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Bird Strike Risk Forecasting: A Modelling Approach

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Introduction

The German Military Geophysical Office (GMGO) issues BIRDTAM (Bird Warning to Airman) on the basis of current bird observations in order to reduce bird strike danger during low-level military missions. BIRDTAM force pilots to avoid or leave airspaces with high bird densities at the specific time period, therefore reducing bird strike danger significantly. However, BIRDTAM are depending on the actual observation of bird movements, are issued often unexpectedly, disturb the flight missions and can only display the risk situation with a validity of about 2 or 4 hours in advance. In order to be aware of possible bird related restrictions air staff and pilots need a forecast of bird strike risk for an at least 24 hour period, so that missions can scheduled under consideration of probable bird hazard avoidance aspects.

Current Forecasting Method

Additionally to BIRDTAM-Warnings GMGO provides daily BIRD STRIKE RISK FORECASTS since many years. The current operational method [1] is based on a statistical analysis on the dependency of birds' migratory movements from weather as it has been evaluated from time lapse radar-images and weather data during a period of more than ten years.

The current forecasting method is based on decision tree algorithms for each season. General dependencies between bird migration and weather situation are used to forecast bird strike risk intensity and height levels. Main weather parameters are duration and intensity of precipitation, wind direction, wind speed, temperature, temperature change and surface condition.

For example during migration seasons a forecast is worked out according to *Figure 1*. This means, that depending on the season meteorological forecasts are provided for up to six departure areas and its corresponding destination areas, which are the risk areas. Within a working sheet, developed by the GMGO – Biology Section, favouring migratory conditions score positive values, whereas limiting conditions lead to score reductions. The initial sum of scores determines the basic bird strike risk level of the risk area. For a balancing effect during migration specific corrections are used. In a similar matter the upper level of the risk areas are determined for certain areas and seasons.

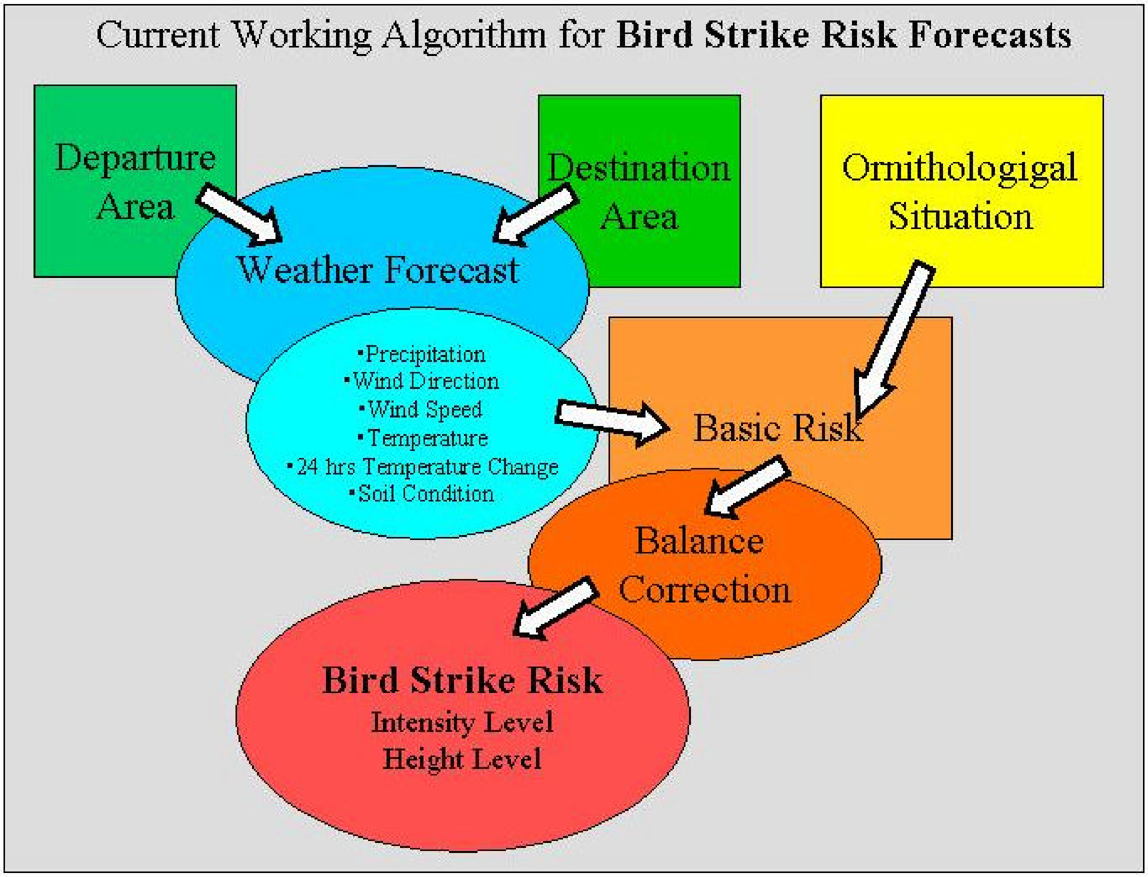

Figure 1: Principle of the algorithm for the assessment of the expected bird strike risk at a specific area during migration periods.

