Building a Better Weather Estimator

Gabriela Bucini

Brian Beckage

Patrick Clemins

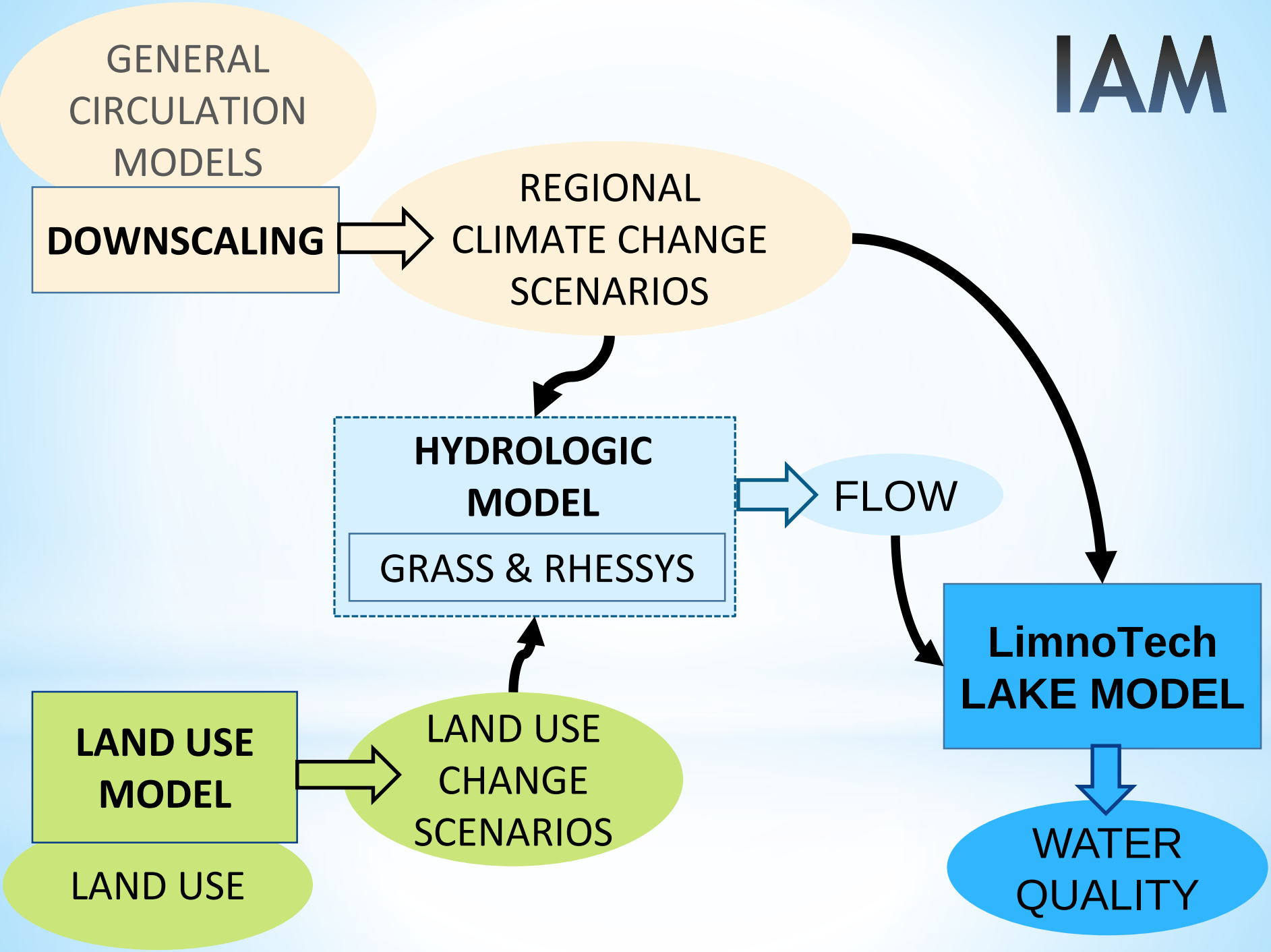
Jonathan Winter

Joshua Klavens and Jacob Page

February 6, 2016

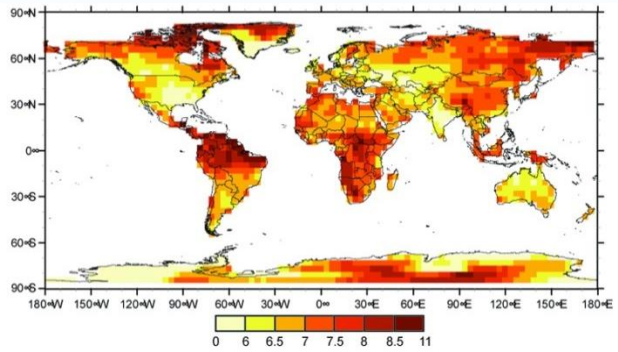
This material is based upon work supported by the National Science Foundation under Grant No. EPS-1101317.
Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

