Agroclimatic conditions in Europe under Climate Change

Mendel University in Brno

COST 734

May 2011 Topolčianky

CZECHGLOBE

Talk structure:

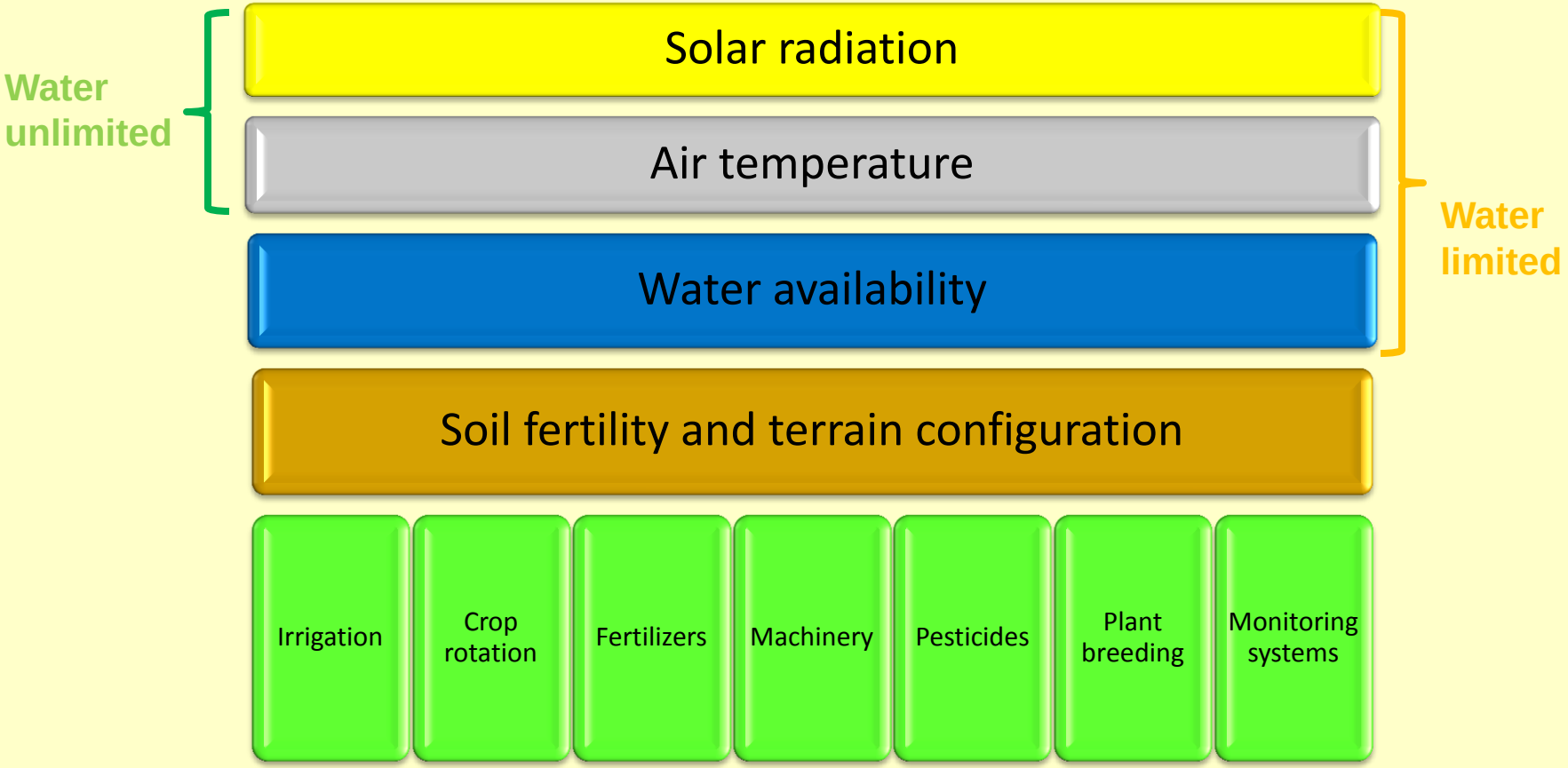
1. Introducing regional differences in agriculture production potential;
2. Range of agroclimatic conditions in this century;
3. A bit of historical context.

More details available in:

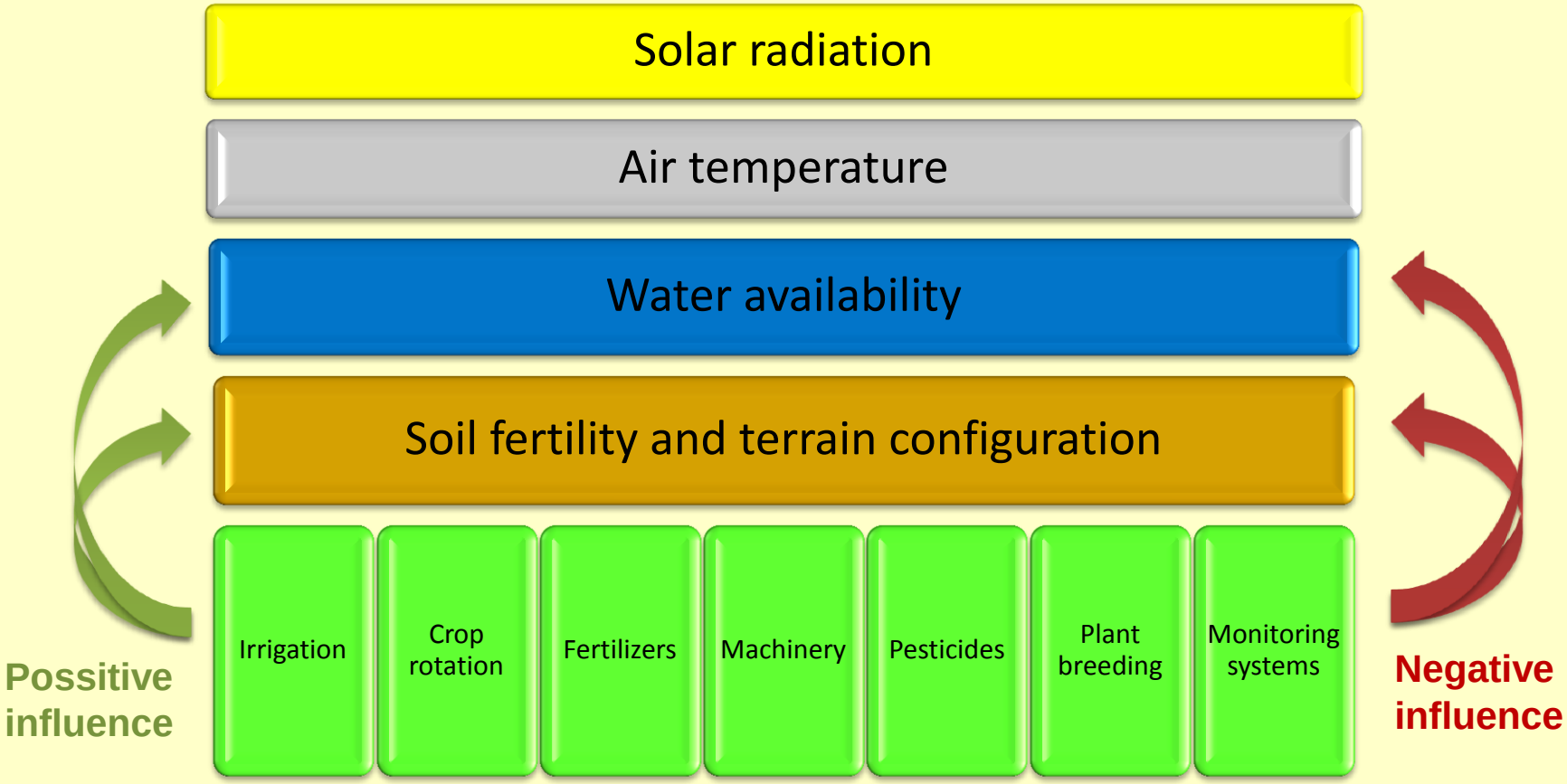
Trnka, M., Olesen, J. E., Kersebaum, K. C., Skjelvag, A. O., Eitzinger, J., Seguin, B., Peltonen-Sainio, P., Rotter, R., Iglesias, A., Orlandini, S., Dubrovsky, M., Hlavinka, P., Balek, J., Eckersten, H., Cloppet, E., Calanca, P., Gobin, A., Vucetic, V., Nejedlik, P., Kumar, S., Lalic, B., Mestre, A., Rossi, F., Kozyra, J., Alexandrov, V., Semeradova, D. and Zalud, Z. (2011), Agroclimatic conditions in Europe under climate change. **Global Change Biology**, 17: no. doi: 10.1111/j.1365-2486.2011.02396.x

