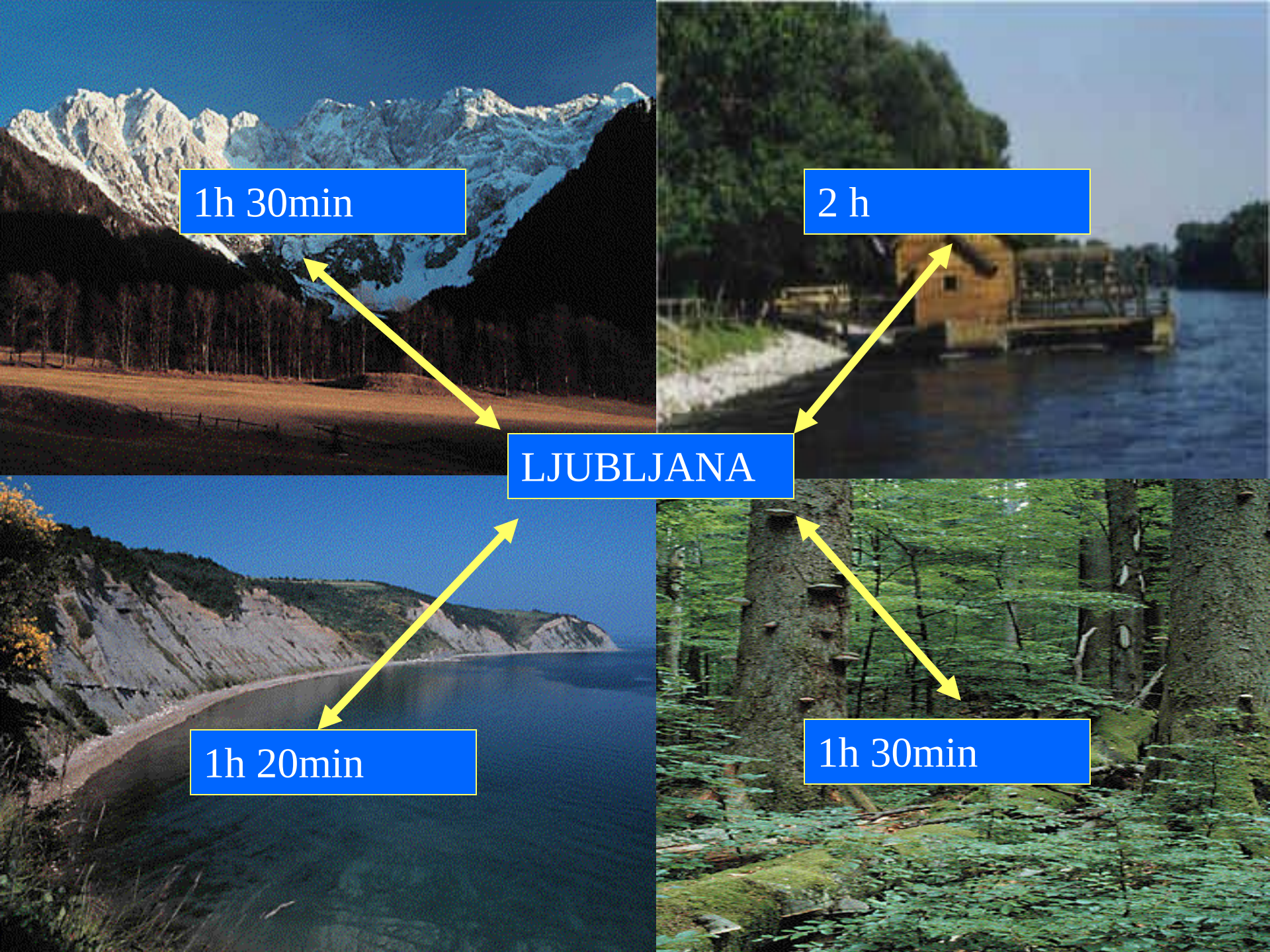
REPUBLIC OF SLOVENIA
MINISTRY OF INFRASTRUCTURE

Questionnaire on Climate Change Impacts and adaptation for Transport Networks and Nodes (2016)

Some conclusions and experiences from Slovenia

Fedor ČERNE, Secretary
Office for International Affairs
Ministry of Infrastructure
Republic of Slovenia

Group of Experts on Climate Change impacts and adaptation for transport networks and nodes (10th session), Geneva 7 July, 2016


1h 30min
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LJUBLJANA
1h 20min
1h 30min

Climate of Slovenia

- Diverse Climate
- Influence of three major climate types
- High spatial variability of all climate variables

