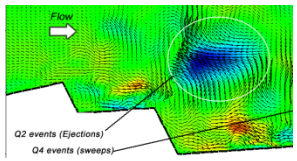
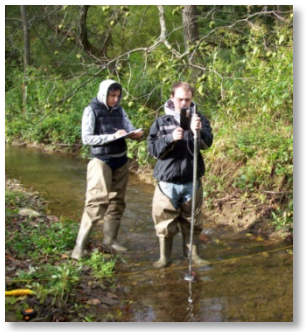
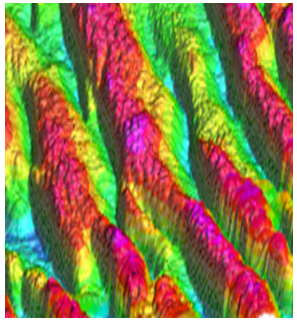
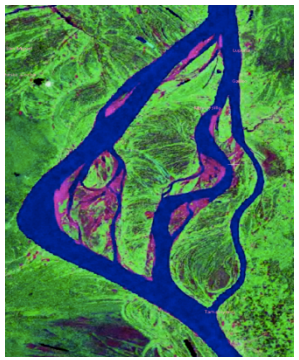
CSDMS
COMMUNITY SURFACE DYNAMICS MODELING SYSTEM

October 29th, 2011









Morphodynamics and river modeling

Jorge D. Abad

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Dept. of Civil and Environmental Engineering (CEE) : http://www.engineering.pitt.edu/Civil/

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Center for Simulation and Modeling (SAM) : http://www.sam.pitt.edu/

Center for Latin American Studies (CLAS) : http://www.ucis.pitt.edu/clas/

Director

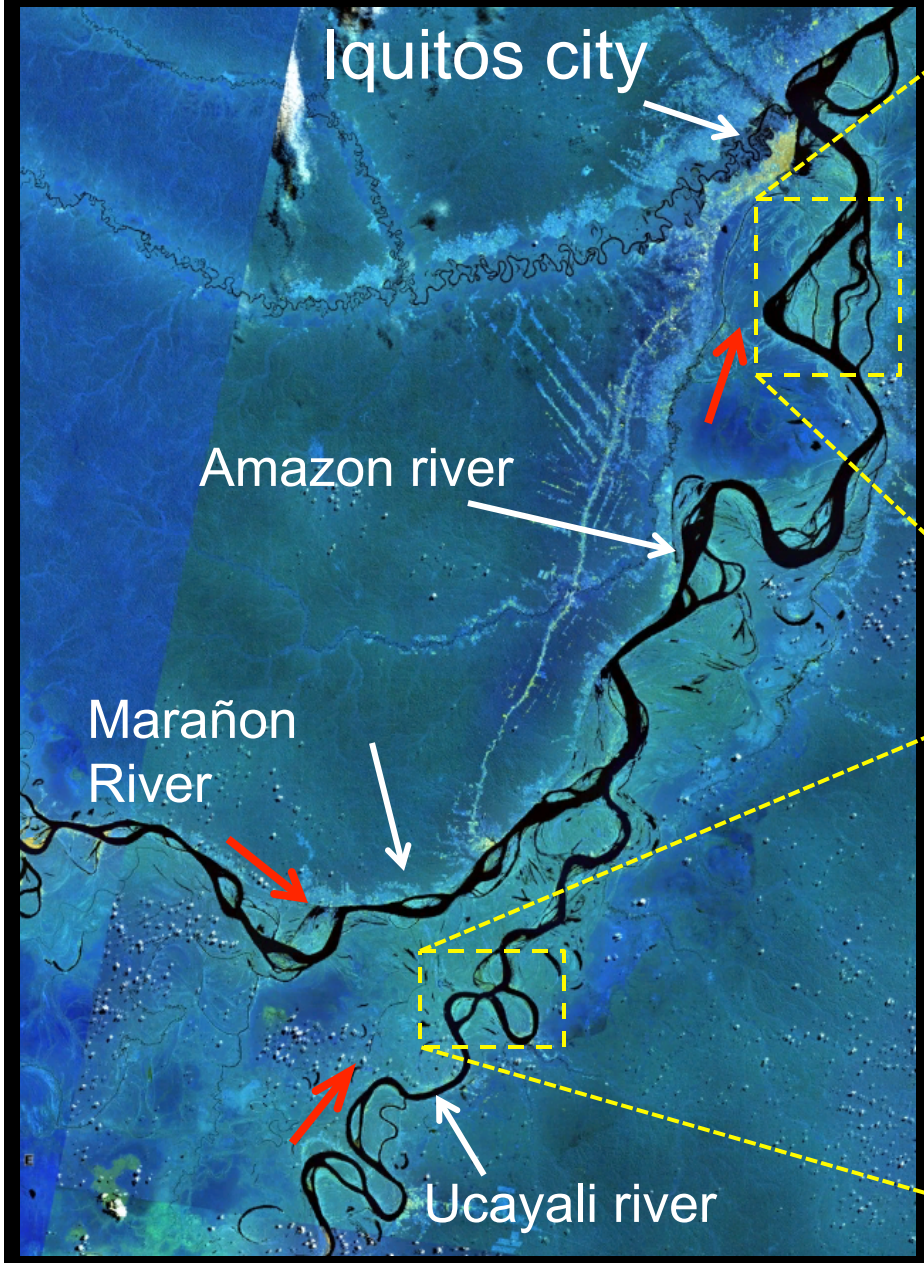
CREAR

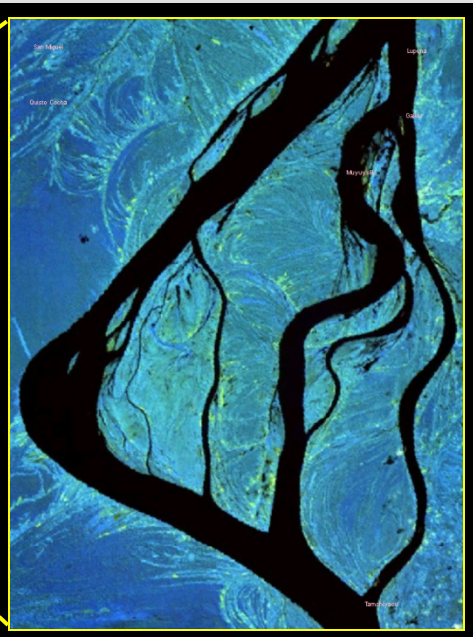
Center for Research and Education of the Amazonian Rainforest

http://www.crearamazonia.org

- **Planform dynamics in meandering and anabranching systems**

❑ Dynamics of meandering and anabranching systems





Anabranching structure (Amazon River)

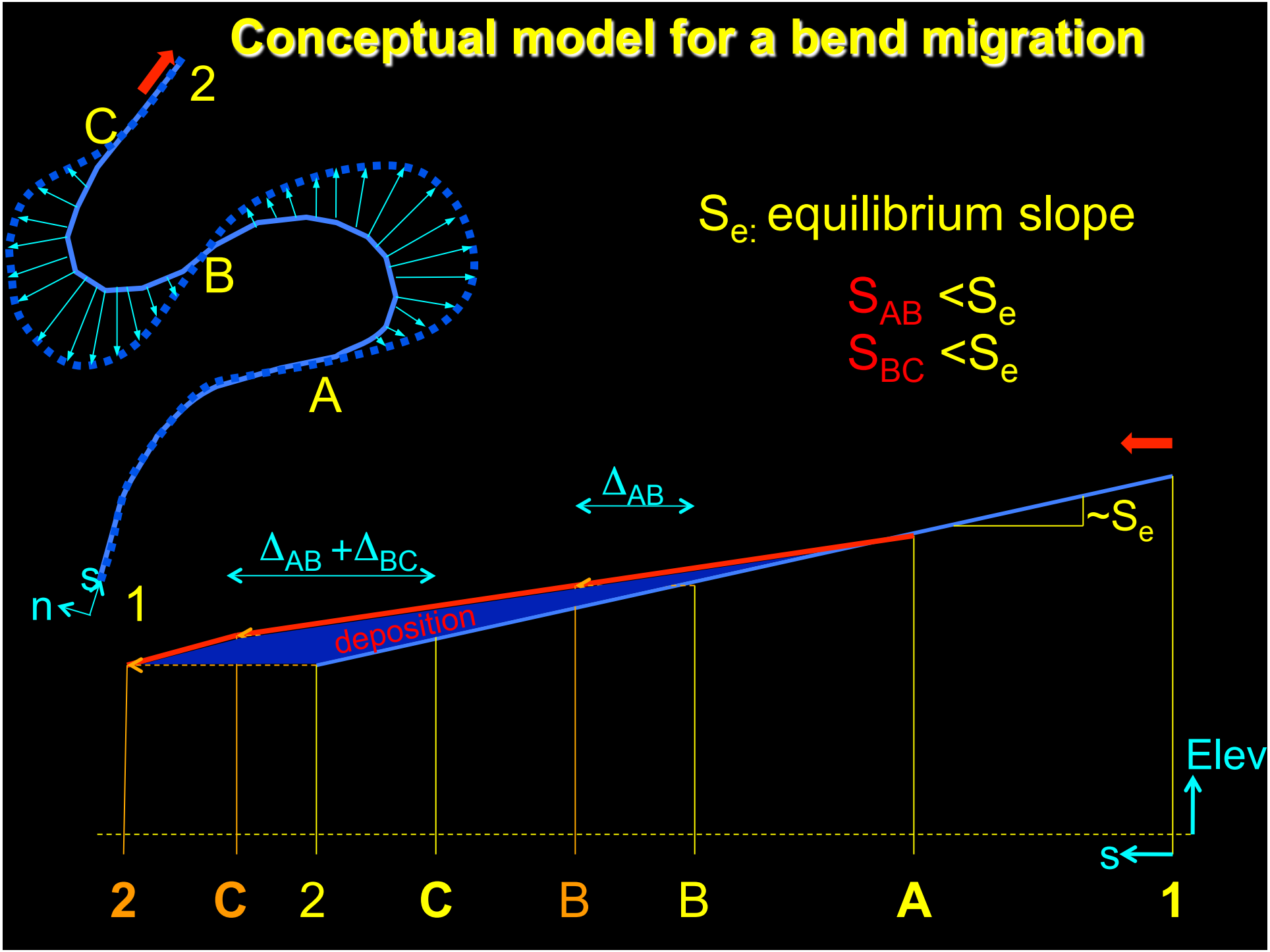
Meandering structure (Ucayali River)

