UNUSUAL WINTER 2011/2012 IN SLOVAKIA

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Last winter (Dec. 2011 – Feb. 2012) had about 0.6 °C higher mean air temperature on the Northern hemisphere continents than the 1961 – 1990 normal. In spite of this some continental regions were significantly below normal, mainly due to unusually cold weather during the first half of February (Central and Eastern Asia, Alaska and Southeastern Europe). On the other hand, the Northern Europe and Northern Asia had mean temperature above normal, the Northern America and the Arctic significantly above normal. Three winter months exhibited extreme deviations of several climatologic variables from normal also in Slovakia. While 17 days (of total 91) were colder than the normal range, 41 days were warmer (normal range for daily mean temperature is ±2.7 °C from the long-term average). Southern Slovakia had only several days with snow cover and precipitation totals about 80% of normal, but some localities in the northwestern Slovakia were paralyzed by heavy snowfalls and precipitation totals exceeded 200% of normal there. General people and media spoke on century cold winter, damages topped millions of Euro. Climatologists are reserved in their statements, because of having long-term measurements and analyses since 1775.

Minulá zima (XII. 2011 – II. 2012) mala na severnej pologuli asi o 0,6 °C vyšší priemer teploty vzduchu ako normál z obdobia 1961 – 1990. Napriek tomu boli niektoré regióny tamojších kontinentov výrazne chladnejšie ako normál predovšetkým kvôli neobvykle studenému počasiu počas prvej polovice februára 2012 (stredná a východná Ázia, Aljaška a juhovýchodná Európa). Na druhej strane, sever Európy a Ázie mali priemer teploty nad normálom, Severná Amerika a Arktída výrazne nad normálom. Tri zimné mesiace vykázali extrémne odchýlky od normálu aj pri viacerých klimatických prvkoch na Slovensku. Kým 17 dní (z celkového počtu 91) bolo chladnejších ako interval normálu, 41 dní bolo teplejších (interval normálu pre denné priemery teploty vzduchu je ±2.7 °C okolo dlhodobého priemeru). Juh Slovenska mal počas zimy iba niekoľko dní so snehovou pokrývkou a úhrn zrážok iba okolo 80 % z normálu, no niektoré lokality na severozápade Slovenska boli paralyzované veľkým množstvom snehu a úhrny zrážok tam prekročili za zimu aj 200 % dlhodobého priemeru. Bežní ľudia a médiá preto hovorili o storočnej zime, škody dosiahli milióny eur. Klimatológovia sú ale opatrní v podobných vyjadreniach pretože majú k dispozícii dlhodobé pozorovania a analýzy od roku 1775.

Keywords: winter characteristics, climate variability, climate change, global warming

INTRODUCTION

The media and other users of weather forecasts asked climatologists on possible winter 2011/12 conditions already in September 2011. Preliminary assessments were to disposal from several professional sources (IRI, CFS, NCDC and others), the outlook for Slovakia was published by the end of October (Lapin, 2011; SHMÚ, 2011). General forecast indicated above normal temperatures on the Northern hemisphere continents with possible isolated incursion of cold air deep to the south of some continental parts because of significantly warmer Arctic than the normal and possible deviations in the Arctic Oscillation. In Slovakia there was expected mostly mild winter with low number of snow cover days in the lowland and higher precipitation than normal in the northwestern part of the country.

Winter weather in Slovakia is usually very complex with several specific events (heavy snow falls, continuous snow cover, temperatures below freezing point, spells of very cold days, temporally thaw of snow cover, winter foods, ice floods, etc.). That is why several useful winter climatic characteristics have been published by various authors. Some of them can be considered as characteristics valid in any mild zone country on the globe and others can be applied only in Slovakia, or country with similar climate. Konček (1956, 1979) and Petrovič (1960) introduced in Slovakia the characteristics as follows: frosty day (daily minimum temperature $T_{min} < 0\,°C$), icy day (daily maximum temperature $T_{max} \leq 0\,°C$), day with strong frost ($T_{min} < -10\,°C$), arctic day ($T_{max} \leq -10\,°C$), sum of winter temperatures (sum of daily temperature means $T_{mean} < 0\,°C$) during whole cold half-year, number of days with snow cover, number of days with uninterrupted snow cover season, sum of daily snow cover depths and some others. Similar characteristics have been applied also in abroad (Nosek, 1972; Okolowicz, 1976; Blüthgen et al., 1980; Tolasz, 2007 etc.). Figure 1 shows sum of annual winter T_{mean} temperatures at Hurbanovo in the period 1900/1901 – 2011/2012 (including 11-year and 30-year running averages). Of course the most common is the mean temperature for whole winter (Win: December to February) or cold half-year (CHY: October to March) as Slovakia average deviation from the 1961 – 1990 mean (Fig. 2). Winter conditions are determined also by precipitation and snow characteristics, Figure 3 shows precipitation totals in winter and in cold half-year 1901 – 2012 period as double weighted averages from 203 stations (Šamaj et al., 1982; SHMÚ, 2012). Weather in winter 1500 – 2010 has been evaluated also in Matejovič (2011).

