Pest risk mapping based on spatial and temporal distribution of production

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Aim

- Develop a simple methodology
- that ranks production locations of a crop species according to the probability of pest invasion
- based on the spatial distribution of the crop species during the past 5-10 years

→ enables more efficient targeting of the plant health surveys

Framework

- Not pest specific – crop specific!
- Based on multiyear spatial distribution of a crop species.
- Modelling is performed on a 0.5 × 0.5 km grid and the results are presented as cell-specific risk indices.
- Indices do not represent actual probabilities, but they allow comparison of the relative probabilities.

Relative probability of invasion

Assessed to each cell followingly

1. Probability of **entry**
2. Probability of **spread**
3. Probability of **survival**

→ Probability of **invasion**

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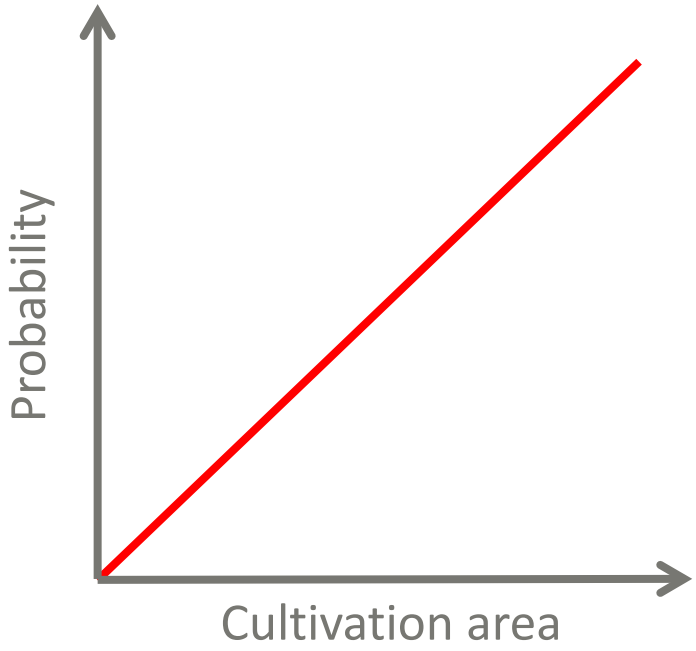
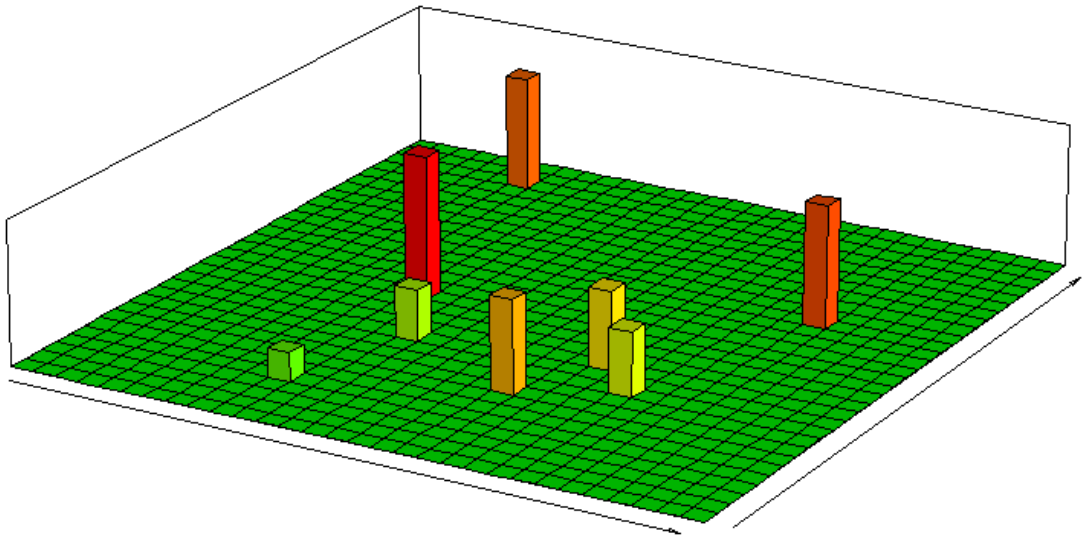
1) Relative probability of entry

to a cell is assumed to depend linearly on the cultivation area of the studied crop plant in that cell



