STATE OF THE ENVIRONMENT REPORT – SLOVAK REPUBLIC

2018

25th anniversary of annual reports

MINISTRY OF ENVIRONMENT OF THE SLOVAK REPUBLIC

SLOVAK ENVIRONMENT AGENCY

CLIMATE CHANGE

KEY QUESTIONS AND KEY FINDINGS

What is the trend in greenhouse gas emissions in the SR?

Greenhouse gas emissions have decreased over the longer term (by 41% between 2017 and 1990). Emissions significantly declined until 1996. Emissions remained stable between 1996 and 2008. After 2008 and 2009, marked by recession, a slight increase in emissions was recorded due to the economic recovery. Year-on-year (2016-2017) greenhouse gas emissions recorded an increase of 2.8%.

What is the observable development of climate change in the SR?

We have seen a rise in the average annual air temperature of 1.73°C in Slovakia in the period from 1881 to 2018. There has been a decrease in annual total atmospheric precipitation by about 0.5% on average (in the south of the SR the decrease was more than 10% in places, while in the north and north-east the total precipitation sporadically increased by 3%); there has been a decrease in relative air humidity; a decrease in all characteristics of snow cover up to a height of 1000 m across almost the whole territory of the SR (at higher altitude an increase has been recorded); an increase in potential evaporation; and a decrease in soil moisture and changes in climate variability (especially rainfall totals).

The increase in average annual air temperature has been most significant in the last thirty years. The average annual air temperature for the 1981 to 2010 period was 10.6°C in Hurbanovo, growth of 0.7 °C compared to the 1951 to 1980 period. The eight hottest years have been reported, based on the average annual air temperatures since 1871, in the last twenty years at the station in Hurbanovo. Strongly above-normal temperatures were recorded in Hurbanovo in 1994, 2000, 2002, 2007, 2008, 2012-2015 and 2017- 2018, and in Liptovský Hrádok in 1994, 2000, 2002, 2007-2009, 2013-2015 and 2017- 2018.

Over the past 15 years there has been a more significant rise in extreme daily and several-day precipitation, which has resulted in an increase in the risk of local flooding in various areas of the SR. On the other hand, in the period from 1989 to 2017 there have been more frequent local or nationwide droughts than before, caused primarily by long periods of relatively warm weather with low precipitation in some parts of the growing season.

Climate change interferes in the function of ecosystems and the provision of ecosystem services. As a consequence of the increased average air temperatures a shift is anticipated in vegetation zones and levels, which from the perspective of biodiversity may result in endangerment to ecosystems, habitats, species of organisms and their communities. We anticipate changes in the structure and composition of habitats, the replacement of species in habitats, which will result in reduced resilience of ecosystems, a reduction in their ability to provide ecosystem services or their collapse. The changed conditions such as the concentration of carbon dioxide, increased average air temperature or availability of water will impact the lifecycles of flora and fauna.

TREND IN GREENHOUSE GAS EMISSIONS

The basic source of data on trends in greenhouse gas emissions is the National Inventory Report of the Slovak Republic for 2019, which states 2017 as the last assessed year.
Total anthropogenic greenhouse gas emissions for 2017 were 43 316 448 tonnes of CO_2 equivalent (without including the LULUCF sector).
Compared to 1990, total anthropogenic emissions decreased by 41%. After a more significant decline in 2009 as a consequence of the economic crisis, the trend in total anthropogenic emissions slightly decreased in 2010 to 2014 and a slight rise recorded in 2015, 2016 and 2017, with a year-on-year increase of 2.8% (2017 compared to 2016). In 2017 we managed to maintain the so-called decoupling, meaning a slower increase in greenhouse gas emissions compared to GDP growth.

