Alterações Climáticas: Enquadramento Geral

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Saúde e Objetivos de Desenvolvimento Sustentável:

Desafios para uma Década

09 de outubro de 2019 | Fundação Calouste Gulbenkian

Outline

1. Aquecimento Global e Variabilidade climática;

2. O mundo em que vivemos (do clima médio aos extremos climáticos);

3. Modelos Climáticos: GCMs e RCMs (ESMs e RESMs)

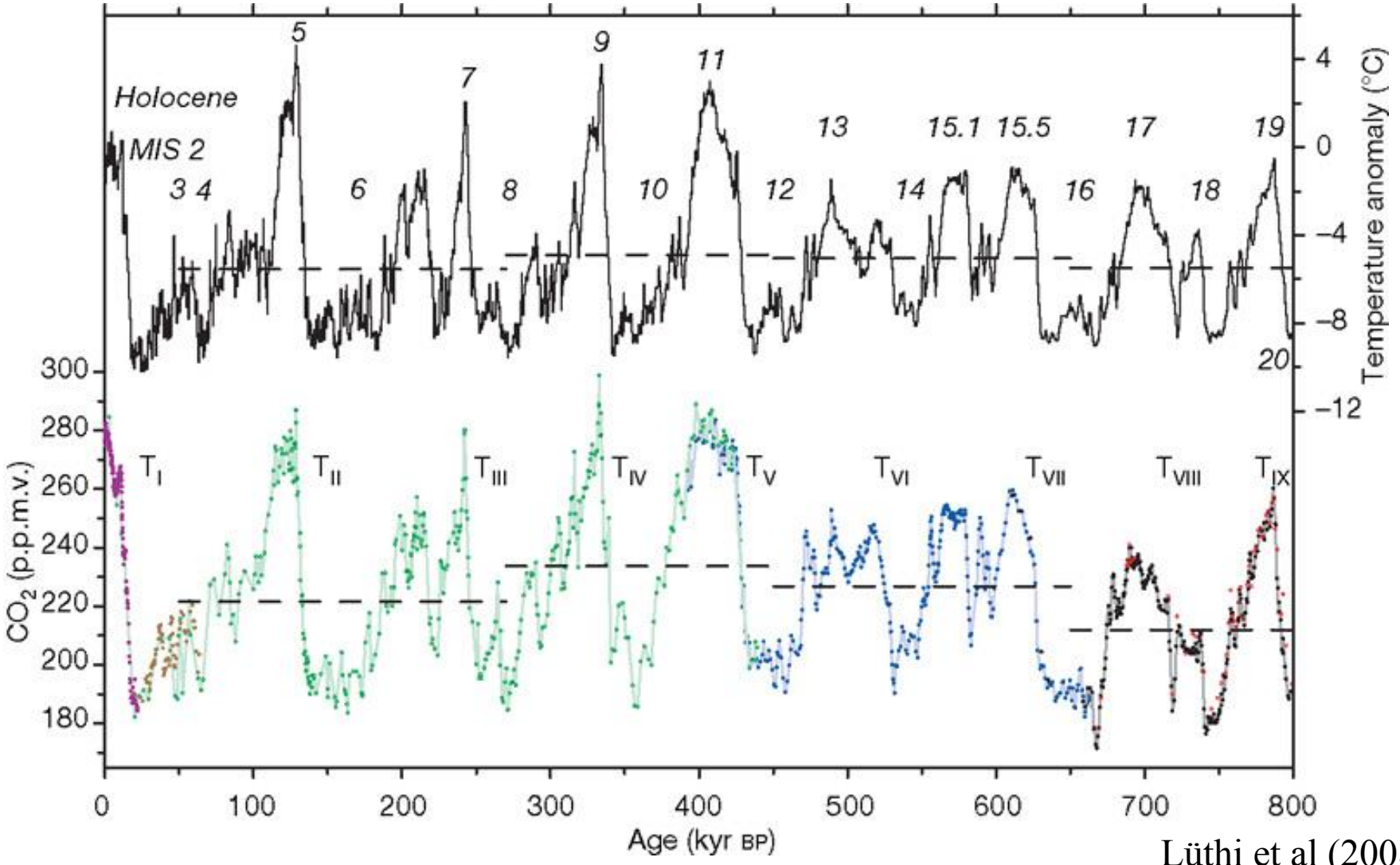
4. O que projectamos para o futuro: global e Portugal

Variabilidade Climática

vs

Alterações Climáticas Antropogénicas

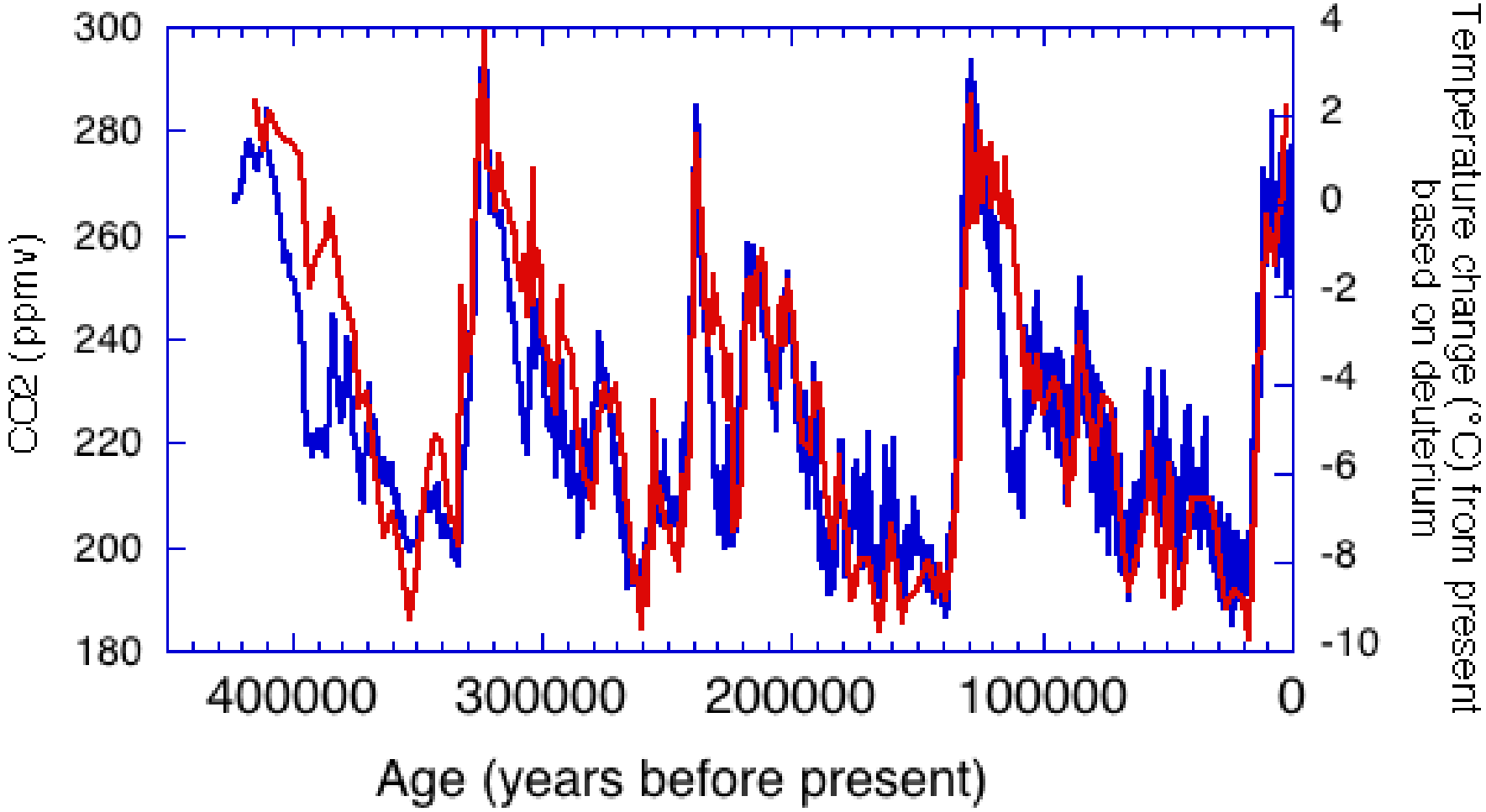
Temperatura e CO_2



Lüthi et al (2008)

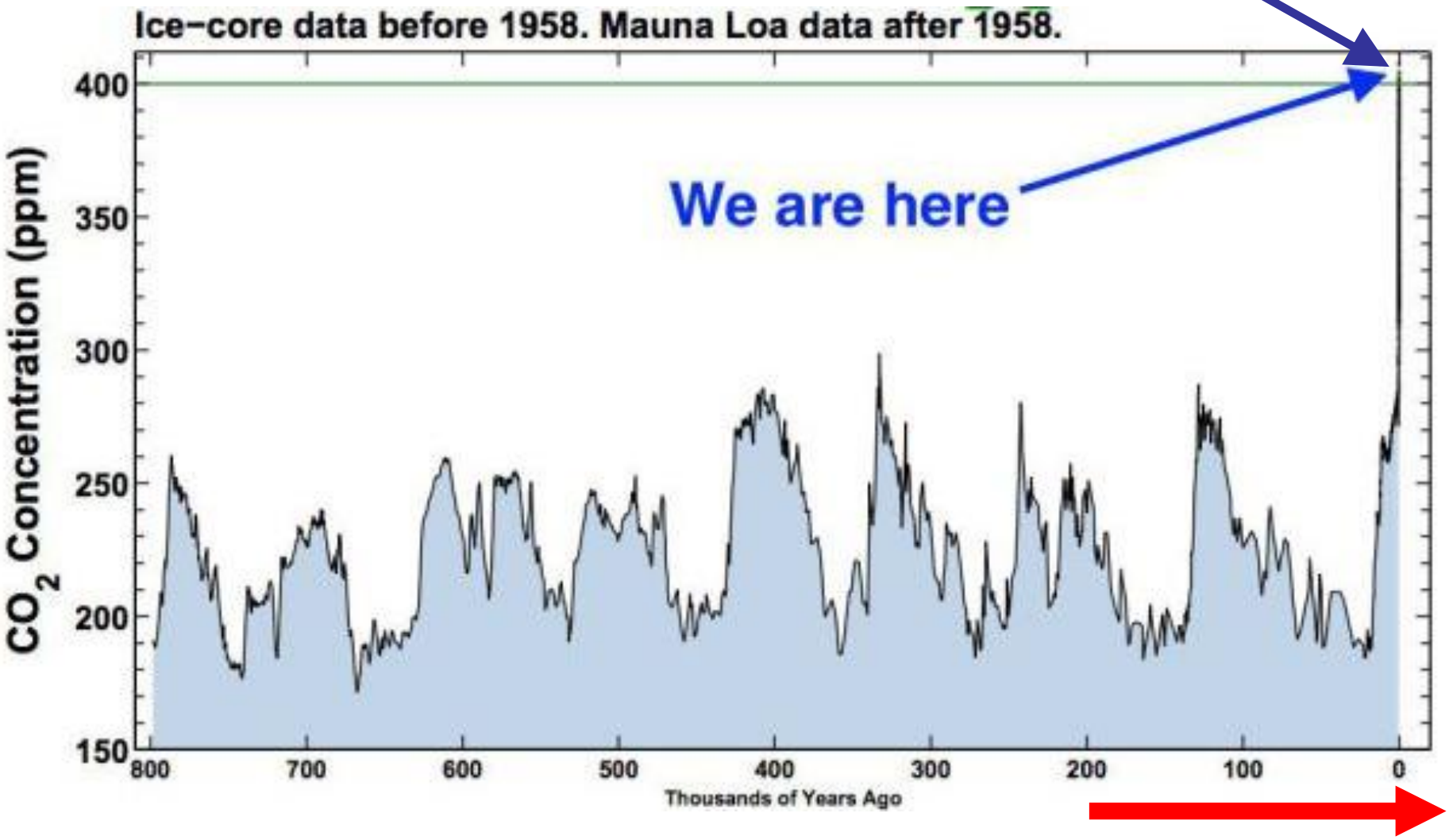
Reconstrução através de
bolhas de ar aprisonadas em núcleos de gelo na Antartica

Temperatura e CO_2



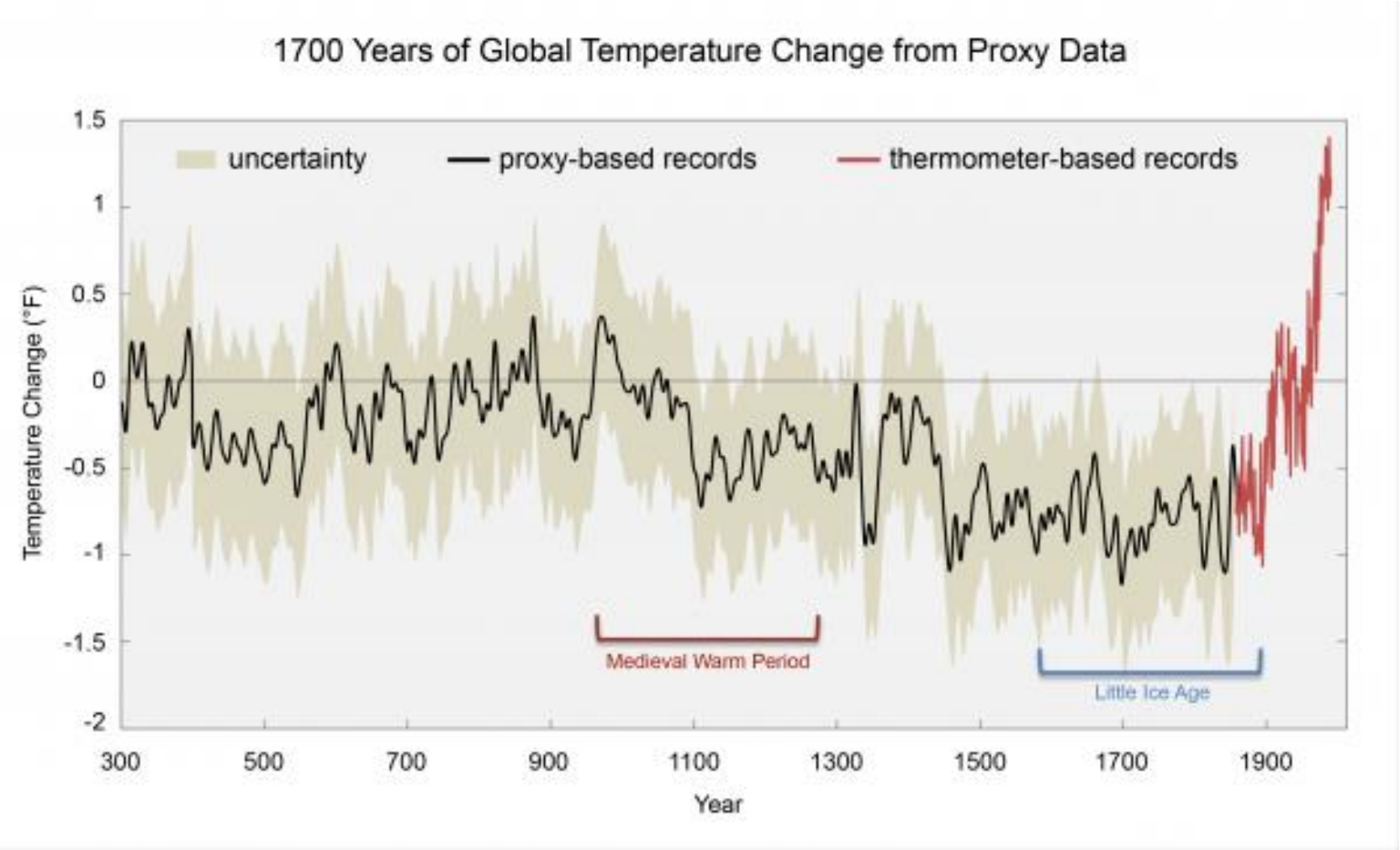
Temperature change (blue) and carbon dioxide change (red) observed in ice core records Many other records are available

408 ppm (1 de Outubro de 2019)



Homo sapiens

Últimos 1700 anos (HN)



anomalias (°C) relativas a 1961-1990

Source: [Climate Change Impacts in the United States: The Third National Climate Assessment]

