Assessing the impact of stratospheric aerosol injection on warm spell characteristics under ARISE-SAI-1.5

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What are warm spells and why should we care about them?

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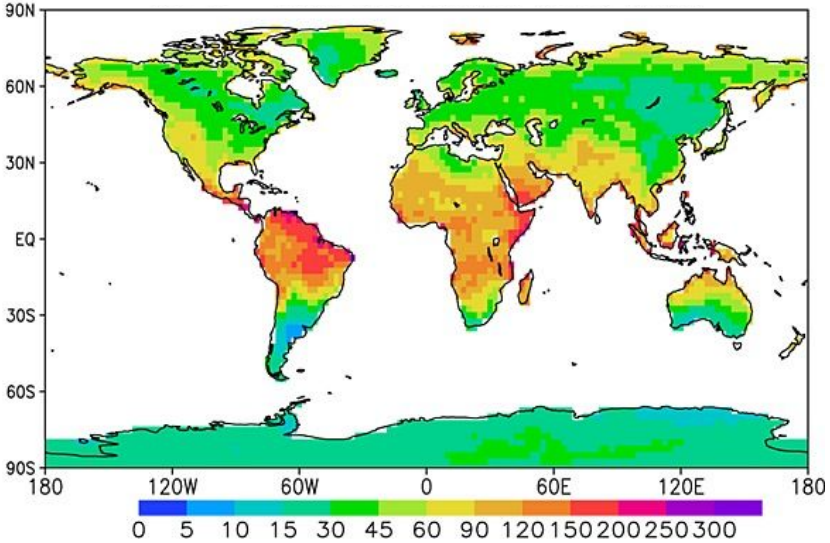
CMIP5 mean change in WSDI (days) from 1981-2000 to 2081-2100 under RCP4.5



From Figure 7 of Sillmann et al. (2013)

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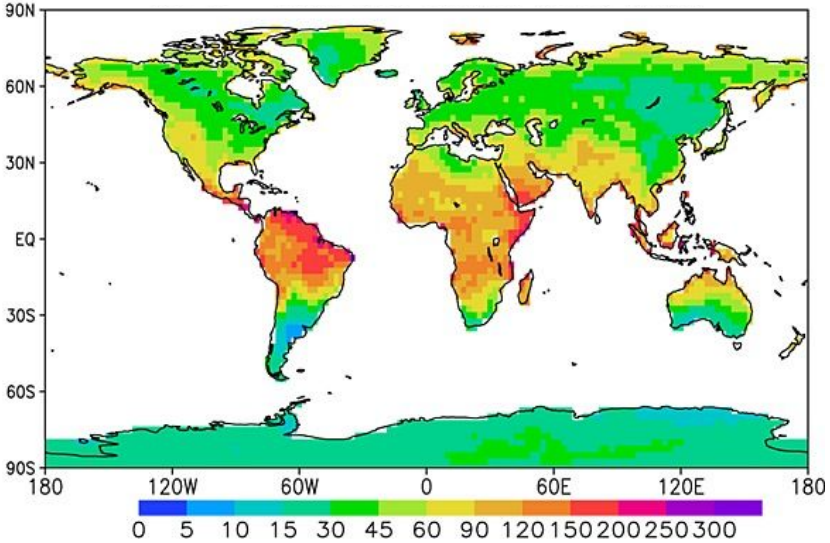

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- Warm spells are projected to increase in frequency as the climate continues to warm

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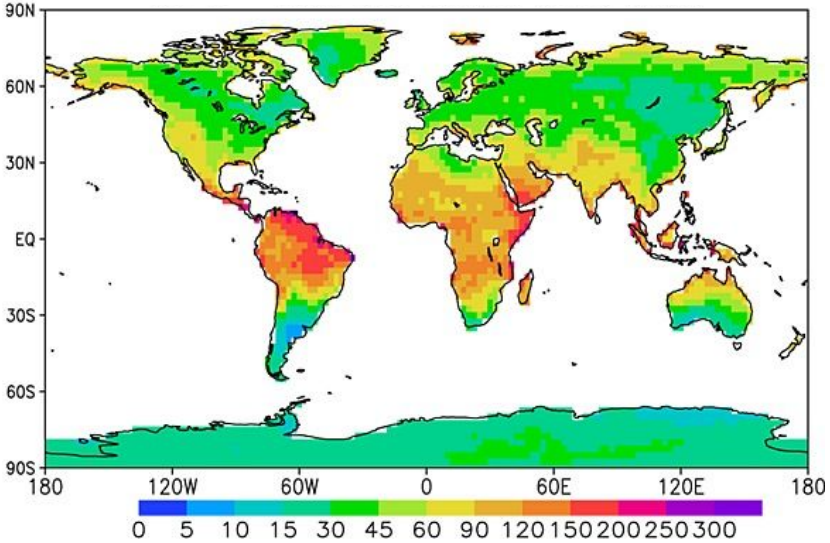

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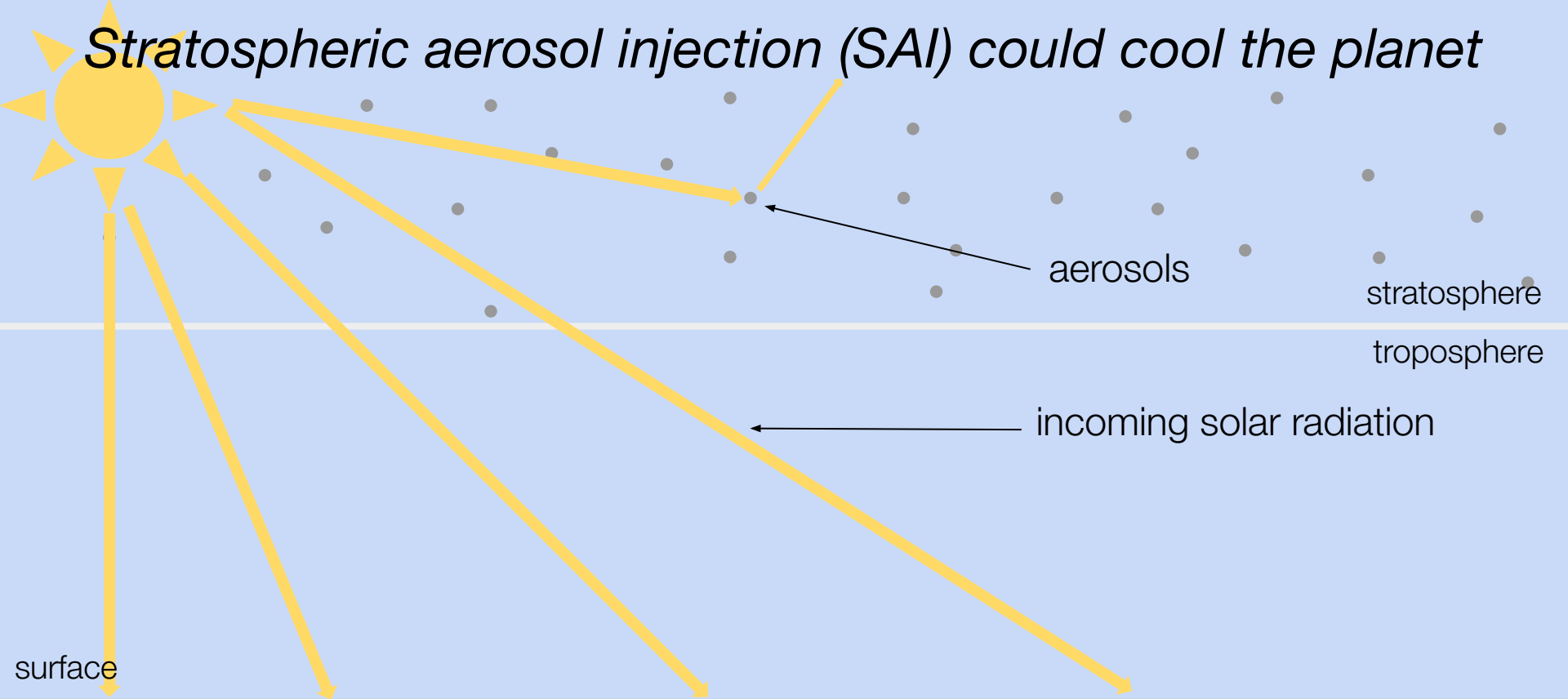
- Other characteristics (Fischer and Schar, 2010):
  - **Warm spell days**: count of days in a year that meet the above warm spell criterion
  - **Warm spell duration**: the maximum length (in days) of a warm spell event in a year
  - **Warm spell amplitude**: the maximum deviation (in ^{o}C) from the base period of T_{max} (T_{min}) that occurred during a warm spell in a year

