Fungal Pathogens and Climate Change

Sarah Ahmed, Phd

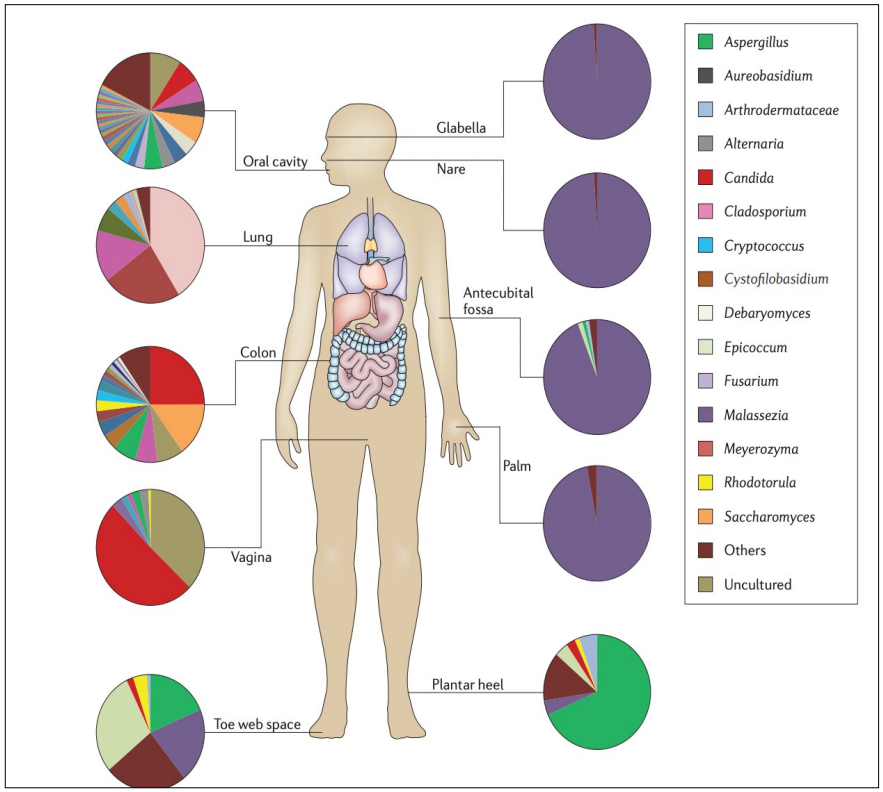
Center of Expertise in Mycology,
RadboudUMC / CWZ

