Regional-MPAS and WRF: Preliminary Comparison and Evaluation

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Regional-MPAS and WRF: issues we are concerned

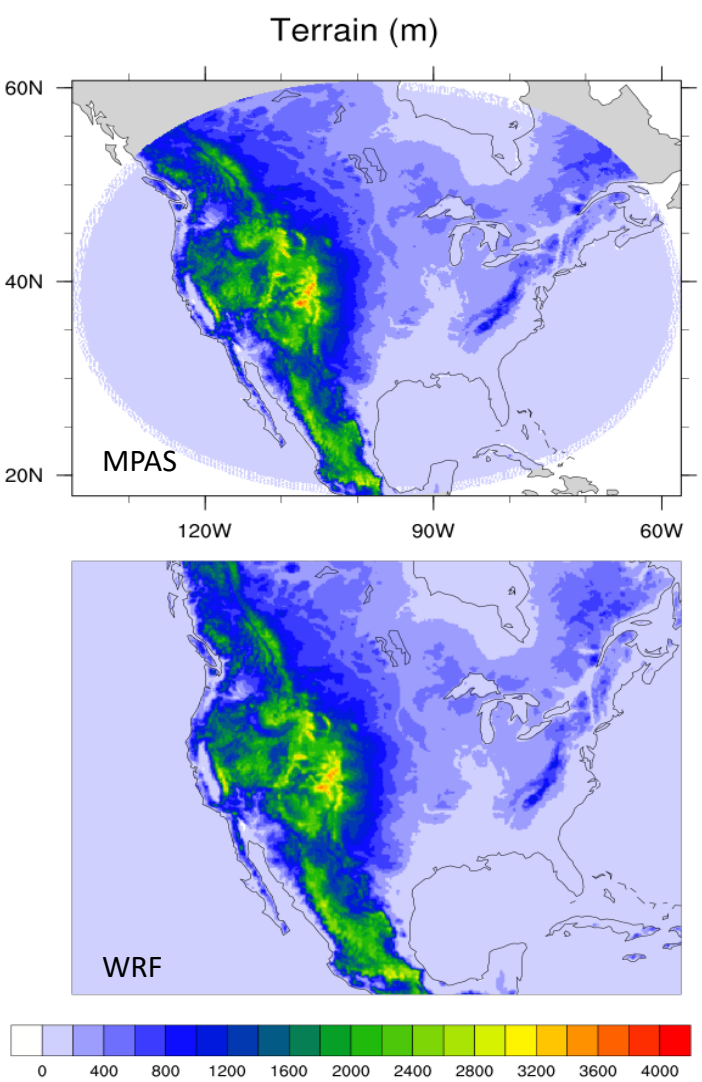
- MPAS and WRF physics unification
- Different grid structures
  - Surface information: vegetation fraction, albedo, terrain, landuse, etc.
  - Specification of vertical levels
- Experiments
  - GFS analysis/forecast for initial condition and lateral boundary forcing
  - 72-hour runs over Feb 1-March 30 and April 20-June 15 2017, initialized at 00 UTC every three days;
- Verification and comparison
  - CMORPH, MRMS and Stage IV precipitation
  - GFS analysis and in-situ observations

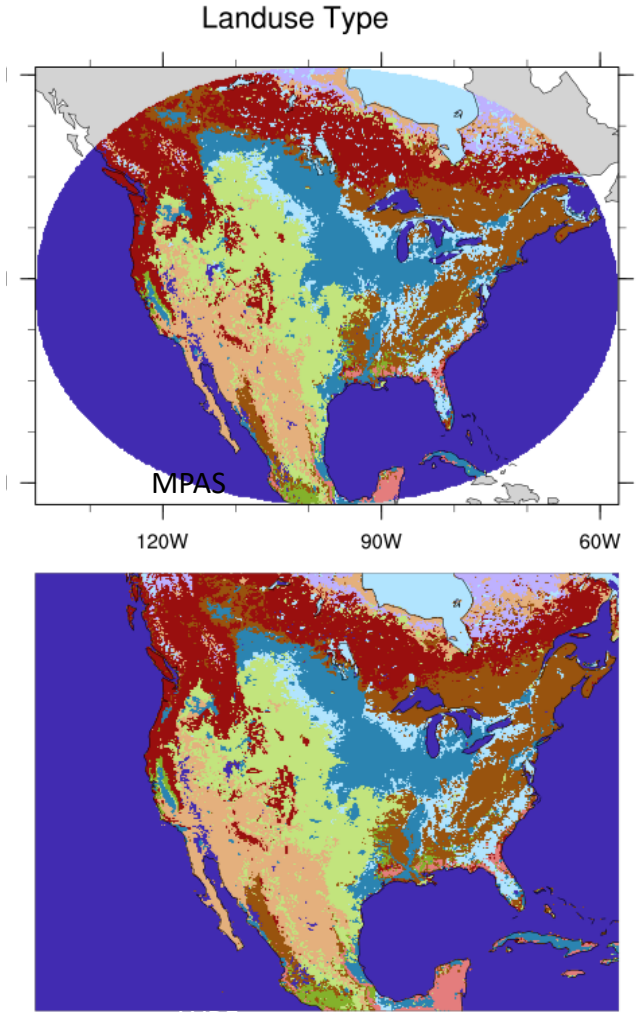
Regional-MPAS and WRF: Physics Unification

- Unified physics configuration in MPAS and WRF

	MPAS	WRF
Physics suite	Mesoscale_reference	Tropical
Ozone	config_o3climatology = True	O3input = 2
effective radii computed in microphysics	config_microp_re = True	use_mp_re = 1
Aerosol	No aerosol is considered	aer_opt = 0
Use snow albedo	sfc_snowalbedo = true	rdmaxalb=true
Sea ice	fractional_seaice =1	fractional_seaice = 1
Gravity wave drag	config_gwdo_scheme = off	gwd_opt = 0

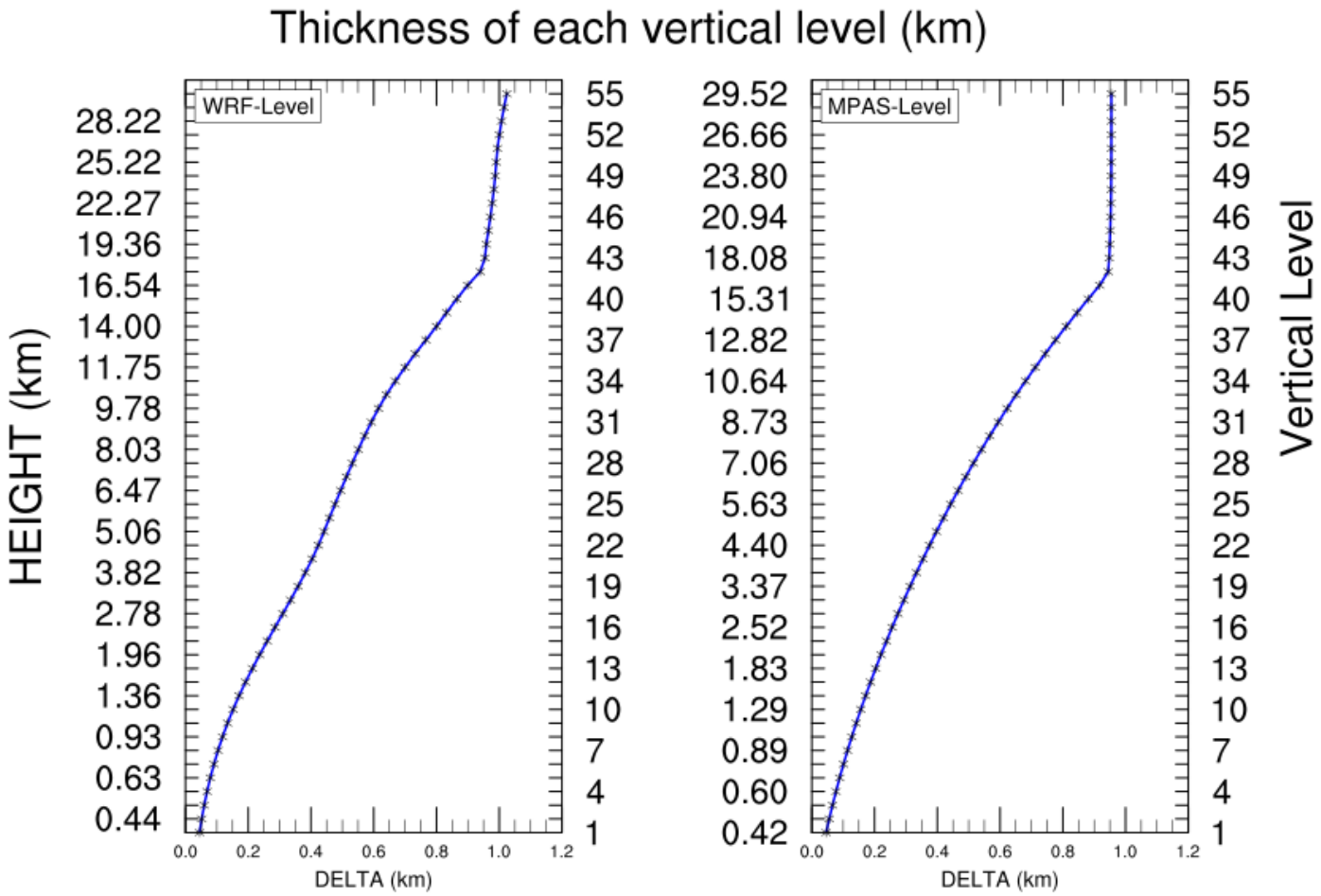
Model domain, static information, etc.



