Cambio Climático: Amenazas y desafíos para la salud pública en Sud América

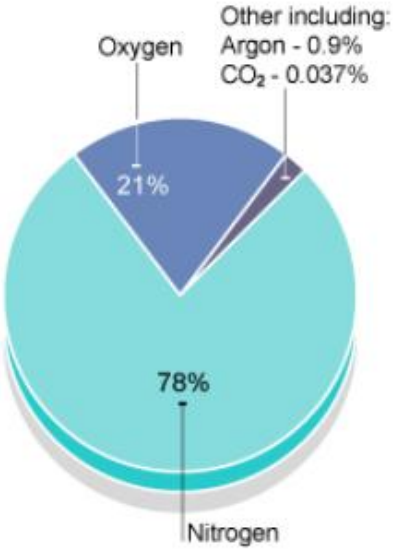
René D. Garreaud
DGF-UCh + CR2

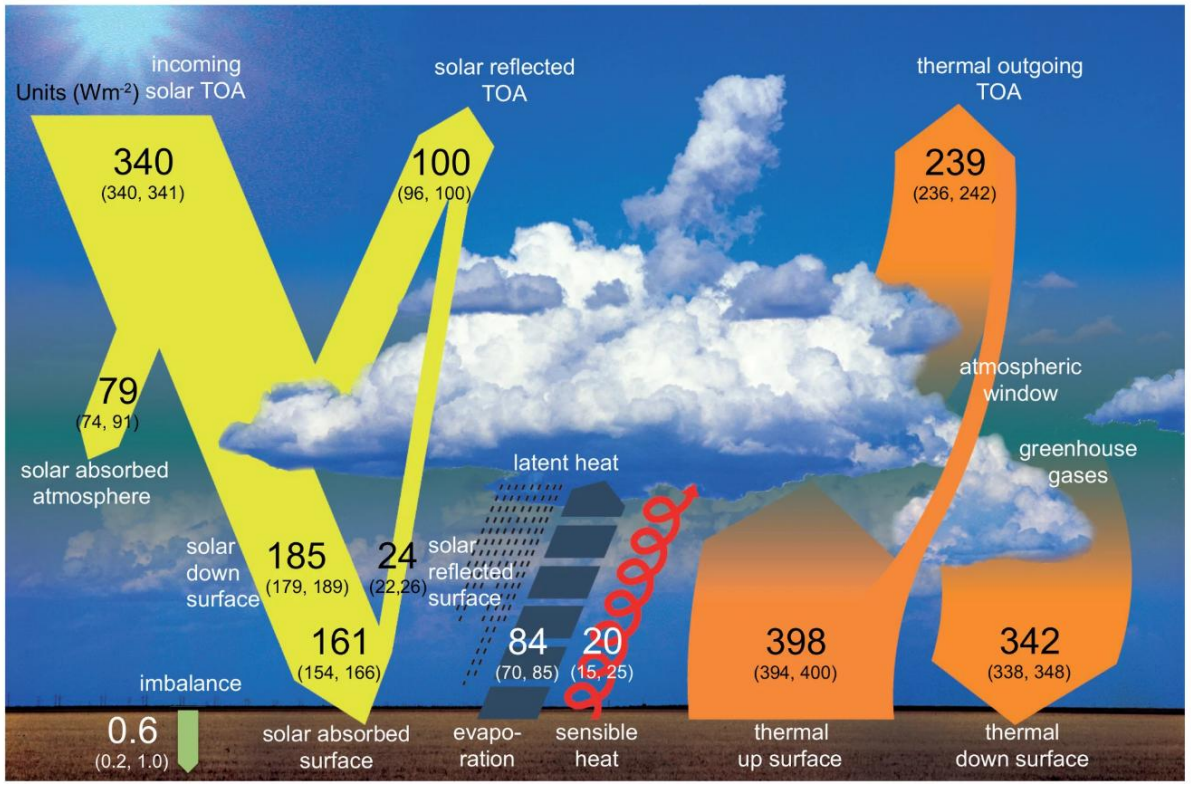
- Bases físicas del problema
- Cambios observados de Temperatura y Precipitación
- Como proyectamos el futuro climático?
- Impactos en Salud Pública
- No todo es cambio climático
- Comentarios finales

Efecto invernadero y cambio climático

Algo pequeño tiene un efecto grande….

CO2, CH4, H20 and other gasses absorb longwave radiation emitted by the surface….





Efecto invernadero y cambio climático

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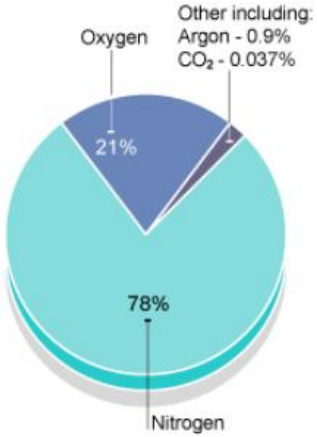
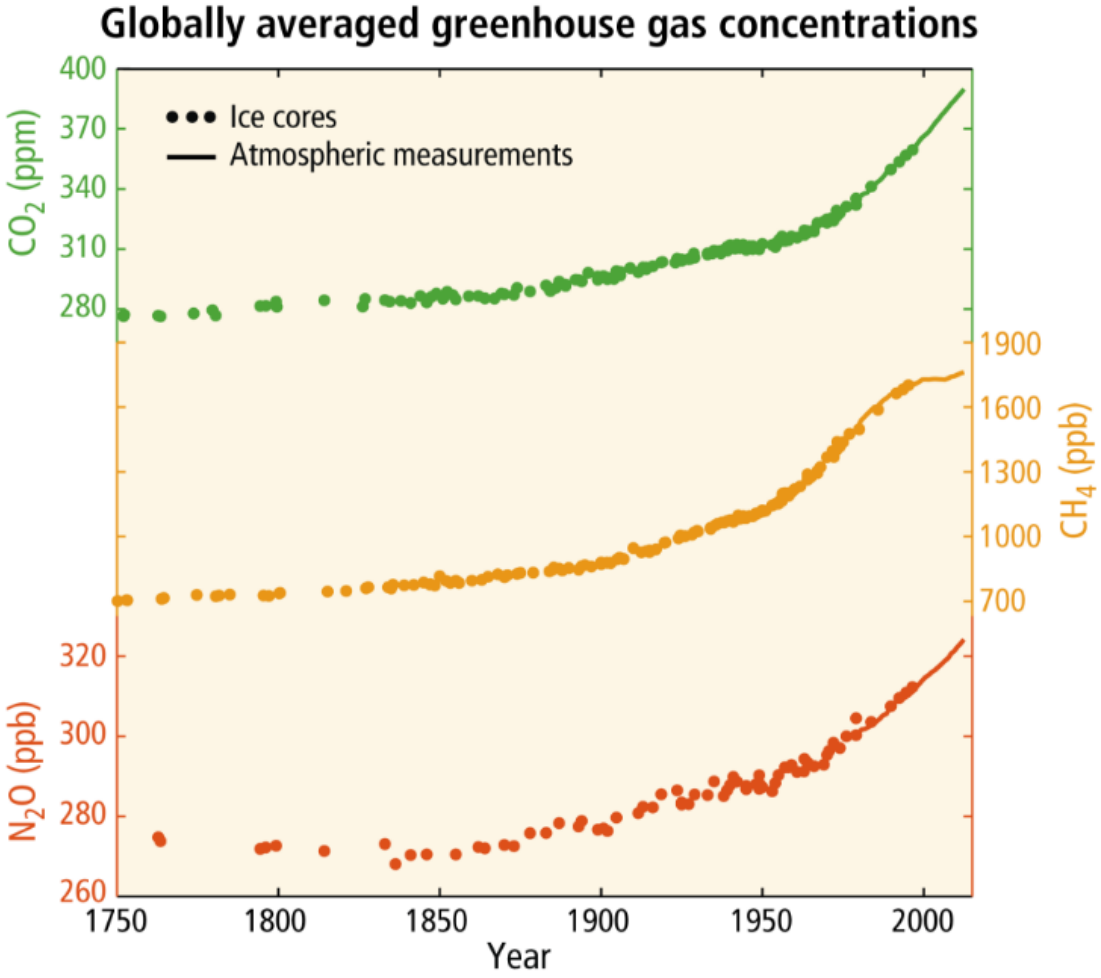
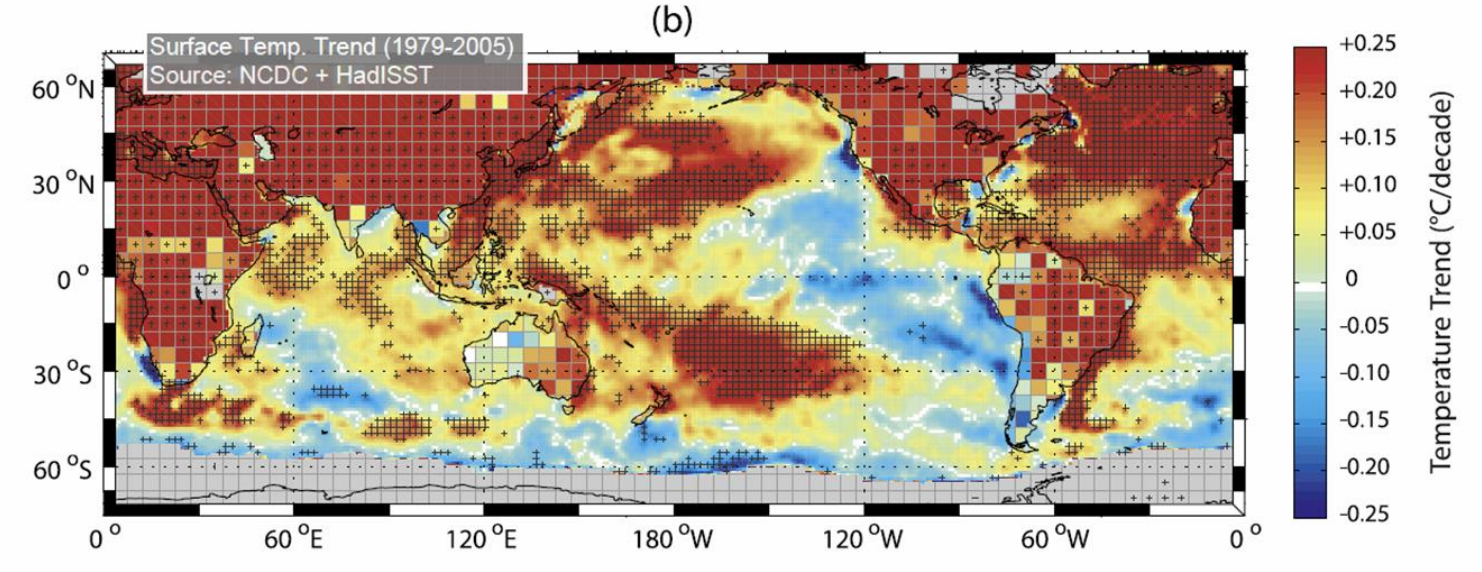


