Climate Change

Climate Change

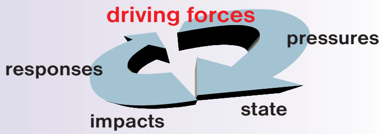
Climate changes clearly indicate the change in global trends with regard to average temperatures on Earth, rising sea level, glacial melting, and extreme weather phenomena (droughts, short-term showers, extreme multi-day rainfall events, etc.), connected with the variability in precipitation quantities. Global warming is principally attributable to increased greenhouse gas emissions, which are the outcome of human activity, especially due to increased consumption of fossil fuels. Greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), CFC-compounds (chlorofluorocarbons), and HCFC-compounds (hydrochlorofluorocarbons). The above listed group of greenhouse gases also includes ozone. In contrast to stratospheric ozone, which is essential for the protection of plants and animals from harmful shortwave UV rays, tropospheric ozone plays a significant role in the greenhouse effect. In addition to the impacts that climate changes have brought upon nature, special consideration should also be given to their adverse effect on human health and changing trends in economic sectors forestry, agriculture, tourism and insurance industry.

Recent scientific researches emphasize a certain connection between greenhouse gases and substances that cause depletion of the ozone layer and create ozone holes. CFCs, HCFCs and greenhouse gases as well belong to the group of ozone depleting substances. The interaction among these substances bears special significance in the areas of the Earth Poles. The size, duration and extent of the ozone hole in the Northern and Southern Poles may, specifically, increase as a consequence of low temperatures in the stratosphere. The latter are related to climate changes.

The Environmental Agency of the Republic of Slovenia (EARS) participates actively in the monitoring of climate changes and consumption of ozone-depleting substances.

The indicators discussed below illustrate current knowledge on the subject matter.

7. CONSUMPTION OF OZONE-DEPLETING SUBSTANCES

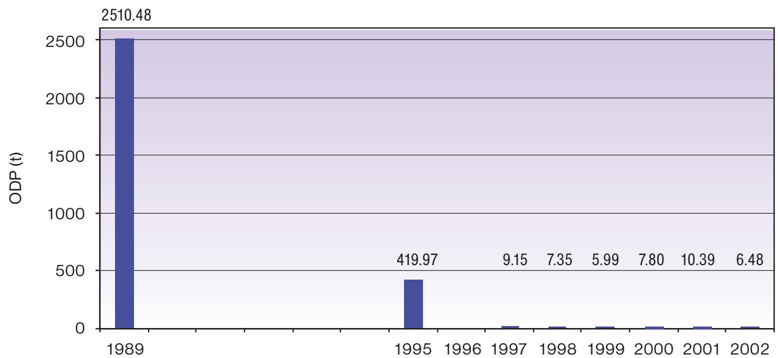


This indicator shows total consumption of ozone-depleting substances, expressed as values recalculated in accordance with the ozone-depleting potential (ODP) in tonnes per year. In methodological terms, the indicator is based on the standard issued by the European Environment Agency (IFC 4.1.b) – Consumption of ozone-depleting substances.

GOAL

The target in this area, as defined by the National Environmental Action Programme, is to ban air emissions of ozone-depleting substances and re-establish a system of management of these substances after their recovery from products and equipment. The targets set in the National Environmental Action Programme are being translated into practice by two operational programmes of the Republic of Slovenia for the management of halons and chlorofluorocarbons (both adopted in July 2003), international commitments taken (the Vienna Convention and the Montreal Protocol on Substances that Deplete the Ozone Layer), as well as two Slovenian regulations, also adopted in 2003.

Figure 7-1: Total consumption of ozone-depleting substances in Slovenia (CFC, CTC, MCF, total halons, HCFC and methyl bromide). The quantities of substances expressed in tonnes are weighted in accordance with their ozone-depleting potentials (ODP).



Slovenia does not produce ozone-depleting substances and from the beginning of 1998, the first enacted regulation covered prohibitions and restrictions with respect to the management of ozone-depleting substances in production, imports, exports, entry into circulation, as well as the use of substances and products whose air emissions deplete the ozone layer. Throughout the world, consumption of ozone-depleting substances is falling dramatically as a result of both international agreements and the changing attitude of individual countries. The trend of abandoning consumption is also made clearly evident by the consumption indicator for Slovenia.

With the adoption of Rules on the Management of Ozone-Depleting Substances (OJ RS, No 62/03) and Rules on the Management of Waste Ozone-Depleting Substances (OJ RS, No 42/03) in 2003, Slovenia brought its domestic regulations in line with the European legislation (Regulation (EC) No 2037/2000 on Substances that Deplete the Ozone Layer). The provisions of the second regulation govern the area of the management of waste ozone-depleting substances, with a view to ban air emissions of these substances from products, equipment and installations during the process of maintenance or dismantling, as well as recovery, reuse and disposal of such substances.

