SSRP
SUSSEX SUSTAINABILITY RESEARCH PROGRAMME

Cities:
Convergence of risks and propagation of impacts

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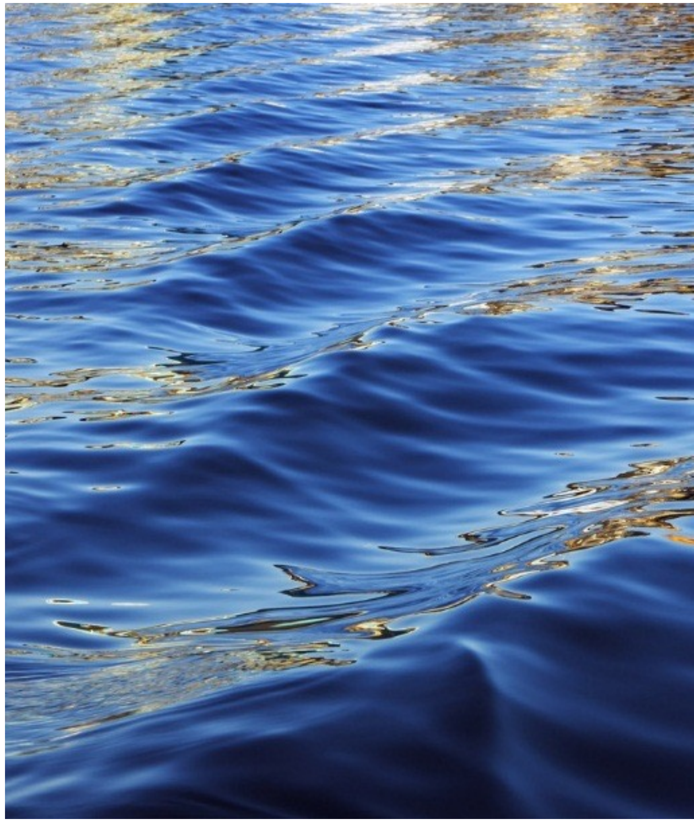
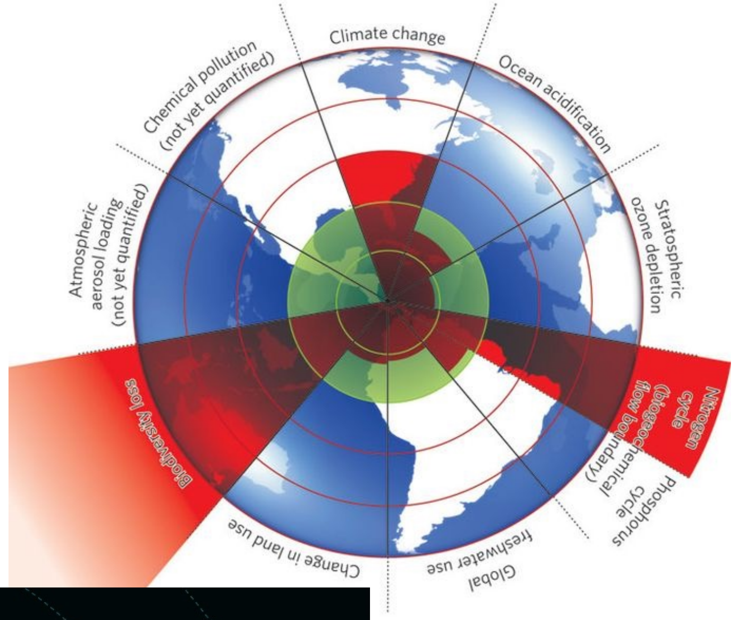
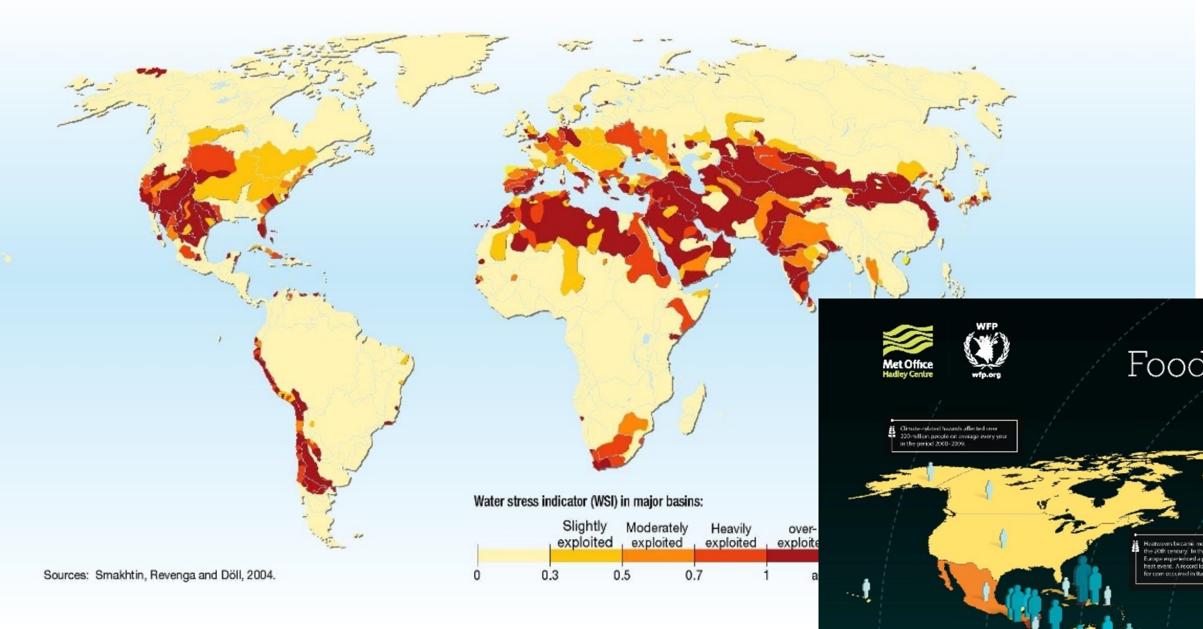
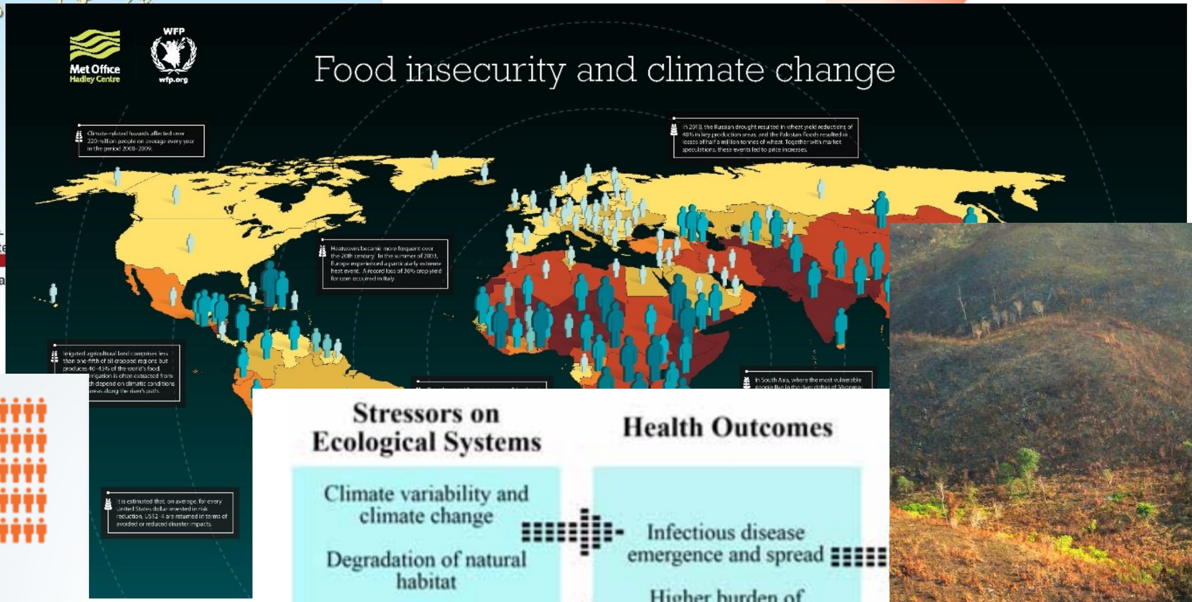
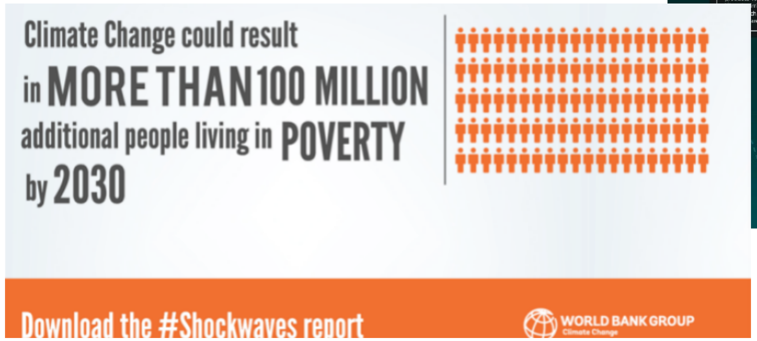


