Extending ecosystem measurements across climatic gradient using a mobile observation system

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מכון ויצמן למדע

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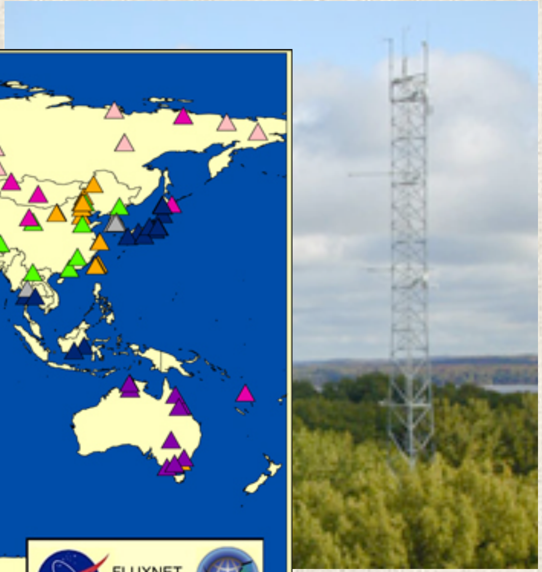
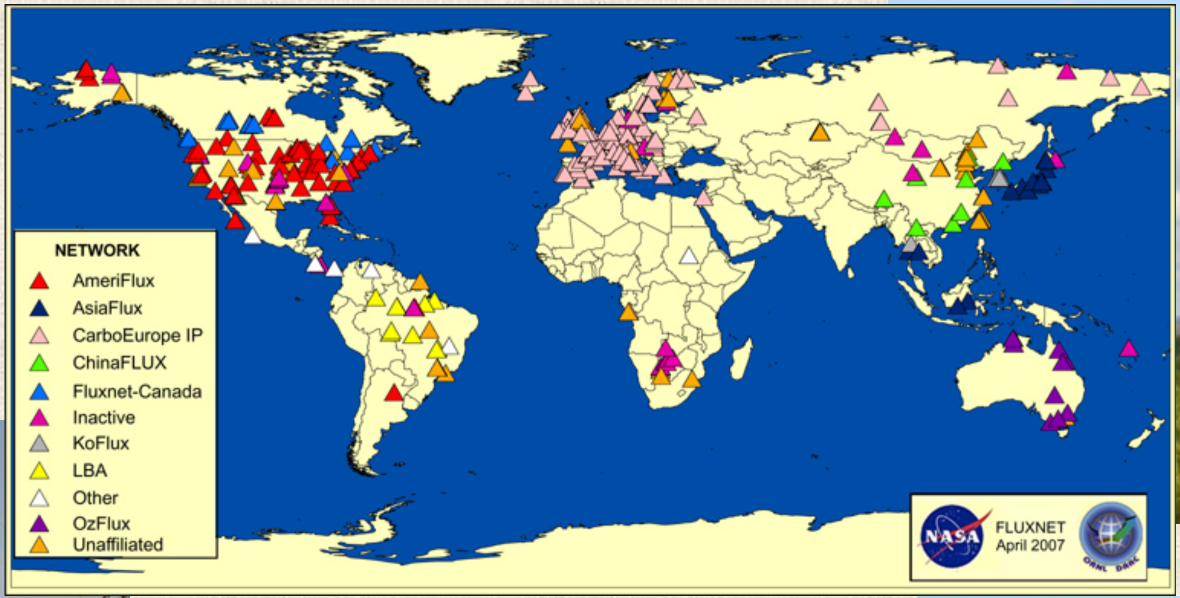
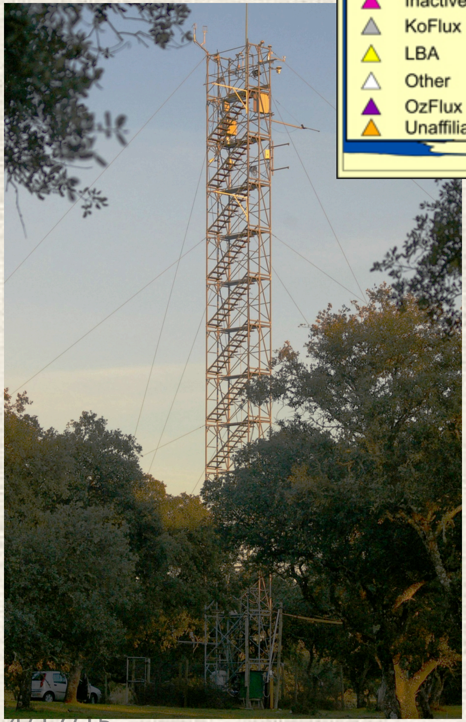
Global observation system based on permanent 'flux towers' (FLUXNET; ICOS)