IAM

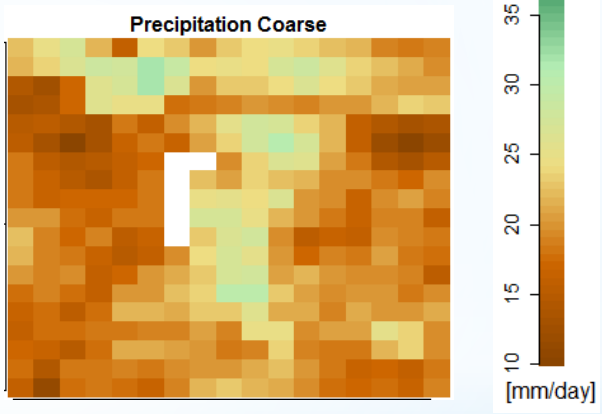

GENERAL CIRCULATION MODELS
DOWNSCALING
REGIONAL CLIMATE CHANGE SCENARIOS
HYDROLOGIC MODEL
GRASS & RHESSYS
FLOW
LimnoTech LAKE MODEL
WATER QUALITY
LAND USE MODEL
LAND USE CHANGE SCENARIOS
LAND USE

Climate downscaling

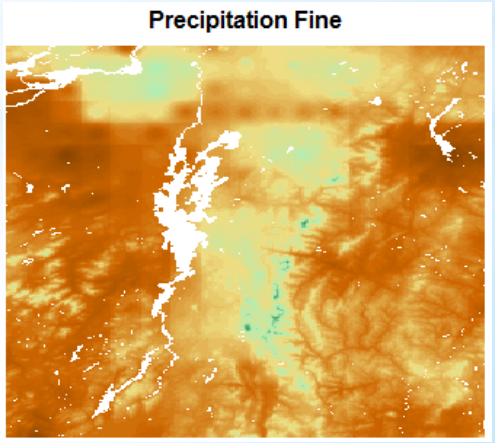
General Circulation Models:
~100 x 100 Km cells

