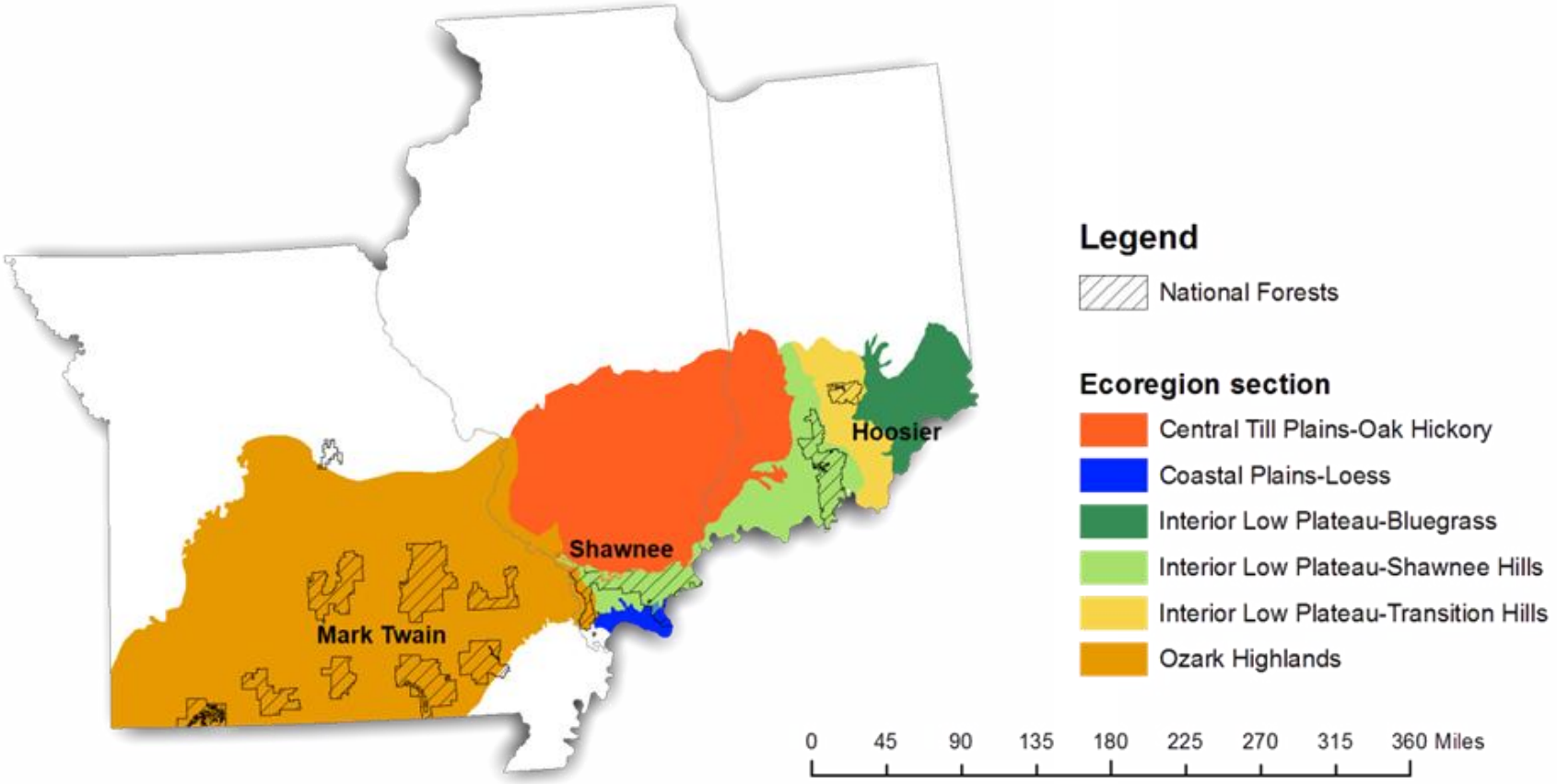
Central Hardwoods:
Past and Future Climate

Objectives

- Understand past climate changes in the area
- Know what models, scenarios, downscaling methods used
- See projected changes in climate under 2 scenarios

Assessment Area



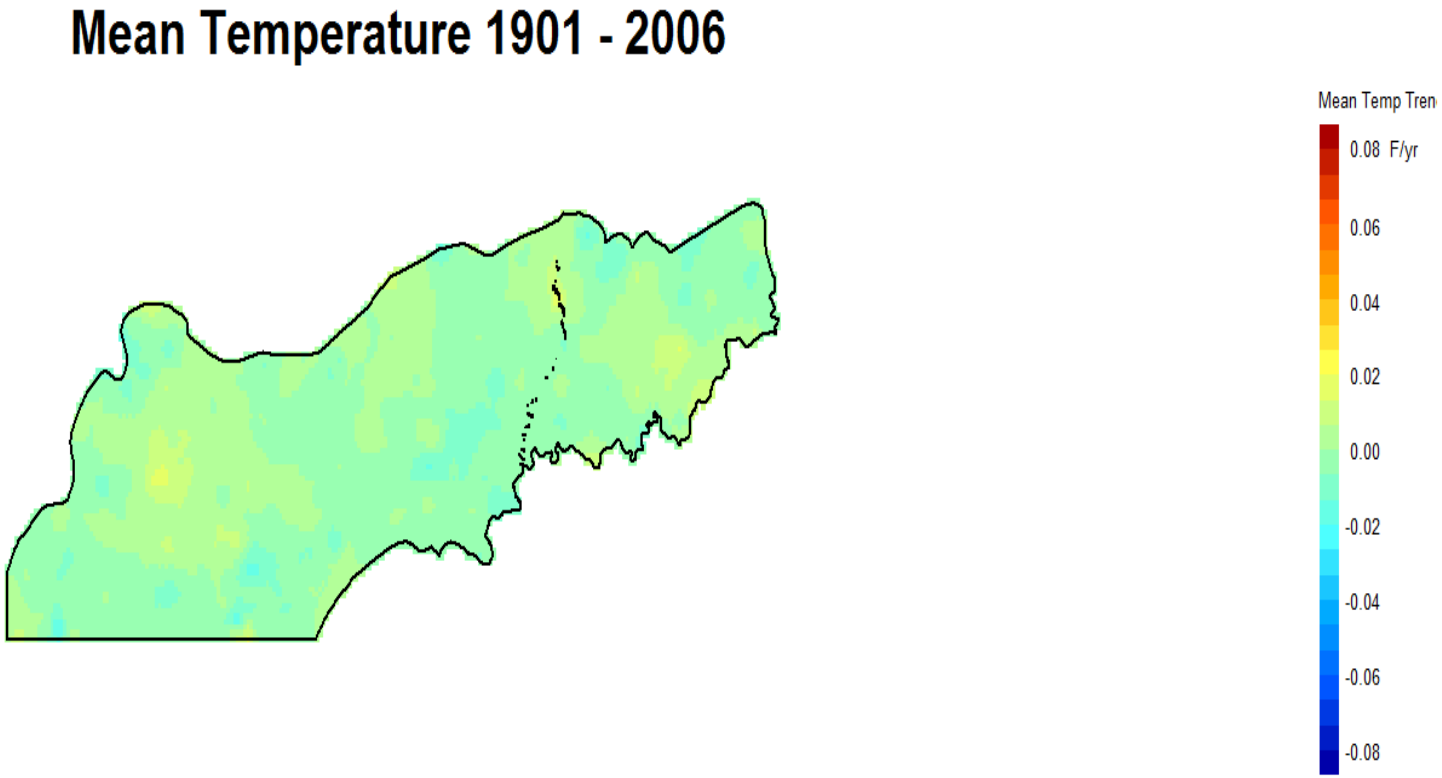
Ecological Subregions: Sections and Subsections of the Conterminous United States

Compiled at 1:500,000 to 1:1,000,000 scales in participation with Federal and State agencies and nongovernmental partners by David T. Cleland, Jerry A. Freeouf, James E. Keys, Jr., Gregory J. Nowacki, Constance A. Carpenter, and W. Henry McNab.

U.S. Department of Agriculture, Forest Service

PAST CLIMATE

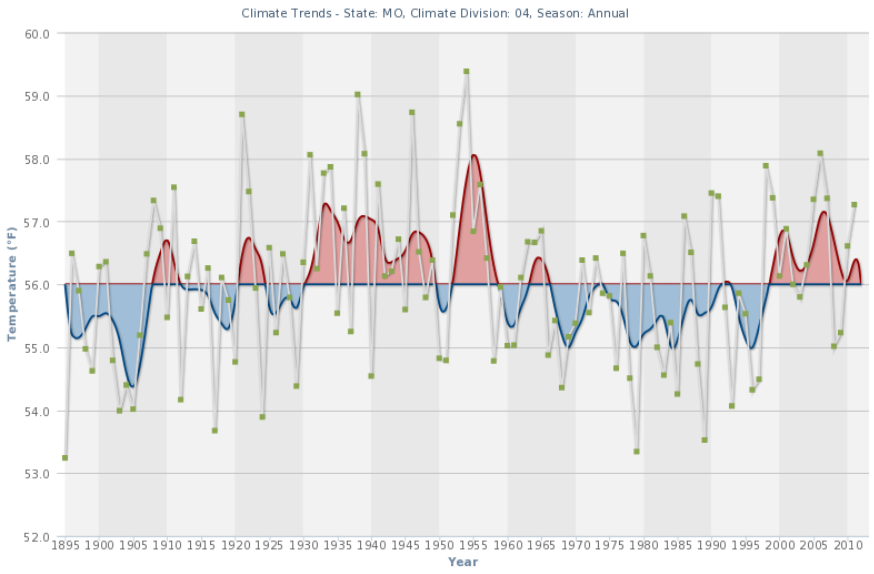
Little Change in Mean Annual Temperatures



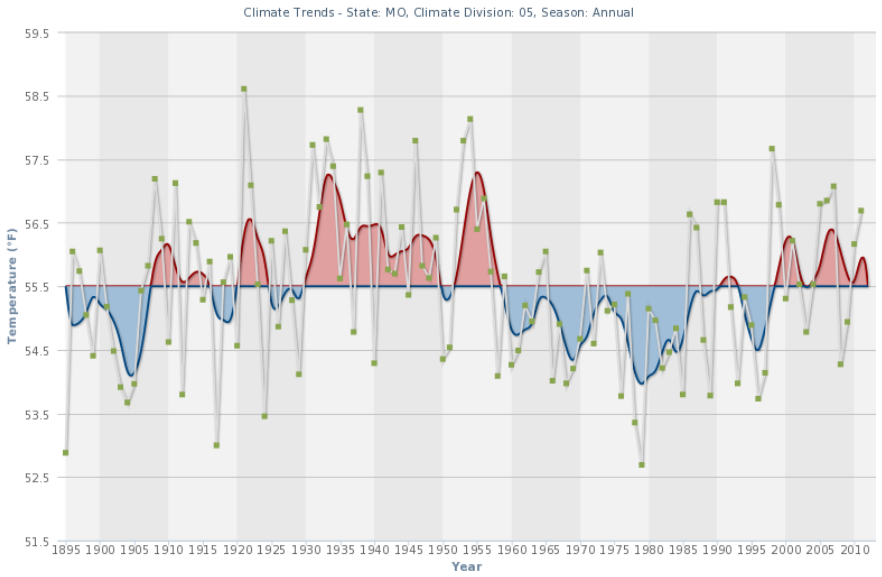
Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

