High-Resolution Atmospheric Modeling using WRF

Surface Pressure

Wind Direction
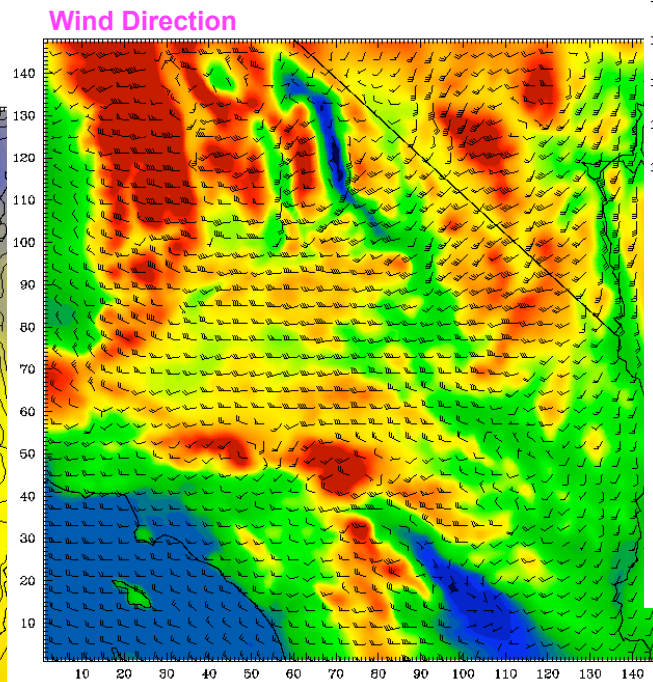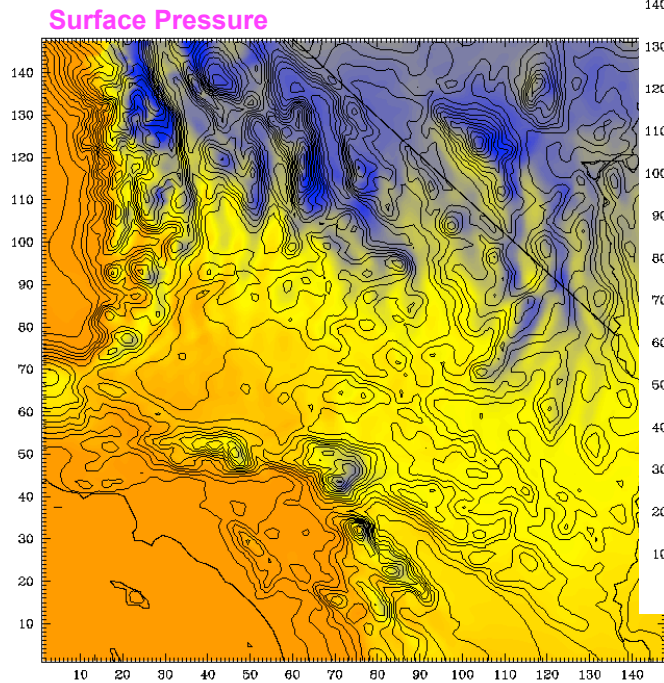
Wind Speed
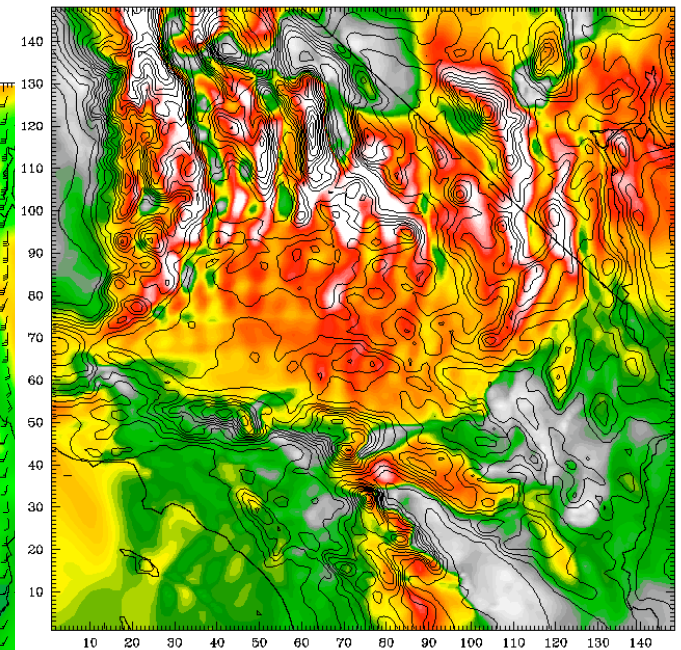
Gary Clow
USGS - Earth Surface Dynamics

What is WRF?

