ASD instruments for continuous unattended measurements in Senegal

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Thanks to co-workers:
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Mathias Madsen
Idrissa Guiro
Cheikh Mbow et al.

ASD instruments for continuous unattended measurements in Senegal

1. Site description
2. ASD automated multi-angular field spectrometric system set-up and measurement protocol
3. Some results: Relationship between ASD hyperspectral reflectance data and savanna ecosystem properties for EO upscaling purposes
4. Lessons learned and recommendations

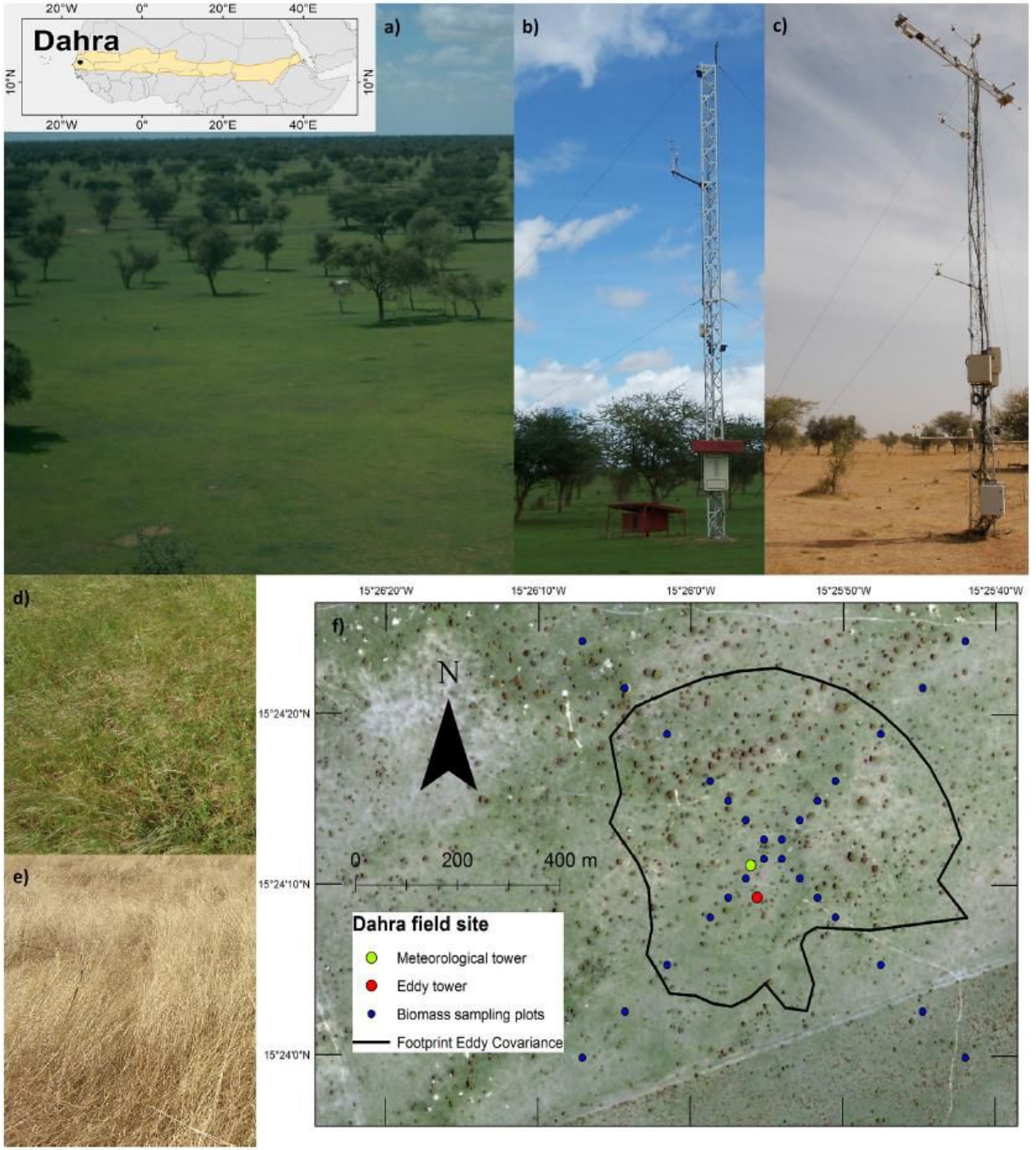
Site description:

Dahra field site in Senegal (15.40° N, 15.43° W)

- Annual rainfall 416 mm
- Mean annual air temperature 29 °C
- Rainy season from July to October
- The site is a typical low tree and shrub savanna environment with ~3%, tree cover
- The land is used as grazed rangeland.
- The site is flat and with homogeneous vegetation cover within a radius of at least 3 km

Site description

ASD's form part of a larger instrumental setup



Global Change Biology

Global Change Biology (2015) 21, 250–264, doi: 10.1111/gcb.12734

Ecosystem properties of semiarid savanna grassland in West Africa and its relationship with environmental variability

TORBERN TAGESSON[1], RASMUS FENSHOLT[1], IDRISSA GUIRO[2], MADS OLANDER RASMUSSEN[13], SILVIA HUBER[13], CHEIKH MBOW[24], MONICA GARCIA[56], STÉPHANIE HORION[1], INGE SANDHOLT[56], BO HOLM-RASMUSSEN[6], FRANK M. GÖTTSCHE[7], MARC-ETIENNE RIDLER[8], NIKLAS OLÉN[9], JØRGEN LUNDEGARD OLSEN[1], ANDREA EHAMMER[1], MATHIAS MADSEN[1], FOLKE S. OLESEN[7] and JONAS ARDÖ[9]

Site description

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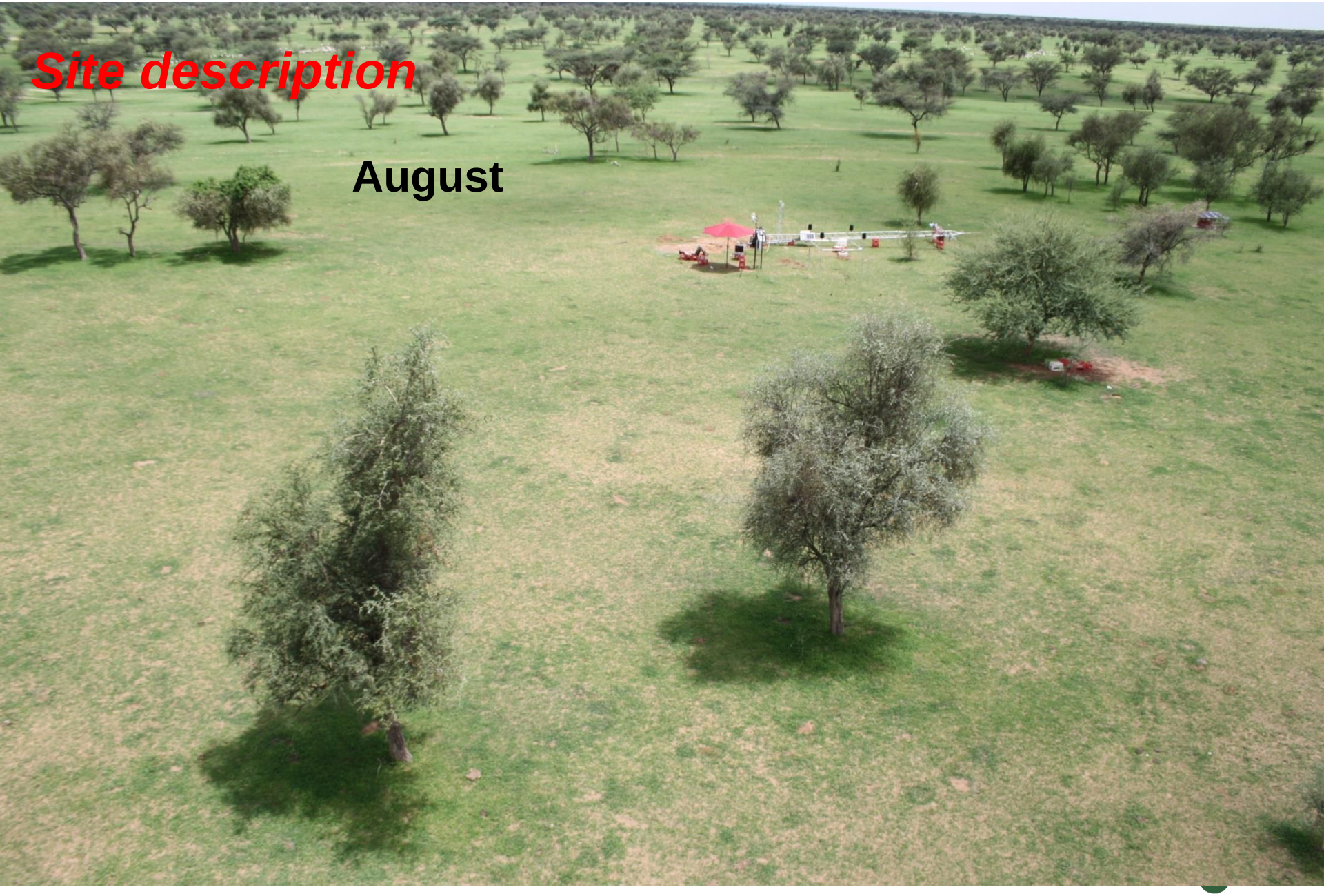

