Earth observation

Bridging the gap to crop-pest systems

Luigi Ponti
www.enea.it
www.casasglobal.org

WSMA16, Matera
Tue 15 Nov 2016

Too much data,

too little information

Earth observation

Bridging the gap to crop-pest systems

The big EO data challenge

Bridge the gap to the field

A process based approach

Add a realistic biological layer

Scaling up the approach

Wide access with low expertise

Earth observation

Bridging the gap to crop-pest systems

The big EO data challenge

Bridge the gap to the field

A process based approach

Add a realistic biological layer

Scaling up the approach

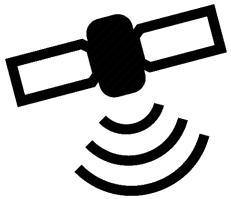
Wide access with low expertise

A gap exists between bottom-up and top-down approaches to on-ground ecosystem problems

A gap exists between bottom-up and top-down approaches to on-ground ecosystem problems

Field observations
(bottom-up, scarce and costly)

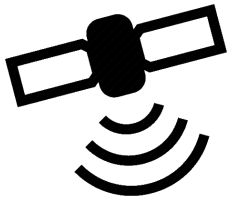
A gap exists between bottom-up and top-down approaches to on-ground ecosystem problems



Remote sensing,
climate models
(top-down, no biology)

Field observations
(bottom-up, scarce and costly)

A gap exists between bottom-up and top-down approaches to on-ground ecosystem problems

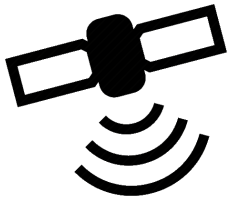


Remote sensing,
climate models
(top-down, no biology)

Ecological niche
models
(top-down, correlative)

Field observations
(bottom-up, scarce and costly)

A gap exists between bottom-up and top-down approaches to on-ground ecosystem problems



Remote sensing, climate models (top-down, no biology) ⟷ Ecological niche models (top-down, correlative)

Current gap (scale, reliability, etc.)

Field observations (bottom-up, scarce and costly)

Earth observation

Bridging the gap to crop-pest systems

The big EO data challenge

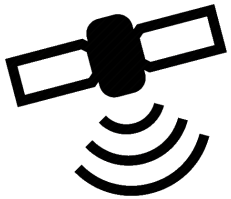
Bridge the gap to the field

A process based approach

Add a realistic biological layer

Scaling up the approach

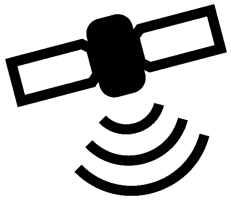
Wide access with low expertise



Remote sensing,
climate models
(top-down, no biology)

Ecological niche
models
(top-down, correlative)

Field observations
(bottom-up, scarce and costly)



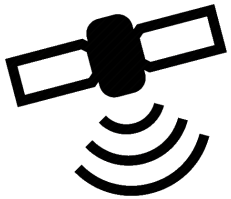
Remote sensing,
climate models
(top-down, no biology)

Ecological niche
models
(top-down, correlative)

(biological processes linked explicitly
to environmental drivers)

Field observations
(bottom-up, scarce and costly)

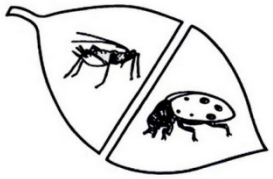
PBDMs link biological processes explicitly to their environmental drivers (no proxies)



Remote sensing,
climate models
(top-down, no biology)

↔

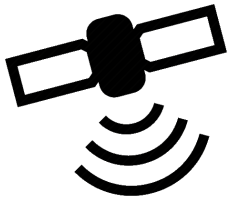
Ecological niche
models
(top-down, correlative)



PBDMs,
physiologically based demographic models
(biological processes linked explicitly
to environmental drivers)

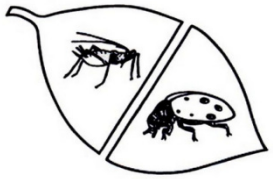
Field observations
(bottom-up, scarce and costly)

PBDMs link biological processes explicitly to their environmental drivers (no proxies)

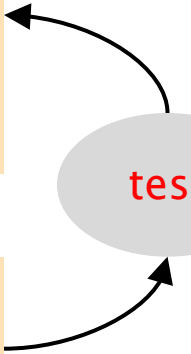


Remote sensing,
climate models
(top-down, no biology)

Ecological niche
models
(top-down, correlative)



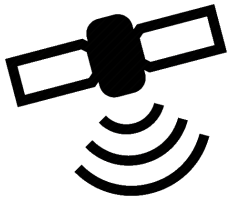
PBDMs,
physiologically based demographic models
(biological processes linked explicitly
to environmental drivers)



test

Field observations
(bottom-up, scarce and costly)

PBDMs link biological processes explicitly to their environmental drivers (no proxies)

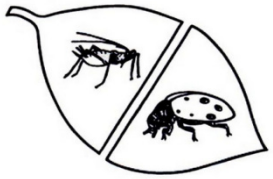


Remote sensing,
climate models
(top-down, no biology)

↔

Ecological niche
models
(top-down, correlative)

drive



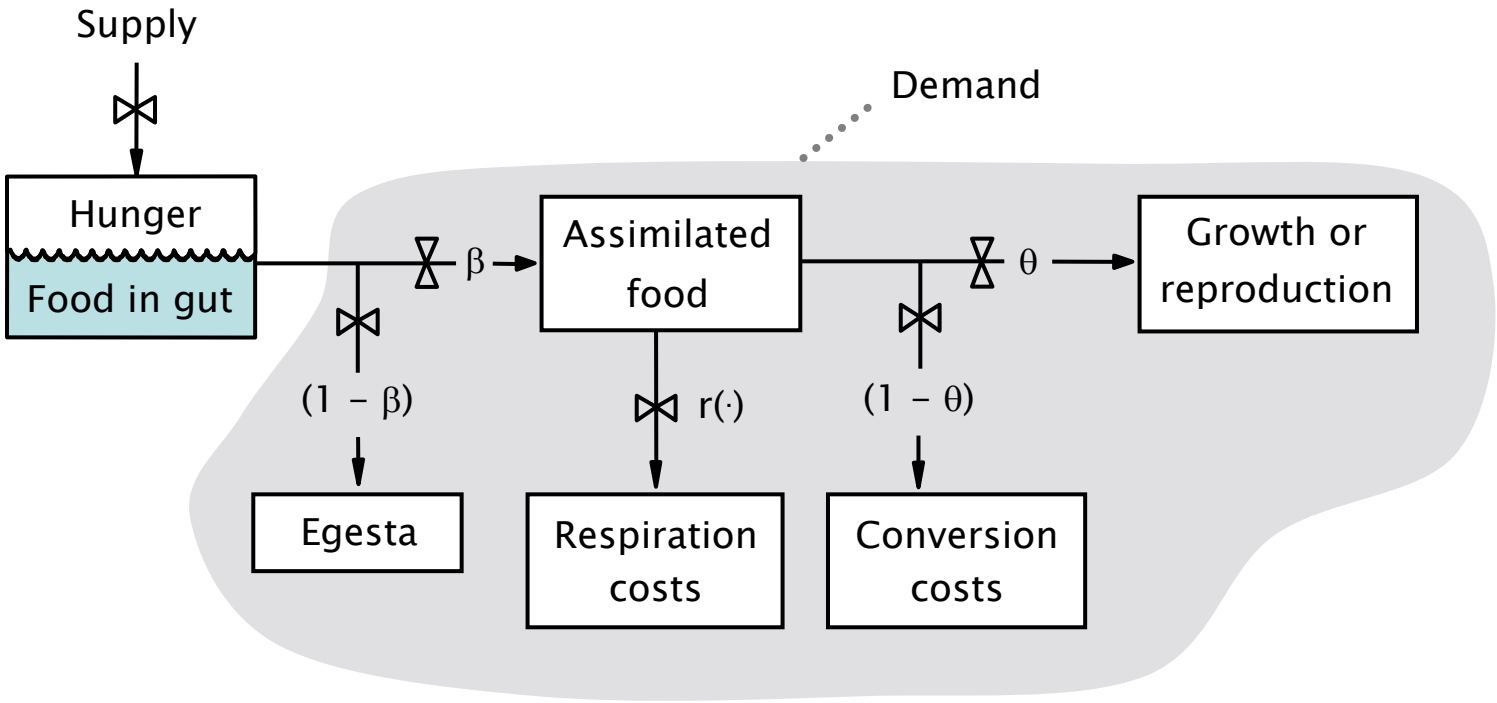
PBDMs,
physiologically based demographic models
(biological processes linked explicitly
to environmental drivers)

test

Field observations
(bottom-up, scarce and costly)