DATA AND SOURCES

Table 7-1: Total consumption of ozone-depleting substances in Slovenia (CFC, CTC, MCF, total halons, HCFC and methyl bromide). The quantities of substances expressed in tonnes are weighted in accordance with their ozone-depleting potentials (ODP).
Source: Annual reports for the Montreal Protocol Secretariat and Database for Substances that Deplete the Ozone Layer, Environmental Agency of the Republic of Slovenia, 2003 (data for the period 1997-2002); records provided by the Chamber of Commerce and Industry of Slovenia (for 1989); Statistical Yearbook RS, Statistical Office of the Republic of Slovenia (data for 1995)

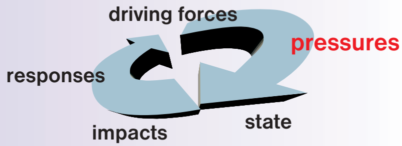
substances	unit	1989	1995	1997	1998	1999	2000	2001	2002
CFC,CTC, MCF total	ODP (t)	2 509.38	403.19	0.45	0.14	0.14	0.53	2.76	0.53
halons total	ODP (t)	n/a	0	0	0	0	0	1.02	0
HFCF total	ODP (t)	1.10	16.19	8.57	7.22	5.86	7.27	6.61	5.96
methyl bromide	ODP (t)	n/a	0.60	0.13	0	0	0	0	0
total	ODP (t)	2 510.48	419.98	9.15	7.36	6.00	7.8	10.39	6.49

On the basis of annual reports made by liable persons according to current regulations, the EARS has maintained a database in recent years. A liable person is a client that has been issued a decision concerning annual imports and, at the same time, authorisation for each individual import of substances. Each year, liable persons are required to report to the EARS (MESPE) on the actual consumption of substances for the previous year. As the data are based on client reporting, cross-checking with other competent authorities (e.g. customs authorities) and the data collected by inspection services is useful for the purposes of verifying their accuracy. The processing of data provides an appropriate overview for comparison between the data collected by respective competent authorities as well as a basis for reporting to the UNEP Secretariat pursuant to the provisions of the Montreal Protocol. The data may be aggregated by type of consumed ozone-depleting substances (authorisations and reports) and recalculated into ODP tonnes (recalculated quantity in accordance with the ozone-depleting potential factor).

The data for 1989 are taken from the records kept at the Chamber of Commerce and Industry of Slovenia (Report on the State of the Environment 1995) – the only available data are those on total quantities of CFC, MFC, HCFC; there are no data concerning individual substances. For 1995, the data are taken from the Annual Yearbook RS (Statistical Office of the Republic of Slovenia). For the period 1997-2002, the data derive from annual reports communicated to the UNEP and prepared by the EARS on the basis of data from the above mentioned database.

It is impossible to draw a quantitative comparison with other countries, since each country's index derives from the quantities in the base year and thereafter reduces consumption according to the recalculation of percentage shares of base quantities. The base year for Slovenia is 1986.

8. GREENHOUSE GAS EMISSIONS



Development of industrialisation has contributed to a considerable rise in greenhouse gas (GHG) emissions, which cause global warming. By signing the United Nations Framework Convention on Climate Change, Slovenia joined the efforts to reduce the influence of human activity on the environment. The next step in this direction was the Kyoto Protocol the signing of which committed Slovenia to reduce its emissions by 8% in respect of the 1986 base year, within the first target period 2008-2012. The indicator shows the trend of total greenhouse gas emission quantities in Slovenia and main source categories. The quantities are calculated using the IPCC methodology (IPCC – Intergovernmental Panel on Climate Change).

GOAL

With accession to the Kyoto Protocol, Slovenia has committed to achieve an 8% reduction in its emissions of greenhouse gases by the period 2008-2012 in respect of the value as identified in 1986. Slovenia also has to fulfil its reporting obligations according to the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

Figure 8-1: Annual emissions of greenhouse gases and the target set for the period 2008-2012 (Slovenia - 8% reduction from the value identified in 1986, EU - 8% reduction from the value identified in 1990)

