

EFSA Epidemiology (Epi) Working Group (WG) for Bluetongue (BT) Virus Serotype 8 Epidemic

Hubert Deluyker
SCA Department
EFSA

Background

- **8 September 2006**
 - local epidemiology network (B, D, NL)
- **22 September 2006**
 - European Commission (EC) Chief Veterinary Officer (CVO) meeting recommends for EFSA to create BT Epi WG with
 - *experts from Commission, Member States (MS), CRL, OIE Ref Lab*
 - *chaired by Prof. D. Pfeiffer (Member EFSA AHAW Sci. Panel)*
- **5 October 2006**
 - EC requests Scientific Assistance from EFSA (under article 31 of Regulation (EC) No. 178/2002)

Mandate from the European Commission

■ objectives and timelines

- regular epidemiological reports: weekly reports
- global epidemiological analysis: draft report on 31 January 2007

■ final steps after 6 and 7 February meetings

- considered comments from 6 and 7 February meetings and put report through 31 January on the EFSA web

http://www.efsa.europa.eu/en/in_focus/bluetongue/bluetongue_report_s8.html

- finalised global epidemiological analysis by 31 March 2007
 - *conducted further in-depth analyses, as needed*
 - *updated reports under review*

Global Epidemiological Analysis - Aims

- **detailed description and exploration of all relevant outbreak data**
- **hypotheses: what factors affect**
 - introduction,
 - establishment, and
 - spread

Global Epidemiological Analysis - Inputs

- **ADNS notification data**
- **more detailed outbreak information**
 - clinical and
 - serological
- **animal density data**
- **international (TRACES) and national movement data**
- **meteorological and environmental data**

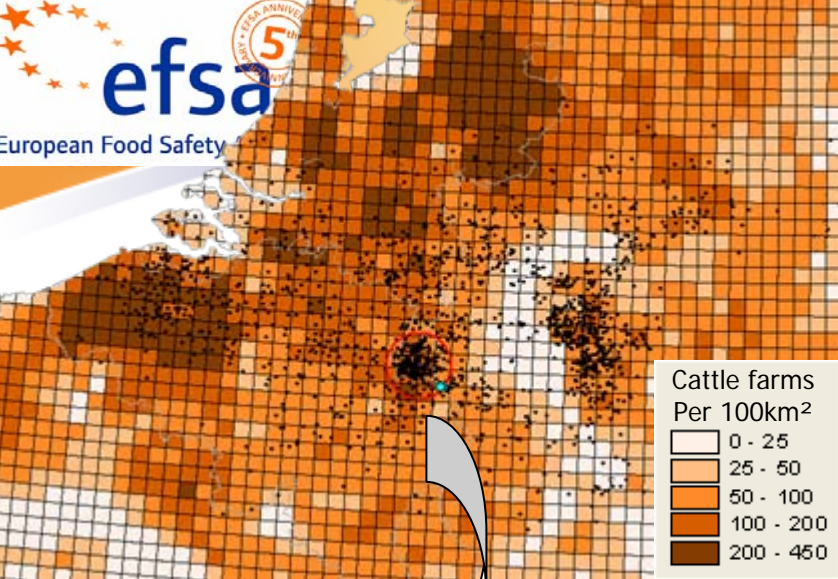
Detailed Description of Epidemic: Onset, Establishment and Spread

- **Time-space distribution of the outbreak between herds & Identification of the area of first infection** – G. Gerbier, CIRAD
- **Description of the clinical aspects of the outbreak and Pattern of the disease within herds** – A. Elbers, CIDC
- **Vector studies** – R. Meiswinkel, CIDC
- **Environmental factors affecting spread** – C. Staubach, FLI
- **Human interventions affecting introduction and spread** – K. Mintiens, VAR

Identification of the area first affected

G. Gerbier

¹CIRAD, France



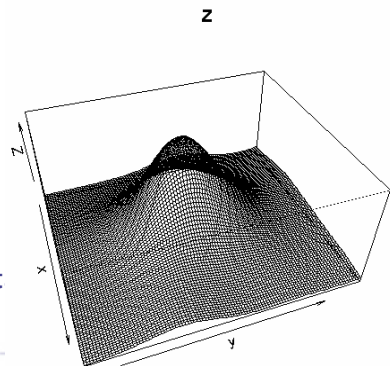
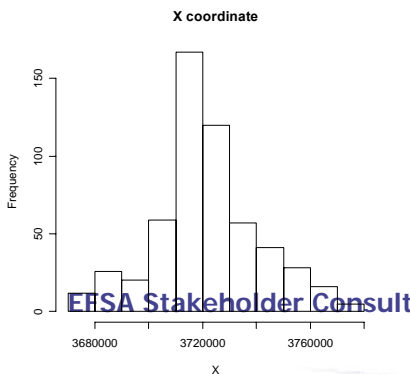
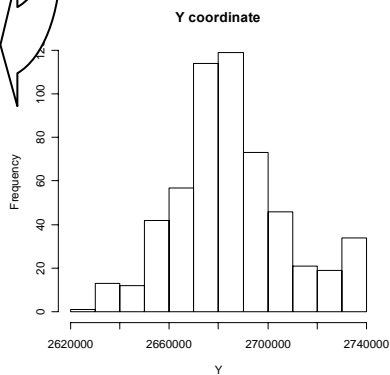
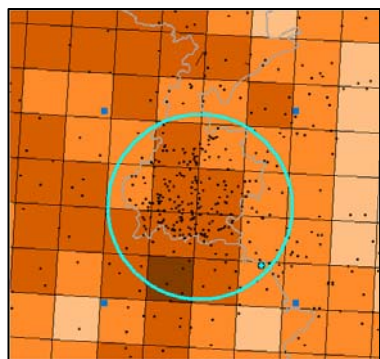
Area of first infection

■ Potential earliest case:

- farm in Belgium 5km from B,NL,D borders
- earliest clinical signs: possibly 17/07/2006

■ Model-based estimation:

- probable origin: centered in The Netherlands close to Maastricht



07, Parma, Italy

Conclusions

- **Not possible to pinpoint precisely farm(s) of first infection statistically (Iceberg effect)**
- **Instead, 20 km area of first infection (AFI) covering:**
 - border area between NL,B,D
 - first reported infections in each country
 - farm with potentially earliest symptoms

