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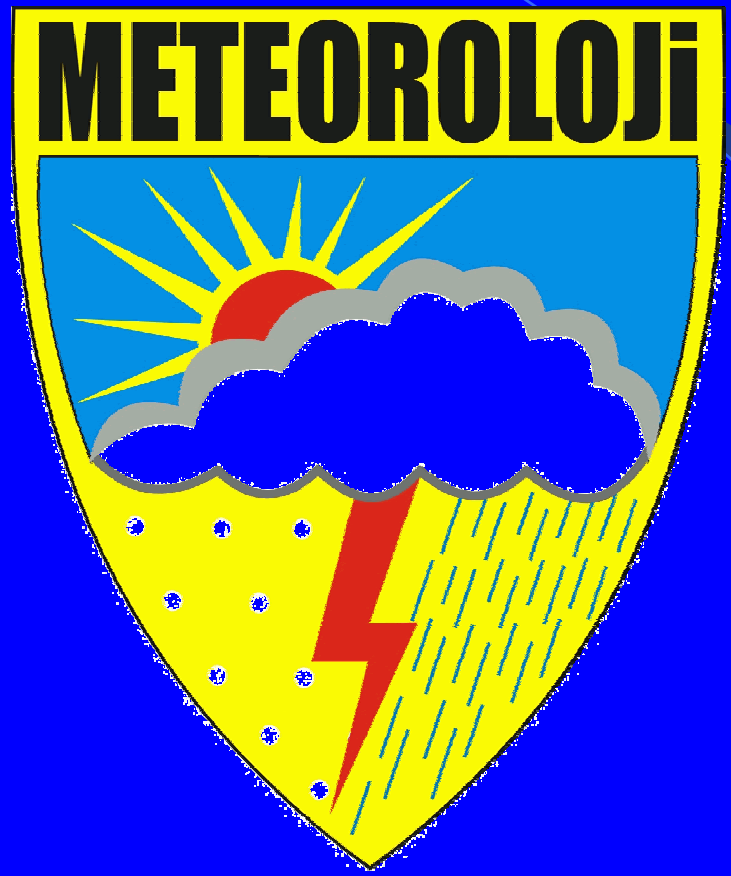
THE MINISTRY OF ENVIRONMENT AND FORESTRY



TURKISH STATE METEOROLOGICAL SERVICE

MODERNIZATION OF OBSERVATION NETWORK IN TURKEY

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1. INTRODUCTION

In line with the increasing needs of the developing world, it has become a necessity to obtain more reliable and continuous meteorological data and transfer these data in due course to those who are concerned. Today many sectors such as aviation, transportation, agriculture, construction, tourism, health, justice, security, national defence, written and visual press, and sports are very much in need of meteorological data support.

Turkish State Meteorological Service (TSMS) started in 1997 the modernisation studies of meteorological systems, prepared investments projects of great importance and got down to execution of them at a very high speed with a view to rendering the best service to all users who demand meteorological support, and furnish the users with more reliable data continually and to put to the service of the domestic and international users the products and innovations developed by modern technology in the field of meteorology.