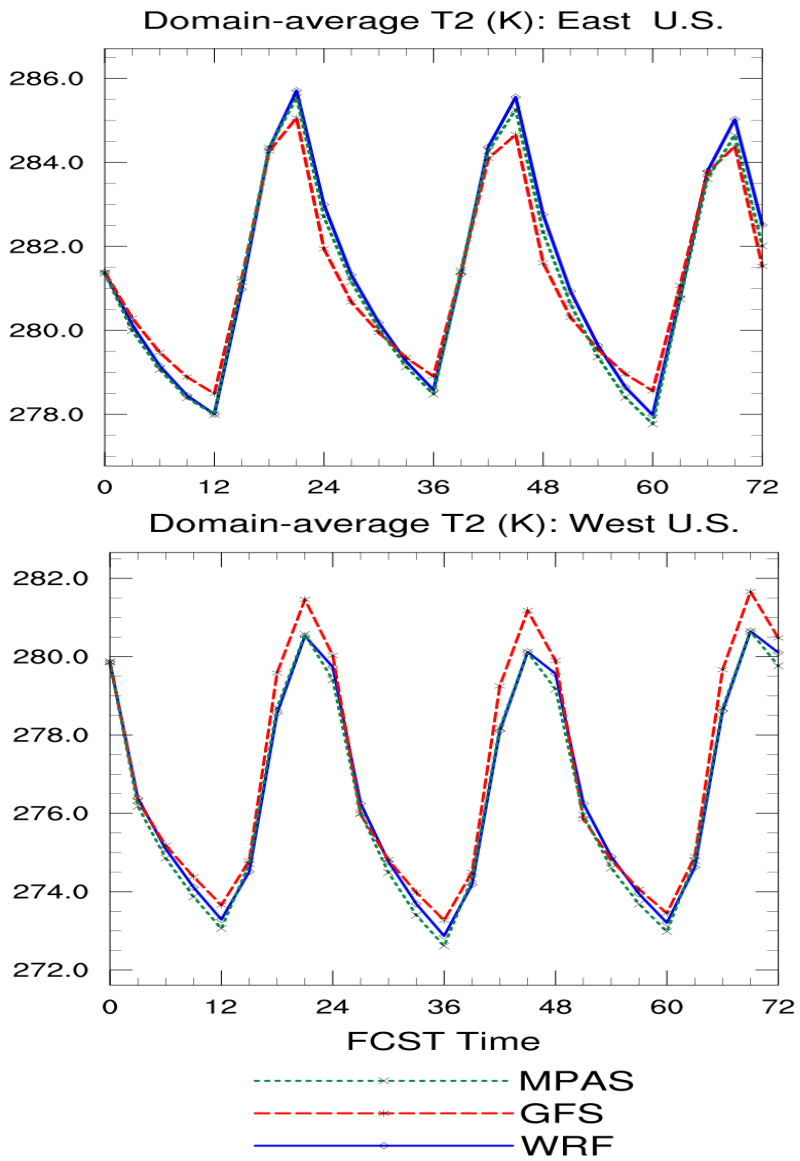


WRF and MPAS: domain, landuse type

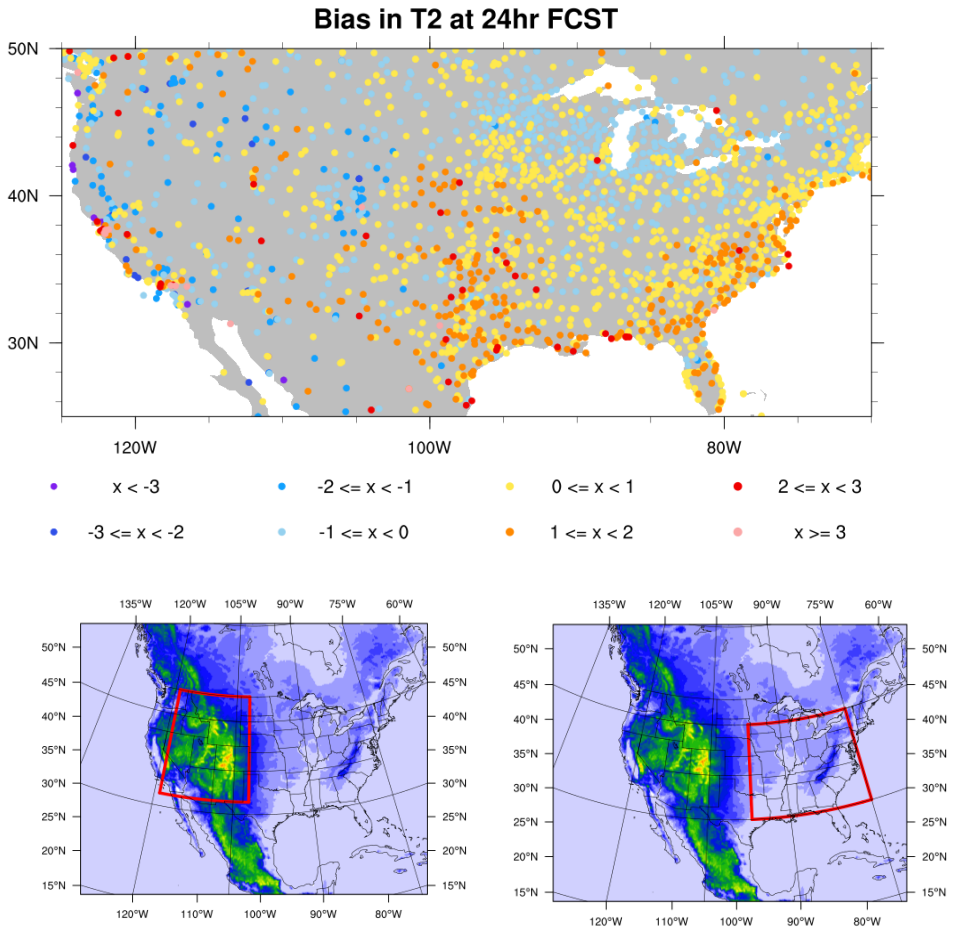
WRF-MPAS Vertical Levels



Surface air temperature: February 1 – March 30 2017



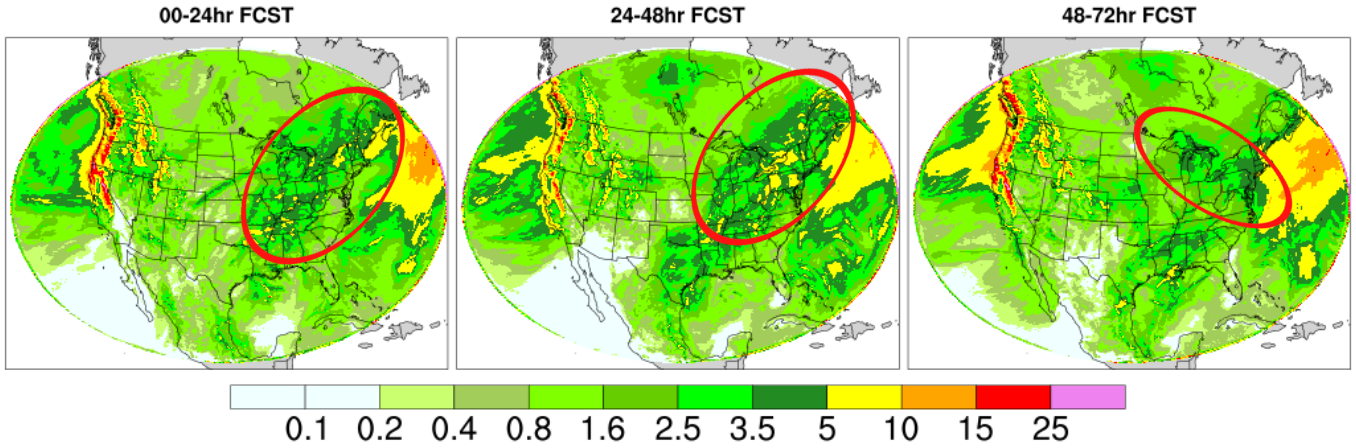
Verification of monthly WRF simulations



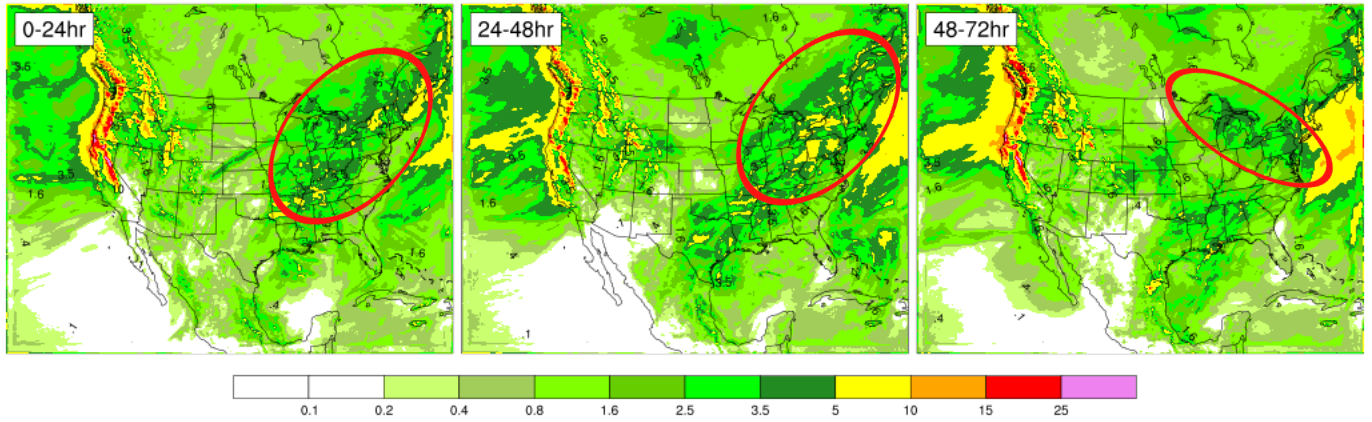
Precipitation Forecasts:

