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The impact of airborne wind and water vapour lidar measurements on ECMWF analyses and forecasts

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Recent impact studies show that the ECMWF forecast error could be reduced significantly by assimilating airborne Doppler lidar observations taken during the Atlantic THORPEX Regional Campaign (A-TReC). This is a very promising result, considering that observations have been gathered from only 28.5 flight hours in a 2-week period. Due to low instrumental and representativeness errors of the observations, lidar winds have a higher analysis influence than dropsondes and conventional wind observations. These encouraging results motivated similar impact studies using airborne Differential Absorption Lidar (DIAL) water vapour observations from several research campaigns. In addition to low observational errors, the high vertical resolution of DIAL lidars of up to a few hundred meters is expected to be crucial for a proper representation of the water vapour field in NWP models. In the current global observing system water vapour is primarily observed through passive satellite instruments, which have a very low vertical resolution and much higher observational errors than lidars. This paper summarizes the impact of airborne wind and water vapour lidar data on ECMWF analysis and forecast fields. Furthermore, an outlook on planned future field campaigns using airborne lidars for targeted observations is presented (COPS/E-TReC, T-PARC, TNADEX).