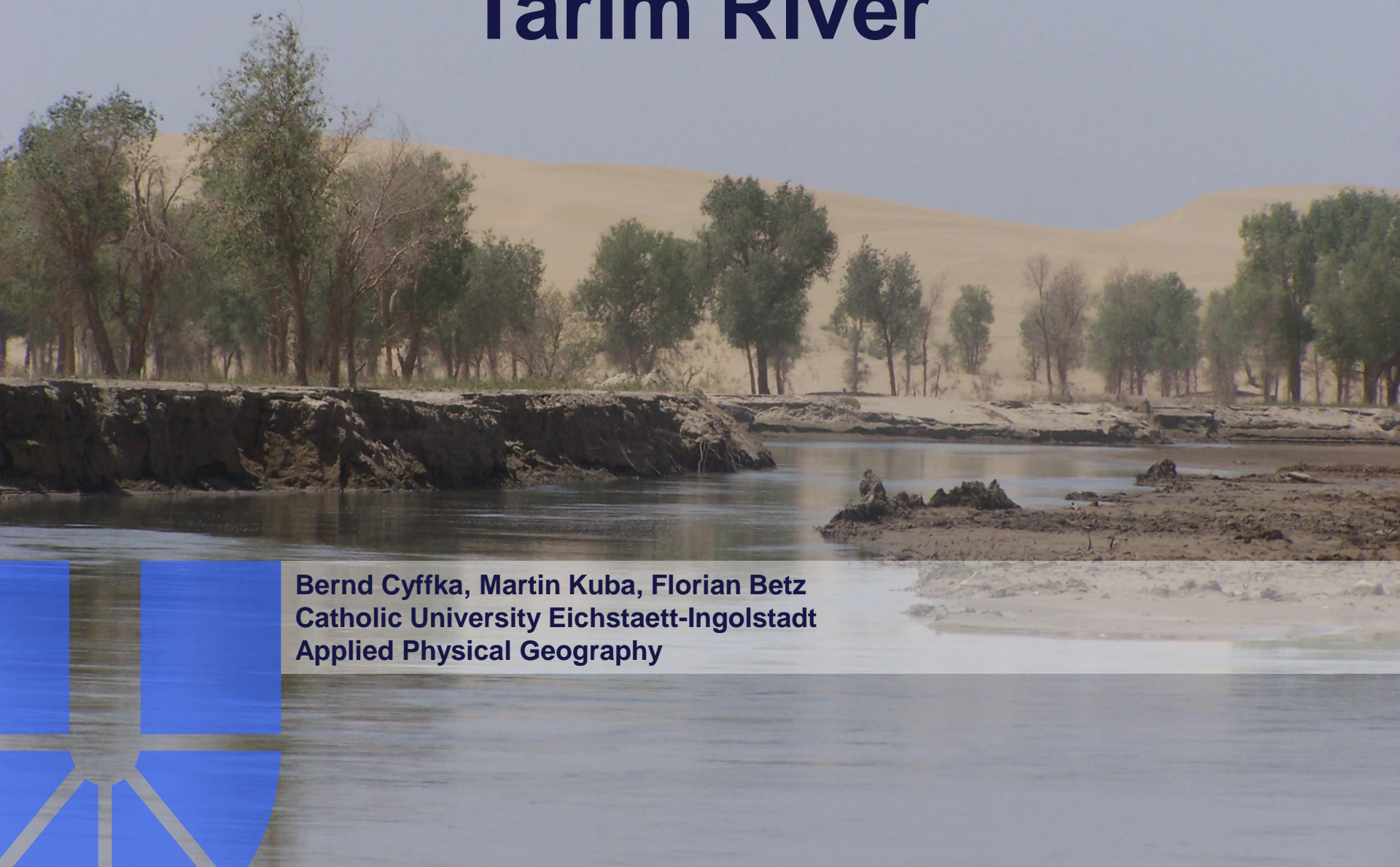
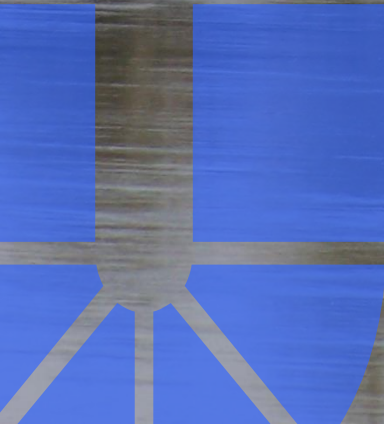


# Dust Retention at the Lower Tarim River



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**Catholic University Eichstaett-Ingolstadt**  
**Applied Physical Geography**