24-hr accumulative precipitation simulated by MPAS and WRF

MPAS: Precipitation Forecast (Feb 1 - Mar 30 2017)

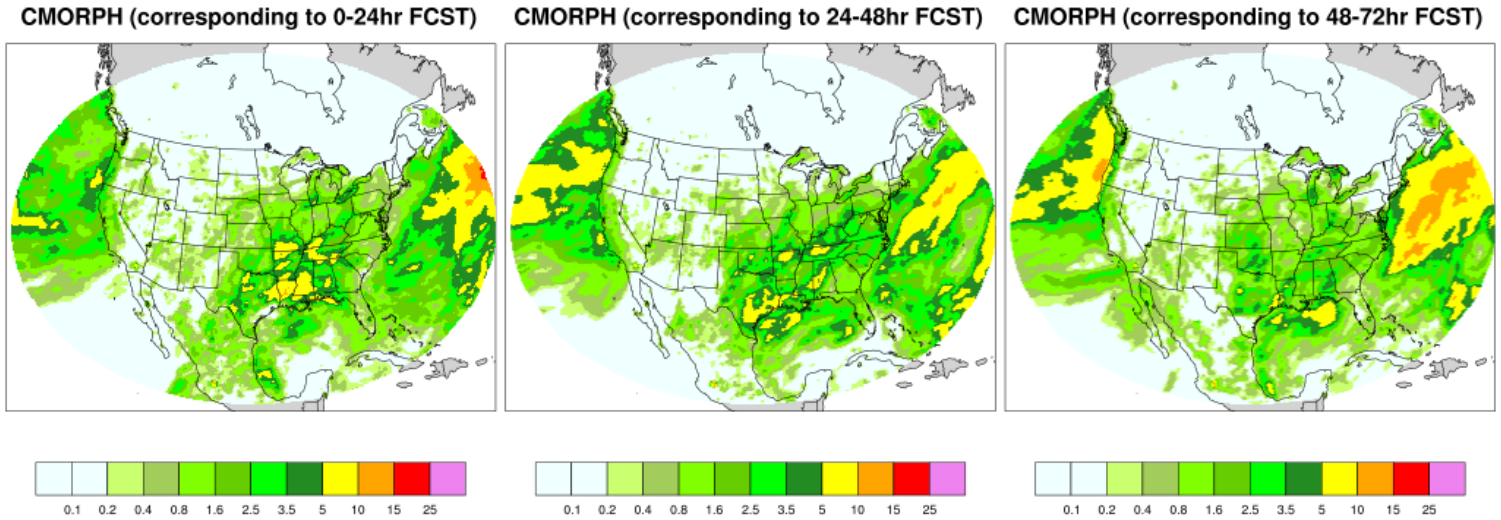


WRF: Precipitaion Forecast (Feb 1 - Mar 30 2017)

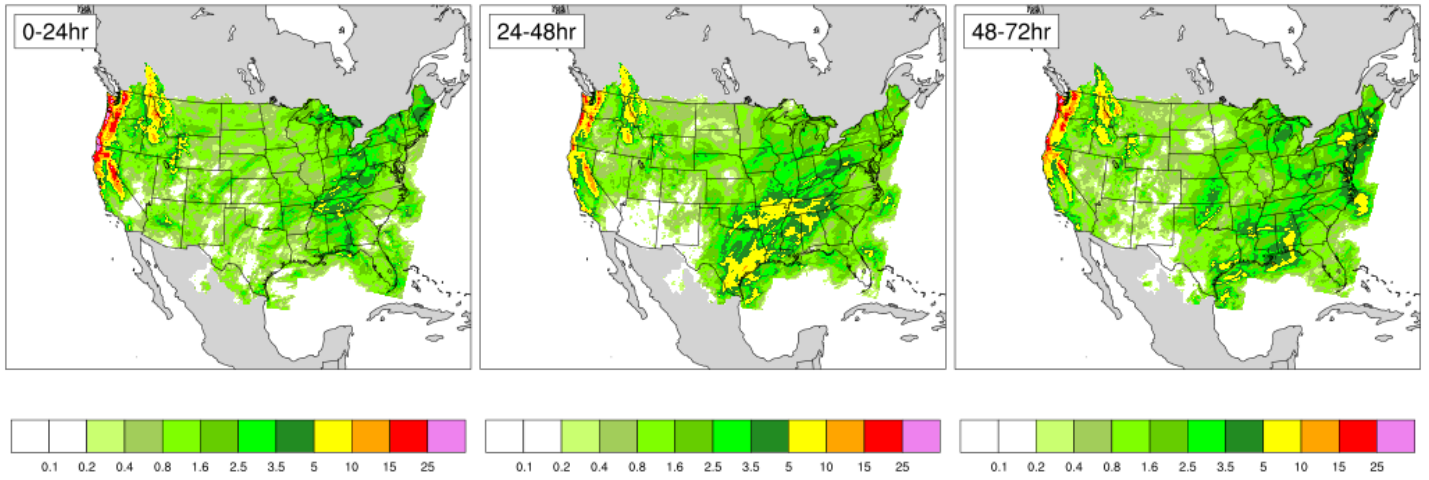


Precipitation Observations (CMORPH and STAGE IV)

CMORPH precipitation on MPAS grid (mm/day)