Stratospheric aerosol injection (SAI) could cool the planet



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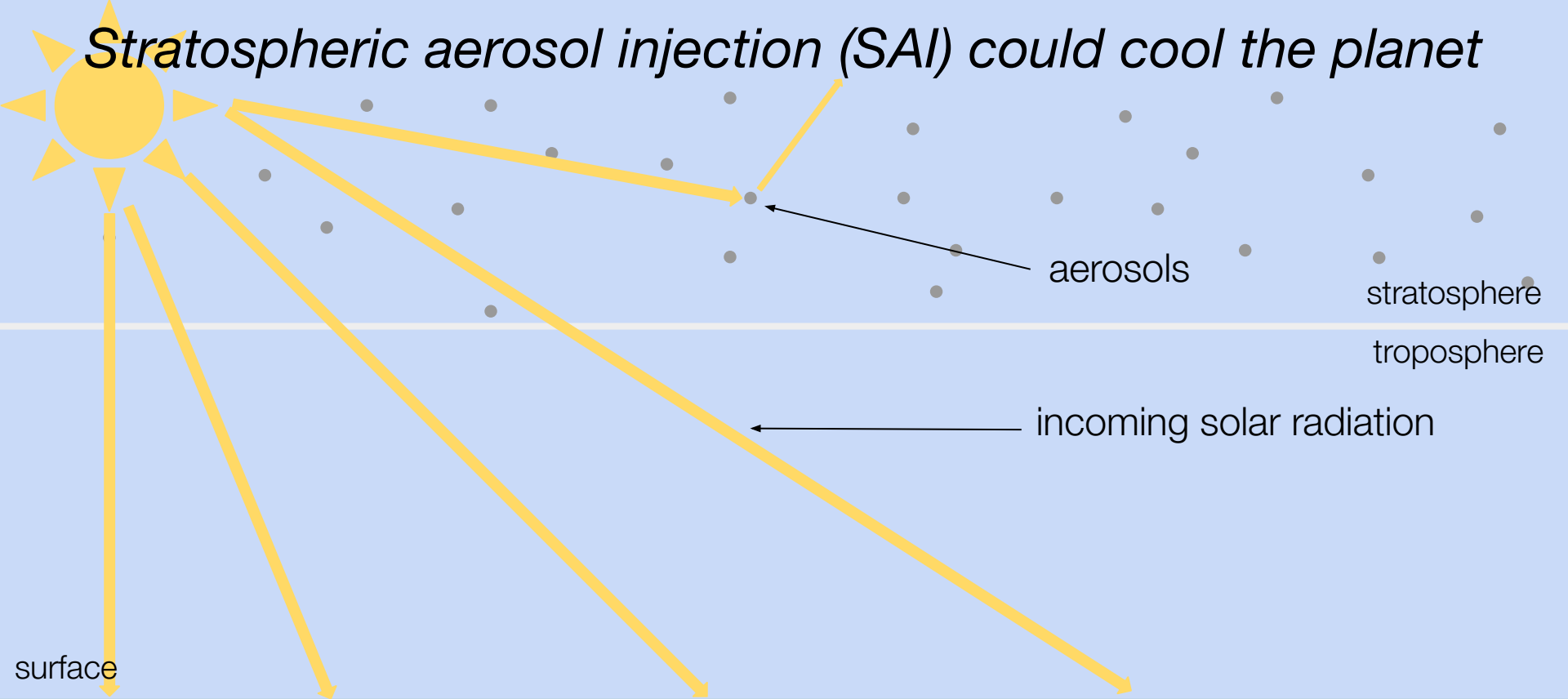

climate intervention methods are not a replacement for climate mitigation

Earth-system models simulate future climates with and without SAI

- Such simulations have been used to assess how SAI might impact:
  - global mean temperature and precipitation (Hueholt et al. 2023; Richter et al. 2022)
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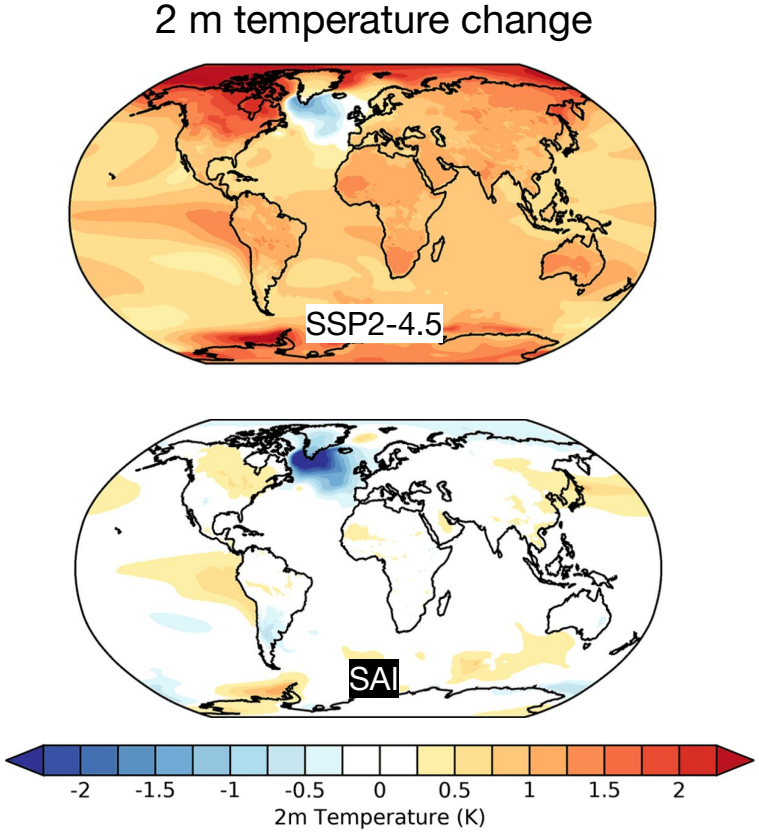