Possible routes of introduction

*E. Meroc¹, K. Mintiens¹, M. Aerts², J. Cortinas², C. Faes²,
E. Ducheyne³, G. Hendrickx³*

¹CODA-CERVA, Belgium, ²Centre for Statistics, Hasselt University, Belgium, ³AVIA-GIS, Belgium

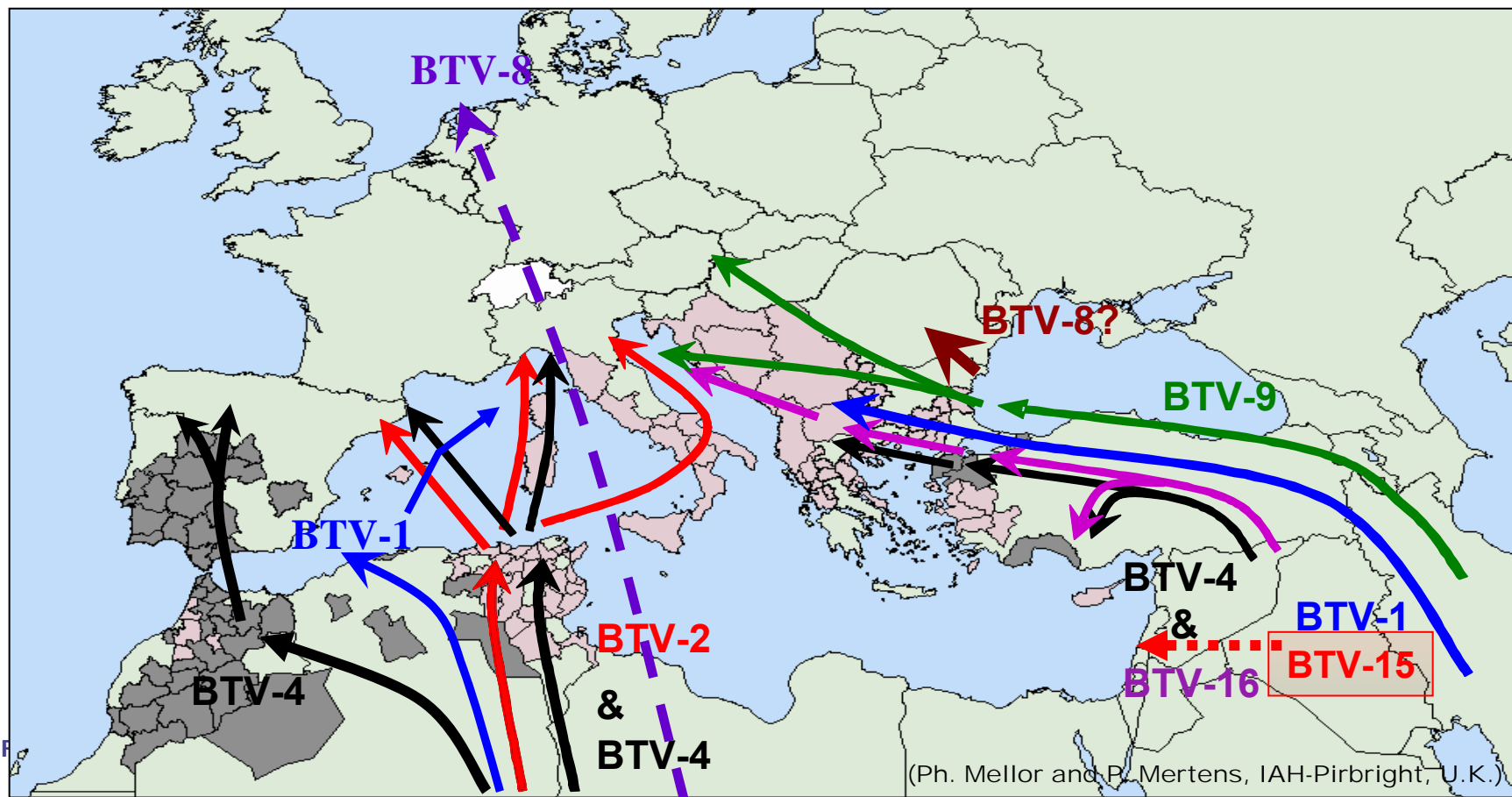
Possible routes of Introduction

- **not an import risk assessment**
- **at first all imports considered: no reliable data on BTV8 occurrence outside the EU**
- **only considered inward movements into AFI**
- **potential imports in the AFI that were explored**
 - **import live ruminant: potential to carry BTV infection**
 - **import non-susceptible mammals: potential to carry BTV-infected vector**
 - **introduction ruminant-live products (semen, ova, embryos): potential to carry BTV**

Conclusions

- **Potential scenarios that were not formally explored - *doesn't mean not potentially important***
 - animals: transit, illegal, travelling animals e.g. circus, zoos
 - vector introduction via plant imports
 - contaminated biologicals
- **Results on imports for explored routes**
 - domestic or wild ruminants: no imports
 - horses: imports took place, but a risk assessment would need to consider mitigating measures and other factors affecting likelihood of vector introduction with horses
 - ruminant-live products: only indirect imports took place

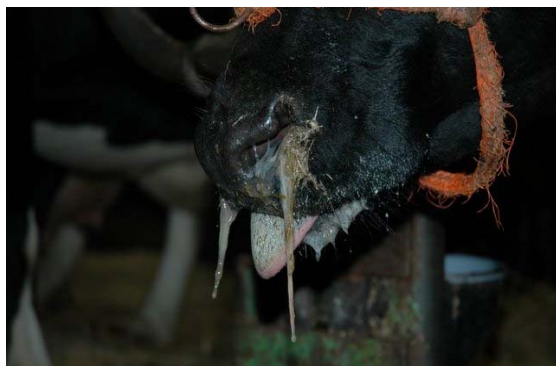
The molecular epidemiology of Bluetongue in Europe since 1998: routes of introduction of different serotypes and individual virus strains



Nature and Severity of Disease in Cattle and Sheep

A.R.W. Elbers¹, K. Mintiens², C. Staubach³, G. Gerbier⁴, A.N. van der Spek⁵, E. Meroc², F.J. Conraths³, H.M. Ekker⁵, A. Backx¹