Fungi are Useful and Harmful

Fungal Conservation

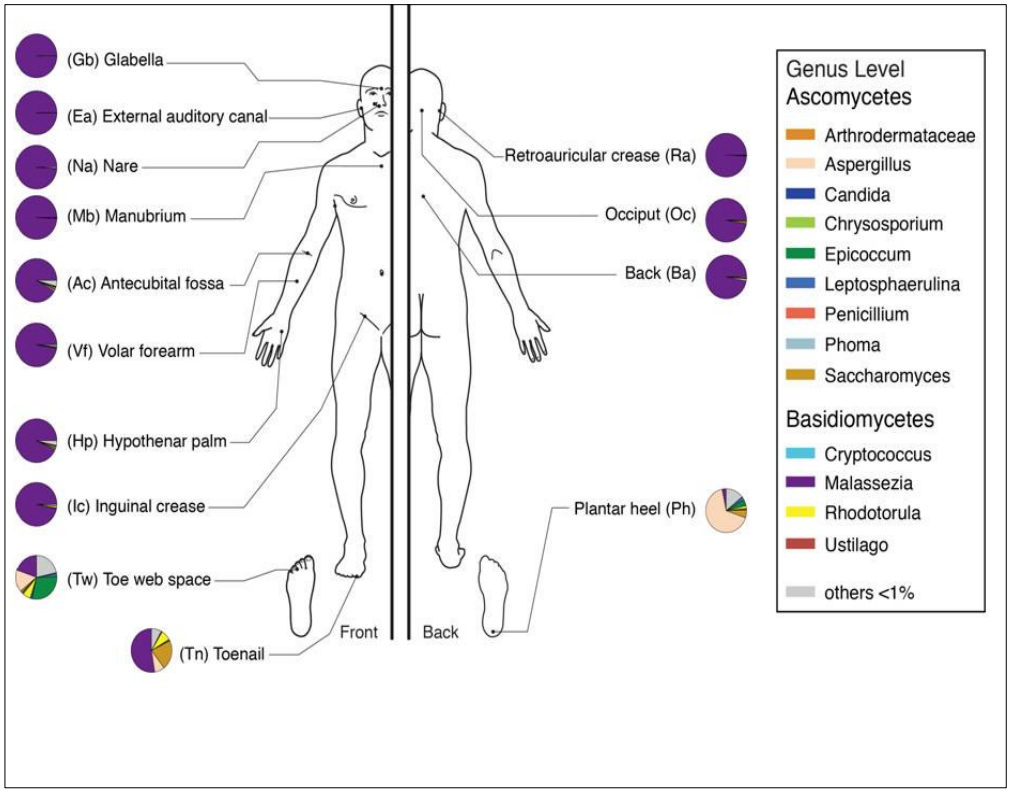
Medical Mycologist

The microbiome in humans



Human body microbiota

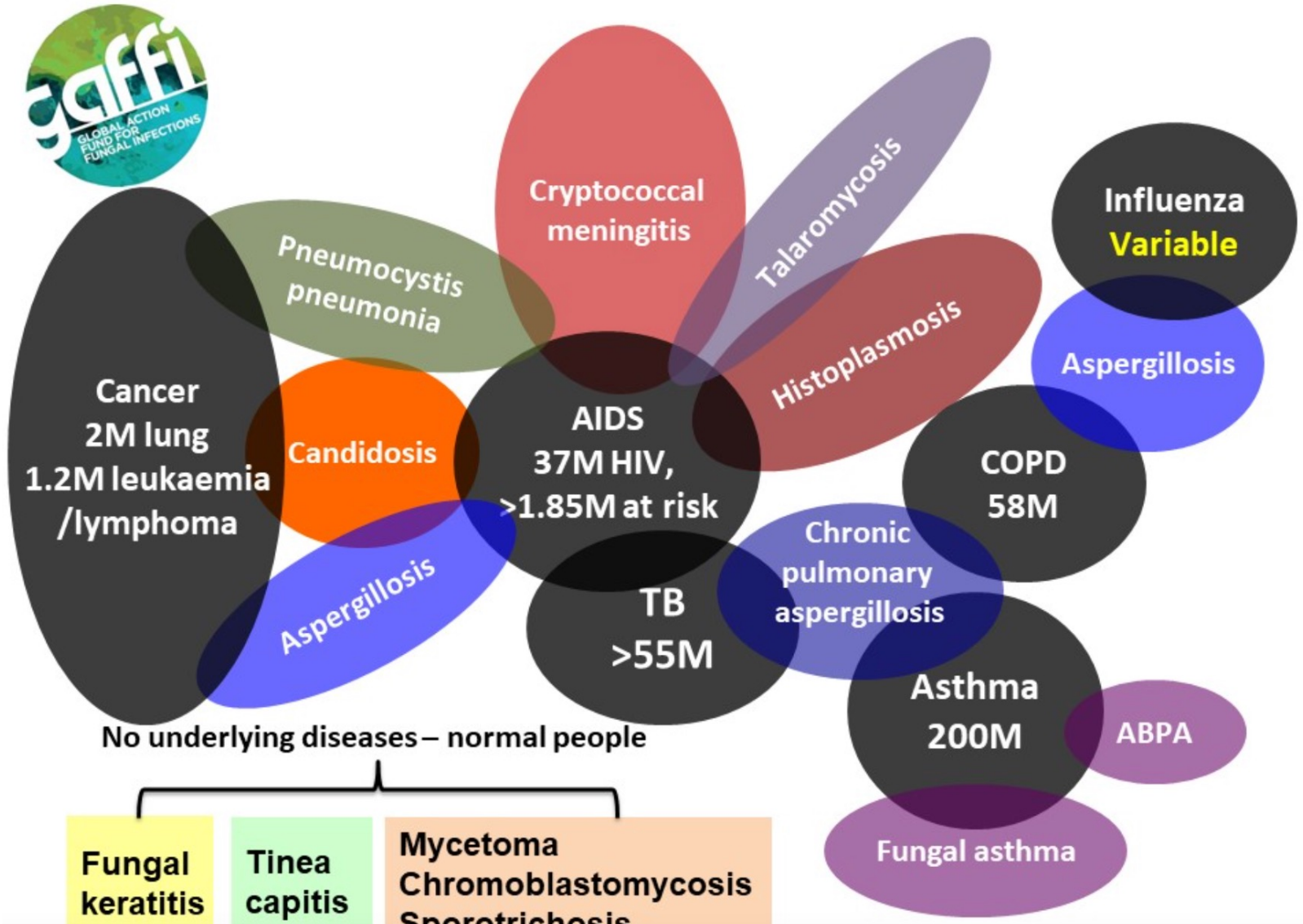
Underhill DM, Iliev ID. doi: 10.1038/nri3684.



Skin mycobiome

Kong HH, Segre JA.doi: 10.1016/j.jid.2016.07.045. PMID: 28411842.

Fungal infections in humans



Burden of fungal diseases

Fungal infection	Number affected	Case fatality rate	Estimated deaths	Comments
Cryptococcal meningitis	223,000 in AIDS	15-20% USA >50% developing world	180,000 in AIDS	CDC estimate
Pneumocystis pneumonia	>400,000 in AIDS >100,000 in non-AIDS	~15% in AIDS with best treatment ~50% in non-AIDS	>200,000 in AIDS >50,000 non-AIDS	Most cases in Africa not diagnosed and 100% mortality
Disseminated histoplasmosis	~100,000	15-30%, if diagnosed and treated	>80,000	Most common in the Americas
Invasive aspergillosis	>1,000,000	~30% mortality in leukaemia in HIC ~45-70% in COPD ~30% mortality if treated in HIC -in AIDS ~50% non-AIDS, in HIC	>500,000 >30,000 in AIDS >125,000 in non-AIDS	Many missed diagnoses globally
Invasive candidiasis	>750,000	~40% mortality treated	>350,000	
Chronic pulmonary aspergillosis	>3,000,000	~15-40% mortality in HIC ~15% mortality in the developed world	>450,000 in non hospitalised populations	Under-diagnosed and mistaken for tuberculosis
Severe asthma with fungal sensitisation (SAFS)	>6,500,000	<1% but no good figures.	350,000 - 489,000 asthma deaths ~50% related to SAFS	Uncertain
Fungal keratitis	1-0-1.4 m	60%	>600,000 bl	Diagnosis often late
Total	~13,500,000		>1,600,000	Probably a significant underestimate

