



Groundwater level regime assessment; quantitative status of GWBs; water scarcity and droughts indicators

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Quantitative status of GWBs

WFD requirements:

- Assessment of status – based on monitoring results
- Monitoring of quantitative status – groundwater level and discharge of springs
- Definition of quantitative status: expression of the degree to which a body of groundwater is affected by direct and indirect abstractions
- Definition of good quantitative status: The level of groundwater in the groundwater body is such that the available groundwater resource is not exceeded by the long-term annual average rate of abstraction.



GWB quantitative status, Czech approach in 1st RBMP

- Groundwater balance – comparison of sum of abstracted water with natural sources of GW
- Unit – groundwater body (hydrogeological zone) – as homogenous unit
- Results of monitoring were used for calculation of natural sources of GWB (verification of base-flow results)



Further work in CZ

- Assessment of groundwater level regime in deep hydrogeological structures (Cretaceous)
- Objective: methodology of GW level regime assessment, proof of poor quantitative status (groundwater level depletion)
- Two different approaches – trend assessment only (statistical methods for time series) or comparison of separated years (or different time periods) with long-term characteristics



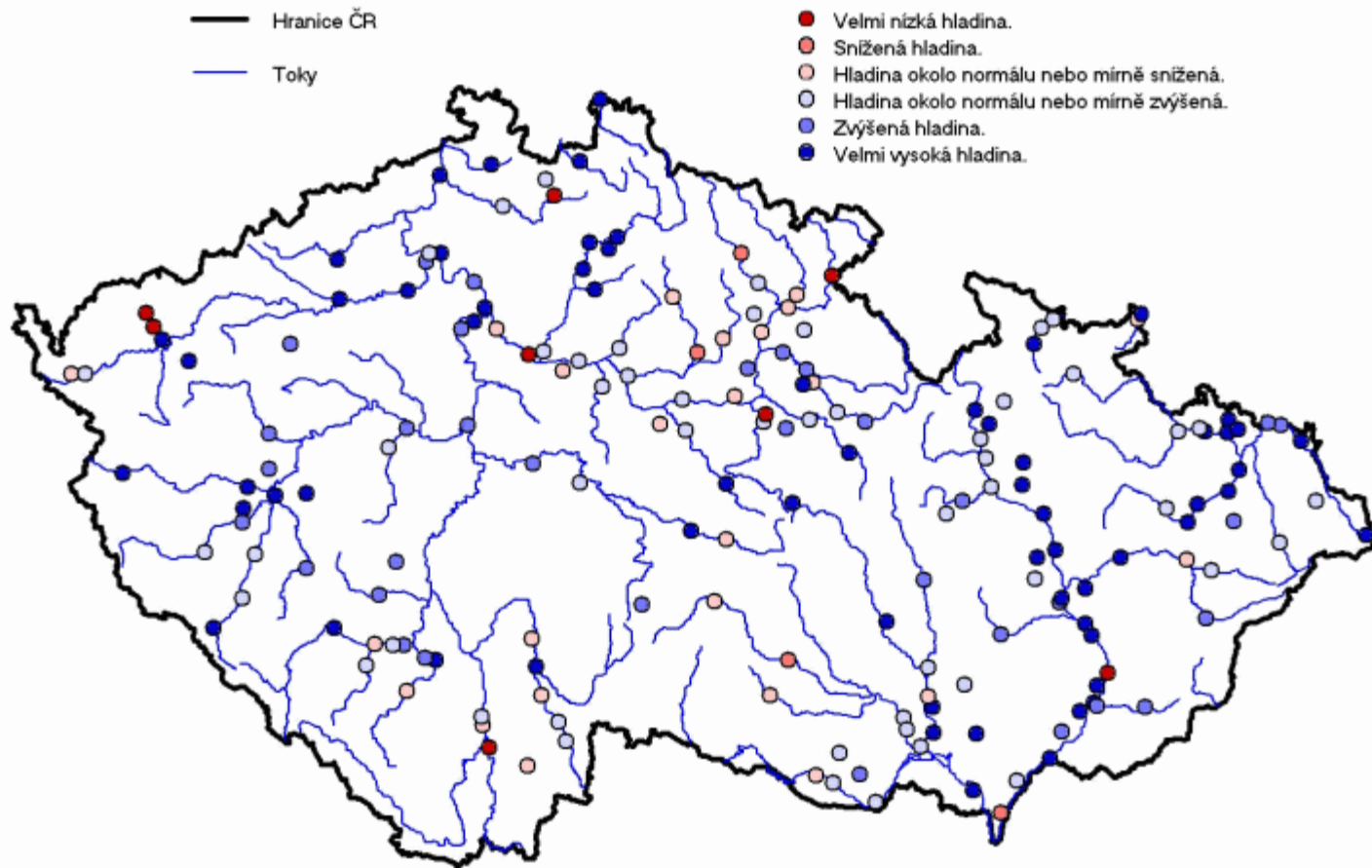
Further work in CZ

- Existing data and results:
- Monitored data from last 15 years (GW level, volume of GW from springs) – on the beginning weekly data, then daily data
- Results: maps with month characteristics (e.g. August 2011) – comparison with long-term characteristic (about 20 - 30 years) of August; comparison with previous month (July 2011) and comparison with the same month of previous year (August 2010) – mainly shallow GW



