The effect of the choice of time resolution on the prediction of deep drainage rates in rocky covers

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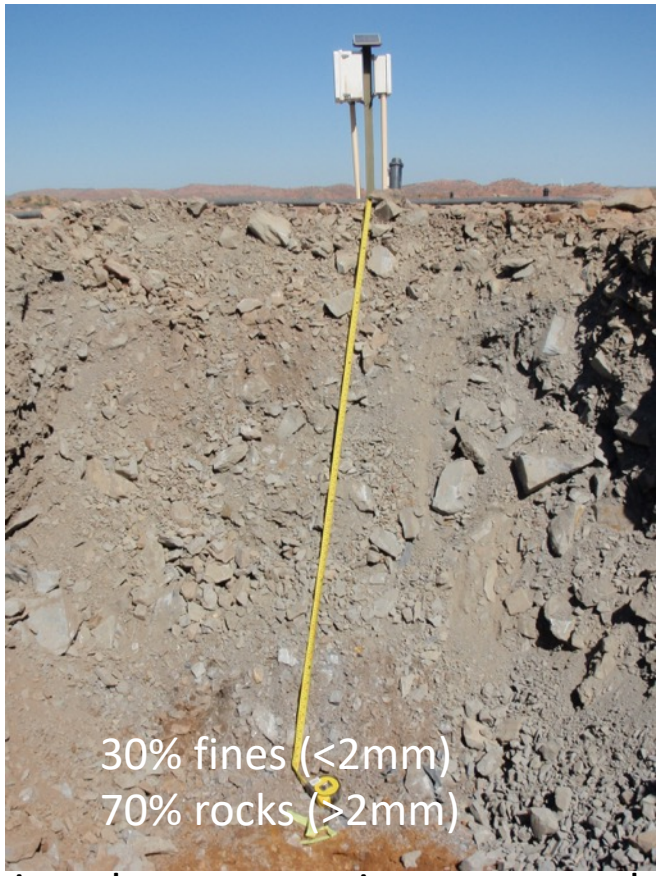
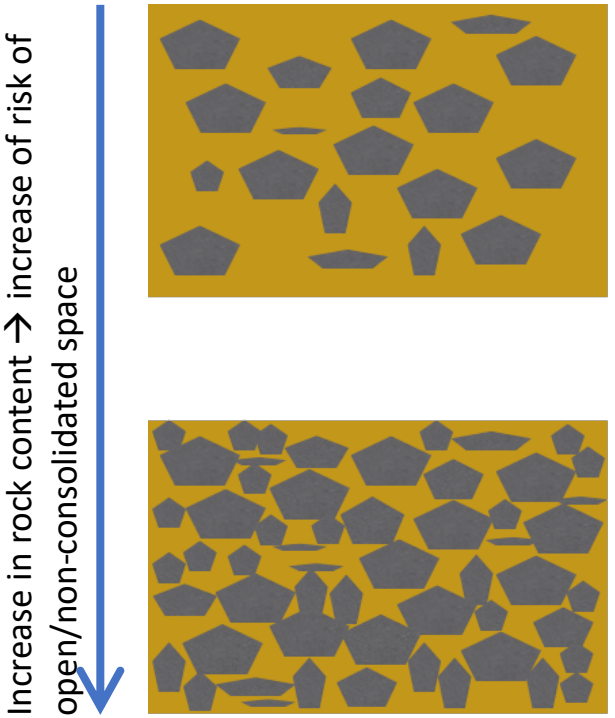
Rocky substrates are used for constructing covers for management of rainfall



