

Frequency of compound hot-dry weather extremes has significantly increased in Australia since 1889

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Supplementary Material

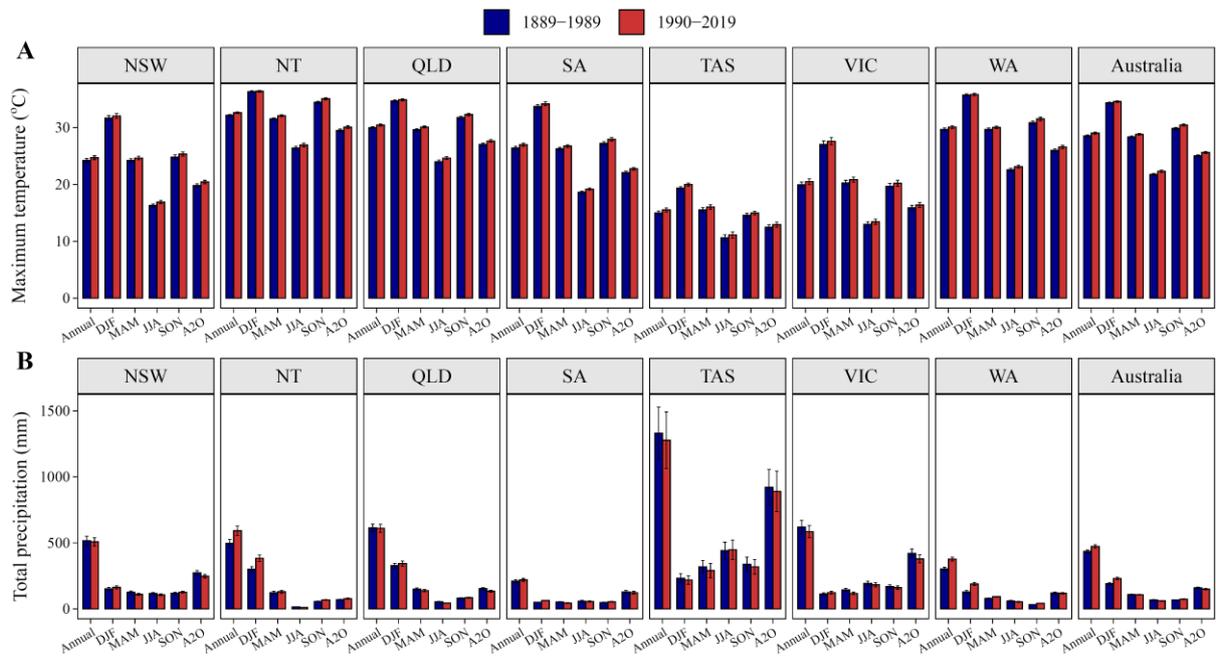


Figure S1. Annual and seasonal averages of daily maximum temperature (**A**) and total daily precipitation (**B**) across states and whole Australia. A2O: autumn-winter, DJF: summer, MAM: autumn, JJA: winter, SON: spring. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

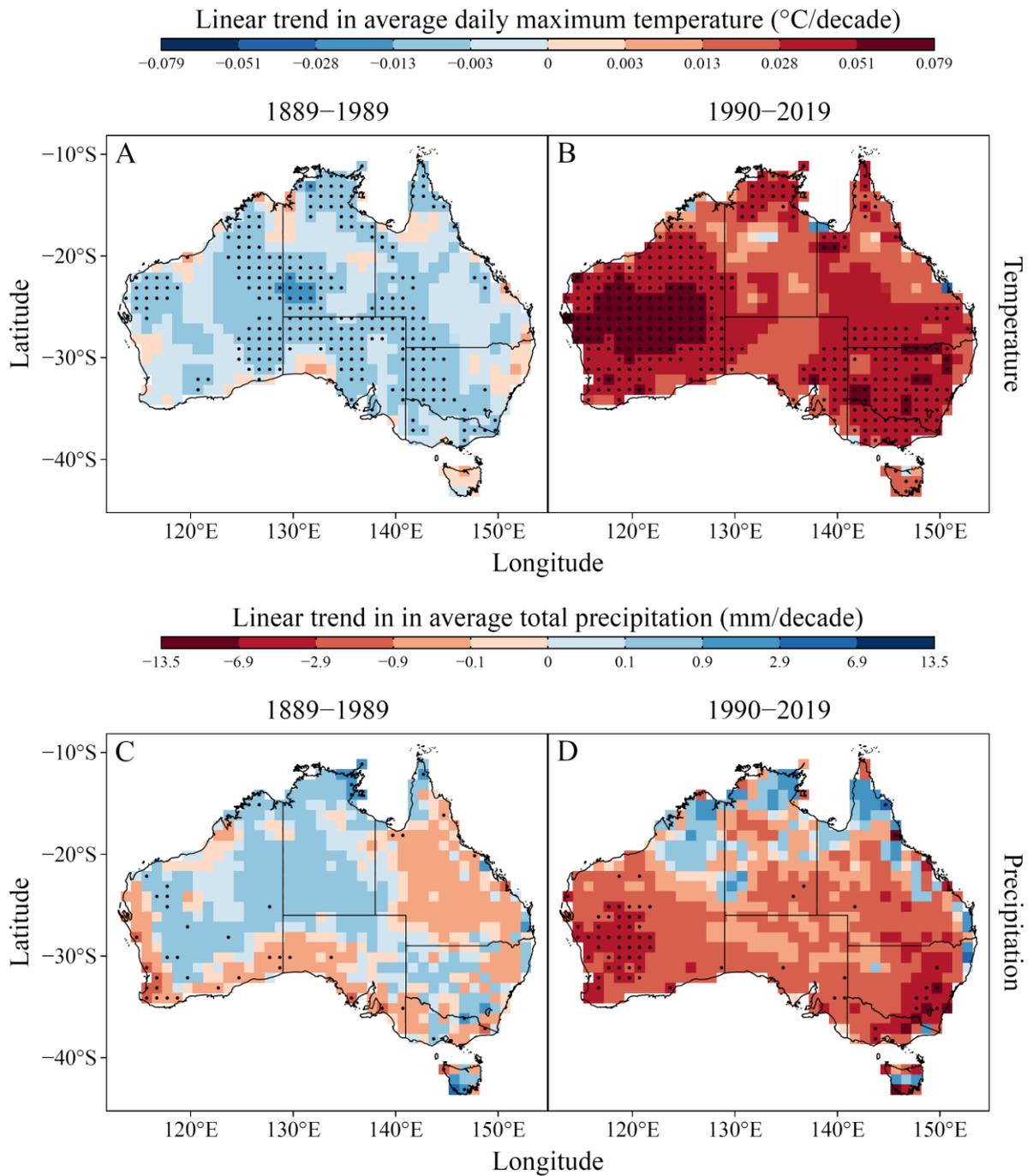


Figure S2. Trends in autumn-winter mean maximum daily temperature (MMT; **A,B**) and total precipitation (TPR; **C,D**) over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

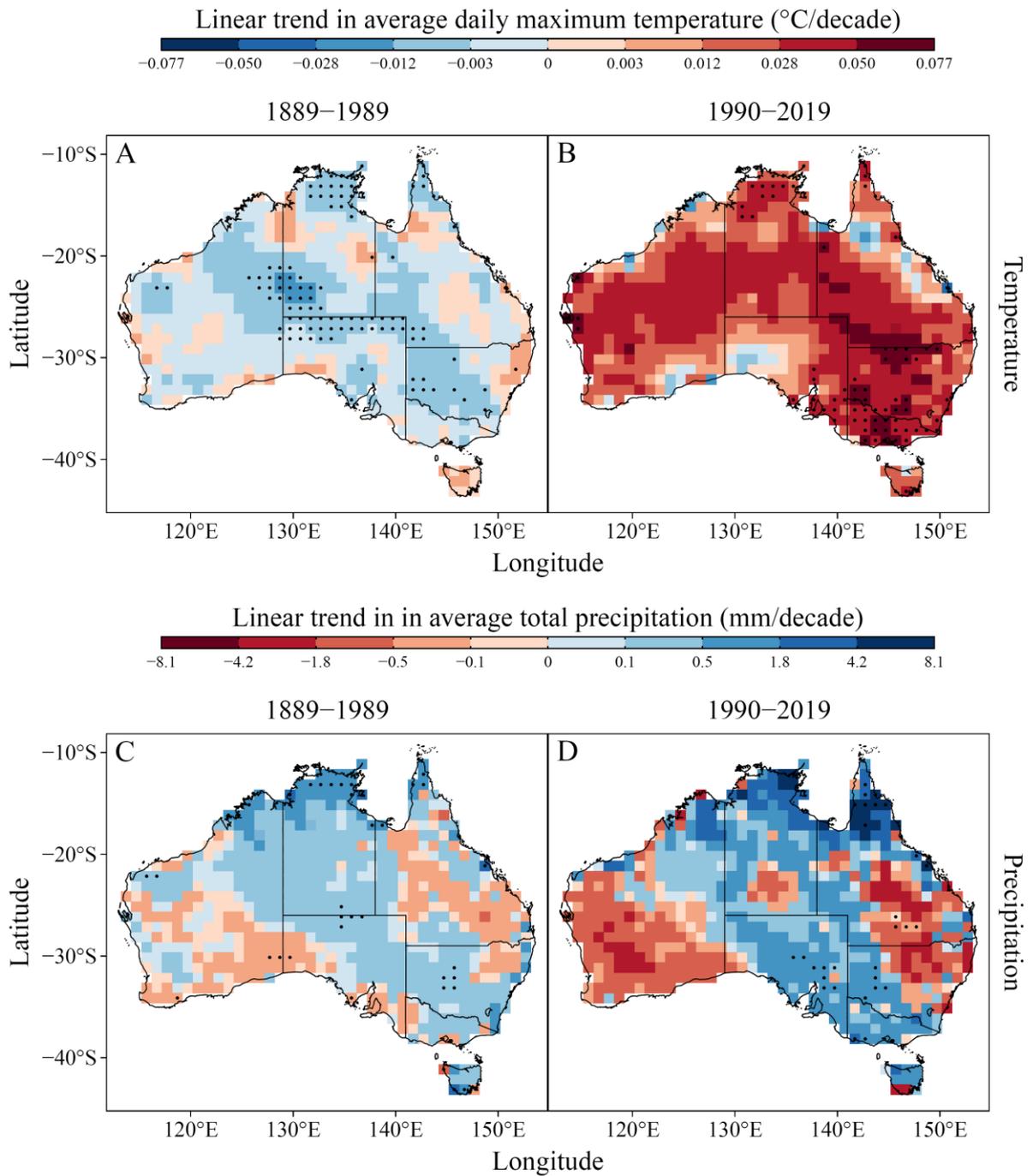


Figure S4. Trends in autumn mean maximum daily temperature (MMT; **A,B**) and total precipitation (TPR; **C,D**) over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

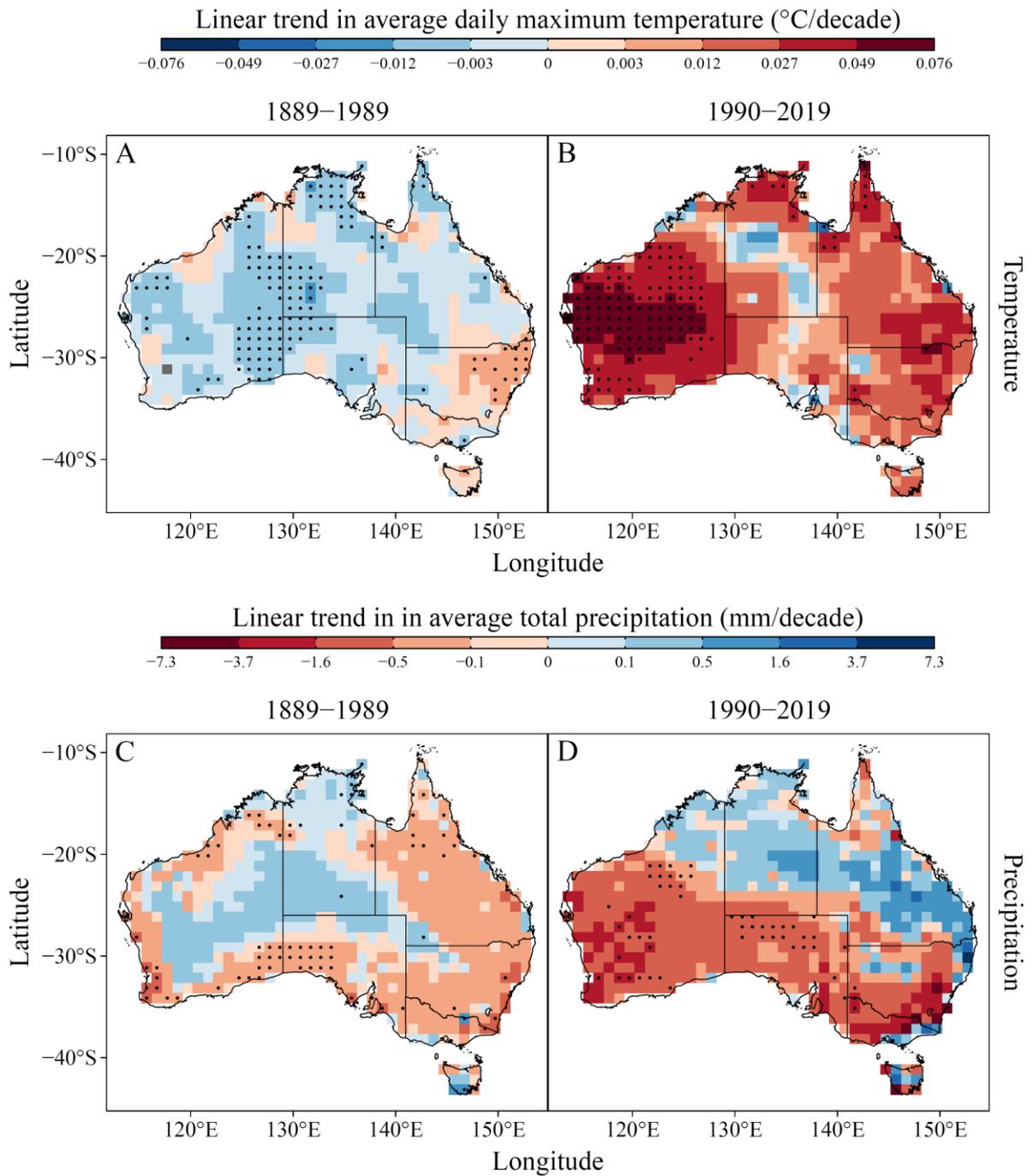


Figure S5. Trends in winter mean maximum daily temperature (MMT; **A,B**) and total precipitation (TPR; **C,D**) over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