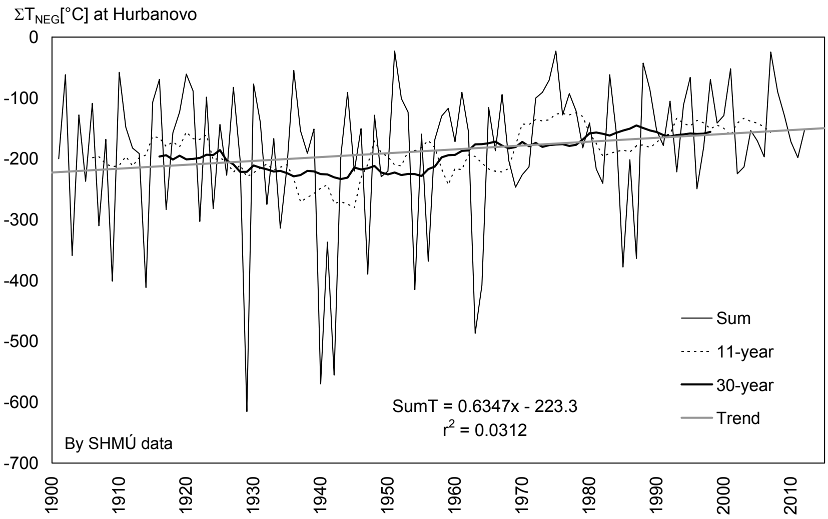


Figure 1.
Winter sum (from September to May) of daily mean temperatures (T_{mean} < 0 °C, ΣT_{neg}) at Hurbanovo [°C] in the period 1900/01 – 2011/12 (including 11-year and 30-year running averages), linear and power trends are significant at 95% level.

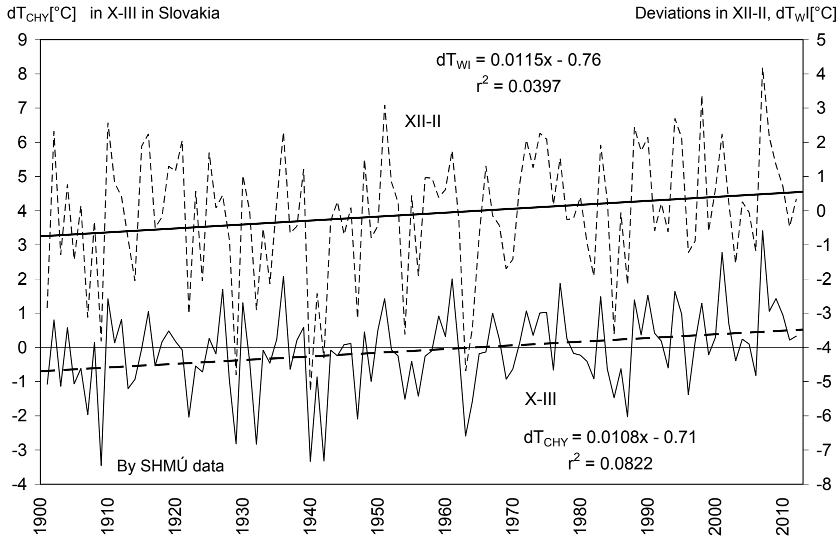


Figure 2.
Deviations of temperature means [°C] in CHY (dT_{CHY}, October – March) and in Win (dT_{WI}, December-February) from the 1961 – 1990 normal in Slovakia (3 stations Hurbanovo, Košice Airport and Liptovský Hrádok average, very close to the average deviation from 16 reliable stations in 1961 – 2012) in the period 1900/01 – 2011/12 (linear trend is significant at 95% level).

