Human health morbidity and mortality in high resolution

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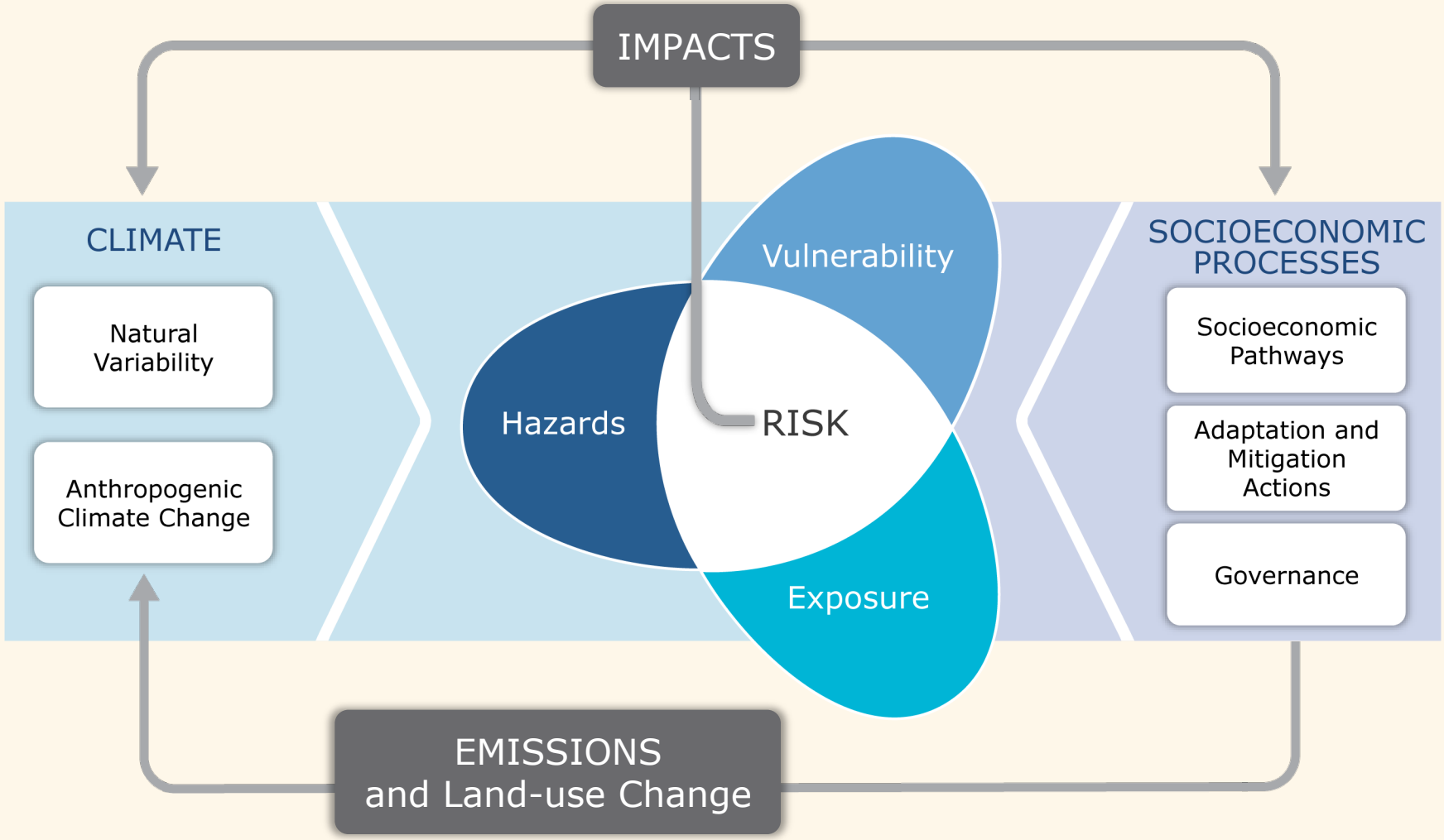
AGCI Workshop on
IMPACT RELEVANCE AND USABILITY OF HIGH RESOLUTION CLIMATE MODELING AND DATASETS

UW Medicine
SCHOOL OF MEDICINE

DEPARTMENT OF GLOBAL HEALTH
UNIVERSITY of WASHINGTON

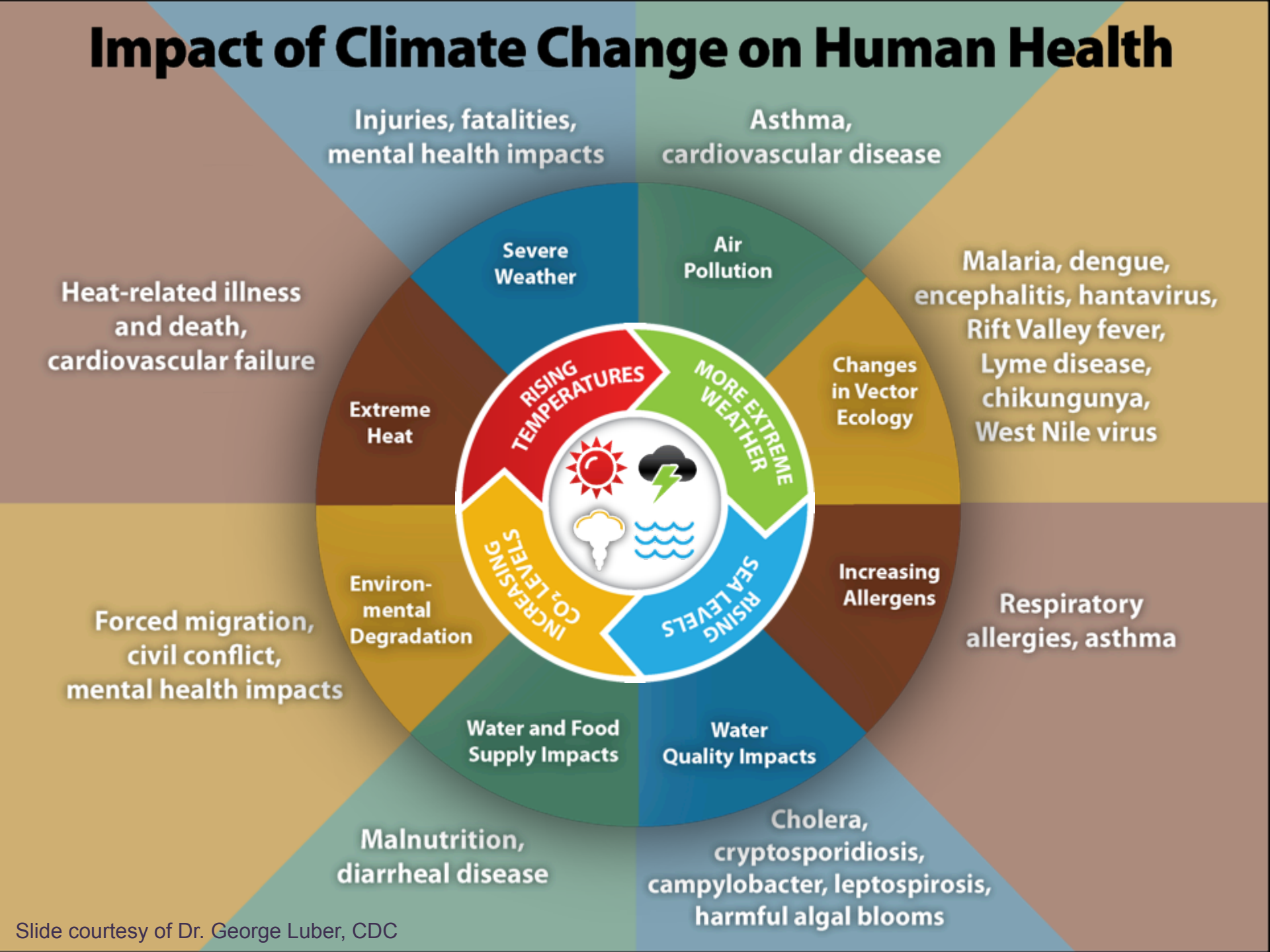
SCHOOL OF PUBLIC HEALTH
UNIVERSITY of WASHINGTON


IMPACTS
CLIMATE
Natural Variability
Anthropogenic Climate Change
Vulnerability
Hazards
RISK
Exposure
SOCIOECONOMIC PROCESSES
Socioeconomic Pathways
Adaptation and Mitigation Actions
Governance
EMISSIONS and Land-use Change

For exposed and vulnerable communities, even non-extreme weather and climate events can have extreme impacts

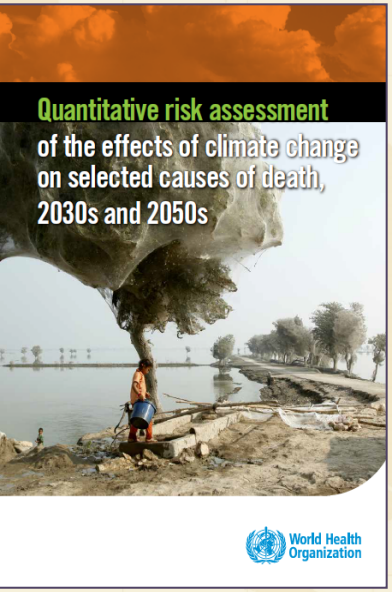
- Africa's largest recorded cholera outbreak
- over 90,000 affected
- over 4,000 killed
- began following onset of seasonal rains
- vulnerability and exposure increased risk