- Next-generation mesoscale Weather Research & Forecasting system

- Community model: *NCAR, NOAA, AFWA, NRL, FAA, universities*

- Fully compressible nonhydrostatic equations
     (designed for use at scales ranging from meters to 1000s of kilometers)

- Suitable for a wide range of applications

- Cloud-resolving when dx < 10 km
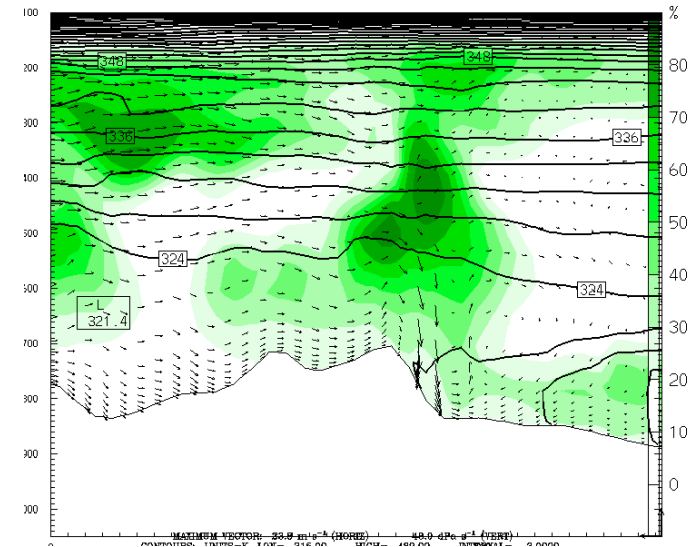
WRF Output and Diagnostic Fields

- ground temperature
- soil moisture
- snow cover
- surface dewpoint temperature
- surface frost point temperature
- wind shear
- sensible heat flux
- latent heat flux
- BL relative humidity

- air temperature
- pressure
- density
- wind speed & direction
- vorticity
- convective instability
- water vapor density

- precipitation
- precip. type (rain, graupel, snow)
- convective vs. non-convective precip.
- column-integrated cloud liquid mass
- cloud cover
- cloud water mixing ratio
- cloud ice mixing ratio
- cloud ceiling
- cloud-top temperature

cloud cover (Arctic Alaska)
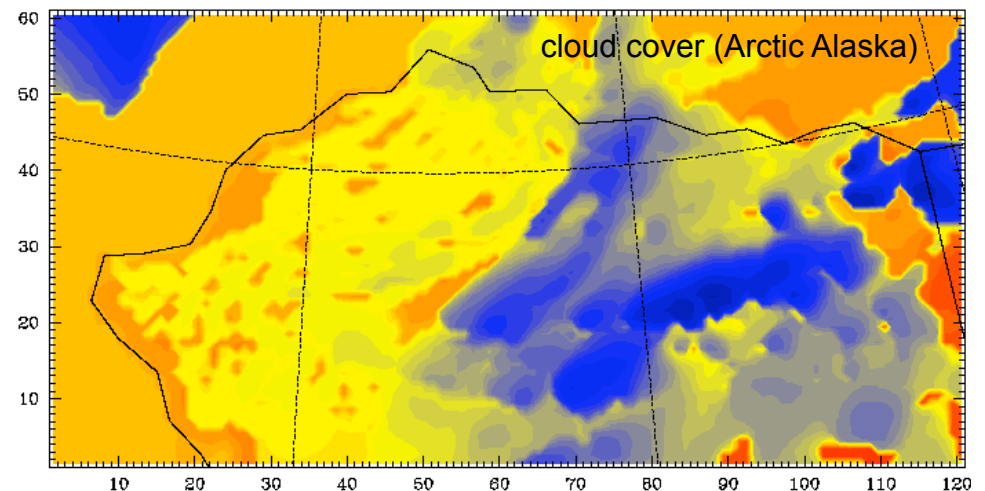
WRF Physics Options

