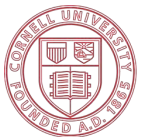


New Climate Projections from CMIP6

Art DeGaetano

Professor, Dept of Earth and Atmospheric Science, Cornell Univ.
Director, NOAA Northeast Regional Climate Center

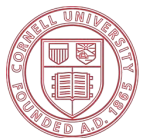


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LOCA

Climate Models	Affiliated Institutions	Original Spatial Resolution
ACCESS1-0, ACCESS1-3	CSIRO, Bureau of Meteorology (Australia)	~250 km
CCSM4	National Center for Atmospheric Research (USA)	~110 km
CESM1-BGC, CESM1-CAM5	National Center for Atmospheric Research (USA)	Various
CMCC-CM, CMCC-CMS	CMCC Foundation (Italy)	~180 km
CNRM-CM5	CNRM (France)	~250 km
CSIRO-Mk3-6-0	CSIRO (Australia)	~200 km
CanESM2	Canadian Centre for Climate Modelling and Analysis (Canada)	~200 km
EC-EARTH	European Consortium	~150 km
FGOALS-g2	Institute of Atmospheric Physics, Chinese Academy of Sciences (China)	~150 km
GFDL-CM3, GFDL-ESM2G, GFDL-ESM2M	Geophysical Fluid Dynamics Laboratory (USA)	~200 km
GISS-E2-R	Goddard Institute for Space Studies (USA)	~200 km
HadGEM2-AO, HadGEM2-CC, HadGEM2-ES	UK Met Office (United Kingdom)	~150 km
IPSL-CM5A-LR, IPSL-CM5A-MR	Institut Pierre-Simon Laplace (France)	~250 km
MIROC-ESM, MIROC-ESM-CHEM, MIROC5	Multiple Japanese Institutions	~150 km
MPI-ESM-LR, MPI-ESM-MR	Max Planck Institute for Meteorology (Germany)	~200 km
MRI-CGCM3	Meteorological Research Institute (Japan)	~200 km
NorESM1-M	Norwegian Climate Centre (Norway)	~140 km
bcc-csm1-1, bcc-csm1-1-m	Beijing Climate Center (China)	~250 km
inmem4	Institute for Numerical Mathematics (Russia)	~200 km



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LOCA2

27 Models

99 model-experiments

ssp 245

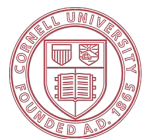
ssp370

ssp585

329 model-experiment-ensembles

26,026 total model years

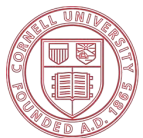
Climate Model	Affiliated Institution	Original Spatial Resolution
ACCESS-CM2, ACCESS-ESM1-5	CSIRO, Bureau of Meteorology (Australia)	~250 km
AWI-CM-1-1-MR	Alfred Wegener Institute (Germany)	~100 km
BCC-CSM2-MR	Beijing Climate Center (China)	~100 km
CanESM5	Canadian Centre for Climate Modelling and Analysis	~200 km
CNRM-CM6-1, CNRM-ESM2-1	National Centre for Meteorological Research (France)	~250 km
EC-Earth3-Veg, EC-Earth3	Multiple European Institutions	~80 km
FGOALS-g3	Institute of Atmospheric Physics, Chinese Academy of Sciences (China)	~100 km
GFDL-ESM4	Geophysical Fluid Dynamics Laboratory (USA)	~100 km
INM-CM4-8, INM-CM5-0	Institute for Numerical Mathematics (Russia)	~140 km/~200 km
IPSL-CM6A-LR	Institut Pierre-Simon Laplace (France)	~250 km
KACE-1-0-G	Korea Institute of Atmospheric Prediction Systems (South Korea)	~100 km
MIROC6	Multiple Japanese Institutions	~100 km
MPI-ESM1-2-HR, MPI-ESM1-2-LR	Max Planck Institute for Meteorology (Germany)	~60 km/~200 km
MRI-ESM2-0	Meteorological Research Institute (Japan)	~130 km
NorESM2-LM, NorESM2-MM	Norwegian Climate Centre (Norway)	~100 km/~60 km



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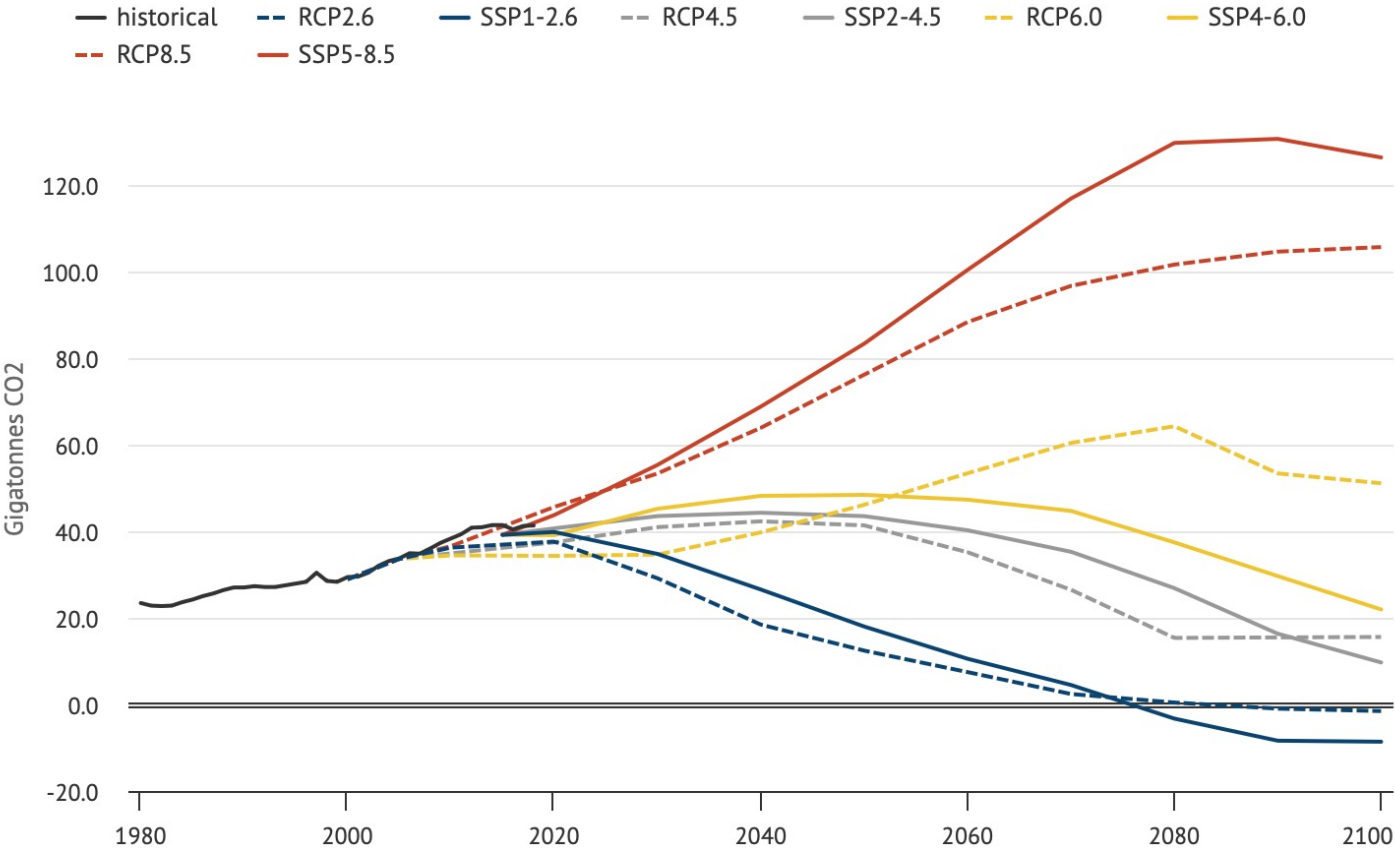


Who does climate modelling around the world?



