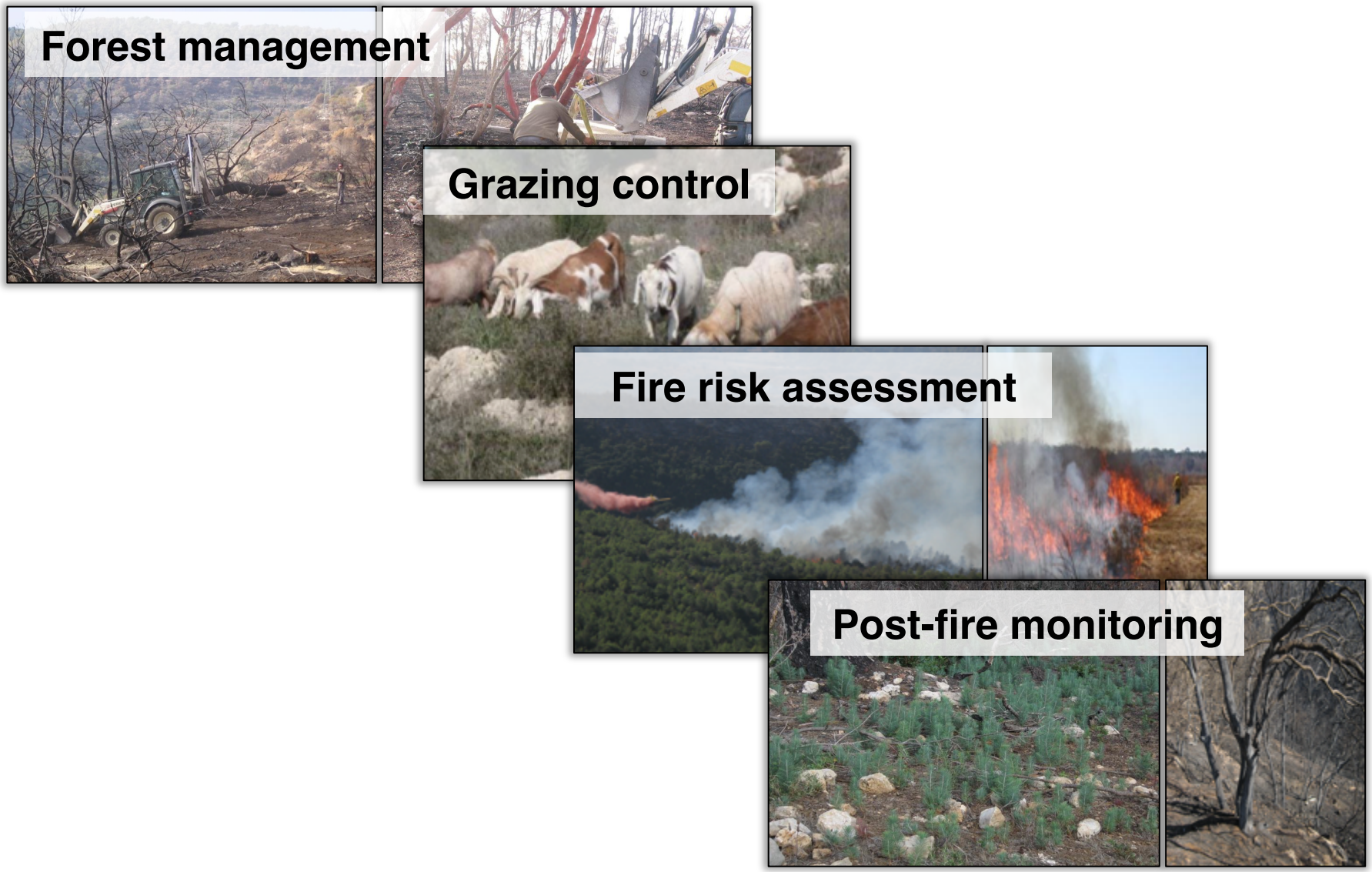
Monitoring vegetation dynamics in evergreen forests by decomposing NDVI time series:
Implications for pre and post-fire monitoring

David Helman
(davidhelman.biu@icloud.com)
Itamar M. Lensky, Naama Tessler, Yagil Osem

