

2017-2018 drought in Belgium

Thomas Vanhamel
KMI / IRM

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Contents of this presentation

1. Introduction
2. 2017-2018 drought in Belgium, some (climatological) data and maps
3. Products and potential developments in light of a cooperation between KMI and HIC (Flemish hydrological service)

The big picture

Drought is a complex and creeping phenomenon that receives more and more attention.

Future climate scenarios indicate a possibility for more (and possibly more severe) droughts in summer time (in Belgium), together with more concentrated and severe precipitation in summer.

Increasing “competition” for water: agriculture, industry, domestic use, ...

Without adaptations, our vulnerability could increase. Drought monitoring and forecasting is a crucial step in adaptation.

2017-2018 drought in large part of Europe: causes

Persistent anticyclonic conditions over Europe caused a shift of the trajectories of depressions to the north / south.

This was especially the case during vulnerable times: the growing season of plants (spring / summer).

2017: more during spring

2018: end spring until summer

In 2018, the dry spell was accompanied with anomalous high temperatures, causing increased evapotranspiration

Some anecdotal info (press articles etc)

Some impacts...

Belgique

Sécheresse: les centrales hydroélectriques wallonnes mises à l'arrêt



La centrale hydroélectrique de Coe - © ISOPIX

Belga

Publié le jeudi 25 octobre 2018 à 16h48

Some anecdotal info (press articles etc)

Some *important* impacts...

Echt dus: frietjes zijn kleiner door de droogte

ADN | 18 september 2018 | 08u56 | Bron: Belga

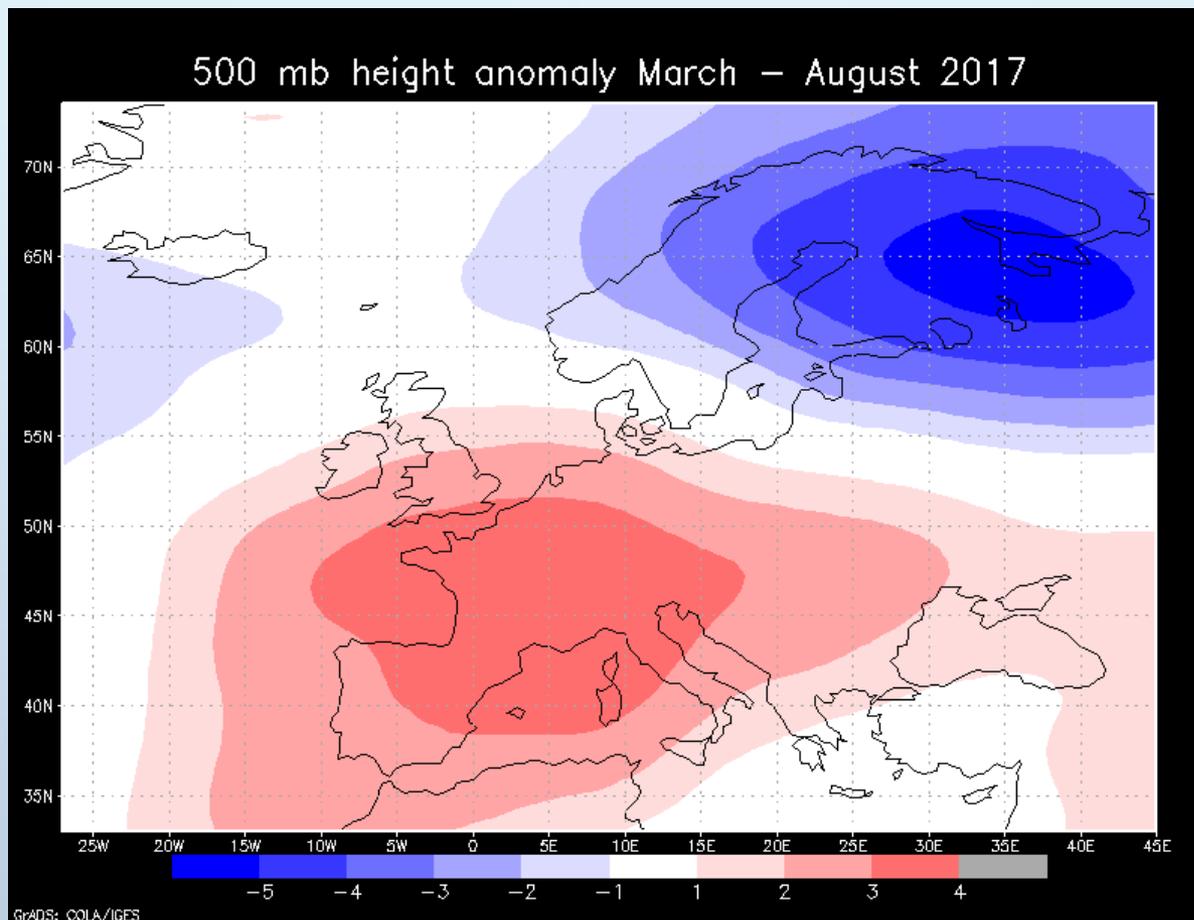


© thinkstock - Illustratiebeeld.

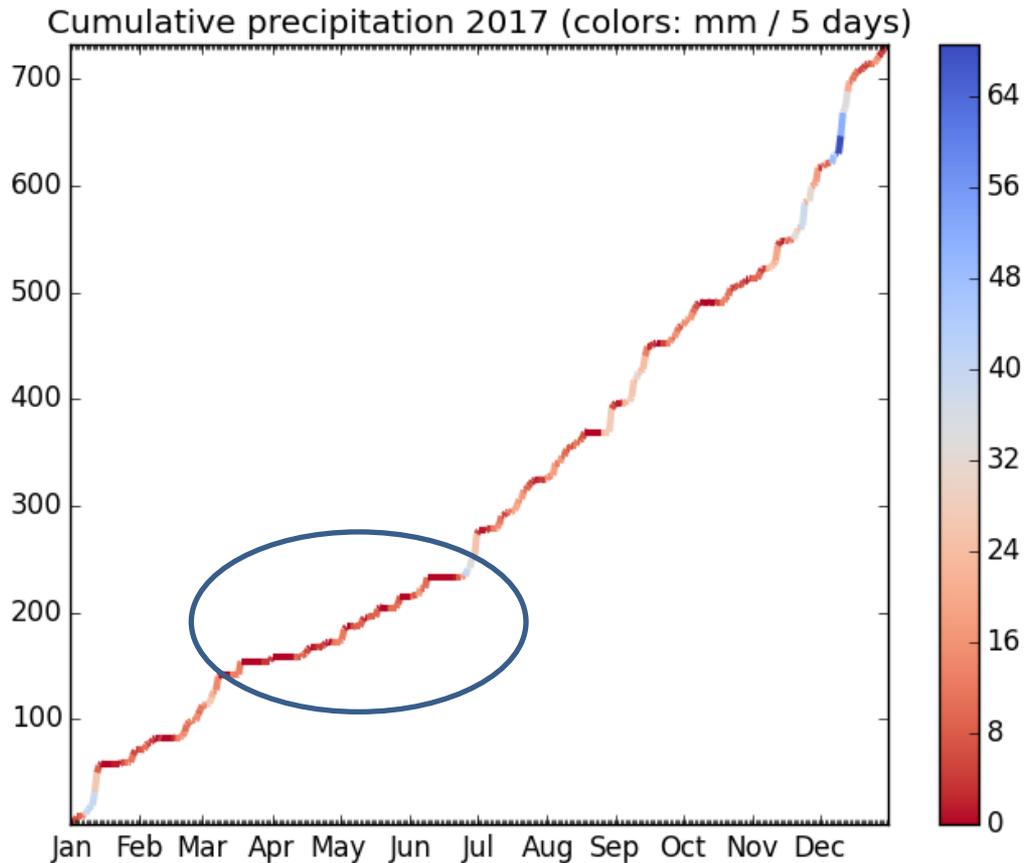
Doordat er de voorbije maanden weinig neerslag is gevallen in België, ligt de aardappeloogst zo'n kwart lager dan normaal. De aardappelen zijn ook kleiner en dus zullen we kleinere frietjes eten. Dat wordt bevestigd door Pierre Lebrun van de Waalse federatie van aardappeltelers (Fiwap) ⁷ in de kranten van Sudpresse.