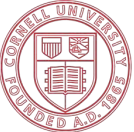
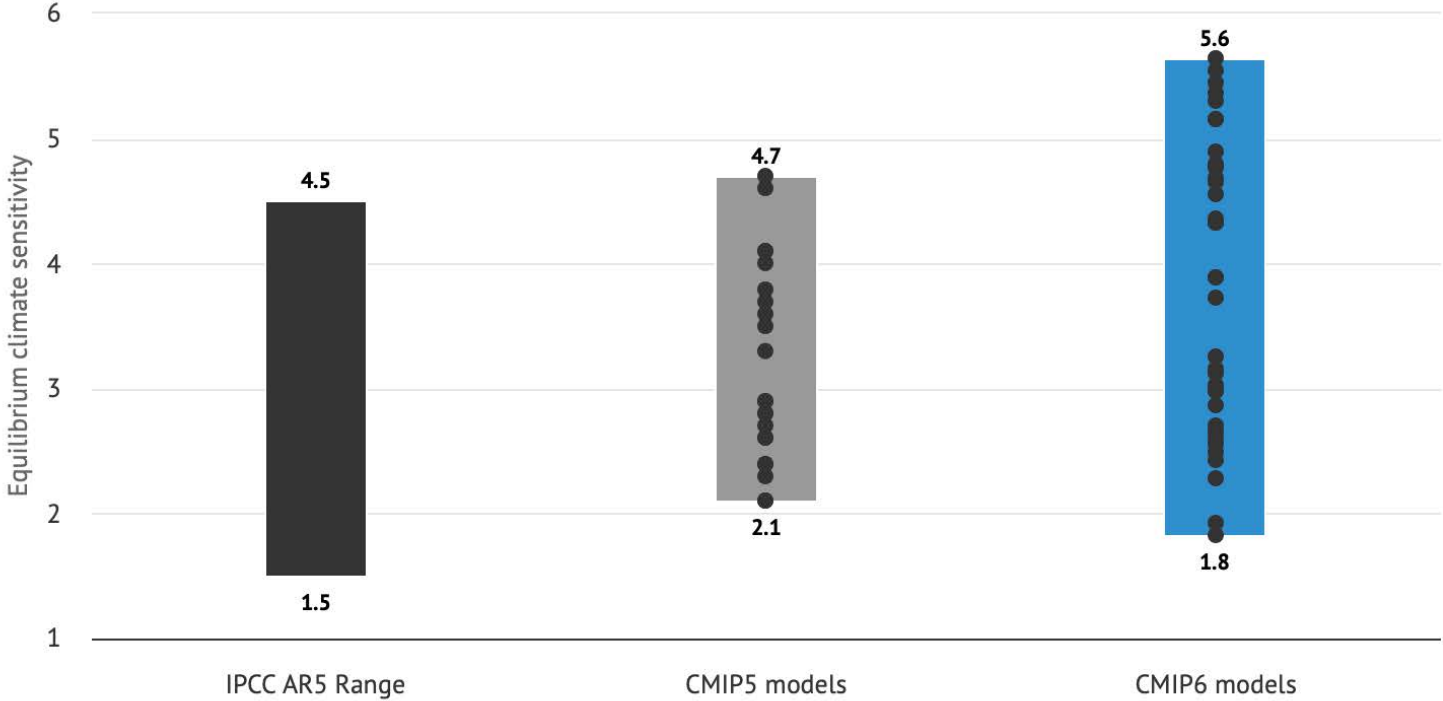
CMIP6 vs CMIP5

CO2 emissions in comparable CMIP5 and CMIP6 scenarios



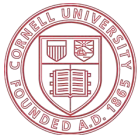
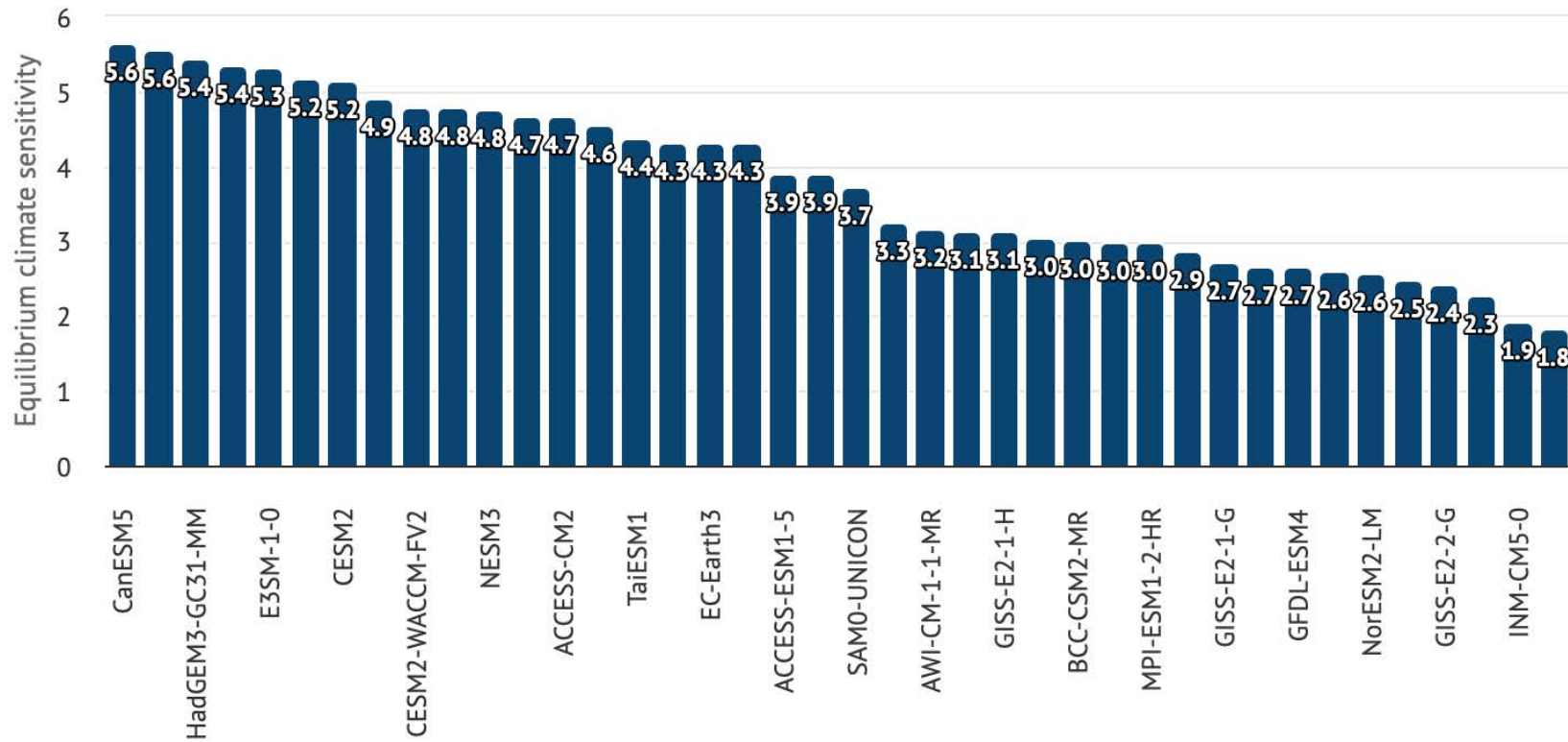
CMIP6 vs CMIP5