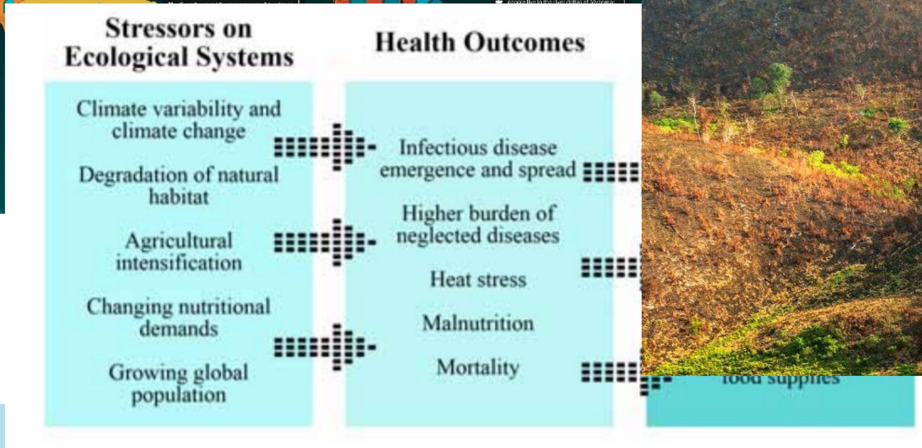
Climate change and the synergies with other social and environmental problems





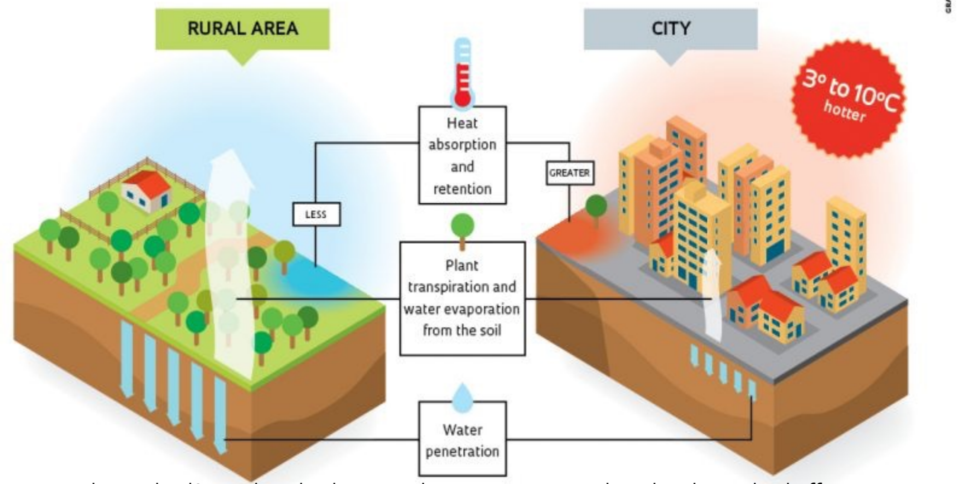






Cities and climate change

Why the urban heat island effect occurs



https://land8.com/how-landscape-architecture-mitigates-the-urban-heat-island-effect/

Wickham et al., Geoinfor Geostat: An Overview 2013, 1:2
http://dx.doi.org/10.4172/gigs.1000104

