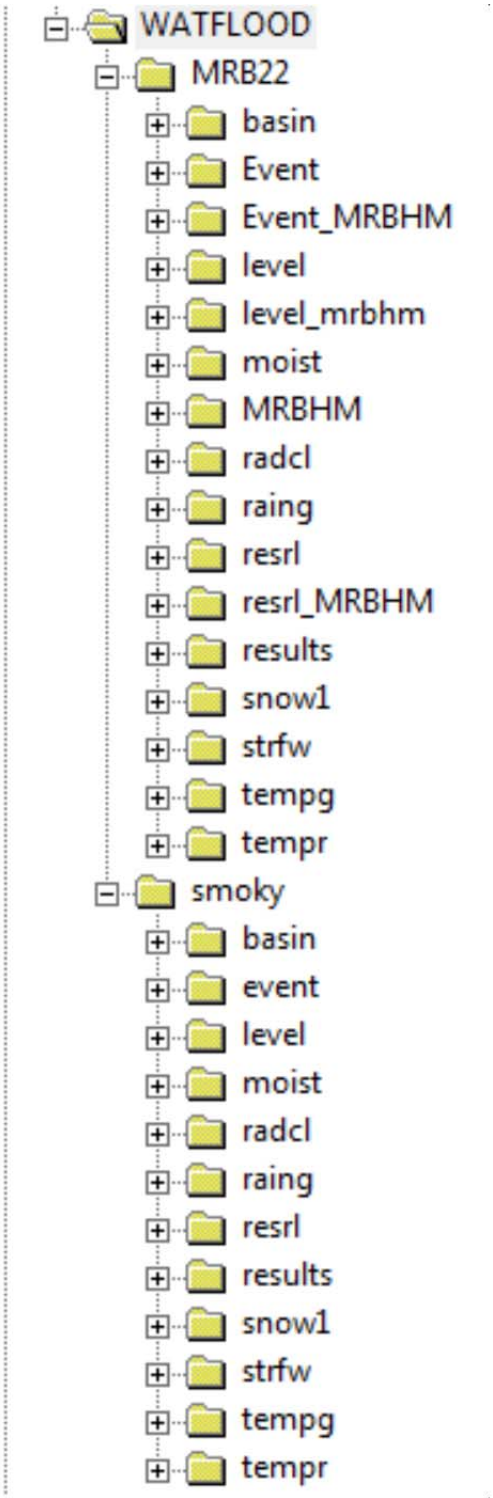
WATFLOOD / MRBHM Workshop – Edmonton Afternoon - June 7, 2016

WATFLOOD file structure



- The file structure is explained in Section 1.1.3 of the WATFLOOD manual. Each type of data file is in a separate directory.
- It is recommended that the WATFLOOD directory be in the root directory on the C: drive and that it be in the computer's path so all executables can be put there.
- Each watershed model has its own directory under WATFLOOD
- Names are meant to be self-explanatory:
  - basin for watershed files
  - event is for config files
  - level is for water level data
  - moist is for initial moisture
  - MRBHM for the master inflow file
  - radcl for gridded precip.
  - raing for point precip
  - resrl for reservoir/lake rules & releases
  - results for model output
  - snow1 for SWE data
  - strfw for flow data
  - tempg for point temperatures
  - tempr for gridded temperature
- For the MRBHM there are 3 extra directories as in addition to the lakes(=reaches) that are normally incorporated in the watershed file, there are additional reaches needed to create inflows at the inflow nodes of the MRBHM. This requires separate files for the level and reservoir data for each reach
- The 2 sets of event files point to the respective sets of files
- the MRBHM directory receives the MRB_master_inflow.tb0 file
- ***Point data files for both MRB22 & Smoky are the same. Gridded files match watershed grid.***

Some basic DOS commands

Start in the root directory: C:

cd \↵	makes the root directory the working directory – same drive
dir↵	shows the files in the working directory
cd watflood↵	makes watflood the working directory
cd smoky↵	makes smoky the working directory
cd ..\mrb22↵	changes from the smoky to the mrb22 directory
cd .. ↵	
dir event↵	shows files in the event directory
dir *.csv file_names.txt	creates a txt file with the list of csv files
del filename.extension↵	deletes this file
del *.* ↵	deletes all files in the working directory
copy junk.txt garbage.*↵	copies file to a different name but same extension
del *.bak ↵	deletes all files with extension bak
cls ↵	clears the screen – often handy
PATH=%PATH%;C:\WATFLOOD↵	Adds the C:\WATFLOOD directory to the path

WATFLOOD commands (i.e. programs)

eg. executables in the PATH::