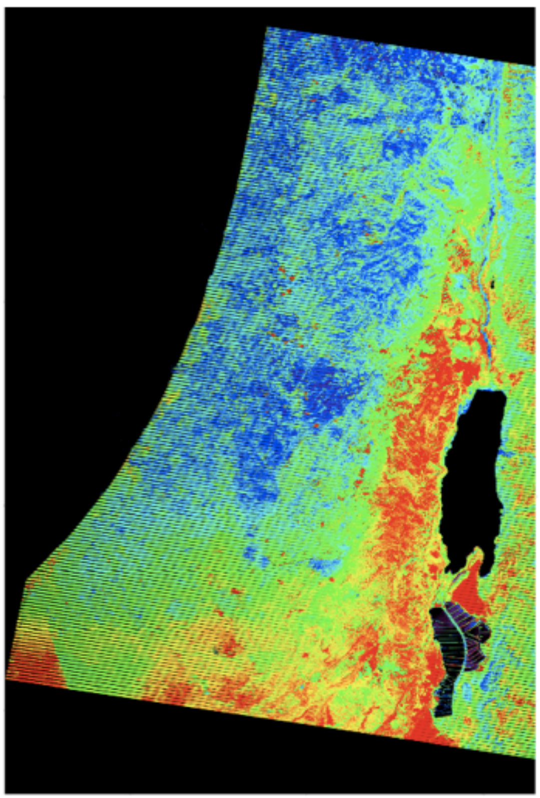


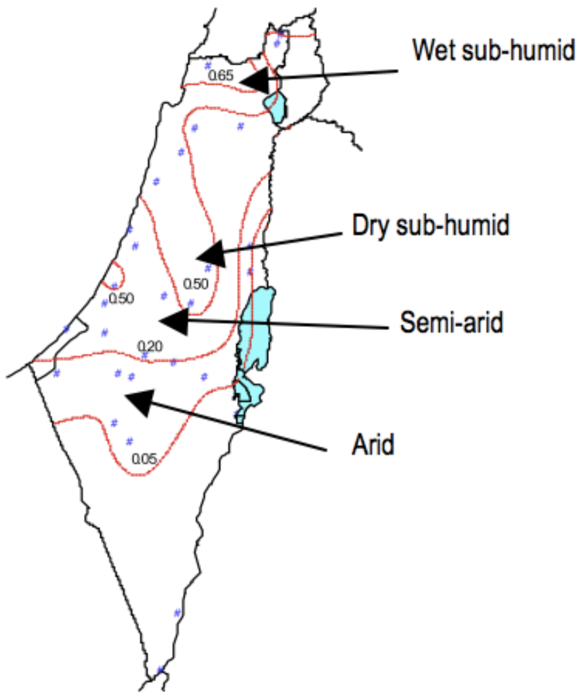


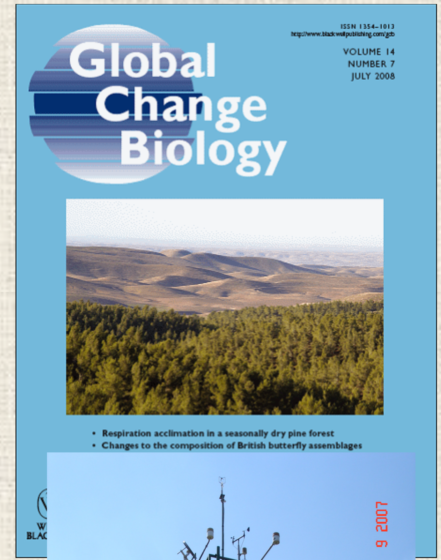


However, there are also significant limitations:

- Limitations of Measurements at one site in a highly heterogeneous region
- There is need to quantify the response to climate variation in short time
- There is need for comparative data on different vegetation type
- Utilizing the climatic gradient for the ‘space for time’ approach

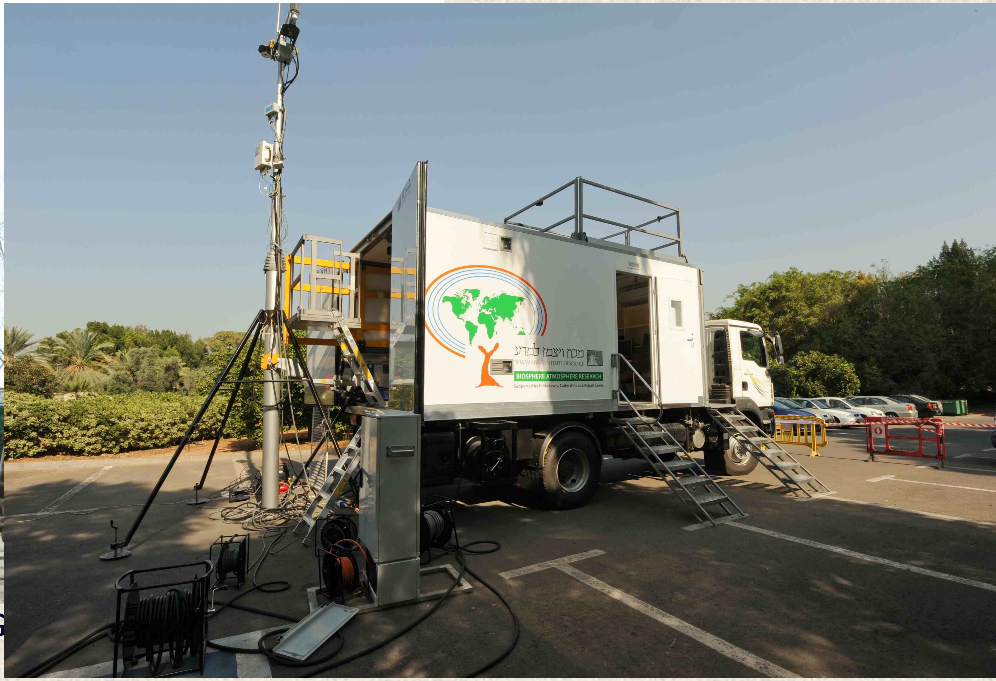




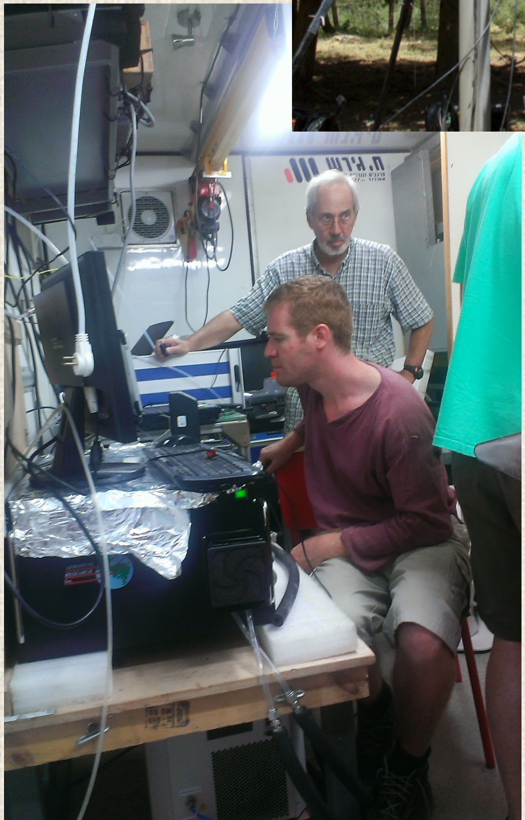


The Yatir fluxnet site, since 2000

Extending the range With the WIS Mobile flux lab







A single permanent flux site can produce significant science, but has its limitations

COMMENTARY

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LETTERS

edited by Jennifer Sills

Forests and Climate: A Warming Paradox

E. ROTENBERG AND D. YAKIR ("CONTRIBUTION OF SEMI-ARID FORESTS TO THE CLIMATE SYSTEM," Reports, 22 January, p. 451) showed that forestation may not be an effective tool for climate change mitigation. They found that in a semi-arid landscape, the warming potential of a for-

