METEOROLOGICAL INFLUENCE ON NATURAL RECHARGE IN THE DOÑANA NATIONAL PARK USING METEO-LYSIMETER MEASUREMENTS

Lidia Molano Leno[1], Claus Kohfahl[1], Daniel Jesús Martínez Suárez[1], Fernando Ruiz Bermudo[1], Antonio Nicolás Martínez Sánchez de la Nieta[1], Carlos Mediavilla[1], Stefan Engerlhardt[2], Karl Vanderlinden[3], Juan Vicente Giráldez[4],

[1]Instituto Geológico y Minero de España , Seville (Spain)

[2]UMS AG, Munich (Germany)

[3]IFAPA, Centro Las Torres-Tomejil, Seville (Spain)

[4]Departamento de Agronomía, Universidad de Córdoba, Córdoba (Spain)

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Claus Kohfahl

Instituto Geológico y Minero de España
Unidad de Sevilla

CLIGRO

UNION EUROPEA
FONDO EUROPEO DE DESARROLLO REGIONAL
"Una manera de hacer Europa"

STUDY SITE

Southwest Spain: Doñana National Park => Almonte-Marismas aquifer

Geography

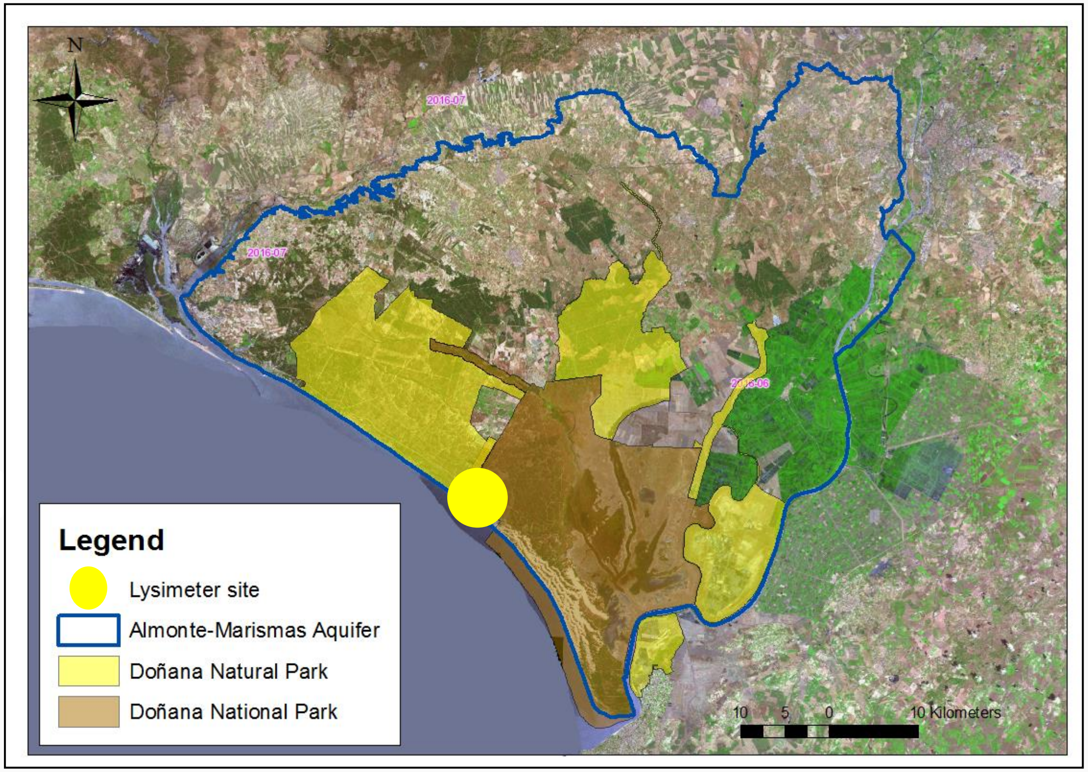
- surrounded by 46 villages and towns =>1.5 Mio people
- Agriculture and Tourism

