4H Thermal convection

When a fluid is heated from below it usually expands and wishes to rise. Under appropriate conditions the fluid will rise, but not in a haphazard manner. The fluid will rise in the centre of a cell and descend at the edges of the cell. This gives rise to a cellular pattern when viewed from above. This phenomenon is known as thermal convection. It is resonsible for cloud formation, flows of magma in planets, and for many real life effects. Indeed, if the convection can be controlled then it can lead to a solar pond which is a way of generating electricity from the sun's rays (renewable energy).

This project develops a mathematical model for thermal convection, and investigates properties of the governing equations using stability theory. In this way it involves mathematical modelling, analysis, and possibly computation of numerical solutions. Introductory reading is in chapter 1 of

Straughan, B. Convection with local thermal non-equilibrium and microfluidic effects. Springer series in Advances in Mechanics and Mathematics, vol. 32, 2015,

or in chapters 1-3 of

Straughan, B. The energy method, stability, and nonlinear convection. Springer series in Applied Mathematical Sciences, vol. 91, Second Edition, 2004.

There are no prerequisites, but courses on continuum mechanics and analysis might help.