RS-PestDyn

חיזוי התפתחות הלקטית ורודה על-ידי מודל תהליכים מבוסס חישה מרחוק

חיים אלבז
דוד הלמן
מיכל אקסלרוד

כנס דיווחי מחקרים בענף הכותנה – עונת 2020

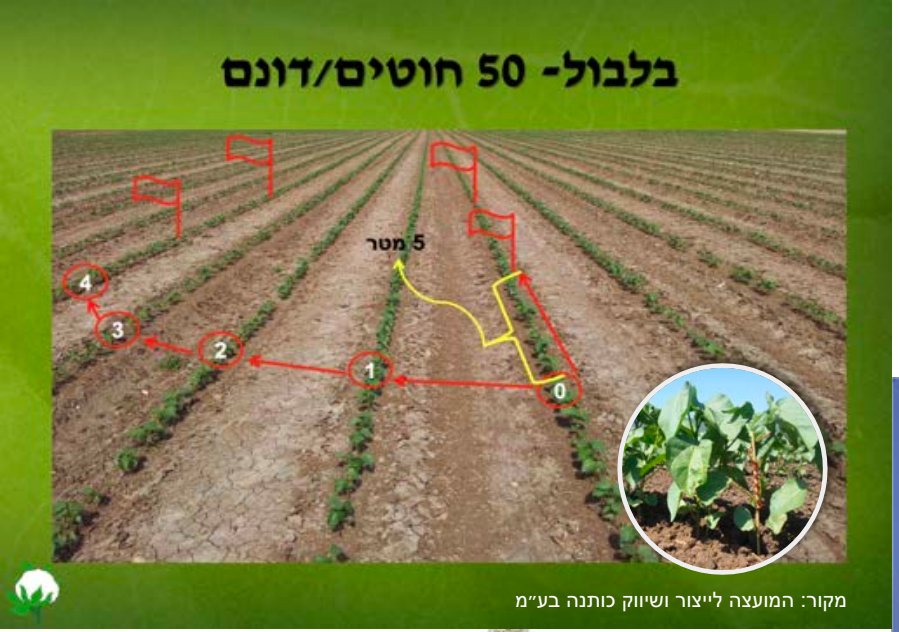
האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Robert H Smith
Faculty of Agriculture,
Food and Environment

משרד החקלאות ופיתוח הכפר
שירות ההדרכה והמקצוע
אגף אגרואקולוגיה וגידולי שדה

המועצה לייצור
ושיווק כותנה בע"מ

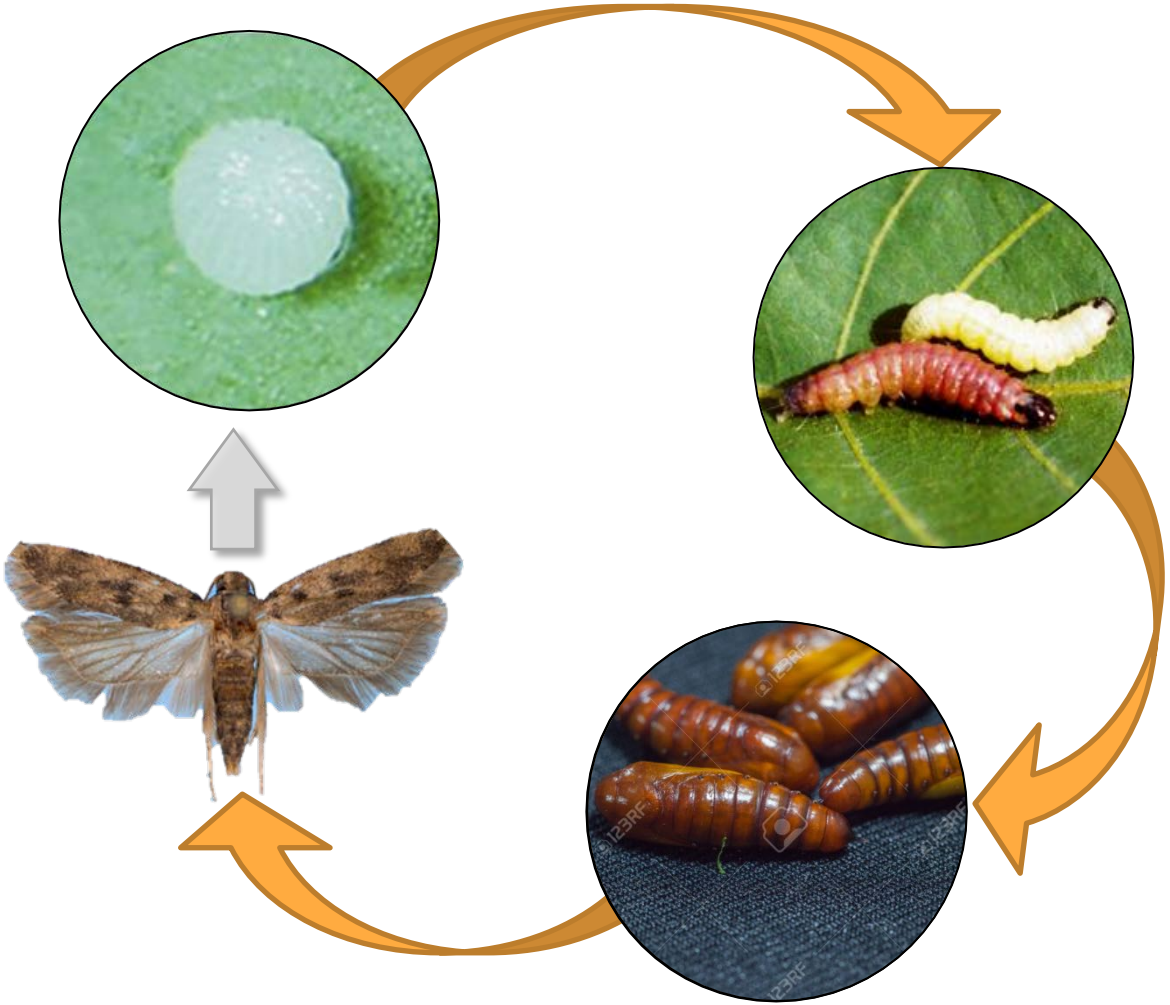
טיפול

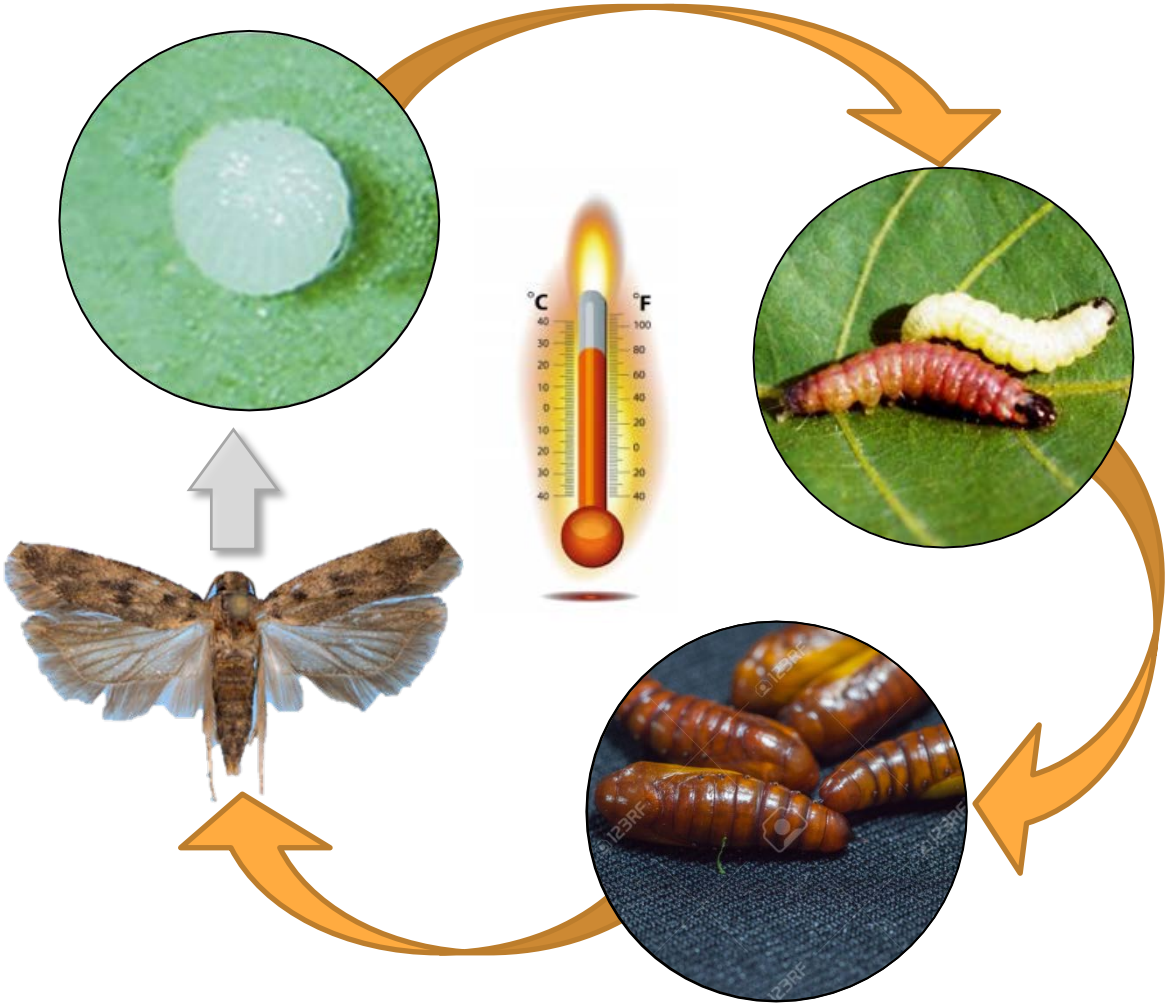


מקור: המועצה לייצור ושיווק כותנה בע"מ

הדברה כימית

סניטציה

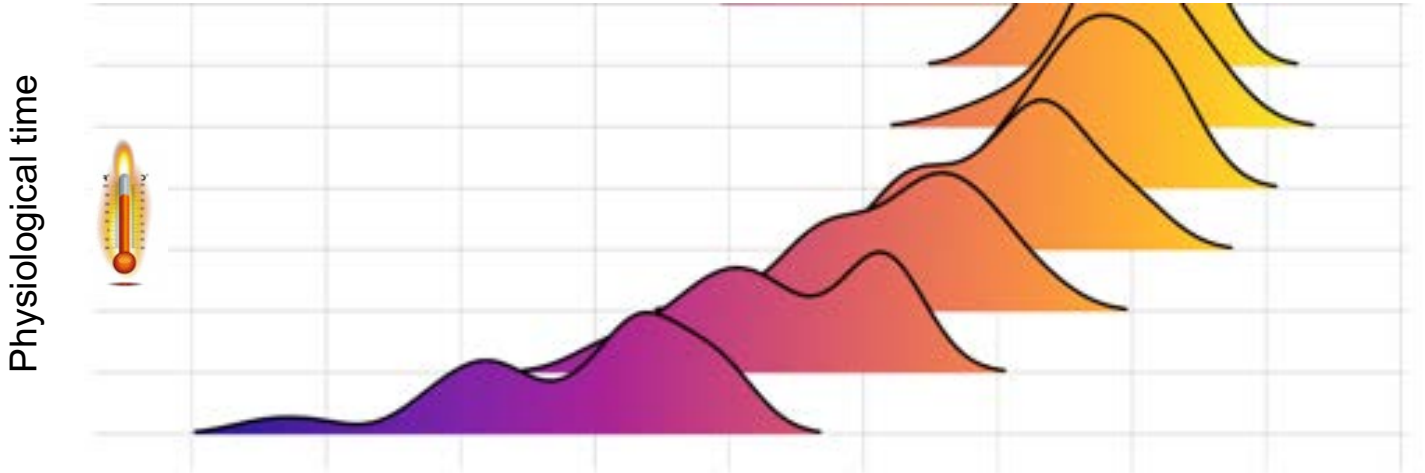



°C
°F

$$\frac{dN_{i,j}(t)}{dt} = \frac{k}{del_j}\left[N_{i-1,j}(t) - N_{i,j}(t)\right] - \mu_i(t) \cdot N_{i,j}(t)$$

