Assessing the Spatial and Temporal Risk of HPAIV Transmission to Danish Cattle via Wild Birds
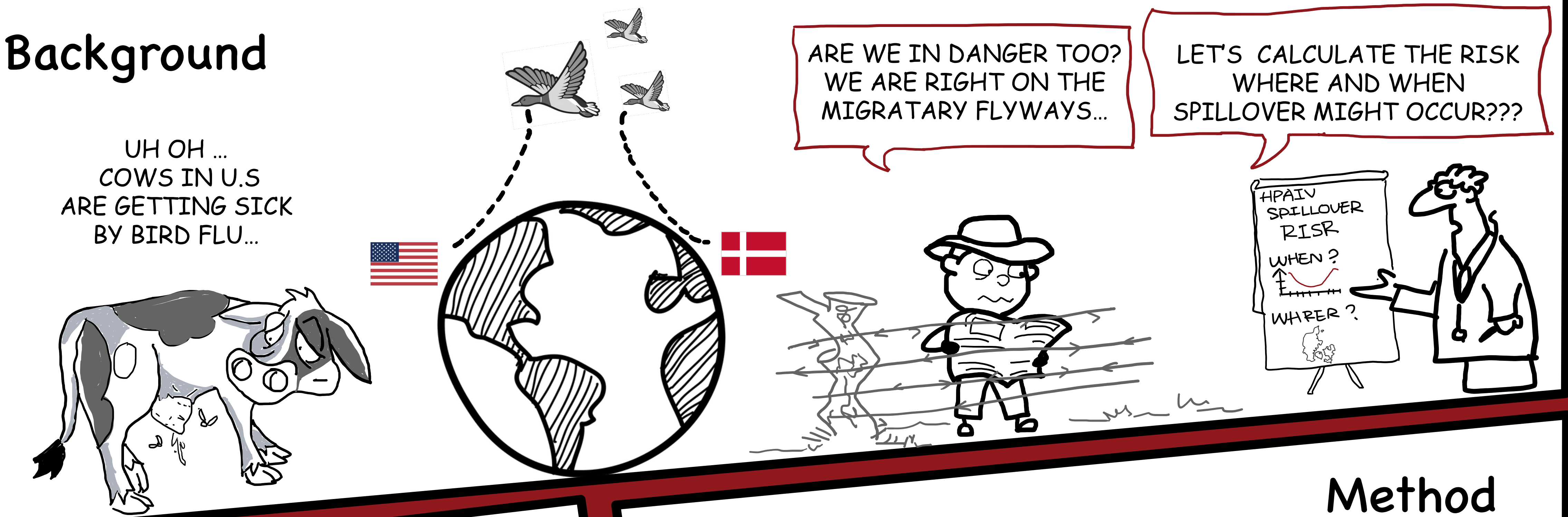
You Chang[1], Jose L. Gonzales[2] , Mossa M. Reimert[1], Erik Rattenborg[3], Mart C.M. de Jong[2], Beate Conrady[1]

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Background

UH OH …
COWS IN U.S
ARE GETTING SICK
BY BIRD FLU…

ARE WE IN DANGER TOO? WE ARE RIGHT ON THE MIGRATARY FLYWAYS…

LET'S CALCULATE THE RISK WHERE AND WHEN SPILLOVER MIGHT OCCUR???

Data

1. Three reported spillover events from wild birds to cattle in U.S. (till 2025 May)
2. Global wild bird abundance data (eBird) [1] extracted 54 waterfowl species
3. Cattle density of the world [2]
4. Predicted indicator of HPAIV in Danish wild birds via Bird Flu Radar [3] (with 4 threshold probability scenarios) integrating of 3 models:
   - Bird abundance model
   - Bird migration model
   - Scenario tree model

Method

Assumption: any dominant HPAIV strains in wild birds can spillover to cattle

1. Estimate the transmission rate parameter from wild birds to cattle

$$P\left(\frac{Spillover\ cases}{Nc}\right) = 1 - e^{-\frac{\beta \cdot Prev_{US} \cdot A \cdot dt}{Nc}}$$

Nc: cattle number; A: wild bird abundance; β: transmission rate parameter from wild bird to cattle; dt: time interval (unit week)
$Prev_{US}$: prevalence of HPAIV in wild birds during an outbreak.