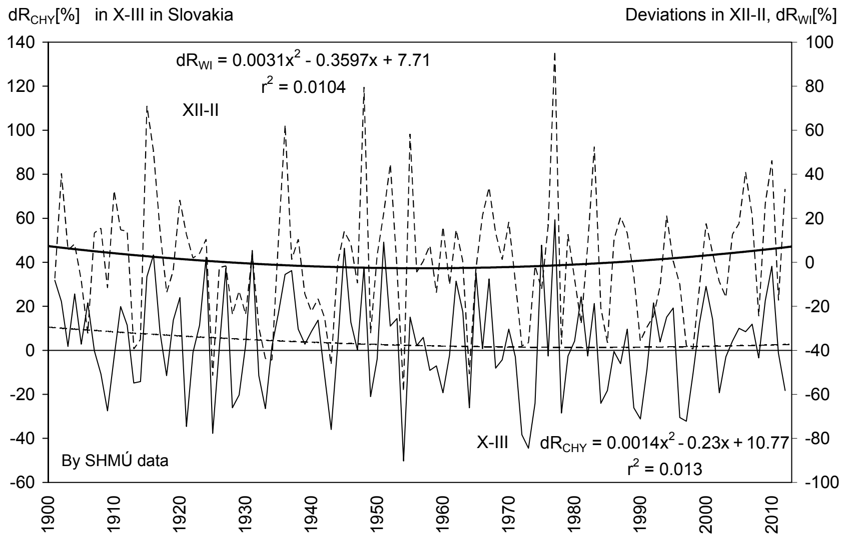


Figure 3.
Deviations of precipitation totals in CHY (dR_{CHY}, October – March) and in Win (dR_{WI}, December – February) in % of the 1961 – 1990 normal in Slovakia (203 stations average) in the period 1900/01 – 2011/12 (linear and power trends are insignificant also at 90% level).

DATA AND METHOD

About 100 climatologic and 700 rain gauge stations are in operation in Slovakia each year. Limited number of stations have uninterrupted and homogeneous data series (30-year at least) usable for long-term means calculation (about 35 climatologic and 500 precipitation stations). The Slovak Hydrometeorological Institute (SHMÚ) prepares and issues maps of selected climatic variables and their deviations from the 1961 – 1990 normal each month and season using all available stations (examples are shown in Figures 4, 5 and 6). Recently (since 2009) mapping based on GIS methods has been applied also at the SHMÚ (Pecho at al., 2006). In order to generate an objective spatial fields of various climatic variables the radial interpolation function have been applied using the 2D and 3D mode of generalized splain with adjustable tension and smoothing parameters.

Correct GIS designing of climatic maps is more difficult in areas with low number of stations, mainly in higher altitudes. The GIS methods of mapping desires adequately dense network of data in all regions and altitudes, that is why several hypothetical fictive stations needed to be designed by regression method in some higher mountains. Monthly and seasonal data in these fictive stations have been calculated by regression method from round stations data in different altitudes, partly modified by expert assessment (Pecho et al., 2006, 2010).

The 2011/2012 winter season (CHY: Oct.– March and Win: Dec.– Feb.) was exceptional from several points of view (temperature, precipitation, snow cover, temporal course of variables). Because of limited space, we selected only several climatic elements to describe winter weather conditions and compare it with normal (daily, monthly and winter temperature means, negative daily temperature mean sums, monthly and winter precipitation totals, snow cover maximum and number of days with snow cover). All used data have been tested for reliability by methods ordinarily used by SHMÚ. Analyses of extreme seasonal weather have been published by Faško et al. (2003, 2008).

NORTHERN HEMISPHERE WEATHER PATTERNS

The LaNiňa effect (cold phase of ElNiňo (ENI)) caused some decrease in global temperature in 2011 and 2012 compared to preceding years. In spite of this the Northern hemisphere (NH) mean temperature on continents was significantly higher than the 1961 – 1990 average. Temperature was relatively very high in the Arctic region, the highest ever measured (Tab. 1, Spr is March to May season). This process influenced also the atmospheric general circulation expressed by ENI, NAO and AO indices (Tab. 1). As a result of such development a series of unusual weather events occurred in several regions (extreme wet weather in the Central Europe and extreme hot and dry in the Eastern Europe in 2010, extreme dry weather in the Central Europe in 2011, very low sea ice extent in the Arctic etc.). Considering only the season from Oct. 2011 to March 2012 the following significant deviations occurred (by the NCDC):

- **October 2011**: most of the Northern Asia, Northern Europe, Northern USA, Canada and Arctic experienced temperatures by about 5 °C above the 1901 – 2000 normal (NH continents 1.29 °C above normal).
- **November 2011**: the same as in October, but Alaska, Southeastern Europe and Central Asia about 3 °C below normal (mostly due to anticyclonic weather), in spite of this the NH continents 0.57 °C above normal.
- **December 2011**: the same as in October, but the Central and Eastern Asia about 3 °C below normal, the Artic even up to 10 °C above normal and nearly whole Europe 2 to 5 °C above normal (NH continents 1.05 °C above normal).
- **January 2012**: the same as in October, but the Central Asia and Alaska up to 5 °C below normal and the Arctic up to 10 °C above normal (NH continents 0.44 °C above normal).
- **February 2012:** most of the Europe (except UK and Scandinavia), Central and Eastern Asia by 1 to 5 °C below normal, whole Northern America, the Arctic and Northern Asia 2 to 10 °C above normal (NH continents 0.31 °C above normal).
- **March 2012**: most of the Europe, Central and Eastern Asia, Northern America (except Alaska) and the Arctic by 1 to 10 °C above normal, the Eastern Europe, Eastern Siberia and Alaska by 1 to 5 °C below normal (NH continents 0.89 °C above normal).
- The **October – March** season (CHY) was by 0.76 °C above normal for the NH continents and the **December – February** season (Win) by 0.61 °C above normal (26^{th} warmest since 1880).