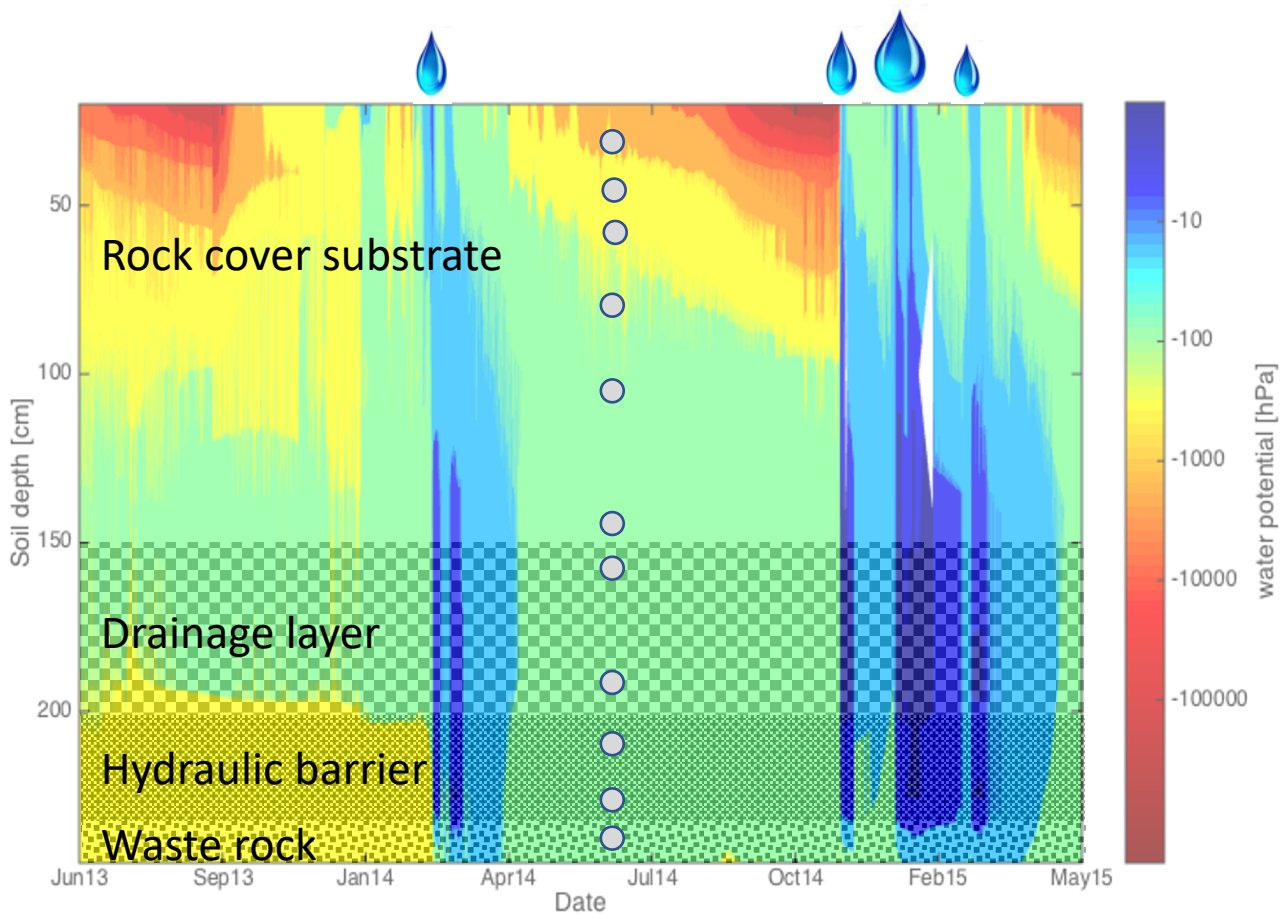


Covers are designed as evaporation covers and are meant to absorb rainfall and release soil moisture to the atmosphere by evaporation.

The idea of the covers design is dimension the depth such that deep drainage of infiltrated rainfall is prevented.

In reality, there is risk of preferential flow and fast flow infiltration has been observed.

Experimental field site:
Water potential distribution monitoring over period of 1 year

