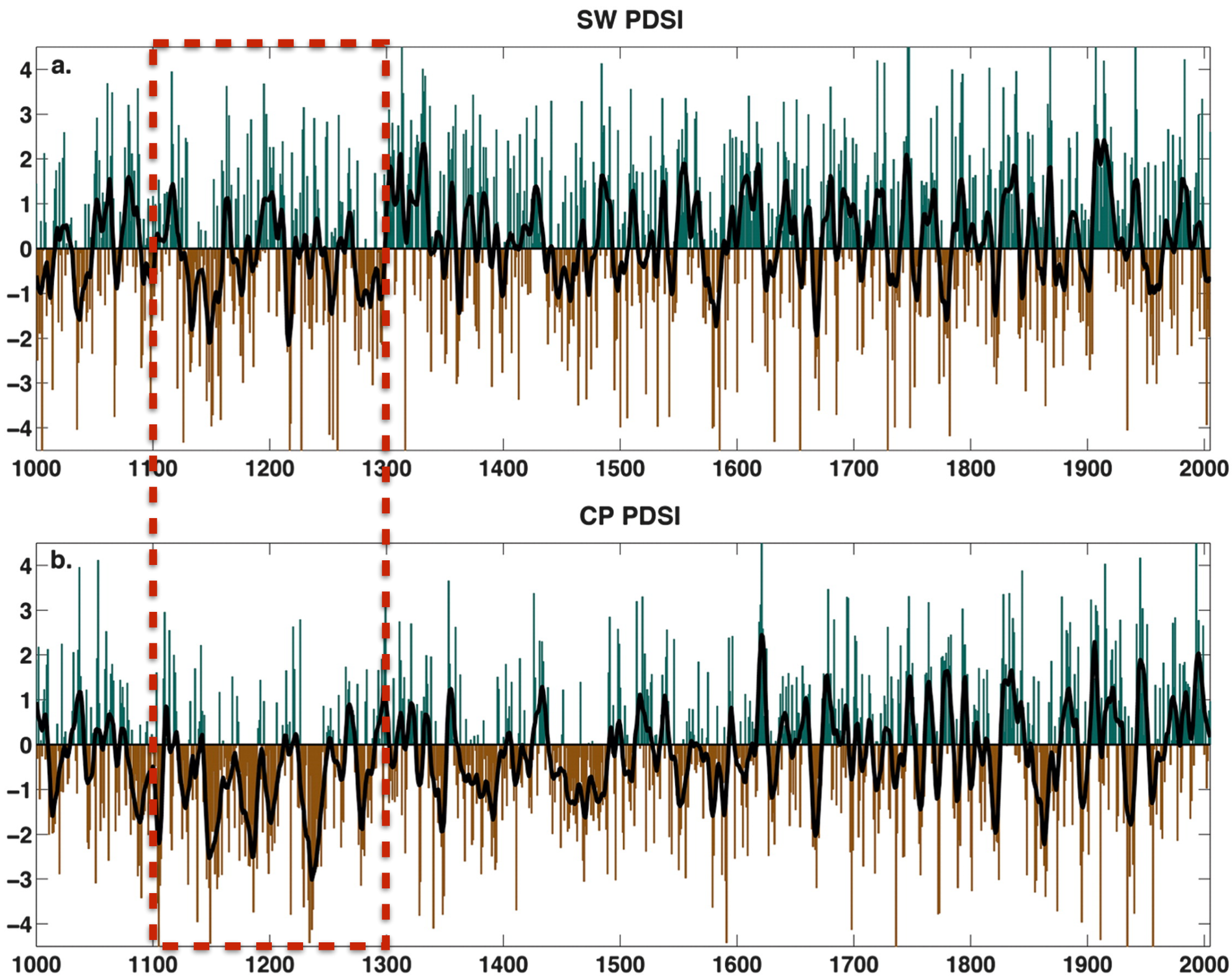
Unprecedented 21st century drought risk in Western North America

How will future drying compare to these pre-industrial megadroughts?