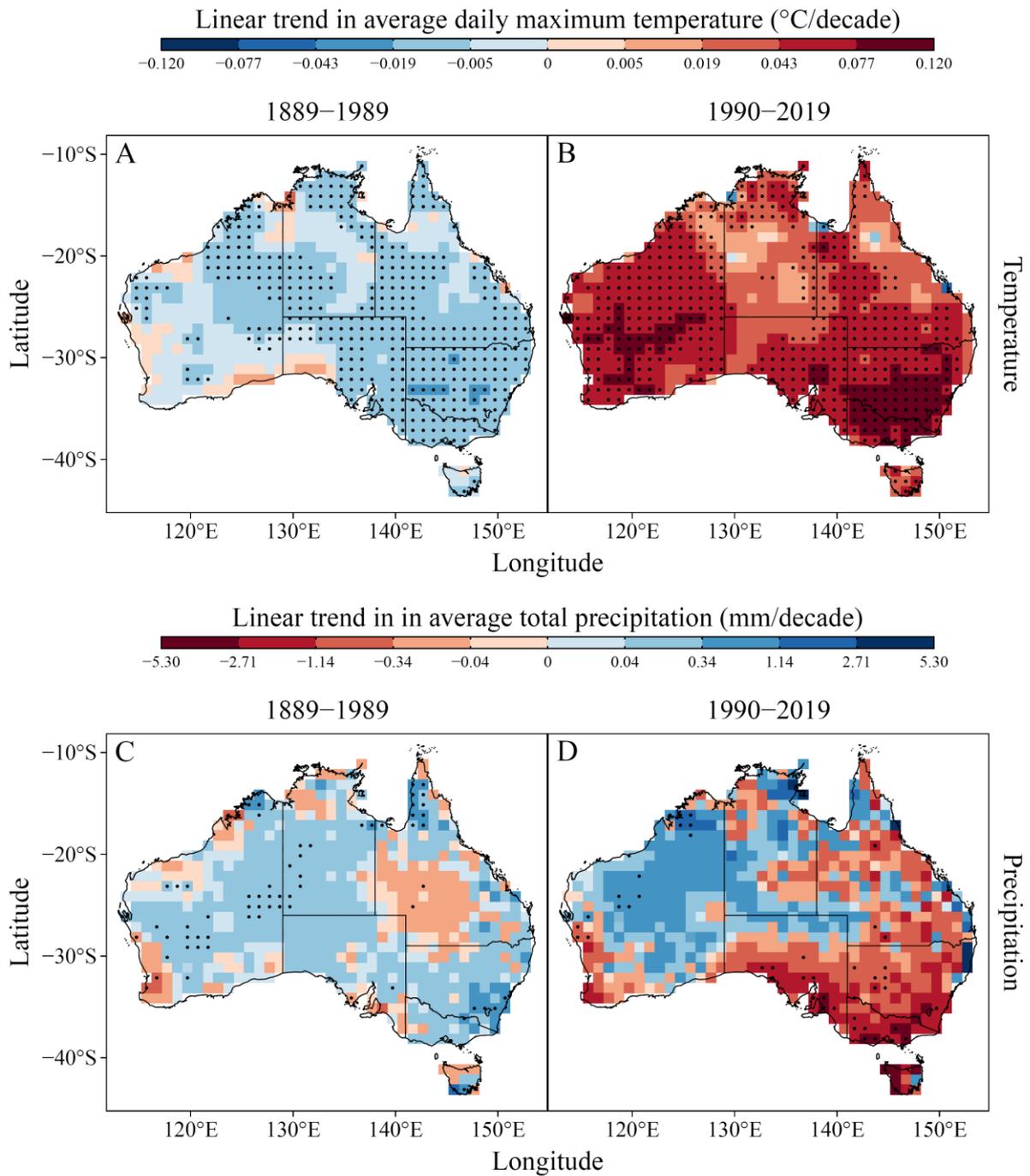


Figure S6. Trends in spring mean maximum daily temperature (MMT; **A,B**) and total precipitation (TPR; **C,D**) over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

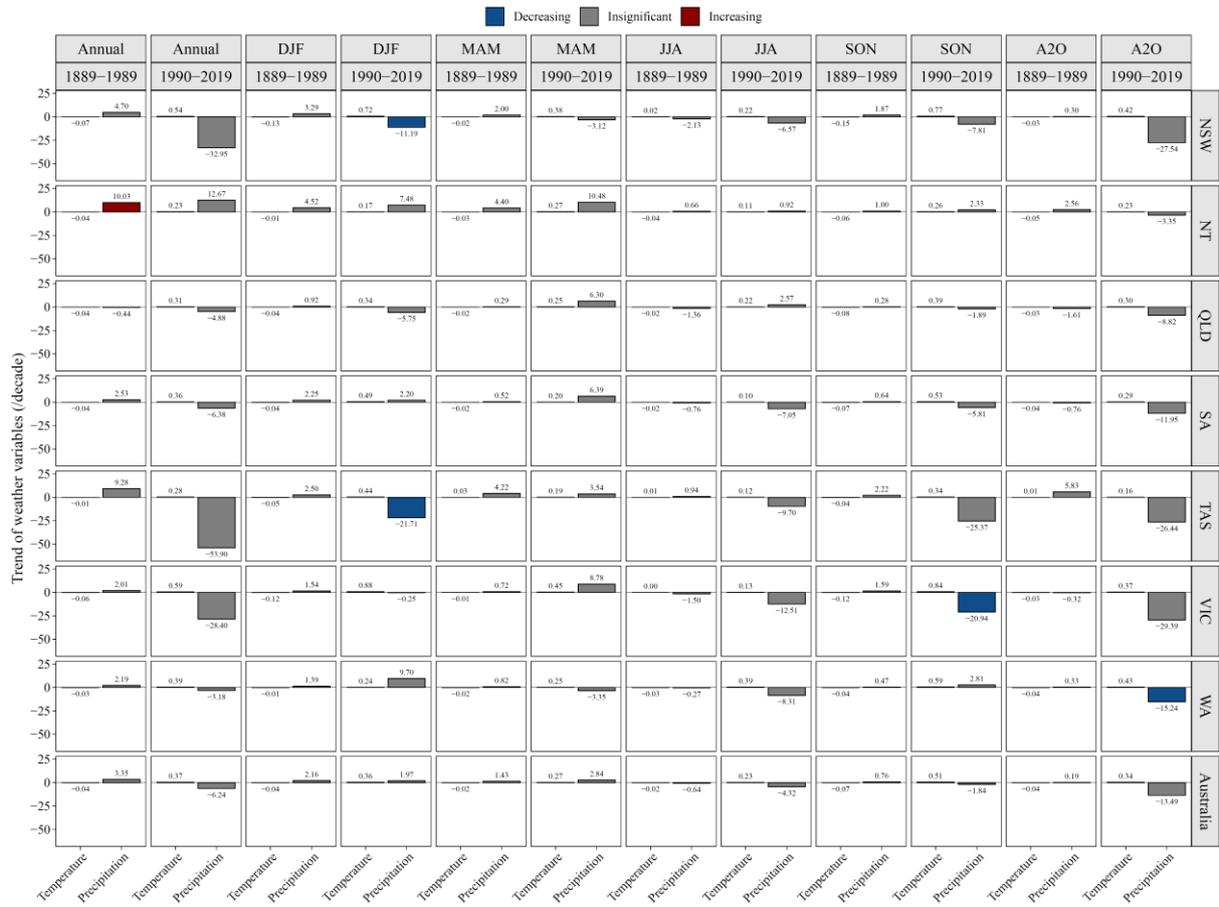


Figure S7. Trends in daily maximum temperature and precipitation averaged across states and whole Australia. A2O: autumn-winter, DJF: summer, MAM: autumn, JJA: winter, SON: spring. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

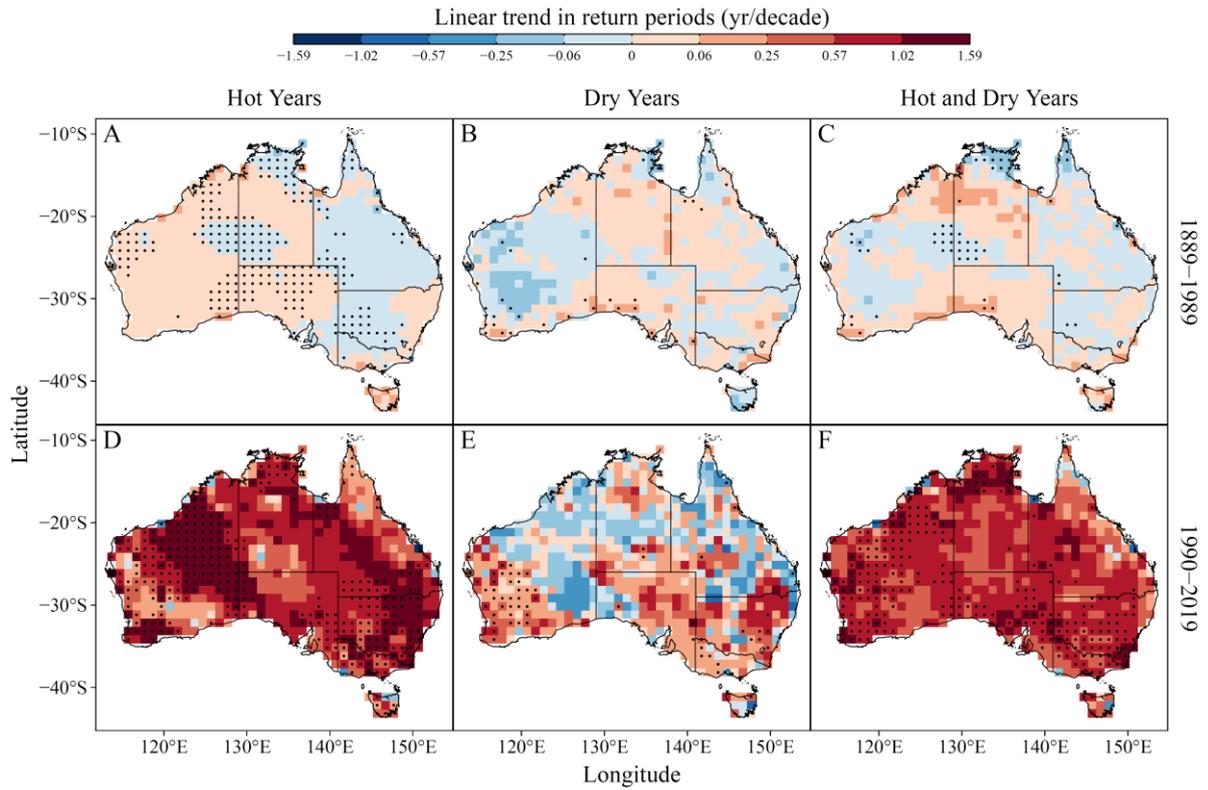


Figure S8. Trends in return periods of autumn-winter hot (**A,D**), dry (**B,E**) and compound hot-and-dry (CHD; **C,F**) extreme events over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