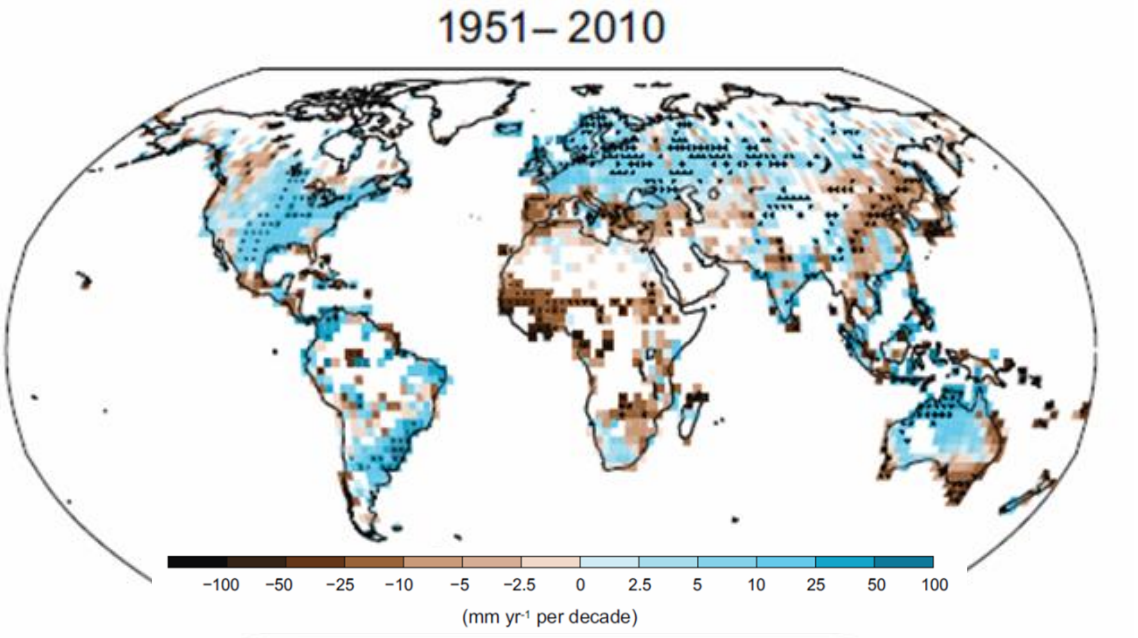


Signos Globales durante el antropoceno

Cambios Observados de Temperatura y Precipitación

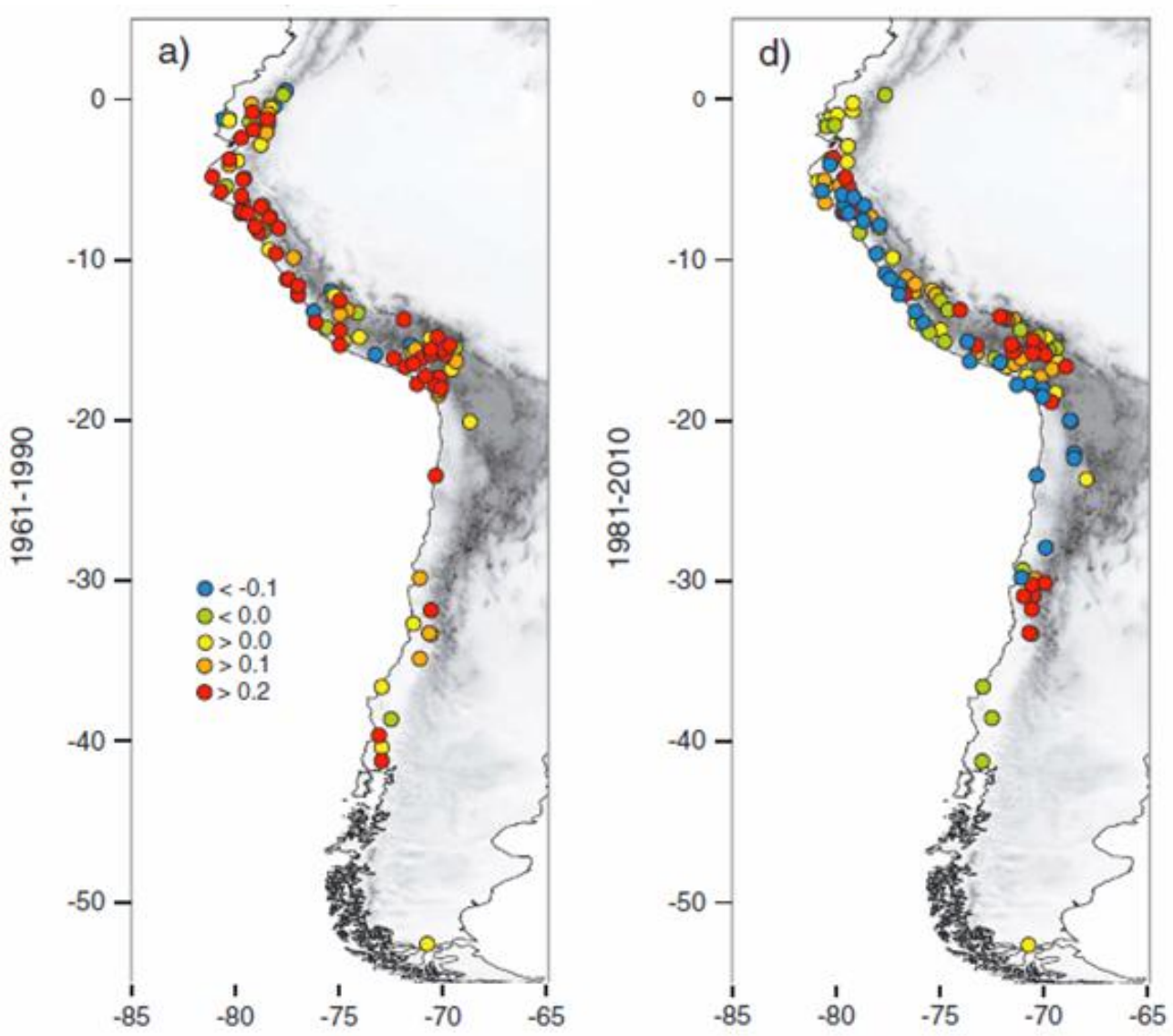


Falvey & Garreaud 2009



IPCC 2013

Cambios Observados de Temperatura



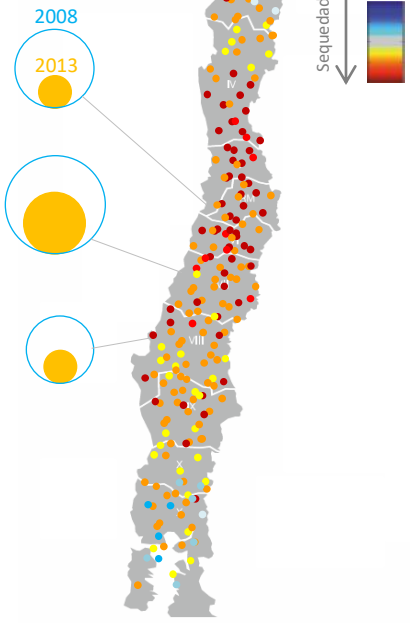
A lo largo de la costa, depende del periodo

En el interior y los Andes, calentamiento permanente

Vuille et al. 2015

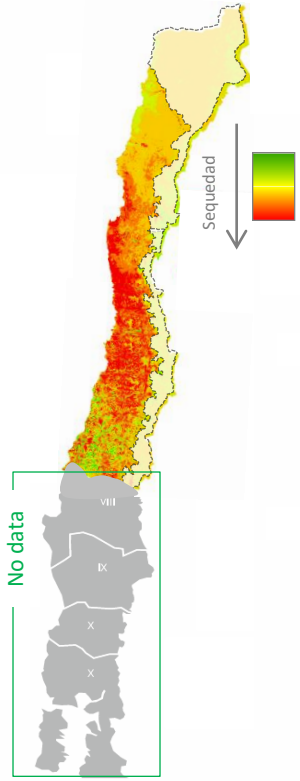
La Megasequía 2010-2018

Transporte de sedimentos en invierno

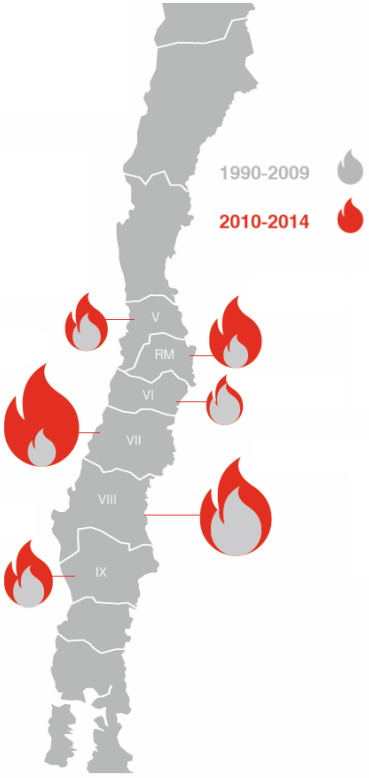


Déficit Pluviométrico (2010-2014)

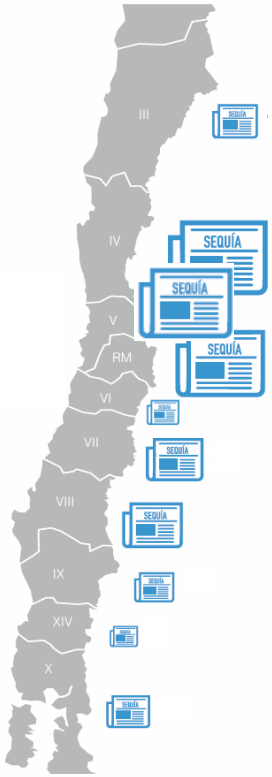
Deterioro vegetación Agosto 2010-2015



Incendios forestales de magnitud



Apariciones en prensa escrita (2014)



Gastos en Camiones Aljibes (Mill$)

Tendencias observadas de precipitación: ¿?

20TH CENTURY CLIMATE CHANGE IN THE TROPICAL ANDES: OBSERVATIONS AND MODEL RESULTS

MATHIAS VUILLE [1], RAYMOND S. BRADLEY [1], MARTIN WERNER [2] and FRANK KEIMIG [1]

[1] *Climate System Research Center, Dept. of Geosciences, Morrill Science Center, Univ. of Massachusetts, 611 North Pleasant Street, Amherst, MA 01003-9297, U.S.A.*
E-mail: mathias@geo.umass.edu
[2] *Max Planck Institute for Biogeochemistry, Jena, Germany*

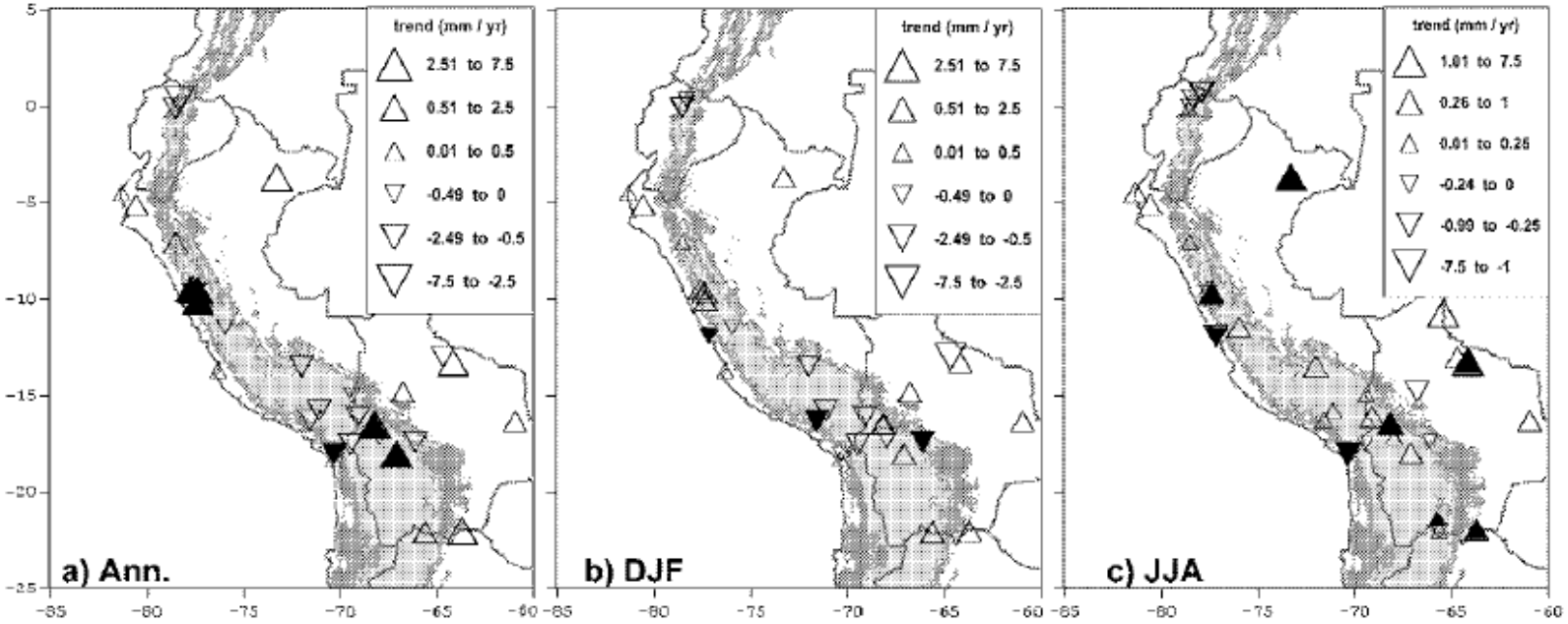


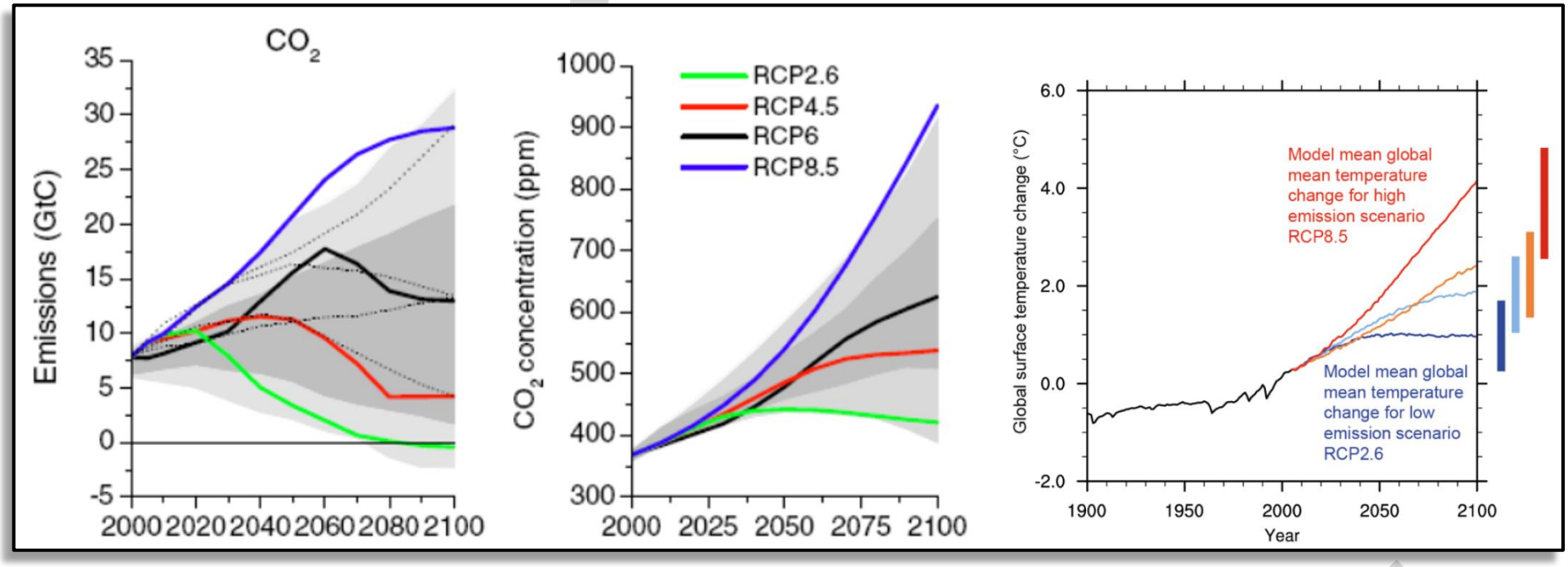
Figure 3. Trends in station precipitation (mm yr^{-1}) between 1950 and 1994 for (a) annual sum, (b) DJF, (c) JJA. Upward (downward) pointing triangles indicate an increase (decrease) in precipitation. Note different scaling in (c). Filled (open) triangles indicate that the trend is (not) significant at the 95%-confidence level. (d) As in (a) but trend in annual precipitation (in % yr^{-1}) versus elevation.