$$r_i(t) = \frac{k \cdot N_i(t)}{del}$$

$$\frac{dr_i(t)}{dt} = \frac{k}{del}\left\{r_{i-1}(t) - \left[1 + \mu_i(t) \cdot \frac{del}{k}\right] \cdot r_i(t)\right\}$$

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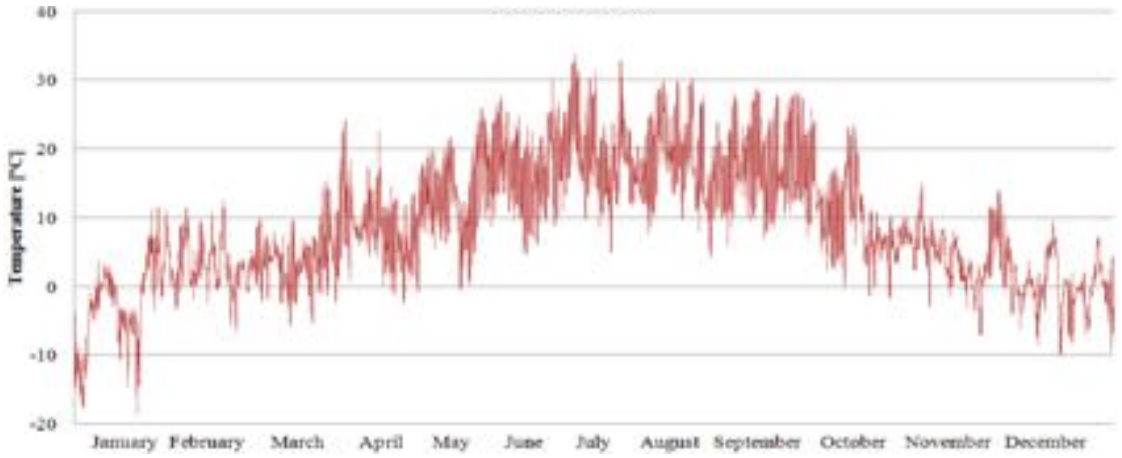
Temperature [°C]
40
30
20
10
0
-10
-20
January
February
March
April
May
June
July
August
September
October
November
December


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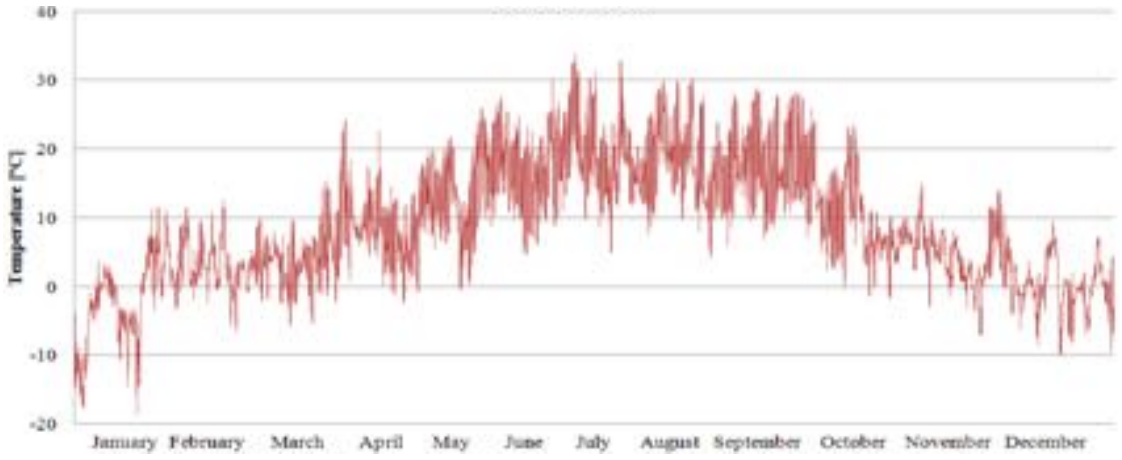
40
30
20
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-20
Temperature [°C]
January
February
March
April
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July
August
September
October
November
December

2-m


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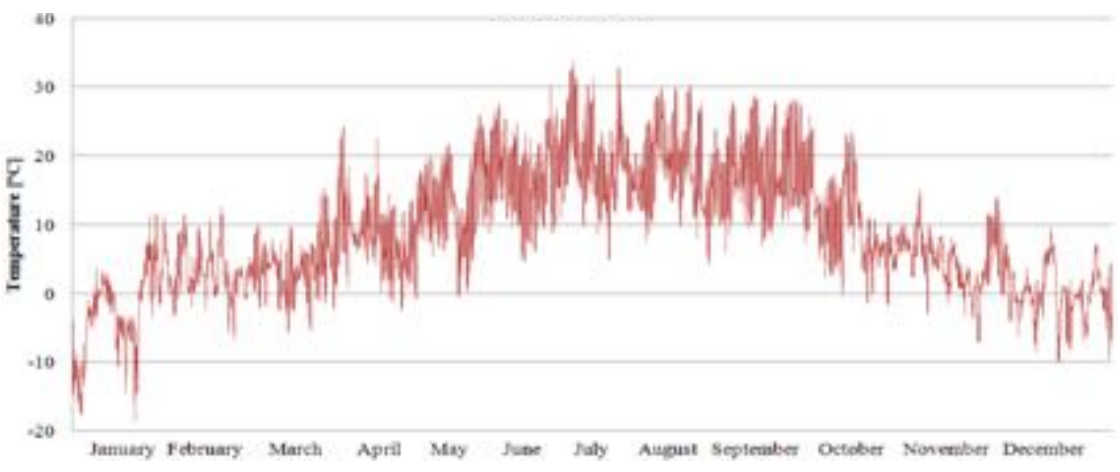
40
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Temperature [°C]
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September
October
November
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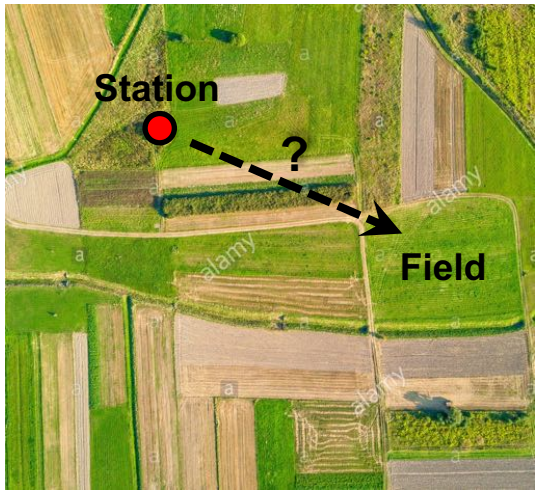
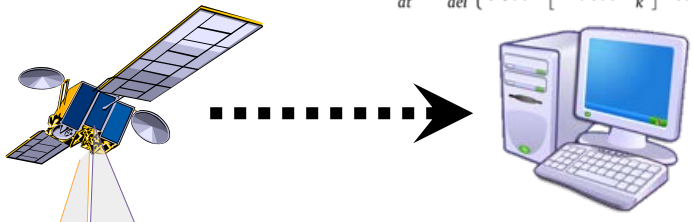
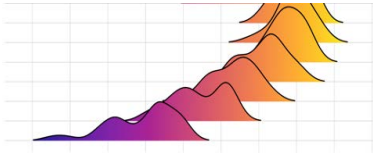

Station
?
Field

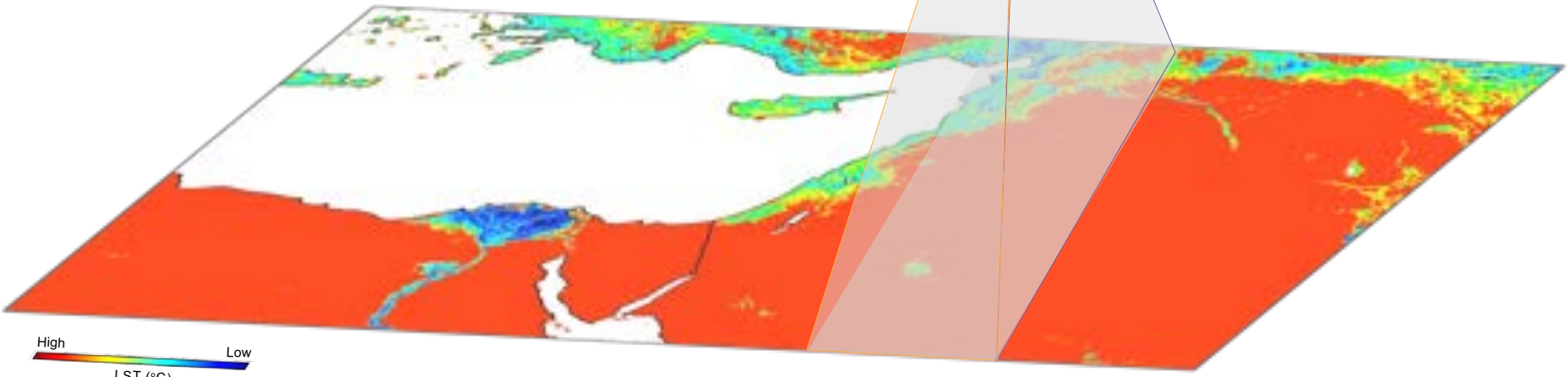
2-m

High
Low
LST (°C)

$$\frac{dr_i(t)}{dt} = \frac{k}{del}\left\{r_{i-1}(t) - \left[1 + \mu_i(t) \cdot \frac{del}{k}\right] \cdot r_i(t)\right\}$$







