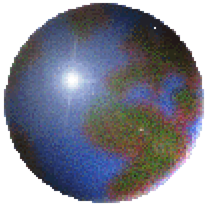
COST733 Final Event, Vienna, 22-24 November 2010



Quantifying the influence of recent circulation changes on European climatic trends

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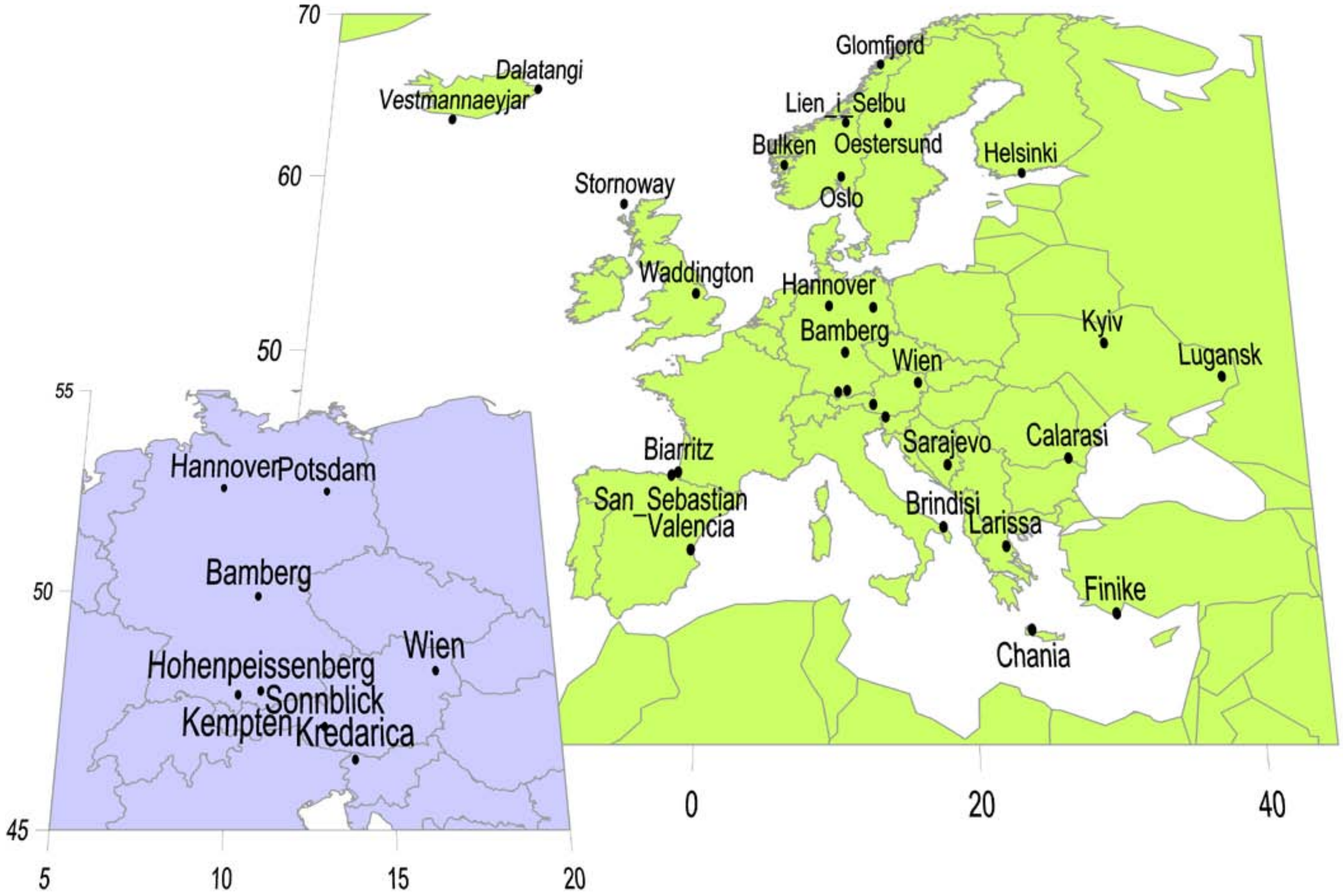
Outline

