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# Detection of Fog/Low Stratus Using MSG SEVIRI Images

**A. Erturk** (1) and J. Prieto (2)
(1) Turkish State Meteorological Service, Ankara, Turkey (agerturk@dmi.gov.tr / Fax: +90-312-3606276)
(2) EUMETSAT-Darmstadt, Germany

## Abstract

Under winter conditions, fog is severely affecting air, sea and land transportation. Automatic detection of fog and low stratus using satellite data is crucial in operational nowcasting. The high temporal resolution and the high spectral discrimination of MSG SEVIRI support the operational nowcasting application in the large scale. Differential droplet emissivity at 10.8 and 3.9 micron bands, and Brightness Temperature Differences (BTD) between the corresponding channels can be applied to detect fog or low stratus. Additionally, the RGB composite called "fog RGB" proves beneficial to detect fog at night time. Its derivation is simple and is described later. At high latitudes on frozen grounds, the use of 8.7µm instead of 3.9 µm is of advantage.

In this study, MSG SEVIRI applications to detect fog or low stratus are discussed. Additionally, the catastrophic fog event occurred at 20-26 November 2009 over western Turkey will be presented. Satellite-based fog detection gives new opportunities to forecasters in the very short term.

## 1. Introduction

Fog is meteorological phenomena with an important economic and social impact on aviation, and on marine and land transportation. Many examples have been reported of the economic benefits of early estimation of fog [6] .

Rawinsonde observations and indices such as the Fog Stability Index (FSI) [7] , the Fog Point and the Fog Threat, based on rawindsonde data, are useful tools.

Detection of fog and low stratus using polar and geostationary satellite data are providing another opportunity to the forecasters. Eyre [5] utilized NOAA AVHRR imagery to detect night time fog and low stratus, Ellrod [2] developed an algorithm using GOES imagery, Cermak and Bendix [1] applied the same approach with MSG SEVIRI imagery.

Channel differences and RGB composites present also clear information day and night for the detection of fog. Erturk [4] developed a tool called MSGView to display and analyze of MSG SEVIRI data.

In this study we present MSG SEVIRI applications to detect fog or low stratus together with a case study over north-west Turkey. In the Data and Method section we give brief information about the SEVIRI channels and the RGB composites. The next section presents a catastrophic event as a case study. The Validation section presents synoptic, rawinsonde observations and temp diagrams to show a meteorological background. In the last section we discuss existing RGB composites and provide suggestions.

## 2. Data and Method

The second generation of imaging radiometers on board of the European geostationary satellite Meteosat is called SEVIRI. It is a Spinning Enhanced Visible and Infrared Imager (SEVIRI), used to support nowcasting and short term forecasting.

The composition of three or more channels and their differences is used to create RGB composite images. RGB composites reflect physical properties of the scene below. The recipes for the generation of the Fog RGB composites are given at Table 1 [3].

Table 1: Range for RGB's detecting fog

| Beam | Channel | Range (K) | Gamma |
|---|---|---|---|
| "night-fog RGB" | | | |
| R | IR12.0-IR10.8 | -4 to 2 | 1.0 |
| G | IR10.8-IR3.9 | 0 to 10 | 1.0 |
| B | IR10.8 | 263 to 293 | 1.0 |
| "24-hours-fog RGB" | | | |
| R | IR12.0-IR10.8 | -4 to 2 | 1.0 |
| G | IR10.8-IR8.7 | +2 to 6 | **2.0** |
| B | IR10.8 | 263 to 293 | 1.0 |

## 3. Fog Event over Istanbul

During the period 21-26 November 2009, a catastrophic fog event occurred over north-western Turkey, covering Istanbul airport. Hundreds of flights were cancelled or deviated to other destination airports.

The Fog RGB composite, here given on Figure 1. Fog and low clouds affected the Marmara Sea and Istanbul.

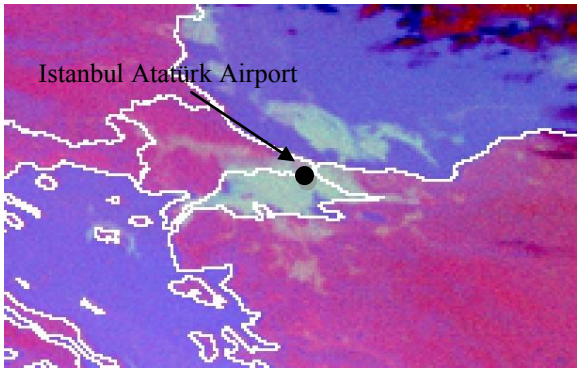


Figure 1: *Fog RGB image, 22 Nov. 2009, 04.00Z*

## 4. Verification

The half-hourly variation of visibility versus BTD at SEVIRI channels is given at Figure 2 for 21 November.

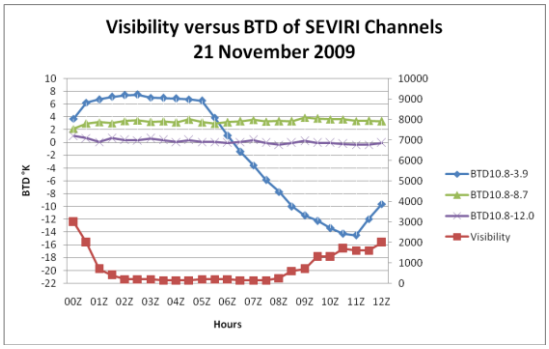


Figure 2: Half hourly variation of visibility versus BTDs of SEVIRI channels for Atatürk airport.

## 5. Summary and Conclusions

The detection of fog by means of MSG radiometric information is reliable. The night and 24-hour RGB products are appropriate to detect and monitor fog. Verification was performed with synoptic observations and TEMP report diagrams. The results are positive and highly correlated. They show too that the vertical and the horizontal extent of fog are not strictly related variables. The satellite is sensitive to the vertical extent, the visibility measurements are performed horizontally. MSG imagery, monitoring large areas, is crucial for fog detection and for nowcasting fog dissipation.

## References

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