# What's it about?

**Tugai  
Forests at  
the Tarim  
River**

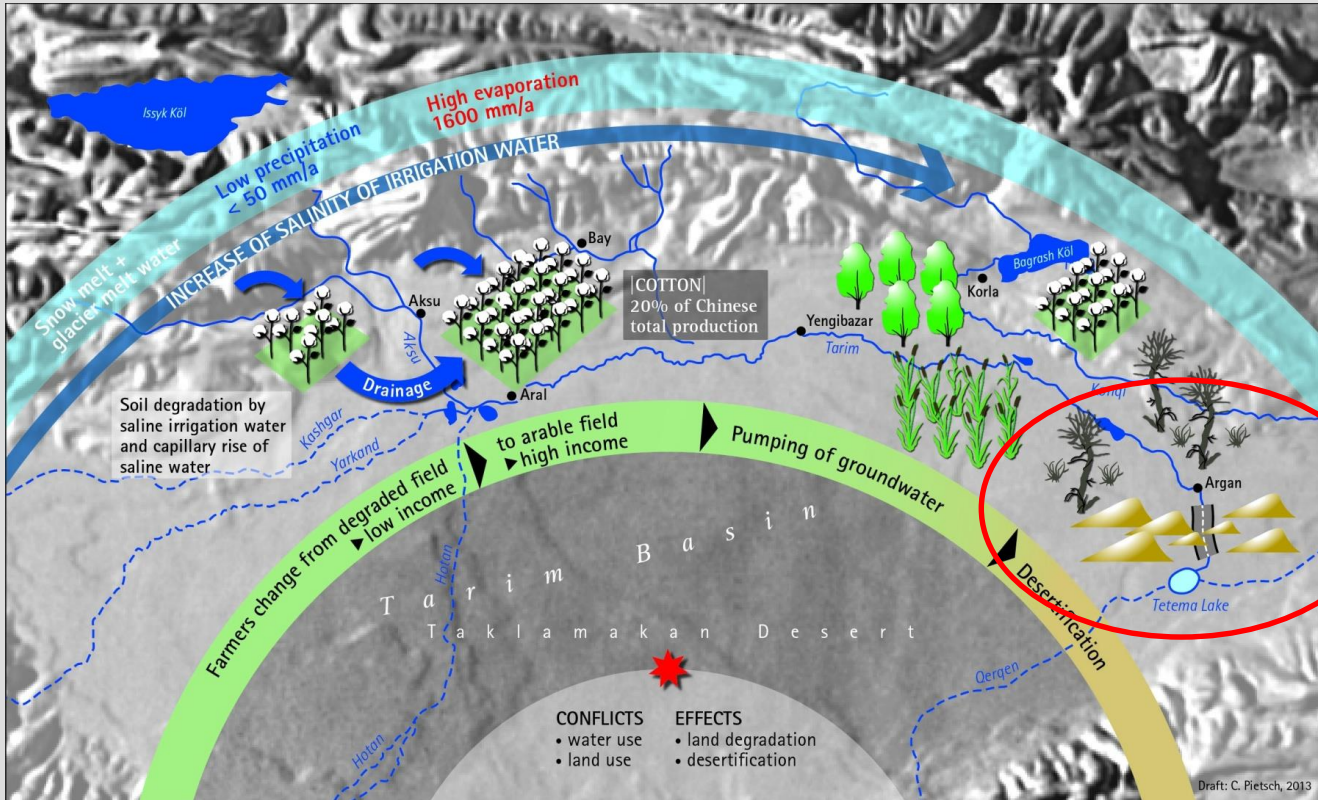
**Sand Storm  
Mitigation**

**Physical Based  
Modelling of  
Sediment fixation**

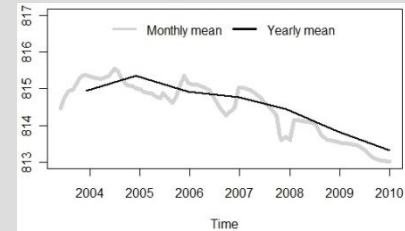
**Ecosystem  
Services**



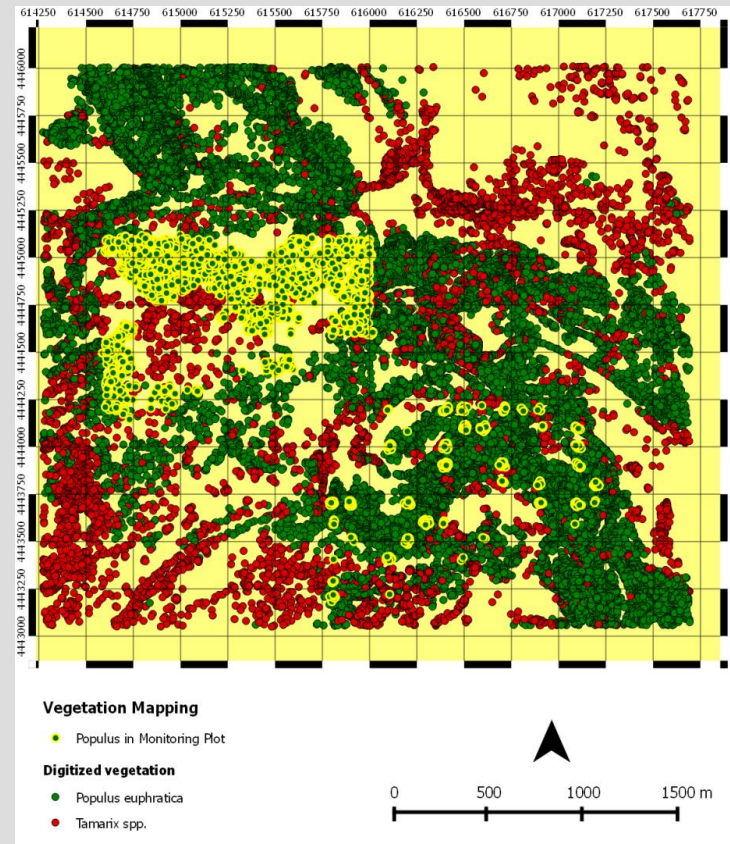
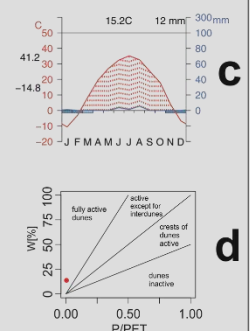
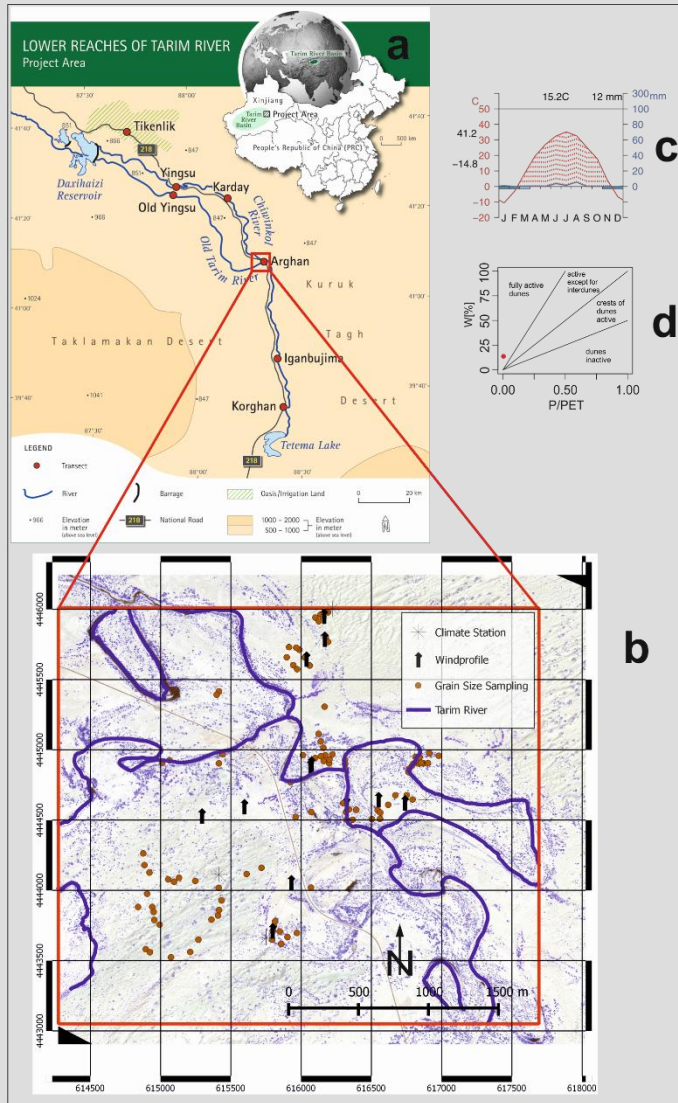
# Introduction



