



# Bee Health Workbench

Collecting and  
Sharing Data on  
**bee health**  
Towards a  
European Bee  
**Partnership**

BRUSSELS, 26 JUNE '17

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*Oxford Internet Institute*





# OVERVIEW

- Data availability & access
- Data collation & management
- Data analysis



# OBJECTIVES

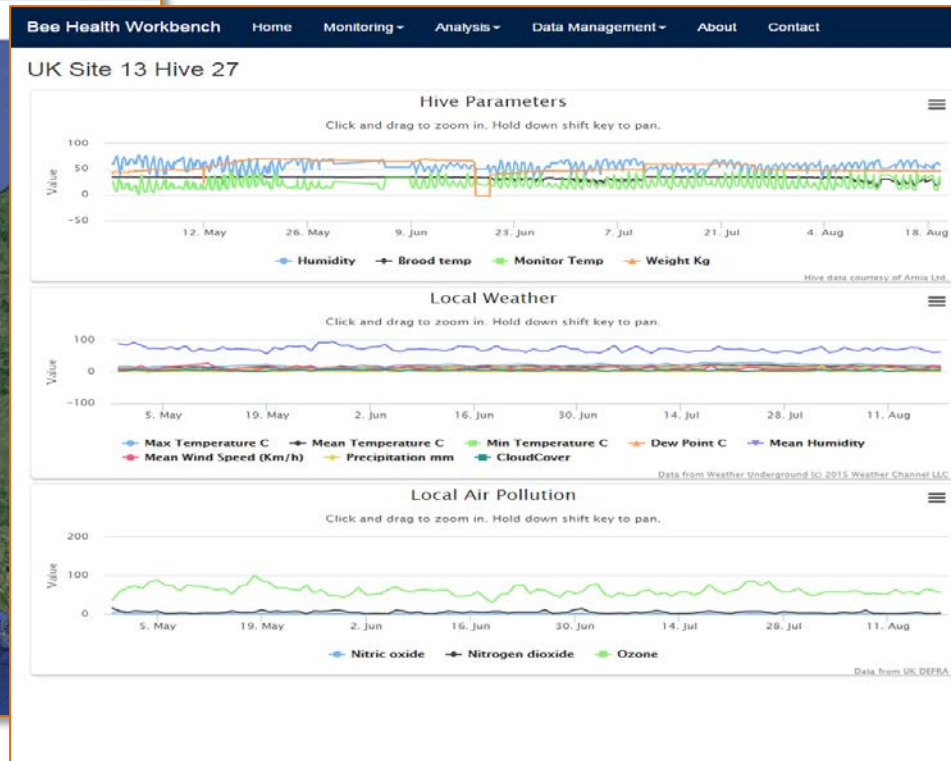
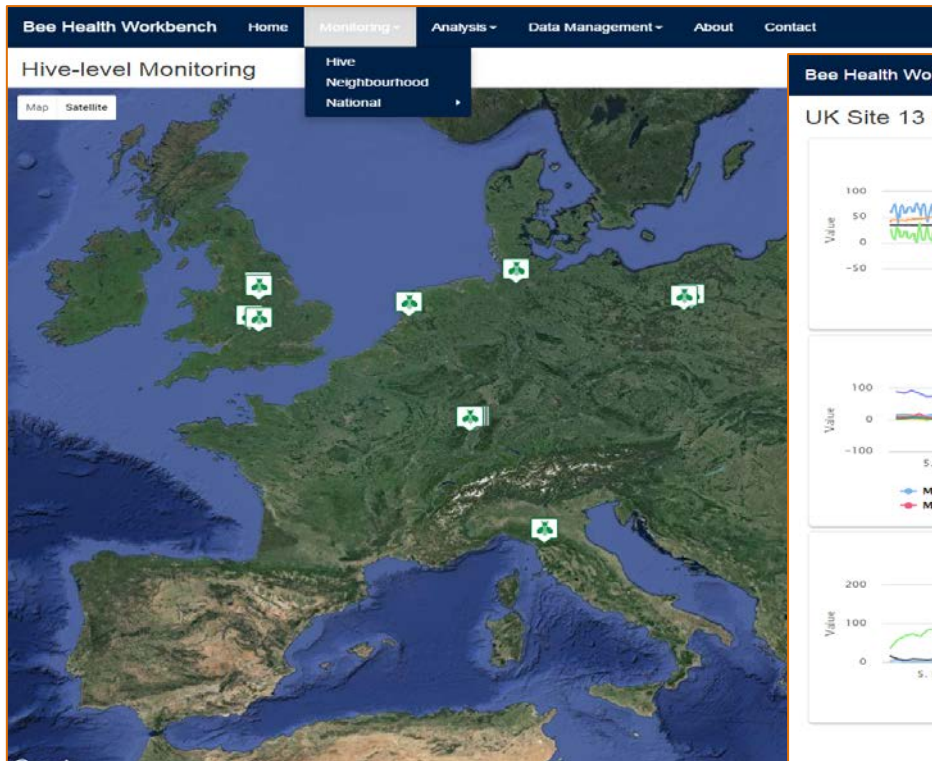
- Import and aggregate data relevant to bee health at several different scales from many different sources:
  - *Micro*: hive- and apiary-level conditions and activity
  - *Meso*: neighbourhood/landscape (crops, insecticides, pollution, infestations)
  - *Macro*: national/EU (pesticides, infestations, policy impacts)
- Understand how environmental factors and, eventually, policies may interact
- Target audience: beekeepers, scientists and policy-makers
- A *demonstrator*, not a production analytics platform



