NATIONAL WEATHER SERVICE
OFFICE of HYDROLOGIC DEVELOPMENT

OB8.2 TEST PROCEDURES

Operational Implementation of a Distributed Hydrologic Model (DHM)

Version 1.0
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TABLE OF CONTENTS

1.0 Introduction and Scope 3
Operational Implementation of a Distributed Hydrologic Model..... 3
2.0 Document Overview 3
3.0 Test Results..... 3
4.0 Test Procedures..... 3
4.1 Regression Tests - verify DHM functions as it did prior to OB8.2 changes. 3
4.2.1 Test precip grid copying only occurs when running DHM 4
4.2.2 Test for writing grid output for times other than 12Z 5
4.2.3 Test for defining DHM Precipitation Mods 7
4.2.4 Test for defining Sac State Mods 11
4.2.5 Test for running a DHM segment with more than one inflow 12
4.2.6 Test Grid Editor Program 14
Appendix A – IFP tests procedures 14
Appendix B – DHM Grid Editor Tests..... 24

1.0 Introduction and Scope

Operational Implementation of a Distributed Hydrologic Model

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The requirements for enhancements to the Distributed Hydrologic Model software for OB8.2 are documented in the OSIP CONOPS and Requirement Specification Document. The features to test in OB8.2 are in the following categories:

a) Precip grid copying to a user's local directory only occurs when running DHM
b) Allow users to define times other than 12Z for grid output
c) Allow users to specify precipitation modifications (Mods)
d) Allow users to specify SAC state Mods
e) Allow users to model basins which use multiple upstream inflows
f) Develop a utility to create operational DHM grids from a previous Calibration (DHM Grid Editor Program)

The test procedures in section 4 of the document use automated and manual tests to prove the features are working as intended.

2.0 Document Overview

This document describes the test procedures for DHM in AWIPS. These tests are conducted prior to delivering the software to AWIPS. This document contains:

- Test Procedures – A description of the procedures the tester will follow to verify the tests are passing

3.0 Test Results

4.0 Test Procedures

4.1 Regression Tests - verify DHM functions as it did prior to OB8.2 changes.

- copy the tar-gzipped file XXXX into a local directory (e.g. the tester's HOME directory)
- extract the file using the following command:
  tar -xvzf XXXX
- The package root directory, dhmtestpackage, has automated and manual tests organized into two separate directories (dhmtestpackage/ofstests are automated and dhmtestpackage/ifptests are manual).
- To run the automated batch mode tests:
  cd to the directory dhmtestpackage/ofstests and run the script run_ofs_batch_tests.
  After 3-5 minutes you should see a summary of the results on the command line:
  XXX right, 0 wrong, 0 ignored, 0 exceptions.
- To run the manual IFP Tests

Follow the test procedures shown in Appendix A

4.2 New Tests – Tests of OB8.2 DHM Enhancements.

4.2.1 Test precip grid copying only occurs when running DHM

Step A: make sure no old directories in /data/dhm/

- cd to /data/dhm/
- type ls –R $LOGNAME
- if any directories exist under $LOGNAME remove them using rm –rf command

Step 1 – execute a test script to setup the data

- cd *dhmtestpackage/ifptests*
- *runIFPWithDHMOP rls*

Result - the two main IFP displays appear

Step 2 – Select the Forecast Group

- From the "Select Forecast Group and Carryover Date" display select DHMFG as the Forecast Group and July1, 2002 12Z as the Carryover Date, Click Load
- From another terminal window cd to /data/dhm/
- Type the following ls –R
- You should see the same output as in step A

Step 3 – Select the dates to run

- From the Options Menu select Set Dates…
- Set End OF Observations to Jul 3 2002 12Z
- Set End Of Run to Jul 3 2002 12Z, Click Set

Step 4 – Run the DHMFG and verify precip grids only exist for the duratioin of the run

- From the "NWSRFS Interactive Forecast Program" display's File Menu select Begin
- From another terminal window cd to /data/dhm/$LOGNAME
- Type the following ls –R precip
- You should see the following output

```
precip:
xmrg0701200213z  xmrg0701200220z  xmrg0702200203z  xmrg0702200210z  xmrg0702200217z  xmrg0703200200z  xmrg0703200207z
xmrg0701200214z  xmrg0701200221z  xmrg0702200204z  xmrg0702200211z  xmrg0702200218z  xmrg0703200201z  xmrg0703200208z
xmrg0701200215z  xmrg0701200222z  xmrg0702200205z  xmrg0702200212z  xmrg0702200219z  xmrg0703200202z  xmrg0703200209z
xmrg0701200216z  xmrg0701200223z  xmrg0702200206z  xmrg0702200213z  xmrg0702200220z  xmrg0703200203z  xmrg0703200210z
xmrg0701200217z  xmrg0702200200z  xmrg0702200207z  xmrg0702200214z  xmrg0702200221z  xmrg0703200204z  xmrg0703200211z
xmrg0701200218z  xmrg0702200201z  xmrg0702200208z  xmrg0702200215z  xmrg0702200222z  xmrg0703200205z  xmrg0703200212z
xmrg0701200219z  xmrg0702200202z  xmrg0702200209z  xmrg0702200216z  xmrg0702200223z  xmrg0703200206z
```

Background Information: Prior to OB8.2 precip grids were copied after selecting "Load" from the "Select Forecast Group and Carryover Date" display. After selecting load all the available precip grids were copied to a user's local directory. This caused the following problems at the RFC:

1. precip grids are only needed for running DHM; non-DHM users were being impacted by grid copying; "Load" took longer than before
2. in some cases /data/dhm/$LOGNAME was filling up

The solution in OB8.2 was to only copy when running DHM (from within the DHM operation), and to only copy the precip grids needed for the current run.

4.2.2 Test for writing grid output for times other than 12Z

Step A – verify only input grids (precip, parameters, states, and pet) and the input Connectivity file exist

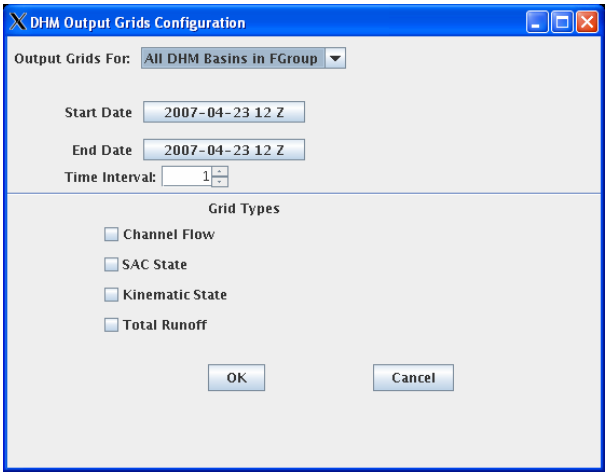
- From another terminal window cd to /data/dhm/$LOGNAME
- Type the following ls –R
- You should see the following output

```
ls -R

Connectivity  parameters  pet  precip  states

./parameters:
rutpix_DS.gz    rutpix_ROUGH.gz  sac_LZFPM.gz  sac_LZSK.gz   sac_PFREE.gz  sac_RSERV.gz  sac_UZK.gz
rutpix_Q0CHN.gz  rutpix_SLOPH.gz  sac_LZFSM.gz  sac_LZTWM.gz  sac_REXP.gz   sac_SIDE.gz   sac_UZTWM.gz
rutpix_QMCHN.gz  sac_ADIMP.gz    sac_LZPK.gz   sac_PCTIM.gz  sac_RIVA.gz   sac_UZFWM.gz  sac_ZPERC.gz

./pet:
pe_APR.gz  pe_DEC.gz  pe_JAN.gz  pe_JUN.gz  pe_MAY.gz  pe_OCT.gz
pe_AUG.gz  pe_FEB.gz  pe_JUL.gz  pe_MAR.gz  pe_NOV.gz  pe_SEP.gz

./precip:
xmrg0701200213z  xmrg0701200220z  xmrg0702200203z  xmrg0702200210z  xmrg0702200217z  xmrg0703200200z  xmrg0703200207z
xmrg0701200214z  xmrg0701200221z  xmrg0702200204z  xmrg0702200211z  xmrg0702200218z  xmrg0703200201z  xmrg0703200208z
xmrg0701200215z  xmrg0701200222z  xmrg0702200205z  xmrg0702200212z  xmrg0702200219z  xmrg0703200202z  xmrg0703200209z
xmrg0701200216z  xmrg0701200223z  xmrg0702200206z  xmrg0702200213z  xmrg0702200220z  xmrg0703200203z  xmrg0703200210z
xmrg0701200217z  xmrg0702200200z  xmrg0702200207z  xmrg0702200214z  xmrg0702200221z  xmrg0703200204z  xmrg0703200211z
xmrg0701200218z  xmrg0702200201z  xmrg0702200208z  xmrg0702200215z  xmrg0702200222z  xmrg0703200205z  xmrg0703200212z
xmrg0701200219z  xmrg0702200202z  xmrg0702200209z  xmrg0702200216z  xmrg0702200223z  xmrg0703200206z

./states:
rutpix_areac1_initial.0701200212z.gz  sac_adimpc_initial.0701200212z.gz  sac_uzfwc_initial.0701200212z.gz
rutpix_areac2_initial.0701200212z.gz  sac_lzfpc_initial.0701200212z.gz   sac_uztwc_initial.0701200212z.gz
rutpix_areac3_initial.0701200212z.gz  sac_lzfsc_initial.0701200212z.gz
rutpix_depth_initial.0701200212z.gz   sac_lztwc_initial.0701200212z.gz
```

Step 1 – Configure DHM to write output grids for every 12 hours from 2002-07-01 12 Z to 2002-07-02 12 Z

- From the “NWSRFS Interactive Forecast Program “Options Menu select “Configure DHM Grid Output”

Result – You should see the following display



- Set Output Grids For to “All DHM Basins in FGROUP”

- Set Start Date to 2002-07-01 12Z
- Set End Date to 2002-07-02 12Z
- Set Time Interval to 12
- Select All Grid Types (Channel Flow, Sac State, Kinematic State, and Total Runoff)
- Select OK

