COMBINING HIGH RESOLUTION ATMOSPHERIC SIMULATIONS AND LAND-SURFACE MODELLING TO UNDERSTAND HIGH ELEVATION SNOW PROCESSES IN AN HIMALAYAN CATCHMENT

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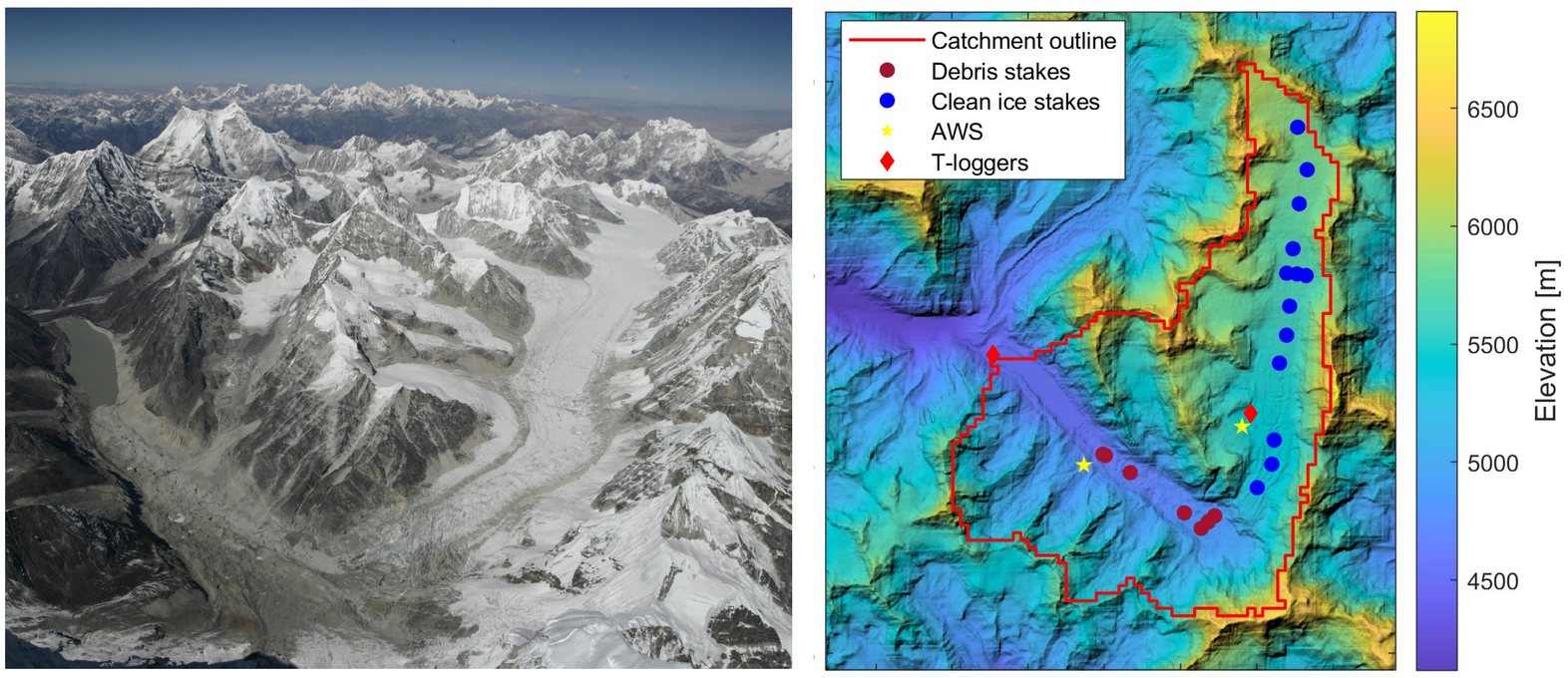


