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The ICELEARNING project - Artificial Intelligence techniques for ice core analyses

Niccolò Maffezzoli[1], Giovanni Baccolo[2], Patrizia Ferretti[1], Barbara Delmonte[2], Kerim Nisancioglu[3], and Carlo Barbante[1]

[1]Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice
[2]Department of Earth and Environmental Sciences, University Milano-Bicocca
[3]Department of Earth Science, University of Bergen

The detection of insoluble particles trapped in ice cores, like volcanic and dust particles, pollen grains, foraminifera and diatom assemblages, represents the experimental basis for multiple lines of environmental paleoresearch regarding the atmosphere, the biosphere and volcanology. To date, except for ice core dust, the detection of such particles is achieved through observations by manual microscopy. Artificial Intelligence predictive models are already applied to several research fields within geoscience, but up to date its implementation to ice core science is missing. The recently EU funded Marie Curie ICELEARNING project (2020-2022) aims to develop a two-phase routine for the automatic quantification of insoluble particles trapped in ice cores. The routine is based on a commercial Flow Imaging Microscope producing micro-scale images of insoluble particles from melted ice core samples. The image collection of mineral dust, tephra, pollen and marine foraminifera obtained from natural and/or ad-hoc prepared samples will constitute the training datasets. The images will be then analyzed by Pattern Recognition algorithms developed for automatic particle classification and counting. The routine will be specifically developed in order to be implemented in ice core Continuous Flow Analysis (CFA) systems, thus improving the more traditional methods and potentially providing continuous ice core insoluble particle records. The ICELEARNING methodology is suitable for melted ice core samples and any diluted aqueous sample, thus representing a ground-breaking analytical advancement for a wide range of research fields, from ice core science to marine geology. The innovative routine here presented is automatic and non-destructive, imperative prerequisites for future Antarctic ice core projects.