Forests and Climate: The Search for Specifics

E. ROTENBERG AND D. YAKIR ("CONTRIBUTION of semi-arid forests to the climate system,"

Science

AAAS

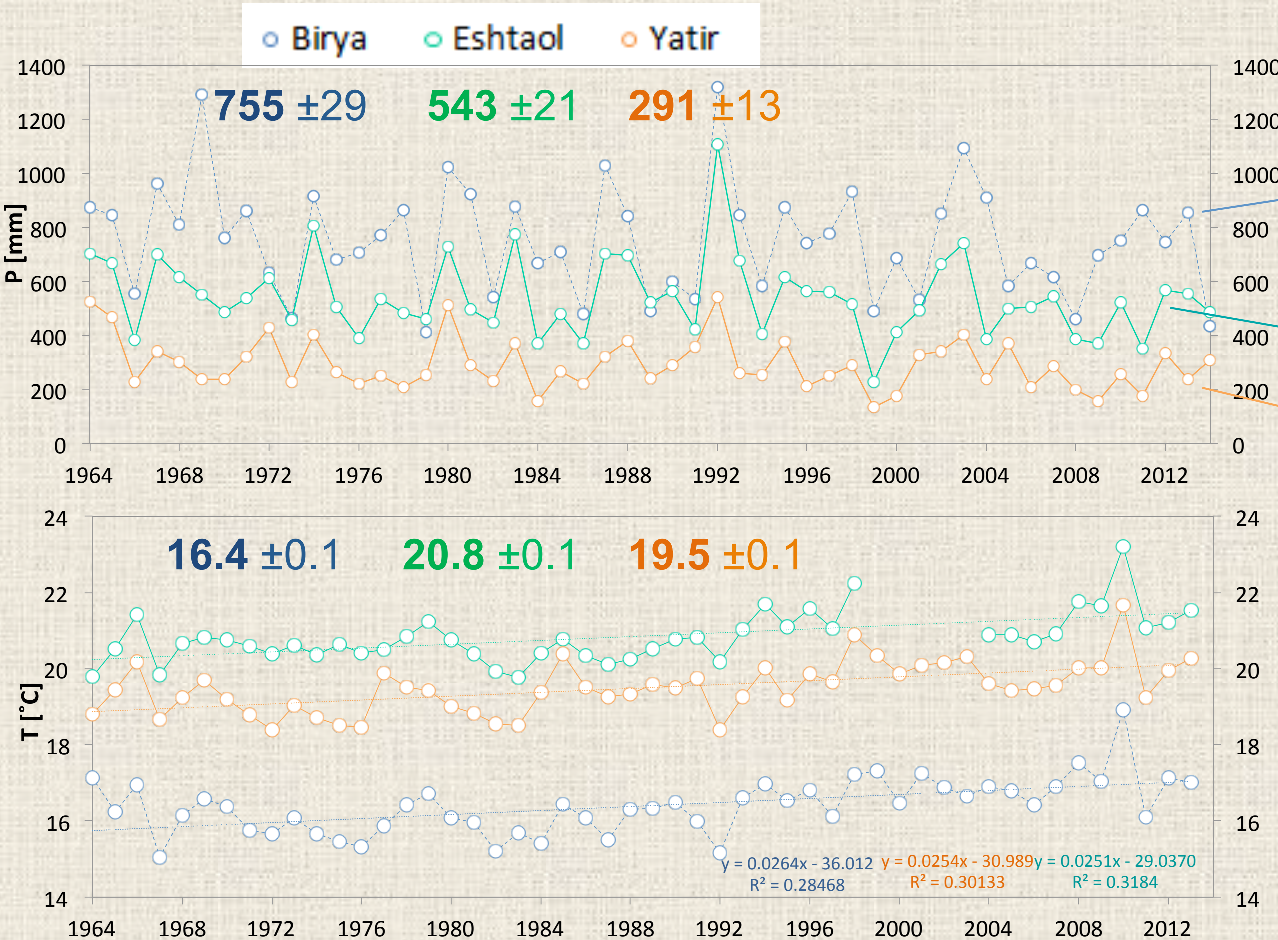
Contribution of Semi-Arid Forests to the Climate System

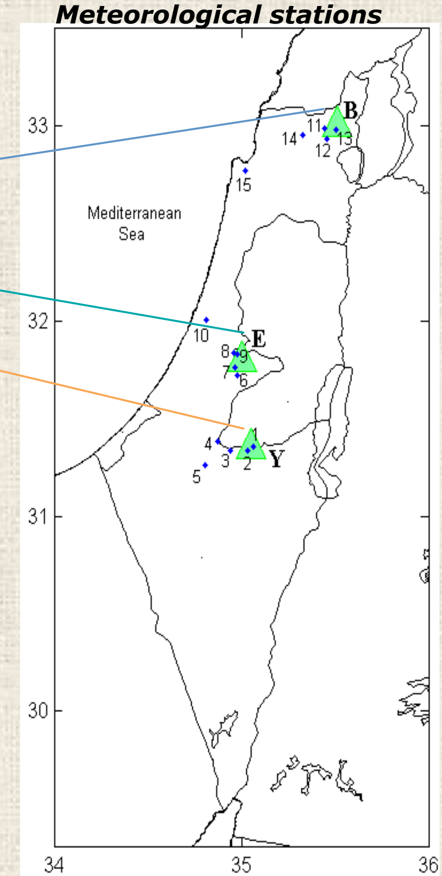
Eyal Rotenberg and Dan Yakir

Science **327**, 451 (2010);

