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Effects of radiation in turbulent boundary layers: Analysis of the mean temperature profile RONAN VICQUELIN, YUFANG ZHANG, OLIVIER GICQUEL, JEAN TAINE, Ecole Centrale Paris, CNRS EM2C — Direct numerical simulations fully coupled with radiative energy transfer in a turbulent channel flow have been performed for different temperature, optical thickness (pressure) and wall emissivity conditions. Radiation is treated from the CK approach and a Monte Carlo transfer method. Analysis of the results shows that, beside an additional wall radiative flux, the structure of the mean temperature field and the wall conductive flux often strongly differ from results without radiation. It is found that gas-gas and gas-wall radiation interactions generate antagonist effects. The first one tends to increase wall conductive flux while the second one to decrease it. Classical wall log-laws for temperature are therefore strongly modified by the global radiation effects. Many conditions encountered in applications are discussed. The observed modifications depend on all the set of conditions (temperature level, wall emissivity, pressure, Reynolds number), i.e. on the relative magnitudes of radiation gas-gas and gas-wall phenomena and of global radiation flux and conductive flux without radiation.

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