CMIP6 models show a wider range of climate sensitivity



CMIP6 vs CMIP5

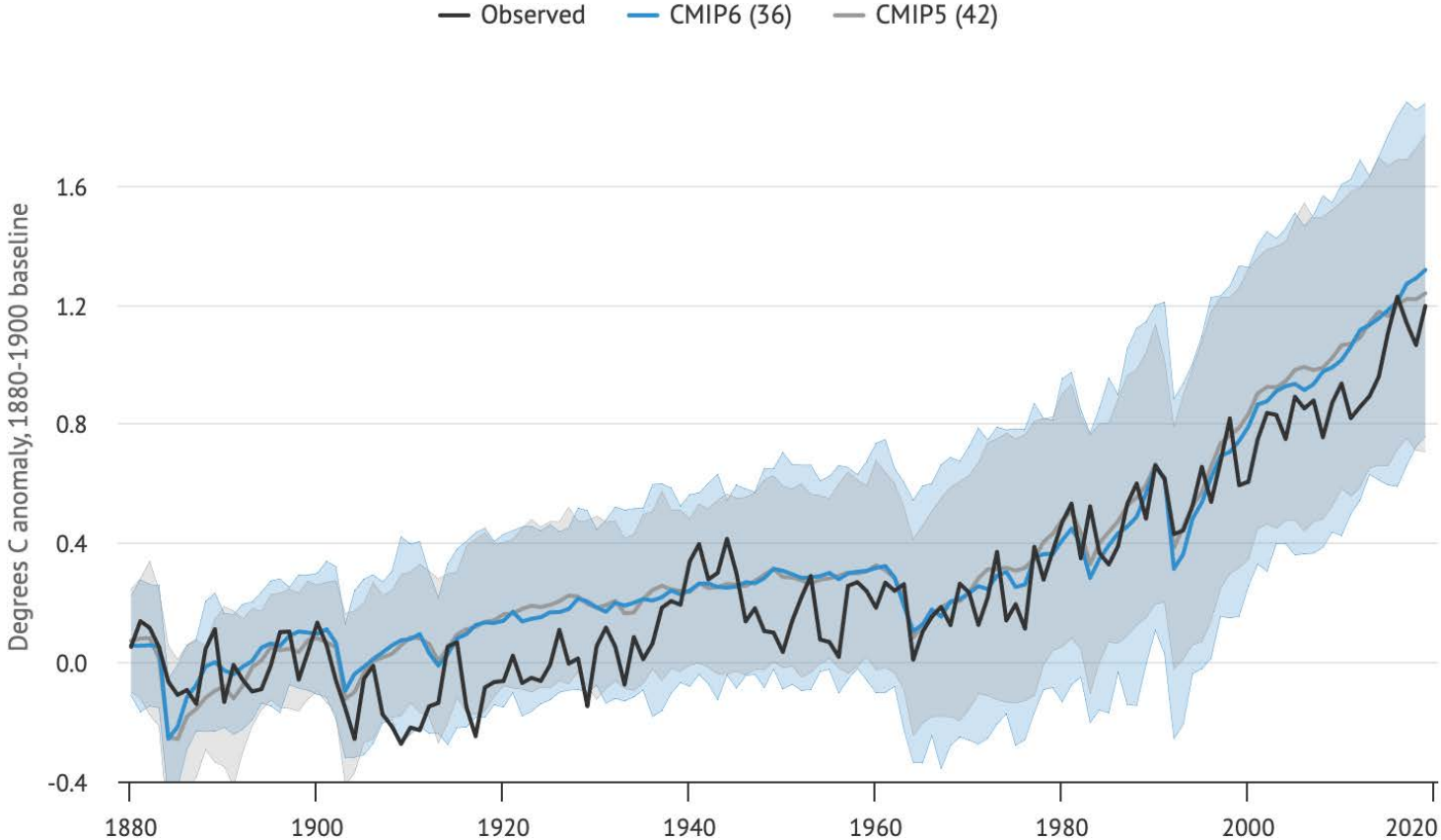
Climate sensitivity in CMIP6 models



CMIP6 vs CMIP5

Global surface temperatures 1880-2019: CMIP5, CMIP6 and observations

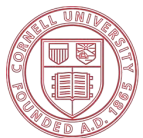
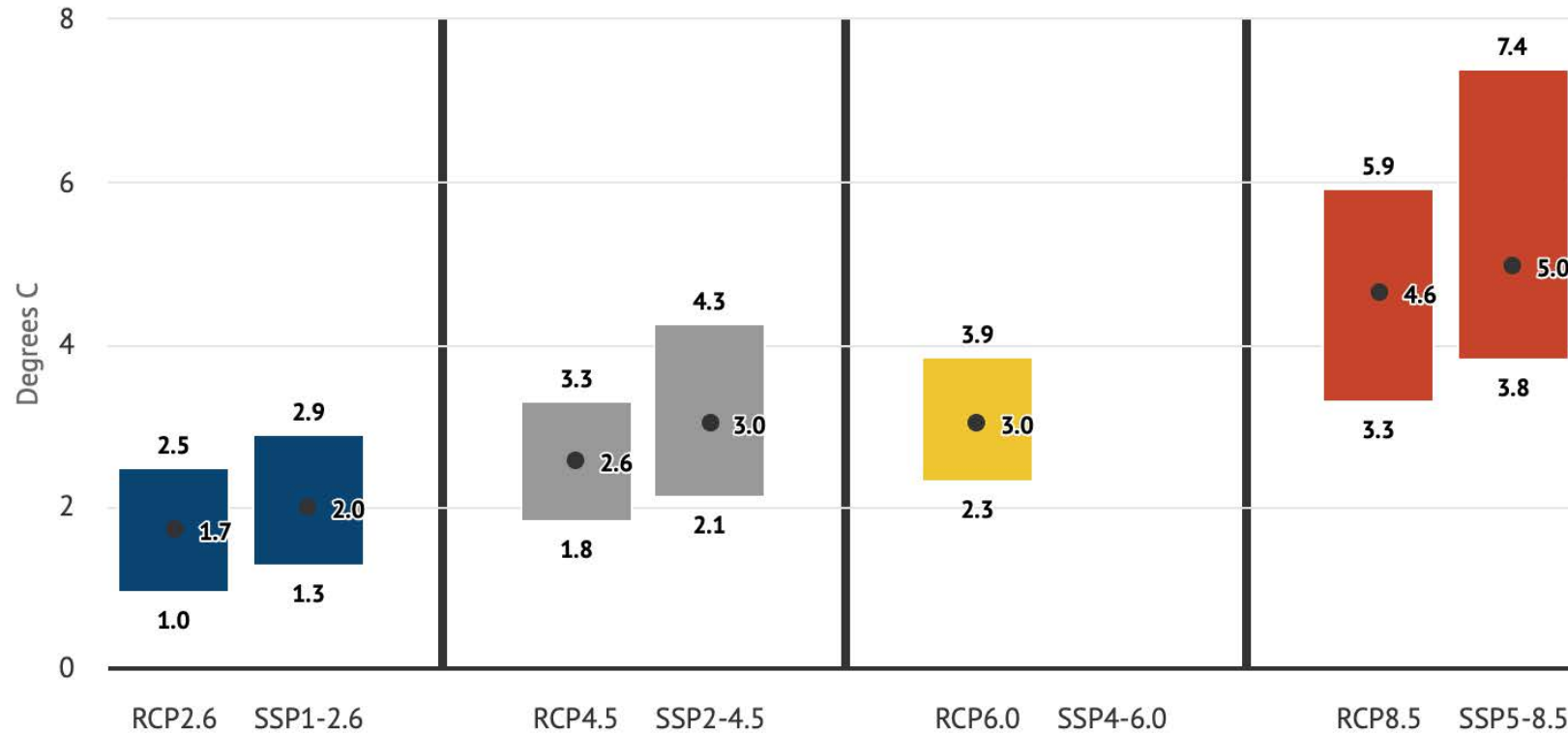
For currently available CMIP6 runs. Observational data from NASA GISTEMP.



CMIP6 vs CMIP5

Comparing CMIP5 and CMIP6 scenarios

For currently available runs, from 1880-1900 to 2090-2100.



