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Observed and Predicted Daily Wind Travels and Wind Speeds in Western Iraq

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Abstract- Calculated daily travel and wind speeds variations were determined. An empirical equation of diurnal changes in wind speeds developed for Western Iraq can be aware of the wind erosion and atmospheric dust storms cause. Wind speed is one of the priority factors to reduce the wind erosion by apply techniques or change environmental systems in that region.

Wind speed calculated based upon the measured hourly values of wind speed for the period of 2000-2010.

Results of research indicate that Western Iraq has a potential of wind speed have significantly during October through march , so land cover is needed and the best land cover is grow perennial biodiversity and artificial land cover which can reduce on soil removal.

Besides, there has been a lack of precise meteorological measurements to aid to monitoring and prediction of high-resolution winds in mulched lands.

This model uses a truncated sin wave function to predict day-time wind speed changes and an exponential function to predict night-time wind speeds. In this method we can realize the impact of land covers on wind erosion.

Key words- *Wind speed, Day-night winds, Wind erosion*

I. INTRODUCTION

Wind erosion and dust storms are a serious problem in many parts of the world. It is worse in dry lands areas most susceptible to wind erosion on agricultural land include much of Western Iraq deep sandy soils generally are considered to be high erodible. The study of wind speed and direction is one of the priority factors to reduce the wind erosion by apply techniques or change farming systems in that area.

Dust has been recorded by climatological stations across Western Iraq for many years, but automation is now phasing out reporting of this useful indicator of wind erosion.

Wind erosion physically removes the lighter, less dense soil constituents such as organic matter, nitrogen, phosphorus, clays, and silts which depend on the wind speed. [1] Found that 7.75% of accumulated dusts were organic materials. Thus it removes the most fertile part of the soil and lowers soil productivity (Lyles, 1975). Lyles (1975) estimated that top soil loss from wind erosion causes annual yield reductions.

Broadscale wind erosion rates can be approximated using meteorological data which reports the frequency of occurrence of dust events (dust storms and local dust events) weighted according to their intensity as a Dust Storm Index (DSI) [2] Changes in wind erosion rates are measured in both space and time using the DSI and the impacts of land use are approximated by comparing measured DSI values with the rates predicted by a wind erosion model (Ew model) [3].

The Ew model is an indicator of wind erosion under natural conditions, without the impact of land use activities. The model predicts the level of wind erosion by utilizing both wind erosivity (the power of the wind to erode) and land type erodibility (the susceptibility of the land to erosion). Wind erosivity is measured using wind run data, and land type erodibility is measured using precipitation and evaporation parameters to estimate effective soil moisture, which when averaged annually, approximates vegetation cover.

The relationship of wind speed variations to atmospheric stability has been studied by Oke who concluded that the greater the transfer of horizontal momentum towards the surface, the greater the surface layer winds.

The study has dealt with different micro-climatologically parameters data types. These include latitude, date, daily wind travel, wind speed, ambient temperature, day length, night length.

During the night time the wind speed used to be calm when buoyancy is reduced and little vertical exchange occurs. Peak wind speed occurs near noon when solar heating promotes vertical exchange resulting in greater momentum transfer toward the surface.

A one dimensional model of the neutral planetary boundary layer is used to predict the wind velocity and coefficient of eddy diffusivity throughout the 2-km planetary layer [4] who concluded that the wind speed prediction error was 1.2 of the observed values.

Average wind speed estimate from the data base have been systematically compared with corresponding wind speed estimate from buoy measurements and model prediction, and very good agreement has been found [5].

The objectives of this study is construct a wind speed model for predicting diurnal changes in wind speed and to evaluate its relation to air temperature for Western Iraq. This study includes a comparison between the measured and calculated diurnal variation of daily wind speed.

II. MEASUREMENTS

The study performed in the, Western Iraq, which is at latitude 33° N, longitude, 44° E. The climate of the study area is semi-arid and sub-tropical. Mean annual precipitation is 420 mm with > 80% of its value is falling from May to October. Mean monthly temperature range from 14C in winter and 45C in summer. The average monthly wind speed is the highest during the summer months.

