



ÇEV903 KÜRESEL İKLİM DEĞİŞİKLİĞİ

Doç. Dr. Özgür ZEYDAN

<https://ozgurzeydan.com.tr/>

İklim Geleceğimiz

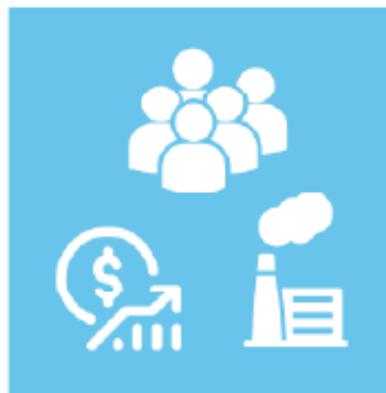
- Senaryolar
- İklim Modelleri
- Projeksiyonlar

IPCC 6. İlerleme Raporu Senaryoları

- IPCC 6. İlerleme Raporu iklim geleceğimizi 5 farklı senaryo ile açıklıyor.
- Emisyonlar, sosyo-ekonomik varsayımlara, iklim değişikliğini azaltma düzeylerine ve aerosoller ve metan olmayan ozon öncüleri için hava kirliliği kontrollerine bağlı olarak senaryolar arasında değişiklik göstermektedir.

SSP Narrative

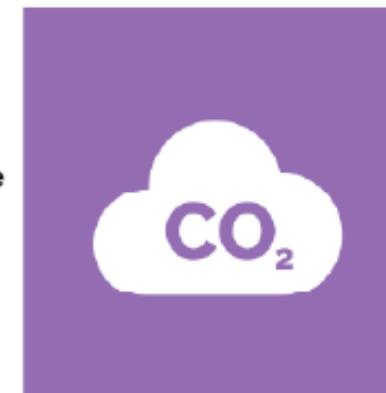
Shared Socio-economic Pathways



Social and economic development patterns

Emission Scenarios

Representative Concentration Pathways



Changes in greenhouse gas emissions, landuse patterns, and other climate drivers

GCM/ESM

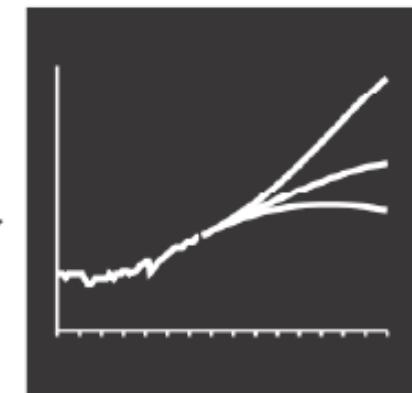
Climate Models



Modelling global climate change

Climate Data

Available on ClimateData.ca



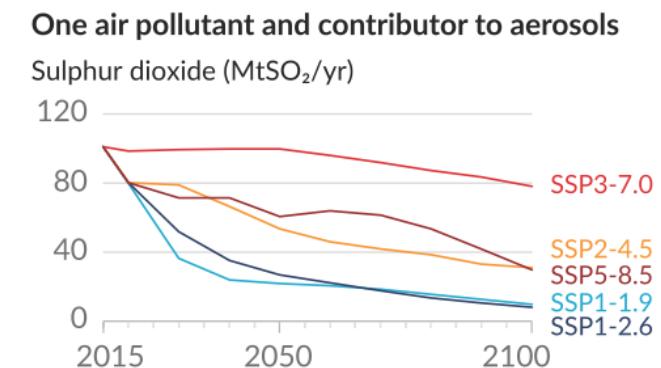
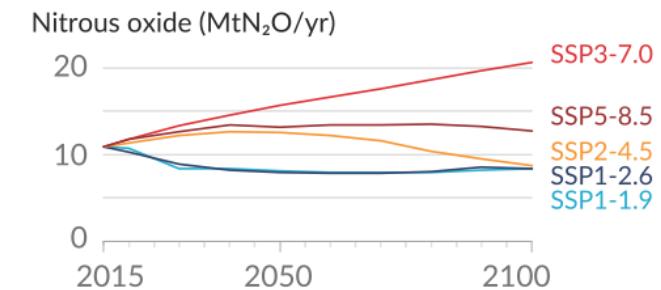
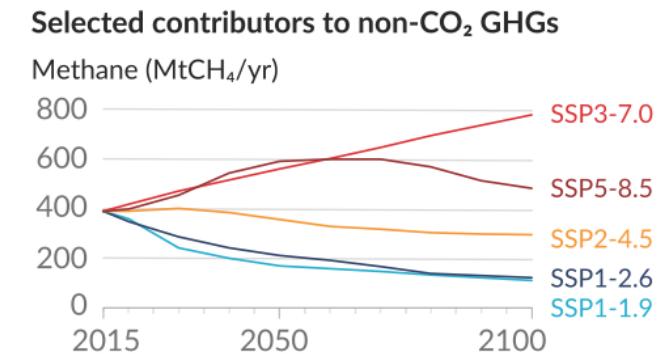
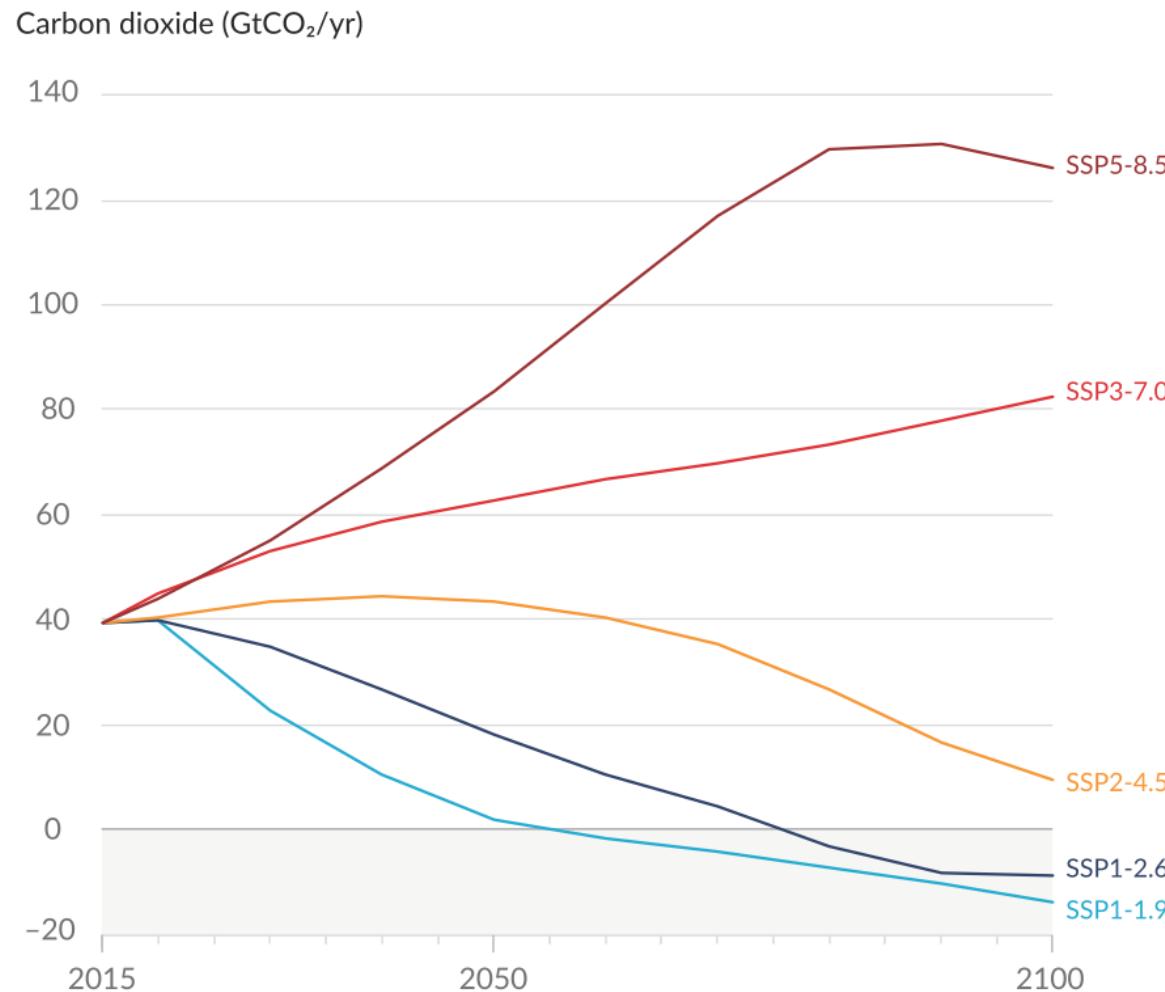
Climate projections based on different emissions scenarios

IPCC 6. İlerleme Raporu Senaryoları

- Senaryo - radyasyon akısındaki artış (W/m^2)
- SSP1 - 1.9 → negatif sera gazı emisyonu (SGE)
- SSP1 - 2.6 → negatif SGE
- SSP2 - 4.5 → orta düzeyde SGE (2050 sonrası azalan)
- SSP3 - 7.0 → yüksek SGE
- SSP5 - 8.5 → çok yüksek SGE
- SSP: Shared Socio-economic Pathways (Paylaşılan Sosyo-Ekonomik Yollar)