¹ CIDC-Lelystad, The Netherlands; ² CODA-CERVA, Belgium; ³ FLI, Germany; ⁴ CIRAD, France; ⁵ VWA, The Netherlands



Results

- Herds without clinical signs in
10% of infected cattle and
less than 2% of infected sheep flocks.
- In majority of cases, only 1 or 2 animals showed clinical signs in a cattle herd or sheep flock at time of clinical inspection
- One or more BTV-associated dead animal(s) at clinical inspection in
9% of infected cattle herds and
34% of sheep flocks
- No follow-up data from these herds

Conclusions

- Clinical signs in infected cattle herds were expressed differently to those in sheep flocks
- BTV-8 associated clinical signs were seen relatively more in sheep flocks than in cattle herds
- Contrary to historical data that BTV produces only transient and mild - if any - clinical signs in cattle, we found BTV-8 to be associated with distinct clinical signs in some cattle in infected herds

PCR- and Seroprevalence within Herds

A.R.W. Elbers¹, K. Mintiens², G. Gerbier³, A.N. van der Spek⁴, E. Meroc², S. Zientara⁵, P.A. van Rijn¹

¹ CIDC-Lelystad, The Netherlands; ² CODA-CERVA, Belgium; ³ CIRAD, France; ⁴ VWA, The Netherlands; ⁵ AFSSA, France



Conclusions

- Only clinically sick animals (1–3 animals within each herd) were sampled at clinical inspection, almost all were found to be positive using PCR and/or serology
- Although based on sparse data “whole-herd-sampling” revealed two tendencies:
 - a high proportion of the cattle within herds were positive using PCR and/or serology, while
 - only a small proportion of the sheep within flocks were positive using PCR and/or serology

These observations are supported by initial results obtained from a longitudinal field study being conducted in The Netherlands

Conclusions

- In cattle herds a large proportion of the animals can be PCR and serologically positive but little distinct clinical signs of disease.
Hence, a monitoring system based on serological screening may be a good option for cattle herds
- In sheep flocks show clear signs of disease but generally few animals within a flock were PCR and/or serology positive
Thus, for sheep a monitoring system based on clinical signs seems to be the better option

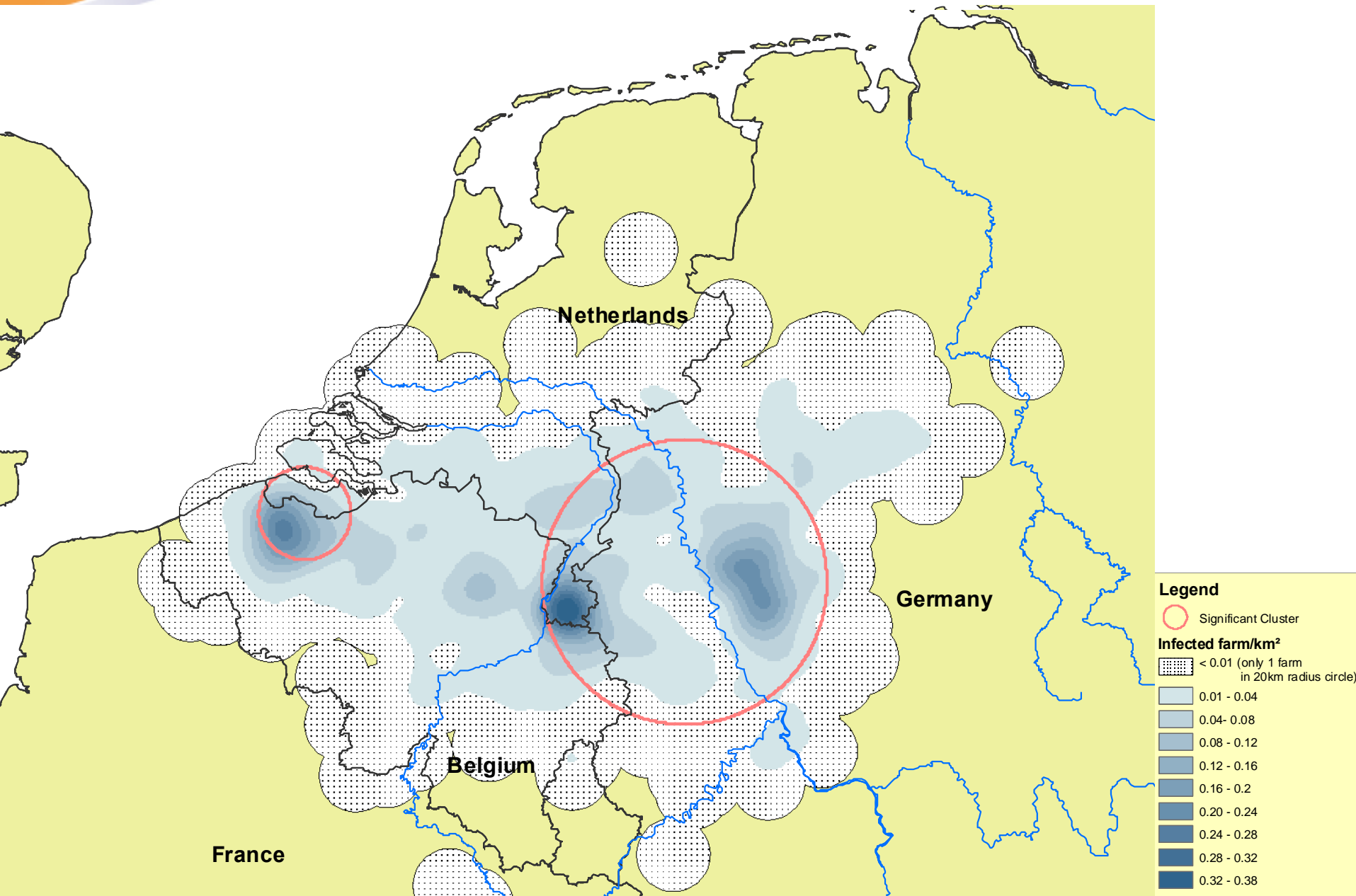
Characterisation of spread: time-space analysis

