Short-duration extreme precipitation in future climate

GWF Pillar 1 project

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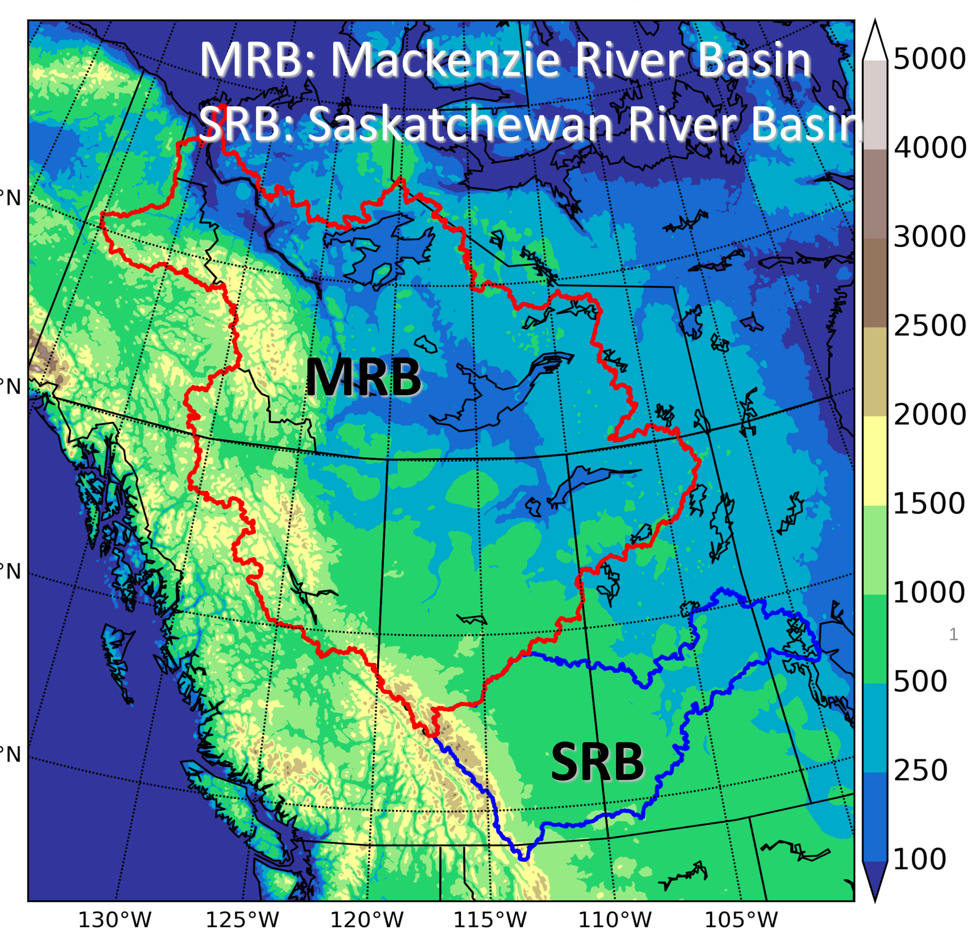
Continental Scale Regional Climate Simulation using 4-KM WRF



WRF Western Canada Model Setup

WRF Model (Version 3.4.1)

A single domain: 2560 x 2800 km^2; 4 km grid spacing; 37 levels

Microphysics Scheme: New Thompson et al.