Step 2 – Run DHMFG again and verify input and output grids exist

- From the "NWSRFS Interactive Forecast Program" display's File Menu select File→Yes→No
- From the "Select Forecast Group and Carryover Date" display select DHMFG as the Forecast Group and July1, 2002 12Z as the Carryover Date, Click Load
- From the "NWSRFS Interactive Forecast Program" display's File Menu select Begin
- From another terminal window cd to /data/dhm/$LOGNAME
- Type the following ls –R
- You should see the following output. There are grids under channelflow, runoff, and states.

```
ls -R
.:
Connectivity  channelflow  parameters  pet  precip  runoff  states

./channelflow:
channelflow_0701200212z.0702200200z.gz  channelflow_0701200212z.0702200212z.gz

./parameters:
rutpix_DS.gz     rutpix_ROUGH.gz  sac_LZFPM.gz  sac_LZSK.gz   sac_PFREE.gz  sac_RSERV.gz  sac_UZK.gz
rutpix_Q0CHN.gz  rutpix_SLOPH.gz  sac_LZFSM.gz  sac_LZTWM.gz  sac_REXP.gz   sac_SIDE.gz   sac_UZTWM.gz
rutpix_QMCHN.gz  sac_ADIMP.gz     sac_LZPK.gz   sac_PCTIM.gz  sac_RIVA.gz   sac_UZFWM.gz  sac_ZPERC.gz

./pet:
pe_APR.gz  pe_AUG.gz  pe_DEC.gz  pe_FEB.gz  pe_JAN.gz  pe_JUL.gz  pe_JUN.gz  pe_MAR.gz  pe_MAY.gz  pe_NOV.gz  pe_OCT.gz
pe_SEP.gz

./precip:
xmrg0701200213z  xmrg0701200219z  xmrg0702200201z  xmrg0702200207z  xmrg0702200213z  xmrg0702200219z  xmrg0703200201z
xmrg0703200207z xmrg0701200214z  xmrg0701200220z  xmrg0702200202z  xmrg0702200208z  xmrg0702200214z  xmrg0702200220z
xmrg0703200202z  xmrg0703200208z xmrg0701200215z  xmrg0701200221z  xmrg0702200203z  xmrg0702200209z  xmrg0702200215z
xmrg0702200221z  xmrg0703200203z  xmrg0703200209zxmrg0701200216z  xmrg0701200222z  xmrg0702200204z  xmrg0702200210z
xmrg0702200216z  xmrg0702200222z  xmrg0703200204z  xmrg0703200210zxmrg0701200217z  xmrg0701200223z  xmrg0702200205z
xmrg0702200211z  xmrg0702200217z  xmrg0702200223z  xmrg0703200205z  xmrg0703200211zxmrg0701200218z  xmrg0702200200z
xmrg0702200206z  xmrg0702200212z  xmrg0702200218z  xmrg0703200200z  xmrg0703200206z  xmrg0703200212z

./runoff:
total_runoff_0701200212z.0702200200z.gz  total_runoff_0701200212z.0702200212z.gz

./states:
rutpix_areac1_0701200212z.0702200200z.gz     rutpix_depth_0701200212z.0702200212z.gz     sac_lzfsc_initial.0701200212z.gz
rutpix_areac1_0701200212z.0702200212z.gz     rutpix_depth_initial.0701200212z.gz         sac_lztwc_0701200212z.0702200200z.gz
rutpix_areac1_initial.0701200212z.gz         sac_adimpc_0701200212z.0702200200z.gz       sac_lztwc_0701200212z.0702200212z.gz
rutpix_areac2_0701200212z.0702200200z.gz     sac_adimpc_0701200212z.0702200212z.gz       sac_lztwc_initial.0701200212z.gz
rutpix_areac2_0701200212z.0702200212z.gz     sac_adimpc_initial.0701200212z.gz           sac_uzfwc_0701200212z.0702200200z.gz
rutpix_areac2_initial.0701200212z.gz         sac_lzfpc_0701200212z.0702200200z.gz        sac_uzfwc_0701200212z.0702200212z.gz
rutpix_areac3_0701200212z.0702200200z.gz     sac_lzfpc_0701200212z.0702200212z.gz        sac_uzfwc_initial.0701200212z.gz
rutpix_areac3_0701200212z.0702200212z.gz     sac_lzfpc_initial.0701200212z.gz            sac_uztwc_0701200212z.0702200200z.gz
rutpix_areac3_initial.0701200212z.gz         sac_lzfsc_0701200212z.0702200200z.gz        sac_uztwc_0701200212z.0702200212z.gz
rutpix_depth_0701200212z.0702200200z.gz      sac_lzfsc_0701200212z.0702200212z.gz        sac_uztwc_initial.0701200212z.gz
```

Background Information: Prior to OB8.2 there was no way to produce grid output when running DHM through IFP. The only DHM grid output were initial SAC and Kinematic state (those with _initial in there name) and channelflow grids, and these were only written as part of batch mode carrysave runs through OFS/FCST.

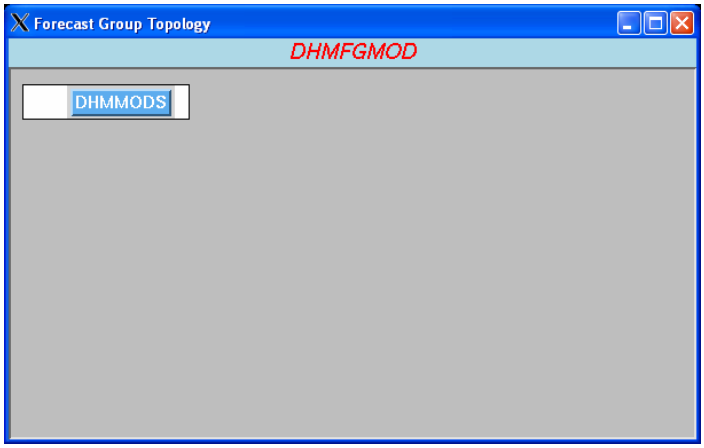
In OB8.2, intermediate sac and kinematic state grids (those without _initial in their name), channelflow, and total runoff can be output when running DHM through IFP. These grids have the format *variableName_startMMDDYYYYHHZ.outputMMDDYYYYHHZ.gz* For example the grid *total_runoff_0701200212z.0702200200z.gz* is a grid covering the entire rfc showing total runoff on July 2, 2002 00Z from a run with start date of July 1, 2002 12Z.

4.2.3 Test for defining DHM Precipitation Mods

Step 1 – Select the Forecast Group and dates to run

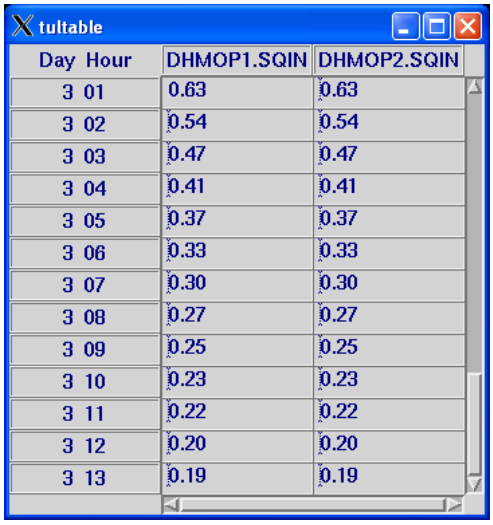
- From the "NWSRFS Interactive Forecast Program" display's File Menu select File→Yes→No
- From the "Select Forecast Group and Carryover Date" display select DHMFGMOD as the Forecast Group and July1, 2002 12Z as the Carryover Date, Click Load

Result – the Forecast Group Topology map shown below is displayed



Step 2 – Run the one segment in the Forecast Group without any mods

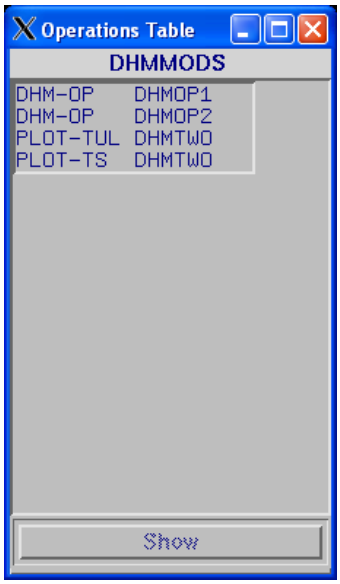
- From the "NWSRFS Interactive Forecast Program" display's File Menu select Begin
- you should see the following tultable (a table GUI in the background)



tultable

Day Hour	DHMOP1.SQIN	DHMOP2.SQIN
3 01	0.63	0.63
3 02	0.54	0.54
3 03	0.47	0.47
3 04	0.41	0.41
3 05	0.37	0.37
3 06	0.33	0.33
3 07	0.30	0.30
3 08	0.27	0.27
3 09	0.25	0.25
3 10	0.23	0.23
3 11	0.22	0.22
3 12	0.20	0.20
3 13	0.19	0.19

Background Information: The topology map shows DHMFGMOD consists of one segment. (DHMMODS). By selecting this segment from the topology display and then selecting *Display→Operations Table* from the "NWSRFS Interactive Forecast Program" display. You will see the following operations table for this segment



The display shows DHMMODS has two DHM-OP operations. By selecting each operation from the table and selecting "Show". The following information appears:

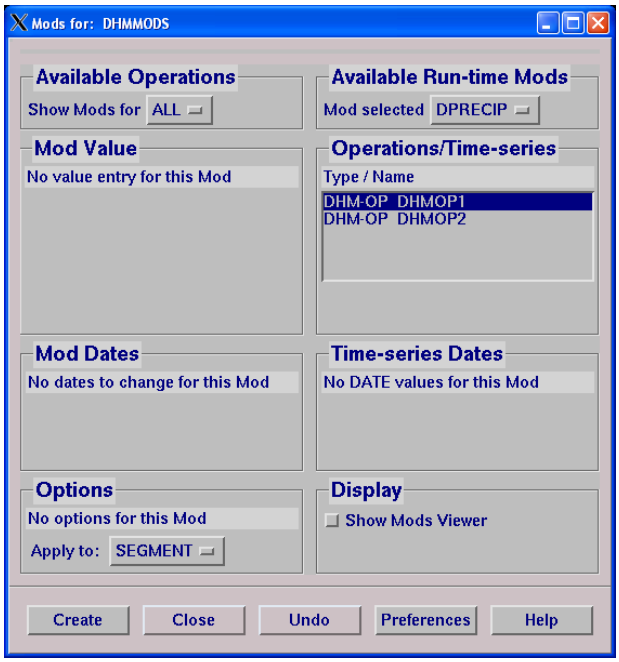
	CONTENTS	ID	TYPE	TIME INTERVAL	BASIN ID
DHMOP1 :	OUTLET FLOW	DHMOP1	SQIN	1 HOUR	DHMMOD1.
DHMOP2 :	CONTENTS	ID	TYPE	TIME INTERVAL	BASIN ID
	OUTLET FLOW	DHMOP2	SQIN	1 HOUR	DHMMOD1.

