Linking past precipitation changes with snowmelt and runoff on Ammassalik island, south-east Greenland

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Research objectives

(1) How is precipitation changing on Mittivakkat glacier?

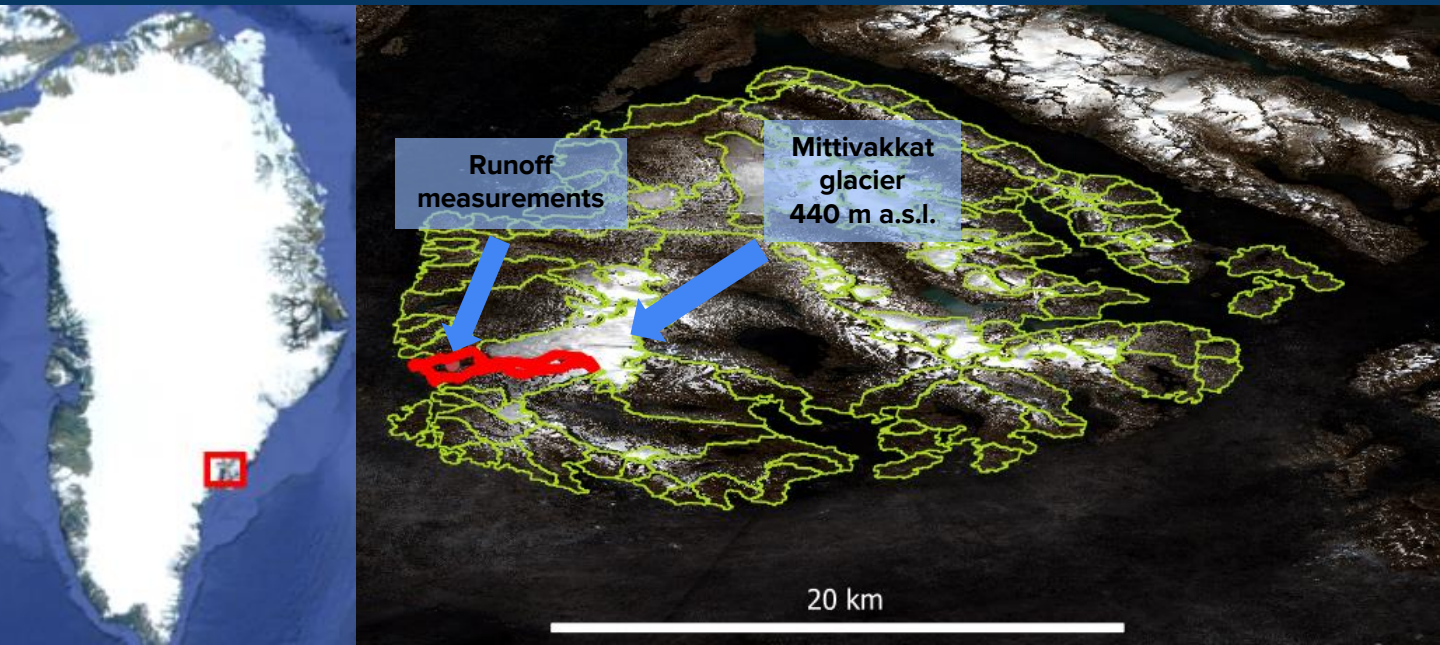
Amount

Phase

(2) What is the affect of extreme liquid precipitation on snowmelt and runoff?