The measurements of microclimatological parameters include wind speed and air temperature data were collected from Metrological Station. The data were recorded continuously (24 hours) on hourly basis for long-term [2000 to 2010], using automatic computer connected on-line with the data acquisition system.

III. CALCULATION PROCEDURE

The model uses a truncated sine wave function for the period from sunrise to sunset and an exponential decay function from early sunset to sunrise. An input for the model includes day length (determined by date and latitude) and maximum and minimum daily wind speed. The following equations are used for calculation of the wind speed (m/s) during day-time (WSd) and night-time (WSn).

$$WSd = (WSmax. – WSmin.) \sin [(n/y+2a)] + WSmin. \qquad (1)$$

$$WSn = (WS – WSmin.) \exp[(-bn)/z)] + WSmin. \qquad (2)$$

Where WSmax. and WSmin. are maximum and minimum wind speed (m/s). WSs is the wind speed at the sunset (m/s). y and z are day and night length (h). n is the number of hours from the hour of minimum wind speed to unset (h). N is the number of hours from sunset to the hour of minimum wind speed (h). a is the time-lag in maximum wind speed (h) and b is a coefficient that controls wind speed decrease at night.

To calculate the values of the variables a and b the non-linear error minimization technique developed by [6] was used taking into account the monthly mean of diurnal wind speed for successive years period (2000 to 2010) for West Midland region. The results show that the values of (a) and (b) were 1.2 and 3.1, respectively. The day-length (y) and night-length (z) were computed from the data and from latitude by a method developed by [7] and effective photoperiod day developed by [8].

IV. RESULTS AND DISCUSSION

A. *Relationships Between DWT, WSd and WSn*

The hourly values for wind speed is not always available, while the total wind speed travel is available more often. For this reason a relation between daily wind travel (DWT) and mean wind speed for the day (WSd) and night (WSn) could be useful.

The hourly values of wind data for the experiment period were used to develop a regression equation. Linear regression analysis from software program package was used to analyze the data set. The resulting relationship was given in Table 1**.**

The scatter diagram of the hourly values of wind speed (WSd,WSn) vs. the hourly wind travel were plotted in Fig. 1.

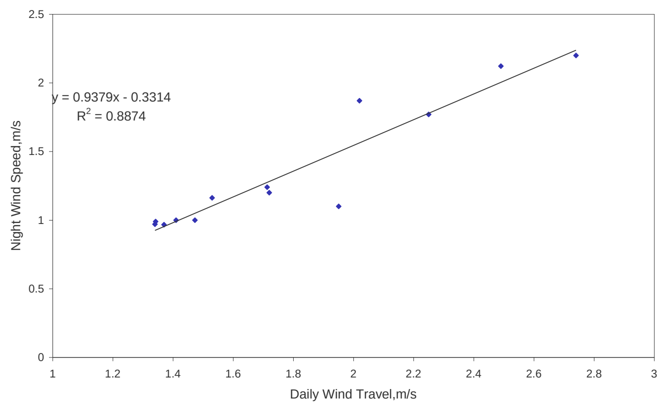

Figure 1. Relationships between night wind speed and daily wind travel0

B. *Relationships Between DWT, WSmax. and WSn*

The scatter diagram of daily wind travel vs. average maximum and minimum wind speed was plotted in Fig. 2.

An average maximum wind speed during the afternoon hours (12:00 to 15:00 h) and average minimum wind speed during the morning hours (03:00 to 06:00 h) were used instead of the instantaneous maximum and minimum daily wind speed to get a more accurate approximation. The resulting regression equation using these data was:

$$WSmax. = 1.297 (DWT) – 0.921 \text{ (m/s)}$$
$$R^2 = 0.921$$
$$WSn = 0.622 (DWT) + 0.544 \quad \text{(m/s)}$$
$$R^2 = 0.713$$