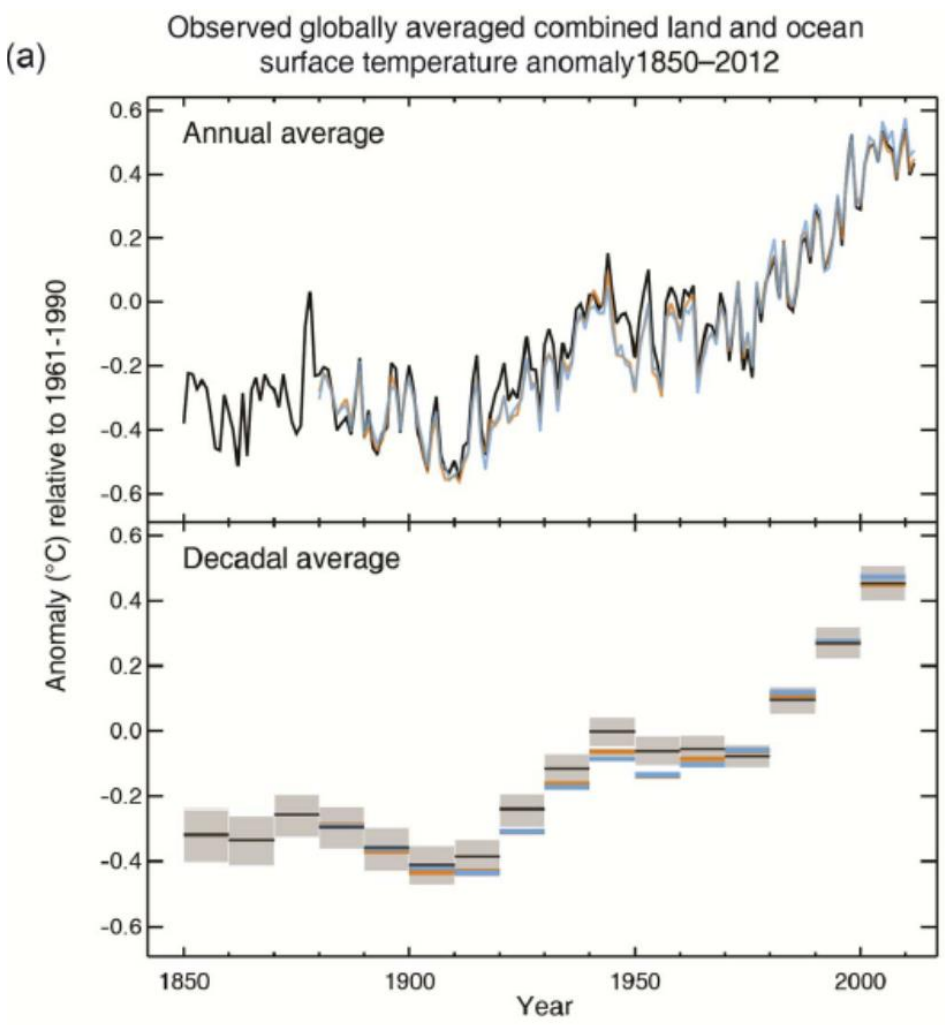
O mundo em que vivemos

IPCC 5th Assessment Report for Climate Change
2013: The Physical Basis

Observed Changes in the Climate System

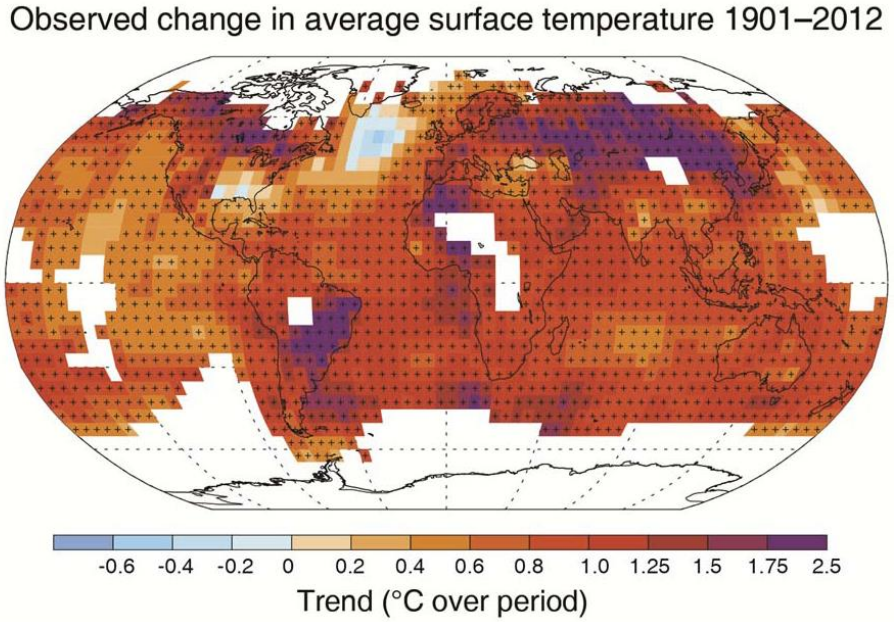
Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia.

The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, sea level has risen, and the concentrations of greenhouse gases have increased.



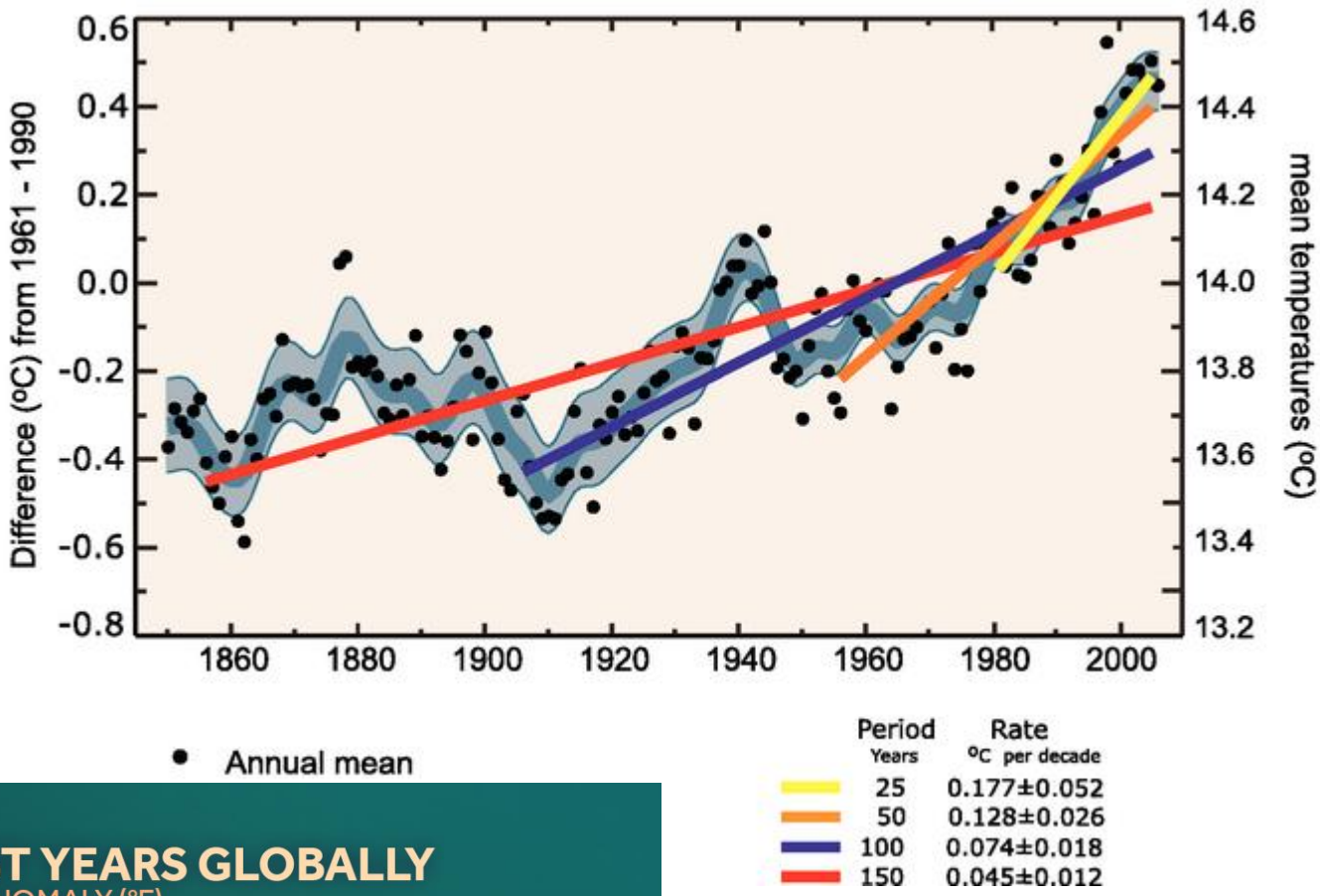
Each of the last three decades has been successively warmer at the Earth's surface than any receding decade since 1850.

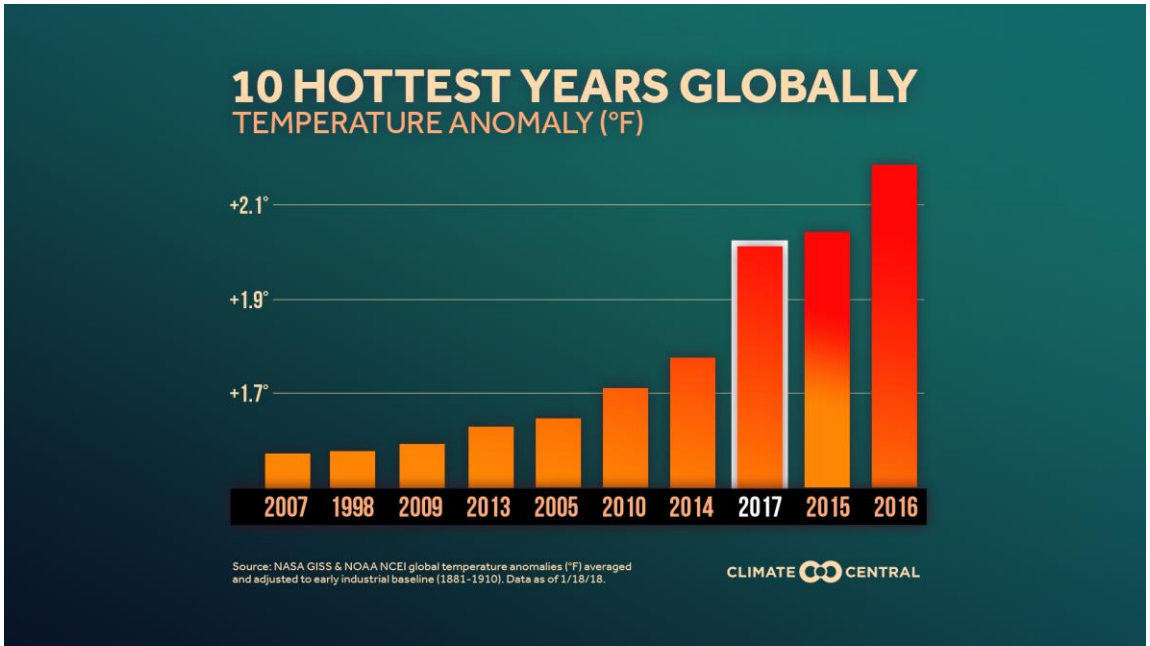
Temperatura



IPCC - 2013

IPCC - 2007

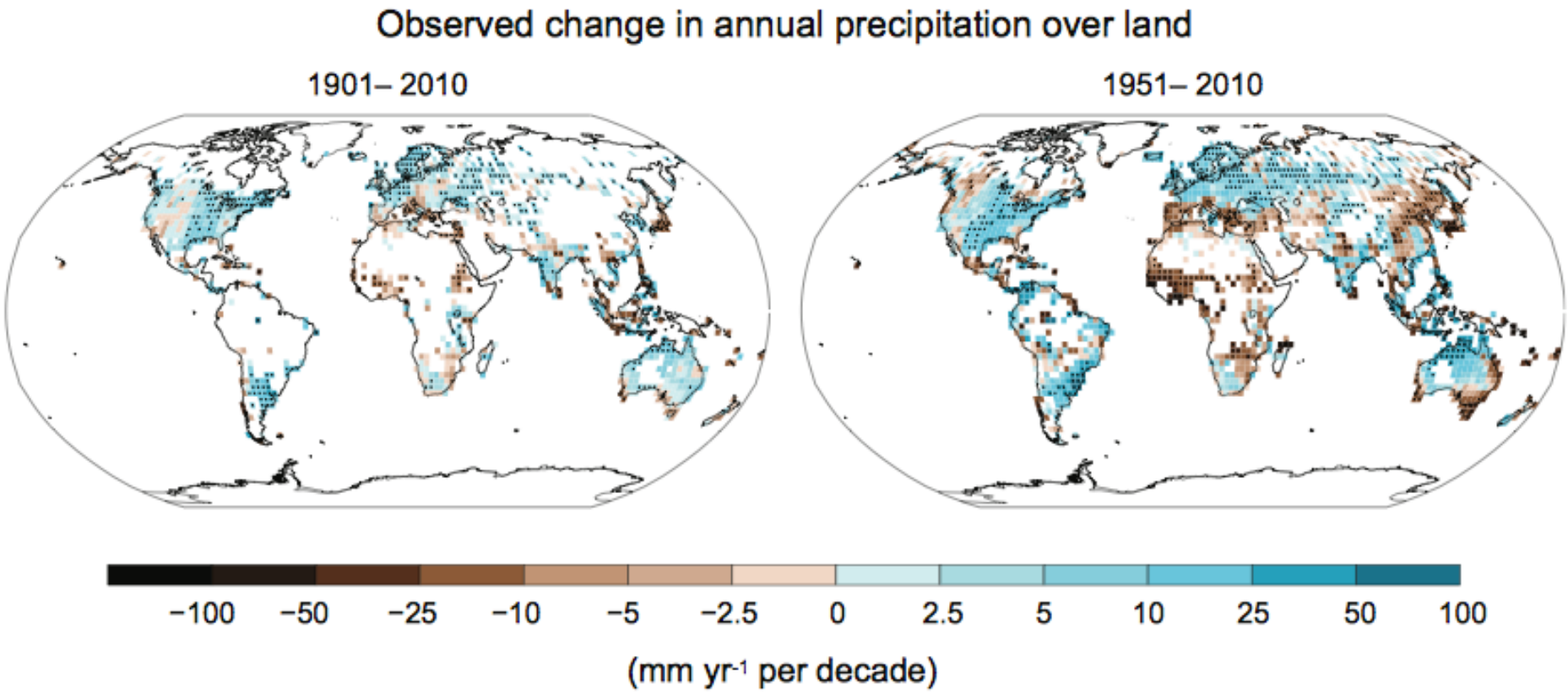




17 dos 18 mais quentes ocorreram desde 2000 !