The operations table and segment definitions show DHMOP1 and DHMOP2 are modeling the same basin (DHMOD1) and storing the resulting outlet flow into separate SQIN time series (DHMOP1 and DHMOP2 respectively)

Step 3 – Re-run the segment after applying a DPRECIP Mod

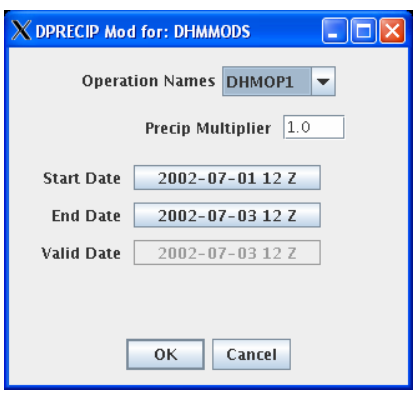
- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select "Other mods"

Result – The display below appears



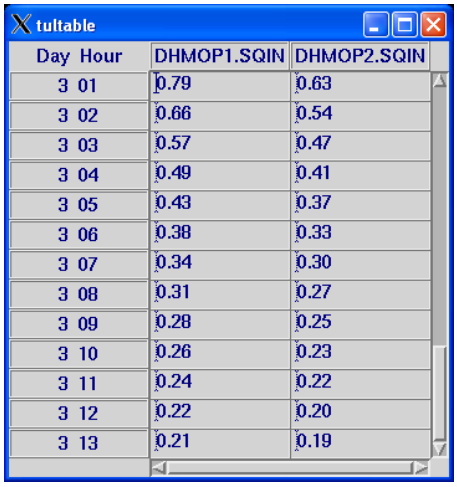
- From the "Mods Selected" tab select DPRECIP

Result – the display below appears



- Operation Names = DHMOP1
- Select Start Date = 07/01/2002 12Z
- End Date = 07/03/2002 12Z
- Precip Multiplier = 2.0
- OK
- From the "NWSRFS Interactive Forecast Program" display's File Menu select Re-Run…

Result – You should seep the following table in the background



tultable

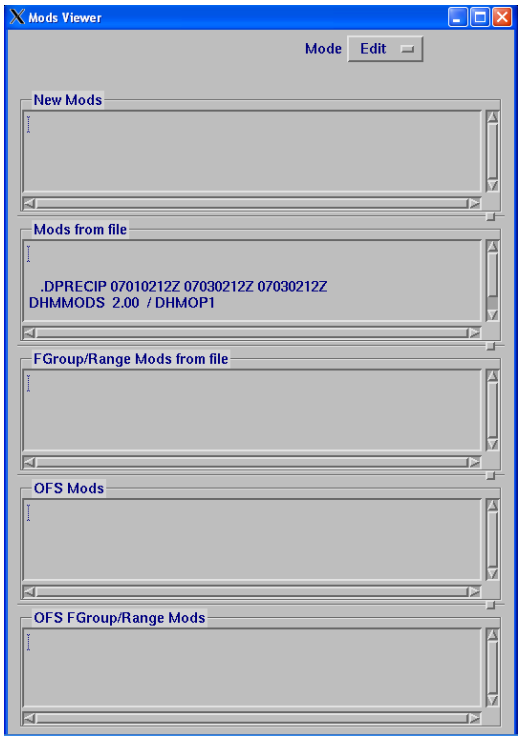
Day Hour	DHMOP1.SQIN	DHMOP2.SQIN
3 01	0.79	0.63
3 02	0.66	0.54
3 03	0.57	0.47
3 04	0.49	0.41
3 05	0.43	0.37
3 06	0.38	0.33
3 07	0.34	0.30
3 08	0.31	0.27
3 09	0.28	0.25
3 10	0.26	0.23
3 11	0.24	0.22
3 12	0.22	0.20
3 13	0.21	0.19

The SQIN values for DHMOP1 are higher because of the precip multiplier

Step 4 – Re-run the segment after applying two DPRECIP Mods

- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select "Mods viewer"

Result – the display below appears



- Remove the previous DPRECIP mod by selecting all the text in the "Mods from file" pane and pressing the space bar
- From the the "NWSRFS Interactive Forecast Program" Modifications Menu re-select "Mods viewer" and "Yes" to save changes
- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select

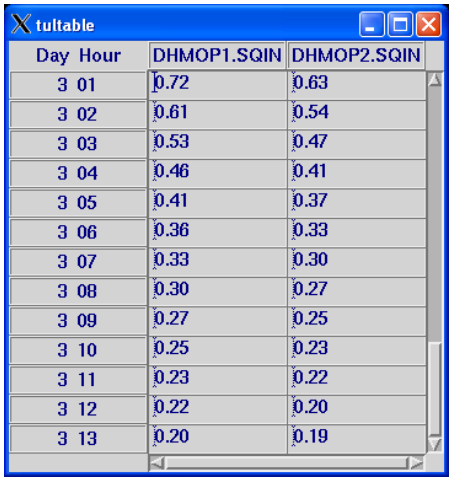
"Other mods"

- From the "Mods Selected" tab select DPRECIP

Set:

- Operation Names = DHMOP1
- Select Start Date = 07/01/2002 12Z
- End Date = 07/02/2002 00Z
- Precip Multiplier = 1.5
- OK
- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select
- "Other mods"
- From the "Mods Selected" tab select DPRECIP
- Set:
- Operation Names = DHMOP1
- Select Start Date = 07/02/2002 00Z
- End Date = 07/02/2002 12Z
- Precip Multiplier = 2.0
- OK
- From the "NWSRFS Interactive Forecast Program" display's File Menu select Re-Run…

Result – You should seep the following table in the background



tultable

Day	Hour	DHMOP1.SQIN	DHMOP2.SQIN
3	01	0.72	0.63
3	02	0.61	0.54
3	03	0.53	0.47
3	04	0.46	0.41
3	05	0.41	0.37
3	06	0.36	0.33
3	07	0.33	0.30
3	08	0.30	0.27
3	09	0.27	0.25
3	10	0.25	0.23
3	11	0.23	0.22
3	12	0.22	0.20
3	13	0.20	0.19

4.2.4 Test for defining Sac State Mods

- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select

"Mods viewer"

- Remove the previous DPRECIP mods by selecting all the text in the "Mods from file" pane and pressing the space bar
- From the the "NWSRFS Interactive Forecast Program" Modifications Menu re-select

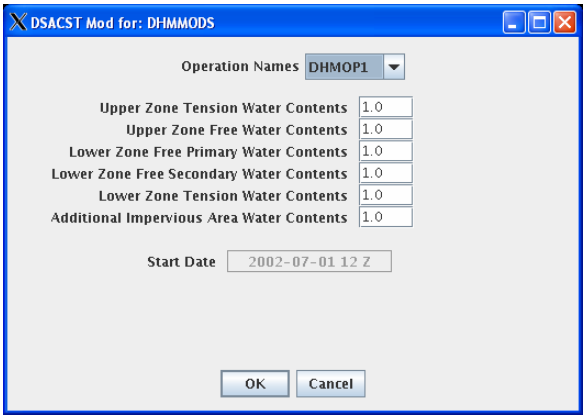
"Mods viewer" and "Yes" to save changes

- From the the "NWSRFS Interactive Forecast Program" Modifications Menu select

"Other mods"

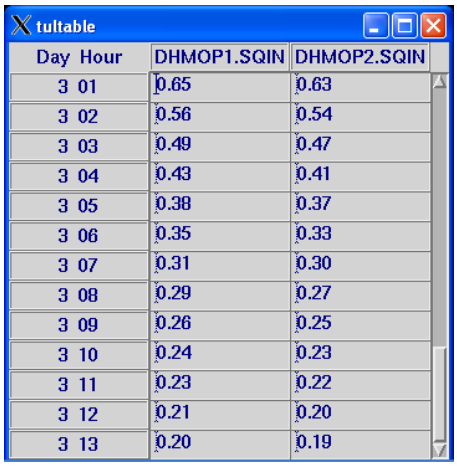
- From the "Mods Selected" tab select DSACST

Result – the display below appears



- Set Upper Zone Tension Water Contents to 2.0
- Set Upper Zone Free Water Contents to 2.0
- Select OK
- From the "NWSRFS Interactive Forecast Program" display's File Menu select Re-Run…

Result – You should seep the following table in the background



tultable

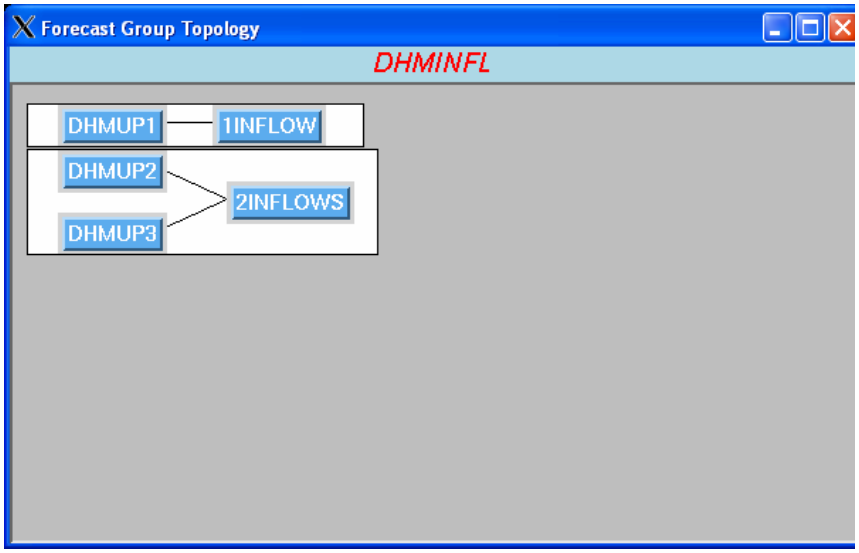
Day Hour	DHMOP1.SQIN	DHMOP2.SQIN
3 01	0.65	0.63
3 02	0.56	0.54
3 03	0.49	0.47
3 04	0.43	0.41
3 05	0.38	0.37
3 06	0.35	0.33
3 07	0.31	0.30
3 08	0.29	0.27
3 09	0.26	0.25
3 10	0.24	0.23
3 11	0.23	0.22
3 12	0.21	0.20
3 13	0.20	0.19

