

**The Inland Penetration of the
Lake Breeze along the
Western Shore of
Lake Michigan**

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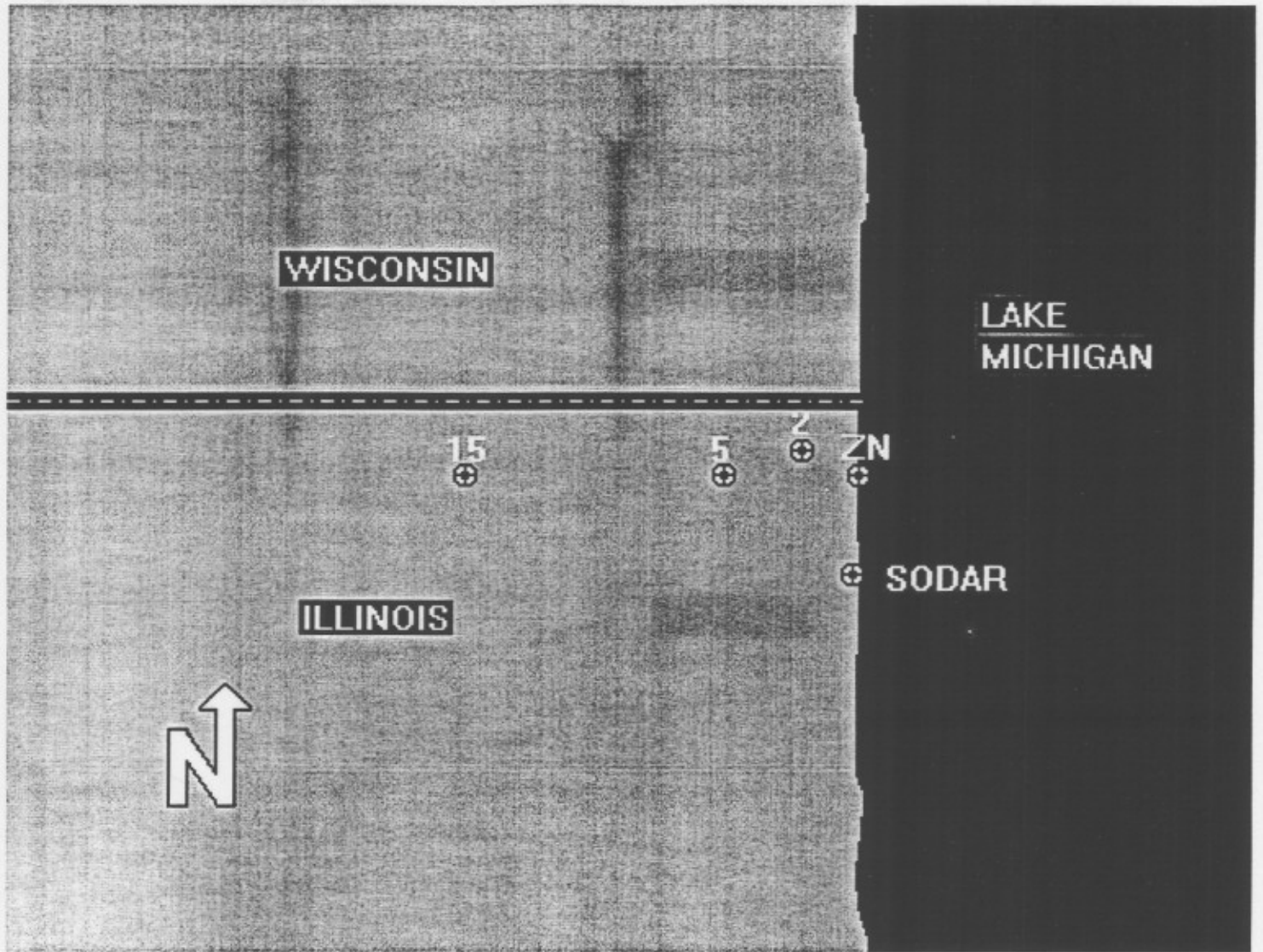
Sea Breeze and Local Winds - Simpson 1994

- ...its subsequent advance inland has been much less fully studied.
- ...rate of advance sensitive to the strength of the opposing wind.
- ...its penetration inland is not straightforward.
- Section 4.3 Prediction of Inland Penetration - 2 figures, 1 page of text
- main point of agreement of many studies: wind strength of the day is a very important factor.
- other factors are not so clear, but are all related in some way to the nature and scale of convection expected.
- others note the lack of inland penetration research.
- lots of sea/lake breeze data limited on inland penetration.

DATA AVAILABLE AT IDNS

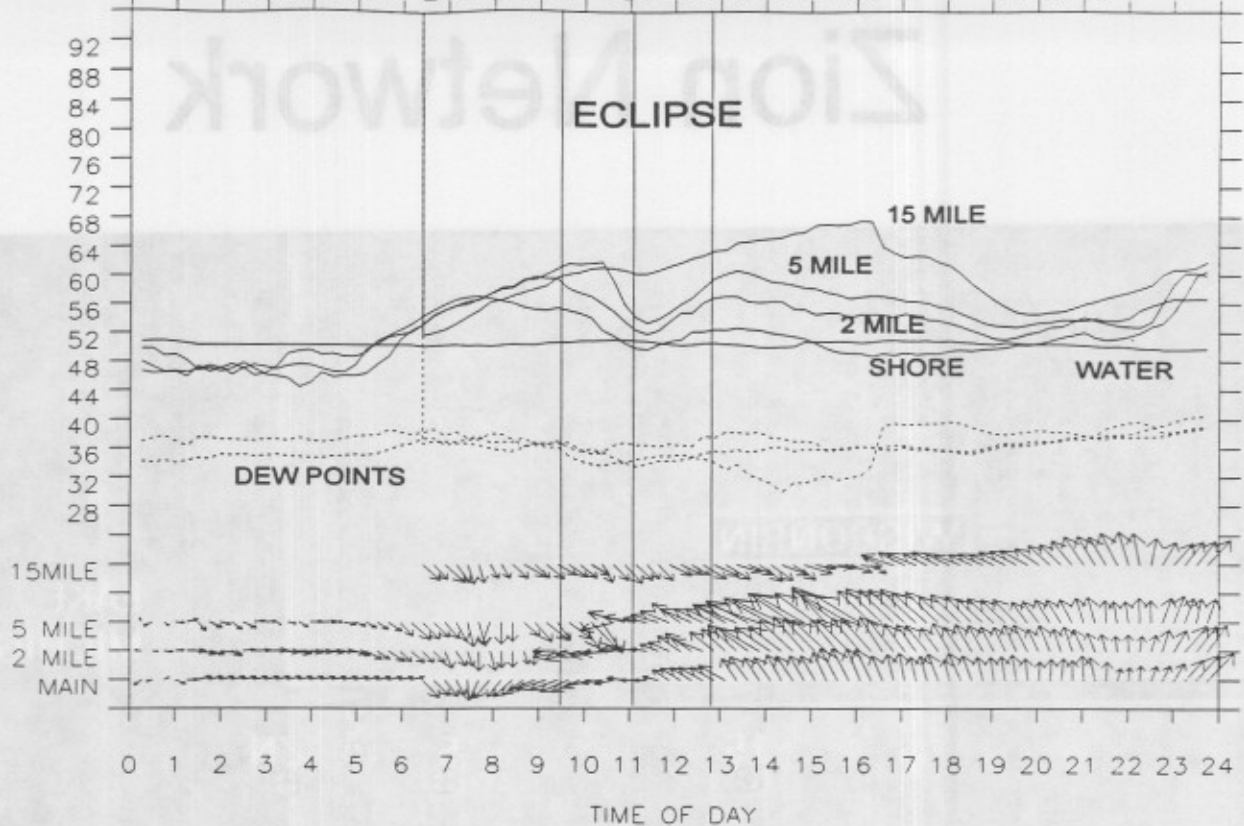
- Over 200 Doppler radar loops from MKX and LOT (1994-98).
- Doppler SODAR along the shoreline.
- ComEd - 76 meter tower at the shoreline.
- ComEd - 10 meter towers at 2, 5, and 15 miles inland.
- Towers at other nuclear power plants.

