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Colloque Santé-Biodiversité
27&28 octobre 2014 à VetAgro Sup

Impact du réchauffement climatique sur les maladies infectieuses vectorielles

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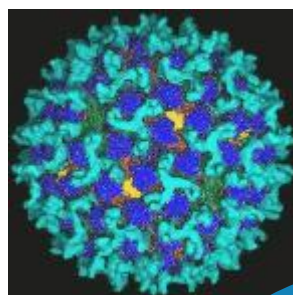


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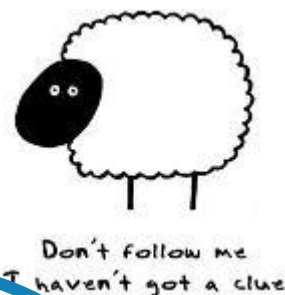
Maladies vectorielles et climat

- Survie
- Taux de replication

Pathogène



Hôte



- Croissance
- Survie
- Distribution

Vecteur



Variabilité climatique
Précipitations
Températures
Humidité
Vents...

- Survie
- Taux de reproduction
- Activité
- Cycle gonotrophique
- Compétence du vecteur

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Travail à Liverpool



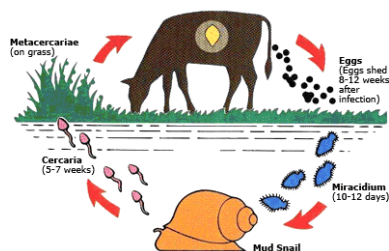
Fièvre catarrhale ovine.

Guis et al., 2012.



Paludisme

Caminade et al., 2014



Douve du foie – *Fasciola hepatica* (en cours)



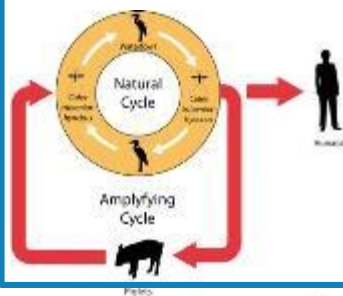
Fièvre de la Vallée du Rift

Caminade, Ndione et al., 2011 & 2014.



Moustique tigre.

Caminade et al. 2012, en collaboration avec Public Health England



Encéphalite japonaise.

Impoinvil et al., 2011, 2013.

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Le moustique tigre



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Pathogènes

Dengue

2 cas en France (2010), 4 en 2014

Chikungunya

Epidémie de Ravenne, Italie, 2007.

Piqûres douloureuses!!!!

Méthodes

- 1) Modélisation d'une enveloppe biologique / climatique pour le moustique tigre en Europe en se servant de différentes méthodes.
- 2) Estimer un risque climatique futur basé sur des simulations
- 3) Différences et similarités -> conclusions

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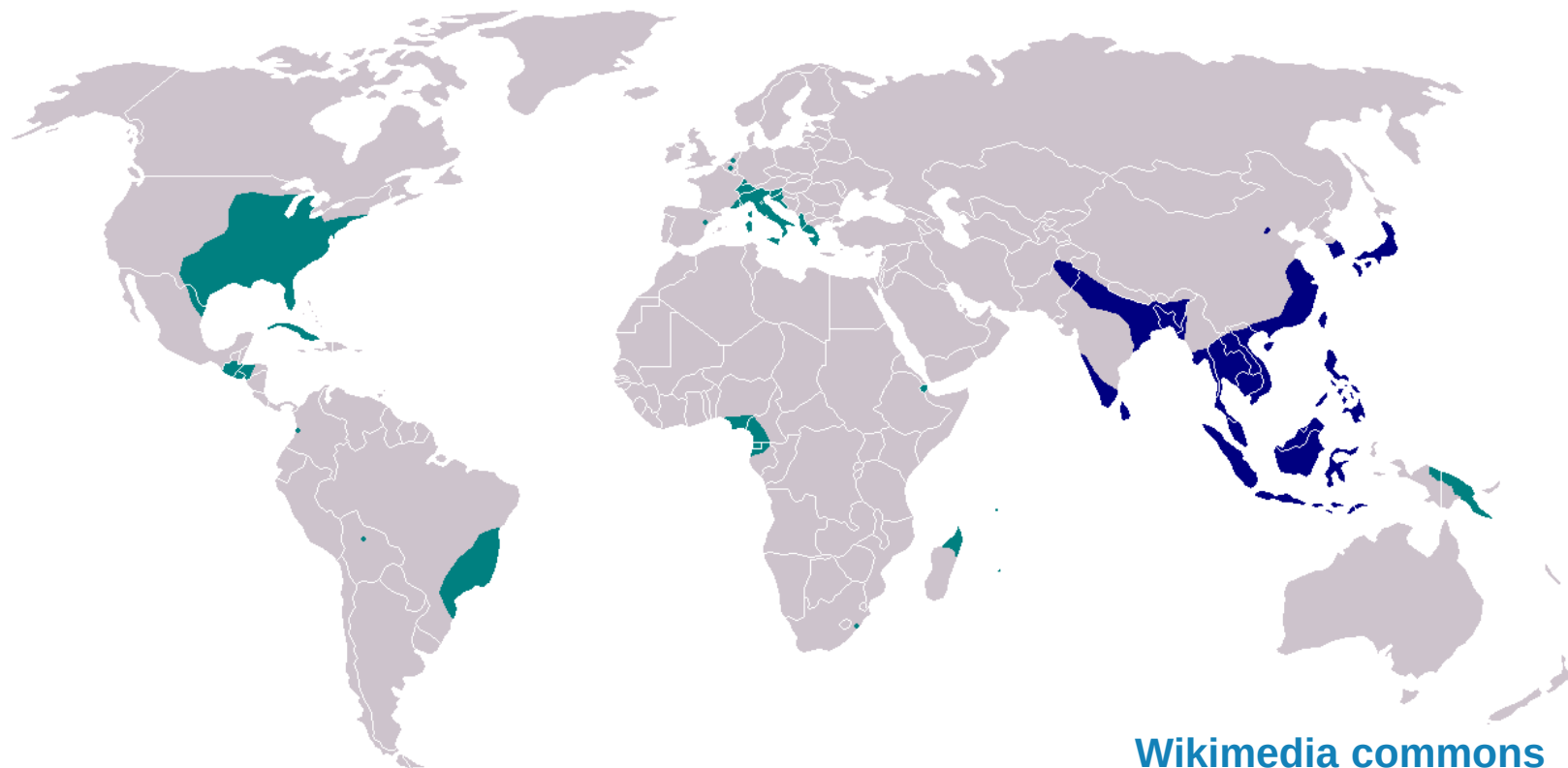




