Snow/rain source mixing and residence time modeling in a sub-alpine mountainous catchment under global warming

This presentation participates in OSPP

Outstanding Student & PhD candidate Presentation contest

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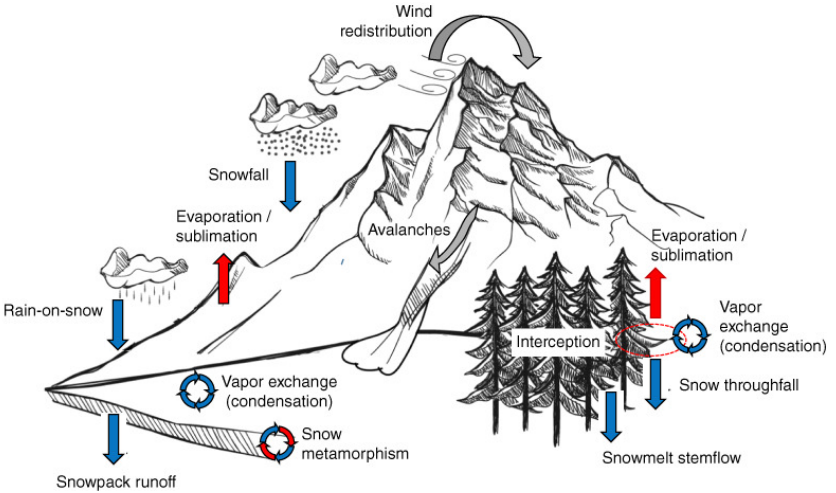
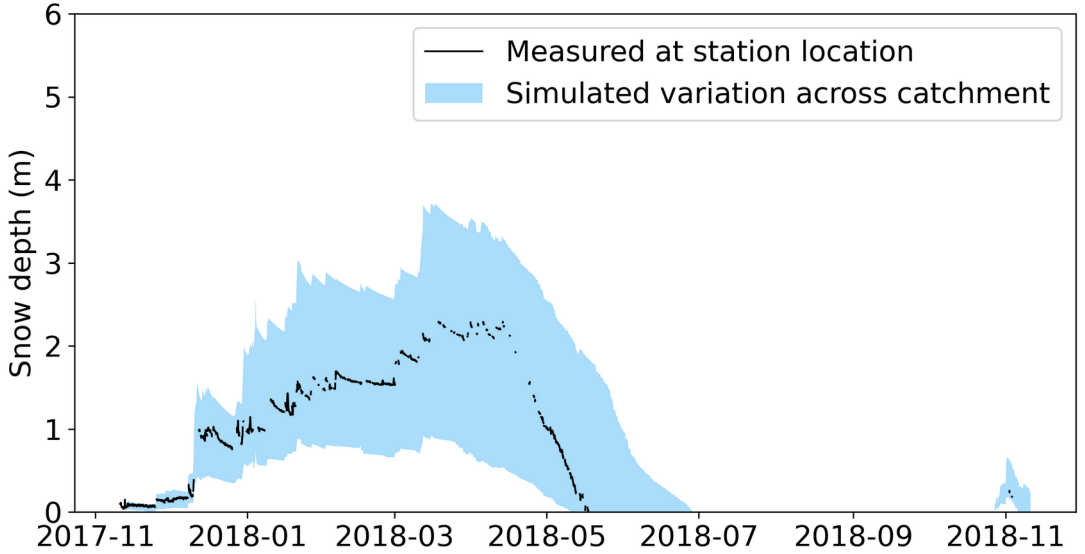
Introduction

- Mountain critical zone is a complex system.
- From top of the canopy to deep subsurface act as an integrated system.
- Snowmelt is dominated component in the hydrological regime.



