Maladies vectorielles et changement climatique

Quand est-il de l'influence des changements climatiques présents et futurs sur le développement des maladies infectieuses vectorielles ?

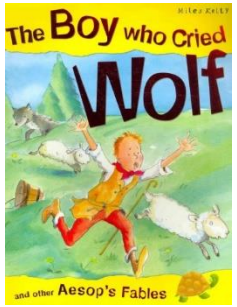
EUPHA, Public Health: How to deal with climate change

Parc Chanot, Marseille, 20th Nov 2019

Reminder: 2nd IPCC report 1995…

- Models project an **increase** in global mean **surface air temperature** relative to 1990 of about 2ºC by 2100.
- Average **sea level is expected to rise** as a result of thermal expansion of the oceans and melting of glaciers and ice-sheets.
- A general warming is expected to lead to an **increase in the occurrence of extremely hot days** and a decrease in the occurrence of extremely cold days.
- **Warmer temperatures will lead to a more vigorous hydrological cycle**; this translates into prospects for more severe droughts and/or floods in some places and less severe droughts and/or floods in other places.
- Sustained rapid climate change could shift the competitive balance among **species** and even lead to forest dieback, altering the terrestrial uptake and release of carbon

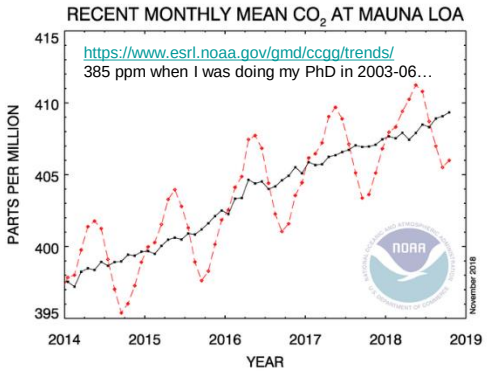
1995 ->



2016

*"The Paris Agreement entered into force on 4 November **2016**" - UNCC*

CO2 last 5 years



Recent news…

Climate change impacts on health

Heatwaves

An Iraqi man shows a thermometer reading more than fifty degrees Celsius on **July 30, 2015** in Baghdad.

Hurricanes and floods

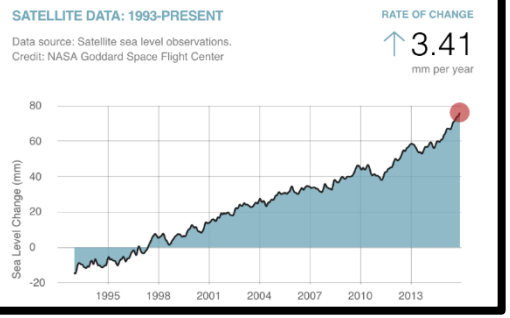
Irma summer 2017

Floods in Florida October 2015

Air pollution

Harbin, China

Sea level rise



Vector-borne diseases -VBD

Arthropods are ectotherms

Vector, water and soil borne pathogens are impacted

Water, agriculture and biodiversity

Scientific American artwork

Starving polar bear
National Geographic

Climate refugees and migration

Somali refugees flee flooding in Dabaab, Kenya (UNHCR)

Infrastructures

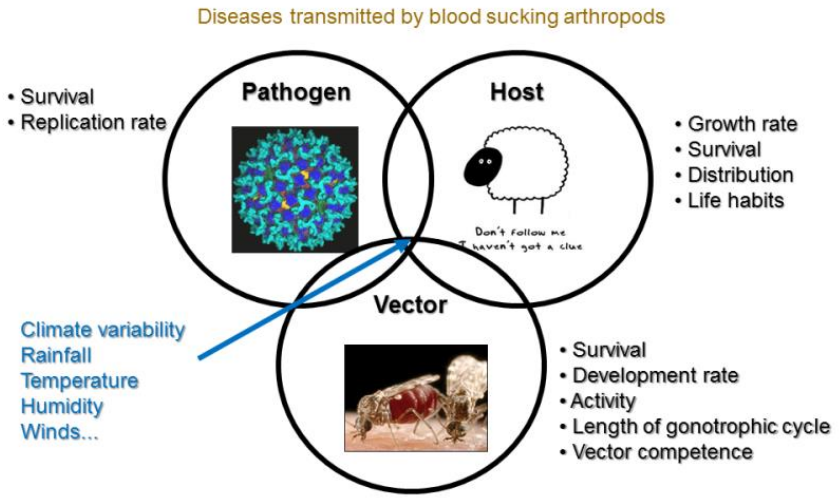
Genoa bridge collapses due to heavy rainfall (ABC news)

