[Global Biogeochemical Cycles]

Supporting Information for

[Fluvial carbon export from an Amazonian rainforest in relation to atmospheric fluxes]

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Contents of this file

Figures S1 to S11

Introduction

[The supplementary figures contain information behind the rainfall data gap filling (Fig. S1), Stage height to velocity relationships (Fig. S2), the response to rainfall in both of the streams (Fig. S3), Stage heights during which DIC, DOC and POC were samples in Stream 1(Fig. S4), Stream 1 changes in conductivity and pH with stage height (Fig. S5), predictions of the C concentration models against the measured values (Fig. S6), the influence of water flow velocity on the CO_2 efflux rate (Fig. S7), CO_2 efflux time series for Stream 1 (Fig. S8) and Stream 2 (Fig. S9), predicted [DIC] time series (Fig. S10) and annual C export budget (Fig. S11) for Stream 2.]

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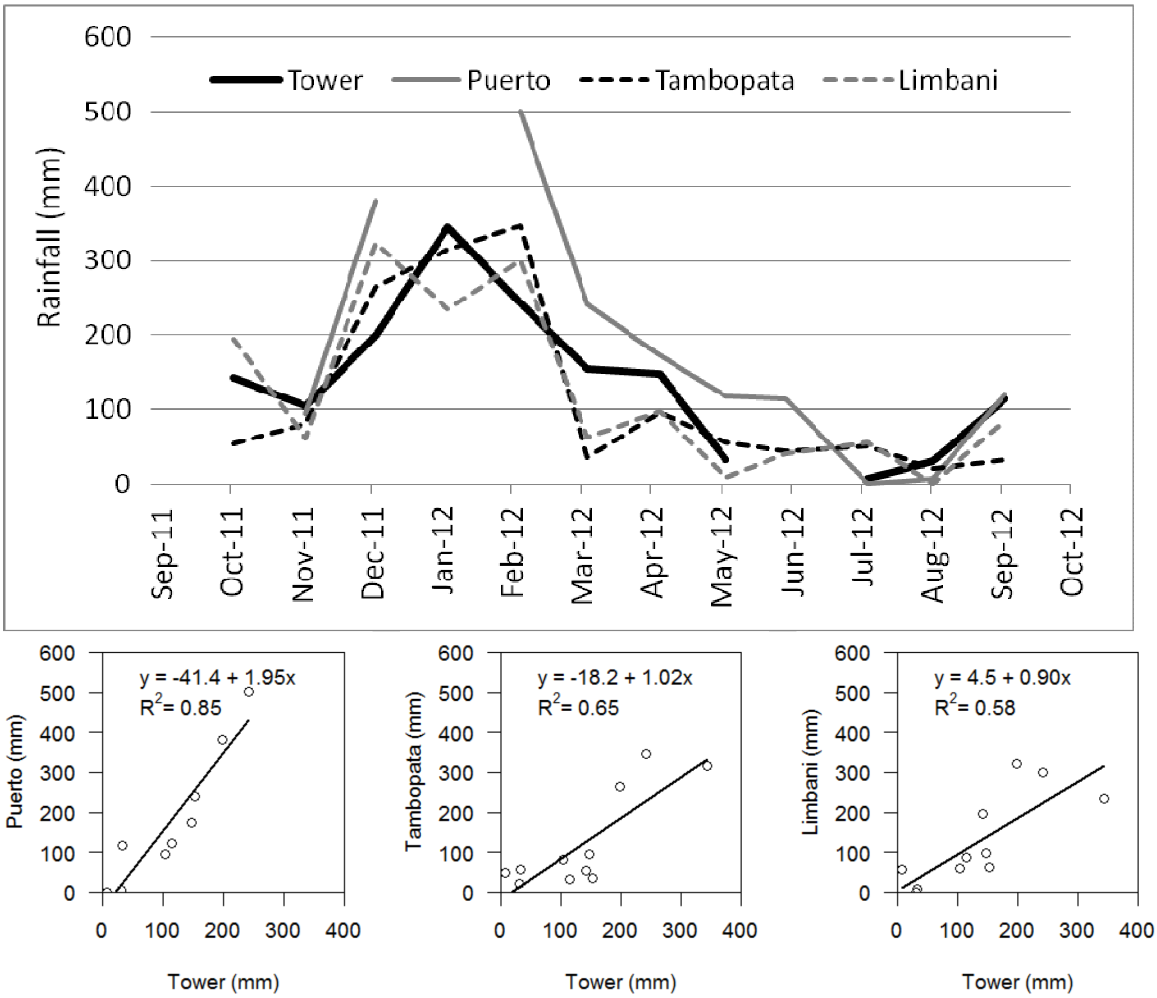

