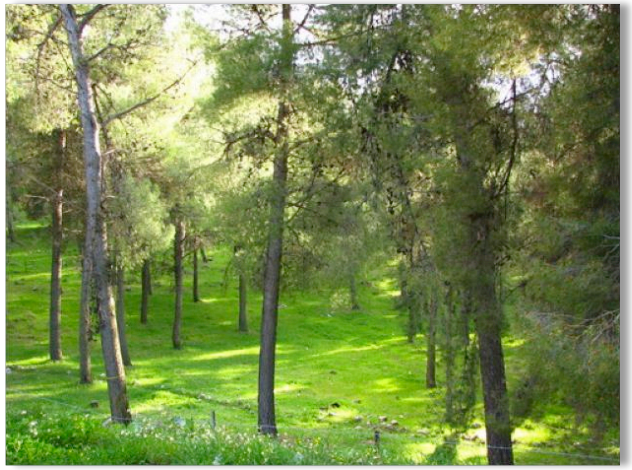
Monitoring the dynamics of vegetation components in Mediterranean forests:

Time-series analysis of satellite-derived NDVI



David Helman and Itamar M. Lensky

Bar-Ilan University

From the 40th Annual Conference of the Israel Society of Ecology and Environmental Science (ISEES), Tel Aviv, October 2012

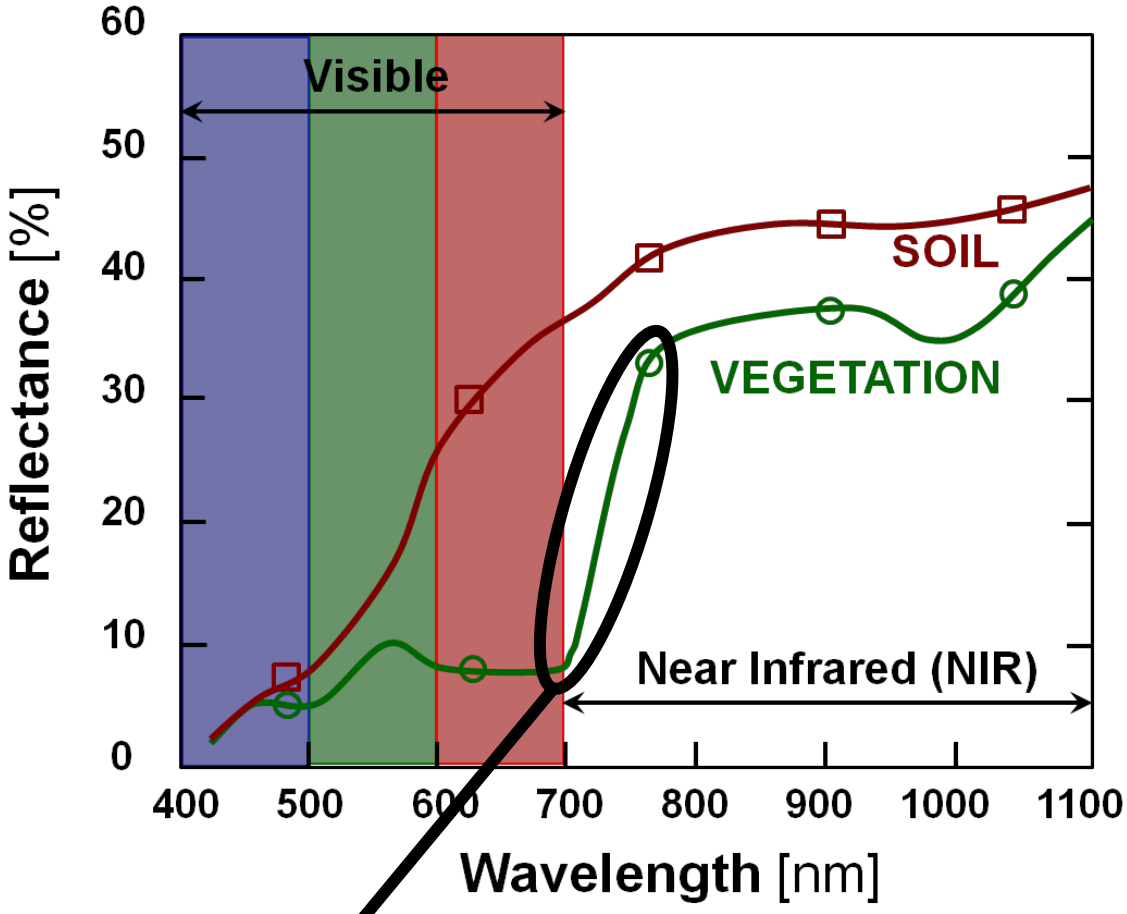
Implications for management

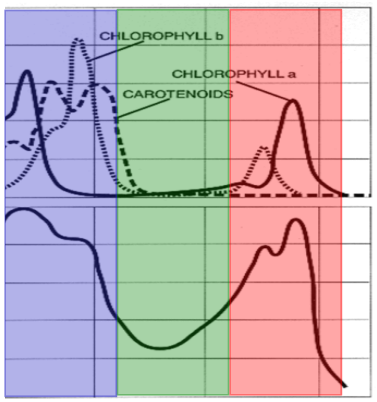
Pre-fire mapping of fire-risk

Mapping the optimal grazing regime

Conservation and afforestation planning

The Normalized Difference Vegetation Index (NDVI)





