Drought monitoring in Hungary

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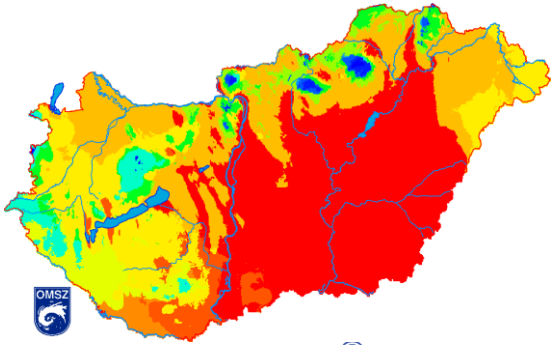
Climate of Hungary

Main climatic drivers

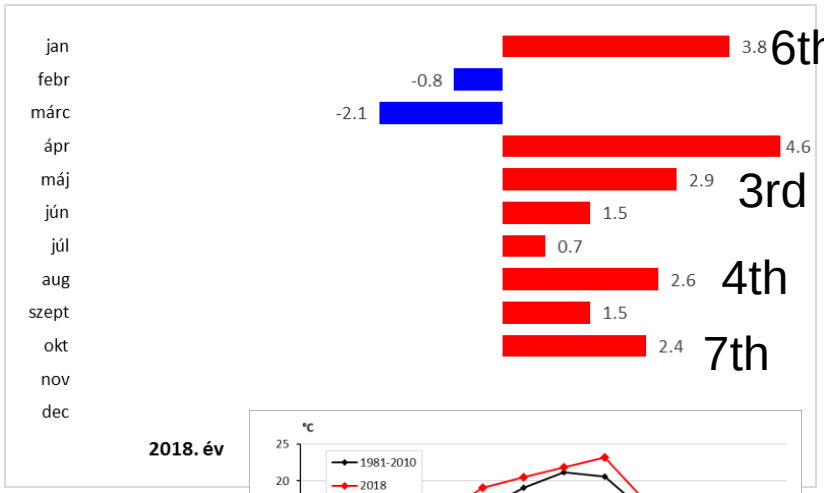
- Absolute position of the country:
  - middle latitude,
  - westerlies,
  - temperate climate zone,
  - four season: hot summer, cold winter,
  - moderate rainfall
- Relative location:
  - Distance from Atlantic-ocean
  - Carpathian basin : topography, 84% of area of Hungary is located below 200m see level height
  - Mix oceanic, mediterranean and continental influences – high variability of climatic element in time and space

ESA, 2018

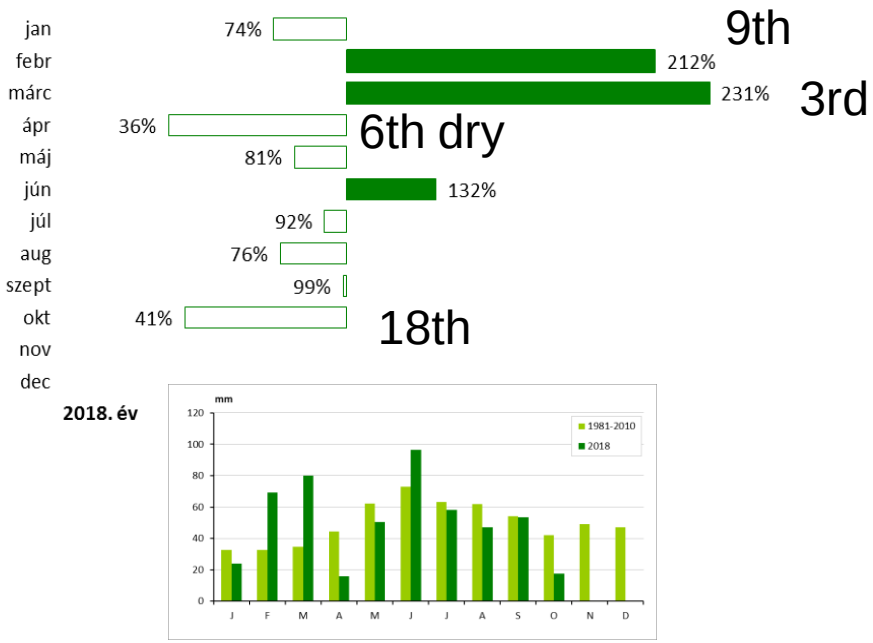


Monthly anomaly compared to 1981-2010

Temperature

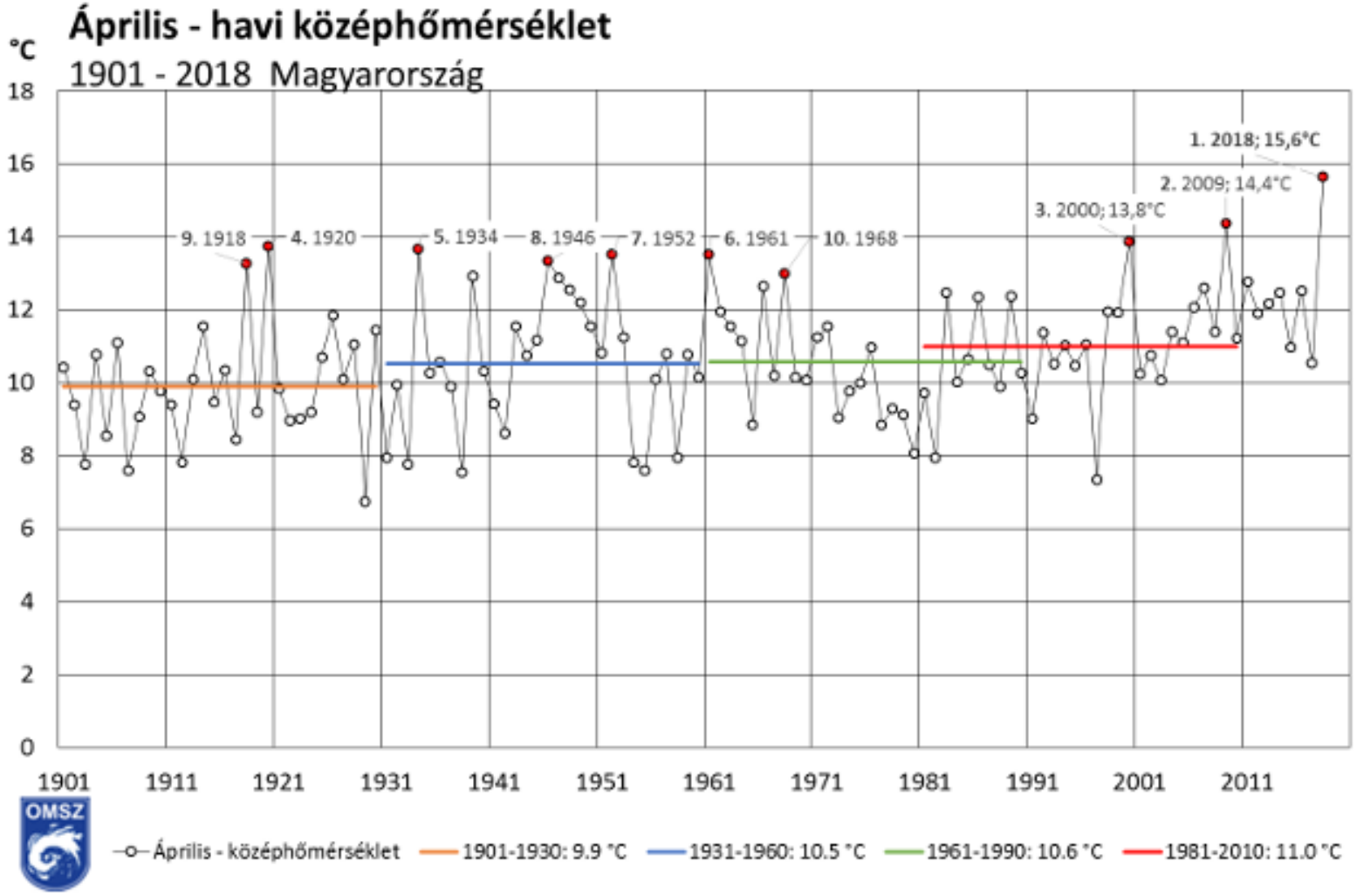


Precipitation



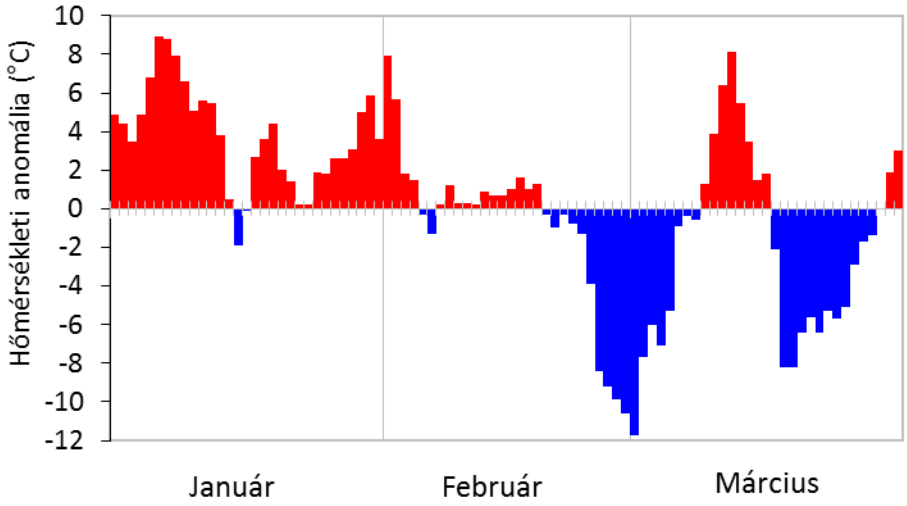
http://www.met.hu/eghajlat/magyarorszag_eghajlata/eghajlati_visszatekinto/elmult_evek_idojarasa

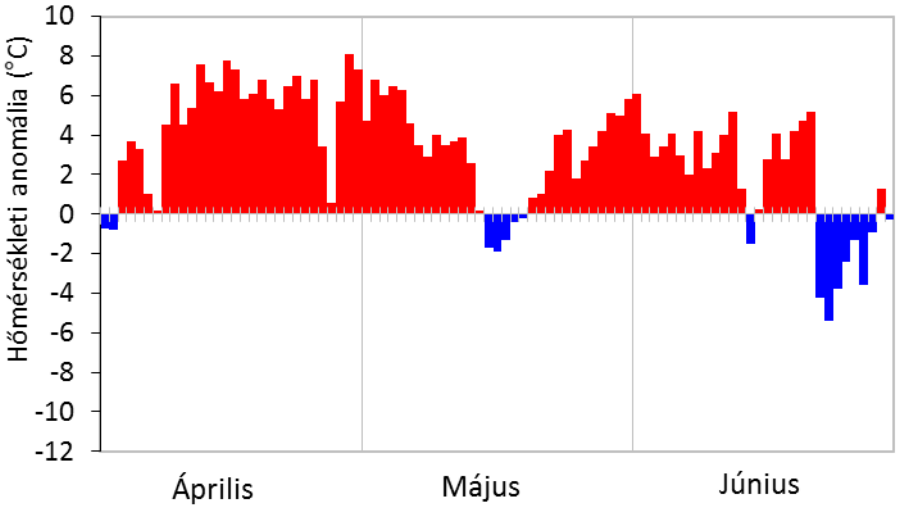
Time series of April's between 1901-2018

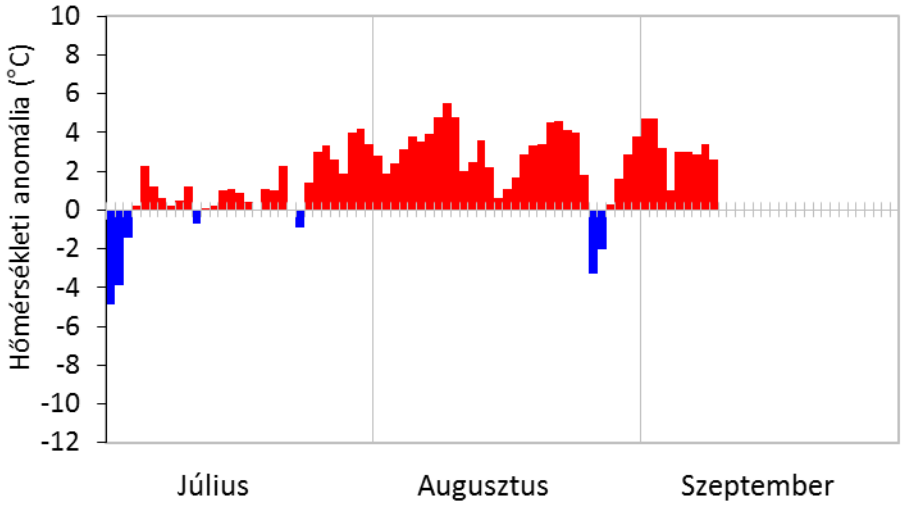


http://www.met.hu/omsz/OMSZ_hirek/index.php?id=2211&hir=A_legmelegebb_aprilis_1901_ota

