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## Forecast Sensitivity of the Aircraft Observations Impact in the WRF 3DVAR Data Assimilation Systems on Guarulhos International Airport Forecast

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Despite of it is well known, it is always good to point that numerical weather prediction is an initial value problem and requires analysis of the initial conditions to begin a time dependent process (Richardson, 1922). Bergthorsson and Döös (1955), in that time, enunciated that analysis could be improved if they were not based solely on available observations, but also on forecasts made by model from previous observations, with background on data assimilation defined usually by a model forecast with errors. Airports are the most weather info powered locations, although all infrastructure, most of the moisture, turbulence, and convective processes circle around 25,000 feet and below, what turns rawinsonde observations an important source, besides, off course, data observations obtained from aircrafts. The aircraft data universe includes the Aircraft Communications Addressing and Reporting System (ACARS) reporting temperature and wind collected during all phases of flight, which composes the subset named Meteorological Data Collection and Reporting System (MDCRS), which has been used by several air carriers. For example, the AMDAR (Aircraft Meteorological Data Relay) program delivers more than 680,000 wind and temperature reports daily (Petersen et al., 2015), and with the advent of humidity sensor (Water Vapor Sensing System - WVSS-II in Hoover et al., 2017), vertical profiles of moisture (ascent and descent) are included in that. Based on current ECMWF numbers, FM-35 WMO provides 413 thousand information's in the assimilation cycle for a typical day, otherwise, aircraft observations provide 1,234 thousands information's (Bonavita in ECMWF, 2020). Numbers obtained from MADIS support page ([amdar.noaa.gov/new\\_soundings](http://amdar.noaa.gov/new_soundings)) shows that on Guarulhos Airport receiving 835 (eight hundred and third five) profiles on period from July, 14 to 20, 2019. It takes a more important role, when it comes to mind that satellites profiles cannot resolve sharp vertical structures, as an example, warming-moisture combination to thunderstorm development. For testing the forecast sensitivity of the aircraft observations impact in the WRF 3DVAR Data Assimilation Systems, the WRF 4.2.1 has been installed without any source code modification, and configured for a 36 hour simulation period in forecast mode, starting in 12Z January, 2<sup>nd</sup> 2020, applying Global Forecast System (GFS) model as initial and boundary condition, for a centred area in Guarulhos Airport, with 9 km spatial resolution. The results were compared against a simulation including aircraft data observation obtained from MADIS for Guarulhos International Airport Forecast, for the same period. That date was marked with strong precipitation starting around 19Z, with damages to the Airport infrastructure, as well, causing flight operations impact. For this

period two profiles have been obtained and applied in the window time around analysis (12Z January, 2<sup>nd</sup> 2020), and both assimilated using 3DVar WRF System. Analysis based on the results obtained demonstrates that there was an increase in precipitation amount forecasted by assimilation experiment and cooling temperature in cloud base, against no-assimilation, leading to conclusion that the aircraft profile data assimilation process can impact a precipitation forecast even 7 hours after analysis, encouraging to apply a 4DVar, in short range forecast and more assimilation experiments.