1. Entry



Relative probability of invasion

Assessed to each cell followingly

1. Probability of **entry**
2. Probability of **spread**
3. Probability of **survival**

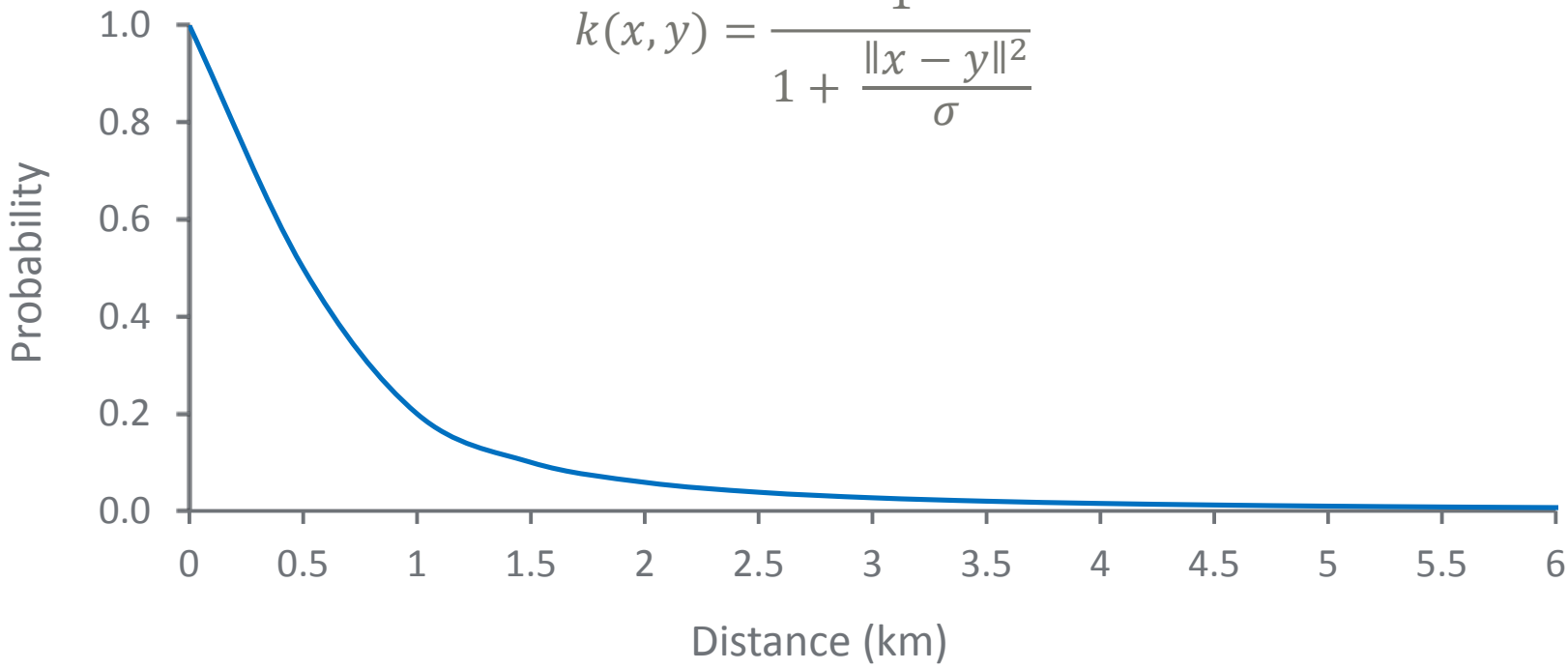
→ Probability of **invasion**

