Response to interactive comment on "Marine boundary layer over the subtropical southeast Pacific during VOCALS-REx – Part 1: Mean structure and diurnal cycle" by D. A. Rahn and R. D. Garreaud.

We wish to thank the reviewer for their comments and address the individual comments below:

1. The biggest difference between the PREVOCA WRF runs and those used for this study were switching from version 2.2 to 3.0 and going from a resolution of 45 to 20 km.

2. From 12-14 November there were strong synoptic changes occurring as a coastal low developed and decayed all during this period (cf. Fig. 2 in Part 2). We wanted to use a period that was less synoptically active. The 12-14 November period is illustrated in Fig. S1. Large changes aloft tended to mask the diurnal changes in the time series and the composite was not as clear either (particularly above the MBL, but the MBL depth does indeed show a strong signal). The response of the MBL still contains the diurnal signal (2 peaks daily) so it is not unrepresentative. The 30 October to 3 November period was more tranquil and showed a clear signal aloft at 2.5 km even in the time series. The simulation shows a similar structure during 12-14 November.

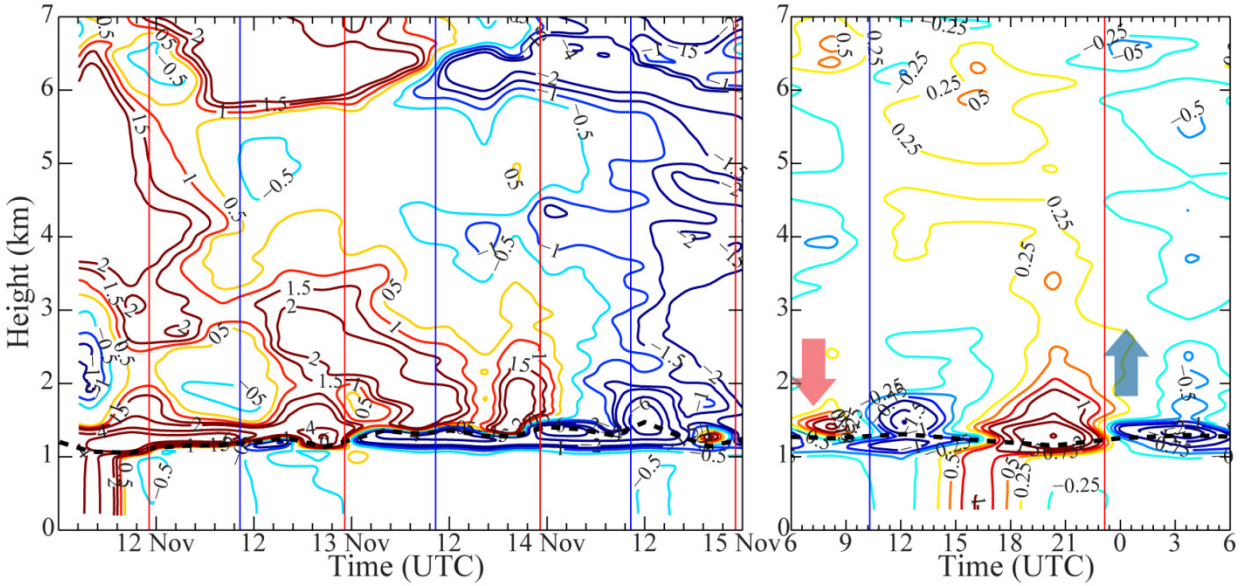

Figure S1. Observed potential temperature anomalies from the mean state taken from *R/V Ron Brown* soundings during the 2nd stationary period (12-14 November) at 20°S, 75°W. Anomalies are shown as a time series (left) and an average diurnal anomaly (right). MBL depth indicated by bold dashed line. Blue and red vertical lines indicate local sunrise and sunset, respectively. Arrows indicate inferred vertical motion aloft.

