Validity of the constant non-unity Lewis number assumption in chemically reacting flows

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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 multi-component 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.