Manual

The initial 0.2 version of the manual covers four sections, i**nstallation of the program**, **how to run/execute the program**, **how to use it**, **possible issues and some extra.** The manual here is the initial release version so it is brief and to the point, if you want to find a pre-documentation of the code, this one can be found in the documentation pdf at the same GitHub.

How to install:

Black tern is a pure C program, due to this can be installed into any machine that supports a gcc compiler. So far the code can be compiled and execute in BSD, OSX, Linux and covers any platform that supports a gcc compiler, so far it uses C99 standard and can be run on an X86-64 platform as any AMD/INTEL powered device or any ARM machine like the Apple-M1/Raspberry-Cortex.

Install instructions:

- Go to the terminal in your system.
- Open the folder where you downloaded the blacktern”version”.c file.
- Run the command: `gcc blacktern”version”.c -o blacktern`
- Run the command: `ls`
- After running the command you should see a new executable file named blacktern.
- It is done!, easy isn’t???!!!.

How to run:

In order to run blacktern you should go to your terminal again and navigate to the folder where blacktern is located, this as below:

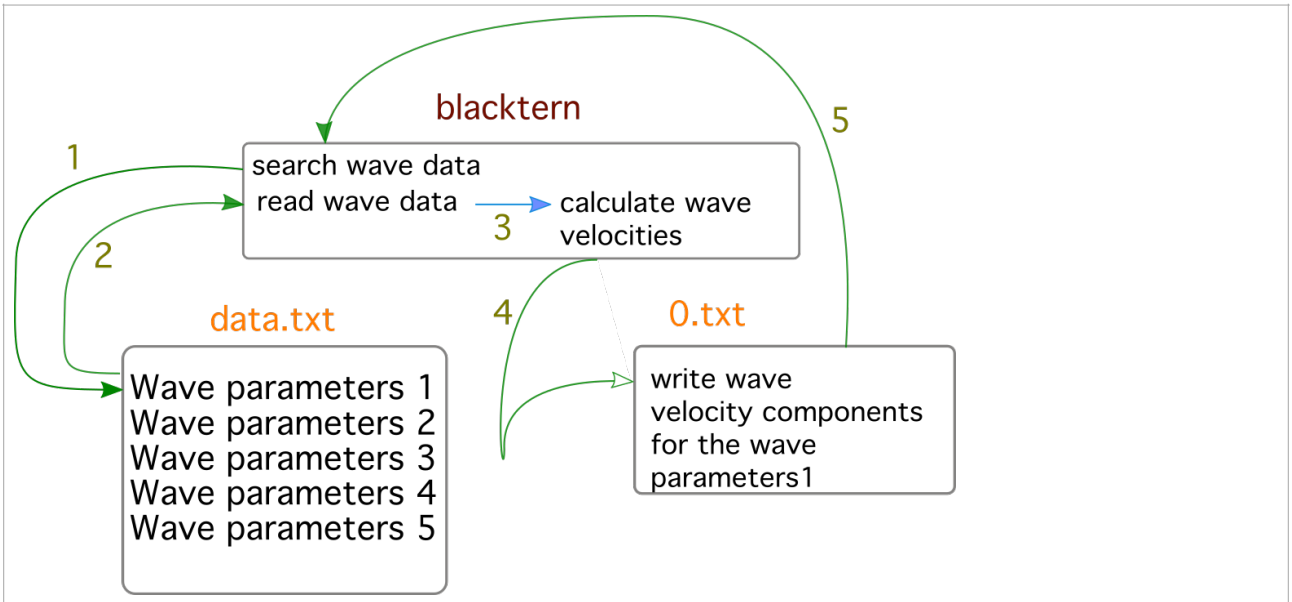
- Open the terminal and type: `cd </path to folder that contains the file/>`

Lets us say that your file is at your desktop in OSX, Linux or BSD, as when you open your terminal in any of those three you start from your user folder, then you will only need to type: `cd /Desktop`

Now that you are in the folder that contains the executable, you just need to type the name of the problem followed by an space and the path to the data file that contains the wave data: `./blacktern <name of file>.txt`

It is advised that your file must be in the same folder as blacktern, this to simplify the process. If your file name is `data.txt`, then you will type: `./blacktern data.txt`

Blacktern will produce series of text files as an output, each output file contains the (x,y velocity components). The files will be named using numbers, if you have a a file that contains the data for 5 wave types, then blacktern will produce 0.txt, 1.txt, 2.txt. 3.txt, 4.txt. The structure of the main work behind can be seen below:



For every wave parameter 1 to 5, one different output file will be generated. Here in this case the process will repeat 1 to 5 during five times to create files 0.txt, 1.txt, 2.txt, 3.txt, 4.txt, 5.txt.

