Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09904, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09904
EGU General Assembly 2008

Effect of El Niño events on sediment yield in a large coastal basin in Peru-Ecuador

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Extreme climate events have often a dramatic impact on sediment fluxes, yet they are still poorly documented. Extreme events are rare by definition and measurement techniques often fail under extreme weather conditions. Nevertheless, there is a need to assess the impact of such events in order to properly understand drainage basin behaviour and evolution.

The basin of Catamayo-Chira is a ca. 17200 km^2 basin located on the border of Ecuador and Peru and is well suited to study the effect of extreme climatic events on sediment yield. The basin strongly affected by El Niño events: at some locations within the basin, annual precipitation during an El Niño event is up to 20 times the average value for normal years, leading to strong increases in streamflow discharge and sediment fluxes. For the Catamayo-Chira basin, the effect of El Niño on sediment fluxes can be assessed by estimating sedimentation rates in the Poechos reservoir located near Piura at the outlet of the catchment as well as by comparing sediment fluxes and sediment rating curves for different years as measured at the inlet of the Poechos reservoir.

Accounting for variations in sediment trapping, we estimate that sediment fluxes during the years 1982/83 and 1997/98 during which an important El Niño took place are ca 1.05 10^8 Mg, corresponding to an average basin-wide sediment production rate of ca. 6.1 kg m^{-2} . Sediment production rates during a normal year vary between 1 10^5 and 1.4 10^7 Mg, corresponding to year sediment production rates between 0.005 and

0.8 kg km^{-2}. Overall, El Niño events are therefore responsible for at least 40 % of total sediment export between 1976 and 2005. However, there are indications that the 1982/83 and 1997/98 events were particularly strong.

We noticed that during years immediately following an El Niño event, sediment fluxes were significantly lower than expected based on sediment-discharge relationships for the period preceding the event. We hypothesize that this is mainly due to the increased vegetation development due to the increased soil water availability. However, sediment depletion may also play a role.

Thus, El Niño events have a strong effect on sediment fluxes in the Catamayo-Chira basin. Our analysis shows that the proper evaluation of the impact of such extreme climate events on surface transport processes requires that not only the direct impact of variations in climate is considered: the response of vegetation to these climate variations, which operates at a longer time scale, also needs be taken into consideration.