Preface

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1 Special issue on environmental buoyancy-driven flows

Buoyancy-driven flows play a key role in atmospheric, oceanic and ecological flows, for example in the horizontal and vertical distribution of fresh water, oxygen, nutrients, and carbon throughout lakes ecosystems. Pollutant spillage, and outflows from desalinization plants, industrial cooling systems and industrial chimneys are another example of these flows. Turbidity currents are able to destroy deep water installations, jeopardize reservoirs storage, shape lakes and ocean floors, and also, through geological time, affect hydro-carbon reservoirs.

In 2015, we organized two special sessions on ‘Buoyancy-driven flows’ that were held in St. Louis during River Flow 2016 and in Liège during the 4th IAHR Europe congresses. The hydraulics and fluid mechanics community appreciated these special sessions, where participation, both in terms of contributions received and people attending the sessions, was very high. The sessions provided an opportunity for long discussions and exchange of ideas on research problems in buoyancy-driven flows. These sessions also provided us an advantaged point view of the debates in the community.

Clearly, investigation on these flows relates to diverse but not necessarily interacting fields of environment engineering and research. The ubiquity of gravity flows in nature and engineering applications results in several independent bodies of knowledge, with sparse information, own languages and different approaches, but they share the same driving physical processes.

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There is a necessity for cross-fertilization between researchers working on different topics of environmental fluid mechanics, where a main flow driver is the buoyancy force. With this special issue on ‘Environmental buoyancy-driven flows’ we tried to bridge this need by inviting contributions from the above mentioned special sessions as well as from top experts in the topic. We intended to gather both engineers and scientists from different fields focusing on the latest advances on ‘Environmental Buoyancy-driven flows’ and using different methodologies such as laboratory experiments, numerical simulations and theoretical analysis.

This special issue spans a wide range of topics on buoyancy-driven flows, including turbidity currents over complex topography, jets, plumes, internal waves, two-layer exchange flows and gravity currents propagating in a porous medium or interacting with a rough bottom or waves. Processes at several scales are investigated, from entrainment processes at the micro scales to open-channel laboratory scale to (oceanic) large-scales. Also, flows over several domains are analysed, porous media and open ambient fluid, as well as buoyancy driven flows related to anthropic and natural phenomena.

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