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Validity of the constant non-unity Lewis number assumption in chemically reacting flows NICHOLAS BURALI, GUILLAUME BLANQUART, Caltech, YUAN XUAN, Penn State — Describing molecular diffusion using constant but non-unity Lewis numbers has been widely used in numerical simulations of chemically reacting flows. These constant Lewis numbers need to be selected carefully, as they should correctly describe the molecular diffusion of different species. However, in practice they are extracted from one-dimensional flame structure calculations. The objective of the current work is to assess the validity of the constant non-unity Lewis number assumption in the description of molecular mixing. Towards this goal, a three-tiered analysis is carried out. First, the sensitivity of key reacting flow characteristics to species Lewis numbers is assessed on both laminar diffusion flames and laminar premixed flames. Second, detailed numerical simulations using the multicomponent diffusion model are performed for the same flames, and used as reference data. The validity of different Lewis number extraction criteria is examined by comparing simulation results obtained by using different sets of Lewis numbers to the reference data, and an optimal criterion is proposed. Finally, as a validation, a turbulent flame simulation is performed using Lewis numbers extracted following this optimal criterion, and results are compared to the experimental measurements.

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