# AVAILABLE DATA SOURCES (2016)

Data Type	Source	Geographic Coverage	Temporal Coverage	Open Source?
Hive behaviour (temps, humidity, weight, activity)	Arnia Ltd.	13 sites (GB, FR, NL, DE, PL, IT)	Apr-Aug 2014; real-time feasible	No, but have shared with us
Bee mortality, infestations	EpiloBee EpiloBee	16 EU countries France	2013-14 2013-14	Yes, Summary data No, Apiary-level mortality and disease data (restricted use)
Air pollution	Eurostat (national); UK DEFRA (regional)	EU National SO <sub>2</sub> , NO, NO <sub>2</sub> ; UK regional (SO <sub>2</sub> , NO, NO <sub>2</sub> , O <sub>3</sub> )		Yes
Weather	Weather Underground	Worldwide (140K weather stations)	Real-time and daily historical	No, but free for non-commercial use
Crops (plantings and flowering dates)	UK DEFRA	UK regional	Historical	Yes
Insecticide Use	Eurostat (national); UK DEFRA	EU National	1999-2013 (EU incomplete); 1990-2014 (UK)	Yes
Regulatory Trends	European Commission, News Sources	EU National	2008-2015	Yes

# MONITORING: HIVE LEVEL



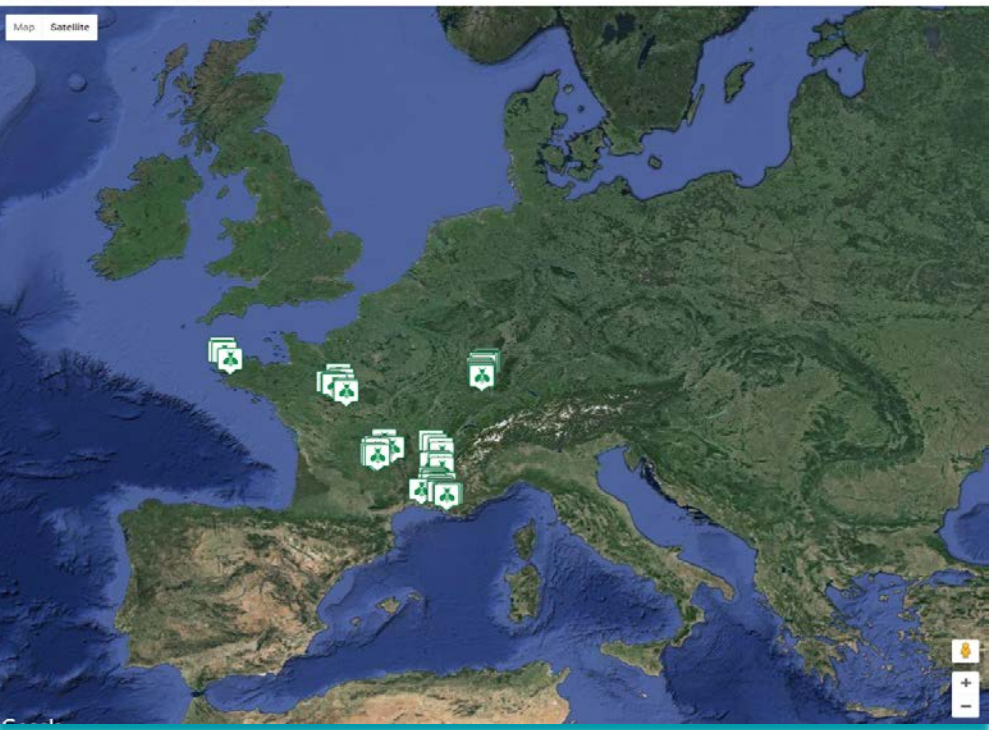


# MONITORING: HIVE LEVEL

## EpiloBee Apiaries

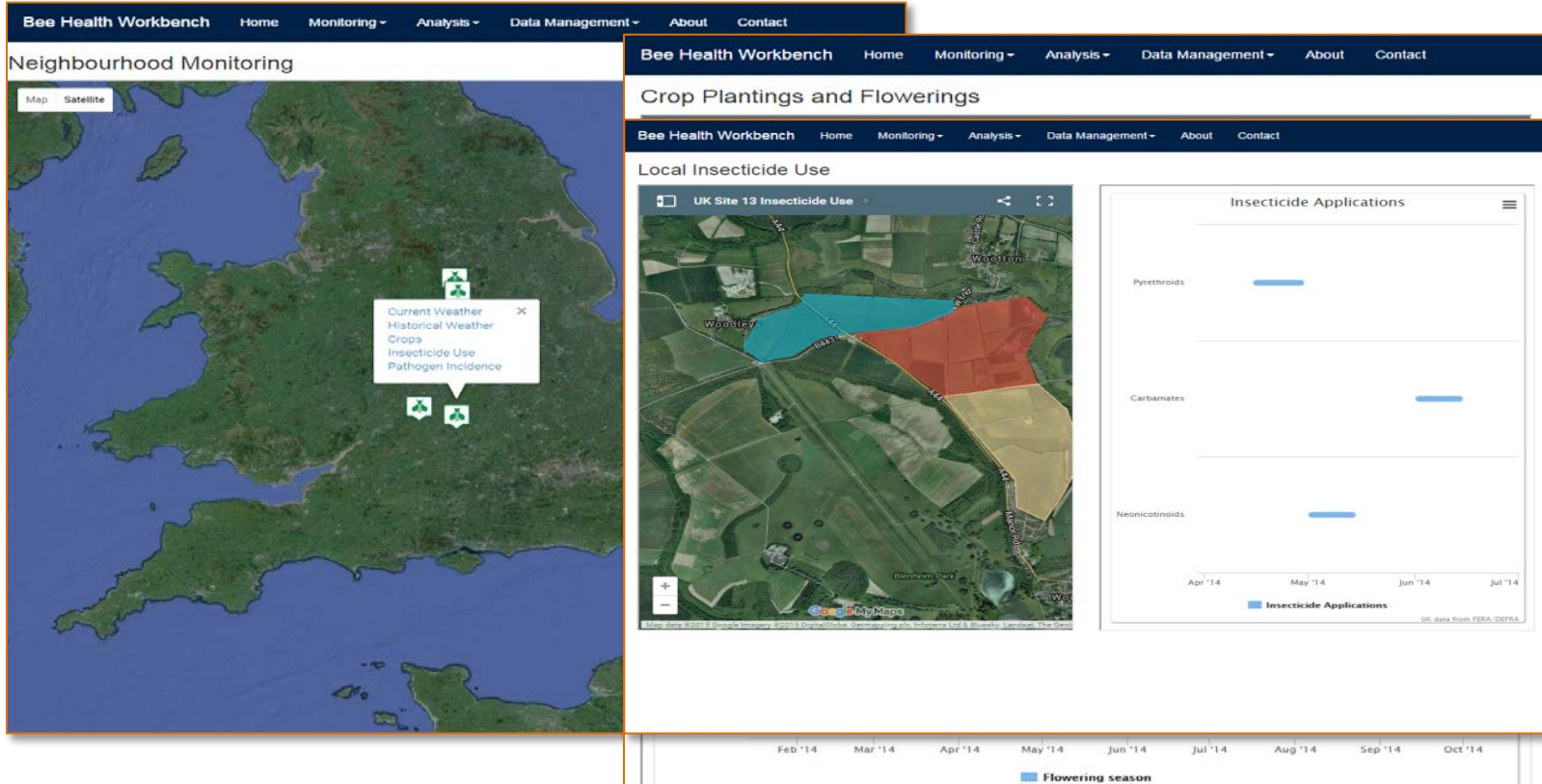


## EpiloBee Varroa Infestations



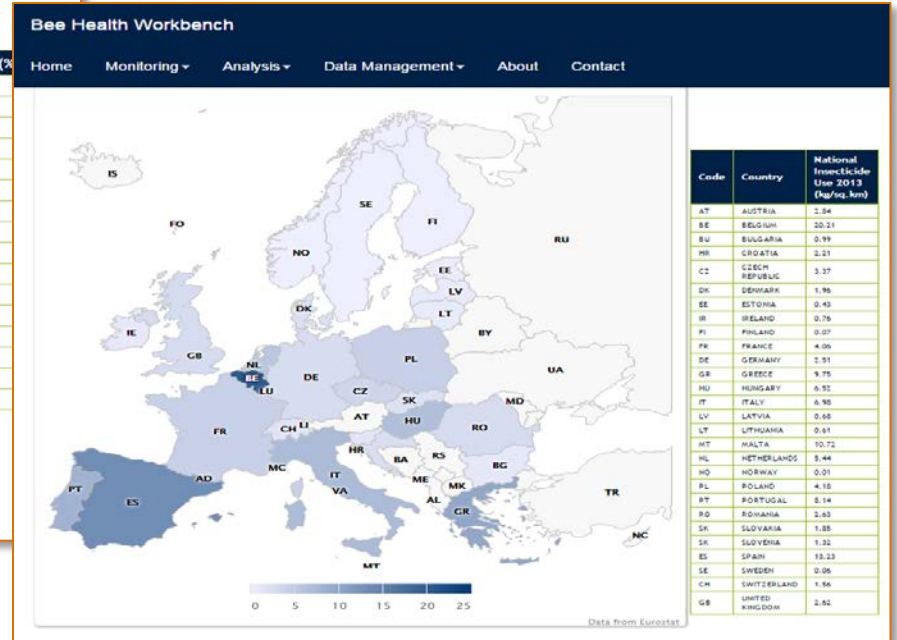
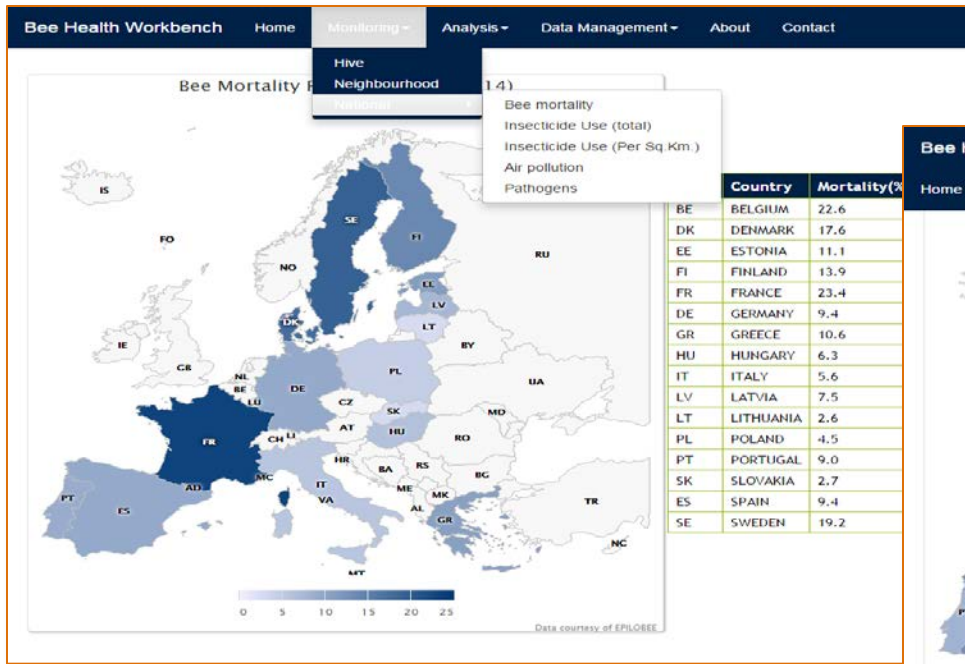
Collecting and sharing data on bee health: Towards a European Bee Partnership