Cook et al (2014), Journal of Climate

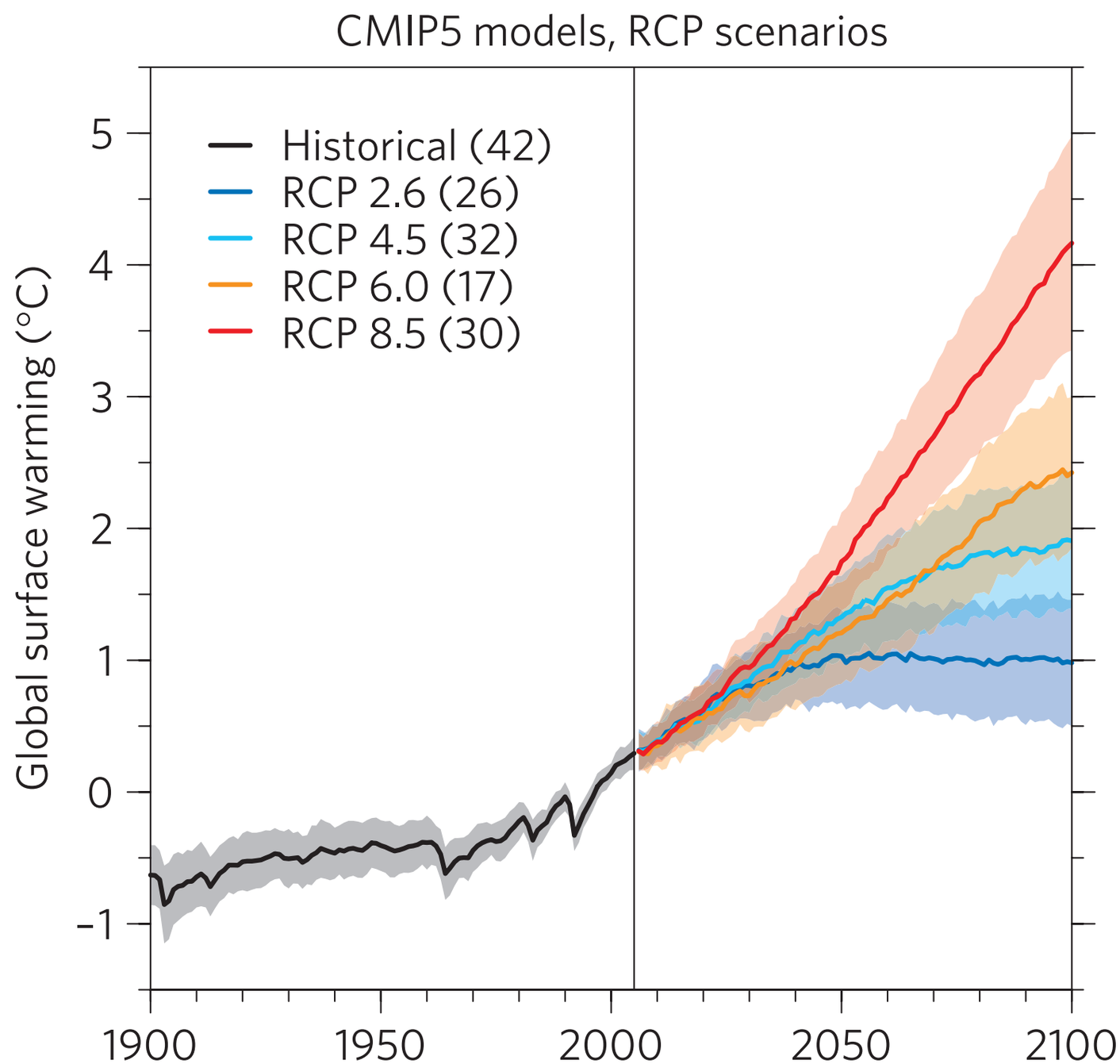
Does PDSI accurately reproduce soil moisture variability in climate models over the Southwest and Central Plains?

Can we use PDSI it to connect model projections with past drought variability?

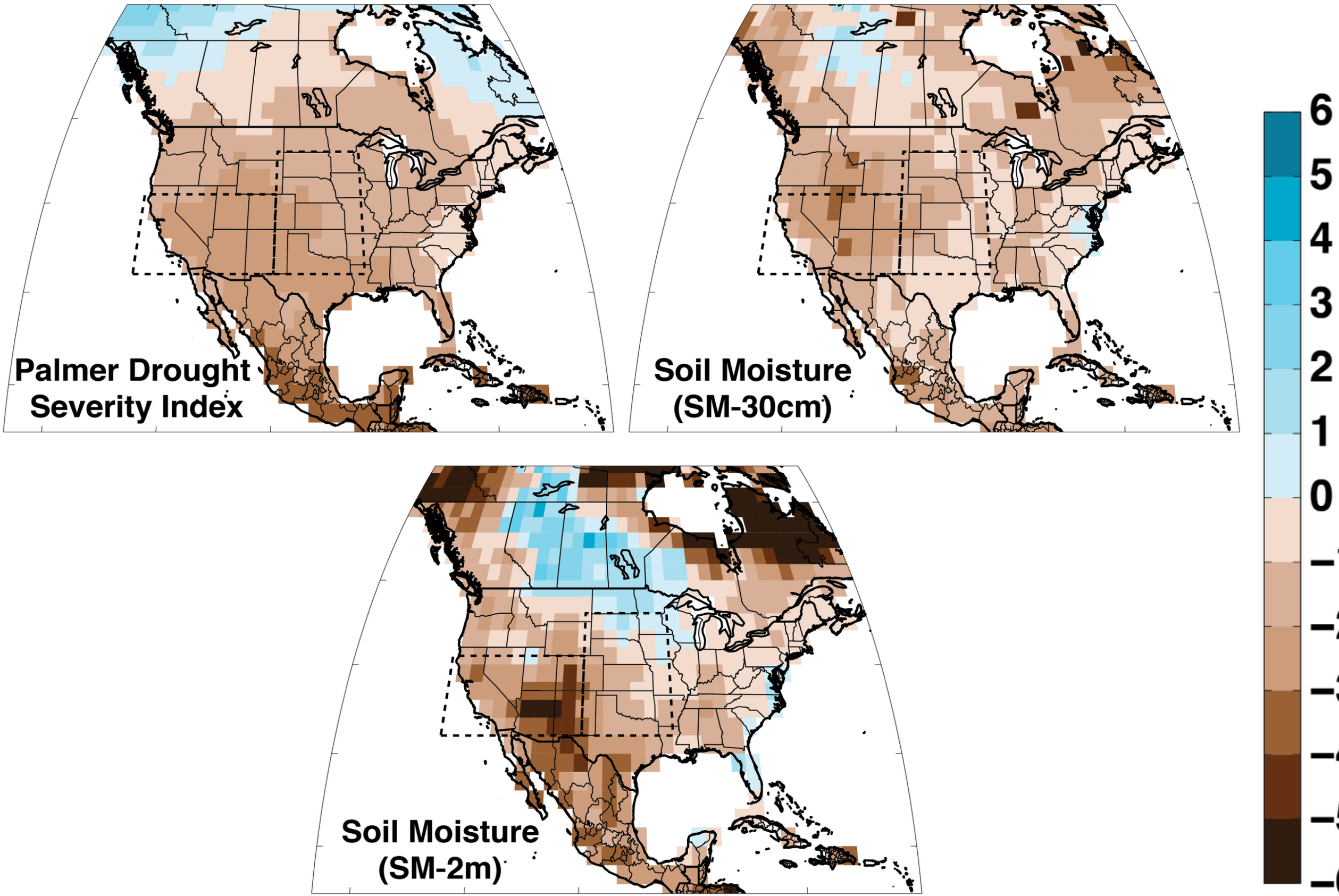
More realistic PET formulation for PDSI (Penman-Monteith)