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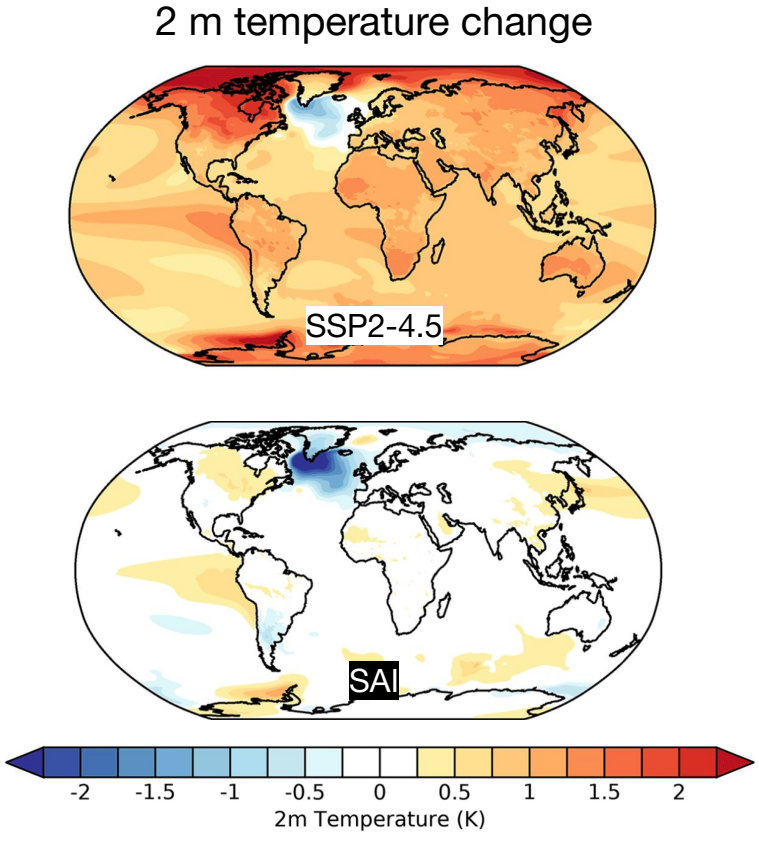

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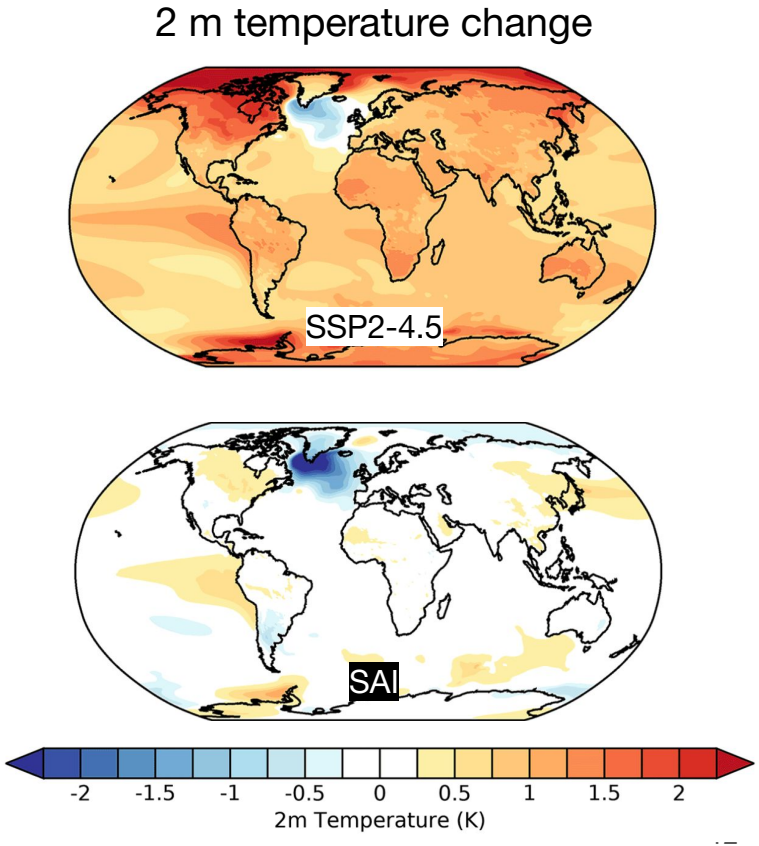
  - There has not been work that has examined how SAI might impact warm spell events at a global scale



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ARISE-SAI-1.5 is used to assess how SAI deployment might impact future projections of warm spell events

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- Two 10-member ensembles (Eyring et al. 2016; Richter et al. 2022):
  - One follows SSP2-4.5 and runs from 2015-2069
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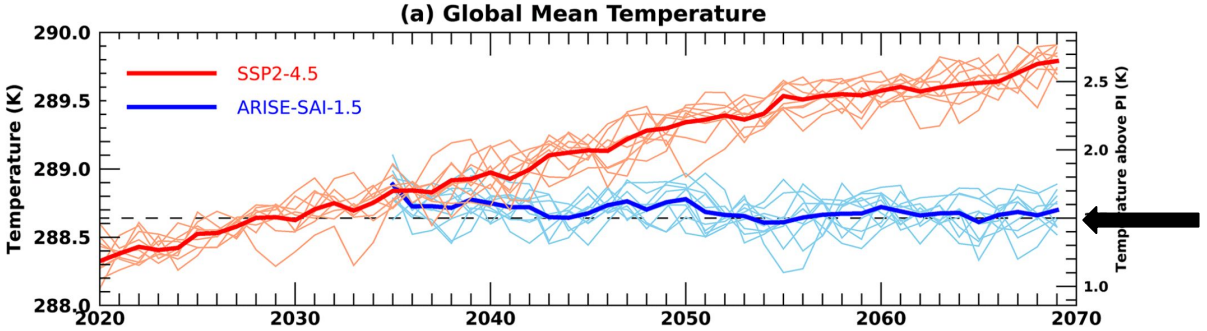