DOI: 10.1126/science.1179998

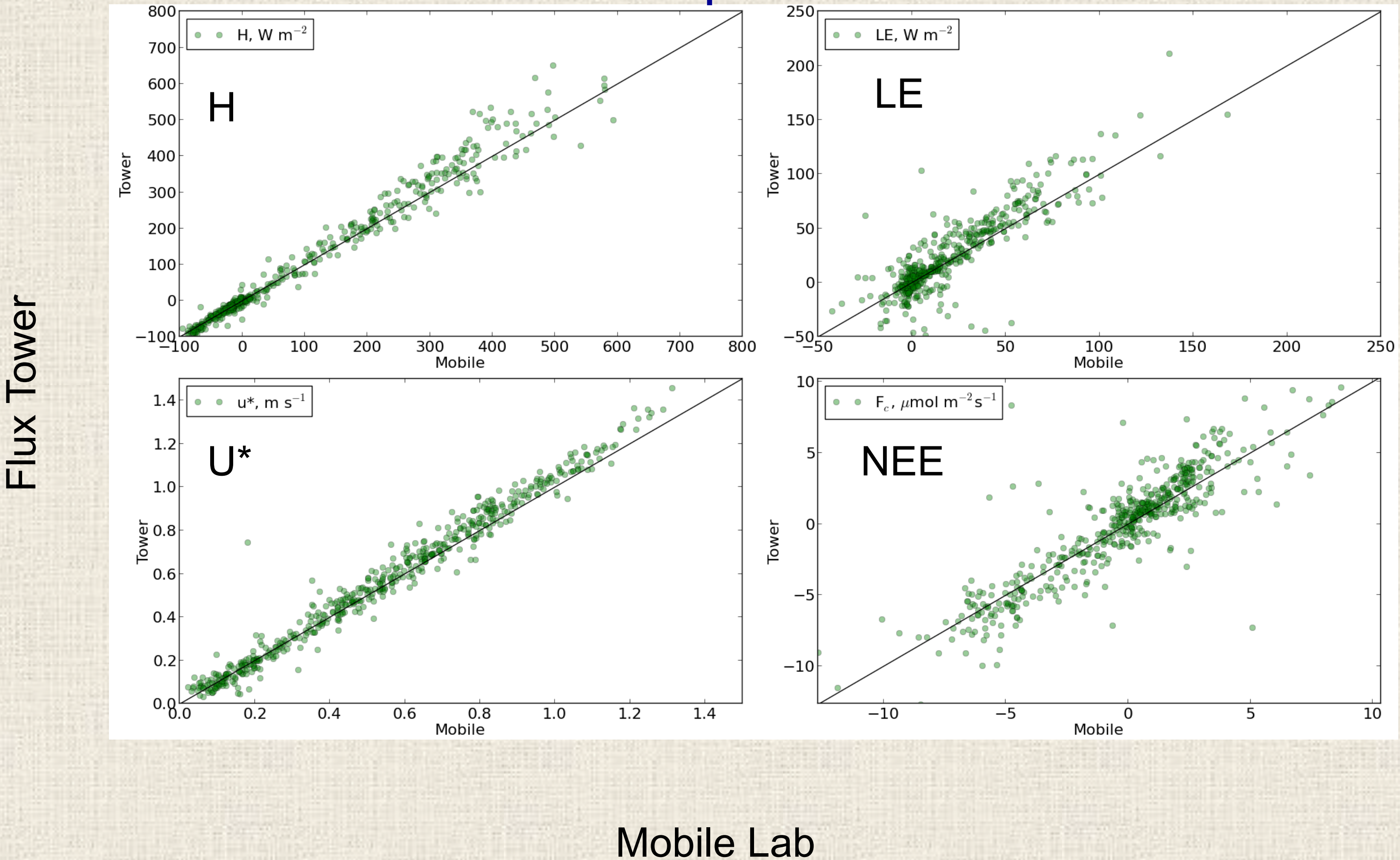
The Climatic Gradient is Manifested in the Precipitation Differences between the Three Sites





Israel Meteorological Services

First step: Comparison between Mobile Lab and permanent flux tower



Measuring Fluxes at the Ecosystem Level (Forest vs. Shrub land)

Study period: 2012-2014
Campaign basis ~two weeks each
Active (wet) season: March, April, May
Non active (dry) season: July, August, September

Birya* forest, *Jan 2015

Daily means:
NEP
SW⇩, SW⇧, LW⇩, LW⇧
H, LE

Birya* shrubs, *Jan 2015

Campaigns Summery

Mobile lab Campaigns 2012-2014

	2012	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2012	Birya				△ *					△ *			
	Solelim												
	Eshtaol			△ *				△ * ●					
	Yatir				△ *		△ ●						

	2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2013	Birya					△ *	△ ●		△ *				
	Solelim					△ *			△ *				
	Eshtaol		△ * ●					△ * ●					
	Yatir				△ *				△ ●				

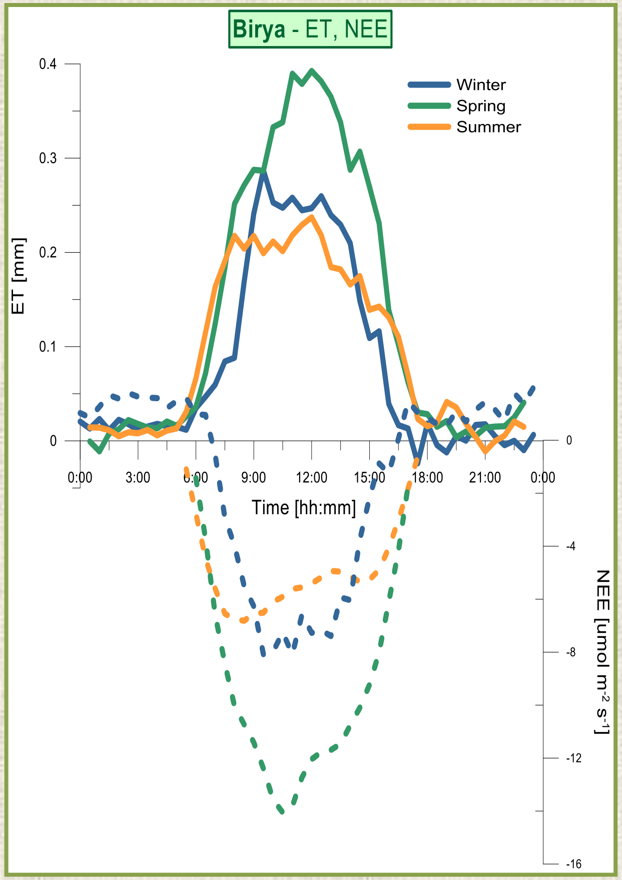
	2013	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2014	Birya		△ * ●										
	Solelim			△ *									
	Eshtaol				△ ●								
	Yatir				△ ●								

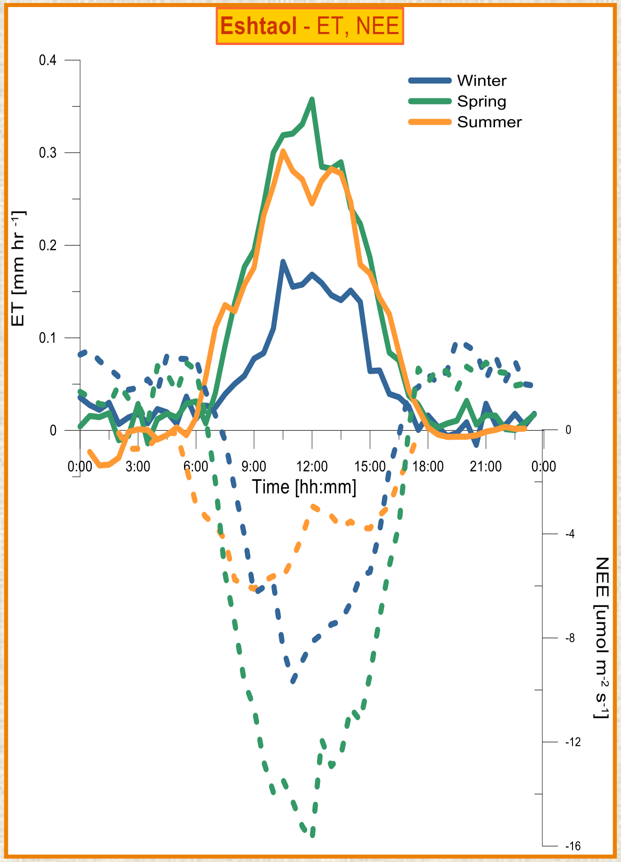
* Mobile measurments in forest ● Mobile measurments out of forest △ Yatir tower mesurments in forest

