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Meltwater suspended sediment concentration: comparison between alpine glaciers and tropical glaciers.

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Glaciers represent valuable natural reservoirs of water which exert a strong control on the drainage characteristics of mountain catchments. Mountains glaciers are generally thought of as delaying runoff by preventing direct evacuation of precipitation. But in mountain glaciers, two types of glacier regimes can be clearly differentiated: the alpine glacier regime in mid-latitude temperate climates, defined by an accumulation period during winter and an ablation period during summer, and the tropical glacier regime in tropical climates, characterised by annual distinct change from a precipitation period to a dry period. In these tropical climates, there is ablation of the tongue of the glacier throughout the year, but a higher ablation period during the precipitation season, which corresponds to the accumulation period. Such water storage occurs either on a sub-seasonal or a sub-daily period, depending on these different glacier regimes, controlled by climate variations. Suspended sediment in glacial meltwater is viewed as a sensitive parameter of environmental change, since suspended sediment is broadly supply-controlled. In this work we intend to compare the difference between suspended sediment concentration (SSC) in tropical and alpine glaciers, and to characterise the various responses of these hydrological systems.

For temperate climates, we studied the Mer de Glace glacier in the Alps (France) from 2002 to 2004, and for tropical climates we chose the Artesonraju glacier in the White Cordillera (Peru) from 2004 to 2006. Suspended sediment was filtered from samples (500 ml) in the field using a pre-weighed wahtman 0, 45μm membrane filter and a

hand-held vacuum pump. For each sample, meltwater discharge was calculated using an automatic gauging station near the Artesonraju glacier, and by the salt dilution method for the Mer de Glace glacier. The monthly distribution of suspended sediment and its variability from year to year were examined. Maximum SSC in meltwater was observed from June to August on the Mer de Glace glacier, and from October to April on the Artesonraju glacier, corresponding to the rainy season. These differences are controlled by the glacier meltwater regime. On the Mer de Glace glacier, there is good correlation between monthly SSC and discharge (R^2 = 0.93), much better than for the Artesonraju glacier (R^2=0.50). On the Artesonraju SSC and discharge crossplot, two different zones can be isolated: a zone below 600 l/s (low discharge) with good correlation between SSC and discharge (R^2=0.69), and a zone above the 600 l/s threshold, where no correlation exists between SSC and discharge. These first results on SSC climate control confirm that temperate glacier SSC is controlled by ice and firn ablation during the melt-out season. In contrast, tropical glacier SSC is not only controlled by ice ablation. Although meltwater is under ice and firn ablation control during the dry season, during the rainy season, meltwater is controlled by snow cover and the resulting albedo. This meltwater regime implies a sub-glacial origin for suspended sediment during the dry season, and probably a supra-glacial and sub-glacial origin for suspended sediments, during the rainy season.