

Initial DMIP 2 Modeling Instructions

For

Sierra-Nevada Basins

September 25, 2006

Revised: December 5, 2006

A. Overview

These initial experiments are designed to address the science questions proposed in the DMIP 2 Science Plan for the American and Carson basins in the Sierra-Nevada region. Participants are referred to the DMIP 2 Science Plan for background information.

A.1 Mandatory and Optional Forcings

We require that all groups participating in the Sierra-Nevada experiments use the supplied gridded precipitation and temperature estimates. These were produced using an algorithm developed by John Schaake and Shuzheng Cong (see notes in DMIP 2 Data web page). They were tested against NWS-derived time series for model calibration and found to be satisfactory as far as water balance is concerned. These data must be used to generate the simulations described below in the specific instructions.

We suggest two sources of data to estimate potential evaporation. First, we provide the climatological monthly mean Free Water Surface Evaporation estimates made available in DMIP 1. Second, we also provide a link to the North American Regional Reanalysis (NARR) web site. DMIP 2 participants are free to extract the needed variables from the NARR data to compute estimates of potential evaporation forcing for their models. Moreover, modelers are free to use the NARR or other energy forcing data to use energy budget snow models.

Note that experiments outlined here represent basic or baseline simulations using existing sources of precipitation and temperature which are used by the RFCs for operational forecasting. These basic simulations will address the questions of distributed and lumped models using existing sources of data for operational forecasting. In the near future, we will provide gridded estimates of precipitation and temperature from the advanced sensors in the HydroMet Testbed (HMT). These ‘value added’ data will be used to help determine the required data quality and network density to improve simulations. In addition, we will provide soil moisture and stream level data from the HMT as soon as it is reviewed for quality. Appropriate modeling instructions will be developed to use these interior point data at a future date.

A.2 Model Warm-up

We specify a warm-up period preceding the calibration period for the American and Carson Basins. Such a period allows the participants to avoid the effects of initial conditions that might adversely affect the goodness-of-fit statistics during the calibration period. We will not provide the observed streamflow data for the warm-up periods. Table 3 presents the warm-up, calibration, and verification periods.

A.3 Model Calibration.

Note: In the evaluation of DMIP 2 participant's contributions, the dominant emphasis will be placed on comparing simulated to observed streamflow. We will have only secondary interest in comparing simulated and observed snow water equivalent (SWE). Participants should take this into account when performing their calibrations.

Calibration will be carried out by comparing observed and simulated streamflow only at the three designated basin outlets (indicated in brown in Section B.1 below) during the calibration period. Participants are free to use areal snow cover data and point SWE data to calibrate their models as the NWS uses such data in the calibration of the lumped models. We provide a basic set of snow cover data for this purpose on the DMIP 2 data web page. In addition, we provide SWE data for two sites in the North Fork American River and four SNOTEL sites in the East Fork of the Carson River. The data for the two sites in the North Fork are from the California Data Exchange Center (CDEC).

Even though observed streamflow and other data may be readily available at some interior nested locations, modelers are asked to ignore these data in the calibration process. One emphasis of the DMIP experiments is to assess how well distributed models predict streamflow and other processes at interior locations, especially at ungauged sites. One reason we do not allow the use of interior point data for calibration in these comparisons is that many NWS forecast basins around the country do not have interior point data available. We recognize that where available, these data may be useful in improving outlet simulations. Therefore, we do not discourage independent investigation into this issue apart from these formal DMIP-2 comparisons.

A.4 Simulations

Modelers will be asked to generate and submit to HL two basic types of simulations at specified points. The first type of simulation will be generated using initial or uncalibrated parameter values of the hydrologic (snow/rainfall-runoff) models and hydraulic routing models. This test is to determine how well distributed models perform with parameters derived from physical data. Hereafter, we refer to these as uncalibrated simulations. Participants will submit their uncalibrated simulations from both the calibration and verification periods. The second type of simulation is generated after hydrologic and hydraulic model parameters are calibrated to observed flows at the designated basin outlets, using observed snow cover and point SWE data provided if desired. This simulation is meant to show how much calibration is required and what improvement in simulation accuracy is gained. Participants will submit their simulations (using calibrated parameters) for both the calibration and verification periods.