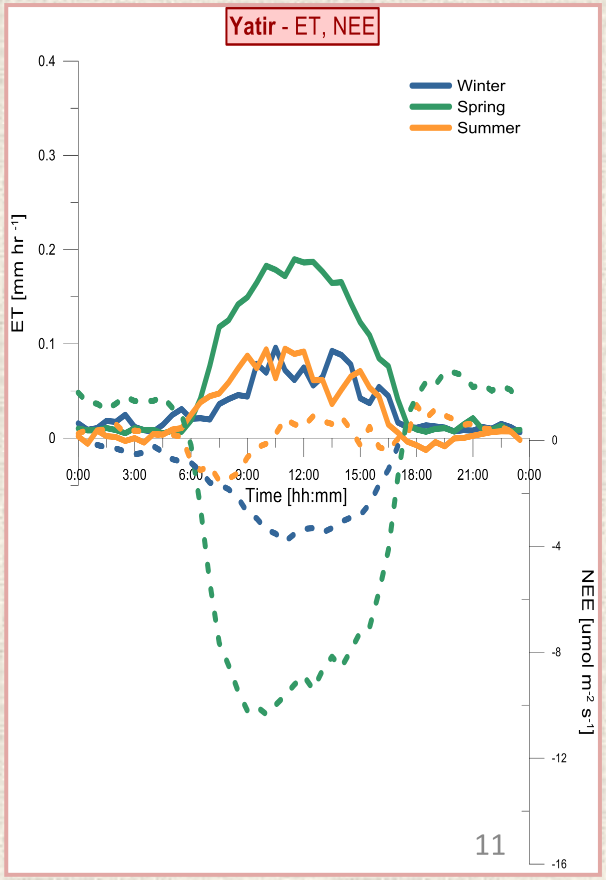
Table1- Campaigns schedule during 2012-2014 in four different sites along the precipitation gradient in Israel.

	# days of measurements	# days processed	% producivity
Birya	47	39	83
Kadita	**30**	**17**	**57**
Eshtaol	45	37	82
Moddin	**36**	**32**	**89**
Solelim	29	20	69
Yatir D	36	29	81
Total	**223**	**174**	

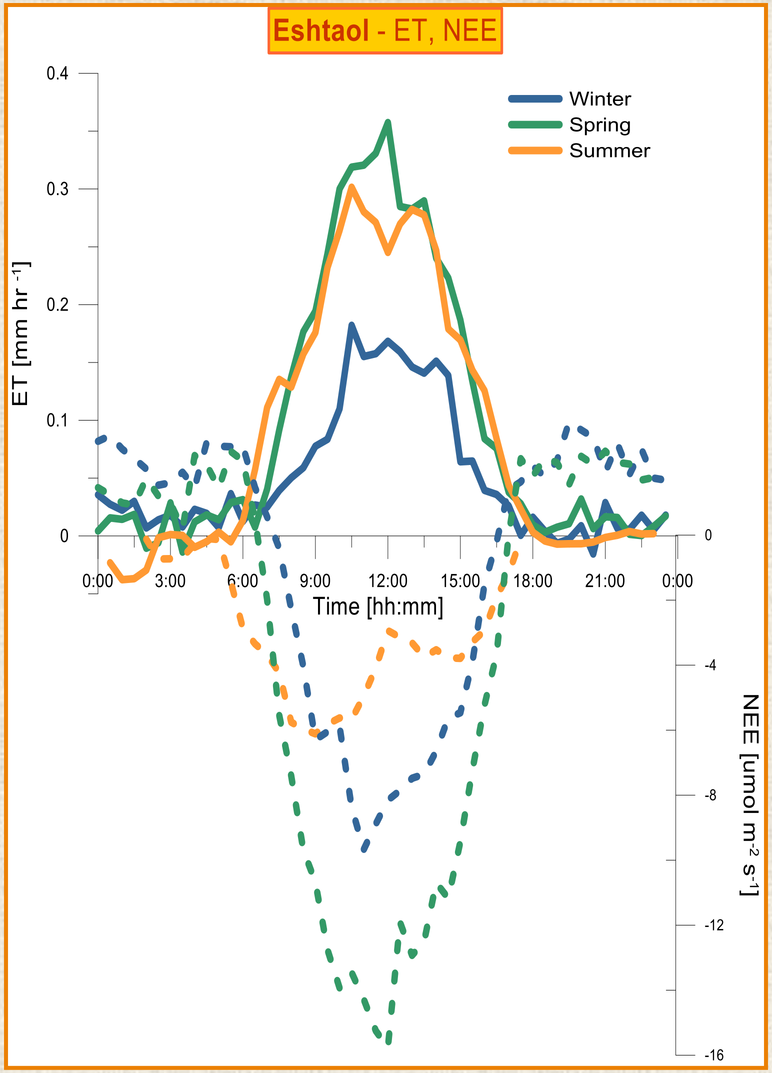
Canopy scale NEE & ET diurnal curves Along the climatic gradient

