Attachment #3

EASTERN REGION TECHNICAL ATTACHMENT
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MARINE FORECASTS
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Labor Day 1988 was a good example of how well forecasters can improve over numerical forecasts for the Great Lakes. It illustrates why this is the time of the year when we can provide the best forecasts for the lakes. On Monday morning September 5, 1988 gale force winds struck Youngstown harbor at 3am damaging a 26 foot cabin cruiser and a motor boat. A 200,000 pound barge broke loose from its mooring along with a tug and ran aground at Olcott about 7am. Waves were reported from 10 to 14 feet.

Gale warnings were posted for Lakes Erie and Ontario Sunday afternoon for Monday as low pressure was forecast to track northeast across the Province of Ontario. 36 hour Forecasts from both numerical models for Monday morning (05/12z) were close although neither was deep enough (NGM about 4 mb too shallow LFM close to 8 mb). Guidance winds for western Lake Ontario were:

MRPGLW

18 hour 05/06z	230 17
24 hour 05/12z	260 17

FD3 24 hour 05/12z

3000 feet	310 18
6000 feet	290 20
9000 feet	290 22

Key ingredients included:

1. An intensifying low.
2. Low forecast at less than 1000 mb tracking northeast across the Province of Ontario.
3. A strong cold front trailed southwest of the low.
4. NGM forecast 4 mb deeper than LFM.
5. Winds fairly well aligned
6. Strong cold air advection at 850 mb.

The decision to issue gale warnings at 25 to 35 knots is especially noteworthy. In view of the lake guidance winds (from the LFM) of less than 20 knots and FD winds 20 to 25 knots, this was an excellent forecast.

Remember, Fall is the season for some of the worst lake storms. Storms are the <u>extremes that numerical and statistical models have trouble catching</u>. Below is a review of my memo of last year detailing ways we can improve our lake forecasts this time of year.

1. Warm lakes mean winds will <u>almost always mix down</u> to the surface in cold air cases. Check BUF and upstream RAOBS.

2. Use the <u>WINDS</u> printout. It was specifically made with the lakes in mind. The FD winds from this product are probably the best guidance (especially when winds are aligned at all levels) in cold air cases.

3. MRPGLW guidance winds are statistical and will never be high enough in cold air, high wind cases. That's when we can show the most improvement. For example if MRPGLW has a 25 knot wind forecast for the lake and the 3000 and 6000 foot winds are 27040 and 28045, then 25 to 35 knots is probably a minimum forecast. If MRPGLW forecasts 20 knots, and a cold front is crossing the area, then 10 to 20 knots is unrealistically undercutting the guidance!

4. Meso analyses are one of our best means of beating the guidance in high wind cases. Models can be 12 hours behind rapid deepening systems (especially the LFM Remember statistical wind forecasts are from the LFM and will always be too weak when lows develop faster than forecast. Dynamic deepeners like this will almost always cause gale force winds if the right track is taken.

5. The Canadians have a thumb rule that any low crossing the Province of Ontario at 1000 mb or less is a good candidate for gale force winds. In dynamic, winds aligned cases, this works pretty well.

6. Watch pressure changes upstream. If a low is moving east, southeast or northeast into Ontario, 3 hourly rises of 5 mb behind the front are a good indicator of potential gale winds.

7. Frontal movement is also an indicator of high winds and winds will usually mix down along the fast moving front. In weaker or marginal cases, gale winds may only last 3 to 6 hours close to the front.

8. Use realtime reports--especially the C-MAN buoys. Use upstream data too. For example if winds at London or Hamilton gust to 30 knots, sustained winds of 30 knots are probably a ball park value on the lake.

9. Boundary layer winds are a good guide, but with the very unstable cold air cases and rapid deepeners, boundary winds may tend to be a bit low over the open water. Since the NGM usually is better with strength of systems, the NGM winds should be better. A good example might be, if the boundary layer is 30 knots and the 3000 foot wind is 40 knots; then 30 to 40 knots is probably a reasonable cold unstable case forecast.

10. Gradients are deceptive in cold unstable cases where upper level winds are more important. About 8 mb between ATY and YHM is probably close to gale, but with strong winds aloft surface gradients may be weaker.

We know that with a given gradient, winds will tend to be stronger in anticyclonic curvature cases than in cyclonic cases. Our highest winds none the less, often occur with cyclonic curvature from a deep low and with frontal passage when upper winds mix down to the surface. That is why the 3 thousand and 6 thousand foot winds are so important.

While there undoubtedly will be cases when statistical guidance will be too high and can be adjusted, such cases seldom involve gale force winds. Again, this is the season when our forecasts can be the best when statistical information fails with cold, dynamic, high wind systems. Use the WINDS printout, and seldom if ever undercut guidance

SCIENTIFIC SERVICES DIVISION, ERH
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