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A tri-reanalysis climatology of cut-off low systems occurrence and an exploratory analysis of their predictability using reforecast

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Cut-off low pressure systems (COLs) are usually closed circulations at middle and upper troposphere developed from a deep trough in the westerlies. Among other peculiar characteristics COLs are important as a mechanism of stratosphere troposphere exchange (STE). In cut-off low systems, the tropopause is anomalously low, thus contributing to produce STE by convective or radiative erosion of the tropopause. There are also two other possible mechanisms of STE: turbulent mixing near the jet stream associated with the cut-off system and tropopause folding along the system. Although smaller in magnitude, the STE associated with COLs is similar to that produced by tropopause folding associated with upperlevel cyclogenesis. Thus, the STE associated with COLs is essential to explain anomalous values of tropospheric ozone in northern midlatitude and subtropical areas. Here we present an upgraded climatology of these systems -firstly developed by Nieto et al. (2005)- for the whole Northern hemisphere. In order to provide a comprehensive approach we use three reanalyses datasets (NCAR-NCEP, ERA-40 and the recently developed Japanese reanalysis JRA-25) checking different characteristics of COLs, namely their area of occurrence, seasonal cycle, duration, movement and interannual occurrence trends. Furthermore we use the CDC reforecast dataset (a dataset of 15 ensemble forecasts available from 1979 to 2005, with a 2.5˚ by 2.5˚ resolution, based on a version of the NCEP MRF 1998 model), to explore the predictability of COLs. Another objective is to find the most predictable seasonal distribution pattern for the main areas of occurrence of COLs using the 15 members of the ensemble for five years. The same automated procedure

by Nieto et al. (2005) was used to identify grid points that fitted the COL criteria. The total number of COLs, when the ensemble mean forecast is used, decreases exponentially with time, particularly beyond two to three days of forecasting, showing that COLs are only predictable at most until 3 days in advance. In general, COLs are detected at higher latitudes in the forecast (compared to their latitudinal band obtained with the analysis), especially in what concerns forecasts performed with two to three days in advance.