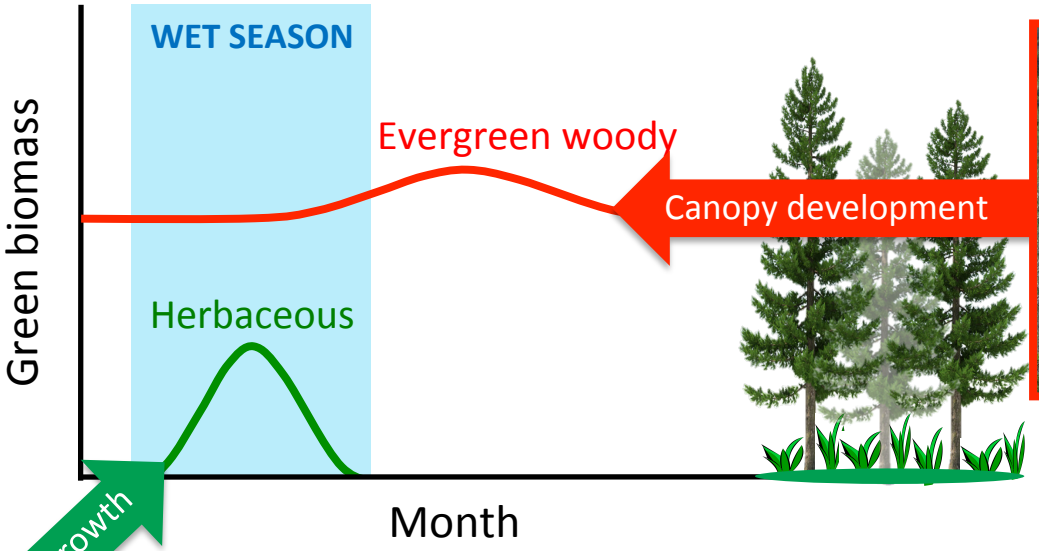
ForestSAT International Conference, Riva del Garda, Italy, November 2014

Importance of monitoring vegetation components in Mediterranean forests



Different phenology for herbaceous and woody vegetation

Vegetation in evergreen Mediterranean forests:



Woody vegetation

Herbaceous vegetation

Herbaceous vegetation appears in the understory shortly after the first rain, drying out in early spring

Evergreen **woody** vegetation become most active from early spring towards the summer

An example from the Yatir pine forest (southern Israel)

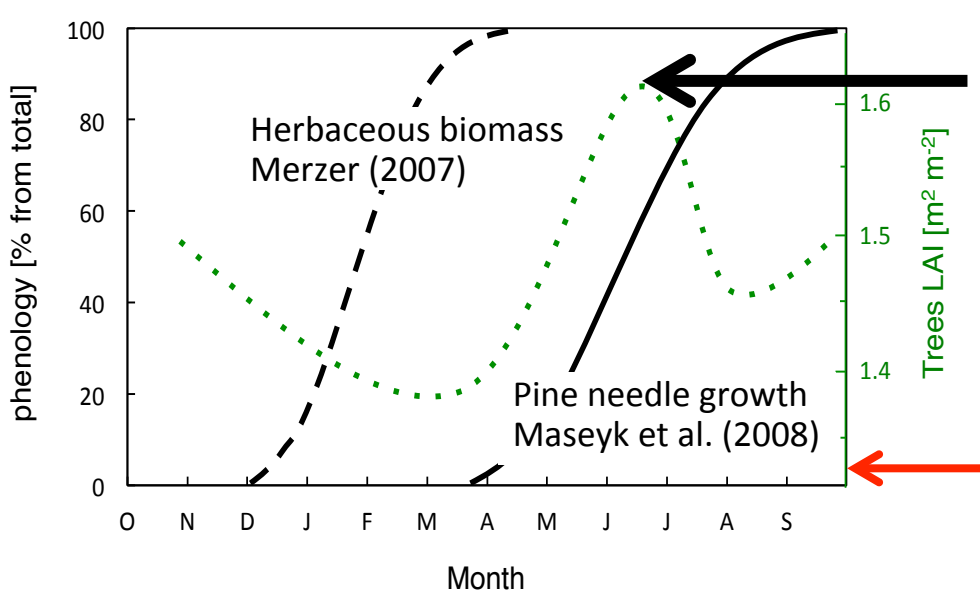
Yatir forest (Israel)

Wet season

Dry season

Photos: Safriel et al. (2011)

The well-defined wet and dry seasons characterizing Mediterranean climate regulate the photosynthetic activity and growth of the vegetation