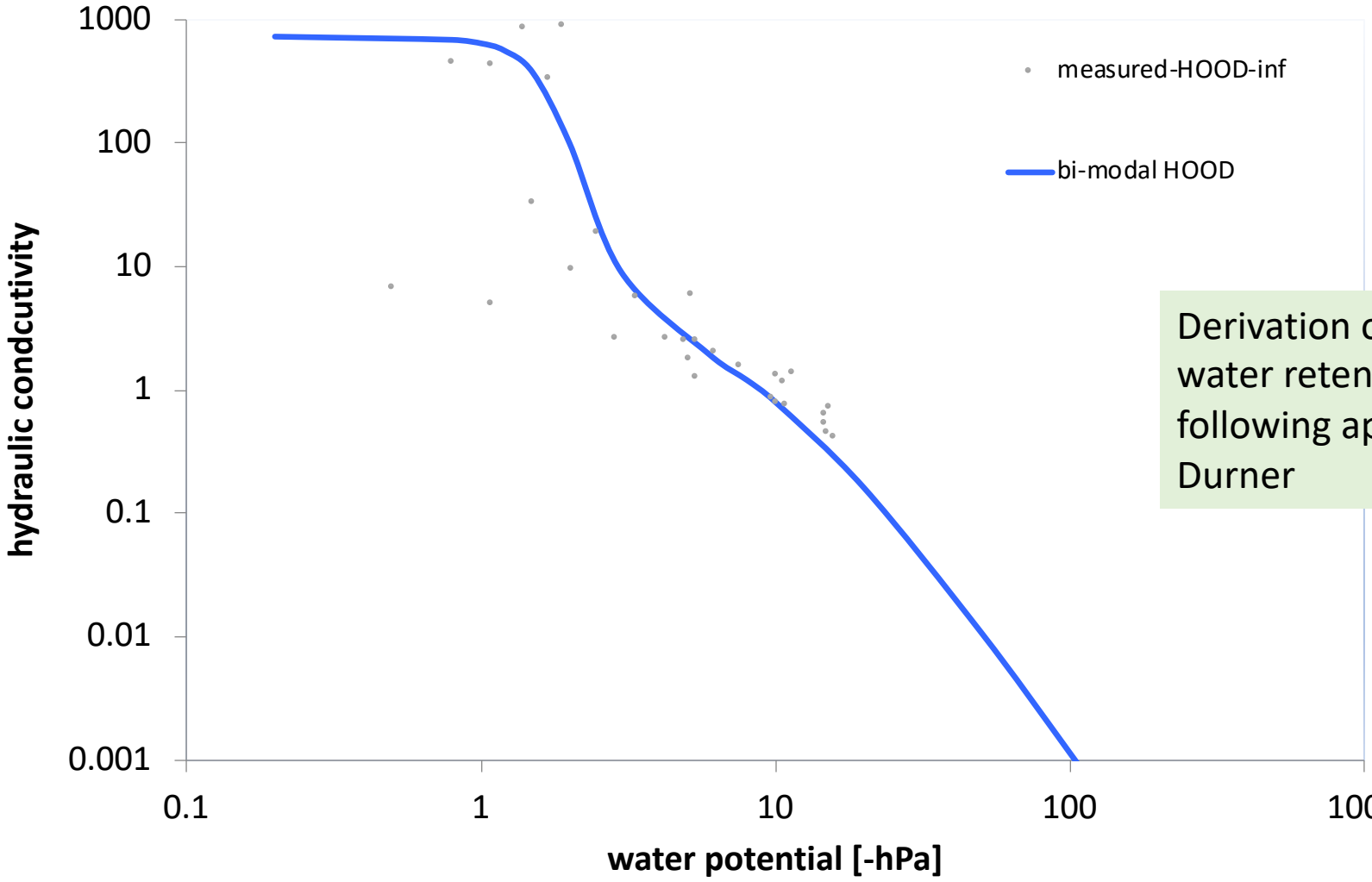


major rain event

Water potential determined with pF-meter (ecotech, Bonn, Germany); in total 11 pF-meters installed across the depth

- Field measurements show a direct response from infiltration to drainage to depth during major rain events (>30mm).
- Water moves through preferential pathways to hydraulic barrier
- Larger rain events/periods of rain cause ponding of water in drainage layer