Modified from Beria et al., 2018



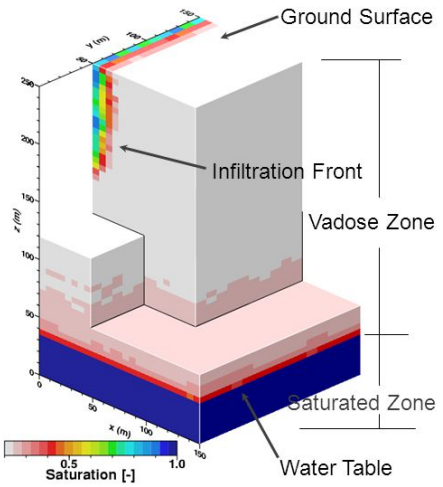
- Spatial variation in snowmelt leads to heterogeneity in terms of saturation.
- Catchment flow path describes the movement, transformation and life cycle of snowmelt and rain infiltration.

Modified from Gupta et al., 2022

Methodology

ParFlow is a combination of:

- Physics
- Solvers
- Parallelism



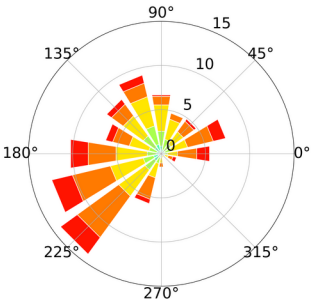
Maxwell et al., 2015

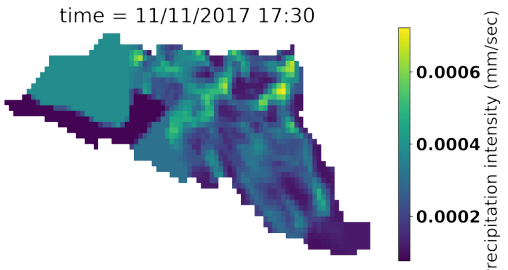
Tracking source water composition: EcoSLIM

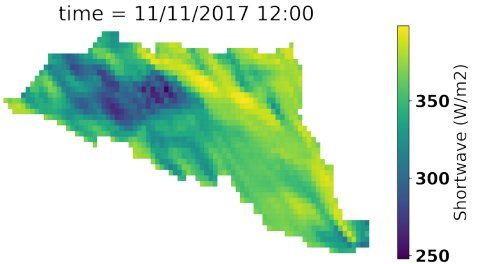
- Lagrangian particle tracking
- Mass weight input/output flux
- Age tracking
- Probabilistic removal of ET from root zone.

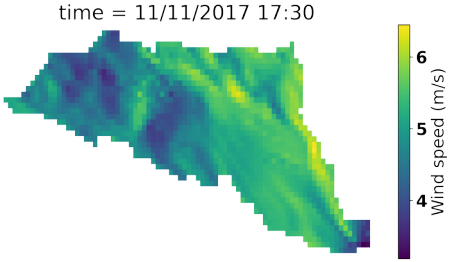
Beisman et al., 2015; Maxwell et al., 2018

