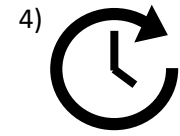


3) Water Budget Estimations

$$ET = \text{blue drop icon} \quad \text{vs.} \quad IR = \text{blue drop icon}$$

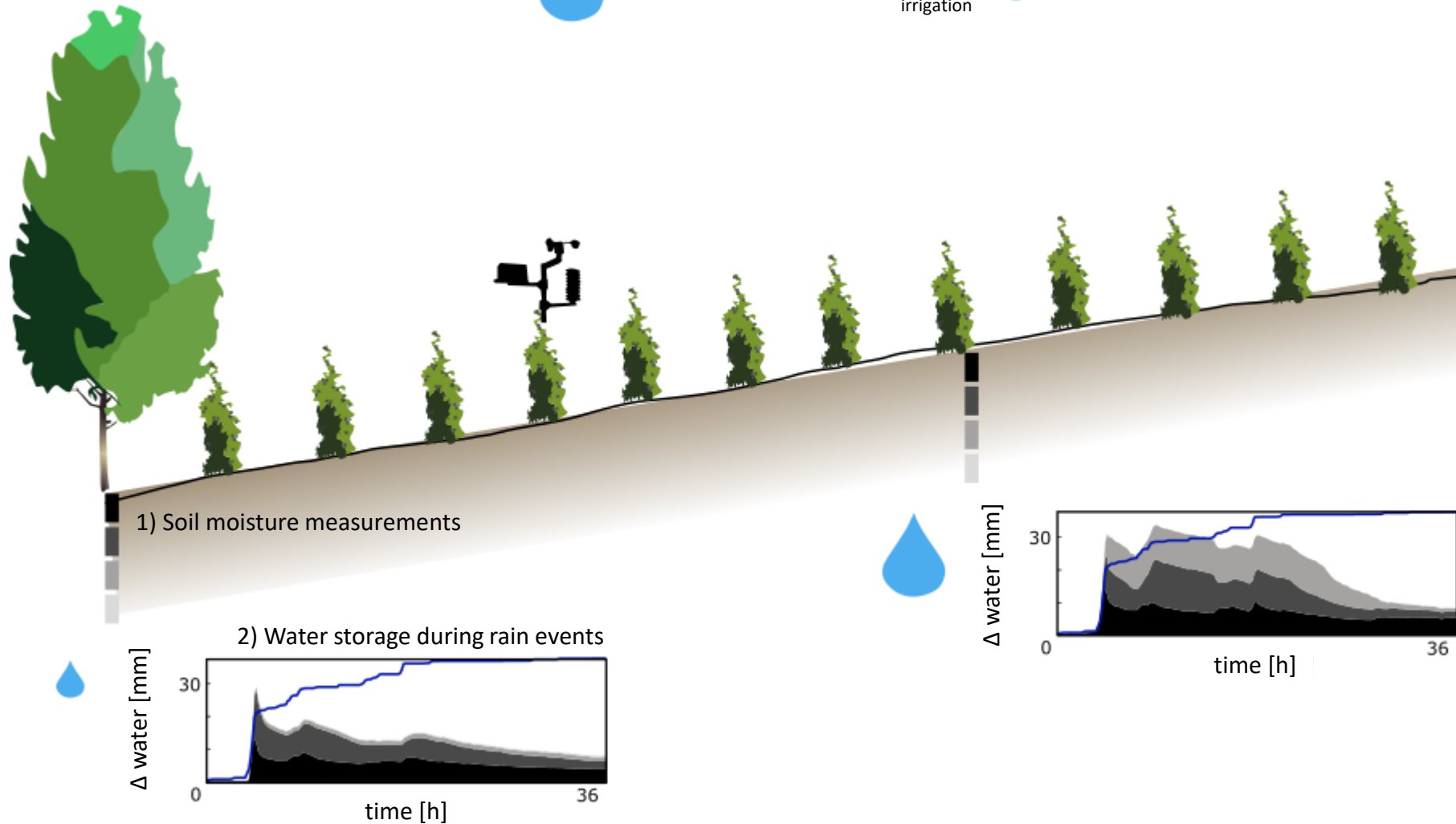
irrigation



Ensemble
Empirical Mode
Decomposition

+

Numerical
Modelling
with Catflow



Hydrological effects of combining Italian alder and
blackberry in **an agroforestry system in South Africa**