Presented by G. Gerbier¹, K. Mintiens²


¹CIRAD, France; ²CODA-CERVA, Belgium

Results: local rate of spread in area of first infection


- assuming 100 days elapsed since the beginning
- whole dataset used
- average BTV dispersal rate of 2 km/day ~ 15 km / week
- compatible with
 - knowledge about active *Culicoides* flight
 - spread observed in other contexts (Sardinia)
- probably mixture of midge and local animal movements












Legend

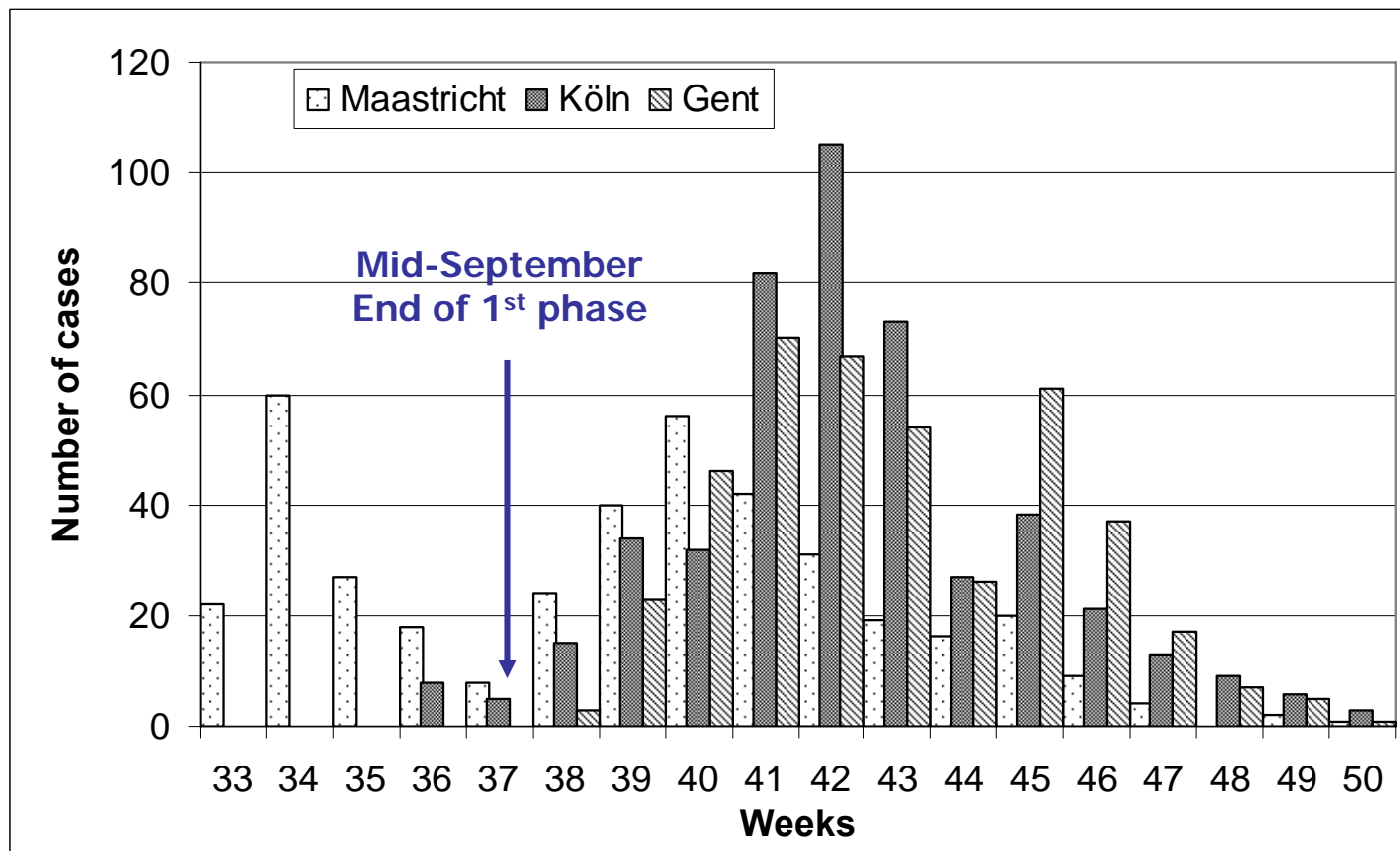
 Significant Cluster

Infected farm/km²

 < 0.01 (only 1 farm in 20km radius circle)

-  0.01 - 0.04
-  0.04 - 0.08
-  0.08 - 0.12
-  0.12 - 0.16
-  0.16 - 0.2
-  0.20 - 0.24
-  0.24 - 0.28
-  0.28 - 0.32
-  0.32 - 0.38

Temporal distribution within the clusters



Conclusions

- **two clusters (Maastricht and Gent) separated by a gap: *clue to long distance spread***
- **circular shape of the two clusters: *clue to local isotropic spread***
- **no merging of the two clusters into one large cluster at the end of 2006**
- **on the fringe of the epidemic: virus circulation was very limited**

Epidemiological characterisation of the control measures

*E. Meroc¹, K. Mintiens¹, M. Aerts², J. Cortinas², C. Faes²,
E. Ducheyne³, G. Hendrickx³*

**¹CODA-CERVA, Belgium, ²Centre for Statistics, Hasselt University, Belgium,
³AVIA-GIS, Belgium**

Description of the measures taken

- **Review based on**
 - procedures and legislation published by affected MSs
- All measures taken in accordance with **directives 2000/75/EC and 2005/393/EC**
 - interpreted slightly differently by NL,D,B
 - more significant differences between NL,D,B and F
- **France**
 - elaborate legislation already in place due to BTV epidemics in the south
 - measures implemented early because of the threat in neighbouring MSs (150km zone)
 - *culling of infected animals imported from affected MS*
 - *epidemiological and entomological surveillance*

Description of the measures taken

- **Most restrictive at the start of the epidemic**
- **Amendments throughout the course of the epidemic:**
 - Always to lower restriction level
 - Mostly based mutual agreements between affected MSs
 - Concerned 'Low-risk amendments' (e.g. animals to slaughterhouse)
- **There was no statistically significant association between the measures taken and the intercept and slope of the BT incidence curve**

Studies on *Culicoides* in the affected countries

¹R. Meiswinkel, ²T. Baldet, ³R. De Deken, ¹M. Goffredo, ⁴J.-C. Delécolle, ⁵A. Conte, ¹P. Leijs

