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BRIEF NOTE

SUMMERTIME AIR CONVERGENCE OVER THE MARBLEHEAD PENINSULA, OHIO[1]

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The diurnal wind systems and temperature structures of capes, peninsulas, and small islands have not been adequately described in the literature in comparison to the coverage of the land-sea breeze circulation. Yoshino (1975) reviewed the literature prior to 1975 on the climatology of these coastal areas. Defant (1951) and Haurwitz (1947) described the basic mechanics of the land-sea breeze system. The details of the lake breeze circulation were documented by Biggs and Graves (1962), Estoque (1981), Estoque and Gross (1981), and Moroz (1967). Eichenlaub (1979) described the general climatology of the Great Lakes region, including a general overview of the lake breeze. Ballentine (1982), Bellaire (1965), and Thomas (1964) presented specific information concerning the effects of the Great Lakes on weather and climate. Harman and Hehr (1972) reported on the double lake breeze of the Upper Peninsula of Michigan.

A peninsula should generate a convergence zone during the summer months due to land-water thermal contrasts (Pielke 1974, Schroeder and Buck 1970). Basically, during the late spring-early summer, the land becomes warmer than the water. As the land warms considerably during the afternoon hours, the air pressure decreases slightly, and an onshore pressure gradient develops. The air should therefore flow from the lake to the land, creating a lake breeze. A convergence zone should form near the center of a peninsula if lake breezes occur simultaneously from two sides.

The purpose of this report is to document and describe a portion of the summertime mesoscale surface wind patterns that formed over the Marblehead Peninsula, Ohio. No other published paper has analyzed the climate of this area. The

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Marblehead Peninsula is located in northern Ohio approximately 64 km east of Toledo. It extends roughly 20 km in an east-west direction, averages four km in a north-south direction, and is surrounded on three sides by Lake Erie and Sandusky Bay. The general topography of the peninsula is flat with the exception of some modification by quarrying. The Marblehead Limestone Quarry consists of 1012 ha and is situated in the center of the eastern tip of the peninsula. The general relief is about 25 m.

Ten sampling locations were established on the eastern one-fourth of the peninsula to determine the surface wind field during the following time periods: one week in late May and early June 1982, one week during the fall of 1982, and two weeks during July 1983. The easternmost stations were approximately four km from the westernmost, and the northernmost were three km from the southernmost. Wind speed data were obtained from a hand-held Science Associates digital anemometer at nine of the locations. A compass was used to determine wind direction. The Marblehead Coast Guard Station (41°32′30″N, 82°43′30″W) provided the wind data for the 10th location.

This preliminary report presents the mesoscale air circulation on 31 May 1982, a representative day of the formation of the Marblehead convergence zone. The 0700 Eastern Standard Time (EST) daily surface weather map for 31 May 1982 (not included in this note) indicated that a low pressure system located over Wisconsin traveled eastward toward Ohio. By 0700 on 1 June, this low had migrated into eastern Michigan. The circulation patterns that developed on the Marblehead Peninsula on 31 May are shown in figures 1 and 2. Note that EST is used rather than Daylight Savings Time; this is consistent with the Department of Commerce (NOAA) who uses Standard Time in the compilation of the daily weather maps. During the morning hours (fig. 1), a general westerly and southwesterly airflow existed. However, by the late afternoon-early evening (fig. 2), the Marblehead convergence zone had developed. The stations located on the northern coast registered a northeasterly airflow, whereas the southern sites recorded southerly or southeasterly flow. Wind speeds ranged from calm to 3.6 m/sec. Velocities up to 6.2 m/sec

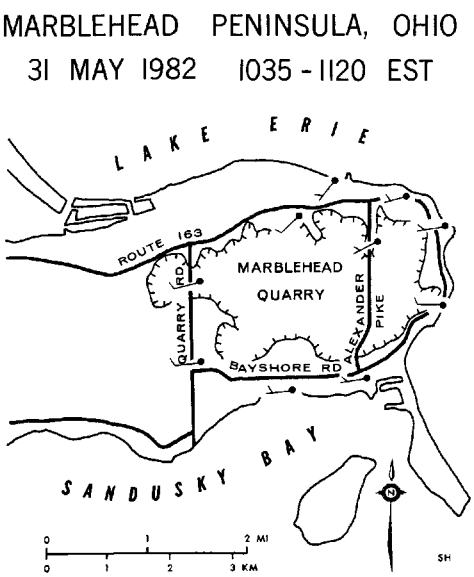

FIGURE 1. Surface airflow 31 May 1982, 1035 to 1120 EST.

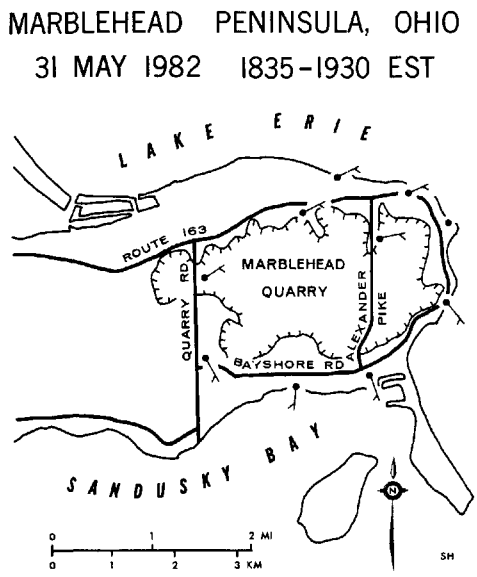

FIGURE 2. Surface airflow 31 May 1982, 1835 to 1930 EST.

have been recorded at similar times on other days during this initial study. These values are consistent with the findings of Eichenlaub (1979) concerning Great Lakes lake breezes. In addition, other observations revealed that the convergence zone did not develop under the influence of strong synoptic wind patterns.

The formation of surface wind convergence zones on peninsulas is usually a daytime summertime convectively-induced phenomenon. Details on the exact formation and decay of the Marblehead Peninsula convergence zone are unknown at this time. Land-water thermal contrasts are the major cause. Another dominating factor is, of course, the general surface air circulation of the entire Midwestern region. A preliminary report of a select day has been presented here to establish the presence of air convergence on the peninsula; a dense network of permanent weather stations would better ascertain the details of the lake breeze circulation, including the possibility of increased convective cloud cover and rainfall in this area.

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