In the Central Europe the monthly means of temperature had different deviations in lowlands (Hurbanovo), in hollows (Poprad) and in the mountains (Chopok), Tab. 2, but the mean temperature was everywhere within the normal interval (about ±0.7 °C in CHY (cold half-year) and ±1.1 °C in winter (Win)). The 1951 – 1980 normal represents quite well the 20^{th} century temperature mean.

Table 1.* *Deviations of seasonal air temperature means [°C] from the 1951 – 1980 normal in Arctic, ENI, NAO and AO seasonal indices from spring 2009 (Spr9) to winter 2012 (Win12), by GISS, UAH, NCDC, NAO (2012).

	Spr9	Sum9	Aut9	Win10	Spr10	Sum10	Aut10	Win11	Spr11	Sum11	Aut11	Win12
Arctic dT	1.0	1.0	1.6	2.4	2.4	1.6	1.7	1.6	1.8	1.4	1.0	1.8
ENI	-0.2	0.5	1.0	1.6	0.7	-0.8	-1.5	-1.4	-0.7	-0.2	-0.8	-0.9
NAO	0.68	-1.18	0.15	-1.67	-1.03	-0.82	-1.11	-0.68	1.01	-1.38	0.76	1.37
AO	0.76	-0.92	-0.07	-3.42	-0.54	0.10	-0.57	-0.91	1.22	-0.80	0.97	0.66

Figure 4. Daily AO and NAO indices in the Oct. 1, 2011 - March 31, 2012 period by NOAA (Northern hemisphere circulation indices by: http://www.cpc.ncep.noaa.gov/products/precip/CWlink/pna/nao.shtml in 2011/2012).

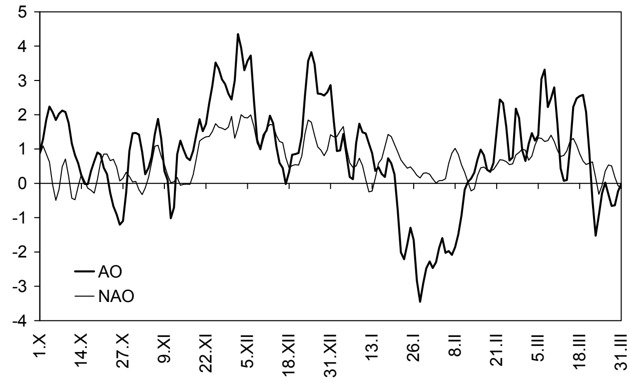


Figure 5. Daily temperature means (T) and T deviations (dT) from normal at Hurbanovo in the Dec. 1, 2011 to Feb. 29, 2012 period by SHMÚ (q1 and q3 – lower and upper quartile of daily T mean deviations from normal, winter long term average T (normal) is 0.0 °C).

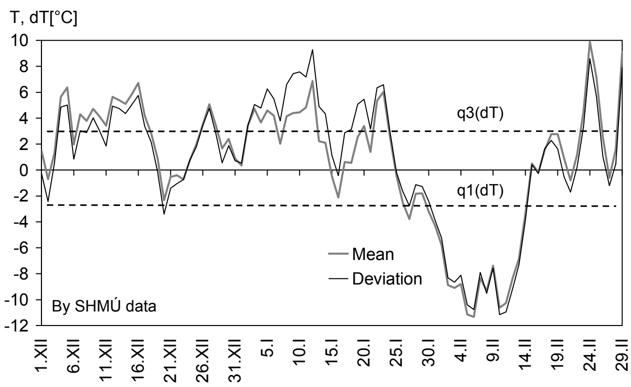


Figure 6. Daily temperature deviations from normal (dT) at Hurbanovo and daily Arctic Oscillation (AO) indices in the Dec. 1, 2011 to Feb. 29, 2012 period by NOAA and SHMÚ.