2) Relative probability of spread

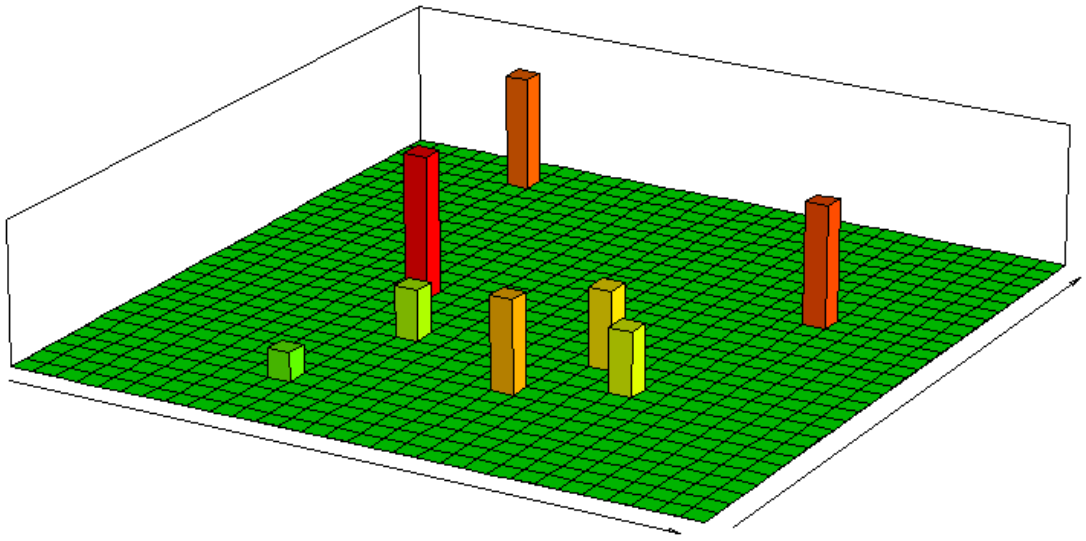
to the surrounding cells is assumed to be distance-dependent

- Modeled with a Cauchy dispersal kernel

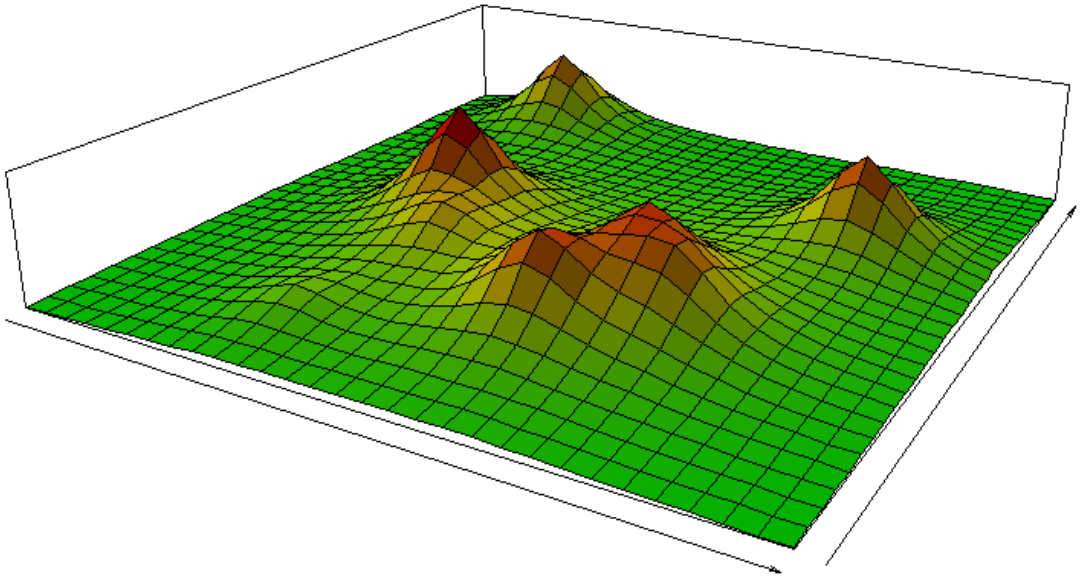
$$k(x,y) = \frac{1}{1 + \frac{\|x-y\|^2}{\sigma}}$$



