We appreciate reviewer's time and effort for providing us with comments and suggestions on our manuscript. We have made the necessary revisions to the manuscript. Below, you will find our response and the summary of our approach, highlighted in *blue,* with modifications to the manuscript highlighted ***in bold***:

Referee#2

The authors have used part of the measurements during the FRAPPÉ study to evaluate the impacts of the Denver Cyclone on the local air quality based on meteorological variables, gaseous and aerosol measurements, some modeling, and comparison of results. This paper is well-written and outlines the details of the data analysis clearly to present the conclusion that the Denver Cyclone does indeed affect regional air pollution levels, especially in the Denver metro area. The data and analysis presented in this paper will be useful for future papers based on data collected during FRAPPÉ and other studies in this region. Overall, the paper is good. I have some suggestions, outlined below, that make it more concise.

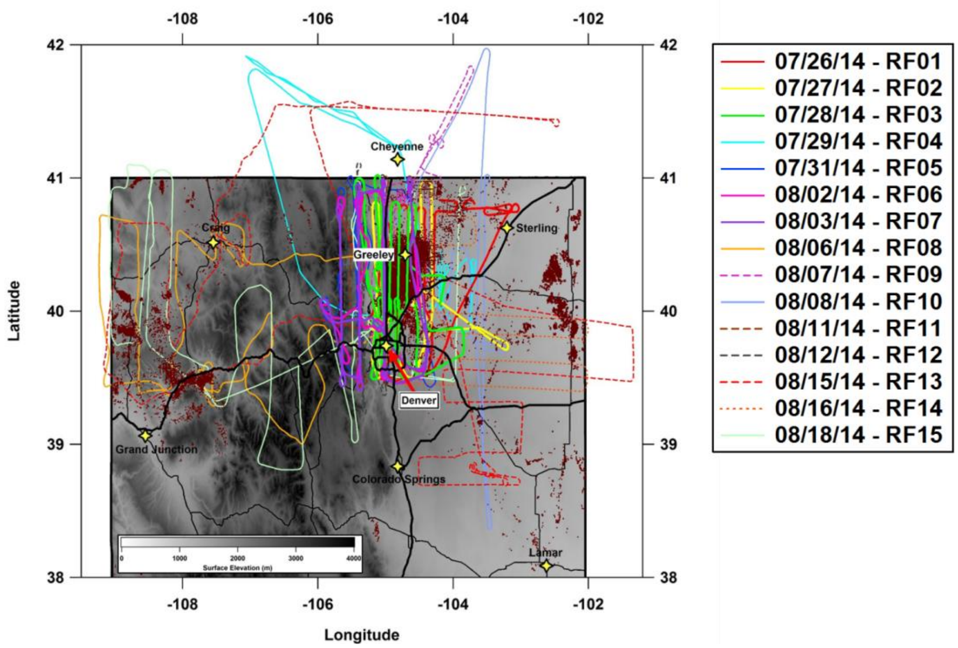
1. **The abstract can be shortened without compromising the intended message. For example, the sentence "Average nitrate mass. . ., respectively." can be excluded from the abstract. Also, the way the abstract is written is just informative of the main text but not of the conclusion or the importance of the paper. After deleting some of the unnecessary information, it would be nice to add a sentence that addresses the importance and/or conclusions of the paper.**

   The abstract has been revised to reflect the reviewer's suggestions:
   "We present airborne measurements made during the 2014 Front Range Air Pollution and Photochemistry Éxperiment (FRAPPÉ) project to investigate the impacts of the Denver Cyclone on regional air quality in the greater Denver area. Data on trace gases, non-refractory sub-micron aerosol chemical constituents, and aerosol optical extinction (β_{ext}) at $\lambda = 632$ nm were evaluated in the presence and absence of the surface mesoscale circulation in three distinct study regions of the Front Range: In-Flow, Northern Front Range, and the Denver Metropolitan. Pronounced increases in mass concentrations of organics, nitrate, and sulfate in Northern Front Range and the Denver Metropolitan were observed during the cyclone episodes (27–28 July) compared to the non-cyclonic days (26 July, 02–03 August). Organics aerosols dominated the mass concentrations on all evaluated days, with a 45 % increase in organics on cyclone days across all three regions while the increase during the cyclone episode was up to ~ 80 % over the Denver Metropolitan. In the most aged air masses ($NO_x/NO_y < 0.5$), background organic aerosols over the Denver Metropolitan increased by a factor of ~ 4 due to transport from Northern Front Range. Furthermore, enhanced partitioning of nitric acid to the aerosol phase was observed during the cyclone episodes, mainly due to increased abundance of gas phase ammonia. During the non-cyclone events, β_{ext} displayed strong correlations ($r = 0.71$) with organic and nitrate in the Northern Front Range and only with organics ($r = 0.70$) in the Denver Metropolitan, while correlation of β_{ext} during the cyclone was strongest ($r = 0.86$) with nitrate over Denver. Mass extinction efficiency (MEE) values in Denver Metropolitan were similar under cyclone and non-cyclone days despite the dominant influence of different aerosol species on β_{ext}. Our analysis showed that the meteorological

patterns associated with the Denver Cyclone increased aerosol mass loadings in the Denver Metropolitan area mainly by transporting aerosols and/or aerosol precursors from the northern regions, leading to impaired visibility and air quality deterioration."