ECmet↵	creates point precip & temp files
ECflw↵	creates flow files
ECrel↵	creates rel files
EClvl↵	creates level files
moist64↵	executes the soil moisture distribution model
snw64↵	distributes point swe to gridded swe
ragmet64x	distributes point precip to gridded precip
tmp64x	distributes point temperatures to gridded temepratures
charm64x↵	executes the model (please download from watflood.ca/executables) OR,

with the executables in the watflood directory (folder)

..\..\..\ecMET↵	creates point precip & temp files
..\..\..\ECflw↵	creates flow files
..\..\..\ECrel↵	creates rel files
..\..\..\EClvl↵	creates level files
..\moist64↵	executes the soil moisture distribution model
..\snw64↵	distributes point swe to gridded swe
..\ragmet64x	distributes point precip to gridded precip
..\tmp64x	distributes point temperatures to gridded temepratures
..\charm64x↵	executes the model (please download from watflood.ca/executables)

WATFLOOD Session

1. Open a window and create a directory called **WATFLOOD** – preferably in the root of C:
2. Add the WATFLOOD directory to your path with the command in a DOS window: **PATH=%PATH%;C:\WATFLOOD↵**
3. Open your DVD drive in another window AND:
    a. Drag the MRB22 & Smoky folders into the C:\WATFLOOD directory (folder)
        i. Do the **smoky** first, then **MRB22**
    b. For 64 bit, drag all execs into C:\WATFLOOD (or where you have your path)
    c. For 32 bit, open the 32bit_execs folder and drag those execs into C:\WATFLOOD
4. Open the WATFLOOD folder and right click on **MRB22**, then click on P**roperties**, and then on the **Read-only box** to make it blank and **Apply**. Then OK
5. Do the same on the Smoky folder
6. From the start menu, open a **Window**.
    a. Go to the **watflood\mrb22\basin** folder and copy **Mack_LC_theme.thm**
    b. Go to the **c:\program Files\CHC\GreenKenue64\Templates\GeoTIFF** window and paste the file there (if you have permission to do this)
7. Open a **DOS** window: If it is not in your **Windows Start** menu, open it in "**Search for programs and files**" with **CMD.**
    a. Maximize the window
    b. Click in the top bar and under properties set the **buffer size** to **999**
    c. Go to the **C:** drive
8. Enter **cd \watflood\smoky**
    a. The Smoky watershed is set up to run from 1960 – 2015 but we will run only 2007 - 2015
    b. Enter **moist64** This creates an initial gridded soil moisture file from point values (for 32 bit users, replace 64 by 32 for the rest of the day)
    c. Enter **snw64** This creates an initial gridded SWE file from point values
    d. Enter **ragmet64x** (or ragmet32x if you are on a 32 bit pc – ditto for other programs) This creates a gridded precip file from point data
    e. Enter **tmp64x** This creates a gridded temp file from point data and also a gridded file with daily temp differences needed for the Hargreaves ET model
    f. Enter **charm64x** This will run the model
9. **Intro to Green Kenue**
    a. Open **Green Kenue** (GK)
    b. Maximize GK window
    c. In the **file** menu, open **c:\watflood\mrb22\basin\mrb22.wsd**
    d. Double Click on **DEM,** drag into the 2D view, and change **wireframe** to **surface**
    e. Double click on **DEM** and then **colour scale** and the **levels** to 40, and change **Linear** to **Quadratic** and hit **apply**
    f. **Now** click on **Colour Scale** and double click on the top colour grid. Change it to **red** and then click on **Colours** and then **Apply**
    g. Drag **Channels** into the 2D view

h. double click on **Channels** and in **display** change the point size to 1; change to **monochrome** and the colour to **white**
i. Open **c:\watflood\smoky\flow_station_location.xyz** – in the bottom right dialogue box look for **Point Sets xyz**
j. Drag the **flow_station_location** into the 2D view
k. Double click on **flow_station_location** and change to **monochrome** and check the **show node label**s , change to bold and make the **point size = 16**
l. The **Smoky River at Watino** is station #52. Find this station and zoom in so it ends up near the top of the 2D view
m. Click on **Channels** in the left menu bar to activate this item in the 2D view. Now double click on the channel at station 52 and see a info box appear. The left click there, add basin and call it **Smoky**
n. Double click on **Smoky** in the left menu bar and change colour to **black**
o. For fun, click on **File, Base Maps, 1:1,000,000 & Cities**
p. **Save the workspace: File, Save Workkspace** as **Smoky** in the **c:\watflood\smoky directory**