D. Lawrence

Longwave Radiation

- RRTM, GFDL, CCSM3

Shortwave Radiation

- Dudhia, Goddard, GFDL, CCSM3

Cloud Microphysics

- Kessler; Lin et al.; NCEP; WSM 3,5,6 class; Ferrier; Thompson; Morrison

Cumulus Parameterization

- Kain-Fritsch, Betts-Miller-Janjic, Grell-Devenvi

Planetary Boundary Layer
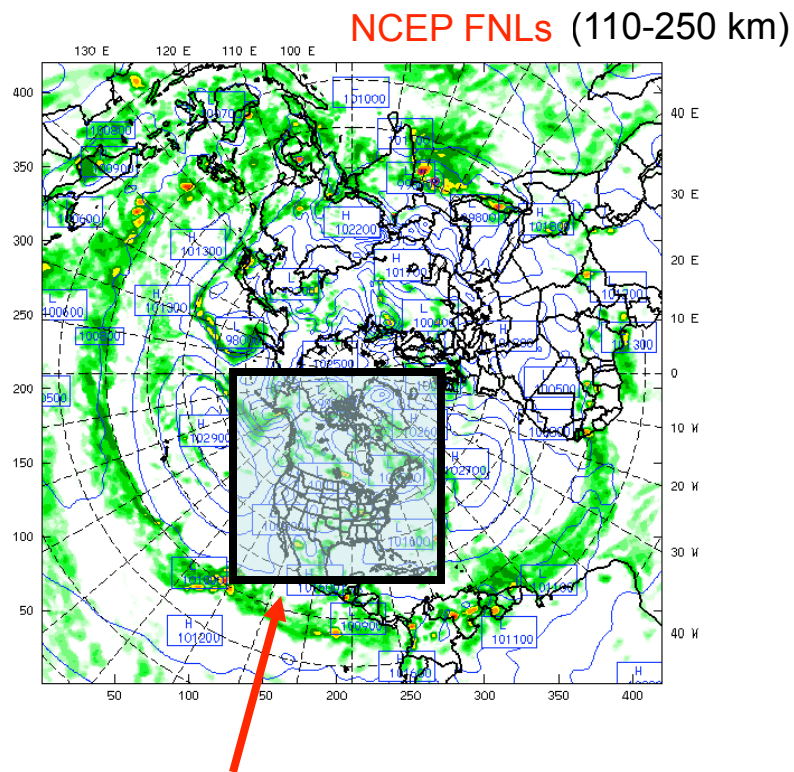
- YSU, Mellor-Yamada-Janjic, MRF

Land Surface Model

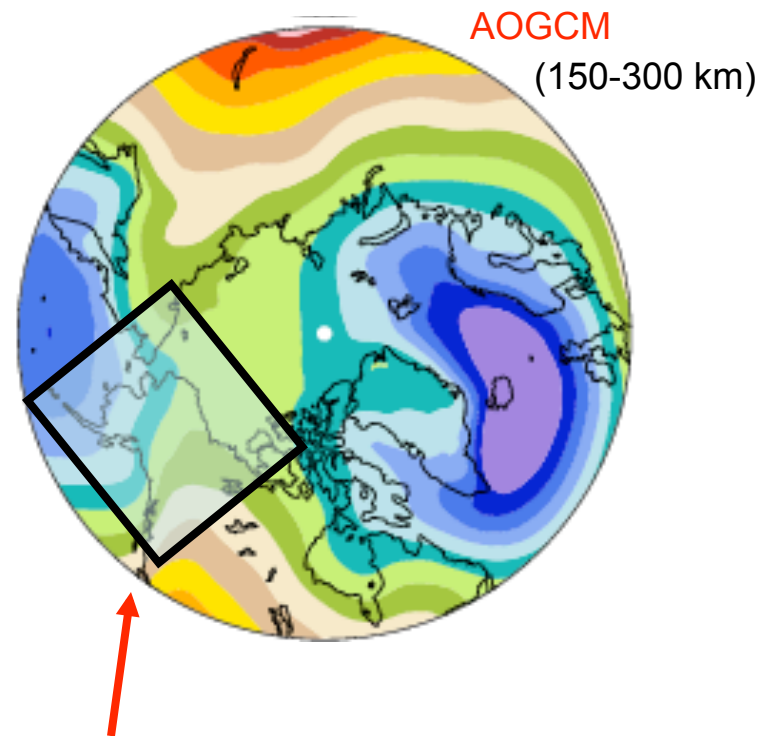- 5 slab soil model, RUC LSM, Noah LSM, Urban Canopy model, CLM (2008/9)

2 Modes

1) Retrospective Analyses

NCEP FNLs (110-250 km)

Nest WRF within observed large-scale circulation.