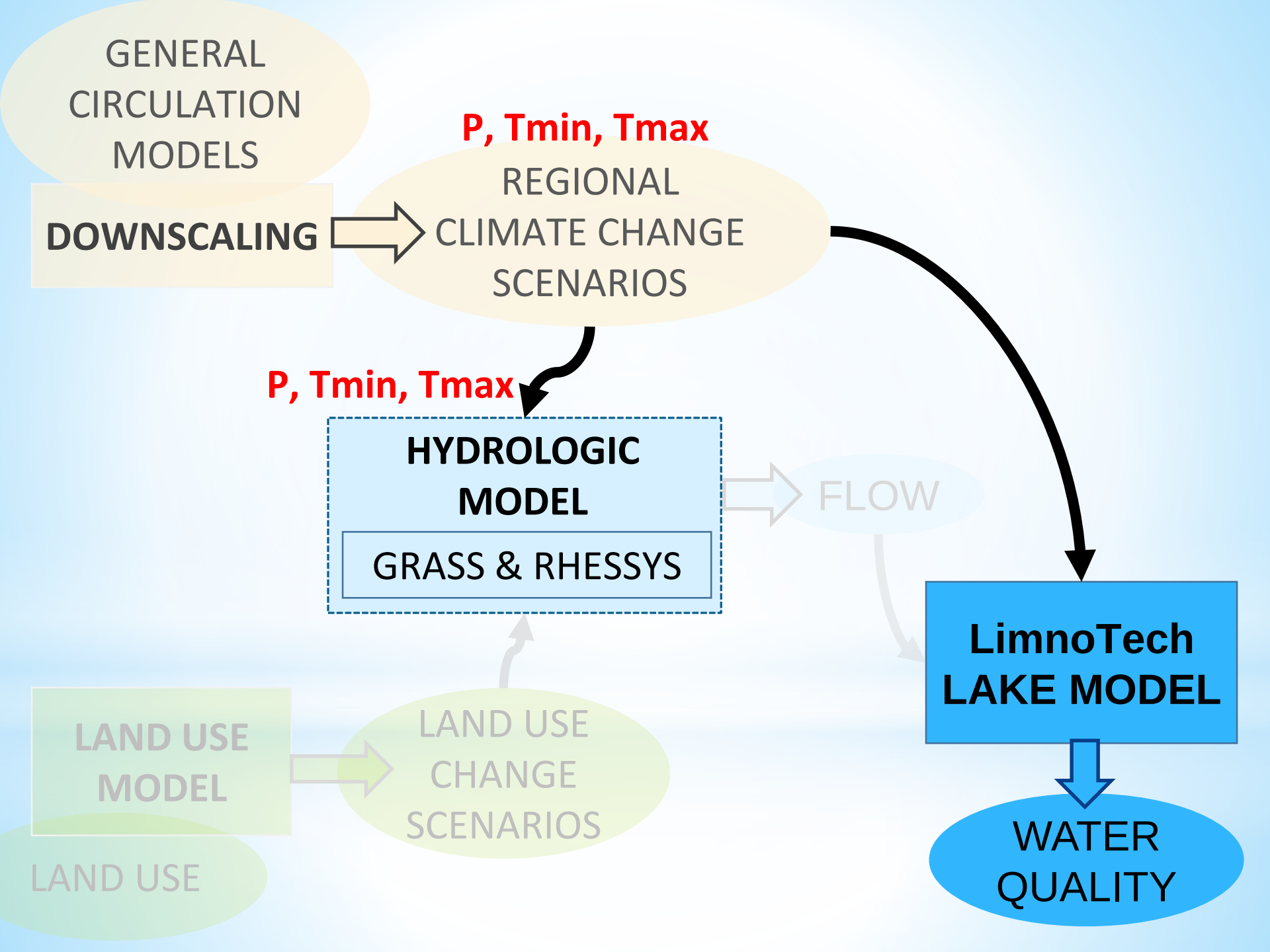


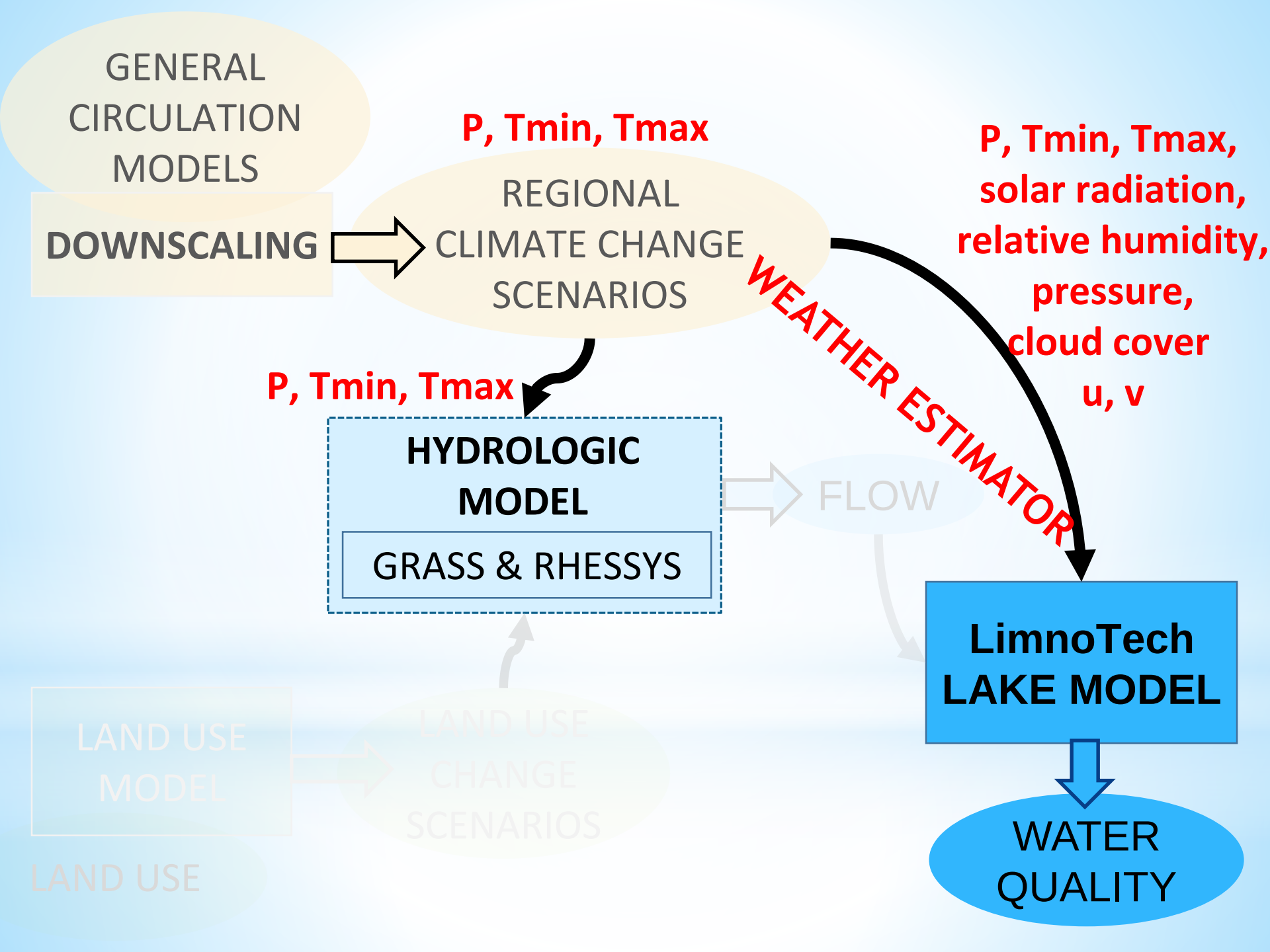
CMIP5 Intermediate Downscaling:
~12 x 12 Km cells



Elevation Downscaling:
< 1 x1 km cells




GENERAL CIRCULATION MODELS
DOWNSCALING
P, Tmin, Tmax
REGIONAL CLIMATE CHANGE SCENARIOS
P, Tmin, Tmax
HYDROLOGIC MODEL
GRASS & RHESSYS
FLOW
LimnoTech LAKE MODEL
WATER QUALITY
LAND USE MODEL
LAND USE CHANGE SCENARIOS
LAND USE


GENERAL CIRCULATION MODELS
DOWNSCALING
P, Tmin, Tmax
REGIONAL CLIMATE CHANGE SCENARIOS
P, Tmin, Tmax, solar radiation, relative humidity, pressure, cloud cover u, v
WEATHER ESTIMATOR
P, Tmin, Tmax
HYDROLOGIC MODEL
GRASS & RHESSYS
FLOW
LimnoTech LAKE MODEL
WATER QUALITY
LAND USE MODEL
LAND USE CHANGE SCENARIOS
LAND USE

Challenge:

GCM projections only provide T and P, but downstream models may need other climate variables as well.