Terrain based meteorological distribution







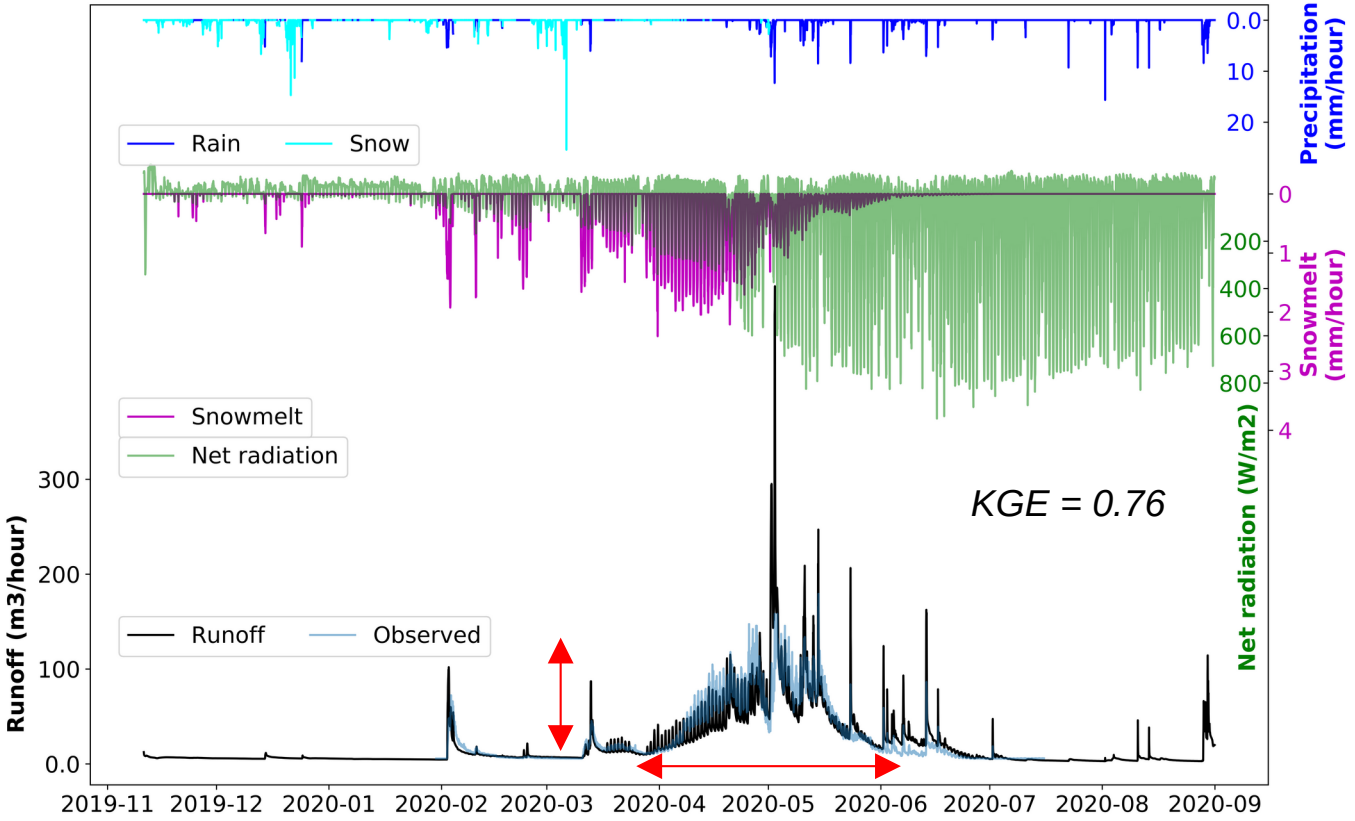


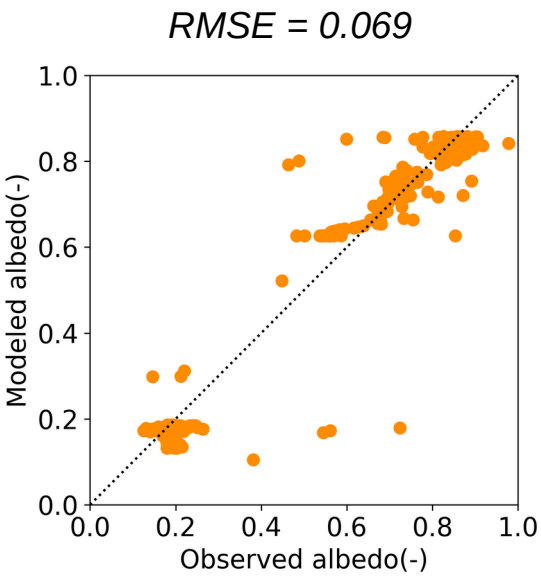
Liston and Elder, 2006

	Distributed	Non-distributed
Precipitation sum (mm)	1443.7	1531.9
Average wind speed (m^3/sec)	3.5	3.6
Average shortwave (W/m^2)	152.1	190.8

Model calibration and validation

- Geophysics top-bottom approach is used to defined subsurface.
- Calibration was achieved with surface and subsurface parametrization.