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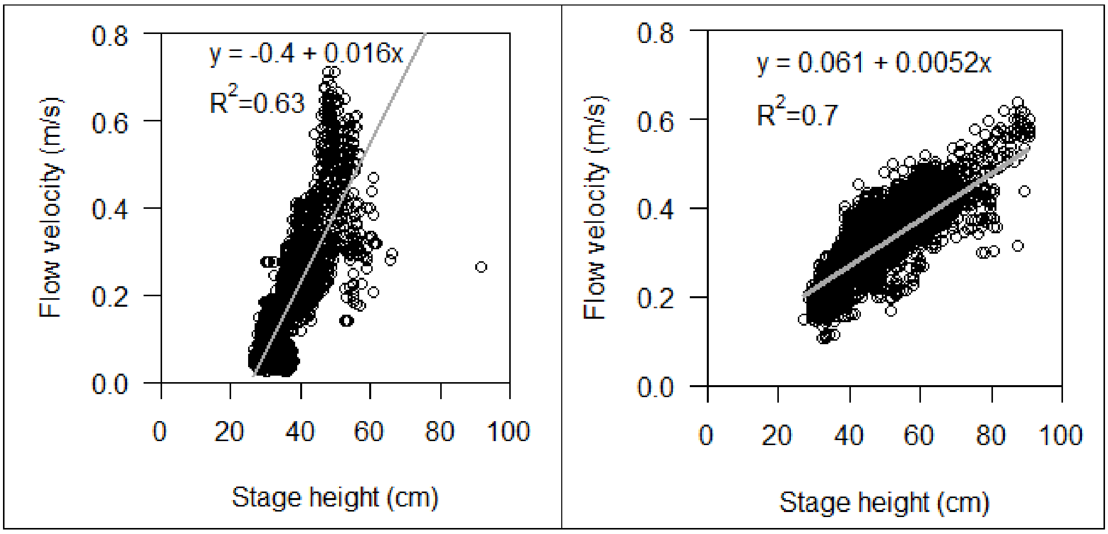
Figure S1. Top: Rainfall time series for the study period as recorded by the flux tower and three SENAMHI met stations: Puerto Maldonado, Tambopata and Limbani. Bottom: best fit regression equations between the tower rainfall and each of the SENAMHI[*SENAMHI*, 2014] stations used to gap fill June 2012 value in the tower record. The average of the three stations was used.



> **Figure S2.** Stage height to velocity relationship for New Colpita stream (left) and Main Trail (right).

