Idős alföldi tölgyesek talajvízszint-változásai az elmúlt 75 évben

(Variation of groundwater level in old growth oak forests on the Great Hungarian Plain in the last 75 years)

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Introduction

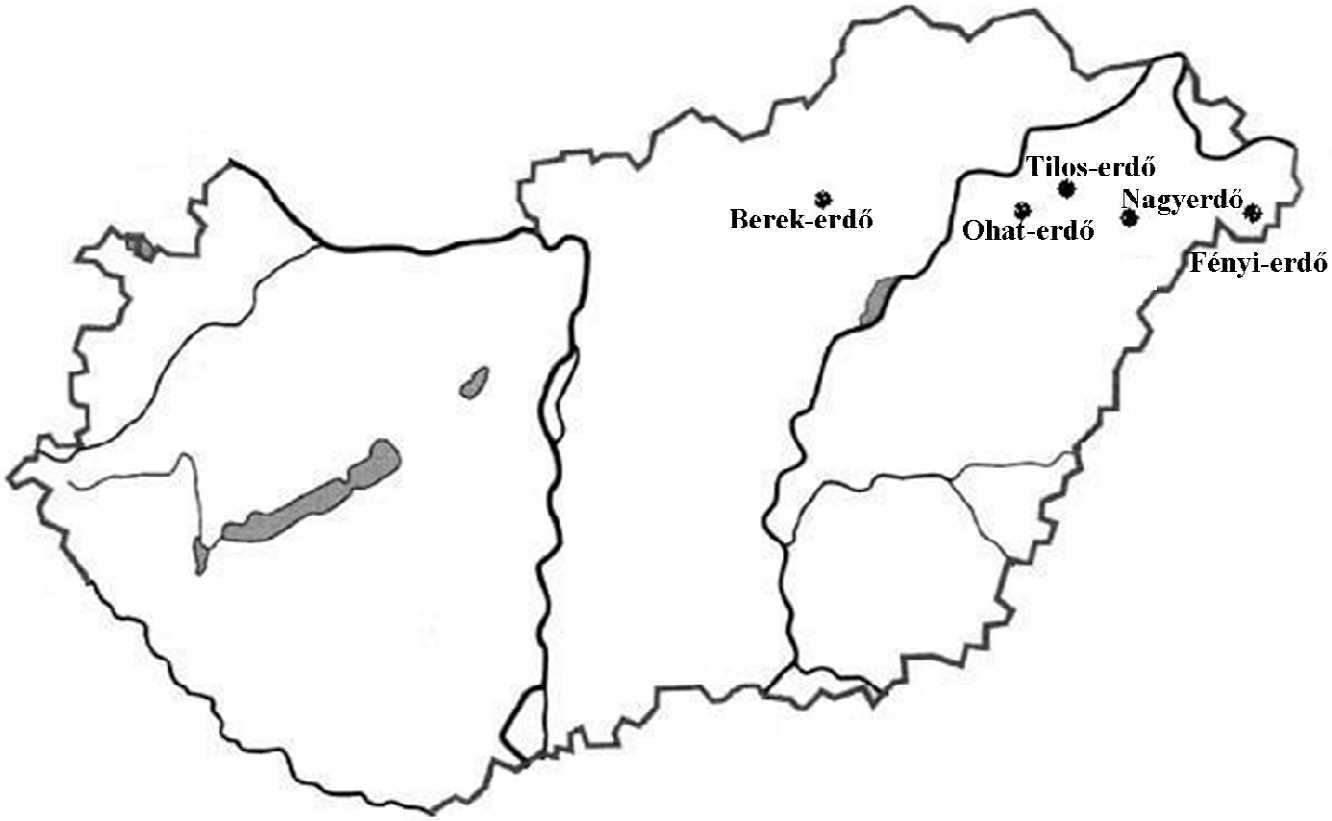
- Lowland oak forests show the marks of drying:
  - drying crown,
  - altering vegetation,
  - waited seedling

- These natural phenomenas are related with the widespread opinion about generally decreasing of the groundwater level in forests on the Great Hungarian Plain

The project has the following objectives:

1. How the groundwater level has been changed at the oldest oak forests ?
2. Based on botanical datas, does the vegetation follow this alteration?

Sample areas



1. Saline oak forest

- Ohat – erdő near Egyek: 91, 93, 103 years old
- Tilos – erdő near Újszentmargita : 100 years old

2. Sandy oak forest

- Nagyerdő at Debrecen - Pallag: 135, 166, 185 years old
- Fényi – erdő near Bátorliget : 100 years old