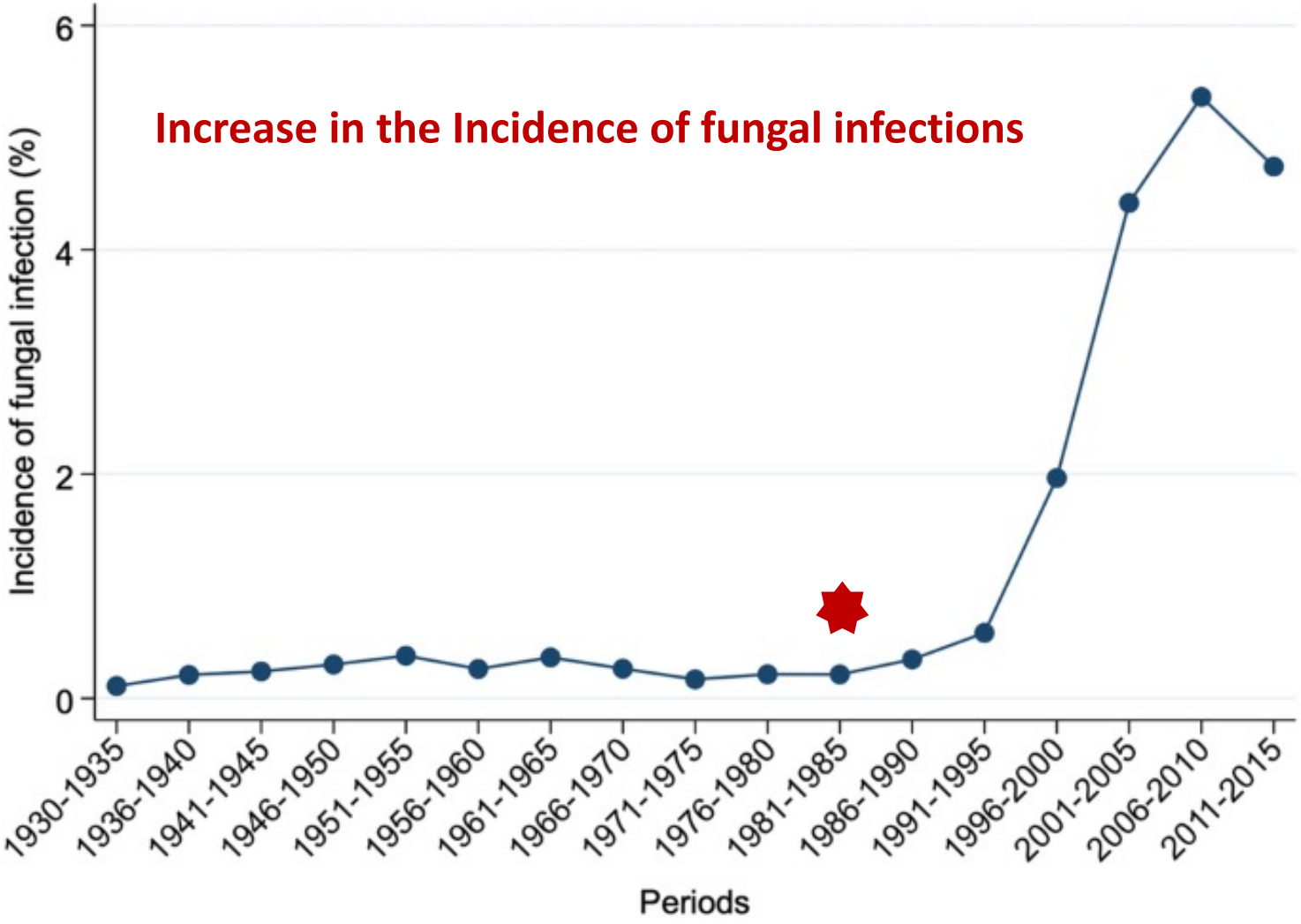
? 100%

13 M

1.6 M

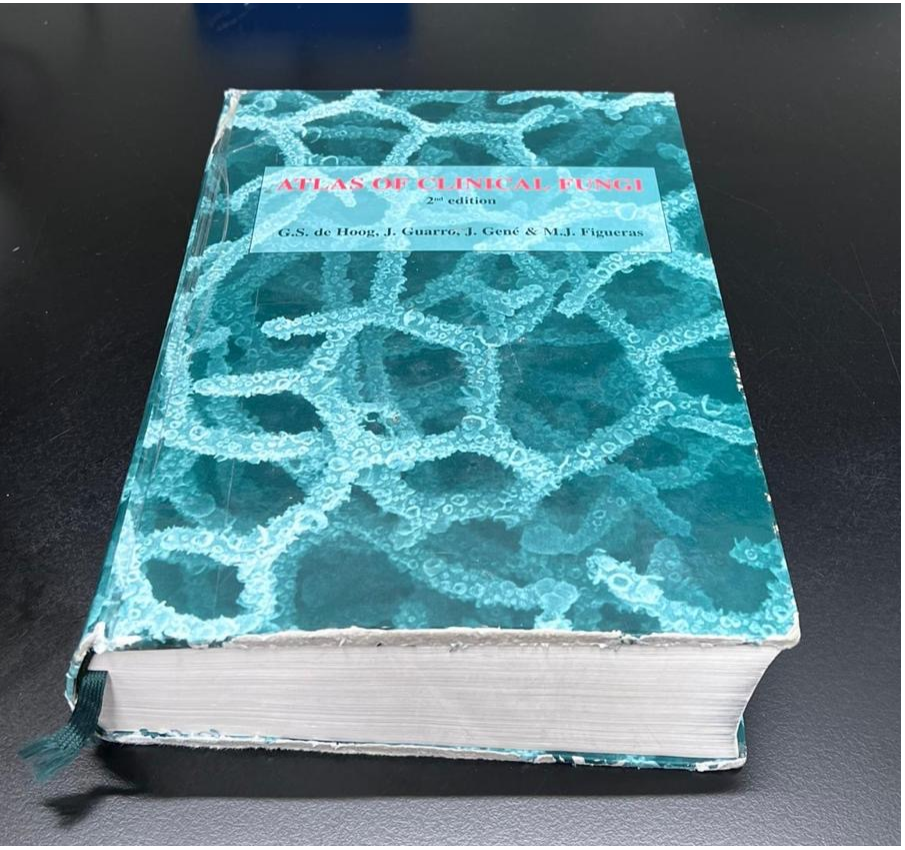
www.gaffi.org

Opportunistic fungal infections



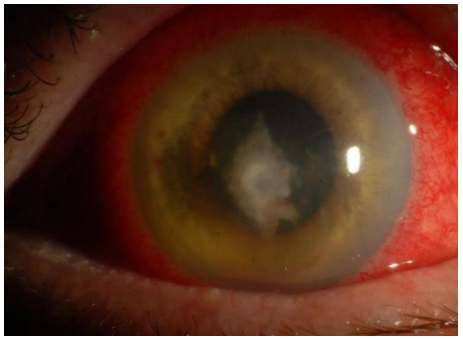
Dantas KC, et al. doi: 10.1038/s41598-021-83587-1.