17 models; 3 soil moisture metric

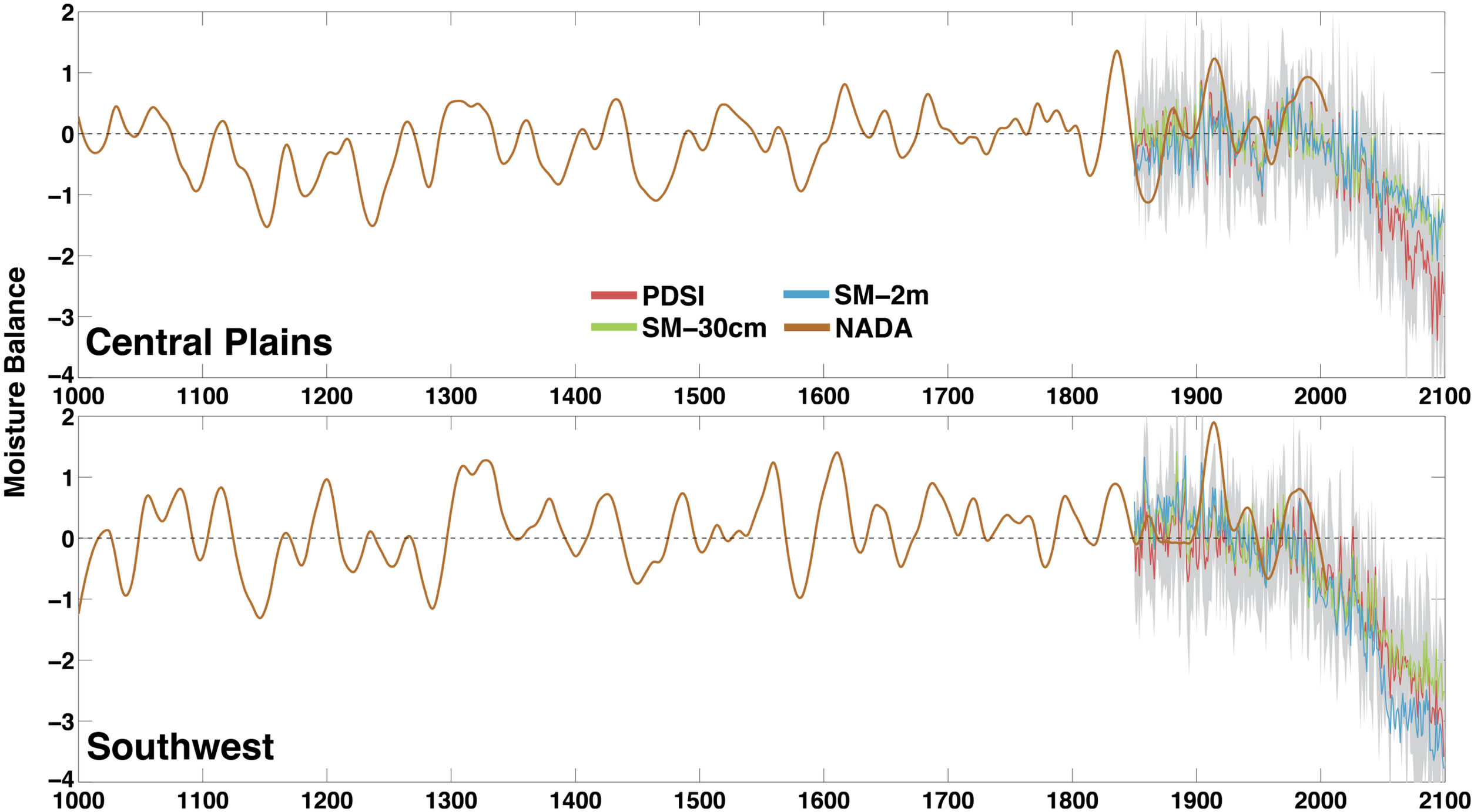
Compare modeled soil moisture trends vs tree ring record (NADA)