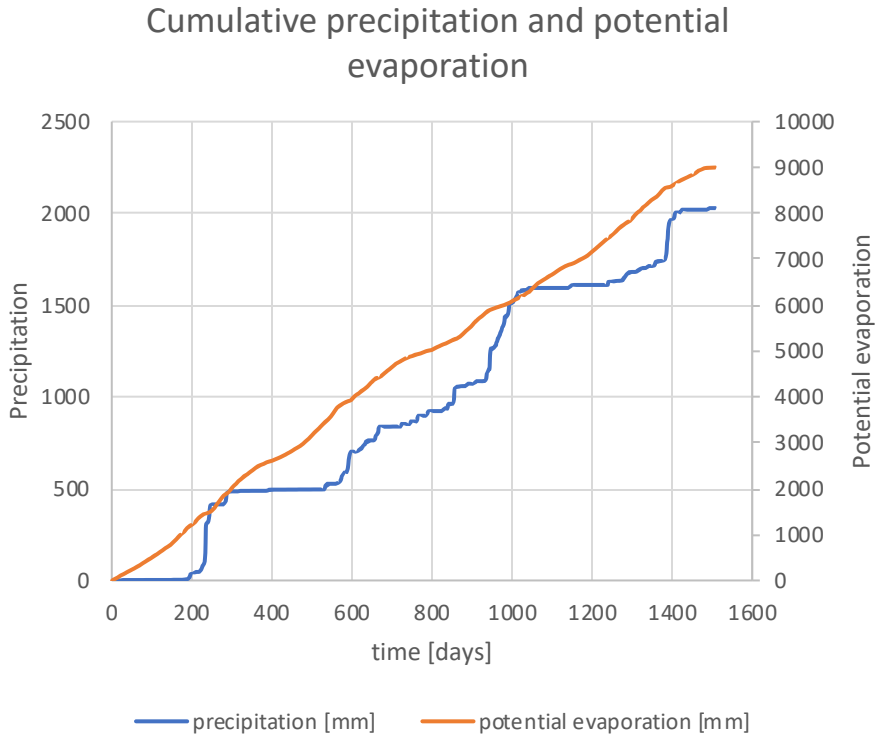
Determination of bi-modal water retention curve derived from infiltration tests (hood infiltrometer tests on surface)

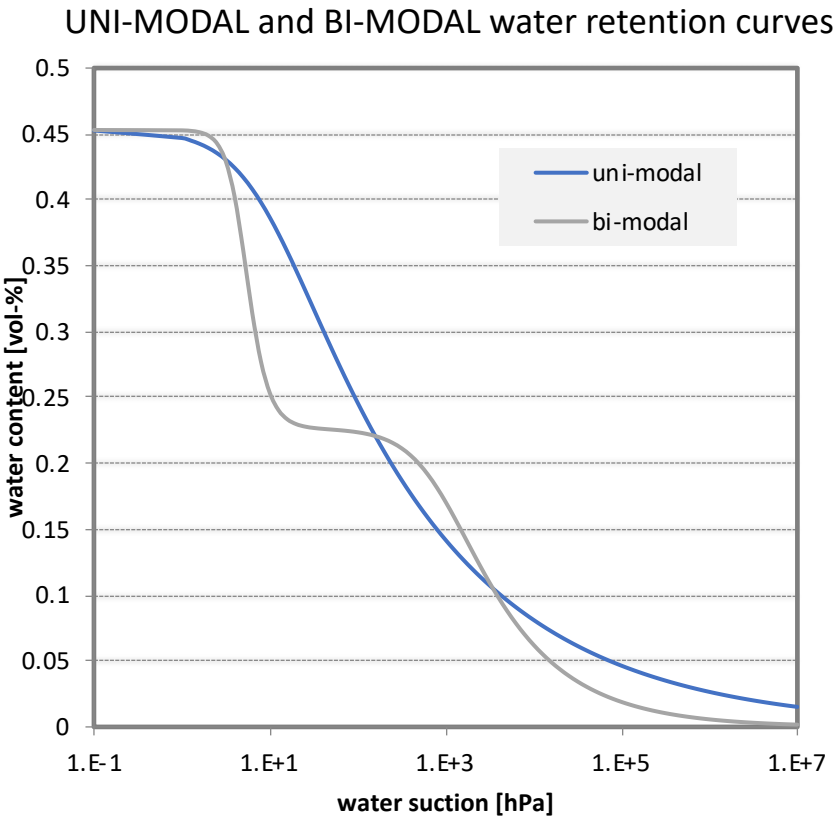


Derivation of bi-modal water retention curve following approach by Durner

Data from PhD thesis A. Schneider (2012): Plant-soil relationships in constructed covers of mine waste material. The University of Queensland