Evolution of meandering channels

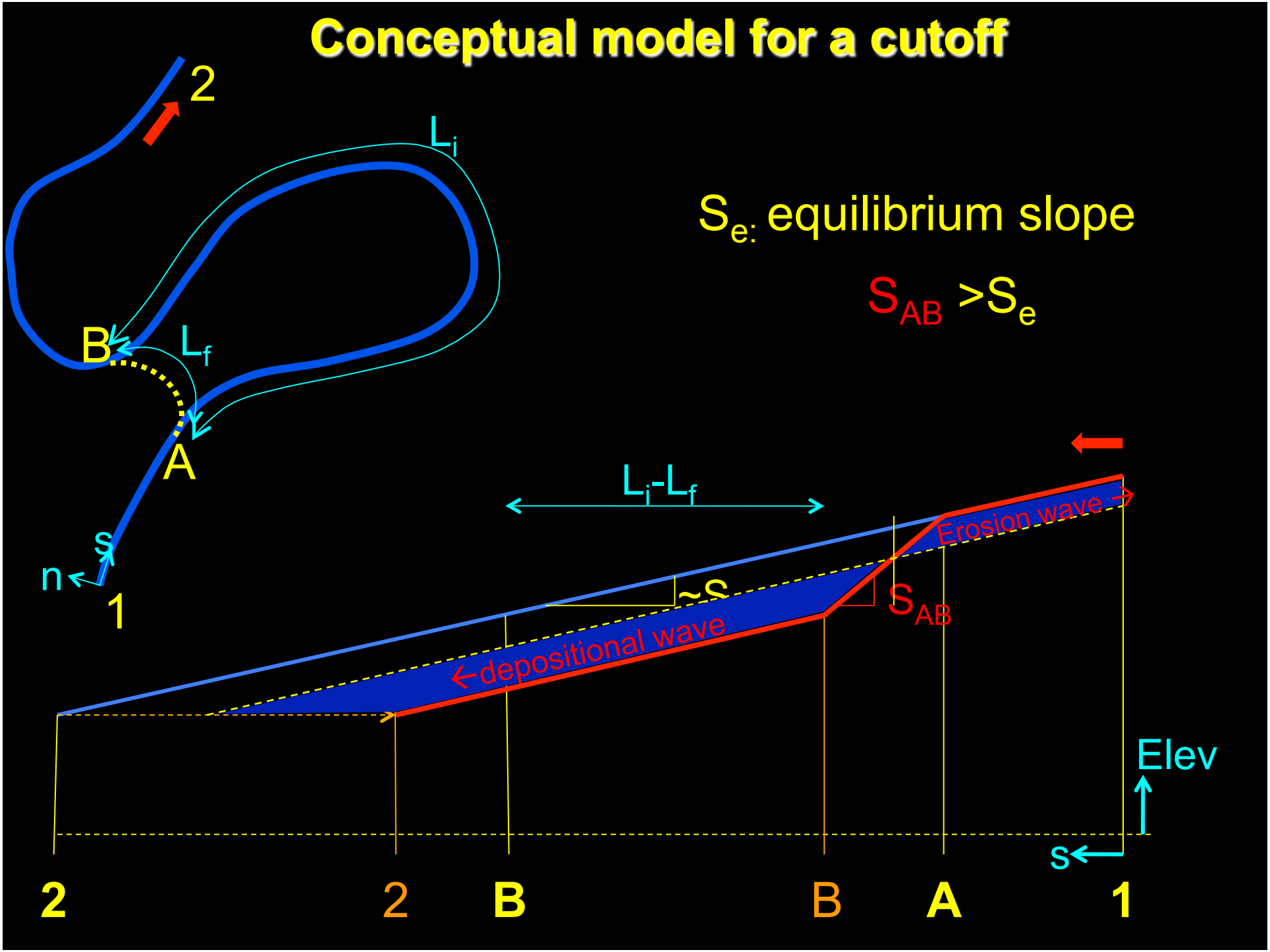
Lancaster, 2002

Dynamic equilibrium

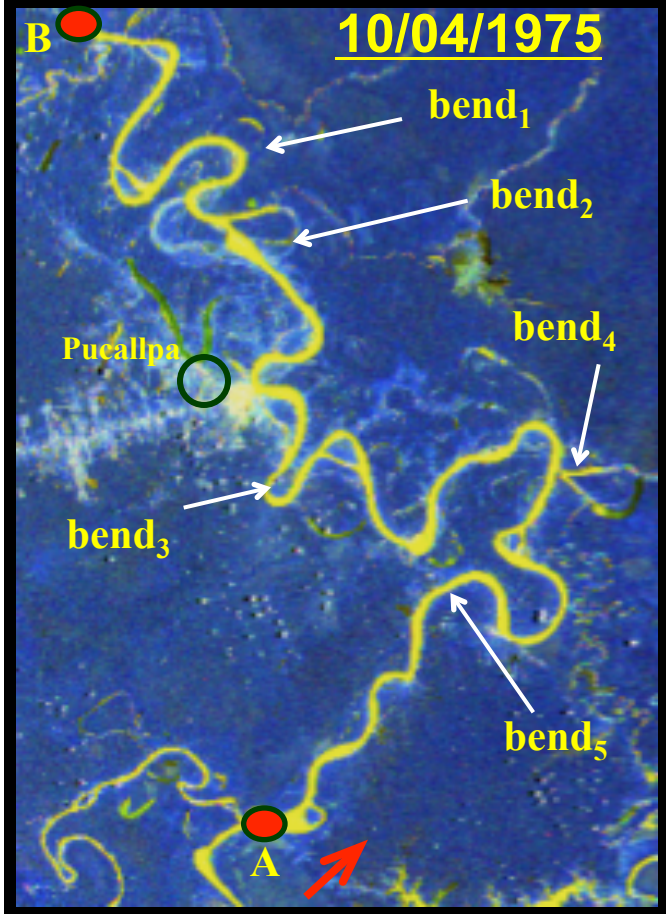
Conceptual model for a bend migration

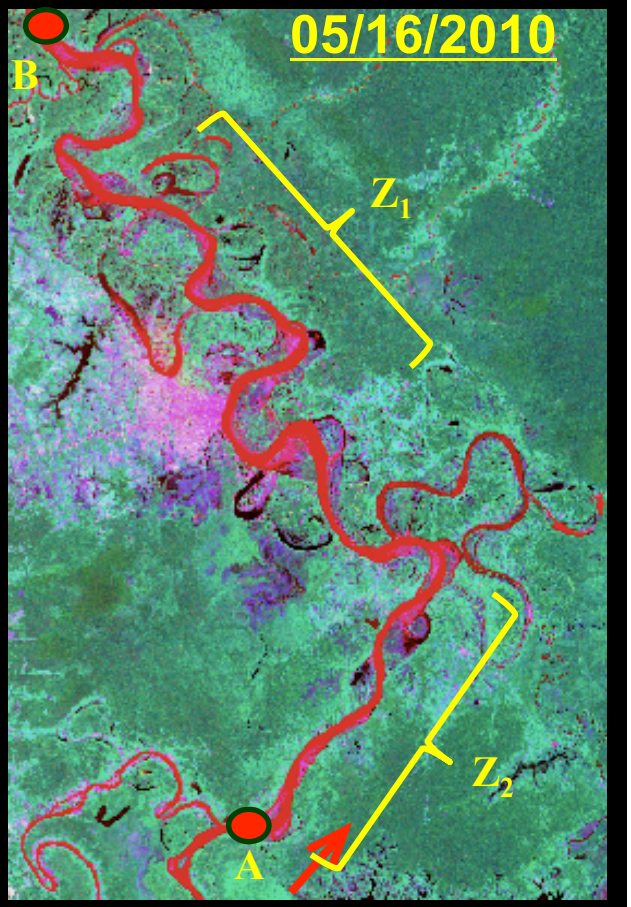


Conceptual model for a cutoff

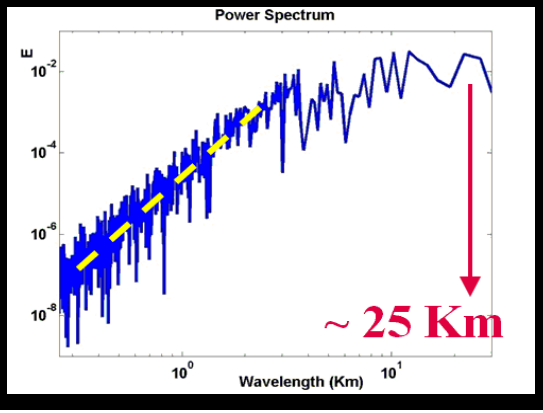


Dynamics of the Ucayali River near Pucallpa City, Peru

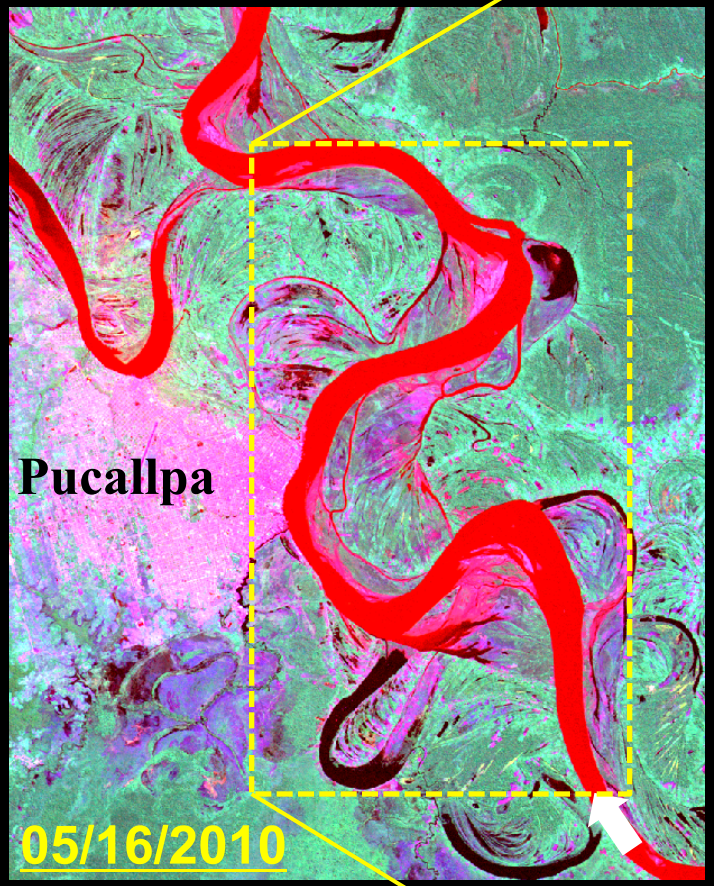


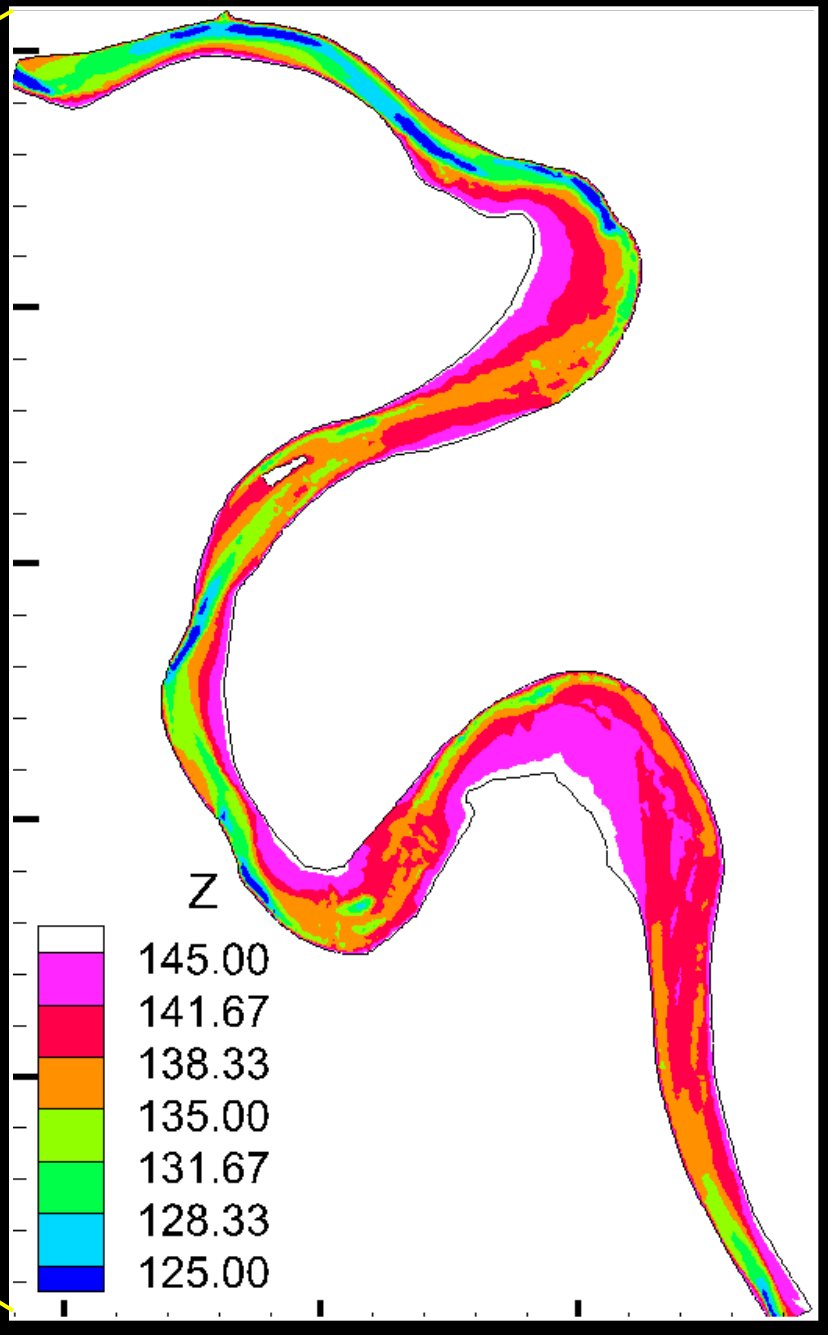