2017 drought: meteorology

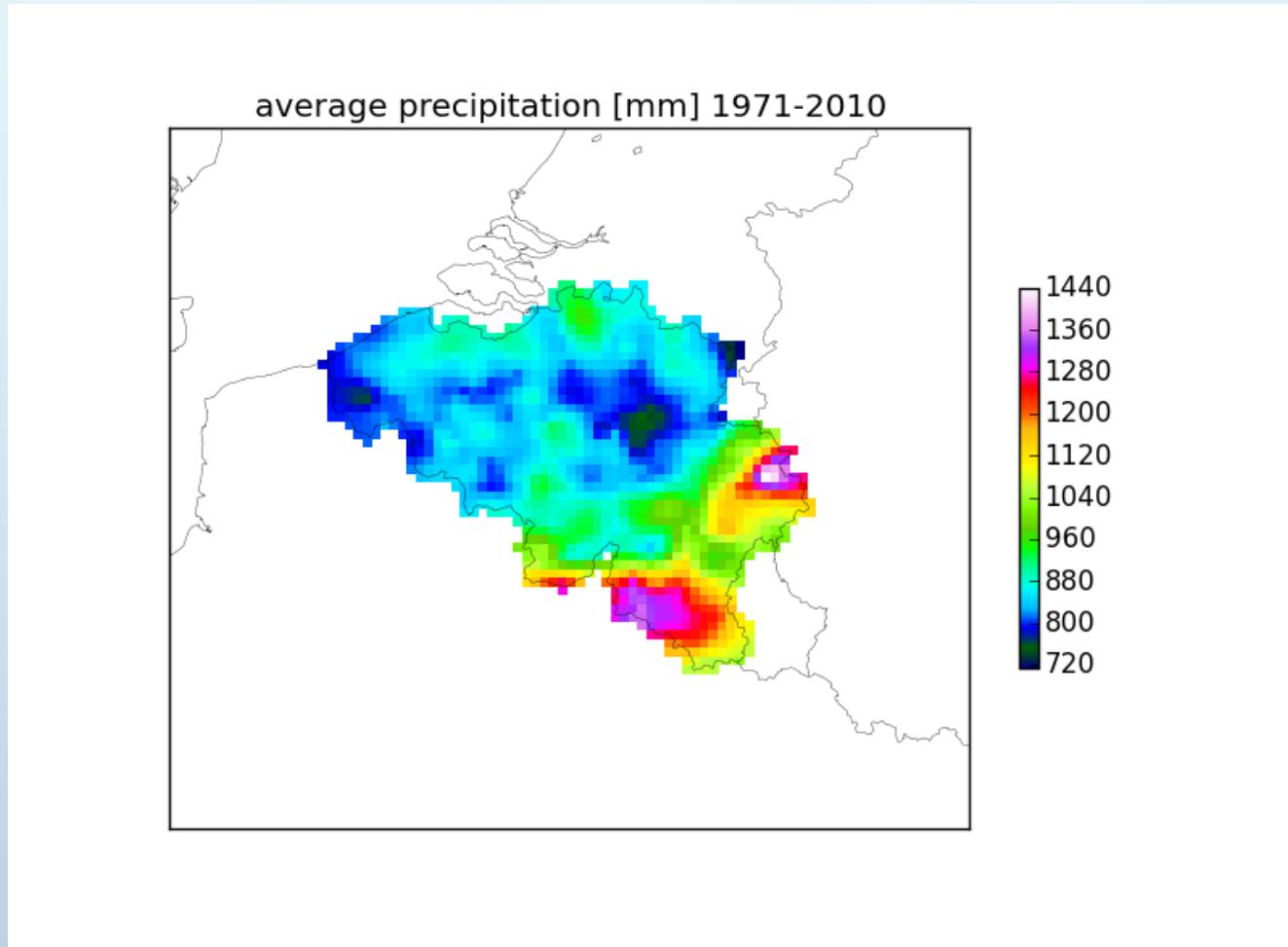
500 hPa geopotential height anomaly for 01/03/2017 – 31/08/2017 (synoptic monthly means ERA Interim) (units = dam) :