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Distribution



Wikimedia commons

bleu: distribution originale, cyan: introduction - 30 dernières années.

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Introduction



Scholte & Schaffner, 2007

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

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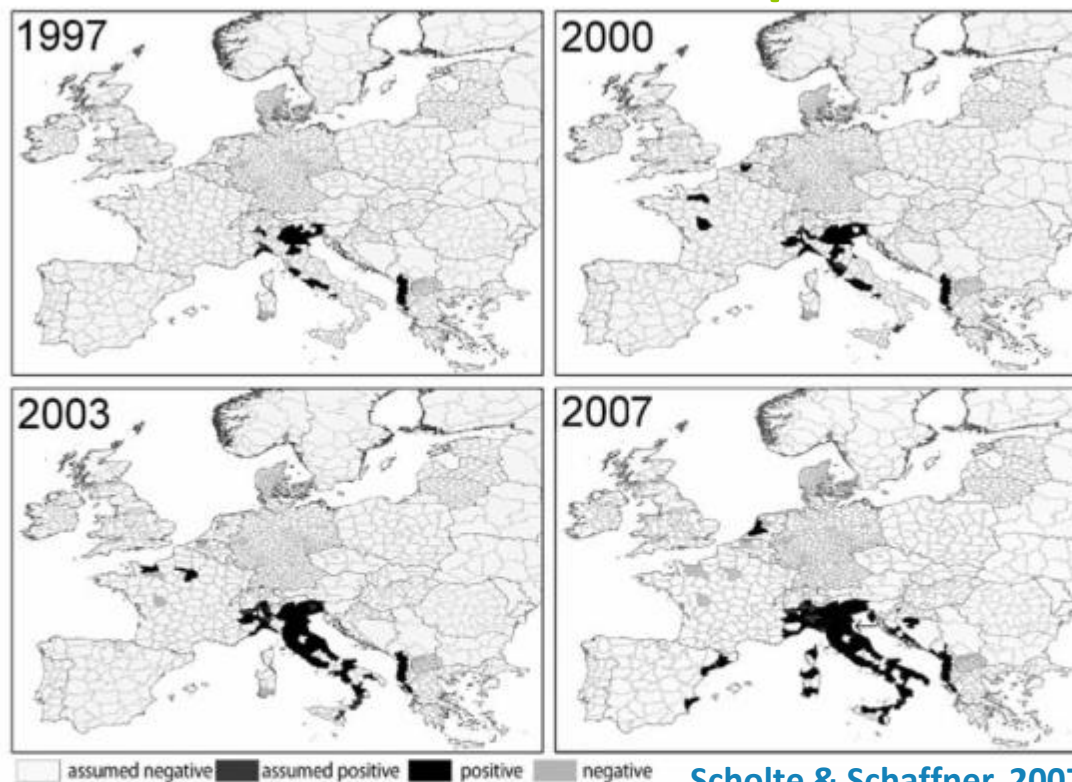