Source: Cyffka et al. 2013



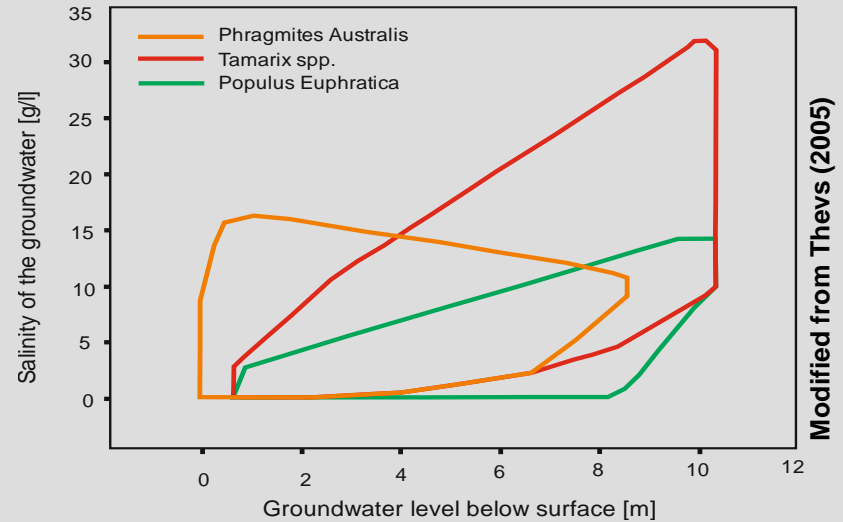
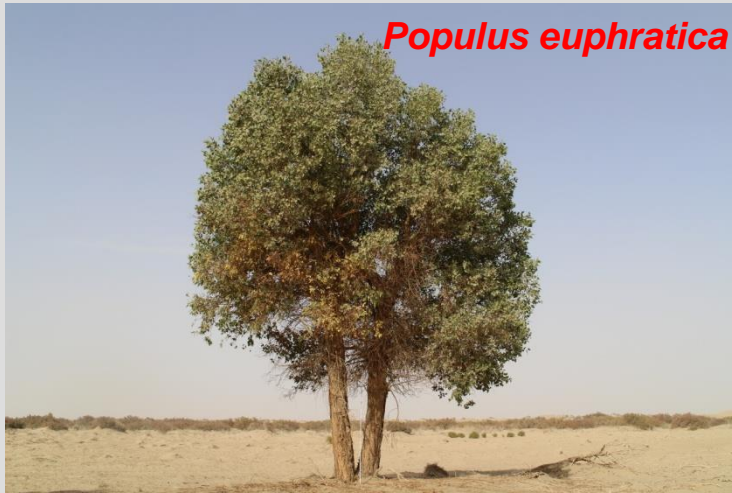
# Some Details about the Study Area