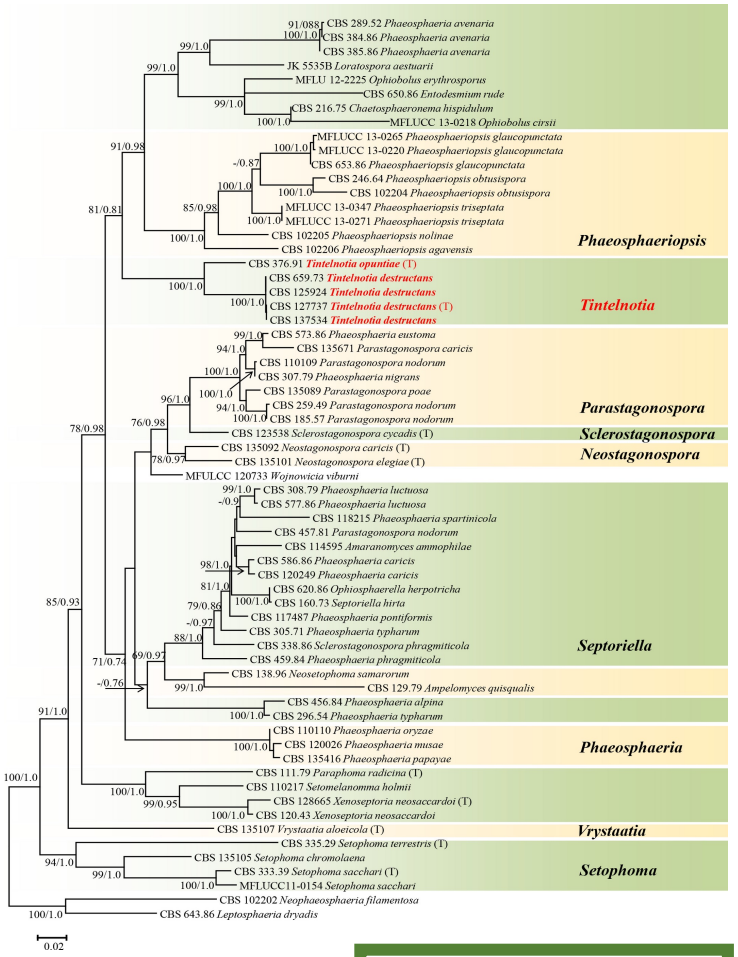
Clinically important fungi



Atlas of Clinical Fungi (2004)
390 species

Atlas of Clinical Fungi (2020)
720 species





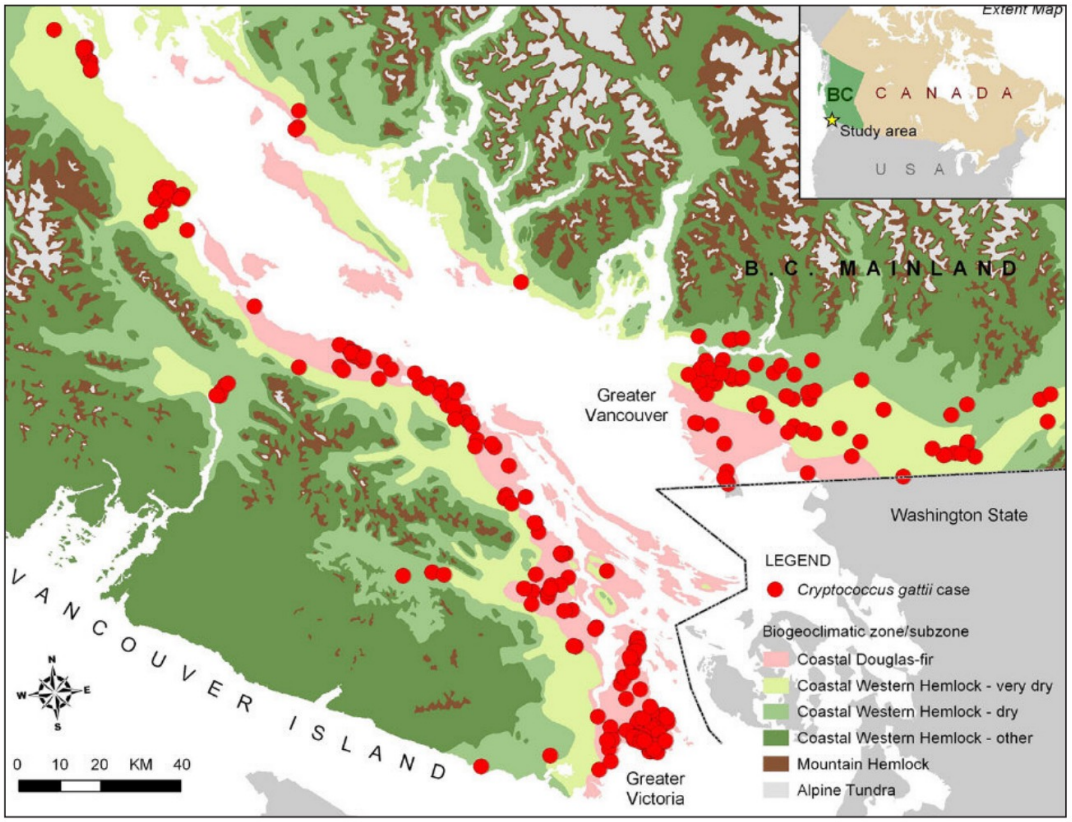
Tintelnotia, a new genus in *Phaeosphaeriaceae* harbouring agents of cornea and nail infections in humans

S. A. Ahmed[1] | W. Hofmüller[2] | M. Seibold[3] | G. S. de Hoog[4,5] | H. Harak[6] | I. Tammer[7] | A. D. van Diepeningen[4] | W. Behrens-Baumann[2]

Germany
Italy
Finland
The Netherlands
Belgium

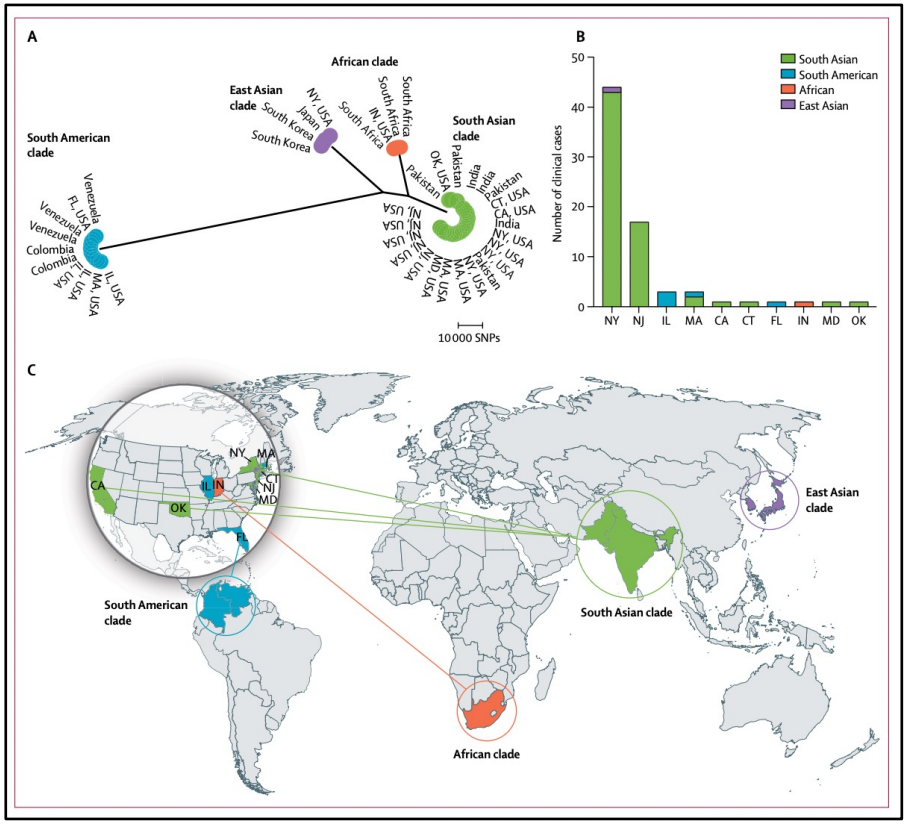
Emerging pathogen - *Cryptococcus gattii*

- Vancouver Island and British Columbia (1999)
- Pneumonia or meningitis 36 cases/million population/year during.
- The fungus (resist, survive, dispersal) present in a high concentrations in the environment.



Hoang LMN, et al. doi: 10.1016/j.clinmicnews.2011.11.003.