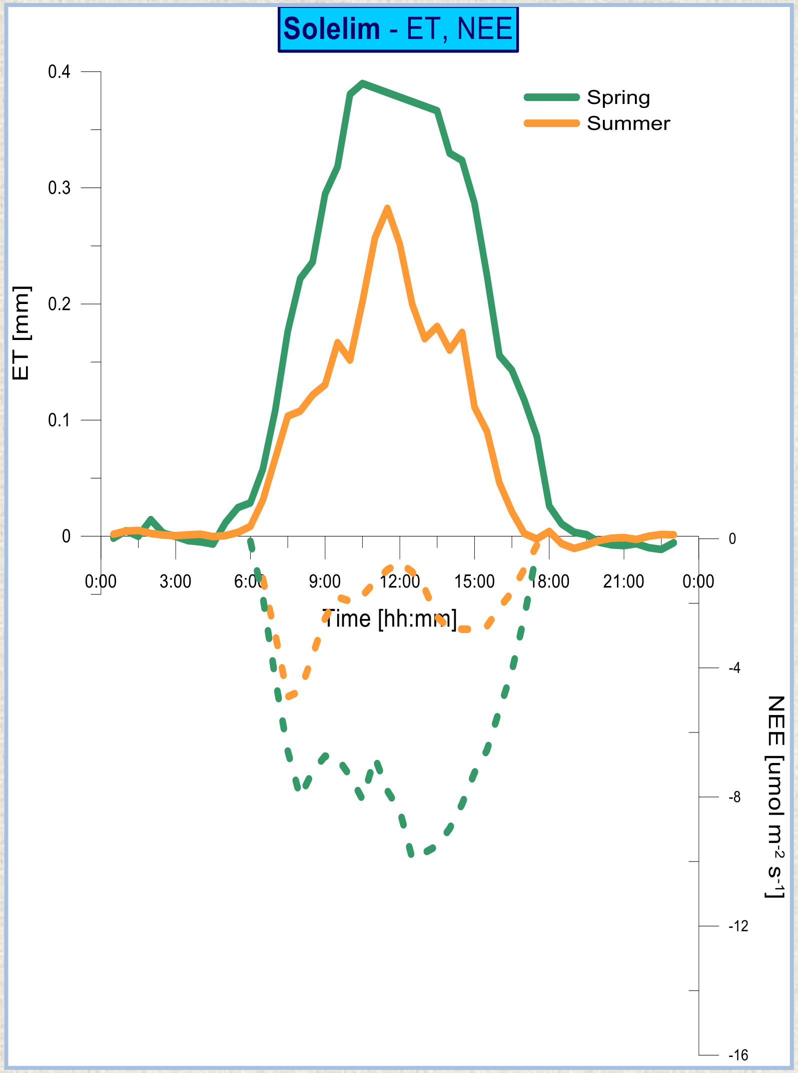




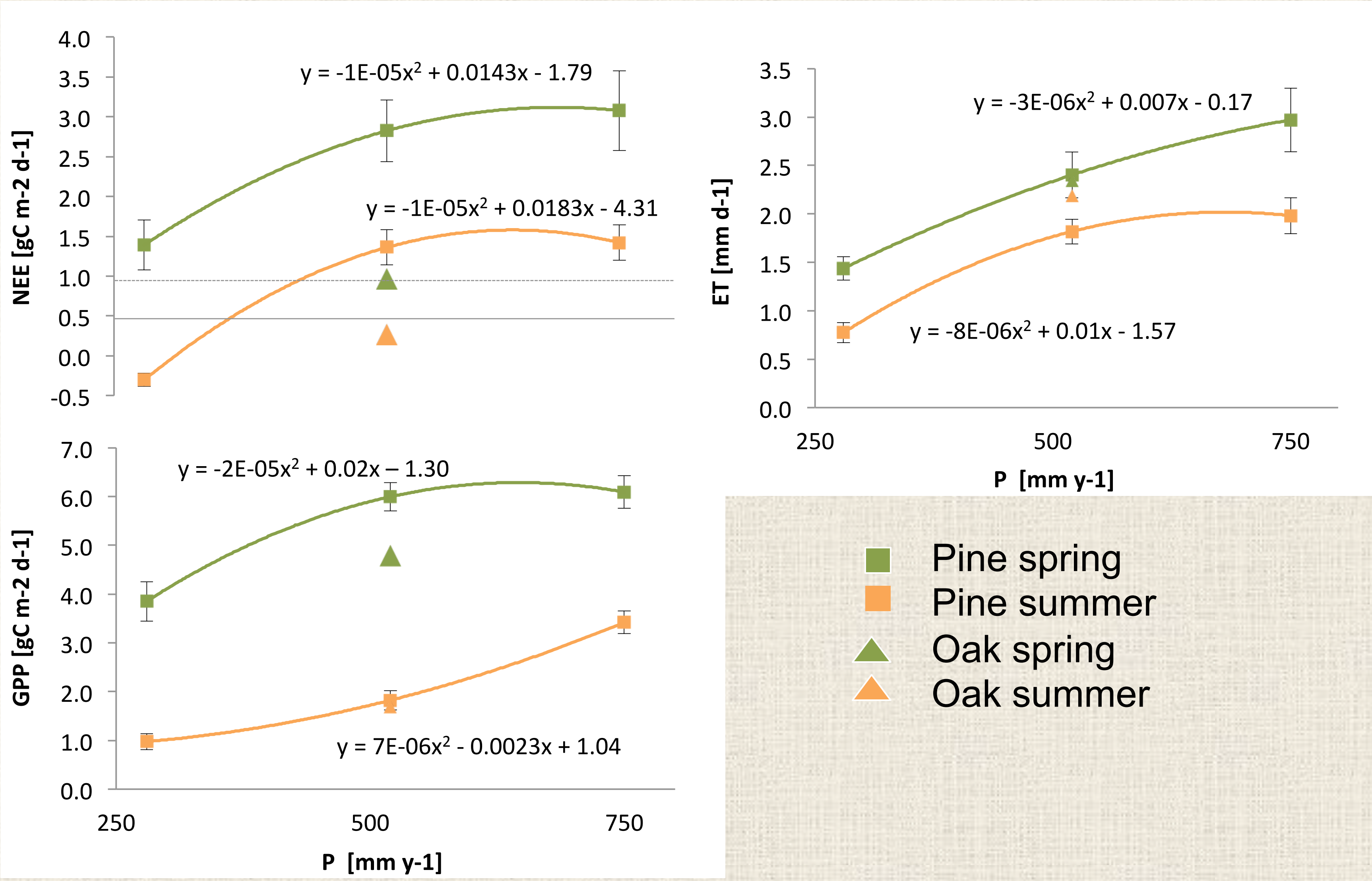


Canopy scale NEE & ET diurnal curves: Pine vs. Oak at the