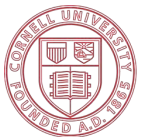
Cornell University



LOCA2 vs LOCA

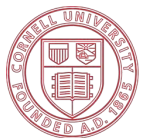
Enhancements in LOCA2 improve the depiction of daily precip extremes

- New precipitation training data set that better represents daily precipitation extremes
- Ensemble bias correction approach that better preserves extreme events in models that have more than one ensemble member



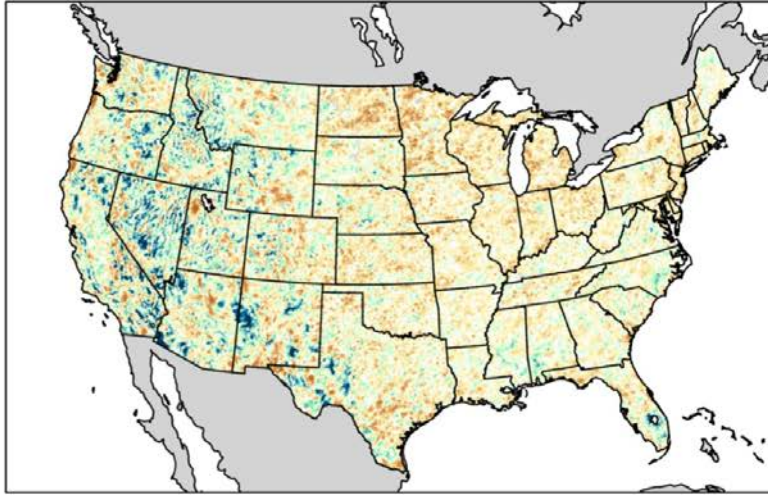
LOCA2 in NCA5

Model Name	BMA Weights
ACCESS-CM2	0.0412
ACCESS-ESM1-5	0.0581
BCC-CSM2-MR	0.0723
CanESM5	0.029
EC-Earth3	0.0498
FGOALS-g3	0.0716
GFDL-ESM4	0.0589
INM-CM4-8	0.0646
INM-CM5-0	0.0649
IPSL-CM6A-LR	0.0449
MIROC6	0.0767
MPI-ESM1-2-HR	0.0731
MPI-ESM1-2-LR	0.0755
MRI-ESM2-0	0.073
NorESM2-LM	0.0736
NorESM2-MM	0.0727

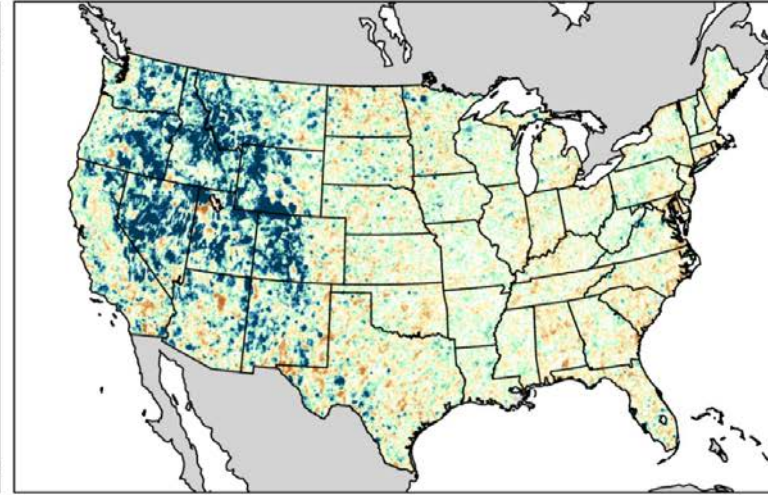


99.9th Percentile Precipitation Relative Difference (%)

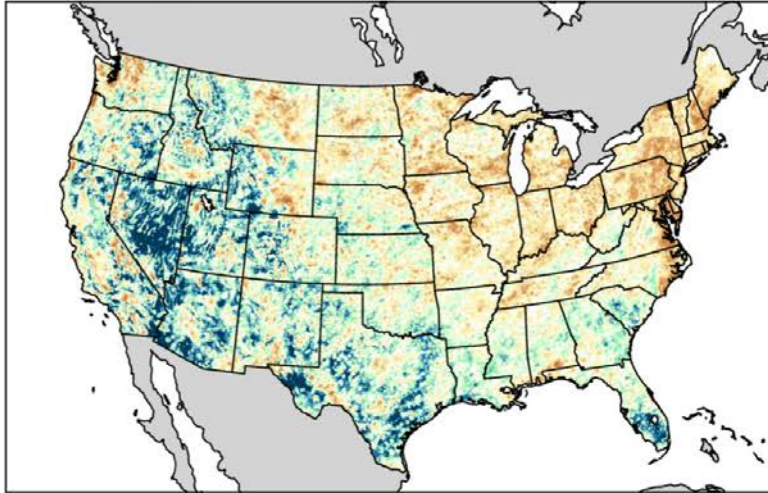
(a) NClimGrid minus PRISM



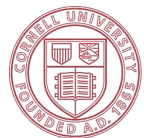
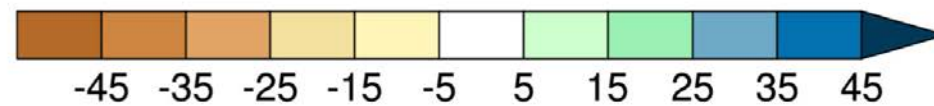
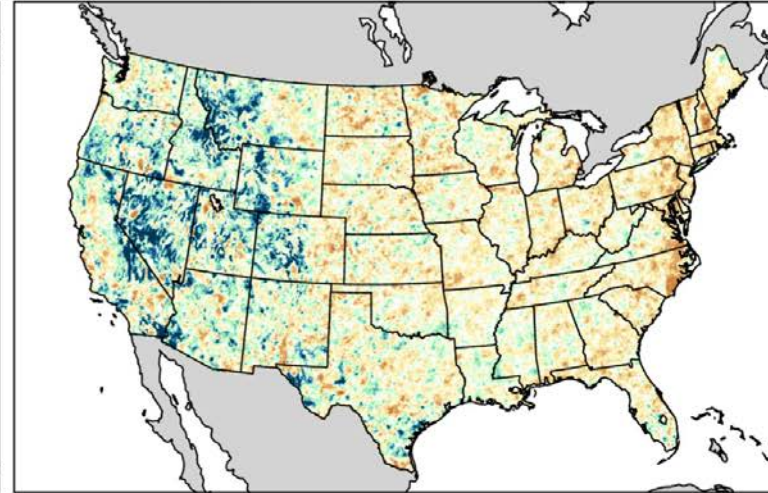
(b) Livneh minus PRISM



(c) STAR-ESDM minus PRISM

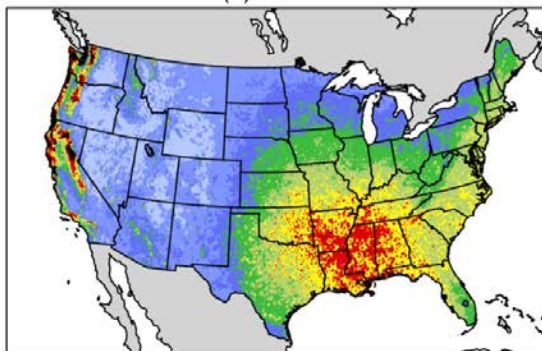


(d) LOCA2 minus PRISM

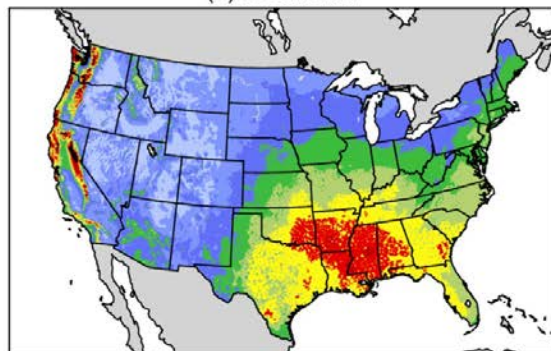


Median Precipitation (mm/day)

