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Particle Image Velocimetry technique to quantify mantle flow, surficial strain and topography in geodynamic laboratory models of subduction

Vincent Strak (1,5), Wouter P. Schellart (1,5), Zhihao Chen (2,5), João Duarte (3,4,5)

(1) Vrije Universiteit Amsterdam, Department of Earth Sciences, Lisboa, Netherlands (vincent.strak@monash.edu), (2) Japan Agency for Marine-Earth Science and Technology, Yokohama, Japan, (3) Instituto Dom Luiz, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal, (4) Departamento de Geologia, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal, (5) School of Earth, Atmosphere & Environment, Monash University, Melbourne, Australia

Particle Image Velocimetry (PIV) is a laboratory state-of-the-art technique that tracks passive tracers to compute displacement fields from which velocity and strain fields are derived. The technique has proven useful in the community of geo-modellers since the 2000s, because it allows quantification of the geological processes under investigation in a non-intrusive way. We will present applications of the PIV technique to geodynamic laboratory subduction models. Using a cutting-edge experimental set-up with stereoscopic PIV and an advanced software, we have quantified and analysed several key features and processes associated to subduction zones. Our method allowed to gain unprecedented insights into subduction-induced mantle flow and overriding plate deformation and topography. Using the stereoscopic PIV technique we produced maps of the 3 components of the subduction-induced mantle flow velocity field in depth- and cross-sections, strain rate maps at the surface of the overriding plate, and we computed overriding plate topography. Using the technique we found evidence, among other results, that the subduction-induced mantle flow plays a major role in shaping the surface associated to subduction zones. It can indeed drive backarc overriding plate deformation and it can produce mantle upwellings that could trigger mantle melting, thereby producing volcanism. The PIV technique is therefore a useful and promising tool that we will continue to develop to study subduction zone processes and other geological phenomena in the laboratory.