Rainfall partitioning in differently used montane forests of Central Sulawesi, Indonesia

Johannes Dietz

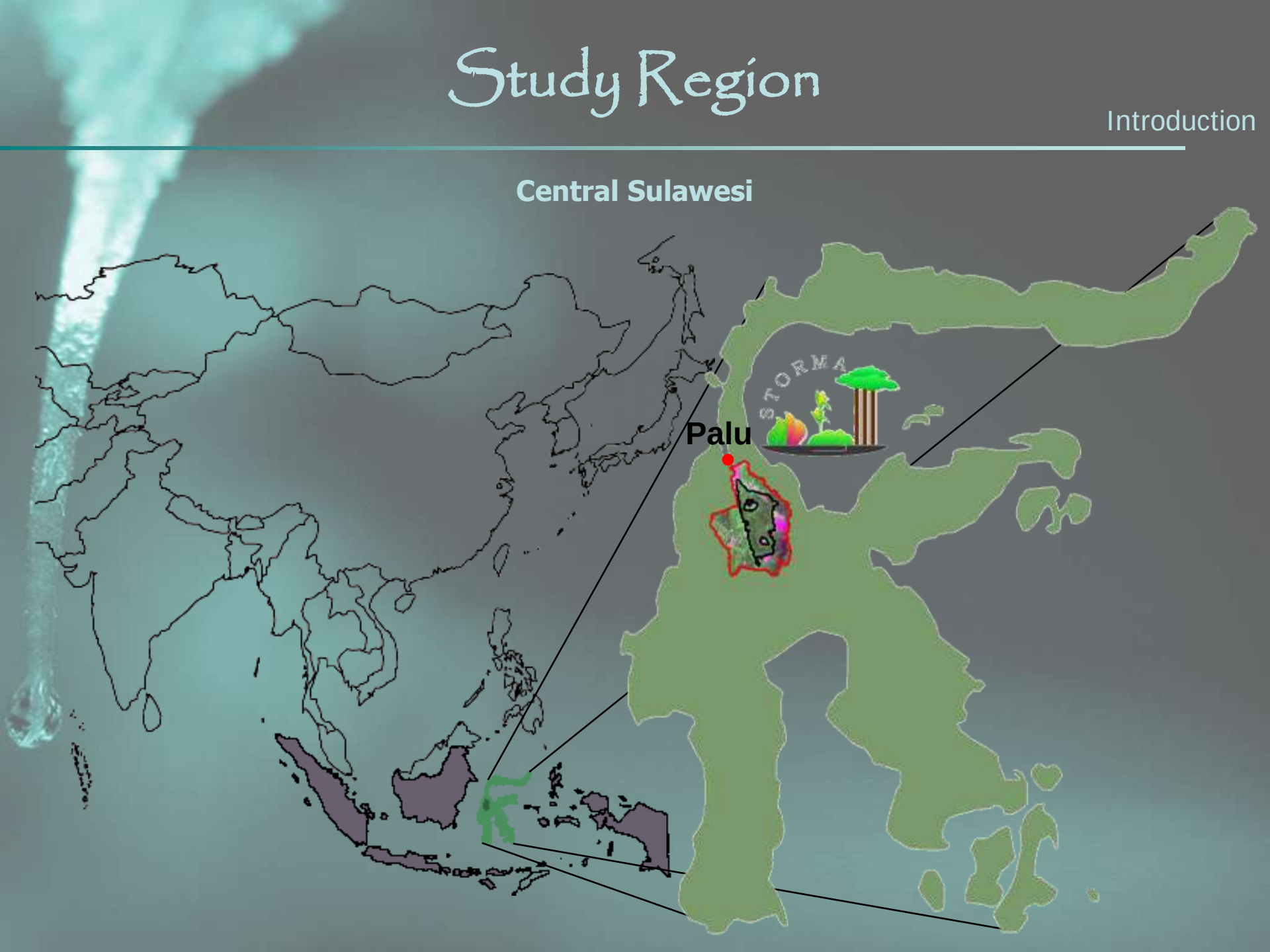
STORMA

Study Region

Indonesia

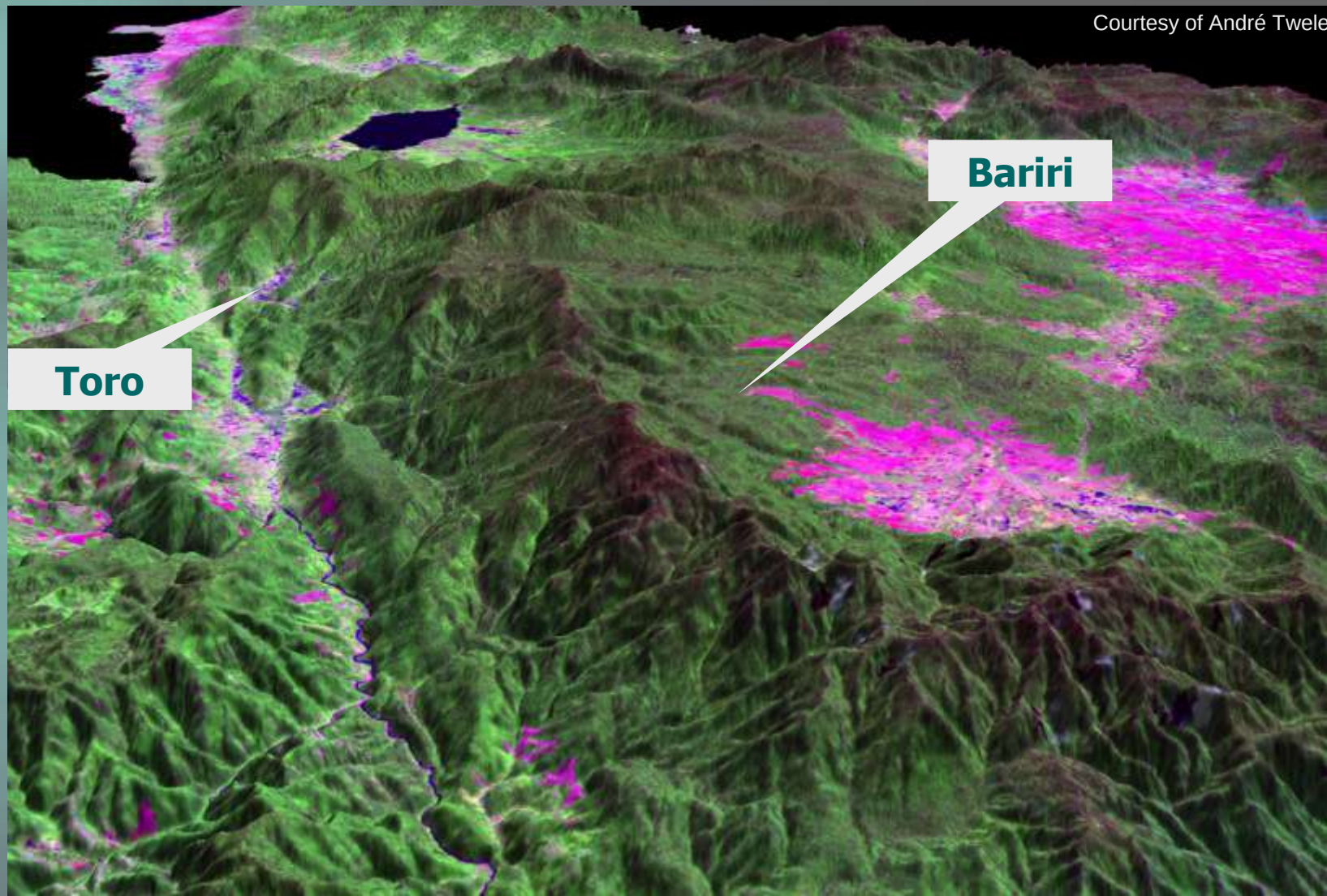


Study Region



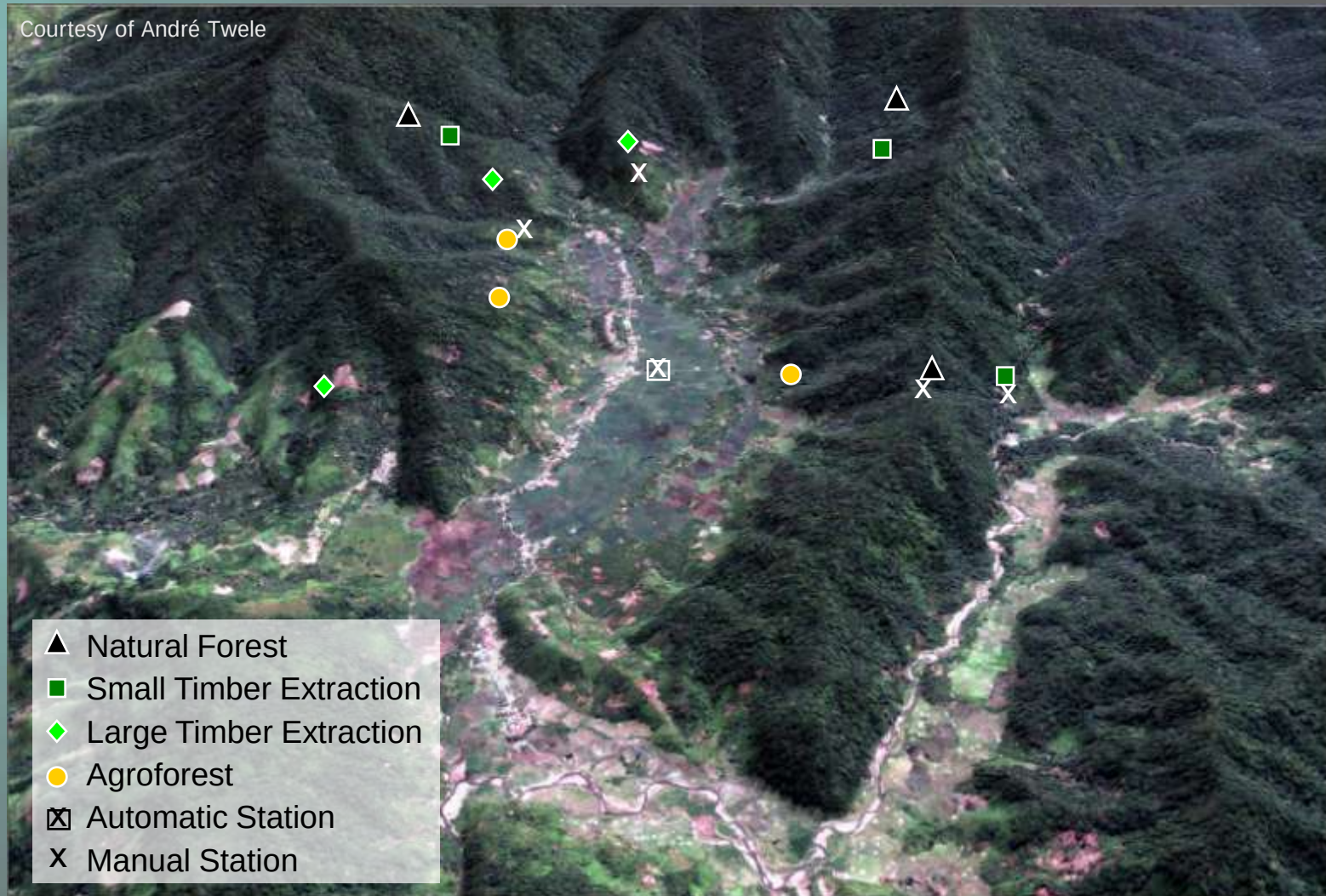
Study Region

Lore Lindu National Park

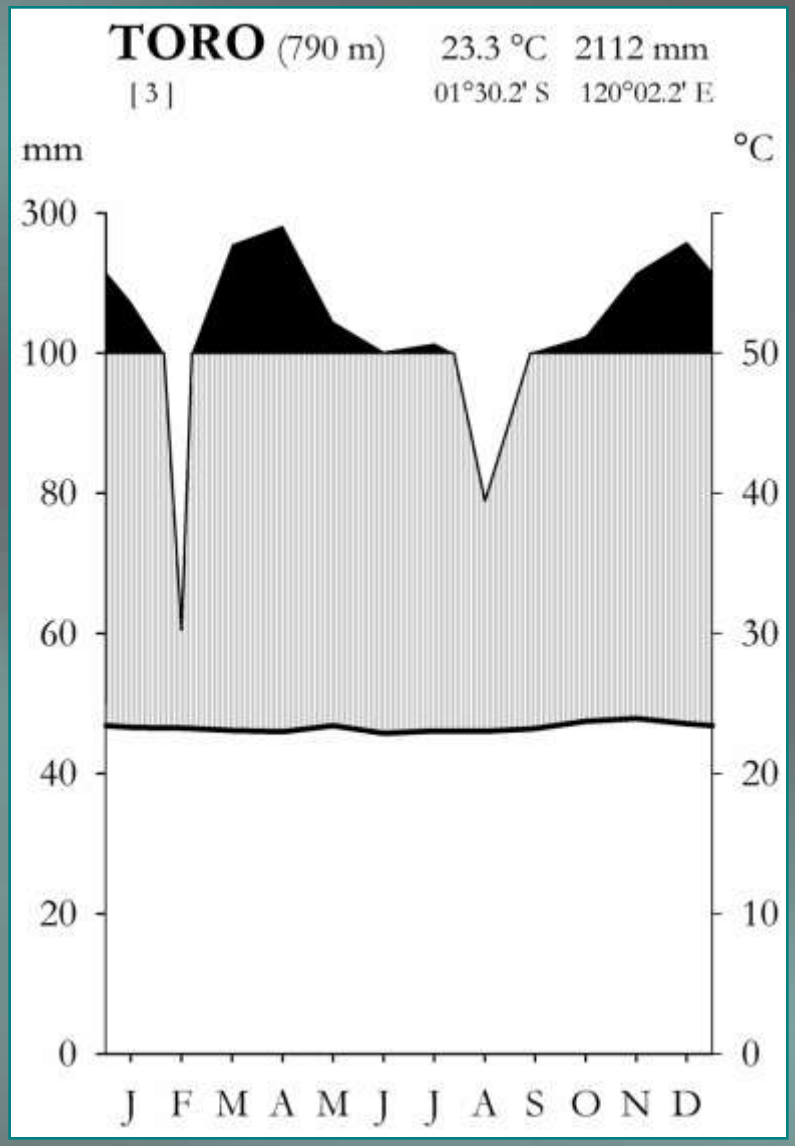


Study Region

Research Sites in Ngata Toro



Climate



Kreilein (unpubl. data)