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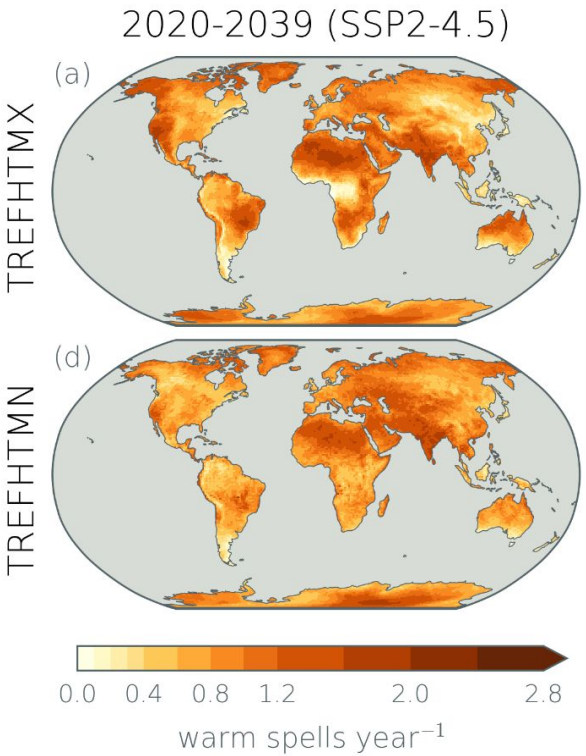
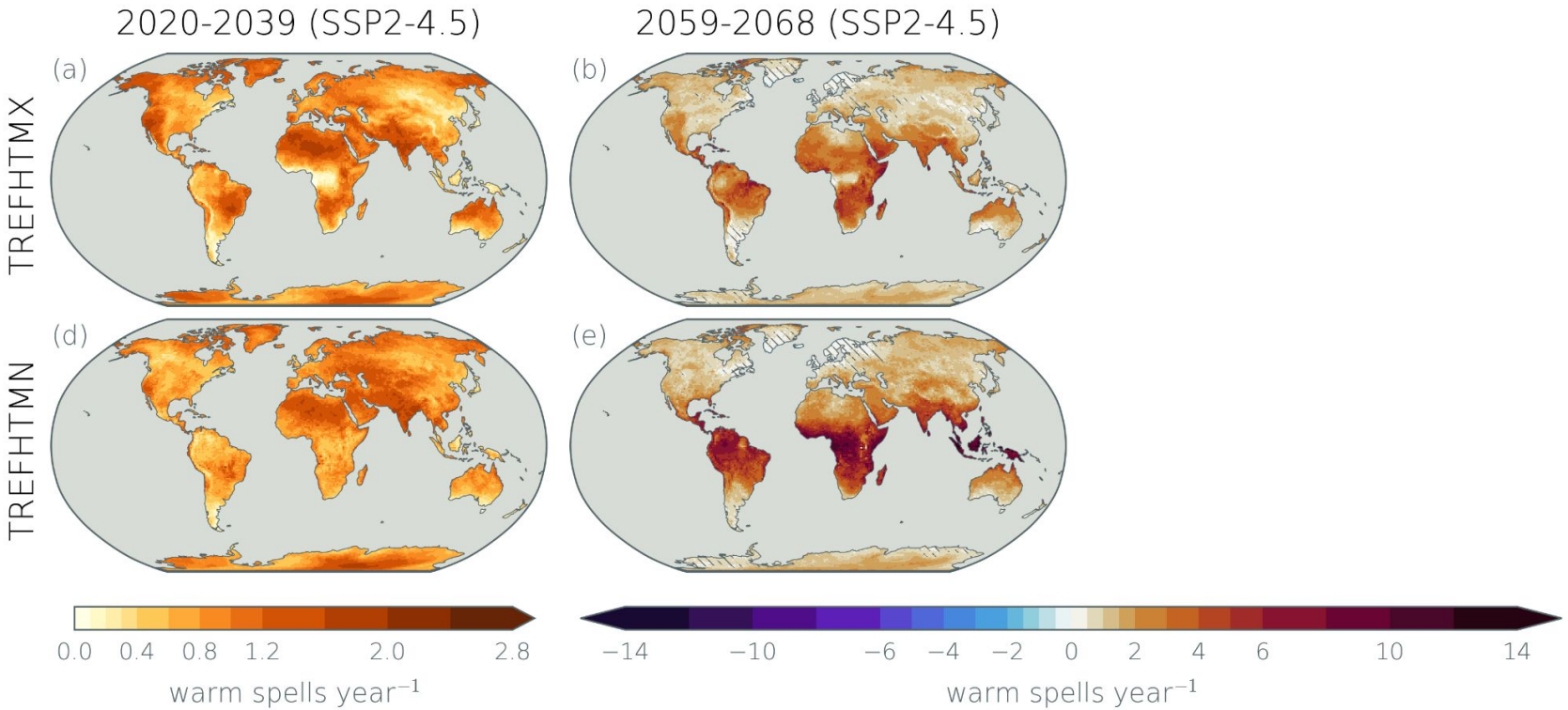
Annual mean warm spell occurrence for 2020-2039

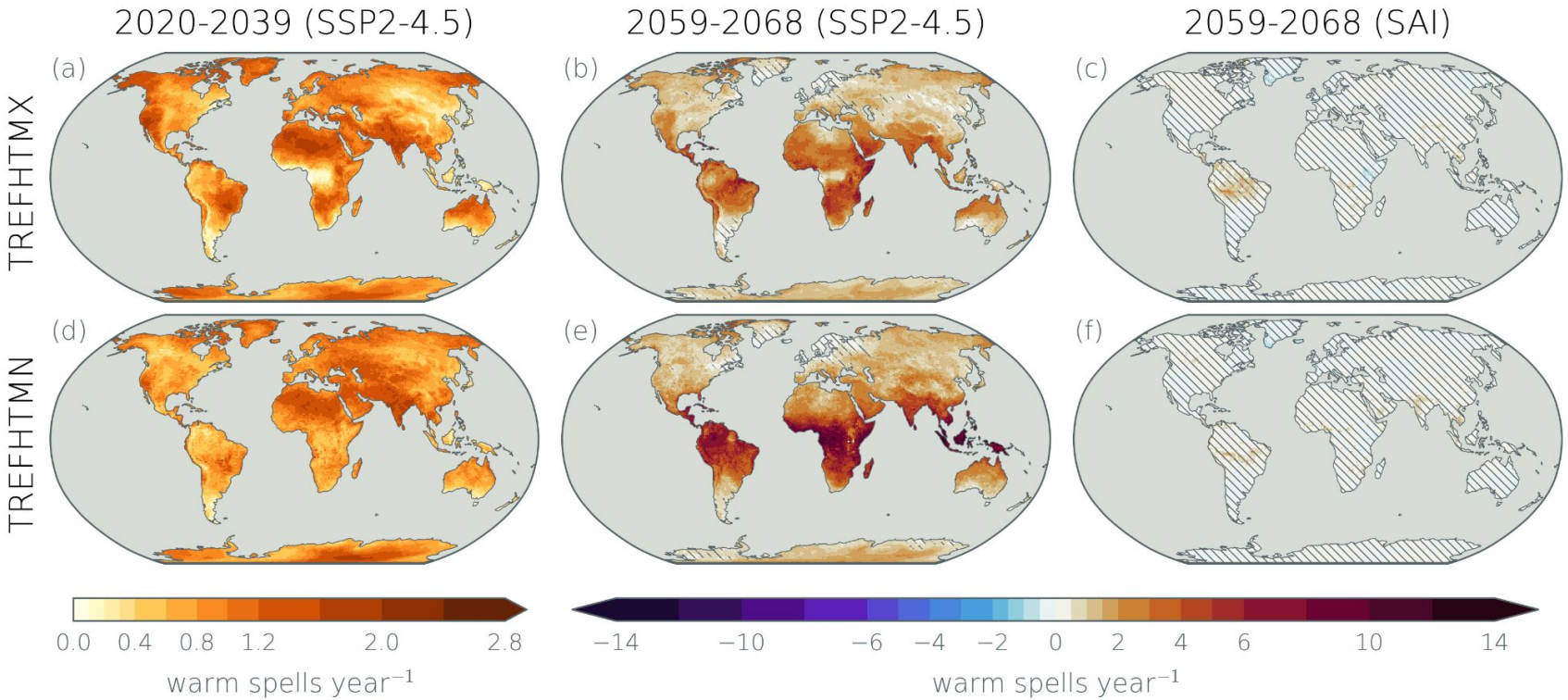


Warm spell occurrences increase under SSP2-4.5



Stippling indicates if the 2059-2068 period is not significantly different from the 2020-2039 period using the two-sample student's t-test (α = 0.05), adjusted for the FDR (Wilks 2016)

Future increases in warm spell occurrence are mostly avoided when SAI is deployed in ARISE-SAI-1.5