Direct impacts

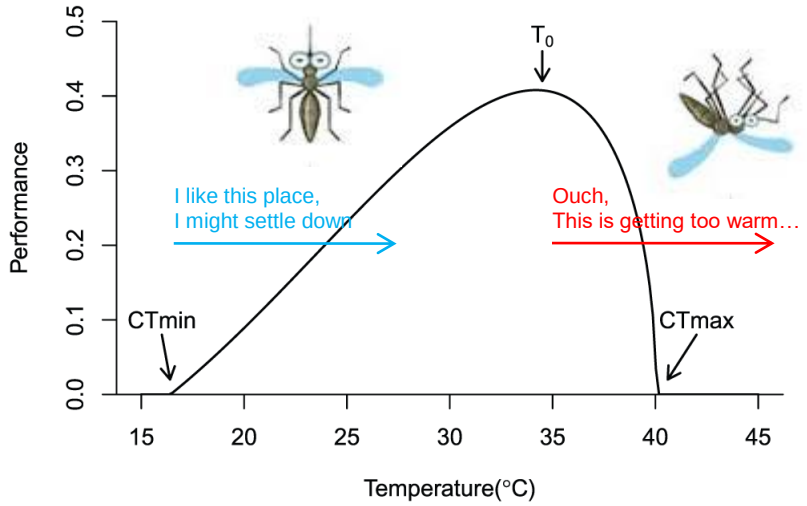
Mediated impacts

Climate change impacts on VBDs

VBDs are climate sensitive



Vectorial capacity = f(T°)

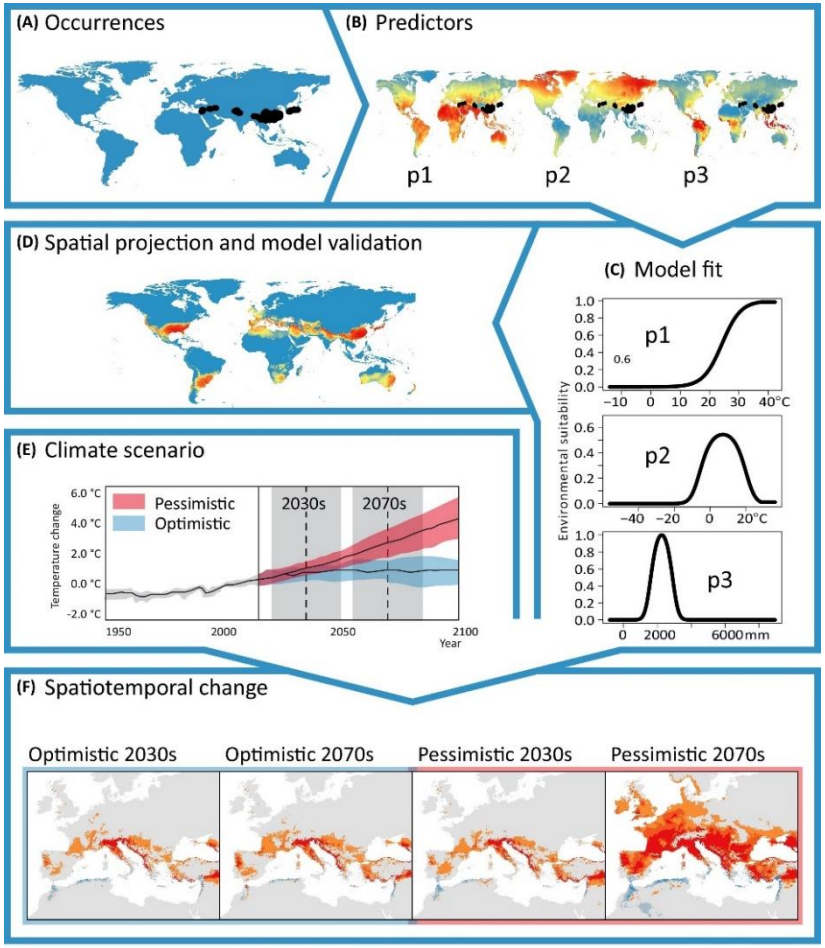


Lafferty KD and Mordecai EA 2016 - F1000Research 2016, 5:2040

Modelling the impact of climate variability on VBD burden, development of early warning systems (seasonal time scales to climate change scenarios).

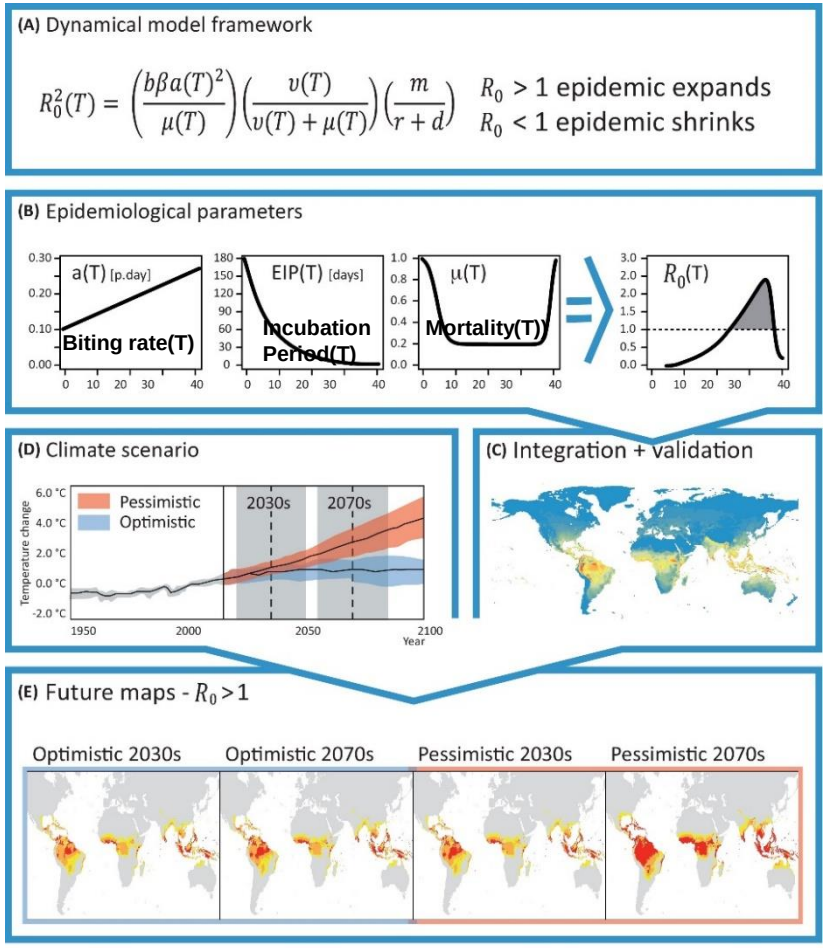
How to model the impact of climate on VBDs

