DECIPHeR Nicola User Manual

**Gauges:**

**47137: Tamarstone (upper gauge)**

**47131: Bridgerule (middle gauge)**

**47133: Crowford bridge (lower gauge)**

# Preparing DEM and raster

1. Parameter class (aka landuse) in .asc format for HRU section

# DTA

1. Enter DECIPHeR DTA

cd ~/Documents/DECIPHeR-master/DTA\_Tamar

1. Set main directory and code directory

MAIN\_DIR=/home/ne240/Documents/DECIPHeR-master/DTA\_TAMAR

CODE\_DIR=/home/ne240/Documents/DECIPHeR-master/DTA

If the code has been modified: make clean followed by make all

1. Set DEM within the script

DEM has been filled with script by GC, lined with -9999 values as a barrier. DEM is 2m resolution.

DEM=tamar\_dem

GAUGES=gauges.txt

RIV=tamar\_river

1. Calculate topographic index, slope and accumulated area from the DEM

Run with the DEM file.

Note: .e files are the running, .d are the ones to use to debug as gives information on the problem.

${CODE\_DIR}/atb\_wfp.e –dem ${DEM}.asc

Outputs include: a topographic wetness index (tamar\_dem\_atb.asc), accumulated area (tamar\_area.asc) and slope (tamar\_dem\_mfd\_slope.asc).

1. Find headwater cells

${CODE\_DIR}/river\_find\_hw.e –dem ${DEM}.asc –river ${RIV}.asc

Can specify the search area by –search 250 default is 500m.

1. Create river

${CODE\_DIR}/river\_run.e –dem ${DEM}.asc –headwater ${RIV}\_HW\_500m\_100m.txt

1. Find gauges

Remember to specify search radius (500m, may need to be changed with the model).

Remember to delete previous files from this if rerunning (tamar\_river\_HW\_500m\_100m.txt) and tamar\_river\_dist.asc. Also delete station\_candidate.txt and \_station\_match.txt files.

${CODE\_DIR}/catch\_find.e –dem ${DEM}.asc –river ${DEM}\_riv.asc –stations ${GAUGES} –search\_radius 20

1. Create routing links between gauges stations (orders the stations based on the river)

${CODE\_DIR}/route\_tree.e –dem ${DEM}.asc –river ${DEM}\_riv.asc –points ${DEM}\_station\_match.txt

1. Generate catchment masks (catchment areas from each river gauge).

mkdir masks

Run first to create a directory called ‘masks’

${CODE\_DIR}/catch\_cut.e -dem ${DEM}.asc -points ${DEM}\_flow\_point.txt -out masks

1. Produce a nested catchment mask where all catchment masks are combined together

${CODE\_DIR}/catch\_mask.e -base ${DEM}.asc -tree ${DEM}\_flow\_conn.txt -mask\_dirs masks

1. Check against river mask

${CODE\_DIR}/mask\_check.e –mask ${DEM}\_mask.asc –riv\_id ${DEM}\_riv\_id.asc

1. Calculate topographic index and accumulation areas.

Reruns DEM TI with new information.

${CODE\_DIR}/atb\_wfp.e –dem ${DEM}.asc –river ${DEM}\_riv\_id\_check.asc –mask ${DEM}\_mask.asc

1. Generate the final information for the river routing files.

${CODE\_DIR}/route\_river\_file.e -dem ${DEM}.asc -river ${DEM}\_riv\_id\_check.asc

