



The ViSTA model: Potential for predicting the impact of land use change in high-altitude deserts

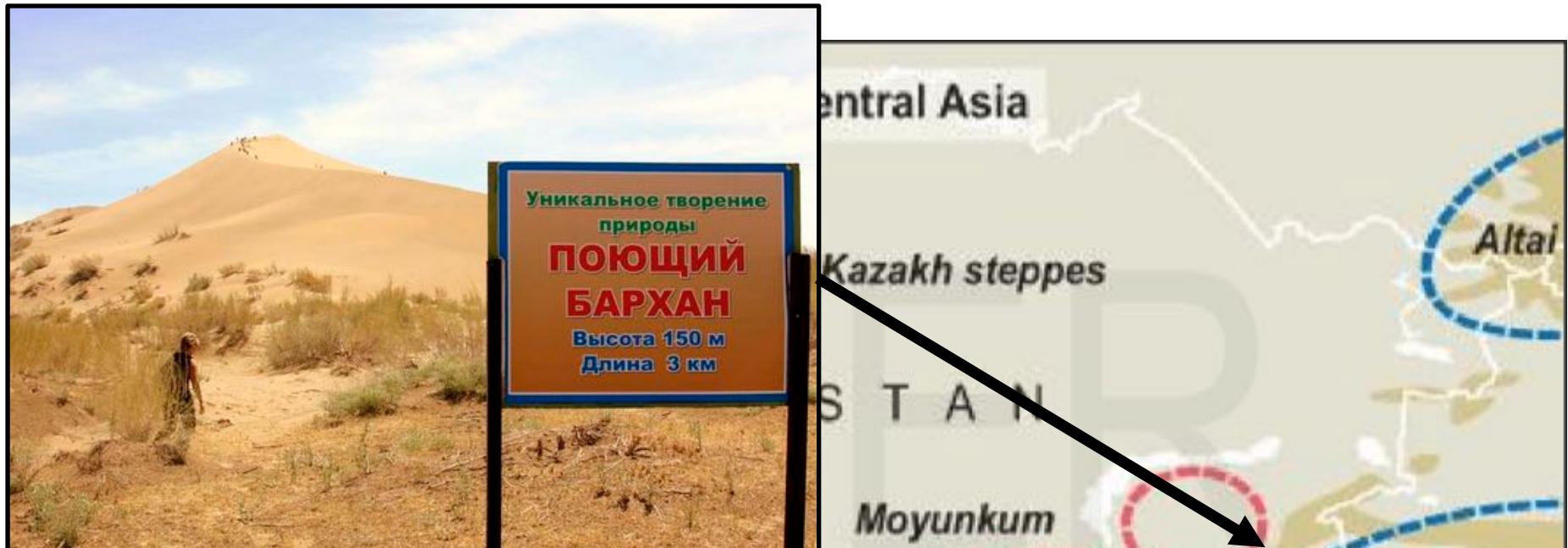
Jerome Mayaud

Oxford University Centre for the Environment

Thanks: R. Bailey, G. Wiggs, J. Richards

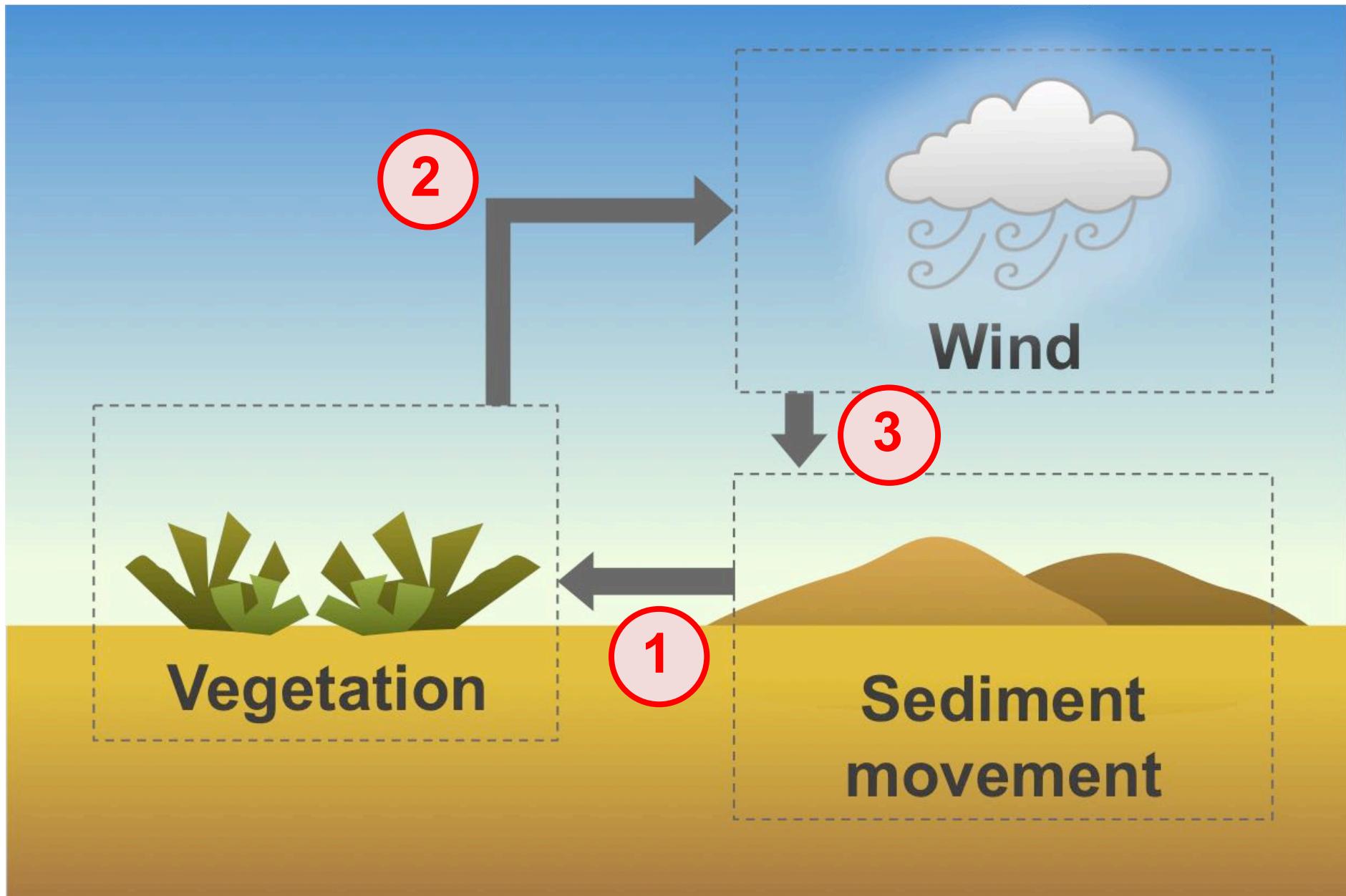


BBC News, Stanford, ContainerNews

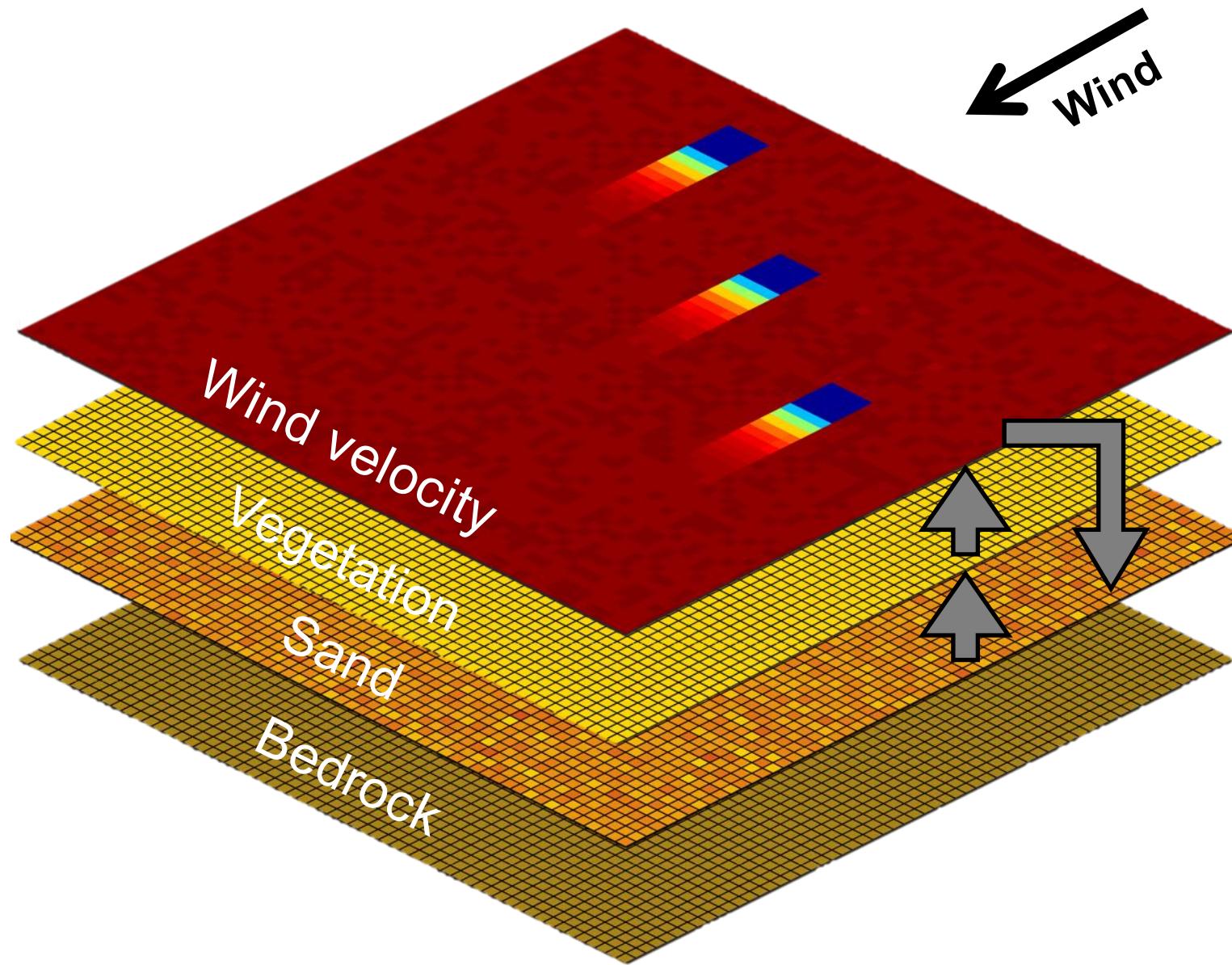


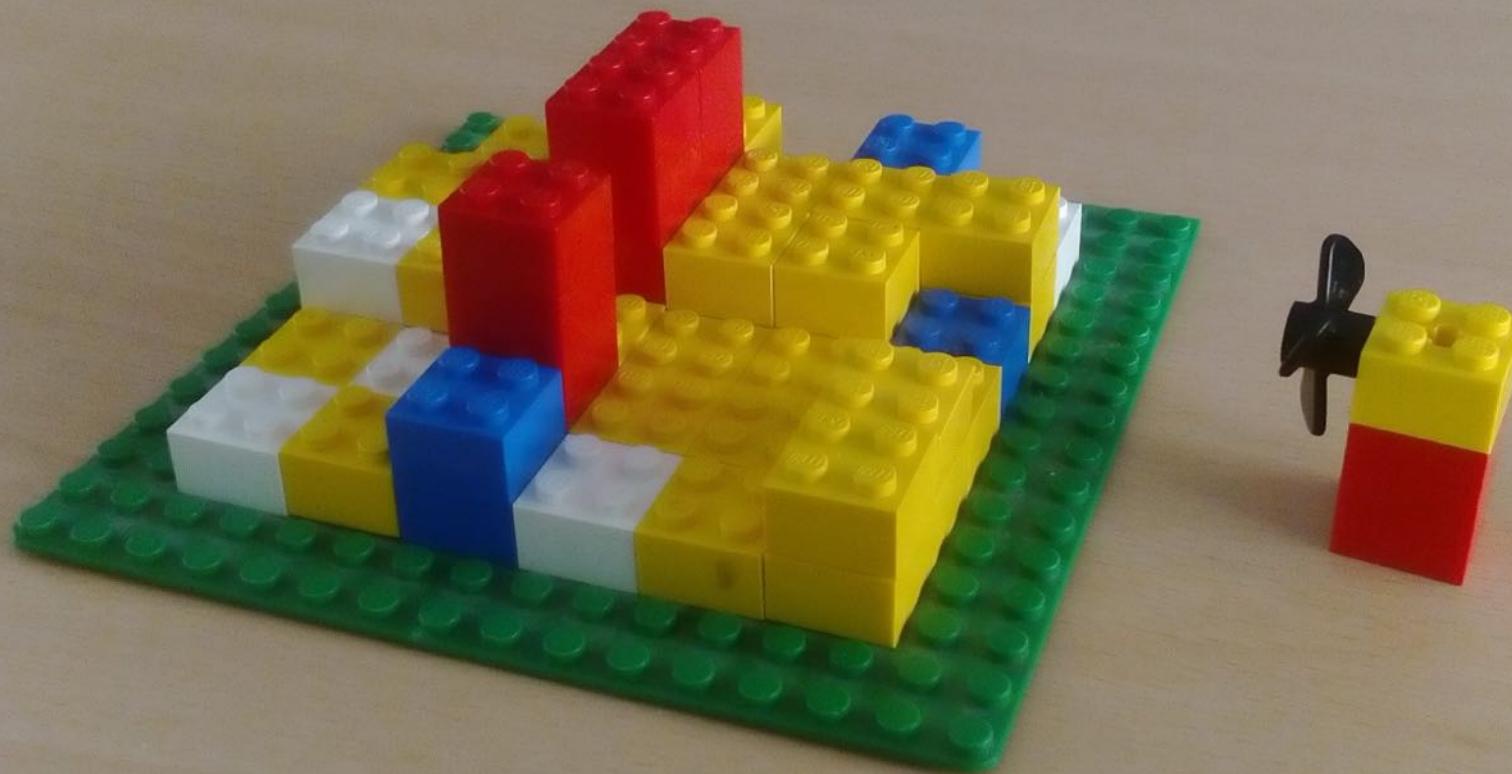
Zoi Environmental Network, Sergei Rzhevsky, Lara Arnott

