



## **A century of land use evolution in flooded areas of the Arve River (Mont-Blanc Massif, France)**

Florent Rumiano (1,2), Dominique Baud (2), Alain Mélo (3), Sophie Pebay-Peyroula (4), Isabelle Ruin (1), and Bruno Wilhelm (1)

(1) University Grenoble Alpes, CNRS, Institute of Geosciences of Environment, Saint-Martin d'Hères, France, (2) University Grenoble Alpes, PACTE, Saint-Martin d'Hères, France, (3) SCOP AXALP, Annecy-le-Vieux, France, (4) CARTODIA, Grenoble, France

How flood risk has been evolved in the Alpine valley of the Arve River in the twentieth century? To study risk climate variability, likely to impact magnitude, frequency and timing of river flooding is one component but exposure and vulnerability are major ones especially in areas facing high real estate market pressure. This study investigates the role of land use changes on flood-related impacts and local community reactions to the largest flood impacts, i.e. whether or not they plan actions to mitigate future flood impacts. Based an interdisciplinary collaborations involving hydrologists, geographers and historians, we reconstruct flood chronicles and land use changes since 1900 in Chamonix-Mont-Blanc and Bonneville, both located along the Arve River which drains the Mont Blanc massif (Northwestern Alps, France). Chamonix-Mont-Blanc located in the upper part of the Arve catchment (ca. 200 km<sup>2</sup>) is threaten by torrential flooding of numerous glacier streams. Changes in land use are mainly due to high touristic pressure. Bonneville located downstream (ca. 1340 km<sup>2</sup>) is affected by slower flooding and since the fifties and seventies changes in land use are respectively dominated by industrial and residential developments.

The study of historical sources enabled to identify a total of 83 and 16 floods that respectively affected Chamonix and Bonneville during the twentieth century. Among them, four events in Chamonix (1944, 1963, 1968 and 1996) and five in Bonneville (1903, 1910, 1930, 1940 and 1968) are considered as catastrophic due to the high level of impacts. For each of these catastrophic events, impacts were localized and mapped to estimate the flooded area. Aerial photos and historical maps were then used to reconstruct changes in land use before and after the catastrophic events. The mapping of the resulting land cover shows for both cities a decrease of cultivated areas in favor of urban areas, especially noticeable in the 1950s and 1970s in Bonneville and in the 1970s only in Chamonix. The first phase of urban development in Bonneville led to great impacts during the 100-year flood of 1968. One may expect that this would have led to the slowing down of urban expansion but in fact only 17% of the 1968 flooded area was built in 1968, against 62% today. By analyzing the urbanization rate and local community risk adaptation in-between the dates of major flooding, we propose to explore the effects of natural and economic drivers on land use changes.