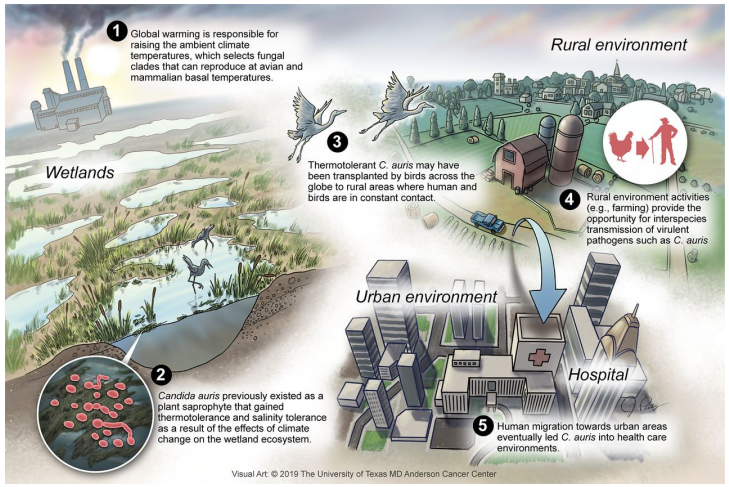
Emerging pathogens- *Candida auris*



In the news

CANDIDA AURIS' POTENTIAL LINK TO CLIMATE CHANGE

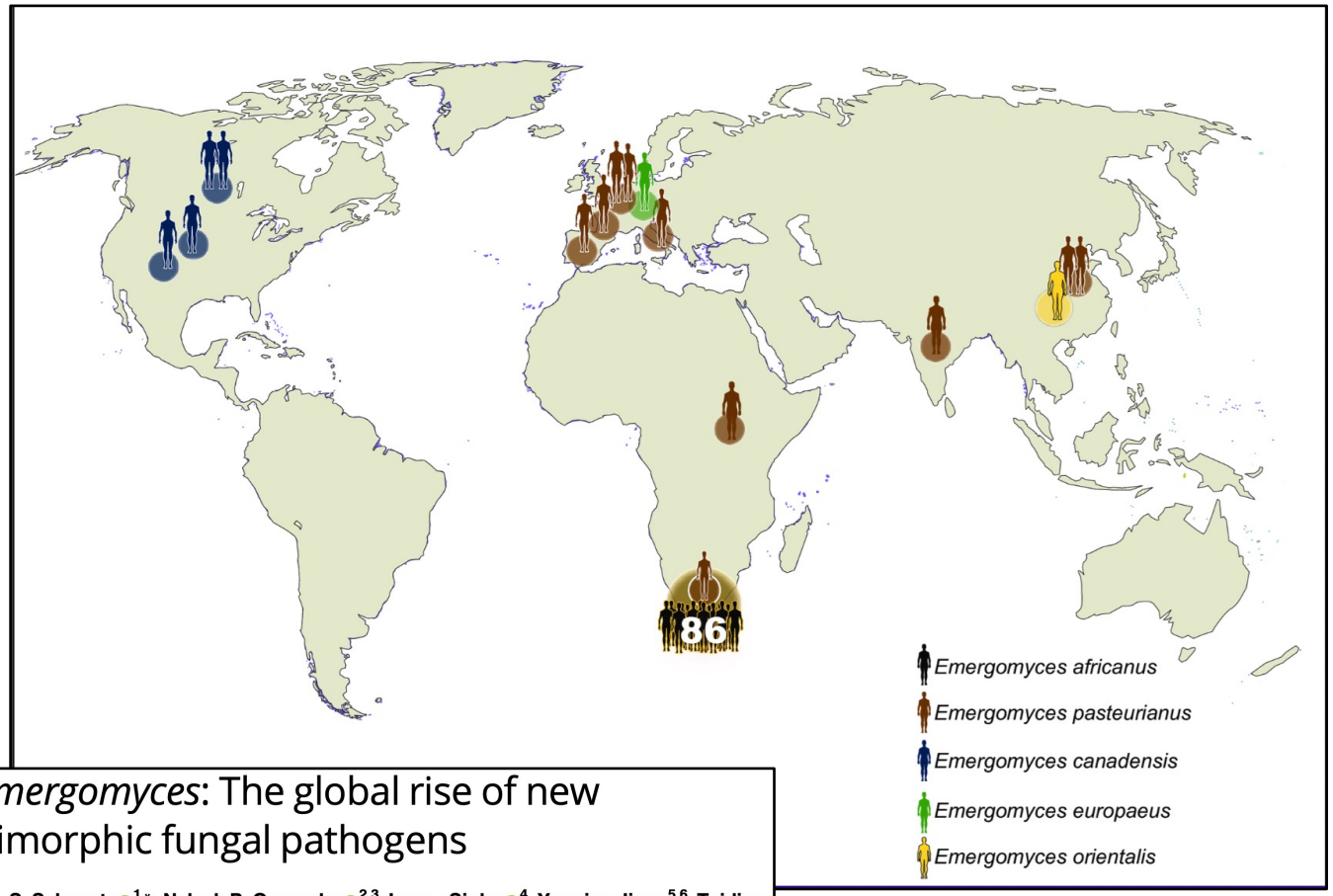
Since its first identification in an ear canal swab from a Japanese hospital patient in 2009, several different lineages of the pathogenic fungus *Candida auris* have emerged independently. *C. auris* is difficult to diagnose and treat, often exhibiting multidrug resistance and causing outbreaks



- Emerged simultaneously in four global regions.
- Multidrug resistant.
- Emergence linked to climate change.

Chow NA, et al. doi: 10.1016/S1473-3099(18)30597-8

Emerging pathogens - *Emergomyces*



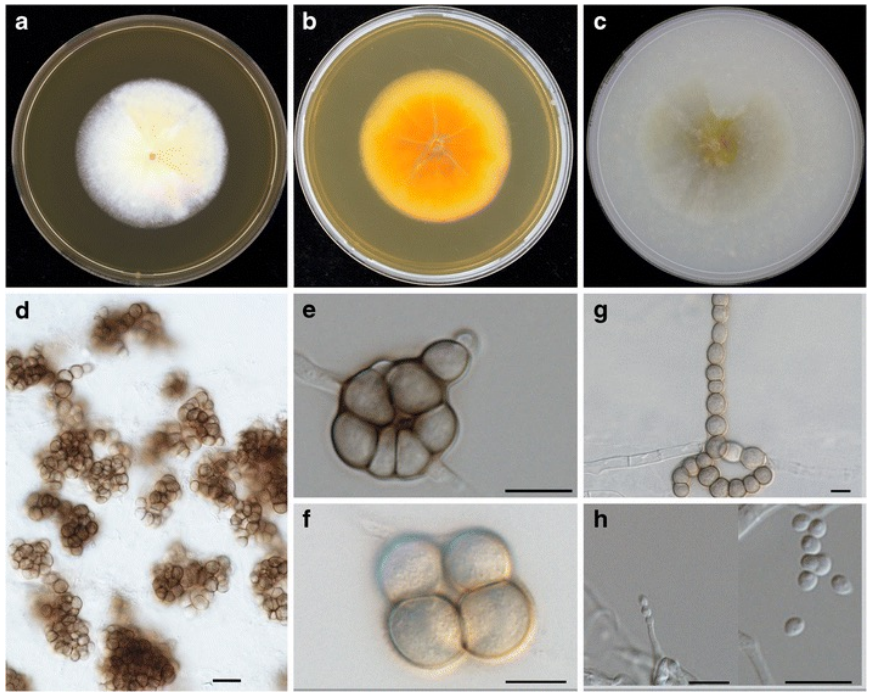
Emergomyces: The global rise of new dimorphic fungal pathogens