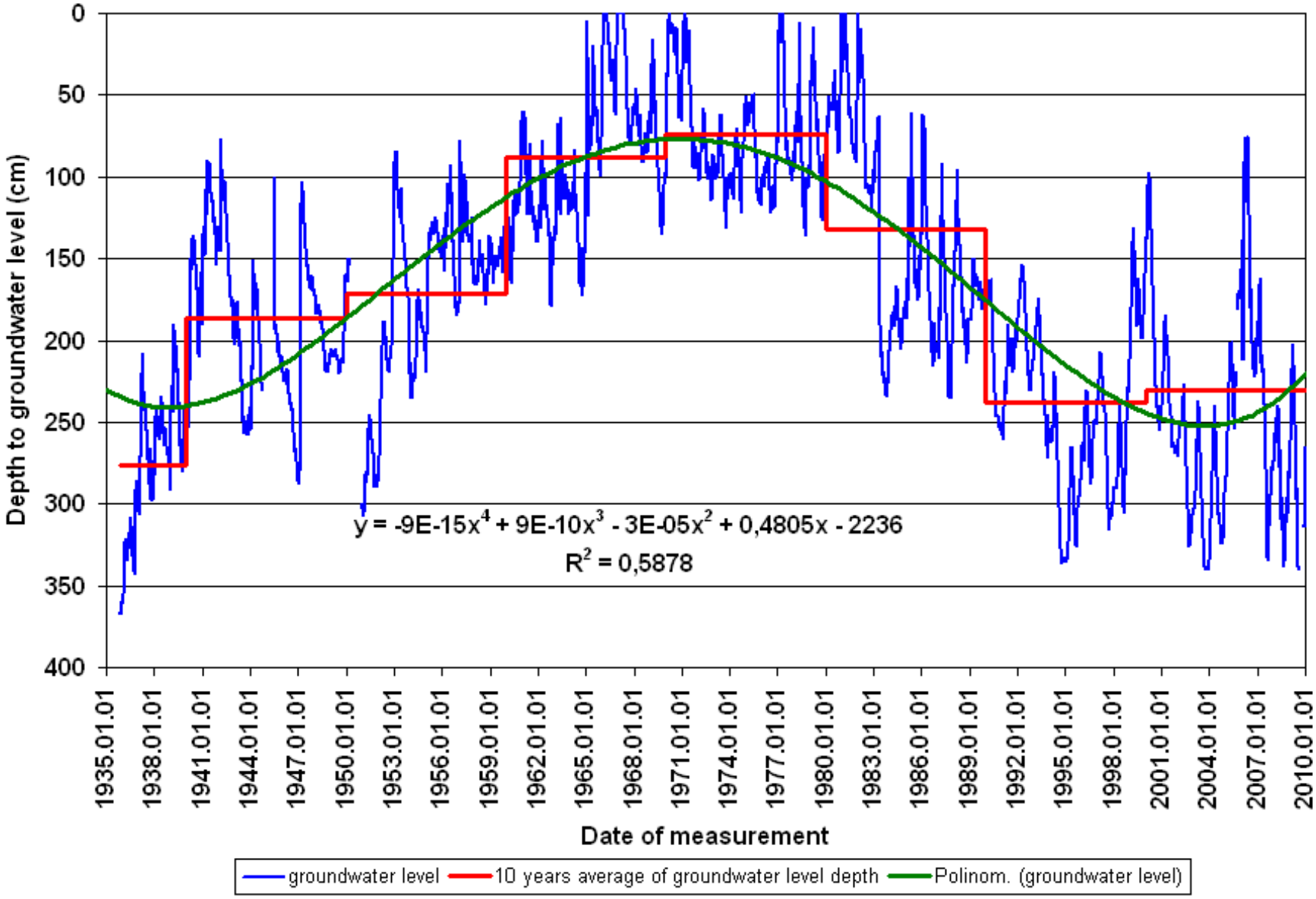
3. Loess oak forest

- Berek – erdő near Kerecsend : 90 years old

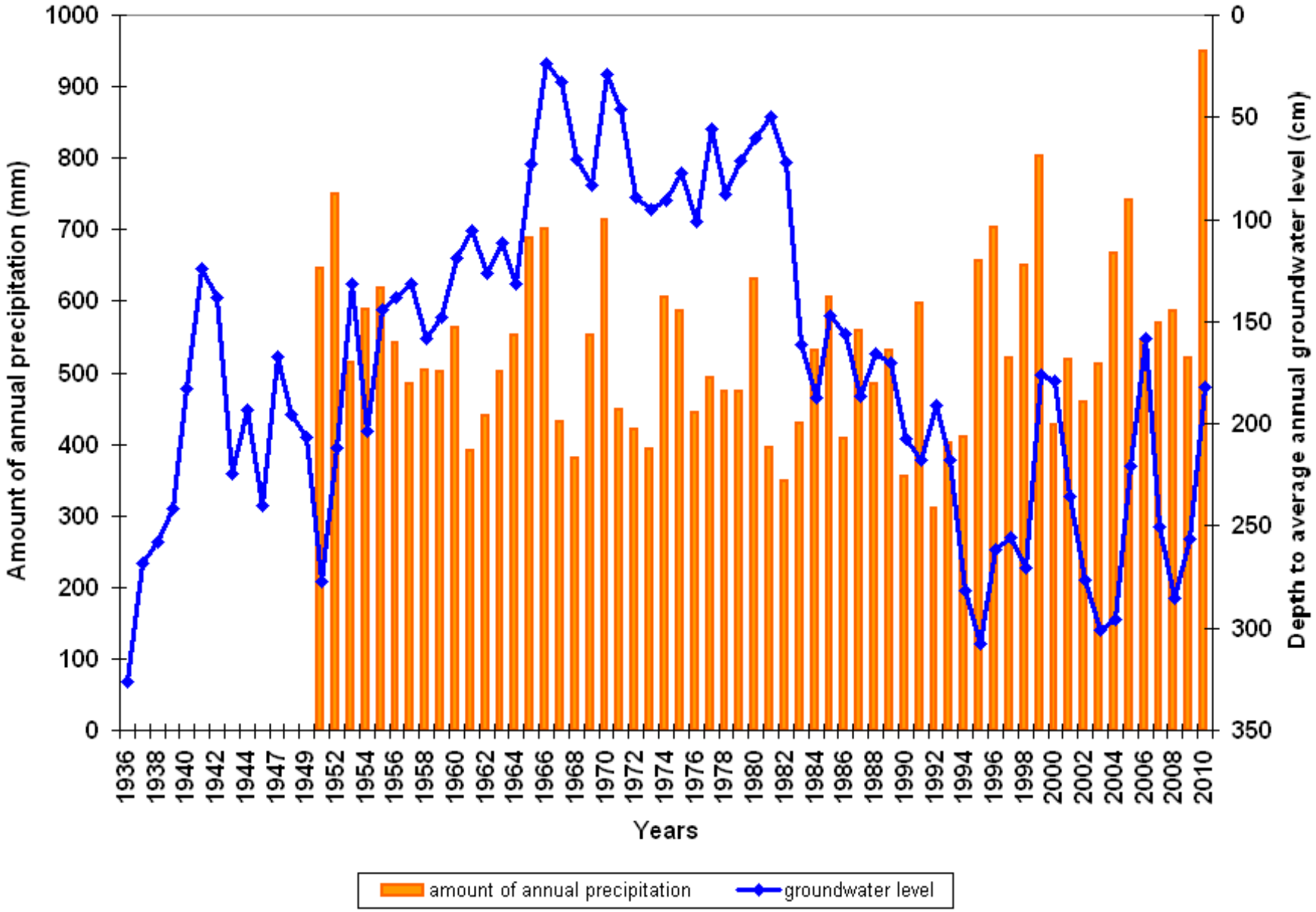
Soils of the sample areas

Forest-fragment identifier	Genetic soil type	Depth of topsoil	Physical type of soil	Hydrology
Kerecsend 8D	Chernozem brown forest soil	medium deep	loam	independent from excess-water effect
Egyek 21 B	Solonetz meadow soils	shallow	clay	varying
Egyek 17 B	Solonetz meadow soils	medium deep	clay	varying
Egyek 15 C	Meadow soils	deep	clay	periodic
Újszentmargita 4 B	Meadow solonetz	shallow	clay	varying
Újszentmargita 4 F	Meadow solonetz	medium deep	clay	varying
Újszentmargita 4 C	Meadow forest soil	medium deep	clay	varying
Debrecen 218 J	Humic sandy soils	deep	sand	periodic
Debrecen 223 A	Banded brown forest soils	deep	sand	periodic
Debrecen 224 B	Humic sandy soils	deep	sand	periodic
Bátorliget 24F	Humic sandy soils	deep	sand	independent from excess-water effect
Bátorliget 21C	Banded brown forest soils	deep	sand	periodic

Change of groundwater level (Ohat – erdő, Egyek)



Annual precipitation and groundwater level (Ohat-erdő, Egyek)



Annual precipitation and groundwater level (Ohat-erdő, Egyek)

Ohat

	Wettest year	2010		Year of highest average groundwater level	1966
10 years average (mm)	mm	912		cm	24
	Driest year	1992		Year of lowest average groundwater level	1936
	mm	299		cm	326
	1951-59	568	10 years average (cm)	1935-39	276
	1960-69	558		1940-49	186
	1970-79	511		1950-59	171
	1980-89	491		1960-69	88
	1990-99	463		1970-79	74
	2000-2010	582		1980-89	132
	average precipitation (mm)	529		1990-99	238
				2000-2010	231

decrease
increase

Characteristic of groundwater level fluctuation (Ohat-erdő, Egyek)

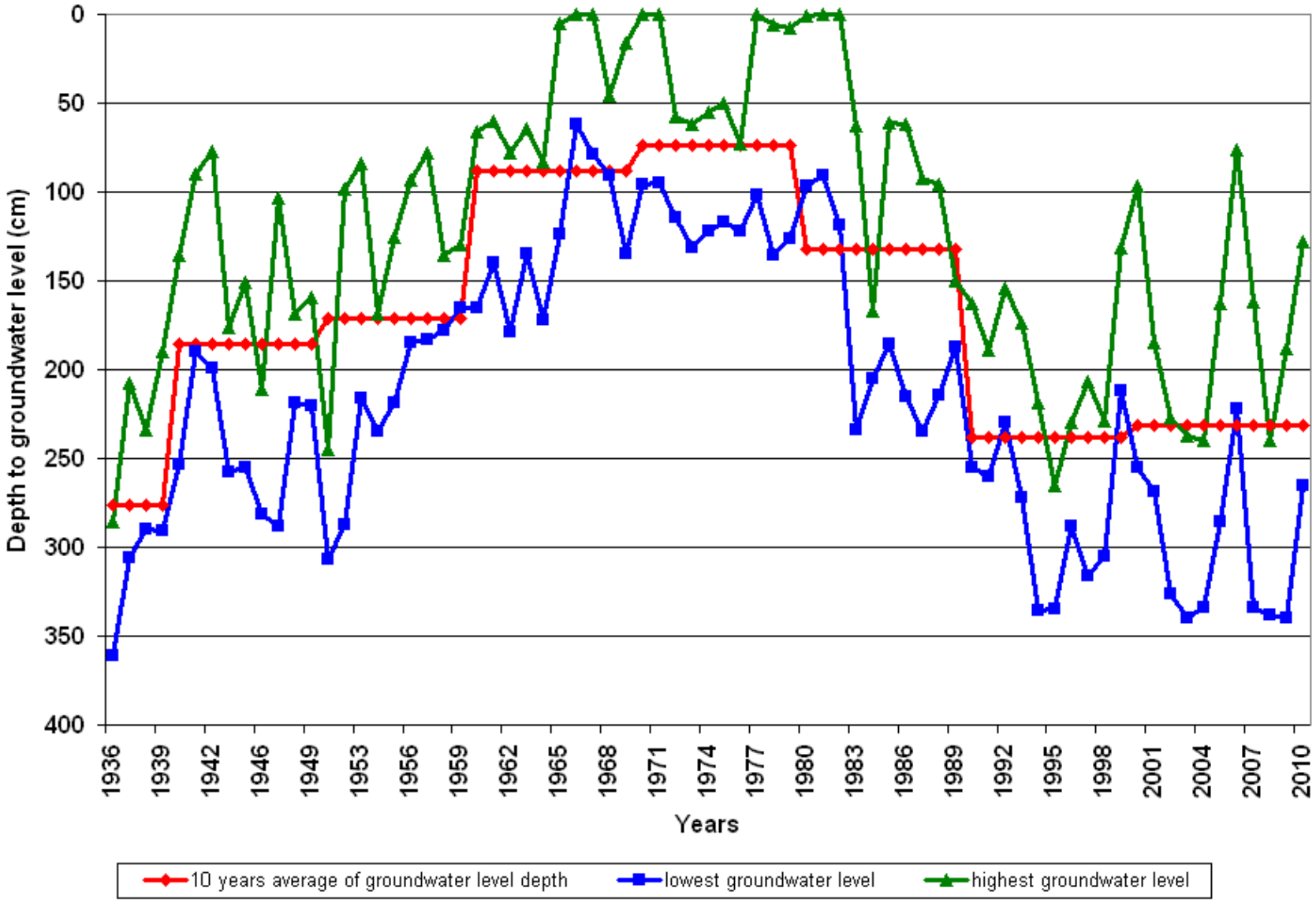
OHAT			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1936	276	326	75
1937	276	268	98
1938	276	257	56
1939	276	241	101
1940	186	183	117
1941	186	124	100
1942	186	138	122
1943	186	224	82
1944	186	193	104
1946	186	240	70
1947	186	168	185
1948	186	195	50
1949	186	207	61
1951	171	277	62
1952	171	212	189
1953	171	132	132
1954	171	203	66
1955	171	144	94
1956	171	138	92
1957	171	131	105
1958	171	158	42
1959	171	148	35
1960	88	119	99
1961	88	105	80
1962	88	126	101
1963	88	112	71
1964	88	131	89
1965	88	73	119
1966	88	24	62
1967	88	33	79
1968	88	71	45
1969	88	83	119
1970	74	29	96
1971	74	46	95
1972	74	89	56
1973	74	95	69
1974	74	90	67
1975	74	77	67
1976	74	101	49
1977	74	56	102
1978	74	88	130
1979	74	71	118

OHAT			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1980	132	60	96
1981	132	50	91
1982	132	72	119
1983	132	161	171
1984	132	187	38
1985	132	147	125
1986	132	156	153
1987	132	186	143
1988	132	165	118
1989	132	170	37
1990	238	207	92
1991	238	217	71
1992	238	191	76
1993	238	218	98
1994	238	282	117
1995	238	307	70
1996	238	261	58
1997	238	255	109
1998	238	271	76
1999	238	176	81
2000	231	179	158
2001	231	236	84
2002	231	277	99
2003	231	301	103
2004	231	295	94
2005	231	220	123
2006	231	158	146
2007	231	251	172
2008	231	285	98
2009	231	256	152
2010	231	182	137

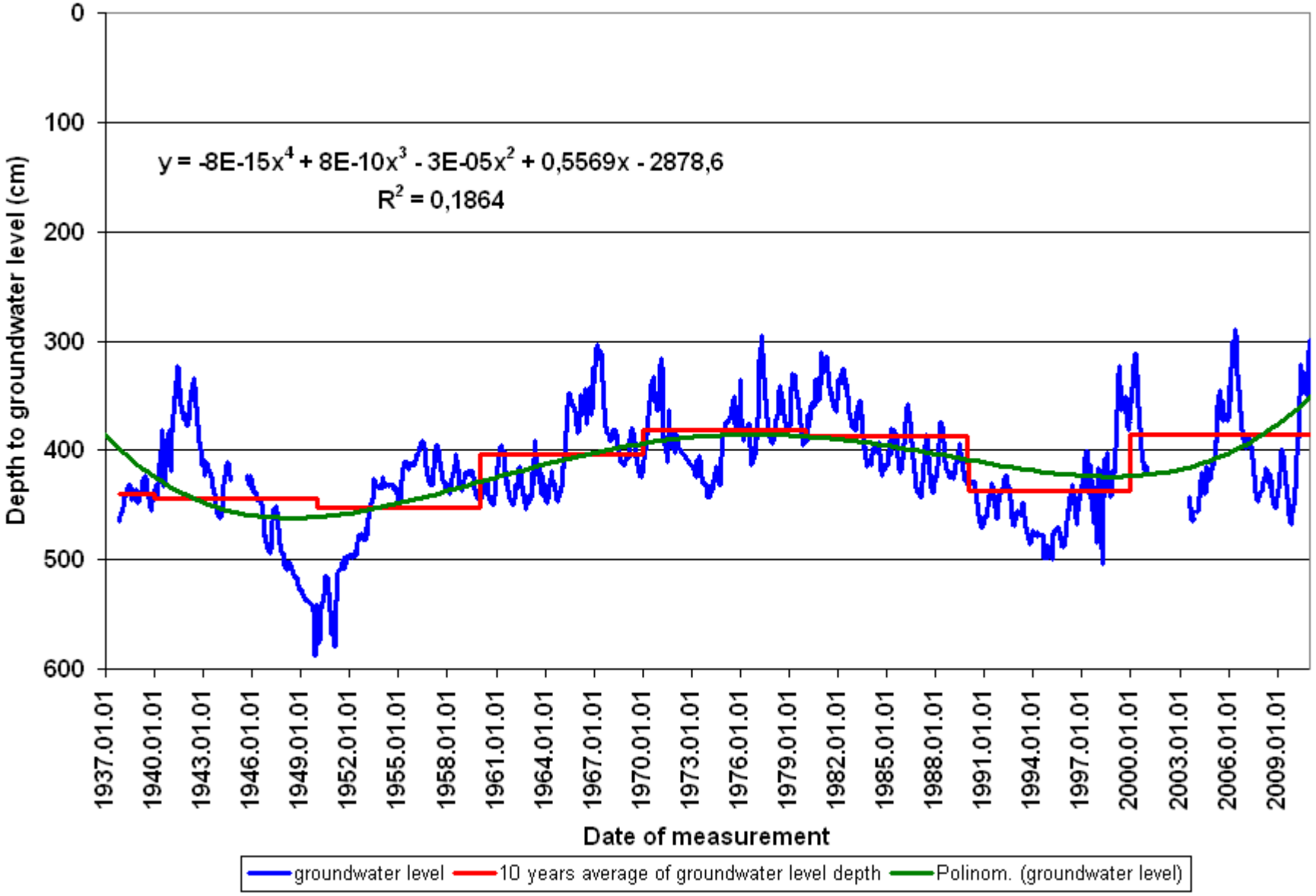
depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