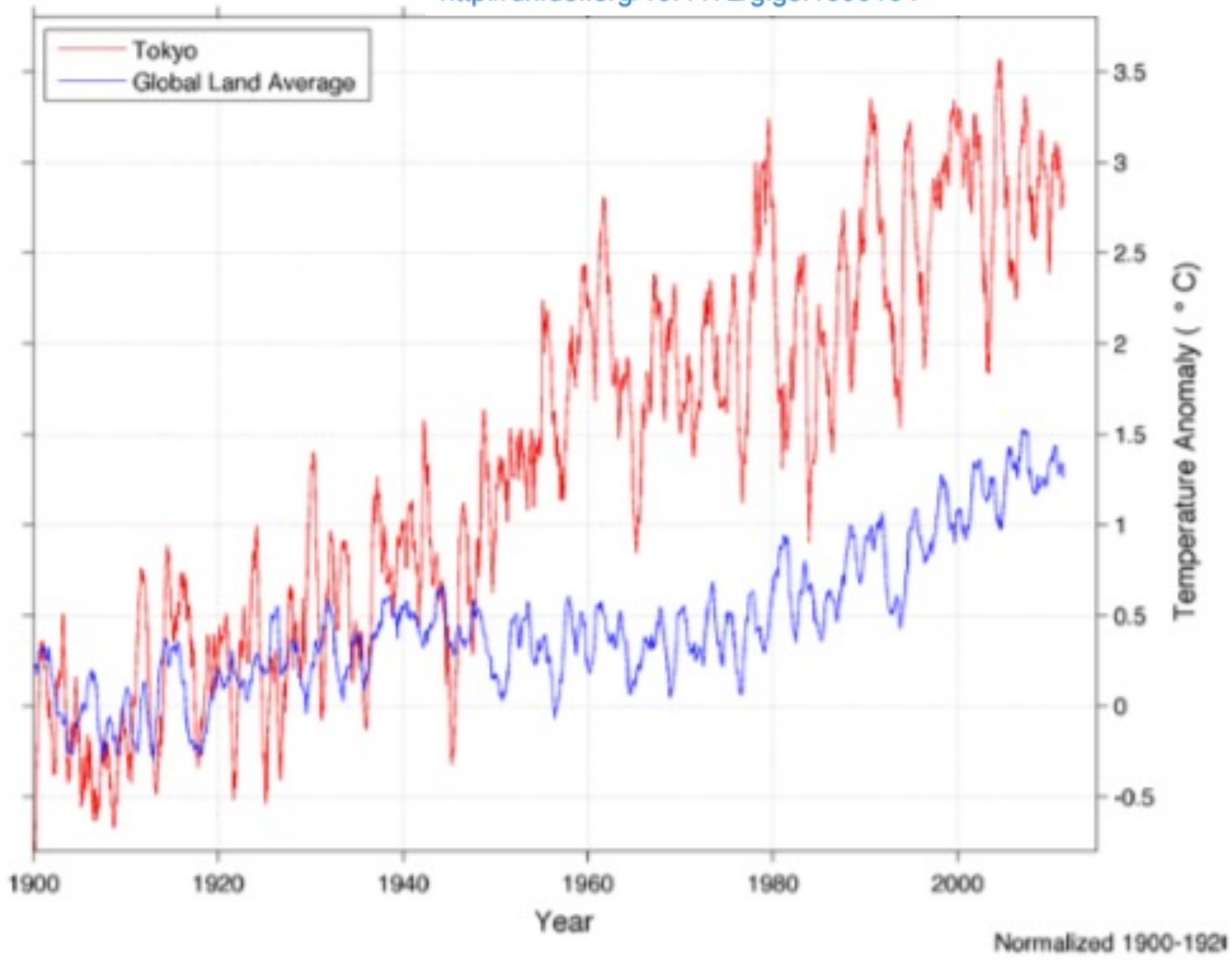
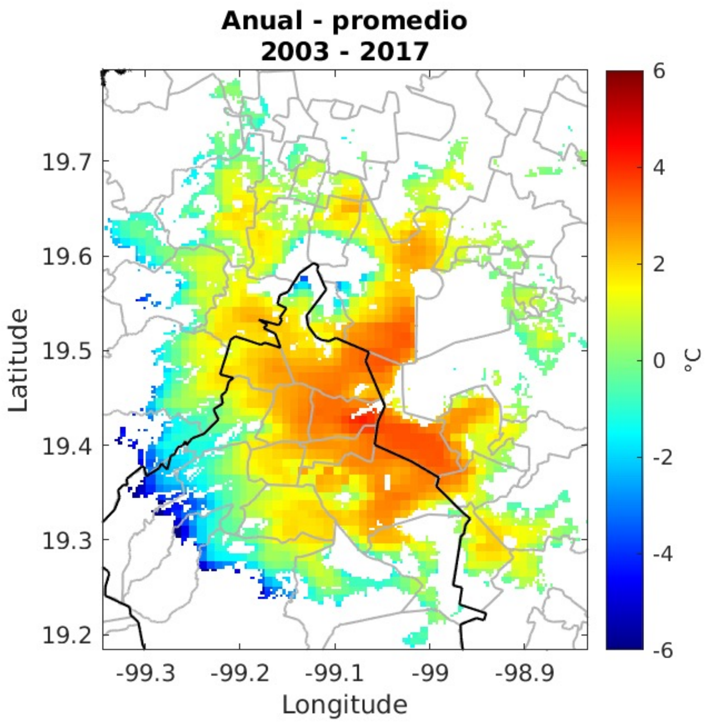
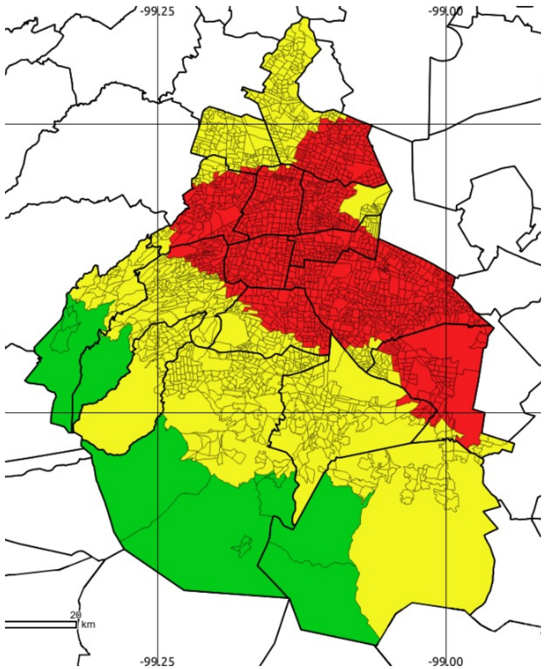


Figure 1: Annual running mean of monthly temperatures at Tokyo compared to a global land average for 1900-2010.

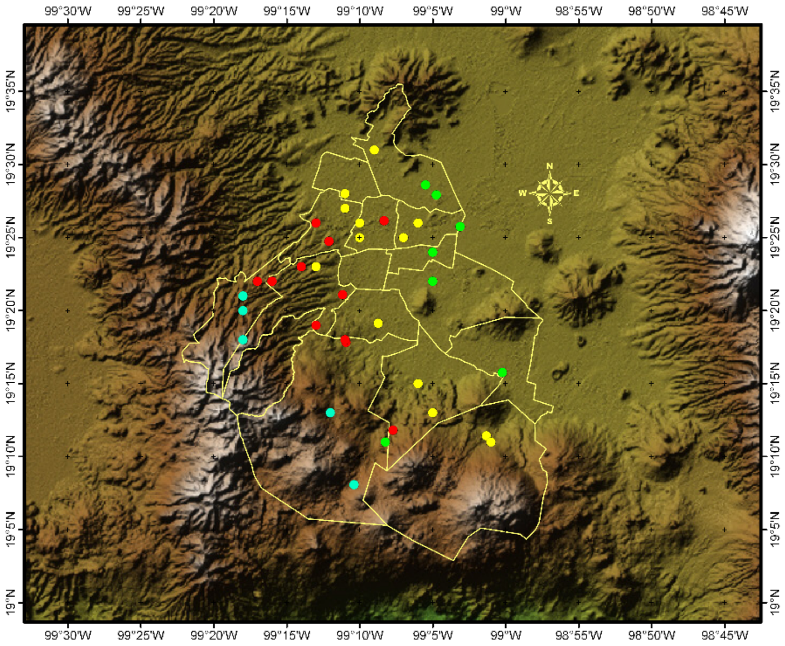
Urban heat island effect



SUHI



Maximum temperature risk index
Mexico City's Risk Atlas



Microclimate classification
(14 variables)