Chlorophyll a

Chlorophyll b

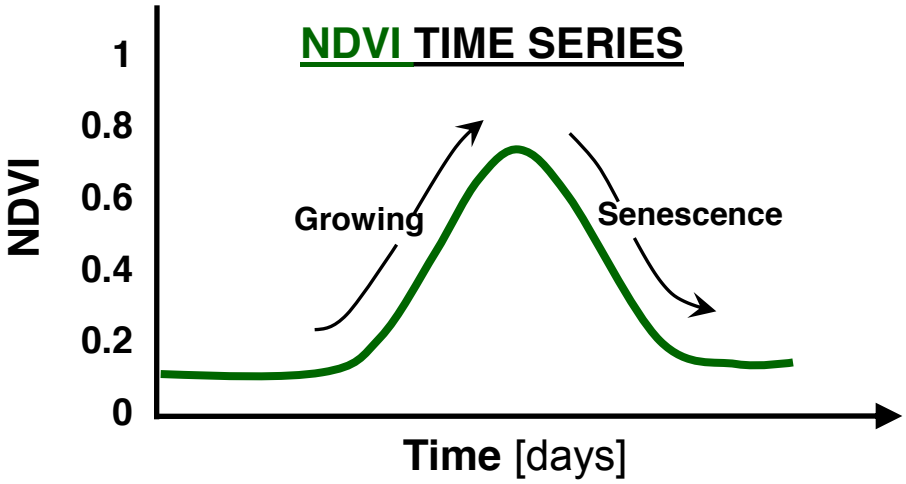
Carotenoids

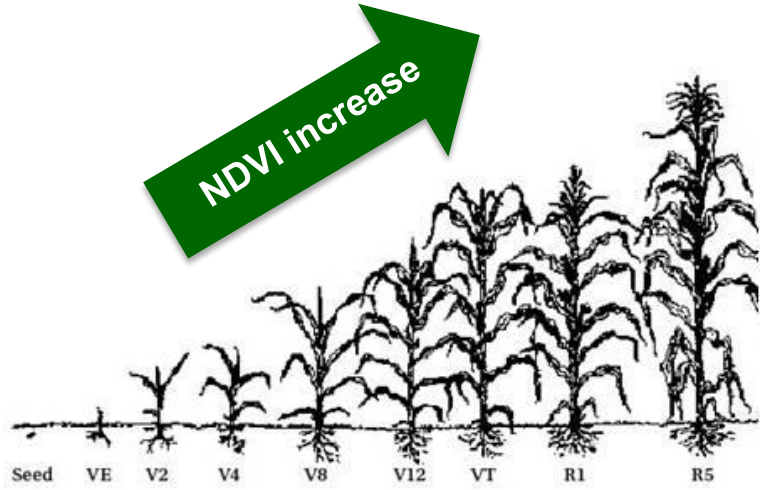
$$NDVI = \frac{NIR - Red}{NIR + Red}$$

$$-1 < NDVI < +1$$

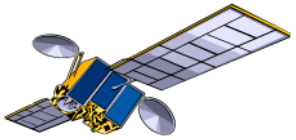
Measuring plant phenology with NDVI

NDVI time series describes well the vegetation's phenology



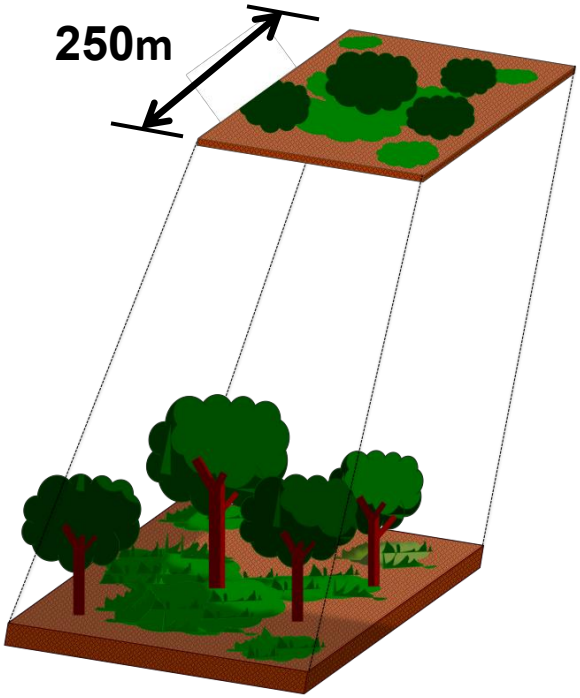


Pixel's complexity – different contributions to NDVI



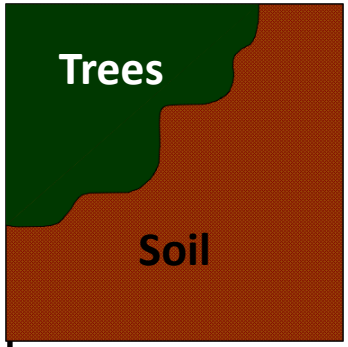
Satellite

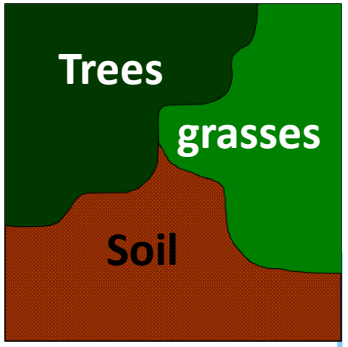
250m

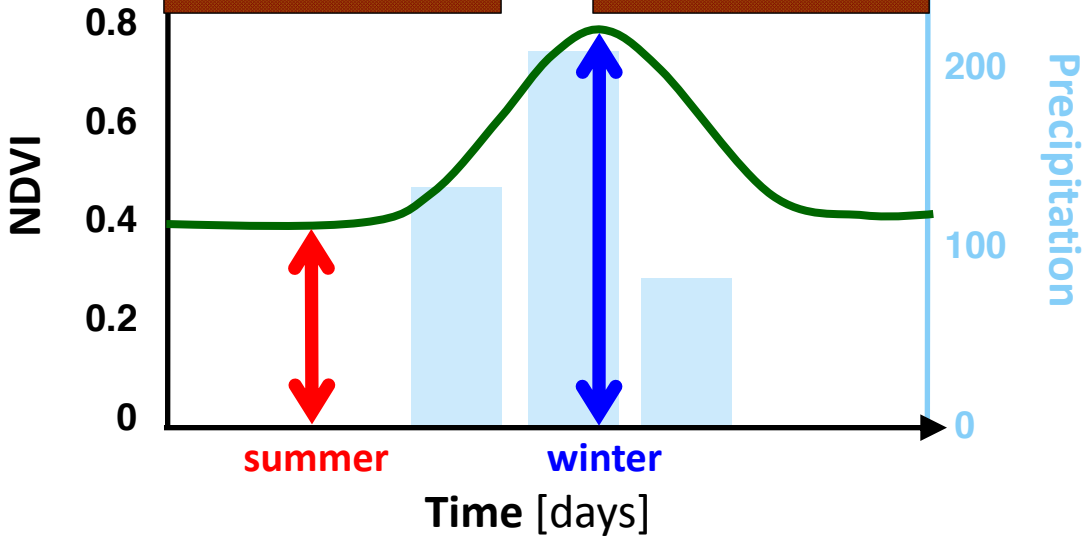


summer

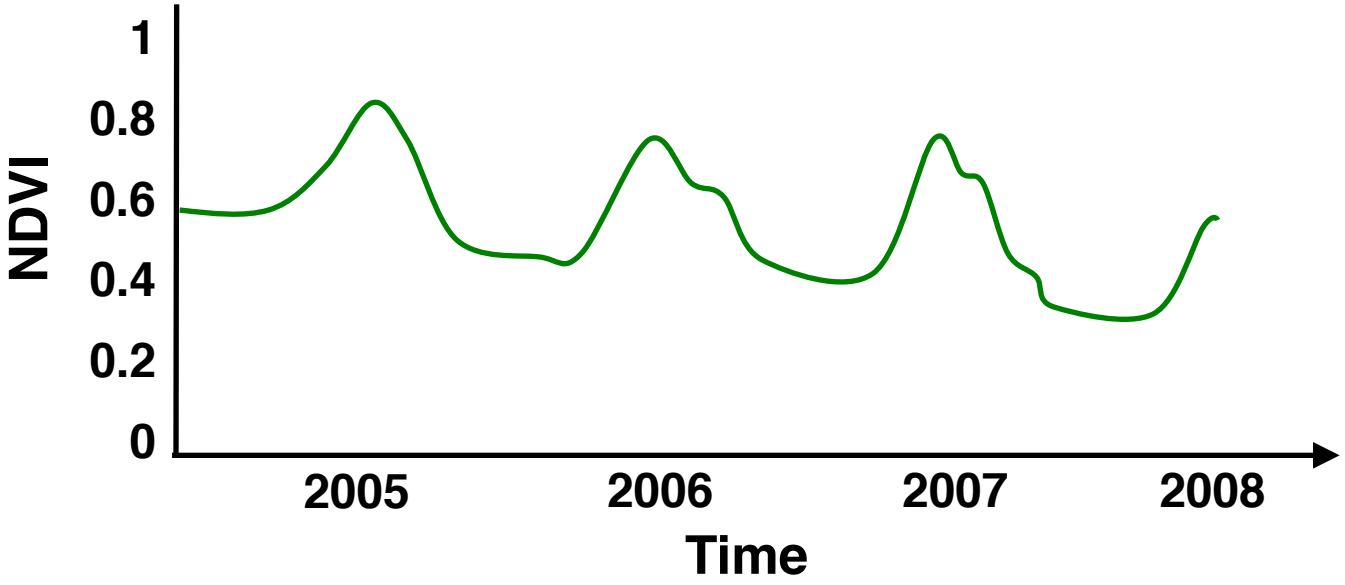
winter

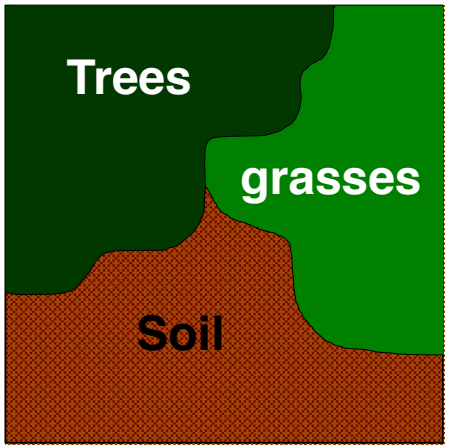






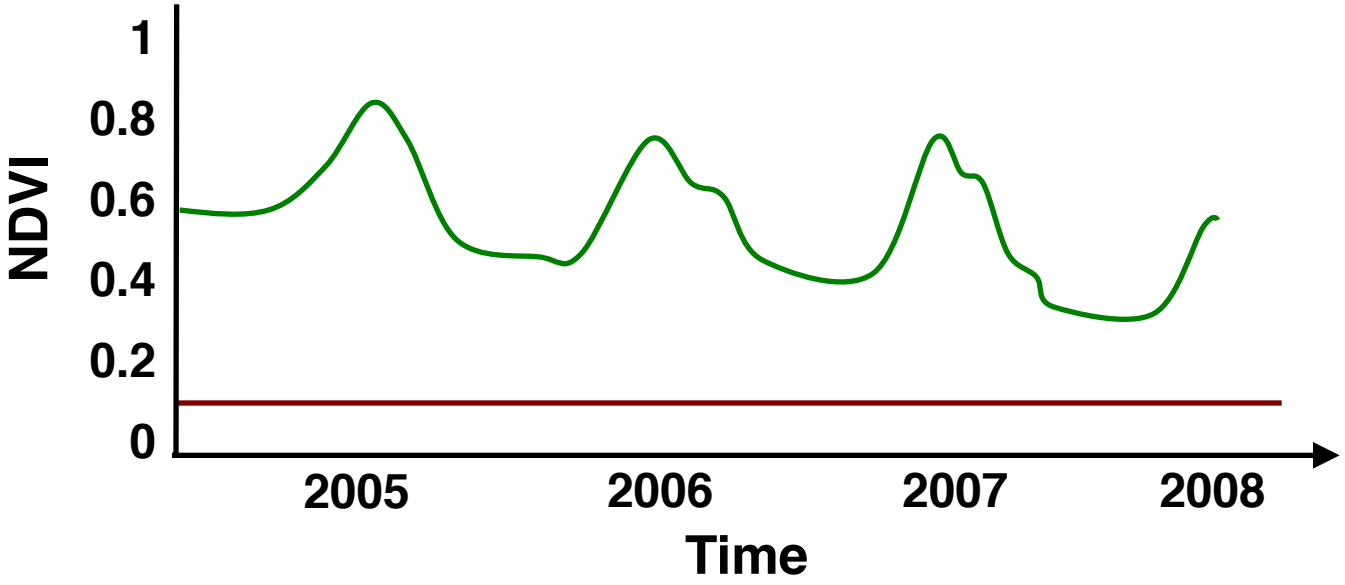
Decomposing NDVI time series into trees and grasses