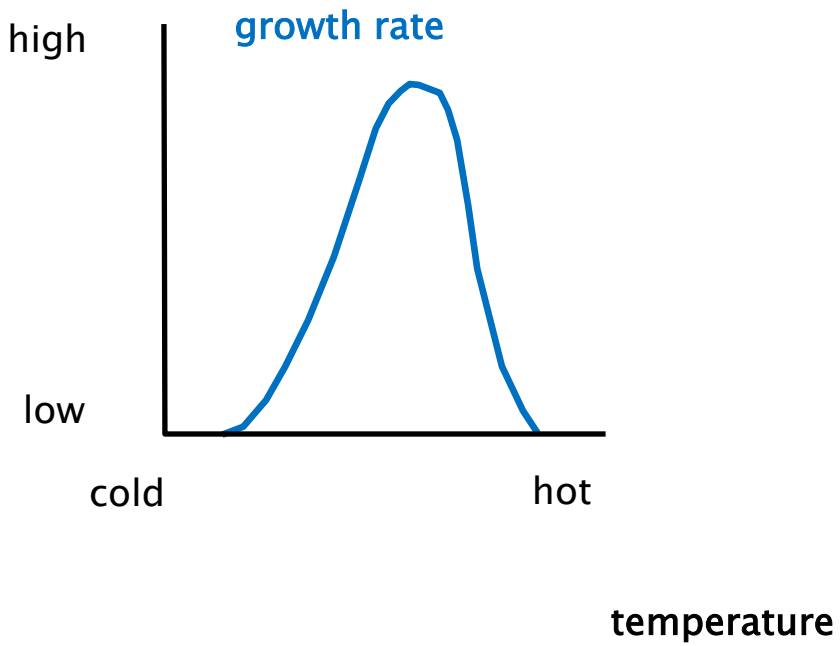
All organisms are consumers with common pattern of resource acquisition and allocation

All organisms are consumers with common pattern of resource acquisition and allocation

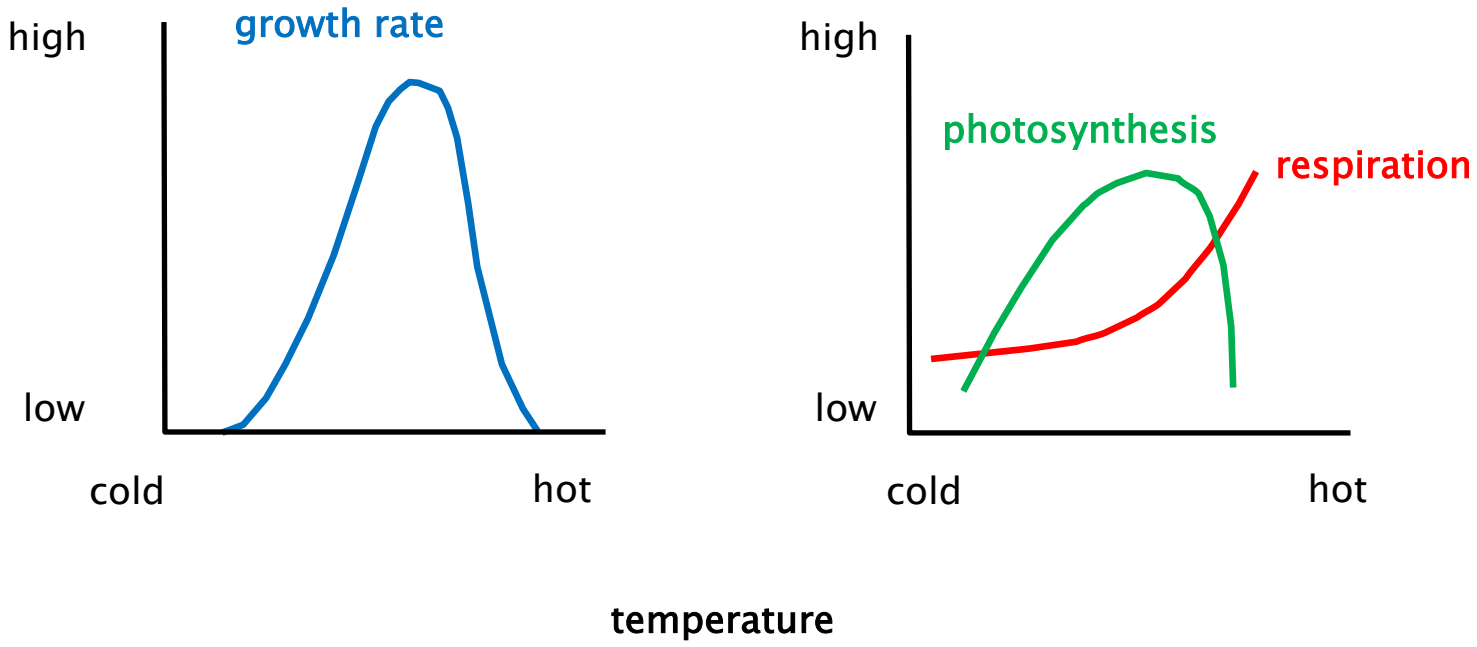


Same models for analogous biological processes are used across trophic levels

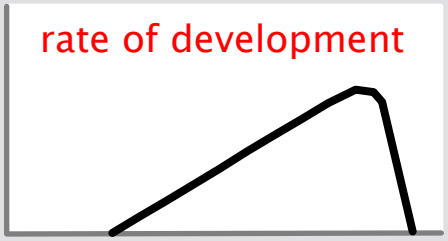
Same models for analogous biological processes are used across trophic levels