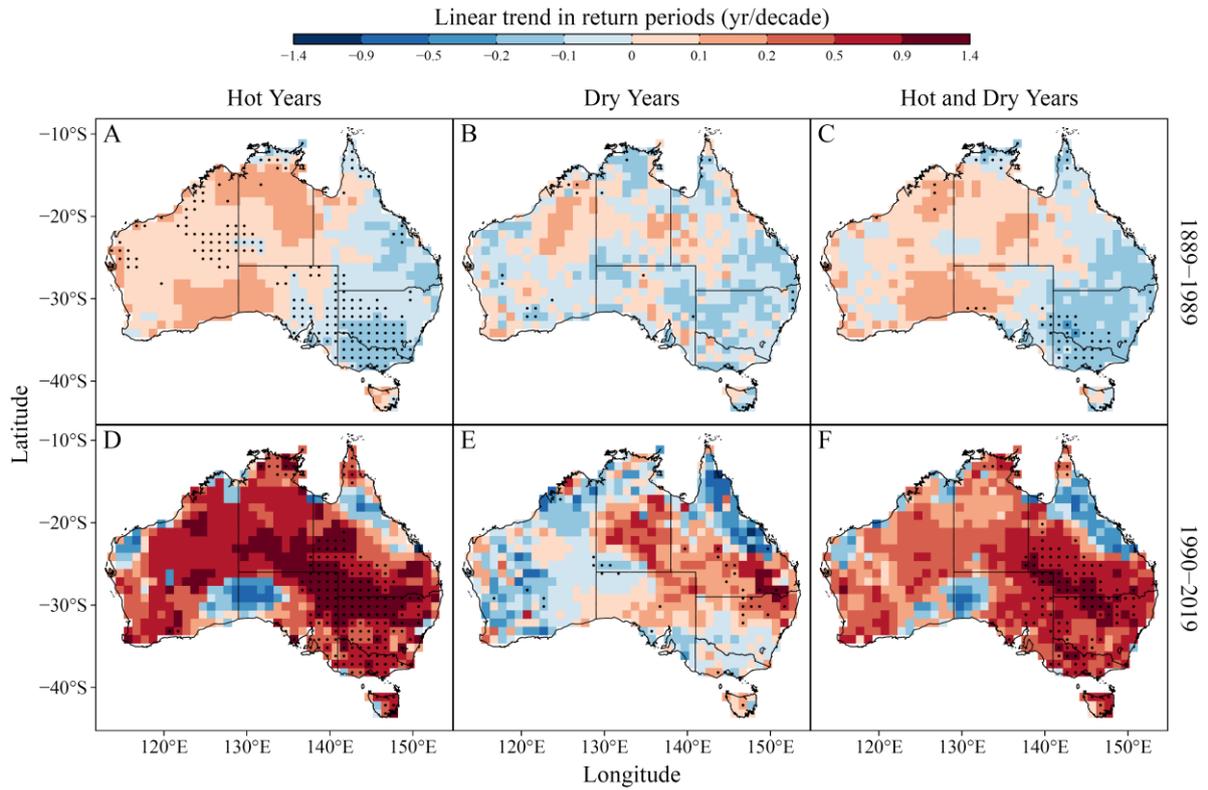


Figure S9. Trends in return periods of summer hot (**A,D**), dry (**B,E**) and compound hot-and-dry (CHD; **C,F**) extreme events over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

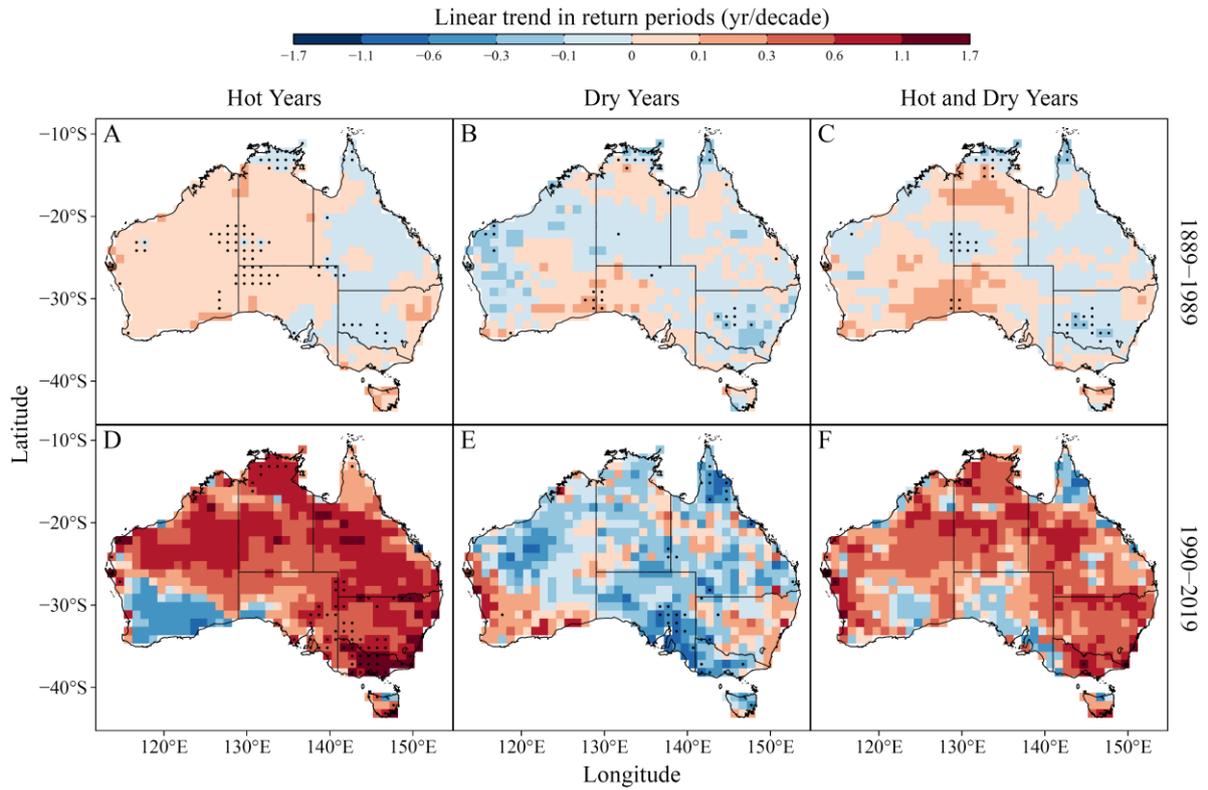


Figure S10. Trends in return periods of autumn hot (**A,D**), dry (**B,E**) and compound hot-and-dry (CHD; **C,F**) extreme events over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

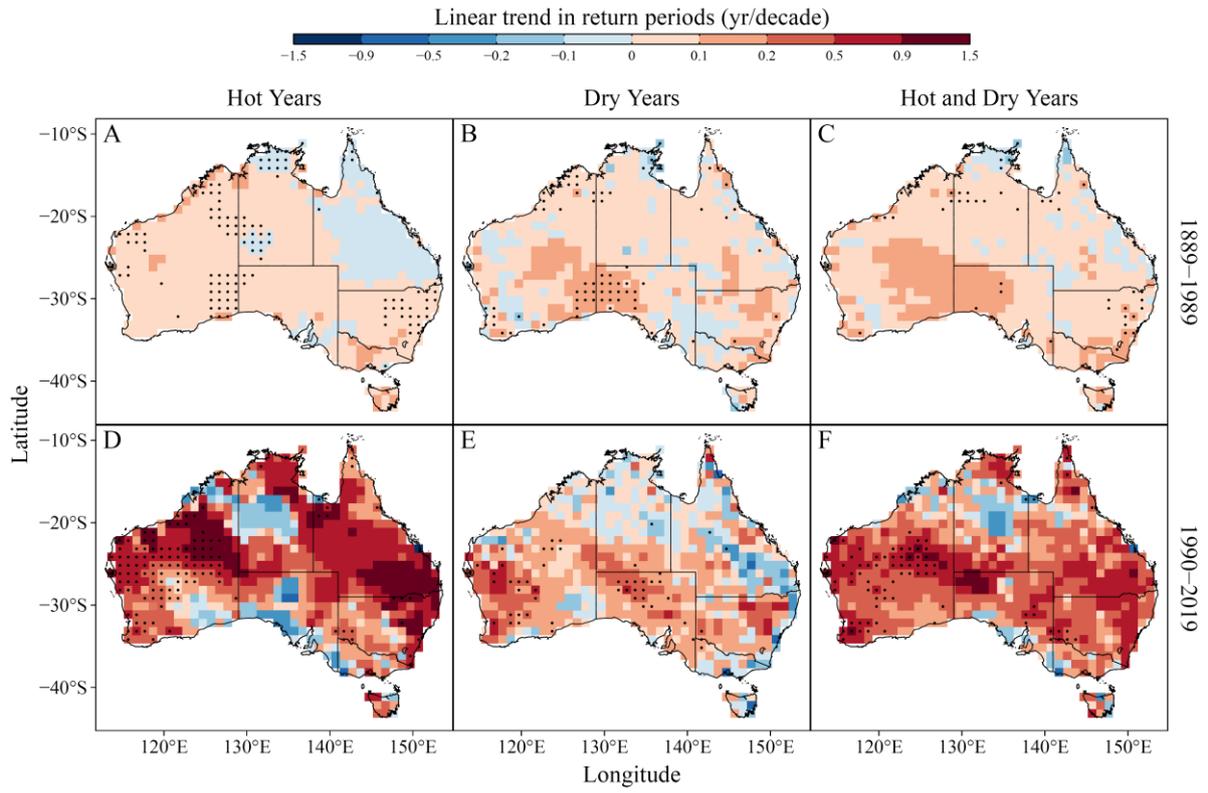


Figure S11. Trends in return periods of winter hot (**A,D**), dry (**B,E**) and compound hot-and-dry (CHD; **C,F**) extreme events over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

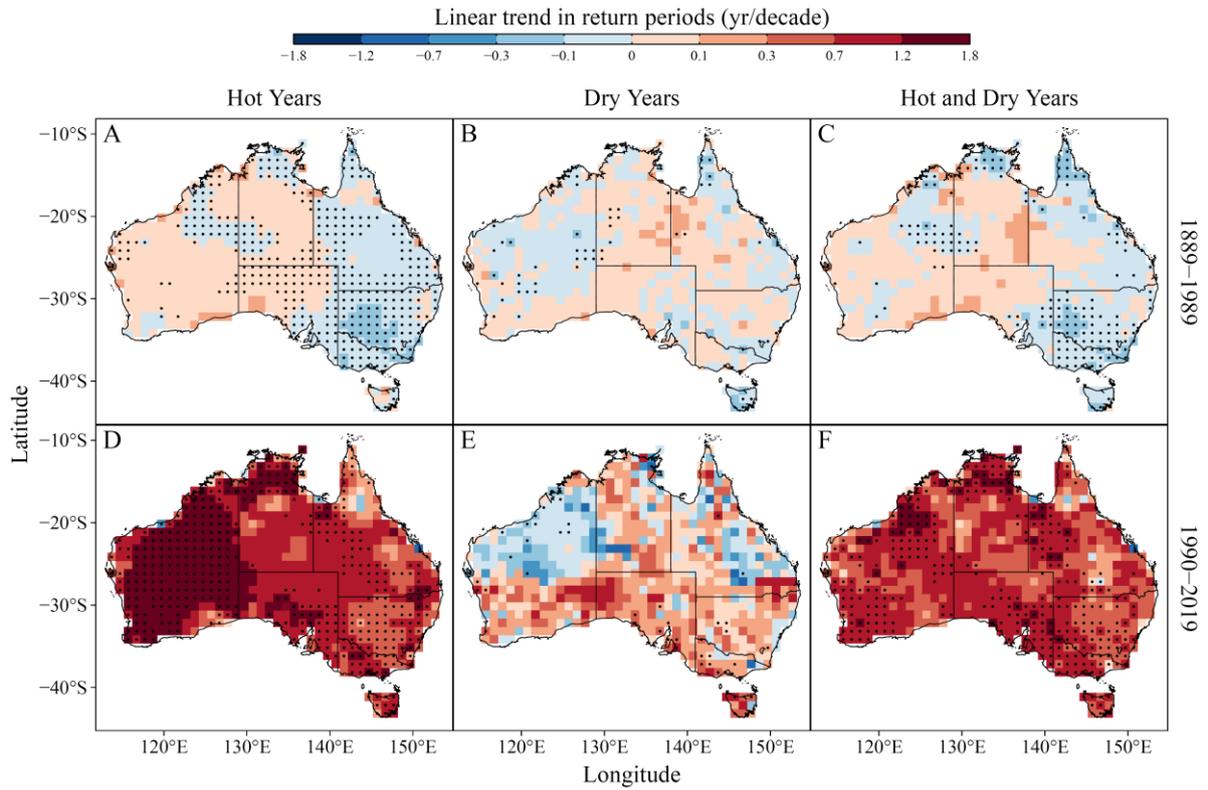


Figure S12. Trends in return periods of spring hot (A,D), dry (B,E) and compound hot-and-dry (CHD; C,F) extreme events over 1889-1989 and 1990-2019. Dots show significant trends ($P < 0.05$).