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Contexte en Europe



Scholté & Schaffner, 2007

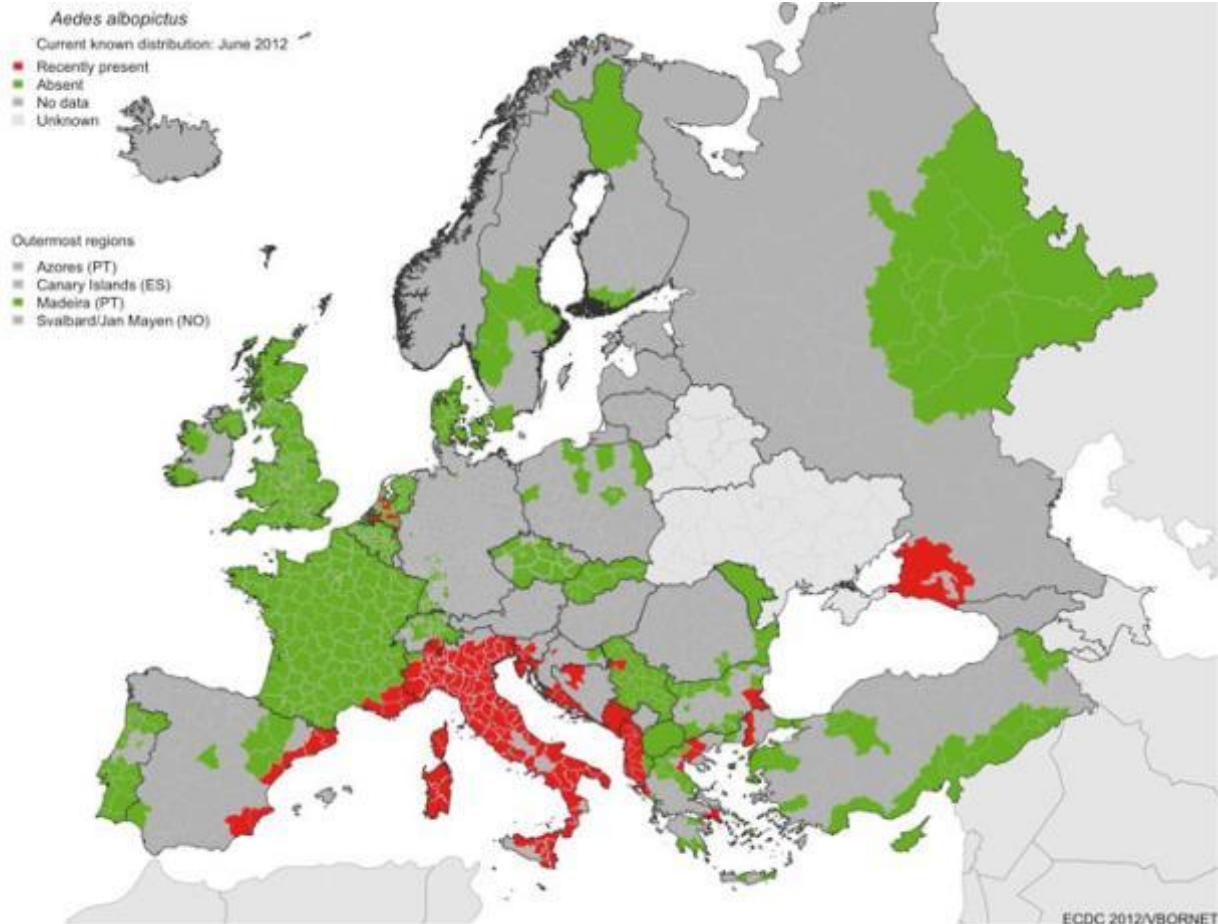
Figure 3. Presence of *Aedes albopictus* in Europe per province for the years 1997-2007. Data to complete this figure were kindly made available by Roberto Romi (Italy), Roger Eritja and David Roiz (Spain), Eleonora Flacio (Switzerland), Charles Jeannin (France), Anna Klobučar (Croatia), Zoran Lukac (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.

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Observations JAN 2012



Hot spots:

- Italy
- Corsica,
- Sardinia
- Sicily
- Eastern coast of Spain
- Southern France
- Adriatic coast
- Greece

