Adjusting state variable initial conditions

Adjusting the soil moisture initial conditions is optional. Because the initial conditions have not been set since 2012, it is possible that they have drifted since then.

It is important to get the soil moisture correct before the fall rains and winter accumulation of snow as the soil moisture controls the spring runoff. The best time to set the soil moisture initial conditions for the Smoky model is in the fall after the end of summer evapotranspiration.

When adjusting the .int files, it is important to know the how the model is set up. The arrangements of sub-basins and HRUs are given in the Lower Smoky River Model manual.

In the .int file, the state variables look something like this:

```
######
A_MtSub_GA3_GrpA Albedo@A
0.152 0.75 0.7 0.7 0.735 0.79 0.679 0.091 0.145 0.145
0.129 0.1 0.1 0.77
######
```

The name of the state variable is broken down as:

`A_MtSub`	Sub-basin in group A, which is a mountain sub-basin
`GA3`	Alphanumeric name of basin
`GrpA`	Group name
`Albedo`	State variable

The values for all of the HRUs in the basin are separated by whitespace, and can be on one line or split over several lines. Note that you have to end the values with the # symbols on an new line.

State variables

The most important fall CRHM state variables for spring runoff are the soil moisture and the depressional storage.

Soil moisture

The soil in each HRU is divided into a an upper (‘recharge’) zone and a lower zone. The upper zone is affected by evaportranspiration, and its state variable is ‘soil_rechr’, which is in mm.

The recharge zone state variables therefore look like:

```
######
A_MtSub_GA3_GrpA soil_rechr@A
9.99 10 10 10 50 50 50 88.97 86.76 94.17
93.93 0 0 0
######
```

and

```
######
A_MtSub_GA3_GrpA soil_moist@A
19.85 11.47 11.43 20 57.93 89.85 100 443.2 387.1 621.4
634.5 0 0 0
######
```

Adjustment of state variables

To adjust the state variables, you need to know a) what are valid values and b) what values to use.

Valid values

You can see the names of the HRUs for each basin in the manual, or by looking in the CRHM .prj file (search for ‘hru_names’). In the case of GA3, the HRU names are:

```
A_MtSub_GA3_GrpA hru_names
'Exposed_Developed' 'Rock_NF' 'Rock_SF' 'Rock_EWF' 'Alpine_Tundra_NF'
'Alpine_Tundra_SF' 'Alpine_Tundra_EWF' 'ConiferousForest'
'DeciduousForest' 'MixedForest'
'RegeneratedClearcut' 'OpenWater' 'SmallChannel' 'MainRiverValley'
```

You do not need to set the values for the Wetland, Open Water, Small Channel, or Main River Valley HRUs.

Because many of the HRUs can have different values in each of the sub-basins, you have to find the actual maximum values from the CRHM .prj file. They are listed for each sub-basin as `soil_rechr_max`, and `soil_moist_max.`

In the case of sub-basin GA3, the values are

```
A_MtSub_GA3_GrpA soil_rechr_max <0 to 250>

10   10   10   10   50   50   50   93   87   97

97   0    0    0
```

Getting data

Modelled soil moisture maps data for the top 60 cm of soil are available from https://agriculture.alberta.ca/acis/climate-maps.jsp. This year’s map for August 31 is shown in Figure 1.

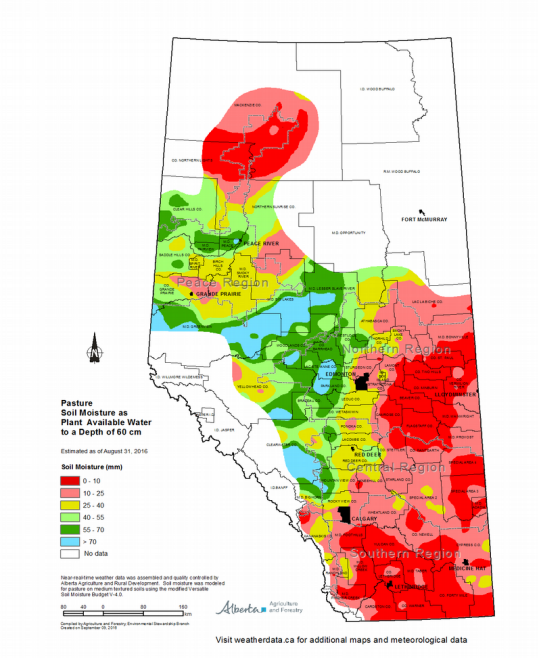

Figure 1: Alberta 60cm plant available moisture map.

Numerical soil moisture data are also available for the Valleyview AGDM site as shown in Figure 2.