8/11 - comparison with long-term characteristic - boreholes

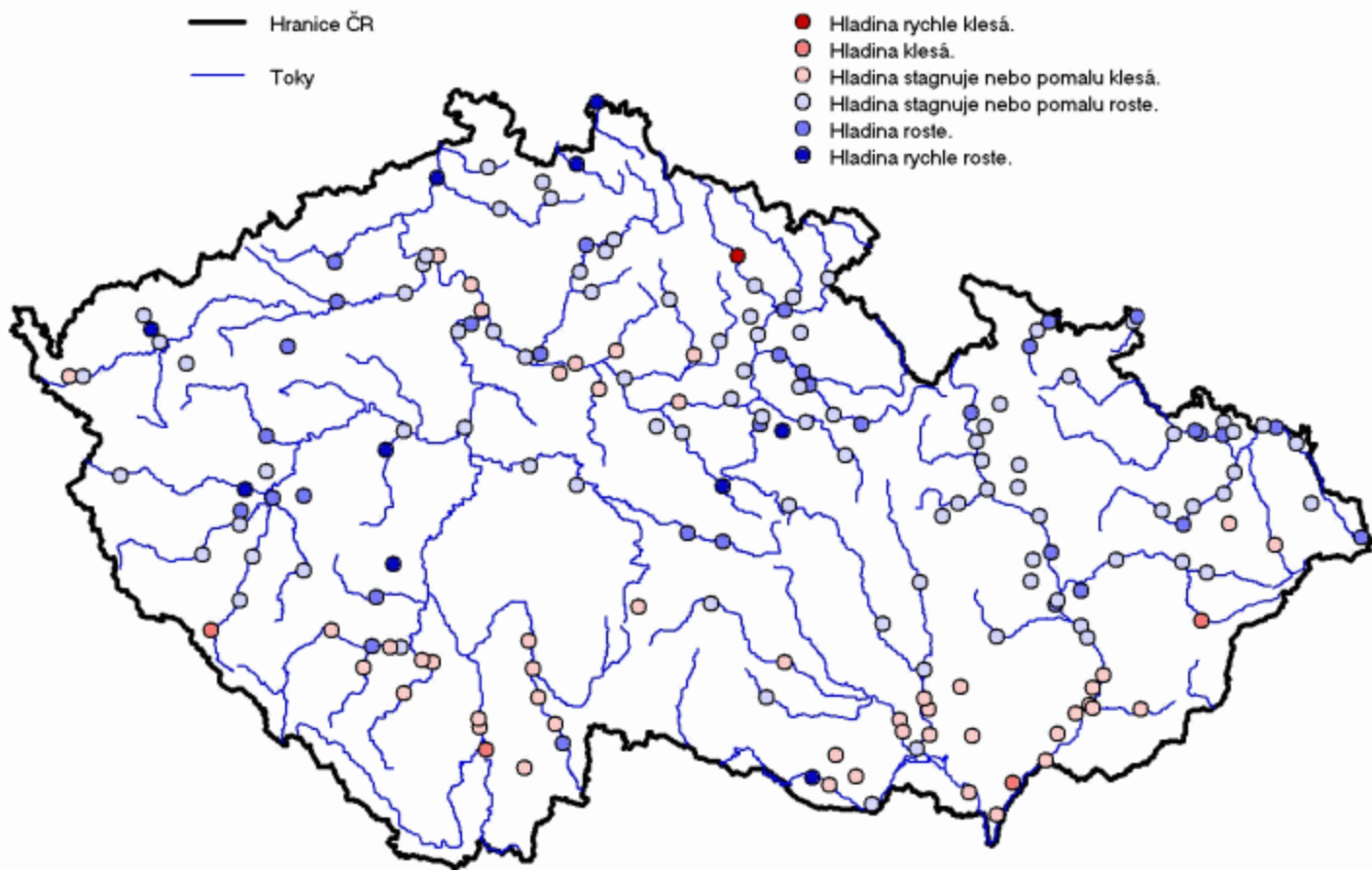
Hladiny ve vrtech hodnocené podle pravděpodobnosti překročení pro měsíc: 08/2011





8/11 - comparison with previous month - boreholes

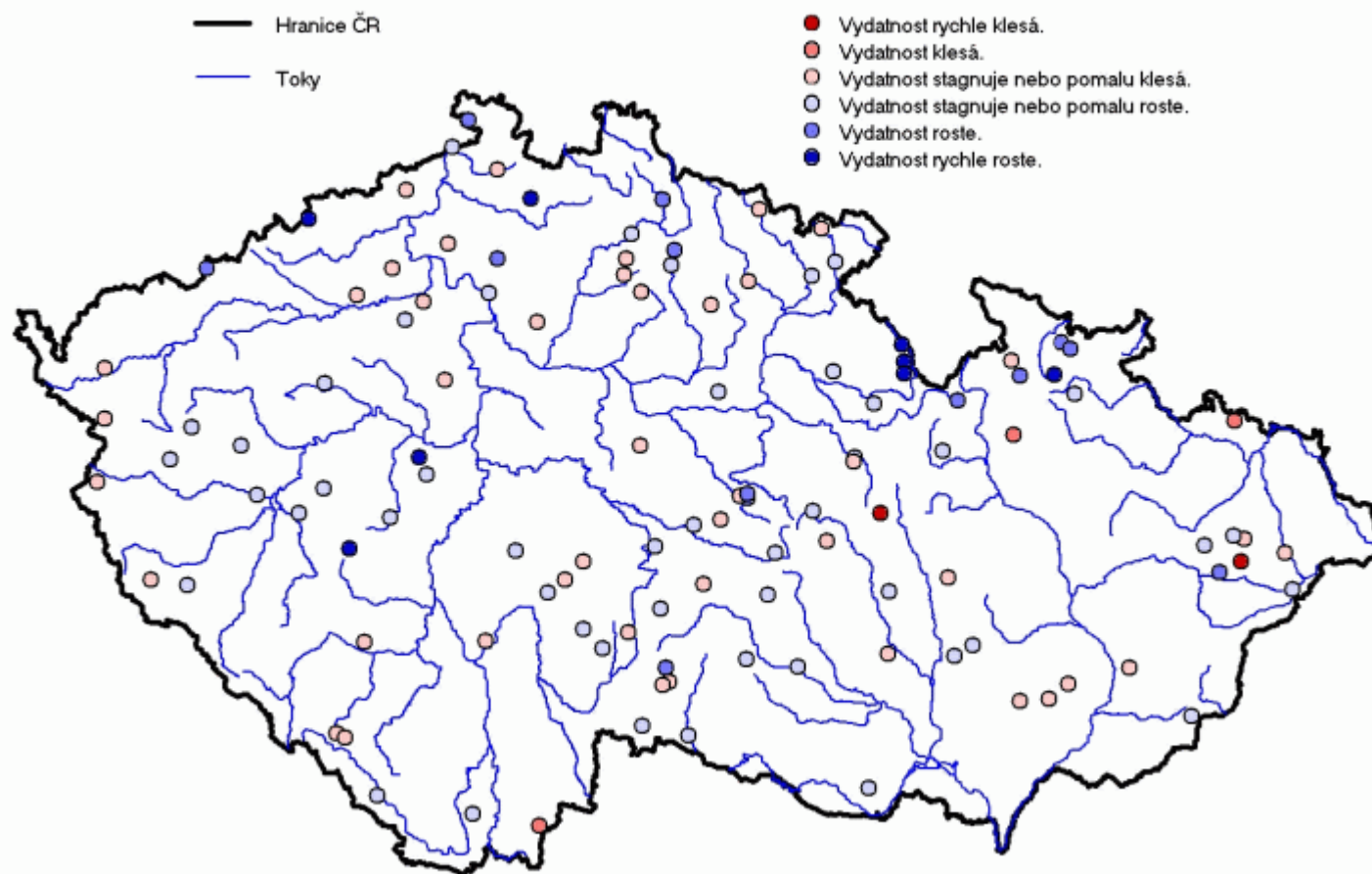
Nárůst nebo pokles hladin ve vrtech v měsíci: 08/2011
Srovnání s předchozím měsícem.





8/11 - comparison with previous month - springs

Nárůst nebo pokles vydatnosti pramenů v měsíci: 08/2011
Srovnání s předchozím měsícem.





