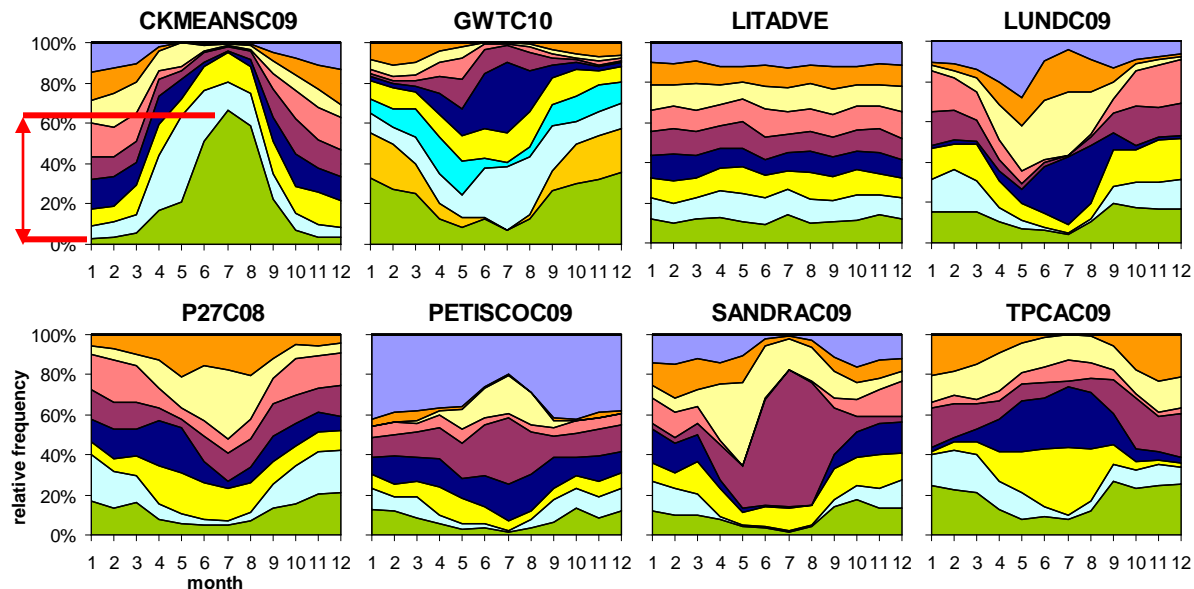
- Under HBGWL, warming of warm CTs is caused mainly by rising persistence
- Under OGWL3, warming is caused mainly by within-type temperature trends