Svenja Hoffmeister et al.
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EGU21-2879

Intro

Water limitation provides the potential to hinder the productivity of agricultural systems especially in arid and semi-arid regions. In **agroforestry systems interactions** between trees and crops range from **mutually beneficial to critically competing**, shaping the **demand for resources, such as water.**

In this study, we investigated the **hydrological effects** of an Italian Alder (*Alnus cordata*) windbreak on an irrigated blackberry plantation near Stellenbosch, South Africa. We determine the **key components of the water budget in the system and compare them at two positions**: alongside the windbreak, and amongst the crop away from the windbreak's influence.

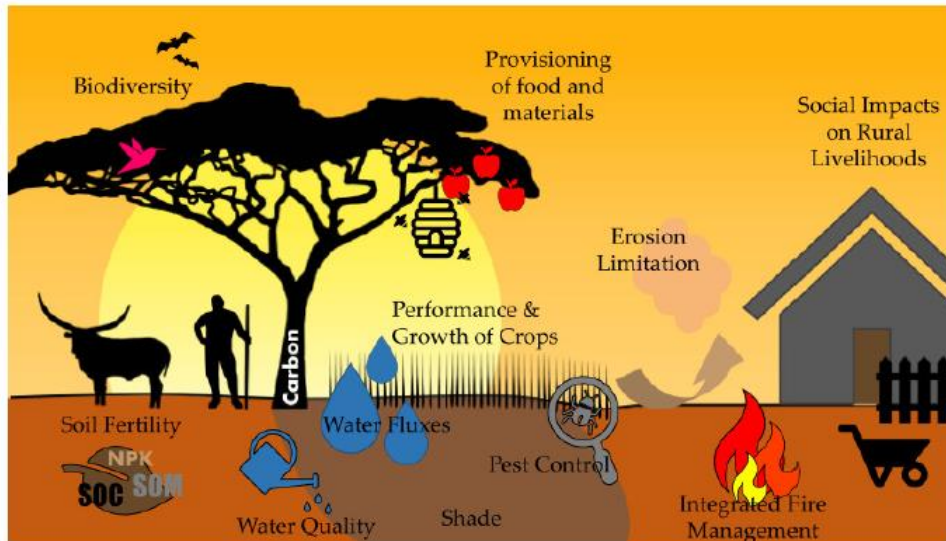
AFS? Agroforestry System!

“AFS are deliberate combinations of at least two differing plant types, or in case of silvopastoral systems, plants with animals, one component within AFS is always a woody perennial.” Sheppard et al. 2020



What is ASAP?

“The research project ‘**A**groforestry in **S**outhern **A**frica - new **p**athways of innovative land use systems under a changing climate (ASAP)’ targets the application of AFS as a suitable response to the impacts of climate change” www.agroforestry-africa.org