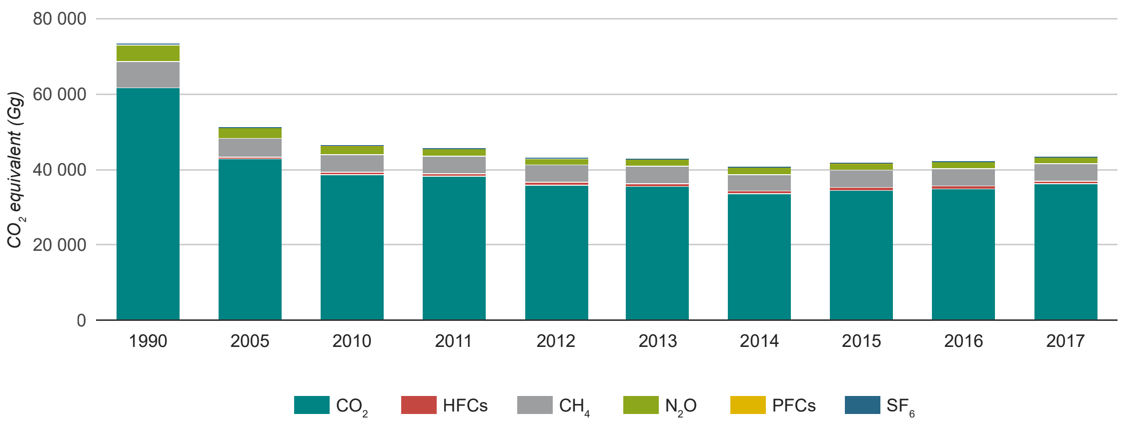
Table 020 I Aggregated anthropogenic greenhouse gas emissions in CO_2 equivalent (Gg)

Year	1990	2005	2010	2011	2012	2013	2014	2015	2016	2017
Spolu (bez LULUCF)	73 361.59	51 142.21	46 295.49	45 545.21	43 057.23	42 727.14	40 659.92	41 644.66	42 153.87	43 316.45
Spolu (vrátane LULUCF)	63 661.06	45 423.07	40 147.60	39 076.69	35 631.45	34 630.78	34 540.84	35 028.01	35 431.74	36 732.06

Source: Slovak Hydrometeorological Institute

Note:
Emissions determined as of 11 April 2019
The years 1990 to 2016 have been recalculated in the table
LULUCF (Land use, land-use change, and forestry)

Chart 092 I Trend in greenhouse gas emissions



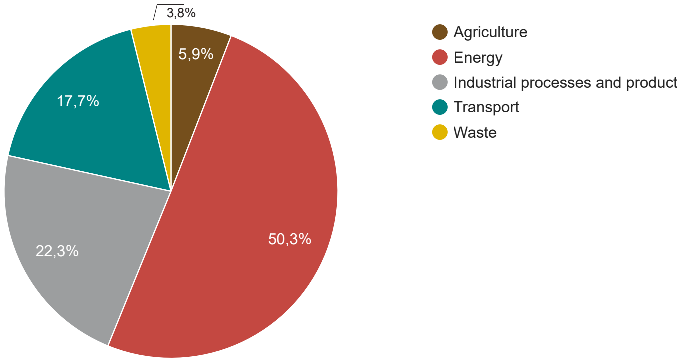
Source: Slovak Hydrometeorological Institute

Note: Emissions without the LULUCF sector (Land use, land-use change, and forestry)
Emissions determined as of 11 April 2019

One important sector in which the SR has not succeeded in stabilising the growth of greenhouse gas emissions is the **road transport sector**. The share in emissions from **the energy sector** including transport in total emissions of greenhouse gases was 68% in 2017 (expressed as CO_2 equivalents), while emissions from transport within the framework of the energy sector made up around 32%. Another problematic area in which it has not been possible to efficiently regulate the increase in greenhouse gas emissions is the **burning of fossil fuels in households**, so-called local emissions sources.
The **industrial processes** sector is the second-most-important sector, with a share of over 22% in total emissions of greenhouse gases in 2017.