4.2.5 Test for running a DHM segment with more than one inflow

Step 1 – Select Forecast group and dates to run

- From the "NWSRFS Interactive Forecast Program" display's File Menu select File→Yes→No
- From the "Select Forecast Group and Carryover Date" display select DHMINFL as the Forecast Group and July1, 2002 12Z as the Carryover Date, Click Load

Result – the Forecast Group Topology map shown below is displayed



Step 2 – Run the segment 1INFLOW

- From the "NWSRFS Interactive Forecast Program" display's File Menu select Begin
- You should see the following tultable

tultable

Day Hour	TEST1.QINE	1INFLOW.SQIN
3 01	7.00	12.39
3 02	6.30	12.72
3 03	6.80	13.34
3 04	7.20	14.12
3 05	7.60	14.92
3 06	7.80	15.61
3 07	8.00	16.21
3 08	8.20	16.75
3 09	8.40	17.27
3 10	8.50	17.70
3 11	8.70	18.14
3 12	8.90	18.59
3 13	9.10	19.02

Step 3 – Run the segment 2INFLOWS

- From the "NWSRFS Interactive Forecast Program" display's File Menu select Next
- You should see the following tultable

tultable

Day Hour	TEST2.QINE	TEST3.QINE	2INFLOWS.SQIN
3 01	5.60	1.40	12.39
3 02	5.10	1.20	12.72
3 03	5.40	1.40	13.34
3 04	5.60	1.60	14.12
3 05	5.80	1.80	14.92
3 06	5.90	1.90	15.61
3 07	6.00	2.00	16.21
3 08	6.10	2.10	16.75
3 09	6.20	2.20	17.27
3 10	6.20	2.30	17.70
3 11	6.30	2.40	18.14
3 12	6.40	2.50	18.59
3 13	6.50	2.60	19.02

Background Information: The topology map shows DHMINFL consists of five segments. DHMUP1 and 1INFLOW are an upstream-downstream combination where the operations table in segment 1INFLOW has a DHM-OP using the results from DHMUP1 (TEST1.QINE) as its inflow. The other three segments (DHMUP2, DHMUP3, and 2INFLOWS) is a second upstream-downstream combination where the results from DHMUP2 and DHMUP3 (TEST2.QINE and TEST3.QINE respectively) are used as inflows for the DHM-OP in segment 2INFLOWS. The DHM-OP definitions in segment 1INFLOW and 2INFLOWS are modeling the same basin. The only difference is the DHM-OP in 1INFLOW uses 1 inflow timeseries, and the DHM-OP in 2INFLOWS uses two. The Tulsa table shows the outlet flow from both DHM-OPs (1INFLOW.SQIN and 2INFLOWS.SQIN) are the same. The magnitude of the inflow flowing into 2INFLOWS (TEST2.QINE and TEST3.QINE equals the inflow flowing into 1INFLOW, TEST1.QINE)

4.2.6 Test Grid Editor Program

The Grid Editor Program is a utility to create operational DHM grids from previous calibration.

The test procedures are shown in Appendix B.

Appendix A – IFP tests procedures

A. Generate test data and start IFP

After extracting the tar zipped testpackage:

1. cd to the directory ./dhmtestpackage/ifptests

2. execute the command *runIFPwithDHMOP rls* - this script creates a set ofs fs5files and starts IFP

   Result: filesize, filecrat, prdutil, sasmdb, goesdb, fcinit, and fcst run in the background, the **NWSRFS Interactive Forecast Program** and **Select Forecast Group and Carryover Date** windows pop up.

B. Run a forecast group with a distributed headwater segment

1. In the **Select Forecast Group and Carryover Date** window Select the DHMFG forecast group with Carryover date Jul 1, 2002 12, Z. Click the load button.

   Result: A dialog saying "Please wait while....." and the **Forecast Group Topology** window displays.

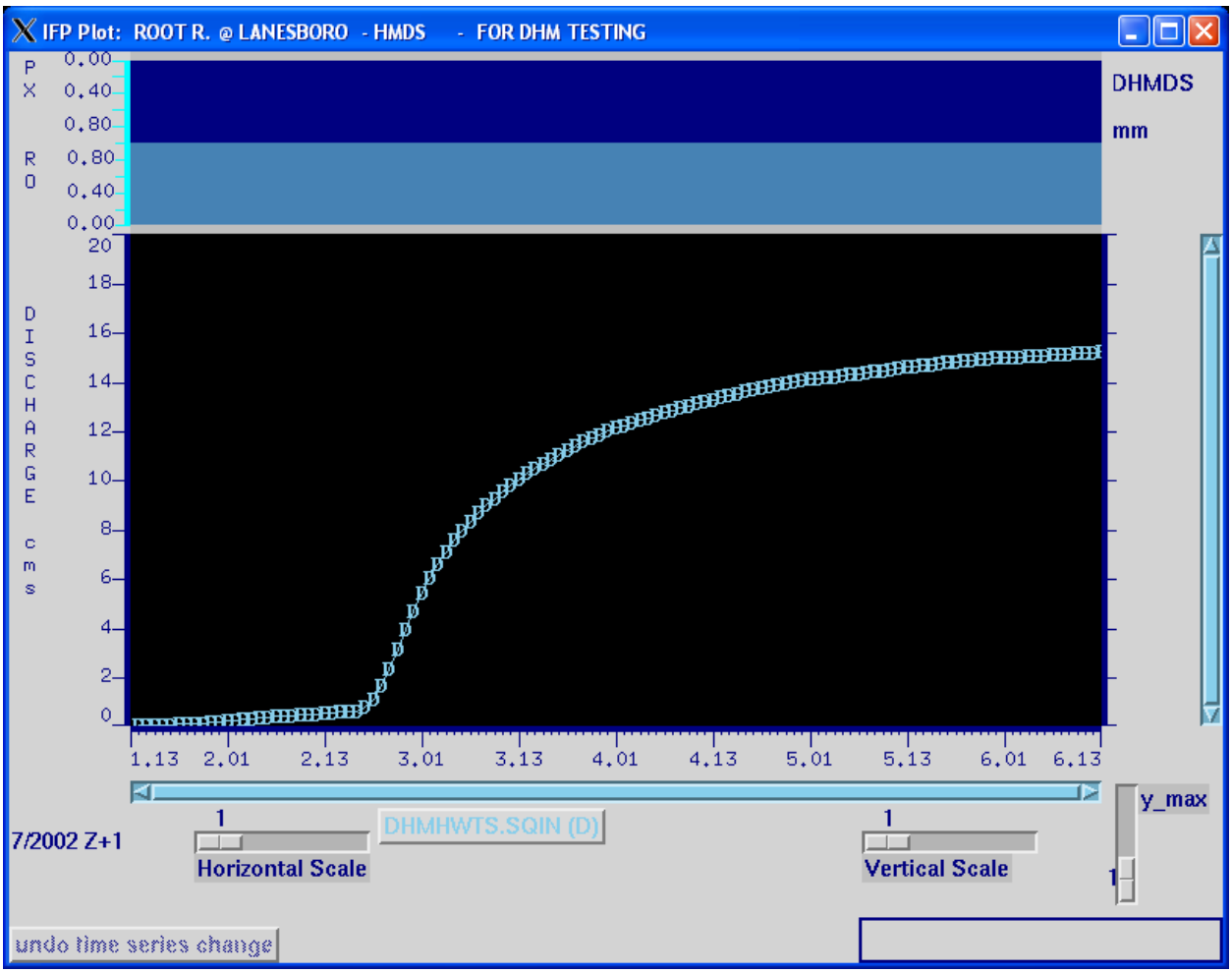
2. In the **NWSRFS Interactive Forecast Program** window Select Options→ Set dates... In the **NWSRFS run dates** dialog Set End of observations to Jul 6 2002 12 Z and End of run to Jul 6 2002 12 Z and Click the Set button.

   Result: Run dates are ready.

3. Select File→ Begin

   Result: In the background window used to start IFP, the DHM settings showed below scroll by. And the IFP Plot window pops up with the plot showed below.

```
*******************************DHM Operation*************************
 * Start of run period: 7/1/2002 12Z
 * Start of forecast period : 7/6/2002 12Z
 * End of run period: 7/6/2002 12Z
 *  Basin ID : DHMBAS1
*  Upstream Basin ID:
* precipitation data directory : /data/dhm/$LOGNAME/precip
* DHM Model data directory : $PWD/test_run_files
* D2D data directory : N/A
* DHM Notify data directory : N/A
 * number of hour(s) of future precipitation: 0
* Carryover will not be saved
*********************************************************************
```



4. This completes the test for running a forecast group containing a segment with one DHM-OP.

C. Run a forecast group with two distributed segments feeding a lumped down stream segment.

1. In the **NWSRFS Interactive Forecast Program** window Select File→New Forecast Group...

   Result: The **NWSRFS Interactive Forecast Program** dialog pops up

2. Click the Yes button.

   Result: The **NWSRFS Interactive Forecast Program** dialog pops down and the **Copy Run-time Mods to NWSRFS dialog** pops up