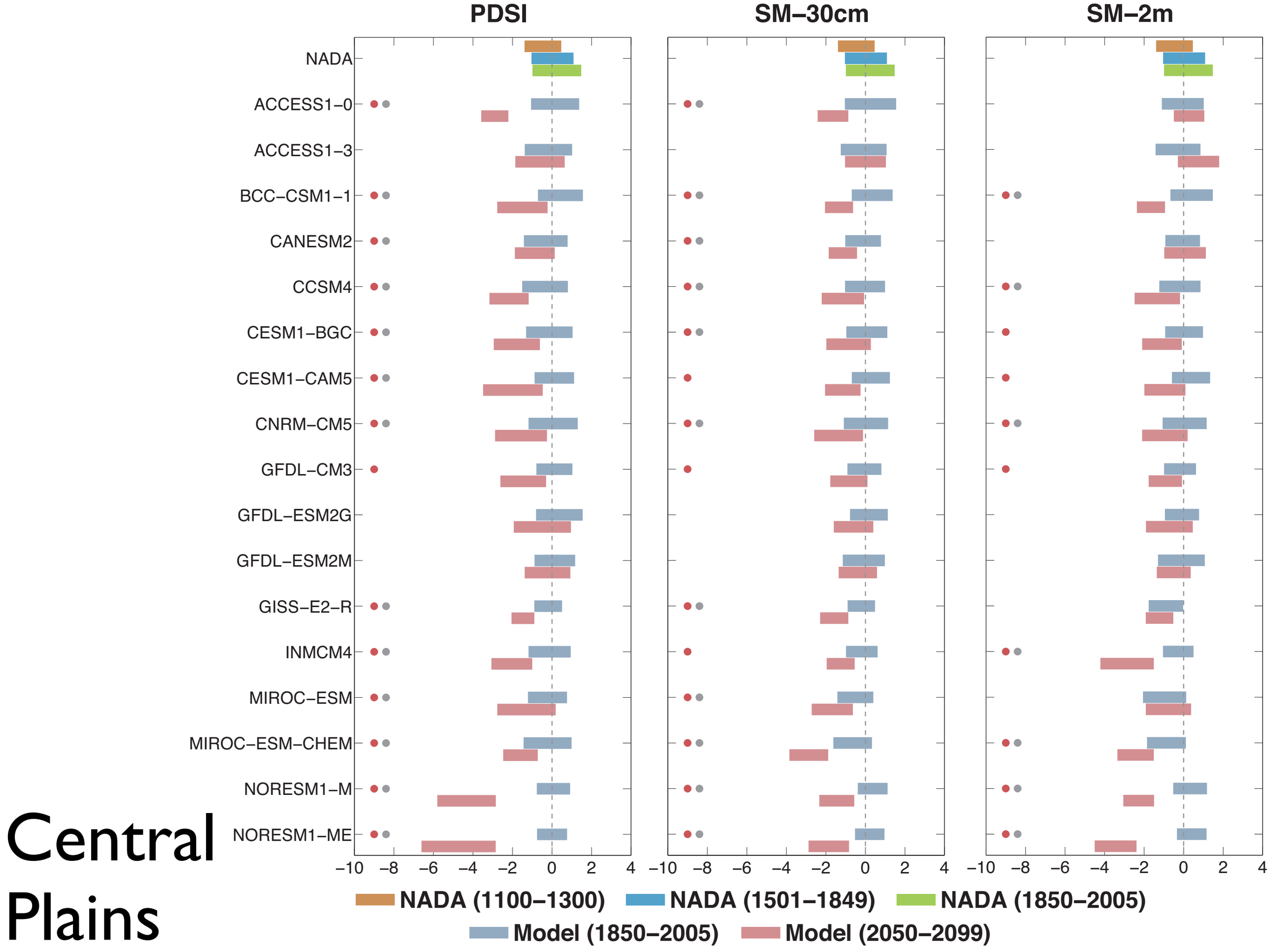


Soil Moisture:
2050-2099 (multi-model mean)