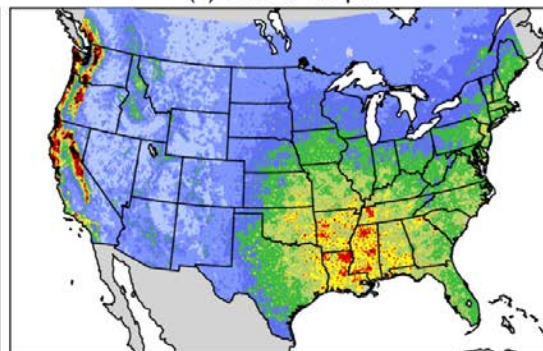
(a) PRISM



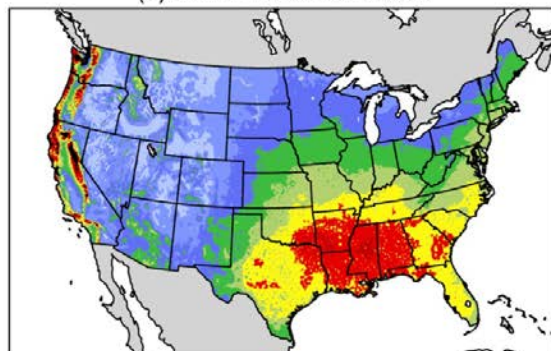
(b) NCLimGrid



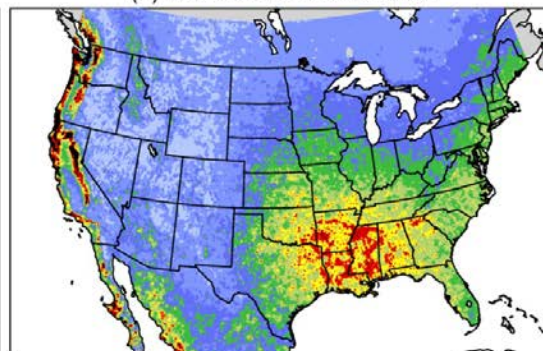
(c) Livneh-unsplit



(d) STAR Ensemble Mean

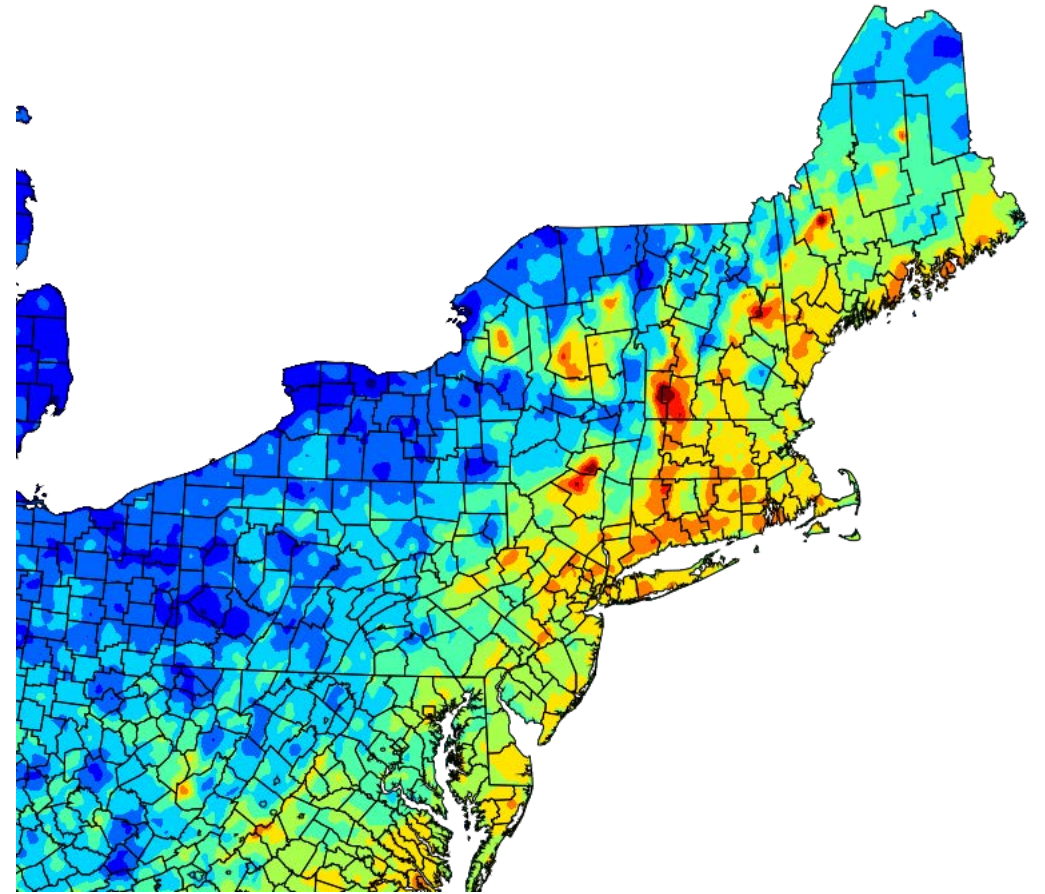
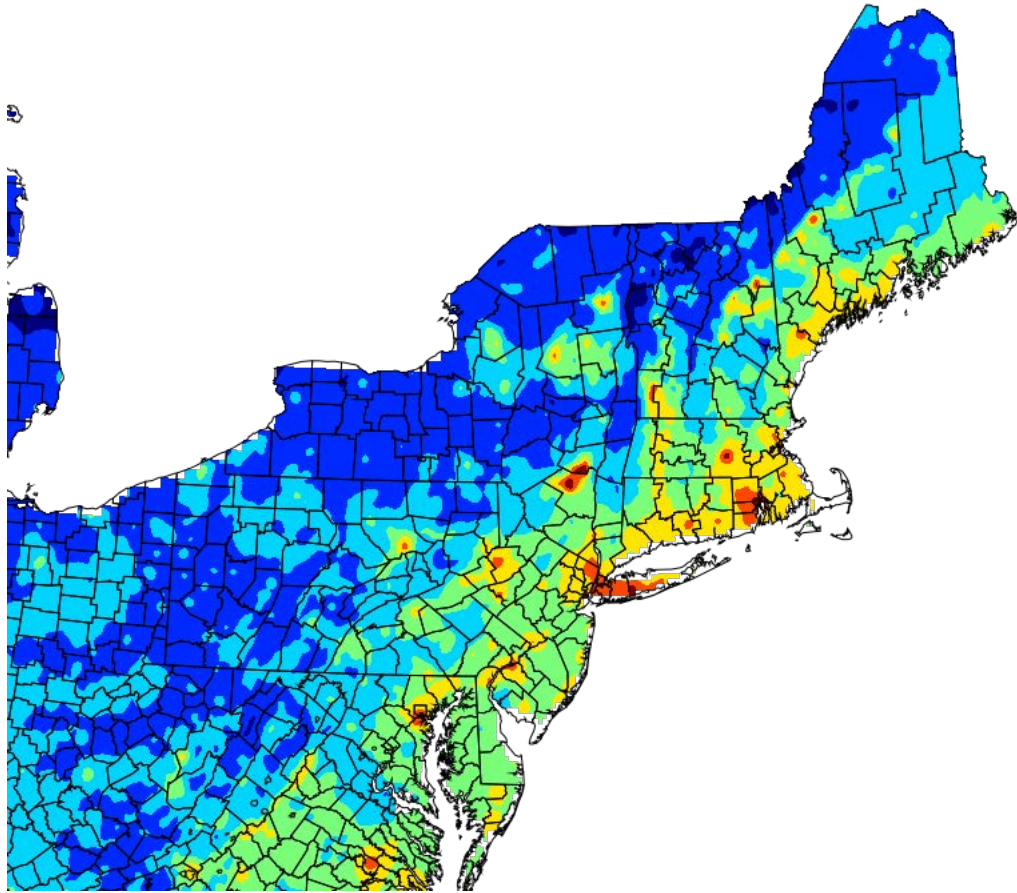