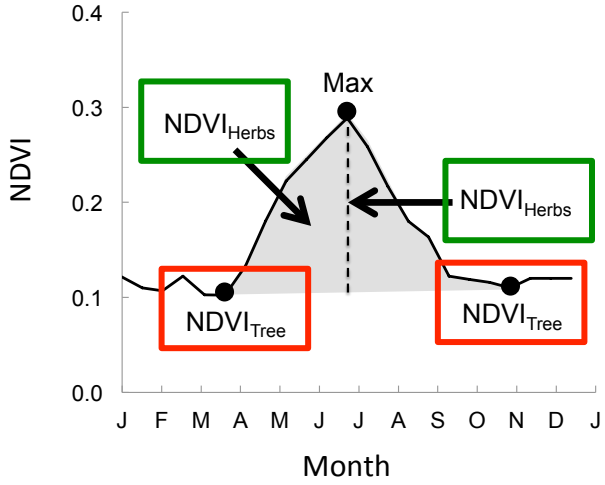


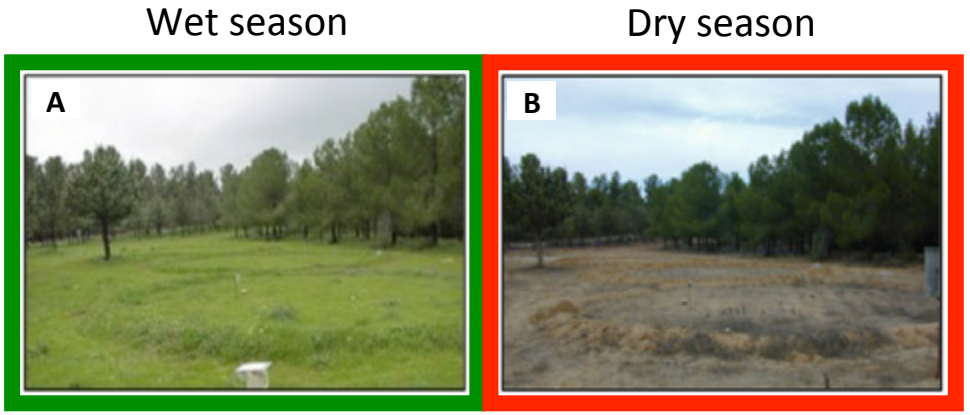
max LAI when leaf growth is only 55% completed due to growth and senescence
Maseyk et al. (2008)

Seasonal year 2004/5

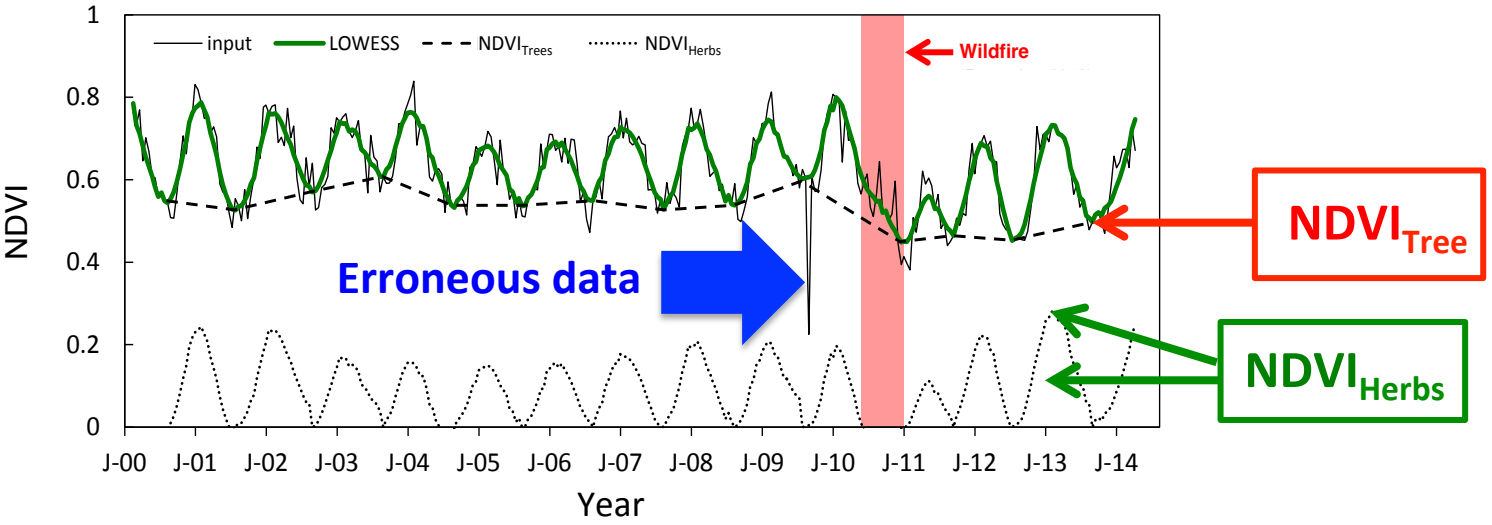
Decomposition of the NDVI signal into woody and herbaceous

Helman et al. (*submitted*)





Photos: Safriel et al. (2011)



MODIS NDVI time series is decomposed into: NDVI$_{Tree}$ and NDVI$_{Herbs}$ for woody and herbaceous contributions, after smoothing with LOWESS (Cleveland 1979)

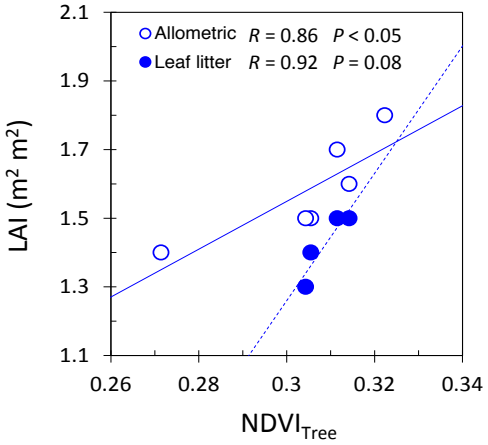
Evaluation of $NDVI_{Tree}$ and $NDVI_{Herbs}$ using field data

Pine forest (Yatir)

Pine-oak forest (Mt Carmel)

