First Na Lidar campaign between Northern/Southern hemispheres during Spring/Autumn equinox.

Luis Navarro[1] Tao-Yuan[1] Fabio Vargas [2] Gary Swenson [2] Alan Liu [3]

[1]Physics and Center for Atmospheric and Space Sciences, Utah State University
[2]Department of Electrical Engineering, University of Illinois at Urbana Champaign
[3]Physical Sciences Department, Embry-Riddle Aeronautical University

Abstract

Exploration of the different results from the Andes Lidar Observatory and from Utah State University are presented to evaluate the Temperature perturbations in the MLT region around the equinox. This last March, a campaign was run between both instruments to take data simultaneously and observe the differences. Some other days close to the equinox was taken into account to get a much better average profile in order to get perturbations out of it. The parameters compared were Density, Temperature and Zonal/Meridional wind which were also put in constrast with physical models like WACCM, MSIS and HWM14 respectively.

Introduction

The study of the MLT region is important to answer questions related to the dynamics like the moment transfer-GW drag relation or the GW-tides interactions. Moreover, there exists technical challengues to measure it as it is too high to use balloons and too low to use satellites or radars. Nevertheless, scientists have been doing great efforts to create technology to study and understand this region. Among the instruments available, we have the Sodium Lidars which take advatange of the vapor sodium left by the ablation of meteors as a tracer to measure different parameters like temperature, density and wind velocity/direction on this layer. Key examples on this technology are the efforts made by the Na Lidar Group at Utah State University and the Andes Lidar Observatory Group.

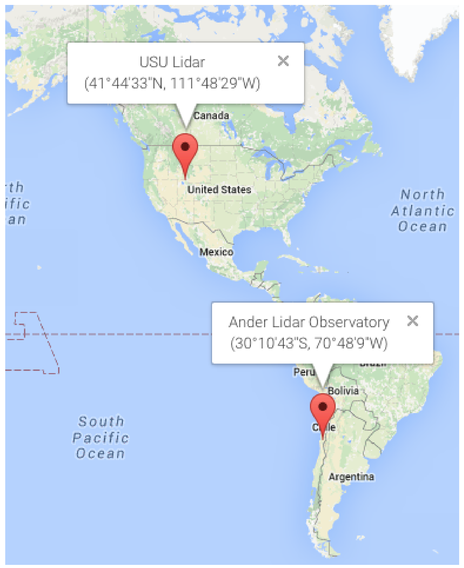


Figure: Locations of Na Lidars

Days in common

Day (UT)	N° of hours	Parameters available
08 Mar 2016	4.6	ρ, T, Zonal/Merid winds
27 Feb 2016	3.5	ρ, T, Zonal/Merid winds
26 Feb 2016	6.4	ρ, T, Zonal/Merid winds
25 Feb 2016	6.6	ρ, T, Zonal/Merid winds
18 Apr 2015	5.7	ρ, T, Zonal/Merid winds

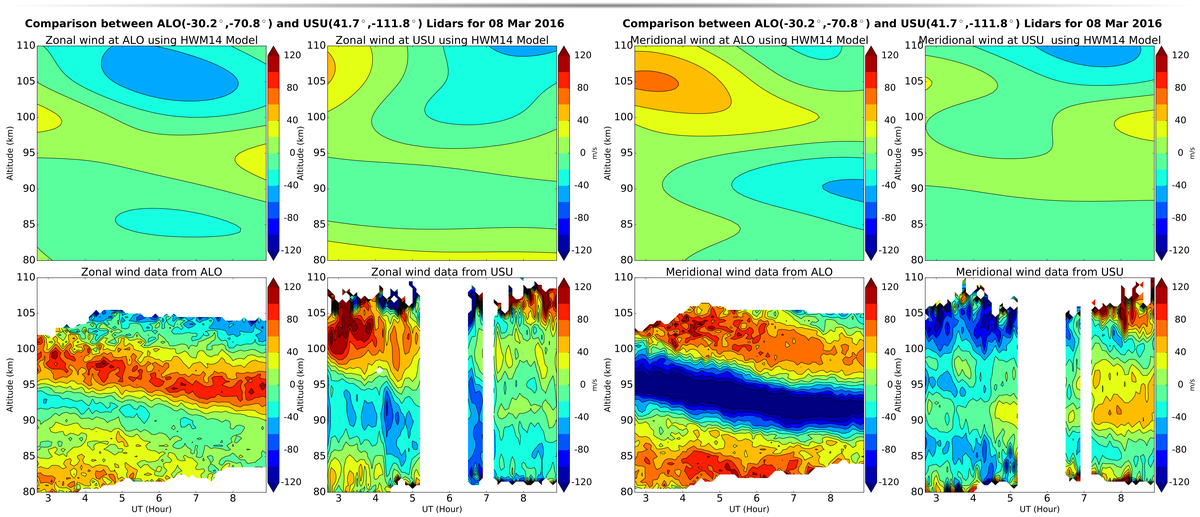
Table: Common hours of operation used for this research.

