VECTRI worksheet 1: station data

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1 Overview

In this exercise we are going to run the VECTRI model for a single point using station input data for a highland station in Africa. The input file has a long record of daily maximum, minimum 2m temperature in addition to rainfall, going back to 1951. We will integrate the model, and investigate the effect of changing the climate or the sensitivity to other model parameters.

2 Getting started

We will need some basic linux commands. Please note that linux is CASE SENSITIVE. All commands are in LOWER case. For variables, case is important.

What are the important files for VECTRI?

- $VECTRI/scripts/vectri_driver: the driver script to run the model
- $VECTRI/input/vectri.options: specify your preferences here
- $VECTRI/highland_location_africa.txt: An input ascii file of format yyyy mm dd tmin tmax rain

3 Running the model

Model input

- We are going to read in data for a highland site in Eastern Africa.
- The data file sits in the sub directory *data*.

Table 1: Basic linux commands

`mkdir dir`	**makes a new directory folder**
`ls dir`	**lists the contents of a folder**
`cd dir`	**change directory**

- You can view it by typing

  `less $VECTRI/data/highland_location_africa.txt`

Let's run the model!

`$VECTRI/scripts/vectri_driver 5 highland_location_africa.txt 100 1000`

We have specified the following options

- 5: mode that reads in ASCII station dats
- highland_location_africa.txt : the file name
- 100 : the population density km^{-2}
- 1000 : run for 1000 days (faster!)

note that 100 km^{-2} is typical for a rural population and thus we are modelling a rural community in the vicinity of the station with a similar climate.

If you now list the output directory,

`ls ./output`

you will see a new file that has been created, **vectri.nc**. Open the output header to see what is in the file

`ncdump -h ./output/vectri.nc`

Note the list of output parameters, their meaning is listed in the manual. At the bottom of the file there are the global parameters for the model options chosen.

Now open the file for viewer with ncview

`ncview ./output/vectri.nc`

First of all you can examine the input data, click on *temperature* and then *rainfall* to examine these variables.

Now click on the parasite ratio variable *PRd* - what do you see? not much, the malaria tails off rapidly after the integration start.

4 Changing the VECTRI options

vectri.options

You can specify new VECTRI options using this file which is situated in the subdirectory *input*. Open it using your favourite text editor, e.g:

`kedit ./input/vectri.options &`

or

`emacs ./input/vectri.options &`

The & symbol at the end is very useful, since it runs the command in the "background". This means you can still enter commands from the command-line while the editor is open

Usually vectri.options is *empty*, which means VECTRI is running with its default parameter settings.

You can specify any option by simply typing

parameter=value

in this file. Don't forget to save it! You can either put a list of options on separate lines (my preference), or they can follow after each other on the same lines separated by commas).

Before we start changing the climate parameters, lets introduce a "spinup" period, i.e. make the model run for several years to adjust away from the artificial initial conditions. Data from this spin-up period is not saved to the output file. To do this add the new parameter option

nyearspinup=5,

You might want to leave vectri.options open for future edits, but *don't forget to save the file if you do!!!*

5 Exercises for the station

5.1 Exercise 1

We will now run the model for the whole period, including the spinup period, and start the investigation!

`$VECTRI/scripts/vectri_driver 5 highland_location_africa.txt 100 21000`

We have now extended the run to last for 21000 days.

Q: Are there vectors in this location using the default model?

Q: Is there malaria in this location using the default model?

You may want to keep this file. If so, you need to rename it, or it will get overwritten the next time you run VECTRI. To do this use *mv* (move)

`mv ./output/vectri.nc ./output/vectri_run1.nc`

you can use whatever name you like for your file of course

5.2 Exercise: mild climate change

We will now investigate the impact of a changing climate. Let's start by warming the climate by 1 C, considered a safe limit for the future. How do you think you can do this? Look through the climate table and you will see the relevant parameter, which you can set to 1.0:

rtemperature_offset=1.0,

in **vectri.options**. *Don't forget to save the file after you edit it!*

Run the model again.

Q: Are there vectors in this location?

Q: Is there malaria in this location?

5.3 Exercise: medium climate change

You can now investigate further warmings, e.g 2, 3 and then 4 C in turn: *rtemperature_offset=2.0*,

Run the model again.

Q: At what temperature do epidemic outbreaks begin to occur?

5.4 Exercise: population density

A population density of 100 km^{-2} is typical for a rural local, although the value can vary greatly of course. Increasing the population density to 1000 km^{-2}, a typical peri-urban value, leaving the other parameters unchanged. Remember that the population density is controlled as a command line option

`$VECTRI/scripts/vectri_driver 5 highland_location_africa.txt 1000 21000`

Q: Is there malaria?

Q: Why do you think this is?

5.5 Exercise: climate trend

We will now return to using a population density of 100 km^{-2}.

Instead of a constant offset to the temperature, let us investigate the impact of a warming trend. Set the offset back to the default value of zero (you can simply delete it from the vectri.options file or set to zero) and instead lets put in a warming of rtemperature_trend=0.06 C yr^{-1}. Over the course of 50 years this leads to a warming of 3 C (larger than previously observed in general).

Run the model (remember with 100 people km^{-2}.)

`$VECTRI/scripts/vectri_driver 5 highland_location_africa.txt 100 21000`

Q: Is there malaria?

Q: Why do you think this is?

Q: Is there a trend in vector numbers?

5.6 Exercise: migration

Once malaria is eradicated by control measures (or dies out) in a region, it can be reintroduced by migration of carrying hosts back into the region.

Keeping the other parameters fixed (e.g. rtemperature_trend=0.06) we will investigate the effect of migration with a very simple approach. If we set rmigration to a positive value of 0.005, this implies that each year, migration always implies a presence of 0.5% of the population with the parasite.

rmigration=0.005

Rerun the model.

Q: Is there malaria?

Q: Why do you think migration has such an impact?

Q: What happens if you reduce or increase the migration rate?

5.7 Exercise: Example sensitivity test - hydrology

Make the ponds last a lot longer by *reducing* the infiltration and evaporation loss term factor to 100 mm/day (the default is 250).

rwaterfrac_evap126=100

Return to the case with an temperature offset=4C and no imposed trend, and reset the migration factor to zero.

Q: what happens to the malaria cases now ?

Q: Compare the water fraction to the case with the default value of rwaterfrac_itau

5.8 Exercise: investigate

See how the model responds to changes in other input variables - do it behave as you suspect? Do you see any strange behaviour you can not explain? (please tell me if so!)