**Study Area is a ~10 km<sup>2</sup> plot around the Arghan village.**



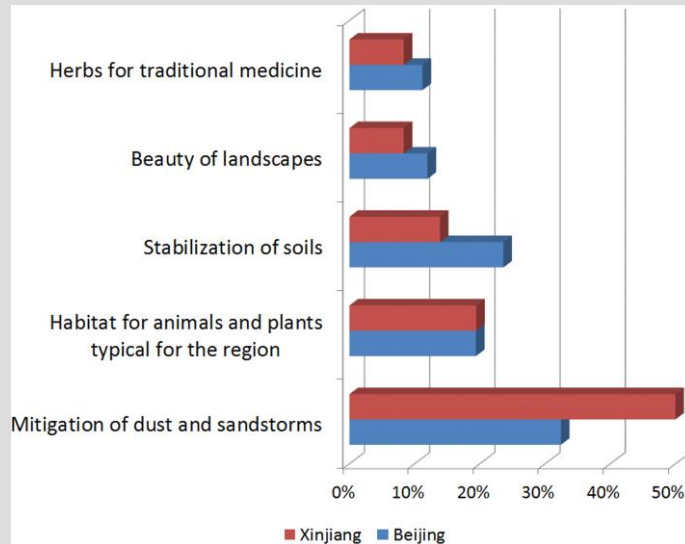
# Some Details about the Study Area



# Sediment Fixation as Ecosystem Service

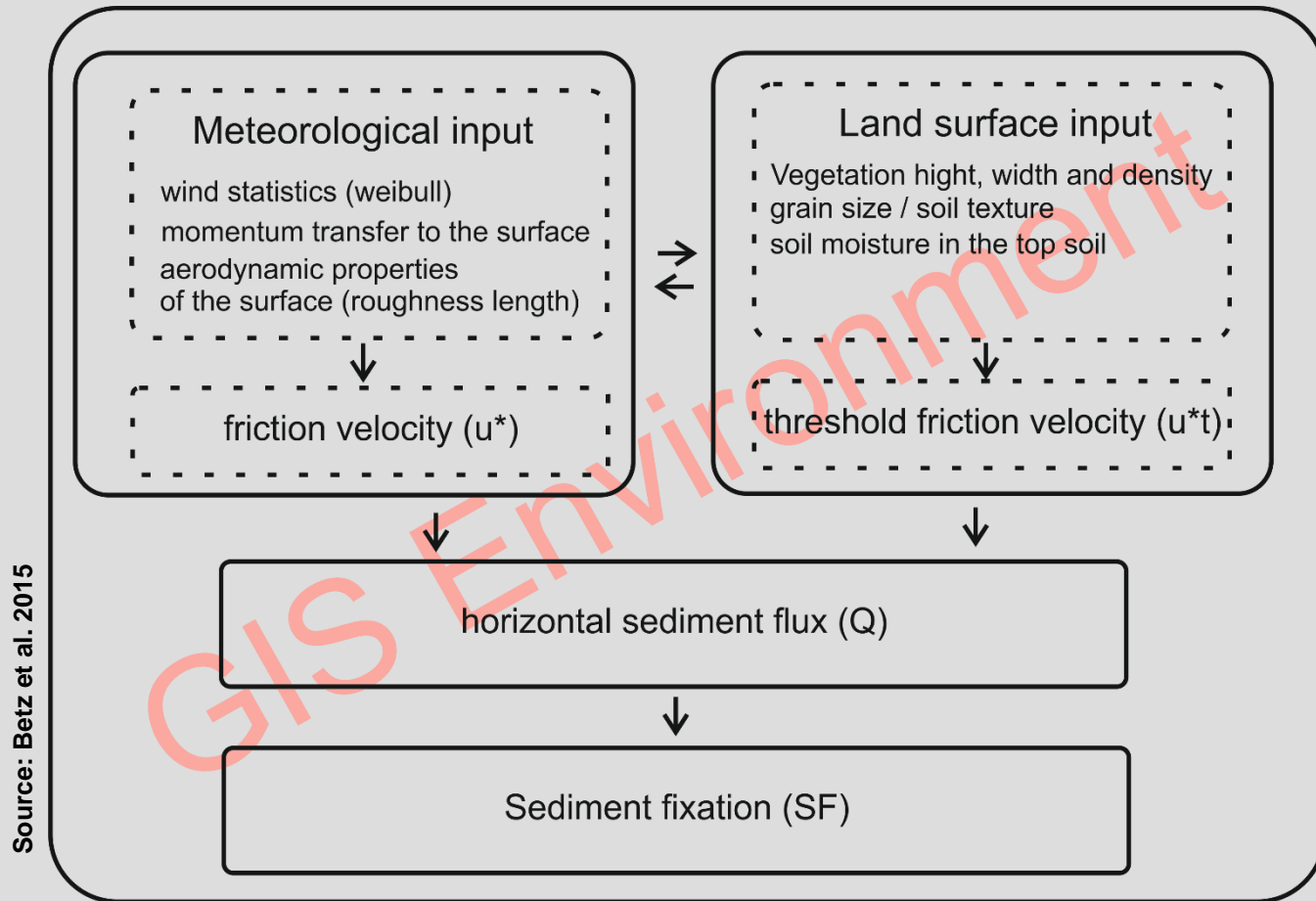


Source: Rumbaer et al. 2015



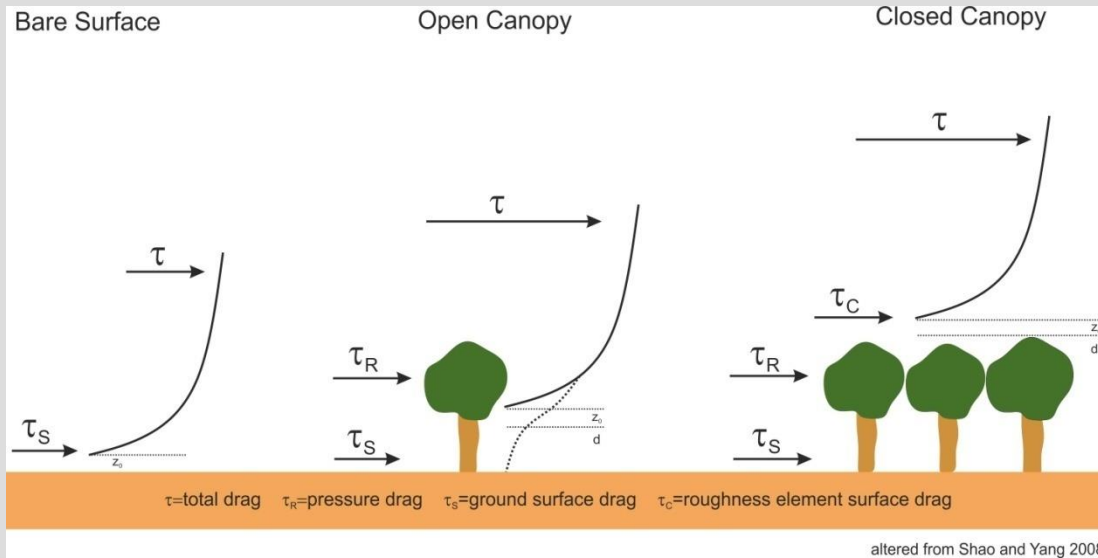
***Reducing sand and dust storms via the fixation of natural vegetation is regarded as main ecosystem service of the Tugai vegetation along the lower reaches of the Tarim River.***

# Modelling Sediment Fixation



***For getting a spatially explicit estimate of the sediment fixation, a physical based GIS model was established following the idea of the integrated Wind Erosion Modelling System (Shao 2008)***

# Modelling Sediment Fixation



Source: Betz et al. 2015

$$\lambda = \frac{nbh}{S} = \frac{nFA}{S} \quad \eta = \frac{nbl}{S} = \frac{n(Diam/2)^2\pi}{S}$$

