

Isotopic composition of Slovenian precipitation: *A 10 year record at station Portorož*

Polona Vreča⁽¹⁾, Ines Krajcar Bronić⁽²⁾, Albrecht Leis⁽³⁾

⁽¹⁾ Jožef Stefan Institute, Department of Environmental Sciences, Ljubljana, Slovenia

⁽²⁾ Ruđer Bošković Institute, Zagreb, Croatia

⁽³⁾ Institute of Water Resources Management, JOANNEUM RESEARCH, Graz, Austria

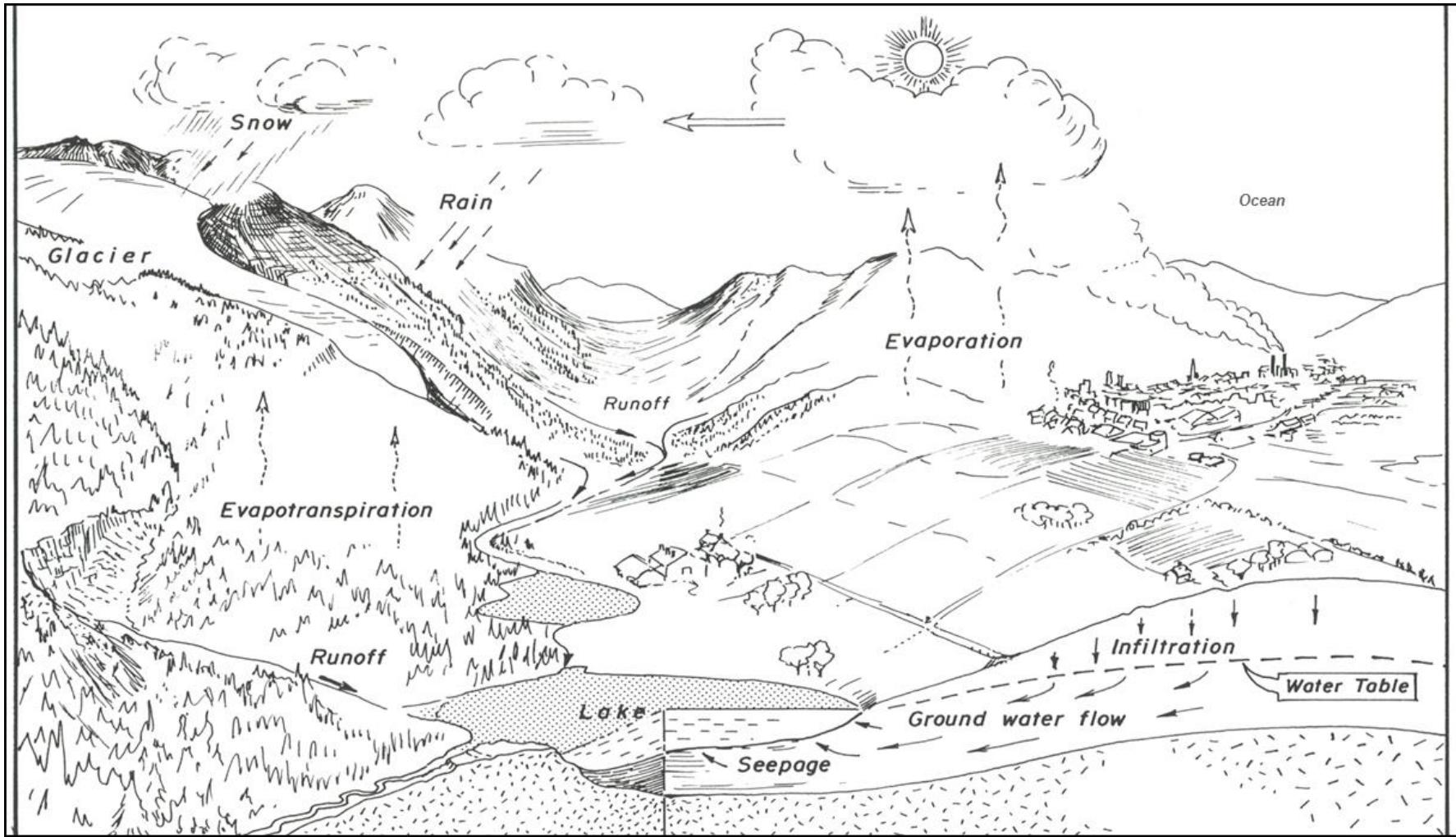


Dynamics of Biogeochemical Systems: Processes and Modeling
The 22nd International Symposium on Environmental Biogeochemistry

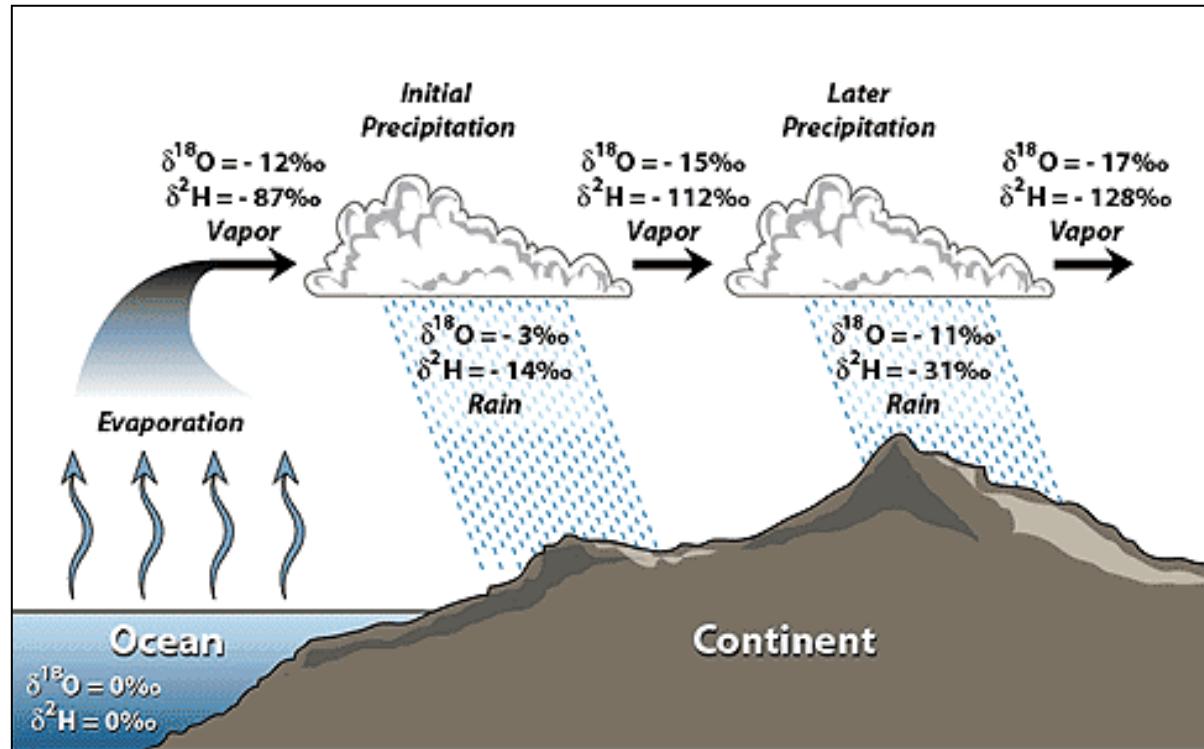
Piran, Slovenia, September 28 – October 2 2015