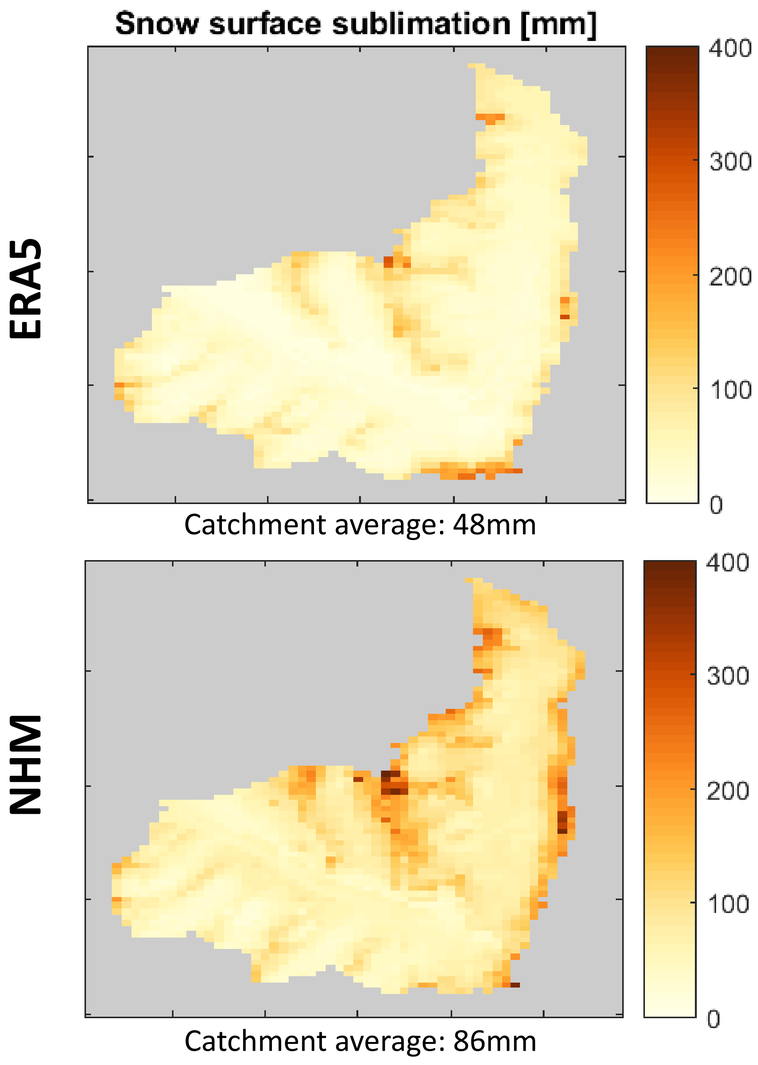
Fig. 1 :Study site in the eastern Himalaya, in Nepal. It mostly contains the Trakarding-Trambau Glacier system. Multi-year mass balance measurements cover most of the glacier elevation range

Abstract

In the Nepal Himalaya, assessing solid precipitation input, especially in the upper accumulation area (> 6000 m a.s.l.), remains key to understanding recent mass losses. We combine a novel non-hydrostatic atmospheric model (NHM; atmospheric core of the cryosphere-oriented regional climate model NHM-SMAP) and an advanced land surface model at cloud-permitting hyper-resolution (~ 100 m) to explore the role of snow processes in the water balance of this glacierized catchment. Preliminary results shows very model performance of land-surface model forced with high resolution atmospheric simulation, which is promising to quantify high elevation snow processes in remote areas, where no measurements are available

Objectives

Explore the role of snow processes in the water balance of this glacierized catchment.



Introduction

Glaciers are key components of the Asian water towers and provide water to large downstream communities for domestic, agricultural and industrial uses. In the Nepal Himalaya, the Indian Summer Monsoon dominates climate, and results in a complex meteorology and simultaneous accumulation and ablation that complicate the quantification of snow processes.

