THE GLOBAL NETWORK OF ISOTOPES IN RIVERS (GNIR)

INTEGRATION OF WATER STABLE ISOTOPES IN RIVERINE RESEARCH AND MANAGEMENT

IAEA Water Resources Programme

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The Global Network of Isotopes in Rivers (GNIR) is a global environmental observation programme, which serves as an essential world-wide repository for riverine isotope data and facilitates public dissemination of contributed riverine isotopic data. GNIR is a complimentary programme to the IAEA's well-established Global Network of Isotopes in Precipitation (GNIP).

What is the aim of GNIR?

- Collect and disseminate time-series and synoptic collections of riverine isotope data from the world's rivers (Fig. 1);
- It relies upon voluntary partnerships with institutions and researchers for riverine sample collections and isotopic analyses (Fig. 2);
- GNIR is publicly accessible through the Water Isotope System for Data Analysis, Visualization and Electronic Retrieval (WISER) interface at https://nucleus.iaea.org/wiser.

What can river isotope observation tell us?

- The stable isotope ratios of the water molecule ($^{18}O/^{16}O$, $^{2}H/^{1}H$) are powerful recorders of river recharge sources (direct precipitation, runoff, soil water, groundwater, lakes, snow, and ice) (Fig. 3);
- Long-term patterns of isotopes in rivers generally correlate with that of local precipitation but can also deviate significantly, indicating important hydrological processes (e.g. water sources mixing, evaporation) in the catchment (Figs 3 and 4);
- Variations of the isotopic composition over time can trace changes in hydrological processes, but also human and environmental impacts occurring between rainfall input and river discharge (Fig. 5).

Get involved in GNIR

At the IAEA, we are happy to receive archived, published data, and new proposals for GNIR stations. To propose a new GNIR station, please contact the GNIR team (gnir@iaea.org). The IAEA may provide support to GNIR stations by providing bottles or by analysing water stable isotopes at the Isotope Hydrology Laboratory in Vienna.

Fig. 1. GNIR Stations.

The figure shows the 2730 GNIR sampling sites for water stable isotopes from 56 countries, covering all continents. The GNIR database covers rivers of all lengths and sizes, including lakes and reservoirs falling within the course of rivers. Sampling sites are either a part of synoptic, longitudinal, or time-series studies.

Fig. 2. GNIR sampling.

Water samples are usually taken monthly as grab samples. Fig. 2 shows GNIR sampling in the Red River Delta, Viet Nam (Photo: Trinh Anh Duc).