1. Entry



2. Spread



Relative probability of invasion

Assessed to each cell followingly

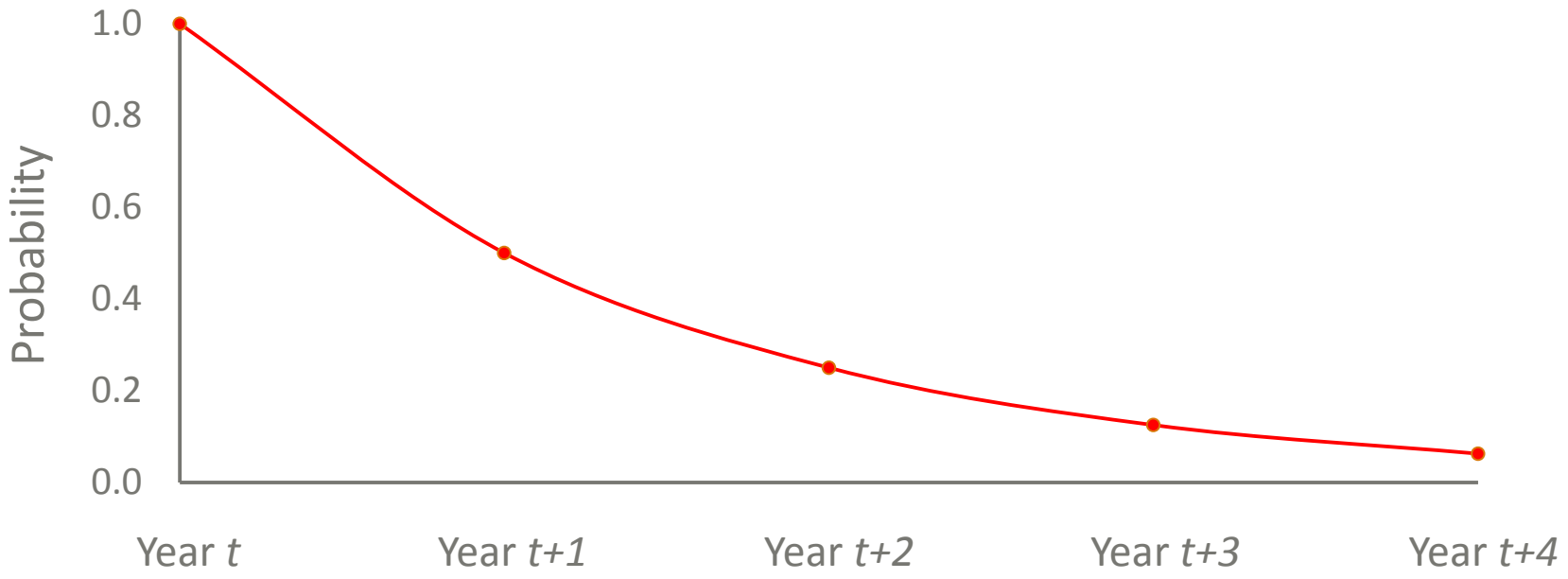
1. Probability of **entry**
2. Probability of **spread**
3. Probability of **survival**