During the same model runs to generate the basin outlet hydrographs (with both outlet calibrated and uncalibrated parameters), participants will also simultaneously generate simulations of stream discharge and point SWE at specified interior points. In the East Fork Carson basin draining to Gardnerville, Nevada, there is an interior USGS gauge with observed discharge data at Markleeville, CA. The Markleeville gauge will be used as both a 'blind' interior simulation point as well as a designated outlet. (Note: In the North Fork American, interior computation points will be identified later after

analysis of the HMT data.) As stated above, there should be no calibration using these interior observed streamflow data. These "blind" simulations will be used to assess how well interior processes can be simulated when calibration was performed using only basin outlet data.

Figures 1a and 1b present the location of the USGS and SNOTEL gages. Tables 1 and 2 provide additional information.

A.5 Stream Gauges in North Fork American Basin

The North Fork of the American River drains an area of approximately 885.8 sq. km. (342 sq. miles). The North Fork flows to the USGS gage number 11427000 at the North Fork Dam. See Appendix B of the DMIP 2 Science Plan for more details on this gage.

A.6 Stream Gauges in the East Fork Carson Basin

The East Fork of the Carson River flows northeast out of the Sierra-Nevada mountains. Just before the California-Nevada border, the East Fork flows to USGS gauge number 10308200 in Markleeville, CA, draining an area of 714.8 sq. km. After the East Fork flows into the state of Nevada, it reaches the USGS gauge 10309000 in Gardnerville, NV, draining an area of approximately 922 sq. km. The East Fork of the Carson with the two USGS gauges will allow the DMIP participants to treat the Markleeville gauge as a 'blind' interior point to see how well distributed models simulate processes in the basin.

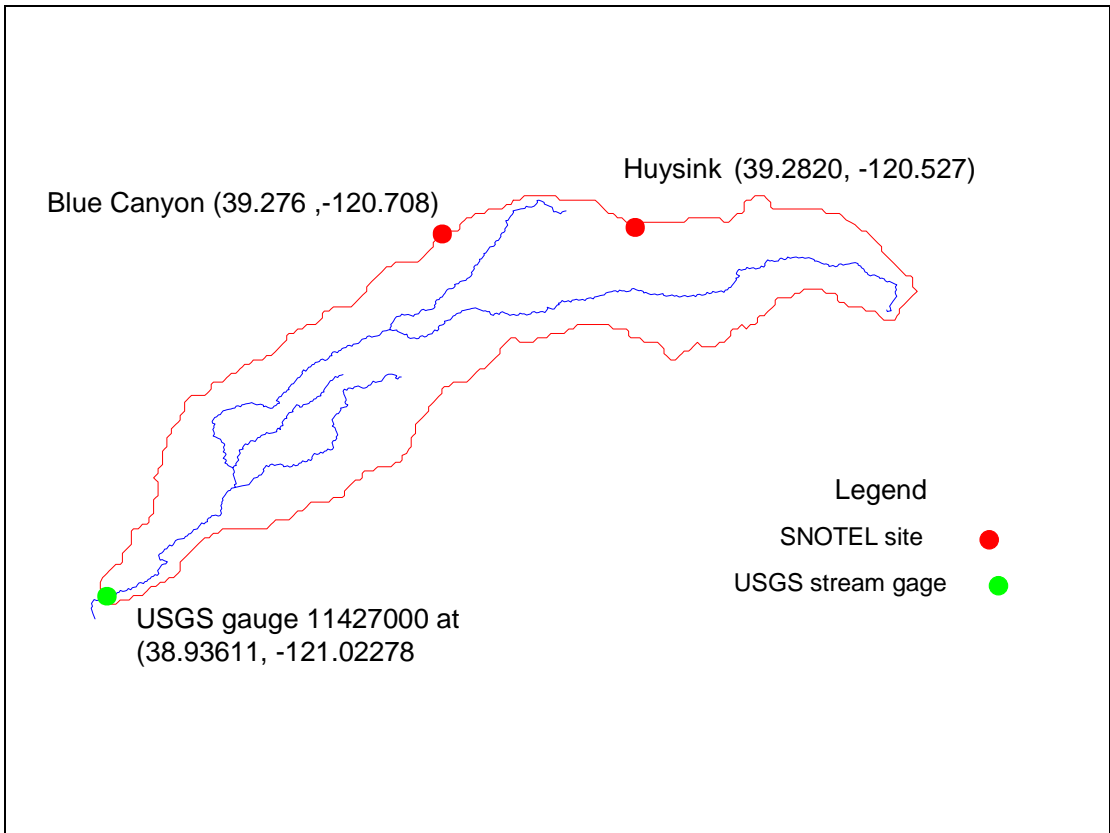


Figure 1a. North Fork American River Basin and location of USGS and California Data Exchange Center (CDEC) snow water equivalent gages.