And What Next...

How much CO2 will be emitted in the future ?

Socio-economic development pathways

Climate Scenarios



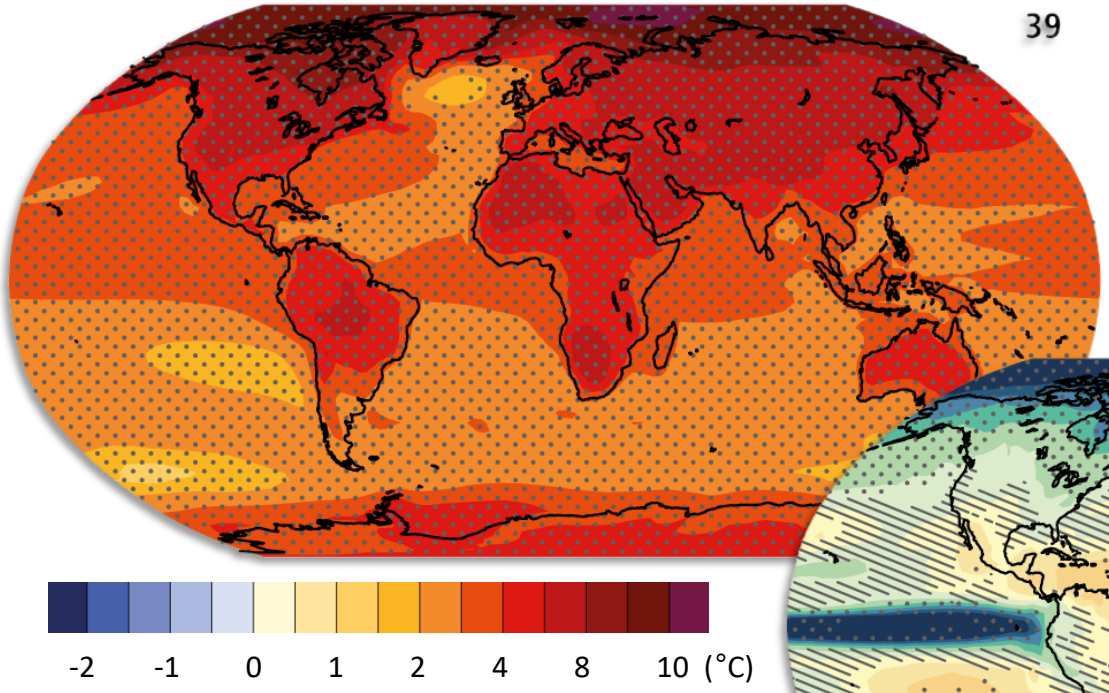
Balance
De Masa

GCMs (more than 40)

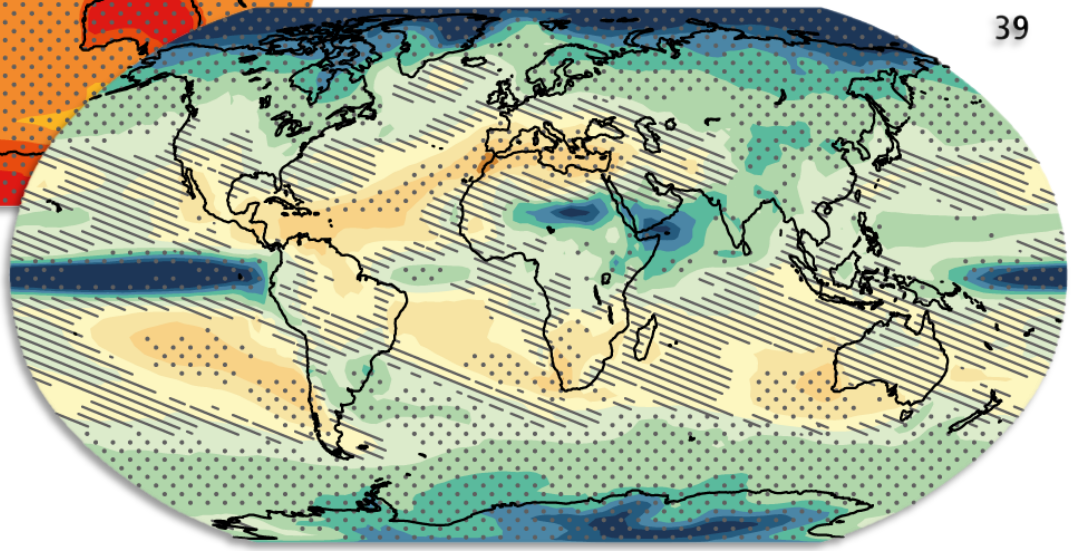
Proyecciones Climáticas Globales

para fines del siglo XXI bajo escenario RCP8.5
(1000 ppm CO2 a fines de siglo)
Promedio 39 GCM

Temperatura

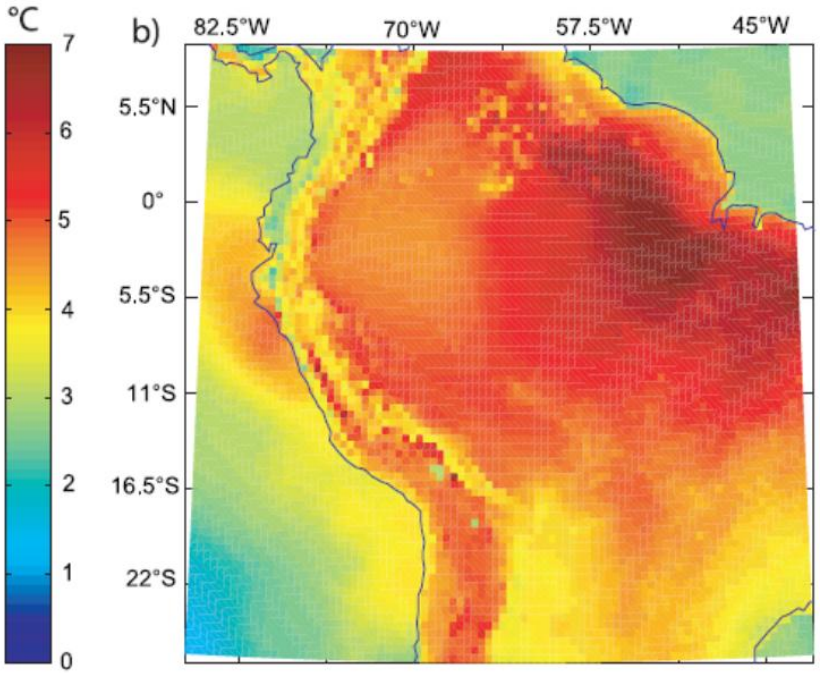


Precipitación



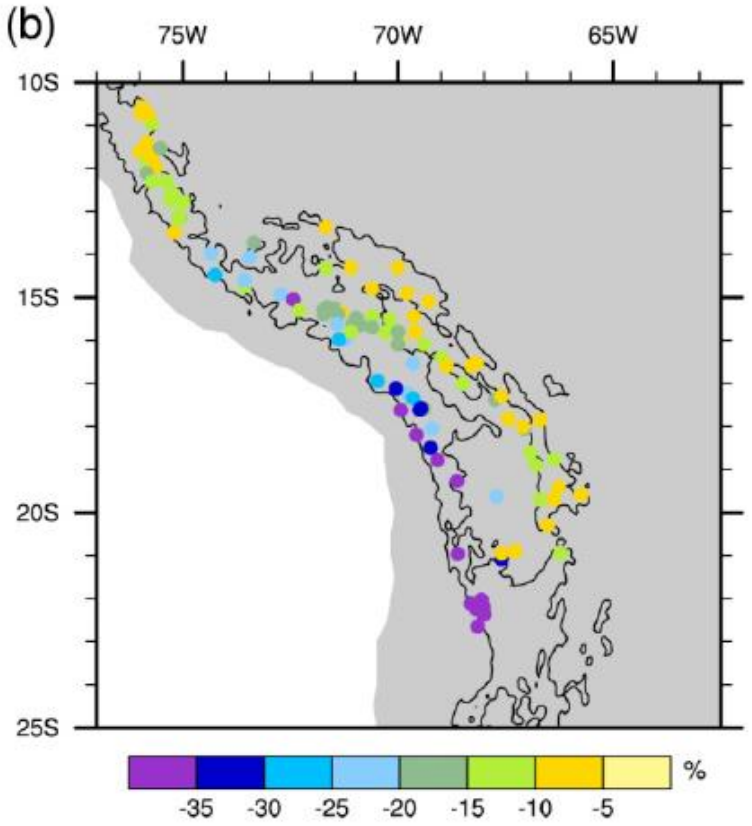
Cambios de temperatura y Precipitación
Escenario A2. Fines de Siglo
Malas noticias para los glaciares

A2-LB



Urrutia and Vuille 2009

dP/Pbl (%)

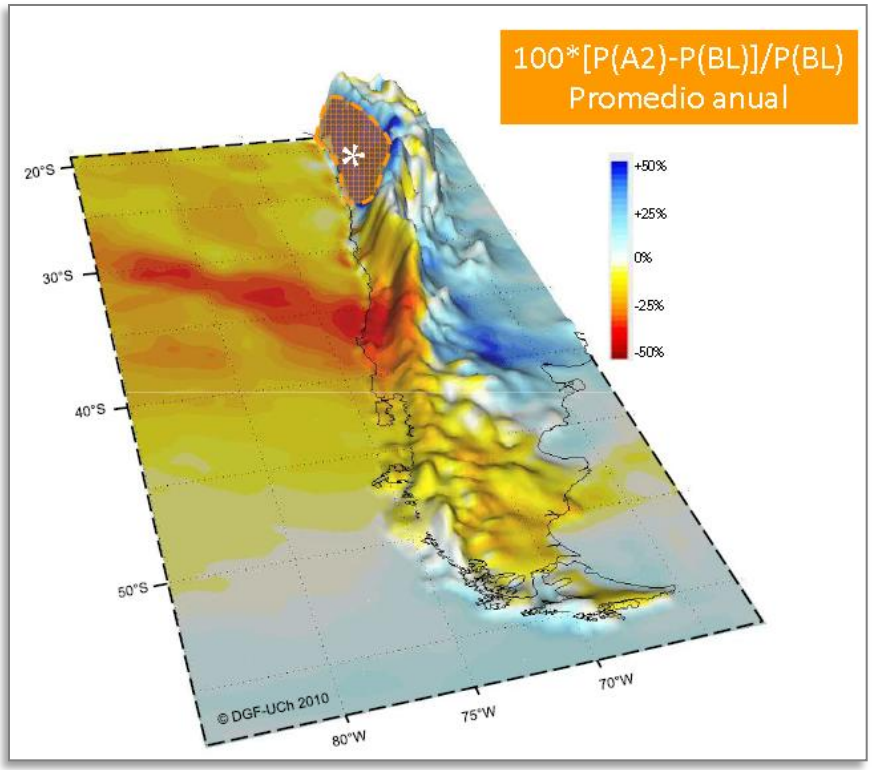


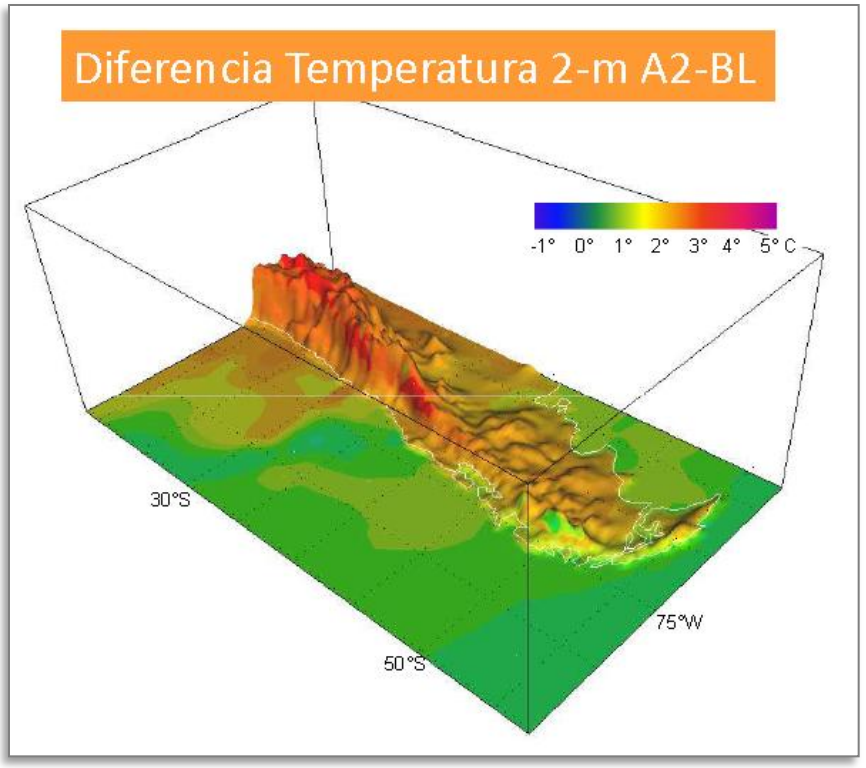
Minvielle and Garreaud 2010

Impactos Regionales del Cambio Climático

- Aumento de temperatura 2.5-3.5ºC (*)
- Disminución de precipitación 25-35% (*)