Climate

In Numbers

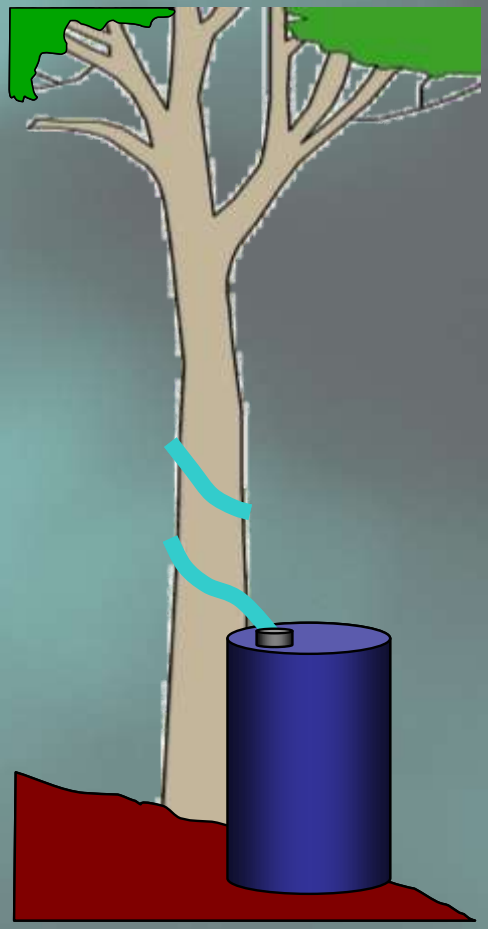
Elevation (m asl)	800 - 1140
Mean temperature (°C)	23.1
Gross precipitation, *Pg* (mm)	1828
Number of days observed	366
Number of days *Pg* > 0.2 mm	218 (60 %)
Number of storms	282
Average storm size (mm)	6.5
Average storm duration (h)	1.9
Avrg. rainfall intensity, $\overline{R}$ (mm h^{-1})	3.4

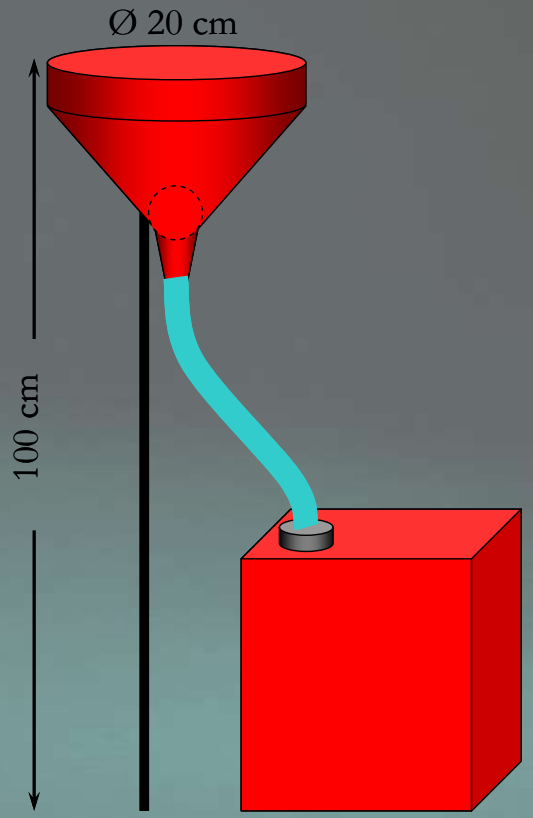
Dietz et al. (2006)