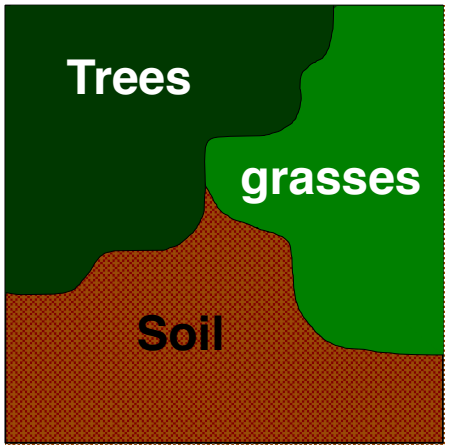




(1) $$NDVI = Trees + grasses + Soil$$

Decomposing NDVI time series into trees and grasses

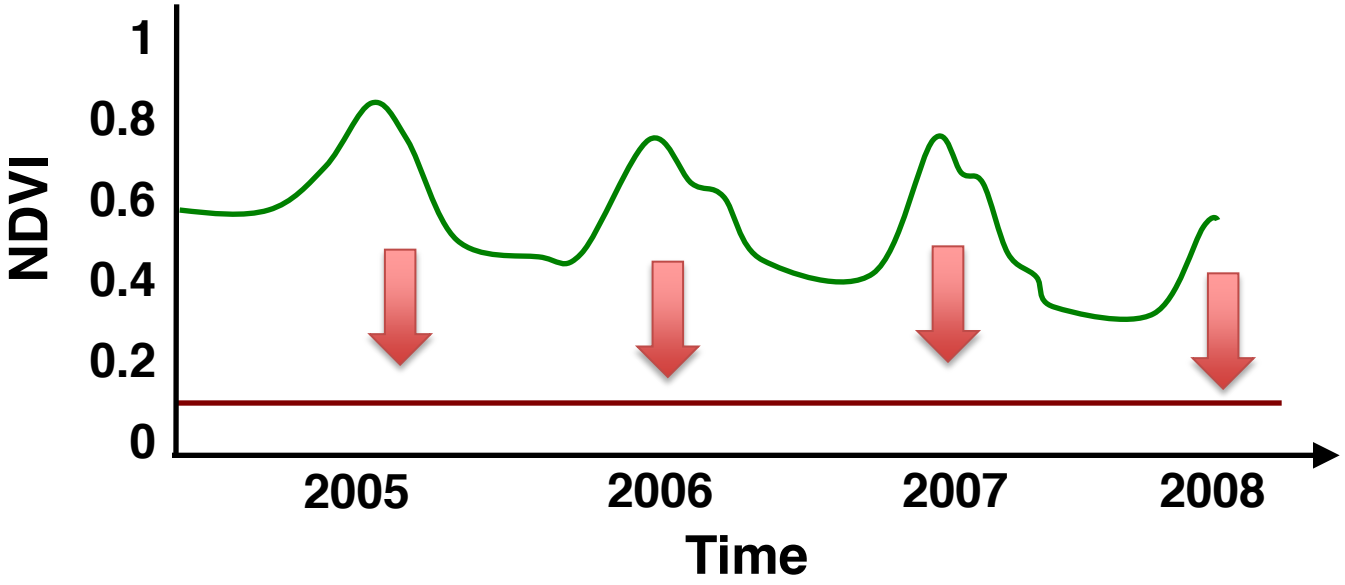


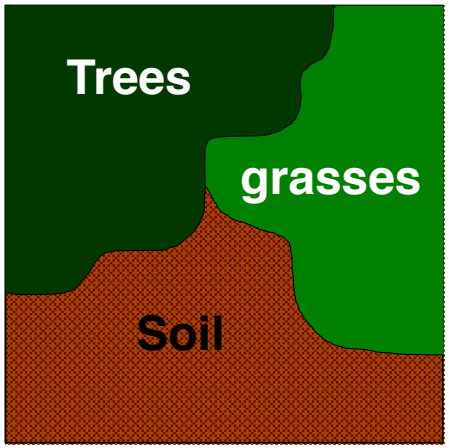


(1) ***NDVI = Trees + grasses + Soil***

(2) ***Soil ≈ constant***

Decomposing NDVI time series into trees and grasses





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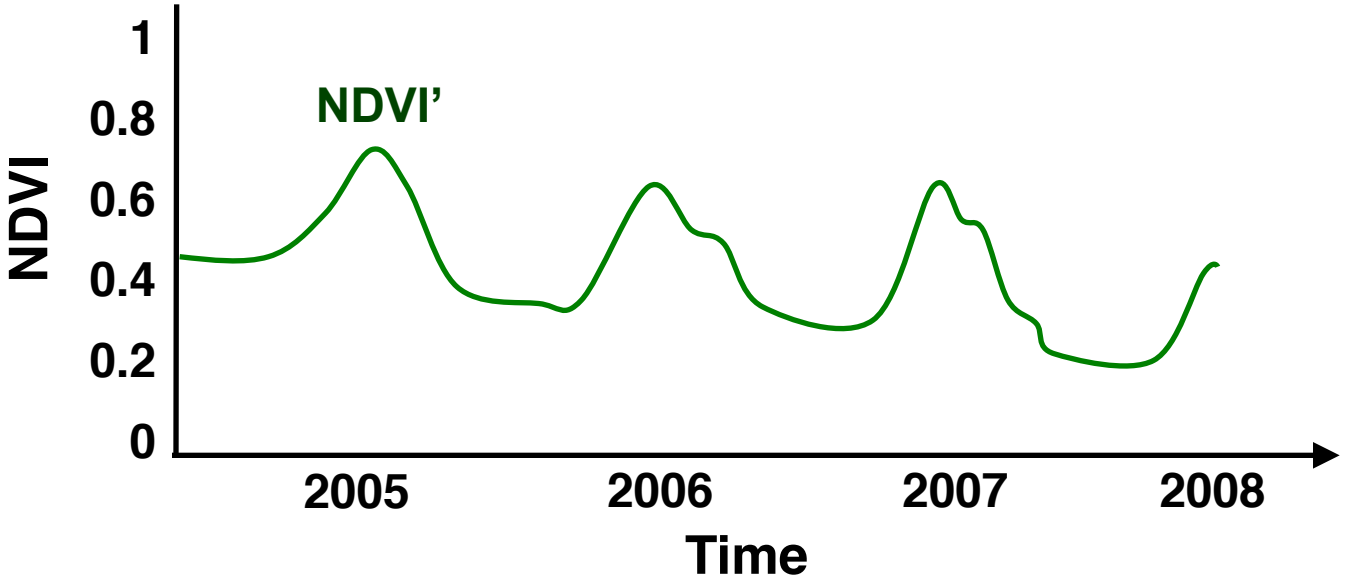
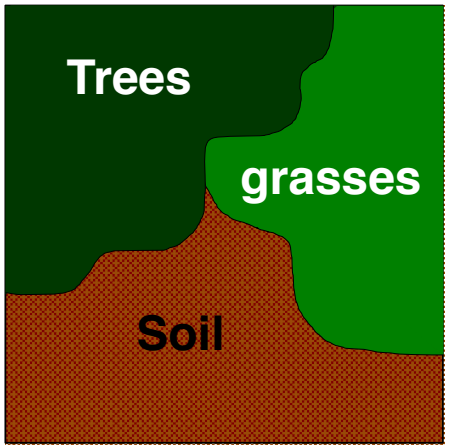
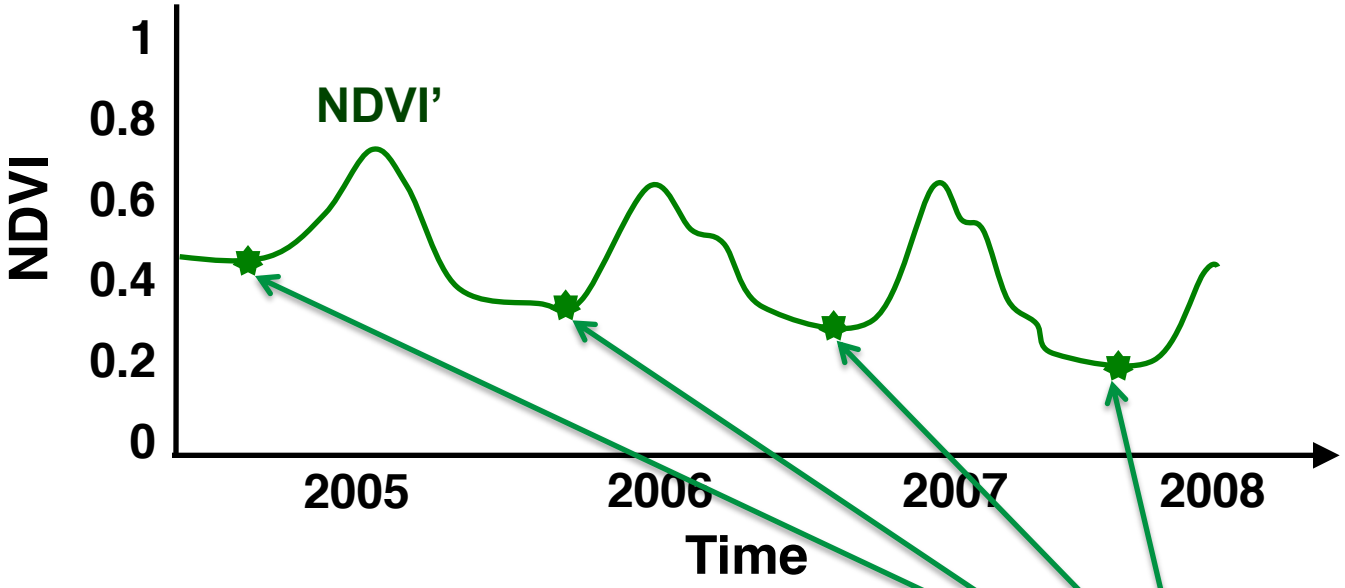
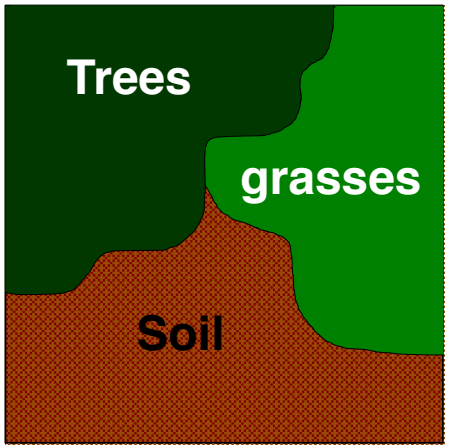




(3) ***NDVI' = Trees + grasses***

Decomposing NDVI time series into trees and grasses

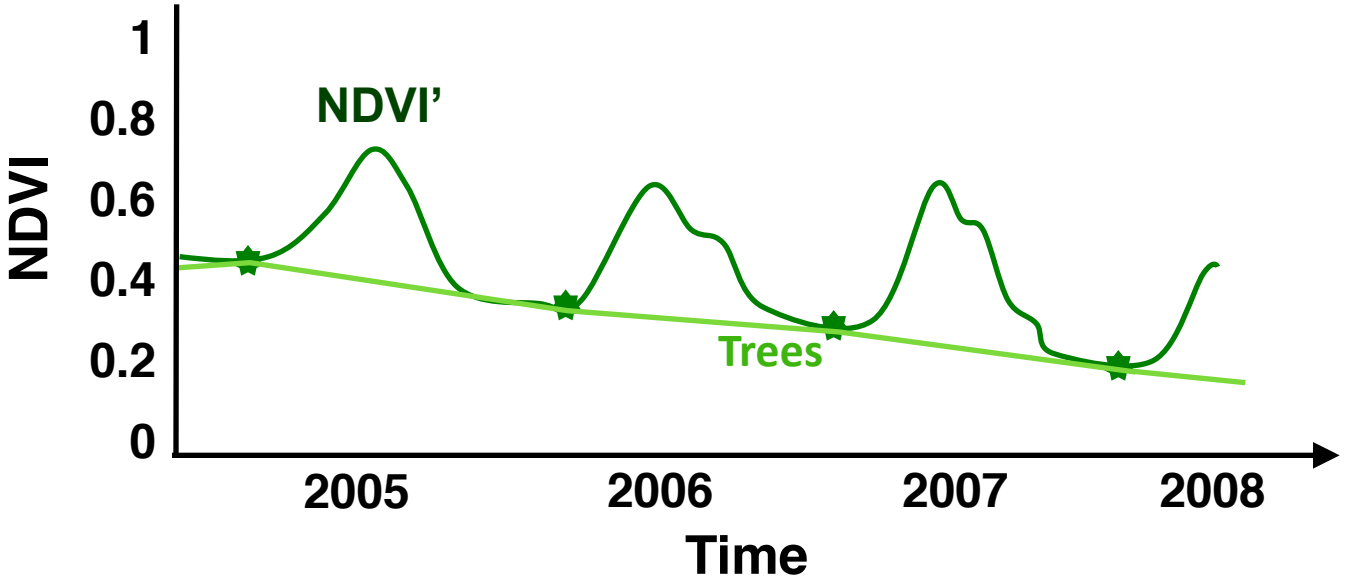


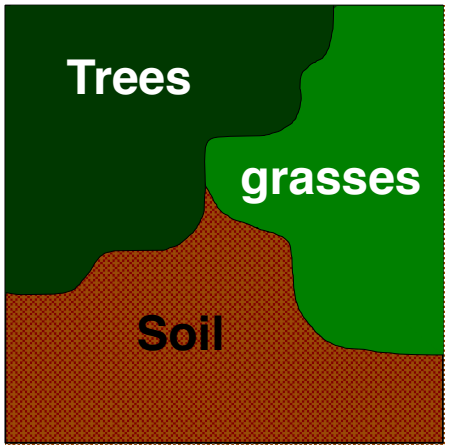


(3) ***NDVI' = Trees + grasses***

Plotting the minimum NDVI' during the summer for the contribution of trees to NDVI (no grasses are present)