10. Looking at the Smoky results

a. **In GK: File → Open .wfo file type: smoky\results\ watflood.wfo**
b. Drag **Grid Outflow** into the 2D view
c. Drag **Channels, Smoky, Cities & flow_station_location** to the top of the 2D view list
d. Change the colour of the **flow_station_location** points to white: double click on the name and use the dialogue box
e. Left click on **Grid Outflow** and click on **animate**
f. Double click on **Grid Outflow,** click on **ColourScale** and change **linear** to **NLog**, **min** to **0**, **Levels** to **40,** check **Show Legend** & **Apply**
g. Fix the colour scale – click on **Col,** change the top box to **red, and click on Col** again and then **OK** Then resize he legend: click on it, drag it to a better place and resize.
h. Double click on the box at station # **52, then right click** and **extract time series**
i. Open a 1D view (squiggly line), place at bottom of the viewing area and reduce its size. Resize the 2D view to a larger view
j. Click on the top bar of the 1D view and in **View → Select Sync. View** and answer with 2D View (1)
k. Drag the **Grid Outflow** (X….. in to **1DView (2)** in the left dialogue bar. This shows the time of the 2D view
l. Hit the **play** button to see the animation. You can jump to anywhere in the time series by clicking the cursor on the play bar.
m. You can zoom in on any part of the hydrograph by messing with your mouse – dragging it & running the wheel and holding down the right key while dragging the mouse.

n. There seems to be a problem at gauge # 50 – the flow bypasses the gauge!!!!! Good trouble shooting in GK Can be fixed by rerouting the flow through the grid. Wrong flows at this station probably did not help the optimization for the Smoky.
o. Drag **Weighted SWE** into the 2D view, right click on this and then on **animate**
p. Repeat step (c).
q. Fix the colour scale as in (g) above with increments of 10 and 40 levels.
r. Extract time series as in (h) above and open a new 1D view, Drag the time series into the 1D View(2)
s. repeat step (j) above & animate (Note: Snow course data can be read in by CHARM and file with observed & computed SWE for each snow course is produced for further analysis)
t. Can this be real ? – Show DEM (make the **SWE** & **GridOutflow** invisible); Double click on DEM and then click on **ColourScale**, set colour scale to min = 500, interval = 50, **linear** mode Note headwaters in mountains & outlet in lowlands. Answer: certainly possible.
u. Drag **Cumulative Precipitation** into the 2D view, right click on this and then on **animate**
v. Then **animate** to the end of the time series to the double arrow
w. Double click on **Cumulative Precipitation**, then **Colour Scale** and then check **Show Legend,** and **Apply**
x. Check that there is precip everywhere in the Smoky watershed
y. Extract a time series for the highest & lowest precip, open a new 1D view and drag both time series into the 1D view – the largest one first. This is a good check on the precip. Flat spots mean missing data at nearby stations & radius of influence too small.
z. Drag **WeightedCumm ET** into the 2D view, right click on this and then on **animate**
aa. Then animate to the end of the time series to the double arrow
bb. Double click on **WeightedCumm ET**, then **Colour Scale** and then check off **Show Legend**
cc. Note: Highest ET where the lowest Precip - Lowest ET where the highest Precip!!!!
dd. Done with GK for now. Leave window open.
ee. Open an EXEL spreadsheet and load **c:\watflood\smoky\results\spl.csv** (= text file)
ff. In the file **c:\watflood\smoky\flow_station_location.xyz** are the obs./comp. plotting columns for each station. #52 = cz & da # 51 = cx & cy #50 – cv & cw # 49 = ct& cu # 48 = cr & cs
gg. So go to cols **cz** & **da** and select these 2, then **insert** a double line continuous curve and expand the graph.
    i. Note: There are 2 columns for each flow station – all the stations for the Mackenzie river basin are in the file. When running a sub-basin, the same str file can be used. Stations outside the sub-watershed just do not have computed flows.
hh. Close Excel