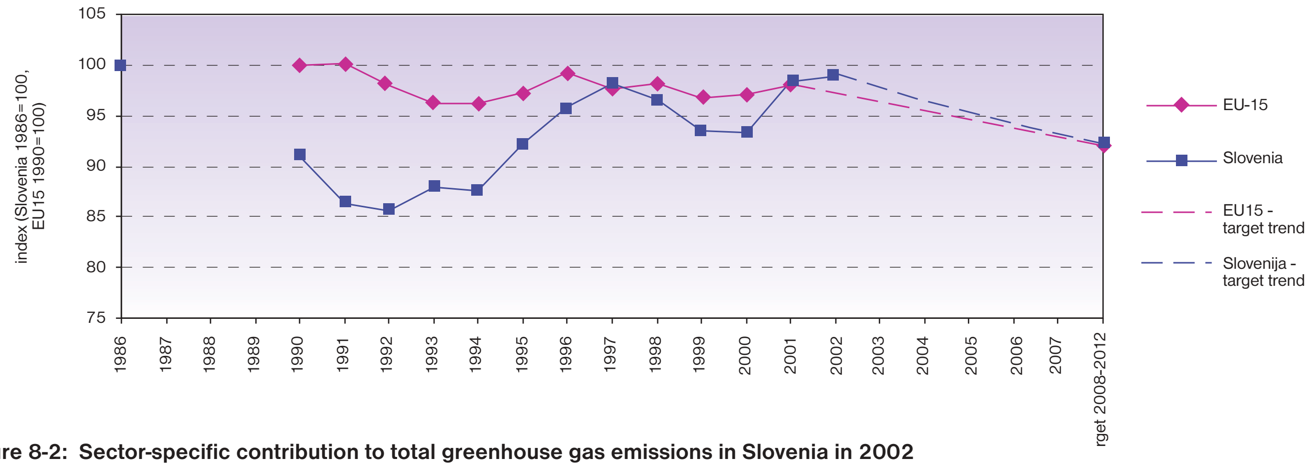
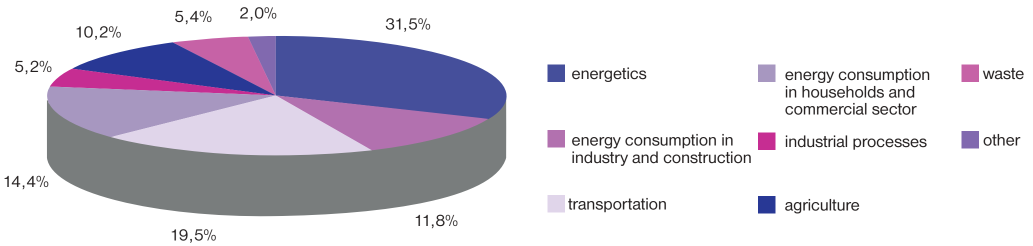


Figure 8-2: Sector-specific contribution to total greenhouse gas emissions in Slovenia in 2002



The greatest contributor among the emissions of greenhouse gases is carbon dioxide – CO_2 (80.2%), which results mailny from fuel combustion; the second largest contributor is methane – CH_4 (11.2%), mostly deriving from wastes and agriculture, and third nitrogen dioxide – N_2O (7.6%), deriving from agriculture as well. Also noticeable are traffic-related emissions. Emissions of F-gases which include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6), are very small, but due to high greenhouse potential, their contribution to global warming is far from insignificant (1%).

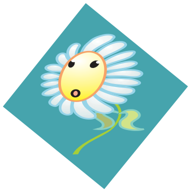
Emissions of greenhouse gases in 2002 amounted to 20 383 Gg in CO_2 equivalents, i.e. only a little more than one percent below the value in the base year. In order to fulfil the obligations arising from the Kyoto Protocol it was therefore necessary to introduce additional measures. The majority of them are described in the Operational Programme for the Reduction of Greenhouse Gas Emissions, drawn up and adopted by the Government of the Republic of Slovenia in 2003. For the reduction of greenhouse gas emissions in the area of energy production and consumption, the Energy Act was adopted in 1999, and the National Energy Programme (NEP) has been drawn up as well. Both these documents envisage a sustainability-oriented development of the energy sector by enhancing the effectiveness of energy as well as consumption of renewable energy sources. In 2005, one of the three most essential Kyoto mechanisms will begin functioning as well, i.e. trade in greenhouse gas emission permits, which will include 98 installation operators from Slovenia. In the EU, trade in permits will be introduced in the period 2005-2007, and on a global level, in the period 2008-2012.

Although total emissions have not changed significantly in comparison with the base year, there is a considerable change in their distribution by sector. The highest, almost 100% rise occurred in traffic emissions, the majority of them resulting from the increase in personal traffic; however, this is exactly the segment for which Slovenia has not yet developed an integrated development programme. The growth in total emissions is also due to emissions arising from fuel consumption in residential and commercial sectors, as well as emissions from wastes.

In the light of the loss of the Yugoslav markets, abandonment of non-profitable production and increase in productivity, the decrease in emissions has been principally contributed to by manufacturing industries. The decrease occurred both in emissions arising from fuel consumption and process emissions. For the purposes of maintaining competitiveness, trade in emissions and the IPPC Directive, the industrial sector is encouraged to make use of currently best available technology (BAT).

Lower emissions than those in the base year are also noticed within the agricultural sector, which is mostly a result of reduction in the number of livestock units. The future projections anticipate that the number of cattle will again rise due to quotas determined for Slovenia. On the other hand, agricultural policy will, by introducing good agricultural practice in fertilising and establishing biogas consumption for electricity and heating production, influence the reduction in agricultural emissions.

Forests cover more than 56% of Slovenia's land surface and constitute an important source of reducing GHG emissions. Calculations of sinks are considerable due to land use change and forestry; in 2002, CO_2 sinks reached 5 561 Gg, exceeding a much lower recognizable level. On the basis of the condition stipulating that these sinks must be a direct result of human activity so that the state may use them for the purposes of fulfilling its obligations, an assessment was selected according to which it will be possible to make use of 840 Gg CO_2 during the period 2008-2012.