Geology

- dunes
- beaches
- marshes

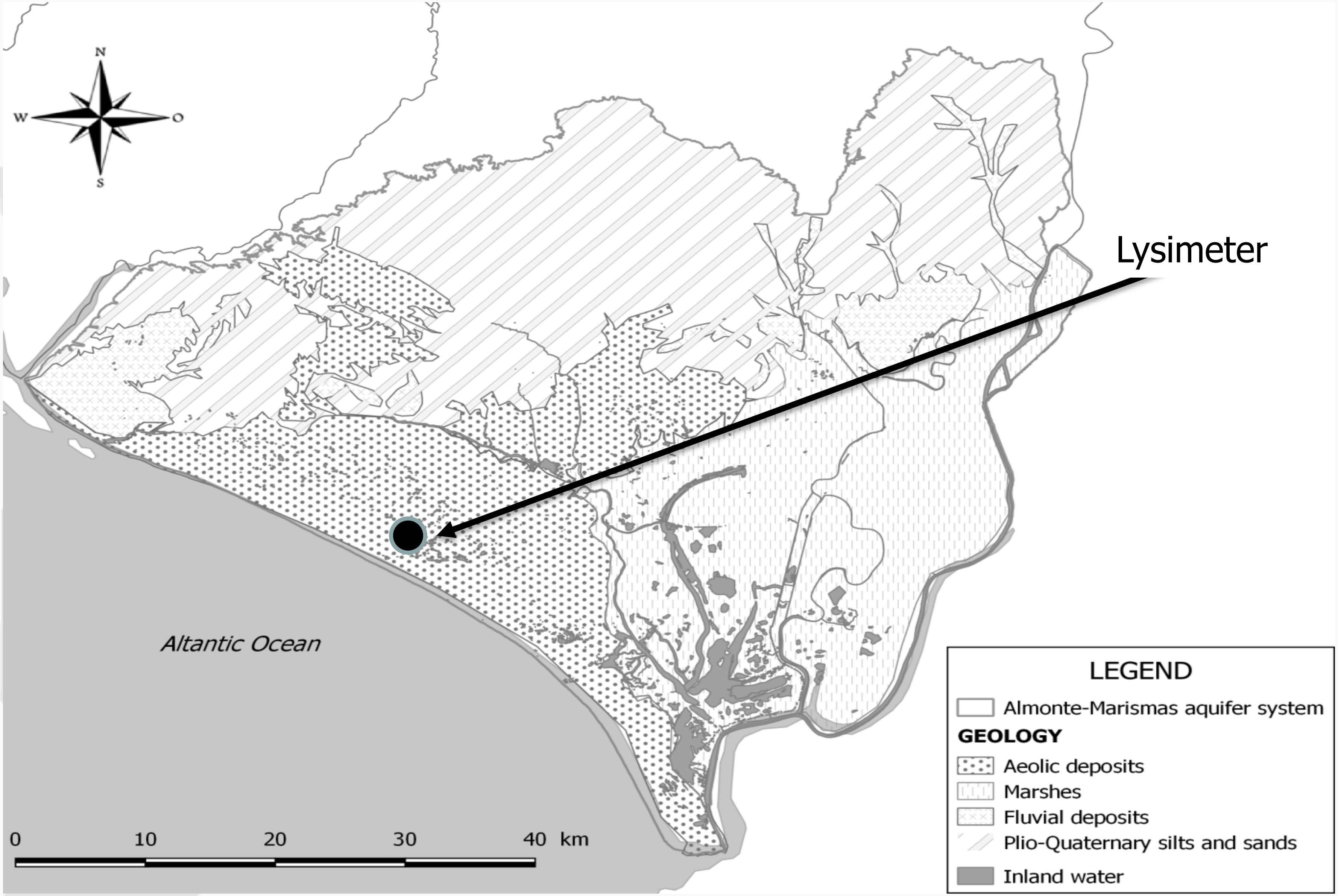
Climate

- Sub-humid Mediterranean with Atlantic influence
- Average rainfall: 500-600 mm
- Average Temperature: 17-18ºC



Ortophoto from Junta de Andalucia webpage: http://www.ign.es/wms-inspire/pnoa-ma

Hydrogeology



INTRODUCTION

Geology and landscape

Dunes and locals swamps

Geology and landscape

Marshes

MOTIVATION

Threat of groundwater resources:

- ✓ Agriculture
- ✓ Tourism
- ✓ Climate Change

Dune belts

⇩

Fundamental for groundwater recharge

Key location for the quantitative and qualitative monitoring of water resources in ecological habitats.

