Lake Erie Thermal Structure.

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Water temperature is a fundamental variable in the study of large lakes, having implications on the physical, chemical and biological components as well as water quality and socio-economic considerations. In Lake Erie, there has been an accumulated wealth of temperature data from the 1960's to the present based on lake surveys, in situ measurements, airborne infrared radiometer techniques and satellite observations. These data allow description of important features of the lake-wide and basin-wide thermal structure characteristics. We describe principal features of the thermal structure focusing on the long-term temperature and heat storage characteristics resulting from radiative and turbulent heat exchanges at the air-water interface and primary characteristics of the annual thermal cycle including advance of the spring thermal bar, variability of the thermocline position and time of overturn. The long-term data record clearly demonstrates that there are years with a lack of data representativeness both spatially and temporally. Such problems make it difficult to rely on the observational record alone for analysis of temperature related issues (e.g., water quality simulations, El Nino responses, etc.), necessitating the development and application of a hierarchy of thermal models for simulating / forecasting lake temperature fields. An important application of thermal models has been in assessing potential lake responses to climate warming. Due to the shallowness of Lake Erie, it's thermal structure is more susceptible to short-term changes in climate compared to the other Laurentian Great Lakes. Preliminary research combining thermal models with climate warming scenarios (e.g., Global Circulation Model scenarios) have indicated that the thermal structure of Lake Erie can be significantly changed which has implications for other ecosystem components and water quality. We use the observational record and thermal model results to indicate the current status of the lake thermal structure, potential responses to climate warming and critical areas for future research.