Missouri Ozark Trends

Western Ozarks

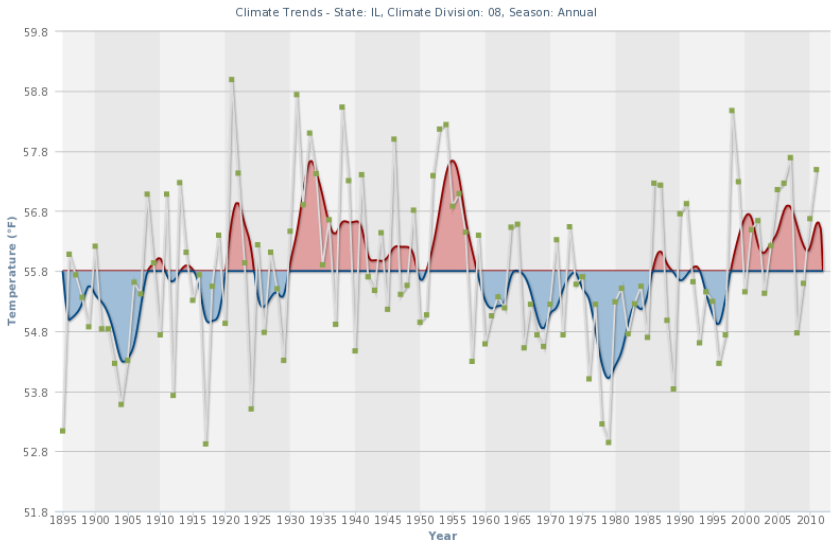


Eastern Ozarks

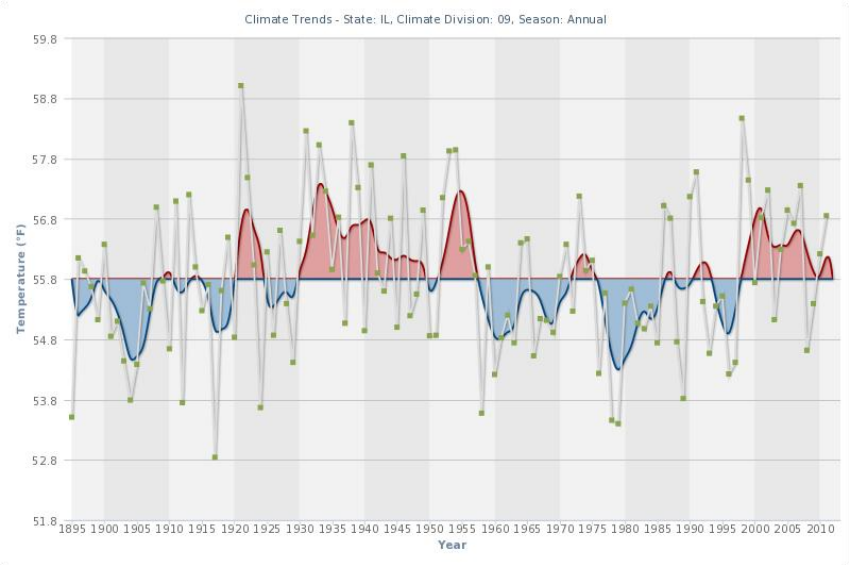


Southern Illinois Trends

Southwest

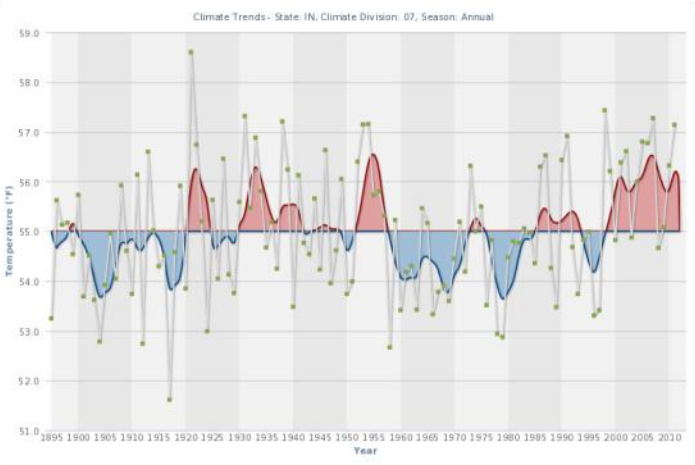


Southeast

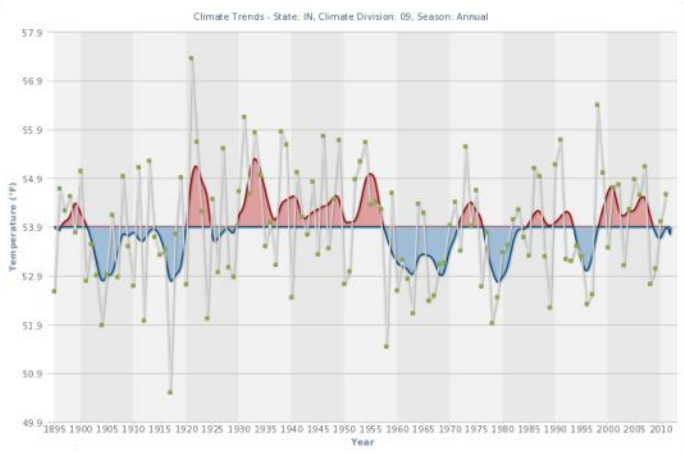


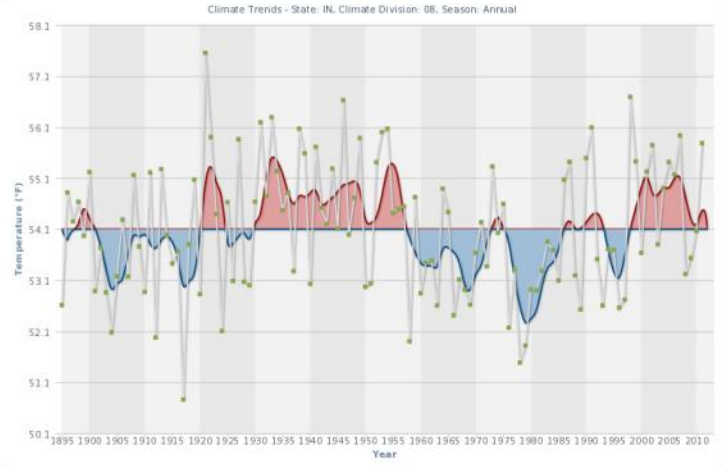
Southern Indiana Trends

Southwest Indiana



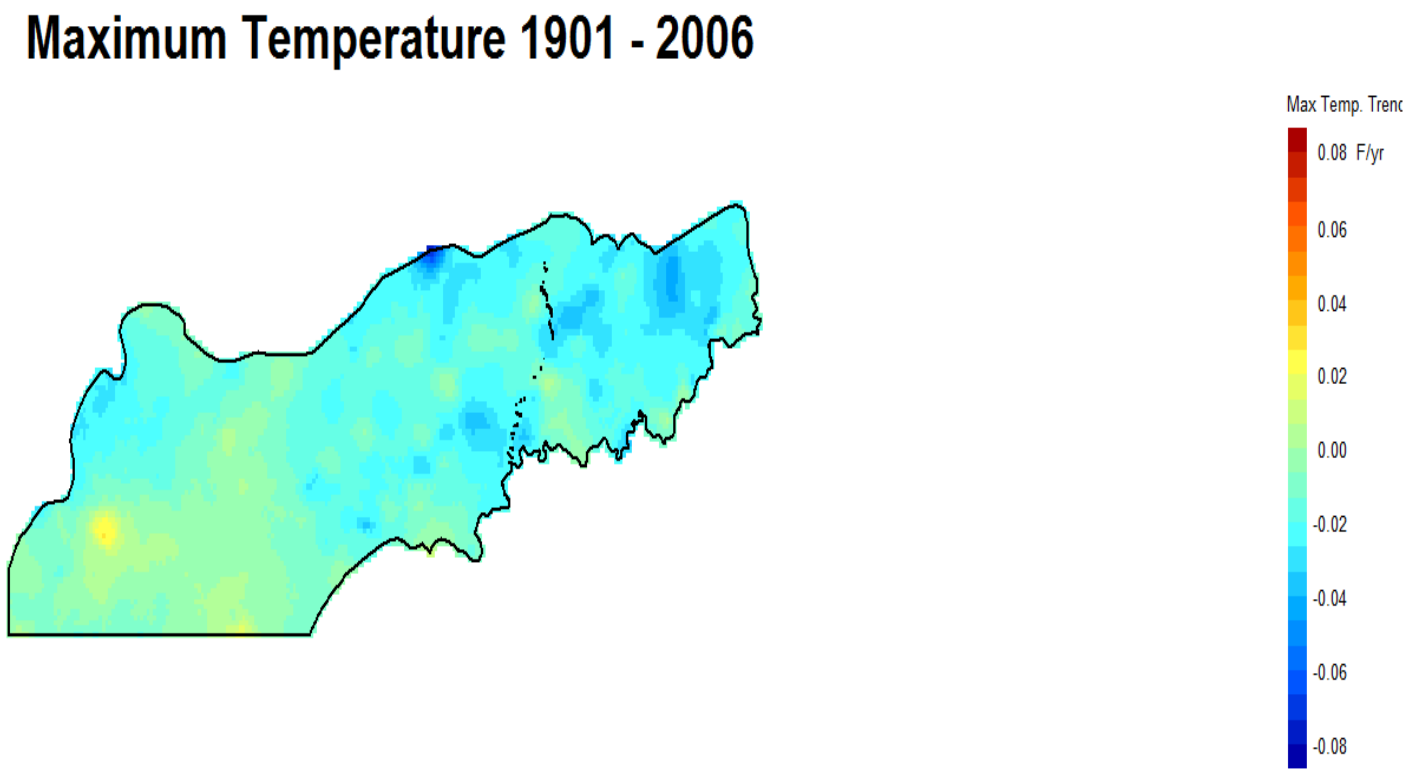
Southeast Indiana





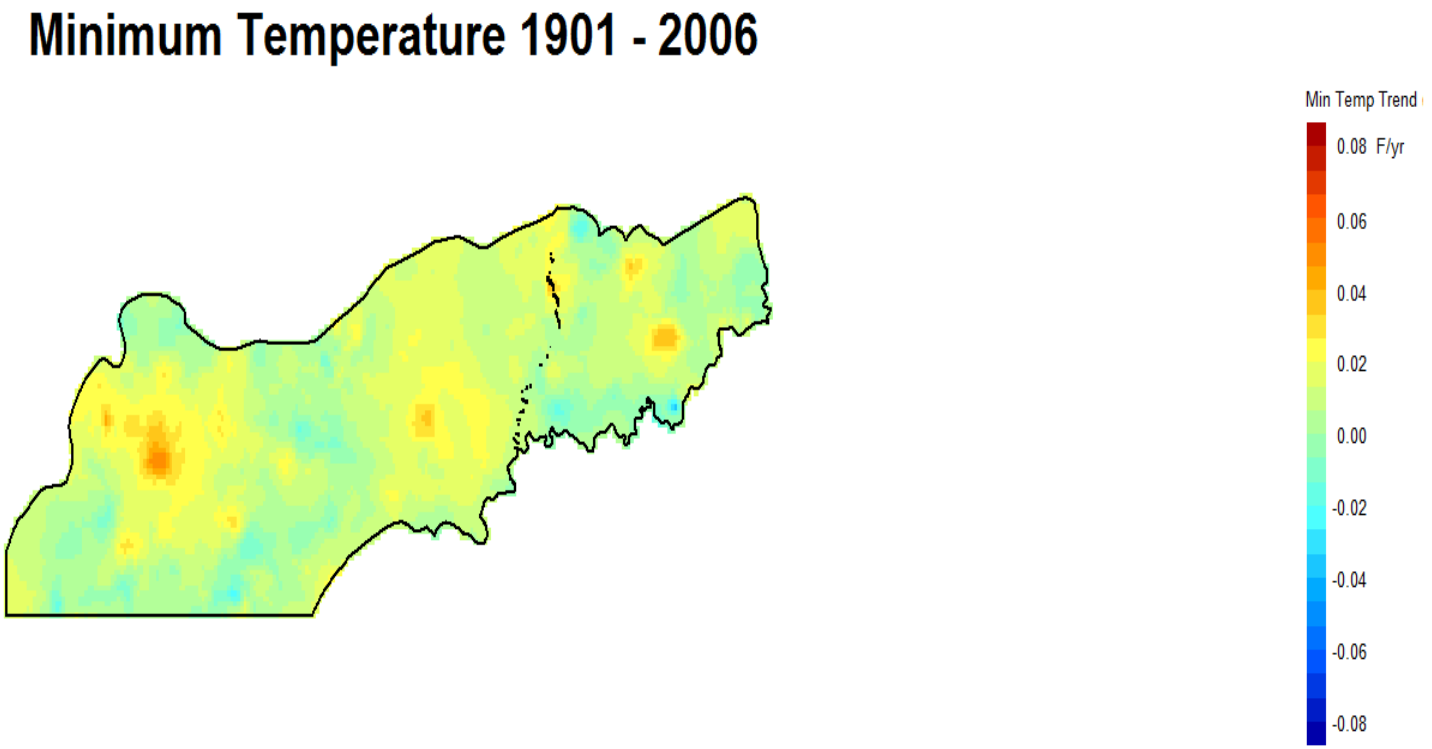
South-central Indiana

Summer Highs Decreasing



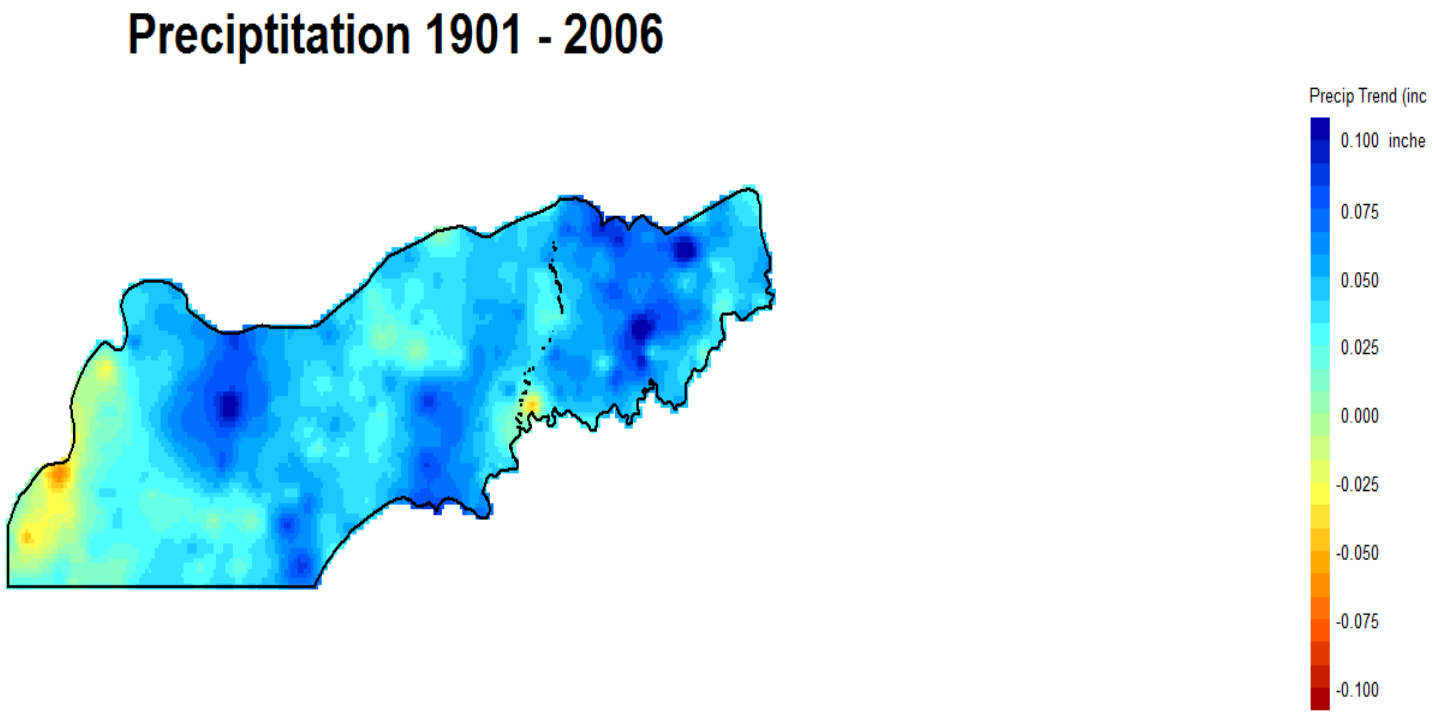
Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

Summer Lows Increasing



Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

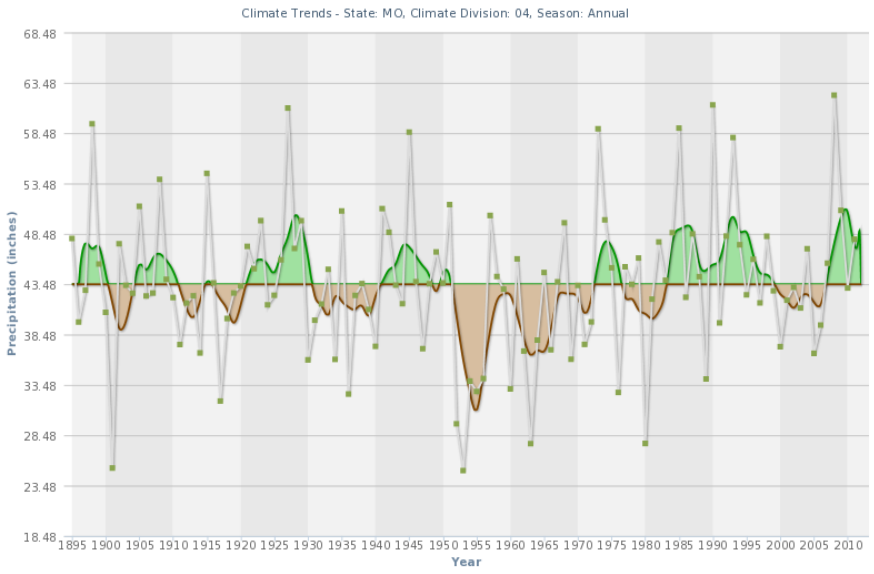
Area is Getting Wetter



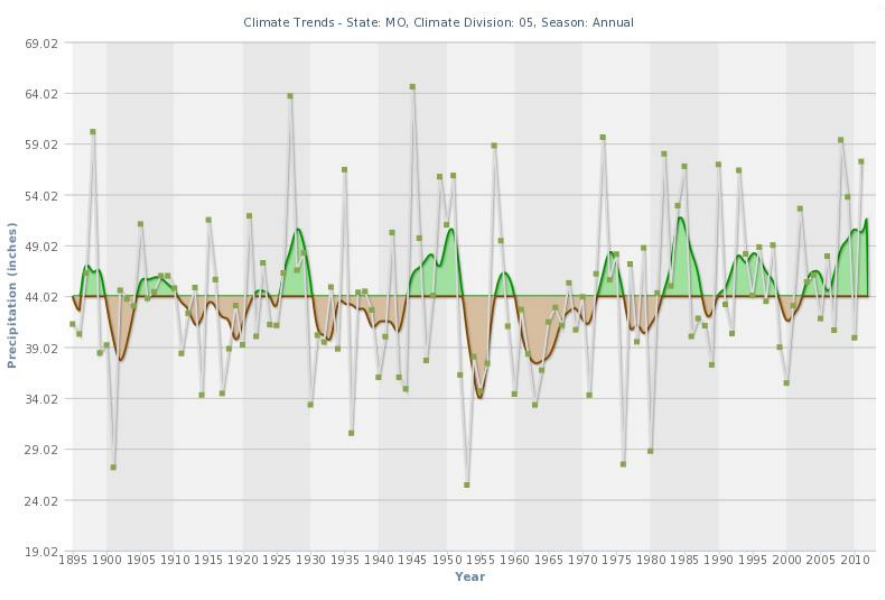
Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