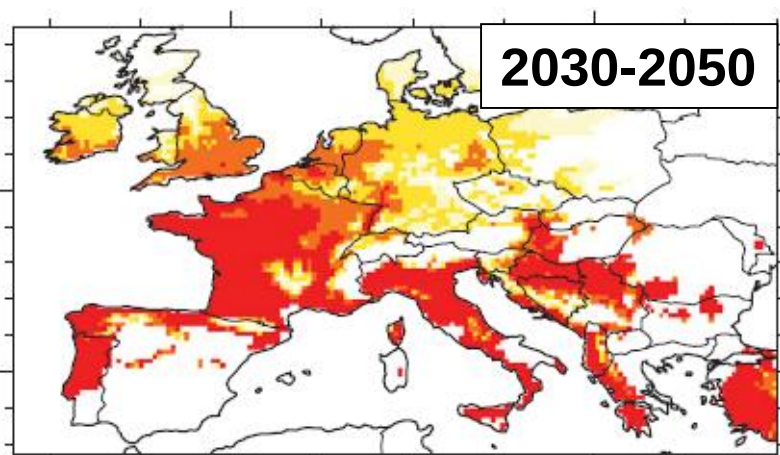
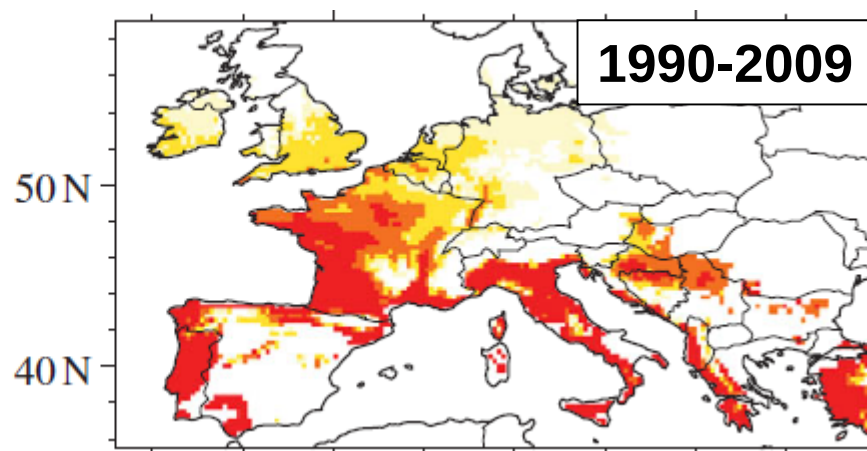
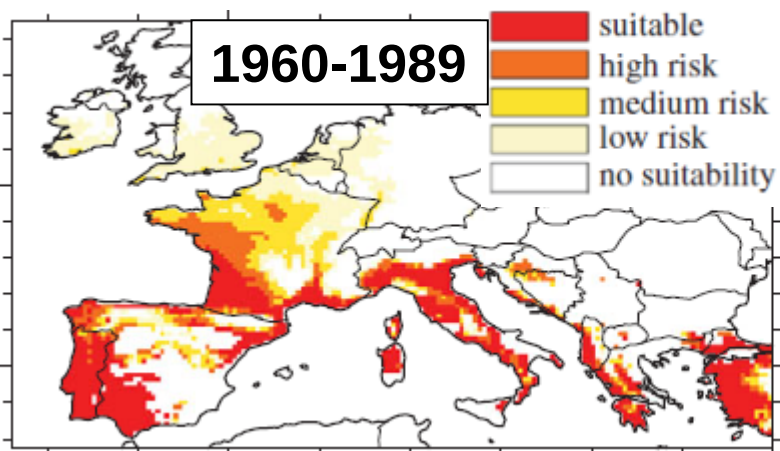
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Simulations



Modèle basé sur un critère d'hivernage ($T_{jan} > 0C$, $Precip_annuelle > 500mm$) et différents seuils en températures annuelles:

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

Risque en hausse: Benelux, Balkans, Ouest de l'Allemagne, Sud du Royaume Uni, grande surface de la France
 Risque en baisse: Espagne et îles / pourtour méditerranéen

Caminade et al., 2012 Colloque Santé-Biodiversité 27&28 octobre 2014 à VetAgro Sup Marcy l'Etoile