Anomaly of the daily mean temperature compared to 1981-2010 average

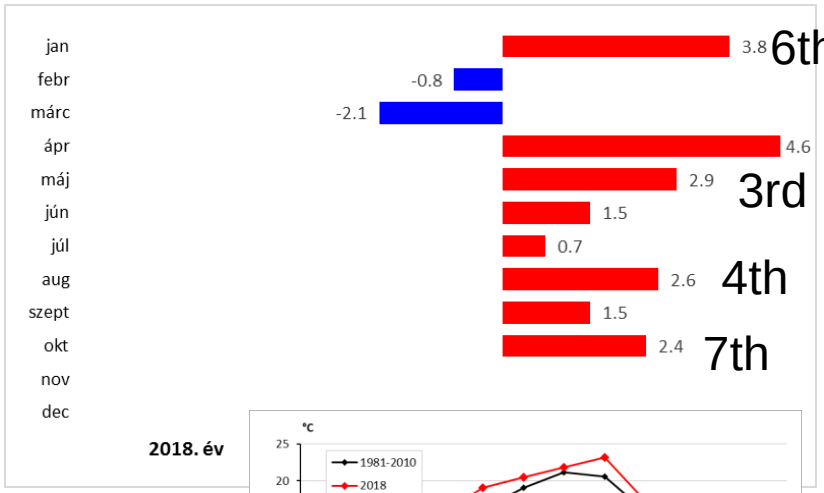




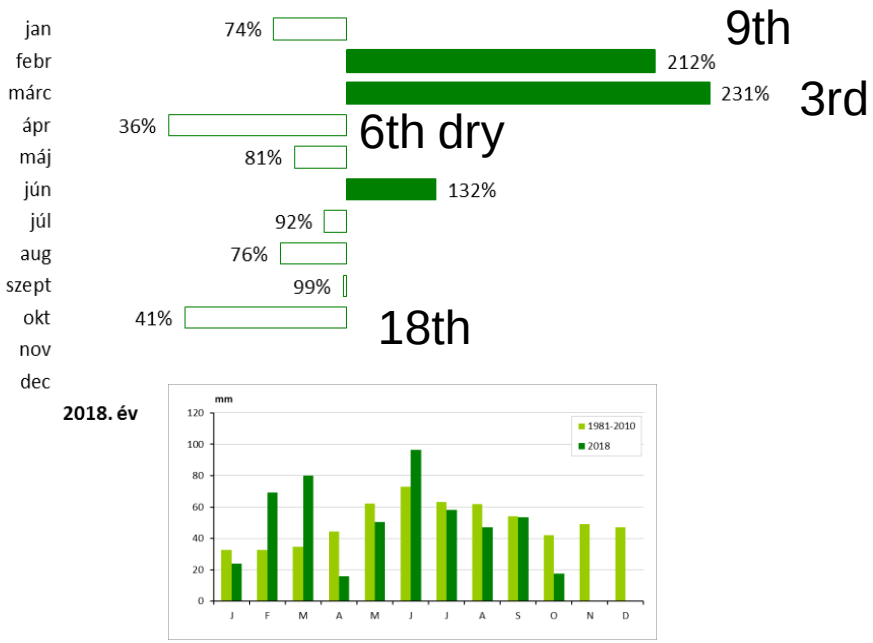


Monthly anomaly compared to 1981-2010

Temperature



Precipitation



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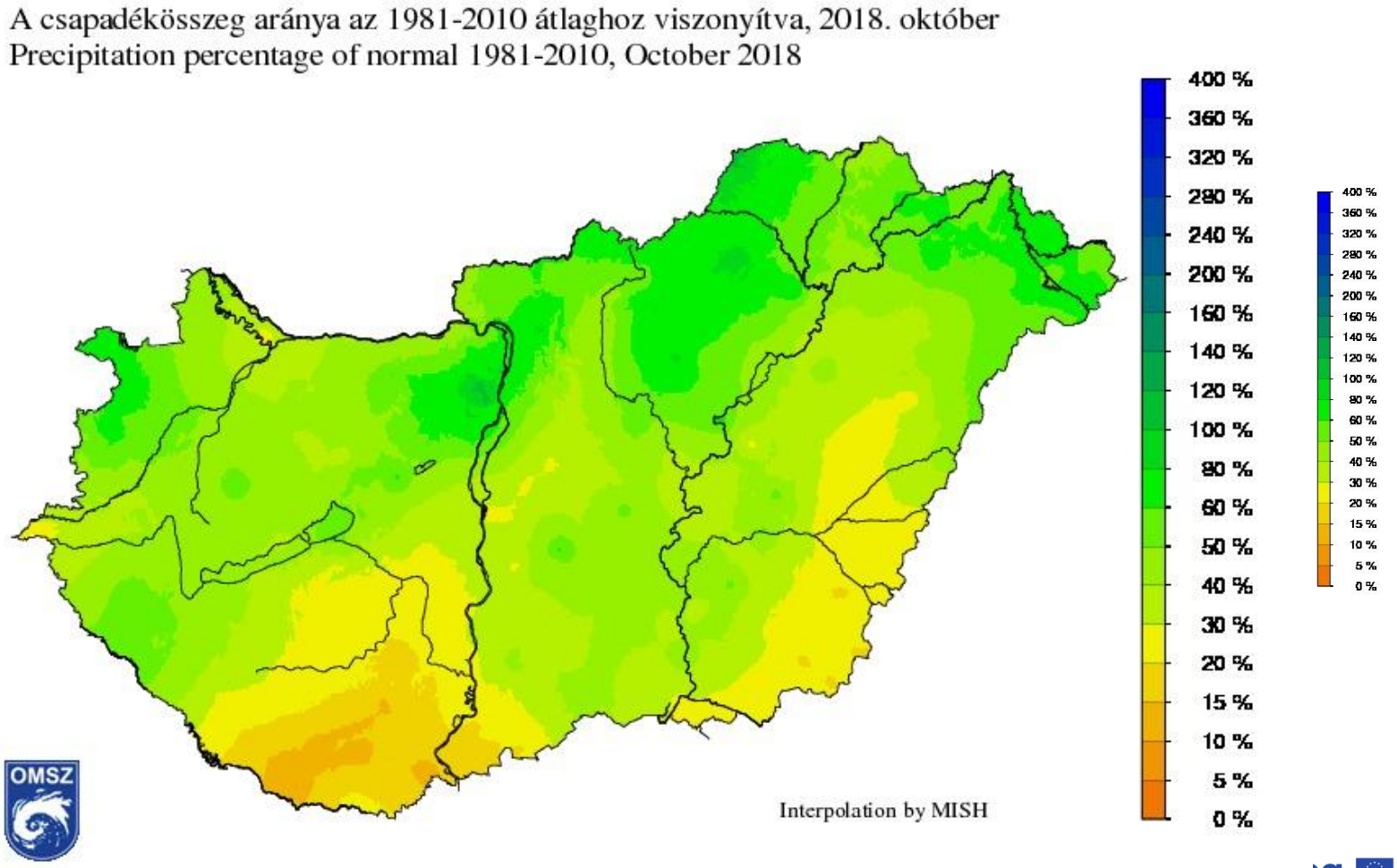
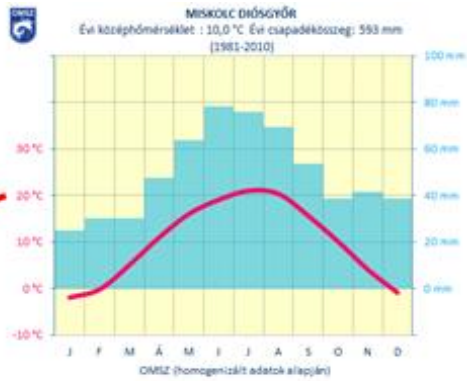
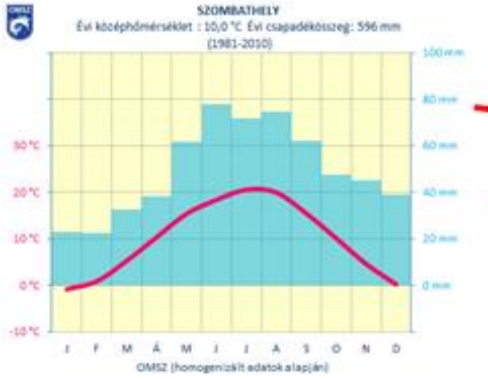
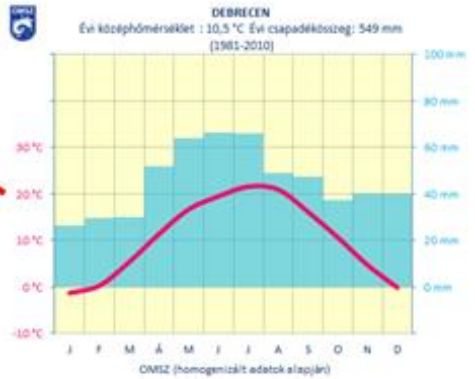
Monthly anomaly compared to 1981-2010