Statistical models



Stat models: **Maxent**, BRTs, Bayesian models, Mahalanobis distance…

Mechanistic models



Mechanistic models: SEIR/SIR, **R0**, Fuzzy logic, climate envelope…

Tjaden et al. (2018). Trends in Parasitology 34(3): 227-245. http://dx.doi.org/10.1016/j.pt.2017.11.006

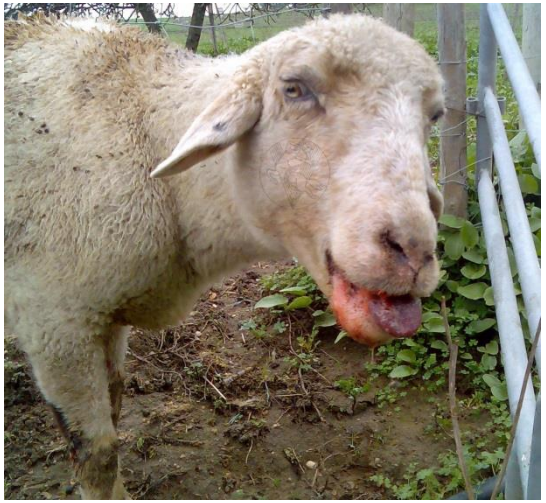
Impacts of VBDs

2nd Plague pandemic 15th century

Malaria in Africa

Zika outbreak in Latin America 2015-2016

Bluetongue outbreak in Northern Europe Aug-Sep-Oct 2006



Yellow fever outbreak – Angola, DRC 2015-2016

The Asian tiger mosquito - *Ae. albopictus*

Ae. albopictus

Source: CSIR

Rapid spread worldwide

Wikimedia commons

blue: original distribution, cyan: areas where introduced in the last 30 years.

Main introduction routes

Figure 2. Main Aedes albopictus *inroduction routes: (A) Used tyres. (B),(C) Lucky Bamboo (*Dracaena *spp.).*

Scholte & Schaffner, 2007

Rapid spread in Europe

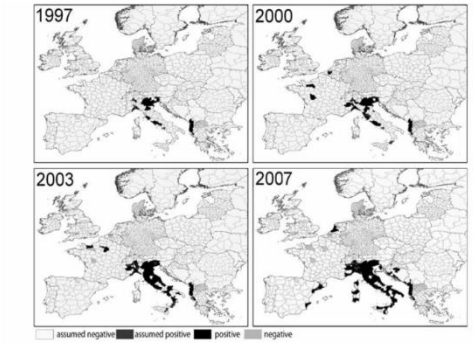
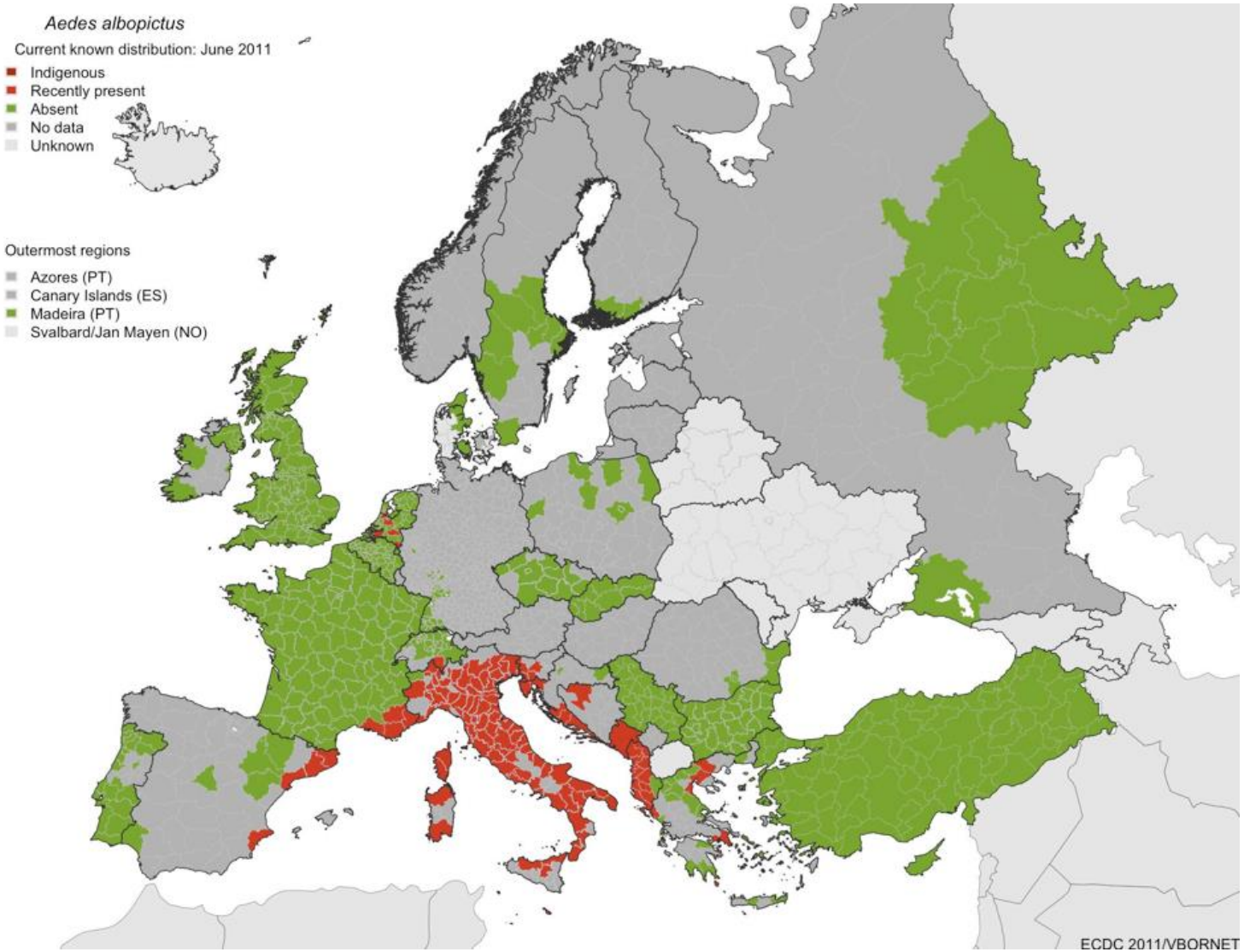


