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Negative production of turbulent kinetic energy in a turbulent separation bubble HIROYUKI ABE, YASUHIRO MIZOBUCHI, YUICHI MATSUO, Japan Aerospace Exploration Agency, PHILIPPE R. SPALART, Boeing Commercial Airplanes — DNS data are used to examine the behavior of turbulence in the boundary layer separating from a flat plate, and reattaching. Particular attention is given to a region of negative production of turbulent kinetic energy. The inlet Reynolds number R_θ based on momentum thickness is equal to 300, 600 and 900. In all cases, the production P_k is weak across the bubble and goes negative with a smaller magnitude than the dissipation at the top, where the streamline curvature is convex. An indicator of streamwise curvature $U_{2,1}$, which comes from a rapid pressure-driven change of the mean strain rate, is indeed associated with negative P_k. That is, the budget term arising from $U_{2,1}$ yields negative Reynolds shear stress ($-\overline{uv} < 0$), and then the product of $-\overline{uv}$ and $U_{1,2}$ contributes to negative P_k. There is no one-to-one correspondence in a region between negative $-\overline{uv}$ and negative P_k. The correspondence is however excellent when the Reynolds shear stress is defined in the streamline orthogonal coordinate system, i.e., $\overline{ab} \equiv \left((\overline{vv} - \overline{uu})U_1U_2 + \overline{uv}(U_1^2 - U_2^2)\right)/\left(U_1^2 + U_2^2\right)$, which underlines that the streamline curvature is an important ingredient for negative P_k.

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