Agricultural colonization of dynamic riverine islands in a tropical wandering river

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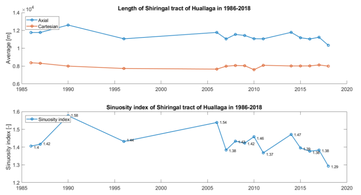
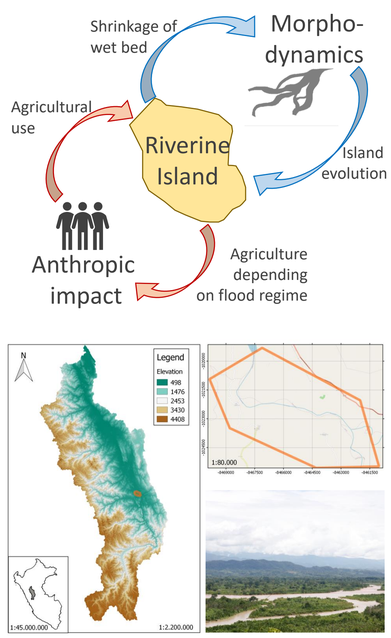
Introduction and case study

We investigate the interplay between riverine islands dynamics in a large tropical wandering river and their use by local communities for agricultural production. The study focuses on a piedmont reach of the wandering Huallaga river (76°2'56,69"W, 9°8'38.87"S), which drains the Peruvian Amazon. Riverine islands are characterized by a high space-time variability in active wandering river systems like the Huallaga, which results from biophysical interactions among flow, sediment transport and riparian vegetation.

Despite the rapid rates of planform changes, islands in the Huallaga are extensively used by local farmers who mainly rely on rainfed, low tech agriculture. This piece of research is part of the international cooperation project entitled "Alto Huallaga - Sustainable Development and Fight against Climate Change" whose main aim is to enhance resilience of local farmers against climate and environmental changes.





Research question

(i) Is there a correlation among morpho-dynamics experienced by the riverine islands and chemical and physical characteristics of their soil?

(ii) Is morpho-dynamics a positive driver for agricultural vocationality?

(iii) Have farmers developed agricultural practices adapted to morpho-dynamics and flood regimes?

Methods

REMOTE SENSING ANALYSES

(1) Coverage classification (water, vegetation, gravel) at reach scale by a semi-automatic procedure in GRASS-GIS environment of 8 Landsat scenes from 1986 to 2018. (2) Analysis of coverage classes changes in GRASS-GIS environment.

COMPUTING

MATLAB

(1) Elaboration of outputs from the semi-automatic procedure and computation of coverage percentage. (2) Assessment of 2 series of weights: (i) time evolution, with exponential expression, (ii) type of morpho-dynamics change, with eigenvalues of a comparative matrix.

FIELDWORK

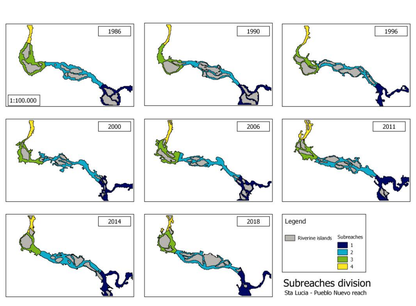
(1) Excavation of soil samples homogeneously displaced across the area of the riverine islands. (2) Identification of vertical soil profile with the classification and sampling of each layer. (3) Survey among local farmers.

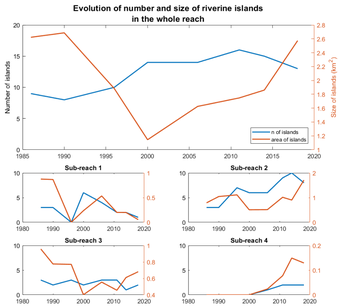
LABORATORY

(1) Analyses of the main chemical and physical characteristics of soil samples to assess the agricultural vocationality: Organic Matter, Cation-exchange capacity, pH, N and P available, and texture.

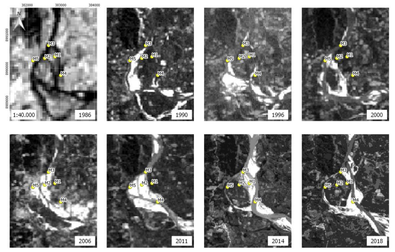
Preliminary results: island bio-morphodynamics

The identification of the riverine islands has been obtained through Landsat imagery analysis. The number of islands, their size and composition have been evaluated at reach and at sub-reach scale, showing high morphological dynamics and sub-reaches differences.