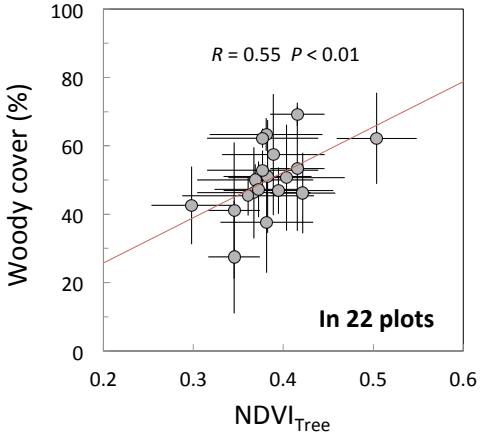
Woody savannah (Negev)

Leaf Area Index

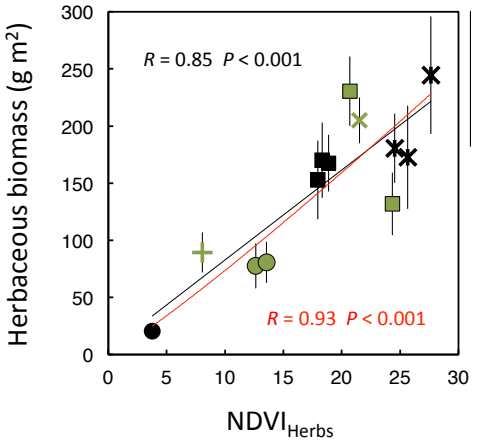


Helman et al. (*submitted*)

Woody cover



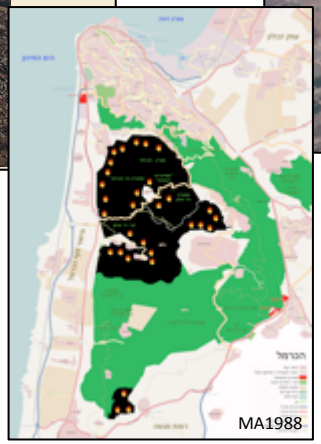
Herbaceous biomass



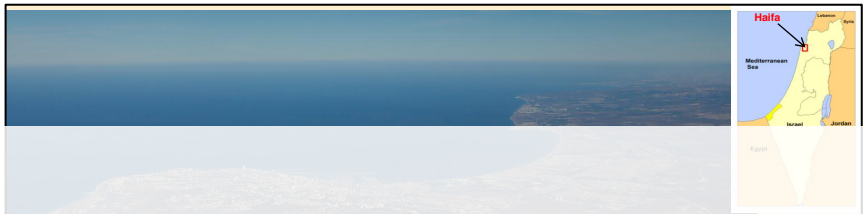
Helman et al. (2014), *AgrForMet*

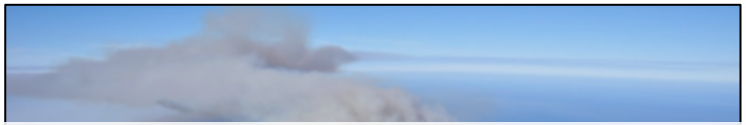
$NDVI_{Tree}$ and $NDVI_{Herbs}$ is significantly correlated with field measurements of LAI, vegetation cover and biomass in evergreen Mediterranean forests and savannah

The wildfire at Mt. Carmel in December 2010 – a case study



The wildfire at Mt. Carmel in December 2010 – a case study





The largest fire ever recorded in Israel

- 44 People killed
- More than 2500 ha of forest stands burned
- More than 350 houses damaged
- Damage estimated at 50 – 60 million **€**

Ofek aerial photos, 2/12/2010, Mt. Carmel

Israeli Police Aerial Unit

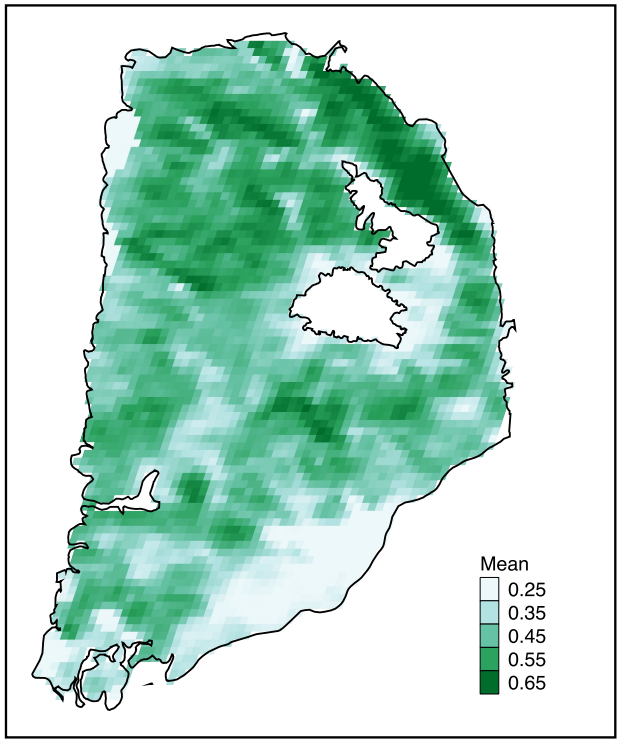
Israeli Police Aerial Unit

$NDVI_{Tree}$ for woody cover and status (2002 – 2009)