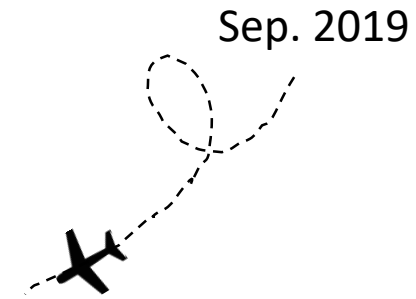
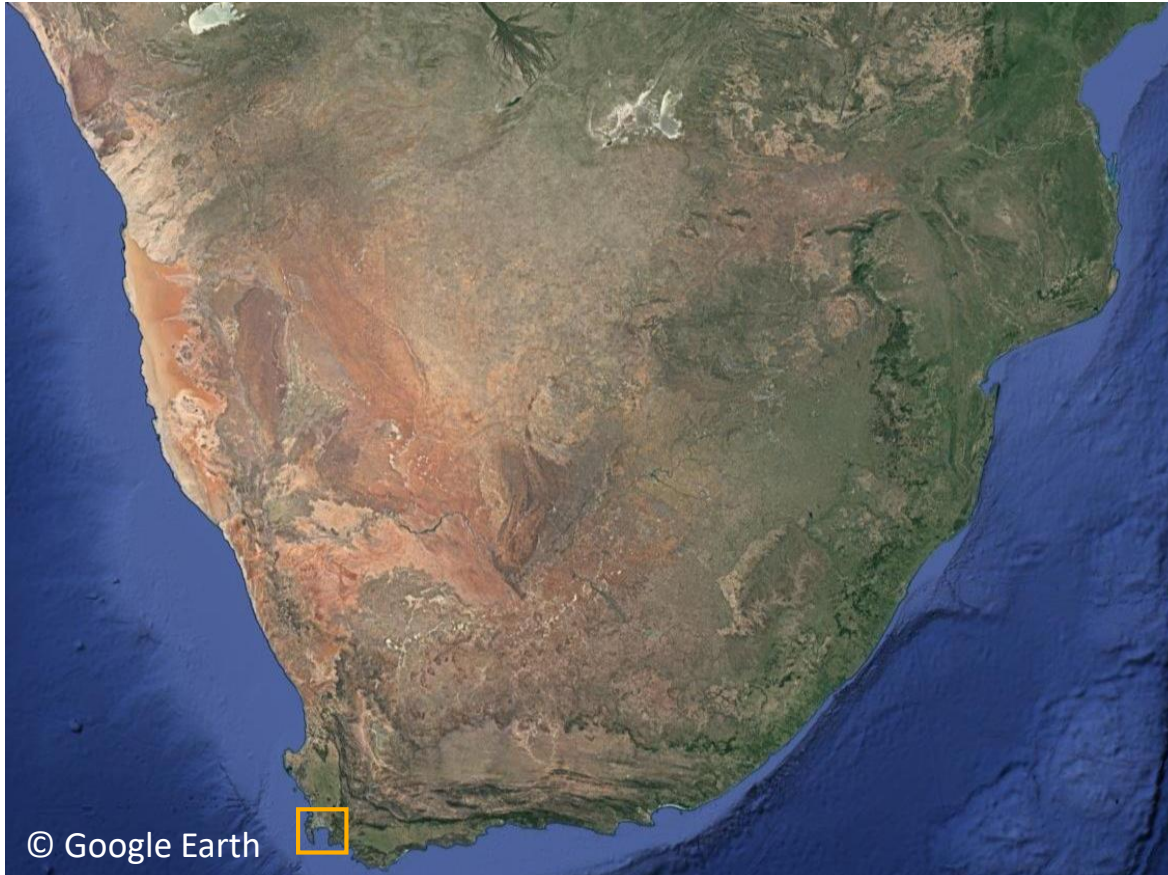
Sheppard et al. 2020

Why Water Fluxes?

