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Fine-grained suspended sediment source identification for the Kharaa River basin, northern Mongolia

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Fine sediment inputs into river systems can be a major source of nutrients and heavy metals and have a strong impact on the water quality and ecosystem functions of rivers and lakes, including those in semiarid regions. However, little is known to date about the spatial distribution of sediment sources in most large scale river basins in Central Asia. Accordingly, a sediment source fingerprinting technique was used to assess the spatial sources of fine-grained (<10 microns) sediment in the 15 000 km2 Kharaa River basin in northern Mongolia. Five field sampling campaigns in late summer 2009, and spring and late summer in both 2010 and 2011, were conducted directly after high water flows, to collect an overall total of 900 sediment samples. The work used a statistical approach for sediment source discrimination with geochemical composite fingerprints based on a new Genetic Algorithm (GA)-driven Discriminant Function Analysis, the Kruskal–Wallis H-test and Principal Component Analysis. The composite fingerprints were subsequently used for numerical mass balance modelling with uncertainty analysis. The contributions of the individual sub-catchment spatial sediment sources varied from 6.4% (the headwater sub-catchment of Sugnugur Gol) to 36.2% (the Kharaa II sub-catchment in the middle reaches of the study basin) with the pattern generally showing higher contributions from the sub-catchments in the middle, rather than the upstream, portions of the study area. The importance of riverbank erosion was shown to increase from upstream to midstream tributaries. The source tracing procedure provides results in reasonable accordance with previous findings in the study region and demonstrates the general applicability and associated uncertainties of an approach for fine-grained sediment source investigation in large scale semi-arid catchments. The combined application of source fingerprinting and catchment modelling approaches can be used to assess whether tracing estimates are credible and in combination such approaches provide a basis for making sediment source apportionment more compelling to catchment stakeholders and managers.