(*) Proyección a fin de siglo bajo escenario A2



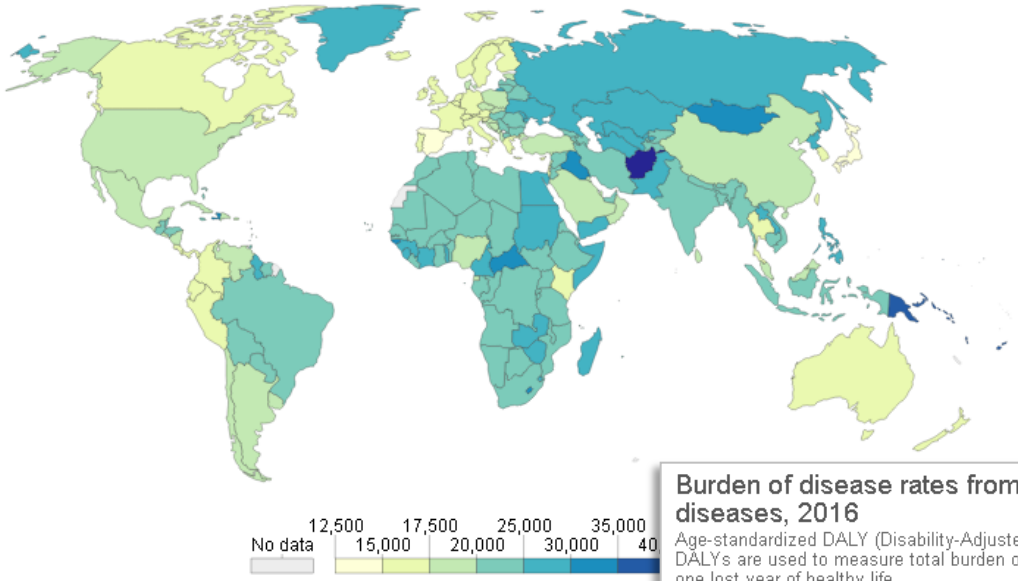


Estudio DGF/UCh-CONAMA 2007 empleando PRECIS

Burden of disease rates from non-communicable diseases (NCDs), 2016

Our World in Data

Age-standardized DALY (Disability-Adjusted Life Year) rates per 100,000 individuals from non-communicable diseases (NCDs). DALYs are used to measure total burden of disease - both from years of life lost and years lived with a disability. One DALY equals one lost year of healthy life.

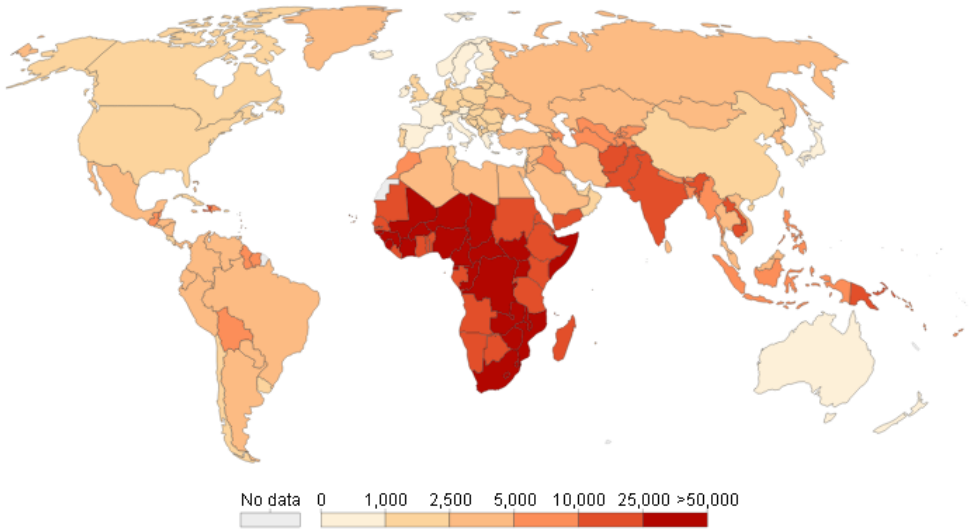


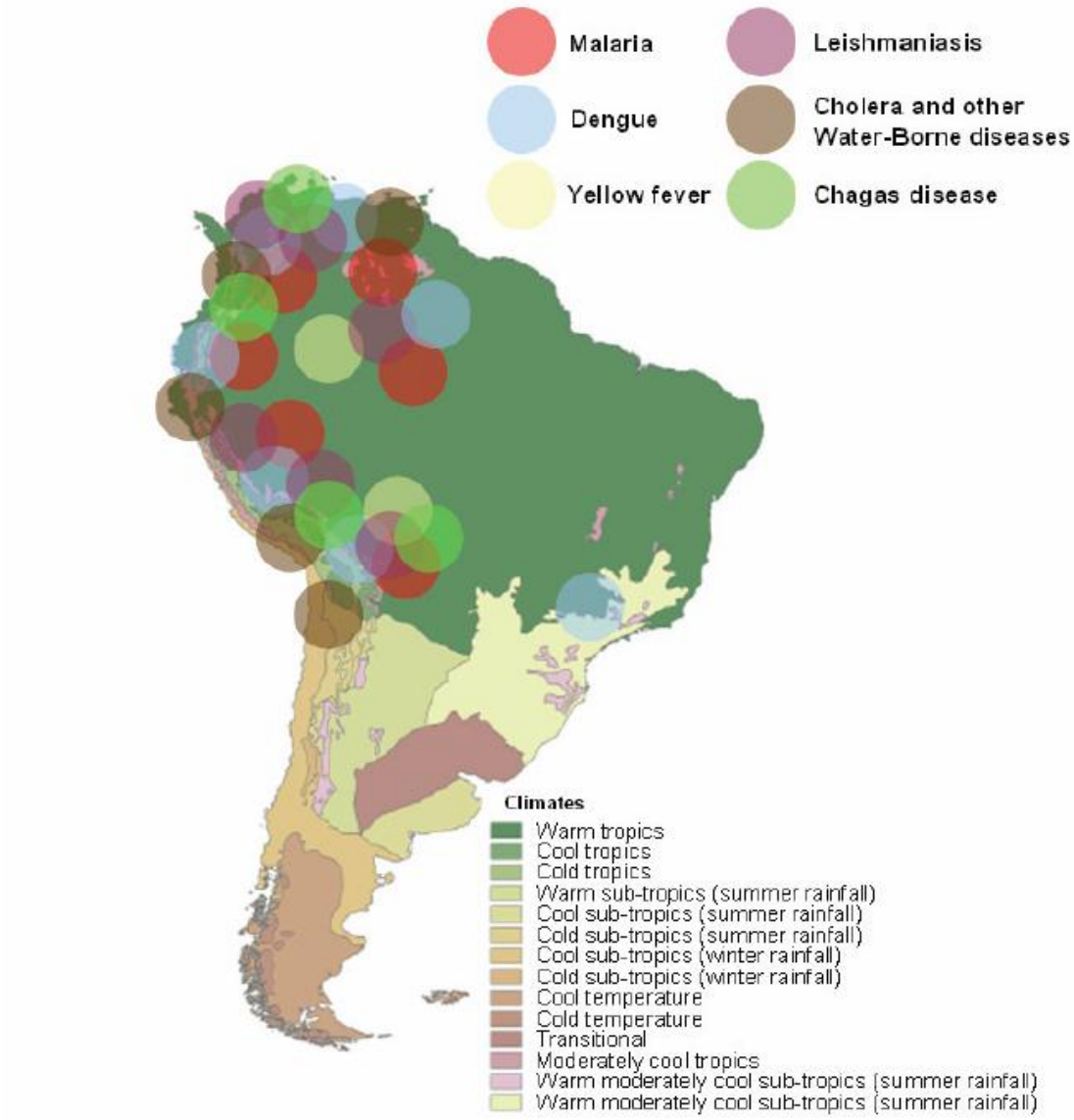
Source: IHME, Global Burden of Disease

Burden of disease rates from communicable, neonatal, maternal & nutritional diseases, 2016

Our World in Data

Age-standardized DALY (Disability-Adjusted Life Year) rates per 100,000 individuals from non-communicable diseases (NCDs). DALYs are used to measure total burden of disease - both from years of life lost and years lived with a disability. One DALY equals one lost year of healthy life.



