



Welcome to the Noah-MP Workshop May 23 – 25 2023

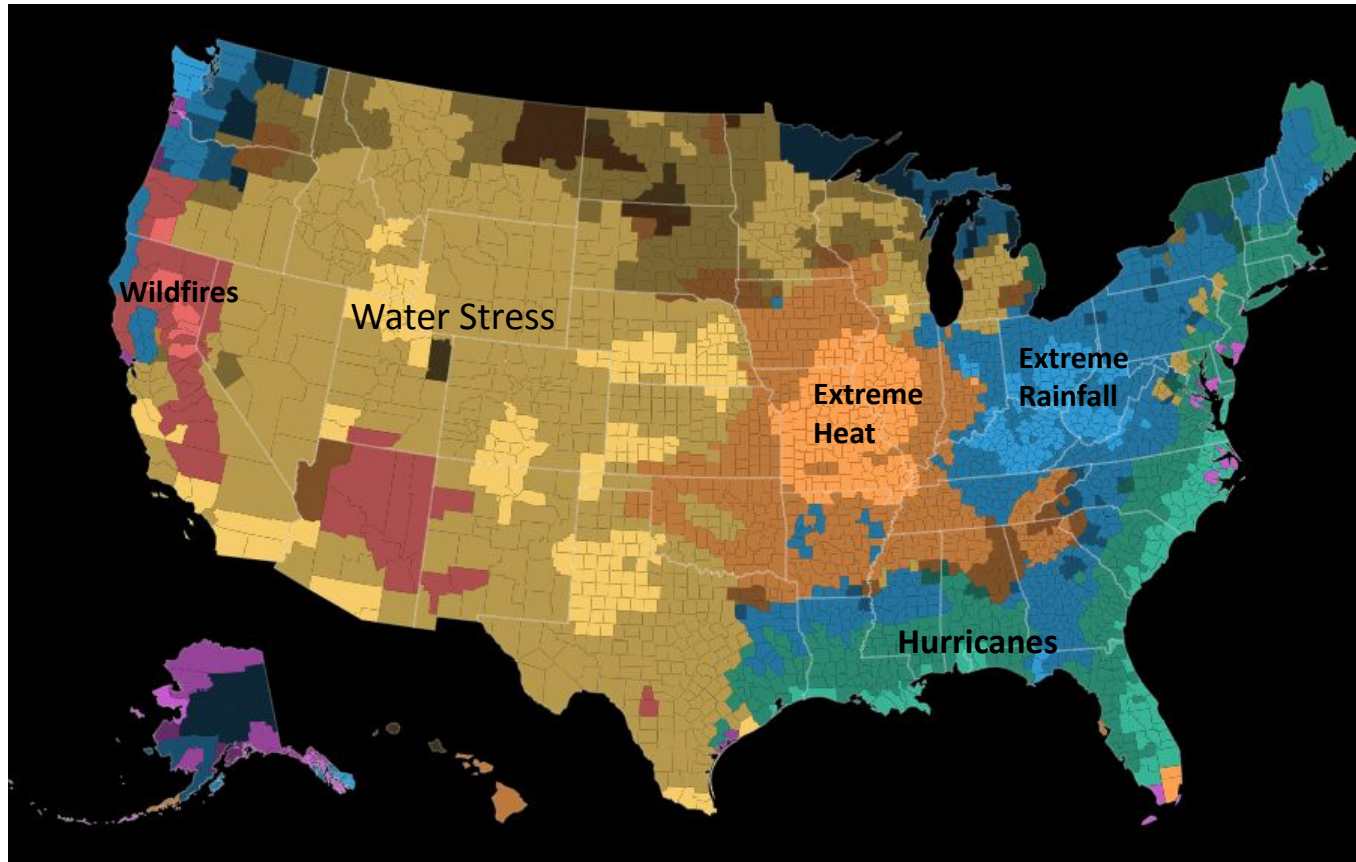
Roy Rasmussen NCAR

Climate extremes over CONUS

NCAR

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Greatest climate extremes from now to 2040 based on analysis from Four Twenty Seven and the New York Times



Many of the extremes involve too much or not enough water and occur at regional and local scales!

How does precipitation (possibly extreme) change as climate changes?