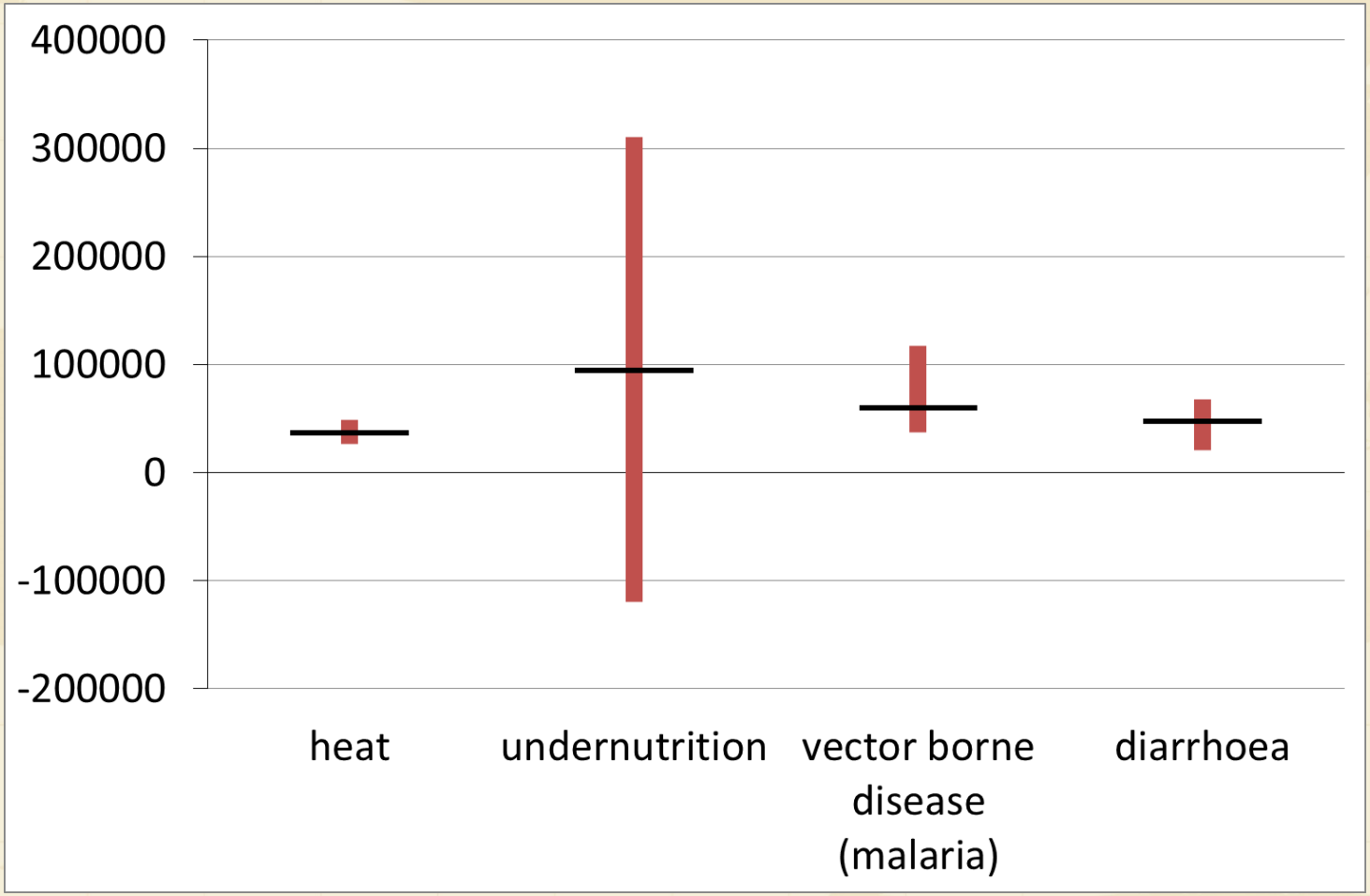
Impact of Climate Change on Human Health



Slide courtesy of Dr. George Luber, CDC

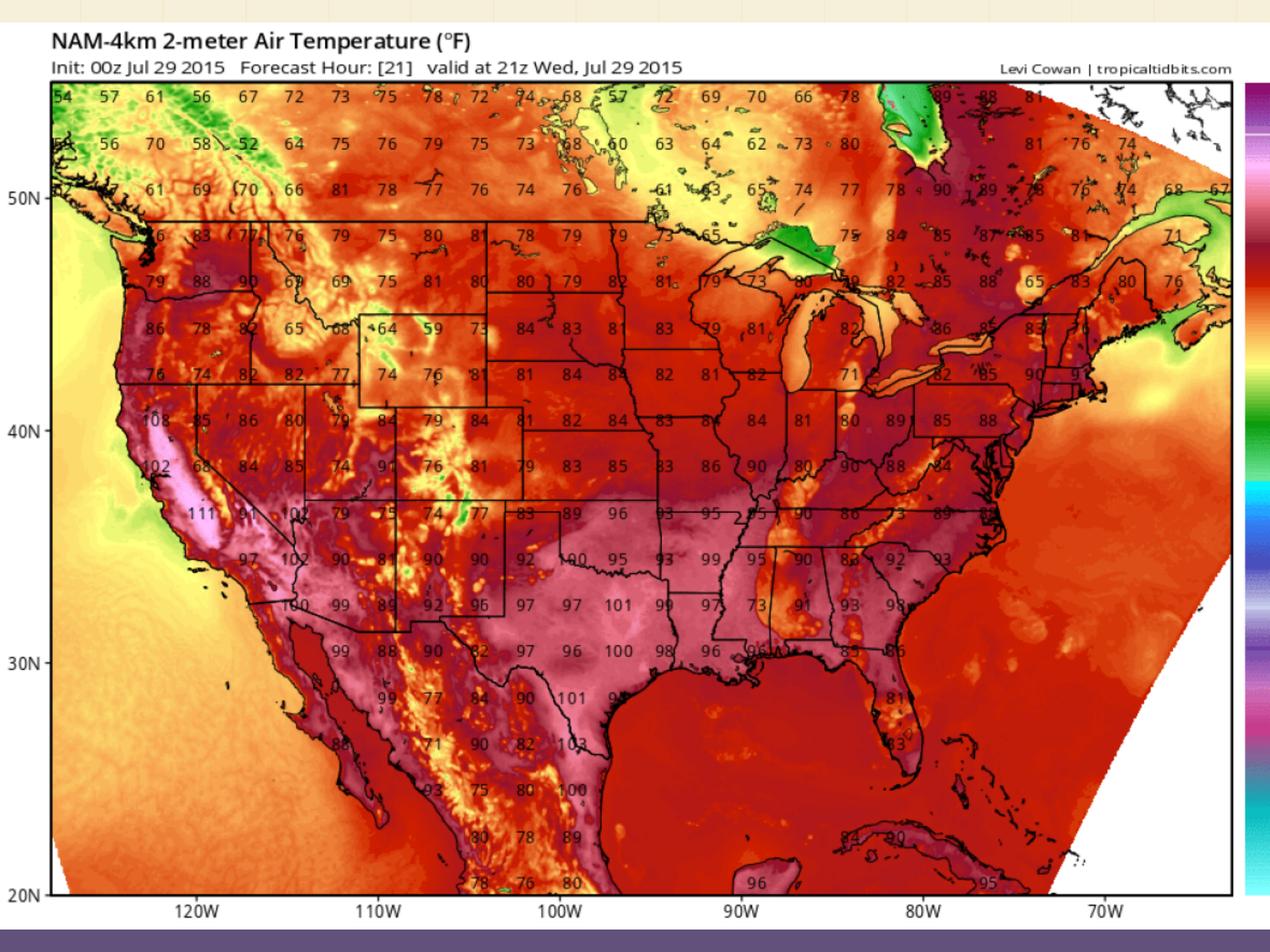
Estimates of mortality due to climate change, 2030s: approximately 250,000 excess deaths/year



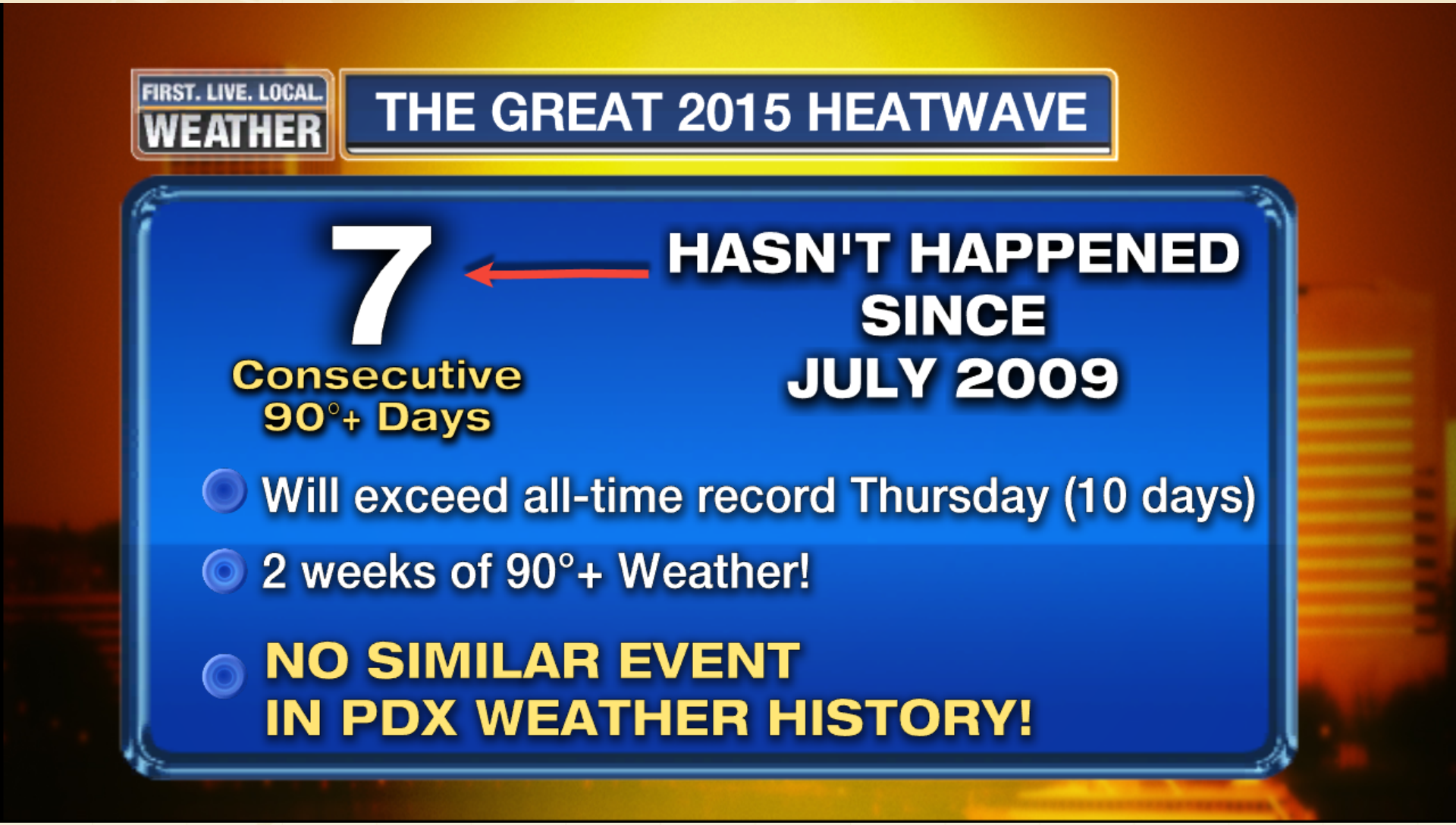


WHO 2014

The Midwest was in the midst of an intense and deadly heat wave on this date in 1995. The heat wave claimed nearly 600 lives in Chicago, where temperatures soared to 106 degrees on the 13th. High dew points made the air feel dangerously hotter.