Zion Network

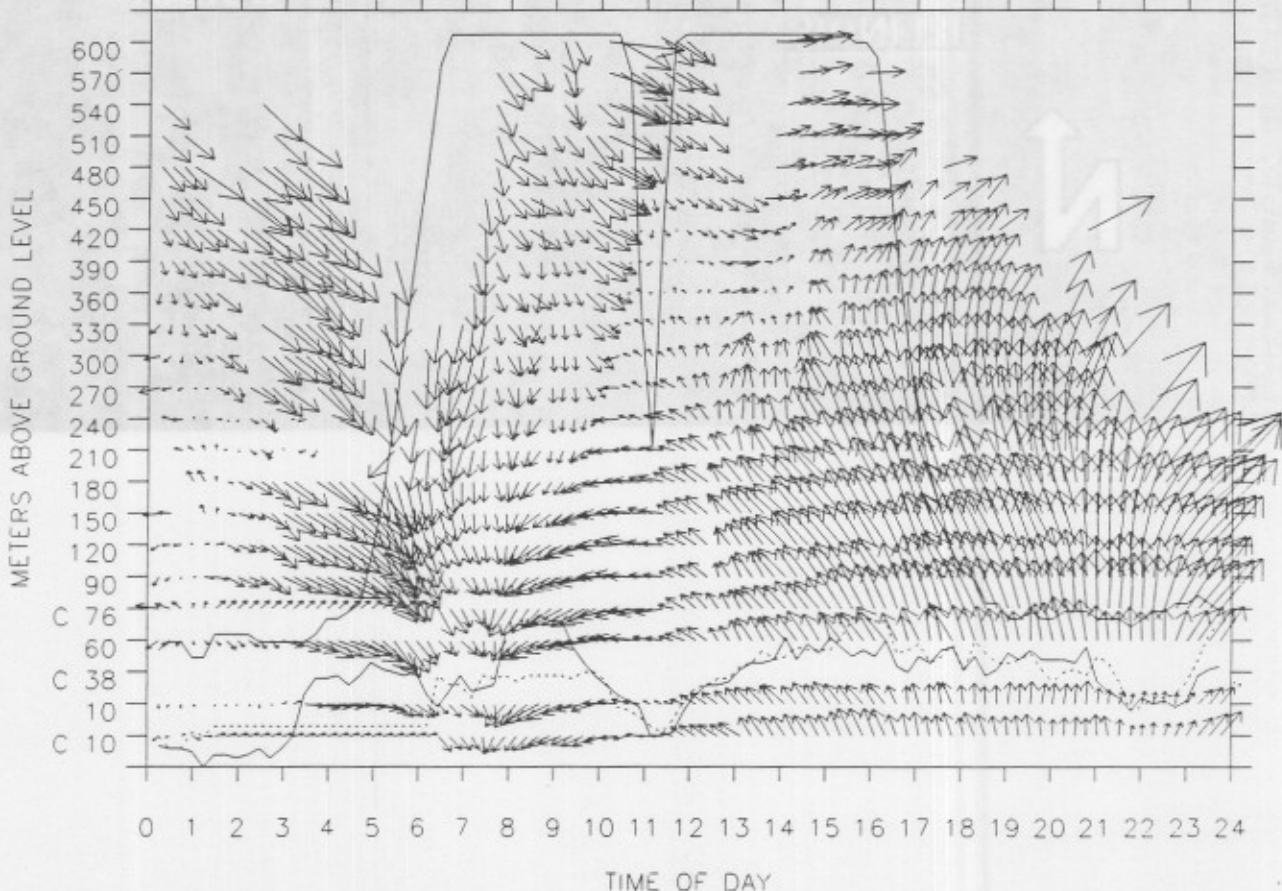


ZION SUPPLEMENTAL TOWER DATA FOR 940510

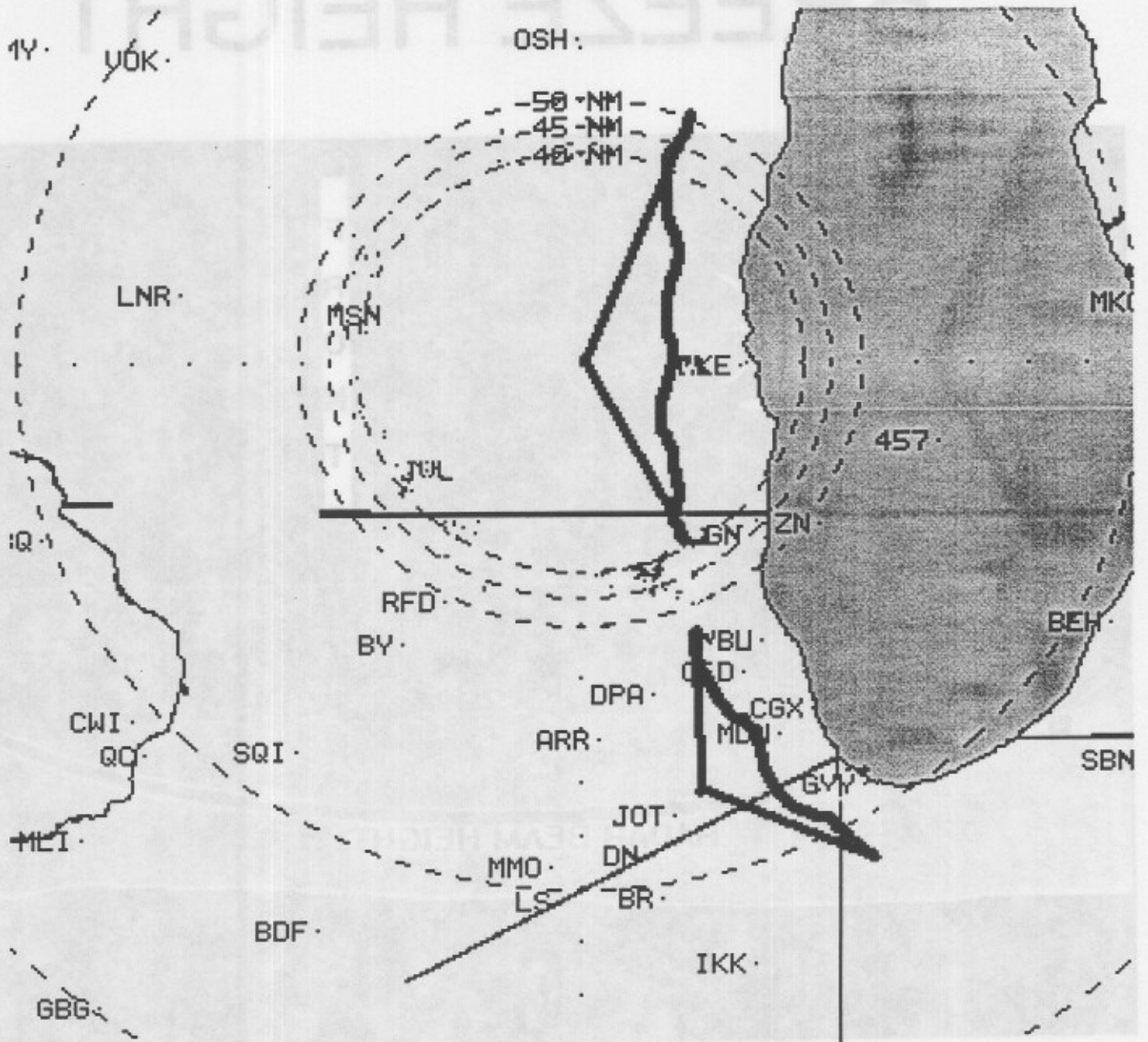
10 METER WINDS --- AIR AND LAKE TEMPERATURE IN DEG F