$Sin_{Ucayali} \sim 1.70$

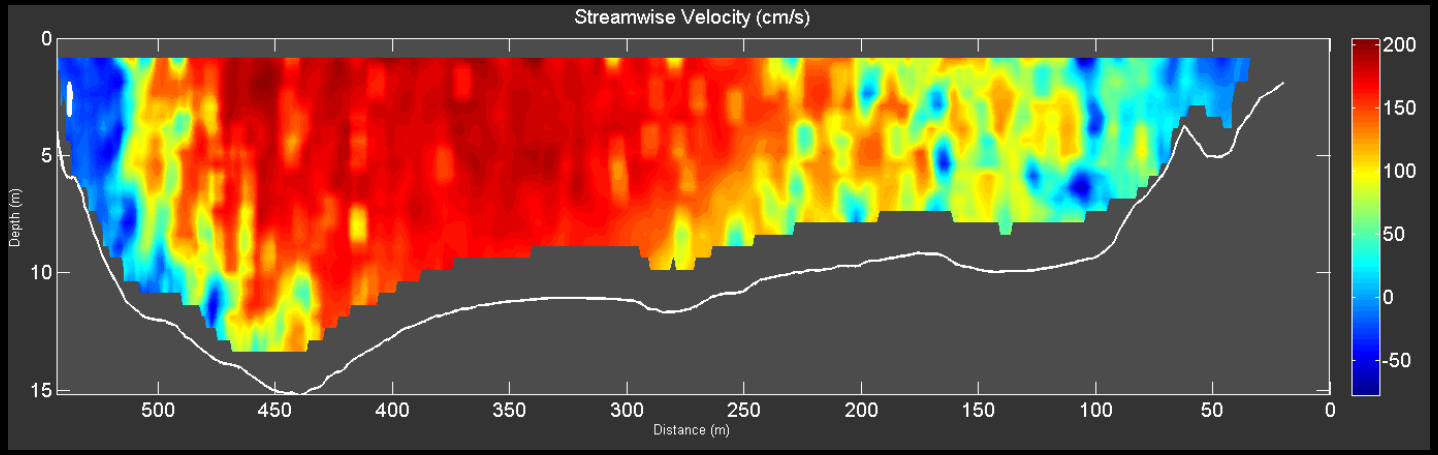


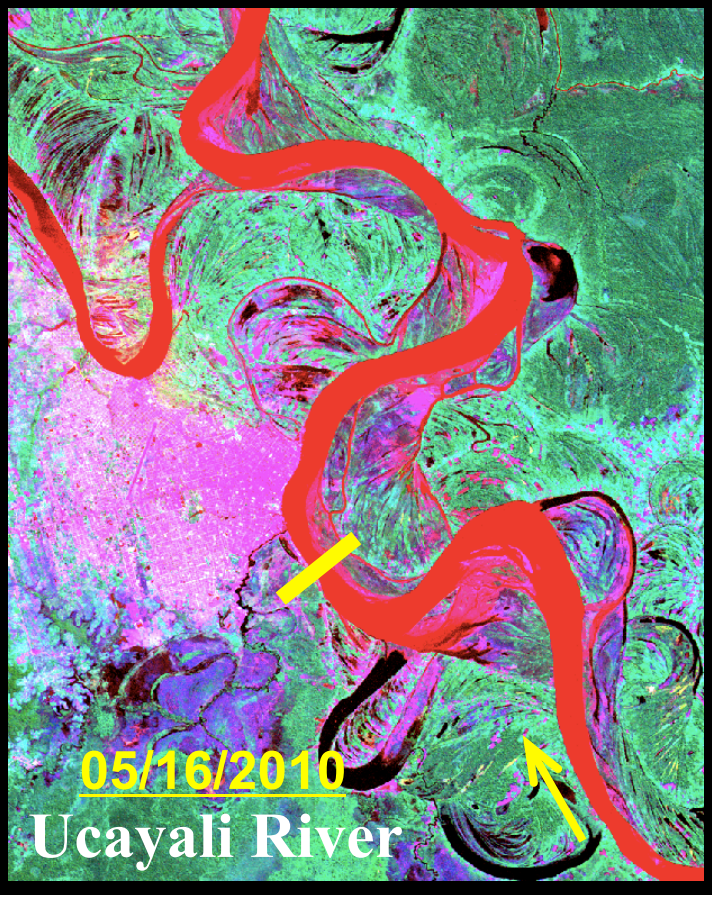
Bathymetry 2011

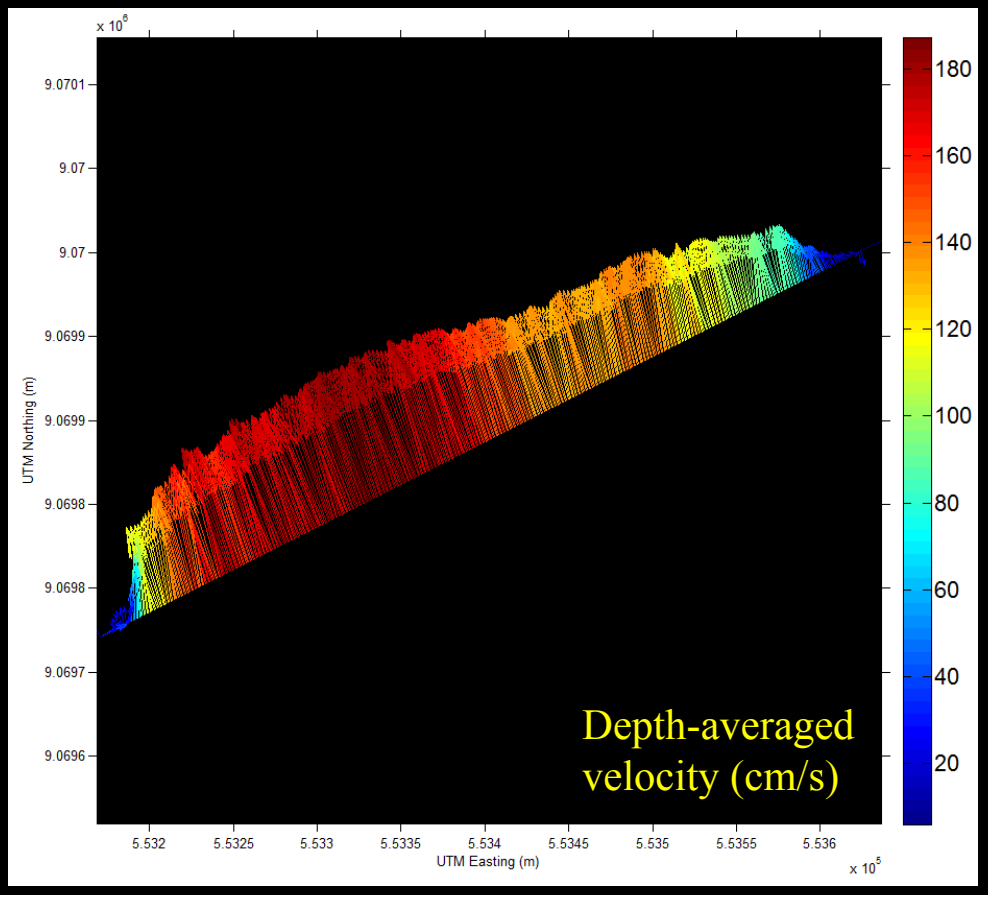




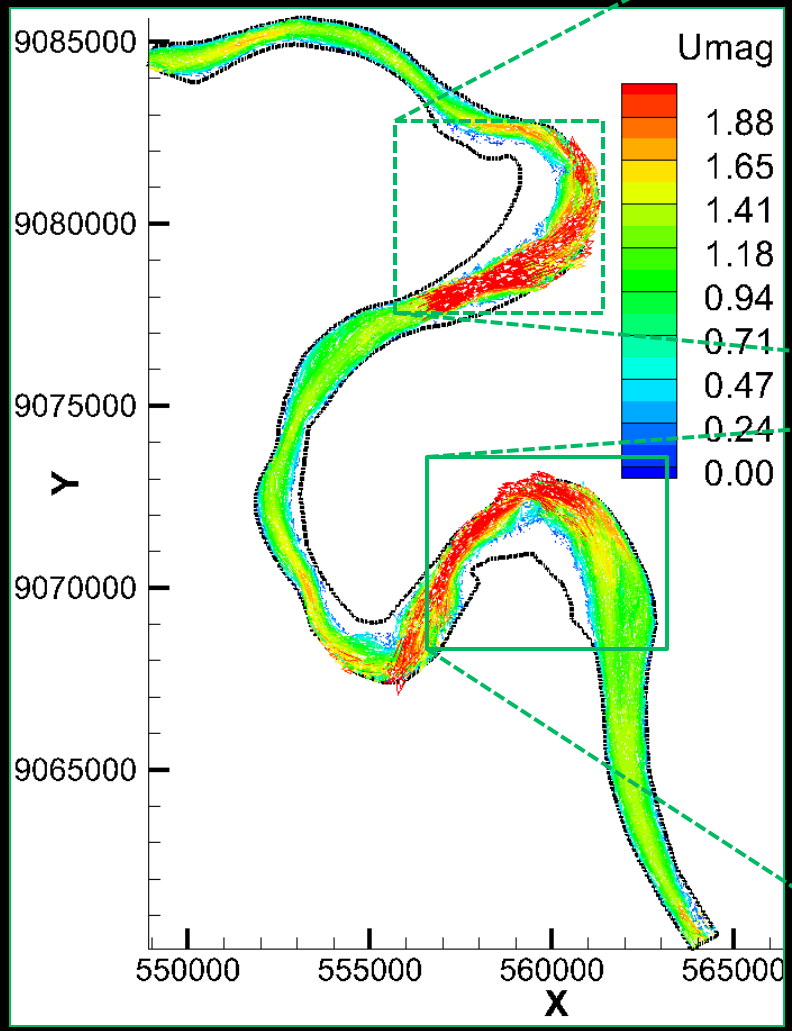
aDcp measurements 2011

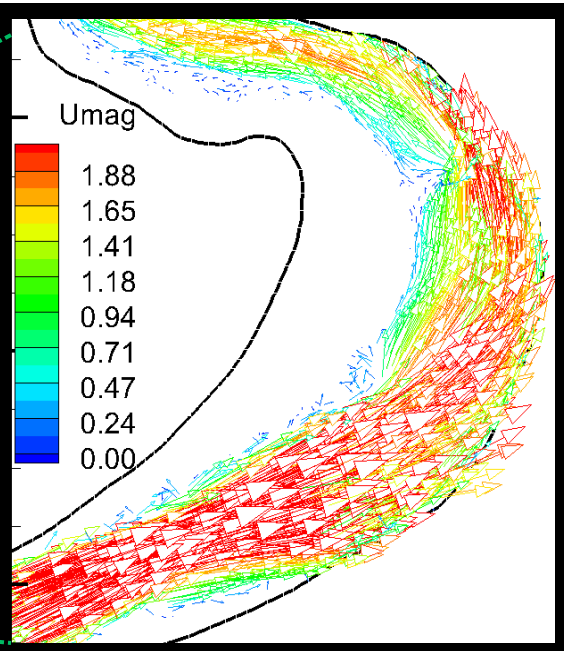


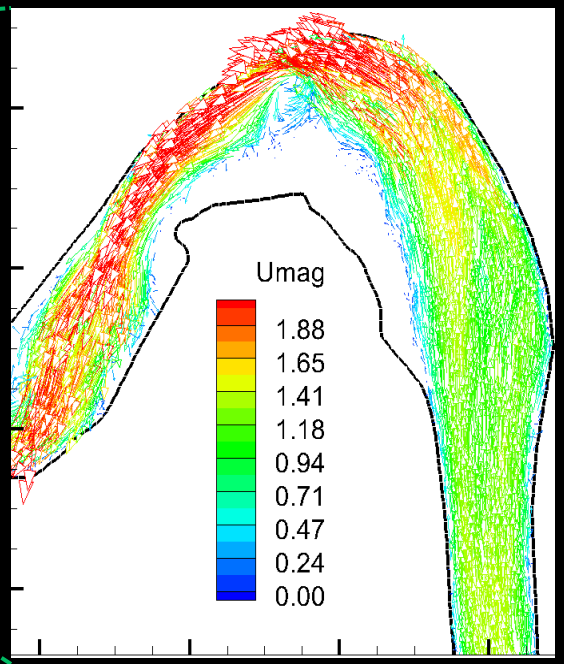




2D modeling

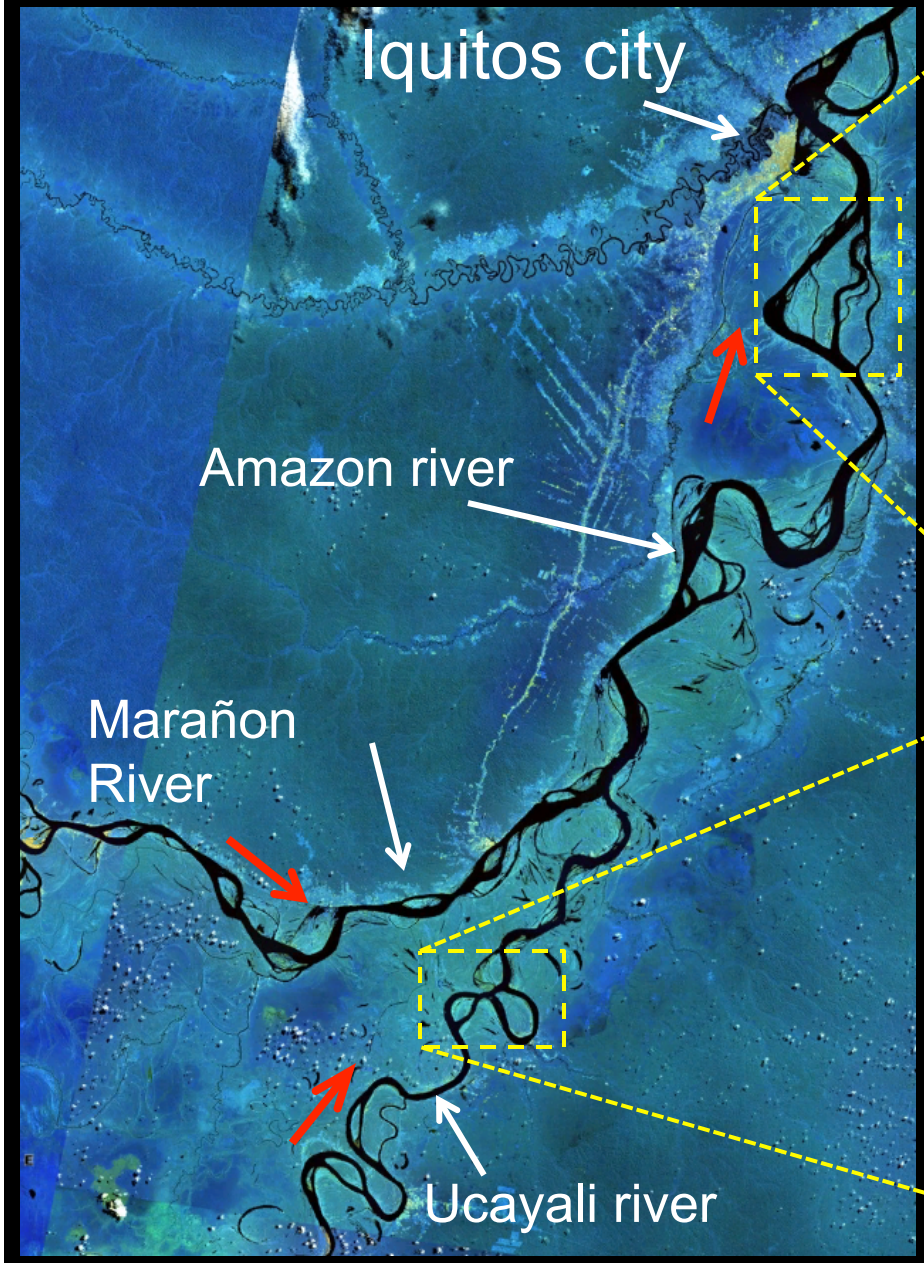


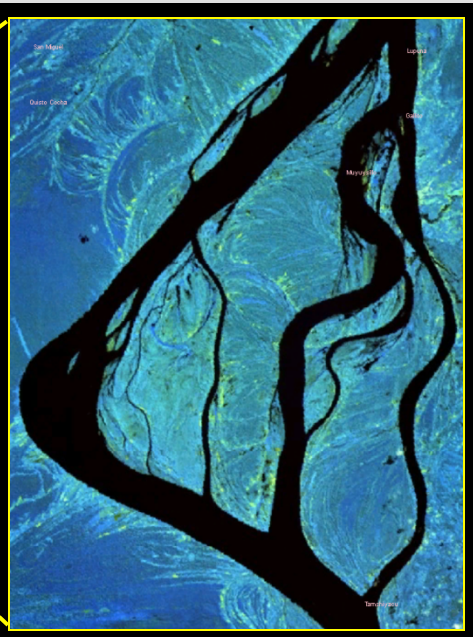




Abad et al. (in preparation)