INTRODUCTION

Climate Change may impact groundwater recharge due to:

- increasing temperatures
- changing seasonal patterns of precipitation
- change in vegetation

MAIN OBJECTIVES

1. To explore the impact of different meteorological conditions on groundwater recharge in dunes belts within semiarid climate.

2. To derive its dependence on regional climate trends predicted by global climate models

Meteo Lysimeter Site Equipment

Weighting Lysimeter
(UMS AG, Munich, Germany)
- $1\ m^2$ area
- 1.5 m height
- 10 g weighting resolution

Six CS650 soil moisture sensors
(Campbell Scientific, Logan UT)

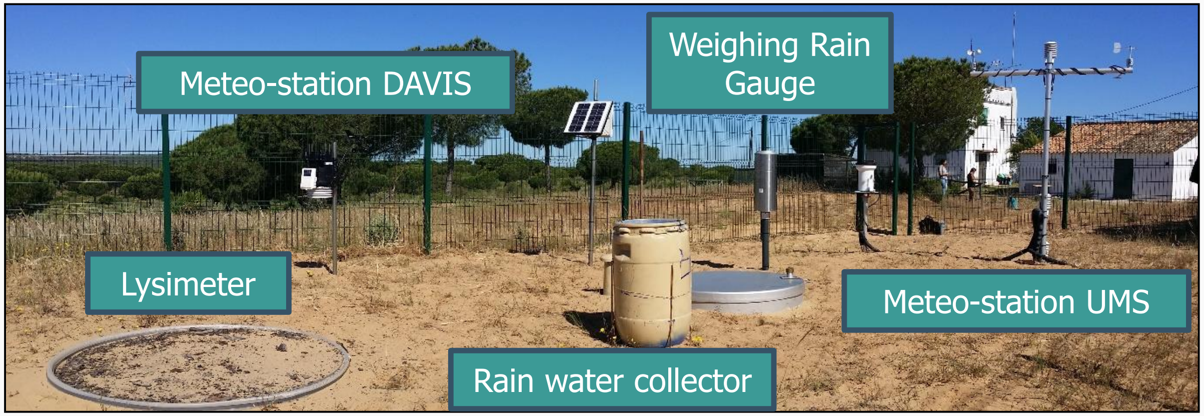
Depths (m)	
0.30	1.60
0.60	2.20
1.20	3

2 Automatic and Meteorological Stations
(Vantage PRO2 Davis, UMS AG, Munich, Germany)

Weighing Rain Gauge (OTT pluvio1)

Rain water collector

Measured parameter	Time interval (minutes)
Soil mass lysimeter	1
Water mass drained from lysimeter	1
Soil water tension	10
Soil moisture	10
Wind direction	10
Wind velocity	10
Net radiation	10
Precipitation	10
Air humidity	10
Air and soil thermal profile	10
Soil bulk density	Once
Grain size distribution	Once
Mineralogy	Once
Metals content	Once