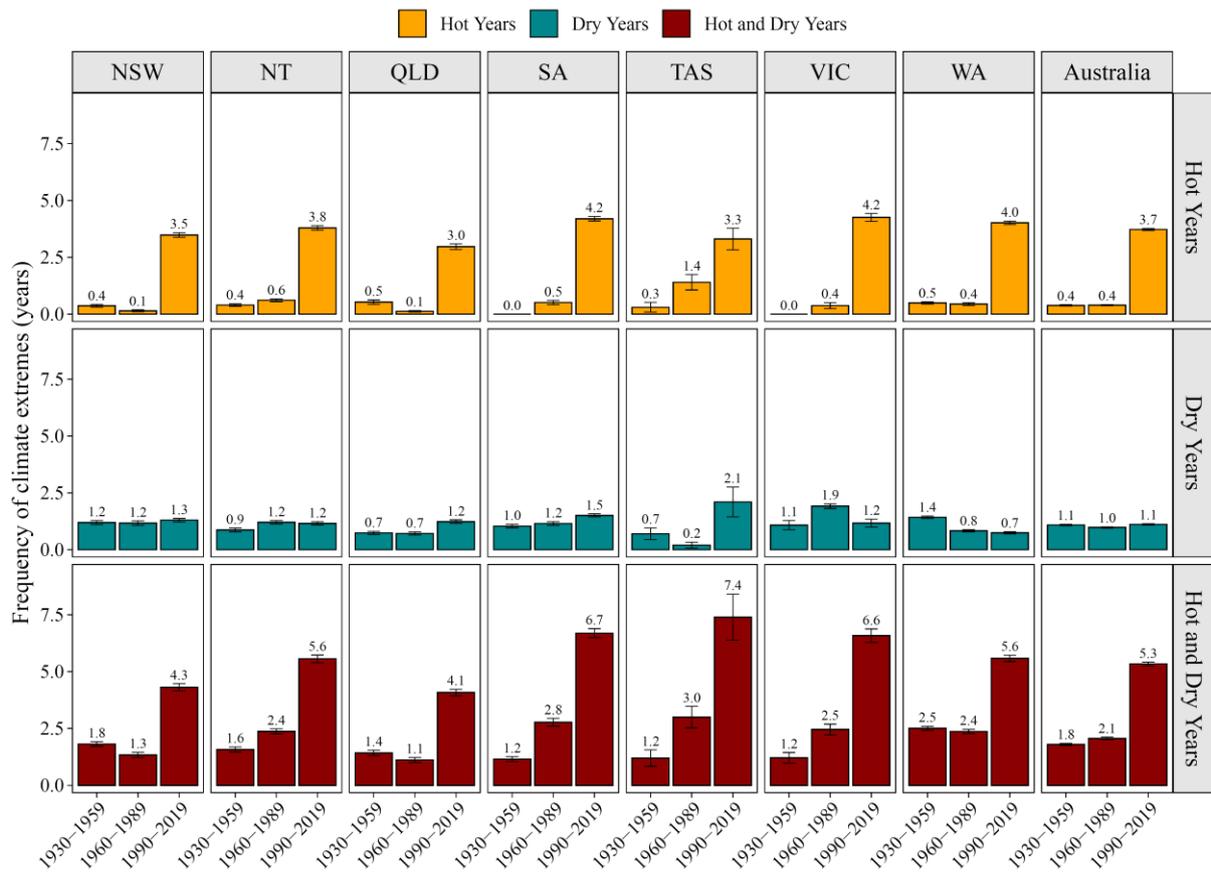


Figure S13. Average frequency of annual CHD events across states and whole Australia. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

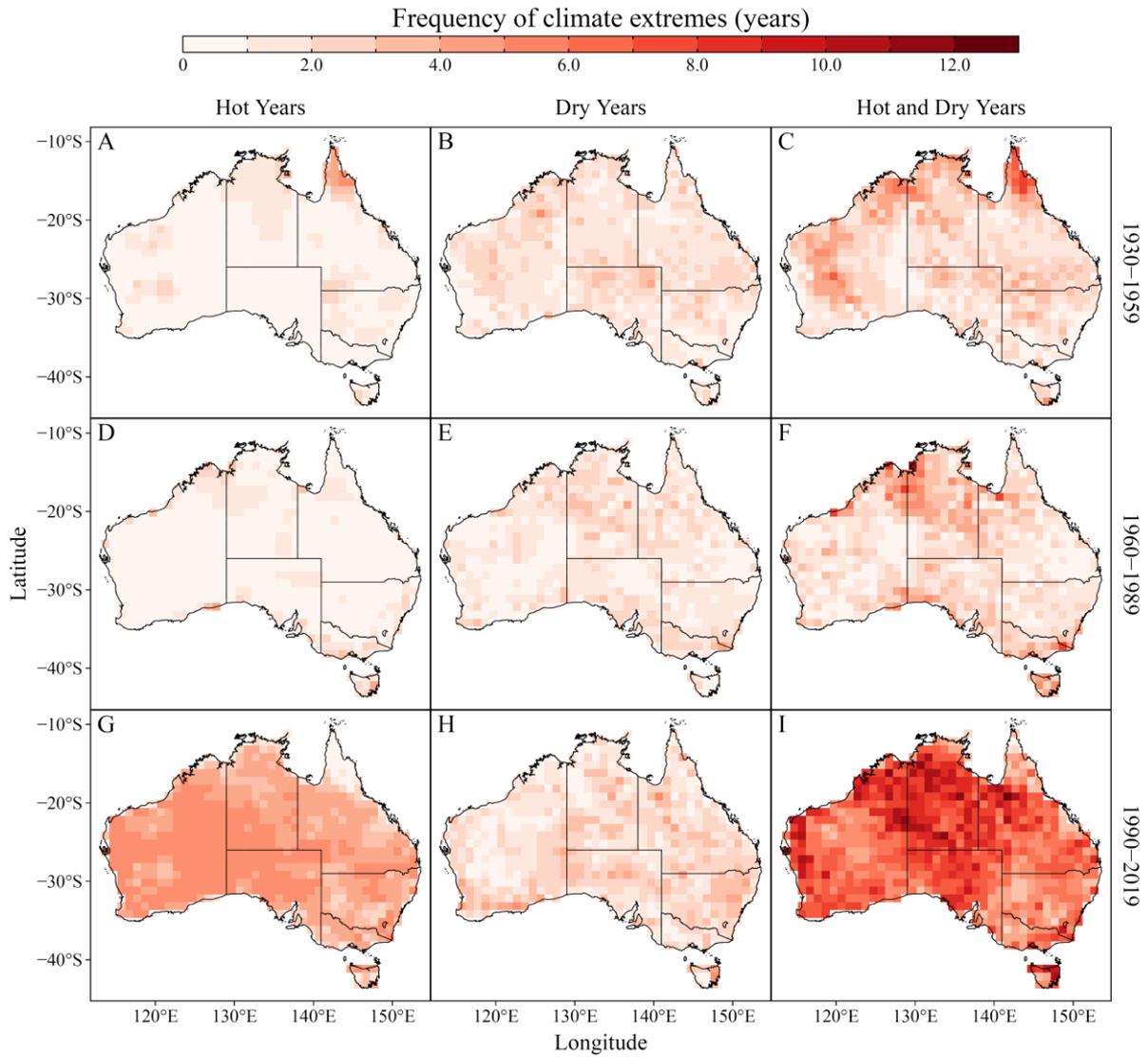


Figure S14. Average frequency of autumn-winter hot (A,D,G), dry (B,E,H) and compound hot-and-dry (CHD; C,F,B) extreme events over three consecutive 30-year periods between 1930 and 2019.

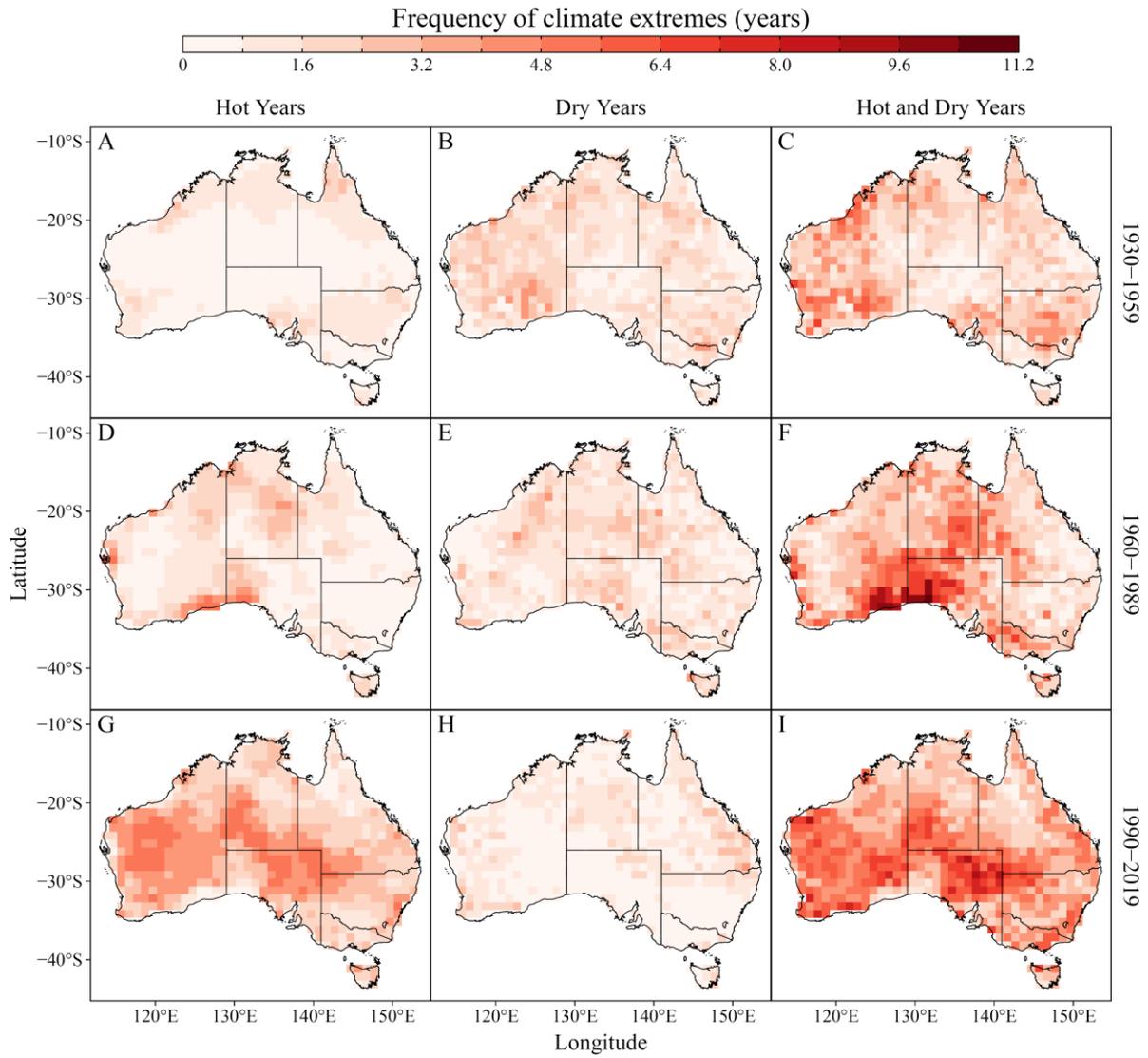


Figure S15. Average frequency of summer hot (A,D,G), dry (B,E,H) and compound hot-and-dry (CHD; C,F,B) extreme events over three consecutive 30-year periods between 1930 and 2019.

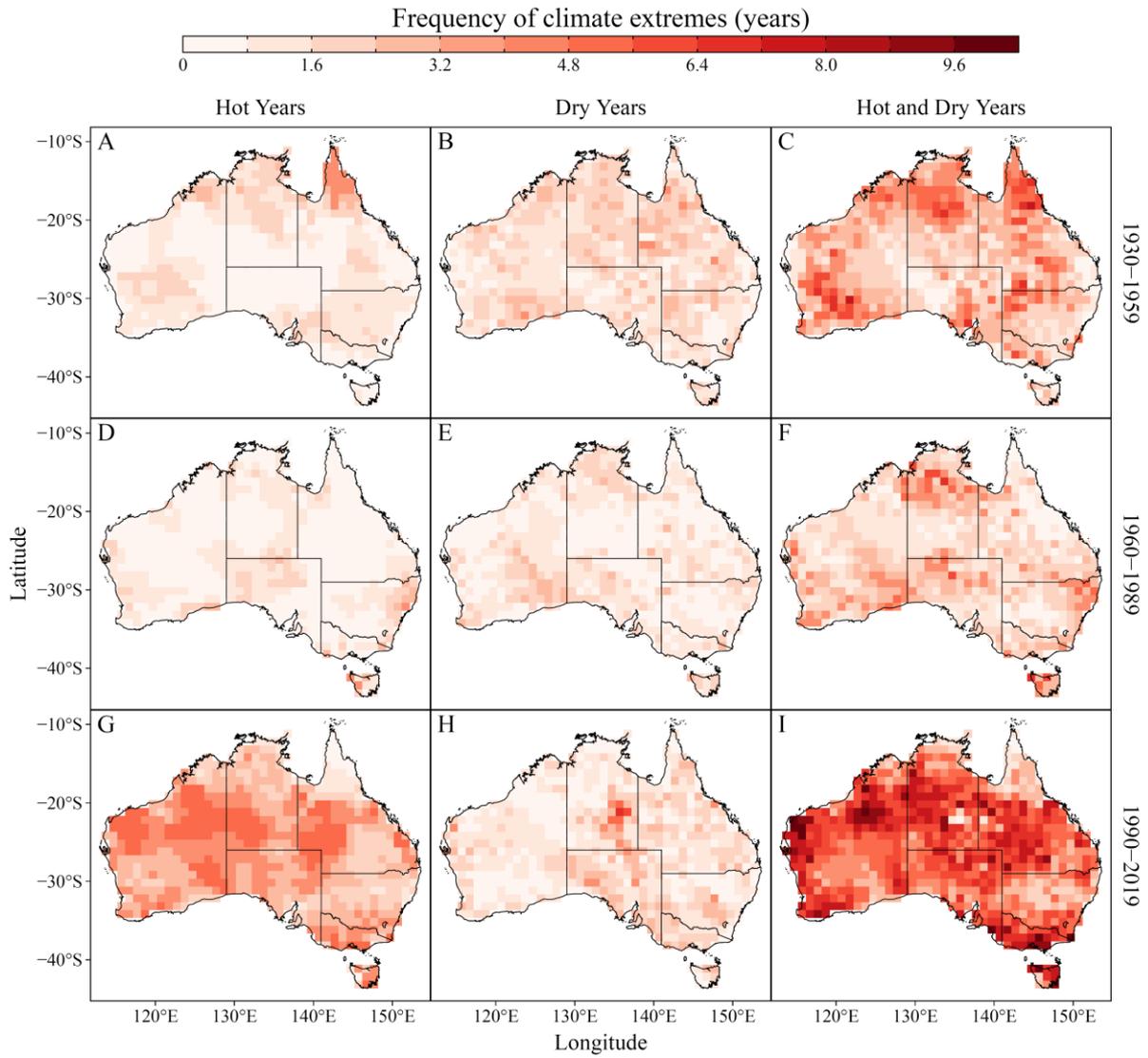


Figure S16. Average frequency of autumn hot (**A,D,G**), dry (**B,E,H**) and compound hot-and-dry (CHD; **C,F,I**) extreme events over three consecutive 30-year periods between 1930 and 2019.