❑ Dynamics of meandering and anabranching systems

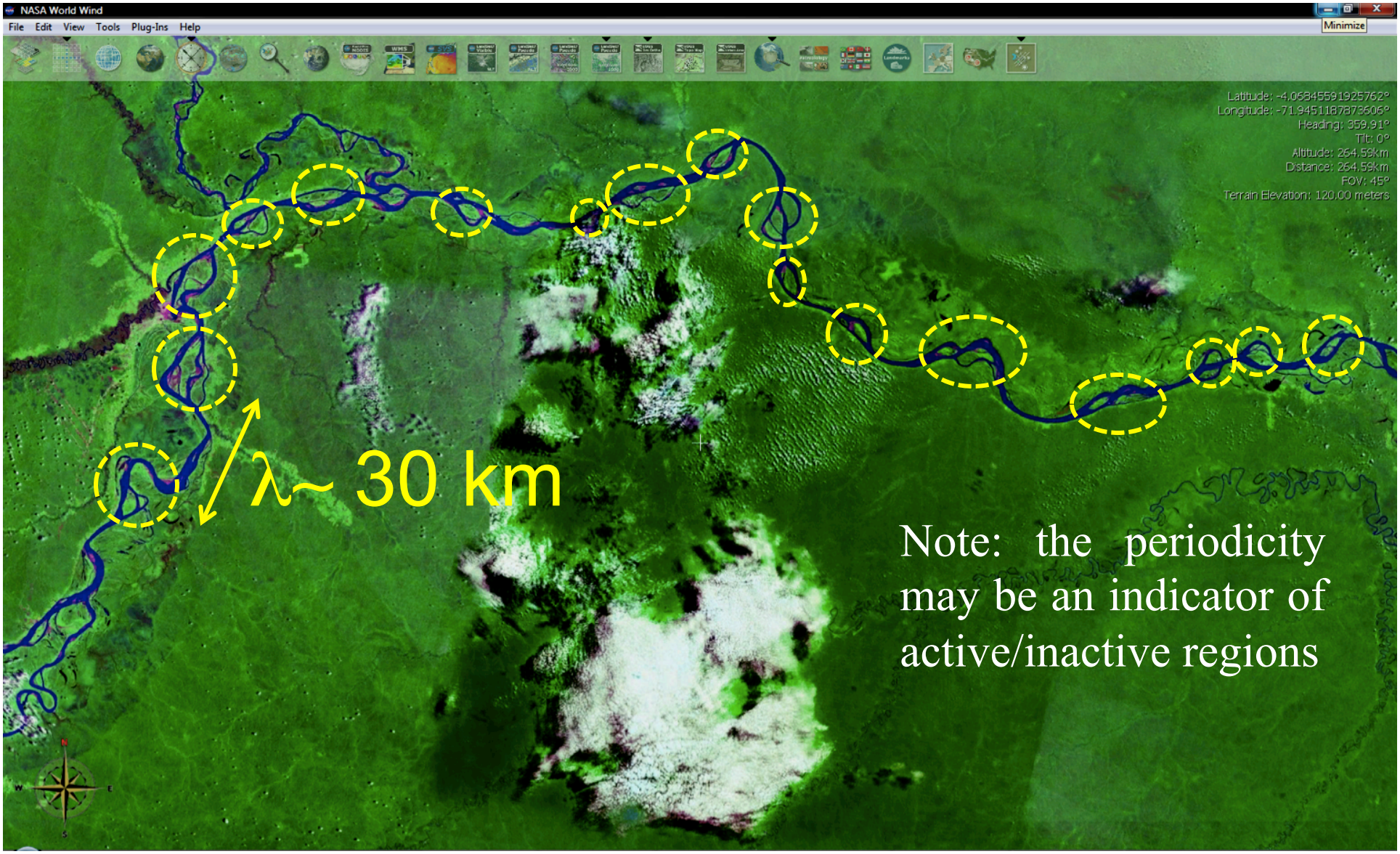




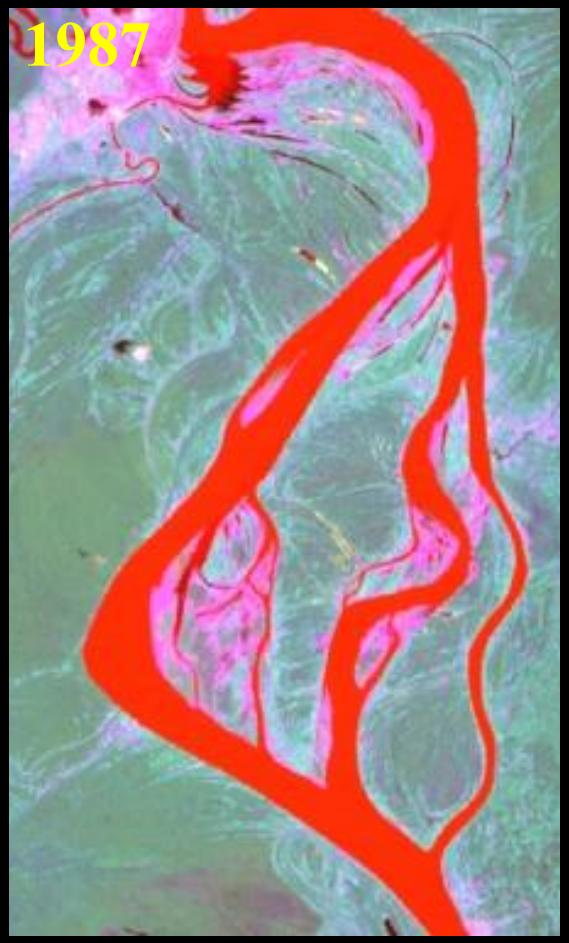
Anabranching structure (Amazon River)

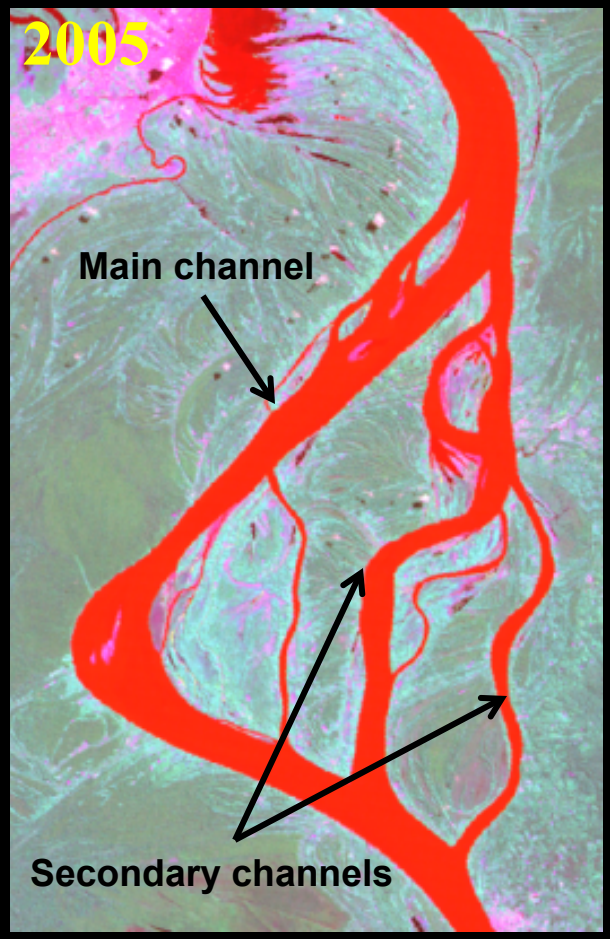
Meandering structure (Ucayali River)

