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Trends in nutrients, organic carbon and sediments export to the coastal zone of four Venezuelan rivers with different land-use: Identification of sources.

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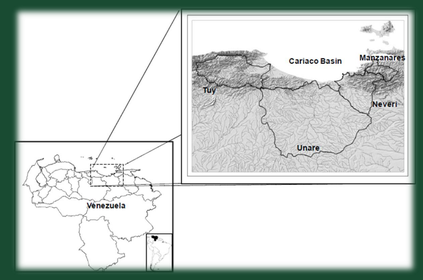
INTRODUCTION

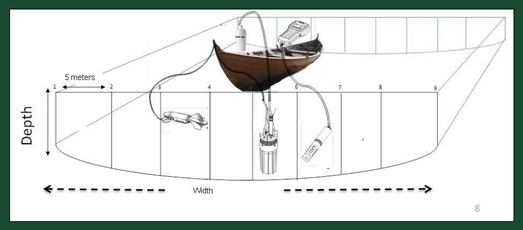
It´s well known that tropical rivers contribute between 70-75% of the total discharge of total organic carbon (TOC), nitrogen (TN) and total phosphorus (TP) to coastal areas[(1,2,3,4)]. This discharge is the contribution of weathered, leached, and human-derived material. Alterations by incrased deforestation, urbanization, discharge of sewage and agriculture, have caused changes in the magnitude of primary productivity and organic matter decomposition rates, therefore it is hard to determine if they are a net sink or source of atmospheric CO_2. Additionally, it´s estimated that tropical rivers provide about 75% of dissolved inorganic nitrogen (DIN) and 80% of dissolved inorganic phosphorus (DIP) to the open ocean from the shelf, and these estimates are based on very few measurement available[(5)]. Therefore, characterizing the nutrient export to coastal areas is of crucial importance to improve our current estimates and understanding C and N ocean biogeochemistry in the tropics. In this study we compare rive export of DIN, DIP, dissolved and particulate organic carbon (DOC and POC, respectively) and POC natural abundance of carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotopes, as indicators of land-derived organic matter in suspended sediments of three mountainous Venezuelan rivers (Tuy, Neveri and Manzanares) and one flat river (Unare) with different land-use. We provide Information about how nutrients discharge is affected by urbanization, agriculture and seasonality and how this export is related to changes in the sources (by correlating $\delta^{13}C$ and $\delta^{15}N$ in POC).

SAMPLING SITES



SAMPLING METHOD

- Triplicate 1L water samples monthly at river mouth (January 2009 to November 2014) with submersible pump.
- River flow with speedometer.
- In situ measurements of dissolved O_2, pH, TSS, salinity, conductivity and temperature using a multiparameter.