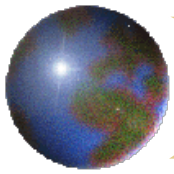


Seasonality of CTs

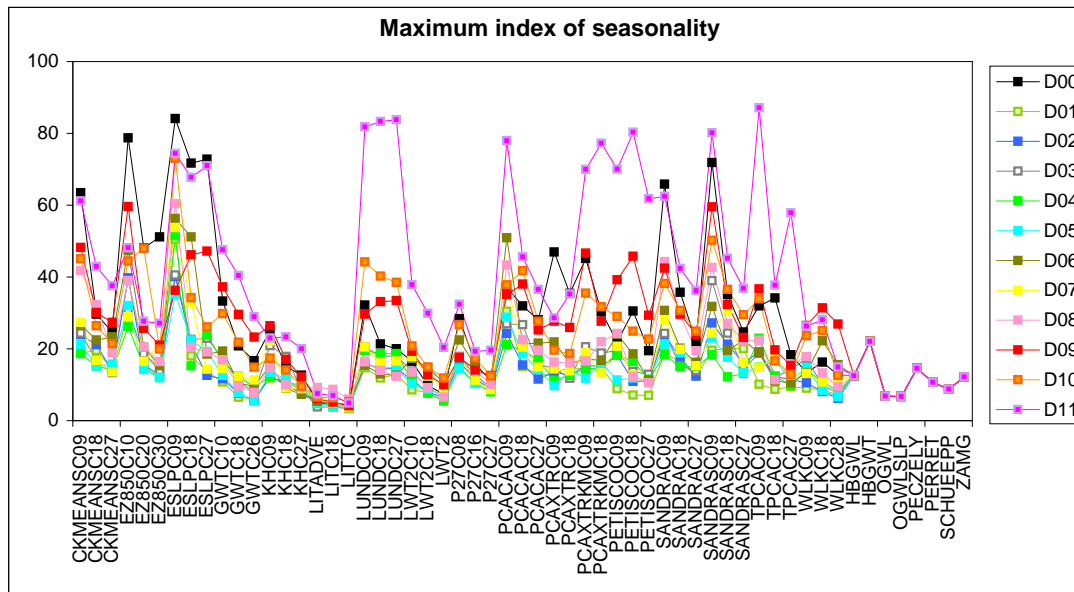
- comparison of classifications according to the seasonal (monthly) relative frequency of CTs
- we have developed several simple indices of seasonality based on monthly relative frequency of CTs
- Do individual classifications share a common long-term pattern of year-to-year changes in the seasonal variations of atmospheric circulation?

