Variations of grain size in relation with cross-section hydrodynamics and tributary confluences in a large sand-gravel bed river: the Loire (France)

Lauren Valverde[1], Stéphane Rodrigues[1], Philippe Jugé[1], Marc Desmet[1], Alain Recking[2], Michal Tal[3]

[1]GéHCO EA 6293, University of Tours, U.F.R. Sciences & Techniques, Tours, 37200, France
Phone: +33-(6)-50-66-51-41
E-mail: lauren.valverde@univ-tours.fr

[2]IRSTEA, 2 rue de la Papeterie – BP 76, 38402, Saint-Martin-d'Hères, France

[3]CEREGE UMR 7330, University of Aix-Marseille, Europôle de l'Arbois BP 80, 13545 Aix-en-Provence, France

Introduction: The Loire River basin is among the ten largest West-European rivers and the largest French basin. It is the subject of both an inter-state-regions program, known as "Plan Loire Grandeur Nature", involving all local stakeholders, and a EU Operational Program with ERDF funding.
Since 2011, researchers from twenty research institutes have worked together through the Observation Network of the Loire river basin Sediments ("Réseau O.S.L.A."), crossing scientific questions with the local stakeholders' operational needs, in order to ensure the basin's sustainable management.
This study was constructed to answer a lack in data needed for hydrosedimentary models specific to the Loire River, as well as scarce literature on grain size distribution in sand-gravel bed rivers.

Methods: From July to December 2012, during low-flow period, an 8 weeks boat survey sampled riverbed sediment of the Loire from PK 420 to PK 930, as well as on the lower 40 km on average of four of its main tributaries: the Allier, Cher, Vienne and Maine rivers, totaling about 675 km, and 500 km on the Loire itself.

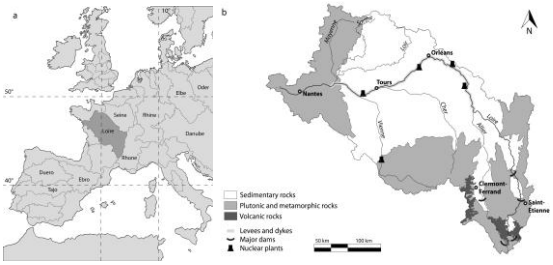

Fig. 1: *Study area: the Loire basin*

Seventy-six transects were selected on the main-stem channels with a 10 km interval, narrowing this to 2 km on the Loire at the tributaries' confluences. Four samples were collected from each transect. Prior to sampling, flow velocity and water depths were recorded using ADCP and an Echo Sounder. One main sampling site per transect was chosen where flow velocity was highest rather than in thalweg (C), and three additional sampling sites were located along the transect depending on differences in flow velocity and bedforms, in order to assess transversal variability (B1, B2, B3).

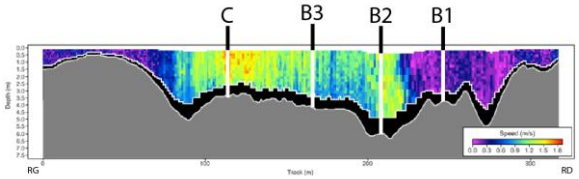

Fig. 2: *Example of ADCP profile with samples location*

Samples were analyzed to qualify grain sizes. After a drying period at 60°C, they were examined using a 3D sieving machine. The following parameters of grain sizes are chosen for the present study: mean grain size (Mz), standard deviation (SD), skewness (Sk), d10, d16, d50, d84 and d90, and fining coefficient were calculated, as well as percentage of gravel (>2 mm), sand (>63 µm) and fine particles (<63 µm). Sands and fine fractions were isolated for subsequent mineral and heavy elements analyses.

Results: At this date, analyses are still being processed. First results show an expected decrease in particle size, but variability is much greater transversally than longitudinally.

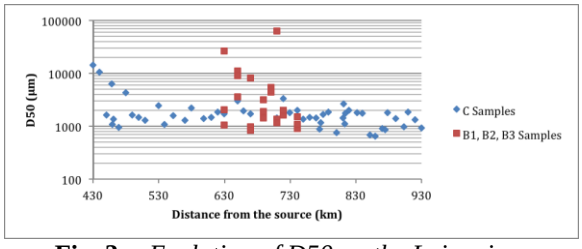

Fig. 3: *Evolution of D50 on the Loire river*

Tributaries seem to recharge bedload with coarser sediments, but this must still be confronted with other parameters such as lithology, slope, bed-width, etc. Compared with Sternberg's law of abrasion, our results are over-estimated by a factor of 10. Although flow velocity varied from 0,40 m/s to 1,80 m/s during sampling, mean grain size stays constant at more or less 1.6 mm.