Missouri Ozark Trends

Western Ozarks

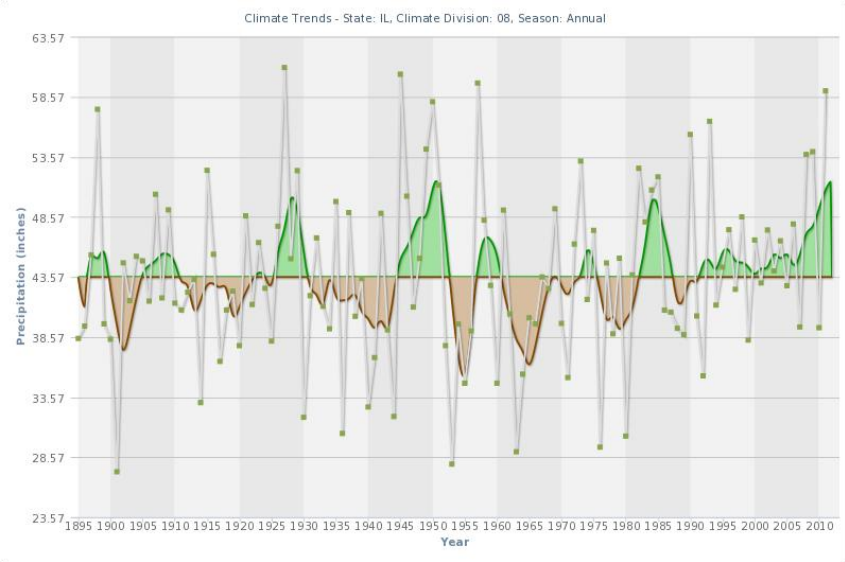


Eastern Ozarks

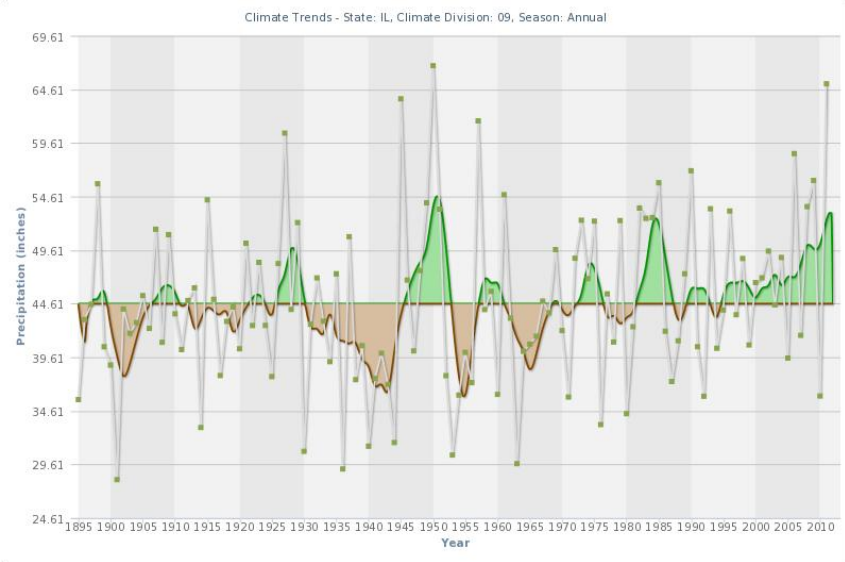


Southern Illinois Trends

Southwest

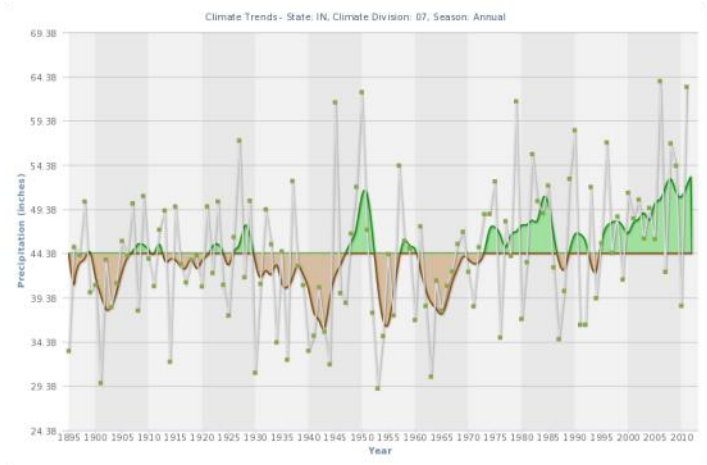


Southeast

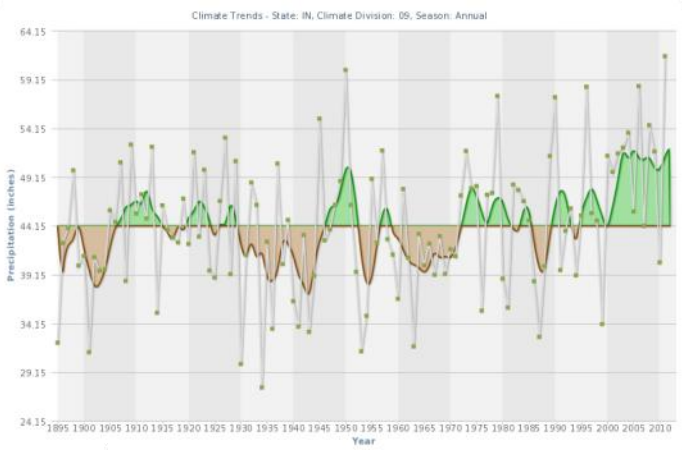


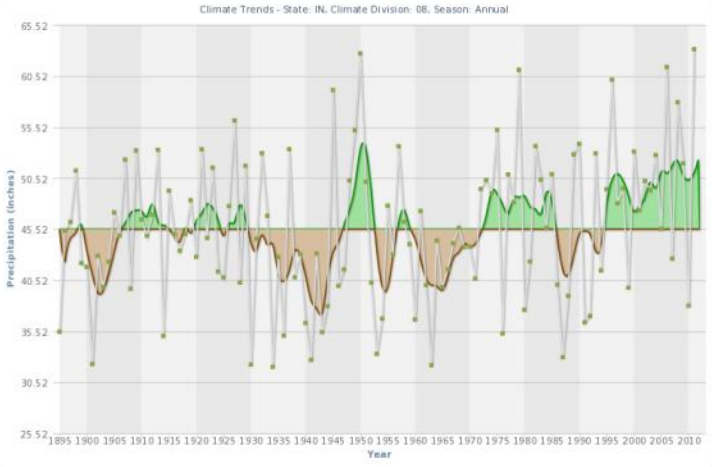
Southern Indiana Trends

Southwest Indiana



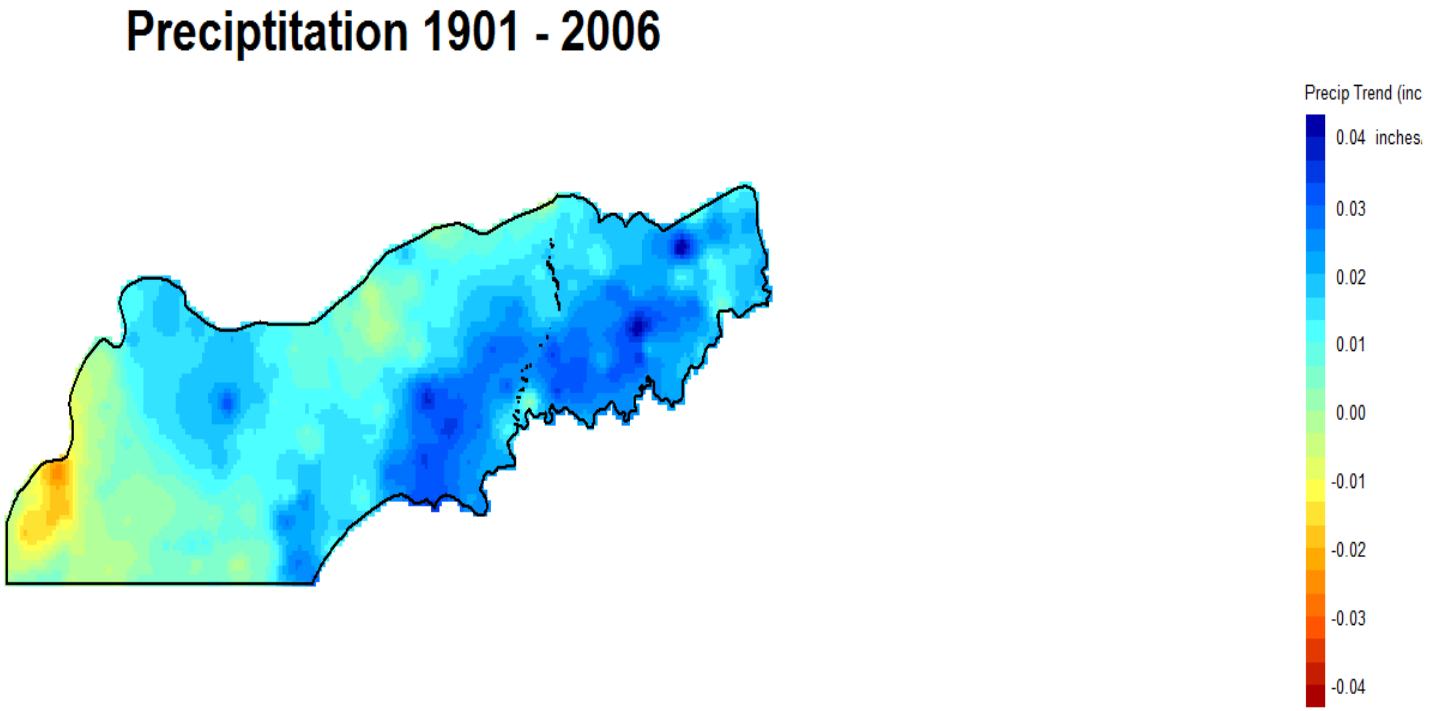
Southeast Indiana



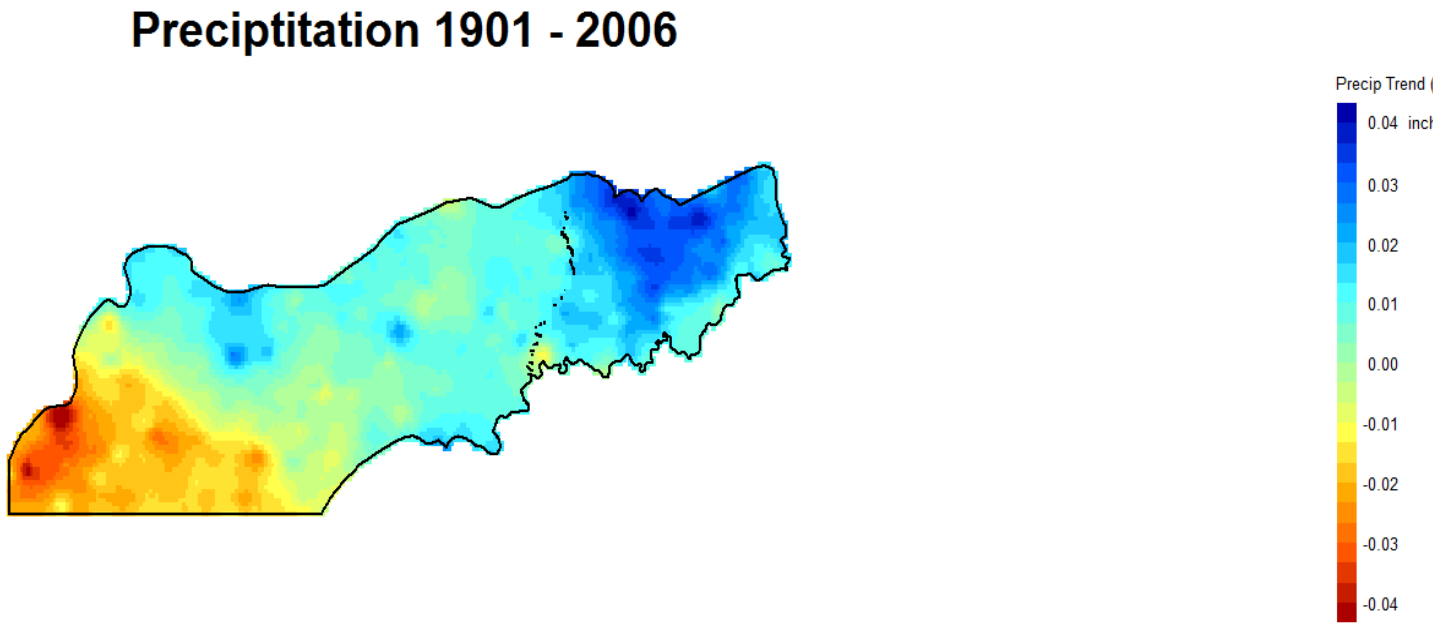


South-central Indiana

Wetter Spring

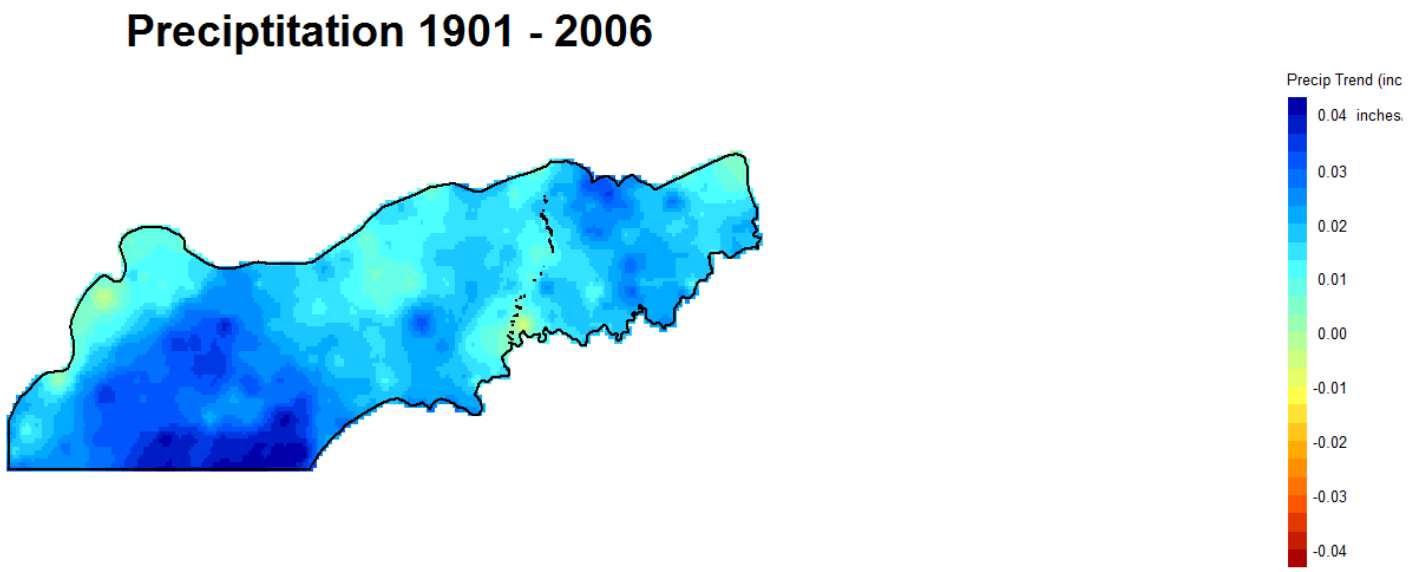


Shifts in Summer Precipitation

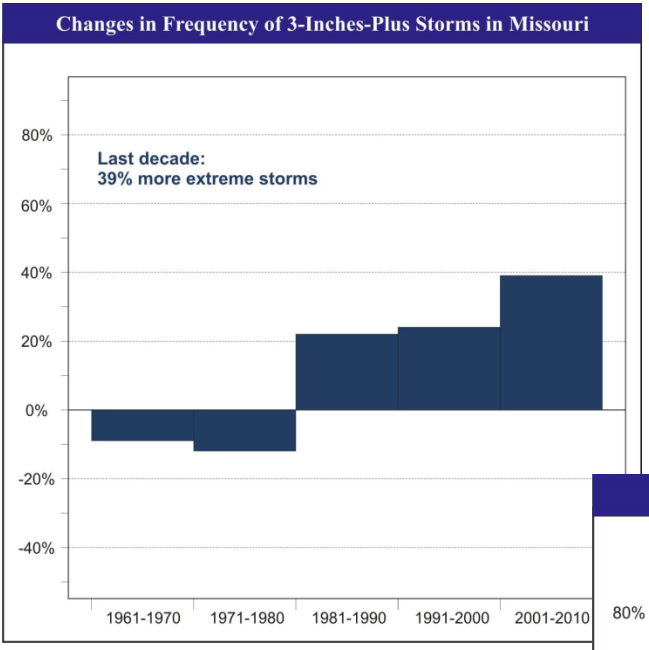


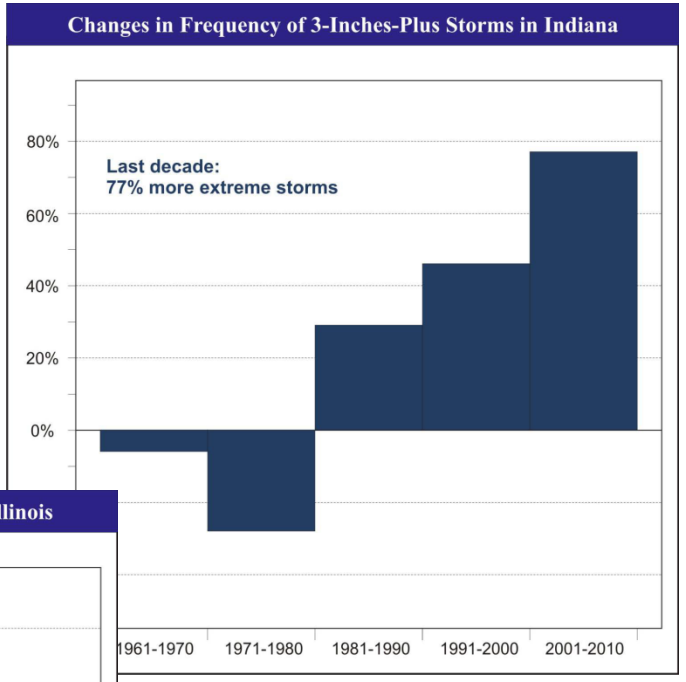
Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