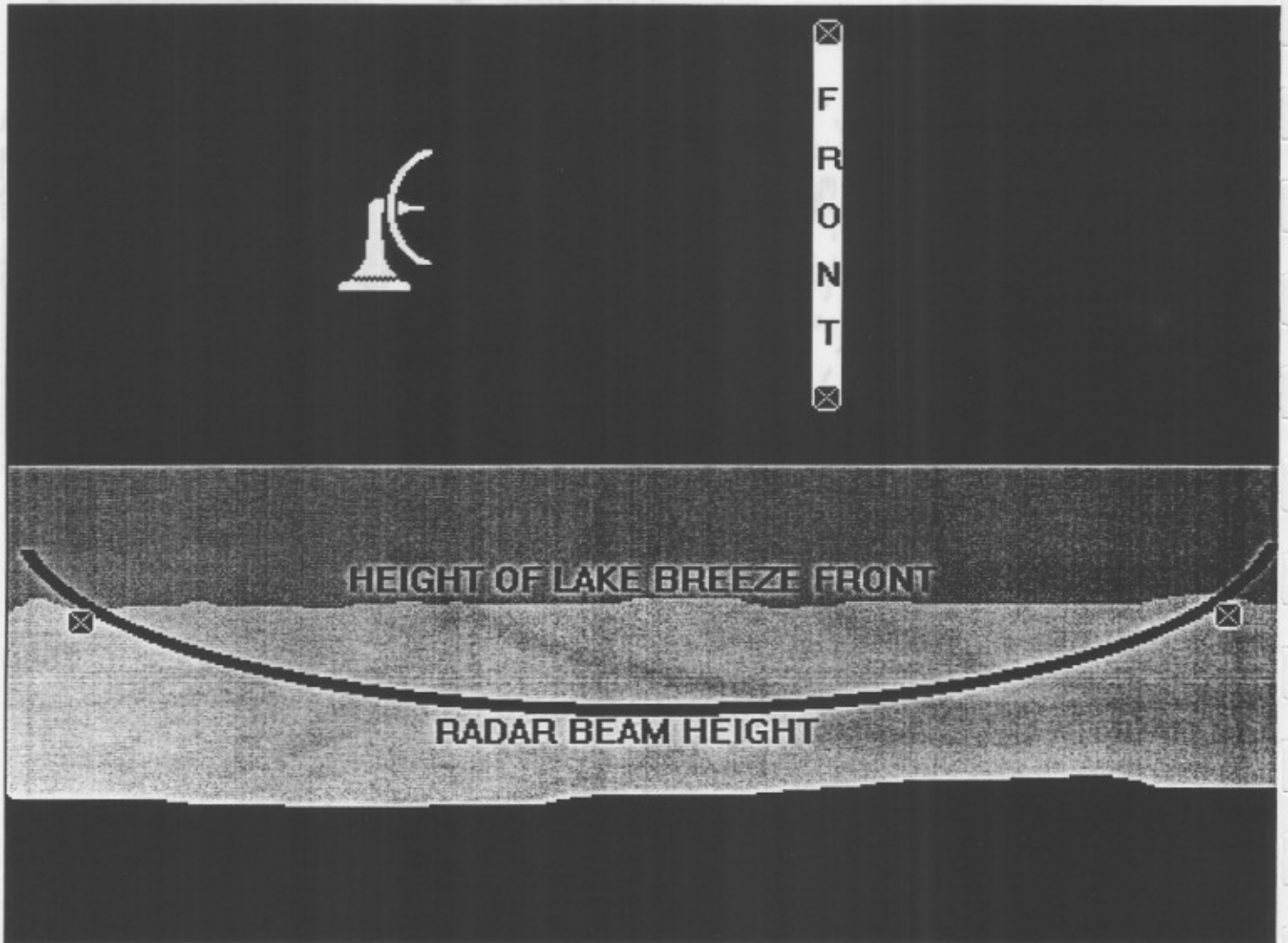
VALID ZION SODAR WINDS FOR 940510



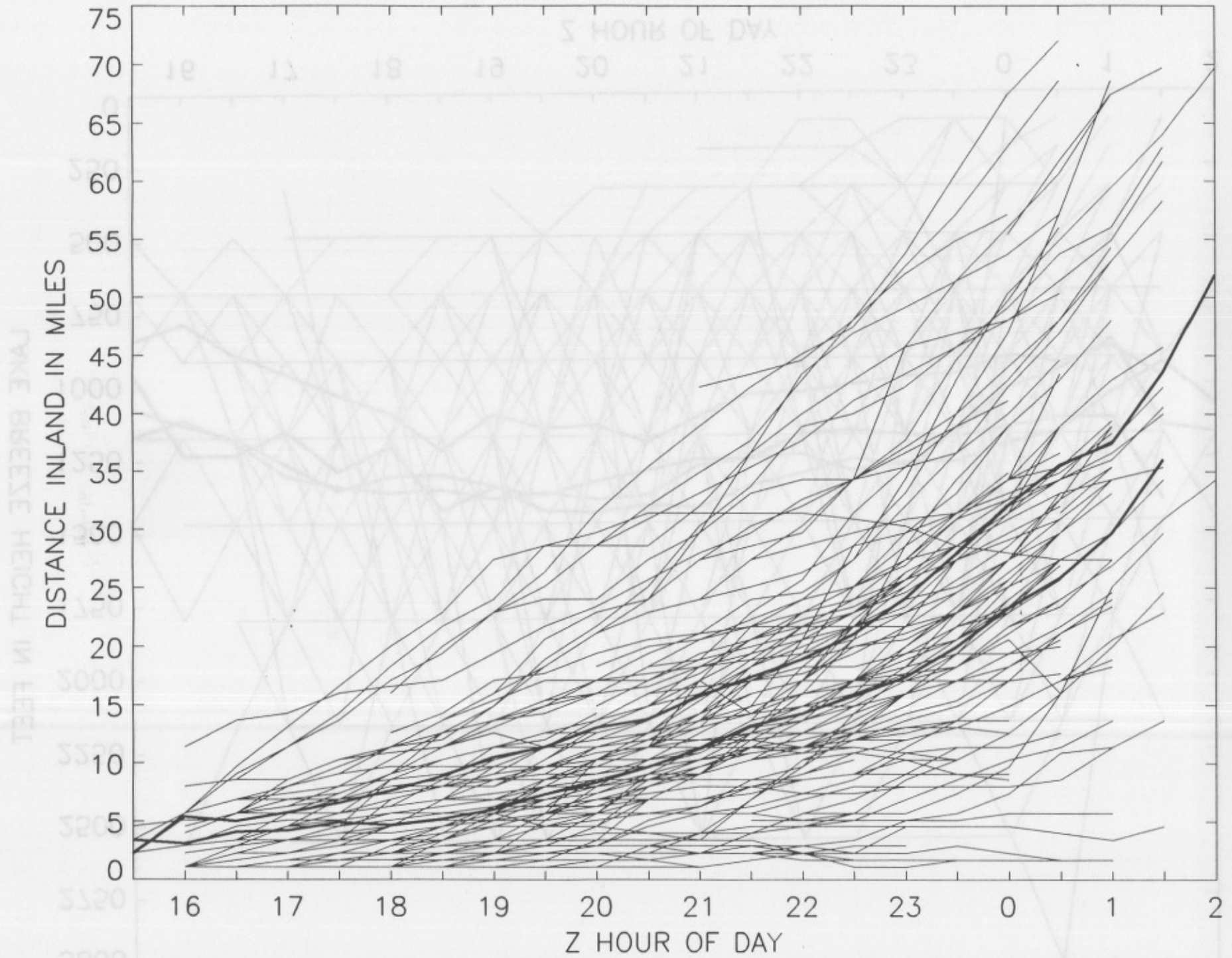
What was measured?