Ammassalik Island, south-east Greenland

- Precipitation rich region of south-east Greenland
- Mittivakkat glacier (well studied)
- Hydrological catchments defined by Mankoff et al. 2020



Data

- Regional Atmospheric Climate Model version 2.3 (Noel et al. 2017)
- Modelled runoff per hydrological catchment (Mankoff et al. 2020)
- Observed runoff (Unpublished, University of Copenhagen)

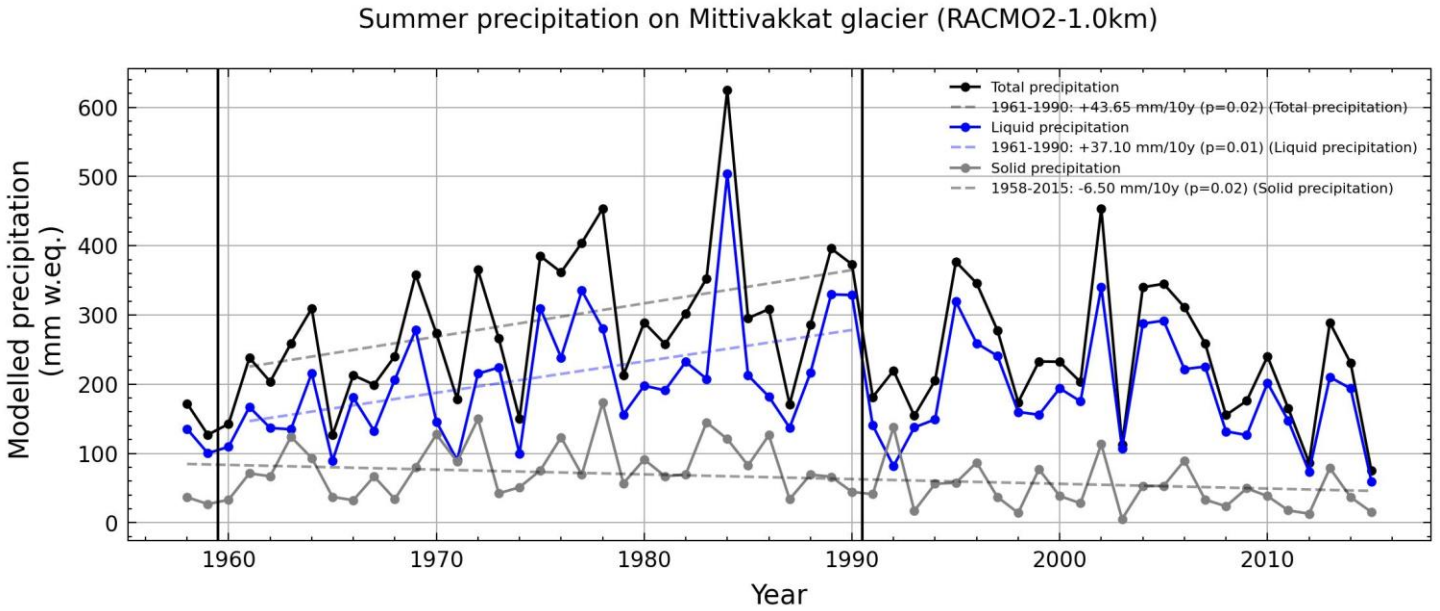
Past precipitation on Mittivakkat glacier