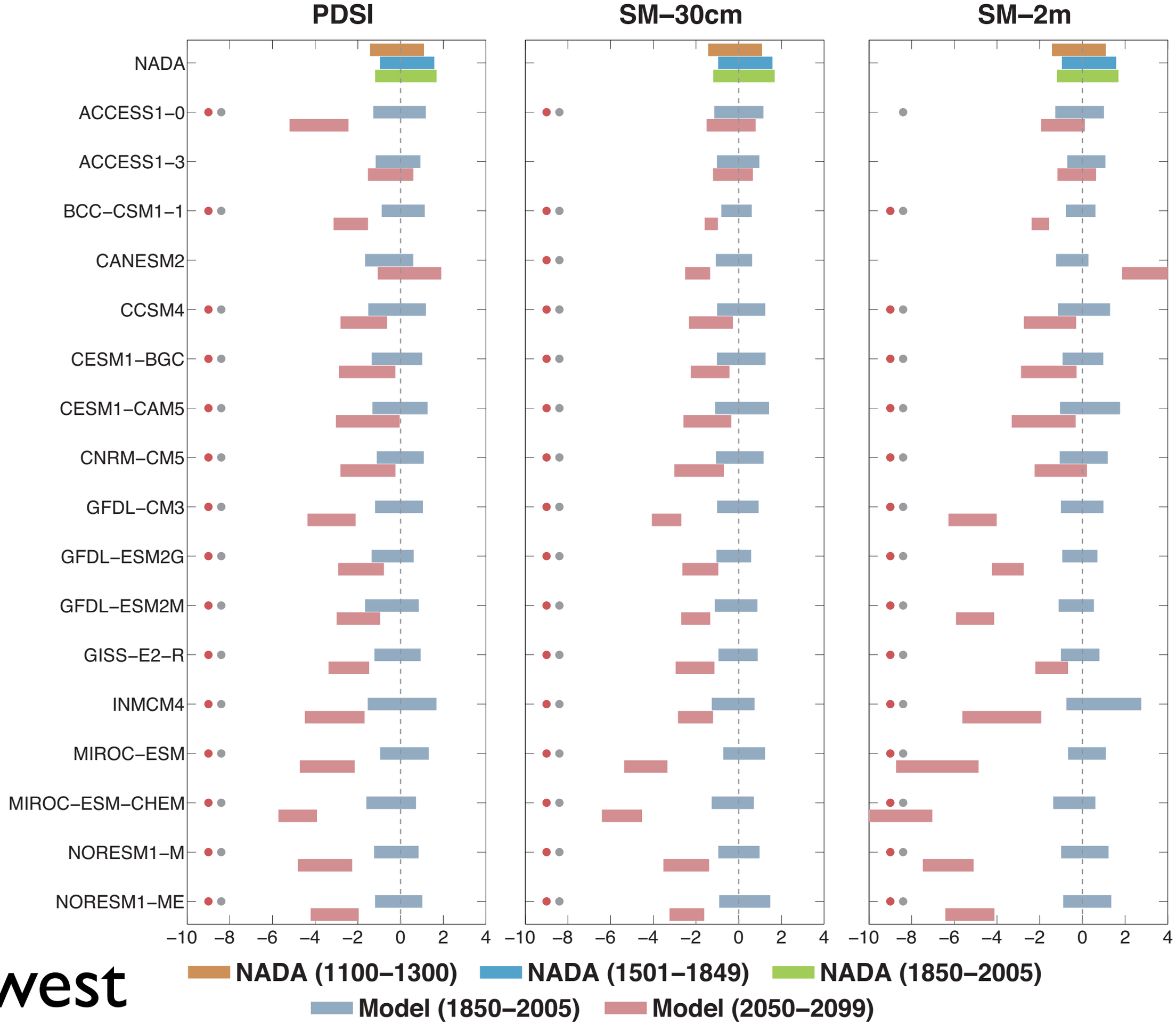


Soil Moisture:
time evolution (multi-model mean)