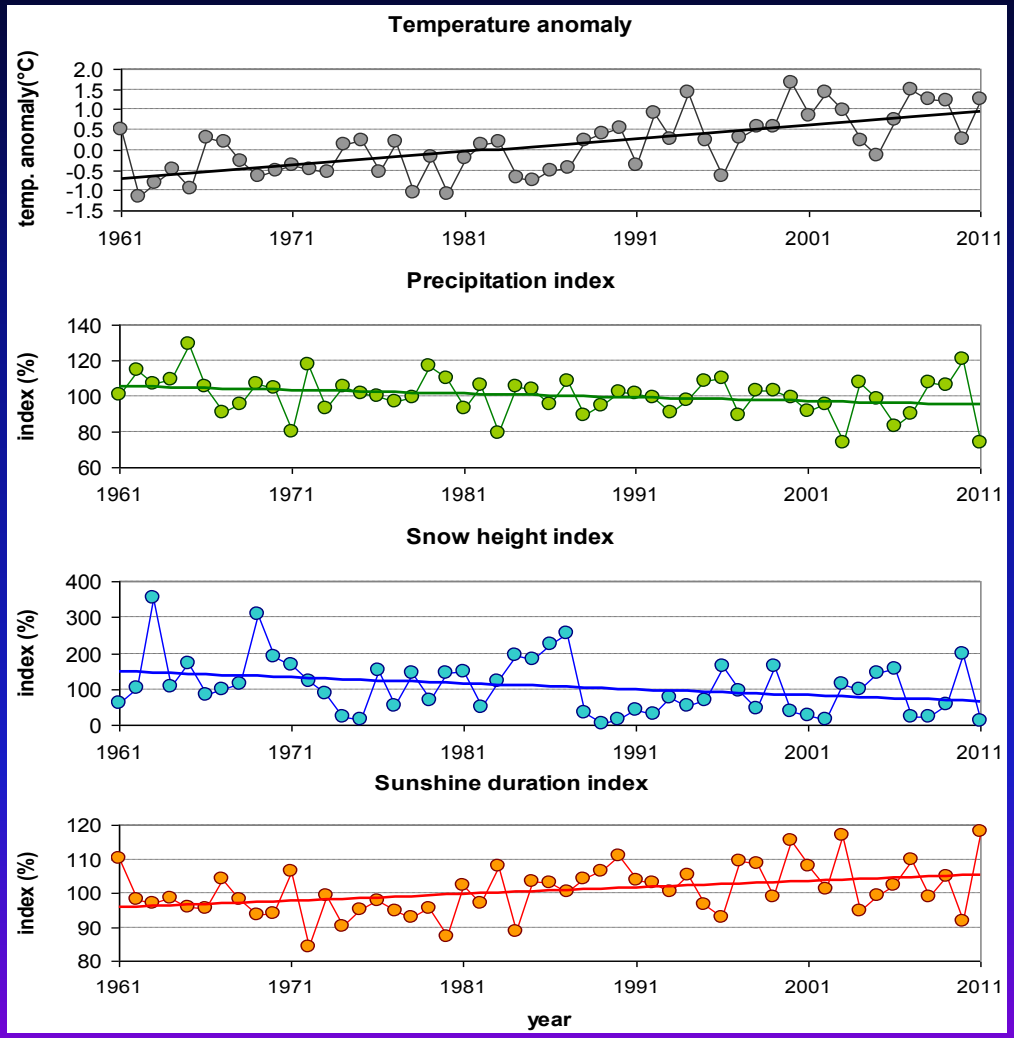
Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Detected climate change in Slovenia

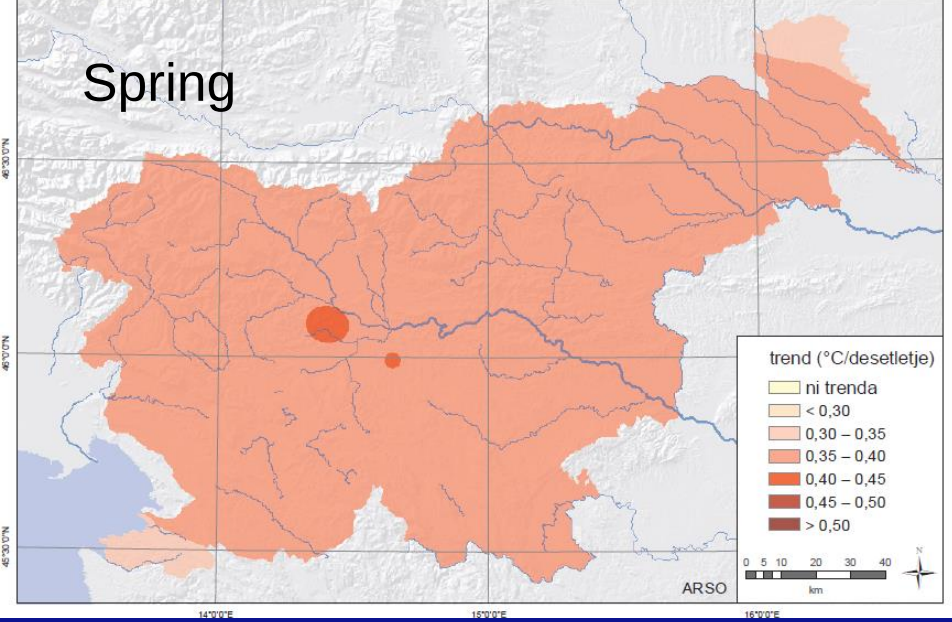
Confirms (locally) different response to global worming!

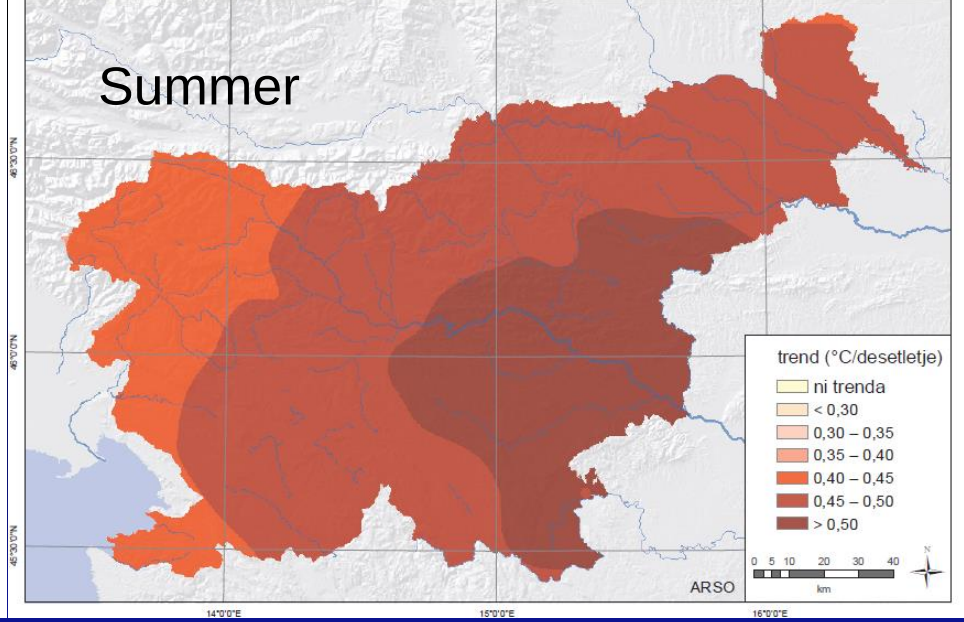
Average linear trend in the period 1961–2011:

- Air temperature: **+0,33 °C/decade**
- Precipitation: **−2 %/decade**
- Snow height: **−15 %/decade**
- Sunshine duration: **+2 %/decade**

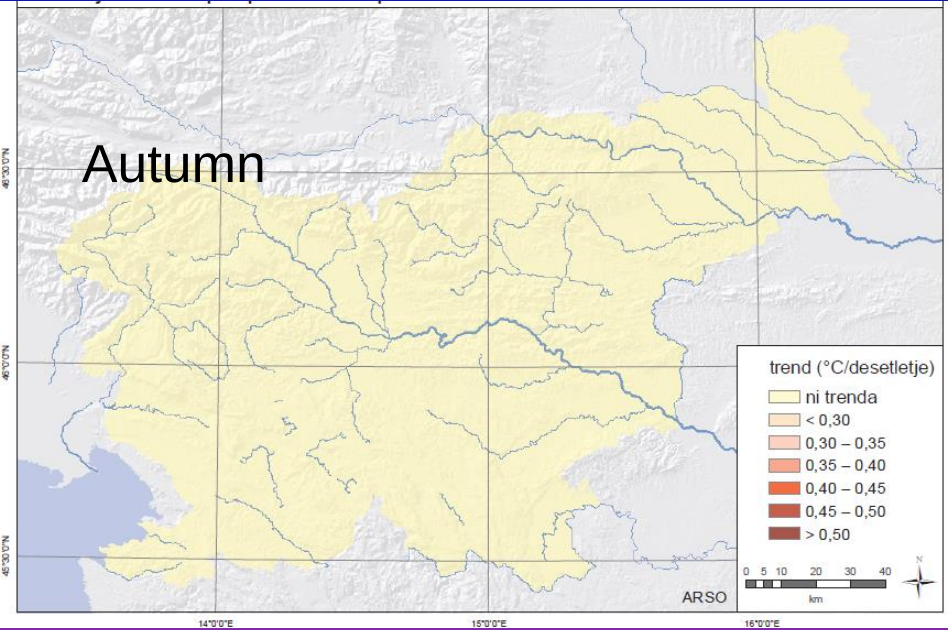


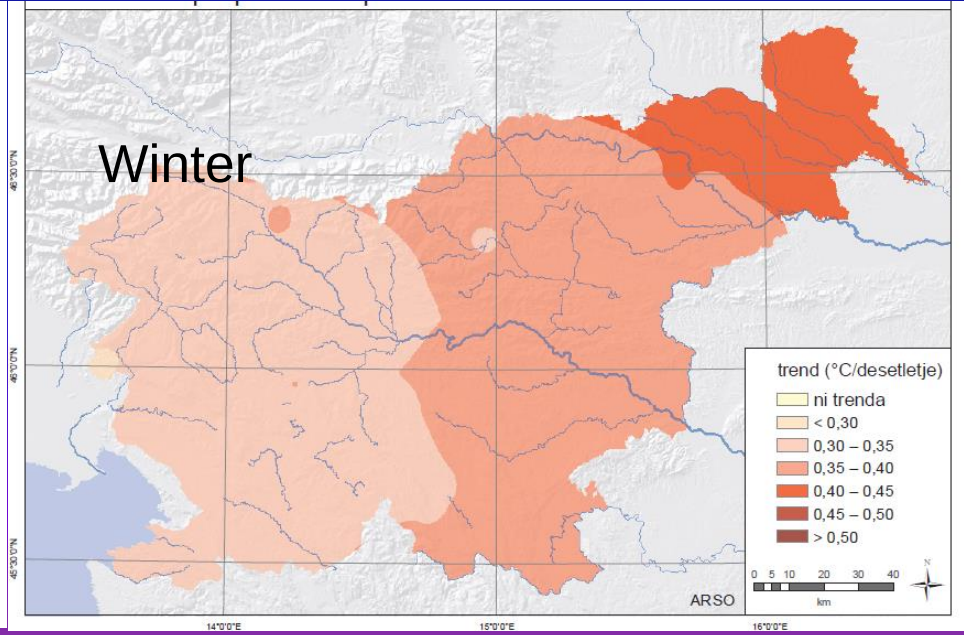
Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office





- In the period 1961−2011 detected rise of mean annual temperature is **1,7°C**
- The temperature rise is higher in the eastern part of the country