Published: 30 July 2020

Economic valuation of climate change–induced mortality: age dependent cold and heat mortality in the Netherlands

W. J. W. Botzen, M. L. Martinius, P. Bröde, M. A. Folkerts, P. Ignjacevic, F. Estrada, C. N. Harmsen & H. A. M. Daanen

Climatic Change (2020) | Cite this article

Defining climate zones in México City using multivariate analysis

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NATURE CLIMATE CHANGE | LETTER

A global economic assessment of city policies to reduce climate change impacts

Francisco Estrada W. J. Wouter Botzen Richard S. J. Tol

Affiliations | Contributions | Corresponding author

Nature Climate Change 7, 403–406 (2017) | doi:10.1038/nclimate3301
Received 15 August 2016 | Accepted 20 April 2017 | Published online 29 May 2017

Synergies between local and global warming

- 1,692 most populated cities of the world
- A large fraction of gobal population has been experiencing a much larger warming
- Damages are at least 2.6 times larger compared with GCC alone
- Local actions to mitigate UHI are needed to manage climate change impacts

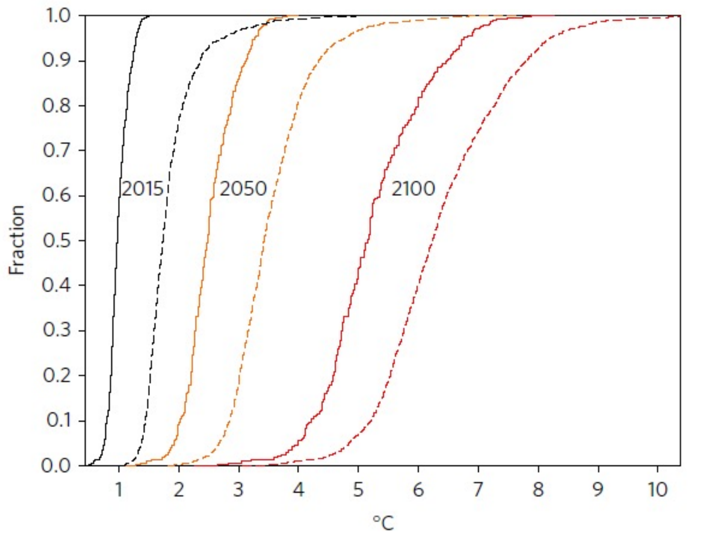


Figure 2 | Cumulative density functions of temperature changes of the 1,692 most populated cities in the world. The continuous lines show the estimated temperature increase for 2015 (black), 2050 (orange) and 2100 (red) under the RCP8.5 emissions scenario. Dashed lines include the estimated temperature increase from the UHI effect.

Table 1 | Accumulated economic impacts of global climate change (GCC) and urban heat island (UHI) separately and combined under different emission scenarios.

	RCP8.5	RCP6	RCP4.5	550 ppm	450 ppm	RCP3PD	350 ppm
GCC	$3.21 × 10^13 [38.9%]	$1.68 × 10^13 [28.8%]	$1.49 × 10^13 [26.9%]	$1.43 × 10^13 [26.4%]	$1.05 × 10^13 [22.3%]	$8.24 × 10^12 [19.3%]	$7.71 × 10^12 [18.6%]
UHI	$1.54 × 10^13 [18.6%] (0.48)	$1.54 × 10^13 [26.4%] (0.92)	$1.54 × 10^13 [27.9%] (1.03)	$1.54 × 10^13 [28.5%] (1.08)	$1.54 × 10^13 [32.7%] (1.47)	$1.54 × 10^13 [36.2%] (1.87)	$1.54 × 10^13 [37.1%] (2.00)
Total	$8.26 × 10^13 (2.57)	$5.84 × 10^13 (3.48)	$5.53 × 10^13 (3.71)	$5.41 × 10^13 (3.78)	$4.71 × 10^13 (4.49)	$4.26 × 10^13 (5.17)	$4.15 × 10^13 (5.38)

Figures in brackets represent the present value of losses due to GCC/UHI as a percentage of the present value of the total losses. Figures in parenthesis represent the present value of the losses due to UHI/Total as a fraction of the present value of the losses produced by GCC alone. The symbol $ denotes US dollars. A 3% discount rate was used. Figures are rounded to three significant digits.

Estrada F., Botzen W.J.W., Tol R.S.J., 2017. A global economic assessment of city policies to reduce climate change impacts. *Nature Climate Change* 7, 403–406. doi:10.1038/nclimate3301.

Urban adaptation and risk reduction actions

Table 2 | Costs and benefits of urban heat island reduction policies under different baseline scenarios.

