

HYDAP - MENDELU



November 2012, Brno



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GREEN = (CzechGlobe



Drought Climatology – Vulnerable regions



Area afected by drought: rSPI 1 month

Area affected by drought: rPDSI



Drought climatology – Regionalization



Drought intensity and crop yields – national level 1920-2003



Months when drought reduces the crop yield (1961-2000)

	П	Ш	IV	V	VI	VII	VIII	IX	Х	XI	XII
Jarní ječmen											
Ozimá pšenice											
Kukuřice na zrno											
Řepka ozimá											
Ozimé žito											
Oves											
Brambory											
Seno											

Brázdil et al., 2010 (TAC) and Hlavinka et al., 2010 (AFM)



Crop response to drought (1961-2000)

a)

Yield departure (kg / ha)

c)

ha)

teparture (kg /

e)

Yield departure (kg /ha)

1000

-1000

-2000

g) 6000

Yield departure (kg /ha)

-6000

-200

1000

-1000

pe. -2000

Regional yield response to 2000 drought

relative Z - index (April-June 2000)





-2.5

What are the trends?



Drought in 200 year context





What are the causes of more frequent droughts?





The crop response is changing in time



The crop response is changing in time





Relationships among the annual differences in mean temperature (T_{mean}) during the May–June period (a, b, e, f, i, j) and Z-index (c, d, g, h, k, l) and the annual deviations of barley yield during 1869–1913 and 1961–2007) at districts Břeclav (a-d), Brno venkov (e-h) and Třebíč (i-l). These three districts are representative of the temperature gradient for all eight districts.

Trnka et al, 2012 (Agricultural and Forest Meteorology)

Estimated change of climate parameters



Trnka et al., 2012 (Global Change Biology)



Trnka et al., 2011 (Climatic change)

Consequences for crop production *Shift of crop poducing areas*

1961-2000





Trnka et al., 2012 (Agronomy for sustainable development)



Topic 1.

Integrated system for drought monitoring in the Czech Republic

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Aim:

- Prepare reliable drought monitoring and early warning system
- Educate decision makers about its use (and usefulness)

Challenges

- Large and small scale variability of climate conditions, soil types, landcover
- Data availability and quality
 - Climate data
 - Soil data
 - Landcover data

Solutions

- High spatial and temporal resolution assimilating all available data sources and applying new procedures
- Using two independent drought monitoring methods for more robust product
- Integrate ground observation, modelling and remote sensing data

Monitoring Diagram – Method I



SoilClim



Hlavinka et al., 2011

SoilClim

Soil para	5		Kc parameters			
Soil parameters loaded from file			Crops	De	egree-days	
Runoff: Runoff thres -1. vrstva- IC: 0.0	0.05 shold: 2	Browse 2. vrstva C: 0.001	Spring crop Winter crop Fodder plant Maize Conifer trees Deciduous trees TBase:	A: B: C: D: E: F:	0 190 1150 4000 4000 4500	
P. [0.2		^ 0.2	Start: 275		*	
			- Number of cuts: 3	- V	yclic simulatio	
CO2 correct	lion	1				
Allow	Concentr	ation: 360				
Simulation r	extart		U.4	1110.	10.95	
Data	Dr1	Dr2	Mid: 1	Mid:	0.8	
0=ini	0	0	End: 0.8	End:	0.8	
57 CD 2			Interim: 0.4	Interim:	0.95	
			Height of plant			
			period and a second	- End	0.2	
			Mid: 0.4	Eric.	1	
0=ini	0	0	Mid: 0.4			
0=ini	0		Mid: 0.4 Interception Ini: 0	End:	0.1	
0=ini Add	0 Update	Delete	Mid: 0.4	End: Interim:	0.1	

Daily data format (example Aug. 7 - 2002 – peak of flood event)

tma_2002_8_VAL07



SoilClim - Biophysical components



Lincoln, Nov, 2011











Drought of 2012









Drought of 2012





Drought of 2012





Method II - VegDRI-CZ - remote sensed data based



How it should look like ..



National Drought Mitigation Centre

Topic 2.

