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	Solenoidal and potential velocity fields in weakly turbulent premixed flames
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	Direct Numerical Simulation data obtained earlier from two statistically 1D, planar, fully-developed, weakly turbulent, single-step-chemistry, premixed flames characterized by different (7.53 and 2.50) density ratios σ are analyzed to explore the influence of combustion-induced thermal expansion on the turbulence and the backward influence of such flow perturbations on the reaction zone. For this purpose, the actual velocity fields are decomposed into solenoidal and potential velocity subfields, followed by independently processing each subfield. Results show that the potential and solenoidal velocities are negatively (positively) correlated in unburned reactants (burned products, respectively) provided that $\sigma = 7.53$. Moreover, not only potential, but also solenoidal velocity subfields contribute to countergradient turbulent scalar transport. Furthermore, correlation between strain rates generated by the solenoidal and potential velocity fields and conditioned to the reaction zone is positive (negative) in the leading (trailing, respectively) halves of the mean flame brushes. The potential strain rate correlates negatively with the flame curvature within the reaction zone, whereas the solenoidal strain rate and the curvature are negatively (positively) correlated in the leading (trailing, respectively) halves of the mean flame brushes. If $\sigma = 7.53$, the stretch rate conditioned to the reaction zone is negative (positive) in regions characterized by large positive (negative, respectively) potential strain rates, whereas the opposite trend is observed for the solenoidal strain rate. Thus, the potential and solenoidal velocity fields differently affect the reaction zone. In the case of $\sigma = 2.5$, such differences are significantly less pronounced. Finally, an approximate decomposition of the mean rate of viscous dissipation of flow kinetic energy into solenoidal and potential contributions is suggested and supported by DNS data. The results also show that the dilatation-induced dissipation plays an important role. Therefore, the influence of thermal expansion on the dissipation rate is not reduced to an increase in mixture viscosity in the rotational dissipation rate.