



# Rotating Thermal Flows in Natural and Industrial Processes

*Marcello Lappa*

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## **Rotating Thermal Flows in Natural and Industrial Processes** Marcello Lappa

Rotating Thermal Flows in Natural and Industrial Processes provides the reader with a systematic description of the different types of thermal convection and flow instabilities in rotating systems, as present in materials, crystal growth, thermal engineering, meteorology, oceanography, geophysics and astrophysics. It expressly shows how the isomorphism between small and large scale phenomena becomes beneficial to the definition and ensuing development of an integrated comprehensive framework. This allows the reader to understand and assimilate the underlying, quintessential mechanisms without requiring familiarity with specific literature on the subject.

Topics treated in the first part of the book include:

- Thermogravitational convection in rotating fluids (from laminar to turbulent states);
- Stably stratified and unstratified shear flows;
- Barotropic and baroclinic instabilities;
- Rossby waves and Centrifugally-driven convection;
- Potential Vorticity, Quasi-Geostrophic Theory and related theorems;
- The dynamics of interacting vortices, interacting waves and mixed (hybrid) vortex-wave states;
- Geostrophic Turbulence and planetary patterns.

The second part is entirely devoted to phenomena of practical interest, i.e. subjects relevant to the realms of industry and technology, among them:

- Surface-tension-driven convection in rotating fluids;
- Differential-rotation-driven (forced) flows;
- Crystal Growth from the melt of oxide or semiconductor materials;
- Directional solidification;
- Rotating Machinery;
- Flow control by Rotating magnetic fields;
- Angular Vibrations and Rocking motions;

Covering a truly prodigious range of scales, from atmospheric and oceanic processes and fluid motion in “other solar-system bodies”, to convection in its myriad manifestations in a variety of applications of technological relevance, this unifying text is an ideal reference for physicists and engineers, as well as an important resource for advanced students taking courses on the physics of fluids, fluid mechanics, thermal, mechanical and materials engineering, environmental phenomena, meteorology and geophysics.

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