Precipitation

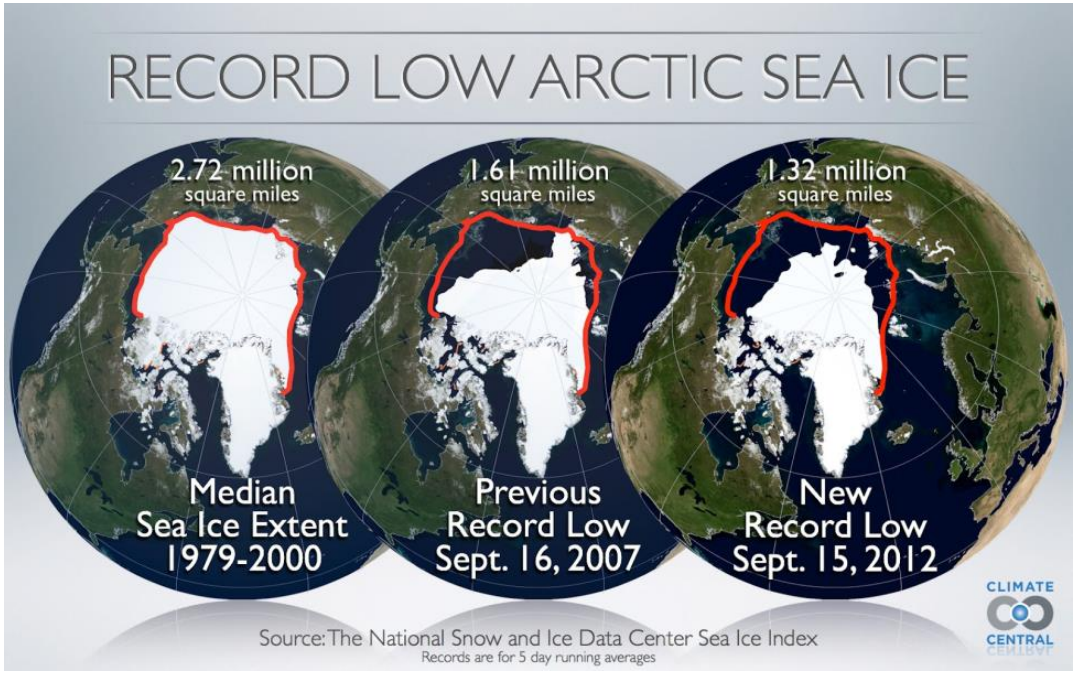
IPCC - 2013

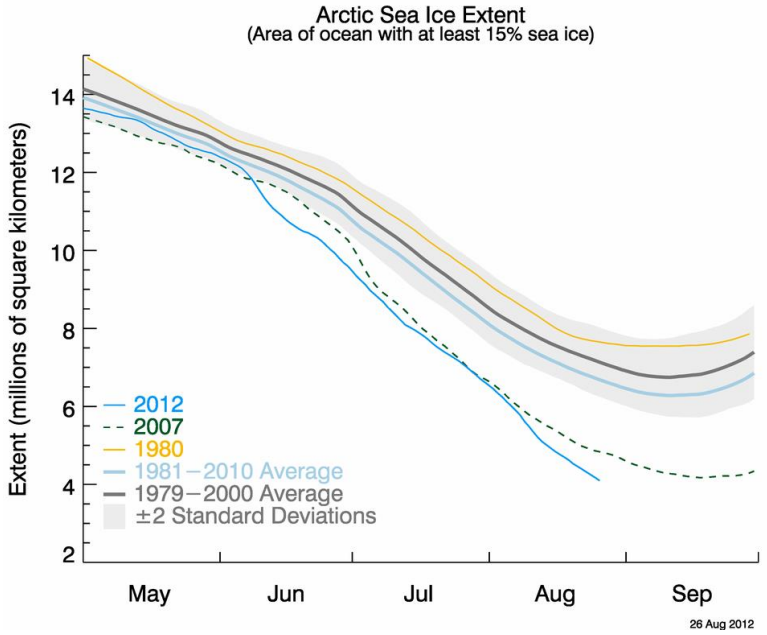


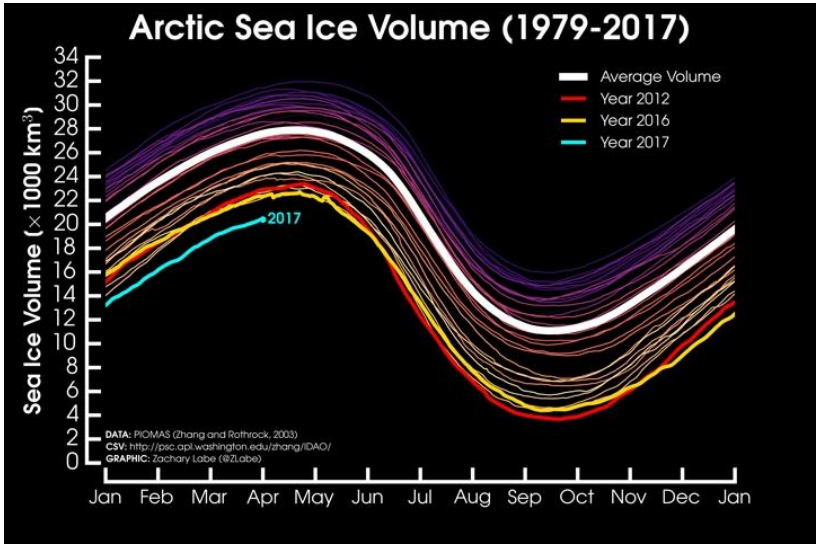
Extremes

- More land regions where the number of heavy precipitation events has increased than where it has decreased.
- The frequency or intensity of heavy precipitation events has likely increased in North America and Europe.

Degelo no Ártico



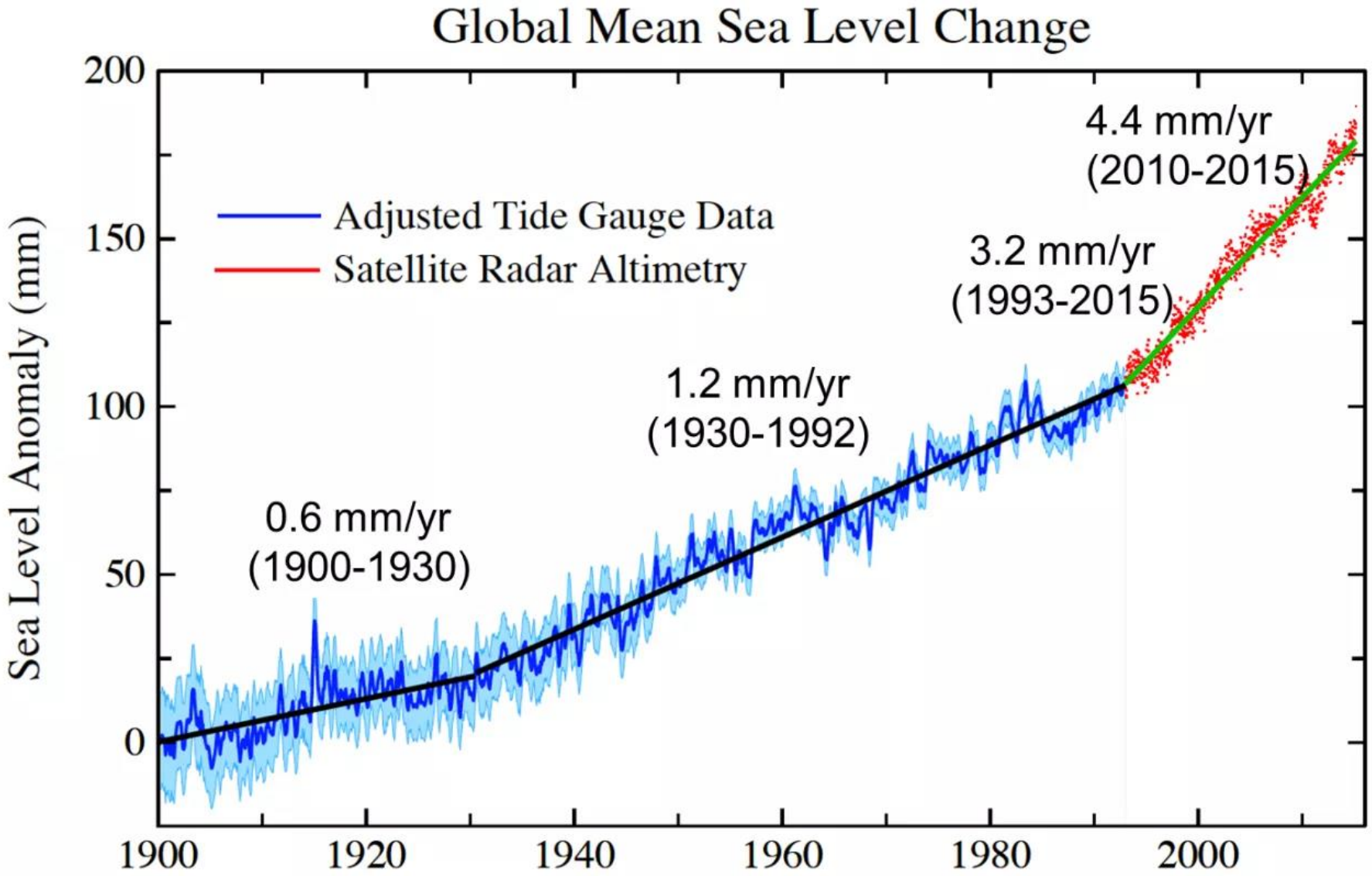




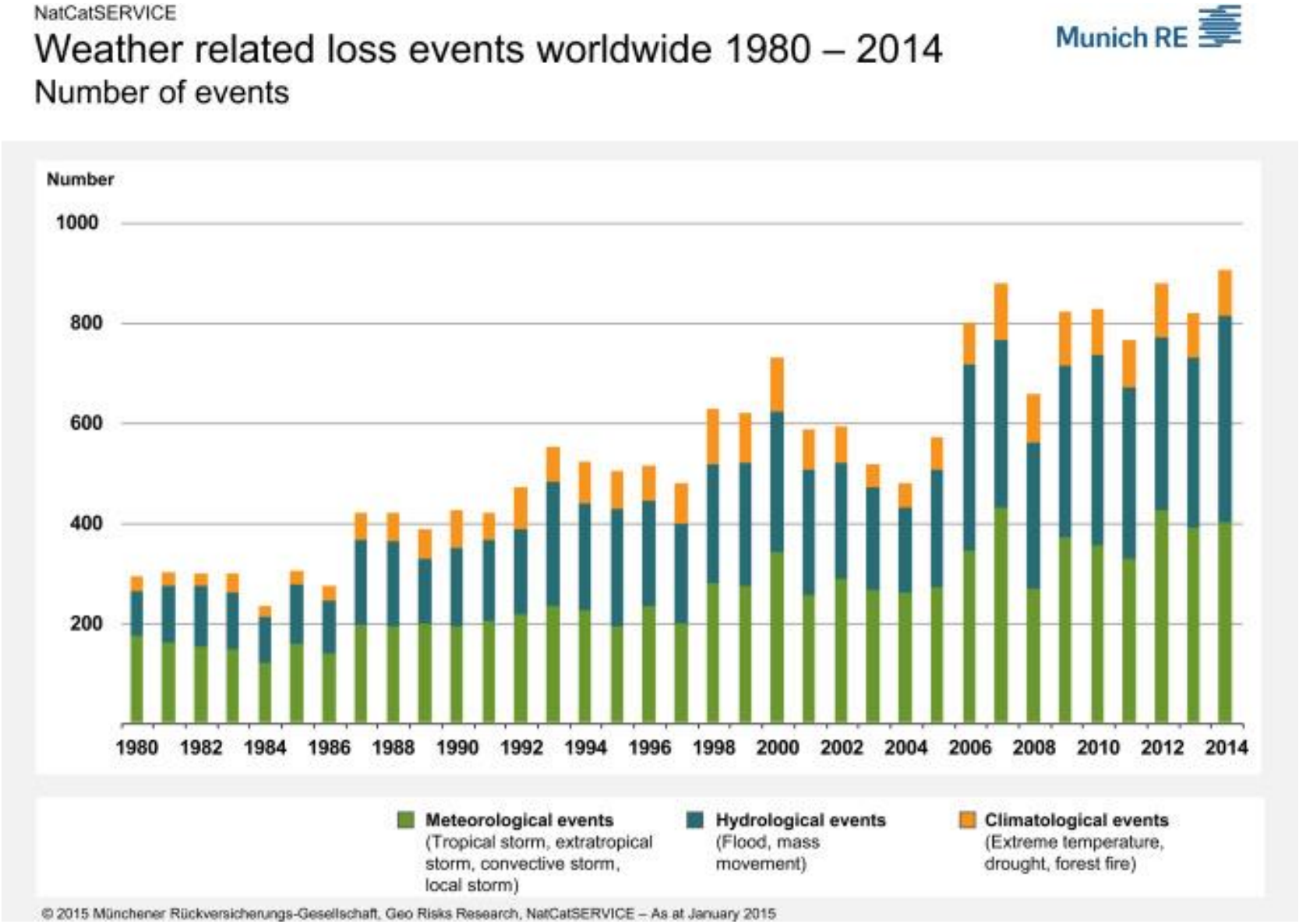
Since 1979, the volume of Summer Arctic Sea Ice has declined by more than 80% and is accelerating…

National Snow and Ice Data Center

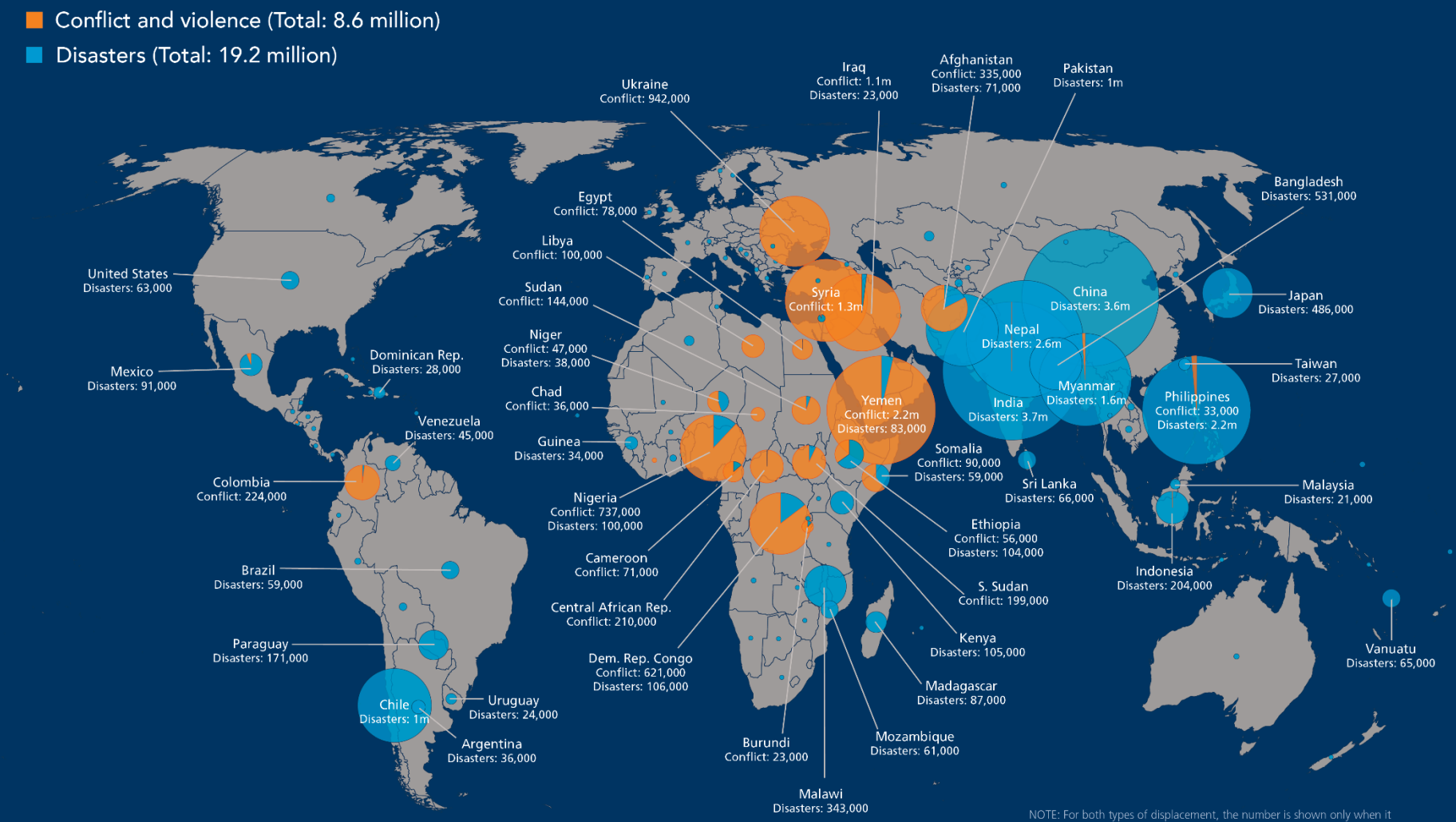
Warming + Melting = Sea Level Rise



Eventos extremos



New displacements associated with conflict and disasters in 2015

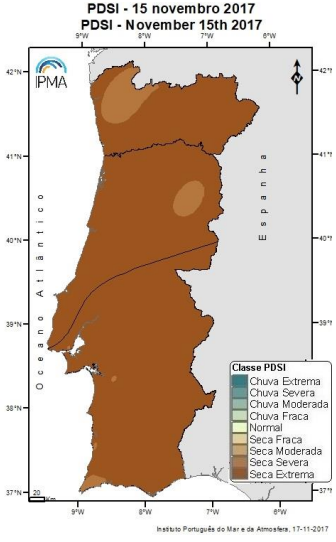


NOTE: For both types of displacement, the number is shown only when it exceeds 20,000. The size of the pie charts is fixed for estimates of 5,000 or less. In a few cases, the same person may be displaced more than once.