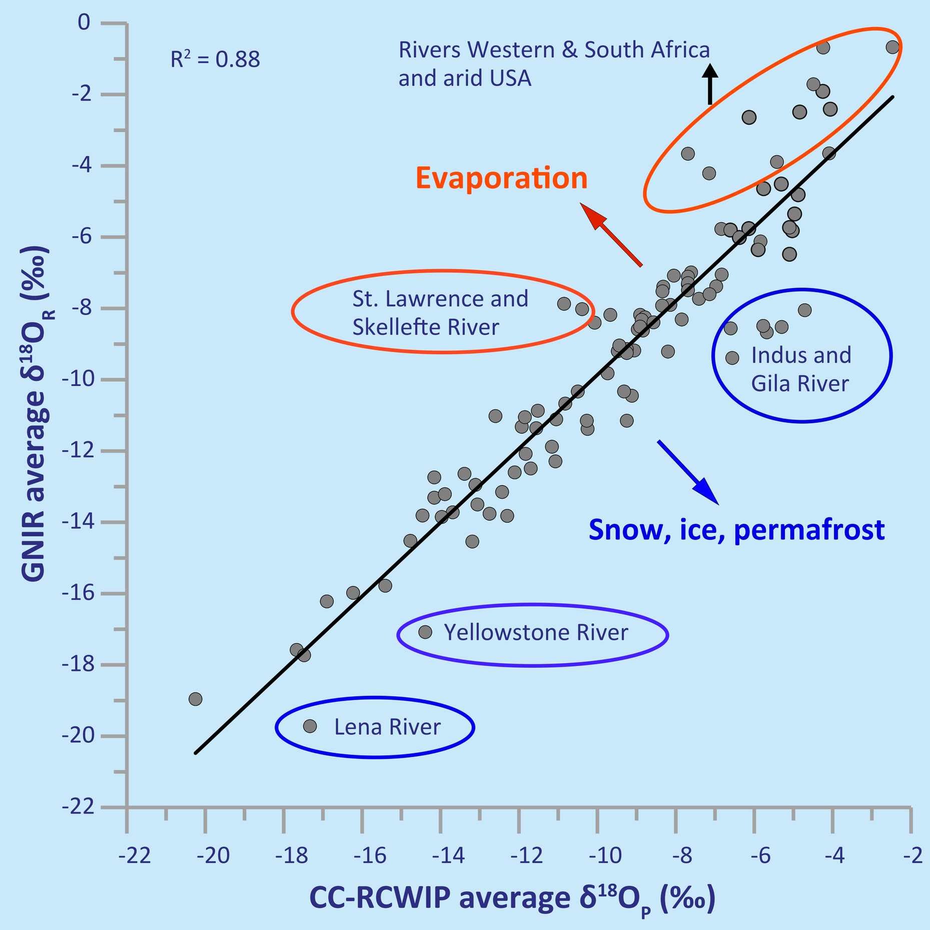

Fig. 3. Comparison of measured and modelled catchment isotope data.

This figure depicted the comparison between the predicted amount-weighted upstream catchment precipitation ($\hat{\delta}^{18}O_P$) against measured (un-weighted) isotopic composition at the GNIR river observation stations ($\bar{\delta}^{18}O_R$). The application of the CC-RCWIP model is described in detail in Terzer et al. (2013) and Halder et al. (2014). GNIR stations for which the CC-RCWIP predicted overly positive $\delta^{18}O$ values indicated that stored water sources from permafrost, snow, and glacier melt-water, were comparatively important contributors to the river-runoff. For river stations where CC-RCWIP predicted $\delta^{18}O$ values that were more negative than observed, the results reveal important evaporation processes.