(e) LOCA2 Ensemble Mean

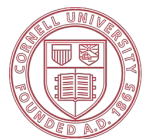


LOCA

LOCA2



Days > 1 inch

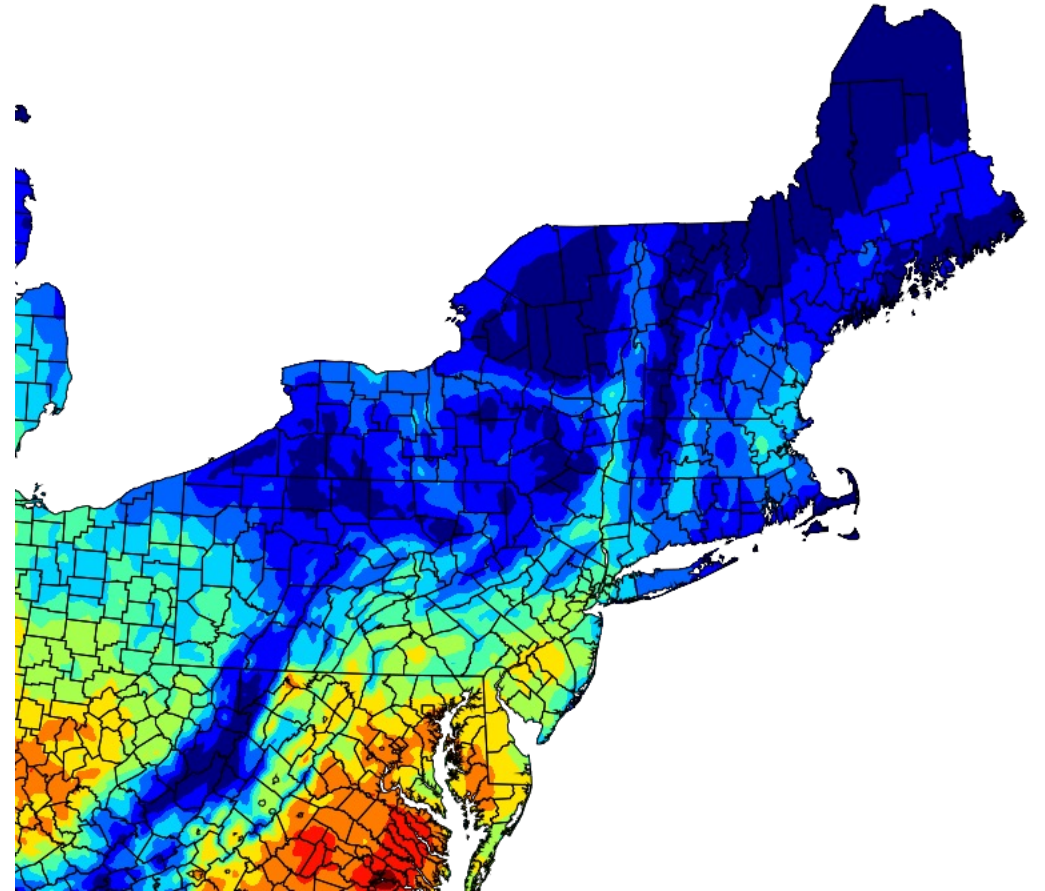
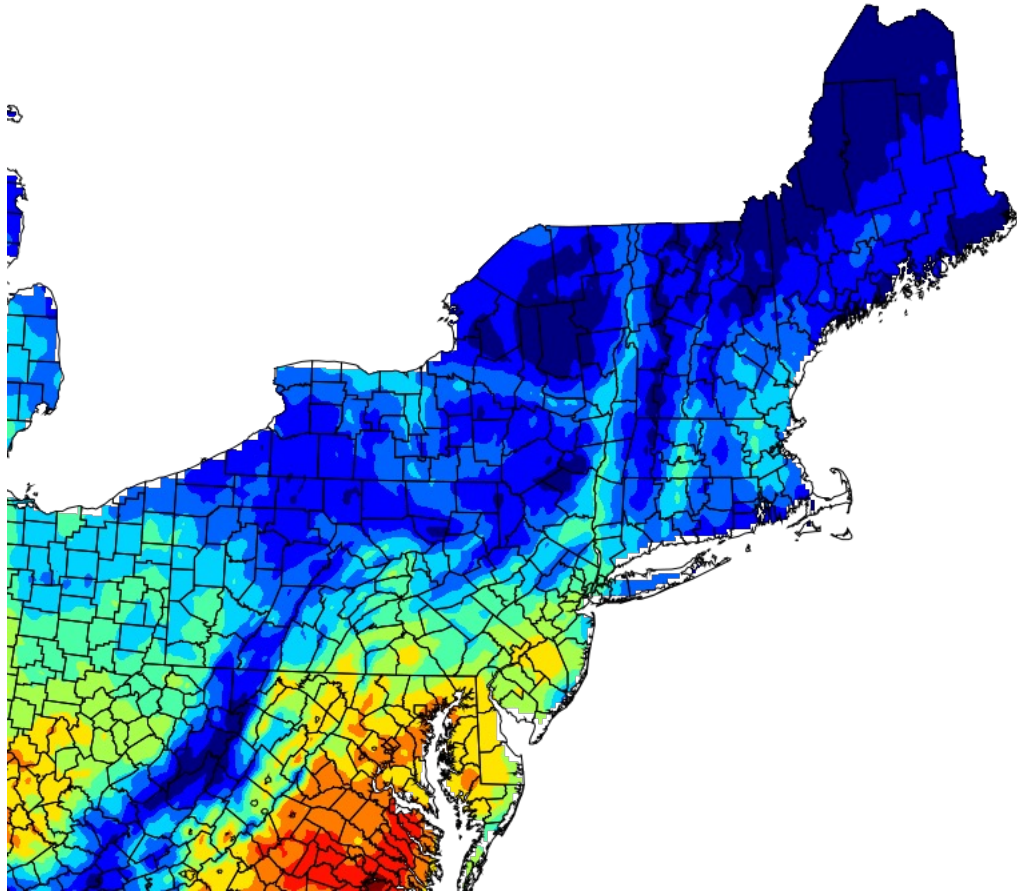


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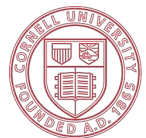


LOCA

LOCA2



Days > 90°F

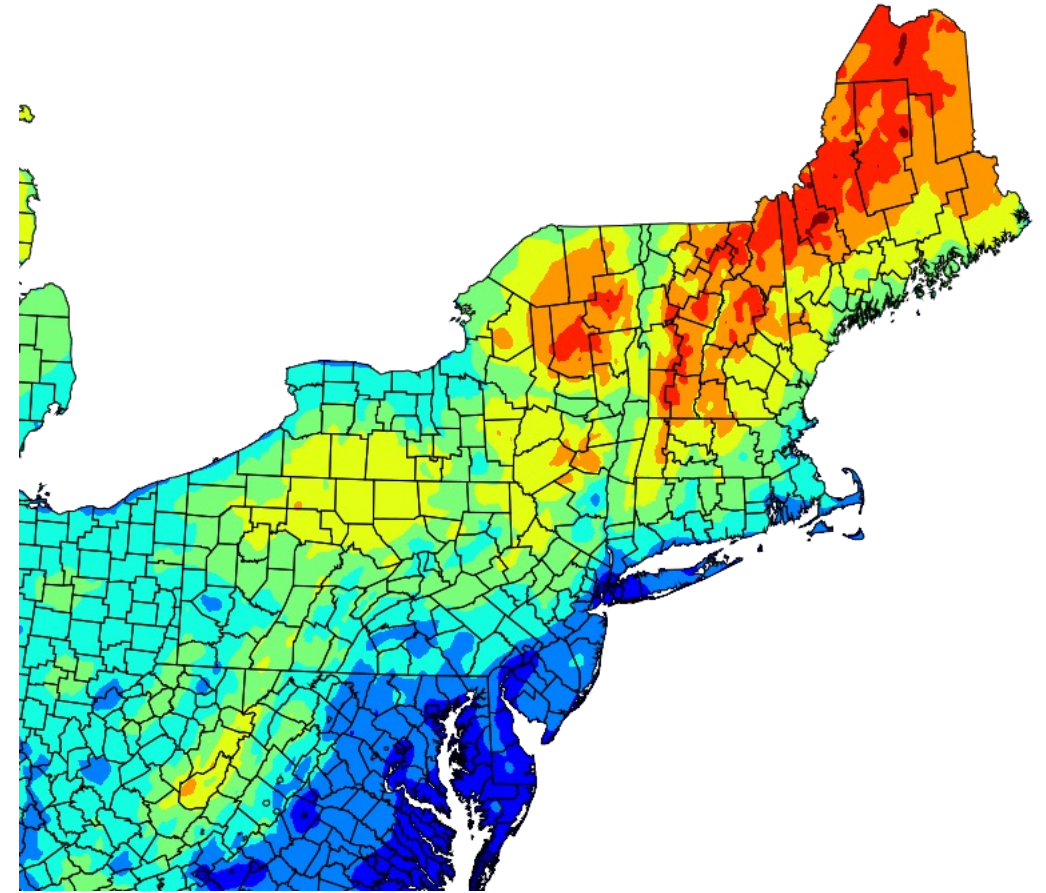
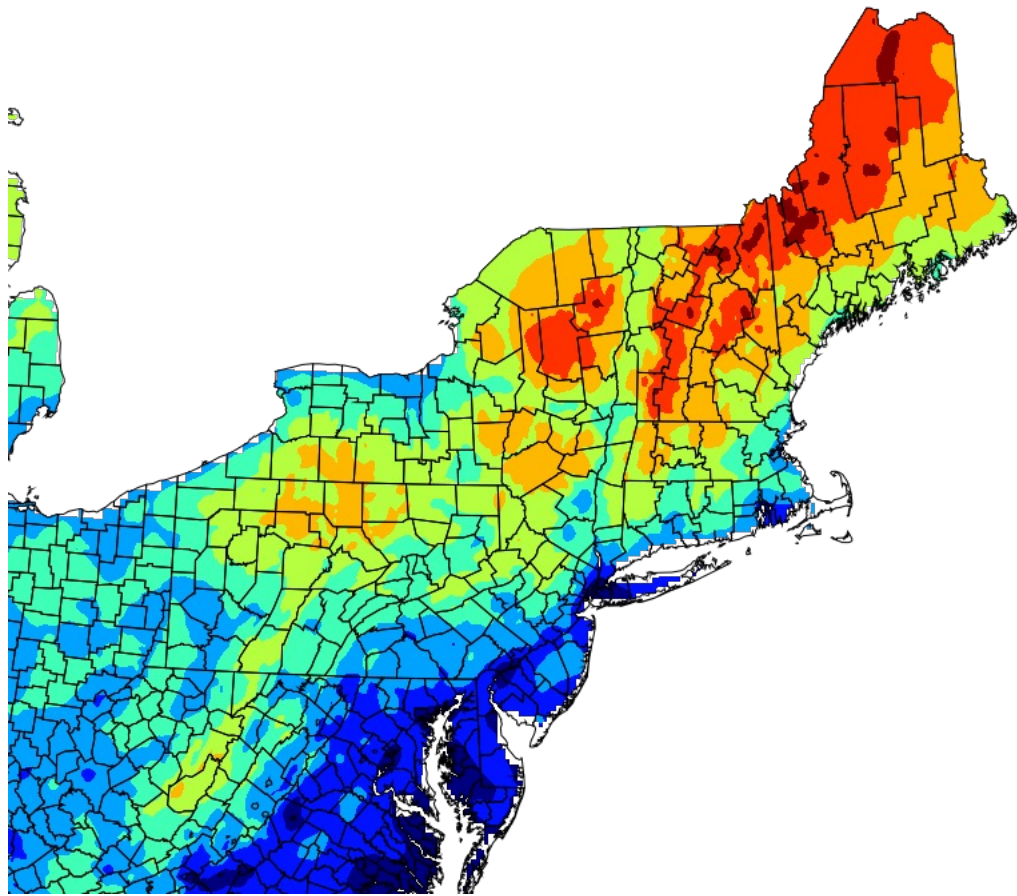