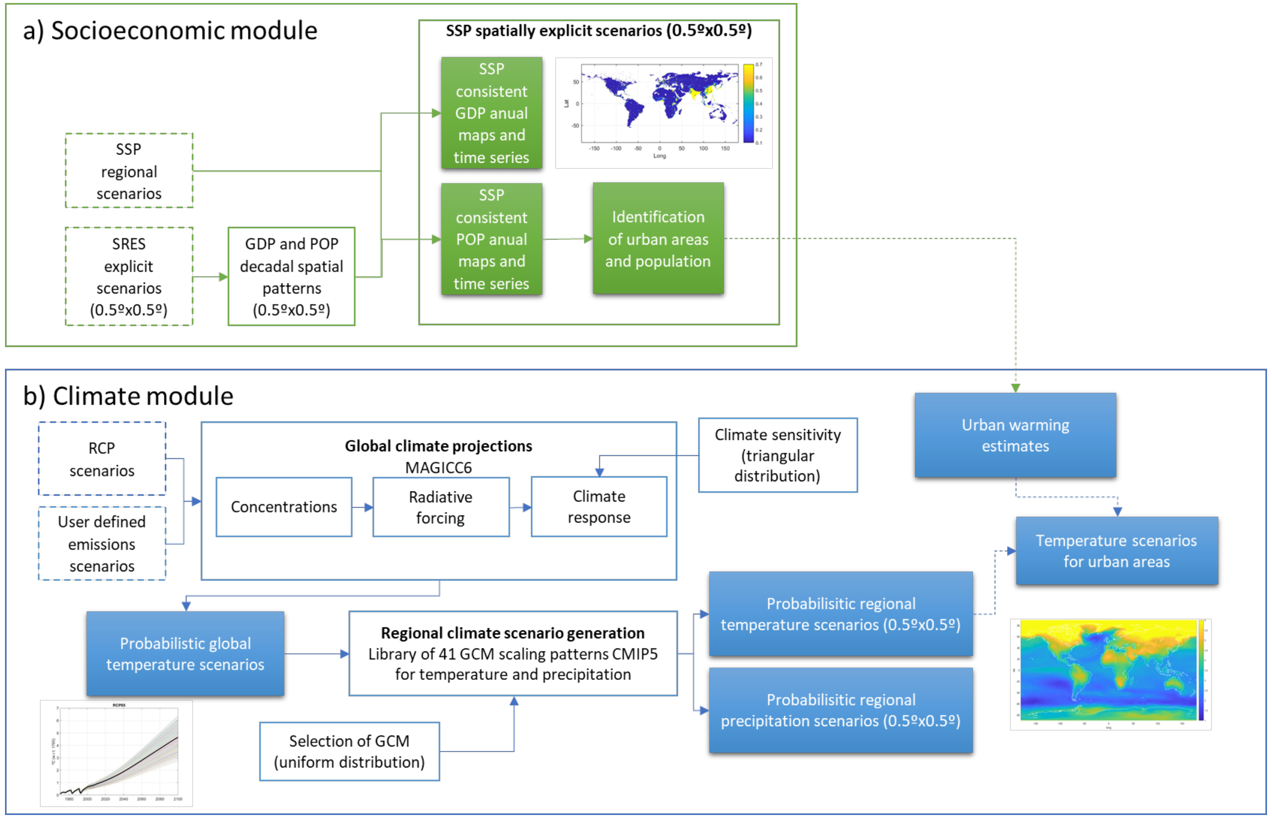
	Policy A	Policy B	Policy C	Policy D
Benefit-cost ratio				
RCP8.5	$14.5 {$5.37, $9.12}	$15.2 {$6.0, $9.25}	$6.09 {$2.35, $3.73}	$3.96 {$1.59, $2.37}
RCP6	$12.3 {$5.37, $6.95}	$13.1 {$6.0, $7.05}	$5.2 {$2.35, $2.85}	$3.4 {$1.59, $1.81}
RCP4.5	$12.1 {$5.37, $6.76}	$12.9 {$6.0, $6.86}	$5.13 {$2.35, $2.77}	$3.35 {$1.59, $1.76}
NGCC	$5.37	$6.0	$2.35	$1.59

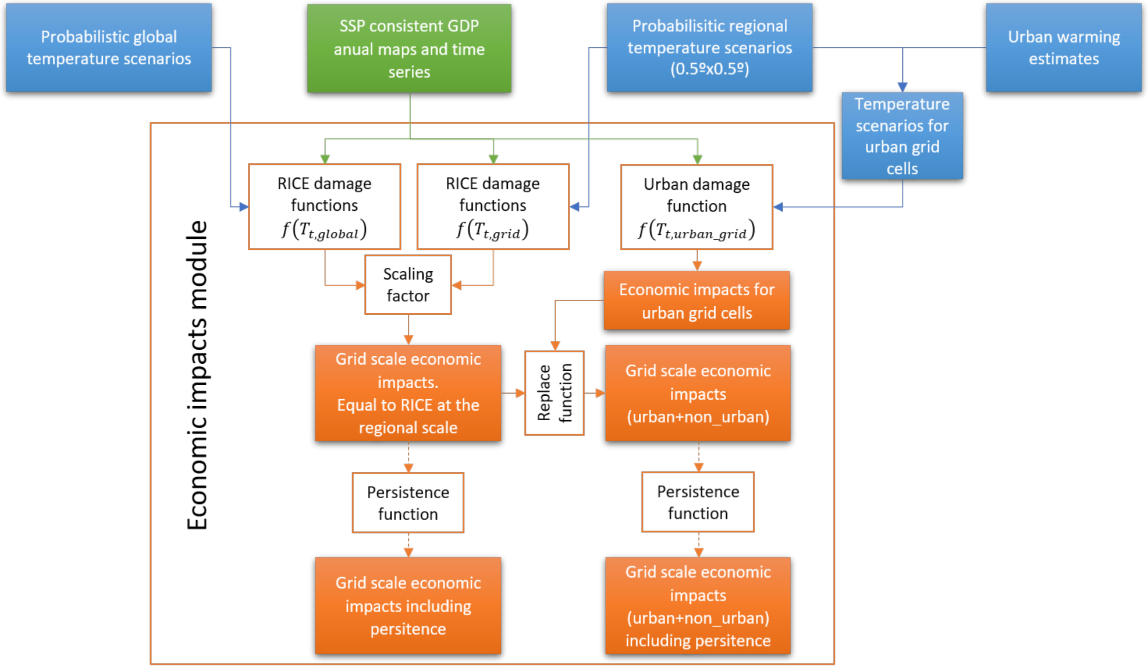
GUP, global urban product. NGCC, a no global climate change scenario. TL, the net present value of the benefits of the different policies as a fraction of the present value of the total losses. Numbers in parenthesis show the percentage of cities with net losses and numbers in brackets show the benefits for the cities in the 2.5th and 97.5th percentiles. The symbol $ denotes US dollars. Figures in braces show the benefit-cost ratio decomposed into the contribution of local policy and interaction effects of global and local climate change, in that order. Policies: A—Large-scale cool roofs and cool pavements; B—Moderate-scale cool roofs and cool pavements; C—Moderate-scale green and cool roofs and cool pavements; D—Small-scale green and cool roofs and cool pavements. Figures are rounded to three significant digits.

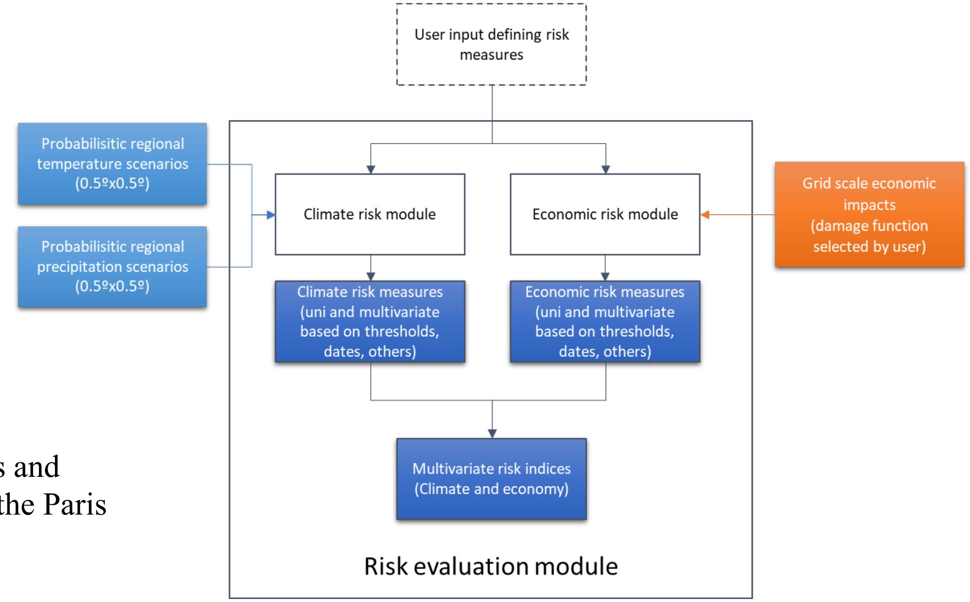
- Policy A, 50% change of total roof area to cool roofs (liquid applied coating) and 100% change of the paved area to cool pavement (hot mix asphalt with light aggregate);
- Policy B, 20% change to cool roofs and 50% to cool pavement;
- Policy C, 10% change to green roofs, 25% change to cool roofs and 50% change to cool pavement;
- Policy D, 10% change to green roofs, 10% to cool roofs and 20% to cool pavement.

