Shocks, Solitons and Turbulence Unit (Emile Touber)

FY2022 Annual Report

Shocks, Solitons and Turbulence Unit
Associate Professor Emile Touber

Abstract

The Shocks, Solitons and Turbulence (S2T) Unit carries out theoretical and computational studies of energy transfers and transport arising from shock/solitary waves and turbulence. We work on a variety of problems (from cosmic to biological scales) expressed in terms of (i) fields obeying some form of conservation laws, (ii) closed using physics-based or simple behavioural arguments, (iii) and found in a turbulent and/or shocked regime.

This report highlights some key moments of the fiscal year. This year we have focused our attention on the study of waves in trees (sap flows) to waves the size of Earth (Tonga eruption). Every project we run is centred around modelling and simulation efforts together with experimental observations. Not being experimentalists ourselves, we invested significant ressources (e.g. manpower time, equipments, data) and collaborative efforts to acquire observation data of the complex dynamical processes we study.

1. Staff

- Emile Touber, Associate Professor
- Adel Rodriguez, Postdoctoral Researcher
- Roman Mukhin, Technician
- Stephen Winn, Technician
- Yussuf Ali, Technician
- Andre Krichikov, Technician
- Saori Chappell, Research Unit Administrator

2. Collaborations

2.1 Space weather

- Description: Impact of the solar activity on the Earth's upper-atmosphere.
- Type of collaboration: Joint research
- Researchers:
    - Professor Ryuho Kataoka, NIPR (Tokyo)
    - Professor Hiroko Miyahara, Musashino Art University (Tokyo)

2.2 dNami: Computational framework to solve systems of balance laws

- Description: In-house solver developed in collaboration with CNAM/ENSAM (France).
- Type of collaboration: Joint research
- Researchers:
    - Professor Nicolas Alferez, CNAM/ENSAM (Paris)

3. Activities and Findings

The S2T unit is particularly interested in how physical principles such as mass conservation, momentum and energy transfers, work to produce wave phenomena, patterns and/or chaos. This year we study these questions mostly in the context of coupled atmosphere-ocean dynamics and water movement in trees. Please refer to the references therein or future reports for details.

4. Publications

4.1 Journals

1. Winn S.D., Sarmiento A.F., Alferez N., Touber E. Two-way coupled long-wave isentropic ocean-atmosphere dynamics*. Journal of Fluid Mechanics,* doi:10.1017/jfm.2023.131(2023)

4.2 Books and other one-time publications

1. Winn S.D., Touber E., Sarmiento A.F. Code and data for "Two-way coupled long-wave isentropic ocean-atmosphere dynamics". *Zenodo*, doi:10.5281/zenodo.7197430

4.3 Oral and Poster Presentations

Nothing to report

5. Intellectual Property Rights and Other Specific Achievements

Nothing to report

6. Meetings and Events

Nothing to report.

7. Other

Nothing to report.