ii. **Done this part.**

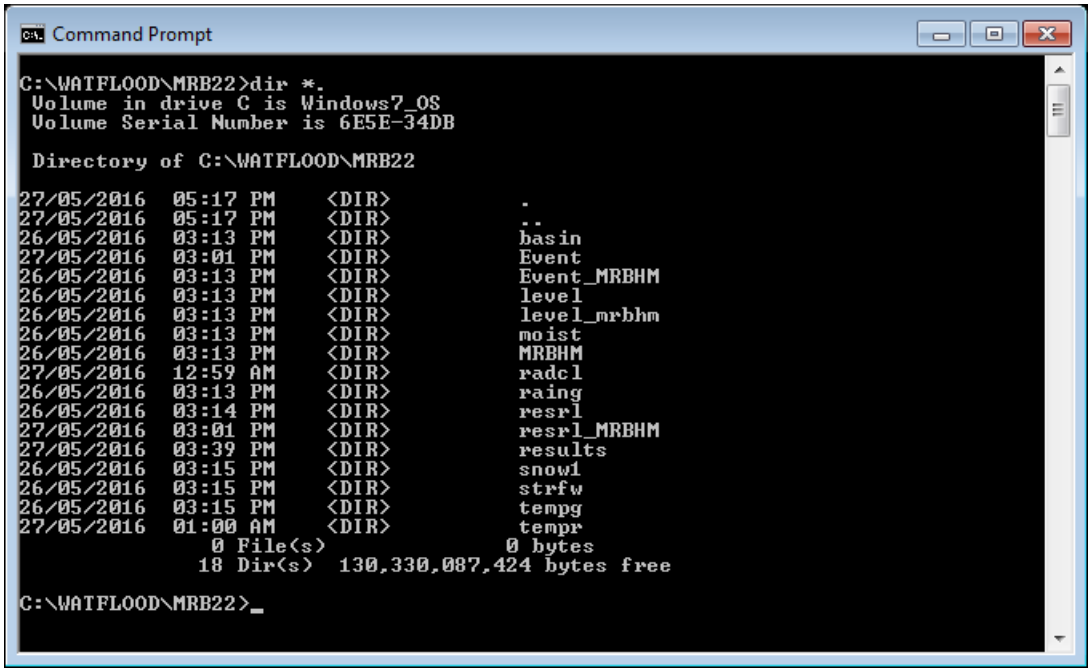
Mackenzie River watershed model for the MRBHM – set up for 2 years

jj. Open a **DOS** window & do the following commands:
kk. **cd c:\↵** will put you in the root (or if to another drive – e.g. **d:↵**)

ll. **cd watflood\mrb22**↵ will put you in the **MRB22** working directory

mm. **dir *.**↵ will show a list of directories in **MRB22** as follows

nn.



oo. To create the master inflow file, all recorded flow files (strfw), precip (raing & radcl), temperatures (tempg & tempr) as well as the initial soil moisture (moist) and SWE (snow1) are common with running a normal WATFLOOD model (i.e. with WATFLOOD routing). However, **event, level & resrl** files are different for creating a master inflow file. So there are 2 directories for each of these with the appropriate files. We will now look at these files: open your favourite text editor. **Wordpad** if you don't have one.

pp. Open the files **c:\watflood\mrb22\event\1960.evt** & **c:\watflood\mrb22\event\1960_mrbhm.evt** (make sure you don't get the backup)

- **i.** Note: <u>both</u> of these are in the **mrb22\event** folder
- **ii.** Note the latter has **routeflg = q** to tell **CHARM** to write the master inflow file and **nudgeflg = 1** to tell it to use the **strfw\nudge_flags.xyz**
- iii. Note: the **strfw\nudge_flags.xyz** can be opened in GK so the values in col 3 can he shown in the 2D view. This is a way of checking that the proper stations are nudged.
- **iv.** Note that the **lvl, ill & rel** file names are different. This is only because there are 24 lakes (reaches) in the regular MRB model & 124 more for the MRBHM (2 are common – Lake Athabaska & Great Slave lake)
- v. Note: these event files are "config" files really.
- vi. Note the list of events to be run in succession at the bottom of the evt file.

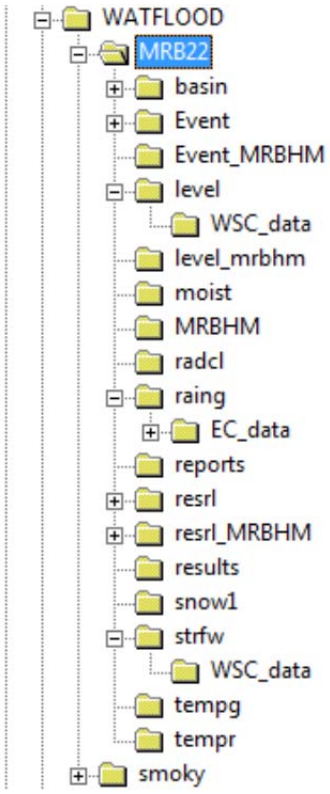
qq. In **1960_mrbhm.evt** set the **kenueflg = a** and save as **event.evt** This will write a default **results\watflood.wfo** file

rr. In **1960_mrbhm.evt** change :**noeventstofollow** from **55** to **1** This means we will run the model for only 2 years (to get done today)

ss. <u>Save as</u> **event.evt** <u>This makes this the active event file</u>. event\event.evt is the default file