2017 drought observations: cumulative precipitation in Uccle

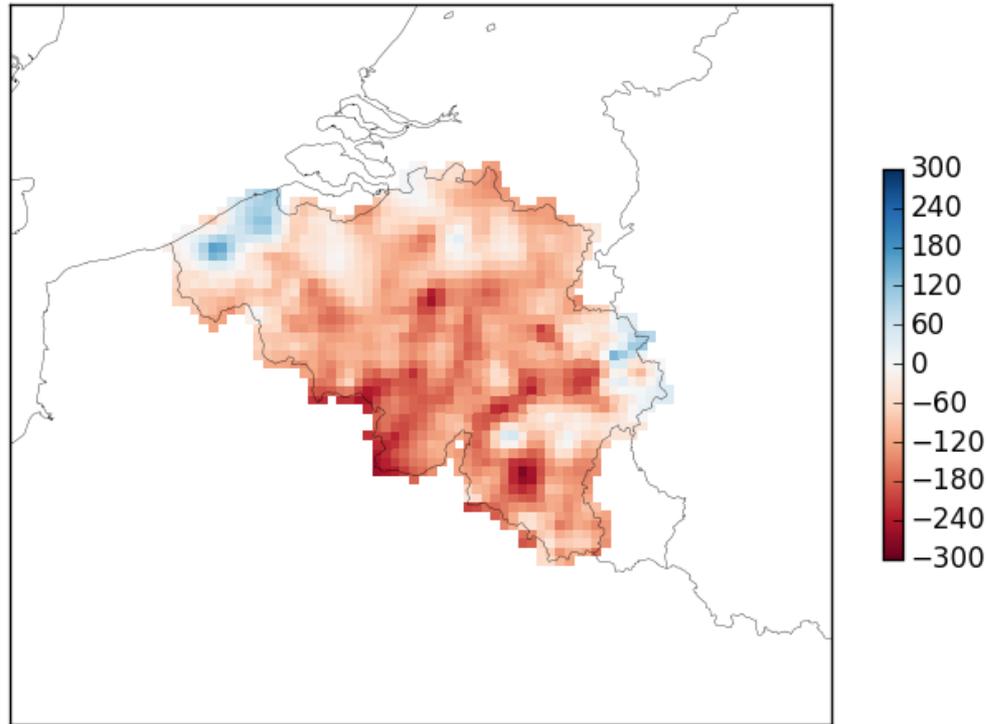


2017 drought observations: climatological mean precipitation



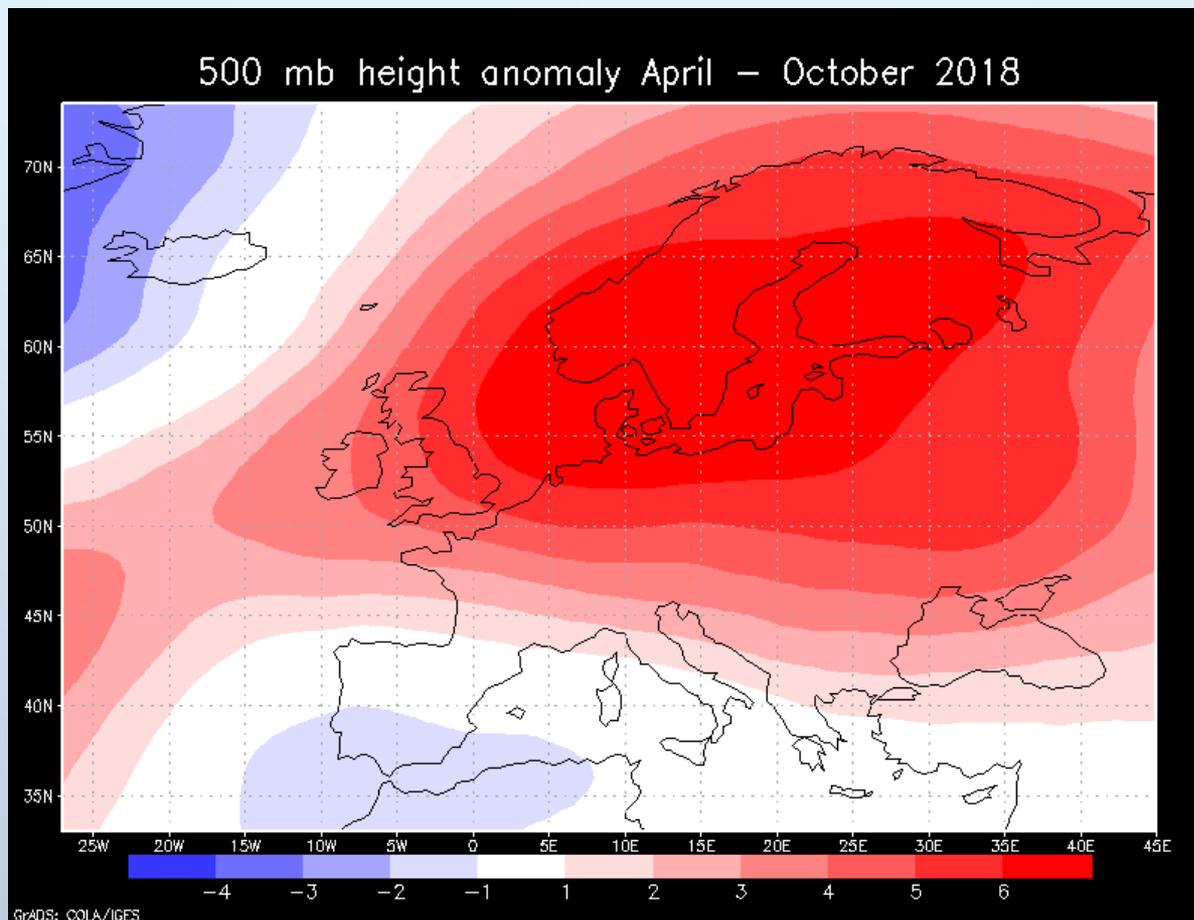
2017 observation: precipitation anomaly

precipitation [mm] difference w.r.t. normal 2017

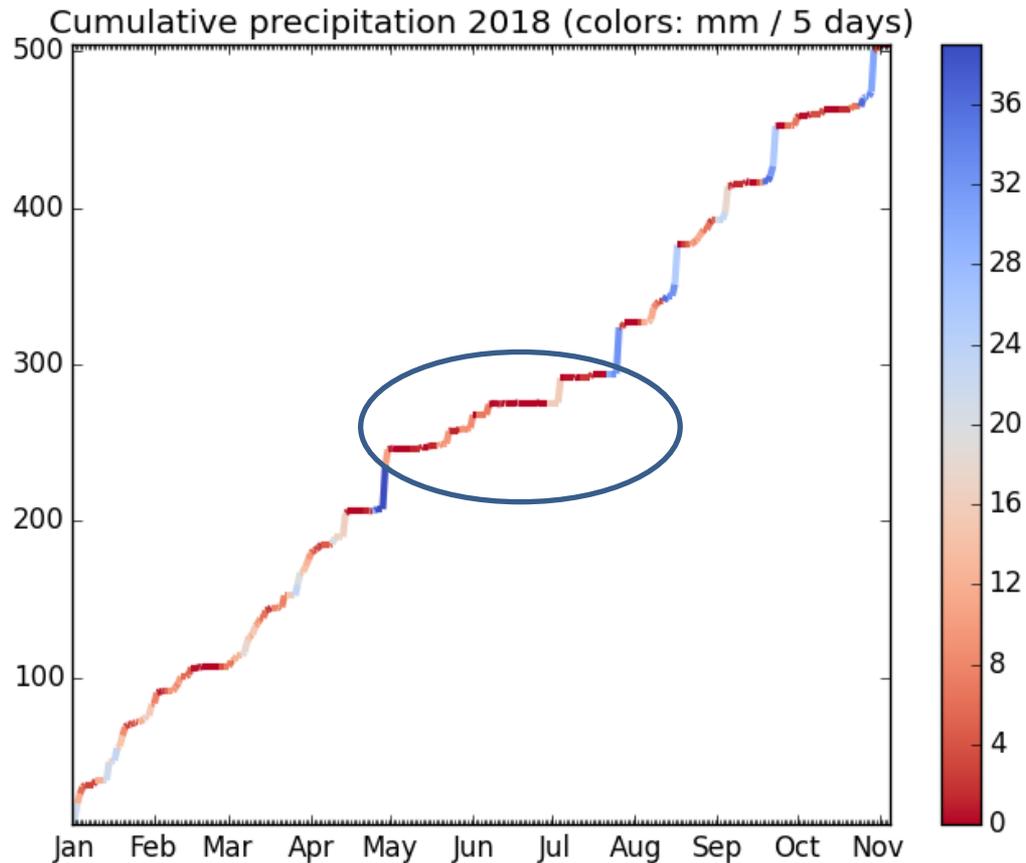


2018 drought: meteorology

500 hPa geopotential height anomaly for 01/04/2018 – 31/10/2018 (synoptic monthly means ERA Interim) (units = dam) :