¹CIDC, The Netherlands, ²CIRAD, France, ³ITM, Belgium, ⁴Université Louis Pasteur Musée Zoologique, Strasburg, Belgium, ⁵IZS Terramo, Italy

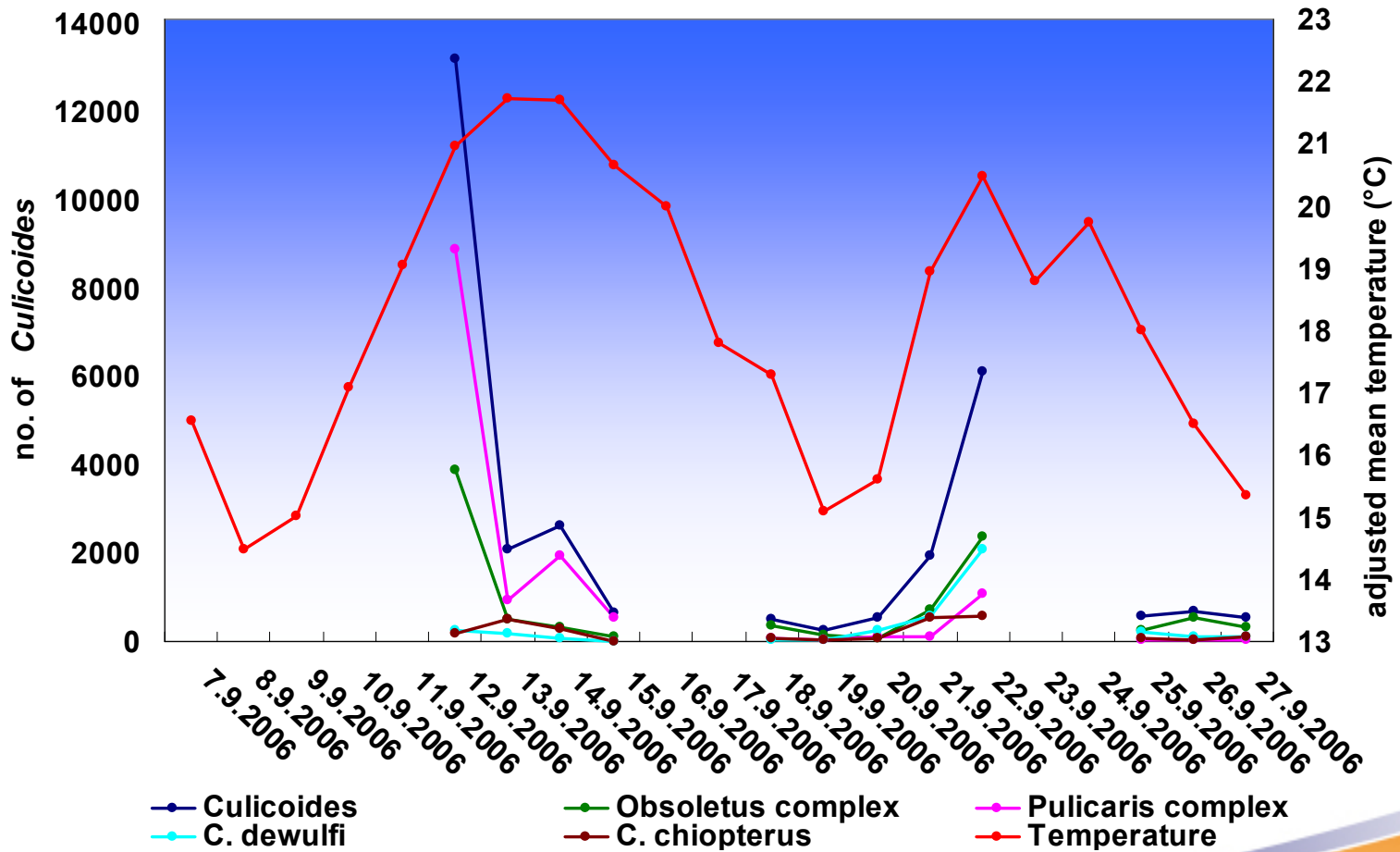


EFSA Stakeholder Consultative Platform, 26-27 April 2007, Parma, Italy

Conclusions

- *Culicoides imicola*, that is involved in BTV transmission on southern Europe, was not found in central Europe
- *Culicoides* endemic to central Europe include multiple vectors of BTV
- hence orbiviruses affecting livestock stand a good chance of being transmitted once they are adventitiously introduced in this part of Europe
- significant numbers of *Culicoides* were found to enter buildings to bite animals indoors

Daily *Culicoides* abundances and altitude-adjusted mean temperature (12 and 27 September 2006)



Main Recommendation: take *Culicoides* seriously

- they transmit at least 60 viruses
- they have been around for 90 million years, so
 - have experienced climate change and
 - are experienced in 'survival' and 'bloodsucking'