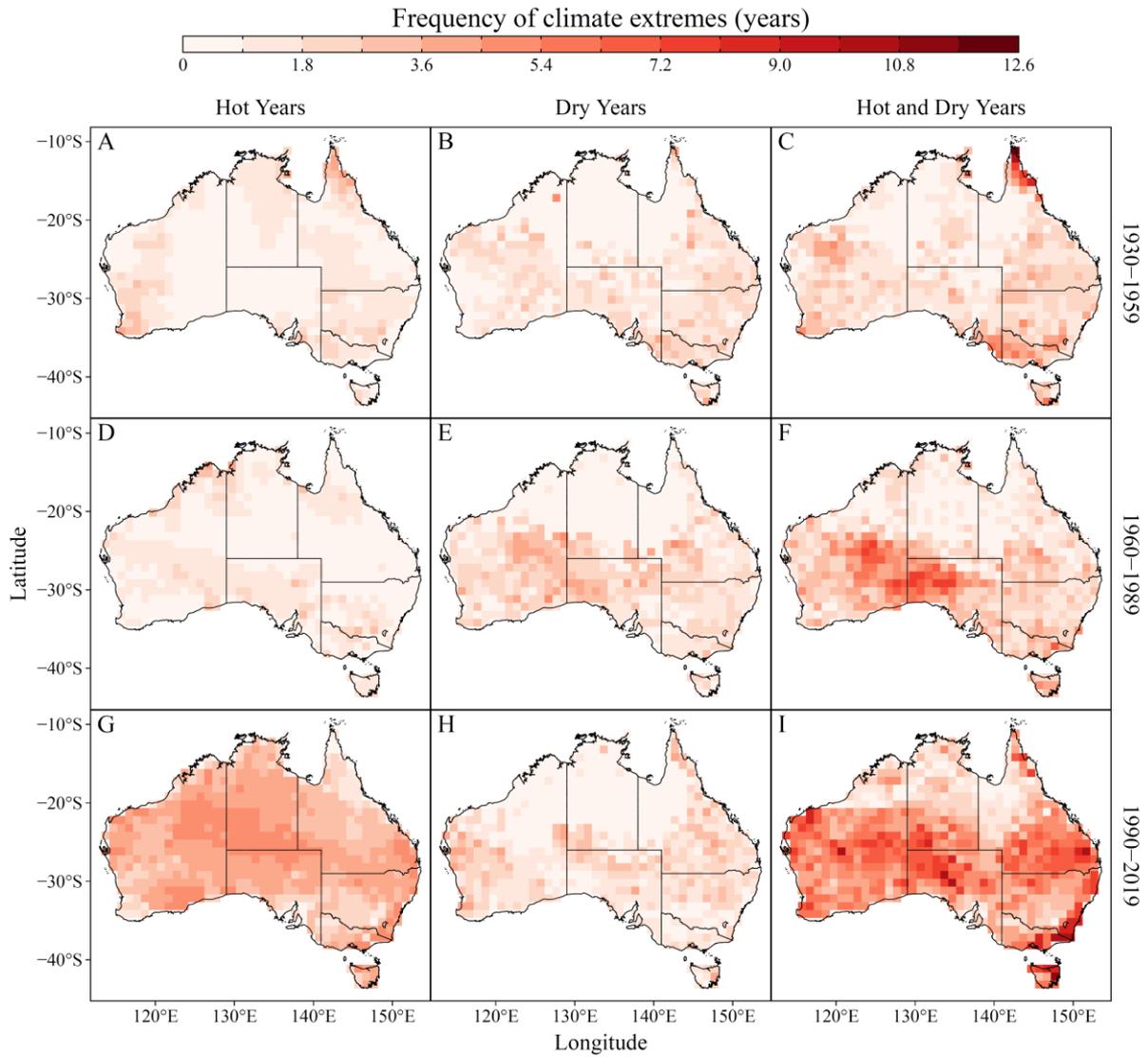


Figure S17. Average frequency of winter hot (A,D,G), dry (B,E,H) and compound hot-and-dry (CHD; C,F,B) extreme events over three consecutive 30-year periods between 1930 and 2019.

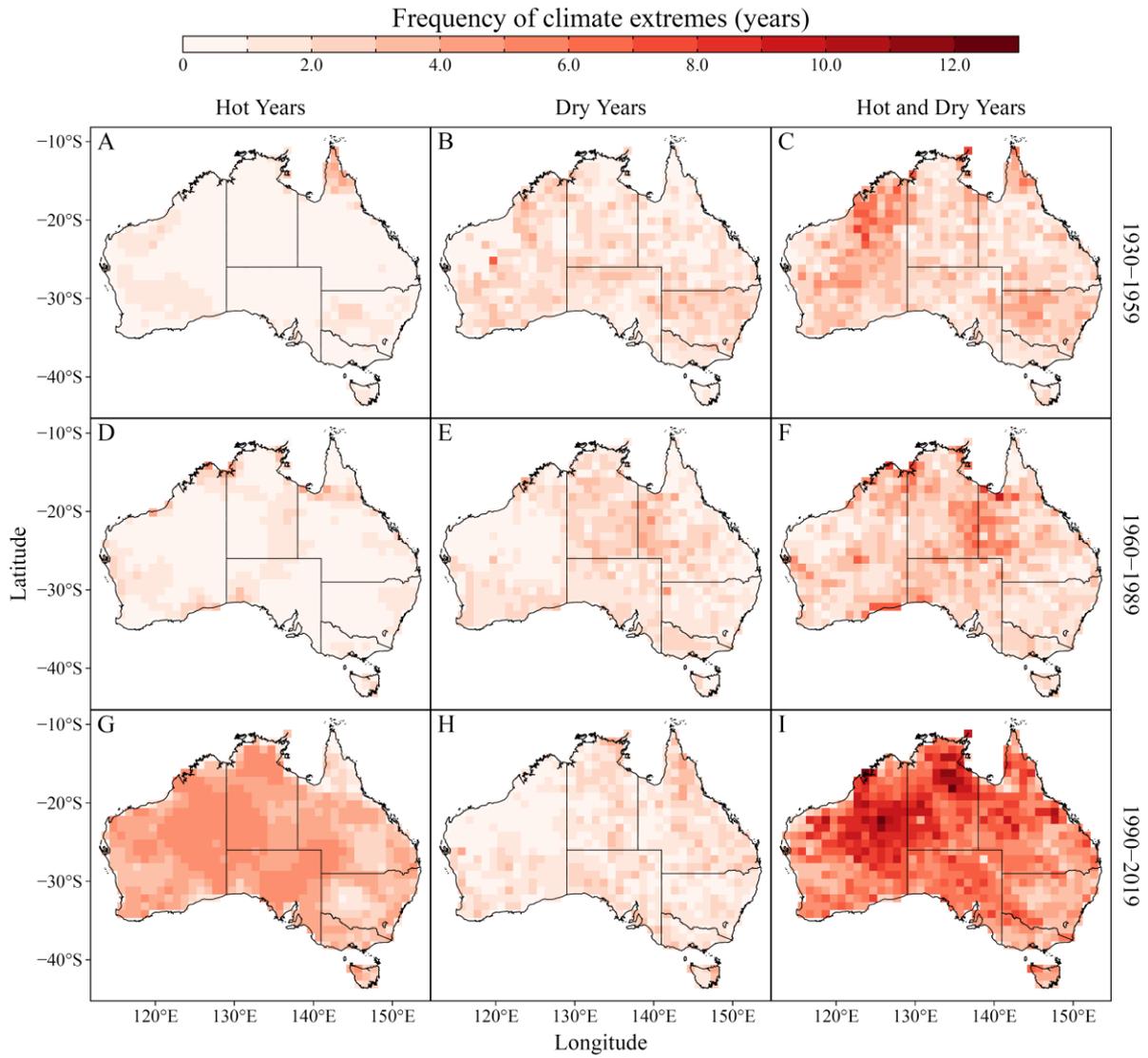


Figure S18. Average frequency of spring hot (A,D,G), dry (B,E,H) and compound hot-and-dry (CHD; C,F,B) extreme events over three consecutive 30-year periods between 1930 and 2019.

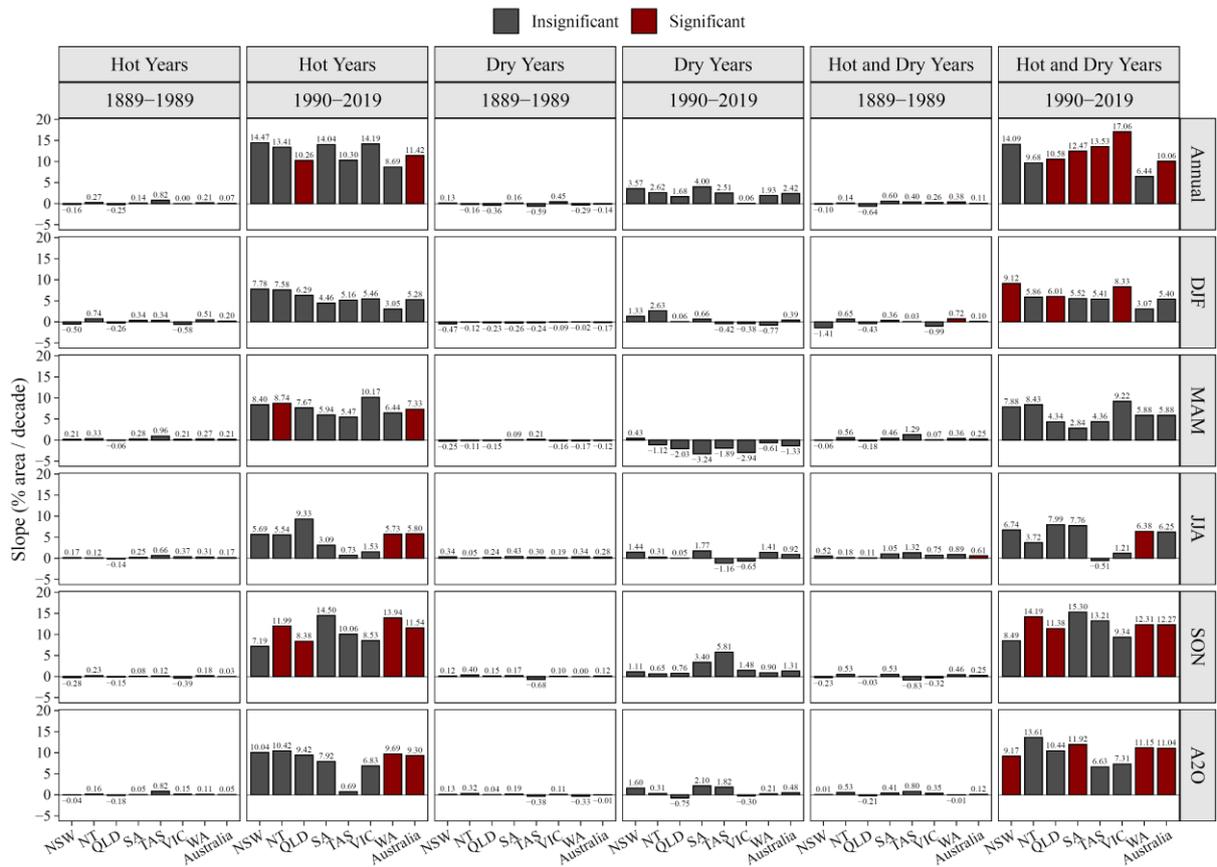


Figure S19. Trend in area affected by hot, dry and compound hot-and-dry (CHD) extreme events over 1889-1889 and 1990-2019. A2O: autumn-winter, DJF: summer, MAM: autumn, JJA: winter, SON: spring. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

