IAEA-WMO PROGRAMME ON

ISOTOPIC COMPOSITION OF PRECIPITATION:

GLOBAL NETWORK OF ISOTOPES IN PRECIPITATION (GNIP)

TECHNICAL PROCEDURE FOR SAMPLING

I. Introduction

The International Atomic Energy Agency in cooperation with the World Meteorological Organization has organized for many years a global network of stations for the collection of monthly precipitation samples for the determination of the isotopic composition. The meteorological and isotope data collected in the programme through this network of stations and National Networks are stored in a database available through INTERNET. The isotopes, the content variations of which are determined, are the stable isotopes oxygen-18 and hydrogen-2 (deuterium) and the radioactive isotope hydrogen-3 (tritium). These data are used as background information for isotopic hydrological investigations and for meteorological and climatological studies.

To obtain reliable isotopic data it is essential that the sampling procedure described below be followed in all detail. Above all evaporation should be avoided, because during evaporation the isotopic composition of the water sample is strongly affected. It is therefore essential to use tight bottles to preserve, ship and store the precipitation samples collected for isotopic analysis. It is advisable to use the bottles provided by IAEA, which have been checked for their tightness. Also during the collection, the water should be removed from the rain collector soon after the rain, or it should protected against evaporation with medicinal paraffin oil.

II. Technical Procedure for Precipitation Sampling for Isotopic Analyses

1. Each sample must represent the integrated precipitation for a one-month period, beginning on the first day of the month and continuing until the end of the month.

2. The bottles provided by IAEA have a volume of 1/2 liter (for tritium analysis) and 50 ml (for stable isotope analysis), which are considered the optimal amounts of water required for isotopic analysis. A minimum amount of about 300 ml of water is needed to perform tritium, deuterium and oxygen-18 analysis. If sometimes less than this amount is available (for instance because the precipitation was scarce), send anyhow the available water to the laboratory in charge of the isotopic analyses, which in this case will carry out only some of them. If tritium and stable isotopes are analysed in different laboratories, fill up 50 ml bottle for the stable isotope analysis and use the rest of water to fill the 1/2 1 bottle (or part of it if the sample is insufficient) for the tritium analysis.

3. The rain water is collected in the standard rain gauge which is read and emptied as soon as possible after each rain event, if practicable, or each morning. After reading the gauge the precipitation should be poured into a 5-litre plastic bottle with a good cap to avoid evaporation. Keep this container in a cool, dark place. It is very important that the cap on the large bottle should be kept tightly closed: evaporation, in fact modifies the isotope composition of water, and therefore all precautions should be taken to prevent it.

4. It is absolutely essential that the water be transferred after every precipitation or every day and the rain collector be dried again with a clean dry cloth or tissue before returning it to its collecting position.

5. If the rain water should remain several days in the rain collector (which can consist simply of a plastic bottle with a funnel) before being transferred to a tight container, then it is necessary to put medicinal paraffin oil, available in a pharmacy, in the rain collector to prevent evaporation. The medicinal paraffin oil layer floating over the water should have a thickness of about 0.5 cm. The rain water with the paraffin oil can be transferred periodically into the tight container. The water is separated from the oil at the end of the month with a separation funnel, or simply by siphoning out the oil.

6. At the end of the month, all the water in the container must then be shaken before filling the bottles to be sent for analysis. If medicinal paraffin oil is present, then the container should not be shaken, but left aside for a week, before filling the bottles. This will ensure mixing but avoid that the oil forms an emulsion with water, which later would make its separation difficult.

7. If the amount of water collected in any month exceeds 5 litres, then a second 5-litre bottle should be used to accumulate the excess water. At the end of the month all the water from both containers must then be mixed before filling the bottles with samples. The operations described in paragraph 3 to 7 should be carried out as rapidly as possible, in order to reduce the time during which the sample is exposed to the atmosphere and thus the risk of evaporation.

8. If the medicinal paraffin oil is used and its separation from water is not possible at the station, then this separation will be made at the laboratory in charge of the isotopic analysis. In this case, try to minimize the amount of oil present in the bottles shipped and be sure that the amount of water largely exceeds that of oil. Remember that an amount of at least 300 ml of water is needed for tritium, deuterium and oxygen-18 analysis.

9. At the end of the month when the bottles with samples are filled, the 5-litre container should be dried again before using it for the next month's precipitation.

10. Never fill any plastic bottle completely. Always leave a slight air gap (~ 5% of bottle volume) to allow for water expansion due to possible temperature increase or decrease below the freezing point. Always be sure to use the bottles provided by IAEA, and ensure the cap is secured tightly.

11. Information concerning the station, month and amount of total precipitation should be clearly marked on the labels provided by IAEA. The bottles should always be marked immediately on filling.

12. There should be no sharp objects in the box when samples are returned (e.g. screws, nails, wood splinters). These can puncture the plastic bottles.