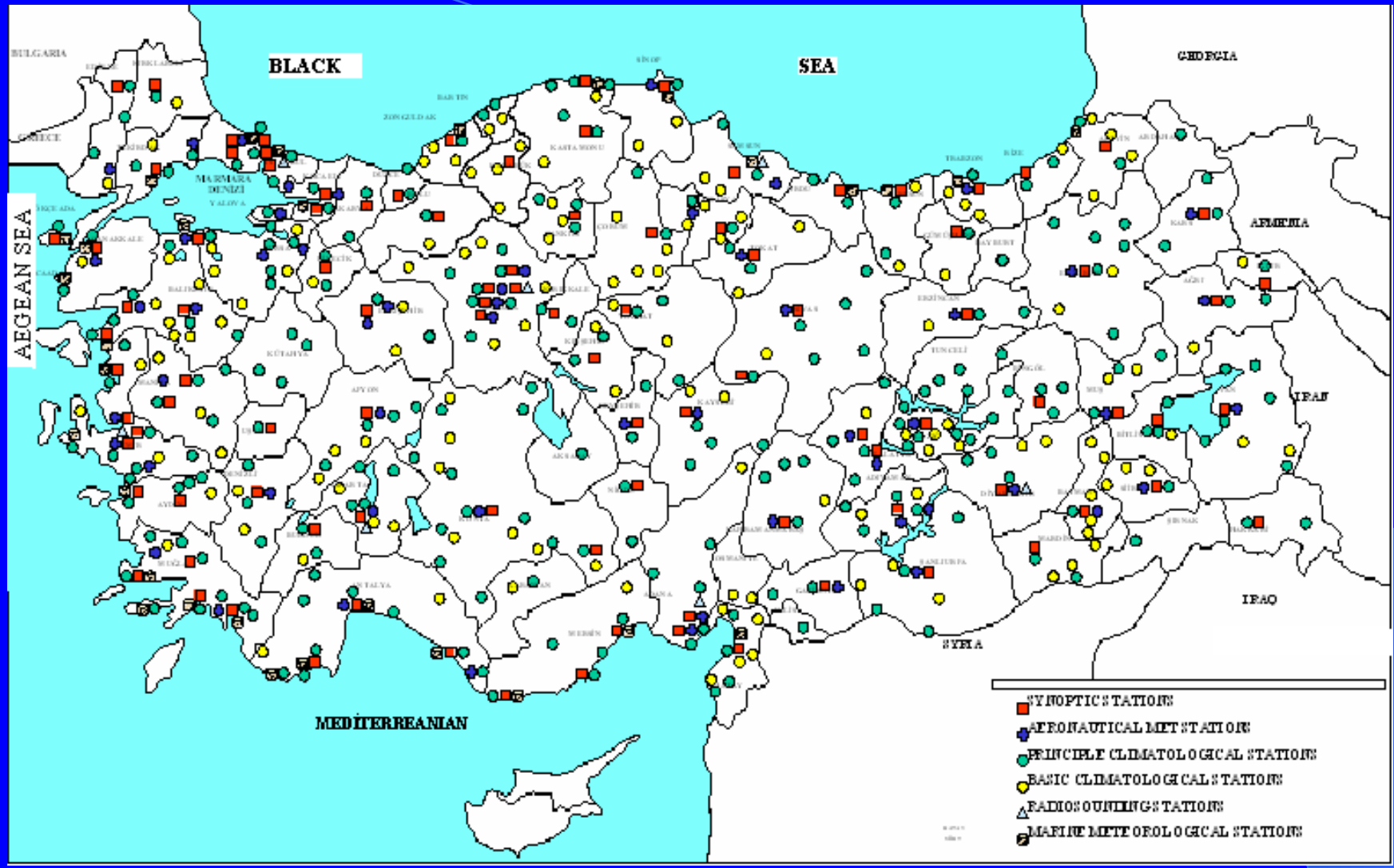
One of those modernisation studies is the renovation of the existing observation network and establishment of automated measuring and reporting systems, i.e. AWOS.

In general, two types of observation have been made in Turkey but this presentation covers the modernisation studies of the surface observation systems only.

2. OBSERVATION NETWORK

TSMS has been operating a meteorological observation network spread all over the country consisting of:

- climatologic stations – 339 (161 automated)
- synoptic stations – 110 (45 automated)
- airport stations – 65 (22 automated)
- automated wind measuring and monitoring systems - 41
- weather radars – 4
- radiosonde stations – 7
- satellite receiving system -1


BLACK
SEA
AEGEAN SEA
MEDITERREANIAN
GEORGIA
ARMENIA
IRAN
IRAQ
SYRIA
SYNOPTIC STATIONS
AERONAUTICAL MET STATIONS
PRINCIPLE CLIMATOLOGICAL STATIONS
BASIC CLIMATOLOGICAL STATIONS
RADIOSOUNDINGS STATIONS
MARINE METEOROLOGICAL STATIONS

The surface observation network before the implementation of modernization program;

- Mainly un-automated
- Conventional meteorological instruments
- A few automated observation instruments

3. MODERNIZATION STUDIES

After starting the modernization program in 1997, stations in the western part of Turkey have been equipped with automated weather observing systems, weather radars and satellite based communication system (VSAT). Those studies are still in progress and remain part of the network is planned to be equipped with automated systems by 2010.