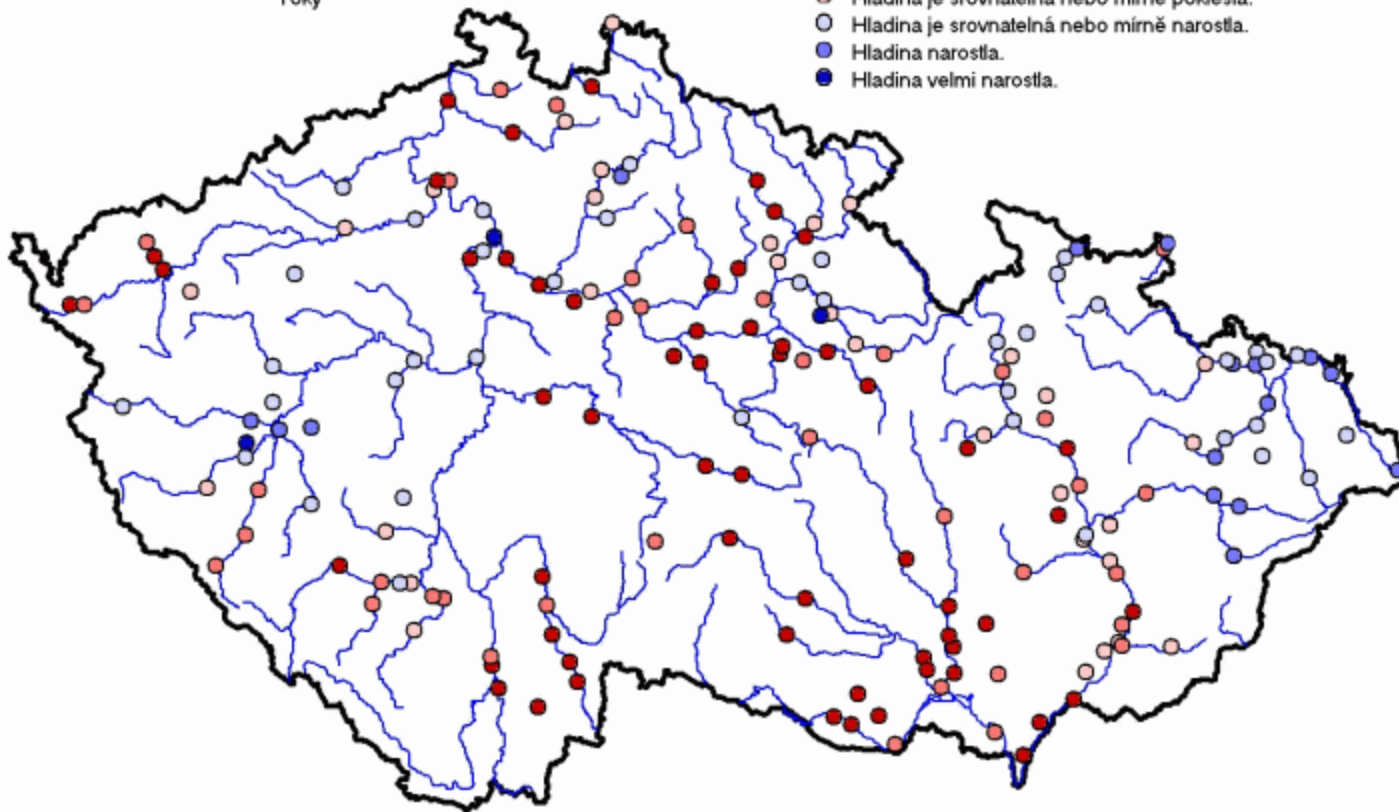
8/11 - comparison with August previous year - boreholes

Nárůst nebo pokles hladin ve vrtech v měsíci: 08/2011
Srovnání se stejným měsícem předchozího roku.

— Hranice ČR

— Toky

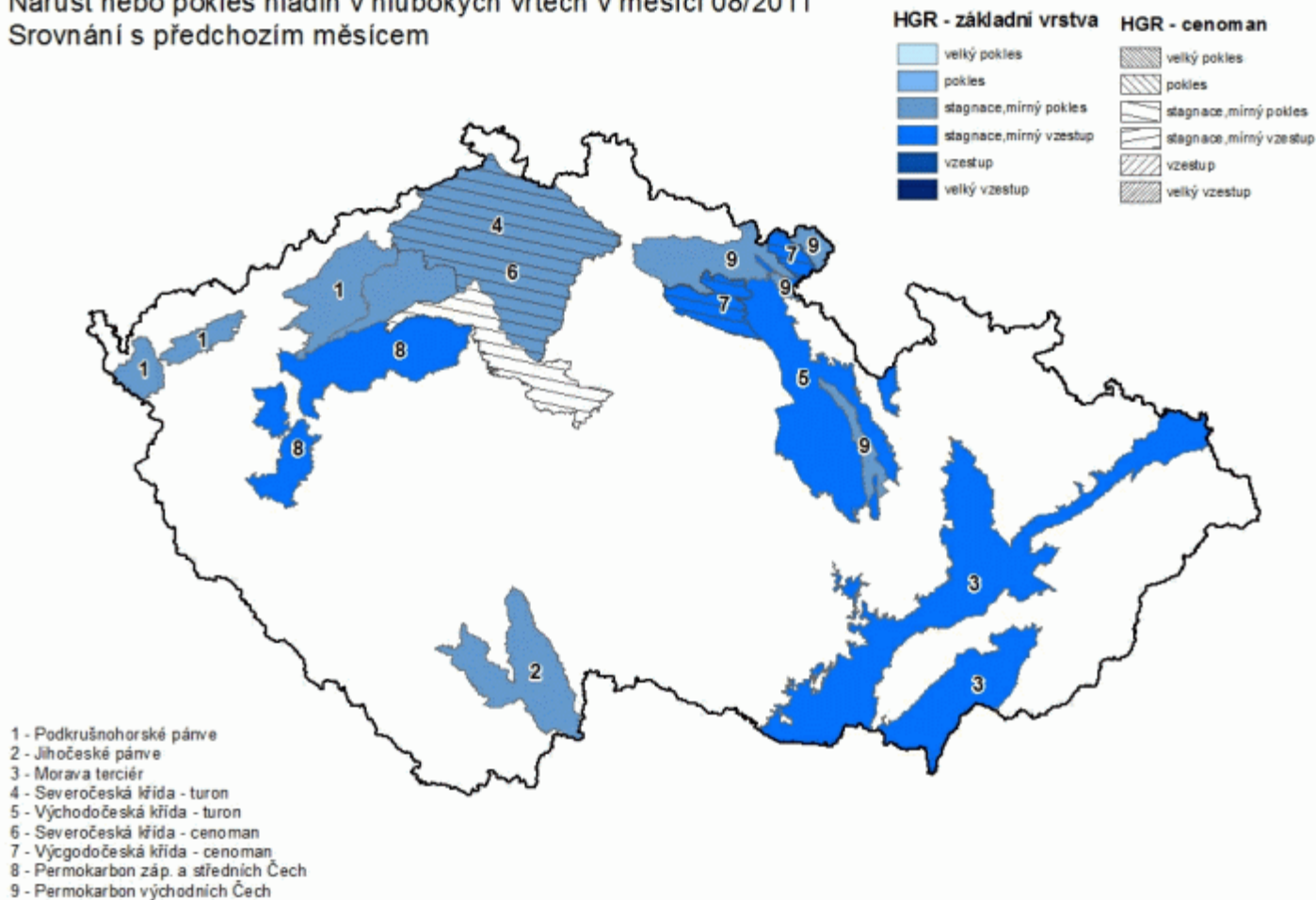
- Hladina velmi poklesla.
- Hladina poklesla.
- Hladina je srovnatelná nebo mírně poklesla.
- Hladina je srovnatelná nebo mírně narostla.
- Hladina narostla.
- Hladina velmi narostla.