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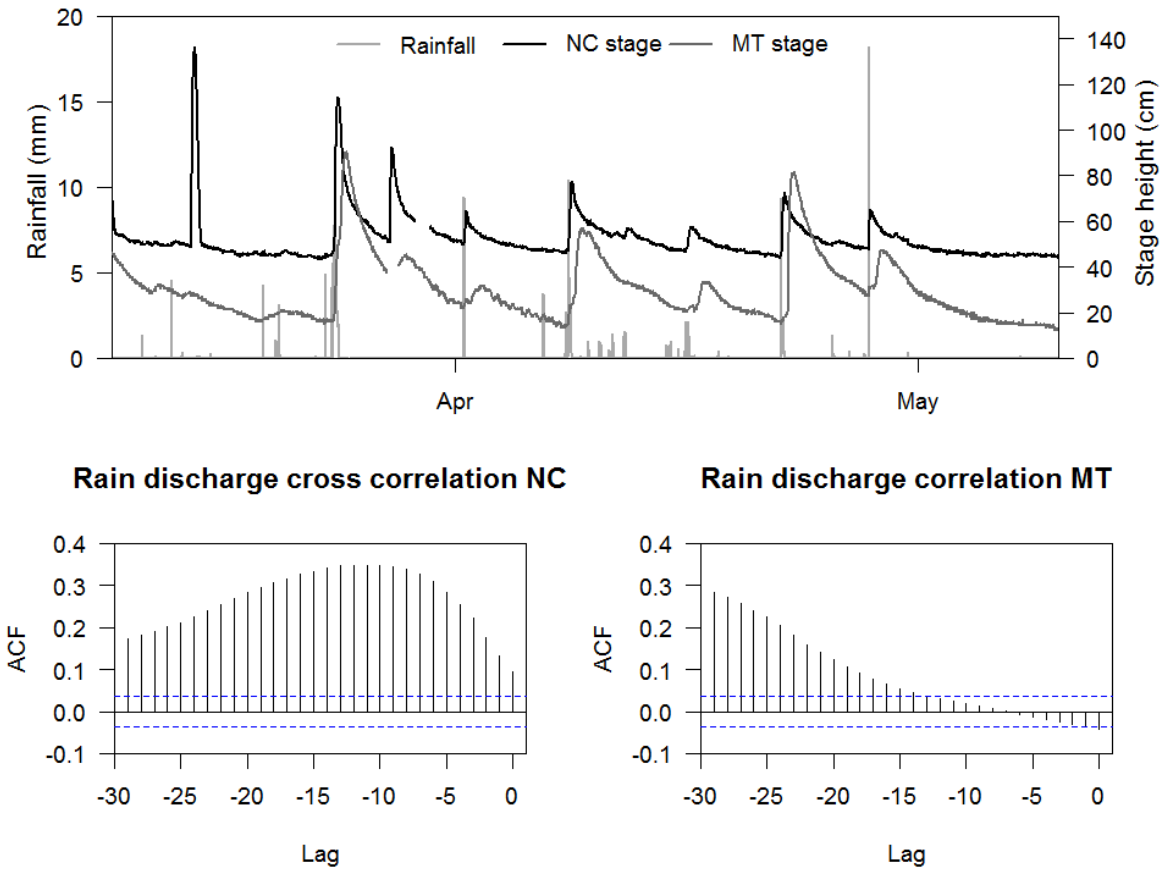

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Figure S3. The response to rainfall in the two streams during the period 09.03 - 10.05.2012. This period was selected to exclude times of flooding at Stream 1 (NC), not usually linked solely to local rainfall but caused by the elevated water level in Tambopata river preventing the outflow from this stream. The cross correlograms (bottom) show the strength of correlation between rainfall and discharge at different lags of rainfall. The rainfall was recorded at 30 min resolution so each lag equals a 30 minute time step, lag -10 corresponding to rainfall five hours prior to the discharge measurement. The bars extending outside the dashed lines are significant correlations.