Figure 3. Presence of Aedes albopictus *in Europe per province for the years 1997-2007. Data to complete this figure were kindly made available by Roberto Romi (Italy), Roger Eritja and David Roiz (Spain), Eleonora Flacio (Switzerland), Charles Jeannin (France), Anna Klobučar (Croatia), Zoran Lukac (Bosnia and Herzegovina), Igor Pajovic and Dusan Petrić (Serbia and Montenegro), Bjoern Pluskota (Germany), Anna Samanidou-Voyadjoglou (Greece). The map was made by Patrizia Scarpulla. The 2007 outbreak of Chikungunya virus in Italy is indicated with an arrow in the 2007 box.*

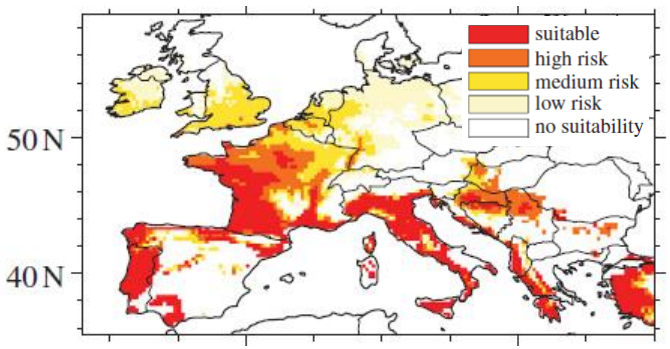
Scholte & Schaffner, 2007

Aedes albopictus distribution - June 2011

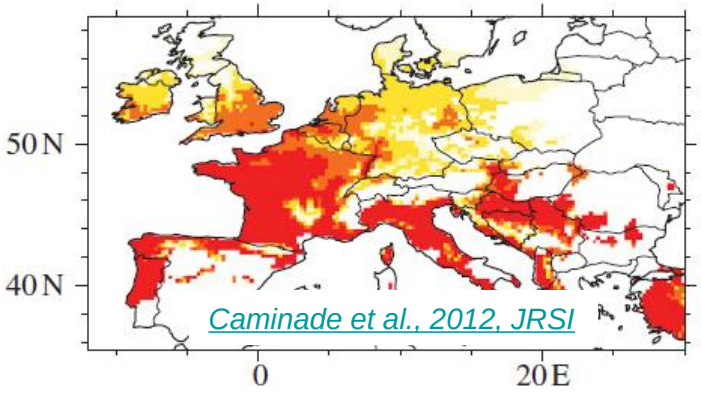


Ae. albopictus: model scenarios vs observations

Model driven by climate obs (EOBS) 1990-2009



Model driven by 11 RCMS (SRESA2) 2030-2050

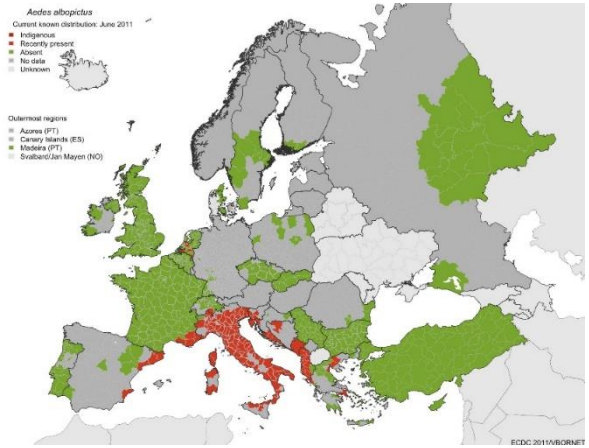


Model based on an overwintering criterion (Tjanuary >0ºC, Rain_annual>500mm) and different thresholds in annual Temperature:

