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Ergodic and mixing properties of the Boussinesq equations with a degenerate random forcing.

The Boussinesq equations play an important role in the analysis of buoyancy driven fluid convection problems. We will discuss the existence, uniqueness and attraction properties of an ergodic invariant measure for the Boussinesq equations in the presence of a degenerate stochastic forcing acting only in the temperature equation and only at the largest spatial scales. The central challenge is to establish time-asymptotic smoothing properties of the Markovian dynamics corresponding to this system. Towards this aim we encounter a Lie bracket structure in the associated vector fields with a complicated dependence on solutions. This leads us to develop a novel Hörmander-type condition for infinite-dimensional systems. Demonstrating the sufficiency of this condition requires new techniques for the spectral analysis of the Malliavin covariance matrix. (Received February 09, 2014)