- we want to assess the magnitude of climatic trends over Europe in 1961-2000 that can be linked to changing frequency of circulation types (as opposed to changing climatic properties of circulation types)
- data
  - 29 stations from the ECA&D project, daily Tmax, Tmin, precipitation
  - 8 objective catalogues from cat.1.2 (CKMEANS, GWT, Litynski, LUND, P27, PETISCO, SANDRA, TPCA), each in 3 variants with 9, 18, 27 CTs
  - all COST733 domains except for D03 – lack of stations
- methods
  - seasonal trends in the frequency of circulation types
  - seasonal climatic trends from station data
  - proportion of climatic trends linked to circulation changes - 2 methods of attribution used
  - comparison of all results using classifications in D00 and small domains representing each of the stations, Alpine stations in D06+D07

Stations

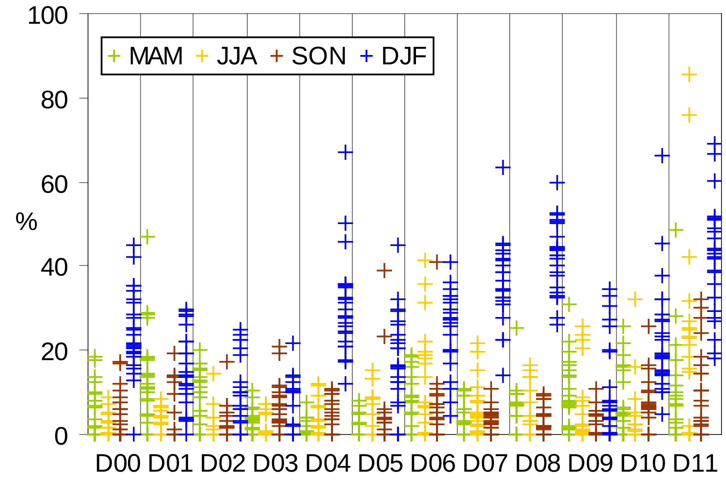


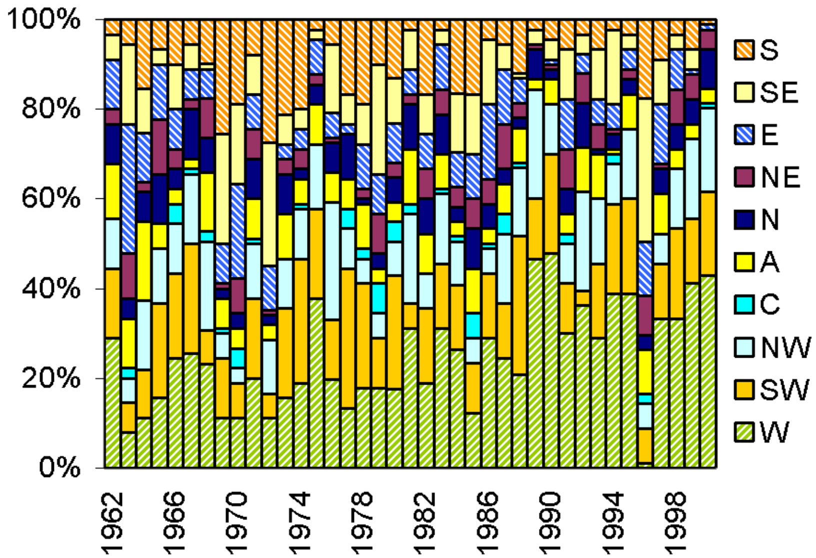
70
60
50
55
50
45
5
10
15
20
0
20
40
Dalatangi
Vestmannaeyjar
Glomfjord
Lien_i_Selbu
Bulken
Oestersund
Oslo
Helsinki
Stornoway
Waddington
Hannover
Bamberg
Wien
Kyiv
Lugansk
Biarritz
Sarajevo
Calarasi
San_Sebastian
Valencia
Brindisi
Larissa
Finike
Chania
Hannover
Potsdam
Bamberg
Wien
Hohenpeissenberg
Sonnblick
Kempten
Kredarica

Results – trends in the frequency of CTs

CTs are unevenly represented

Percentage of days occupied by CTs with trends in the seasonal frequency significant at the 95% level in 1961-2000





Changes in winter relative frequency of CTs in GWTC10 in Central Europe (D07)

Upward (downward) stripes denote types with positive (negative) linear trend significant at the 95% level