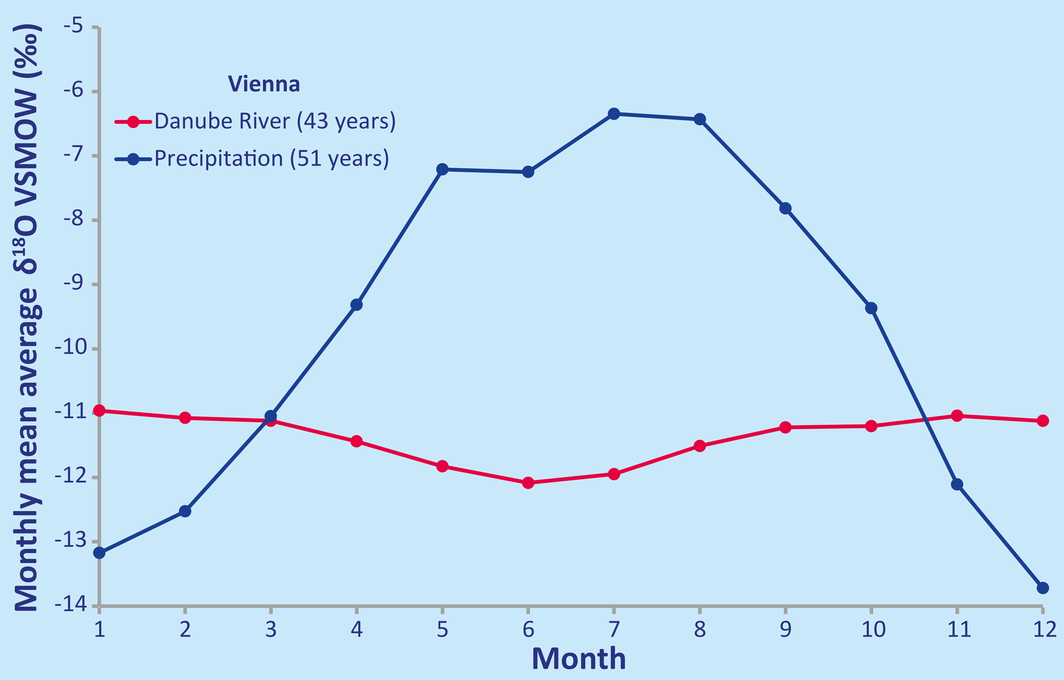

Fig. 4. Isotopic composition of precipitation and Danube River water in Vienna.

This figure compares the monthly mean average of the stable oxygen isotope composition ($\delta^{18}O$) of Danube River water (red) and precipitation (blue) in Vienna. The difference between both can be explained by the mixing of (1) river baseflow (well mixed summer and winter precipitation) and (2) snow melt (delayed run-off of winter precipitation). Data are taken from Seibersdorf research: IAEA/ZAMG.

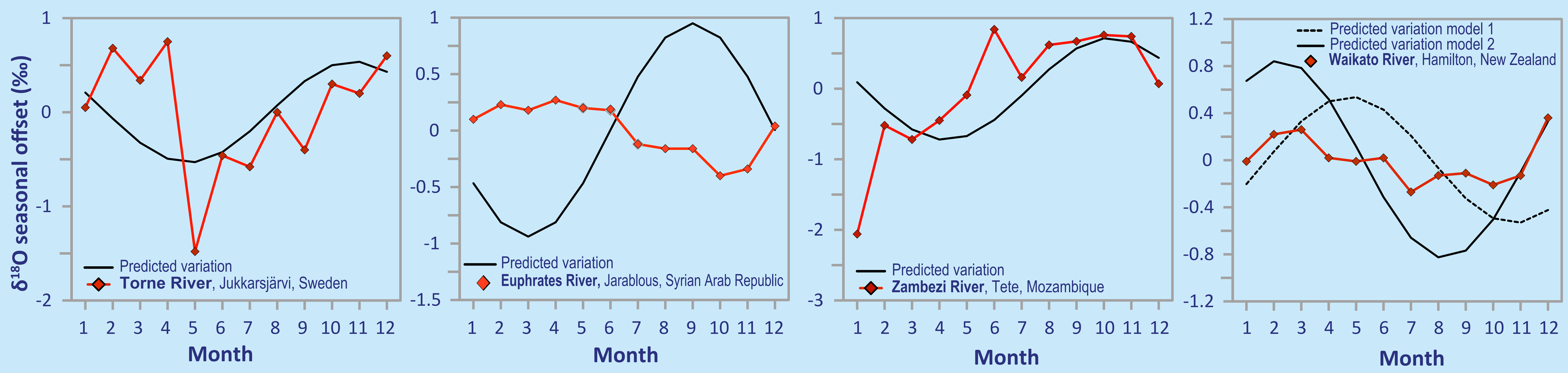

Fig. 5. Isotopic composition in impacted river systems.

The figure shows four examples of reservoir influenced river systems and underlines the difference between the expected (Halder et al., 2014) and measured isotopic composition. For example, the freezing of upstream surface water, which changes the river runoff components in winter (Torne River downstream of Lake Torneträsk, Sweden, Burgman et al., 1981); the averaging of different water sources due to cumulative dam systems (e.g. Euphrates River, Syrian Arab Republic, Kattan, 2012 and Waikato River, New Zealand, Mook, 1982), mixing of evaporated water and reverse seasonal flow from the outflow of regulated reservoirs having long water residence times (e.g. Zambezi River downstream of Cahora Bassa Dam, Mozambique, Talma et al., 2012).

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