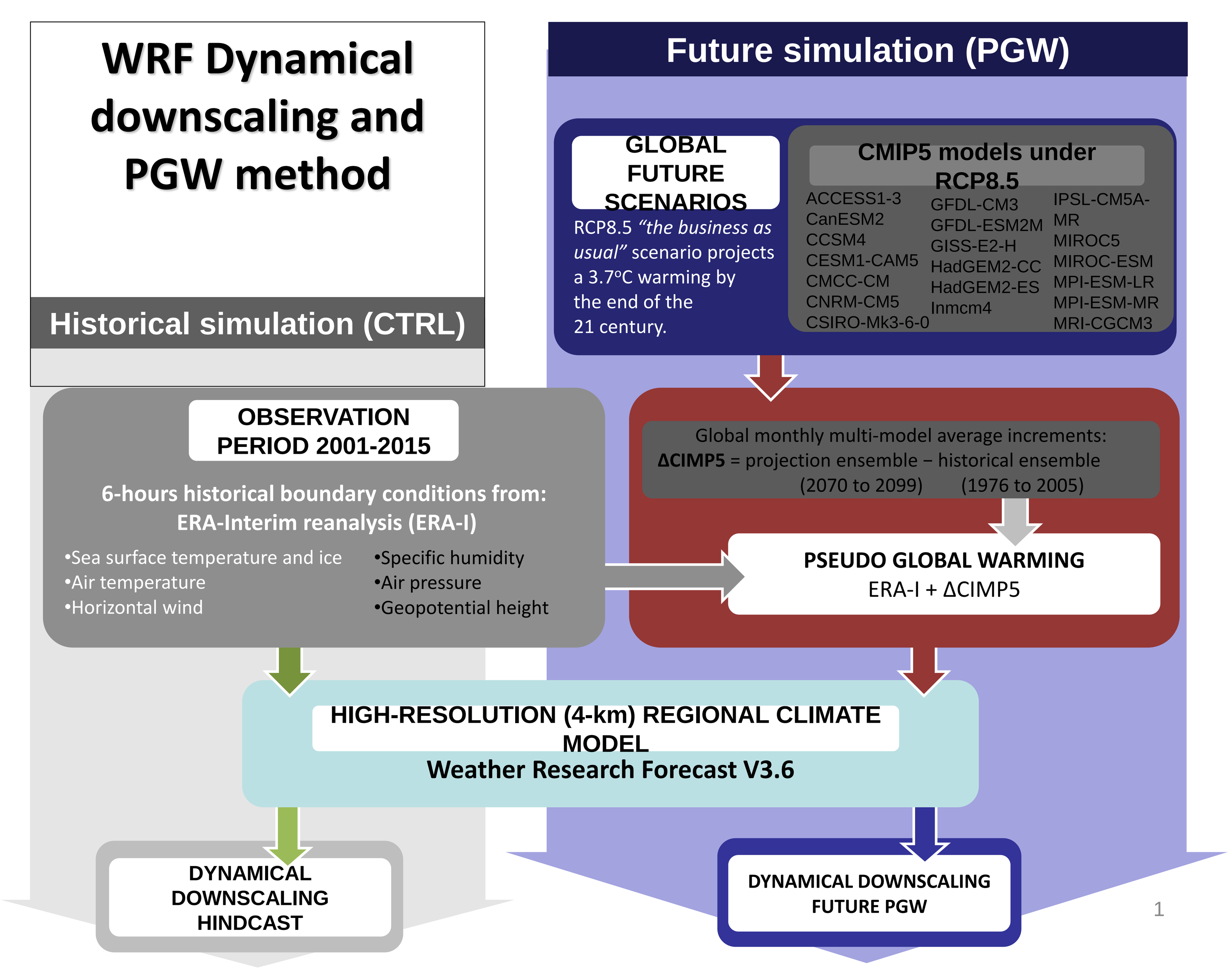
PBL scheme: YSU

RRTMG Long-wave and Short-wave scheme

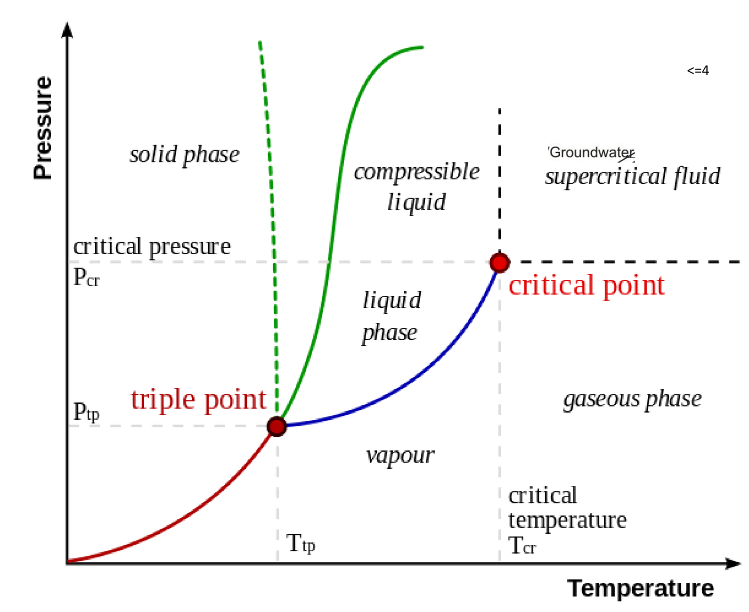
No Cumulus parameterization used, assumed explicit