Trnka M, Brázdil R, Dubrovský M., Semerádová D., Štěpánek P., Dobrovolný P., Možný M., Eitzinger J., Málek J., Formayer H., Balek J., Žalud Z. (2011) A 200-year record of climate in Central Europe and its implications for agriculture, **Journal of Sustainable Agronomy**, (in print)

Production potential of agriculture:

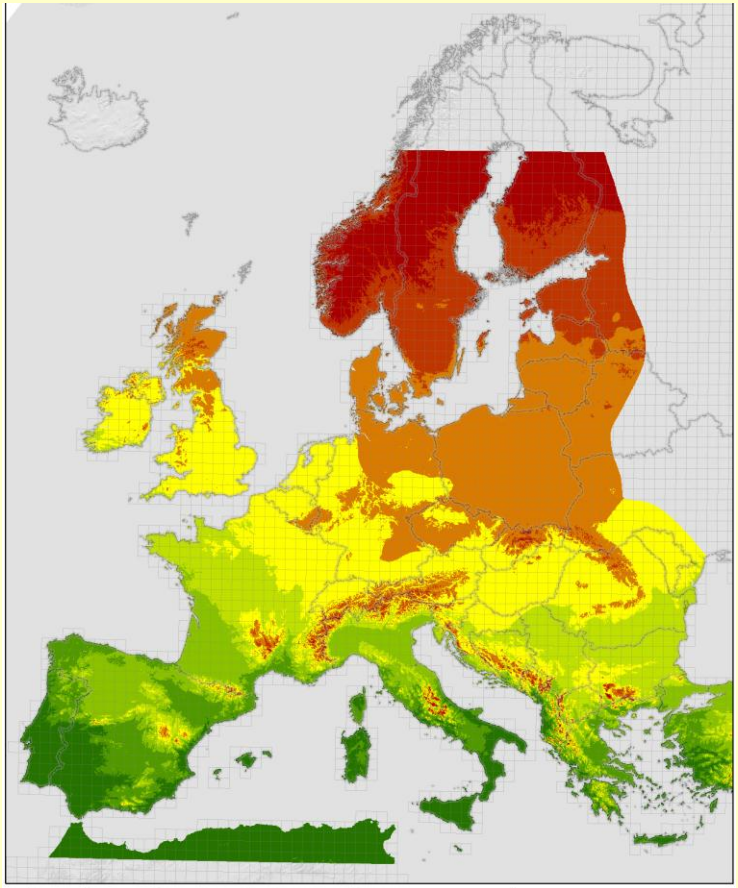


Production potential of agriculture:



Production potential of agriculture:

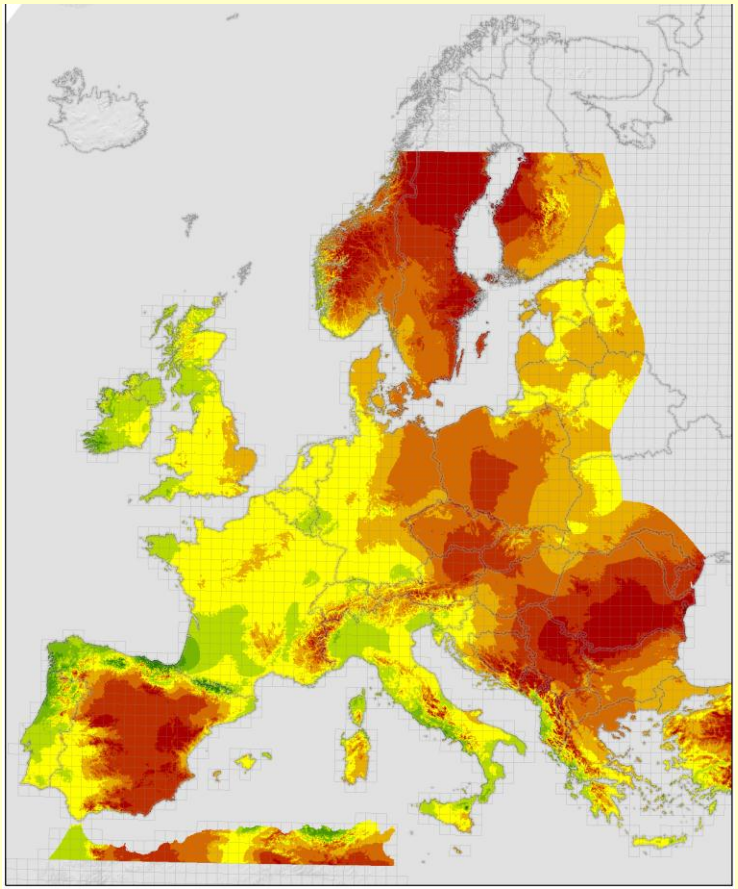
Water unlimited



Number of potential growing season days with daily global radiation above 5 MJ/m2