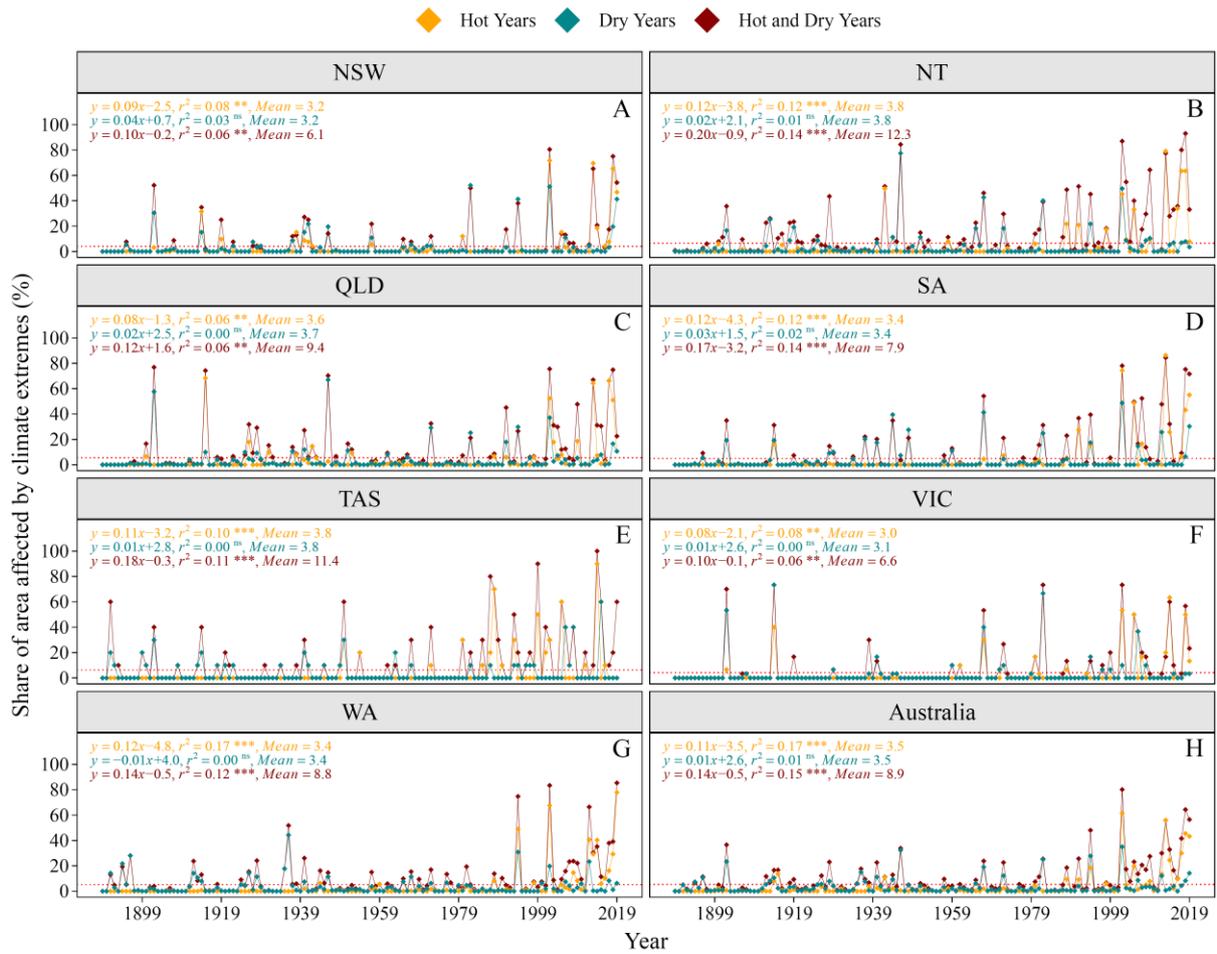


Figure S20. Area affected by autumn-winter hot, dry and compound hot-and-dry (CHD) extreme events over 1889-2019. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

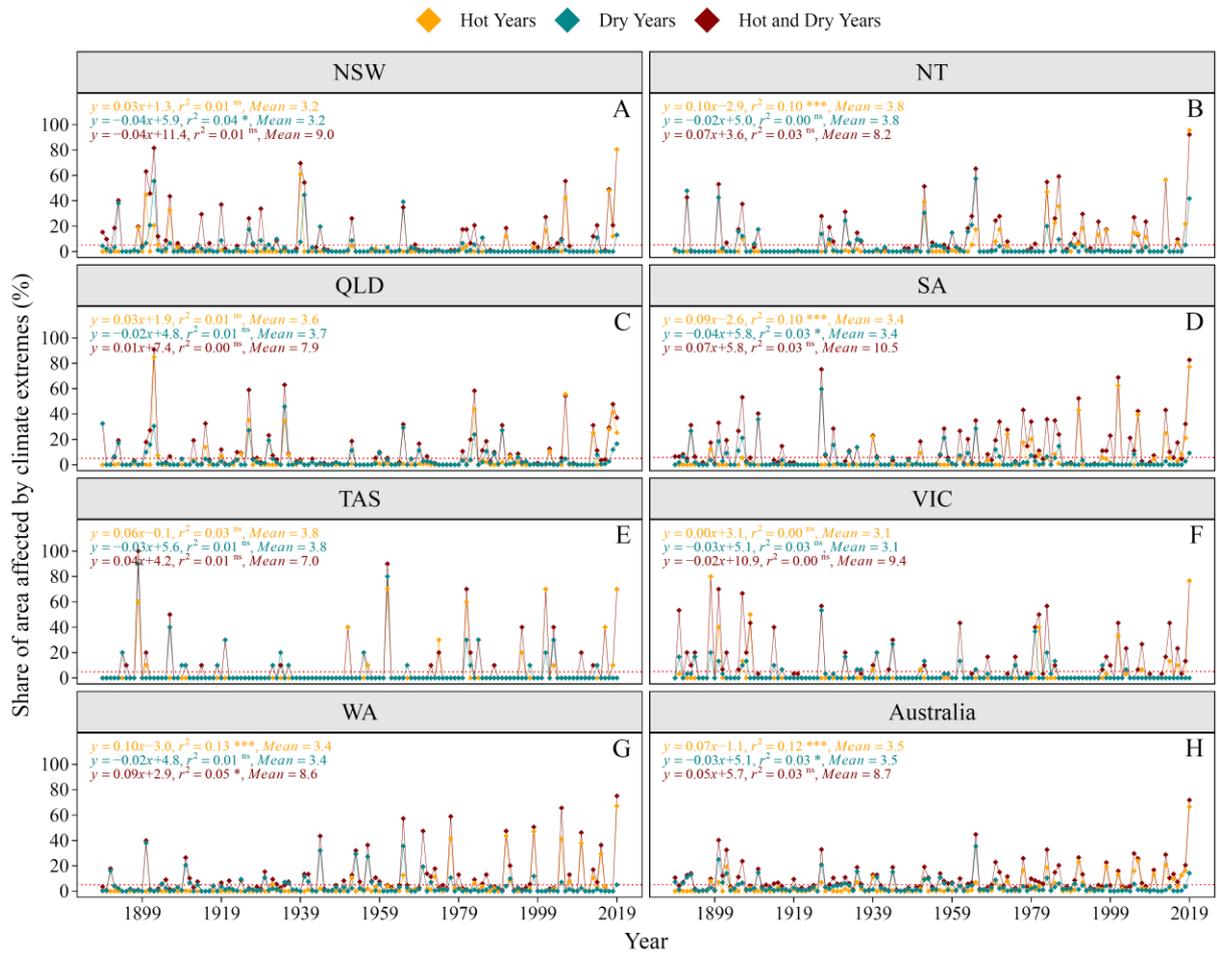


Figure S21. Area affected by summer hot, dry and compound hot-and-dry (CHD) extreme events over 1889-2019. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

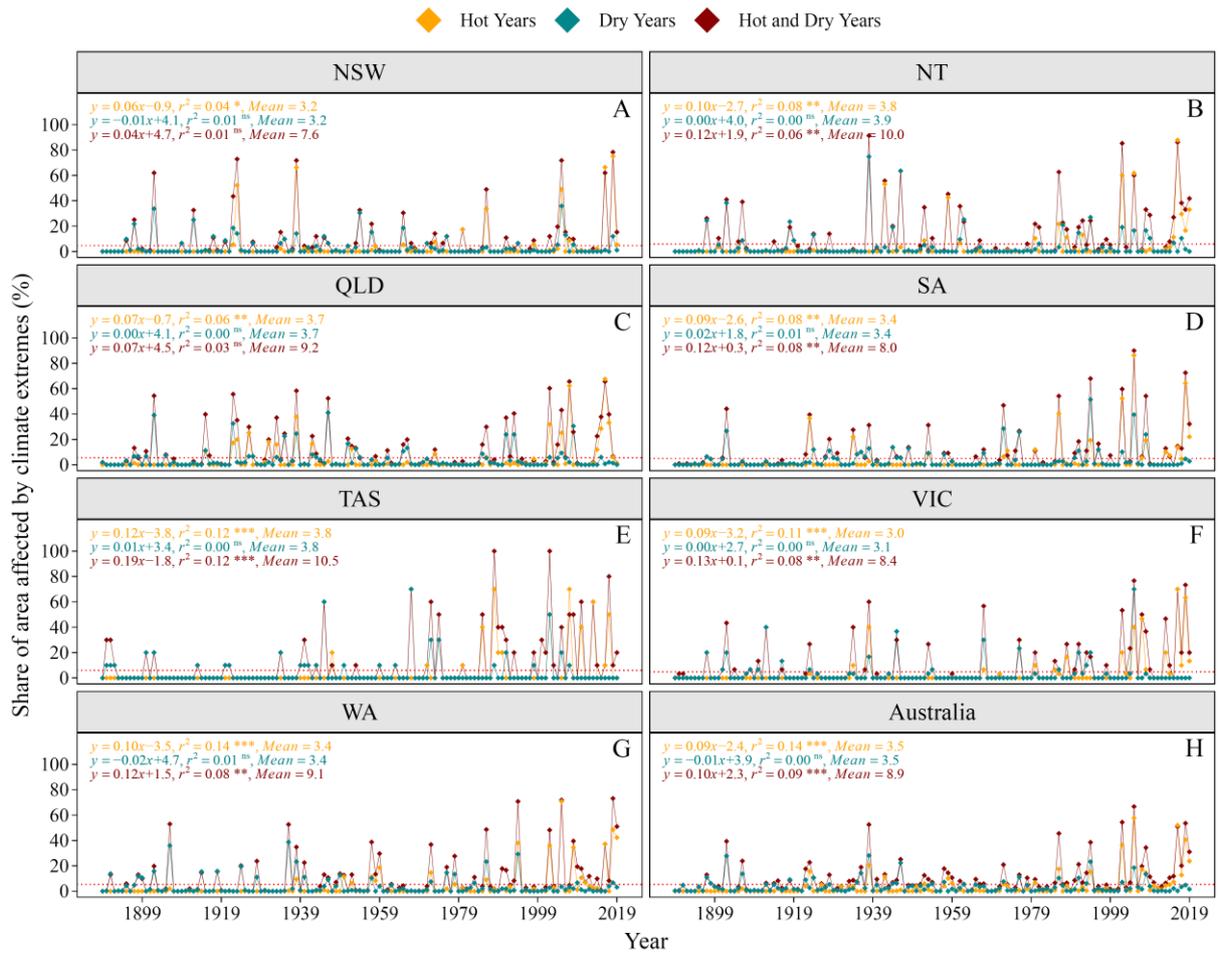


Figure S22. Area affected by autumn hot, dry and compound hot-and-dry (CHD) extreme events over 1889-2019. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

