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Using a multi objective framework for improved calibration and spatial interpolation in hydrological models of the Berg river catchment, South Africa

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Importance of precipitation for HM

- Spatial and temporal representation of precipitation critical for hydrological model (HM) performance
- Hydrological modelling still reliant on climate station data as the main sources of input data which requires interpolation
- Important to understand the sensitivity of HM to data from different station to identify:
  - Areas which exert the strongest control on simulate runoff
  - Critical stations which require data patching
  - Improvements to regionalisation approaches

Study approach

1. Calibrate and validate a J2K rainfall/runoff model which can be used to asses station sensitivity
   - Automated calibration approach: NSGA2
   - Objective functions: Nash Sutcliff (E2 and logE2), Bias and KGE
2. Investigate station weight vectors
   - Importance in terms of data delivery
3. Precipitation sensitivity analysis run to determine station importance for peak and low flows
   - Sensitivity to E2 and logE2

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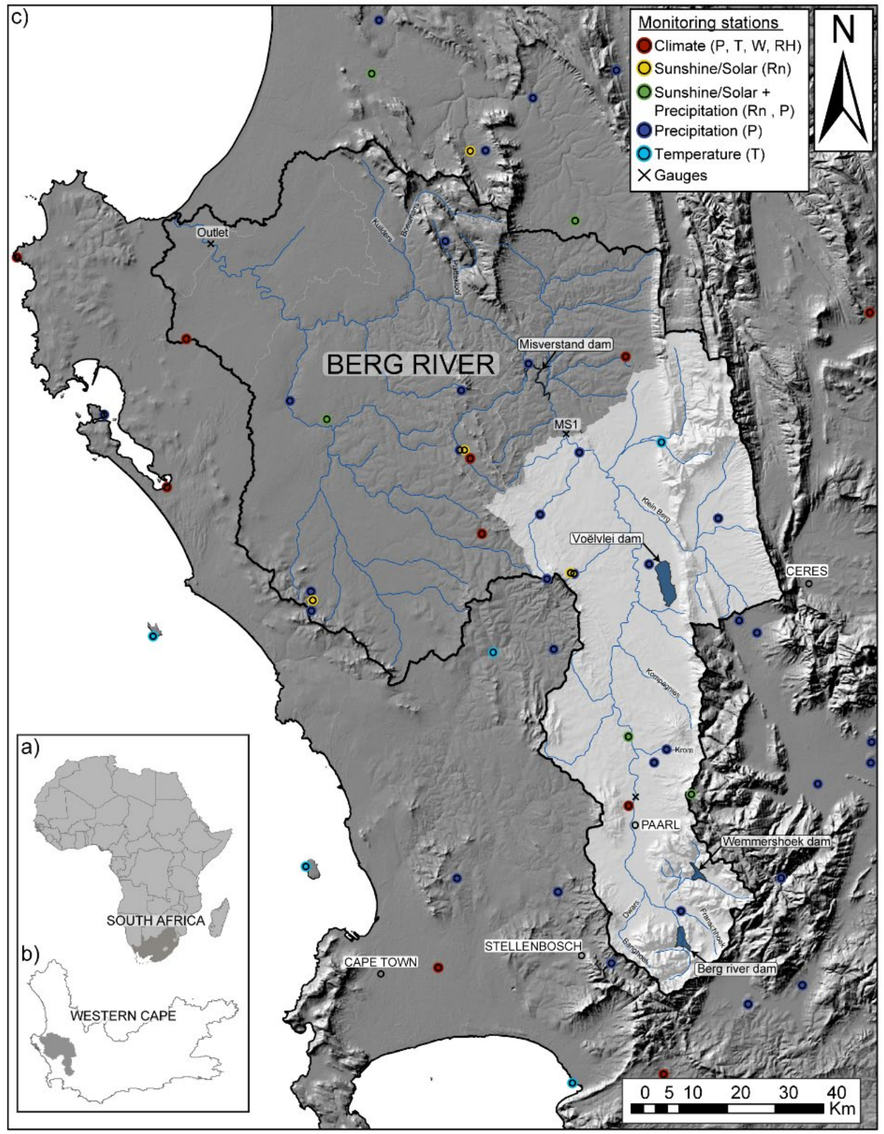
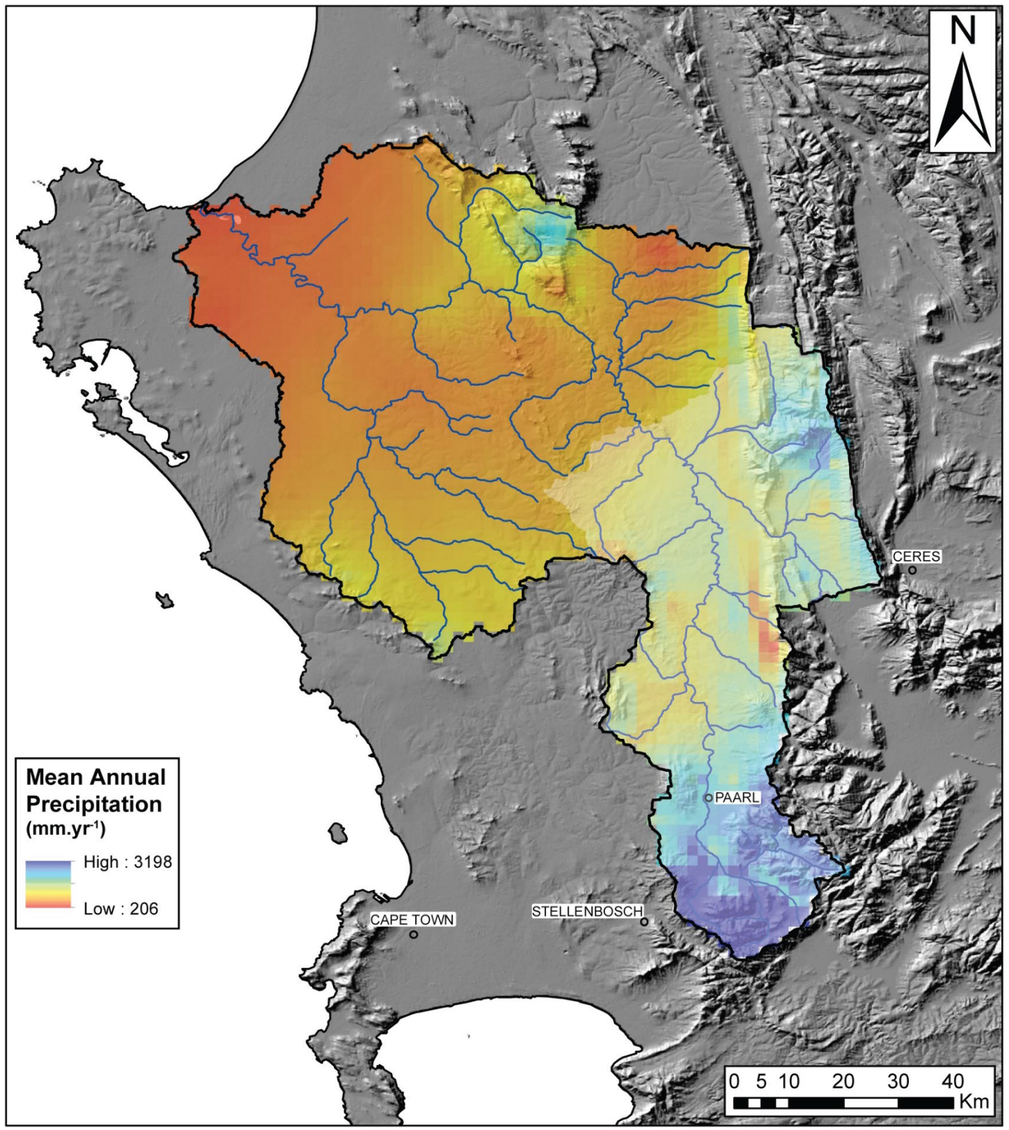
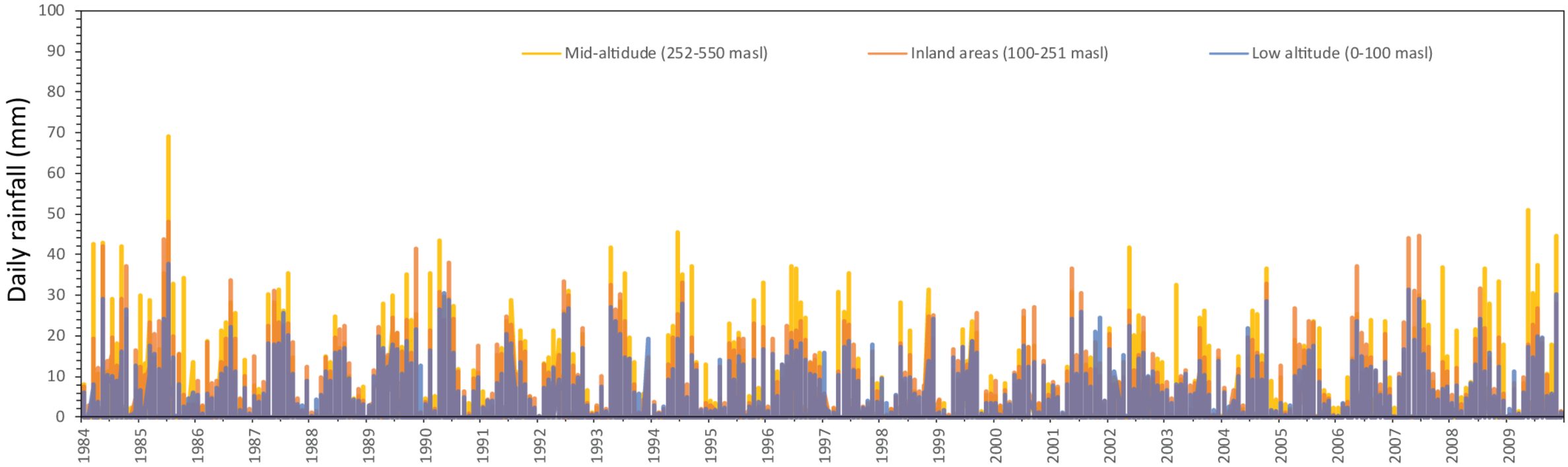
Study site-Berg River, SA





