The study of inflight data from sailplane flights to determine better forecast of the Atmopsheric Boundary Layer used for soaring

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Introduction

This study aims to analyze the performance achieved today by **forecasts of thermal conditions** during **gliding competitions** using the **Regional Atmospheric Soaring Prediction** (RASP) model, fig. 1 [1], derived from United States ' Global Forecast Model (GFS) run by the National Weather Service and adapted for Romania, with an objective to develop recommendations for improving the accuracy of the forecast. In the data analysis we have taken into account that the sailplane's mean flight speed during the entire flight task is an important indicator of the thermal condition (updraft strength). Therefore, we compared the inflight data obtained from the sailplane flights with the forecast provided by the model.

Data & Methods

For the study, data from several cross-country sailplane flights from the National Cross-Country Championship held at Craiova Airfield (Romania) between 9th and 18th August 2017 were used. Data provided by the flight recorder on the aircraft location, expressed in 4D coordinates (position in space +time plots), permit the calculation of the height of boundary layer along the glider course. The weather forecasts on convection derived from the RASP model were represented by the maps with the **daily rating of convection**, for the area of interest. The daily rating scale (Star Rating) used to measure qualitatively how good the soaring conditions are consists of five levels, from 0 (poor) to 5 (excellent) stars. The method used consists in making an intercomparison between the specific daily rating of thermal conditions forecasted by RASP in each day of the competition fig. 2 and the flight performances achieved by the first three ranked competitors expressed in mean task speed, fig. 3. Relative units were used on the same graph, fig. 4, to depict the aforementioned comparison where both curves were plotted, respectively the **real relative thermal conditions** resulted from the mean task speed of the glider, in red, and the **forecast relative thermal conditions** resulted from the daily rating of RASP using the star rating scale, in blue.

Results

➢ RASP daily ratings and flight recordings for 09-18 August 2017

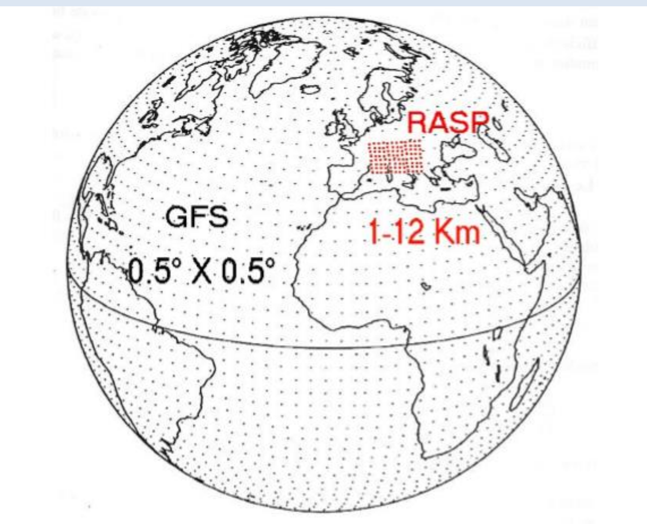

Fig.1 – RASP model nested inside the GFS model [3]

- ❖ One outputs of RASP are the **Boundary Layer Information Prediction MAP** (BLIPMAP) forecasts created by the US meteorologist John W. Glendening [2], PhD in atmospheric physics and glider pilot.
- ❖ **RASP** is a **"fine-mesh"** model with a better resolution **(1-12 km)** than the macroscale ("coarse-mesh") parent model U.S. GFS (about 50 km resolution) which typically covers the entire globe [3].
- ❖ In **Romania** the RASP model has been introduced by **Dragoș Constantinescu** [4], with a resolution of **2.2km**.
- ❖ Daily forecast uses observations from **18 UTC** previous day and the next day forecast uses observation from **00 UTC** current day.

