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Main areas of research

Modelling glacier-climate interactions; Glacier response to a changing climate and high elevation water resources and water security; Green-blue water interactions in high mountain catchments; Debris covered glaciers and their response to climate; Snow processes and its importance for catchments water balance.

Professional positions

03/2023–	*Full Professor*, Institute of Science and Technology Austria (ISTA), AT
2018–	*Group Leader*, Swiss Federal Research Institute WSL, CH
2015–	*Associate Professor*, Faculty of Engineering and Environment, Northumbria University, UK
2007–2014	*Oberassistentin*, Institute of Environmental Engineering (IfU), ETH Zurich, CH
2004–2007	*Postdoctoral Research Associate*, IfU, ETH Zürich, CH

Education

2004	*Doctor of Philosophy (Ph.D.)*, Environmental Engineering, IfU, ETH Zürich, CH
1999	*Degree in Environmental Engineering (Laurea)*, University of Rome “La Sapienza”, IT

MAJOR SCIENTIFIC ACHIEVEMENTS

Achievement 1: Ragettli, S., W. Immerzeel and **F. Pellicciotti**. 2016. Contrasting response to a warming climate of glacierised catchments in the Andes of Chile and Nepalese Himalaya, *Proceedings of the National Academy of Science (PNAS)*, **113** (33), 9222–9227.

This paper, published in the prestigious PNAS, is the synthesis of several years of research on glaciers and water resources and their response to climate in distinct mountain regions of the world. It represents world-class expertise in glacio-hydrological modelling and the cumulation of previous work including: i) advances in the understanding and modelling of near-surface meteorology (Juszak and Pellicciotti, 2013; Pellicciotti et al., 2011); new models for melt simulations for both clean ice and debris-covered glaciers (Pellicciotti et al., 2005, 2008, 2009, 2013; Carenzo et al., 2016); iii) understanding of glacier-scale mass changes and surface dynamics (e.g. Pellicciotti et al., 2015; Ragettli et al., 2016); and application of the most advanced downscaling techniques to climate model outputs. It also represents the culmination of years of knowledge development for data-scarce regions, resulting from major but exciting and rewarding efforts in building relationships of trust and cooperation with local scientists, collecting scarce data, and from major campaigns in remote areas of the Andes and Himalaya. We built all this into the best glacio-hydrological model (of the time) to understand changes to glaciers and water resources in a future climate in areas where the cryosphere matters, i.e. where glaciers provide key water resources and water scarcity is a pressing

concern. *Our projections indicated that climate change adaptation in Central Chile should focus on dealing with a reduction in water availability, whereas in Nepal preparedness for flood extremes should be the policy priority*. This research was conducted by one of my PhD students, a talented young scientist that published with me 13 papers (six as first author). I devised, wrote, and then scientifically led the project from which this work results (the SNF UNCOMUN project, an extremely successful project with 24 publications, including one in Nature Geoscience and two in PNAS).

Achievement 2: ERC (European Research Council) Consolidator Grant

In December 2017, I was awarded a prestigious ERC Grant for work on the glaciers and water resources of High Mountain Asia (*RAVEN: Rapid mass loss of debris covered glaciers in High Mountain Asia*, 2 million euros). This recognises the novel, ground-breaking and relevant nature of my research, the impact-level importance of my prior work and the novel ideas I am pursuing. It blends new lines of investigation on debris-covered glaciers and their anomalous thinning patterns with my interest in water resources to propose a novel understanding and modelling of glaciers and water resources in High Mountain Asia (HMA). HMA hosts the largest ice masses outside the Poles, together with one of the highest densities of people, and a context of political instability, overexploitation of resources, poverty and ethnic conflicts. Water resources from glaciers and snow are key for fragile ecosystems and equally fragile communities and societies, and future projections of glacier runoff and high mountain hydrology are vital. The project builds on my past research to take it to a new level, both in scale (the whole HMA) and research questions (*What drives the anomalous thinning patterns of debris-covered glaciers in HMA? What drives regional differences in glacier changes? What is the distribution of debris over glaciers and what controls it*? *Is debris-cover really increasing in a warming climate and what will be the consequences for glacier melt and runoff*?). It has since produced major results regarding glacier health, glacier changes and processes (with a paper just published in Nature Geoscience, one in Nature Communication and one more in review in NatGeo). *We have quantified for the first time the thickness of debris on all glaciers in HMA, shown that 30% of current ice volume cannot be sustained, and 35% of glaciers are committed to lose at least half of their volume.* Importantly, it is building the next generation of glacio-hydrological models, and stimulating new research avenues (e.g. on the importance of precipitation in high mountains, or of snow for river runoff, both pursued within the HOPE and ASCENT SNF-funded projects).

Achievement 3: Chair of the Working Group on Debris Covered Glaciers of IACS (International Association of Cryospheric Sciences).

