Convection-permitting climate model research updates

Lintao Li

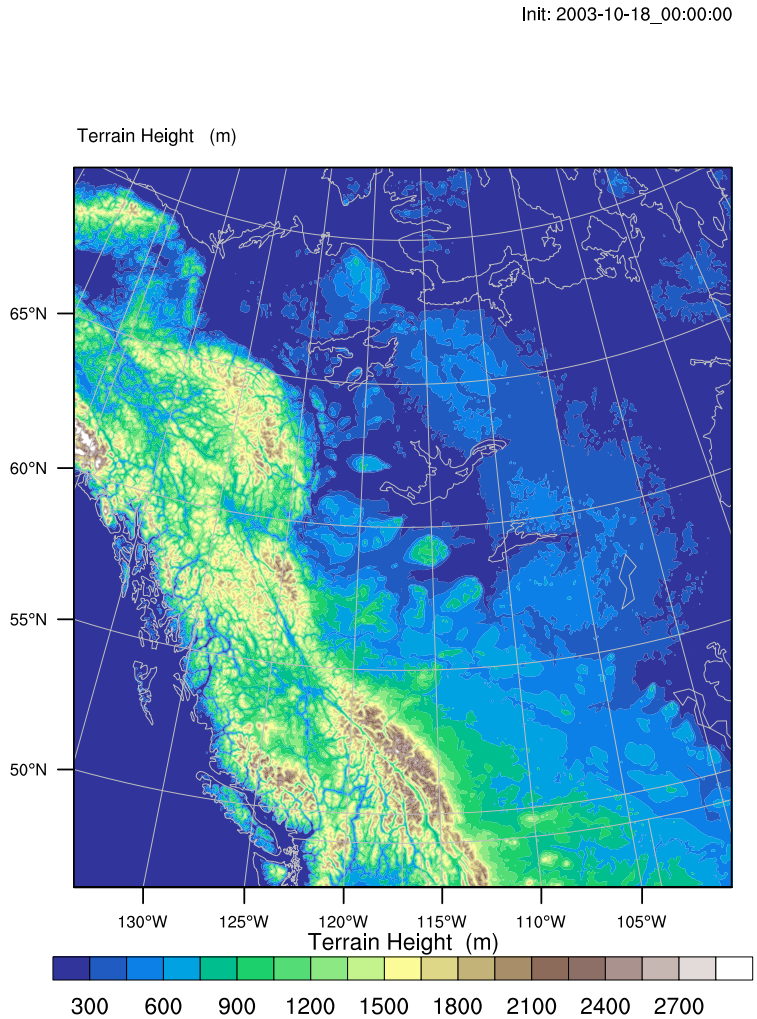
Global Institute for Water Security

March 26, 2019

Contents

Tracking precipitation systems

Method for Object-Based Diagnostic Evaluation (MODE) with Time Domain (MODE-TD, or MTD)



Tracking precipitation systems

Method for Object-Based Diagnostic Evaluation (MODE) with Time Domain (MODE-TD, or MTD)