2) Future Climate Projections

AOGCM (150-300 km)
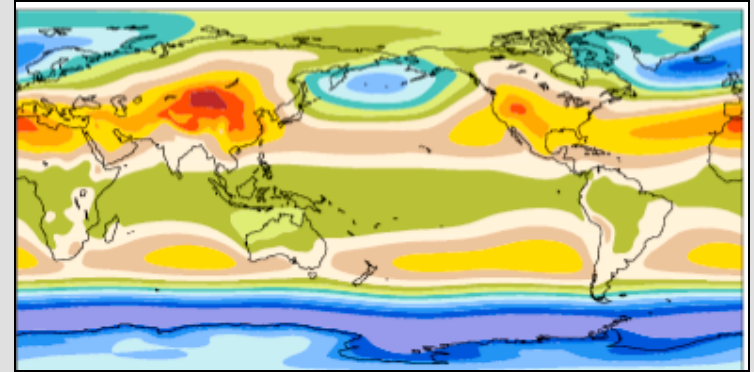

Nest WRF within large-scale circulation projected by an AOGCM.
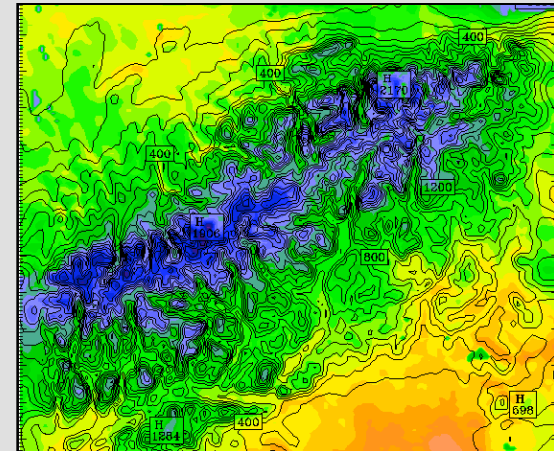
NCEP/FNLs or AOGCMs