Introduction

- Water is a unique resource.



Isotopes as water cycle tracers – isotopic fractionation in precipitation

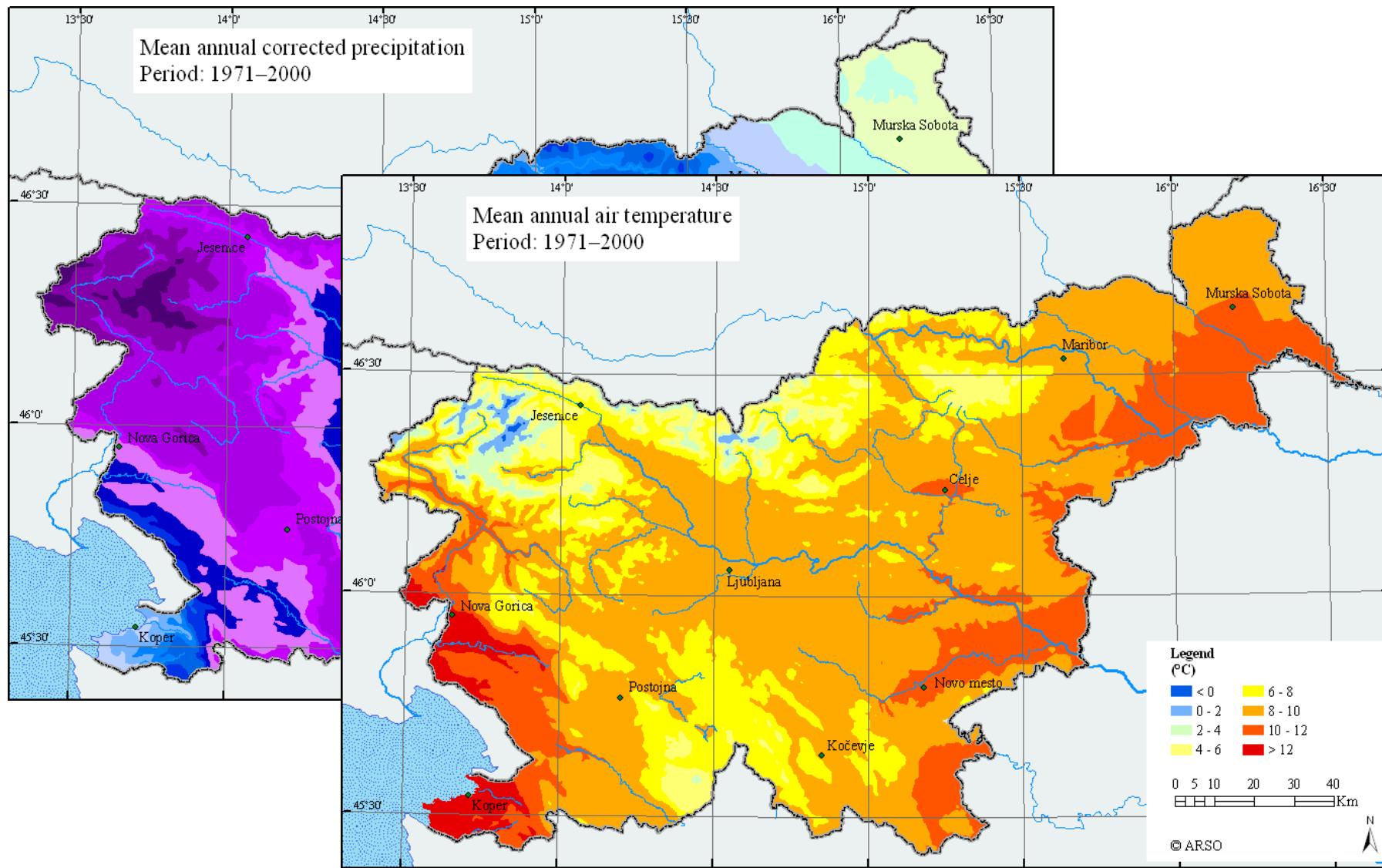


The observed variations of stable isotopic composition of H and O in natural waters are closely related to isotopic fractionation occurring during the evaporation and condensation of water, when the heavy water molecules preferentially remain in or pass into the liquid (solid) phase.

Introduction

- Global Network of Isotopes in Precipitation (GNIP database) organized by International Atomic Energy Agency (IAEA) and World Meteorological Organisation (WMO)
http://www-naweb.iaea.org/napc/ih/IHS_resources_gnip.html
- Use of GNIP data for:
 - Monitoring atmospheric thermonuclear test fallout through levels of tritium – initially, in 1961;
 - Hydrologic investigations of water resources as observation network of stable H and O isotope data – after 1970;
 - Verifying and improving atmospheric circulation models;
 - Studying climates, interactions between water in the atmosphere and biosphere;
 - Providing baseline information for the authentication, migration and forensic studies.

