Cloud Mapping by Using the Data from Different Observing Systems

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Abstract

Technological developments in the field of the meteorological instrumentation have provided opportunity to make the observations of many meteorological parameters without need for human observers by means of modern observing systems such as automatic weather stations, weather radars, satellites, etc. Although there is a fast development in this field in recent years, cloud observations of coverage, type, height and thickness are still an important issue to solve and human observers are needed in most cases. Cloud observations have been requested for many applications, in particular for the low level flights to ensure the flight safety for visual flights. In this study, we tried to develop an algorithm to prepare a cloud map for Turkey covering whole country. The basic concept of our study is to use all available observational data to make an estimation for cloud information. There is a huge integrated observing network consists of different type of observing systems in Turkey.

1. Introduction

Although the availability of such an observing network, it is obvious that there are some gaps due to the fact that it is not possible to install every sensor at each area. By using the observational data from the existing observing systems, we have developed the algorithm to estimate the cloud information and to make interpolation for the areas in which there is no observational data. So, by using the observational data from ceilometers, weather radars, meteorological satellites, automatic weather stations, manned observing stations and lightning detection systems, we have developed an algorithm to generate a cloud map covering whole country including the information of cloud coverage, cloud type, height of cloud base, and cloud thickness. The first results of this study presented in this paper are very encouraging, and we hope this will be a good solution to overcome the automated observation/estimation of cloud related data.

2. Methods

2.1. First step of the study is decoding synoptic observation received from manned and unmanned station from all over Turkey, Reading satellite IR10.8 channel data and cloud type product created by EUMETSAT for related hour.

Radar Max product is also read for all Turkey from the current network.

Lightning network product for all Turkey is also received from the database for the selected date and time.

Manned synoptic stations are used for confirmation of the created data. There are almost 135 manned synoptic stations and 2400 unmanned meteorological stations in Turkey. Both manned and unmanned stations have automatic measurement systems.

Synoptic code for unmanned stations are created hourly at the centre automatically with existing measured parameters.

2.2. When all synoptic, satellite, radar and lightning data received for the selected hour, cloud amount and base height are calculated for each synoptic stations as follow:

- Eumetsat channel 10.8 data is used to determine whether there is cloud around the stations or not. For this measured ground temperature and EUMETSAT cloud top temperature is used. Difference between ground temperature and cloud top temperature is lower than the threshold (9.2 C) then it is accepted as that point is cloud for the station. Nearest 5x5 grid point around the station is checked and sky cover is classified as 0% - 100% covered.
- If there is a cloud cover over the automatic station, cloud type is estimated by using the CT product EUMETSAT by checking 5x5 pixel CT data over the station.
- Radar MAX data is controlled over station to check whether precipitation is possible for that station.
- If there is lightning echo around the station this data is used to define cloud type to CB for that station.
- All above calculated data and ground temperature with dew point is used to estimate possible lowest and highest cloud base for the automatic station point. Created data is classified from blue to red based on the cloud base height. If there is a CB and thunderstorm possibility, it is also displayed.

2.3. Cloud Information on Web Based Interactive Map

The Comma Separated Value (.csv) which is named date and time (2018082706.csv means 27.08.2018 06.00) file is sent to web server by FTP.

This file contains a lot of observed and estimated values with station information that are shown on map.

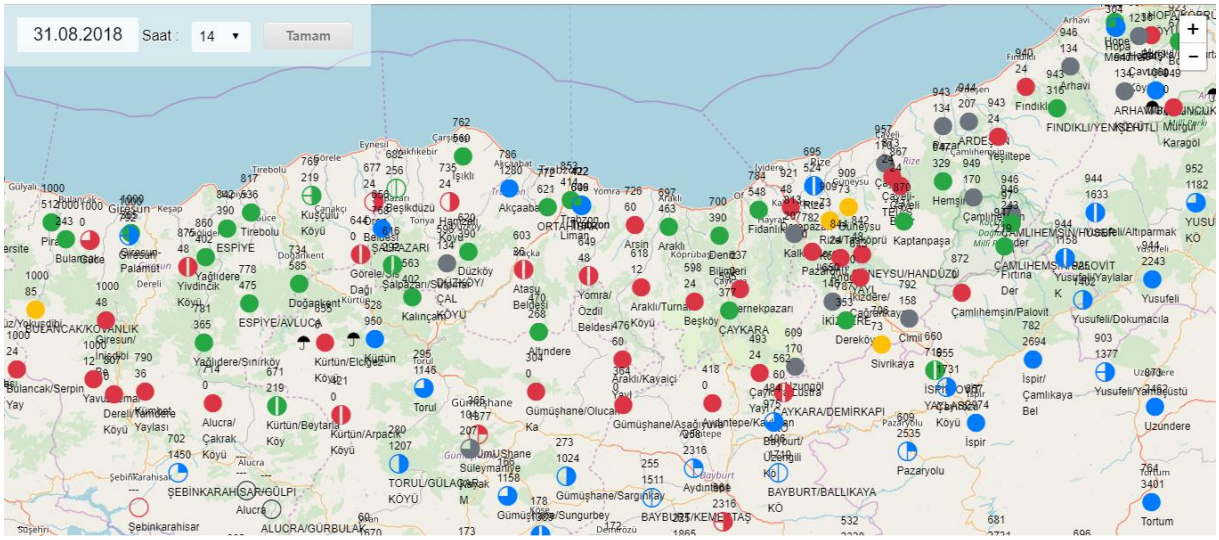

Figure 1: Cloud cover icon on the map

Markers that represent stations are located on the map. Each marker is a station with estimated/observed cloud cover and other values. By clicking on a marker, a popup appears that includes more details.

