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Dynamical contibution 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 stratophere, 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]:

$$PV = -g\xi_a \frac{\partial \theta}{\partial p} - g\frac{fp}{R}(\frac{p_0}{p})^{\frac{R}{C_p}}[(\frac{\partial U}{\partial p})^2 + (\frac{\partial V}{\partial p})^2] \quad (1)$$

Where ξ_a is the vertical component of the absolute vorticity, U and V the horizontal wind components, θ 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:

$$MPV = \frac{1}{P_1 - P_2}\int_{P_1}^{P_2} PV.\delta p \quad (2)$$

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:

$$MPV = 5.3146\ 10^{-2} * O_3 - 13.445 \quad (3)$$

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

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[1] HYdrological Cycle in Mediterranean EXperiment