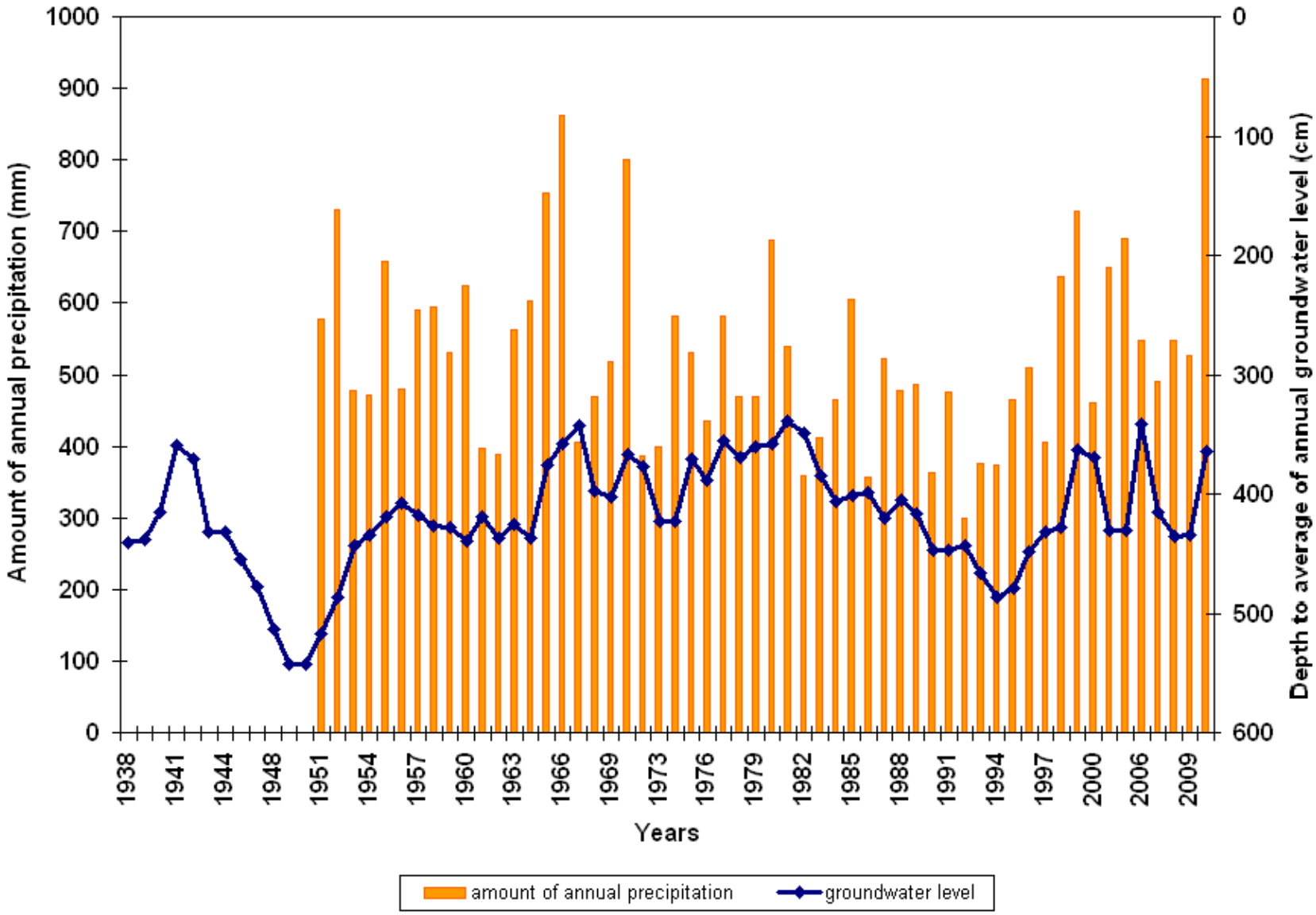
Characteristic of groundwater level fluctuation (Ohat-erdő, Egyek)



Change of groundwater level (Tilos – erdő, Újszentmargita)



Annual precipitation and groundwater level (Tilos – erdő, Újszentmargita)



Annual precipitation and groundwater level (Tilos – erdő, Újszentmargita)

Újszentmargita

10 years average (mm)	Wettest year	2010	10 years average (cm)	Year of highest average groundwater level	1981
	mm	949		cm	339
	Driest year	1992		Year of lowest average groundwater level	1950
	mm	309		cm	543
	1951-59	572		1935-39	441
	1960-69	519		1940-49	444
	1970-79	505		1950-59	452
	1980-89	492		1960-69	403
	1990-99	540		1970-79	381
	2000-2010	591		1980-89	387
	average precipitation (mm)	537		1990-99	437
				2000-2010	386

decrease
increase

Characteristic of groundwater level fluctuation (Tilos – erdő, Újszentmargita)

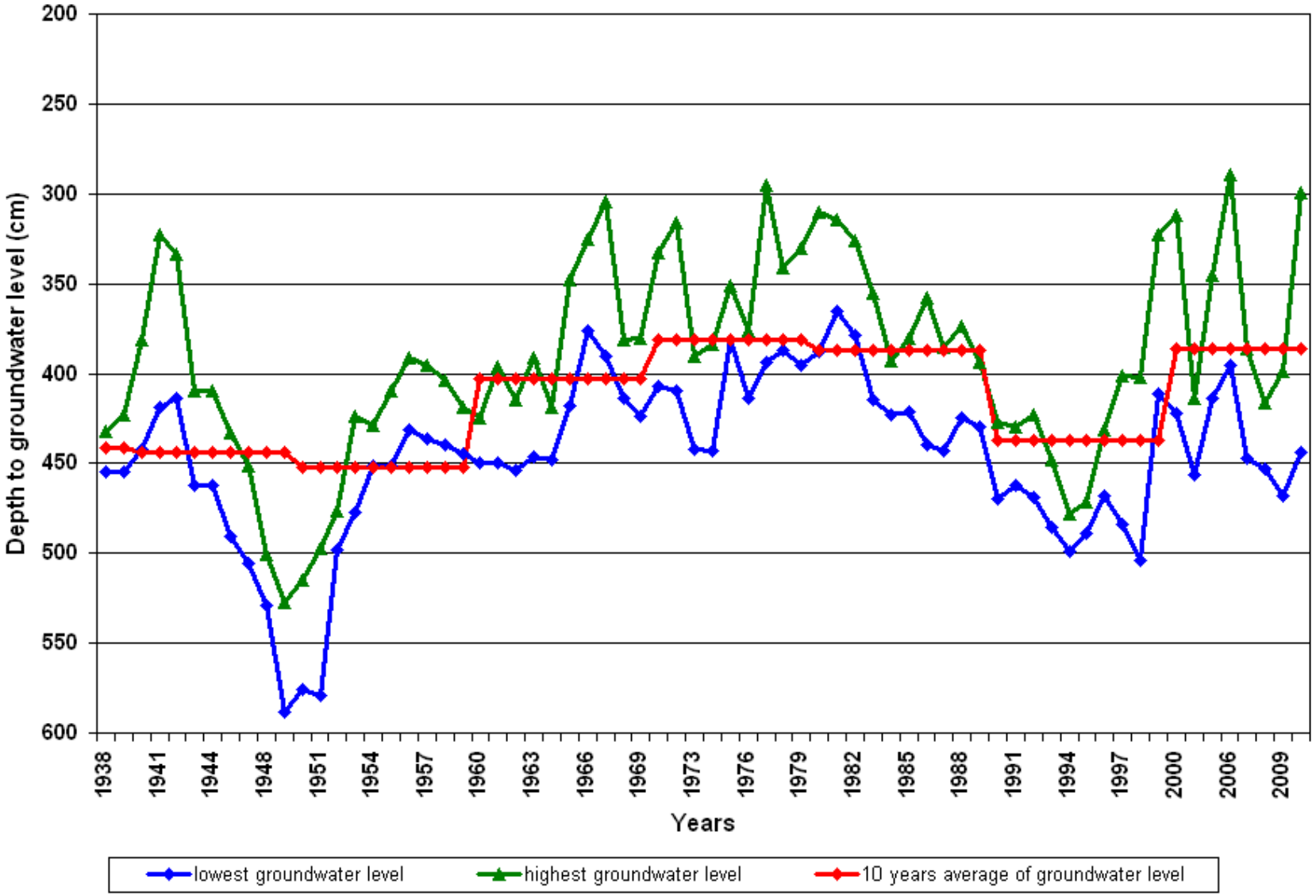
ÚJSZENTMARGITA			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1938	441	441	23
1939	441	438	32
1940	444	416	61
1941	444	359	96
1942	444	370	80
1943	444	432	52
1944	444	432	52
1946	444	455	58
1947	444	477	55
1948	444	513	28
1949	444	542	61
1950	452	543	61
1951	452	517	82
1952	452	487	22
1953	452	443	53
1954	452	434	22
1955	452	419	41
1956	452	408	40
1957	452	417	41
1958	452	427	36
1959	452	429	26
1960	403	439	25
1961	403	420	54
1962	403	437	39
1963	403	425	55
1964	403	437	29
1965	403	376	70
1966	403	358	51
1967	403	343	86
1968	403	398	33
1969	403	403	44
1970	381	366	74
1971	381	378	94
1973	381	423	52
1974	381	423	59
1975	381	370	30
1976	381	389	38
1977	381	355	99
1978	381	369	46
1979	381	361	65