Decomposing NDVI time series into trees and grasses

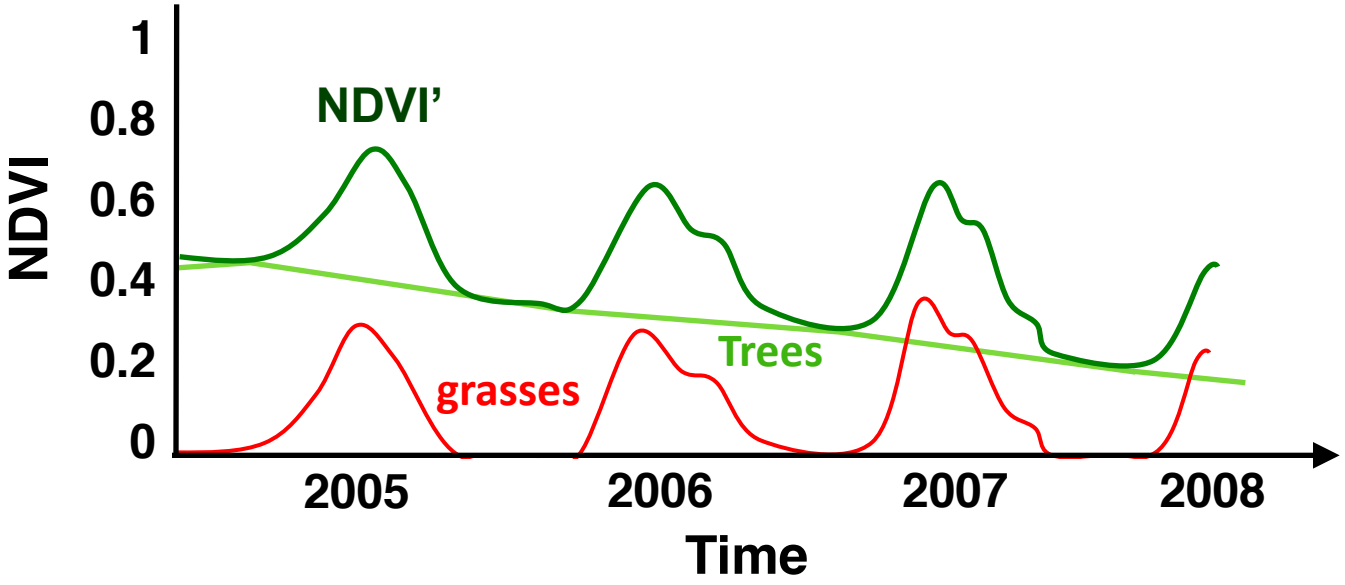


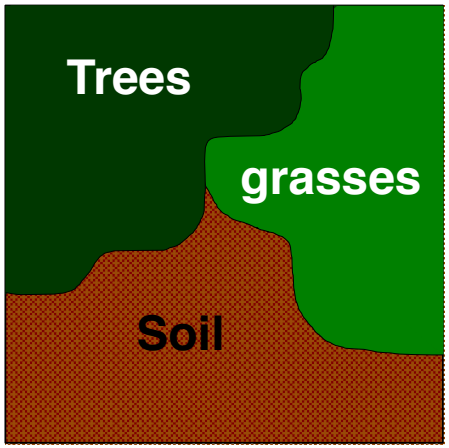


(3) ***NDVI' = Trees + grasses***

(4) ***Trees = NDVI'$_{min}$*** **(in summer)**

Decomposing NDVI time series into trees and grasses





(3) ***NDVI' = Trees + grasses***

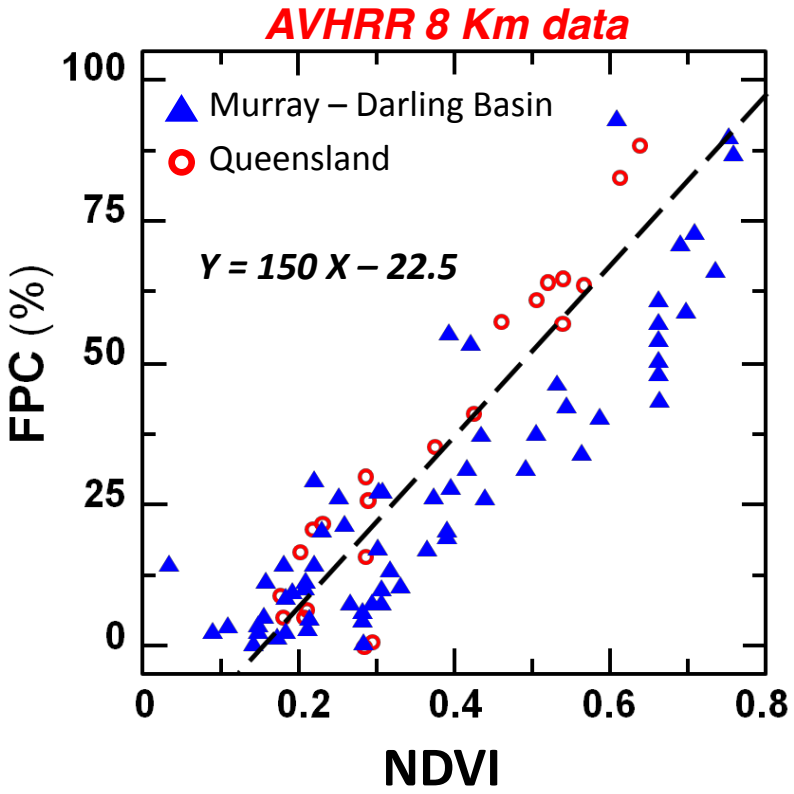
(4) ***Trees = NDVI'$_{min}$*** **(in summer)**

(5) ***grasses = NDVI' – Trees***

NDVI – The biophysical meaning

FPC – Foliage Projection Cover (%)

$$FPC = a \bullet NDVI + b$$



Lu *et al.* (2003)

Linear correlation between field measured data and NDVI from satellite

FPC can be estimated relatively:

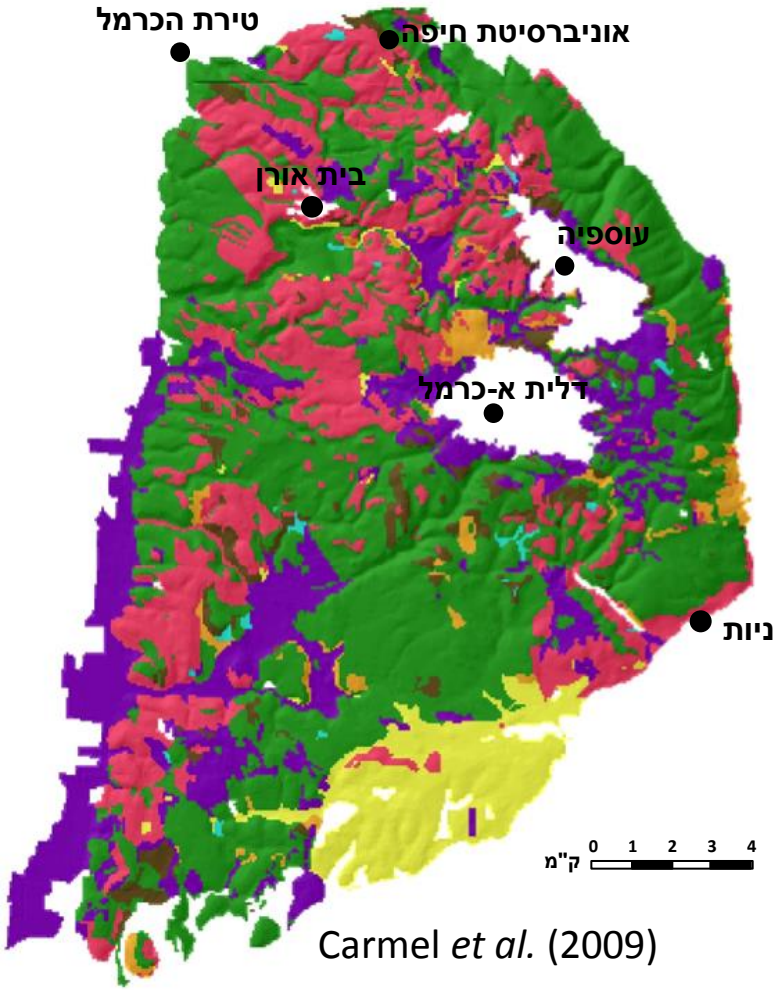
$NDVI_{max}$ = ***pixel of full vegetation*** *(~100%)*

$NDVI_{min}$ = ***Soil*** *(0% vegetation)*

Roderick *et al.* (1999)

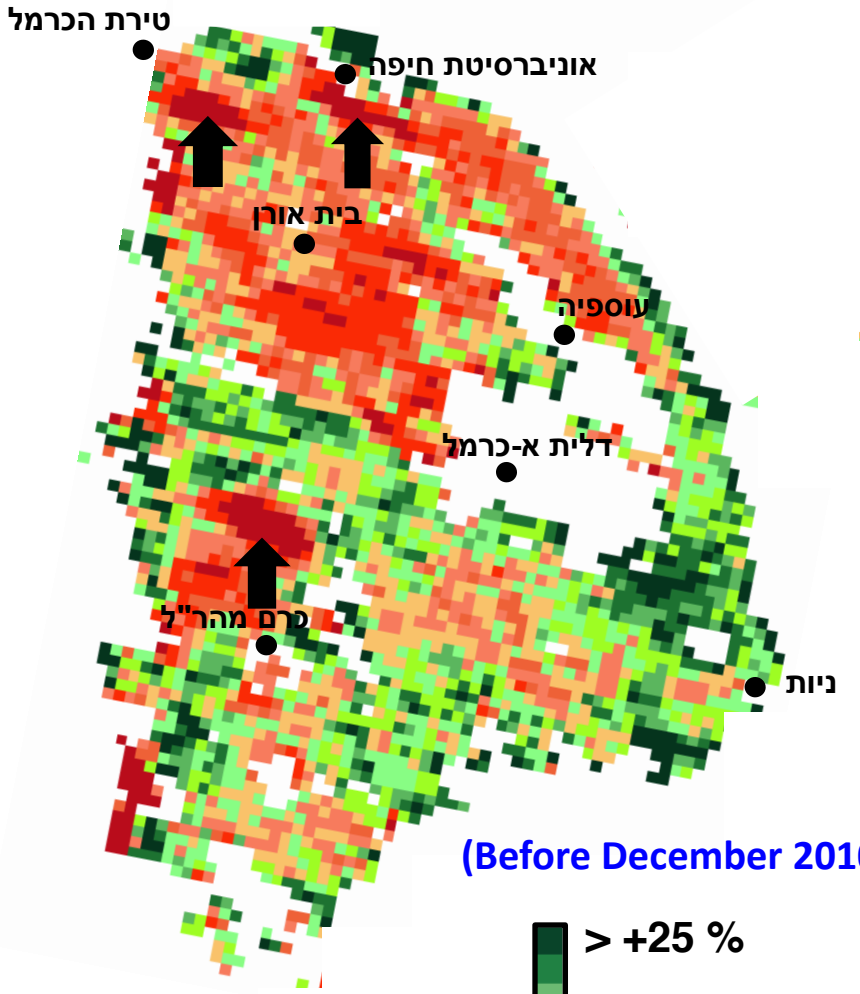
$$FPC = \frac{NDVI\ Trees}{NDVI_{max} - NDVI_{min}}$$