Results – trends in the frequency of CTs

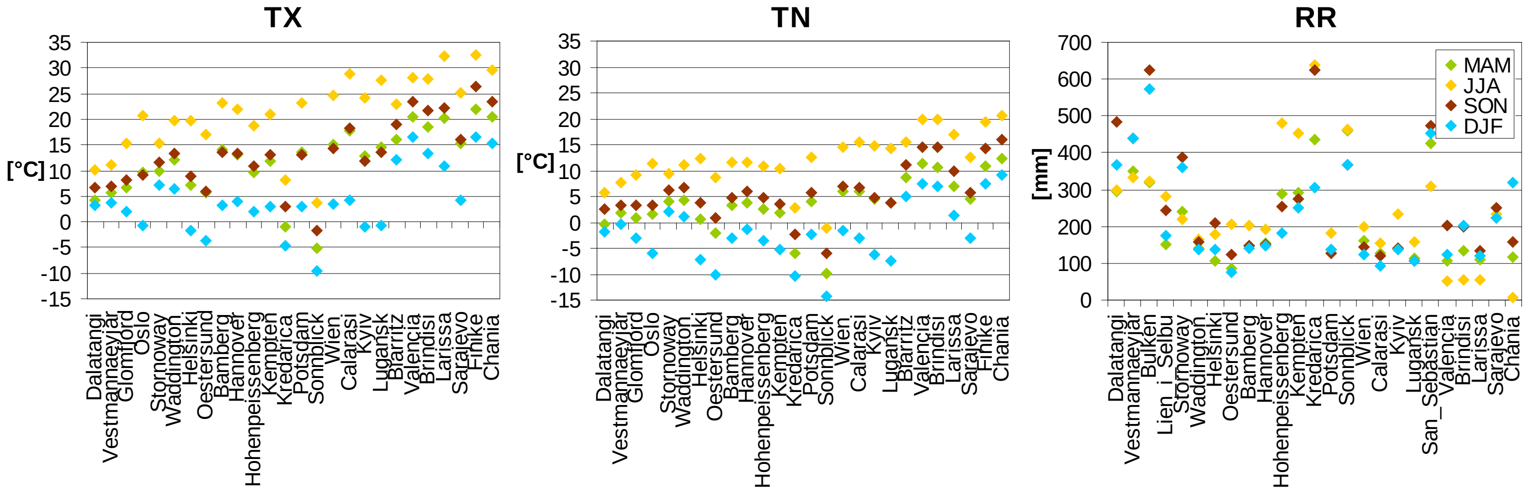
Magnitude of significant trends in the frequency of CTs in GWTC10 (days per season in 1961-2000)

		W	SW	NW	C	A	N	NE	E	SE	S
spring	D00								-5		
	D01								-8		
	D02	6			-3						
	D03								-5		
	D04										
	D05										
	D06										
	D07										
	D08										
	D09							-8		5	3
	D10										
	D11										
summer	D00										
	D01						-4				
	D02										
	D03										
	D04										
	D05										
	D06					2					
	D07				-2						
	D08										
	D09						-7				
	D10				-2						
	D11										