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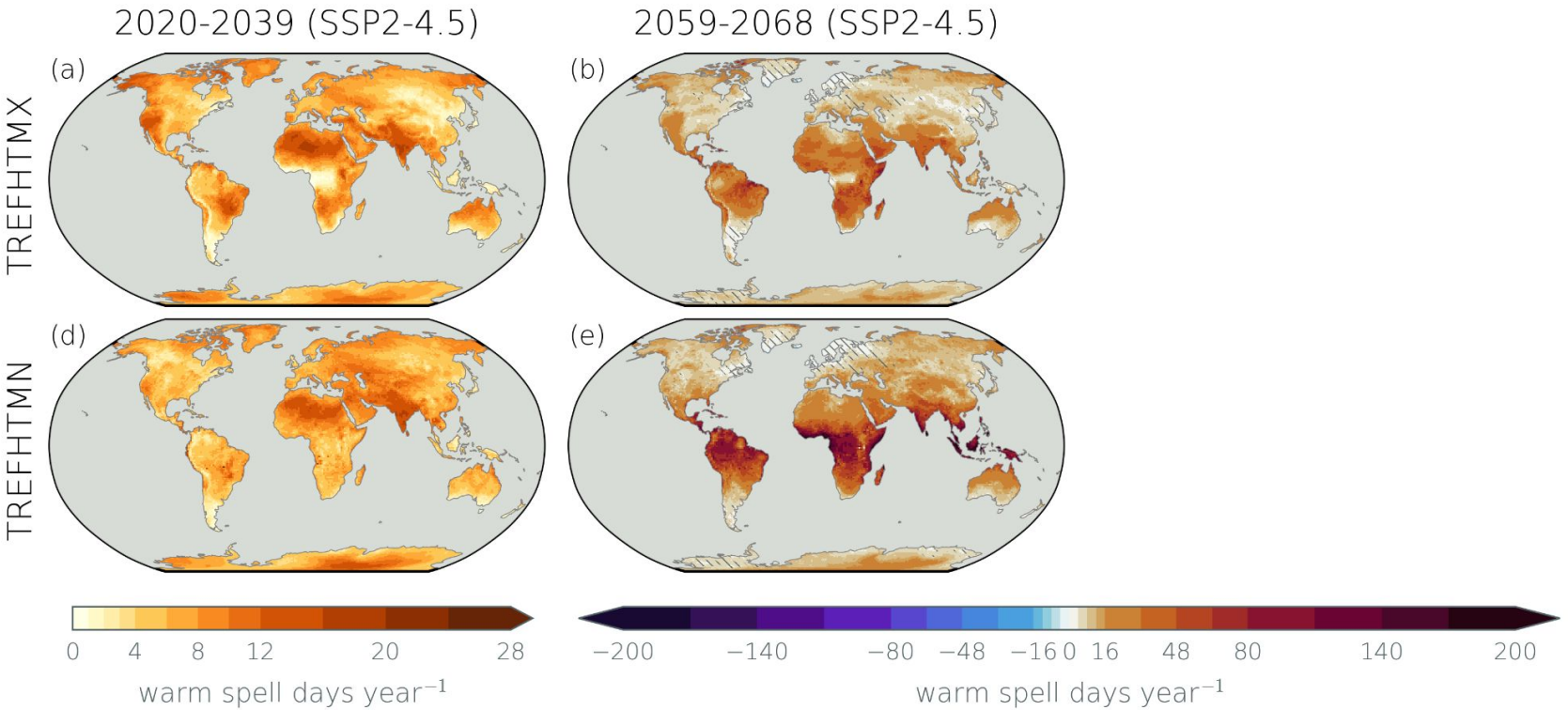
The spatial pattern of warm spell day changes is similar to that of warm spell occurrence



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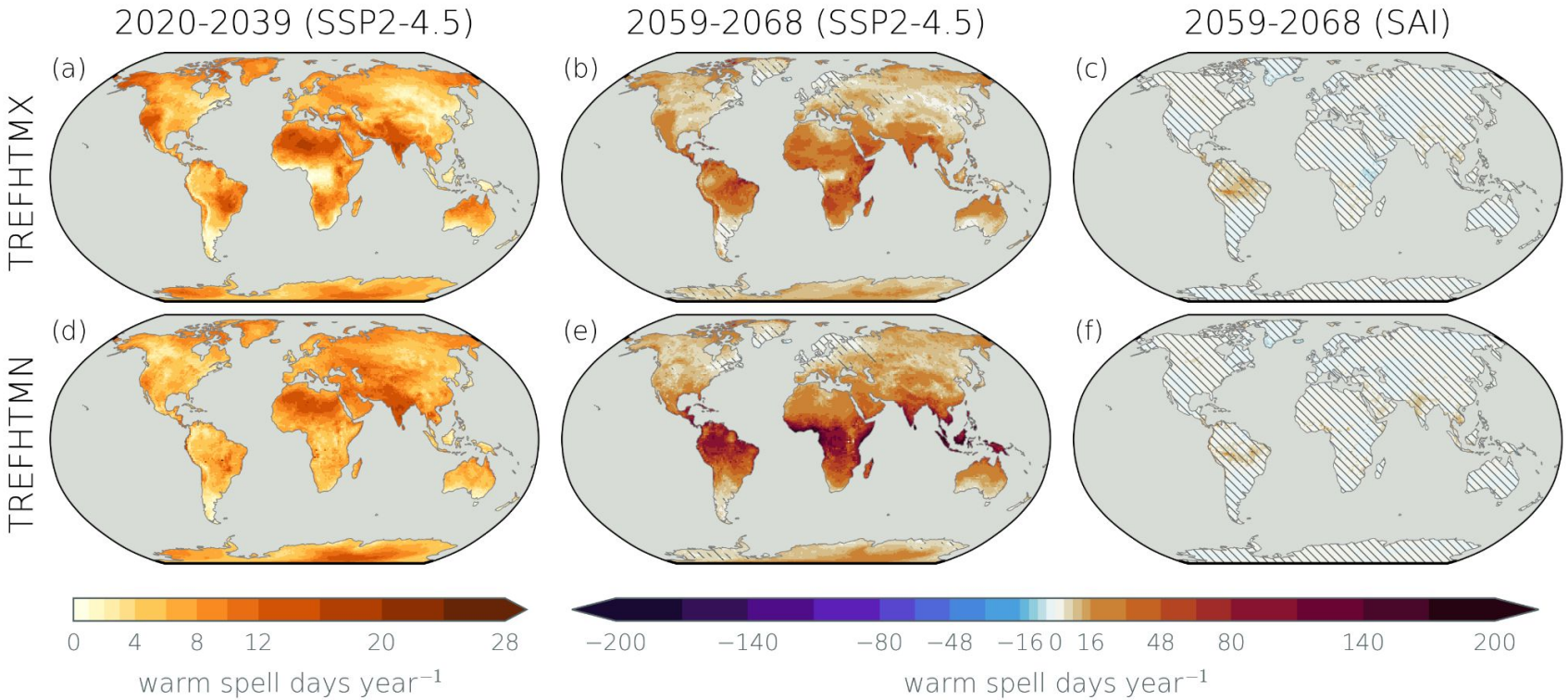

