Sensitivity and uncertainty analysis of the basic reproduction number for bluetongue

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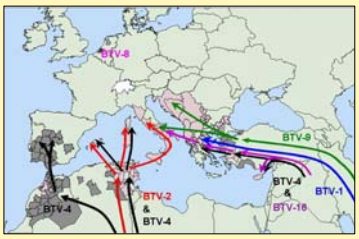
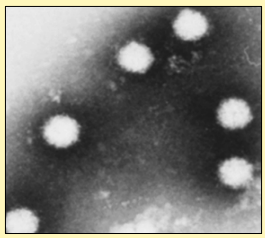
1. Introduction

- Since 1998 bluetongue (BT) has expanded northwards in Europe in an unprecedented series of incursions
- The extension of BT further north in Europe suggests there is a risk to the large and valuable UK livestock industry
- The basic reproduction number, R_0, provides a powerful tool with which to assess the level of risk

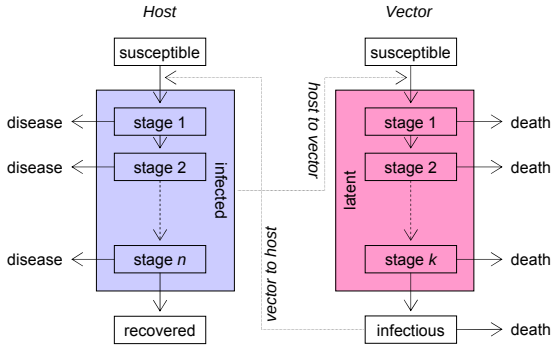




2. Methods

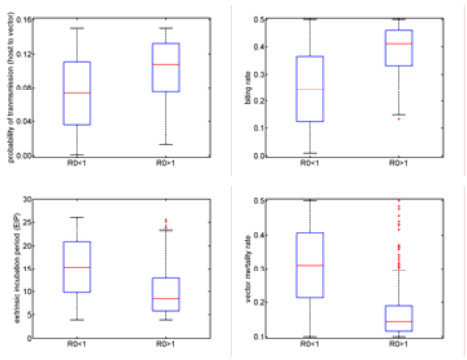
- Simple two host (cattle and sheep), one vector transmission model (see Box 3)
- R_0 calculated as the dominant eigenvalue of the next-generation matrix for the model
- Plausible ranges and distributions for each of 12 parameters (see Box 5) obtained from literature
- Uncertainty and sensitivity analysis based on:
  - Latin hypercube sampling
  - partial rank correlation coefficients (PRCC)

3. Model structure



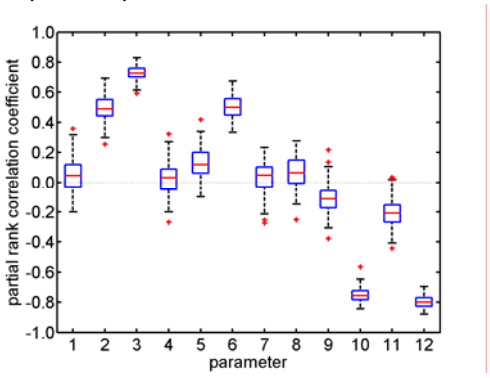
4. Uncertainty analysis

- Box and whisker plots showing distribution of sampled parameters yielding $R_0<1$ or $R_0>1$



5. Sensitivity analysis

- Identified five key parameters, each with $|PRCC|>0.5$ (nos 2, 3, 6, 10 & 12)



1-prob. transmission (vector to host); 2-prob. transmission (host to vector); 3-biting rate; 4-host preference; 5-vector to cattle ratio; 6-vector to sheep ratio; 7-duration of viraemia (cattle); 8-duration of viraemia (sheep); 9-mortality rate (sheep); 10-EIP; 11-no. stages in EIP; 12-vector mortality rate

6. Conclusions

- Five key parameters identified:
  - probability of transmission (host to vector)
  - biting rate
  - ratio of vectors to sheep
  - extrinsic incubation period (EIP)
  - vector mortality rate
- Biting rate, EIP and vector mortality rate strongly influenced by environmental factors
- The relationship between these parameters and environmental factors should be quantified

Acknowledgements

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