Seca, Ondas de Calor, Fogos, Tempestades, etc

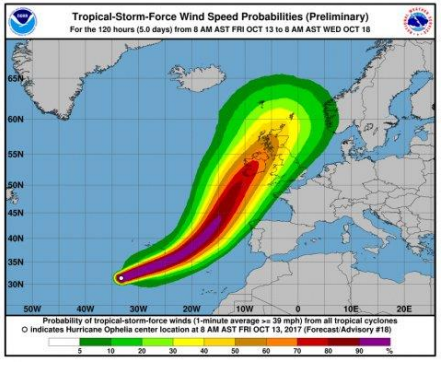
2017
2018
2019

Ago 2018
Max abs…
Tmax



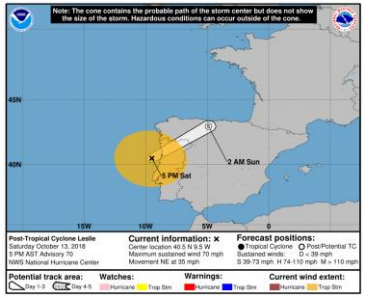
Pedrogão Jun 2017

Ophelia
Out 2017

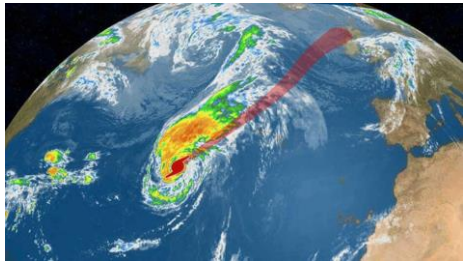


Monchique Ago 2018

Leslie
Out 2018



Marinha Grande Out 2017



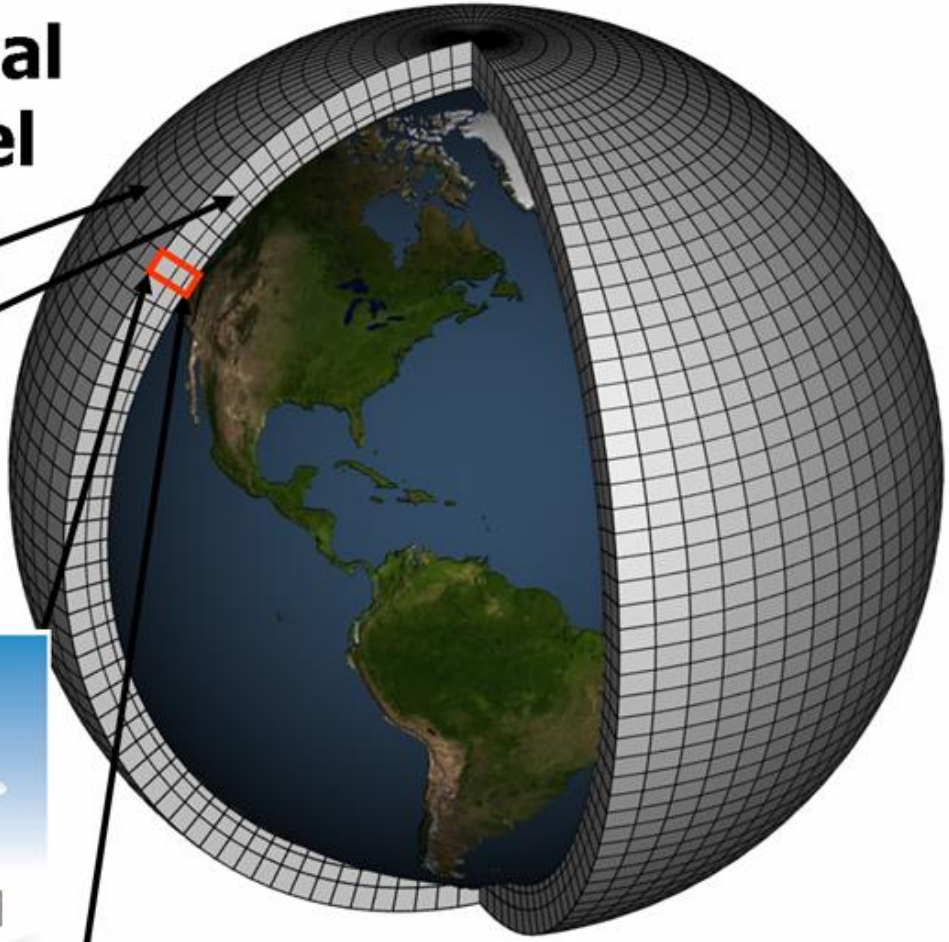
Lorenzo
Set/Out
2019
Cat5

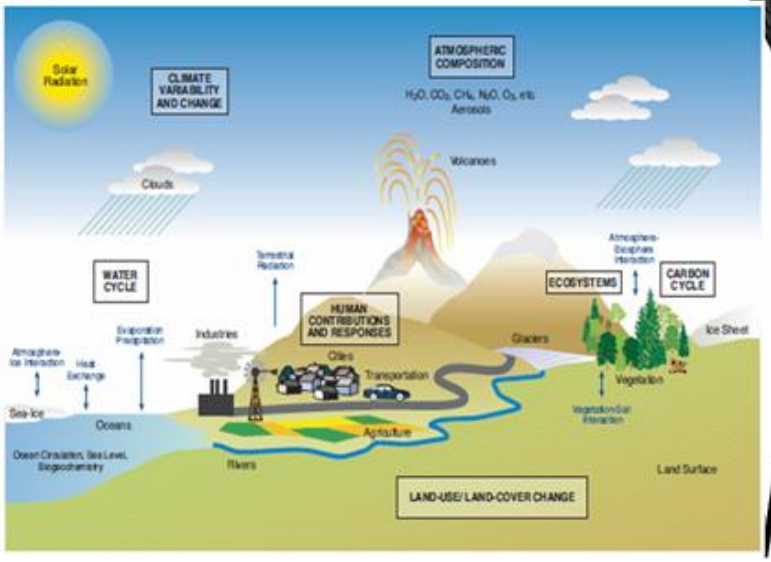
Como estudamos o clima presente e futuro?

Schematic for Global Atmospheric Model

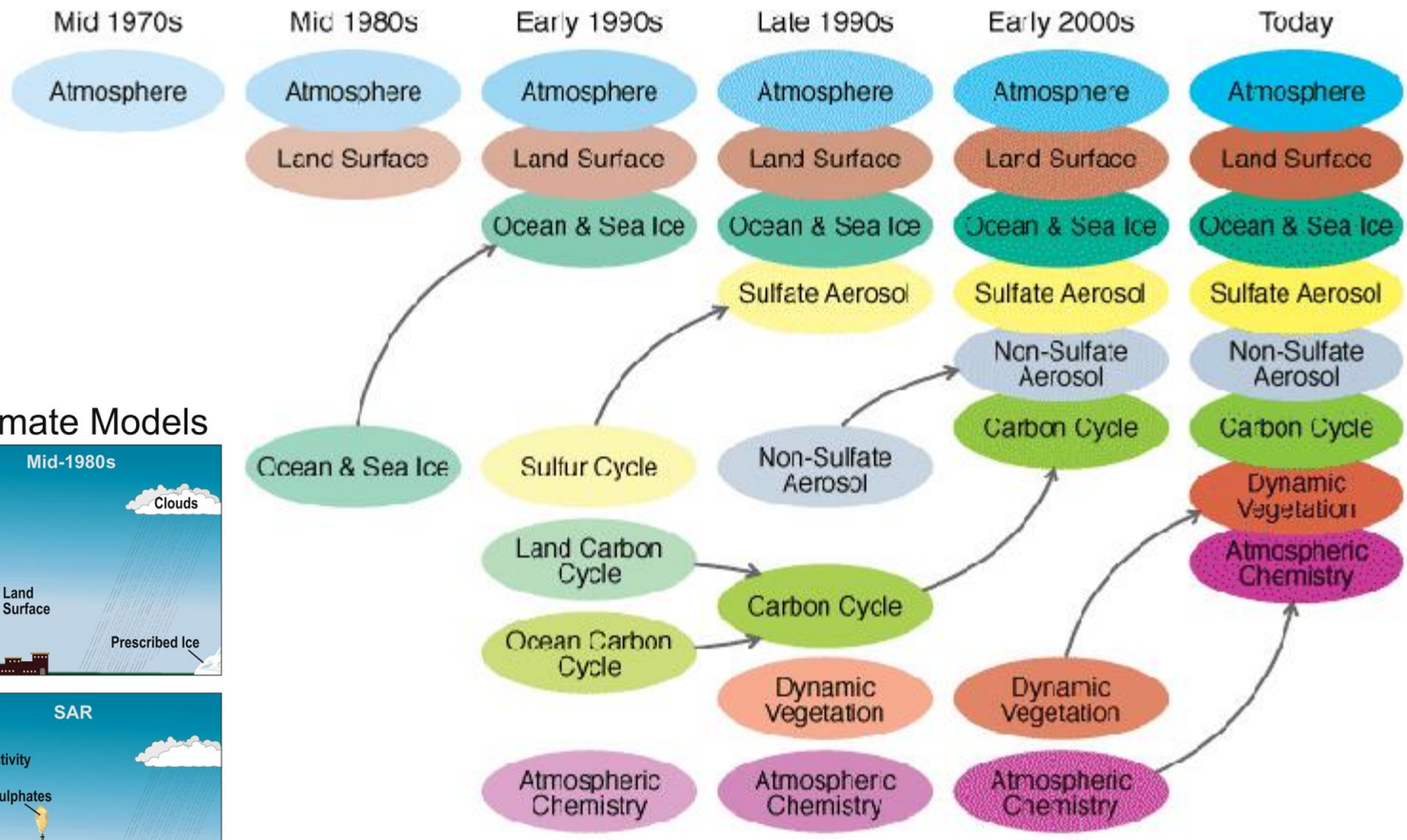
Horizontal Grid (Latitude-Longitude)

Vertical Grid (Height or Pressure)

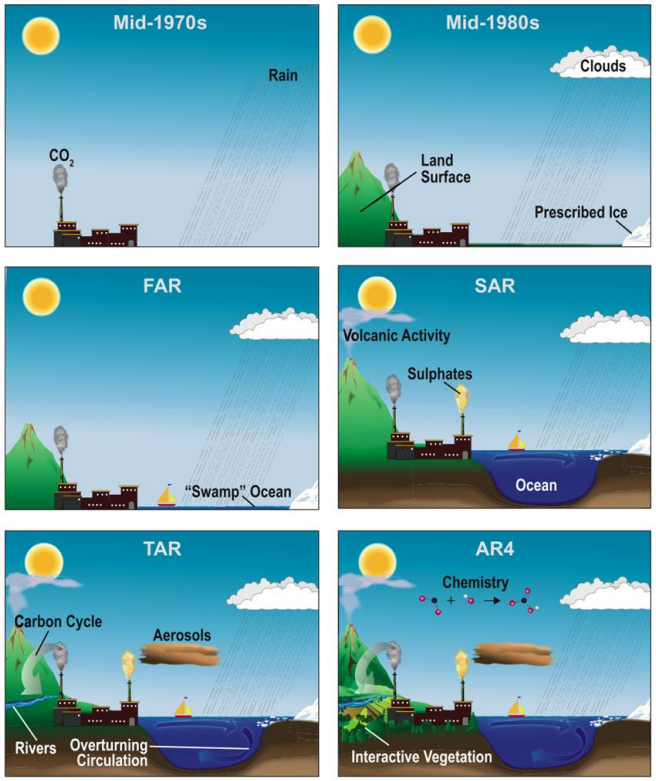




Development of Climate Models



The World in Global Climate Models



How Well Have GCMs performed? Attribution

Anthropogenic and natural forcings

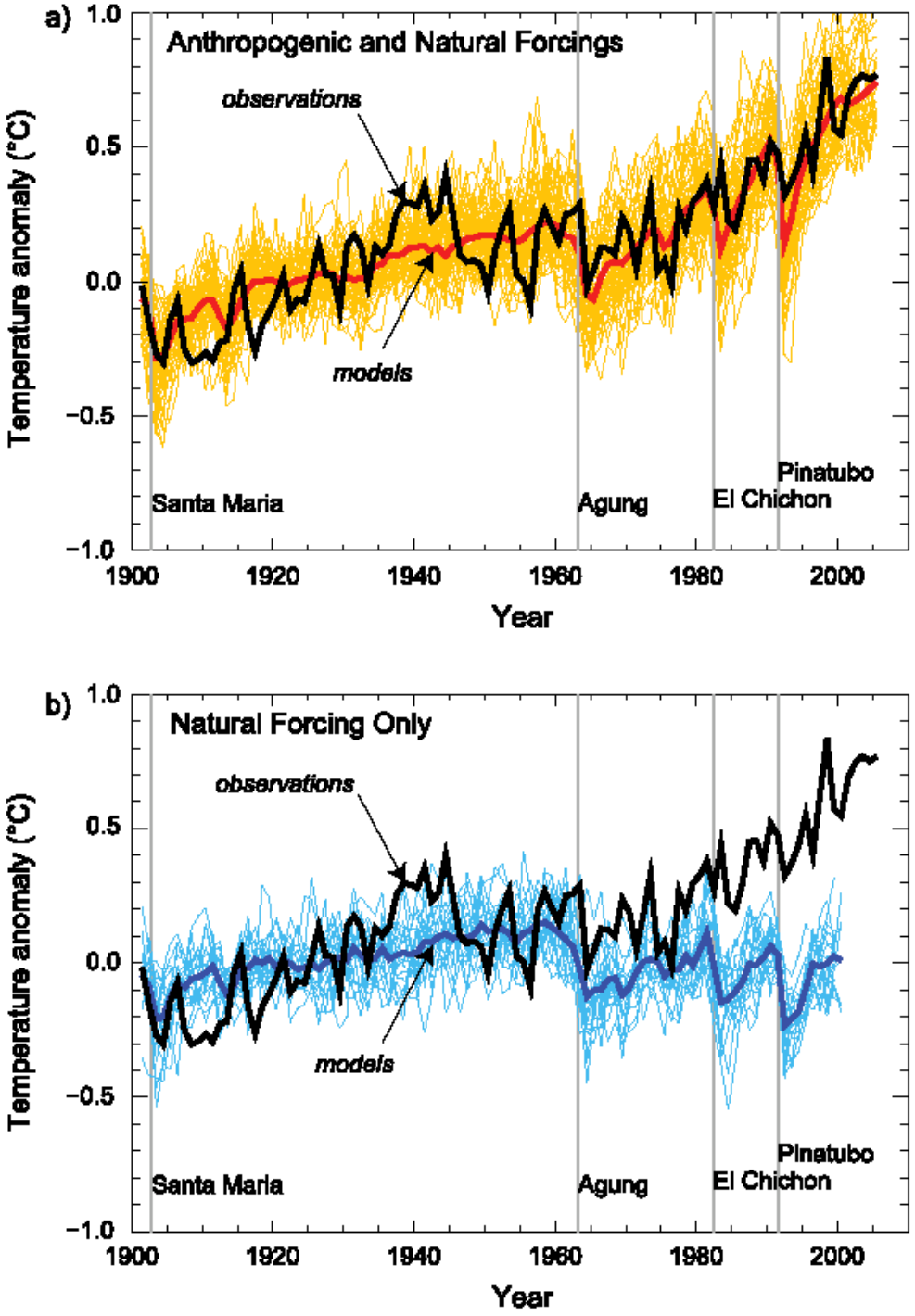


Figure TS.23. *(a) Global mean surface temperature anomalies relative to the period 1901 to 1950, as observed (black line) and as obtained from simulations with both anthropogenic and natural forcings. The thick red curve shows the multi-model ensemble mean and the thin lighter red curves show the individual simulations. Vertical grey lines indicate the timing of major volcanic events. (b) As in (a), except that the simulated global mean temperature anomalies are for natural forcings only. The thick blue curve shows the multi-model ensemble mean and the thin lighter blue curves show individual simulations. Each simulation was sampled so that coverage corresponds to that of the observations. {Figure 9.5}*

Source: IPCC 2007a (WG I TSp.62)

O que projectamos para o futuro

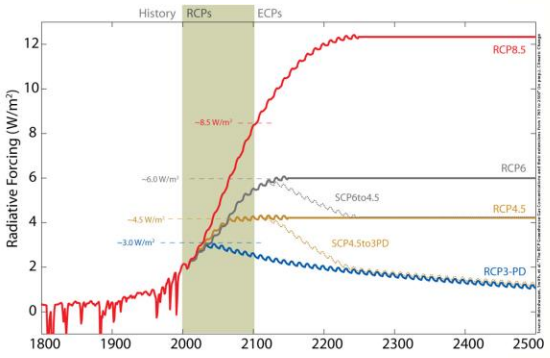
Global

Future Climate Change

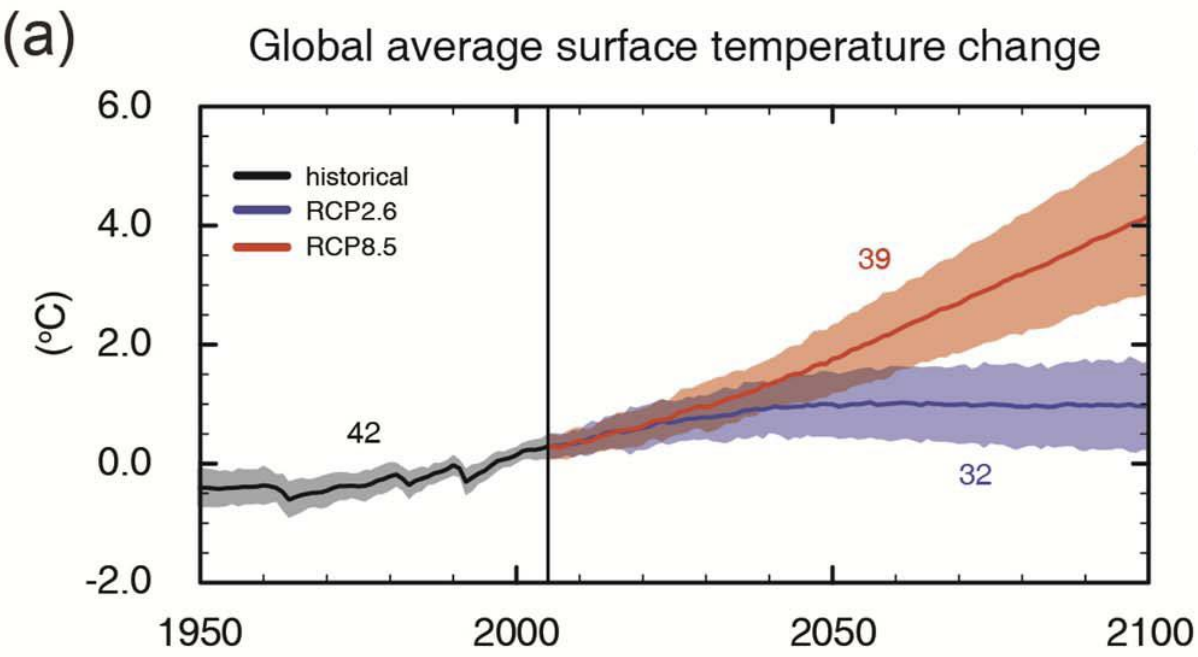
CMIP5 multi-model simulated time series from 1950 to 2100