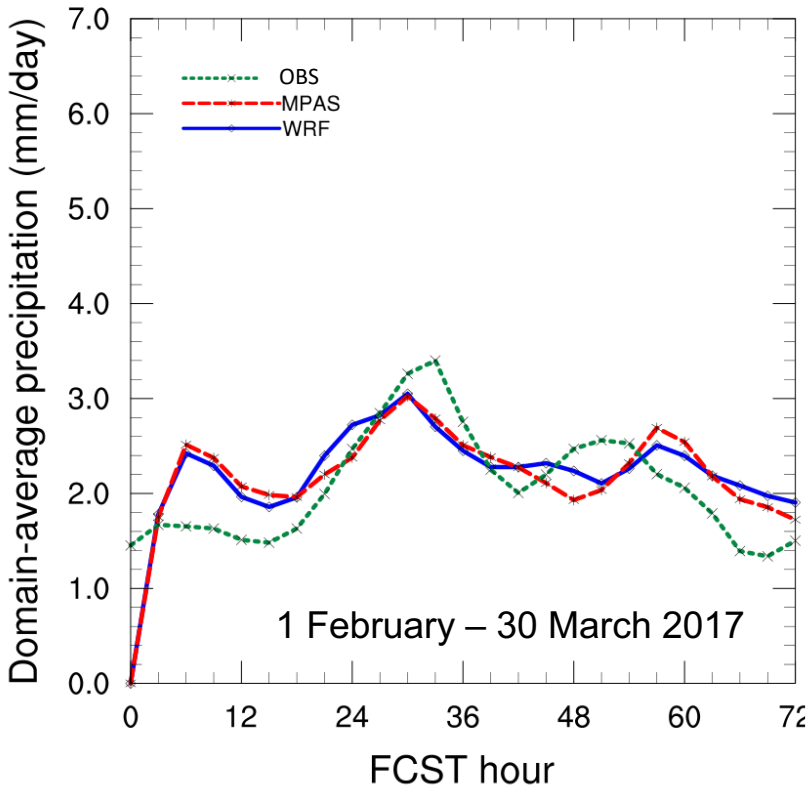


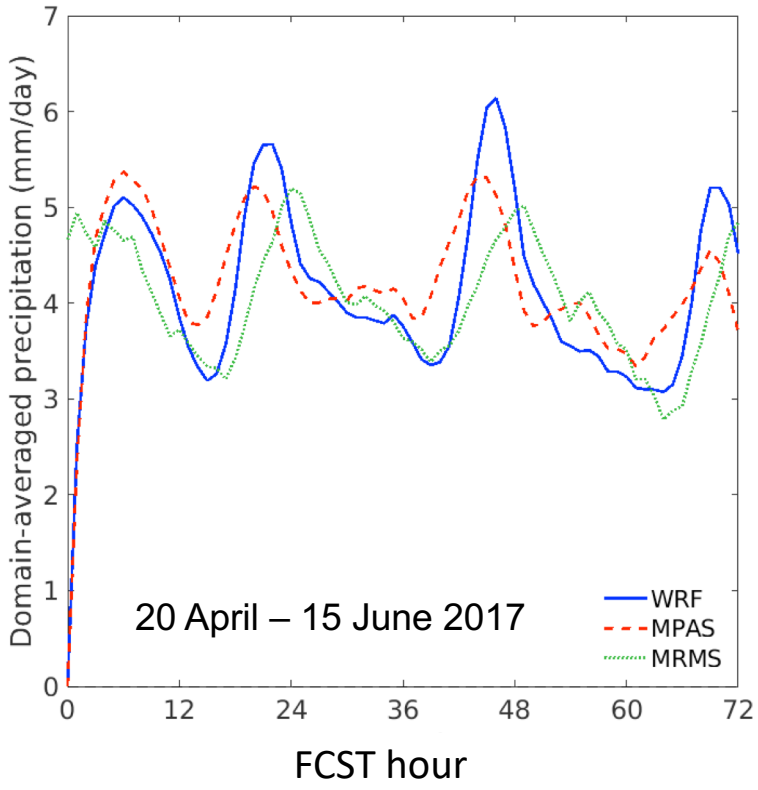
Stage IV precipittaion (Feb 1 - Mar 30 2017)

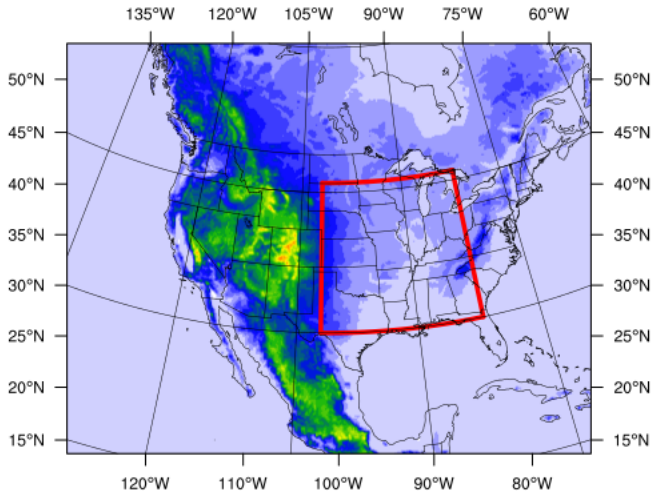


Domain-averaged precipitation

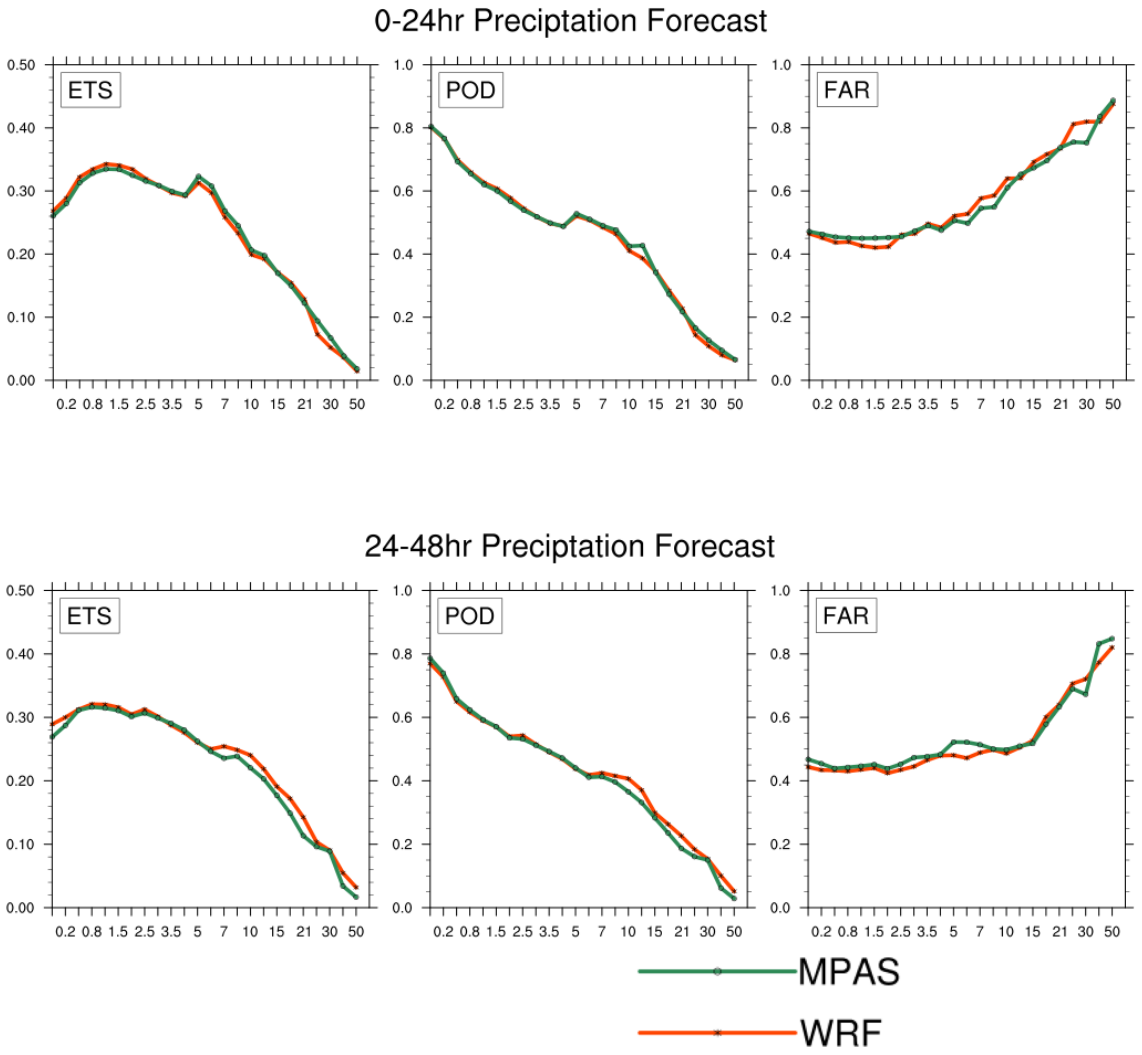
Domain-averaged precipitation (mm/day)