Some of the proposed systems within the scope of modernization program have already been installed and put into the service. These are:

- C-Band Meteorological Doppler Radar (4)
- Automated Weather Observation Systems (228)
- Electronic Wind Measuring Systems (41)
- GPS based radiosonde stations (7)
- Satellite Based Communication System (VSAT-228)
- Meteorological Satellite Receiving System (1)
- Message Switching System (1)

3. 1. Automated Weather Observing Systems (AWOS)

Automated Weather Observation Station is a complete observing set consisting of:

- sensors and sensor interfaces
- data collection unit
- central control and processing unit
- display unit
- communication interfaces
- power supplies

3.2.Site selection

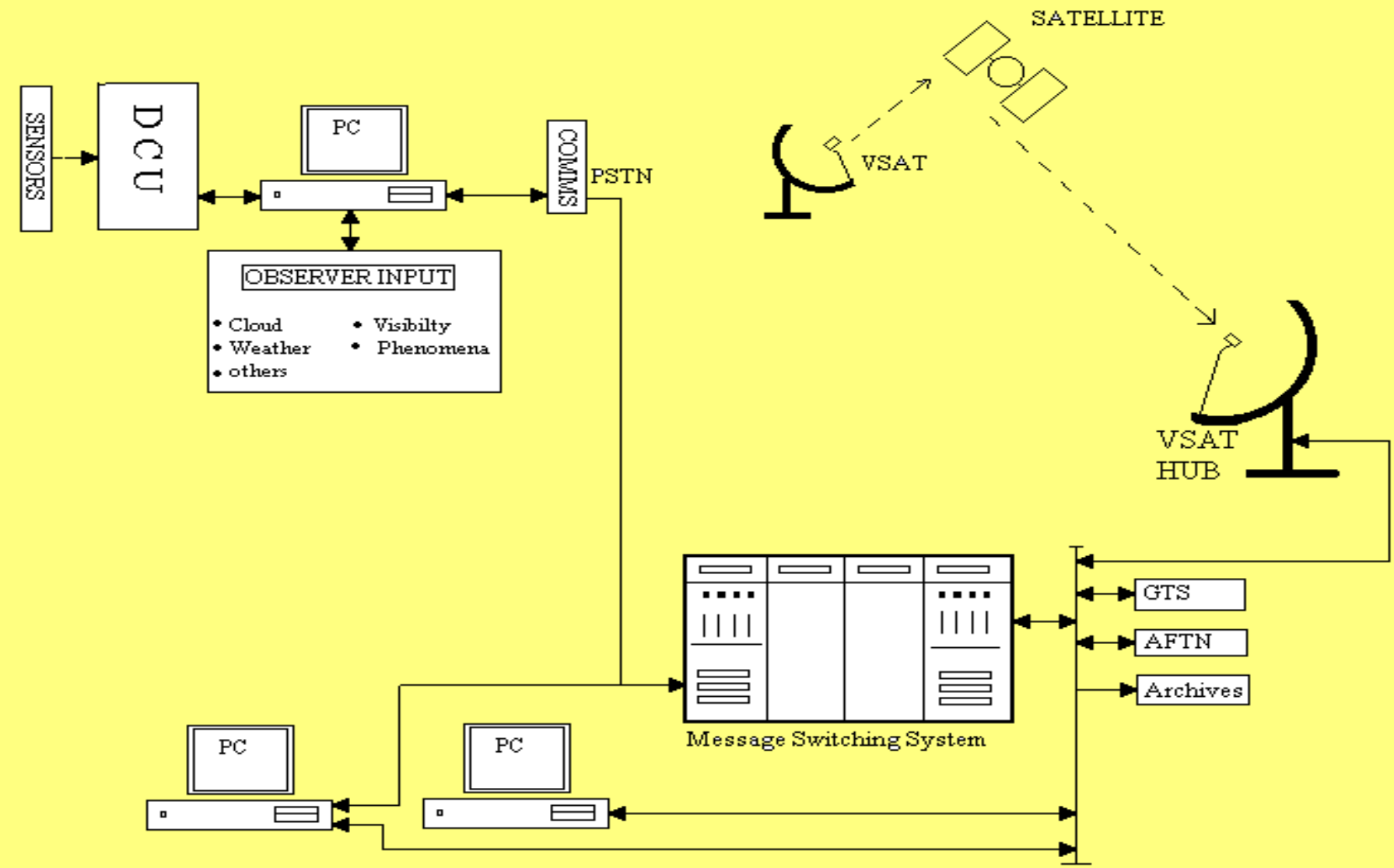
Determination of the correct locations to install AWOSs is the first and the most important step for overall success of the project. These locations have been determined by TSMS considering WMO recommendations. During that determination study following criteria were considered:

- types of meteorological parameters to be measured
- purpose of obtaining those parameters

- variability of parameters according to the other places around the station
- the size of the area presented by the station
- suitability for meteorological observation
- infrastructure and communication facilities

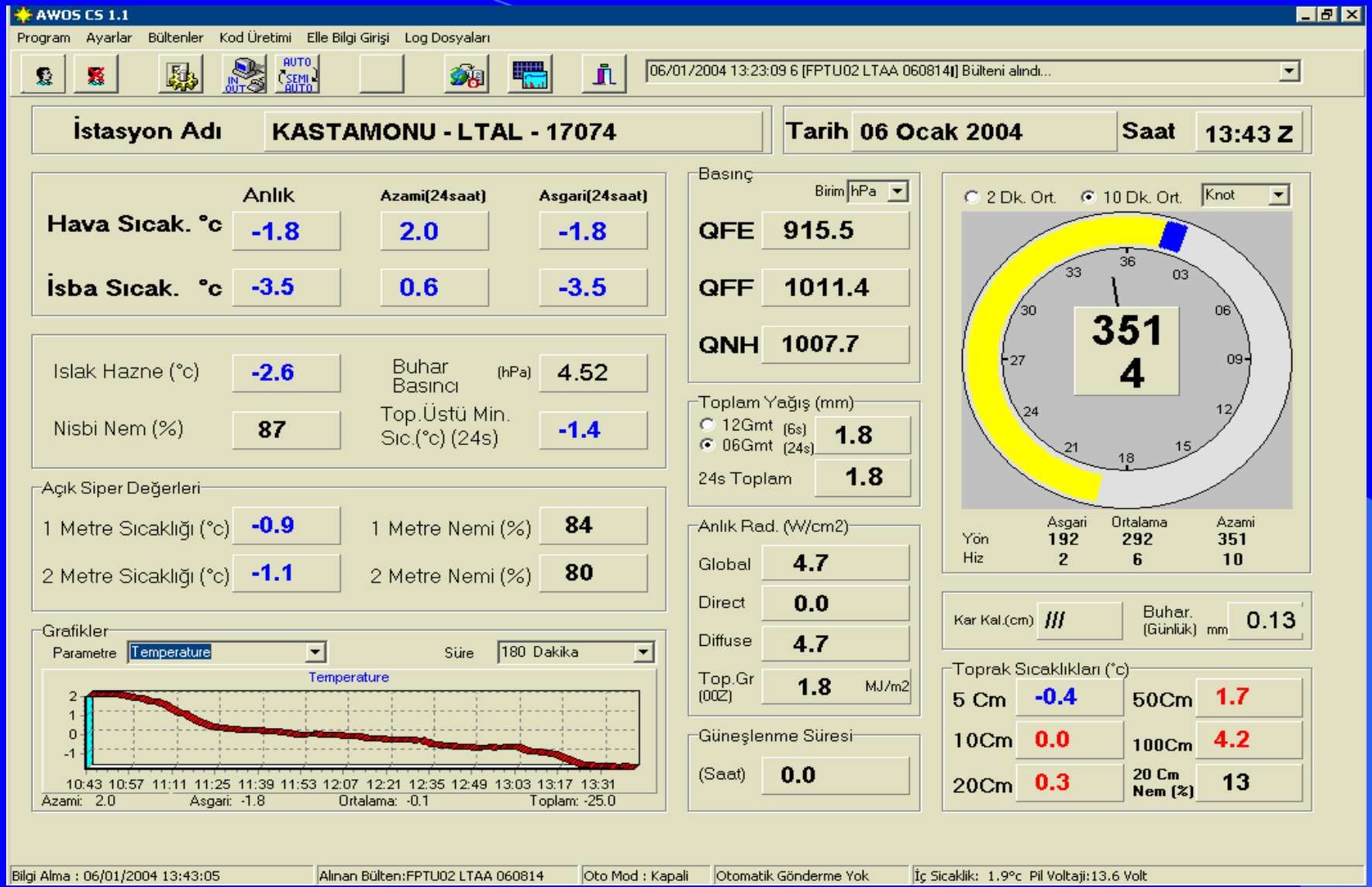
3.3.General system architecture

- A general architecture and system components of AWOS network is shown below. This configuration uses the VSAT network as the primary communications medium. A secondary communication channel using PSTN is proposed for maintenance purposes as well as a backup line if the VSAT network becomes unserviceable.


SATELLITE
SENSORS
DCU
PC
COMMS
PSTN
VSAT
OBSERVER INPUT
• Cloud
• Weather
• others
• Visibilty
• Phenomena
VSAT
HUB
GTS
AFTN
Archives
Message Switching System
PC
PC