Weather estimator resampling

Downscaled GCM	NARR
T and P	T, P, u, v, RH, Pressure, Solar Radiation, Cloud Cover
Daily, 1950 - 2099	Daily, 1979 - 2014

North American Regional Reanalysis (NARR)
32 km grid resolution, daily from 1979 – 2014
http://www.esrl.noaa.gov/psd/data/gridded/data.narr.html

For each future daily T and P

Find a matching pair of T and P in historic NARR

Steps:

1. ***Filter*** by season
2. Collect a set of ***nearest T and P neighbors***
3. ***Randomly*** select one neighbor

daily weather sequence of all climate variables

PRODUCTS

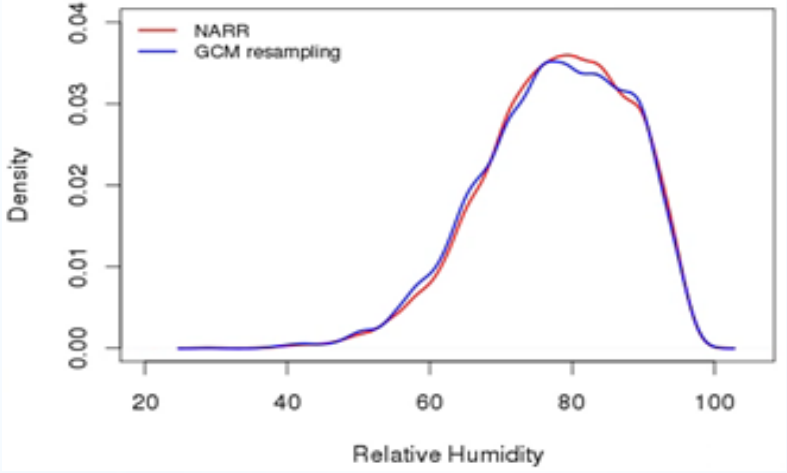
Two types of output available:

1. Weather time series at point location(s)

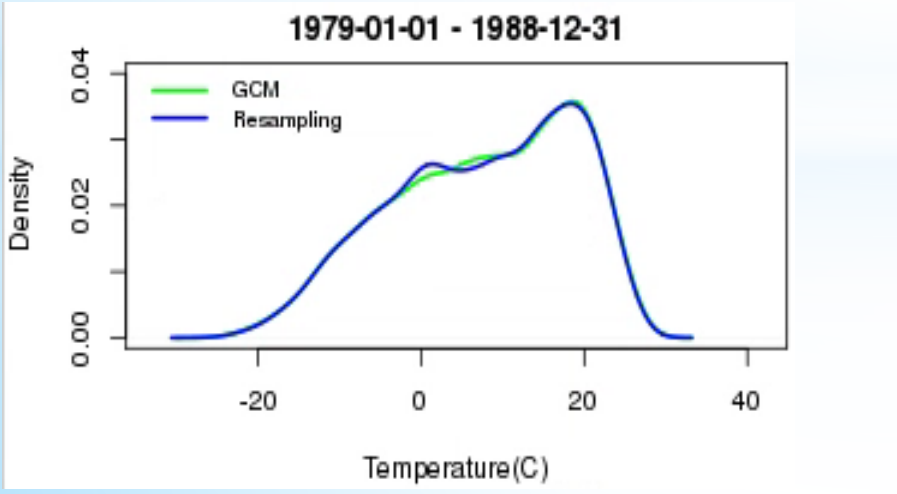
2. Gridded weather time series for the whole study area

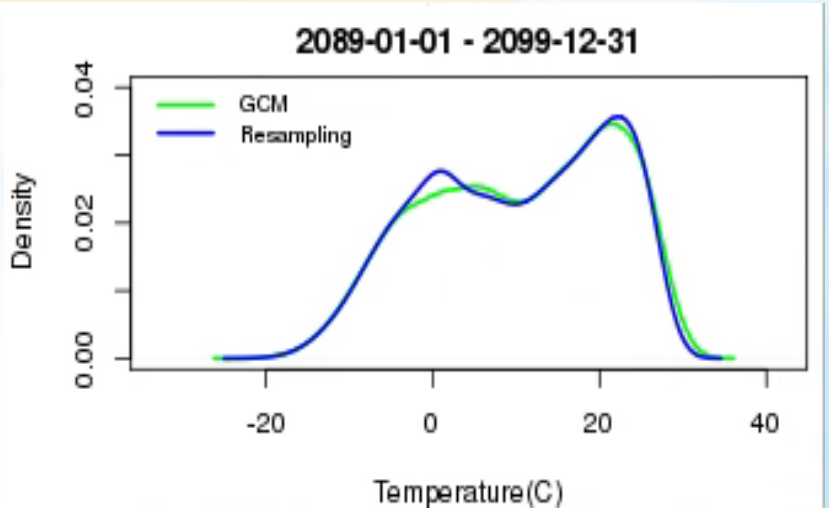
How well does it do?