2. **Adding a small table with the measurement dates and specifications (e.g., location) would be very helpful.**

   An additional flight map has been added to the supplemental materials section (Fig. S1) that depicts flight tracks of the entire field campaign with their corresponding, flight number, dates, and locations of the active O&G wells.



3. **Page 3, second paragraph: I would suggest excluding this paragraph or making it more concise.**

   Our goal to include such a paragraph in the Introduction was to highlight the major studies previously carried out in the region and to compare our results and put the current summertime measurements in context. This paragraph has now been revised and shortened, as following:

   "Emission sources and meteorological conditions affecting air quality in the greater Front Range have been previously studied in the region. The 1973 Denver Air Pollution Study (Russell, 1976), focused on episodes of winter pollution in Denver, described occurrences of rapid dispersal of pollutants to the north-northeast of Denver due to strong winds and recurring reversal of winds, bringing aged pollutants back to the urban center. Additionally, the Denver Haze Study conducted in the winter of 1978-1979 and the 1987-88 Metro Denver Brown Cloud study provided objective apportionment to the observed brown cloud pollution

over Denver. The occurrence of the wintertime inversion layer and emissions from the local gas and coal burning power plants had a profound effect on air quality and visibility degradation. Among the measured aerosol species, elemental carbon, ammonium sulfate, and ammonium nitrate contributed to the majority of optical extinction, decreasing visibility in the visible range by about 38%, 20%, and 17%, respectively (Countess et al., 1980; Groblicki et al., 1981; Wolff et al., 1981; Watson et al., 1988; Neff, 1989)."

4. **Page 4, first paragraph: This is a really good section of the introduction, but it gets lost in the current structure of the introduction. Re-structuring or making the introduction more concise will help bring this paragraph more attention.**

   The referenced paragraph has been moved to an earlier section in the Introduction to explain the meteorology in the Front Range before discussing previous measurements.

5. **Page 6, lines 4-10: Why do the authors emphasize the calibration procedures for the AMS, when they are using data from other instruments too? I suggest moving this paragraph to the supplementary material if the authors wish to keep it.**

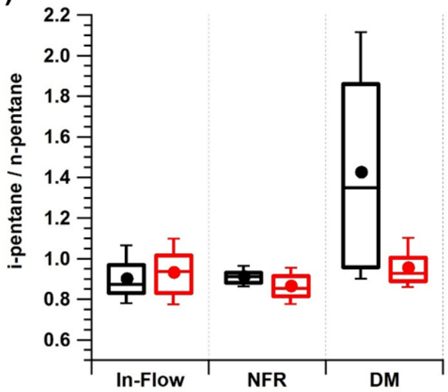
   Since observed aerosol concentrations are a major focus of this manuscript and because of the recent discussions about the quantification limits of the AMS instrument, we choose to keep this information in the main text for completeness and to provide the AMS users with the necessary operational and sensitivity related details. We have re-structured the above referenced lines to be included in section 2.2, following the introduction of the AMS instrument.

6. **Page 9: Were i-pentane and n-pentane measured and could the authors use the ratio (or i/n butane) to discuss the O&G influence further?**

   This is a great suggestion. We examined the ratio of i-pentane to n-pentane and indeed very different ratios were observed in DM during the cyclone and non-cyclone days due to the influence of O&G emissions. We have added a discussion on this in Section 3.3.1 and statistics of the ratio in Fig. 7e.

   "To better understand the influence of O&G operations over DM during the cyclone, we examined the ratio of i-pentane to n-pentane since O&G emissions show a characteristic ratio in the range of 0.8 – 1.2 (Gilman et al., 2013; Swarthout et al., 2013; Thompson et al., 2014; Halliday et al., 2016) in contrast to urban sources predominately impacted by vehicular emissions, which typically have a higher ratio between 2-3 (Broderick and Marnane, 2002; Baker et al., 2008). Figure 7e represents the statistical analysis of i-pentane to n-pentane ratio in the threes study regions. Non-cyclone days show a significant urban source of pentanes in DM compared to NFR. During the cyclone, a minor decrease in the ratio was observed in NFR, whereas the ratio decreased substantially in DM to values close to those in NFR. These observations suggest that the significant increase in C_2H_6 mixing ratio observed over DM during the cyclone cannot be solely explained by BL height differences, but rather driven by transport of O&G-impacted and C_2H_6-rich air masses from NFR into the DM."

(e)



7. **Figure 4: If possible to do without cluttering the figure too much, it would be helpful to have an outline of the O&G rich area on one of the maps in this figure.**

   Figure 1, 4-6a, and S1 now include markers that represent active oil and gas wells in the Colorado Front Range for reference.