Estrada F., Botzen W.J.W., Tol R.S.J., 2017. A global economic assessment of city policies to reduce climate change impacts. *Nature Climate Change* 7, 403–406. doi:10.1038/nclimate3301.

CLIMRISK: a model for estimating the economic costs and risks of climate change







CENTRO DE CIENCIAS DE LA ATMÓSFERA UNAM

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Estrada F., Botzen W.J.W., **2021**. Economic impacts and risks of climate change under failure and success of the Paris Agreement. *Ann. N.Y. Acad. Sci.* https://doi.org/10.1111/nyas.14652

ANNALS OF THE NEW YORK ACADEMY OF SCIENCES
Special Issue: *The Year in Climate Science Research*

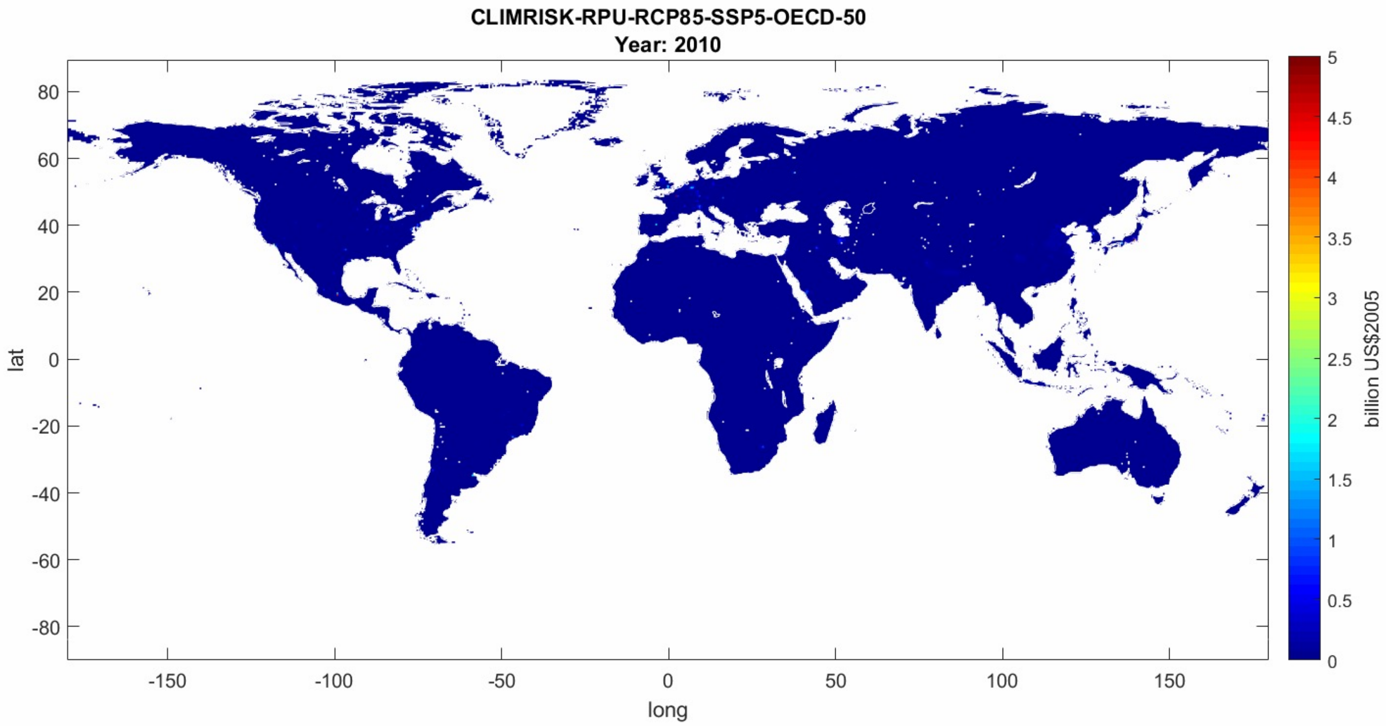
Original Article

Economic impacts and risks of climate change under failure and success of the Paris Agreement

Francisco Estrada[1,2,3] and W. J. Wouter Botzen[2,4]