(question asked at the beginning of the NCAR Water Cycle program by Kevin Trenberth)



Global Hydrological cycle:

1. Mean
2. Annual cycle
3. Diurnal Cycle of precipitation, intensity, duration and frequency.
4. Trends

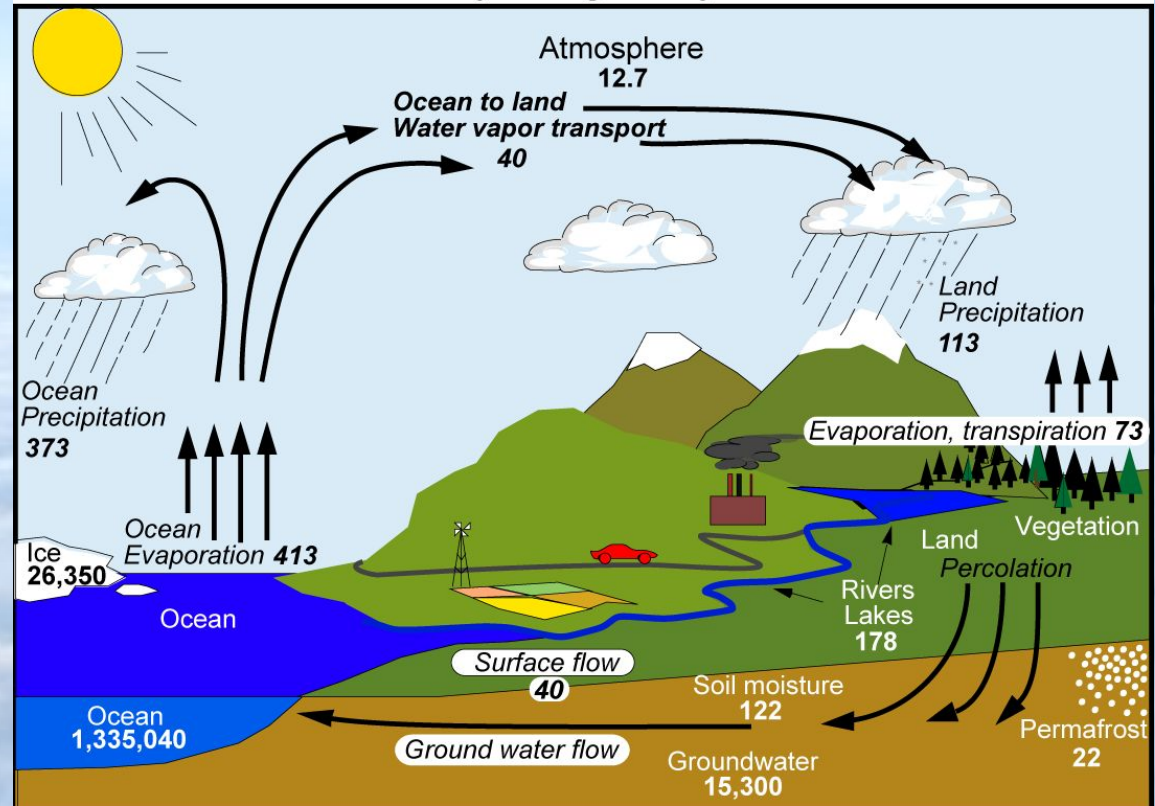
Can we do this for each month of the year?

For each region?