In 2018, I was asked by the IACS board to establish a new WG on Debris Covered Glaciers. This recognises my contributions in building the foundations of knowledge in an emergent discipline of glaciology, as well as my strong leadership skills, international recognition and large network. We have produced novel knowledge on the state and stage of debris cover on glaciers globally (published in Nature Geo), and are developing new approaches to model melt under debris and to investigate debris surface features. I have pioneered key studies to assess the mass balance and hydrology of debris-covered glaciers, and I am currently leading the first debris covered glacier melt model intercomparison (to be submitted in August 2021), a major effort that includes more than 40 scientists world-wide and 13 models, with key new results on the importance of model complexity and current knowledge gaps, which will establish the evidence base for future glacier modelling efforts across scales.

Supervision (past and current)

Postdocs: 7; Doctoral students: primary supervisor = 12; co-supervisor = 5; Masters and Bachelors students = 42 (main & co-supervisor)

Additional research and professional achievements (selected recognitions, etc.)

Funding	23 Grants, 22 since 2010, for about 9'700k CHF
2020, 2022	ERC Consolidator Panel Member
2019	Convener, Debris-covered glaciers session at IUGG in Montreal
2018–	Chair, IASC Working Group on Debris-covered glaciers
2018–	Scientific Editor, The Cryosphere
2016–	Member of Steering Committee, INARCH (The International Network for Alpine Research Catchment Hydrology)

Ten recent publications. For a complete list, please see link.

1. Potter E., Fyffe C.L., Orr A., Quincey D., Ross A., Rangecroft S., Medina K., Burns H., Llacza A., Jacome G., Hellström R.A., Castro J., Cochachin A., Montoya N., Loarte E., **Pellicciotti F.** 2023. A future of extreme precipitation and droughts in the Peruvian Andes, accepted in npj Climate and Atmospheric Science.
2. Shaw T., Miles E., Chen D., Jouberton A., Kneib M., Fugger S., Ou T., Lai H., Fujita K., Yang W., Fatichi S., **Pellicciotti F**. Multi-decadal monsoon characteristics and glacier response in High Mountain Asia. 2022. *Environmental Research Letters*, 17(10) 104001. 10.1088/1748-9326/ac9008
3. McCarthy M., Meier F., Fatichi S., Stocker B. D., Shaw T. E., Miles E., Dussaillant I., **Pellicciotti F**. Glacier contributions to river discharge during the current Chilean megadrought. 2022. *Earth's Future*, 10(10) e2022EF002852. 10.1029/2022EF002852
4. Jouberton A., Shaw T.E., Miles E., McCarthy M., Fugger S., Ren S., Dehecq A., Yang W., **Pellicciotti F**. Warming-induced monsoon precipitation phase change intensifies glacier mass loss in the southeastern Tibetan Plateau. 2022. *Proceedings of the National Academy of Sciences of the United States of America*, 119(37) e2109796119. 10.1073/pnas.2109796119
5. Fugger S., Fyffe C.L., Fatichi S., Miles E., McCarthy M., Shaw T.E., Ding B., Yang W., Wagnon P., Immerzeel W., Liu Q., **Pellicciotti F.** Understanding monsoon controls on the energy and mass balance of glaciers in the Central and Eastern Himalaya. 2022. Cryosphere, 16(5) 1631-1652. 10.5194/tc-16-1631-2022
6. Miles E.S., Steiner J.F., Buri P., Immerzeel W.W**., Pellicciotti F**. Controls on the relative melt rates of debris-covered glacier surfaces. 2022. Environmental Research Letters, 17(6) 64004. 10.1088/1748-9326/ac6966
7. Fyffe C.L., Potter E., Fugger S., Orr A., Fatichi S., Loarte E., Medina K., Hellström R.Å., Bernat M., Aubry-Wake C., Gurgiser W., Perry L.B., Suarez W., Quincey D.J., **Pellicciotti F**. The Energy and Mass Balance of Peruvian Glaciers. 2021. Journal of Geophysical Research: Atmospheres, 126(23) e2021JD034911. 10.1029/2021JD034911
8. Miles E., McCarthy M., Dehecq A., Kneib M., Fugger S**., Pellicciotti F**. Health and sustainability of glaciers in High Mountain Asia. 2021. Nature Communications, 12(1) 2868. 10.1038/s41467-021-23073-4
9. Herreid S., **Pellicciotti F**. 2020. The state of rock debris covering Earth's glaciers. Nature Geoscience, 13 621–627. 10.1038/s41561-020-0615-0.
10. Ragettli S., Immerzeel W.W., **Pellicciotti F**. Contrasting response to a warming climate of glacierised catchments in the Andes of Chile and Nepalese Himalaya. 2016. Proceedings of the National Academy of Science (PNAS), 113 (33), 9222–9227. 10.1073/pnas.1606526113