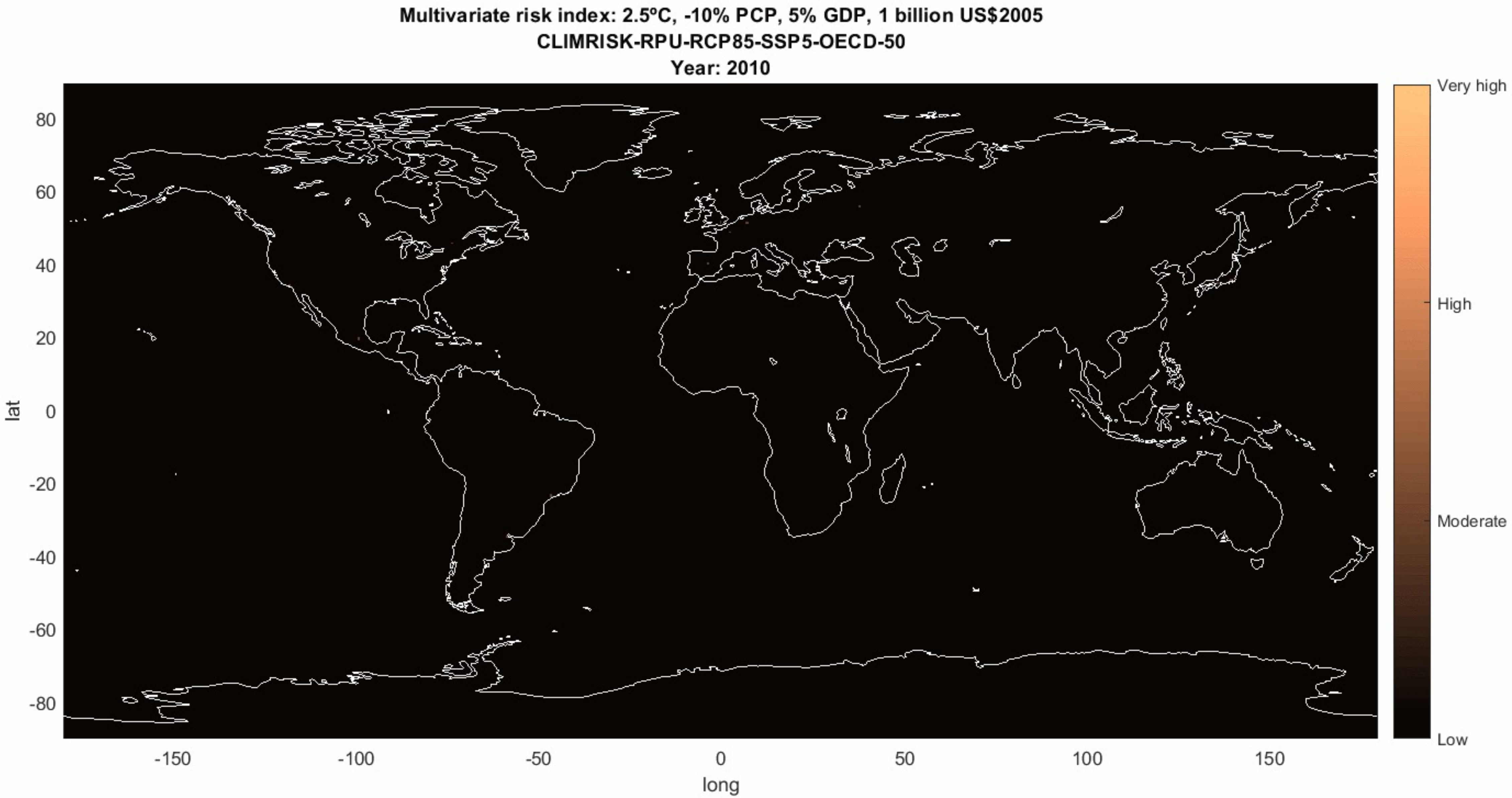
[1]Centro de Ciencias de la Atmosfera - Atmospheric Sciences, Universidad Nacional Autonoma de Mexico, Mexico, Mexico. [2]Institute for Environmental Studies, Vrije Universiteit, Amsterdam, Netherlands. [3]Programa de Investigación en Cambio Climático, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico. [4]Utrecht University School of Economics (U.S.E.), Utrecht University, Utrecht, Netherlands

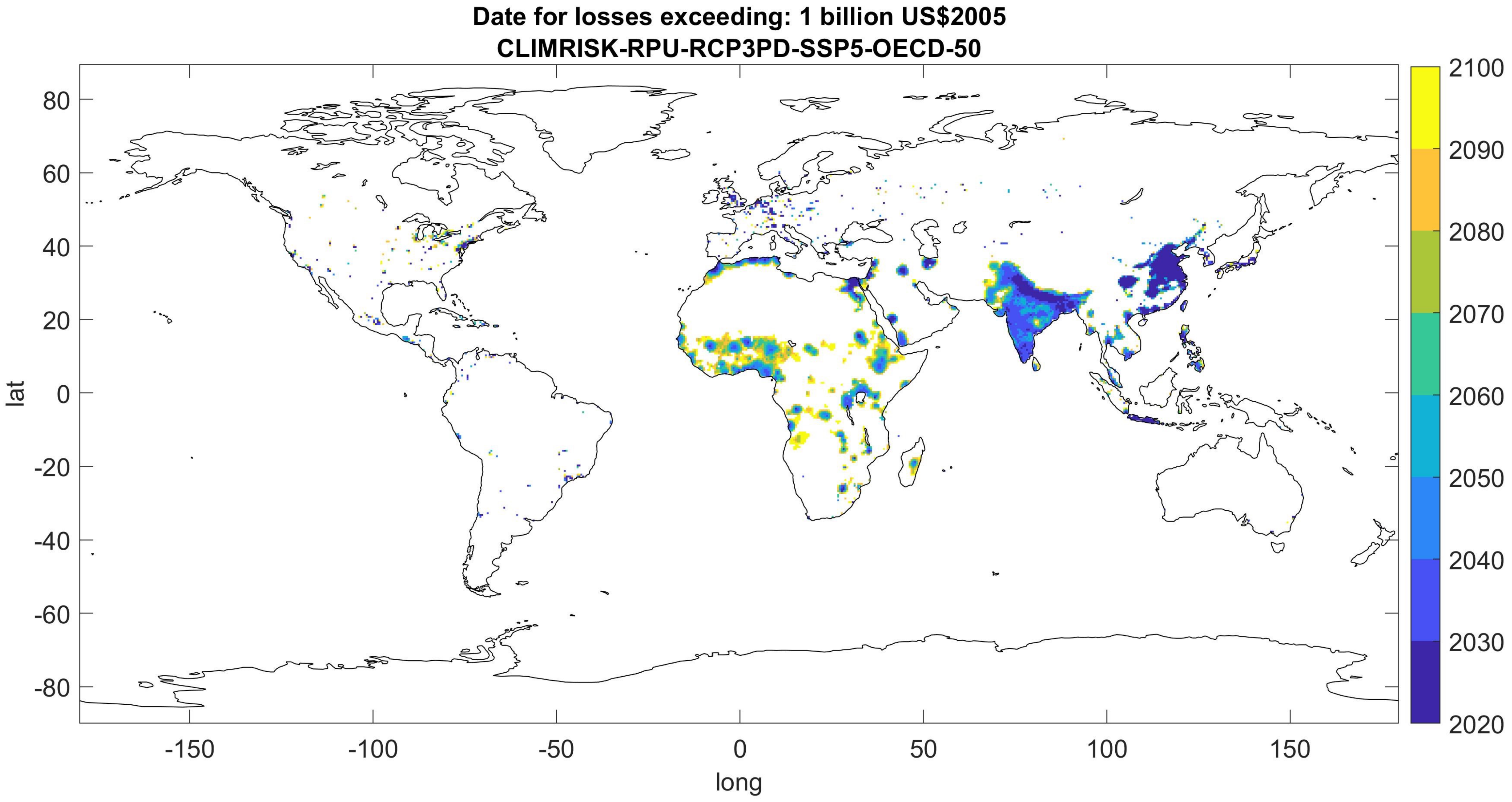
Cities and regional/global damages



Median total discounted economic costs of climate change over this century expressed as a percentage of a region's current GDP and in billions US$2005 under the RCP8.5 and SSP5 scenarios

Region	Without urban warming	With urban warming
USA	45% (23%, 71%) $5947 [$2990, $9382]	90% (52%, 133%) $11844 [$6819, $17476]
EU	47% (24%, 74%) $6968 [$3501, $10998]	102% (60%, 148%) $15164 [$8921, $22131]
AFRICA	581% (330%, 862%) $15988 [$9073, $23736]	830 (482, 1219) $22857 [$13272, $33560]