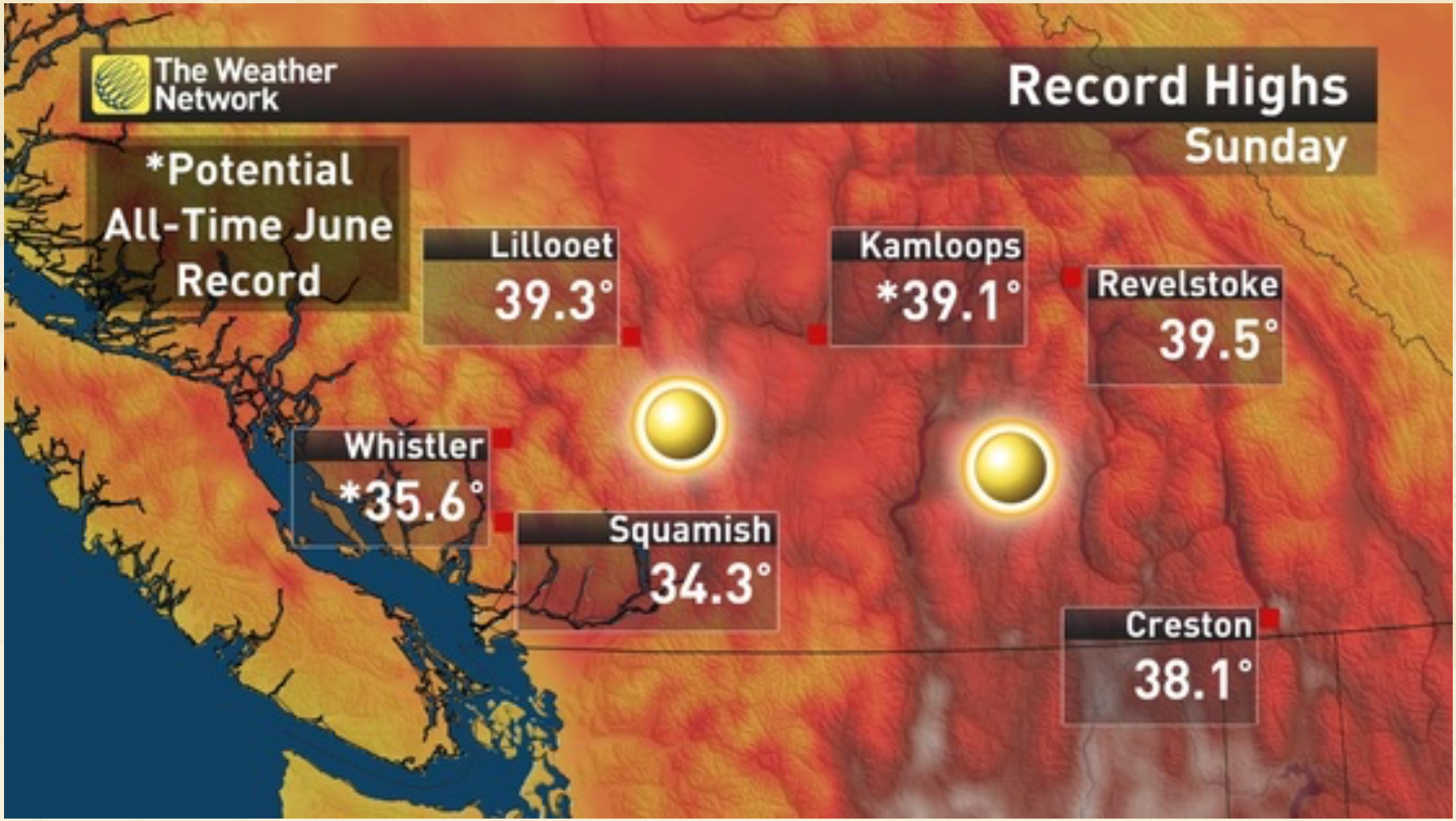

NAM-4km 2-meter Air Temperature (°F)
Init: 00z Jul 29 2015 Forecast Hour: [21] valid at 21z Wed, Jul 29 2015
Levi Cowan | tropicaltidbits.com
50N
40N
30N
20N
120W
110W
100W
90W
80W
70W