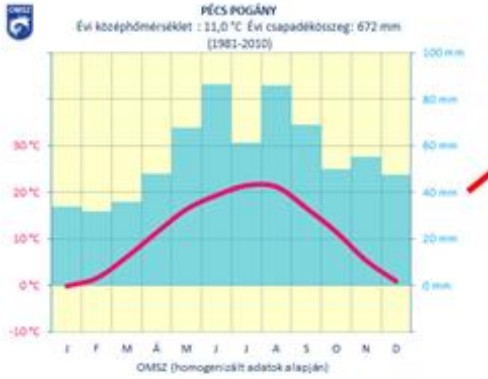


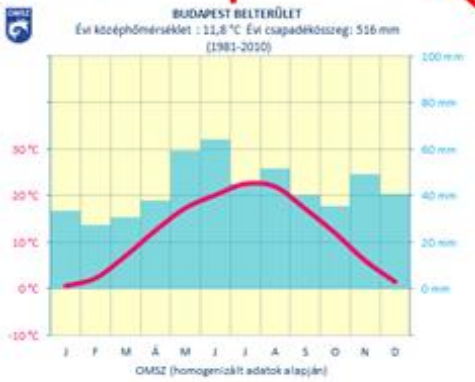
Annual precipitation 1981-2010

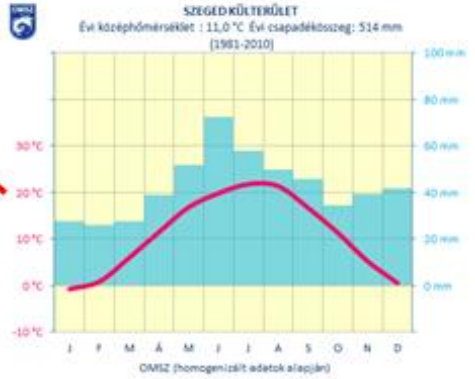


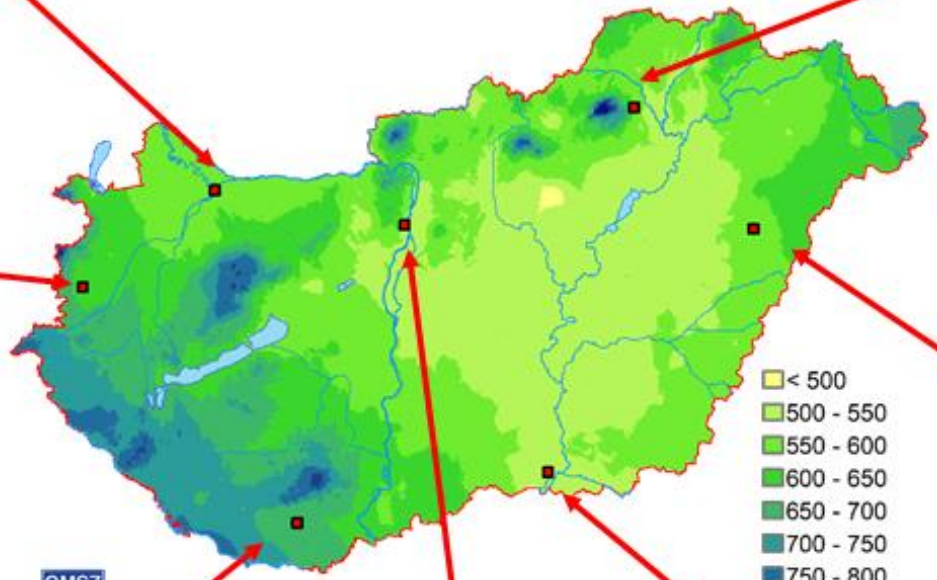




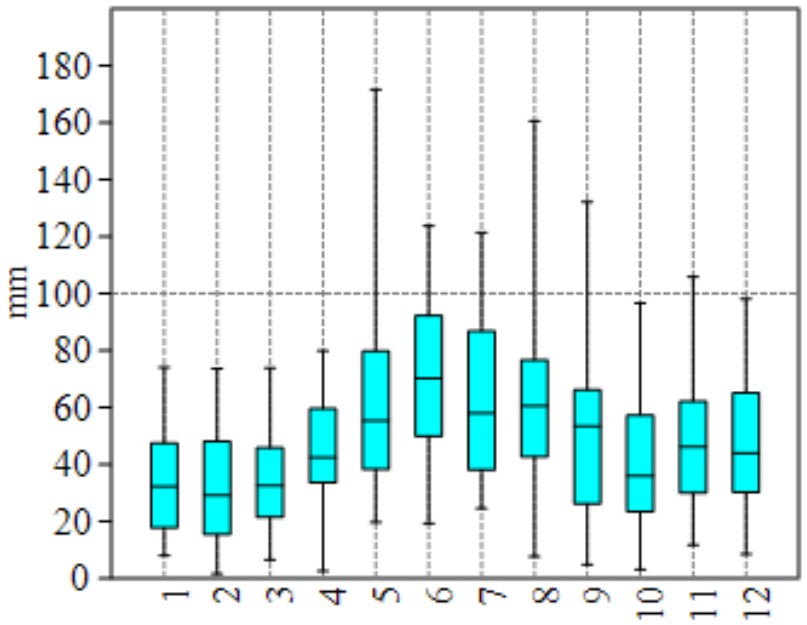


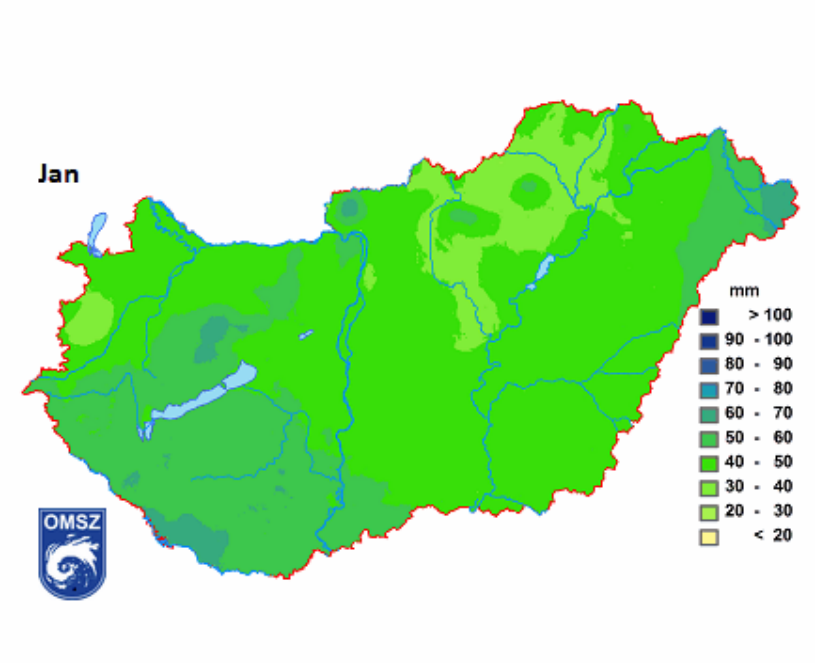




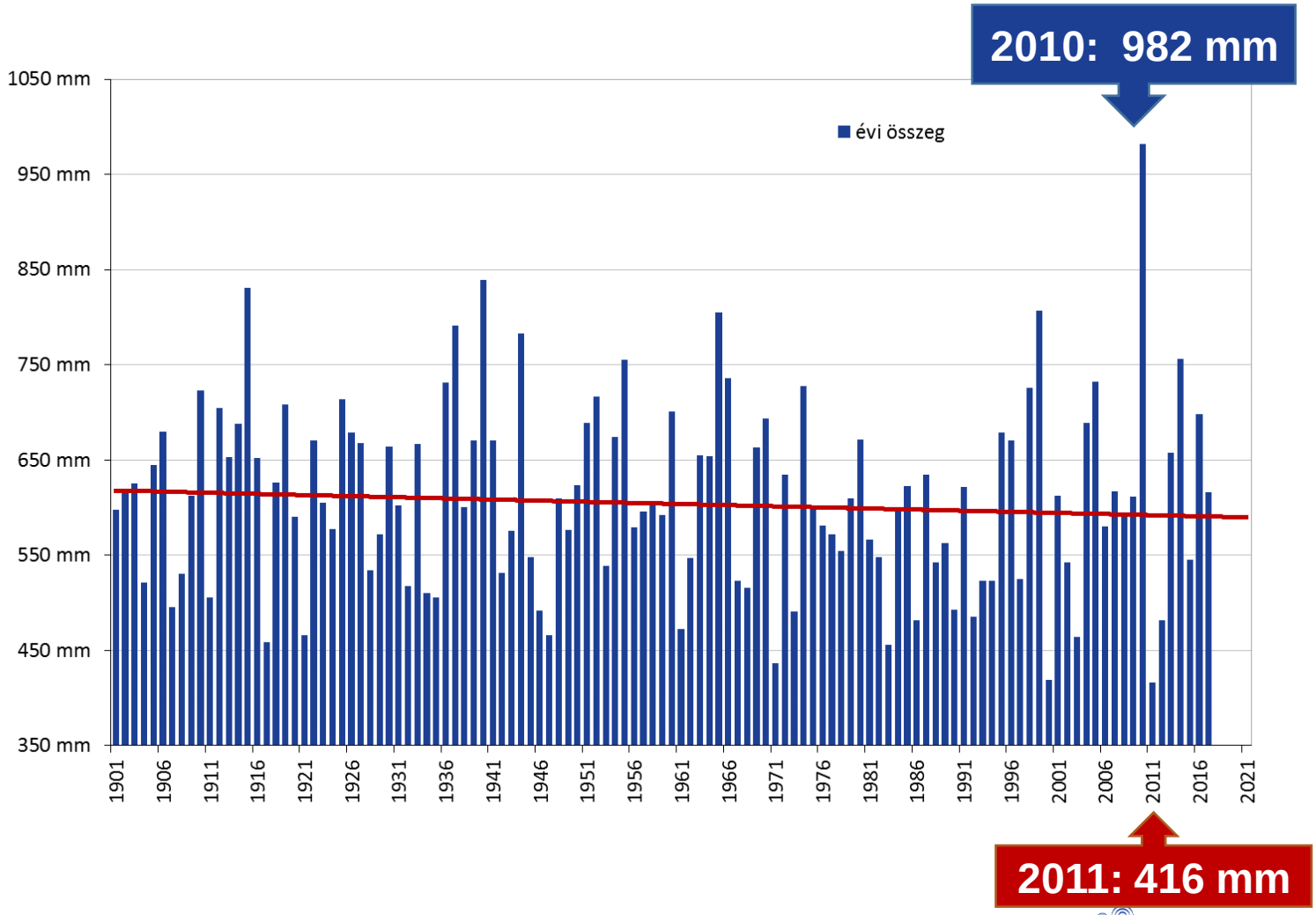


Monthly precipitation 1981-2010





Time series of annual precipitation in Hungary between 1901 and 2017

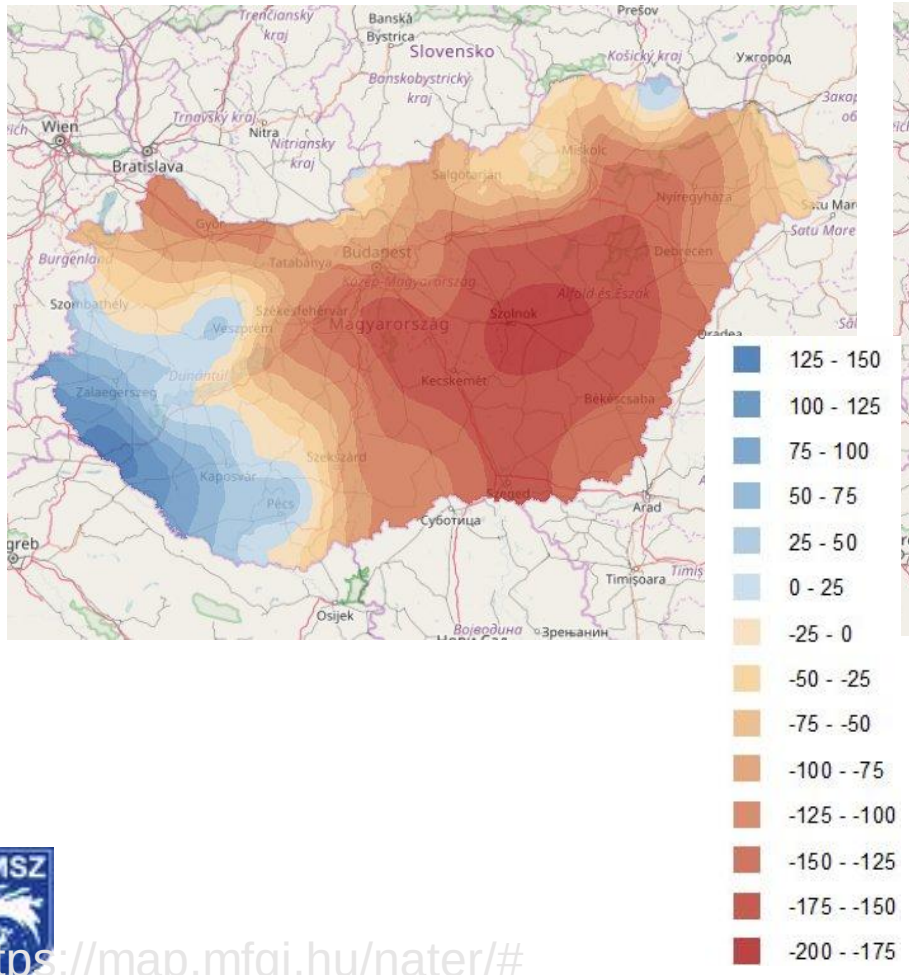


OMSZ

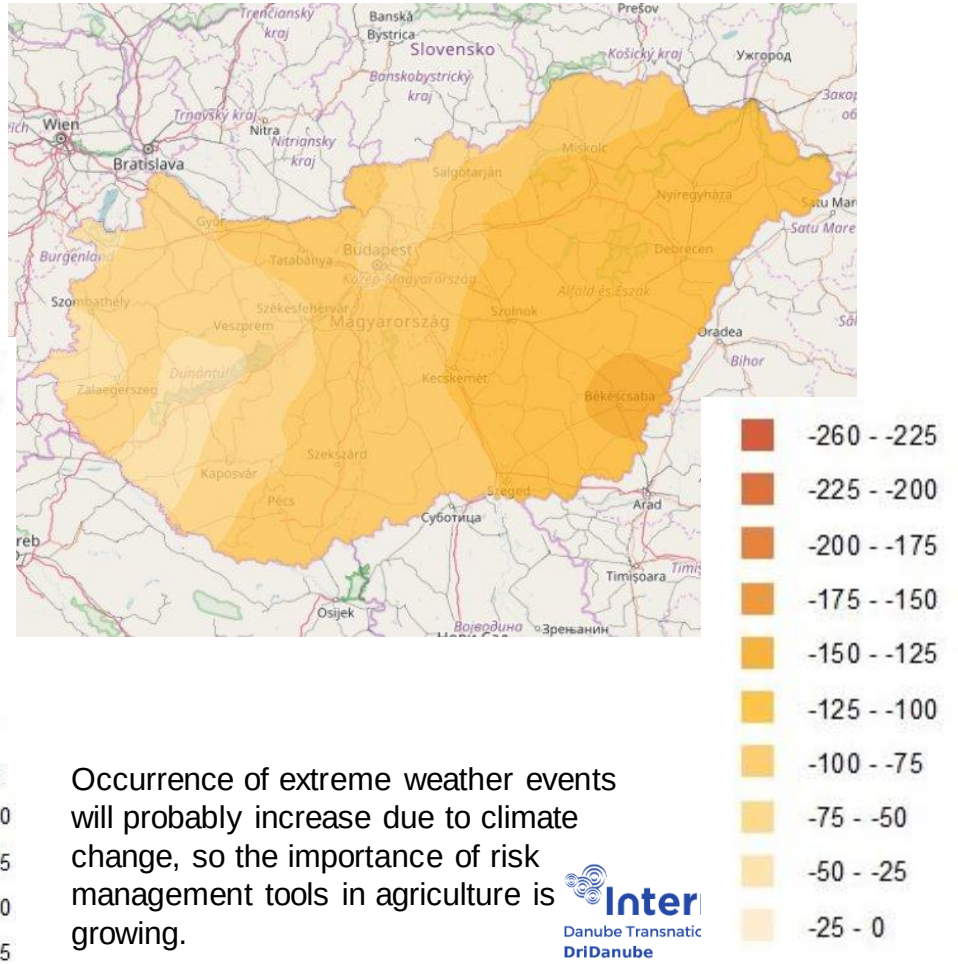
Interreg
Danube Transnational Programme
DriDanube