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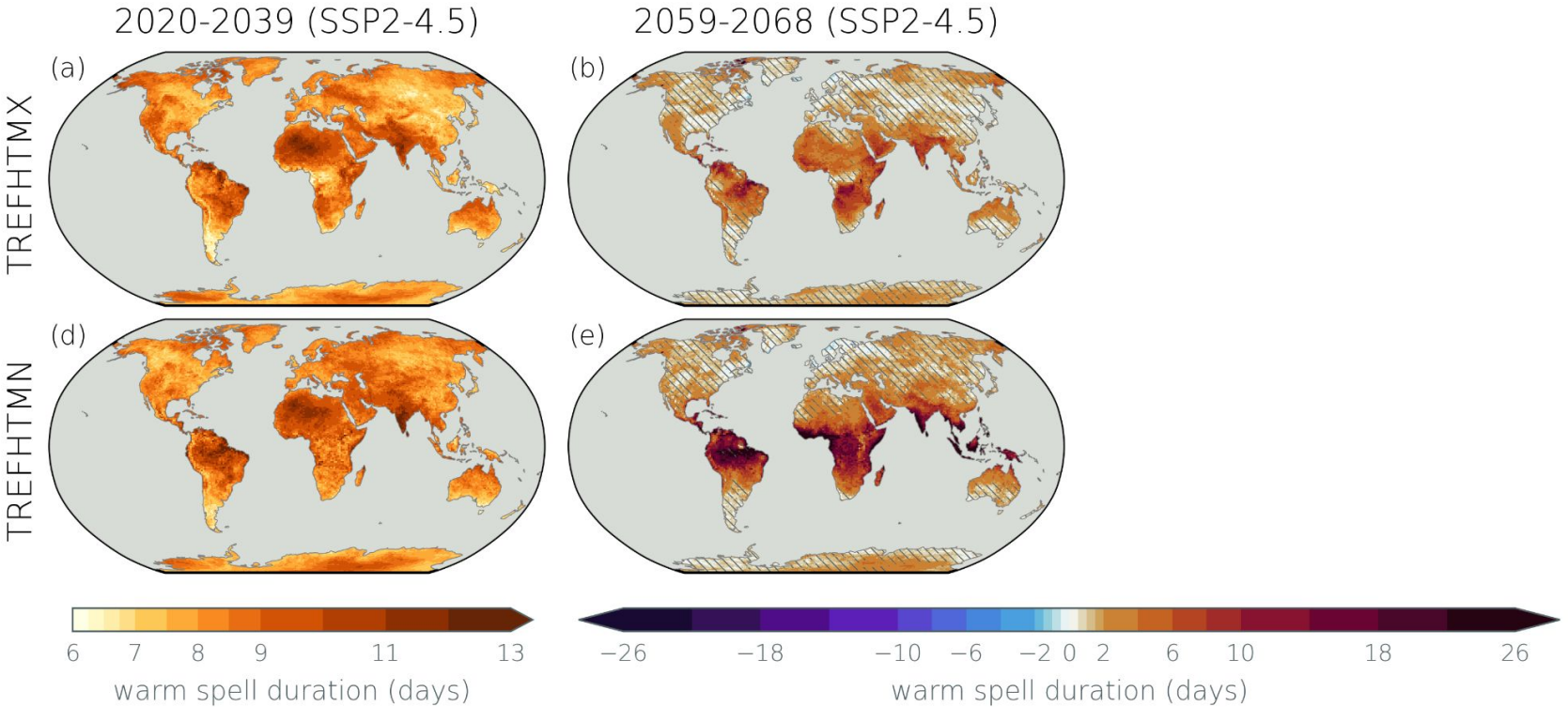
Future increases in warm spell duration are largest at lower latitudes



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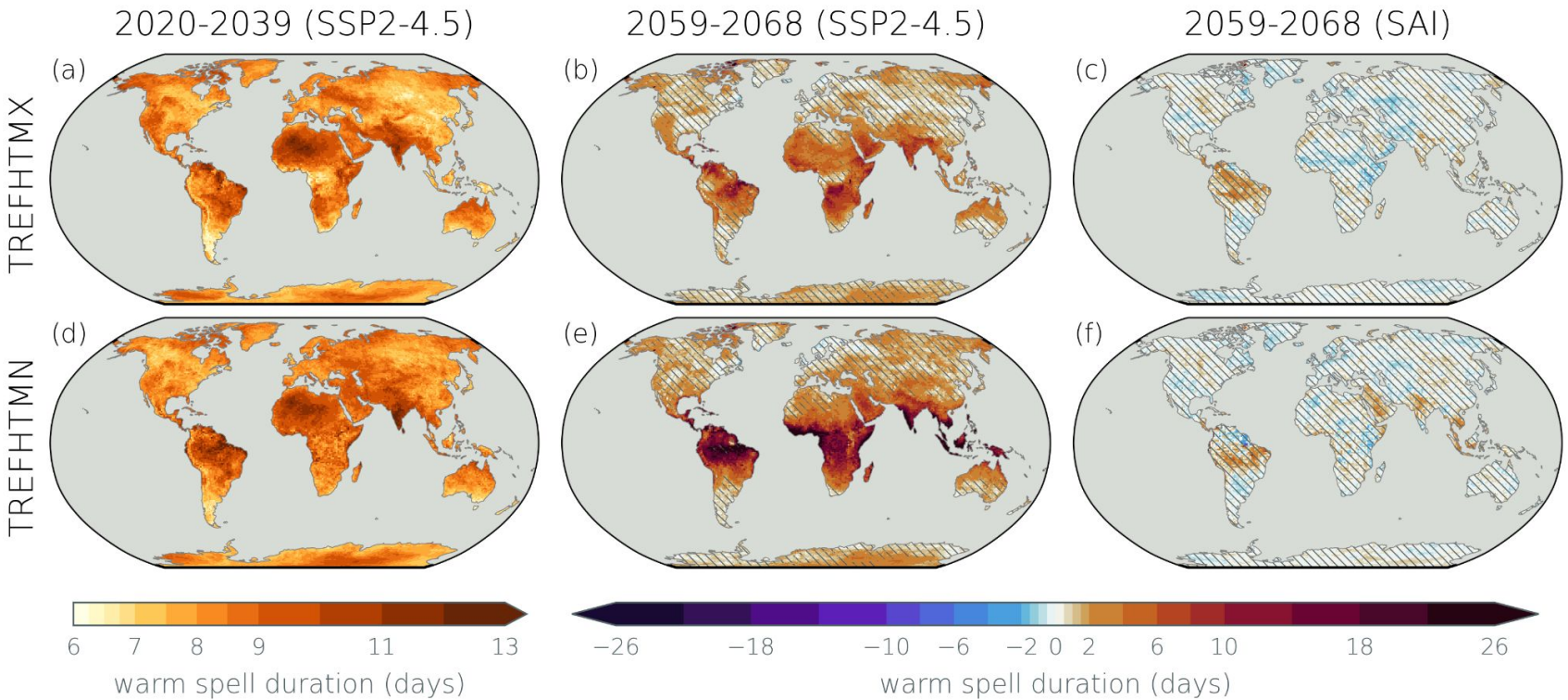
There are small changes in warm spell duration under SAI that vary regionally



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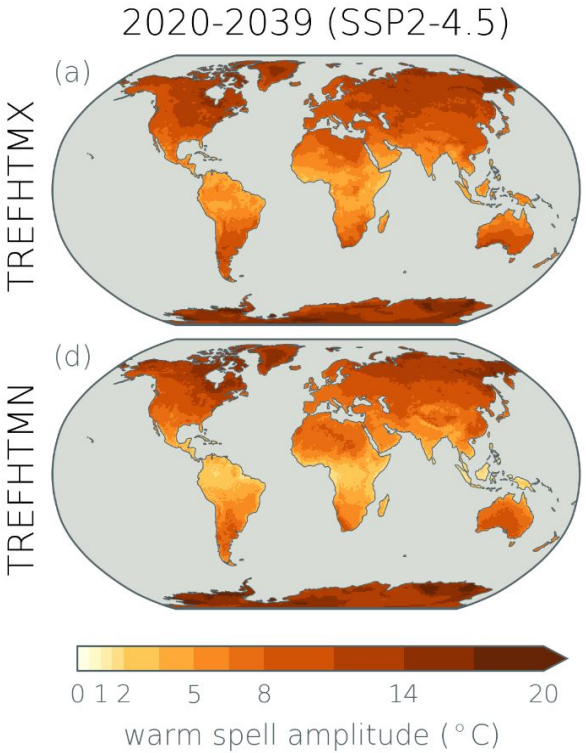
Warm spell amplitude is highest at high latitudes