Same models for analogous biological processes are used across trophic levels

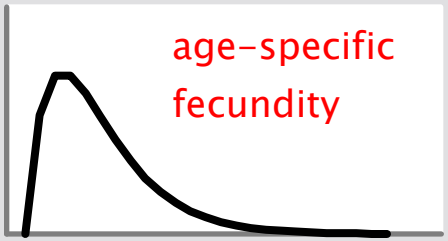


1 / days

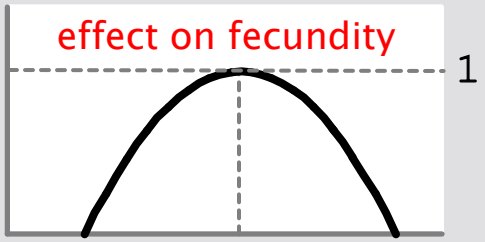


scalar for developmental time

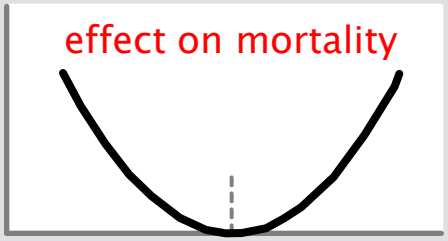
eggs per female per day



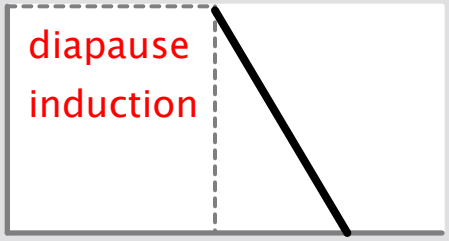
scalar for eggs per female



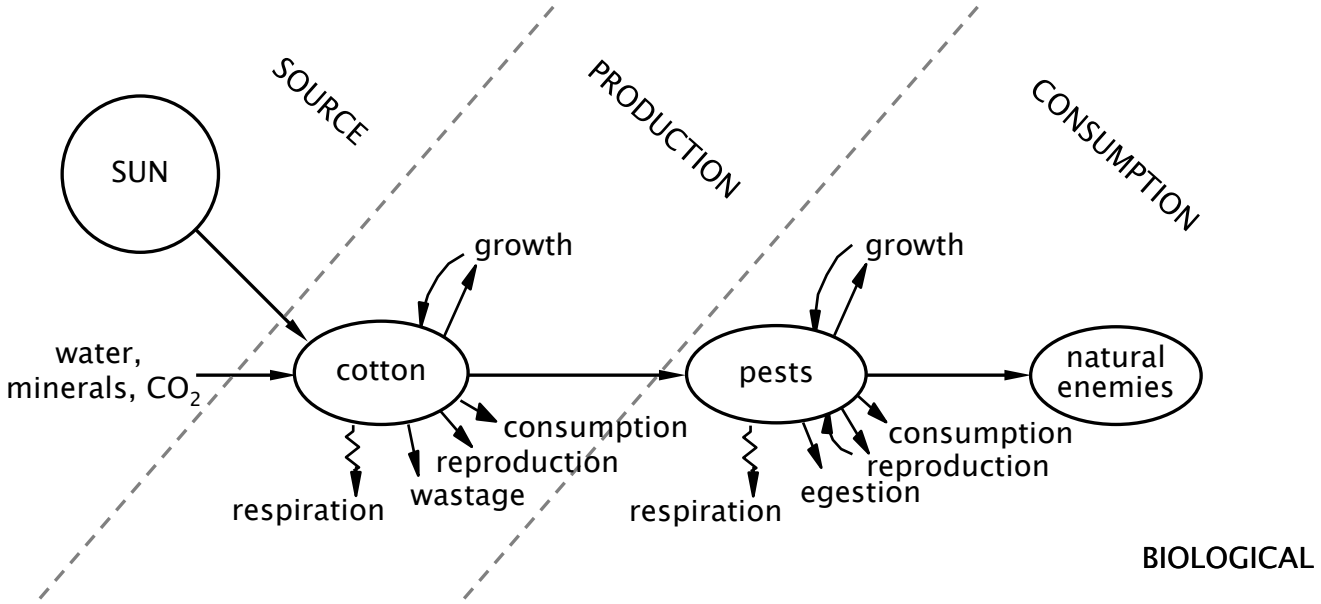
proportion dying per day



proportion diapause per day

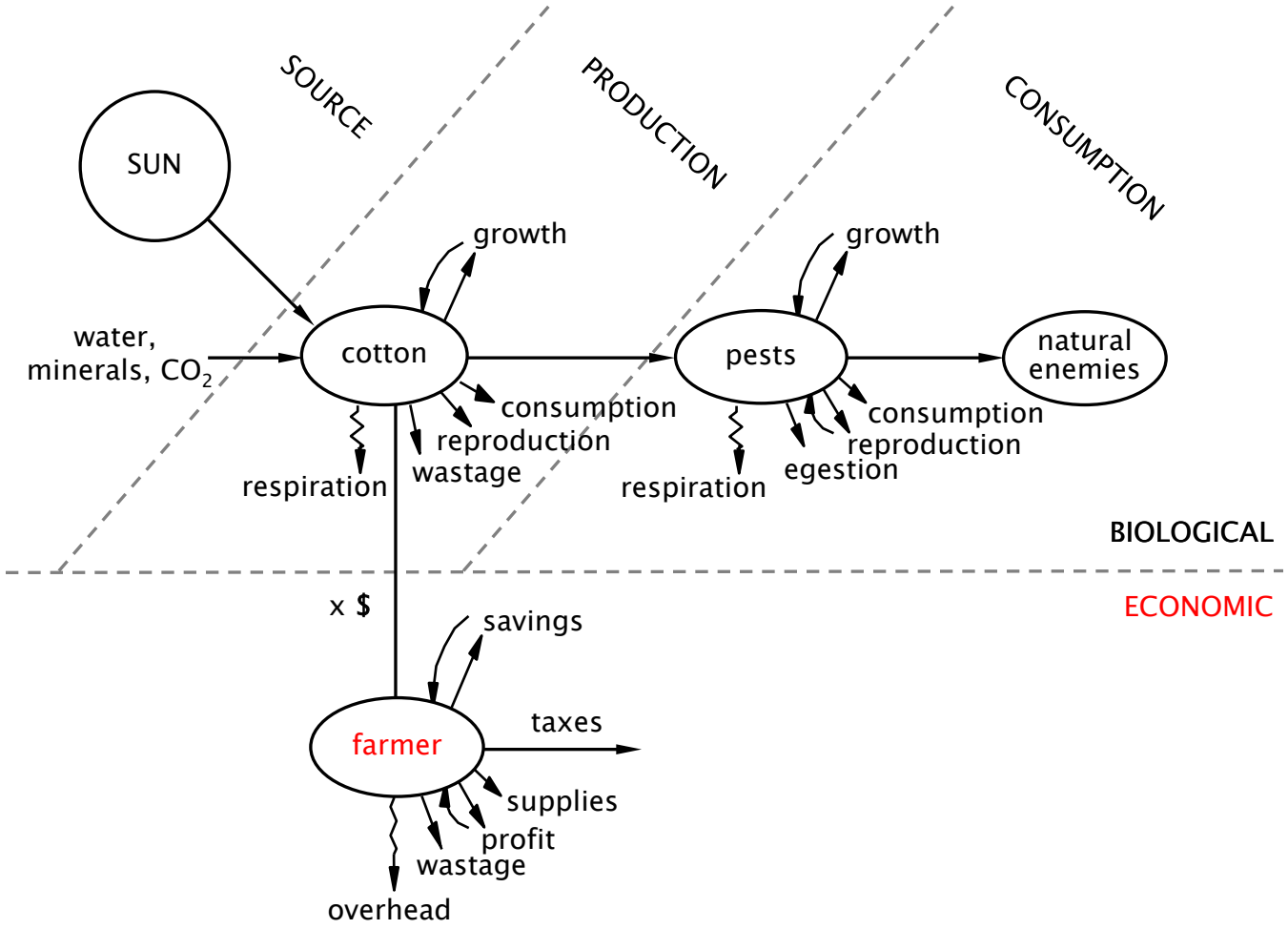


Same model describes species biology across trophic levels



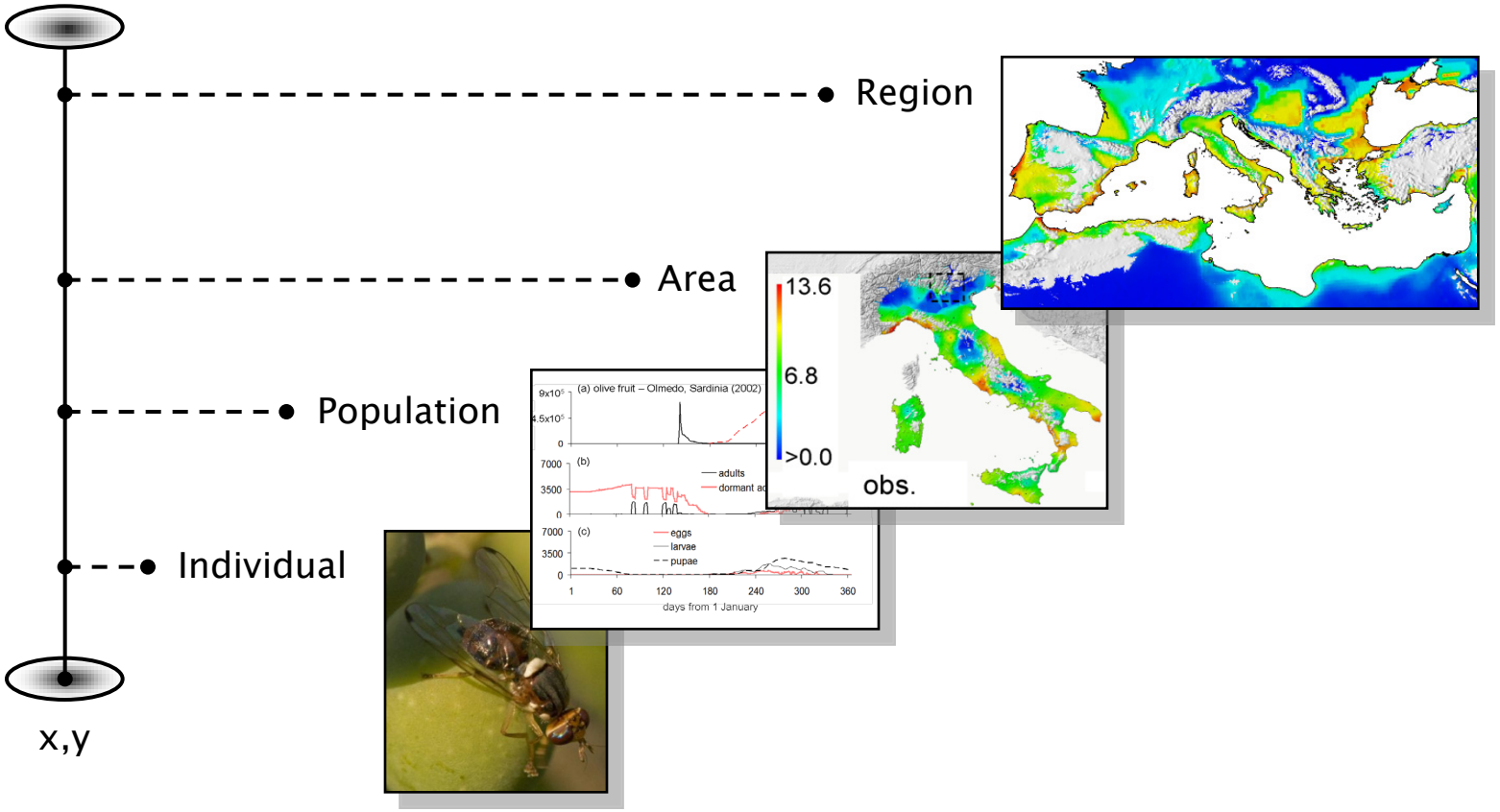
Gutierrez et al. 2015

Same model describes species biology across trophic levels including the economic one