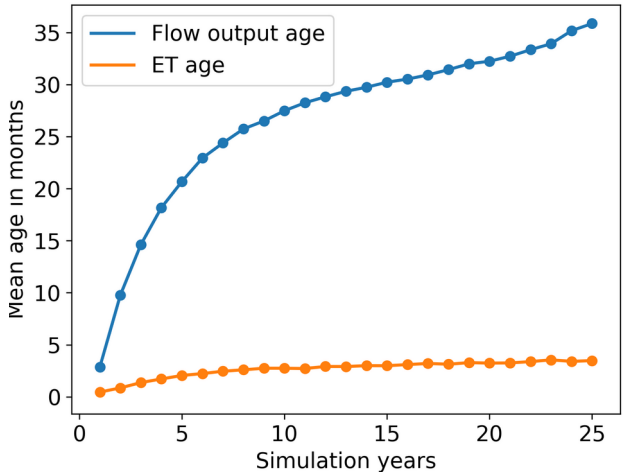


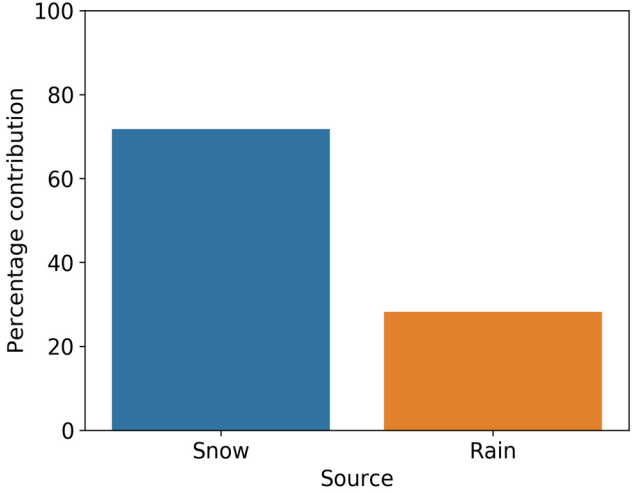


Daily cycle

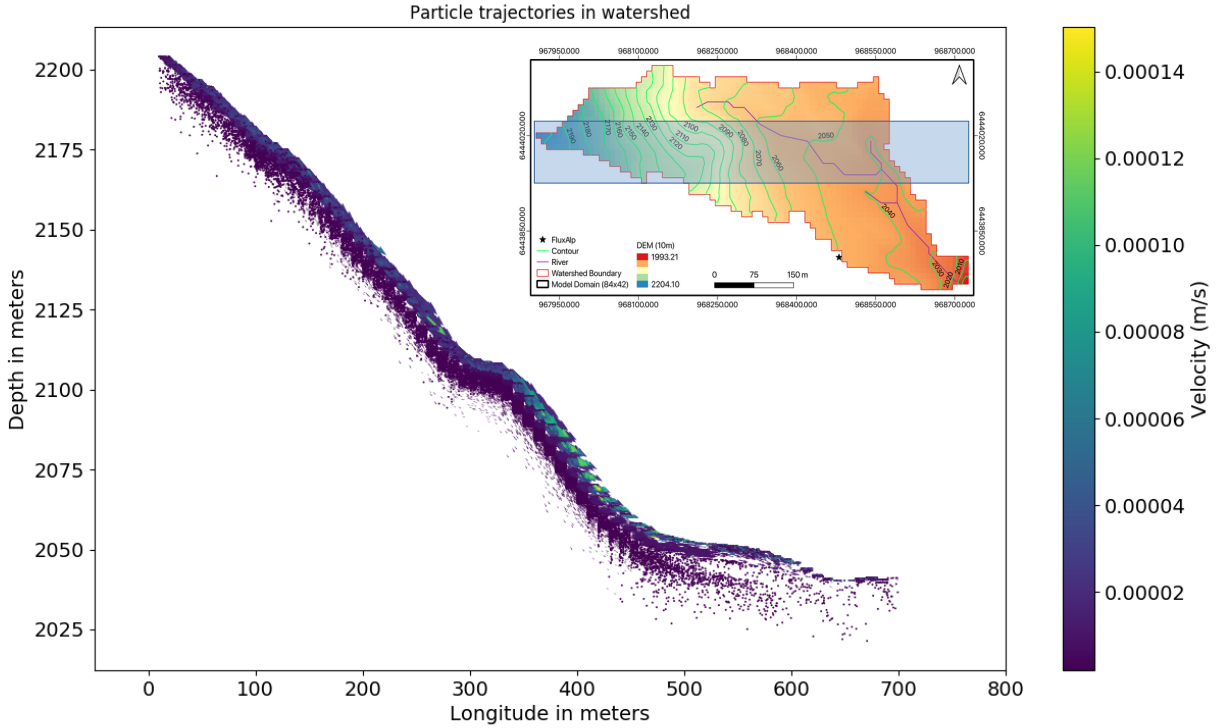
