Engineering 1D04
Assignment VII

The following is due at the **BEGINNING** of the tutorial (JHE/317-319) the week of March 10 to March 14, 2003:

1) The pseudo-code for the given problem. This must be typed, not hand-written. Make sure that you keep a copy of the pseudo-code so that you can use it to develop your C code. You will also need a copy to hand-in as an appendix for the next assignment.
2) Answers to the question(s) provided at the end of this assignment.

NOTE: Please include your tutorial number on every assignment. Also, remember that at the top of the first page of every assignment the following must be included:

"This assignment represents my own work"

followed by your signature, and your e-mail address. You need to include this information, or your assignment mark will be ZERO. Late assignments should be taken to the Drop-In-Centre (ITB/101). Late assignments will not be accepted after 4:30 on the day of your tutorial.

Problem

During scientific and engineering experiments, large volumes of raw data are often produced. Recently an experiment on contaminant transport at the ocean surface was performed in the North Atlantic. Among others values, the measurements of wind velocity *W* over the ocean surface were carried out. To make measurements a sonic anemometer was used. The wind velocity was measured systematically every Δt seconds producing several thousand readings.

You are required to make a preliminary analysis of field data to describe the behaviour of a single dust particle over the ocean surface and to estimate the surface drift currents and surface conditions during the field experiment. You can assume that a particle has the same density as the surrounding medium, and is influenced only by the wind blowing along the x-axis (one dimensional problem)(figure 7).

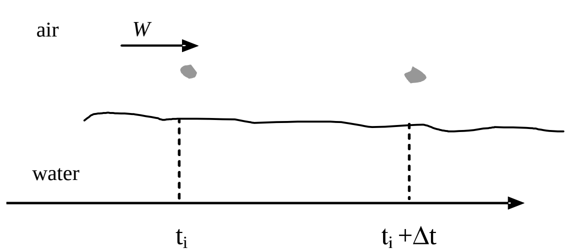

Figure 7: The position of a dust particle above the water body at two sequential moments of time t_i and t_i+Δt

The preliminary analysis of collected data sets has to inform a researcher about

(i) the acceleration of a single dust particle that is influenced by the wind ,

(ii) the values of surface drift currents when the speed of the wind is greater than 2 m/s, and

(iii) surface conditions during the period of measurements.

Before starting the pseudo-code, specify any assumption(s), that simplifies the problem and insert them as a comment before the start of the data declaration and pseudo-code.

When analysing the input information, the values of surface drift currents can be calculated using the following empirical formula

$$u = \frac{k}{\sqrt{\sin\varphi}} W$$

where u is the surface drift current in cm/s, W is the wind velocity in m/s, φ=52 °*N.L*, k=1.27 × 10^{-2} is the empirical coefficient (in addition to its empirical meaning, this coefficient includes the conversion from m/s to cm/s).

The pseudo-code will describe how to display (output) a table with the following format:

Time (s)	Wind velocity (m/s)	Acceleration of a dust particle (m/s^2)	Surface Drift Currents (cm/s)	Surface Conditions
t_0	W_0			
t_1	W_1			
t_2	W_2			
t_3	W_3			
…	…			

The second to last column must contain the calculated values of surface drift currents when the speed of the wind is greater than 2 m/s. Otherwise, no value is displayed in the column.

The final column will hold information on the surface conditions at the time the measurements were taken. If the wind velocity is greater than W_{max}, where W_{max} is 7 m/s, then the final column should indicate "**storm**". When the wind velocity is 5 m/s ≤ W ≤ W_{max}, the final column should indicate "**near storm phase**". When the wind velocity is 2 m/s < W < 5 m/s, the final column should indicate "**transition phase**". Otherwise, the final column should indicate "**calm**".

Notes

- It is the student's responsibility to formulate the problem and assumptions explicitly, and to determine the mathematics required for this problem.
- Your pseudo-code must allow a user to input the initial time (t_0) of the beginning of the measurements and the time step (Δt). In your pseudo-code, you must compute the times of measurements, using the following formula: $t_{i+1} = t_i + \Delta t$. The pseudo-code should store this information about the moments of time when measurements were done and about the results of measurements in a structure containing only two fields: time of measurements and wind velocity.
- Include in the pseudo-code sub-routines for input/output and the calculations.
- The main program should simply combine the subroutines.

Questions

1. What is a mathematical model?

2. What is modular programming?