

Response to interactive comment on “Marine boundary layer over the subtropical southeast Pacific during VOCALS-REx – Part 2: Synoptic Variability” by D. A. Rahn and R. D. Garreaud.

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

G1. The diurnal impact has a small influence compared to synoptic variation for a couple of reasons. The first reason is that near the coast in the Peruvian bight, there can be a damped diurnal MBL height variation because of the diurnal upsidence wave. At 20°S, 75°W the MBL height varies little (Part I: Fig. 10d). However, farther from the coast (20°S, 85°W) there can be a constructive enhancement to the MBL diurnal cycle. The range of this diurnal cycle can be as big as 350 m as found in the Ron Brown soundings here during VOCALS-REx (Bretherton et al. 2004 reported values closer to 200 m). This brings us to the second point. Synoptic changes show a range up to ~1000 m in both observed and modeled MBL height that lasted for 3-5 days with transitions of ~1-2 days between them (Fig. 4). Deviations from the mean of ± 500 m over 3-5 days contribute more to the overall standard deviation than the maximum diurnal variations with changes at most ± 125 m around the daily mean peaking in the morning and evening and less during other times of day. As a result, synoptic changes dominate the signal. If conditions were not as synoptically active, the diurnal variations will indeed have a larger impact. So, it is not necessary to filter out daily variations. We include in the text the following statement: “*The diurnal cycle is not filtered out since synoptic variation dominates.*”

S1. The bottom half of this paragraph been re-written to try and clear this up:

“In October, the observed and simulated MBL depths have comparable variations, but the simulated MBL is typically 200 m lower than those observed, also evident in the scatter plot shown in Fig. 4b. Because the variation is the primary interest in this study, a simple underestimate of the MBL depth does not impact the results as much as a random or incoherent variation. In contrast to October, during November (Fig. 4c) there is less correlation between observations and simulations, and the simulated MBL is consistently lower than the observed MBL. This is attributed to the lack of strong synoptic changes that are able to modify the MBL height so that the noise obscures any trend.”

S2. The two differences were not clearly identified. We thought to identify the first difference as the relatively higher variation near the coast in central Chile, and the second difference as the higher variability extending to toward Point Omega (20°S, 80°W). It is best just to say *'there are differences'*, omitting the *'two'*.

S3. We agree that it is not really fair to make a direct comparison and now shift focus to nature of the relative zonal changes in variation. The sentence is reworded thusly: *"Near the coast and south of 25°S, the variation of MBL depth increases toward the coast while the variation of surface pressure decreases toward the coast."*

S4. The Chilean coast experiences southerly wind on average. Greatest changes in MBL depth are in central Chile (30-35°S) when mid-latitude systems move through and the wind has an enhanced onshore or offshore wind component, leading to a deeper or shallower MBL due to the topography. When the MBL height anomaly is present, this implies the wind at the top of the MBL is no longer exactly southerly (zonal wind perturbations are linked to the MBL height perturbations). Possible advection of the MBL depth is no longer strictly to the north and so has a lesser impact on the MBL depth in northern Chile.

A nice example of this is a satellite image of the clouds during a coastal low event where the clear air (and thus one can infer low MBL depth) extends to the northwest while Sc remains in the Arica bight (Fig. S1a). Also, it is noteworthy that the 10-m wind rarely shows large cross-shore wind components, even when large deviations happen aloft near the MBL height. This is misleading if one uses 10-m wind to be what is advecting the MBL depth. Figure S1b shows the QuikSCAT 10-m wind with the C130 observed wind at the top of the MBL from the 11 November 2008 coastal low/coastal jet event. Note that the wind near the coastal jet has a substantial offshore component (even greater farther south in the core of the jet), so the advection of the anomalously low MBL height in central Chile impacts the region far to the northwest (reaching ~80°W) and not so much the coast to the north.