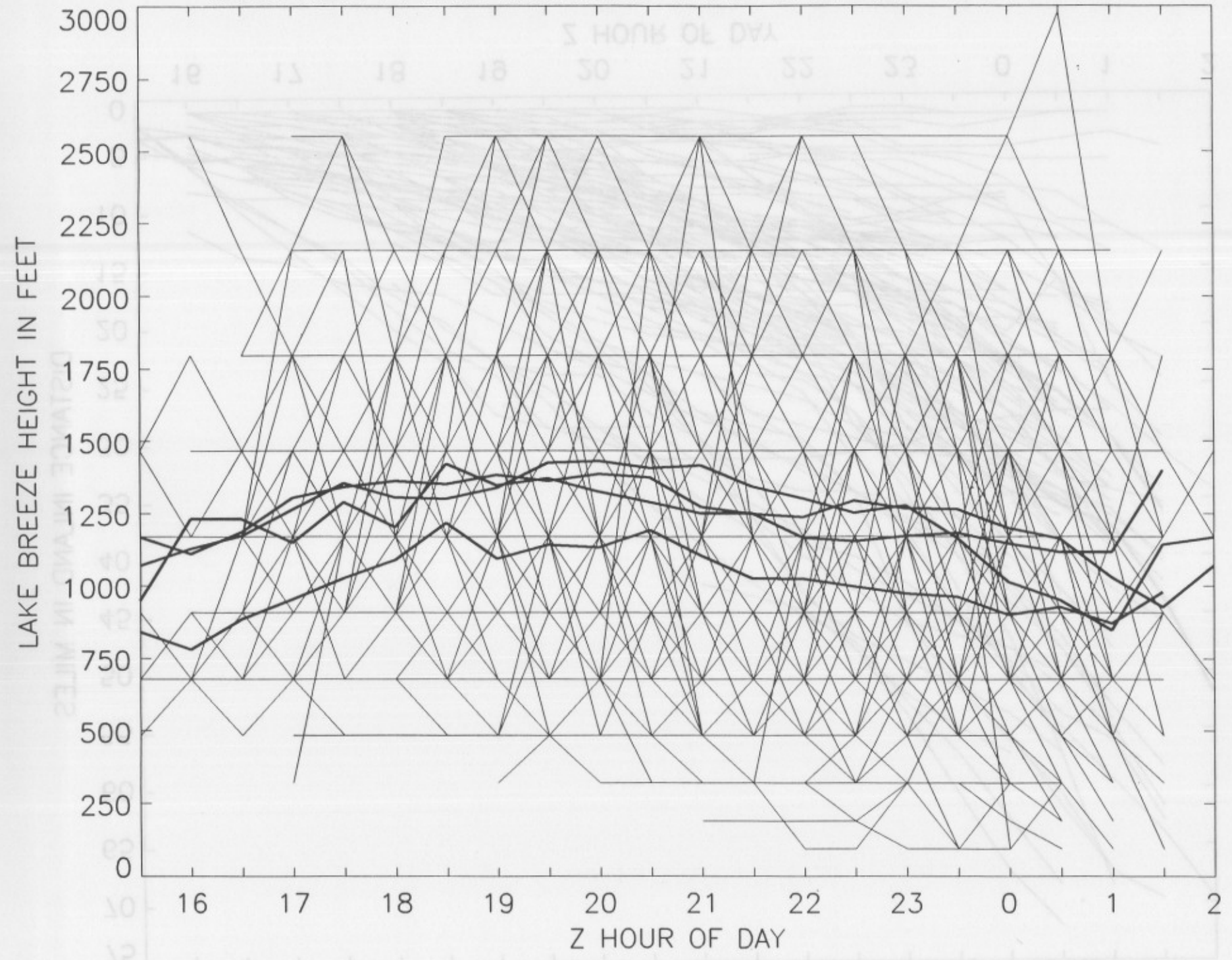
OBTAINING THE LAKE BREEZE HEIGHT



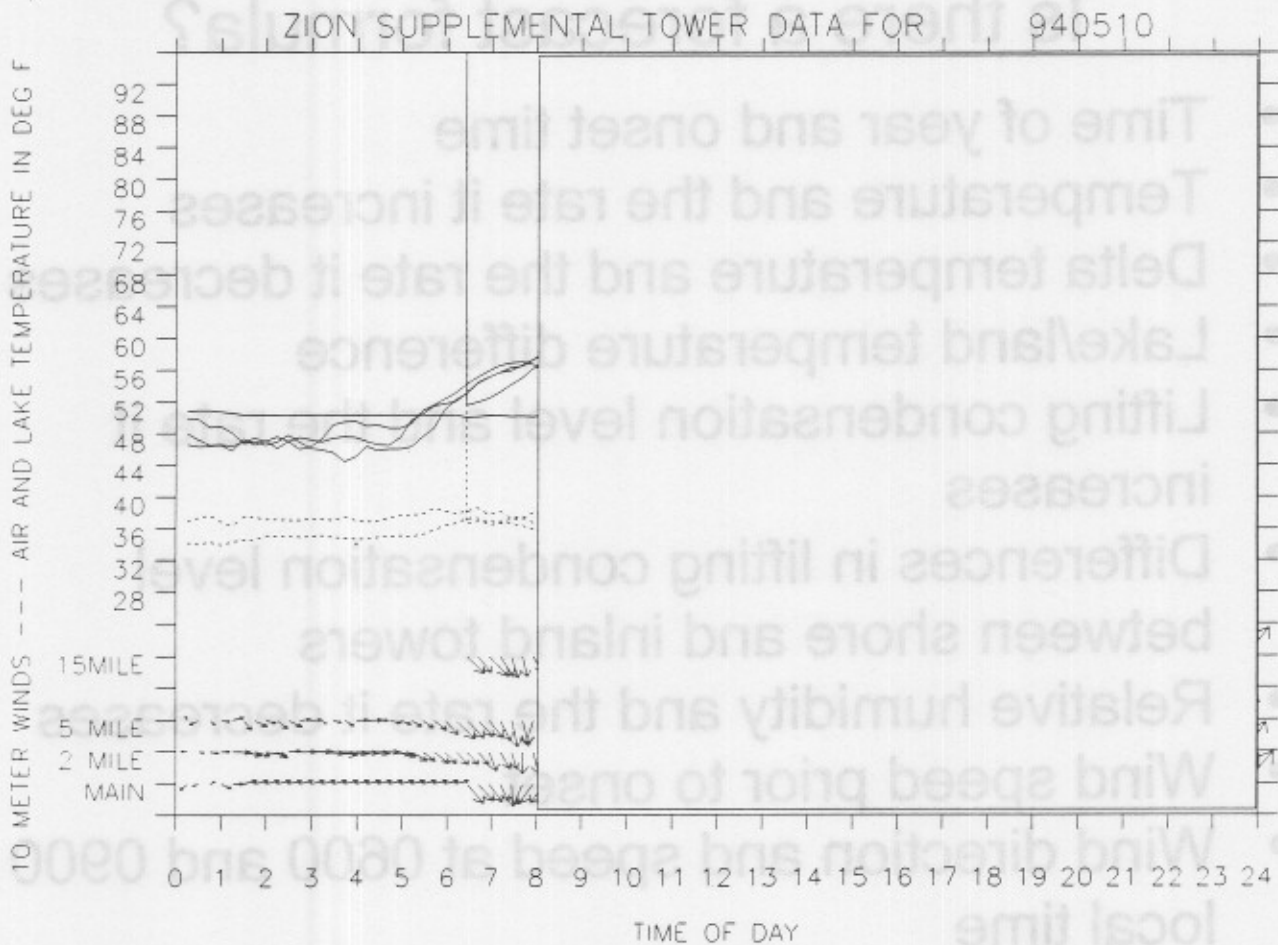
SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



Can penetration distance prior to onset be forecasted with this much data?