# MONITORING: NEIGHBOURHOOD





# MONITORING: NATIONAL





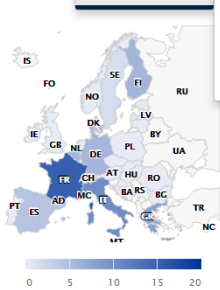
# MONITORING: NATIONAL

## National Pathogen Incidence

- Hive
- Neighbourhood

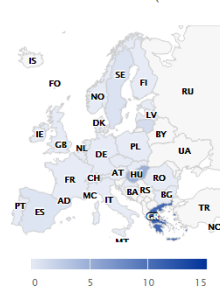
- Bee mortality
- Insecticide Use (total)
- Insecticide Use (Per Sq.Km.)
- Air pollution
- Pathogens

### Varroa Infestation Rates (2014 season, %)



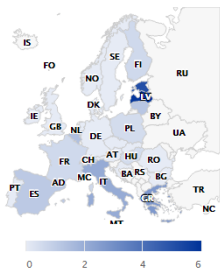
Data courtesy of EPILOBE

### Nosema Infestation Rates (2014 season, %)



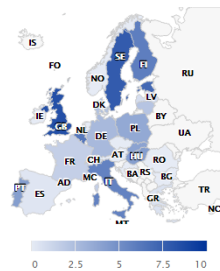
Data courtesy of EPILOBE

### Foulbrood Infestation Rates (2014 season, %)



Data courtesy of EPILOBE