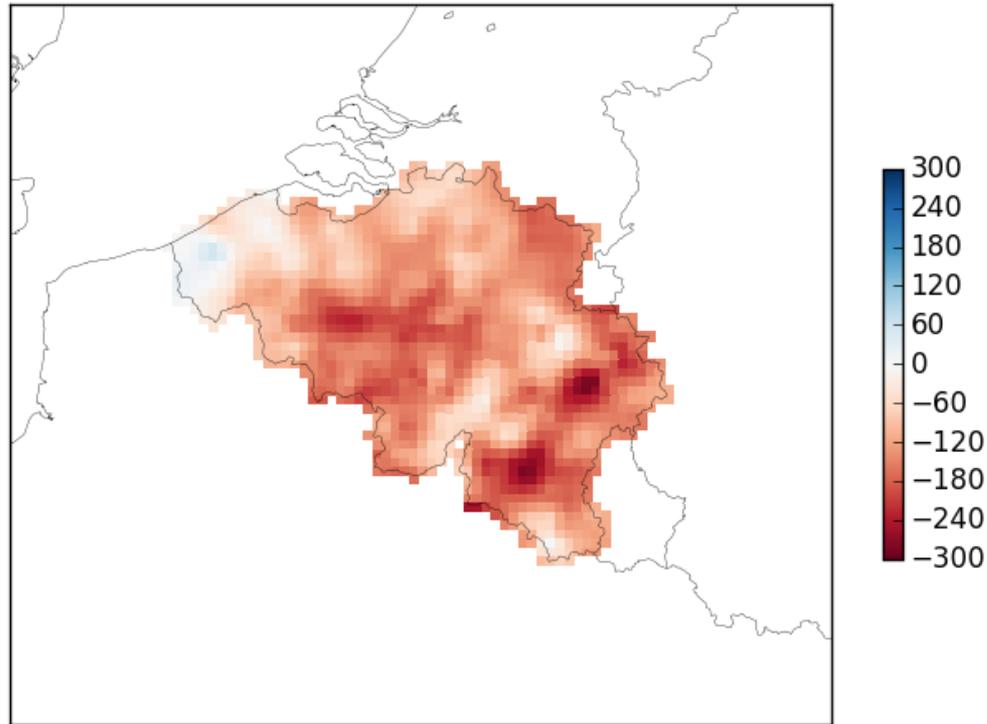


2018 drought observations: cumulative precipitation in Uccle



2018 observation: precipitation anomaly

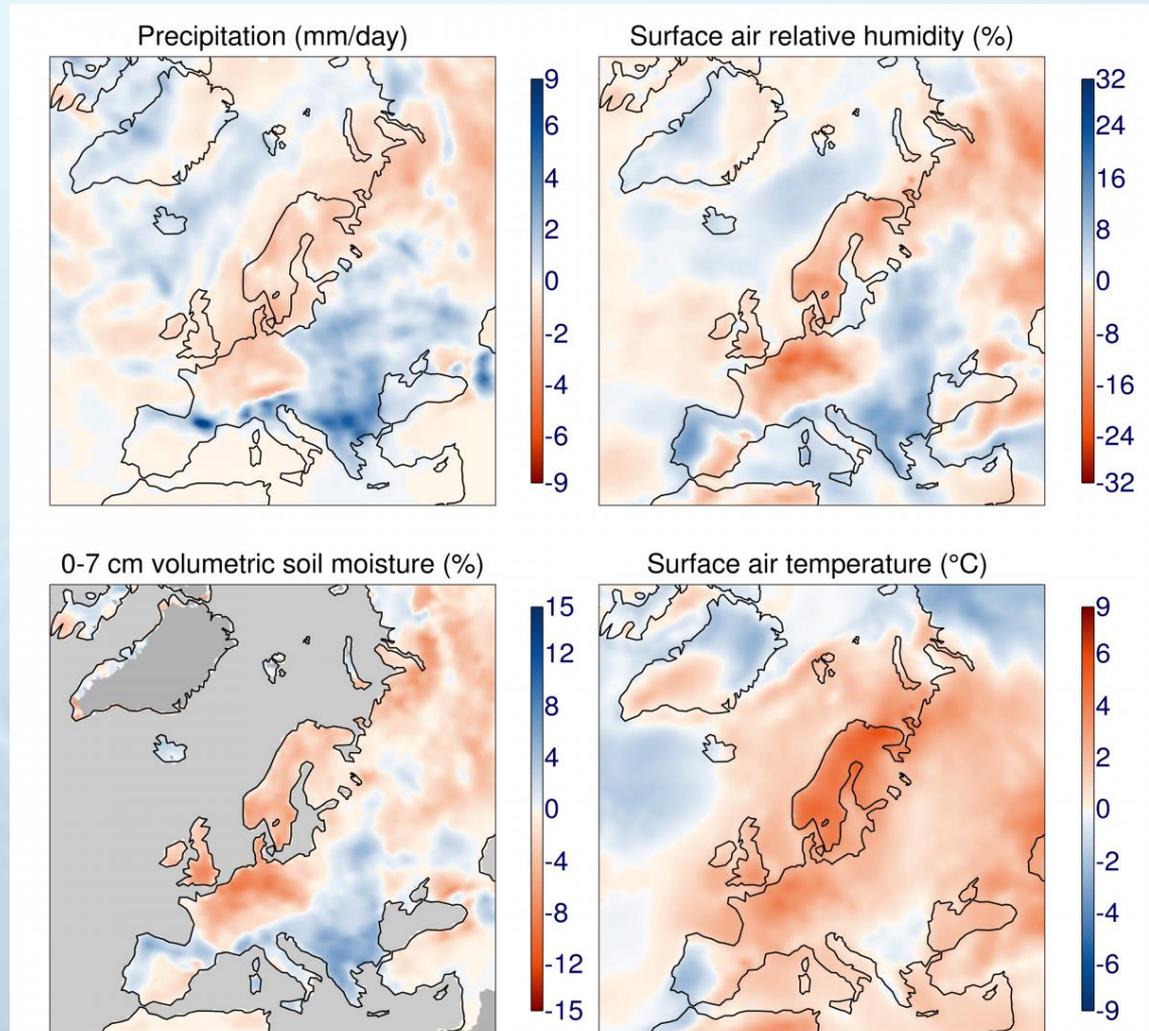
precipitation [mm] difference w.r.t. normal 2018 (Jan-Sept)



August 2018: drought + heatwave

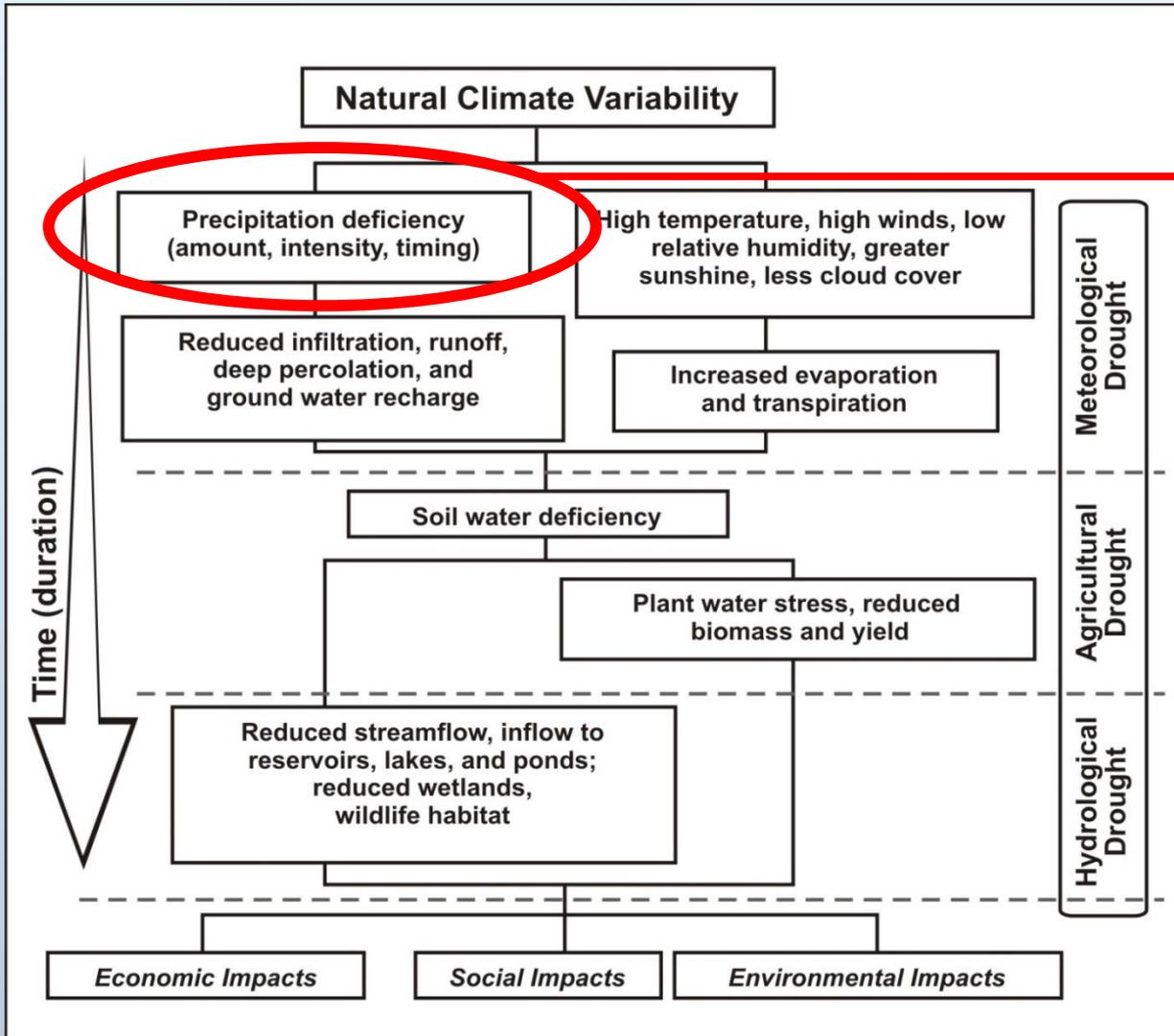
The unusual warm period began in April and continued into the summer, bringing 2 heat waves in July (15 days in duration) and July/august (10 days).