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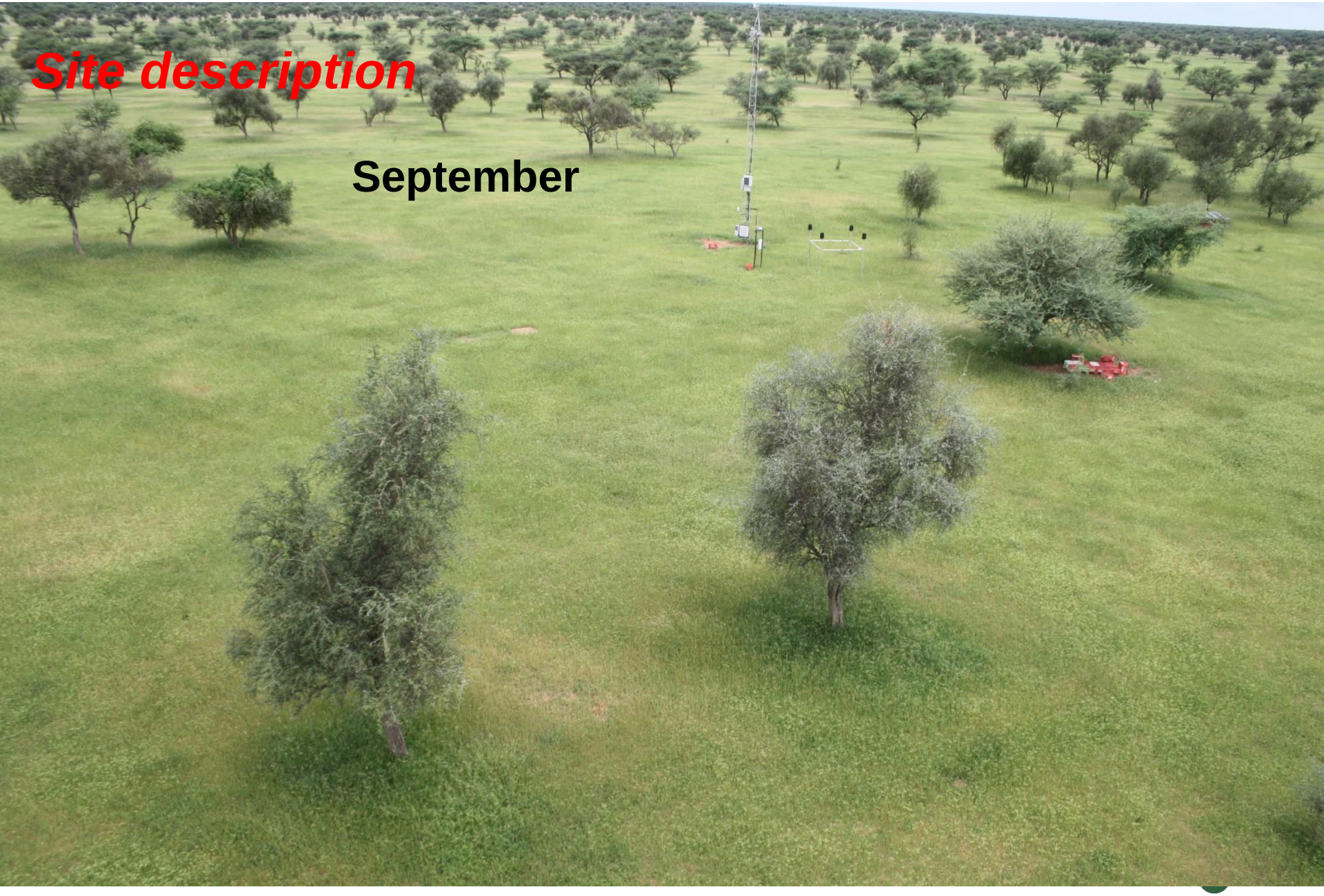

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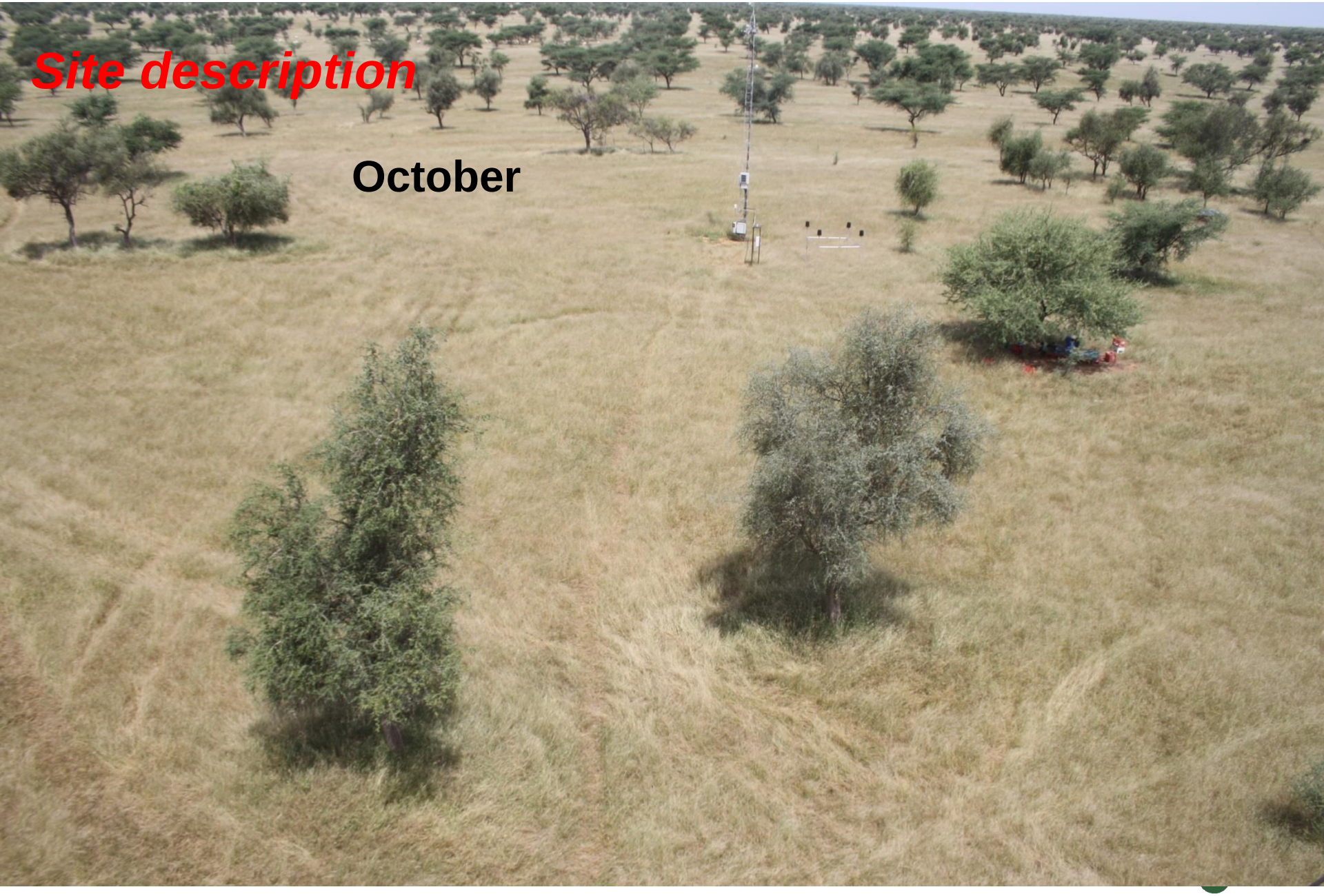
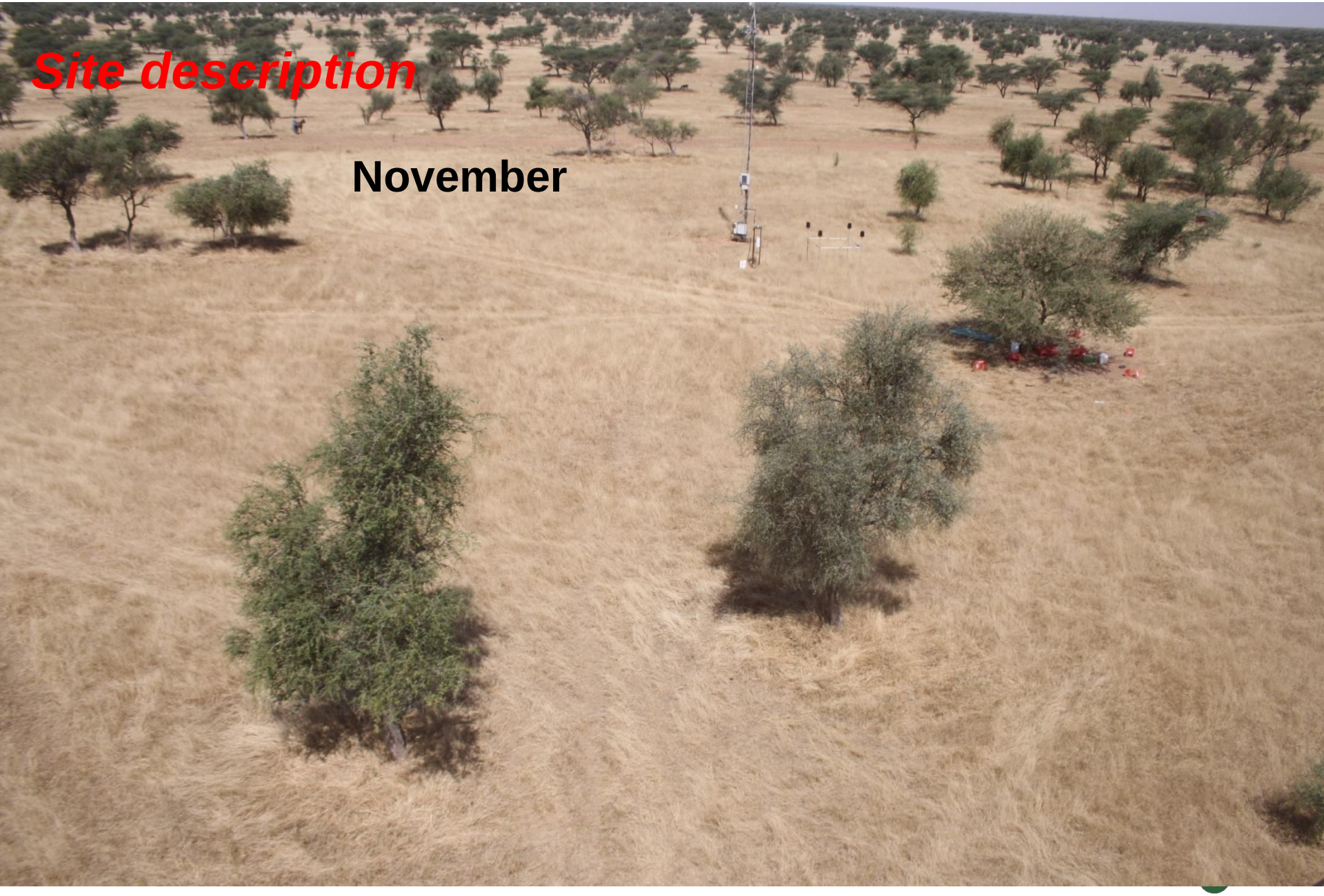
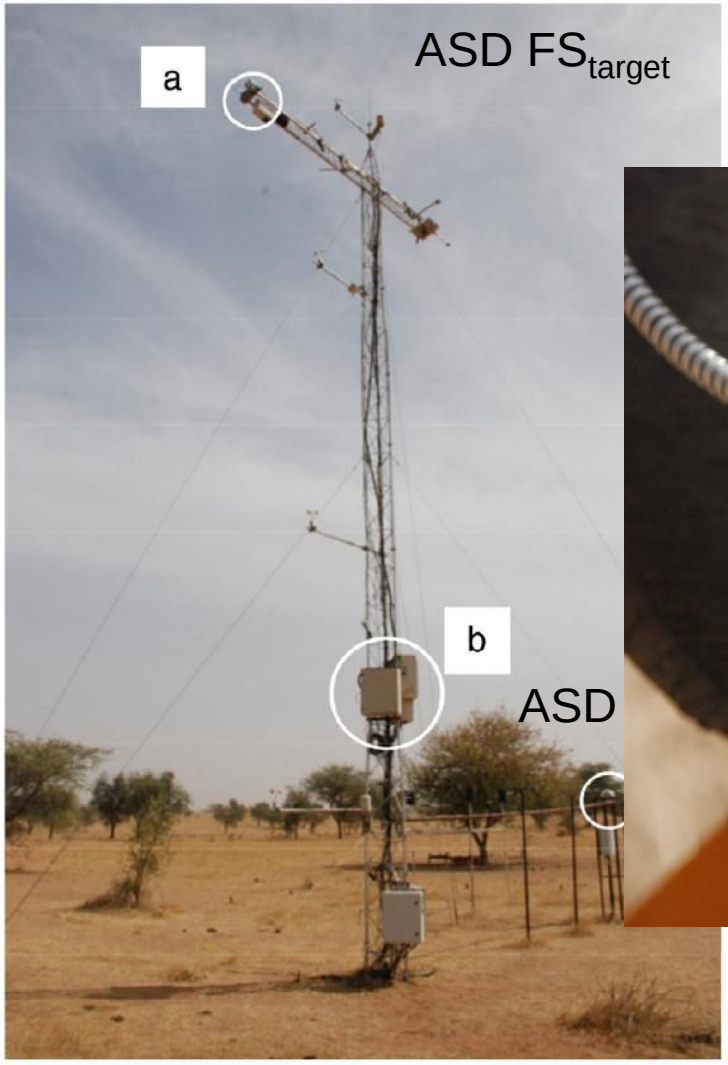