The ViSTA model

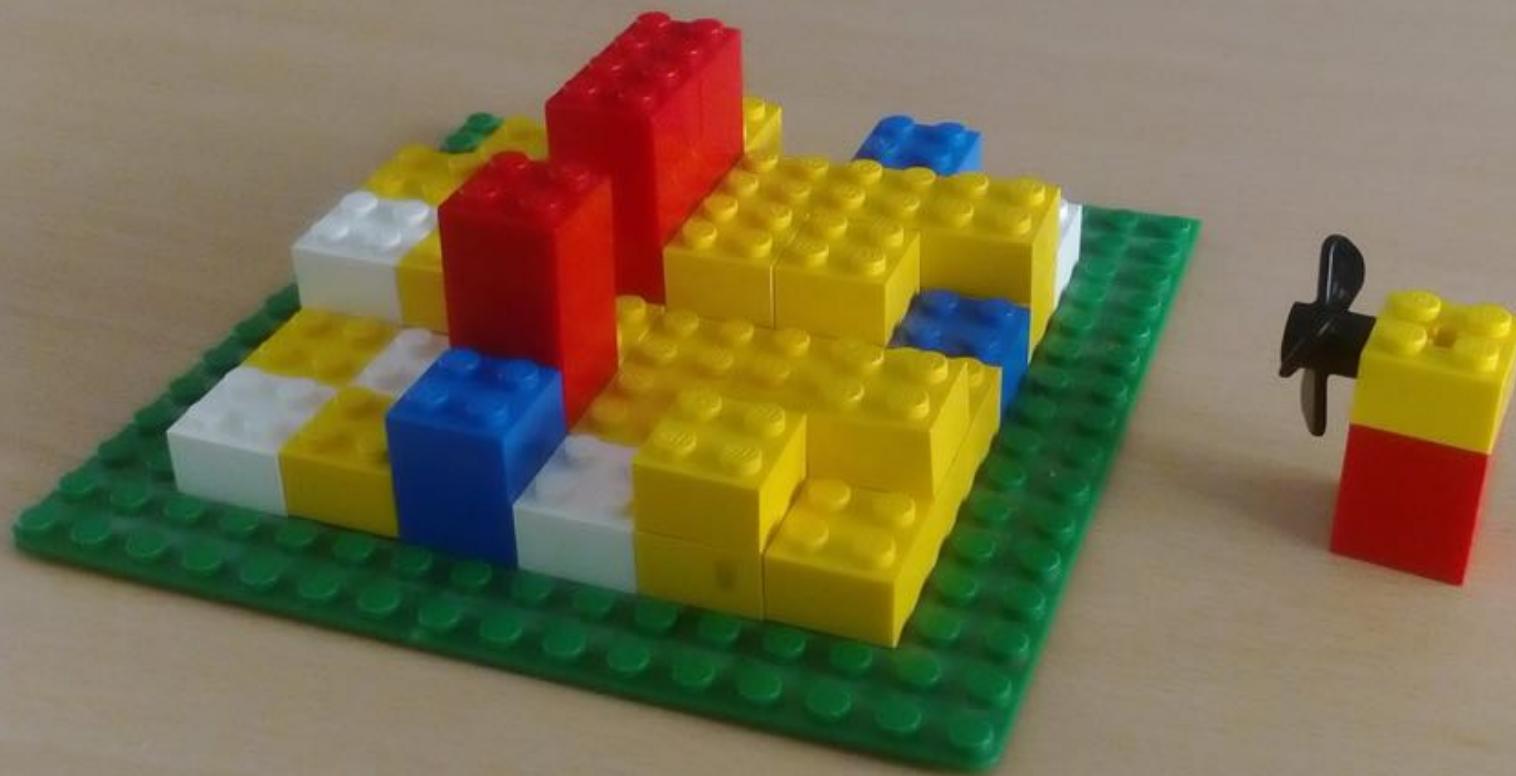


Grid-based approach

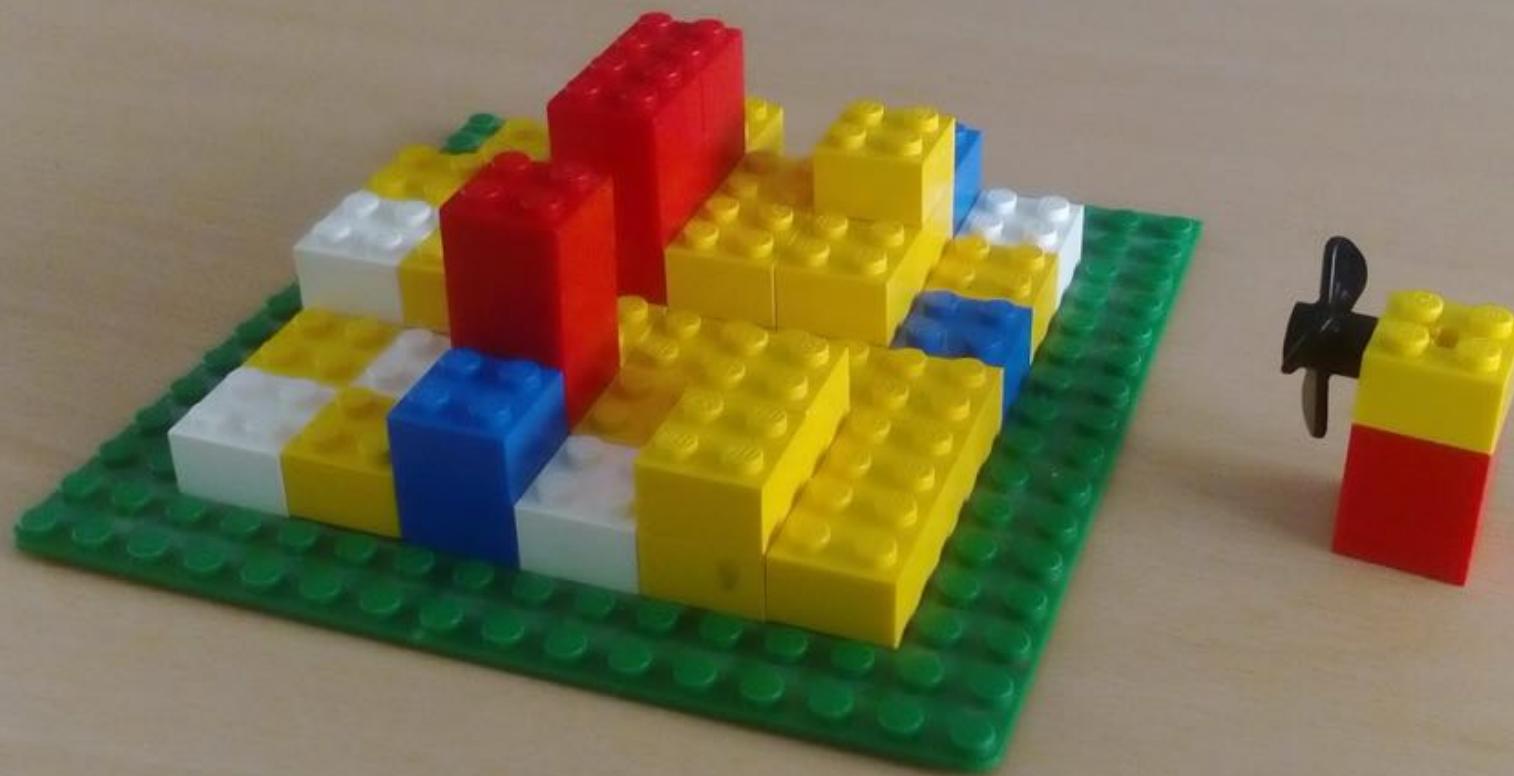




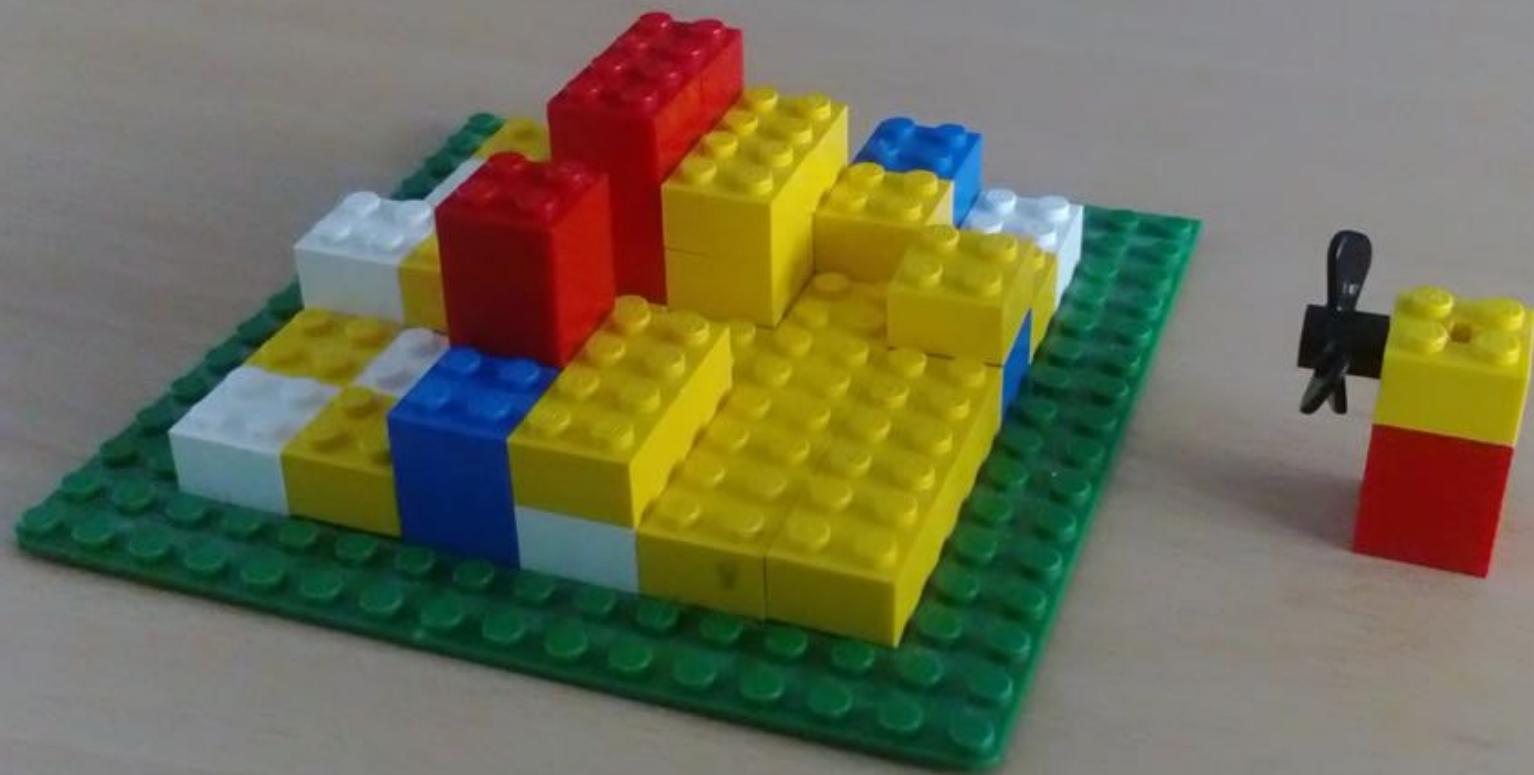
Animation: J. Richards



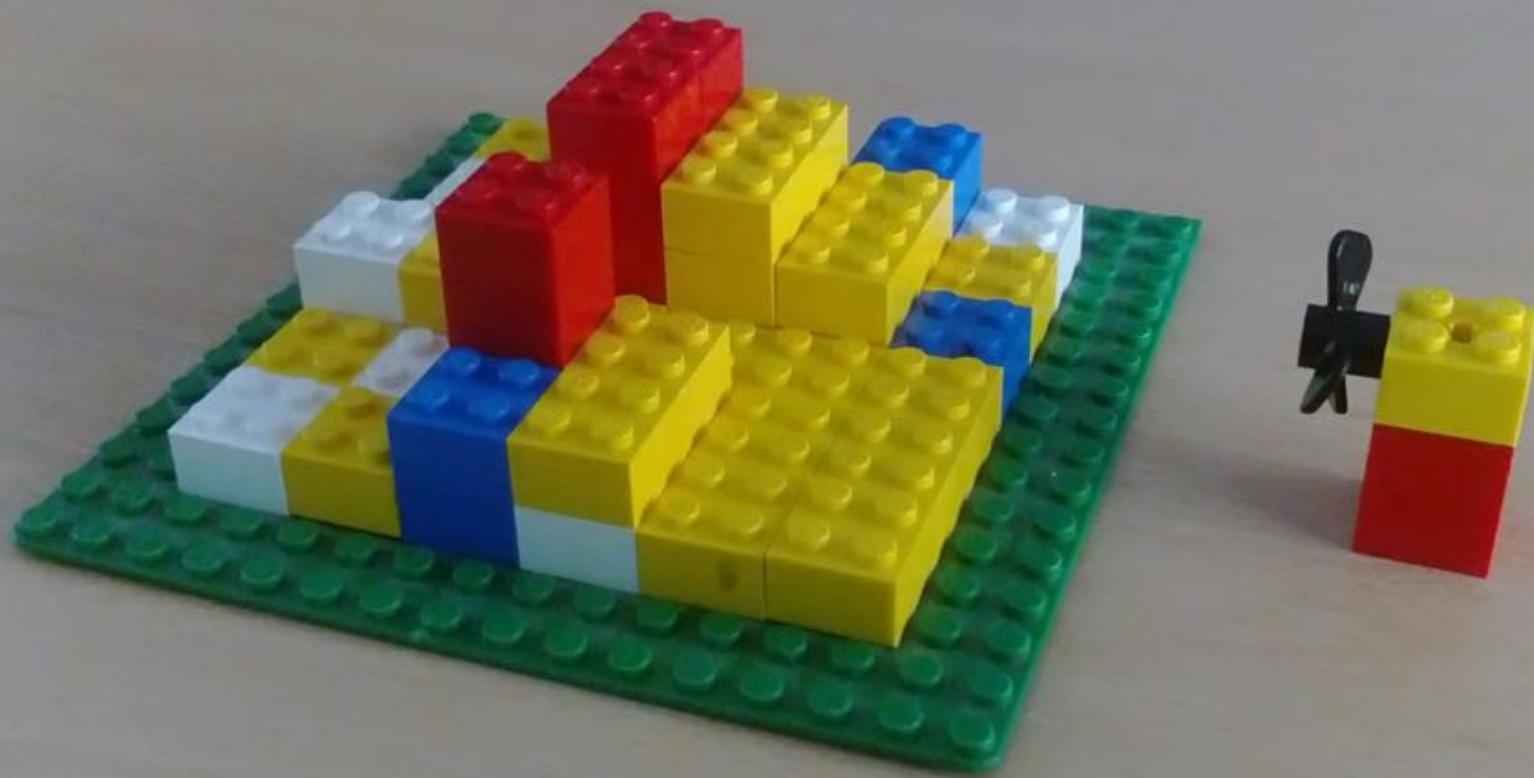
Animation: J. Richards



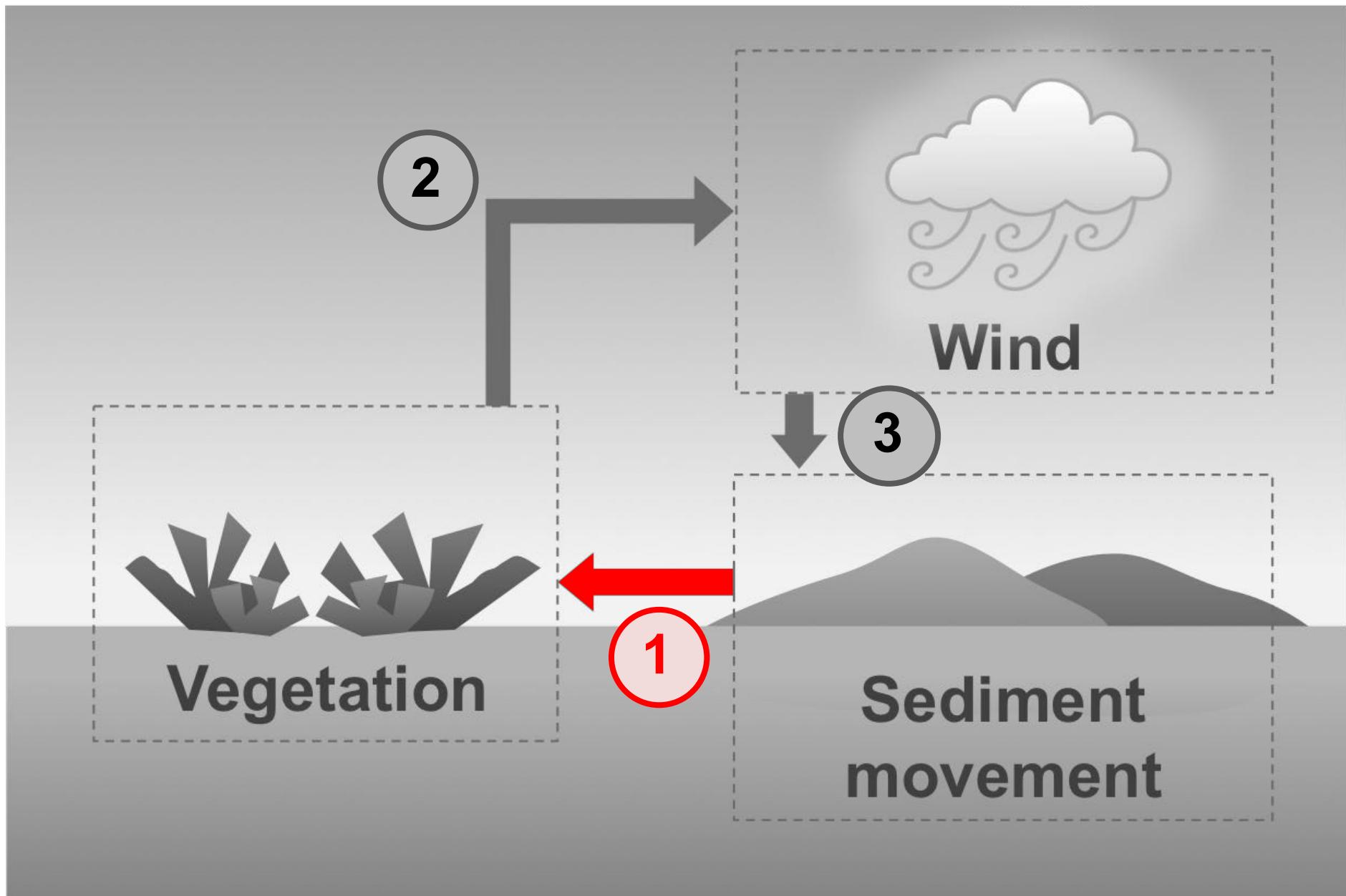