Methods

Stemflow

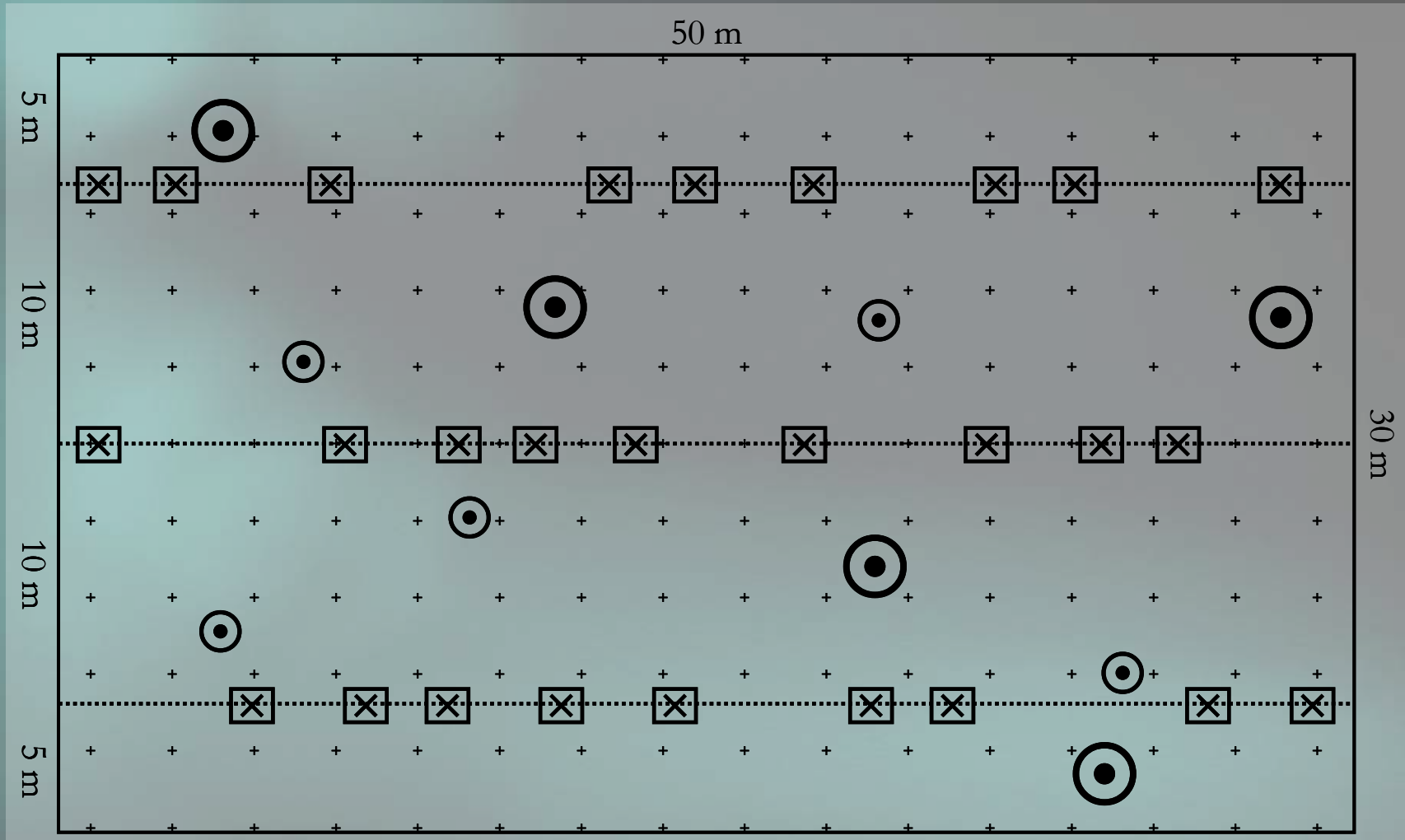
Throughfall





Methods

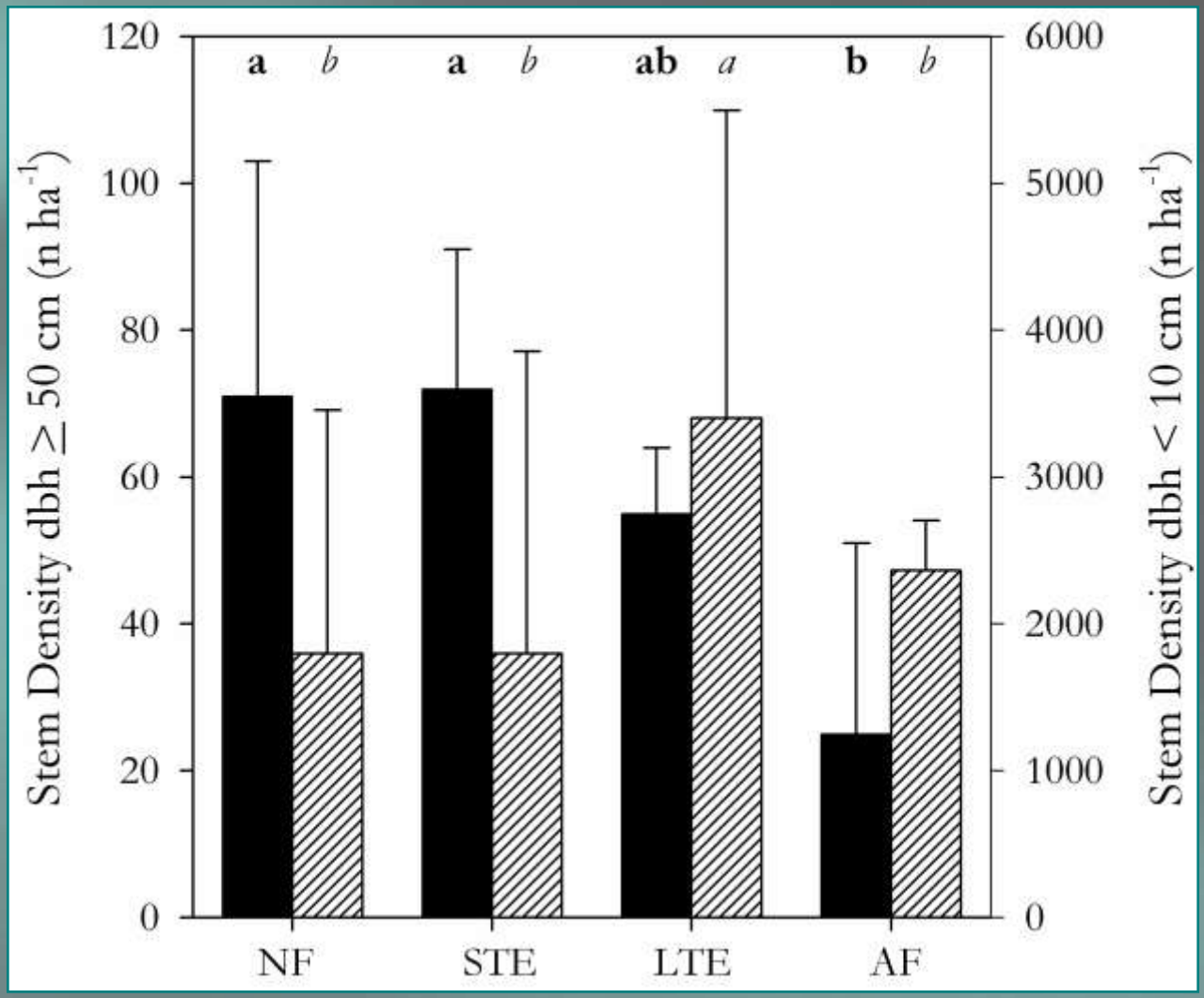
Plot Setup



Objectives

- To conduct a quantitative, comparative analysis of stand structural characteristics presumed to be important for rainfall partitioning under the notion of different forest use.
- To determine rainfall partitioning into throughfall, stemflow and interception in the differently used forest stands.
- To single out stand structural characteristics that may control the partitioning by regression analyses.
- To quantify the spatial variability of throughfall with fine resolution in contrasting vegetation types.
- To analyze leaf wetness patterns in rainless and rainy periods.

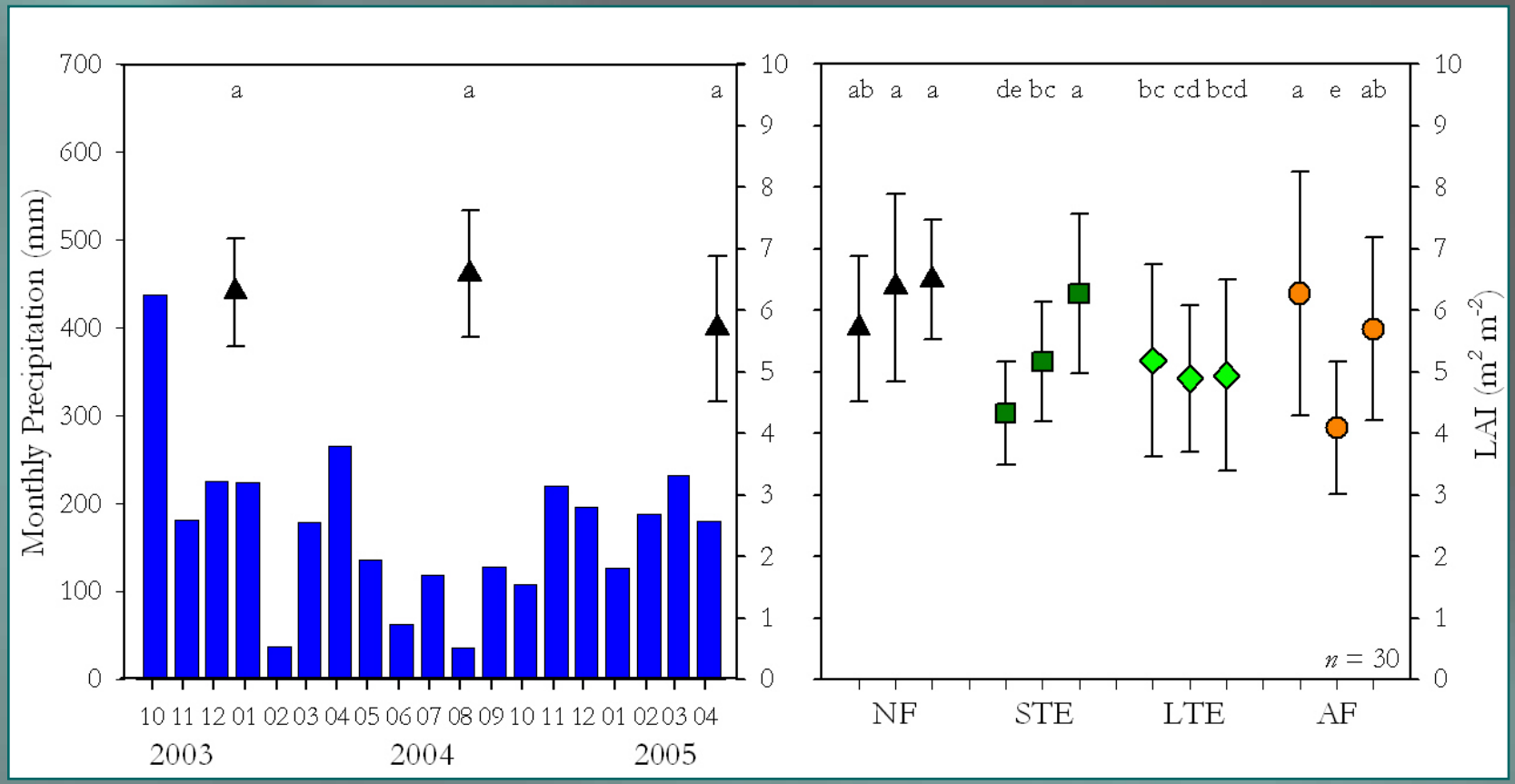
Stem Density



Dietz et al. (2007)