Carmel Forest – patterns of tree cover (2001-2010)



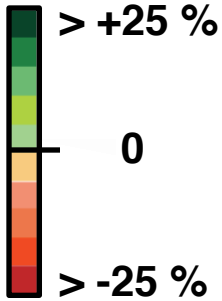
Carmel *et al.* (2009)

- **עשבונים**
- **עצים ירוקי-עד רחבי עלים** (אלון מצוי, חרוב מצוי)
- **עצים ירוקי-עד מחטניים** (אורן ירושלים)
- **חקלאות**
- **קרקע**
- **בני שיחים** (סירה קוצנית)
- **שיחים** (קידה שעירה, רתמה קוצנית, אלת המסטיק)

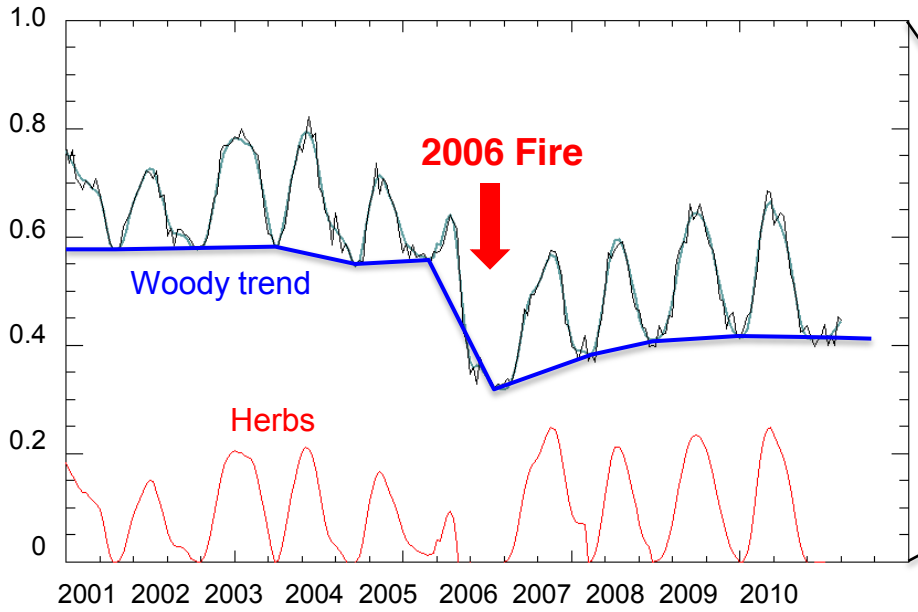


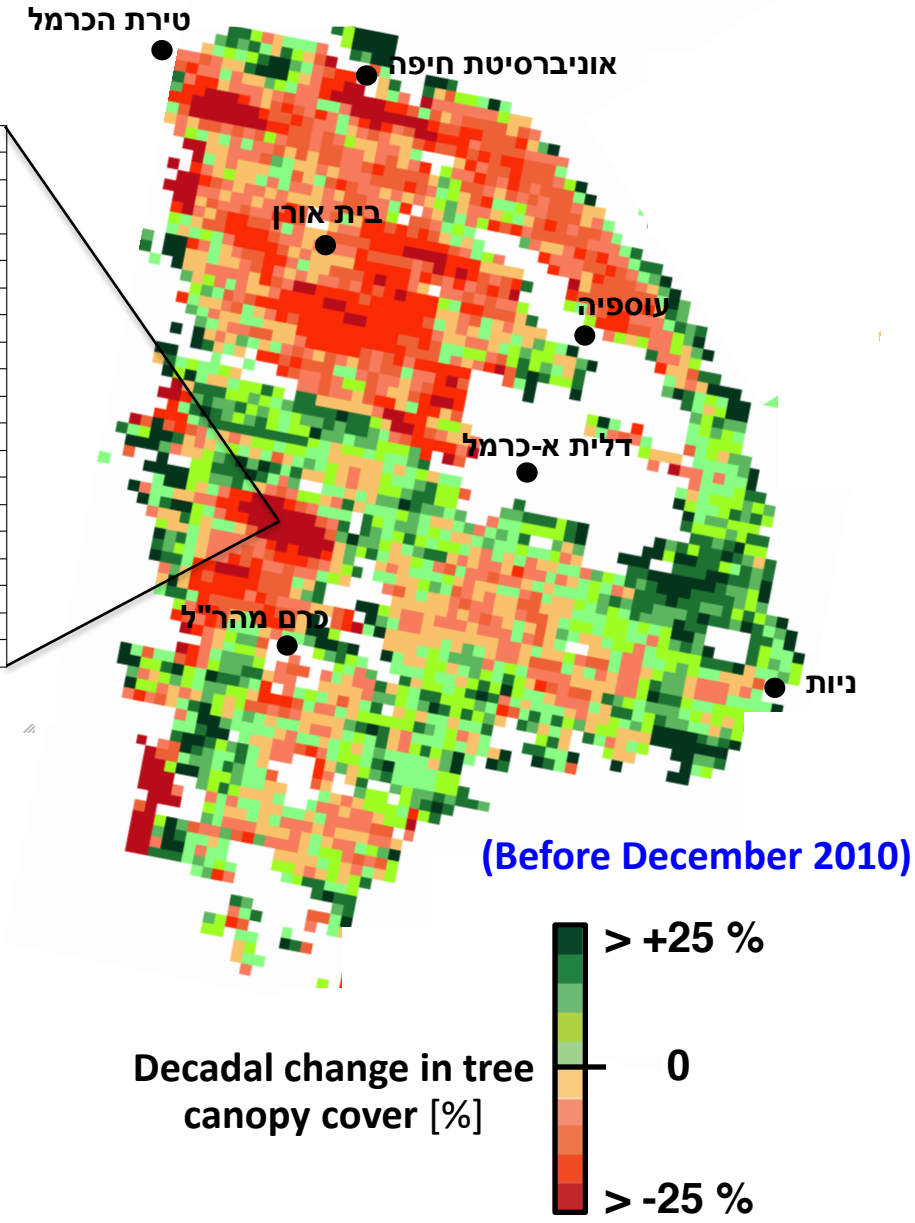
(Before December 2010)

Decadal change in tree canopy cover [%]



Carmel Forest – patterns of tree cover (2001-2010)