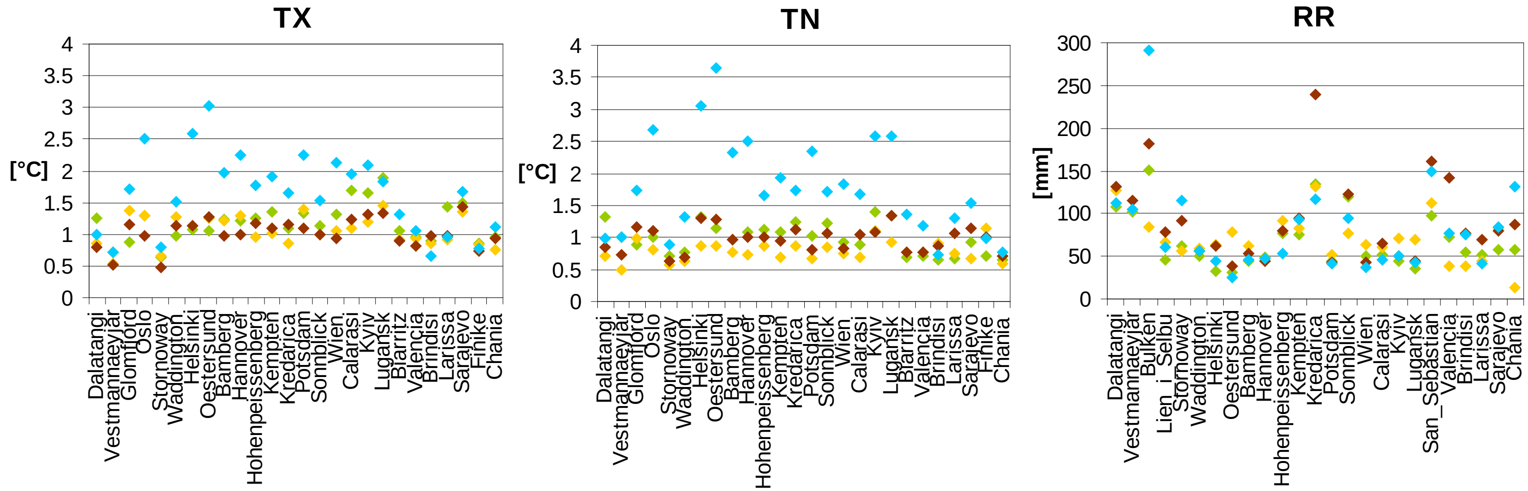
		W	SW	NW	C	A	N	NE	E	SE	S
autumn	D00		9								
	D01										
	D02										
	D03							3	4		
	D04										
	D05										
	D06										
	D07						3				
	D08				3						
	D09										
	D10										
	D11										
winter	D00	16			-8			-3			
	D01				6						
	D02		7								
	D03										
	D04	13	13						-7		-7
	D05										
	D06	9				3			-8		
	D07	20							-6		-7
	D08	16			-3					-10	-8
	D09										
	D10			5	-4	2					-6
	D11							14			-7

Results – seasonal climatic mean and interannual variability

(a) long-term seasonal mean

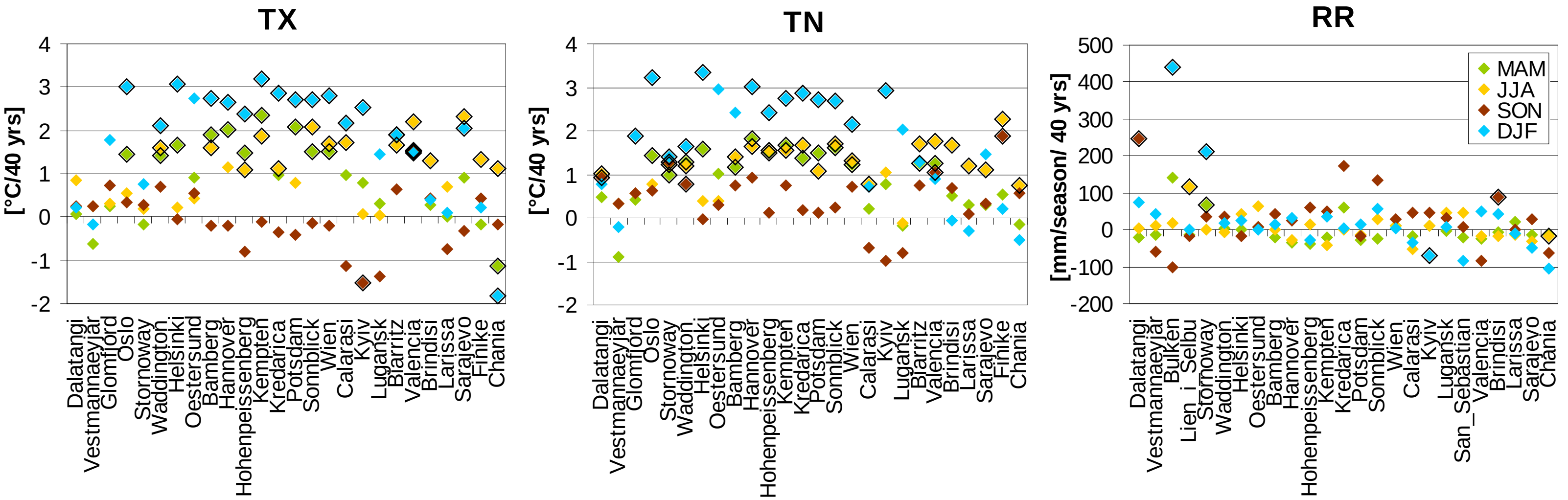


(b) standard deviation of seasonal means



Results – seasonal climatic trends

magnitude of linear trend per 40 years (1961-2000)

