INFLUENCE OF SHADING AND SKY-VIEW FACTOR ON ROAD TEMPERATURE FORECAST

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VI. INTRODUCTION

Within the ICEWARN project, the Institute of Atmospheric Physics of CAS, Prague, and the Czech Hydrometeorological Institute currently collaborate in developing and application of the FORTE model for a linearly continuous road weather forecast in the city of Prague (1). The model stems from the METRo model (2), the initial modifications being described in (3). The ensemble method (4) is not applied in the current project ICEWARN. In cities, the impact of obstacles on the modification of radiation fluxes, and consequently on the road temperature, is of a particular importance. The modification includes shading the direct shortwave radiation and the sky view restriction. Our present contribution is focused on implementing and testing a parametrization of these effects in the FORTE model.

VII. METHODS AND MODEL TESTS

Radiation fluxes on the road surface are modified by the surrounding topography, buildings or trees. We prepared a detailed pre-calculated dataset where for individual points along the road, sky-view factors are stored as well as zenith angles of the upper edge of obstacles in a fine azimuthal resolution.

In the computation of modified radiation fluxes in the FORTE model, at each time step the decision whether shading of the direct shortwave radiation occurs is based on a comparison of the Sun zenith angle with the stored obstacle information for the corresponding azimuth. For the sky-view effect on the longwave and the diffuse shortwave radiation, we adopted a simple parametrization according to Müller and Scherer (5). Four model versions are tested:

I. no modification of radiation fluxes applied
II. only shading of direct shortwave radiation included
III. shading + sky-view effect after (5)
IV. shading + sky-view effect after (5) but omitted reflection of shortwave radiation

Model results are evaluated against the road temperature measurements.

VIII. RESULTS

When evaluating the model results for a winter period as a whole, shading effects were found for none of the locations of road weather stations (RWS) in Prague. That was why we decided to test the model against the RWS in the NW part of the Czech Republic. An example of the root mean square error (RMSE) of the road surface temperature for 3 winter months is shown in **Fig. 1**.

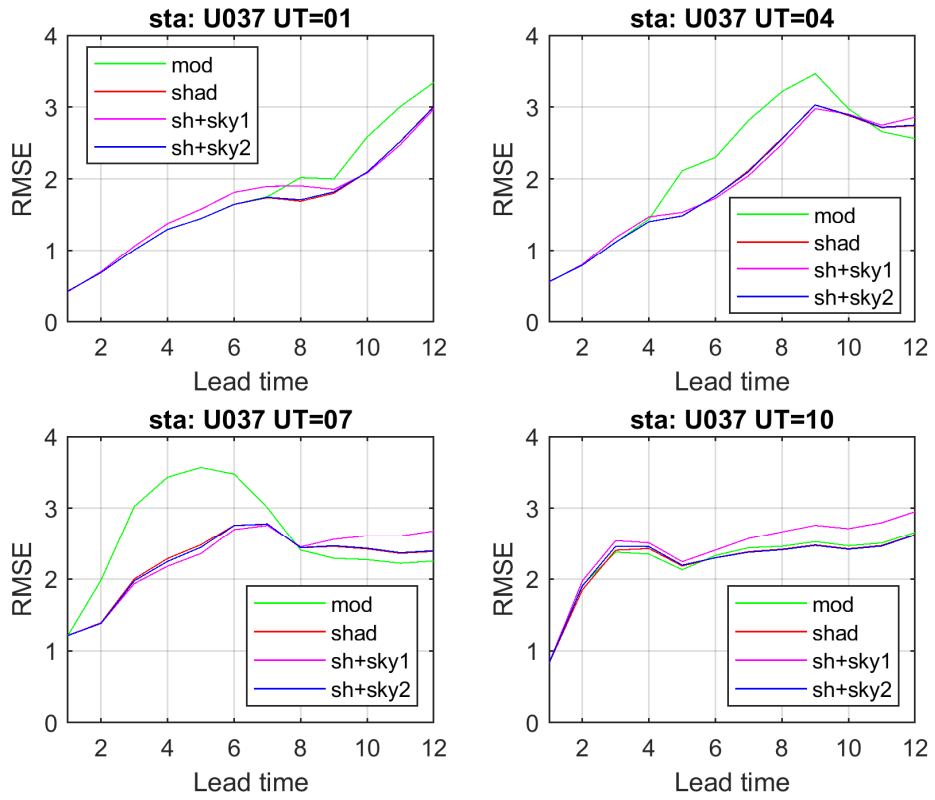

Fig. 1. Root mean square errors (RMSE, in degrees) of the road surface temperature forecast for the RWS U037, which is exposed to shading. The RMSE values were calculated for the whole period January-March 2017. They are plotted in dependence on the lead time up to 12 hours for the forecasts started at 01, 04, 07 and 10 UTC. The coloured lines correspond to the results of model version I (green line), II (red line), III (magenta line), and IV (blue line).

IX. DISCUSSION

It is evident from **Fig. 1** that including the shading effect on the direct shortwave radiation lowers the RMSE of the road surface temperature during the daylight period even if no data selection with respect to cloudiness is applied. There are only minor differences among the other model versions. The plots indicate that including the reflection of shortwave radiation (model version III), as suggested in (5) for mesoscale models, is not suitable for our purpose. Apart from the effect of modified radiation fluxes, a positive impact of starting the model run every hour in the nowcasting mode (3) is apparent when the RMSE for a certain hour is compared with the RMSE for the same hour in the run started earlier.

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