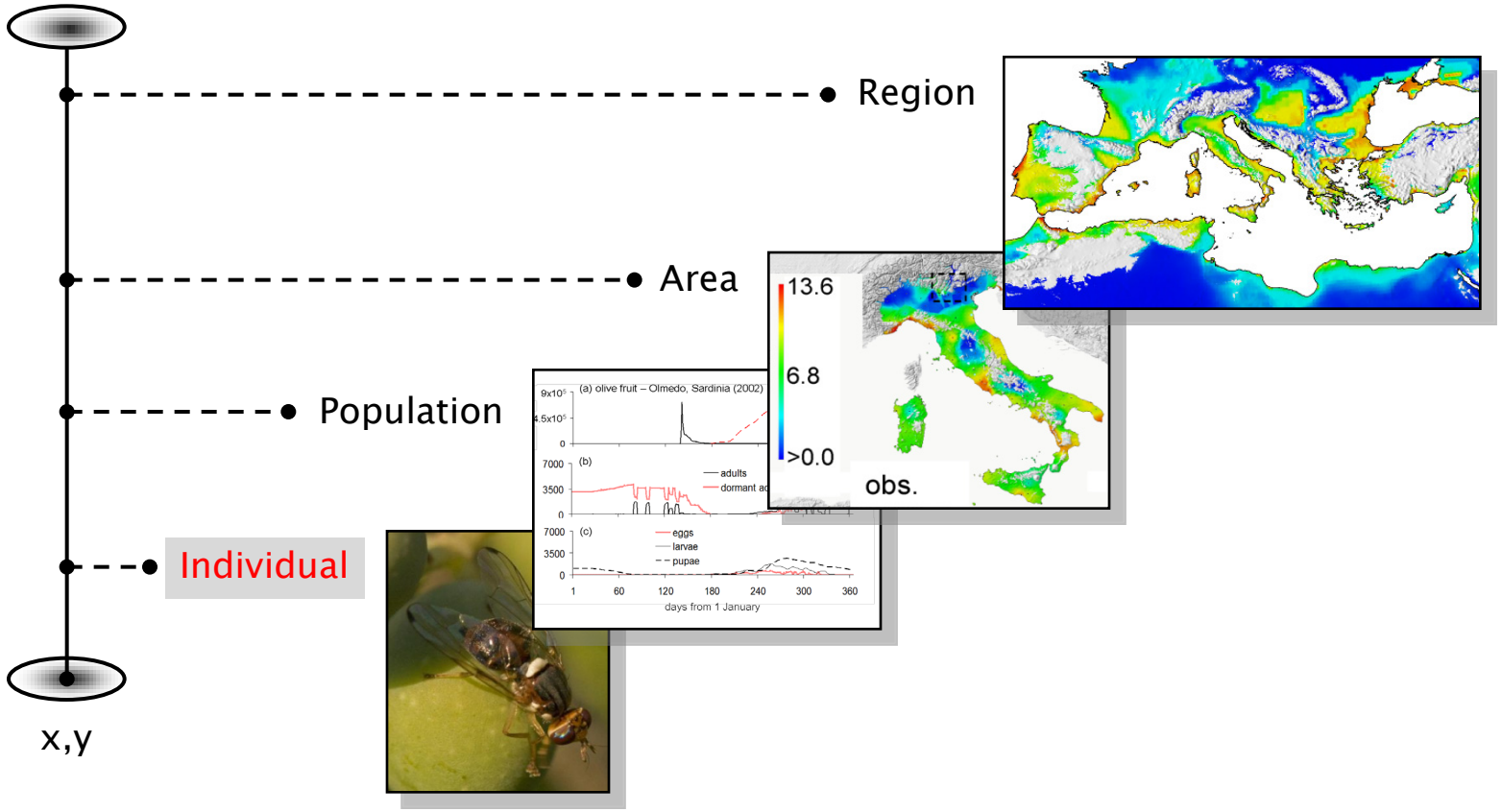
Gutierrez et al. 2015

Factors are modeled on a per-capita basis, GIS integration occurs at the population level



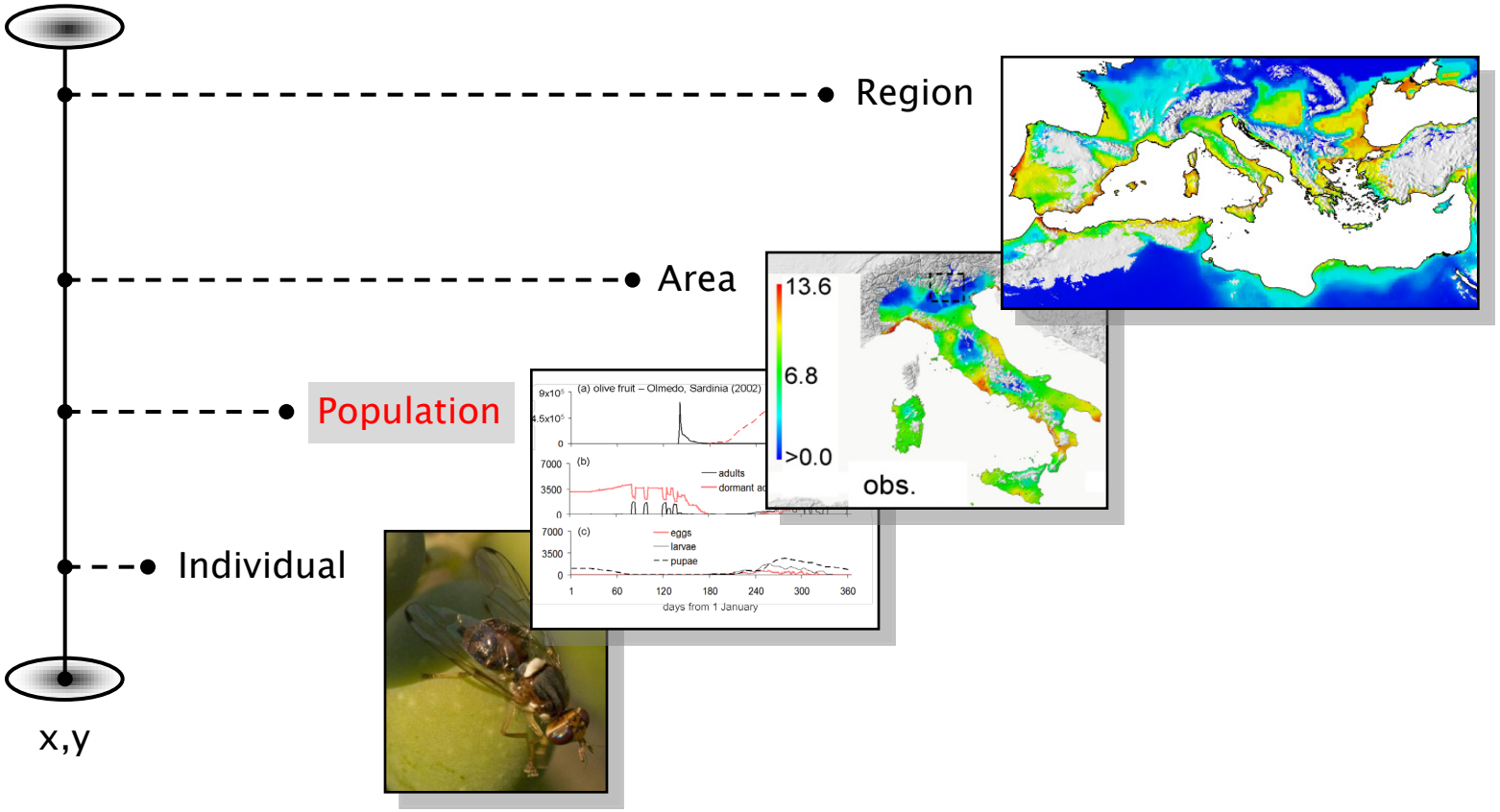
Gutierrez, Ponti & Gilioli 2010

Factors are modeled on a per-capita basis,
GIS integration occurs at the population level