DATA AND SOURCES

Table 8-1: Annual emissions of greenhouse gases and the target set for the period 2008-2012 (Slovenia - 8% reduction from the value identified in 1986, EU - 8% reduction from the value identified in 1990)
Source: Greenhouse Gases Emission Inventory for 1986 and 1990-2002, Annual European Community Greenhouse Gas Inventory 1990-2001 and Inventory Report 2003, European Environment Agency, 2003

		1986	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	target 2008–2012
EU-15	index (SI 1986=100; EU 1990=100)	n/a	100.0	100.2	97.9	96.1	96.3	97.2	99.2	97.7	98.2	96.7	97.0	98.0	n/a	92.0
Slovenia	index (SI 1986=100; EU 1990=100)	100.0	90.9	86.4	85.7	88.0	87.6	92.2	95.9	98.1	96.5	93.4	93.4	98.4	98.9	92.0

Table 8-2: Sector-specific contribution to total greenhouse gas emissions in Slovenia in 2002
Source: Greenhouse Gases Emission Inventory for 1986 and 1990-2002, Environmental Agency of the Republic of Slovenia, 2004

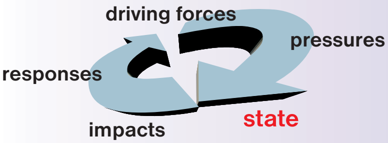
	unit	energetics	energy consumption in industry and construction	transportation	energy consumption in households and commercial sector	industrial processes	agriculture	wastes	other	total
greenhouse gas emissions	t	6 430	2 412	3 965	2 938	1 050	2 070	1 110	409	20 383
share	%	31.5	11.8	19.5	14.4	5.2	10.2	5.4	2.0	100.0

Greenhouse Gases Emission Inventory for 1986 and 1990-2002, Matej Gasperič, Tajda Mekinda Majaron, Environmental Agency of the Republic of Slovenia, April 2004.

For the purposes of reporting according to the Framework Convention of the United Nations on Climate Change, using IPCC methodology, records were made of emissions of greenhouse gases for 1986 and 1990-2002, provided in CRF format (i.e. Common Reporting Format). In the future, greenhouse gas emissions will be reported once a year, by 15 January for the year immediately preceding the previous year. In the event that new data are available or calculation methods used have been changed, recalculations must also be made for older periods. The accuracy of calculations and the appropriateness of the data used shall be supervised by the Convention Secretariat with annual revisions of reports. Calculations of emissions from fuel consumption sectors and partially also industrial processes are fairly accurate, while assessments in the areas of agriculture and wastes are appreciably less reliable, owing to the nature of the process.

Supporting studies for 2nd/3rd state report to the conference of parties to the Framework Convention of the United Nations on Climate Change, Final Report, IJS – Energy Efficiency Centre, 5 May 2004.

Annual European Community Greenhouse Gas Inventory 1990-2001 and Inventory Report 2003, European Environment Agency, 2003.



9. PRECIPITATION AND TEMPERATURES

The indicator shows the movement of average annual air temperatures and average annual precipitation in selected areas across Slovenia in the period 1992-2003.

GOAL

Regular monitoring of the trend in temperatures and precipitation allows for the determination of long-term changes in the environment, preparations for newly arising conditions and mitigation of possible adverse consequences.

Figure 9-1: Mean annual air temperature at individual measuring sites

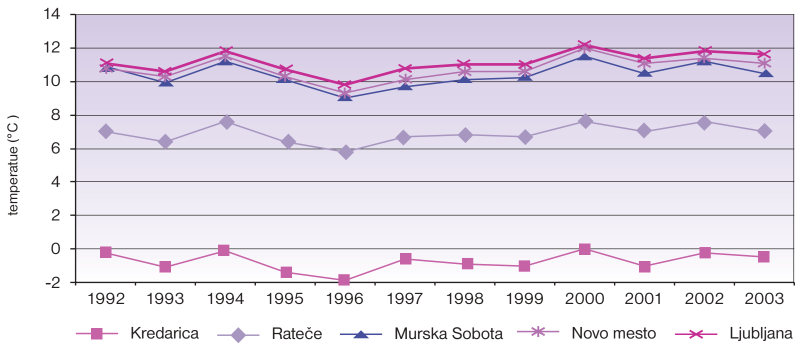
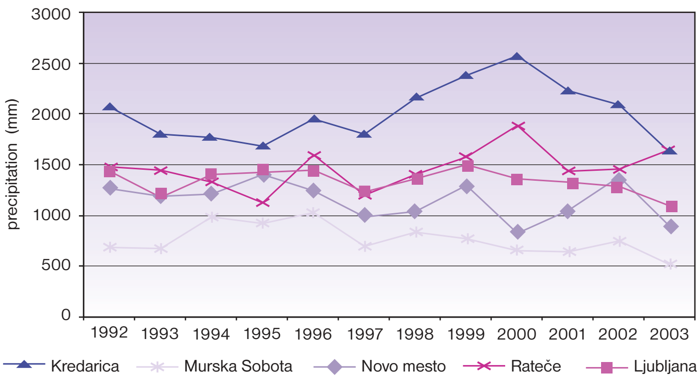