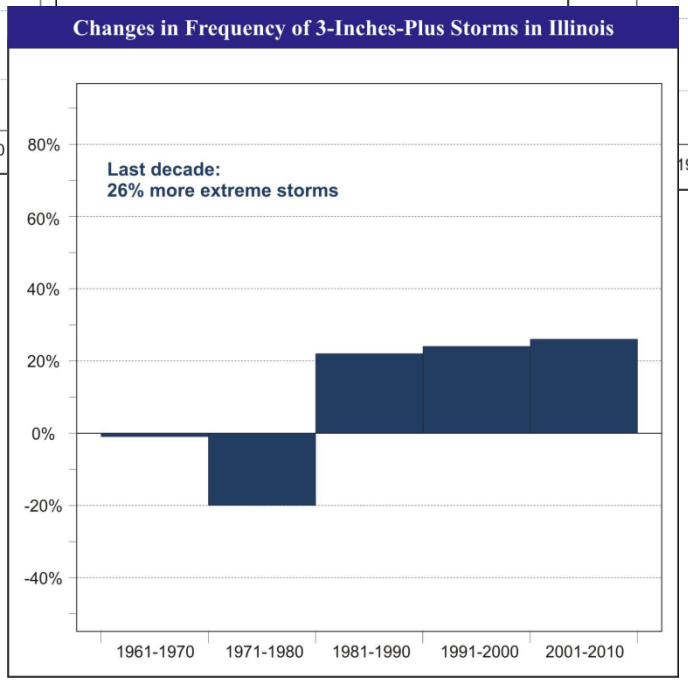
Wetter Fall


Preciptitation 1901 - 2006
Precip Trend (inc
0.04 inches
0.03
0.02
0.01
0.00
-0.01
-0.02
-0.03
-0.04
Map produced by ClimateWizard (c) University of Washington and The Nature Conservancy, 2012.
Base climate data from the PRISM Group, Oregon State University, http://www.prismclimate.org

More Heavy Precipitation Events





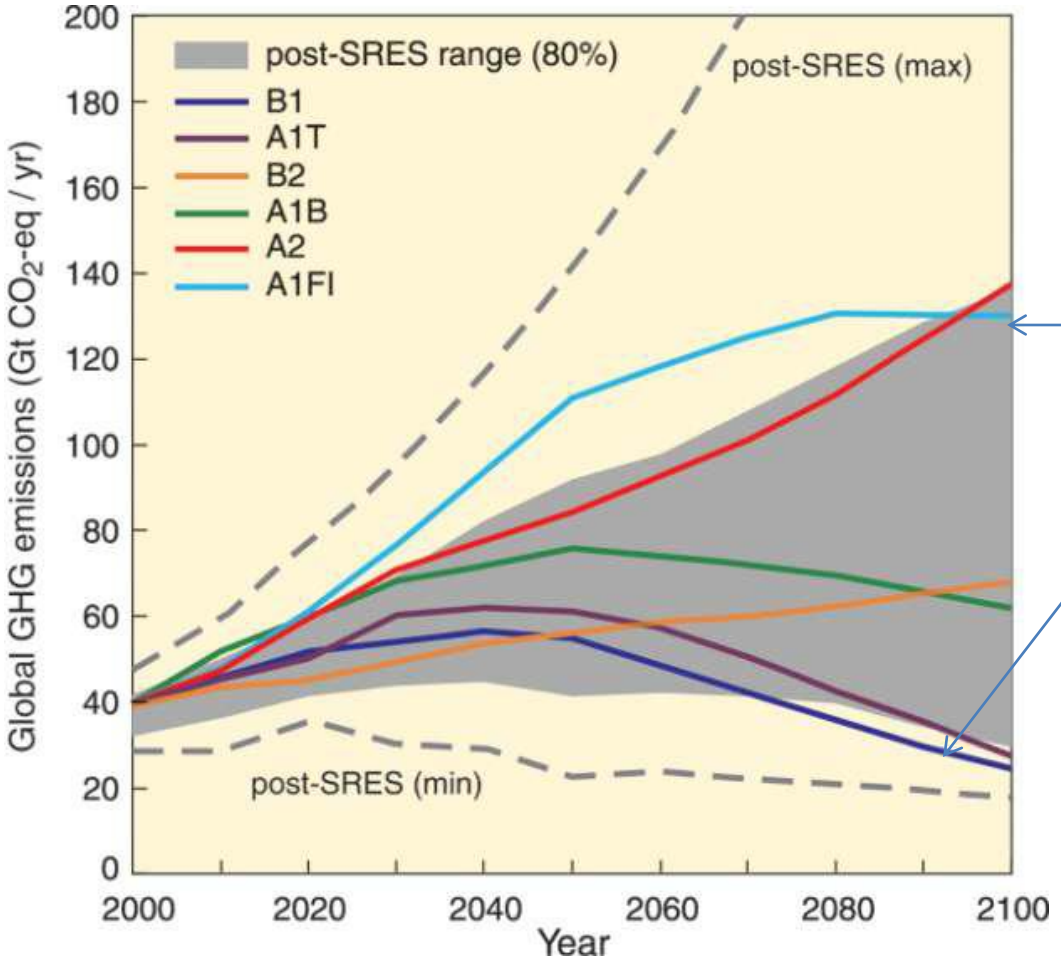


Saunders et al. 2012

MODELING INTRODUCTION

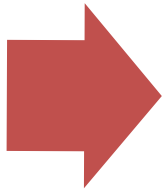
1. **Emission scenarios** developed and used as inputs

Emission Scenarios



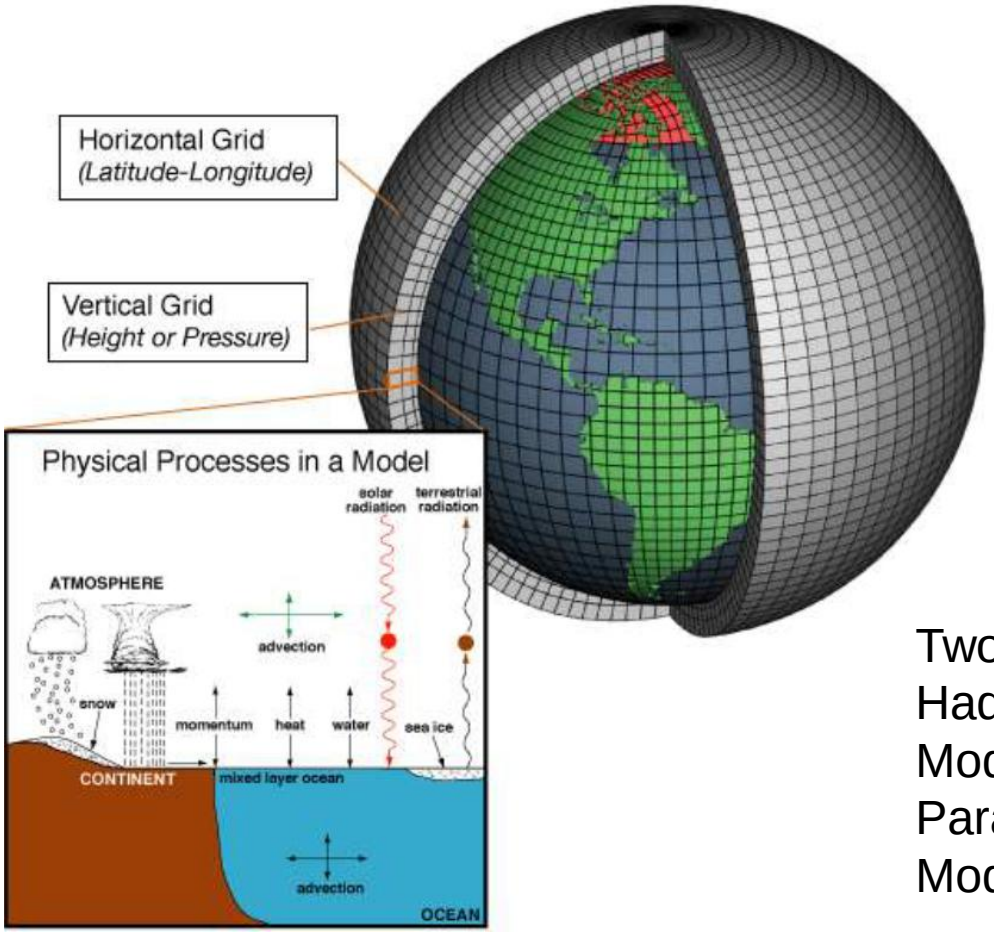
Emission Scenarios used

1. **Emission scenarios** developed and used as inputs



2. Models projections are run using **GCMs**

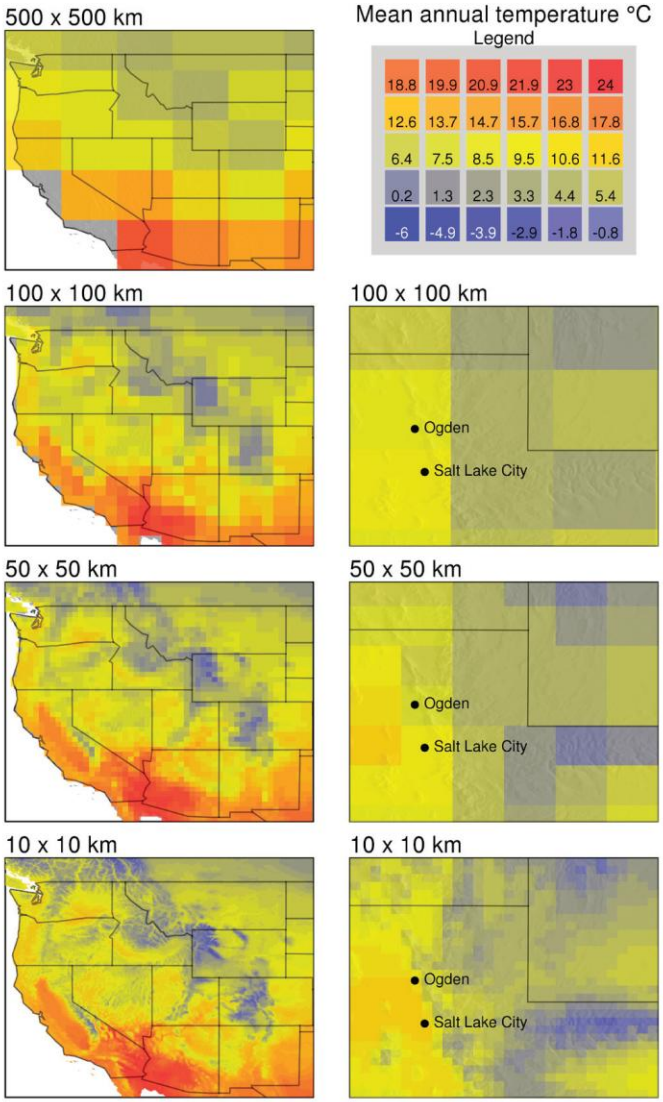
Generalized Circulation Models



Two models:
Hadley Climate Model (HadCM3)
Parallel Climate Model (PCM)


1. **Emission scenarios** developed and used as inputs
2. Models projections are run using **GCMs**
3. GCM projections are **downscaled** to a smaller grid scale

Downscaling

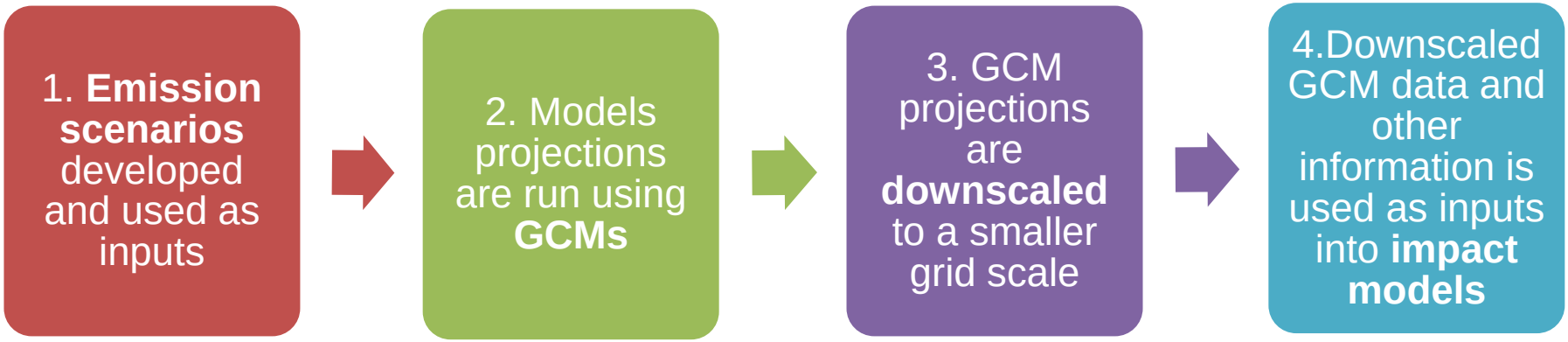


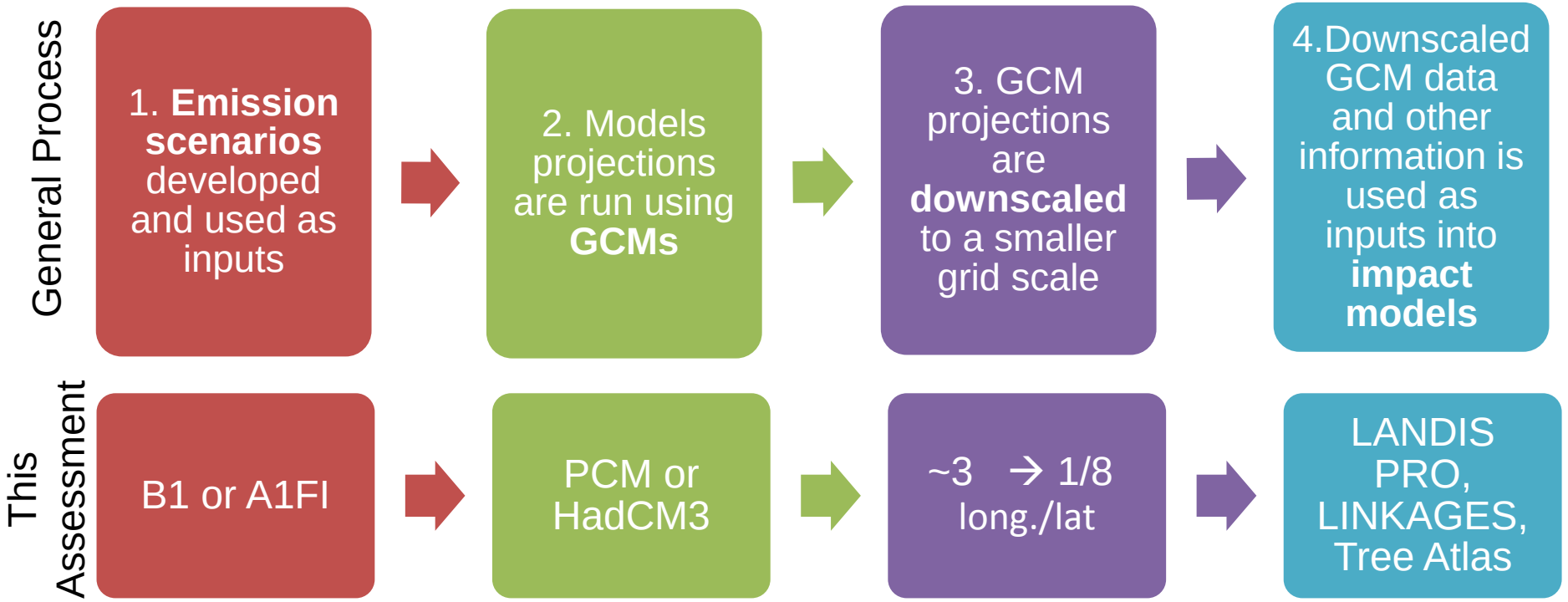
GCMs

Dynamically Downscaled

Statistically Downscaled

12 km


1. **Emission scenarios** developed and used as inputs
2. Models projections are run using **GCMs**
3. GCM projections are **downscaled** to a smaller grid scale
4.Downscaled GCM data and other information is used as inputs into **impact models**