140 170 200 230 260 290 330

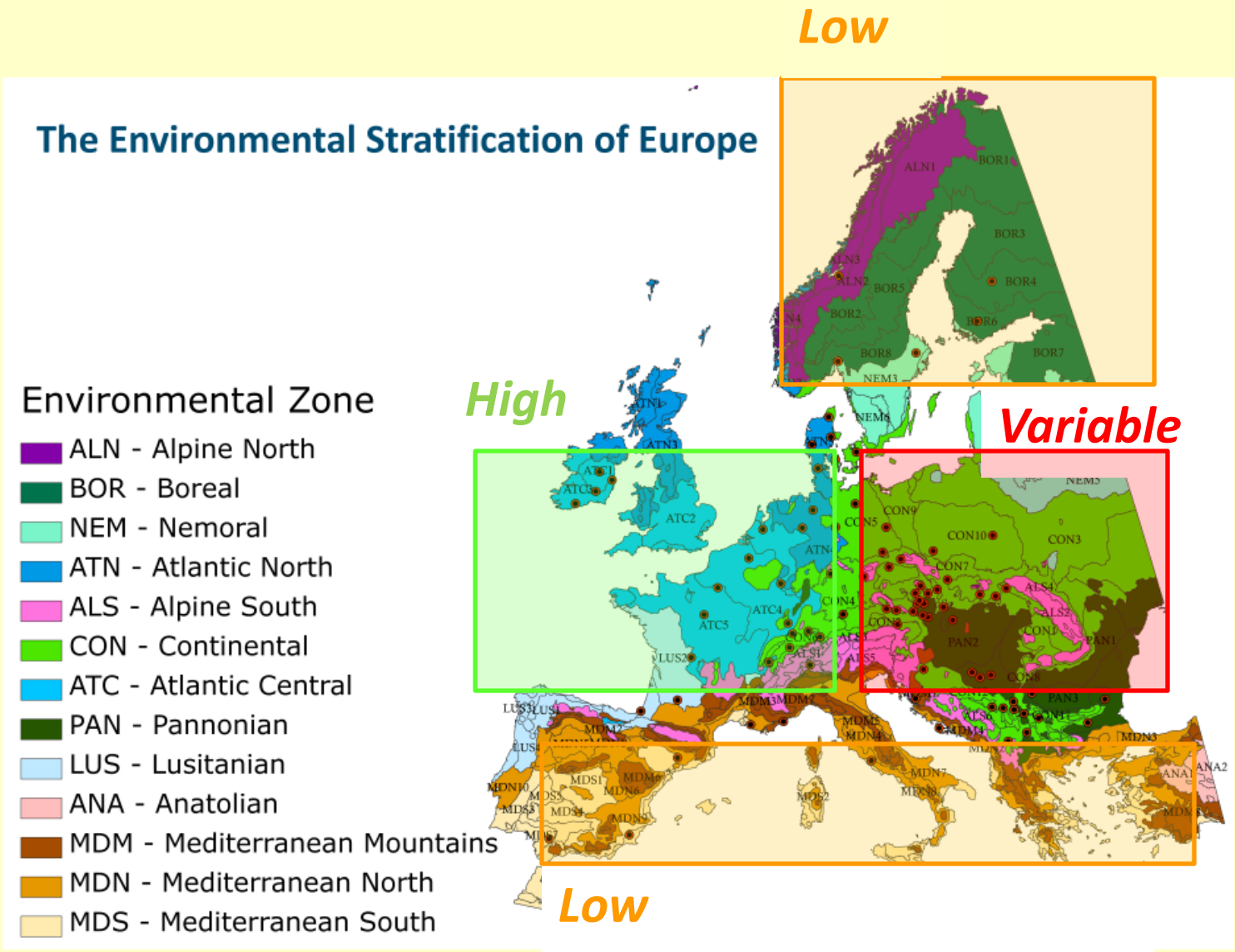
Water limited

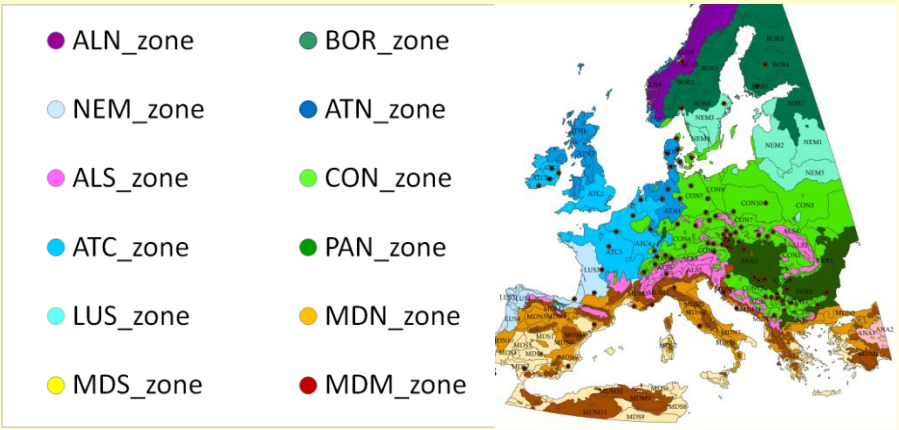


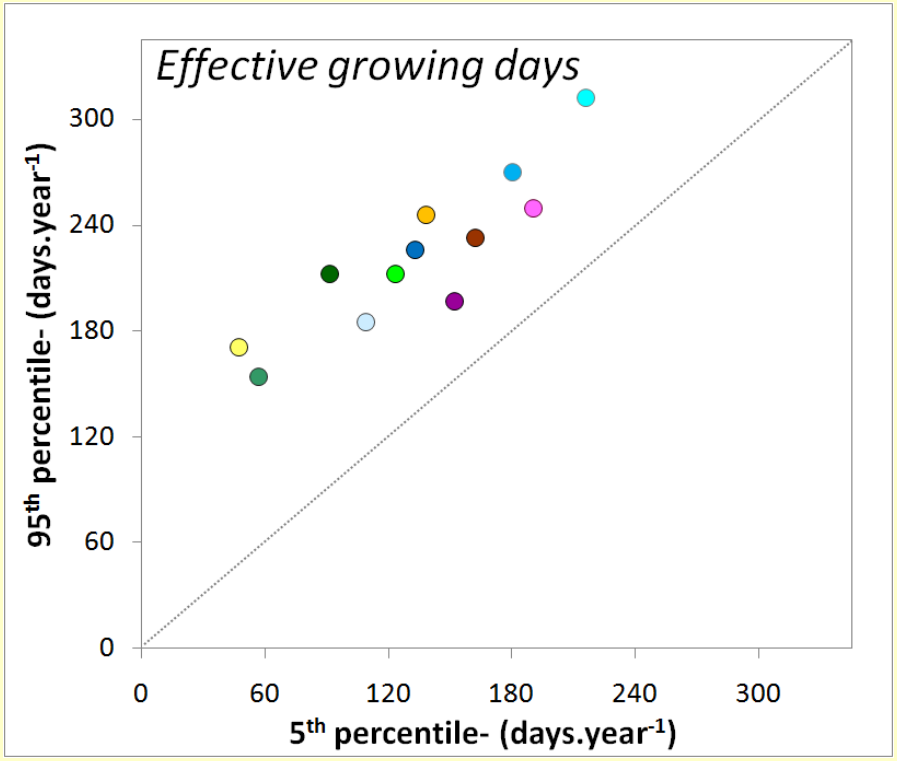
Number of effective growing season days with daily global radiation above 5 MJ/m2