Animation: J. Richards



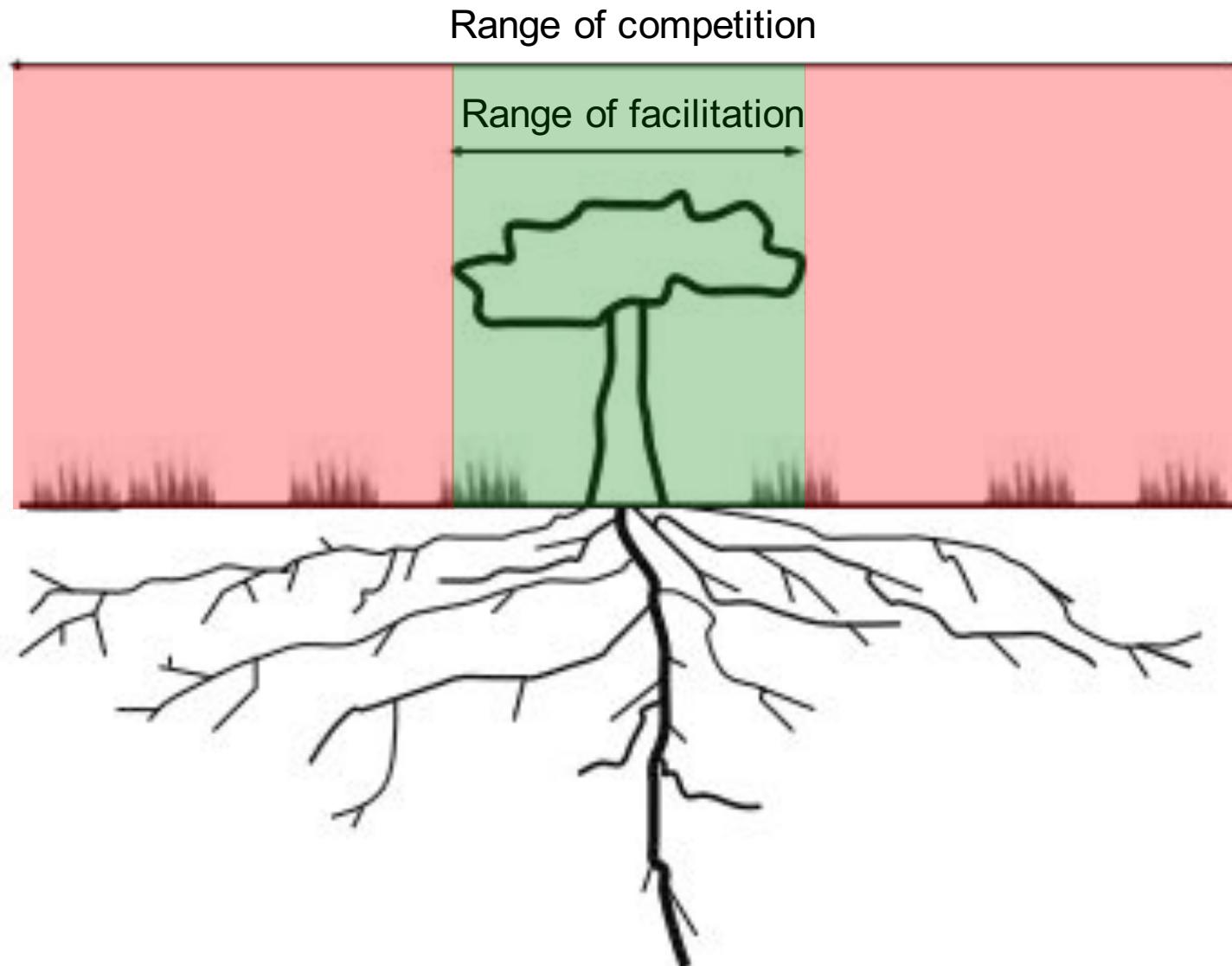
Animation: J. Richards



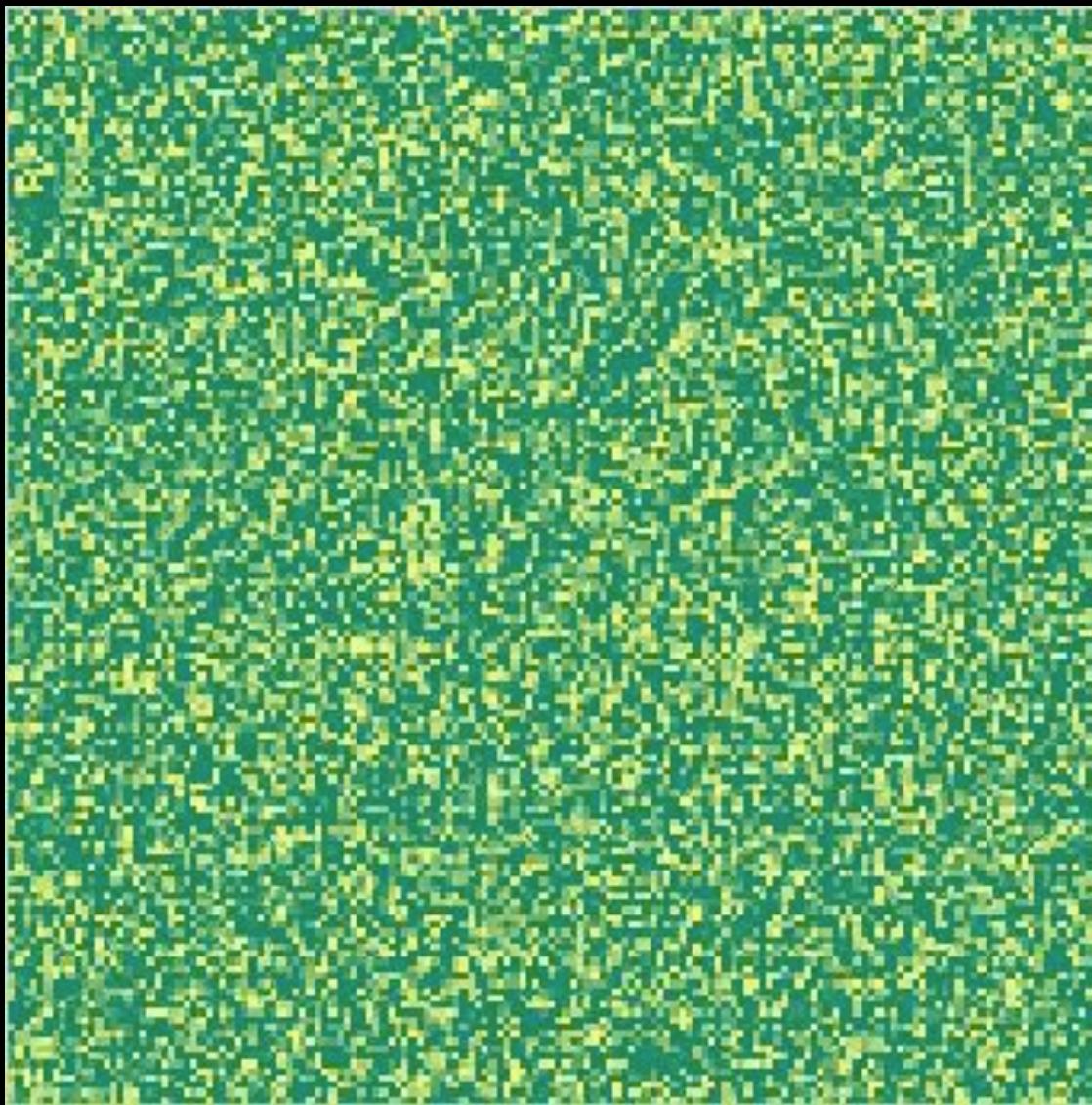
Animation: J. Richards



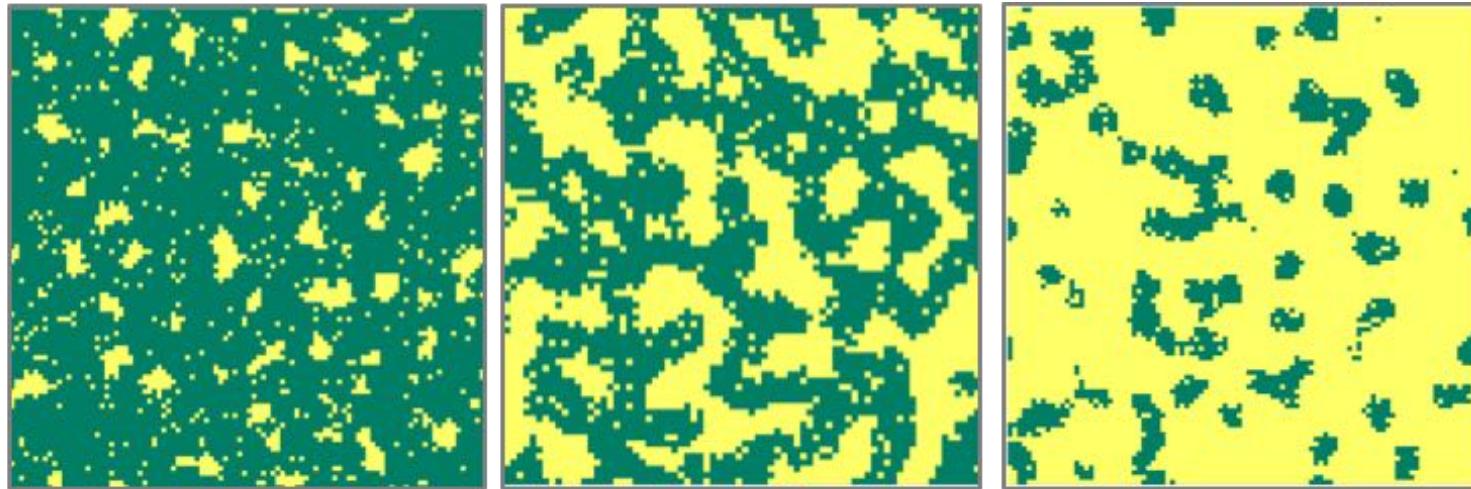
Simple rules



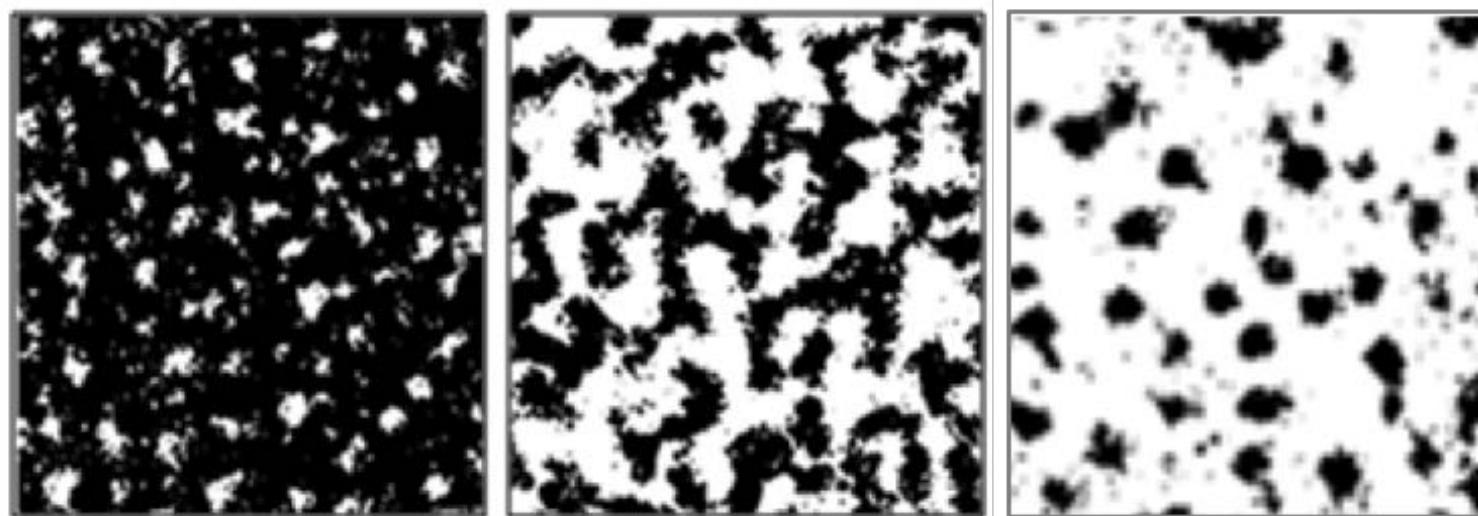
Adapted from: Borgogno et al. (2009), *Rev. Geophys.*