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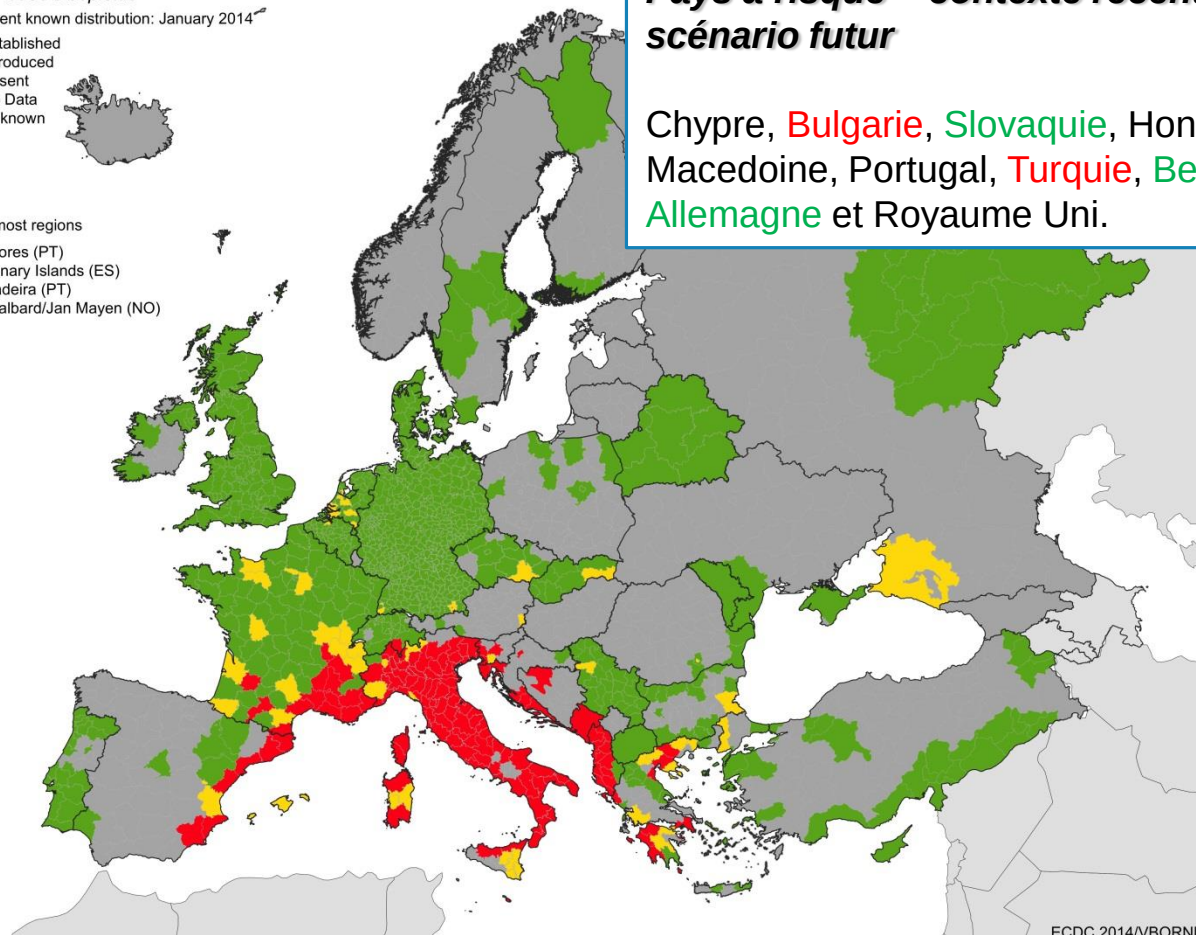
Observations JAN 2014

Aedes albopictus
Current known distribution: January 2014

- Established
- Introduced
- Absent
- No Data
- Unknown

Outermost regions

- Azores (PT)
- Canary Islands (ES)
- Madeira (PT)
- Svalbard/Jan Mayen (NO)



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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 ROSE WILKINSON
PUBLISHED: 02:34, 25 April 2012 | UPDATED: 03:24, 25 April 2012

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.

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07/13/13 ISSUE

In the Eye of the Tiger

Globally spread of Asian tiger mosquito could fuel outbreaks of tropical diseases in temperate regions

By Carrie Arnold
Web edition: June 12, 2013
Print edition: June 19, 2013 Vol. 433 #13

There is no shortage of mosquitoes in North America, and adding one more variety might seem like just a minor uptick in summertime's itch-scratch. But the Asian tiger mosquito, *Aedes albopictus*, comes with some particularly worrying characteristics. It's an aggressive bit-and-run biter that frequently lives in close contact with humans. It's a daytime feeder that dines on humans, dogs, livestock, birds and a host of other animals. "The feeding behavior of *Aedes albopictus* is very captivating," says Diane O'Neil, a vector-borne disease expert at Duke University in Durham, N.C. "It feeds on everything."

People in the southeastern United States are already well acquainted with the Asian tiger, named for its black and white stripes. But these mosquitoes are creating quite a buzz as they drift northward into more temperate climates along the East Coast, where their eggs can survive even cold winters.

The buzz would be just so much hand-wringing if it didn't include an alarming public health component: The Asian tiger turns out to be a competent vector for a raft of diseases, some lethal. It can carry dengue fever, yellow fever, chikungunya virus, West Nile fever and two forms of encephalitis named for St. Louis, Mo., and La Crosse, Wis. Among these diseases, only yellow fever is preventable by vaccine. Ominously, dengue has already gotten a foothold in southern parts of the United States.