5 July 2015



10 July – 12 of past 15 days above 90 degrees

29 June 2015

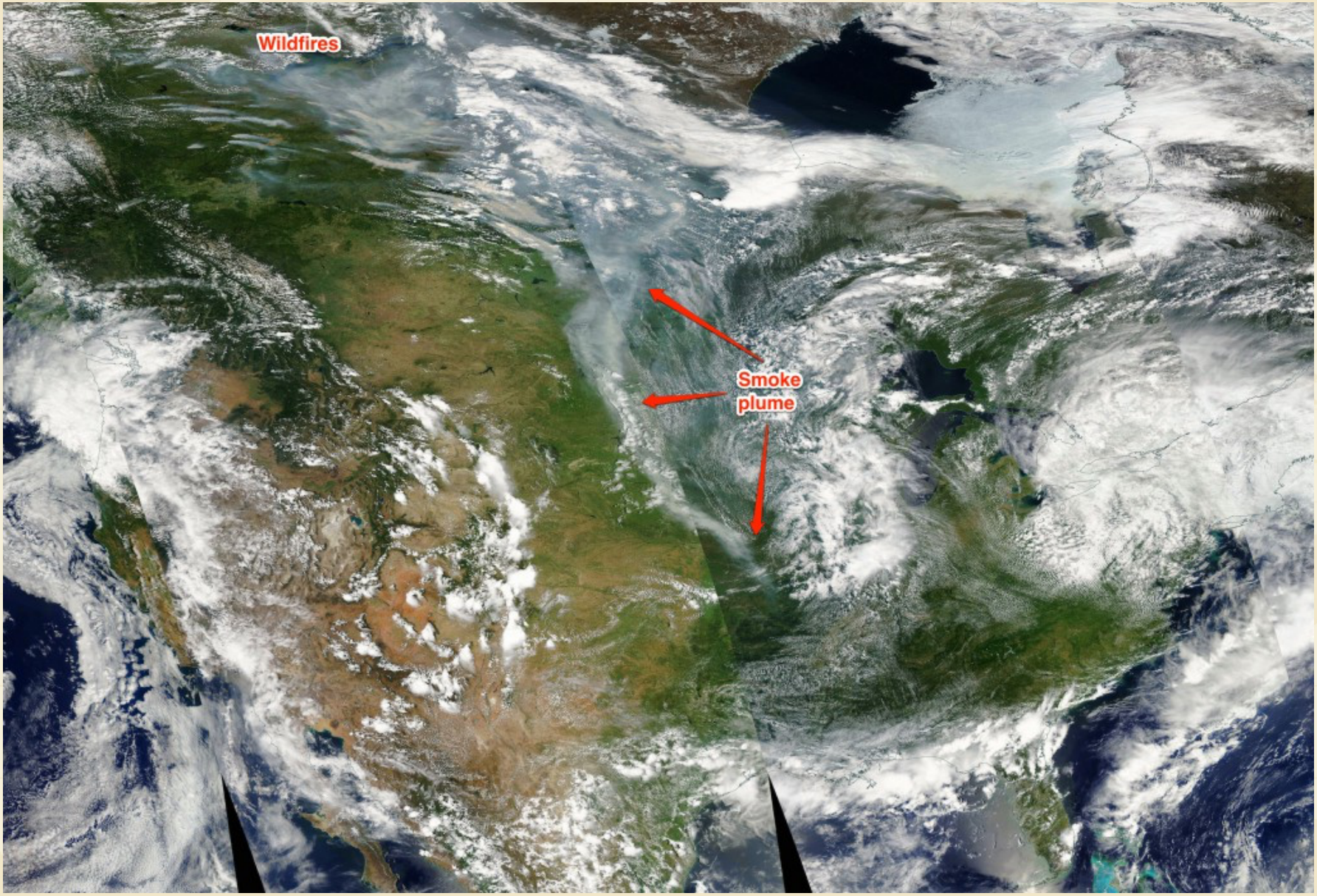


120-year records broken in multiple communities

Western Wildfires

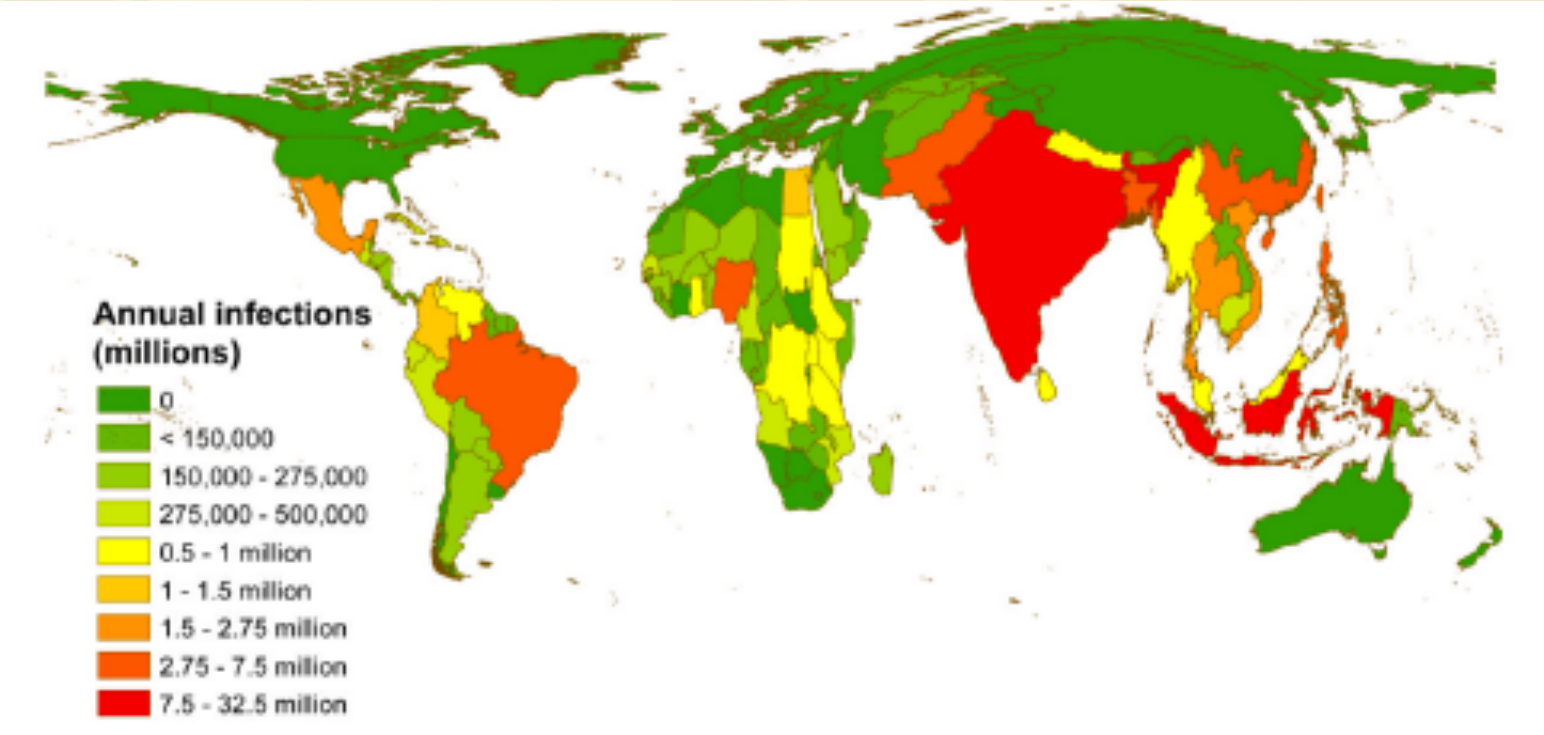
6 July 2015

28 June 2015



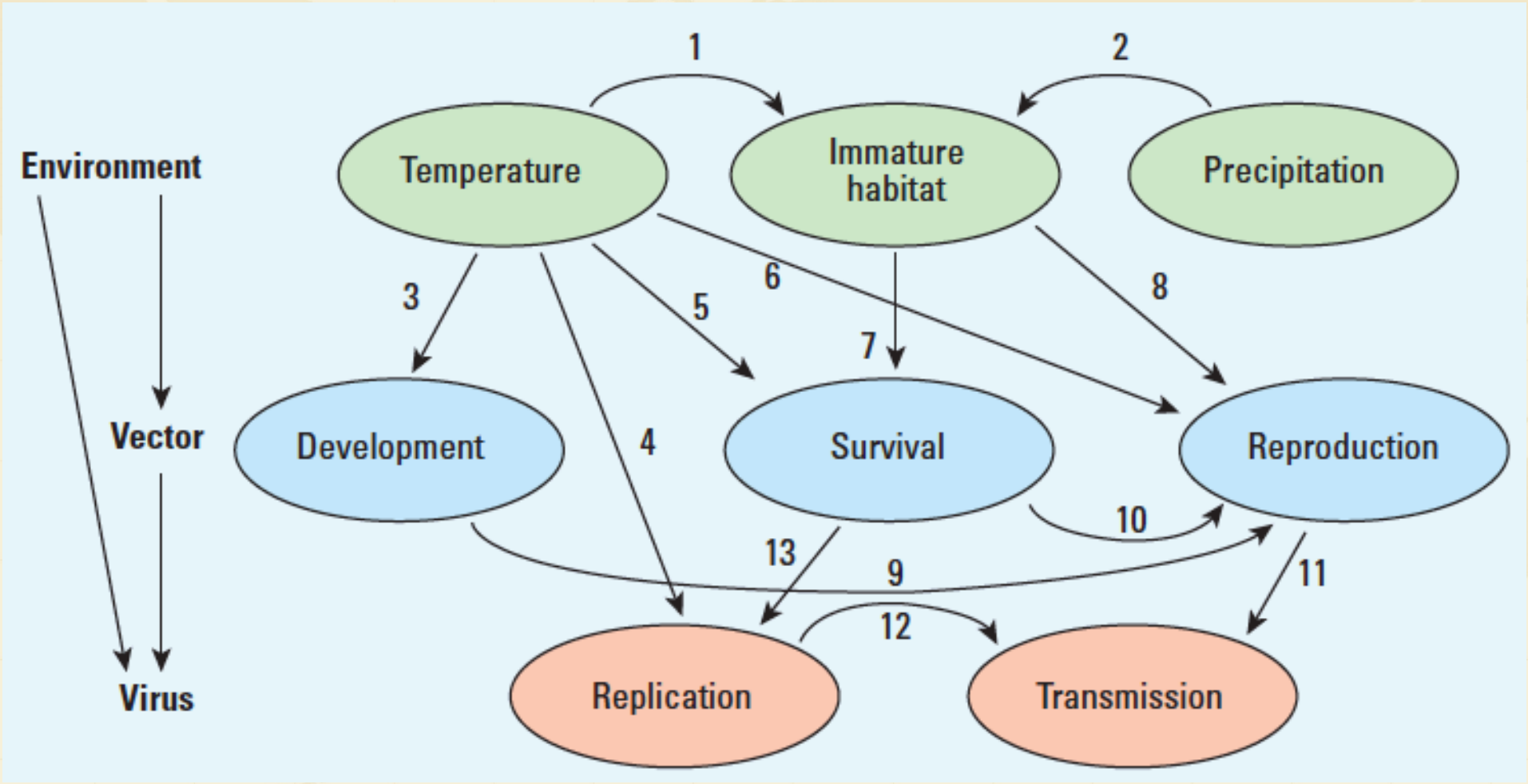
Aedes aegypti	*Aedes albopictus*
Yellow fever mosquito	Asian tiger mosquito
Bright silvery lyre-shaped dorsal pattern and white banded legs	Single longitudinal silvery dorsal stripes and white banded legs
Occupies urban areas with or without vegetation	Associated with thickets and arboreal vegetation
Bites, rests, and lays eggs indoors and outdoors	Mostly an outdoor (garden) mosquito
Sneaky biter	Aggressive biter
High preference for taking blood meals from humans and to a lesser extent from domestic mammals	Bites humans but also a variety of available domestic and wild vertebrates that do not carry the dengue virus, which lowers its capacity to transmit them
Main dengue vector worldwide	Main dengue vector in some areas, but is mostly a secondary vector
Major production places are mam-made containers, tree holes, and bamboo internodes holding water	Preference for tree holes and bamboo internodes with water but can also utilize human-made containers for its immature development
Most containers with water used for immature development are within or in close proximity to households	Utilizes water-filled containers around or further away from households

Cartogram of 2010 dengue infections



Bhatt et al. 2013

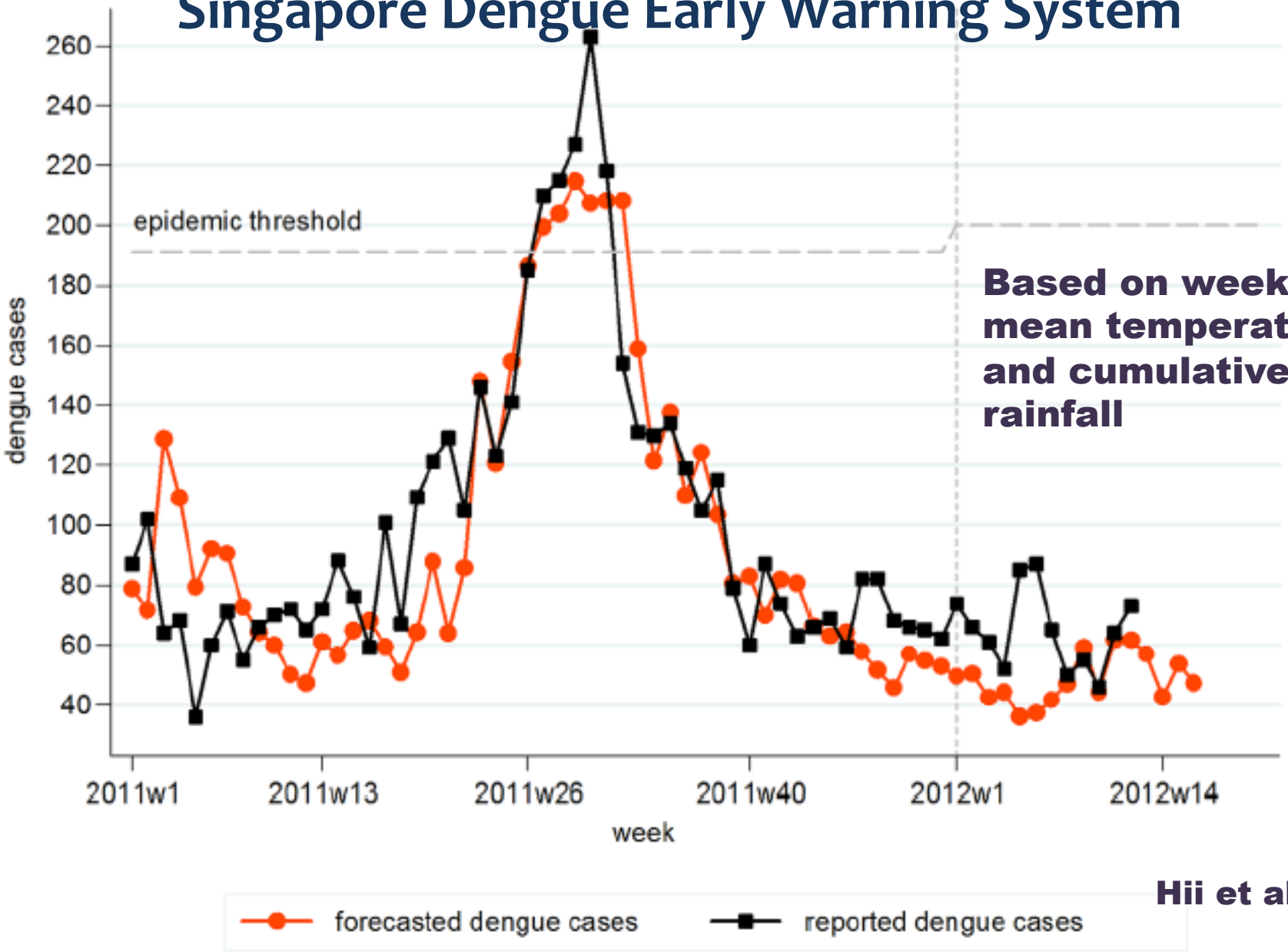
Biophysical influences on dengue ecology showing the interactions between climate variables, vectors, and the virus