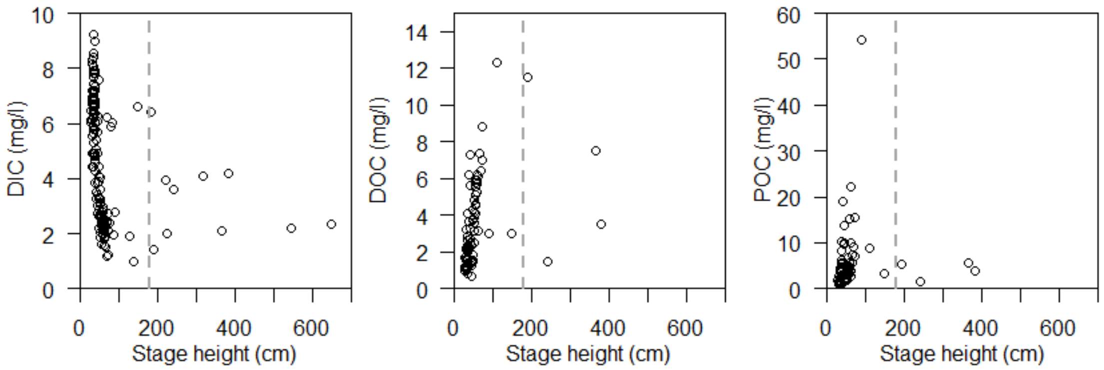

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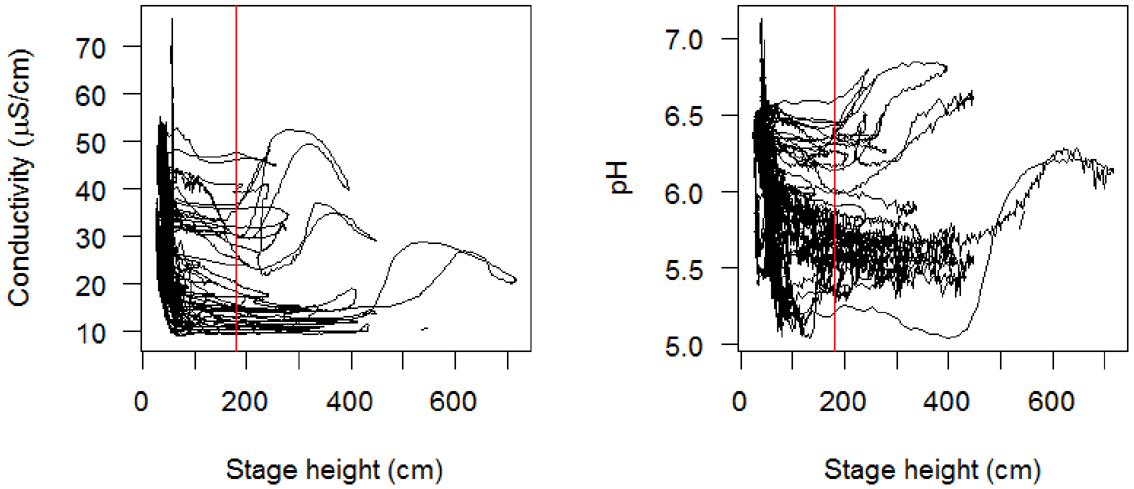
Figure S4. The C species concentrations measured in Stream 1 as a function of the stream water level. The grey dashed line indicated stage height 180 cm after which the motion of water was considered ceased and the sampling point flooded.



>**Figure S5.** Plots of conductivity (left) and pH (right) as function of stage height in Stream 1 with the vertical line indicating the onset of flooded conditions.

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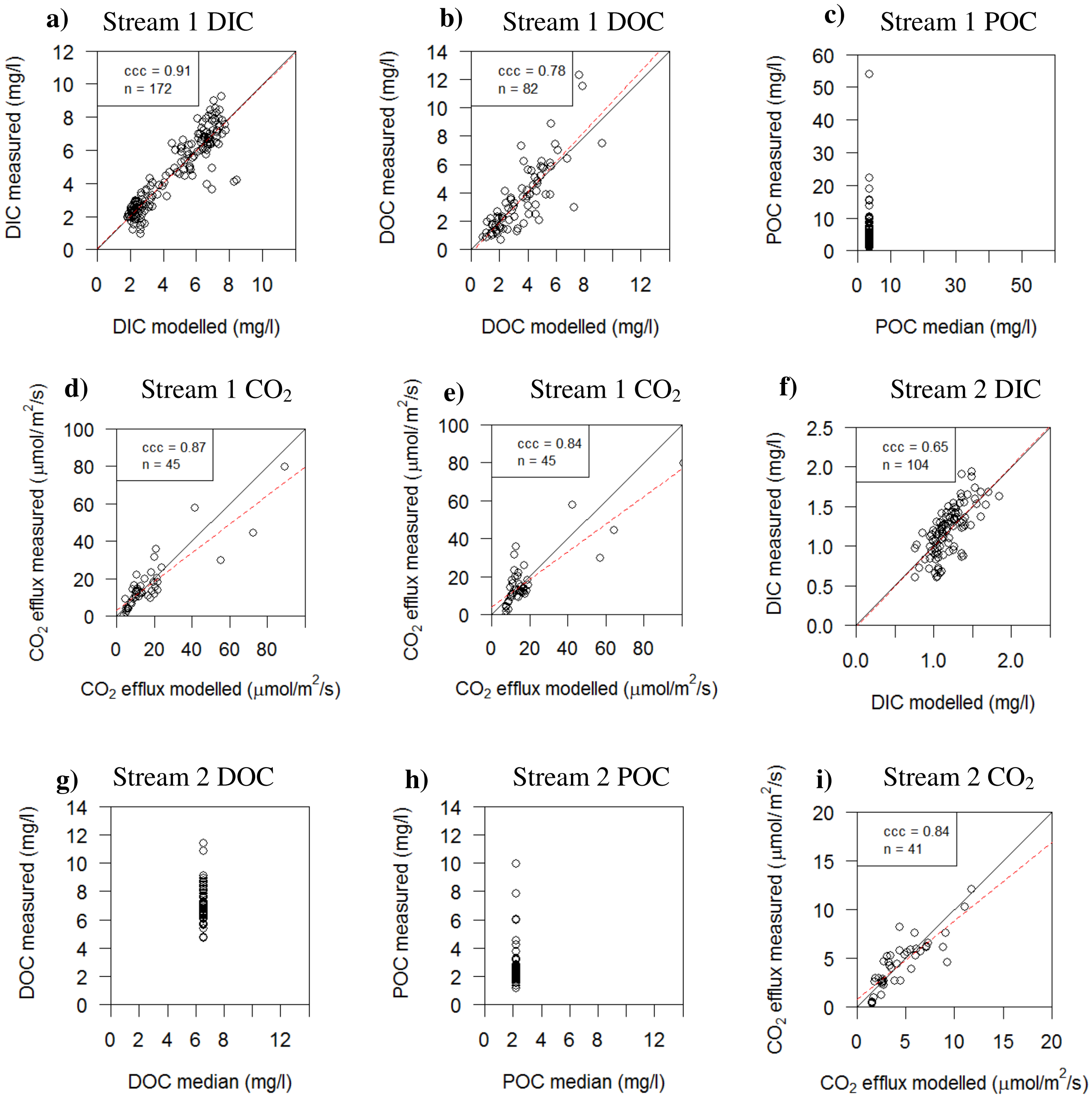