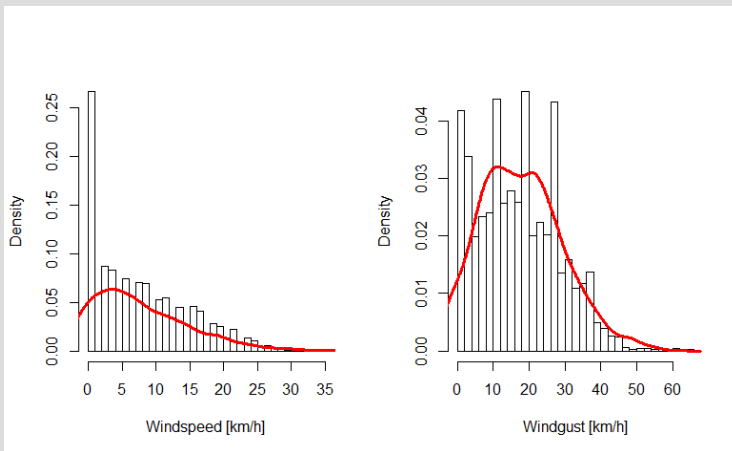
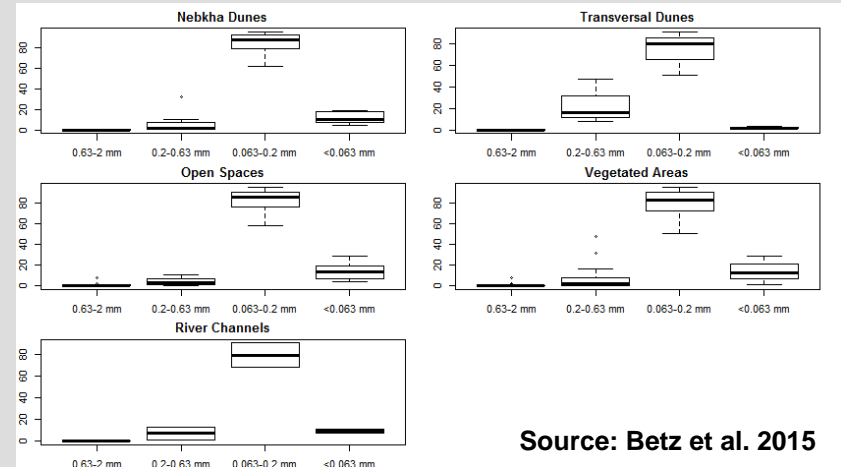
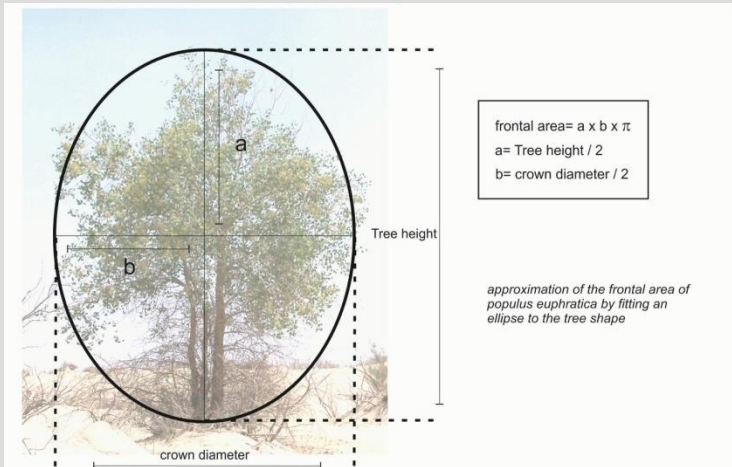
$$\frac{\tau_S}{\tau} = \left(1 - \frac{\beta\lambda e}{1 + \beta\lambda e}\right) \exp(-bs\eta)$$

**Vegetation reduces the aerodynamic forces acting onto the soil surface. This reduces the amount of sediment mobilized by the wind.**

**The distribution of the aerodynamic forces can be calculated based on shear stress partitioning**

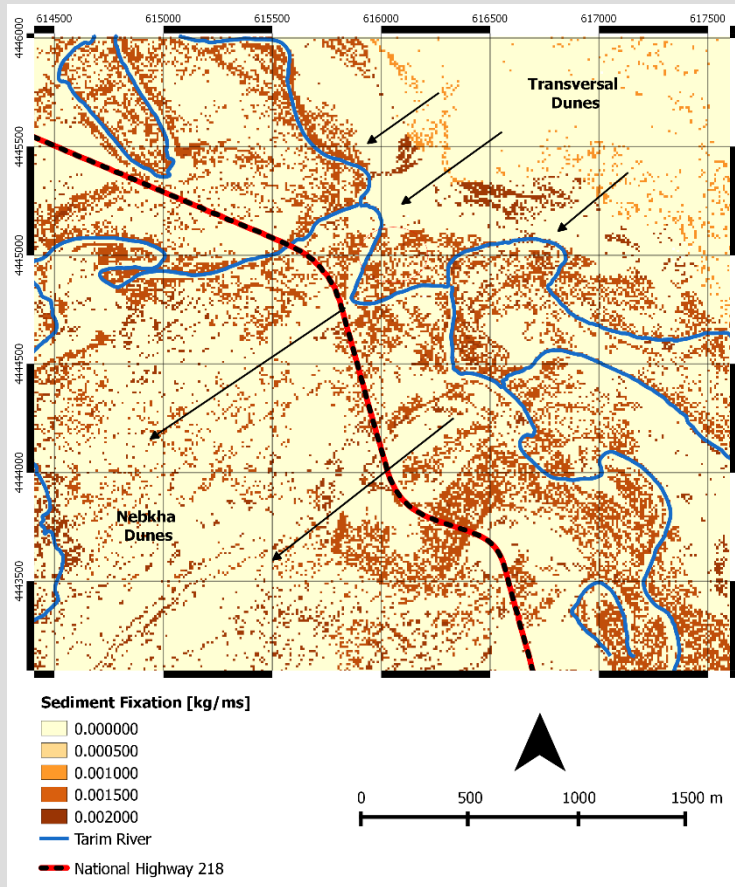


# Modelling Sediment Fixation

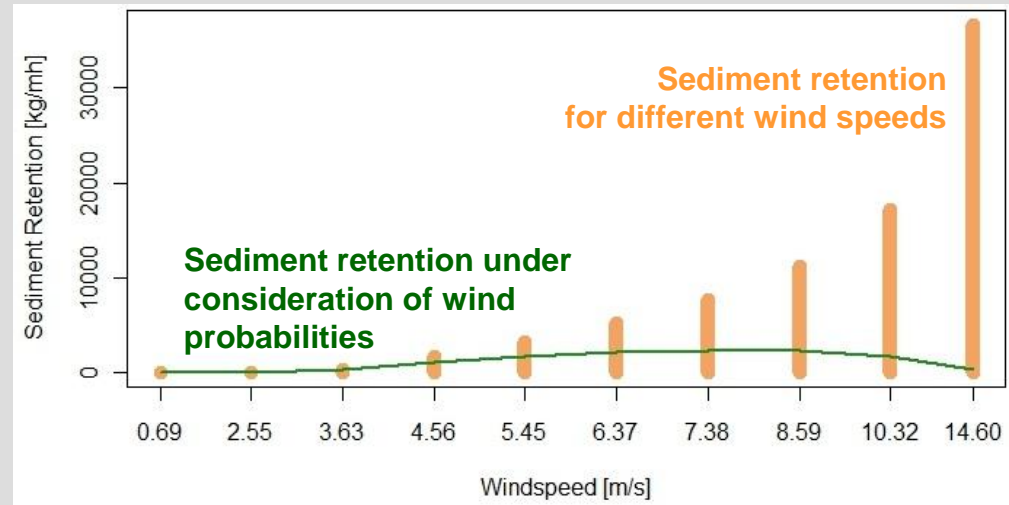


***The parameterization includes land surface parameters regarding vegetation and soil properties. Meteorology is parameterized via wind statistics and roughness length of the surface.***