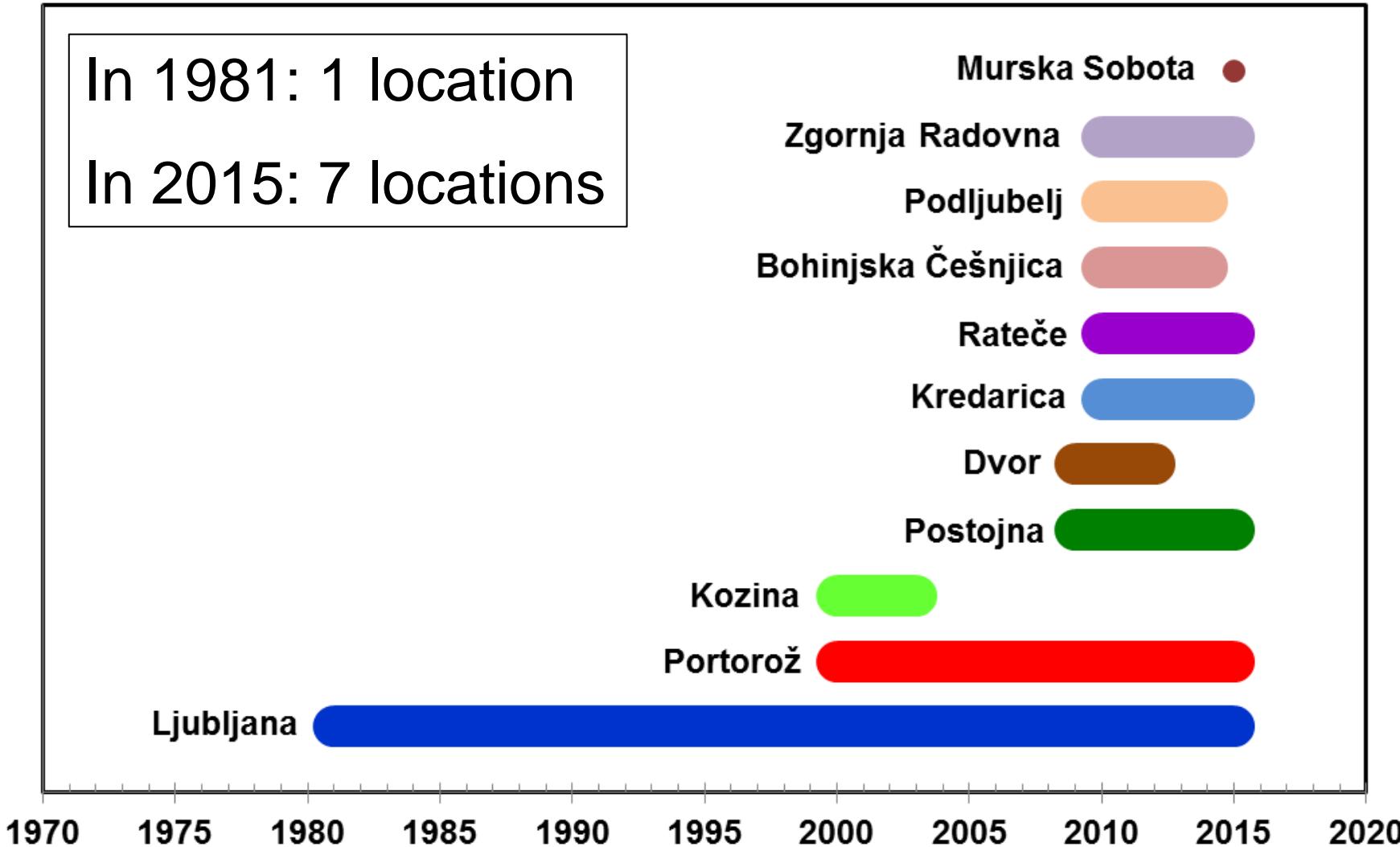
Mean annual corrected precipitation and annual air temperature; 1971–2000



Sampling locations in Slovenia

In 1981: 1 location

In 2015: 7 locations



Sampling location Portorož Airport

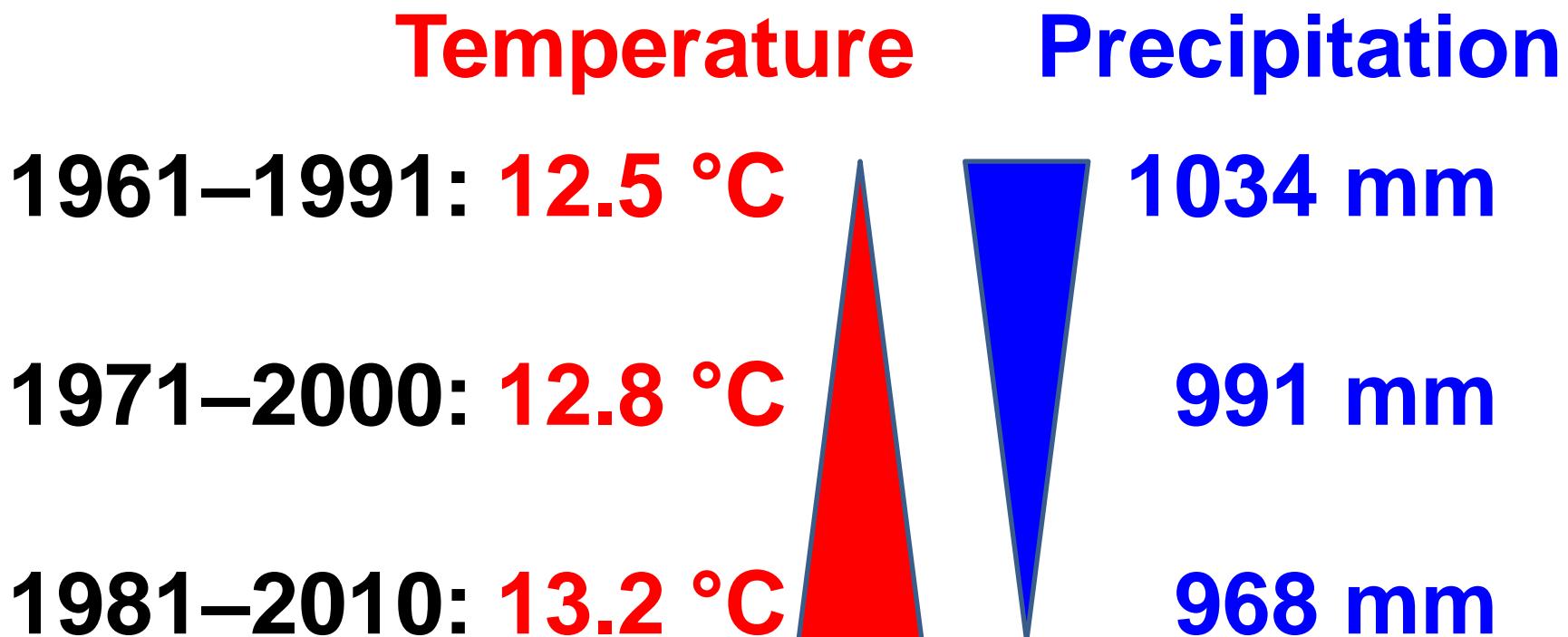
- Synoptic station, part of Slovenian national meteorological network, Slovenian Environment Agency (SEA)
- $45^{\circ}28'N$, $13^{\circ}37'E$; 2 m a.s.l.



