Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

A simple and complete two-interface model for spatially developing flow in rigid and flexible canopies SAMANEH SADRI, PAOLO LUZZATTO-FEGIZ, UC Santa Barbara — At the front of a canopy, flow deceleration is associated with strong vertical fluxes of mass and momentum. Accurately describing this region is important in many applications, including terrestrial and aquatic vegetation, as well as large wind farms. Simple models can provide a framework to analyze these flows, thereby guiding and complementing more refined and computationally intensive tools. Jerram *et al.* (2003) introduced a linearised model that describes the flow field through sparse canopies, albeit at the cost of solving a PDE. A simpler approach involves vertically integrating the governing equations across the canopy, yielding scalings that relate key variables (e.g. Chen & Nepf 2013), which in turn can be used to construct empirical fits. We build a simple and complete model, by separating the flow in three horizontal layers. These comprise the canopy, the overlying boundary layer, and the outer flow, such that exchanges of mass and momentum occur at two interfaces. We parameterize turbulent exchanges by means of the entrainment hypothesis; this is a closure that has been used extensively in other problems in geophysical fluid dynamics. We neglect pressure gradients inside the canopy, but account for upstream pressure variations and retain nonlinear terms. Our two-interface model quantitatively describes the flow velocities and boundary layer heights in developing canopy flows, and successfully accounts for the effect of ambient stratification. Finally, we discuss developments accounting for the effects of flexibility in vegetation canopies.

Paolo Luzzatto-Fegiz
UC Santa Barbara

Date submitted: 02 Aug 2015 Electronic form version 1.4