Forcing Data

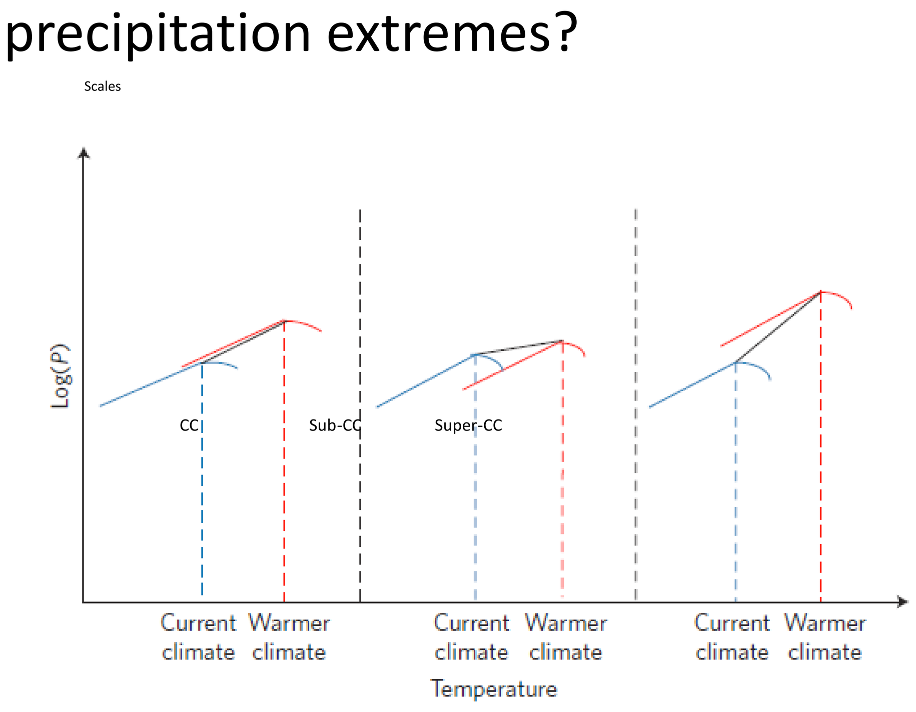
The 6-hourly, 0.703^0 x 0.703^0 resolution ERA-Interim reanalysis data provide the initial and lateral boundary condition



WP1: Whether temperature scaling works at convective-permitting resolutions for short-duration local precipitation extremes?