8/11 - comparison with previous month – area aggregation

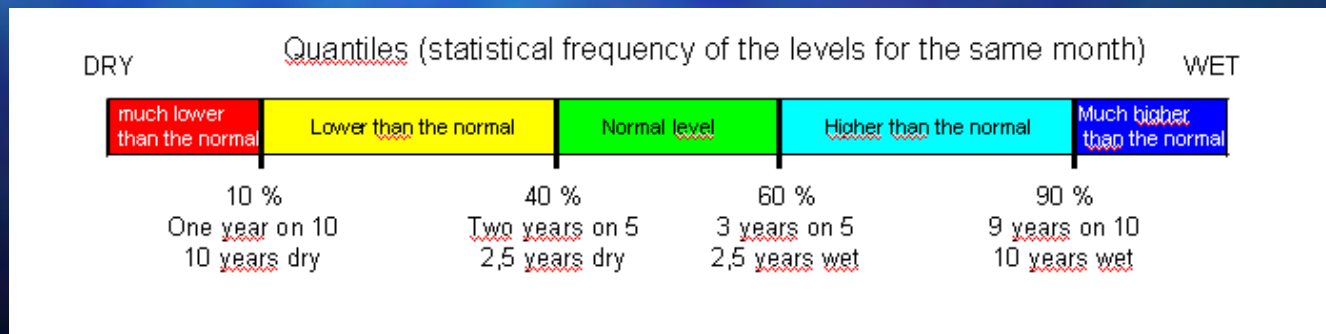
Nárůst nebo pokles hladin v hlubokých vrtech v měsíci 08/2011
Srovnání s předchozím měsícem





Indicators development (EU level)

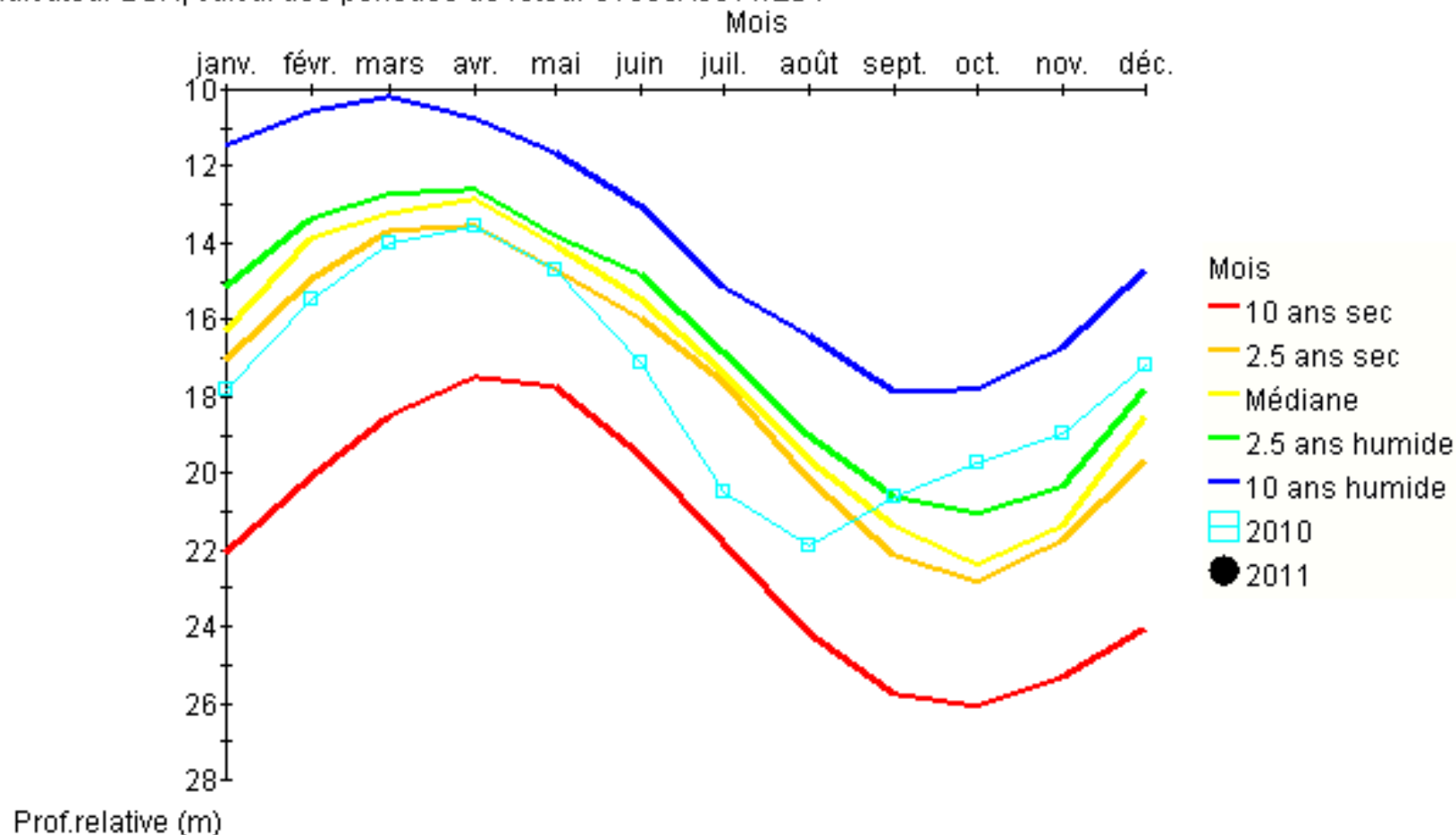
- Indicators for water scarcity and droughts:
- Groundwater level indicator to drought and/or water scarcity
- French proposal: The groundwater level indicator is the period of return of the average monthly level observed for a measuring station, divided into five quantiles, the driest (represented in red) to the wettest (in dark blue)