Gelecekteki Emisyonlar

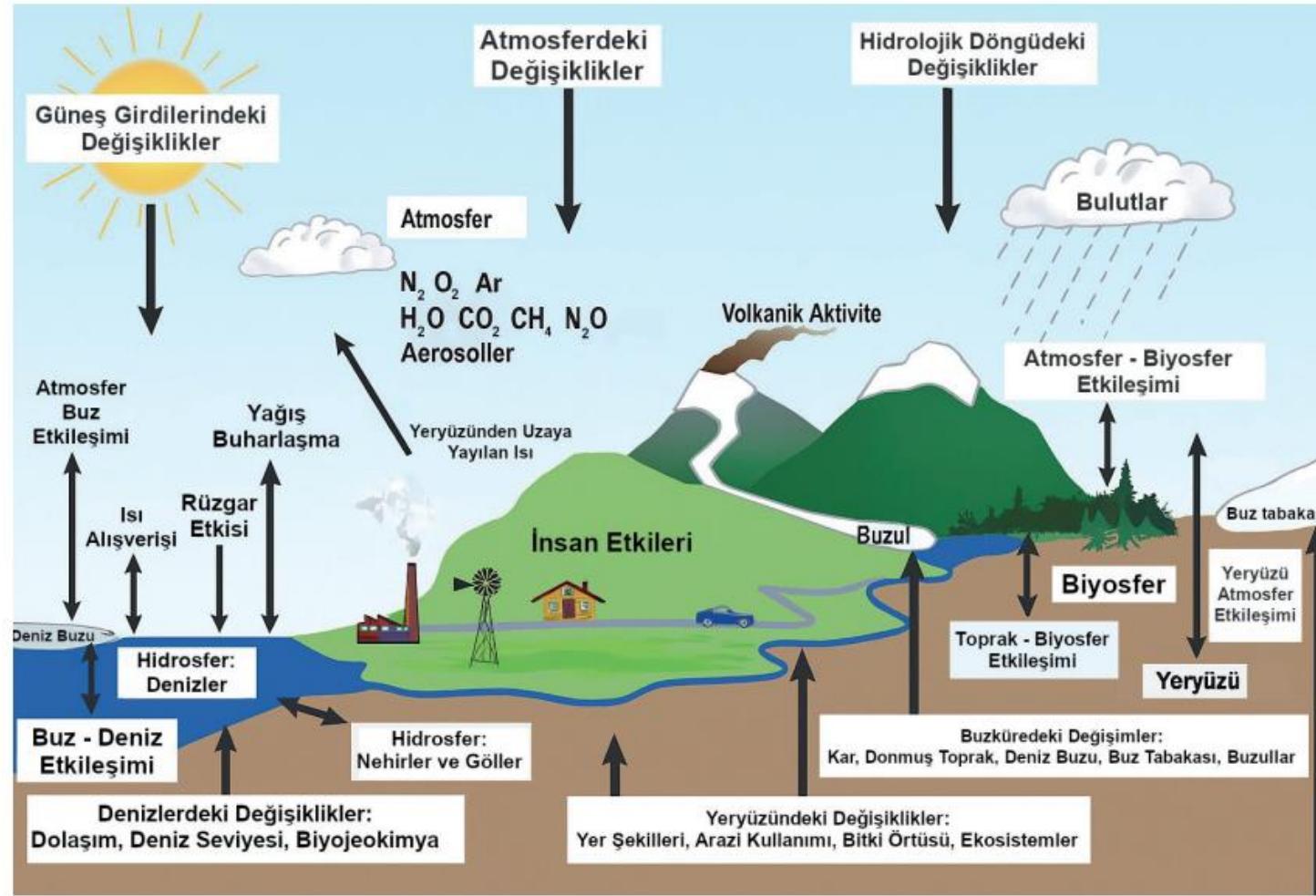
(a) Future annual emissions of CO₂ (left) and of a subset of key non-CO₂ drivers (right), across five illustrative scenarios



İklim Modelleri

- İklim modelleri dünyayı belirli coğrafi konumları ve yükseklikleri temsil eden üç boyutlu bir hücre ızgarasına böler.
- Bileşenlerin her biri (atmosfer, kara yüzeyi, okyanus ve deniz buzu), sıcaklık gibi bir dizi iklim değişkeni için küresel ızgarada hesaplanan denklemlere sahiptir.
- Zaman içinde nasıl değişiklerini hesaplayan model bileşenlerine ek olarak, farklı parçalar ısı, su ve momentum akışını da değiştirir.
- Birbirleriyle birleşik bir sistem olarak etkileşime girerler.

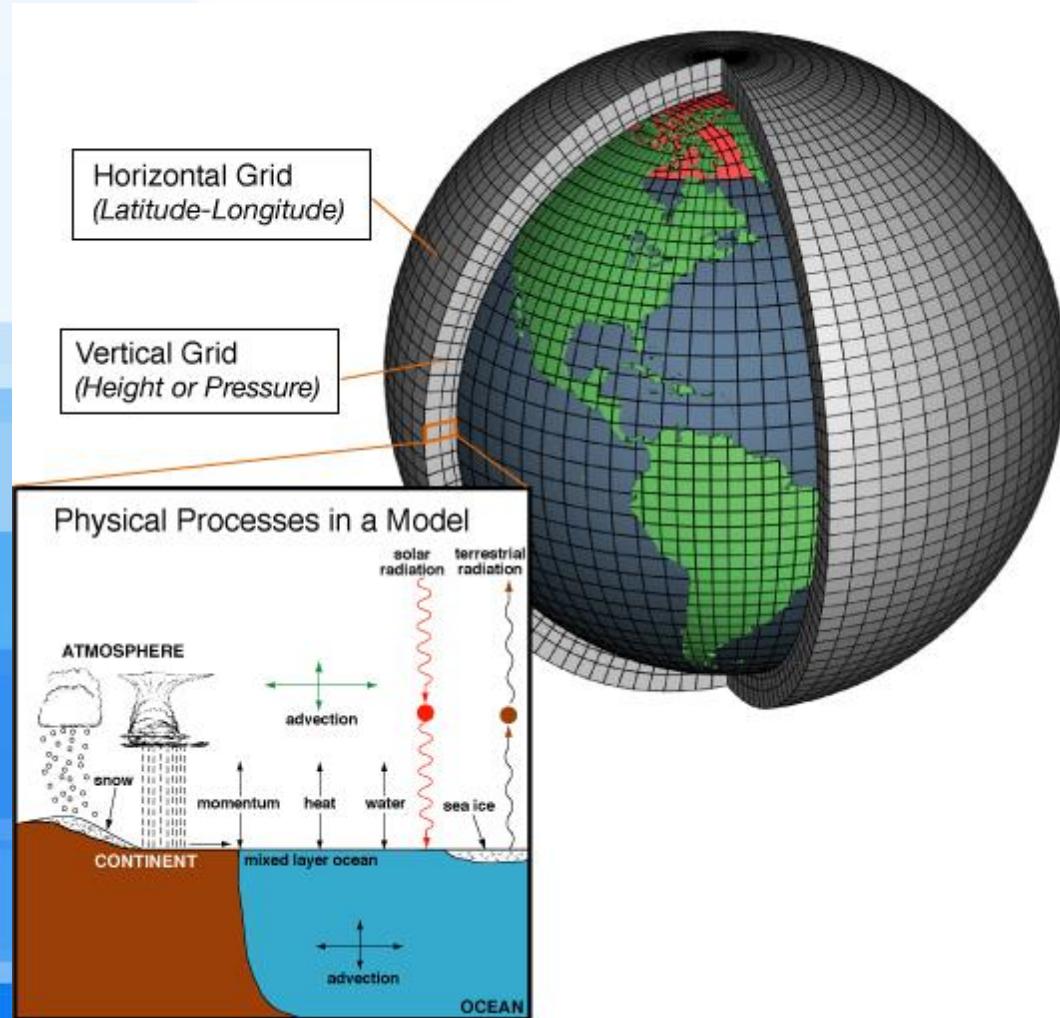
İklim Modellerine Etki Eden Faktörler



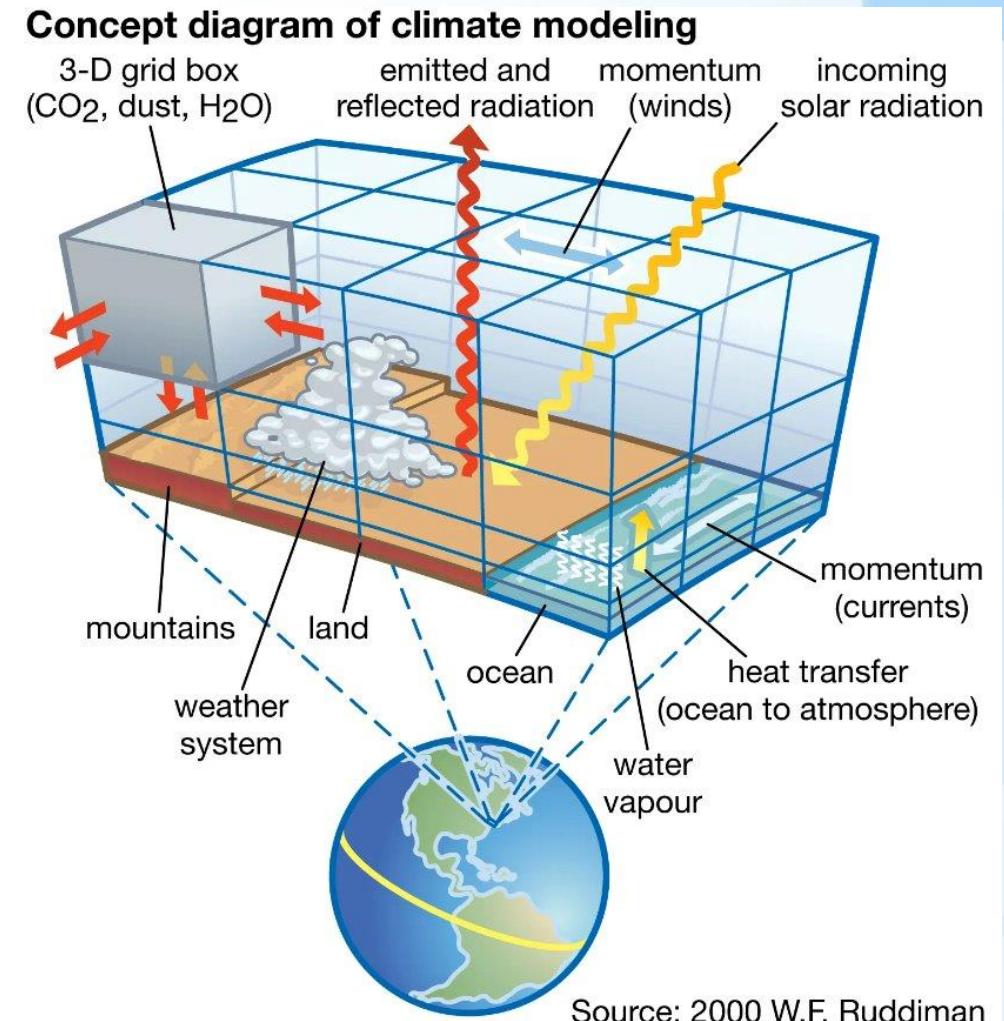
Türkiye ve Yakın Çevresinde İklim ve
Çevresel Faktörlerin Hareketlilik Üzerindeki Olası Etkileri:

**Senaryolar ve
Gelecek Perspektifleri**

İklim Modelleri



<https://www.climate.gov/media/10042>



Source: 2000 W.F. Ruddiman

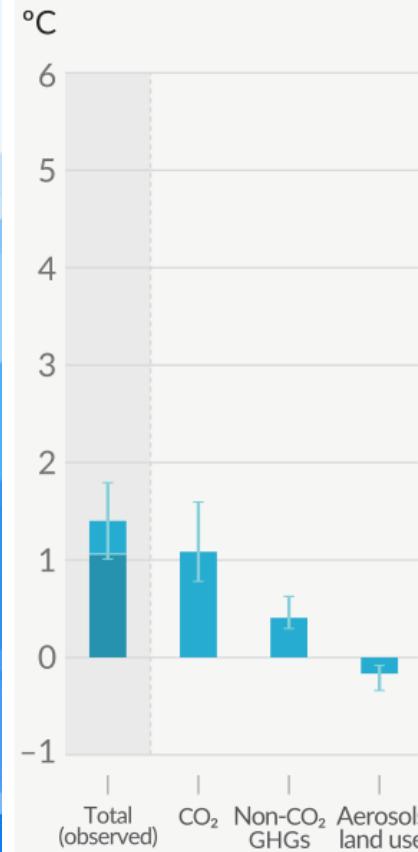
<https://www.britannica.com/science/global-warming/Theoretical-climate-models>

Sera Gazlarının Isınmaya Katkıları

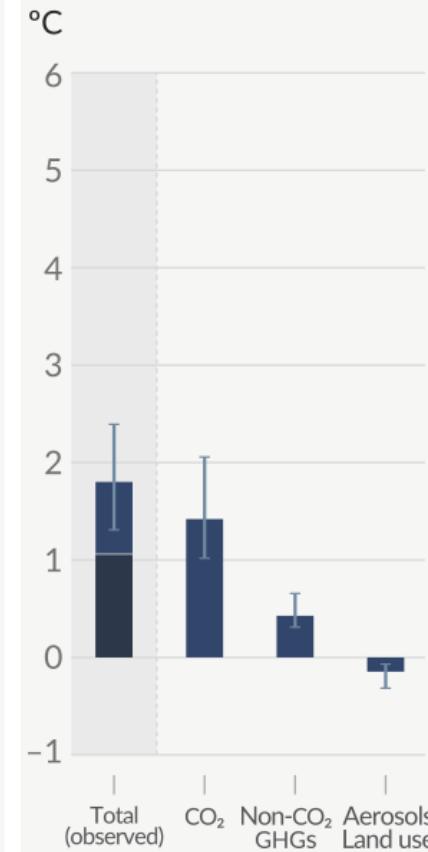
(b) Contribution to global surface temperature increase from different emissions, with a dominant role of CO₂ emissions

Change in global surface temperature in 2081–2100 relative to 1850–1900 (°C)

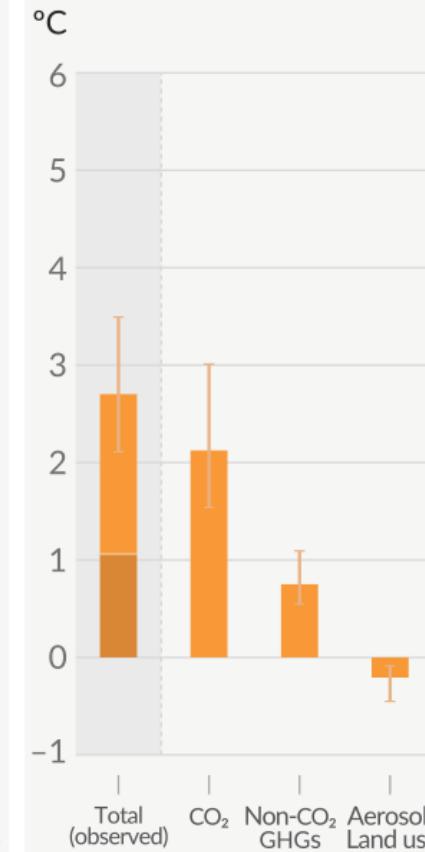
SSP1-1.9



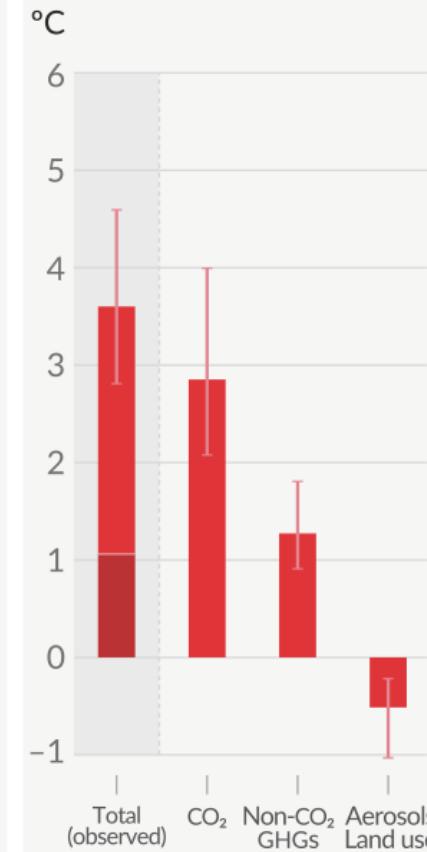
SSP1-2.6



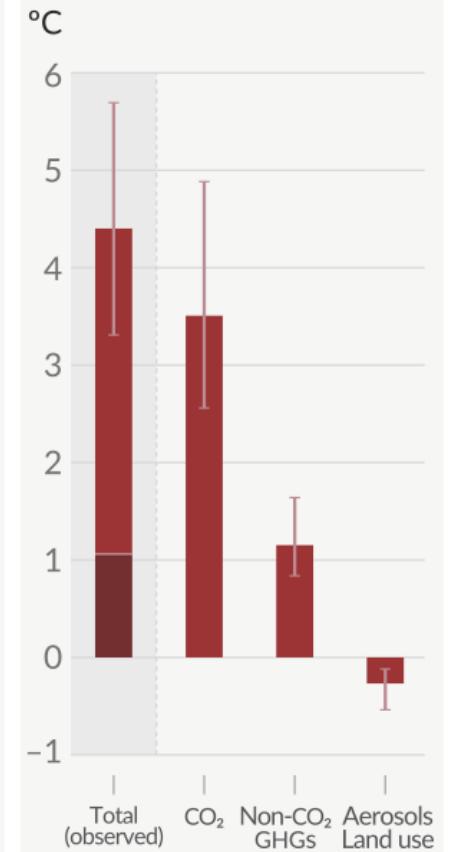
SSP2-4.5



SSP3-7.0



SSP5-8.5



Total warming (observed warming to date in darker shade), warming from CO₂, warming from non-CO₂ GHGs and cooling from changes in aerosols and land use

Gelecekteki Isınma Tahminleri

1850 – 1900 dönemine kıyasla

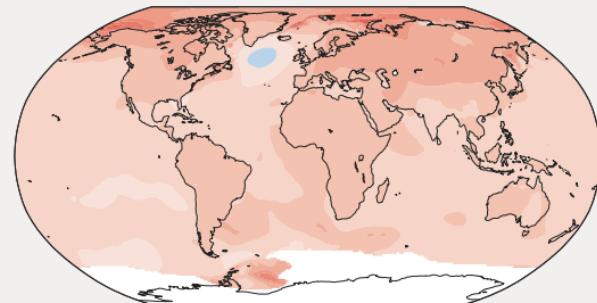
Scenario	Near term, 2021–2040		Mid-term, 2041–2060		Long term, 2081–2100	
	Best estimate (°C)	<i>Very likely</i> range (°C)	Best estimate (°C)	<i>Very likely</i> range (°C)	Best estimate (°C)	<i>Very likely</i> range (°C)
SSP1-1.9	1.5	1.2 to 1.7	1.6	1.2 to 2.0	1.4	1.0 to 1.8
SSP1-2.6	1.5	1.2 to 1.8	1.7	1.3 to 2.2	1.8	1.3 to 2.4
SSP2-4.5	1.5	1.2 to 1.8	2.0	1.6 to 2.5	2.7	2.1 to 3.5
SSP3-7.0	1.5	1.2 to 1.8	2.1	1.7 to 2.6	3.6	2.8 to 4.6
SSP5-8.5	1.6	1.3 to 1.9	2.4	1.9 to 3.0	4.4	3.3 to 5.7

Sıcaklık Projeksiyonları

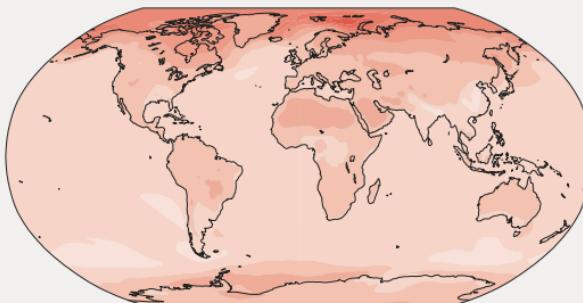
(a) Annual mean temperature change ($^{\circ}\text{C}$) at 1°C global warming

Warming at 1°C affects all continents and is generally larger over land than over the oceans in both observations and models. Across most regions, observed and simulated patterns are consistent.

Observed change per 1°C global warming



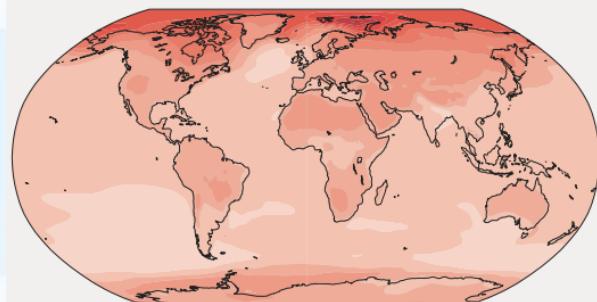
Simulated change at 1°C global warming



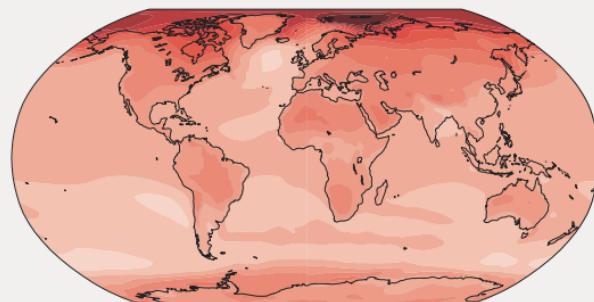
(b) Annual mean temperature change ($^{\circ}\text{C}$) relative to 1850–1900

Across warming levels, land areas warm more than ocean areas, and the Arctic and Antarctica warm more than the tropics.

