Abstract Submitted
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Three-dimensional flow and vorticity transport in idealized airway model from laminar to turbulent regimes SAHAR JALAL, TRISTAN VAN DE MOORTELE, ANDRAS NEMES, University of Minnesota, AZAR ESLAM PANAHA, Pennsylvania State University, FILIPPO COLETTI, University of Minnesota — The presence and intensity of secondary flows formed by the inhaled air during respiration has important consequences for gas exchange and particle transport in the lungs. Here we focus on the formation and persistence of such secondary flows by experimentally studying the steady inspiration in an idealized airway model. The geometry consists of a symmetric planar double bifurcation that respects the geometrical proportions of the human bronchial tree. Physiologically relevant Reynolds numbers from 100 to 5000 are investigated, ranging from laminar to turbulent regimes. The time-averaged, three-dimensional velocity fields are obtained from Magnetic Resonance Imaging (MRI), providing detailed distributions of vorticity, circulation, and secondary flow strength. Information on the velocity fluctuations are obtained by Particle Image Velocimetry (PIV). The measurements highlight the effect of the Reynolds number on the momentum transport, flow partitioning at the bifurcations, strength and sense of rotation of the longitudinal vortices. A marked change in topology is found at a specific Reynolds number, above which the influence of the upstream flow prevails over the effect of the local geometry. Finally, turbulence and its role in the mean vorticity transport are also discussed.

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