Ecological Modelling 311 (2015) 39–47

Contents lists available at ScienceDirect

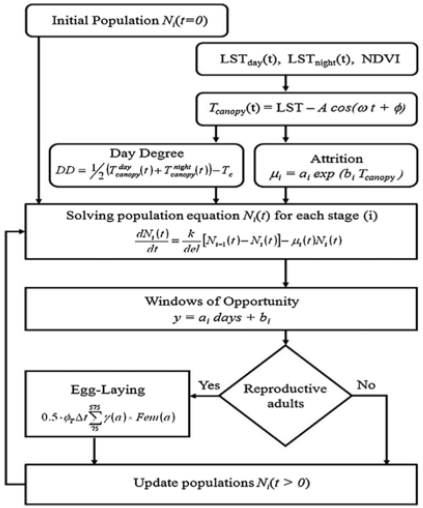
Ecological Modelling

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

Modeling insect population fluctuations with satellite land surface temperature

Moshe Blum[a], Itamar M. Lensky[a], Polychronis Rempoulakis[b], David Nestel[b,*]

[a] Department of Geography and Environment, Bar-Ilan University, Ramat-Gan 52900, Israel
[b] Department of Entomology, Agricultural Research Organization, The Volcani Center, PO Box 6, Bet Dagan 50250, Israel



Ecological Modelling 369 (2018) 1–12

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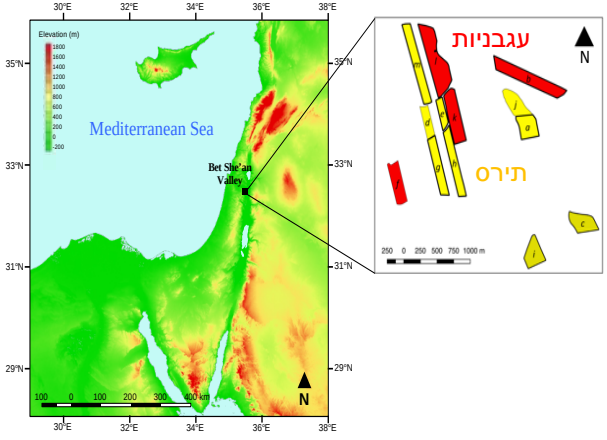
Predicting Heliothis (*Helicoverpa armigera*) pest population dynamics with an age-structured insect population model driven by satellite data

Moshe Blum[a,b], David Nestel[b], Yafit Cohen[c], Eitan Goldshtein[c], David Helman[a,c], Itamar M. Lensky[a,*]

[a] Department of Geography and Environment, Bar-Ilan University, Ramat Gan 52900, Israel
[b] Department of Entomology, Agricultural Research Organization, The Volcani Center, Rishon LeZion, Israel
[c] Department of Agricultural Engineering, Agricultural Research Organization, The Volcani Center, Rishon LeZion, Israel



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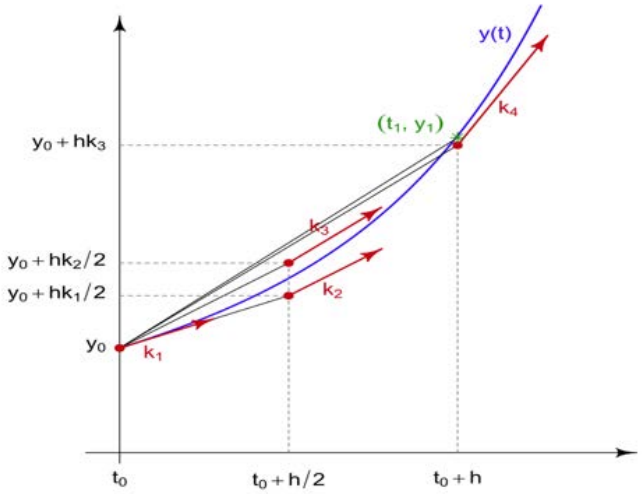

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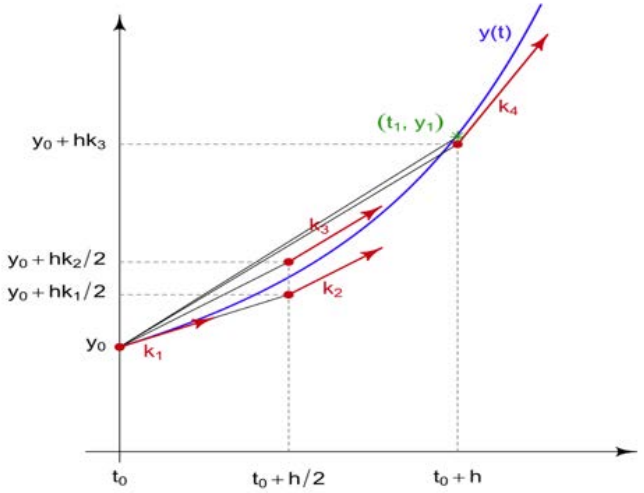

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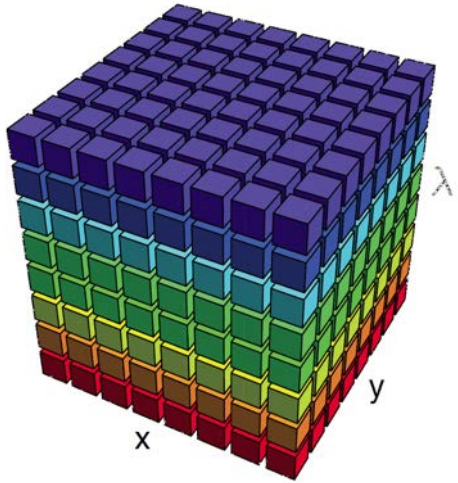

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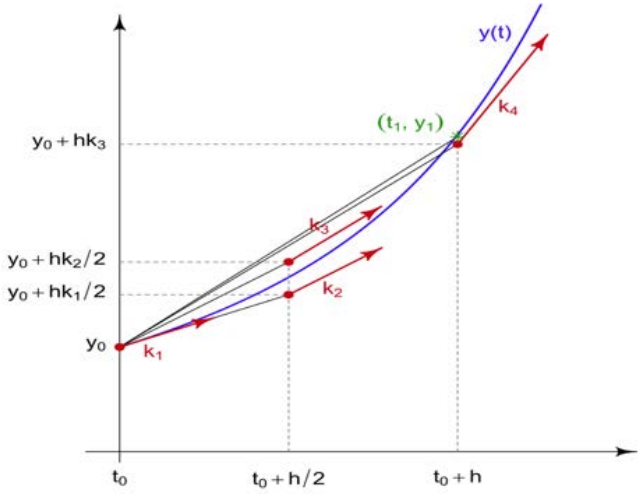

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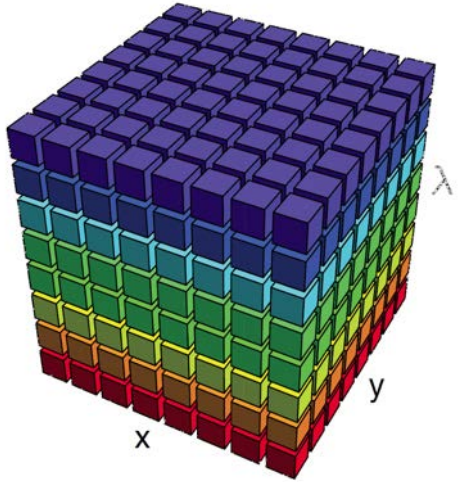
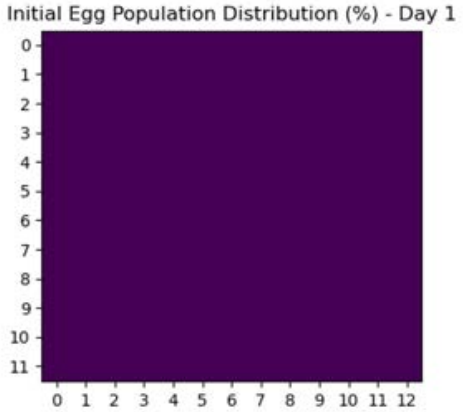
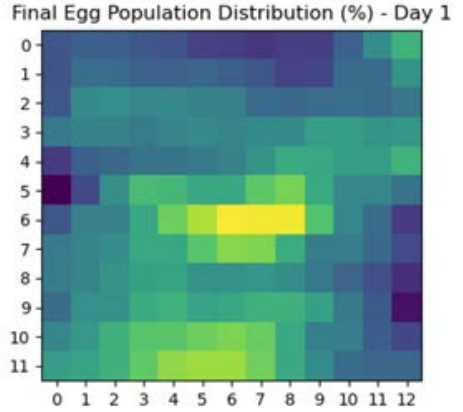


C (Real) spatial representation





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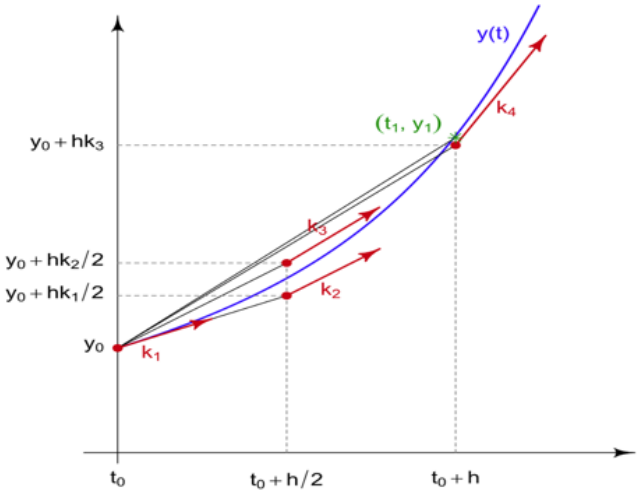

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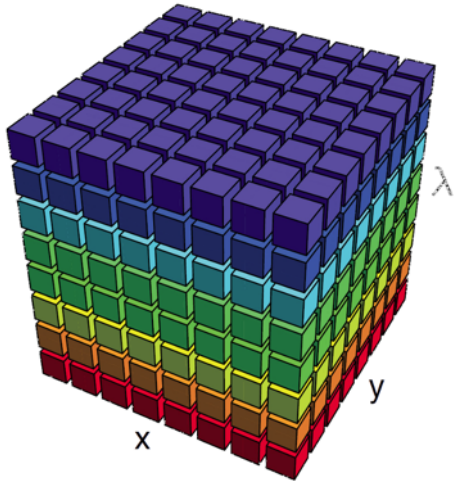