maximum seasonality

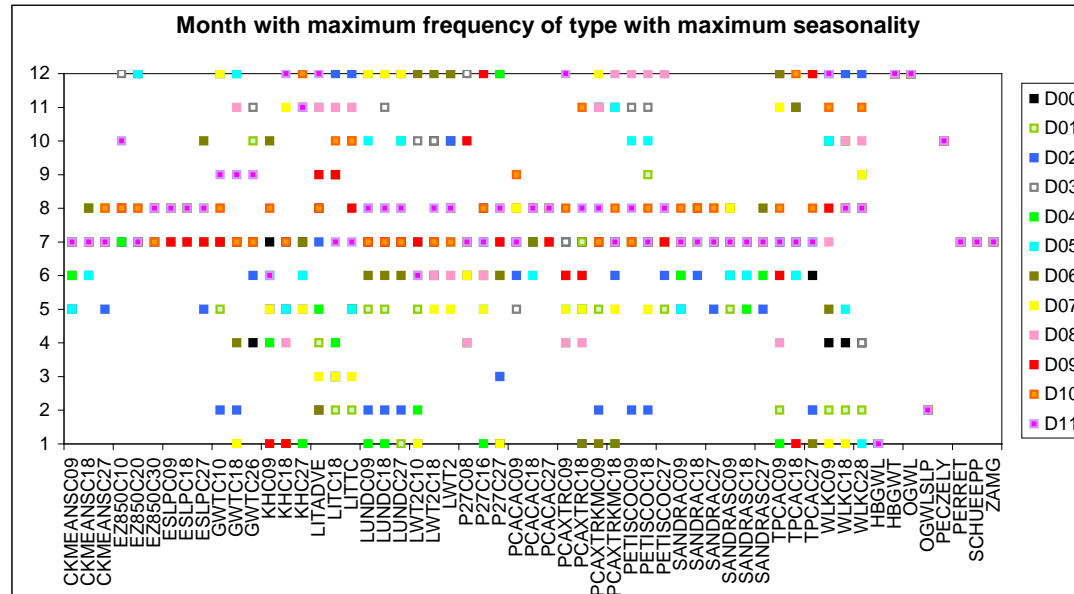


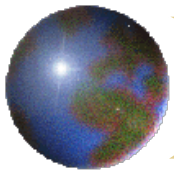


Seasonality of CTs



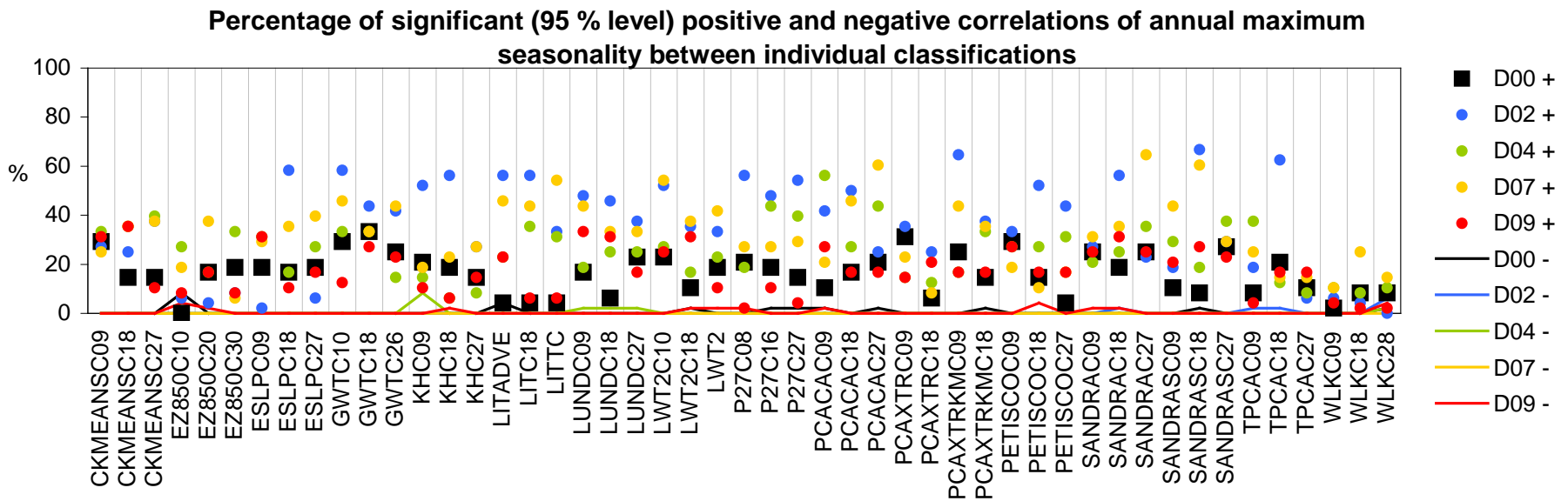
seasonality of the most seasonal CT

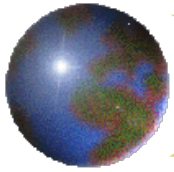




Seasonality of CTs

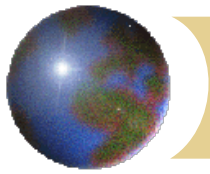
- Do individual classifications share a common long-term pattern of year-to-year changes in the seasonal variations of atmospheric circulation?
- correlation of time series of maximum seasonality index between pairs of classifications





Conclusions

- ✦ Systematic circulation changes in the ERA-40 period were only found in winter
- ✦ These reflect the strengthening of the NAO
- ✦ Persistence of CTs does not bear any systematic trends
- ✦ The Hess-Brezowsky catalogue is biased in terms of persistence
- ✦ Long-term variations of persistence and seasonality are not uniform in the individual classifications



References

- ✦ Cahynová M., Huth R. (2009): *Long-term trends in the frequency of atmospheric circulation types in European regions (poster)*.
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- ✦ Cahynová M., Huth R. (2009): *Enhanced lifetime of atmospheric circulation types over Europe: fact or fiction?* Tellus A 61: 407–416.
- ✦ Cahynová M., Huth R. (2010): *Seasonal variations in the frequency of atmospheric circulation types in European regions (poster)*.
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- ✦ Cahynová M., Huth R. (2010): *The influence of persistence of atmospheric circulation on temperature anomalies revisited (poster)*.
EGU General Assembly
- ✦ Cahynová M. (2010): *The influence of long-term changes of atmospheric circulation on observed trends of surface climatic elements in the Czech Republic and Europe*
PhD thesis to be defended on December 14, 2010