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Growth of gravity-capillary waves in countercurrent air/water turbulent flow[1] FRANCESCO ZONTA, ALFREDO SOLDATI, University of Udine, MIGUEL ONORATO, University of Torino — Mass, momentum and energy transport phenomena through a deformable air-water interface are important in many geophysical processes and industrial applications. In this study we use Direct Numerical Simulations (DNS) to explore the dynamics of countercurrent air/water flow. The motion of the air/water interface is computed by solving an advection equation for the interface vertical elevation (boundary fitted method). At each time step, the physical domain is mapped into a rectangular domain using a nonorthogonal transformation. Continuity and Navier-Stokes equations are first solved separately in each domain, then coupled (velocity/stress) at the interface. DNS are performed in the Weber, Froude and Reynolds number (We,Fr,Re) parameter space. Regardless of Re, Fr and We, the process of wave generation is driven by surface tension and follows a universal scaling ($t^{2/5}$). Later in time, the waves growth rate differs depending on the value of Fr,We: for small capillary waves, we don not observe substantial changes from $t^{2/5}$ law; for larger and longer waves (gravity waves) we observe a faster growth rate. We also derive simple phenomenological models to explain our results.

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