Assimilation Exercises

iSWGR Modeling Course
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Setup

- Save the package you've downloaded and unzip it. Open Matlab.

First exercise

- Check out the calibrated model: open 'RunModel.m' and run the script.
- Run the model for WYs 1991, 1992, 1993, and 1994 (default)
- What do you notice about SWE accuracy? Is the model well-calibrated? What would your next steps be to calibrate? (See exercises on your own…).
- Choose some other WYs. You can do this by changing line 6 of the 'RunModel' script, and inserting your own WYs. Note that the model was calibrated for WYs 1984-1988. Do your interpretations change?
- Try changing one of the parameters… maybe try increasing Fmax to .075. What changes?

Second exercise

- Assimilate snow course observations from Reynolds Creek at the sheltered site into the simple temperature index model: First run and examine the default case. Open 'EnKFCourse.m', and run the script. It will take about 30 seconds to run. It will run the 1989-1992.
- Analyze the output graphically: enlarge Figure 1, and zoom in to look at the performance. Answer these questions:
    - What is the effect of the observations in the accumulation season of WY 1989? How does this compare to the effect during the accumulation season during WY 1990?
    - What is the effect of the observations during melt? Is this consistent across all four years? Why?
- Look at Figure 2: zoom in on the ensemble behavior. Note the expansions and contractions of the ensemble. What do these mean? Are they reasonable? Does this filter estimate conserve mass?
- Compare the RMSE statistics for the filter estimate, open loop, and the observations. What do you see?

Third Exercise

- Run some different years of the snow course assimilation: you'll need to first generate a new observation file. To do this, open 'ExtractObservationsCourse.m'. Change the water years to some other values. Be sure that they are sequential. When you run this script, the file 'ObservationsCourse.mat' is updated to the WYs you specified
- Now rerun the assimilation code.
- You may be seeing that the filter error estimate is greater than the observations, but less than the model. What might this indicate?

Fourth Exercise

- Assimilate acoustic snow depths by invoking a measurement operator of density: open: 'EnKFDepth.m'. Scroll down to line 29. Note that 'H' is the observation operator which will map the observations of depth into the "observations" of SWE. Verify that 'H' is calculated correctly.
- Do you think the assumption of constant density is a good idea? What do you expect to see in the results?
- Run the script. What do the results look like? Is there anything surprising here?
- If interested, rerun for some other years, following the steps in the third exercise, but using the script 'ExtractObservationsDepth.m'

Fifth Exercise

- Modify the previous exercise to include time-variable estimates of density: open: 'EnKFDepthDV.m'. Scroll down to line 28. If interested, open the function invoked on that line. How well do you think this simple density model will predict bulk density? Will results be better or worse than previously?
- Run the script. Compare the results with the fourth exercise. What does the time-variable density buy you?

Exercises on your own time

- Redo the calibration. The parameter set chosen for the assimilation exercises gets the accumulation season about right, but melts out too late. Can you find a combination of parameters that fits the melt out time correctly as well?
- All of the evaluation is being applied over the entire timeseries. As Dr. Slater pointed out, this would include months of zero snow accumulation during the summer. Redo the evaluation to be only during times of snow accumulation.