LABORATORY ANALYSIS

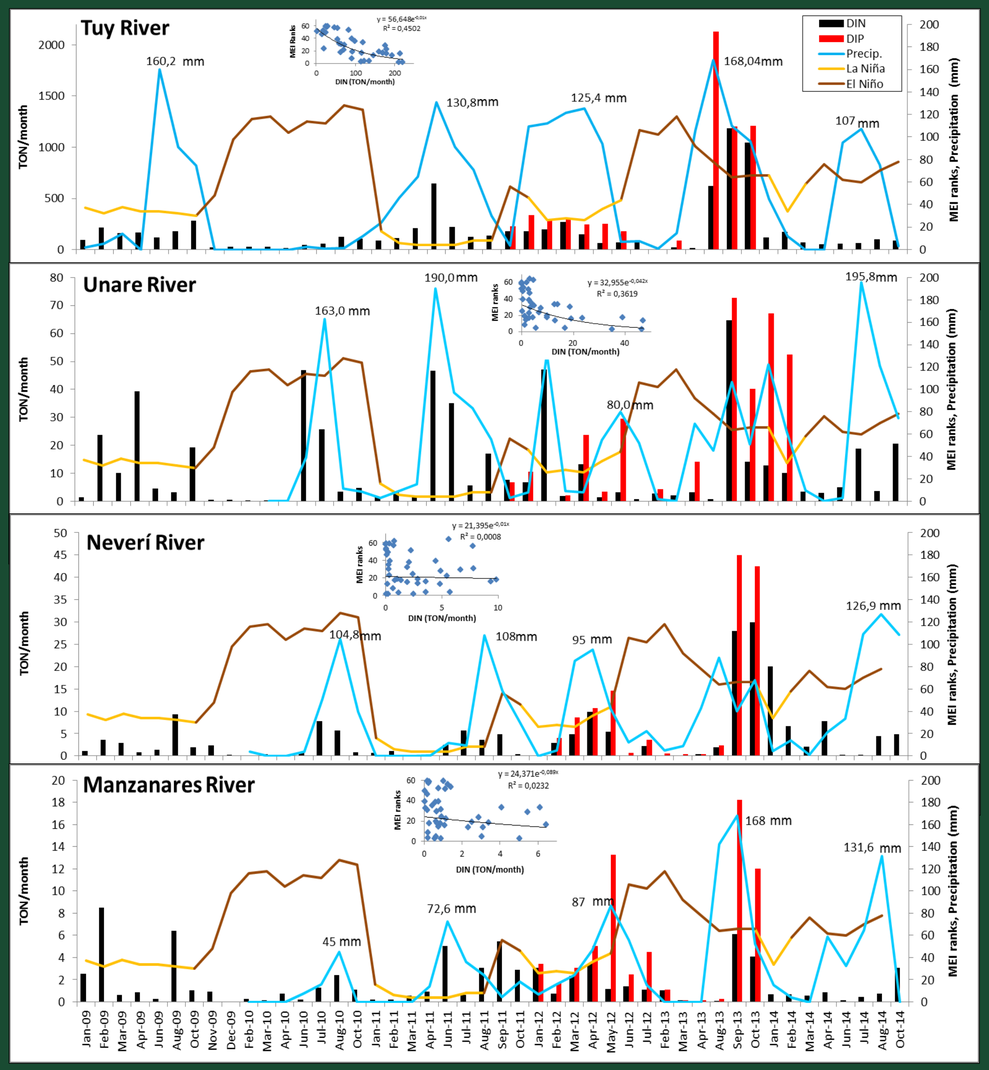
- **Dissolved inorganic nitrogen (DIN= $NH_4^+ + NO_3^- + NO_2^-$) and Dissolved Inorganic Phosphorus (DIP):** Flow injection analysis (Autoanalyzer Technicon II).
- **Total Suspended Sediments (TSS):** We filtered the three 1L samples using 47mm quartz filters.
- **Stable Carbon and Nitrogen Isotopes in TSS*:*** Automated on-line combustion coupled with conventional isotope ratio-mass spectrometry.

