
Water Resources

Objective

To support Member States in using isotope hydrology for assessment and management of their water resources, including characterization of climate change impacts on water availability.

Assessment of Mining Impacts on Water Resources Utilization and Pollution

Two technical cooperation projects completed in 2020 in Argentina and Chile illustrated the contribution of isotope hydrology tools to evaluating and minimizing the impact of mining activities in adjacent water bodies. In Argentina, a remediation project at the abandoned uranium mine of Los Gigantes used geochemical and isotope tools to characterize and map the groundwater's interconnection with local rivers. The study informed local authorities on the suitability of the remediation measures adopted at the mining complex. In Chile, a mining company used environmental isotopes to manage a tailings dam by tracking and mapping groundwater origin and movement. Stable isotopes of sulphur and nitrogen identified the sources of salinity affecting both surface water and groundwater. Isotope tools were also instrumental in proving a hydraulic barrier's correct performance, effectively controlling the release of heavy metals to the nearby freshwater aquifers.

The development and application of stable isotope and radioisotope based approaches to better manage water resources in mining operations is the focus of a new coordinated research project entitled 'Development and Application of Isotope Techniques for Efficient Water Resources Management in Mining Areas'. Isotope methods will provide data to evaluate mining impacts on water pollution, such as discharge of acid mine drainage into rivers (Fig. 1).

Application of Machine Learning Tools for Global Isotope Hydrology Networks

During 2020, machine learning models were developed to improve the spatial resolution of collated global stable isotope data. The new models fill in gaps in long term data records to produce improved isoscape maps of seasonal, monthly, annual and regional variations in oxygen and hydrogen isotopes in global precipitation.

Development of these improved models allowed analysis of 60 years of monthly oxygen isotope data in global precipitation that revealed distinctive long term (decadal) patterns and break points. The findings reveal that coordinated long term monitoring of stable isotopes in precipitation, coupled with basic meteorological parameters such as air temperature and precipitation amount, is essential to better understand the impact of larger scale hydroclimate variation on regional and local climate variability, and to help interpret long term hydroclimatic changes (Fig. 2).



FIG. 1. Pascua-Lama is an open pit mine producing gold, silver, copper and other minerals located in the Andes Mountains, in the southern reaches of the Atacama Desert, straddling the border between Chile and Argentina at an altitude of over 4500 metres. (Photograph courtesy of Albert Soler, University of Barcelona, Spain.)

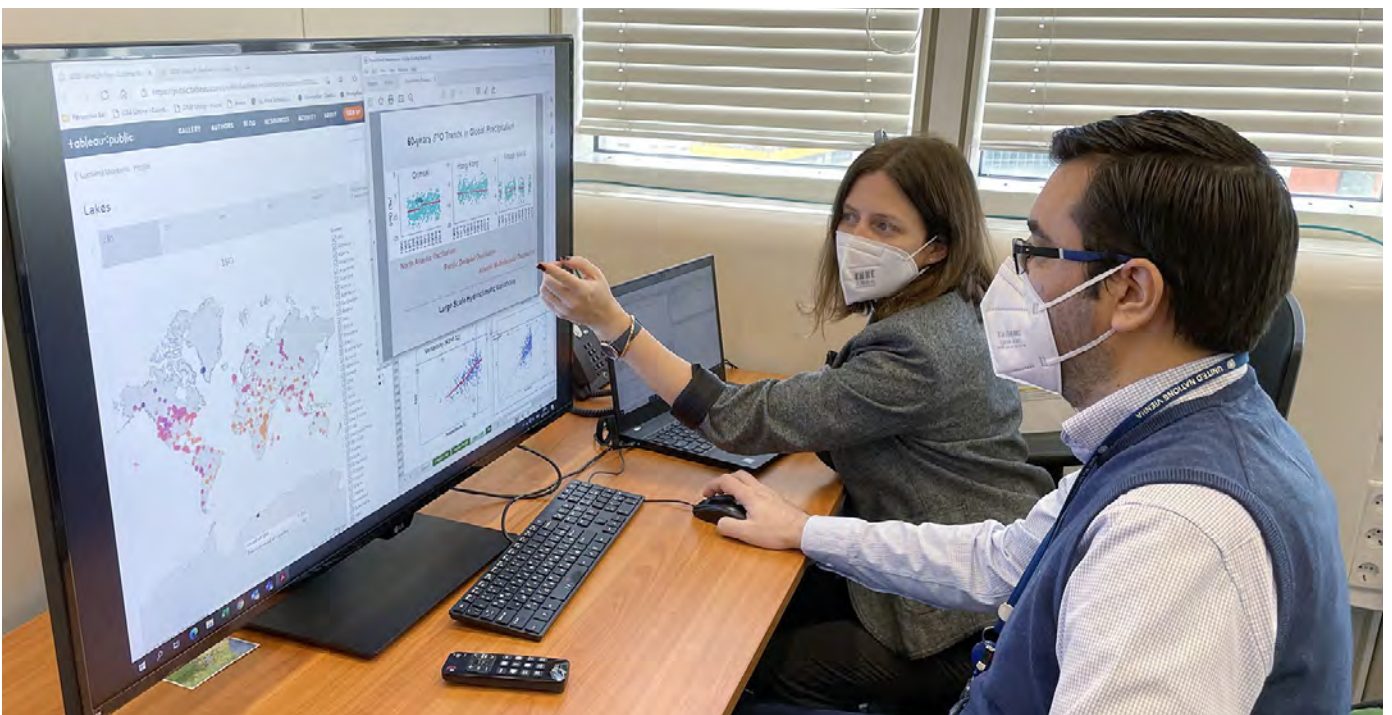


FIG. 2. Analysis of machine learning outputs for interpretation of global stable isotope precipitation records.