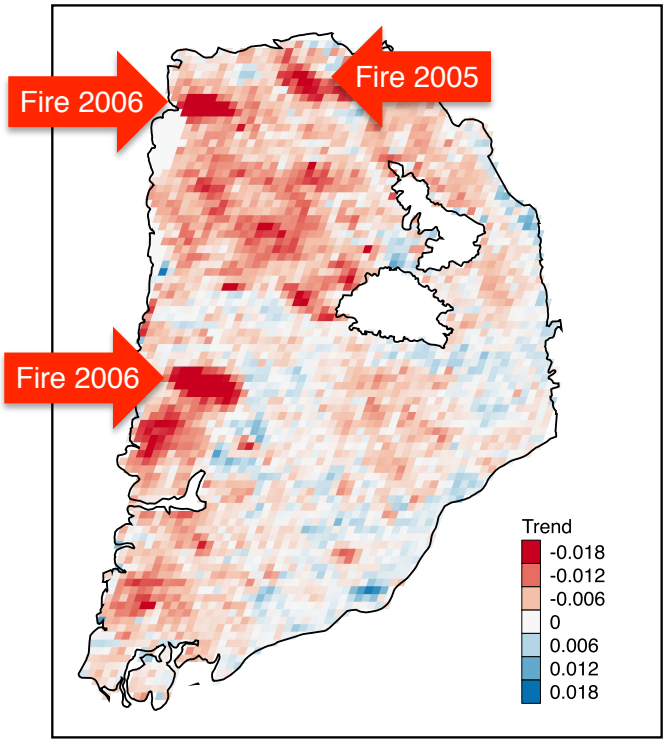
Helman et al. (*in prep.*)

Mt. Carmel ridge

1. Woody cover (Mean $NDVI_{Tree}$)



2. Woody status (Trend in $NDVI_{Tree}$)



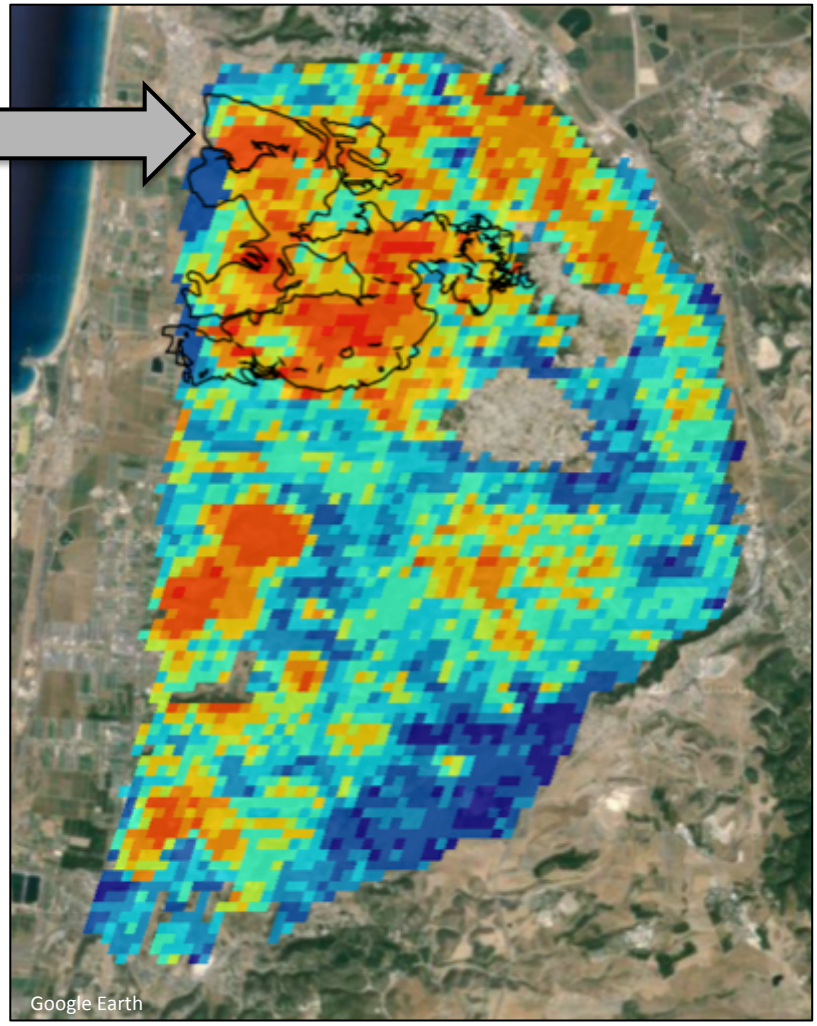
Combining both maps we produced a fuel-based fire risk map that not only consider present conditions (woody cover) but also past conditions (trend in $NDVI_{Tree}$)

Fuel–based fire risk map from $NDVI_{Tree}$

Helman et al. (*in prep.*)

Mt. Carmel wildfire
(December 2010)