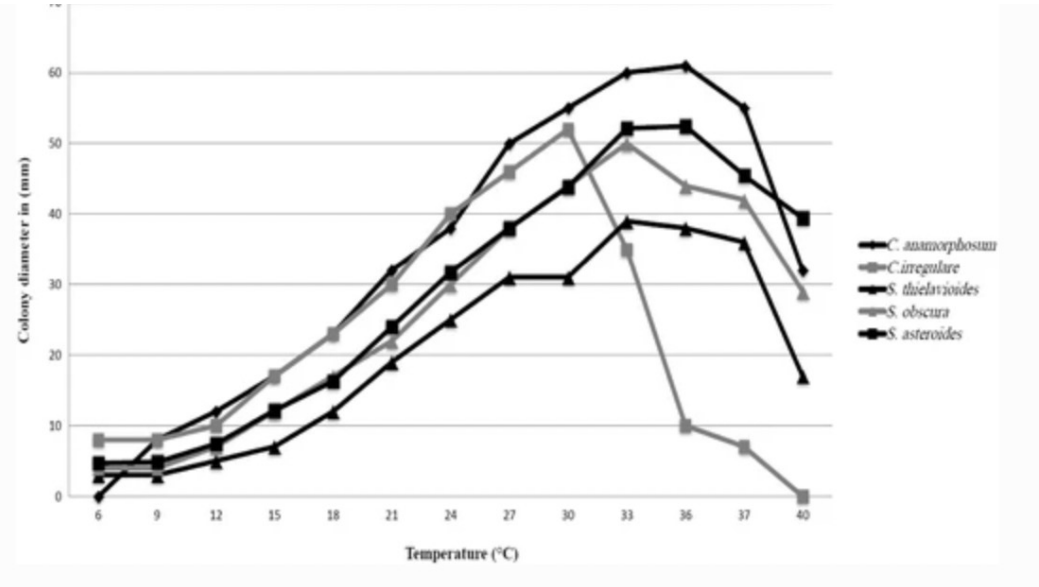
Ilan S. Schwartz[1]*, Nelesh P. Govender[2,3], Lynne Sigler[4], Yanping Jiang[5,6], Tsidiso G. Maphanga[2,7], Barbra Toplis[8], Alfred Botha[8], Karolina Dukik[5], J. Claire Hoving[9], Jose F. Muñoz[10], Sybren de Hoog[5,11], Christina A. Cuomo[10], Robert Colebunders[12], Chris Kenyon[13,14]

Kenyon et al. A Dimorphic Fungus Causing Disseminated Infection in South Africa. 2013. N Engl J Med.

Successful pathogens

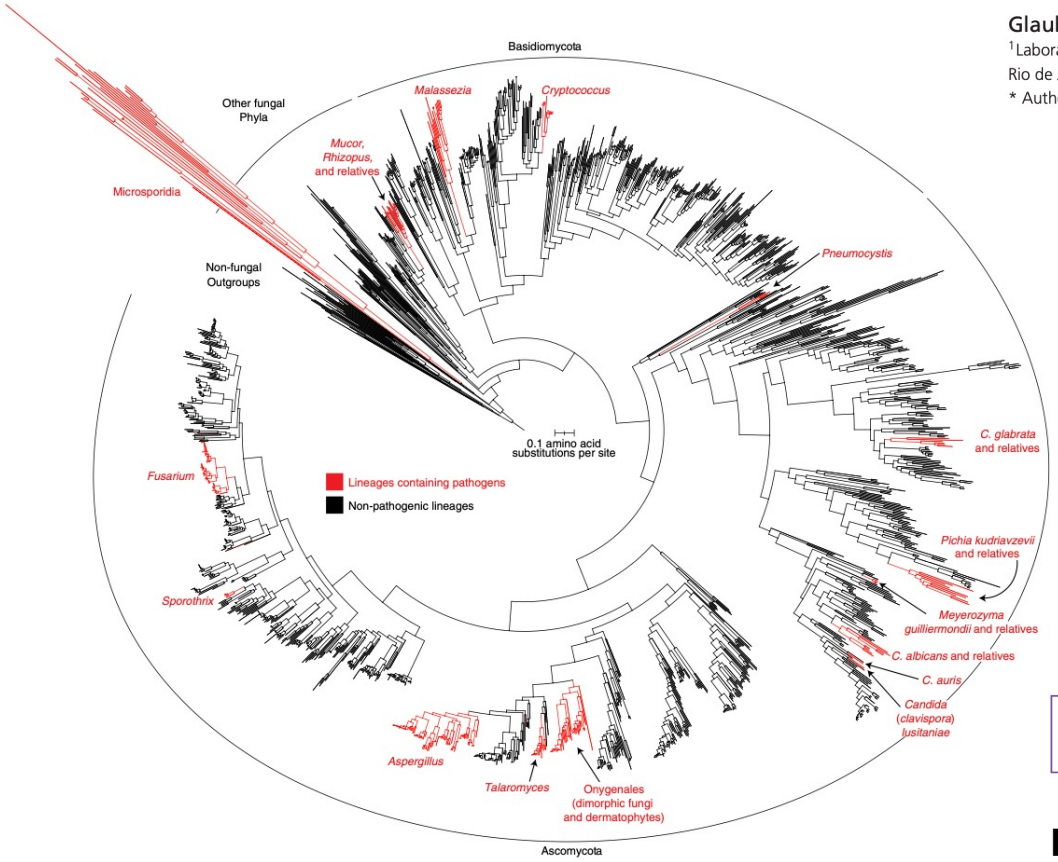
- Able to grow at **37℃** or above (**Casadevall**: fungal infection-mammalian selection)
  - emergence of mammals as the dominant land species (endothermy and homeothermy)
- Able to breakthrough the barriers and invade human host.
- Able to survive inside human body (lysis/absorption).
- Resist the immune system.





Chaetomium anamorphosum (Subramaniula anamorphosa) from peritonitis.

Ahmed SA, et al. doi: 10.1007/s13225-015-0338-5



The hidden pathogenic potential of environmental fungi

Glauber R de S Araújo[1], Wanderley de Souza[1] & Susana Frases*[,1]
[1]Laboratório de Ultraestrutura Celular Hertha Meyer, Instituto de Biofísica Carlos Chagas Filho, Federal University of Rio de Jar
Rio de Janeiro, RJ, Brazil
* Author for correspondence: Tel.: +55 21 3938 6593; susanafrases@biof.ufrj.br

Fungi between extremotolerance and opportunistic pathogenicity on humans

Cene Gostinčar[1,2] · Janja Zajc[1,3] · Metka Lenassi[4] · Ana Plemenitaš[4] · Sybren de Hoog[5,6] · Abdullah M. S. Al-Hatmi[5,6,7] · Nina Gunde-Cimerman[1]

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nature microbiology
REVIEW ARTICLE
https://doi.org/10.1038/s41564-022-01112-0