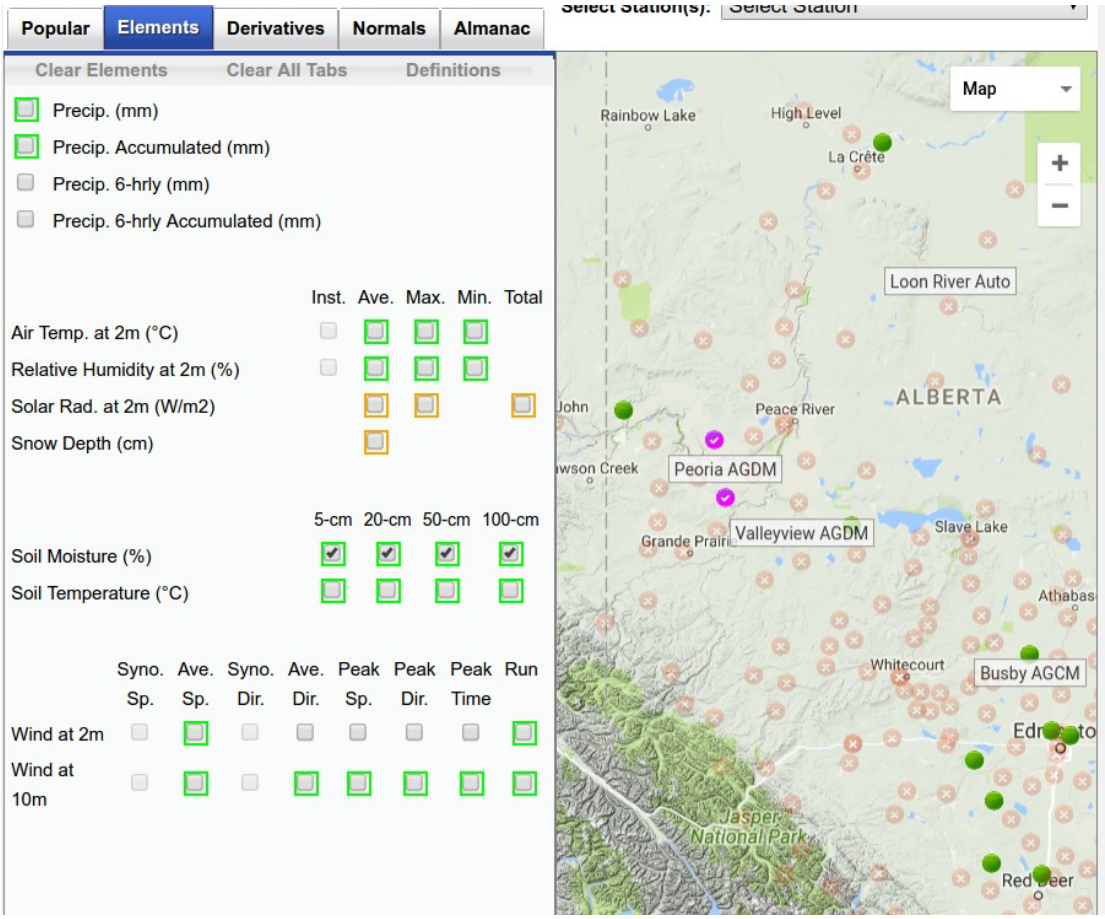

Figure 2: Measured soil moisture locations

When using the measured/modelled soil moisture data, there are a few things to keep in mind:

1. The modelled and measured soil moisture depths do not exactly correspond with the CRM soil depths. The CRHM recharge layer is set by the plant rooting depth which is typically > 1m.
2. CRHM has many more types of HRUs than are measured or modelled
3. The CRHM model extends outside of the area being modelled and is a very long way from the Valleyview AGDM site.

Given these restrictions, I would advise being careful how you use the data. I would restrict the modification of the CRHM .int file soil moistures to the recharge layer, i.e. to the `soil_rechr` values. Also, I would not just use the numbers as they are. If you are using the values specified for the top 60 cm, you would need to adjust the values for the rooting depth. For what, this can be up to 150 cm (Fan et al, 2016).

Since the Valleyview AGDM values are as a percent of saturation, you can calculate the values of `soil_rechr` by multiplying the value of `soil_rechr_max` by the saturation fraction.

Finally, you will need to account for the differences among HRU types. This is very difficult to do, as different soils have varying values of `soil_rechr_max` and have differing plant types. You will have to figure out some type of relative adjustment factor for the varying HRUs.

Frankly, if the `soil_rechr` values in the .int file look approximately correct, it might not be worth changing them, as there is a great deal of uncertainty in the measured values.