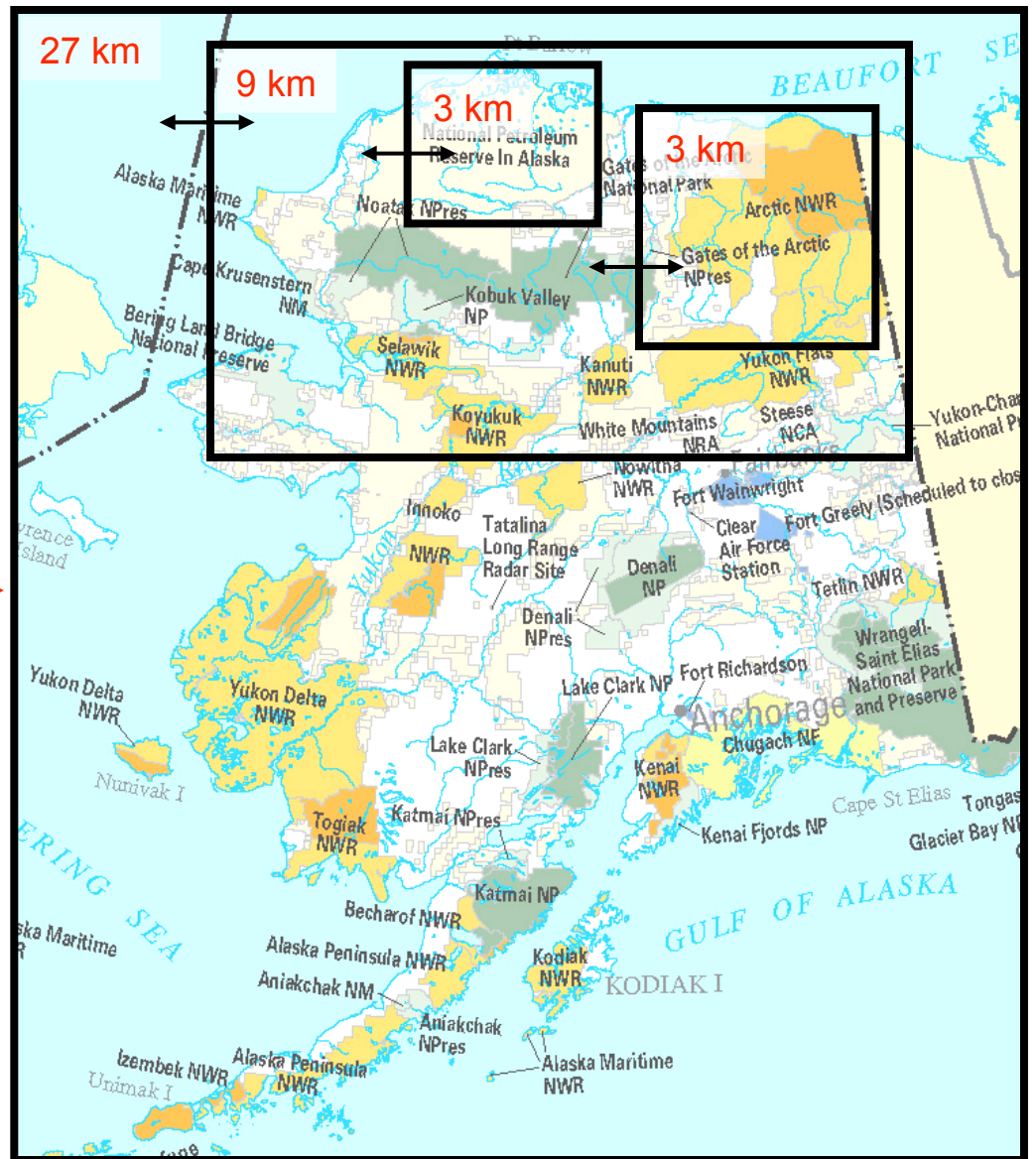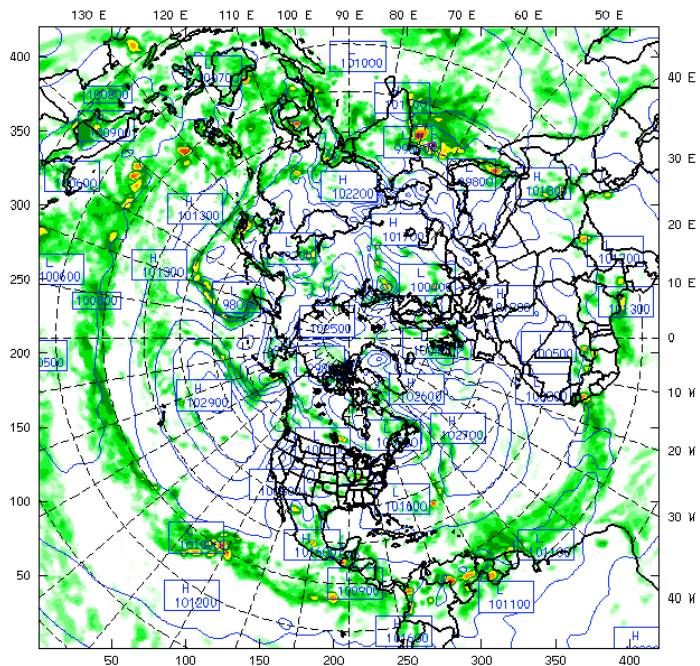110-300 km
(macroscale)

WRF
(primarily an atmospheric model)