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Figure S6. Model diagnostics plots showing modelled values against the field measurements for aquatic carbon ([DIC], [DOC] and [POC]) and CO_2 efflux in the two studied streams. When no significant explanatory variables were found ([POC] in both streams and [DOC] and in Stream 2), the spread of measured values were plotted against the median value used to calculate the export budgets. In case of the Stream 1 two models were derived for the efflux of $CO_{2.}$ One used both water chemistry and flow velocity variables (graph d) and the second flow velocity alone (graph e). The second model was used when oxygen saturation and conductivity values were outside the range measured during the CO_2 efflux chamber deployment. Dashed line is the best fit regression line and ccc the concordance correlation coefficient.

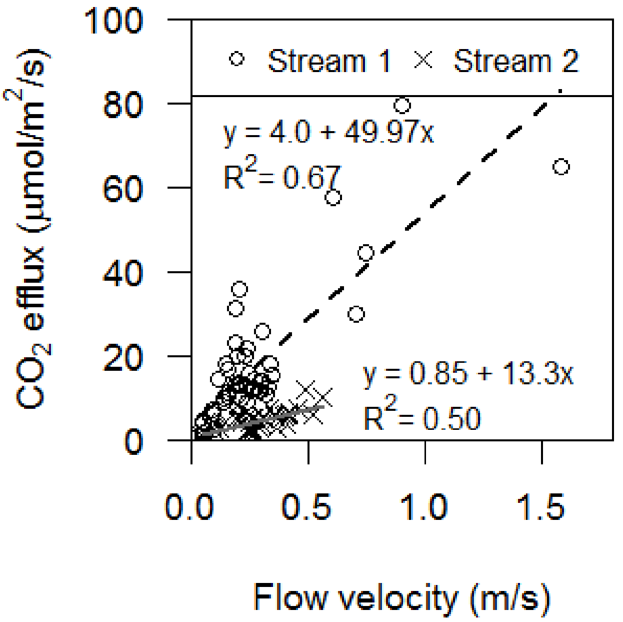

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Figure S7. Water flow velocity within the stream was a strong control on the resulting CO_2 efflux (lines represent the best fit regression lines). The flux rates at a given velocity differed markedly between the streams.

