As described in Gaubert et al. (2016), our reanalysis of MOPITT CO uses the Community Atmosphere Model with Chemistry of the Community Earth System Model (CESM/CAM-Chem) (Timilsina et al., 2015) and the ensemble-based Data Assimilation Research Testbed (DART) (Anderson et al., 2009). Both conventional meteorological observations and Moderate Resolution Imaging Spectroradiometer (MODIS) V65 (MOPITT-CO) multiparametric retrievals of CO partial columns (Deeter et al., 2013; Worthy et al., 2010) are assimilated every 6 h as described in Barret et al. (2015).

We investigated the impact of assimilation on the chemical state and dismantle the chemical and dynamical effects on the CO trends, and related OH trends. We found that:

- The assimilation of CO highlights the non-linear impact of the coupled tropospheric chemistry, reducing CO emissions leads to higher chemical CO production, through a natural OH feedback (Gaubert et al., 2016, JGR).
- The decrease of CO observed in the last decade leads to an increase in globally average OH and therefore a decreasing trend in the CH4 lifetime.
- Increasing both CH4 and OH leads to a positive trend in CO atmospheric chemical production.

These trends are consistent with global modeling of OH sources and sinks (Holmes et al. 2013; Naik et al., 2013; Dalsoren et al. 2016). The OH trends are explained by an increase in the ratio of sources to sinks, where the main sources are NOx photochemistry, and ozone, and CO and CH4 are the sinks (Wang and Jacob 1998; Dalsoren and Isaksen 2006; Fiore et al. 2006; Murray et al. 2014). Nicely et al. (2017) found that CO, the OH photolysis, CO, and chemical mechanism differences are the main drivers of OH variations, between global models. Thanks to the increasing availability of satellite observations, chemical reanalysis (Formenti-Cheney et al. 2011; Inness et al. 2013; Miyazaki et al. 2015; Gaubert et al. 2016; Flammer et al. 2017) provide explicit modelling of the main factors driving OH while optimizing the major species (CO, NOx, O3, H2O, CH4) controlling OH.

Here we compare our results with the Tropospheric Chemistry Reanalysis version 2 (Miyazaki et al. 2015; Miyazaki et al. 2017) to investigate how robust and consistent is the derived trend.

**Figure 4** shows the trend and the PH component of the CH trend decomposition of the tropospheric oxidants across the Northern Extratropics (NE), the Tropics and the Southern Extratropics (SE).

**Figure 5** shows the trend and the PH component of the OH trend decomposition of the tropospheric oxidants across the Northern Extratropics (NE), the Tropics and the Southern Extratropics (SE).