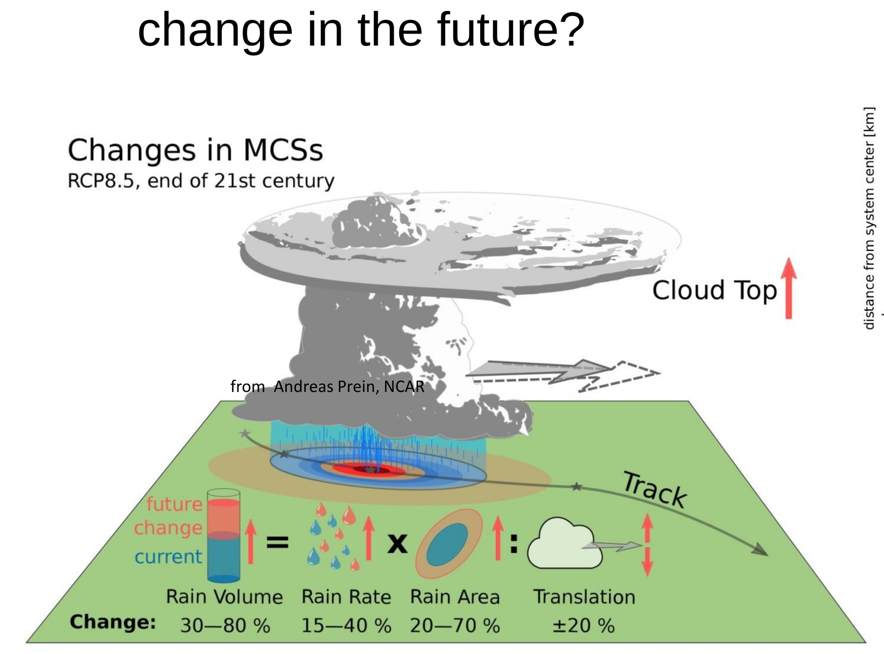


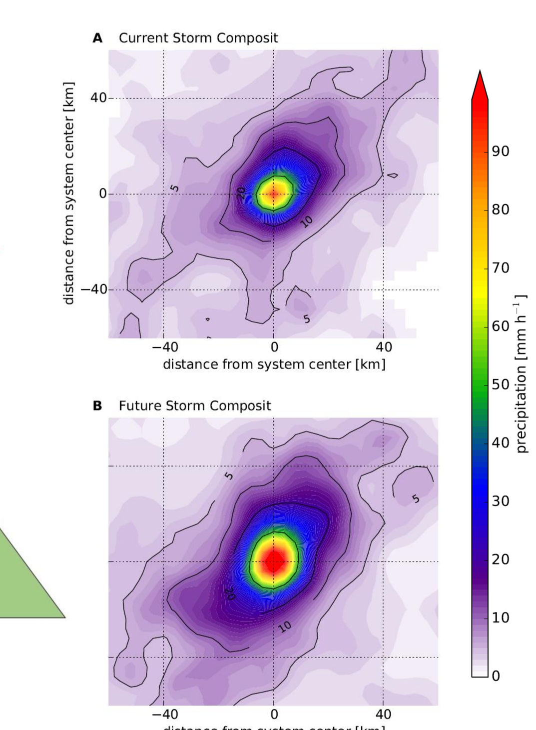
Clausius–Clapeyron (CC) relation

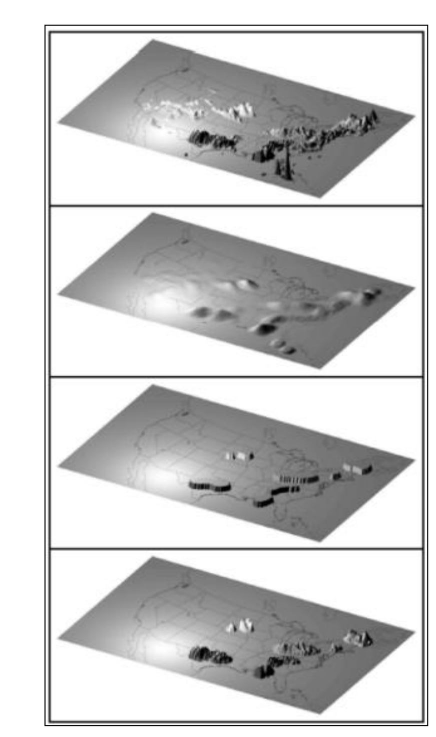


Zhang et al. (2017)

WP2: How will the characteristics of mesoscale convective systems (MCSs) such as the precipitation intensity, size and life-span of storms change in the future?