# Modelling Sediment Fixation



Source: Betz et al. 2015

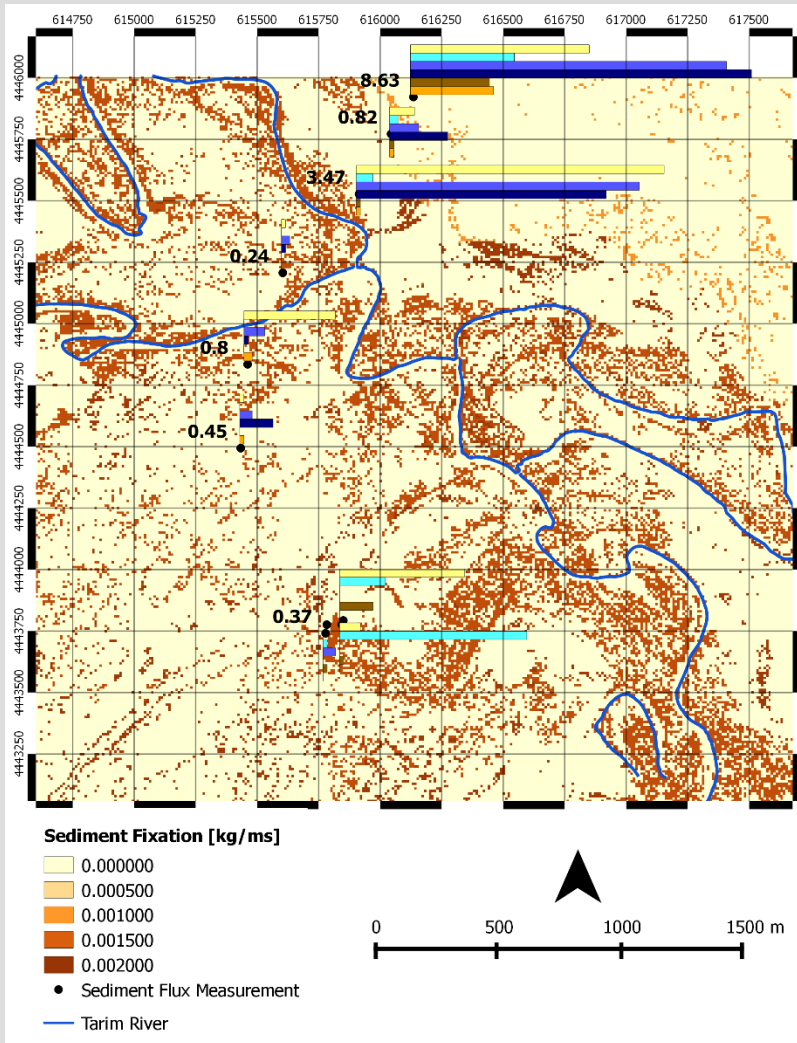


Modified from Betz et al. 2015

***The vegetation has a considerable effect on the Aeolian sediment mobilization. For a small investigation area the sediment fixation has already an amount of 11,656 kg/mh.***

$$SF = Q(bs) - Q(veg)$$

# Modelling Sediment Fixation

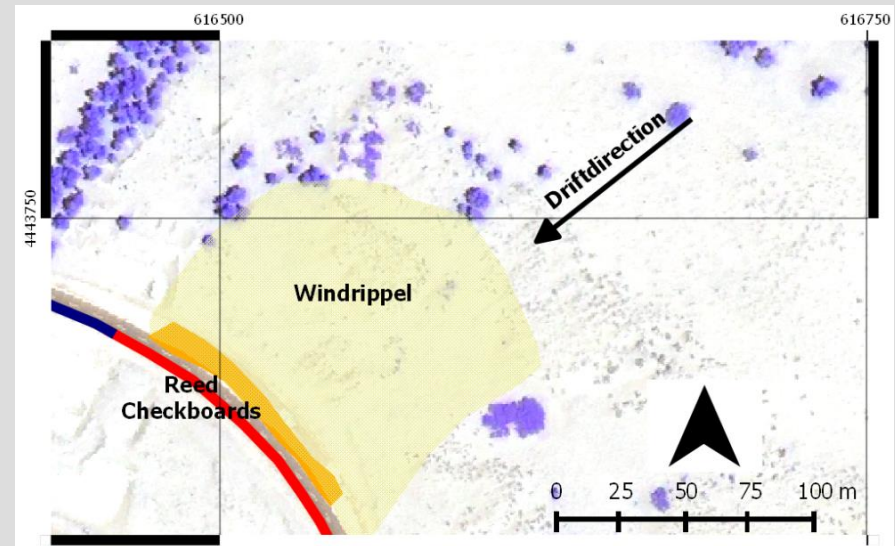
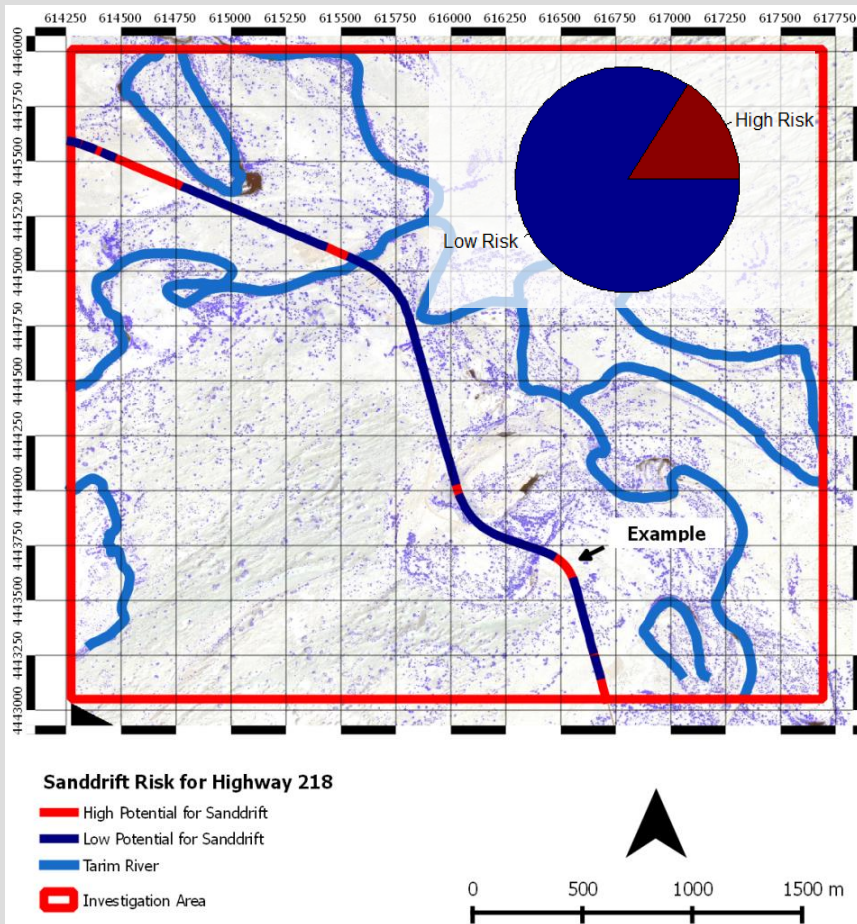