# HRU Setup

1. Set up the new directory for code and output.
   1. Go to file in HRU\_Tamar ‘hru\_class.dat’ to adjust inputs

cd ../HRU\_Tamar

CODE\_DIR=/home/ne240/Documents/DECIPHeR-master/DTA

ROOT\_FN=/home/ne240/Documents/DECIPHeR-master/DTA\_TAMAR/tamar\_dem

OUTPUT\_DIR=/home/ne240/Documents/DECIPHeR-master/HRU\_Tamar

GAUGELIST=${OUTPUT\_DIR}/gauge\_list.txt

HRU\_CLASS\_FILE=${OUTPUT\_DIR}/HRU\_class.dat

CATCHMASK\_DIR=/home/ne240/Documents/DECIPHeR-master/DTA\_TAMAR/masks/

1. Subset larger datasets to gauges of interest.

${CODE\_DIR}/preprocess.e -gaugelist ${GAUGELIST} -hru\_class\_file ${HRU\_CLASS\_FILE} -root\_fn ${ROOT\_FN} -output\_folder ${OUTPUT\_DIR} -catchmask\_folder ${CATCHMASK\_DIR}

1. Determine HRUs and calculate fluxes between HRUs.

${CODE\_DIR}/calculate\_hrus.e -gaugelist ${GAUGELIST} -hru\_class\_file ${HRU\_CLASS\_FILE} -output\_folder ${OUTPUT\_DIR}/

# Rainfall Runoff Modelling Setup

1. Create folders for rainfall runoff modelling.

* A main directory ‘RRMODEL\_Tamar’
* INPUTS, SETTINGS and OUTPUT folders.

1. Copy across the relevant folders into INPUTS:

* Routing files
  + \*\_riv\_data.dat
  + \*\_flow\_conn.dat
  + \*\_flow\_point.dat
* HRU files
  + \*\_dyna\_hru.dat
  + \*\_hru\_meta.dat

Add other input files:

* Discharge (discharge\_input\_file.txt)
* PET (PET\_input\_file.txt)
* Rainfall (rainfall\_input\_file.txt)

1. Create setting files

Add settings files:

* Model\_structure.dat
* Params.dat
* Settings.dat

# Running a simulation

1. Copy DECIPHeR\_V1.exe into RRMODEL\_Tamar
2. Change to new directory cd ../RRMODEL\_Tamar
3. Run code in Linux: ./DECIPHeR\_v1.exe which creates the part needed.
4. Enter number depending on the project, HRU files and input files (usually 1 as can have multiple per run).
5. Outputs:
   * .flow files, which match the time steps of the input files. Import these as would text files into Microsoft excel.

# Remote access

1. Open remote access and type in 144.173.239.90
2. Username ne240, password Welcome123
3. To return to home directory is cd ~
4. To apply code edits, navigate to folder, type make clean then make all
5. Original DTA and RRmodel are compiled in ~/Download/DECIPHeR-master/
6. Create a zip of outputs:
   1. cd ~/Documents/DECIPHeR-master/RRMODEL\_TAMAR

zip -r OUTPUT OUTPUT/

1. Reverse this with: unzip OUTPUT.zip
2. RRmodel folder is in: cd ~/Documents/DECIPHeR-master/RRMODEL\_TAMAR
3. MAIN\_DIR=/Documents/DECIPHeR-master/RRMODEL\_TAMAR
4. CODE\_DIR=/Documents/DECIPHeR-master/RRMODEL
5. Run code in Linux: ./DECIPHeR\_v1.exe which creates the part needed
6. \_Tamar is the original, anything \_50 is the % landcover. RRMODEL\_11\_20\_20 is the new dta test

# Making land cover rasters

1. Polygon to raster:
   1. Value field = LandCover
   2. Output to LC\_rasters
   3. Cellsize = 2
   4. Change no data in catalogue to -9999
2. Reclassify (**save it as a tif, change missing data values to nodata**!):
   1. 4 (grassland) = 1
   2. 21 (urban) = 2
   3. 1 (woodland) = 3
   4. 5 (unimg) = 4
   5. 3 (arable) = 5
   6. 14 (water) = 6
   7. (note: 0% land cover raster is 1 improved grassland, 2 urban, 3 woodland, 4 arable, 5 water)
3. DEM\_buffer\_codeR.R: run code, be sure to check the extent of the raster at each step.
4. Transfer to onedrive
5. Open in linux text editor and check file, change ncols, nrows, xllcorner, yllcorner and cellsize to lower case