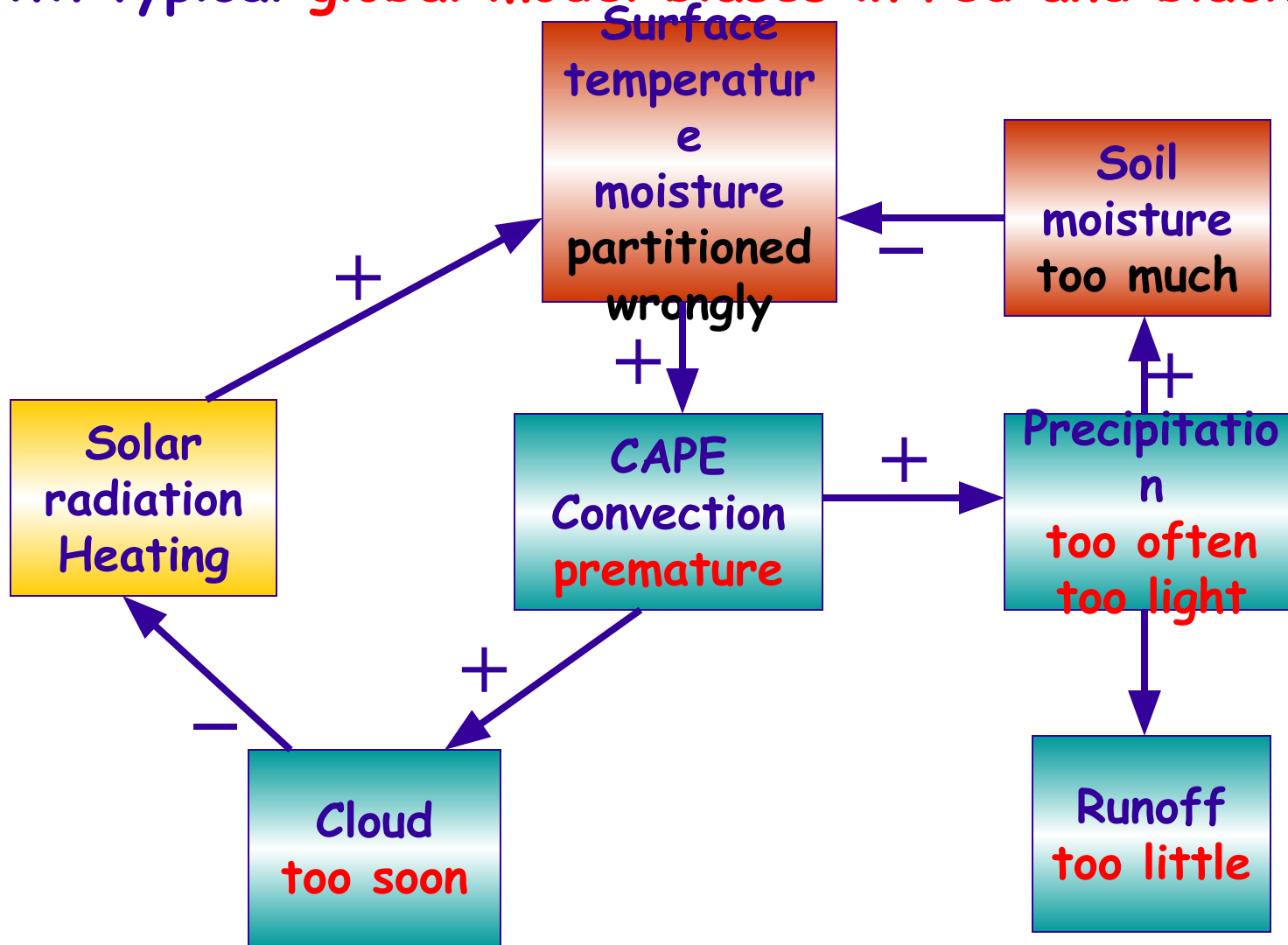
Can we do time series?