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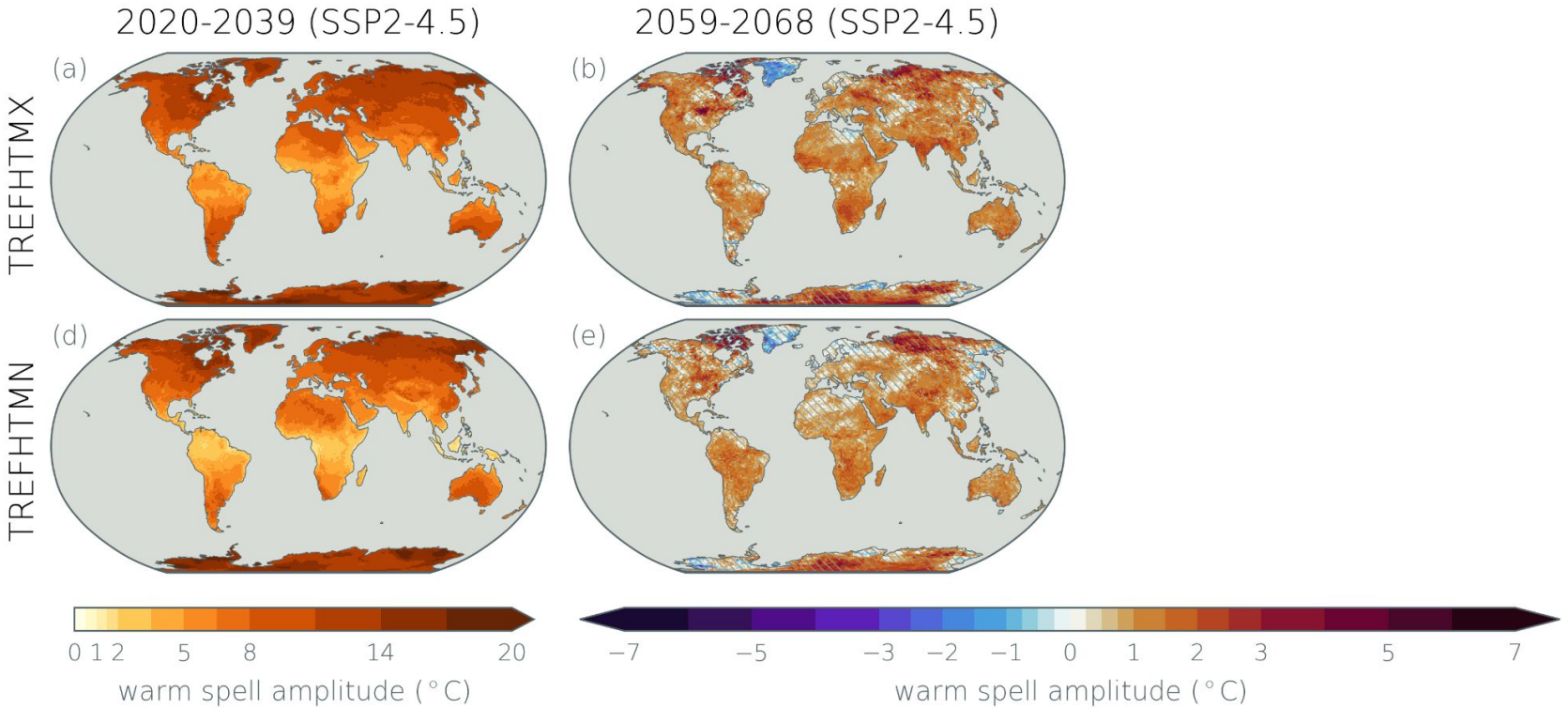

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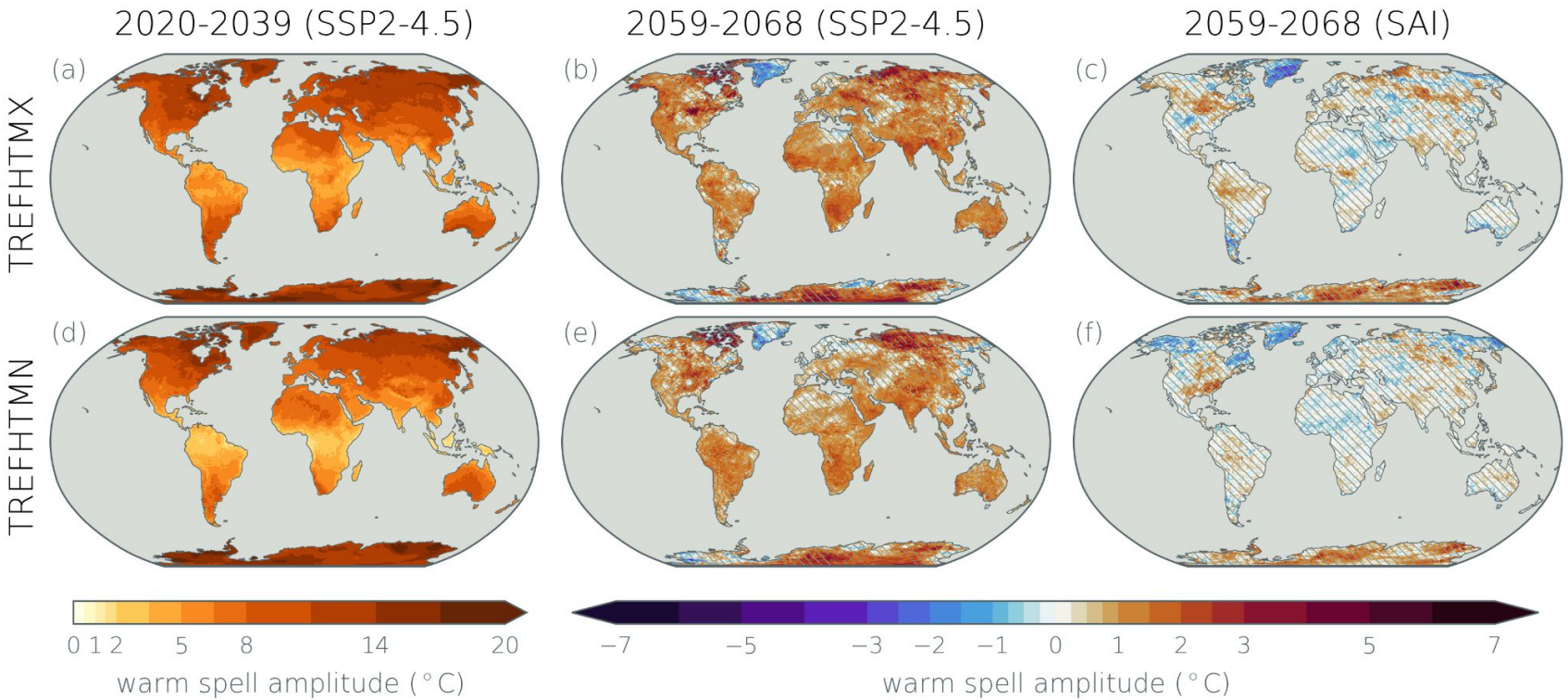