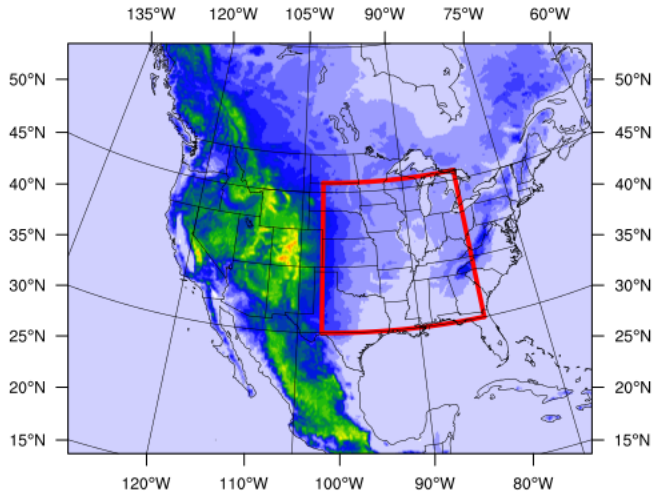






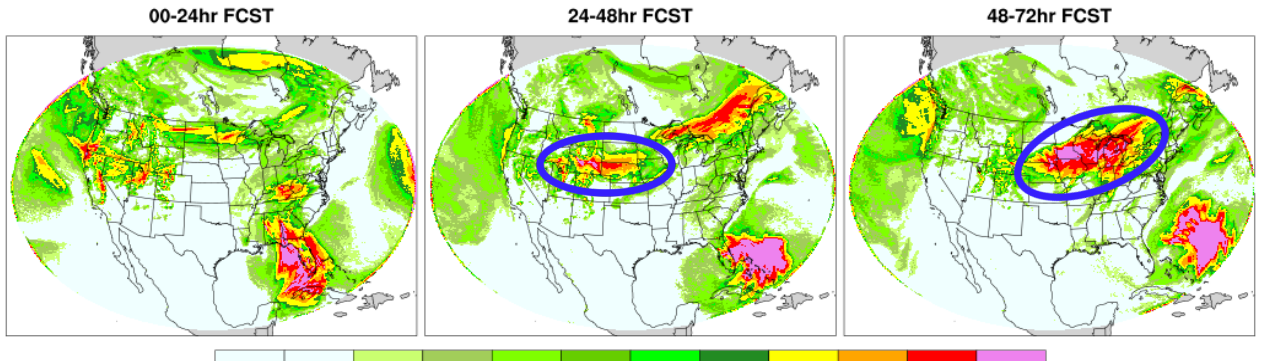
Skill scores for precipitation forecast



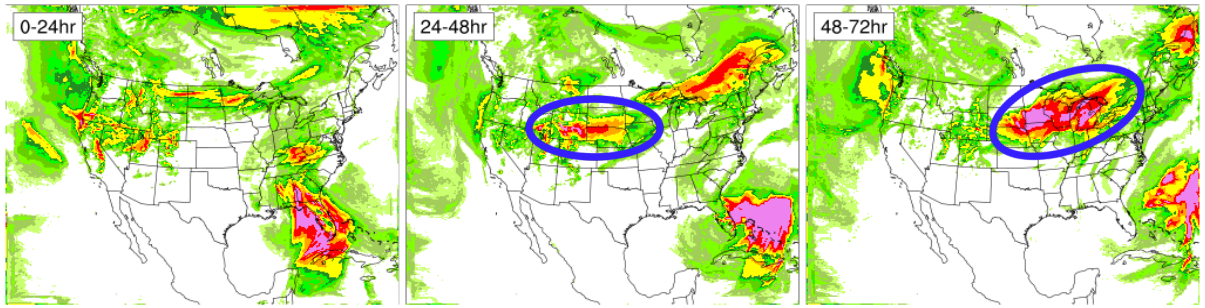


A single case study: the winter storm on Feb 22-25, 2017

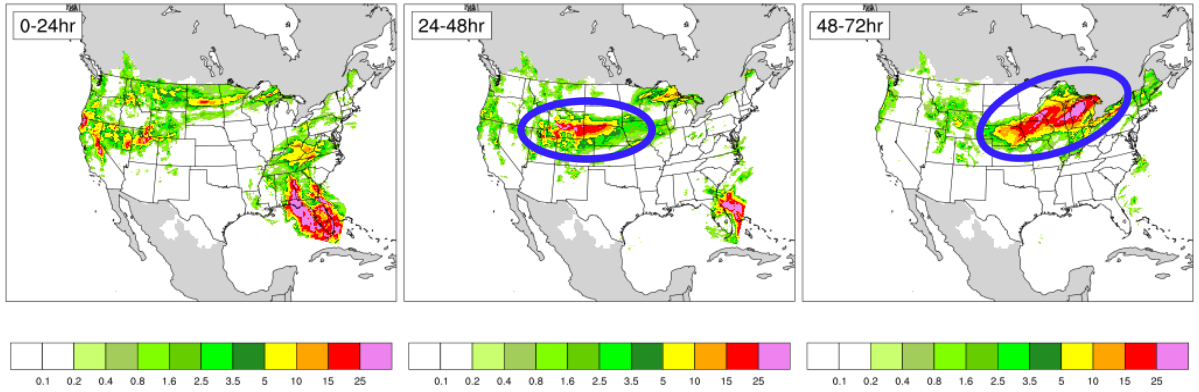
MPAS simulation

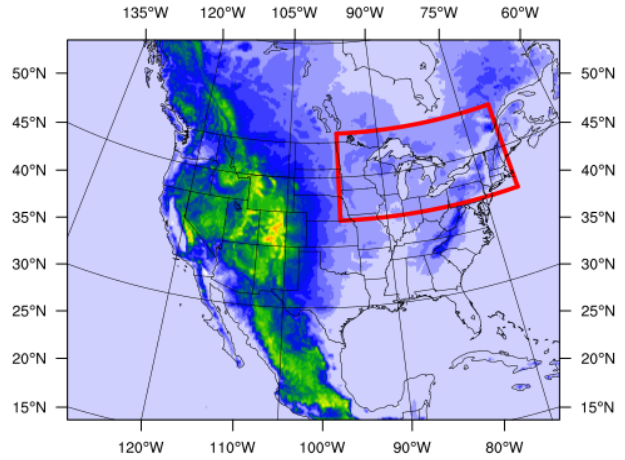


WRF simulation (Feb 22-24, 2017)

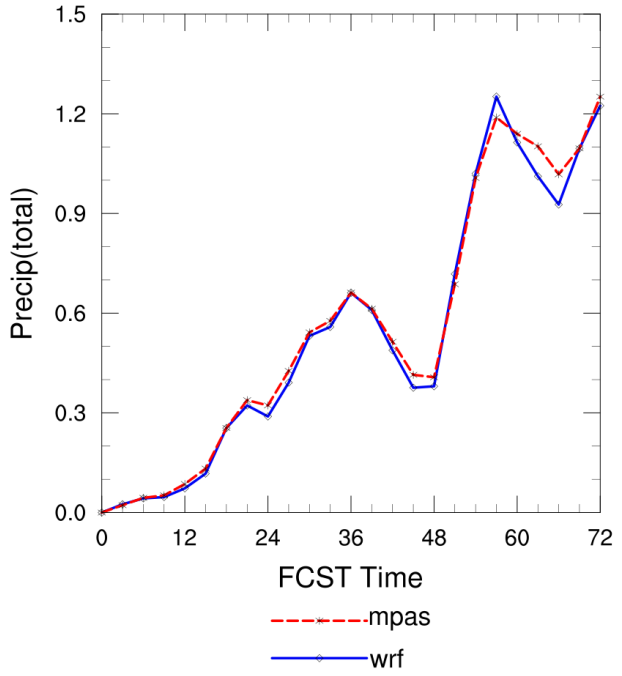


Stage IV precipittaion (Feb 22-24, 2017)



