Long-range collective dynamics of cilia, mucus transport and tissue polarity in bronchial epithelium

Julien Favier / M2P2 / julien.favier@univ-amu.fr
Annie Viallat / CINaM / annie.viallat@univ-amu.fr

Abstract

Airway epithelium is protected by the **active transport** at its surface of a layer of a complex fluid, the mucus. It is powered by the **coordinated beats** characterized by a strong **long-range orientational** order of billions of microscopic cilia carried by epithelial cells. Recently, we experimentally showed that, during ciliogenesis, large milling patterns of ciliary beats leading to mucus vortex flows spontaneously emerged on reconstituted epitheliums and that the removal of mucus and further addition of model fluids could destroy and reconstitute this order, respectively. Our objectives are to understand the emergence and the maintain of the collective dynamic order of ciliary beats, which involve the mechanical cilia-mucus coupling mediated by long-range hydrodynamic interactions, and the active mechanotransductive response of ciliary beats. We propose to combine an **in-vitro** experimental approach on cultures at Air Liquid Interface and an **in-silico** approach based on Lattice Boltzmann simulations to build a reliable **numerical model** of mucus transport.

Keywords

Mucociliary transport – severe asthma – collective motion - active matter – metachronal waves - ALI cultures – Lattice Boltzmann simulations - airways