NARR Original vs. Resampled (1979-2014)



Future: GCM projected vs. Resampled





SUMMARY

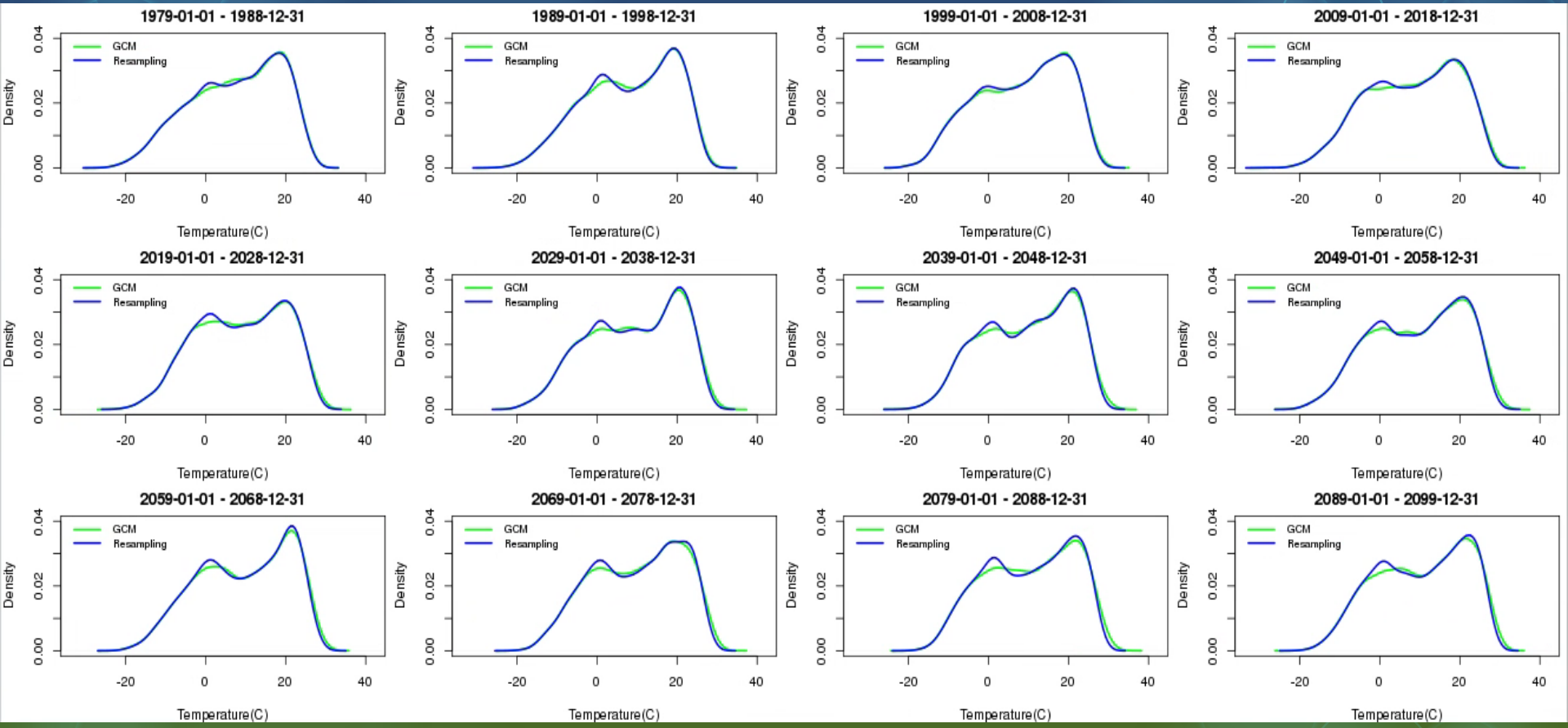
Resampling Weather Estimator:

Large set of climate variables consistent with our very high-resolution P and T projections