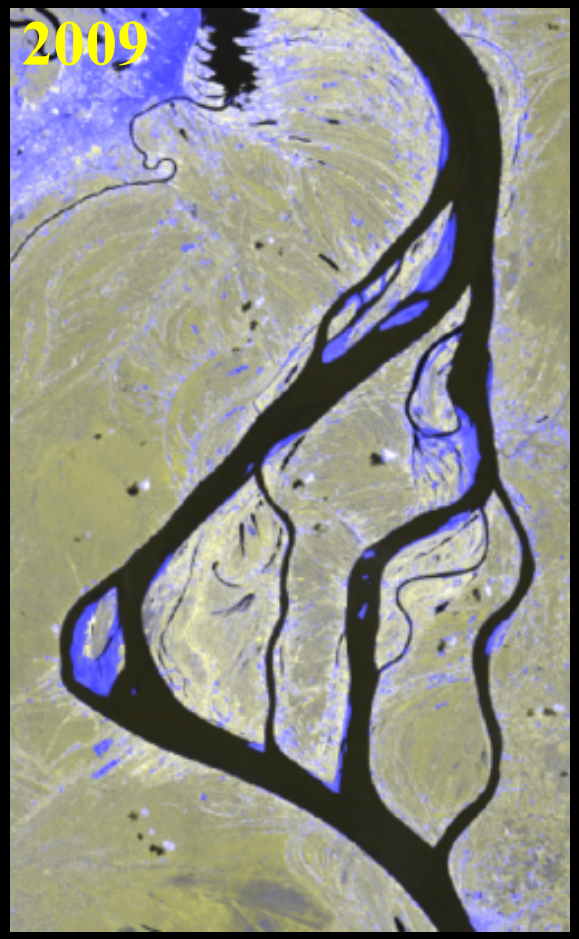
Occurrence of anabranching structures



Muyuy area

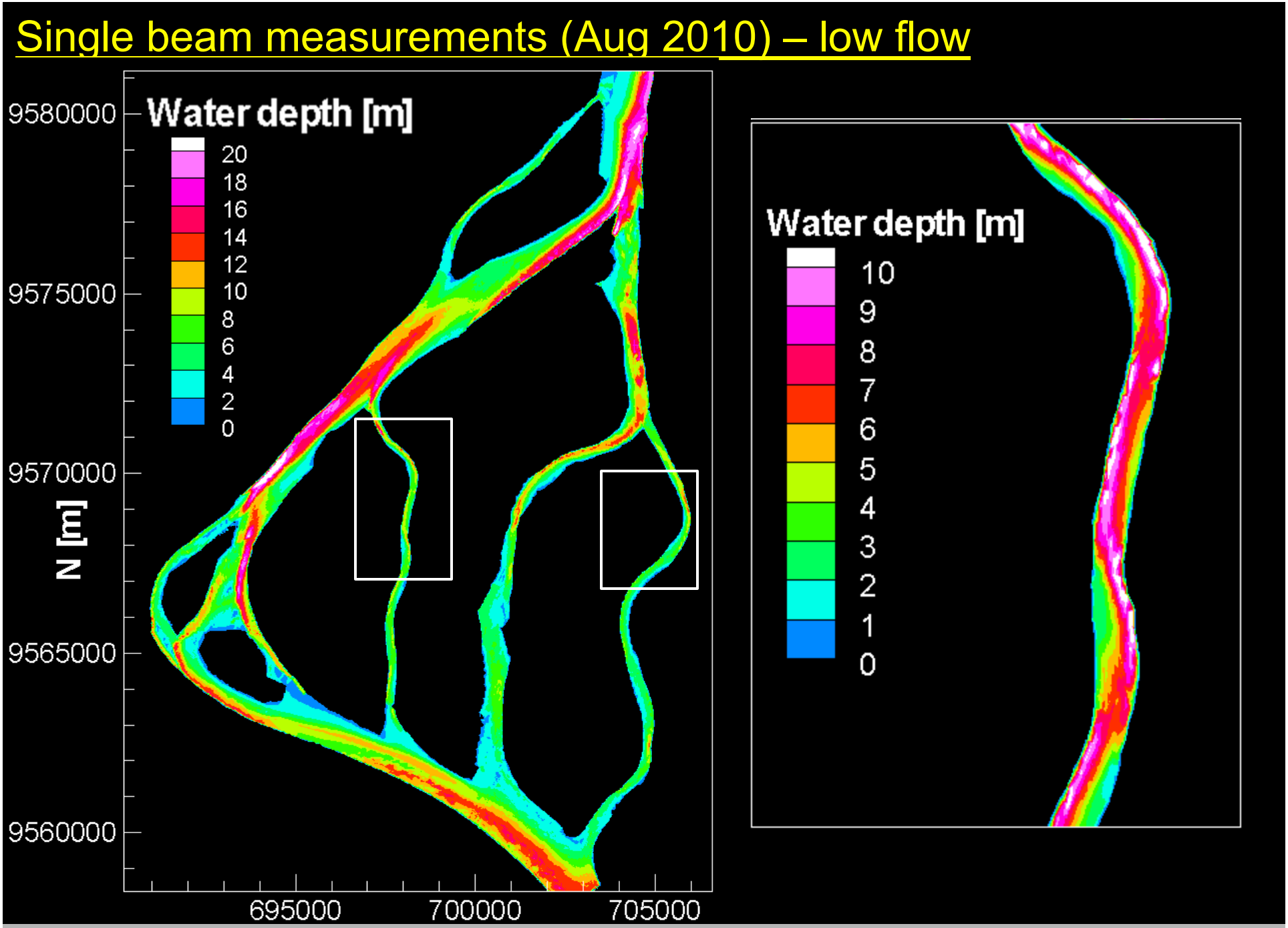






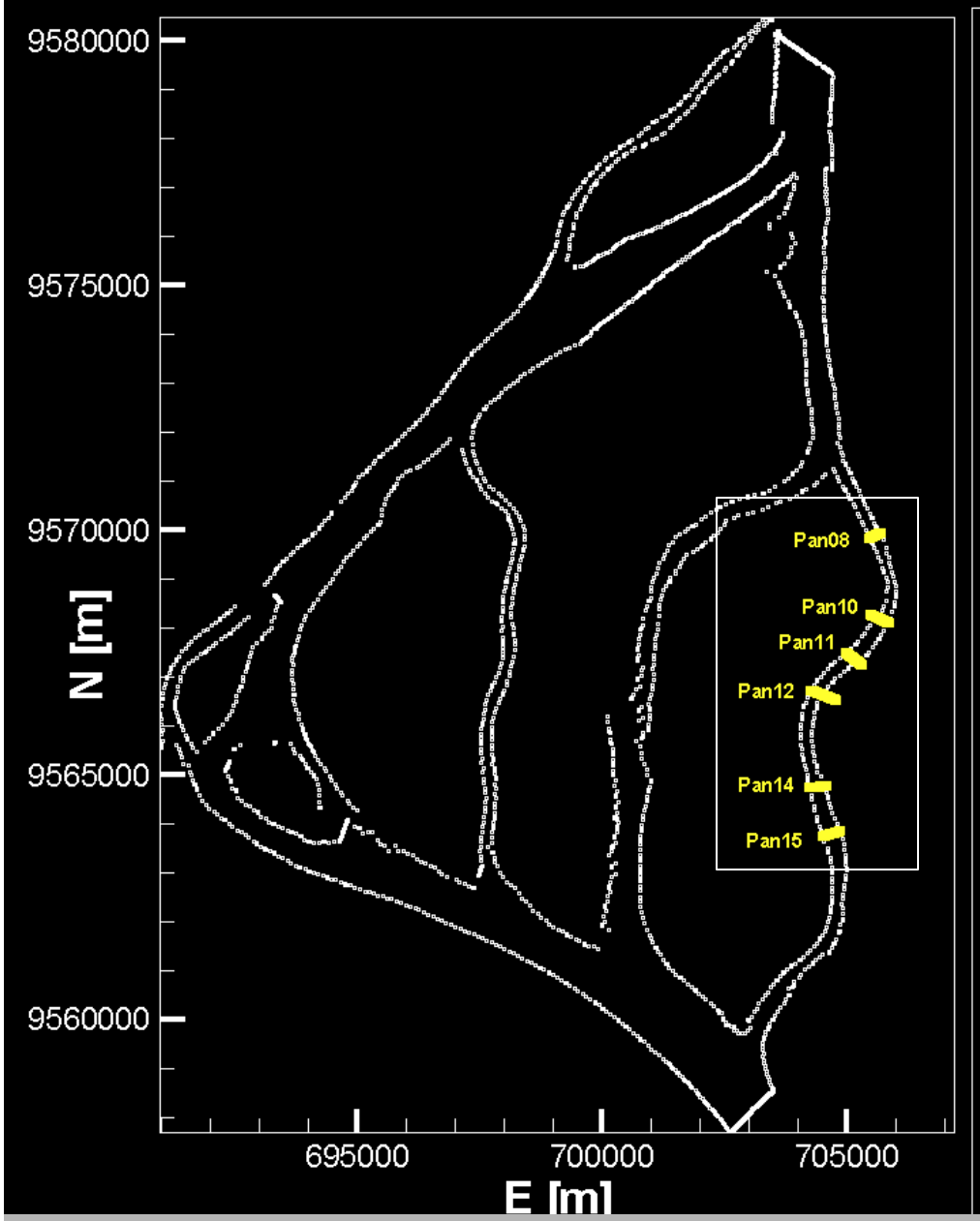
Notice: Individual secondary channels are behaving as meander bends, maybe the main channel will start to evolve more if other regions are turn off to be inactive

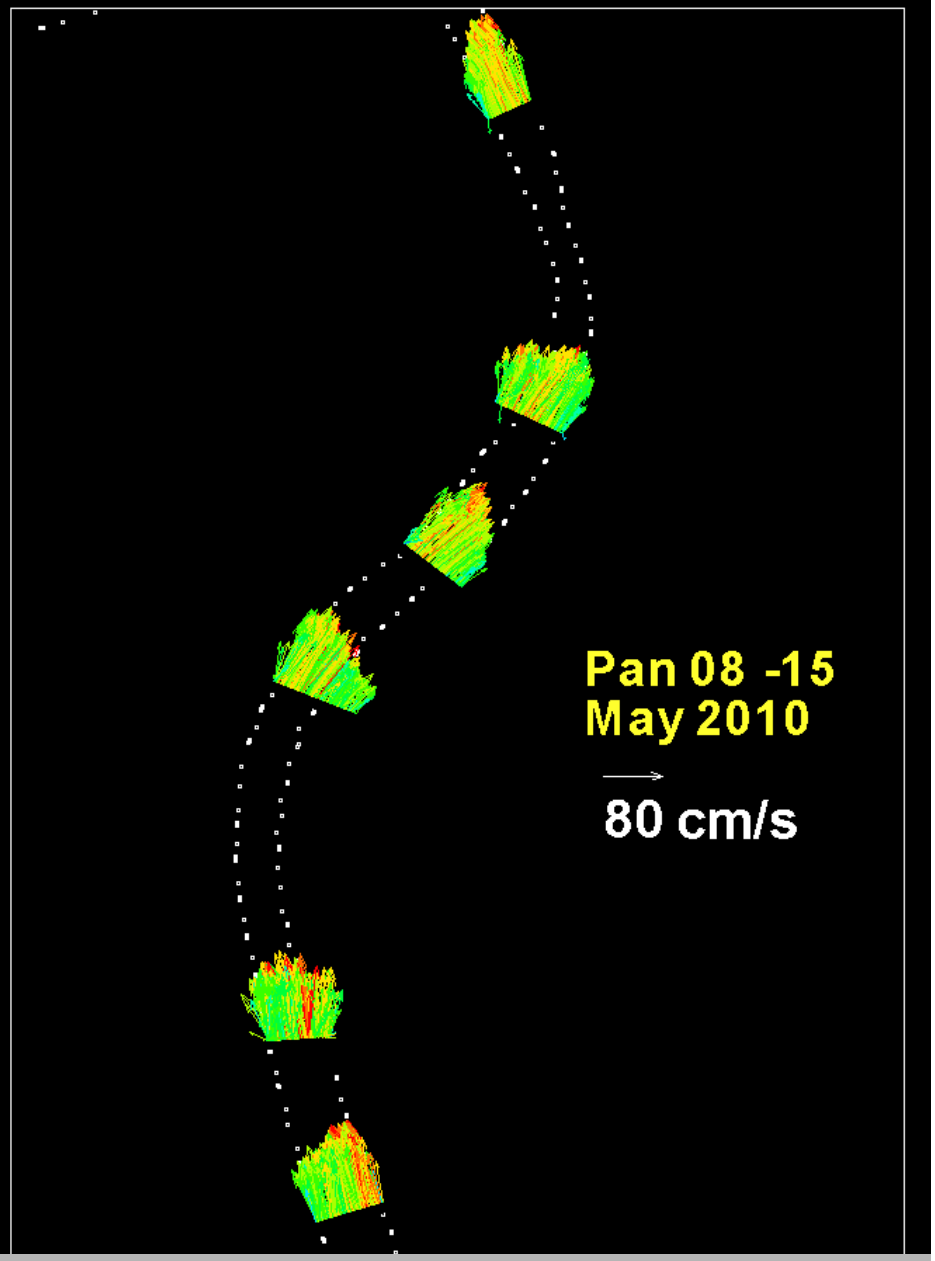
Single beam measurements (Aug 2010) – low flow



SC are non-developed meandering channels

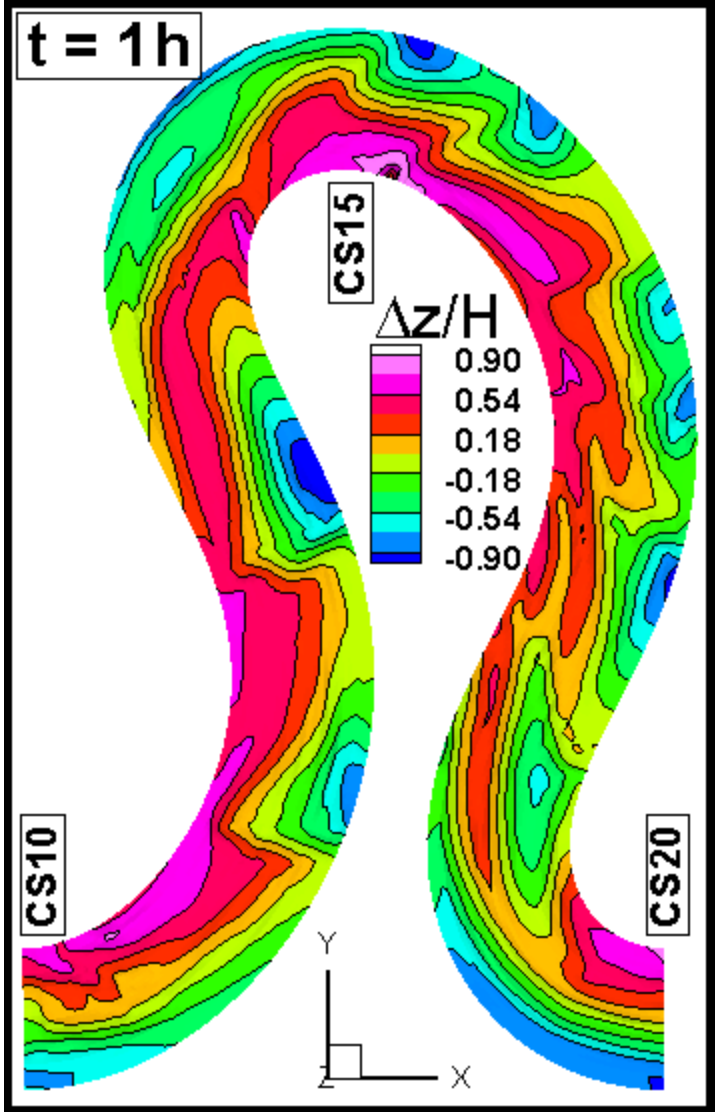
Abad et al. (in preparation)