Photos: N.Tessler



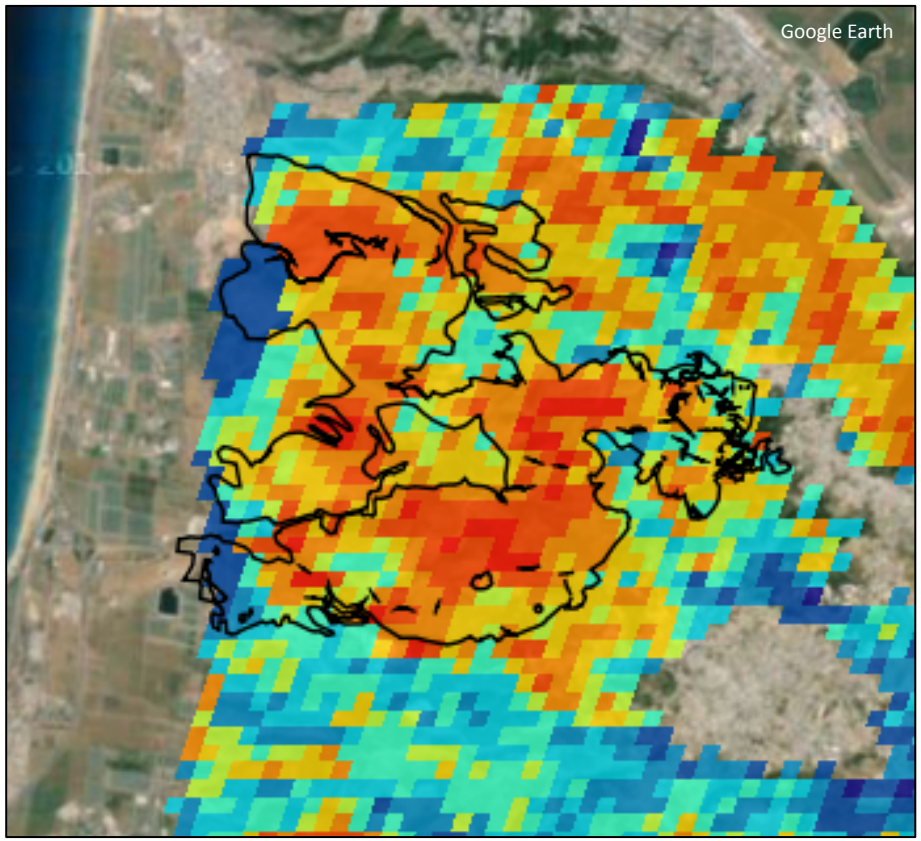
The $NDVI_{Tree}$-based risk map explains the fire behavior of Mt. Carmel 2010 wildfire

Fuel–based fire risk map from $NDVI_{Tree}$

Helman et al. (*in prep.*)

Mt. Carmel wildfire
(December 2010)

Photos: N.Tessler

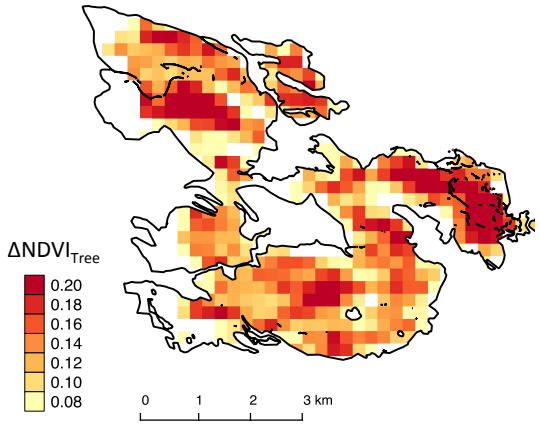


The $NDVI_{Tree}$-based risk map explains the fire behavior of Mt. Carmel 2010 wildfire

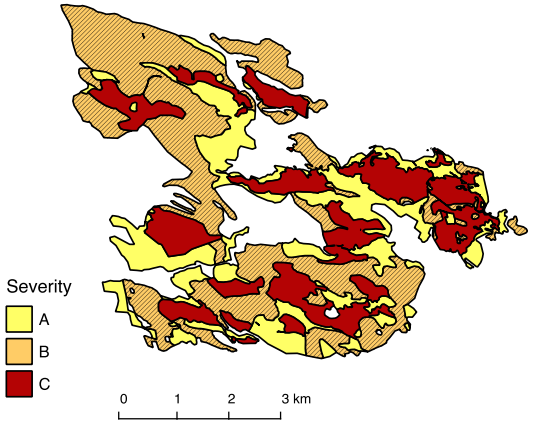
$\Delta NDVI_{Tree}$ as an estimator for fire severity in the burnt area

Helman et al. (*in prep.*)