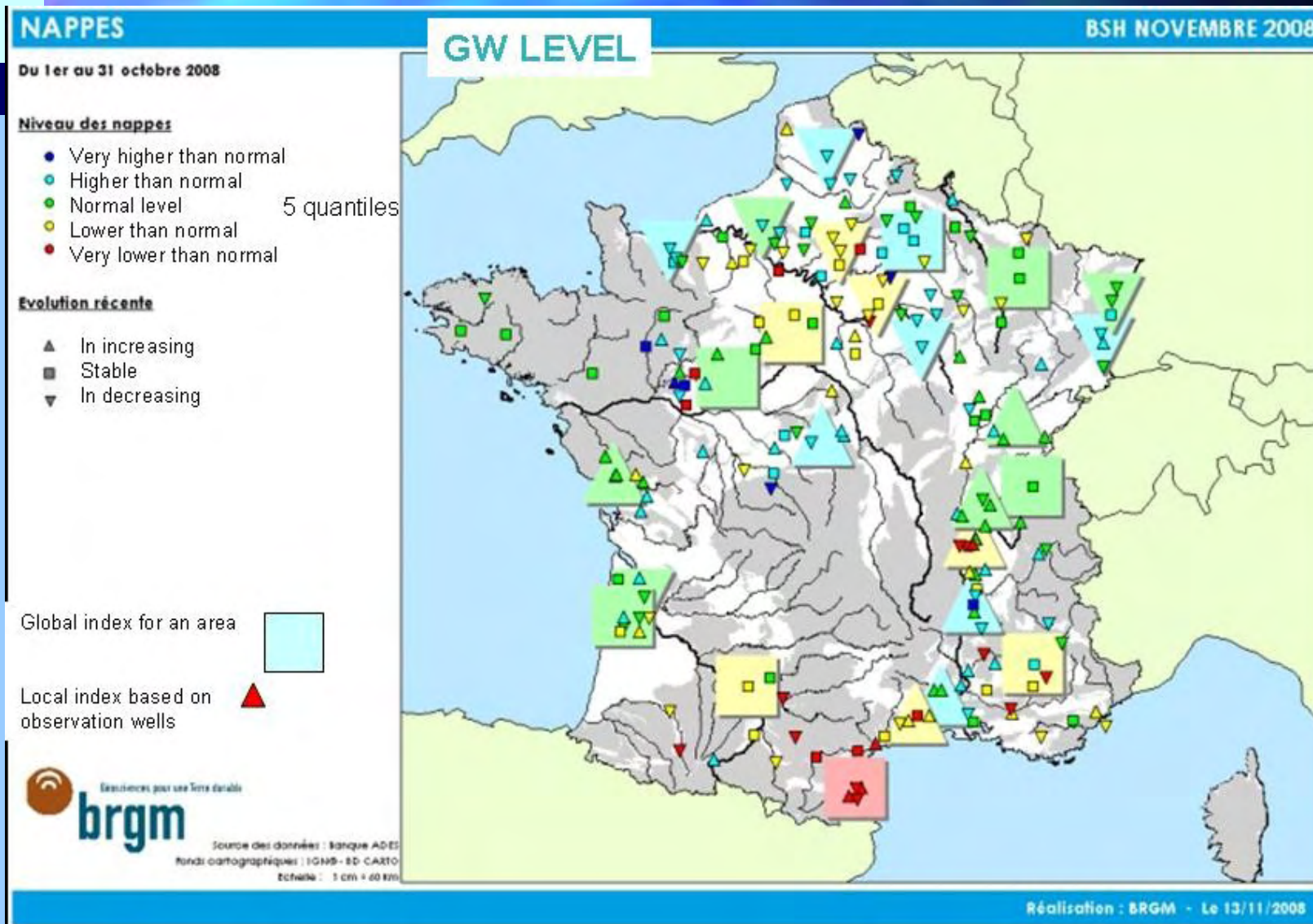


Indicators development (EU level)

Indicateur BSH, calcul des périodes de retour 01086X0011/LS4



Indicators development (EU level)





Czech proposed methodology

- Analysis of monitoring stations, aggregation of results for groundwater body
- Monitoring stations:
- Comparison of year characteristics with long term characteristics
- Analysis of every year
- Aggregation for groundwater body

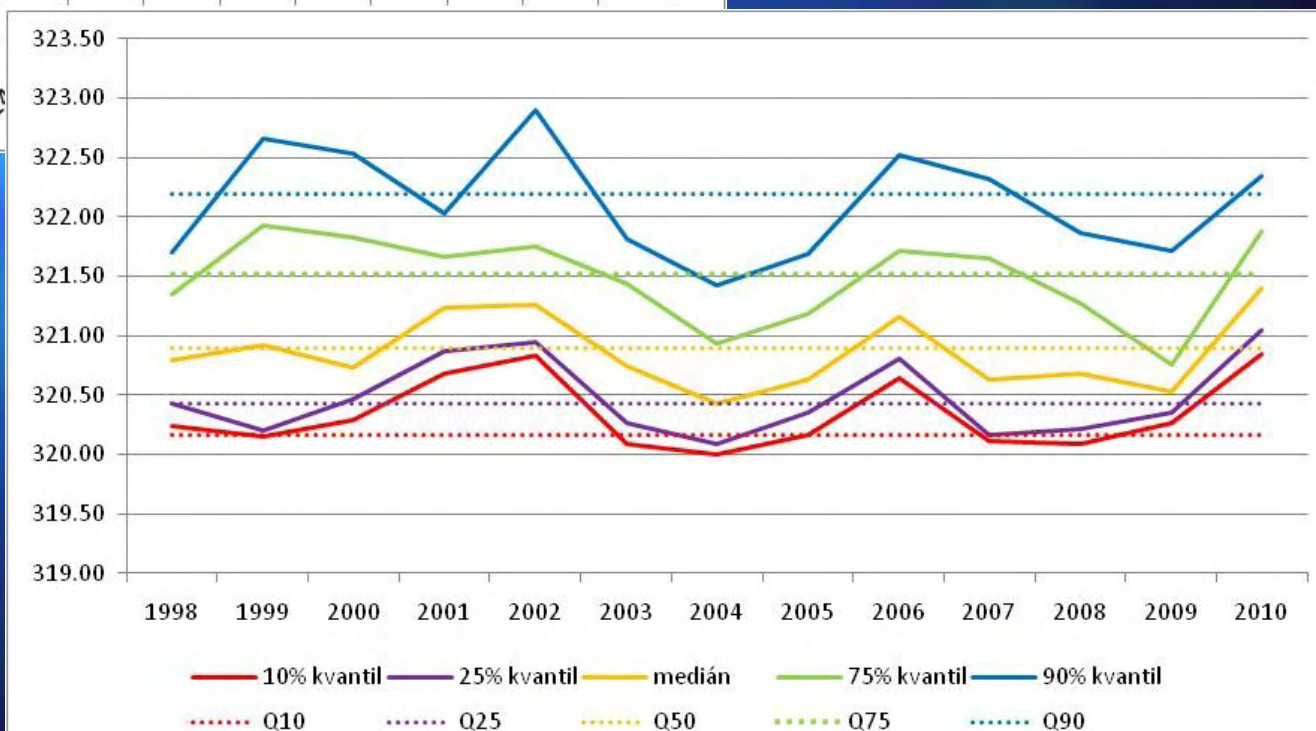
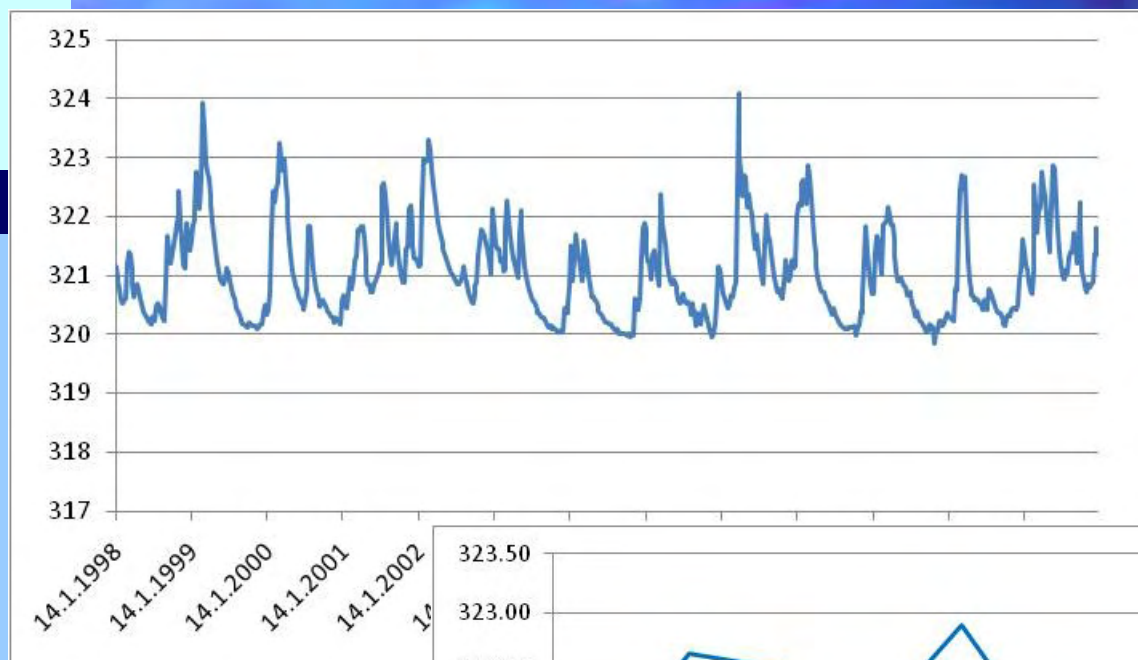
Czech proposed methodology

