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On relaxing the Boussinesq approximation in scrape-off layer turbulence (SOLT) model simulations[1] D.A. RUSSELL, D.A. D'IPPOLITO, J.R. MYRA, Lodestar Research Corporation — In the Boussinesq approximation, spatial variations in the plasma density are ignored in the convection of vorticity, leading to an equation of evolution for $n\nabla^2\phi$ rather than $\nabla\cdot(n\nabla\phi)$, where n and ϕ are the density and potential. In the blob-dominated turbulence of the near edge and SOL, density and potential fluctuation scales are similar, making this approximation hard to justify. The shortcomings of the approximation have been shown in studies of isolated blob motion [1], while recent studies of SOL turbulence suggest a relatively weak effect [2]. The numerical hardships and physical advantages of relaxing the approximation in the SOLT model [3] are discussed. On the algorithmic side, a Poisson solve for the potential becomes $n\nabla^2\phi + \nabla n\cdot\nabla\phi = \rho$, to be solved for ϕ at each time step, given the evolved *turbulent* fields n and ρ. We present multi-grid relaxation and direct (sparse matrix) methods for doing so. Eliminating the approximation allows us to add physics to the SOLT model that could not otherwise be included, such as *self-consistent* ion diamagnetic drift evolution.

[1] G. Yu et al., Phys. Plasmas **13**, 042508 (2006).
[2] K. Bodi et al., 38$^{\text{th}}$ EPS Conf. Plasma Phys. (2011).
[3] D.A. Russell et al., Phys. Plasmas **16**, 122304 (2009).

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