Frequency and Influence of Elevated Mixed Layers Upwind of Lake Erie

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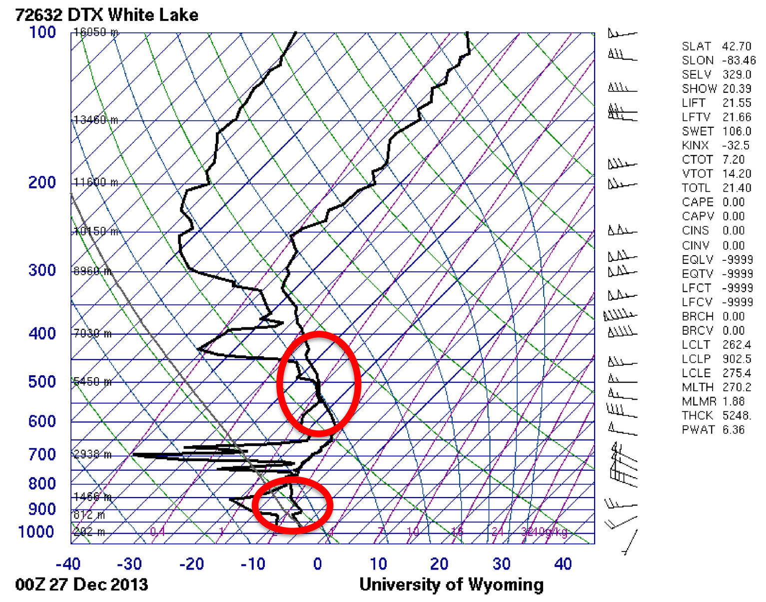
INTRODUCTION

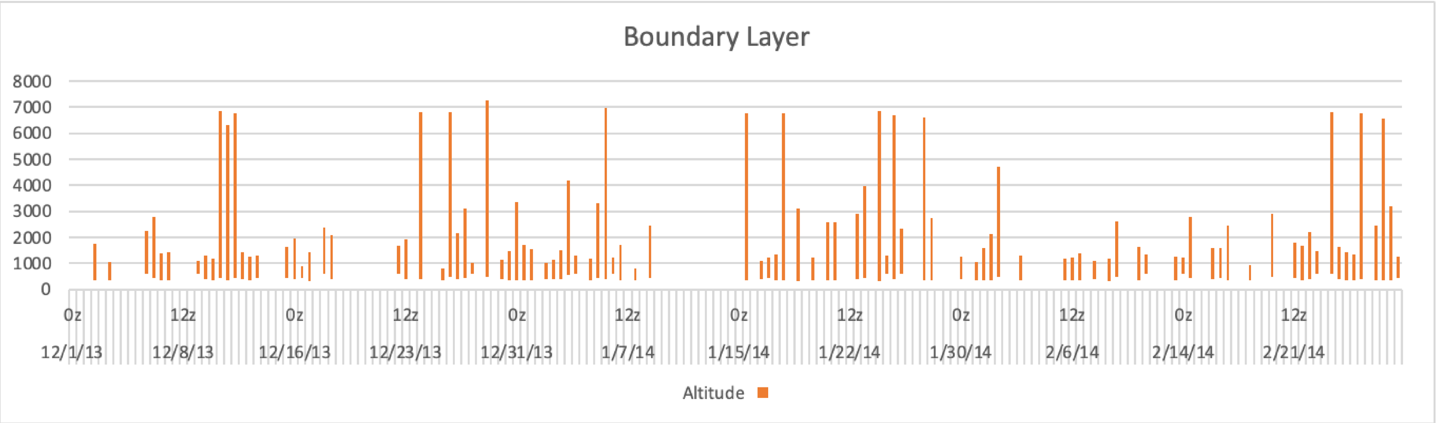
- Lake effect storms have significant impacts on over 30 million people living in the Great Lakes region every year.
- Conditions on the upwind side of a lake play a large role in the development of lake effect storms that produce snow on communities located near the downwind shore.
- We are investigating the influence of elevated mixed layers upwind of Lake Erie on the frequency and development of lake effect storms.
- The depth of the lake effect boundary layer grows from the upwind to downwind side of the lake.
- If the lake-effect boundary layer deepens to the height of the elevated mixed layer, rapid deepening of convection can occur.
- Our results show that elevated mixed layers are much more common over the upwind side of Lake Erie than previously believed.
- Deeper convection causes heavier snow near the downwind side of the lake, which has a significant impact on people's lives.