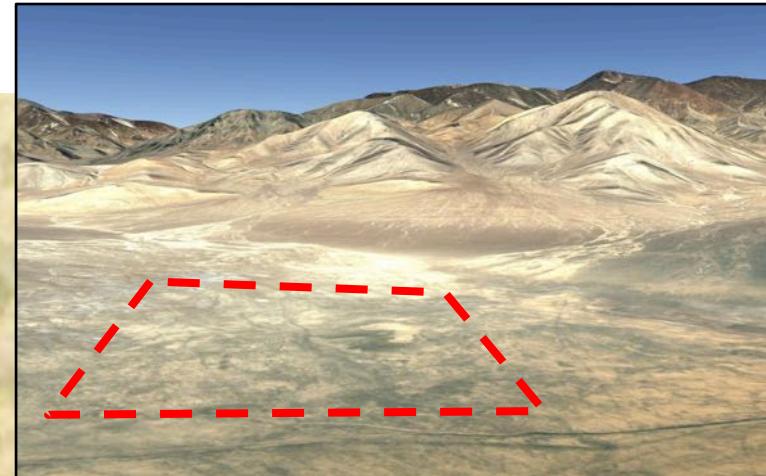
Model



Observed

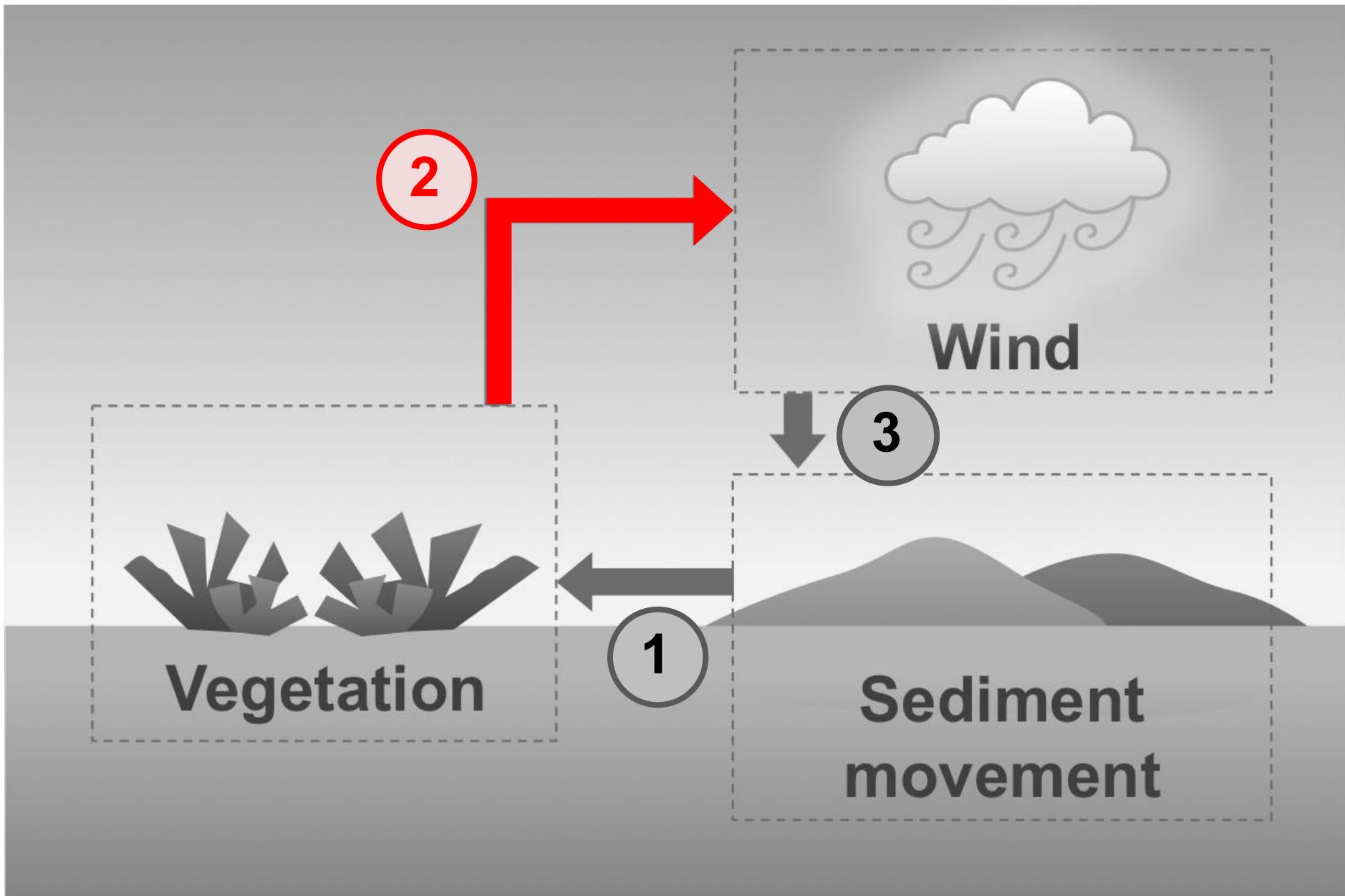


Eastern Pamirs



© bjh12

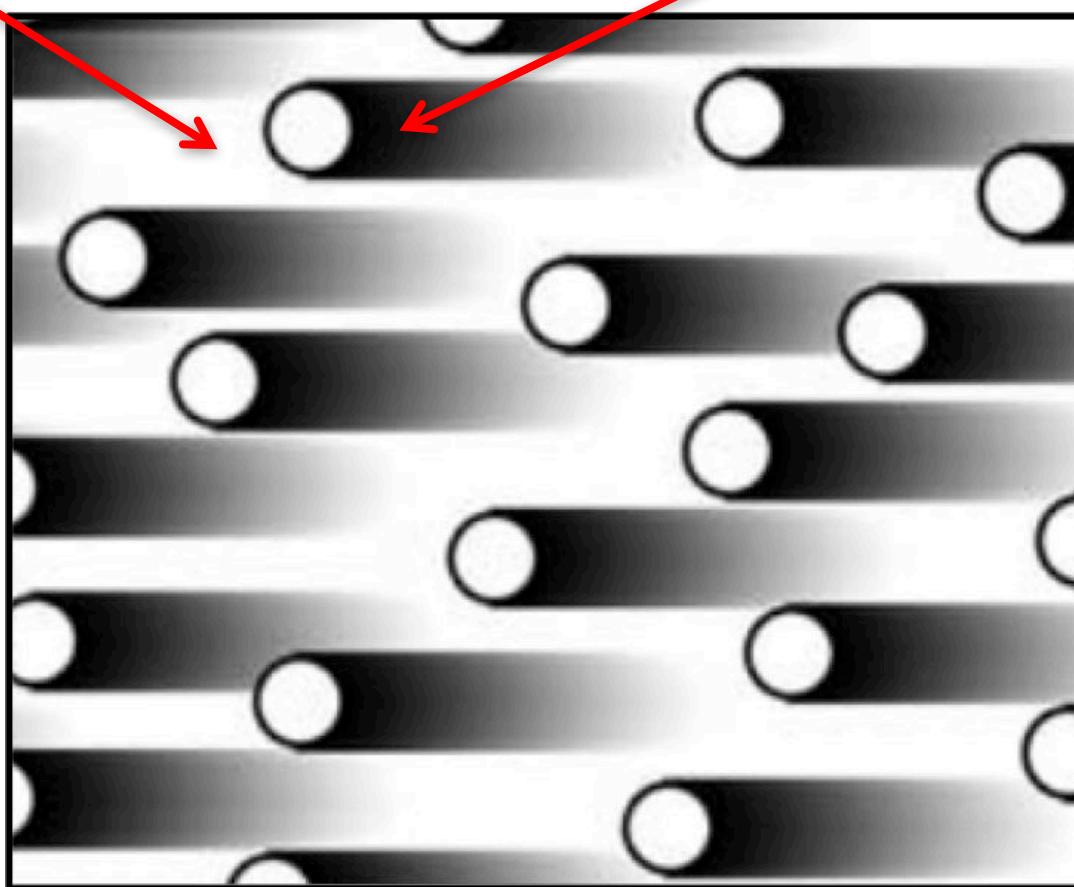
Google Earth, 2017

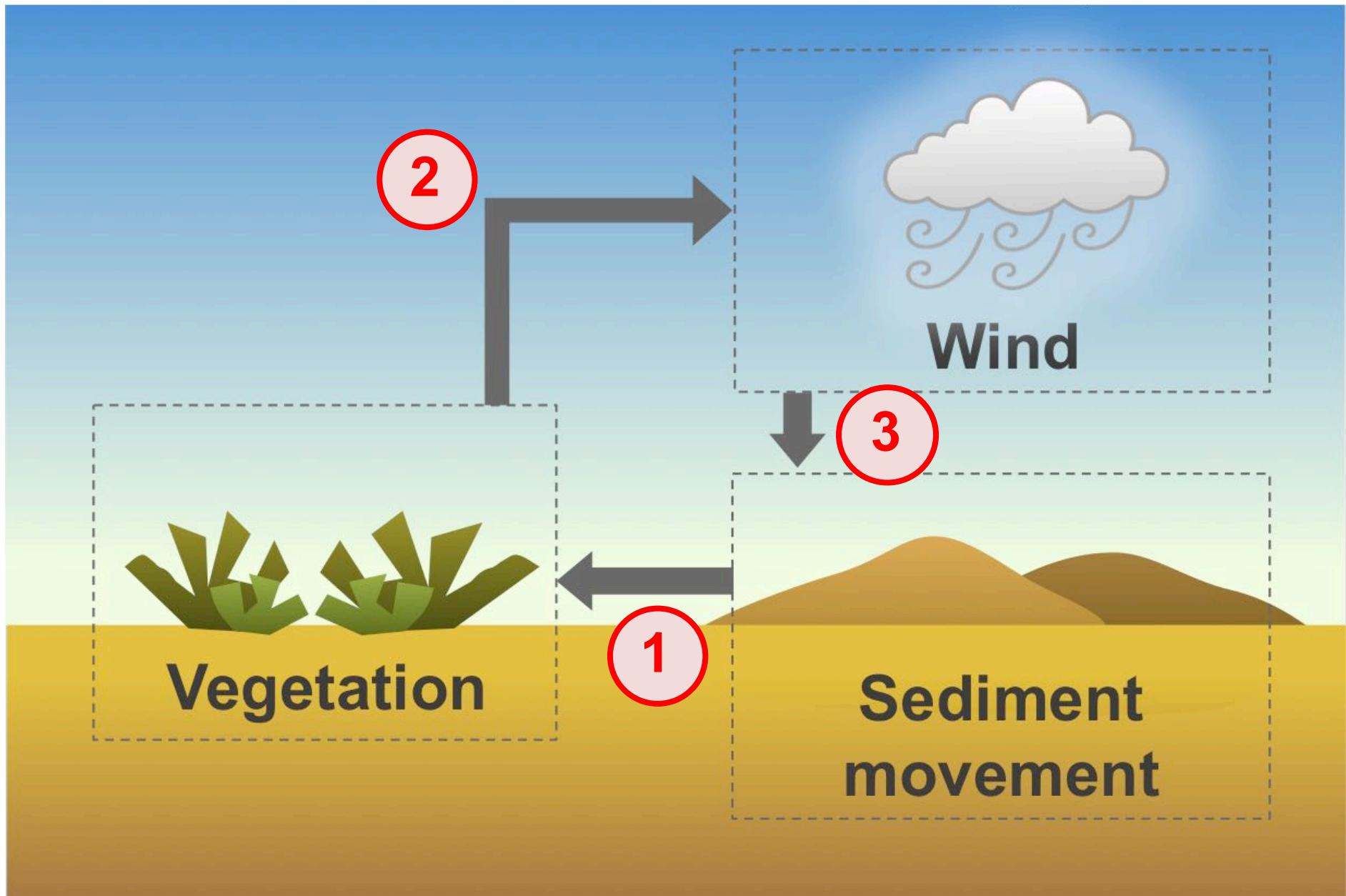


High windspeed

Low windspeed

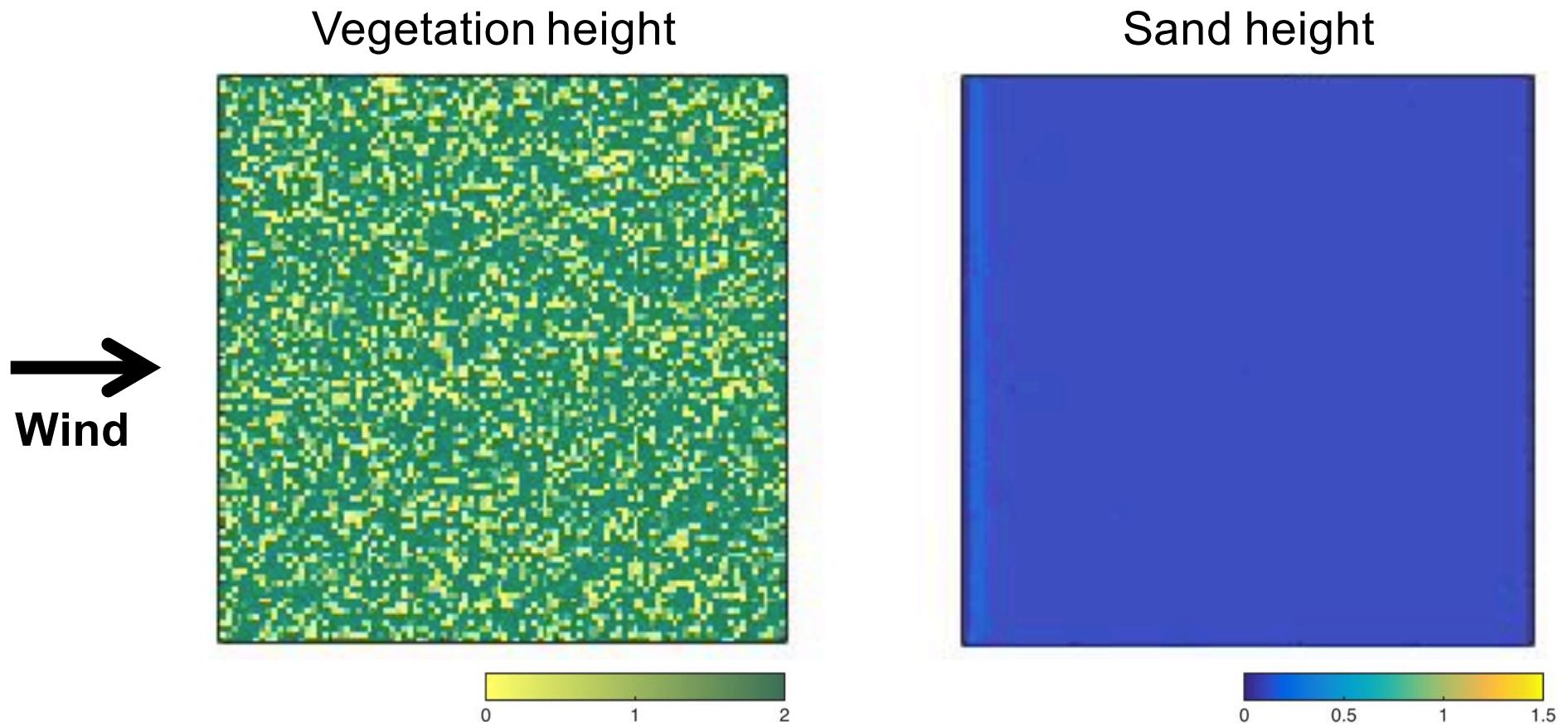
→
Wind





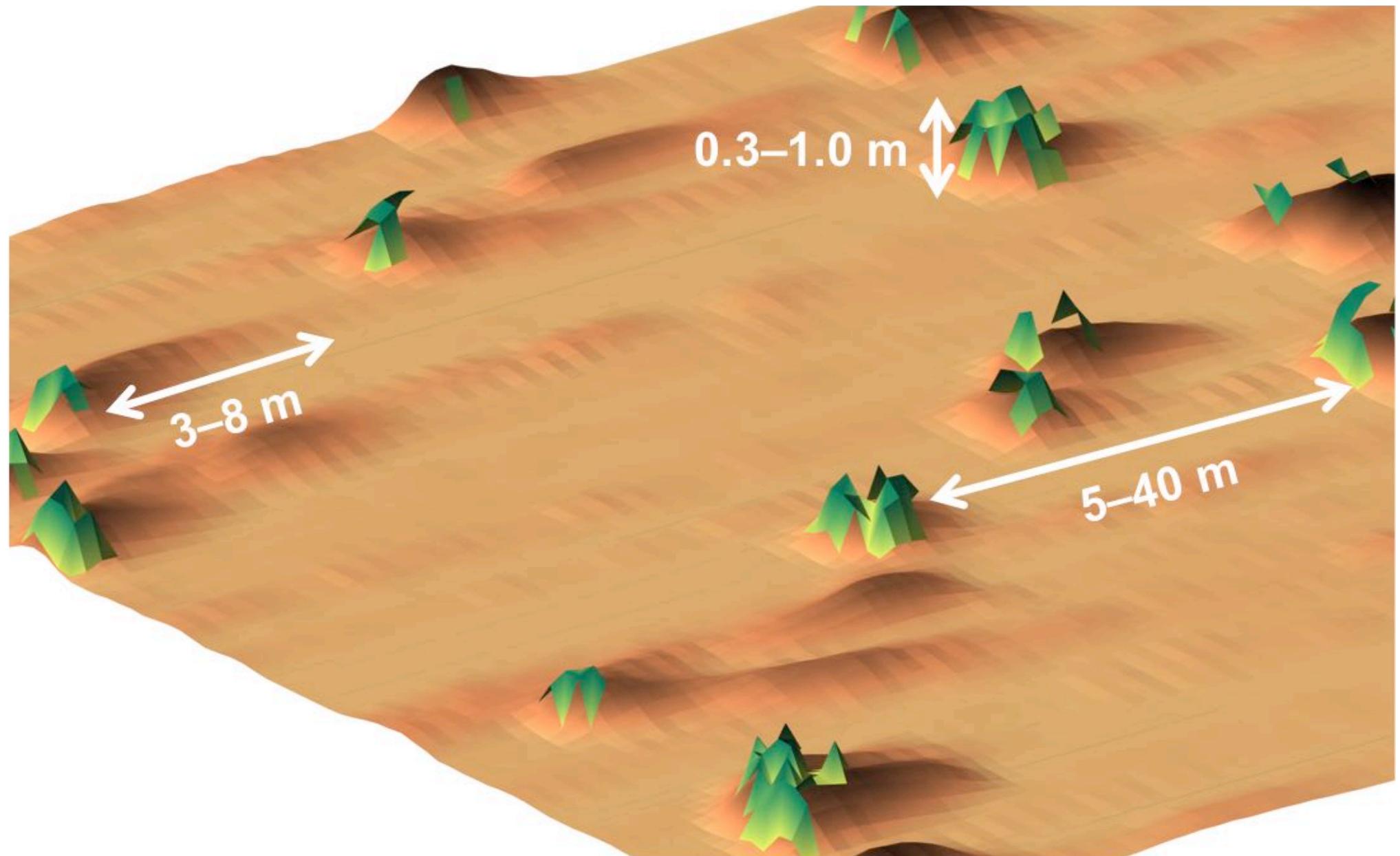


Realistic dunes?

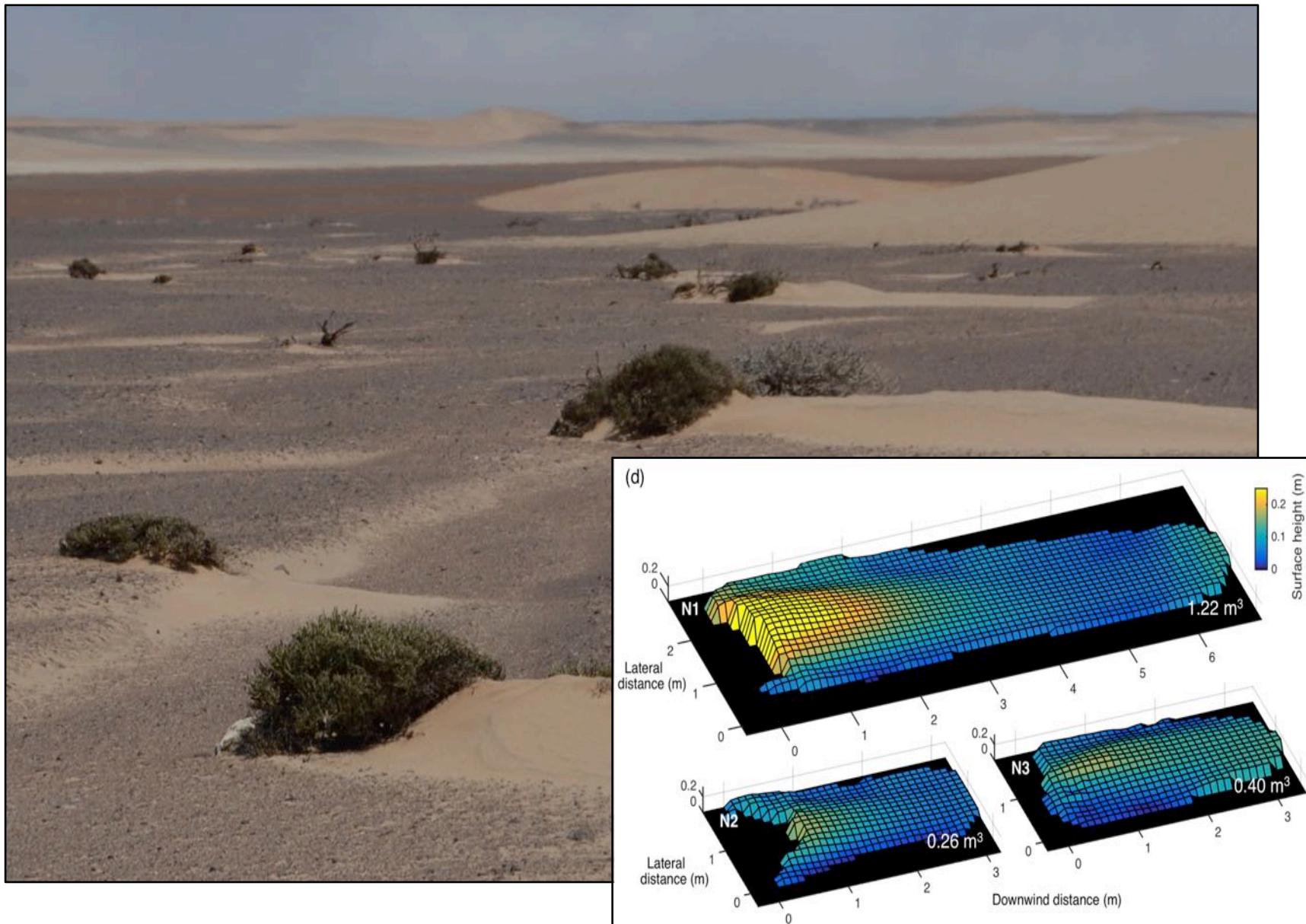


*Simulation period: 25 years
Rainfall regime: 80 mm yr⁻¹ (harsh)*

Realistic dunes?



Realistic dunes?



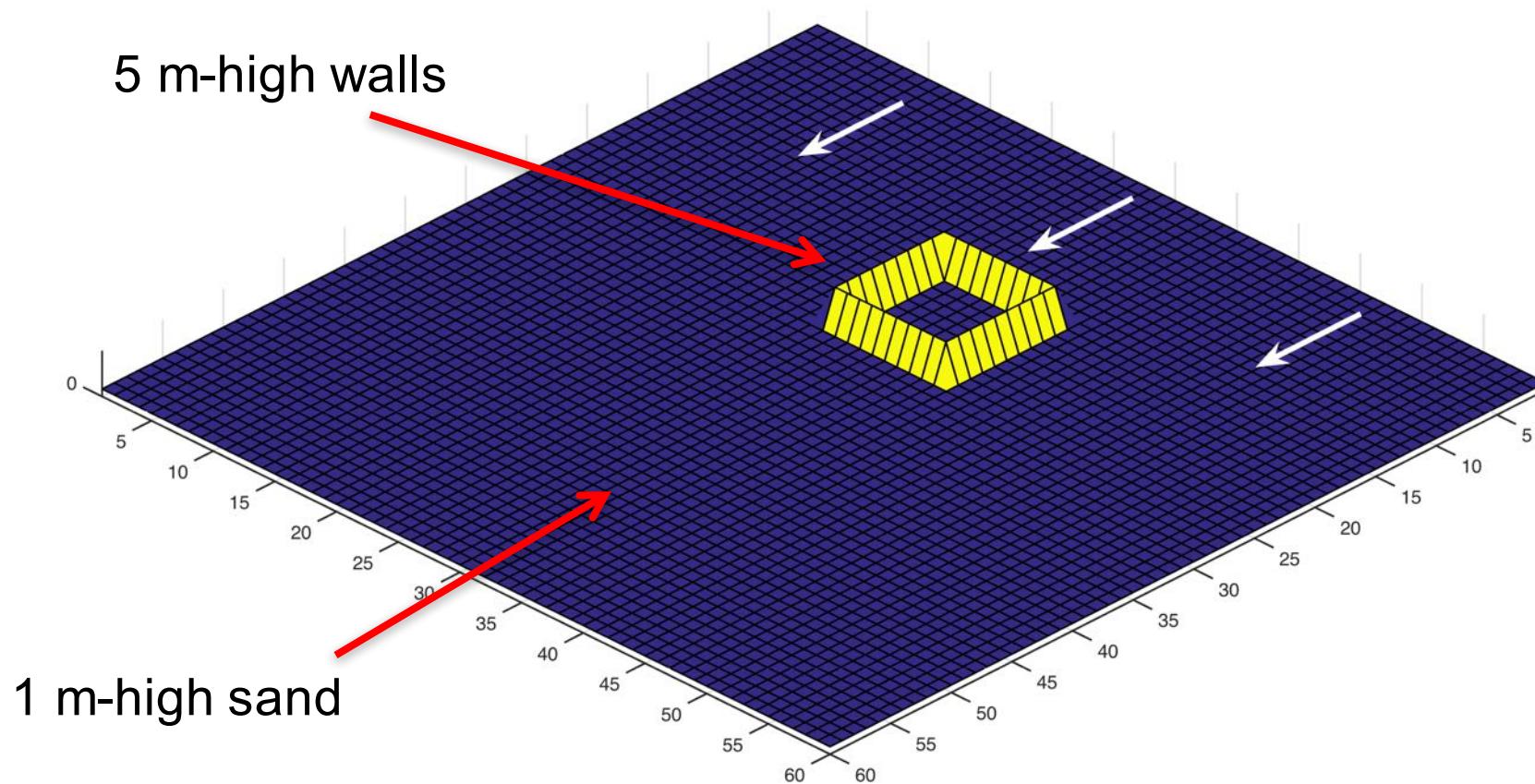
Desert walls: Khorezm fortresses, Kyzylkum



