FOOTPRINT

Climatic aspects in FOOTPRINT

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Why focus on climatic aspects today?

- The work on climatic zonation was undertaken in the first year of the project
- And was published in 2 scientific papers
- Interesting piece of work because it has both advantages and disadvantages
- Outlook
  - Overview of the work done
  - The FOOTPRINT climatic zones
  - Advantages and disadvantages
  - Alternative approaches

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Climatic aspects

- New methodology for development of a climatic classification for Europe (and any other territory)
- Approach
  - Identification of key climatic factors influencing pesticide fate
  - Statistics and derivation of a climatic zonation
  - Assignment of representative daily meteorological data
- People involved:
  - Hayley Fowler, Aidan Burton, Steven Blenkinsop, John Hollis, Tom Nolan, Igor Dubus, Nicolas Surdyk, Nick Jarvis, Stefan Reichenberger

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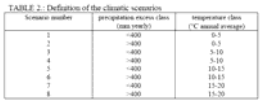
The usual approach

- The definition of climatic scenarios for pesticide fate and modelling typically is based on average temperature and average annual rainfall…
- …but are these the most important variables regulating pesticide loss?

FOCUS, 1995

- Are temperatures and average annual rainfall the most important variables regulating pesticide loss?



FOCUS, 1997

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Methodology

- Undertake MACRO modelling for:
  - Leaching and drainage
  - 3 pesticides
  - 9 soil types (4 for drainage, 5 for leaching)
  - 2 application seasons (spring vs. autumn)
  - 10 application dates
  - 6 synthetic climate series for the same station
- Characterise the weather datasets (Oxford and Zaragosa) in detail
- Relate the loss of pesticides to climate characteristics
  - Univariate stats: Spearman correlations
  - Multivariate stats: Data mining CART analysis

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Characterization of climatic series

Over 100 variables representing…

- ***Cumulative rain* for indicated time (days) before or after application**

  Rx [x = -91, -61, …, 0, 1, 2, …, 14, 30, 61, …, 365, 729]

- ***Average temperature* over indicated time (days)**

  Tx [x = 0, 1, 2, …, 14, 30, 61, …,365, 729]

- ***"Lag" time in days until single-day rain event (mm) before or after application***

  Ly [y = -30, -20, -10, 10, 30, 40, 50]

- ***Time in days for cumulative rain amount (mm)***

  Cy [y = 2, 5, 10, 20, 50, 100]

- ***Winter rain amount for indicated months***

  WRA_m_n [m = Sep, Oct, Nov; n = Mar, Apr]

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Spearman Correlations – Leaching Example

Ludford soil					
Pesticide 1		Pesticide 2		Pesticide 3	
L50	*-0.648*	*WRA_nov_apr*	*0.862*	*WRA_oct_apr*	*0.973*
R10	*0.494*	*WRA_nov_mar*	*0.822*	*WRA_nov_apr*	*0.971*
R61	*0.487*	*WRA_oct_apr*	*0.813*	*WRA_sep_apr*	*0.925*
C100	-0.474	*WRA_sep_apr*	*0.789*	*WRA_oct_mar*	*0.918*
R20	0.463	*WRA_oct_mar*	*0.787*	*WRA_nov_mar*	*0.869*

The top 5 correlated variables are shown for each soil-pesticide combination

The most influential variables are at the top. A colour coding scheme is used

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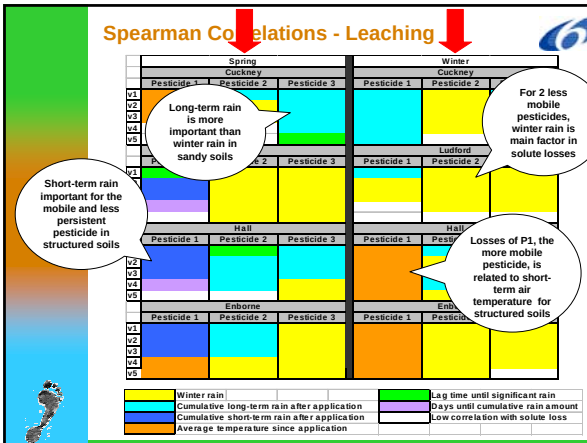
Spearman Correlations - Leaching



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Variables to be used in the definition of climatic zones