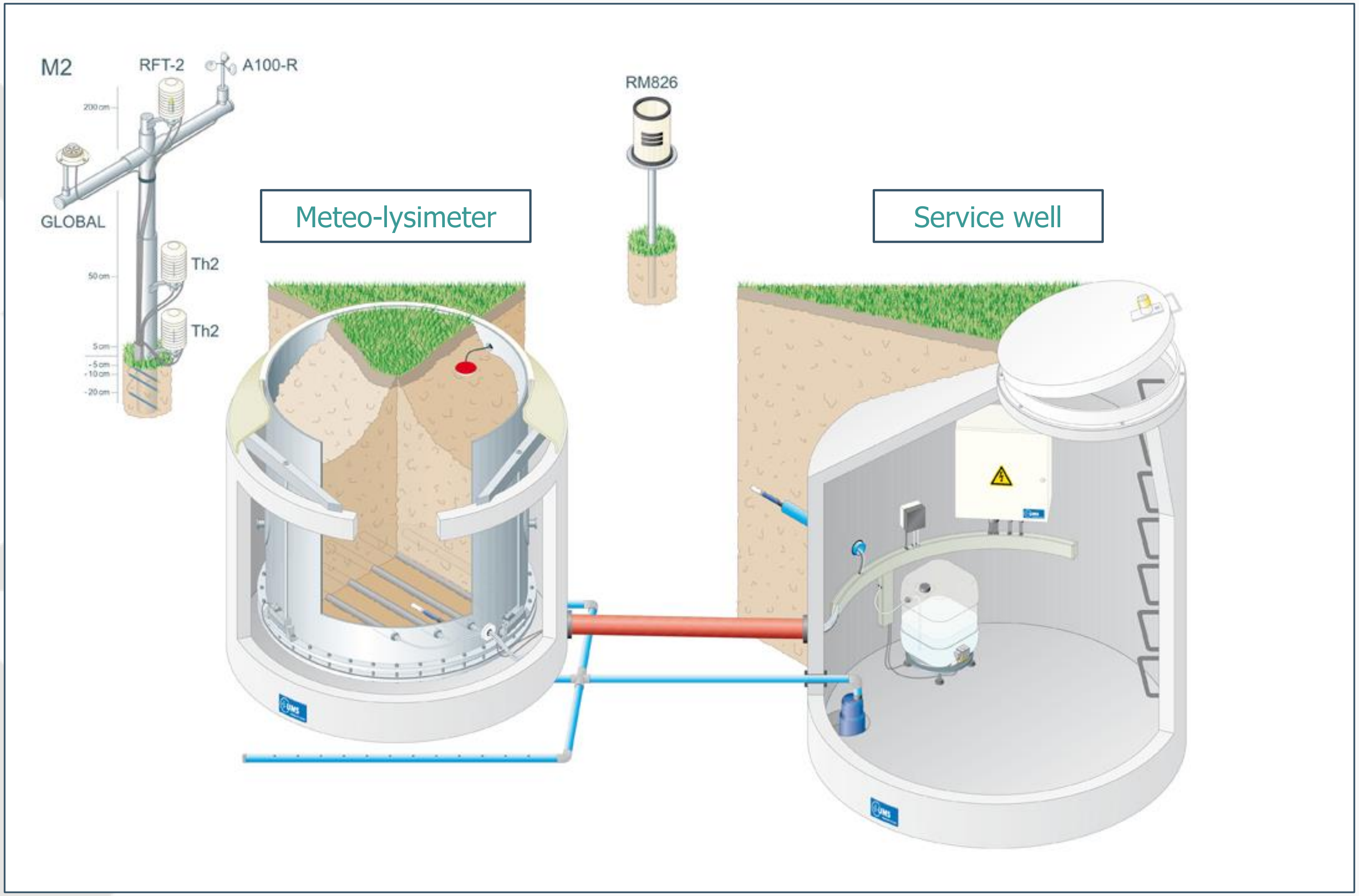


MATERIAL AND METHODS

High Precision Weighing METEO LYSIMETER

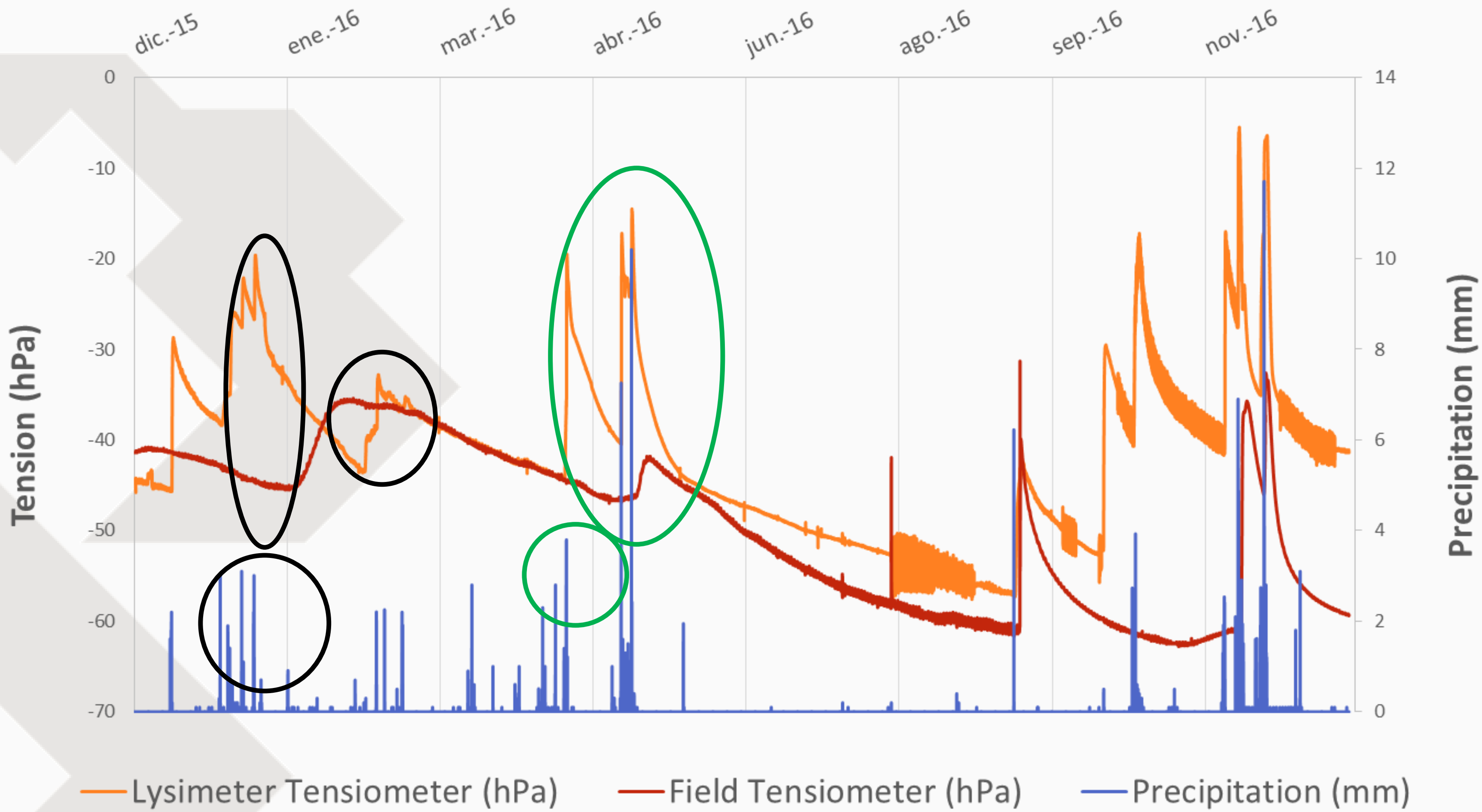
- Most precise measures for recharge, precipitation and evapotranspiration.
- Mostly installed for agricultural purpose in crop areas.
- Limited knowledge exists about recharge dynamics and its dependence on meteorological parameters in dune belts.

METEO LYSIMETER



FIRST RESULTS AND DISCUSSION

Tensiometer. Lower Boundary Control



Data Noise Filtration: AWAT (Peters et al. 2014)

$$\mathbf{P = R + ET + \Delta S}$$

$$\Delta W = \Delta w_{lys} + \Delta w_{drain}$$

Parameter measured by lysimeter:

$$P = \begin{cases} \Delta W, & \Delta W > 0 \\ 0, & \Delta W \leq 0 \end{cases}$$

