Assimilation of snow interception information into a Cold Regions Hydrological Model
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Methodology

- **Mass balance interception estimation**: Int = ΔSWE_{loc} – ΔSWE_{g}
- Fresh snow density estimation: Hedstrom and Pomeroy (1998)
- Model: Cold Region Hydrological Modelling platform (CRHM)
  - Snowpack module: Snobal (Marks et al., 1998)
- Snow interception assimilation: CRHM forced by ECCC’s GEM NWP
- Ensemble Kalman Filter (EnKF)
- Tree measured interception (DA_Tree)
- SRSO-derived interception (DA_SRSO)
- Rule based insertion
- Time-lapse photos interception (DA_TLC)
- Model SWE>1 mm & Observed canopy snow = YES: Model SWE = 3 mm
- Model SWE>1 mm & Observed canopy snow = NO: Model SWE = 0 mm
- Others: No DA
- No DA controls: CRHM forcing by GEM (GEM) & local observed climate data (ObsMet)

Results

- Comparison of snow storm duration (hours) to the difference between measured and calculated fresh snow density using two methods at the Upper Clearing.
- Comparison of simulated snow interception from DA with CRHM driven by GEM data (DA_Tree, DA_TLC) and control open loop simulations (GEM, ObsMet) to suspended tree measurement and time-lapse camera derived canopy measurements (unit: mm).

Limitations of DA

- In sheltered environments during snowstorms, fresh snow density can be effectively estimated using air temperature from the Hedstrom-Pomeroy (1998) relationship with a small snowfall densification rate.
- Although the GEM driven simulations after DA were not as accurate as model driven by locally observed meteorology, DA improved the simulation accuracy of snow interception amount and timing.
- Snow interception data assimilation is greatly influenced by the assimilation frequency and quality of forcing data. There are limits to improvements of simulations when forcing data are poor.

Conclusions

- In sheltered environments during snowstorms, fresh snow density can be effectively estimated using air temperature from the Hedstrom-Pomeroy (1998) relationship with a small snowfall densification rate.
- Although the GEM driven simulations after DA were not as accurate as model driven by locally observed meteorology, DA improved the simulation accuracy of snow interception amount and timing.
- Snow interception data assimilation is greatly influenced by the assimilation frequency and quality of forcing data. There are limits to improvements of simulations when forcing data are poor.

References


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