**A case study on prediction of temperatures variation trend in mountainous roads by a numerical mesoscale model**

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ABSTRACT

Atmospheric situation forecasting of mountain regions has always been important regarding to its various aspects such as research on water resources, road transportation an so on, but the exact forecasting quantities temperature, precipitation and humidity in mountain regions and topographically complicated areas is one of the main meteorological problems. This paper attempts to summaries how we can forecast temperature trends to purpose ice formation on surface roads in mountain area, by using a numerical mesoscale model. The most transportation problems and road risks occur when low pressure dynamic systems act over area. The prediction of road weather conditions requires the production of forecasts of temperature, precipitation and humidity at the road surface. It is a big challenge to obtain sufficient forecast accuracy of the road weather. In recent years, there has been a growing among authorities in getting predictions for temperature trend for ice formation on roads. Since proper decisions about road salting require accurate predictions of ice formation several hours' ahead, valuable warnings of road ice could be issued to the public as well.

In this study, some samples of low dynamic systems acting on Alborz mountain (Haraz and Firuzkuh roads) causing heavy precipitation and intense icing, and another sample atmospheric situation on area have been simulated by using mesoscale meteorological model which is called limited area model MM5.

MM5 is run with two-way nested grids initialized at 1200UTC using initial and boundary conditions from the NCEP's operational Aviation model output. It is configured with two domains. The outer domain has a horizontal grid spacing of 15 km and covers the large area, and an inner domain that has a horizontal grid spacing of 5 km and covers Alborz mountain and Tehran area. The number of grid points and grid width amount to 135 95 with 15 km, and 64 64 with 5 km for domain 1, and 2, respectively. The MM5 produces 3-hourly output to 72 hours in nested 15 km and 5 km grids. MRF and BETS-MILLER schemes are used to parameterizations of convection and boundary layer processes respectively. The model was run for two different weather situations, one with a presence of dynamical low pressure that produced sever precipitation and ice formation, and the other one with a stable system over the region. The model outputs for the innermost nest were studied for the first 72 hours of the forecast. The model

results were compared with observed 2m temperature at Abali, Firuzkuh and Aloodegi stations.

At first, a number of experiments were carried out for different biases at observation locations and performs an analysis over the grid to estimate the spatial field of model forecast bias. Comparison of height from level between the topography used in the MM5 model and the selected meteorology station indicated existence of errors in the heights of topography used in the model. The height difference is a factor leading to forecast errors in the model. For each model grid point, the bias computed at the nearest 3 observation stations which are within 300-450 m vertical elevation from the model grid point elevation and are of the same basic landuse category as the model grid point are averaged. The heights for the station of Abali and Aloodegi are underestimated and for the Firuzkuh station overestimated in the model. Surface temperature prediction for the station higher than 2000m in height Abali and Aloodegi are more exact than prediction for the station lower than 2000m in height. For better justification, the need to compare more selected station seems to be urgent. So mesoscale model forecasts can contain significant systematic errors for forecasts of temperature trends. Because these biases are so systematic, some methods can be successfully used to correct for them. Experiment 2 was set up to assess the effect of increasing vertical levels. Increasing the number of vertical level in the model from 23 to 40 levels, do not reveal significant improvements in the forecasted temperature fields, that considering height of present stations, increasing number of vertical levels in lower parts could be one of factors for that.

Regarding shortcomings of numerical models in mountainous regions with complex topography as beside Alborz predictions of the MM5 model were of acceptable accuracy. If the temperature variations trend to be predicted by the model with a relatively good accuracy, then icing can be predictable. With more experiments and suitable physical schemes in boundary layer of the model and possible past processing using statistical methods, instead of using estimated correction coefficients more accurate predications can be expected. But in these regions that even the number of target stations are not enough, prediction of variation trend of meteorology quantities with comparable acceptable accuracy can be quiet beneficial.