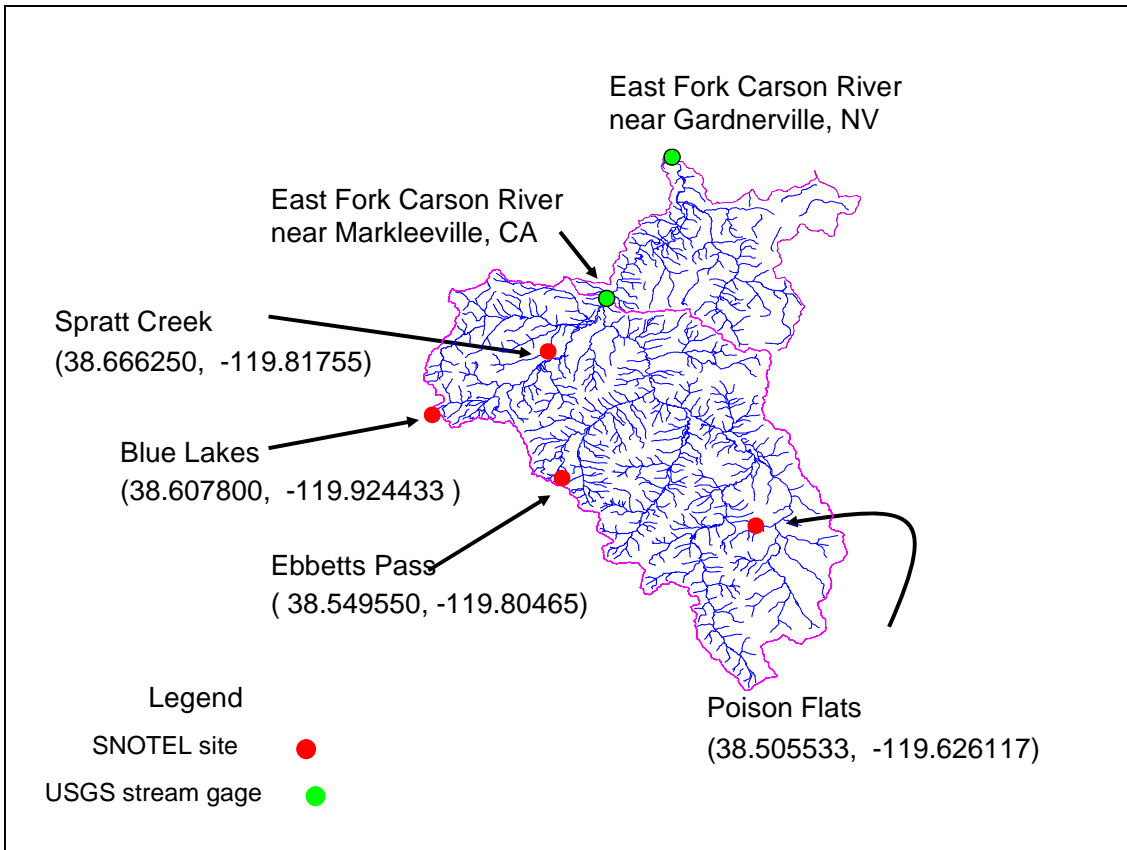


Figure 1b. East Fork Carson River Basin and location of SNOTEL and USGS gages.

Table 1. Data for USGS Stream Gauges in the Sierra-Nevada Region.

No	USGS No	Name	Latitude (degrees)	Longitude (degrees)	Area (km ²)
1	11427000	North Fork American R. at North Fork Dam, CA	38.93611	-121.02278	885.8
2	10308200	East Fork Carson River near Markleeville, CA	38.71472	-119.76389	714.8
3	10309000	East Fork Carson River near Gardnerville, NV	38.845	-119.70361	922

Table 2. Station Information for Observed Point SWE Values for Calibration

Basin	Station	Lat/Lon.	Elev. Feet	SNOTEL or CDEC ID	Owner	Observation time
North Fork American	Huysink	Latitude: 39.2820 Longitude: -120.527	6600	HYS	Bureau Rec.	0400 Local time; 1200 Z time ¹
North Fork American	Blue Canyon	Latitude: 39.276 Longitude: -120.708	5280	BLC	Bureau Rec.	0400 Local time; 1200 Z time ¹
East Fork Carson	Blue Lakes	Latitude: 38.607800 Longitude: -119.924433	8057	356	NRCS Snotel	2400 Local time; 0800 Z time (next day) ²
East Fork Carson	Ebbetts Pass	Latitude: 38.549550 Longitude: -119.804650	8765	462	NRCS Snotel	2400 Local time; 0800 Z time (next day) ²
East Fork Carson	Poison Flats	Latitude: 38.505533 Longitude: -119.626117	7736	697	NRCS Snotel	2400 Local time; 0800 Z time (next day) ²
East Fork Carson	Spratt Creek	Latitude: 38.666250 Longitude: -119.817550	6115	778	NRCS Snotel	2400 Local time; 0800 Z time (next day) ²