P: Precipitation
ET: Evapotranspiration
R: Recharge
ΔS : Change in storage

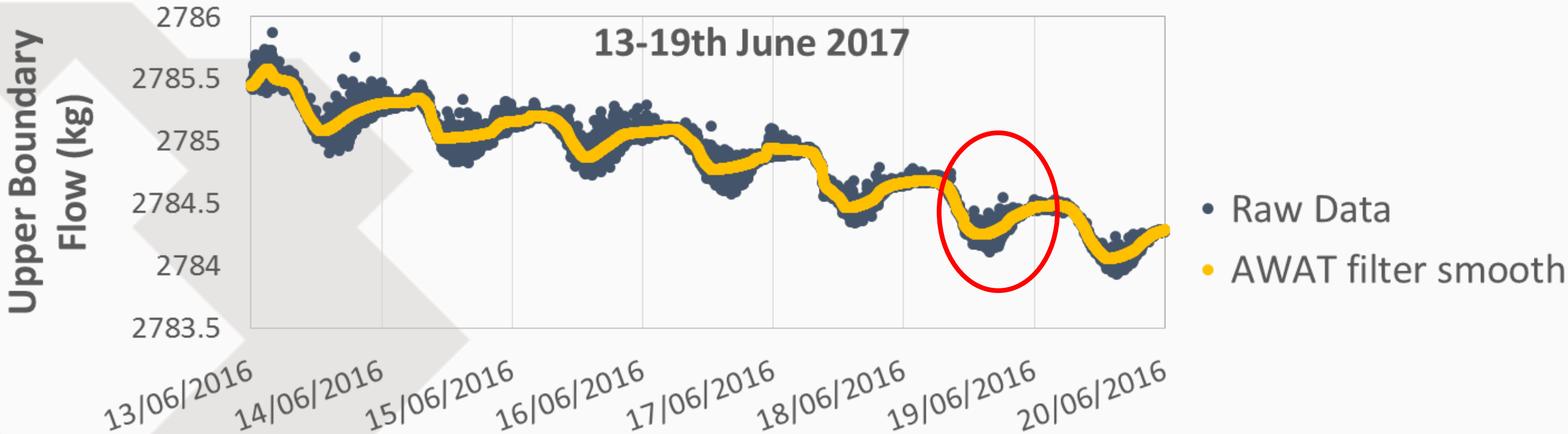
$$ET = \begin{cases} \Delta W, & \Delta W < 0 \\ 0, & \Delta W \geq 0 \end{cases}$$

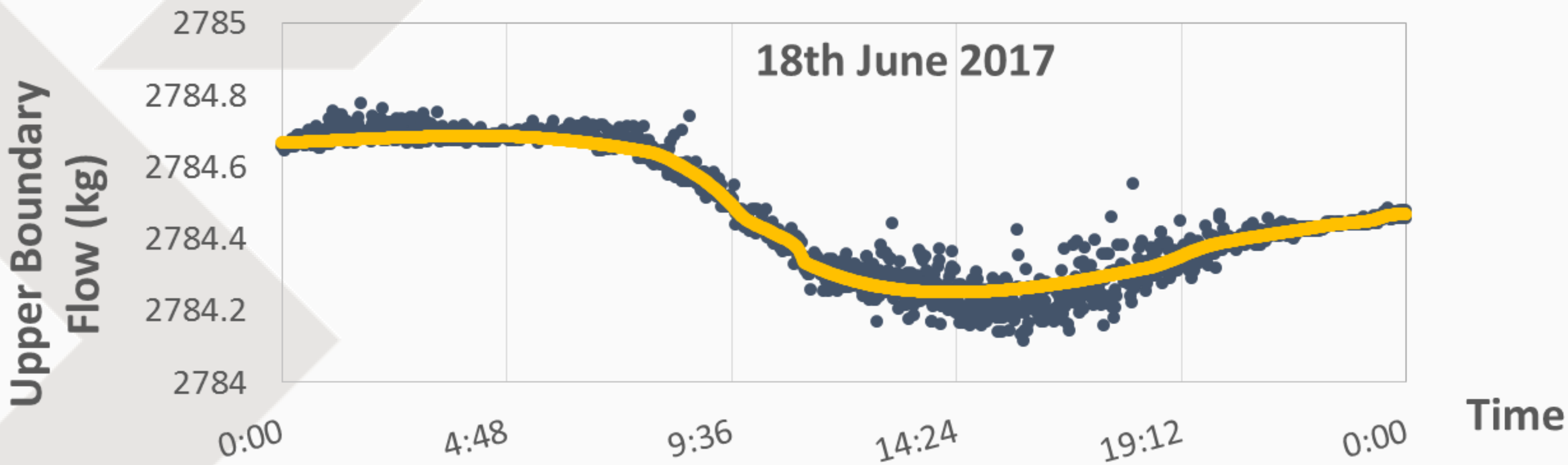
Intrinsic noise reduced by smoothing → **AWAT**

Adaptive **W**indow **A**daptive **T**hreshold

Data Noise Filtration: AWAT (Peters et al. 2014)