Figure 9-2: Mean annual precipitation at individual measuring sites



The period 1992-2003 recorded 1996 as the coldest year and 2000 as the warmest. Particularly during the last two decades, there has been a noticeable increase in average temperatures in Slovenia, with warmest years and months being more frequently recorded in the present than was the case in the past. In 2003, Slovenia experienced an extraordinarily hot and arid summer. However, owing to appreciable differences among regions, the rise in temperatures is not distributed evenly across the country, with the lowest temperature rise recorded in the coastal region. The rise in average temperatures is also apparent on global and European scales, as well as an accumulation of above-average warm years and months within the last 25 years.

Nevertheless, Slovenia is encountering even greater and more significant deviations with regard to precipitation. There are considerable differences among regions, since average annual precipitation in individual areas within the Julian Alps reach as much as 3500 mm, while towards the east, the amount of precipitation is rapidly dropping, reaching an annual average of a mere 800 mm in the easternmost part of the Prekmurje region. In 2000, Kredarica received the largest share of precipitation during the twelve-year period in question (1992-2003), while Prekmurje received the smallest. Furthermore, there are also apparent differences at each measuring station during the course of individual years. The coastal area reveals a trend of decreasing precipitation over the last 50 years. A similar situation is also present in the Zgornjesavska Valley; the Posočje region shows again a slight increase, while Kredarica recorded a low precipitation period in the latter half of the 1960's and in the early 1970's. Precipitation in Prekmurje does not reveal a distinctive trend of decreasing, at least not with regard to annual precipitation. Yet, even more troubling than the variability in annual precipitation are the deviations from average values that occur within shorter time spans (such as periods of several days, months or seasons). The consequences of precipitation deviations from normal values may be manifested as droughts, floods or landslides. Torrential floods, on the other hand, may already result from an exceptionally heavy rainfall appearing over a very short interval of time. Slovenia is therefore very likely most sensitive to climate changes in the areas that are vulnerable to the consequences of precipitation variability. With regard to precipitation considerations, Europe also expresses utmost concern over extreme weather events such as drought, intense passing showers and heavy prolonged rainfall. During recent years, several resounding instances have been recorded of all the three above listed extreme weather events, causing considerable economic damage. The heaviest was probably the toll from the massive floods sweeping across Eastern Europe in August 2002.

DATA AND SOURCES

Table 9-1: Mean annual temperature at individual measuring sites
Source: Meteorological Office, Environmental Agency of the Republic of Slovenia, 2003

measuring site	unit	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Kredarica	°C	-0.2	-1.1	-0.1	-1.4	-1.9	-0.6	-0.9	-1.0	0.0	-1.0	-0.2	-0.5
Murska Sobota	°C	10.9	9.9	11.2	10.1	9.0	9.7	10.1	10.2	11.5	10.5	11.2	10.5
Novo mesto	°C	10.8	10.3	11.5	10.3	9.3	10.1	10.6	10.6	12.0	11.1	11.4	11.1
Rateče	°C	7.0	6.4	7.6	6.4	5.8	6.7	6.8	6.7	7.6	7.0	7.6	7.0
Ljubljana	°C	11.1	10.6	11.8	10.7	9.8	10.8	11.0	11.0	12.2	11.4	11.8	11.6

Table 9-2: Mean annual precipitation at individual measuring sites
Source: Meteorological Office, Environmental Agency of the Republic of Slovenia, 2003

measurung site	unit	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Kredarica	mm	2066	1802	1769	1680	1951	1800	2157	2376	2573	2230	2093	1623
Murska Sobota	mm	689	677	989	924	1026	692	839	772	651	643	754	515
Novo mesto	mm	1264	1188	1211	1405	1245	991	1041	1299	827	1051	1379	886
Rateče	mm	1483	1446	1327	1129	1597	1195	1401	1579	1891	1440	1458	1651
Ljubljana	mm	1433	1177	1407	1423	1446	1230	1359	1501	1363	1328	1288	1091

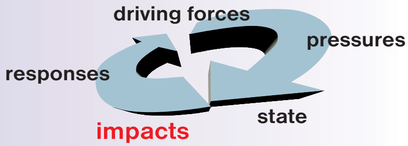
Source of data is Meteorological Office, Environmental Agency of the Republic of Slovenia.

The accuracy of measurements and the quality of data comply with the recommendations of the World Meteorological Organisation.