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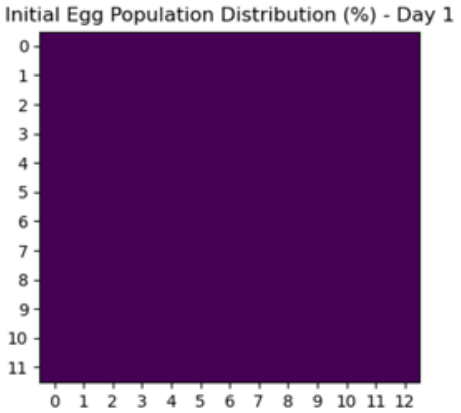
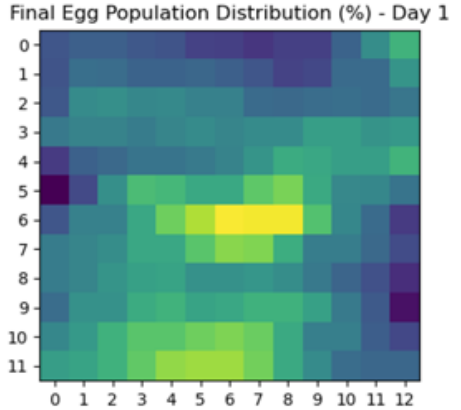
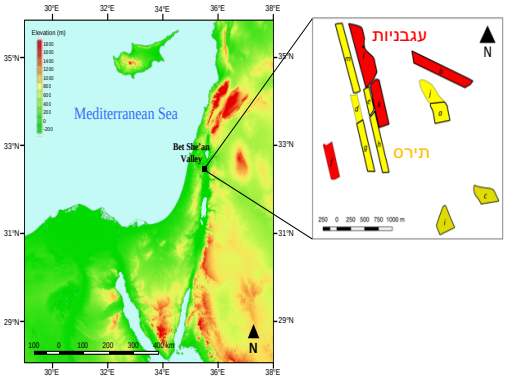




Blum *et al.*
(1D)



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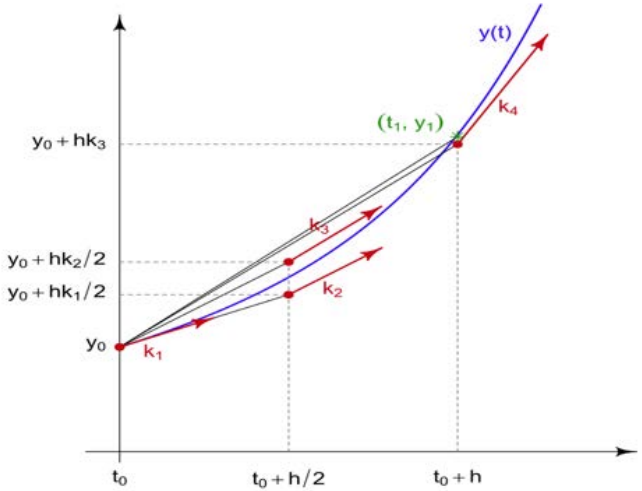

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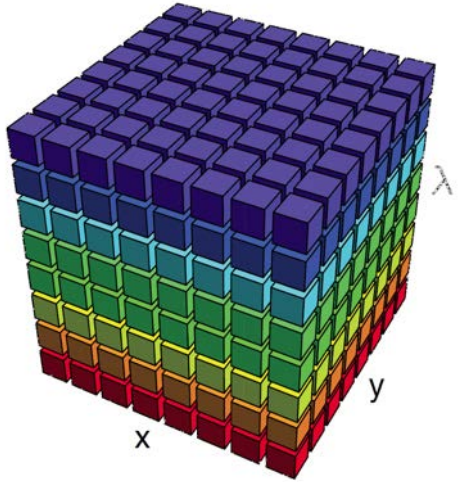

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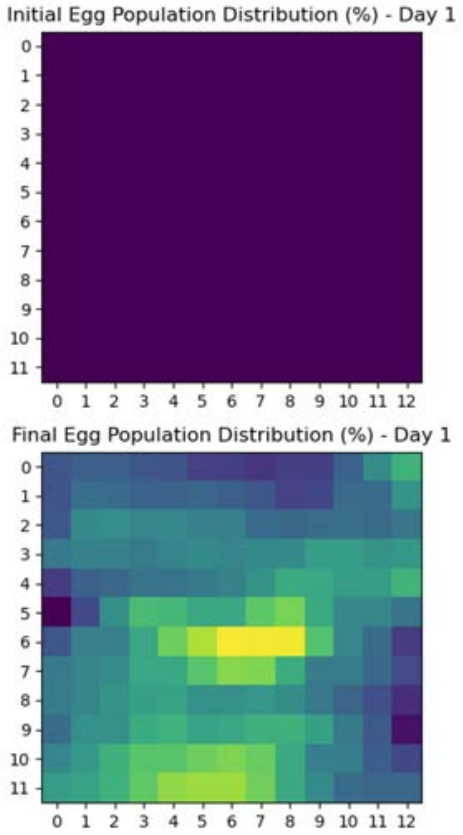

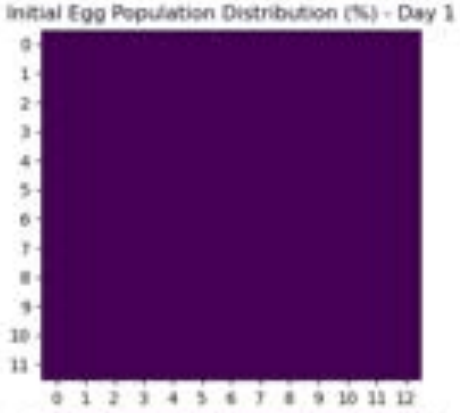

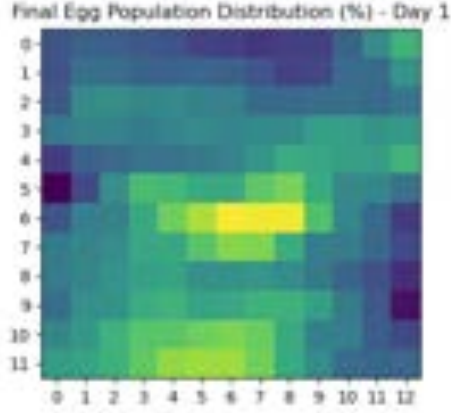

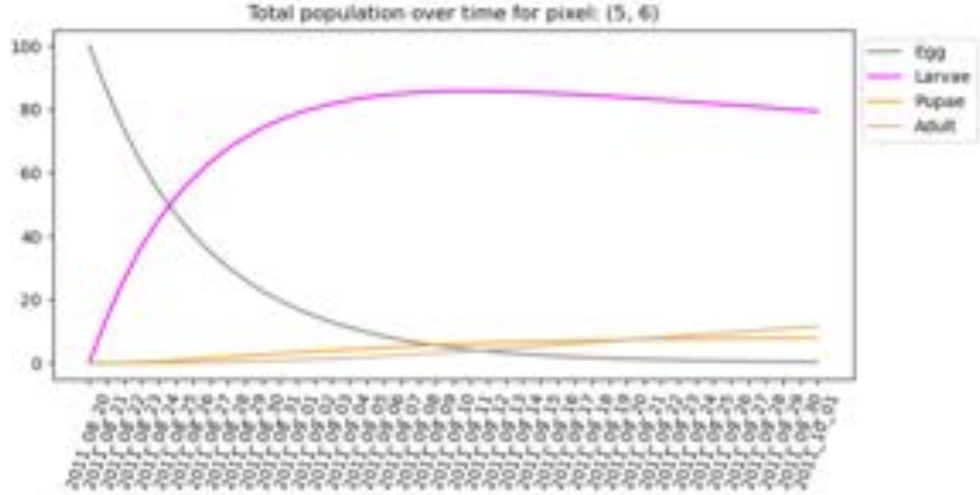

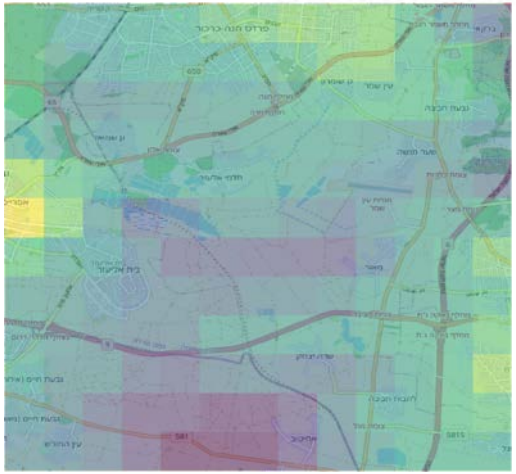

Previous Life Stage	Next Life Stage
Previous Day	Next Day

STAGE A - Biology

Table 3

Estimated parameters of the linear and non-linear models fitted to median development rates
temperature range used for fitting linear relationship: Egg stage (15–35 °C); larval stage (15–30
minus sign. Thermal constant calculated by taking inverse of slope (b) i.e. 1/b. Non-linear mod

Life stage	Linear model							
	a	b	T_{min} (°C)	DD	R^2	F	df	p
Egg	−0.154 (0.04)	0.014 (0.00)	11.23	72.99	0.97	92.83	1,3	0.00
Larva	−0.039 (0.005)	0.003 (0.00)	11.37	285.71	0.99	303.21	1,2	0.00
Pupa	−0.076 (0.05)	0.007 (0.01)	11.00	144.92	0.97	146.60	1,4	0.00
Egg- Adult	–	–	11.20	503.62	–	–	–	–

Peddu *et al.* (2020), *Crop Protection*

STAGE A - Biology

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Peddu *et al.* (2020), *Crop Protection*

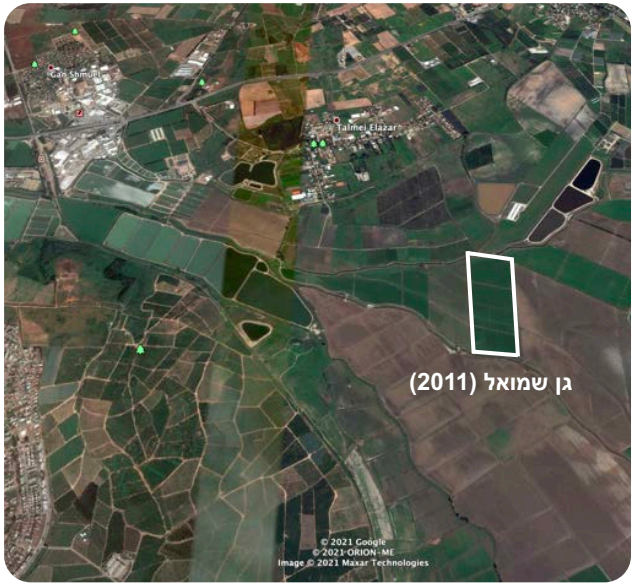
Table 3. t_L, linear regression parameters (SE) of PBW developmental rate (1/days), and mean DD (SD) durations for selected age classes of eggs and larvae, the pupal stage, and egg to adult