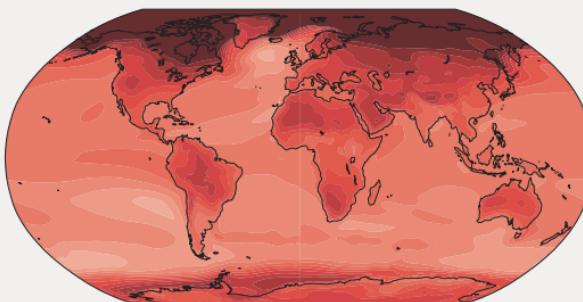
Simulated change at 1.5°C global warming



Simulated change at 2°C global warming

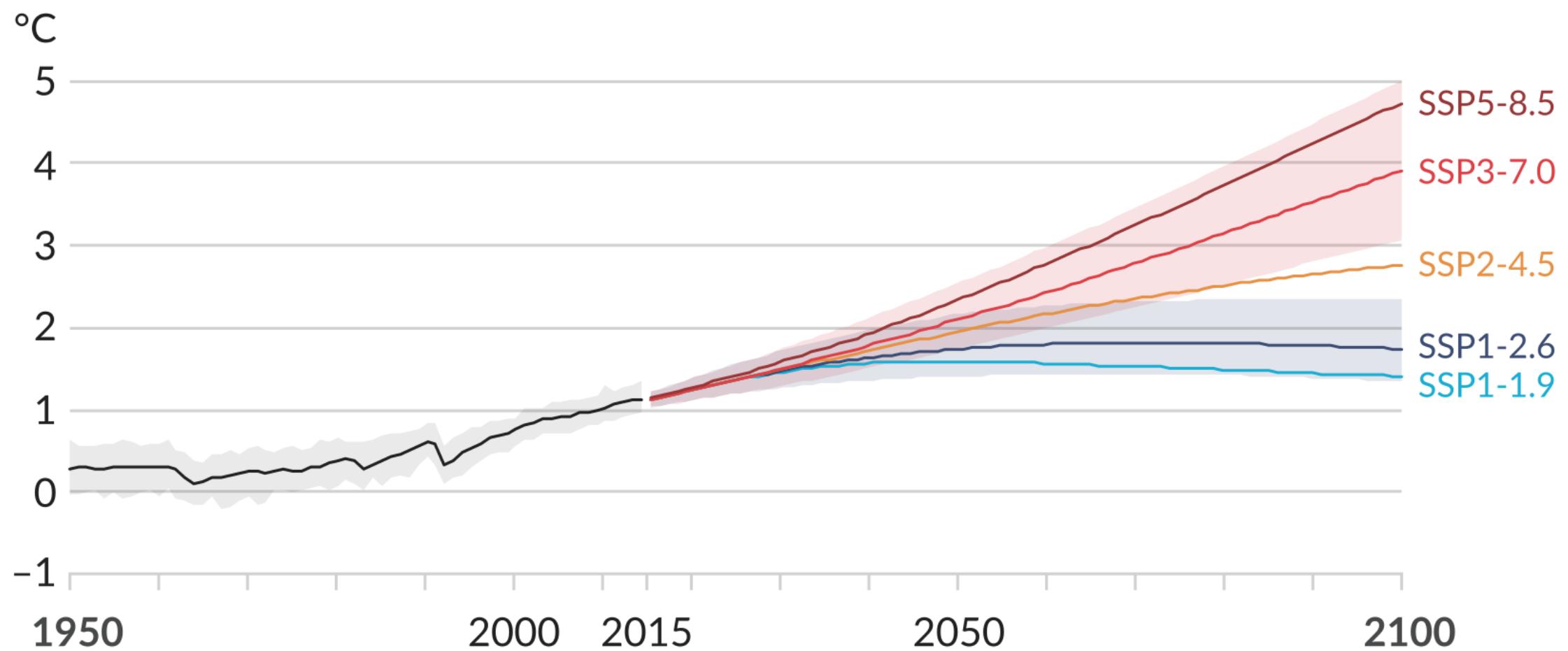


Simulated change at 4°C global warming



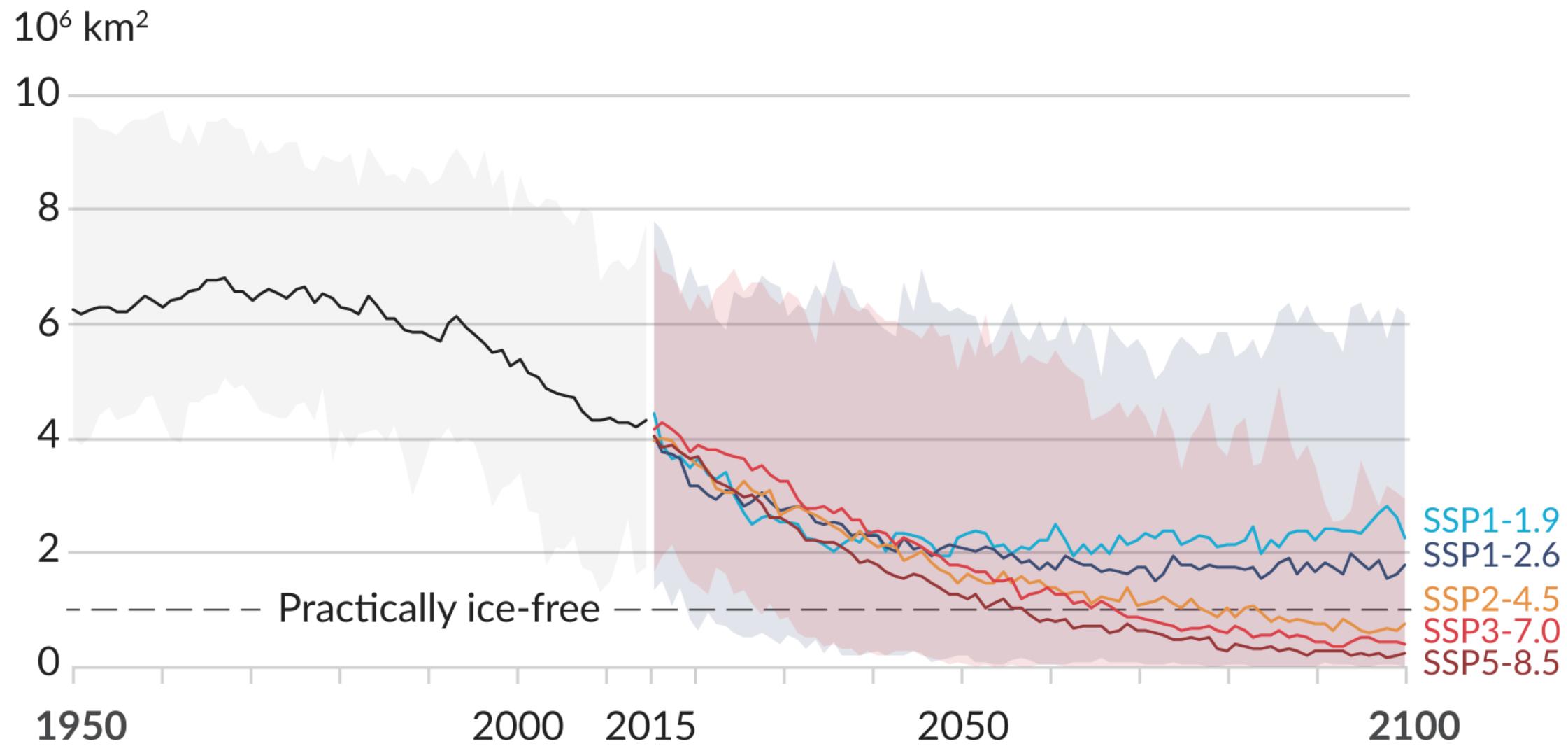
Sıcaklık Projeksiyonları (yıllara göre)

(a) Global surface temperature change relative to 1850–1900



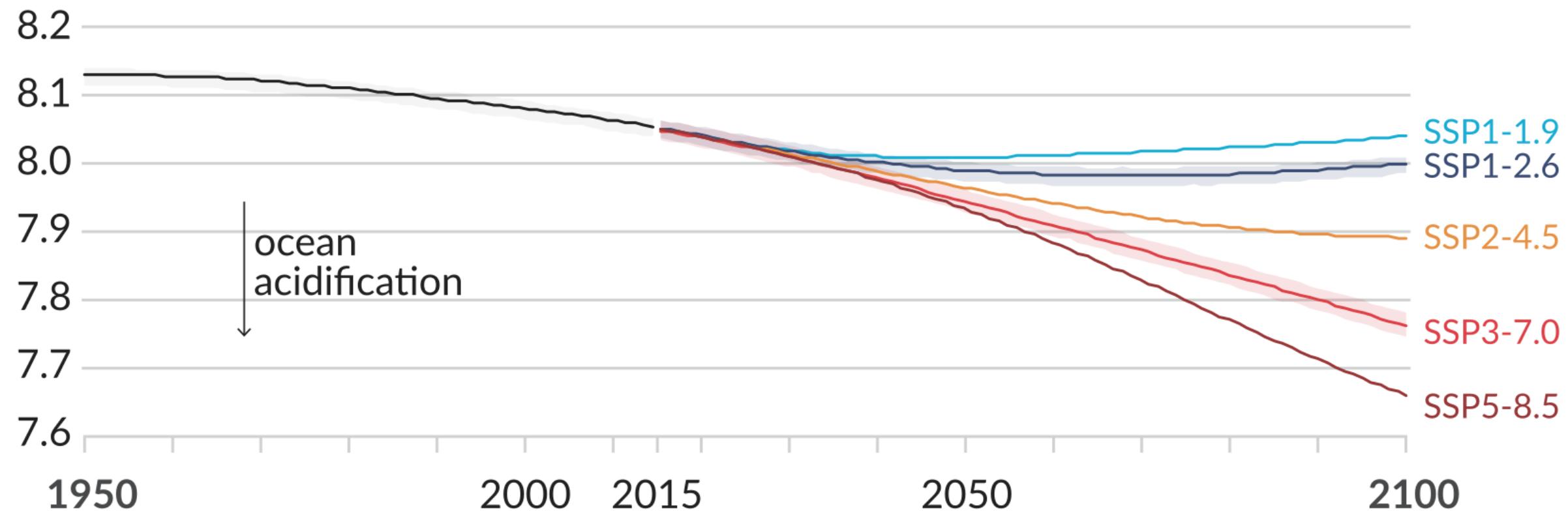
Arktik Buzul Erimesi (Eylül ayı – yıllara göre)