Leaf Area

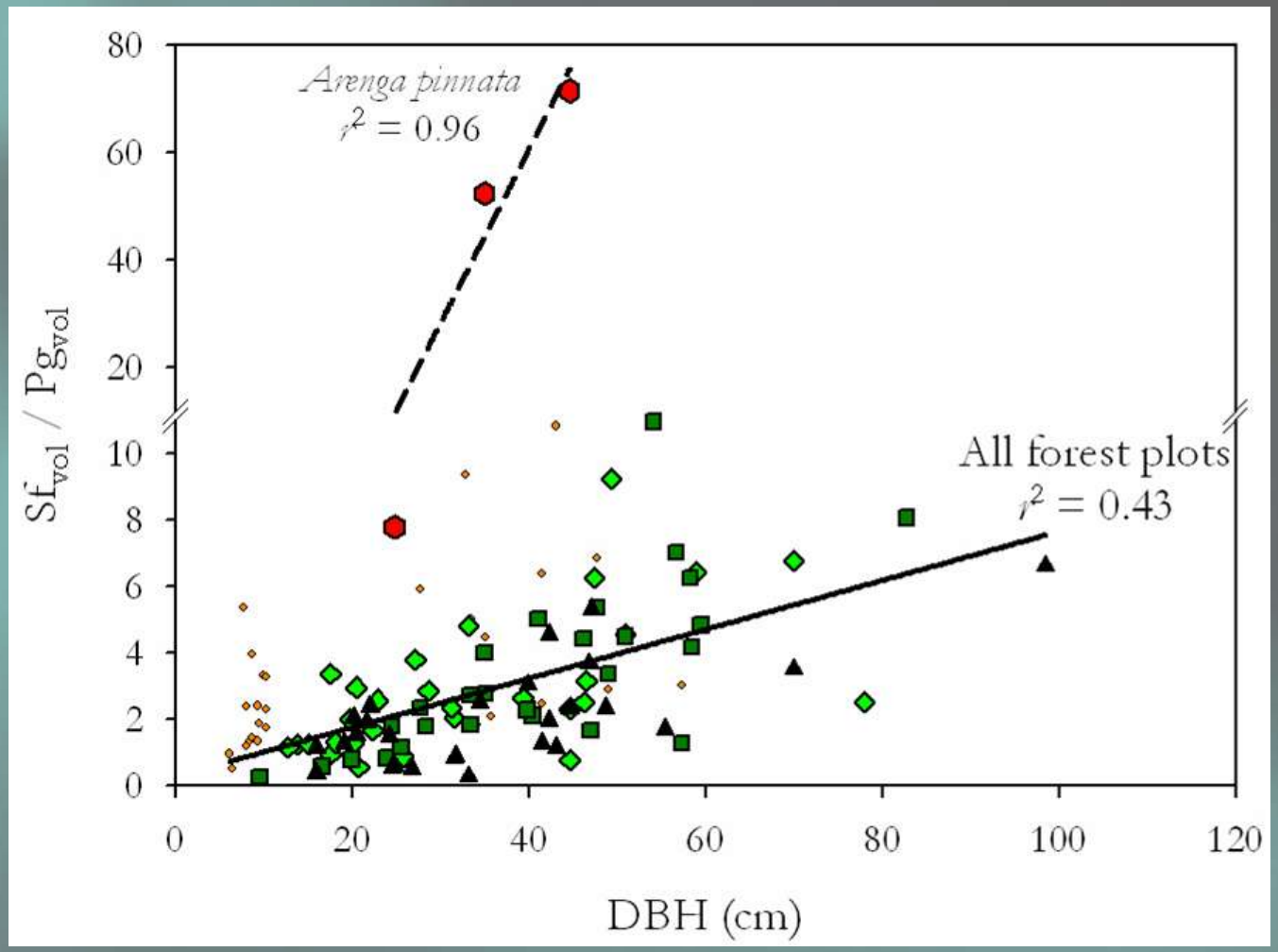
Seasonality vs. Forest Use Intensity?



Dietz et al. (2007)

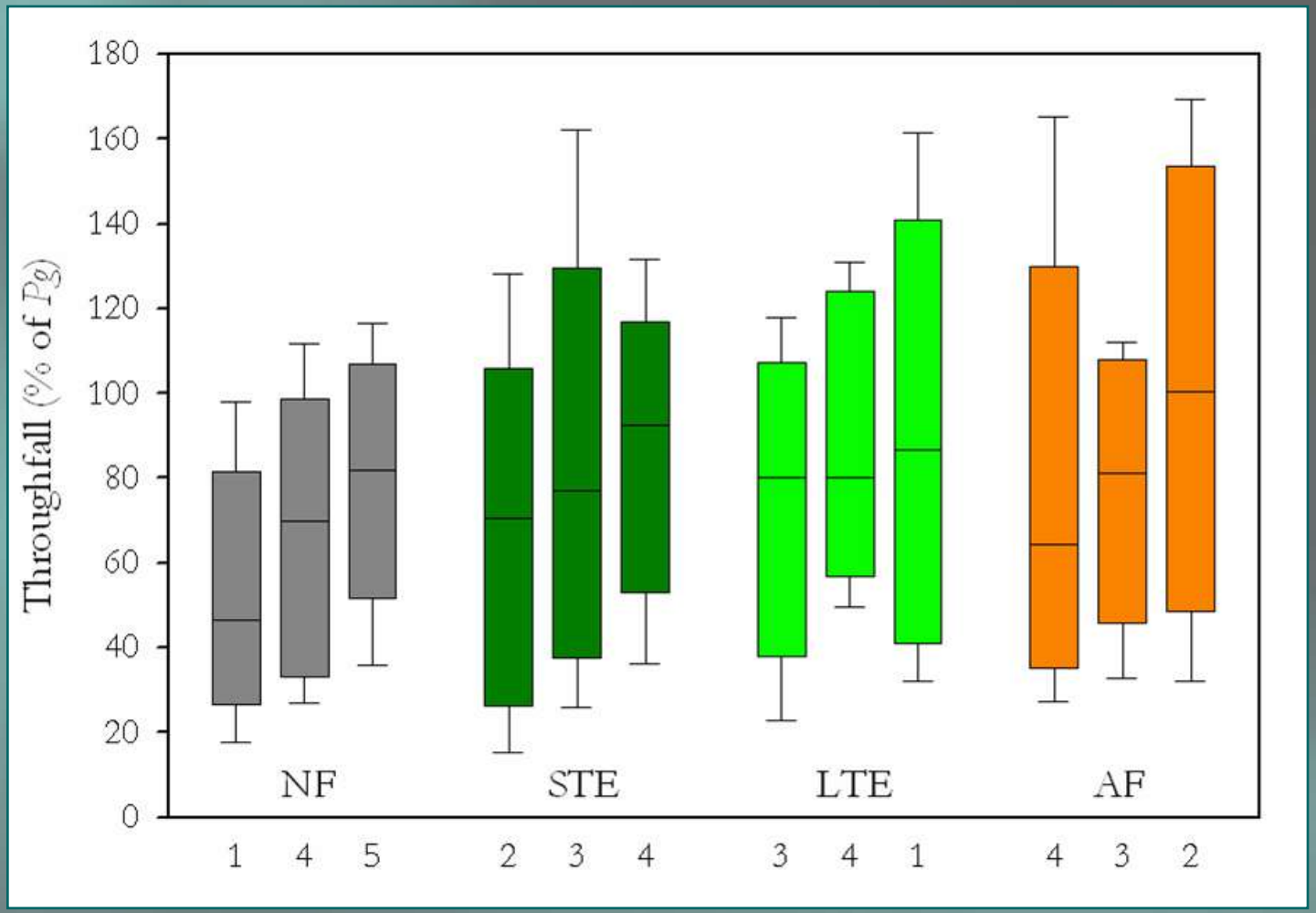
Stemflow

Impact of palms?