Stage/instar	t_L (°C)	Linear regression parameters		r^2	DD (>t_L)[a]		Temp range
		a (SE)	b (SE)		x̄ (SD)	n	(°C)
Egg							
White	8.17	−0.3185 (0.0944)	0.0390 (0.0037)	0.97	22.92 (5.77)	364	20–30
Orange	13.96	−0.3923 (0.0212)	0.0281 (0.0008)	0.99	35.79 (4.80)	429	20–32.5
Head capsule	14.34	−1.2616 (0.3467)	0.0880 (0.0137)	0.93	10.84 (3.67)	364	20–30
Total	13.10	−0.1887 (0.0179)	0.0144 (0.0007)	0.99	68.03 (5.20)	429	20–32.5
Larval[b]							
L1	10.29	−0.1883 (0.0241)	0.0183 (0.0009)	0.99	54.92 (9.28)	354	20–32.5
L2	10.00	−0.1821 (0.0303)	0.0182 (0.0011)	0.98	56.44 (8.92)	354	20–32.5
L3	12.63	−0.3043 (0.0634)	0.0241 (0.0024)	0.96	40.29 (6.95)	354	20–32.5
L4	12.90	−1.1419 (0.0121)	0.0110 (0.0005)	0.99	90.82 (7.86)	355	20–32.5
Total	12.38	−0.1557 (0.0059)	0.0045 (0.0002)	0.99	221.92 (4.38)	377	20–32.5
Pupal	11.69	−0.0854 (0.0142)	0.0073 (0.0005)	0.98	137.79 (2.39)	377	20–32.5
Egg–adult	12.04	−0.0277 (0.0005)	0.0023 (0.0001)	0.99	442.61[c] (3.50)	—	20–32.5

[a] Based on age-specific t_L; n = number of individuals surviving the age class for the given temperature range.
[b] For four-instar larvae.
[c] Based on mean cohort durations for each stage (assuming four-instar larvae) at each temperature rather than for n individuals (i.e., same individuals not followed from egg to adult); n = 6 for each temperature from 20 to 32.5°C.

Hutchison *et al.* (1986), *Annals of the Entimol. Soc. of America*

STAGE B – Test the model with real Tsat data on a short period of time (1.5 months)



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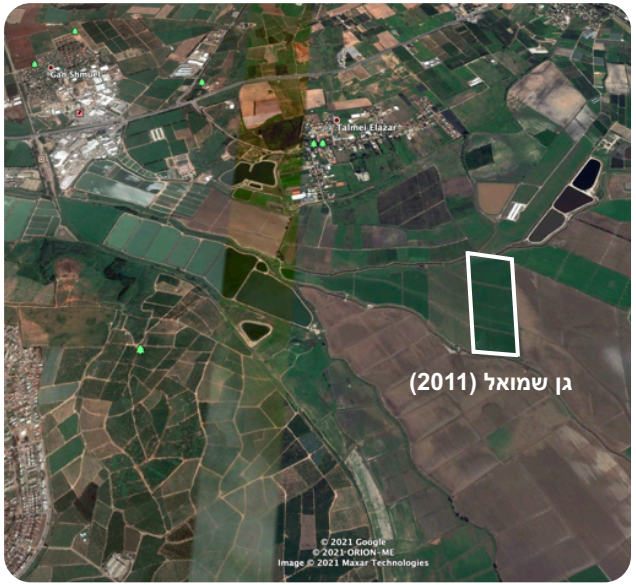
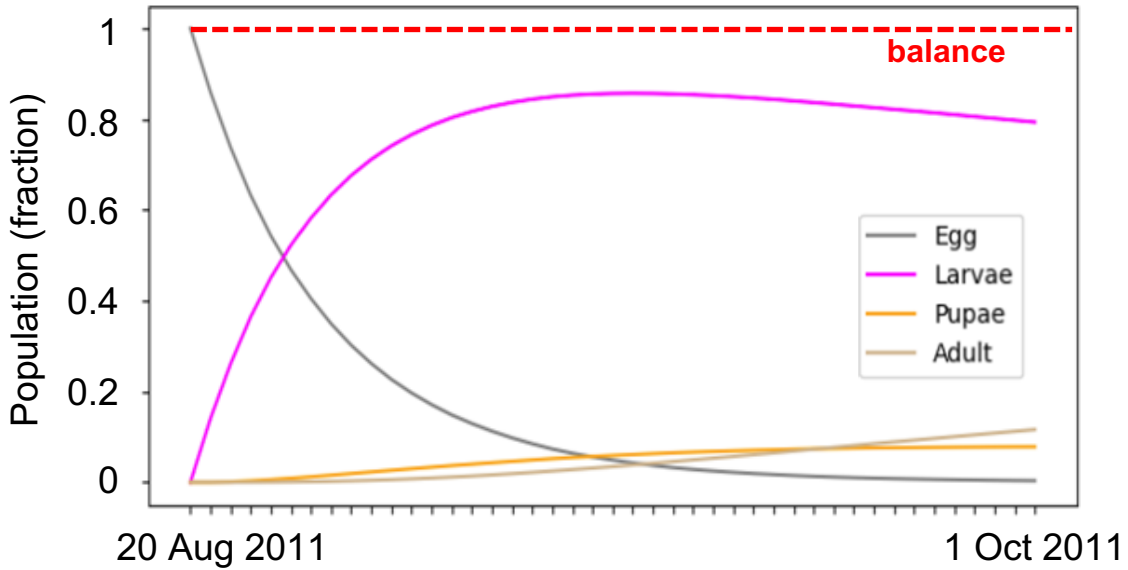
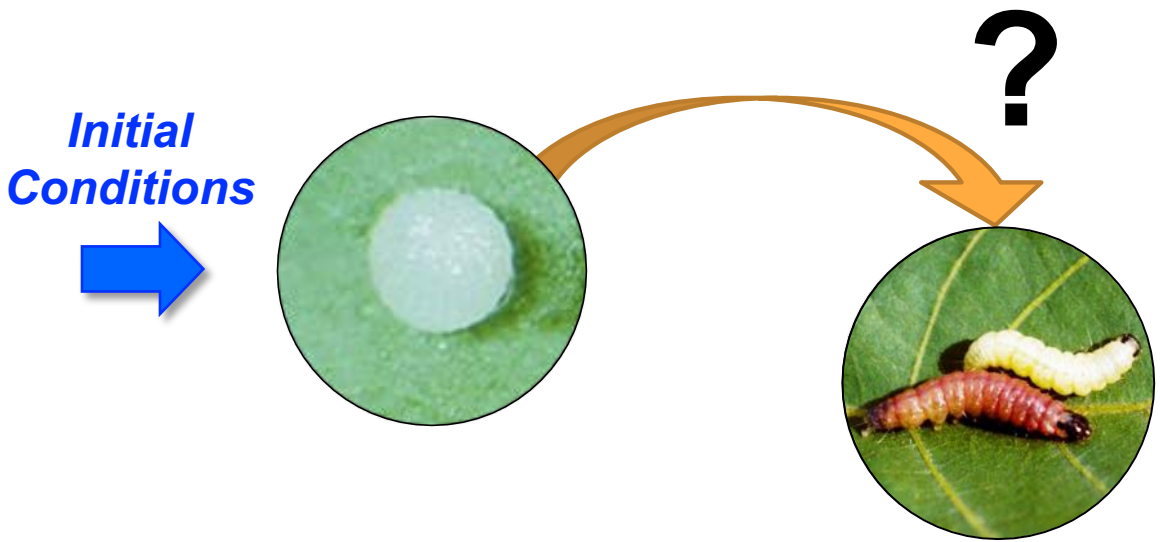


(not considering mortality)



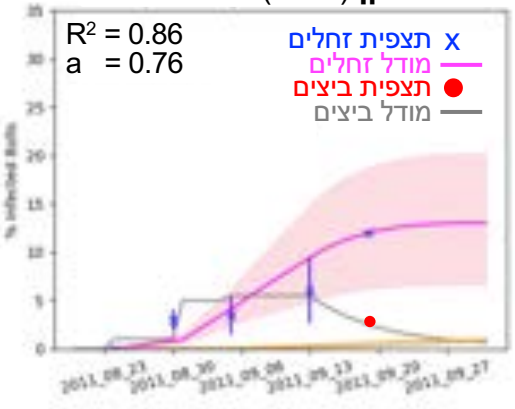
STAGE C – Initiate model with real data (egg population)



STAGE C – Initiate model with real data (egg population)

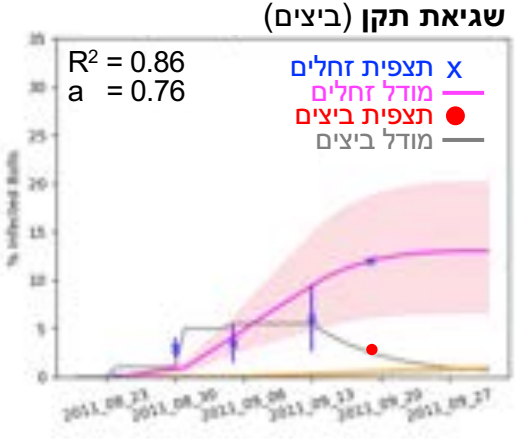
Satellite (MODIS)

שגיאת תקן (ביצים)



STAGE C – Initiate model with real data (egg population)

Satellite (MODIS)



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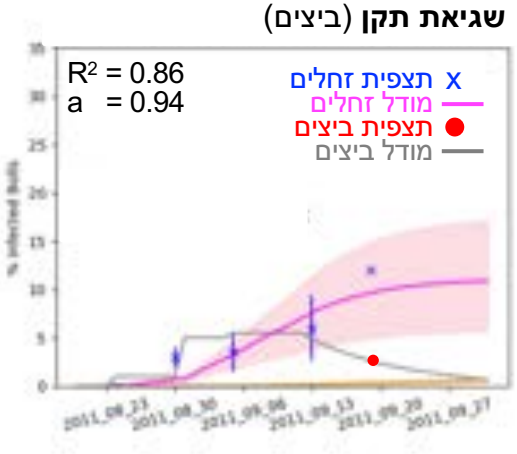
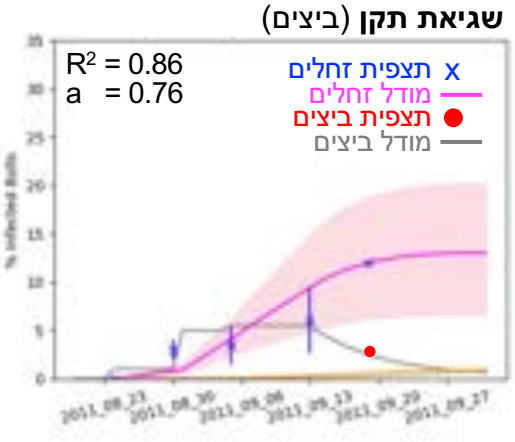
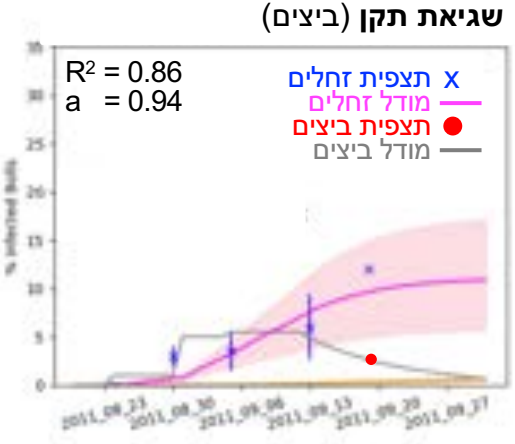