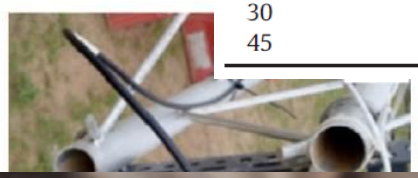
Site description

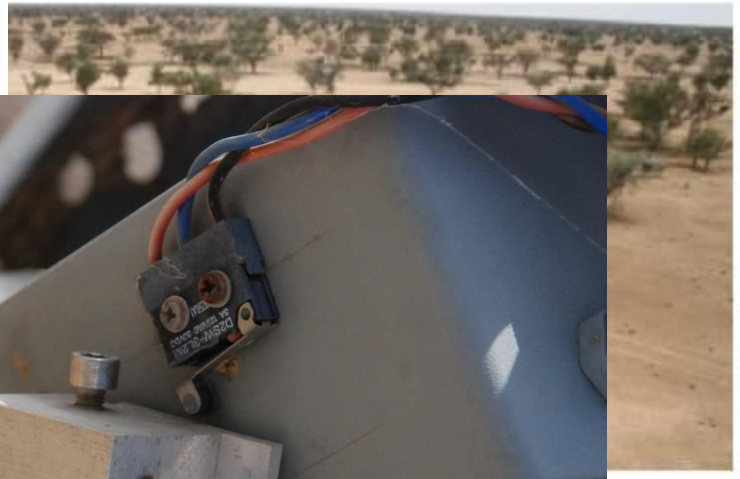


System setup

2 ASD FieldSpec3®







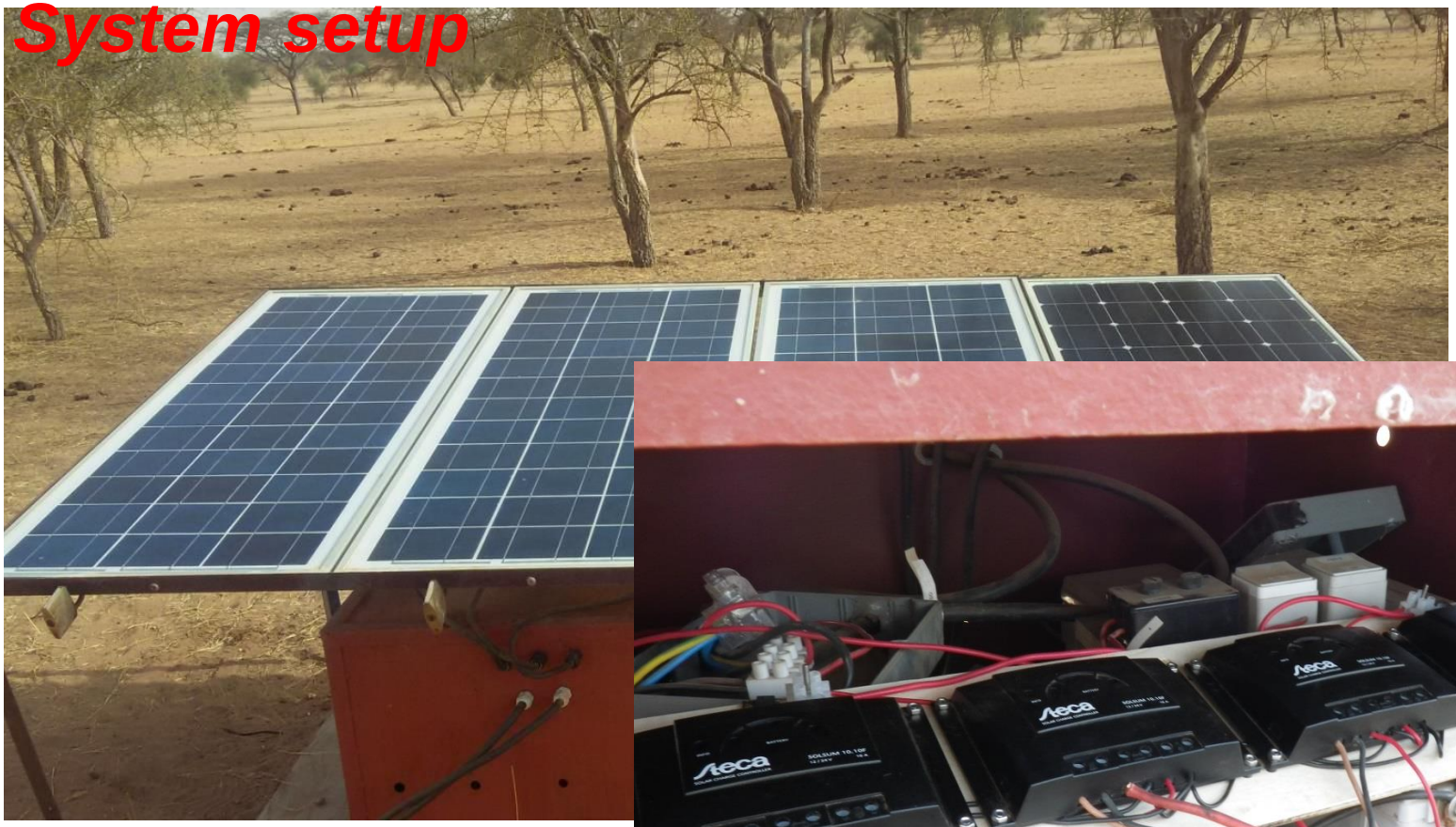
Remote Sensing of Environment 152 (2014) 547–556

Change of the ground instantaneous field of view (GIFOV) relative to the observation angle. Note that the major half axis of the GIFOV is changing asymmetrically in the along (east-west) and across direction from the center point.

Observation angle [°]	Major half axis along sensor track [m]	Major half axis across sensor track [m]	Sampled area [m^2]
0	2.34	2.34	17.22
15	2.67	2.37	18.52
30	3.58	2.77	23.34
45	6.02	3.83	36.22

System setup

System setup



System setup

System setup

System setup

ASD Measurement sequence

(every 15 minutes from 6 am to 6 pm):

1) ASD_{ref} optimization (sensitivity to illumination)
2) ASD_{ref} dark current (DC) correction (VIS/NIR)
3) ASD_{ref} white reference measurement

4) ASD_{target} optimization (sensitivity to illumination)
5) ASD_{target} dark current (DC) correction (VIS/NIR)
6) ASD_{target} measurement (7 viewing angles)

System setup

ASD Measurement sequence

(every 15 minutes from 6 am to 6 pm):