Climatic Water Balance (mm)

1961-1990



Change of Climatic Water Balance by 2021-2050 ALADIN-Climate modell



Occurrence of extreme weather events will probably increase due to climate change, so the importance of risk management tools in agriculture is growing.

https://map.mfgi.hu/nater/#

Monitoring of Drought

There are many different methodologies for monitoring drought in Hungary:

1. Hungarian Meteorological Service is operating an SPI calculation system for monitoring ***meteorological drought***. From June 2017 have a new *daily drought monitoring* based on modeled data.
2. There is a Hungarian drought monitoring which is operated by ATIVIZIG (They use own developed drought indexes (PAI, PADI, HDI to monitoring and forecasting ***agricultural drought*** in Hungary)

Drought at ATIVIZIG

Agricultural Drought:
PAI (Pálfai Aridity Index)

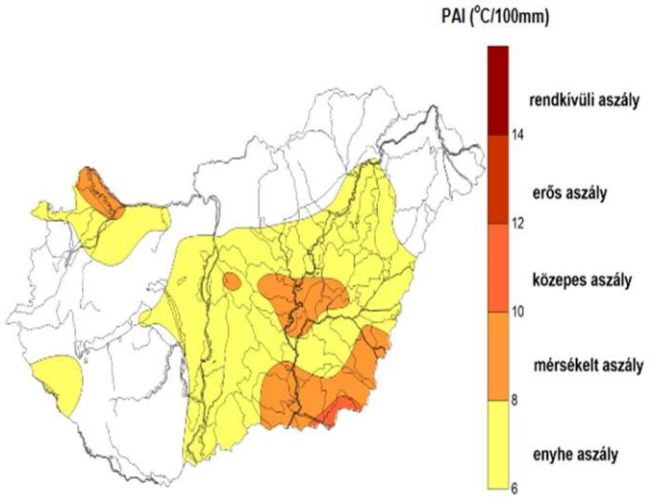
And
PaDI (Palfai Drought Index) developed by Pálfay, I. et al. in the'80s.

$$PaDI_o = \frac{\left[\sum_{i=apr}^{aug} T_i\right] / 5*100}{c + \sum_{i=oct}^{sept}(P_i * w_i)}$$

$$PaDI = PaDI_o * k_1 * k_2 * k_3$$

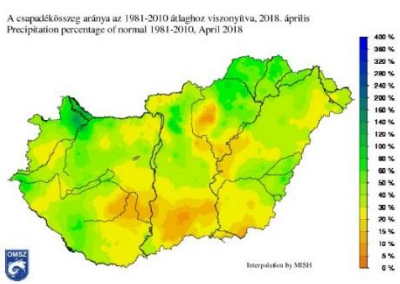
HDI(Hungarian Drought Index) is developed by Fiala et al.

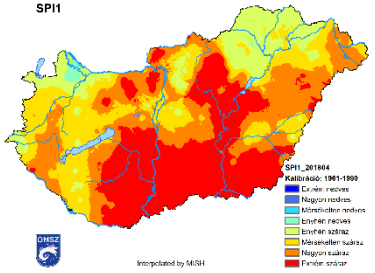
Az aszályindex (PAI) 2017. évi értékeinek területi eloszlása

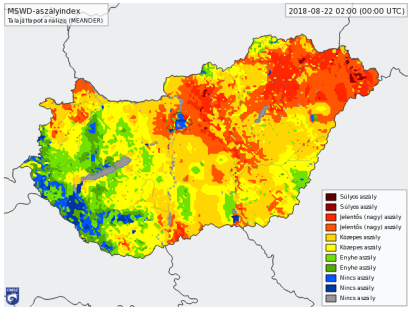


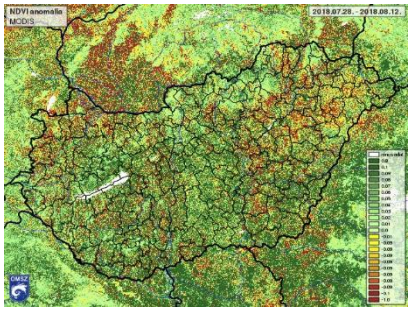
Drought indexes at OMSZ

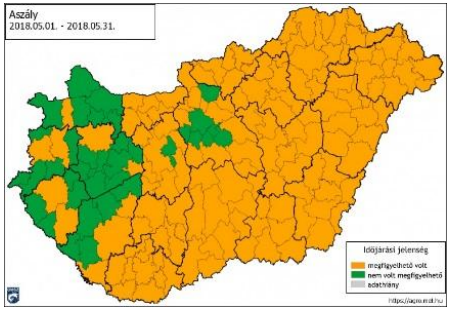
1. **Meteorological Drought:** Monthly anomaly of precipitation, SPI
2. **Agricultural Drought:** Operative daily drought monitoring based on NWP, MSWD
3. **Satellite** (MODIS TERRA) **based drought monitoring**: NDVI, NDDI, VCI, EVI
4. Complex Agricultural Risk Management System 2011. évi CLXVIII. Law regulation - **administrative drought**





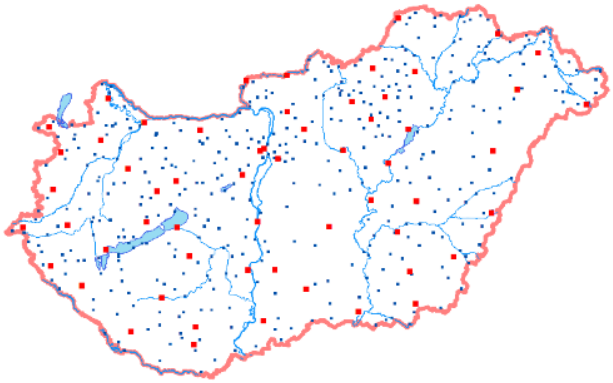






Meteorological drought: SPI (Standard Precipitation Index)

- The Hungarian SPI calculation system (developed by SZENTIMREY, T.) work since 2009.
- Presently it uses precipitation data from 461 rain gauge station. The time series of precipitation began in 1951 until present. The time series were controlled and filled by MASH method (Szentimrey et. al, 2011).
- We use MISH method to prepare gridded dataset and mapping.
- We calculate monthly SPI1, SPI3, SPI6, SPI9and SPI12.
- The calibration period is 1961-1990.

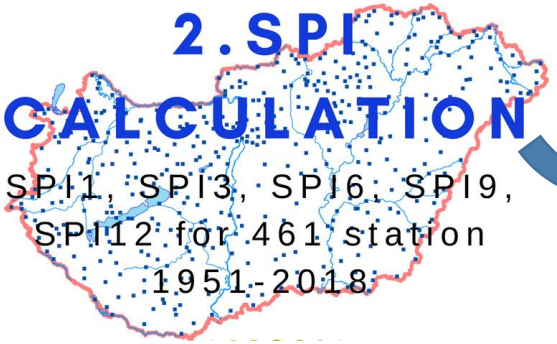


SPI calculation process

1. MASH

Fill gaps, quality control and homogenization of precipitation data

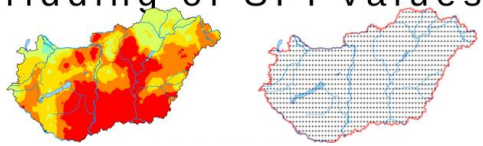
2.SPI CALCULATION



SPI1, SPI3, SPI6, SPI9, SPI12 for 461 station 1951-2018

3.MISH

Spatial Interpolation and gridding of SPI values



4. SPI SUPPORT PROGRAMS

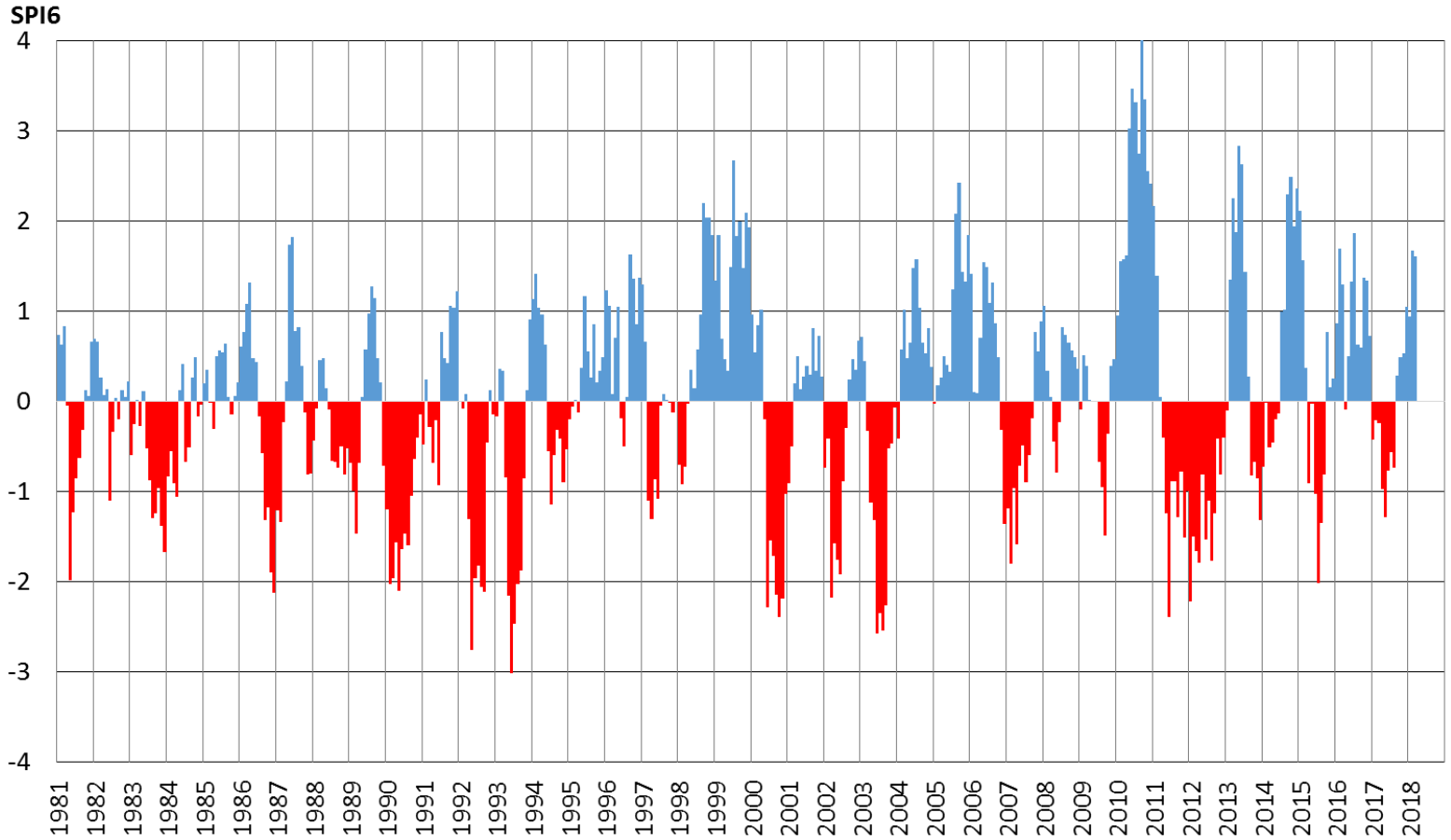
Countywide average of SPI in every month Calibration again for 1961-1990 period