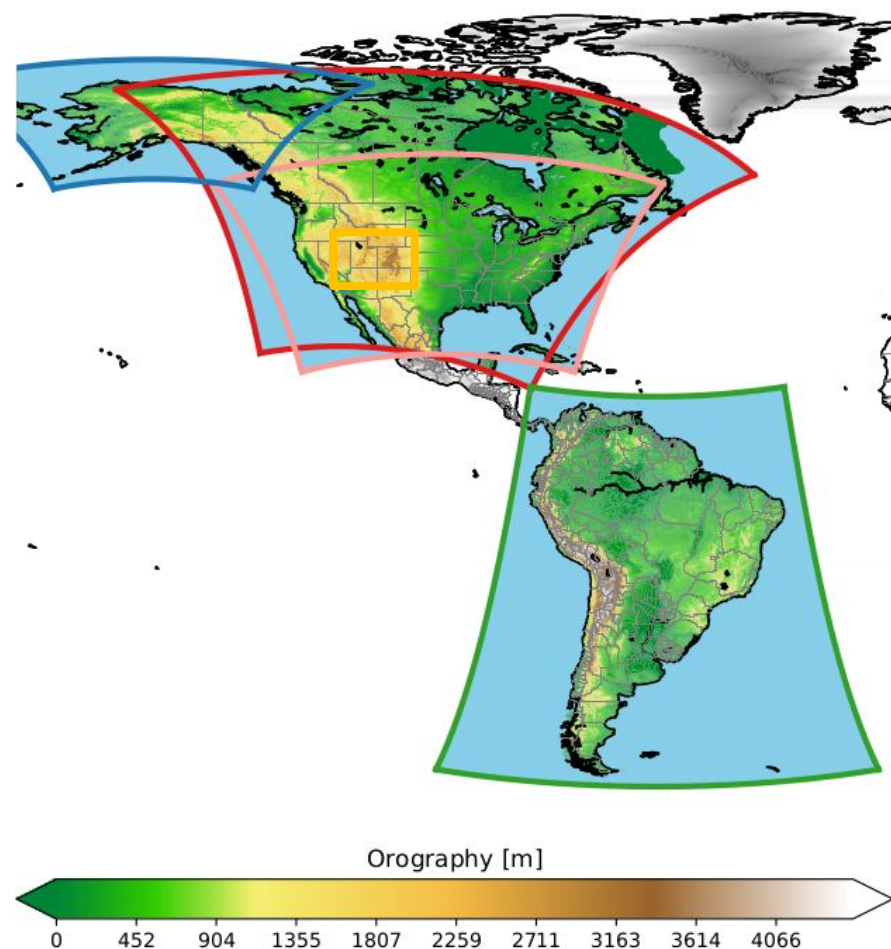
Trenberth et al. 2004

Hydrological Cycle



Key feedback mechanisms in diurnal cycle with typical **global model biases** in red and black





NCAR/RAL Kilometer-Scale Climate Simulations

CO-Headwaters [Ikeda et al. 2010, Rasmussen et al. 2011, 2014]

- Reanalysis downscaled
- 2001-2008
- dx=4 km
- future – PGW, RCP8.5

CONUS-1 [Liu et al. 2017, Clim Dyn. Prein et al. 2017, Ikeda et al. 2021]

- Reanalysis downscaled
- 2001-2013
- dx=4 km
- future – PGW, RCP8.5

CONUS-2 [in progress]

- GCM downscaled
- 1995-2014
- dx=4 km

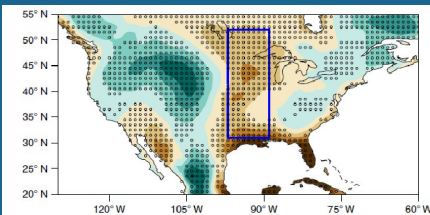
CONUS404 [USGS funded]

- Reanalysis downscaled
- 1979-2019
- dx=4 km

South America [in progress]

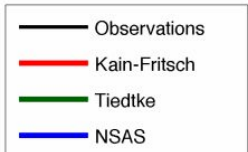
- Reanalysis downscaled
- 20-years
- dx=4 km
- future – PGW, RCP8.5

(CAUSES) project
[Lin et al. 2017, Nat. Com.]



Significant improvement in diurnal cycle of precipitation intensity, duration and frequency