ÚJSZENTMARGITA			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1980	387	358	78
1981	387	339	51
1982	387	349	53
1983	387	385	60
1984	387	407	30
1985	387	401	41
1986	387	398	82
1987	387	421	58
1988	387	406	51
1989	387	416	36
1990	437	447	43
1991	437	447	32
1992	437	444	46
1993	437	467	38
1994	437	486	21
1995	437	479	18
1996	437	448	37
1997	437	432	83
1998	437	428	102
1999	437	363	88
2000	386	370	110
2004	386	430	42
2005	386	430	69
2006	386	342	106
2007	386	415	61
2008	386	436	37
2009	386	434	69
2010	386	364	145

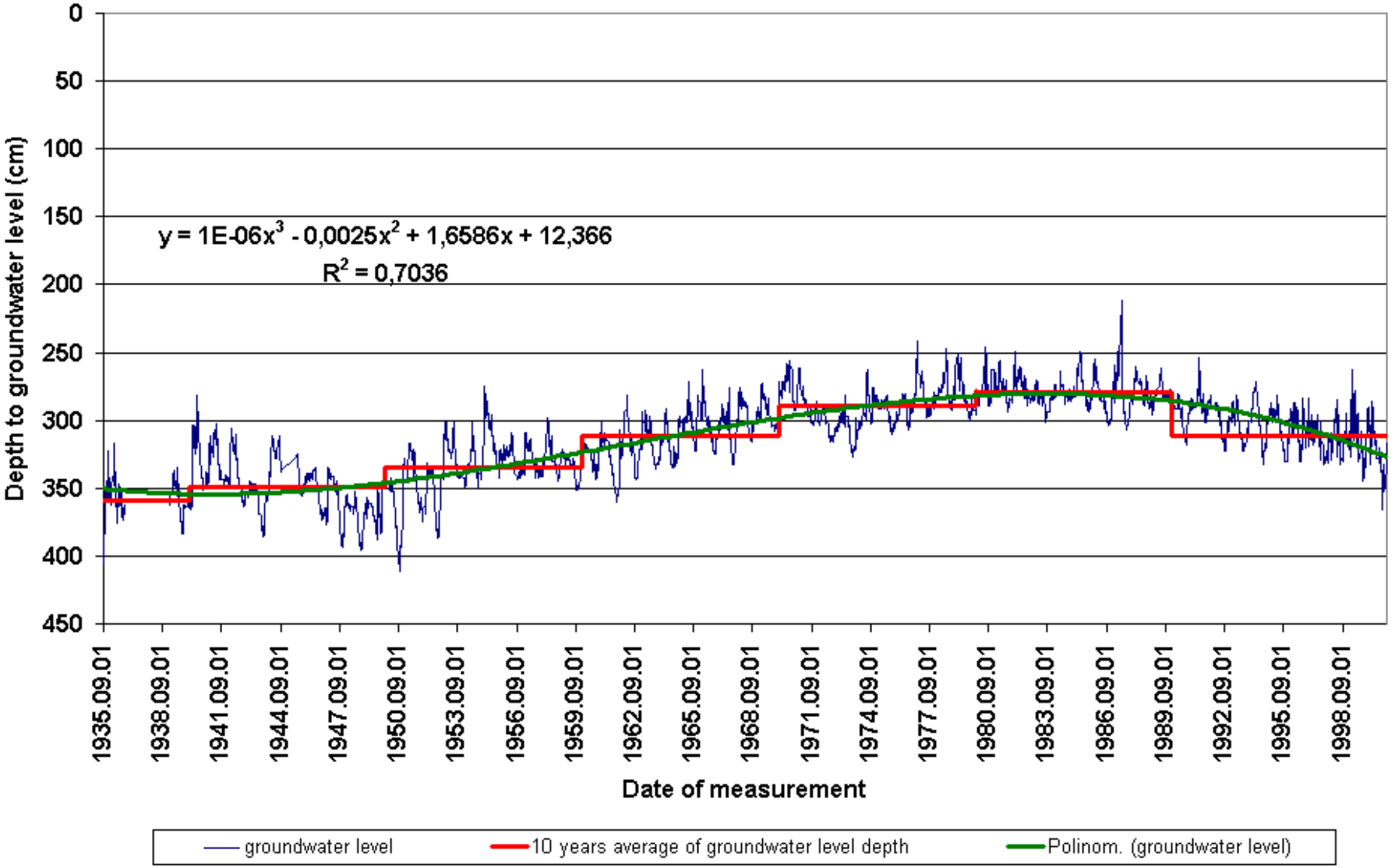
depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

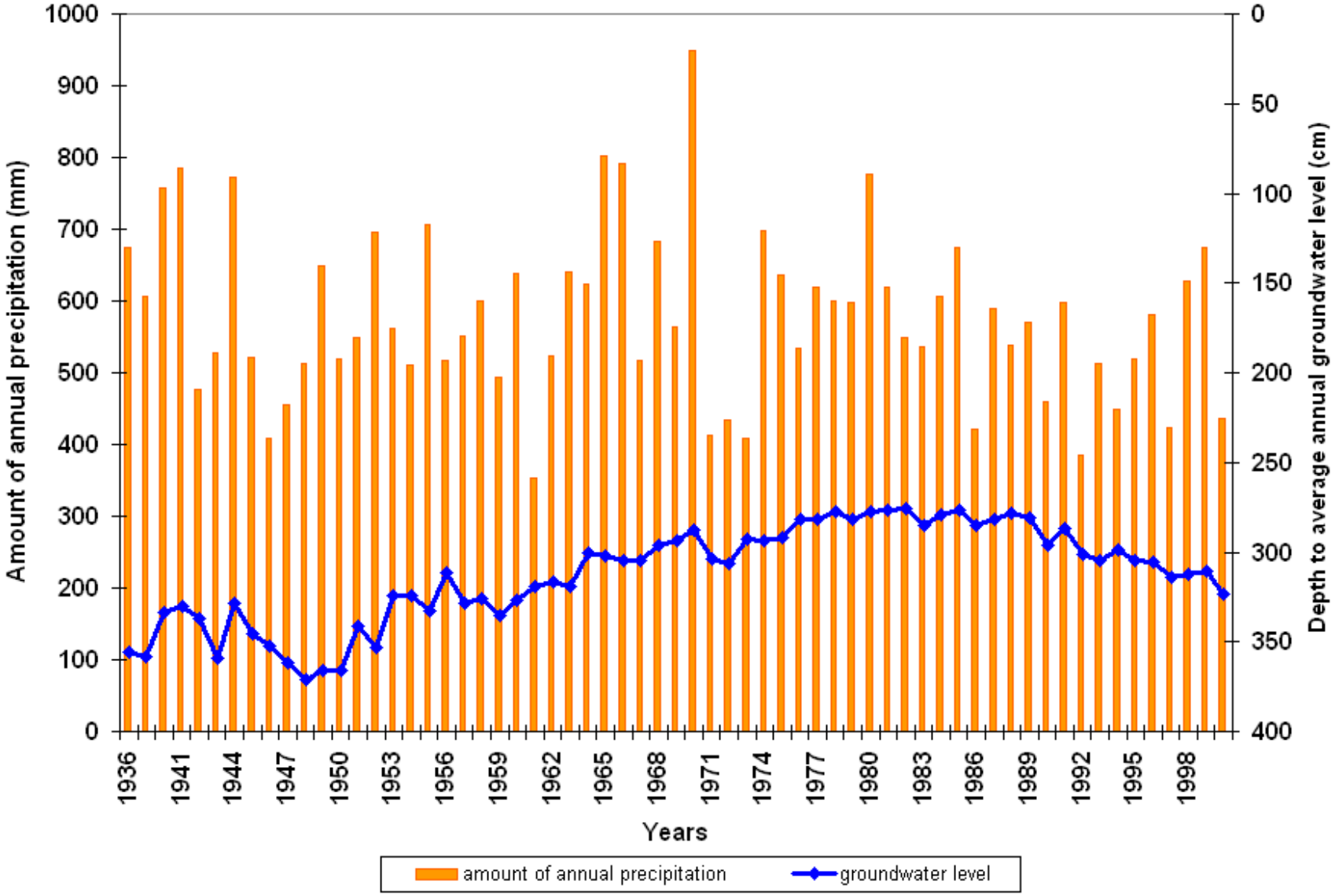
Characteristic of groundwater level fluctuation (Tilos – erdő, Újszentmargita)



Change of groundwater level (Nagyerdő, Debrecen)



Annual precipitation and groundwater level (Nagyerdő, Debrecen)



Annual precipitation and groundwater level (Nagyerdő, Debrecen)

Debrecen

	Wettest year	1970		Year of highest average groundwater level	1982
10 years average (mm)	mm	950		cm	275
	Driest year	1961		Year of lowest average groundwater level	1948
	mm	354		cm	371
	1951-59	571	10 years average (cm)	1935-39	359
	1960-69	614		1940-49	349
	1970-79	589		1950-59	335
	1980-89	588		1960-69	311
	1990-99	523		1970-79	289
	2000-2010	588		1980-89	279
	average precipitation (mm)	581		1990-99	312
				2000-2010	

decrease

increase

Characteristic of groundwater level fluctuation (Nagyerdő, Debrecen)

