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Recent Advances in the Similarity Theory of the Stable Boundary Layer

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The gradient-based scaling for the stably stratified boundary layer is introduced and examined by using data collected during the SHEBA field program in the Arctic. The resulting similarity functions for fluxes and variances are expressed in an analytical form, which is practically unaffected by self-correlation. The flux Richardson number Rf is found to be proportional to the Richardson number Ri, with the proportionality coefficient varying slightly with stability, from 1.11 to 1.47. The Prandtl number decreases from 0.9 in nearly-neutral conditions to 0.7 for larger values of Ri. The budget of the turbulent kinetic energy indicates that for Ri > 0.7, turbulence must be non-stationary and decaying or sporadic. Turbulence within the stably stratified boundary layer is classified into four regimes: “nearly-neutral”, “weakly-stable”, “very-stable”, and "extremely-stable".