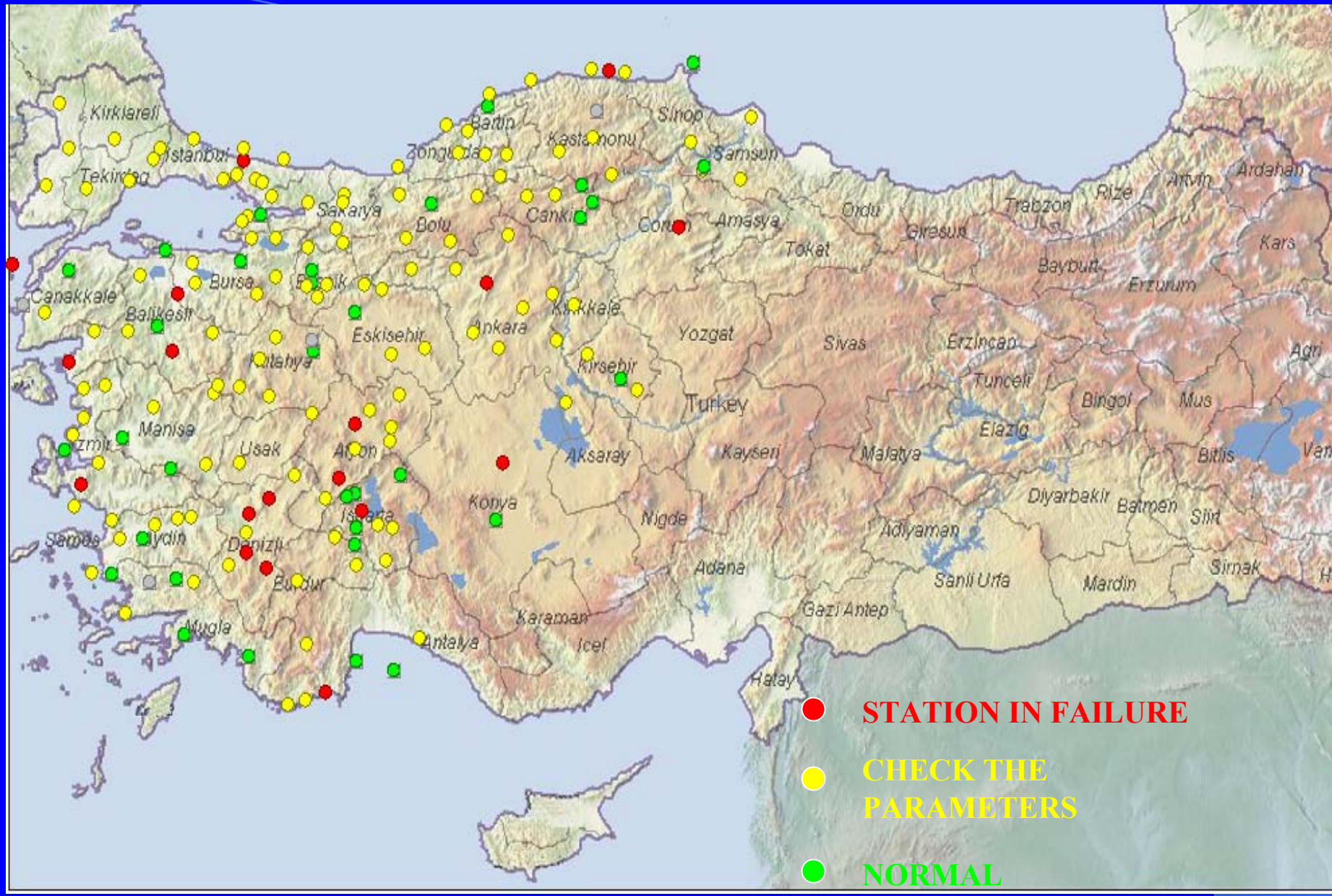
- The Observer console is a user friendly system that displays meteorological information coming from a Data Collection Unit (DCU) as well as allow an observer to manually supplement other meteorological variables such as cloud, visibility, weather, phenomena, etc. into the overall station observation process. The console automatically accepts data from a DCU and log this information in its local database.

Observer Console Screen



- The Network Monitor Terminal is a centralised computer system used by operational staff in the forecasting centre to view and control automated surface observation network. That terminal allows the operators to interrogate a station and upload high-resolution (10 min., 1 min.) data that is logged within the Observer console or DCU in the remote station to support forecasting activities, scientific research and data management activities.

- The Network Maintenance Terminal is a centralised computer system used by the maintenance staff to assist in the maintenance of the automated surface observation network.By using this terminal, maintenance