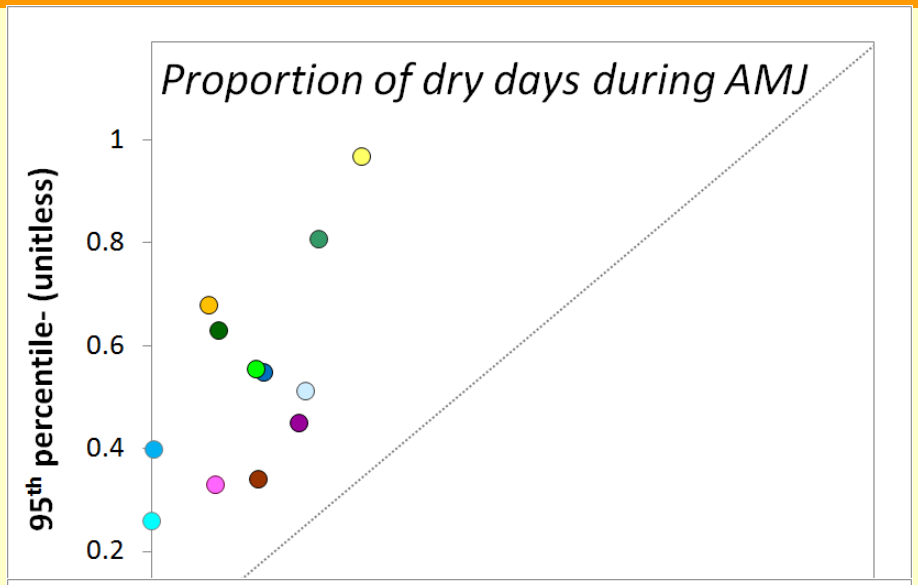
25 50 75 100 125 150 175 200

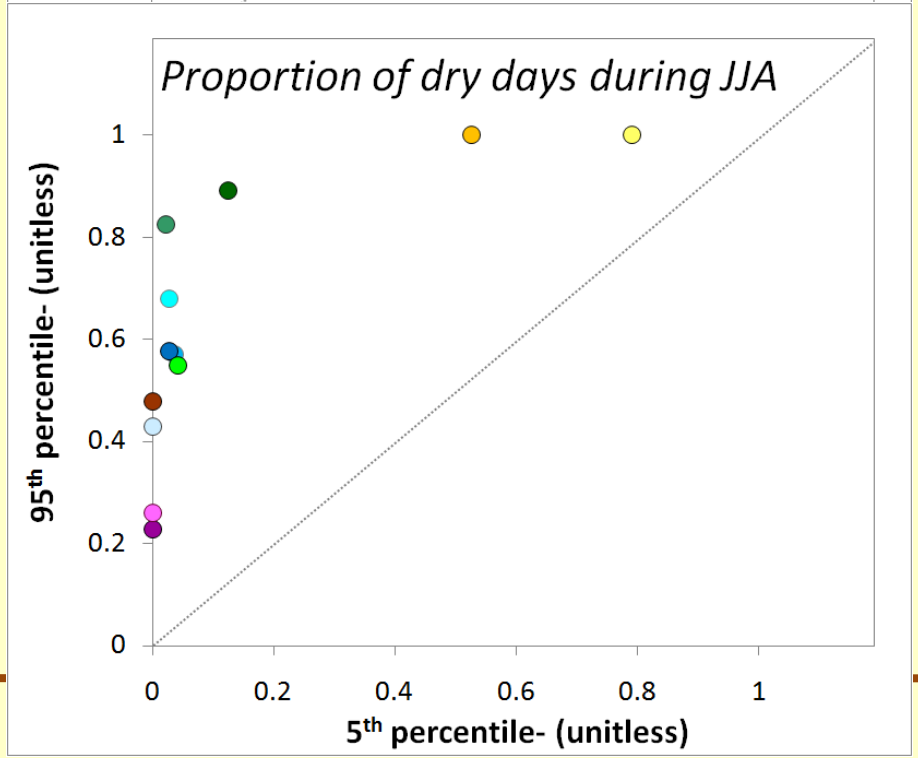
Environmental zones – rainfed productivity:



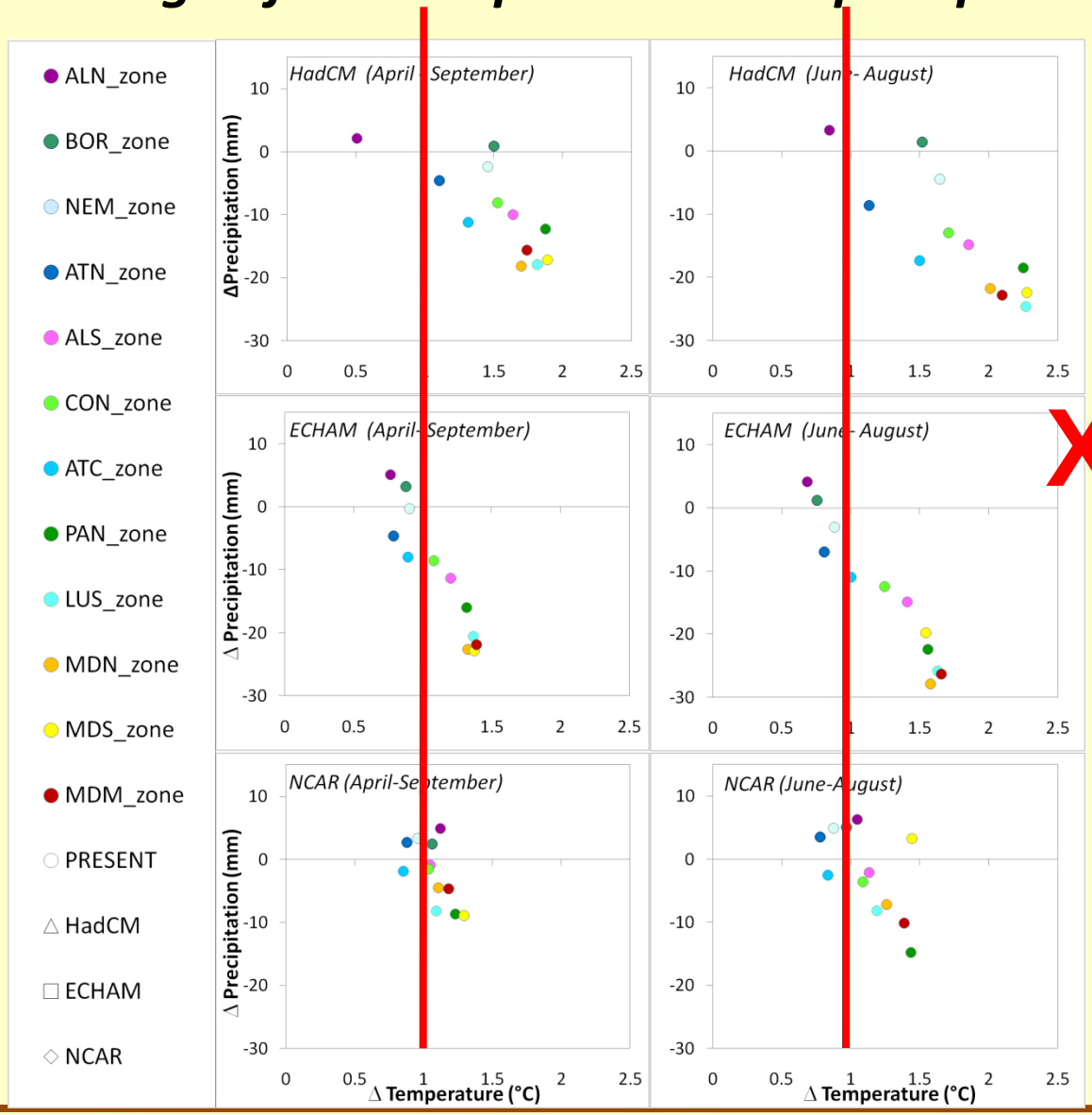

ALN_zone
BOR_zone
NEM_zone
ATN_zone
ALS_zone
CON_zone
ATC_zone
PAN_zone
LUS_zone
MDN_zone
MDS_zone
MDM_zone


Effective growing days
95th percentile- (days.year-1)
5th percentile- (days.year-1)
0
60
120
180
240
300

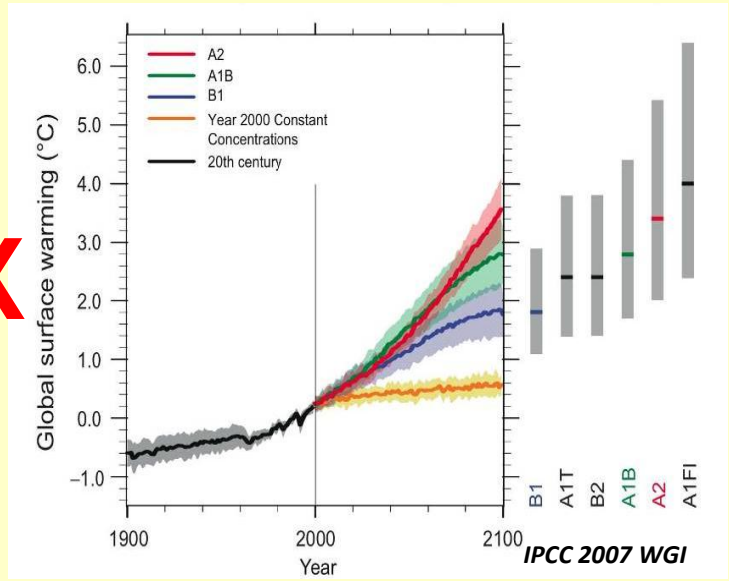

Proportion of dry days during AMJ
95th percentile- (unitless)
0.2
0.4
0.6
0.8
1


Proportion of dry days during JJA
95th percentile- (unitless)
5th percentile- (unitless)
0
0.2
0.4
0.6
0.8
1

Change of the temperature and precipitation per 1°C warming



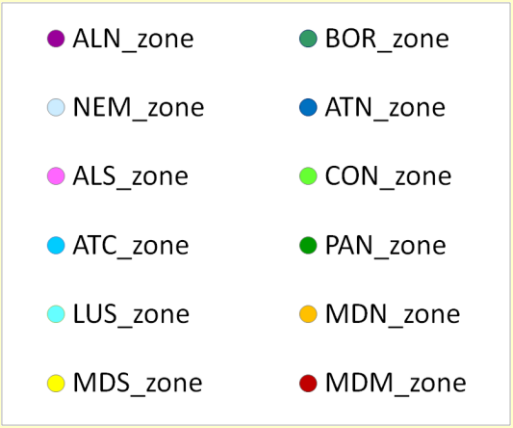
X



Impact on the agroclimatic conditions

5°C

Environmental Zone	Effective global radiation change (%)			Effective growing days change (days)			Huglin index change (%)			Date of the last frost change (days)			Proportion of dry days in AMJ change (%)			Proportion of dry days in JJA change (%)			Proportion of sowing days - early spring change (%)			Proportion of sowing days - fall change (%)		
	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N
ALN	10	19	28	95	88	129	81	106	126	-33	-37	-40	-11	-14	-10	-2	-1	2	33	33	38	8	15	17
BOR	16	3	5	76	46	91	78	148	96	-22	-35	-25	1	8	10	2	27	8	31	37	39	19	28	30
NEM	7	-3	16	64	20	117	79	135	83	-31	-30	-33	-5	0	-10	31	48	5	34	32	36	16	22	26
ATN	-12	-11	7	28	8	80	64	92	71	-43	-46	-52	-11	-15	-23	49	54	14	20	17	24	10	12	11
ALS	-25	-22	5	-24	-28	18	71	97	61	-50	-53	-50	5	5	-7	60	61	20	15	12	5	11	10	18
CON	-24	-24	-3	-10	-17	21	66	95	63	-31	-39	-35	-5	-3	-13	46	52	23	17	17	14	11	13	18
ATC	-17	-24	-7	-15	-33	12	62	92	59	-45	-59	-56	3	10	-7	45	59	24	9	10	9	6	4	9
PAN	-47	-41	-28	-44	-30	-25	62	89	58	-31	-31	-27	21	22	4	47	48	37	13	13	10	-17	1	-2
LUS	-48	-48	-27	-102	-97	-64	71	94	57	-50	-52	-50	49	52	34	76	76	48	7	12	5	-2	-2	5
MDM	-46	-37	-18	-58	-48	-17	71	85	58	-15	-16	-13	35	29	9	43	43	29	4	7	5	-2	3	11
MDN	-42	-34	-18	-55	-38	-23	51	68	44	-37	-39	-36	45	38	18	17	17	10	2	2	0	-9	-2	3
MDS	-57	-56	-27	-62	-60	-31	48	67	45	-54	-52	-51	27	26	19	1	1	1	-27	-26	-16	-37	-24	-5