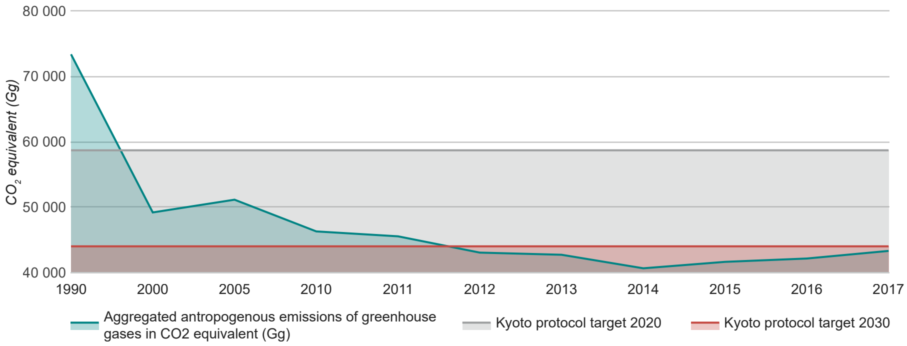
The **agriculture** sector had a 6% share in total emissions of greenhouse gases in 2017. Emissions in this sector fell sharply from 1990, however since 2000 their trend has been stable and only affected by agricultural commodity prices and subsidies. The significant decrease in the 1990s was primarily due to the significant decrease in the use of nitrogen-based fertilisers and livestock numbers. Improvements in agriculture practices as well as the introduction of organic farming have created additional prerequisites for the favourable development of emissions in this sector in coming years.
The waste sector accounted for almost 4% of total emissions of greenhouse gases in 2017. The share of the individual sectors in total emissions of greenhouse gases in 2017 did not significantly differ from that in 1990.

Chart 093 I Share of individual sectors in emissions of greenhouse gases (2017)



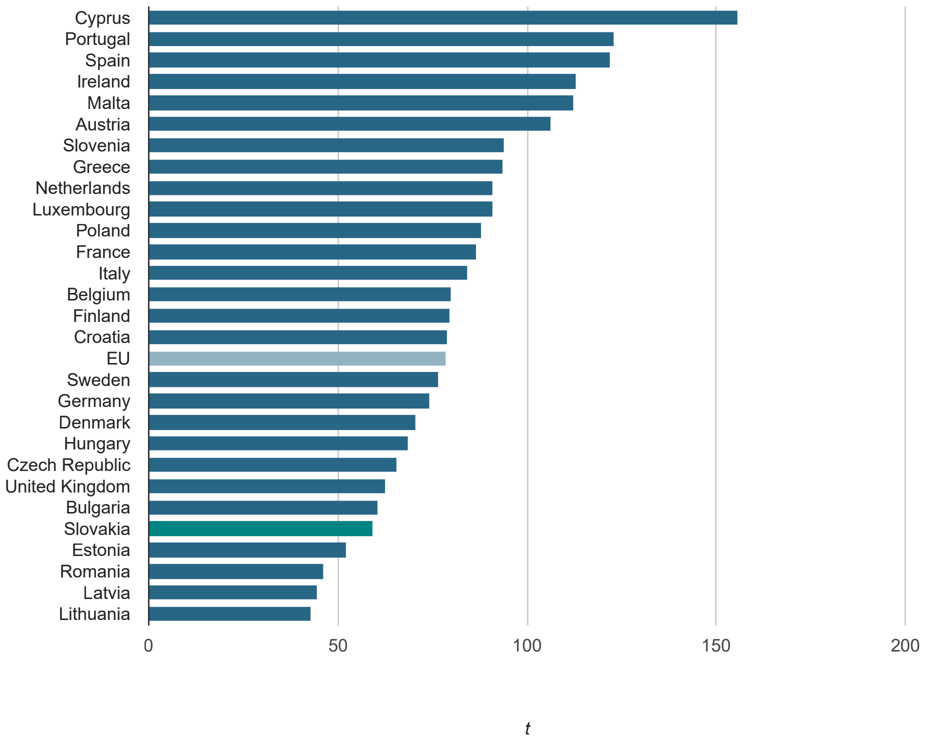
Source: Slovak Hydrometeorological Institute
Note: Emissions determined as of 11 April 2019

Chart 094 I Trend in greenhouse gas emissions in connection with meeting Kyoto Protocol targets



Source: Slovak Hydrometeorological Institute
Note: Emissions determined as of 11 April 2019

Chart 095 I International comparison of greenhouse gas emissions (CO2 equivalent) per inhabitant in 2017



Source: Eurostat

MANIFESTATIONS OF CLIMATE CHANGE AND ADAPTATION TO THE UNFAVOURABLE CONSEQUENCES OF CLIMATE CHANGE

The climate trend is assessed using trends in long-term time series (1951 2018) for individual climate elements and based on a comparison of the values for individual years with the normal climatology period of 1961-1990. Together with climate elements, hydrological flow characteristics that immediately react to climate development are also assessed (meaning atmospheric precipitation, air temperature and evaporation). To ensure a representative assessment of indicators in relation to the altitude of Slovakia, two monitoring stations have been selected. For lowland areas this is the Hurbanovo weather station, for higher areas the Liptovský Hrádok weather station.