Includes all local tower data,
current surface map, and a satellite photo

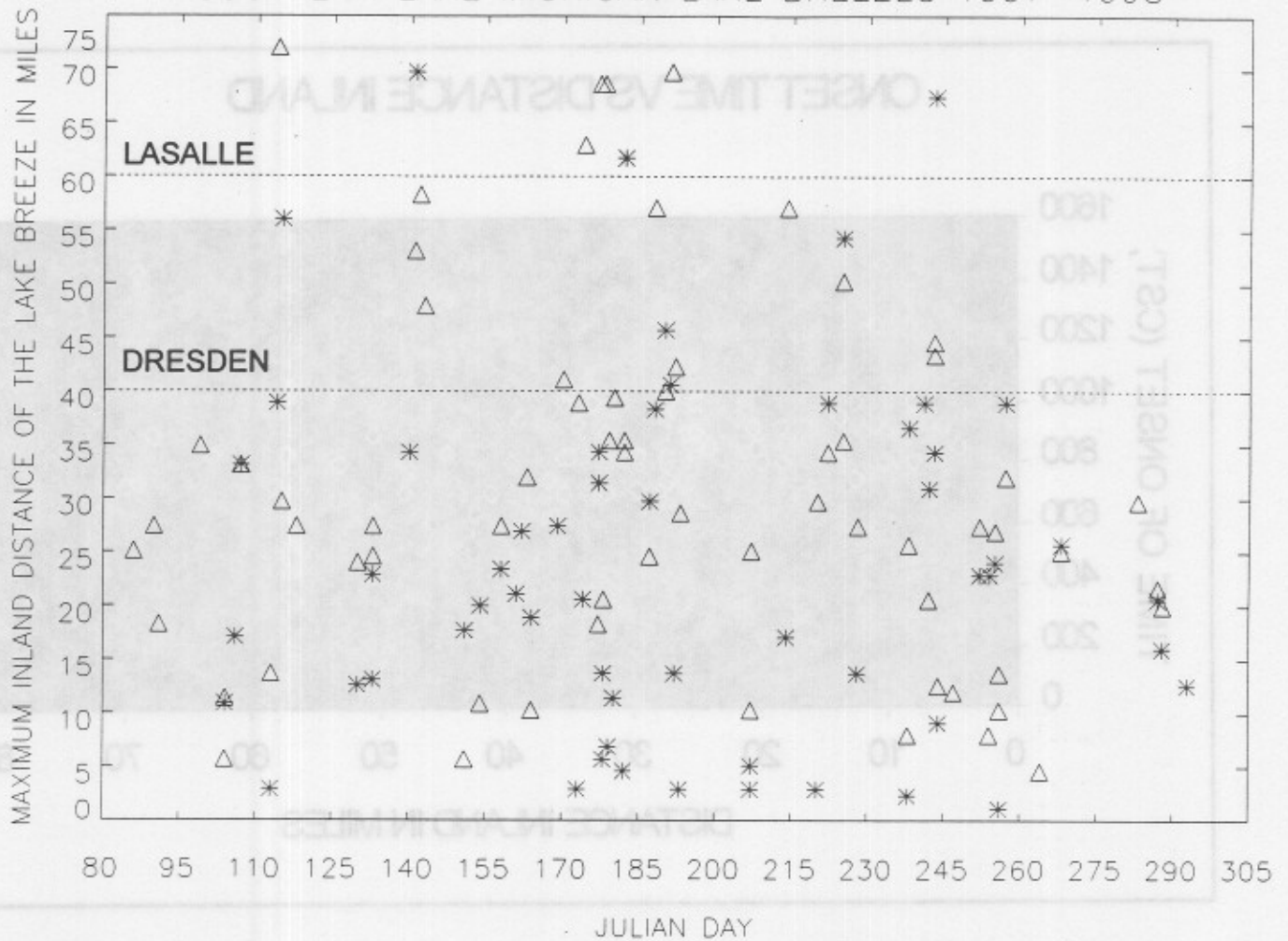
Parameter relationships we reviewed for forecasting inland penetration distance

Is there a forecast formula?

- Time of year and onset time
- Temperature and the rate it increases
- Delta temperature and the rate it decreases
- Lake/land temperature difference
- Lifting condensation level and the rate it increases
- Differences in lifting condensation level between shore and inland towers
- Relative humidity and the rate it decreases
- Wind speed prior to onset
- Wind direction and speed at 0600 and 0900 local time
- Solar radiation
- Overall synoptic situation