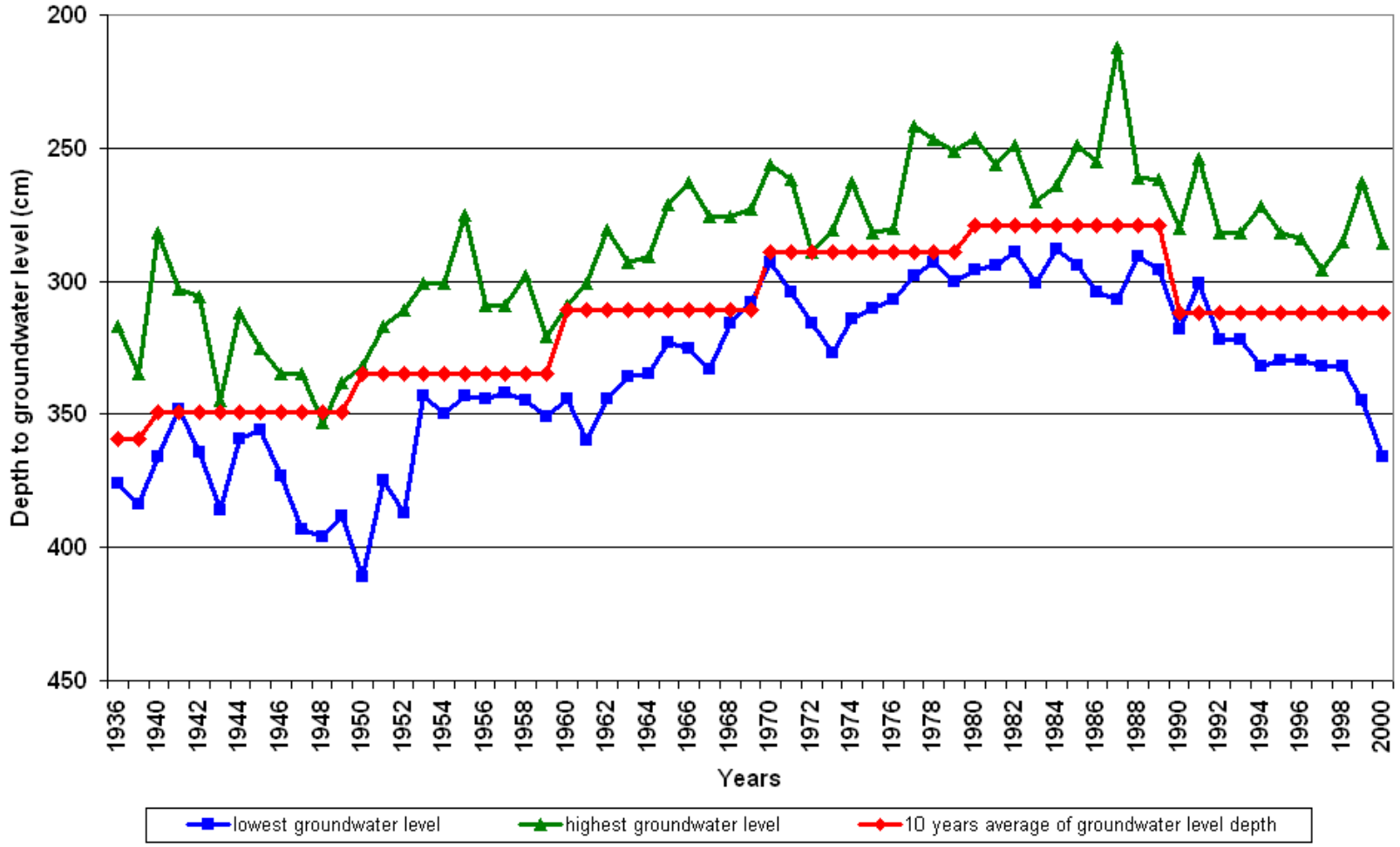
DEBRECEN			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1936	359	356	59
1939	359	359	49
1940	349	333	84
1941	349	330	45
1942	349	337	58
1943	349	359	41
1944	349	329	47
1945	349	346	31
1946	349	352	38
1947	349	361	58
1948	349	371	43
1949	349	366	50
1950	335	366	79
1951	335	342	58
1952	335	353	76
1953	335	325	42
1954	335	325	49
1955	335	333	68
1956	335	312	35
1957	335	329	33
1958	335	326	47
1959	335	335	30
1960	311	327	35
1961	311	320	59
1962	311	317	63
1963	311	319	43
1964	311	301	44
1965	311	302	52
1966	311	305	62
1967	311	305	57
1968	311	296	40
1969	311	294	35

DEBRECEN			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1970	289	288	37
1971	289	304	42
1972	289	307	27
1973	289	292	46
1974	289	294	51
1975	289	292	28
1976	289	282	27
1977	289	282	56
1978	289	277	46
1979	289	282	49
1980	279	277	50
1981	279	277	38
1982	279	275	40
1983	279	285	31
1984	279	279	24
1985	279	277	45
1986	279	285	49
1987	279	282	95
1988	279	279	30
1989	279	281	34
1990	312	296	38
1991	312	287	47
1992	312	301	40
1993	312	305	40
1994	312	299	60
1995	312	305	48
1996	312	306	46
1997	312	314	36
1998	312	313	47
1999	312	311	82
2000	312	323	80

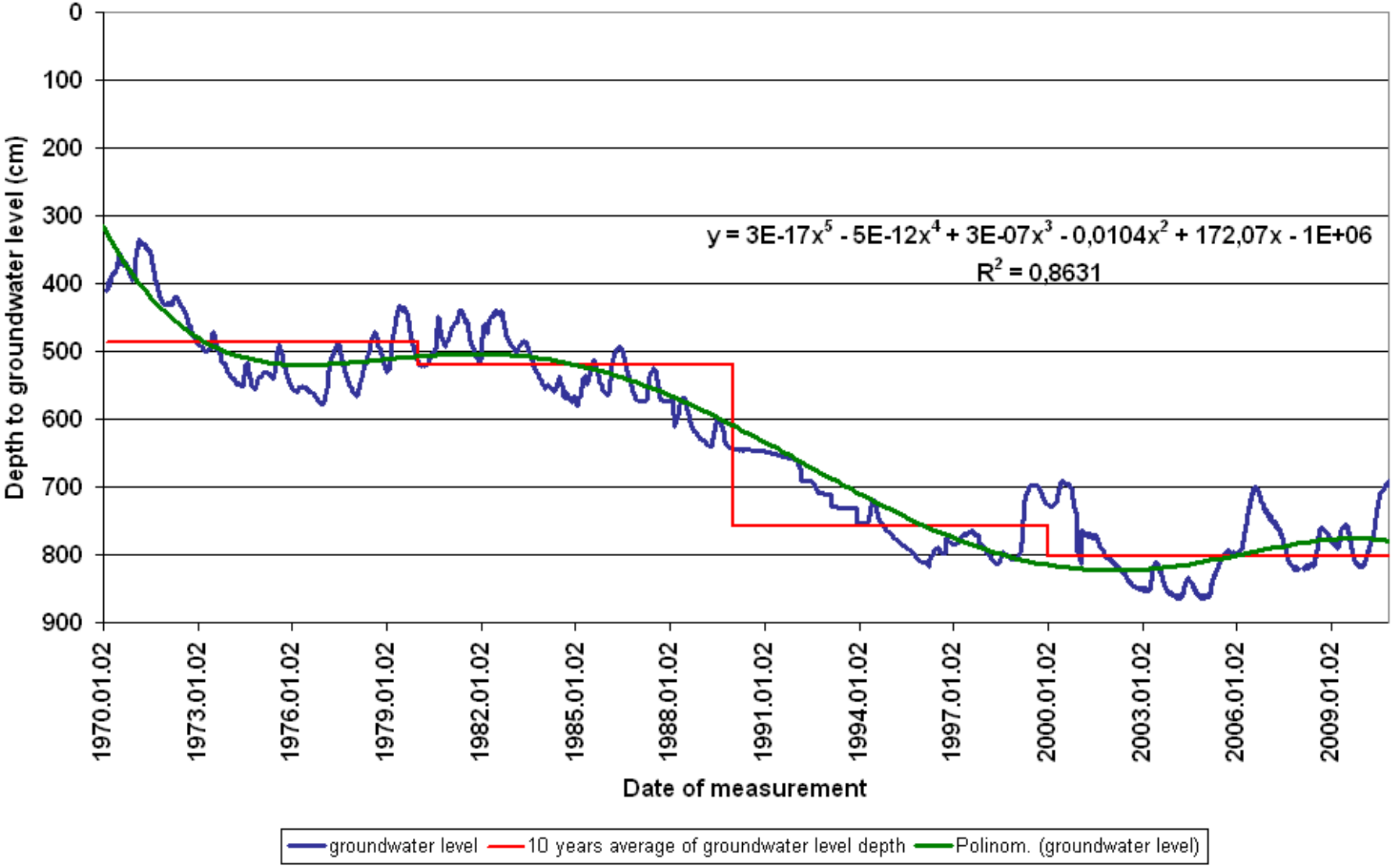
depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

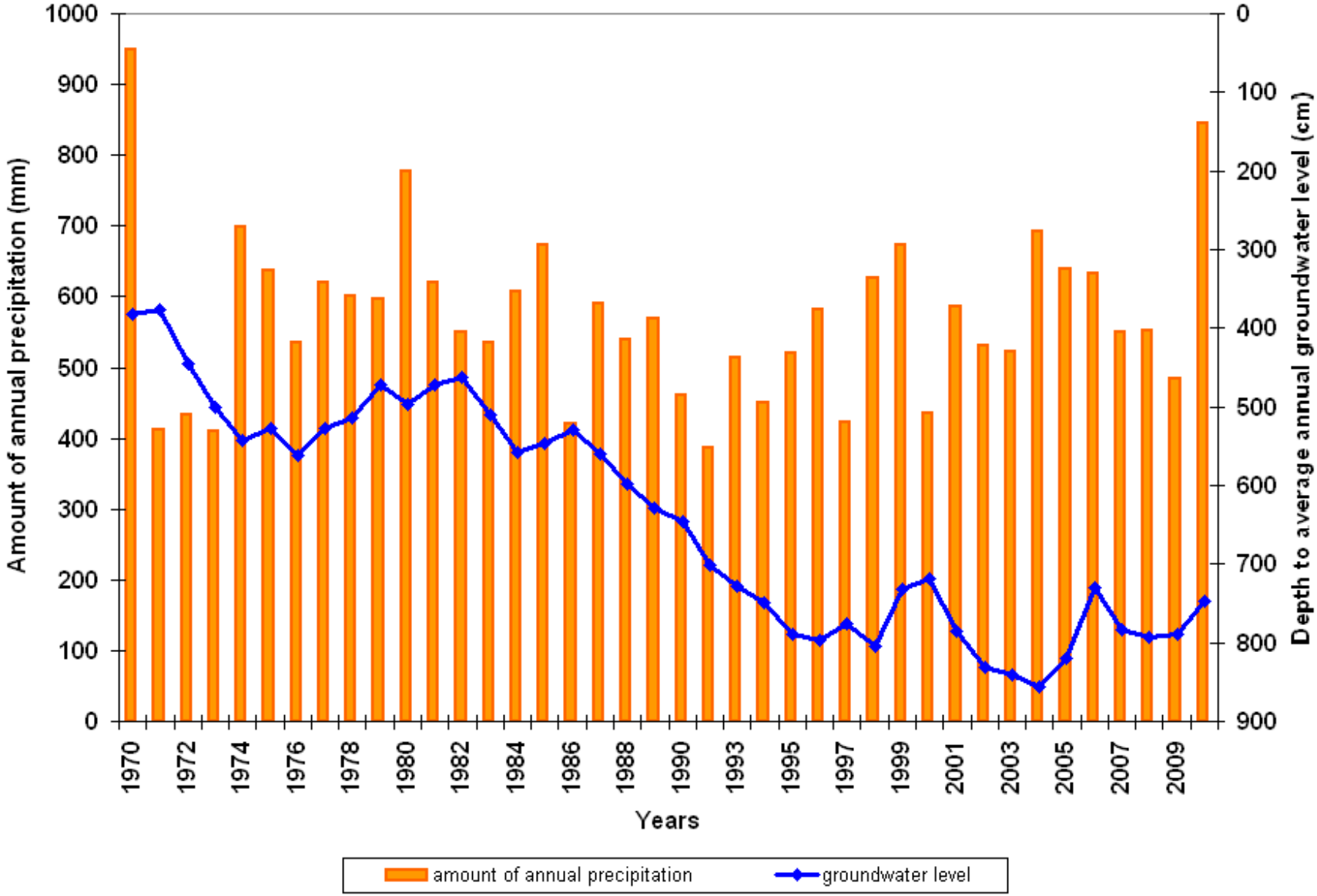
Characteristic of groundwater level fluctuation (Nagyerdő, Debrecen)