Anton Ivanov

Desert walls

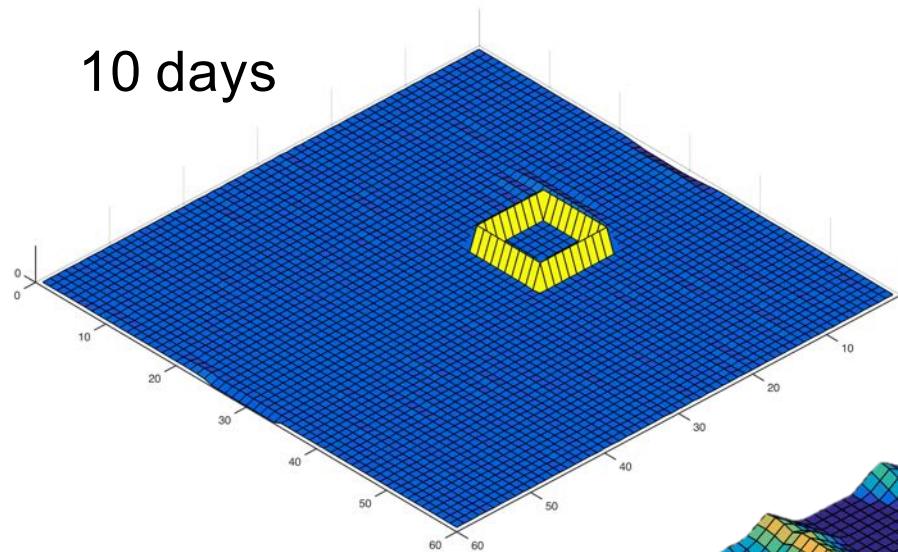
Initial setup



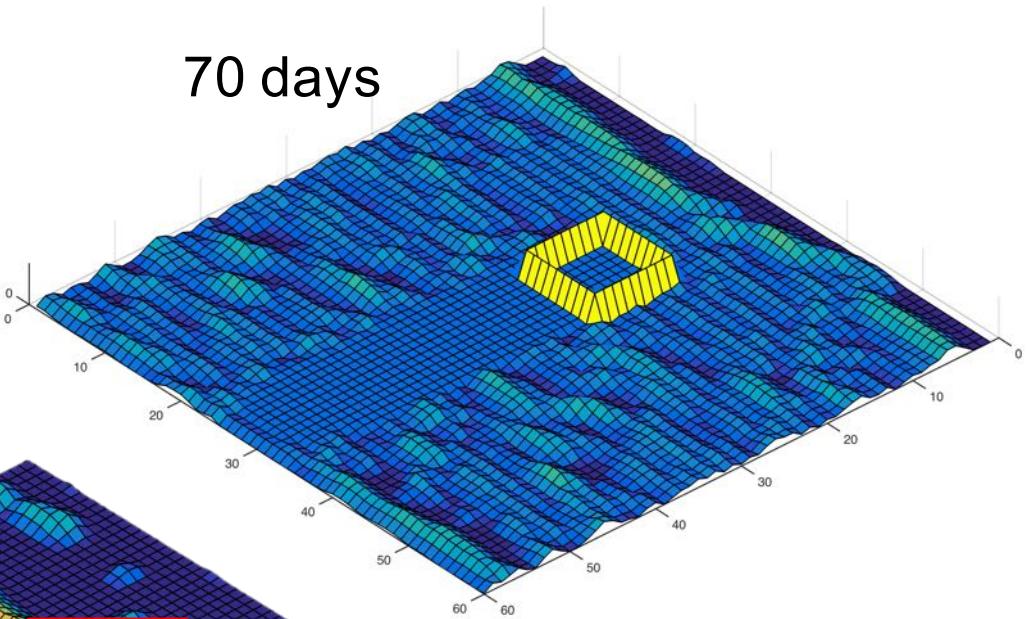
Desert walls

Wind

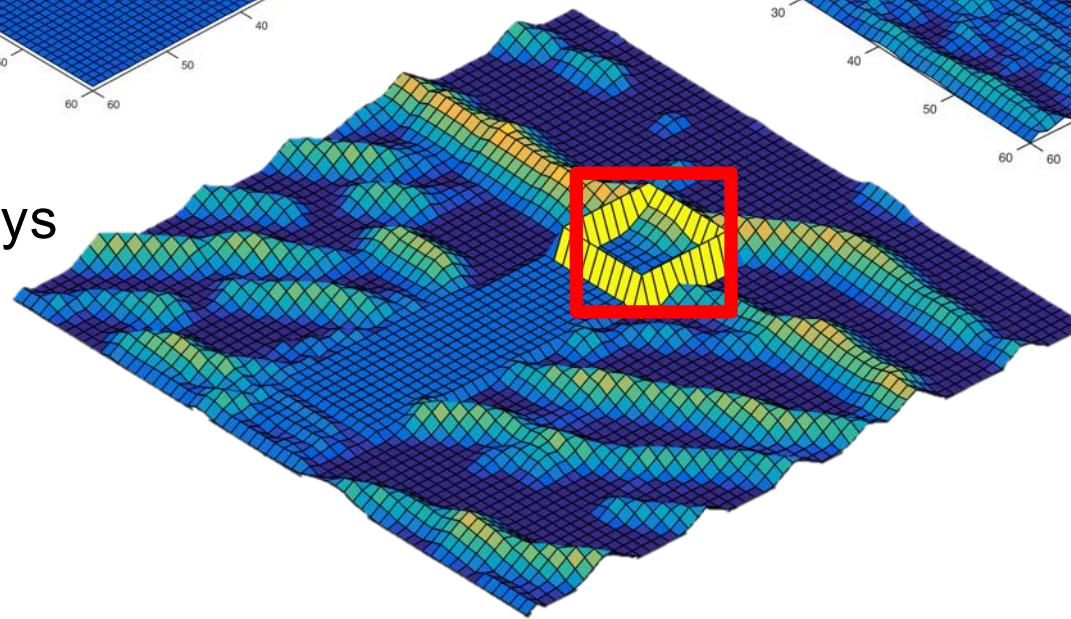
10 days



70 days

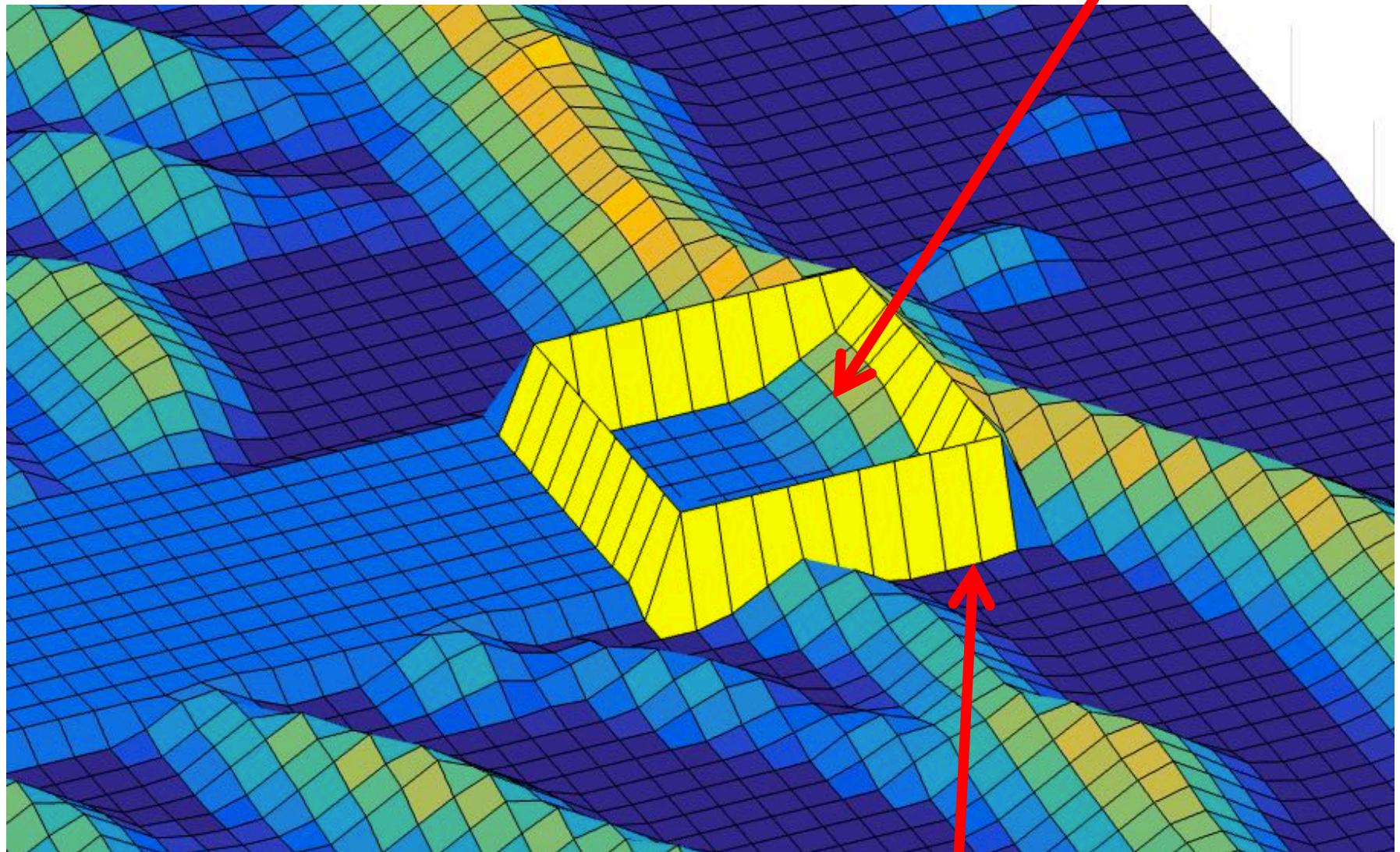


250 days



Desert walls

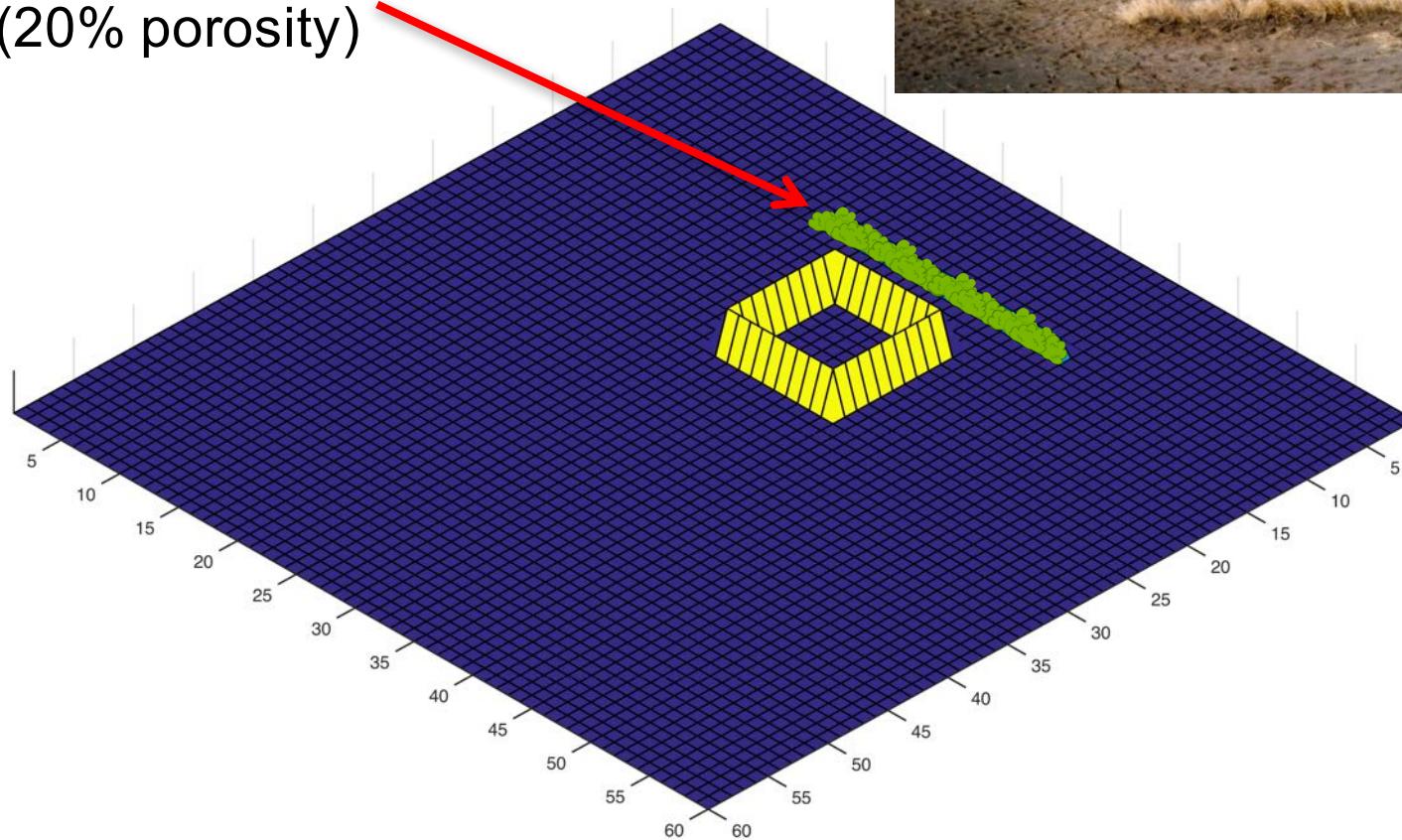
Dune 'overspill'



Scour at foundations

Desert walls

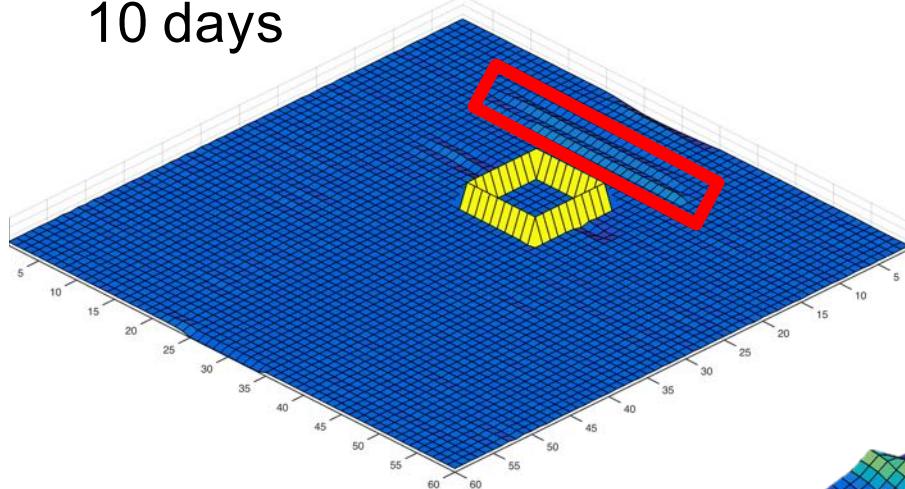
1 m-high shelter belt
(20% porosity)