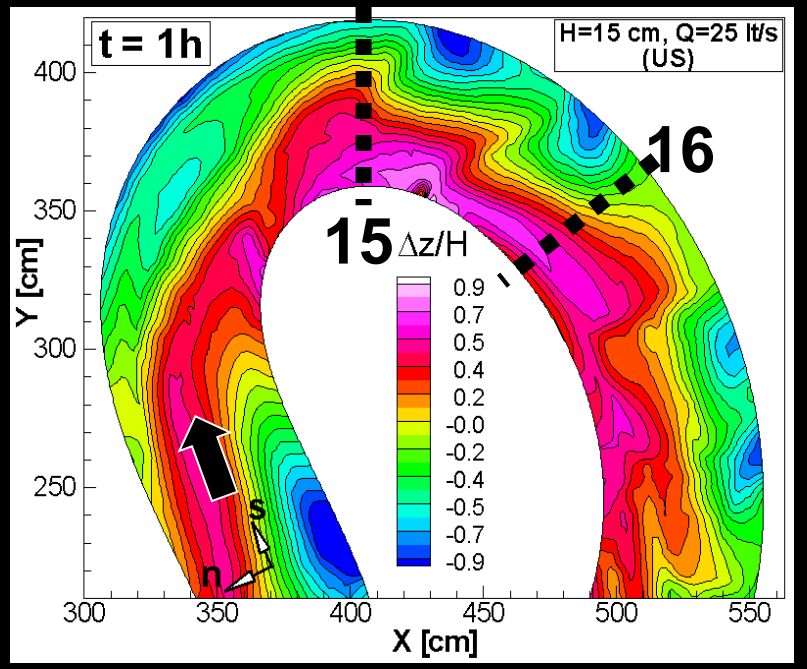


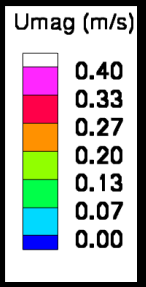
❑ Bed morphodynamics

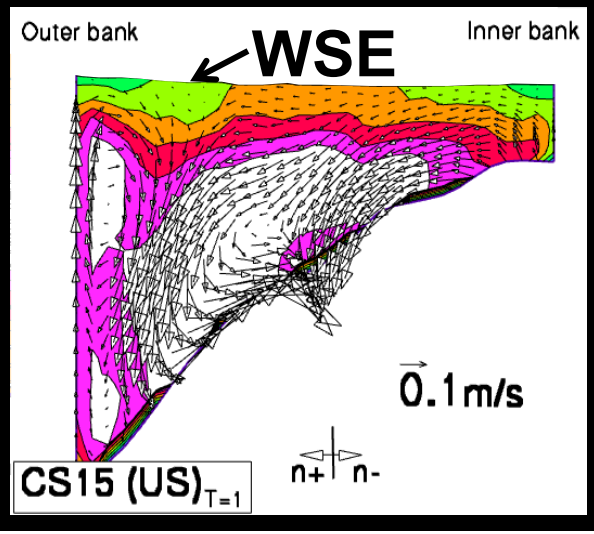
Kinoshita channel – UofI
Secondary flow

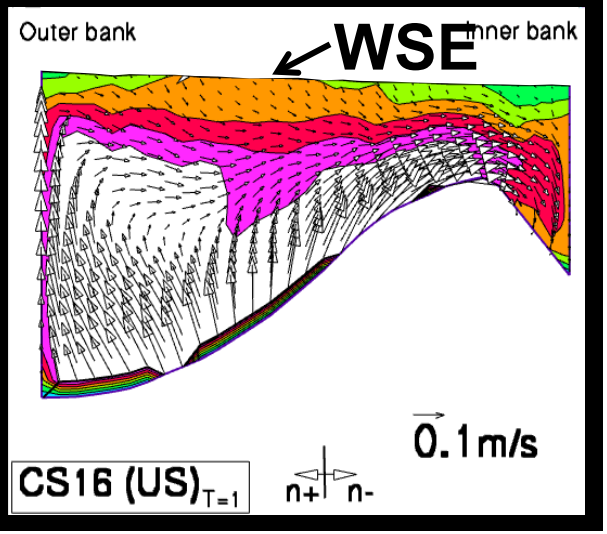


Abad (2008)

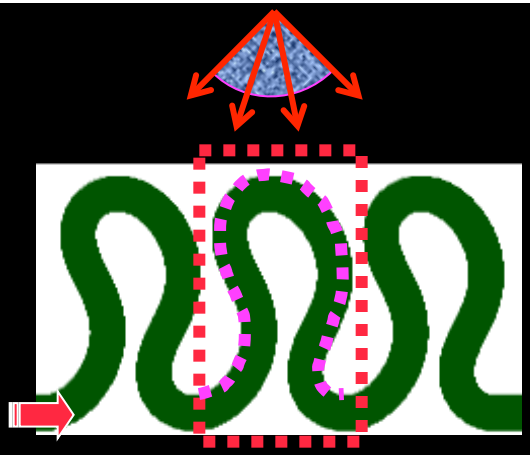


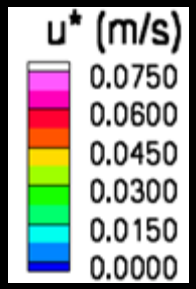


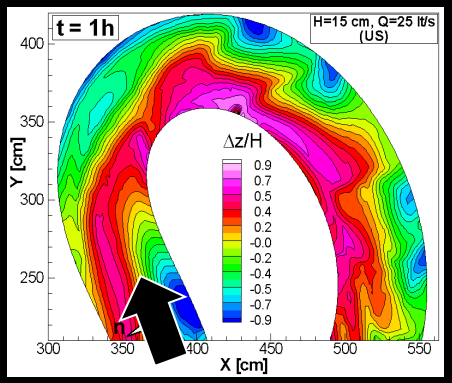


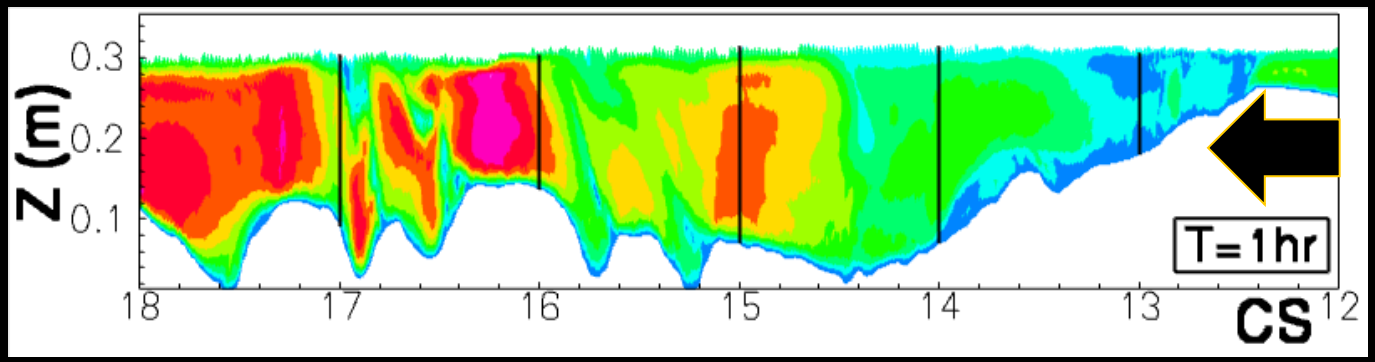


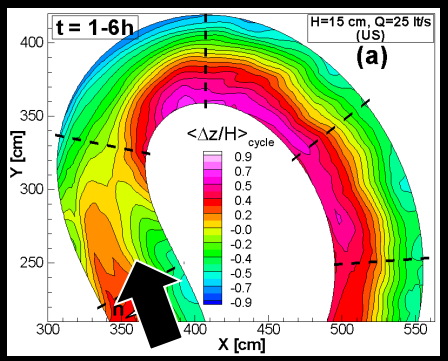
Kinoshita channel – UofI
Shear stress - banks

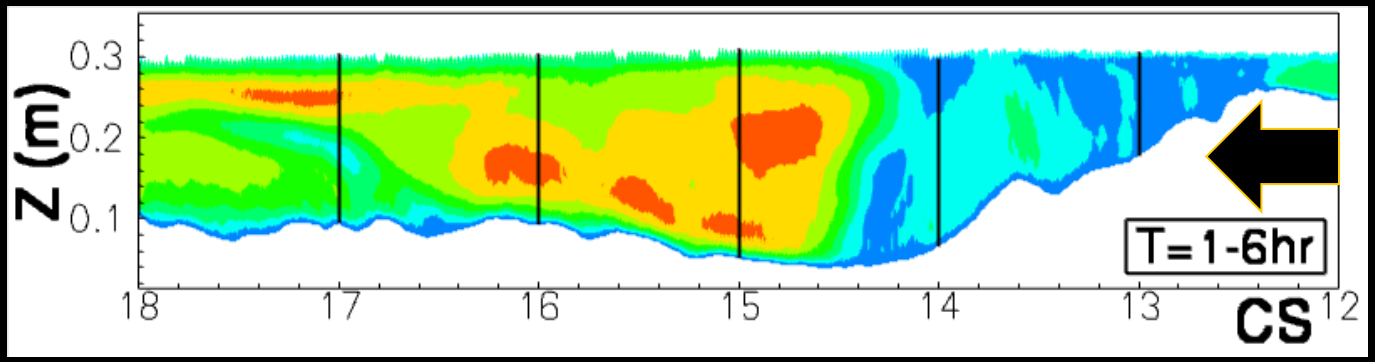




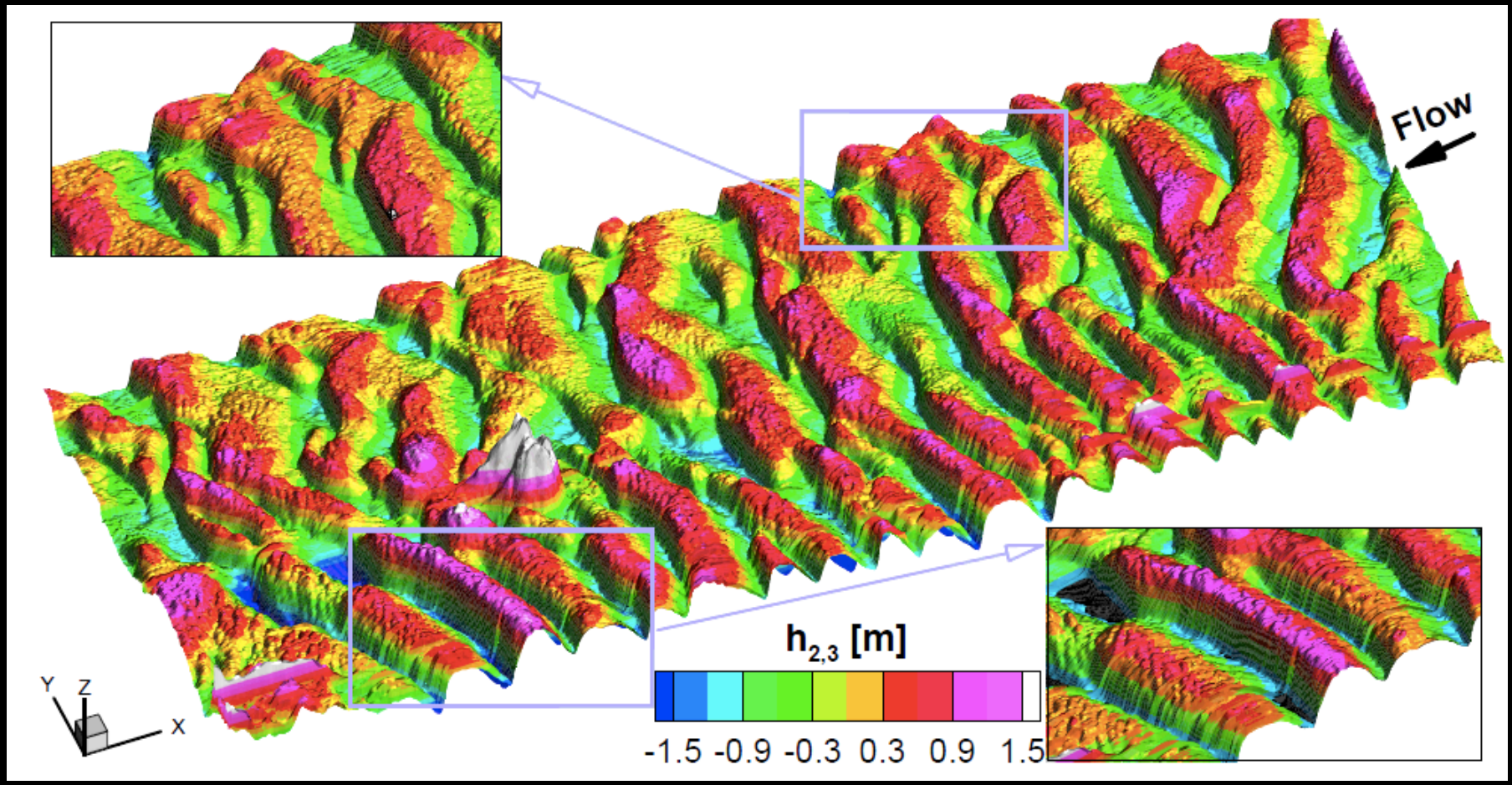






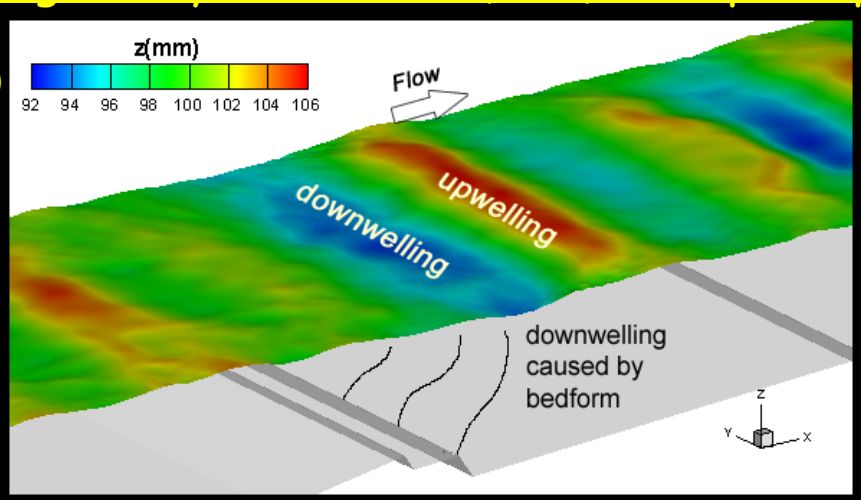


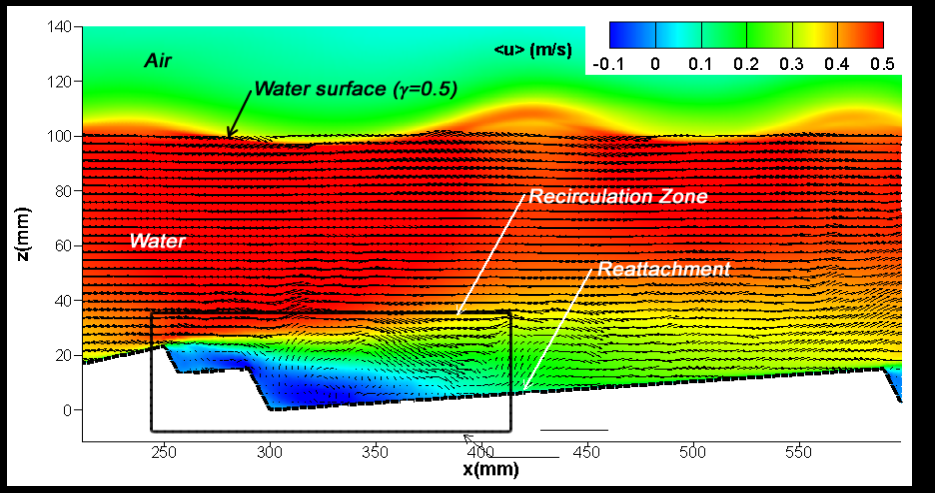
Wavelet Analysis of Bedforms in Large River Systems

