CHORAL
RESEARCH PROJECT *(max. 5 pages)*
APPLICATION FORM TO REQUEST FOR FUNDING FOR JOINTLY SUPERVISED DOCTORAL THESIS

TITLE OF THE RESEARCH PROJECT

Use of early contemporary cartography a,d sort information to asses the hydrological water balance in the Alps along the last two centuries

SUPERVISORS

From recruiting University	First name	LAST NAME	University	Department
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Regulating ecosystem services of mountan ranges
Ancestral water management
Traditional agriculture

ABSTRACT *(250 words max.)*

The Alps and the other European mountain ranges historically played, and still play, a crucial regulating role of the water fluxes, thanks to their capability of storing snow during cold seasons. Yet the present climate change, characterised by fastly increasing temperatures, is alterating the mountain water cycle and reducing winter snow accumulation. At the same time, the abandonment of mountain—areas rural activities exacerbates the hydrogeological hazard, whereas well managed slopes would let the soil to spontaneously act as a natural water reservoir and mitigate the perturbations of the hydrological cycle.

In this context, the proposed research will contribute to understand the evolution of the water cycle in some Alpine basins, since the early 19th Century, at the beginning of the recession of the Little Ice Age. Since then social dynamics as urbanization and abandonment of mountain agriculture and silviculture in favour of valley and low land ones provoked the loss of many slope maintenance activities, local afforestation and the loss of most of the agriculture and silviculture related nonmaterial culture. Many of these changes are well documented by military and cadastral maps, as well as by contemporary surveys.

The researcher will interpret 19th Century maps and ancient agricultural techniques, in view of comparing the ancient and present landuse and management. Based on the maps, the researcher will perform the historical water balance and compare it with the contemporary one. The research therfore requires an interdisciplinary approach which mainly involves Hydrology and Geography, with elements of Climatology and Environmental History.

Research aims and methodology

The research aims at contributing to understand the climatic and anthropogenic change feedbacks on the hydrological cycle at the scale of the small and medium range basin (area smaller than 10 000 km^2), and at exploring the potentialities of ancestral soil management techniques at mitigating the change of the water fluxes. In doing so, the research will also contribute to define the water—cycle regulating ecosystem services of

nonmaterial knowledge related to ancestral mountain agriculture and silviculture.

In order to do so the research is structured into three main steps:

(1) Collections, digitalization, georeferencing and classification of ancient military and cadastral maps in order to describe the landuse evolution in some Alpine basin selected as a case—study target. The classification will be performed also on the basis of the analysis of documented ancestral land management techniques... data collection in museums and previous publications. (detail)

(2) Collection and (eventual) analysis of temperature, precipitation and runoff series for the selected basins to detect climatic changes with classical climatic tests;

(3) Simulation of the ancient and present water balance with the identified landuse scenarios to detect how different climatic forcings, anthropogenic activities and landuse management scenarios affect the partitionning of the water fluxes.

Relevance and added-value of the proposed research in relation to the current state of knowledge

It is very well consolidated that the climate is experiencing an almost continuous and recently accelerating temperature increase, both at the global and at the local scale, starting from the recession of the Little Ice Age, at the beginning of the 19th Century (see e.g. for the Greater Alpine Region Auer et al., 2007), which is the reference for the maximum extension of the glaciated areas in modern Europe.

Yet, on the other hand, many aspects of the hydrological cycle still remain challenging, expecially those related to the runoff and streamflow (Douville et al., 2021). Indeed the evolution of the runoff and steramflow regimes is affected by many drivers, viz the climatic temperature increase (and reduction of winter snow accumulation), the landuse change and the anthropogenic withdrawal (see for the Adda river basin, in the Central Italian Alps, the recent analysis by Ranzi et al., 2021, of the daily runoff series).

Moreover, since the beginning of 19th Century, in the Alps and other European mountain ranges, social dynamics as urbanization and abandonment of mountain agriculture in favour of valley and low land one provoked the loss of terraces (Tarolli et al., 2014) and of many slope maintenance activities, local afforestation and loss of high elevation pastures, together with the loss of most of the agriculture and silviculture related nonmaterial culture.

These changes presumably affected the hydrological cycle, but a quantitative assessment of their feedback on the cycle on a long time scale seems not having been performed yet. Therefore, despite Alpine agriculture and landscape management could be considered meaningful for being inscribed in the Globally Important Agricultural Heritage Systems

(GIAHS) Programme (Scheurer et al., 2018), there is a lack of knowledge on how much the the shift between the ancestral agricultural and silvicultural landuse affected the hydrological cycle.