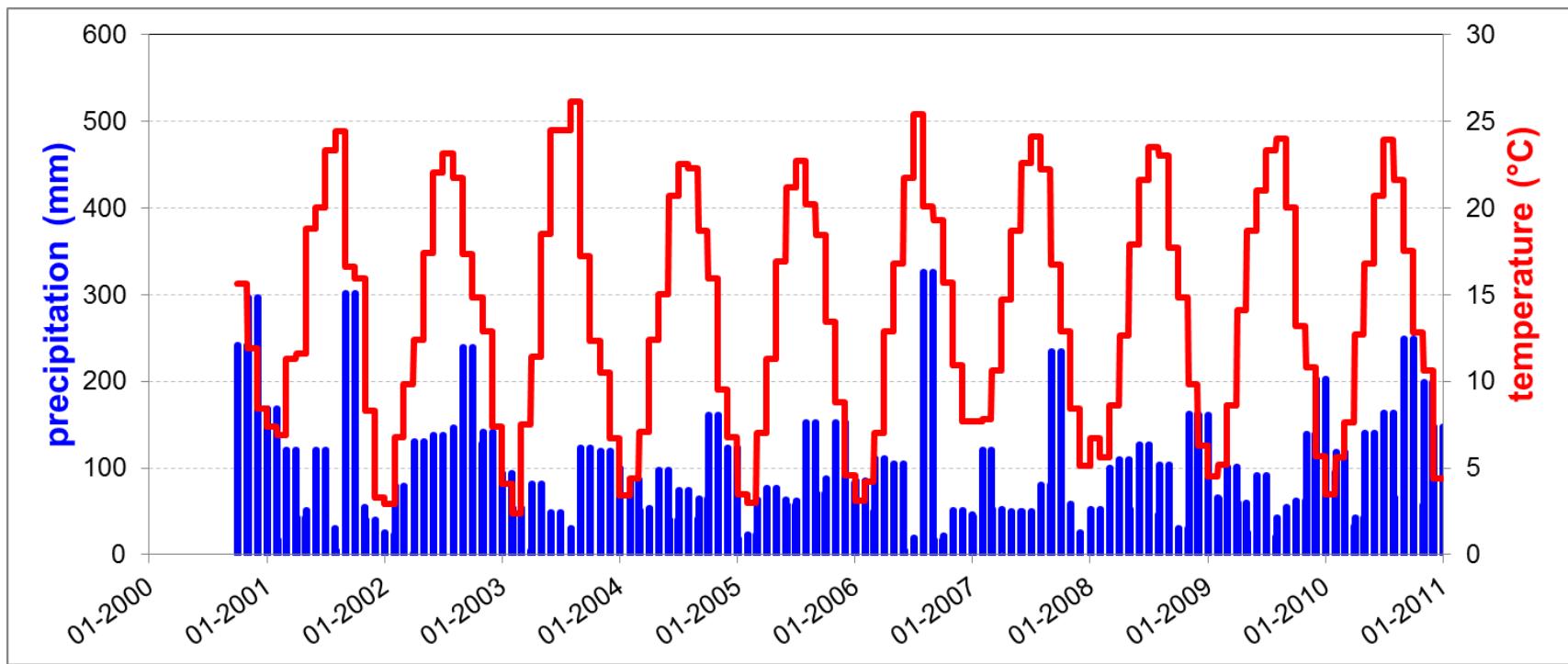
Sampling & Analysis

- Since 2000 sampling is performed by staff of SEA
- Monthly composite precipitation samples
- In the lab:
 - 50 mL for the stable isotope analysis ($\delta^{18}\text{O}$, $\delta^2\text{H}$)
 - 1L (or less) for tritium analysis (${}^3\text{H}$)
- Stable isotopes determined at JSI or JR by IRMS; results reported as δ values in per mil (‰)
- Tritium determined at RBI by GPC or LSC; results in Tritium Units (1 TU = 0.118 BqL⁻¹)
- Meteorological data obtained from SEA
<http://meteo.ars.si/>