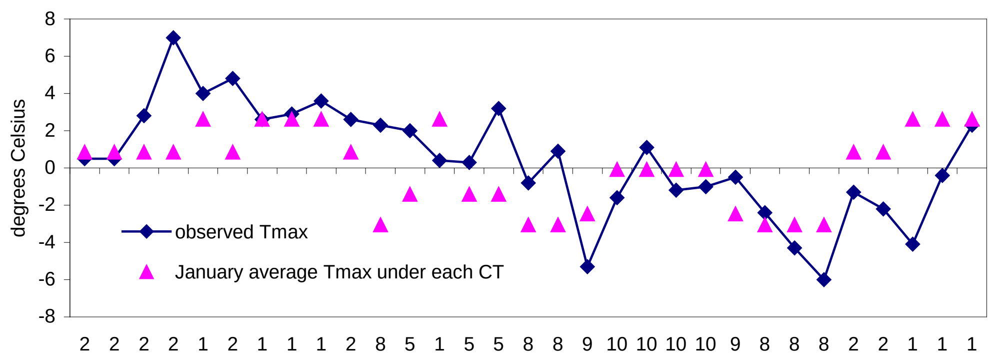


◇ trend significant at the 95% level

- massive winter warming at most stations
- autumn cooling in Central and Eastern Europe – decreasing daily temperature range
- few stations report significant trends in precipitation

Methods of attribution of climatic trends

1. Ratio of "hypothetical" (circulation-induced) and observed long-term seasonal trends. The "hypothetical" trend is calculated from a daily series, constructed by assigning the long-term monthly mean of the given variable under the specific circulation type to each day. See e.g. Huth (2001).