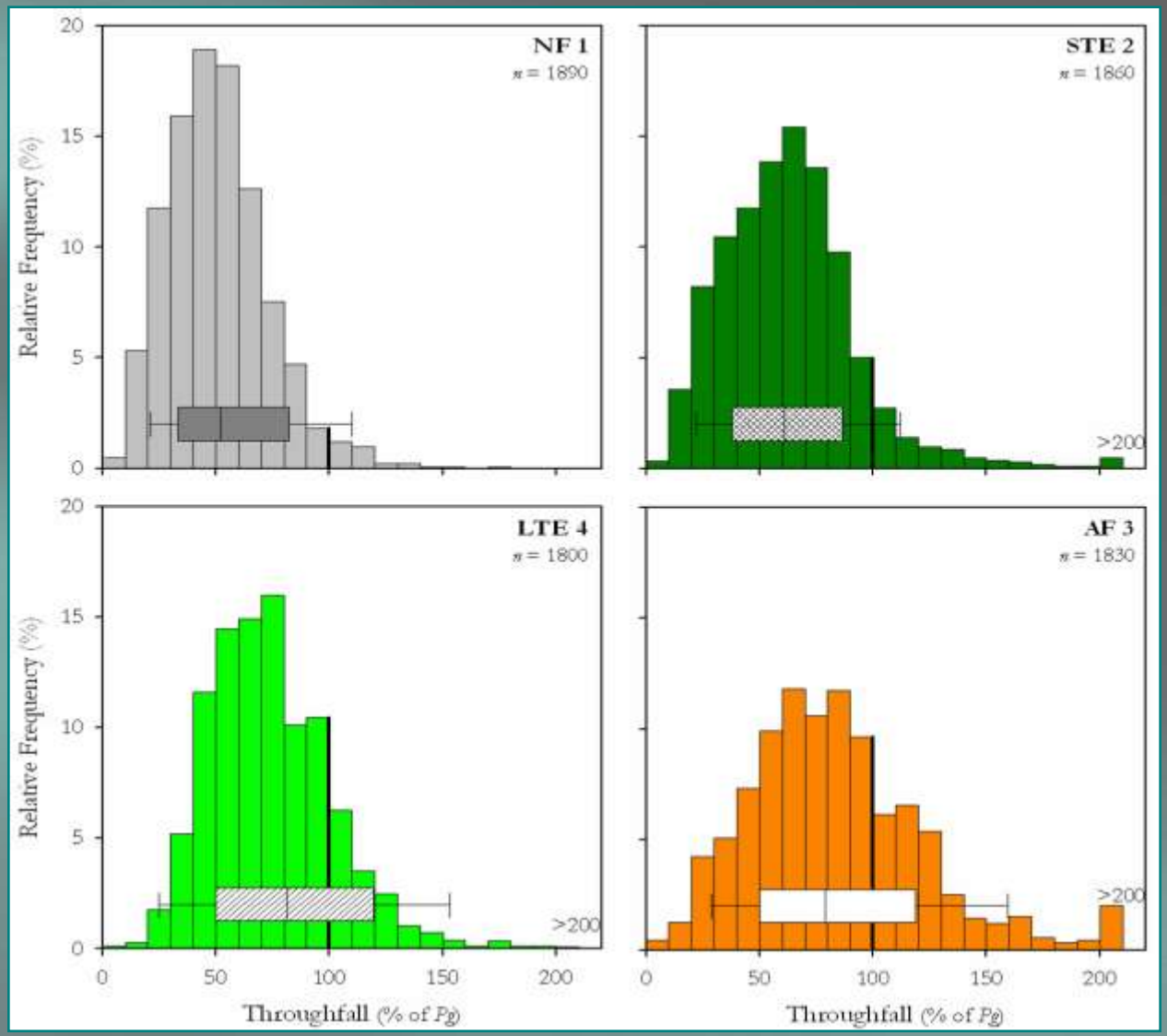


Throughfall

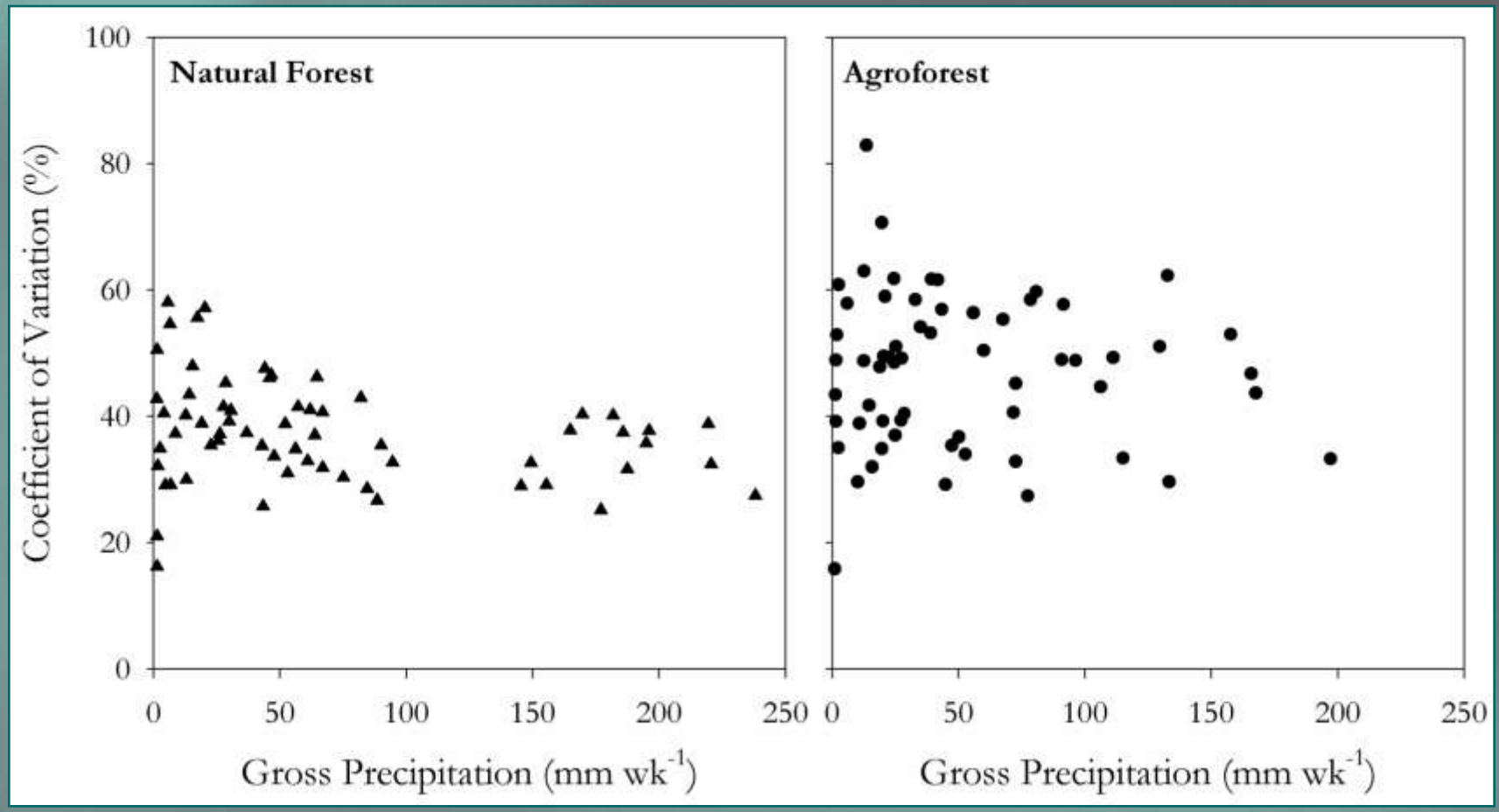
Impact of Forest Use Intensity?



Spatial Distribution



Spatial Variation



Klank et al. (under review)

Spatial Variation

		Throughfall in natural forest			Throughfall in agroforest		
		Pg > 0 mm	*Pg* 0-5 mm	*Pg* ≥ 5 mm	*Pg* > 0 mm	*Pg* 0-5 mm	*Pg* ≥ 5 mm
Canopy Openness		0.01	-0.02	0.03	0.03	**0.10**	0.03
LAI		**0.11**	0.08	**0.10**	0.09	0.05	0.05
Trees	≥ 2 m	*n.d.*	*n.d.*	*n.d.*	0.00	-0.02	-0.01
	dbh < 10 cm	*n.d.*	*n.d.*	*n.d.*	0.00	0.00	0.02
	dbh ≥ 10 cm	-0.07	-0.08	0.02	-0.02	-0.05	-0.03

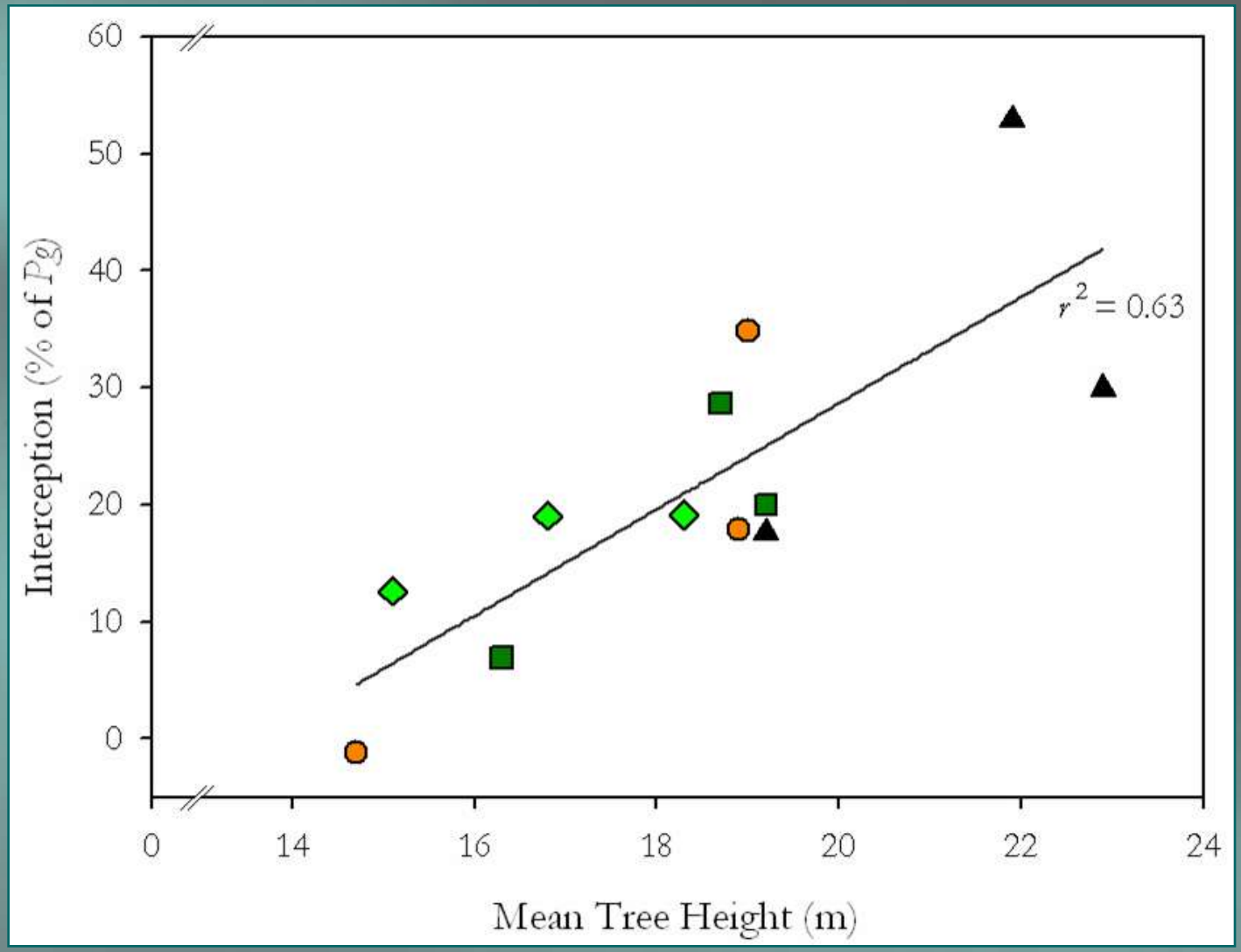
Correlations

Rainfall Partitioning

	Throughfall (% of *Pg*)			Interception (% of *Pg*)
	Pg ≤ 10 mm d^{-1}	*Pg* > 10 mm d^{-1}	All days	All days
Elevation (m asl)	-0.02	0.40	0.32	-0.32
Exposition (°)	-0.13	-0.13	-0.03	0.03
Inclination (°)	0.19	-0.50	-0.36	0.36
Stem density				
all stems (n ha^{-1})	0.13	0.24	0.16	-0.16
dbh ≥ 10 cm (n ha^{-1})	-0.12	0.23	0.09	-0.09
dbh ≥ 50 cm (n ha^{-1})	-0.39	-0.31	-0.39	0.39
Basal area				
all stems (m² ha^{-1})	-0.42	-0.45	-0.52	0.52
dbh ≥ 10 cm (m² ha^{-1})	-0.56	-0.28	-0.41	0.41
Mean dbh (dbh ≥ 10 cm) (cm)	-0.36	**-0.83** ***	**-0.69** *	**0.60** *
Mean tree height (dbh ≥ 10 cm) (m)	**-0.58** *	**-0.76** **	**-0.74** **	**0.74** *
Stand mid height (mean dbh) (m)	**-0.58** *	**-0.69** *	**-0.71** **	**0.71** *
Stand top height (highest 10 %) (m)	**-0.69** *	-0.52	-0.51	0.51
Crown extension (m)	-0.32	**-0.73** **	**-0.61** *	**0.61** *
Low crown limit (m)	**-0.71** *	**-0.78** **	**-0.83** ***	**0.83** ***
Leaf area index (m² m^{-2})	-0.15	0.09	0.14	-0.14
Canopy openness (%)	-0.01	0.13	0.29	-0.29