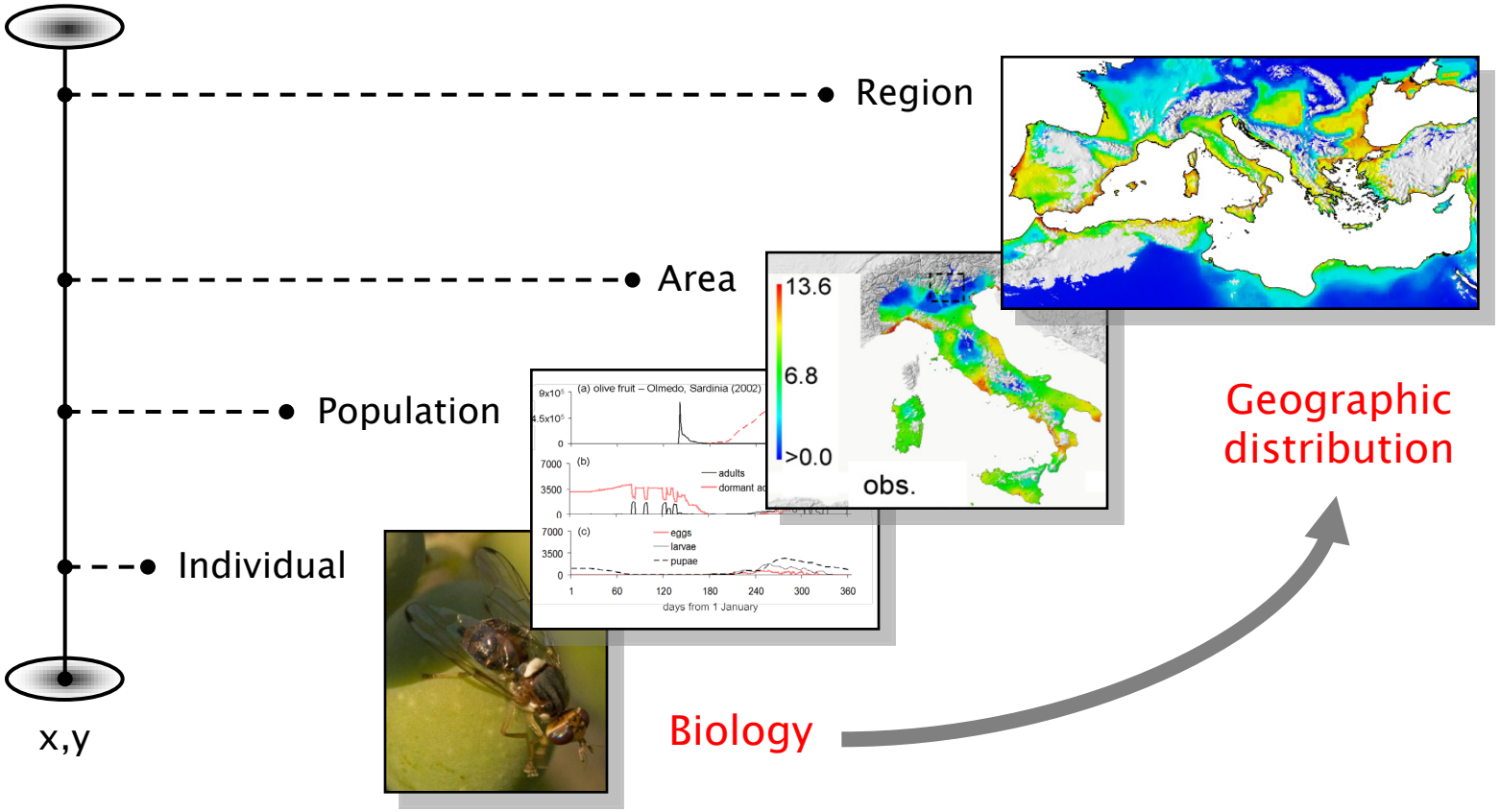
Gutierrez, Ponti & Gilioli 2010

Factors are modeled on a per-capita basis, GIS integration occurs at the population level



Gutierrez, Ponti & Gilioli 2010

Factors are modeled on a per-capita basis, GIS integration occurs at the population level



Gutierrez, Ponti & Gilioli 2010

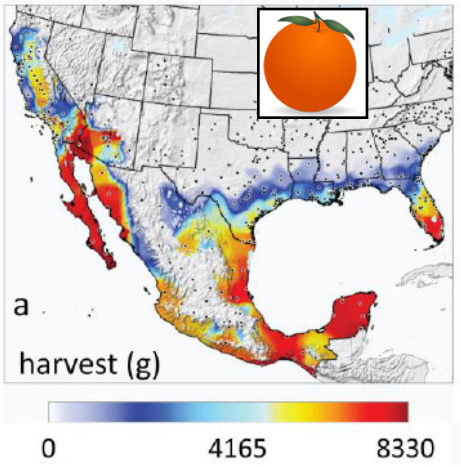
Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

In USA, vector arrived in 1998, disease in 2005 (Florida then other states)

Gutierrez & Ponti 2013

Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

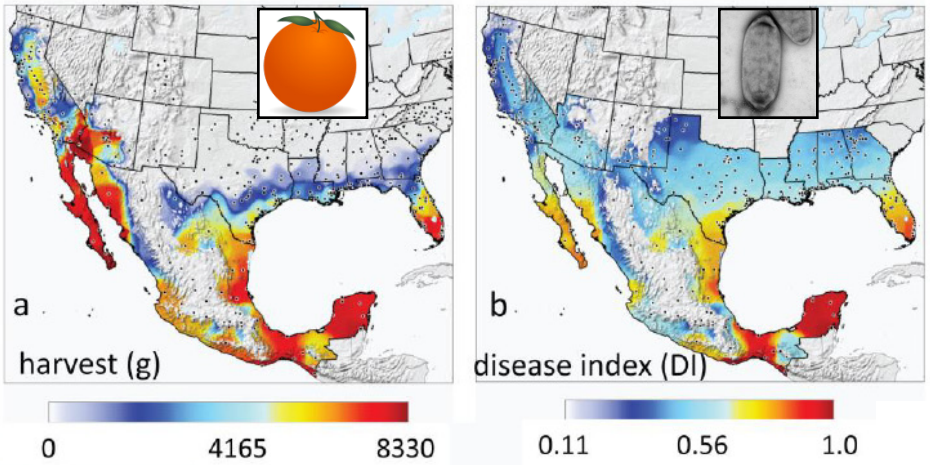
In USA, vector arrived in 1998, disease in 2005 (Florida then other states)



Gutierrez & Ponti 2013

Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

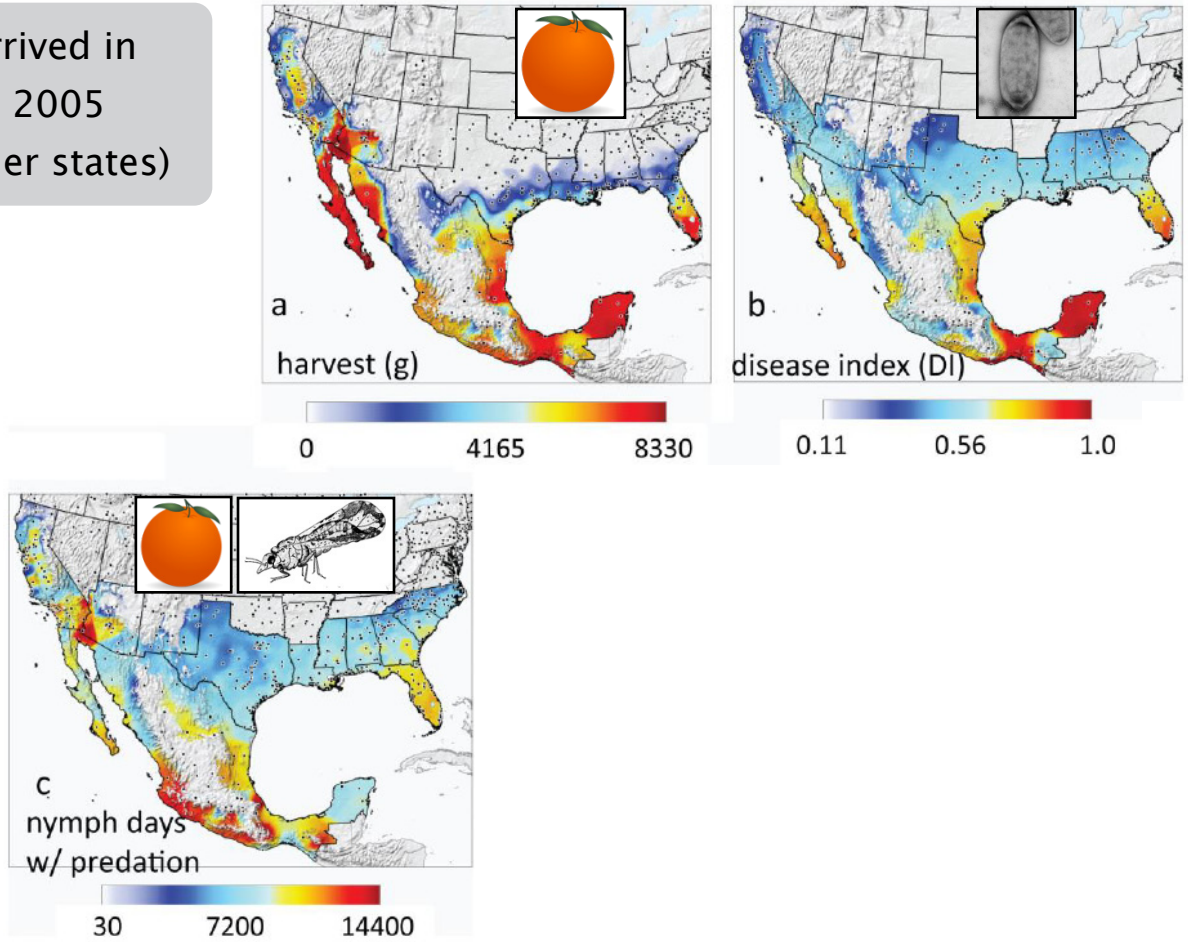
In USA, vector arrived in 1998, disease in 2005 (Florida then other states)