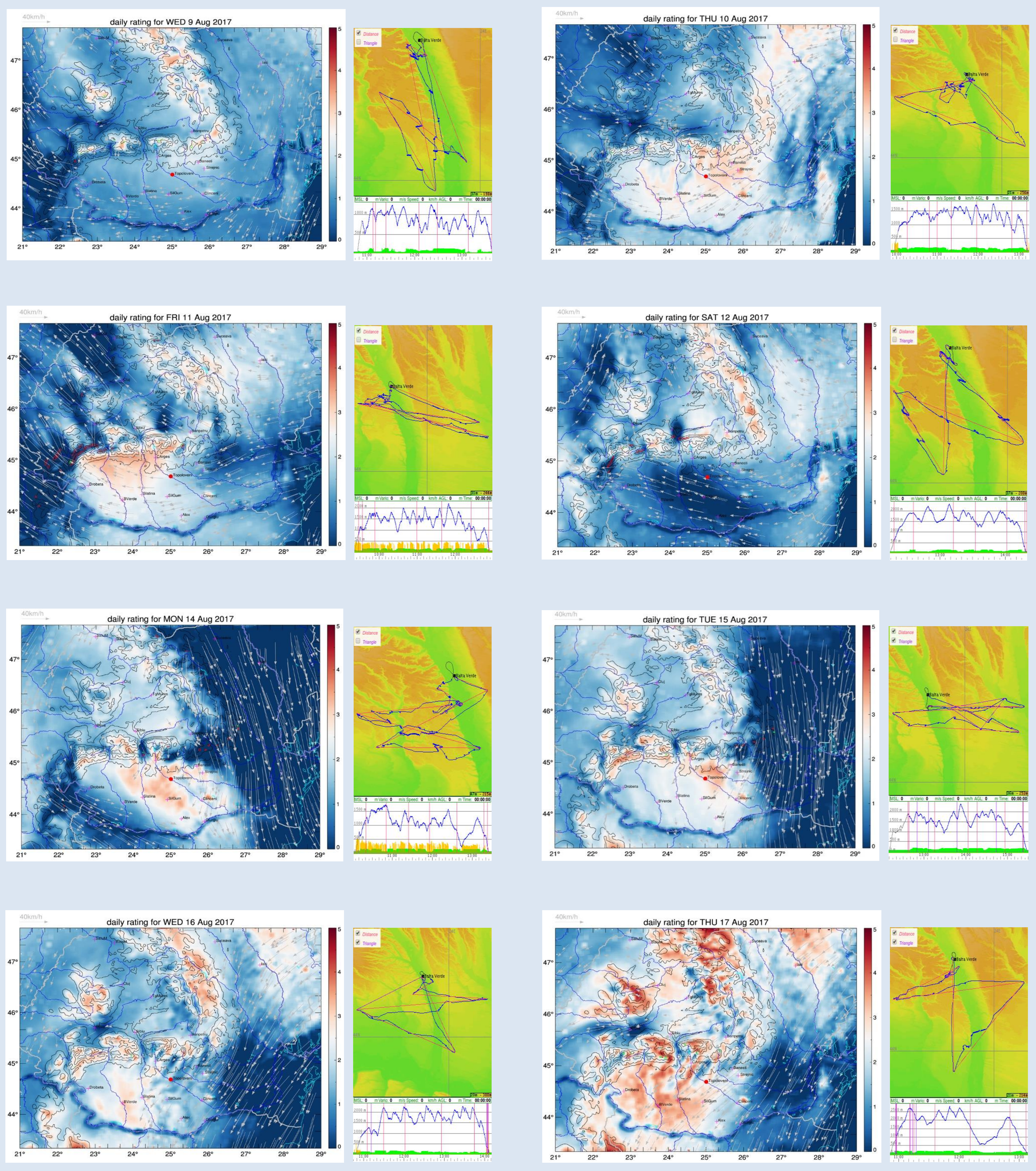
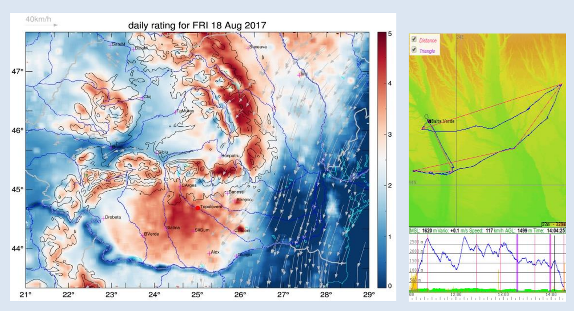

Fig. 2 – RASP daily ratings and flight recordings for 09-18 August 2017

➢ Intercomparison between daily rating of thermal conditions forecasted by RASP and flight performances achieved