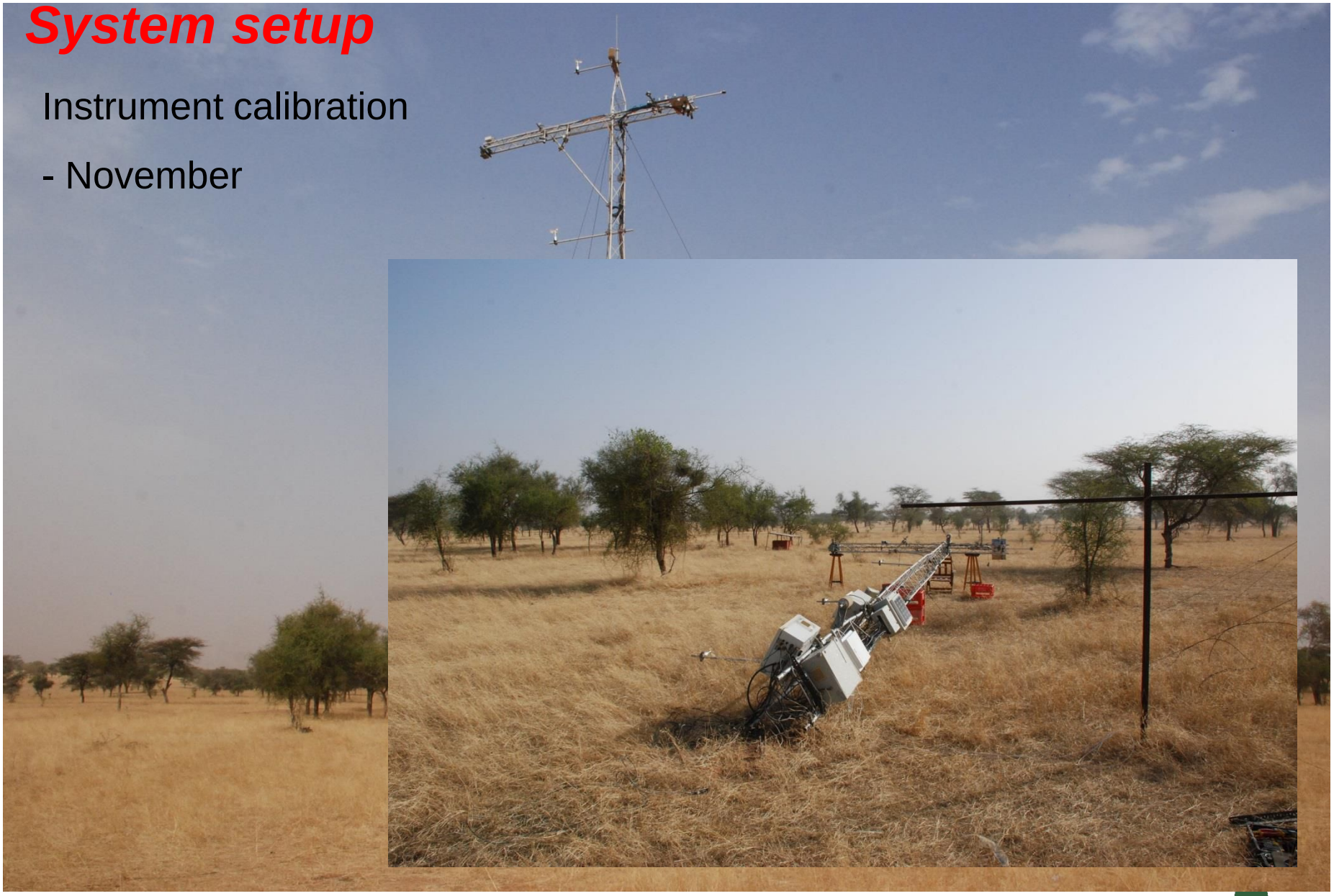
7) ASD_{ref} optimization (sensitivity to illumination)
8) ASD_{ref} dark current (DC) correction (VIS/NIR)
9) ASD_{ref} white reference measurement

- 1. and 2. ASD_{ref} measurents used for data filtering (removing measurements of fractions outside 0.95-1.05)
- 30 scans are averaged every time
- Full measurement sequence takes less than 1 minute

