

Colloquium n. 608 - Dynamics of gravity currents

Dates and location

28 June — 30 June 2023, Grenoble, France

Chairperson

Negretti, Maria Eletta

Co-chairperson

Linden, Paul

Conference fees

- Registration: **280.00 €**
- Early.bird: **230.00 €**
- Accompanying person: **90.00 €**

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.

Applicants (members)

1. Claudia Adduce
2. Kiran Bhaganagar
3. Thomas Bonometti
4. Julien CHAUCHAT
5. Cyril Gadal
6. Louis Gostiaux
7. Laurent Lacaze
8. Paul Linden
9. Sandro Longo
10. Eckart Meiburg
11. Matthieu Mercier
12. Marie Rastello
13. Pietro Salizzoni
14. Bruno Voisin
15. Andy Woods
16. Tamar Zemach

Applicants (non members)

1. Bruno Alvarez Scapin
2. Koen Blanckaert
3. Christophe Brun
4. Luca Chiapponi
5. Brivaël Collin
6. George Constantinescu
7. Samuel Cristobal
8. Lianzheng Cui
9. Albert Dai
10. Etienne Dureuil
11. Sofia Farina
12. Safir Haddad
13. Benjamin Kneller
14. Stefano Lanzini
15. Dongfeng Li
16. Maria Rita Maggi
17. Nicolò Merli
18. François Mettra
19. Florence NAAIM

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25. Jean Schneider
26. Manohar Kumar Sharma
27. MOSTAFA SHEHATA
28. Ivana Stiperski
29. Axel Tassigny
30. Shungo Tonoyama
31. Marius Ungarish
32. Anna Wåhlin
33. Achim Wirth
34. Dino Zardi

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
United Kingdom	5
United States	3
Brazil	2
Austria	2
China	2
Israel	2
Spain	1
Republic of Taiwan	1
Switzerland	1
Sweden	1
TOTAL	50