DATA AND METHODOLOGY

- To identify elevated mixed layers, we analyzed sounding data from the DTX White Lake station during the OWLeS campaign (December-February 2013-2014).
- We calculated dθe/dz, a value of less |0.02|K/m was considered a mixed layer.
- The SKEW-T below is from one of these days, it shows a coupled boundary layer with an elevated mixed layer above. You can see there are two identifiable layers where the gradient is smaller.
- The boundary layer and elevated mixed layer are circled in red.

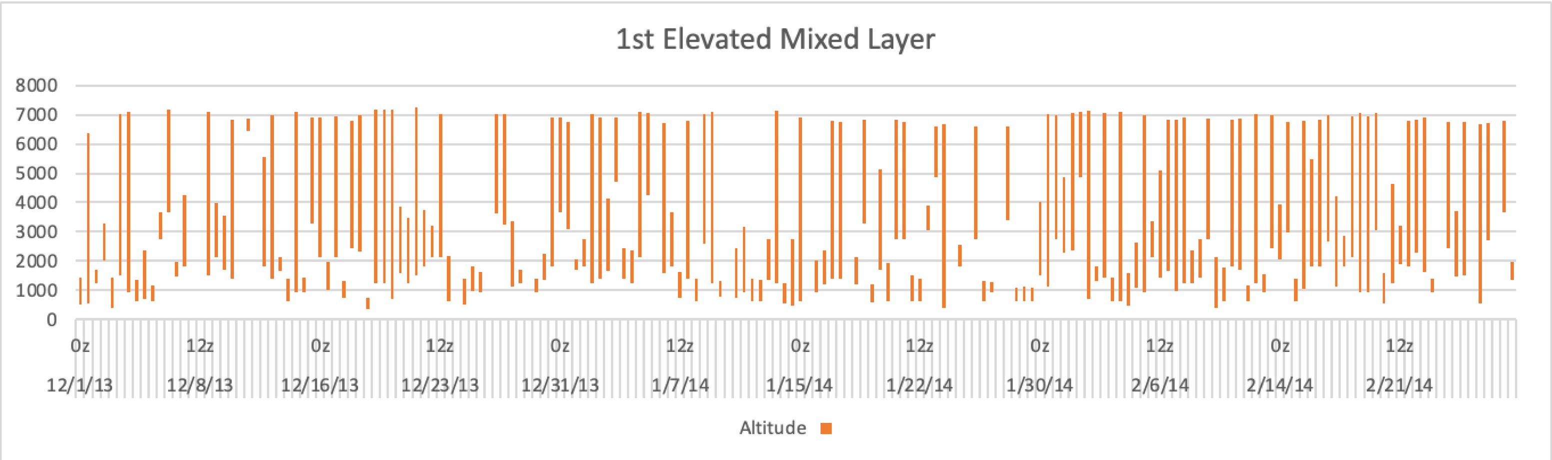


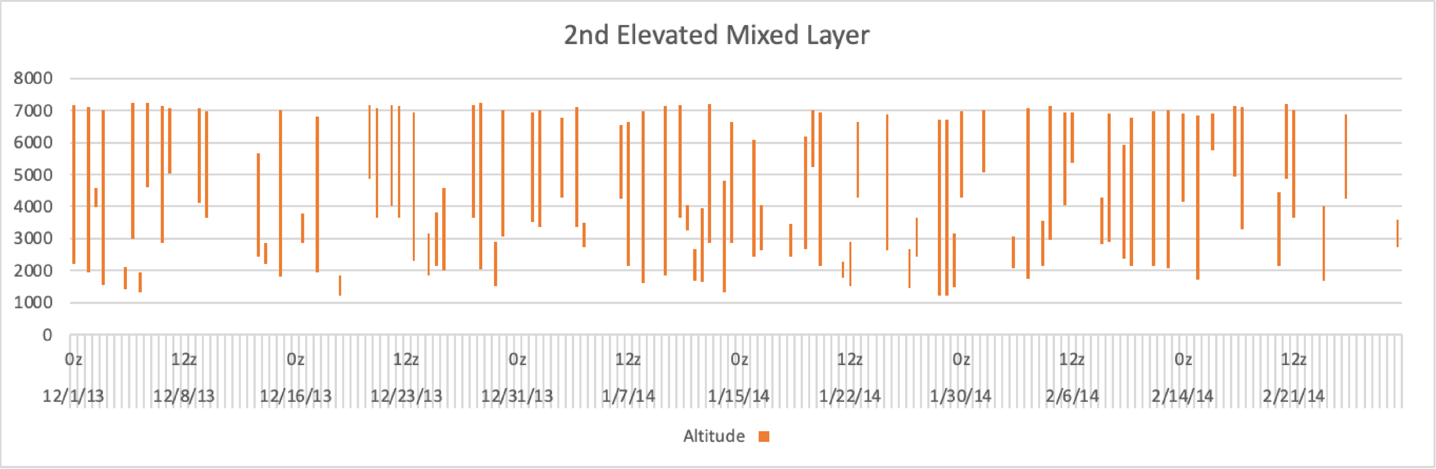
RESULTS



Boundary layer frequency and height range on the upwind side of Lake Erie.

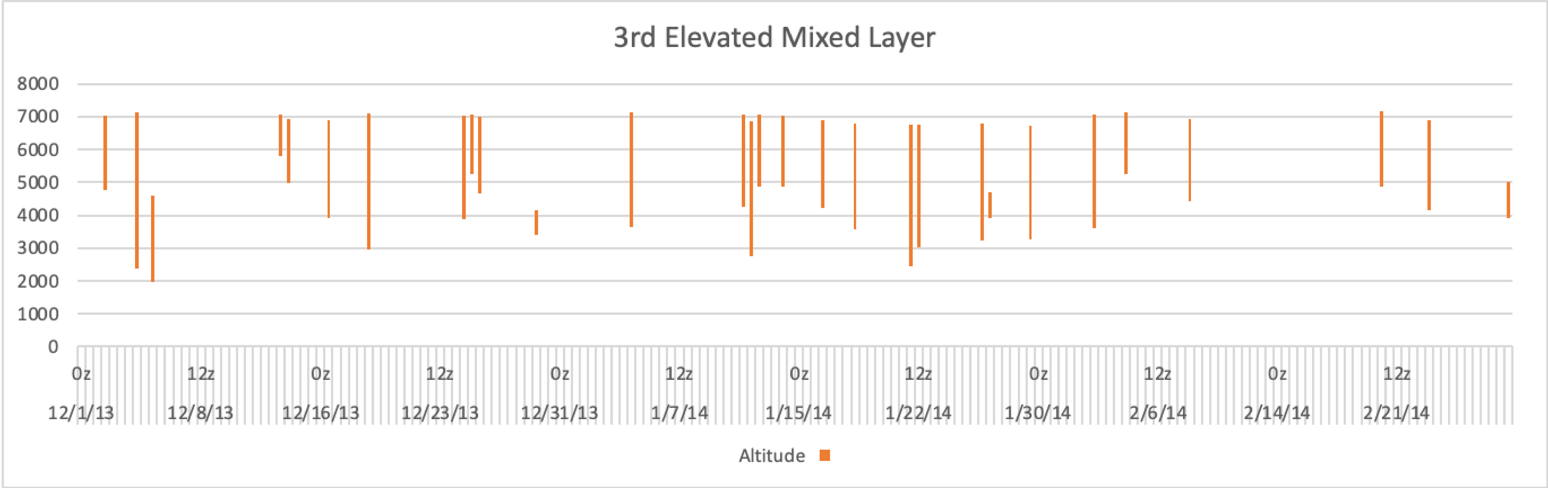
Frequency and height range of first-elevated mixed layers.