Temporal changes at Portorož

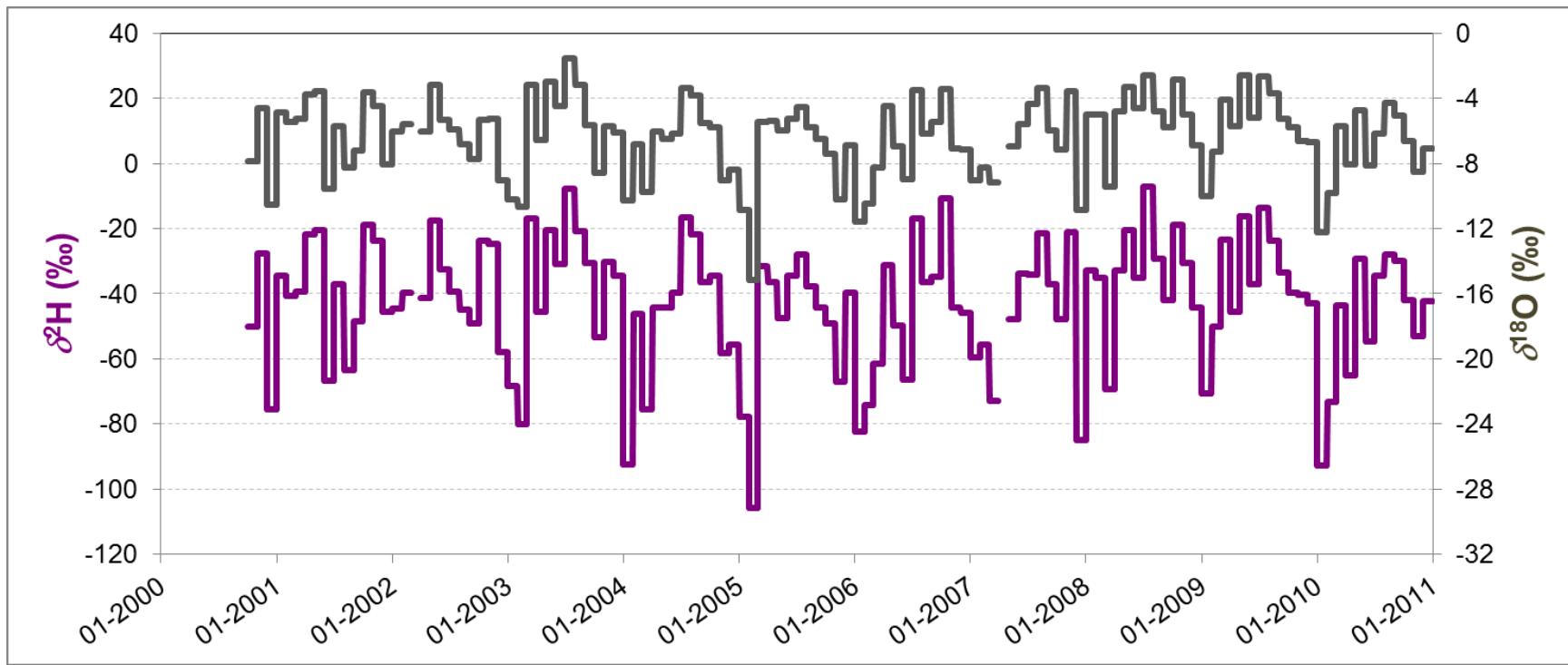


Climate diagram – period 2000–2010



Precipitation 2001–2010: 974 mm
Temperature 2001–2010: 13.7 °C

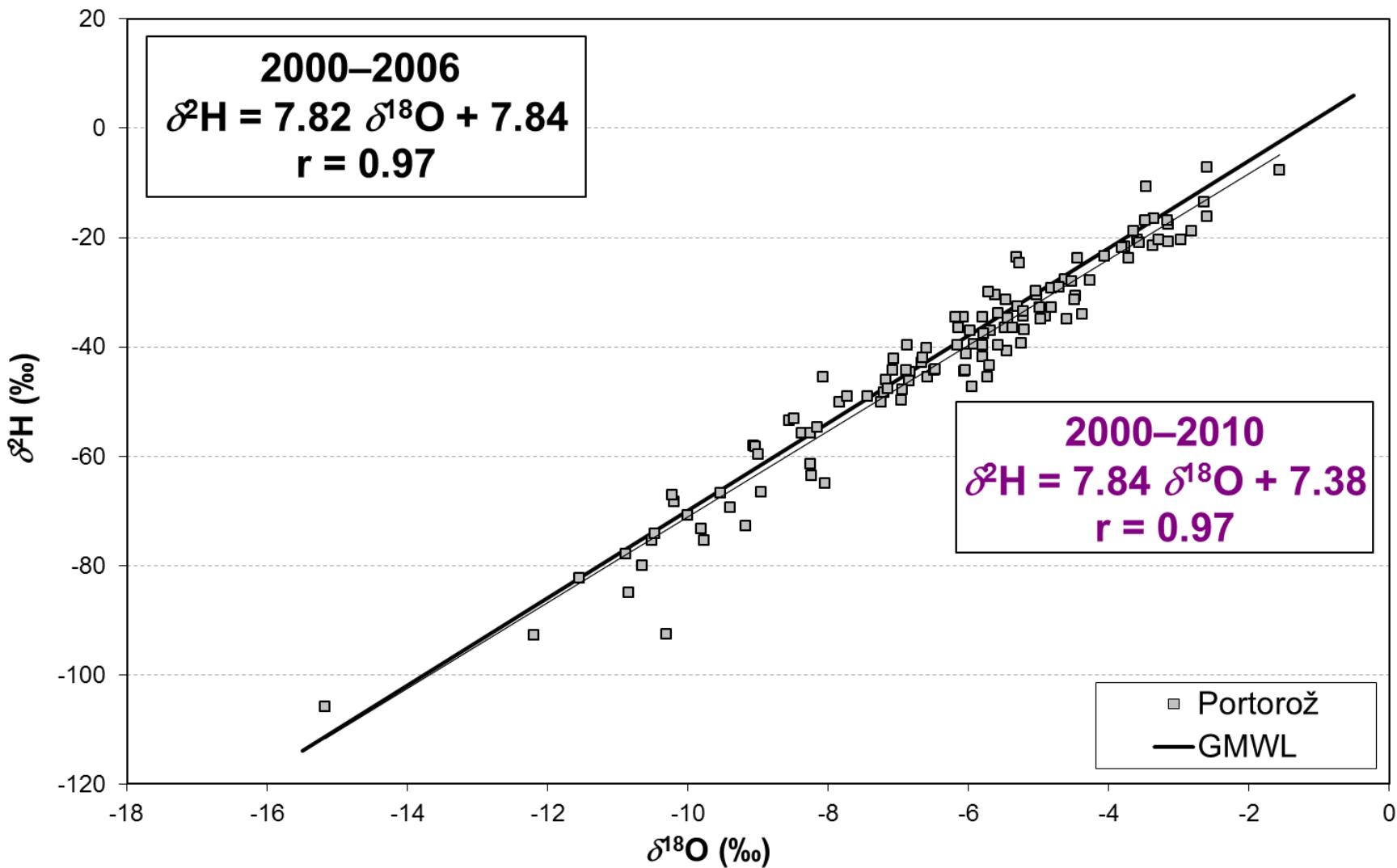