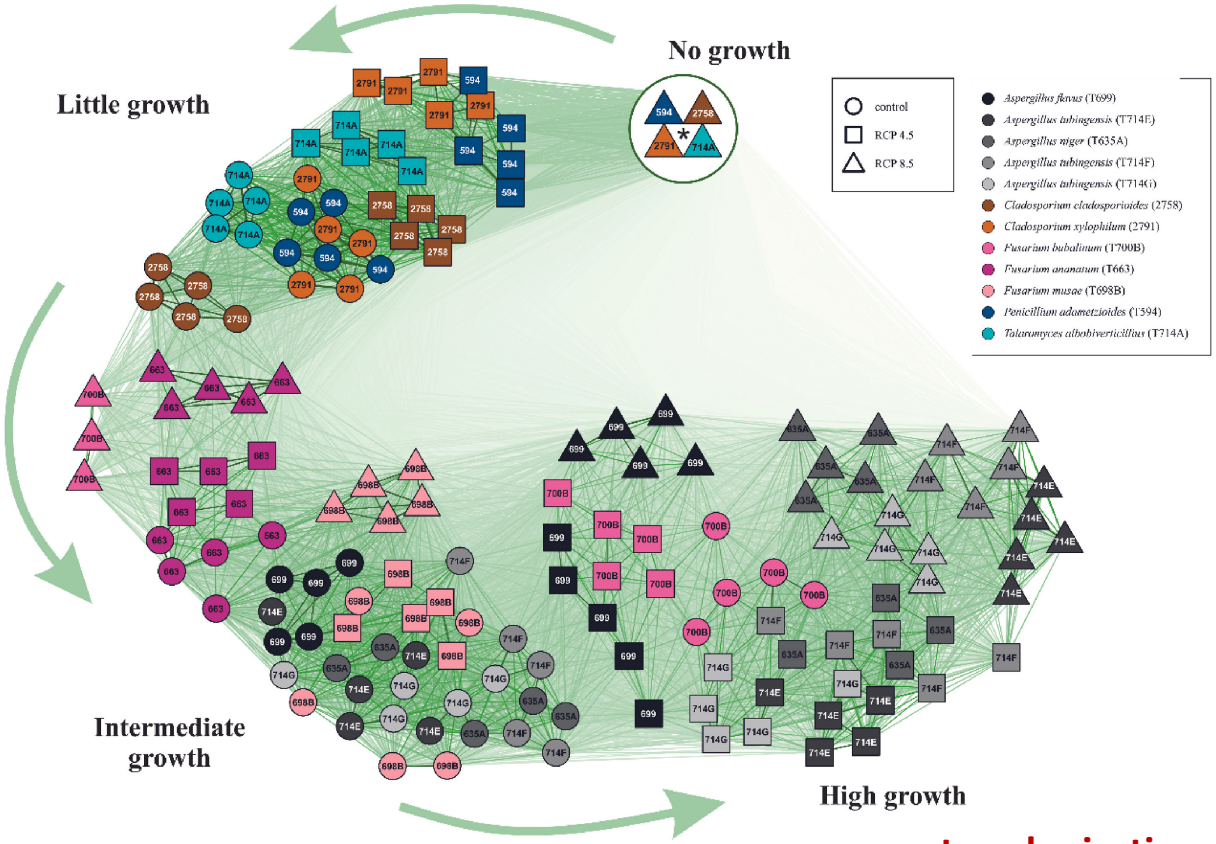
Evolution of the human pathogenic lifestyle in fungi

Antonis Rokas[1,2] ✉

Climate effect on fungal distribution

Pannonian Region in Europe

Aspergillus spp. and *Fusarium* strains from tropics tolerate heat waves.

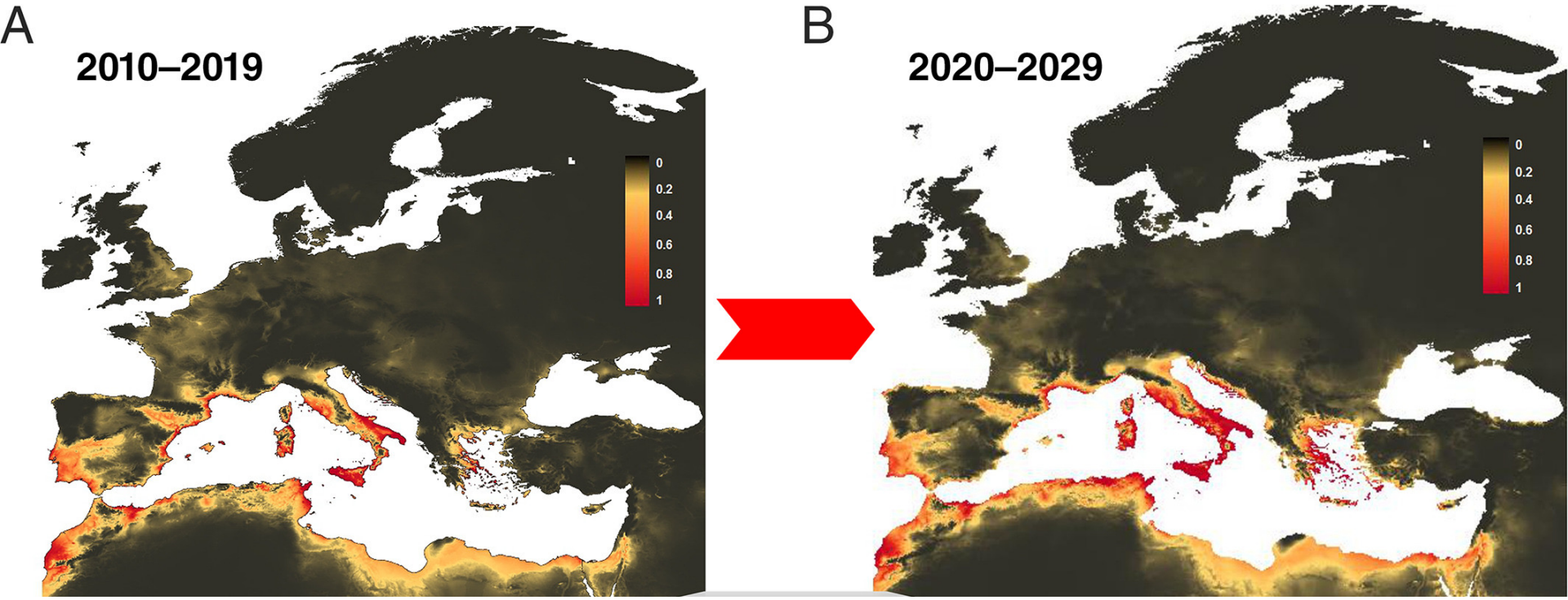


promote colonization growth

Survival and growth of microscopic fungi derived from tropical regions under future heat waves in the Pannonian Biogeographical Region

Zsófia Tischner [a], Anna Páldy [b], Sándor Kocsubé [c], László Kredics [c], Csaba Dobolyi [a], Rózsa Sebők [a], Balázs Kriszt [a], Bence Szabó [d], Donát Magyar [b]

