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Comparative Analysis of CFD Modelling Approaches on a Two-Element Wingsail Near Stall

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ABSTRACT

As wind propulsion devices on cargo vessels, wingsails can contribute to fuel savings and reduced carbon emissions. For optimal performance, automated trimming, i.e. adjusting the geometry in varying sailing conditions, is crucial. A profound understanding of the wingsail's aerodynamic characteristics is essential for effective trimming. Recent wind tunnel tests on a rectangular planform wingsail with two symmetric elements demonstrated a distinct stalling behaviour including two abrupt stall stages. This study aims to enhance the understanding of the observed behaviour through CFD simulations using steady and unsteady RANS as well as IDDES. The numerical results show good agreement in regions of attached flow; however, only the first abrupt stall stage is replicated. Instead of a second abrupt loss in lift, the lift coefficient continuously decreases as the separated flow region on the main wing grows. The flow remains attached on the flap in all investigated configurations. This behaviour was consistent across all modelling approaches.