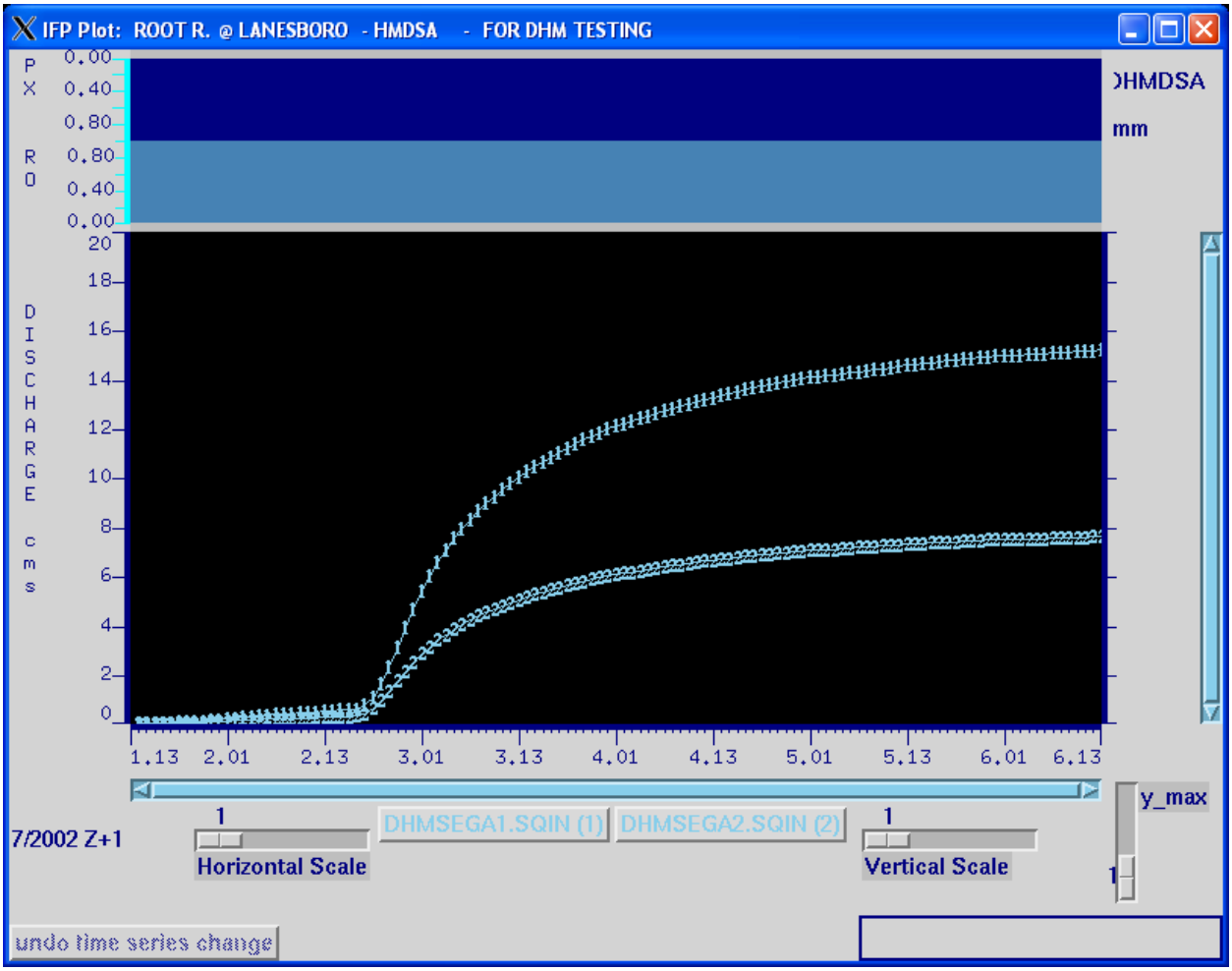
3. Click the NO button.

   Result: Dialog **Copy Run-time Mods to NWSRFS** pops down and the window **Select Forecast Group and Carryover Date** pops up.

Select the DHMFGA forecast group, Jul 1, 2002 12, Z as the Carryover date, Use previous IFP files from the drop down menu, and click the Load button.

Result: The **Forecast Group Topology** window pops up.
In the **NWSRFS Interactive Forecast Program** window Click File→Begin...
Result: In the background window used to start IFP, the DHM settings for each segment scrolls by. And the IFP Plot window showed below pops up.

*******************************DHM Operation*******************



4. This completes the test for two DHM-OP segments feeding a lumped downstream segment.

D. Run a forecast group where the downstream outlet hydrographs show the total flow using lumped and distributed routing

1. In the **NWSRFS Interactive Forecast Program** window Select File→New Forecast Group...

   Result: The **NWSRFS Interactive Forecast Program** dialog pops up

2. Click the Yes button.

   Result: The **NWSRFS Interactive Forecast Program** dialog pops down and the **Copy Run-time Mods to NWSRFS dialog** pops up

3. Click the NO button.

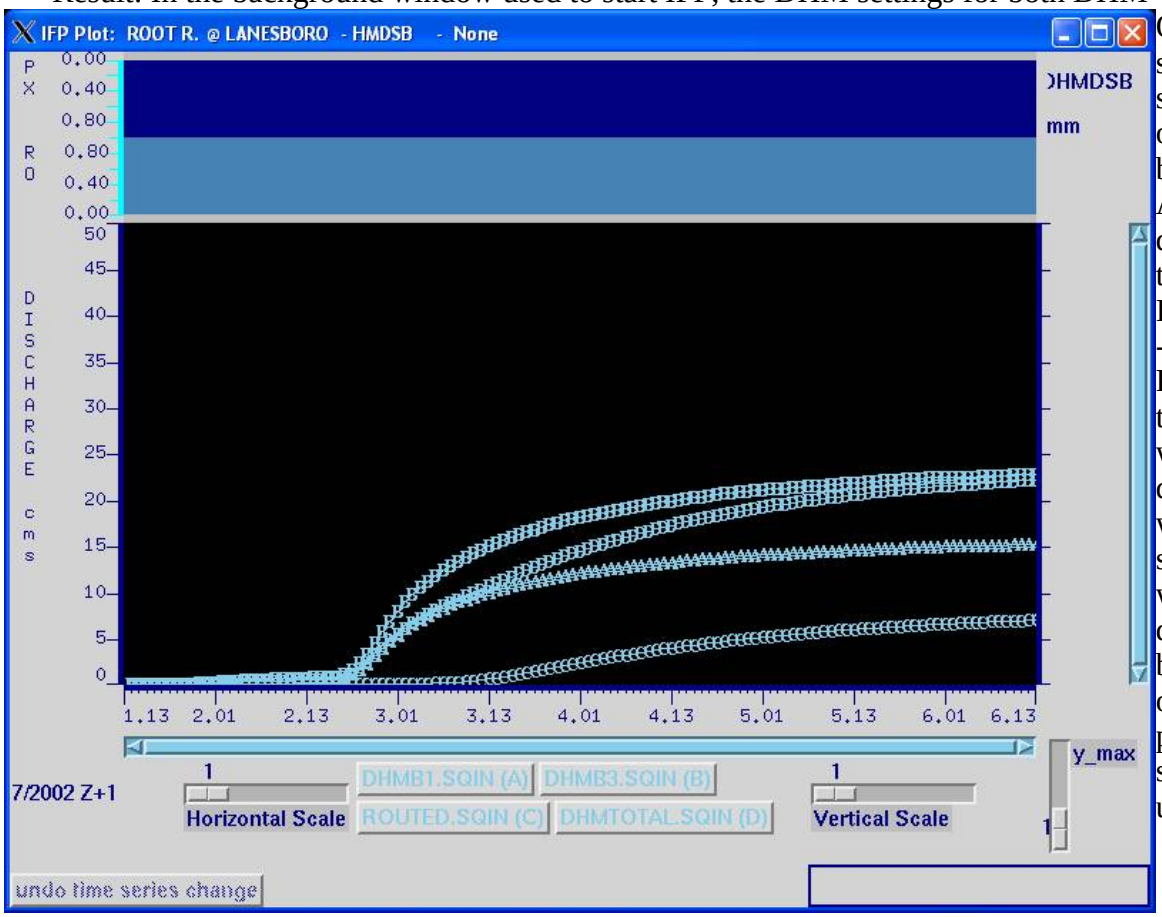
   Result: Dialog **Copy Run-time Mods to NWSRFS** pops down and the window **Select Forecast Group and Carryover Date** pops up.

4. Select the DHMFGB forecast group, select Use previous IFP files from the drop down menu, and click the Load button.

Result: The DHMFGB forecast group loads. And **Forecast Group Topology** window pops up.

5. Click File→Begin...

   Result: In the background window used to start IFP, the DHM settings for both DHM-OPs scroll by. And the IFP-Plot window showed below pops up



6. This completes the test of generating a hydrograph at a downstream distributed segment.

E. Run a forecast group with lumped (SAC-SMA and Unit Hydrograph) and distributed (SAC-SMA and Kinematic Routing) modeling the same area.

1. In the **NWSRFS Interactive Forecast Program** window Select File→New Forecast Group...

   Result: The **NWSRFS Interactive Forecast Program** dialog pops up

2. Click the Yes button.

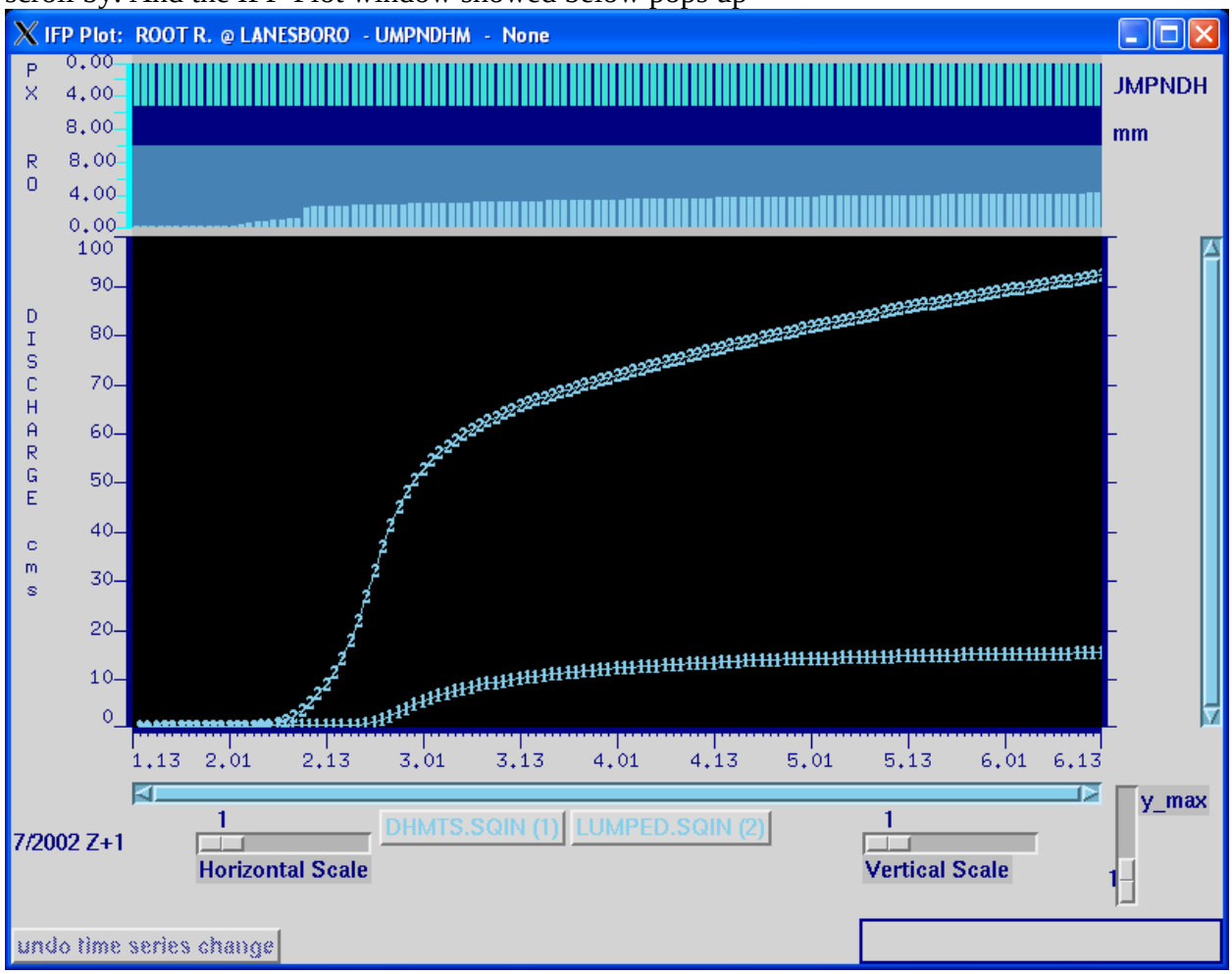
   Result: The **NWSRFS Interactive Forecast Program** dialog pops down and the **Copy Run-time Mods to NWSRFS dialog** pops up