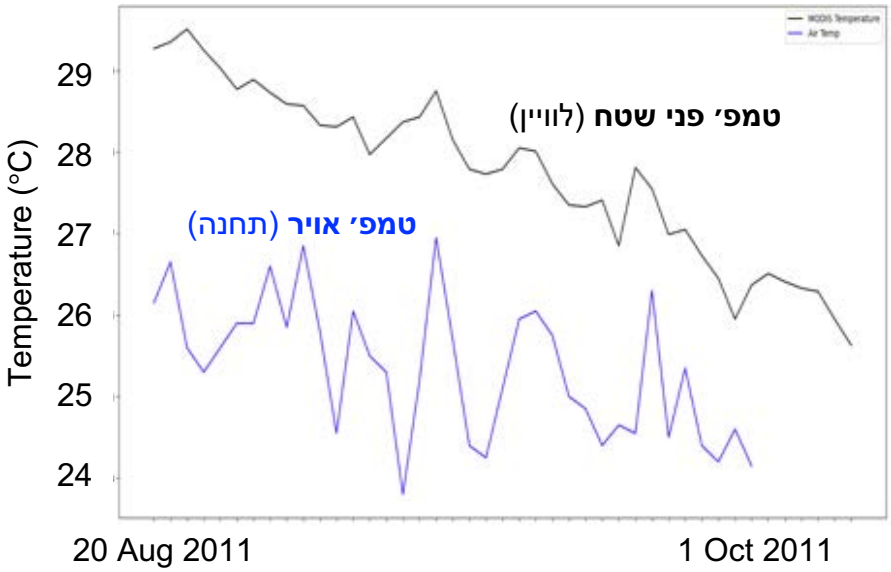
STAGE C – Initiate model with real data (egg population)

Satellite (MODIS)



Station

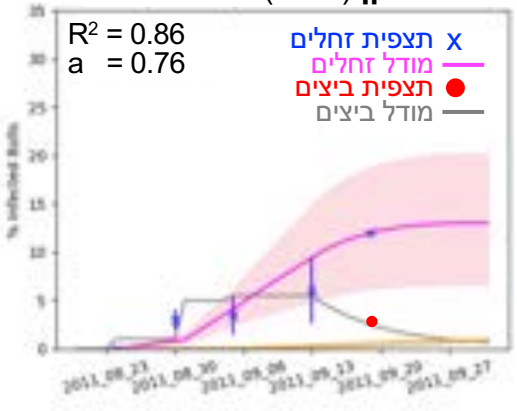




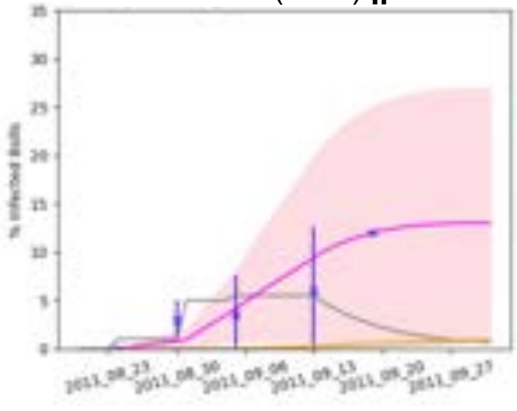
STAGE C – Initiate model with real data (egg population)

Satellite (MODIS)

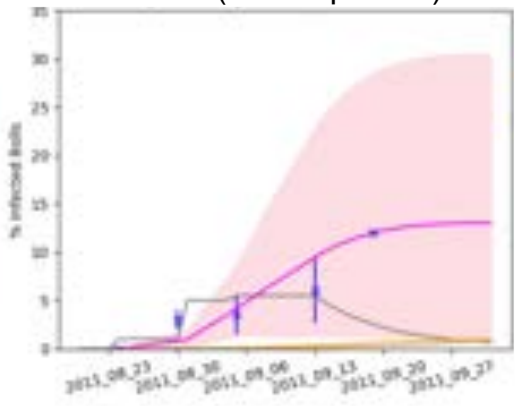
שגיאת תקן (ביצים)



סטיית תקן (ביצים)

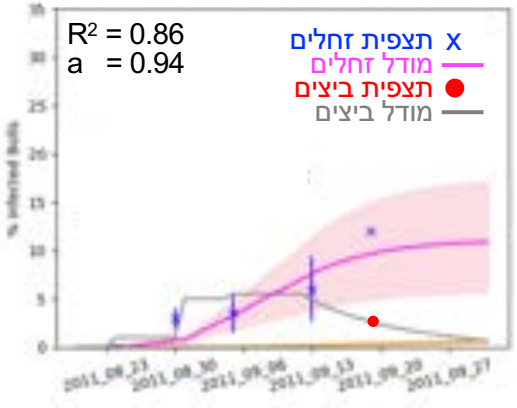


טווח (מיני׳-מקס׳ ביצים)

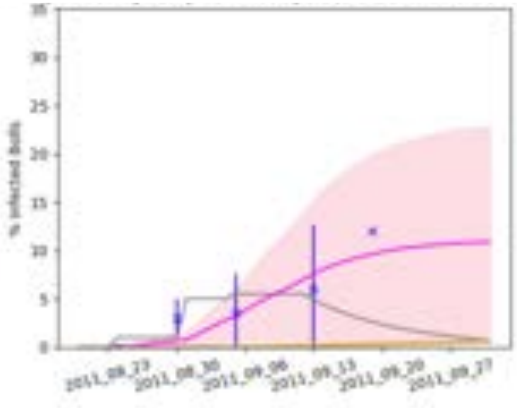


Station

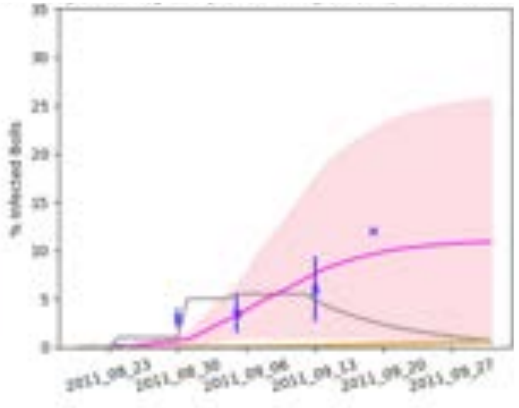
שגיאת תקן (ביצים)



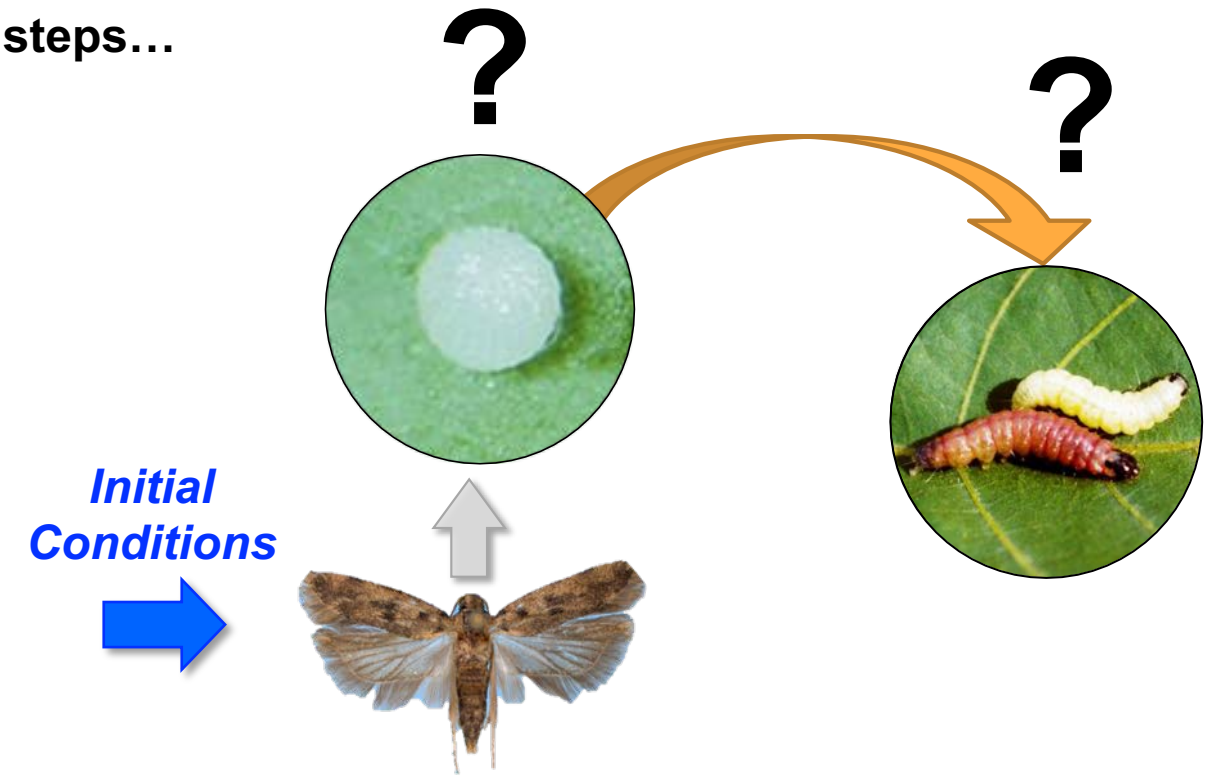
סטיית תקן (ביצים)



