Aerodynamic hysteresis at high sideslip angles for an unconventional fixed-wing UAV

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Abstract. This paper examines an unconventional double-delta fixed-wing UAV characterized by strong aerodynamic coupling due to the generation of vortices. While aerodynamic coefficients are often computed using quasi-steady CFD simulations, this study shows that for strongly coupled configurations, unsteady simulations with imposed yaw rate yield different results. CFD analysis was performed in Ansys Fluent. Results show that above some value of β, unsteady simulations with increasing sideslip predict higher rolling moment and delayed lateral instability compared to static cases, whereas decreasing sideslip aligns more with static results, leading to a hysteresis effect. The relationship between the value of yaw rate and the change in aerodynamic characteristics is nonlinear. Those effects are caused by the vortex flow.