2. Calculate the expected spillover events in Denmark by combining:
   - HPAIV presence in wild bird in Denmark (Bird Flu Radar)
   - Spillover risk from wild birds to cattle, using the β estimated from U.S. data

Results

- In 2024, 1.93 spillover cases could have occurred, CI (0.48, 4.98).
- High risk season: week 50– 10 (Fig 1)
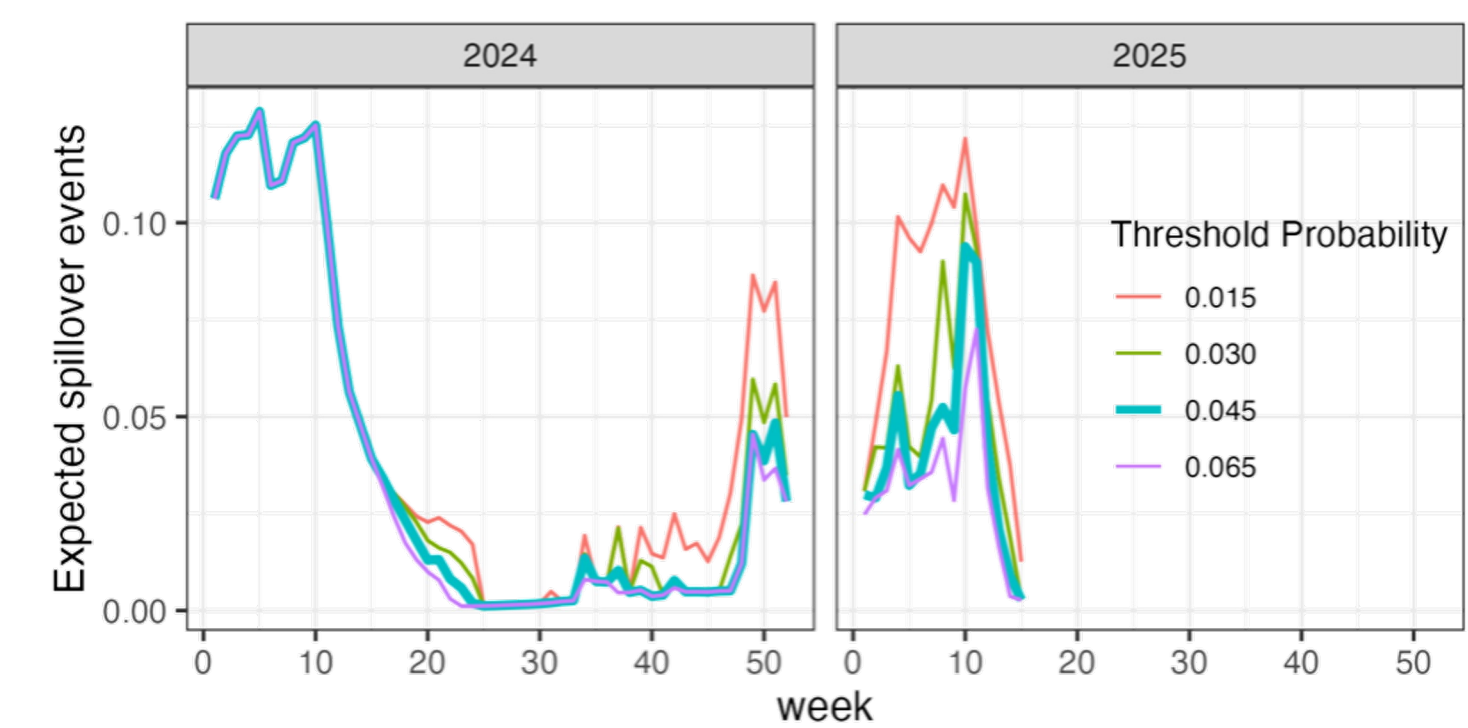- High risk area: Danish coastline (Fig 2)