Combined effect of lack of precipitation and high temperatures in large part of W-Europe →



Source: C3S

Measure for drought: SPI



SPI timescales and type of droughts:

1-3 months :
meteorological

6 months :
agricultural

12-24 months :
hydrological

Hisdal and Tallaksen, 2000

Drought monitoring @ KMI

- SPI is calculated daily and shown on our website
- Since March 2018, KMI delivers SPI to Waterbouwkundig Laboratorium (contacts are ongoing; more products to be delivered in short term)



Drought comitee

Recently (Sept. 2017), the Flemish government has appointed a comitee concerning droughts.

- Coördinatiecommissie Integraal Waterbeleid (CIW): droogtecommissie
- Several institutes deliver products concerning droughts / water quality (RMI delivers SPI, products by other institutes are e.g. river discharge, water quality, Oxygen-concentration, ...)
- The comitee decides on the “status” of the drought
- Advising and monitoring role
- Streamlining of measurements (e.g. limitations to using drinking water): local governments decide on restrictions

Drought comitee

DOSSIER WARM EN KURKDROOG



Code oranje: algemeen sproeiverbod in Antwerpen, Oost- en West-Vlaanderen, gedeeltelijk sproeiverbod in Limburg

Bart Rooms
d1 24 jul 19:38
d1 24 jul 14:03



In Antwerpen, Oost- en West-Vlaanderen mag er voorlopig niet meer worden gespreeid. De drie provincies volgen daarmee het advies van de Droogtecommissie, die een totaalverbod voorstelt om auto's te wassen of gras te besproeien in heel Vlaanderen. Limburg volgt het advies gedeeltelijk en voert een sproeiverbod voor leidingwater in. De commissie heeft code oranje uitgeroepen omdat de droogte blijft aanhouden.

Drought committee: situation on 25/10/2018

Actuele droogtetoeestand: ALARM (ERG DROOG)



Update 25 oktober 2018:

Het blijft erg droog. Code oranje voor droogte blijft daarom aangehouden in heel Vlaanderen. De peilen en debieten van vele rivieren en beken en de grondwaterniveaus blijven zeer laag. Sommige waarden behoren tot de laagst gemeten waarden voor de tijd van het jaar (onder de 1-percentielniveaus).

De neerslag van afgelopen weken is op de meeste plaatsen onvoldoende om de grote neerslagtekorten weg te werken. De regenbuien zorgden enkel voor een kortstondige toename van de debieten. Waterbeheerders moeten nog steeds maatregelen nemen om de waterstanden op peil te houden. Ook de komende dagen wordt te weinig neerslag voorspeld voor een structureel herstel. De toestand wordt permanent opgevolgd. Van zodra de situatie wijzigt, wordt dit via deze website gecommuniceerd.

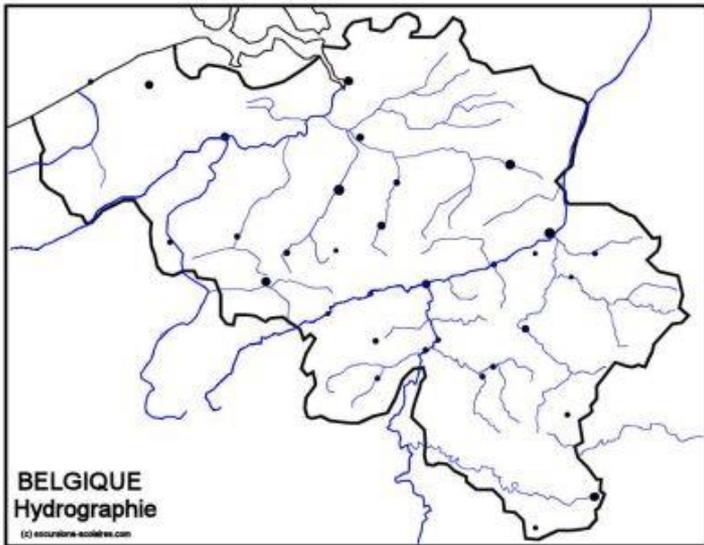
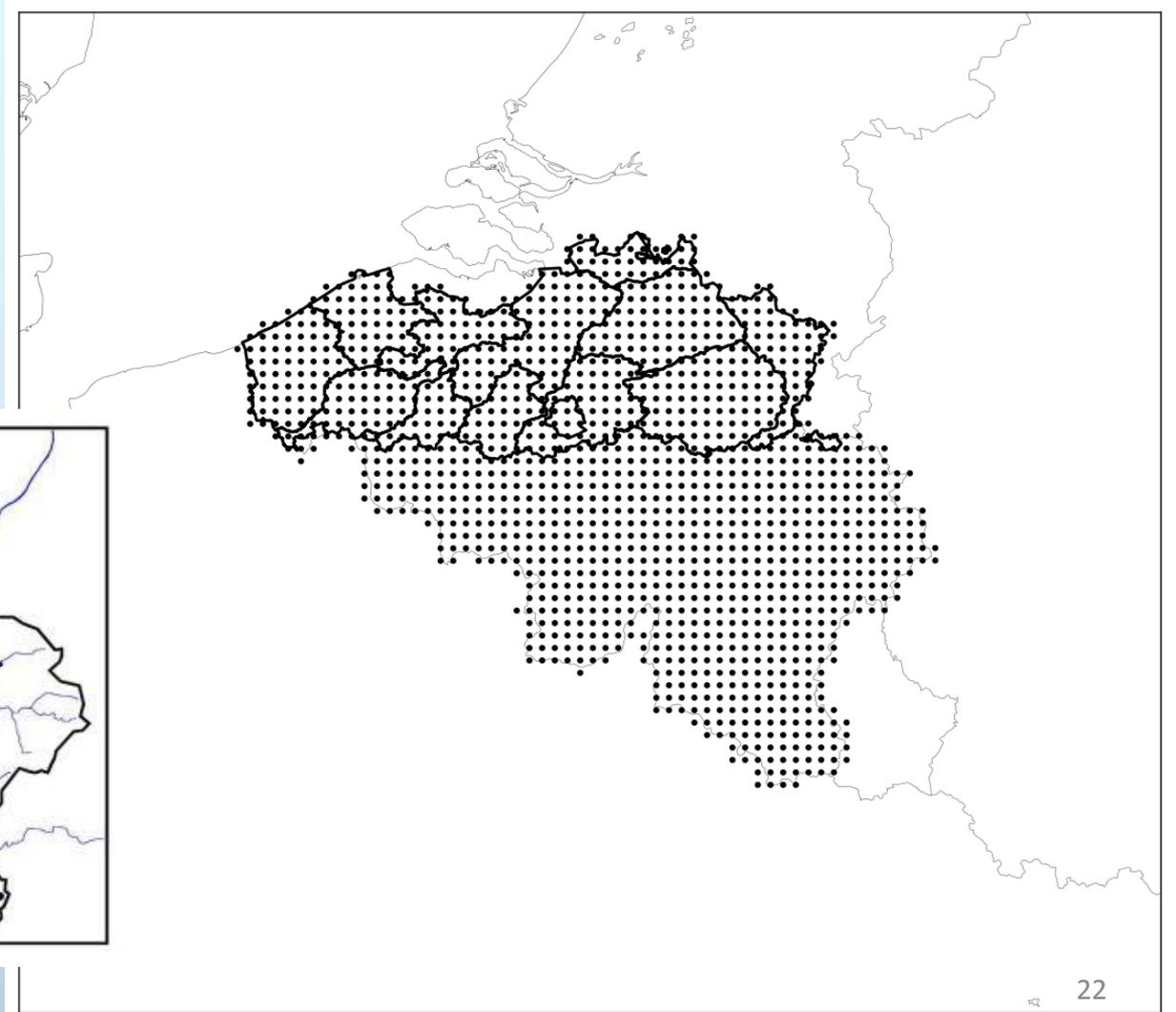
Water is en blijft een schaars goed. De Droogtecommissie blijft dan ook oproepen tot een spaarzaam gebruik van leidingwater, oppervlaktewater, grondwater en regenwater.