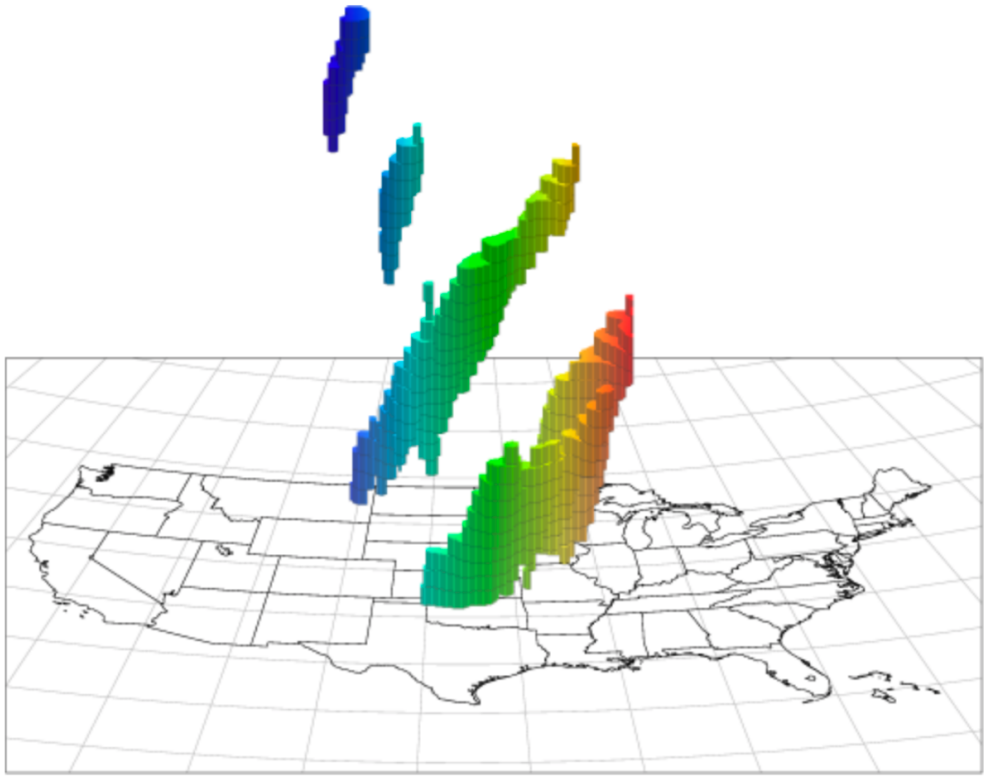


Figure: MTD Spacetime Objects

Tracking precipitation systems

Method for Object-Based Diagnostic