Morin et al. 2013

1. Habitat availability for mosquito larvae is influenced by temperature through evaporation and transpiration;
2. And incoming precipitation;
3. Temperature is a major regulator of mosquito development;
4. And of viral replication within infected mosquitoes;
5. And mosquito survival;
6. And the reproductive behavior of mosquitoes;
7. Habitat availability is required for immature mosquito survival;
8. And reproduction of adult mosquitoes;
9. Faster mosquito development will accelerate mosquito reproduction;
10. And and increased survival will accelerate mosquito reproduction;
11. Increased mosquito reproduction enhances the likelihood of transmission by increasing the number of blood feedings;
12. Whereas faster viral replication increases transmission by shortening the time for the virus to develop in the mosquito; and
13. Increase survival of the adult mosquito increases the amount of viral replication.

Singapore Dengue Early Warning System

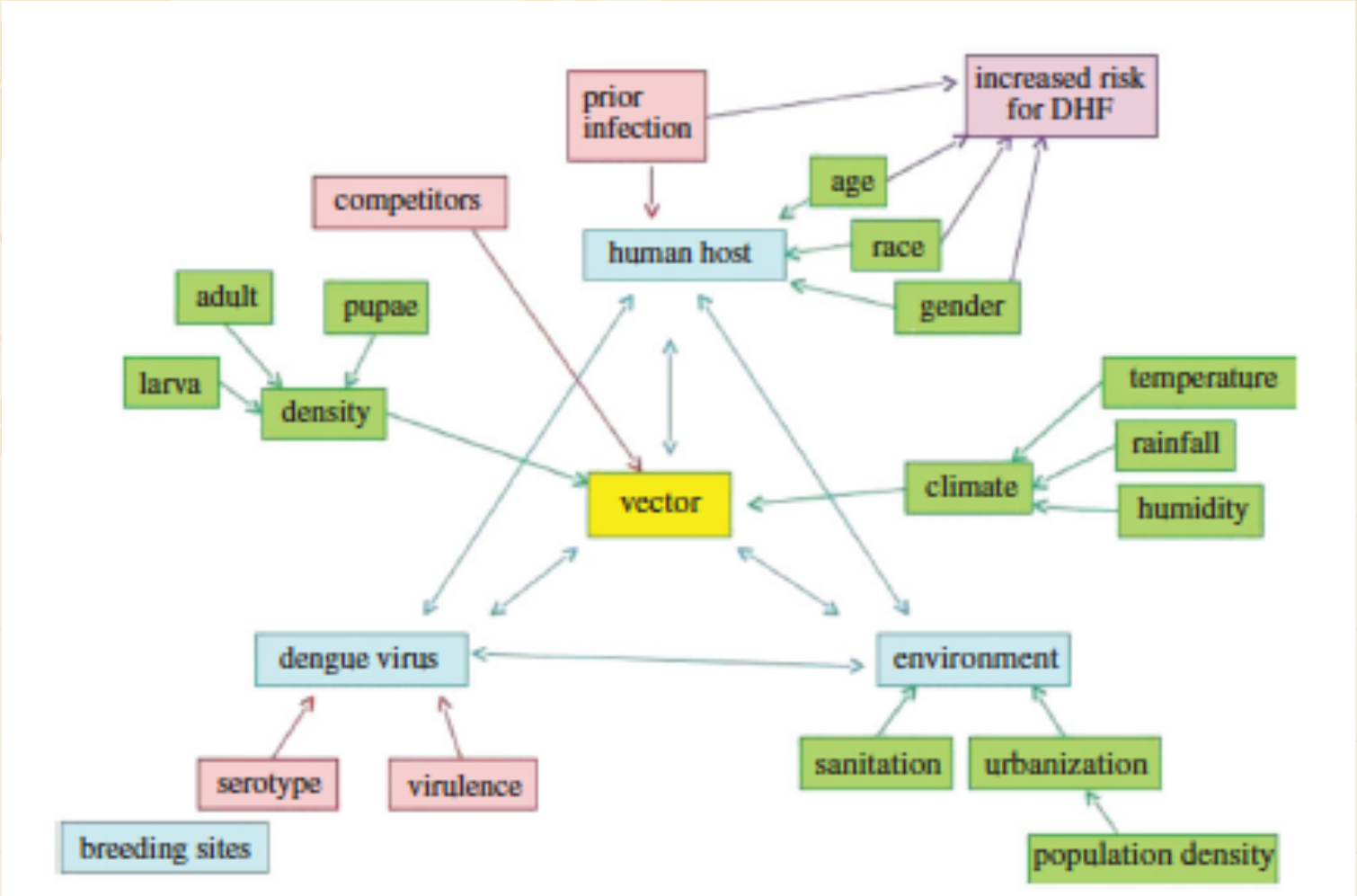


Based on weekly mean temperature and cumulative rainfall

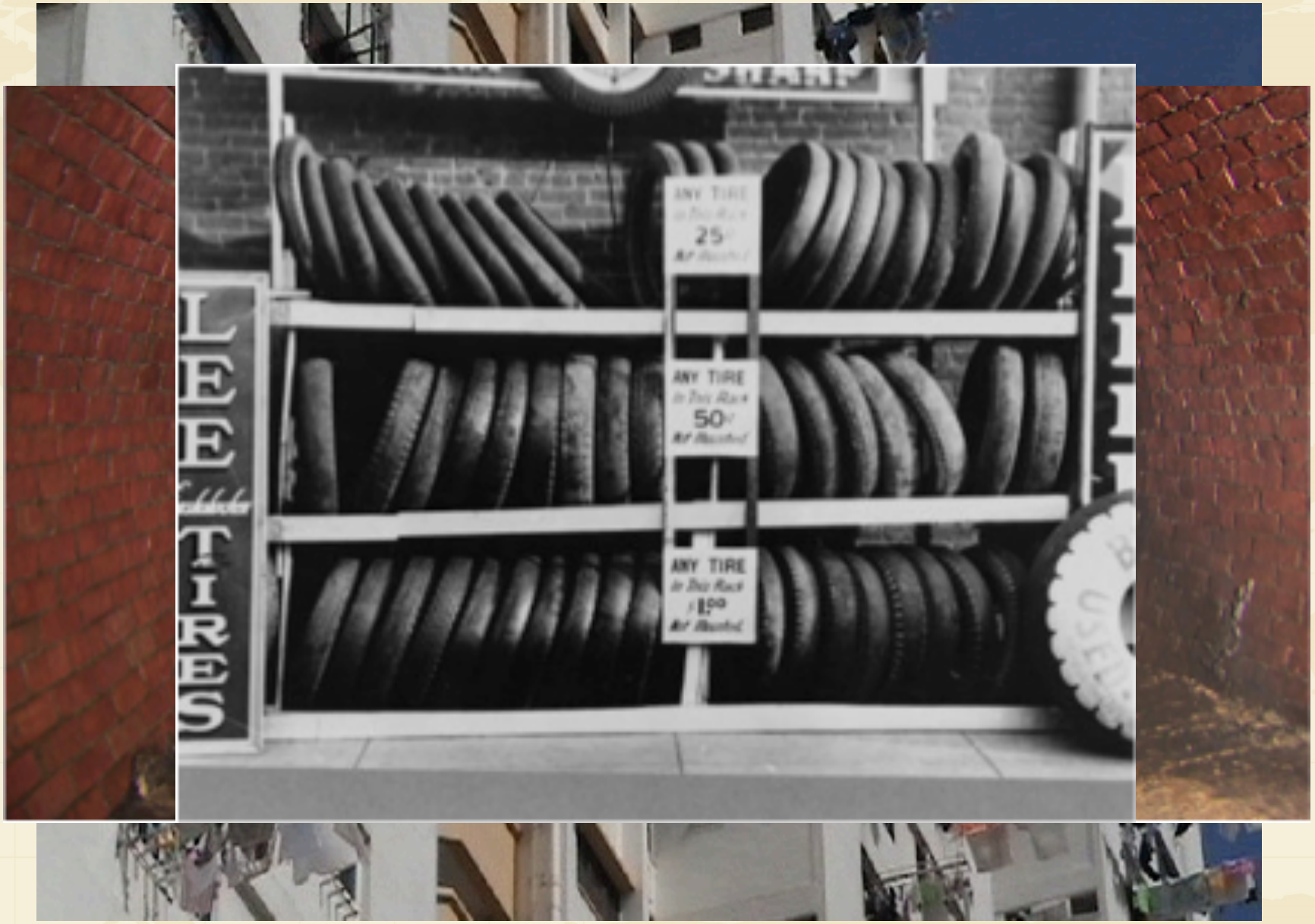
Hii et al. 2012

Figure 3. Forecasted dengue cases versus reported dengue cases in 2011–2012. Weekly forecasted dengue cases compared with reported cases during the validation period from 2011 week 1 to 2012 week 16. Epidemic threshold was 191 cases for 2011 and 200 cases for 2012.
doi:10.1371/journal.pntd.0001908.g003

