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The Jacob Blaustein Institutes for Desert Research (BIDR)
Ben Gurion University of the Negev (BGU), Sede Boqer Campus

Modelling dynamic water redistribution patterns in arid catchments in the Negev Desert of Israel

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1 Objective

In arid areas redistribution of water is highly relevant for water erosion and vegetation cover. Therefore landscape evolution models should be able to handle water redistribution processes and patterns.

This study focuses on modelling water redistribution in arid catchments using LAPSUS. The aim is to test LAPSUS on its capabilities to handle varying surface characteristics.

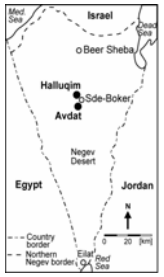

Figure 1. Location of the catchments in the Negev Desert of Israel.

2 Studied catchments

Halluqim (93 mm annual precipitation) (Figure 1 and 2):

- 3.5 ha (34,144 m^2) steeply incised rocky catchment
- 47% of surface bare rock, soil depth 0.10±0.22 m
- 36% vegetation cover per rootable soil, including Mediterranean species

Avdat (87 mm annual precipitation) (Figure 1 and 2):

- 30 ha wide loess covered valley, steep rock outcrops at east side. 2.5 ha sub-catchment used for modelling (24,864 m^2)
- 5% of surface bare rock, soil depth 0.25±0.29 m
- 20% vegetation cover per rootable soil, only desert species

Figure 2.Studied catchments.

References

Schoorl, J.M., Sonneveld, M.P.W., Veldkamp, A., 2000. *Three-dimensional landscape process modelling: the effect of DEM resolutions.* Earth Surface Processes and Landforms 25: 1025-1034.

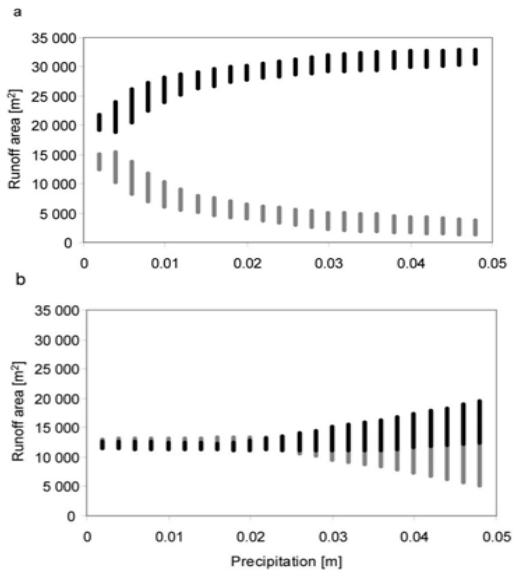

Figure 3. Catchment response to varying precipitation events (0.002 – 0.048 m) is shown with runoff receiving area (grey dots) and runoff producing area (black dots) (in m^2) for Halluqim (a) and Avdat (b).

3 The LAPSUS model

LAPSUS is a spatially explicit landscape evolution model which simulates water erosion and sedimentation based on water redistribution using the multiple flow principle (Schoorl *et al*, 2000). Infiltration is a fraction of the discharge of a grid cell and is corrected for storage capacity of the soil (soil depth and pore volume). Finally, erosion and sedimentation is calculated by comparing the sediment transport rate with the actual sediment in transport. As precipitation input daily precipitation events are used.

4 Methods

1. Comparison of the catchment response to precipitation related to varying surface characteristics
2. Comparison of infiltration patterns and vegetation cover at different grid cell sizes

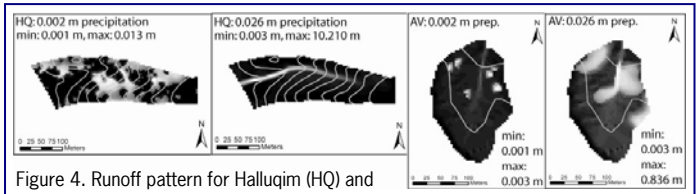

Figure 4. Runoff pattern for Halluqim (HQ) and Avdat (AV) for 0.002 m and 0.026 m precipitation (black: low, white: high runoff).

5 Results and discussion

1. The catchments have very different responses to precipitation (figure 3 and 4). The rocky catchment of Halluqim redistributes much more water than the loess covered catchment of Avdat. Halluqim has more moist positions than Avdat, and can sustain Mediterranean species.
2. Vegetation cover agrees only broadly with infiltration patterns, as part of the variation in vegetation cover is not captured by LAPSUS (figure 5). The results of Halluqim vary greatly with grid cell size, caused by a high surface heterogeneity. Avdat has more homogeneous surface characteristics and appears less scale dependent.

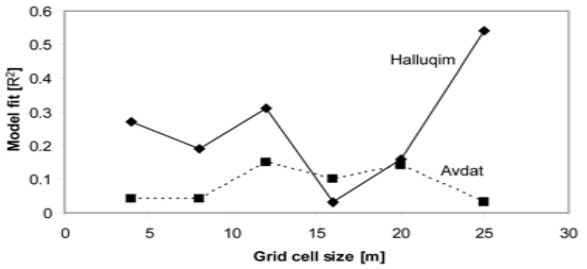

Figure 5. The effect of grid cell size (m) on linear model fit (R^2) for total infiltration (m) as function of herbaceous plant density [%] for Halluqim and Avdat.

6 Conclusions

- Catchments with different surface characteristics yield very different water redistribution patterns
- Halluqim is locally “wetter” than Avdat