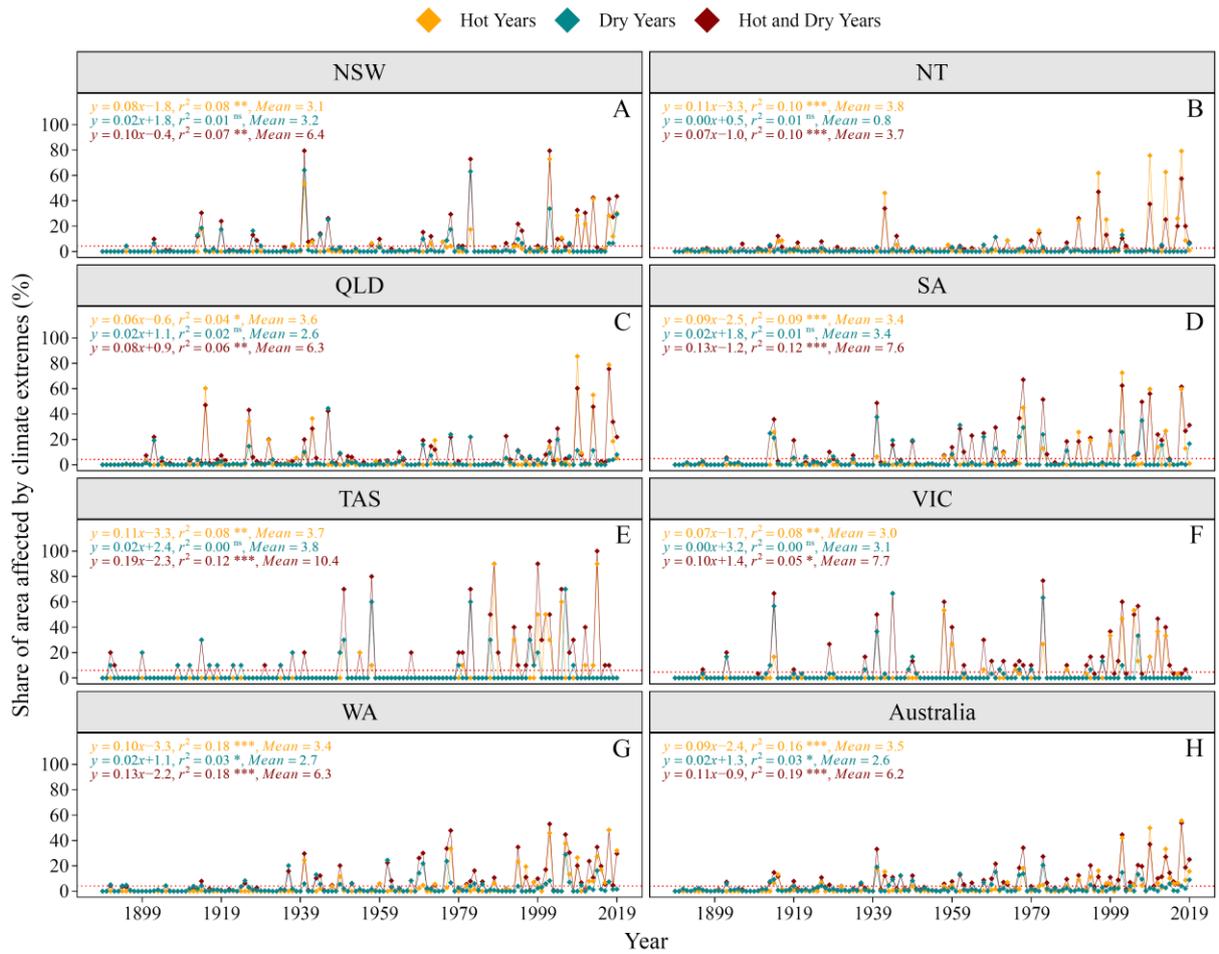


Figure S23. Area affected by winter hot, dry and compound hot-and-dry (CHD) extreme events over 1889-2019. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

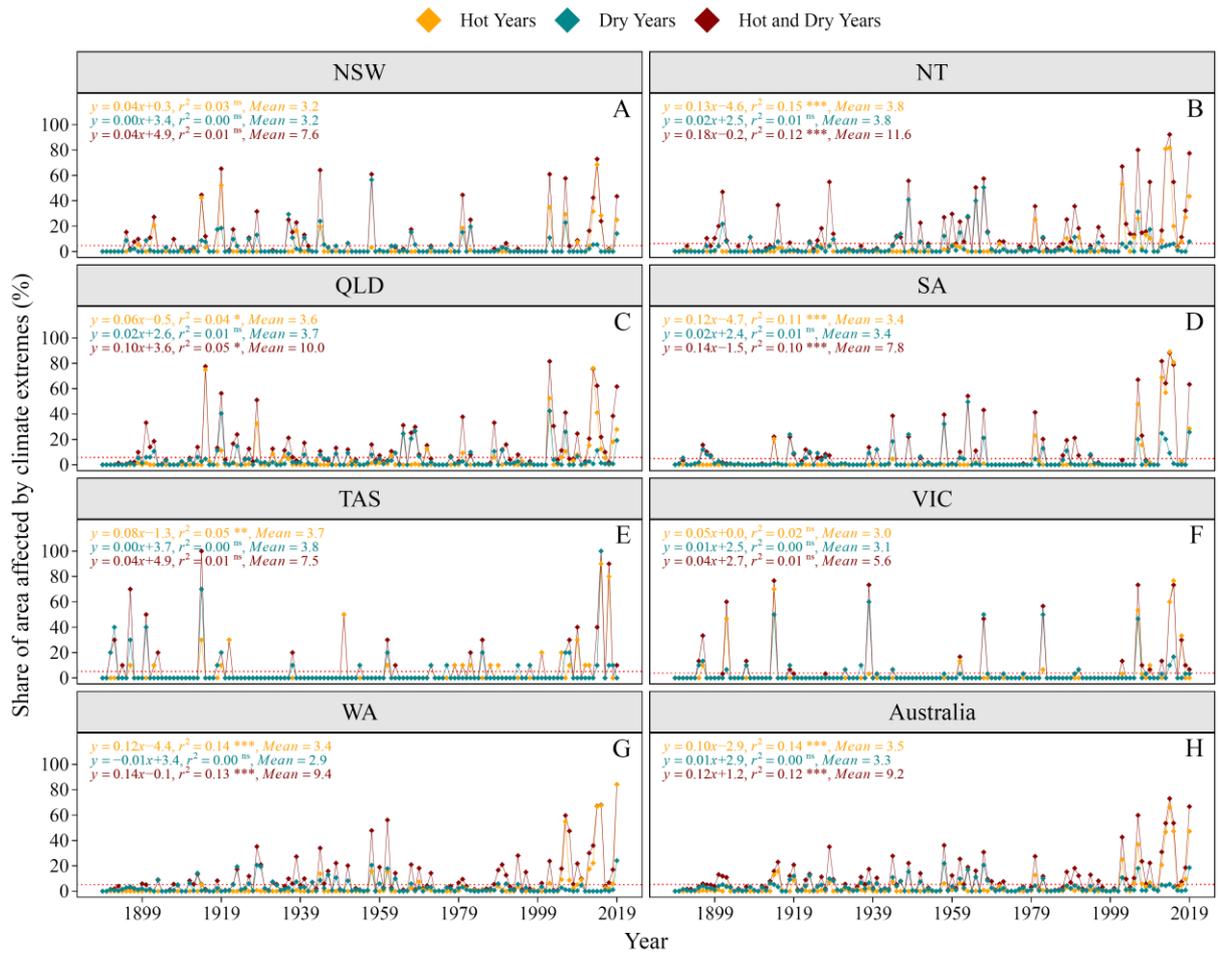


Figure S24. Area affected by spring hot, dry and compound hot-and-dry (CHD) extreme events over 1889-2019. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

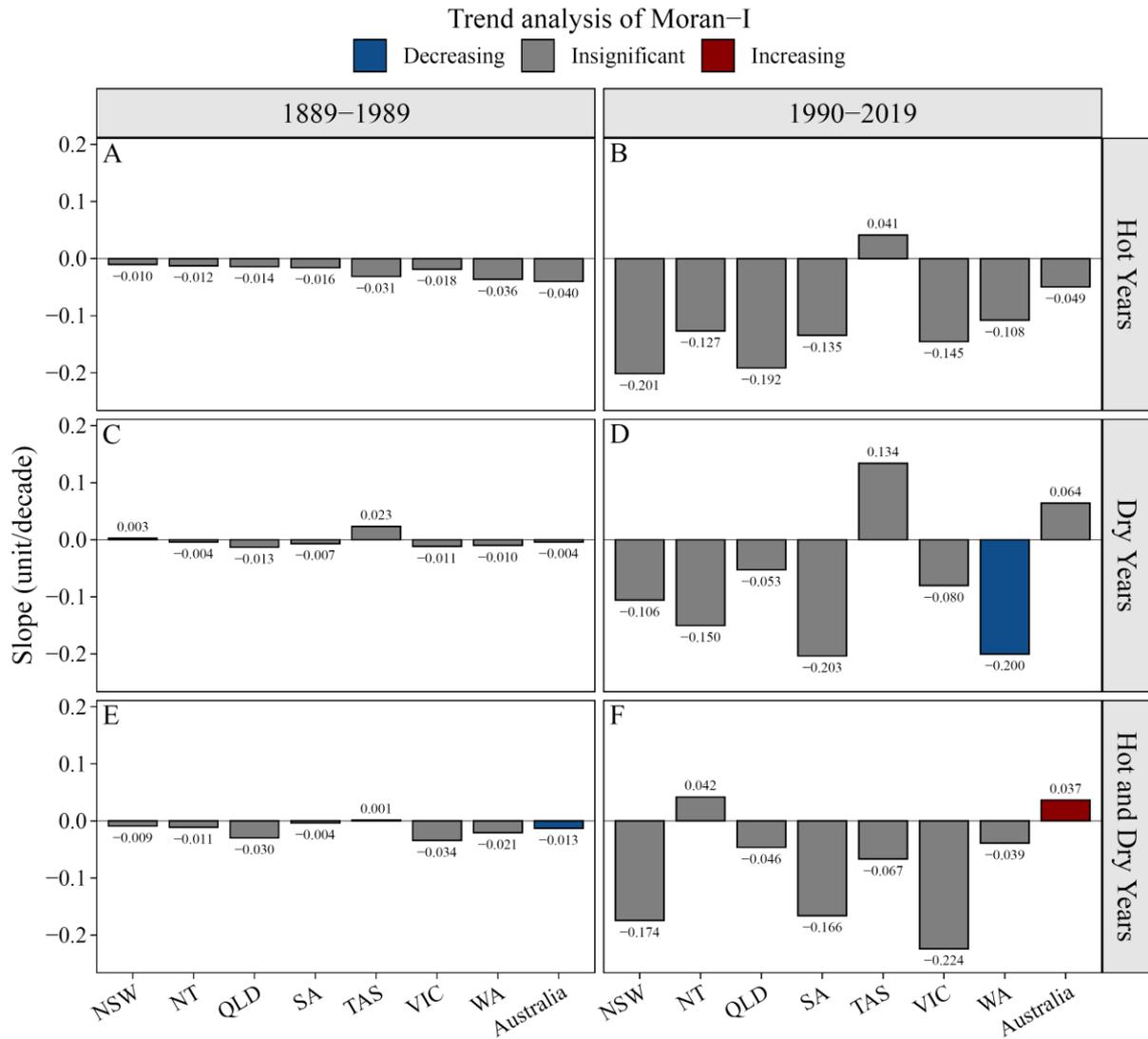


Figure S25. Trends in Moran-I values for autumn-winter hot (A,B), dry (C,D) and compound hot-and-dry (CHD; E,F) extreme events over 1889-1989 and 1990-2019. Blue and red colors show significant ($P < 0.05$) decreasing and increasing trends. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

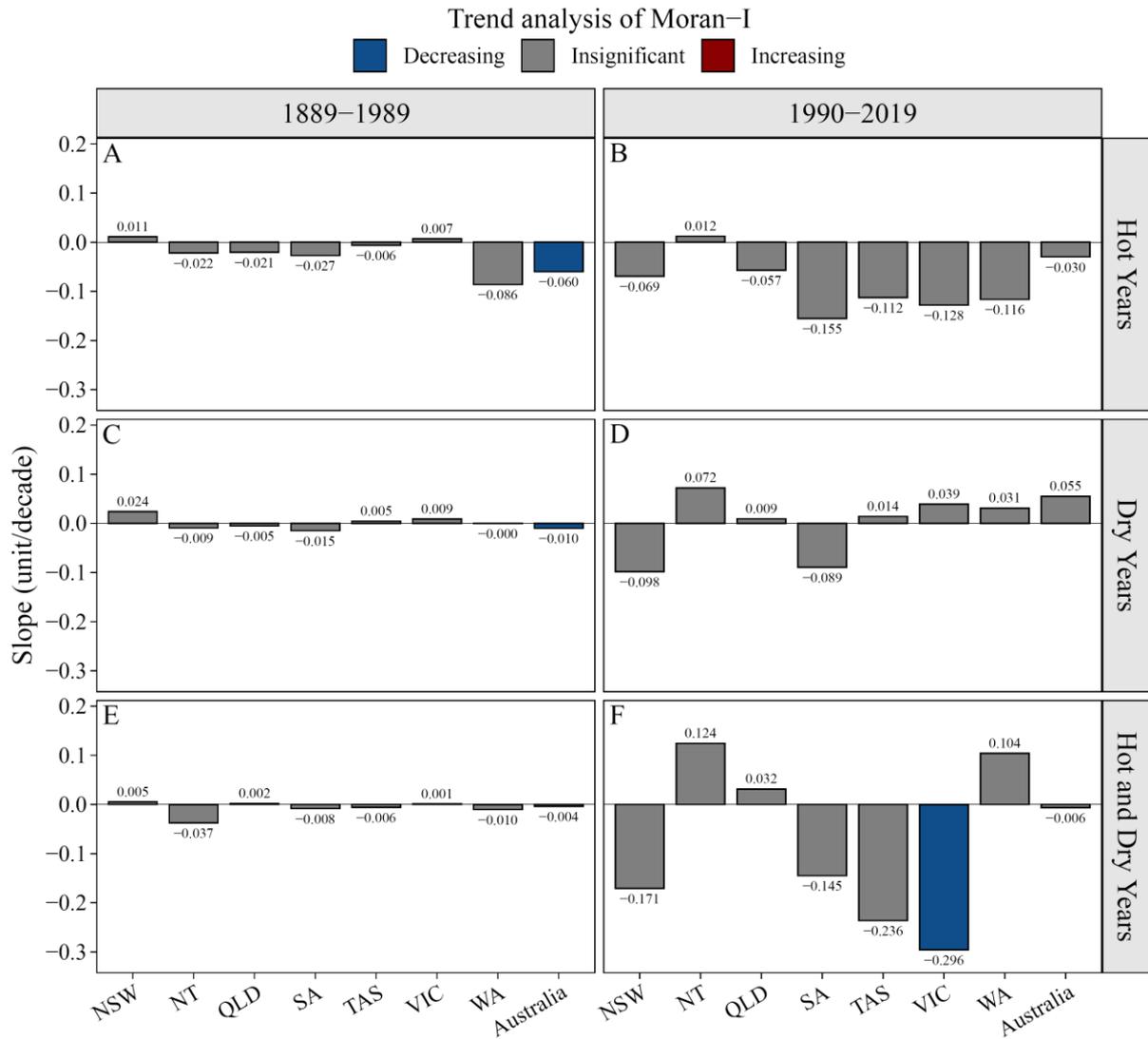


Figure S26. Trends in Moran-I values for summer hot (A,B), dry (C,D) and compound hot-and-dry (CHD; E,F) extreme events over 1889-1989 and 1990-2019. Blue and red colors show significant ($P < 0.05$) decreasing and increasing trends. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