Kicking the competition

The Asian tiger mosquito has joined a rogues' gallery of invasive species—including brown mussels, red imported fire ants and Africanized bees—now established in North America. In Florida and other subtropical parts of the Deep South, it has shown clear signs of displacing a predecessor-in-crime, the *Aedes aegypti* mosquito, which is best known for spreading yellow fever before that scourge was quelled by a vaccine, while it's unclear whether the Asian tiger has muscled out resident mosquitoes farther north, one



AN APPETITE FOR BLOOD
An aggressive biter, the Asian tiger mosquito can carry a variety of pathogens that cause debilitating diseases in humans and some domestic animals.
—DANIELA RIZZO/ISTOCK

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Human activities assembled in their past, a view

Vidéo sur youtube:

<http://www.youtube.com/watch?v=WFqmNgtXOrM>

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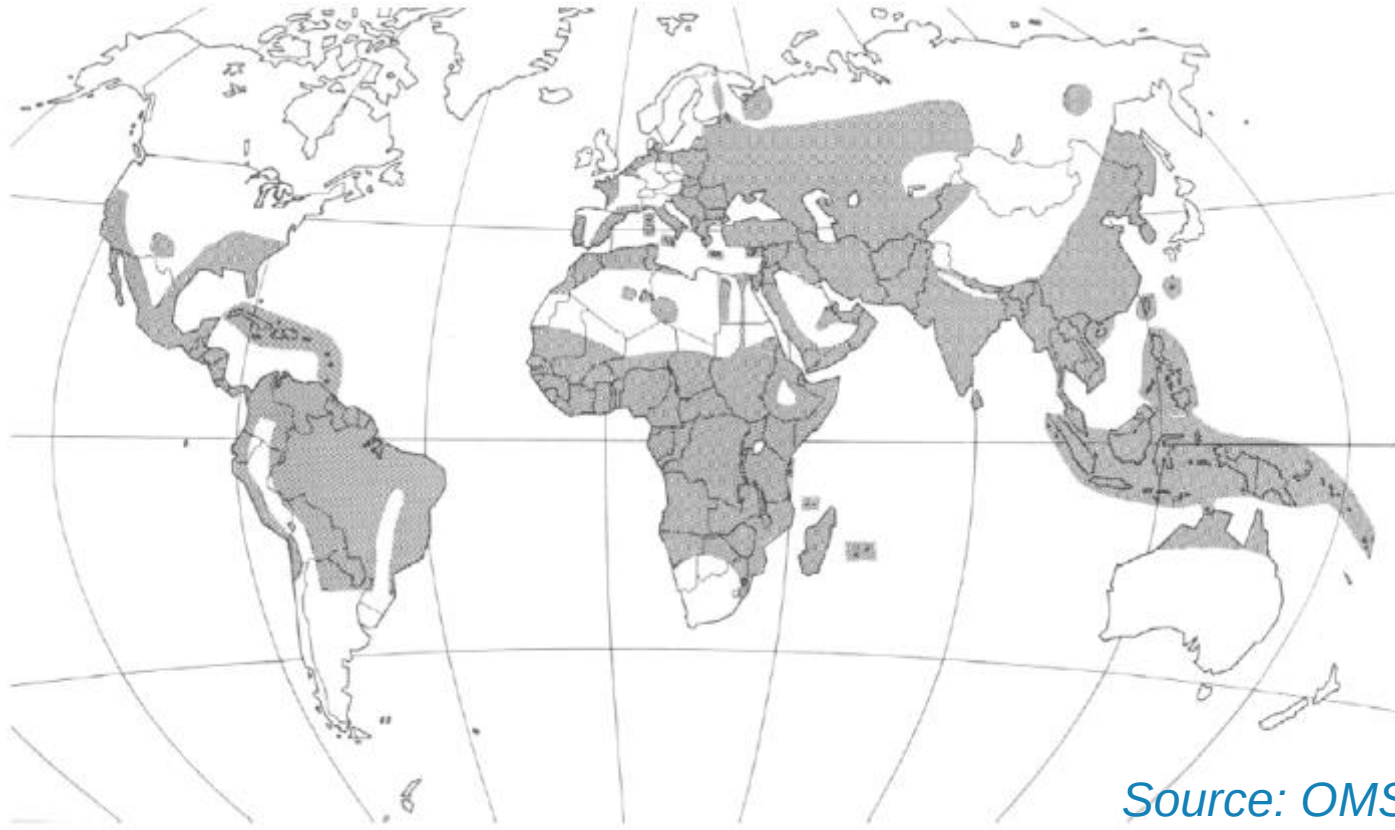
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Paludisme: contexte