System setup

Instrument calibration

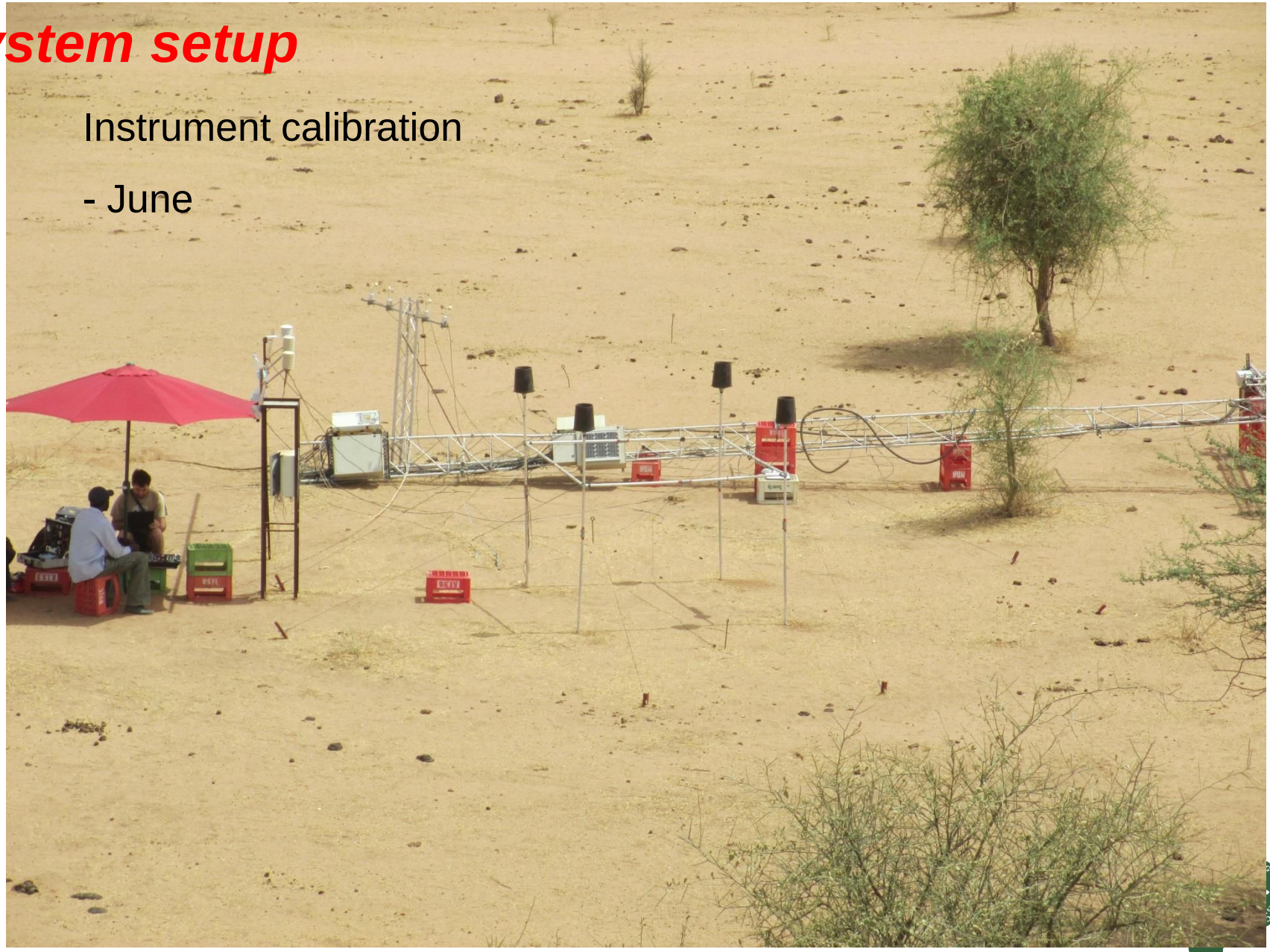
- November



System setup

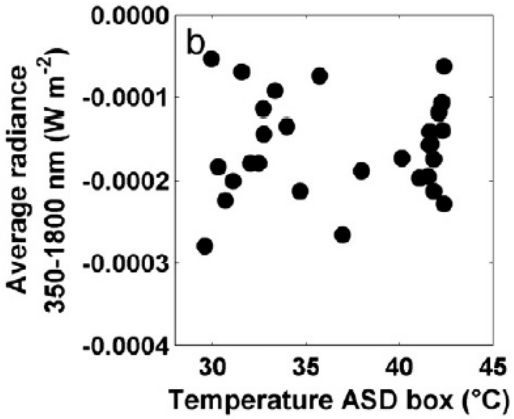
Instrument calibration

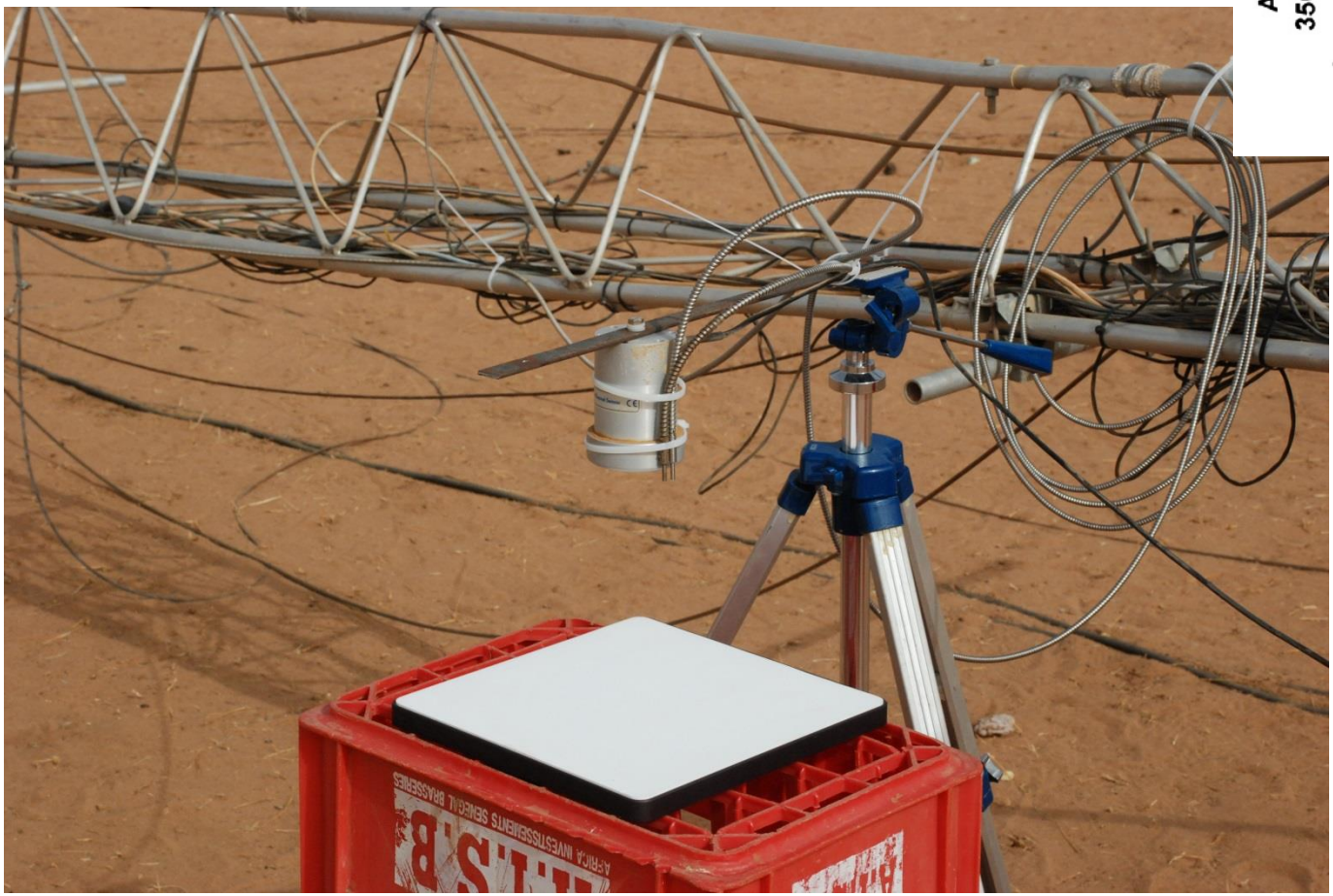
- June



System setup

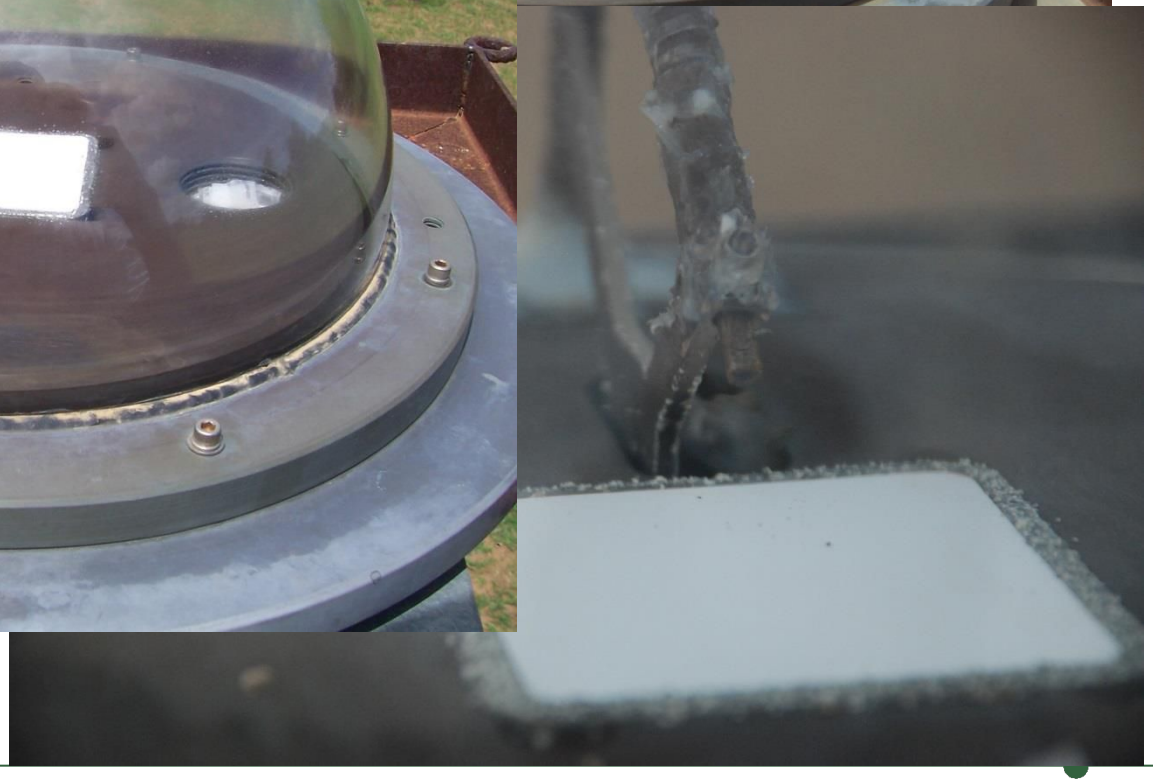
Instrument calibration





System setup

Instrument maintenance



System setup

External threats

ASD instruments for continuous unattended measurements: *Some results*

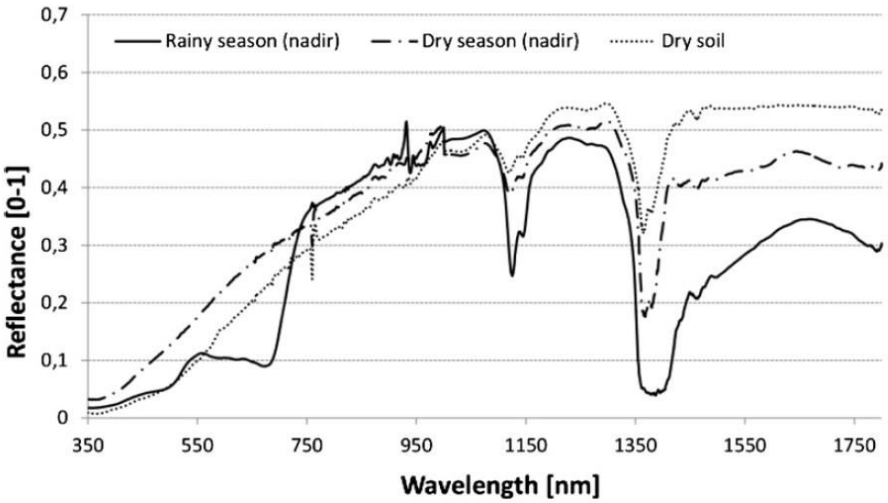


Fig. 5. Mean nadir spectra for the rainy season 2011 (DOY 237–251), the dry season 2012. (DOY 71–85) and dry soil 2013 (DOY 14).

Contents lists available at ScienceDirect

Remote Sensing of Environment

journal homepage: www.elsevier.com/locate/rse

An automated field spectrometer system for studying VIS, NIR and SWIR anisotropy for semi-arid savanna

Silvia Huber [a,*], Torbern Tagesson [b], Rasmus Fensholt [b]

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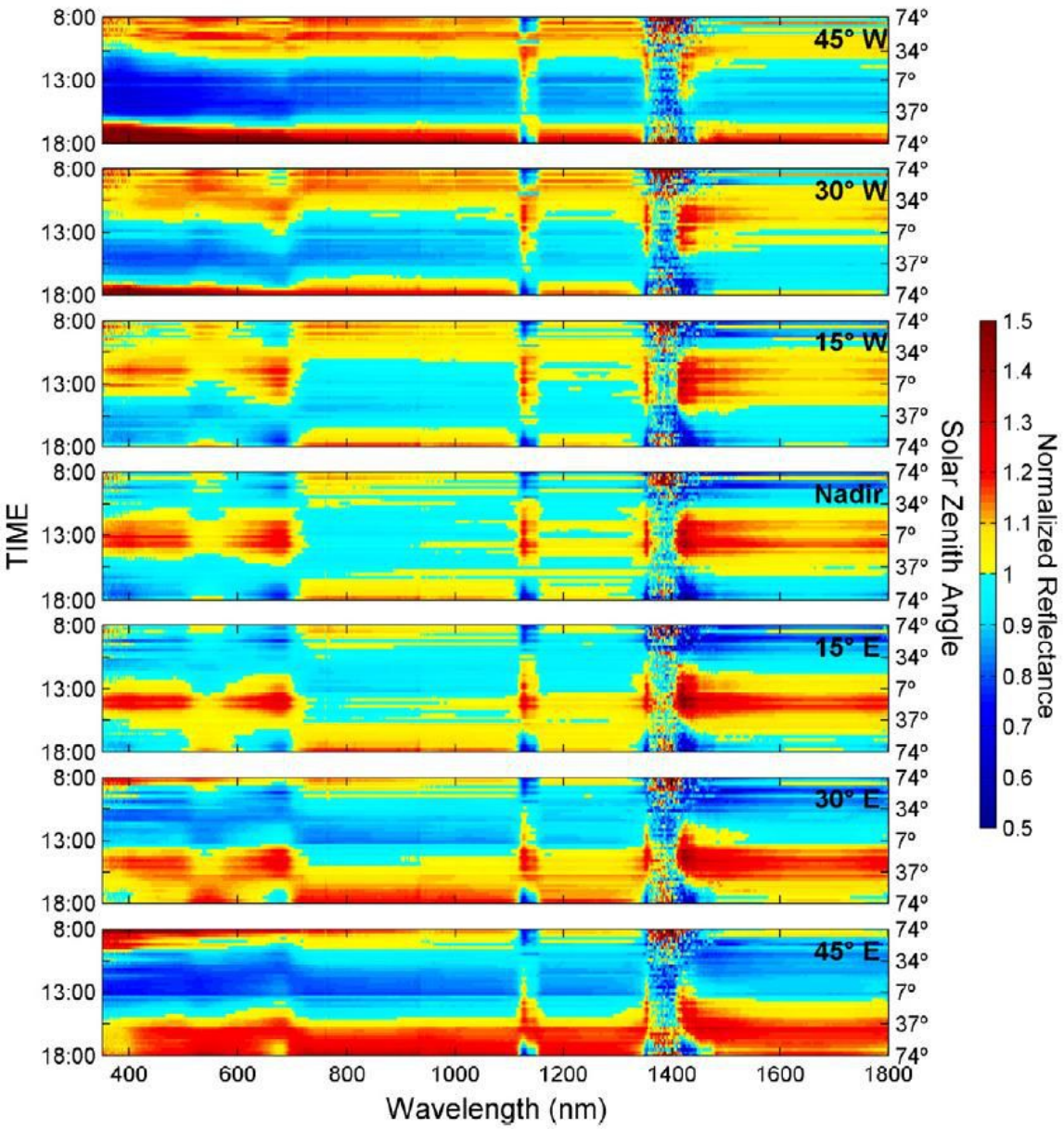
[b] Department of Geosciences and Natural Resource Management, University of Copenhagen, Øster Voldgade 10, DK-1350 Copenhagen, Denmark