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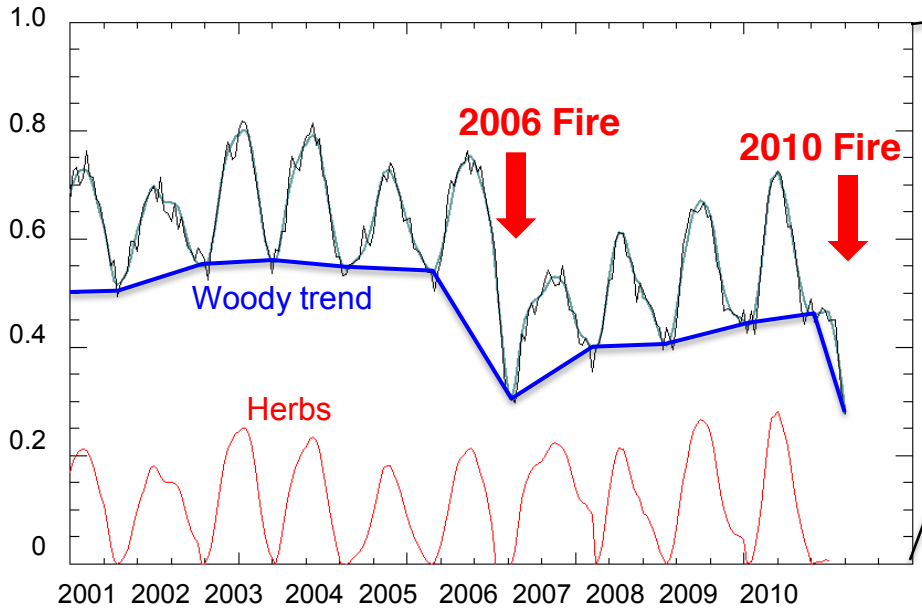
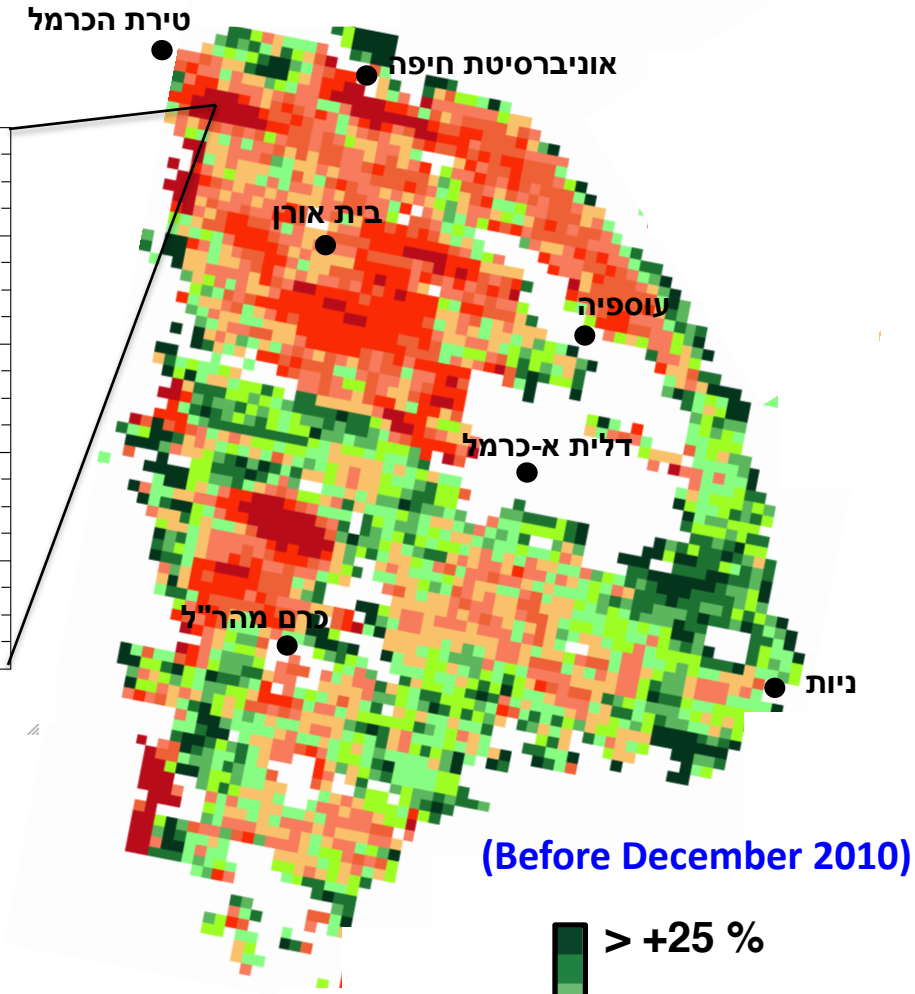
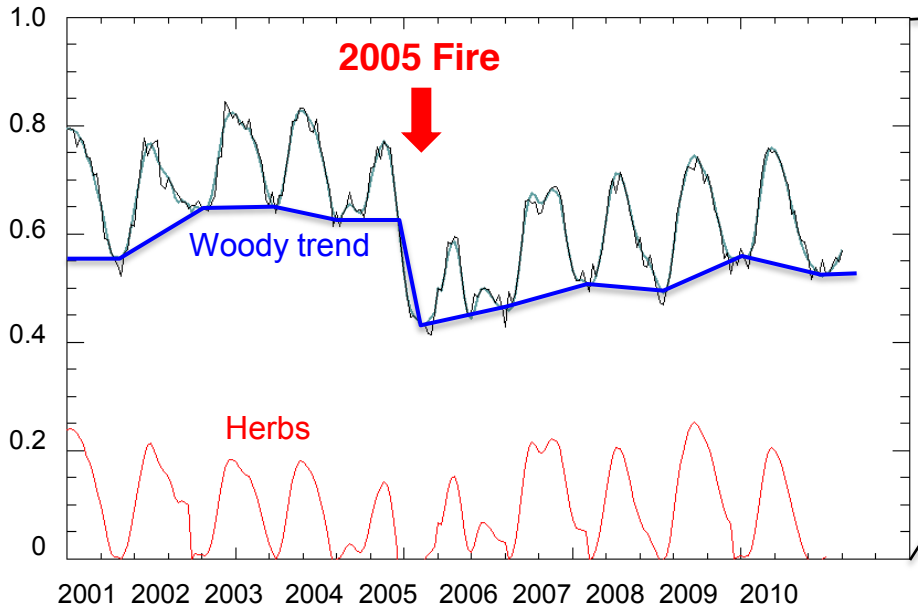
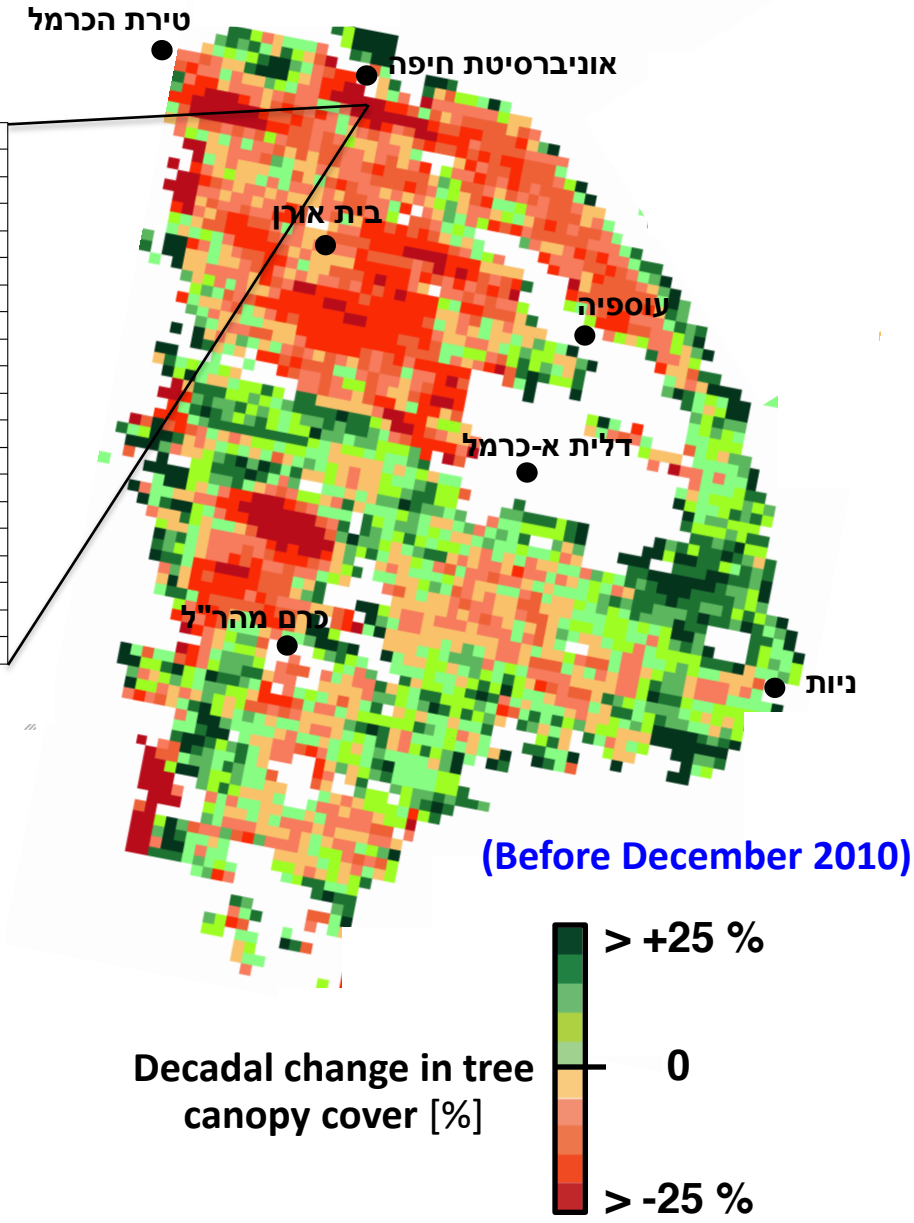


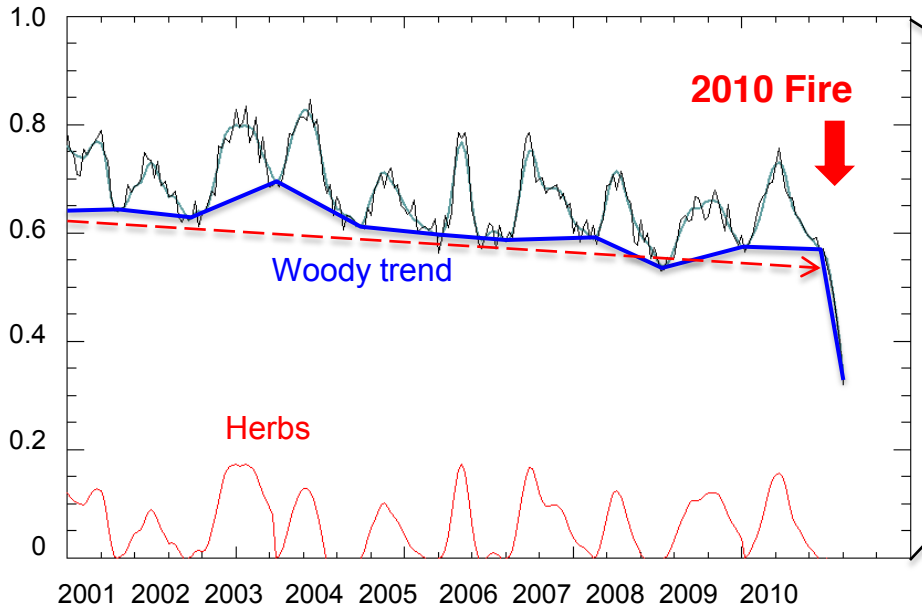


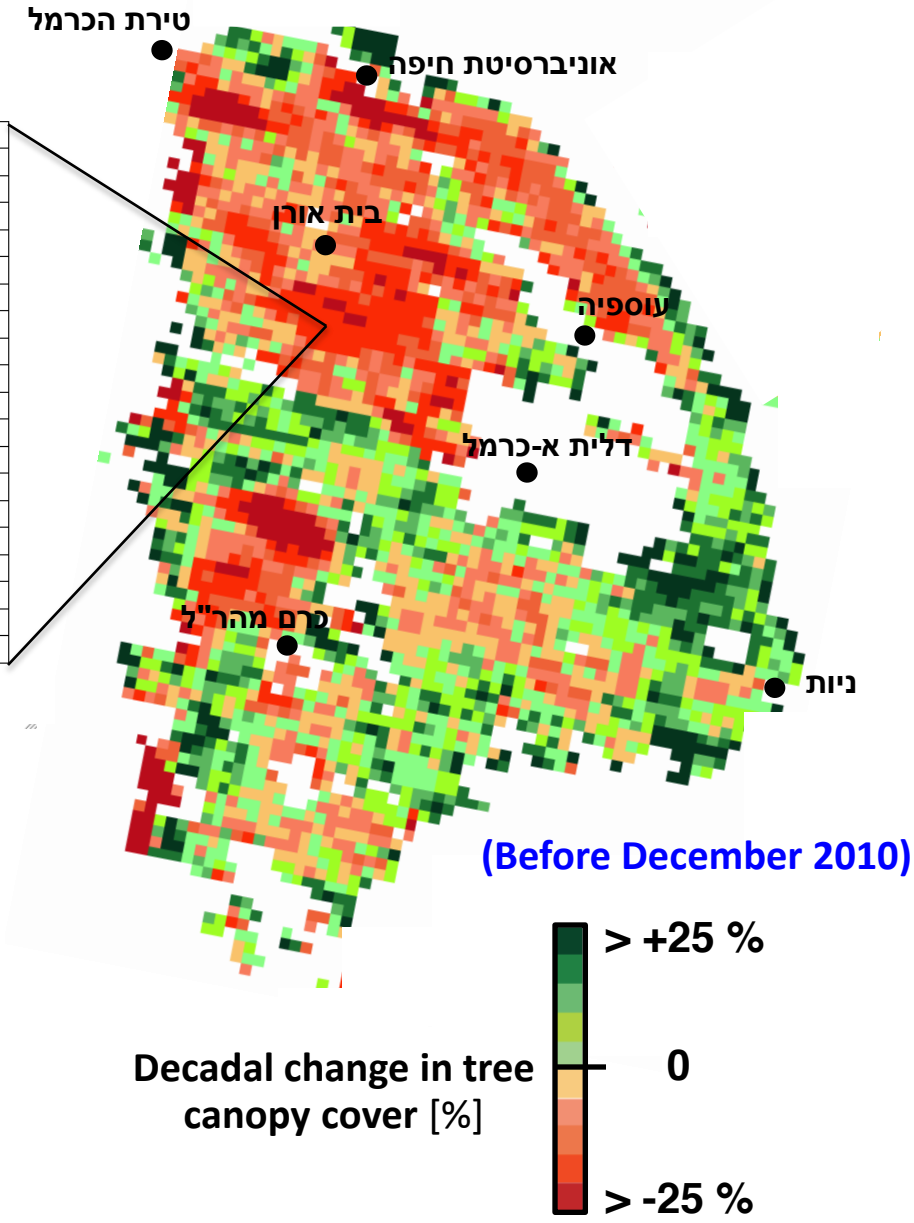
Carmel Forest – patterns of tree cover (2001-2010)