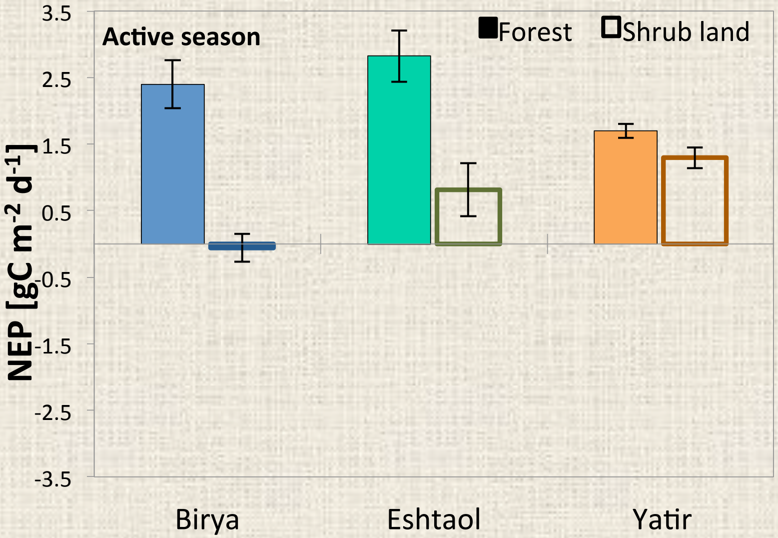


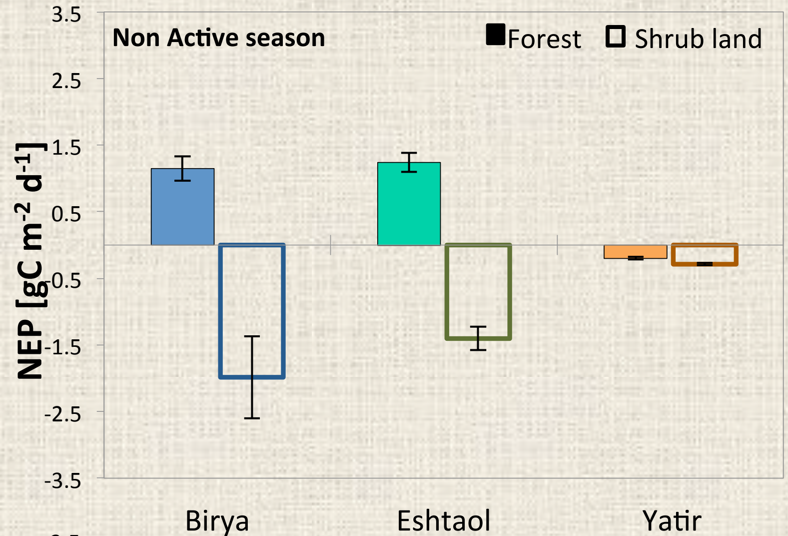


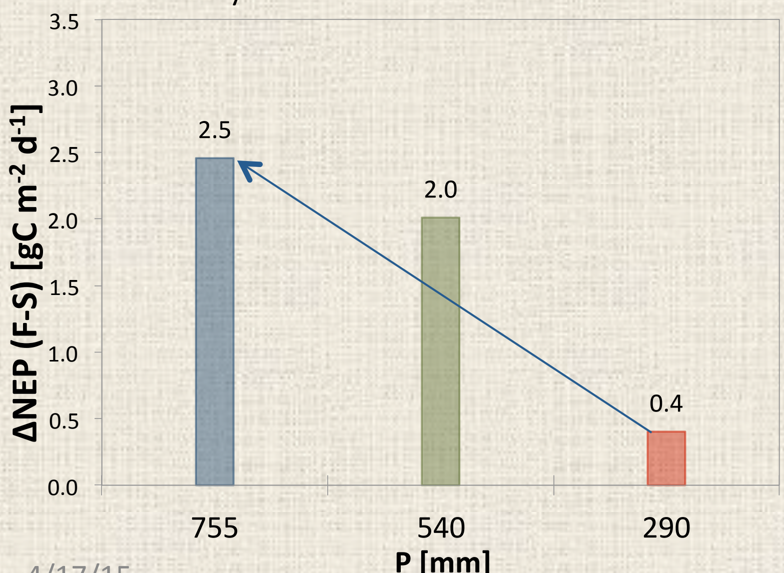
Response across the Climatic Gradient is not linear