ALN_zone
BOR_zone
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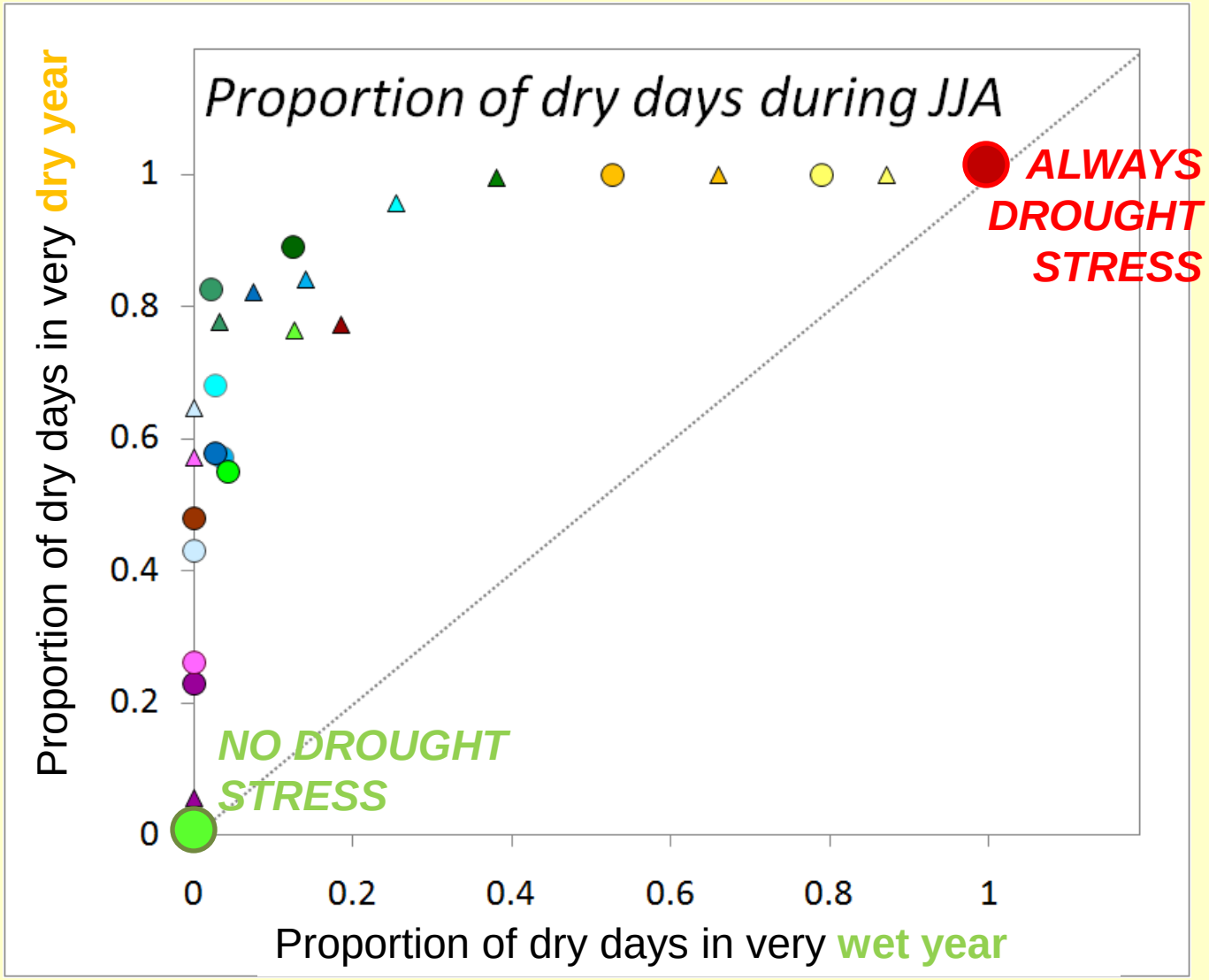
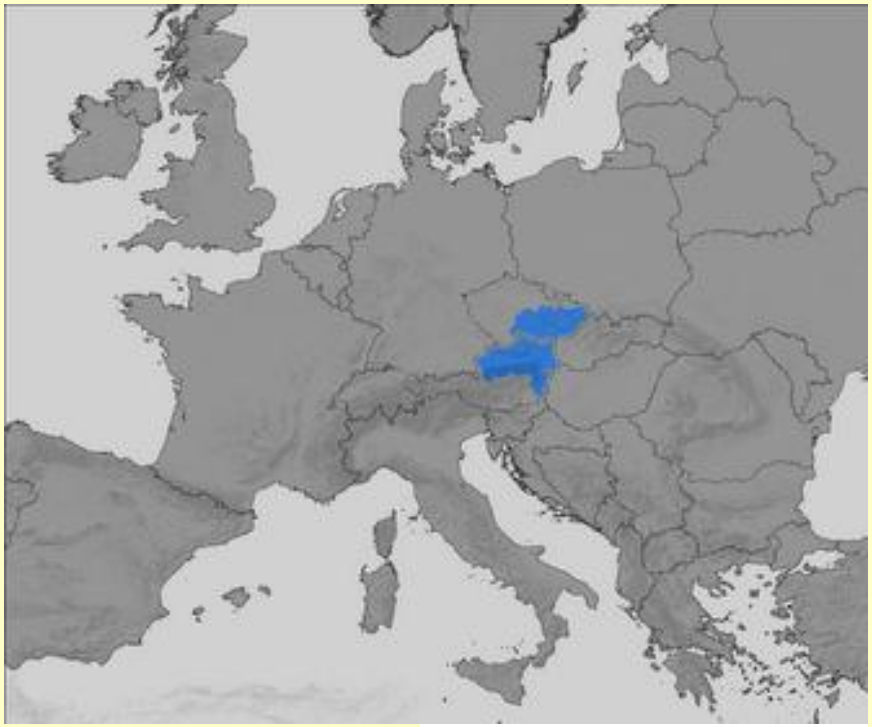
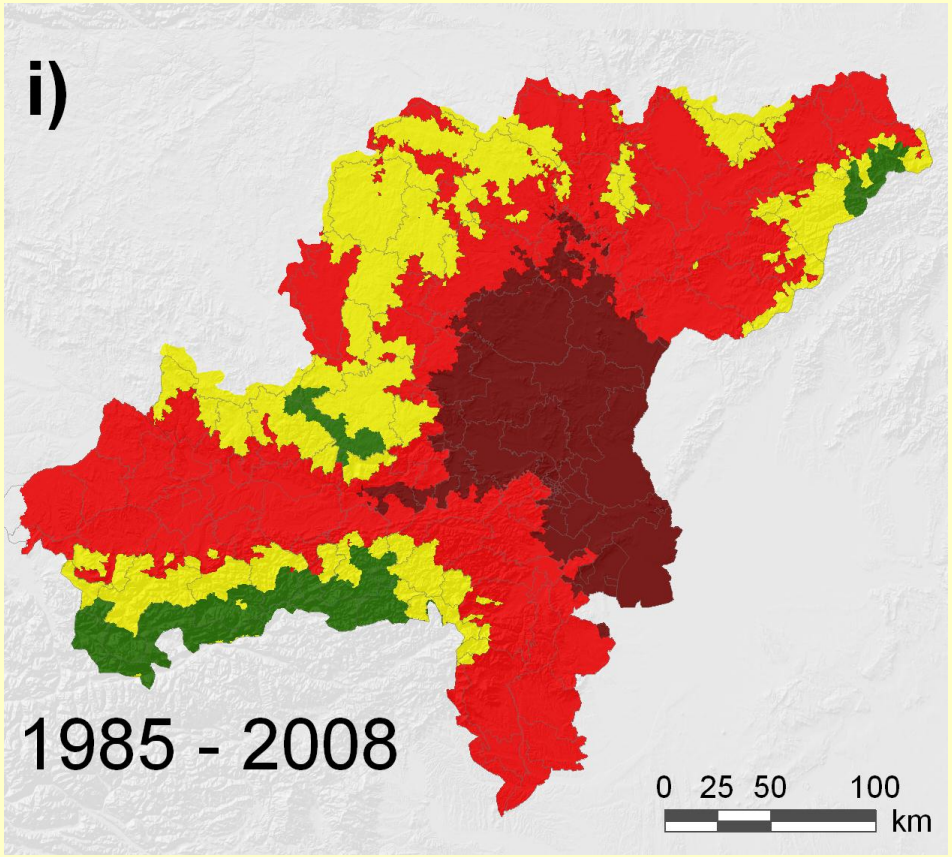