Technical differences

Parameter	ALO	USU
Power-aperture product	$0.6 \mathrm{W} m^2$	$0.2 \mathrm{W} m^2$
Counts per shot	500	100
N° Channels	4	2
Data spatial resolution	500m	500m
Data time resolution	6'	6'

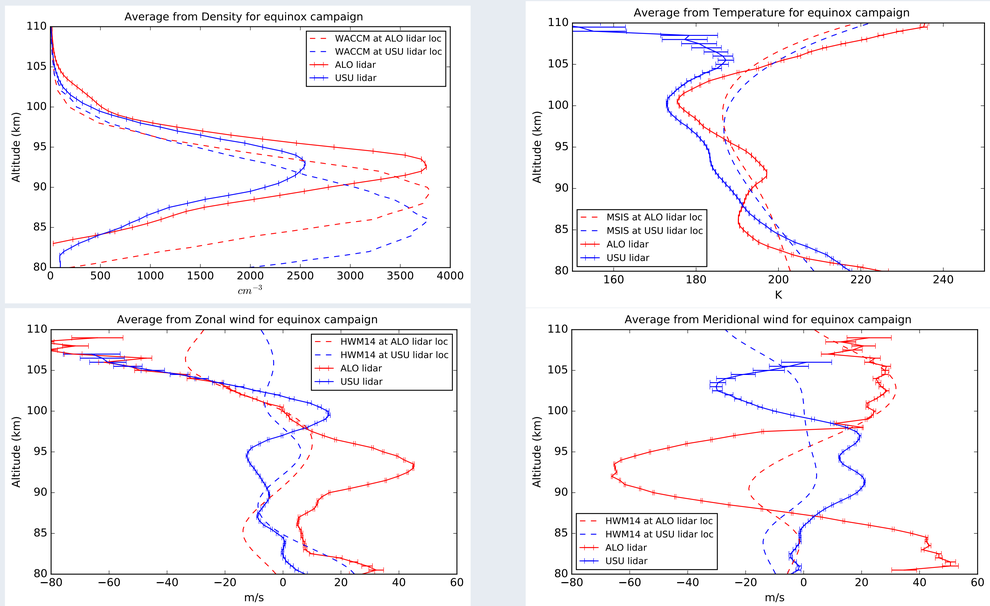
Table: Technical comparison between instruments

Daily comparison

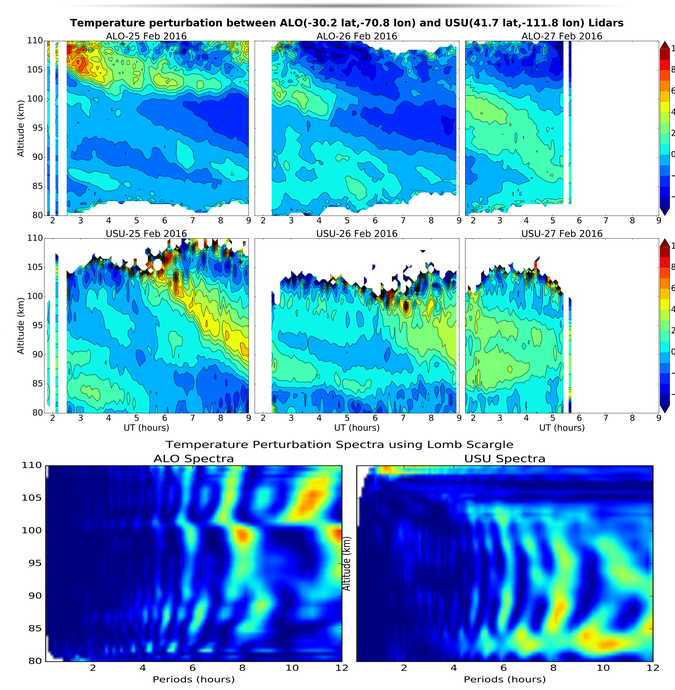


Daily comparison was performed along this campaign to compare the parameters with different models. For example the images above show the differences on winds for 08 March 2016. Later, a weighted average is performed along the common hours only to build a climatology profile for every parameter. This can be observed in the image below.

Climatology for common hours



Perturbations



The climatological profile was substracted from the daily data to obtain temperature perturbationsas it can be seen in the image above.

Conclusions

1. More simultaneous campaigns are needed to have a more concrete understanding of the thermal/wind dynamics between Northern/Southern hemispheres.
2. The tidal structure looks quite different from the wind comparison. The tide signature looks to be stronger at 30S than at 40N.
3. In general, the data shows more dynamic than the models. Nevertheless, it is in good agreement.
4. This comparison is very important for empirical models since they can improve its accuracy by having simulatenous measurements to deal with. Therefore, we'll promote more Summer/Winter equinox campaigns.

References

[Yuan et al., 2008] Yuan, T., She, C.-Y., Krueger, D. A., Sassi, F., Garcia, R., Roble, R. G., Liu, H.-L., and Schmidt, H. (2008). Climatology of mesopause region temperature, zonal wind, and meridional wind over fort collins, colorado (41n, 105w), and comparison with model simulations. *Journal of Geophysical Research: Atmospheres*, 113(D3):na–na.

Contact Information

- Web: http://www.usu.edu/nalidar/project1/
- Email: luis.navarro.dominguez@usu.edu