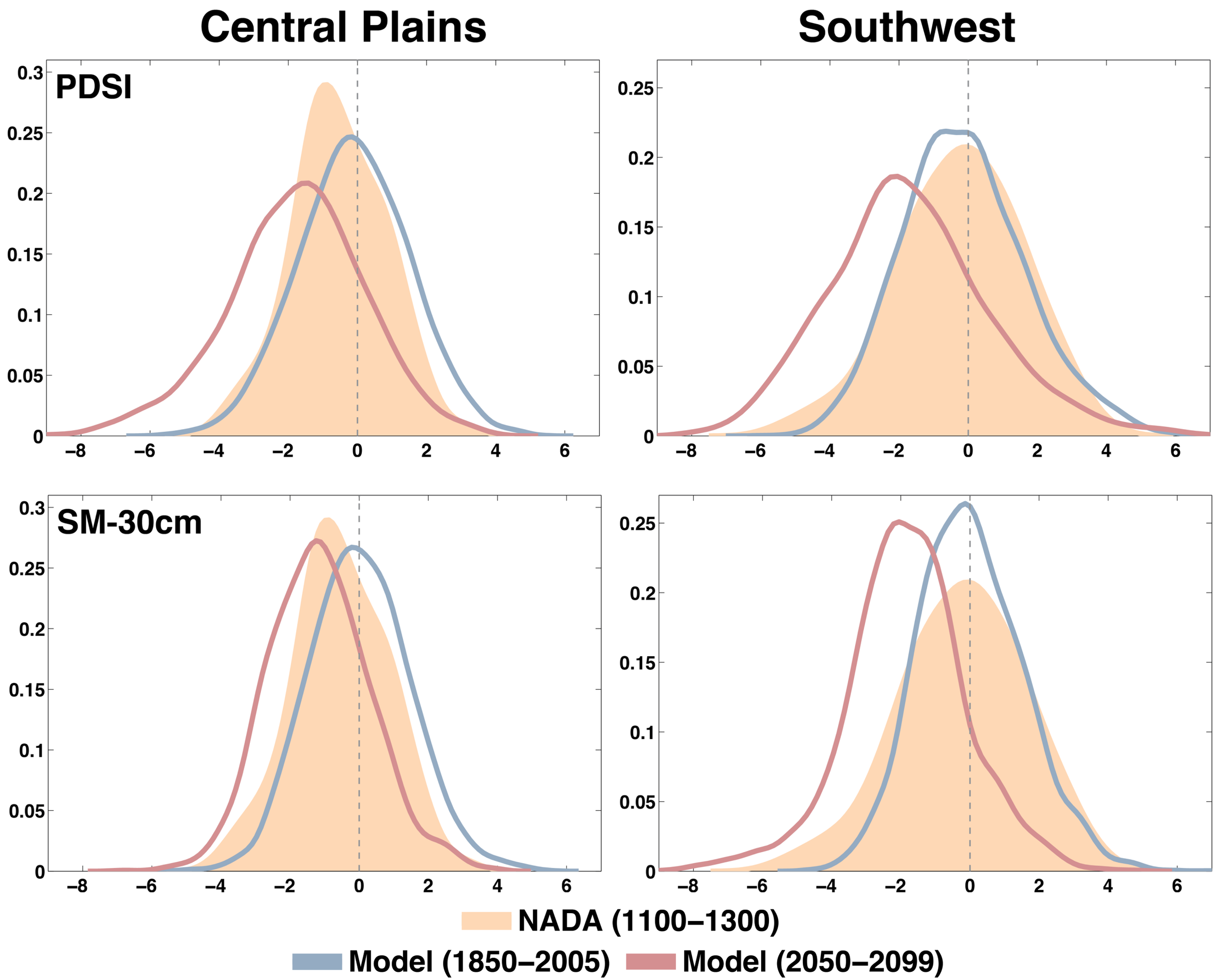




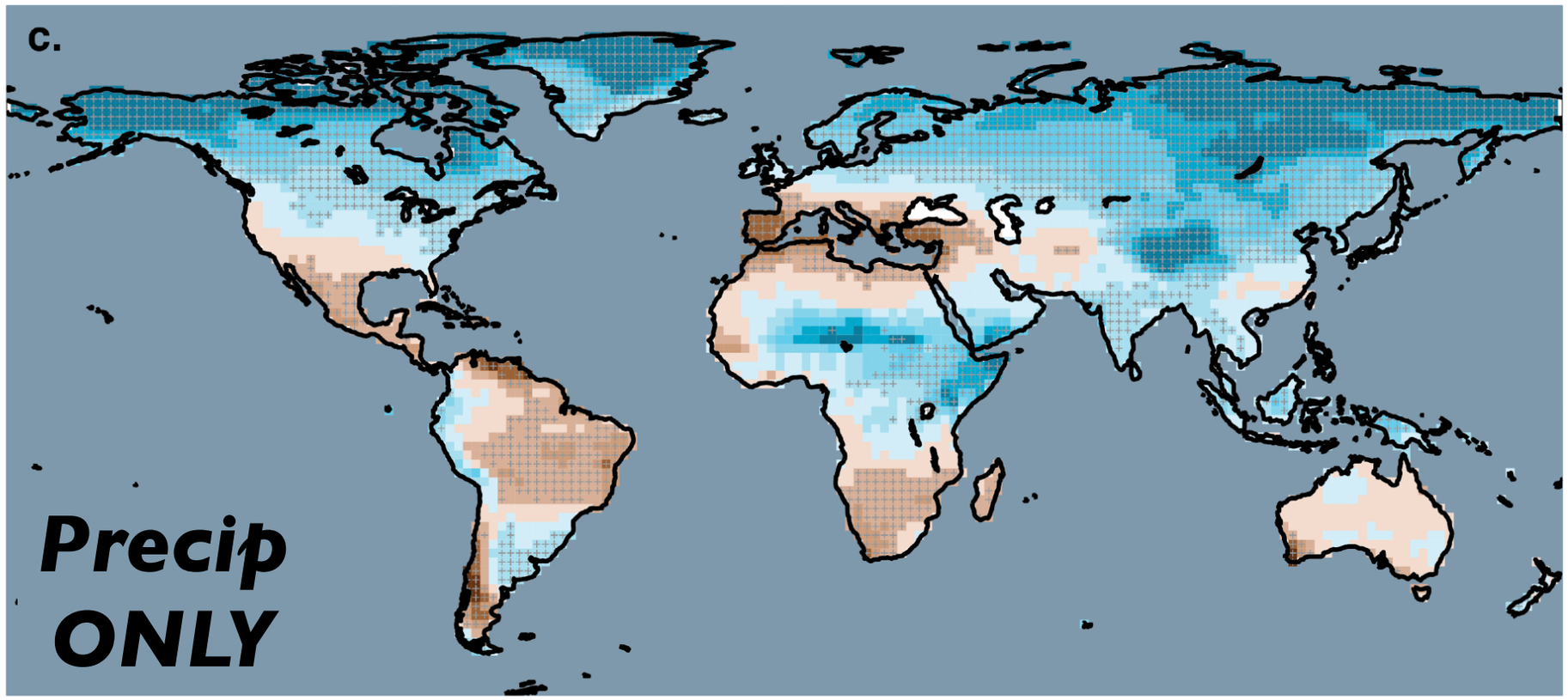
Central Plains


PDSI
SM–30cm
SM–2m
NADA
ACCESS1–0
ACCESS1–3
BCC–CSM1–1
CANESM2
CCSM4
CESM1–BGC
CESM1–CAM5
CNRM–CM5
GFDL–CM3
GFDL–ESM2G
GFDL–ESM2M
GISS–E2–R
INMCM4
MIROC–ESM
MIROC–ESM–CHEM
NORESM1–M
NORESM1–ME
–10 –8 –6 –4 –2 0 2 4
NADA (1100–1300)
NADA (1501–1849)
NADA (1850–2005)
Model (1850–2005)
Model (2050–2099)