→ Probability of **invasion**

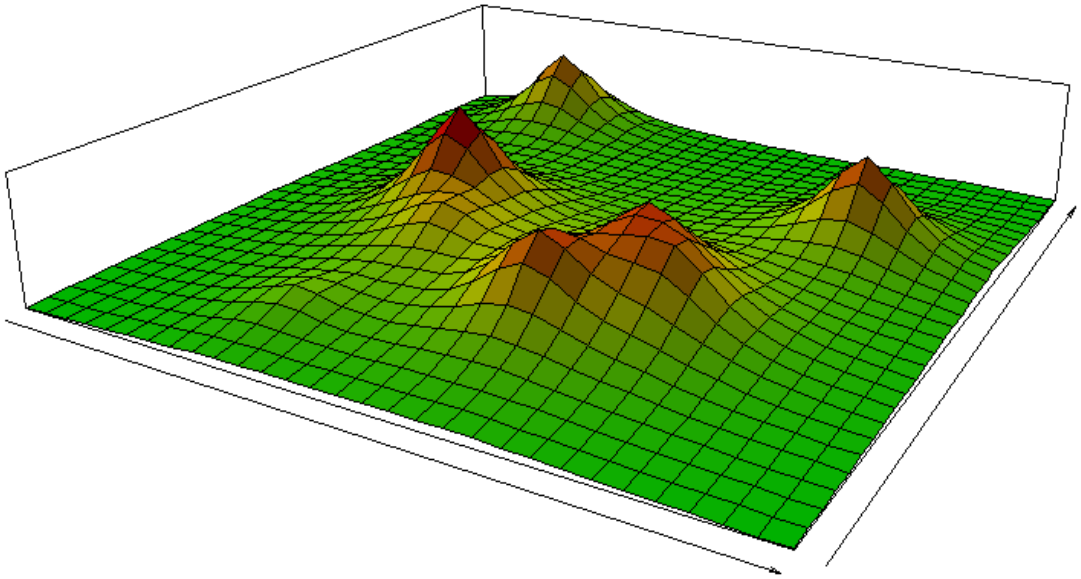
3) Relative probability of survival

in a cell is assumed to depend on the presence of the studied crop species in that cell

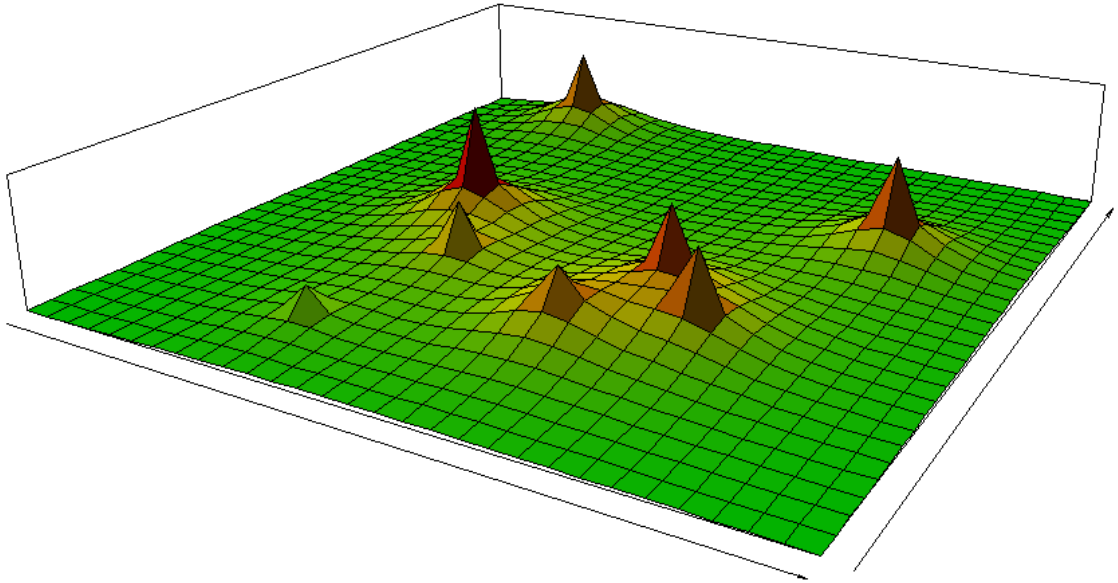
- If host plants are cultivated in the cell, the index remains unchanged
- If host plants are not cultivated in the cell, the index decreases according to a predetermined proportion