Malaria Distribution 1948



Source: OMS

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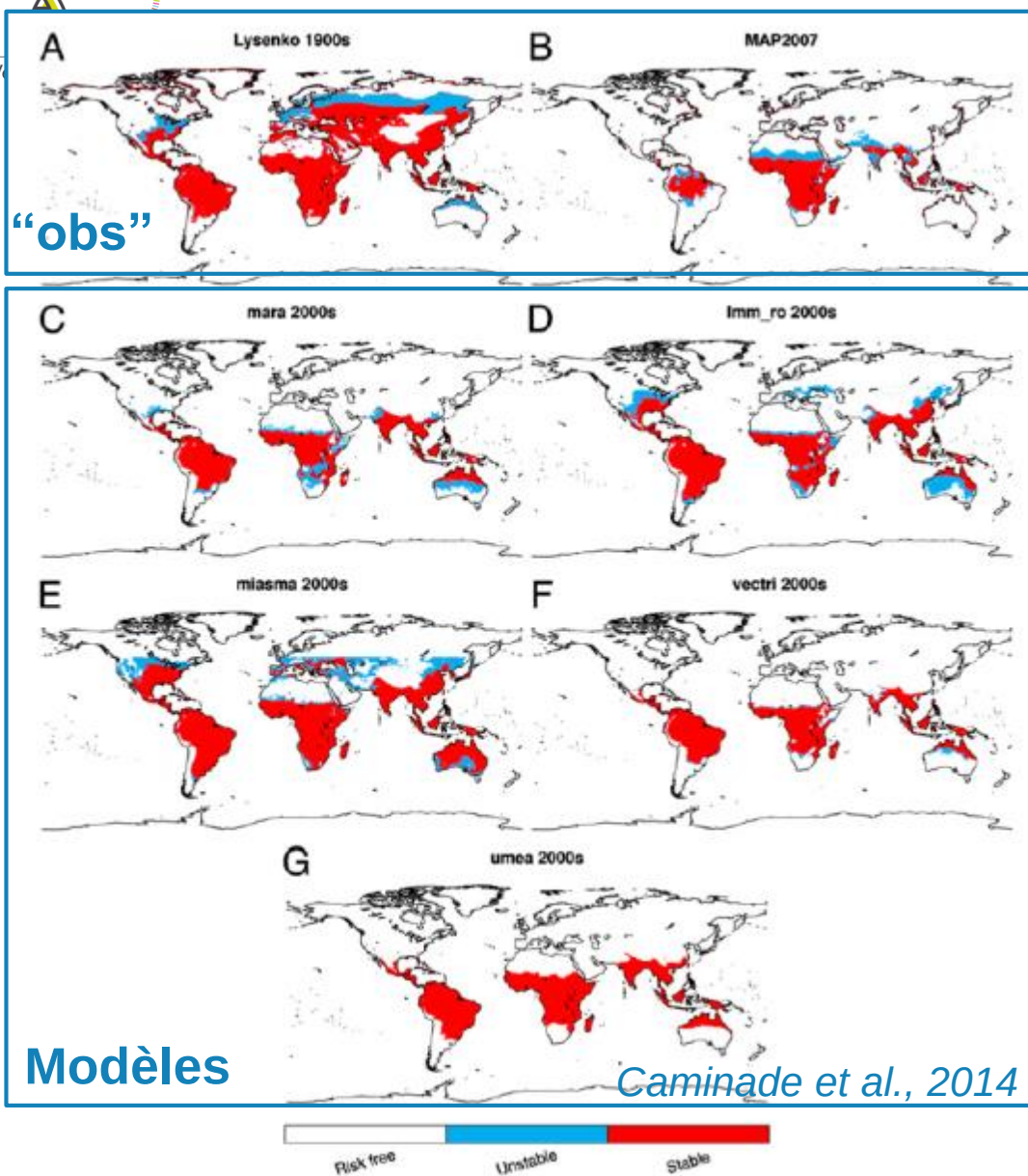