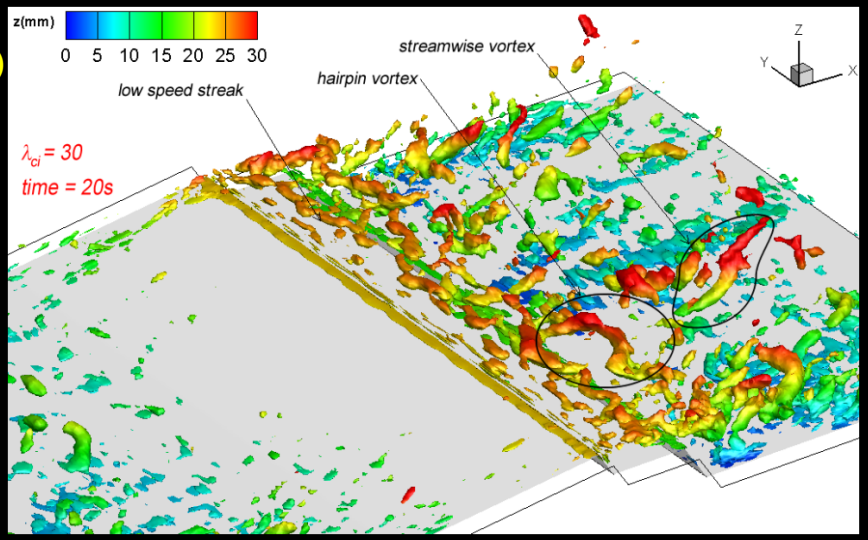


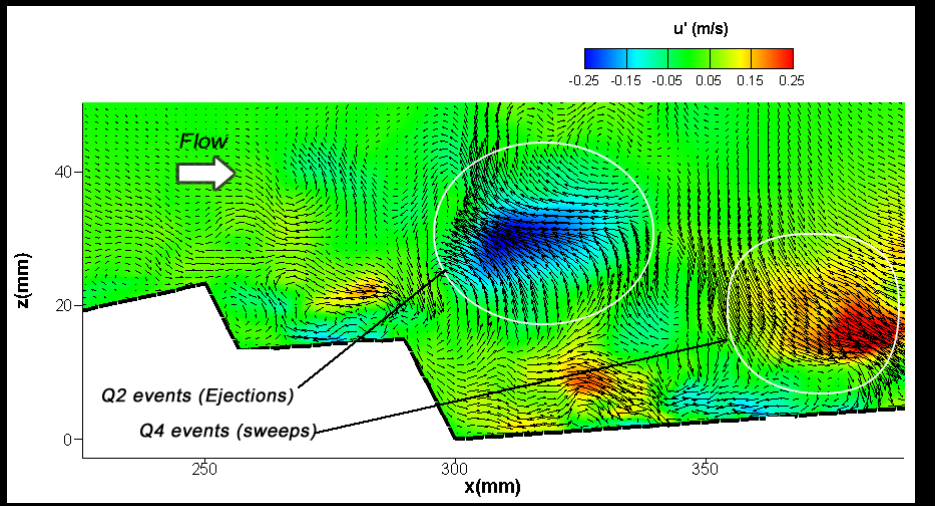
(Gutierrez et al., in submission)

Large Eddy Simulation (LES) of superimposed bedforms









a) Bedform effect in the water surface, b) Isosurfaces for a swirling strenght of 30 to visualize vortical structures, c) Contours of average velocities and vectors of instantaneous velocities, d) Streamwise velocities perturbations in a plane Y=0.

Frias and Abad (in submission)

www.rvrmeander.org

GIS-based long-term morphodynamic model

Acknowledgments:

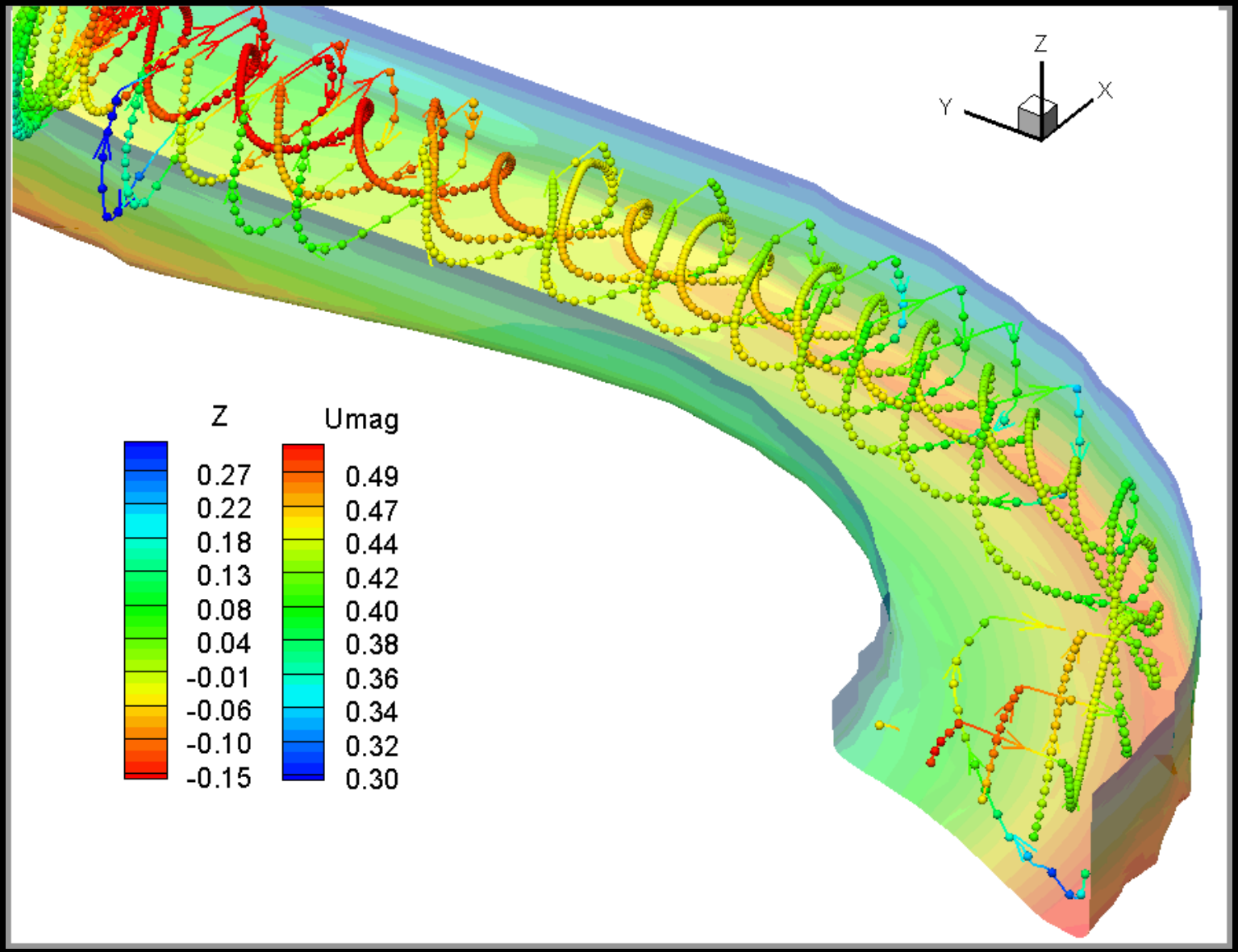
RP1: Morphodynamics of Complex Meander Bends on Large Rivers
Collaborators: Jim Best, Bruce Rhoads, Marcelo Garcia (Univ. of Illinois at Urbana-Champaign)
Funding: NSF-Geomorphology & Land Use Dynamics, Hydrologic Sciences (2009-2013)

RP2: Enhancement of the channel evolution model CONCEPTS
Collaborators: Eddy Langendoen (USDA-ARS, National Sedimentation Laboratory)
Funding: USDA-ARS (2010-2013)

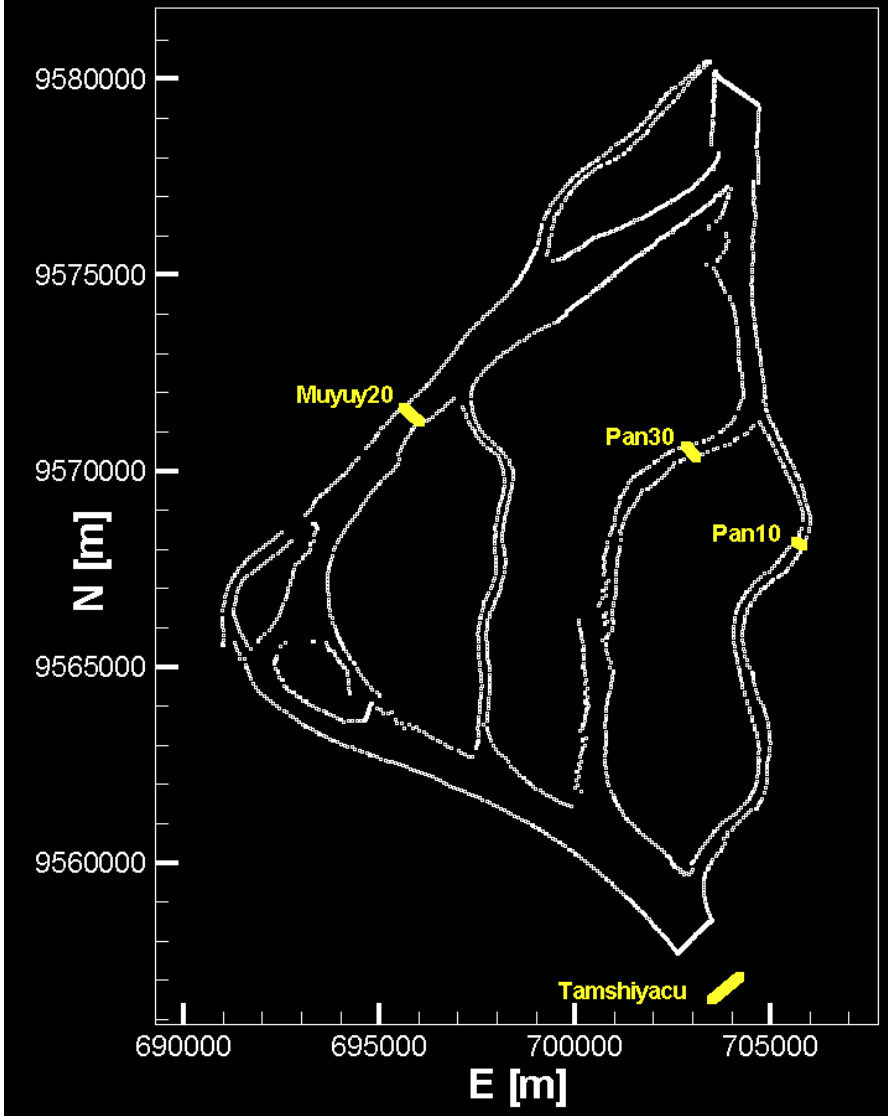
RP3: Peruvian Navy
Collaborators: Commander Hugo Montoro
Funding for field campaigns

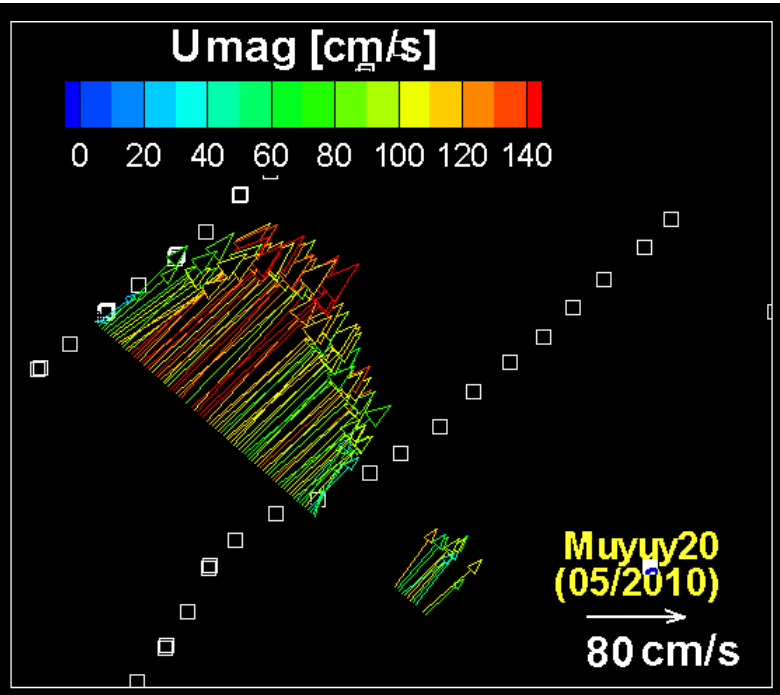
@ University of Pittsburgh
My students
CEE and SSOE start-up funding