3. Click the NO button.

4. Result: Dialog **Copy Run-time Mods to NWSRFS** pops down and the window **Select Forecast Group and Carryover Date** pops up.
5. Select the DHMFGC forecast group, select Use previous IFP files from the drop down menu, and click the Load button.

   Result: The DHMFGC forecast group loads. And **Forecast Group Topology** window pops up.
6. Click File→Begin...

   Result: In the background window, the DHM settings for the DHM-OP in DHMSEGC scroll by. And the IFP-Plot window showed below pops up



7. This completes the test of a distributed and lumped SAC-SMA feeding a lumped downstream segment test.

F. This forecast group run is the same as in section B, but the amount of future precipitation data DHM-OP uses is adjusted through the IFP GUI.

1. In the **NWSRFS Interactive Forecast Program** window Select File→New Forecast Group...

   Result: The **NWSRFS Interactive Forecast Program** dialog pops up

2. Click the Yes button.

   Result: The **NWSRFS Interactive Forecast Program** dialog pops down and the **Copy Run-time Mods to NWSRFS dialog** pops up

3. Click the NO button.
4. Result: Dialog **Copy Run-time Mods to NWSRFS** pops down and the window **Select Forecast Group and Carryover Date** pops up..
5. In the **Select Forecast Group and Carryover Date** window Select the DHMFG forecast group with Carryover date Jul 1, 2002 12, Z. Click the load button.

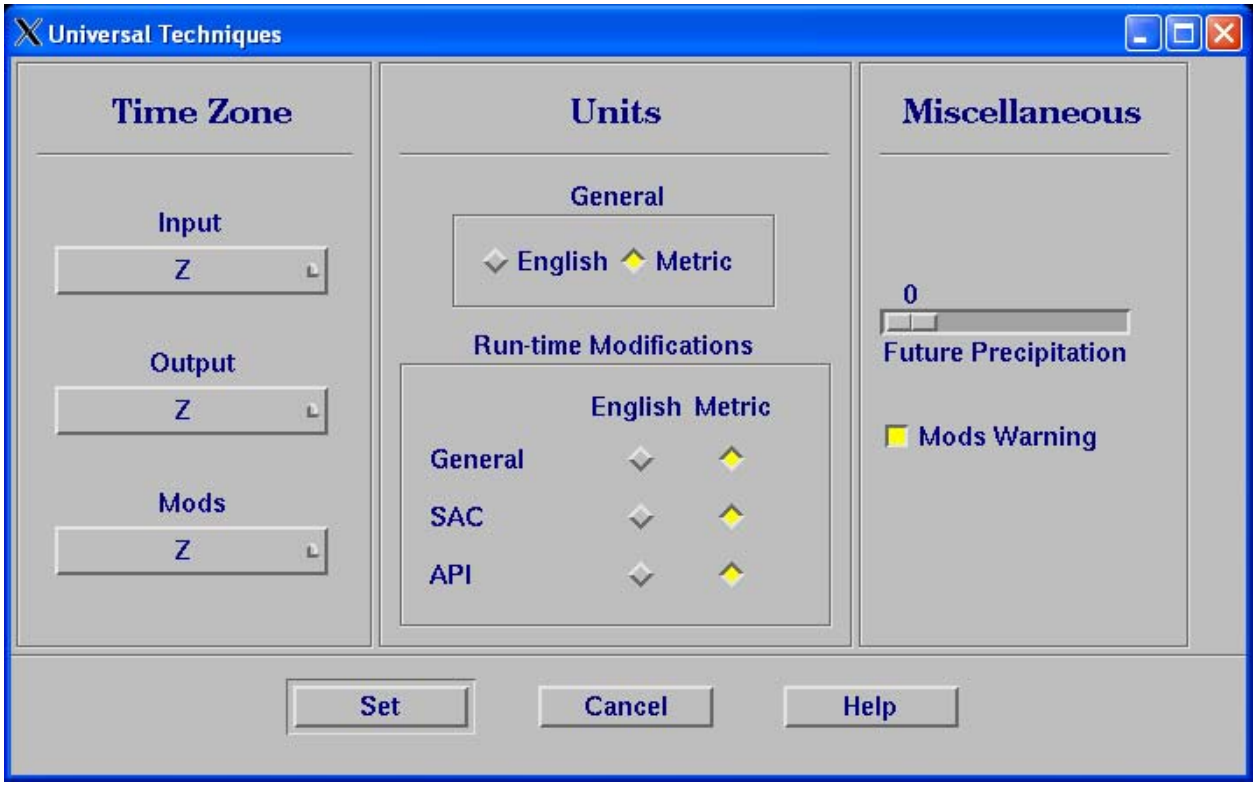
   Result: A dialog saying "Please wait while....." and the **Forecast Group Topology** window displays..

6. In the **NWSRFS Interactive Forecast Program** window Select Options→ Set dates... In the **NWSRFS run dates** dialog Set End of observations to Jul 6 2002 12 Z and End of run to Jul 4 2002 12 Z and Click the Set button.

   Result: Run dates are ready.

7. Click Options→Techniques→Universal...

   Result: The Universal Techniques window shown below pops up.



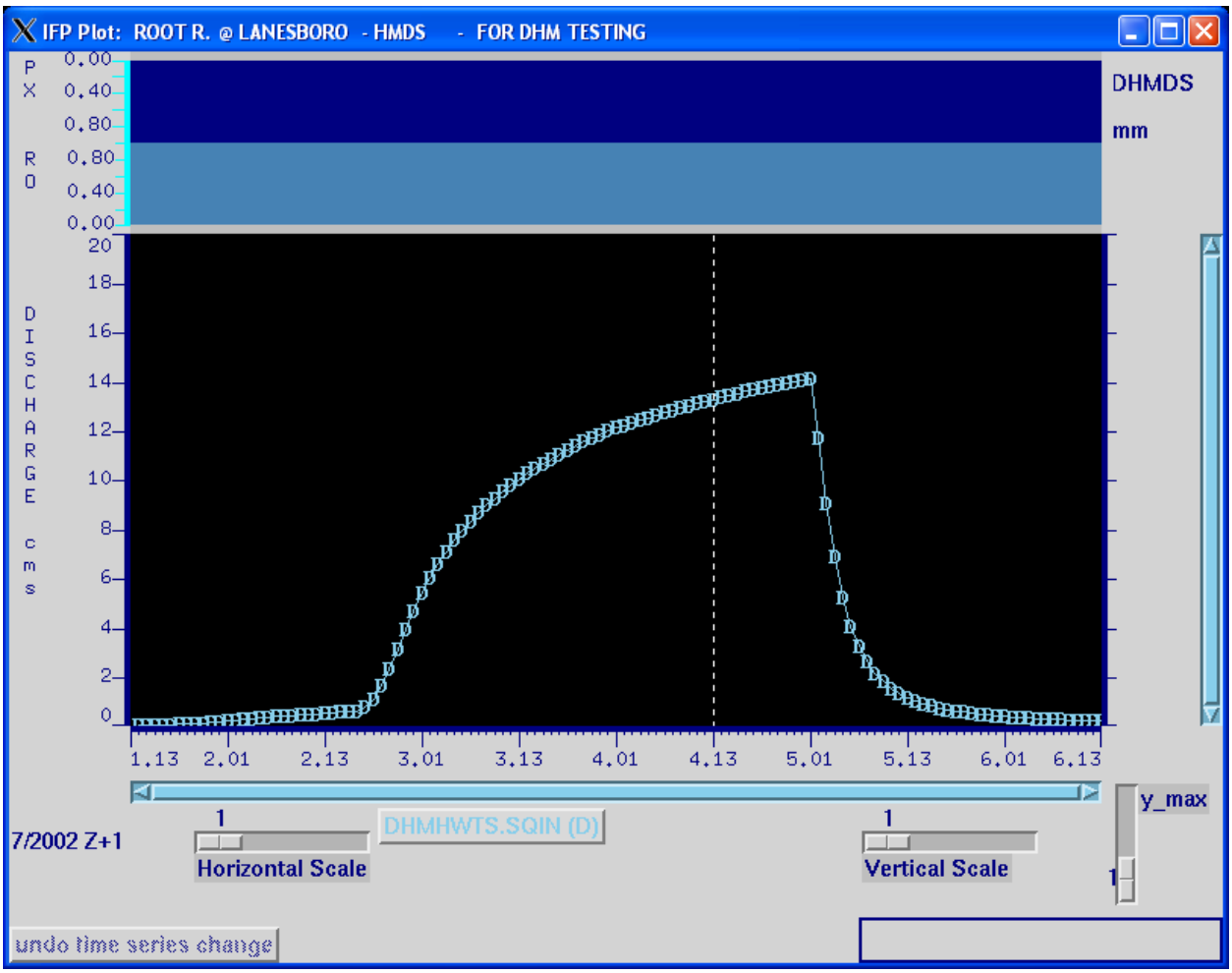
8. Set Future Precipitation to 12 (this specifies the number of hours of gridded future precipitation to use). Click the Set button.