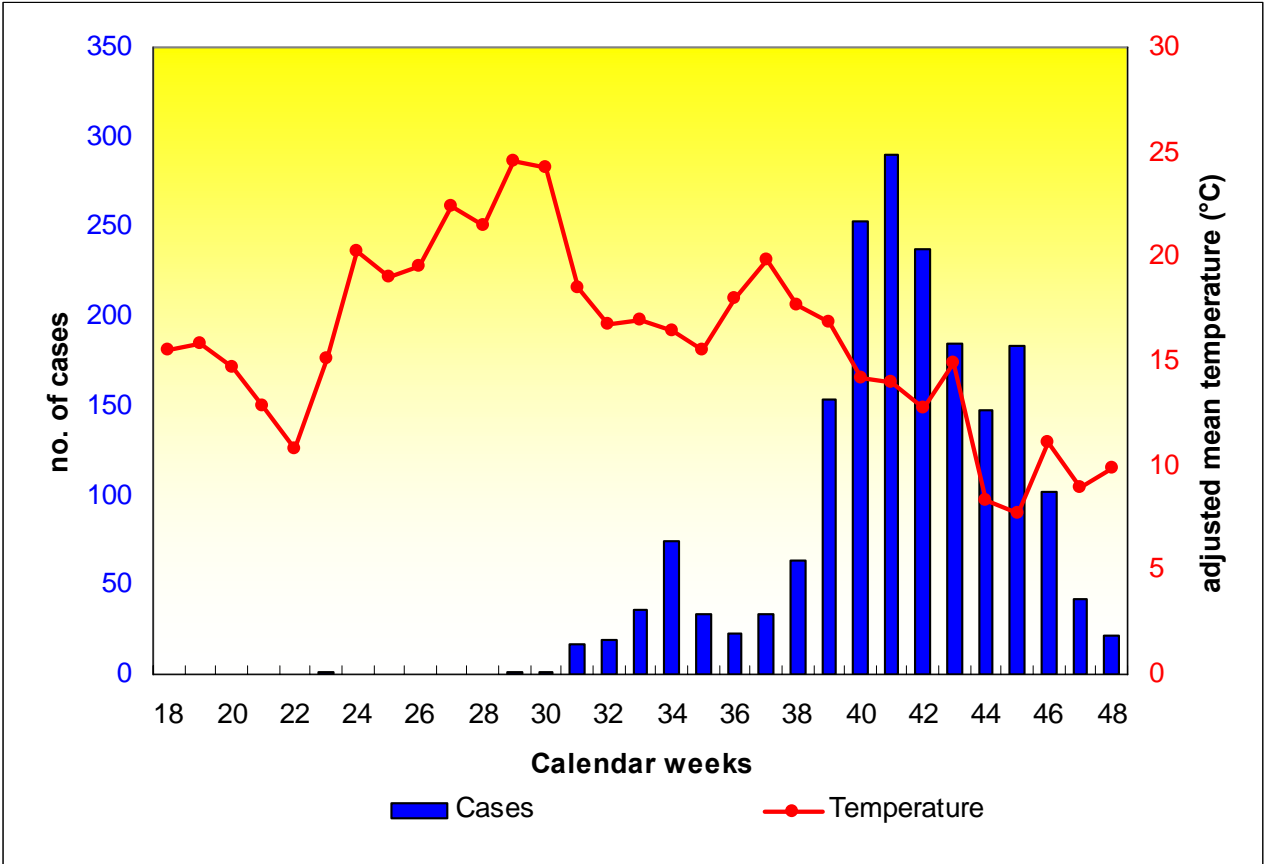
Environmental and Climatic Factors affecting the Vector and the Disease

¹C. Staubach, ²A. Conte, ³R. Meiswinkel, ¹F.J. Conraths, ¹J. Gethmann, ¹F. Unger, ¹A. Fröhlich, J. ⁴Gloster, ⁵B. Purse

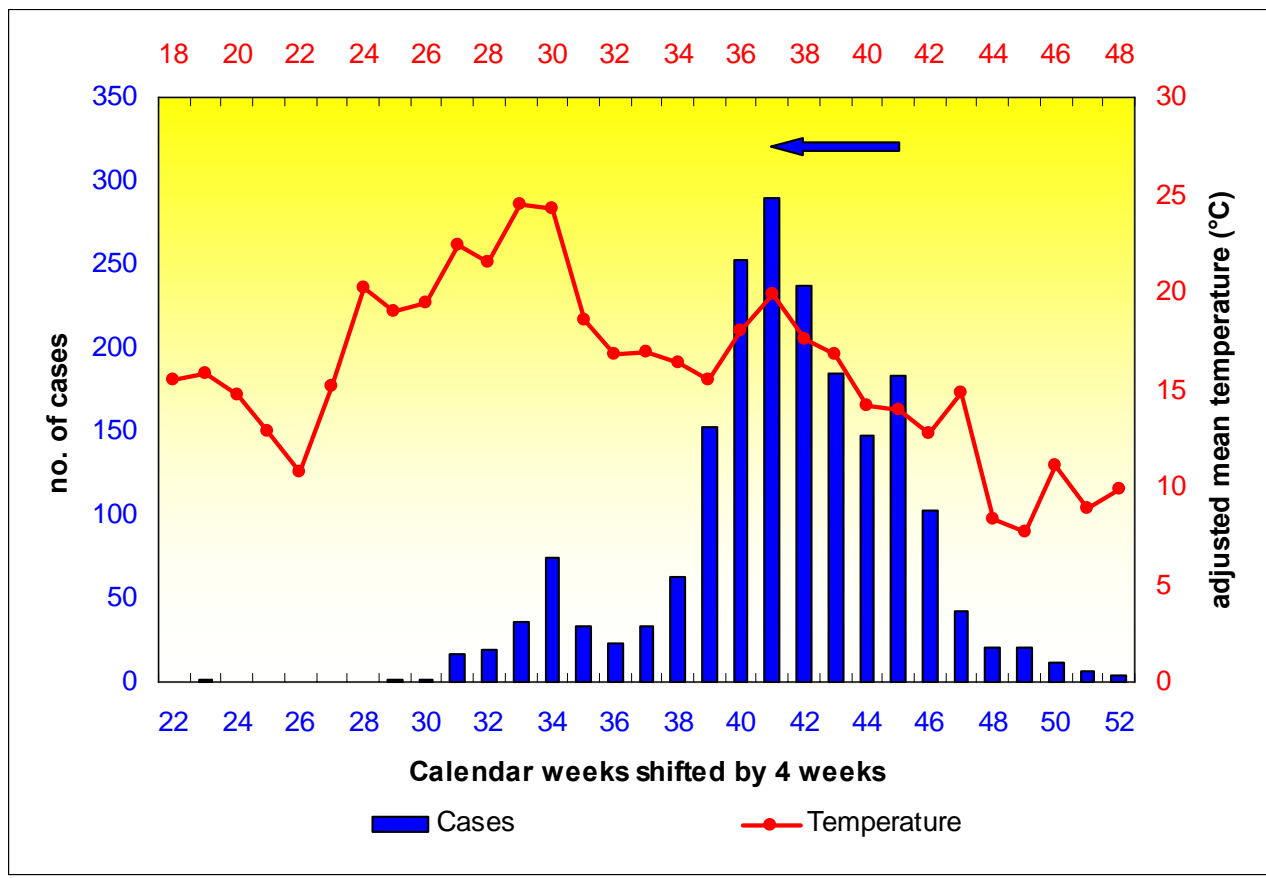
¹FLI, Germany, ²IZS, Teramo, Italy, ³CIDC The Netherlands, ⁴CRL-IAH, UK, ⁵Oxford University, UK



