EUROPEAN MECHANICS SOCIETY

Colloquium Final Report

N. 608 – Dynamics of gravity currents

Dates and location: **28/06/2023 - 30/06/2023, Grenoble, France**

Chairperson **Negretti, Maria Eletta**

Co-Chairperson **Linden, Paul**

Conference fees

- Early.bird **230.0 €**
- Registration **280.0 €**
- Accompanying person **90.0 €**

What other funding was obtained? **Support from the University of Grenoble Alpes (1100€)**

What were the participants offered? **Booklet of Abstracts, coffee breaks, welcome cocktail, banquet, social dinner, participation to scientific and poster sessions.**

Number of members of Euromech (reduced registration fee) **14**

Number of non-members of Euromech (full registration fee) **35**

Applicants (members)

- Kiran Bhaganagar
- Thomas Bonometti
- Samuel Cristobal
- Louis Gostiaux
- Laurent Lacaze
- Paul Linden
- Sandro Longo
- Eckart Meiburg
- Matthieu Mercier
- Marie Rastello
- Pietro Salizzoni
- Jean Schneider
- Bruno Voisin
- Andy Woods

Applicants (non members)

- Claudia Adduce

- Bruno Alvarez Scapin
- Koen Blanckaert
- Christophe Brun
- Julien CHAUCHAT
- Luca Chiapponi
- Brivaël Collin
- George Constantinescu
- Lianzheng Cui
- Albert Dai
- Etienne Dureuil
- Sofia Farina
- Cyril Gadal
- Safir Haddad
- Benjamin Kneller
- Stefano Lanzini
- Maria Rita Maggi
- Nicolò Merli
- François Mettra
- Florence NAAIM
- Maria Eletta Negretti
- Eric Newland
- Eduard Puig Montella
- Sevan Retif
- KARINA RUSCHEL RUSCHEL
- Manohar Kumar Sharma
- MOSTAFA SHEHATA
- Ivana Stiperski
- Axel Tassigny
- Shungo Tonoyama
- Marius Ungarish
- Anna Wåhlin
- Achim Wirth
- Dino Zardi
- Tamar Zemach

Scientific Report

Gravity currents represent a ubiquitous phenomenon in nature and technology. They constitute predominantly horizontal flows driven by hydrostatic pressure gradients as a result of density variations due to differences in temperature, chemical composition or suspended particles. Examples of atmospheric gravity currents include sea breezes and thunderstorm outflows, while buoyant river plumes and the Mediterranean and Red Sea outflows represent important oceanic gravity currents. Within the realm of technical applications, gravity currents are encountered under a large variety of circumstances, including the heating and cooling of buildings, tunnel fires, flows within water treatment facilities, as oil slicks on the ocean surface, or during CO2 sequestration in depleted oil reservoirs. Turbidity currents, snow avalanches, pyroclastic flows and haboobs represent a class of gravity currents in which the particles are largely or wholly suspended by fluid turbulence. Turbulence is mainly generated at the lower and (where unstable) upper boundaries of the domain by the forward motion of the current, this motion in turn being driven by the action of gravity on the density difference between the particle-fluid mixture and the ambient fluid. The ambient fluid is generally of similar composition to (and miscible with) the interstitial fluid, and, in most natural cases on the Earth’s surface, is water or air. Particulate gravity currents are non-conservative in that they may exchange particles with the bed by deposition or

suspension, and may exchange fluid with the ambient by entrainment or detrainment.

The aim of this colloquium was to gather the European scientific community to exchange ideas and results on recent developments in this topic. Many recent advances such as integral models using vorticity arguments, 3D numerical simulations and measurements of 3D flow fields in the laboratory, new techniques for the simultaneous measurement of velocity and particle concentration fields, were provided during the colloquium. Contributions at the colloquium has enabled these advances to be shared among the community and helped promoting cross fertilizations and collaborations.

The colloquium brought together engineers, geoscientists, oceanographers and meteorologists to give insights into the current state of understanding of gravity currents of all types, from theoretical, computational and experimental perspectives and from direct observations in the environment and industry, with an emphasis on their fluid mechanics.

The contributions included:
• Conceptual/experimental models for density currents and compositional/particulate gravity currents
• Realistic experimental models of gravity currents, in the geophysical and industrial context
• High-resolution simulations of density currents
• Interaction of density currents with bottom topography, including roughness, obstacles and bottom sediments
• Interaction of gravity currents with stratified ambients, internal waves
• Oceanic overflows modeling and parametrization
• In situ observations of oceanic and atmospheric gravity currents
• Dynamics of compositional/particulate gravity currents, including non-newtonian gravity currents
• Quantifying the role of erosion and deposition
• High-resolution numerical simulations of composite density currents in interaction with solid particles
• Gravity currents in porous media
• Non-Boussinesq gravity currents

The colloquium was on invitation only, and was organized in five sessions:
1. Oceanic flows
2. Atmospheric flows
3. Particulate gravity currents
4. Conceptual modeling of gravity currents
5. Interaction with the bottom (topography, roughness, obstacles and mobile bed)

Three keynote speakers represented each the first three main topics: Anna Wahlin for Topic 1, Ivana Stipersky for Topic 2 and Eckart Meiburg for Topic 3.
The sessions each day were organized based on the five topics given above and the methodology: (i) theoretical, (ii) experimental, (iii) numerical modelling and (iv) field observations and industrial applications. The opening of the poster session was organized at the end of the first day and was kept throughout the colloquium.

The participants appreciated especially the fruitful exchanges and the high quality of the contributions, the inclusion of in situ data presentations which together with the informal atmosphere allowed extensive discussions and exchanges amongst participants.
We thank EUROMECH for his financial and scientific support which made the

Meeting possible.

Maria Eletta Negretti
July 10, 2023

Number of participants from each country

Country	Participants
France	23
Italy	7
Sweden	1
United States	3
Republic of Taiwan	1
Israel	2
Switzerland	1
China	1
Austria	2
United Kingdom	5
Brazil	2
Spain	1
Total	**49**

Please send this report in electronic form to the Secretary General of EUROMECH, within one month after your Colloquium.