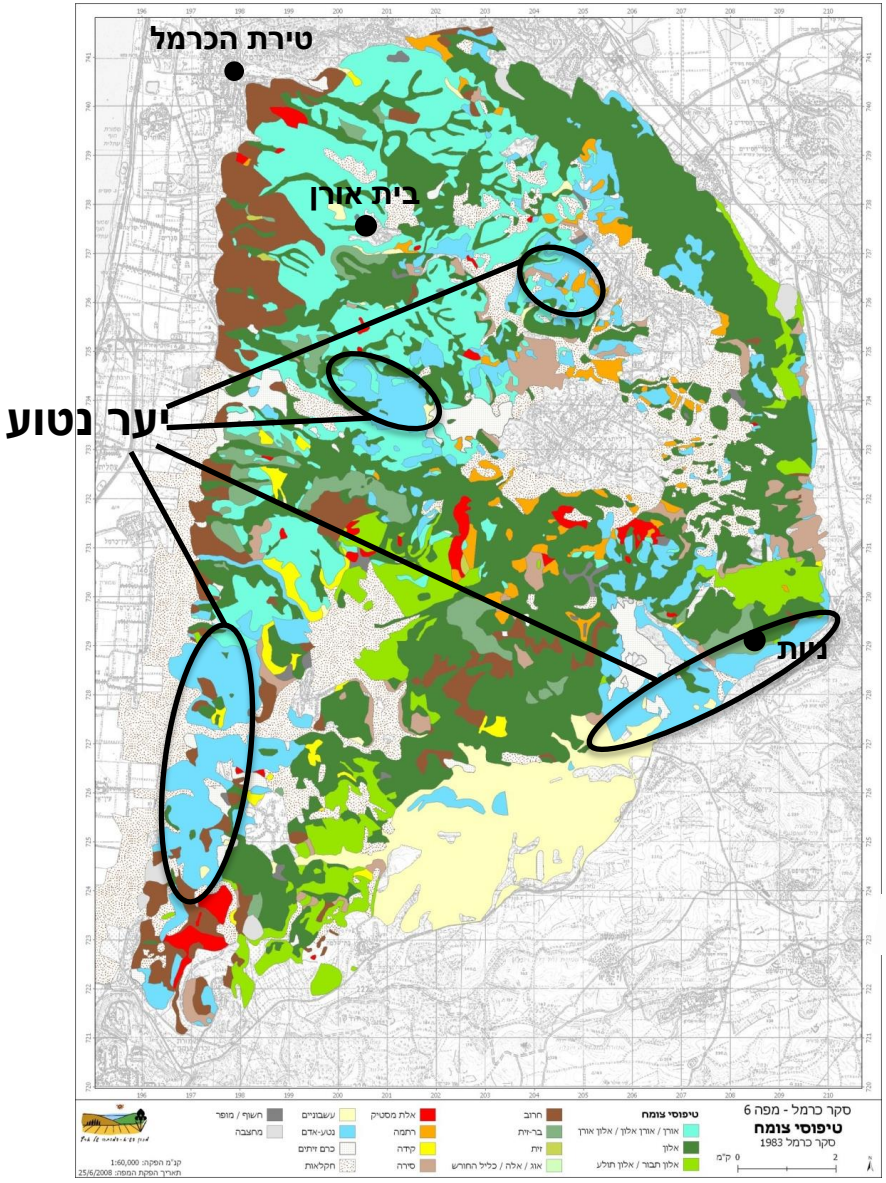


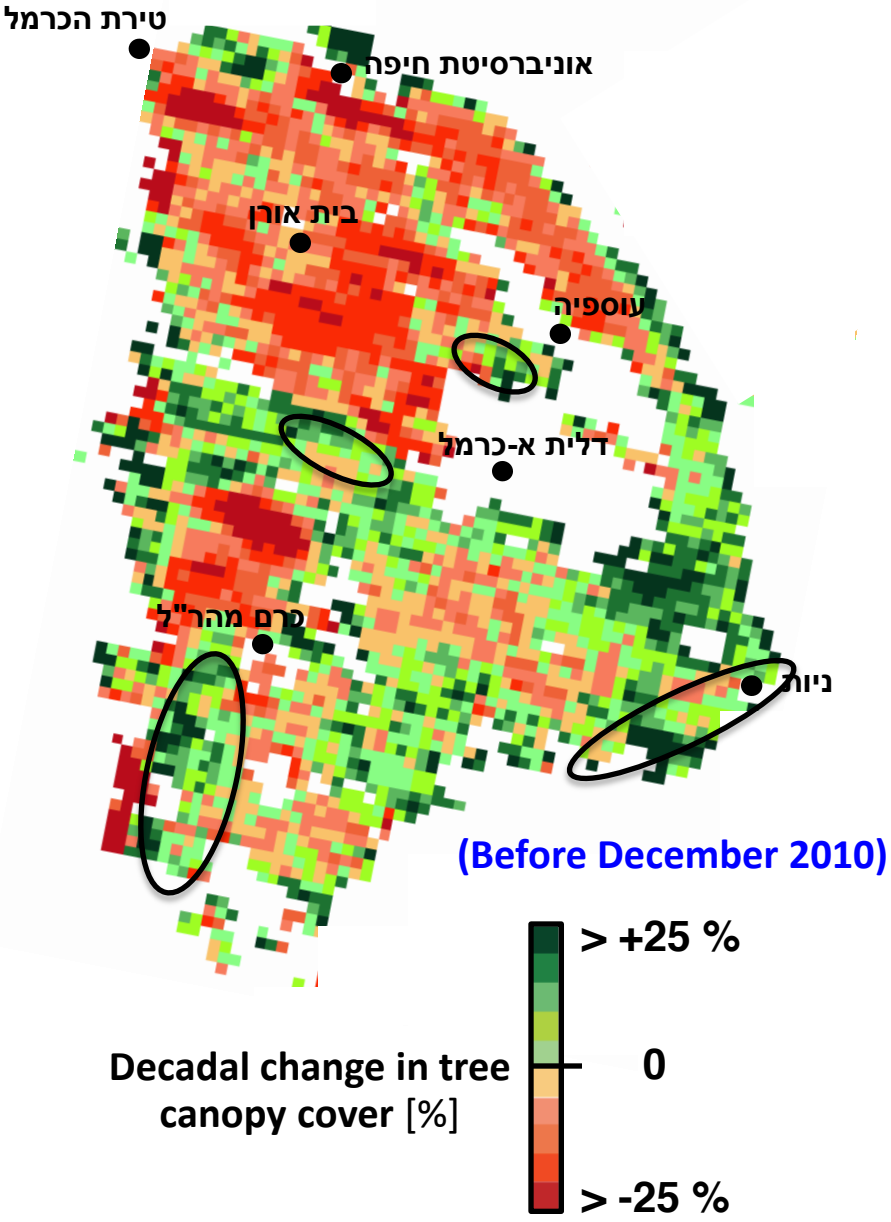
Carmel Forest – patterns of tree cover (2001-2010)





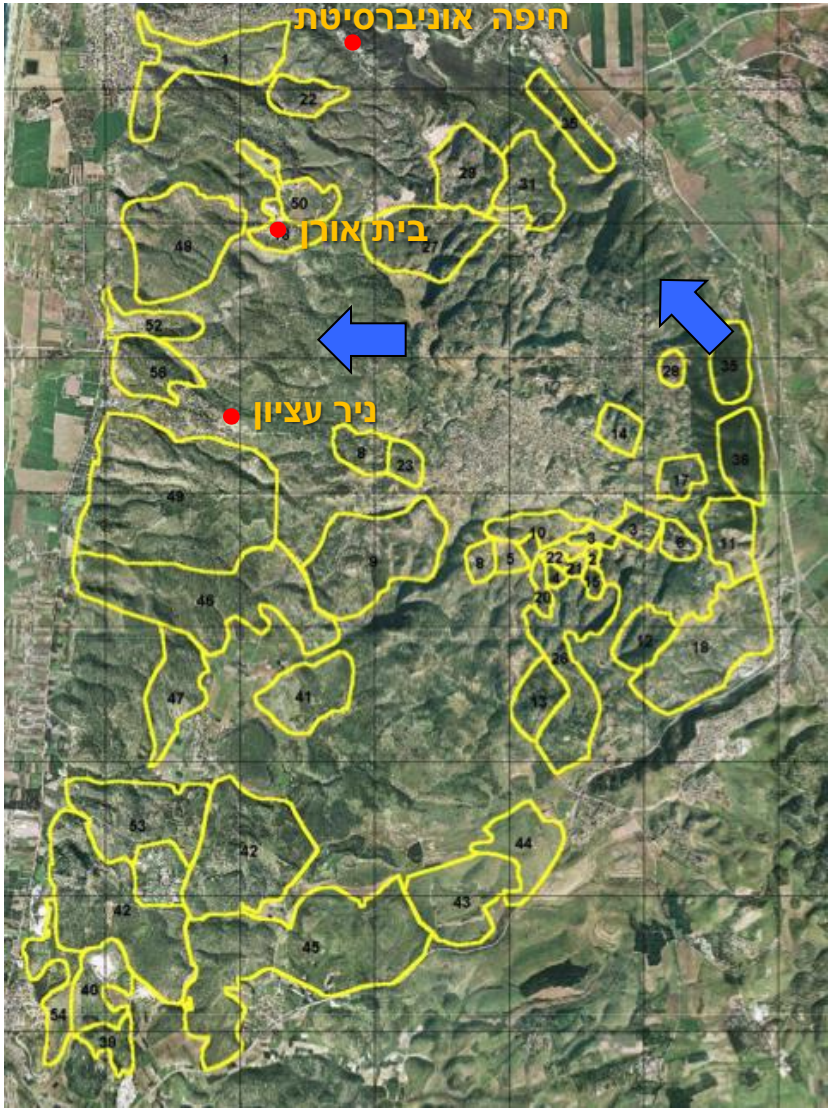
Carmel Forest – patterns of tree cover (2001-2010)