Seasonal assessment of crop status in the Czech Republic

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Aim:

- Develop practically usable products assessing the impact of stresses (especially drought and frost damage) on crops
- Build upon the experimental database (observed water balance, snow cover modelling, yields and phenology)
- Combine it with drought monitoring tool Impact indicator

Challenges

- Large variability (in terms of crops grown) between seasons
- High variability of the landscape (although smaller problem than in other countries in Europe)
- Data availability and quality
 - Yield and crop distribution data

Solutions

- High spatial and temporal resolution assimilating all available data sources and applying new procedures
- Take advantage of phenological observations and modelling
- Testing several levels of spatial resolution
- Integrate remote sensing with model approaches and drought monitoring system



Landsat multispectral image of CZ-Austria border line

Figure 1: The position of 12 experimental sites (fields) within the Czech Republic.

Figure 2: The map with experimental field No. 10; (lines: red – investigated squares 500 x 500 m; black – available grids with NDVI in resolution 250 m; blue – cadastral border).

Topic 3.

Network of water balance measurement sites and field experiments ...where modeler meets reality

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Aim:

- Develop and sustain sufficient experimental base for ground-truthing of models/methods
- Establish permanent CzechGlobe-MENDELU measurement network (combine it with Ecosystem sites of CzechGlobe)

Challenges

- Costs especially maintanance & calibration
- Operational burden

Solutions

- Automatization and standartization of the network
- Pooling resources and multiple use across projects
- Bargaining chip for future data negotiations

Water balance assessing

• eddy covariance vs. Bowen ratio method

Main experimental site

Research field locality Domanínek

- Czech-Moravian Highlands
- altitude 530 m a.s.l.
- mean annual precipitation 588 mm
- mean annual temperature 6.6 °C
- luvic cambisol, water table below 4 m
- arable land (marginal agriculture areas)

Main experimental site

Experimental species

- spring barley
- winter wheat
- winter oil seed rape
- turf grass
- extensive grassland
- short rotation coppice

Present situation

Experiments - Domanínek

- Bowen ratio system
- Mobile Eddy covariance
- Sap flow mesurement
- 2nd Eddy covariance
- Base station
- Lab building

Scintilometer path

www.czechglobe.cz

2013 outlook

www.czechglobe.cz

Experimental site - poplar plantation

established - 2002, 10,000 ha-1

strong weed competition

Populus Maximowiczii x P. nigra

canopy closure in the 4th year

Optimum fertilisation scheme for SRC is known

No large scale experiment conducted under comparable conditions as far as literature is concerned.

March P.

- Lime
- Mineral fertilization
- Ash + sewage sludge
- Non-treated control

Fertilisation experiment:

- Unique and large-scale
- Focusing on sustainable practice
- Monitored as much as possible
- First results just being obtained, harvest planned for 2015-2016

HYDAP research question

- Estimating effect of thermal stress on crops in sensitive stages
 - Field level
 - Methods of upscaling
 - Combination with the remotely sensed data

Motivation

- Drought impacts are mostly combined with effect of high temperature
- Empirical analysis proved promising correlations both on field and regional levels
- HYDAP team would be a perfect set-up for in-depth analysis of the problem through model driven experimental approach.

Motivation

Topic 4. Scaling issues

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Aim:

- Understand better the effect of scalling and integration
- Link our ongoing research to precision agriculture community

Motivation

- Scalling is the cross cutting issue in all efforts we do
- Many solutions have more general applications
- Interesting area for research (what happens below the grid level?)

NUTS 3 level

Issue just worth of exploring

The field variability is influenceed by land management and field area. Region with high water erosion of soil (Archlebov-Ždánice) in ortophoto from 2009

Same region in 50. of 20th century.

Soil variability within the 52ha field obtained by aerial survey – visible and thermal image of bare soil (Přísnotice, 8th March 2008)

Within field soil variability can be observed by various methods of survey

The map of crop yield variability – an information about the final production (Přísnotice, 52ha, 2008)

The heterogeneity of the field can be seen by eye – flowering of poppy (Přísnotice, 52ha, June 2007)

Thank You for Your attention...

and if you are just waking up don't worry...sleep prevents stress!