Drought index RMI: input

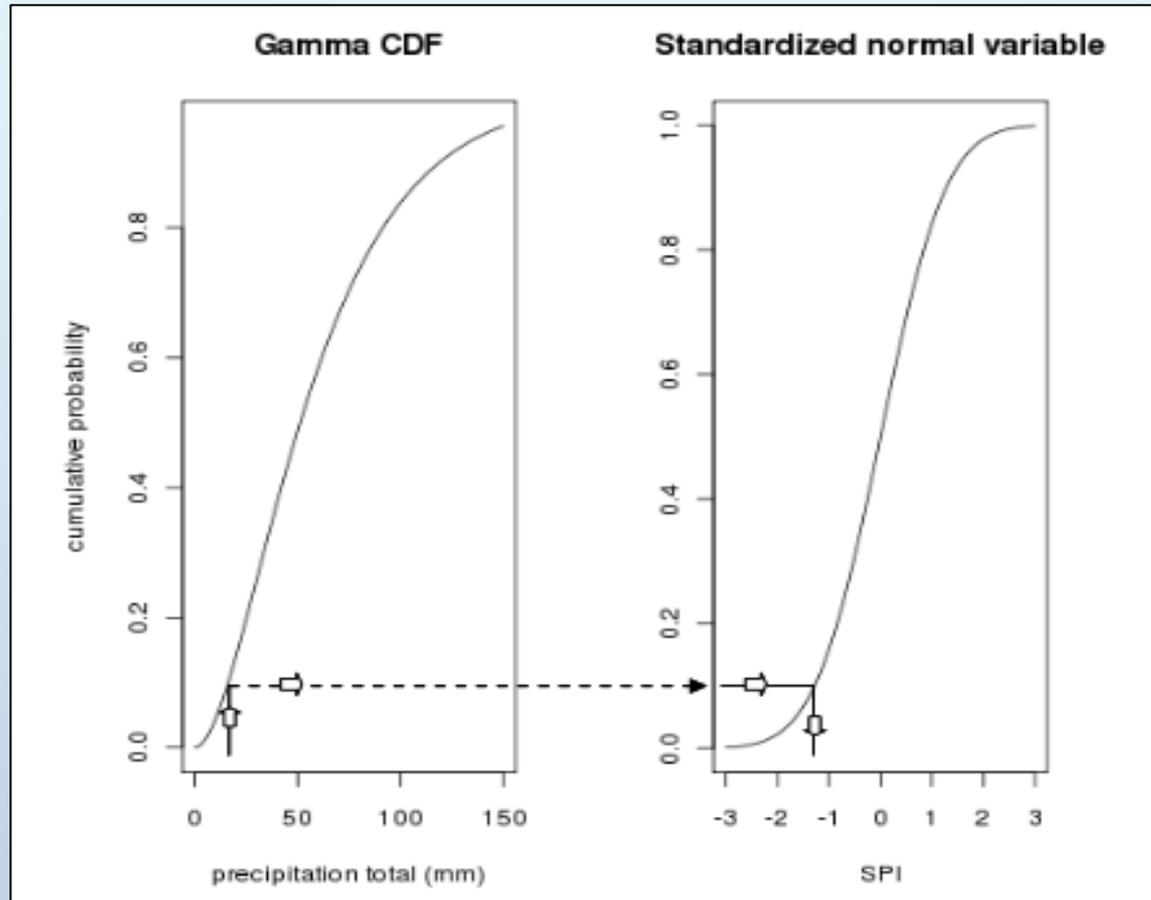
- A gridded database is available in our database with climatological observations over Belgium (“Climate Grid”)
- Climate Grid has a horizontal resolution of $\sim 5 \text{ km} \times 5 \text{ km}$
 - Daily temporal resolution
 - Constructed with spatial interpolated observations (SYNOP, AWS, other networks, auxiliary data like Meteosat, etc ...). On a day-to-day basis, the dataset is investigated whether there exist spatial dependency (e.g. correlation temperature – altitude). This is exploited in the interpolation.
 - Parameters: precipitation, min and max temperature, relative humidity, evapotranspiration, ...

Input data

Climate Grid:
grid points and
the polygons of
the basins →



Definition SPI



Procedure

- For each basin, a climatological reference of the precipitation (1981-2010) is calculated (alpha and beta parameters of the gamma-distribution estimated with a maximum likelihood method)
- For each basin, recent basin-precipitation is queried (3, 6 and 12 months). SPI for each lag is calculated by transforming the gamma-distribution to a normal distribution and comparing the cumulative precipitation to the normalized distribution.