Kredarica is representative of the conditions in mountainous regions. Rateče is a measuring station where the conditions in the area surrounding the measuring point have for decades remained unchanged; therefore this measuring station is representative of valley areas in northern Slovenia. Murska Sobota describes the climate situation in the flatlands stretching across the north-eastern part of Slovenia, where the continental climate conditions are most evident in the entire country. Novo mesto is a typical representative of the climate conditions prevailing in the Lower Carniola region (Dolenjska). The area surrounding the measuring point in Ljubljana has undergone significant changes during recent decades; the data are nevertheless representative for the climate conditions in the city that is both the capital of and the largest city in Slovenia. Yet, it should be emphasised that these data are suitable neither for the illustration of changes in the climate conditions within a wider area nor for the assessment of changes arising directly from global climate changes. Temperatures are primarily dependent on elevation, therefore the data for Kredarica diverge most from average values; the temperatures measured at Rateče are also lower than the rest.

Due to appreciable inter-year variability, which in recent years has considerably exceeded the observed trends, it is not reasonable to derive a trend based on an eleven-year series. Therefore, the conclusions are made on the basis of all data available for the past 50 years.

The assessment of global trends and conditions in Europe is taken from the World Meteorological Organisation.

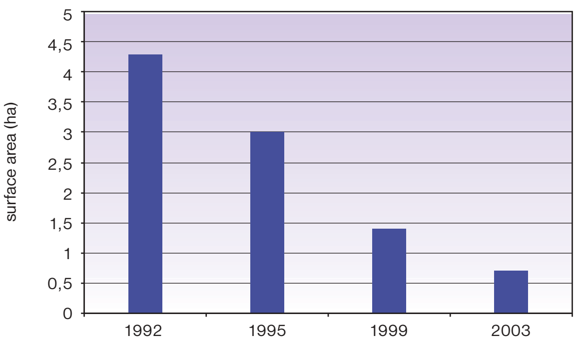


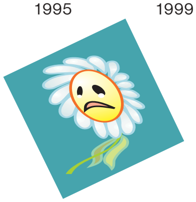
10. CHANGES IN GLACIER EXTENT

A glacier is an extensive body of land ice which moves downhill under its own weight in response to gravitational force, transporting ice from an area of accumulation to an area of ablation. Glaciers can form in mountain regions above the snow line where the perennial average amount of snow falling is greater than the amount of snow melting. The snow is gradually transformed into glacier ice which moves downhill reaching far down below the snow line. The key factors of ablation are the following: solar radiation, air temperature, precipitation and wind.

Changes in glacier volume and extent are an illustrative indicator of climate changes. During the last decade, the trend of rapid glacier retreat has been characteristic of all Alpine glaciers. In Slovenia, there are two glaciers, i.e. the Triglav glacier and the Skuta glacier, both exceptionally sensitive to climate changes due to their extreme south-eastern position and low elevation. Since the above mentioned Slovenian glaciers are small, their relative shrinkage in respect of their present extent and volume is greater than is the case with other Alpine glaciers.

Figure 10-1: Changes in the Triglav glacier surface area

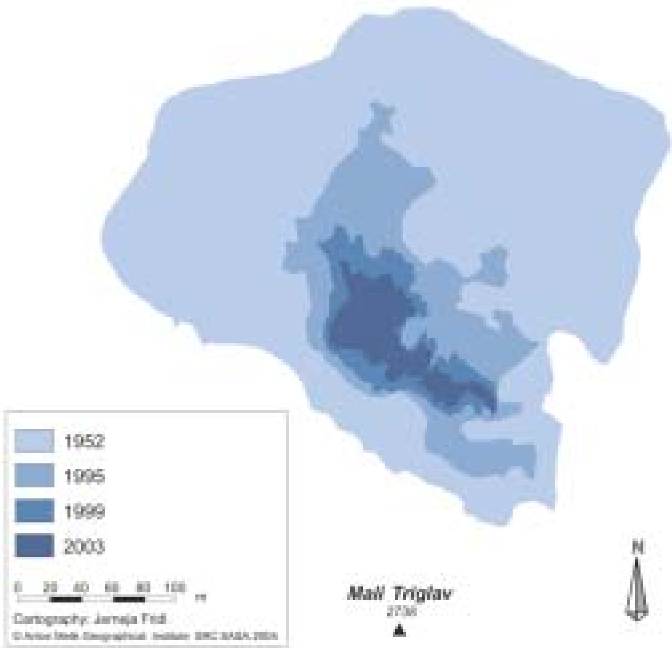




GOAL

Glaciers are highly sensitive to climate changes; therefore the oscillations in their surface area and volume constitute a reliable indicator of climate changes. Global understanding of climate changes can prove helpful in the preparation of adjustment procedures for the newly arising conditions and mitigation of possible adverse effects (National Environmental Action Programme).