11. Updating data files files for WATFLOOD from Env. Can. data

a. Note the extra data folders **WSC_data** in the **level** & **strfw** folder and **EC_data** in the **raing** folder **:**



b.

c. The raw downloaded data is put in these **data** folders and processed there as follows:

d. Look in each of the folders **raing\EC_data**, **strfw\WSC_data** & **level\WSC_data**

e. **cd c:\↵** will put you in the root - then **cd \watflood\mrb22\raing\EC_data OR**

f. if already in **MRB22** then just **cd raing\EC_data**

g. **..\..\..\ECmet↵ OR c:\watflood\ECmet↵** Do 1960 – 1961 Will create the **raing\yyyymmdd_rag.tb0** & **tempg\yyyymmdd_tag.tb0** files for **RAGMET.exe** & **TMP.exe**

   i. use **..\..\..** if execs not in PATH OR enter the whole path.

   ii. Note: leave out **..\..\..** if execs are in the path

h. **cd c:\↵** will put you in the root

i. **cd \watflood\mrb22\strfw\WSC_data**

j. **..\..\..\ECflw↵** Answer "**y**" for natural flows. Enter 1958 – 1959, let it start and then hit **Ctrl C↵** !!!!!! Takes too long but will create the **strfw\yyyymmdd_str.tb0** files from HYDAT & provisional flow data. Would take 10 – 20 minutes to read in 120 HYDAT files.

k. **..\..\..\ECrel↵** Do 1960 – 1961 Answer "**n**" to insert reservoir releases into the rel files. Will create the **resrl\yyyymmdd_rel.tb0 & level\yyyymmdd_ill.pt2** files 1 Answer **2** to do the rel files for the MRBHM option

l. **cd c:\↵** will put you in the root

m. **cd \watflood\mrb22\level\WSC_data**

n. **..\..\..\EClvl↵** Do 1960 – 1961 Will create the **level\yyyymmdd_lvl.tb0** files

12. Run the model: it is set to run just 2 years (in the event file)

a. In **DOS** window be in the **watflood\mrb22** directory

b. Execute the watflood programs in the dos window. If execs are in **Dr:\WATFLOOD:**

c. **..\snw64↵** < 1 sec. **if in the path:** **snw64↵**

d. **..\moist64↵** < 1 sec. **moist64↵**

e. **..\ragmet64x↵** ~ 1 min. **ragmet64x↵**

f. **..\tmp64x↵** ~ 1 min. **tmp64x↵**

g. **..\charm64x↵** ~ 10 min. **charm64x↵**

13. Open the **watflood\mrb22\mrbhm\MRB_MASTER_INFLOWS.tb0** file and have a look

a. Note: Some stations need to be renamed

i. 32_1097 must be 32_1097.5

ii. 31_66.1 must be 31_-66.1

iii. 42_325 must be 42_325.05341

14. Go back to GK window.

a. Delete **watflood.wfo** in the current GK window

b. **Open watflood\ MRB22\results\watflood.wfo**

c. Zoom way out to show the whole Mackenzie watershed

d. Drag **Grid Outflow i**nto 2D view and zoom out

e. Right click in **Grid Outflow** and **animate**

f. Double click on **Grid Outflow,** change **min** to **0, levels** to **40, and linear** to **NLog,** hit **Apply** and fix the colour scale

g. Drag **Channels, Flow station location** and **cities** to the top of the 2D view

h. So I forgot to make a watershed outline for the Mackenzie River basin. Click on **Channels** in the workspace window – it will be highlighted. Now double click in the river outline just below Arctic Red River. Zoom in first. The Right click & **add basin**. Call it **Mackenzie**.

i. Click on **File**, then **Save Copy As** - go to **mrb22\basin\i3s_files** - and hit **save**

j. Change the colour of the line to red and make the line width 3

k. Note: Flows in the Athabaska, Peace, Slave & Mackenzie are missing as they were written to the master inflow file and not routed.

l. Extract a time series for the **Liard** near Fort Simpson.

m. Close all 1D views and open a new one

n. Drag the **Liard** time series into the 1D view (in the workspace bar)

o. Click on the 1D view window and then **View** and **Select Sync View**, and pick **2D view (1)**

p. Hit the **play** button You can rewind, step through forward of backward. Try it.

15. NK show other files. rag, met, tag, tem, str, rel, ill

16.Q & A ☺