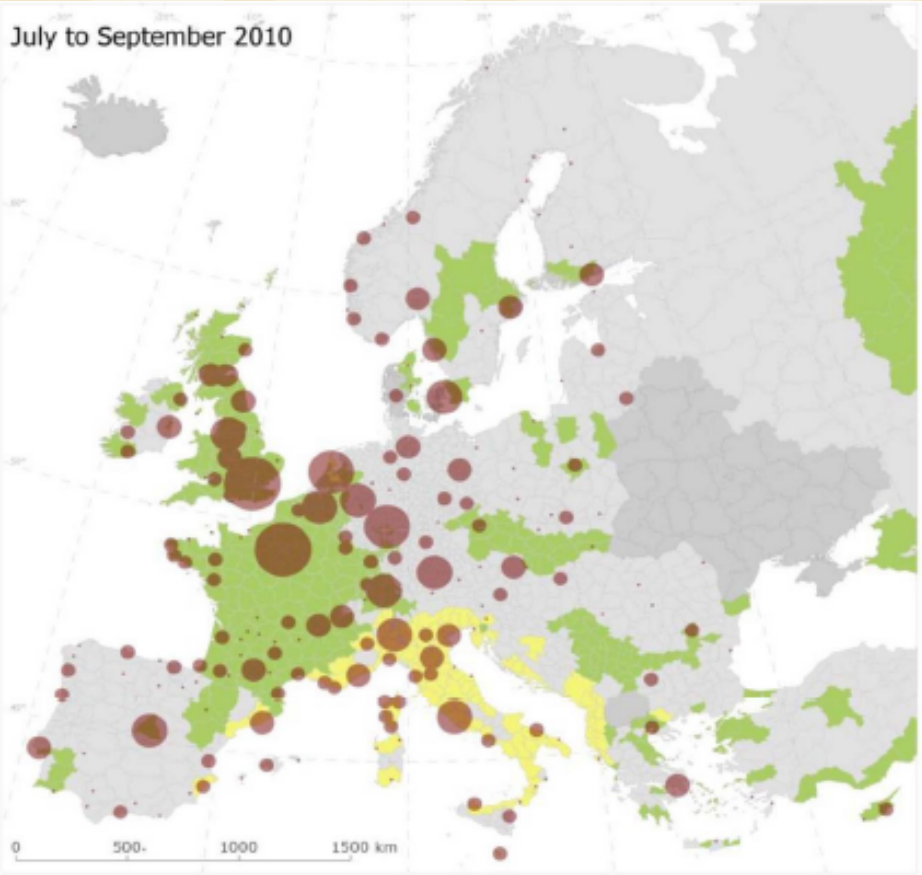
Schematic diagram of key requirements for understanding the risks of dengue virus transmission

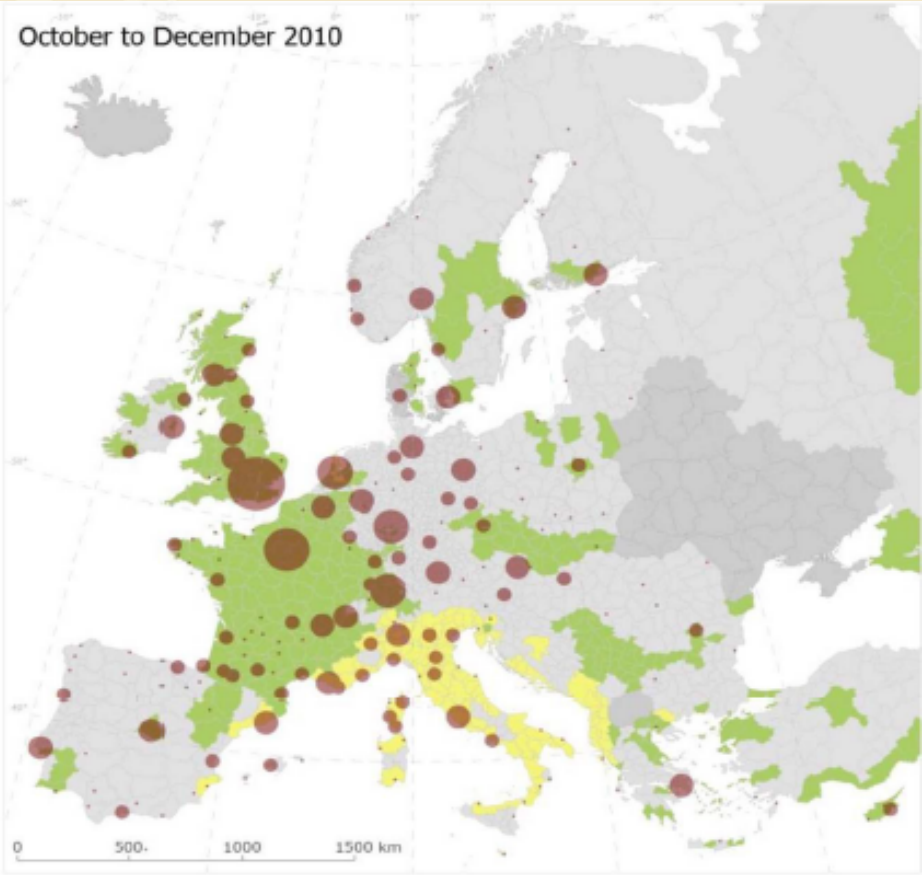


Parham et al. 2015


LEE TIRES
ANY TIRE
25
ANY TIRE
50
ANY TIRE
1.00

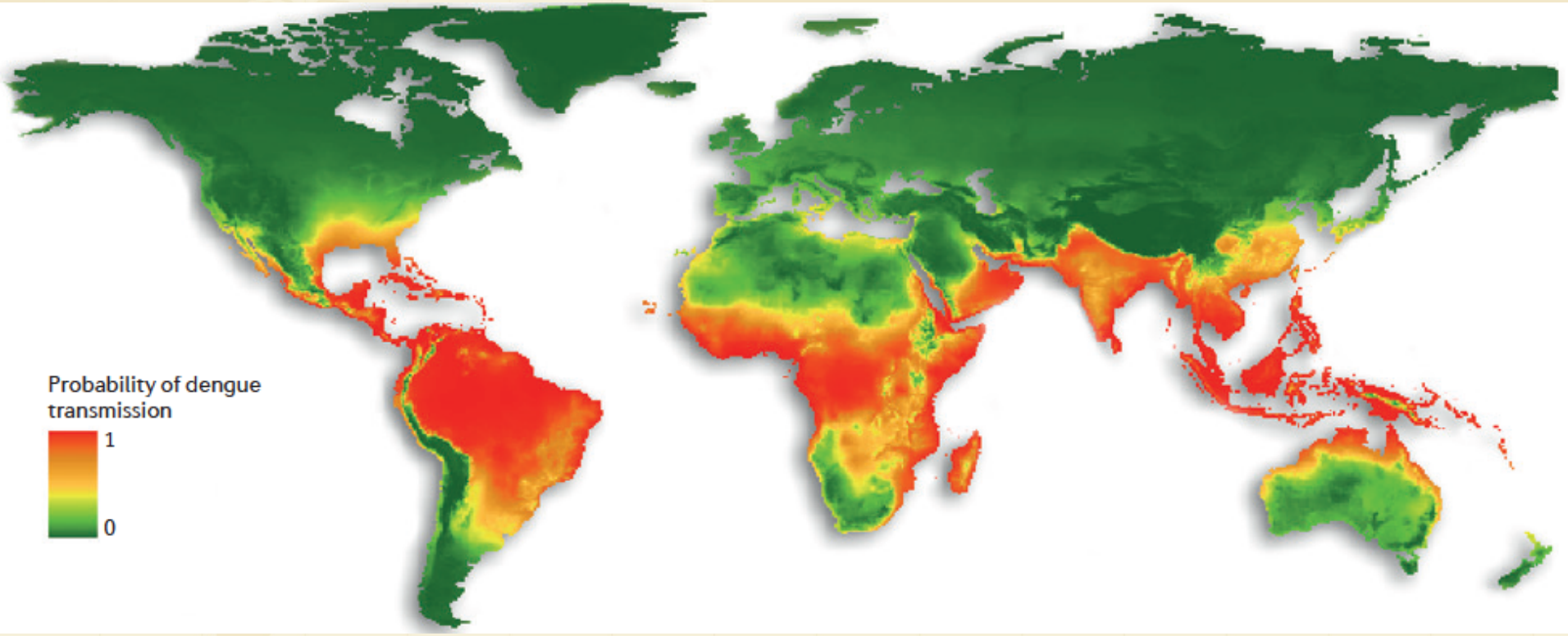
Airport final destination of international travelers from dengue affected areas