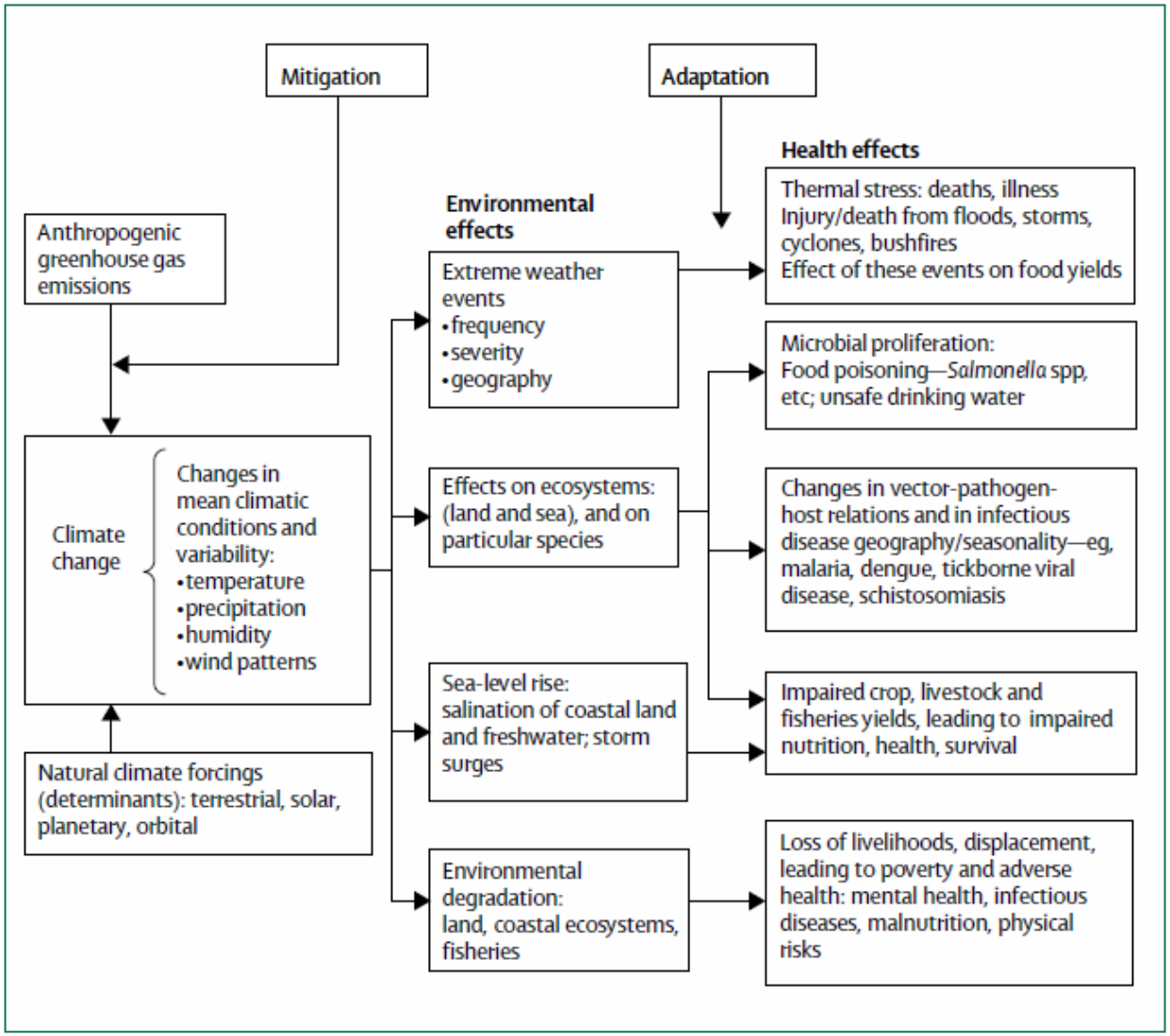


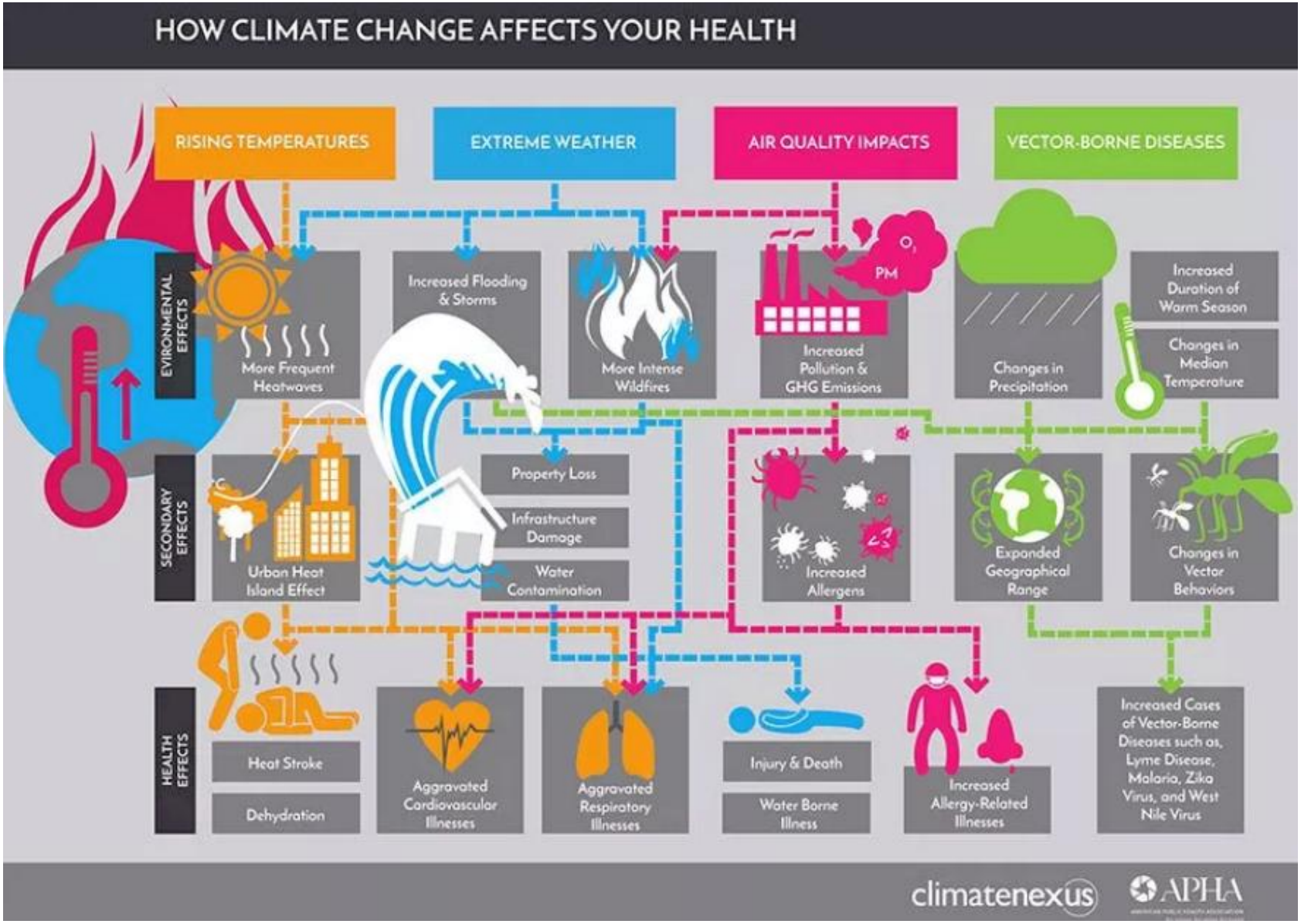
Impact of climate change on health and disease in Latin America

Alfonso J. Rodríguez-Morales, Alejandro Risquez and Luis Echezuria

Climate change and human health: present and future risks

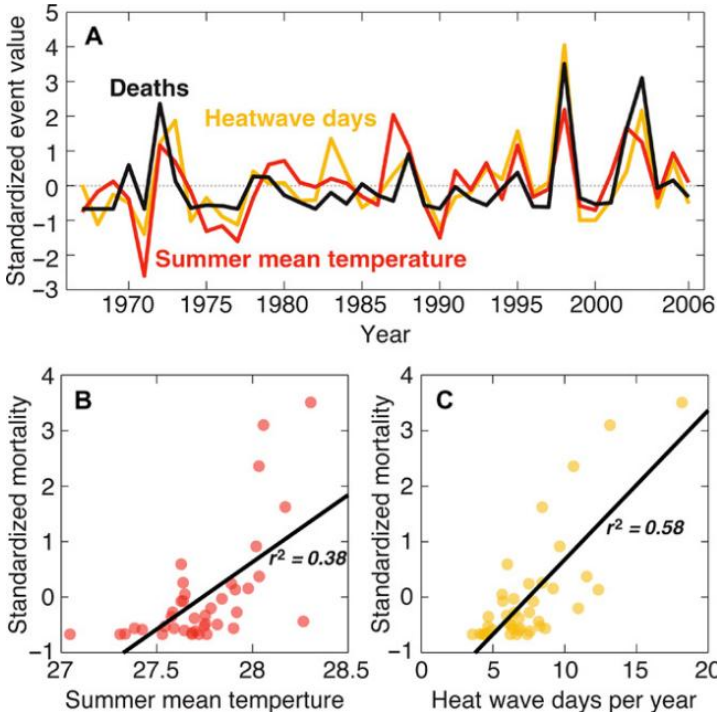
Anthony J McMichael, Rosalie E Woodruff, Simon Hales

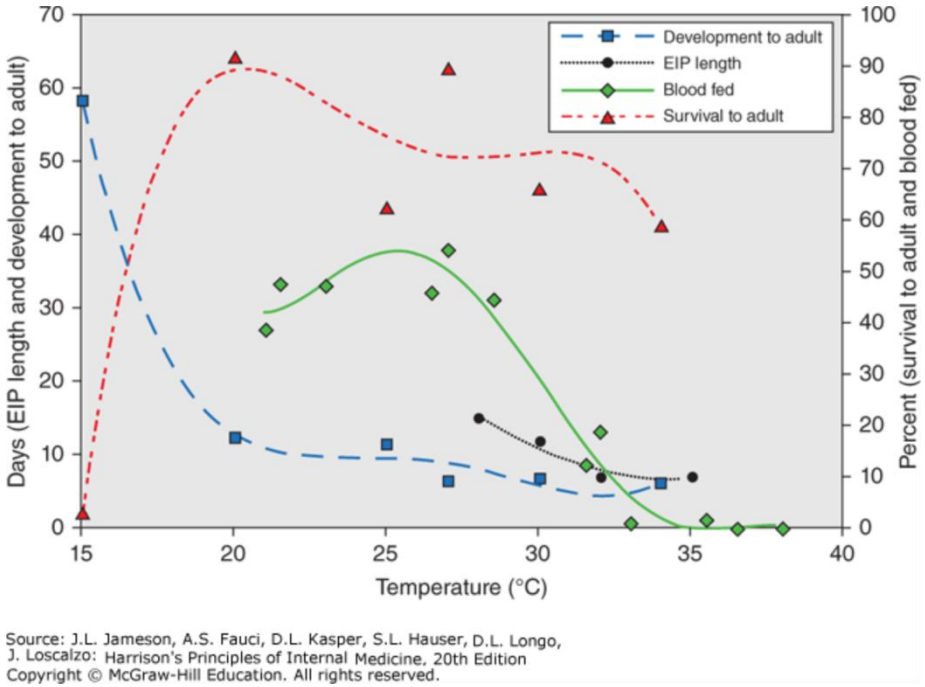



HOW CLIMATE CHANGE AFFECTS YOUR HEALTH
RISING TEMPERATURES
EXTREME WEATHER
AIR QUALITY IMPACTS
VECTOR-BORNE DISEASES
ENVIRONMENTAL EFFECTS
SECONDARY EFFECTS
HEALTH EFFECTS
More Frequent Heatwaves
Increased Flooding & Storms
More Intense Wildfires
Increased Pollution & GHG Emissions
PM
Changes in Precipitation
Increased Duration of Warm Season
Changes in Median Temperature
Urban Heat Island Effect
Property Loss
Infrastructure Damage
Water Contamination
Increased Allergens
Expanded Geographical Range
Changes in Vector Behaviors
Heat Stroke
Dehydration
Aggravated Cardiovascular Illnesses
Aggravated Respiratory Illnesses
Injury & Death
Water Borne Illness
Increased Allergy-Related Illnesses
Increased Cases of Vector-Borne Diseases such as, Lyme Disease, Malaria, Zika Virus, and West Nile Virus
climatenexus
APHA

Cambio Climático y salud pública

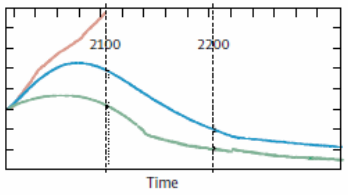
El relato es simple y se fundamenta en asociación observada a nivel interanual
La cuantificación es compleja….modelos estadísticos y mecanicistas



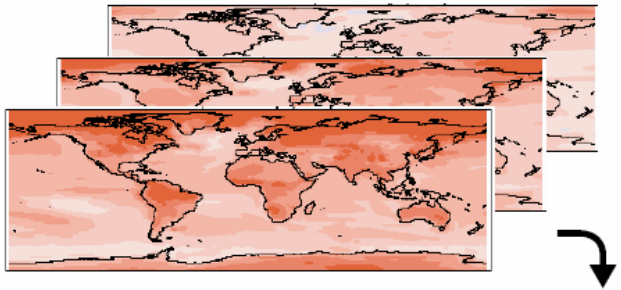


Source: J.L. Jameson, A.S. Fauci, D.L. Kasper, S.L. Hauser, D.L. Longo, J. Loscalzo: Harrison's Principles of Internal Medicine, 20th Edition

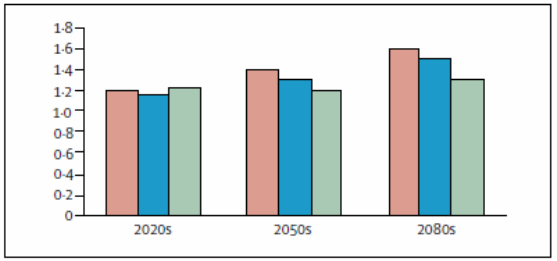
Greenhouse gas emissions scenarios



Global climate modelling
Generates series of maps of predicted future climate



Health impact model
Estimates the change in relative risk of specific diseases



Conversion to a single health measure DALY (disability adjusted life year)

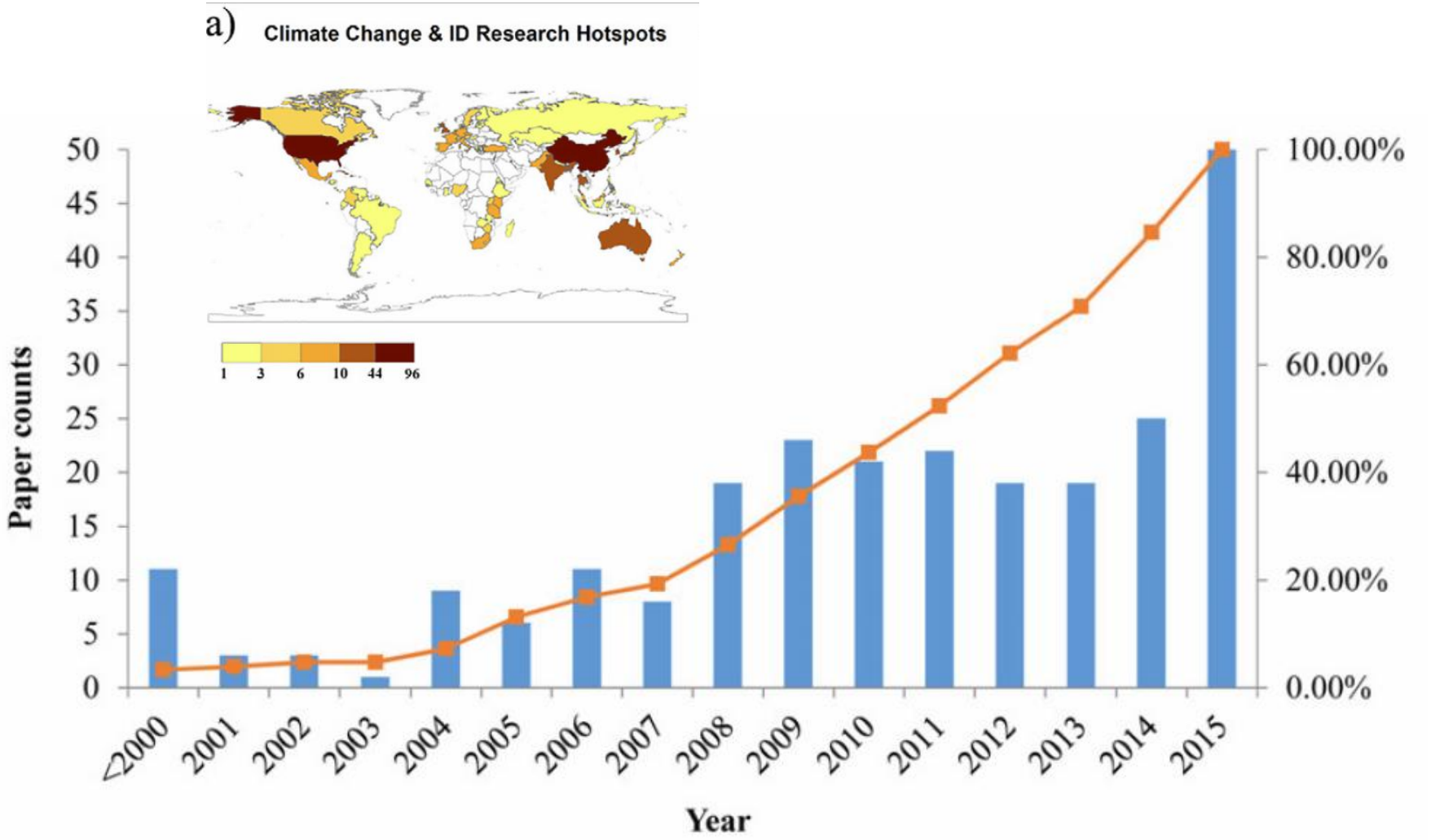
Subregion	Malnutrition	Diarrhoea	Malaria	Floods	All causes	Total DALYs/million population
AFR-D	293	154	178	1	626	2185·78
AFR-E	323	260	682	3	1267	3839·58
AMR-A	0	0	0	4	4	11·85
AMR-B	0	0	3	67	71	166·62
AMR-D	0	17	0	5	23	324·15
EMR-B	0	14	0	6	20	147·57
EMR-D	313	277	112	46	748	2145·91
EUR-A	0	0	0	3	3	6·66
EUR-B	0	6	0	4	10	48·13
EUR-C	0	3	0	1	4	14·93
SEAR-B	0	28	0	6	34	117·19
SEAR-D	1918	612	0	8	2538	2080·84
WPR-A	0	0	0	1	1	8·69
WPR-B	0	89	43	37	169	111·36
World	2846	1459	1018	193	5517	925·35