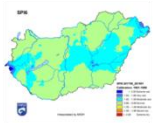
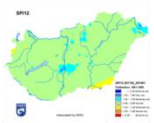
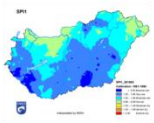
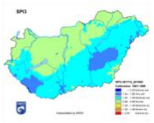
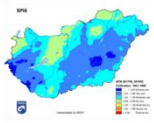
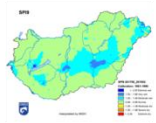
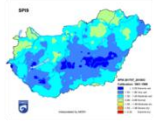
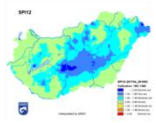
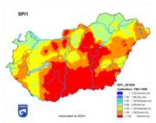
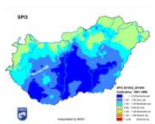
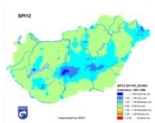
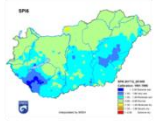
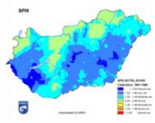
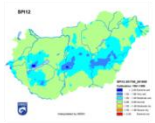
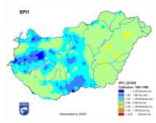
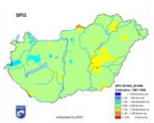
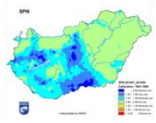
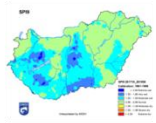
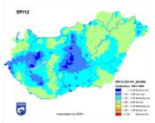
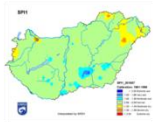
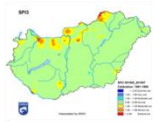
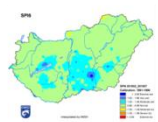
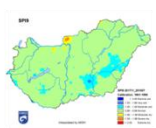
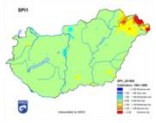
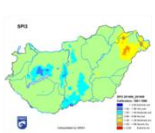
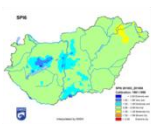
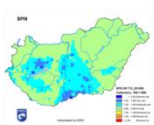
OMSZ

Interreg Danube Transnational Programme DriDanube

Meteorological drought

SPI6



2018	SPI1	SPI3	SPI6	SPI9	SPI12
Jan.					
Feb.					
Mar.					
Apr.					
May.					
Jun.					
Jul.					
Aug.					
Sept.					

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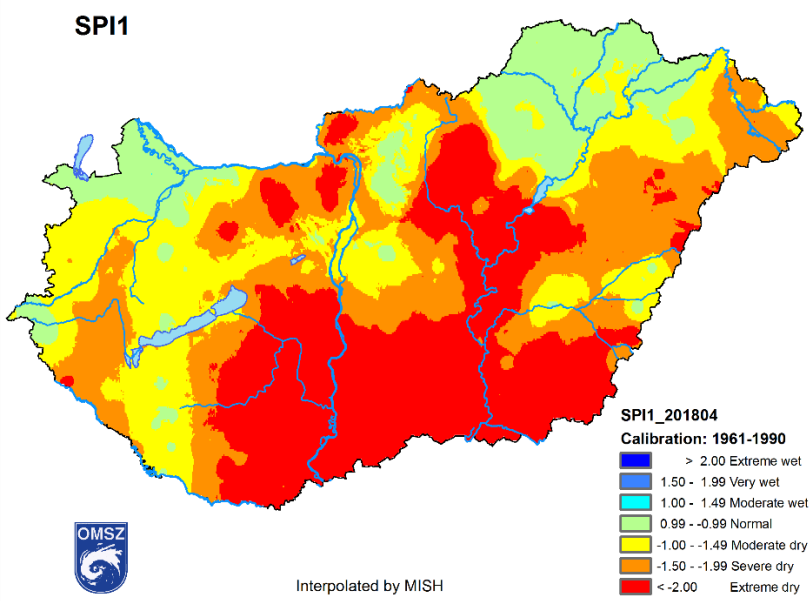
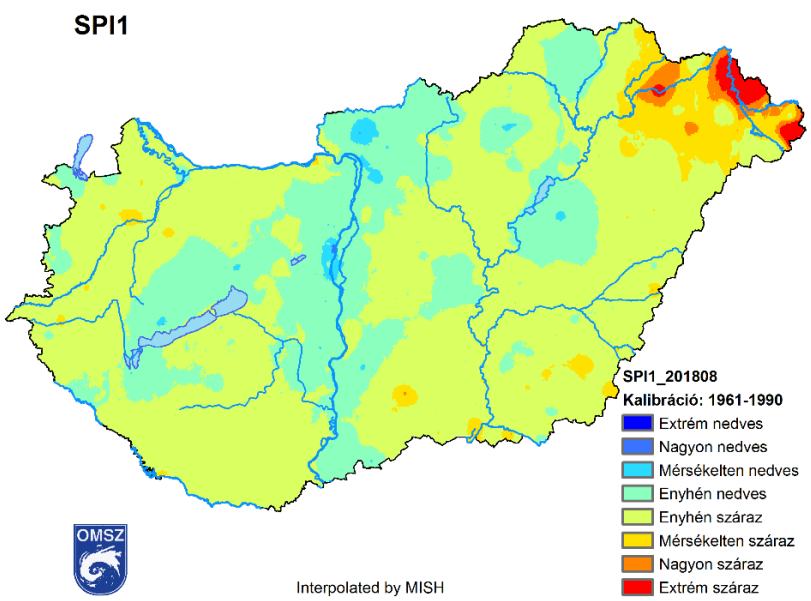
Meteorological Drought SPI1 – early warning