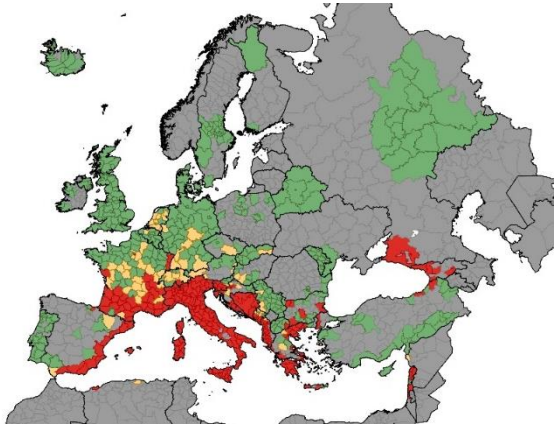
suitable	12C< T_annual
high risk	11C< T_annual < 12C
medium risk:	10C< T_annual < 11C
low risk:	9C< T_annual < 10C
no suitability:	T_annual < 9C

Future risk increase: Benelux, Balkans, western Germany, the southern UK
Future risk decrease: Spain and Mediterranean islands

ECDC-EFSA mosquito maps – June 2011

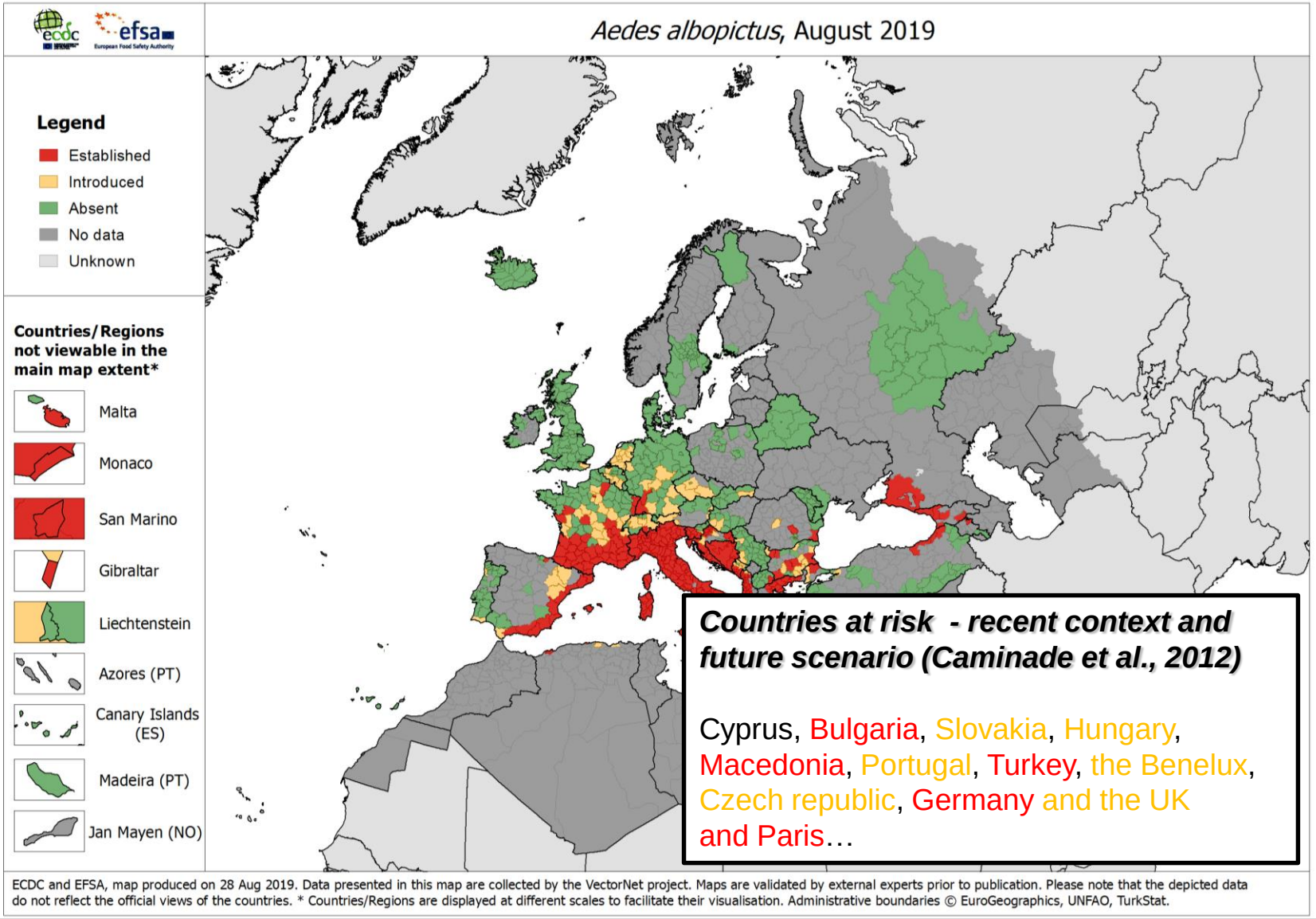


ECDC-EFSA mosquito maps – April 2017

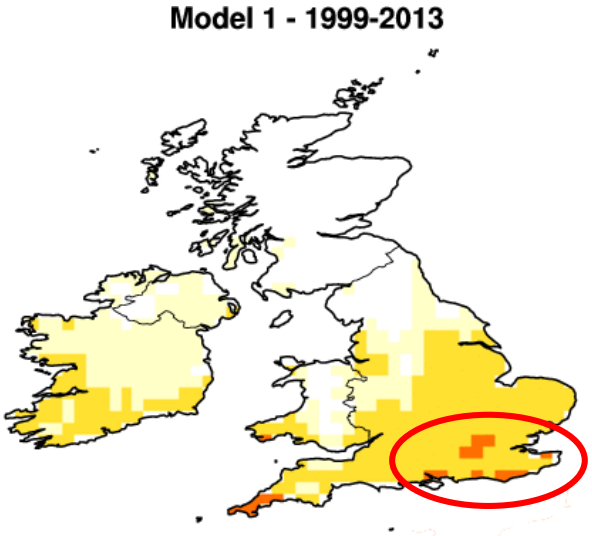


ECDC-EFSA Vectornet - https://ecdc.europa.eu/en/disease-vectors/surveillance-and-disease-data/mosquito-maps

