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Lacustrine particle dynamics in high-altitude Estany Redó (Spain) - a high resolution sediment trap study

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ABSTRACT

Particle fluxes were measured from 2000 to 2001 with 3 integrating open traps (O-traps) and a sequencing trap (S-trap) in the 73-m deep, oligotrophic, high-mountain Estany (Lake) Redó (2240 m a.s.l.) over a period of 558 days. O-traps were deployed at 26, 46, and 66 m water depth to measure overall sedimentation rates, while the S-trap was deployed at 66 m water depth to detect dynamics of seasonal particle fluxes with a resolution of 4 days (during ice break-up, summer, ice formation) to 21 days (during ice cover). Our results show a high degree of seasonal variability in particle dynamics. Total particle fluxes vary from almost zero to more than 600 mg m^{-2} d^{-1}. The highest fluxes occur during short time windows after ice-break-up (minerogenic particles), during spring (planktonic biomass), and during fall overturn (chrysophycean cysts). Particle fluxes also differed markedly from year to year in absolute values (2000: 644 mg m^{-2} d^{-1}, 2001: 370 mg m^{-2} d^{-1}) as well as in average values (2000: 76 mg m^{-2} d^{-1}, 2001: 44 mg m^{-2} d^{-1}). Annual and seasonal meteorological changes and events have a clear influence on the lake system and on the amount and composition of particles. C/N ratios during April and May increased significantly from 2000 (6-14) to 2001 (>28), reflecting the more intense soil erosion and transport of terrestrial plant remains into the lake caused by heavy precipitation in 2001. Air temperature strongly influences the timing of the occurrence of the main bio-productivity peak. Strong wind events shorten the period of ice cover. Our investigation shows that sediment trap studies lasting more than one limnological cycle are useful in studying the effects of short-term meteorological changes and weather events on high mountain lakes. However, long-term particle flux measurements would be necessary to determine amplitudes of natural seasonal cycles and for the interpretation of the decadal-scale environmental changes occurring in such lakes.

Key words: sediment trap, high-resolution particle flux, high mountain lake, seasonality, bio-productivity