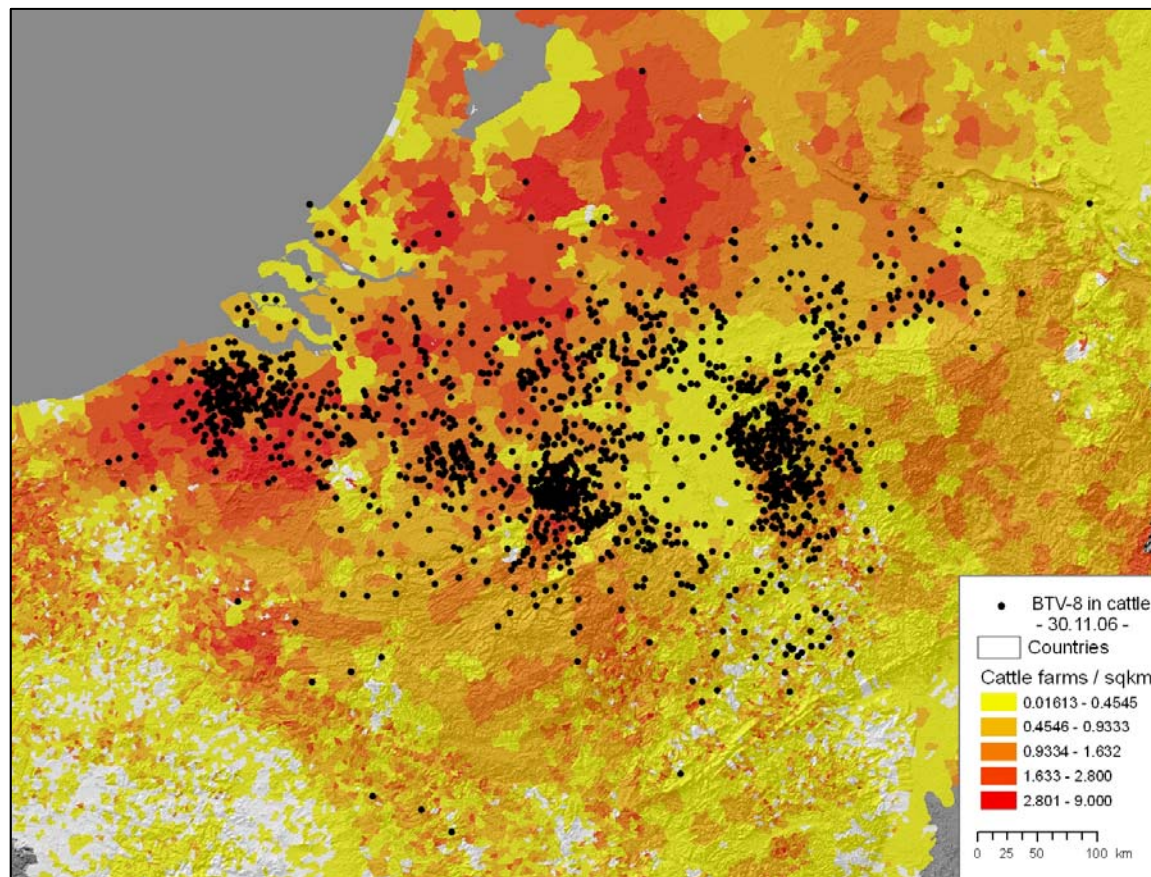
BTV-8 and mean temperature (altitude-adjusted)



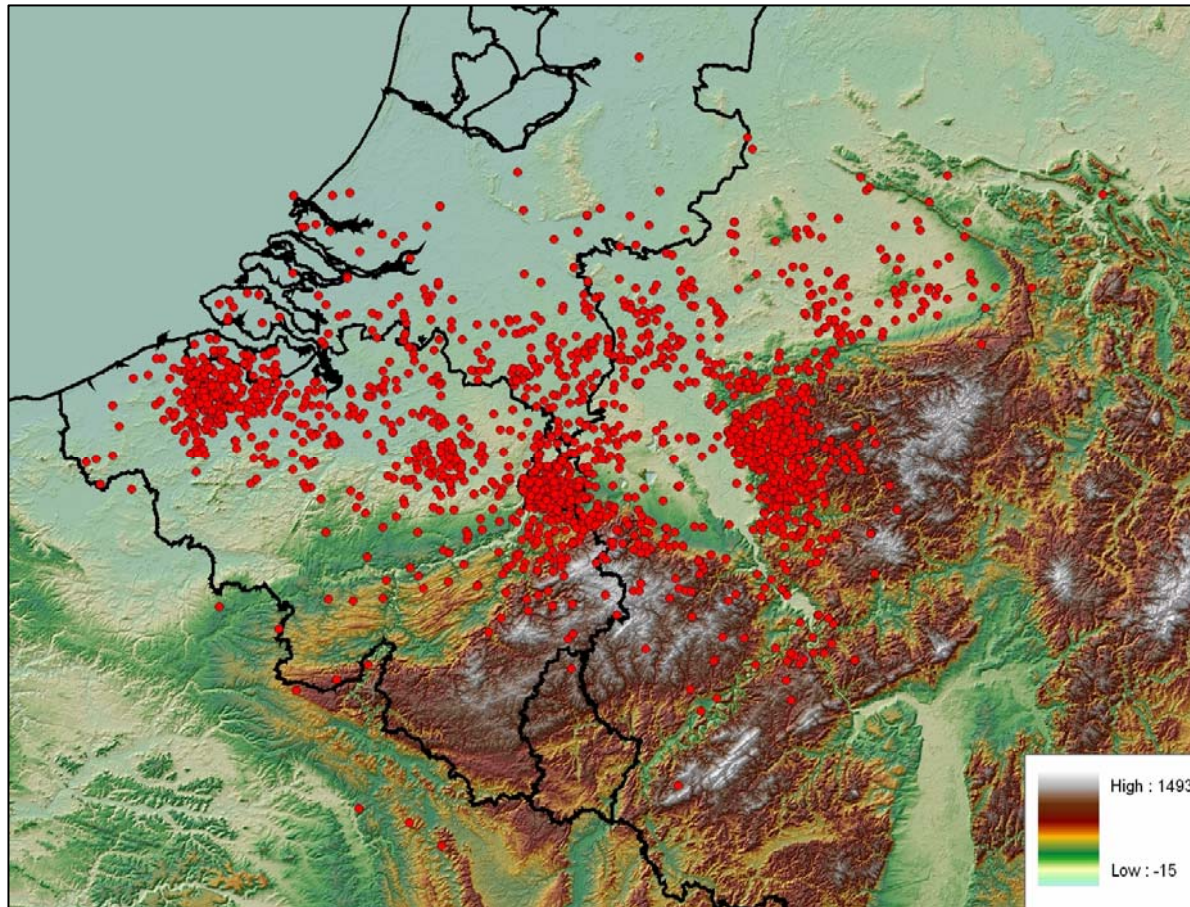
Weekly BTV-8 cases (shifted back by 4 weeks) and altitude-adjusted mean temperature