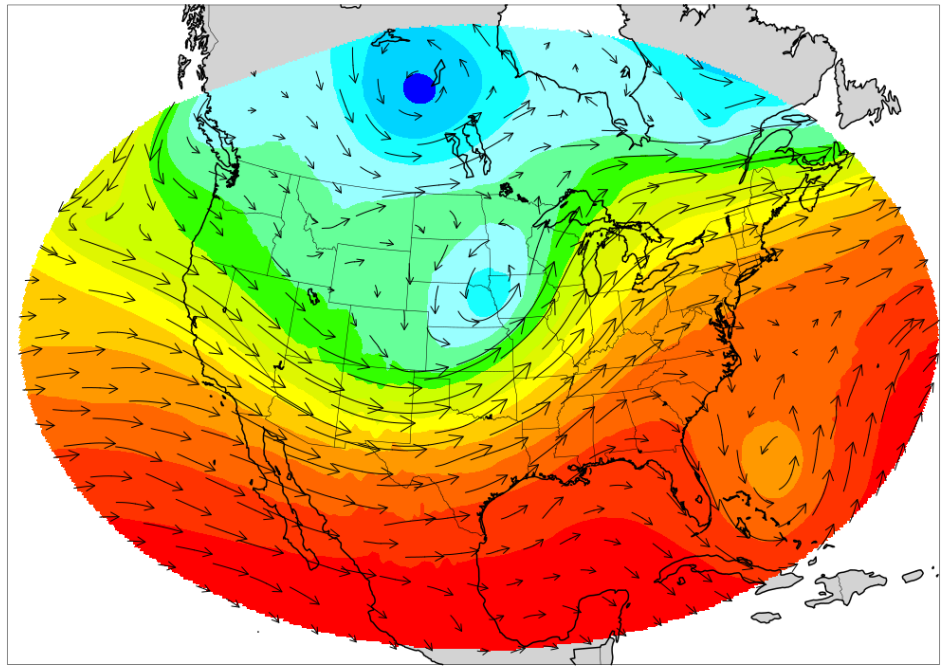


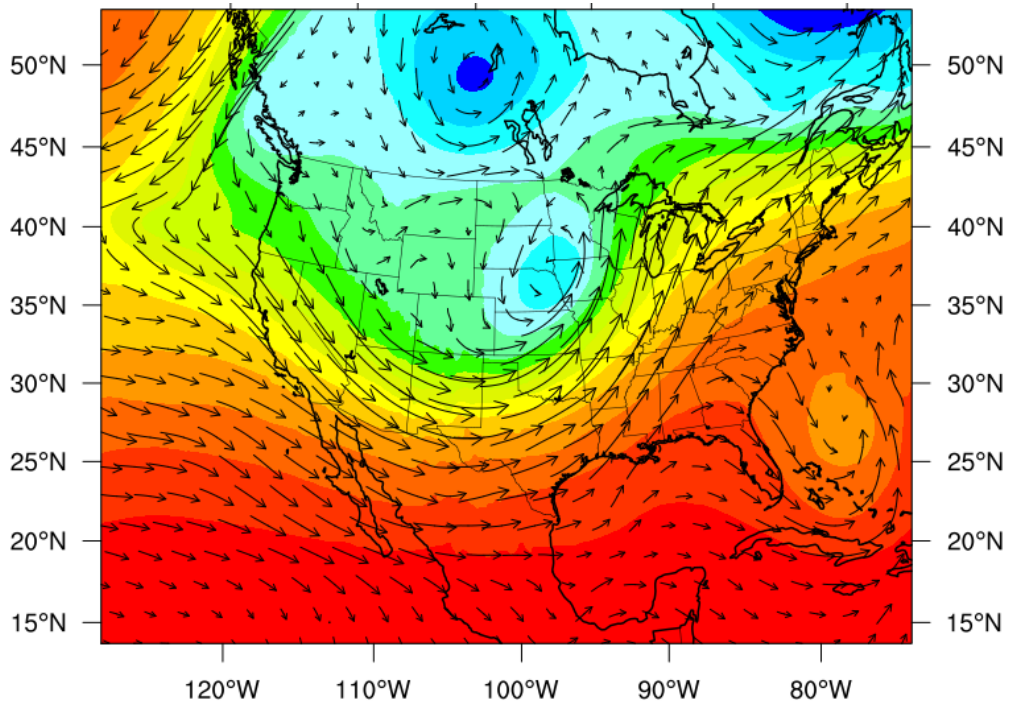
DOMAIN-AVERAGE 3-HOUR PRECIPITATION (mm)



A single case study: winter storm on Feb 22-25, 2017

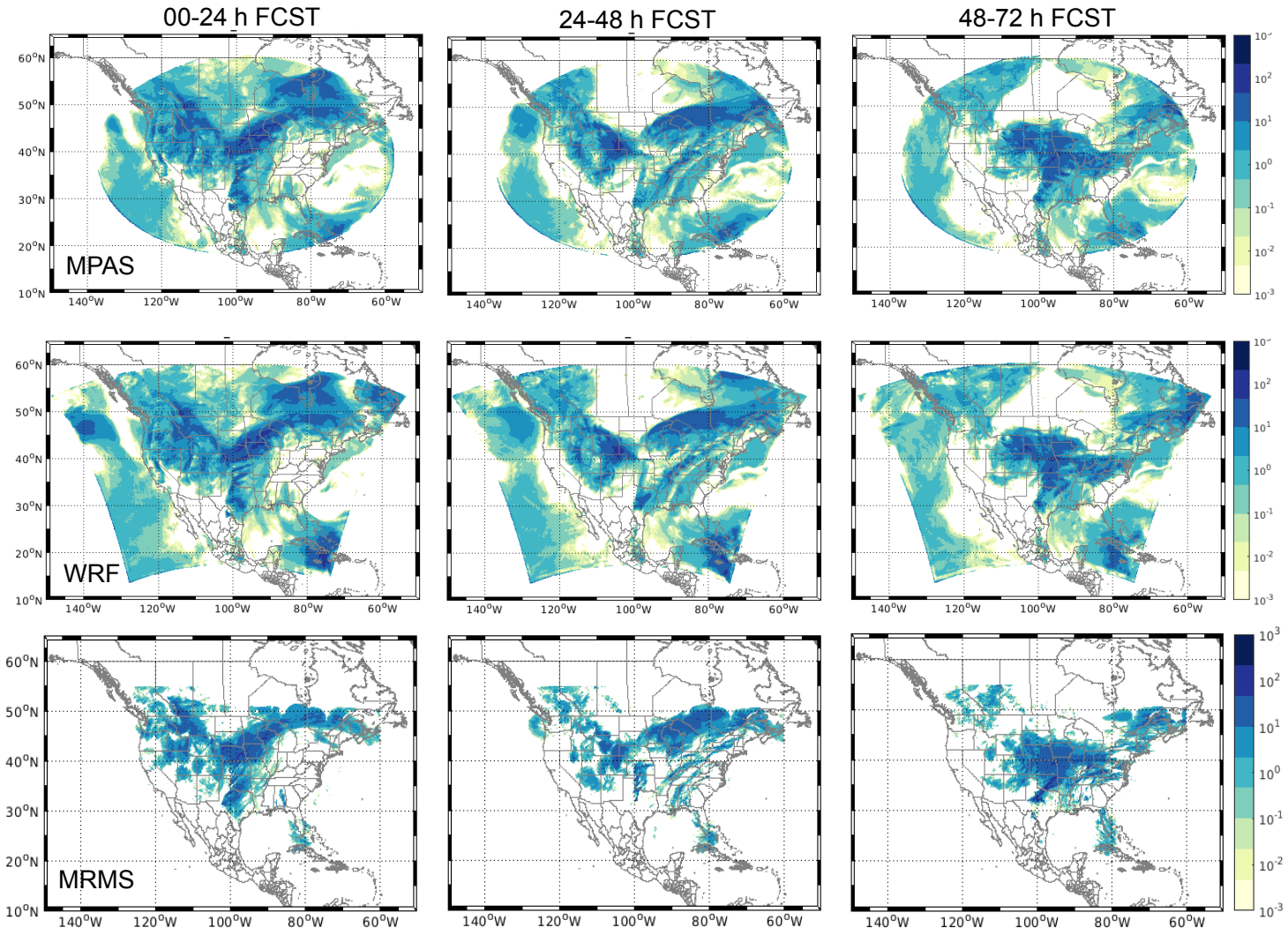
Geopotential height and winds at 500 hPa (12UTC 24 February 2017)

