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A wall model for LES accounting for radiation effects RONAN VICQUELIN, YUFANG ZHANG, OLIVIER GICQUEL, JEAN TAINE, Ecole Centrale Paris, CNRS EM2C — In several conditions, radiation can modify the temperature law in turbulent boundary layers. In order to predict such an effect and the corresponding change in conductive heat flux at the wall, a new wall model for large eddy simulation (LES) is proposed. The wall model describes the inner boundary layer which cannot be resolved by the LES. The radiative power source term is calculated from an analytical expression of the intensity field within the inner layer. In the outer layer, wall stress and conductive heat flux predicted by the wall model are fed back to the LES which is coupled to a reciprocal Monte-Carlo method to account for radiation. Several mixing-length models and turbulent Prandtl number formula are investigated. Then, the level of accuracy of the discretized radiation analytical model is investigated. Finally, fully coupled results are compared with Direct Numerical Simulation/Monte-Carlo results of turbulent channel flows at different Reynolds number, wall temperature and pressure conditions. The proposed wall model greatly improves the accuracy of the predicted temperature profiles and wall conductive heat fluxes compared to approaches without radiation accounted for in the inner layer.

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