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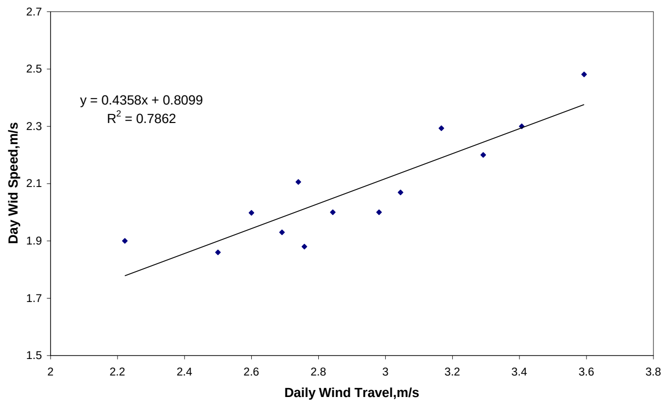


Figure 2. Relationships between maximum wind speed and daily wind travel

C. *Observed - calculated wind speeds*

The measured and calculated data of wind speed for the recording period were shown in Fig.3**.** The figure shows that the linear relationship exists between the values. By fitting the data points in the figure, the following equation was formed with a high correction coefficient, R^2 = 0.982.

WSc = 1.042 (Wm) + 0.1934 (m/s)

Where: WSm and WSc are measured and calculated wind speeds respectively.

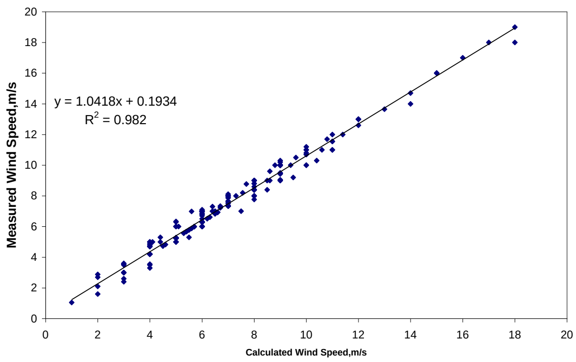


Figure 3. Relationships between calculated and measured wind speeds.

TABLE I. THE EXPANSION COEFFICIENT IN Y = AI + AX EQUATION THE CORRELATION COEFFICIENT (R^2).

Case	Intercept	Slope	R2
WSd	0.810	0.435	0.786
WSn	0.331	0.938	0.887
WSmax.	0.124	1.30	0.921
WSn	0.544	0.622	0.713

D. *Evaluation of wind speeds estimation*

Closeness of the calculated wind speeds to the measured values were checked by comparing: (I) the differences between the calculated and measured wind speeds averaged over the recording period and (II) standard deviation of the averaged difference is defined as:

$$D = 1/n\ \Sigma\ (WSc - WSm) \qquad (3)$$

$$S.D = \sqrt{[\Sigma\ (WSc - WSm) - nD]\ Rs/\ n^{-1}}$$

Where: WSc and WSm are calculated and measured wind speed (m/s) respectively, and n is the number of observations.

Table 2. gives the value of average differences, D and standard deviation of the differences, S.D. for the values of calculated wind speeds. The S.D. of the average differences was the greatest in February (1.7 m/s) and trends to decrease (0.4 m/s) in March.

TABLE II. AVERAGE DIFFERENCES AND STANDARD DEVIATION OF THE DIFFERENCES BETWEEN THE OBSERVED AND CALCULATED WIND SPEED, M/S.

Months	Average Differences [D]	Standard Deviation [S.D.]
January	-0.02	1.658
February	-0.40	1.747
March	-0.02	0.409
April	-0.02	0.964
May	-0.38	0.554
June	-0.39	1.154
July	-0.01	1.270
August	-0.02	1.087
September	-0.01	0.635
October	-0.29	1.706
November	-0.03	1.670
December	-0.36	1.554
Annual,2000-2010	-0.16	0.481

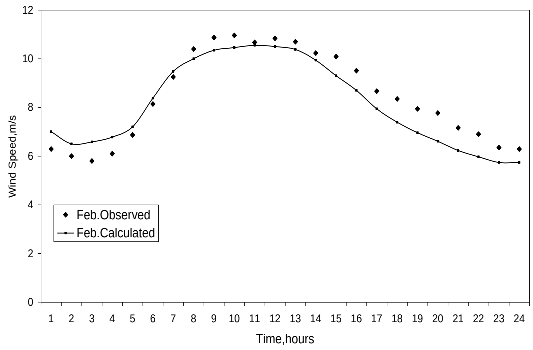
Figure 4. shows that the method does well in calculating the mean monthly diurnal wind speeds compared to the measured values. Also, the seasonal changes in the pattern are well represented in the calculation method. During October through March the most effective wind speeds can be occur, so we suggest perennial and tagasaste are the best fodder to be grown to reduce land exposure and reduce wind speeds.