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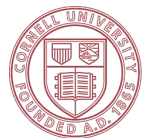


LOCA

LOCA2



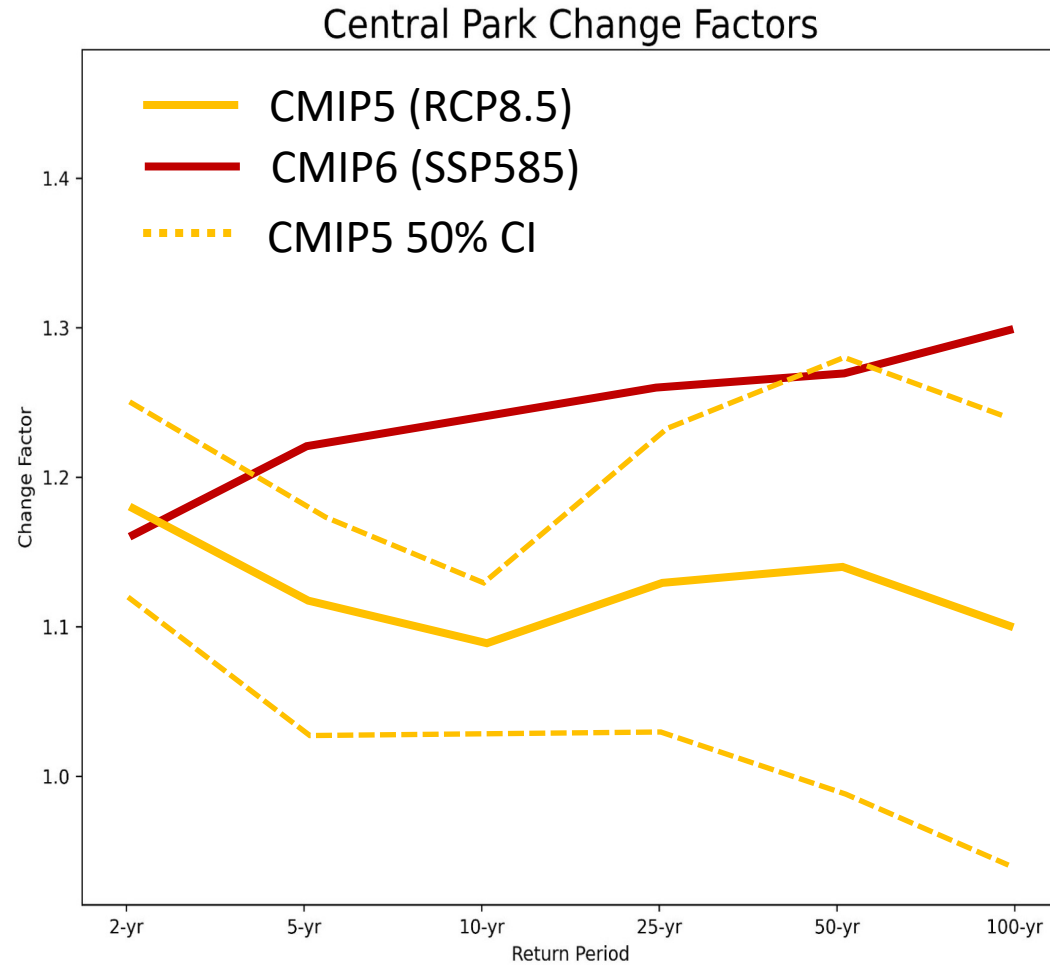
Days <32°F



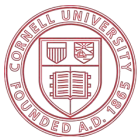
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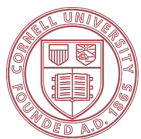
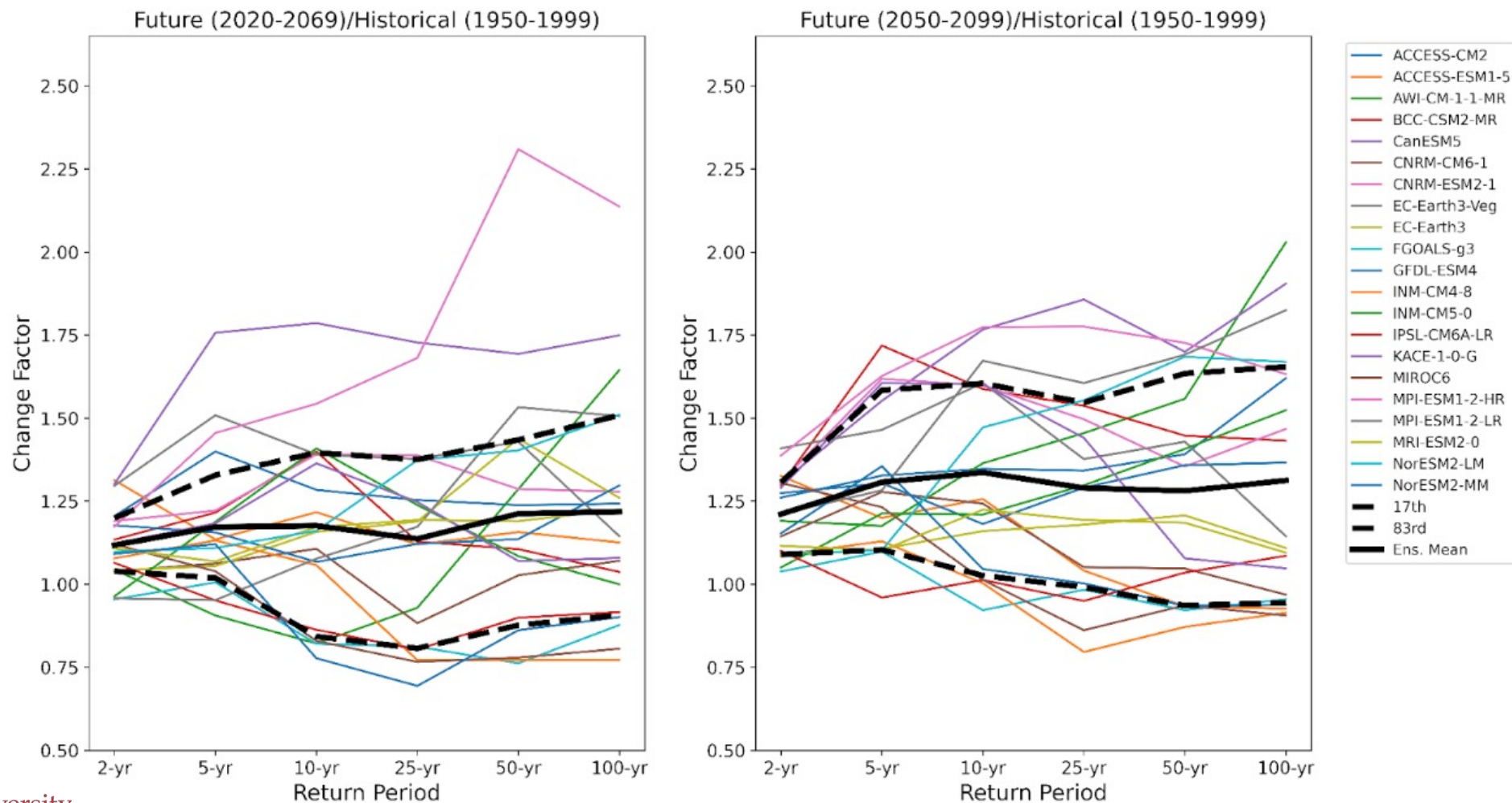
LOCA vs LOCA2



Take Home Message: CMIP6 Extremes tend to be **LARGER** than CMIP5, especially at high return periods. Significance is Marginal