CLIMATE ELEMENTS

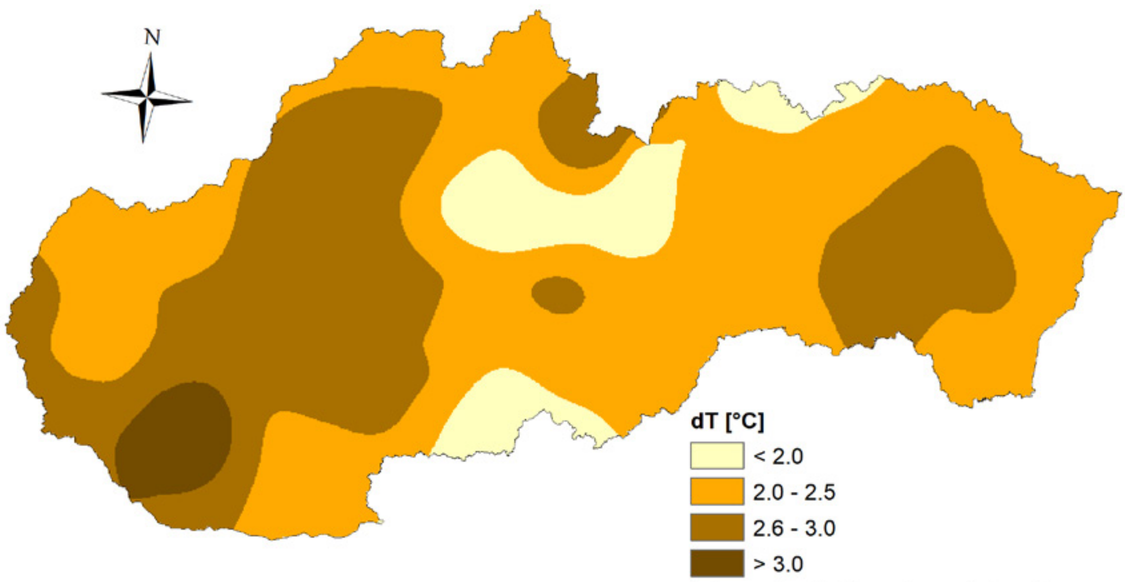
AIR TEMPERATURE

2018 was assessed in most of the territory of Slovakia as **exceptionally to extremely warm**. The territorial average for the SR as a whole in 2018 (10.1 °C) **was the second-highest at least since 1951** with a deviation of 2.4 °C from the average of the temperatures from the 1961 to 1990 period. In the southwest and southeast of Slovakia it was actually the warmest year since records began (in **Hurbanovo 2018 was the warmest since 1871**). At the same time, an average annual air temperature of 12°C and over was recorded at the most ever meteorological and climatological stations. **In Žihárec** the average annual temperature in 2018 was even **13°C**, while this marked the first ever recording of such a temperature in Slovakia.

A comparison of average temperatures in 2018 compared to the 1961 to 1990 period:

- Number of icy days (maximum temperature under 0 °C) - 12 fewer
- Number of frosty days (minimum temperature under 0 °C) - 32 fewer
- Number of summer days (temperature over 25 °C) - 45 more
- Number of tropical days (temperature over 30 °C) - 16 more.