Results – angular dependence



Normalized reflectance

(fraction of the time-specific reflectance divided by the daily average)

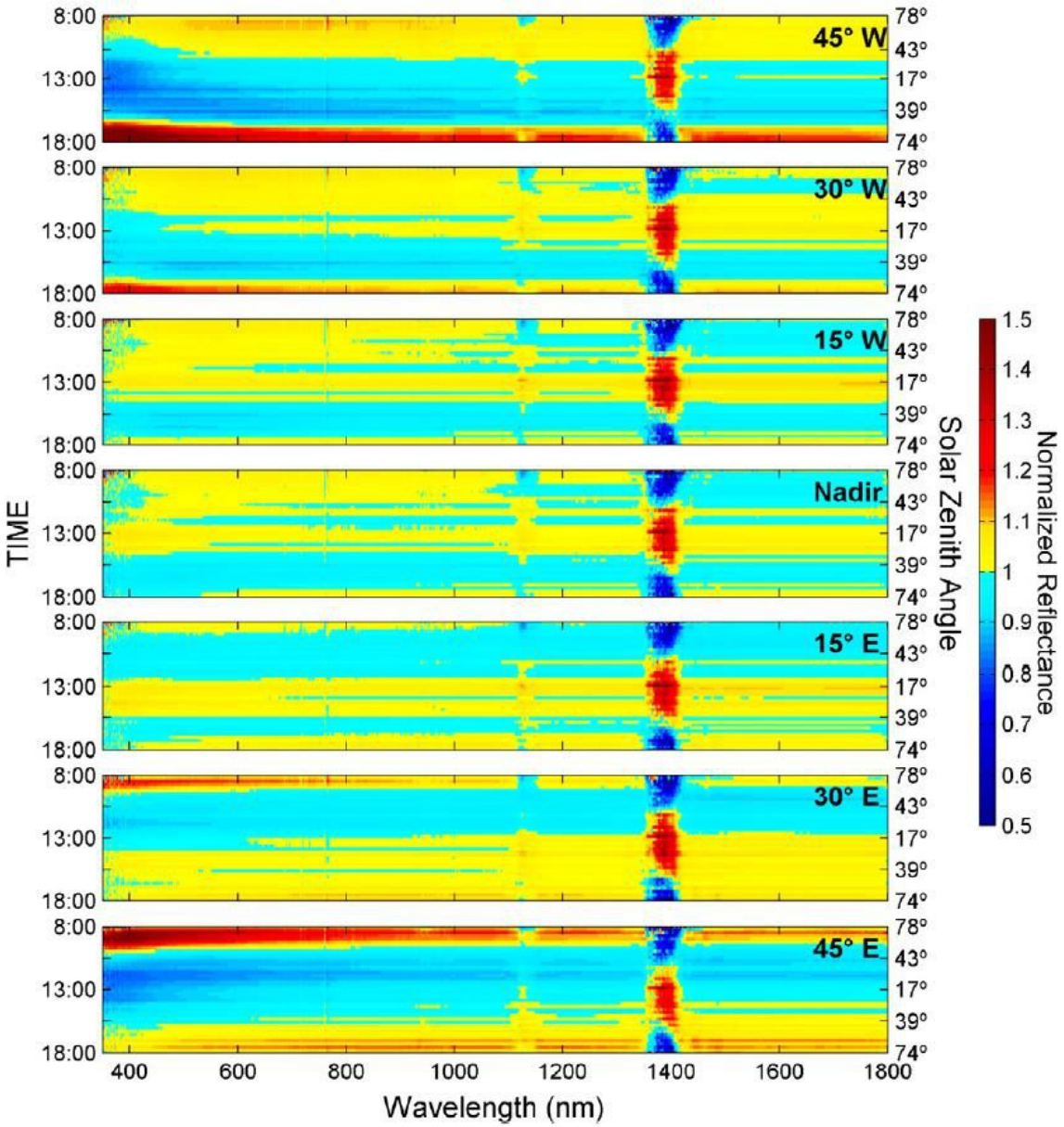
for the rainy season 2011

(DOY 237–251)

measured from sunrise to sunset

(solar noon is around 13:00).

Results – *angular dependence*



Normalized reflectance

(fraction of the time-specific reflectance divided by the daily average)

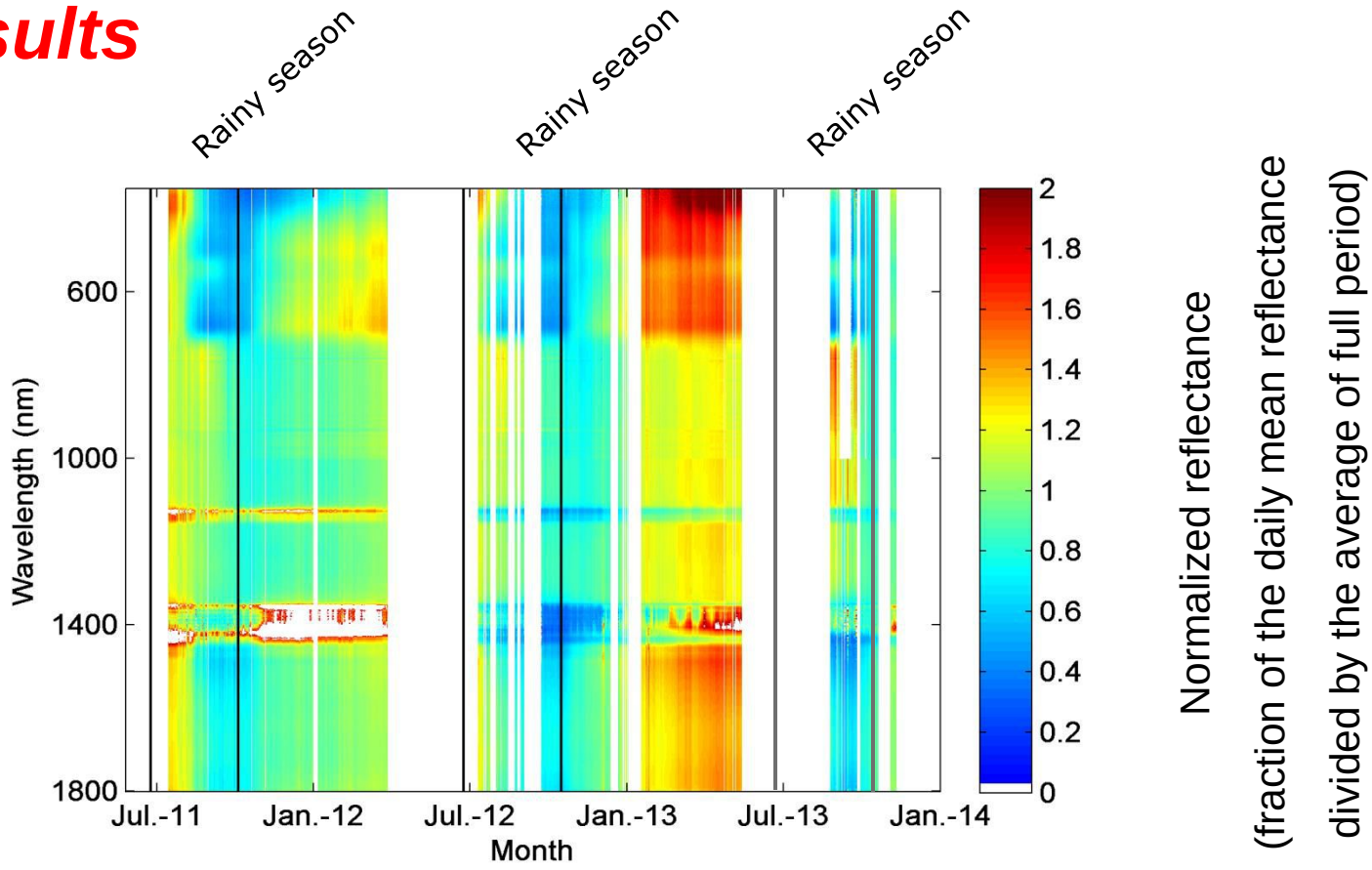
for the dry season 2012

(DOY 71–85)

measured from sunrise to sunset

(solar noon is around 13:00).

Results

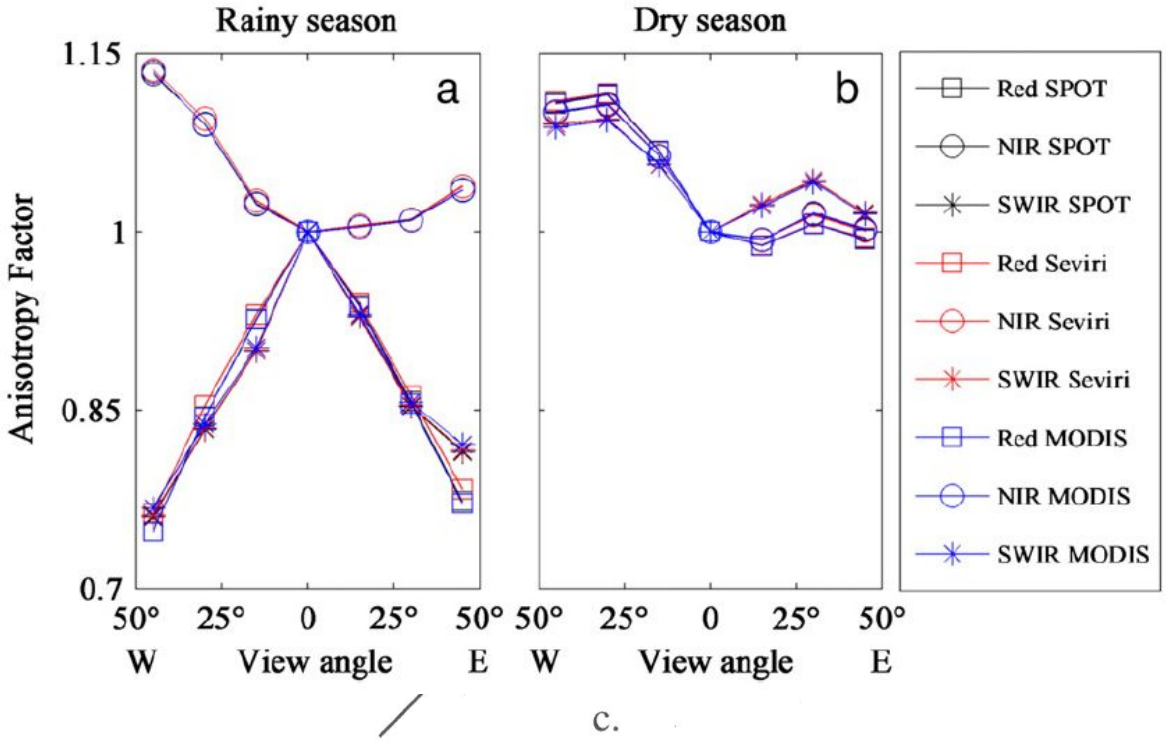


From June 2015 – today:

Measurements without data-gaps acquired

with DC shutter turned off/removed (applied twice a year)

Vegetation indices and directional effects



c.