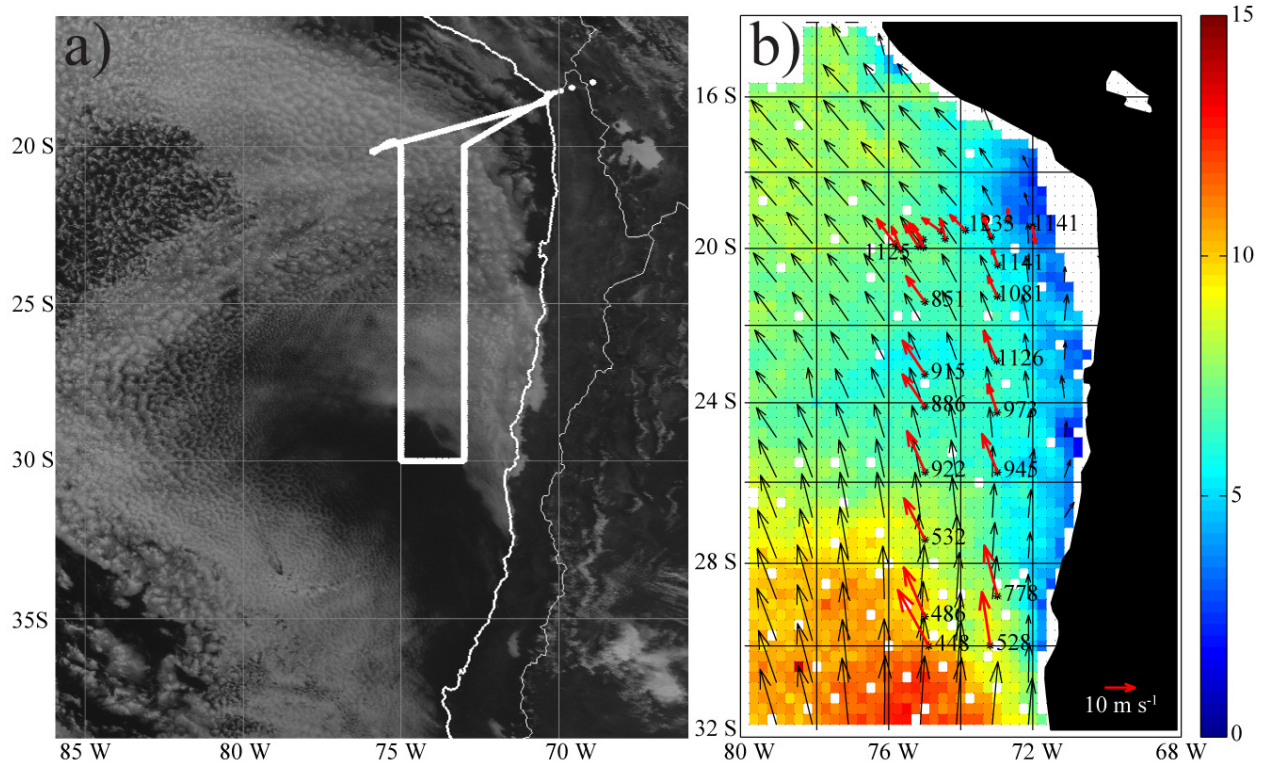


Figure S1. (a) Visible satellite image at 1500 UTC 11 November 2008 overlaid with the C130 flight track. (b) QuikSCAT inferred 10-m wind (m s^{-1} , color and black vectors), observed wind at MBL height from the C130 (m s^{-1} , red vectors), and MBL height (numbers).

S5. The deeper MBL ahead of the cold front is the result of advection, but also other processes occurring in the vicinity of the maritime front are contributing. Explaining the interaction of the front, MBL, and synoptic forcing aloft is not trivial and requires its own rigorous treatment. We believe that this is indeed an important question that ought to be addressed, but for now we must be content to hold to our central point that changes in the mid-latitudes (its details yet to be explored fully) impact the subtropics.

S6. We have modified the text here to indicate that wind is from the SSW only south of 25°S:
“...from the SSW south of 25°S, advecting...”

T1. Indeed, ‘*mass balance*’ is more appropriate than ‘*force balance*’ and the text has been changed to reflect this.

T2. The units are removed.

T3. We have added the missing ‘*depth*’.