Gutierrez & Ponti 2013

Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

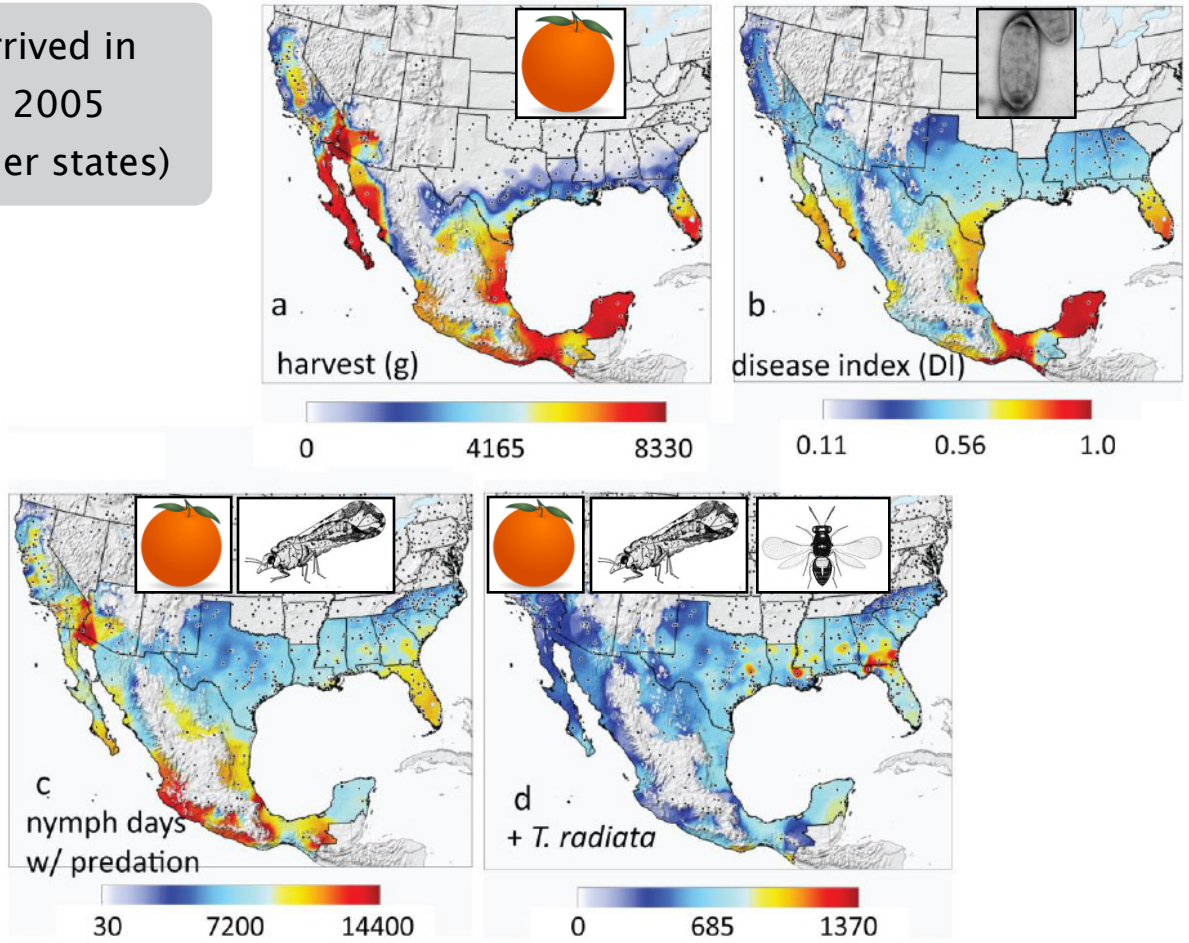
In USA, vector arrived in 1998, disease in 2005 (Florida then other states)



Gutierrez & Ponti 2013

Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

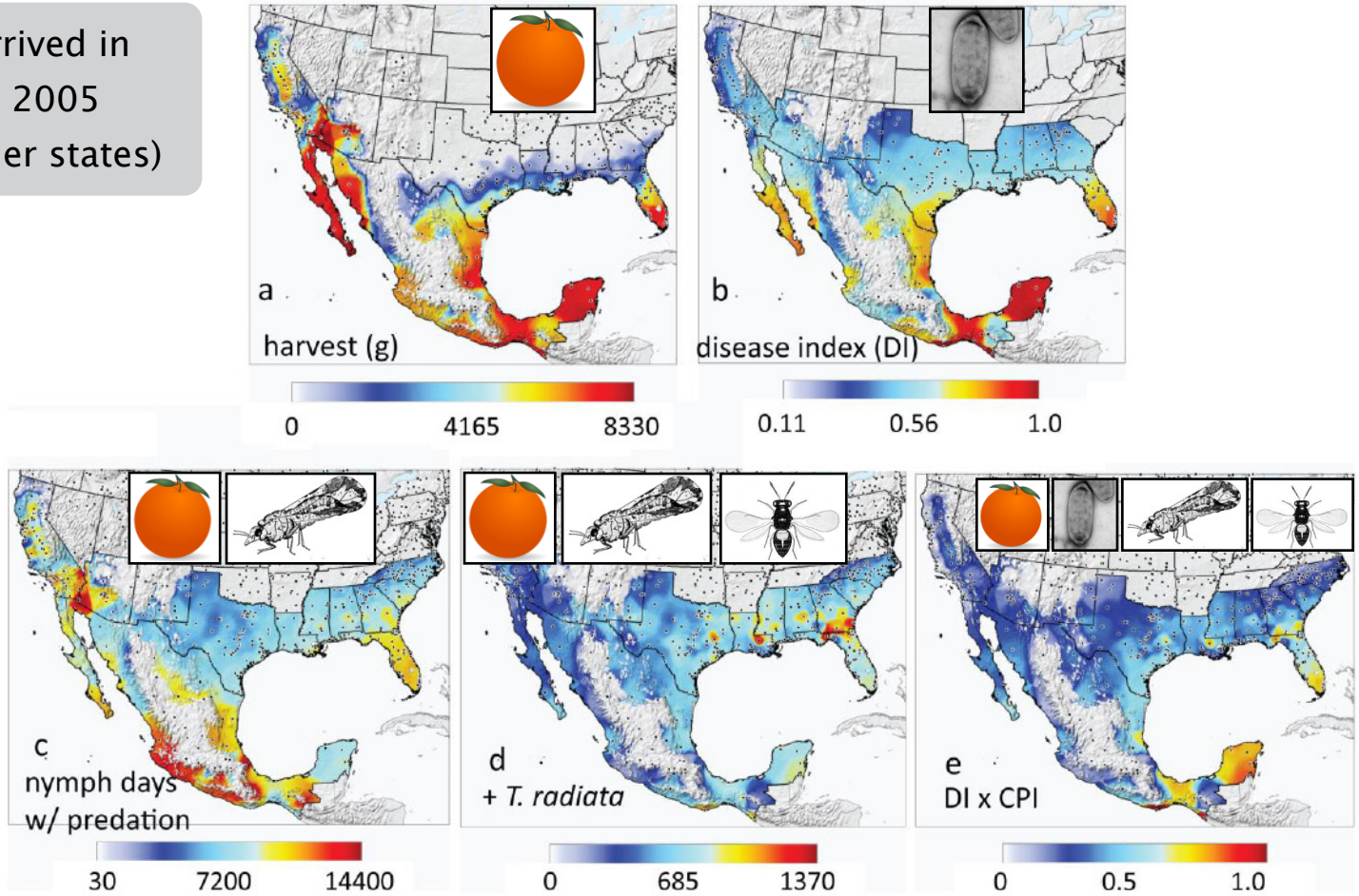
In USA, vector arrived in 1998, disease in 2005 (Florida then other states)