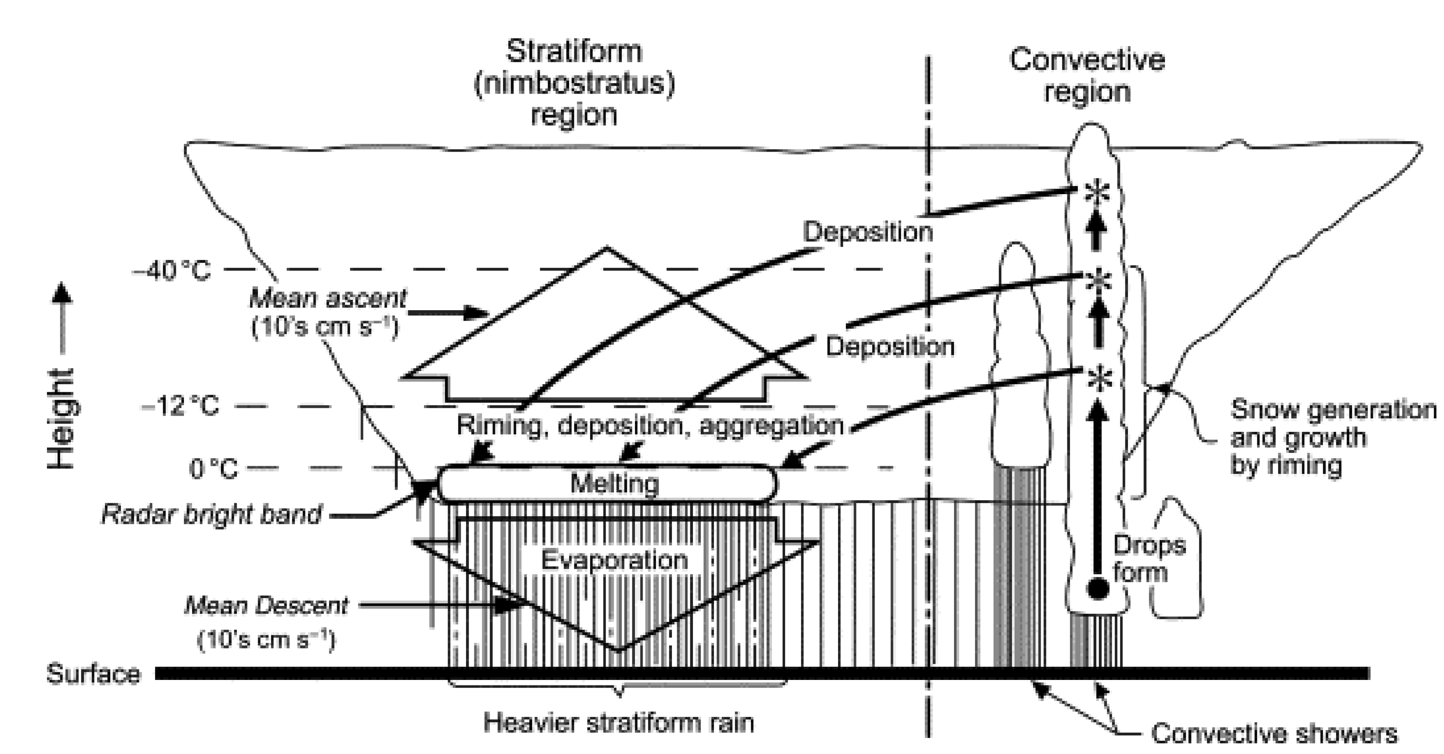


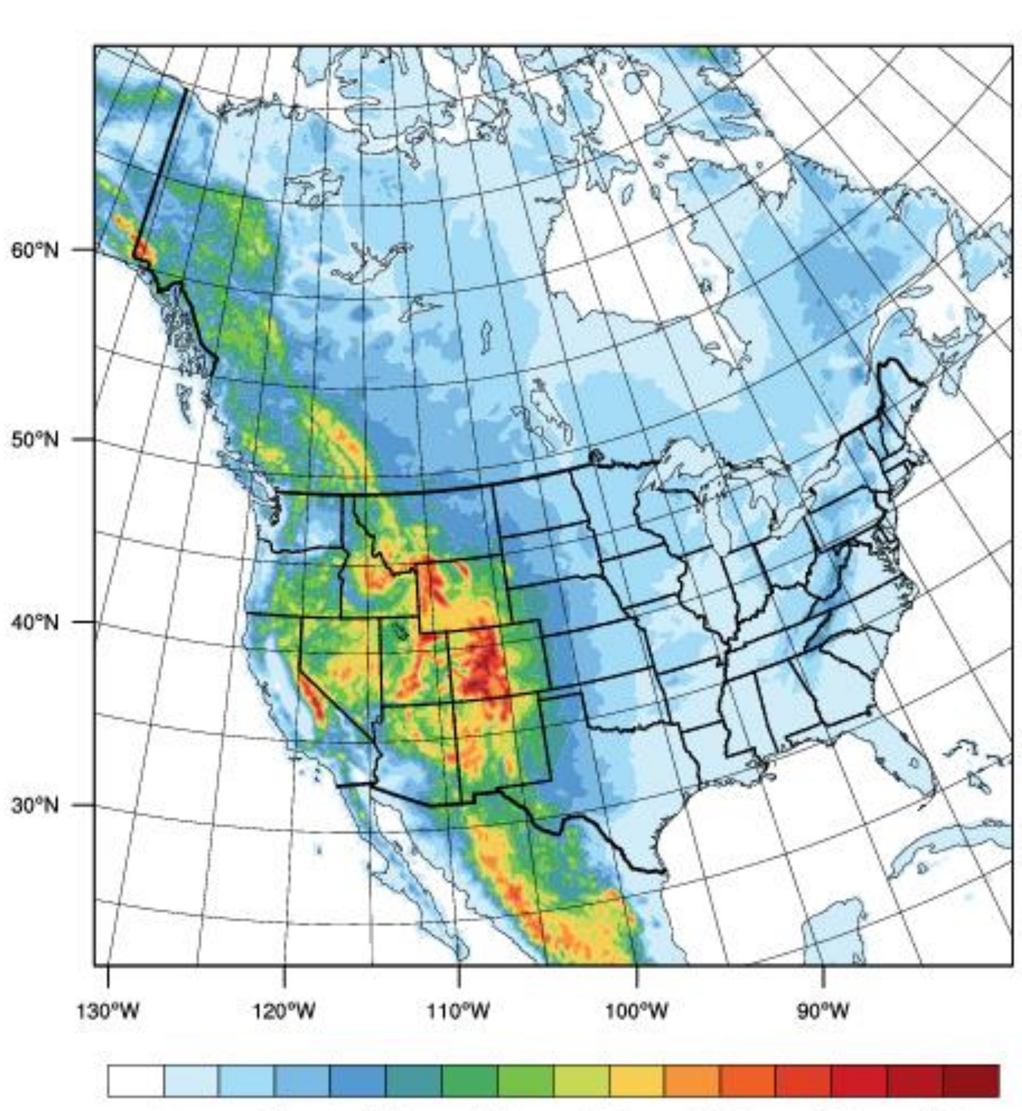




Method for Object-based Diagnostic Evaluation (MODE-TD)

WP3: What are the underlying physical processes for changes in MCSs and storm properties?