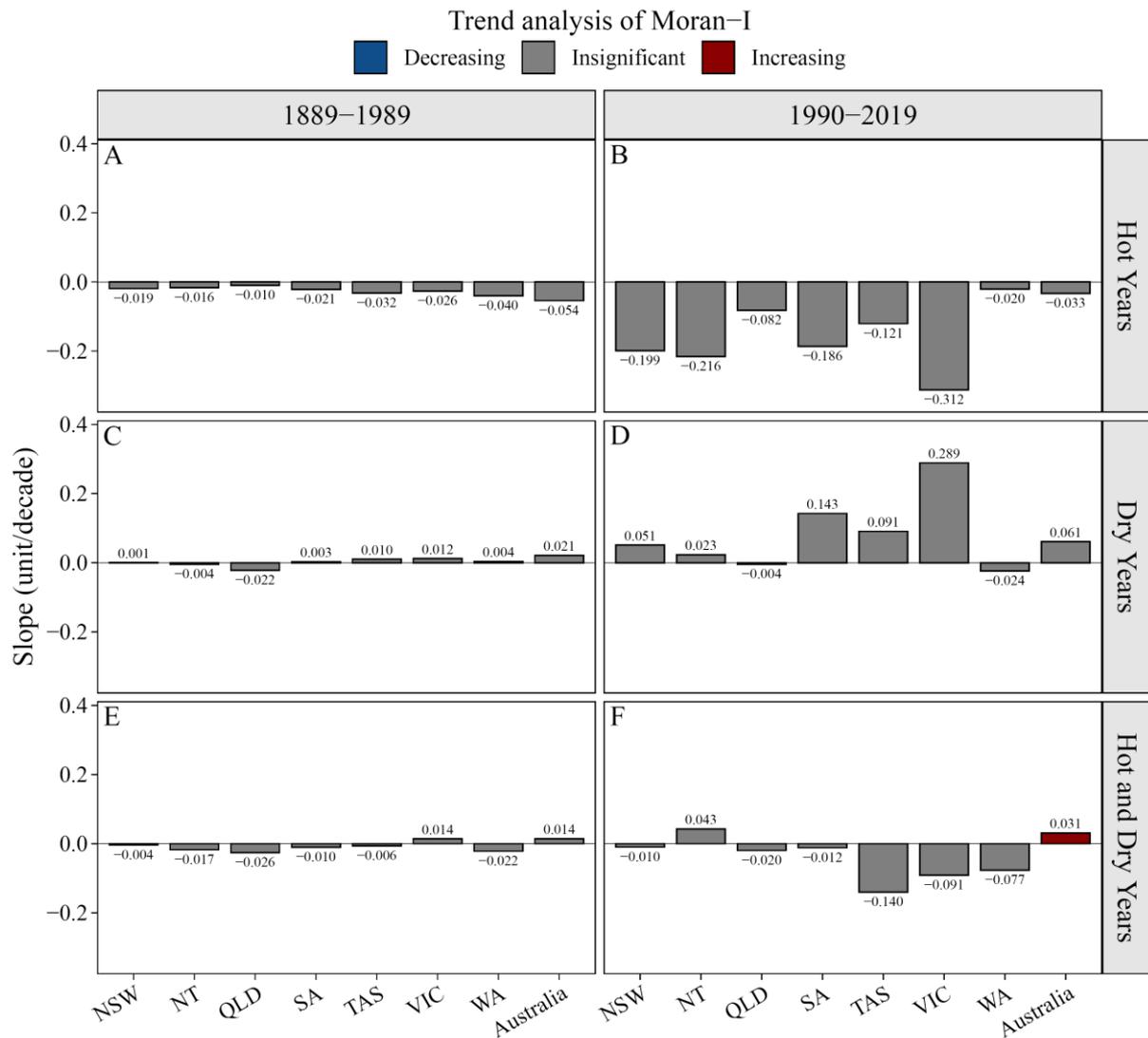


Figure S27. Trends in Moran-I values for autumn hot (A,B), dry (C,D) and compound hot-and-dry (CHD; E,F) extreme events over 1889-1989 and 1990-2019. Blue and red colors show significant ($P < 0.05$) decreasing and increasing trends. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

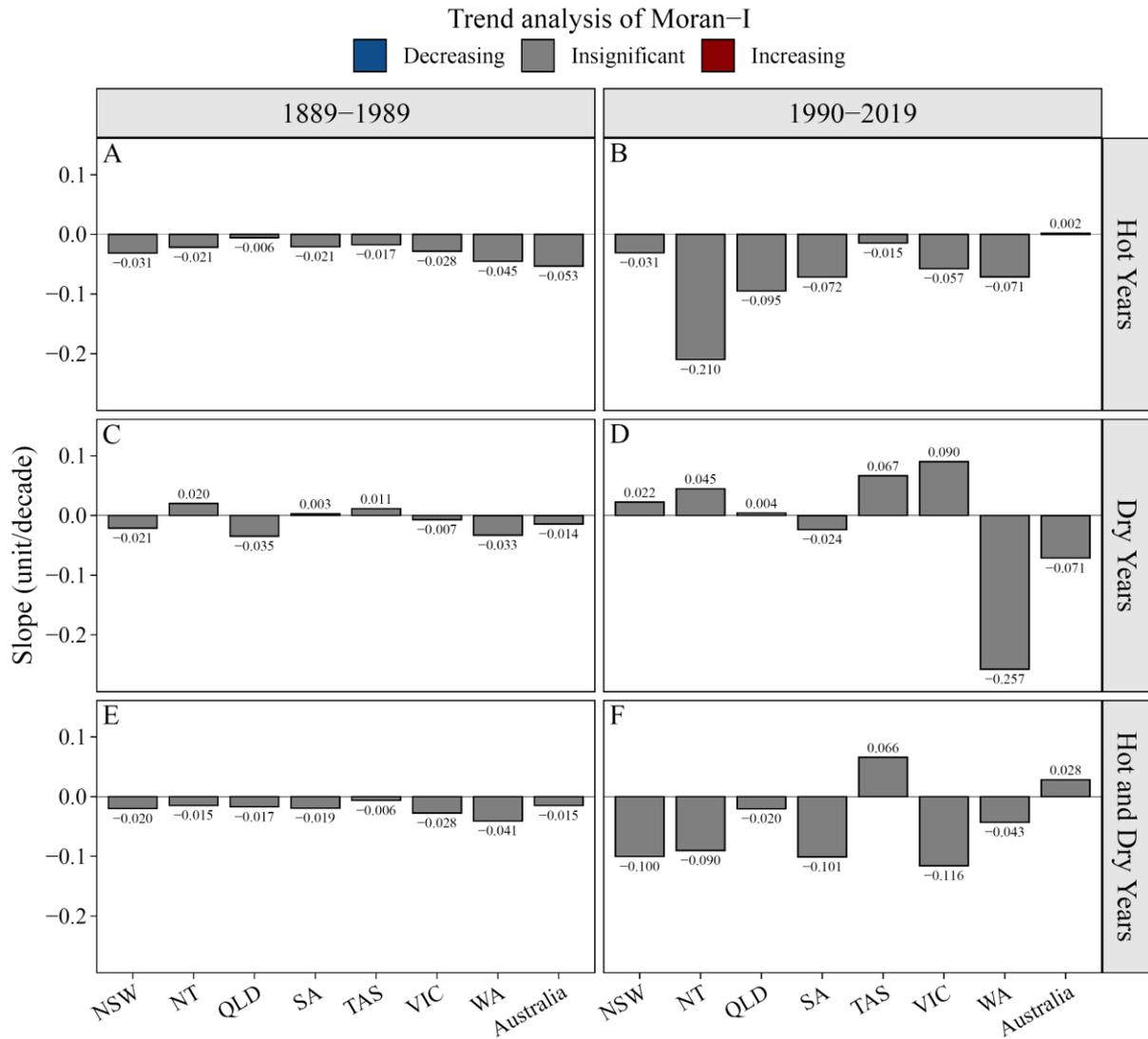


Figure S28. Trends in Moran-I values for winter hot (A,B), dry (C,D) and compound hot-and-dry (CHD; E,F) extreme events over 1889-1989 and 1990-2019. Blue and red colors show significant ($P < 0.05$) decreasing and increasing trends. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.

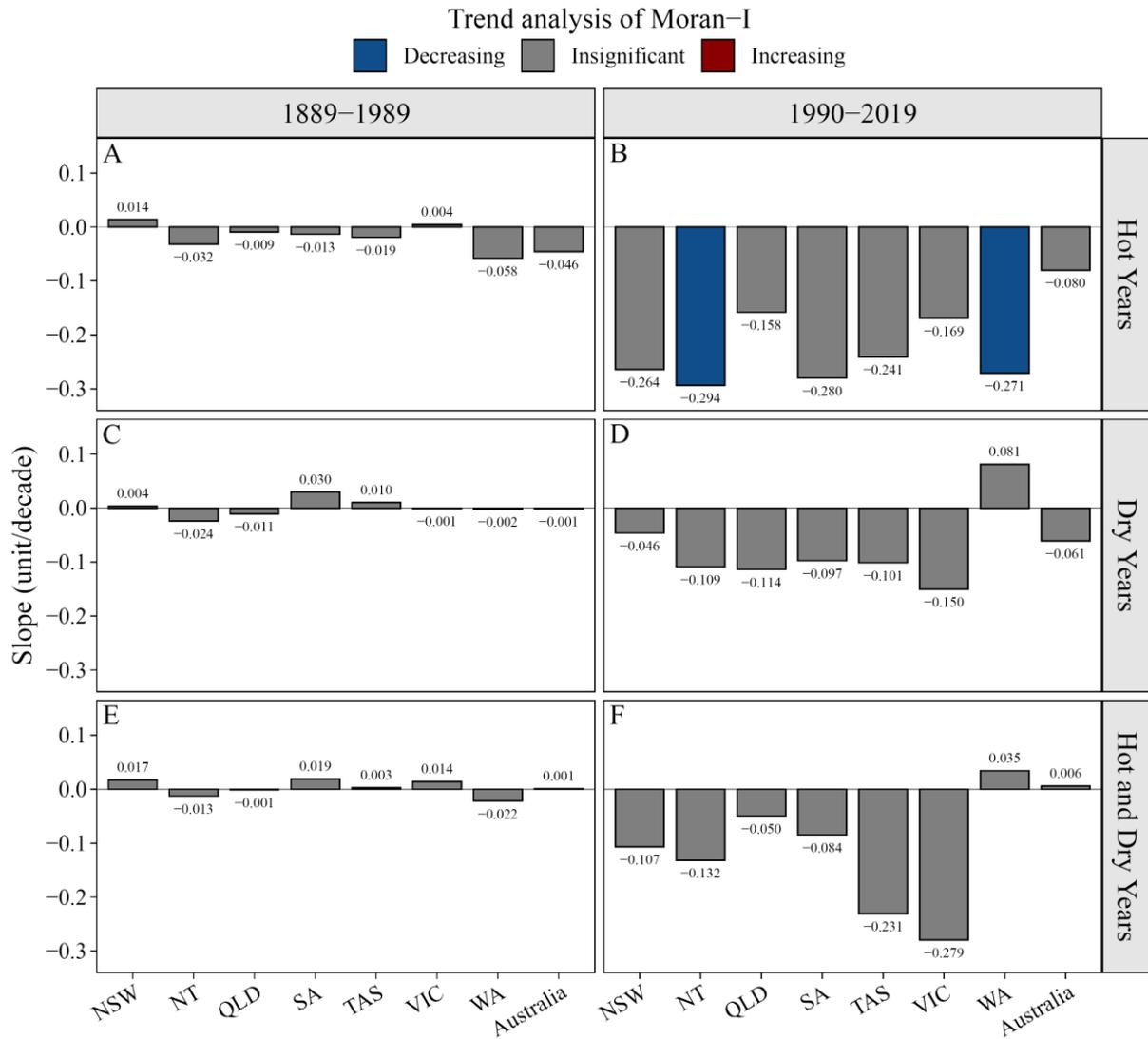


Figure S29. Trends in Moran-I values for spring hot (A,B), dry (C,D) and compound hot-and-dry (CHD; E,F) extreme events over 1889-1989 and 1990-2019. Blue and red colors show significant ($P < 0.05$) decreasing and increasing trends. NSW: New South Wales, NT: Northern Territory, QLD: Queensland, SA: South Australia, TAS: Tasmania, VIC: Victoria, WA: Western Australia.