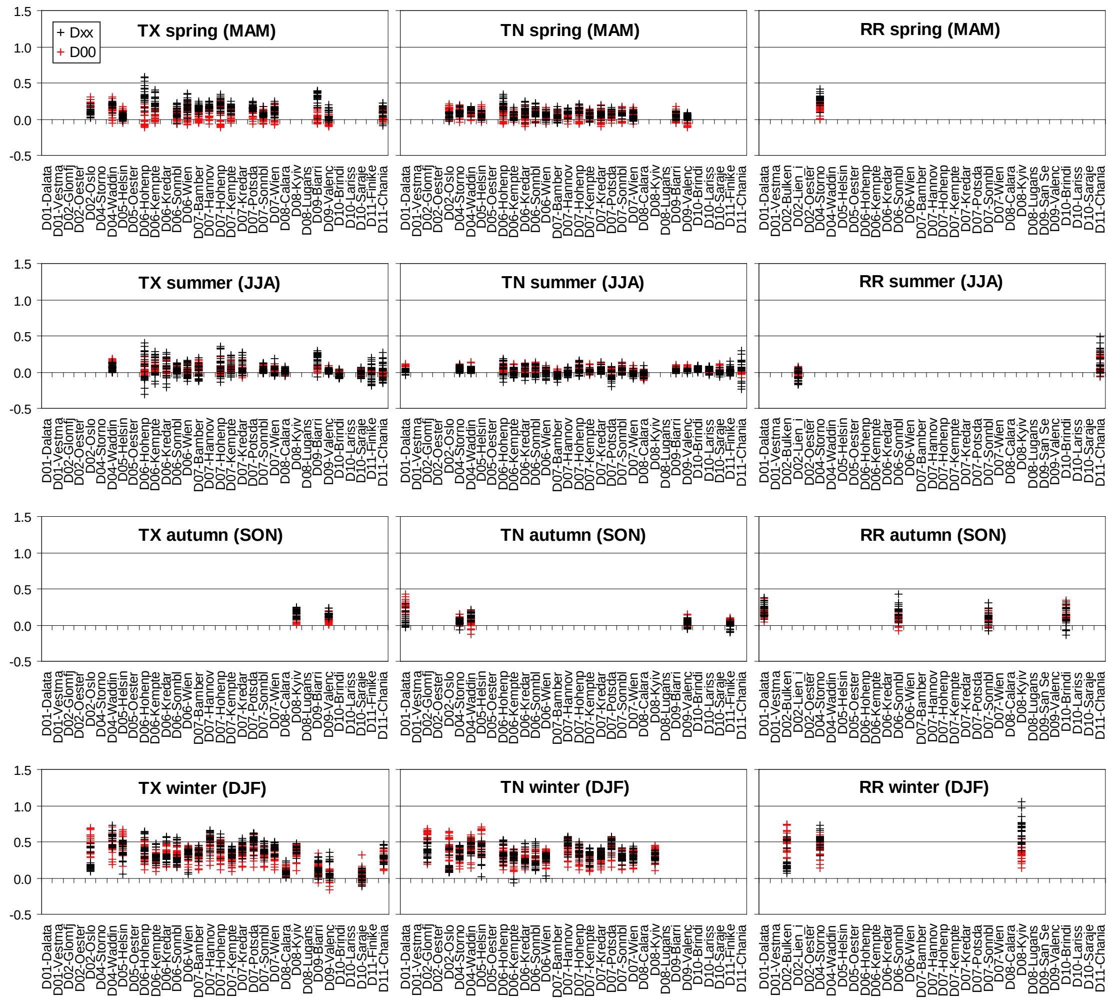


2. Decomposition of climatic change that took place between the 1st and the 2nd half of the period into frequency-related and within-type change.
   See e.g. Beck, Jacobeit, Jones (2007).

$$\Delta\bar{C} = \sum_{i=1}^{G}\left[\Delta F_i \left(C_i + \Delta C_i\right)/n + F_i \cdot \Delta C_i / n\right]$$

ad 1. Circulation-induced part of climatic trends

Ratio of circulation-induced ("hypothetical") and observed trends 1961-2000 at stations where the observed trend is significant at the 95% level

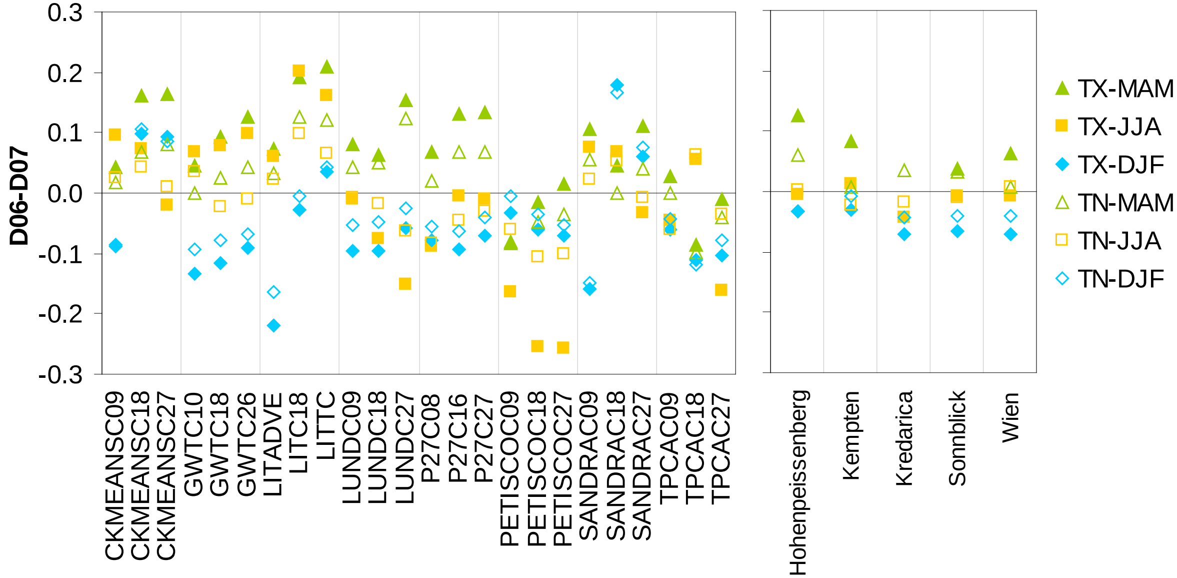


Results of 24 classifications (8 methods*3 variants) from D00 and small domains

ad 1. Circulation-induced part of climatic trends

Ratio of circulation-induced ("hypothetical") and observed trends 1961-2000 at stations where the observed trend is significant at the 95% level