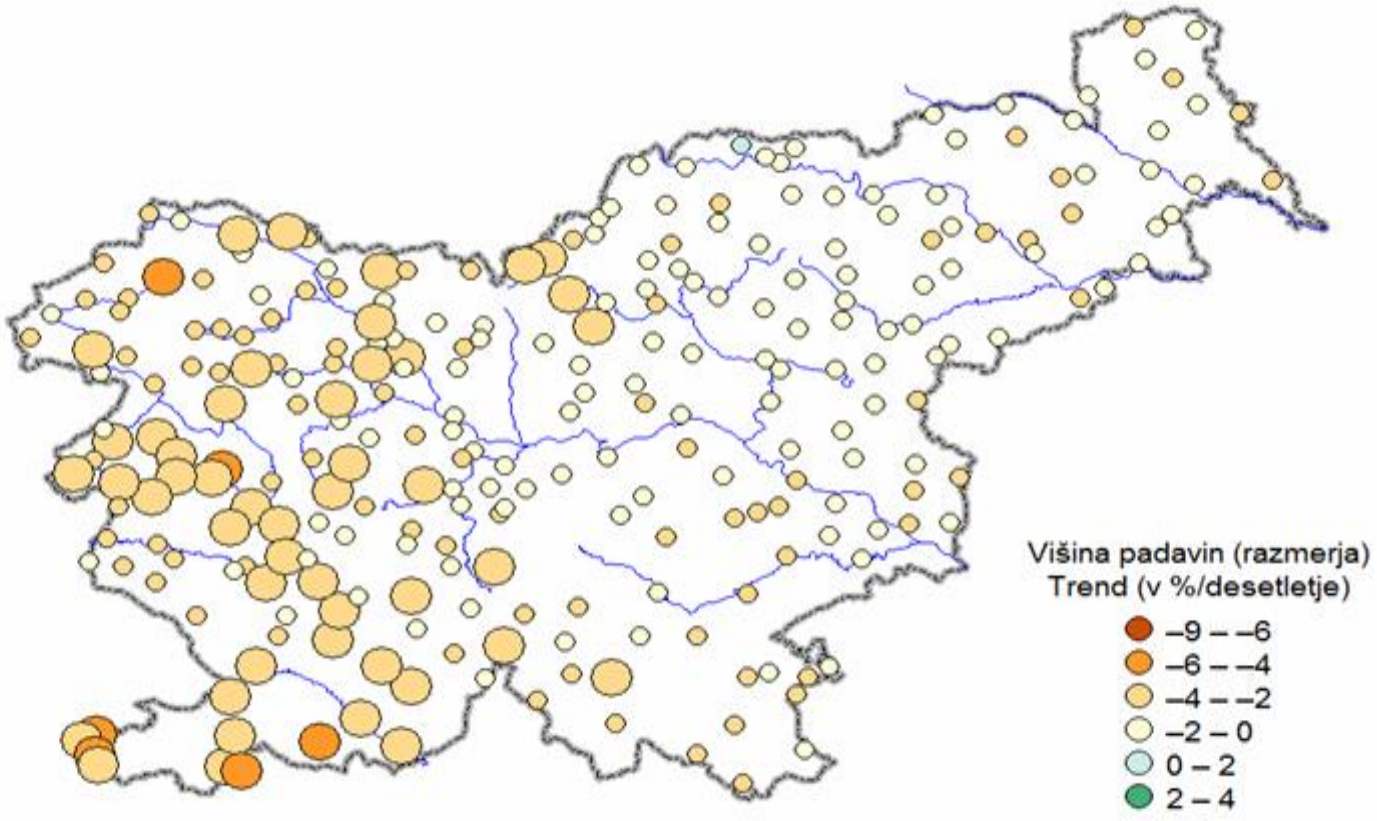




Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Detected precipitation changes

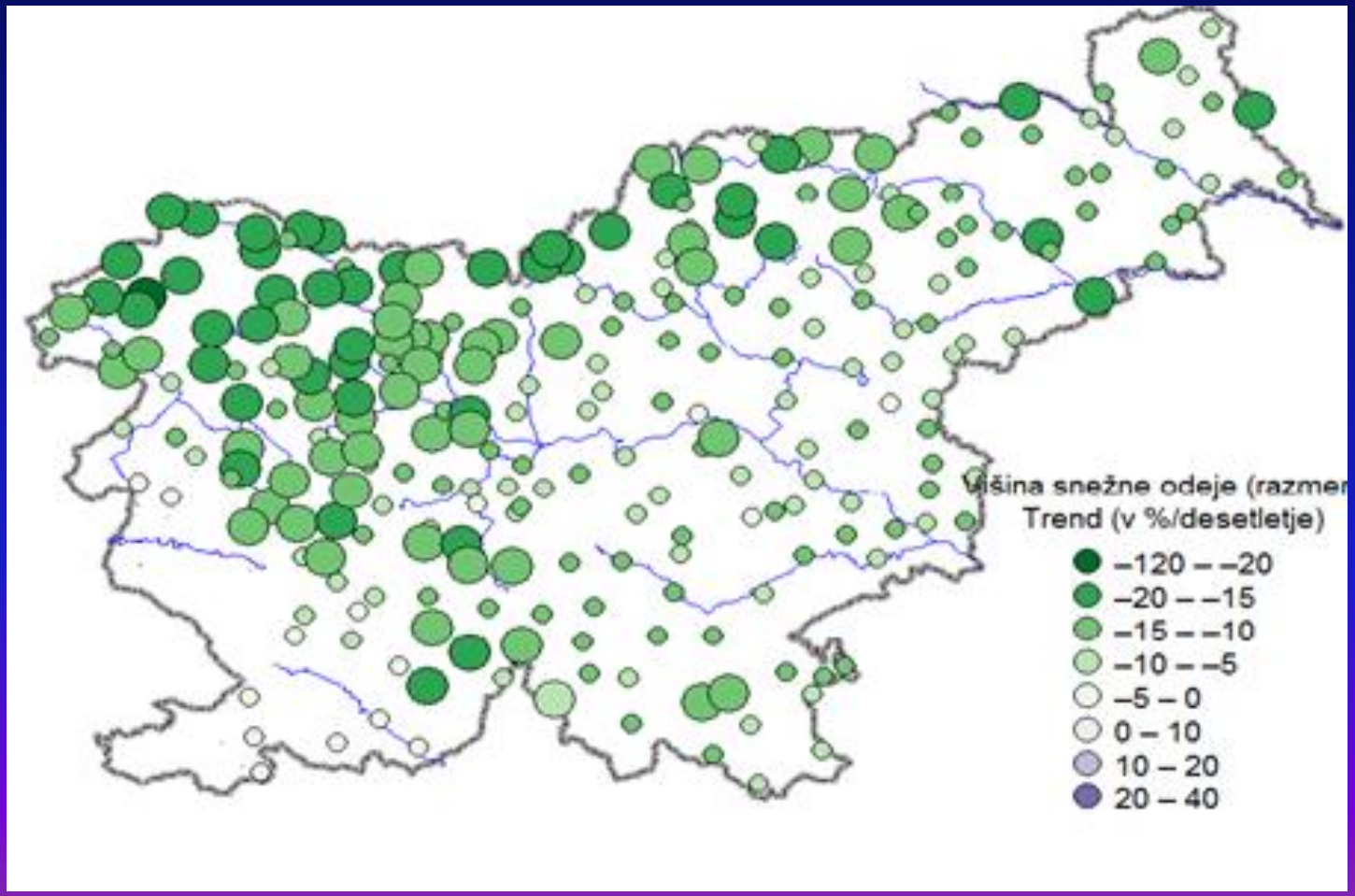
There is significant change in annual precipitation amount in the western part of the country.



Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Detected snow cover change

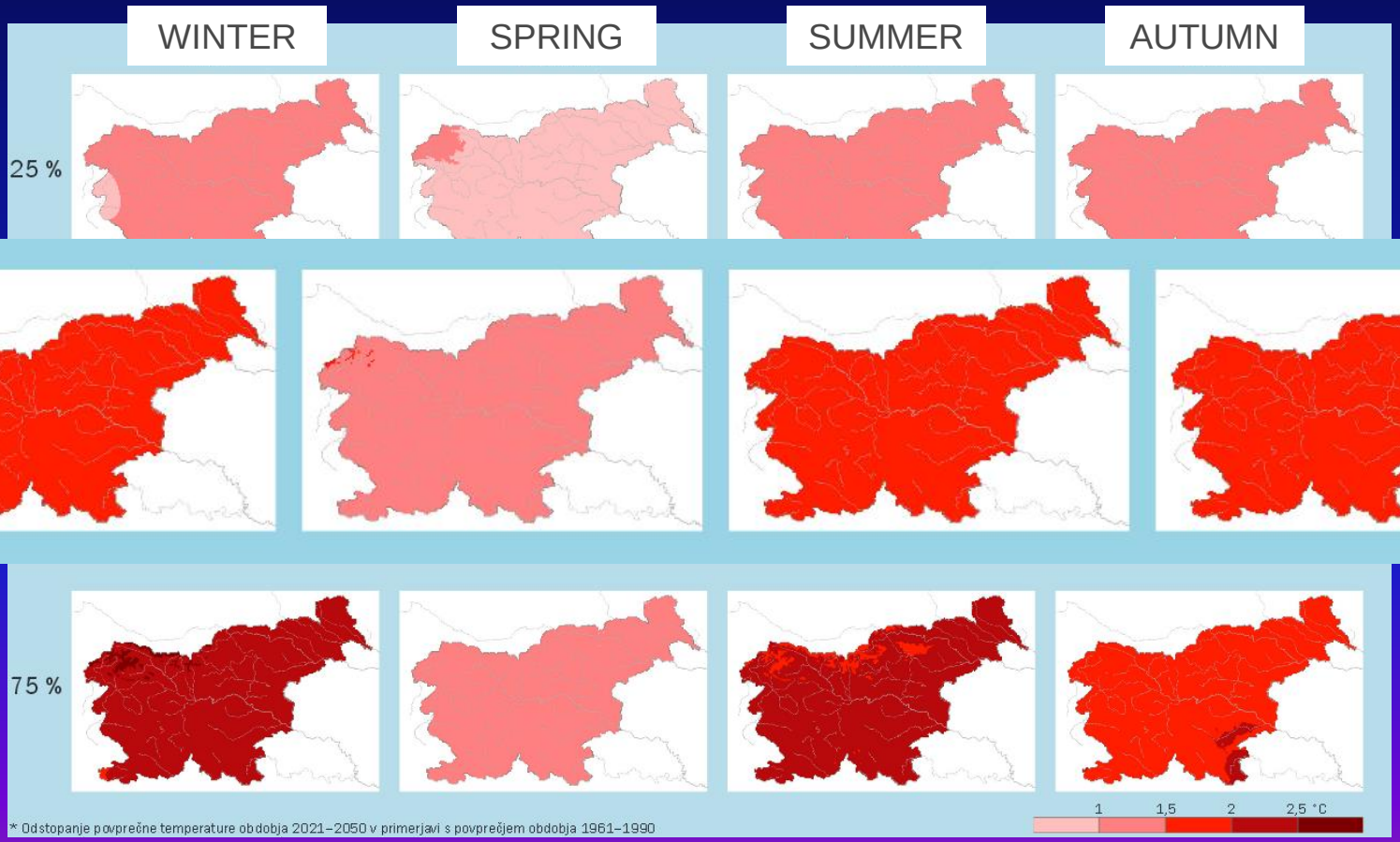
Snow depth has significantly decreased on more than a half precipitation stations, especially in higher region



Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Future temperature conditions

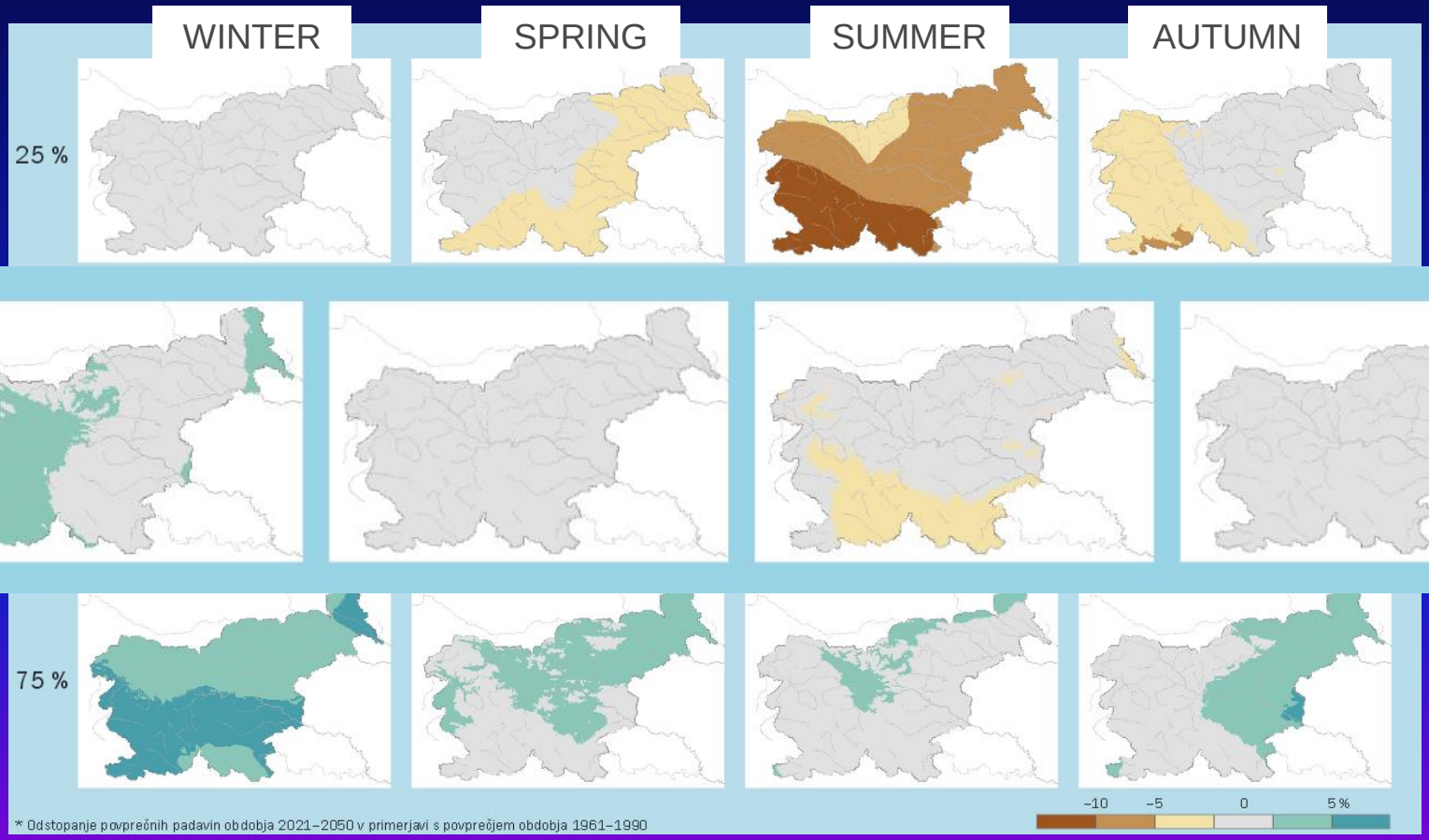
Mean annual temperature rise in the period 2021–2050 compared to the 1961–1990 mean



Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Future precipitation conditions

Mean annual precipitation change in the period 2021–2050 compared to the 1961–1990 mean



Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Expected future climate extremes in Slovenia

- Longer and stronger (summer) heat waves
- Higher temperature and precipitation variability in summer
- Higher frequency with favourable conditions for storms