Results O & H – period 2000–2010



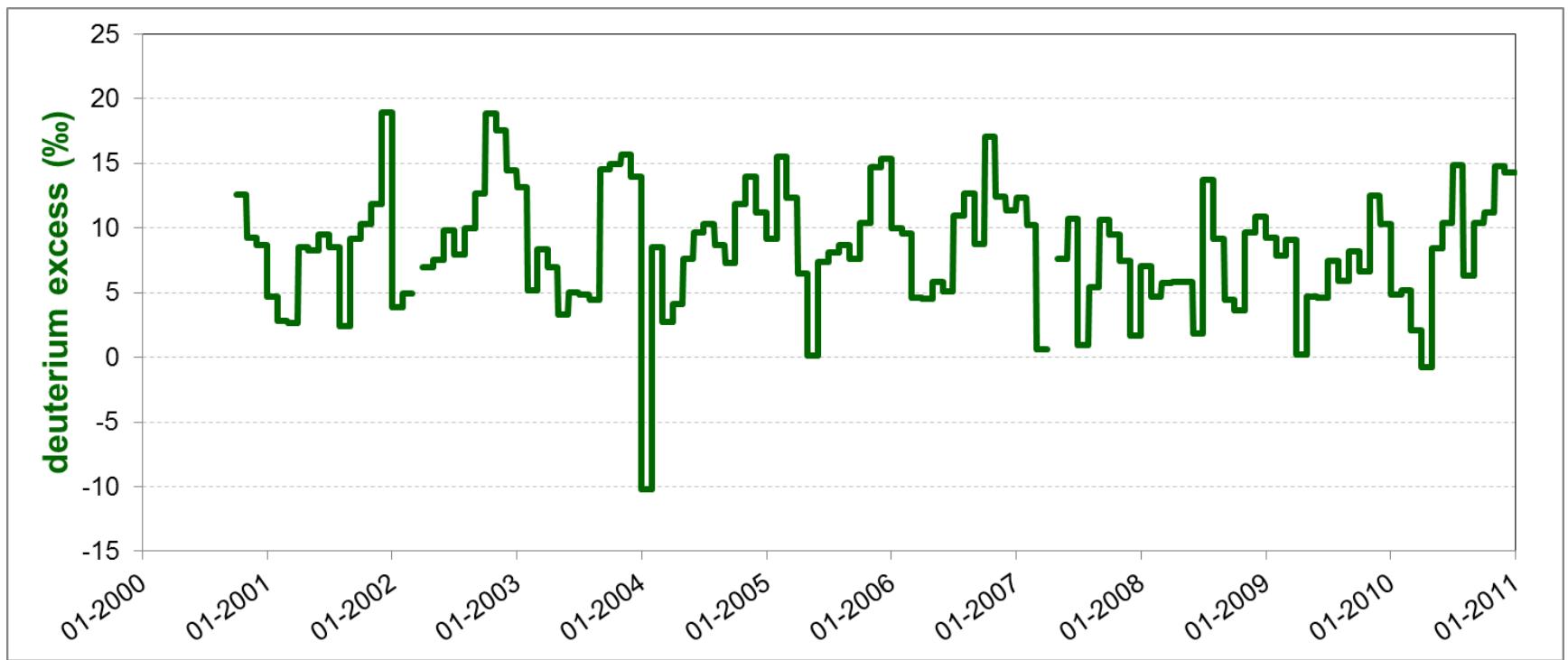
$\delta^{18}\text{O}$ 2001–2010: -6.5 ‰ (-6.6 ‰)
 $\delta^2\text{H}$ 2001–2010: -43 ‰ (-43 ‰)

(results for 2001–2006 period, Vreča et al 2011)