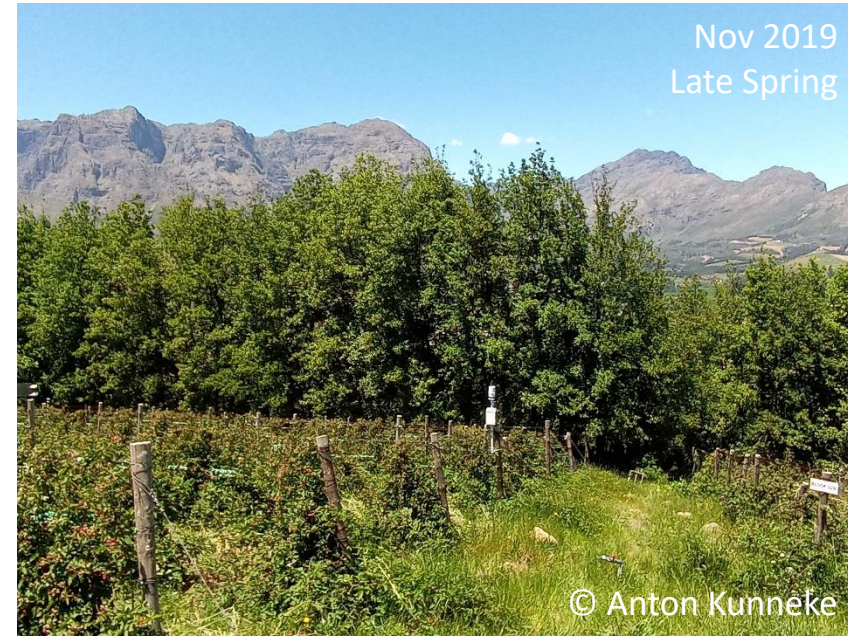


“Hydrological interactions between trees and crops in AFS range from **mutually beneficial to critically competing**, especially in dry regions where water can be a limiting factor for plant growth.”
Sheppard et al. 2020

Location of the field site



Changes with the seasons



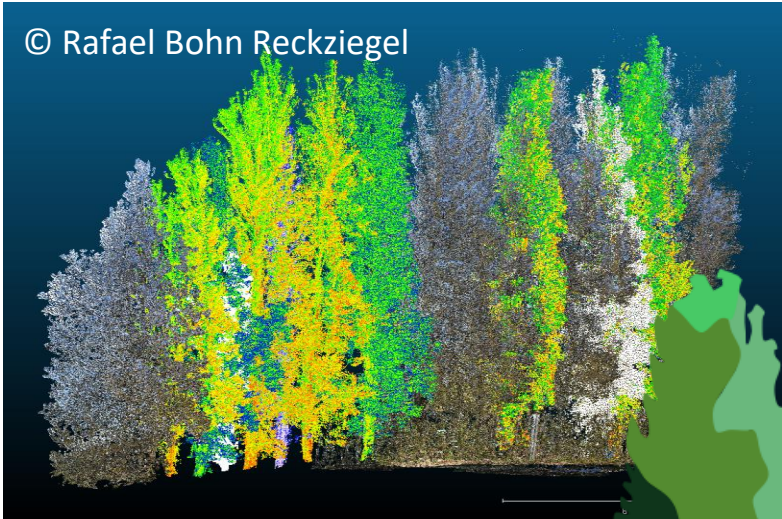
Reminder:
At the windbreak
and in the crop

Methods

We measured **soil water content depth profiles** in the summer months, from October 2019 to March 2020, in both locations with four consecutive time domain reflectometry (TDR) tube sensors, each integrating over 20 cm depth. **Potential evapotranspiration** (ET) was estimated from site based meteorological observations. We surveyed and classified the local soil, and defined **soil chemical and physical properties** (e.g. texture, matrix potential). The **windbreak structure** was measured on a single tree basis (e.g. tree height, volume and biomass) using manual and terrestrial laser scanning methodologies.

Measurements

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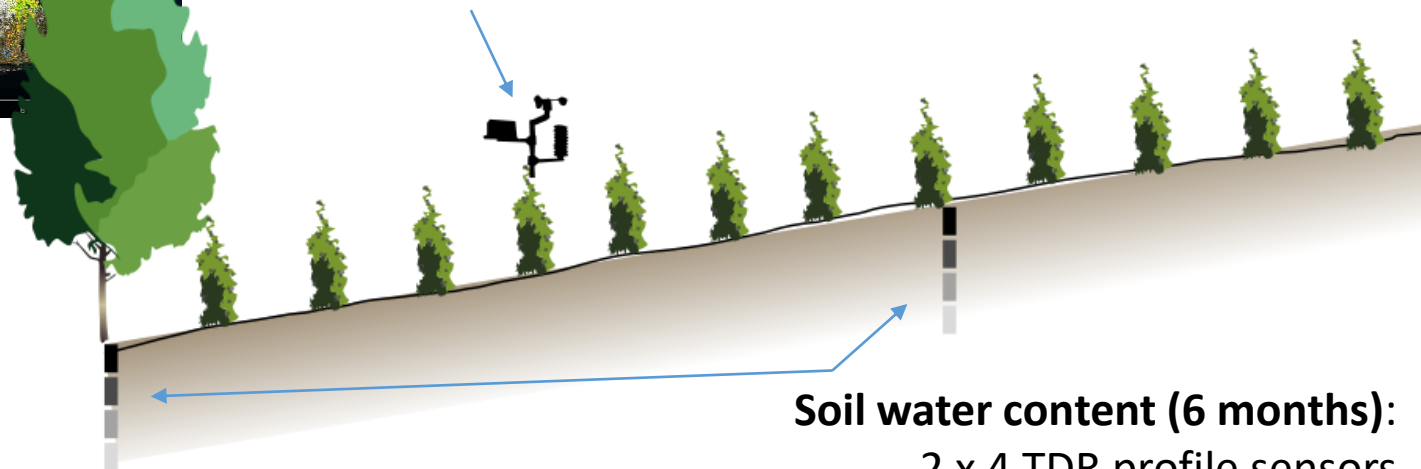