Result: Future Precipitation is set to 12 hours (the rest of the forecast period will use 0 for future precipitation).

9. Click File→Begin...

   Result: In the background window, the DHM settings are shown with future precipitation set to 12 hours. And the **IFP Plot** window pops up with the display showed below.

******************************DHM Operation*******************************
** Start of run period: 7/1/2002 12Z*
** Start of forecast period : 7/4/2002 12Z*
** End of run period: 7/6/2002 12Z*
** Basin ID : DHMBAS1*
** Upstream Basin ID:*
** precipitation data directory : /data/dhm/$LOGNAME/precip*
** DHM Model data directory : $PWD/test_run_files*
** D2D data directory : N/A*
** DHM Notify data directory : N/A*
** number of hour(s) of future precipitation: 12*
** Carryover will not be saved*
*******************\



10. This completes the test to show setting the amount of future precipitation used by DHM-OP

G. End of IFP run.

1. Select File->Quit

   Result: IFP windows pop down.

This completes the IFP portion of the DHM test.

Appendix B – DHM Grid Editor Tests

Grid Editor Test Procedures

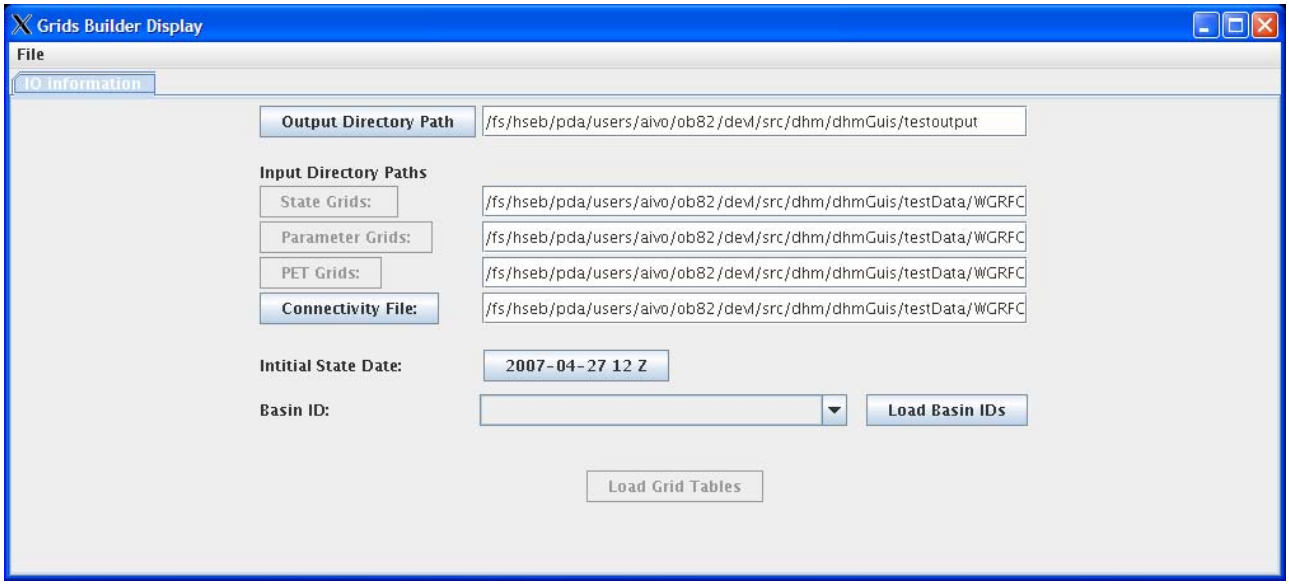
Do the following steps:

cd dhmtestpackage

Run setup script. Type:
. runsetup

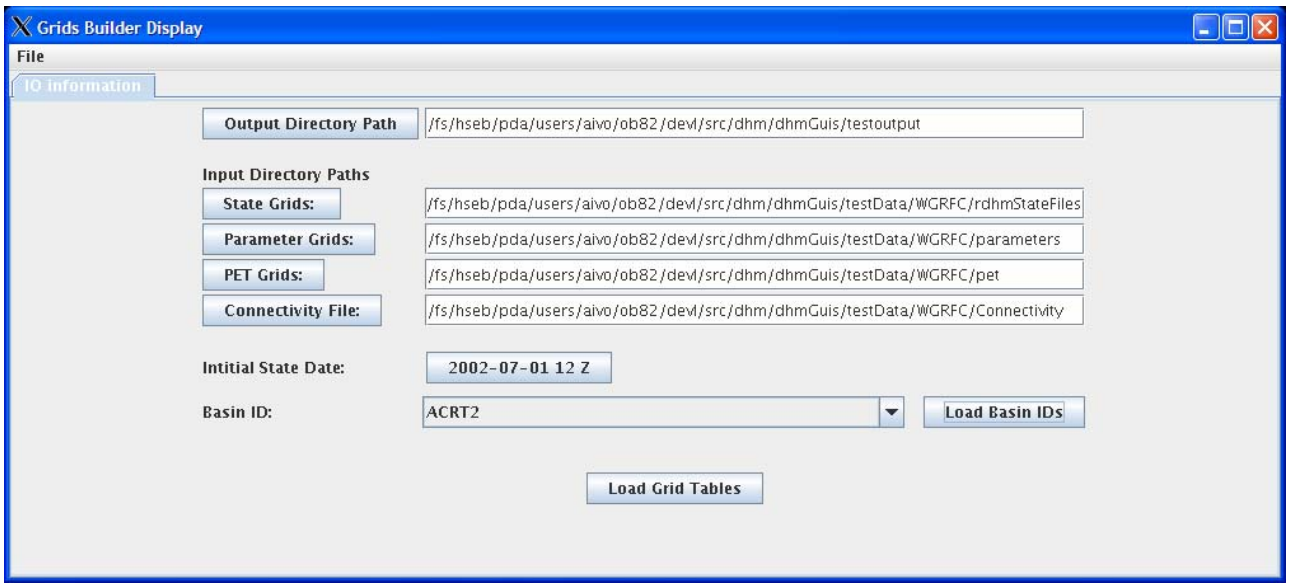
Run the script "run_dhm_grid_editor". Type:
cd $(gad util_rls)
run_dhm_grid_editor&

Result: The following display will pop up.



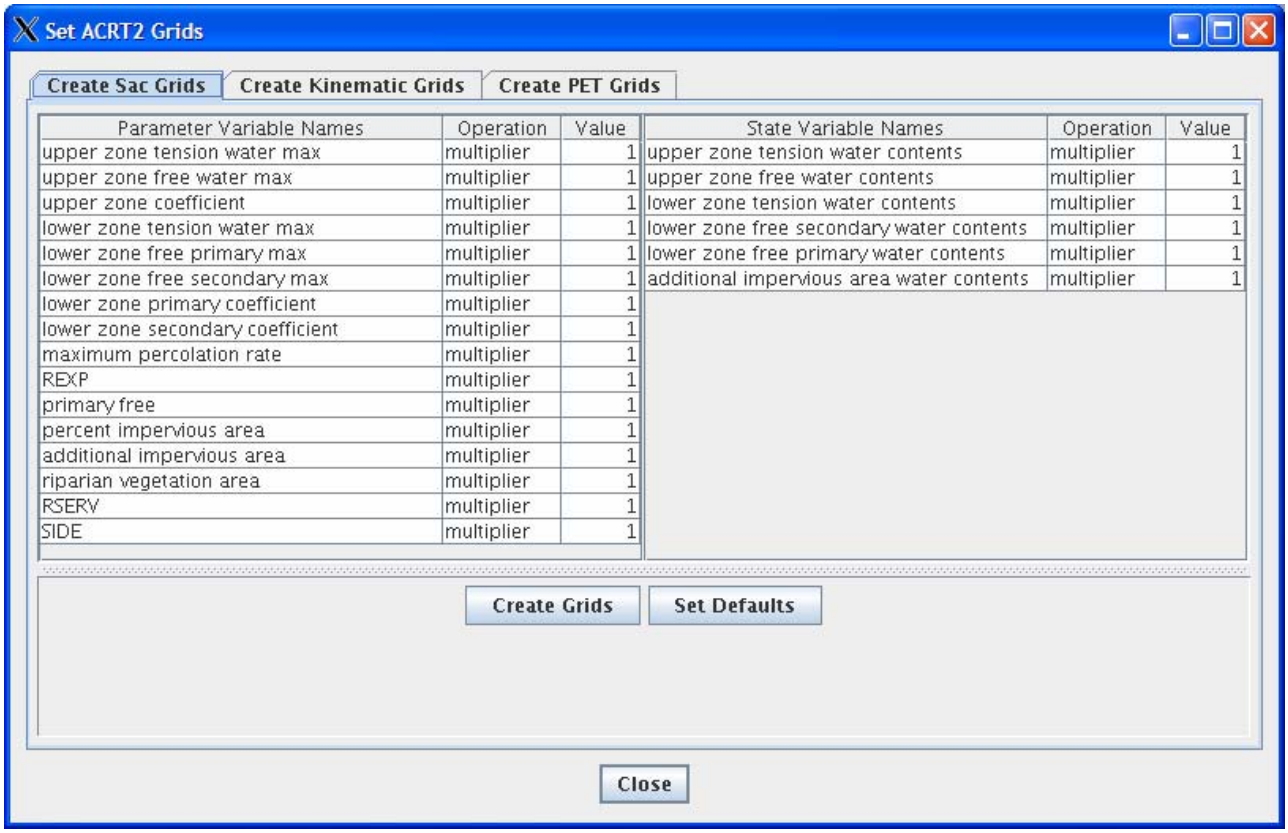
Enter Input and Output directory selection. Do the following steps:
- Click on "Connectivity File" button to enter connectivity file, select the file "Connectivity".
- Click on "State Grids" button to enter State grids input directory, select file "rdhmStatefiles"
- Click on "Parameter Grids" button to enter parameter grids input directory, select file "parameters"
- Click on "PET Grids" button to enter the PET input directory, select file "aprioriPet"
- Click on "Initial State Date" button to enter date, select "July 1, 2002" for date
- Click on "Load Basin IDs" button

Result: The following display will pop up.



1) Test Change Parameter Grids using Operation Multiplier.

From the main window, do the following steps:
- Click on "Load Grid Tables" button
Result: the "Set ARCT2 Grids" display will pop up.