General Process
1. **Emission scenarios** developed and used as inputs
2. Models projections are run using **GCMs**
3. GCM projections are **downscaled** to a smaller grid scale
4.Downscaled GCM data and other information is used as inputs into **impact models**
This Assessment
B1 or A1FI
PCM or HadCM3
~3 → 1/8 long./lat
LANDIS PRO, LINKAGES, Tree Atlas

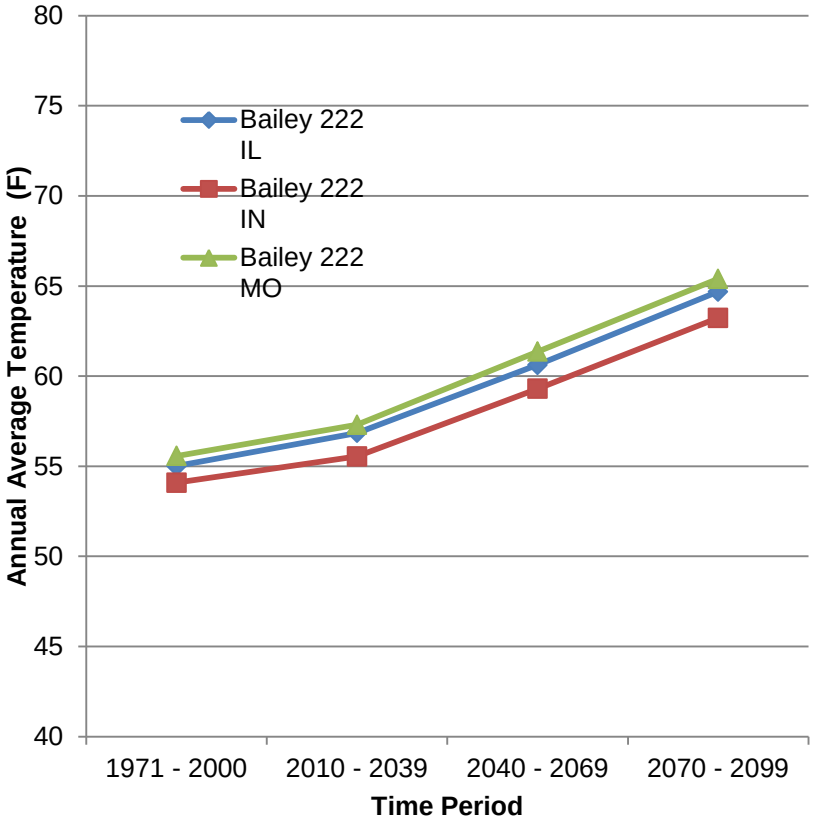
Impact Models

- VIC-hydrology
- Forest Change
  - Statistically-based: Tree Atlas
  - Process-based:
    - LINKAGES
    - LANDIS Pro

