



A COMPARATIVE STUDY ON WIND AND WAVE SOURCES FOR TURKISH BLACK SEA COAST

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COASTAL METEOROLOGICAL STATIONS (CMS):

The Coastal Meteorological Stations (CMSs) around Turkish coasts have been in use for more than 30 years and some are even as old as 50 years. There are more than 100 CMSs around Turkish coasts and 28 of them are along Turkish Black Sea Coast (TBC) (Figure 1). CMS can be defined as a meteorological station located within 20 km inland of the coastline. However, as the topography of TBC is mostly mountainous, this definition may not be applied for all CMSs along TBC. Therefore, not all of the CMSs are representative for their regions in terms of winds blowing from open sea directions. Wind roses obtained from CMSs for some selected sites are shown in Figure 2 as an example.



Figure 1- Coastal Meteorological Stations (CMSs) along Turkish Black Sea Coast (TBC)

There are several reasons behind this non-representativeness:

- High urbanization around CMS (buildings, etc.)
- Heavy forestation around CMS
- Poor choice of CMS locations
- Complex topography around CMS
- Lack of calibration of the measuring equipments

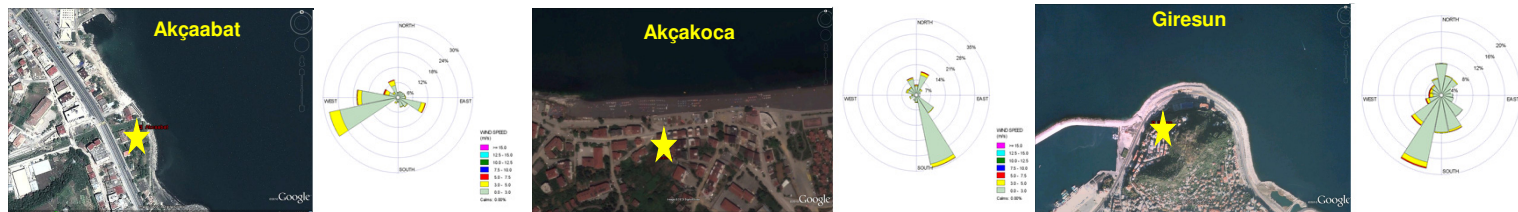


Figure 2- Examples of Wind Roses Obtained from Hourly Wind Measurements of CMSs for 3 Locations along TBC

WIND SOURCES:

As most of the CMSs along TBC are non-representative in terms of wind climate, it became a necessity to find and use an alternative wind source for TBC. ECMWF is chosen as the alternative wind source since it is more commonly available and also Turkey is a member country. A comparative study has been performed between the hourly wind measurements of CMSs and 6 hourly wind data of ECMWF (Operational Archive, 0.1° grid resolution).

Comparisons have been performed for all 28 CMSs along TBC. The results indicate that compared to ECMWF:

- Case 1. CMSs may totally miss some storms for different wind directions
- Case 2. CMSs may totally give higher peak wind speeds during storm conditions
- Case 3. CMSs may give lower wind speeds

An example is shown in Figure 3 for Sinop region highlighting the above given cases.

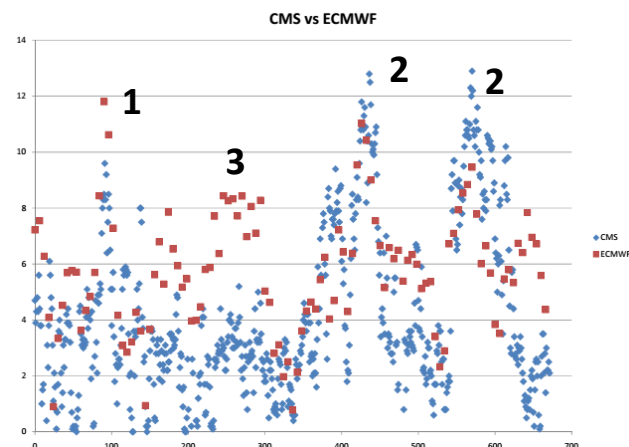


Figure 3- CMS vs ECMWF (42.20°N 35.10°E) for Sinop region (February, 1983)

EXTREME WAVE STUDIES:

The general engineering application in Turkey is obtaining the wave climate from wind data sources. Therefore, to compare the results obtained from hourly wind measurements of CMSs and 6 hourly ECMWF wind data, a numerical wave prediction model is used. The numerical model, W61 which was developed by Ocean Engineering Research Centre, Civil Engineering Department, METU, uses Pierson-Moskowitz empirical relationship to predict both long-term and extreme wave data. The application of the numerical model has been performed for several regions along TBC. An example of a comparative study for extreme wave statistics between CMSs and ECMWF is given in Figure 4.

The application area is shown as red star, and the locations of CMSs and ECMWF are also given as yellow stars in Figure 4. Graphs of "Deep Water Significant Wave Heights (H_s) vs Probability" for ECMWF (41.20°N-38.10°E), Giresun CMS and Ordu CMS are given in Figure 5. The extreme wave heights are also shown in Table 1. The results show that the extreme waves obtained from CMSs are lower than extreme waves obtained from ECMWF.

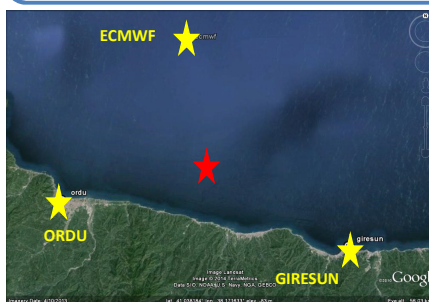


Figure 4 – Study Location (Red Star), ECMWF, Giresun and Ordu CMSs (yellow stars)

Table 1 – Extreme Wave Statistics Results

Rp (years)	Hs (m)		
	ECMWF	Giresun	Ordu
5	4.83	2.09	2.16
10	5.37	2.50	2.38
50	6.56	3.41	2.86
100	7.07	3.79	3.06

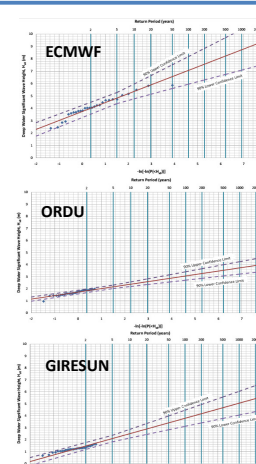


Figure 5 – "Deep Water Significant Wave Heights (H_s) vs Probability" Graphs for ECMWF (41.20°N-38.10°E), Giresun and Ordu CMSs

CONCLUSION:

This study is the first step of a series of studies on wind sources that may be used for coastal engineering applications in TBC. Up-to-date studies show that CMS wind measurements are not reliable enough for their regions in terms of wind climate as well as extreme wave statistics.

Comparative studies are being carried out including in-situ measurements to have a reliable result on the use of ECMWF wind data in coastal engineering applications in TBC