Snow model comparison in the semi-arid Andes of Chile

A sensitivity analysis with SNOWPACK and SnowModel

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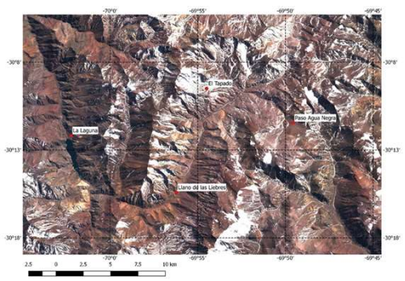
Motivation:

- Melting snow is main water resource for the population of Chile (Favier et al., 2009).
- No comparisons between snow models in the semi-arid Andes yet.
- High sublimation rates, which are complex to model.

This study:

- Snow models SNOWPACK (Bartelt, Lehning, 2002) and SnowModel (Liston, Elder, 2006).
- Sensitivity to input parameters and parametrizations.
- Model evaluation on point scale at AWS Tapado (4306 m.a.s.l.) in 2017.



Calibration of models:

- Ensemble approach with different parametrizations.
- Testing of snow roughness lengths.

Sensitivity analysis:

- Monte Carlo approach (1000 runs) with variations in TA (°C), RH (%), WS (m/s), WD (°), P (hPa), S↓ (W/m^2) and L↓ (W/m^2) with and without precipitation.

Simulated **sublimation**:

61% of total ablation with **SNOWPACK**, whereas it's only **42%** with **SnowModel**

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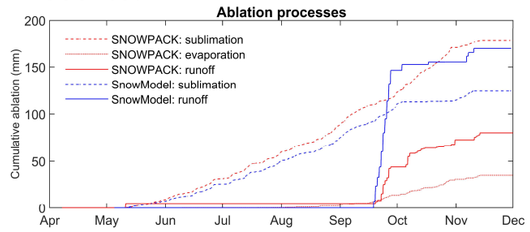
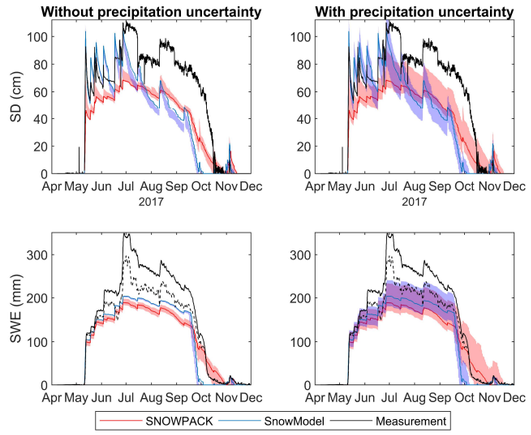
Results:



Average sublimation:

- SnowModel: 1.2 mm/day
- SNOWPACK: 1.7 mm/day
- Snow roughness length: 1 mm



- Precipitation is the main model uncertainty.
- Differences between models in snow density calculations, melt processes and albedo, strongly depending on TA and RH.

Discussion:

- Model calibrations: without wind transport and not all possibilities tested, to establish similar calibrations.
- Sublimation rates are unvalidated, as turbulent flux measurements are unavailable.
- Sublimation in range of results of Réveillet et al,. 2019; Gascoin et al., 2013.
- Physical differences in models, i.e. SNOWWPACK models evaporation.

Conclusion:

- Simulated melt water is very different for different reasons.
- Similar sensitivity to forcing data.

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Manuscript of paper in preparation