FOG FORECASTING, DETECTION AND MONITORING IN THE UAE USING SEVIRI-MSG DATA

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1. ABSTRACT

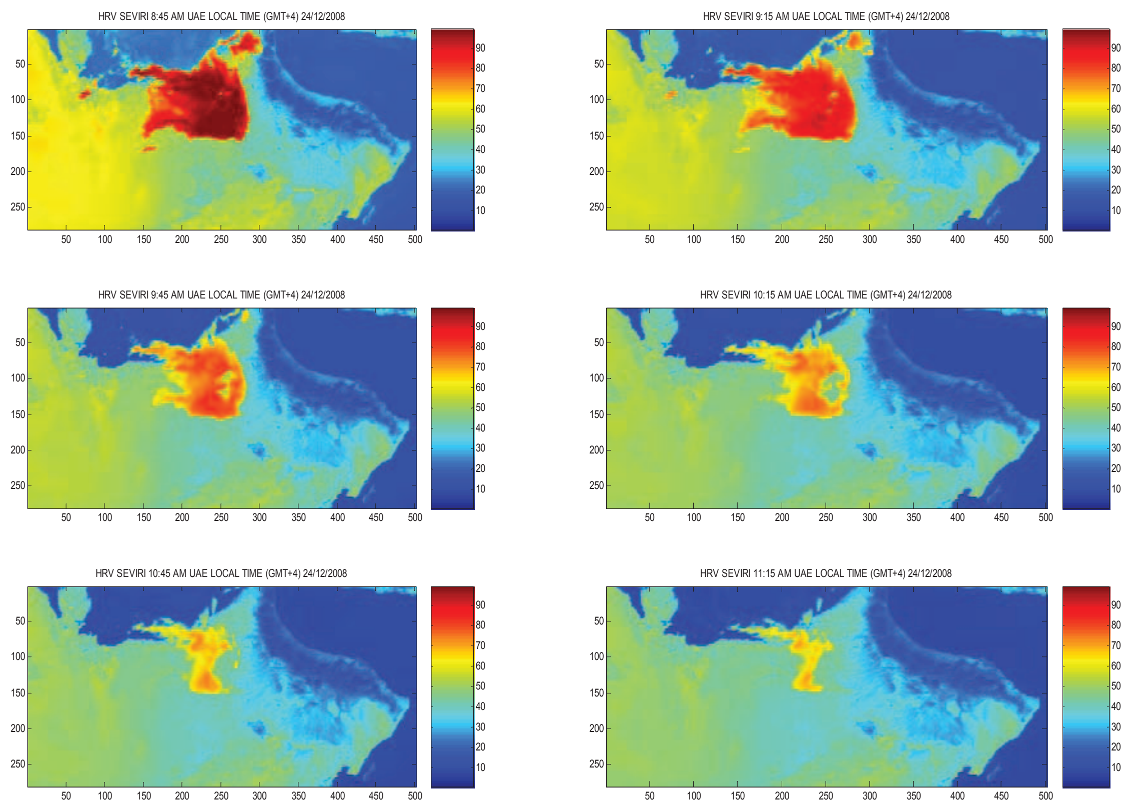
Fog is a major cause of airline delays, as well as road accidents and fatalities. Fog occurrences also produce hazy conditions with a major problem for traffic safety. The UAE location on the edge of a very warm sea and a hot and dry desert create the optimal conditions of inland fog forming. The afternoon sea breeze, which is almost a daily event in UAE coastal areas, transports moisture inland. At clear sky conditions at night, the desert environment radiates heat very efficiently and temperatures fall quickly. The rapid cooling of accumulated inland moisture during the night represents the optimal conditions for fog development. There are on average 20 occurrences of dense fogs each year in Dubai (with visibilities of ¼ mile or less).

Satellite remote sensing is an important tool in the detection and short range forecasting (nowcasting) of fog events. Fog over land develops primarily during the late-night and pre-dawn hours, infrared remote sensing is indispensable in observing fog formation at night, while visible imagery helps to monitor the extent and density of fog after sunrise. However, the prediction of fog clearing time is an important forecast problem that can be aided by pre-dawn estimates of fog thickness based on IR data.

The temperature difference between two infrared bands (11 µm and 4 µm) forms the basis for fog detection and classification. These two frequencies, available in the US geostationary satellite GOES, are widely used in fog detection and monitoring in North America. However, the main weakness of the existing detection and monitoring tools is their occasional confusion between fog/low stratus and stratiform cloud layers. METEOSAT/SEVIRI sensor has an additional infrared band at 1.6 µm (not available in GOES) will help to reduce significantly the confusion between fogs and low clouds. It has been demonstrated from previous studies that fog thickness is proportional to brightness temperature difference in the two IR channels (for cloud layers <1 km thick). After sunrise, the brightness difference between the fog and surrounding cloud-free areas can also help in improving the estimation of dissipation time. Additionally, dry soil warms up faster than moist soil after sunrise, resulting in faster clearing of fog. Conversely, fog that overlies a cold surface such as sea water tends to dissipate more slowly. An additional problem that may surface in applying such tools in the UAE is the potential confusion between fog and some desert areas (with high concentration of silicate soils) where their emission properties result in false fog signatures.
The Weather Research and Forecasting model (WRF) is among the tools used by the UAE meteorological forecasters. However, WRF is not always successful in predicting fog formation [1]. In this study, several fog events occurred in fall 2008 have been selected to be used in the development of the fog forecasting tool. Data acquired by the European satellite

METEOSAT/SEVIRI and covering the Gulf region is currently used in this project. This data is currently used as the main source of information in different fog applications: fog occurrence, depth, properties and dissipation time [2].

The maps presented in the figure below show the temporal evolution of one dense fog event occurred on December 24, 2008. These maps represent reflectance values measured in the high resolution visible channel (HRV) of SEVIRI-MSG between 8:45 and 11:15 am UAE local time. Soil moisture maps derived from passive microwave satellite (SSM/I and AMSR-E) will be used to improve the forecast of fog dissipation time.



2. REFERENCES

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