Years assessment														
annual and long-term		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
90%	absolute value	-0.49	0.46	0.34	-0.17	0.71	-0.38	-0.78	-0.50	0.32	0.13	-0.33	-0.48	0.15
75%	absolute value	-0.16	0.41	0.30	0.14	0.24	-0.08	-0.59	-0.34	0.19	0.13	-0.25	-0.76	0.35
median	absolute value	-0.09	0.02	-0.15	0.35	0.37	-0.14	-0.45	-0.25	0.27	-0.26	-0.21	-0.36	0.50
25%	absolute value	0.00	-0.23	0.04	0.44	0.51	-0.16	-0.33	-0.07	0.38	-0.26	-0.22	-0.07	0.61
10%	absolute value	0.08	-0.01	0.13	0.52	0.67	-0.07	-0.16	0.00	0.48	-0.05	-0.07	0.11	0.68
90%	%	-23	21	16	-8	32	-18	-36	-23	15	6	-15	-22	7
75%	%	-8	19	14	7	11	-4	-27	-16	9	6	-11	-35	16
median	%	-4	1	-7	16	17	-6	-21	-12	12	-12	-10	-16	23
25%	%	0	-10	2	20	24	-7	-15	-3	18	-12	-10	-3	28
10%	%	4	0	6	24	31	-3	-7	0	22	-2	-3	5	31
Rise	count of weights	0	2	2	3	7	0	0	0	4	0	0	0	6
Decline	count of weights	-1	-1	0	0	0	-1	-6	-3	0	-2	-3	-4	0
Total		-1	1	2	3	7	-1	-6	-3	4	-2	-3	-4	6
Final year assessment		0	0	0	+	++	0	--	-	+	0	-	-	++

Category of deviation - portion of interquartile range 25-75%			Portion	Value of portion	%	Weight
minus	plus	Very significant absolute deviation	0,5	0.54	25	2
minus	plus	Significant absolute deviation	0,2	0.22	10	1

Year category*		Range
++	significantly wet year	<5; 10>
+	wet year	<3; 4>
0	average year	<-2; 2>
-	dry year	<-4; -3>
--	significantly dry year	<-10; -5>

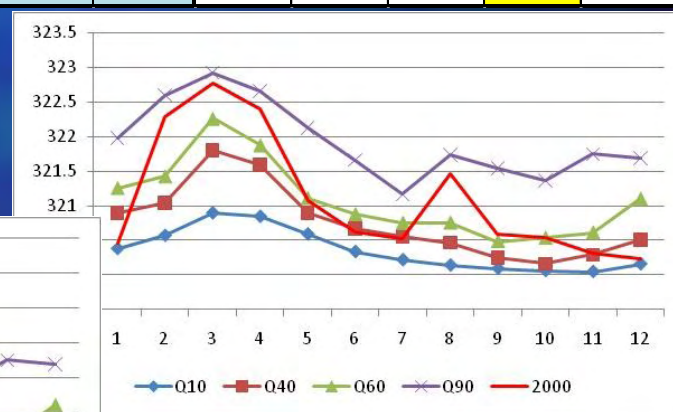
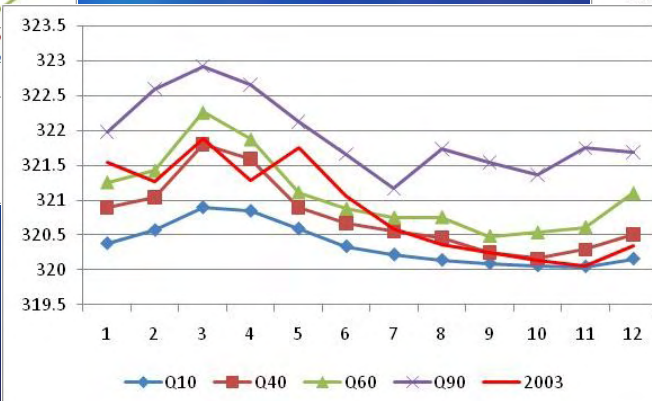
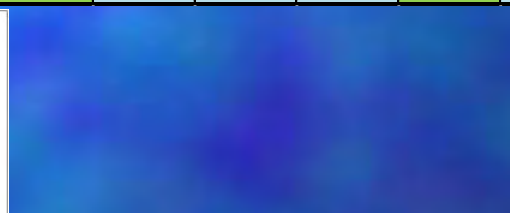
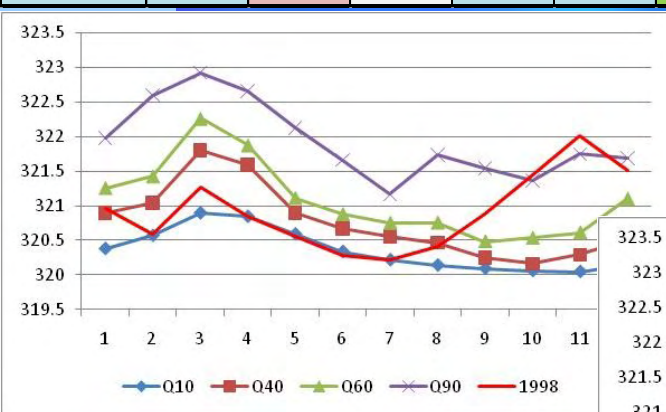
Czech proposed methodology