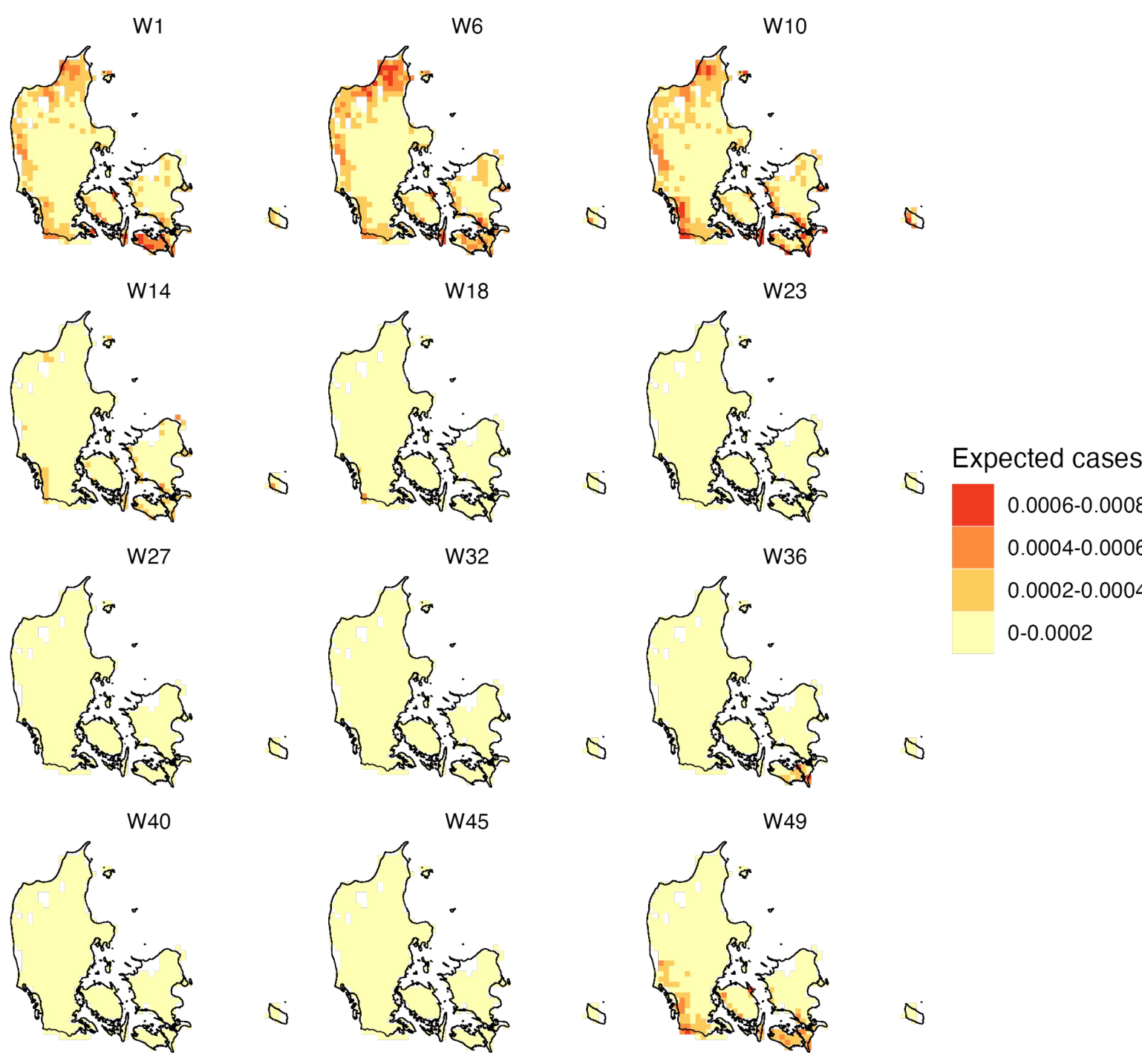Fig 1. Temporal changes of expect spillover cases from wild birds to cattle

Fig 2. Spatial distribution of expect cases. The maps show the first week of each month in 2024

Discussion

Results can be influenced by:
- Underreported U.S. data
- Assumed equal wild bird prevalence
- Limited wild bird species included
- Differences in cattle husbandry and biosecurity
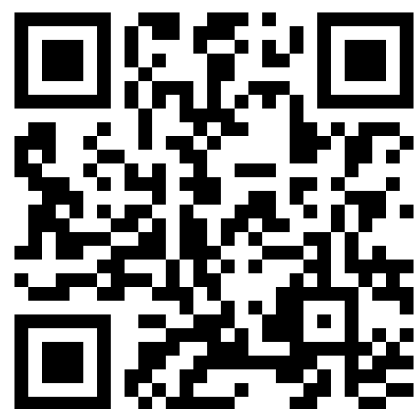
References:
[1] Fink, D., et al (2023). eBird Status and Trends, Data Version: 2022
[2] Gilbert, M., et al (2022). Global cattle distribution in 2015
[3] Gargallo, G., et al (2022). Development of a prototype early warning 15 system for avian influenza in the EU based on risk-mapping

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