### *S1 : Material and method description*

### *Hydroclimate data*

### Mean annual rainfall was extracted for each basin from the TRMM v.7 (Tropical Rainfall Measuring Mission - period: 1998-2009) acquisition free, downloaded from the TRMM website (<http://www.geog.ucsb.edu/~bodo/TRMM/#tif>).

### At the 5 HYBAM stations, daily river discharge was measured by the hydrological institutes for their respective countries (INAMHI in Ecuador and SENAMHI in Peru). These data were reported at a daily timescale in the HYBAM database for the monitoring stations and at an annual timescale (Lavado et al. (2012), ANA (2012) and Rau et al. (2017b)) for the discrete sampled Peruvian rivers. Water levels were collected daily or twice daily using a conventional hydrological method. At the monitoring stations, gauging was accomplished using a current mechanical meter in Peru and a 1200 kHz Acoustic Doppler Current Proﬁler (ADCP) in Ecuador. The daily discharge record was then calculated from rating curves (using the discharge - water level relationship) using the Hydraccess software (Vauchel, 2005).

*Hydrochemistry*

Conductivity and pH were generally measured every 10 days at the 5 HYBAM monitoring stations. At these stations, a sample of 650 ml was collected monthly for 4 to 10 years, depending on the monitoring station. These samples were filtered on site using a 0.2 µm porosity filter. At the 23 stations, 650 ml of discrete surface water samples were filtered with a 0.45 µm porosity filter. Major element concentrations (Ca2+, Mg2+, Na+, K+, Cl-, SO42-, HCO3- and Si) were determined at the GET laboratory (Géoscience Environnement Toulouse, France). Cl- and SO42- concentrations were measured by ion chromatography, and Na+, Ca2+, Mg2+, K+ and Si were analyzed by ICP-AES (Inductively Coupled Plasma-Atomic Emission Spectroscopy). Alkalinity was determined by acid titration. The TDS concentration corresponds to the sum of the cations (Ca2+, Mg2+, Na+ and K+), the anions (HCO3-, SO42- and Cl-) and SiO2 concentrations, all expressed in mg.L-1. Data are reported in Table S3. Based on the analyses of geostandards, the analytical error was less than 10% for both sampling periods. At the gauging station the charge imbalance (NICB = TZ- - TZ+ / TZ-+TZ+ \*100) was < to 5% at the monitoring stations and <20% for discrete sampling.

*Annual flux calculations for monitored rivers*

Based on the available database, we calculated the TDS and annual flux of major elements at the 5 HYBAM monitoring stations. Figure S1 represents the distribution of daily discharge during the monitored period as well as the daily discharge distribution, which corresponded to the days sampled for TDS measurements. These graphs show that the monitoring strategy allowed sampling of all hydrological conditions at each gauging station for TDS measurements.

Moatar et al. (2006, 2013) proposed a method to estimate annual TDS flux uncertainties based on the estimated proportion of material flux that was transported by a station during 2% of the hydrological cycle (M2%). Indeed, we calculated for each station the M2% for each station and we used their formulas to calculate bias, uncertainties and imprecision for each station (Table S6 in supplementary material). According to these calculations, bias was less than 2% for the five stations, and uncertainty was less than ± 15%.

We also estimate the solute and TDS fluxes exported by the 23 discrete sampled rivers. At the monitoring stations, the TDS concentration did not vary more than 37% during the hydrological cycle. Because TDS concentrations and individual elements varied according to the sampling month, and because the unimodal hydrological cycle is in phase along the Pacific coast, we hypothesis that the concentration of a solute at a given station co-vary according to a similar pattern. Therefore, we corrected the discrete sampled TDS and solutes concentration according to the table reported in the supplementary material (Table S7). We then multiplied the corrected concentration by the annual discharge to estimate annual flux.

The TDS specific flux was calculated by dividing the flux by the total area of the basin at the gauging station.

*Atmospheric correction*

Atmospheric inputs were estimated based on the following formula: Xatm = Clriv atm \* (X/Cl)cycl, where Cl riv atm is the Cl concentration in the river derived from atmospheric inputs, and X is the element considered. We used the typical marine Cl ratio (ex: Berner and Berner, 1983). Cl riv atm is considered to be constant throughout the Pacific coast basins and is determined based on the lowest Cl concentration recorded in Pacific rivers from the database (Cl atm riv = 0.02 mmoles l-1).