A time series of environmental tracer data from deep meromictic Lake Lugano, Switzerland

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ABSTRACT: An 11-yr (1990-2001) time series of tritium-helium-3 (^3H-^3He) apparent water ages as well as one sulfur hexafluoride (SF_6) profile were used to study the development of the vertical mixing dynamics of the deep, meromictic northern basin of Lake Lugano. The density stratification of the water column was dominated by an increase in dissolved ions with depth, which remained approximately constant during the 1990s. The deep-water temperature increased steadily during this period, passing a threshold above which cooling of the surface water could force convection. However, increasingly mild winter temperatures prevented the occurrence of a turnover until 2005. The maximum apparent ^3H-^3He water age increased from about 16 yr in 1990 to 23 yr in 2001. The maximum apparent SF_6 age in 2001 was 12.8 yr. The large difference between the apparent ^3H-^3He and SF_6 ages is at least partly due to nonlinear effects of mixing, causing SF_6 ages to underestimate the true mean deep-water residence time, whereas ^3H-^3He ages overestimate it. The decreasing concentrations of ^3H and ^3He are more reliable indicators of the continuous deep-water exchange in the lake than are the apparent ages. Budget calculations using the tracer concentrations reveal an annual renewal of the deep water below 100 m in depth by about 8% and enable the calculation of long-term mean profiles of the effective vertical turbulent diffusivity Kz. No trend in the mixing intensity during the 1990s could be determined. The radiogenic He flux into the lake is comparable to estimates of the whole crustal degassing flux.

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