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USE OF SATELLITE WIND DATA TO MONITOR DYNAMIC CHANGES IN TURBULENCE FOR AVIATION

Abstract

Climate change is causing significant impacts on aviation in terms of design, business, and economics. The rising global mean tropospheric temperatures are leading to uneven localized environmental trends. Moreover, there has been a significant increase in the frequency and intensity of gusts, not only in typical air corridors as the transatlantic route but also in traditionally calmer regions. This change leads to longer en-route flight times and increased fuel consumption. The growing turbulence also presents challenges for crew comfort and flight safety. Recognizing the correlation between wind gusts and aircraft performance is crucial for ensuring aviation safety and operational efficiency. Adapting to evolving weather patterns is essential as the aviation industry transforms continuously. Leveraging space technology and innovative payloads is imperative to comprehend atmospheric dynamics and improve forecasting capabilities. This study examines the impact of climate change on aviation, focusing on the relationship between changing wind patterns and increasing turbulence. This work conducts an in-depth analysis using Aeolus satellite data from 2018 to 2022 to reveal the dynamic changes in wind gust intensity on both seasonal and annual scales. The high-resolution observations of global wind provide valuable insights into the temporal evolution of wind gusts. Comparative analysis with normative benchmarks reveals substantial deviations during the study period. The research further examines trends in wind gust intensity, identifying noteworthy shifts with far-reaching consequences. Particular emphasis is given to the capabilities of assessing changes in wind patterns in commercial aviation altitudes by using radar Doppler technology. Nevertheless, the need to develop innovative payloads capable of detecting unpredictable turbulence, including Clear Air Turbulence (CAT), is demonstrated. The research proposes the development of new Geostationary Earth Orbit (GEO) satellites equipped with features such as water vapour channels to predict turbulence events. It highlights how satellites can be used to improve turbulence prediction and their potential for forecasting events beyond aviation concerns.