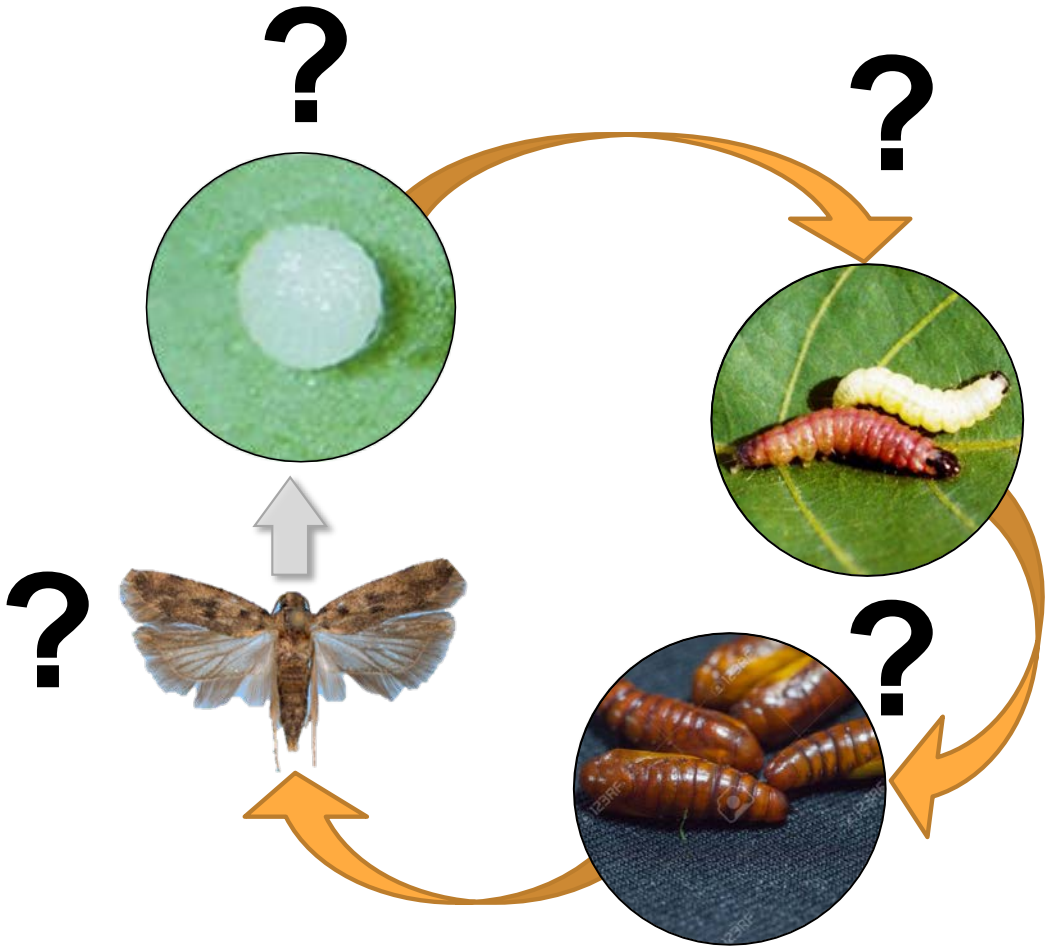
טווח (מיני׳-מקס׳ ביצים)