0.01 - 100 km

Landscape Change models
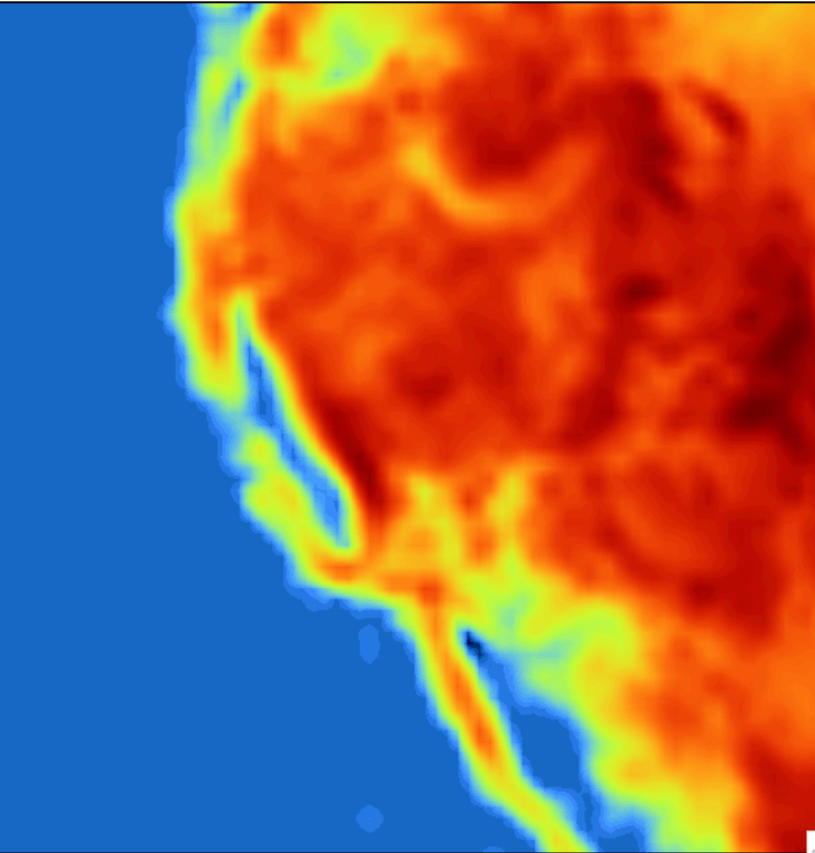Ecosystem Change models

NCEP FNLs
(110 km)