Evaluation (MODE) with Time Domain (MODE-TD, or MTD)

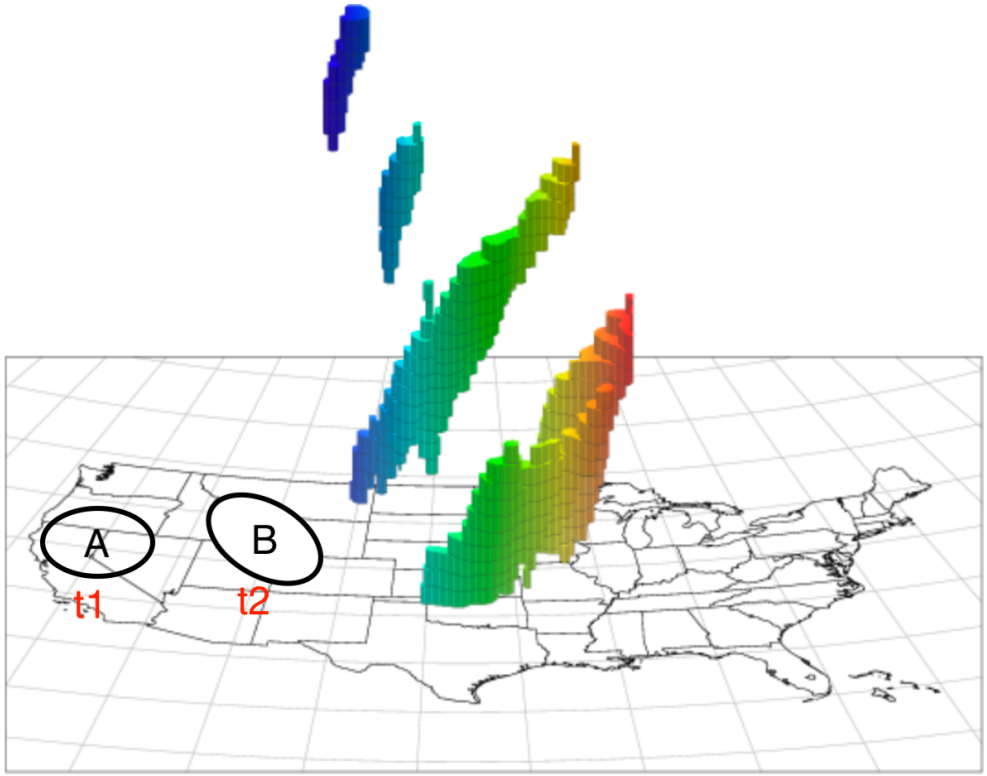
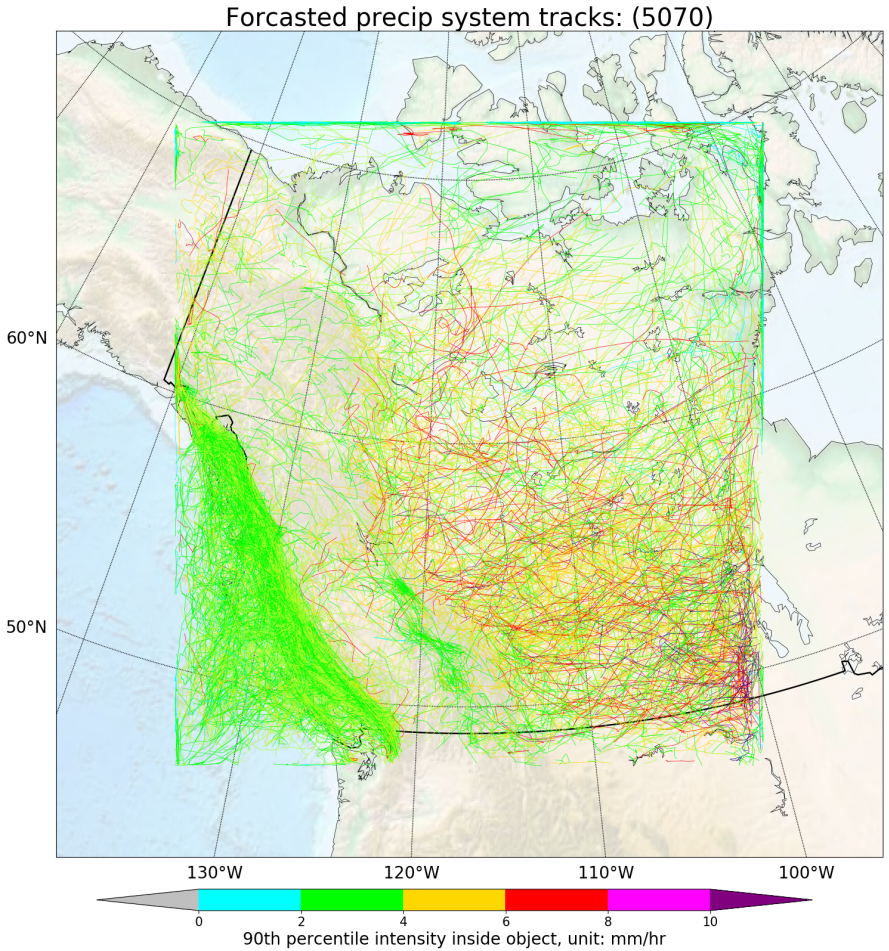