Change of groundwater level (Nagyerdő, drinking-water well, Debrecen-Pallag)



Annual precipitation and groundwater level (Nagyerdő, drinking-water well, Debrecen-Pallag)



Annual precipitation and groundwater level (Nagyerdő, drinking-water well, Debrecen-Pallag)

	Debrecen			drinking water
	Wettest year	1970	Year of highest average groundwater level	1971
10 years average (mm)	mm	950	cm	376
	Driest year	1961	Year of lowest average groundwater level	2004
	mm	354	cm	855
10 years average (mm)	1951-59	571	1935-39	
	1960-69	614	1940-49	
	1970-79	589	1950-59	
	1980-89	588	1960-69	
	1990-99	523	1970-79	486
	2000-2010	588	1980-89	520
	average precipitation (mm)	581	1990-99	758
			2000-2010	803

decrease
increase

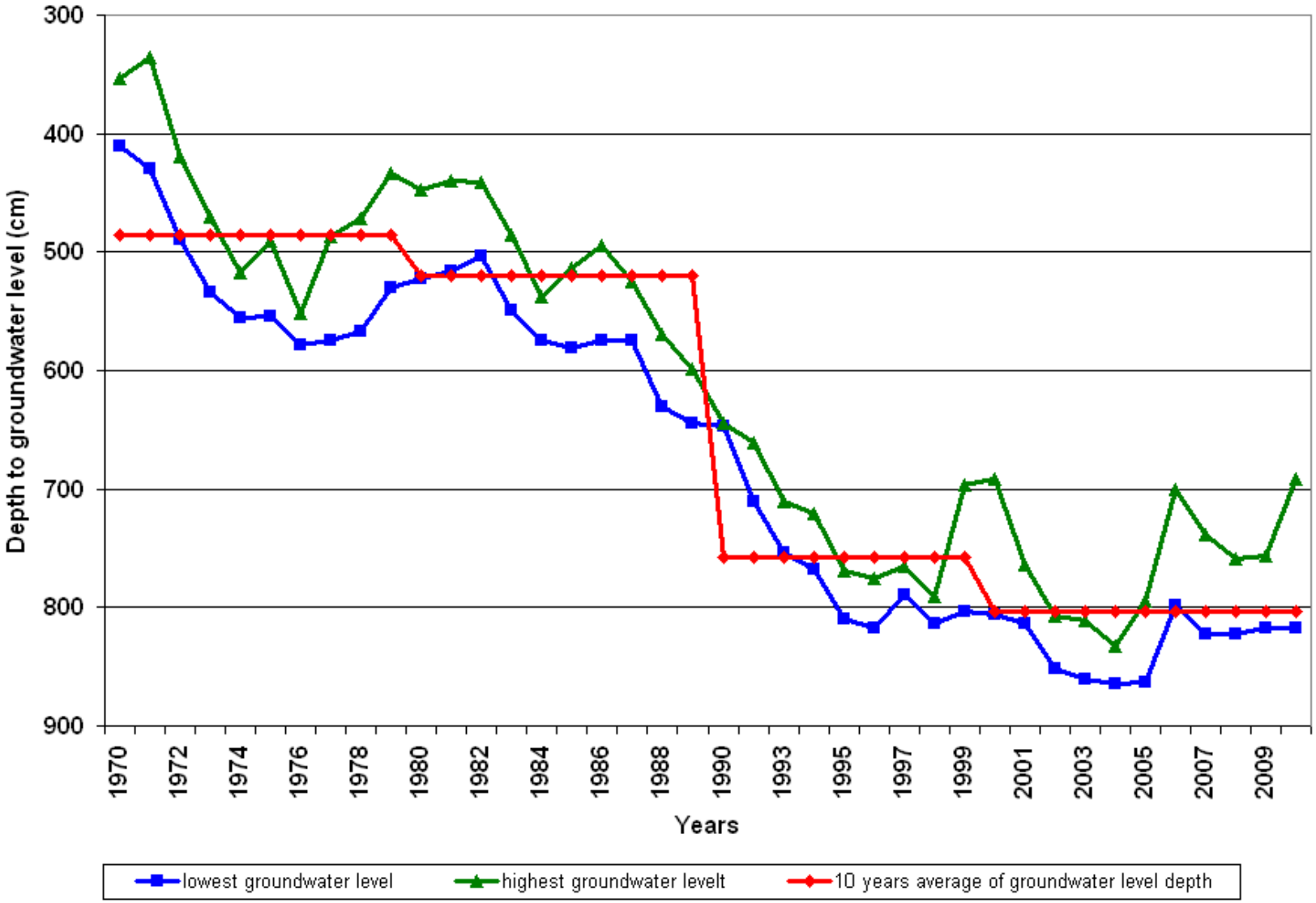
Characteristic of groundwater level fluctuation (Nagyerdő, drinking-water well, Debrecen-Pallag)

DEBRECEN-PALLAG			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1970	486	382	57
1971	486	376	95
1972	486	445	70
1973	486	500	64
1974	486	542	38
1975	486	527	63
1976	486	562	26
1977	486	528	87
1978	486	513	95
1979	486	472	96
1980	520	498	74
1981	520	473	76
1982	520	462	63
1983	520	509	64
1984	520	558	37
1985	520	546	68
1986	520	530	80
1987	520	560	49
1988	520	597	61
1989	520	628	45
1990	758	646	2
1992	758	700	49
1993	758	729	44
1994	758	748	47
1995	758	790	41
1996	758	796	42
1997	758	776	25
1998	758	804	23
1999	758	732	107
2000	803	719	114
2001	803	784	49
2002	803	831	45
2003	803	841	50
2004	803	855	32
2005	803	820	69
2006	803	729	98
2007	803	783	83
2008	803	792	63
2009	803	789	61
2010	803	746	125

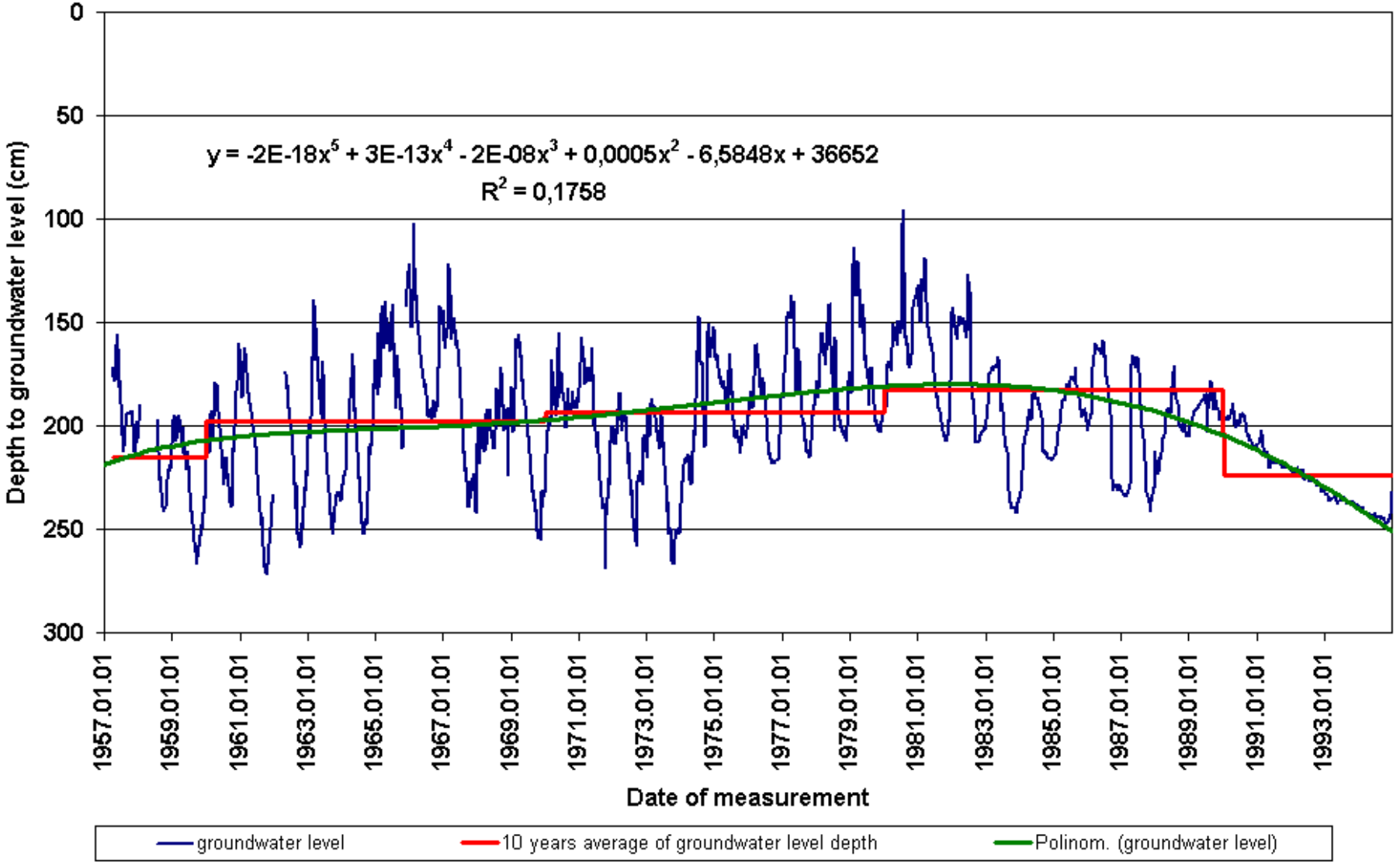
depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

