Three-dimensional instabilities of miscible fingers in a Hele-Shaw cell RAFAEL OLIVEIRA, UCSB, FELIX HEUSSLER, MICHAEL JOHN, ECKART MEIBURG, UCSB — We perform three-dimensional DNS simulations of the transient, variable viscosity Boussinesq Navier-Stokes equations, coupled to a convection-diffusion equation for a concentration field, to simulate miscible viscous fingers in Hele-Shaw cells. The three-dimensional problem allows for new instabilities and patterns that cannot be captured by traditional gap-averaged modeling. For constant density displacements, we find that a streamwise vorticity quadrupole forms that induces fluid transport from the walls of the cell to its center, thereby leading to a new hydrodynamic instability, termed “inner splitting.” If gravity is included, the nature of the two-dimensional base flow and its subsequent instability changes dramatically. The interaction between Saffman-Taylor and Rayleigh-Taylor instabilities can lead to additional splitting events, and it can significantly enhance the mixing rates of the two fluids, thereby altering the overall displacement efficiency. This work is supported by NSF, and a CAPES/Fulbright fellowship.