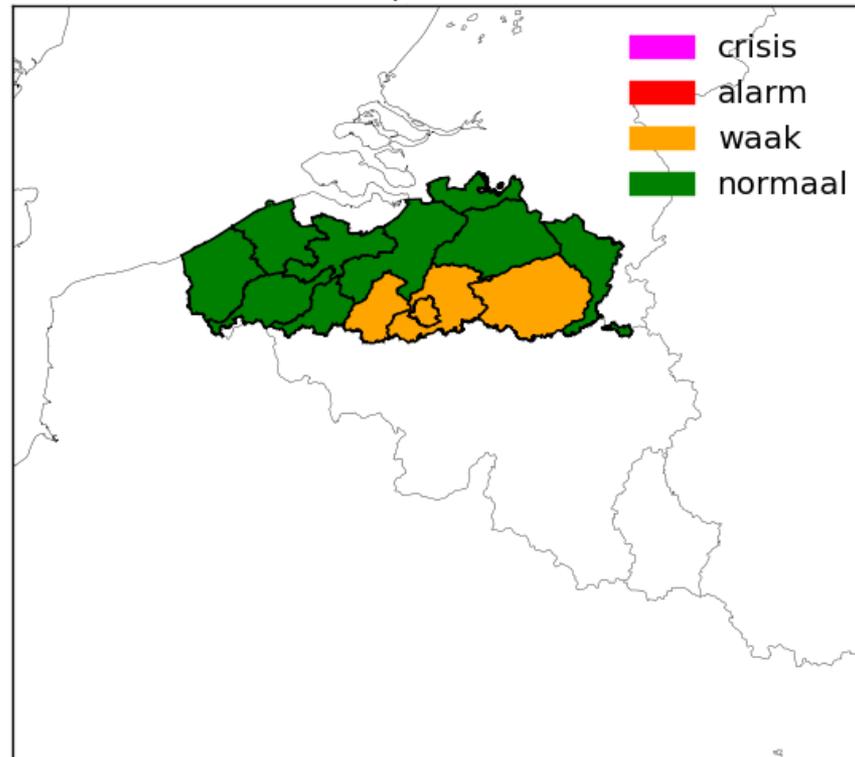
Procedure

Raw SPI values are converted to a code (alert, warning, ...)

12		Izerbekken			eden-Scheldebek			Denderbekken			Dijlebekken			Demerbekken			Netebekken			kken Brugse Poldkken			Gentse Kanal			Leiebekken			iven-Scheldebekk			Maasbekken					
13		KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI	KMI			
14		SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12	SPI-3	SPI-6	SPI-12			
15	1/02/2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
16	2/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	3	1			
17	3/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	3	1			
18	4/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	3	1			
19	5/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	3	1			
20	6/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	2	1	1	3	1			
21	7/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	1	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	1	3	1	
22	8/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
23	9/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
24	10/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
25	11/02/2017	1	1	1	1	2	1	1	3	1	1	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
26	12/02/2017	1	1	1	1	2	1	1	3	1	2	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
27	13/02/2017	1	1	1	1	2	1	1	3	1	2	3	1	2	3	1	1	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	1	2	3	1	
28	14/02/2017	1	1	1	1	2	1	2	3	1	2	3	1	3	3	1	2	2	1	1	2	1	1	2	1	1	2	1	1	1	1	2	2	1	3	3	1
29	15/02/2017	1	1	1	2	2	1	2	3	1	3	3	1	3	3	1	2	2	1	2	2	1	2	2	1	2	2	1	1	2	1	2	3	1	3	3	1
30	16/02/2017	1	1	1	2	2	1	3	3	1	3	3	1	4	3	1	3	2	1	2	2	1	2	2	1	2	2	1	2	1	1	3	3	1	4	3	1
31	17/02/2017	1	1	1	3	2	1	3	3	1	4	3	1	4	3	1	3	2	1	2	2	1	2	2	1	3	1	1	3	3	1	4	4	1	4	1	
32	18/02/2017	1	1	1	3	2	1	3	3	1	4	4	1	4	3	1	3	2	1	2	2	1	2	2	1	2	2	1	2	2	1	3	3	1	4	4	1
33	19/02/2017	1	1	1	3	3	1	3	3	1	4	4	1	4	4	1	3	3	1	2	2	1	3	2	1	3	2	1	3	3	1	4	4	1	4	4	1
34	20/02/2017	1	1	1	3	3	1	3	3	1	4	4	1	4	4	1	3	3	1	2	2	1	3	2	1	3	2	1	3	3	1	4	4	1	4	4	1
35	21/02/2017	1	1	1	3	2	1	3	3	1	4	4	1	4	3	1	3	2	1	2	2	1	2	2	1	2	2	1	2	2	1	3	3	1	4	4	1
36	22/02/2017	1	1	1	3	2	1	3	3	1	3	3	1	4	3	1	3	2	1	2	2	1	2	2	1	2	2	1	2	1	1	3	3	1	4	3	1
37	23/02/2017	1	1	1	2	2	1	3	3	1	3	3	1	3	3	1	2	2	1	2	2	1	2	2	1	2	2	1	2	1	1	3	2	1	3	3	1
38	24/02/2017	1	1	1	2	2	1	2	3	1	3	3	1	2	3	1	2	2	1	2	1	1	2	2	1	2	2	1	2	1	1	2	2	1	2	3	1
39	25/02/2017	1	1	1	2	2	1	2	3	1	3	3	1	2	3	1	2	2	1	2	1	1	2	2	1	2	2	1	2	1	1	2	2	1	2	3	1
40	26/02/2017	1	1	1	2	2	1	2	3	1	3	3	1	2	2	1	2	2	1	2	1	1	2	1	1	2	1	1	2	1	1	2	2	1	2	3	1
41	27/02/2017	1	1	1	2	2	1	2	3	1	3	3	1	2	2	1	2	2	1	2	1	1	1	1	1	1	1	2	1	1	2	2	1	2	3	1	

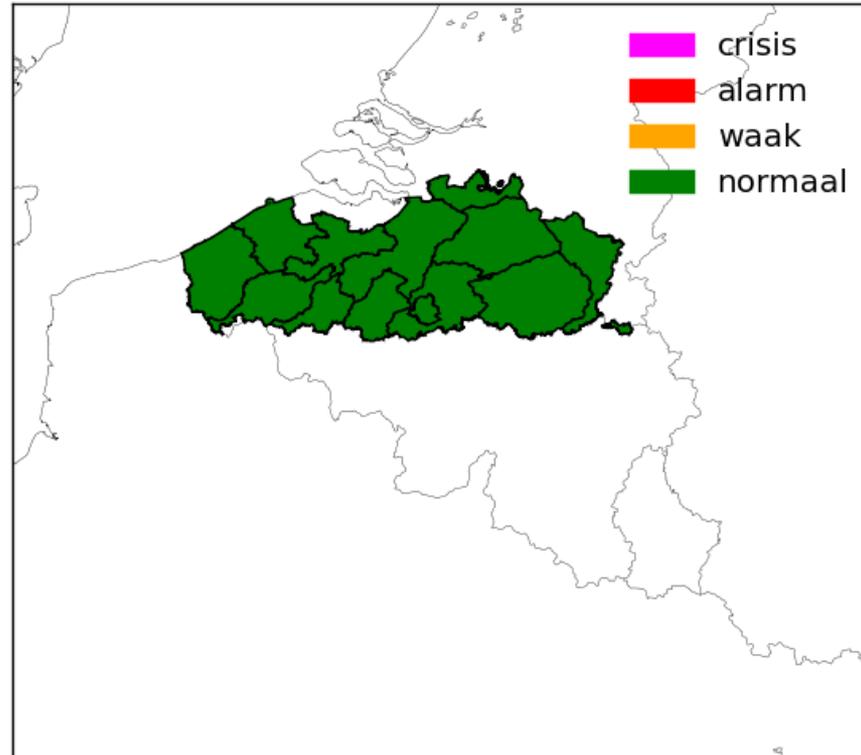
Examples of 2017

SPI 3 op 01-03-2017



Examples of 2018

SPI 3 op 01-03-2018



Further developments in the KMI – HIC cooperation (2019)