Climate change and human health: impacts, vulnerability, and mitigation

A Haines, R S Kovats, D Campbell-Lendrum, C Corvalan

Climate change and human infectious diseases: A synthesis of research findings from global and spatio-temporal perspectives

Lu Liang [a,b,*], Peng Gong [b,c]



Impact of climate change on global malaria distribution

Cyril Caminade[a,b,1], Sari Kovats[c], Joacim Rocklov[d], Adrian M. Tompkins[e], Andrew P. Morse[b], Felipe J. Colón-González[e], Hans Stenlund[d], Pim Martens[f], and Simon J. Lloyd[c]

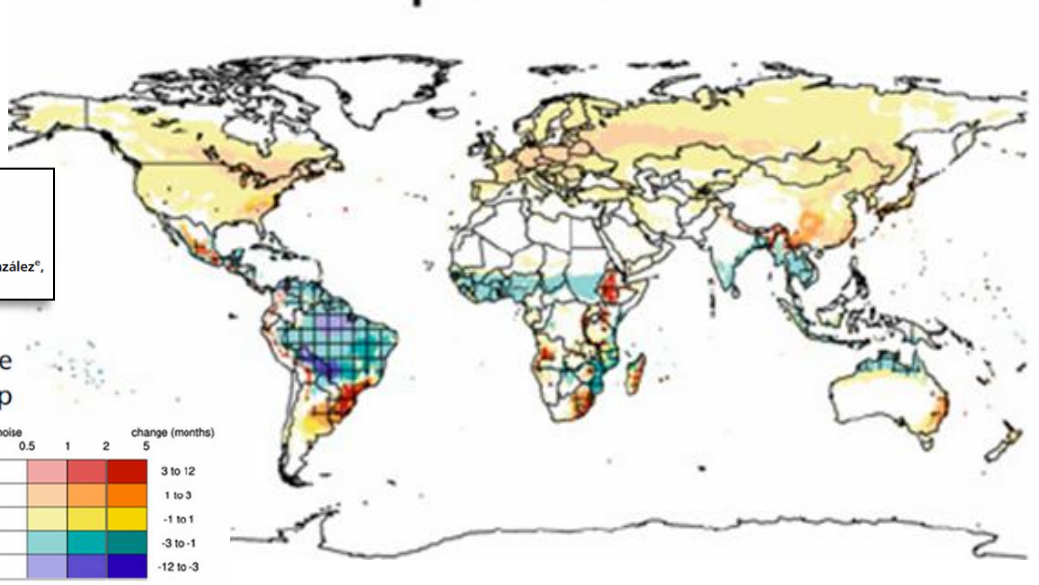


Fig. 2. The effect of climate scenarios on future malaria distribution: changes in LTS. Each map

Malaria ecology and climate change

G.C. McCord[a]

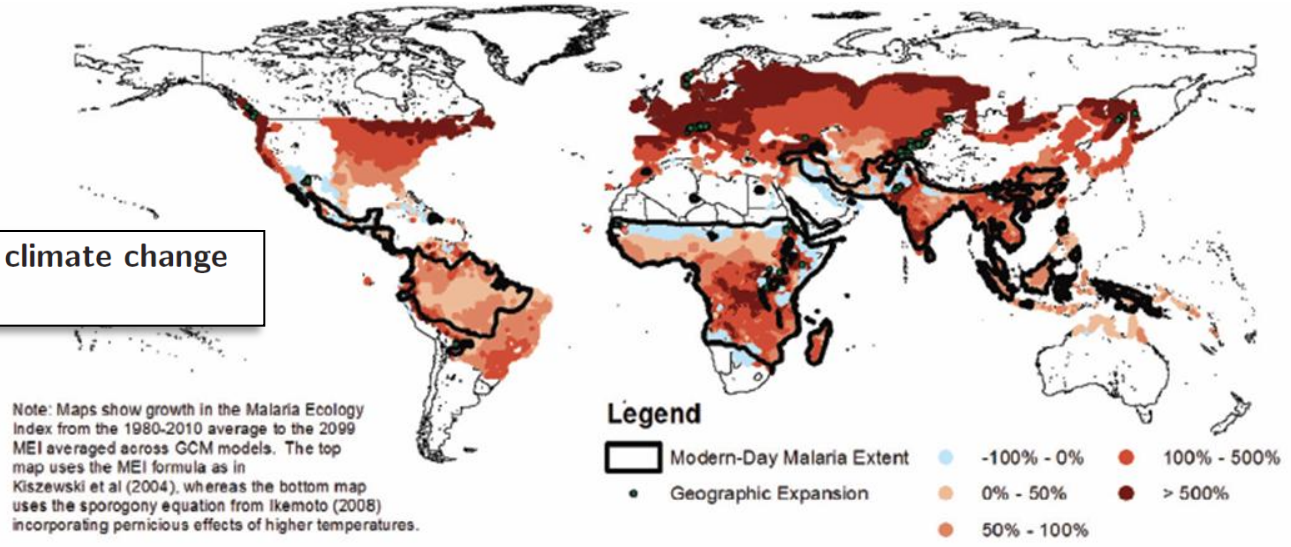
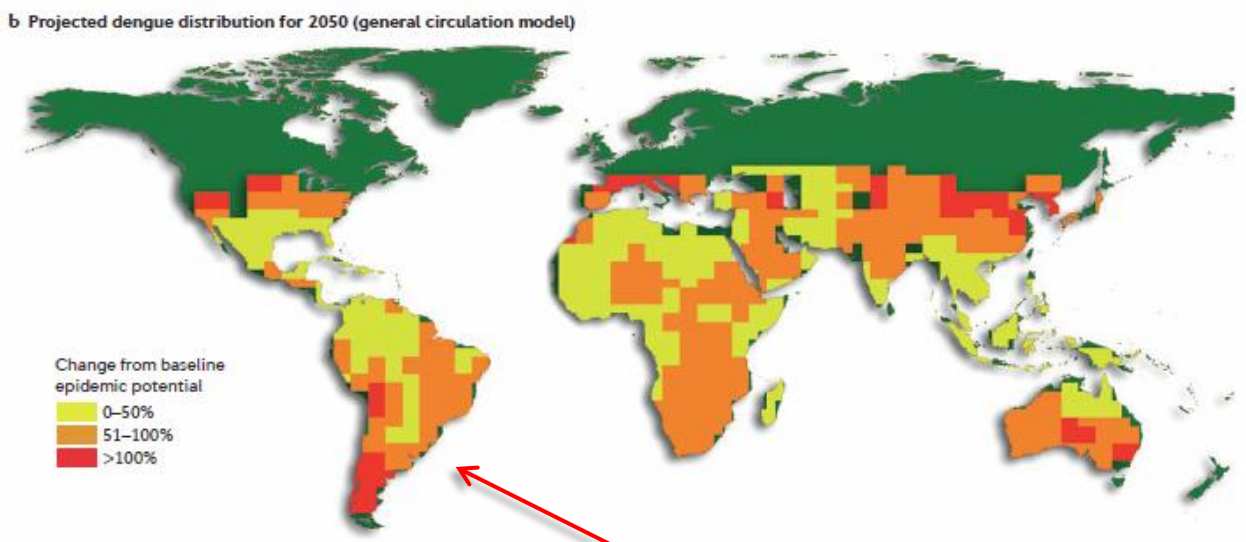


Fig. 5. Growth in Malaria Ecology Index using 2099 GCM Averages.

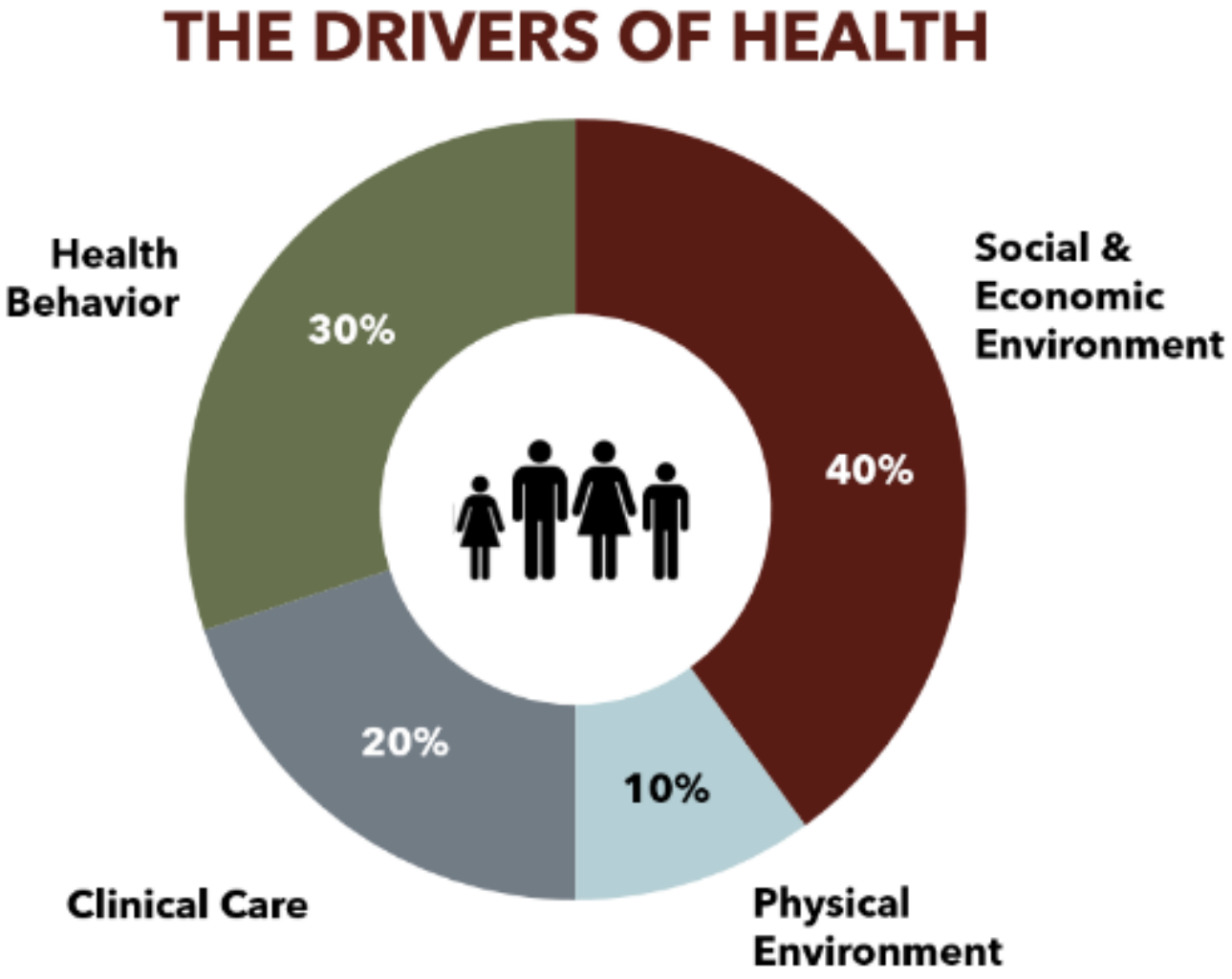
The many projected futures of dengue

Jane P. Messina[1], Oliver J. Brady[1], David M. Pigott[1], Nick Golding[1], Moritz U. G. Kraemer[1], Thomas W. Scott[2,3], G. R. William Wint[4], David L. Smith[1,3] and Simon I. Hay[1,3]



Esto se ve muy mal!