Application of French proposed methodology

	1	2	3	4	5	6	7	8	9	10	11	12	-2	-1	0	1	2
1998	0	-1	-1	-2	-2	-2	-1	-1	1	2	2	1	3	4	1	2	2
1999	1	1	1	1	1	1	1	0	-1	-1	-1	-1	0	4	1	7	0
2000	-1	1	1	1	0	-1	-1	1	1	1	0	-1	0	4	2	6	0
2001	-1	-1	-1	0	-1	1	2	2	1	1	1	1	0	4	1	5	2
2002	0	2	2	1	1	1	1	1	1	1	1	1	0	0	1	9	2
2003	1	0	0	-1	1	1	0	-1	0	-1	-1	-1	0	5	4	3	0
2004	-1	0	-1	-1	-2	-1	-2	-2	-2	-2	-2	0	6	4	2	0	0
2005	1	0	-1	0	0	0	0	0	0	0	-1	-1	0	3	8	1	0
2006	-1	-2	-2	2	2	2	2	1	1	1	1	0	2	1	1	4	4
2007	2	1	1	-1	-1	-1	-1	-1	-1	-1	0	1	0	7	1	3	1
2008	-1	0	0	0	0	0	0	-1	-1	-1	-1	-1	0	6	6	0	0
2009	-2	-1	1	-1	-1	-1	-1	0	0	0	0	0	0	5	5	1	1
2010	1	-1	0	1	1	2	1	1	1	2	1	1	0	1	1	8	2





Results from pilot GWB

Yearly assessment

	VP7203	VP7221	VP7222	VP7224	VP7225
1992	dry	-	significantly dry	significantly dry	-
1993	dry	-	normal	significantly dry	normal
1994	wet	-	normal	normal	wet
1995	wet	-	normal	wet	significantly wet
1996	normal	-	wet	wet	wet
1997	dry	-	normal	wet	wet
1998	significantly dry	dry	wet	normal	wet
1999	dry	wet	significantly wet	wet	significantly wet
2000	dry	wet	normal	normal	wet
2001	wet	normal	normal	normal	normal
2002	normal	wet	wet	wet	dry
2003	normal	normal	dry	dry	significantly dry
2004	significantly dry	significantly dry	significantly dry	dry	significantly dry
2005	wet	normal	dry	dry	dry
2006	wet	wet	wet	wet	dry
2007	normal	dry	dry	dry	dry
2008	dry	dry	dry	dry	dry
2009	dry	normal	dry	dry	dry
2010	wet	wet	wet	wet	dry



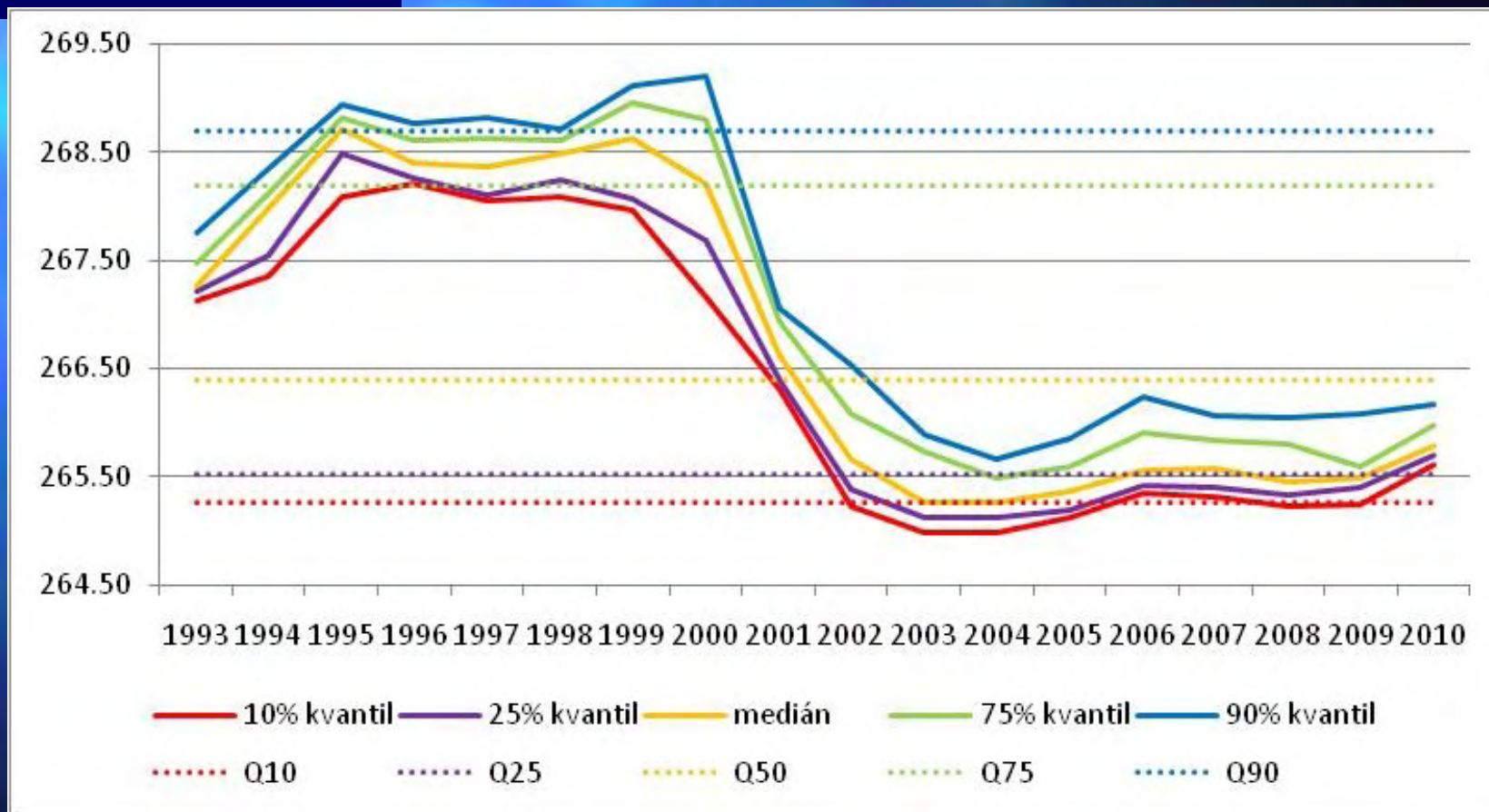
Results from pilot GWB

Monthly assessment

	VP7203	VP7221	VP7222	VP7224	VP7225
1992	0	-	--	--	-
1993	--	-	-	--	+
1994	0	-	+	+	++
1995	++	-	++	++	++
1996	0	-	+	0	++
1997	-	-	0	0	++
1998	-	0	++	++	++
1999	-	0	++	++	++
2000	0	0	+	0	++
2001	0	+	+	0	0
2002	0	++	++	++	--
2003	0	0	0	0	--
2004	--	--	--	--	--
2005	0	-	--	-	--
2006	-	+	0	0	--
2007	0	0	0	0	--
2008	0	-	-	-	--
2009	--	-	--	--	--
2010	++	++	++	++	--