Global warming and future outbreak

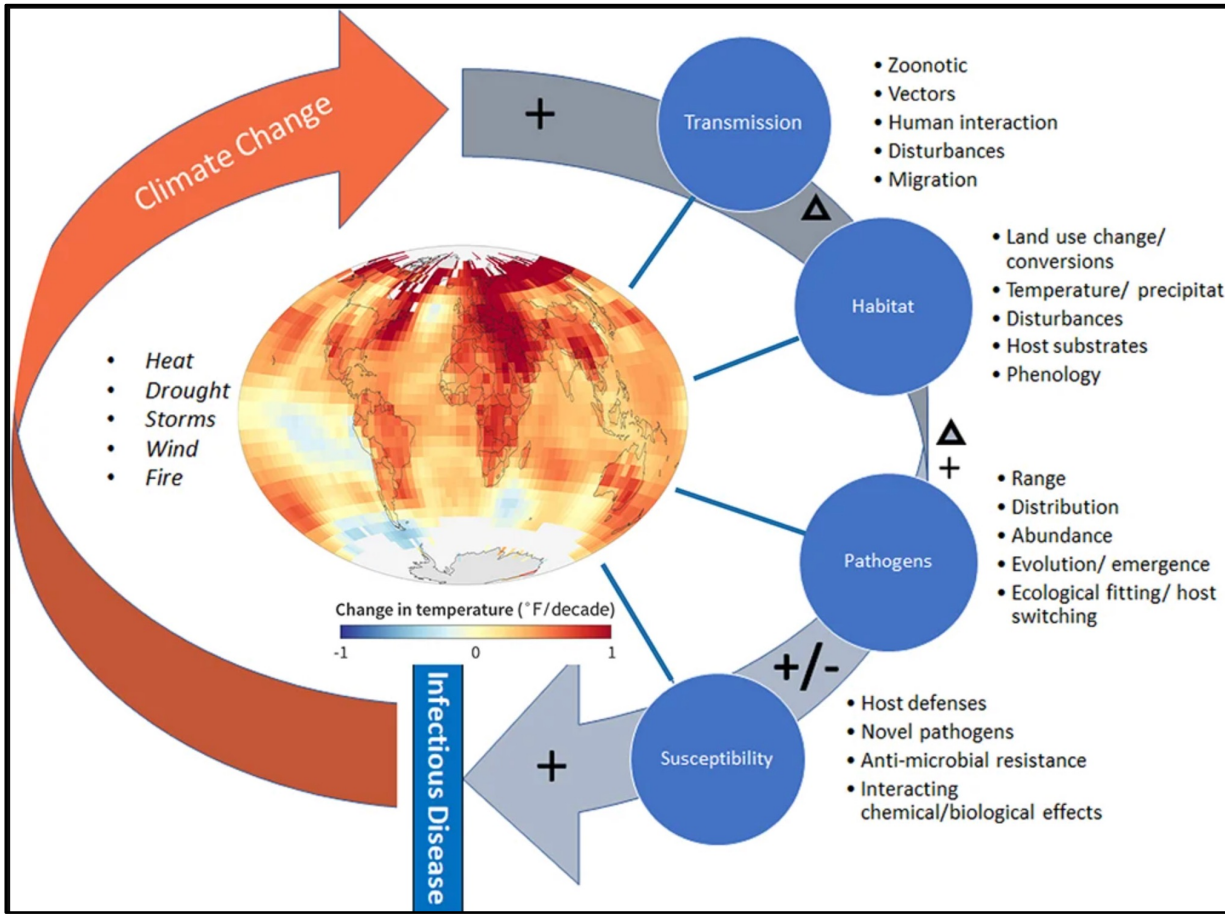


Global warming impact on the expansion of fundamental niche of *Cryptococcus gattii* VGI in Europe

- Niche modelling of *Cryptococcus gattii* VGI in Europe and Mediterranean.

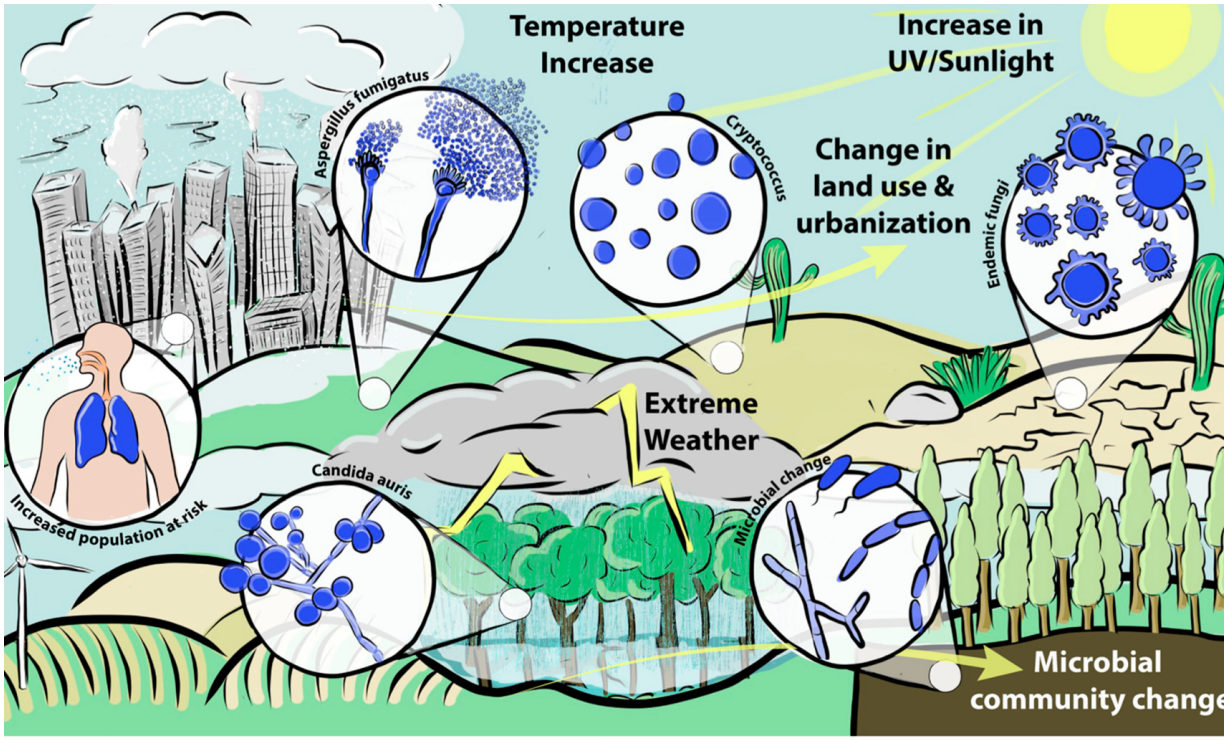
Cogliati M. doi: 10.1111/1758-2229.12945.

Global warming and infectious diseases



Hauser N, et al. doi: 10.1111/1758-2229.12945.

Global warming and new fungal pathogens



van Rhijn N, Bromley M.
doi:10.3390/jof7050367.

Thank you for your attention