Map 014 I Deviations in the average annual air temperature from the 1961 to 1990 normal in Slovakia in 2018

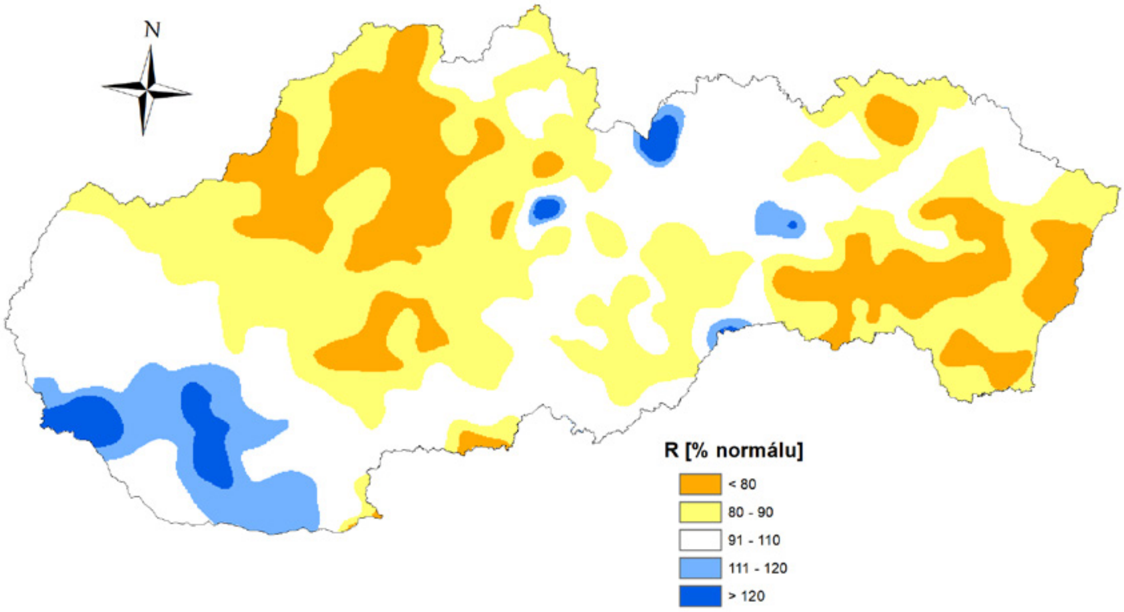


Source: Slovak Hydrometeorological Institute

ANNUAL TOTAL OF ATMOSPHERIC PRECIPITATION

2018 was **subnormal in terms of precipitation**, with the total reaching 88% of the long-term average for ;1901 to 2000. The atmospheric precipitation balance was negative in April and May, with an even longer period with a negative precipitation balance from July to November, while this was interrupted in western Slovakia by heavy rains at the start of September. There was another negative precipitation balance in January, but not as significant as in the months mentioned above. The precipitation deficit created was corrected by precipitation that occurred primarily in June, but also in March and December and then the mentioned precipitation in the rainy part of September. Compared to the values from the 1961 to 1990 period, an excess of annual atmospheric precipitation was observed only in the extreme southwest of Slovakia, where the percentage of normal annual precipitation relative to the above 30-year period reached over 120% in places.

Map 015 I Total atmospheric precipitation in Slovakia in 2018 as a % of the 1961 to 1990 base



Source: Slovak Hydrometeorological Institute

DROUGHT INDEX

The drought index is based on the difference between the sum of potential evapotranspiration and total atmospheric precipitation.

A drought index of 1.6 in Hurbanovo in 2018 giving a deviation (positive) compared to the 1961 to 1990 period base of 0.12.
A drought index of 0.58 in Liptovský Hrádok giving a deviation compared to the 1961 to 1990 period of 0.16.

SOIL DROUGHT

Regarding soil drought, the situation until mid-April was quite favourable. In the second half of April the drought began to spread initially towards the north east, and subsequently also towards the east of Slovakia. At the start of May it was extremely dry over **16% of the country**, while the worst status was in the **Žilina, Prešov and Trenčín regions.** In the second half of May the situation improved to some extent. The extreme dryness once again expanded in the first ten days of June, especially in the east and northwest of Slovakia. By 10 June the extreme dryness had impacted 7.5% of the country. In July and in August soil drought was not as extended. There was a deterioration in September, when there was extreme drought especially in the extreme east of Slovakia. The soil moisture deficit in the extreme east reached up to **-100 mm**. Relative saturation was at its lowest value on 5 and 19 August, when over 1.2% of the SR saturation was **under 10%.** The point of reduced availability (relative saturation under 50%) was over approximately 2/3 of the country in this period. The estimated revenue loss was **30% and over** in several districts in Slovakia. The highest estimated loss of revenue was in the districts of **Rimavská Sobota, Michalovce, Košice-okolie and Nové Mesto nad Váhom.**

HEATING SEASON

In the 1951 to 2018 period a statistical and significant fall **in the number of heating days** in lowland areas was seen. In **Hurbanovo** this was, with 183 days in 2018, a decrease of 22 days.