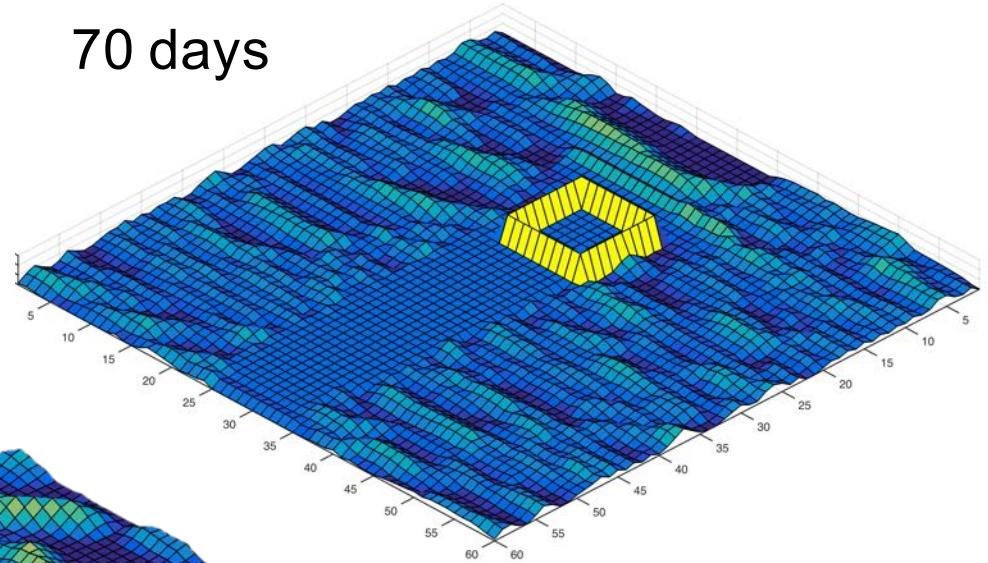
Desert walls

Wind

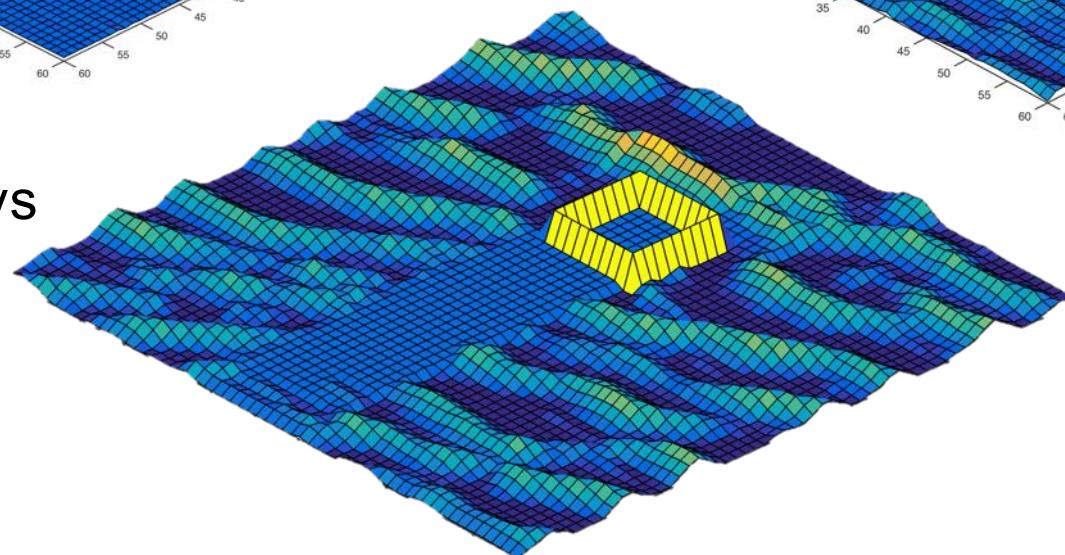
10 days



70 days

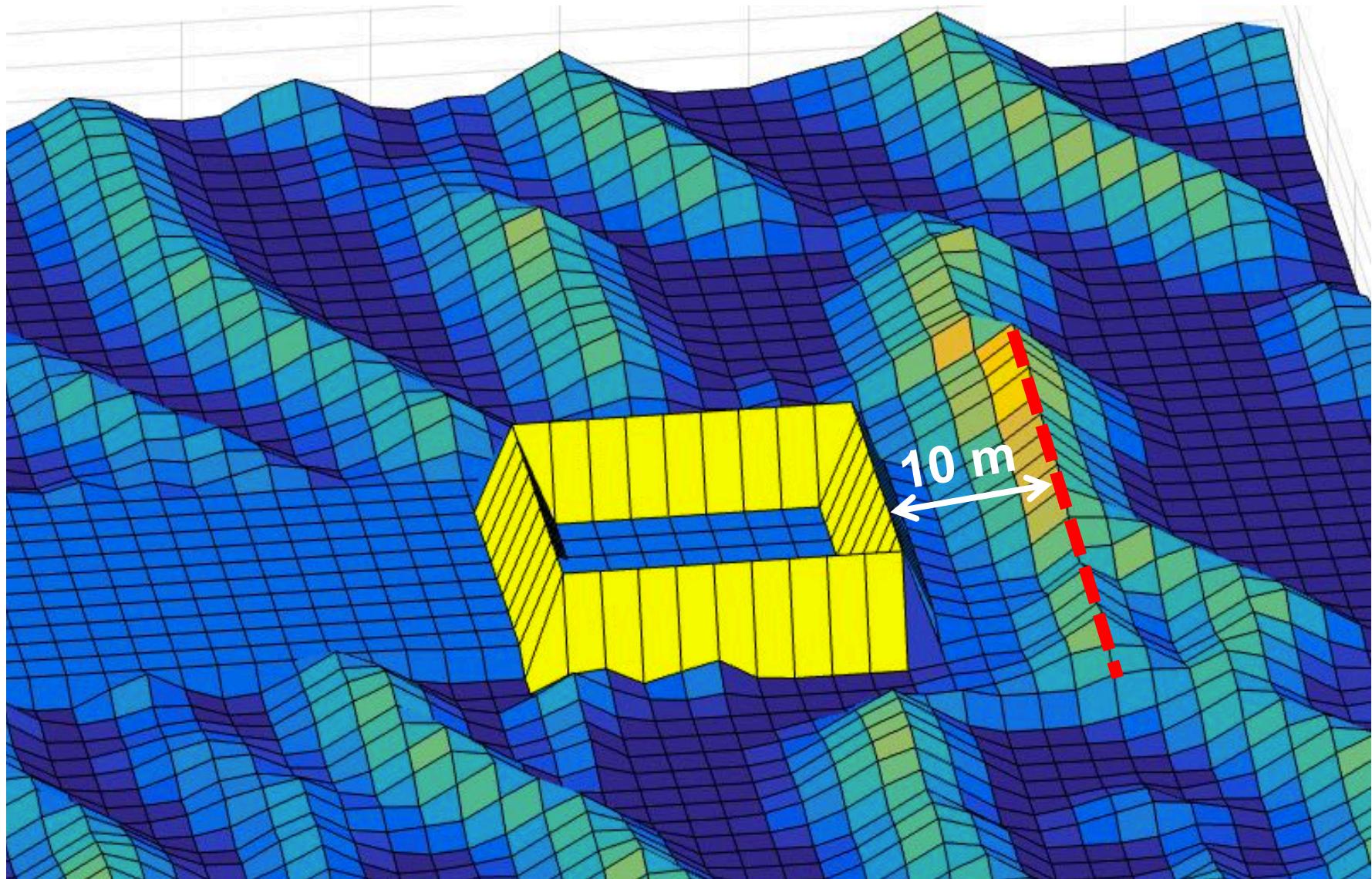


250 days

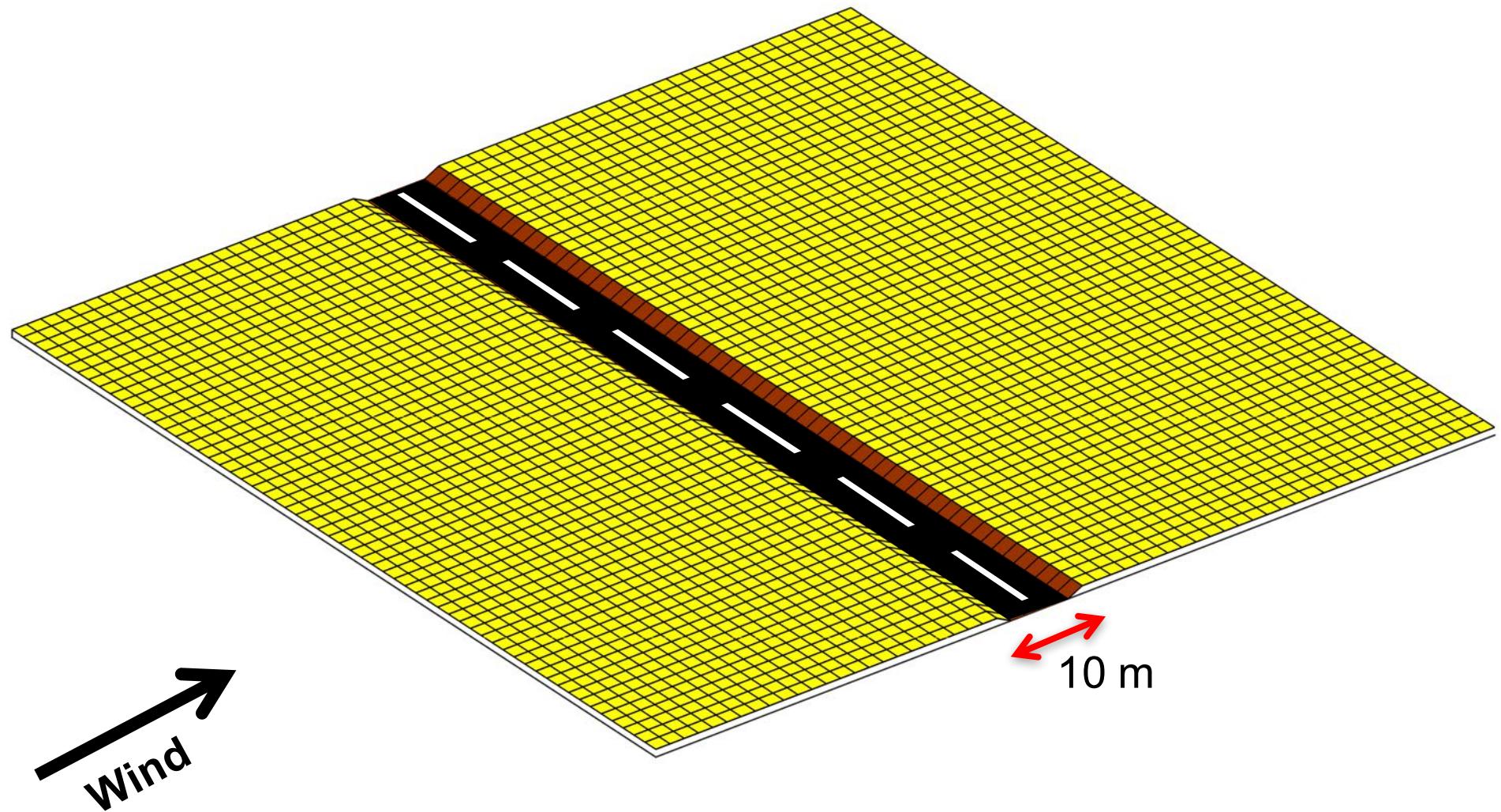


Desert walls

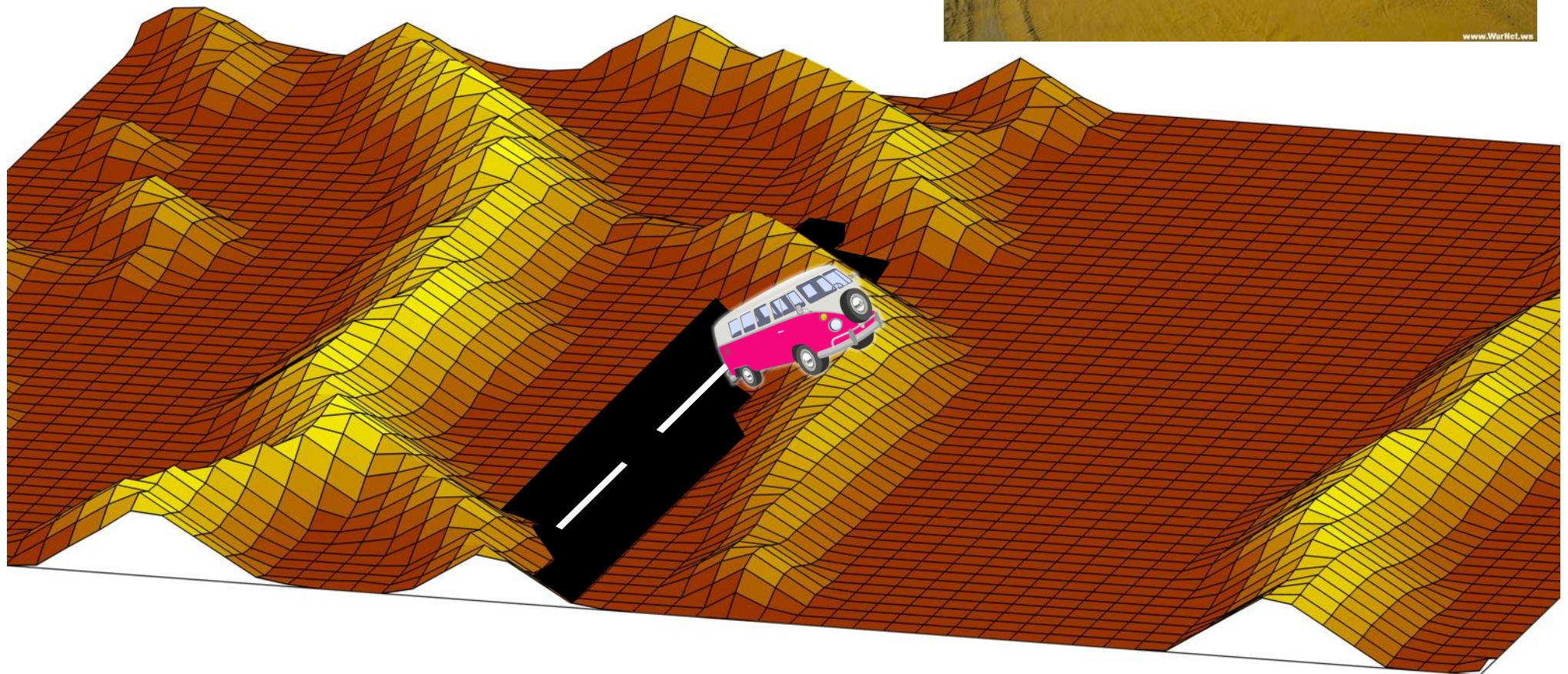
Shelter belt halts dune
encroachment



Desert roads



Desert roads



250 days later...

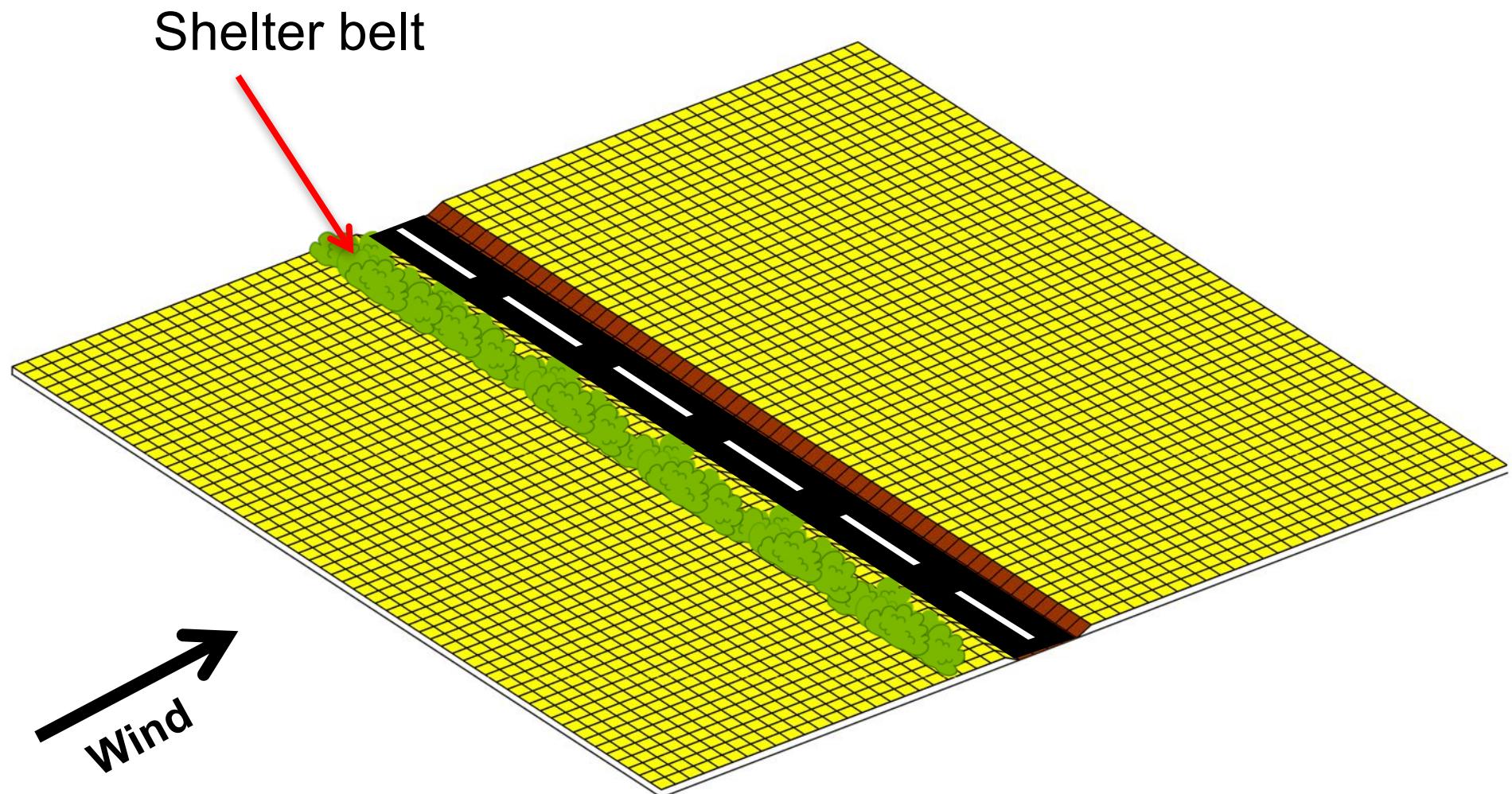
Desert roads

near Taldykorgan (Kazakhstan)

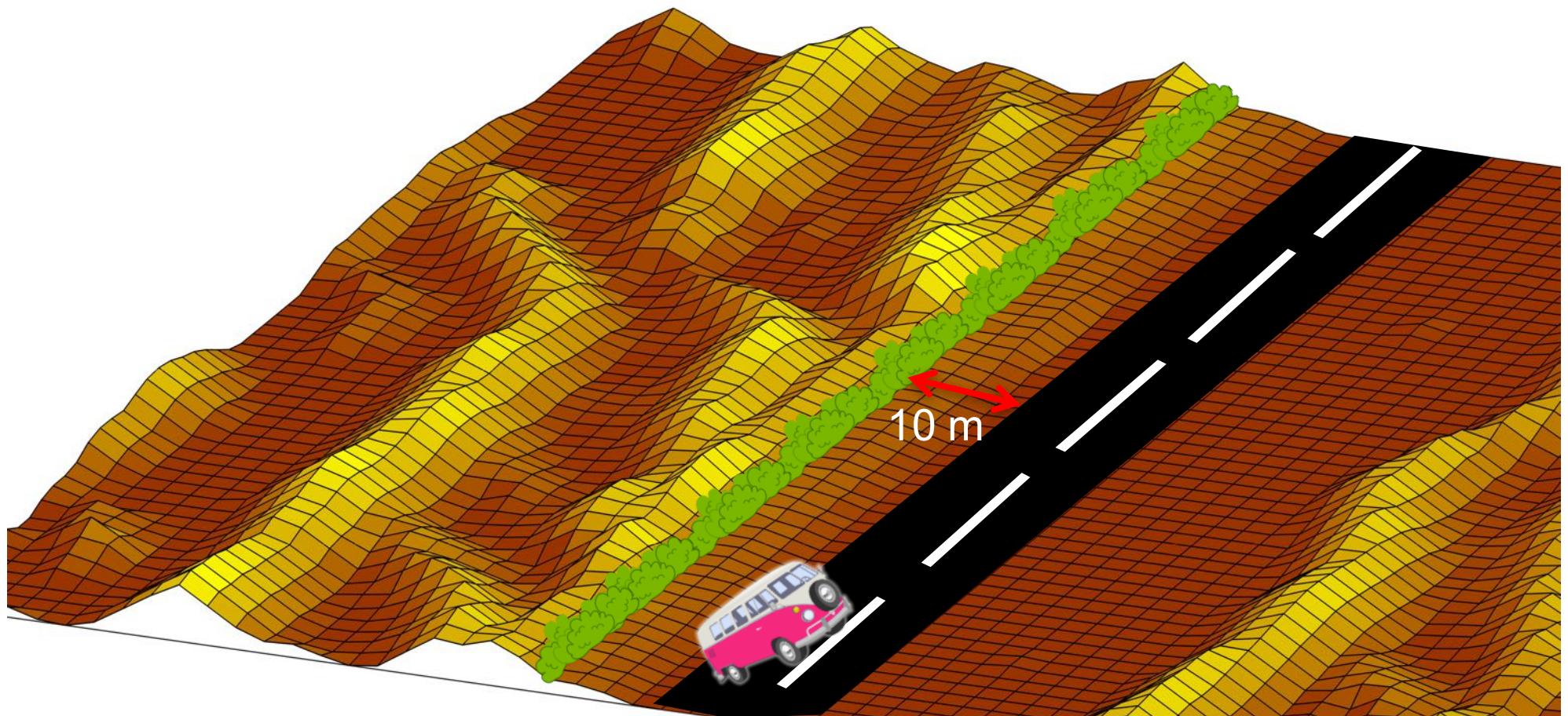


Google Earth, 2017

Desert roads

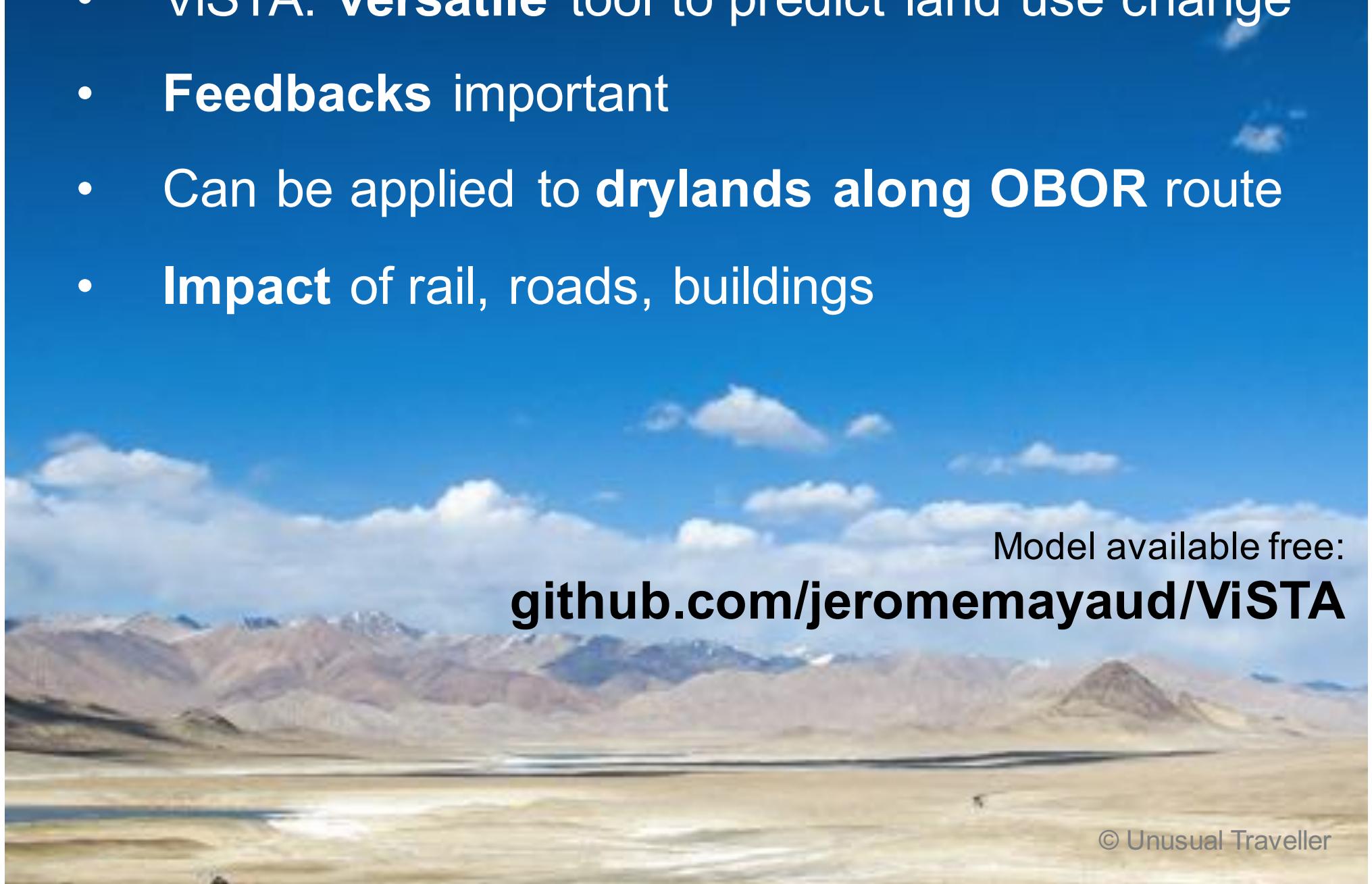


Desert roads



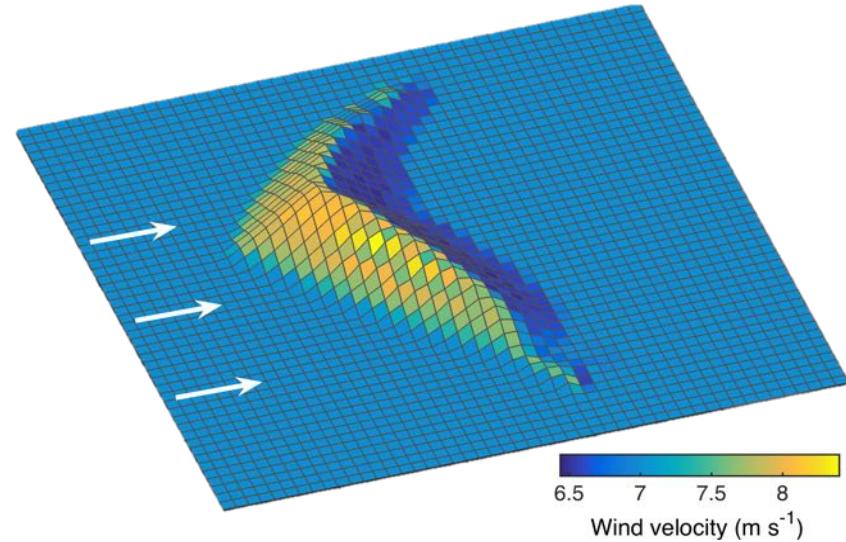
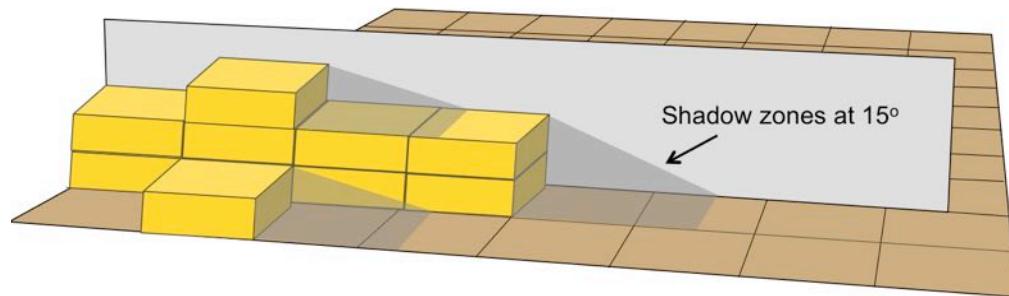
250 days later...