Snowmelt duration

EcoSLIM simulations

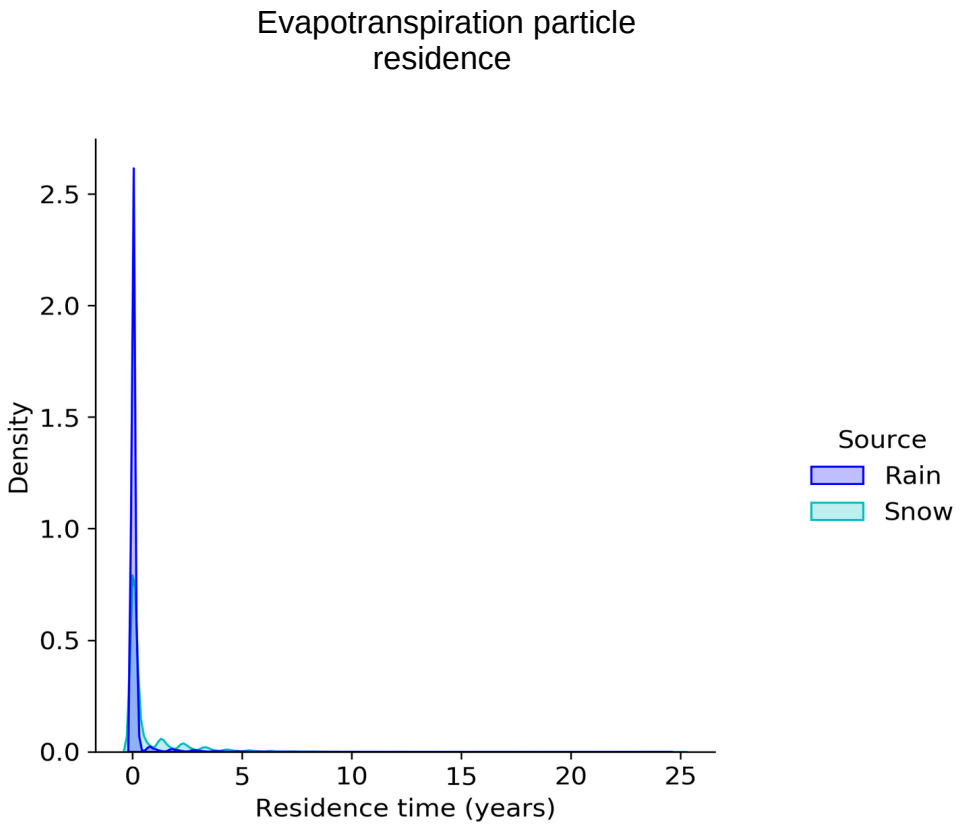


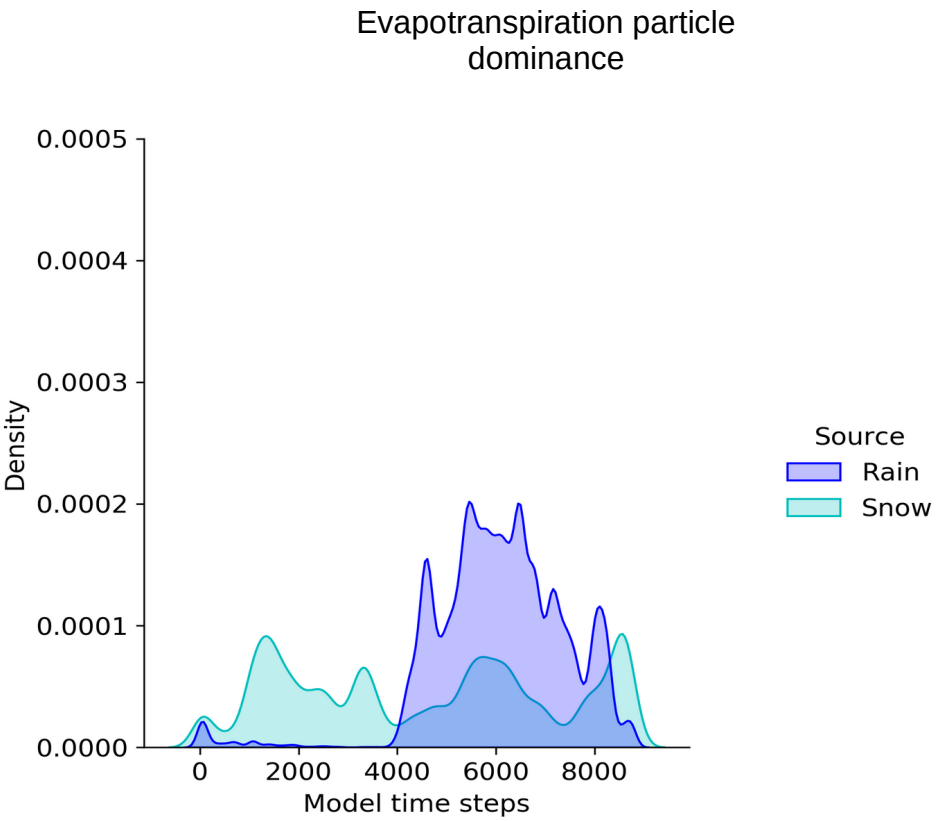


- 25 years of spin up to stabilize particle movement.
- >70% of source particles are of snow origin.
- Most of the flow lines are within few meter depth from the surface.

