

## **BIRD MIGRATION, WEATHER AND FLIGHT SAFETY: TOWARDS A BIRD AVOIDANCE MODEL IN THE MIDDLE EAST**

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### **Abstract**

Several data driven models have been developed to predict changes in migration speed, altitude, timing and intensity in relation to local weather conditions and weather at distant sites in order to forecast changes in migratory behavior in the Middle East. Model results can serve as part of an advance warning system for aviation to improve flight safety. The focus of this study was on soaring bird migration, due to the hazard these birds cause to flight safety as well as the large numbers that pass through the Middle East when migrating between breeding grounds in Europe and Asia to wintering grounds in Africa. Data on bird migration was collected using various techniques including satellite telemetry, motorized glider tracking and ground surveys. Meteorological data was collected from local meteorological stations as well as from the National Center for Environmental Prediction (NCEP) providing data on a global scale through the Internet. Multiple linear regression models and general additive models were used to analyse and describe the relation between migratory behaviour and meteorological conditions such as temperature, pressure, wind speed and direction, humidity as well as thermal depth and intensity. The convection model ALPTHERM, used to predict daily soaring conditions for glider pilots based on midnight radiosonde data, proved to be an efficient way to predict soaring bird flight altitudes over Israel. Changes in migration altitude were affected by thermal depth, intensity, topography and wind load of the bird. Migration timing in Israel was influenced by temperature and pressure in the breeding grounds several weeks prior to arrival in Israel. Autumn migration intensity in Israel was influenced by pressure, temperature, humidity, wind speed and direction and pressure and temperature trends in Turkey, several days prior to arrival in Israel.

Scientific research based a variety of data sources is an important step in creating boundary conditions for bird avoidance models intended to serve the aviation community. Cooperation, by sharing data, ideas, expert knowledge, modelling concepts and techniques, the input supporting such bird avoidance models and systems can be strengthened on an international level.