Bird strike risk forecasts (Figure 2) are worked out by meteorological staff at the GMGO-Forecast Center following a specific working sheet, designed by the GMGO-Biology Section. They are submitted daily at 03 UTC via WMO - Global Telecommunication Network. Twice a week (Monday and Friday) an outlook on the expected bird strike risk situation is attached. During spring and autumn migration an update is submitted daily at 10 UTC, which has an additional input from actual radar observations and new meteorological forecasts.

The information is transferred in a standard text format and is displayed by geophysical staff at the military units. It is a regular part of the pilots' briefing before mission planning and flight.

The current operational technique can be considered as a simple biological forecast model mostly depending on the weather forecast. As it is a conceptual model approach there are possibilities for extensions and improvements of the algorithm.

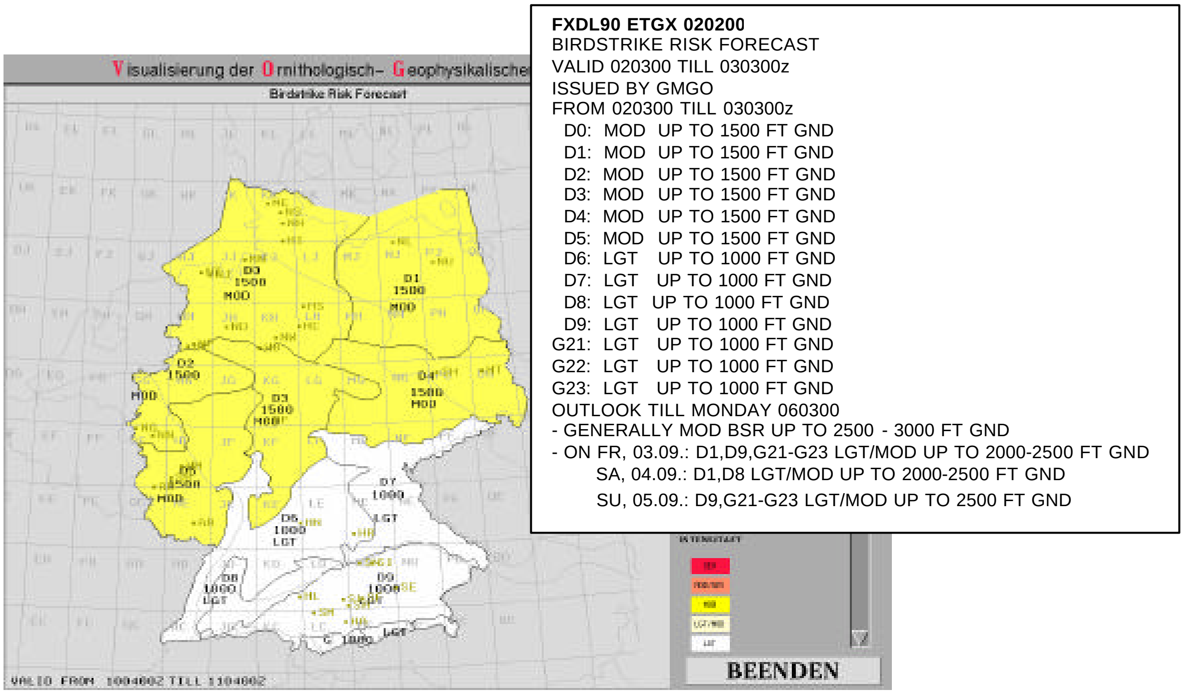

Figure 2: Example of Bird Strike Risk Forecast and its Graphical Display.

Modelling Concept

A new modelling algorithm will use principles of the current method, but will have to incorporate more meteorological and biological dependencies and details as before. The model will have to describe a highly complex biological system depending on weather and birds' migratory behaviour. The general concept is to set up a biological-physical model with statistical-stochastical components. Requirements are:

- Forcing by relevant biological and meteorological parameters
- Coupling with a numerical weather forecast model
- Modular set-up of model
- Automatic model output at a fixed time schedule
- Standardized message exchange format
- Graphical display also via internet
- Continuous update

Database

New data sources and computer technology provide the background for setting up a new forecast algorithm that will allow a much more sophisticated forecast. The systematic collection of relevant data has been initiated several years ago.