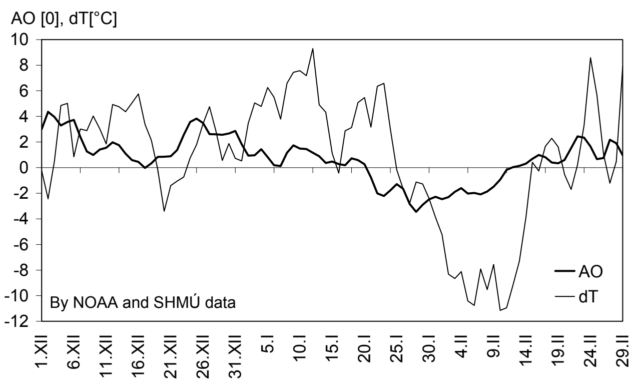


Table 2. Deviations of monthly air temperature means [°C] from the 1951 – 1980 normal at Hurbanovo, Poprad and Chopok in October 2011 to March 2012 (CHY: Oct.–March, Win: Dec.–Febr., by SHMÚ).

Station	Location in Slovakia	Altitude [m a.s.l.]	X	XI	XII	I	II	III	CHY	Win
Hurbanovo	SW	115	0.2	-1.8	2.1	3.2	-3.3	2.8	0.5	0.7
Poprad	NE	695	-0.3	-1.5	2.6	0.5	-5.4	3.1	-0.2	-0.8
Chopok	CE	2008	-0.8	3.4	0.9	-0.6	-2.8	1.9	0.3	-0.8

AIR TEMPERATURE ANOMALIES

As shown in Table 1 the mean Arctic temperature was significantly higher than the 1951 – 1980 average in the 2009 – 2011 period. Warmer weather was there in spite of LaNiňa cold phase starting in summer 2010 and lasting until spring 2012 at least. The North Atlantic Oscillation (NAO) and Arctic Oscillation (AO) indices were mostly negative in the same time (better possibilities for deep penetration of cold air from the Arctic to lower latitudes somewhere in Europe and Asia). Different NAO and AO properties were only in autumn 2011 and winter 2011/2012 (positive NAO and AO indices in the seasonal average, NAO, 2012).

More detailed analyses of daily AO and NAO indices (Fig. 4) revealed that only during Jan. 21 to Feb. 10 significantly negative AO indices occurred in winter 2011/2012. Very low temperature (negative dT) was in Hurbanovo during Jan. 26 to Feb. 14 (Fig. 5). The best correlation coefficient of AO and winter temperature deviations from normal dT ($r = 0.723$) was from Nov. 21 to Feb. 19 for AO and from Dec. 1 to Feb. 29 for dT (winter season, Fig. 6). It means the shift of dT compared to AO indices was +11 days (delay due to atmospheric circulation). Deep penetration of cold air masses from the Arctic to lower latitudes in Europe and Asia can have several tracks, so the obtained correlation is representative only for the region of actual cooling during winter (Central Asia, Canada and Alaska in 2007/08, Eastern Siberia and Canada in 2008/09, Western Siberia, Western and Northern Europe in 2009/10, 2010/11, Eastern Europe, Central and Eastern Asia, Alaska in 2011/12 etc., NCDC, 2012).

In spite of such dramatic cooling in the Central and Eastern Europe the mean temperature was within the normal interval over the whole territory of Slovakia (and in the Central Europe as well) in winter and cold half-year 2011/2012 (Tab. 2, Fig. 7). The NAO indices do not have any significant correlation with air temperature that is why the correlation of NAO indices with precipitation totals and snow cover was analyzed.

In Table 3 a review of the coolest days in Slovakia since 1929 is presented (daily minimum temperature). Just two stations (Hurbanovo and Košice) lie in the southern Slovakian lowlands, all other stations are situated in relatively colder hollows and valleys. It can be seen clearly, that the coolest days in February 2012 are well behind the coolest days in the past, mainly in the lowlands (especially behind the years 1929, 1985 and 1987, unverified –44°C was measured allegedly by private person at Oravská Lesná on Feb. 11, 1929). This review also shows that people usually consider cold weather only in comparison with preceding weather during the same winter. Figure 5 shows that remaining part of the winter 2011/2012 (except the very cold spell from Feb. 1 to Feb. 14) was mostly relatively very mild.

Table 3. Absolute minimum of air temperature (in 2 m height) in selected years.