Amount

1958-2015: No trend in annual mean

1958-2015 (JJA): Decreasing solid precipitation

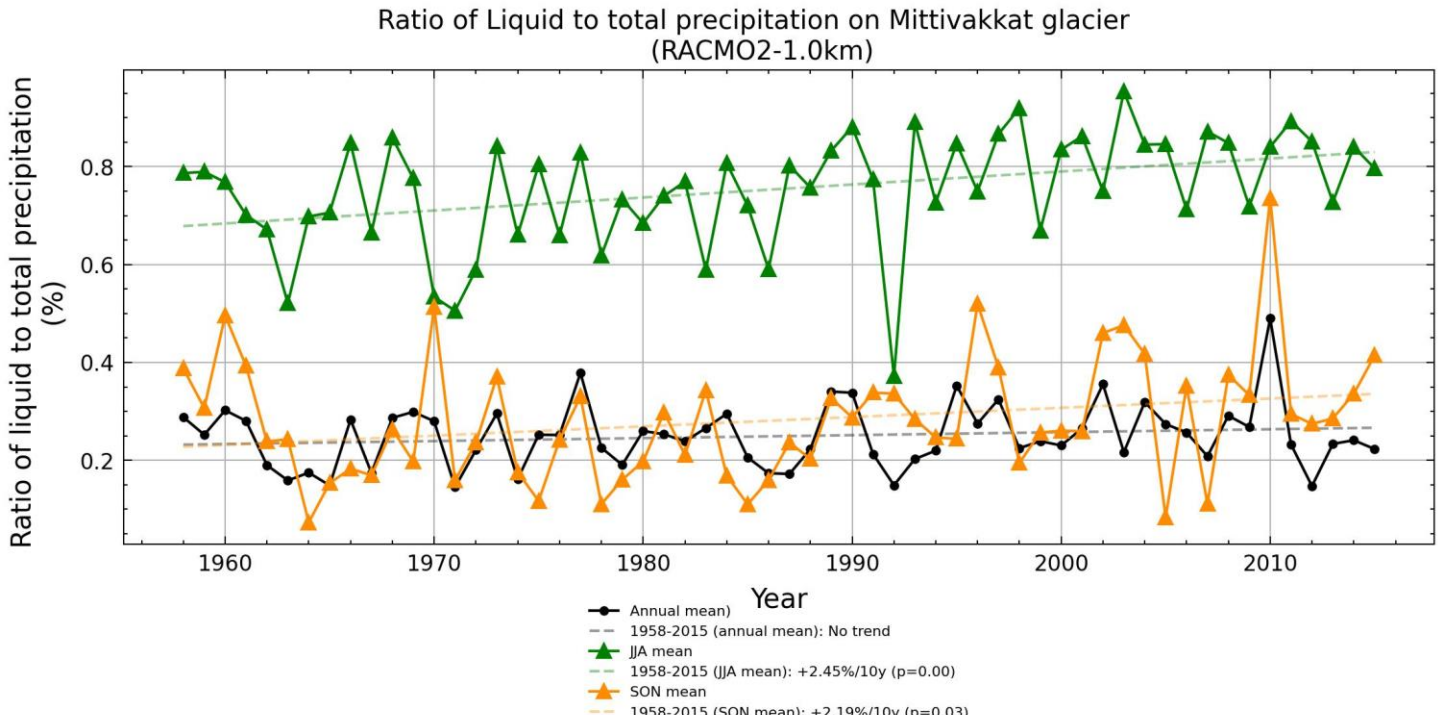
1961-1990 (JJA): Increasing total and liquid precipitation