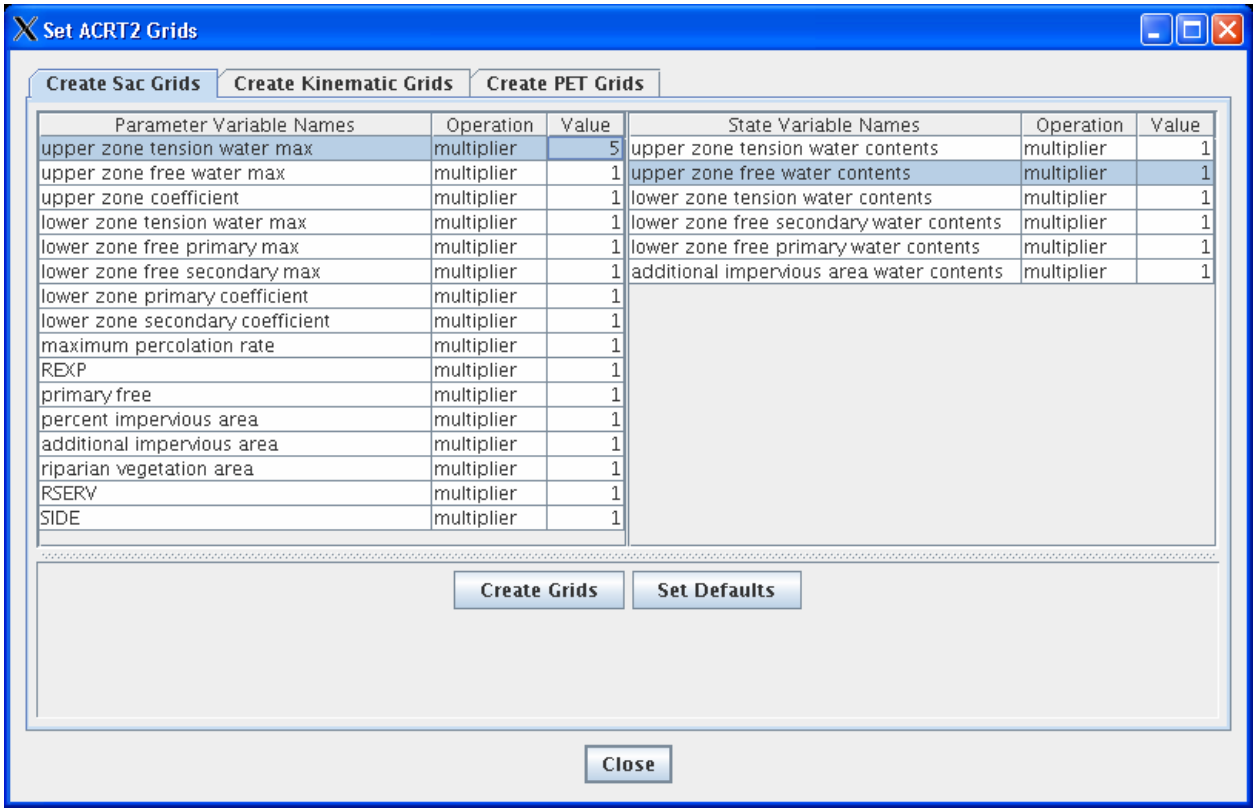
Parameter Variable Names	Operation	Value
upper zone tension water max	multiplier	1
upper zone free water max	multiplier	1
upper zone coefficient	multiplier	1
lower zone tension water max	multiplier	1
lower zone free primary max	multiplier	1
lower zone free secondary max	multiplier	1
lower zone primary coefficient	multiplier	1
lower zone secondary coefficient	multiplier	1
maximum percolation rate	multiplier	1
REXP	multiplier	1
primary free	multiplier	1
percent impervious area	multiplier	1
additional impervious area	multiplier	1
riparian vegetation area	multiplier	1
RSERV	multiplier	1
SIDE	multiplier	1

State Variable Names	Operation	Value
upper zone tension water contents	multiplier	1
upper zone free water contents	multiplier	1
lower zone tension water contents	multiplier	1
lower zone free secondary water contents	multiplier	1
lower zone free primary water contents	multiplier	1
additional impervious area water contents	multiplier	1

There are three display tabs “Create SAC Grids”, “Create Kinematic Grids”, and “Create PET Grids” allowing the user to change grids values.

From “Create SAC Grids” table, Type:
- For parameter variable name: upper zone tension water max”, set “Value” = 5

Result: the following display will pop up



Parameter Variable Names	Operation	Value
upper zone tension water max	multiplier	5
upper zone free water max	multiplier	1
upper zone coefficient	multiplier	1
lower zone tension water max	multiplier	1
lower zone free primary max	multiplier	1
lower zone free secondary max	multiplier	1
lower zone primary coefficient	multiplier	1
lower zone secondary coefficient	multiplier	1
maximum percolation rate	multiplier	1
REXP	multiplier	1
primary free	multiplier	1
percent impervious area	multiplier	1
additional impervious area	multiplier	1
riparian vegetation area	multiplier	1
RSERV	multiplier	1
SIDE	multiplier	1

State Variable Names	Operation	Value
upper zone tension water contents	multiplier	1
upper zone free water contents	multiplier	1
lower zone tension water contents	multiplier	1
lower zone free secondary water contents	multiplier	1
lower zone free primary water contents	multiplier	1
additional impervious area water contents	multiplier	1

- Click on “Create Grids”

Result: SAC Grid data have been written to the grid output data.

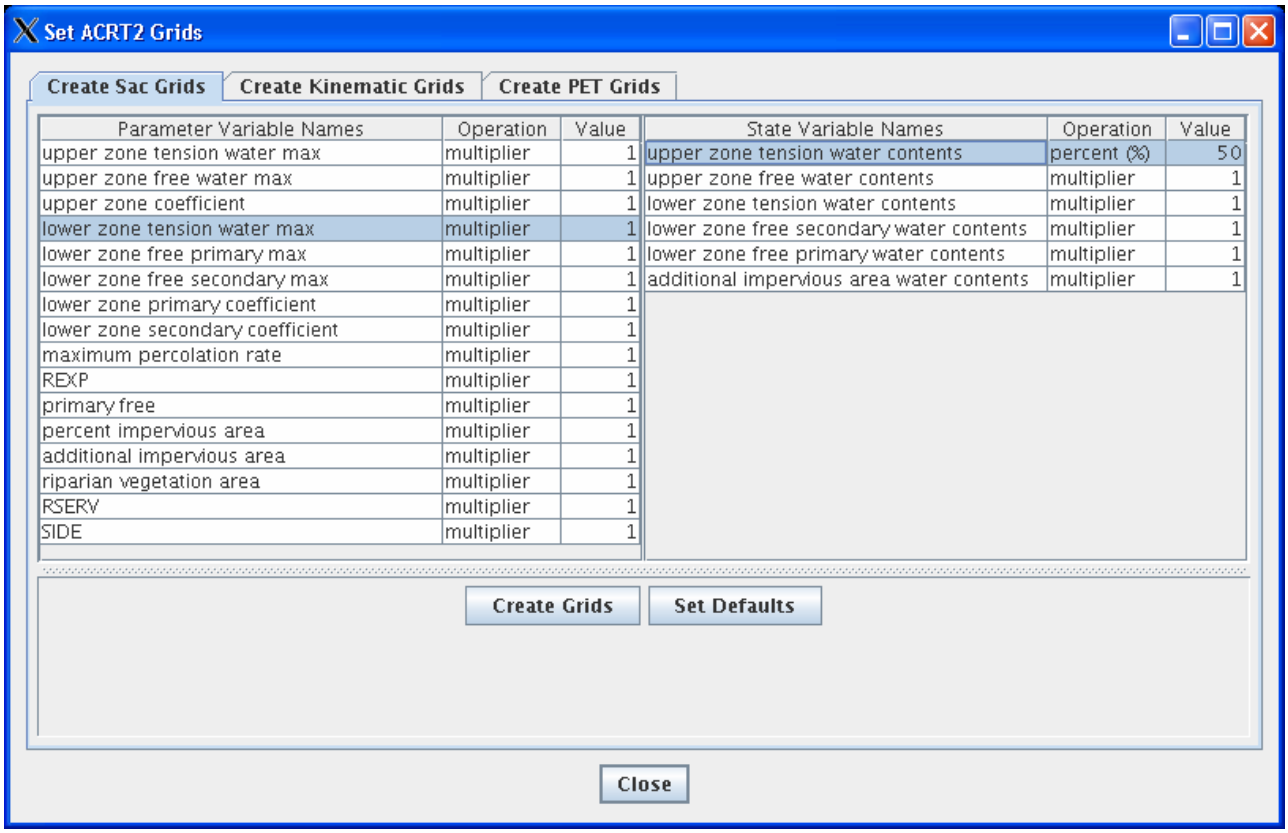
Verify correct data have been written to the file. Type:
cd dhmtestpackage/grideditortests
run_grid_editor_tests

Result: 2 right, 0 wrong, 0 ignored, 0 exceptions

2) Test Changing State Grids using Operation Percent.

From “Create SAC Grids” table, do the following steps:
- For state variable name: upper zone tension water contents” , set “Operation” to percent and “Value” = 50

Result: the following display will pop up



Parameter Variable Names	Operation	Value
upper zone tension water max	multiplier	1
upper zone free water max	multiplier	1
upper zone coefficient	multiplier	1
lower zone tension water max	multiplier	1
lower zone free primary max	multiplier	1
lower zone free secondary max	multiplier	1
lower zone primary coefficient	multiplier	1
lower zone secondary coefficient	multiplier	1
maximum percolation rate	multiplier	1
REXP	multiplier	1
primary free	multiplier	1
percent impervious area	multiplier	1
additional impervious area	multiplier	1
riparian vegetation area	multiplier	1
RSERV	multiplier	1
SIDE	multiplier	1

State Variable Names	Operation	Value
upper zone tension water contents	percent (%)	50
upper zone free water contents	multiplier	1
lower zone tension water contents	multiplier	1
lower zone free secondary water contents	multiplier	1
lower zone free primary water contents	multiplier	1
additional impervious area water contents	multiplier	1

- Click on “Create Grids”

Result: SAC Grid data have been written to the grid output data.

Verify correct data have been written to the file. Type:
cd dhmtestpackage/grideditortests
run_grid_editor_tests states

Result: 2 right, 0 wrong, 0 ignored, 0 exceptions

From the “Grid Builder Display” select “File”→”Exit” to close the program.

The test is completed.