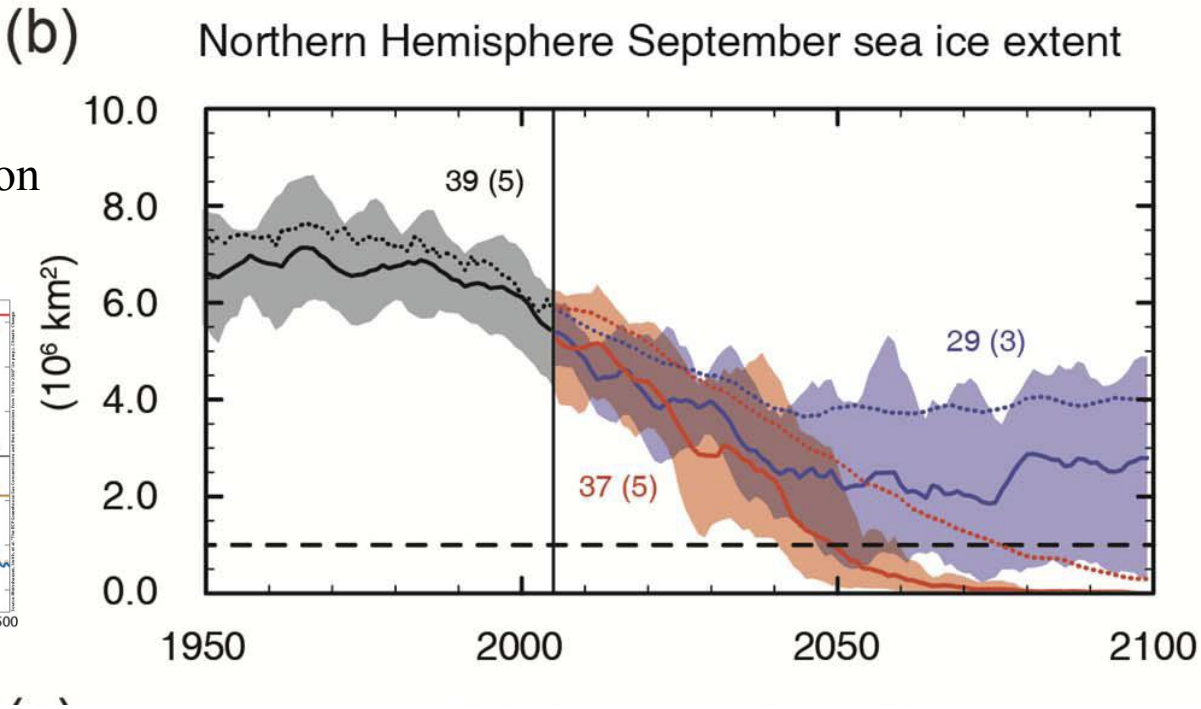
mean surface temperature relative to 1986–2005

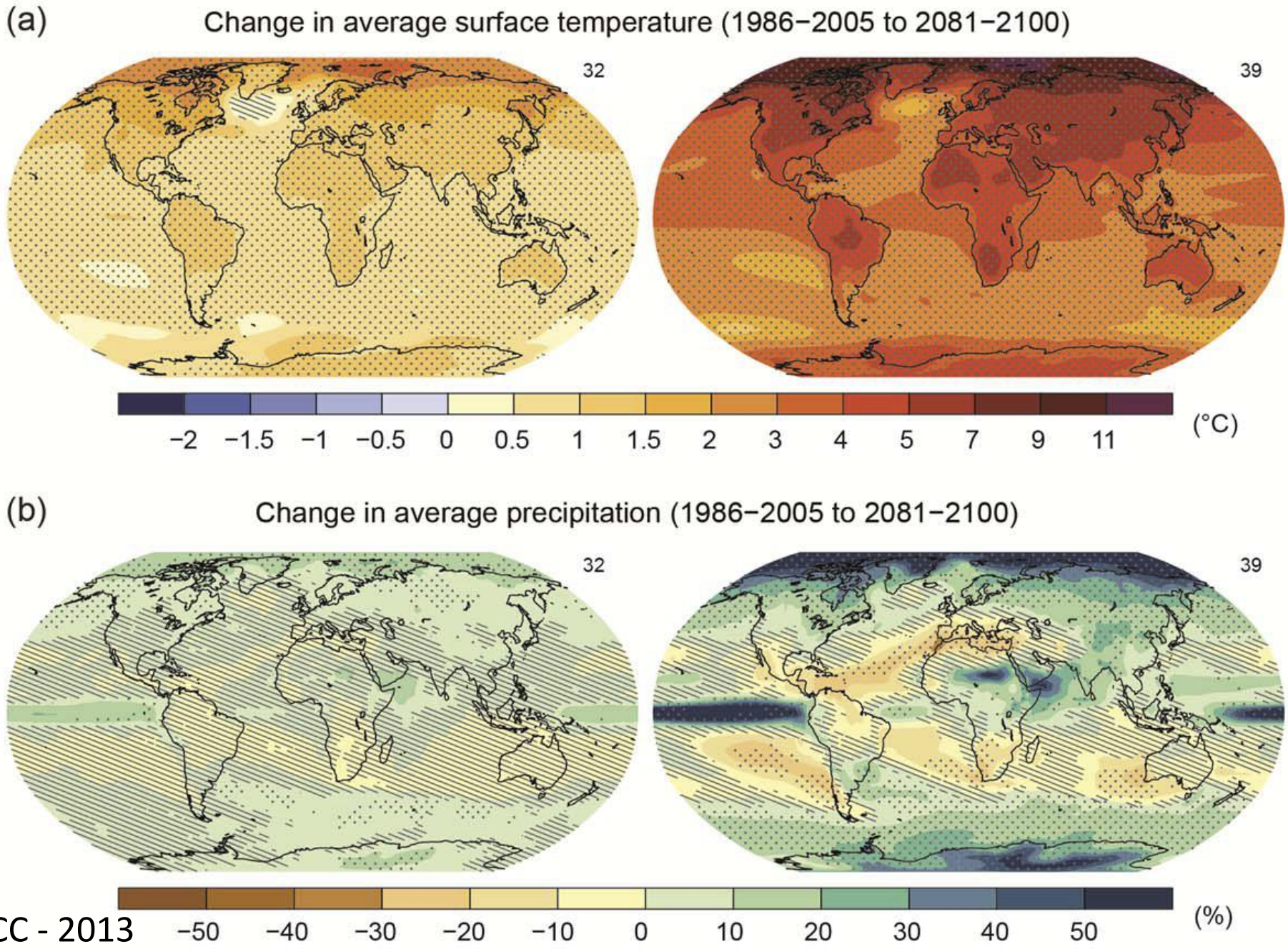
Representative Concentration Pathways (RCPs)



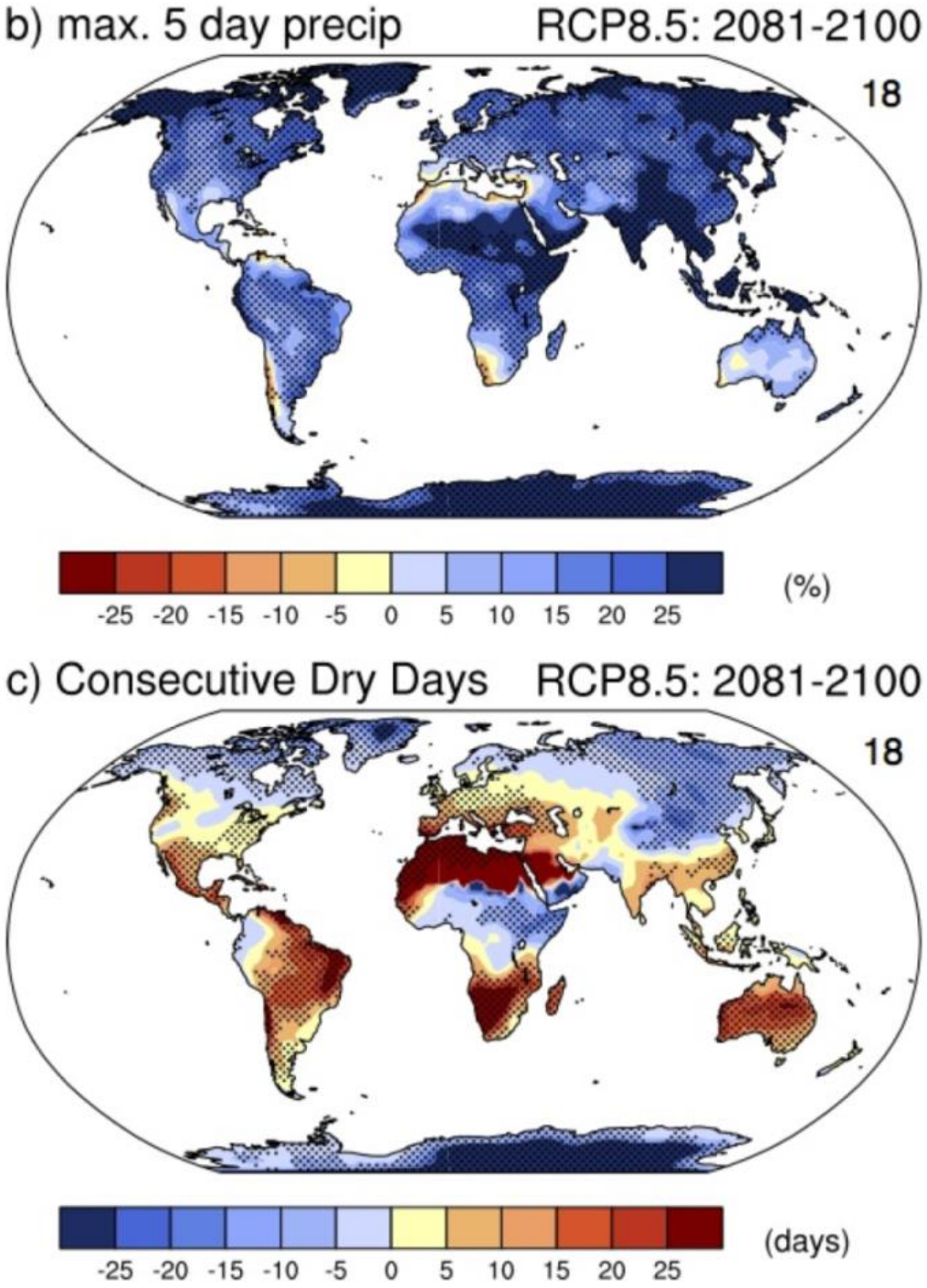
IPCC - 2013



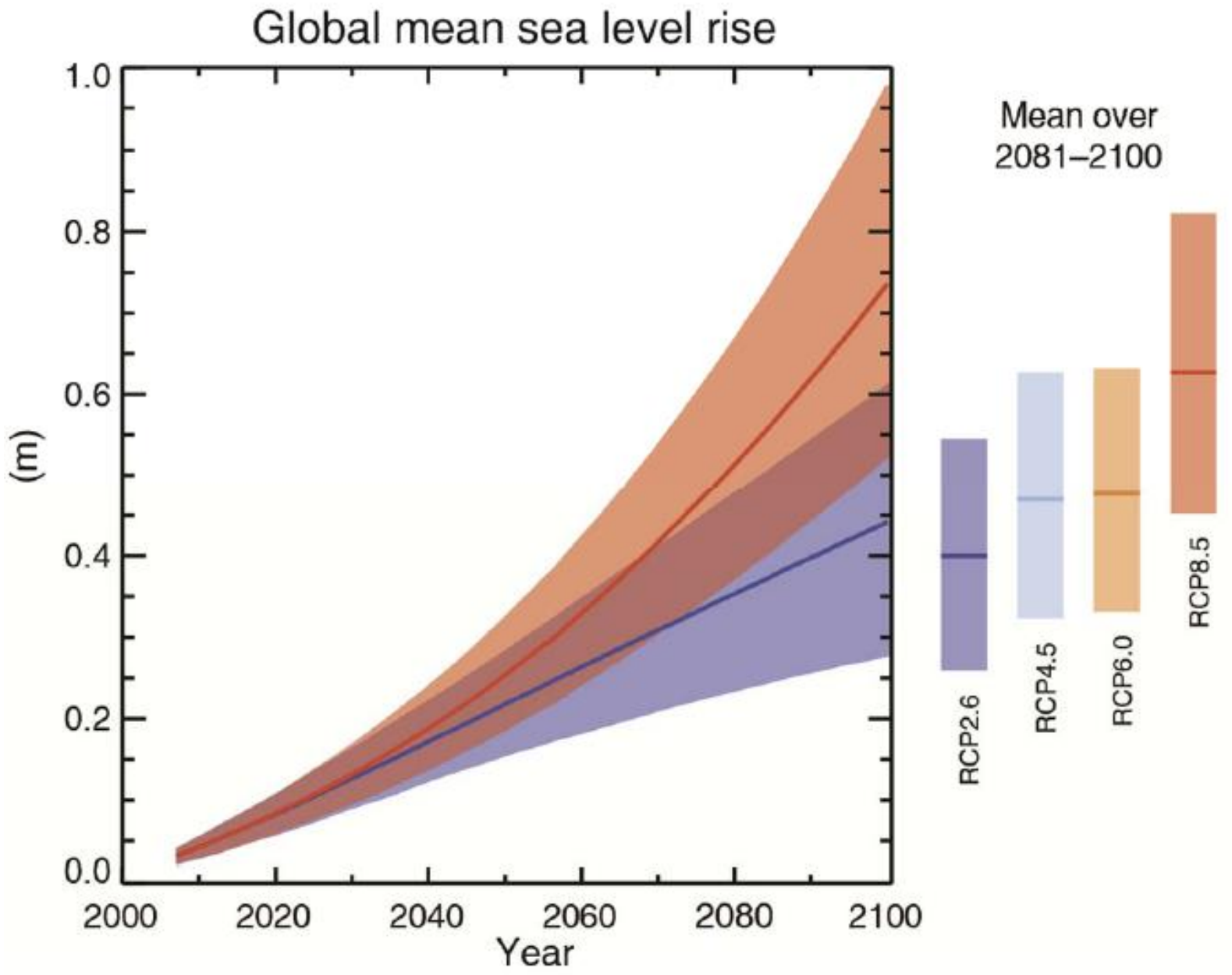



RCP 2.6
RCP 8.5
(a)
Change in average surface temperature (1986−2005 to 2081−2100)
32
39
−2 −1.5 −1 −0.5 0 0.5 1 1.5 2 3 4 5 7 9 11
(°C)
(b)
Change in average precipitation (1986−2005 to 2081−2100)
32
39
−50 −40 −30 −20 −10 0 10 20 30 40 50
(%)

IPCC - 2013


b) max. 5 day precip
RCP8.5: 2081-2100
18
-25 -20 -15 -10 -5 0 5 10 15 20 25
(%)
c) Consecutive Dry Days
RCP8.5: 2081-2100
18
-25 -20 -15 -10 -5 0 5 10 15 20 25
(days)

IPCC - 2013


Global mean sea level rise
1.0
0.8
0.6
0.4
0.2
0.0
(m)
2000
2020
2040
2060
2080
2100
Year
Mean over
2081–2100
RCP2.6
RCP4.5
RCP6.0
RCP8.5