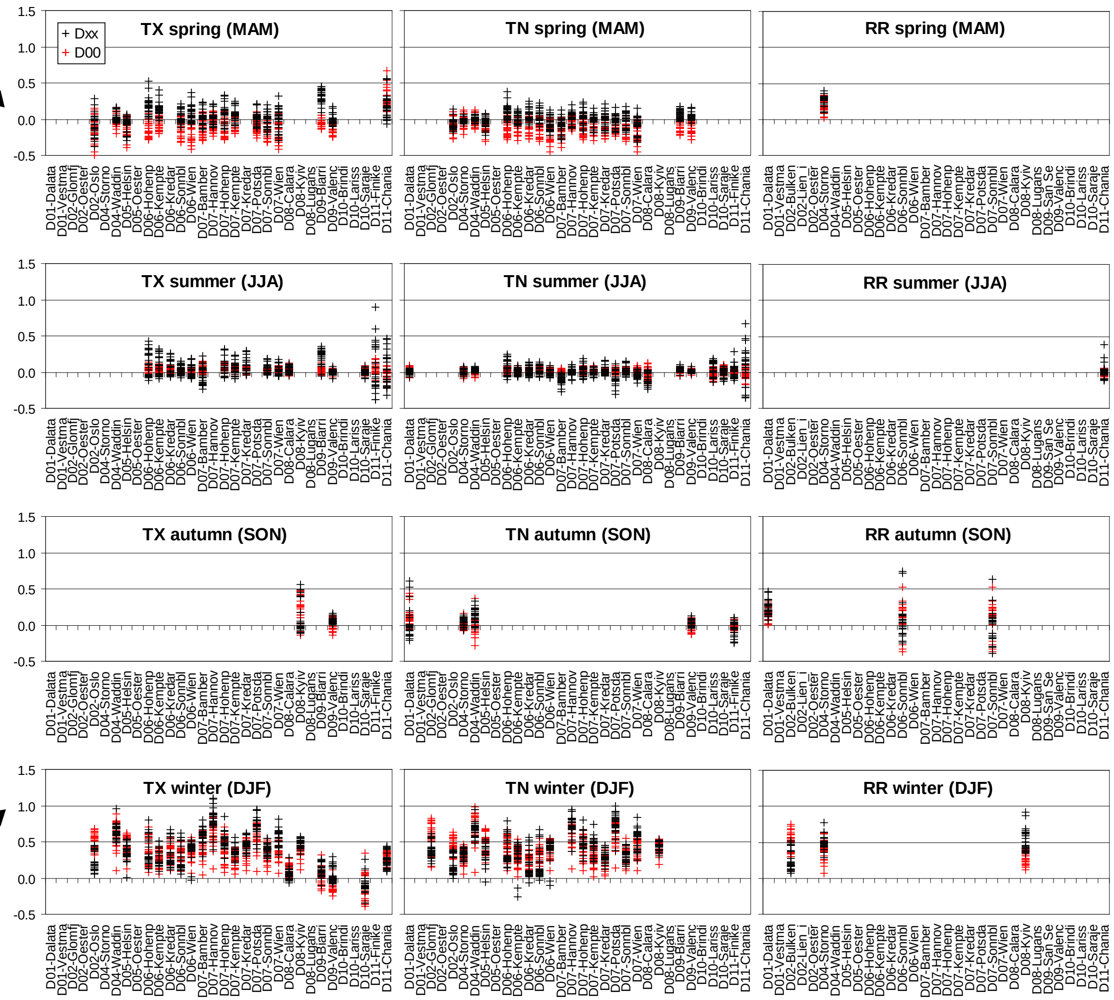
Difference between classifications from D06 (Alps) and D07 (Central Europe)



ad 2. Circulation-induced part of climatic change between the 1st and the 2nd half of the period

Proportion of climatic change that can be attributed to changing frequency of CTs