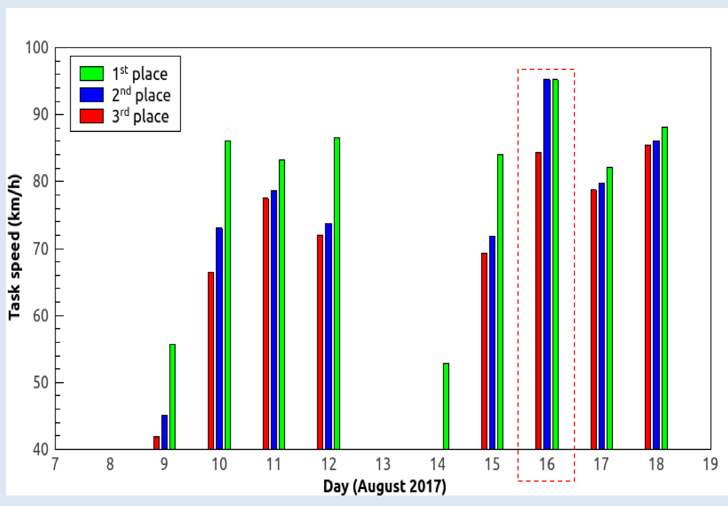

Fig. 3 Mean task speed for the first three ranked competitors

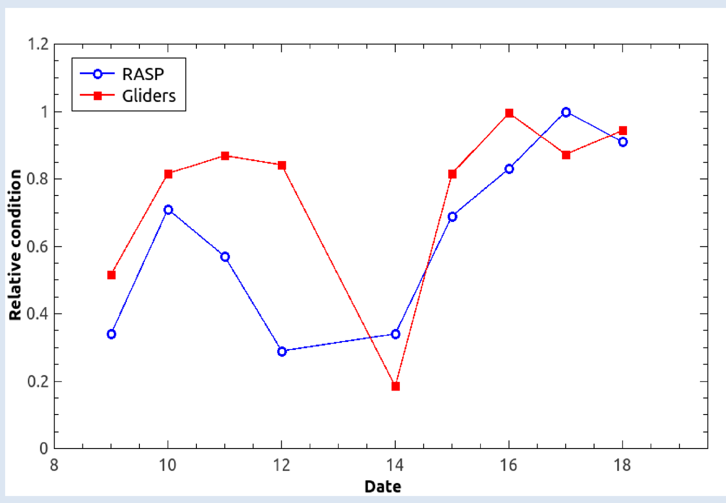

Fig. 4 Relative thermal condition as results from RASP and glider flights

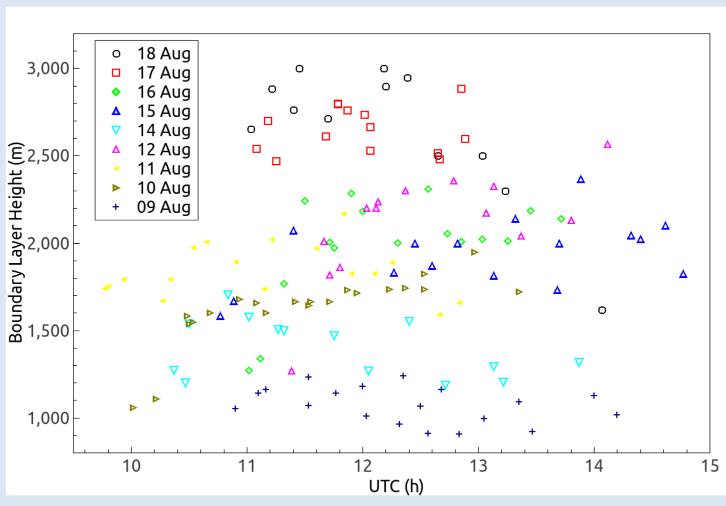

Fig. 5 Flight recorder data for boundary layer heights

- in fig. 4, the ***real* relative thermal conditions** (red curve) results from the ratio between the **mean task speed** for the first three ranked competitors in each competition day and the **best mean task speed** for the first three ranked competitors in the day with the most favorable thermal condition (namely 16 August 2018),
- in fig. 4, the ***forecast* relative thermal conditions** (blue curve) results from the ratio between the **forecast daily rating** (0-5) in each competition day (09-19 August 2017) and the **highest forecast rating** during the competition period (namely 17 August 2018, with an approx. rating of 3.8 of 5),
- differences existed between the forecast thermal conditions and that actually experienced, with some forecasts better than others; the best real thermal conditions were on 16 August, whereas, in according with RASP, they were on 17 August,
- for those **days with Cu clouds** development, namely 15-18 August period, the **RASP forecast was relatively close to the actual conditions** experienced,
- for those **days with blue thermals** (without Cu clouds), **the errors were quite significant**; for instance in the day of 12 August 2017, the RASP significantly underestimated the thermal conditions,
- values of the **boundary layer heights** in fig. 5 does not fit very well the features mentioned in fig. 4, but for the worse flying days and the best ones, the corresponding boundary layer heights are correctly grouped around the same heights.

Conclusions

- RASP may be a convenient and useful tool for anticipating the thermal conditions for the next day; it is useful primarily for planning cross-country flights, although it is also instructive for local flying;
- the study has identified some examples during the 2017 Romanian national gliding championships with days when the forecasts provided by RASP failed, but also days with successful forecasts;
- errors in the forecast were observed mostly on those days without convective cloudiness [5];
- to meet the requirements for high accuracy forecasts on the boundary layer during gliding competitions, RASP model has to be complemented with local soundings on vertical temperature profile provided, for instance, by an appropriate equipped drone.

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