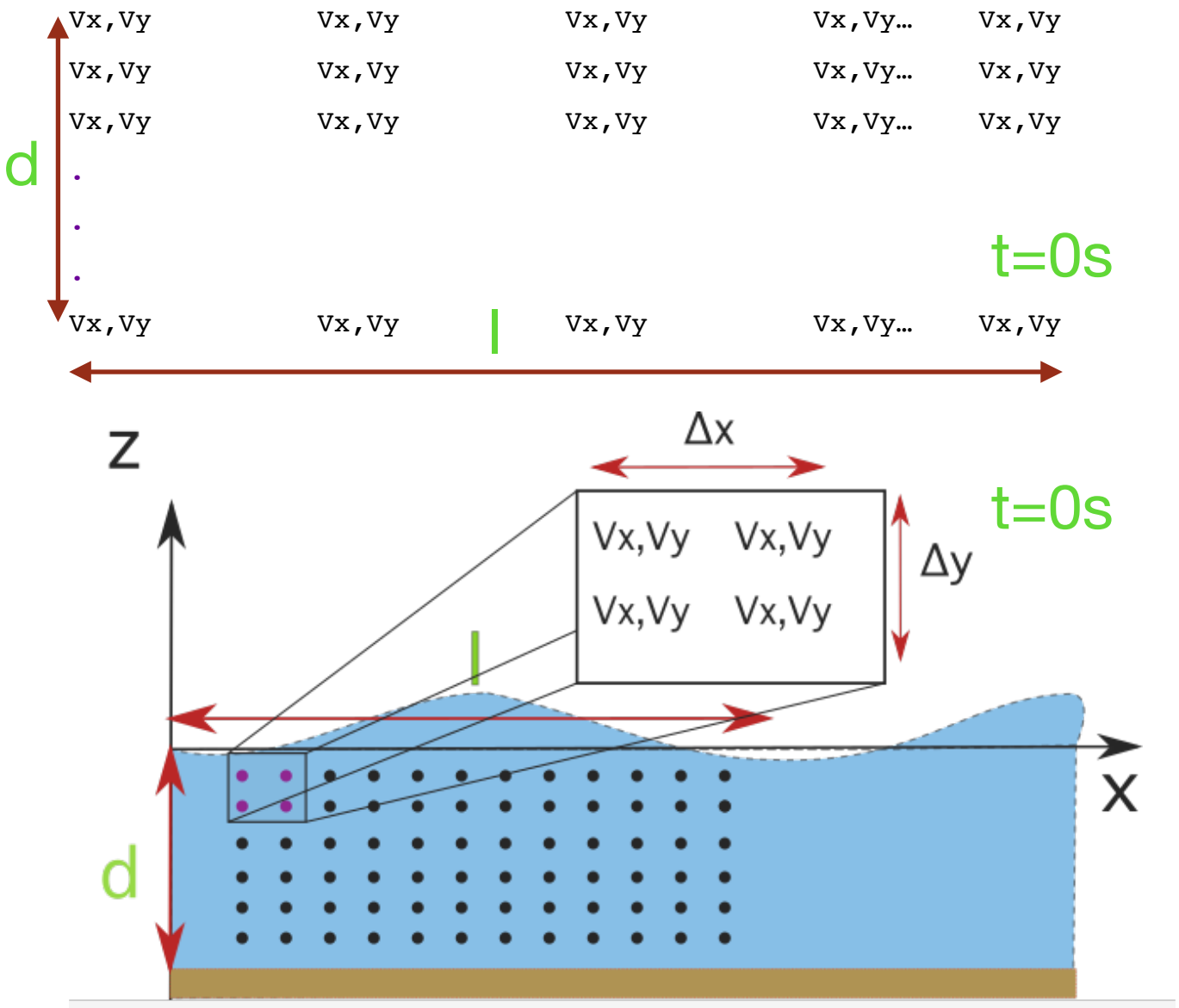
The output files will be named after its wave regime, for example if the conditions set for the wave parameters 1 are for a linear swell in deep waters and the conditions for wave parameters 2 have a swell moving in transitional water, then the files names will be:

`0.txt`

`1t.txt`

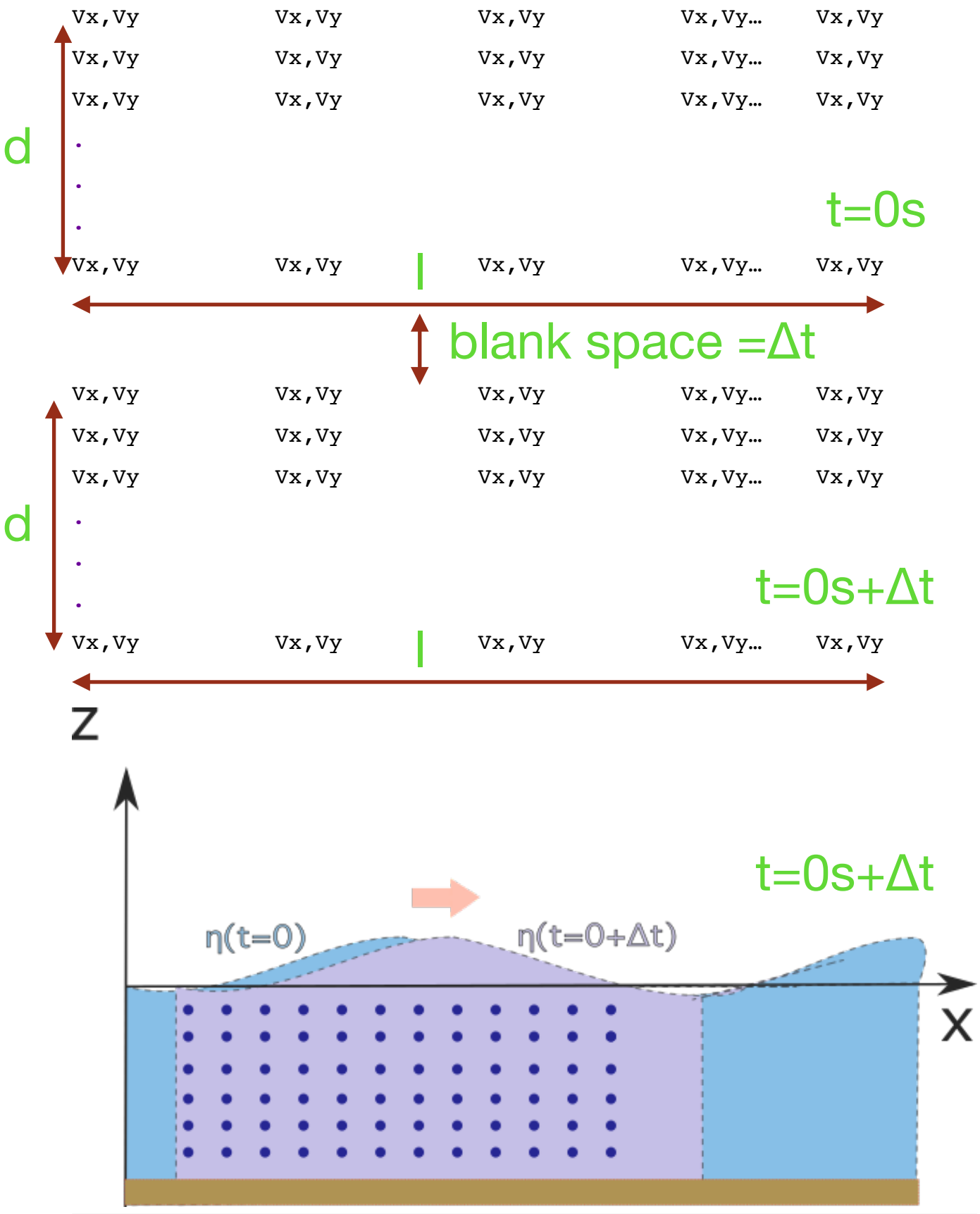
The extra t for the second output will denote the regime this wave is moving, **no letter** will tell us that the wave move in deep waters, **t** will tell us that the wave is on transitional waters, **s** will tell us that the move is moving in shallow waters.

The output files will have and structure of columns and rows, where the pairs of data will represent the x,y velocity components. The components will be calculated in a length that goes from 0 to the maximum wavelength of the wave and from the mean water surface z=0 to the death where the wave is moving. The structure of the output and how it relates to the physical model can be seen in the figure below.



Δx and Δy are given by the user in the wave data file, this will be mentioned in the next section

As the velocities are calculated from 0 to l and 0 to d, the variation on the velocities on time will be calculated next from 0 to the maximum period of the wave. The output file will have a jump with a blank space after calculating all instant velocities at t=0s, then will jump to t=0s+Δt. This will be repeated until a full wave period is completed, thus meaning that a full wave cycle passed over the area were we are calculating the instant velocities.



The new values for each point in the grid will correspond to the new flow velocity values as the waves moves over the defined area.