Figure: MTD Spacetime Objects

Tracking precipitation systems

Method for Object-Based Diagnostic Evaluation (MODE) with Time Domain (MODE-TD, or MTD)



Tracking precipitation systems

Method for Object-Based Diagnostic Evaluation (MODE) with Time Domain (MODE-TD, or MTD)

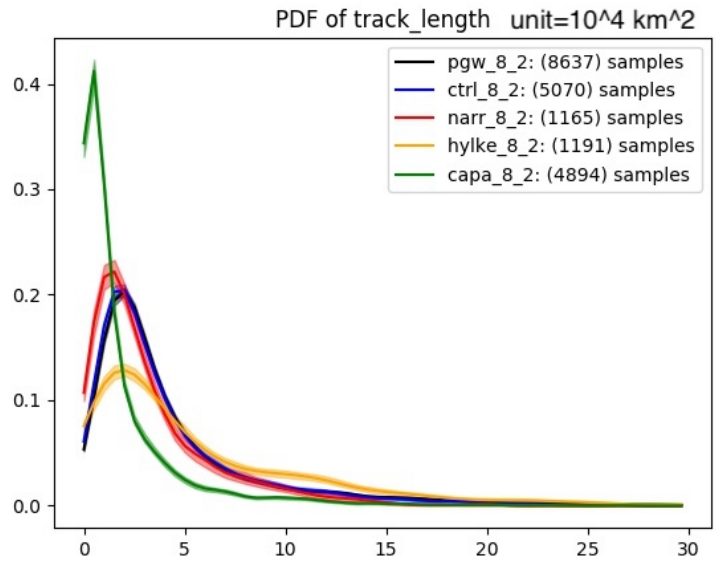
Spatial features

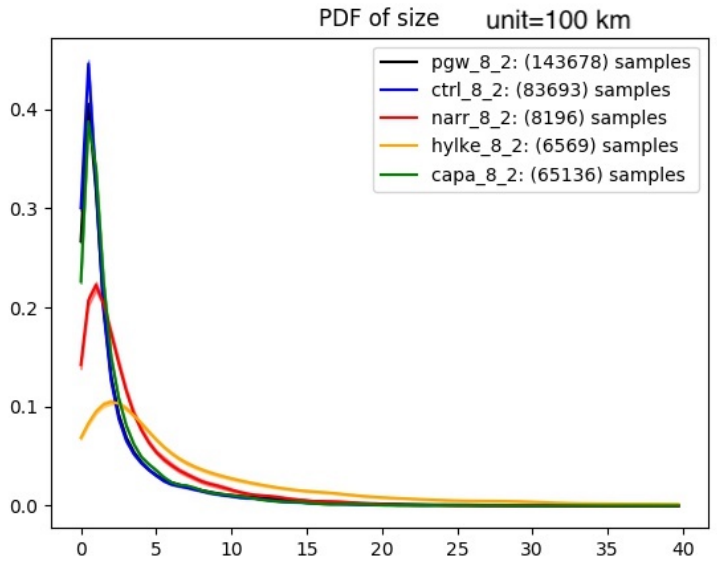
Track length; object size.

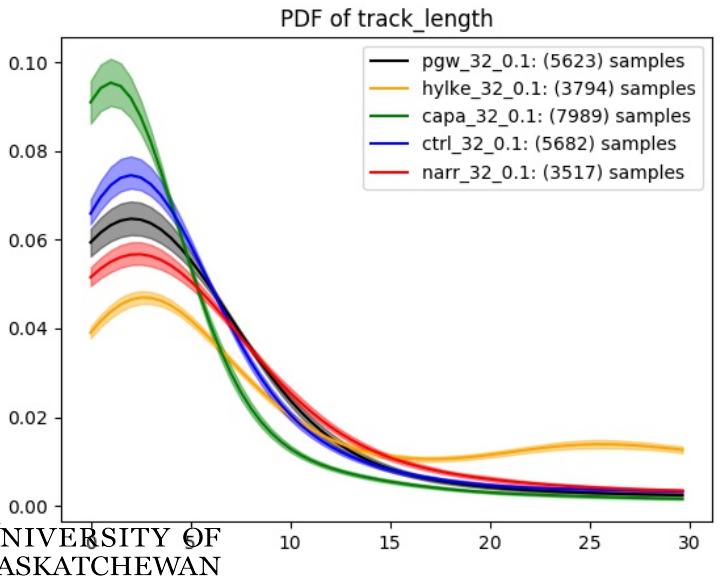
Temporal features

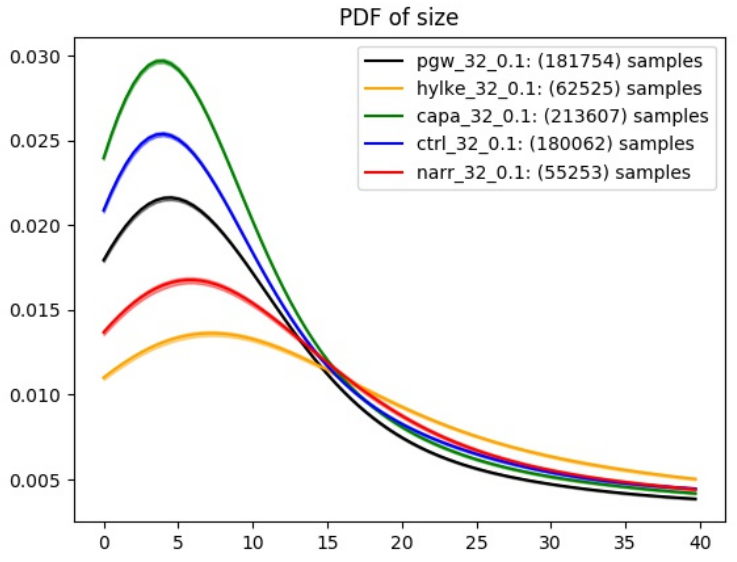
Object lifetime; object speed.