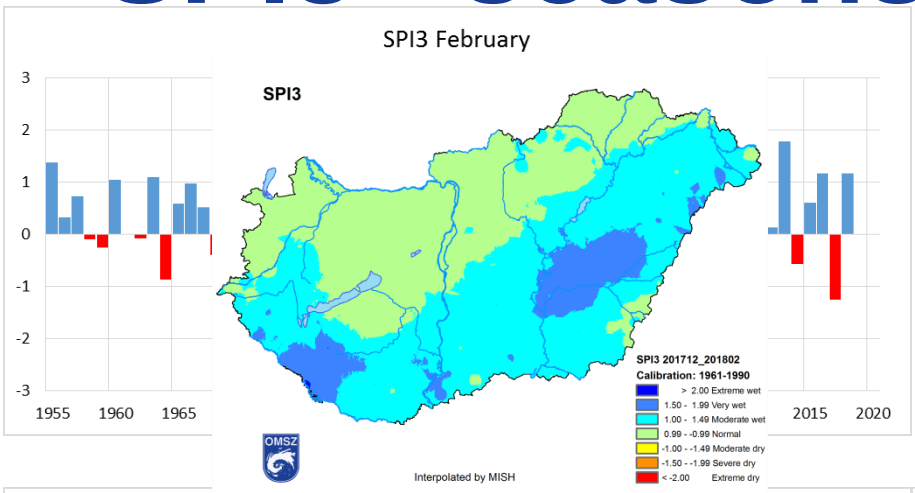
2018 April

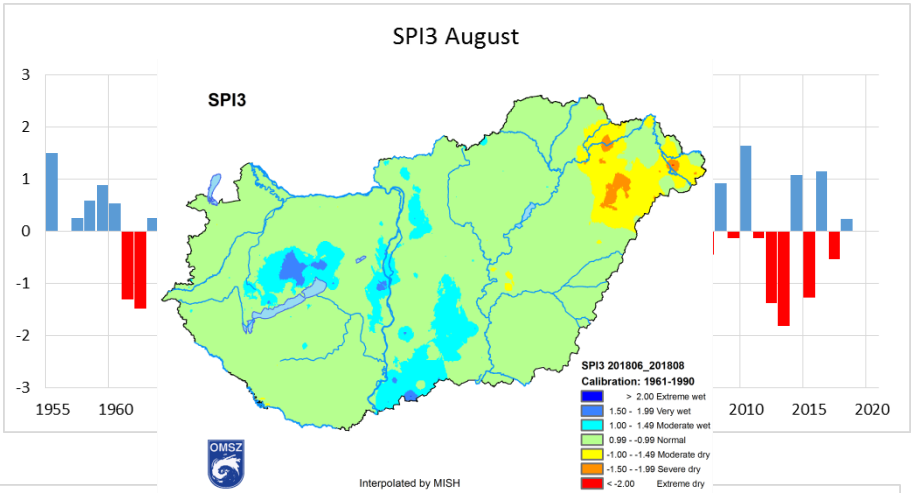


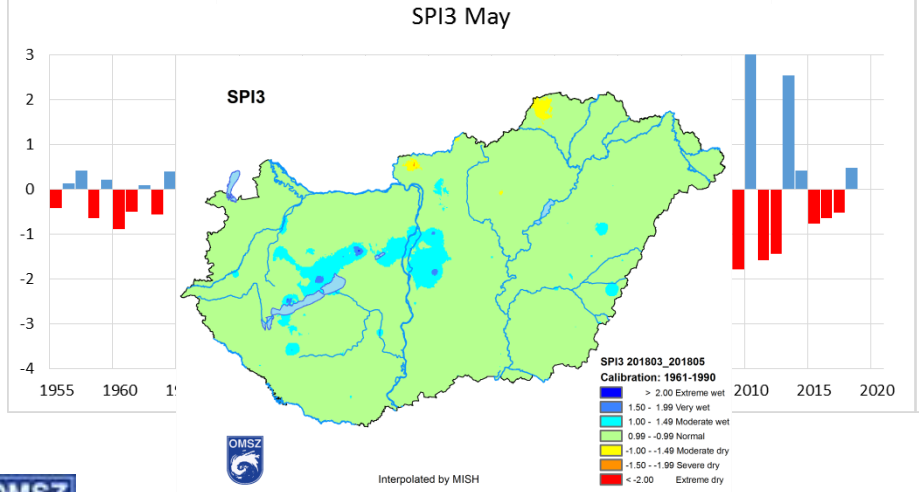
2018 August

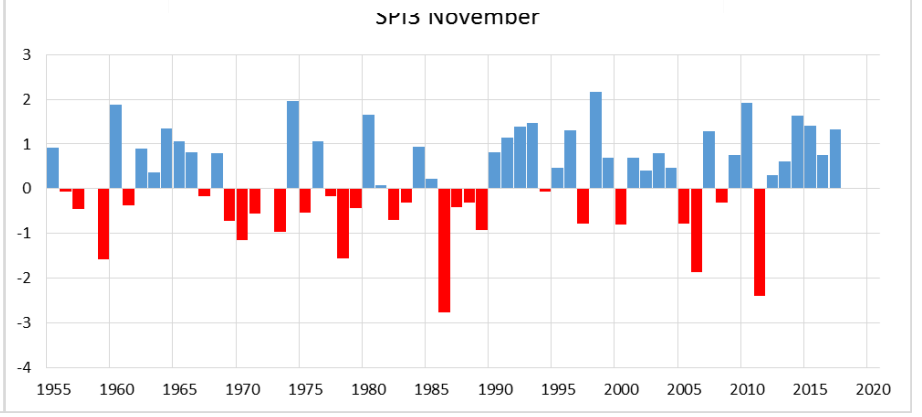


Meteorological drought SPI3 - seasons

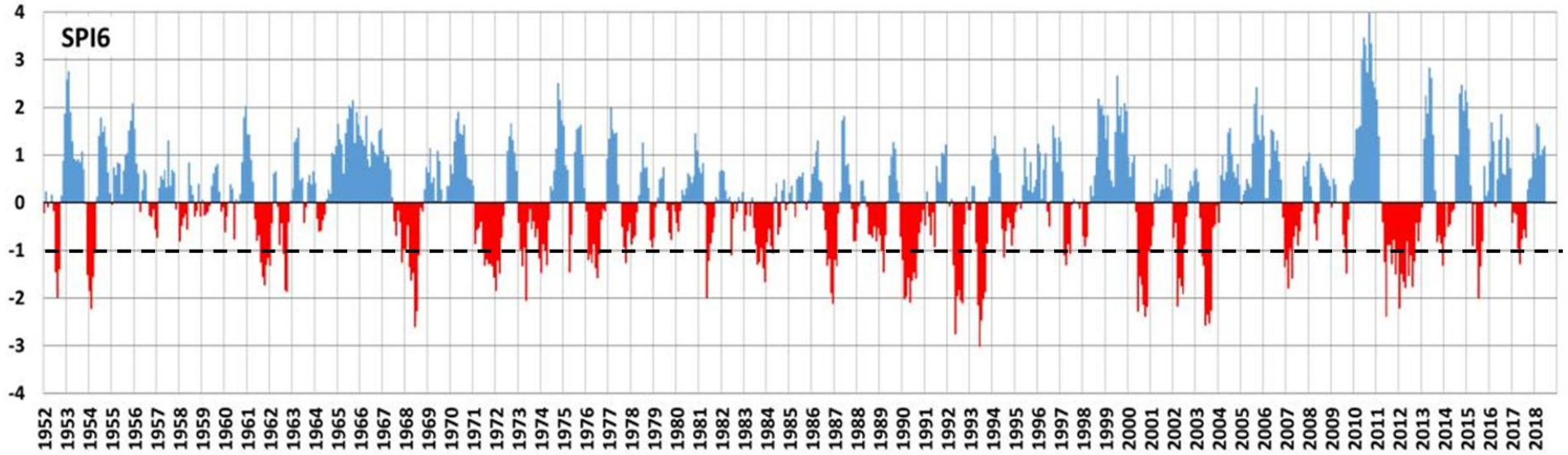








Meteorological Drought SPI6 1952-2018



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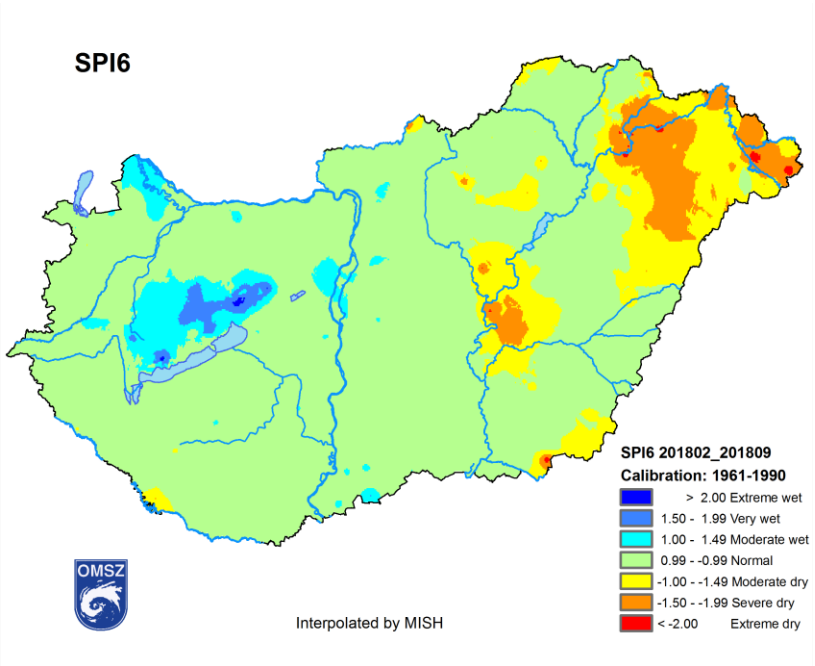
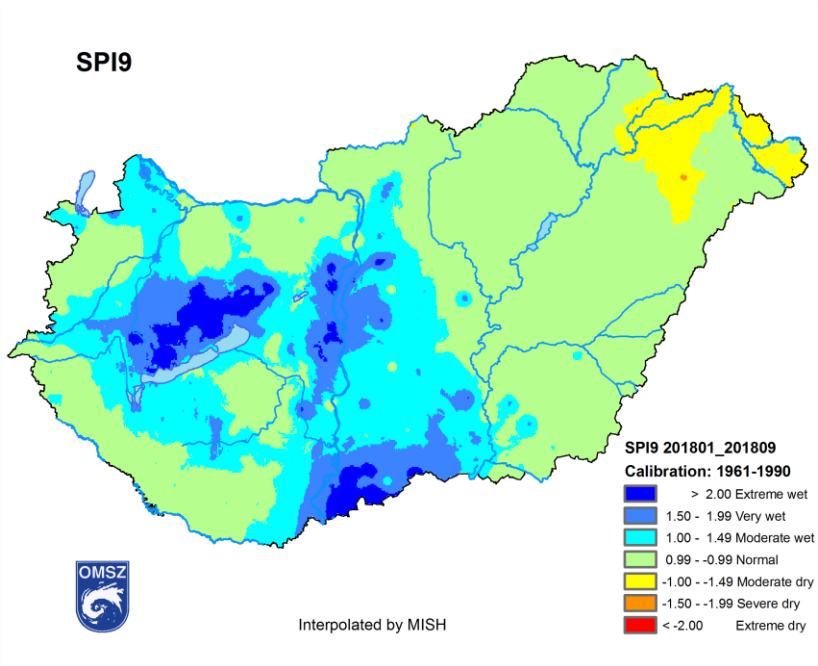
Meteorological drought in the vegetation period

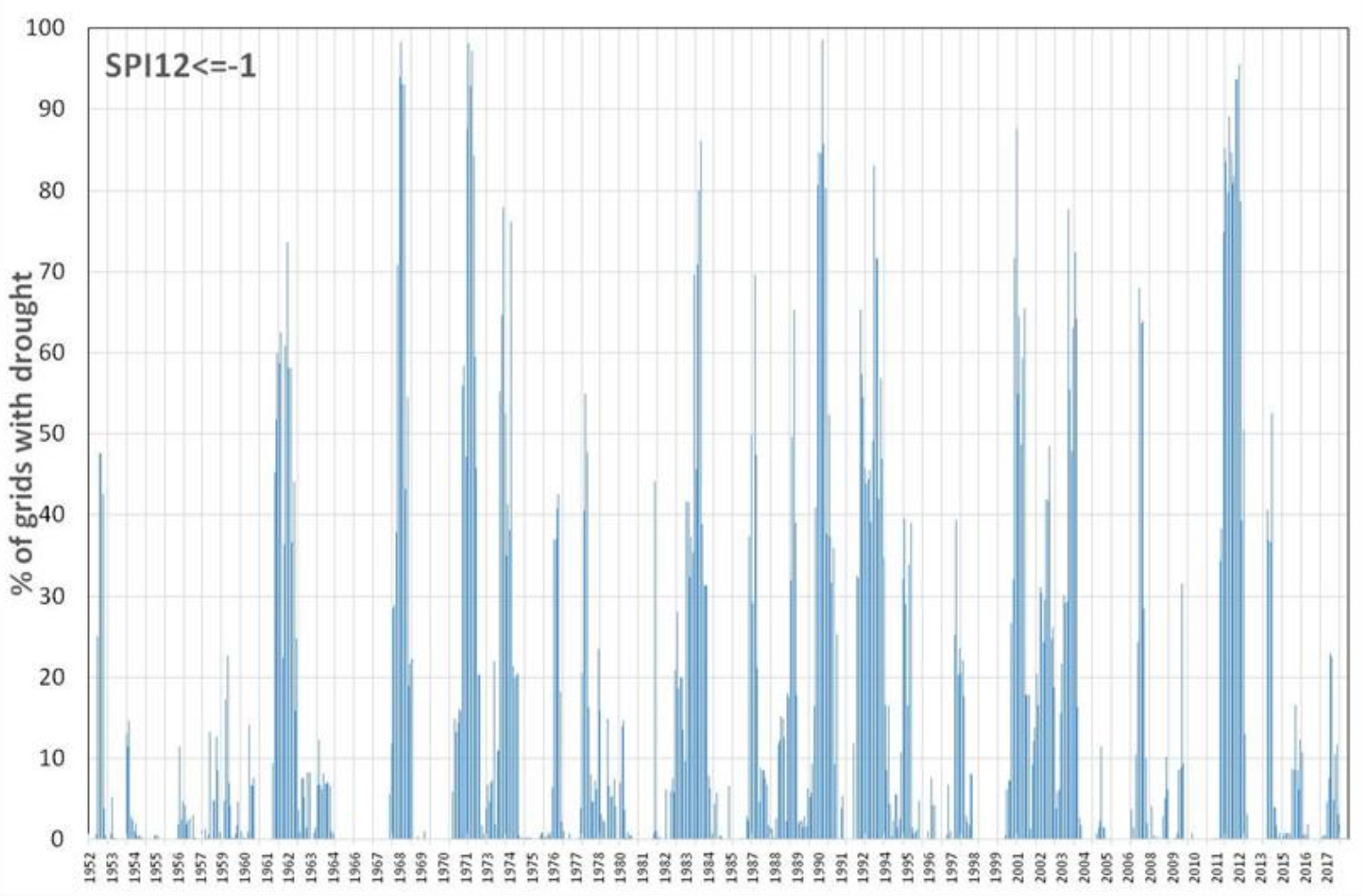
SPI6



SPI9



Time series of drought effected grids in % (SPI12≤-1)