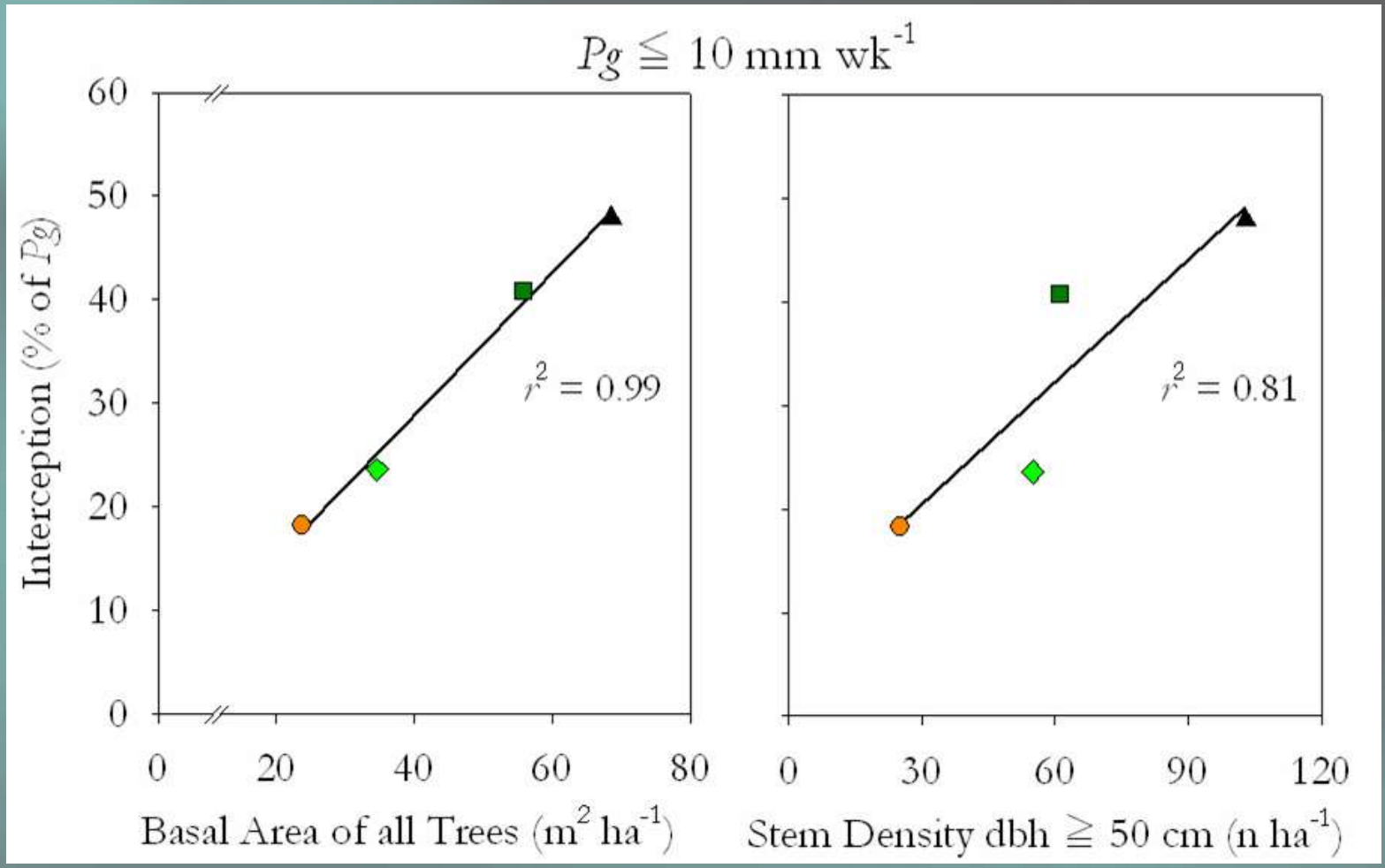
Dietz et al. (2006)

Interception

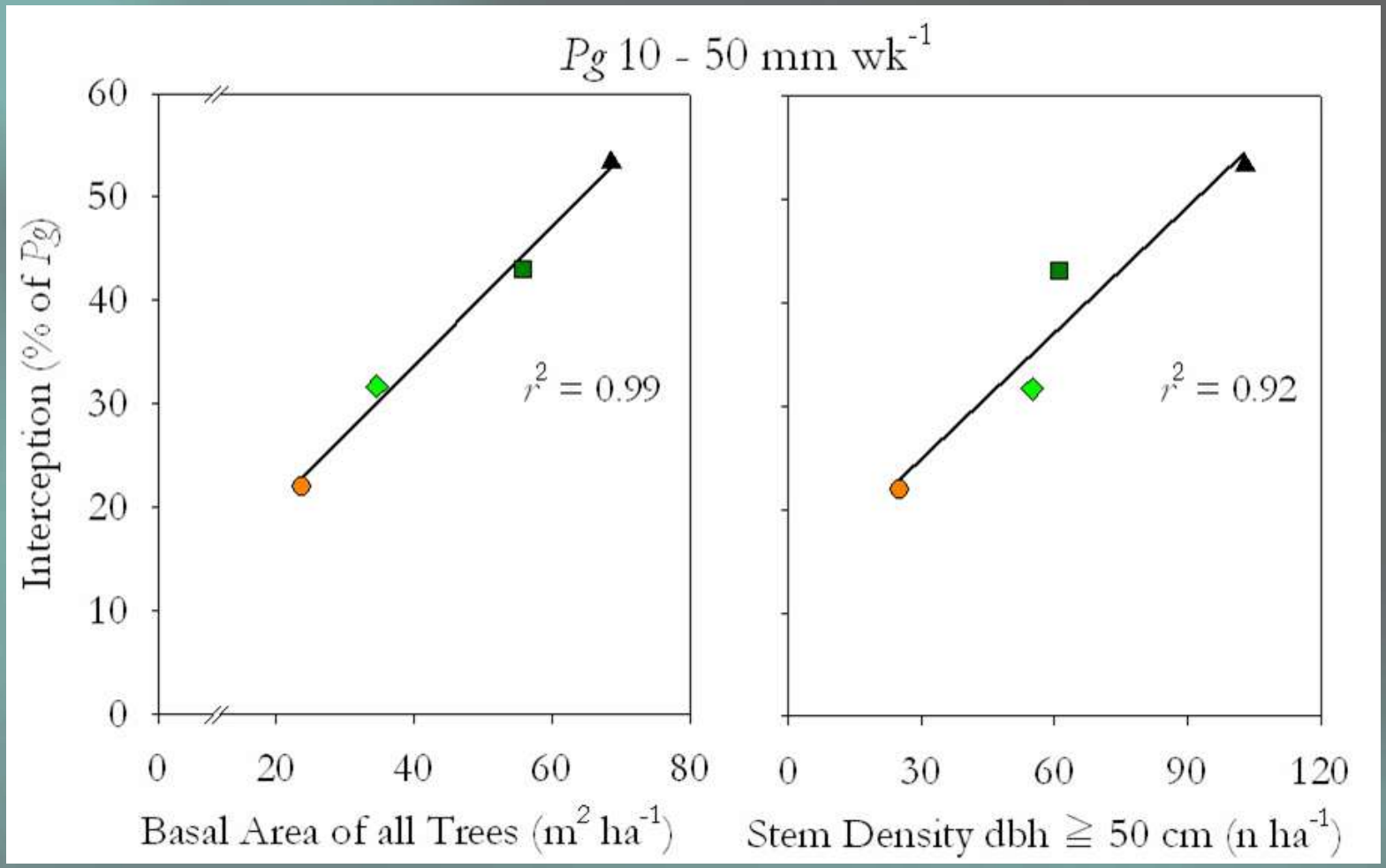


Dietz et al. (2006)

