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Effects of altitude on the climbing performance of Monarch butterflies[1] CHANG-KWON KANG, MADHU SRIDHAR, DAVID LANDRUM, Univ of Alabama - Huntsville, HIKARU AONO, Tokyo University of Science — Millions of Monarchs annually travel up to 4,000km, the longest migration distance among insects. They fly and overwinter at high altitudes. However, the aerodynamic mechanism enabling the long-range flight of Monarch butterflies is unknown. To study the effects of altitude on the aerodynamic performance of Monarch butterflies, a unique combination of a motion tracking system and a variable pressure chamber that allows controlling the density is used. The condition inside the chamber is systematically varied to simulate high altitude conditions up to 3,000 m. An optical tracking technique is used to characterize the climbing trajectories of freely flying Monarch butterflies. Customized reflective markers are designed to minimize the effects of marker addition. Flapping amplitude and frequency as well as climbing trajectories are measured. Lift acting on the butterfly is also determined by considering the force balance. Results show that the average flight speed and the Reynolds number, in general, decreased with the altitude, whereas, interestingly, the lift coefficient increased with the altitude. More detailed measurements and analyses will be performed in the future to explain the lift enhancement by flying at higher altitudes.

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