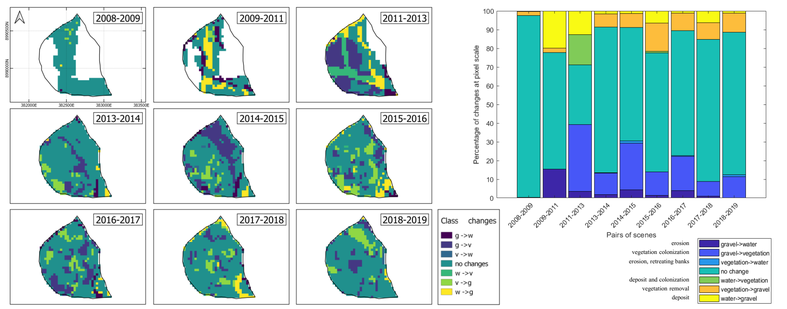


A more detailed analysis of three riverine islands in three different sub-reaches has been conducted to observe their generation process and evolution. This poster, focuses on Soto island, in the third sub-reach.



The series of intensity-hue-saturation (IHS) elaborations showing the fluvial dynamics in the third sub-reach, indicates that Soto island formation occurs during 2011-2014. Thus, further Landsat scene have been elaborated at year-time scale in order to detect the several and rapid changes.

Land cover changes within the evolving islands surface indicate the high dynamics that characterize this island sub-reach. White areas within the perimeter did not belong to the active bed area in each period.



Pajaro Bobo
Tessaria Integrifolia

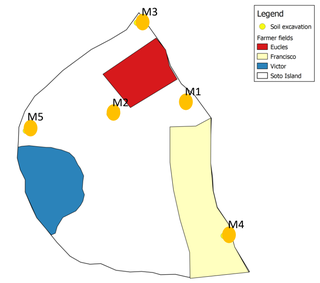
First excavation

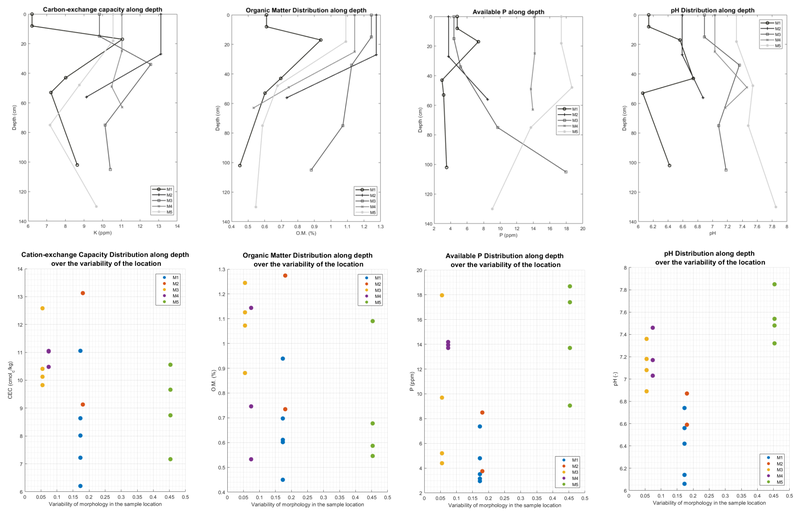
Excavation and infiltration test

Preliminary results: island soil characteristics

All the three interviewed farmers reported that they use to crop according to the seasonal fluvial dynamics. They do not relate the soil fertility with flood regime, nevertheless two of them reported that they moved to the island due to the fertility of soils. The five sample locations and the three fields of the interviewed farmers are shown in the Figure on the right side. Vertical profiles of some chemical and physical characteristics of the five stratigraphies excavated are presented in the Figures below.

Finally, the relation among soil characteristics and fluvial dynamics are presented in the Figures on the last row.





Conclusions

The study reach is highly dynamic with rapid turnover of vegetated islands. The relation among soil characteristics and fluvial dynamics is not evident yet. Further results on other two riverine islands in the same Shiringal reach will be key to confirm the preliminary results. However, the preliminary results show, in certain cases, such as pH and available P, a likely correlation.

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