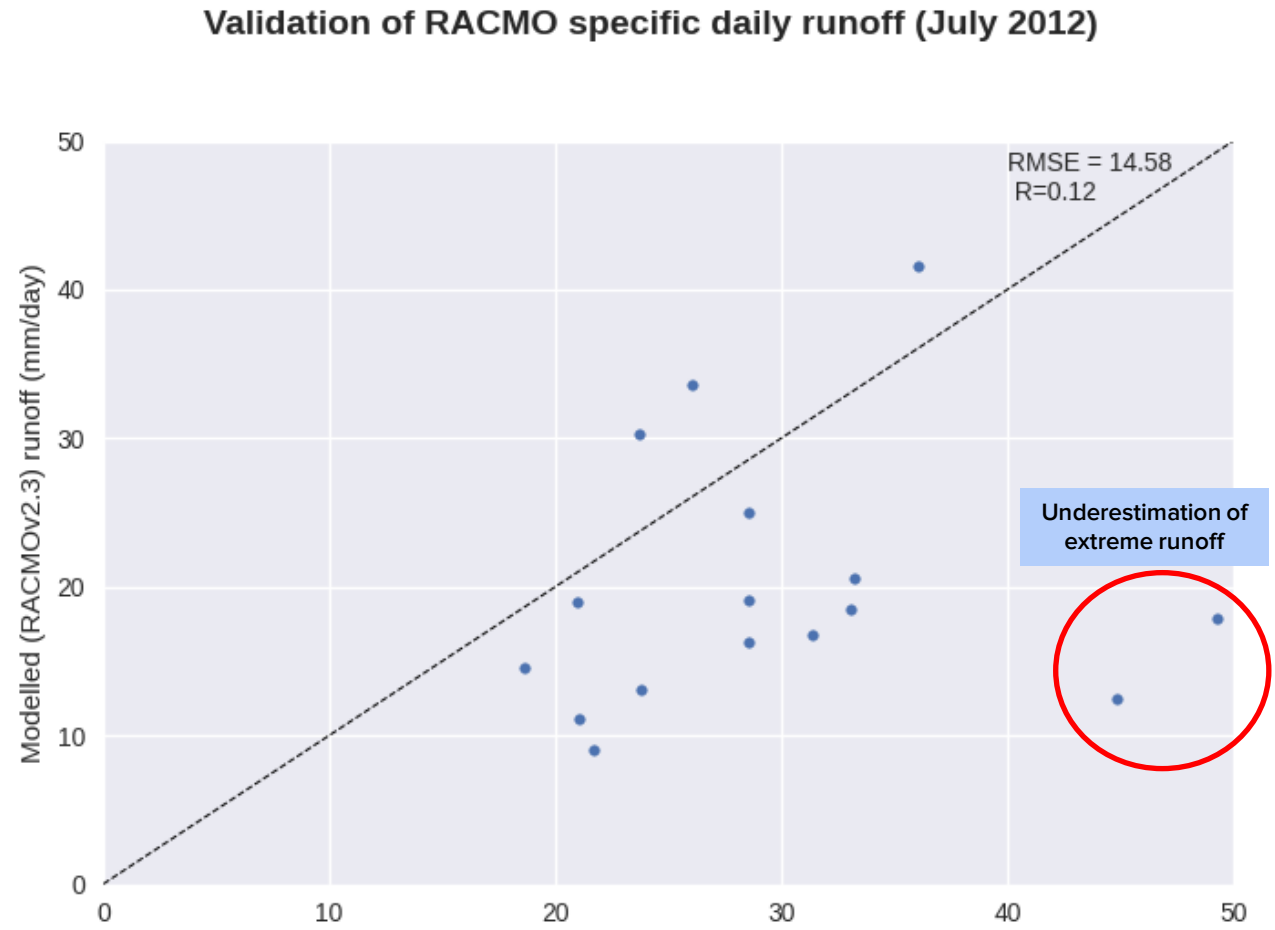
Past precipitation on Mittivakkat glacier

