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Interactive comment on "Characteristics and sources of gravity waves observed in NLC over Norway" *by* T. D. Demissie et al.

Anonymous Referee #2

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The manuscript presents an analysis of the mesospheric gravity waves observed as they propagate through the NLC layer visible during the summer months from Trondheim, Norway. The authors have studied 4 NLC seasons, determining the GW characteristics (horizontal wavelength, observed phase speed, observed period, direction of propagation and amplitude) and comparing them with previous results. In order to find the sources of these waves, they have also ray-traced a large number of GW originating from 2 different altitudes (5 and 60km), corresponding to 2 different creation mechanisms. The manuscript is well-written and investigates the dynamics of the mesopause layer for a region and period (high latitude and summer months) which have not being studied much so far, mostly because of the limits in the airglow and NLC observation techniques (weather conditions, permanent daylight during a large part of

the year, aurora...). It is thus quite relevant to the aeronomy field. Nevertheless, the authors should address the following comments: - References are missing concerning high-latitudes GW observations, especially Suzuki, S., Shiokawa, K., Hosokawa, K., Nakamura, K., and Hocking, W.K., Statistical characteristics of polar cap mesospheric gravity waves observed by an all-sky airglow imager at Resolute Bay, Canada, J. Geophys. Res., 114, A01311, doi:10.1029/2008JA013652, 2009, and Suzuki, S., Lubken, F.-J., Baumgarten, G, Kaifler, N., Eixmann, R., Williams, B.P., and Nakamura, T., Vertical propagation of a mesoscale gravity wave from the lower to the upper atmosphere, J. Atmos. Solar-Terr. Phys., 97, 29–36, 2013 - Intrinsic horizontal phase speeds would be more interesting to use. There are several radars operating from Andoya Island which is in the NLC imager field of view... - The authors should mention that NLC are not visible every night, which is one of the reasons (with the weather conditions) they have so few events over 4 summer seasons. - Even if the number of GW events is limited, it would be interesting to see the evolution of the GW characteristics during the summer, especially the directionality. - On figure 9, it is surprising that the waves seem to originate from regions north of the FOV. These waves should be seen as propagating southward. At the same time, the waves observed by the NLC imager and propagating towards NNE don't seem to come from the 5 or 60km altitudes, which still leave their origin opened. - Is it possible to ray-trace backward the actual waves to see where they are coming from? As mentioned before, there are available radar wind data from northern Norway for high altitudes. Wind models can be safely used for lower altitudes as they are not as strong.

Minor comments: p1 l 10: remove second "high latitudes" p2 l 23: as their source regions, are essential (add comma) p2 l 27: add Suzuki et al. references p3 l 22: not sure why the cadence depends on the solar elevation angle p3 l 24: of an NLC image p4 l 16: not nice, could be "Figure 2 is the processed NLC picture shown in Figure 1, projected onto..." p5 2nd paragraph: not clear. Why not use 2D FFT to get the direction and WL? p6 l 3: a short explanation on what an Hovmoller diagram is would be nice p7 l 9: longitude p7 l 10: determine the waves p8 l 26: remove "of" after "phase speed"

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13, C10652–C10654, 2014

p9 l 1: replace "of waves" by "of events" p9 l 7: mesosphere instead of stratosphere p9 l 22: remove one "in" p10 l 19: airglow p10 l 21: were found p11 l 23, 28 and p12 l 2: gravity waves

Figure 2 doesn't show much the NLC structures, especially with the superimposed coastline of Norway. Maybe using an image after correction of the Rayleigh scattering would be better. I don't understand fig 5d, 6d and 7d! How can the total percentage of waves be way above 100%!!! Maybe the horizontal axis should be "event number"?

To answer one of reviewer #1 comments concerning the bias due to the wave tilt, wintertime all-sky airglow observations from Andoya exhibit the same directionality (not published yet), with 2 main directions of propagation: NNE and SW, thus, results from this paper are possibly real and not biased by the limitations due to the observation technique.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 29303, 2013.