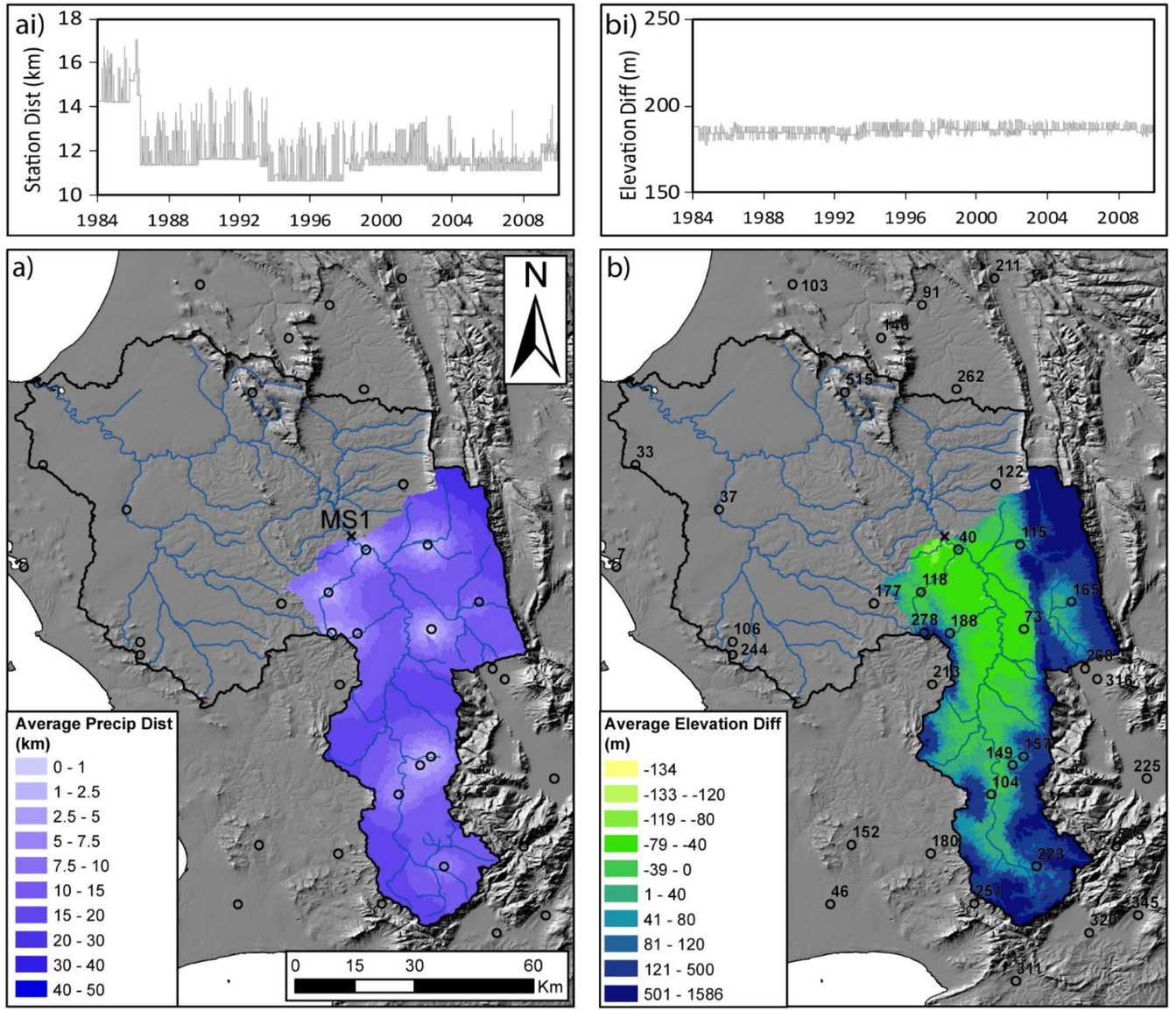
Precipitation data problems

- Discontinuous records
- Limited high elevation data



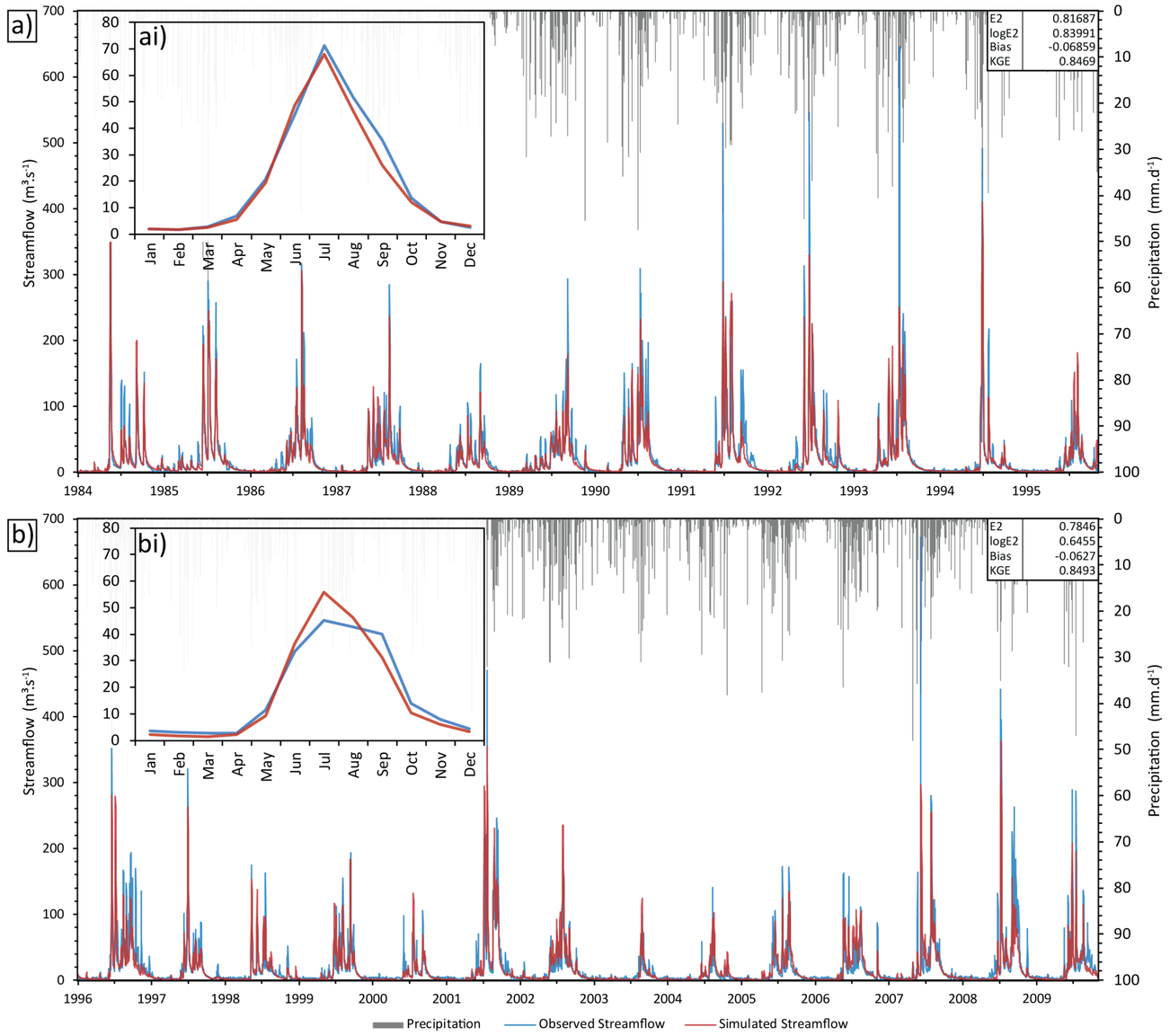