The set up of the WRF 4-KM CONUS II simulation

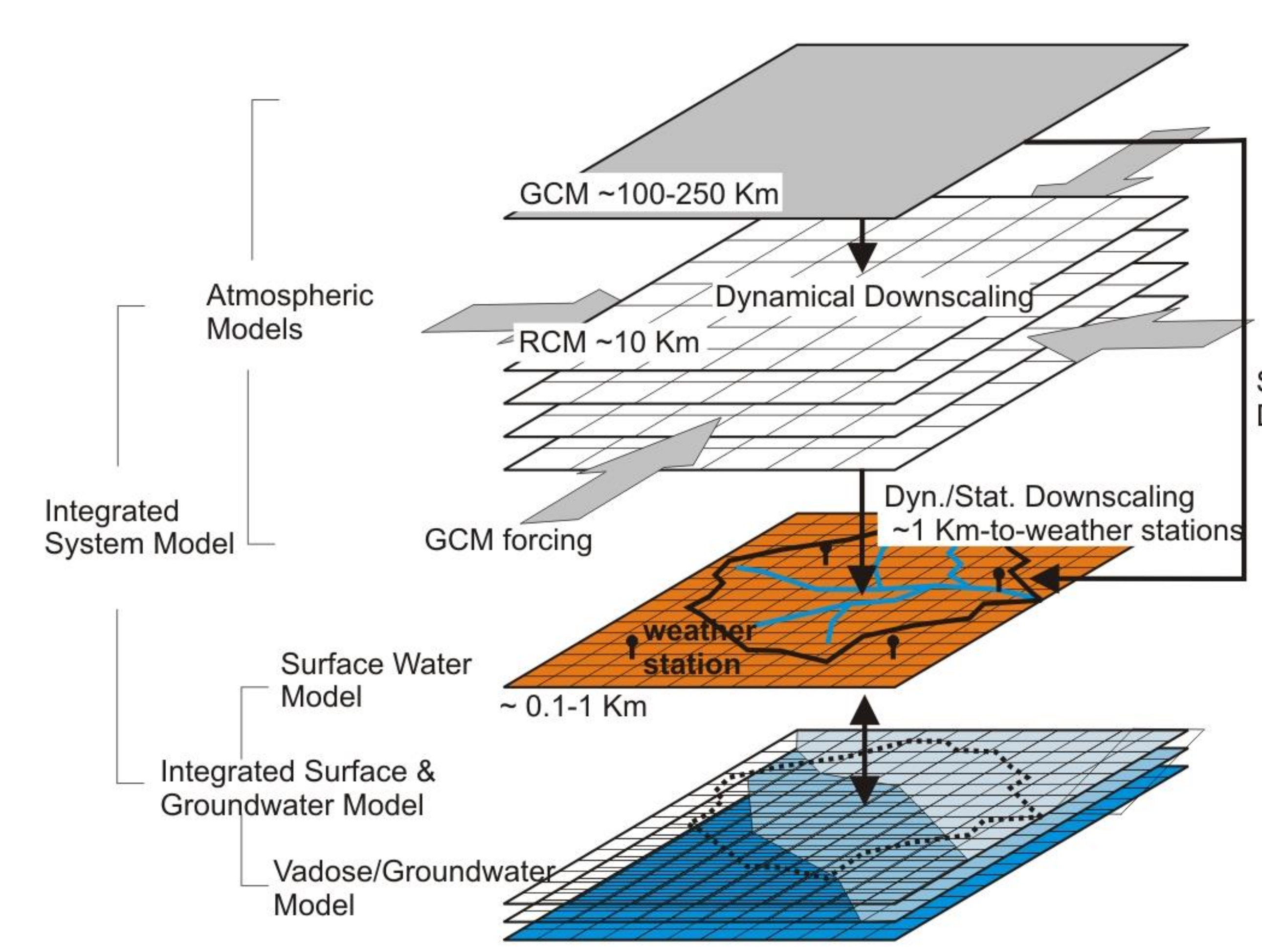
Simulation time periods confirmed:

1) Historical period simulation: 20-year integration plus 1-year spinup: 1995-2015
2) Future period simulation: 20-year integration plus 1-year spinup: 2080-2100

Forcing information:

1) Historical period simulation: It will be forced with 6-hr CCSM4 data, and ERA-Interim reanalysis will be used for bias correction;
2) Future period simulation: It will be forced with 6-hr CCSM4 data, and 19 CMIP5 model ensemble mean will be used for bias correction.

WP4: How do extreme precipitation features scale across resolution from GCMs to RCMs to convective permitting WRF?



Summary: This project focuses on physical processes affecting short-duration extreme precipitation and their possible changes in the warming world. This is motivated by the fact that short-duration extreme precipitation is critical for many GWF's users and understanding of physical mechanisms required for proper interpretation of projections produced by most global and regional climate models because these models do not directly simulate the processes that produce the extreme precipitation. We are working on questions related to precipitation and temperature relationships, the influence of storm types on the relationship, changes in mesoscale convective systems that affect the precipitation intensity, size and life-span of storms, and changes in mesoscale dynamics such as pre-storm atmospheric stability, convective inhibition (CIN), convective lifting strength, and precipitable water. These questions will be addressed by making extensive use of a convection-permitting modelling tool running in a pseudo-global warming mode and existing simulations by global and regional climate models. Progress will lead to a better understanding of the physical soundness of future projection by climate models, thereby providing a scientific foundation for the proper use of model projections that many GWF's users depend on.