Gutierrez & Ponti 2013

Complex invasive vector-borne disease systems (e.g. citrus) can be assessed regionally

In USA, vector arrived in 1998, disease in 2005 (Florida then other states)



Gutierrez & Ponti 2013

Earth observation

Bridging the gap to crop-pest systems

The big EO data challenge

Bridge the gap to the field

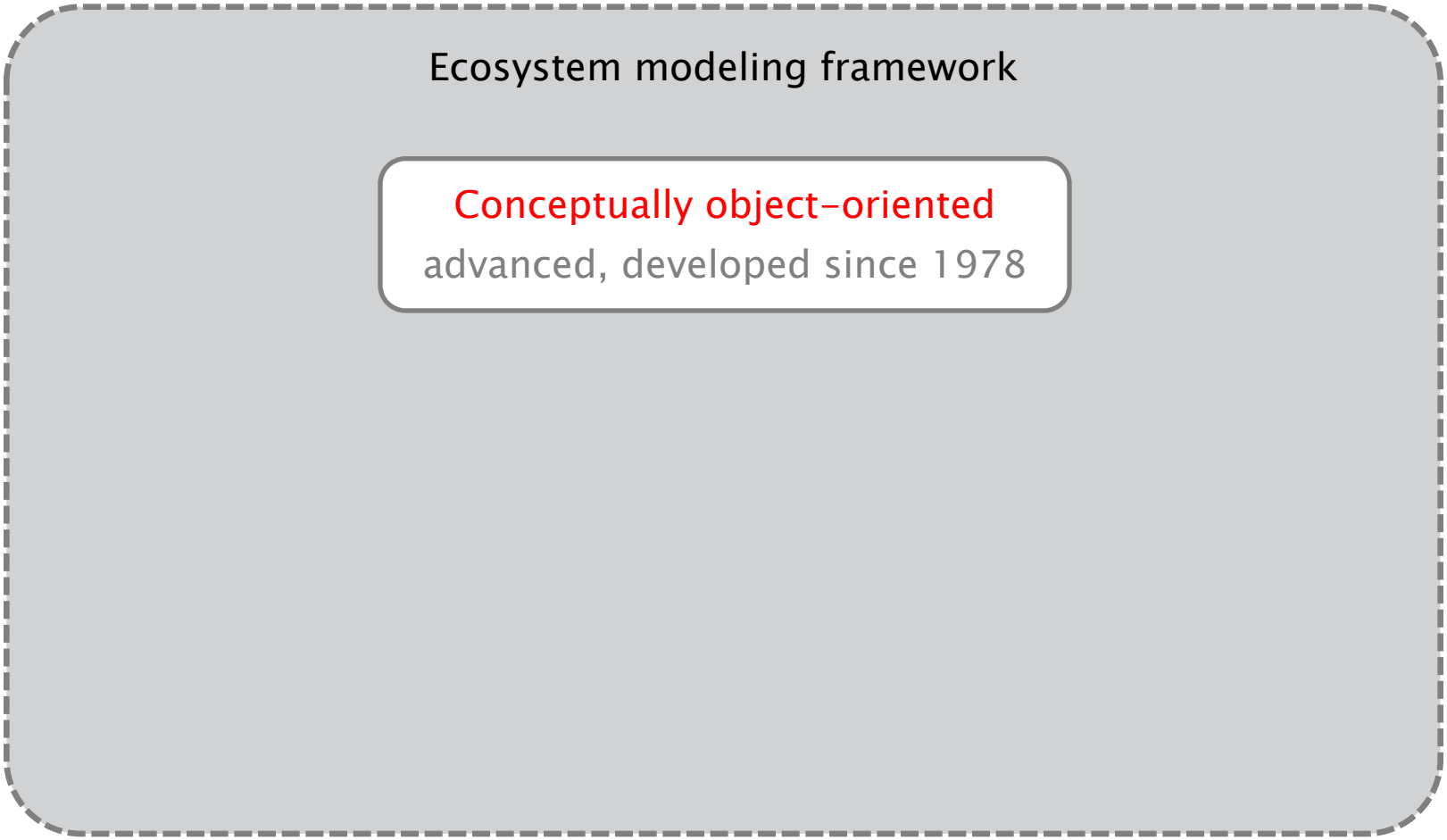
A process based approach

Add a realistic biological layer

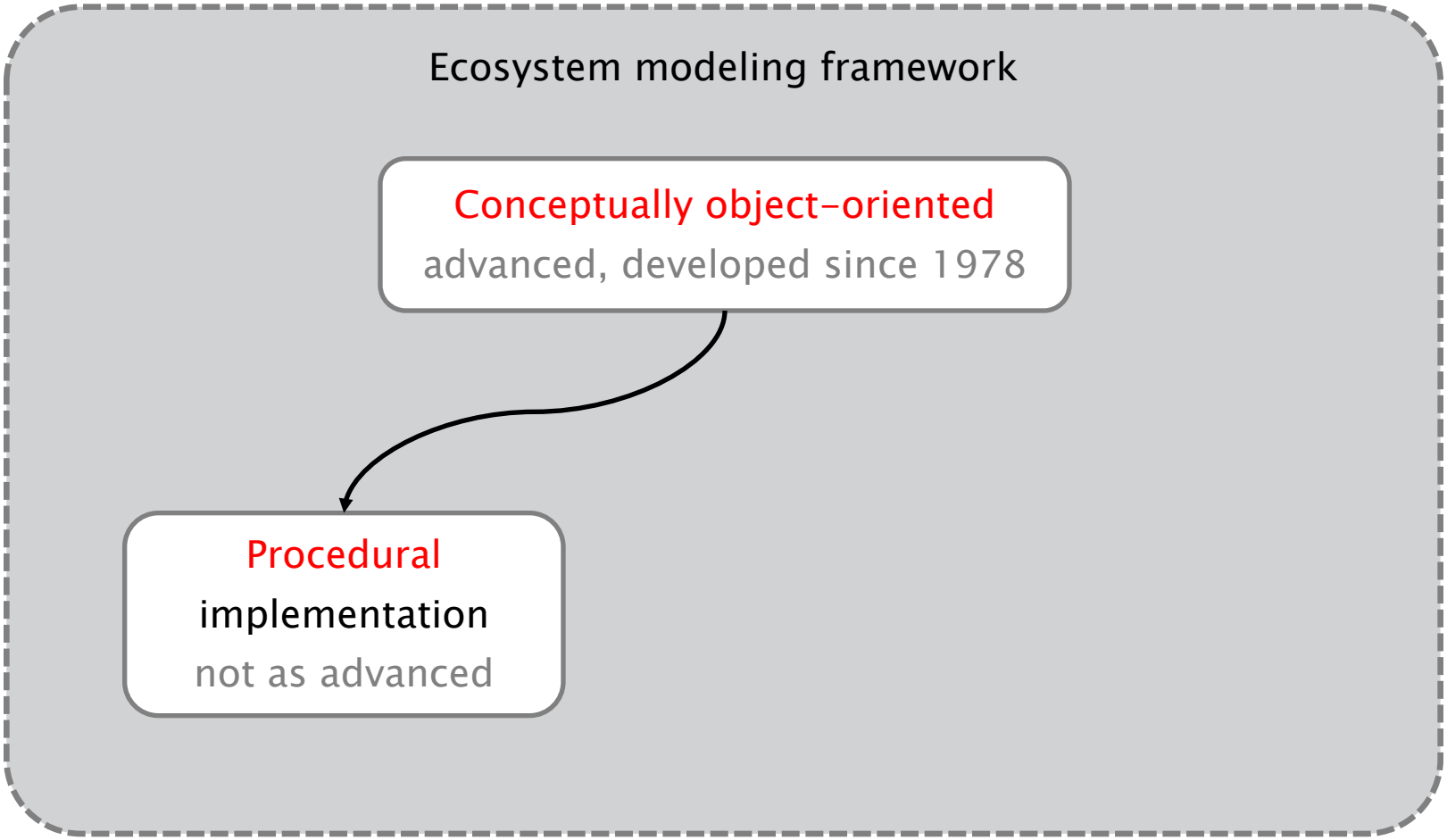
Scaling up the approach

Wide access with low expertise

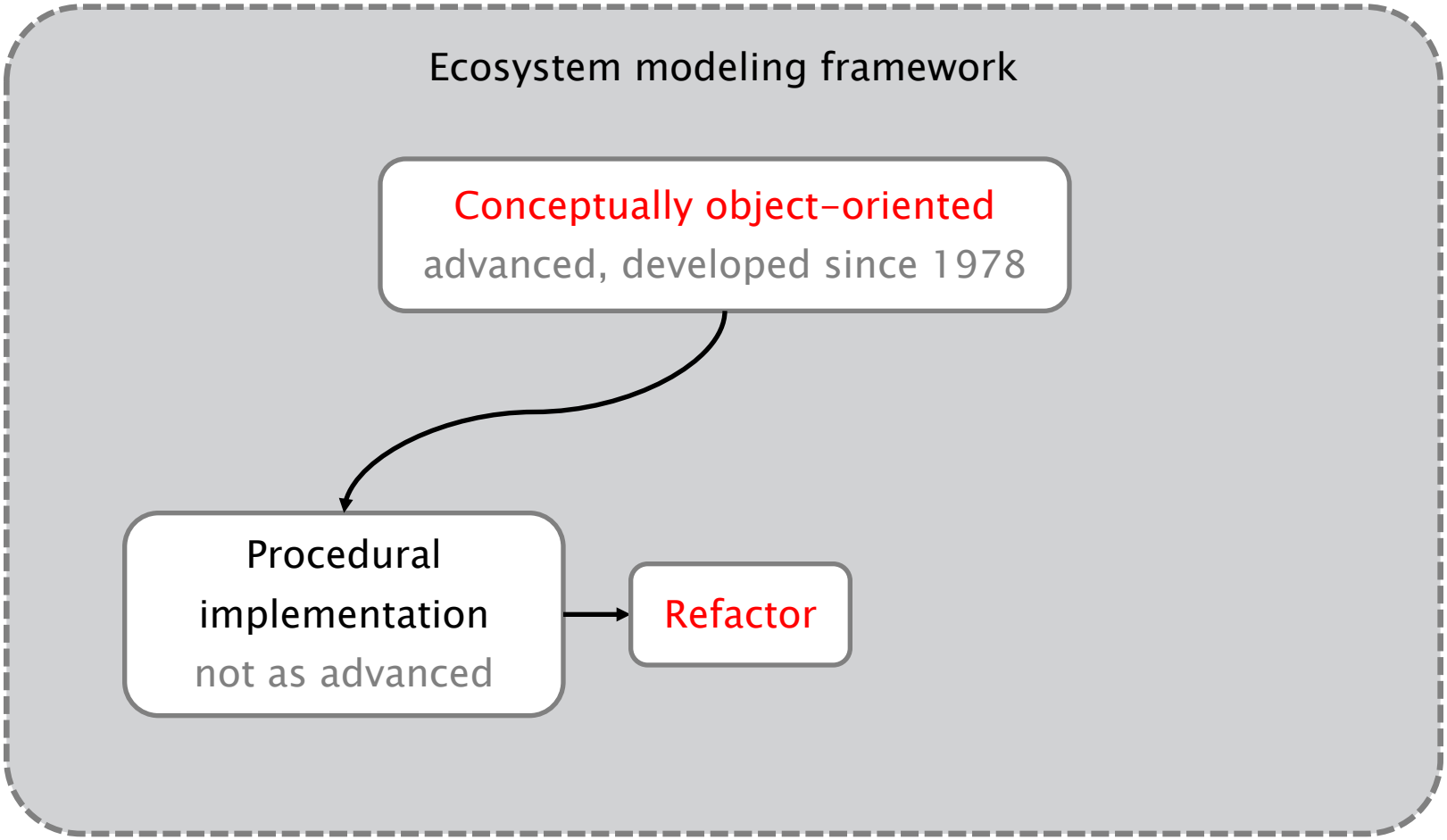
The paradigm of ecological analogies enabled description of diverse systems



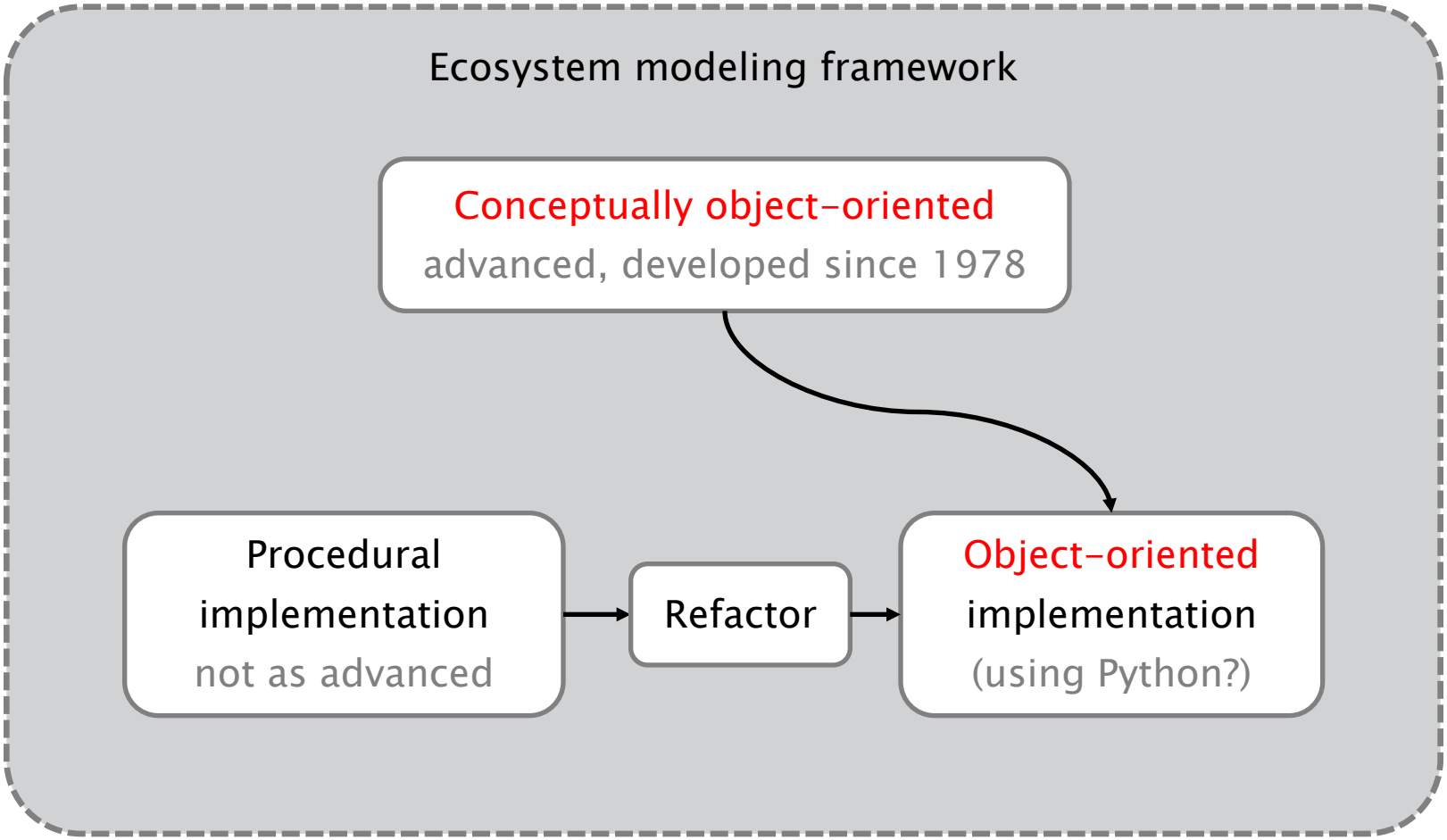
The paradigm of ecological analogies enabled description of diverse systems



Higher abstraction via new software semantics means wide access with minimal expertise



Would a (Python) class of organisms plus adequate semantics do the job?



Earth observation

Bridging the gap to crop-pest systems

Luigi Ponti
Luigi.Ponti@ENEA.it

WSMA16, Matera

Tue 15 Nov 2016

Earth observation

Bridging the gap to crop-pest systems

Luigi Ponti[1,2], Andrew Paul Gutierrez[2,3], Massimo Iannetta[1]

[1] Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA), Centro Ricerche Casaccia, Via Anguillarese 301, 00123 Roma, Italy, luigi.ponti@enea.it (LP); massimo.iannetta@enea.it (MI)

[2] Center for the Analysis of Sustainable Agricultural Systems Global (CASASA Global), Kensington, CA 94707-1035, USA, http://casasglobal.org

[3] College of Natural Resources, University of California, Berkeley, CA 94720-3114, USA, casas.global@berkeley.edu

Further info

Ponti, L., Gutierrez, A.P., Iannetta, M., 2016. Climate change and crop-pest dynamics in the Mediterranean Basin. ENEA Technical Report, 27: 18 pp.

http://hdl.handle.net/10840/8042

Workshop "When Space Technologies meet Agriculture:
Fostering Interregional collaborations, investments and definition of users requirements",
14 – 15 November 2016, Matera, Italy