- ViSTA: **versatile** tool to predict land use change
- **Feedbacks** important
- Can be applied to **drylands along** OBOR route
- **Impact** of rail, roads, buildings



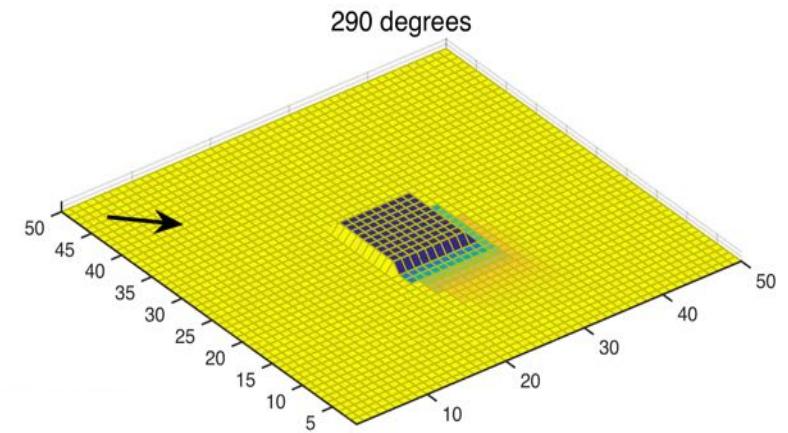
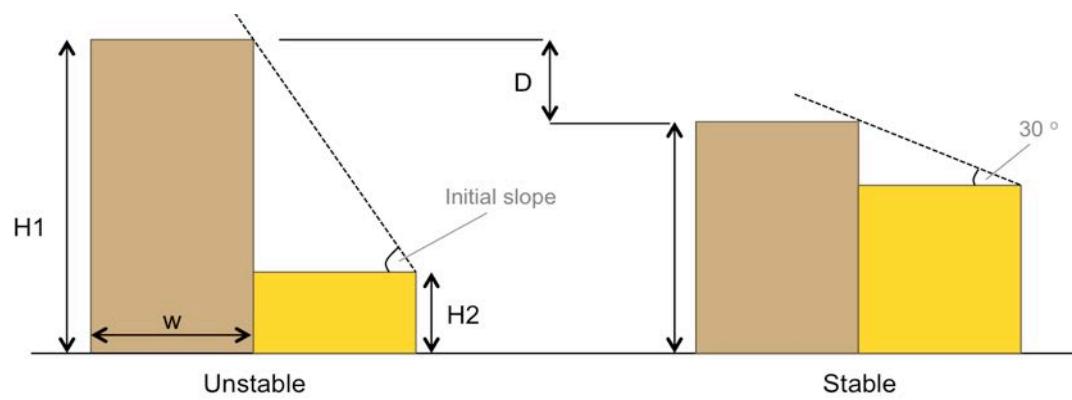
Model available free:
github.com/jeromemayaud/ViSTA

Shadow zones



Airflow compression

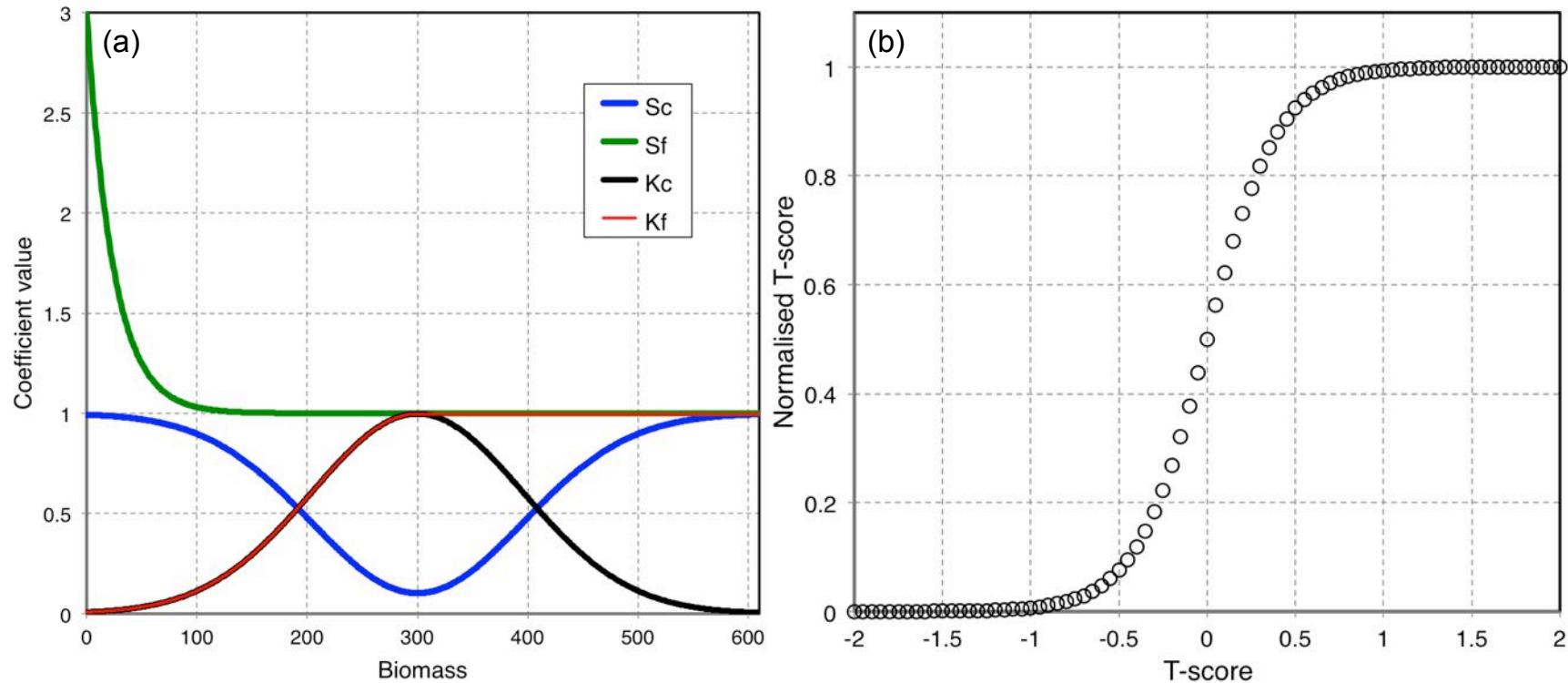
Avalanching



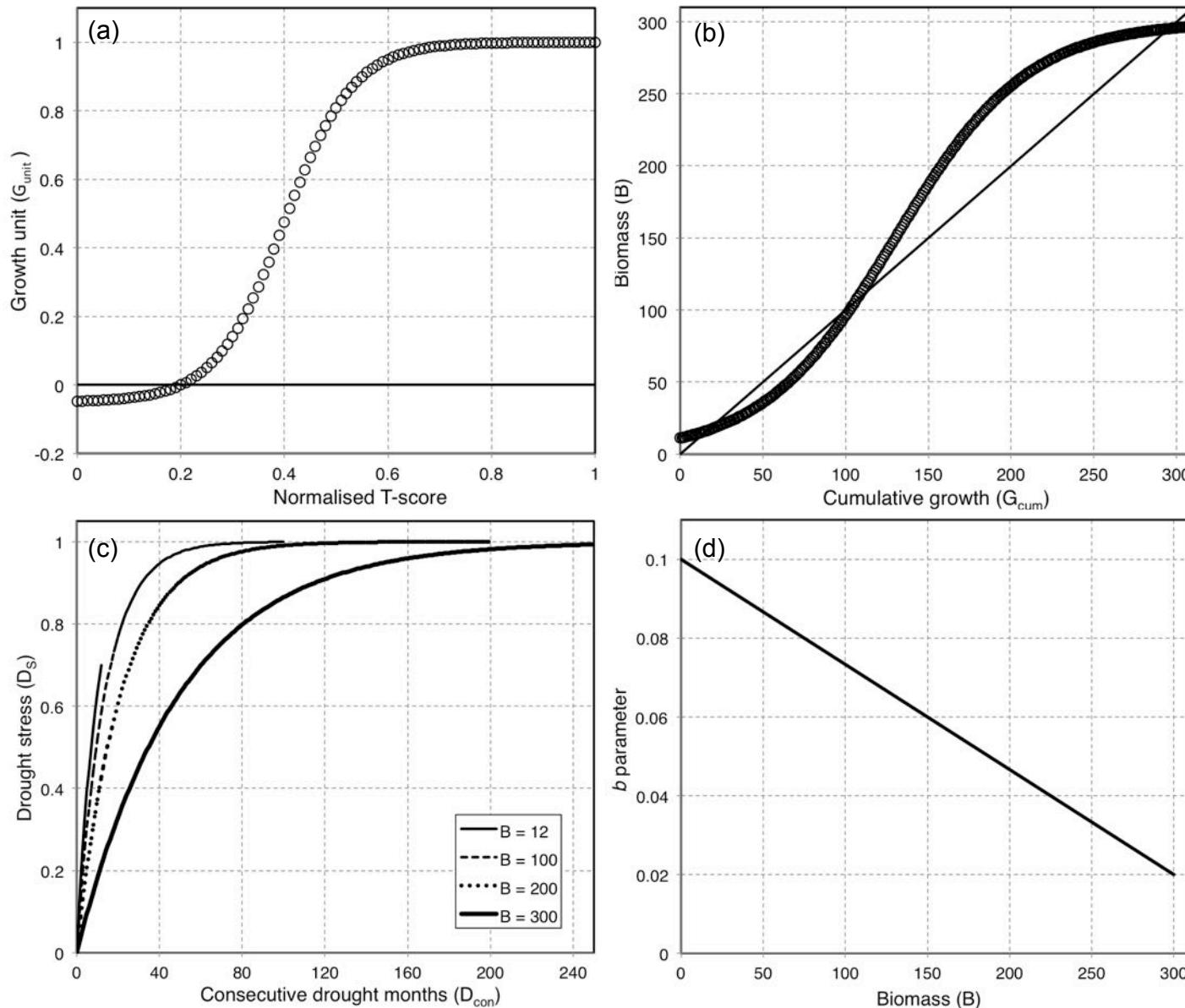
All wind directions

Neighbourhood interactions

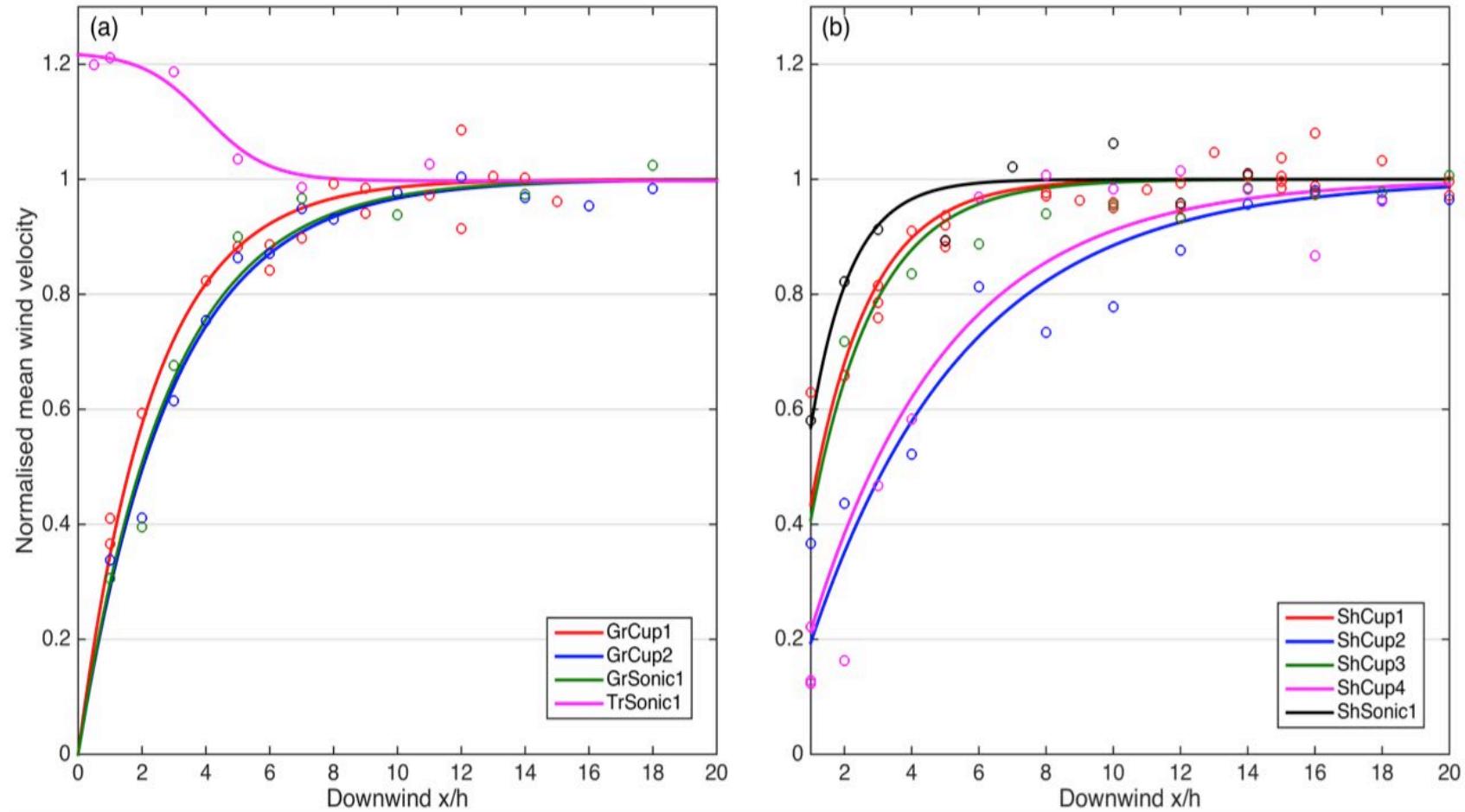
$$T = \sum_{i=1}^2 \left(\sum_{j=1}^{i \times 8} (a_{i,j} c_i k_{f(i,j)}) \right) s_f + \sum_{i=3}^5 \left(\sum_{j=1}^{i \times 8} (a_{i,j} c_i k_{c(i,j)}) \right) s_c + \rho_s$$

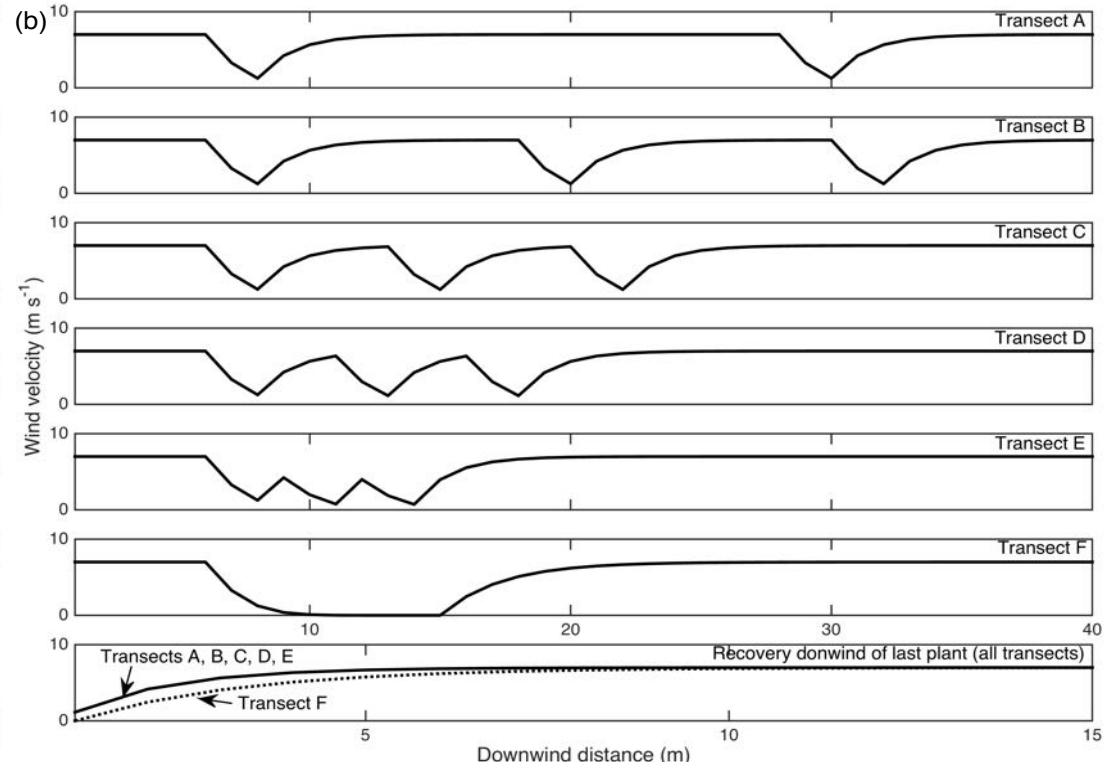
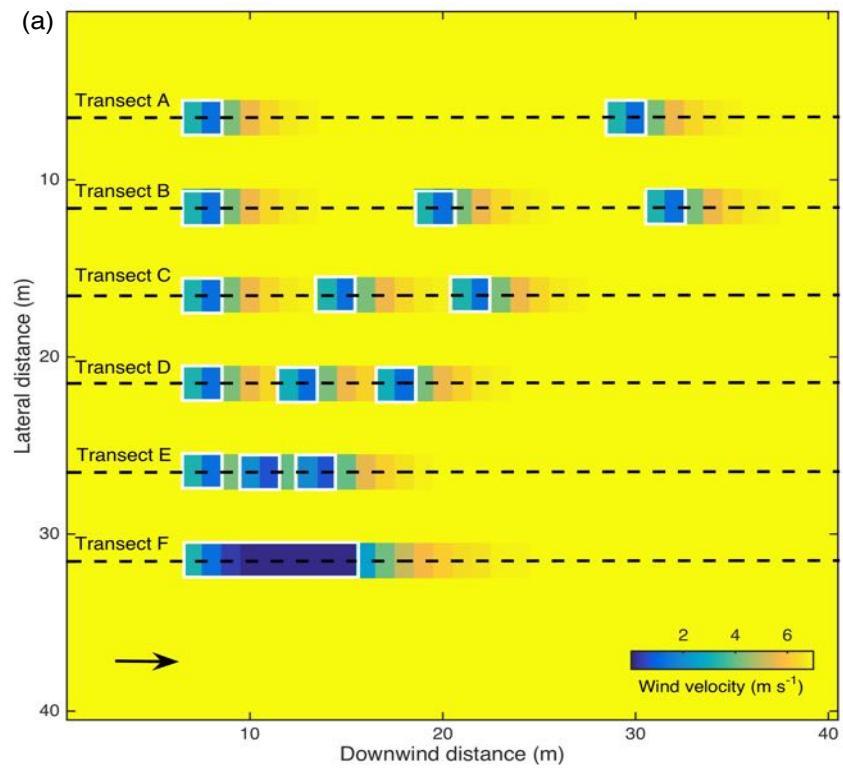