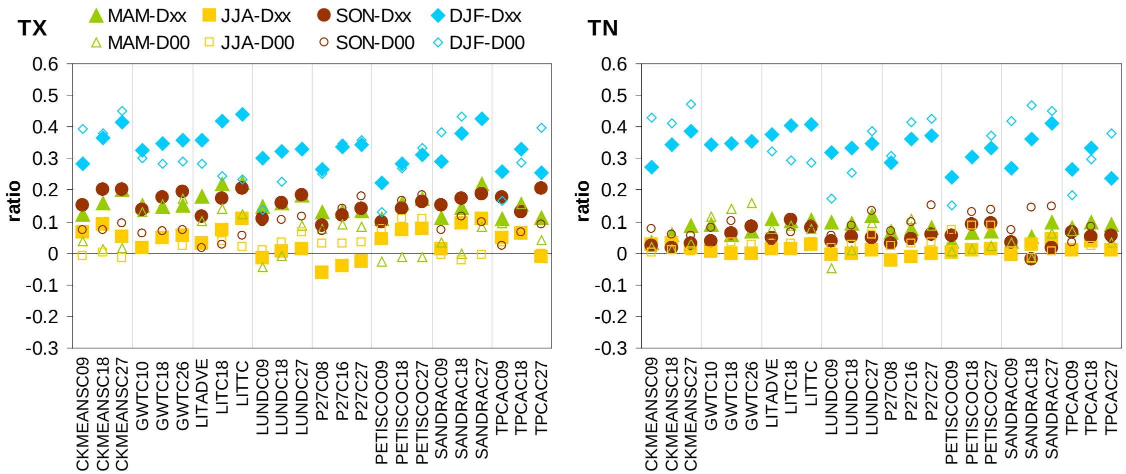
higher variability both between stations and within stations



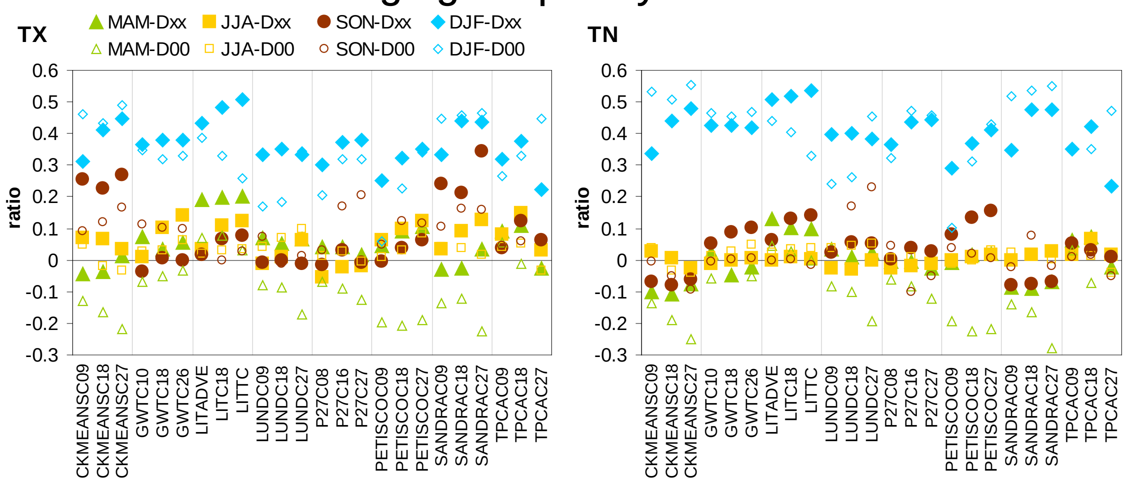
Comparison of individual classifications

Averages of stations with significant observed trends

ad 1. Ratio of circulation-induced (“hypothetical”) and observed trends 1961-2000



ad 2. Proportion of climatic change between the average of 1961-1980 and 1981-2000 that can be attributed to changing frequency of CTs



Conclusions

- We have studied seasonal linear trends in the frequency of CTs in 24 classifications in cat. 1.2 and their relations with trends of Tmax, Tmin, and precipitation in European regions in the period 1961-2000.
- Significant trends in the frequency of CTs occur mostly in winter in domains 00 and 04 through 11, and also in summer in the Mediterranean.
- Climatic trends can be only partly explained by the changing frequency of CTs, the link being the strongest in winter. In the other seasons, within-type climatic trends are responsible for a major part of the observed trends.
- Classifications in the small domains are usually more tightly connected with climatic trends than those in D00, except for the northernmost stations.
- There are large differences between results obtained with individual classifications – therefore all studies using just a limited number of them should be taken with a grain of salt.

References

- Cahynová M., Huth R. (2009): *Are recent climatic trends in Europe caused by circulation changes? (poster)*

  EGU General Assembly

- Cahynová M., Huth R. (2010): *Relations of atmospheric circulation and recent climatic variability and trends in Europe – a comparative approach based on the COST733 classifications database (poster)*

  10th EMS/8th ECAC

- 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*

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