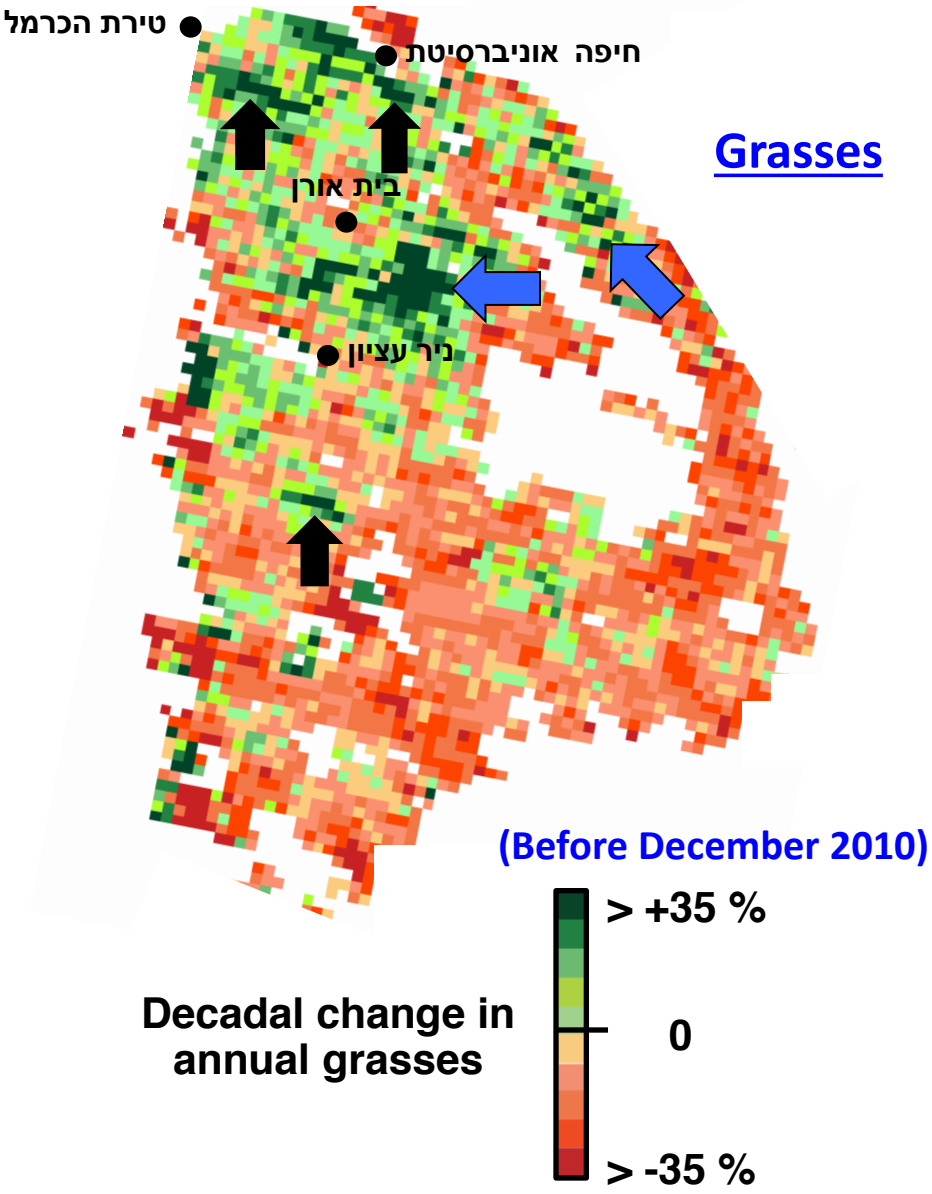


Carmel Forest – patterns of herbs cover (2001-2010)

Grazing areas map

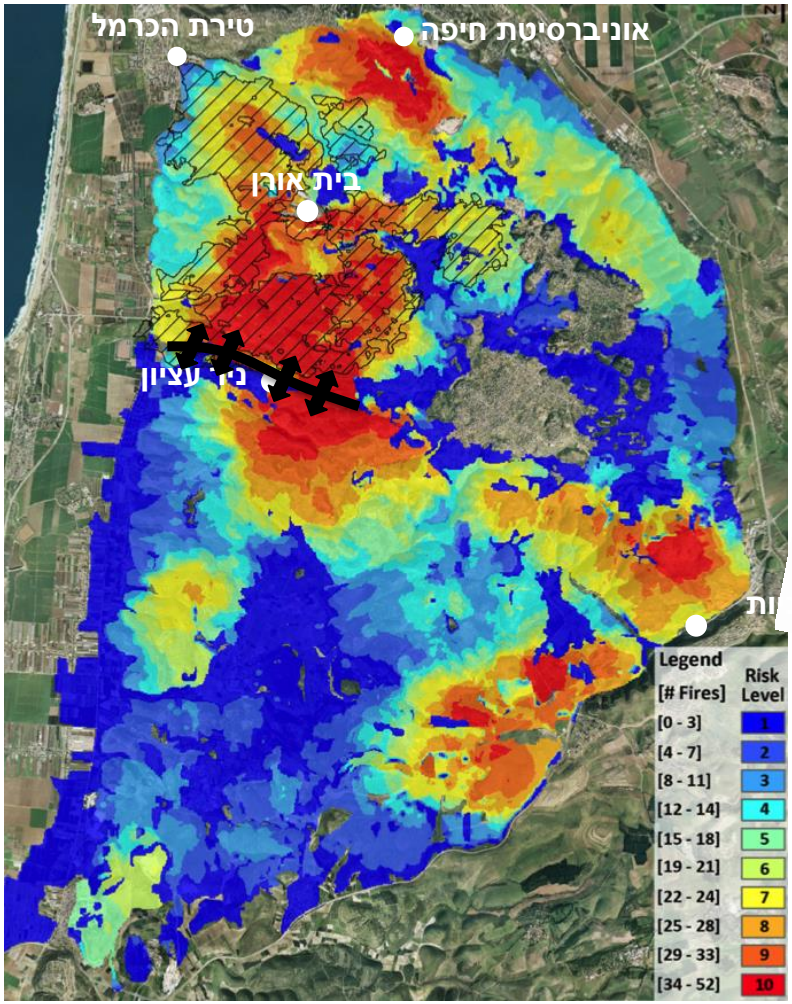


ש. אשכנזי [2003]
(ממשק הצומח המעוצה של הכרמל – קק"ל)



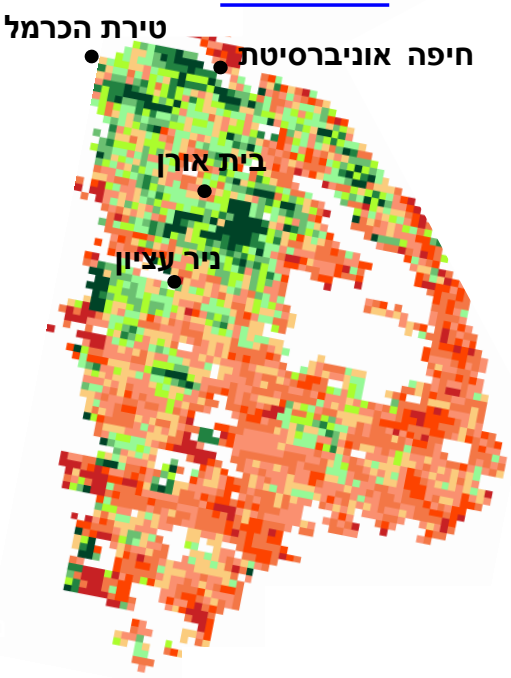
Carmel Forest – patterns of trees and grasses cover

December 2010 wildfire on Mt. Carmel and Fire-risk map

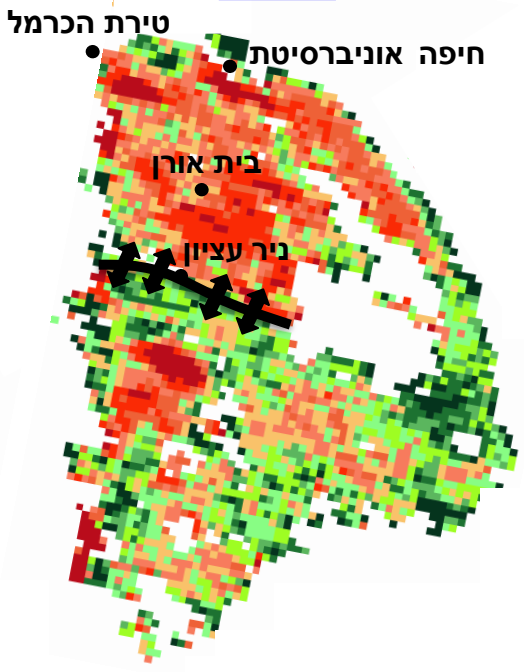


Paz S. *et al.* (2011)

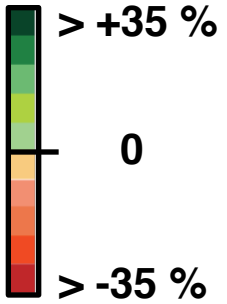
Grasses



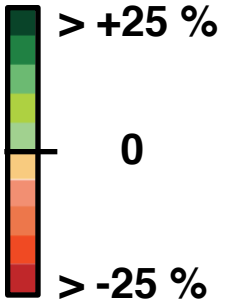
Trees



Decadal change in annual grasses



Decadal change in tree canopy cover



Implications for management and research

Local Scale

1. **Pre-fire mapping of fire-risk**
2. **Grazing management**
3. **Monitoring severe disturbances in forests** (wildfires, tree mortality etc.)
4. **Monitoring biodiversity hotspots** (vascular vegetation)

Regional to global scale

5. **Climate change effect on forest structure**
6. **Patterns of change in vegetation in Mediterranean forests**
7. **Mapping climate-sensitive zones within the forests**