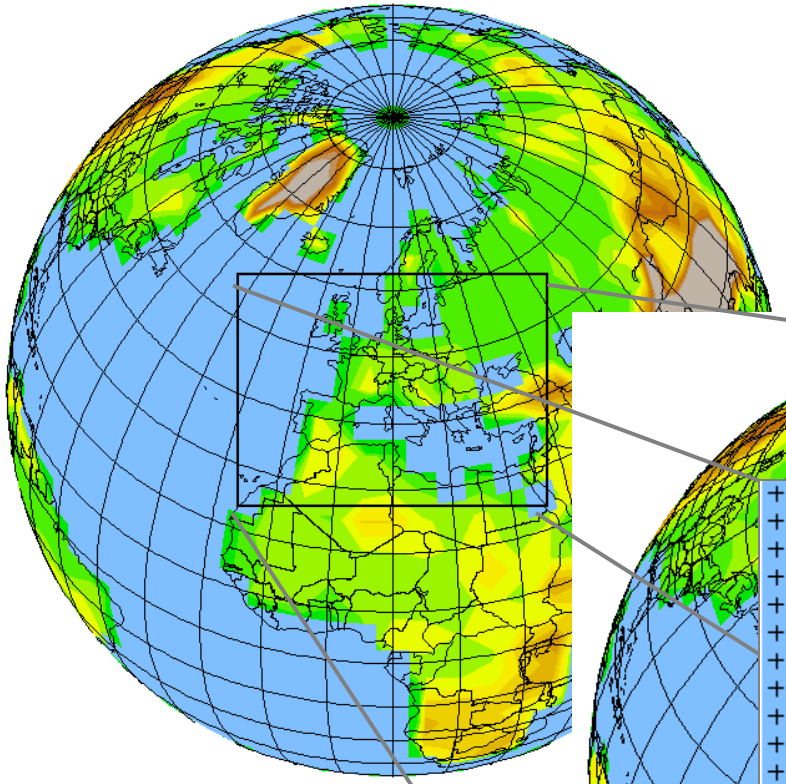
IPCC - 2013

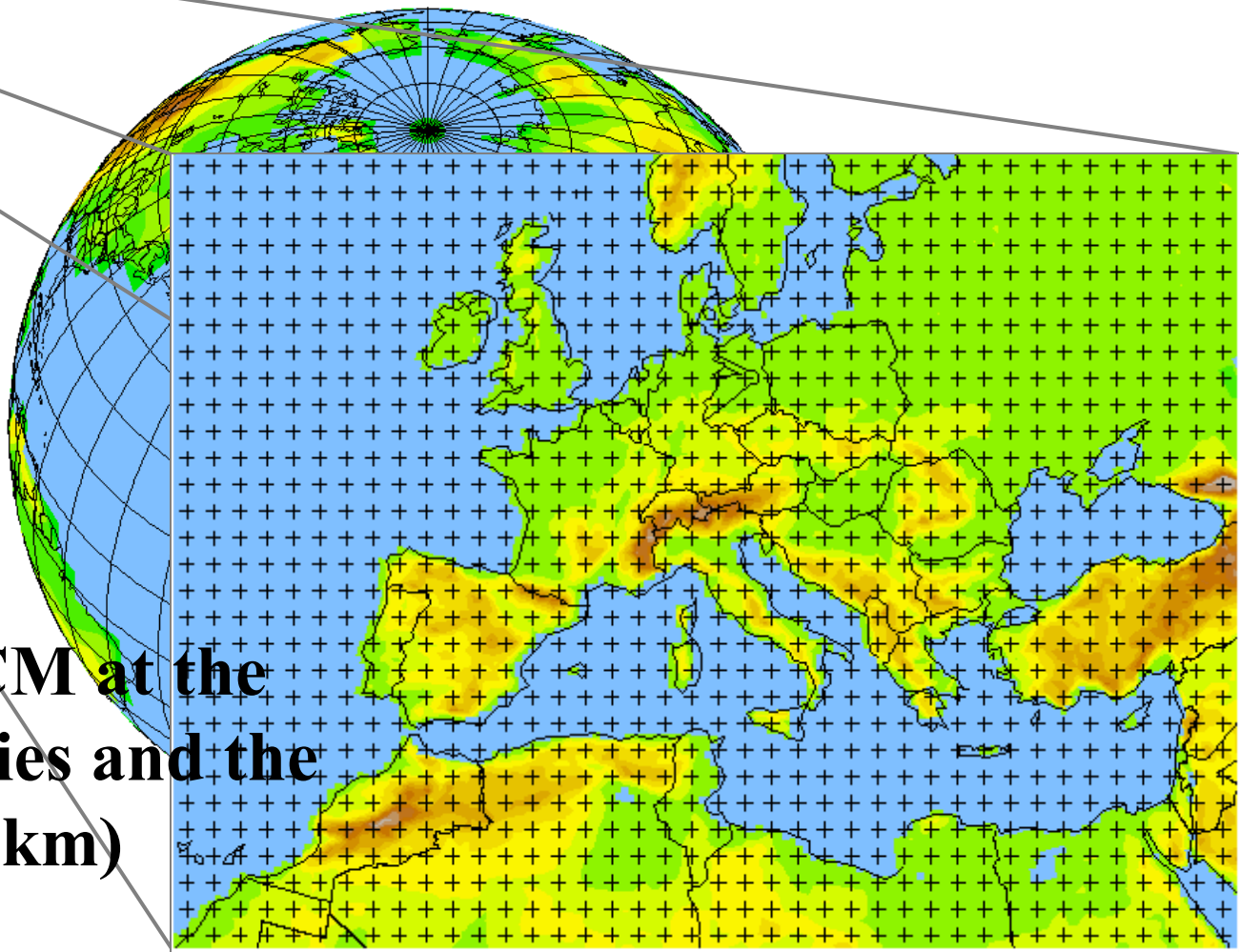
Regional

global para regional (e local)

Modelação climática

GCM





RCM Nesting

GCM forces RCM at the lateral boundaries and the sea surface (~12km)

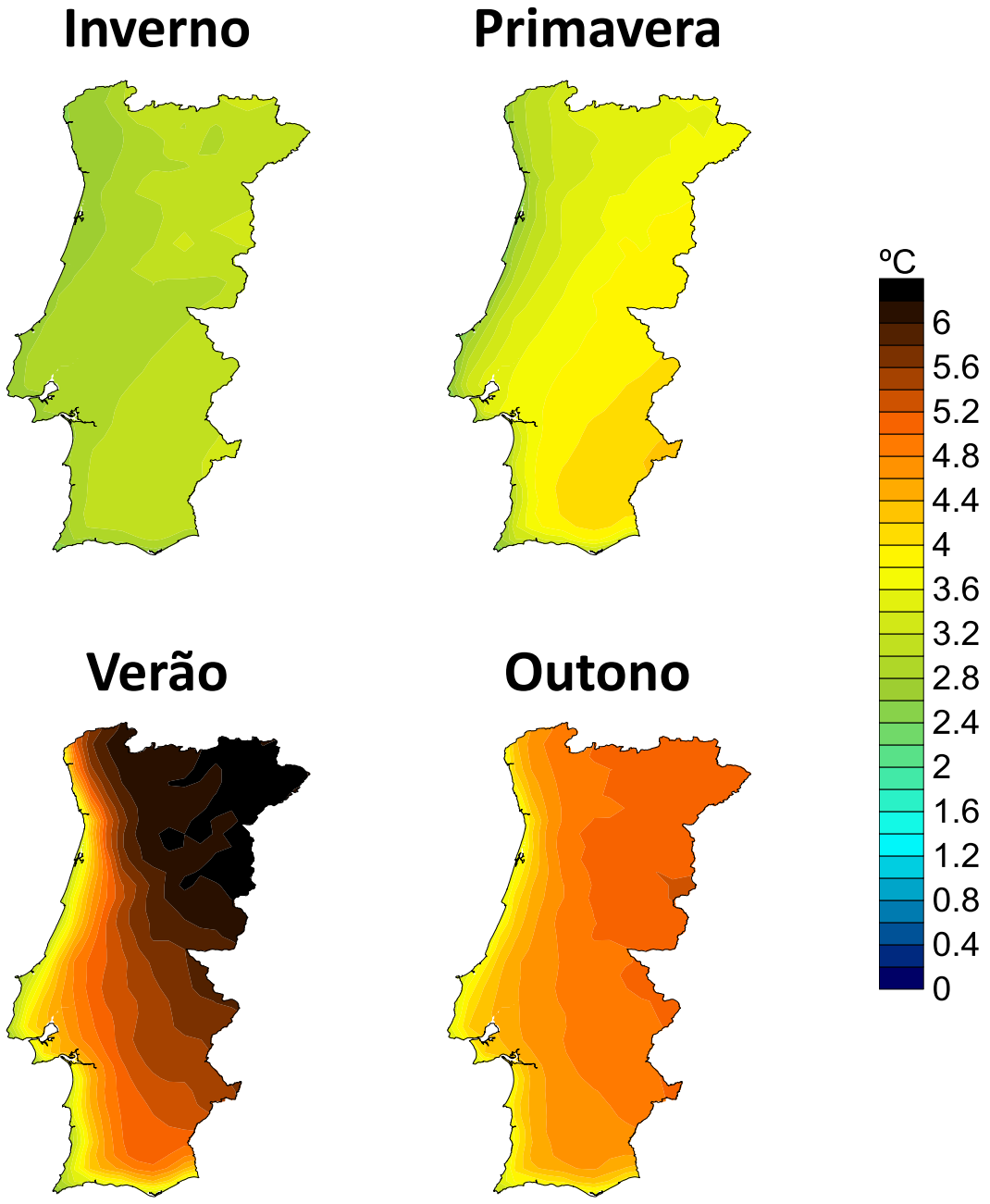
Portugal

IDL-FCUL

Temperatura

Anomalias de Temperatura máxima para o clima futuro

2071-2100
RCP8.5 (cenário)

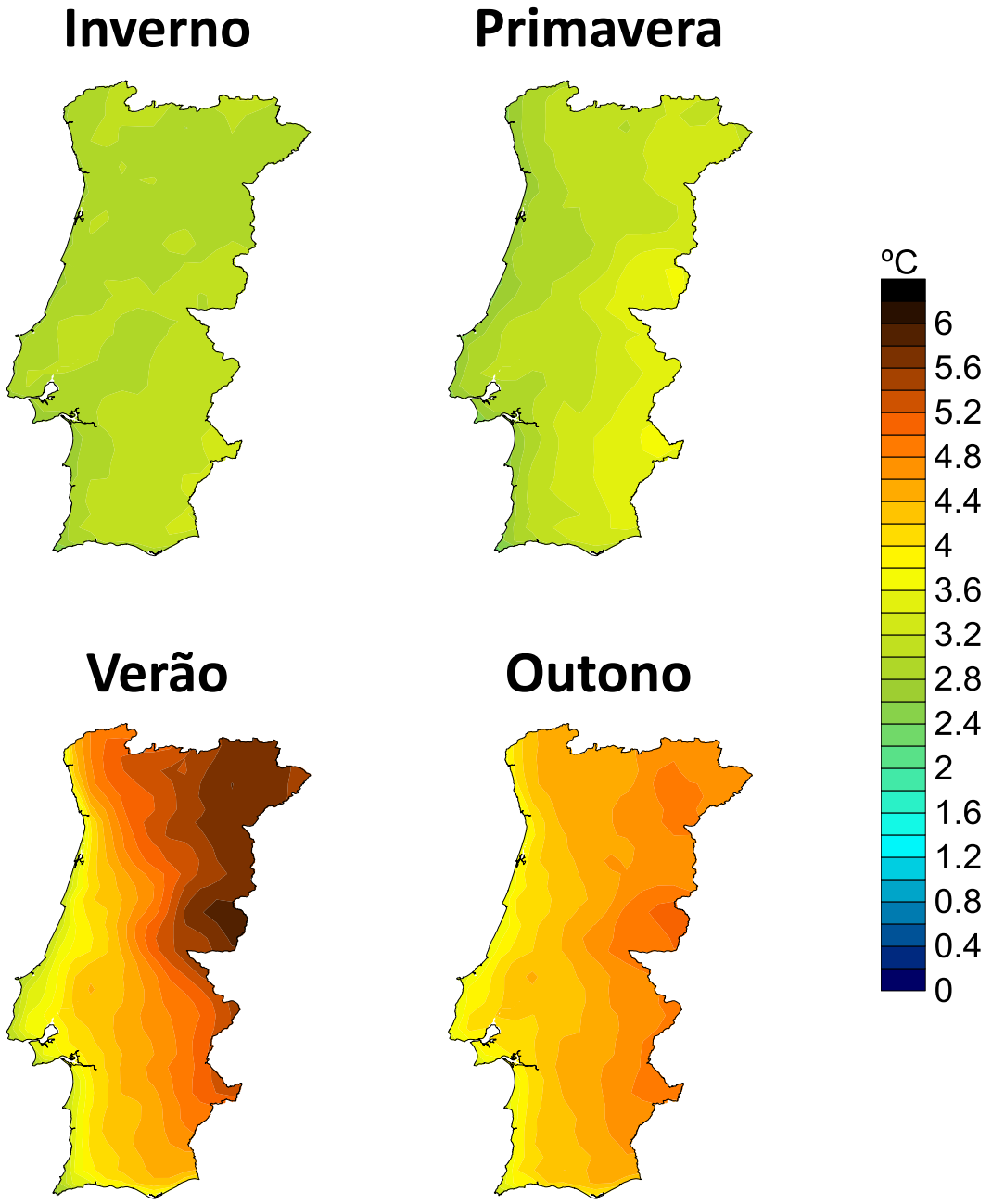


2071-2100
menos
1971-2000

Cardoso et al. (2018)

Anomalias de Temperatura mínima para o clima futuro

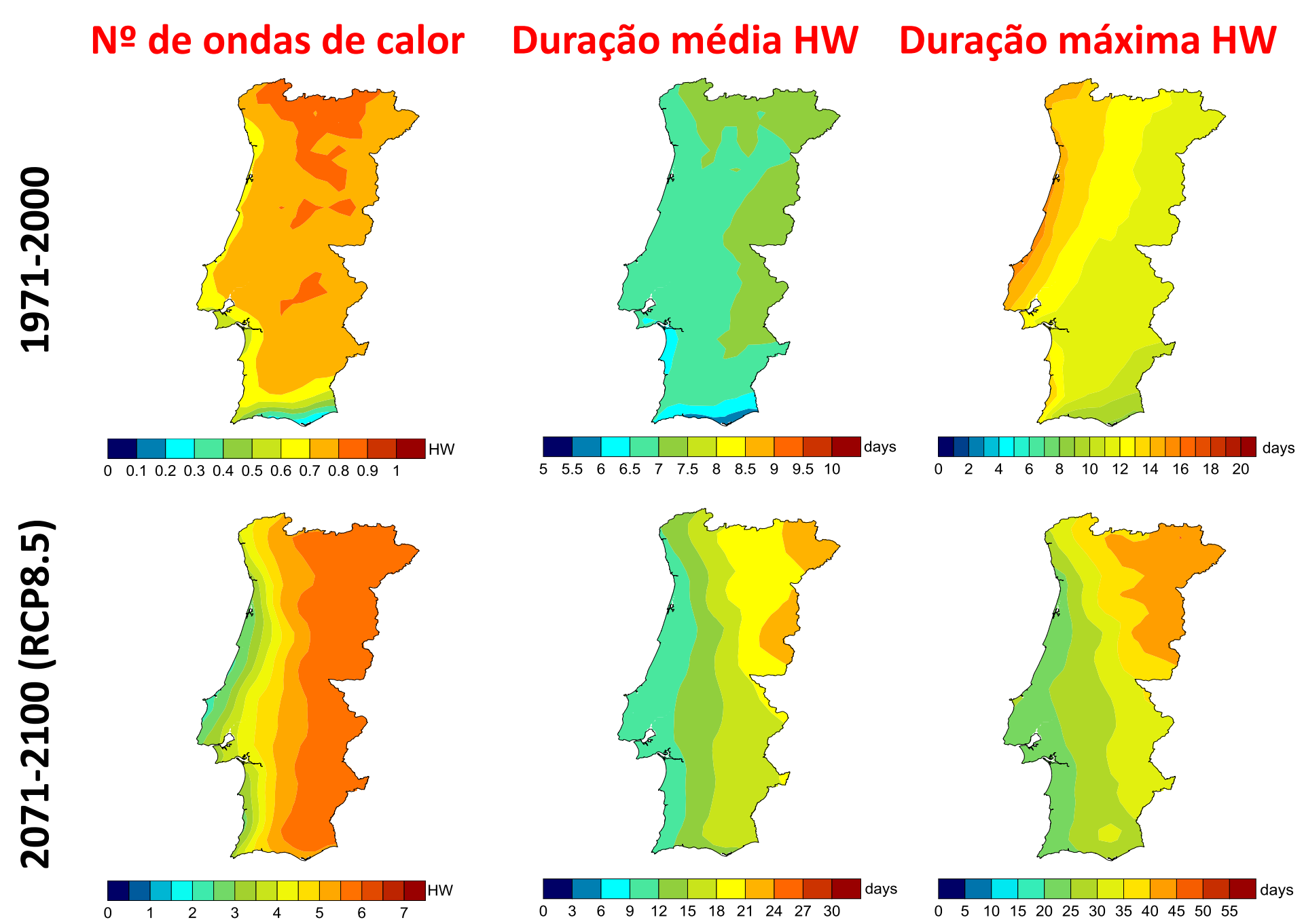
2071-2100
RCP8.5 (cenário)



