**Visibility prediction during fog and precipitation using the WRF model over Tehran**

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**Extended Abstract**

 Visibility is one of the most important optical characteristics of the atmosphere. It is equal to the maximum distance where a black object is detectable relative to its background. Prediction of visibility is essential for air pollution, air traffic, flight safety, road traffic and shipping. Visibility reduction may cause lots of safety concerns in airplane flights. It also effects on air and road traffics.

Visibility reduction in the atmosphere may be caused by different reasons. Insistence of too much liquid or solid particles suspended in the atmosphere may cause visibility reduction. Fog is one of the most common reasons of visibility reduction, i.e. the droplets of water suspended in the atmosphere reduce the visibility to less than 1 km. Since fog is very local and depends on topography, prediction of fog by NWP models is very challenging. One of the other reasons that may reduce visibility is precipitation. Solid or liquid suspended particles that fall from atmosphere and reach the ground are known as precipitation. Precipitation prediction has also challenges like discontinuity in time and place of precipitation.

Visibility prediction is very complicated because there are many different factors and phenomenon responsible for visibility reductions and most of them are local. To calculate visibility by using NWP models outputs we also can use relationship between visibility and dew point temperature, droplet number concentration and mass concentration. Purpose of the present work is to study the ability of WRF model to predict visibility during fog and precipitation over Tehran area in January 11th, 2014 and March 7th, 2013. To achieve this goal, four different algorithms including UPP1, AFWA, FSL and SW99 have been experimented to predict visibility. Predicted visibility by the four aforementioned algorithms has been compared to observations, including Synoptic and METAR data in Imam Khomeini and Mehrabad airport in Tehran, Iran. Mehrabad airport is one of the most portable airports of Iran, however, Imam Khomeini airport has the largest number of foreign flights among all airports in the country. Therefore, the proper visibility prediction in these airports can be much important in air traffic and reduction of financial loss due to delays in flights. Since the study does not look at the reduction in visibility caused by dust, although the loss of vision due to the presence of aerosols and phenomena such as dust is important, the days are chosen in such a way that the effect of dust is negligible.In January 11th 2014 rain and shower reported in Imam Khomeini airport and in Mehrabad Airport, the dominant phenomenon has occurred is fog. Main phenomenon in both airports in March 7th 2013 is the snow.

In this paper the WRF version 3.8.1 has been used to simulate precipitation and fog. In this simulation model configuration defined in Lambert uniform space. The model consist three nested domains. First domain was a 27-km grid model (83×65), surrounding a 9-km grid model (112×94) which was surrounding a 3-km grid model (112×97). Center of all domains was at longitude 51° and 44' and latitude 36° and 5' which is located almost at center of Tehran. All domains had 40 vertical layers and model top was located at 100hPa. The out puts of 3-km domain is used for visibility estimation. Initial and boundary conditions were set by using FNL data which is 1°×1° degree grid data. This data is available every 6 hours. Simulations were in 36 hours and first 12 hours was the spin up time. The physics packages used to simulate include new Thompson micro physics scheme, BMJ cumulus parameterization scheme, MM5 scheme, YSU planetary boundary layer scheme, Dudhia short wave radiation scheme, RRTM long wave radiation scheme.

Results show that most of these algorithms can partly predict visibility reduction. The FSL algorithm works better than the other methods in fog situation and SW99 works better in snow situation. Comparing results shows that the visibility reduction during snow is more reliable than during fog. There were some errors in model predictions some of them were due to visibility algorithms, because the coefficients of these algorithms were driven in other parts of earth. The other errors were systematic errors of WRF. Predictions of temperature had warm bias and also there were positive bias in prediction of relative humidity.

**Keywords:** visibility prediction, WRF, fog, precipitation.