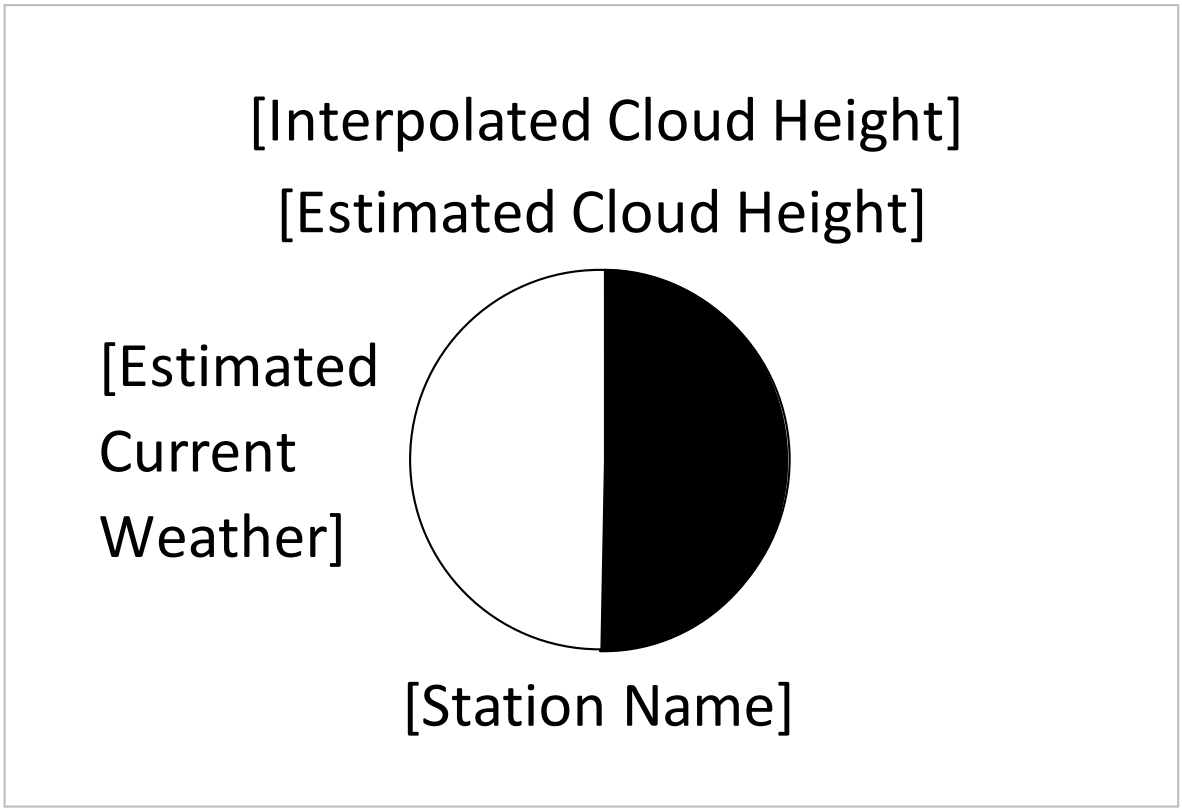

Figure 2: Estimated cloud and weather icon

Marker on the map represents station with Interpolated Cloud Height, Estimated Cloud Height, Estimated Current Weather, Estimated/Observed Cloud Cover Icon and Station Name values on Figure 2.

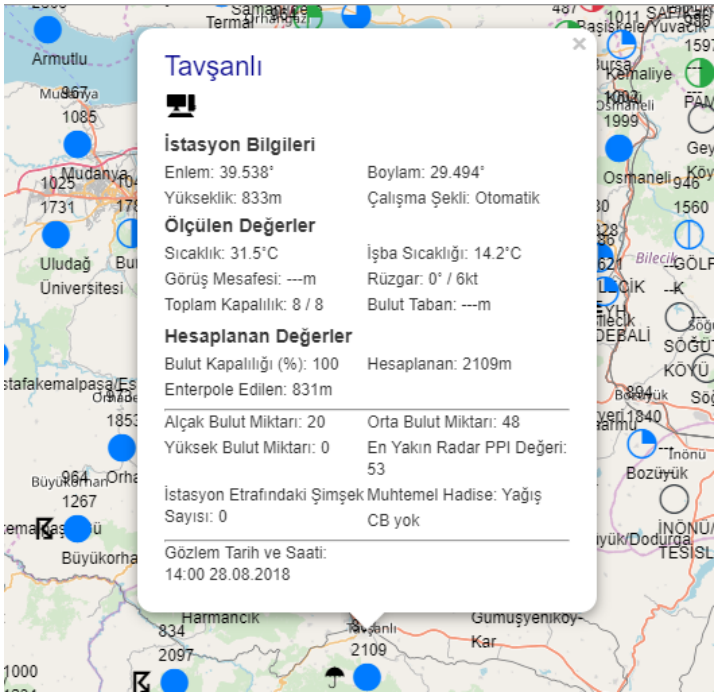

Figure 3: Station information and estimated/observed value details

Detailed station information and estimated/observed values is shown in a popup on the Figure 3.

Colour	*Cloud Bottom*	*Visibility*
	200 ft	800 m
	300 ft	1600 m
	700 ft	3700 m
	2500 ft	8000 m
	> 2500 ft	> 8000 m
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Table 1: Cloud cover icon colour information

Station icon colours represent the cloud or visibility information on the map. The colours explained on table 1.

Conclusion

This project is an alpha version. Estimated values may differ observed values. Users can under their responsibilities on the estimated values. Next version of this project is planned to use artificial intelligence framework. Source codes of the web modules is published at https://github.com/Jason-Air/CloudCover