Aedes albopictus – August 2019



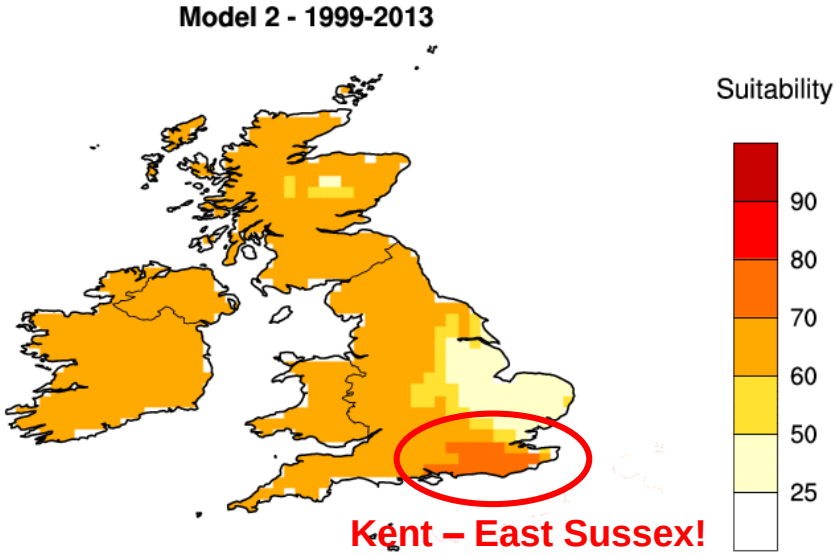
HPRU kick off meeting, Liverpool Nov 2014



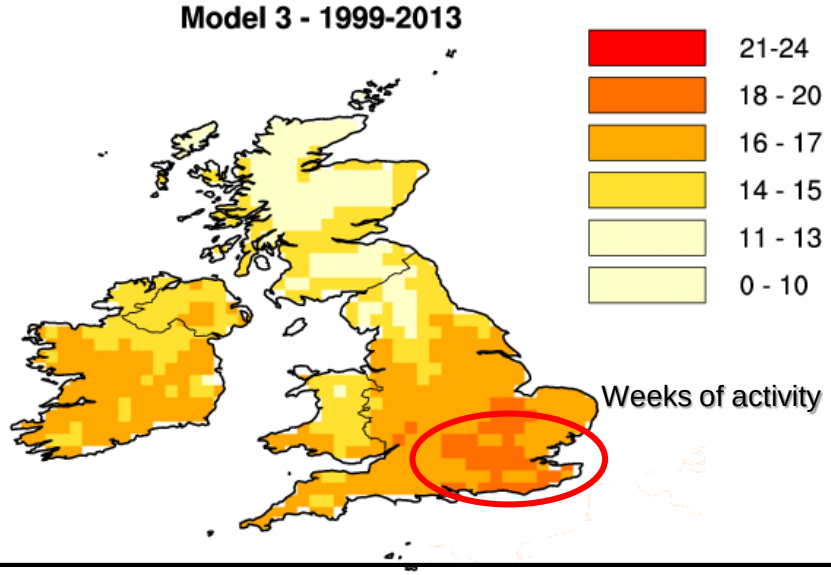
Model 1: Overwintering criterion + Annual temperature and rainfall thresholds (Kobayashi et al., 2002)

- Suitable [Tan > 12°C]
- High [11°C < Tan < 12°C]
- Medium [10°C < Tan < 11°C]
- Low [9°C < Tan < 10°C]

Model 2: Suitability functions (ECDC, 2009)



Model 3
Overwintering, temperature and photoperiod (Medlock et al., 2006).