Tracking precipitation systems: Spatial features

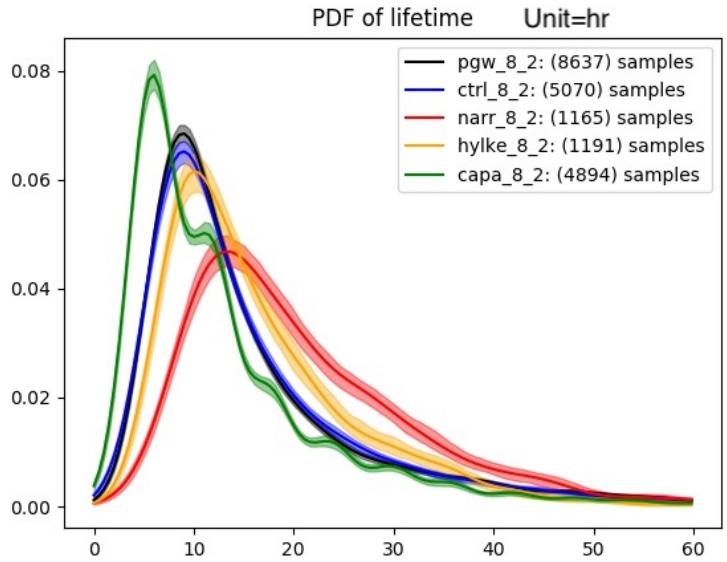


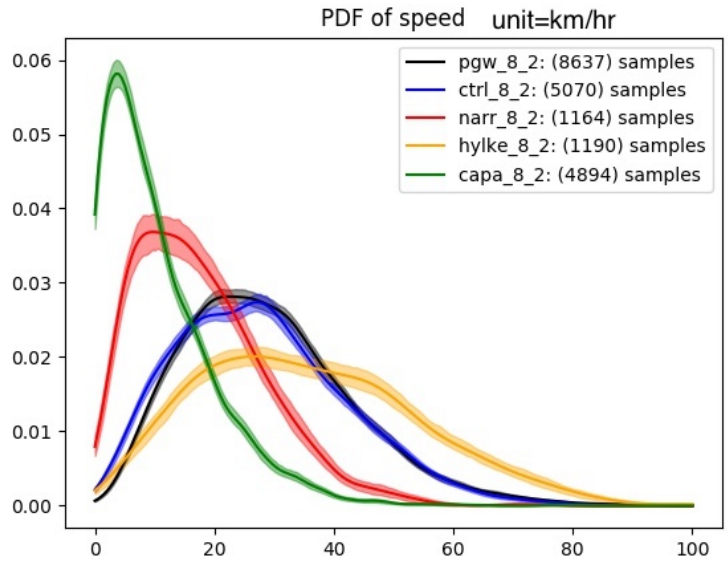


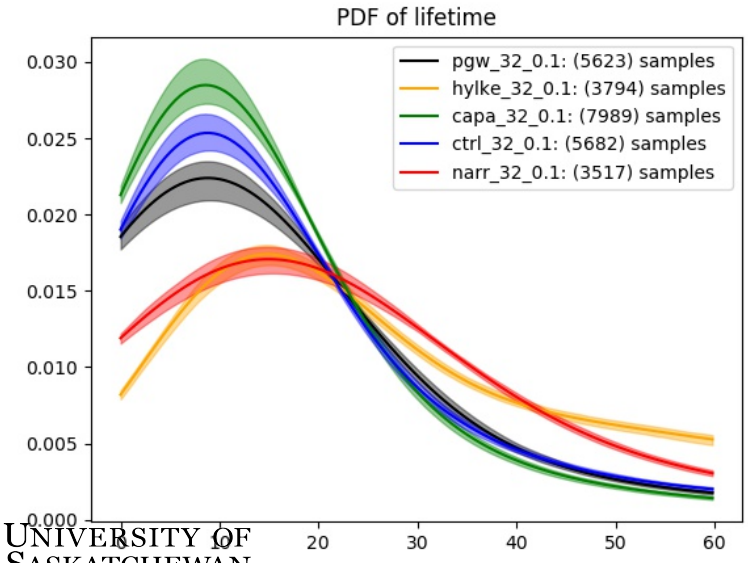


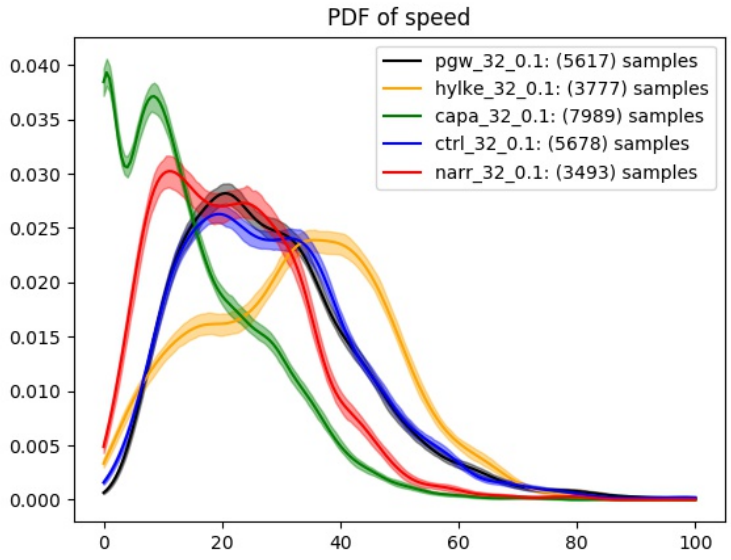


Tracking precipitation systems: Temporal features

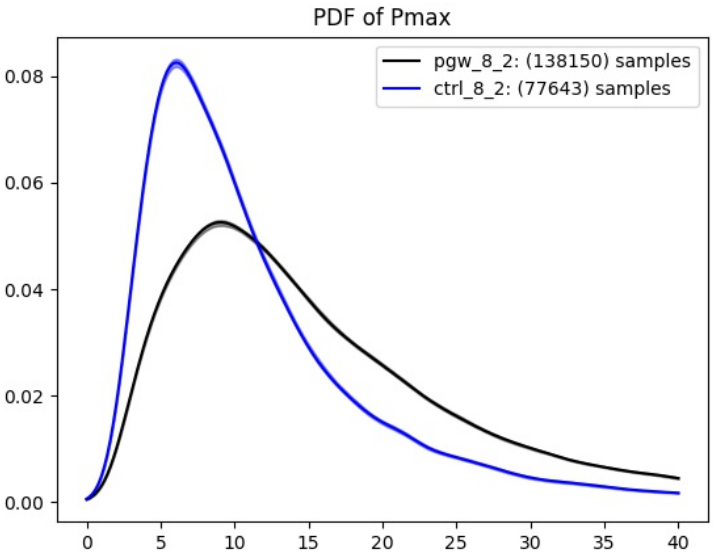


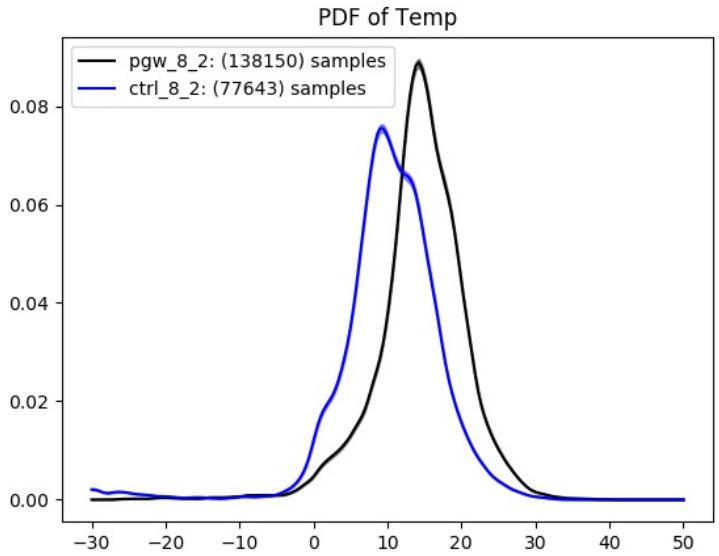


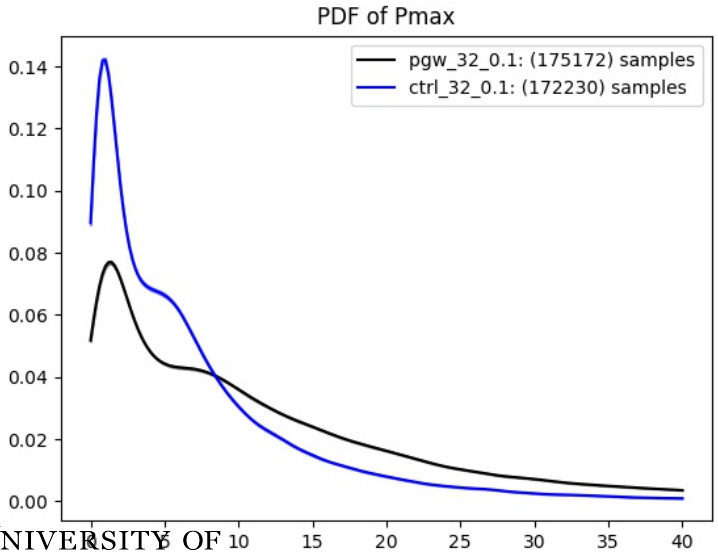


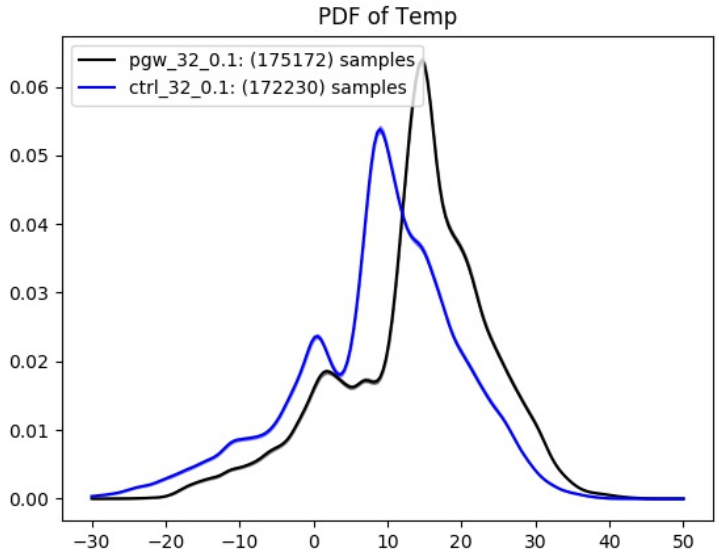


Tracking precipitation systems: Future conditions





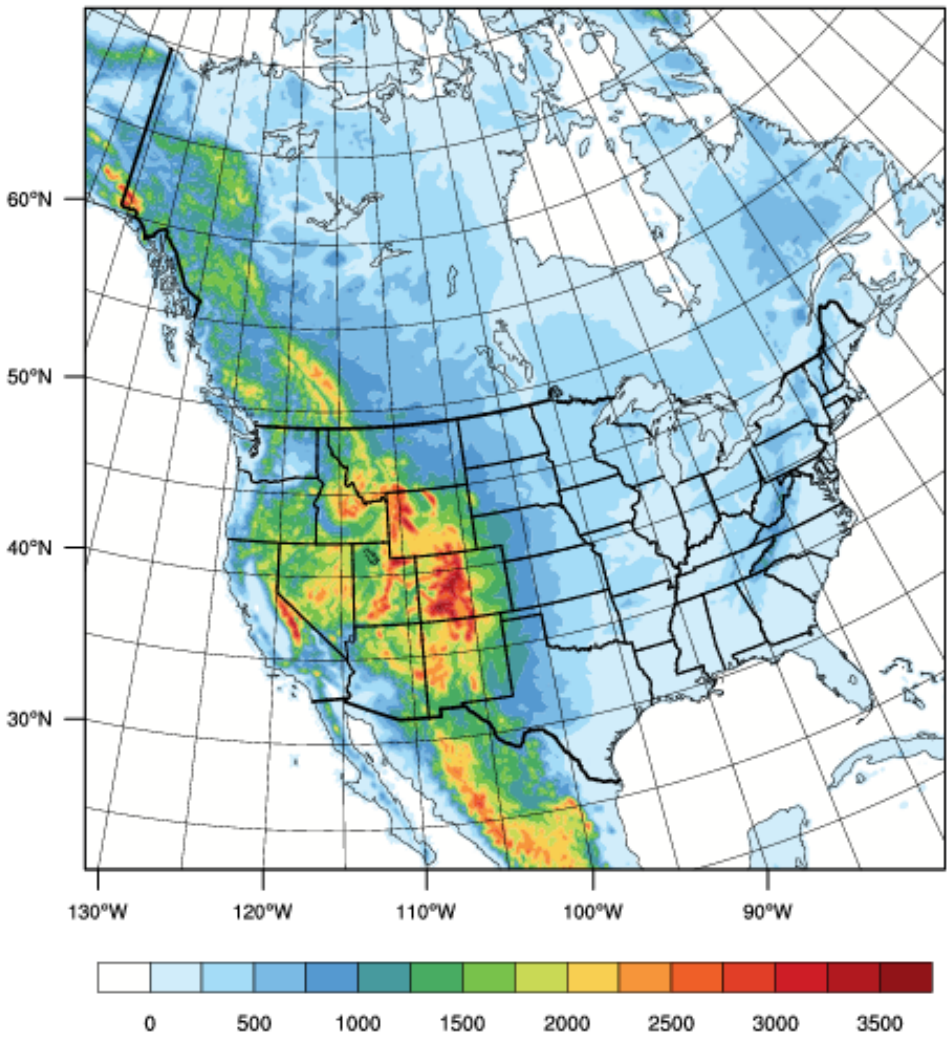




CONUS-II test runs

1. Version 3.9.1.1
2. Grid spacing: 12km
3. Microphysics: Thompson
4. Convection scheme: New Tideke
5. PBL schemes: YSU
6. Radiation: RRTMG