The proposed reserarch will contribute with an interdisciplinar approach based on both quantitative and qualitative informaton, at bridging this gap and at unveiling aspects of the evolution of the water balance which will connect ancestral landuse and soil management with modern issues and might therefore useful for future land management policies.

Auer, I., Böhm, R., Jurkovic, A., Lipa, W., Orlik, A., Potzmann, R., Schöner, W., Ungersböck, M., Matulla, C., Briffa, K., Jones, P., Efthymiadis, D., Brunetti, M., Nanni, T., Maugeri, M., Mercalli, L., Mestre, O., Moisselin, J., Begert, M., Müller-Westermeier, G., Kveton, V., Bochnicek, O., Stastny, P., Lapin, M., Szalai, S., Szentimrey, T., Cegnar, T., Dolinar, M., Gajic-Capka, M., Zaninovic, K., Majstorovic, Z. and Nieplova, E. (2007) HISTALP—historical instrumental climatological surface time series of the greater alpine region. International Journal of Climatology, 27, 17–46. https://doi.org/10.1002/joc.1377.

Douville, H., K. Raghavan, J. Renwick, R.P. Allan, P.A. Arias, M. Barlow, R. Cerezo-Mota, A. Cherchi, T.Y. Gan, J. Gergis, D. Jiang, A. Khan, W. Pokam Mba, D. Rosenfeld, J. Tierney, and O. Zolina, 2021: Water Cycle Changes. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1055–1210, doi:10.1017/9781009157896.010.

Ranzi, R, Michailidi, EM, Tomirotti, M, Crespi, A, Brunetti, M, Maugeri, M. A multi-century meteo-hydrological analysis for the Adda river basin (Central Alps). Part II: Daily runoff (1845–2016) at different scales. Int J Climatol. 2021; 41: 181–199. doi.org/10.1002/joc.6678

Scheurer Th., Agnoletti M., Bürgi M., Šmid Hribar M., Urbanc M., Exploring Alpine Landscapes as Potential Sites of the Globally Important Agricultural Heritage Systems (GIAHS) Programme, Mountain Research and Development, 2018, 38(2), 172-174

Tarolli P., Preti F., Romano N., Terraced landscapes: From an old best practice to a potential hazard for soil degradation due to land abandonment, Anthropocene, 2014, 6: 10-25, ISSN 2213-3054, doi.org/10.1016/j.ancene.2014.03.002.

Interdisciplinary nature of the research together with the alignment with the CHORAL programme and complementarity expertise of the teams

The proposed research is framed in all the four main topics of CHORAL programme, that are (1) Study and preservation of tangible cultural heritage (focus on the ancestral and traditional landscape and irrigation and drainage systems); (2) Intangible cultural heritage and identity narratives (focus on the ancestral land and soil management); (3) Innovation policies for the development of marginalised areas (focus on the understanding of the capabilities and potentialities of ancestral landuse and land management at regulating the water fluxes); (4) Enhancement and dissemination of cultural and natural heritage (as a feedback of point 3).

The interdisciplinary approach of the research requires mainly expertise in Hydrology, provided by team of the Università degli Studi di Brescia (prof. Giovanna Grossi and prof. Stefano Barontini), and in Geography, provided by the team of the Universitatea de Vest din Timişoara (prof. Cretan Remus), together with some expertise in Climatology and in Environmental History (the researcher will interact with experts which will be identified after choosing the target investigation areas).

Output plan including publication and dissemination activities

The researcher will contribute to write papers for international peer reviewed journal (two submitted contributions are expected), for international and national congresses (two submitted contributions are expected). Opportunities of dissemination of the research will be organised either in public conferences or with a documentary exhibition based on the investigated cases. The activities of the EU LOESS project (https://loess-project.eu/), focused on the dissemination of the knowledge of the services provided by the soil, may offer the researches an opportunity of dissemination of the research.

Estimated schedule

Months 1 to 4: Literature review and introduction to the research;
5 to 12: Literature review and advanced formation;
9 to 12: Identification of the cases, data and maps collection;
13 to 20: Data analysis and maps analysis;
21 to 28: Water balance simulations and analysis;
29 to 36: Analysis of the results and thesis writing.