27 km
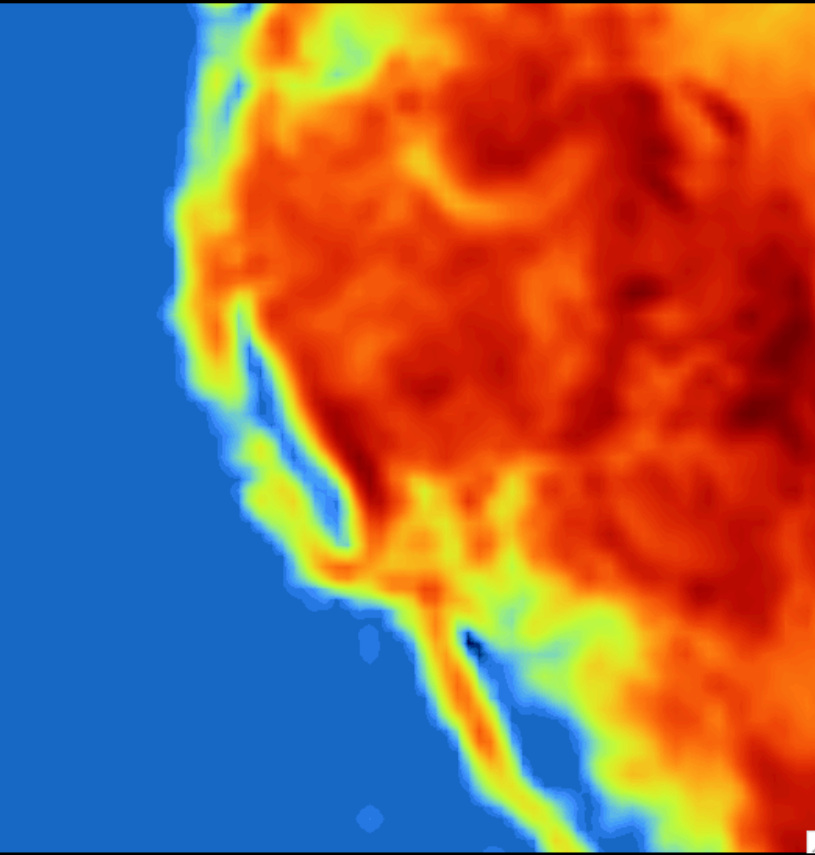
9 km

3 km
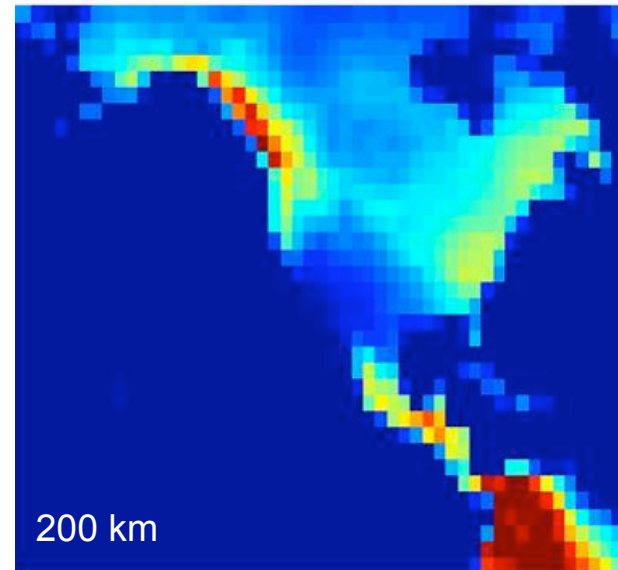
3 km

Domain 1: 27 km

WRF Resolution for Mojave Simulations

Domain 1: 27 km

GCM Resolution