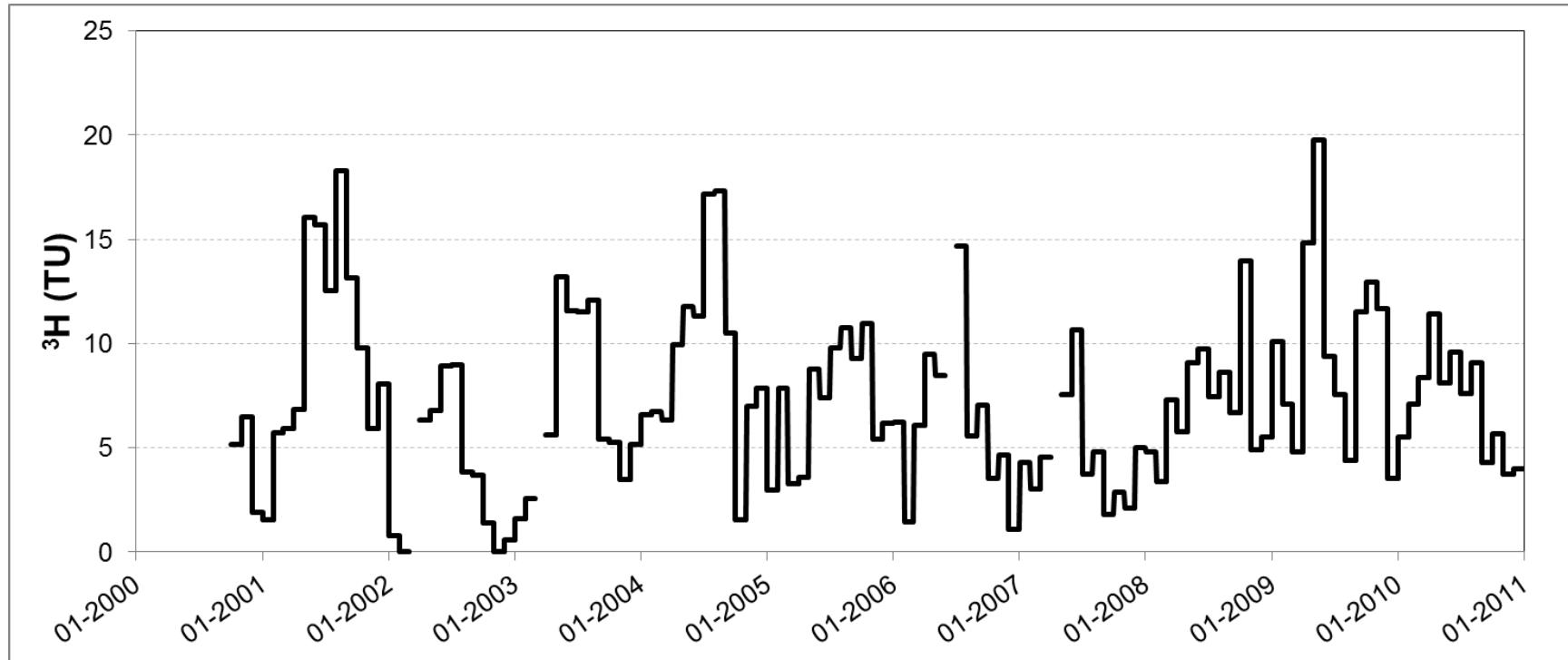
Results O & H – period 2000–2010



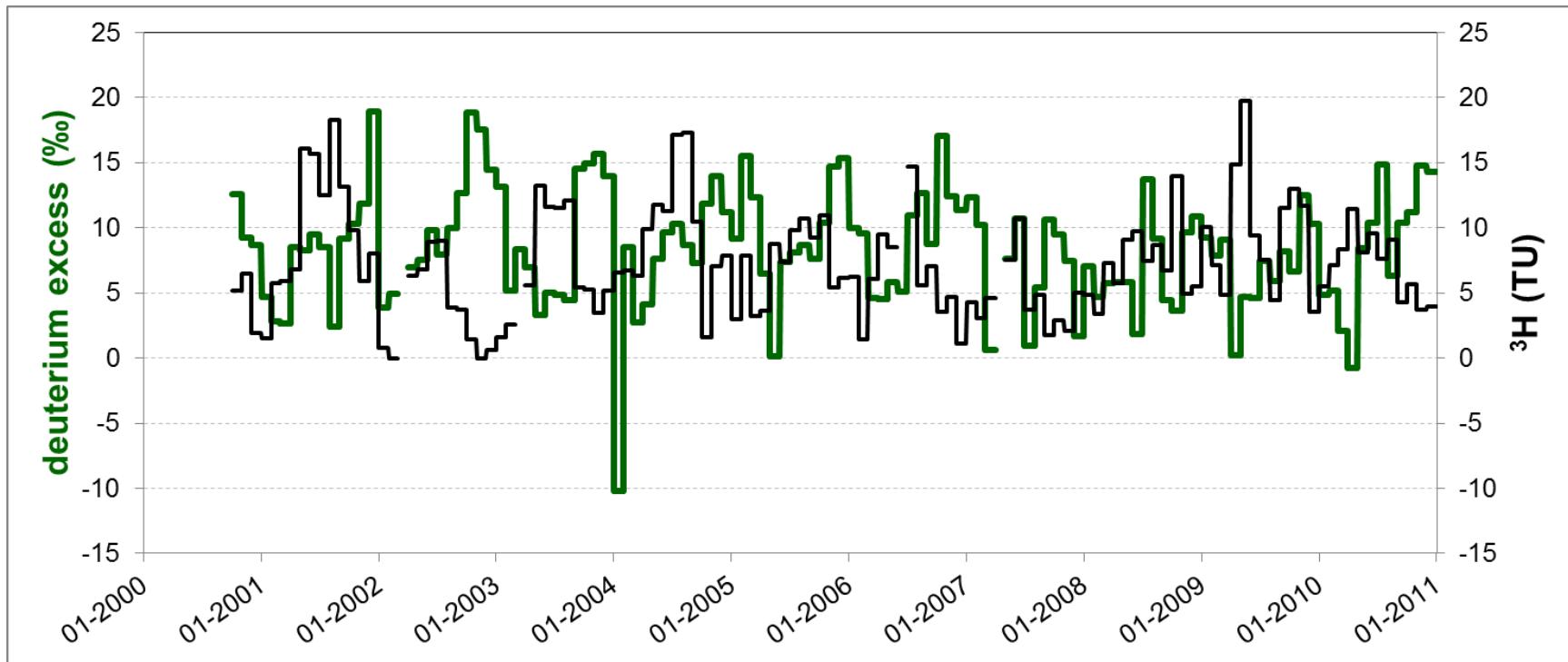
Results d – period 2000–2010



Results ${}^3\text{H}$ – period 2000–2010



Results d & ${}^3\text{H}$ – period 2000–2010



Deuterium excess 2001–2010: 8.8 ‰ (9.8 ‰)
Tritium 2001–2010: 6.7 TU (6.9 TU)

(results for 2001–2006 period, Vreča et al 2011)

$\delta^{18}\text{O}$ vs T – temperature coefficients

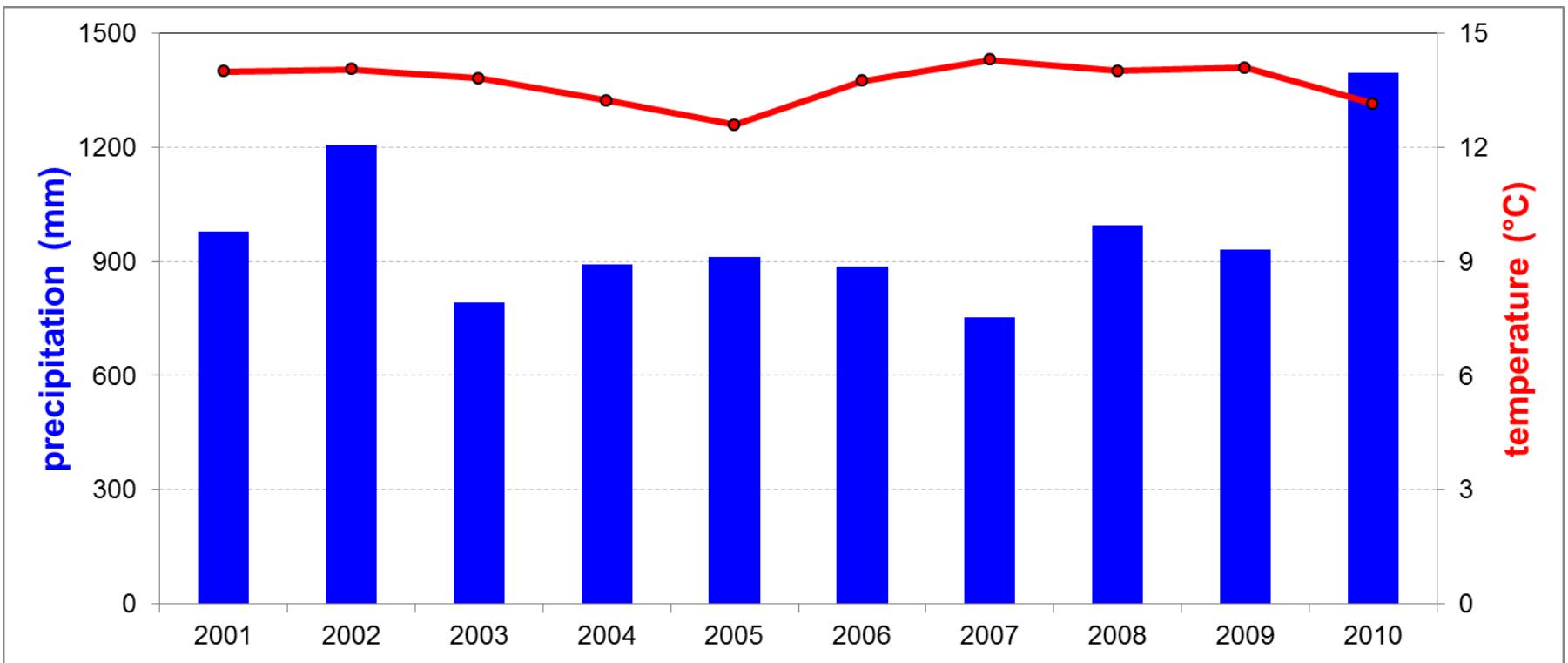
Slope	Intercept
2001–2003: 0.11 ‰ per °C	-7.4 (n=35, r=0.36)
2001–2006: 0.19 ‰ per °C	-9.2 (n=74, r=0.54)
2001–2010: 0.20 ‰ per °C	-9.1 (n=121, r=0.57)