WRF 36 km

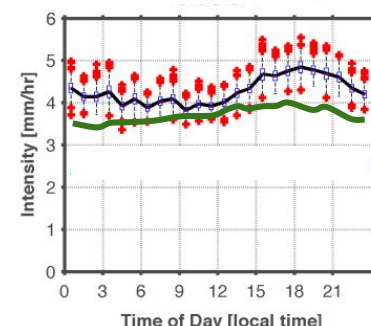
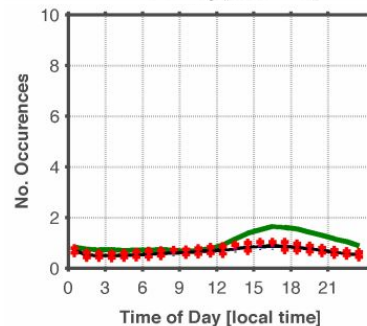
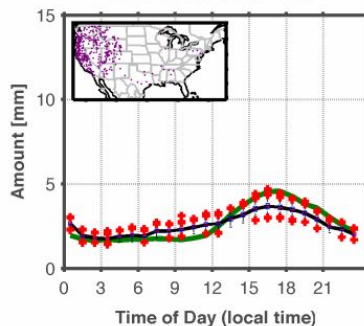
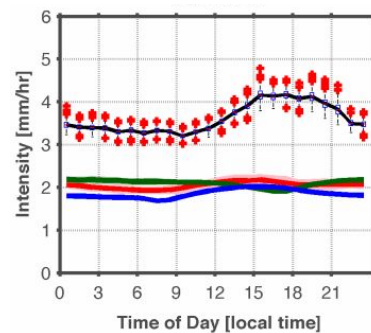
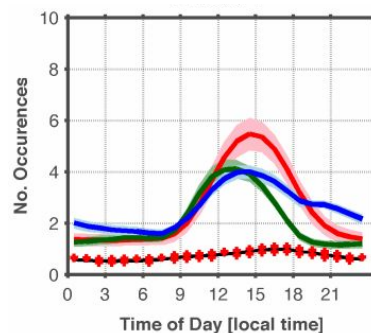
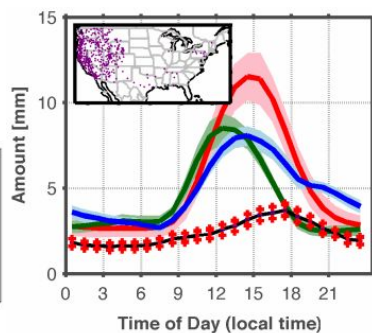