Abstract: These are important points and are added to the abstract:
"Weather Research and Forecasting (WRF) simulations underestimate MBL height the most near the coast but improve offshore."
"Interference is clearly seen in the soundings at Iquique which are driven by a strong upsidence wave contrary to the radiation-driven cycle, leading to a diurnal cycle opposite of the other sites. Because WRF simulations have a lower MBL height, the speed of the simulated gravity wave is slower than observations and accounts for most of the discrepancy between observed and simulated phase speeds."

Introduction: Parts of the first paragraph (mostly the last half) have been rewritten to tighten it up and references should now be in order: *"…The MBL is often topped by a shallow layer of stratocumulus (Sc) cloud. Indeed, the SEP is blanketed by the largest and most persistent deck of Sc in the world (Klein and Hartmann, 1993), thus playing a major role in the regional and global climate (Ma et al., 1996; Stephens, 2005 and references therein). The Andes Cordillera rises to more than 4500 m ASL within 200 km of the coastline, which provides a sharp lateral boundary and contributes to an increased lower tropospheric stability, enhancing the Sc (Richter and Mechoso, 2006). The diurnal cycle of the clouds and free troposphere circulation is also particularly marked over the SEP (Garreaud and Muñoz, 2004; O'Dell et al., 2008; Wood et al., 2008). A high aerosol concentration is typically present in the coastal MBL (Bennartz, 2007) in sharp contrast with clean air farther offshore (Tomlinson et al., 2007) with a maximum in the Arica Bight (Painemal and Zuidema, 2009). Contributions to higher aerosol come from coastal copper smelters, power plants, and other anthropogenic activities along the Chile-Peru coast (Huneeus et al., 2006) as well as natural sources such as volcanoes (Anders et al., 1998)."*

Section 3.2 & 3.3: The 00 and 12 UTC average MBL height for Iquique, Antofagasta, and Paposo (20-25°S, extending over 550 km) are 1053, 972, and 1028 m with standard deviations of 154, 177, and 201 m. Since the greatest difference between the mean is 81 m and the standard deviation is at least 154 m, we are comfortable with claiming that this is fairly flat. Arica had fewer soundings (mainly from aircraft taking off and landing in the area). However, we do now stress that it is just for this period of 2 months during VOCALS-REx and also emphasize that this is just for the northern region. *"…and relatively flat in the north of Chile between Paposo*

and Arica (18.5-25°S) during this two month period." (page 8, line 17). Also included is a statement acknowledging the gap in data. *"Note that there is an 8° gap between the northern soundings and Santo Domingo which may contain significant structure between central Chile and the greater sampling in the northern region."* (page 8, line 26)

Section 4/Diurnal cycle: We agree that having local time would be beneficial, so both are now included in the text (LST in parenthesis) and in new Figs. 7, 8, 10, 11, and 12. For the figures, UTC is in bold text and LST is in italics. We comment that LST is UTC – 4 in Chile, UTC – 5 offshore to 82.5°W, and UTC – 6 from 82.5 – 97.5°W. UTC – 5 is used when multiple time zones are displayed. We label the blue and red vertical lines in Fig. 10b,d indicating sunrise and sunset to make them clearer to the reader. Figure 11 now includes the approximate sunrise/sunset as well.

Section 4.2: We did not emphasize the reinforcement of the cycle at 20°S, 85°W for those reasons.

Summary: We now indicate that the discrepancy is at 75°W.

Figures: There are several editorial things that we will request to make these figures more readable. The discussion paper tended to shrink the images a lot. We will work to make sure they are clearly legible in the final version.

Figure 5 is re-orientated to up-down instead of left right to take up a column to be bigger and easier to read.
Figure 6 is meant to be an entire page, which should help. Caption now states that data is from radiosondes from the Ron Brown.
Figure 7 includes local time and the scale is clearer. Caption states that red is down and blue is up.
Figure 8 is meant to be an entire page and includes local time.
Figure 9 caption identifies the horizontal lines as the average MBL depth
Figure 10 includes local time.

Figure 11 includes approx. sunrise and sunset and a local time.

Figure 12 should be a full page and now includes bigger fonts and local times.

Table 1 lists latitudes and local time by each name.

References updated.