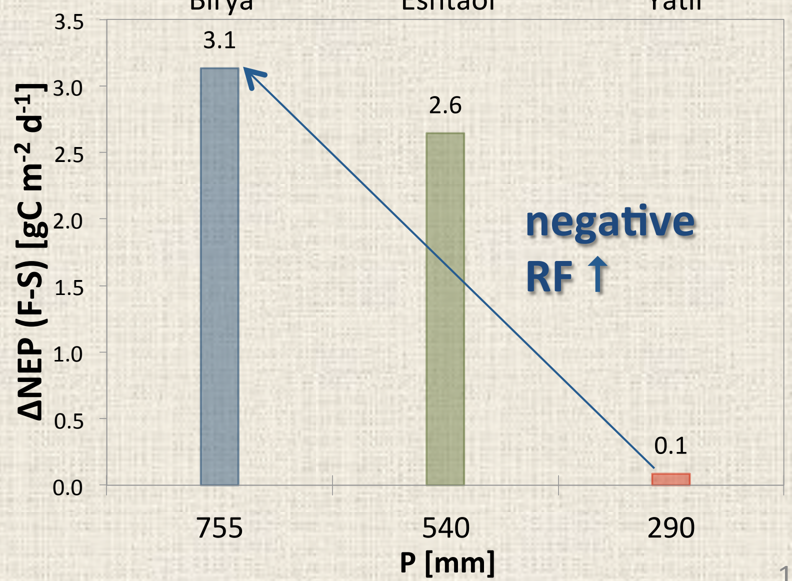


Increasingly larger forest Carbon Sequestration across the Climatic Gradient

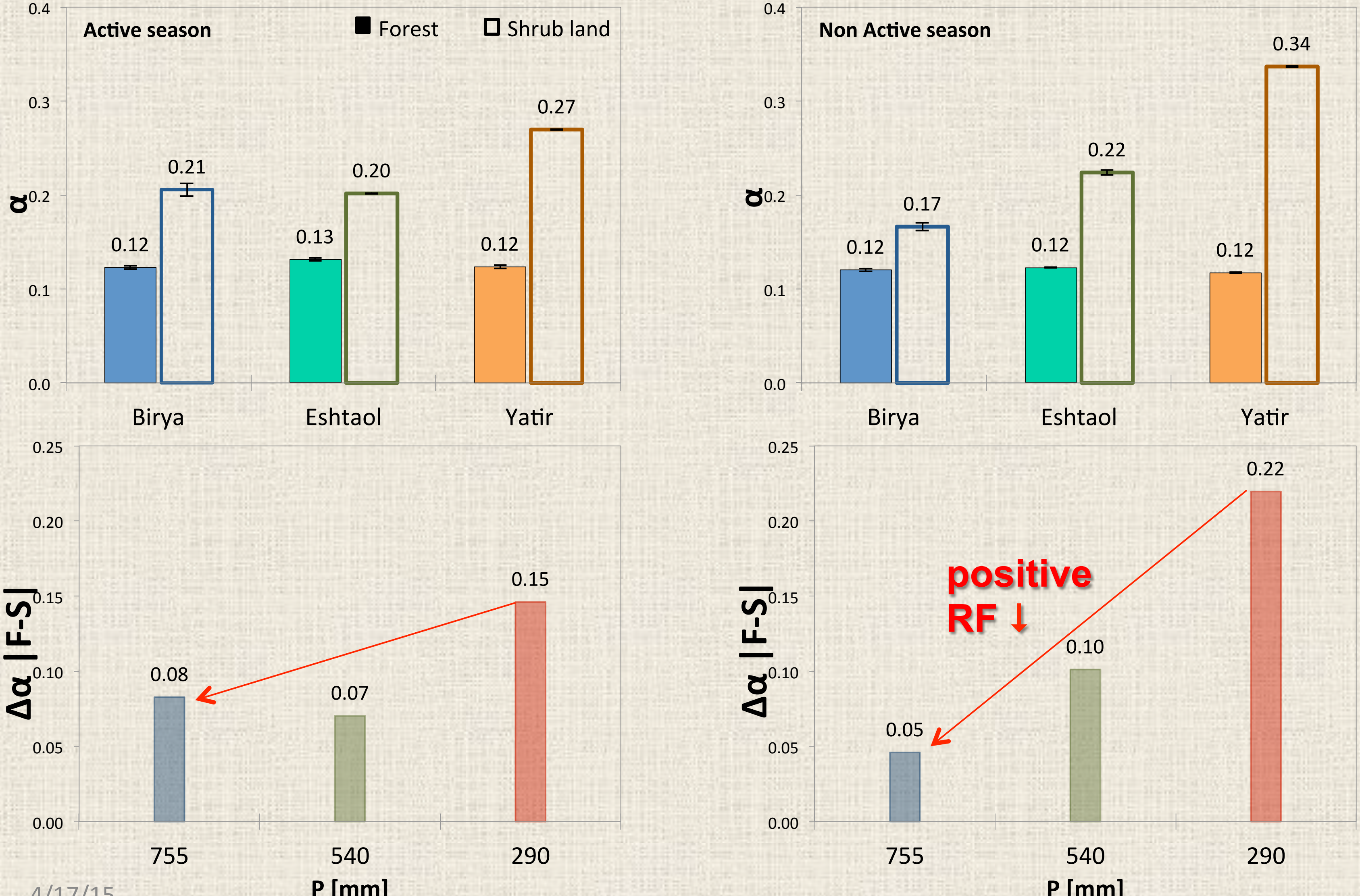






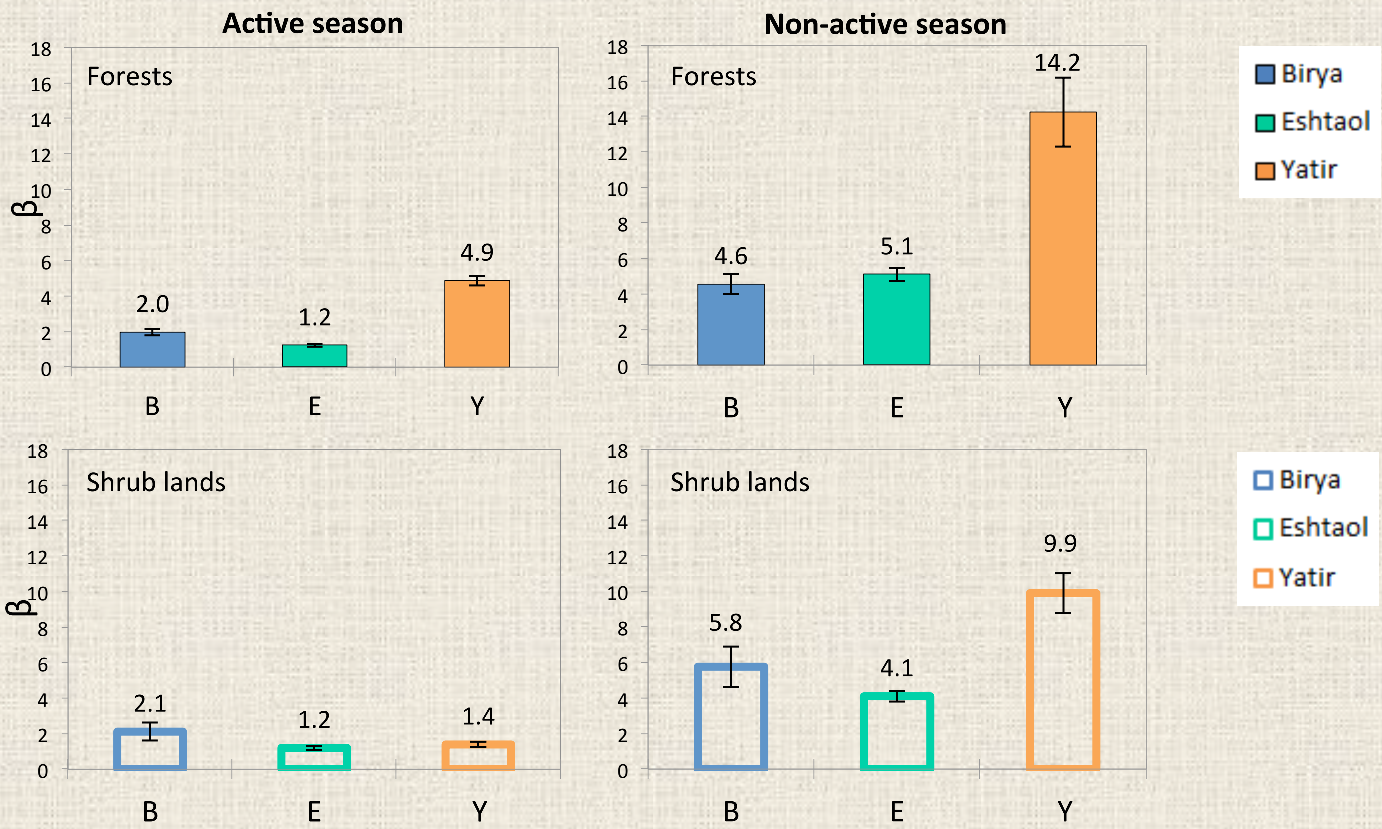


Decreasing forest 'albedo effect' across the climatic gradient



Decreasing Bowen Ratio along Precipitation gradient

$$\boldsymbol{H/LE} = \beta \; (Bowen\ ratio)$$



Conclusions

- ✓ Forestation enhances the **carbon sink**. This enhancement is positively (but not linearly) correlated with annual precipitation, along the climatic gradient.

- ✓ Forestation decreases surface **albedo**. This effect is more dramatic in the dry climate, due brighter soil.

- ✓ The “negative (warming) climatic effect” of forestation observed in Yatir diminishes along the climatic gradient in Israel (from ~50W m^{-2} to ~0W m^{-2}).

- ✓ Changes in Bowen ratio along the climatic gradient show a major shift from H to LE-dominated dissipation of energy.

- ✓ Combining permanent and mobile flux systems provide a powerful and efficient extension to the current global ecosystem observing system.

--- A long-term team work---