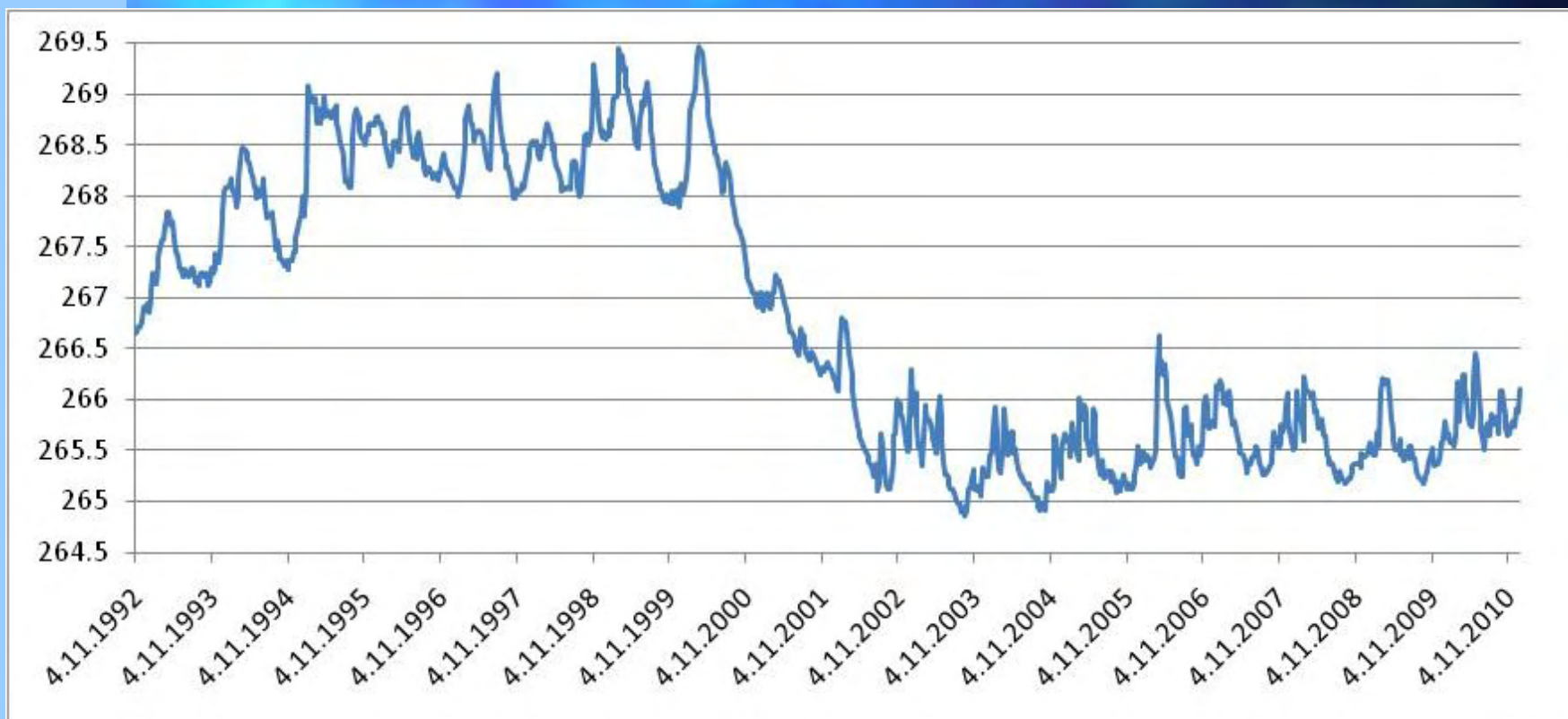
Results from pilot GWB





Results from pilot GWB

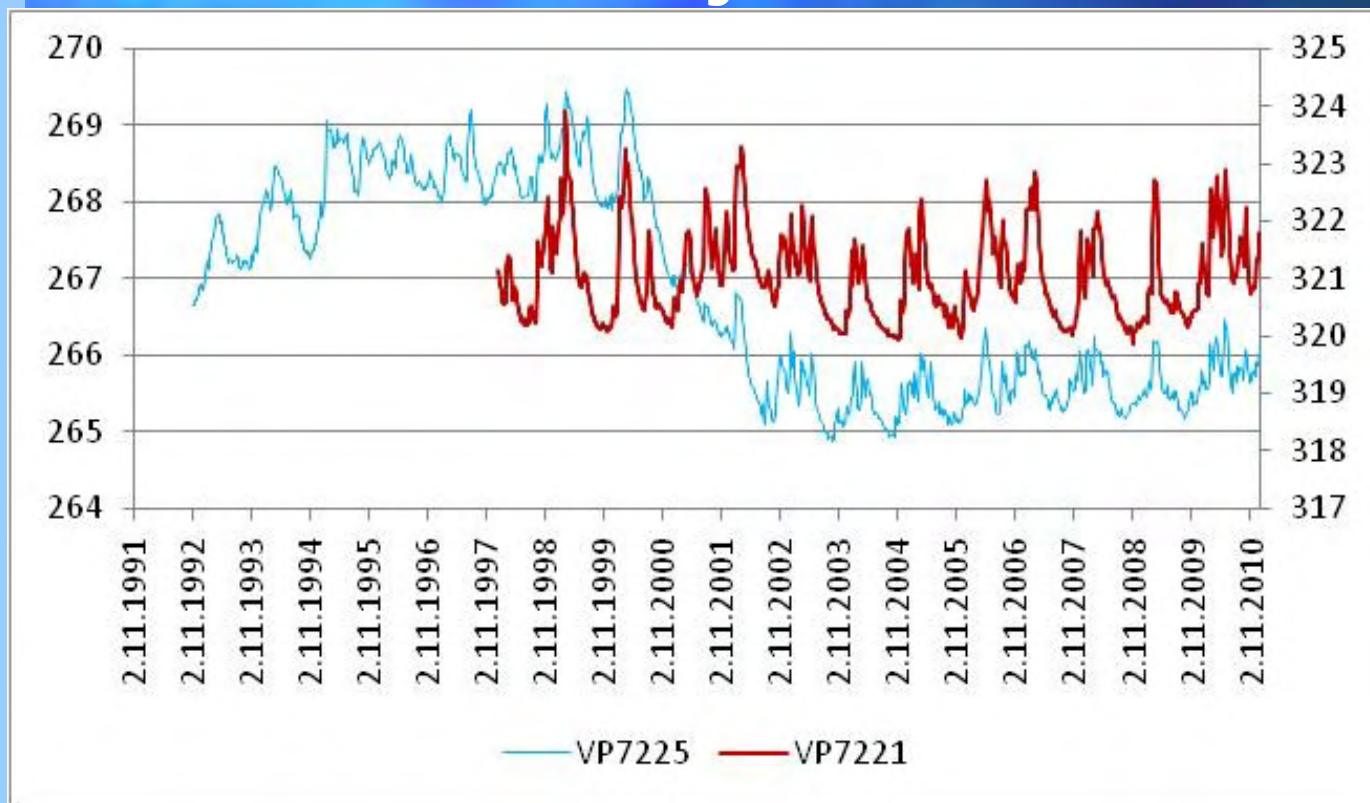
Problematic results from object:





Results from pilot GWB

Comparison of problematic result
with another object:





Results from pilot GWB

- Both methodology have similar results
- Precise methodology for monthly or yearly assessment, but not aggregation per year (monthly assessment) or per area
- Monthly assessment is important for further analysis and distinction of (proportion of) climate change, regular dry periods and impact of human activity (abstractions)
- Although the pilot area was indicated as influenced by droughts (or water scarcity), no results proved it



Results from pilot GWB

- Necessary activities:
 - ✓ Validation of data
 - ✓ Elimination of problematic results or objects
 - ✓ Selection of representative objects
 - ✓ Comparison of GW level results with GW recharge and precipitation
 - ✓ Analysis of related abstraction changes



Thank you for your attention