How to use it:

Step A

I order to use blacktern you will need already wave processed data, another processing tools will be added later. Blacktern uses a text file with extension .txt, the file must be composed solely by 5 rows that are separated by a space or tab space. The composition this file must have is:

- Wave period
- Wave amplitude
- Δx
- Δy
- Δt

The structure will be:

```
T1    a1  Δx1  Δy1  Δt1
T2    a2  Δx2  Δy2  Δt2
T3    a3  Δx3  Δy3  Δt3
.
.
.
Tn    an  Δxn  Δyn  Δtn
```

Every Δ is given by the user, lets say that we want to calculate the velocity field meter by meter, each second of a swell of 1m amplitude and period of T=10.5s. Then our file will be composed as:

```
10.5 1    1    1    1
```

Now if we want to calculate three wave swells with periods 10.5, 12.3, 14.5 and amplitudes of 1.2m, 1.5m, 0.8m then our text file will be composed as:

```
10.5 1    1    1    1
12.5 1    1    1    1
14.5 1    1    1    1
```

Of course, each Δ can be different, but if all wave components belong to the same analysis it will be advised to keep them at same Δ.

Step B:

After the file has been defined, now we only need to run blacktern and specify the file address or its name if the file its stored at same folder. Lets say our file is again named data.txt and blakctern is stored at same place as the data, then we will write:

```
./blacktern data.txt
```

The output will be stored at the same folder where blacktern us being used.

Example:

- We provide a file called data.txt with a very simple wave parameters, this file has some long linear waves in deep waters and some long linear waves in transitional waters. Download blacktern.c and the file at the same folder in your machine.
- Now that you already downloaded the code and the file, just open your terminal at the place and type: `gcc blacktern.c -o blacktern`
- There must be now an executable named blacktern in your folder too, now just check again (just to be sure), that the data file data.txt is at same folder than blacktern.
- Now type the name of the program followed by a space and the name of the data file as: `./blacktern data.txt`
- Now the program will ask you two things first the depth were the waves are moving, just enter a value and click enter.
- The program will ask you now the latitude of the buoy systems were you got this data, enter the values un decimal system as 35.456 on the example. Now click enter.
- If everything went well, now yo have several new text files from `0.txt, 1.txt, 2t.txt, 3t.txt`

Possible issues:

1) Blacktern can be compiled in BSD, OS-X and Linux or any system supporting gcc and pure C, however; some compilation instructions may change. It is known that for some linux-unix systems compile any C program using the library math.h, will need a flag. To do this then just compile using the next instruction:

```
gcc blacktern -o blacktern.c -lm
```

2) Black tern needs the name of file if this one is stored at the folder than the executable, if not we will need to path to the data file. AS an example lets us say that blacktern is at Desktop and the `data.txt` is at downloads, in OS-X or Linux we will use the next:

- Open your terminal at desktop.
- Type: `./blacktern /Downloads/data.txt`

Remember that blacktern will store the files at the place where blacktern is located, so the files wont be located where the `data.txt` file is.

3) Can't fin the output files?, as mentioned in last paragraph the output files will be stored at the same location as the executable.

4) Compilation gives an error?, usually the program even if small is tested to run each time so could be two things: I made a mistake and did not notice it or must be your machine or gcc installation. If any error arises please sent a message to try to reproduce it, this with the data and way that this occurred.

Extra:

Why blacktern asks for the buoy latitude and the depth of propagation?.

Well blacktern will possibly be an standalone code, however it is not meant to be one as this is just a piece of a larger program to analyse data. Black tern aims to have a something like:

Data stream -> code path ways->code[calculation]->code pathways->Data produced.

The code path ways is a very rough manner to talk about a non defined source of data, as this will be modified meanwhile the code grows. The aim is that the program will just plug into several types of data stream, this to maintain flexibility; by now the data streams that are implemented are just temporary but a good way to start!.

The data that is handed uses a double or float point value, however it only prints X.XXX length?.

The calculus in fact in black tern use double so the numbers can be quite long to keep all the possible decimals, however when we save data we only keep the dimensions till what would be 1cm. Cause you know its a bit too much!.

Blacktern uses linear and weakly linear theory, is that still a thing?.

Well blacktern aims to do fast calculations with and minimum of agreements on what in conditions will be ideal for the wave velocities. It is indeed true that even a weakly linear theory as Stokes dealing with non-linear functions in a Fourier expansion way might be “debatable for some mathematicians/physicists” and definitely for most of the engineers/ oceanographers out there. But meanwhile a solution is found to do fats as possible with strong non-linearities (that a there is, it exists definitely a rough approach) this will be postponed for later (Poncaire might forgive us for this!).

Blacktern is acurate?.

Well first, in the license clearly says that there no responsibility over the results, however in the theories that blacktern uses it is quite a good approach. The results are from time to time, compared to the solutions produced with tools as Mathematica with the exact analytical expressions.

And so far, so good!. But of there is any mistake please sent a message!.

Please:

As a request, if you use it at least tell about how it went and how bad or good this is done!.