Esto es difícil para un climatólogo



The many projected futures of dengue

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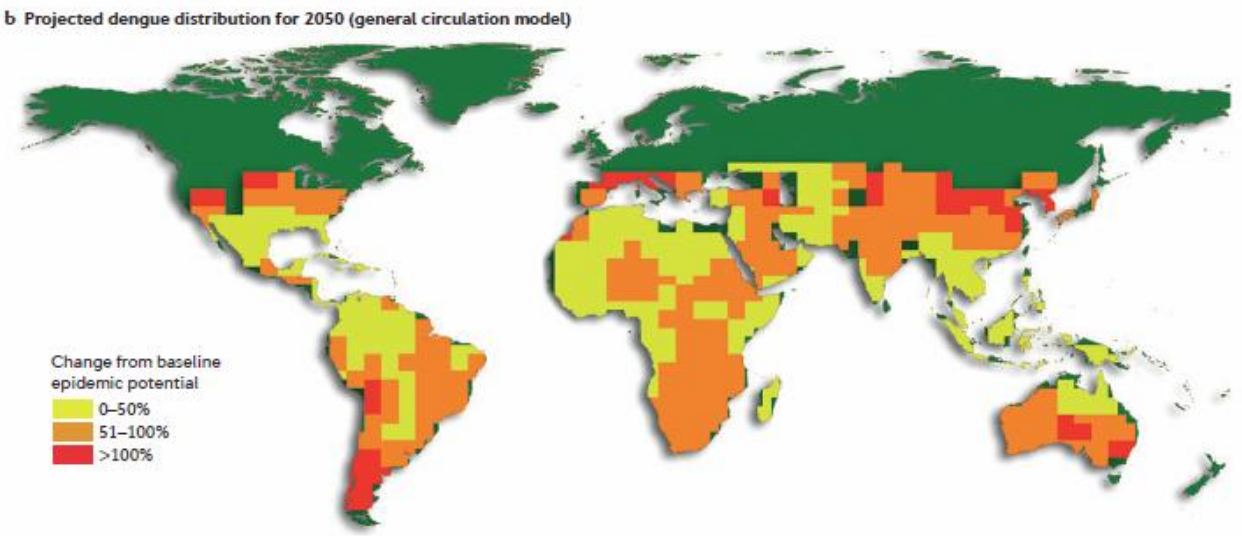
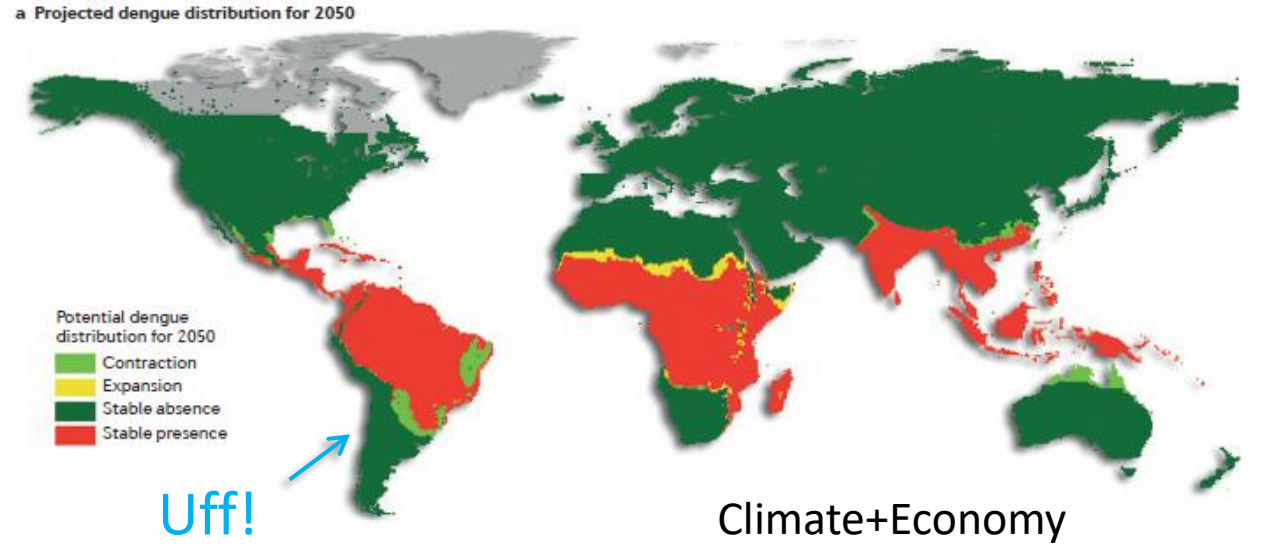
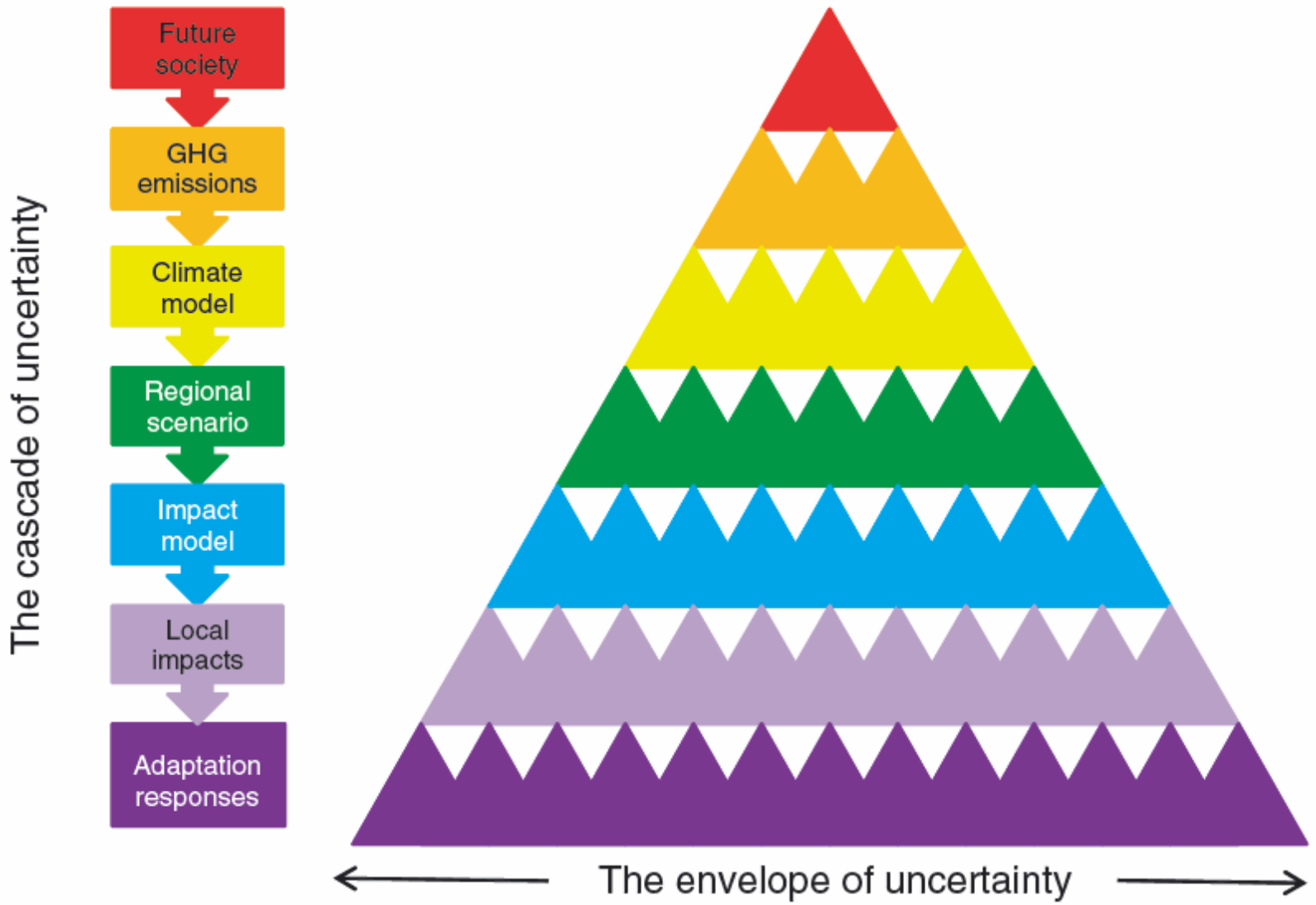