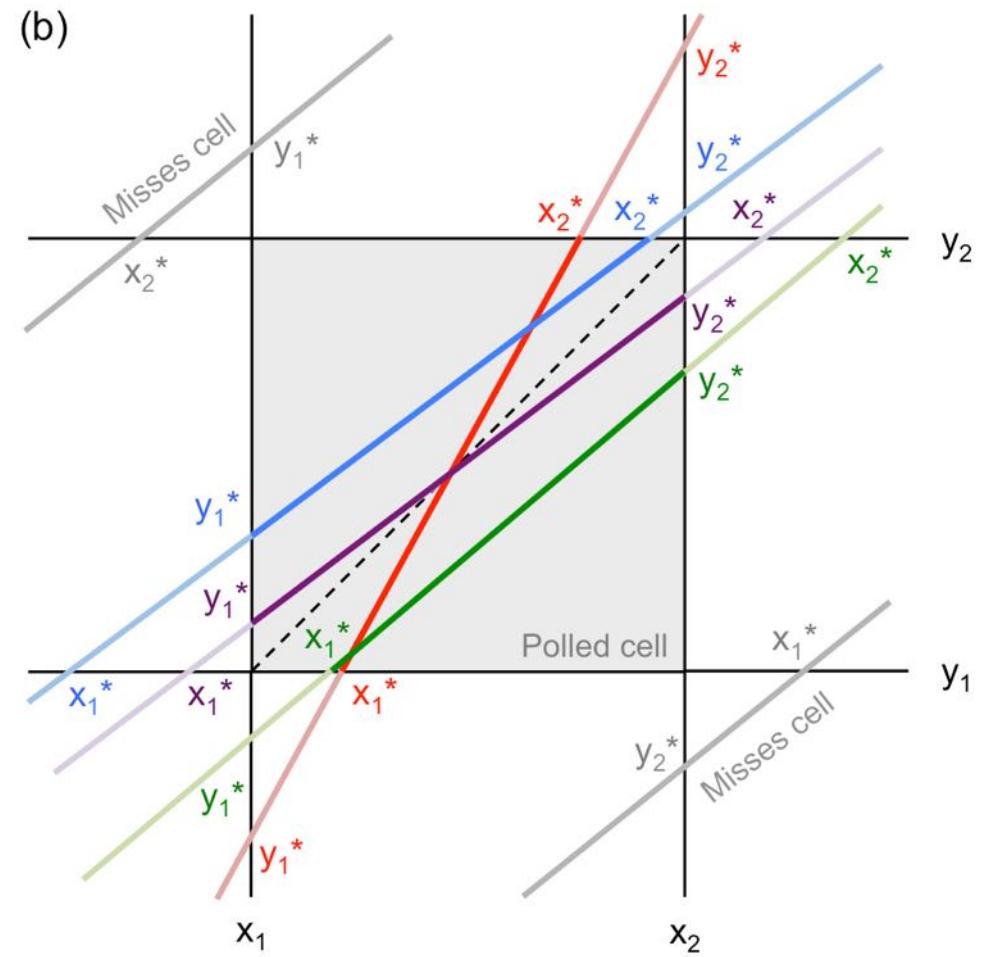
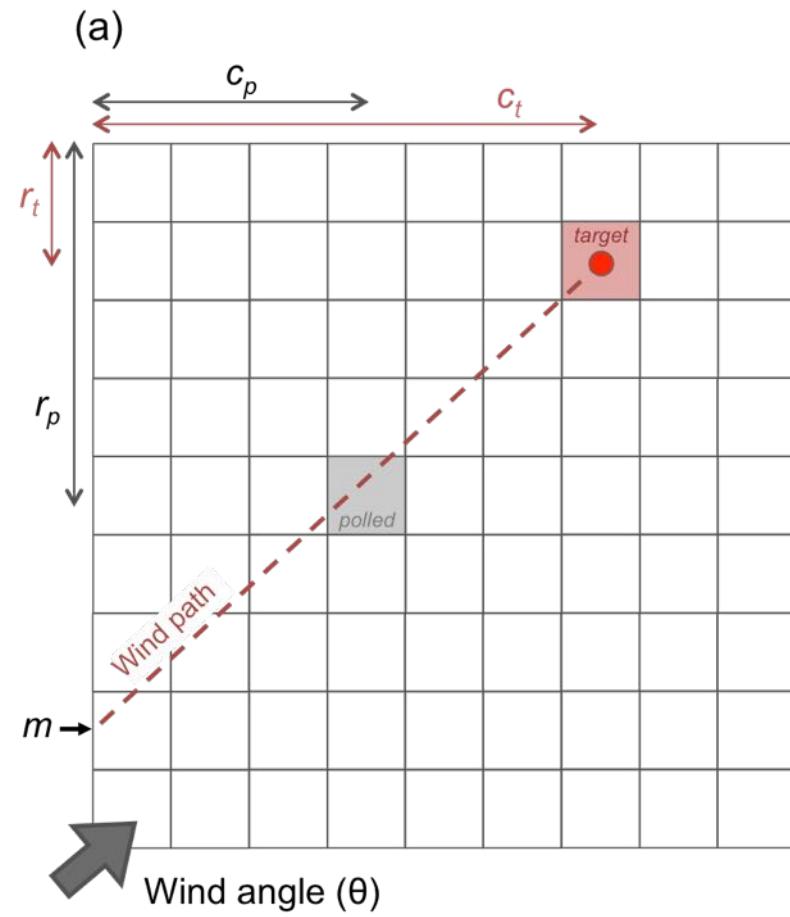
Plant growth

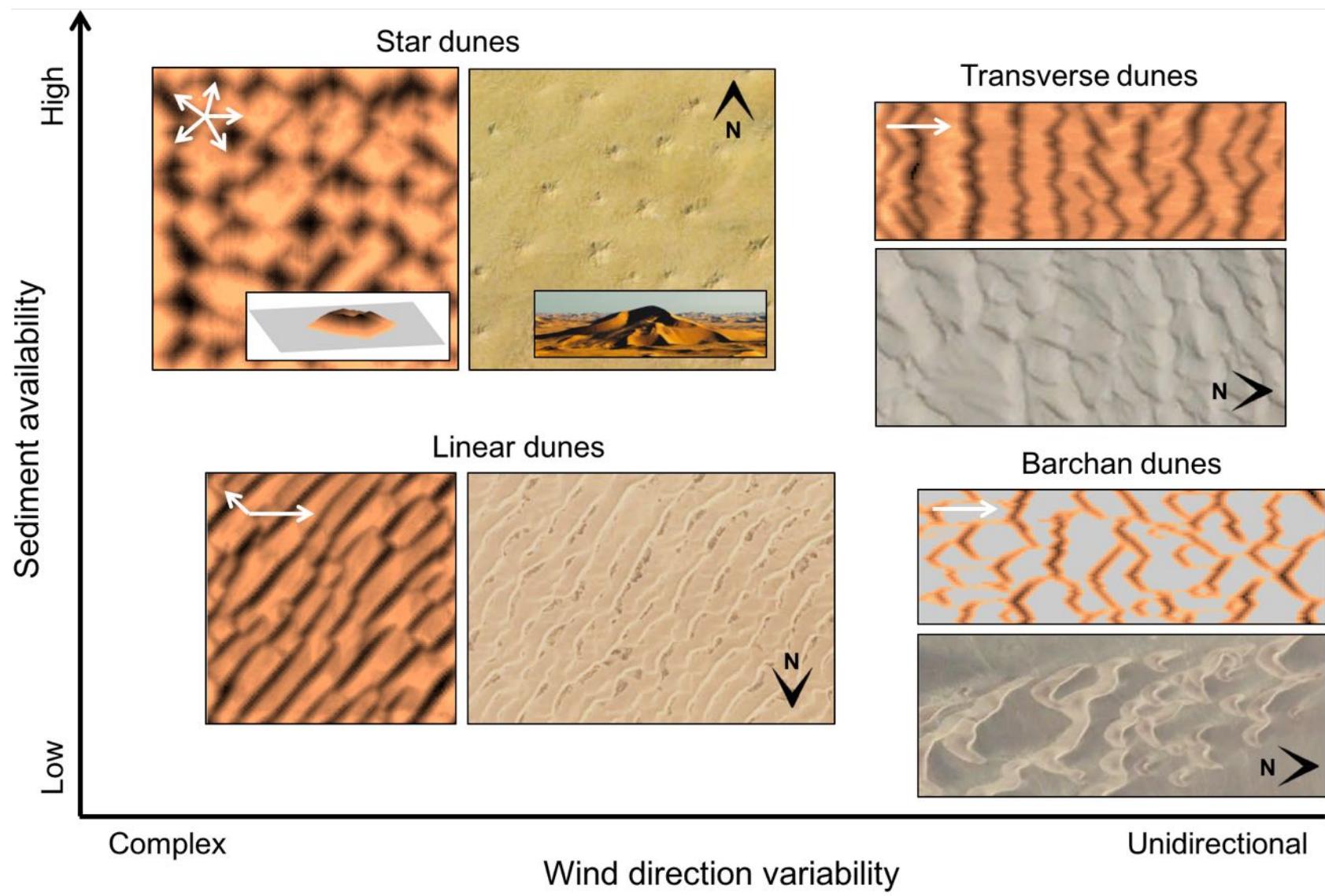


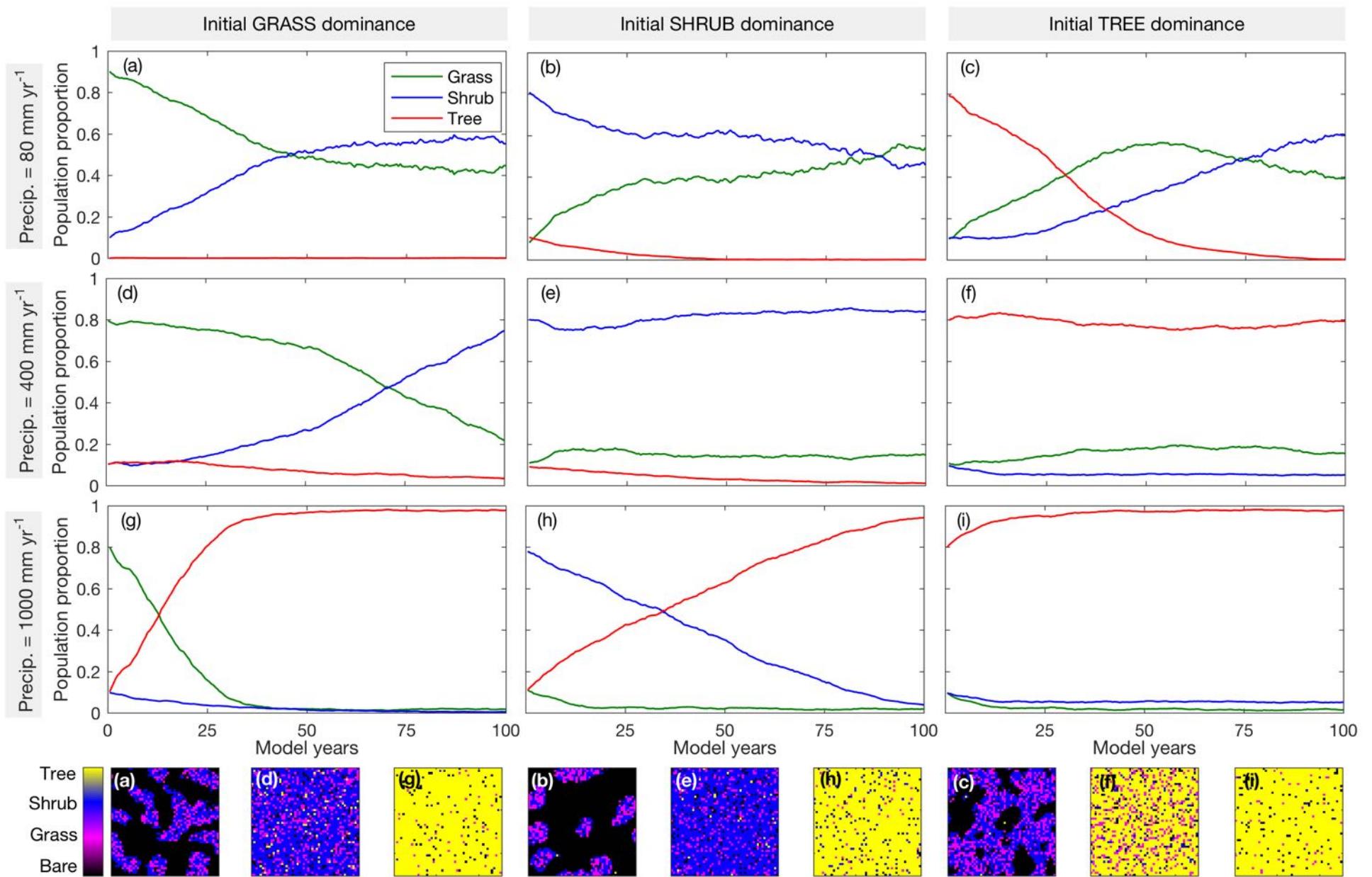
Wind recovery



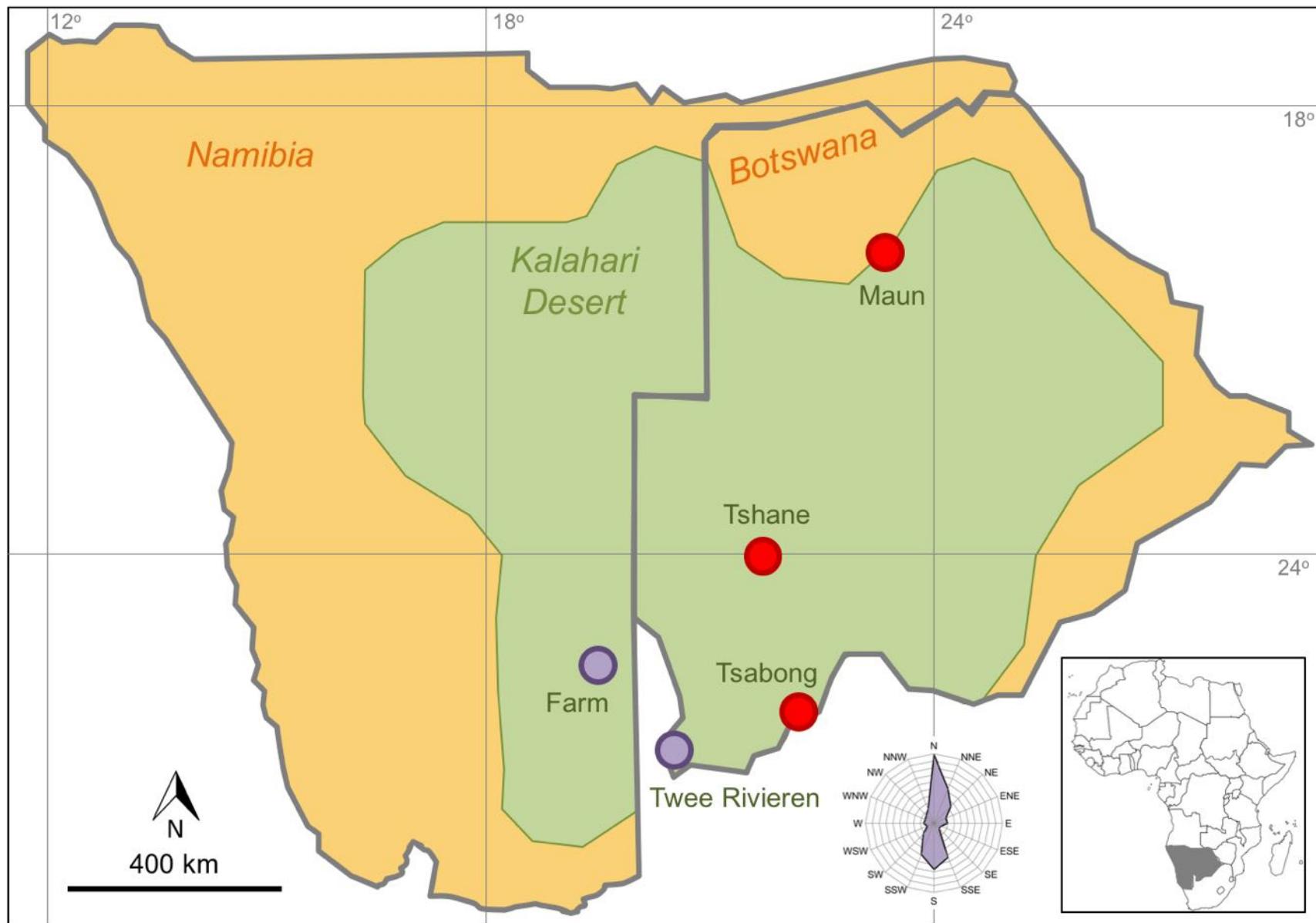




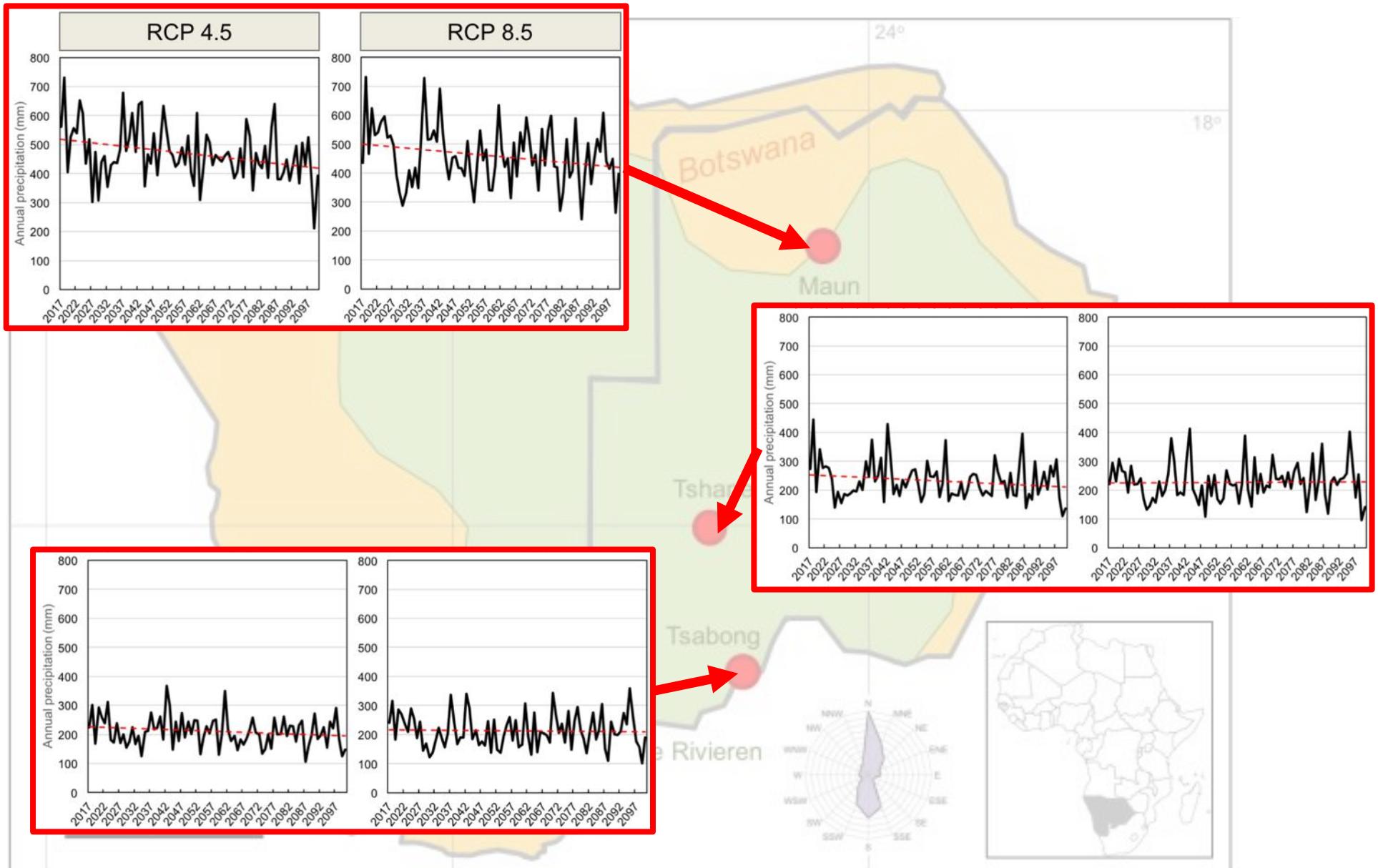




Climate and land use change



Climate change



Climate change