A similar trend was recorded in higher mountain locations - at the station in **Liptovský Hrádok** with 210 days in 2018, the decrease was 24 days compared to the 1951 to 2018 period.

HYDROLOGICAL ELEMENTS

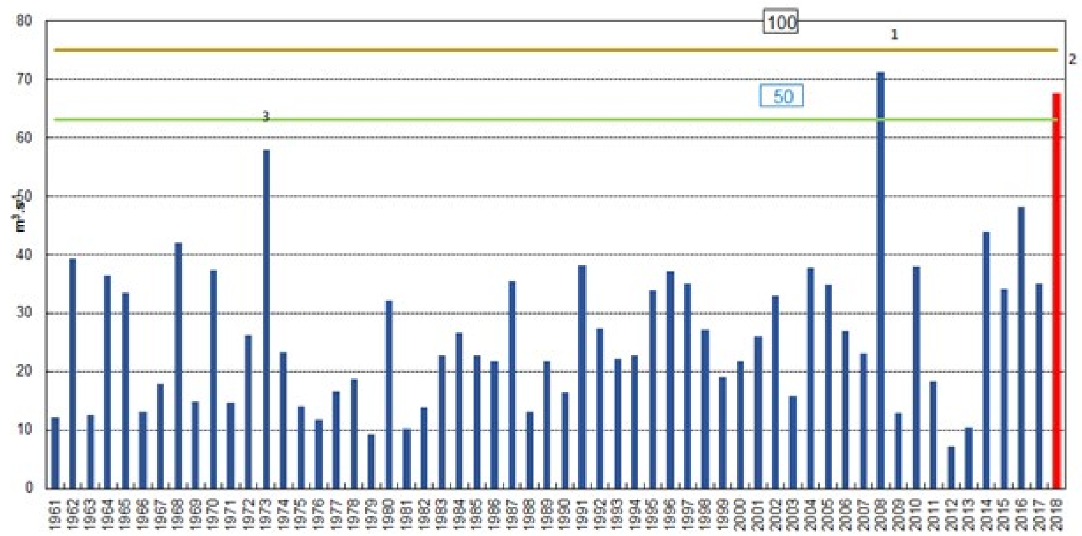
AVERAGE WATER LEVELS

The **outflows** from Slovakia corresponded to the average precipitation in 2018 (**assessed as dry in terms of precipitation**), and were **under the long-term values** in all parts of Slovakian river basins (reference period 1961 to 2000).

MAXIMUM FLOW RATES

In 2018, despite the fact that it was a relatively dry with a significant dry period in June to August, significant flooding occurred (especially in the northern part of Slovakia). The most significant culmination situations were recorded in the night of 18 July 2019 at the water-measuring stations Ždiar-Lysá Poľana na Bielej Vode (20-50 years' flow), Ždiar-Podspády na Javorinke (50-100-year flow) and Podbanské na Belej (10-year flow). Significant culmination flows also occurred in the early morning of 19 July at the stations Červený Kláštor-Kúpele na Lipníku (10-year flow), in Batizovce na Velickom potoku (10-20-year flow) and in Starej Lesnej na Studenom potoku (20-50-year flow; the water-measuring station was destroyed by the floodwater). The second-highest culmination since 1961 was recorded by the Ždiar-Podspády station for the Javorinka. In other areas of Slovakia the maximum inflows mostly did not exceed the 1-year flow rate in 2018.