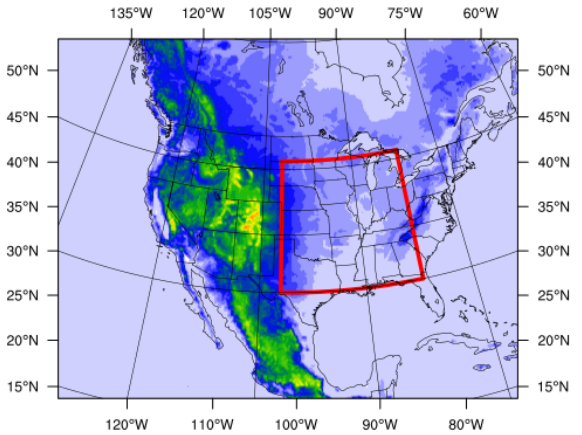




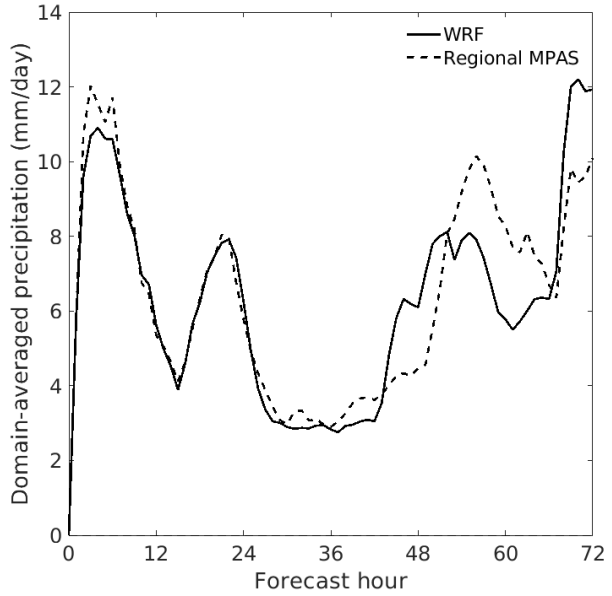
A single case study: severe hailstorm on May 17-20, 2017

24-hr accumulative precipitation simulated by MPAS and WRF





Domain-averaged hourly precipitation



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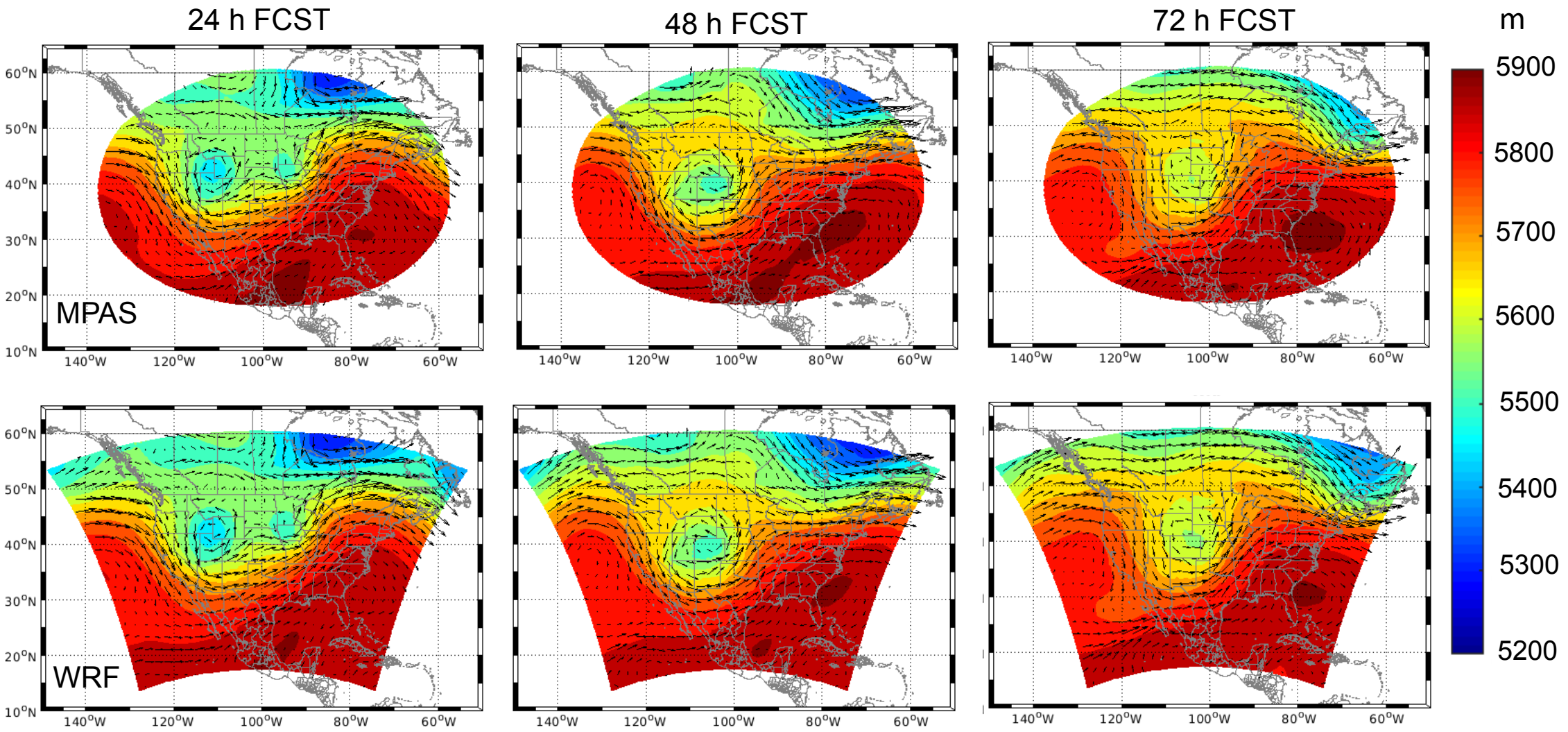
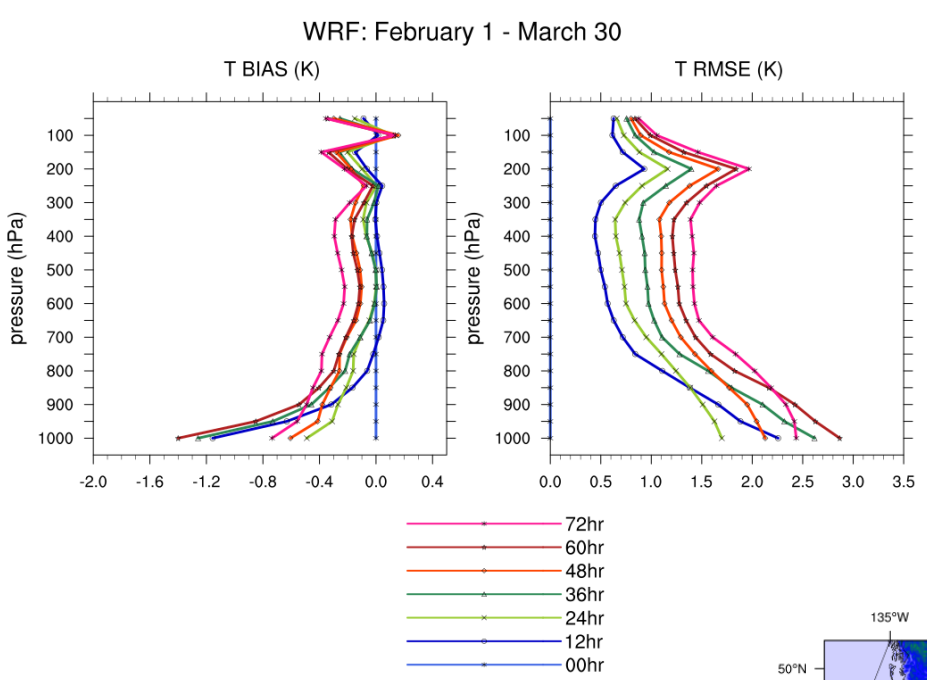
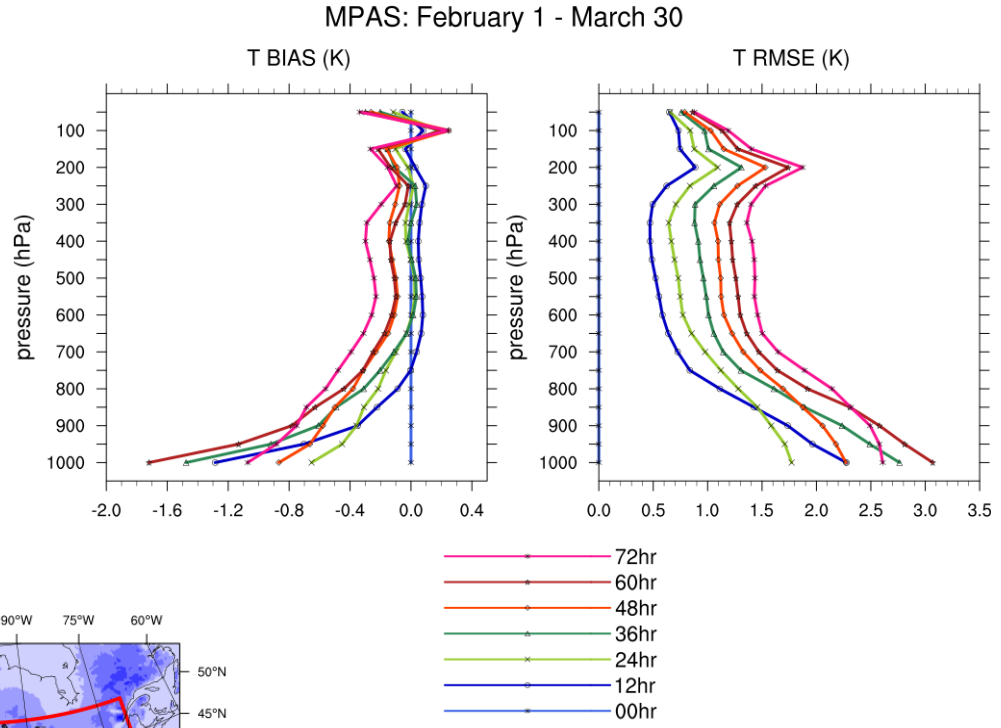
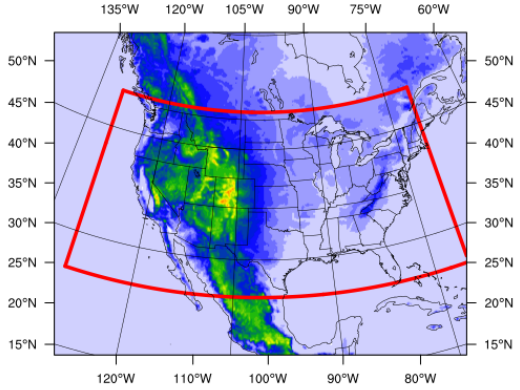


