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Sediment source fingerprinting to quantify fine sediment sources in forested catchments, Chile.

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A study to improve the understanding of the primary sediment sources and transfer pathways in catchments disturbed following forest plantation harvesting is being undertaken in South-Central Chile. The study focuses on two sets of paired experimental catchments (treatment and control), located about 400 km apart, with similar soil type but contrasting mean annual rainfall: Nacimiento (1,200 mm year-1) and Los Ulmos (2,500 mm year-1).
Sediment source fingerprinting techniques are being used to document the primary fine sediment sources. In each catchment, three potential sediment sources were defined: clearcut slopes (Z1), forest roads (Z2) and the stream channel (Z3). In each catchment, multiple representative composite samples of the different potential source materials were collected before harvest operations from the upper 1 cm layer in Z1, Z2, and from the channel bank and bed for Z3. A time-integrating trap sampler installed in the discharge monitoring station constructed at the outlet of each catchment has been used to collect samples of the suspended sediment and these have been supplemented by sediment collected from the weir pools. Total suspended sediment load is been quantified in the monitoring stations using discharge records and integrated water sampling.
Caesium-137 (137Cs), excess lead-210 (210Pbex) and other sediment properties are being used as fingerprints. After air-drying, oven-drying at 40°C and disaggregation, both the source material samples and the sediment samples collected in the discharge monitoring stations were sieved through a 63-μm sieve and the <63-μm fractions were used for subsequent analyses. For radionuclide assay, the samples were sealed in Petri dishes and after 4 weeks the mass activity density (activity concentration) of 137Cs and 210Pbex was determined by gamma analysis, using an ORTEC extended range Ge detector of 53% relative efficiency.
The 137Cs and 210Pbex activity and organic carbon (Corg) concentration associated with potential source materials and the target sediment show that the two radionuclides used in combination with the Corg property provide effective source fingerprints. Additional work using a mixing model taking account of particle size effects is required to establish the relative contributions of the three sources to the fine sediment loads of the study catchments.

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