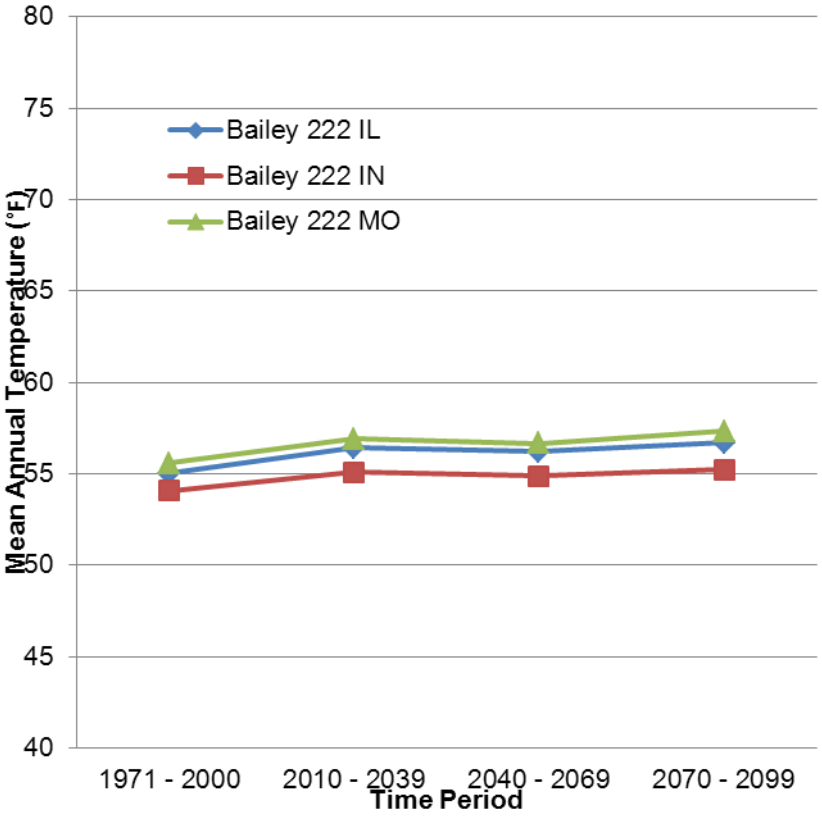
PROJECTED CLIMATE

Mean Temperatures

Hadley-Hi

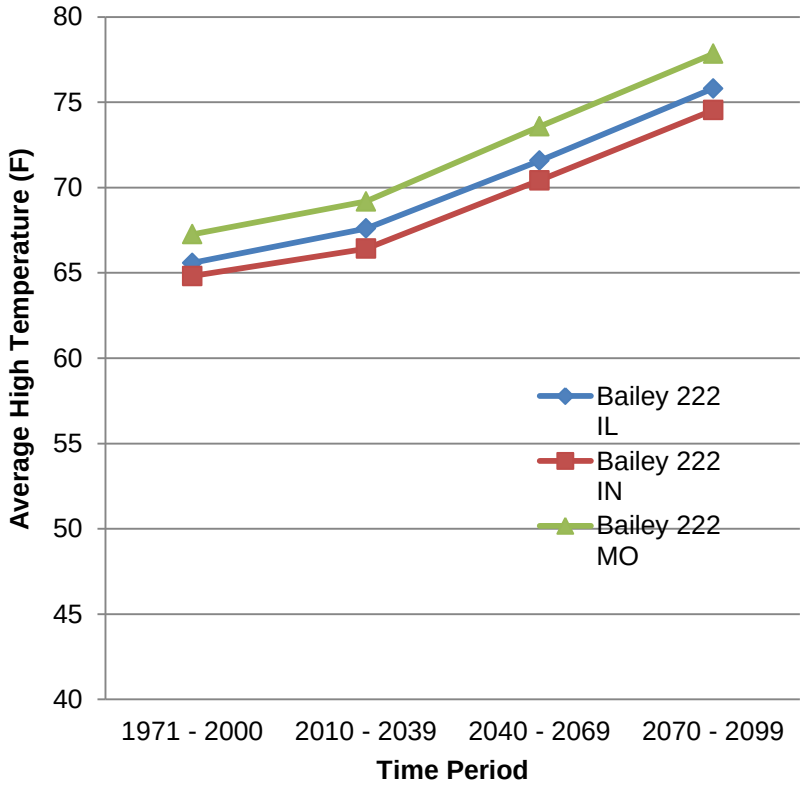


PCM-Lo

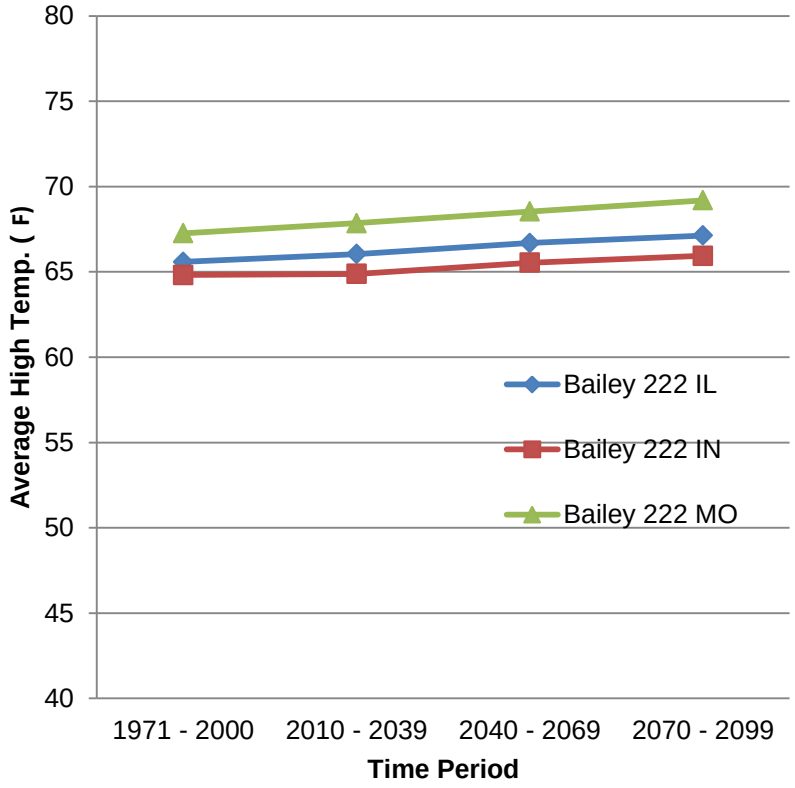


Average High Temperature

Hadley-Hi

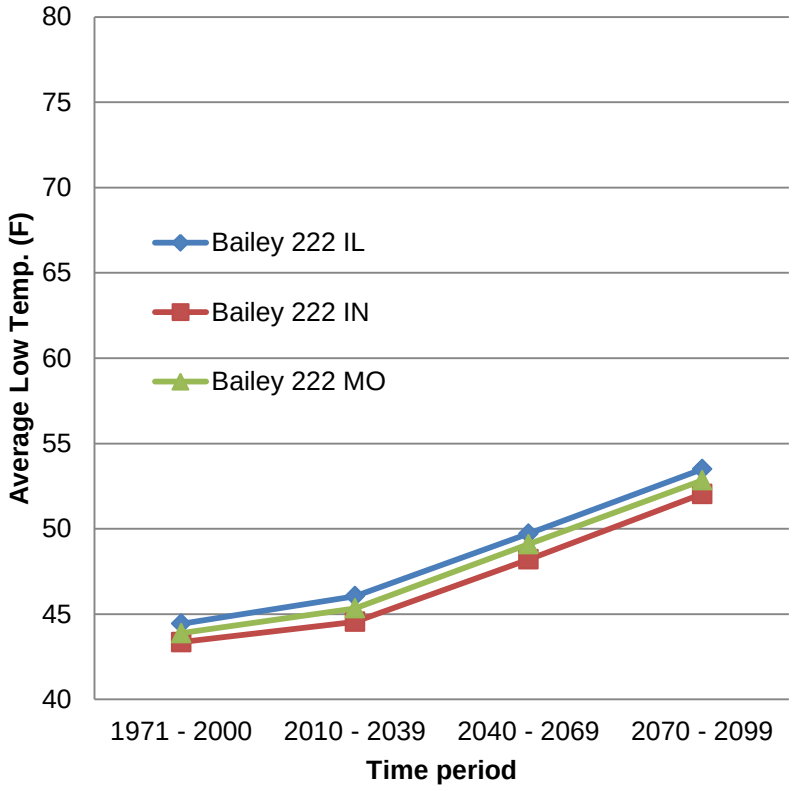


PCM-lo

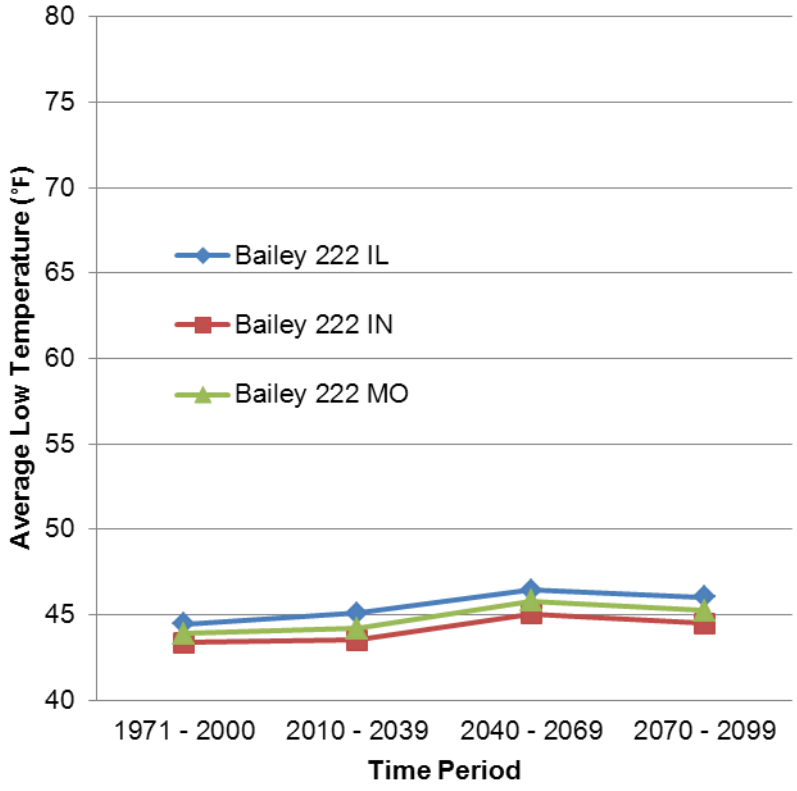


Average Low Temperature

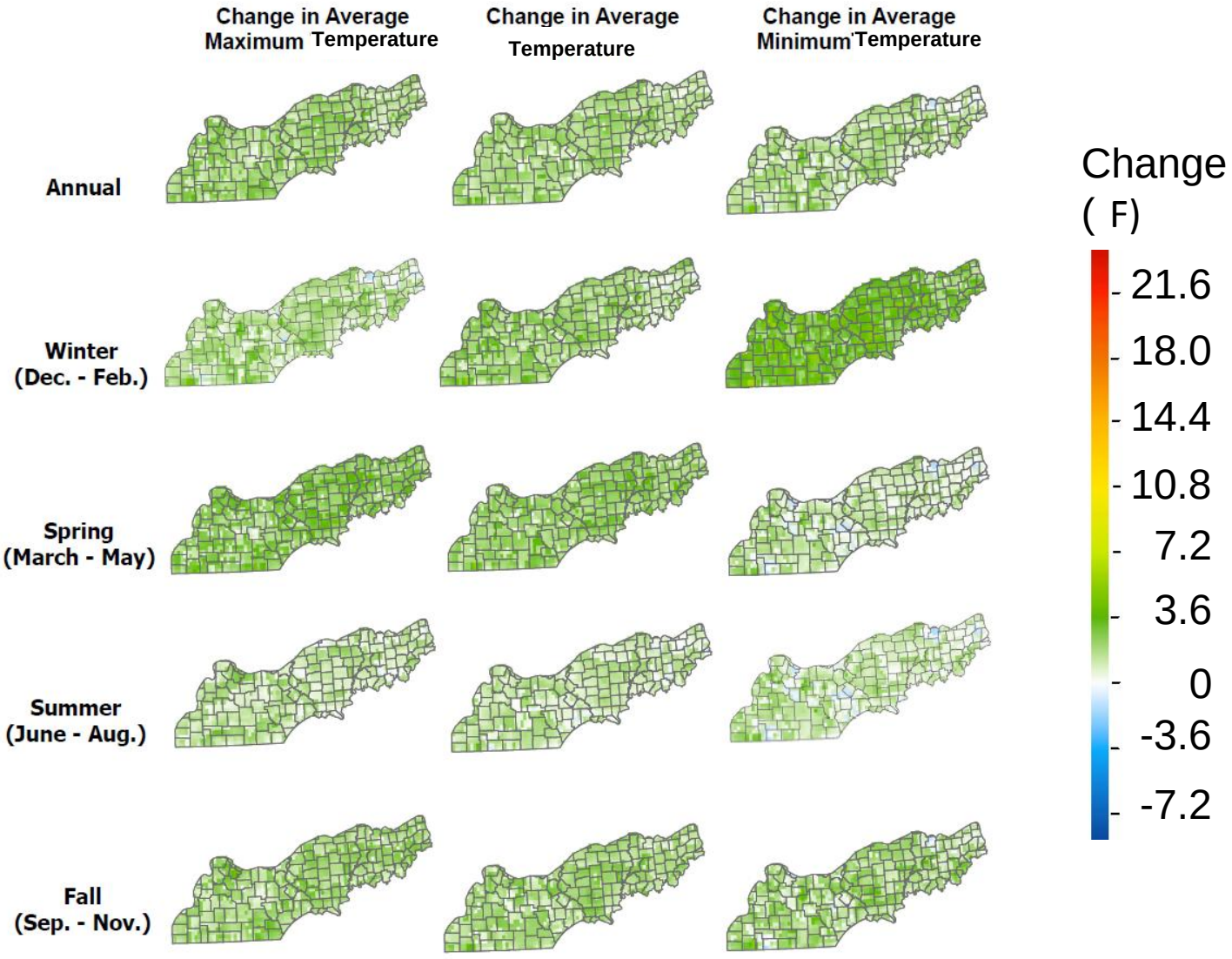
Hadley-Hi



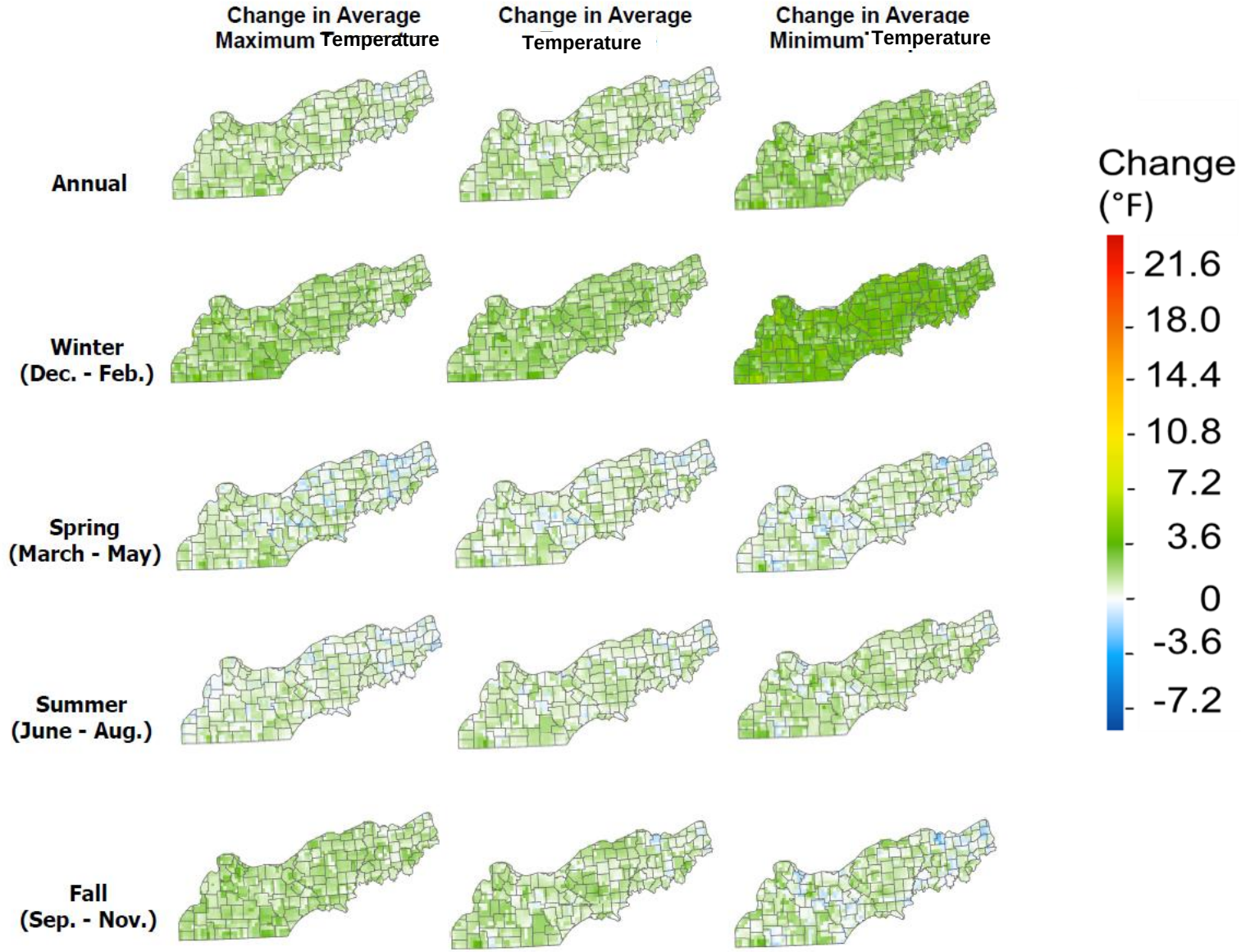
PCM-lo

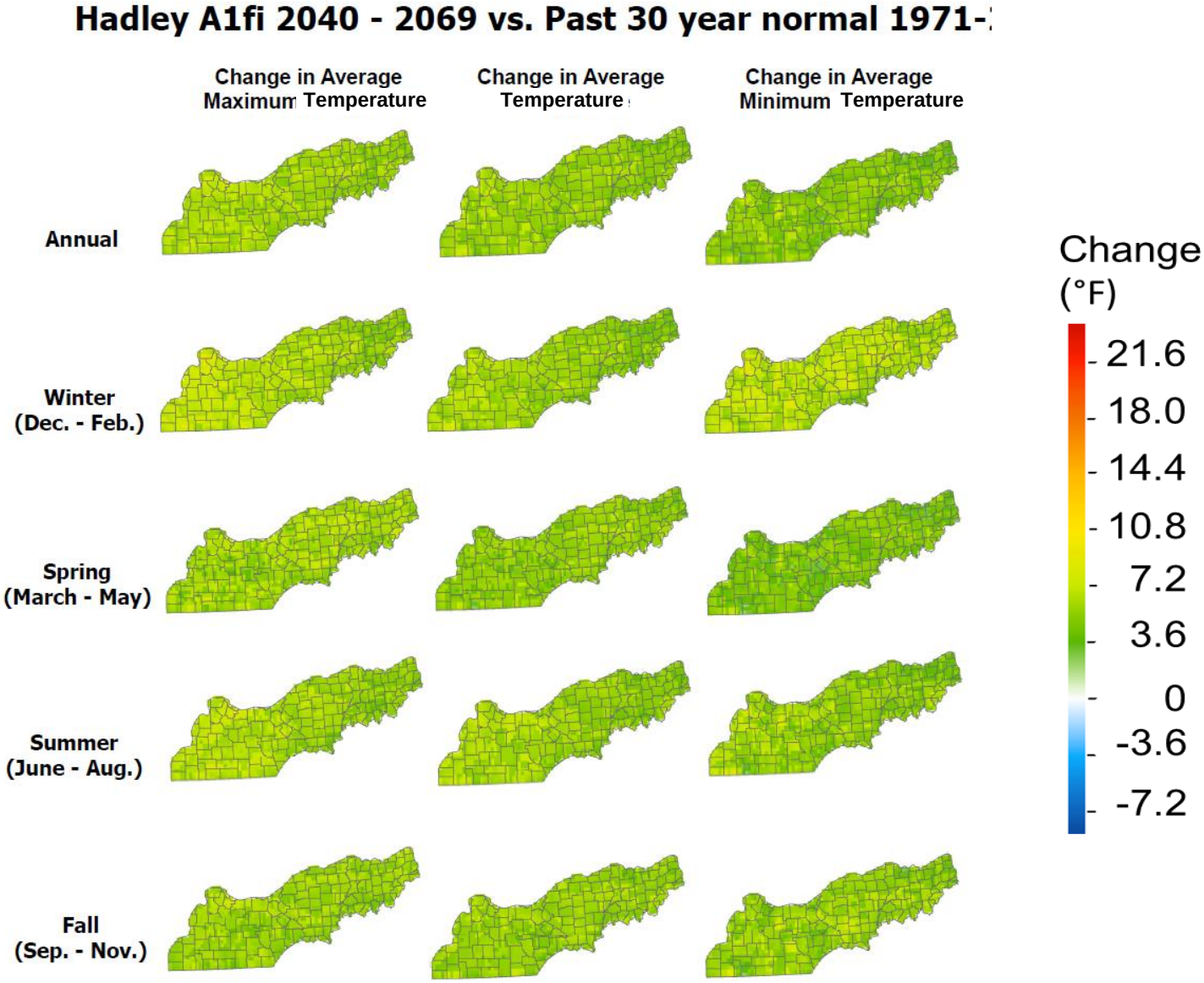


Hadley A1fi 2010 - 2039 vs. Past 30 year normal 1971-2000