Station density

- Average distance from HRU to station
- Average elevation difference between HRU and station



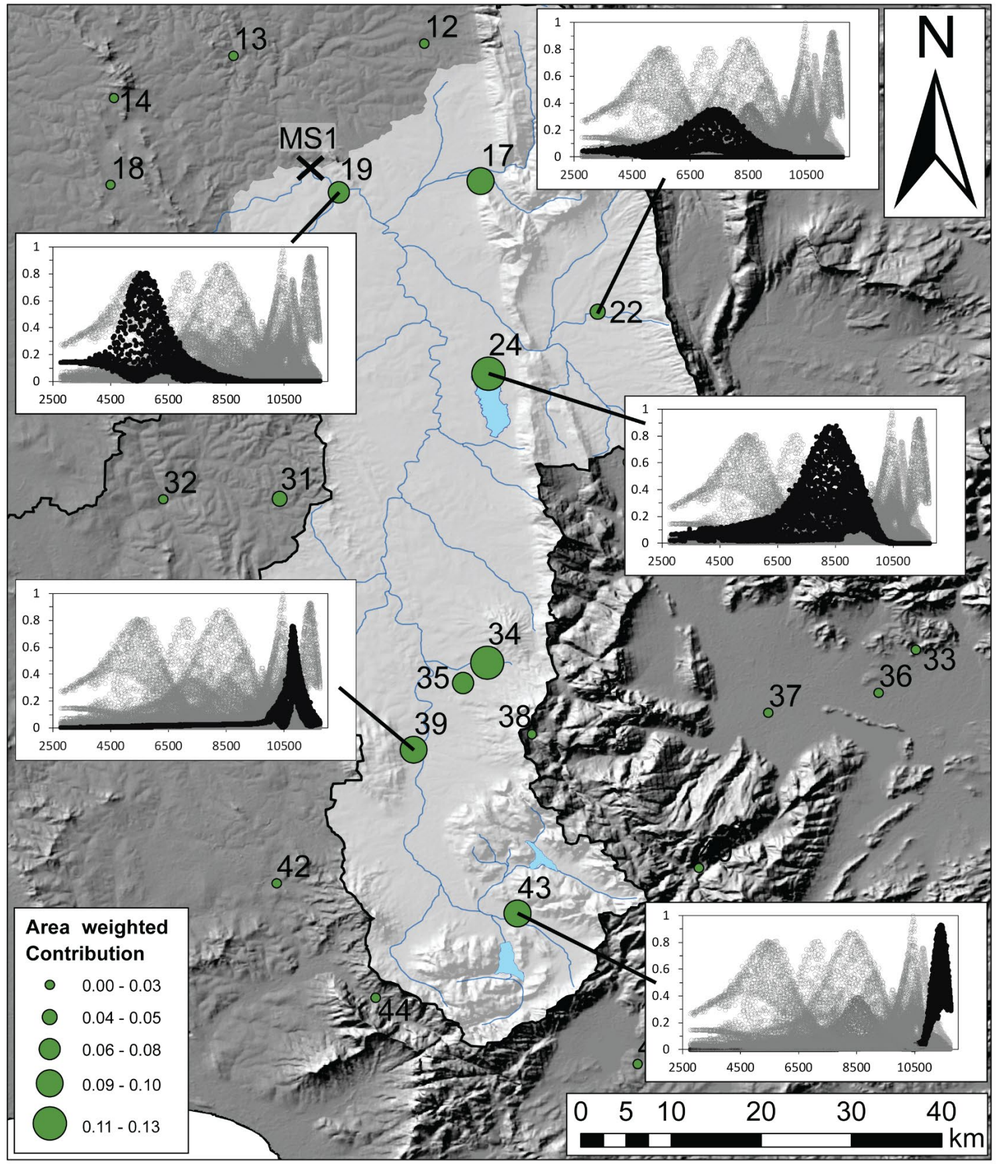
Model calibration/validation

- NSGA2 auto-calibration
- Validation impacted by dam construction and reservoir operations