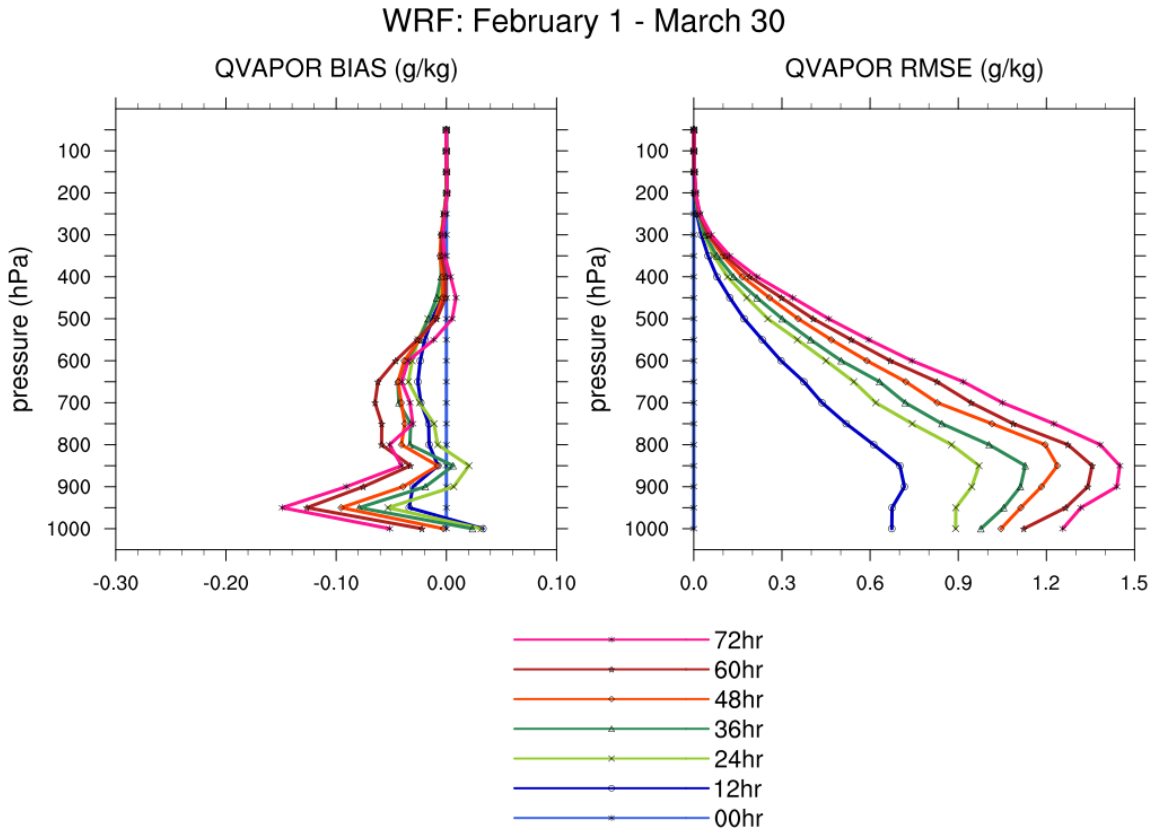
Vertical distribution of BIAS: February 1 – March 30

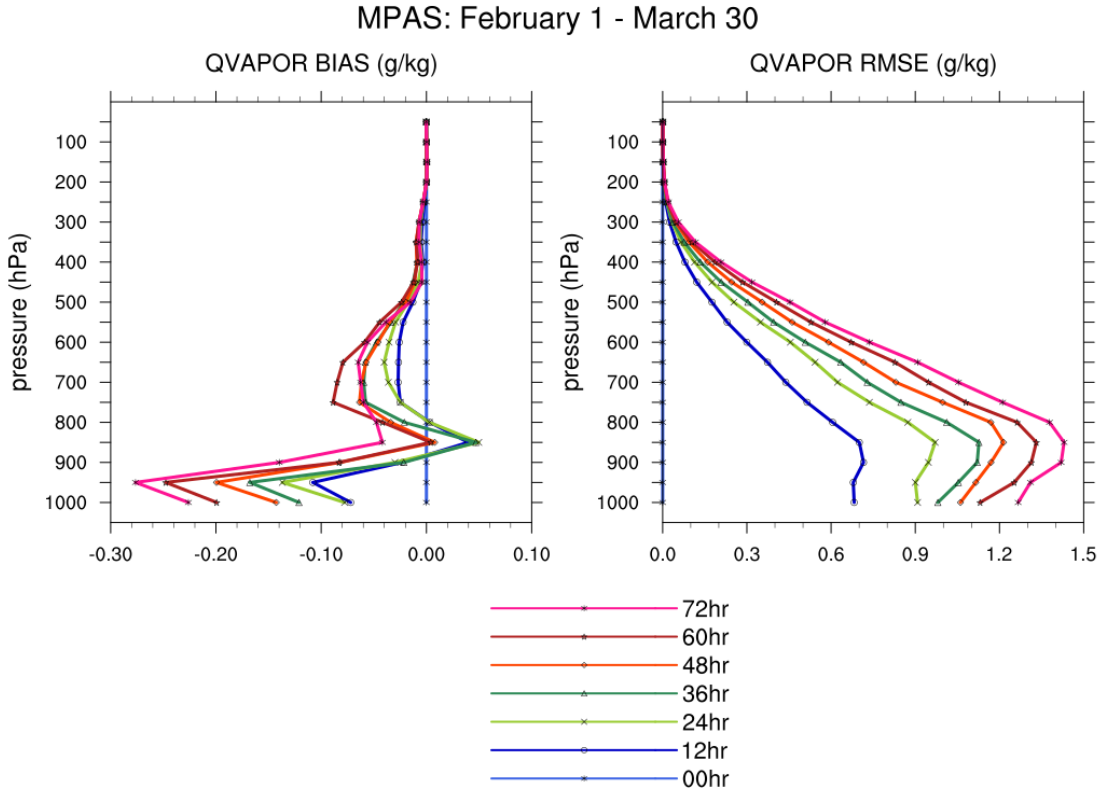






Vertical distribution of BIAS: February 1 – March 30





Summary

- Statistically, regional MPAS and WRF simulations agree very well
- Case studies of winter and spring storms indicate the two model simulations are consistent, especially in the winter.
- Both models can well reproduce light to moderate precipitation. But 15-km is not fine enough to capture the location/shape of heavy precipitation ((>30mm/24hr), --- we will look at results of 3km runs.
- Both WRF and MPAS show cold and dry deviations from GFS analysis throughout the troposphere.