Dynamical contribution of Mean Potential Vorticity pseudo-observations derived from MetOp/GOME2 Ozone data into weather forecast, a Mediterranean High Precipitation Event study.

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In the absence of observations covering the upper troposphere - lower stratosphere, headquarters of several disturbances, and knowing that satellites are uniquely capable of providing uniform data coverage globally, a methodology is followed [1] to convert Total Column Ozone, observed by MetOp/GOME2, into pseudo-observations of Mean Potential Vorticity (MPV). The aim is to study the dynamical impact of Ozone data in the prediction of a Mediterranean Heavy Precipitation Event observed during 28-29 September 2012 in the context of HYMEX\(^1\). This study builds on a previously described methodology [2] that generates numerical weather prediction model initial conditions from ozone data. Indeed, the assimilation of MPV in a 3D-var framework is based on a linear regression between observed Ozone and vertical integrated Ertel PV. The latter is calculated using dynamical fields from the moroccan operational limited area model ALADIN-MAROC according to [3]:

\[
P V = -g \xi a \frac{\partial \theta}{\partial p} - g \left( \frac{p_0}{p} \right)^\frac{g}{R} \left[ \left( \frac{\partial U}{\partial p} \right)^2 + \left( \frac{\partial V}{\partial p} \right)^2 \right] \tag{1}
\]

Where \( \xi a \) is the vertical component of the absolute vorticity, \( U \) and \( V \) the horizontal wind components, \( \theta \) the potential temperature, \( R \) gas constant, \( C_p \) specific heat at constant pressure, \( p \) the pressure, \( p_0 \) a reference pressure, \( g \) the gravity and \( f \) is the Coriolis parameter.

The MPV is estimated using the following expression:

\[
MPV = \frac{1}{P_1 - P_2} \int_{P_1}^{P_2} PV \delta p \tag{2}
\]

With \( P_1 = 500hPa \) and \( P_2 = 100hPa \)

In the present study, the linear regression is performed over September 2012 with a correlation coefficient of 0.8265 and is described as follows:

\[
MPV = 5.3146 \times 10^{-2} \times O_3 - 13.445 \tag{3}
\]

where \( O_3 \) and MPV are given in Dobson Unit (DU) and PVU (1 \( PVU = 10^{-6} m^2 K kg^{-1} s^{-1} \)), respectively.

It is found that the ozone-influenced upper-level initializing fields affect the precipitation forecast, as diagnosed by a comparison with the ECMWF model.

References


\(^1\)HYdrological Cycle in Mediterranean EXperiment