***Sediment fixation is directly measurable in the field for model validation. When comparing sediment flux measurements with modelled sediment fixation, there is a plausible pattern.***

Source: Betz et al. 2015

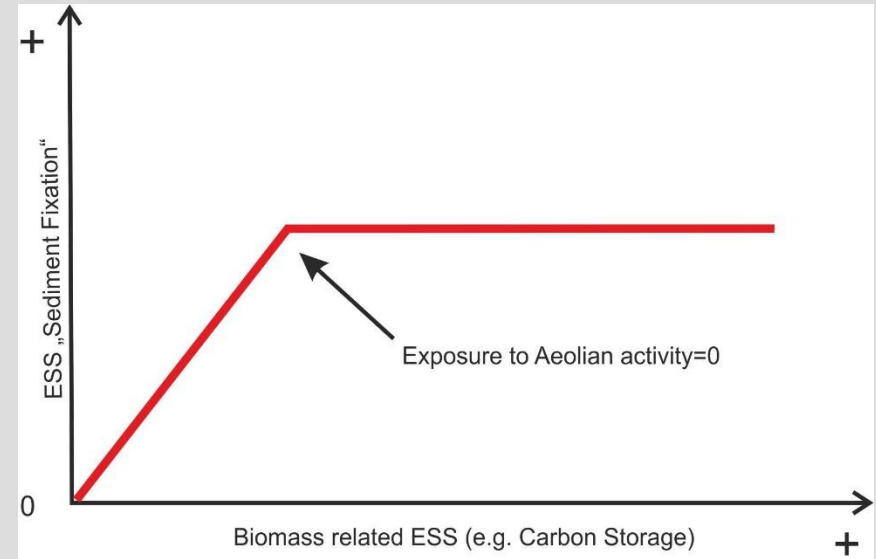
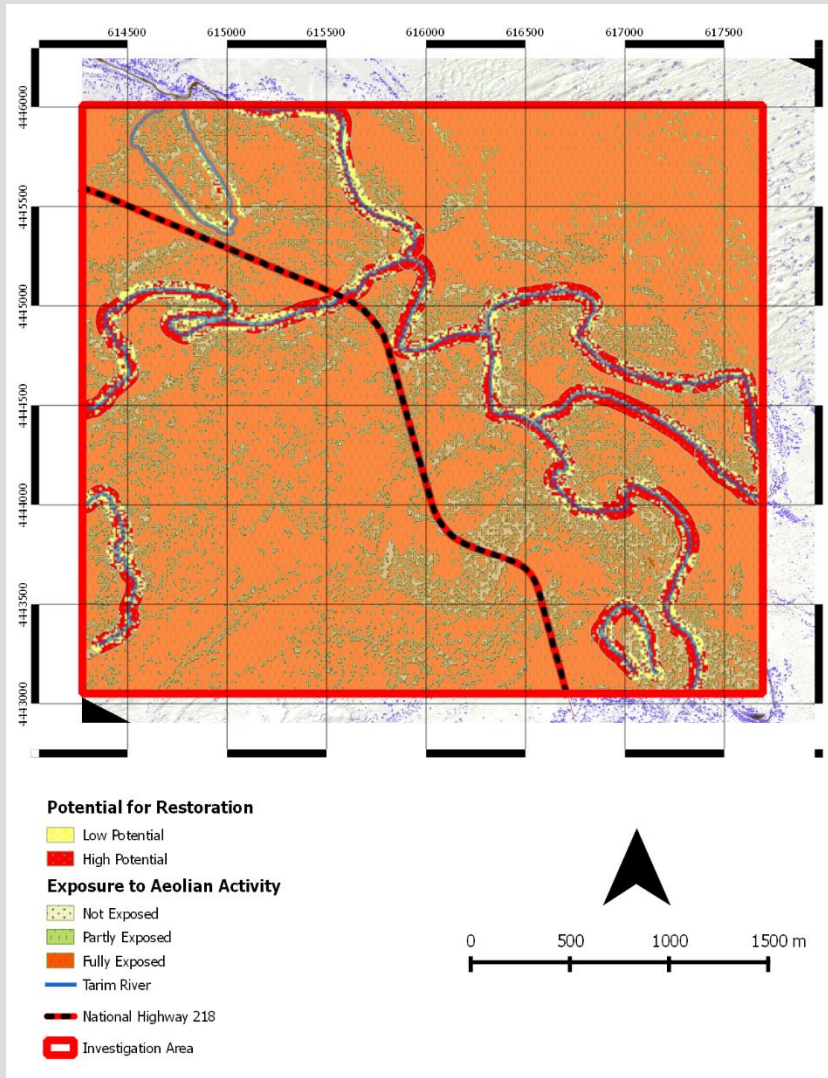