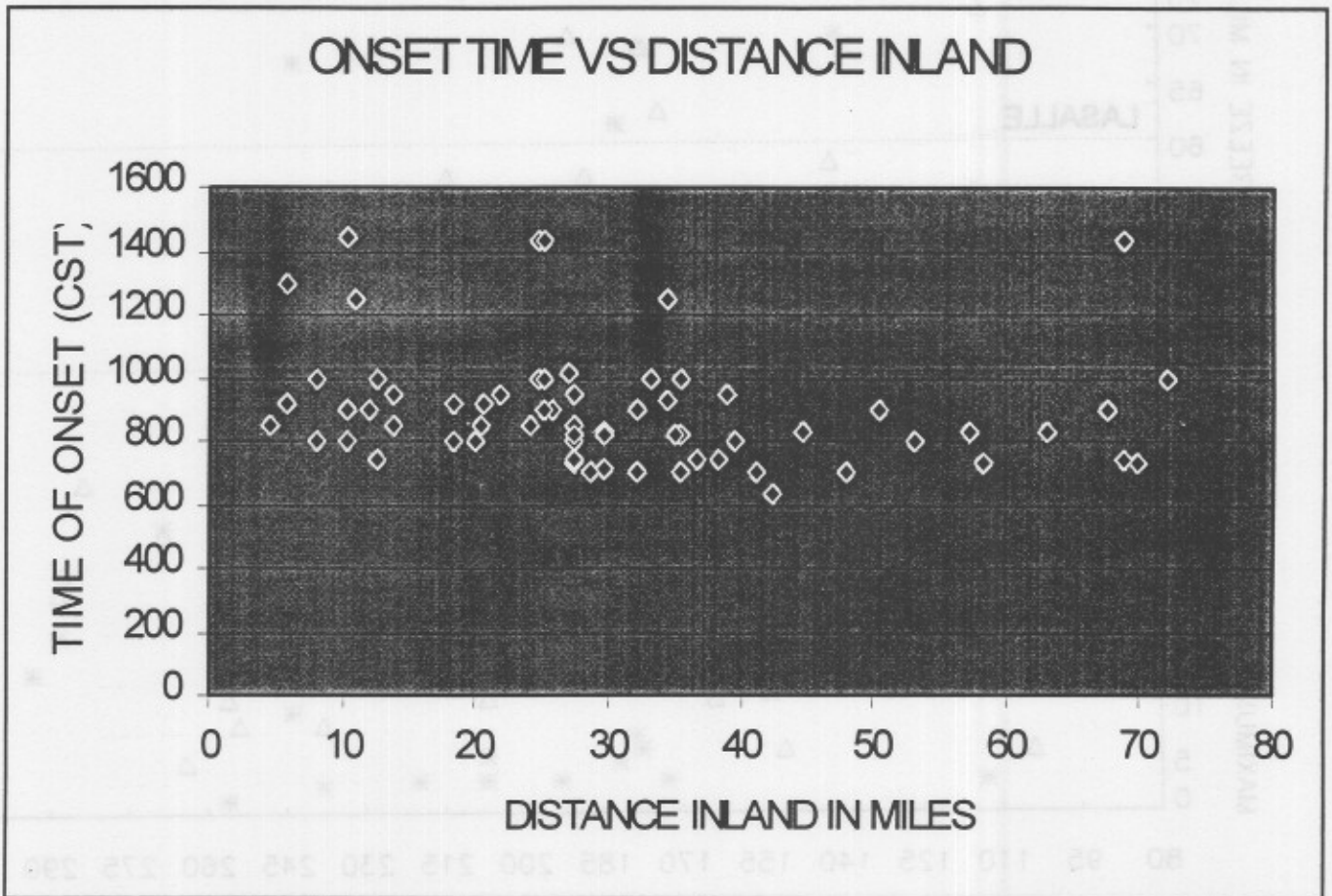
Time of year

SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998

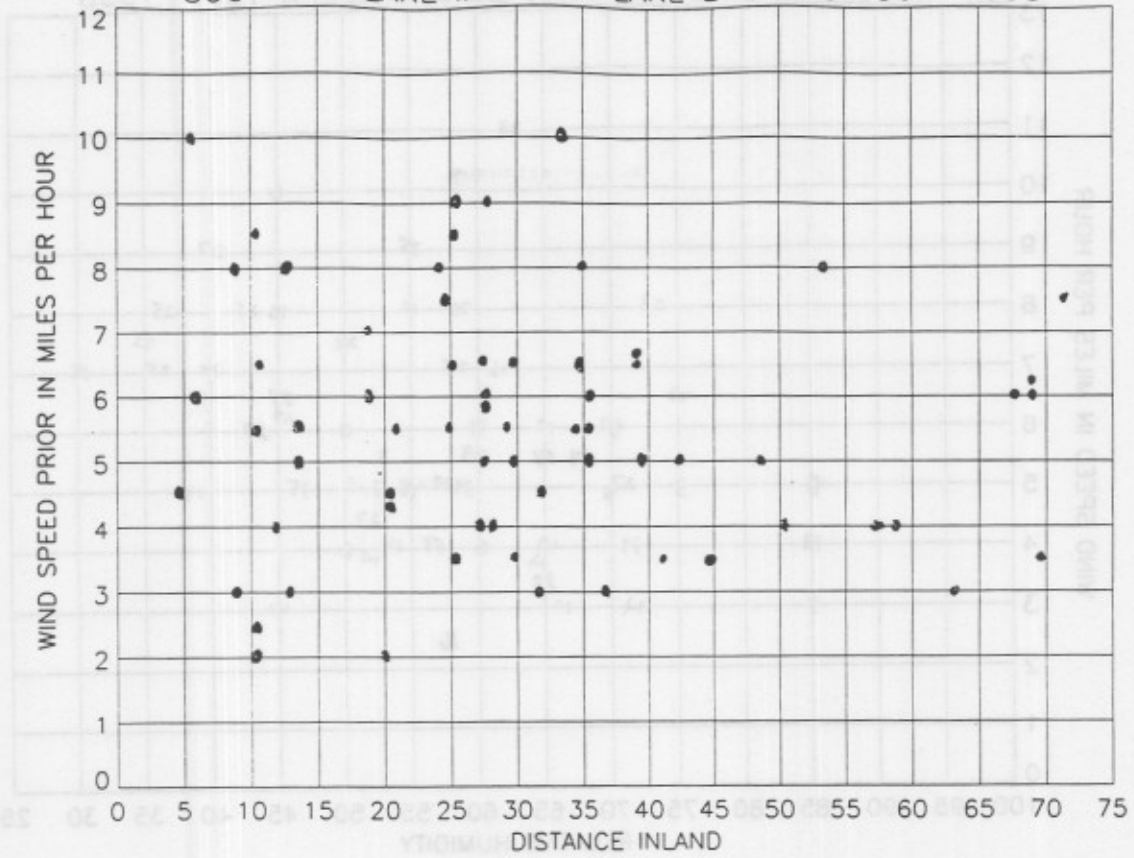


MKX(TRIANGLE) LOT(STAR)

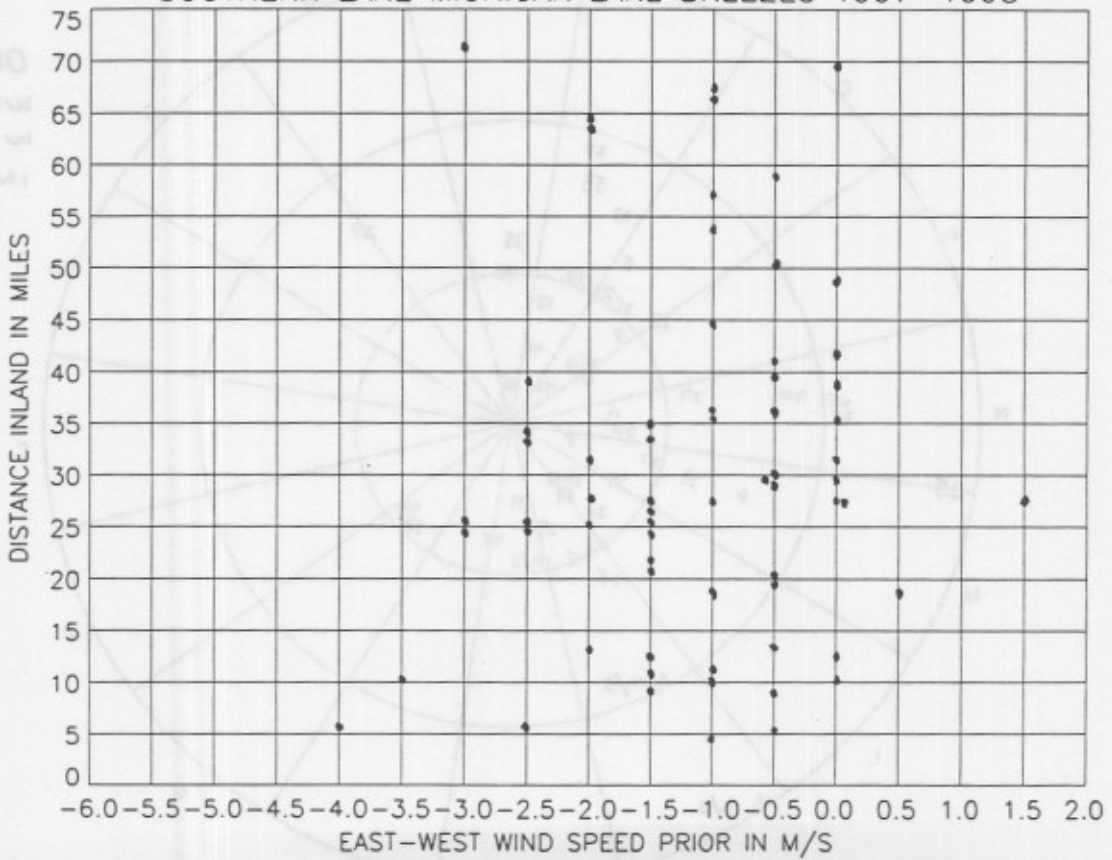
Onset Time



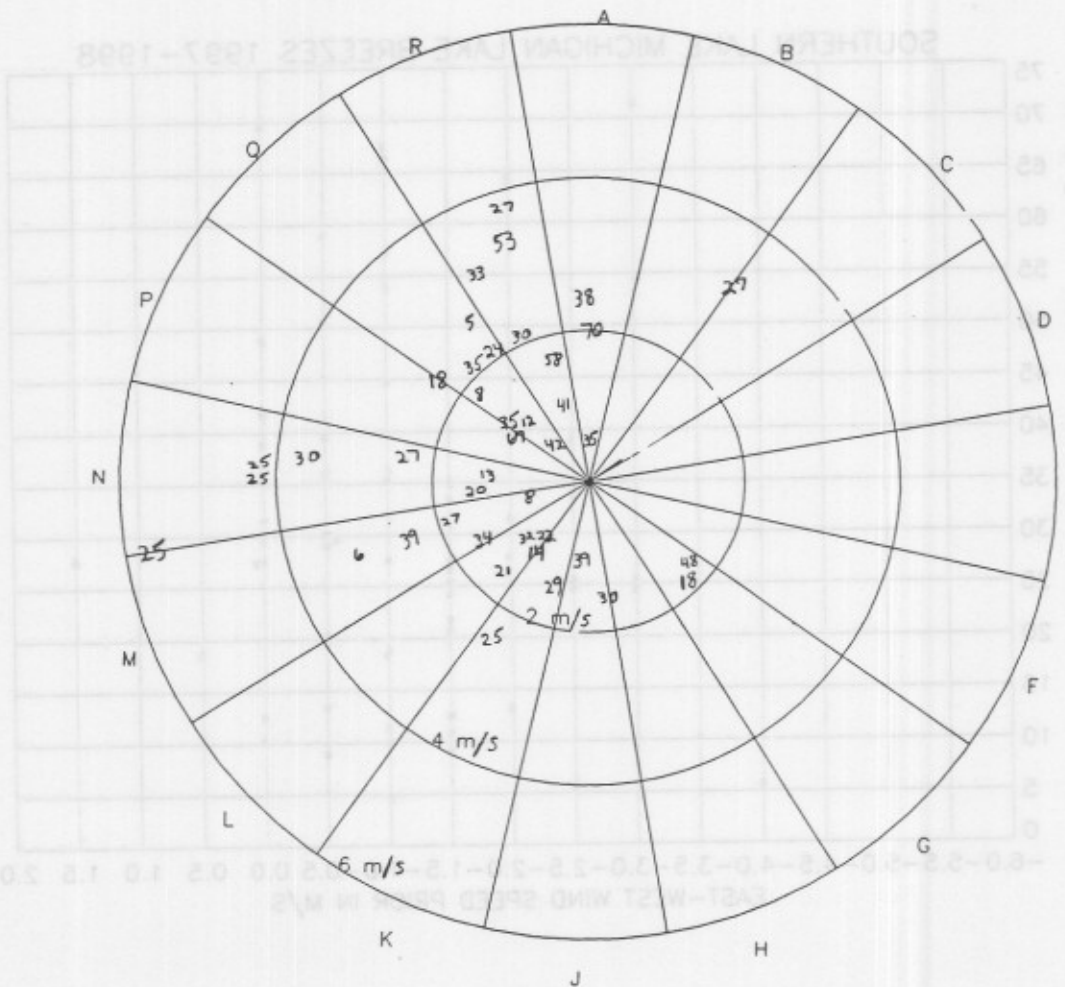
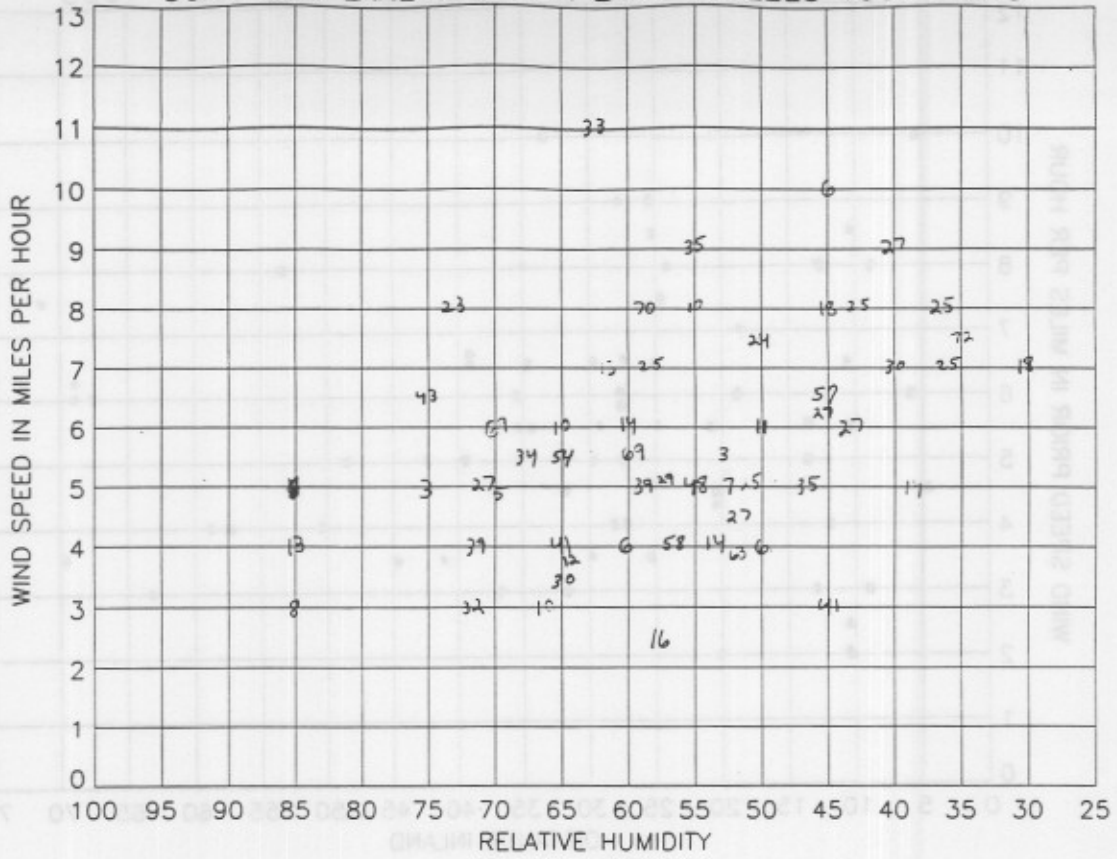
SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