Bird migration observations include an approx. 5-year continuously 2-D radar observation data set of hourly bird observations at 8 sites in Germany; similar data exist from major German airports. Since approx. 2 years 3-D radar plot data are collected over northern Germany. Examples of the data have been presented at the Bird Strike '99 – Conference/Vancouver [2] and the 25th Meeting of the IBSC/Amsterdam [3].

Since 1998 a systematic storage of highly time and space resolved 3-D meteorological numerical forecast model data of central Europe, which are relevant for bird migration surveys has been initiated. Data are extracted automatically from a database of an operational meteorological mesoscale boundary layer model.

For 355 squares of 1° Latitude X 1°Longitude over Europe a data set consisting of values for temperature, wind speed, wind direction in 6 vertical layers between surface and 1500 m as well as single values of precipitation, cloudcover, moisture and a convective index are systematically stored in a data base in 3-hourly intervals.

Data collecting is still continuing in order to get the best available basis for evaluating statistical parameter and biological dependencies. Figure 3 gives an example of corresponding bird migration patterns in different years, which can be considered as a first guess towards a model formulation.

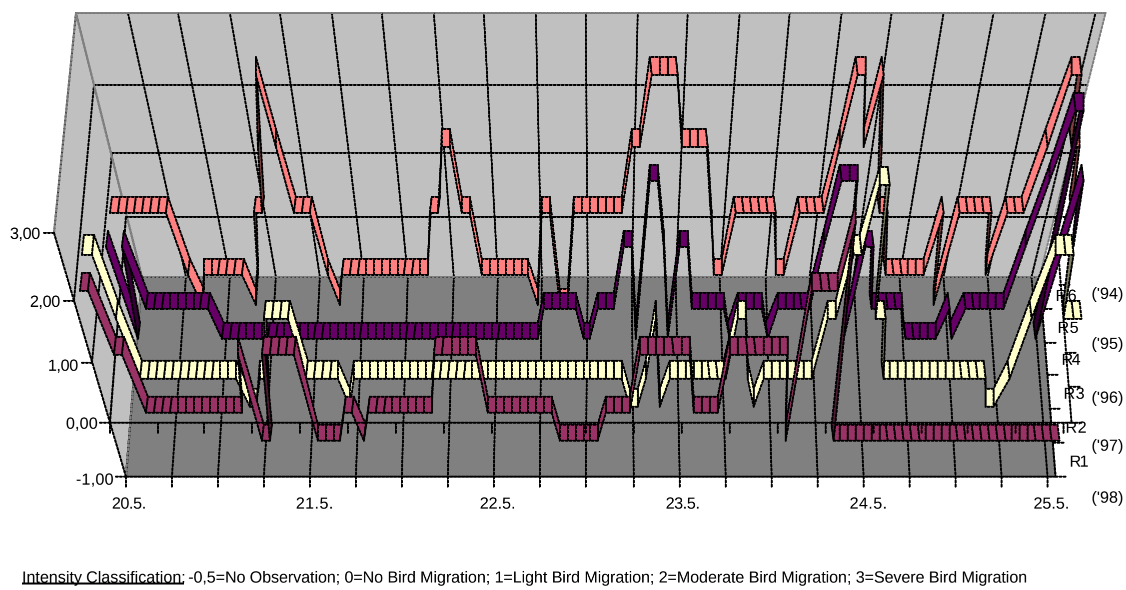

Figure 3: Example of a Comparison of Bird Intensities from Radar Data of Subsequent Years at the Same Site.

Research Needs

After the collection of relevant data, the statistical analysis of the data will be enforced. The framework of basic relationships will have to be formulated and transferred into computer code. Additional parameter values will have to be evaluated. Bird population distributions and numbers will be extracted from literature and other data sources.

Conclusions

The experience of many years in operational forecasting of bird strike risk over central Europe with a simple modelling technique as well as daily experience with bird migration observations by radar provides a good background for a new model approach. A sufficient database is now available for a redesign of dependencies among weather and bird migration. Additional information is available as well as the technical equipment. First steps are scheduled for this year.

References

[1] RUHE, W. (1994): Das Vogelschlagrisikovorhersageverfahren des Geophysikalischen Beratungsdienstes der Bundeswehr. Vogel und Luftverkehr, 14/1, 29-36.

[2] RUHE, W. (1999): The German Military Geophysical Service Bird Migration Observation, Warning and Forecasting System: *New Developments towards an Automated Bird Migration Information System.* Proceedings – Bird Strike '99, Vancouver, 219-224.

[3] RUHE, W. (2000): ASR – Bird Observation Program at German Airports. Proceedings II – IBSC 25th Meeting, Amsterdam, 157-165.