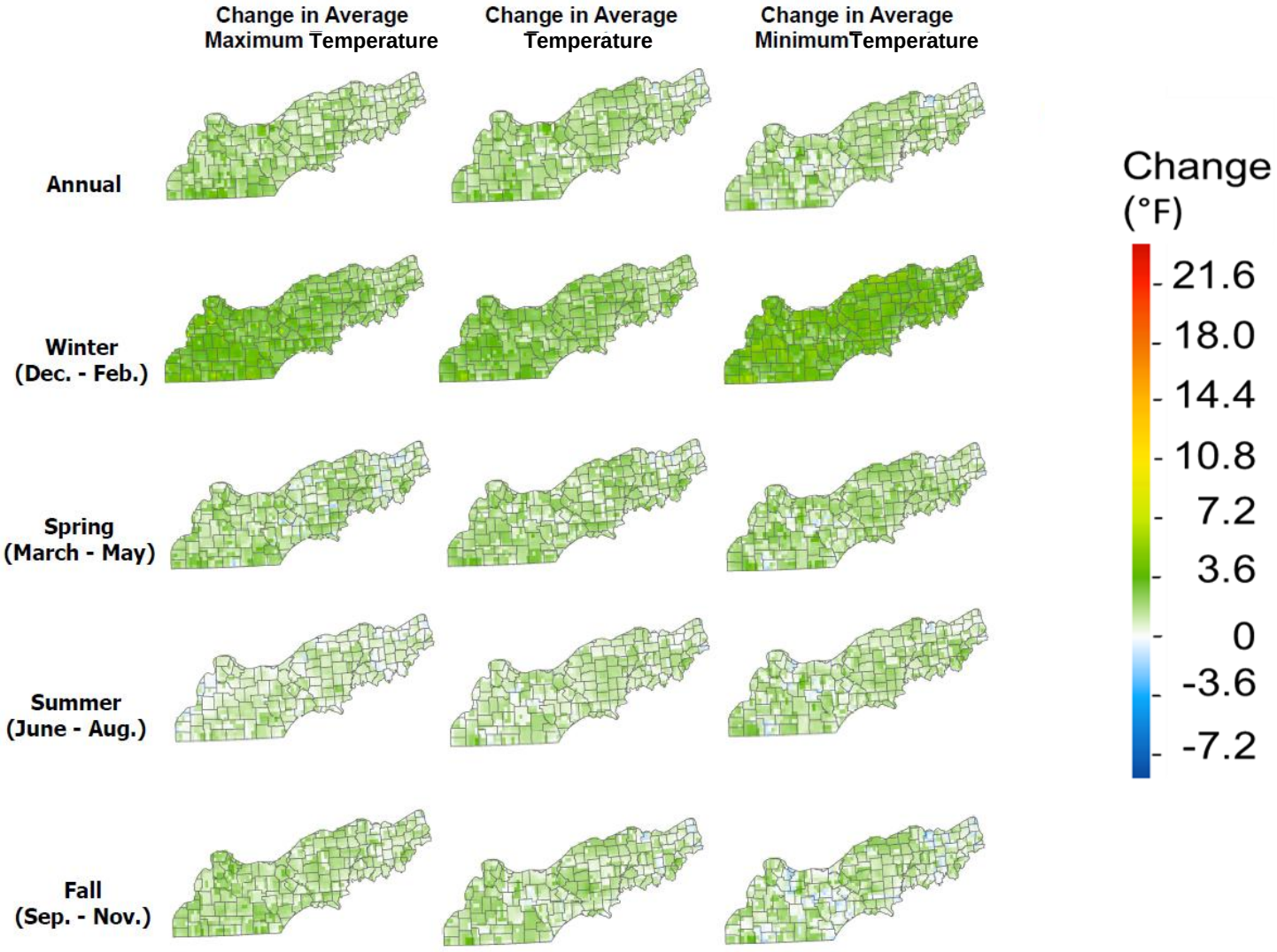


PCM B1 2040 - 2069 vs. Past 30 year normal 1971-2000

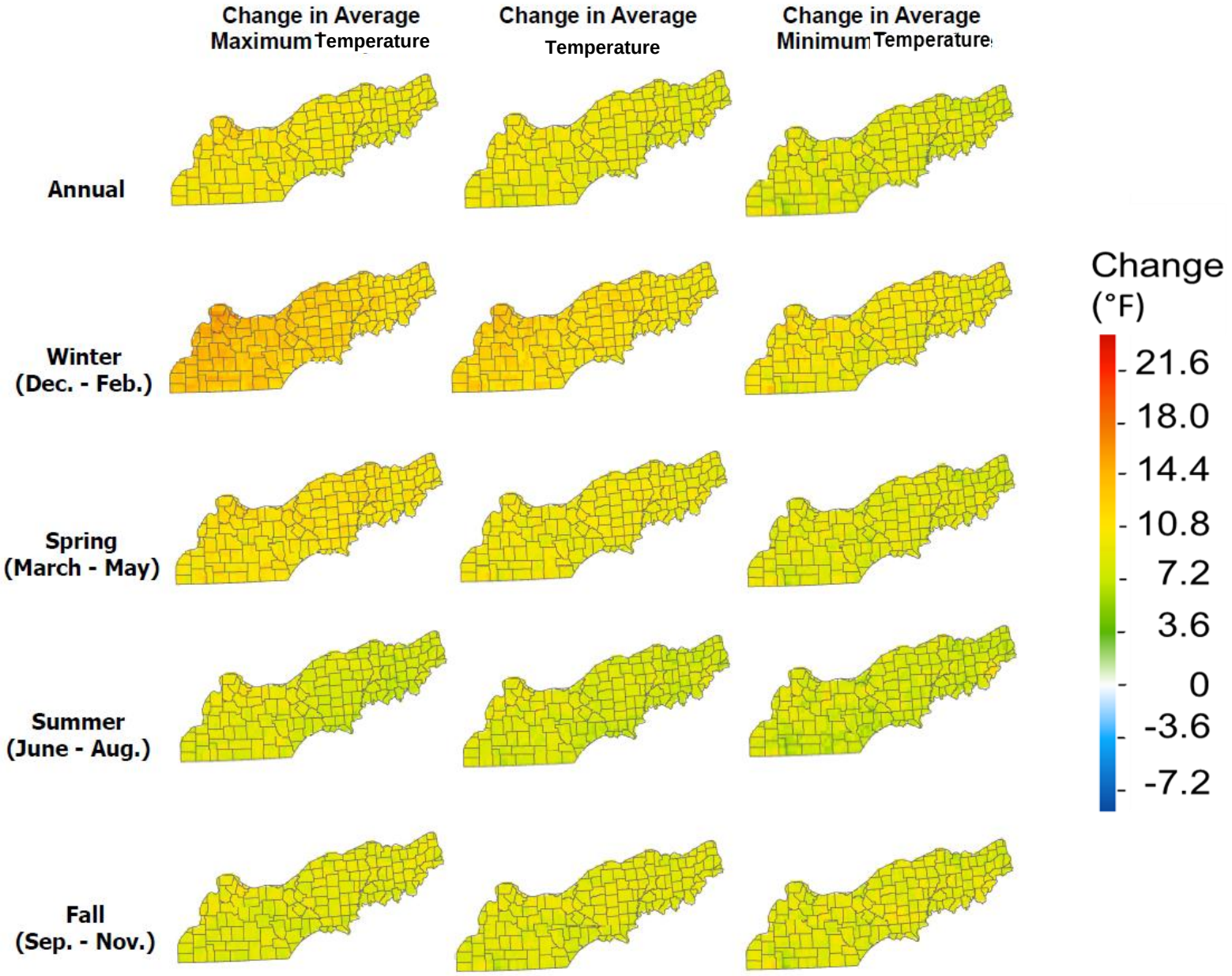



Hadley A1fi 2040 - 2069 vs. Past 30 year normal 1971-
Change in Average Maximum Temperature
Change in Average Temperature
Change in Average Minimum Temperature
Annual
Winter (Dec. - Feb.)
Spring (March - May)
Summer (June - Aug.)
Fall (Sep. - Nov.)
Change (°F)
21.6
18.0
14.4
10.8
7.2
3.6
0
-3.6
-7.2

Change in average temperature (°C)
PCM B1 2070 - 2099 vs. Past 30 year normal 1971-2000