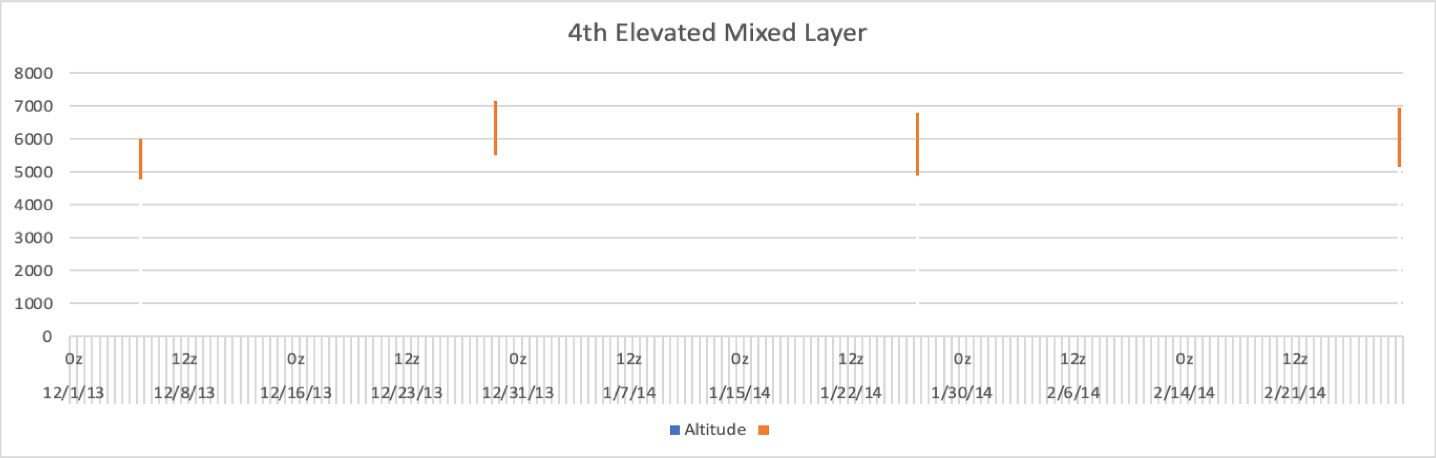




Frequency and height range of second elevated mixed layers.

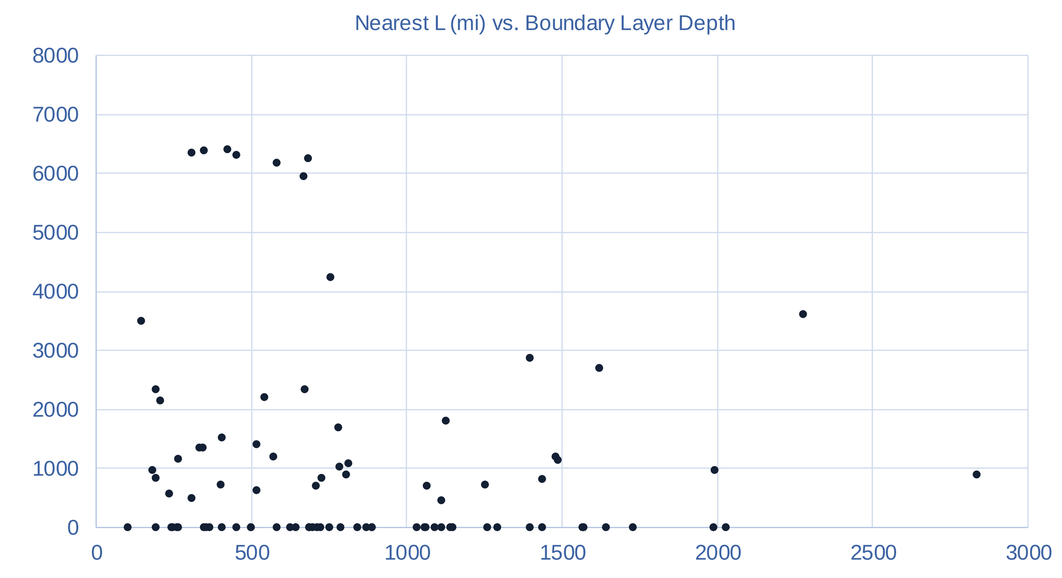
Frequency and height range of third elevated mixed layers.





Frequency and height range of fourth elevated mixed layers.

RESULTS



- Boundary layer depth vs. Distance to the nearest low-pressure center (12z).
- Boundary layer depth grows with proximity to a low pressure center.
- A deep boundary layer is usually accompanied by fewer elevated mixed layers below 400mb.

CONCLUSIONS

- Elevated mixed layers are more common upwind of Lake Erie than previously believed.
- 1-2 elevated mixed layers were observed most often, but it was common to see 3 or even 4.
- More days lack a boundary layer altogether than predicted.
- Boundary layer depth shows a tendency to grow with proximity to a low-pressure center.
- Atmospheric instability is most associated with a deep boundary layer accompanied by one or two elevated mixed layers.

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