Typical slope of maritime stations with smaller temperature variations during the year and a mean temperature higher than 10°C (Rozanski et al 1993).

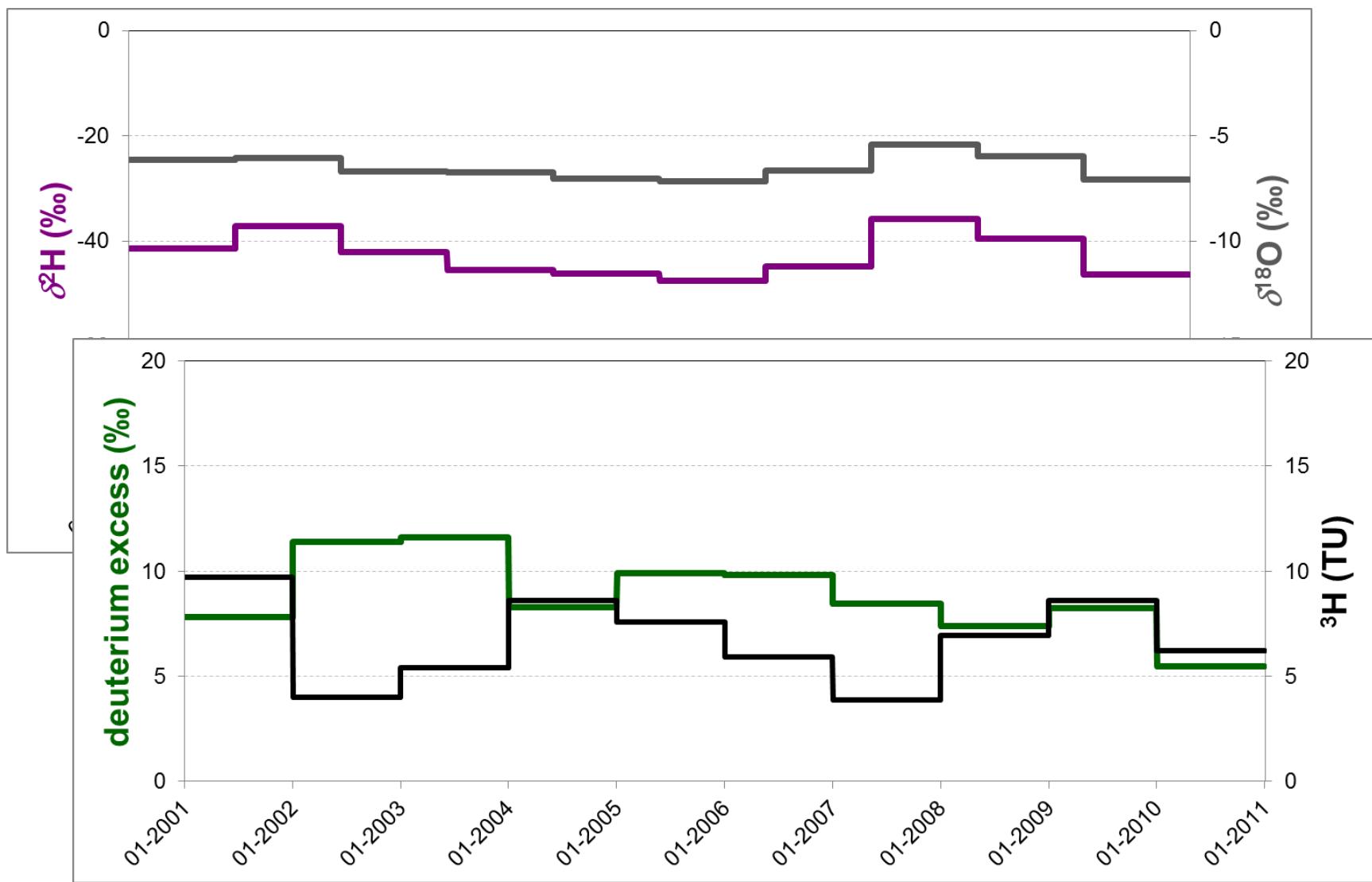
results for 2001–2003 period, Vreča et al 2006

results for 2001–2006 period, Vreča et al 2011

Results P & T – period 2001–2010



Isotope results – period 2001–2010



Acknowledgement

- Thanks to all colleagues who helped with sampling and analysis, particularly the staff of the meteorological station at Portorož Airport, S. Žigon, Z. Trkov, S. Lindbichler, B. Obelić, N. Horvatinčić, J. Barešić, A. Rajtarić, L. Gourcy and the staff of the Isotope Hydrology Section Laboratory of the IAEA
- The work was financially supported by the Slovenian Research Agency (P0-0531-0106, P1-0143, BI-HR/01-03-011, BI-HR/09-10-032), the IAEA CRP F31002 and Forschung Austria