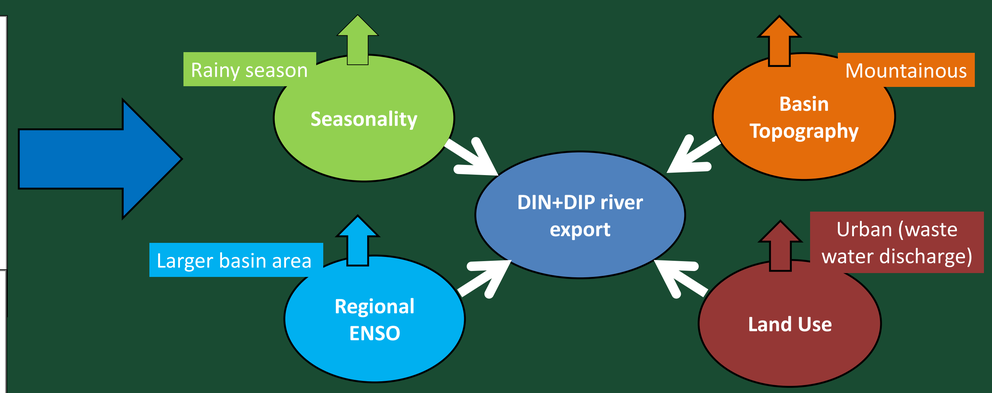
Autoanalizer Technicon II

BASINS DESCRIPTIONS

	Headwater height m.a.s.l.	Basin area (10^3 km^2)	Cities in basin	Population density (people/km^2)	Precipitation [(a)] (mm)	Discharge[(b)] (m/s)	Sediment load (103 ton/km^2 year	Sediment yield (ton/km^2 year	Land use area percentage coverage (%)
Mountainous rivers									
Tuy	2429	660	Caracas	671	835-2400	53.1	66	1000	Urban (11.0) Forest (80.0) Agriculture (2.3)
Neverí	2280	299	Barcelona	142	912-2000	16.7	3	300	Urban (3.0) Forest (86.1) Agriculture (6.9)
Manzanares	2300	165	Cumaná	204	400-2000	20.6	3	250	Urban (4.7) Forest (94.2) Agriculture (4.0)
Lowland river									
Unare	400	22.5	Small towns	10	400-900	31.2	11	500	Urban (0.4) Forest (54.2) Agriculture (35.5)

RESULTS AND DISCUSION



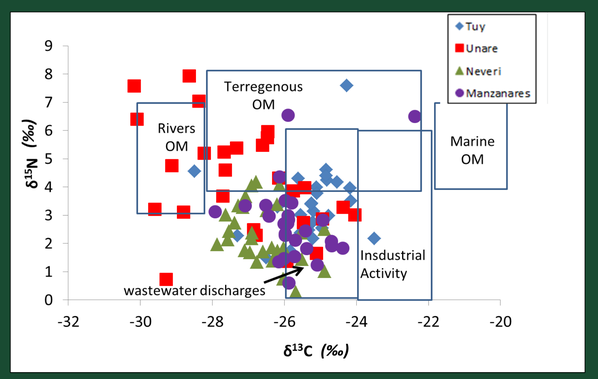


Basins Export

	DIN	DIP	DOC	POC	TSS
	(kg/ ha yr)				
Mountainous rivers					
Tuy	25,61	59,30	15,57	31,56	2,22E+03
Neveri	1,14	2,18	4,46	2,12	141,03
Manzanares	0,94	1,90	18,37	9,21	370,16
Lowland river					
Unare	0,41	1,09	4,84	1,37	146,40

Urbanization is the main driver for river export (i.e. Tuy River)[(2,6)].

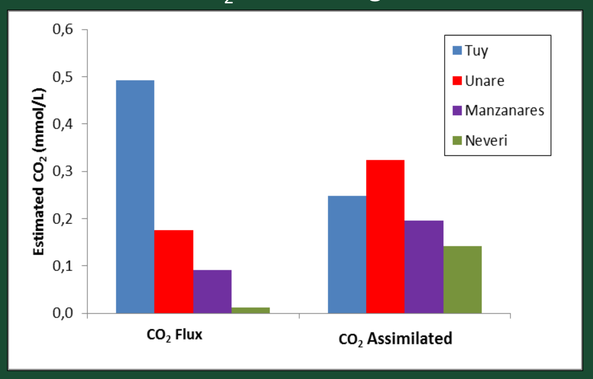
TSS Sources



- In all rivers isotope values show a mixing line of potential sources (sewage, terrestrial and river organic matter discharges). There is no evidence of marine organic matter contribution.
- ***Tuy River:*** Largely influenced by sewage discharges.
- ***Unare River:*** Impact of fertilized soils (large $\delta^{15}N$ variability).

Potential global carbon cycle implications

Estimation of CO_2 fluxes using Redfield ratios[(7,8)]



- Rivers that are highly impacted by urbanization can potentially emit a large fraction of C to the atmosphere.
- Next goal: CO_2 fugacity measurements in coastal waters impacted by river plume.

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