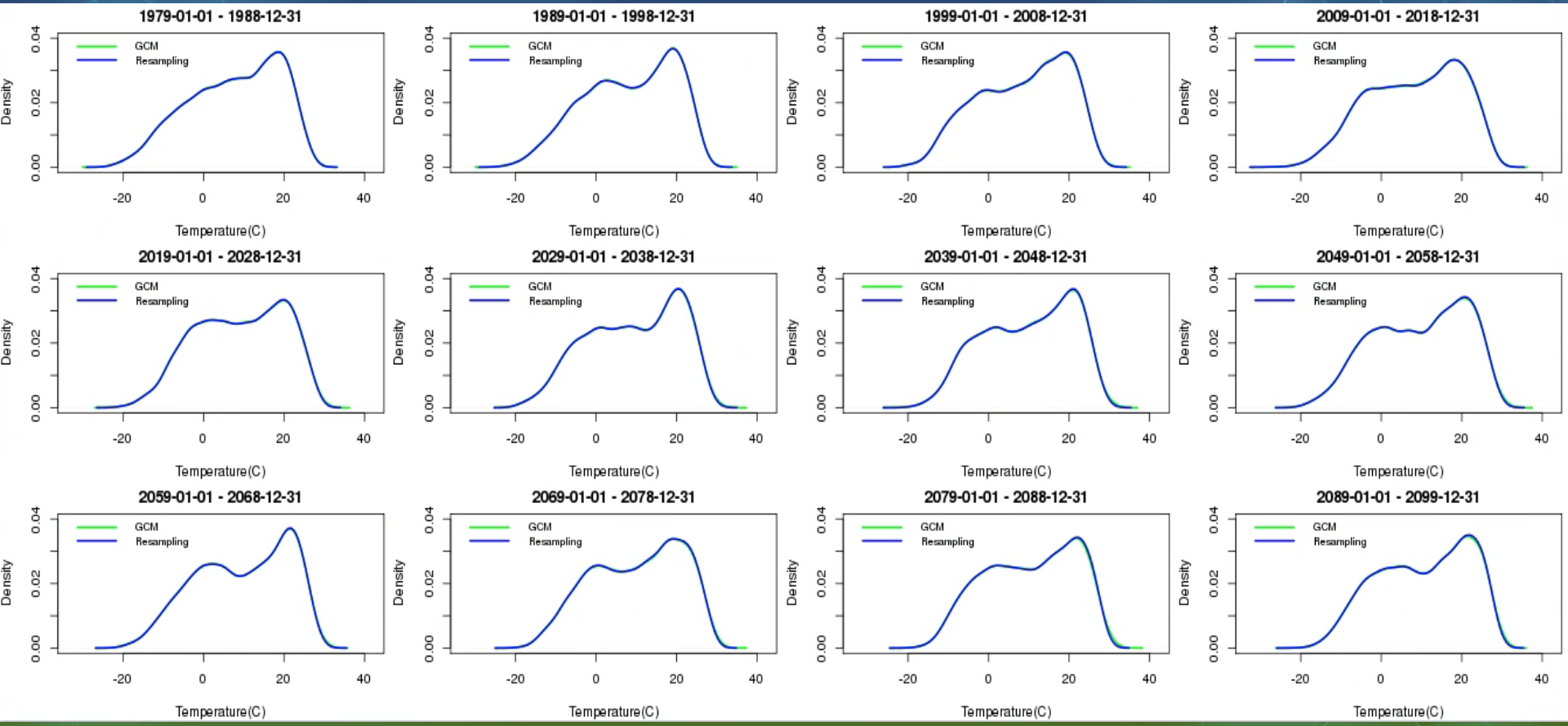
THANK YOU!