CONUS1
WRF 4 km



Convective Precipitation Diurnal Cycle

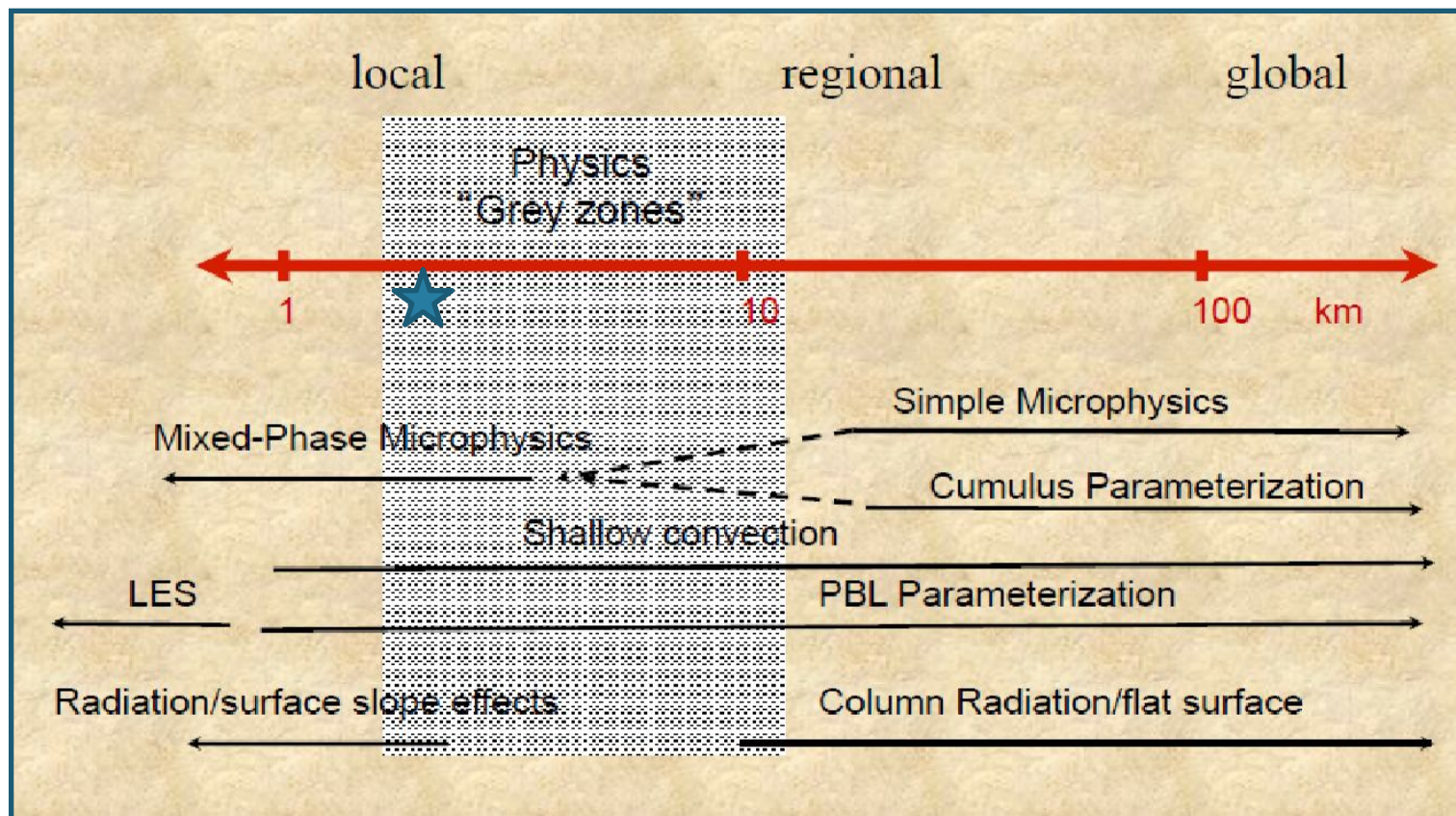
Amount



[Mooney et al. 2016; Ban et al. 2015]

Land Surface parameterization improvements?