# Modelling Sediment Fixation



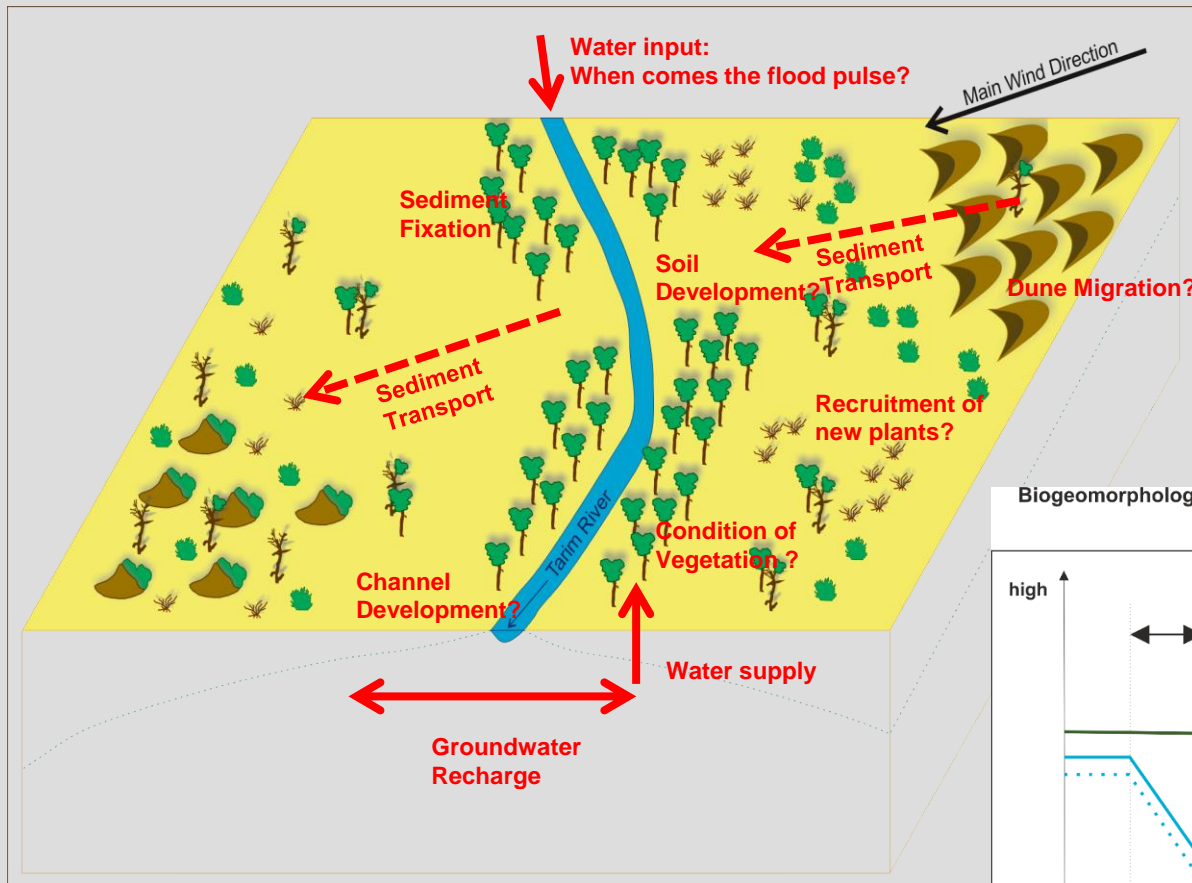
***Low sediment retention close to the highway results in a high potential for sand drift hazard***

# Modelling Sediment Fixation



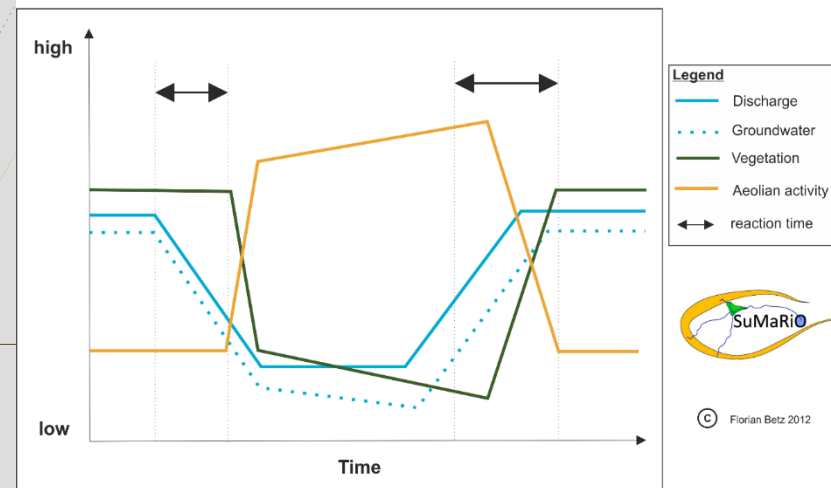
***Once the soil surface is completely sheltered from the wind forces, an increasing vegetation coverage does not lead to an increase in the ESS “Sand/ Dust Fixation”***

# Ecological Complexity vs. Model Simplicity



**Modelling of the ESS “sediment fixation” makes it necessary to assume simplified ecological relationship.**

Biogeomorphological disturbance regime at the lower reaches of the Tarim River





# Conclusion

- **Sand/ Dust Fixation is among the most important ecosystem services of the natural Tugai forests.**
- **Physical based modelling is a suitable tool for deriving a scientifically justified assessment of sediment fixation**
- **Vegetation has a large effect on the entrainment of sediment and thus is very important for the fixation of sand and dust**
- **Sediment Fixation can reach a maximum, where a further vegetation development does not effect sediment fixation anymore.**
- **An issue are the areas far from the river with low sediment fixation but also with a low potential for a natural establishment of young seedlings**
- **(Ecological) complexity is challenging for modelling but also for assessing ecosystem services for decision making**



**Thanks for your Attention!**



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