(b) September Arctic sea ice area



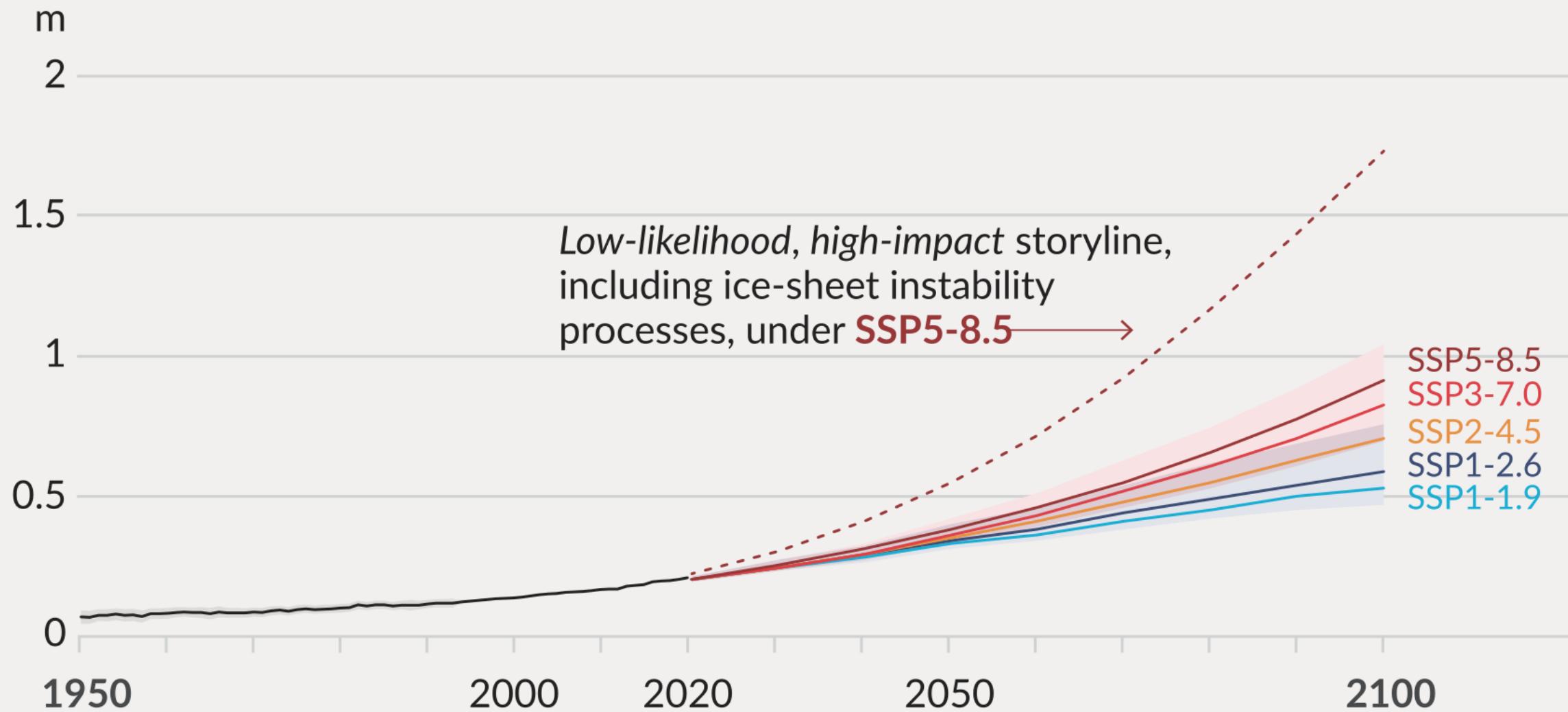
Okyanus Asitleşmesi (yıllara göre)

(c) Global ocean surface pH (a measure of acidity)



Deniz Seviyesi Yükselmesi (yıllara göre)

(d) Global mean sea level change relative to 1900

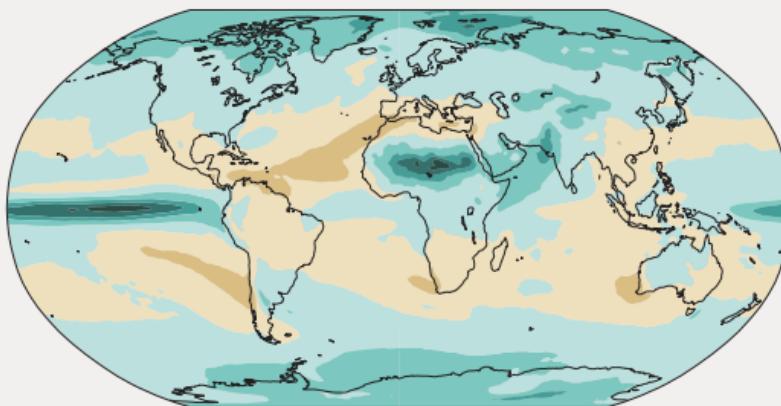


Yağış Projeksiyonları

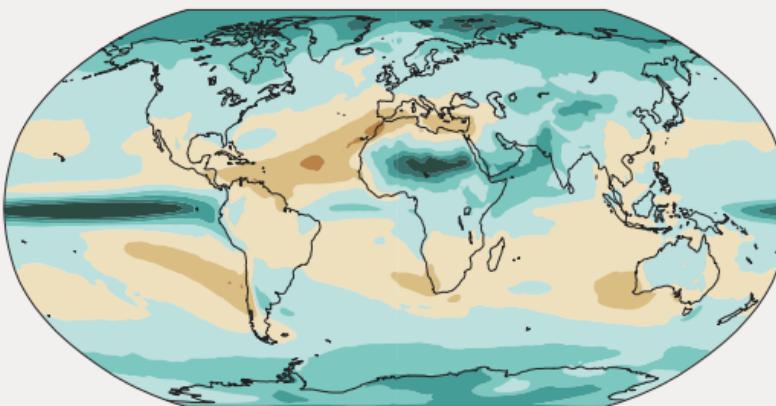
(c) Annual mean precipitation change (%) relative to 1850–1900

Precipitation is projected to increase over high latitudes, the equatorial Pacific and parts of the monsoon regions, but decrease over parts of the subtropics and in limited areas of the tropics.

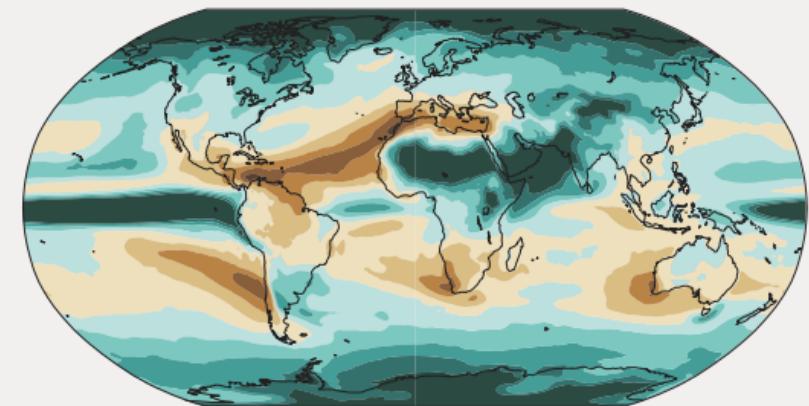
Simulated change at 1.5°C global warming



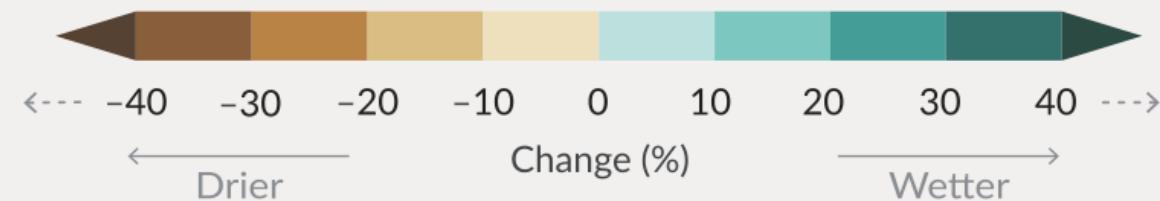
Simulated change at 2°C global warming



Simulated change at 4°C global warming



Relatively small absolute changes may appear as large % changes in regions with dry baseline conditions.

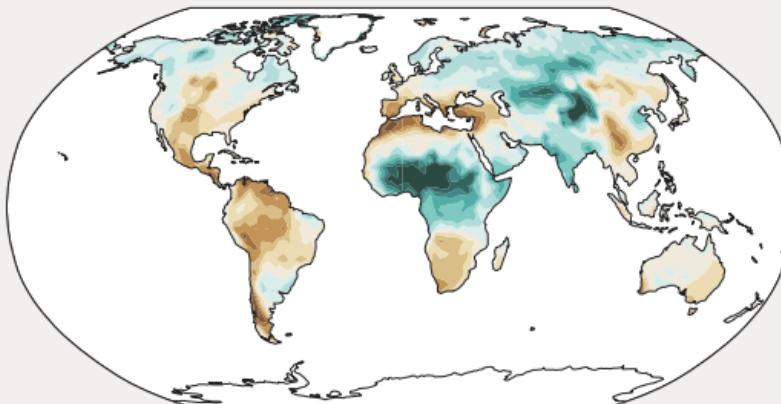


Toprak Nemi Projeksiyonları

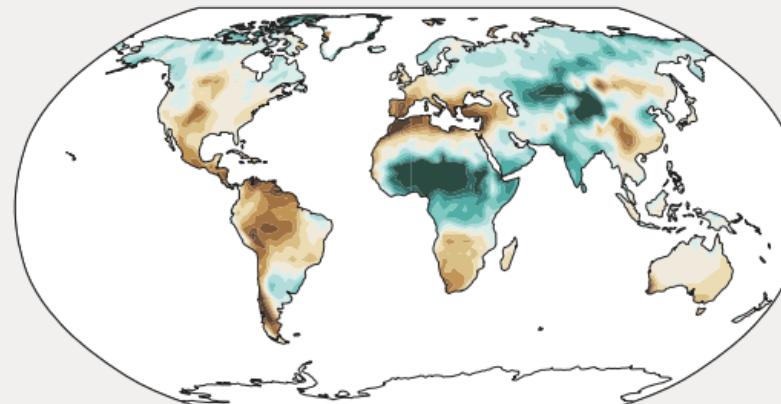
(d) Annual mean total column soil moisture change (standard deviation)

Across warming levels, changes in soil moisture largely follow changes in precipitation but also show some differences due to the influence of evapotranspiration.