Windbreak characteristics:
Terrestrial laser scanning



Meteorological observations (6 months):

Air temperature, relative humidity,
wind speed and direction, precipitation,
solar radiation



Soil water content (6 months):
2 x 4 TDR profile sensors

Soil profile characterisation

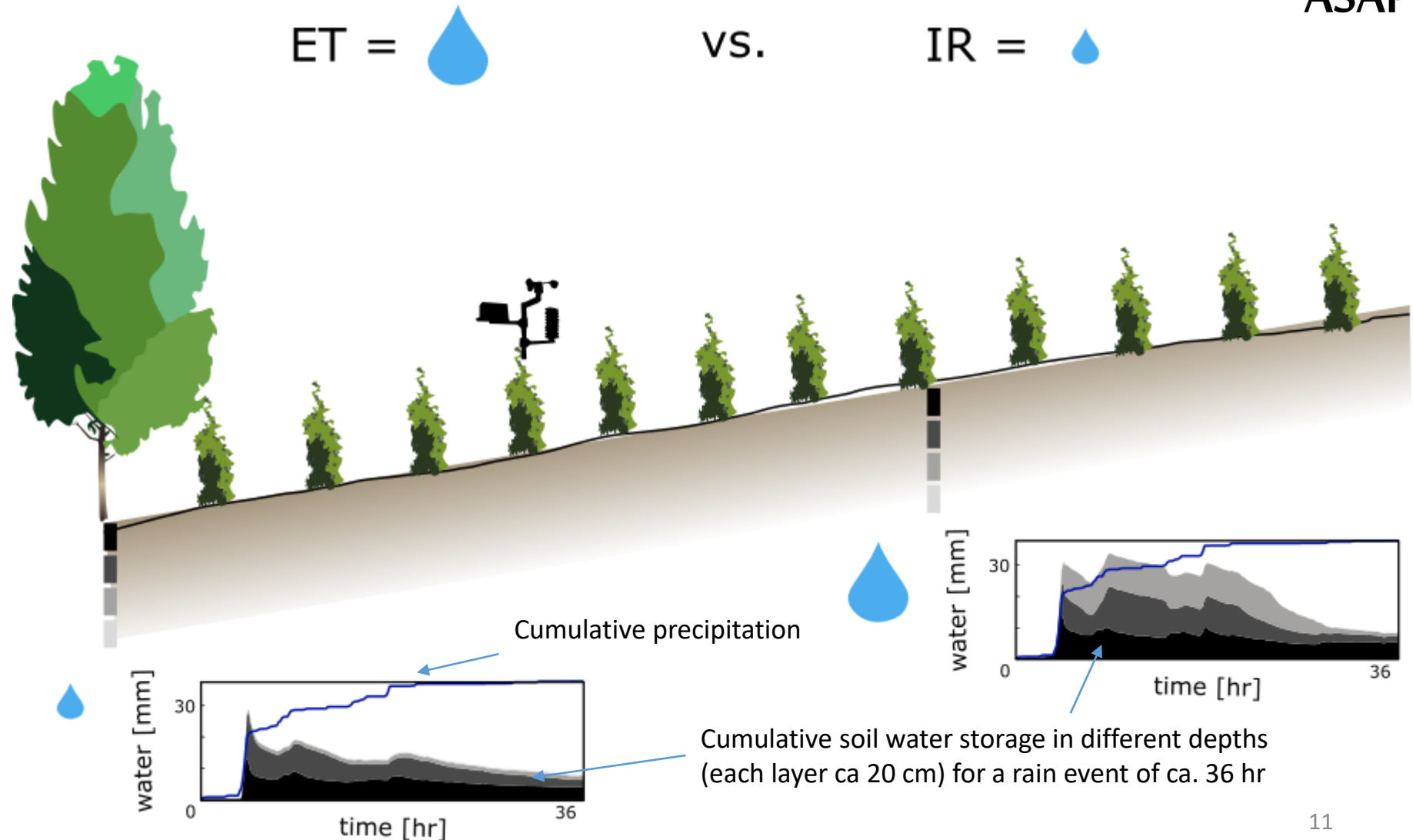


Results & Discussion

The data indicate that **high potential ET**, caused by high summer temperatures and strong winds, **dominates the water budget** at the study site, **exceeding the water input of the drip irrigation**. We found **differences in the water dynamics between the two sites**, e.g. greater soil water content at greater distances from the windbreak. Possible reasons are: (1) **the water demand of trees increases underground competition for water, and/or;** (2) **microclimatic conditions closer to the windbreak increase ET.**