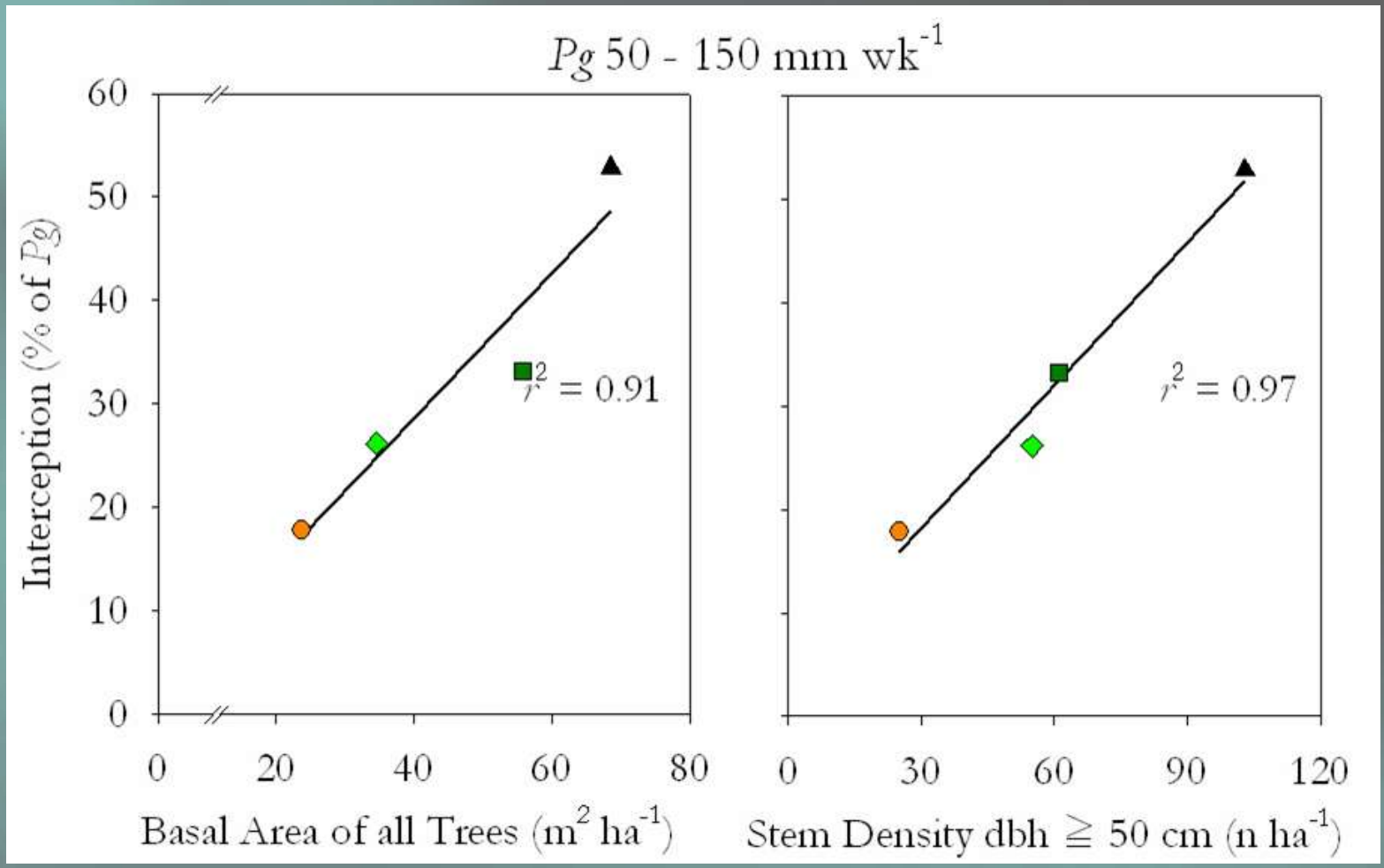
Rainfall Intensity



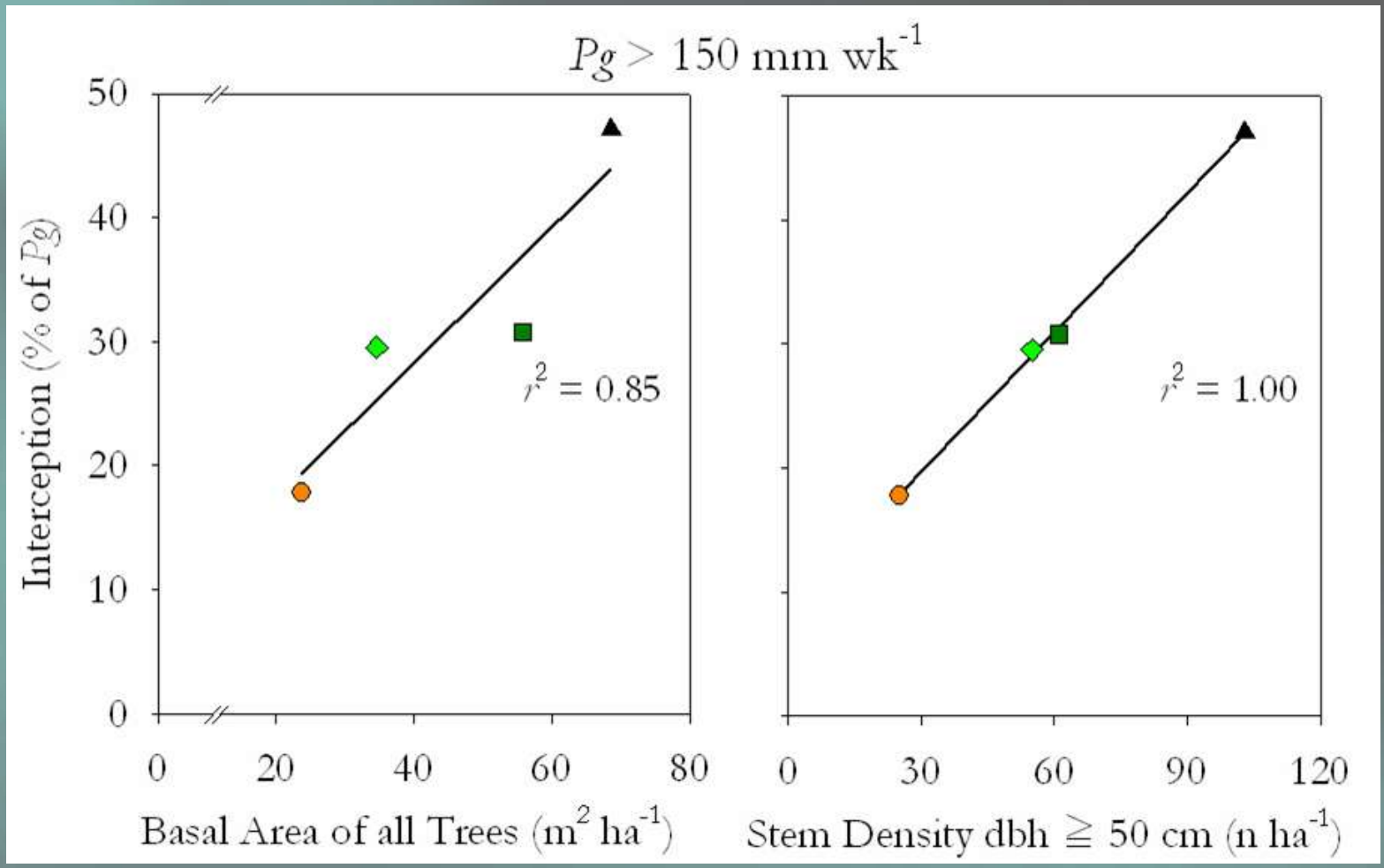
Rainfall Intensity



Rainfall Intensity

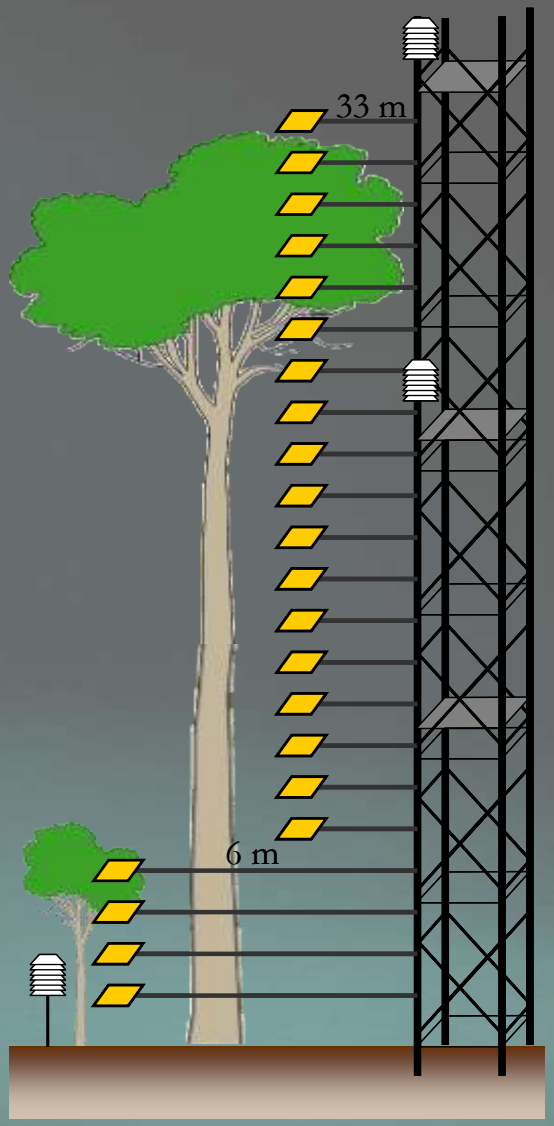


Rainfall Intensity

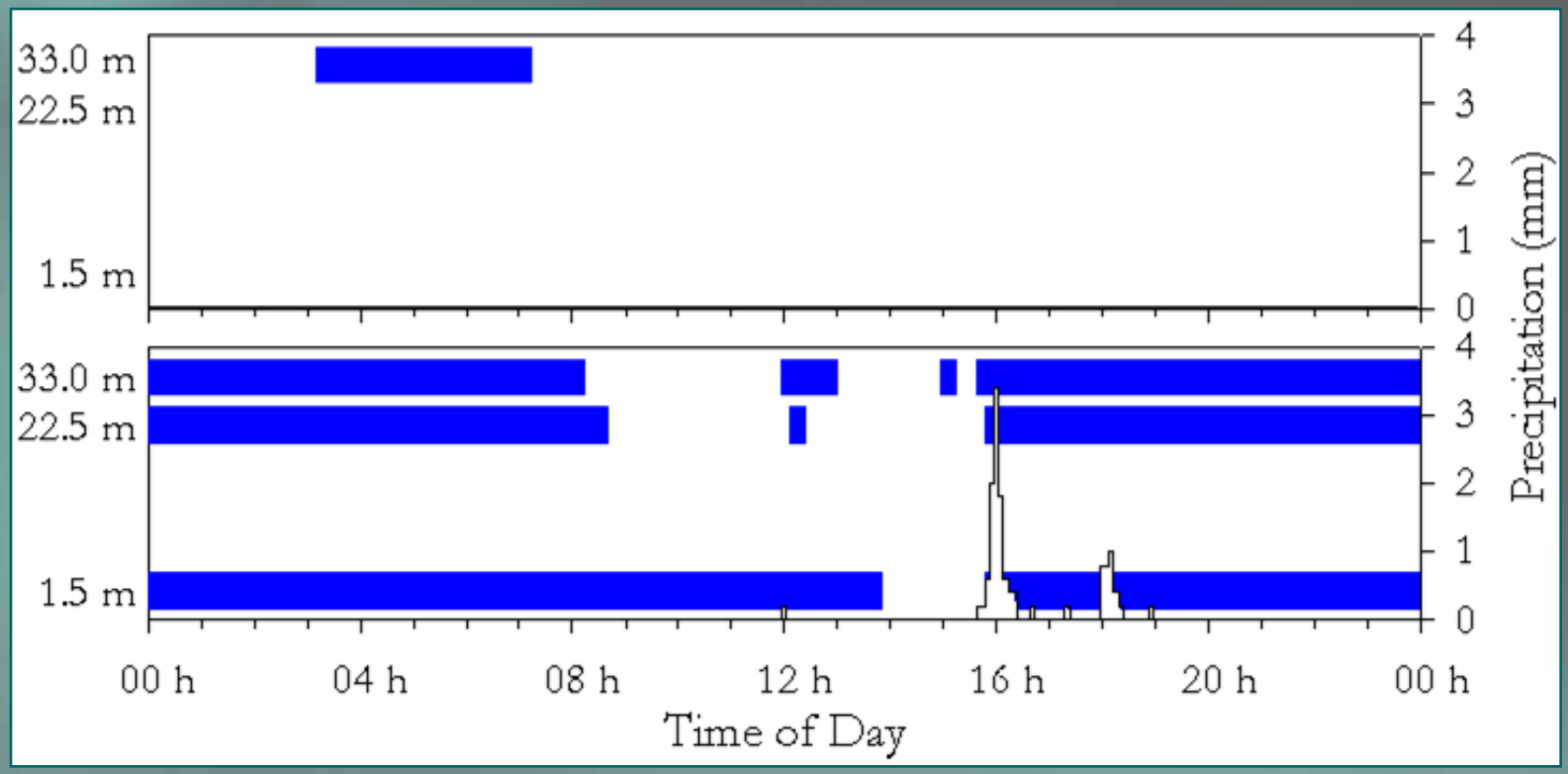


Sensor setup





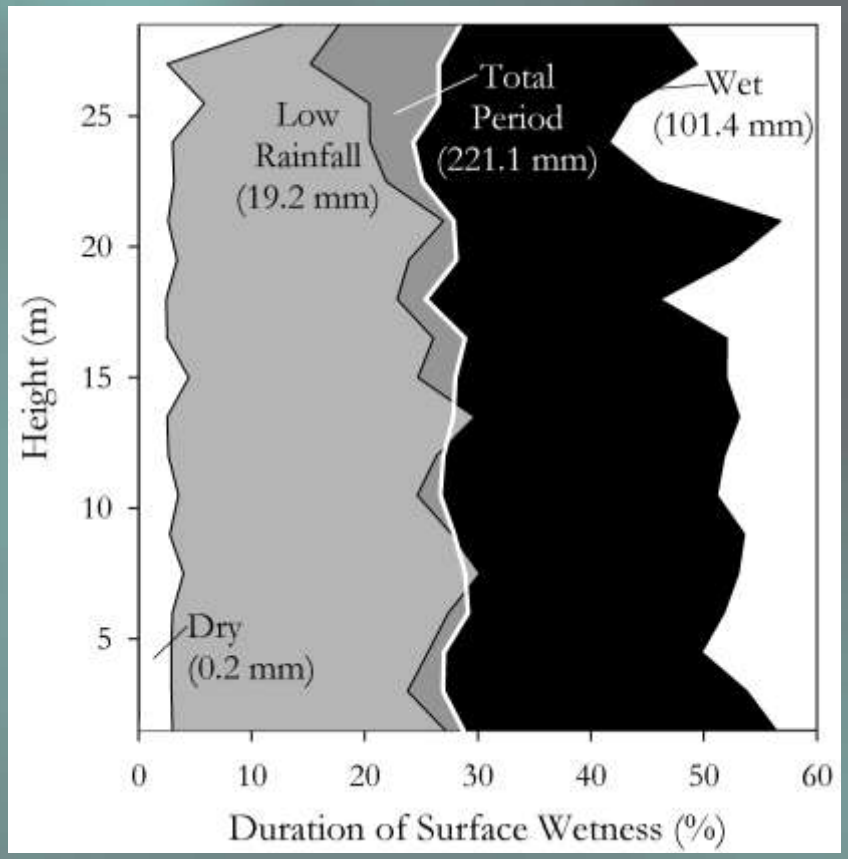
Wetness Duration

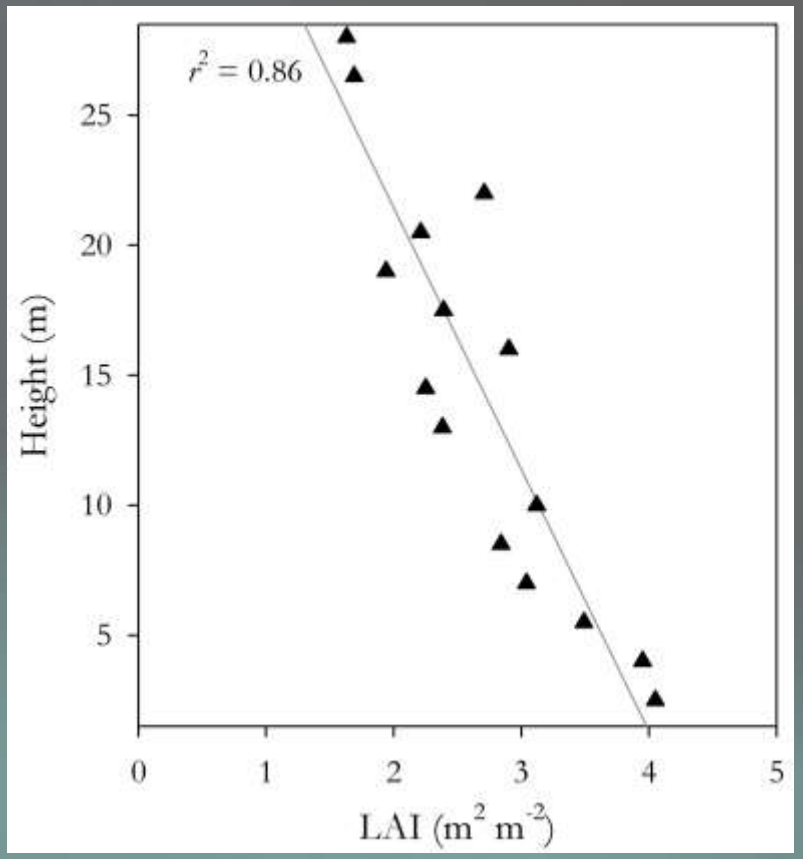


Dietz et al. (2007)

Wetness Duration

Wetness Duration vs. Leaf Area?





Dietz et al. (2007)

Conclusions

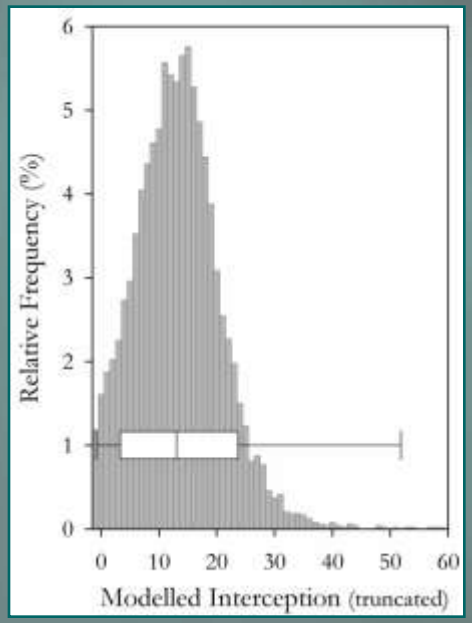
- Different traditional forest use in the margin zone of the LLNP changed the stand structural characteristics considerably.
- The partitioning of rainfall into throughfall, stemflow and interception was associated with stand structural characteristics.
- Human forest use, particularly the formation of cacao agroforests, led to an increase in throughfall and its spatial variability.
