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European Seaports and Airports facing the Global Player *Aedes albopictus* and its Pathogens

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Background

Introduction of disease vectors at European seaports and establishment promoted by climate change: Human assisted introductions of vectors mainly by global shipping of goods. These activities helped shaping the global distribution of the Asian tiger mosquito (*Aedes albopictus,* Fig.1). After having overcome oceanic barriers, future climate change may promote this thermophilic species to extent its distribution.

Introduction of disease pathogens at European airports: Of further interest are pathogens, which may be imported by infected travelers coming from endemic areas. A growing number of dengue cases have been reported at higher latitudes, for instance, as a consequence of increased international travel and intensified and frequent outbreaks around the world.

Fig 1. *Aedes albopictus* is an invasive and highly competent vector for various arboviruses.

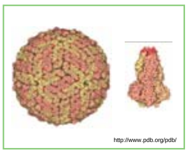

Fig 2. Dengue virus (DENV) is an (+)ssRNA virus of the family Flaviviridae with four serotypes.

Methods

A) **Climatic constraints for vector and pathogen**
***Aedes albopictus* and dengue:** Bioclimatic variables are detected, supported by previous investigations and expert knowledge. (*Aedes*: mean temperature of the warmest and of the coldest quarter, annual mean temperature, annual precipitation, altitude; Dengue: extrinsic incubation period (EIP) after Watts et al. 1987 and Blanc et al. 1930).

B) **Regional climate models:** The future suitable climatic conditions are modeled for *Aedes albopictus* and Dengue virus amplification in Europe based on this bioclimatic variables.

We compared different IPCC scenarios and present here the A1B scenario (very rapid economic growth, global population that peaks mid-century and a balance across fossil-intensive and non-fossil energy sources).

C) **Dispersal mechanisms:** Moreover introduction pathways of vector and pathogen, seaports and airports, respectively are considered.

D) **Risk map for dengue transmission:** Areas with climatic suitable conditions for (further) establishment of Aedes albopictus and the required extrinsic incubation period for dengue virus amplification in the vector are super-imposed (Fig.4).

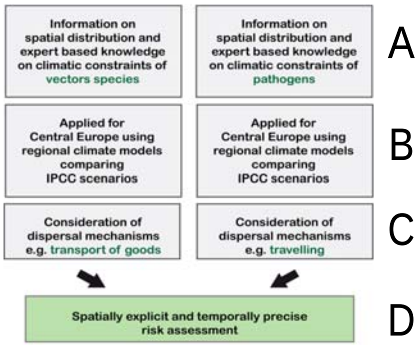

Fig 3. Approach for a spatially explicit and temporally precise risk assessment for vectors and pathogens.

Results

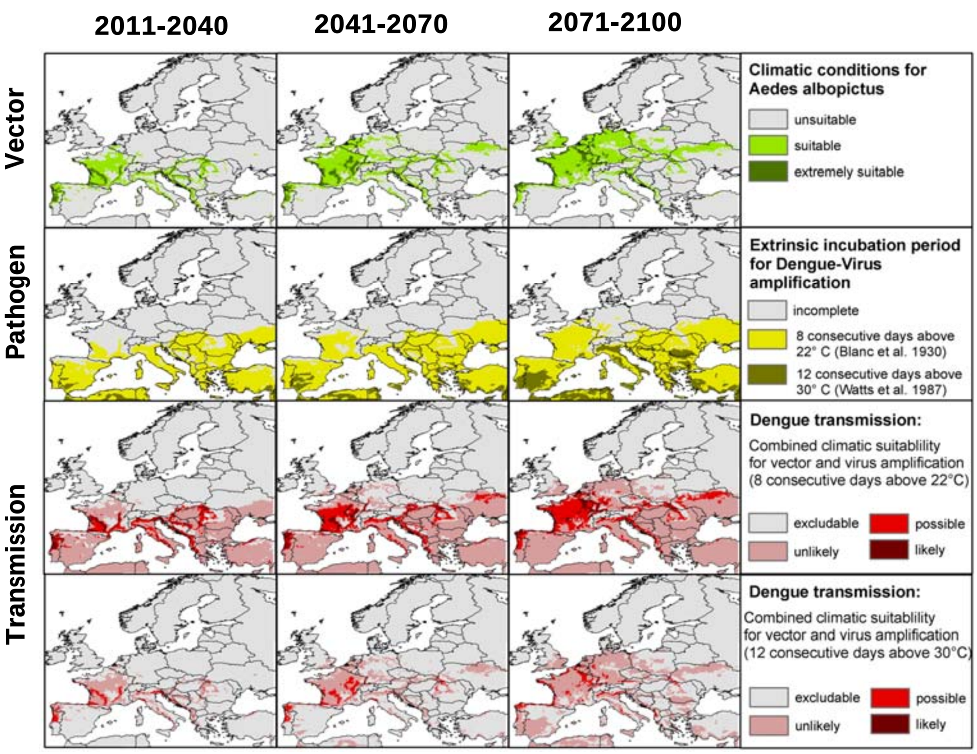

Fig 4. Climatic projection (A1B Scenario) of *Aedes albopictus* (mean temperature of the warmest and of the coldest quarter, annual mean temperature, annual precipitation, altitude) and dengue virus amplification (EIP after Blanc et al. 1930: 8 consecutive days with 22°C and Watts et al. 1987: 12 consecutive days with 30°C)

Seaports and airports climatically at risk for dengue: Here, we exemplify the European seaports and airports at risk for dengue transmission in the forthcoming quarter of the century by making a "worst case" assumption: climate change will follow the A1B scenario and the EIP of dengue virus is already fulfilled with 8 consecutive days with 22°C.

In the adjacent areas of the airport Lyons and the seaport La Spezia dengue transmission is likely to occur. Areas of possible dengue transmission are found near the airports of Lisbon, Milan, Nice and Vienna and the seaports of Genoa and Gioia Tauro (Fig. 5).

Population density is also a known modulating factor in dengue transmission. Therefore economically prospering areas such as airports and seaports are particularly at risk.

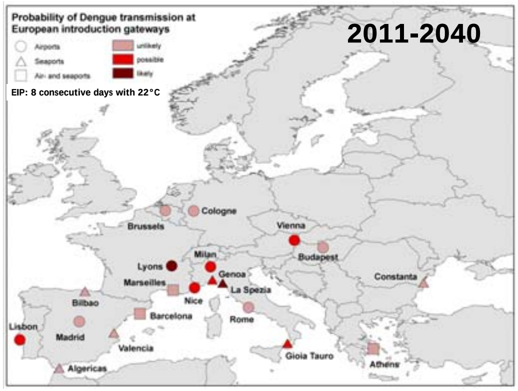

Fig 5. Probability of dengue transmission at European seaports and airports

Conclusions

Implementing efficient bio-security measures at European airports and seaports may limit accidental introductions of exotic disease vectors and pathogens. However, we see the importance of detecting preferred bioclimatic suitable habitats of disease vectors and pathogens. Then, specific monitoring systems can be concentrated in the respective regions.

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