Phase

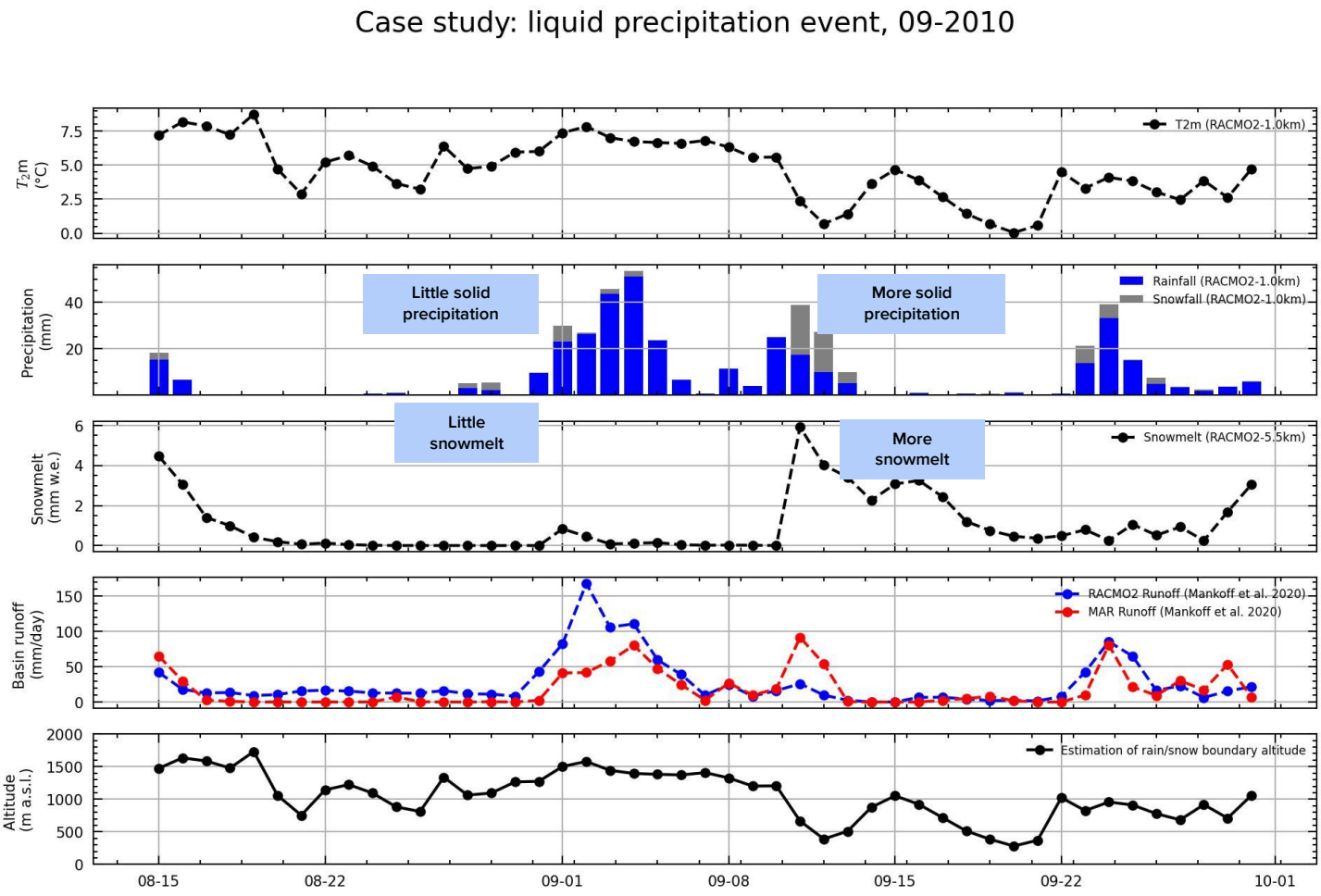
1958-2015: No annual trend, increasing ratio summer and autumn