7. Land surface model: NoahMP with bug-fixed ground water treatment
8. Subgrid cloud: Xu-Randall
9. Aerosol impact: aer_opt = 1
10. Model input: bias-corrected CCSM4
11. Simulation period: 1995 - 2005

CONUS-II test runs



CONUS-II test runs

1. EXP1 (completed)
   - no bias correction
2. EXP2 (completed)
   - bias correction
3. EXP3 (completed)
   - bias correction, daily sea ice
4. EXP4 (completed)
   - bias correction, daily sea ice, snow fraction
5. EXP5 (ongoing)
   - testing Thompson cloud fraction
6. EXP6 (ongoing)
   - lake model testing

Bias Correction

Forced with transient weather signal from one CCSM4 run plus bias-corrected (toward ERA-I) CMIP5 ensemble mean climate.

Expect to start the full CONUS-II simulation in April.

Appendix - Forcing Data Constructions

1. Historical simulation (1995-2015)

$$WRF_{input} = CCSM' + \overline{CMIP5} - \overline{CMIP5}_{bias}$$

$$= (CCSM - \overline{CCSM}_{1976\text{-}2005}) + \overline{CMIP5}_{1976\text{-}2005}$$

$$- (\overline{CMIP5}_{1976\text{-}2005} - \overline{ERA\text{-}I}_{1979\text{-}2005})$$

$$= CCSM - \overline{CCSM}_{1976\text{-}2005} + \overline{ERA\text{-}I}_{1979\text{-}2005}$$

CCSM: 6-hr CCSM4 data

$\overline{CCSM}_{1976\text{-}2005}$: 1976-2005 monthly mean from 6-hr CCSM4 data

$\overline{ERA\text{-}I}_{1979\text{-}2005}$: 1979-2005 monthly mean from 6-hr ERA-I data

Appendix - Forcing Data Constructions

2. Future simulation (2070-2099)

$$WRF_{input} = CCSM' + \overline{CMIP5} - \overline{CMIP5}_{bias}$$

$$= (CCSM - \overline{CCSM}_{2071\text{-}2100}) + \overline{CMIP5}_{2071\text{-}2100}$$

$$- (\overline{CMIP5}_{1976\text{-}2005} - \overline{ERA\text{-}I}_{1979\text{-}2005})$$

CCSM: 6-hr CCSM4 data

$\overline{CCSM}_{2071\text{-}2100}$: 2071-2100 monthly mean from 6-hr CCSM4 data

$\overline{CMIP5}_{1976\text{-}2005}$, $CMIP5_{2071\text{-}2100}$: 1976-2005 (2071-2100) monthly mean from 19 CMIP5 model ensemble mean

Appendix - Data Sources

Short name	Long name	Spatial resolution	Temporal relolution
CaPA	Canadian Precipitation Analysis system	0.125 degree; 12km	1hr, interpolated from 6 hrly data
NARR	North American Regional Reanalysis	0.3 degree; 32km	3hr
Hylke	Multi-Source Weighted-Ensemble Precipitation	0.1 degree; 10km	3hr