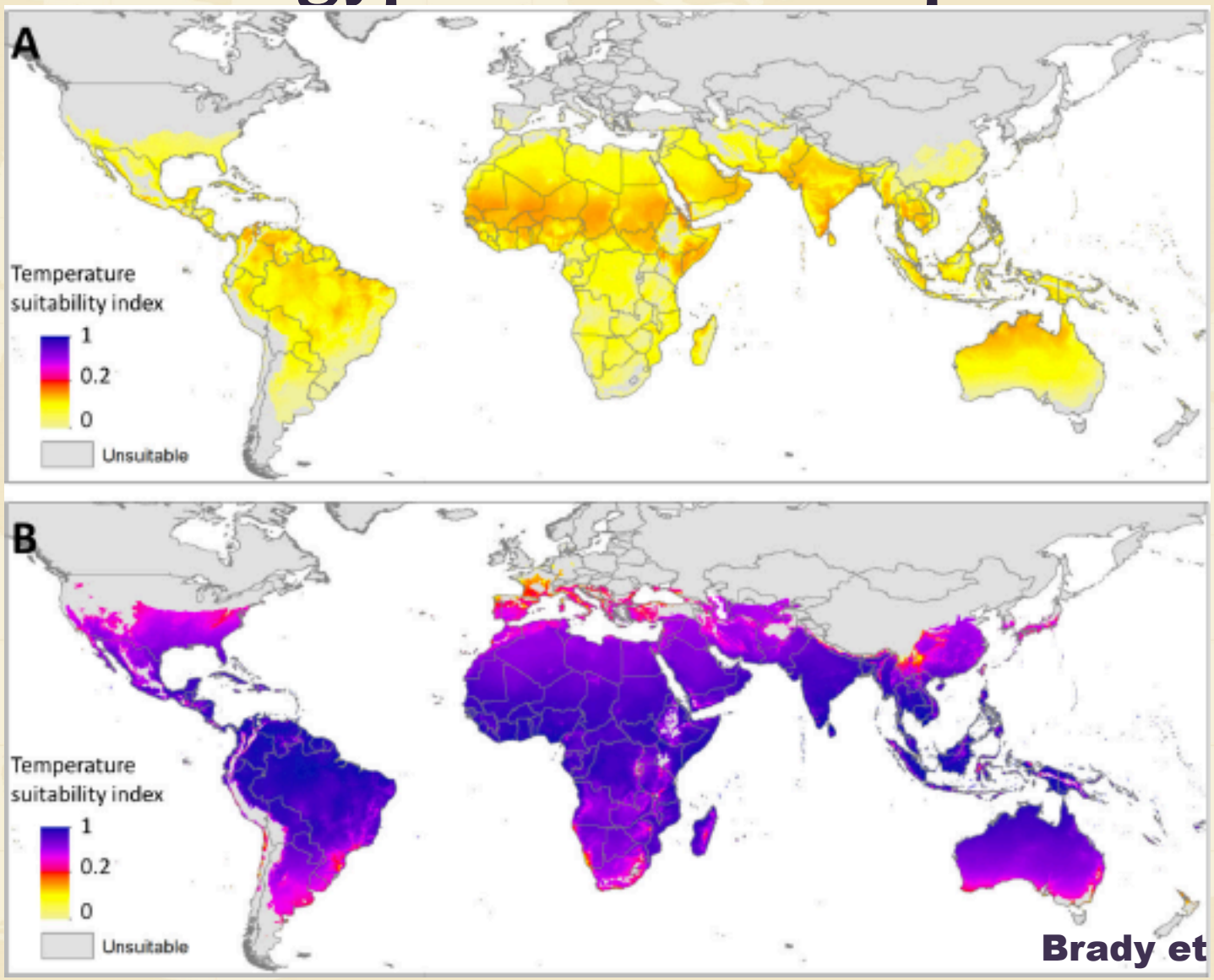
Semenza et al. 2014

Projected dengue distribution 2085



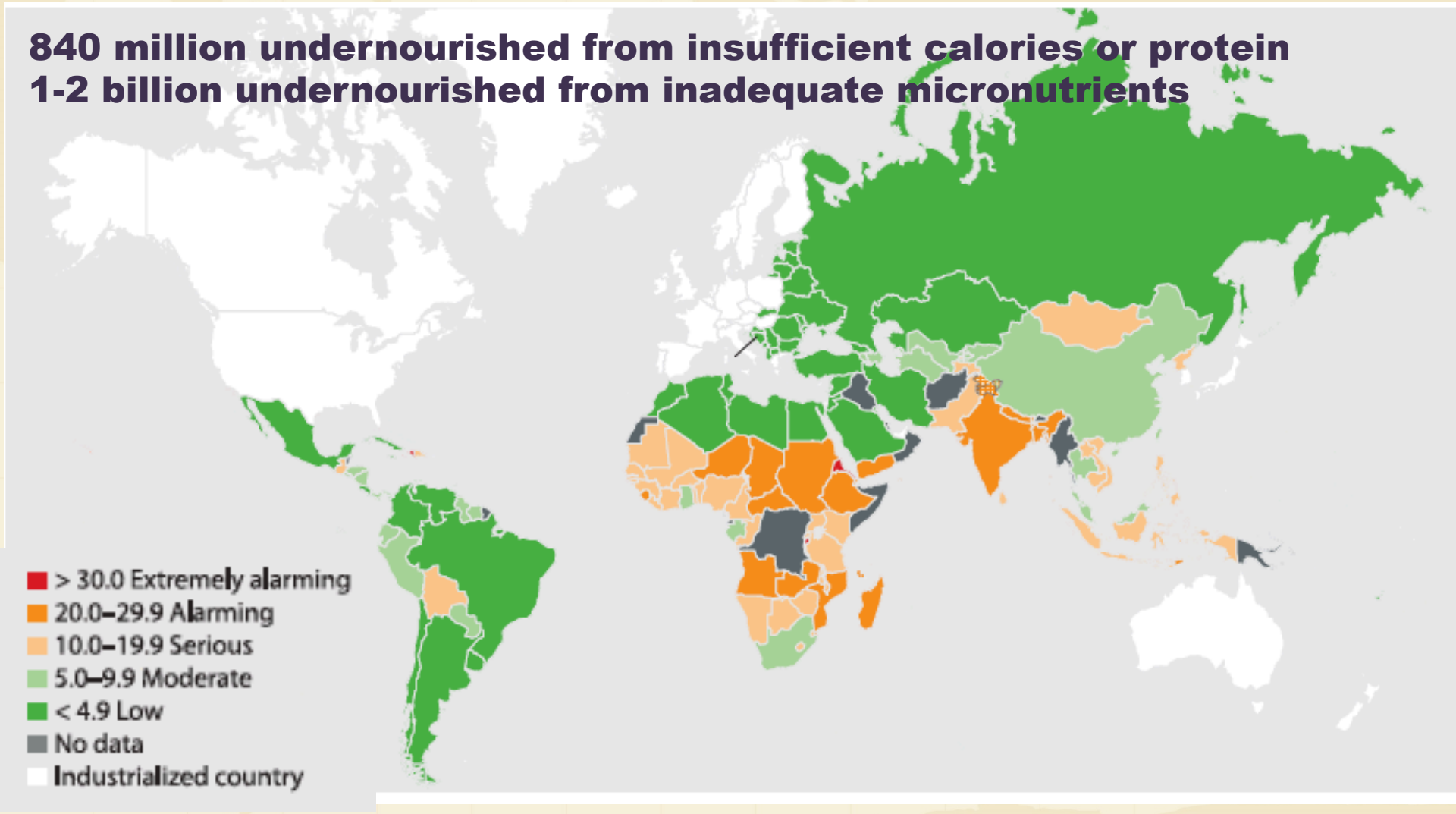
Messina et al. 2015

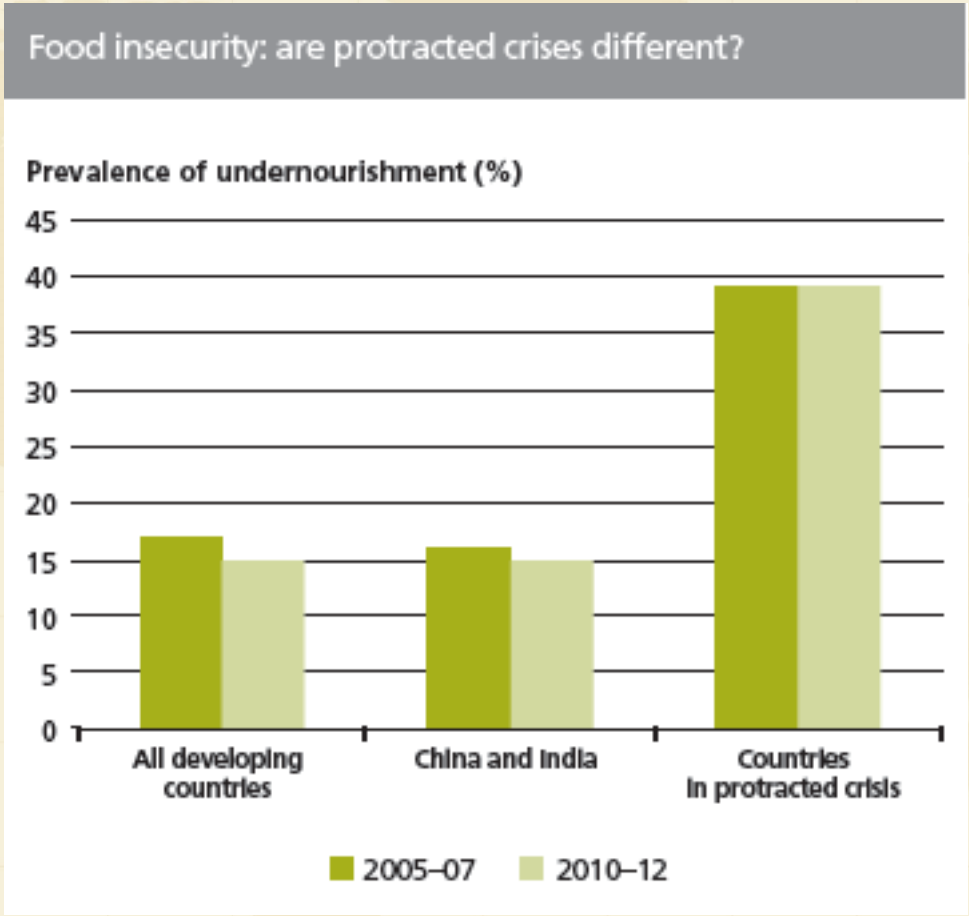
Comparative temperature suitability of Ae. aegypti and Ae. albopictus



