IC5.7: Optional Exercise Answer Key

Lake Effects

Question 1. What is the temperature/dewpoint of the surface air at 21 UTC on 24 November 2005 as it crosses:

Lake Erie: T ~___15____^{o}F T_d ~____4____^{o}F

Lake Ontario: T ~___17____^{o}F T_d ~____10___^{o}F

Question 2. Based on your answers in Question 1 and the graphic above, what is a good approximation for the T/T_d of a parcel above the surface of each lake? (input answers on the next page)

Lake Erie Parcel: T ~___33____^{o}F T_d ~___15____^{o}F

Lake Ontario Parcel: T ~___35____^{o}F T_d ~___20____^{o}F

Question 3. How much Convective Available Potential Energy (CAPE) is there with the modified sounding?

CAPE off Lake Erie: _____685_____J/kg

CAPE off Lake Ontario: ___449_____J/kg

Question 4. What is the modified equilibrium layer height?

EL off Lake Erie: _____13.4_____ kft

EL off Lake Ontario: ___14.7_____ kft

Question 5. Do you expect thermal convergence along either Lake Erie or Ontario to be <u>the primary contributor</u> to the snowband? Why or why not?

No, I don't expect thermal convergence to be the primary contributor because surface winds are strong enough that a well-defined region of thermal convergence is not possible. A small portion of the total convergence is still likely due to thermal convergence, however.

Question 6. Relative to each of the 2 lakes, where is the convergence setting up? Explain why convergence is setting up in these regions.

Both lakes have parallel shorelines aligned along their major axes. Prevailing near-surface winds were blowing nearly parallel to the major axis of Lake Ontario at the analysis time, while across Lake Erie the winds were at about a 45o angle to the Lake's major axis. With time the winds veer to nearly parallel along the major axis of Lake Erie. Winds blowing parallel either of the Lake's major axis is modified by frictional drag owing to differences between the water surface and land surface. Frictional drag deflects winds to the left along the shoreline, leading to convergence along the south shores of the Lakes. On the leeward side of the lakes, frinction also causes convergece. At 21 UTC the surface wind convergence is set up along the south and leeward shorts of both Lakes, indicating a predominace of frictional convergence. The NAM appears to miss the WSW flow south of Lake Erie shown in the observations. It does a pretty good job over the Tug Hill area downwind of Lake Ontario, but the snow band over the Lake is not well captured by the model.

Question 7. Based on the wind direction at 21 UTC, which New York counties downwind of each lake do you think will see enhanced snowfall due to orographic effects?

There will be some orographic effects off of Lake Erie but the winds are at a weak angle relative to the terrain gradient. The New York Counties on the leeward side of Lake Erie that could see some slight modification from orographics are Chautaqua, Cattaraugus, and SW Erie County. Off Lake Ontratio, the winds are blowing normal to the Tug Hill Plateau at 21 UTC, thus Lewis and extreme eastern Jefferson and Oswego Counties are likely to see significant enhancement due to orographics.

Question 8. At 21 UTC, is the snow single banded or multiple banded (circle one) downwind of Lake Erie? What is the primary reason for this?

Lake Erie at 21 UTC appears to be multiple banded but there is an embedded stronger snow band. Because winds are at a 45° angle to the Lake's major axis, multiple bands would be possible.

Question 9. Same as question 8, but for Lake Ontrario.

Lake Ontario has a single snow band owing to the combined effects of frictional and thermal convergence. Winds blowing nearly parallel to the Lake's major axis lead to the frictional conergence and a single well-defined snow band.

Question 10. At 21 UTC, how well does the vertical motion field fit the radar observations for each lake?

Surprisingly well considering the model resolution. Both the NAM 12 and NAM 40 accurately depict a single region of vertical motion over each of the Lakes, although the geographic placement is a little too far south near Lake Ontario. Across Lake Erie the vertical motion fields should be weaker than those over Lake Ontario but they are not. The location of the vertical motion over Lake Erie looks okay.

Question 11. Unfortunately, NAM12 does not allow ageostropic plots with this case, but the vertical circulation should show a similar wind field perpendicular to the orientation of the band as described in the training module on slide 34. Does the NAM12 have a reasonable depiction of the vertical circulation at 21 UTC on 24 November? Explain your answer with regards to each Lake.

rculation but at least the omega fields have conergence below and divergence above. For Lake Erie, has a very strong ascent along the south shore but no closed circulation as seen in the training material. There is convergence below and divergence above the maximum upward motion as should be expected. The Lake Erie cross section is further proof that a multiple bands are responsible for the snowfall at 21 UTC. The Lake Ontario band is better resolved with a closed circulation. The closed circulatoin ascending branch is on the south side of the Lake, but the omega files appear too weak. In face, they are only 1/3 as strong as the Lake Erie vertical velocities. Divergence fields are consistent with the vertical motion fields for Lake Ontario as well.

Question 12. Given your answers to Question 11 and all previous questions, how would you modify the NAM12 QPF based on the model's depiction of the location and intensity of the snow bands? Focus on the next 6 hours (through 03 UTC 25 November 2005).

Veering winds will allow for the development of a well-defined single snow band across Lake Erie, and winds across Lake Ontario continue to be favorable for a single band through 3 UTC. The snowfall appears to weaken considerably or shut off completely right around 03 UTC for both Lakes. From 21-00 UTC on the 24th the veering winds to 270° will shift the snowbands slighly north on the leeward and south sides of both Lakes

and the model does not accurately pick up on this. The Lake Ontario band appeared too weak in the models, so I would adjust the QPF upward on the leeside of the Lake.

VERIFICATION (from BUF Website): This event named “Bengal” by the BUF office was “3 Flakes” on the Lake Flake Scale. Buffalo metro area received 6-10 inches storm total snowfall in the late afternoon hours of 25 November. Below are tables of snowfall totals off of both Lakes.

Table 1: Lake Erie Snowfall Totals

Ellicottville	24 inches
South Dayton	22 inches
Perrysburg	16 inches
Sinclairville	13 inches
Lancaster	11 inches
Warsaw	10 inches
Buffalo	7 inches
Dunkirk	5 inches

Table 2: Lake Ontario Snowfall Totals

West Leyden	24 inches
North Osceola	22 inches
Watertown	16 inches
Turin	14 inches
West Monroe	14 inches