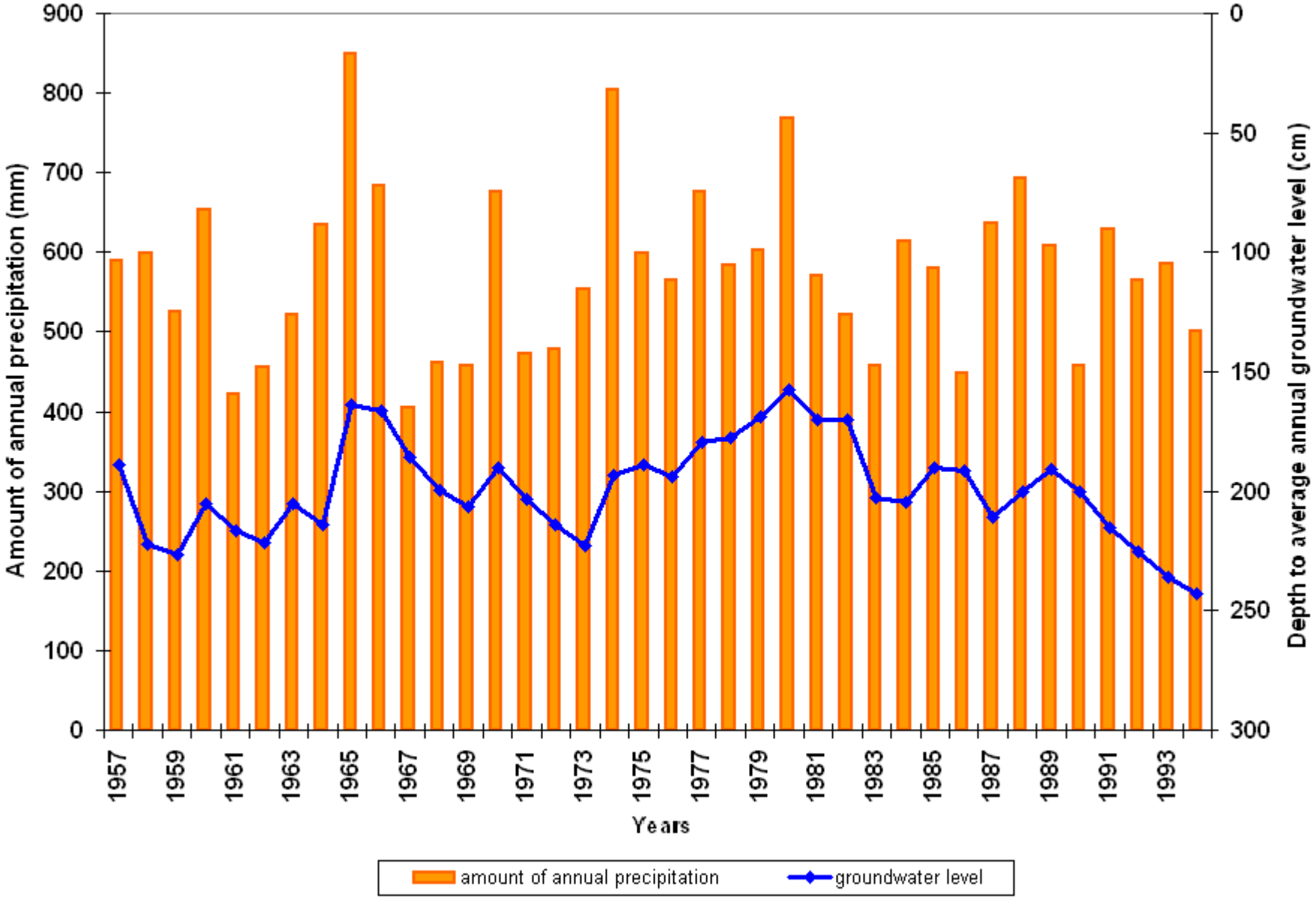
Characteristic of groundwater level fluctuation (Nagyerdő, drinking-water well, Debrecen-Pallag)



Change of groundwater level (Fényi – erdő, Bátorliget)



Annual precipitation and groundwater level (Fényi – erdő, Bátorliget)



Annual precipitation and groundwater level (Fényi – erdő, Bátorliget)

Bátorliget

	Wettest year	2010		Year of highest average groundwater level	1980
10 years average (mm)	mm	1230		cm	157
	Driest year	1967		Year of lowest average groundwater level	1994
	mm	405		cm	243
	1951-59	599	10 years average (cm)	1935-39	
	1960-69	554		1940-49	
	1970-79	601		1950-59	215
	1980-89	590		1960-69	198
	1990-99	629		1970-79	193
	2000-2010	746		1980-89	182
	average precipitation (mm)	622		1990-99	224
				2000-2010	

decrease

increase

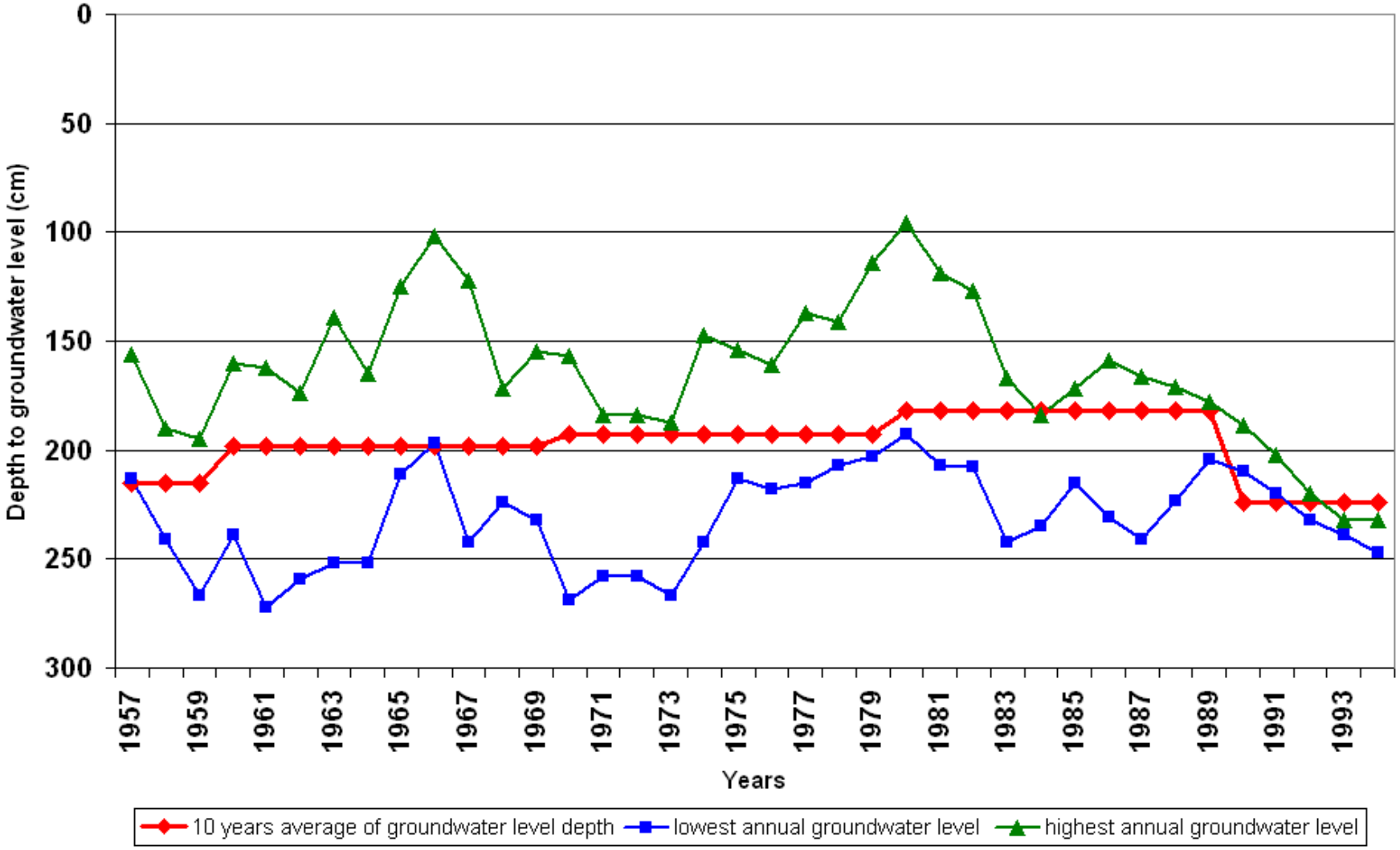
Characteristic of groundwater level fluctuation (Fényi – erdő, Bátorliget)

BÁTORLIGET			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1957	215	189	57
1958	215	222	51
1959	215	227	72
1960	198	205	79
1961	198	217	110
1962	198	222	85
1963	198	205	113
1964	198	214	87
1965	198	164	86
1966	198	166	95
1967	198	186	120
1968	198	200	52
1969	198	207	77
1970	193	190	112
1971	193	203	74
1972	193	214	74
1973	193	223	80
1974	193	193	95
1975	193	189	59
1976	193	194	57
1977	193	180	78
1978	193	178	66
1979	193	169	89
1980	182	157	97
1981	182	170	88
1982	182	170	81
1983	182	202	75
1984	182	205	51
1985	182	190	43
1986	182	192	72
1987	182	211	75
1988	182	200	52
1989	182	191	26
1990	224	200	21
1991	224	216	18
1992	224	225	12
1993	224	236	7
1994	224	243	15

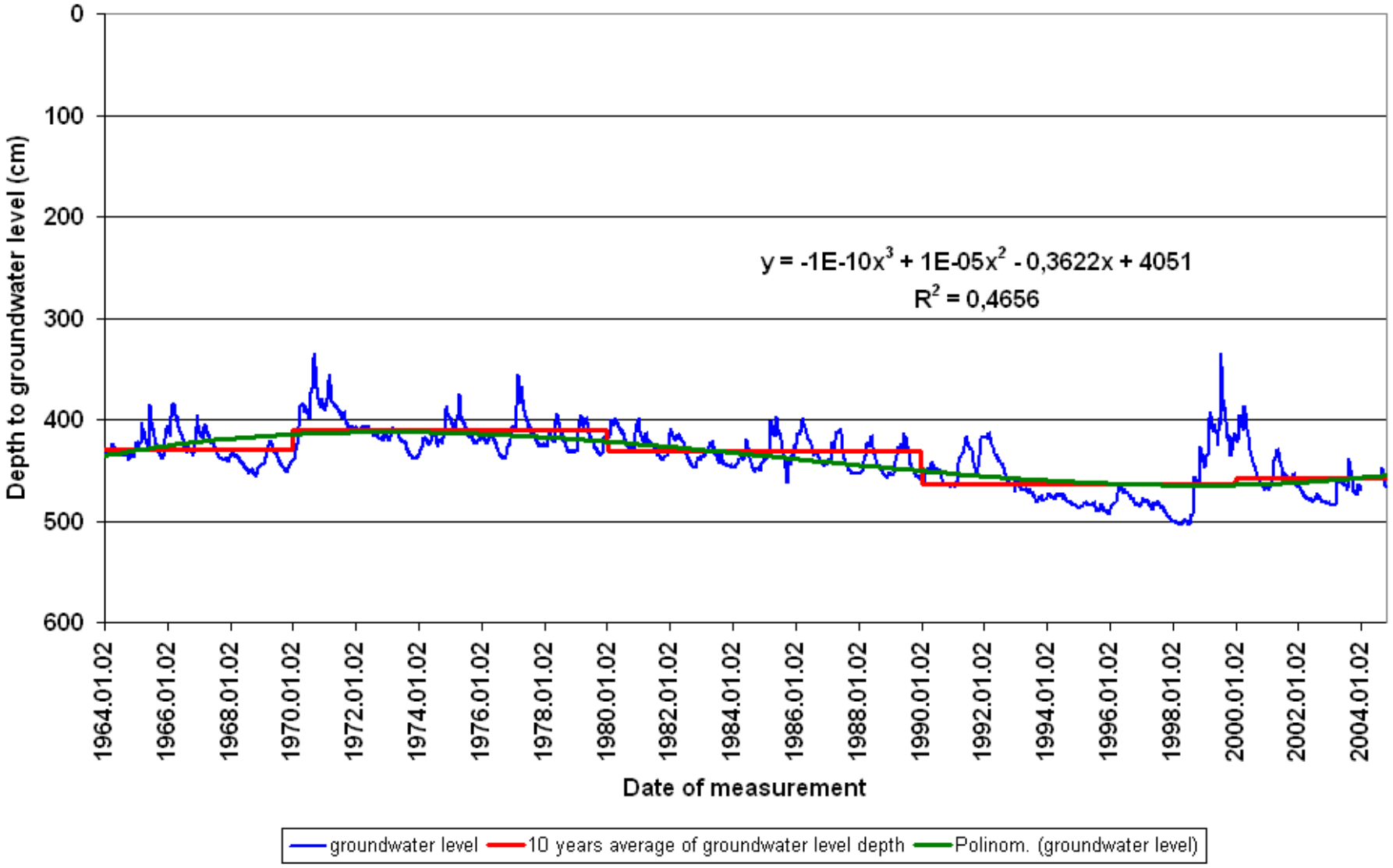
depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