Figure 10-2: Extent of the Triglav glacier by individual year
Source: Anton Melik Geographical Institute at the Scientific Research Centre of the Slovenian Academy of Sciences and Arts, 2004



Typical of all Alpine glaciers are similar oscillations within the last 400 years. Following the peak at the onset of the 17th century, glaciers remained at their maximum extents for the next 250 years, undergoing relatively insignificant changes. A majority of glaciers in the Eastern Alps reached their second peak between 1770 and 1780, and in the mid-19th century. However, the post-1920 period records a continuous retreat of glaciers; the only variations occurring between individual years and decades were those concerning the rate of glacier retreat. The Triglav glacier shrinking progressed during the 1990's. The increasingly rapid thinning of the ice sheet caused individual rock formations appearing in the middle of the glacier finally cutting it into two completely separated parts in 1992. The shrinking of the Triglav glacier is still continuing, with occasional halts in the process occurring in years with exceptionally high snow cover during late spring.

Similar trends are typical of all Alpine glaciers. The variations in change rates are the result of different elevations, geographical positions and glacier extents.

DATA AND SOURCES

Table 10-1: Changes in the Triglav glacier surface area

Source: Anton Melik Geographical Institute at the Scientific Research Centre of the Slovenian Academy of Sciences and Arts, 2003

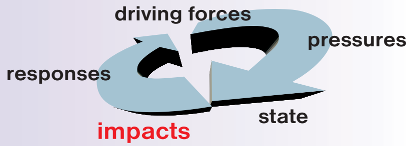
	enota	1992	1995	1999	2003
glacier's surface	ha	4.3	3	1.4	0.7

Ever since 1946, the Anton Melik Geographical Institute at the Scientific Research Centre of the Slovenian Academy of Sciences and Arts conducts regular annual measurements of the Triglav and Skuta glaciers.

In 1946, measuring points were set up around the Triglav glacier from which the distance to the glacier was measured with a measuring tape. On the basis of these measures glacier drawings were made by individual year as well as assessments of the glacier's surface area. With the glacier retreating, several measuring points became too remote, and subsequent years saw the establishment of new ones. Given that the locations of all measuring points are geodetically measured, it has been possible all these years to make fairly accurate calculations of the glacier's surface area. Along with performing measurements, the expert team of the Anton Melik Geographical Institute also took regular photographs of the glacier from the Begunjski vrh. Moreover, these photographs serve as an excellent source for the reconstruction of the glacier's extent throughout the past decades. Since 1976, there is also a regular monthly photographing of the glacier from two fixed locations on Kredarica. As a rule, regular annual measurements are performed in mid-September, at the end of the melting period. In individual years measurements were, however, rendered impossible by early snow falls.

In 1952, 1995 and 1999, the glacier was also measured geodetically. Since 1999, an airborne photogrametric survey has been organised every second year. This photographic material has facilitated the calculations of changes in the glacier's surface area and volume between individual years. In 1999 and 2001, geo-radar measurements were carried out for the provision of data on ice layer thickness by individual cross-section.

World Glacier Monitoring Service based in Zurich collects data on glacier oscillations. In several glaciers, the series of data dates as far back as 1894.



11. ANNUAL GROWING SEASON LENGTH

The length of the annual growing season is the period between the day when the average daily air temperature in spring exceeds the temperature threshold of 5 °C and the day when it drops below this value in autumn.
Air temperature at 5 °C is generally recognised as the lower temperature threshold for plant vegetation, while the period with average air temperatures exceeding the temperature threshold denotes the length of annual cycle of vegetation. The temperature threshold so determined is used as one of the conditions for the classification of agri-ecological zones.

GOAL

The length of annual growing season as one of environmental change indicators, together with its changes in time and space, allows for an assessment of the impact that the changing climate has on the development of plants and their environment. This indicator can also prove helpful in the preparation of adjustment procedures for the newly arising conditions and mitigation of possible adverse effects (National Environmental Action Programme).

Figure 11-1: Changes in the average annual growing season length in individual places throughout Slovenia

