# Defining risk zones for Chikungunya Fever in Europe: A biogeographical approach.

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## Background

Until recently epidemic outbreaks of Chikungunya, a viral disease transmitted by mosquitoes, were geographically restricted to Southeast Asia, India and Africa. This changed in December 2013, when the first case of autochthonous (local) transmission on the Caribbean Island of St. Martin was reported. In the following months, a rapid spread across the Caribbean was observed, accompanied by cases on the Central- and South American Mainland. From continental Europe, sporadic cases of autochthonous transmission have been reported since 2007. Given the pervasive presence of the Asian Tiger Mosquito Aedes albopictus (a competent vector for Chikungunya) in southern Europe, increased influx of potentially infected travelers as observed by the European Centre for Disease Prevention and Control (ECDC) poses a serious threat to public health. Here we aim to identify European risk zones for Chikungunya, utilizing the current and potential future climatic suitability for the vector, flight patterns of travelers from affected regions, and other environmental parameters that affect potential disease spread.

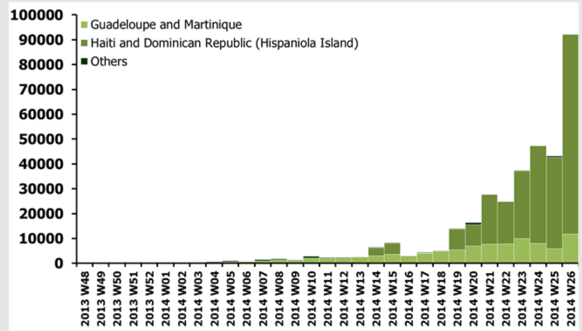


Fig. 1: Number of reported cases of Chikungunya in the Caribbean region by week (ECDC data)

## Materials & Methods

- Risk of Chikungunya importation assumed proportional to number of travelers from affected countries entering the EU
  → Monthly air passenger volumes extracted from Eurostat (2009–2013) for major airports
- Local transmission requires vector to be present → Occurrence data for *Ae. albopictus* obtained from VBORNET
- Virus amplification requires an ambient mean temperature of about 20°C (Fischer 2013) → monthly temperature data obtained from Worldclim

## Results & Discussion

- Air traffic volumes from affected countries peak in July and August, where Mosquitoes are most active and transmission is facilitated by higher temperatures (data not shown)
- Airport catchment areas of Barcelona, Milan and Rome seem to be the destinations with the highest potential for CHIKV importation and subsequent autochthonous CHIKV transmission (Fig 2).
- Climate-based species distribution models for *Ae. albopictus* suggest that more areas with high passenger influx from affected countries may become suitable habitats for the vector in the future (Fischer et al. 2014).
- Eurostat air travel data does not account for stop-over flights or connecting flights inside the EU. For better precision, IATA data will be used in the future.
- Instead of raw passenger numbers, an importation index including incidence rates in the source countries will be used in the future.

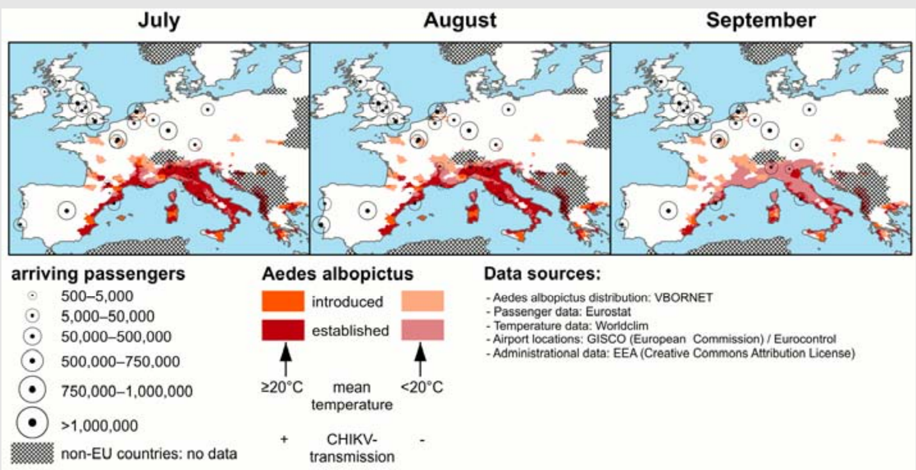


Fig. 2: Passenger volume (monthly mean of 2009-2013) by month arriving from American countries with current autochthonous Chikungunya transmission (up to June 2014). Data is overlaid with information on where the vector *Ae. albopictus* is currently established, where it has recently been introduced (as of June 2014), and the climatic envelope for Chikungunya transmission.

## Conclusion

In Europe, the regions around the Mediterranean Sea show the highest potential risk for introduction of Chikungunya fever. Here, suitable habitats for the vector *Ae. albopictus* and high summer temperatures facilitating virus amplification meet airports with high amounts of travelers entering the EU from countries where the Chikungunya virus is currently circulating.

## Further References

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