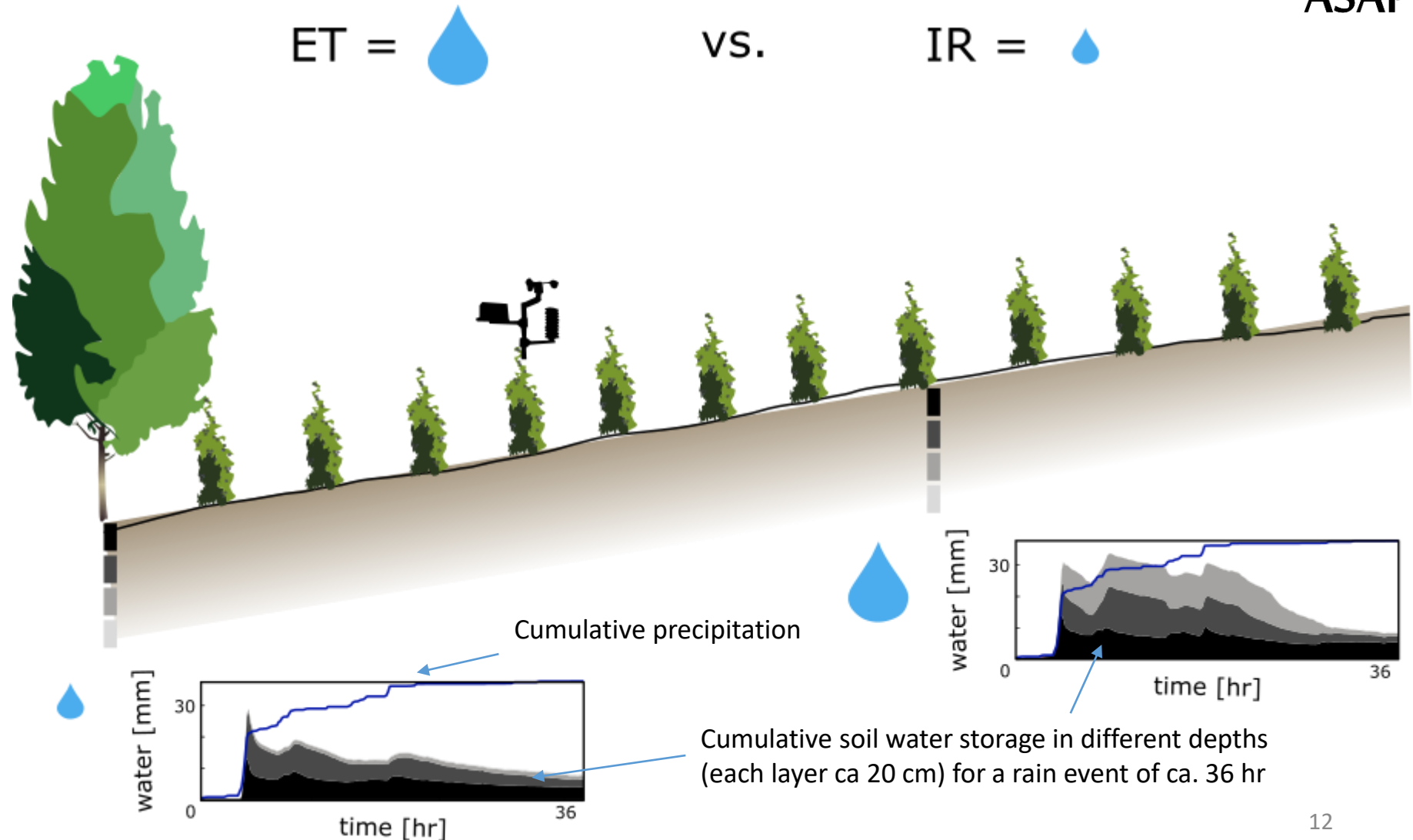
Results

1. Less soil water content the closer to the windbreak
2. Different dynamics of soil water storage during rain events
3. Potential evapotranspiration (ET) exceeds irrigation (IR)



Challenges

1. Potential ET might differ quite a lot from actual ET
2. Little information on irrigation input
3. Sensors can have different offsets → problems when comparing different locations

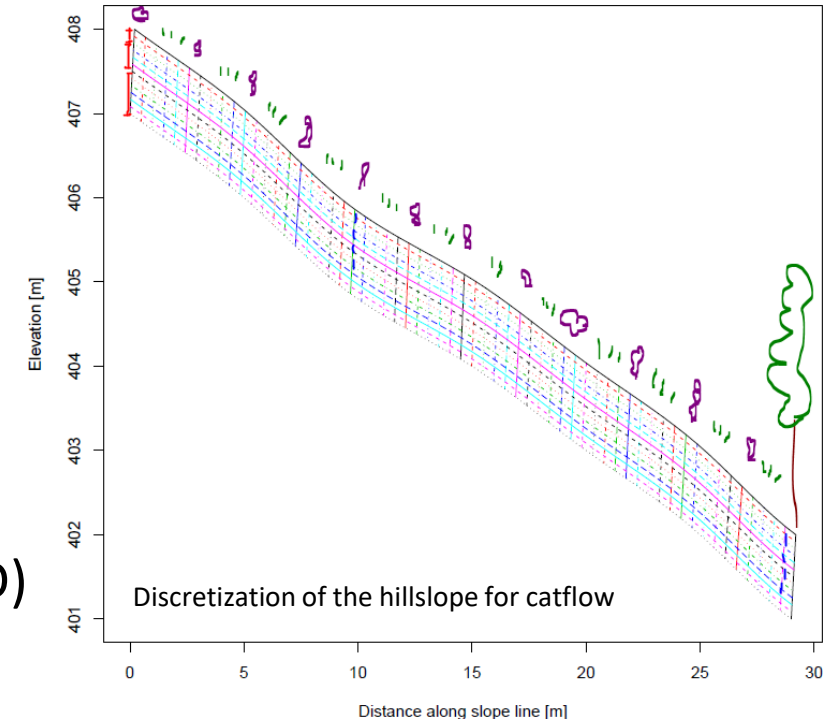


Future

Modelling of the windbreak influence on the ET and further **analysis of water fluxes** will be conducted as next steps to combine the results from the sensors and the joint field campaign.

Next Steps

- Numerical model Catflow
 - ✓ Chosing appropriate discretization of the hillslope
 - ✓ Defining land-use parameters representing the different plants
 - Calibration
 - Extracting information on actual evaporation under different climatic conditions (shading, wind)
 - Tests with different amounts of irrigation
 - ...
- Complete Ensemble Empirical Mode Decomposition (cEEMD) after Torres et al. (2011)
 - ✓ cEEMD on all soil water content data
 - Using the different modes acquired as “filter” to remove long-term trends and noise
 - Comparing the “new” data at the two sites



Please contact us!

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