Brady et al. 2014

Global hunger map: 2012



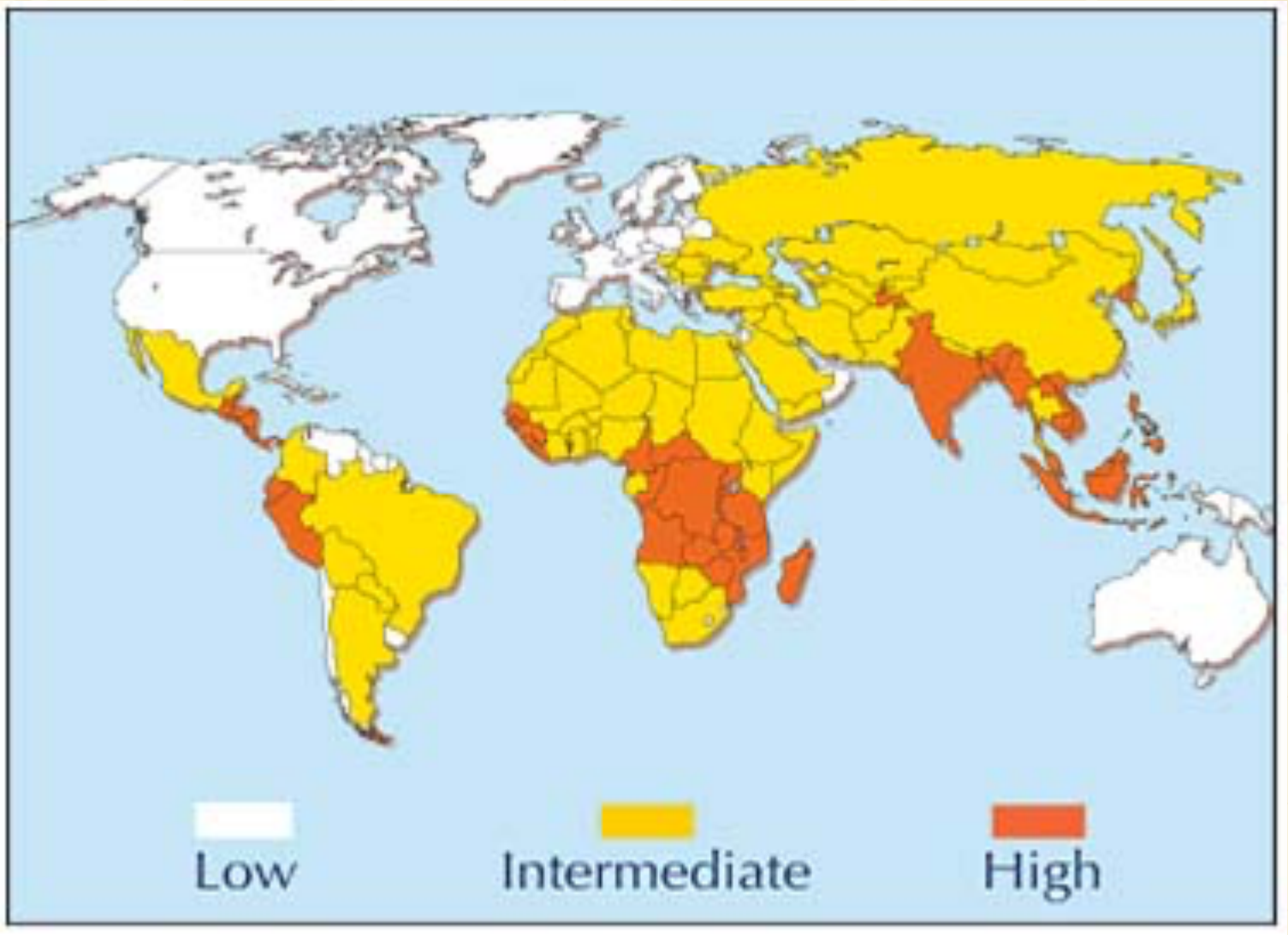


- In 2012, 366 million people in 20 countries lived in protracted crisis
  - 129 million were undernourished or 19% of the global total of food-insecure people
- Prevalence of undernourishment in these countries was 39% compared with 15% for the rest of the world

Typology of crises shifted over the past 30 years to more structural, longer-term, and protracted situations resulting from a combination of factors, especially natural disasters and conflicts, with climate change increasingly among the exacerbating factors

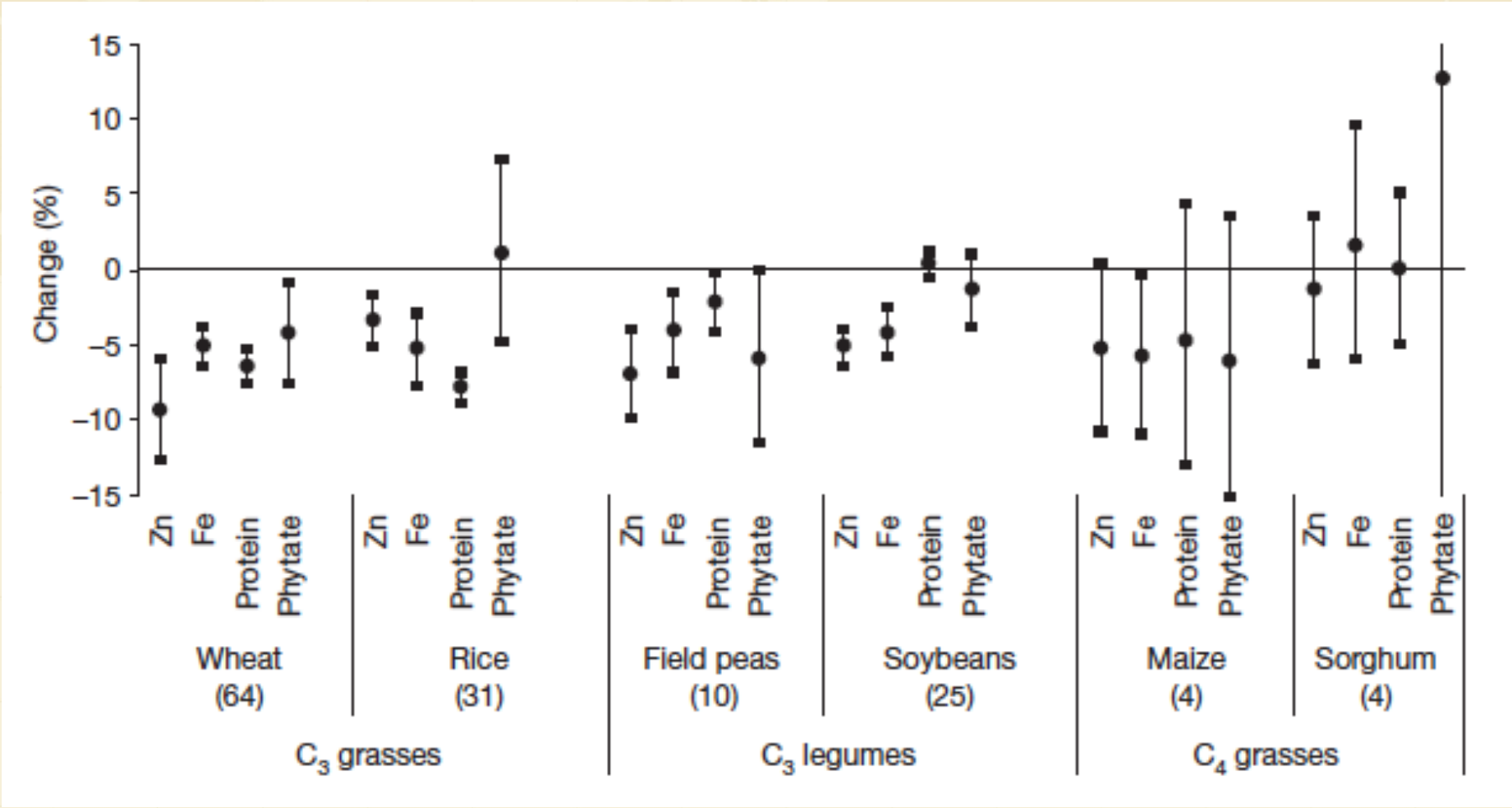
FAO 2015

Zinc deficiency risk



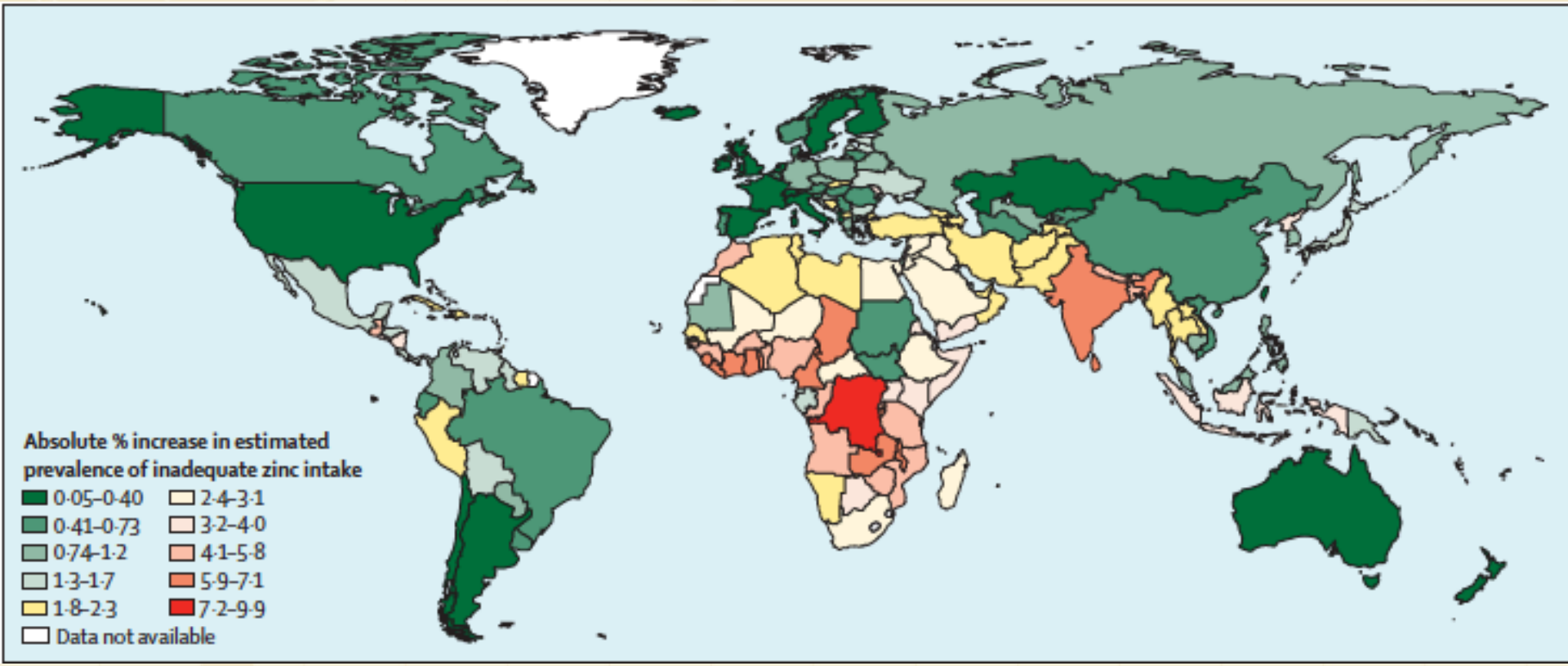
http://www.izincg.org/

% change in nutrients in elevated (~ 550 ppm) vs. ambient CO2



Myers et al. 2014

Absolute % increase in risk of zinc deficiency in response to elevated CO_2



Myers et al. 2015