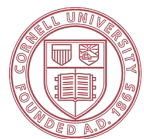
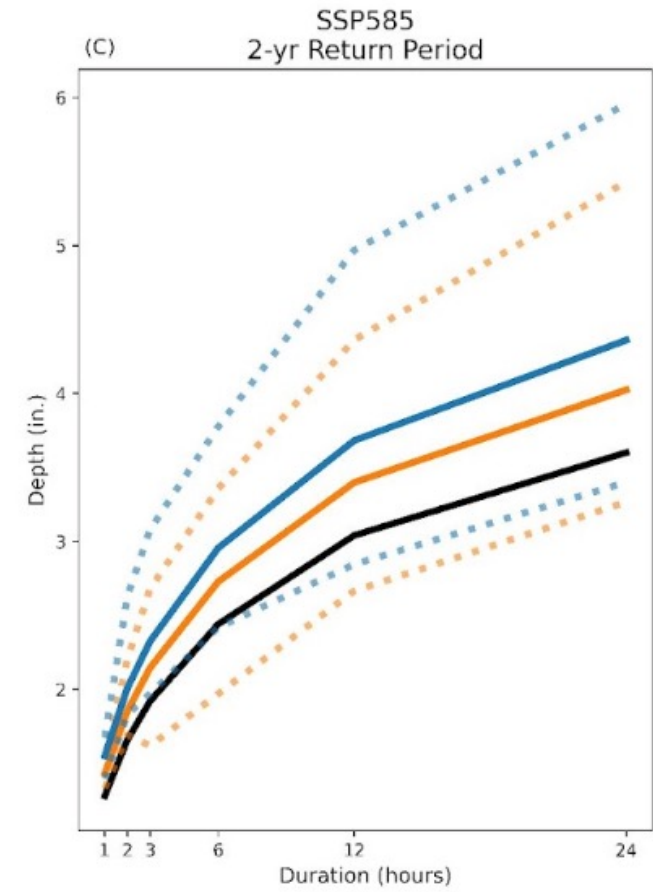
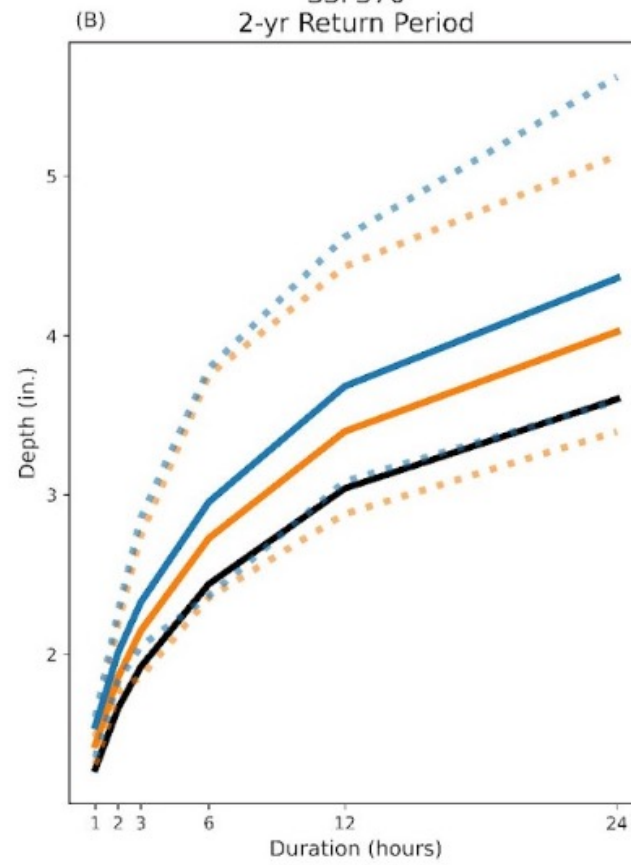
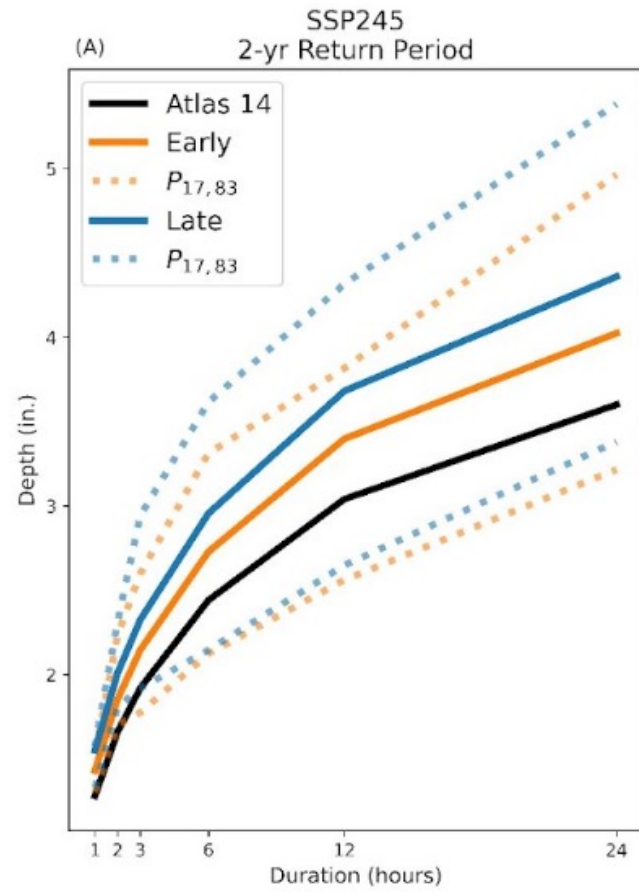
Central Park Change Factors LOCA2 SSP585



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Central Park Intensity Duration Frequency Curves



Central Park Intensity Duration Frequency Curves