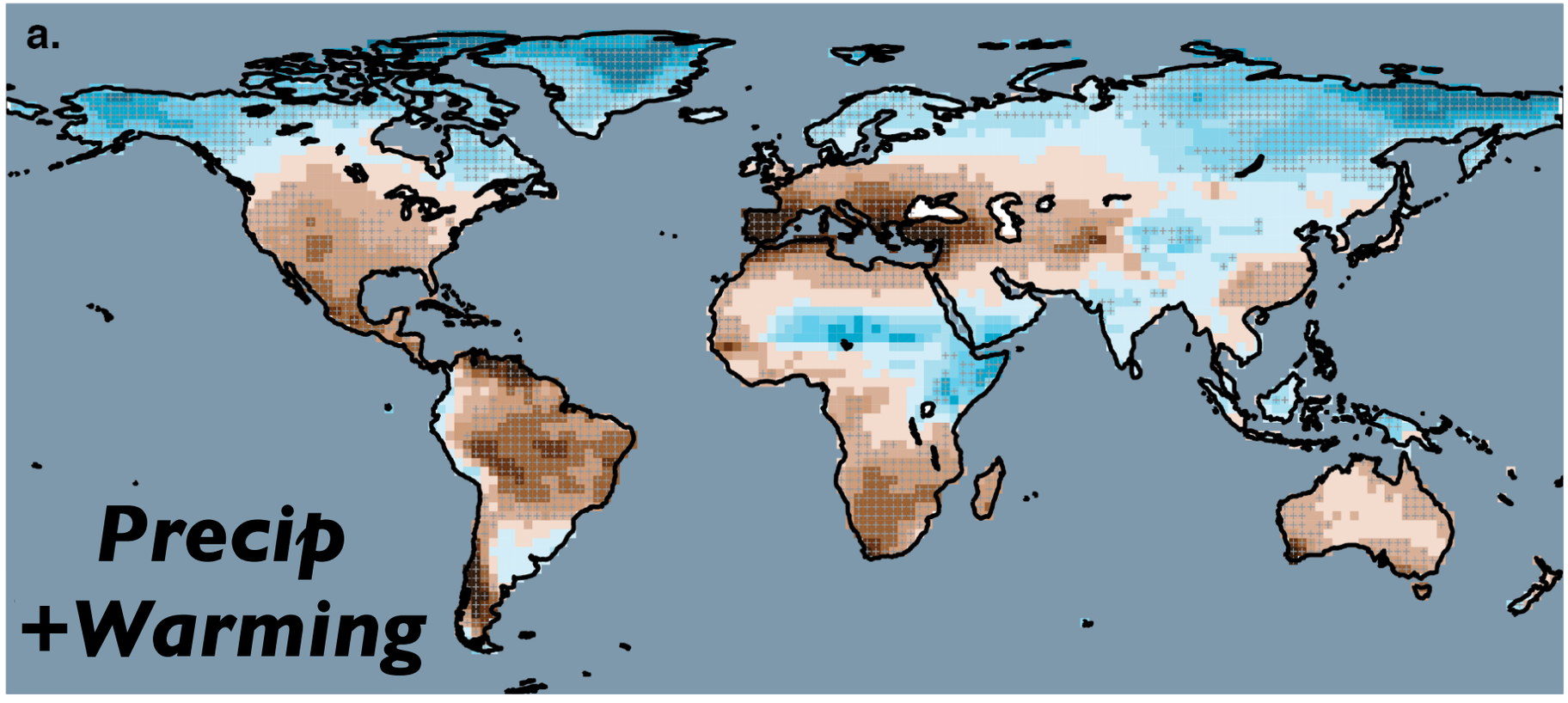
Southwest

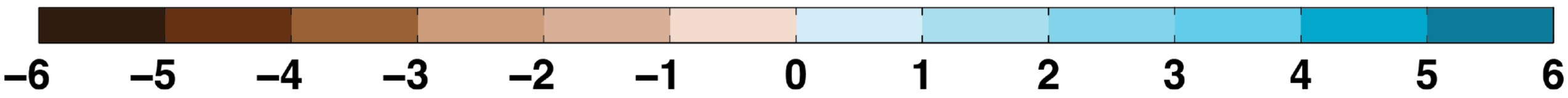

Central Plains
Southwest
PDSI
SM-30cm
0.3
0.25
0.2
0.15
0.1
0.05
0
−8
−6
−4
−2
0
2
4
6
NADA (1100–1300)
Model (1850–2005)
Model (2050–2099)