2071-2100
menos
1971-2000

Cardoso et al. (2018)

Temperatura
Extremos



Cardoso et al. (2018)

Precipitação

Precipitação Anual

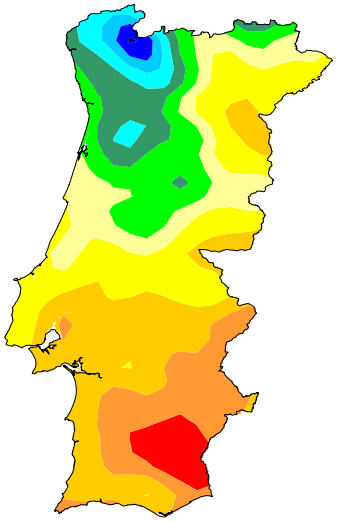
Presente, Futuro e Anomalias relativas anuais

RCP8.5

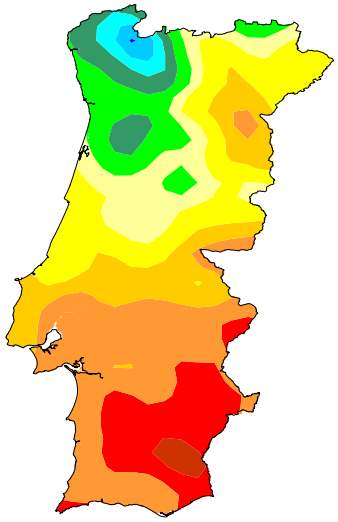
(2071-2100 menos 1971-2000)/1971-2000

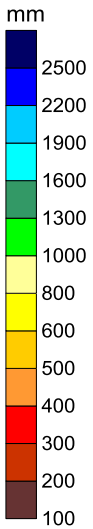
Soares et al. (2017)

Presente

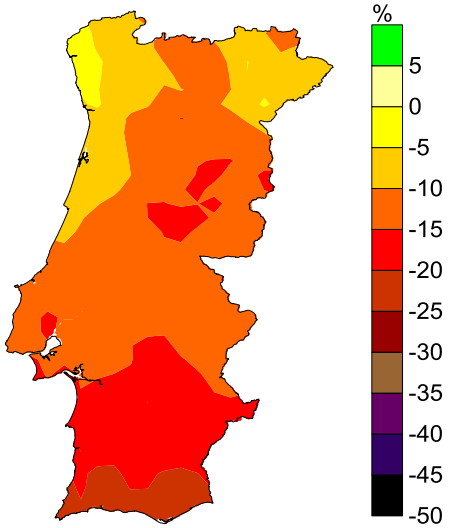


RCP8.5





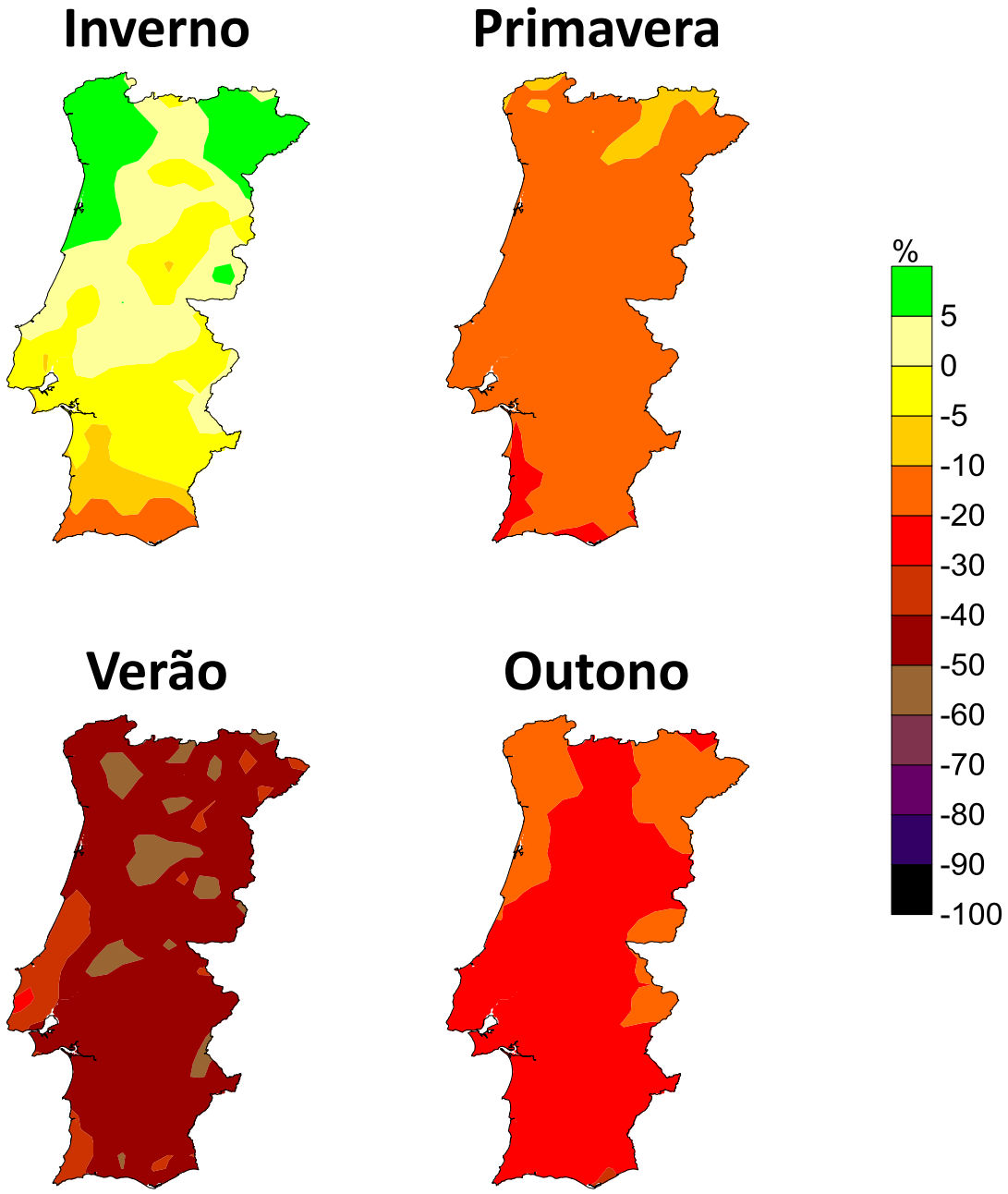
Anomalia Relativa



Precipitação

Anomalias Sazonais relativas

(2071-2100 menos 1971-2000)/1971-2000

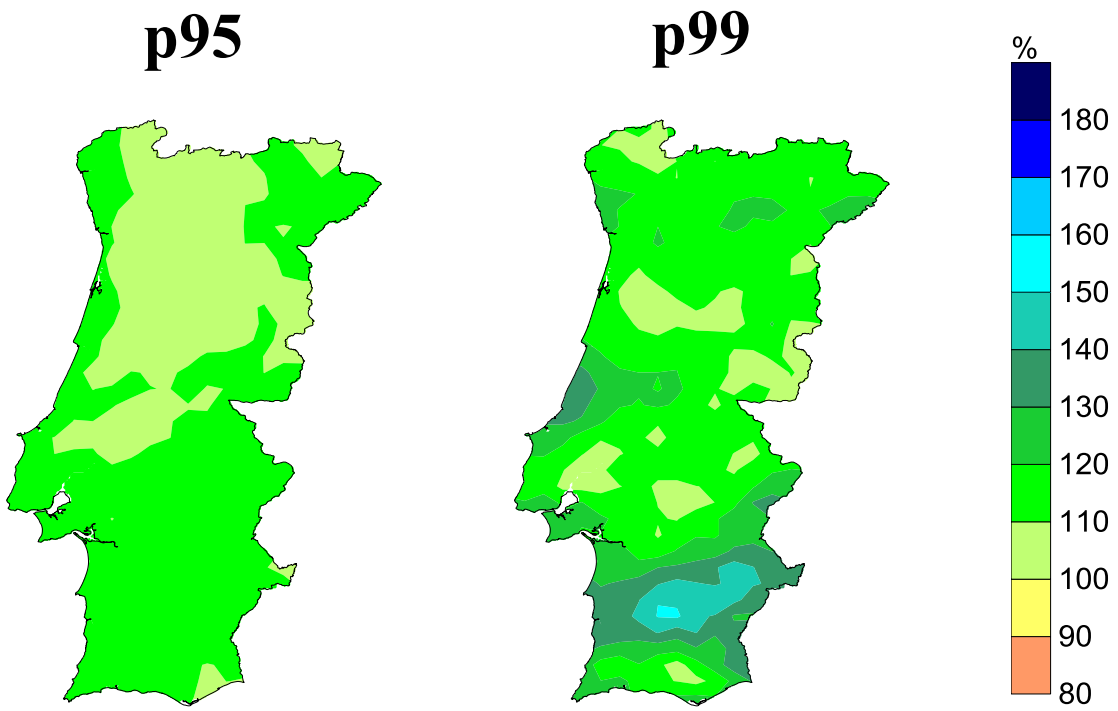


Soares et al. (2017)

Precipitação Extremos

Precipitação Extrema

Anomalia anual relativa



(2071-2100 menos 1971-2000)/1971-2000

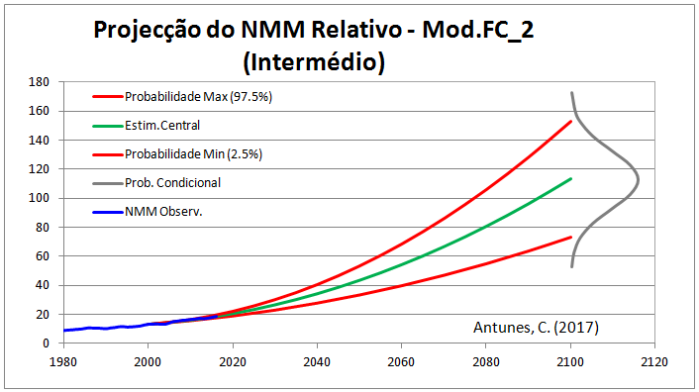
Soares et al. (2017)

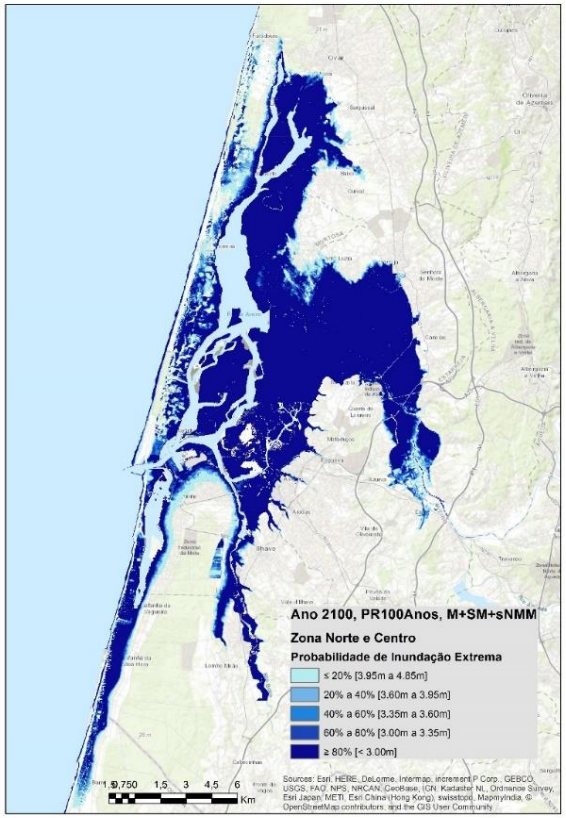
Nível médio do Mar

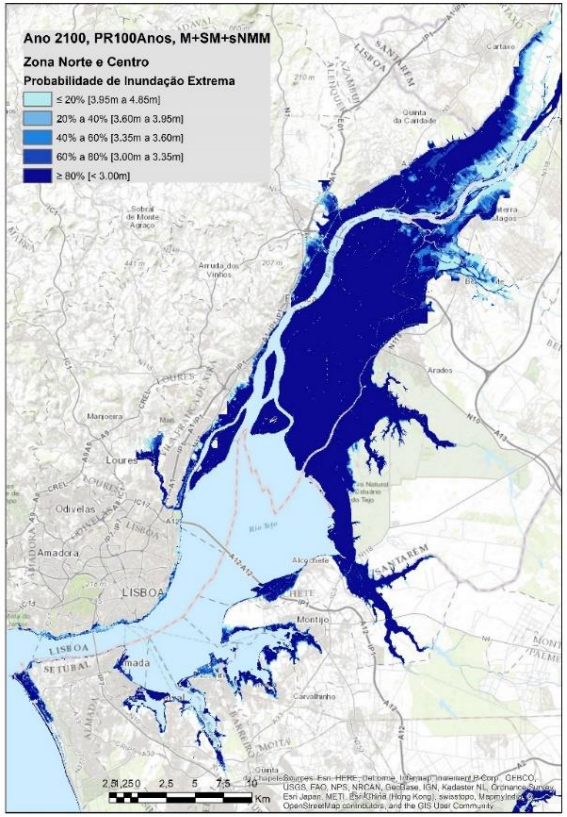
Cenários de Inundação Costeira

Cenários de Inundação Extrema para 2100

Rocha C., Antunes C. Catita C. (2018)

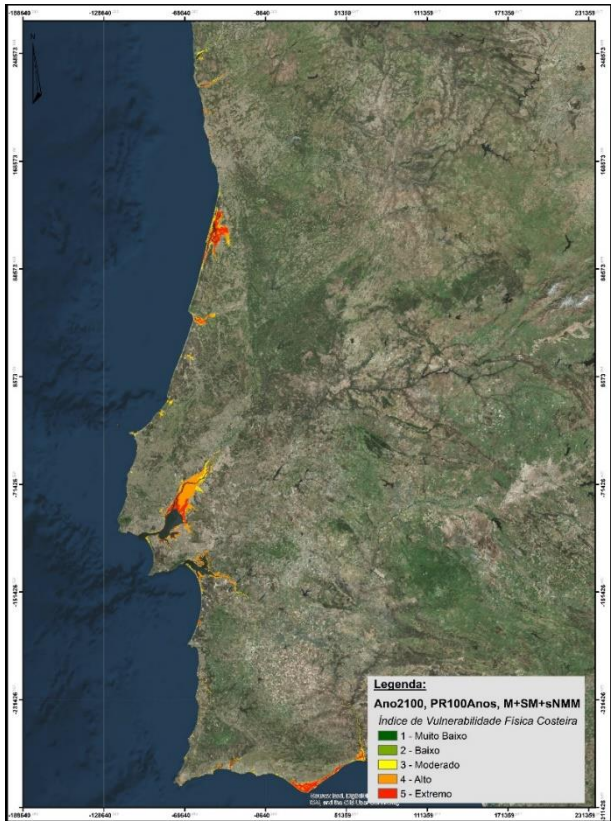






Cenários de Vulnerabilidade Costeira

Cenário: Ano 2100



Distritos	1 - Muito Baixo	2 - Baixo	3 - Moderado	4 - Alto	5 - Extremo	Total (km^2)
FARO	0.11	6.60	22.03	75.98	106.14	210.86
BEJA	0.01	0.42	2.17	4.48	0.21	7.29
SETÚBAL	0.36	11.02	27.66	111.02	24.08	174.13
LISBOA	0.04	1.81	16.02	174.92	56.79	249.58
SANTARÉM	0.00	1.84	39.47	83.18	28.44	152.93
LEIRIA	0.38	4.92	13.86	14.07	0.82	34.05
COIMBRA	0.05	1.82	7.65	34.46	10.02	53.99
AVEIRO	0.01	2.70	31.72	74.10	110.10	218.63
PORTO	0.07	1.13	2.46	1.61	0.39	5.65
BRAGA	0.00	0.17	2.87	2.99	1.57	7.61
VIANA DO CASTELO	0.18	3.29	9.96	12.43	5.22	31.08
Total Geral	1.2	35.7	175.8	589.2	343.7	1145.7

1146 km^2

CENSOS 2011

62 453

80 034

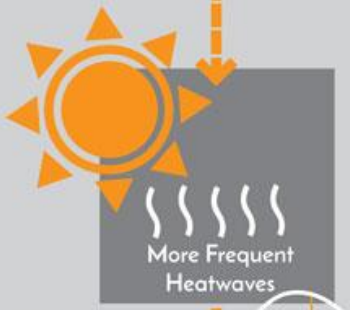
Rocha C., Antunes C. Catita C. (2018)

