Numerical modelling of turbulent convection in an asymmetric rough Rayleigh-Bénard cell

Mebarek Belkadi[1,3], Anne Sergent[1,2] & Bérengère Podvin[1]

[1] LIMSI, CNRS, Université Paris-Saclay, F-91405 Orsay, France
[2] Sorbonne Universités, UFR d'Ingénierie, F-75005 Paris, France
[3] Sorbonne Universités, IFD, 4 place Jussieu, 75252 PARIS cedex 05, France
Mebarek.Belkadi@limsi.fr

We present direct numerical simulations of turbulent buoyant convection over a rough heated plate placed in a Rayleigh Bénard cell. The roughness is introduced by a set of cubic obstacles regularly spaced, modelled by using an immersed boundary method. This study aims at clarifying interactions between the large scale circulation filling the box, plume emission and the enhancement of the heat transfer. The simulations are performed in a box-shaped cell at fixed Prandtl number ($Pr = 4.38$) with the Rayleigh number Ra ranging from 5×10^5 to 5×10^9.

As expected, results show an enhancement of heat transfer measured by the Nusselt number Nu, depending on the relative sizes of the mean boundary-layer thicknesses and the obstacle height in agreement with previous experimental and numerical studies from the literature (for example [1,2,3,4]). By varying Ra, we investigate the successive regimes of the turbulent heat transport, from inactive roughness to a regime where the heat transfer relative increase is larger than the relative surface increase induced by roughness addition.

Références

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