### Hornet Infestation Rates (2014 season, %)

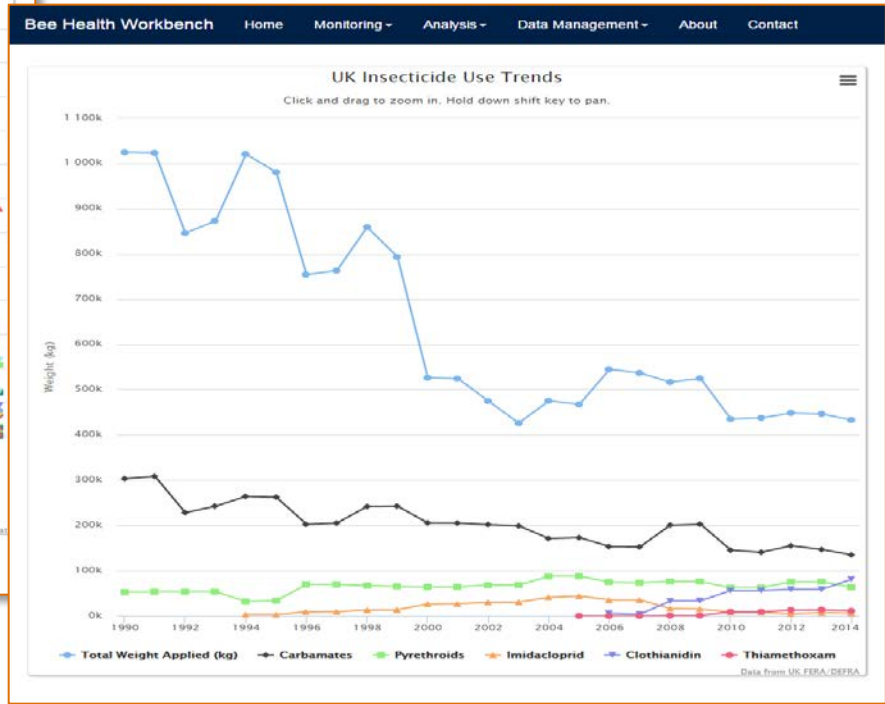
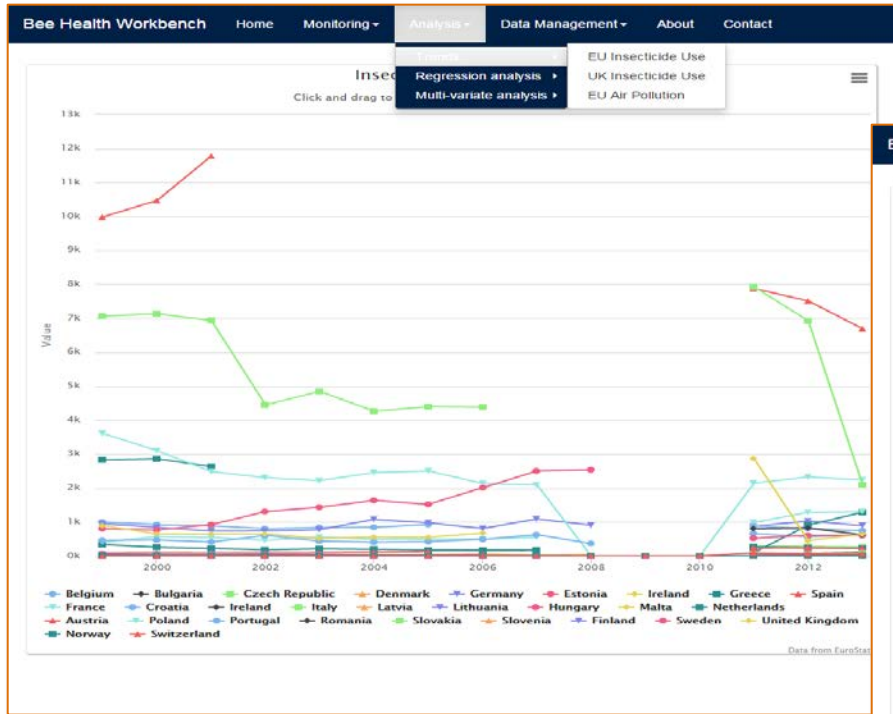


Data courtesy of EPILOBE





# ANALYSIS: TRENDS





# ANALYSIS: TRENDS

Regulatory Trends

**the guardian**  
The Guardian

MAY 2013  
**EU WIDE BAN ON NEONICOTINOIDS**  
Neonicotinoids banned in EU  
Europe will enforce the world's first continent-wide ban on widely used insecticides alleged to cause serious harm to bees, after a European commission vote on Monday.

REGULATION 283/2013

UK SUSPENDS BAN ON NEONICOTINOIDS

Italy National

United Kingdom

EU wide ban on.

