RCEM 2017
Encontro das Aguas, Manaus, Brazil: Twenty years later

C. Gualtieri[1], M.Ianniruberto[2], N.Filizola[3], A.Laraque[4], and J.Best[5]

[1] Dept. of Civil, Architectural and Environmental Engineering, University of Napoli *Federico II*, Napoli, Italy. carlo.gualtieri@unina.it
[2] Instituto de Geociências, Universidade de Brasília, Brasilia, Brazil. ianniruberto@unb.br
[3] Universidade Federal do Amazonas, Manaus, Brazil. naziano.filizola@gmailcom
[4] GET, UMR CNRS / IRD / UPS – UMR, Toulouse, France. alain.laraque@ird.fr
[5] Departments of Geology, Geography & GIS, Mechanical Science & Engineering & Vent te Chow Hydrosystems Laboratory, University of Illinois at Urbana-Champaign, Urbana, USA. jimbest@illinois.edu

1. Introduction

In the last four decades a wide body of theoretical, experimental, and field research has emerged concerning the fluvial dynamics of river confluences. This abstract discusses and compares the results from three large field studies carried out in 1997, 2006/2007 and 2014/2015 at of the Negro/Solimões confluence in the Amazon Basin that ranks among the largest on Earth.

2. Field site and instrumentation

The first field study was conducted in September 1997 (relatively low flow conditions) by the French–Brazilian HYBAM program (Laraque et al., 2009). During this study measurements using acoustic Doppler velocity profiling (ADCP), conductivity/temperature/density (CTD) profiles and specific sampling were collected upstream, at and downstream of the Negro/Solimões confluence. The second campaign was conducted at the confluence in 2006/2007 in 4 key times throughout the hydrological cycle using ADCP (Filizola et al., 2009). The third study was conducted as a part of the EU-funded CLIM-Amazon Project in both low (October 2014) and relatively high flow conditions (April/May 2015), respectively (Trevethan et al., 2015) using ADCP and high-resolution seismic methods alongside CTD and water sampling for suspended sediment concentrations.

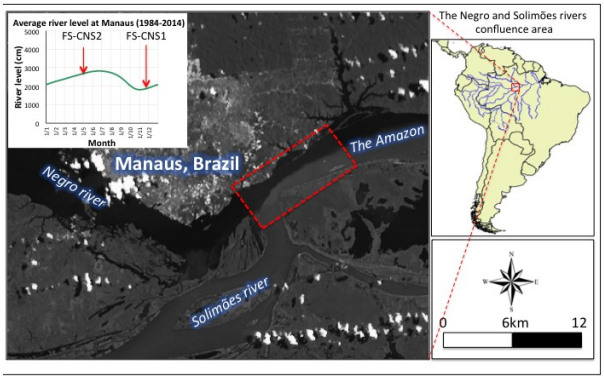

Figure 1. Map of the Negro/Solimões confluence.

2. Principal results

The field studies accomplished a comprehensive survey of the confluence hydrodynamics, sediment transport and features of flow mixing. Table 1 lists the main flow properties of the Negro and Solimões rivers during the field studies. During the 2014/2015 field campaign several common morphodynamic features noted in previous confluence studies, such as scour hole, deposition in the stagnation zone and downstream separation zone, were also observed. These included even large bed-forms on the Solimões side of the Amazon channel. These features are compared with those observed during the other two studies.

Table 1. Main flow properties of Negro and Solimões Rivers during the field studies. Data from 2006/2007 are omitted as they are variable

Field study	River	Q (m^3s)	h_{med} (m)	$V_{depth\text{-}avg}$ ($m\ s^{-1}$)	SST ($mg\ L^{-1}$)
1997	Negro	24961	30.4	0.31	6.5
	Solimões	63260	19.2	1.00	84
2014	Negro	24510	24.4	0.41	8.3
	Solimões	63380	27.2	1.35	185.3
2015	Negro	33501	31.2	0.44	4.1
	Solimões	105205	28.6	1.57	108.6

In addition, water chemistry data highlighted commonalities and differences in the mixing process of the Negro and Solimões waters during the field campaigns. This process results from a complex interaction between the differences in velocity and density, bed friction and form roughness at the junction.

3. Conclusions

A comparative study based upon 3 field campaigns in 1997, 2006/2007, 2014/2015 explored the relationship between hydrodynamics, morphodynamics and mixing at the Negro/Solimões confluence under varying flow conditions.

Acknowledgments

The authors acknowledge financial support from HYBAM, Petrobras and EU (CLIM-AMAZON Project).

References

Filizola, N., Spinola, N., Arruda, W., Seyler, F., Calmant, S., and Silva, J. (2009). The Rio Negro and Rio Solimões confluence point – hydrometric observations during the 2006/2007 cycle. *6th Symposium on River, Coastal and Estuarine Morphodynamics (RCEM 2015)*, Santa Fe, Argentina, September 21-25, 2009

Laraque, A., Guyot, J., and Filizola, N. (2009). Mixing processes in the Amazon River at the confluences of the Negro and Solimões Rivers, Encontro das Aguas, Brazil. *Hydrological Processes*, 23, 3131-3140.

Trevethan, M., Ianniruberto, M., Santos, A., De Oliveira, M., Filizola, N., and Gualtieri, C. (2015b). Morphodynamics and hydrodynamics features observed about the confluence of Negro and Solimões rivers, Brazil. *9th Symposium on River, Coastal and Estuarine Morphodynamics (RCEM 2015)*, Iquitos, Perù, August 30/September 3, 2015, Paper 69