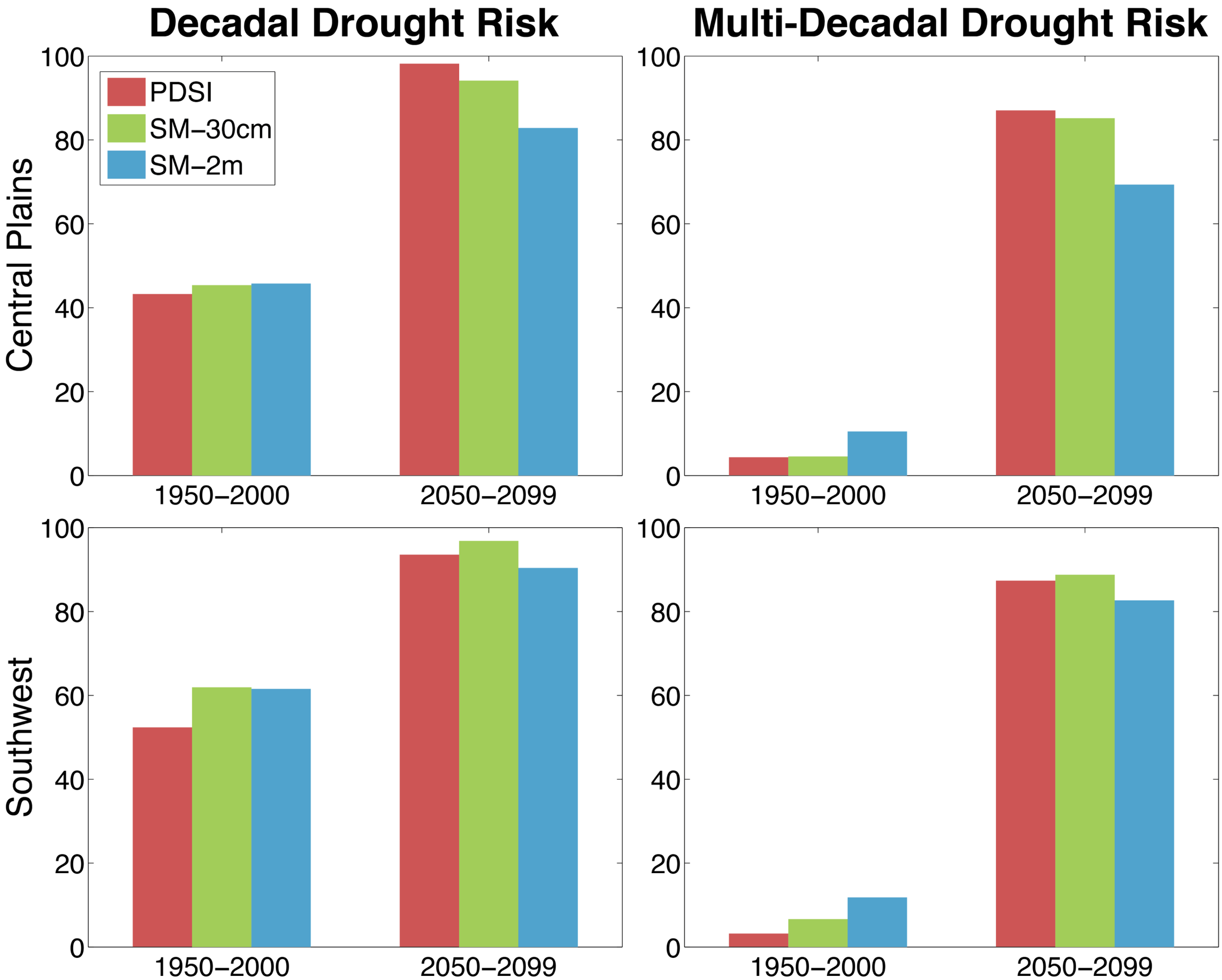
PDSI: 2080-2099



Warming intensifies and spreads the area of soil moisture drying






Decadal Drought Risk
Multi-Decadal Drought Risk
PDSI
SM−30cm
SM−2m
Central Plains
Southwest
0
20
40
60
80
100
1950−2000
2050−2099