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Low-dimensional models of a temporally evolving free shear layer using template-based methods MINGJUN WEI, Princeton University, CLARENCE ROWLEY, Princeton University — Two-dimensional spatially periodic, temporally developing free shear layers are simulated and modeled. Low-dimensional models are obtained using a modified version of proper orthogonal decomposition/Galerkin projection, in which the basis functions can scale in space as the shear layer spreads. In particular, the solution is scaled at each time so that it matches a pre-selected template function, and the correct scaling is kept track of separately. Projection of incompressible Navier-Stokes equations onto the first two POD modes of the lowest spatial wavenumber gives a 2-mode model, which can describe certain single-frequency features, such as vortex roll-up, nonlinear saturation, and viscous damping. If the first two POD modes are retained for the first two spatial harmonics, the resulting 4-mode model describes more complex dynamics such as vortex merging. Phase differences between the first (symmetric) and second (asymmetric) POD modes of each wavenumber are examined, and qualitative differences are observed before and after saturation occurs.

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