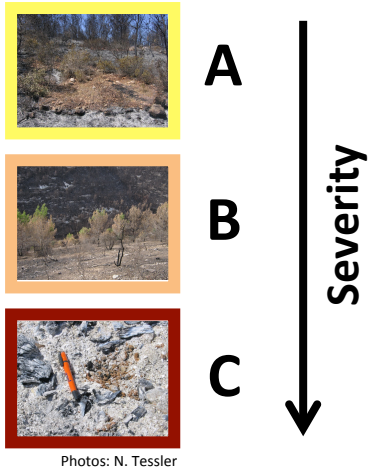
$\Delta NDVI_{Tree}$



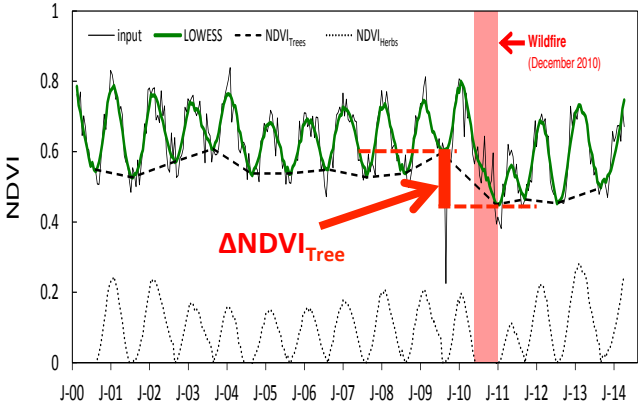
Field assessment



Neary et al. (2005)

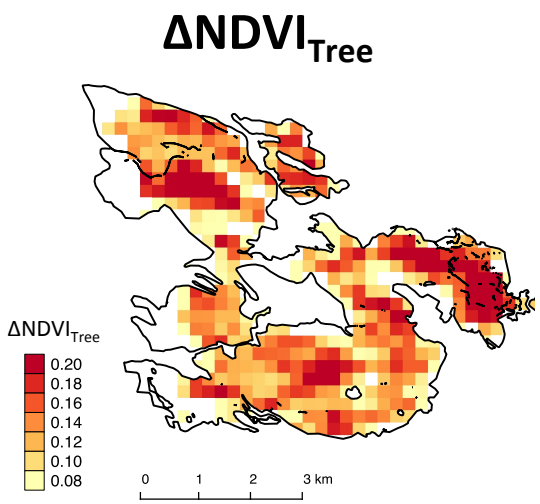


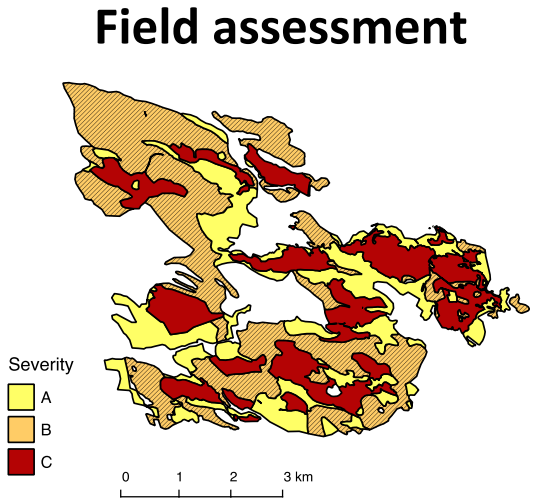
Photos: N. Tessler



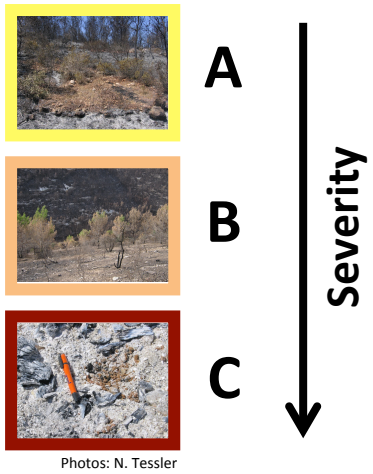
$\Delta NDVI_{Tree}$ as an estimator for fire severity in the burnt area

Helman et al. (*in prep.*)

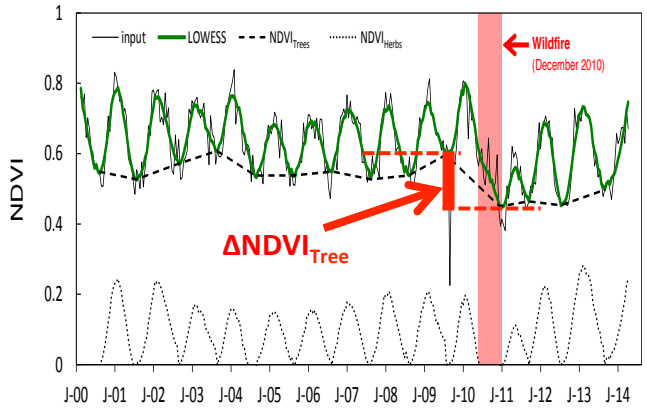


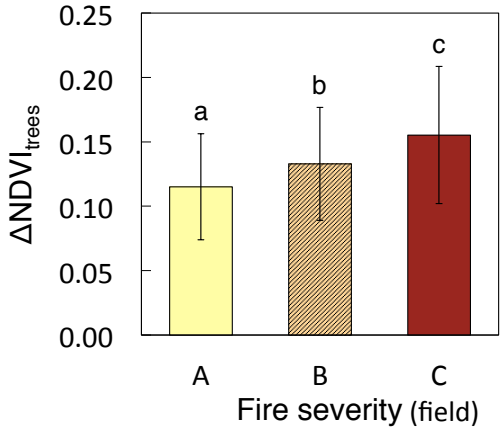


Neary et al. (2005)