V. CONCLUSIONS

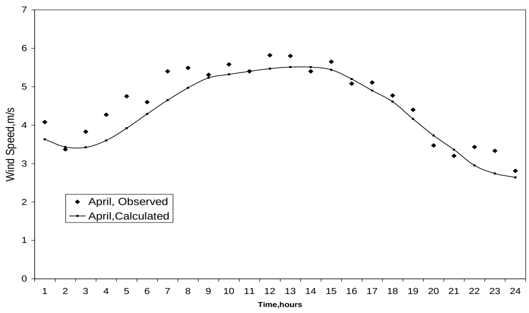
The wind model has potential applications in dust storms and agricultural, biological, of Western Iraq research and application models. An analysis wind speed and air temperature was performed for the Western of Iraq region for the period of 2000 – 2010. A sine exponential model for the diurnal variation of wind speed estimation was used for this purpose.

The study shows that using long-term average gives better results since extremes tend to be smoothed out as more data are averaged. The difference between the measured and calculated wind speed can be simulated within 6% - 27% with mean of 18%.

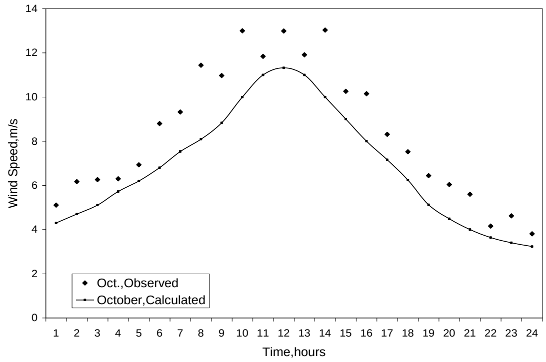
A good relationship between daily wind travel and mean wind speed for day and night maximum and minimum wind speeds was obtained



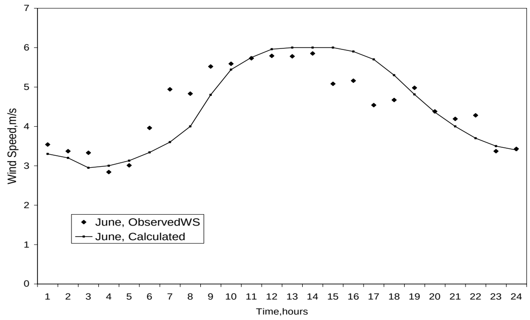
(a)



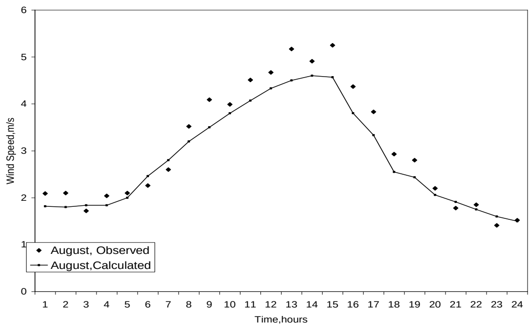
(b)



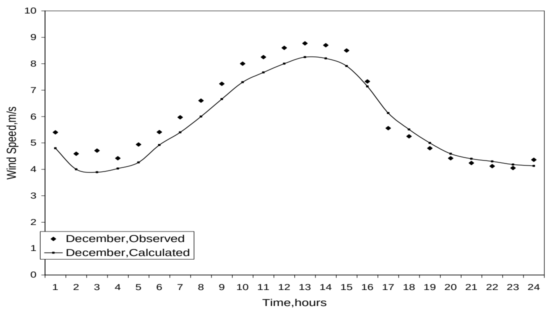
(c)



(d)



(e)



(f)

Figure 4. Comparison between calculated and observed wind speeds

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