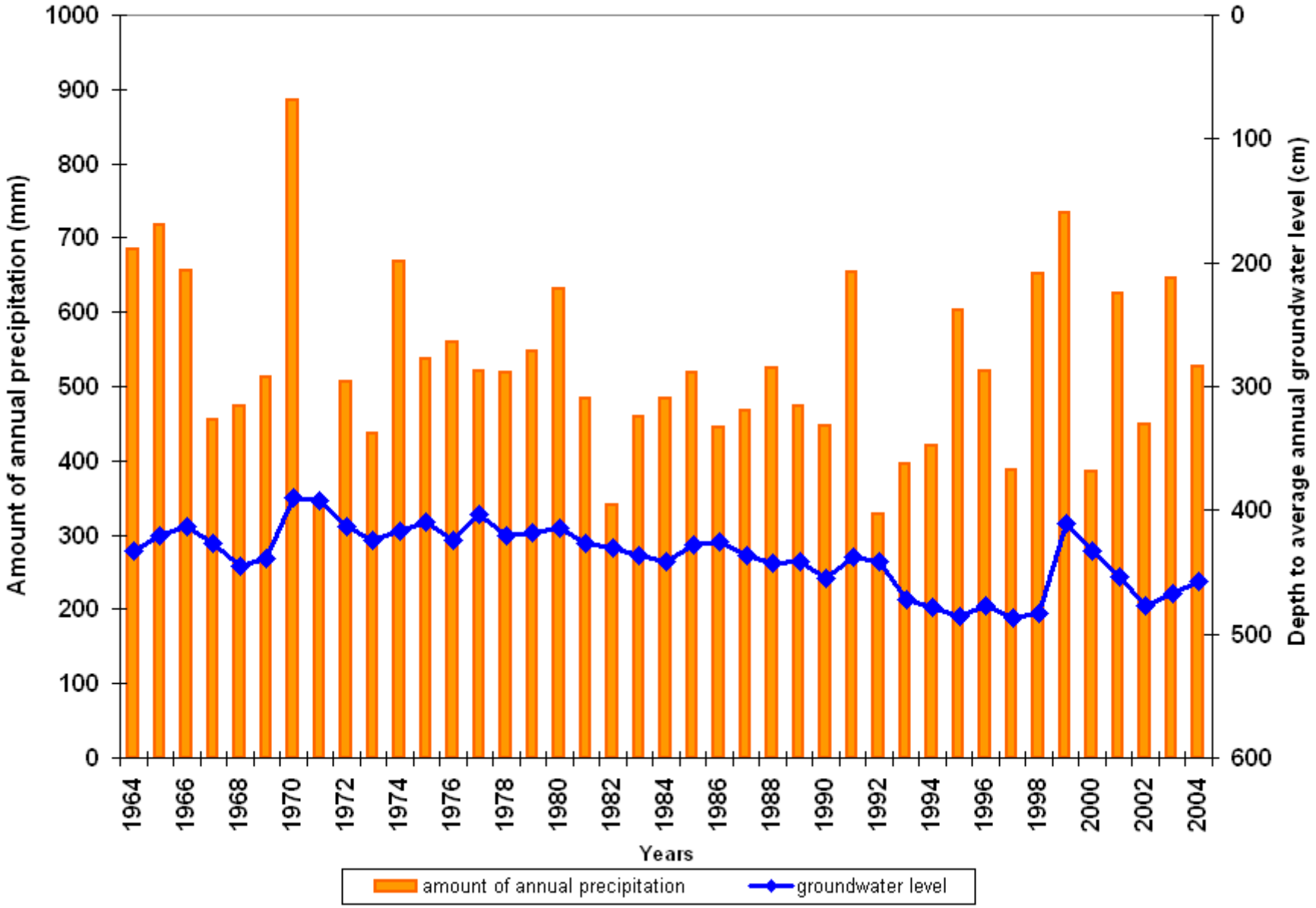
Characteristic of groundwater level fluctuation (Fényi – erdő, Bátorliget)



Change of groundwater level (Berek- erdő, Kerecsend)



Annual precipitation and groundwater level (Berek- erdő, Kerecsend)



Annual precipitation and groundwater level (Berek- erdő, Kerecsend)

Kerecsend

	Wettest year	2010		Year of highest average groundwater level	1970
10 years average (mm)	mm	949		cm	389
	Driest year	1992		Year of lowest average groundwater level	1997
	mm	328		cm	487
	1951-59	606	10 years average (cm)	1935-39	
	1960-69	559		1940-49	
	1970-79	552		1950-59	
	1980-89	482		1960-69	429
	1990-99	514		1970-79	411
	2000-2010	598		1980-89	432
	average precipitation (mm)	552		1990-99	463
				2000-2010	

decrease

increase

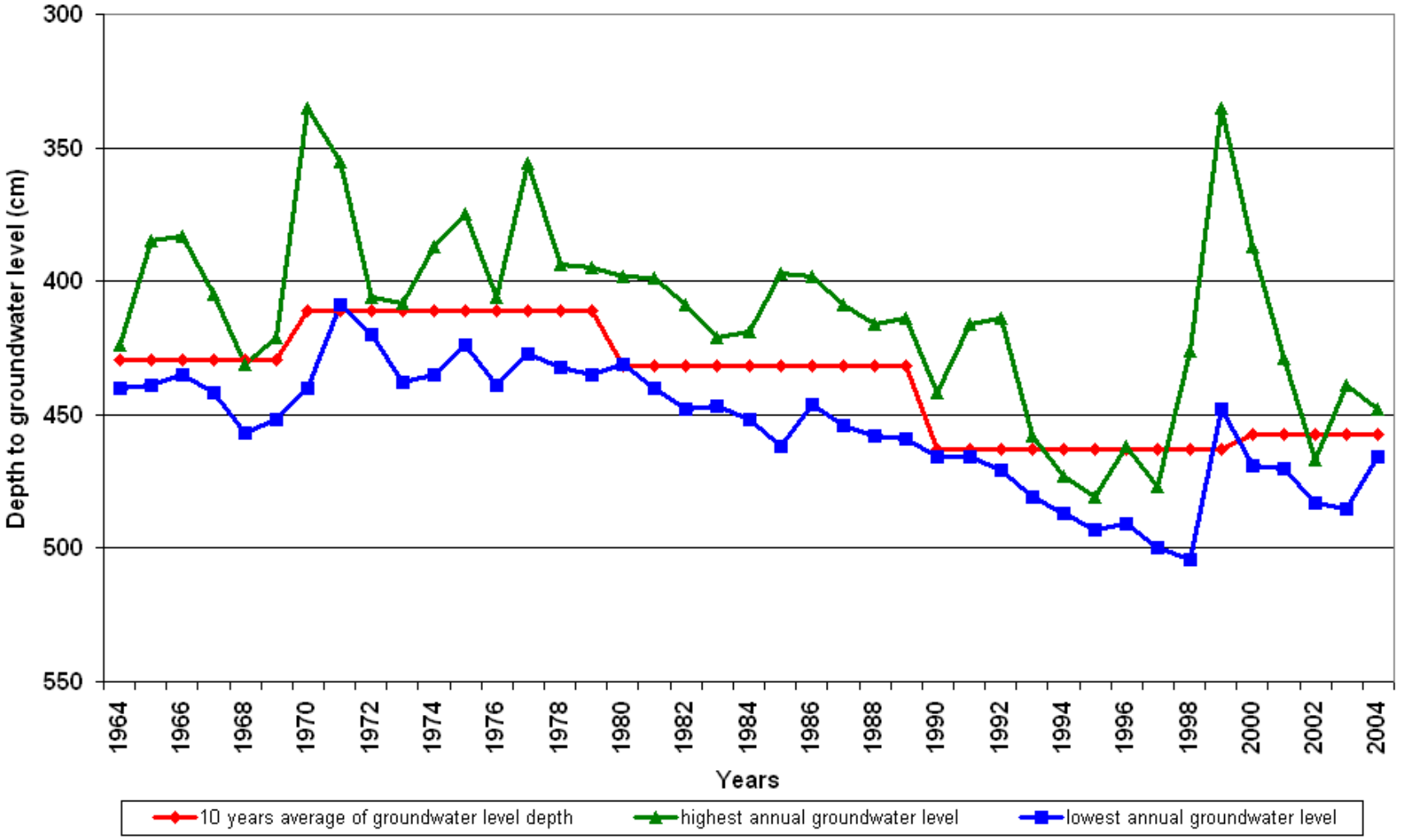
Characteristic of groundwater level fluctuation (Berek- erdő, Kerecsend)

KERECSEND			
Year	10 years average of groundwater level (cm)	annual average of groundwater level (cm)	groundwater fluctuation (cm)
1964	429	432	16
1965	429	421	54
1966	429	413	52
1967	429	426	37
1968	429	445	26
1969	429	439	31
1970	411	389	105
1971	411	392	54
1972	411	413	14
1973	411	424	30
1974	411	417	48
1975	411	409	49
1976	411	425	33
1977	411	403	71
1978	411	420	38
1979	411	418	40
1980	432	414	33
1981	432	426	41
1982	432	430	39
1983	432	437	26
1984	432	441	33
1985	432	428	65
1986	432	426	48
1987	432	436	45
1988	432	442	42
1989	432	441	45
1990	463	455	24
1991	463	438	50
1992	463	441	57
1993	463	472	23
1994	463	479	14
1995	463	486	12
1996	463	477	29
1997	463	487	23
1998	463	483	78
1999	463	411	113
2000	457	433	82
2001	457	454	41
2002	457	477	16
2003	457	467	46
2004	457	457	18

depth to groundwater level	
0-70 cm	high
71-350 cm	middle deep
351-599 cm	deep
600- cm	very deep

groundwater fluctuation	
0-50 cm	low
50-100 cm	high
101- cm	very high

Characteristic of groundwater level fluctuation (Berek- erdő, Kerecsend)



The next steps

- Further analysis about groundwater level and precipitation
- Continue the botanical monitoring
- Comparison of botanical and hydrological databases
- Comparison of the results of botanical and hydrological analyses

Thank you for your attention!