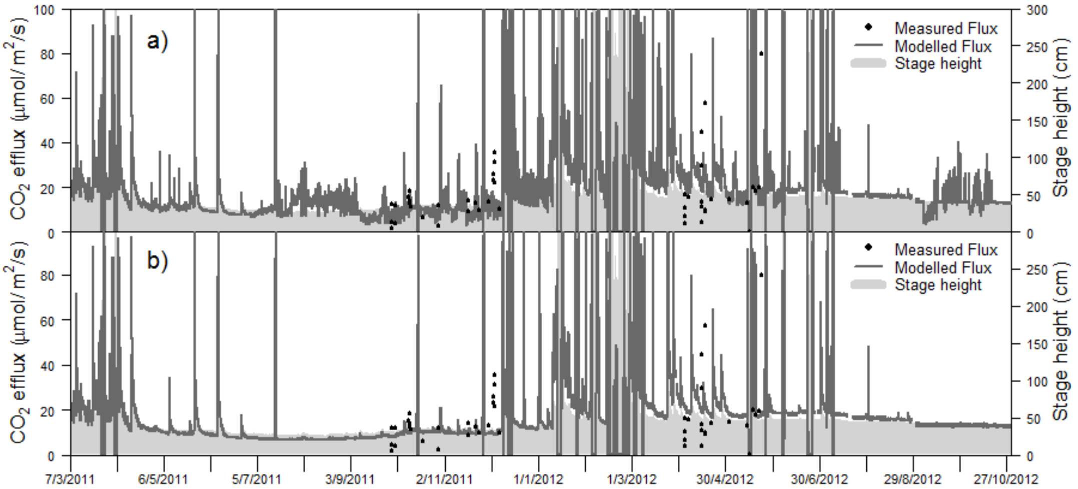

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Figure S8. Efflux time series for Stream 1, a) using the full model and b) using only flow velocity as the explanatory variable. Measured efflux rates vary considerably even between consecutive measurements taken on the same day as they are dependent on the flow velocity of the spot selected. The modelled efflux relates to velocity measured at a fixed point in the stream and hence can differ from the mobile chamber measurements. The values under flooded conditions (stage height >180cm) has been assigned CO_2 efflux rate of 0.3 µmol/m^2/s based on what was measured on field (n=1).

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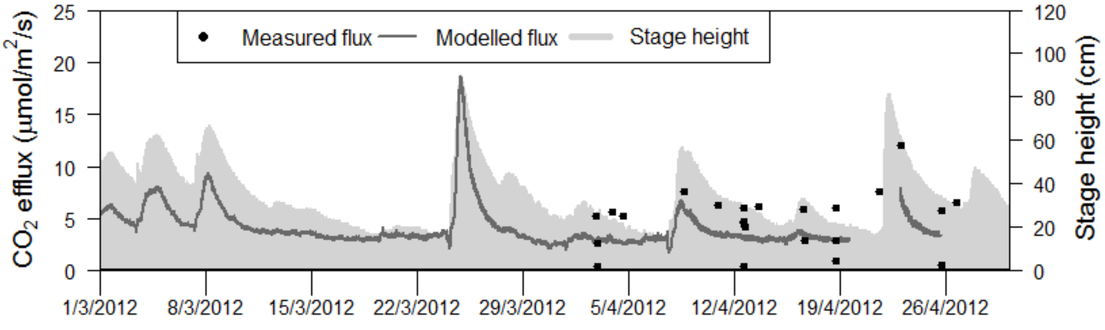

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Figure S9. Stream 2 measured CO_2 efflux and modelled time series for March-April period when continuous water chemistry data was available. Efflux rate is very sensitive to flow velocity. The modelled values agree well with values measured near the flow velocity logger but in slow flow sections of the stream the measured efflux rates are considerably lower and therefore different from the modelled values.

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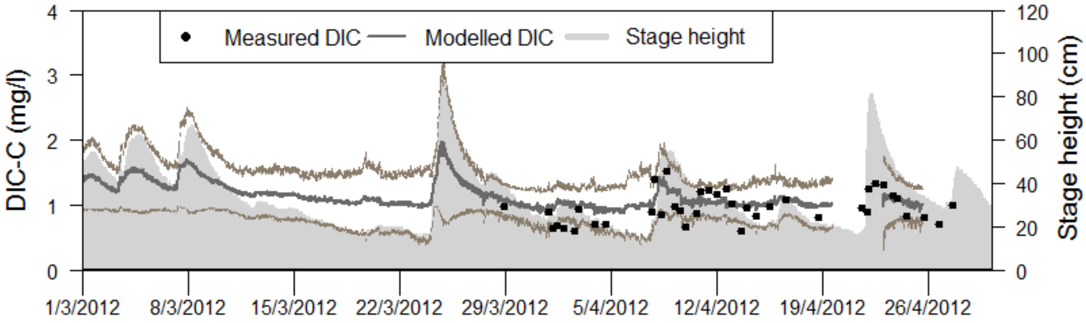