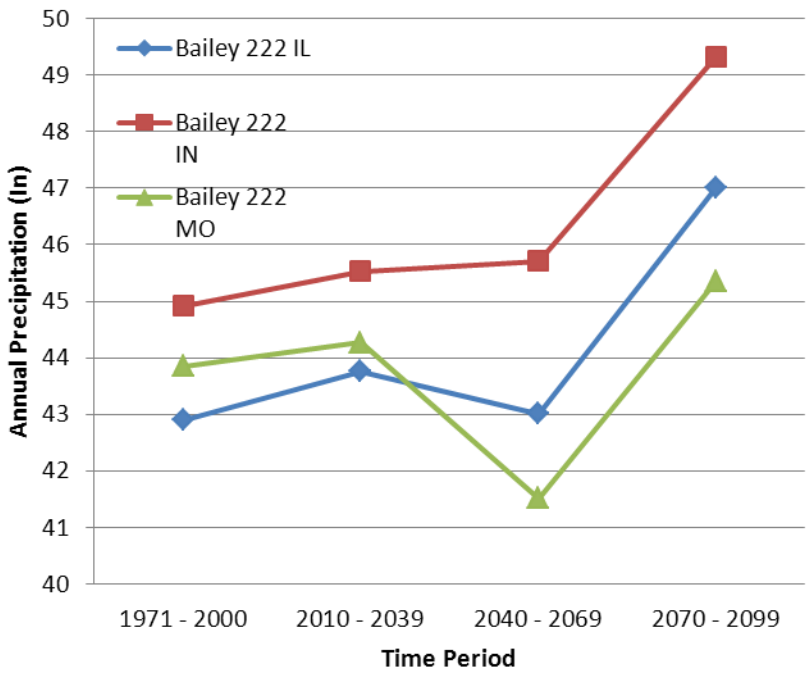


Hadley A1fi 2070 - 2099 vs. Past 30 year normal 1971-20

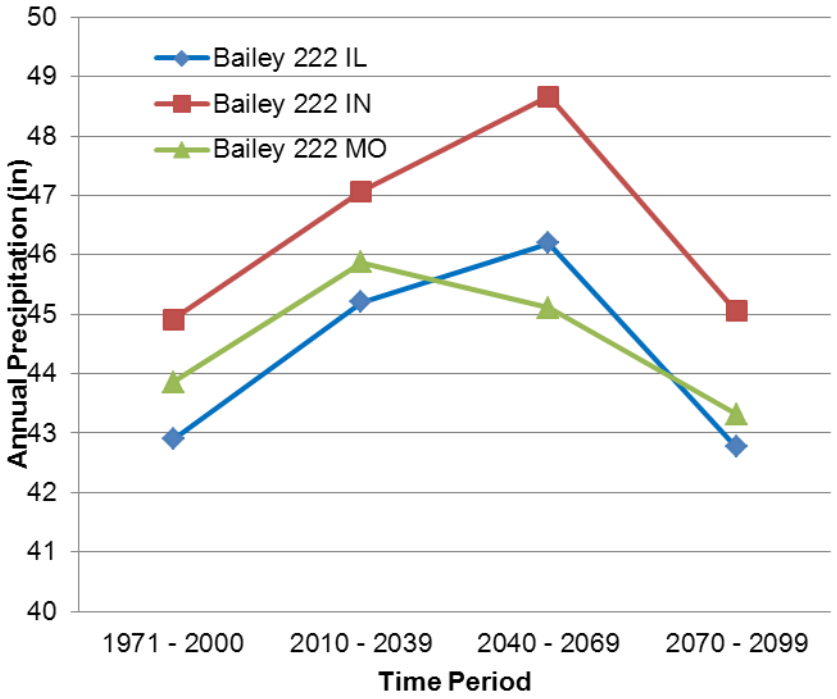


Annual Precipitation

Hadley Hi

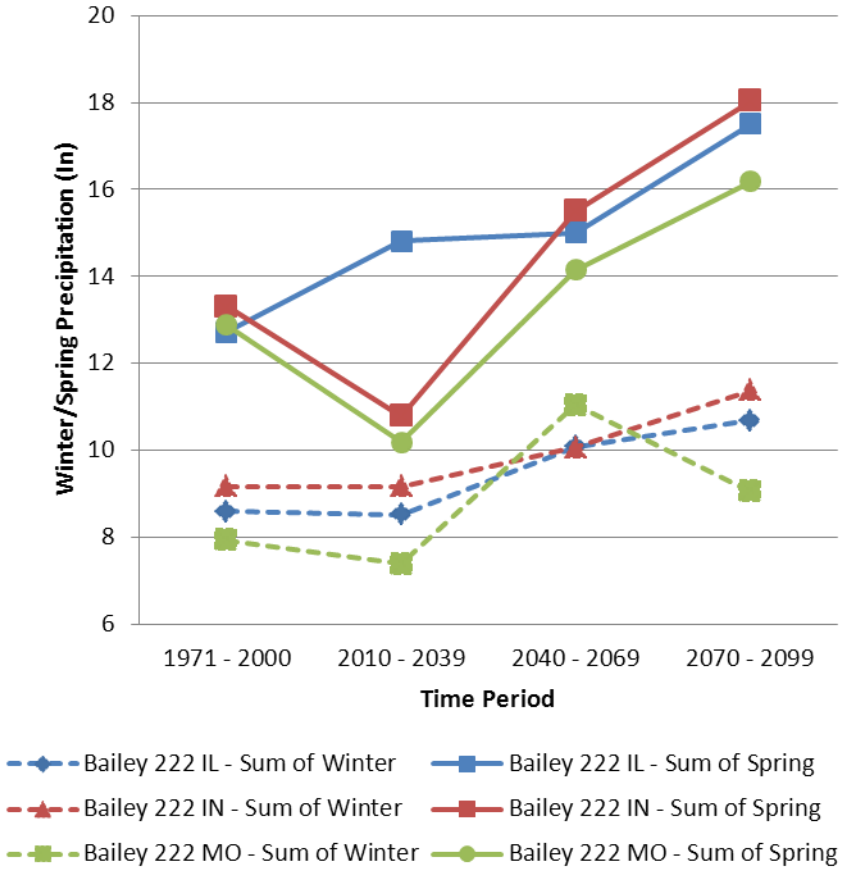


PCM-lo

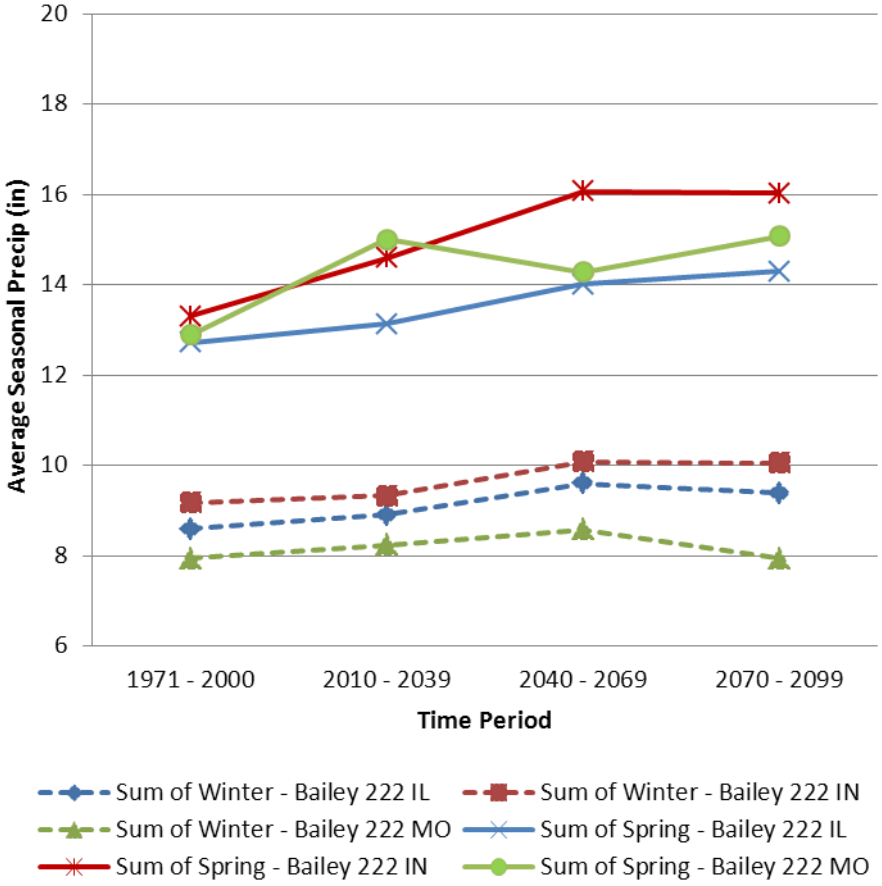


Winter/Spring Precipitation

Hadley-hi

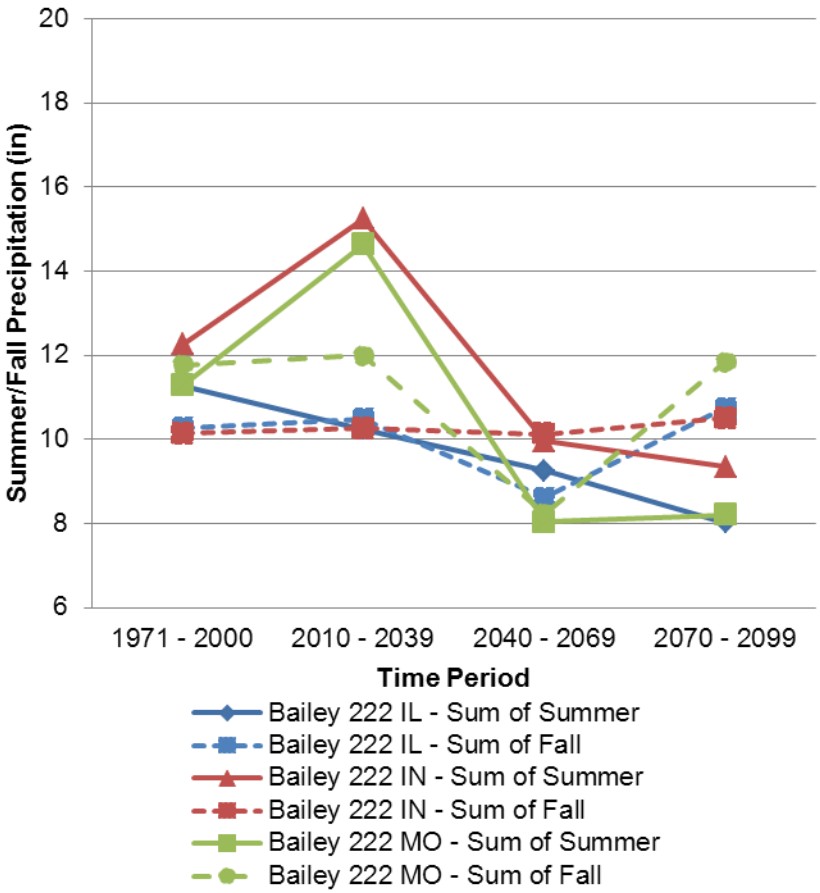


PCM lo

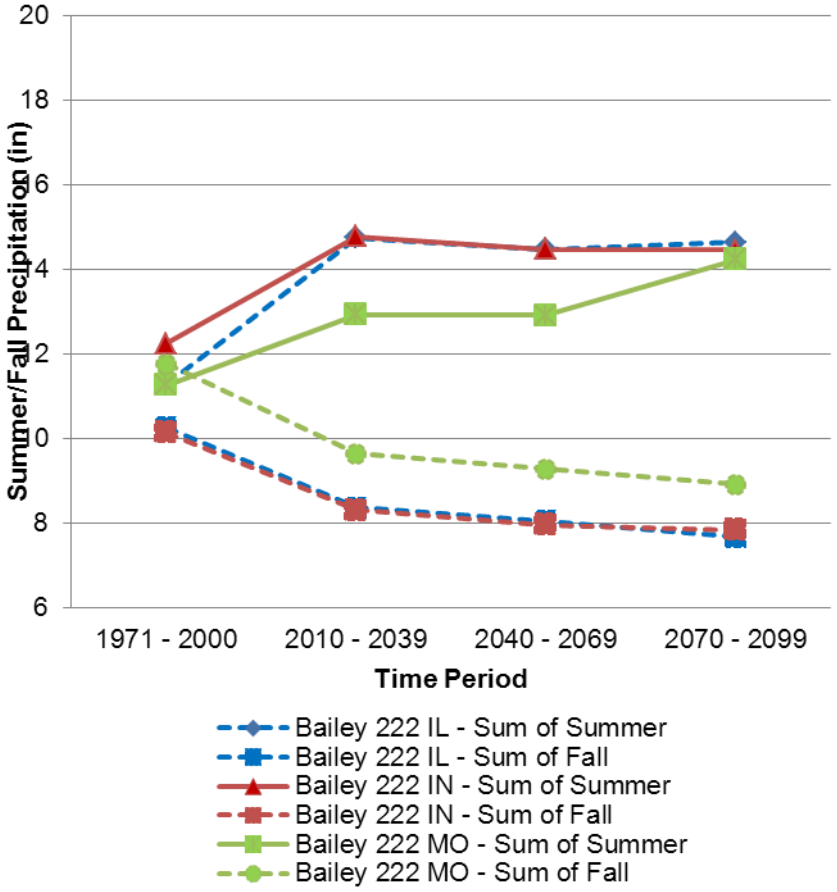


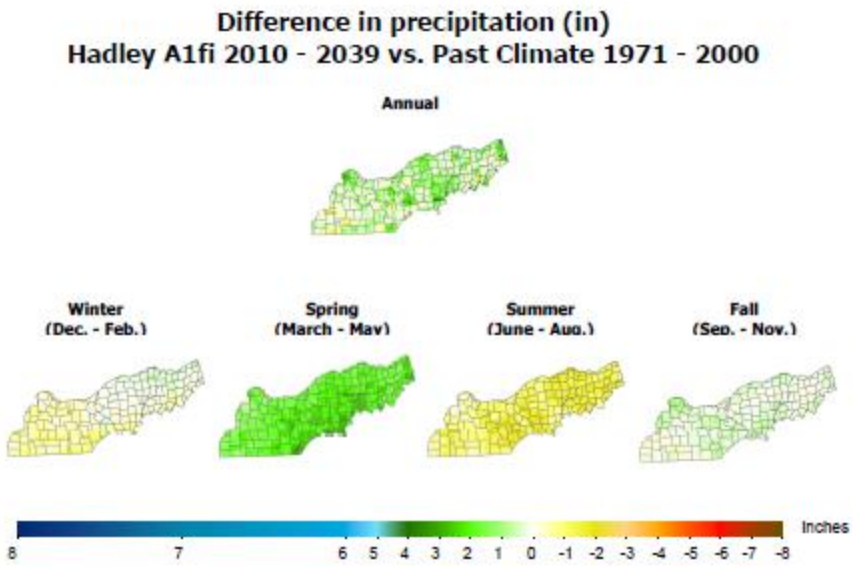
Summer/Fall Precipitation

Hadley-Hi



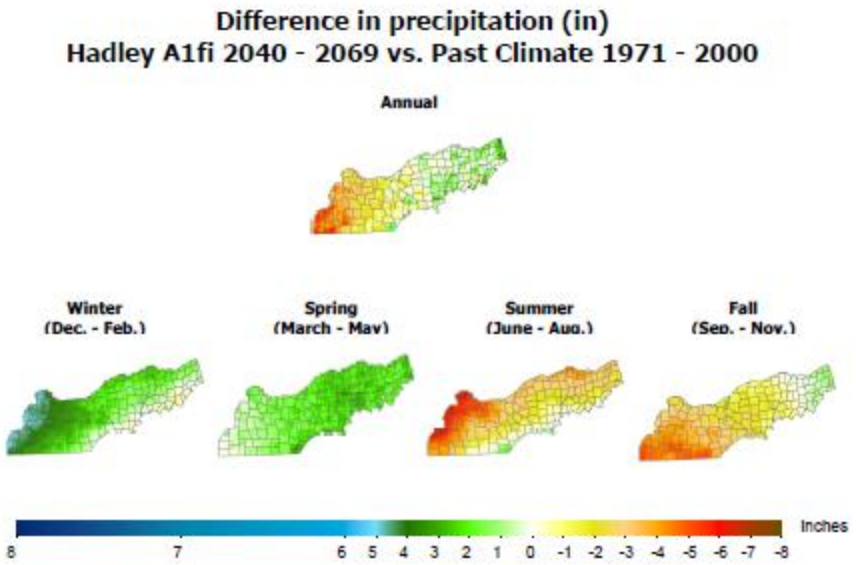
PCM-lo



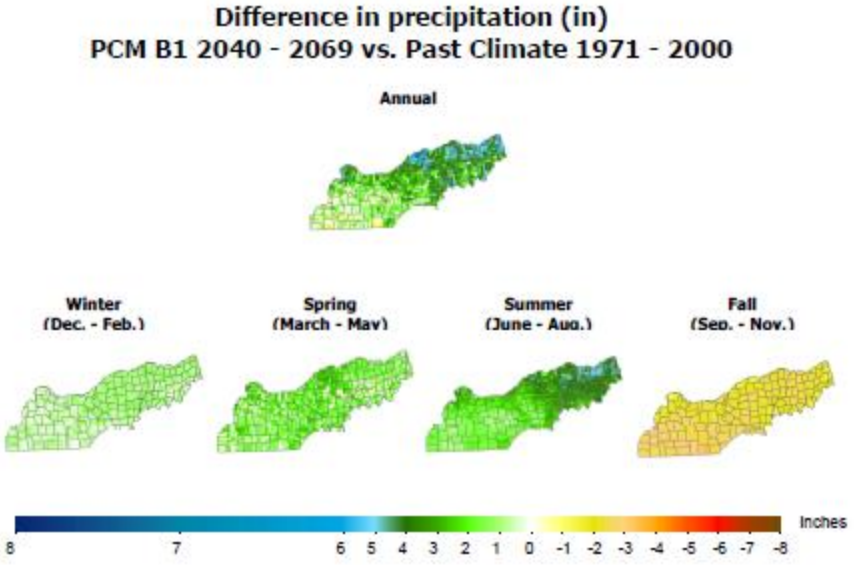

Difference in precipitation (in)
Hadley A1fi 2010 - 2039 vs. Past Climate 1971 - 2000
Annual
Winter
(Dec. - Feb.)
Spring
(March - May)
Summer
(June - Aug.)
Fall
(Sep. - Nov.)
Inches
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-7
-8

Mid-century

Had-hi

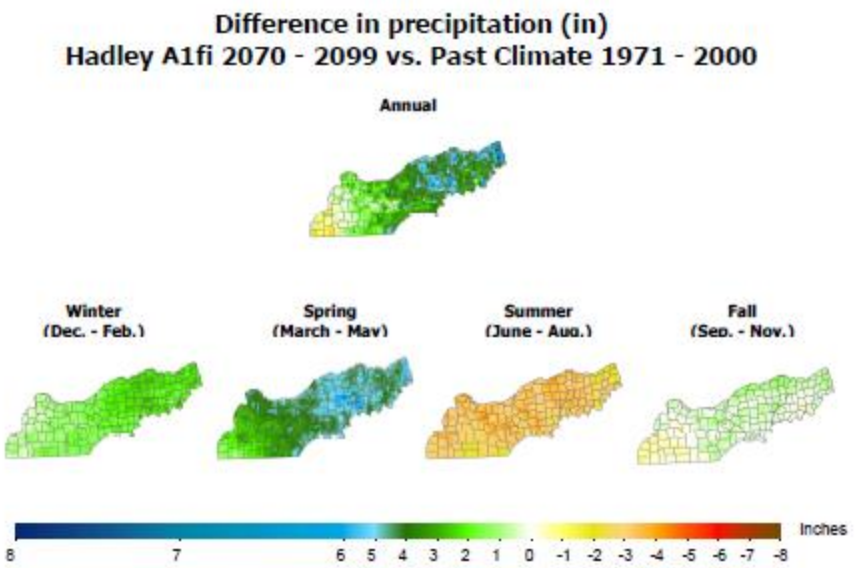


PCM-lo

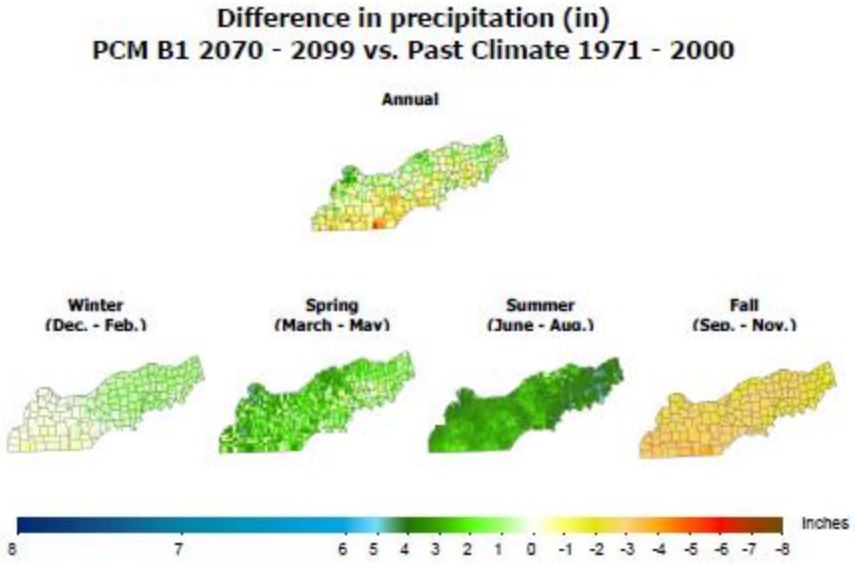


End of Century

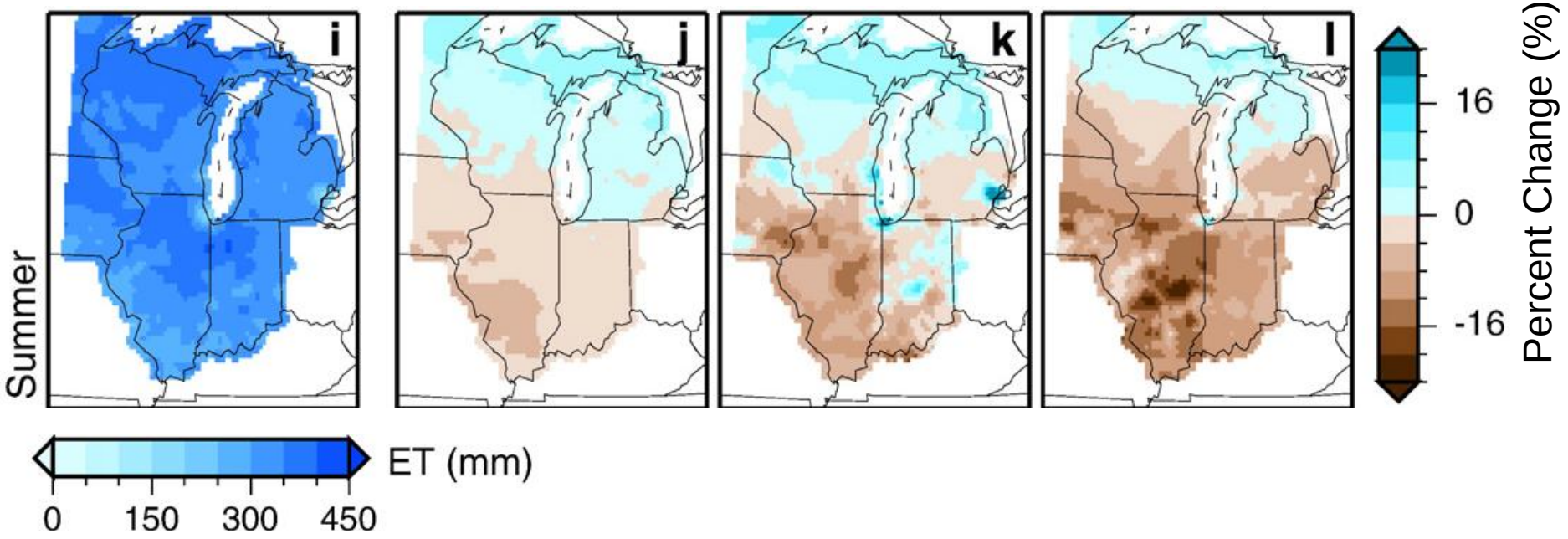
Had-hi



PCM-lo

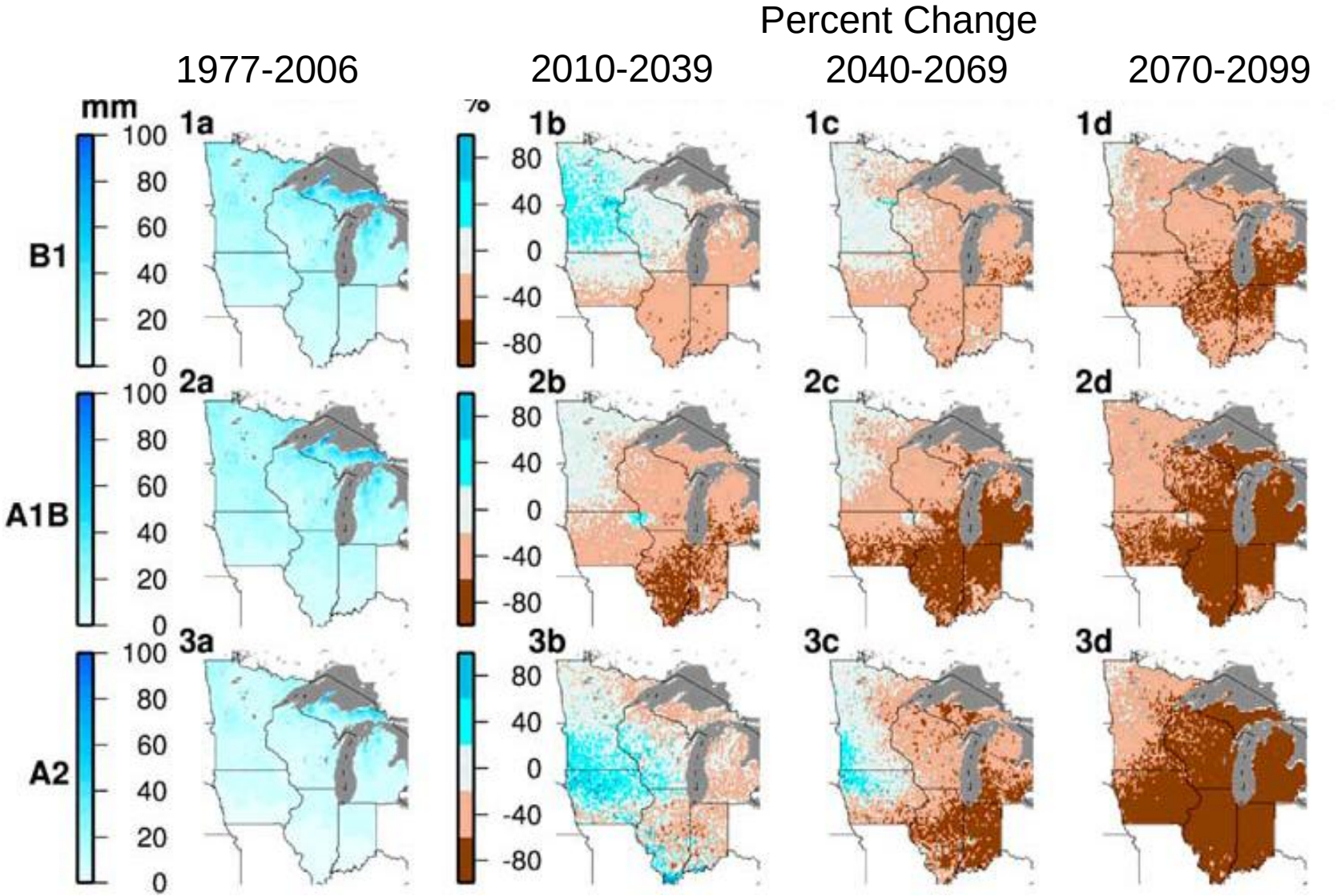


Evapotranspiration



From Cherkauer and Sinha 2010

Snow Water Equivalent



From Sinha and Cherkauer 2010