Proportion of dry days during JJA
ALWAYS DROUGHT STRESS
NO DROUGHT STRESS
Proportion of dry days in very dry year
Proportion of dry days in very wet year
0
0.2
0.4
0.6
0.8
1

Brief summary:

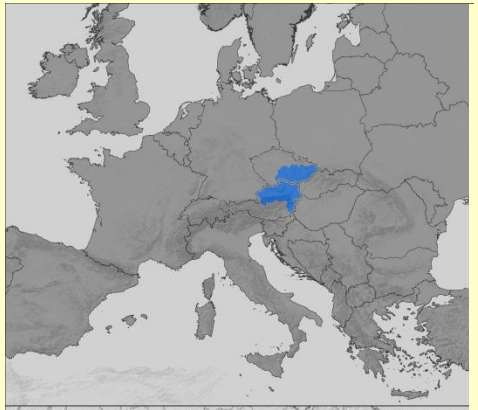
1. Throughout most of the environmental zones, there were clear signs of agroclimatic condition deterioration and a marked need for adaptive measures;
2. Rainfed agriculture might face more climate-related risks, although the analyzed agroclimatic indicators will most likely remain at a level that permits acceptable crop yields;
3. evidence also suggests that there is the risk of an increasing number of extremely unfavorable years in many climate zones, which result in poor economic returns.

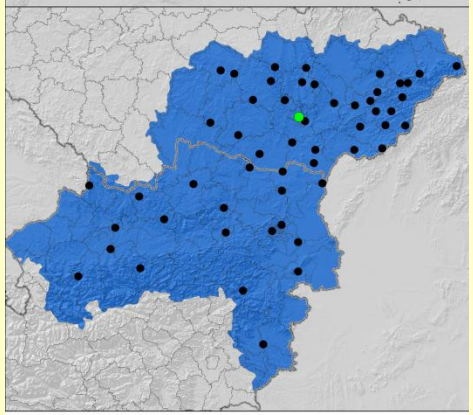
Historical context study of agroclimatic conditions

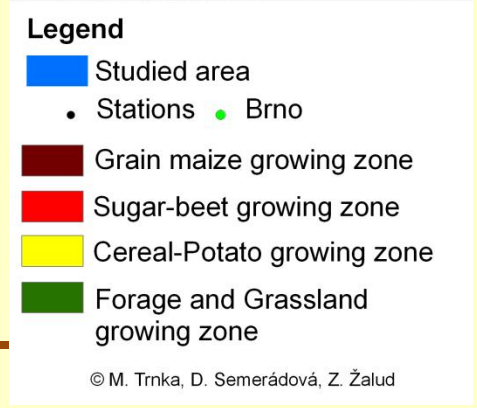




Historical context study of agroclimatic conditions







1800-1825

~1771 – last large-scale famine caused by crop failure

Introduction of Norfolk crop rotation system

1826-1850

~ 1827 – modern plow comes into use

1848 – abolition of corvée duties

1851-1875

wider use of mineral fertilisers

1876-1900

Massive introduction of new machinery (still relying on horse power)

