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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Using GRACE to derive corrections to precipitation data sets and improve modelled snow mass at high latitudes" *by* Emma L. Robinson and Douglas B. Clark

Anonymous Referee #2

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This work demonstrated systematically underestimations of high latitude precipitation existing in four popular atmospheric forcings. After precipitation correction by GRACE total water storage (TWS) data, these four atmospheric forcings were used to drive the land surface model JULES in order to assess improvements in simulating hydrological cycles in four Arctic river basins. By comparing to independent datasets, the authors showed that the simulated monthly max snow water equivalent (SWE) was significantly improved. Although river discharges were still underestimated particularly during the spring, the limitation of the model and other possible reasons were explicitly discussed.

This study is well designed. Although there are a lot of uncertainties in estimating

precipitation using GRACE TWS (e.g., uncertainty of ET data, groundwater depletion, etc), the authors ingeniously avoided most of possible perturbations by carefully selecting the research region and season. This work will make hydrologists and modellers re-consider the precipitation in meteorological products, which is the first-order driver of land hydrological cycles. The contents fits the scope of the journal. The manuscript deserves consideration after several questions are addressed.

Page 4, Line 31-32: The resolution of the river basins is coarse. Is there significant difference of basin area between this one and other fine resolution products?

Page 6, Section 2.2: Is GRACE RL05 a mascons solution, which is more advanced than the standard spherical harmonic approach especially for high latitudes?

Page 7, Section 2.4: GLEAM ET is a model output. It is also driven by atmospheric forcing. The aim of using GLEAM ET is to show negligible ET during the cold season. Is there any other ET datasets available for a parallel comparison? Is it better to assume zero ET in cold season than introduce GLEAM ET in Equation 6?

Page 11, Equation 5-6: I think it should be P = dS_tot/dt + E + Q_out as dS_tot/dt = P - E - Q_out.

Page 12 Section 4.3: Here you only re-scaled precipitation in the cold season (not during the whole year). Perhaps this leads to discharge underestimation in spring (Figure S9). Does it make sense to launch a simple simulation with re-scaled precipitation over the whole year? Maybe it can explain the underestimated discharges.

Page 17 Line 19: remove "it".

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