- Rainfall from 1 October to 31 March
- Average Annual Rainfall
- Number of 2-mm rainfall events in April-May-June
- Number of 20-mm rainfall events in April-May-June
- Number of 50-mm rainfall events in April-May-June
- Number of 20-mm rainfall events in September-October-November
- Average temperatures in September-October-November
- Average temperatures in April-May-June

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The derivation of the climatic zonation

- Based on the ECA (European Climate Assessment) and MARS (Monitoring Agriculture with Remote Sensing) datasets
- Principal Components Analysis + cluster analysis on the data
- Definition of FOOTPRINT climatic zones for Europe
- 12-18 zones considered appropriate

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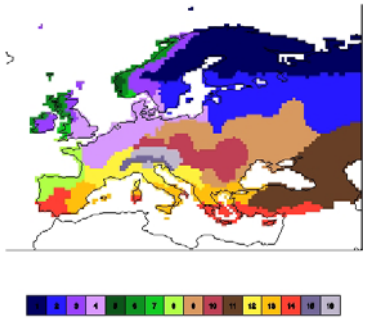
The 16 FOOTPRINT climate zones



The 16 FOOTPRINT climatic zones

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FCZs in plain English

Climate Type	FCZ	Description
Northern	1	North European climate, cold and dry.
	2	North European climate, cool and dry.
Temperate	3	Modified temperate maritime climate, cool with moderate precipitation.
	4	Temperate maritime climate, warm with moderate precipitation.
Maritime	5	Very, wet, mountainous maritime climates, with more frequent extremes.
	6	Wet, maritime climates, on exposed western coasts, more frequent extremes.
	7	Modified upland maritime climate, more frequent extremes.
	8	Warmer maritime climate, wetter but fewer wet spring days.
Continental	9	Continental climate, warm and dry.
	10	Continental climate, warm and dry with moderate frequency of extremes.
	11	Continental climate, warm and dry.
Mediterranean	12	North Mediterranean climate, warm and moderate precipitation.
	13	Mediterranean climate with more frequent extreme rainfall.
	14	Mediterranean climate, warmer, lower rainfall with more dry days but higher winter rainfall.
Alpine	15	Alpine climate, cool and wet, relatively more extremes.
	16	Sub-Alpine continental climate, warm, moderate rainfall but low winter rainfall, moderate frequency of extremes.

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Assigning data to the FOOTPRINT climatic zones

Precipitation	>	ECA
Max temperature	>	ECA
Min temperature	>	ECA
Mean temperature	>	ECA
PET	>	MARS
Wind speed	>	MARS
Solar radiation	>	MARS

Correlation studies to ensure the integrity of the final dataset

> 26 years of daily data

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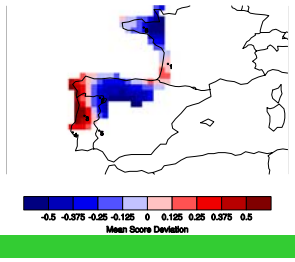
Selecting representative stations for each FCZs

> Calculation of a PCA score for each grid cell in each FCZ

> Comparison of PCA scores for each grid cell against average score for the FCZ, to calculate deviations

> Selection of meteorological station for cell with minimum deviation



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The advantages of the approach

> The FOOTPRINT climatic zonation defines homogeneous zones accounting specifically for those meteorological factors which influence pesticide fate

> The zones allow users to undertake risk assessments across the European Union

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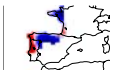
The disadvantages

> The FOOTPRINT climatic zones are large

> No accounting of climate variability in a given zone

> The representative station for a specific location may be that of a far location



> The solution is to develop national versions of FOOTPRINT

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The example of France

> Country with a diverse agriculture which is a reflection of the diversity in climate, geology and soils

> 4 different options for defining a climatic zonation (at the large scale)

- Administrative classification
- Existing climatic classifications
- FOOTPRINT classification
- Classification based on agricultural regions

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Administrative classification

96 départements

22 régions

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FOOTPRINT type classification

Existing climatic classification

5 zones

29 zones

Agricultural classification

432 "régions agricoles"

The four options

> The four options presented are all valid

> The selection of one or the other depends on the objectives of the national developments

In summary

> There are many different options for defining climatic zones

> The FOOTPRINT team selected one which offers the advantage of allowing a deployment of the tools throughout Europe

> Other more precise options can be investigated as part of the development of national versions of the FOOTPRINT tools

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