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Figure S10. Modelled [DIC] time series in Stream 2 (Mar-April 2012). During the end of dry season (Oct, Nov 2012) this stream was not active, it only filled with water on the 9th of December 2011 and dried up again in June 2012. Due to equipment malfunctioning water chemistry data was lost January – February 2012 and in May 2012 only spot measurements were taken. Therefore continuous DIC time series could only be modelled for this short period in 2012 when tower data is available. Uncertainty around the modelled time series is standard deviation.

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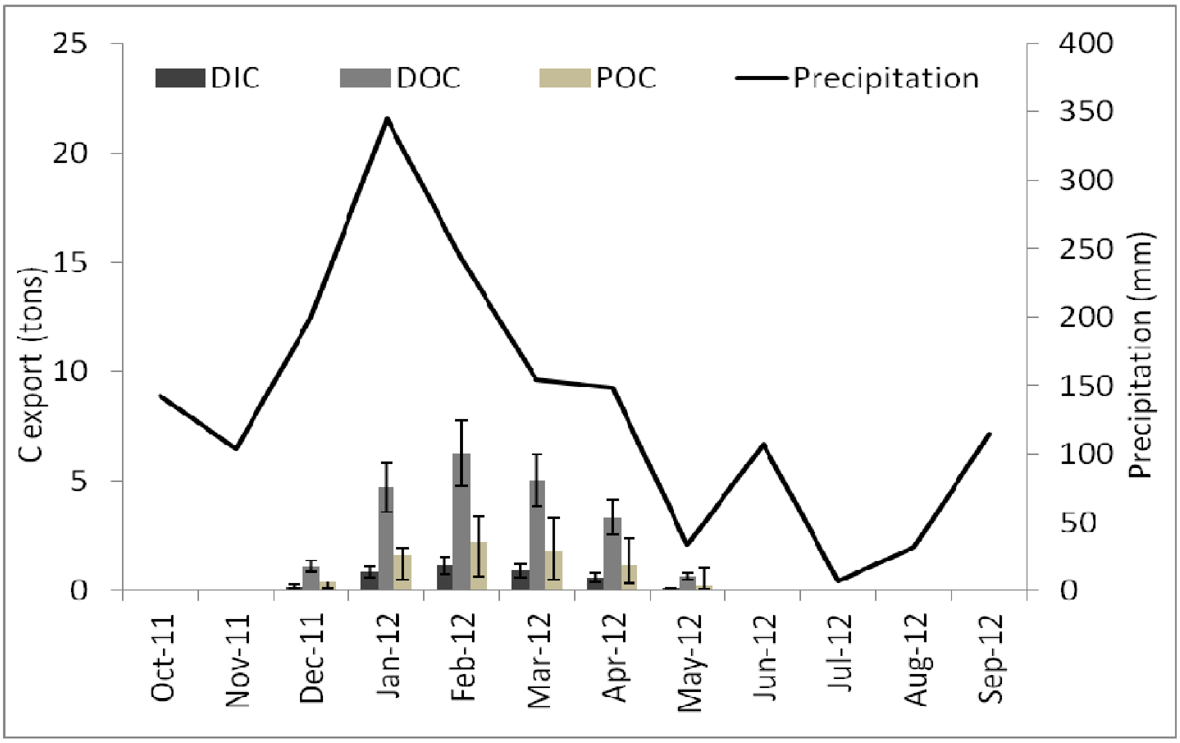

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Figure S11. C export from the seasonal Stream 2. Calculated values are based on the median C concentrations and discharge in all cases. Despite [DIC] being successfully modelled there were too many data gaps to derive a satisfactory times series to derive export estimates for the December 2011- May 2012 period. Error bars are standard deviation.

References

SENAMHI (2014), *http://www.senamhi.gob.pe/*.