Physics in Multiscale Model

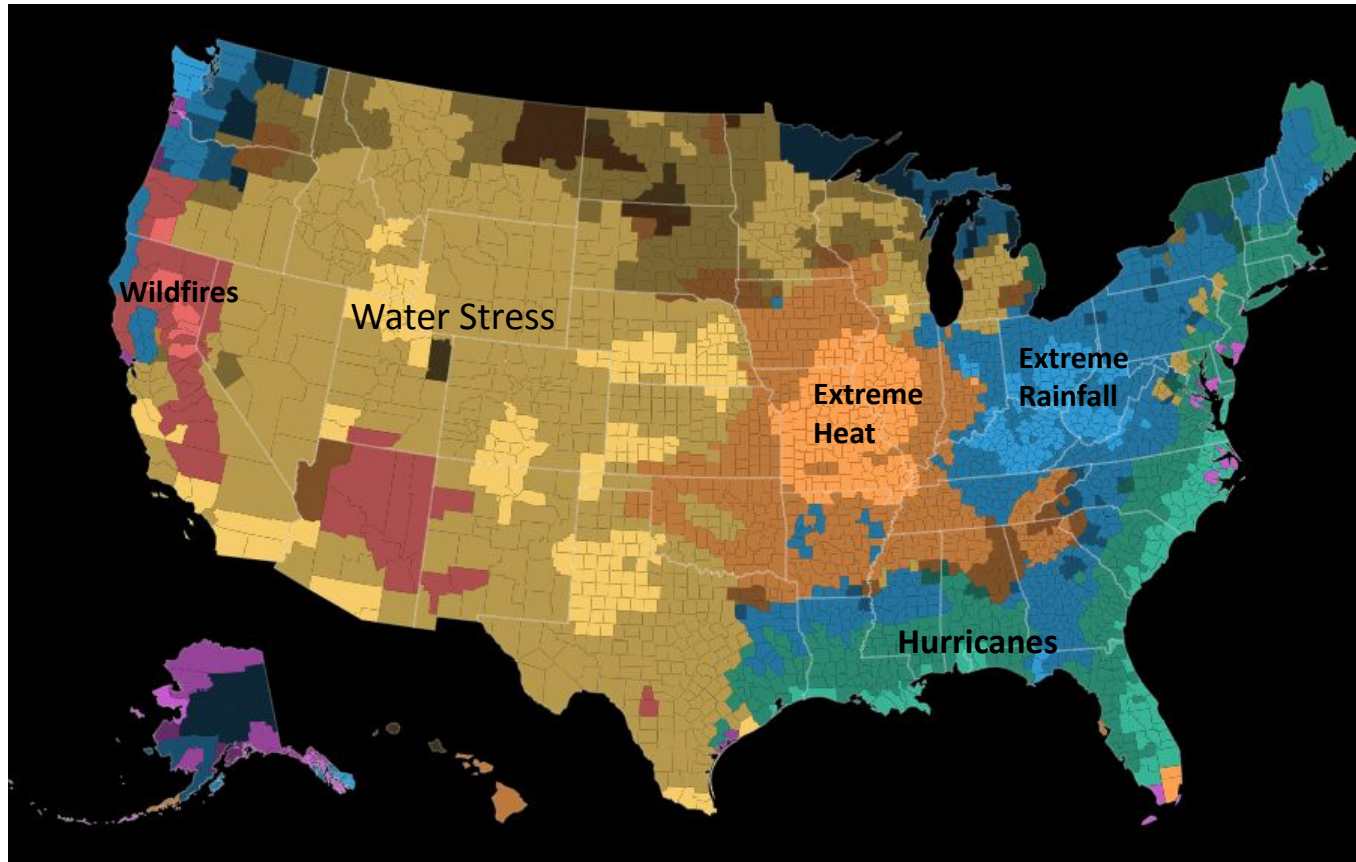


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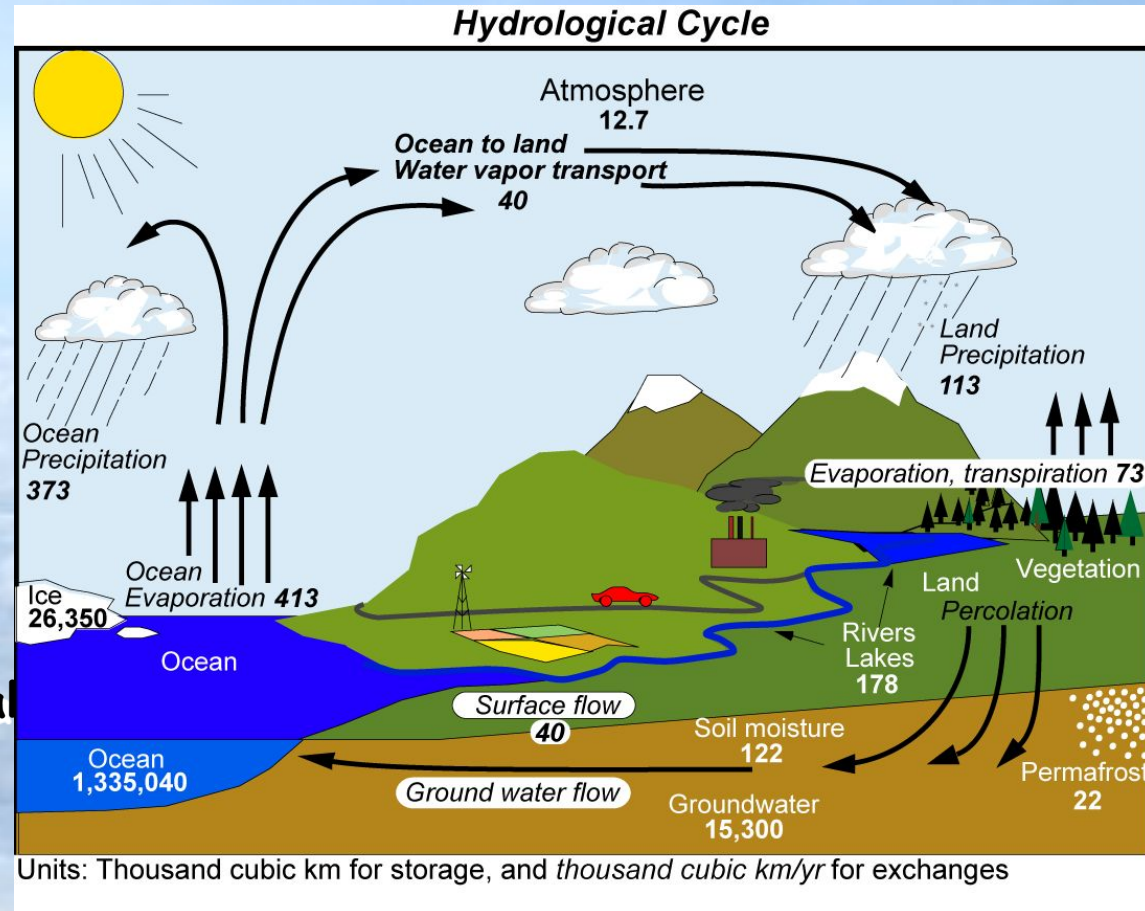
Global Hydrological

cycle:

1. Mean
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NCAR Water System research has shown that convective permitting modeling (4 km horizontal grid spacing or less) allows us to capture the mean precipitation cycle (mean, annual cycle, diurnal) over continental regions (CONUS and South America).

