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Modeling and optimal design of CO_2 Direct Air Capture systems in large arrays SAMANEH SADRI IRANI, PAOLO LUZZATTO-FEGIZ, UCSB — As noted by the 2014 IPCC report, while the rise in atmospheric CO_2 would be slowed by emissions reductions, removing atmospheric CO_2 is an important part of possible paths to climate stabilization. Direct Air Capture of CO_2 with chemicals (DAC) is one of several proposed carbon capture technologies. There is an ongoing debate on whether DAC is an economically viable approach to alleviate climate change. In addition, like all air capture strategies, DAC is strongly constrained by the net-carbon problem, namely the need to control CO_2 emissions associated with the capture process (for example, if DAC not powered by renewables). Research to date has focused on the chemistry and economics of individual DAC devices. However, the fluid mechanics of their large-scale deployment has not been examined in the literature, to the best of our knowledge. In this presentation, we develop a model for flow through an array of DAC devices, varying their lateral extent and their separation. We build on a recent theory of canopy flows, introducing terms for CO_2 entrainment into the array boundary layer, and transport into the farm. In addition, we examine the possibility of driving flow passively by wind, thereby reducing energy consumption. The optimal operational design is established considering the total cost, drag force, energy consumption and total CO_2 capture.

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