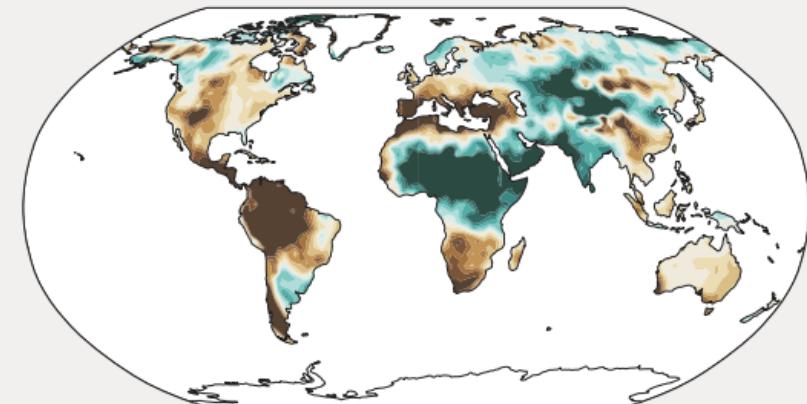
Simulated change at 1.5°C global warming



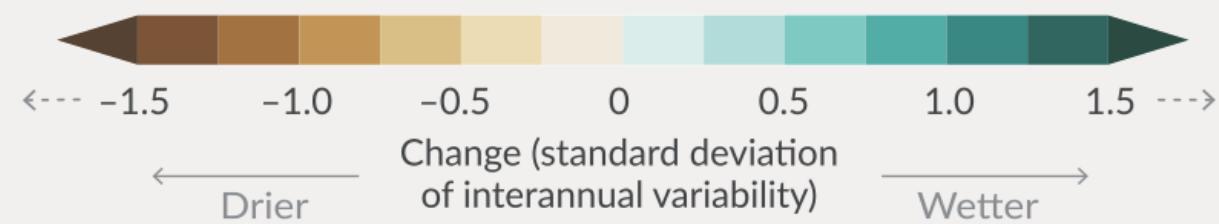
Simulated change at 2°C global warming



Simulated change at 4°C global warming



Relatively small absolute changes may appear large when expressed in units of standard deviation in dry regions with little interannual variability in baseline conditions.

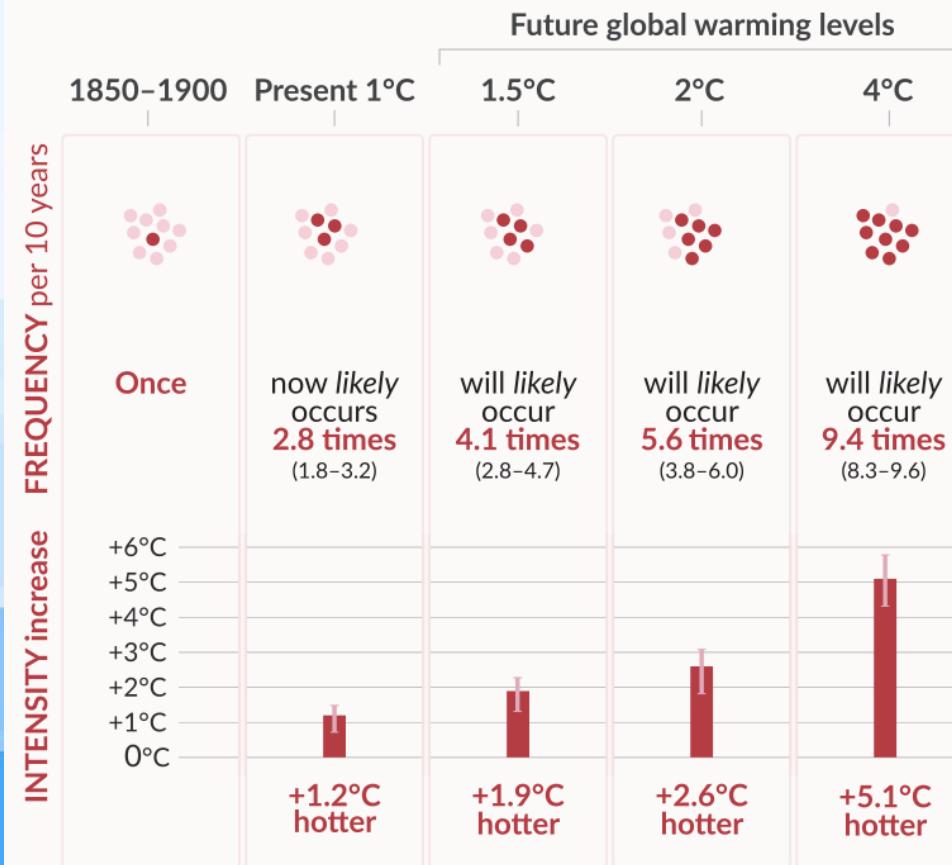


Aşırı Sıcaklık Olayları

Hot temperature extremes over land

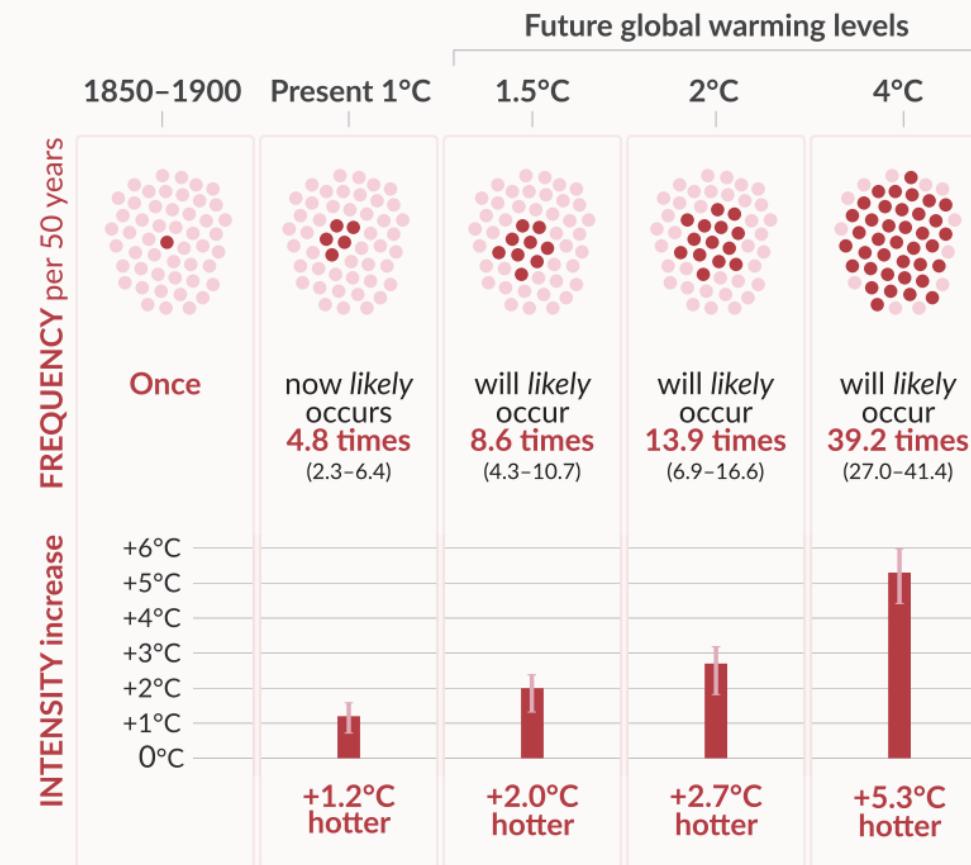
10-year event

Frequency and increase in intensity of extreme temperature event that occurred **once in 10 years** on average in a climate without human influence



50-year event

Frequency and increase in intensity of extreme temperature event that occurred **once in 50 years** on average in a climate without human influence

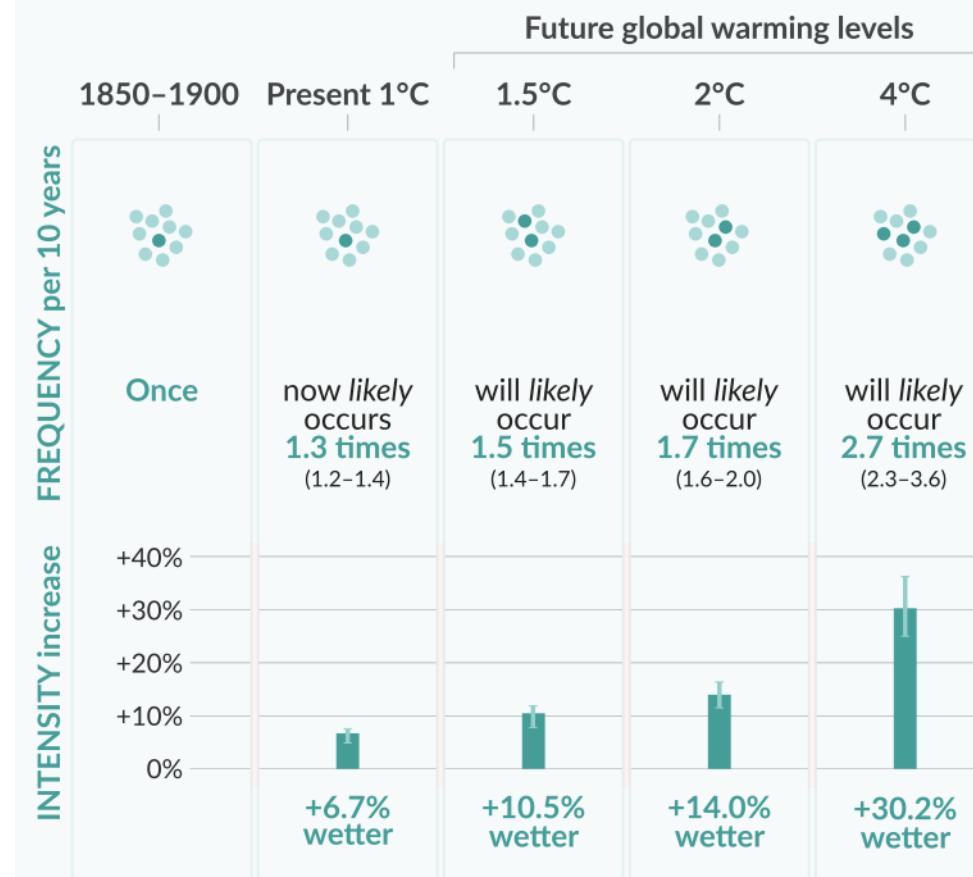


Aşırı Yağış Olayları

Heavy precipitation over land

10-year event

Frequency and increase in intensity of heavy 1-day precipitation event that occurred **once in 10 years** on average in a climate without human influence