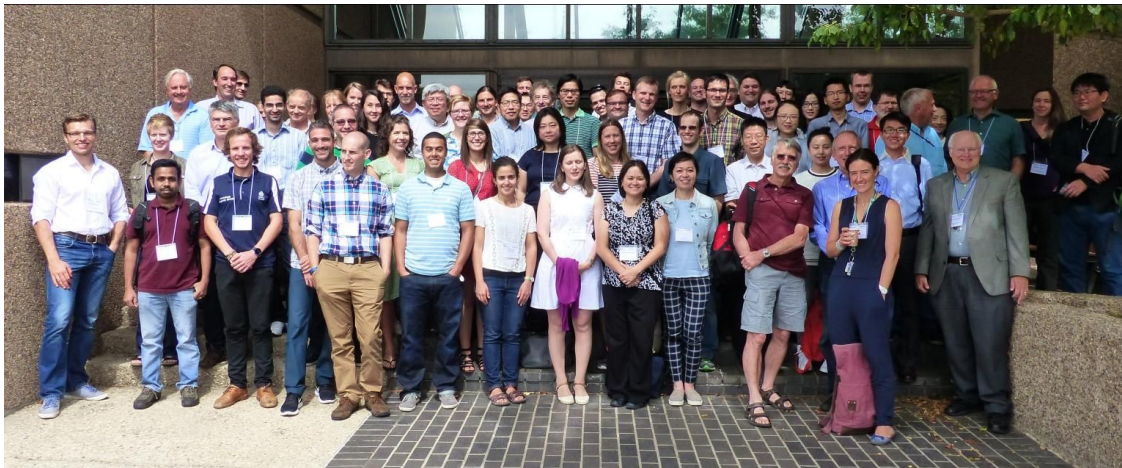
5. Next step: Improved representation of the land surface!



CPCM Literature

1st GEWEX CPCM Workshop

- 6–8 September 2016
- 70 scientists from 13 countries



Google Scholar search for convection permitting/resolving climate modeling

2nd GEWEX CPCM Workshop

- 4–6 September 2018
- 79 scientists from 14 countries



3rd GEWEX CPCM Workshop

- 21-23 August 2019
- Zurich, Switzerland

Latsis Symposium 2019

High-Resolution Climate Modeling:
Perspectives and Challenges

Date: August 21-23, 2019
Venue: ETH Zurich, Switzerland



Google Scholar search for convection permitting/resolving climate modeling

BAMS article 2022 Jan. 1st summary

What: The purpose of the workshop was to discuss the performance of convection-permitting models (<4-km horizontal grid spacing) at global and local scales and also to discuss the potential of CPMs data for hazard and impact studies. Recent advance-ments in CPM research were highlighted and key challenges discussed. The workshop also focused on the potential of applying CPMs to the Asian region.

When: 2–4 September 2020
Virtual

The Fifth Convection-Permitting Modeling Workshop 2021 (CPM2021)

High-Resolution Climate Modeling and Hazards Virtual

September 7 (Tue) -10 (Fri) , 14 (Tue)



TOUGOU

JMBSC



NCAR

viCPCMW
Buenos Aires city, 2022 Sep. 7-9th

Convection-Permitting Climate
Modeling Workshop

7-9 September 2022, C. A. Buenos Aires, Argentina

<http://www.cima.fcen.uba.ar/cpcmw2022/index.php>

VII Convective Permitting Climate Modeling workshop:

Bergen, Norway
Host: Stefan Sobolowski

August 28-30, 2023

Notable Achievements

1. Kilometer-Scale WRF Climate Simulations Largely Improve
 - a) The amount, frequency, intensity, duration and phase of precipitation
 - b) Simulation of snowpack dynamics
 - c) Simulating of the convective precipitation diurnal cycle
 - d) The frequency and intensity of mesoscale convective systems
2. Correctly simulating land surface processes is essential (Barlage et al. 2021 GRL paper). Need to improve Noah-MP!
3. The same model physics work well over mid-, and high-latitude land areas. Starting to work on South and Central America. What is the role of the land surface?
4. Good luck on your first workshop and hope you will have many more!