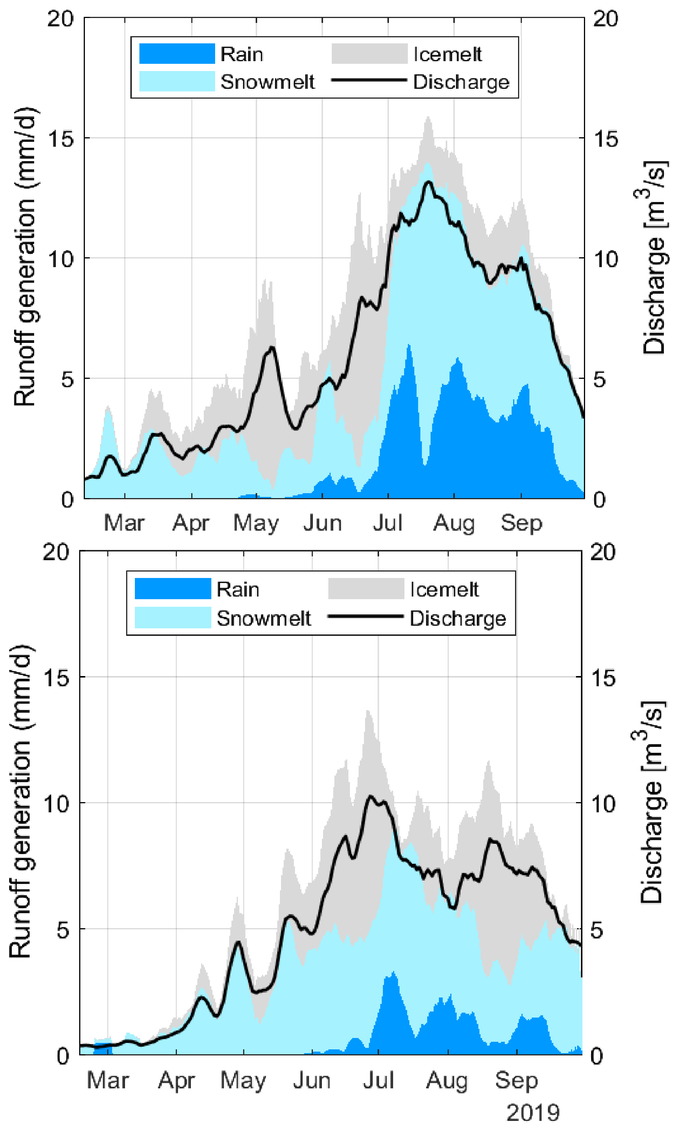
Methods

Model : Thetys-Chloris, land-surface model, fully distributed, high-resolution (200 m, hourly time step),

Forcing : Downscaled NHM and ERA5-Land

Study period : 2018 to 2019

Calibration & validation datasets: mass balance stakes, and remote sensing observations of snow cover from MODIS



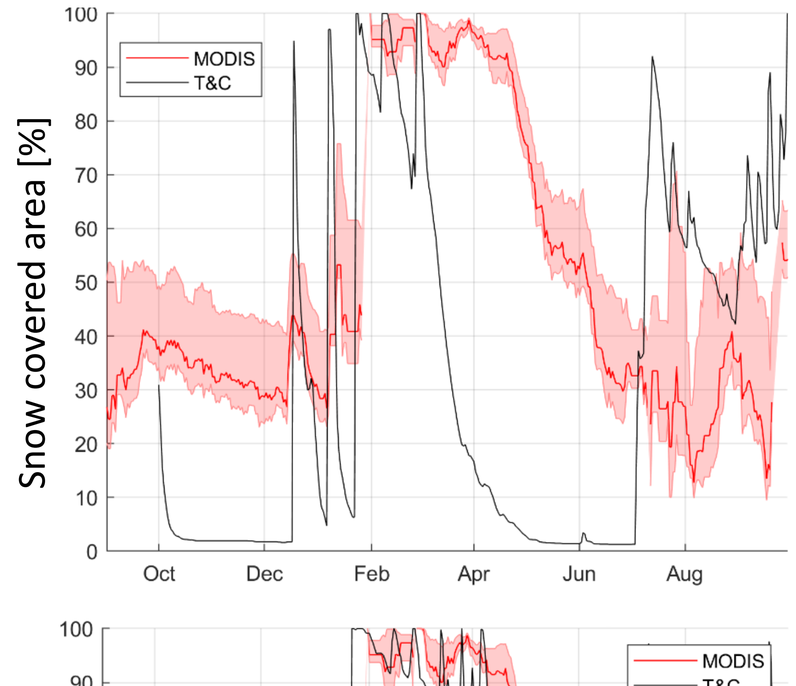


Fig. 2: Comparison of snow cover fraction observed by MODIS and simulated by Thetys-Chloris forced with the two different datasets.

Results and Discussions

- Using NHM or ERA5-Land as forcing leads to different hydrographs, both in term of timing, magnitude, and also relative contribution of snowmelt, icemelt and rain. This is mostly due to differences in downscaled precipitation and temperature
- A good model performance is achieved using the NHM forcing, as shown by the snow cover validation.
- Snow sublimation amount were greatly sensitive to the forcing dataset, with 79% more sublimation simulated with NHM

Conclusions

We obtained a very good model performance of land-surface model forced with high resolution atmospheric simulation, despite no model calibration or forcing correction being performed. This is promising to quantify high elevation snow processes in remote areas, where in-situ measurements are not available.

Major references

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