United Kingdom - 2012-2016

"Press" release – Daily mail April 2012

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Huge Asian 'tiger' mosquitoes poised to invade UK - and could bring deadly tropical diseases such as dengue fever with them

By ROB WAUGH

PUBLISHED: 03:34, 25 April 2012 | UPDATED: 03:34, 25 April 2012

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A mosquito that spreads tropical diseases including dengue fever may be poised to invade the UK because of climate change, experts have warned.

The Asian tiger mosquito, Aedes albopictus, has already been reported in France and Belgium and could be migrating north as winters become warmer and wetter.

Scientists urged 'wide surveillance' for the biting insect across countries of central and northern Europe, including the UK.

The Asian tiger mosquito, Aedes albopictus, has already been reported in France and Belgium and could be migrating north as winters become warmer and wetter

LSHTM – Public Health England Oct 2016

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Home → News and Events → News → 2016

Asian Tiger mosquito eggs found in Kent - expert comment

Wednesday, 19 October 2016

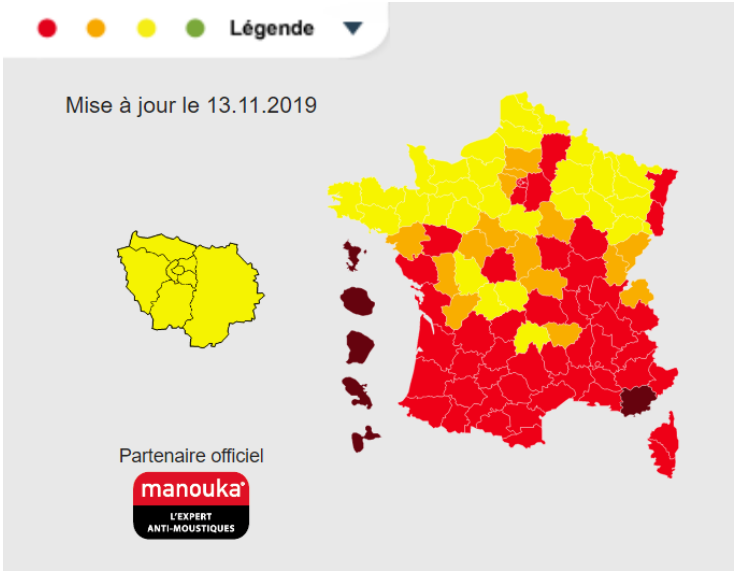
A small number of eggs of the *Aedes albopictus* (or Asian Tiger) mosquito, which is capable of transmitting diseases including dengue, chikungunya and Zika have been found in the UK for the first time.

In recent years, there have been a number of exotic mosquitoes that have become established in Europe and Public Health England (PHE) conducts surveillance for invasive mosquitoes in the UK. It was through this routine surveillance that PHE confirmed eggs from *Aedes albopictus* in one trap in Kent.

Not established yet. Eggs found 3 years in a row. To be continued…

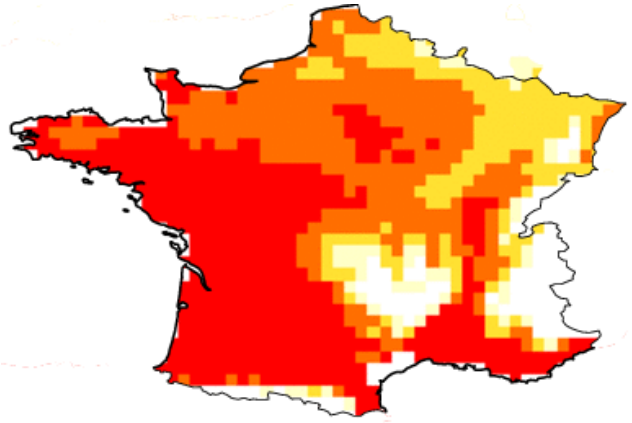
GIS - Climate and health conference - Paris Oct 2014