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| Date | Input | Details |
| 12/11/2020 | DTA, DTA Tamar, HRU Tamar and RRModel Tamar | Redoing the DTA for analysis. HRU set up again for original land use. Final output 0.88 NSE (previous was 0.89) |
| 19/11/2020 | HRU 50% land cover | HRU\_50 landcover test, 1000 simulations for test |
| 30/11/2020 | Original DTA | New Lnt0 value trials |
| 02/12/2020 | Original DTA | Trialling new source code change to dyna\_param\_setup.f90 |
| 20/01/2021 | Original DTA | Testing new parameters for LnT0. NSE now = 0.89 |
| 15/02/2021 | Original DTA, new f90 | Adapted dyna\_param\_steup.f90 with Lnt0 that is now proportional (lines 84 and 85) |
| 16/02/2021 | Original DTA, adapted f90 | Adapted dyna\_param\_setup.f90 with line 84 and 84 + 0.5 not \*1.1 |
| 19/02/2021 | Original DTA, adapted f90 | Adapted dyna\_param\_setup.f90 with SRmax parameter changed so unimproved is always greater than improved |
| 22-23rd 02/2021 | 10%, 20% and 30% | Run simulations on each restoration scenario |
| 03/03/2021 | LnT0 values from <35% organic matter | Test run of original LnT0 values with adapted dyna\_param\_setup.f90 |
| 08/03/2021 | Test tun HRU\_70 | Test run of two simulations using 70% restoration |
| 15/03/2021 | HRU\_0  RRMODEL\_Tamar | Running HRU/RRMODEL for 0% unimproved grassland and rerunning HRU\_Tamar and RRMODEL\_Tamar with original data |
| 16/03/2021 | RRMODEL\_Tamar | Using rerun HRU to model >35% parameters |
| 12/04/2021 | RRMODEL\_Tamar | Rerun model using new LnT0 +1 instead of 0.5 |
| 14/04/2021 | RRMODEL\_30 | Top 10 with Lnt0 +1on 30% Culm |
| 14/04/2021 | RRMODEL\_TAMAR | Rerun Lnt0 +1.5 |
| 15/04/2021 | RRMODEL\_30 | Simulations with Lnt0+1.5. |
| 15/04/2021 | RRMODEL\_TAMAR | 1000 runs with SRmax \*1 and Lnt0 +1 |
| 19/04/2021 | RRMODEL\_30 | Op 10 simulations with Lnt0 +1 and Srmax the same |
| 30/04/2021 | RRMODEL\_TAMAR | New dyna.init.satzone.f90 and dyna\_param\_setup.f90 files to fix Lnt0 problem. Had to change line 166 in dyna\_main.f90 as got stuck on 581 |
| 04/05/2021 | RRMODEL\_30 | Sensitivity analysis 0.5, 1 and 1.5 |
| 06/05/2021 | DTA\_TAMAR, HRU\_TAMAR, HRU\_30 | Rerun DTA Tamar and HRU tamar, top ten 30% restored. |
| 07/05/2021 | RRMODEL\_TAMAR | Rerun 1000 |
| 12/05/2021 | RRMODEL\_0/10/20/30 | Run all ten simulations for each one. 10 and 20 still some issues |
| 13/05/2021 | RRMODEL\_ORG | Rerun original simulations and sim935. |

# Event Extraction

1. Run script DECIPHeR\_output.R for original data
2. Select best runs (top ten) and run through qsim\_prep. R to separate each run

Speeding up the process:

* Line 1382: extract the events
* Lines 1396-1488: Plot checks (only needed for the obs files, not the qsim files) (currently commented out)
* Line 1649: Manual check
* Line 1828: Stop here to avoid final plot checks

1. Run event extraction for Qobs file (original DEM). Check events and write down what ones are deleted.
2. Follow this with each 10, 20 and 30% simulations for each matching simulation.