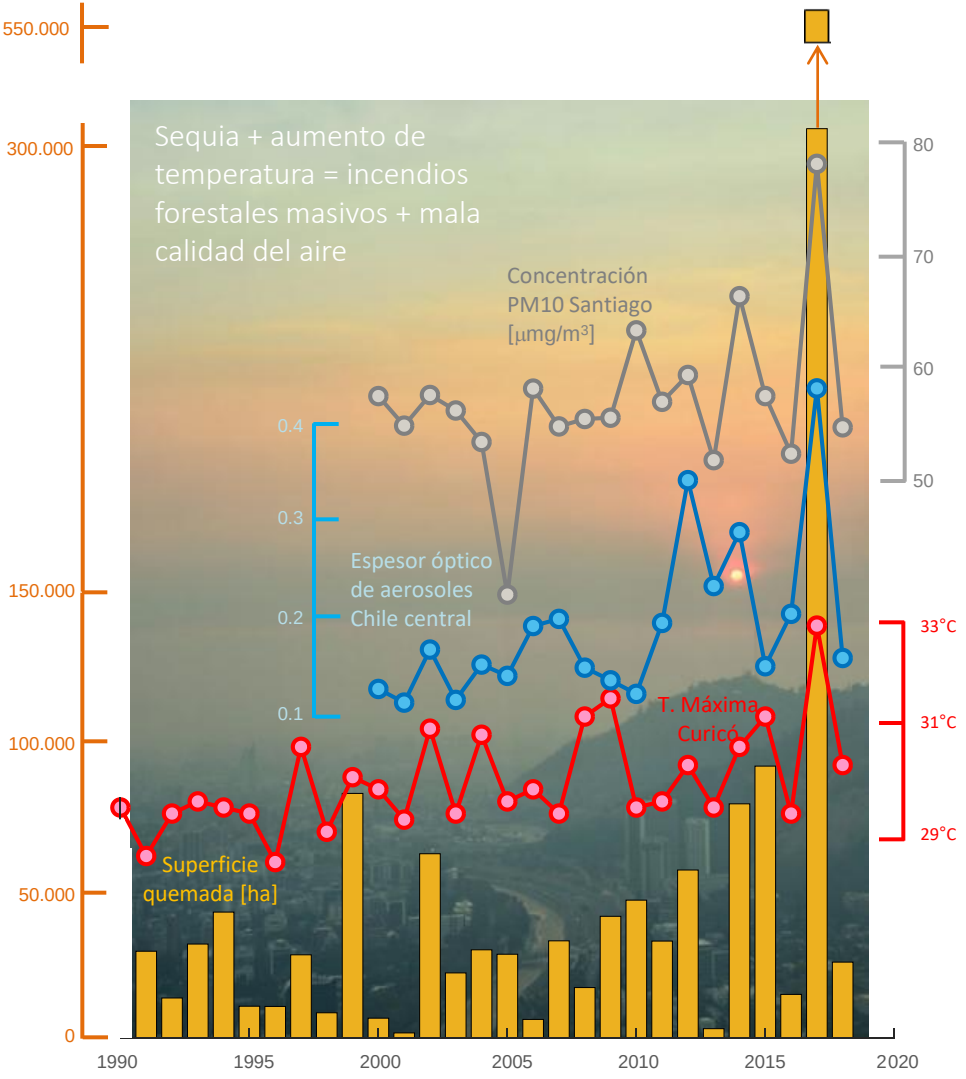
La pirámide de incertidumbre



Wilby and Dessai 2010

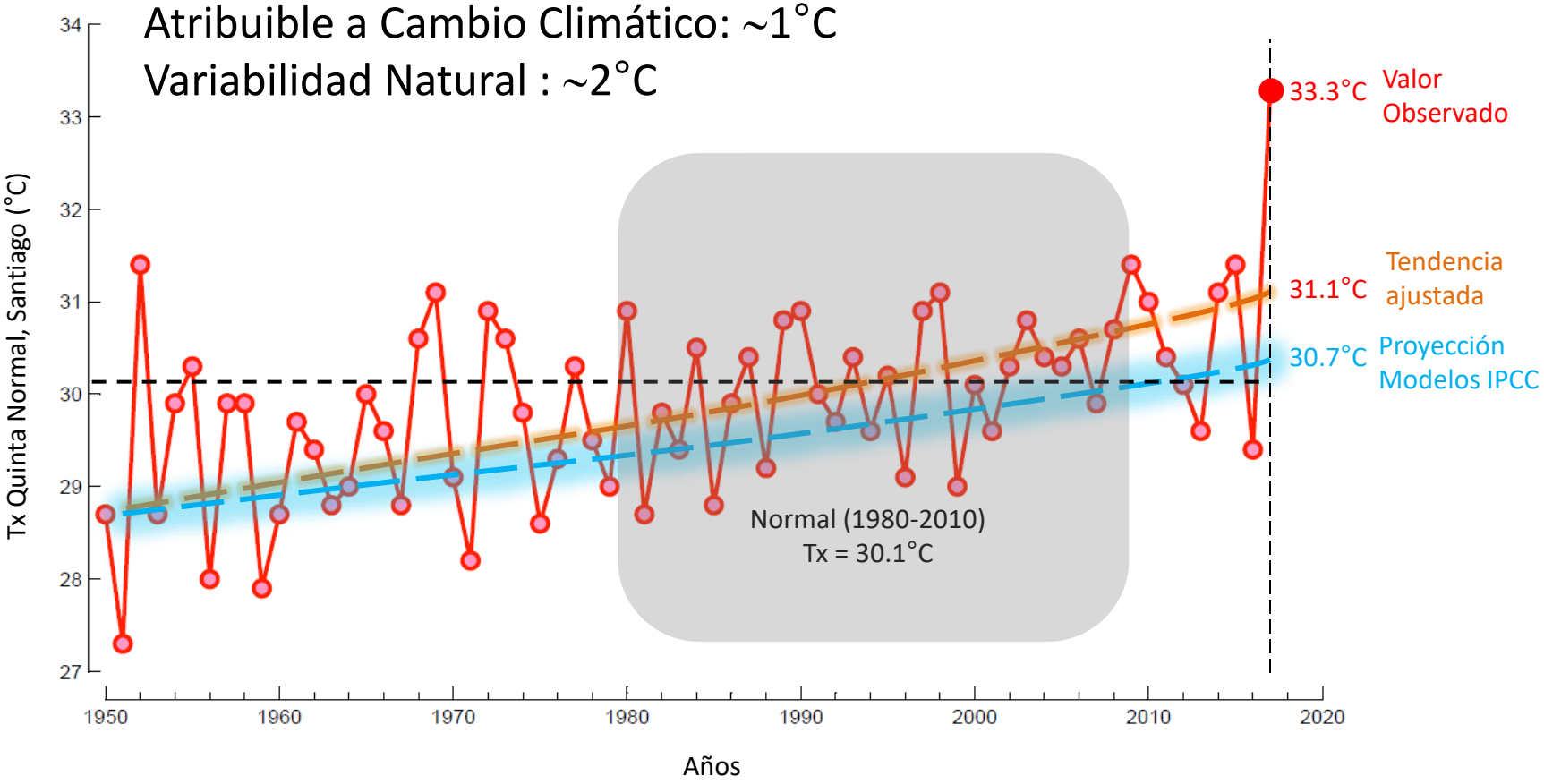
No todo es cambio climático

Imagen MODIS Visible 27-01-2017

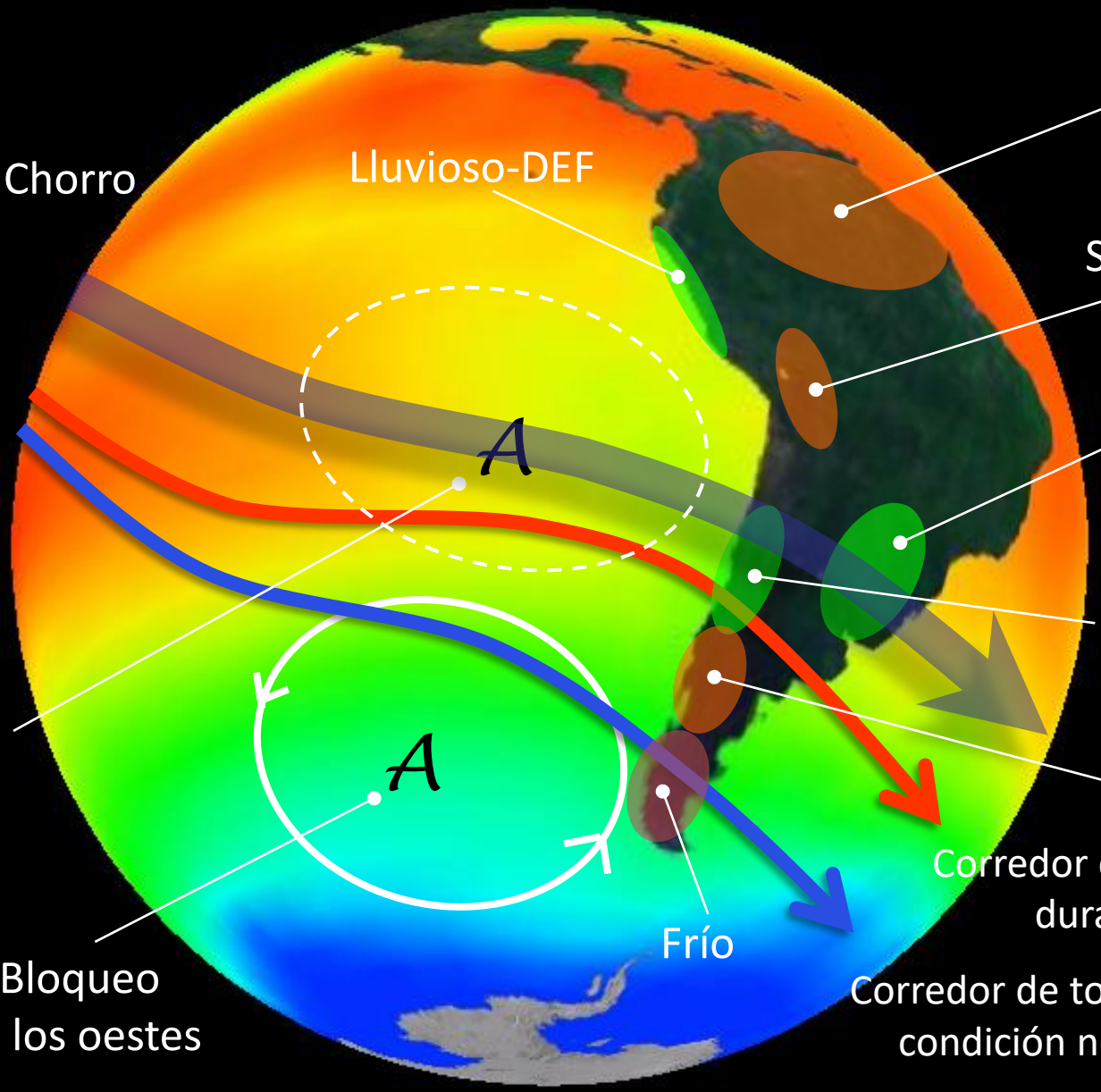


No todo es cambio climático

TMax Stgo. Enero 2017: 33.1°C
Aumento por encima de la normal: +3°C
Atribuible a Cambio Climático: ~1°C
Variabilidad Natural : ~2°C



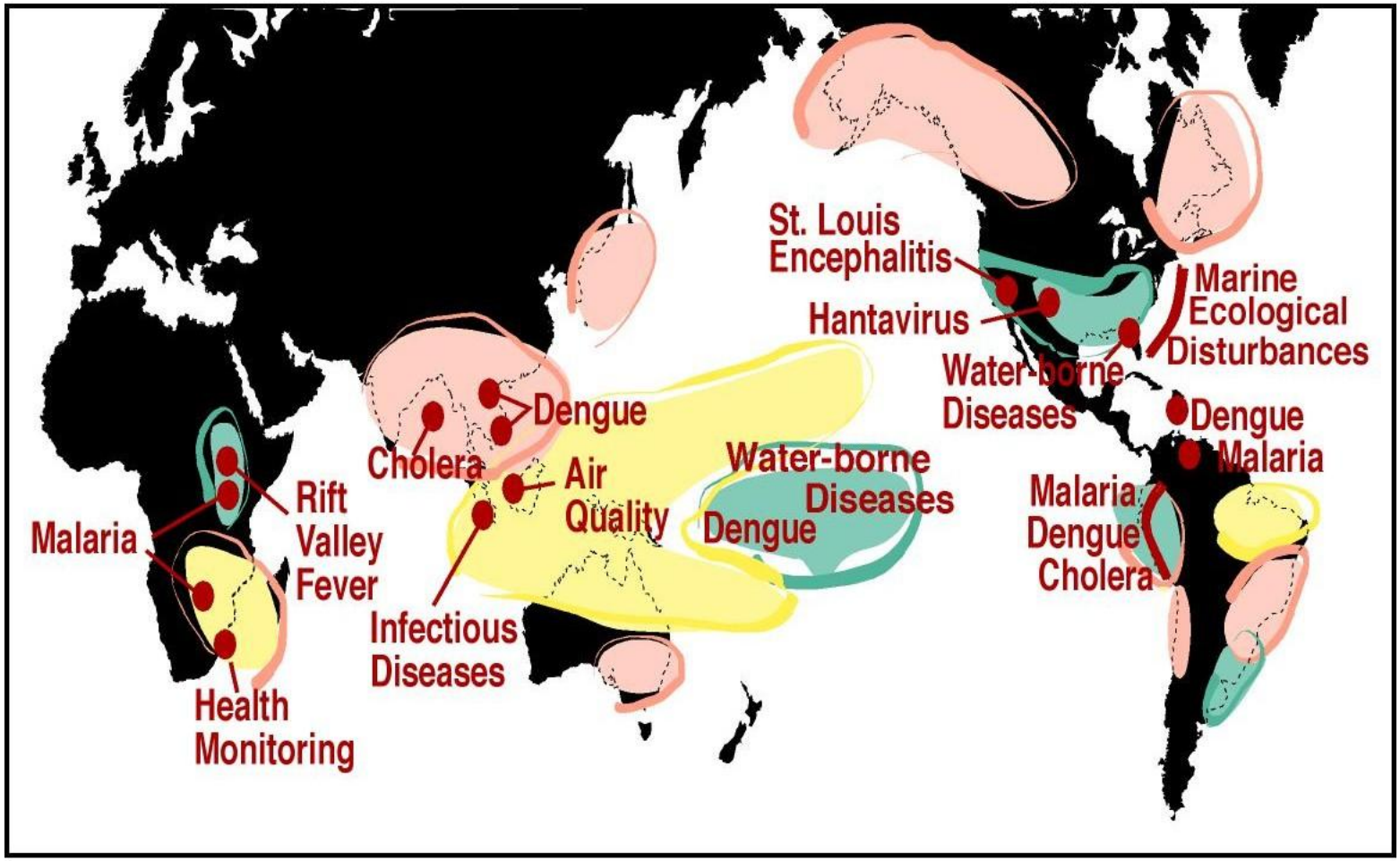
Principales impactos climáticos durante años El Niño



Calentamiento costero y precipitación

>200 fallecidos, 3.1 Bill US$

Exploring the Linkages between the El Niño-Southern Oscillation (ENSO) and Human Health

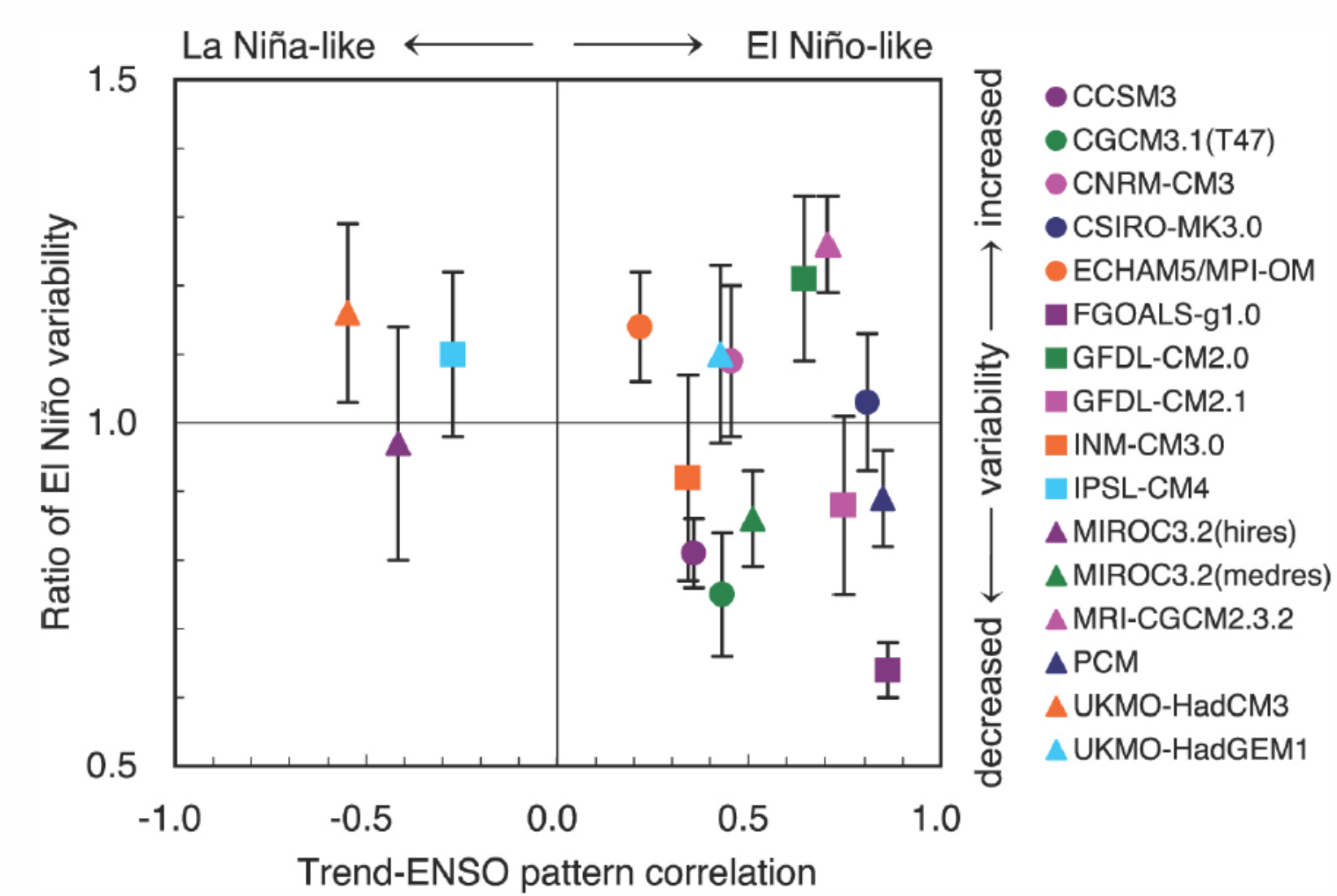


Generalized El Niño-Southern Oscillation (ENSO) Impacts

= DRY
= WET
= WARM
= DRY & WARM
= WET & WARM
= WET & COOL

Ref: CPC/NCEP/NOAA

A major question: ENSO in the future



Mensajes finales

- Las condiciones climáticas modulan aspectos importantes de la salud publica, y es plausible que cambios de las condiciones climáticas medias tengan repercusiones sustanciales
- Cuantificar esos cambios es complejo y debe abordarse caso a caso
- Existen forzantes no climáticas que están cambiando aceleradamente
- Las proyecciones climáticas tiene niveles importantes de incertidumbre
- Epidemias y otras crisis usualmente se asocian a extremos climáticos (e.g. El Niño), cuyo futuro es incierto

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