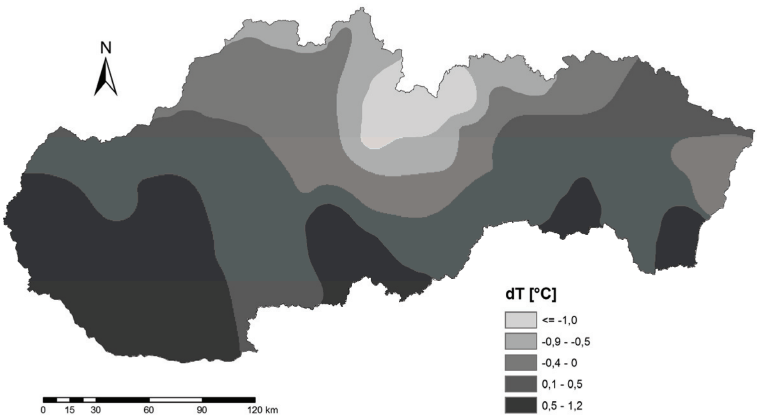
	Location in Slovakia	Altitude [m a.s.l.]	1929 [°C]	1940 [°C]	1942 [°C]	1954 [°C]	1956 [°C]	1961 [°C]	1963 [°C]	1968 [°C]	1985 [°C]	1987 [°C]	1996 [°C]	2012 [°C]
Hurbanovo	SW	115	**-35.0**	-25.2	-30.5	-23.6	-21.9	-16.8	-21.7	-22.0	-23.0	-23.0	-21.4	-17.5
Košice, airport*	SE	230	**-30.5***	**-30.5***	-22.8*	-26.9	-21.1	-17.5	-20.0	-21.5	-19.6	-25.9	-17.9	-17.5
Liptov. Hrádok	N	640	**-38.0**	-31.0	-32.2	-30.6	-27.2	-30.2	-29.3	-29.5	-27.8	-29.5	-26.1	-29.0
Poprad, airport	NE	695	**-35.3**	-32.0	-29.6	-27.2	-26.6	-25.2	-28.9	-26.8	-26.6	-29.1	-28.5	-29.0
Červený Kláštor	NE	474	N	N	N	N	-31.0	-32.0	**-35.8**	-32.0	-33.5	-35.6	-34.0	-33.3
Oravská Lesná	NW	780	N	N	N	-37.1	-35.0	-35.2	-33.5	-34.4	-36.6	-33.7	-33.5	-30.2
Spišské Vlachy*	E	396	N	-31.7*	-31.1*	-30.0*	-30.0*	-29.8*	**-35.7***	-30.6	-25.6	-30.6	-30.2	-27.4
Vígľaš, Pstruša	CE	368	**-41.0**	-34.0	-31.0	-27.2	-31.4	-26.0	-32.1	-32.0	-34.0	-32.6	-30.0	-22.2

** Change of station location compared to the present site,* N *– no measurement*

Table 4. Precipitation totals in % of the 1901 – 1990 normal (in mm for CHY and Win in last two columns) at Hurbanovo, Košice, Poprad, Oravská Lesná and all Slovakia, based on 203 stations in October 2011 to March 2012** (CHY: Oct. – March, Win: Dec. – Febr., by SHMÚ)**.

	Location in Slovakia	Altitude [m a.s.l.]	X [%]	XI [%]	XII [%]	I [%]	II [%]	III [%]	CHY [%]	Win [%]	CHY [mm]	Win [mm]
Hurbanovo	SW	115	44.6	0.2	67.9	138.4	46.5	7.3	48.1	82.6	118.7	96.4
Košice	SE	230	44.6	5.8	143.3	60.3	21.3	8.9	46.7	81.7	106.2	79.4
Poprad	NE	695	131.7	0.0	66.9	109.7	42.2	11.4	60.4	73.3	117.9	61.0
Oravská Lesná	NW	780	73.4	0.7	127.3	290.4	175.5	82.5	123.9	197.0	573.0	455.7
Slovakia			72.5	1.6	63.0	179.8	104.6	24.6	78.9	132.5	240,0	187,0

Figure 7.
Winter (Dec. 2011 – Feb. 2012) temperature deviations [°C] from the 1961 – 1990 normal (dT) in Slovakia by the SHMÚ data
(dT are from about –1.5°C in high mountains and some northern Slovakia hollows to about 1.2°C in southwestern Slovakia, like that from the 1951 – 1980 normal).



PRECIPITATION AND SNOW COVER ANOMALIES

Monthly precipitation totals have significantly greater temporal and spatial variability than the monthly temperature means that is why the 1901 – 1990 precipitation normal was applied at comparisons. Since 1991 the precipitation regime has changed very probably (short period does not allow to proof this statement). Table 4 shows main aspects of precipitation conditions development in Slovakia in Oct. 2011 to March 2012 (great variability, much more precipitation in the northwest, low precipitation totals in the southern lowlands and hollows affected by lee effect (Poprad)). Such development in the cold half-year 2011/2012 can be explained also by the NAO values during all season (Tab. 1, Fig. 4). Mostly positive NAO indices resulted in the fact that atmospheric currents and fronts were oriented from the Atlantic Ocean to the Scandinavia and only low number of the Mediterranean cyclones occurred. It is known, that the Southern Slovakia has usually more precipitation in the cold half-year mainly due to cyclones moving to the Central Europe from the Mediterranean area (Blüthgen et al., 1980).

The same can be stated also on snow conditions. Figure 8 shows only winter maximum of snow cover depth [cm] in Slovakia based on data from about 700 stations. Some southern stations had less than 5 cm of snow cover depth and less than 10 days with snow during the whole cold half-year 2011/2012 (method published by Pecho et al., 2006).