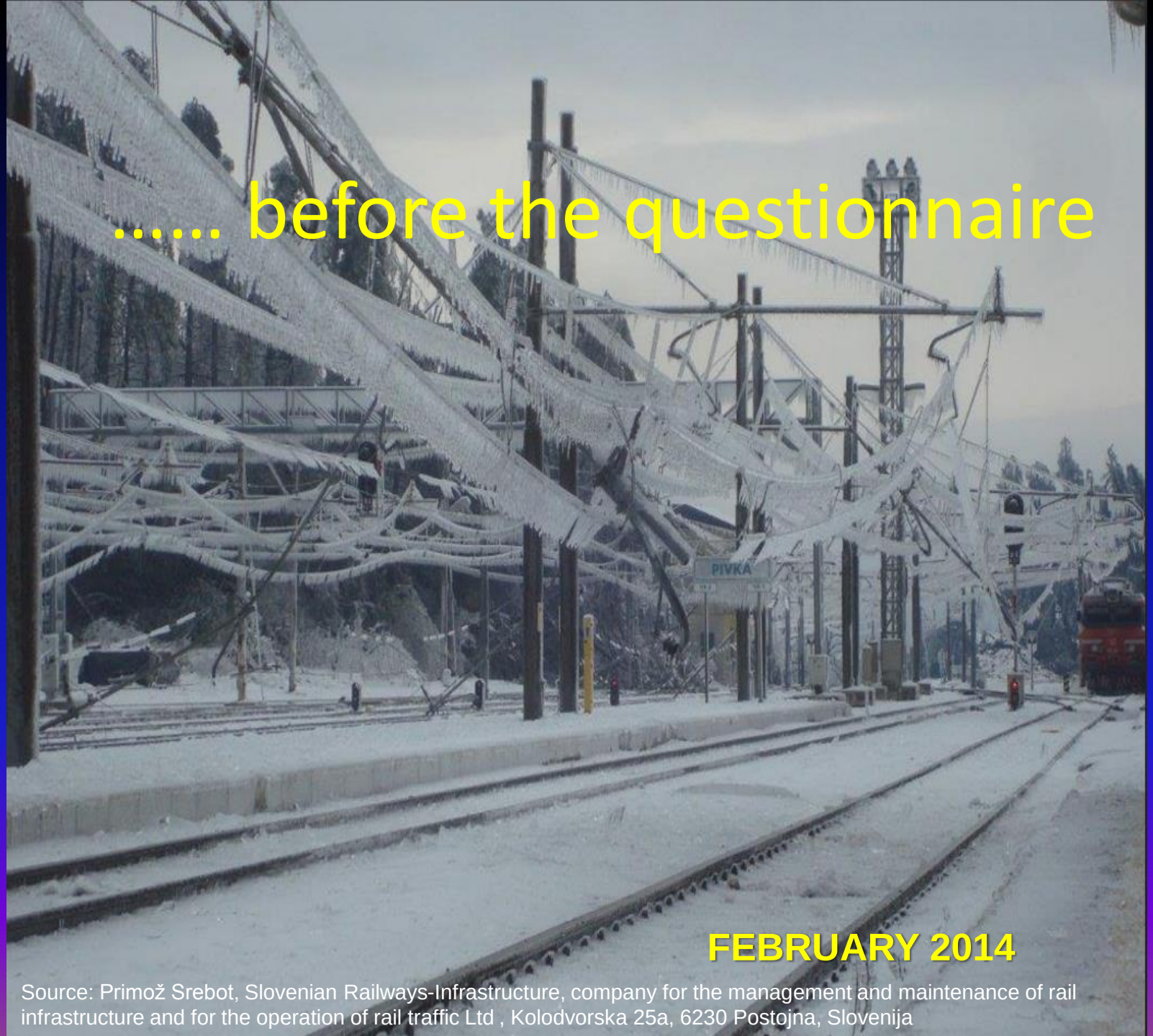
Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office

Expected future climate extremes in Slovenia

Strengthening of hydrological cycle

- Higher frequency of strong precipitation events (higher water vapour content)
- 100-years floods would become more frequent
- Higher frequency of summer droughts

Source: Mojca Dolinar, Head of Department for Meteorological application, Slovenian Environment Agency, Meteorological Office



…… before the questionnaire

FEBRUARY 2014

Source: Primož Srebot, Slovenian Railways-Infrastructure, company for the management and maintenance of rail infrastructure and for the operation of rail traffic Ltd , Kolodvorska 25a, 6230 Postojna, Slovenija

Source: http://dlz.ilbis.com/zled-v-sloveniji-2014/

Question 1. To which extent do you consider climate change and/or extreme weather events to be a problem for transport in your country/region (on a scale of 1–10)

- Slovenia is a mostly mountainous country.
- The climate conditions with frequent extreme weather events influenced the planning and use of the transport infrastructure.
- The problem of climate change impacts is assesed as relatively small (3).

TEN-T network: Critical infrastructure

- Strong impact on national and international transport

Source: http://ec.europa.eu/transport/themes/infrastructure/ten-t-guidelines/doc/ten-t-country-fiches/si_sl.pdf

Question 3. Do your Government / organization plan any investments in the next 5 years in the above mentioned critical infrastructure?.....

- The focus of the investments is on the elimination of bottleneck situations, increase of capacity, achievement of the TEN-T standards, increase of traffic safety, etc.
- In the planning of investments, the climate change impacts have to be considered.

Question 4. Which of the following weather or climate related factors have impacted your critical infrastructure mentioned above
- case: railways -

- Precipitation / landslides
- Strong winds / damaged d trees fall on the railway tracks
- High temperatures / fires along the track – dry vegetation catches fire (as a result of burning waste when braking) and track deflections
- Low temperatures / track fractures, the formation of icicles in tunnels and formation of glaze ice (difficulties for electric trains – glaze ice does not conduct electricity) – diesel locomotives are necessary.

Question 5. Over time, has the magnitude of damage and/or disruption caused by weather or climate related events:

- Increased
  - Embankment erosion
  - Slope stability
- More or less the same
  - Wind
  - Fog
  - Icing/low temperatures
  - Slope stability (

Question 6. Have users of the critical infrastructure requested implementation of effective response measures?

- Yes
- After floods, accidents caused by fog and restrictions due to wind

Question 8. Is there information available on the following climate change impacts that have affected or will potentially affect critical infrastructure in your country/region/organization?

- All the information as asked in the questionnaire are available
- Highways / By means of its weather stations, DARS as the network manager closely monitors in particular the temperatures in winter for reasons of timely action and wind speed in certain areas in order to restrict the transport in due time.
- Highways / Risk analyses for individual infrastructure projects are based on the "Climate Change in Slovenia – Climate Bases for Preparation of Risk Assessment and Opportunities that Climate Change Brings for Slovenia – Report 1 (version 2)), (ARSO, Ljubljana, December 2014) and on the data from the website of the European Environmental Agency http://www.eea.europa.eu/themes/climate/european-climate-adaptation-platform-climate-adapt.