Chart 096 I Maximum peak flows since monitoring began at the Ždiar-Podspády station with marked repetition time of 50 and 100 years



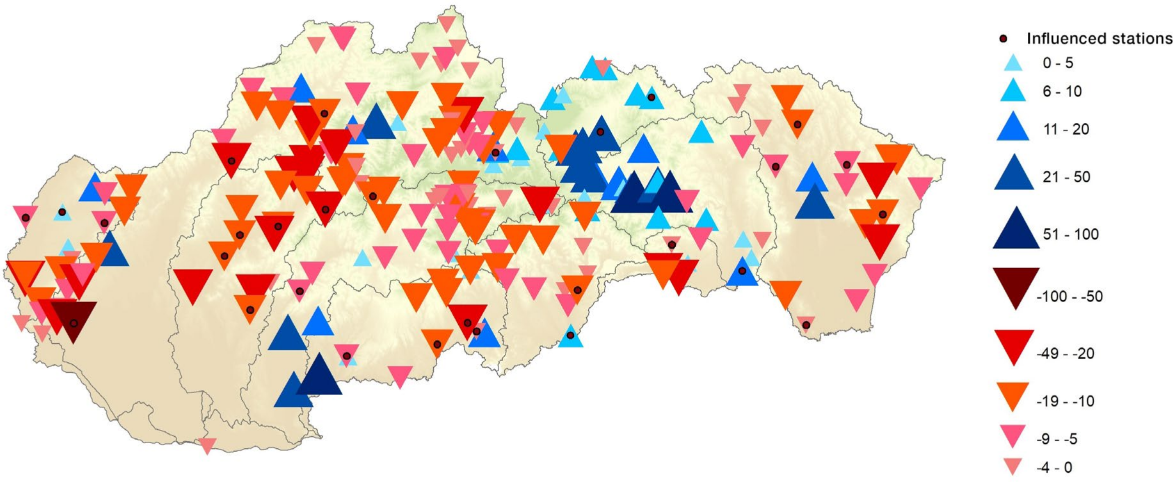
Source: Slovak Hydrometeorological Institute

MINIMUM FLOW RATES

The prolonged exceptionally warm period with occasional storms meant that in the period from June to August 2018 low to extremely low water values were recorded. For more than half the water-measuring stations in 2018 there were minimal average daily inflows lower than or equal to the 355-day flow rate, which is a low water value.

When assessing the long-term annual flow rates based on analyses of differences for the 2001 to 2015 period against the 1961 to 2000 reference period, the majority of the country showed a slight decrease in flow rates with the exception of the northern area, e.g. in the Poprad and Dunajec river basins and in the upper part of the Hornád basin, where some water-measuring stations recorded an increase in flow rates.

Map 016 I Differences in long-term average flow rates in the 2001 to 2015 period against the 1961 to 2000 reference period



Source: Slovak Hydrometeorological Institute

Note: On the map, falls in compared flow rates are represented with a red triangle pointing down and increases with a blue triangle pointing up in the individual assessed profiles. The shades of blue and red and the size of the triangle correspond to the size of the changes in % as follows: Stations whose hydrological regime is partly influenced by human activity are indicated on the maps with a black dot in the corresponding triangle.

ADAPTATION TO THE UNFAVOURABLE CONSEQUENCES OF CLIMATE CHANGE

ACTION PLAN FOR THE IMPLEMENTATION OF THE STRATEGY FOR THE ADAPTATION OF THE SR TO CLIMATE CHANGE (ACTION PLAN)

The preparation of the Action Plan, which began in 2018, is the responsibility of the Ministry of the Environment of the SR in cooperation with the Prognostic Office of the SAS. Adaptation measures will be prioritised in the Action Plan based on qualitative and quantitative analyses. The prioritisation will be based on the results of a participation process that will include all the relevant actors. Short-term measures for the 2020 to 2022 period and medium-term measures for the 2022 to 2025 period with an outlook to 2027 will be identified. The measures will be prioritised pursuant to their importance, feasibility and the availability of financial resources. The Action Plan should contribute to better translating adaptation measures into the sectoral policies of the relevant ministries. It should also include a proposal for a vulnerability monitoring system, a proposal for a medium-term assessment system for the adaptation process in Slovakia, including cost-benefit linkages, and a platform for publishing and sharing positive experiences.

The adaptation action plan should be submitted to the Government of the SR by 31 December 2020.