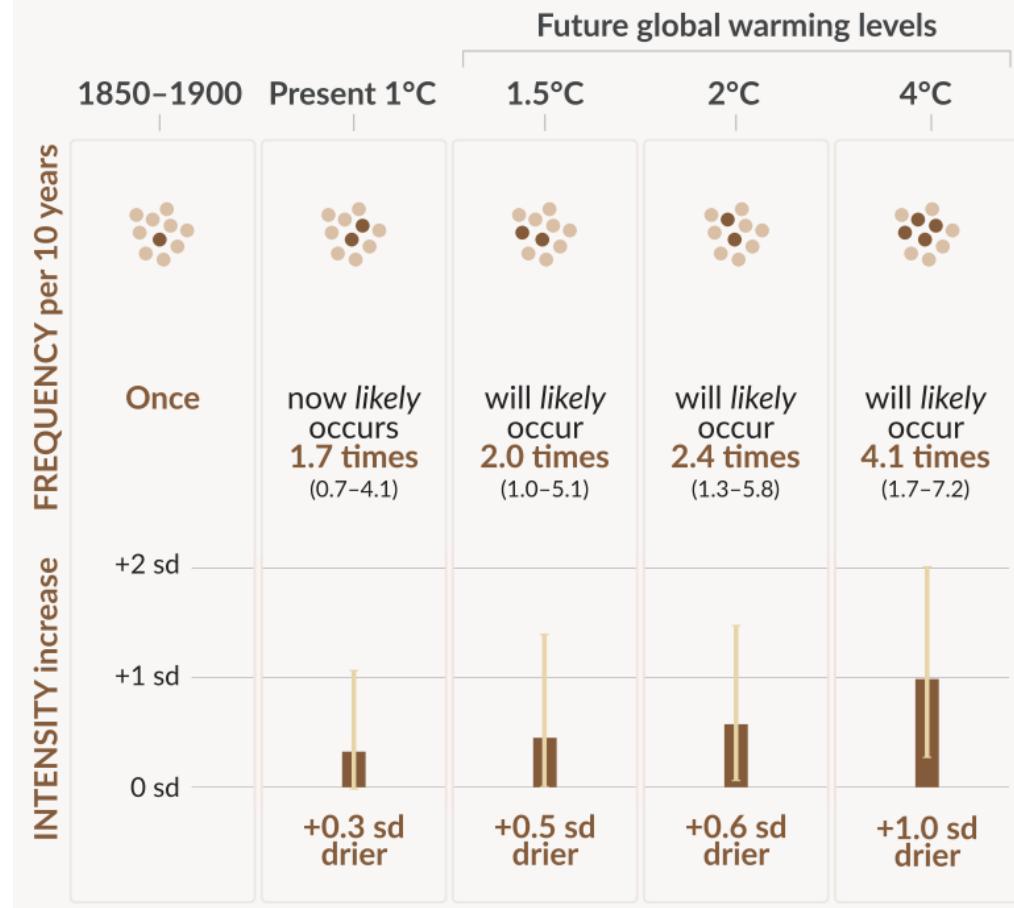


Tarımsal ve Ekolojik Kuraklık

Agricultural & ecological droughts in drying regions

10-year event

Frequency and increase in intensity of an agricultural and ecological drought event that occurred **once in 10 years** on average across drying regions in a climate without human influence



Türkiye için İklim Projeksiyonları



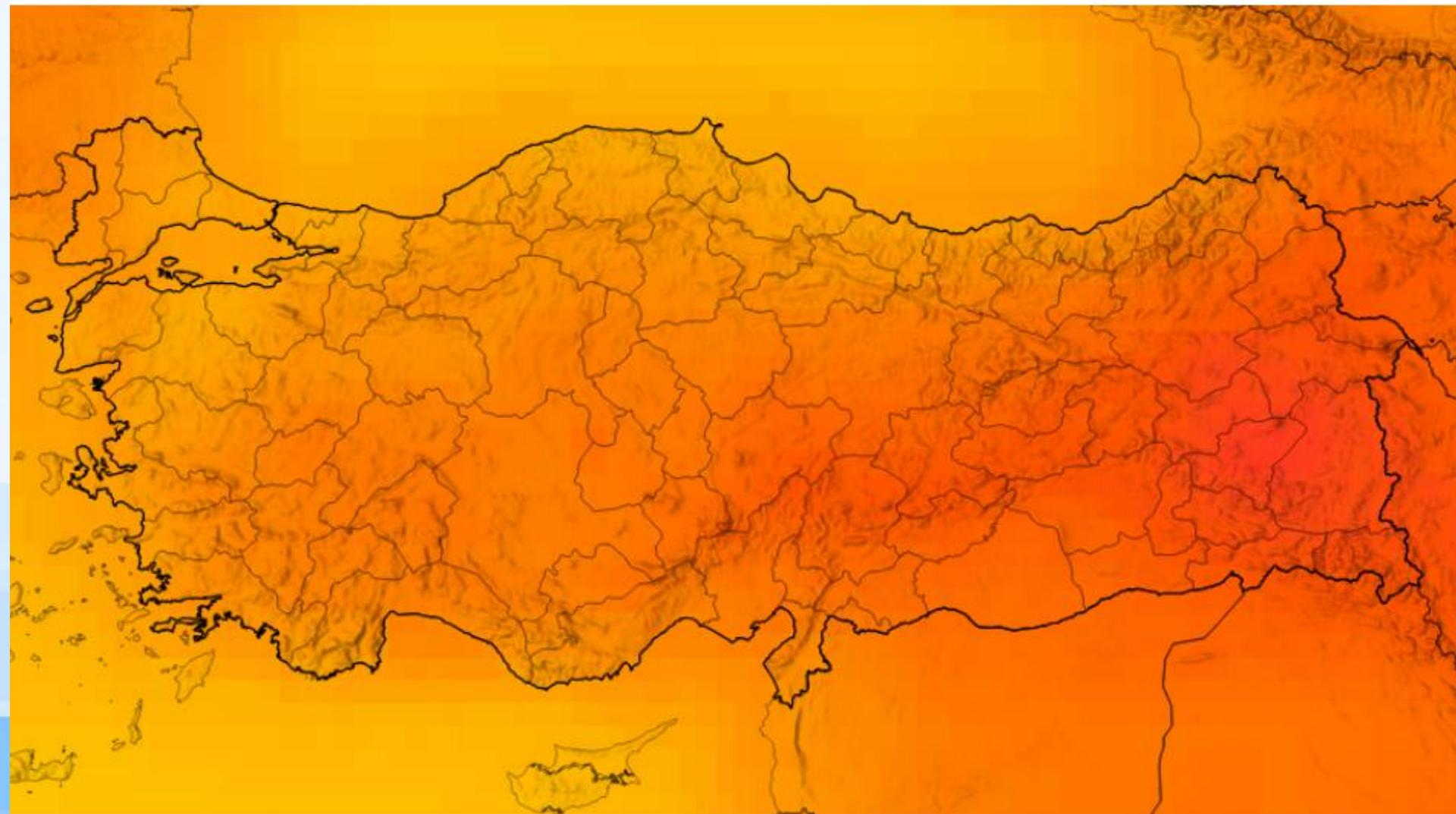
- İklim projeksiyon verileri, Dünya İklim Araştırma Programı tarafından denetlenen Eşleştirilmiş Model Karşılaştırma Projeleri'nin (CMIP'ler) küresel iklim modeli derlemelerinden modellenmiş verilerdir. Sunulan veriler, CMIP'lerin Altıncı Aşaması'ndan türetilen CMIP6'dır.
- CMIP'ler, IPCC Değerlendirme Raporları'nın veri temelini oluşturur. CMIP6, IPCC'nin Altıncı Değerlendirme Raporunu destekler.
- Veriler $0,25^{\circ} \times 0,25^{\circ}$ (25 km x 25 km) çözünürlükte sunulmaktadır.
- <https://climateknowledgeportal.worldbank.org/country/turkiye/climate-data-projections>

Projected Anomaly of Average Mean Surface Air Temperature

EXPAND MAP



Türkiye • 2080-2099 • Annual • SSP5-8.5 • Multi-Model Ensemble • Ref. Period: 1995-2014



TEMPERATURE(°C)