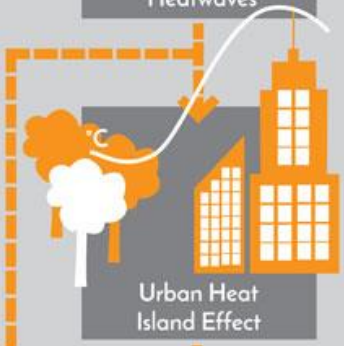
HOW CLIMATE CHANGE AFFECTS YOUR HEALTH

RISING TEMPERATURES

AT LEAST 37 STATES
saw record high temperatures in the summer of 2010 [1]

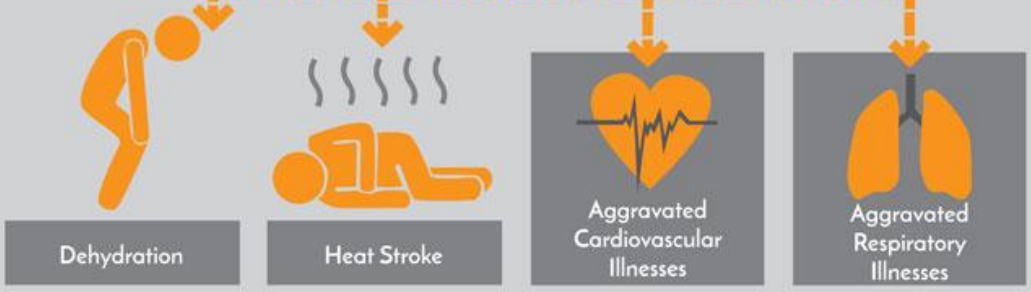
7,415 DEATHS
were attributed to excessive natural heat from 1999 to 2010 [4]





150,000 AMERICANS could DIE
before the end of this century due to excessive heat caused by climate change [3]

CHILDREN, THE ELDERLY, and THE POOR
are more vulnerable to heat-related illness [2]



1. http://www.cdc.org/health/climate/heat.asp
2. https://www3.epa.gov/climatechange/impacts/health.html
3. http://www.cdc.org/globalwarming/killer_heat/
4. http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6136a6.htm

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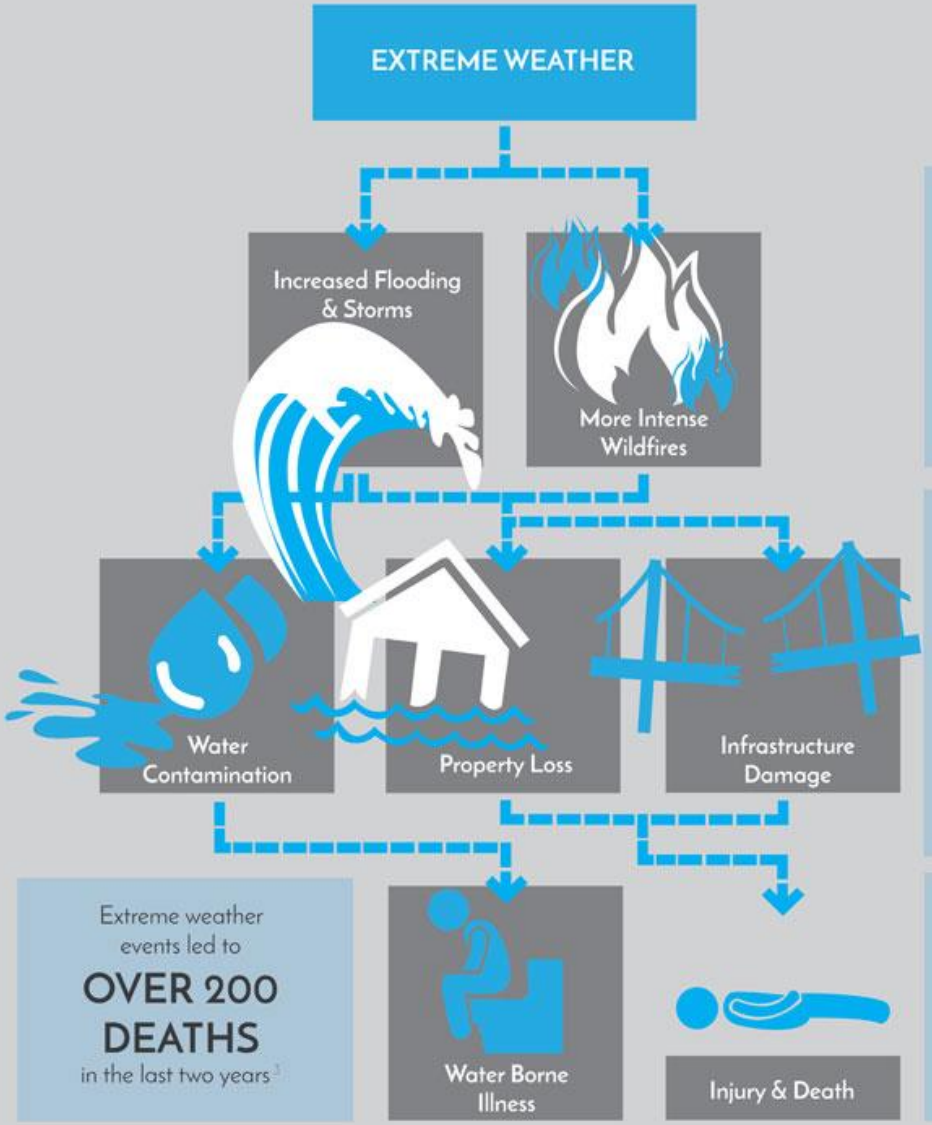

RESPIRATORY SYNDROME increases by 25% during wildfires [1]

51% of WATER-BORNE OUTBREAKS followed extreme precipitation events [4]

159 DEATHS from Superstorm Sandy in October 2012 [3]

Extreme weather events led to **OVER 200 DEATHS** in the last two years [3]

1. http://www.cdc.gov/nceh/publications/books/wildfires/wildfires.htm
2. https://www.nwf.org/Wildlife/Threats-to-Wildlife/Global-Warming/Global-Warming-is-Causing-Extreme-Weather/Extreme-Weather-and-Climate-Justice.aspx
3. http://www.ncdc.noaa.gov/billions/events
4. http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.91.8.1194

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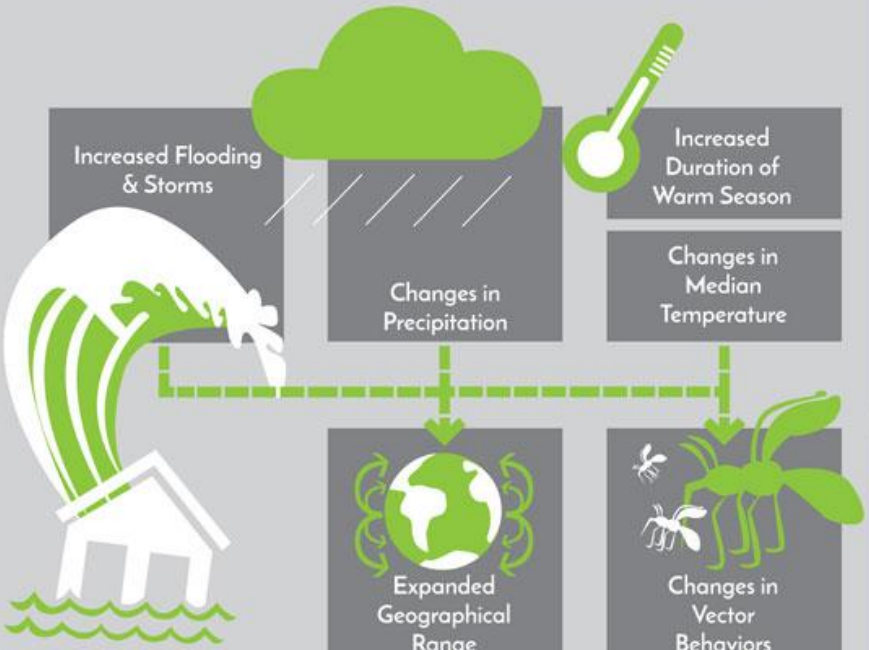
VECTOR-BORNE DISEASES



42,000 CASES OF WEST NILE VIRUS in the U.S. since 1999, of which **more than 1,700** people have died [1]

ABOUT 68% of Califonia will have increased probability for West Nile virus by 2050 [2]

Incidences of **LYME DISEASE DOUBLED** from 1991 to 2013 [4]

Increased Cases of Vector-Borne Diseases such as, Lyme Disease, Malaria, Zika Virus, and West Nile Virus

As temperature rises, the range of **TICKS CARRYING LYME DISEASE** will expand [3]

1. http://www.cdc.gov/features/westnilevirus/
2. http://onlinelibrary.wiley.com/doi/10.1111/gcb.12534/pdf
3. https://www3.epa.gov/climatechange/impacts/health.html
4. https://www3.epa.gov/climatechange/science/indicators/health-society/lyme.html

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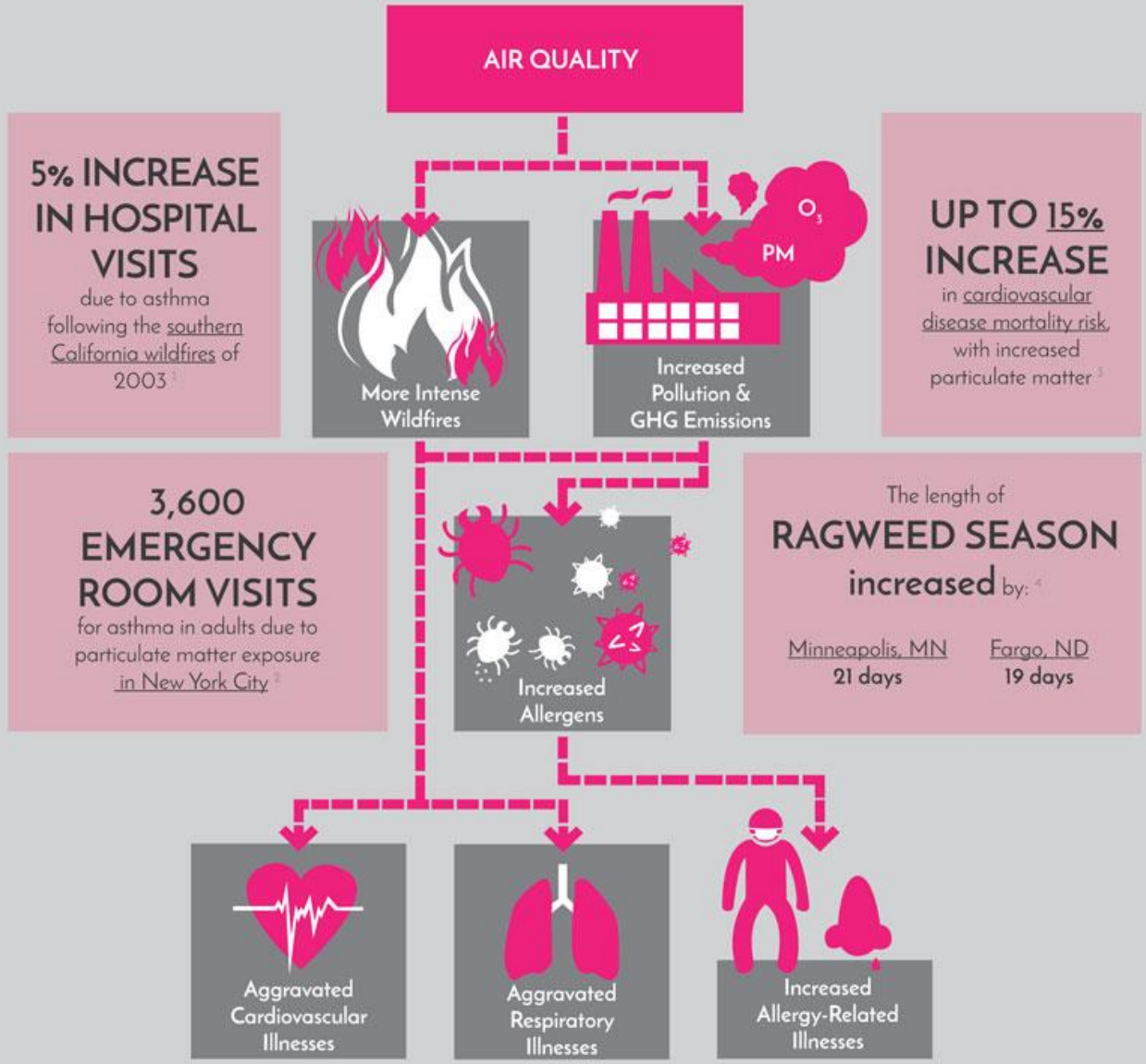

1. http://www.ncbi.nlm.nih.gov/pubmed/19020694
2. http://www.nyc.gov/html/doh/downloads/pdf/eode/eode-air-quality-impact.pdf
3. http://circ.ahajournals.org/content/121/20/2331.full
4. https://www.whitehouse.gov/sites/default/files/docdoc/the_health_impacts_of_climate_change_on_americans_final.pdf

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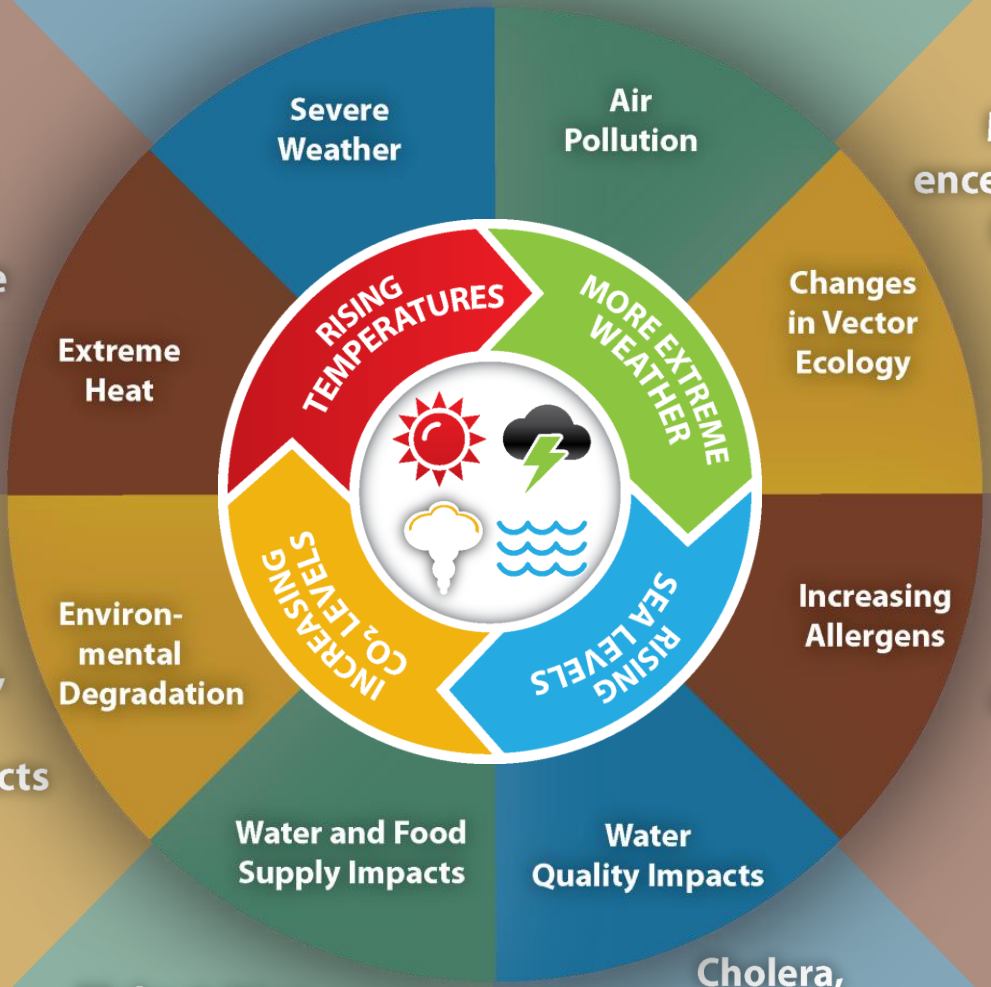
Impact of Climate Change on Human Health



Injuries, fatalities, mental health impacts

Asthma, cardiovascular disease

Heat-related illness and death, cardiovascular failure

Malaria, dengue, encephalitis, hantavirus, Rift Valley fever, Lyme disease, chikungunya, West Nile virus

Forced migration, civil conflict, mental health impacts

Respiratory allergies, asthma

Malnutrition, diarrheal disease

Cholera, cryptosporidiosis, campylobacter, leptospirosis, harmful algal blooms

CDC

Muito Obrigado