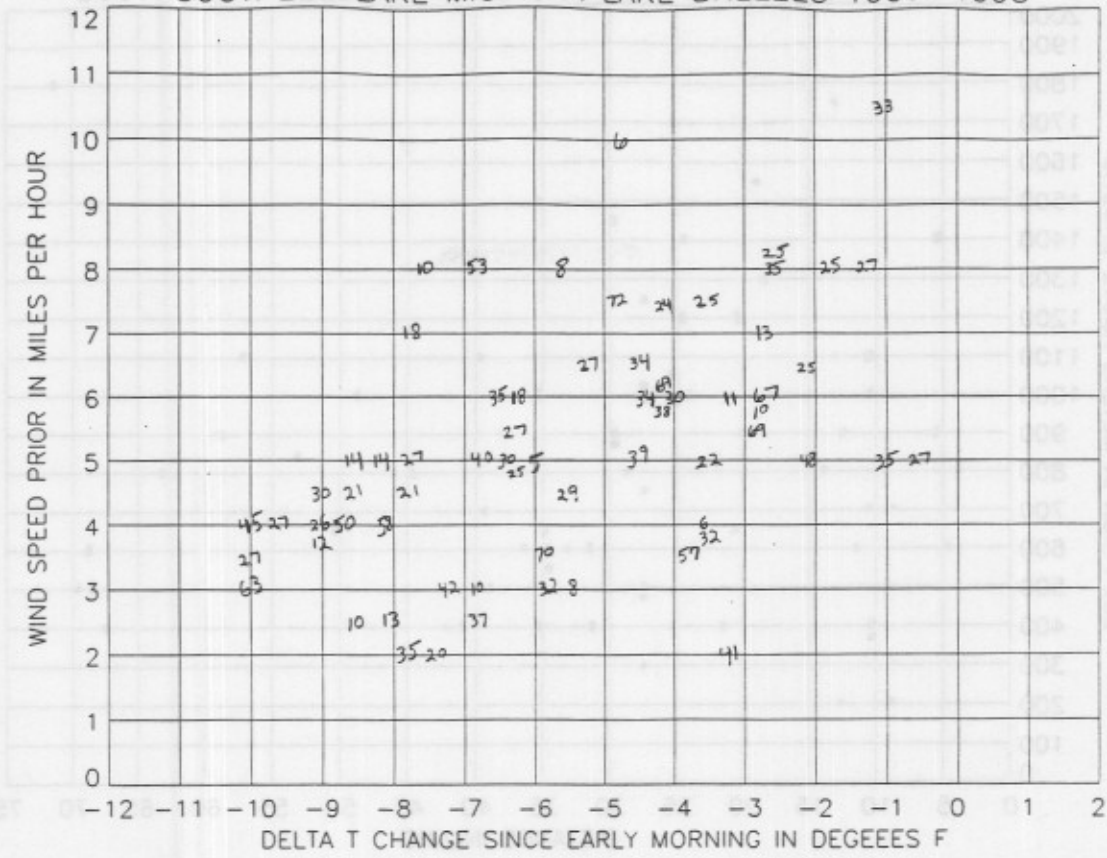
SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



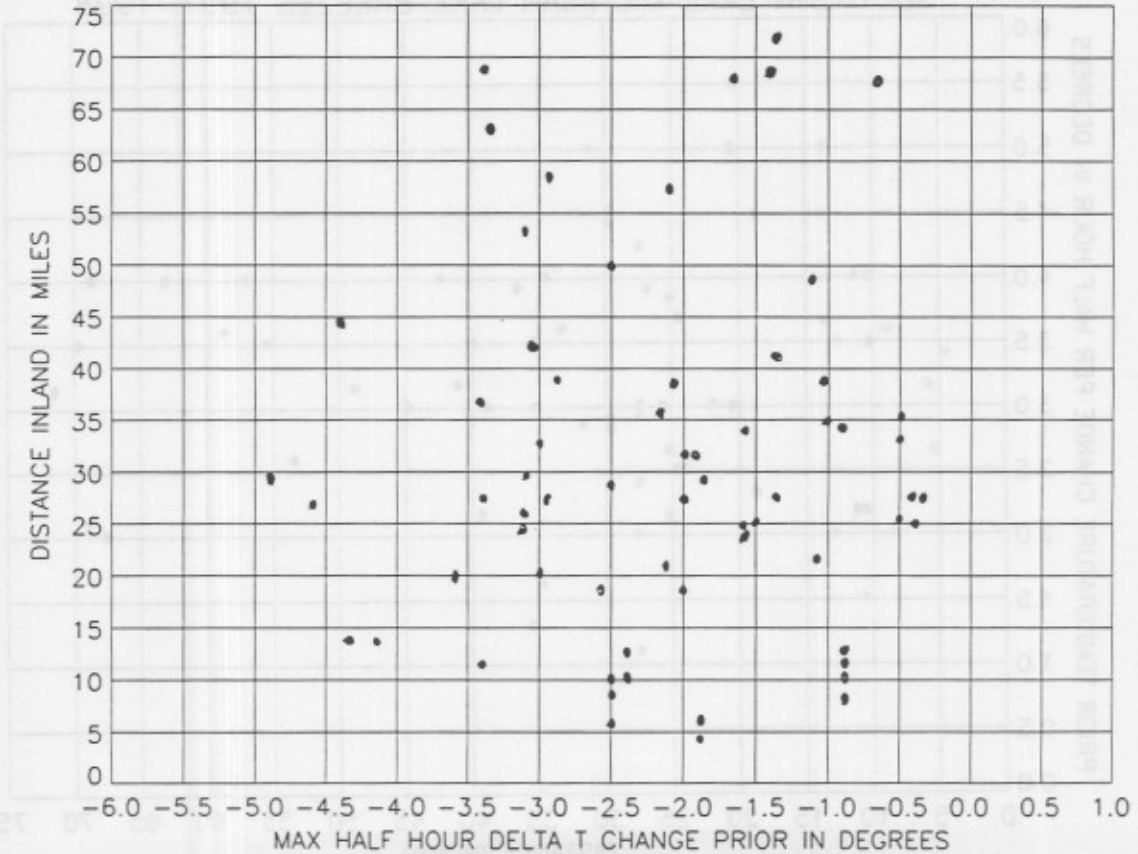
SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