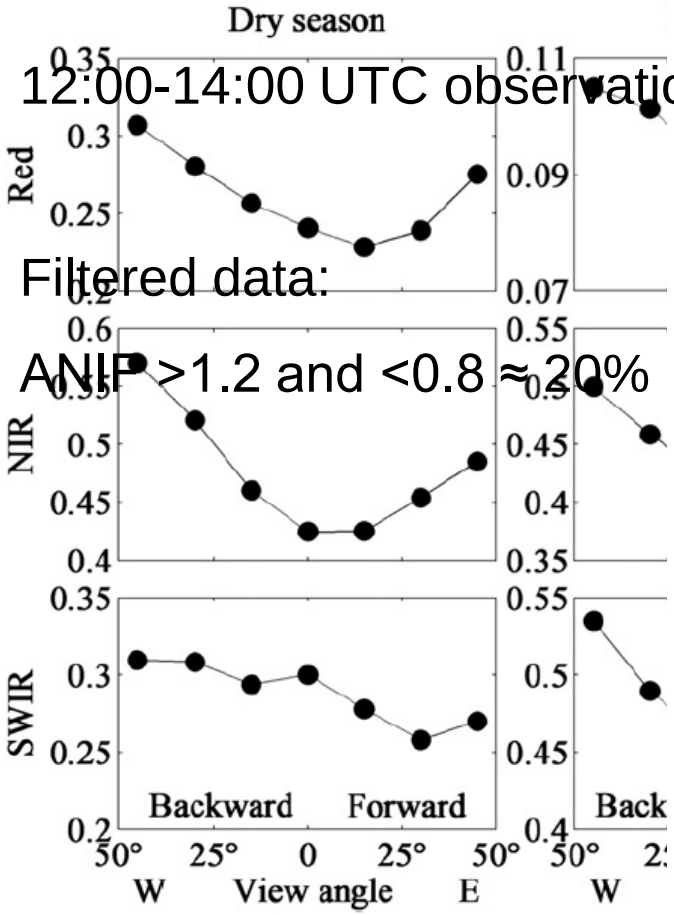
Red, near infrared (NIR) and shortwave infrared (SWIR) bandwidths for MODIS, SEVIRI and SPOT, respectively.

Sensor	Red [nm]	NIR [nm]	SWIR [nm]
MODIS	620-670 (50)	841-876 (35)	1628-1652 (24)
SEVIRI	560-710 (150)	740-880 (140)	1500-1780 (280)
SPOT	610-680 (70)	780-890 (110)	1580-1750 (170)

ANIF:

The portion of radiation reflected into a specific view direction relative to the nadir reflectance.

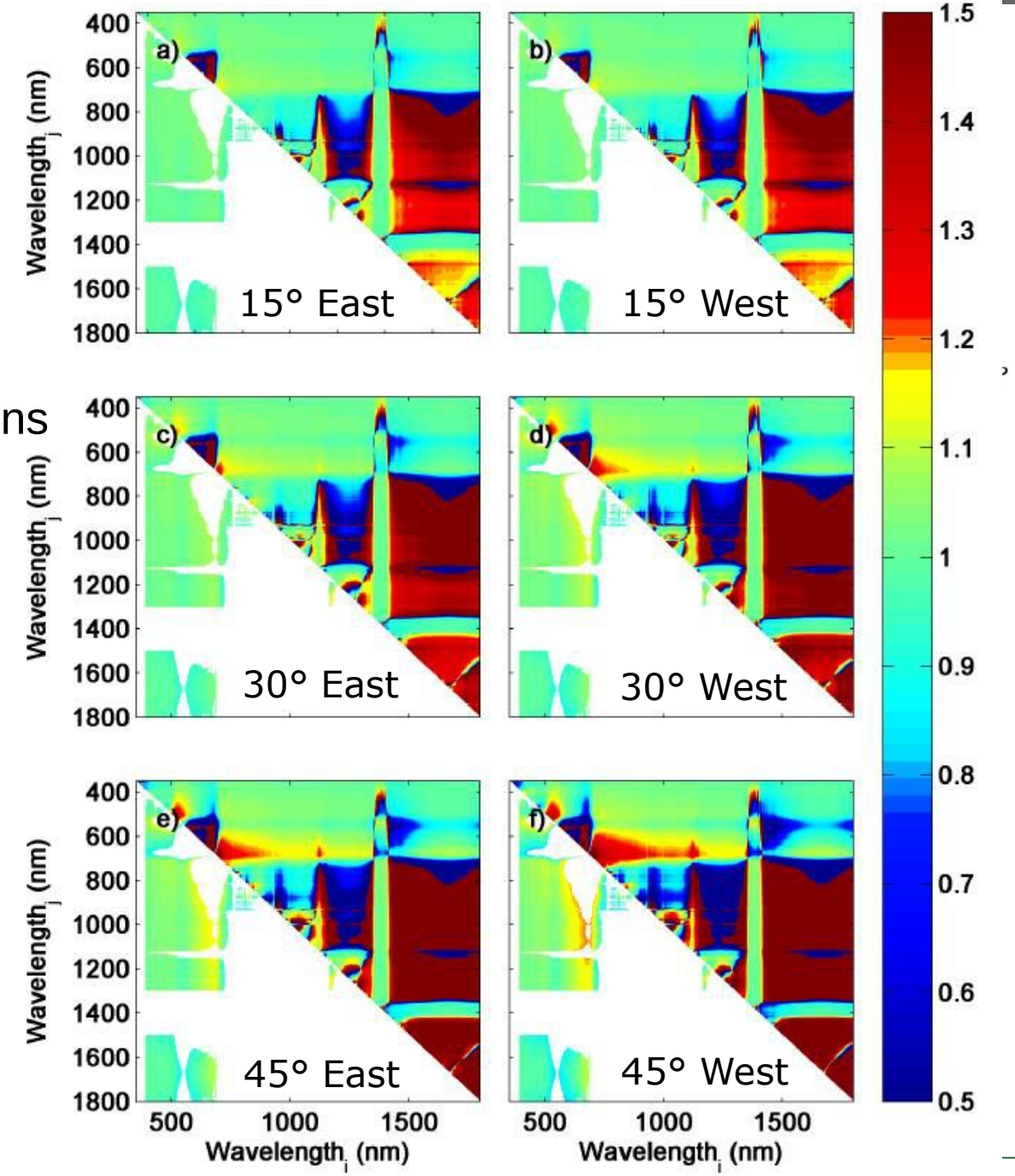
Vegetation indices a directional effects



12:00-14:00 UTC observations

Filtered data:

ANIP >1.2 and <0.8 ≈ 20%



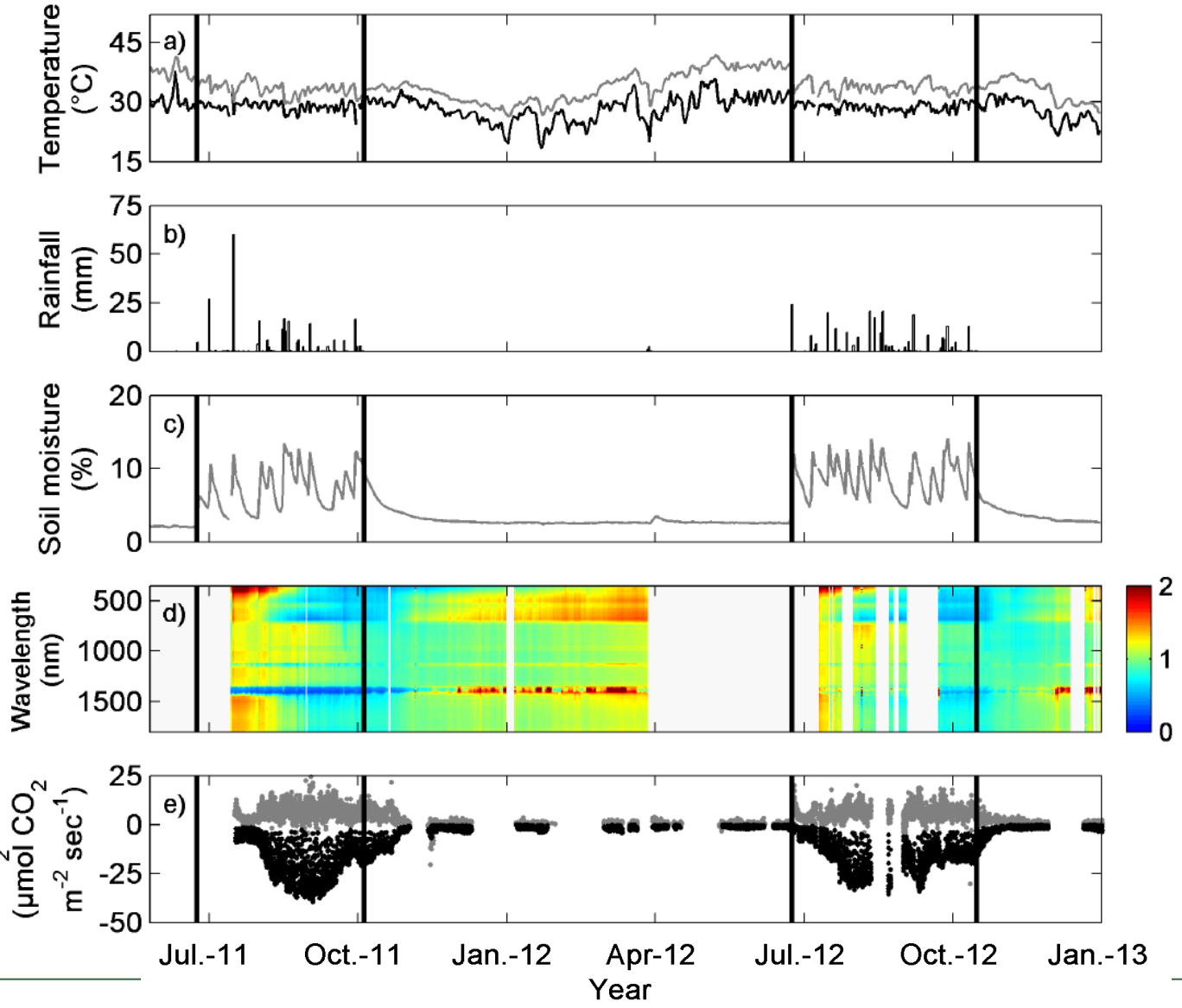
ASD hyperspectral reflectance data and savanna ecosystem properties