Multivariate risk index: 2.5ºC, -10% PCP, 5% GDP, 1 billion US$2005
CLIMRISK-RPU-RCP85-SSP5-OECD-50
Year: 2010
lat
80
60
40
20
0
-20
-40
-60
-80
-150
-100
-50
0
50
100
150
long
Very high
High
Moderate
Low


Date for losses exceeding: 1 billion US$2005
CLIMRISK-RPU-RCP3PD-SSP5-OECD-50
80
60
40
20
0
-20
-40
-60
-80
lat
-150
-100
-50
0
50
100
150
long
2100
2090
2080
2070
2060
2050
2040
2030
2020

Environ. Res. Lett. 16 (2021) 074039 https://doi.org/10.1088/1748-9326/ac0d7a

ENVIRONMENTAL RESEARCH
LETTERS

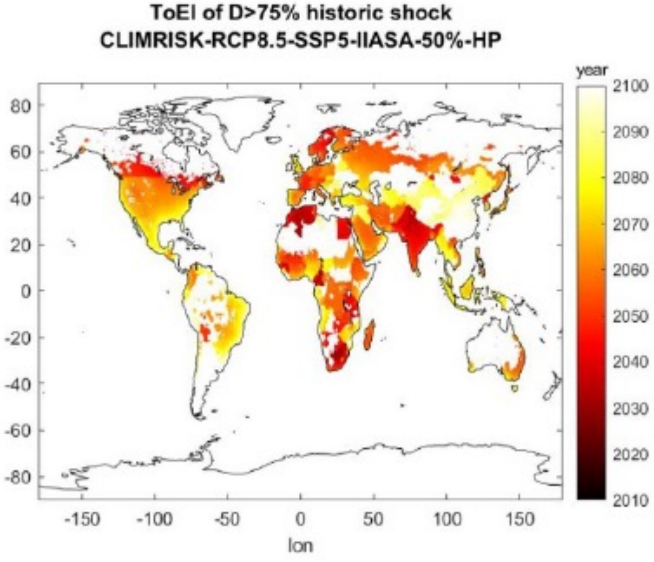
LETTER

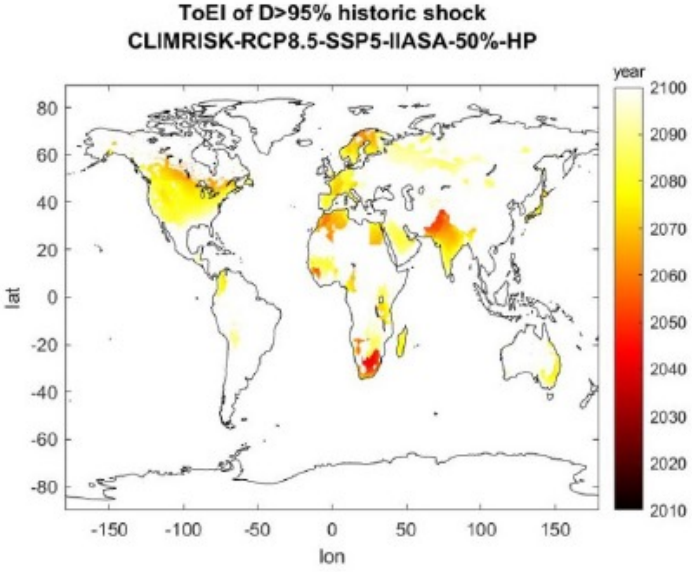
Time of emergence of economic impacts of climate change

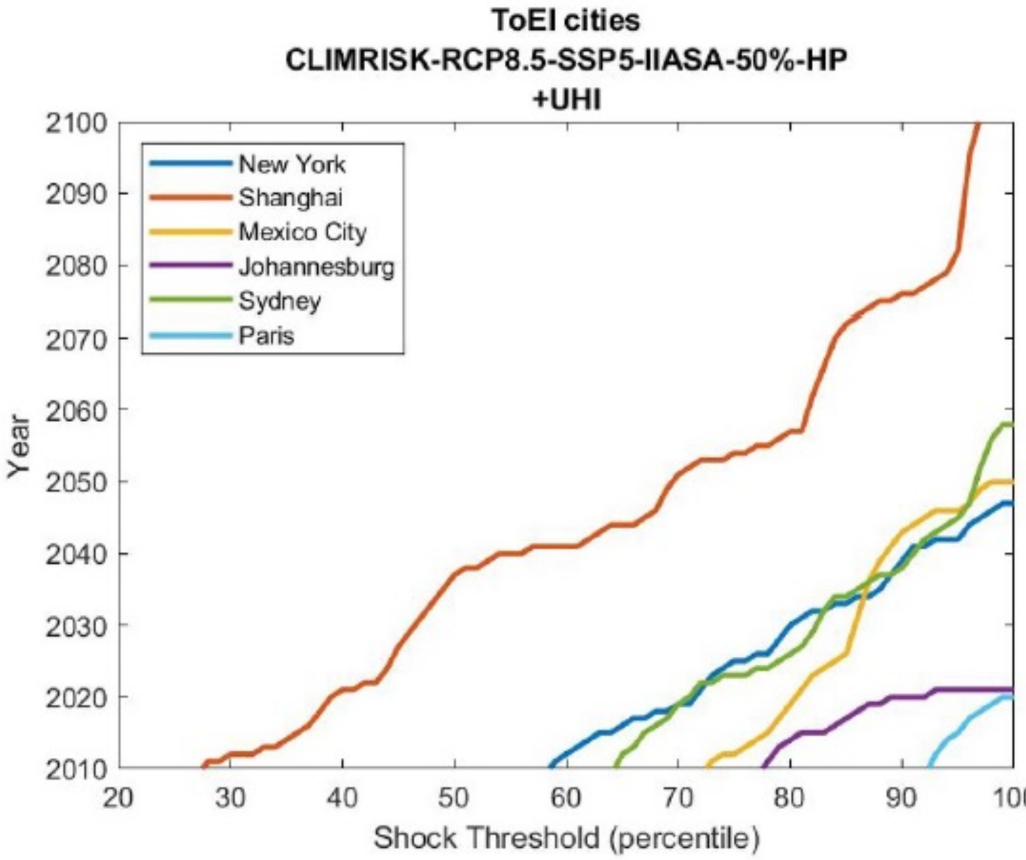
Predrag Ignjacevic[1,*], Francisco Estrada[1,2,3] and W J Wouter Botzen[1,4]

When would we start "feeling" the climate change impacts on the economy?

- ToEI: Identifies the initial moment when the climate change impact signal exceeds a previously defined threshold of past economic output shocks in a given geographic area.







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Aligning the Climate and SDG Agendas

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Thank you for your attention

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