SOUTHERN LAKE MICHIGAN LAKE BREEZES 1997-1998



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We compared two groups of lake breezes:
>50 mile penetration
<18 mile penetration

Found no single parameter or combination of parameters that would help us determine inland penetration distance

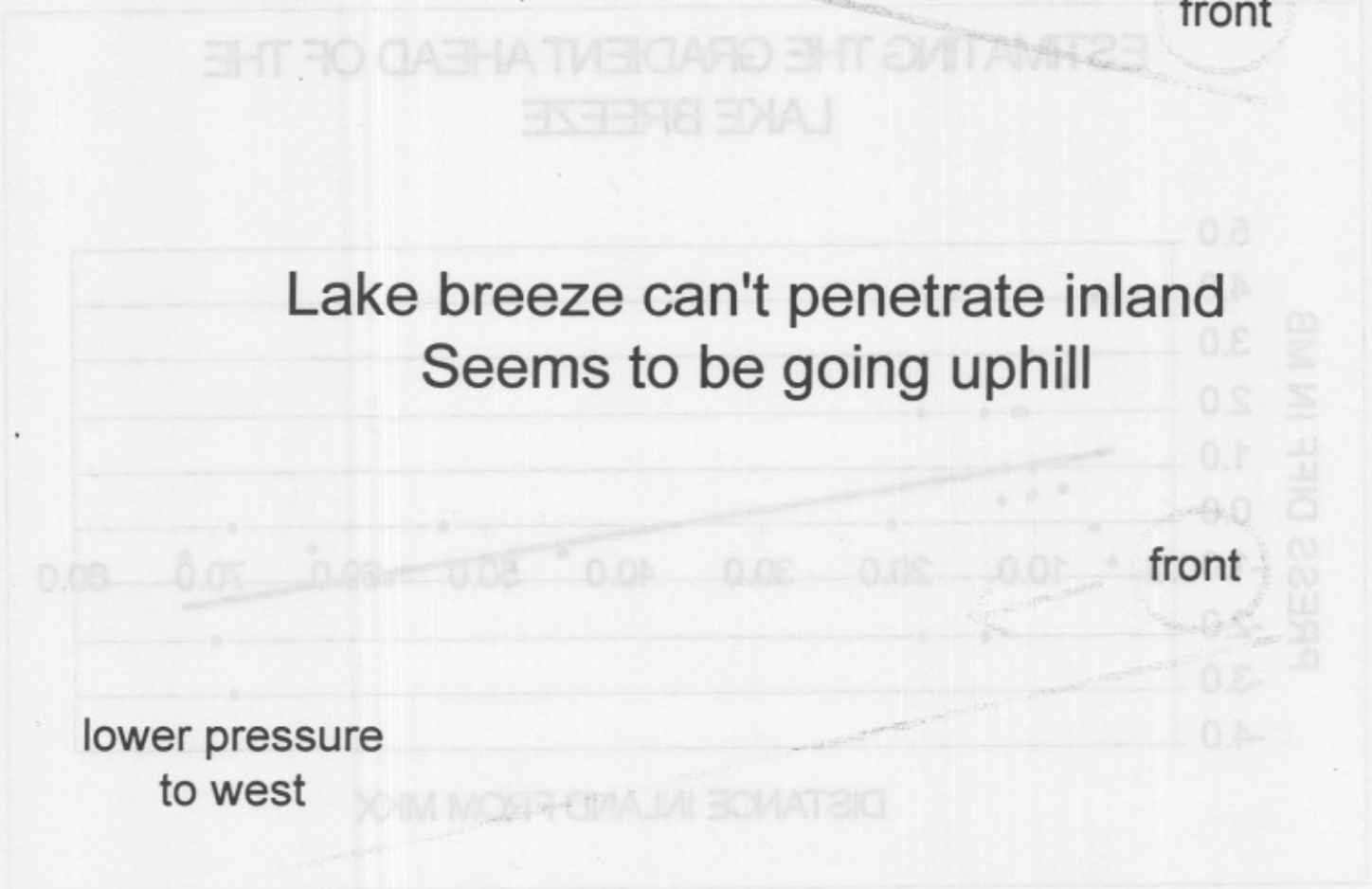
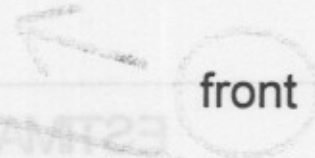
What we learned

The slope of pressure gradient in the direction the lake breeze is the key to inland penetration!



What's going on?

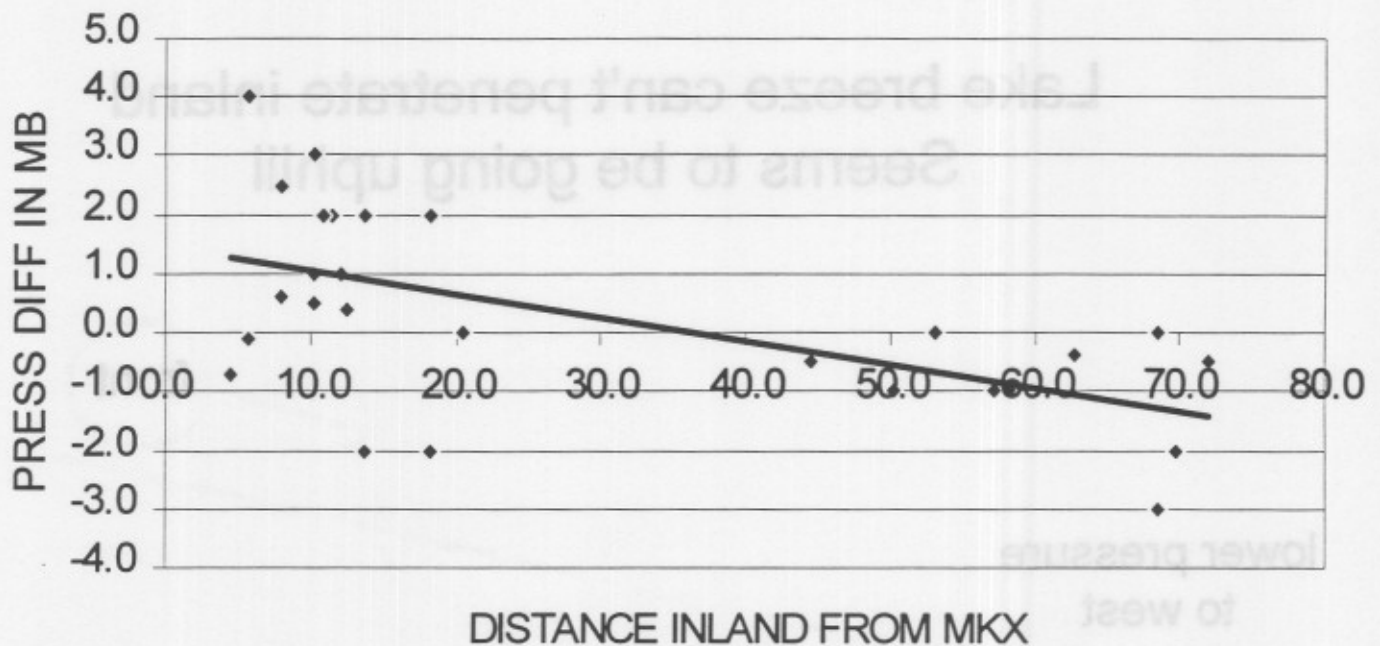
higher pressure
to west



Lake breeze penetrates well inland
Seems to be going downhill

A Tool for Forecasting Inland Penetration

ESTIMATING THE GRADIENT AHEAD OF THE LAKE BREEZE



About 25 miles inland for every millibar