BTV-8 and cattle density (km²)



BTV-8 and elevation



EFSA Stakeholder Consultative Platform, 26-27 April 2007, Parma, Italy

Conclusions

- daily variations in *Culicoides* numbers were strongly correlated with prevailing temperatures
- lag time between temperature and outbreaks is estimated at ~4 weeks
- lower average temperatures in cooler, hilly areas may have slowed down the spread of the disease
- lower cattle and sheep densities interrupted the spatial continuity of outbreaks of BTV-8

Possible Vector Spread through Wind

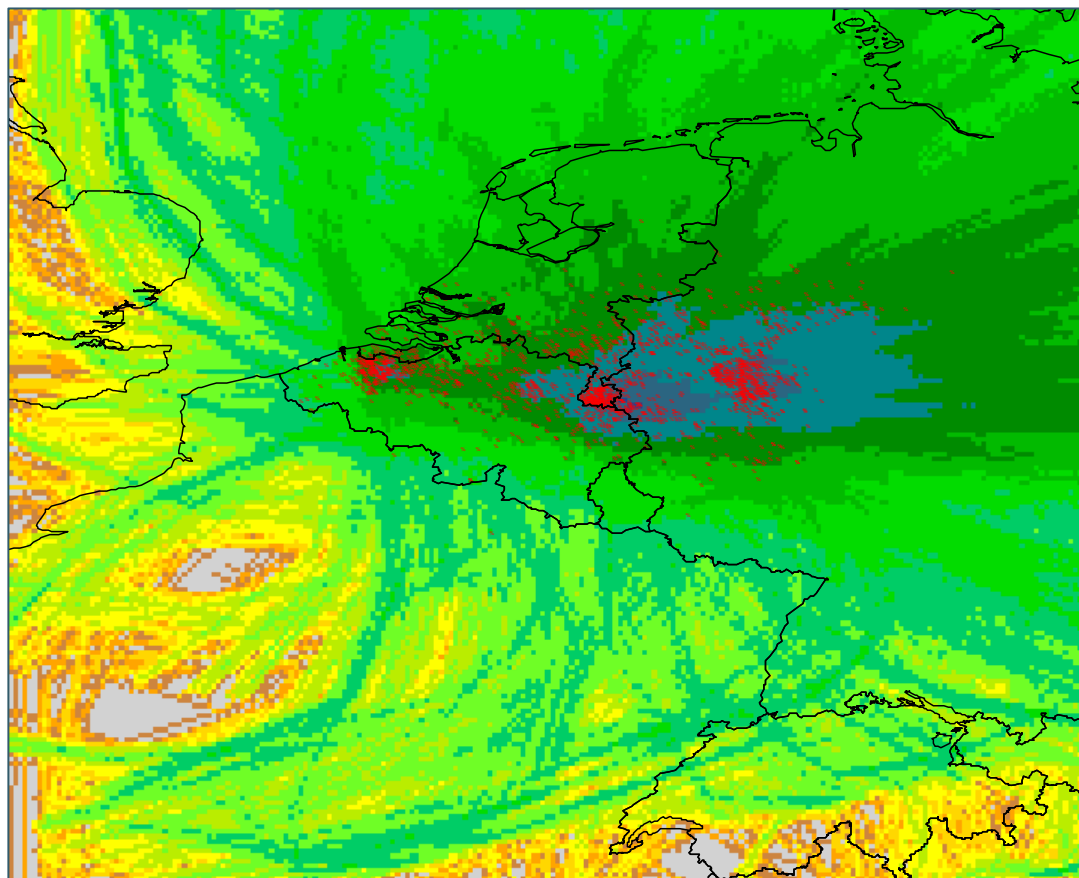
G. Hendrickx¹, E. Ducheyne¹

¹AVIA-GIS, Belgium

BTV-8: Wind density model

- **two types of flight behaviour of *Culicoides*:**
 - Short distance flights to and from feeding and breeding habitats
 - Long distance wind-assisted dispersal
- **can wind events explain the epidemic pattern?**

BTV8 2006 outbreak area: 4 week time lag wind / outbreaks)



0
1
1 - 2
2 - 4
4 - 8
8 - 16
16 - 32
32 - 64
64 - 132
132 - 264
264 - 528
528 - 1056
1056 - 2112
2112 - 4224
No Data

Cumulated Wind density – Week **43** Outbreaks – Week **47**

Conclusions

- **observed density of wind events in an east-west direction** may partly explain this ‘horizontal’ spread of the epidemic
- the **relatively low number of cross-channel wind density events**, especially after the outbreaks had reached the Belgian coastal zone, may explain why BTV did not arrive in the UK
- **terrain roughness** may be an important factor preventing the spread of infected midges on the wind
- **preventing the establishment of dense primary foci of infected *Culicoides* on farms** should probably inhibit subsequent long-range spread of BTV, assuming infected animal movement is controlled

Overall Conclusions: epidemic results from interactions

- ***Biology:*** both virus and vector
- ***Environment:*** may be influenced by climate change
- ***Human intervention:*** can affect movement of infected animals and vectors

Overall Conclusions: Success Factors for Epidemiological Transboundary Animal Disease Outbreak Investigations

- **the good cooperation between institutions involved**
 - Member States
 - Commission
 - EFSA
- **data access**
 - confidentiality issues
 - consistency of data from different Member States
 - quality small ruminant data
- **preparedness through training and standardisation**