2. Spread



3. Survival



Relative probability of invasion

Assessed to each cell followingly

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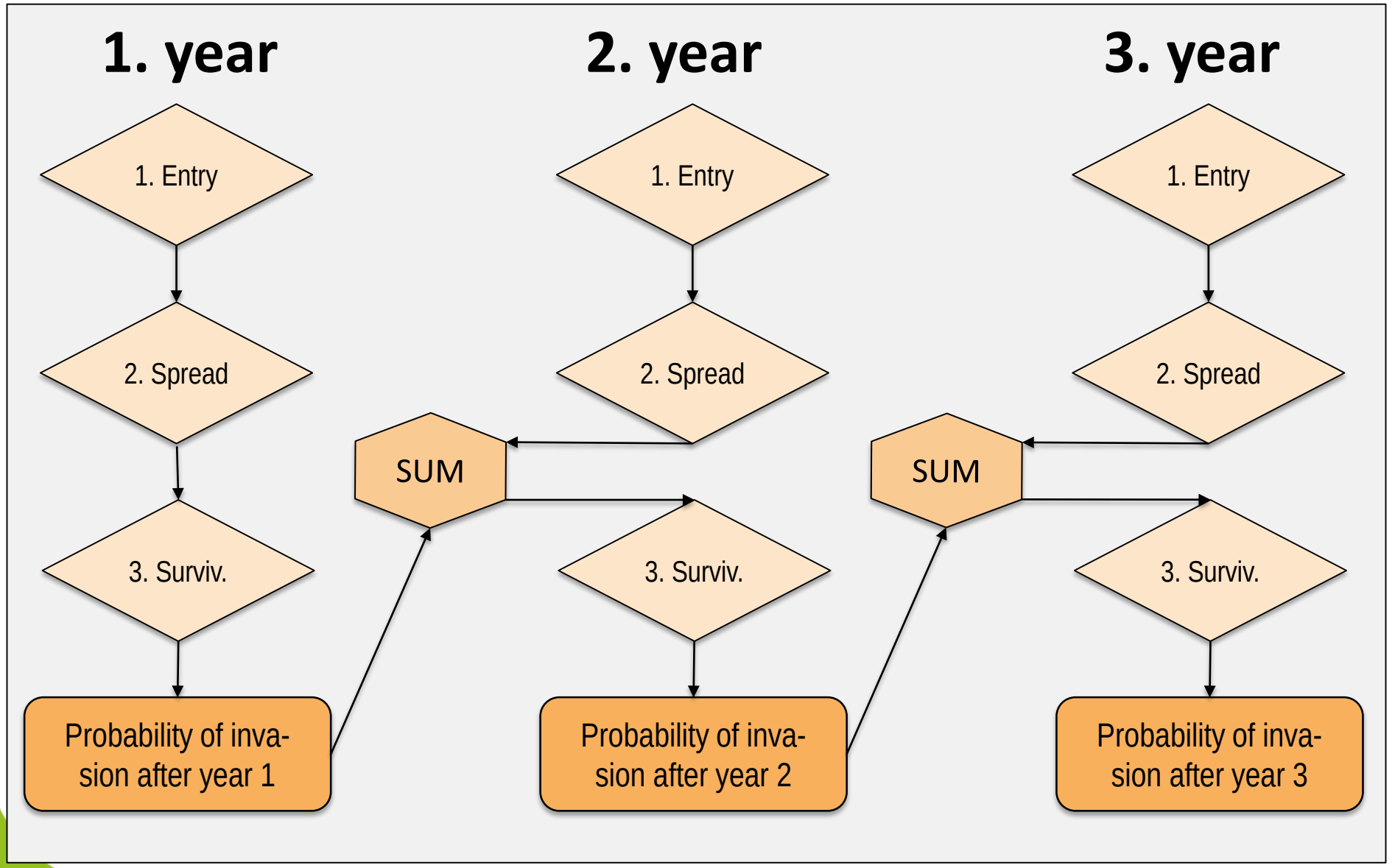
Accumulation of the probability over the years



Uncertainty

Pest generic approach!

- "fit for all purpose" parameters of **spread** and **survival** cannot be set

→ Simulation of

- Spread parameter (kernel smoothing) from a uniform distribution (0 – 0.5)
- Survival parameter from a uniform distribution (0 – 0.5)