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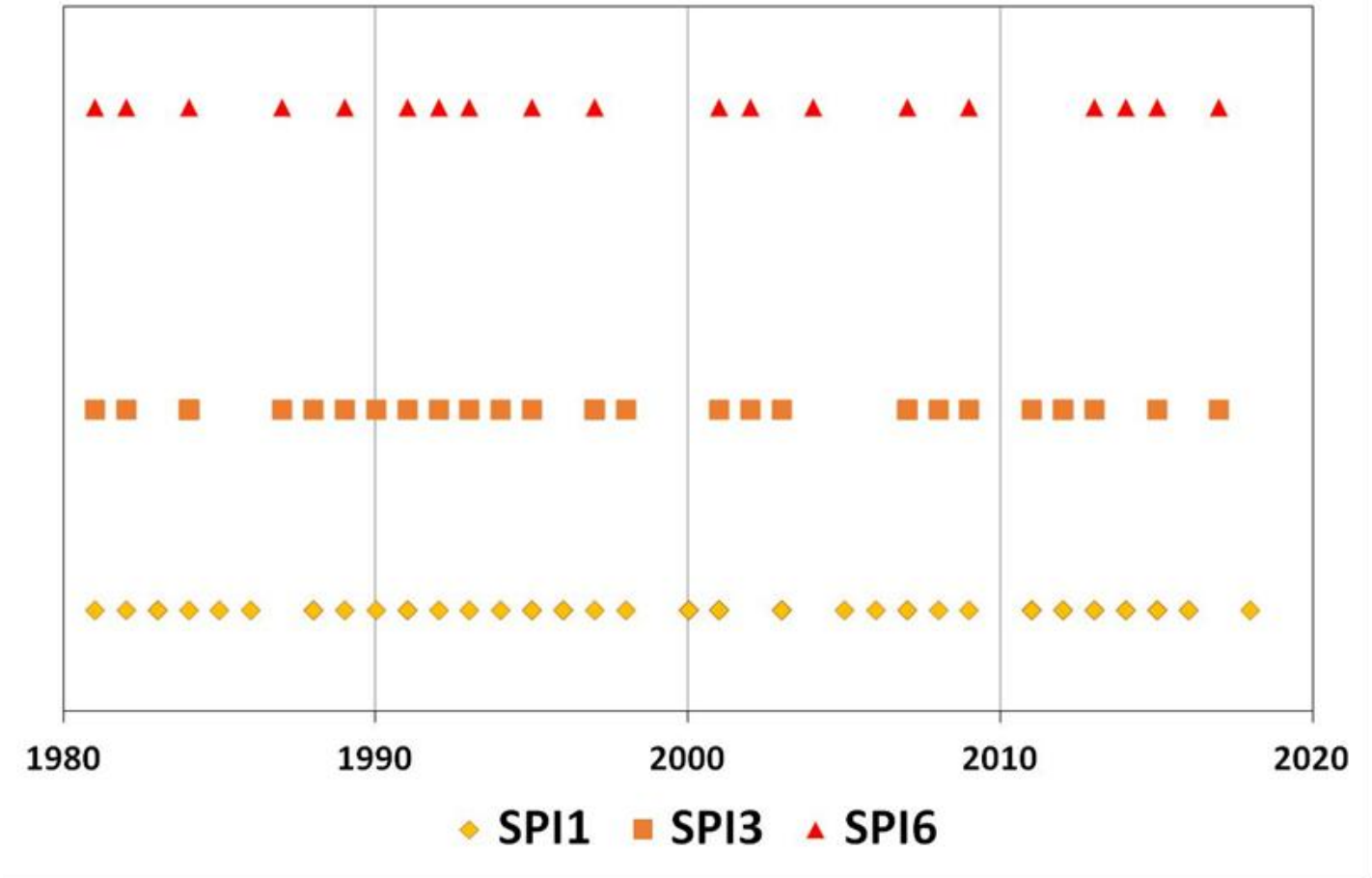
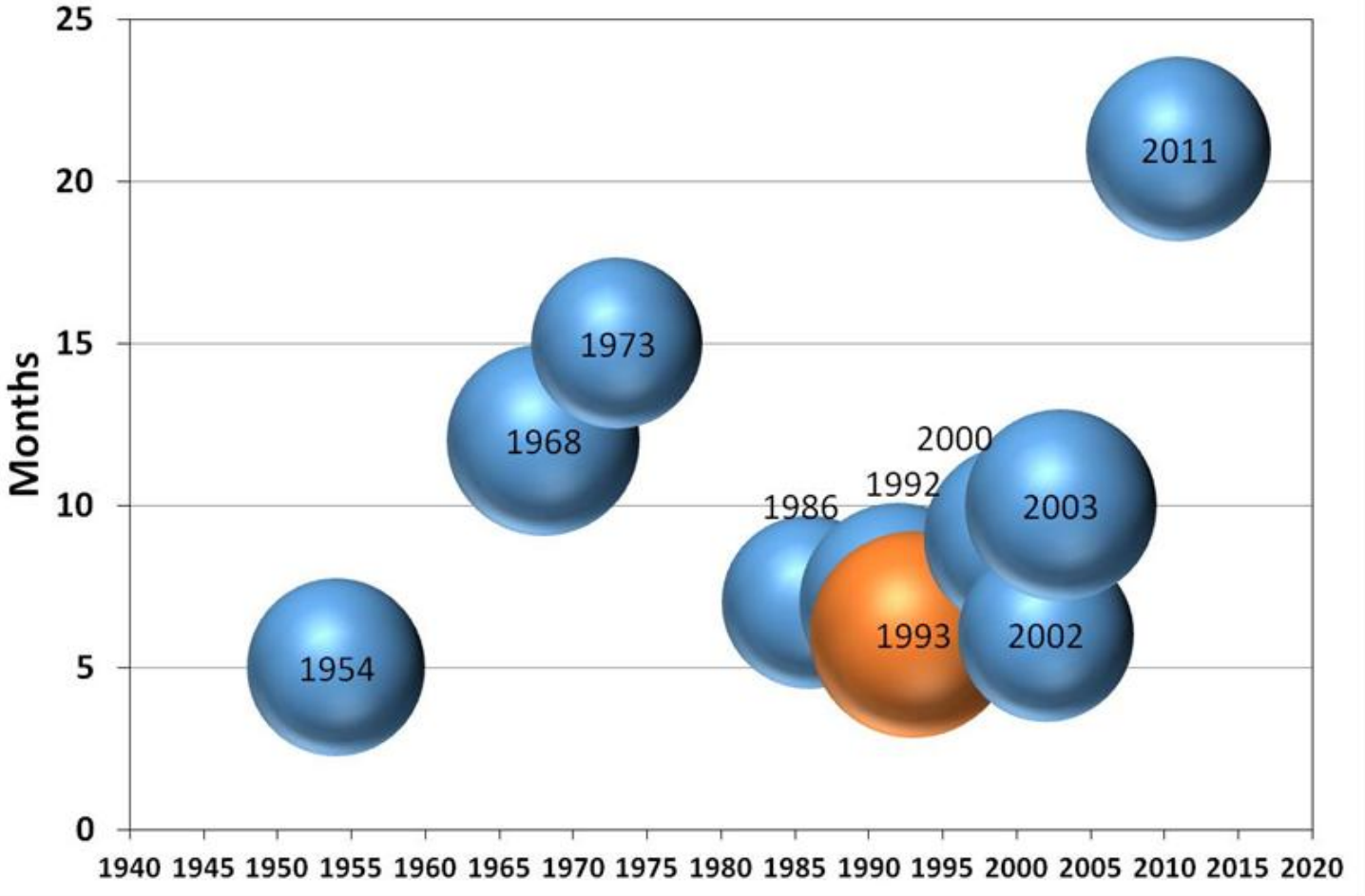
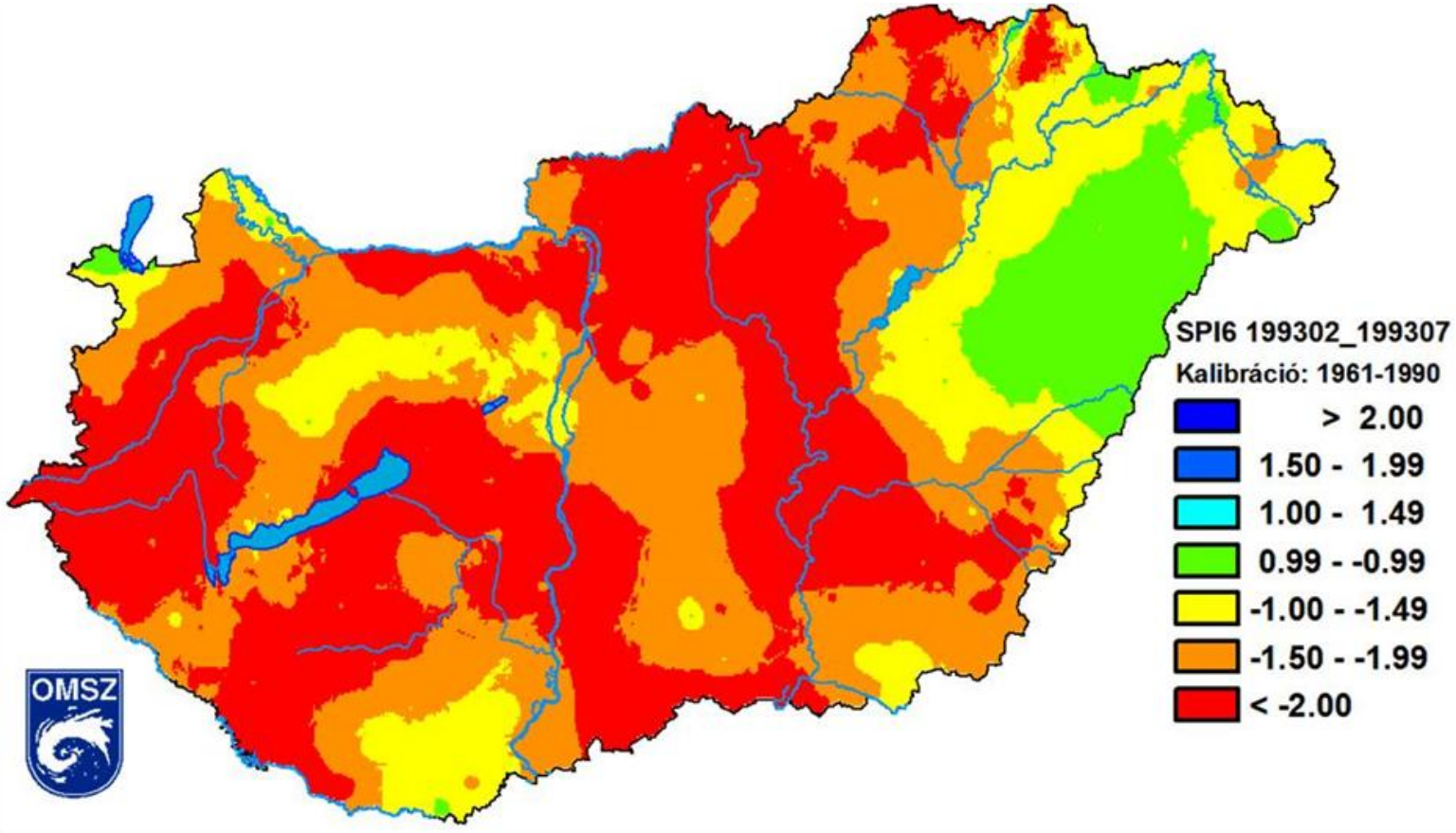
Frequency of drought events by SPI1, SPI3, SPI6 after 1981



Top10 drought events after 1951 by SPI6



The most severe (SPI6= -3.02) drought event in July 1993



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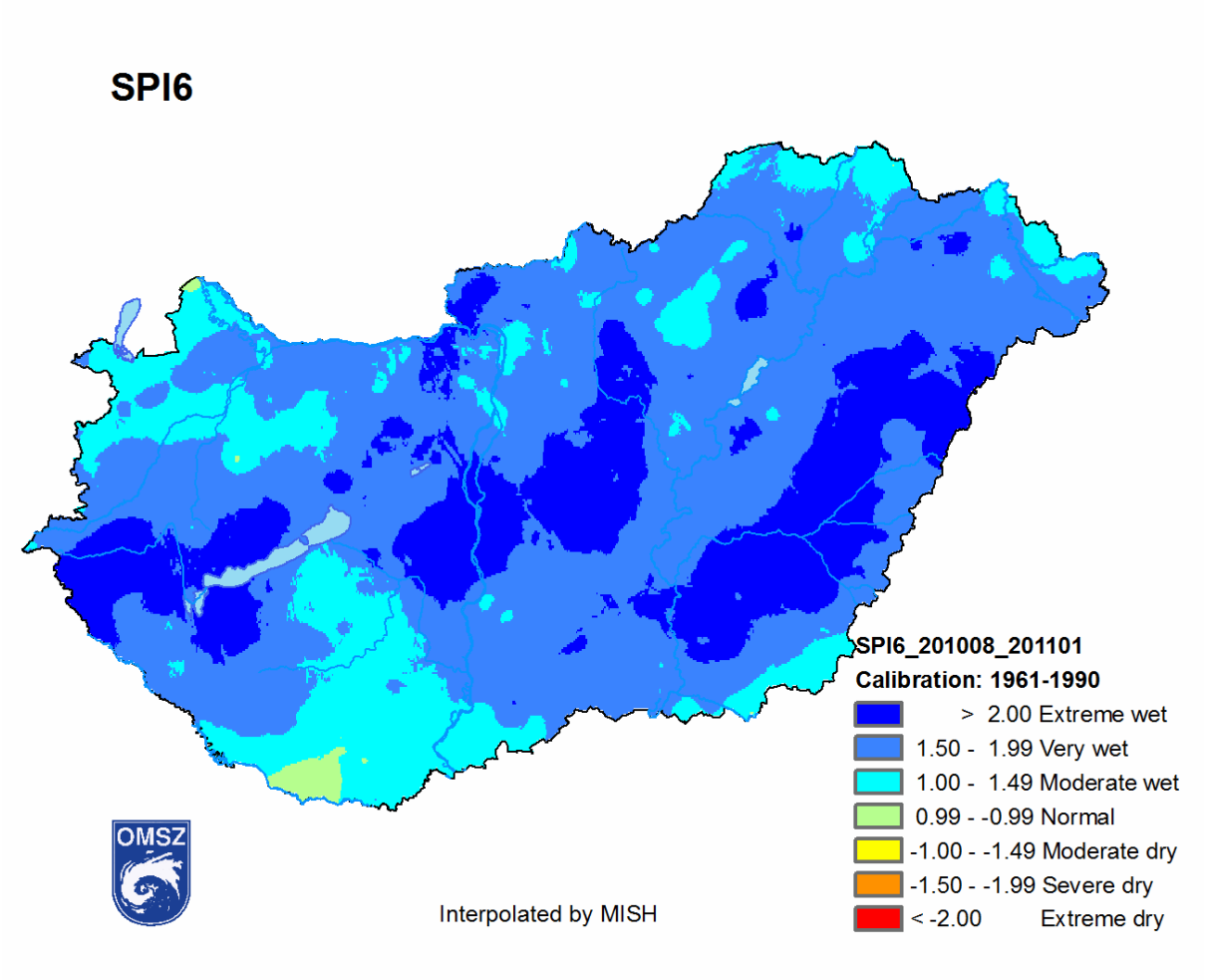
The longest dry period in Hungary (2011-2012)



Complex Agricultural Risk Management System

- In the system, OMSZ provides **gridded information** about the occurrence of the specified meteorological events on a grid with 0.05° resolution.
- Freely available for users (private farmers, enterprises) on agro.met.hu webpage.
- The following extreme events are identified: drought, frost, rainstorm, hail, windstorm.
- Their definition is more administrative than scientific, the aim was to find easily understandable definitions both for decision-makers and end-users.