Winter (Dec. to Feb.) 2011/2012 precipitation events occurred within longer season with very low precipitation totals in Slovakia since Aug. 2011 (55% of normal in Aug. 2011, 28% in Sept. 2011, 72% in Oct. 2011, 1.6% in Nov. 2011, 25% in March 2012 and 84% in April 2012; SHMÚ, 2012). Because of low share of convective conditions the winter precipitation totals have well expressed vertical gradient (increase with the altitude) and significant influence of upwind and lee effects. As shown in Figure 4 most of the cold half-year and winter 2011/2012 seasons had significantly positive NAO indices (Northern Atlantic Oscillation with prevailing south western atmospheric currents in Western Europe). Such synoptic conditions results in low number of Mediterranean cyclones moving to the Central Europe. On the other hand most of precipitation events were connected with western circulation over Slovakia. This resulted in significantly higher precipitation totals in upwind localities (Northern and Northwestern Slovakia and slopes of mountains) and very low precipitation totals in Southeastern and Southern Slovakia and in some hollows affected by lee effects (Fig. 9).

Winter precipitation totals ranging from 200 to 500 mm occurred in the Northwestern Slovakia (northwest from the mountains Štiavnické vrchy and Slovenské Rudohorie) and in very Northeast Slovakia. On the other hand very low precipitation totals occurred except the abovementioned Southern Slovakia also in the Spiš region and mainly in the Hornád river basin (mostly from 80 to 100 mm, occasionally also less than 80 mm (e.g. 61 mm in Poprad)). Average precipitation total in Slovakia was 187 mm (132.5% of normal). That is on the upper limit of normal range, but about half of Slovakia had precipitation less than 100% of normal and 80% of Slovakia less than 125% of normal, Fig. 9 (e.g. 73% in Poprad, all by SHMÚ, 2012).

Snow conditions in Slovakia were also exceptional in the winter and cold half-year seasons 2011/2012. Considerable territorial differences occurred mainly in winter maximum of snow cover depth, number of snow cover days and in duration of so-called continuous snow cover season. The first notable snowfall was recorded on Dec. 6, 2011 and since then continuous snow cover lasted in some northern regions until the end of March (till April in higher localities). Other heavier snowfalls were registered at the beginning and in second half of Jan. 2012. In the Southern Slovakia the snowfalls were insignificant or did not occur at all and in some sites the first events with snow were registered on Feb. 15, 2012 (e.g. Sereď), what was the latest event with the first winter snowfall since the observations start. As mentioned before (Fig. 8), very deep snow cover occurred in the Northwestern Slovakia also in lower localities (e.g. 107 cm in Čadca, 423 m a.s.l., 141 cm in Novoť, 770 m a.s.l.) but considerable large area in the southern and eastern Slovakia had maximum of snow cover lower than 5 cm (e.g. Dvory nad Žitavou 2 cm, Šaštín, Malacky, Rusovce, Veľké Kosihy, Zlatná na Ostrove and Majcichov 3 cm etc.). The number of snow cover days was very variable as well. Full winter season snow cover (91 days) was registered in the highest High Tatras altitudes only (even on Chopok (2009 m a.s.l. in the Low Tatras) it was "only" 87 days). Altogether 85 days with snow cover were (from winter 91 days) in several regions of the Orava, Turiec, Liptov, Spiš and Horehronie also in lower altitudes (all in northern half of Slovakia). On the other hand less than 10 days with snow cover were in the lowlands southwards from the line Skalica – Senica – Bratislava – Senec – Trnava – Nitra – Levice. Only 3 or 4 days with snow cover have been registered in Sereď, Dvory nad Žitavou and Horné Saliby. These values are about the extreme low ever observed in southern Slovakia.

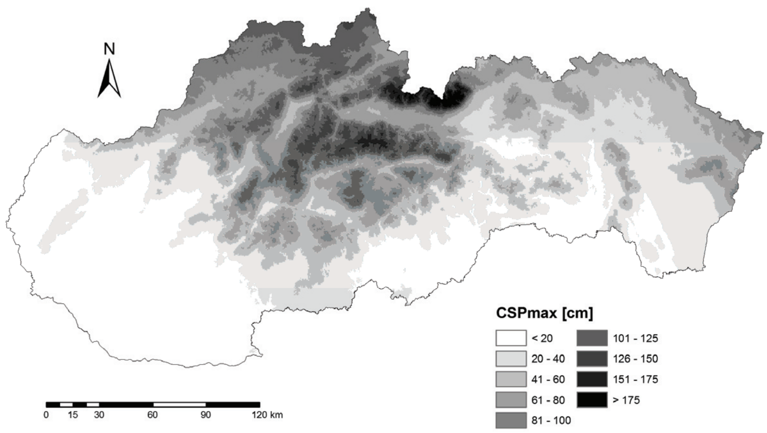


Figure 8.
Winter (Dec. 2011 – Feb. 2012) maximum of snow cover depth [cm] in Slovakia according to the SHMÚ data *(depths are from about 200 cm in high mountains, 107 cm in Čadca (NW Slovakia, 423 m a.s.l.) and like that in some northwestern Slovakia localities to 2 cm or 3 cm in southern Slovakia).*