1901-1925

Start of crop breeding institutions

1926-1950

Phasing out the horse power

Introduction of industrial pesticides

1951-1975

Signs of agrosystem degradation

1976-2000

Phasing out many agrochemicals

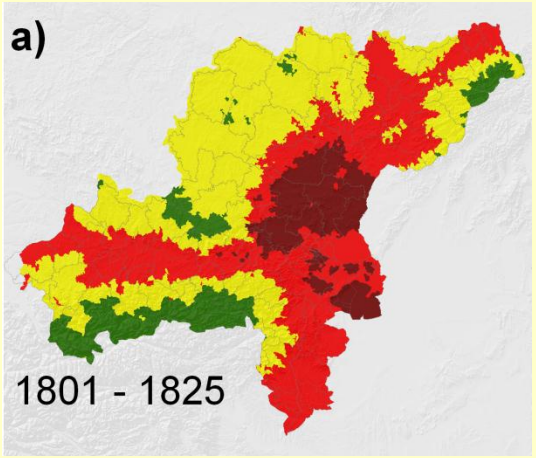
Emphasis on sustainability

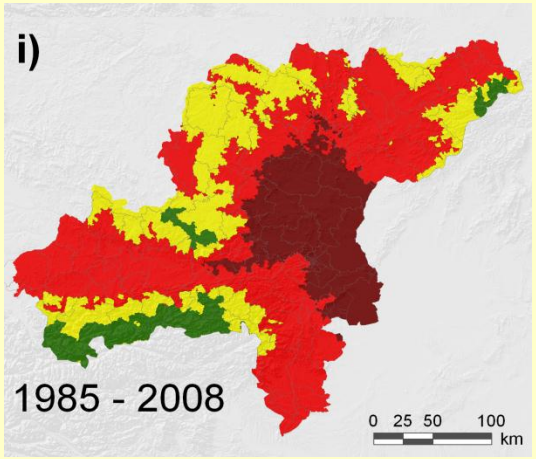
1985-2008

Signs of changing climate conditions

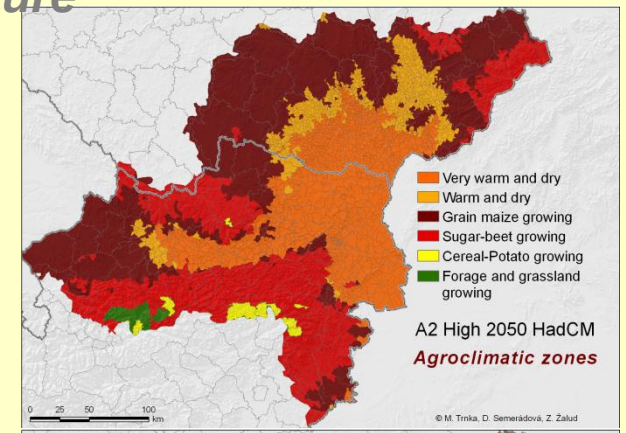
Expected future agroclimatic conditions

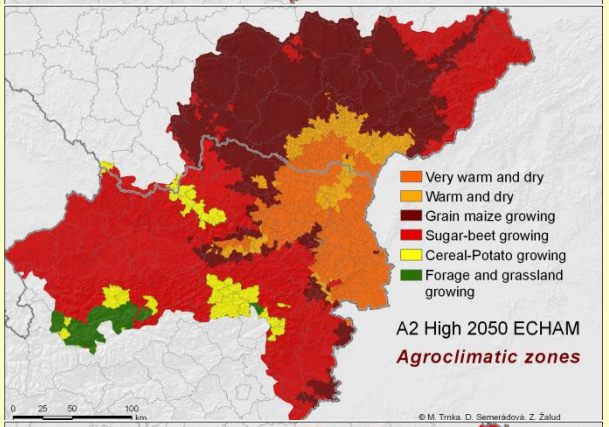
„Observed“

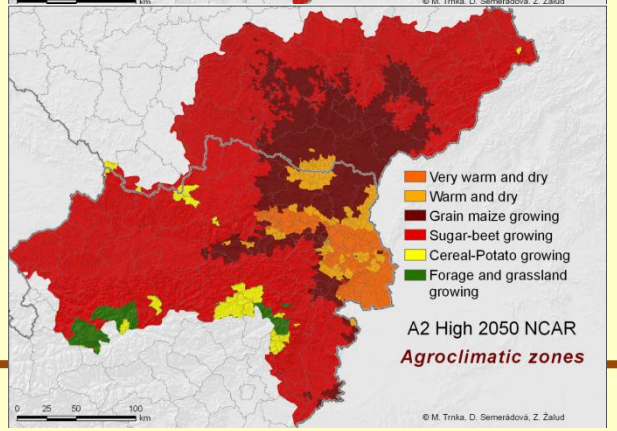




„Future“







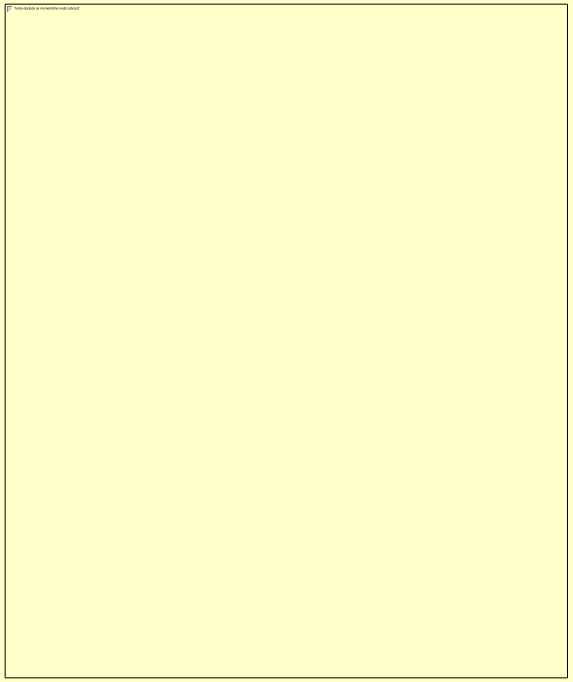
Brief summary:

1. Even local agroclimatic conditions tend to vary significantly;
2. However the expected change of agroclimatic conditions is unprecedented and likely beyond range experienced by modern agricultural systems;
3. Changes in climate will affect other parts of the landscape and soil processes in particular;
4. Adaptation is possible but will require substantial investment both in terms of finances, research and creative thinking….**and the investment seems to be lacking!**

Results presented could not be achieved without:

1. Colleagues from:
    - MENDELU (Z.Žalud, P. Hlavinka, J. Balek, D. Semerádová);
    - Masaryk University (R. Brázdil, P. Dobrovolný);
    - Institute of Atmospheric Physics (M. Dubrovský);
    - BOKU University (J.Eitzinger, H. Formayer);
2. Members of COST Action 734 CLIVAGRI participating on the studies presented in the talk: (*J.E. Olesen, K.C Kersebaum, A.O. Skjelvåg, J. Eitzinger, B. Seguin, P. Peltonen-Sainio, Ana Iglesias*, *S. Orlandini, M. Dubrovský, H. Eckersten, E. Cloppet, P. Calanca, R. Rötter, A. Gobin, V. Vučetić, P. Nejedlik, S. Kumar, B. Lalic, A. Mestre, F. Rossi, J. Kozyra., V. Alexandrov*
3. *Support by projects COST 734, Ministry of Education project KONTAKT OC 187* and *Research plan No. MSM6215648905*.

Thank You for Your attention



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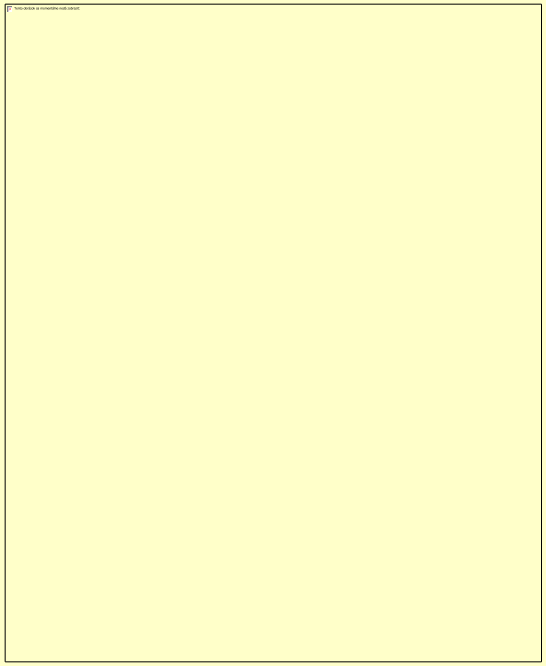

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