0

2

4

6

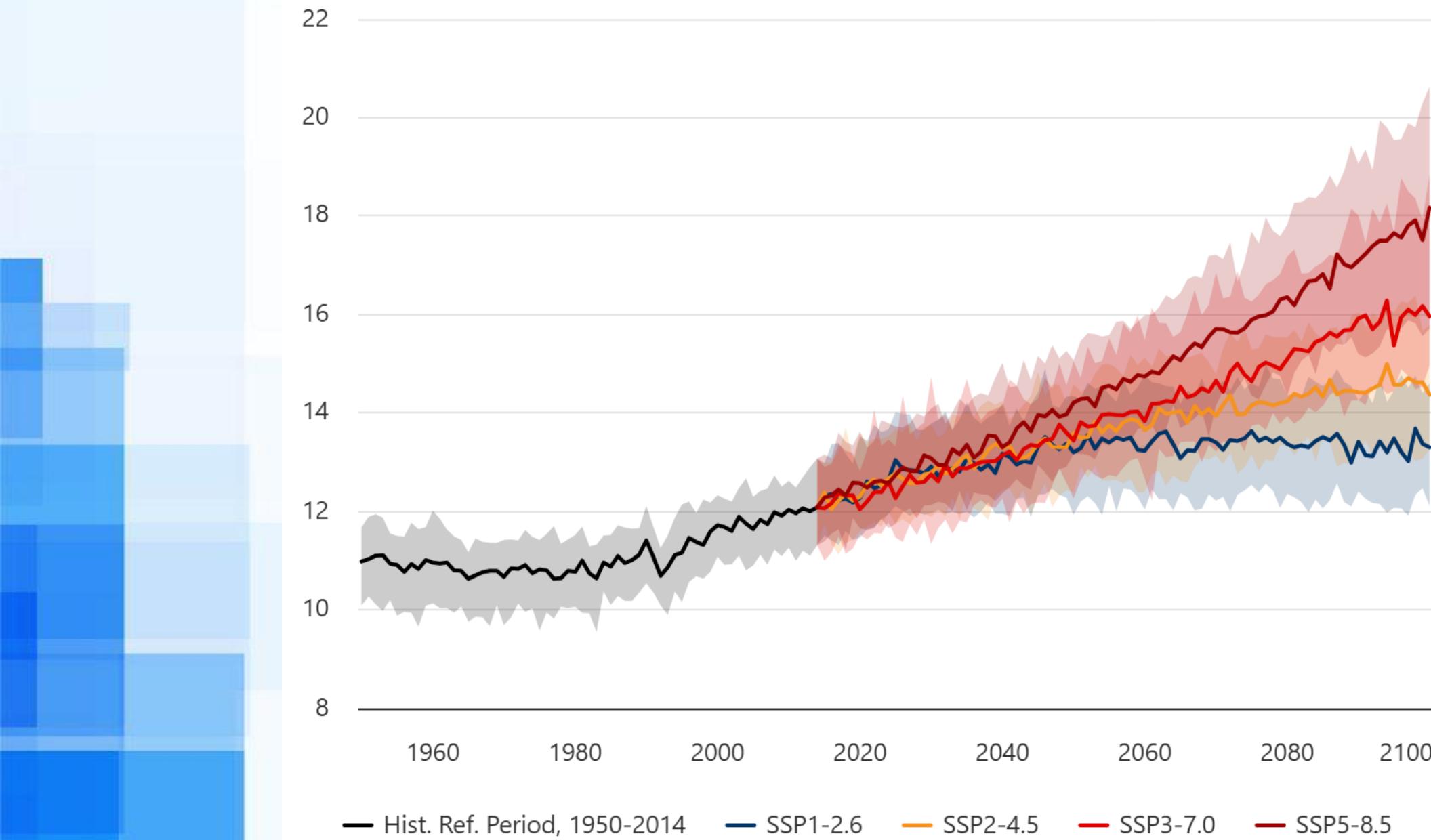
9

11

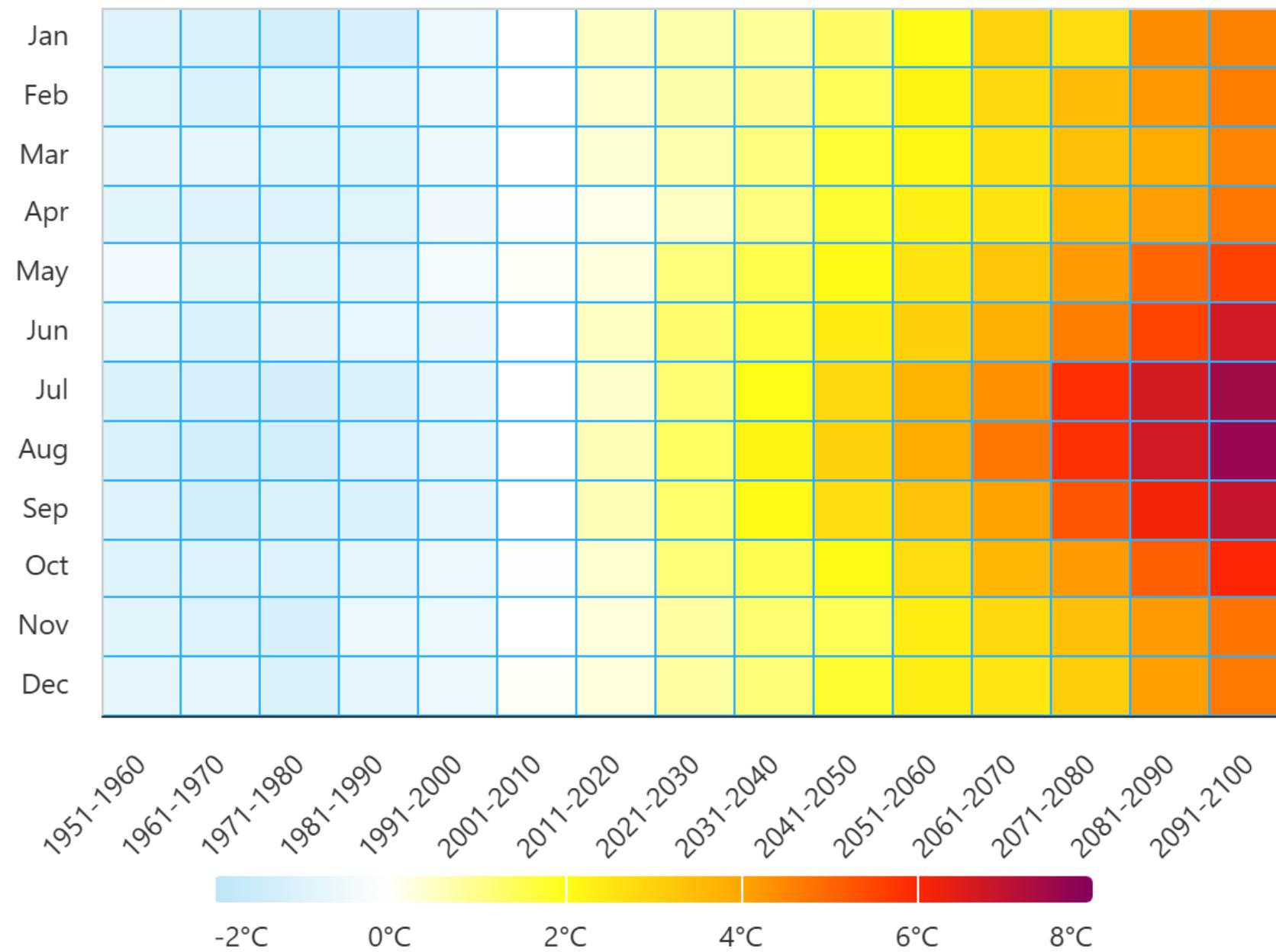
13

15

Projected Timeseries Anomaly of Average Mean Surface Air Temperature
Türkiye 1950-2100 Multi-Model Ensemble Ref. Period: 1995-2014



Projected Heat Plot Average Mean Surface Air Temperature Türkiye
(Ref. Period: 1995-2014) SSP5-8.5 Multi-Model Ensemble

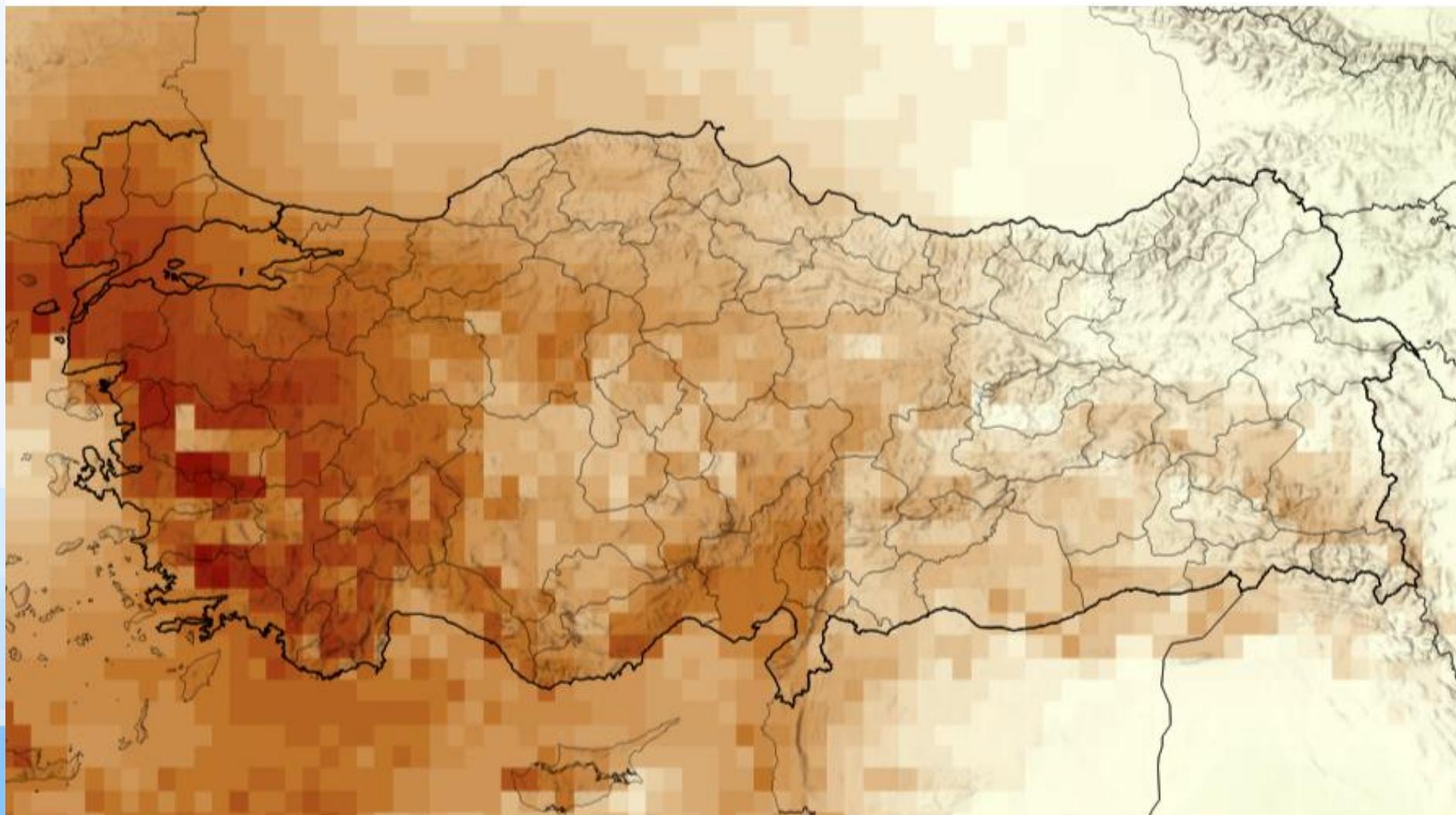


Projected Anomaly of Precipitation Percent Change

EXPAND MAP



Türkiye • 2080-2099 • Annual • SSP5-8.5 • Multi-Model Ensemble • Ref. Period: 1995-2014



PERCENT(%)



Kaynaklar

- [https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC AR6 WGI SPM.pdf](https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf)
- <https://www.gfdl.noaa.gov/climate-modeling/#:~:text=Climate%20models%20divide%20the%20globe,climate%20variables%20such%20as%20temperature.>
- <https://www.mgm.gov.tr/iklim/iklim-degisikligi.aspx>
- <https://climateknowledgeportal.worldbank.org/country/turkiye/climate-data-projections>