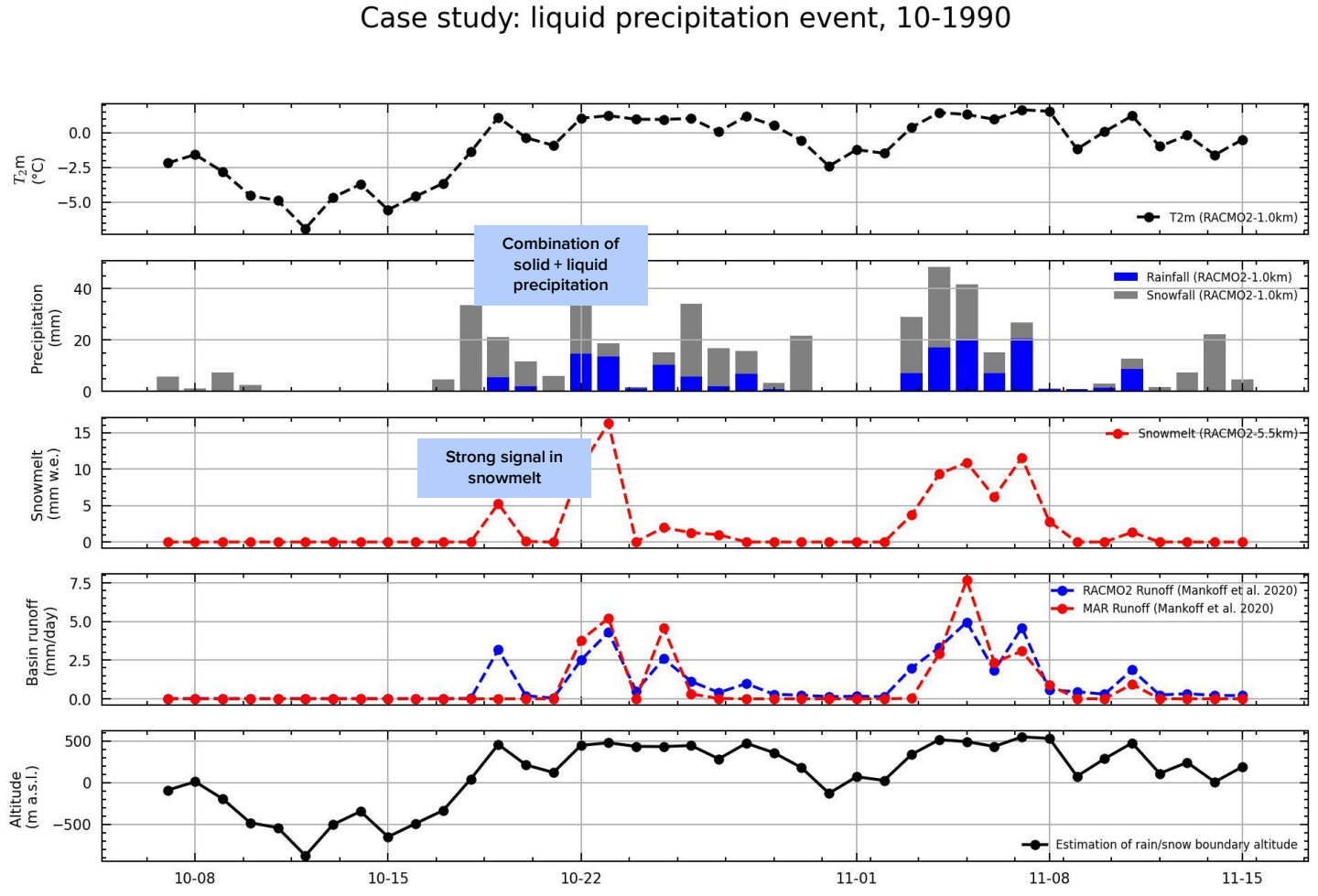
Validation: model performs well, but…