Vermont EPSCoR

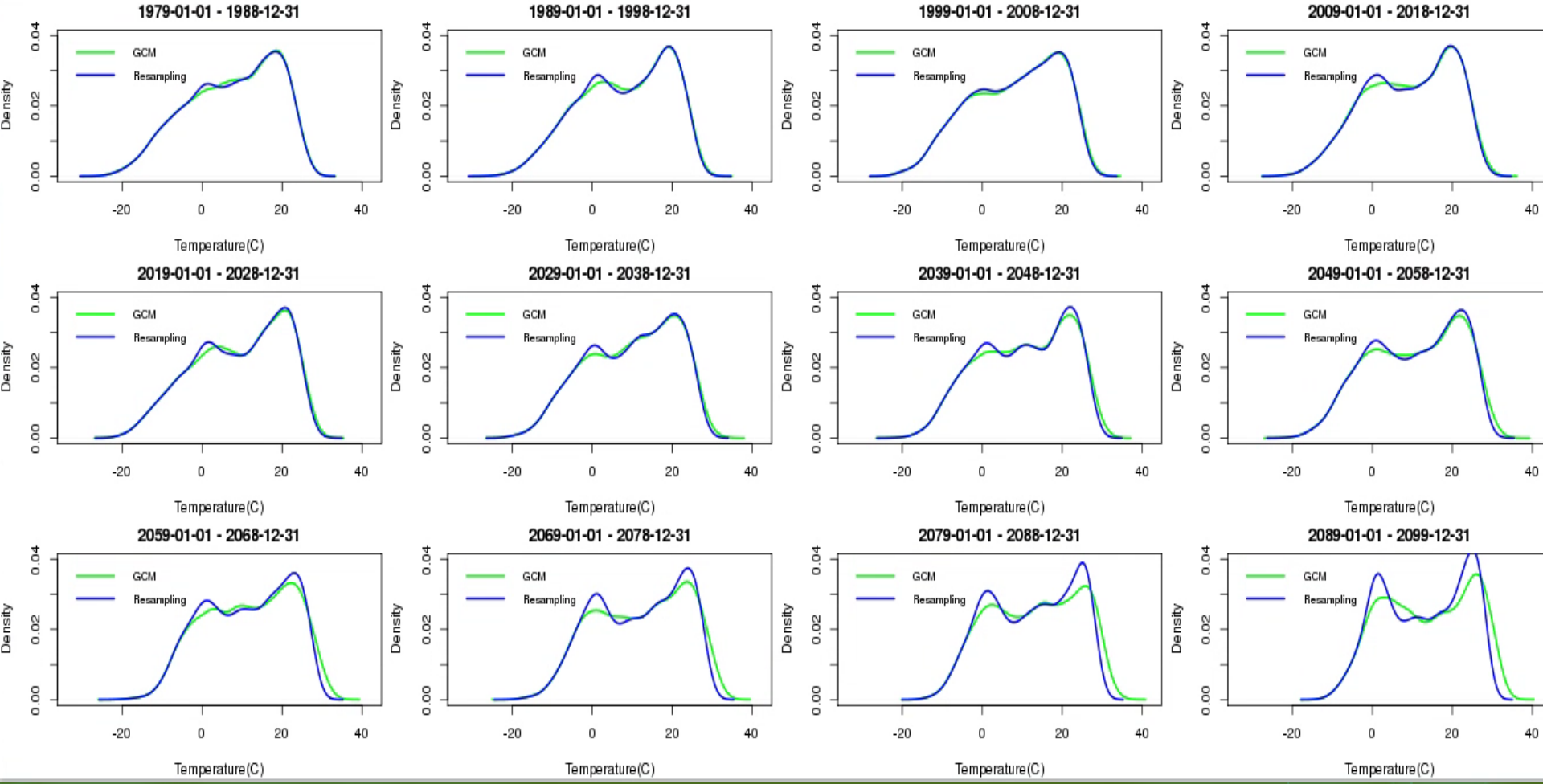
RCP45 5-DAY T


1979-01-01 - 1988-12-31
1989-01-01 - 1998-12-31
1999-01-01 - 2008-12-31
2009-01-01 - 2018-12-31
2019-01-01 - 2028-12-31
2029-01-01 - 2038-12-31
2039-01-01 - 2048-12-31
2049-01-01 - 2058-12-31
2059-01-01 - 2068-12-31
2069-01-01 - 2078-12-31
2079-01-01 - 2088-12-31
2089-01-01 - 2099-12-31
GCM
Resampling
Density
Temperature(C)
0.00
0.02
0.04
-20
0
20
40

RCP45 60-DAY T

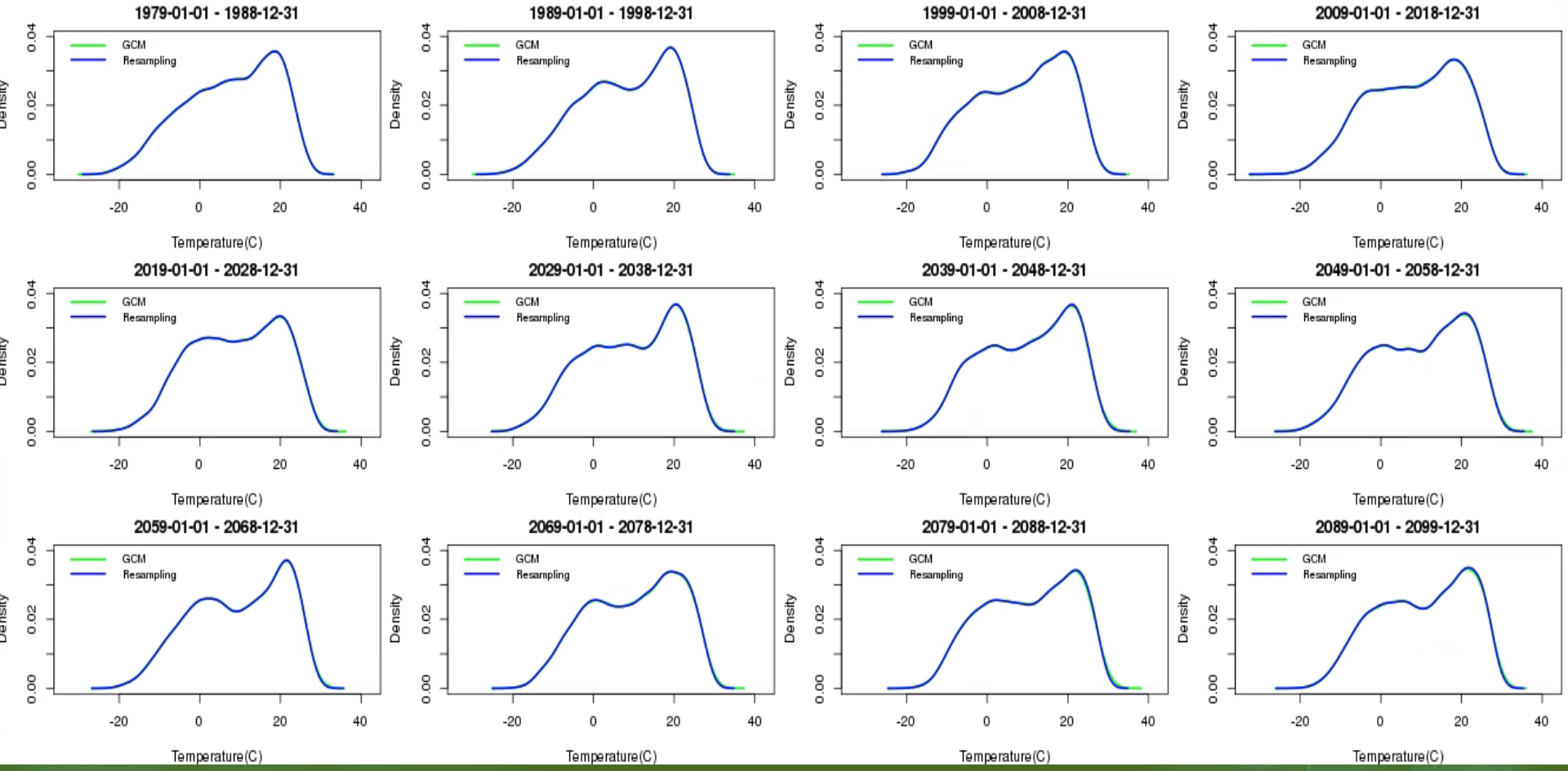


RCP85 5-DAY T



Look at how the GCM runs away by the end in 85!