Observation



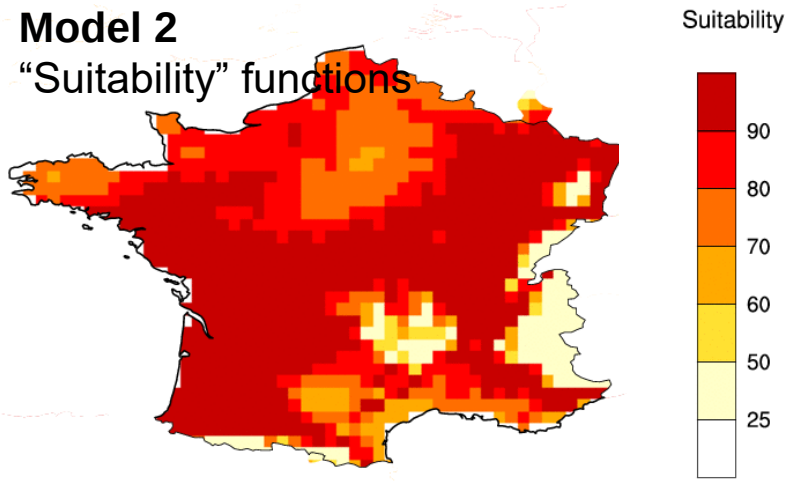
Model 1

Overwintering + Annual Temperature and rainfall thresholds



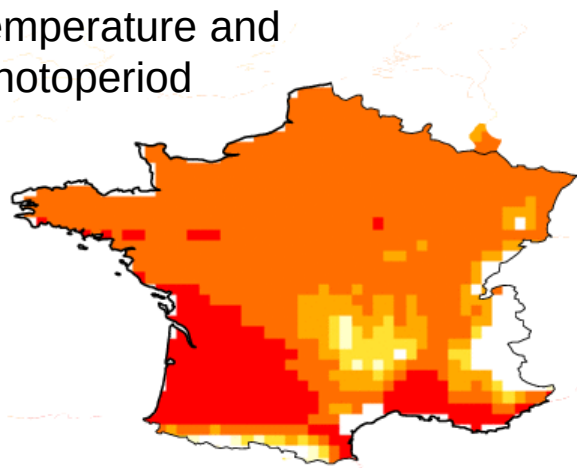
Model 2

"Suitability" functions



Model 3

Overwintering, temperature and photoperiod



Local Zika virus transmission in Hyères! PACA Nov 2019

World Health Organization

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- Diseases
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- Disease outbreak news

Zika virus disease – France

Disease outbreak news
1 November 2019

On 9 October 2019, the French authorities reported an autochthonous Zika virus (ZIKV) case in Hyeres, Var department, France. The case had reported symptom onset on 29 July 2019. No travel history to Zika endemic countries was reported for the patient or partner. Since this notification, French authorities reported an additional two probable autochthonous ZIKV cases, identified through active case finding, in Hyeres, in the same area and same timeframe (symptom onsets of the three cases from 6 to 15 August 2019). All three patients have recovered.

/ PROVENCE-ALPES-CÔTE D'AZUR / VAR / HYÈRES

Un deuxième cas autochtone de virus Zika diagnostiqué à Hyères, dans le Var

Une personne atteinte de l'infection au Virus Zika a été diagnostiquée à Hyères, dans le Var annonce ce lundi l'Agence Régionale de Santé. Cela porte à deux le nombre de cas autochtones dans cette ville et dans le département.

European Centre for Disease Prevention and Control
An agency of the European Union

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Home > News & events > Epidemiological update: third case of locally acquired Zika virus disease in Hyères, France

News & events

Epidemiological update: third case of locally acquired Zika virus disease in Hyères, France

Epidemiological update
31 Oct 2019

On 30 October, French authorities reported a third autochthonous case of Zika virus (ZIKV) disease in Hyères city, Var department, France. The case had no travel history to Zika-endemic countries.

On 30 October, French authorities reported a third autochthonous case of Zika virus (ZIKV) disease in Hyères city, Var department, France. The case had no travel history to Zika-endemic countries.

The case was identified through active case-finding activities and resides in the close vicinity of the first two cases. These three cases had onset of symptoms in early/mid-August 2019, and all have recovered.

Measures implemented

Other diseases affected by climate change…

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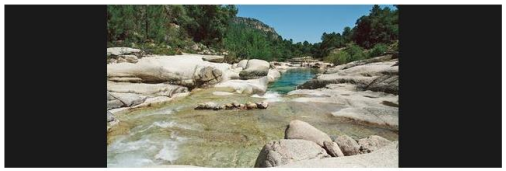
Comment la bilharziose, maladie tropicale, s'est invitée en Corse

Par Guillaume Mollaret | Publié le 17/05/2016 à 12:10



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Russia

Anthrax outbreak triggered by climate change kills boy in Arctic Circle

Seventy-two nomadic herders, including 41 children, were hospitalised in far north Russia after the region began experiencing abnormally high temperatures

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Alec Luhn in Moscow
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Yemen cholera cases pass 300,000 as outbreak spirals - ICRC

10 July 2017 | Middle East | Share

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SUSTAINABILITY

Has Climate Change Made Lyme Disease Worse?

As Lyme disease spreads across the U.S., those in its path cope with a debilitating, bewildering array of maladies, misery and afflictions

By Marianne Lavelle on September 22, 2014

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Brain-eating amoeba claims year's third life in Sindh

Naegleria fowleri, the brain-eating amoeba, has claimed another life in Karachi: a young man of around 29 years of age who died due to infection caused by the deadly microorganism at a private hospital on June 28, the Sindh Health Department disclosed on Tuesday.

"Ali Amjad, a teacher by profession and a resident of KDA Scheme No 1 in Karachi, was admitted to the Aga Khan

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Naegleria Fowleri
Sindh
Health

Conclusions

- Climate impacts vector borne diseases distribution (breeding sites – development and survival of vectors, pathogen development rate inside the vector e.g. EIP…)
- Increasing evidences that climate change already played a role in the background over the past 20 years: worrying trends have been observed in different temperate, arctic and highland regions.
- Many factors to consider to anticipate the real future of infectious diseases (socio-economic, demography, land use changes, drug and insecticide resistance, technological break through…).
- Need to use different disease modelling approaches and ensemble of climate models, emission & population scenarios to assess uncertainties, and these can be quite large!
- Model validation is critical but difficult - validation relies on the quality of health and climate data!
- Climate change is already affecting our health directly (climatic extremes: heat waves, floods, air pollution…) and will have significant indirect effects from macro to micro scale e.g. on freshwater and oceanic resources, agriculture, livelihoods, population migration… It only started…