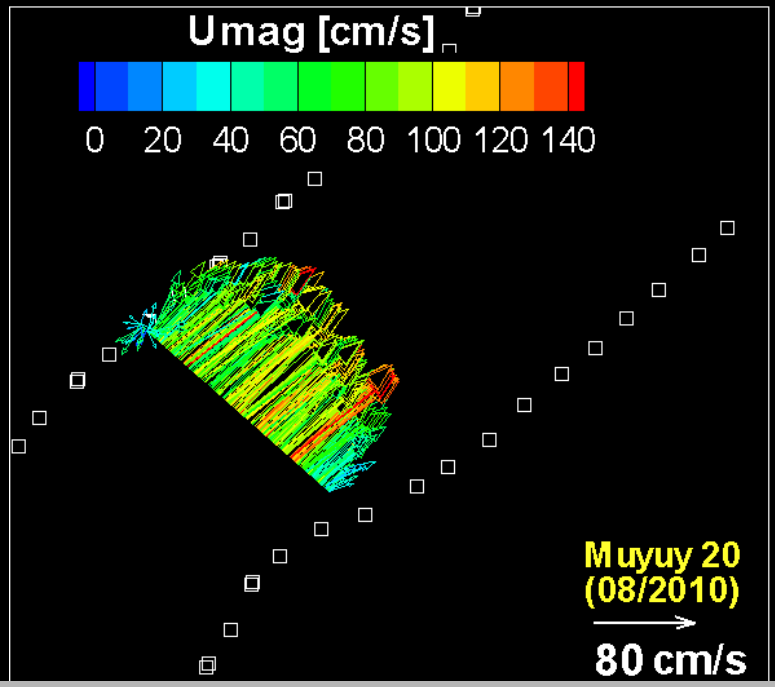
Flujo secundario



ADCP measurements

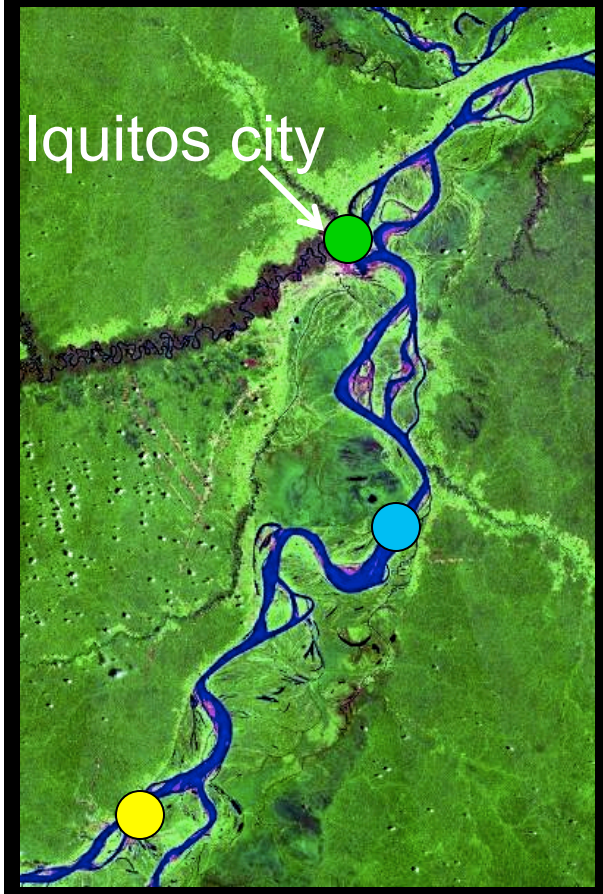


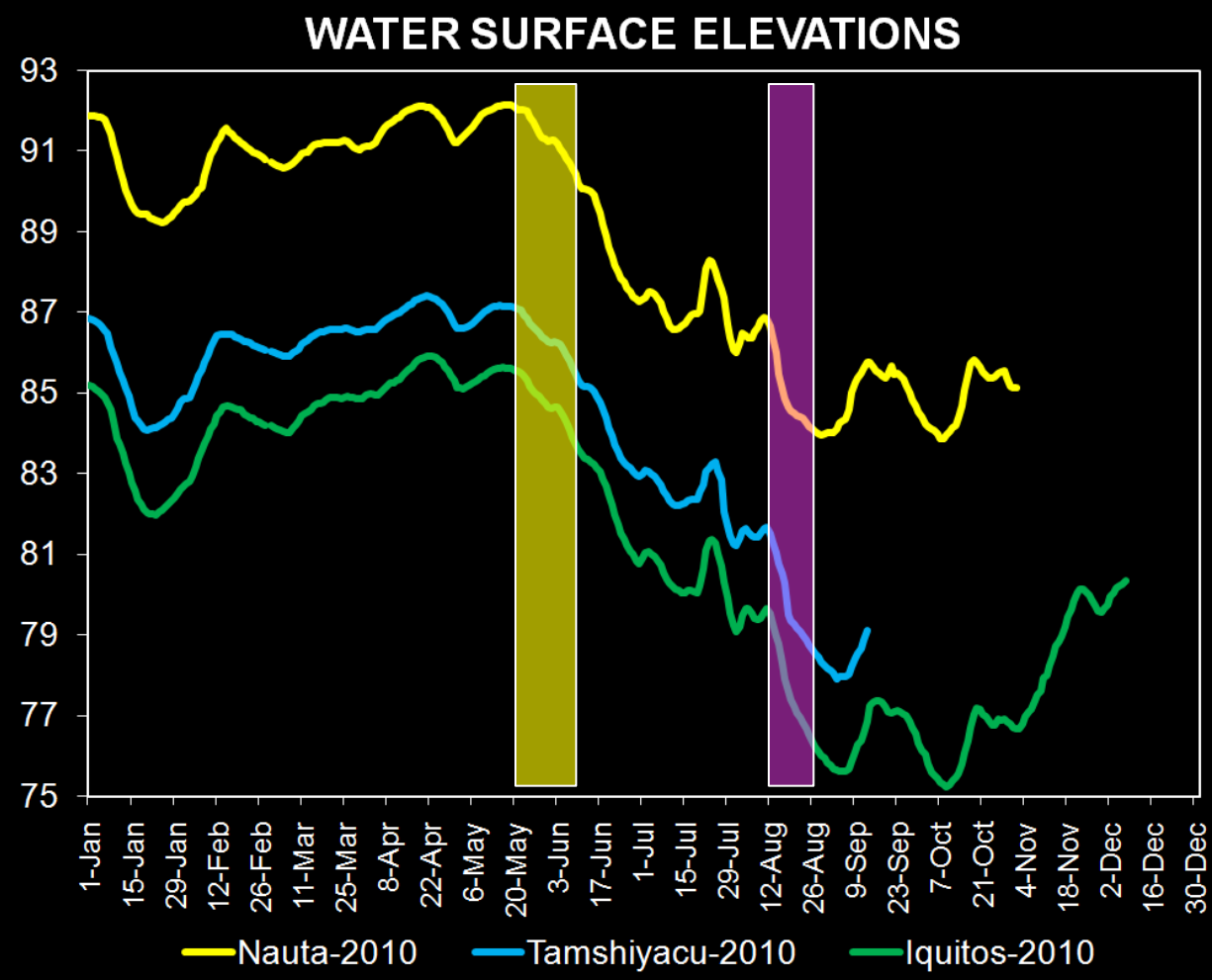




[3]

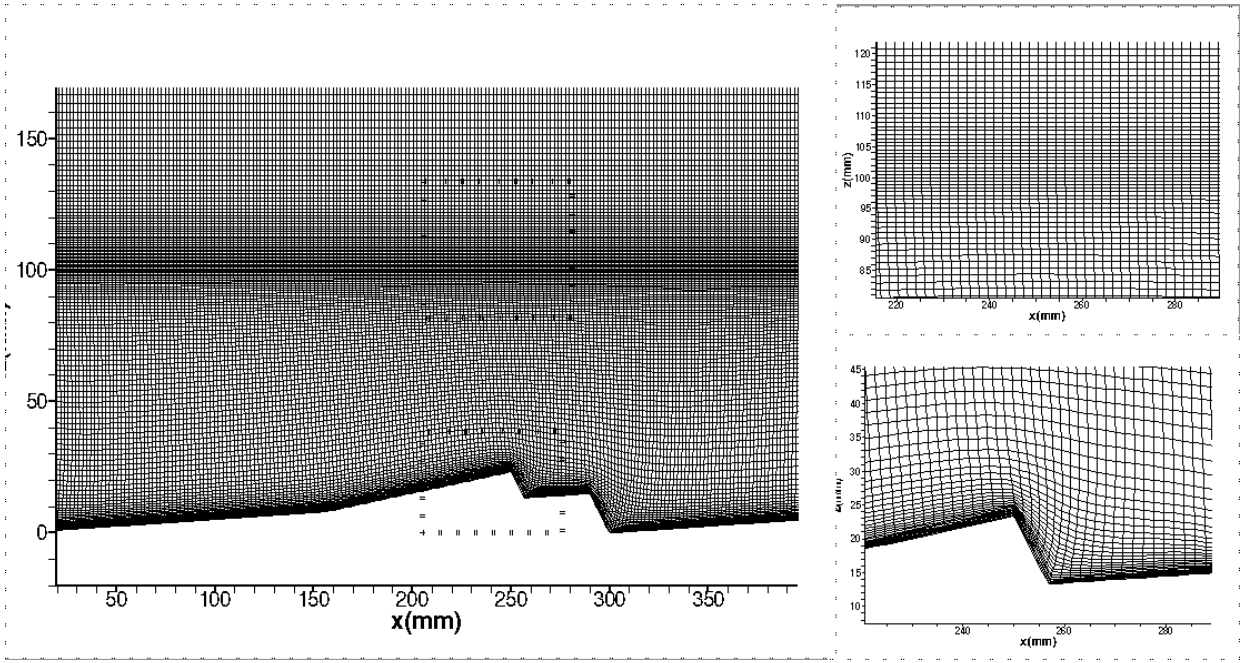
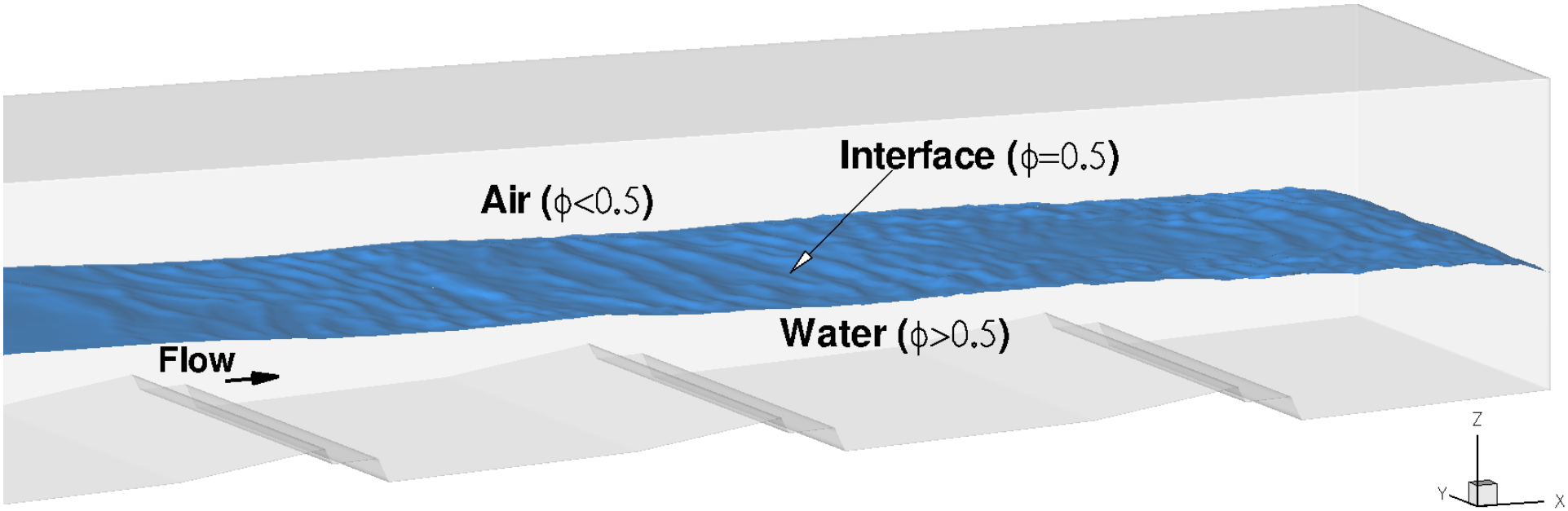
Field measurements: Campaigns May and August 2010





Marañon River	Ucayali River	Amazon River
~ 21280 m^3/s	~ 12270 m^3/s	~ 33550 m^3/s
		~ 12390 m^3/s

Water changes in the Amazon River

	Low flow	High flow
U (m/s)	1.5	2.2
Qw (m^3/s)	5 000	55 000
Qs (Ton/day)	150 000	4’ 000 000
B (m)	1 000	3 000
H (m)	10	50

Superimposition of ripples over dunes