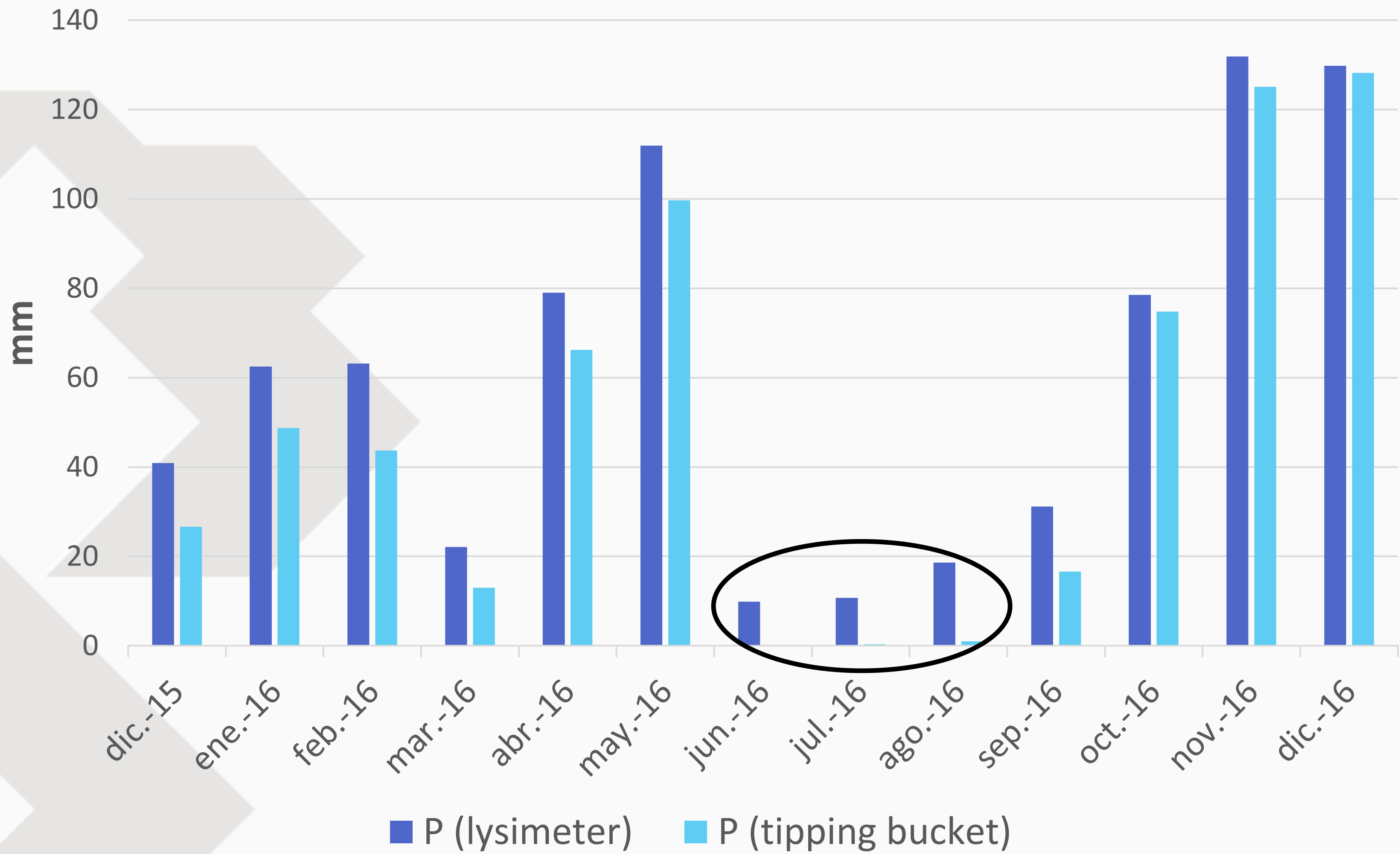
Examples of smoothing:



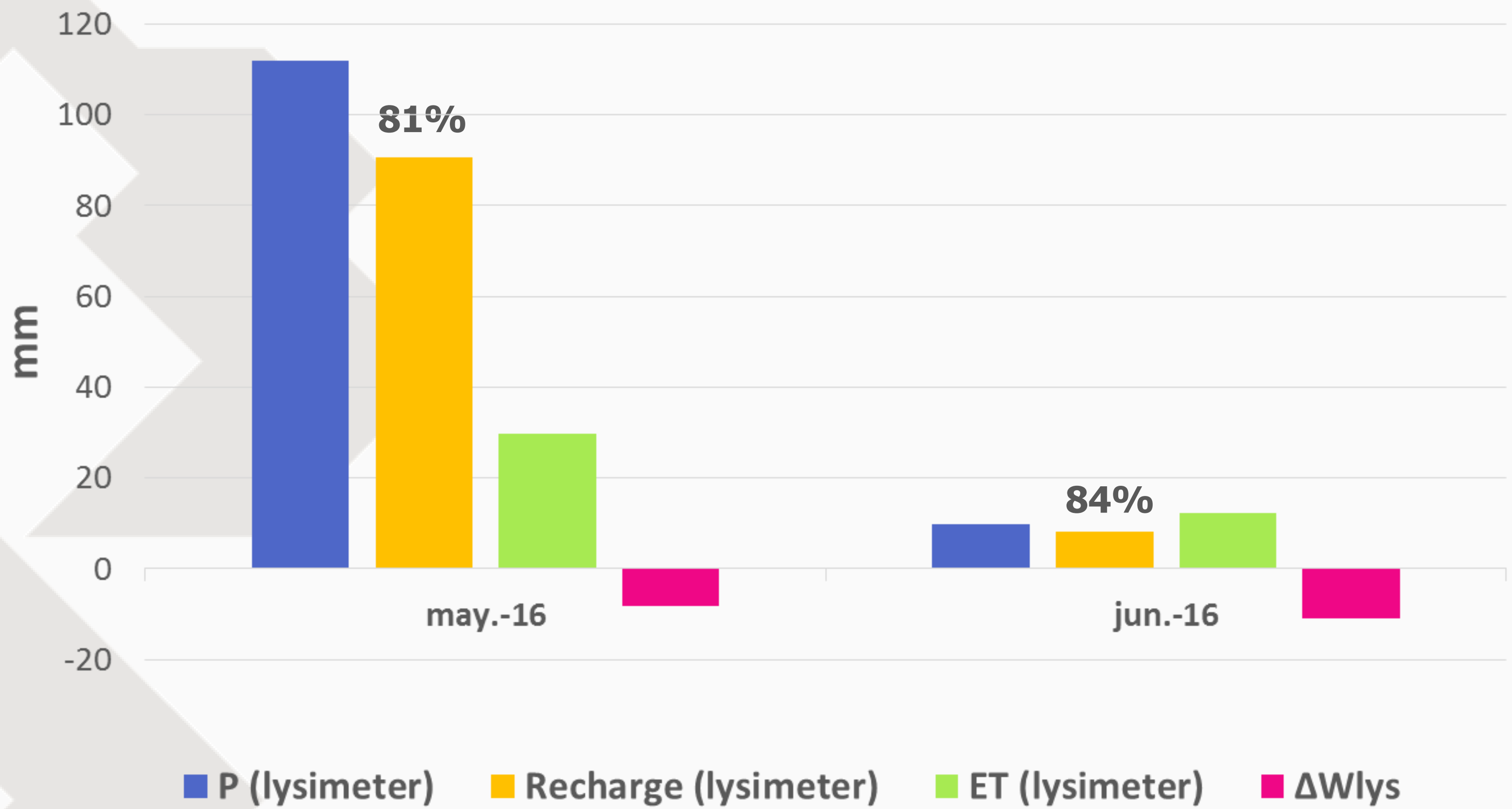


FIRST RESULTS AND DISCUSSION

Monthly Measured Rainfall



Example Monthly Soil Water Balance Components



OUTLOOK

- Compare different rainfall measurements methods (Hellmann, tipping bucket, lysimeter)
- Sensitivity study of noise filtering parameters and algorithms
- Dependence of soilwater components on meteorological parameters
- Model based interpretation of measured data by HYDRUS1D (e.g. influence of low boundary control, prognostic simulations for climate change scenarios, upscaling to other sites).
- The role of dew for soil water balance and recharge
- The applicability of ET equations for the study site

¡GRACIAS!

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- Peters A, Nehls T, Schonsky H, Wessolek G (2014) Separating precipitation and evapotranspiration from noise - A new filter routine for high-resolution lysimeter data. Hydrology and Earth System Sciences, 18(3): 1189–1198

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