→ a distribution of risk index values for each cell

Ranking of the cells

- Possible to rank the cells based on the average, or other summary metric

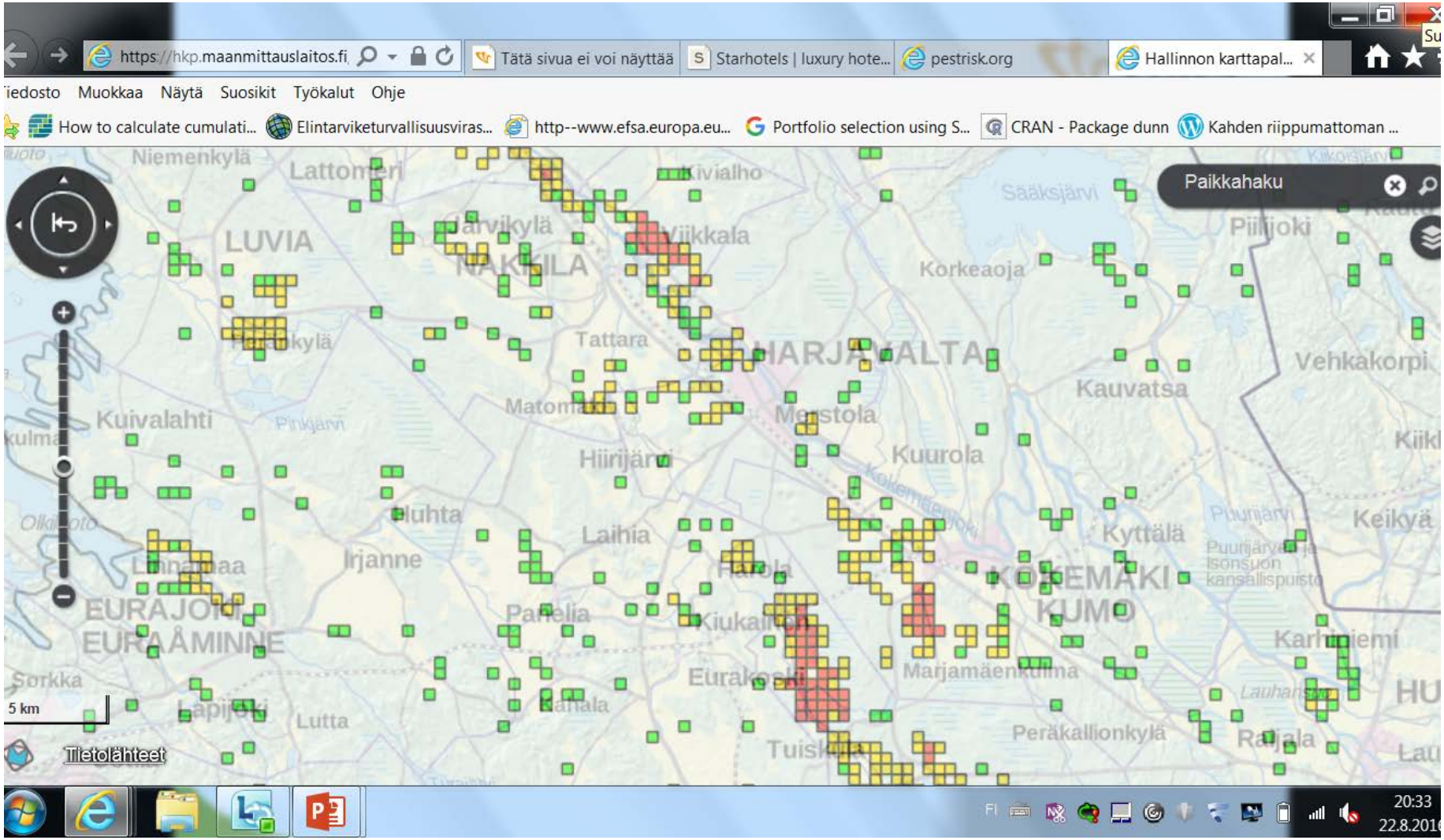
- Yet, if we whish the ranks to represent real differences in the indices, the whole distribution must be used in the ranking by **stochastic ordering techniques**

Potato as an example (2011-2015)

Summary

- Spatial and temporal distribution of places of production is used to map the invasion probability of pests with risk indices
- Indices do not represent actual probabilities, but they allow comparison of the relative probabilities
- Simple methodology for a practical problem, i.e. targeting phytosanitary surveys

Kiitos!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Eurakoski
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Lutta
Kanala
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