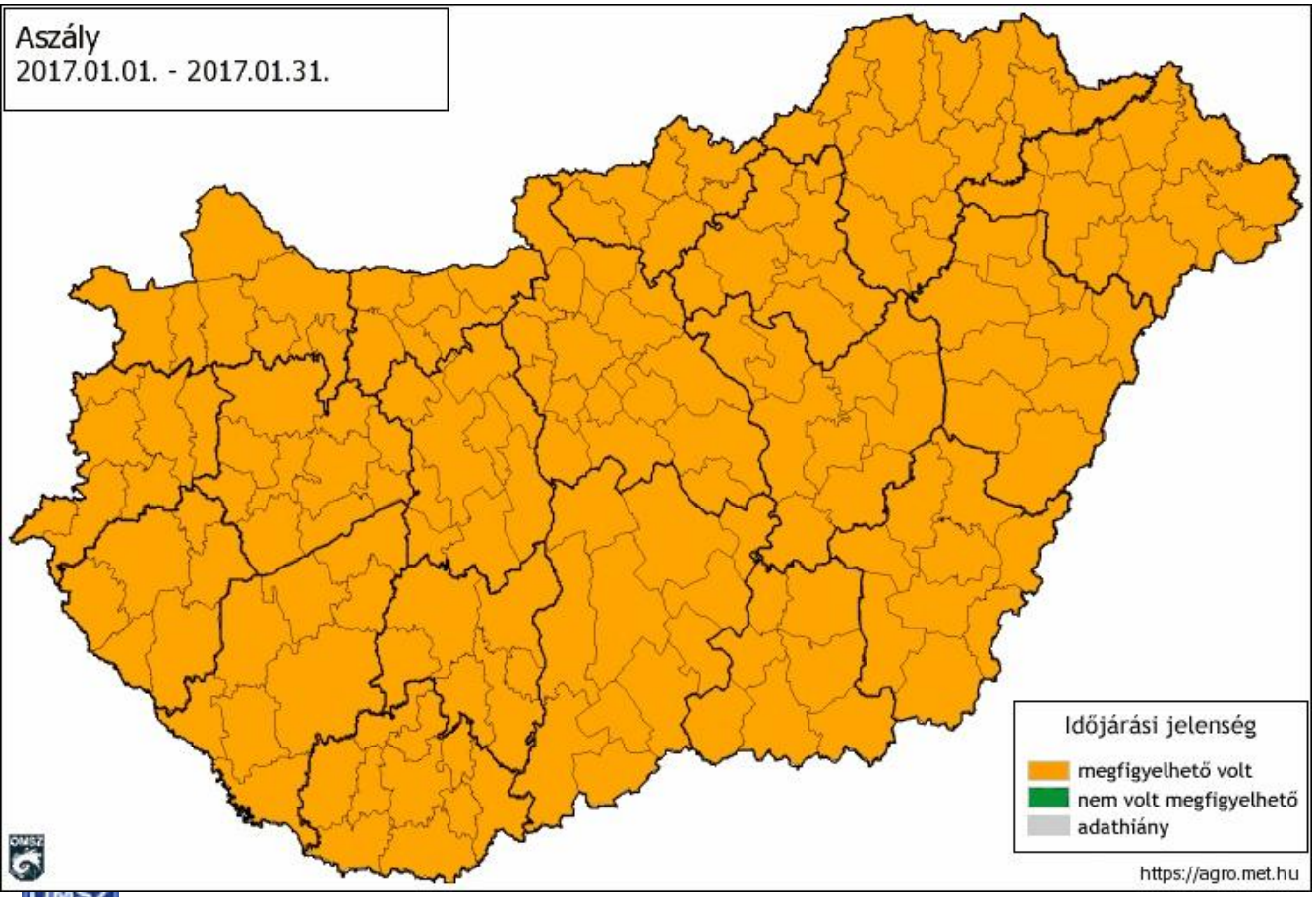
Administrative drought definitions

1. Precipitation amount is less than 10 mm during 30 consecutive days (before 15 June 2017)

or

2. Precipitation amount is less than 25 mm during 30 consecutive days and daily maximum temperature above 31°C during 15 consecutive days.

Drought between January and August of 2017



Source: mezohir.hu

r<10mm/30day

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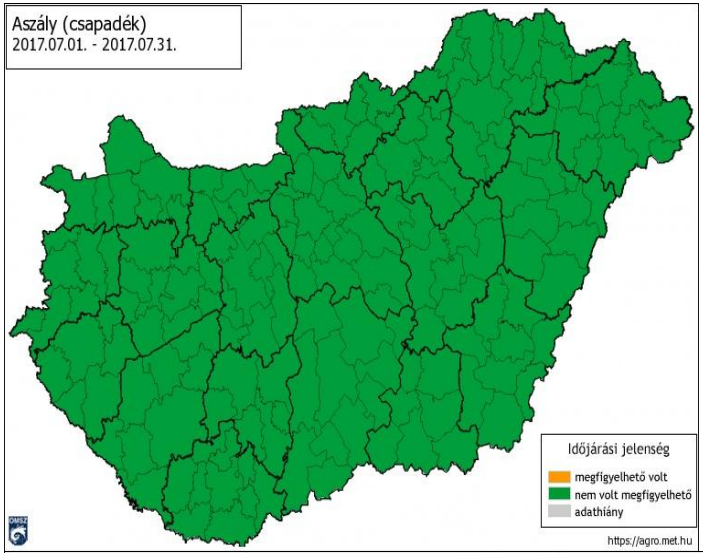
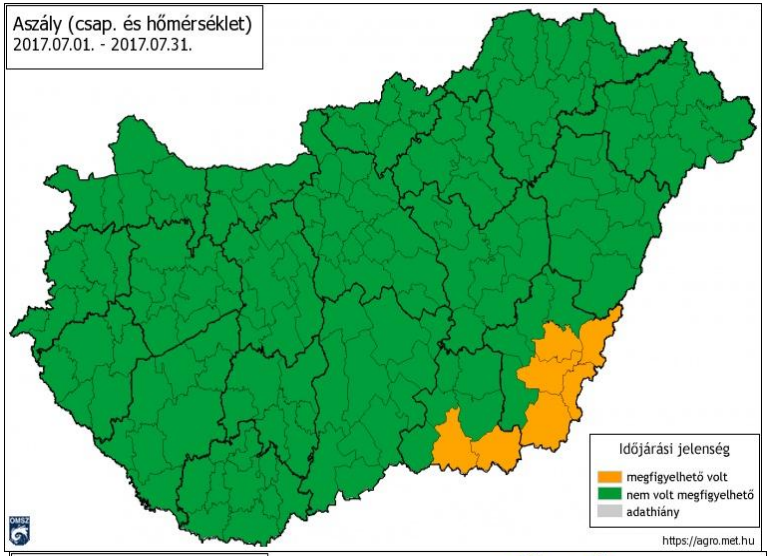
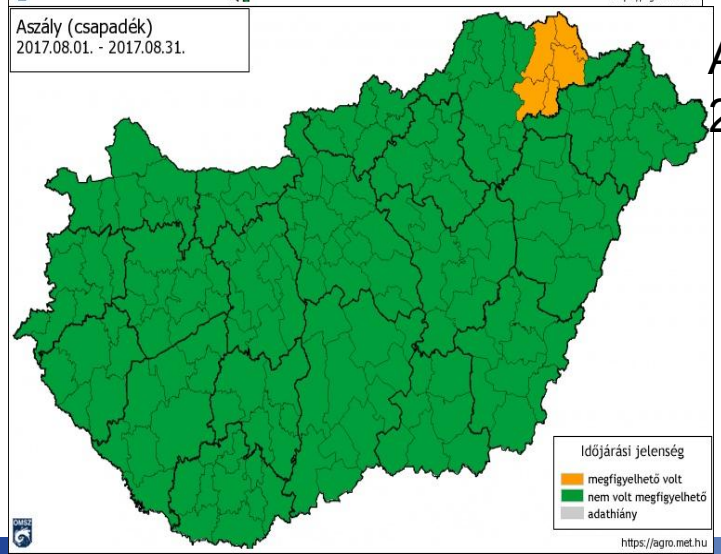
New definition of drought after 15 June 2017

r<25mm/30day and Tx>31°C/15day

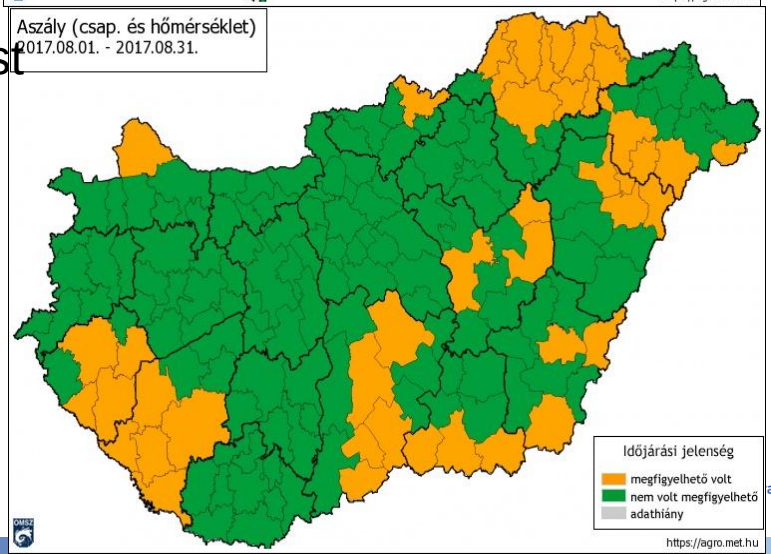


July 2017

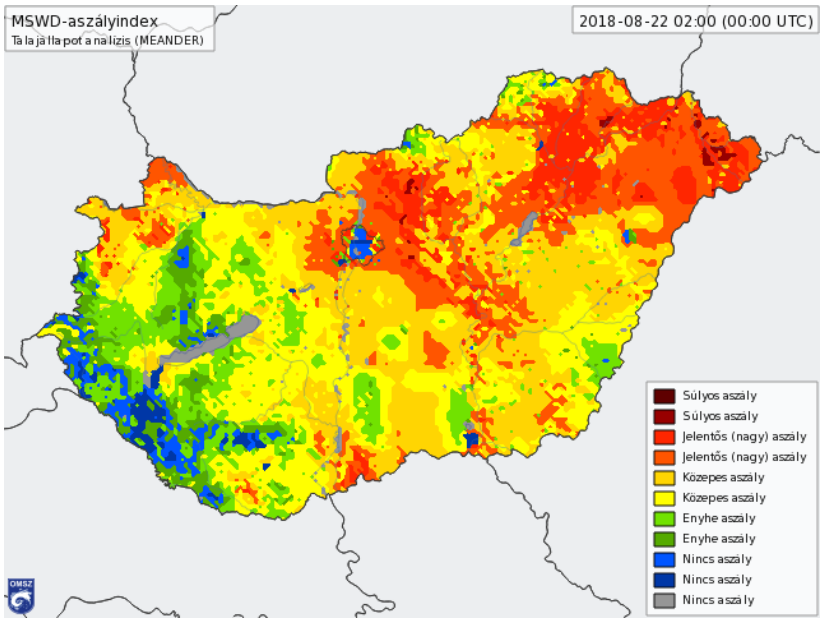




August 2017



Operative daily drought monitoring with NWP



- Developed by Horváth Á. et al. in June 2017
- Based on modeled soil moisture data (MEANDER) and 4M
- 4x in day
- 5 category for drought
- There are a great effect on physical properties of soils on value of daily index
- Calculation an MSWD (maximum soil water deficit) index too.

Conclusion


MTI/Czeglédi Zsolt

- There are many different methodologies for monitoring drought in Hungary.
- The drought is a complex natural disaster which regularly hit area of Hungary.
- Nessesary to improve cooperation and collaboration between instiutes whose participant in drought management in Hungary

kircsi.a@met.hu