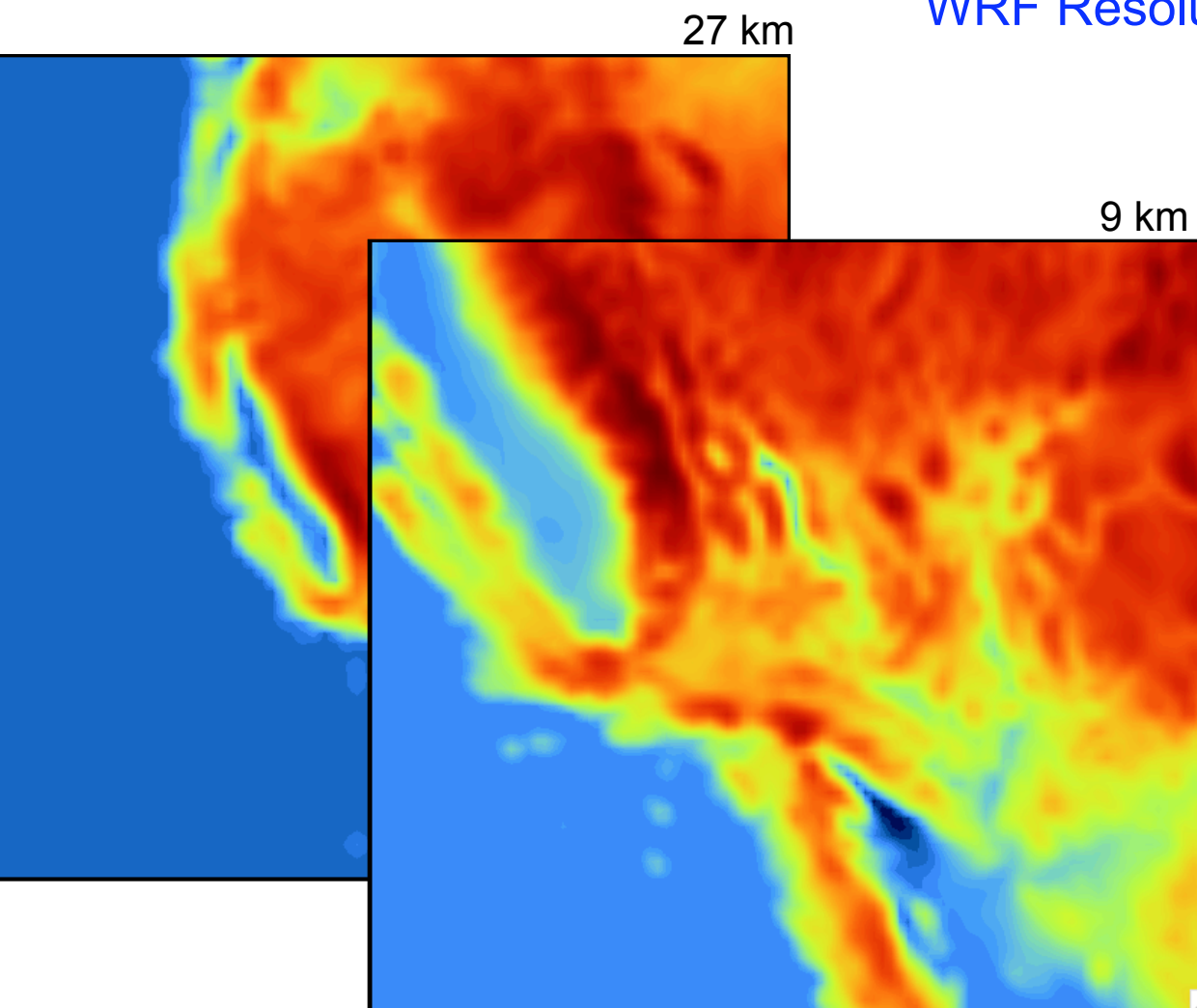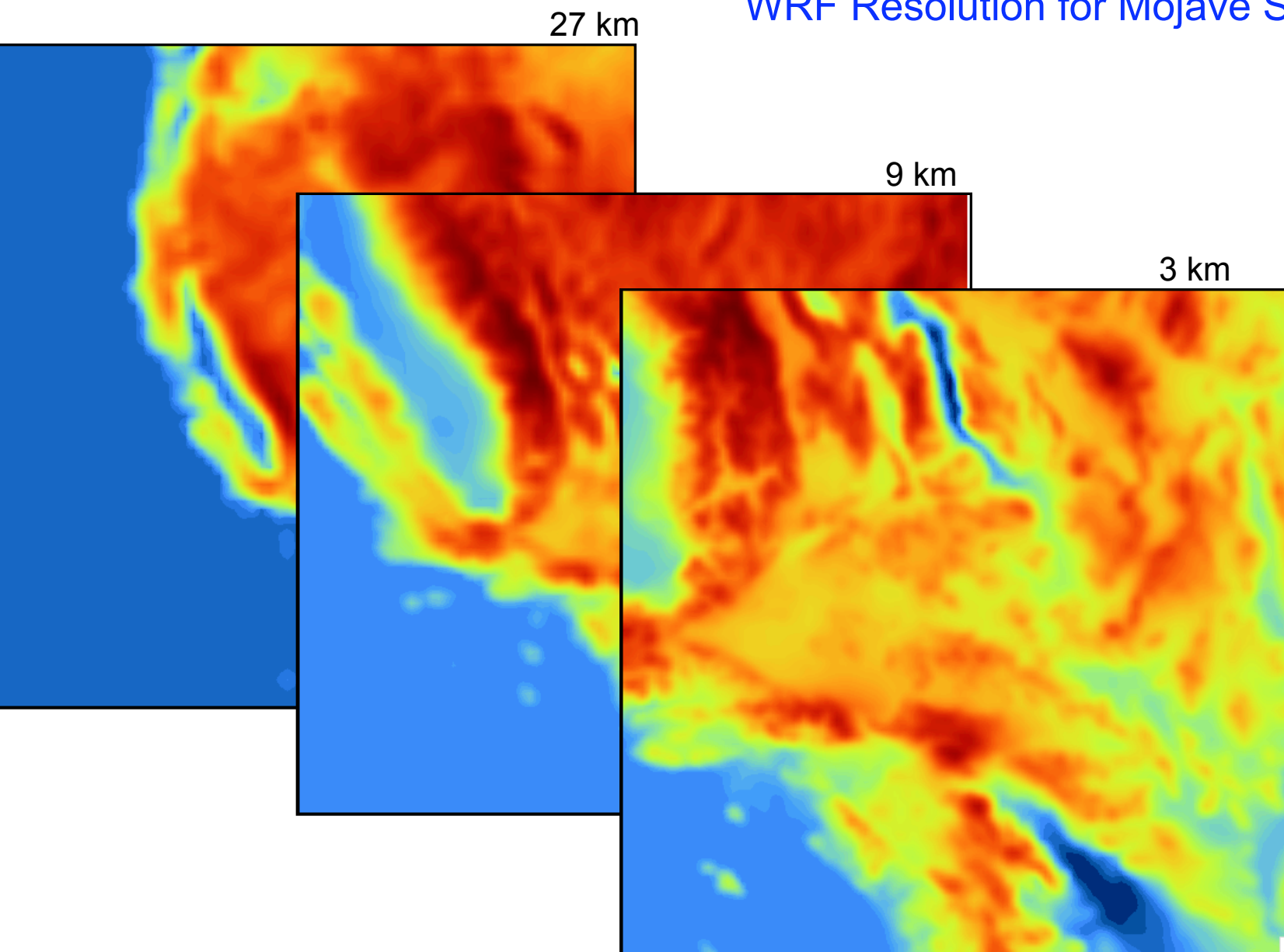
200 km

WRF Resolution for Mojave Simulations

27 km

9 km

WRF Resolution for Mojave Simulations

27 km

9 km

3 km

WRF Resolution for Mojave Simulations

27 km

9 km

3 km

1 km