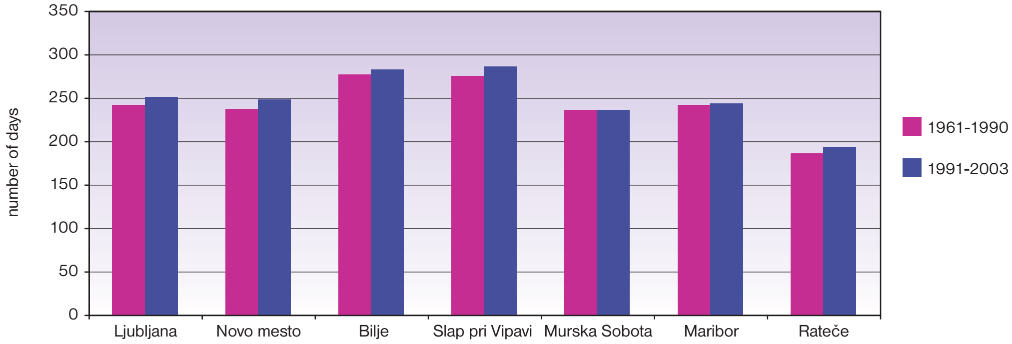
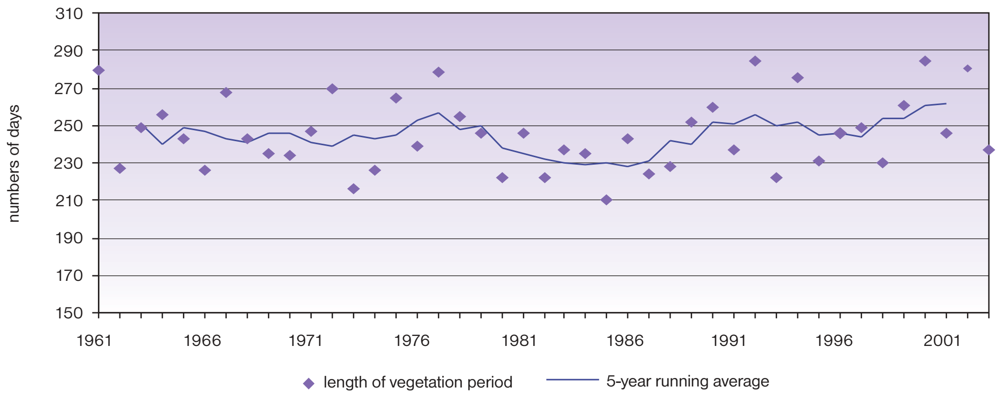
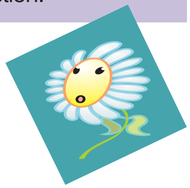


Figure 11-2: Changes in the average annual growing season length in Ljubljana



The rise in average air temperatures and the increased frequency of days with temperatures exceeding the vegetation threshold influence the prolongation in the length of annual cycle of vegetation. The latter has a non-homogeneous character, with appreciable deviations within the period in question (i.e. 1961-2003). The 5-year running average indicates a slight cyclic oscillation. The last cycle of 5-year running average values indicates the prolongation in the length of annual cycle of vegetation since the 1990's, which is also made strikingly evident by the comparison of average values for the periods 1961-2003 and 1991-2003.
The adjustments to the changed length of cycle of vegetation are expressed as gradual changes in agricultural technology, which, owing to the nature of agricultural production, is a lengthy process. In introducing new technologies into agricultural practice, special account is to be taken of environmental factors, the laws of environmental protection and supporting information systems (agri-meteorological data). In accordance with the National Environmental Action Programme, reduction of the burden caused by the changing length of cycle of vegetation (introduction of new varieties) will require upgrading of existing legal and economic instruments for environmental protection (biodiversity, sustainable development), acting in line with the adopted international conventions (Framework Convention of the United Nations on Climate Change), strengthening supervision over sources of environmental hazards, heightening environmental awareness, enhancing the knowledge on environmental issues, and encouraging sustainable forms of agricultural production.



DATA AND SOURCES

Table 11-1: Changes in the average annual growing season length in individual places throughout Slovenia
Source: Archive of Meteorological Data, Environmental Agency of the Republic of Slovenia, 2004

annual growing season lenght	enota	Ljubljana	Novo mesto	Bilje	Slap pri Vipavi	Murska Sobota	Maribor	Rateče
1961–1990	number of days	243	238	278	276	237	243	187
1991–2003	number of days	252	248	283	287	237	244	194

Table 11-2: Changes in the average annual growing season length in Ljubljana
Source: Archive of Meteorological Data, Environmental Agency of the Republic of Slovenia, 2004

	unit	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
length of vegetation period	no. of days	279	227	249	256	243	226	268	243	235	234	247	270	216

	unit	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
length of vegetation period	no. of days	226	265	239	278	255	246	222	246	222	237	235	210	243

	unit	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
length of vegetation period	no. of days	224	228	252	260	237	284	222	275	231	246	249	230	261

	unit	2000	2001	2002	2003
length of vegetation period	no. of days	284	246	280	237

The source of the original database is the Archive of meteorological data, Environmental Agency of the Republic of Slovenia.

For the illustration of the length of annual growing season in Slovenia, an analysis was made of daily air temperatures at 7 meteorological stations for the period 1961-2003 (meteorological stations: Rateče, Bilje, Slap pri Vipavi, Ljubljana, Novo mesto, Maribor, Murska Sobota). Criteria for the calculation of the length annual growing season are taken from the CCL/CLIVAR (Working group on Climate change Detection, European Climate Assessment & Datasets), which labels the length of annual growing season as an indicator of climate changes No 143 (www.knmi.nl/samenw/eca). The annual growing season length presents the number of days between the first occurance of at least six censecutive days with the daily mean air temperature above 5 °C and the first occurence after July 1 of at least six consecutive days with daily mean temperature below 5 °C. In relation to the climate situation in Slovenia, the spring condition has been changed in such a way that the spring temperature threshold occurs after the last series of six or more consecutive spring days with the temperature above 5 °C, thereby excluding at least six-day long early winter warmings.