Question 9. If yes, have the observed trends already necessitated or will require adaptation responses?

- The described trends have always required adaptation. The cooperation of the network managers with the competent meteorological services, which ensures timely notification of extreme weather events, is efficient.
- The highway network has already been built on the basis of data on past weather events. Therefore, special additional measures, with the exception of prompt response to possible critical weather situations, are not necessary.

Question 11. Are downscaled forecasts or assessments available for your critical infrastructure regarding the following climate forcings and factors? If so, at which time scale? (Check all that apply)

Factor/forcing	*10 years*	*30 years*	*50 years*	*> 50 years*	*Not available*
Precipitation (average/extreme precipitation) and floods		X	X		
Temperature (averages and extremes)		X	X		
Winds (e.g. average and extremes, number of days of high winds)					X
River water levels					X
Coastal sea levels and storm waves/surges					X

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Question 12. At which thresholds do you expect that the integrity and functionality of the critical infrastructure of your country/region/organization will be significantly impaired?

Railways¶

Extreme precipitation [mm/day]	-
Extreme temperatures (high, in C0]	Above 30
Extreme temperatures (low, in C0]	Below -10
Exrtreme wind speed [in km/hr]	Above 100 km/h
Extreme river water level (high in metres)	
Extreme river water level (low in metres)	
Extreme coastal water levels/storm surges (in metres)	
Highways	
Extreme precipitation [mm/day]	Above 200 mm/day

Question 12. At which thresholds do you expect that the integrity and functionality of the critical infrastructure of your country/region/organization will be significantly impaired?

Highways¤	¤	¤
Extreme·precipitation·[mm/day]¤	Above·200·mm/day¤	¤
Extreme·temperatures·(high,·in·C0]¤	¤	¤
Extreme·temperatures·(low,·in·C0]¤	¤	¤
Exrtreme·wind·speed·[in·km/hr]¤	Above·100·km/h·for·heavy·goods·vehicles·and·above·150·km/h·for·all·other·vehicles¤	¤

Question 14. Do you expect that the critical infrastructure in your country/region /organization will be (indirectly) affected by weather and/or climate induced changes to the following? (Check all that apply)

Migration trends and population settlement patterns affecting capacity	NO
Changes in energy demands	NO
Agricultural production changes	NO
Industrial production changes	NO
Transport modal shifts	YES
Competition issues or trade diversion to other networks/nodes	YES
Supply chain disruptions	YES
Labour shortages	YES
Other (please specify)	

Question 15. Has any of the critical infrastructure mentioned above ever been impacted by weather and/or climate related factors, including extreme events? If yes, indicate the type and extent of impact (check all that apply):

- *Railway infrastructure:*
  - *High and low temperatures constitute a problem on average for 1 month within a period of one year*
  - *Large amounts of rain for 1-7 days within a period of 2-3 months*
  - *Large amounts of snow for 1-7 days within a period of one year*
  - *Wind with snowdrifts constitutes a problem from 1-10 days within a period of one year*
  - *In the period from 30 January to 7 February 2014 (9 days), glaze ice constituted an extreme problem* ***(in such intensity, it cannot be referred to as a regular annual event).***

Railway infrastructure: Extreme events
Glaze ice in 2014: the Borovnica–Pivka railway line (50 km) was paralyzed for 1 week

Source: Primož Srebot, Slovenian Railways-Infrastructure, company for the management and maintenance of rail infrastructure and for the operation of rail traffic Ltd., Kolodvorska 25a, 6230 Postojna, Slovenija

Railway infrastructure: Extreme events
Landslide on the line Divača – Koper 2013

Railway infrastructure: Extreme events

High sea water level – in 2011, the entire Koper freight station was flooded by as much as 30 cm above the tracks.














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Highway infrastructure: Extreme events

Source: www.siol.net

Source: www.24ur.com

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Question 16. Has your Government / organization mainstreamed weather and/or climate related considerations in planning, design and construction of transport infrastructure? If yes please specify.

- Weather conditions are considered in the planning of the transport infrastructure, as already determined by the natural conditions in the country
- All analyses and assessments of future conditions are regularly monitored, which will also serve as the basis for the adoption of additional measures.

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Question 17. Which (hard or soft) adaptation measures involving the critical infrastructure of your country/region/organization do you consider effective, good value for money and an example of best practices?

- New construction, infrastructure modernization, larger investments in regular maintenance (limited by resources available)
- Good weather prediction, snow/wind fences on highways

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Question 18. Please provide any other information you consider relevant.

- Climate scenarios for Slovenia on local level are prepared for the A1B (IPCC SRES) scenario until the mid-century for average climate conditions only
- New scenarios for the new IPCC GHG emissions (RCP4.5 and RCP8.5) are under preparation and will presumably be finished at the end of 2017

This presentation has been prepared in coperation with

- Ministry of Infrastructure, Republic of Slovenia
- Slovenian Railways
- DARS, Motorway Company in the Republic of Slovenia
- Slovenian national building and civil engineering institute
- Port of Koper
- DRI Investment Management, Company for Development of Infrastructure Ltd.

Thank you for your atention!

Ministry of Infrastructure
Langusova 4, 1000 Ljubljana
Republic of Slovenia
Phone: +386 1 478 8319 | Fax: +386 1 478 81 41
E-mail: fedor.cerne@gov.si

Fedor Černe, PhD