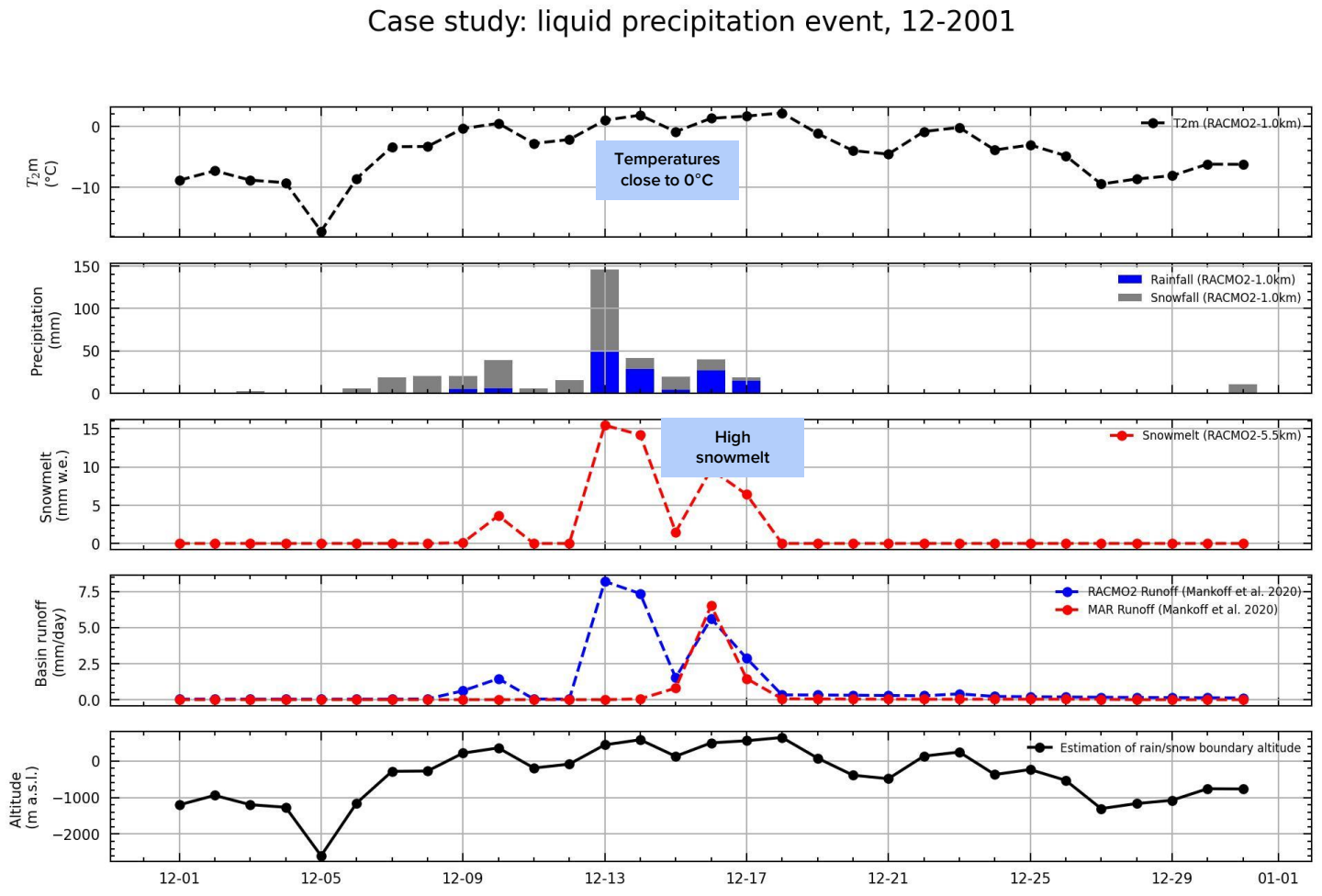
Case study 1: Extreme liquid precipitation (2010)