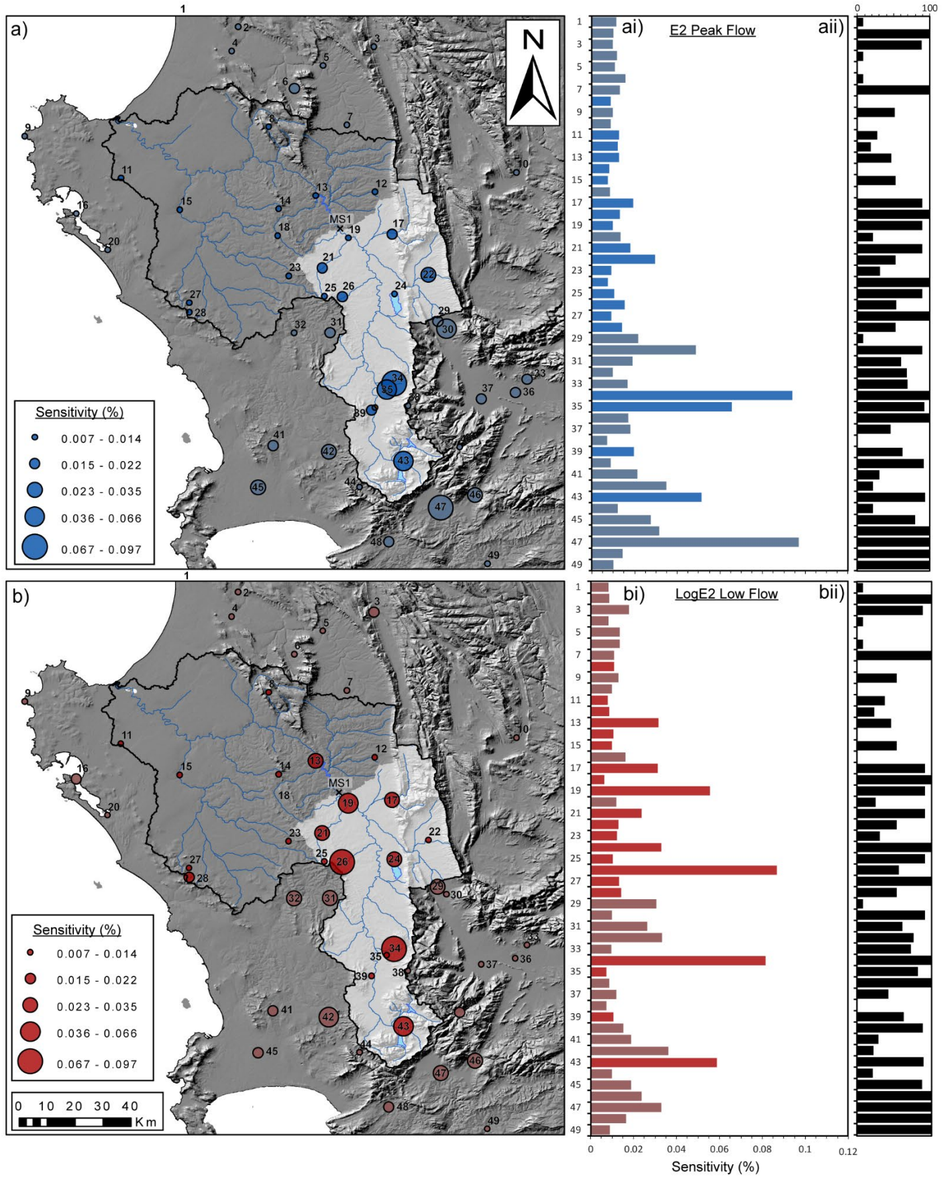
Station IDW weight vectors

- Station importance split into two:
  1. Stations with a low weight but serve a large amount of HRUs (22 & 24)
  2. Stations with a high weight and only serve a few HRU (39 & 43)



Station sensitivity

- Peak flow
  - Stations in the headwater of the catchment
- Low flow
  - Downstream areas more important



Conclusion

- Important to position climate station in critical areas to capture the bulk of precipitation patterns that impact runoff generation
  - Rather than increasing the overall density of measuring devices
- Optimised station weights to account for microclimatic variability has the potential to improve HM in data scarce regions and improve physical representativeness of HM