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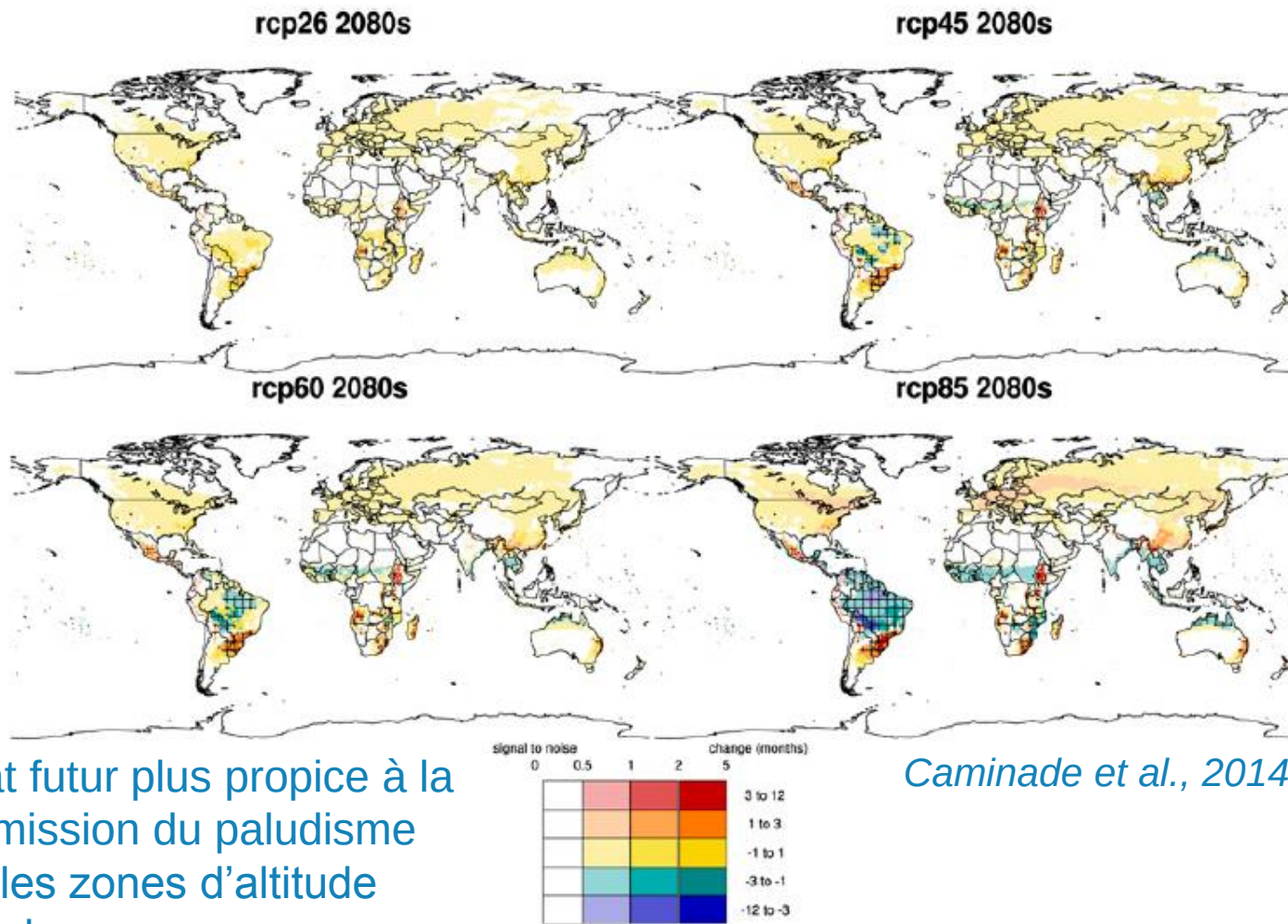


Diminution de la prévalence du paludisme à l'échelle globale (moustiquaires, test de diagnostic précoce, contrôle des vecteurs...)

Fig. 1. Observed (A and B) and simulated malaria distribution (three categories: risk-free in white, unstable/epidemic in blue, and stable/endemic in red) for five malaria models (C, D, E, F and G). For the observation (A and B) all endemic subcategories (hypoendemic, mesoendemic, hyperendemic, and holoendemic) have been included in the stable category. The 1900s data (A) are based on ref. 38 (considers all plasmodium infections), and the 2000s data (B) are based on ref. 14 (considers only *P. falciparum* infections). For the simulations, unstable malaria is defined for a length of the transmission season (LTS) ranging between 1 and 3 mo, and suitable is defined for LTS above 3 mo (based on TRMMERAI control runs for the period 1999–2010; *SI Appendix, Fig. S11* shows the CRUTS3.1 control runs). The TRMMERAI runs are constrained to span 50°N–50°S owing to the TRMM satellite data availability. For the UMEA malaria model only estimates of stable malaria were available.



Scénarios futurs



Climat futur plus propice à la transmission du paludisme dans les zones d'altitude tropicales.

Caminade et al., 2014

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Conclusions et Perspectives



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- Plus de preuves scientifiques reliant changement climatique et maladies vectorielles infectieuses / vecteurs (paludisme, moustique tigre, fièvre catarrhale ovine, fasciolose...)
- **MAIS importance majeure** des pratiques agricoles, de la qualité des services de santé, des densités de population, de l'urbanisation, de la globalisation et de la résistance aux traitements...
- Les modèles de maladies infectieuses sont dans leur phase infantile. Les moustiques subissent la météo pas le climat (et autres paramètres).
- Utilisation de larges bases de données et différentes sources de simulations: utile et nécessaire (utilisation d'ensemble de modèles de maladie, de climat, de scénarios climatiques et démographiques)
- Arrêter la course pour la performance des modèles, regarder où les choses pourraient se passer...
- Approche multidisciplinaire (entomologistes, épidémiologistes, spécialistes de santé humaine et animale, climatologues-météorologues, sciences spatiales et humaines...)-> One Health
- Approche multisectorielle de l'estimation des impacts du réchauffement climatique (projet ISI-MIP).

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