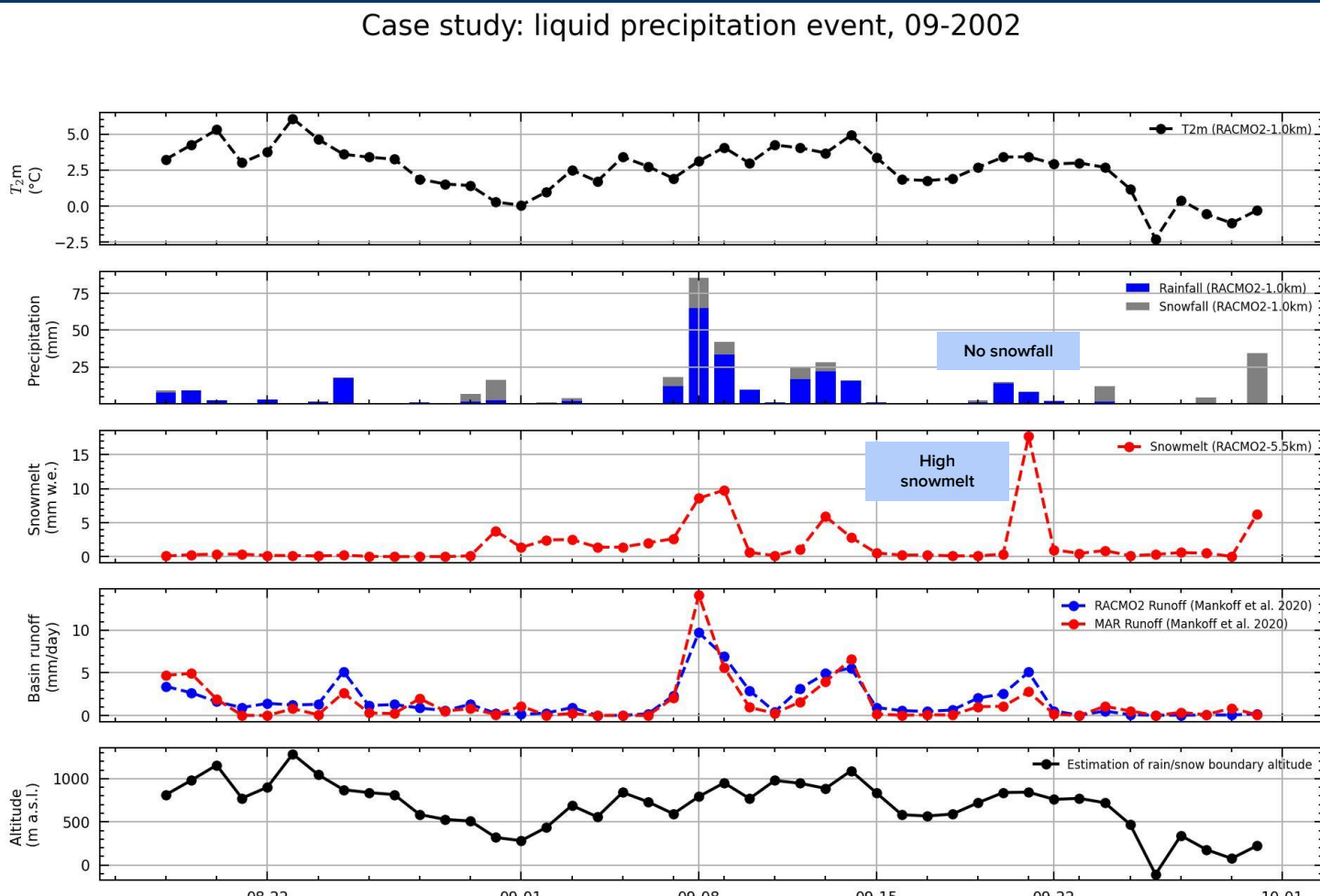
Case study 2: Extreme liquid+solid precipitation (1990)



Case study 3: High snowmelt, low temperatures (1990)



Case study 4: High snowmelt, without prior snowfall (2002)



Key message

How is precipitation changing on Mittivakkat glacier?

Overall: not much, but in summer:
1) Increased rainfall fraction mainly due to less snowfall
2) Rainfall at higher altitudes

If rainfall amounts will increase (as is projected by climate models) this could influence snowmelt and runoff.

Runoff signal closely follows precipitation
Complex relation between precipitation and snowmelt

References

Mankoff, K. D. *et al.* (2020) ‘Greenland liquid water discharge from 1958 through 2019’, *Earth System Science Data*, 12(4), pp. 2811–2841. doi: 10.5194/essd-12-2811-2020.

Noël, B. et al. (2017) ‘A tipping point in refreezing accelerates mass loss of Greenland’s glaciers and ice caps’, Nature Communications, 8(9296). doi: 10.1038/ncomms14730.

Thank you for listening

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