- Deliver the products automatically (SPI, QPE and other radar products, pluviometric quality controls, forecast products)
- Investigate further improvements (e.g. for SPI / forecast products) :
 - Add evapotranspiration: SPEI
 - Extend basin areas outside Flanders (Wallonia and France => data needed)
 - Look for other indices that might be more suitable than SP(E)I
 - Use of NWP model-data: forecast of drought index
 - Use of NWP model-data: drought indicators (soil moisture etc)
 - Develop derived products: e.g. drought guidance / outlook based on ECMWF extended range / long range forecasts

Other drought indices to consider (Handbook of Drought Indicators and Indices)

Table 1. Indicators and indices listed in this handbook

<i>Meteorology</i>	<i>Page</i>	<i>Ease of use</i>	<i>Input parameters</i>	<i>Additional information</i>
Aridity Anomaly Index (AAI)	11	Green	P, T, PET, ET	Operationally available for India
Deciles	11	Green	P	Easy to calculate; examples from Australia are useful
Keetch–Byram Drought Index (KBDI)	12	Green	P, T	Calculations are based upon the climate of the area of interest
Percent of Normal Precipitation	12	Green	P	Simple calculations
Standardized Precipitation Index (SPI)	13	Green	P	Highlighted by the World Meteorological Organization as a starting point for meteorological drought monitoring
Weighted Anomaly Standardized Precipitation (WASP)	15	Green	P, T	Uses gridded data for monitoring drought in tropical regions
Aridity Index (AI)	15	Yellow	P, T	Can also be used in climate classifications
China Z Index (CZI)	16	Yellow	P	Intended to improve upon SPI data
Crop Moisture Index (CMI)	16	Yellow	P, T	Weekly values are required
Drought Area Index (DAI)	17	Yellow	P	Gives an indication of monsoon season performance
Drought Reconnaissance Index (DRI)	17	Yellow	P, T	Monthly temperature and precipitation are required
Effective Drought Index (EDI)	18	Yellow	P	Program available through direct contact with originator
Hydro-thermal Coefficient of Selyaninov (HTC)	19	Yellow	P, T	Easy calculations and several examples in the Russian Federation
NOAA Drought Index (NDI)	19	Yellow	P	Best used in agricultural applications
Palmer Drought Severity Index (PDSI)	20	Yellow	P, T, AWC	Not green due to complexity of calculations and the need for serially complete data
Palmer Z Index	20	Yellow	P, T, AWC	One of the many outputs of PDSI calculations



Example of drought outlook (NOAA)

Valid Sunday October 28, 2018 to Thursday November 08, 2018

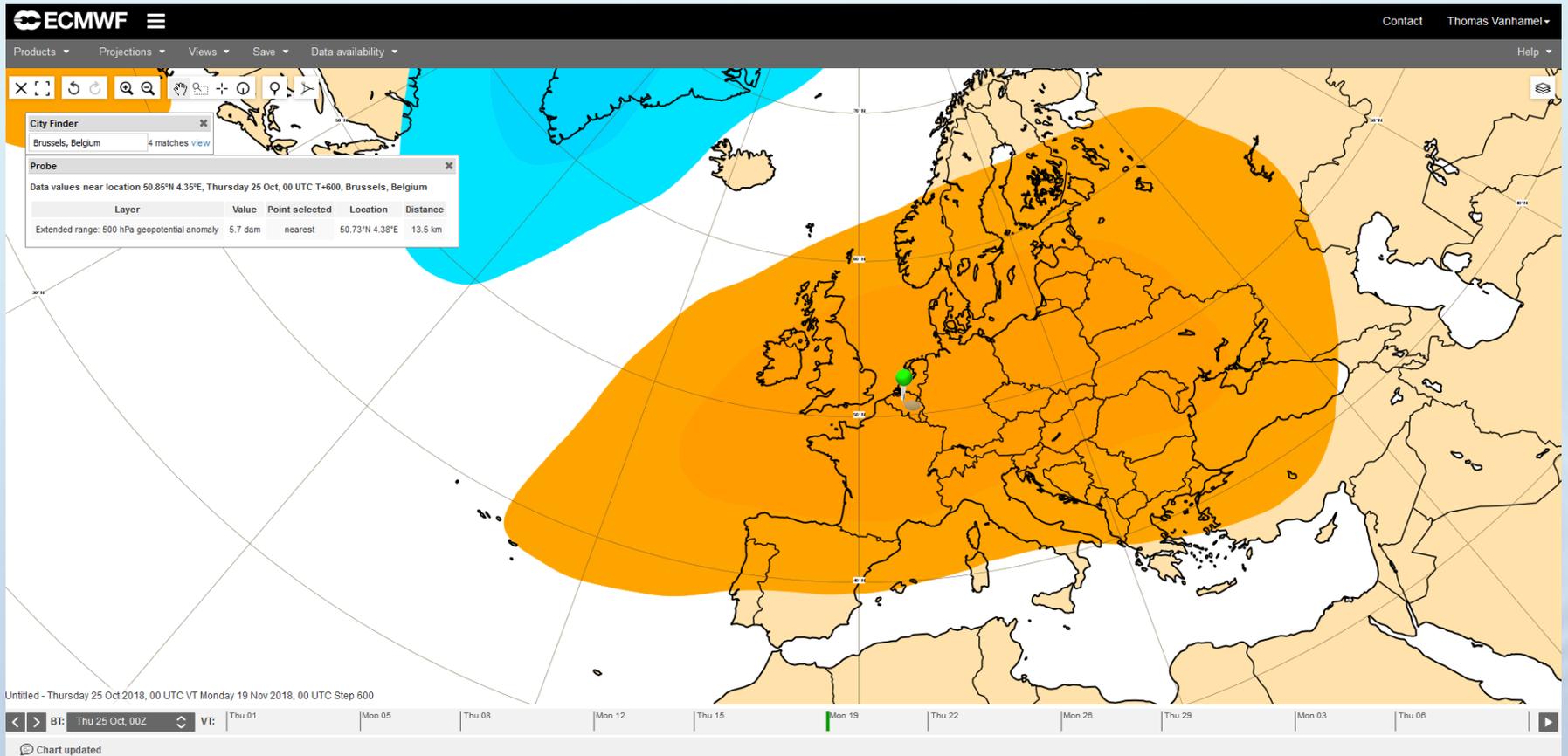
US Hazards Outlook
NWS Climate Prediction Center College Park MD
300 PM EDT October 25 2018

Synopsis: The first significant Atlantic coastal storm of the season is predicted to lift out of New England and continue across the Canadian Maritimes early in the 3-7 day period. Several surges of cold air are forecast to penetrate far to the south, well off the Gulf Coast. Out West, several low pressure systems are expected to move across the Pacific Northwest and northern Intermountain region during the 3-7 day period. Several low pressure systems are forecast to affect south-central and southeastern Alaska (including the Panhandle) during this same period. For Week-2, models predict mid-level troughs of low pressure over the central CONUS and western Alaska, and mid-level ridges of high pressure over the far western and far eastern CONUS, and interior western Canada.

The U.S. Drought Monitor, valid October 23, indicates a slight decrease in severe to exceptional drought (D2 to D4) coverage from 13.51 percent last week to 13.23 percent this week. Localized areas of improvement and degradation were made to the depiction this week across the southern CONUS.

Forecaster: Anthony Artusa

Drought outlook: ECMWF extended range



Conclusions

- The impacts of drought receive more and more attention by media, governments, ...
- The (meteorological) drivers of drought initiate the process, but as duration and intensity increases, the problem gets more and more complex and intertwined with other fields => inter-disciplinary work is crucial
- Potential for developments:
 - Cooperation with other fields (hydrology, agronomy, energy, ...): establishing contacts and networks
 - Meteorological basis needed: national meteorological services can add value here
 - Increasing accuracy of extended range forecasts