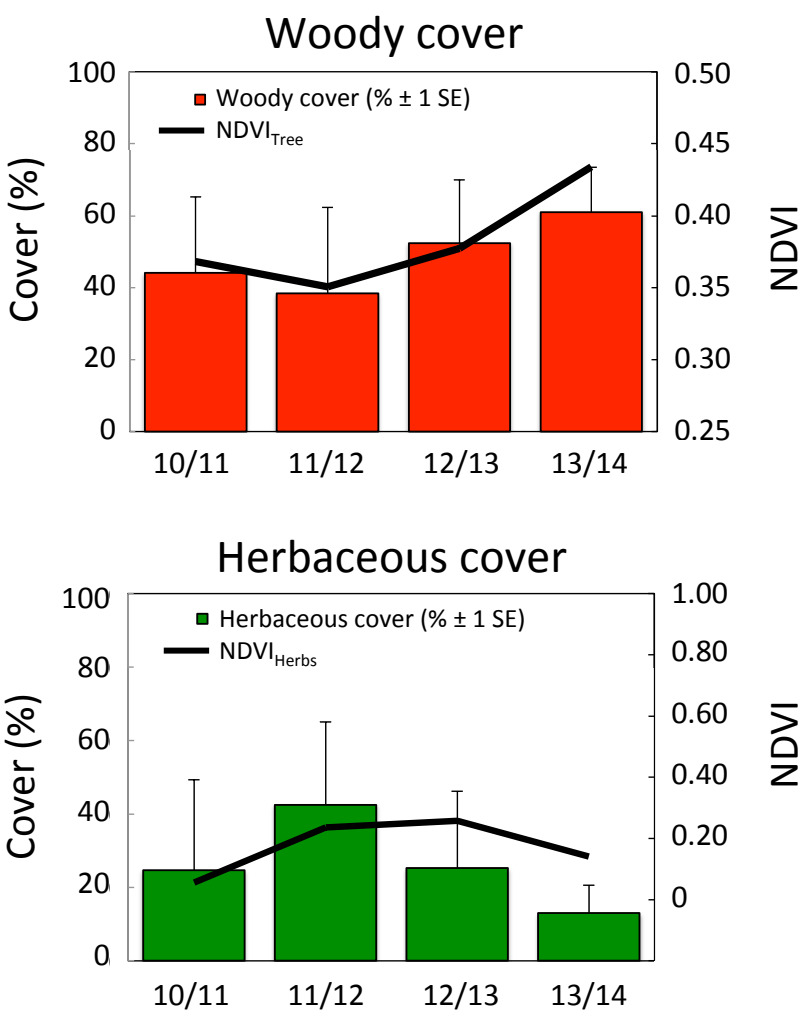
Photos: N. Tessler





$\Delta NDVI_{Tree}$ between fire severity classes assessed from field survey were significantly different ($P < 0.01$), with higher values for most severe burnt areas

Post fire monitoring – woody & herbaceous cover (2010-14)



Vegetation cover in the burnt area (2010-2014)

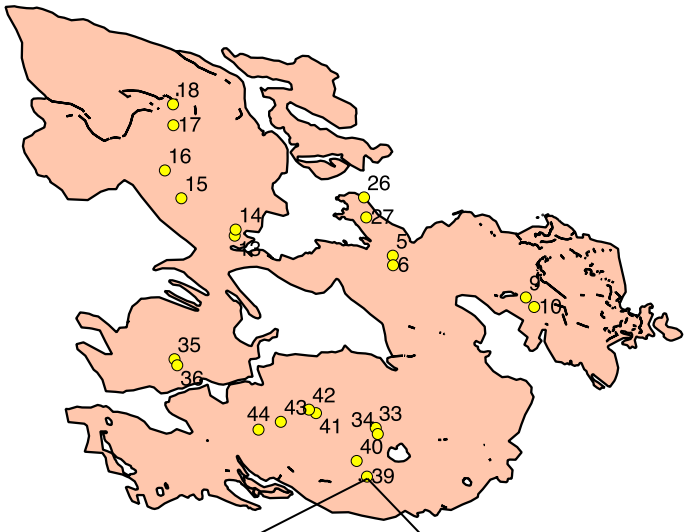


Photo: N. Tessler

Vegetation cover was estimated in 100 m^2 plots (N = 22)

NDVI$_{Tree}$ and NDVI$_{Herbs}$ showed similar interannual changes observed from field assessment.

Summary and conclusions

- Good correlations between $NDVI_{Tree}/NDVI_{Herbs}$ and field woody/herbaceous estimates
- $NDVI_{Tree}$ enables producing fuel-based fire risk maps
- $\Delta NDVI_{Tree}$ useful for fire severity assessment
- $NDVI_{Tree}/NDVI_{Herbs}$ useful for post-fire monitoring

THANK YOU!

www.davidhelman.weebly.com