Biogeosciences, 12, 4621–4635, 2015
www.biogeosciences.net/12/4621/2015/
doi:10.5194/bg-12-4621-2015

Biogeosciences

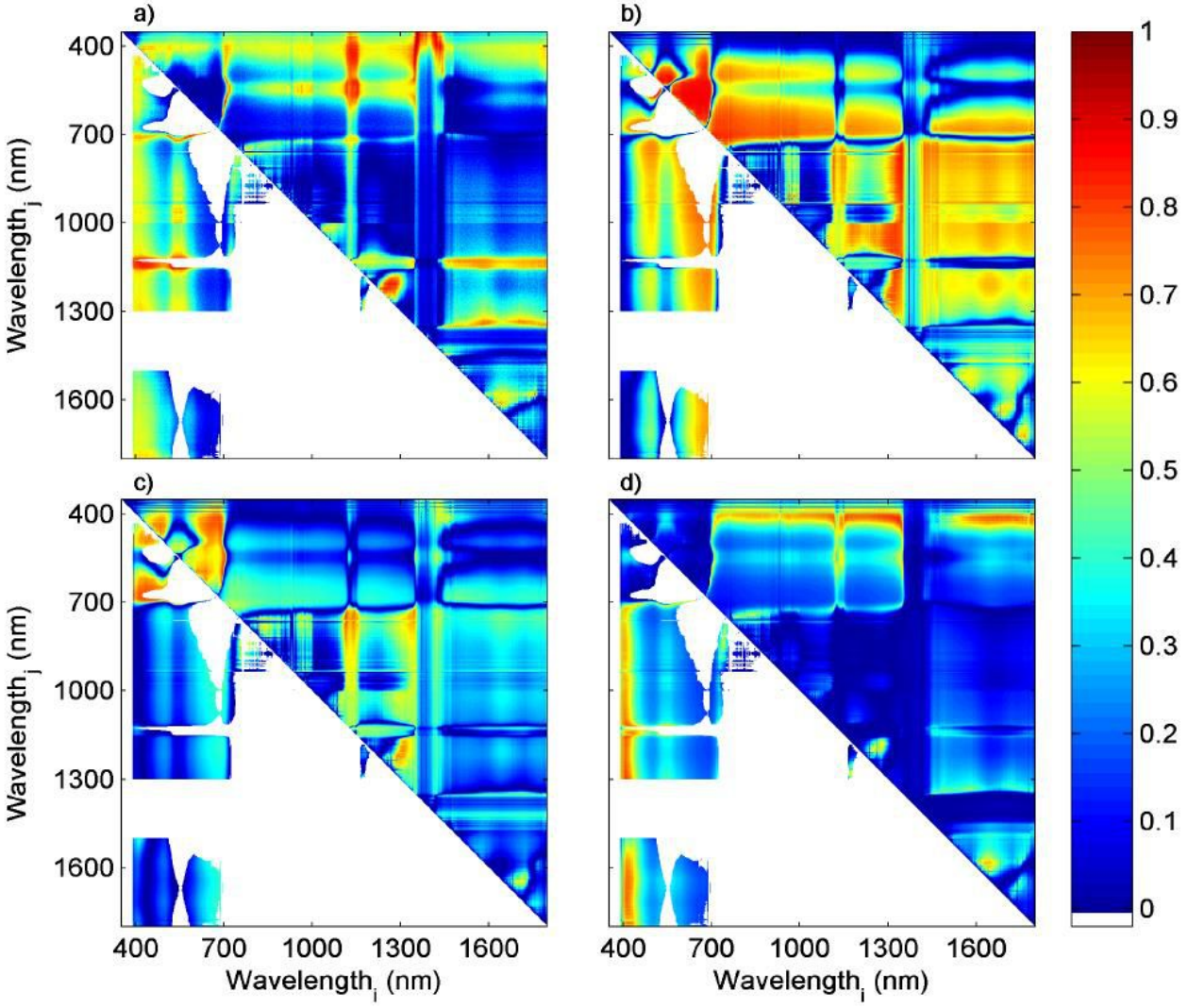
Deriving seasonal dynamics in ecosystem properties of semi-arid
ıds from in situ-based hyperspectral reflectance

. Huber[2], S. Horion[1], I. Guiro[3], A. Ehammer[1], and J. Ardö[4]



ASD hyperspectral reflectance data and savanna ecosystem properties

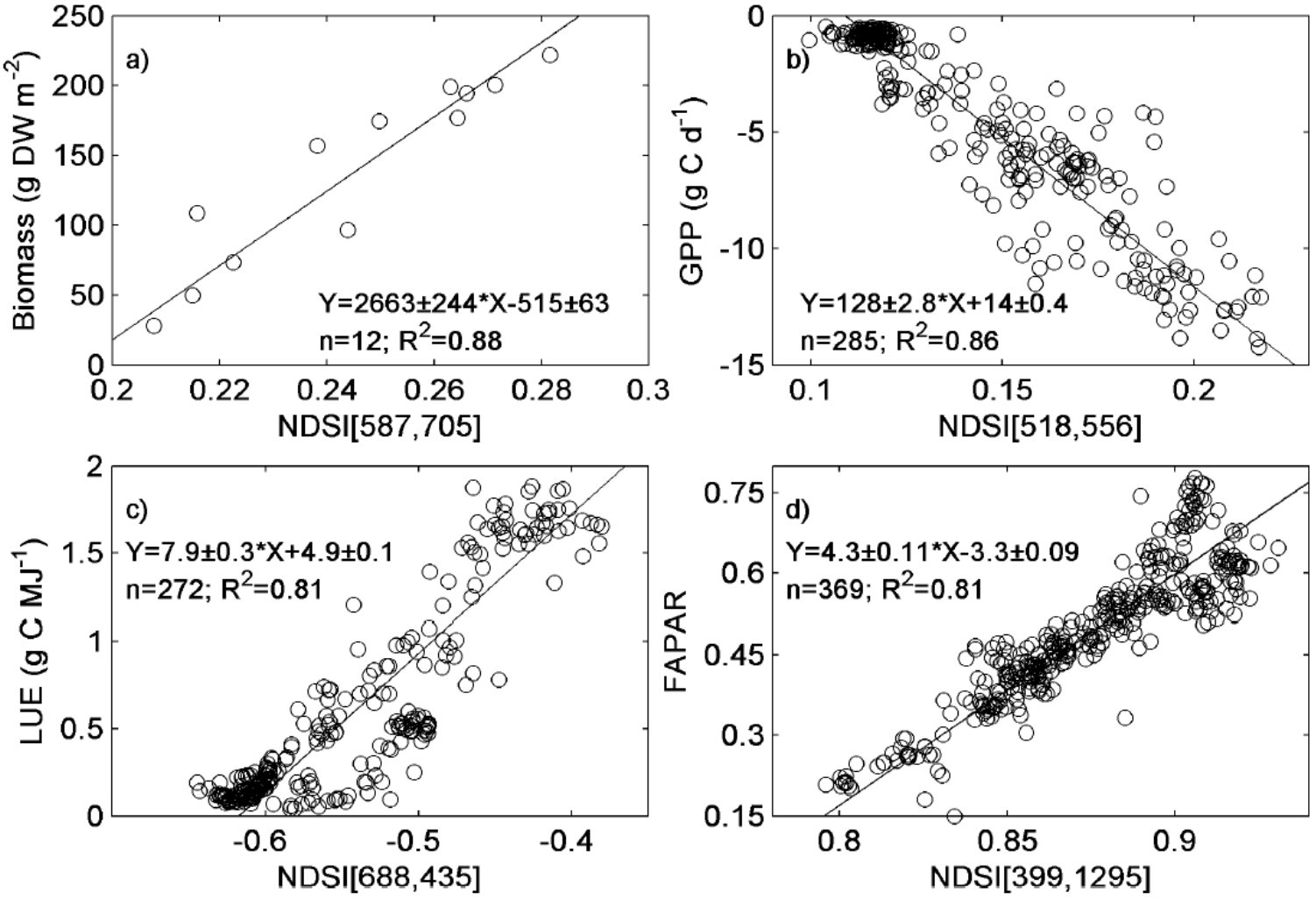
$$NDSI = \frac{(\rho_i - \rho_j)}{(\rho_i + \rho_j)}$$



ASD hyperspectral reflectance data and savanna ecosystem properties

$$NDSI = \frac{(\rho_i - \rho_j)}{(\rho_i + \rho_j)}$$

Strongest correlation:



Lessons learned and recommendations for ASD continuous unattended measurements

- **Avoid excessive use of Dark Current calibration**
- **Frequent instrument inter-calibration**
- **Use metal coated fiber-optical cables**
- **Regular cleaning of dome (maintenance)**

Thank you

– and sorry for not being there in person