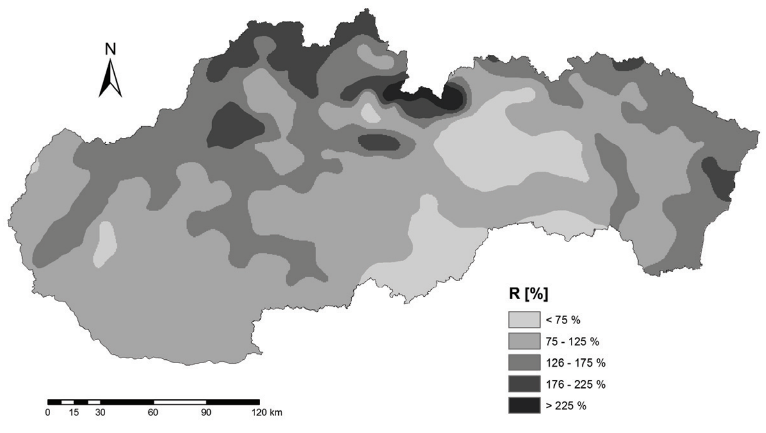


Figure 9.
Winter (Dec. 2011 – Feb. 2012) precipitation totals in percentage of the 1961 – 1990 normal R[%] in Slovakia according to the SHMÚ data *(R[%] are from about 70% in some localities in the Southern Slovakia and the Spiš to more than 200% in the northwestern Slovakia and the Tatras (the 1961 – 1990 normal is slightly lower than the 1901 – 1990 normal, mainly in the southern Slovakia).*

Among important snow characteristics the duration of continuous snow cover can be count. We considered as a continuous snow season the period of everyday snow cover (1 cm at least) with no more than 3 days interruption. This is a pertinent snow attribute showing the snow cover stability at the site. In the 2011/2012 winter there have been created quite good conditions for continuous snow season occurrence in most of Slovakia (but except its southern part) mainly in the second half of the winter. Comparison of snow cover seasons since 1951 proofed that by the end of the 20th century the stability of continuous snow cover had worsen significantly over majority of the Slovakian area, however in the high mountainous localities the snow cover stability increased. For instance in the Liptovský Hrádok site, situated in the large northern Slovakia hollow, the duration of 2011/2012 snow season had 62 days what ranked it among the first 10 winters in the last 25-year period. Prior to 1987/1988 as many as 17 winters had longer snow season than the 2011/2012 one, that means nearly one half of winters since 1951/1952. Similar characteristics can be shown also at other Slovak sites.

Precipitation regime from Aug. 2011 to April 2012 resulted in dramatic low soil moisture on considerable large area in the southern and eastern Slovakia with impacts on runoff and ground water stages. Extreme rainy weather in 2010 (the highest totals ever observed in Slovakia), enough precipitation and snow in the northwestern Slovakia in 2011 and at the beginning of 2012 created conditions with overabundance of water in hydrologic cycle there.

CONCLUSION

Temporary very cold weather spells occur sporadically and are very popular in all countries of global mild climate zone. Such events are usually hyperbolized mainly by mass media. Sometimes several-day-event of extraordinary cold weather results in general meaning on significantly colder winter season than the normal range. The role of professional meteorologists and climatologists in assessment and judgment of any actual weather is obvious. They have to take into consideration very long-term regime of weather (50 years at least) and to evaluate actual weather events using correct statistical methods. Based on this the last winter 2011/2012 was in Slovakia everywhere within the normal temperature range (±1.1 °C), but with significant positive and negative deviations of several day periods. Very interesting and partly unusual fact was there the significantly higher precipitation total in the northwest (up to 200% of normal) than in the south and southeast of Slovakia (up to 70% of normal). This resulted in low number of days with snow cover in the southern Slovakia (up to several days only) and long snow season with abundance of snow in the mountainous northwestern Slovakia (up to 107 cm depth in lower localities and probably up to 250 cm in the higher mountains). Winter hydrologic conditions depend significantly on temporal regime of several variables (temperature, precipitation, snow cover, etc.). Possible impacts of climate change on the mentioned regime was analyzed e.g. by Hlavčová et al. (2008).

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