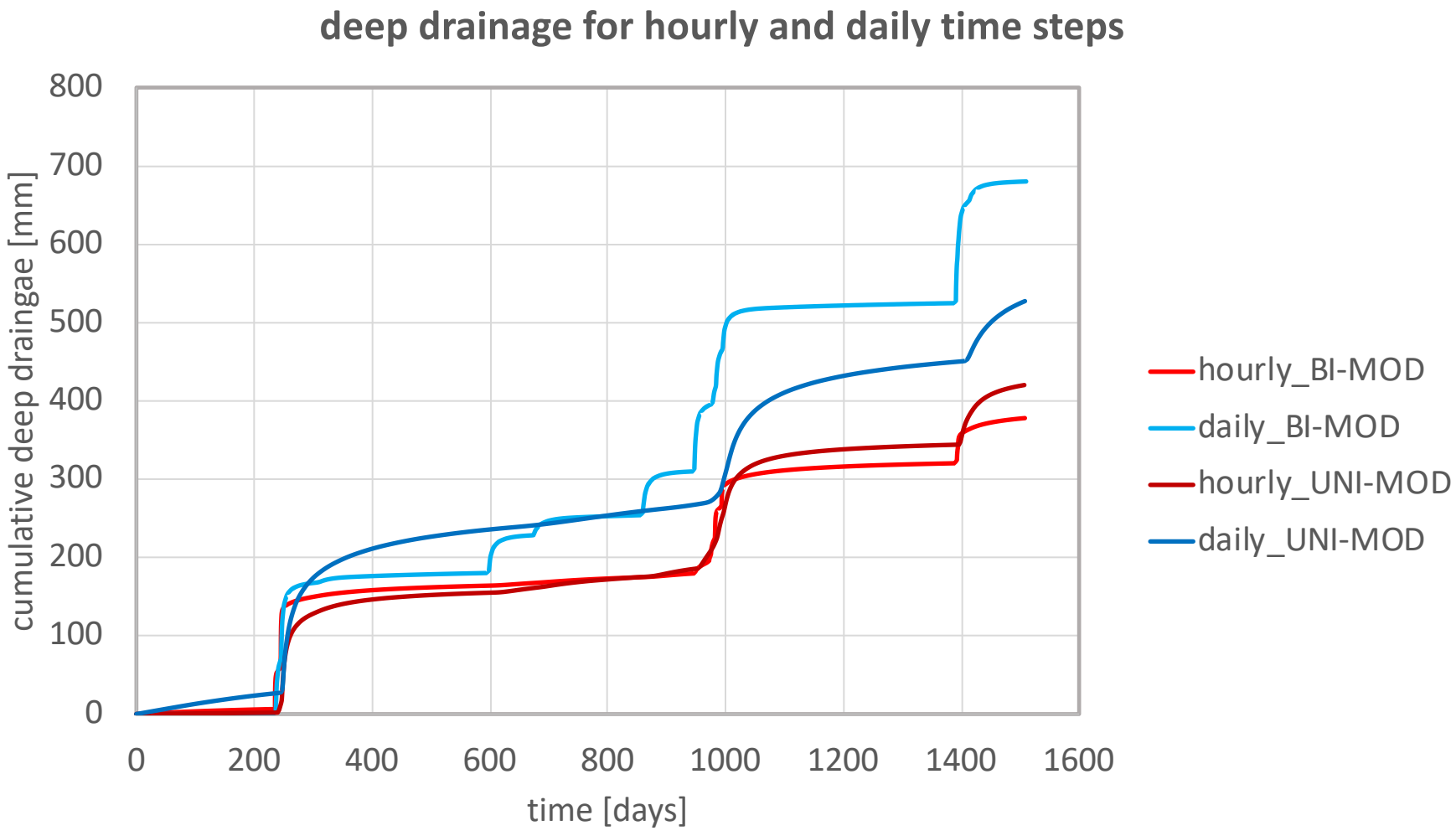
Numerical modelling using different time steps - hourly vs daily input data





Precipitation and potential evaporation from weather station data were used as hourly data and aggregated to daily data for the numerical modelling

Numerical modelling using different time steps - modelling results



Geometry: 2mx2m, horizontal; initial condition: water potential -1000hPa

Numerical modelling using different time steps - conclusions

- Modelling deep drainage through a rocky substrate resulted in a large variability of calculated water volumes when using different time steps (hourly vs daily)
- The difference was exacerbated when comparing the calculation of a BI-MODAL WRC with a UNI-MODAL WRC
- For UNI-MODAL WRC drainage for the hourly time step (21% of precipitation) is calculated as 80% of the water throughflow compared to daily (26% of precipitation) time step
- BI-MODAL calculates only 56% of the water throughflow for the hourly time step (19% of precipitation) compared to daily (34% of precipitation)

→ Larger difference of BI-MODAL model result with different time steps

→ Although BI-MODAL WRC reflects water flow regime better for rocky substrates, the validation of drainage (using e.g. lysimeter) seems to be more important - if not critical - for correct quantification of flow volume