RCP85 60-DAY T



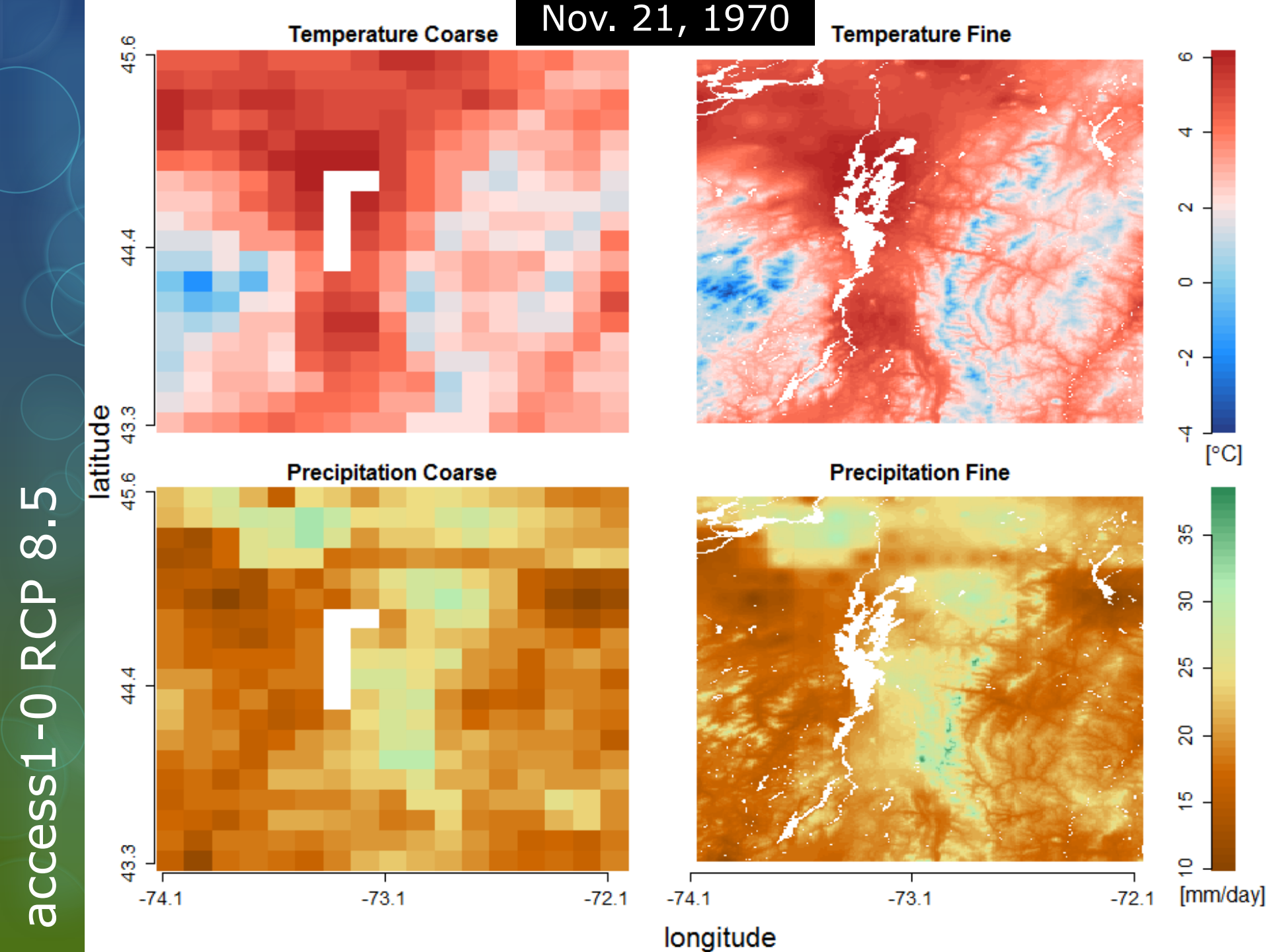
Strong snapping in to place of Resampling when day range increased to 60.

Our accomplishments:

Estimating the suite of climate variables under GCM projections by

- downscaling
- resampling from historical NARR reanalysis data

Data source: North American Regional Reanalysis (NARR)
http://www.esrl.noaa.gov/psd/data/gridded/data.narr.html


Nov. 21, 1970
Temperature Coarse
Temperature Fine
Precipitation Coarse
Precipitation Fine
latitude
longitude
45.6
44.4
43.3
-74.1
-73.1
-72.1
6
4
2
0
-2
-4
[°C]
35
30
25
20
15
10
[mm/day]
access1-0 RCP 8.5