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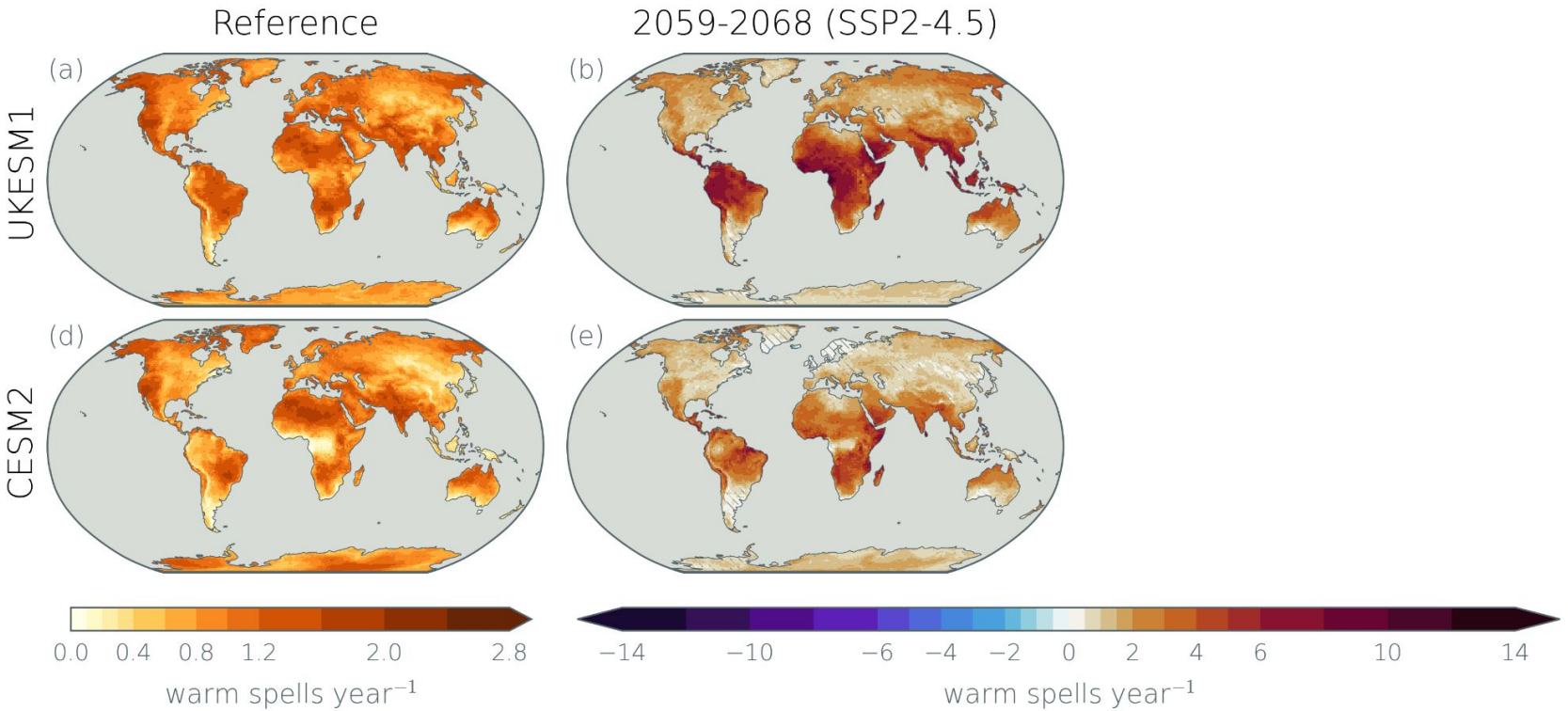
Warm spell occurrences differ between CESM2 and UKESM1



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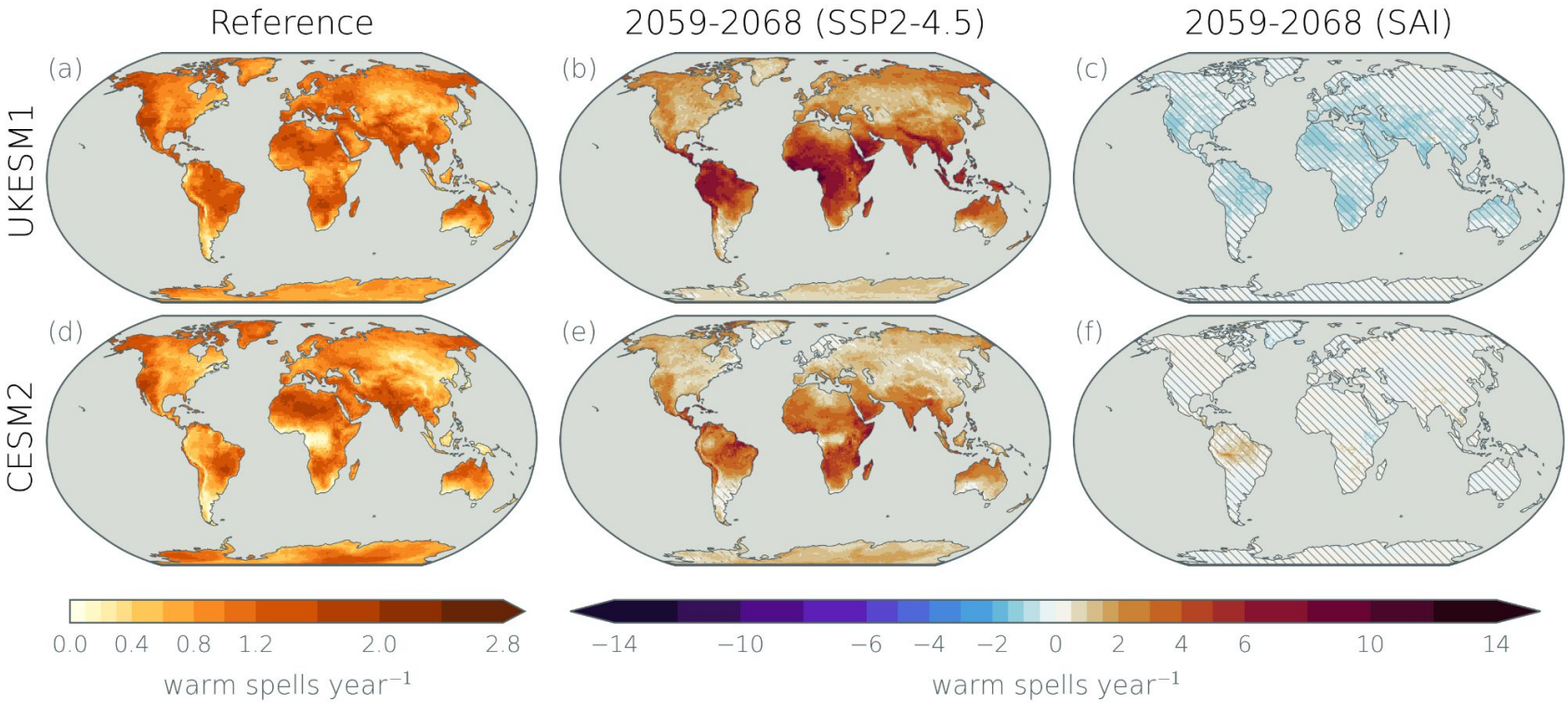
There are small decreases in warm spell occurrence when SAI is deployed in UKESM1



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- There are distinct differences in warm spell projections under identical climate change and SAI scenarios using two different Earth-system models: CESM2 and UKESM1.
- Future work may investigate the physical drivers behind the differences in the spatial pattern of warm spell events in CESM2 and UKESM1