staff can analyse status and diagnostics information on the operational network. The system would also allow central connection to any observational site to perform remote first-in maintenance or further system diagnosis. The system is also used to remotely upgrade outstation software on both the Observer Console and the DCU equipment.


Kirklareli
Istanbul
Tekirdag
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Sivas
Turkey
Manisa
Usak
Aksaray
Kayseri
Konya
Nigde
Adana
Aydin
Denizli
Mugla
Antalya
Karaman
Icel
Hatay
Sinop
Samsun
Amasya
Tokat
Ordu
Giresun
Trabzon
Rize
Artvin
Ardahan
Kars
Erzurum
Erzincan
Tunceli
Bingol
Mus
Elazig
Malatya
Diyarbakir
Batmen
Siirt
Sirnak
Mardin
Sanli Urfa
Gazi Antep
Adiyaman
Agri
Bitlis
STATION IN FAILURE
CHECK THE PARAMETERS
NORMAL

3.4.Parameters measured automatically

- Wind speed
- Wind direction
- Air temperature
- Dew point
- Relative humidity
- Precipitation
- Air pressure
- Solar radiation
- Height of Cloud base
- MOR and RVR
- Runway Surface Temperature

3.5. Advantages of automated weather observing systems

Advantages of automated systems can be summarised as follows:

- Standardisation of observations (both time and quality)
- Continuous measuring of parameters daytime and night-time
- More accurate
- More reliable

- Higher resolution
- Collection of data in a greater volume
- Adjustable sampling interval for different parameters
- Free from reading errors
- Free from subjectivity
- Automatic QC in both collection and reporting stages
- Automatic message generation and transmission

- Monitoring of meteorological data
- Access of archived data locally or remotely
- Data collection from harsh environments

3.6. Disadvantages of automated observations

Automated observations have also some disadvantages. Those systems require;

- Ongoing periodic maintenance
- Periodic test and calibration
- Well trained technicians and specialists
- Well trained operators
- High cost of instrumentation and operation

3.7. Features of AWOS Network

The AWOS network is capable of:

- Collecting, processing and displaying meteorological data
- Performing automated generation and transmission of meteorological reports such as SYNOP, METAR, SPECI, etc.
- Being configured to support a wide range of sensor configurations

- Supporting a vast range of data communication options
- Managing all communication protocols for the various sensors and other data communication equipment
- Storing all relevant data for subsequent retrieval as required
- Allowing for manual input of additional information unable to be automatically measured
- Providing Quality Control on both data measurements and message generation
- Allowing authorised users to access remotely for any tasks to be performed

3.8. Sensors in AWOS network

Following parameters are measured automatically by the sensors connected to DCU:

- Wind speed
- Wind direction
- Air temperature
- Relative humidity
- Air pressure
- Precipitation
- Height of Cloud Base

- Visibility
- Soil Temperatures
- Soil moisture
- Global radiation
- Direct radiation
- Snow depth

In addition to measured parameters, some parameters are calculated by using measured data. These are:

- Wet bulb temperature
- Dew point
- Vapour pressure
- Evaporation
- Diffuse radiation
- Sunshine duration
- Runway Visual Range

3.9. Network Maintenance

In a very near future, TSMS will be operating a very large observation network consisting of 600 automated stations, 15 weather radars, communication equipment, etc.

The most important process after the installation of such systems is regular maintenance of the network and each sub component.

Maintenance policy:

- -Protective maintenance
- -Corrective maintenance
- -Calibration

3.9.1. Protective maintenance

- Daily maintenance:
  - by local technicians and/or operators
  - general system control
  - checking data transmission, recorders, printers,etc.
  - cleaning of components
  - reporting to the centre

- Weekly-monthly maintenance:
  - by local technicians
  - general system control
  - checking data transmission, recorders, printers,etc.
  - cleaning of components
  - Quality control of data
  - reporting to the centre

- 6 month-and yearly maintenance:
  - By trained technicians from centre
  - general system control
  - System performance test
  - Field calibration
  - checking data transmission, recorders, printers,etc.
  - Correction of failures if any

3.9.2. Corrective maintenance

Any system failure can be repaired by two ways:

- Locally:

  System failures in certain level shall be repaired by local technicians with remote support from maintenance centre.

- From centre:

- The failures which can not be repaired by local technicians shall be under the responsibility of system specialists and technicians in the centre.
- In case of such a failure, these specialists or technicians will reach the station as soon as possible and solve the problem.

3.9.3. Calibration

- It is necessary to calibrate the systems to maintain the quality of data.
- TSMS has planned to upgrade its instrument laboratory to support that network.
- This laboratory is proposed to be of sufficient standard and staffing to act as the country's national standard for meteorological observations and to possess linkages to the WMO Regional Instrument Centre , and other national laboratories.

4. CONCLUSION

- Using of modern observation systems seems to be a necessity to meet the requirements.
- It seems very difficult for the automated systems to replace of observers.
- While operating automated system we should also keep the manual systems in operation for a certain period as a back-up system as well for comparison.

- The observers should be trained for new systems.
- Technicians should have basic knowledge of meteorology with the knowledge of related science.
- Such systems require periodic maintenance and technical service to maintain the system in operation properly.
- Meteorological services should share their experiences.