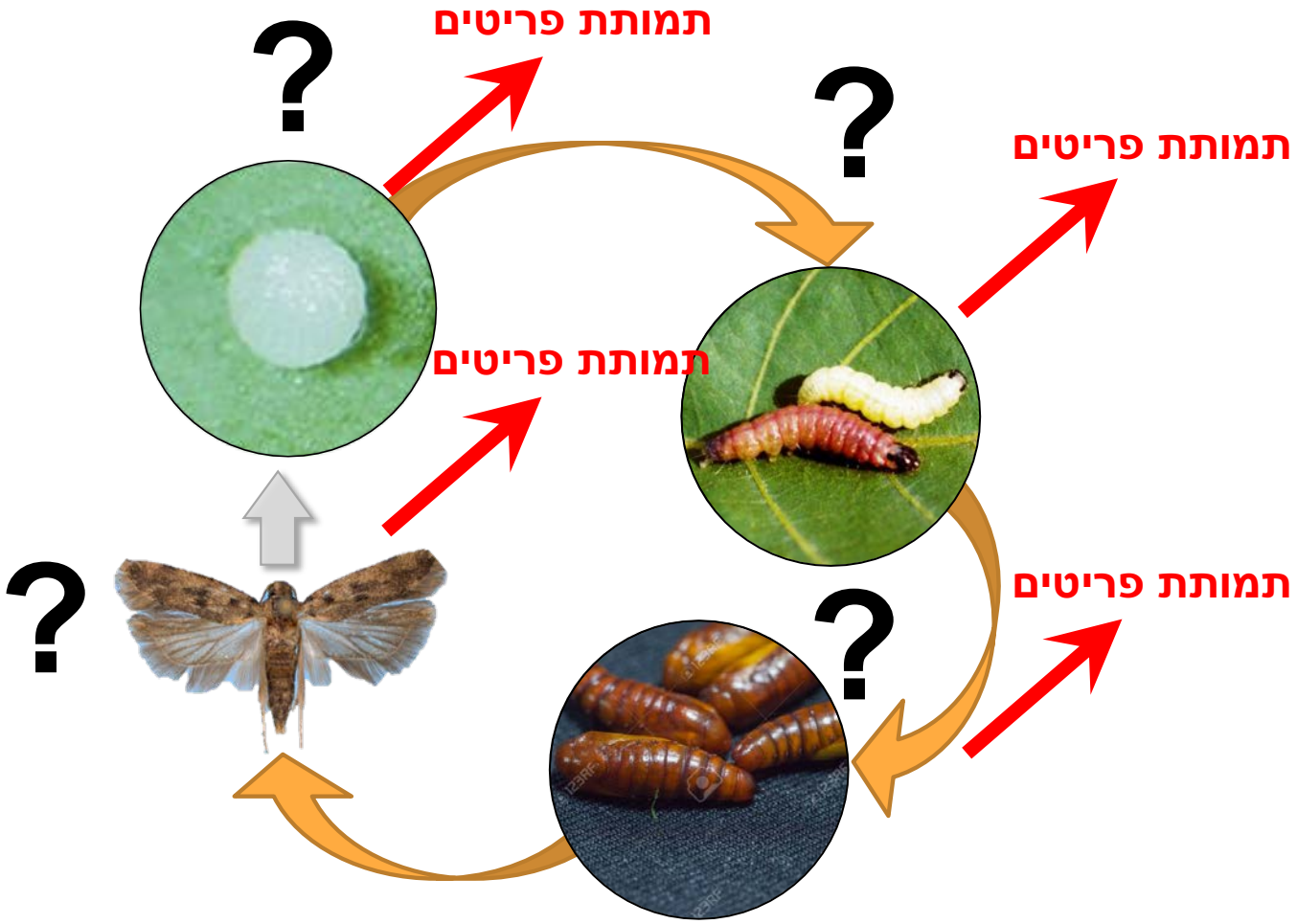
Next steps…



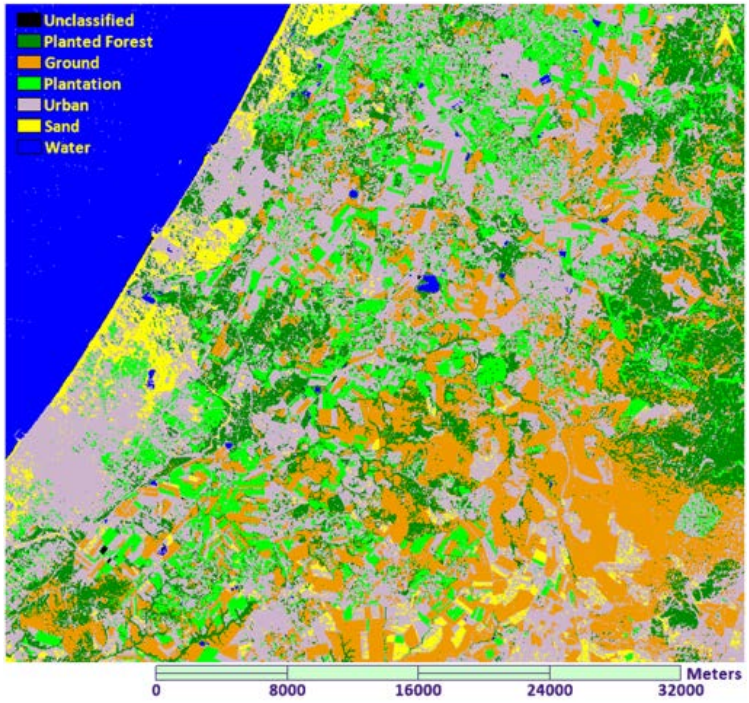
Next steps…

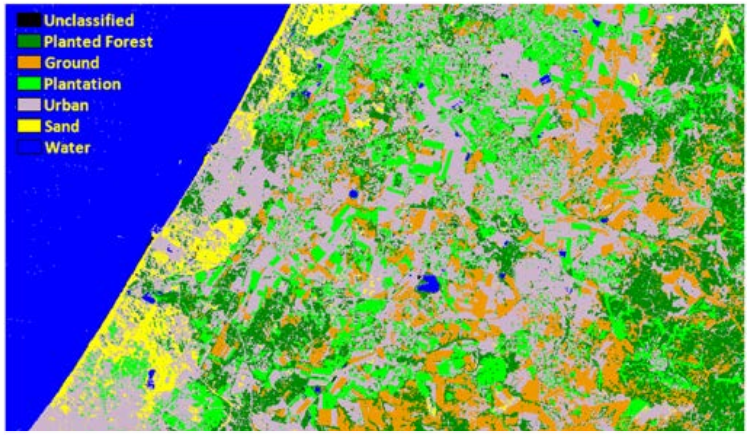


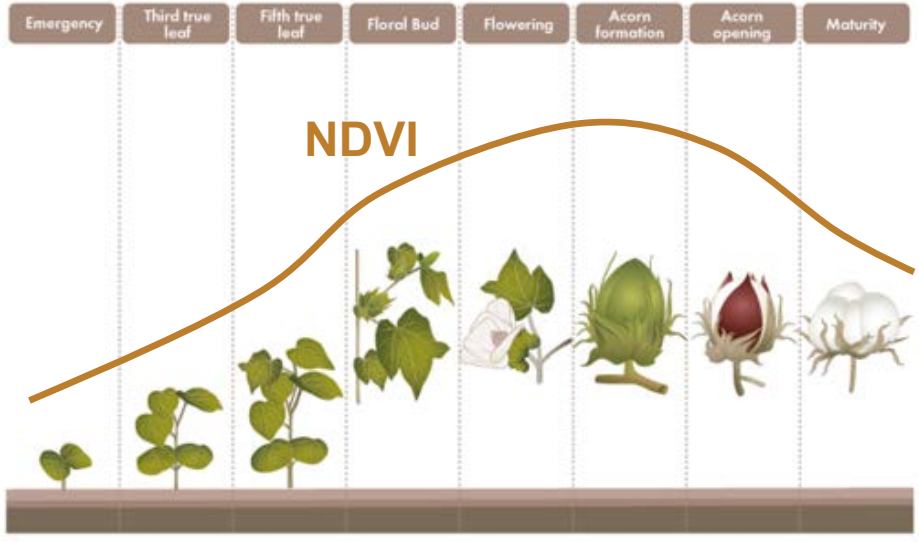
Next steps…



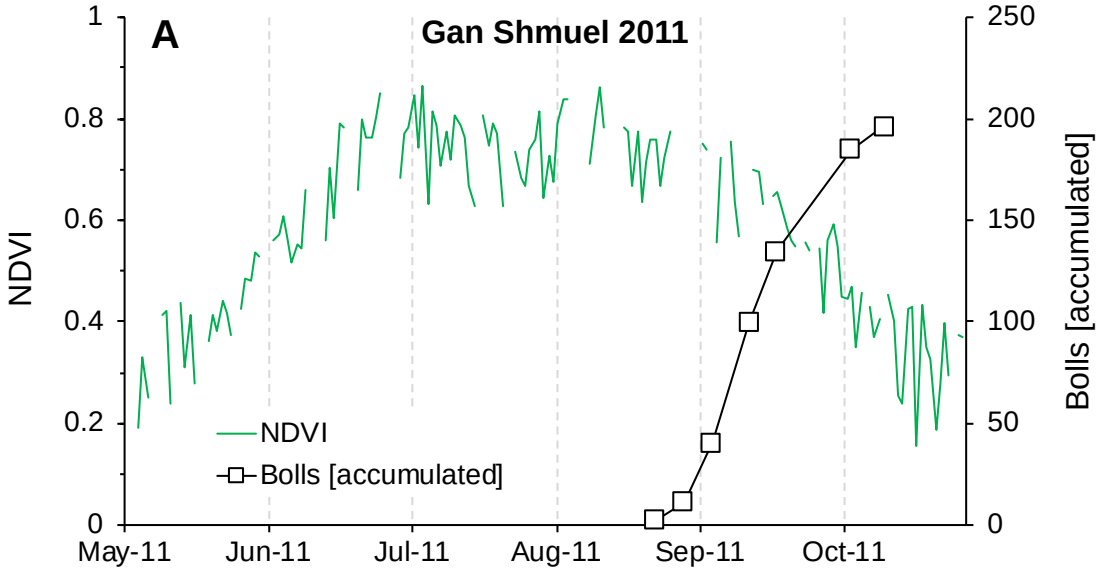
Next steps…

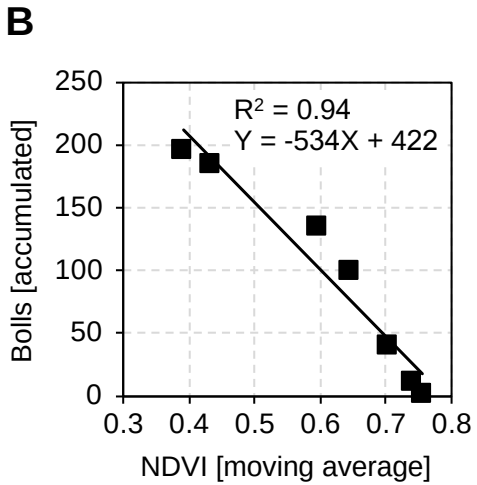

Unclassified
Planted Forest
Ground
Plantation
Urban
Sand
Water
Meters
0
8000
16000
24000
32000

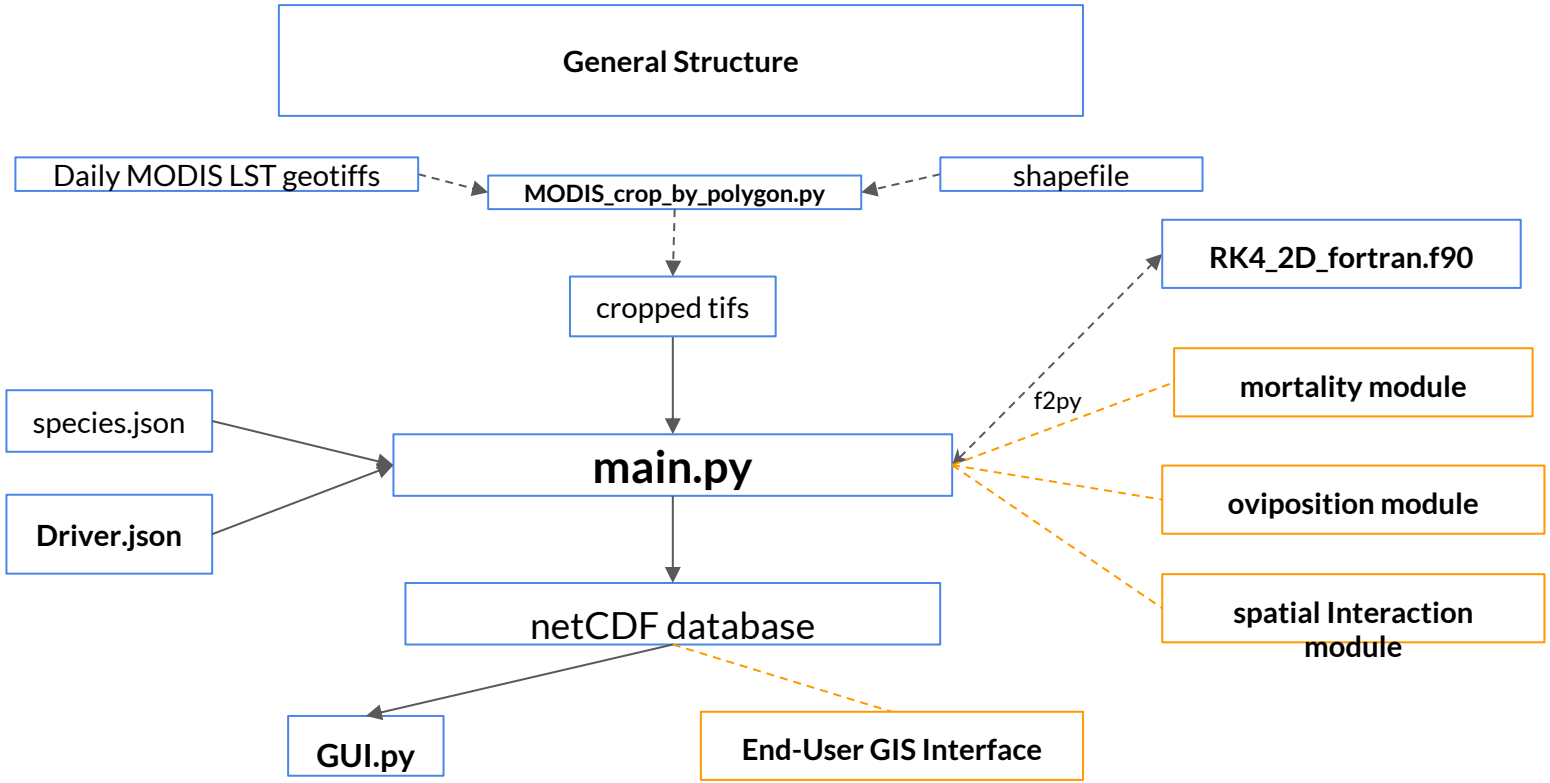

Unclassified
Planted Forest
Ground
Plantation
Urban
Sand
Water


Emergency
Third true leaf
Fifth true leaf
Floral Bud
Flowering
Acorn formation
Acorn opening
Maturity
NDVI

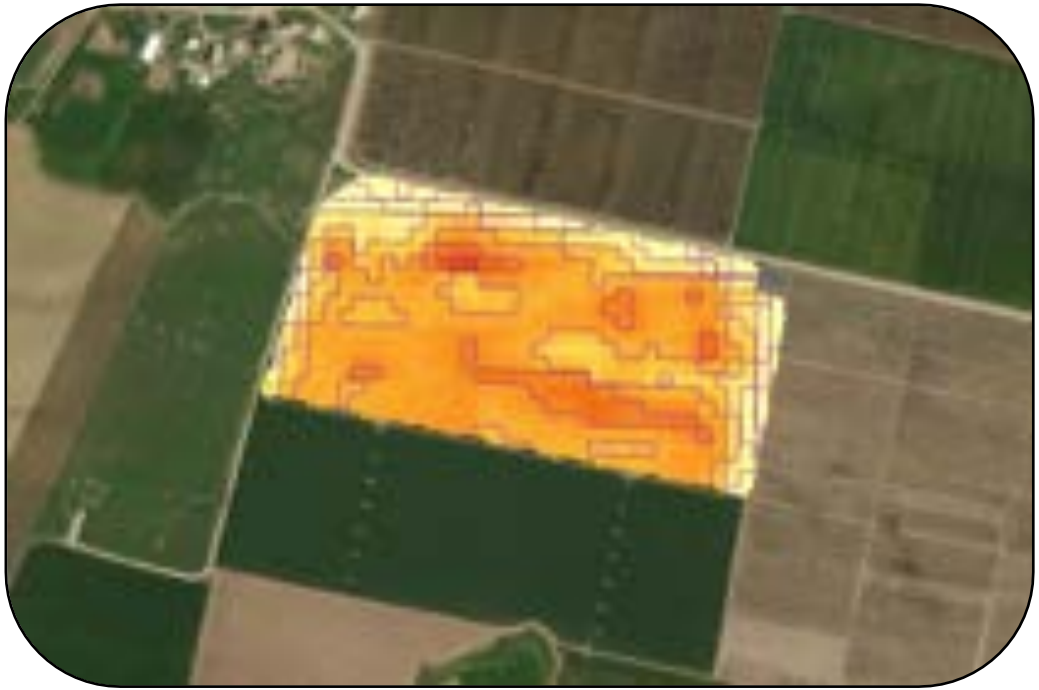
הקשר בין NDVI מלוויינים ומספר הלקטים בשדה






General Structure
Daily MODIS LST geotiffs
MODIS_crop_by_polygon.py
shapefile
cropped tifs
RK4_2D_fortran.f90
mortality module
f2py
species.json
main.py
oviposition module
Driver.json
netCDF database
spatial Interaction module
GUI.py
End-User GIS Interface

תצוגה מקדימה (הדמיה)
של תוצר המודל בשדה כותנה (2018)



תצוגה מקדימה (הדמיה)
של תוצר המודל בשדה כותנה (2018)

RS-PestDyn

חיזוי התפתחות הלקטית ורודה על-ידי מודל תהליכים מבוסס חישה מרחוק

חיים אלבז
דוד הלמן
מיכל אקסלרוד

Lab website:
http://davidhelman.weebly.com

המועצה לייצור ושיווק כותנה בע"מ

האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

The Robert H Smith Faculty of Agriculture, Food and Environment

משרד החקלאות ופיתוח הכפר
שירות ההדרכה והמקצוע
אגף אגרואקולוגיה וגידולי שדה

כנס דיווחי מחקרים בענף הכותנה – עונת 2020