Response to Anonymous Referee #1

Below we respond to each of the referee's general comments:

1. Role of increasing NO_x emissions on O_3 production rates: As the referee concludes, the manuscript as written primarily addresses the state of the atmosphere over the North Pacific in 2006. However, calculation of the dependence of the O_3 production rate on NO_x abundances (Fig. 5) provides an opportunity to comment on the sensitivity of the sampled airmasses to future changes in NO_x. This point will be clarified in the abstract, and in the text. As suggested, we will expand the discussion to place it within the context of previous analyses (e.g., Parrish 2004) as suggested by Referee #3).

2. Uncertainty in input parameters: The referee requests that we include a broader discussion of the uncertainty associated with the findings that are presented. We will broaden the discussion of the calculation of the ozone production rate to include a discussion of the uncertainties derived from measurements of OH, HO_2, NO_2 and NO as they most significantly impact the calculations. Assessment of the uncertainty in the measured acetaldehyde concentrations, and the impact of nitrate radical chemistry are more problematic due to limitations in measurements. Nonetheless statements on model limitations will be added. Specifically, we will comment on the role of systematic bias in the calculation of $\Delta(O_3)$.

3. Broader referencing: The referee comments that the paper "seemed to be hastily written in parts" and "should be better cited throughout". In what follows we address the referee's specific concerns regarding inconsistencies in the manuscript. In addition, we will expand the citations in the manuscript, particularly in response to referee 2 and 3's suggestions for including more context on how the measurements described here in the remote North Pacific can be interpreted within the context of the observations made closer to the west coast of North America (ITCT 2K2 and Mt. Bachelor).

Below we respond to each of the referee's specific comments:

1. P.24956, line 20: Reactive nitrogen here and throughout the paper refers to both the gas and the particle phase. This will be clarified here and elsewhere. We include in Fig. 3 particulate nitrate and comment on the extent to which it impacts the reactive nitrogen budget, specifically below 6 km south of 35°N. We only exclude particulate nitrate in the calculation of the daytime flux through the meridonial plane, due to limited spatial coverage. An assessment of the potential contribution of particulate nitrate to the westerly flux will be added. We will also expand the instrumental section to comment on the potential for TD-LIF to sample compounds such as N_2O_5, $ClNO_2$, HONO, and particulate nitrate.

2. P.24957, line 3 and P. 24958, line 13: Section 1 provides a general introduction to reactive nitrogen chemistry, highlighting the production of a host of reservoir compounds (ΣANs, ΣPNs, HNO_3, N_2O_5, HONO, and $ClNO_2$). As the referee points out, Section 1 does not provide a complete discussion on the fate (and relative lifetime) of each of these compounds and how this may vary as a function of altitude. We will include statements on HNO_3 + OH as a potential NO_x source (as we discuss later in the MS) as well as a discussion of photolysis of PNs and ANs (as pointed out by another referee).

3. P.24960, line 1: We further define the un-sampled transport corridor as the region between 135-180W, 15-60N and 0-12km during Northern Hemisphere spring. This region had only been sampled during the ferry flights for PEM-WEST B and TRACE-P, with the majority of the transit flight conducted in the upper troposphere. We have also provided a citation to the sampling domains of each of the previous NASA and

NOAA flight campaigns that have targeted either the Asian source region (e.g., TRACE-P) or coastal North America (e.g., ITCT 2K2).

4. P. 24962, line 23: The observations of the partitioning of reactive nitrogen presented here for the remote North Pacific are (as one might expect) dramatically different than those made over the US or off the eastern coast of the US. As shown in Parrish et al 2004 (and also in our own INTEX-NA measurements), a much larger fraction of NO_y is found as HNO_3 as compared with our measurements during INTEX-NA. While discussion of these differences is beyond the scope of this paper, it is most likely a result of regional differences in oxidant loadings and vertical transport mechanisms, in addition to the objectives of each field campaign.

5. 24964, line 18: As the referee notes, the box model is constrained by measurements made aboard the DC-8, where OH, HO_2, NO, and many others are used to calculate ΔO_x (as shown in Fig. 5). As suggested, we have conducted a more complete error analysis to assess how both random and systematic uncertainty in the observations impacts our conclusions.

6. P. 24964, line 19: Given that the mean surface area measured during INTEX-B was 14.7 ± 19.7 (1σ) μm^2 cm^{-3} (median = 7.7 μm^2 cm^{-3}) we expect heterogeneous NO_3 and N_2O_5 chemistry to play a minor role in impacting O_3 production rates in these regions (even at the most aggressive values of $\gamma(N_2O_5)$ = 0.03 and $Y(ClNO_2)$ = 1). RO_2 production from NO_3 radical initiated chemistry is more difficult to assess due to limited measurements of reactive VOC.

7. P. 24966, line 11: The estimates of Parrish et al (9%) will be included in the discussion. However, this section will be revised extensively with regard to the comments of Referee #3.

8. P. 24966, line 22: The sparse spatial coverage for particulate nitrate measurements limits their use in many of the analyses (e.g., flux calculation). However, this does not mean that they are an insignificant component of the reactive nitrogen budget (as shown in Fig. 3). We will stress this point in the manuscript in Section 3 and the discussion of Fig. 3.

9. P. 24966, line 23: Agreed. The flux measurements were calculated between 20-55 N (as shown correctly in Fig 6, although incorrectly stated in the MS as 25-55N) and 0-10km in altitude. We have included a citation to Forster et al (2004), that indicates for a 15year average from MAM along the 125 W transect (Fig 2B) that the Asian CO tracer is concentrated between 25-50N and 3-12km. In addition, the revised manuscript will discuss transport features specific to the INTEX-B campaign that have been described previously in the literature. We will include reference to the work of both Walker et al and Zhang et al that have conducted analyses of the trans-pacific transport of O_3, NO_y, and CO for this time period. Specifically, satellite observations of CO from AIRS and TES and O_3 columns from TES were used in combination with kinematic trajectory analyses. In each of these cases, the export of the Asian plume was found to be North of 20 °N at 150 °W.

10. P. 24967, line 9: This has been reconciled by expanding Section 1 to provide a more complete discussion of HNO_3 loss mechanisms in the free troposphere (as discussed earlier).

11. P. 24967, line 18: This section has been removed from the revised manuscript.