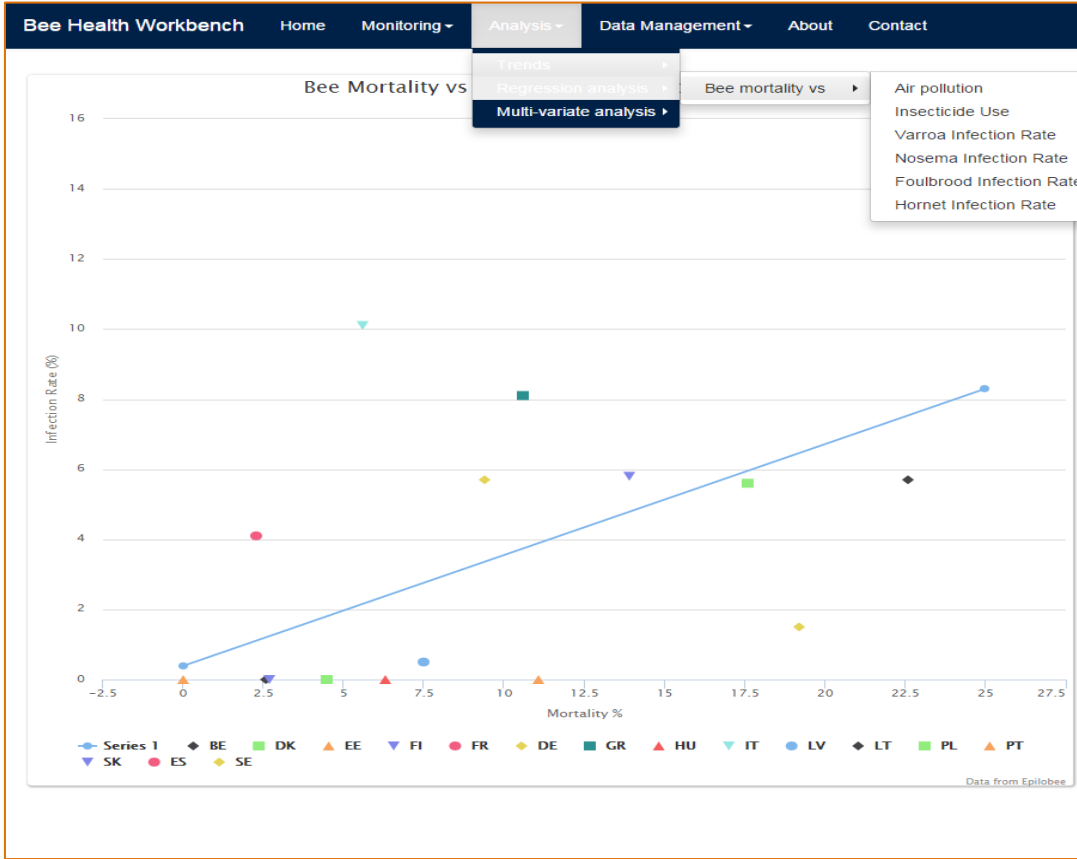
Regulation 284/2013

Regulation 283/2013

DEC 2012 MARCH MAY JULY SEPT NOV FEB APRIL JUNE AUG OCT 2013 2014



# ANALYSIS: REGRESSIONS





# ANALYSIS: CORRELATIONS

Bee Health Workbench Home Monitoring Analysis Data Management About Contact

MINE: Maximal Information-based Non-Parametric Exploration

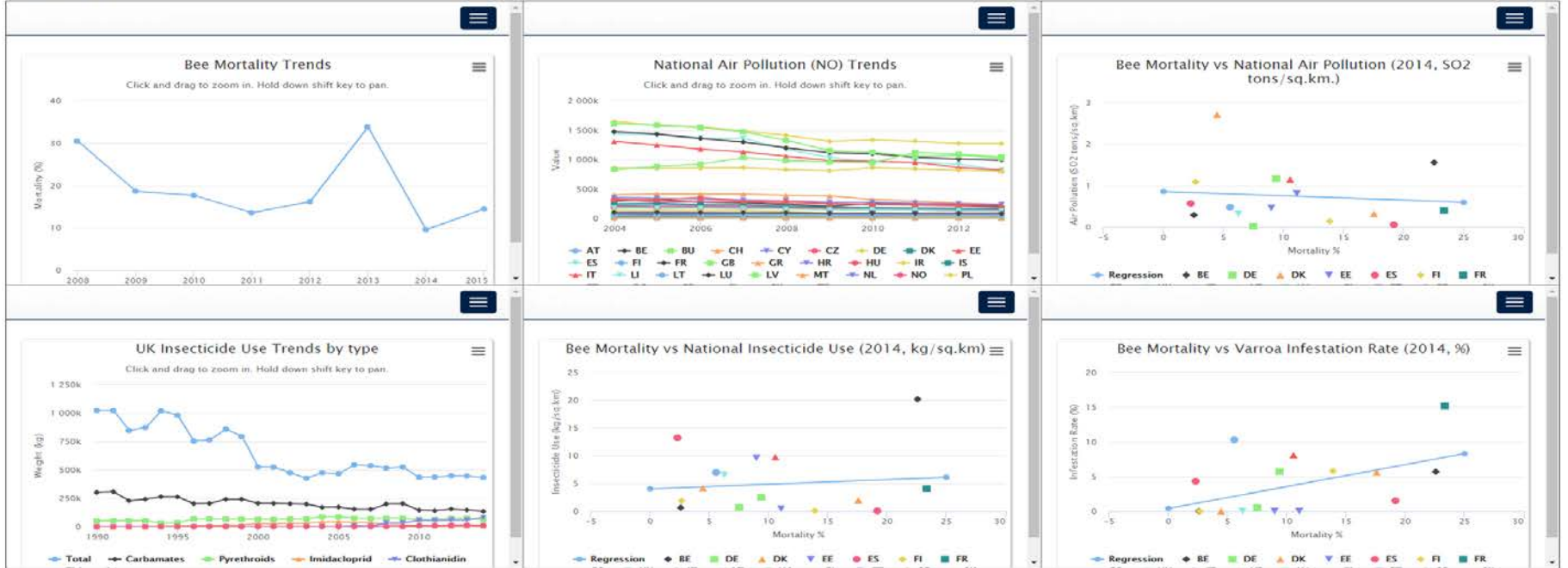
X var	Y var	MIC (strength)	MIC-p <sup>2</sup> (nonlinearity)	Multi-variate analysis		Exploration	
				monotonicity	functionality	PCA	Correlation
Mortality (%)	Varroa Infection Rate (%)	0.31127	0.047622293	0.0	0.31127		
Mortality (%)	Hornet Infection Rate (%)	0.31127	0.21584651	0.0	0.31127	2.0	0.30890694
Mortality (%)	Nosema Infection Rate (%)	0.24014	0.23179439	0.0	0.24014	2.0	-0.09135435
Mortality (%)	Insecticide Use (kg/sq.km)	0.21899	0.20182869	0.0	0.21899	2.0	0.13100117
Mortality (%)	Air pollution (SO2 tons/sq.km)	0.12425	0.10616452	0.0	0.12425	2.0	-0.13448226
Mortality (%)	Foulbrood Infection Rate (%)	0.11369	0.100228816	0.0	0.11369	2.0	-0.11602233

D. Reshef, Y. Reshef, H. Finucane, S. Grossman, G. McVean, P. Turnbaugh, E. Lander, M. Mitzenmacher, P. Sabeti. Detecting novel associations in large datasets. Science 334, 6062 (2011). See also [www.exploredata.net](http://www.exploredata.net)



# DASHBOARD

## Dashboard





## LESSONS LEARNED

- Surprisingly limited available data at micro- and meso-scale
  - Not being collected?
  - Not being published?
  - Not public-domain?
- Even national data are sometimes incomplete or inconsistent
- Would crowd-sourcing help?
- Most scientific studies necessarily limited in scope and examine only a few variables at a time



## WITH THANKS TO:

- Colleagues at Oxford Internet Institute and Technopolis Group
- George Clouston of Arnia Ltd for access to hive monitoring data
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