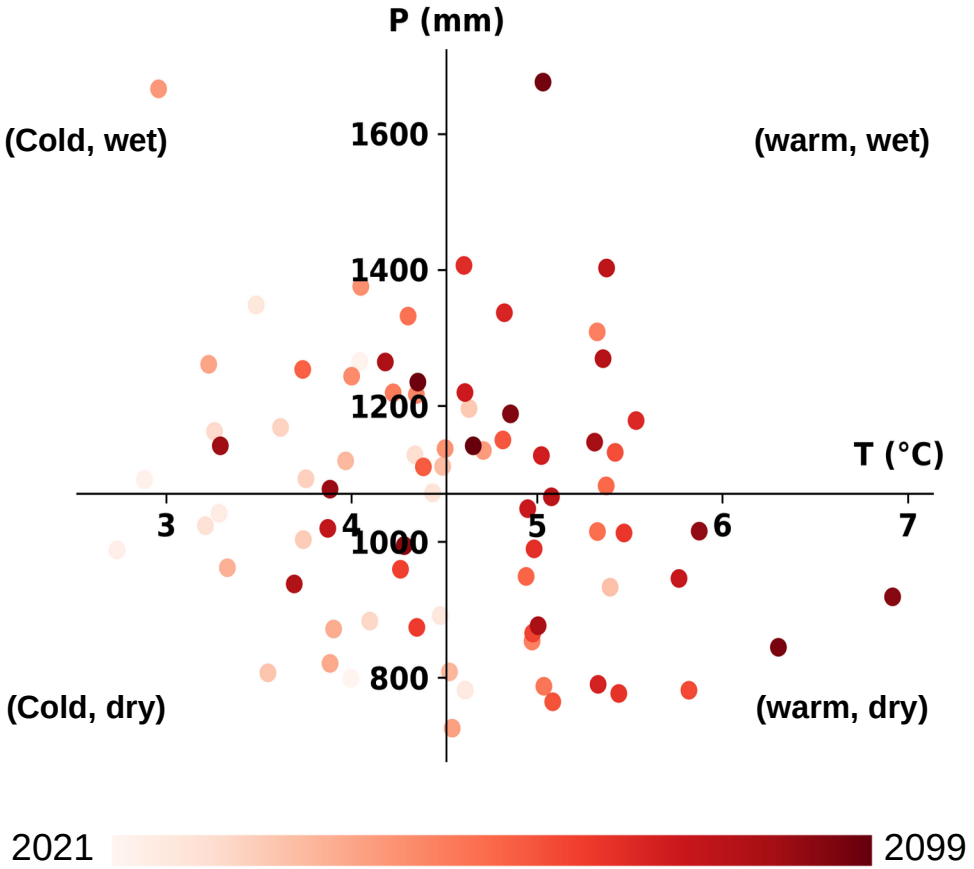


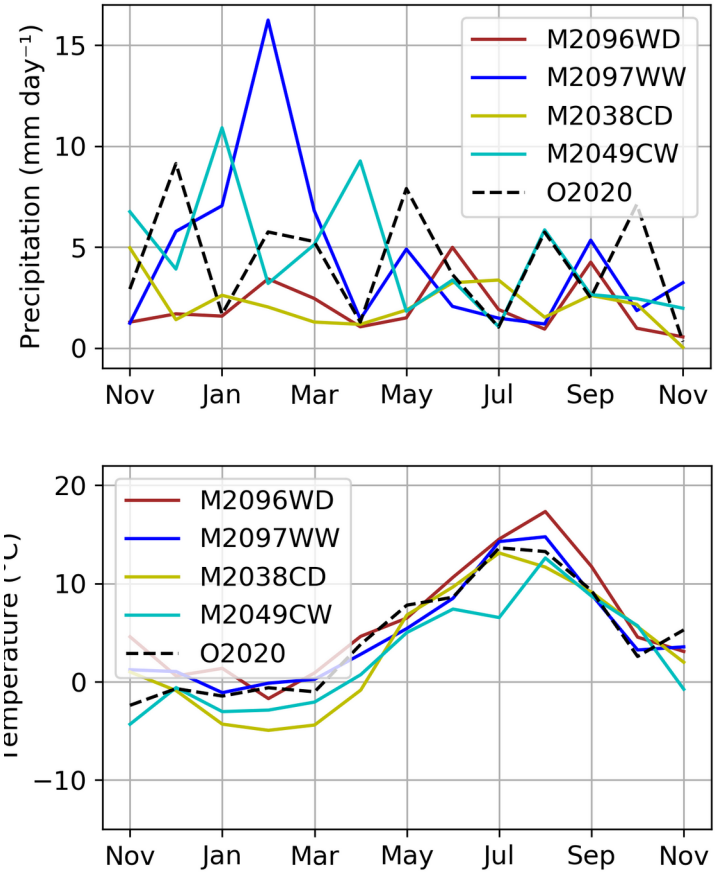
Tracking source particle



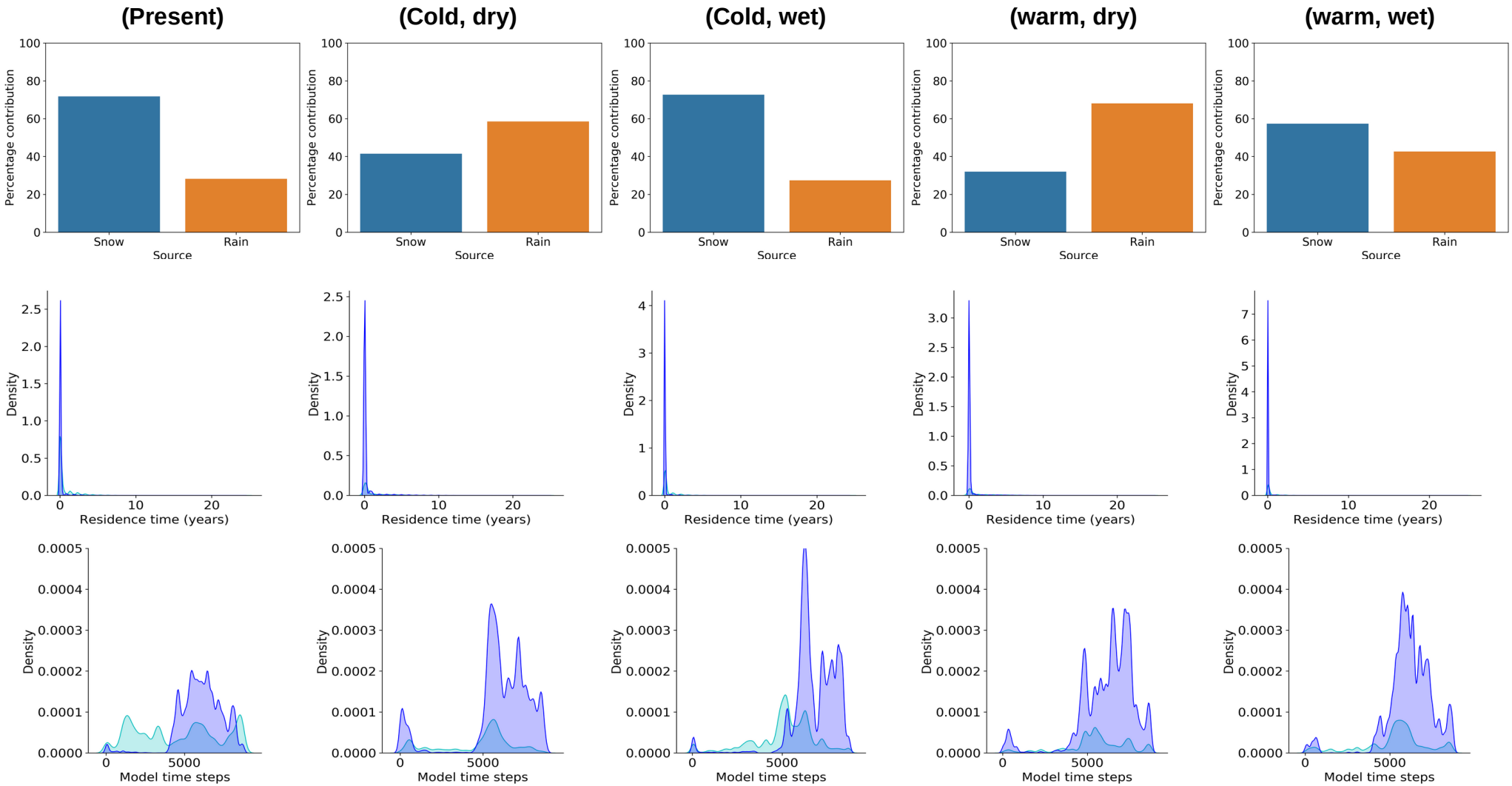


ADAMONT/CNRM-ALADIN53 Model data (RCP 4.5)





Impact of climate on source particle



OUR TEAM

https://doi.org/10.5194/hess-2021-639
Preprint. Discussion started: 10 January 2022

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Impact of distributed meteorological forcing on snow dynamic and induced water fluxes over a mid-elevation alpine micro-scale catchment

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