Anonymous Referee #2

This article describes about the atmospheric diurnal cycle and synoptic variability in the north of Chile during VOCALS REx (Oct-Nov 2008), with emphasis on the stations at Paposo (25S) that were established for this campaign. The authors also put forward the hypothesis that the different timing of the diurnal cycle of temperature at sea level and at the base of the inversion is forced by the diurnal cycle in coastal subsidence driven by the enhanced afternoon upslope flow and the associated vertical thermal advection.

***REPLY**:*
We thank Reviewer´s comments and suggestions.

With respect to the latter, I have the following comments:
1) The numerical model needs validation, which can be done with the observational data presented (radiosounding, surface station, etc). For instance, a duplicate of Fig. 2 using model output would be useful.

***REPLY**:*
Done. We added a model validation of Figure 2 by constructing the same cross sections based upon model results in new Figure 7. Above the MBL, the model reproduces the main features of the observed coastal wind diurnal cycles. The corresponding text is at the beginning of section 3.3. As commented in the text, the model is less capable of producing a realistic coastal MBL.

2) The authors have not tested the null hypothesis of dominant local heating (i.e. shortwave through sensible surface heat fluxes), which at Paposo Alto could be at least comparable to the presumed effect of vertical advection. This could be done at least in two ways: a) Compare the vertical advection term with the residual (= @_=@t+w@_=@z) and show that it is indeed larger; b) Check whether the amplitude of the diurnal cycle of temperature maximizes near the inversion layer (compared with further inland).

***REPLY**:*
The coastal warming during the afternoon actually maximizes at the free troposphere at ~ 800 hPa (Fig, 10), suggesting little influence of the surface below. A quantitative assessment of the effect of vertical velocity on the coastal 800 hPa warming has been added in the before-last paragraph of section 3.3 of the revised manuscript. The sole vertical advection leads to changes larger than observed, requiring additional compensating cooling mechanisms, like, for example, horizontal advection.

3) Unless the above is satisfied, the model simulation can be not be considered to support the hypothesized mechanism proposed by the authors. Particularly, the lag in the diurnal cycle of temperature could not be considered as evidence for the hypothesized diurnal cycle in subsidence.

***REPLY**:*
Please see the above response.

Minor comments:

a) Since the general reader will probably not be familiar with the region, it would be useful if the authors could provide more background regarding the temporal representativeness of the measurements with respect to the seasonal cycle and, spatially, with respect to the South Pacific anticyclone. For instance, it is normal that the alongshore wind is so weak?

***REPLY**:*

The new Introduction has now a brief description of the low-level circulation off northern Chile, including alongshore wind variability. As per the temporal representativeness we verified that the subsidence inversion base height at Antofagasta during VOCALS-Rex falls well in the long-term climatological distribution (last paragraph section 3.2). Finally, VOCALS-REx took place under near-neutral ENSO conditions (Toniazzo et al., 2011).

b) Topographic maps for each site, indicating geographic features, would be very useful to follow the first half of Section 2.

***REPLY**:*

That part was removed.

c) The top panel in Fig. 1 would benefit from axis labels (lon/lat).

***REPLY**:*

Done.

d) It would be useful to include, in Fig. 2, the mean diurnal cycle of potential temperature.

***REPLY**:*

The figure includes temperature plots, which we consider sufficient to show the thermal structure.

e) Considering that Paposo had no nocturnal soundings, how can Fig. 2 depict a nocturnal northerly low-level flow (lower-center panel)? Is this an artifact of the contouring scheme?

***REPLY**:*

In fact, 06 UTC sounding at Paposo existed from November 11 onwards (see added Table 2), so that some nocturnal data is included in the averaging period.

f) The labels for the top row in Fig. 2 say "1998". Shouldn't this be "2008"?

***REPLY**:*

Thanks. Corrected.

g) I recommend flipping the lower two panels in Fig. 4 so that the left (right) column consistently refers to Paposo Alto (Bajo).

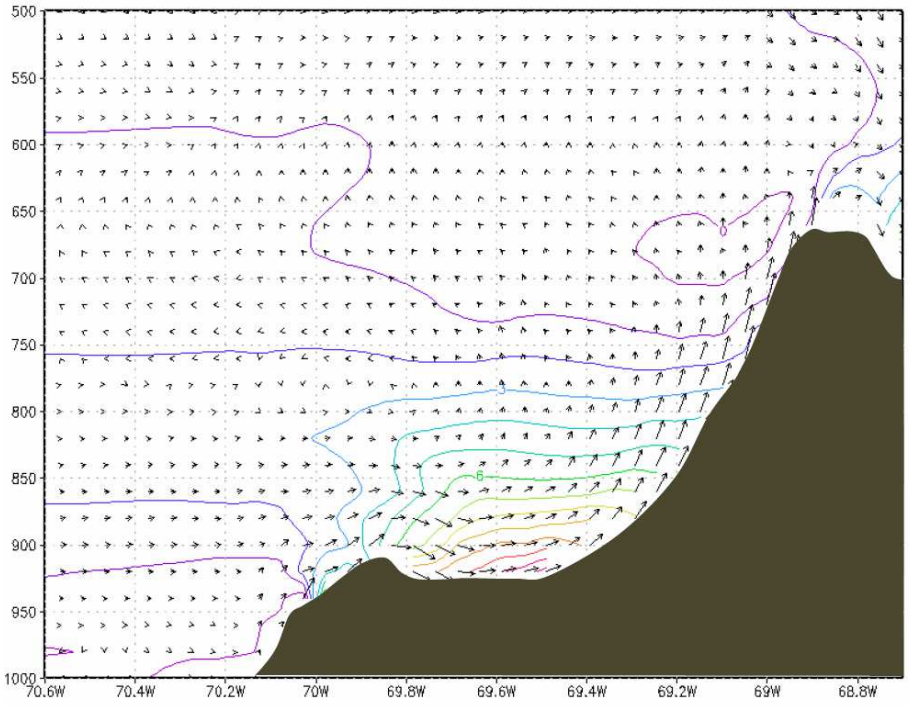
***REPLY**:*

Done. Corrected in new version of Figure 4.

h) Fig. 7 could include diurnal temperature anomalies. This could be used to address comment 2) above if an afternoon localized maximum is found near the mean position of the inversion.

***REPLY**:*

In sake of clarity we have refrained from adding more information in Fig. 7. Nevertheless, we did calculate the PM minus AM temperature difference shown below along with the (u,w) wind difference (contours shown every 1°C).



The afternoon warming over the central depression (the desert plateau at about 970 hPa) extends up to about 750 hPa. Nevertheless, the warming over the coast is modest and can't be attributed to the inland heating given the onshore flow that prevails in the coastal column.

i) Fig. 7 should have larger axis labels.

***REPLY**:*

Done.