Notes:

¹ The daily snow water content data for Huysink and Blue Canyon are retrieved from the real-time hourly or 15-minute data collected from automated sensors. The 4AM reading is normally used, unless it is missing or is erroneous. If it is missing, then 5AM or 6AM are possibly used.

² Daily values for snow water equivalent are the midnight reading at the SNOTEL site.

B. Detailed Modeling Instructions for the Sierra-Nevada Experiments.

B.1. Comparison of Lumped and Distributed Simulations

B.1.1 Model Run Periods

Table 3. Model Run Periods

Basin	'Warm Up'	Calibration	Verification
North Fork American	October 1, 1987 to September 30, 1988	October 1, 1988 to September 30, 1997	October 1, 1997 to December 31, 2002
East Fork Carson at Markleeville, CA	October 1, 1989 to September 30, 1990	October 1, 1990 to September 30, 1997	October 1, 1997 to December 31, 2002.
East Fork Carson at Gardnerville, NV	October 1, 1989 to September 30, 1990	October 1, 1990 to September 30, 1997	October 1, 1997 to December 31, 2002.

Note that we will extend the verification period beyond 2002 when we are able to process the data.

B.1.2 Time Zone and Time Step:

Participants are requested to generate streamflow simulations in Z time (GMT). Streamflow simulations should have an hourly time step or have an ordinate spacing that includes hourly values to facilitate comparison to the USGS observed hourly discharge data. The USGS hourly discharge data, precipitation data, and temperature data are supplied by HL in Z time. Simulations of SWE should have a daily time step, with the value corresponding to the observation time of the station as shown in Table 2.

B.1.3 Model "Warm-Up Periods"

Participants are encouraged to use the specified periods as 'warm up' periods prior to the designated calibration period.

B.1.4 Simulations to Submit

B.1.4.1. North Fork River with basin outlet at USGS gauge 11427000 at the North Fork Dam, California. Drainage area 885.8 sq. km.

a. Generate 2 streamflow simulations at the basin outlet USGS gauge that span both the calibration and validation periods:

1. with uncalibrated/initial parameters
2. with calibrated parameters

b. While generating the 2 basin outlet streamflow simulations above, compute interior SWE simulations for the calibration/validation periods at:

1. Blue Canyon: Latitude: 39.276 Longitude -120.708
2. Huysink: Latitude 39.2820 Longitude -120.527

NOTE: No calibration is allowed using other observed interior data even though they may be available from the HMT or other sources.

B.1.4.2. East Fork Carson River with designated basin outlet at USGS gauge 10309000 near Gardnerville, CA. Drainage area 922.0 sq. km. (356 sq. miles).

a. Generate 2 streamflow simulations at the basin outlet that span both the calibration and validation periods:

1. with uncalibrated/initial parameters
2. with calibrated parameters

b. While generating the 2 basin outlet simulations above, compute interior streamflow simulations at:

East Fork Carson River at USGS gauge 10308200 near Markleeville, CA. Drainage area 714.8.0 sq. km. (276 sq. miles).

NOTE: They are to be "blind" simulations. No calibration is allowed using observed streamflow data at Markleeville, CA, for simulations in 1 and 2 above, even though calibrated simulations for this point are requested in B.1.4.3 below.

B.1.4.3. East Fork Carson River with designated basin outlet at USGS gauge 10308200 near Markleeville, CA. Drainage area 714.8.0 sq. km. (276 sq. miles).

a. Generate 2 simulations at the basin outlet that span both the calibration and validation periods:

1. with uncalibrated/initial parameters
2. with calibrated parameters

b. While generating the 2 basin outlet simulations above, compute interior SWE simulations for the calibration/verification periods at:

1. Blue Lakes Latitude: 38.607800 Longitude: -119.924433
2. Ebbets Pass Latitude: 38.549550 Longitude: -119.804650
3. Poison Flats Latitude: 38.505533 Longitude: -119.626117
4. Spratt Creek Latitude: 38.666250 Longitude: -119.817550