- Rainfall intensity and altered forest structure complementarily influenced the patterns of rainfall partitioning.
- Leaf wetness duration varied with different rainfall conditions and possibly with the vertical distribution of foliage.

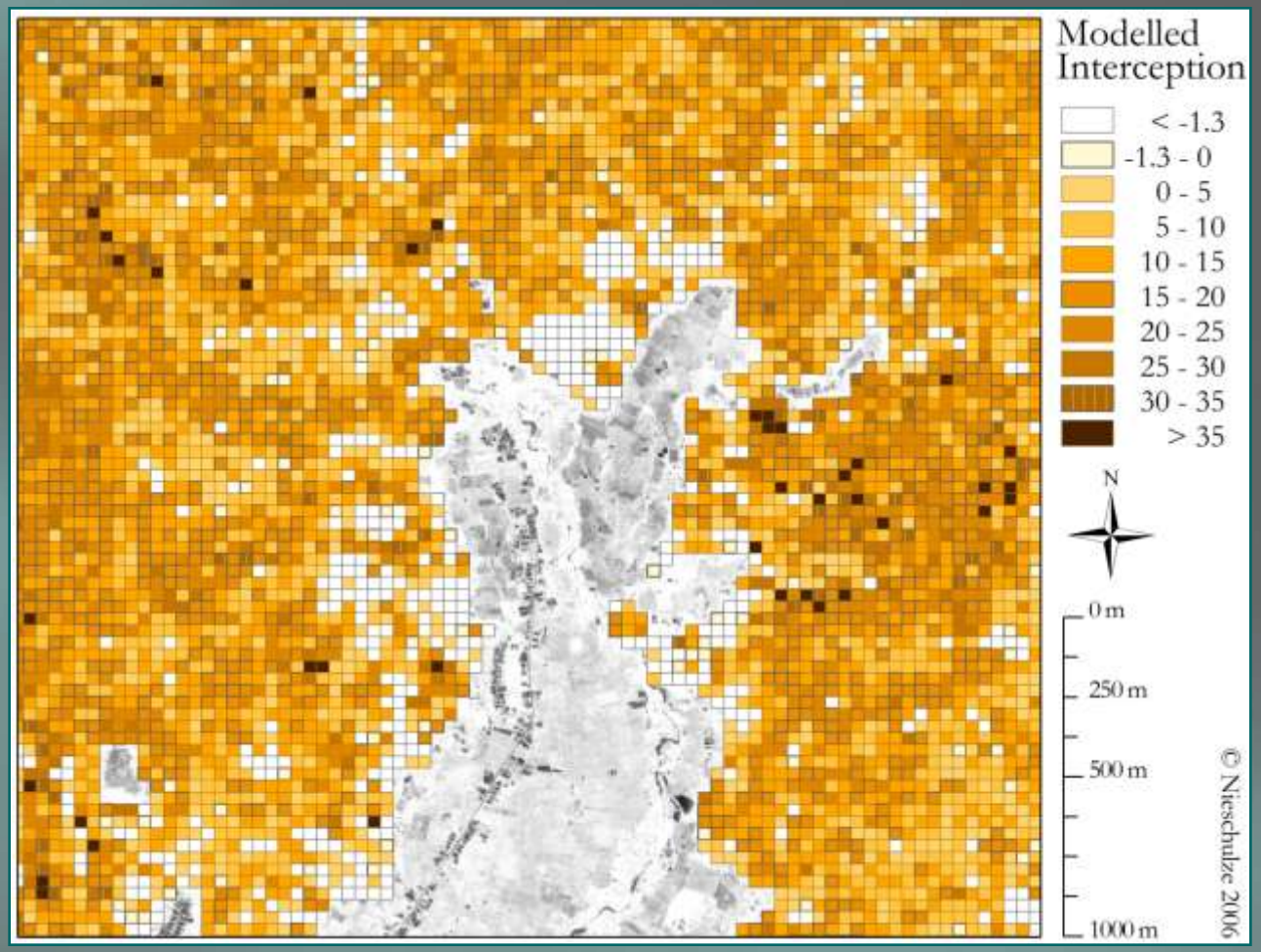
Questions Remaining

- How does biodiversity influence rainfall partitioning?
- How does rainfall partitioning influence biodiversity?
- What are the implications of altered throughfall patterns for erosion, infiltration and soil moisture regimes?
- Can the consideration of leaf wetness duration improve inter-ception models?
- Is it practicable to extrapolate the impact of land use on rainfall partitioning beyond the regional level?
- Can interception patterns be regionalized based on our findings?

Regionalization

Nieschulze et al.
(under review)





Thank You!

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