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Impact of Aeolus Winds on NOAA Global Forecast of 2019 Winter Storms in the US

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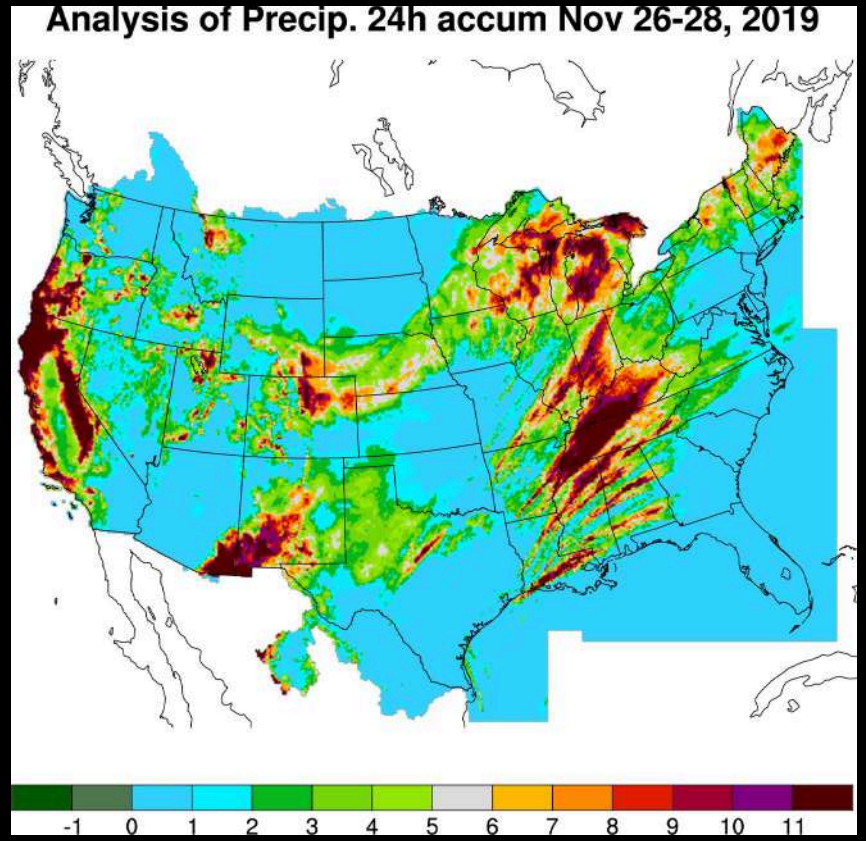
3rd Aeolus NWP Impact and L2B product quality working meeting, 3 Dec 2021

Objectives

- Explore impact of Aeolus winds on synoptic scale forecast of heavy precipitation in the US.
- Understand the mechanisms of Aeolus impact, e.g., on conveyor belts of Pacific/Gulf of Mexico moisture, known as atmospheric rivers, into the US.

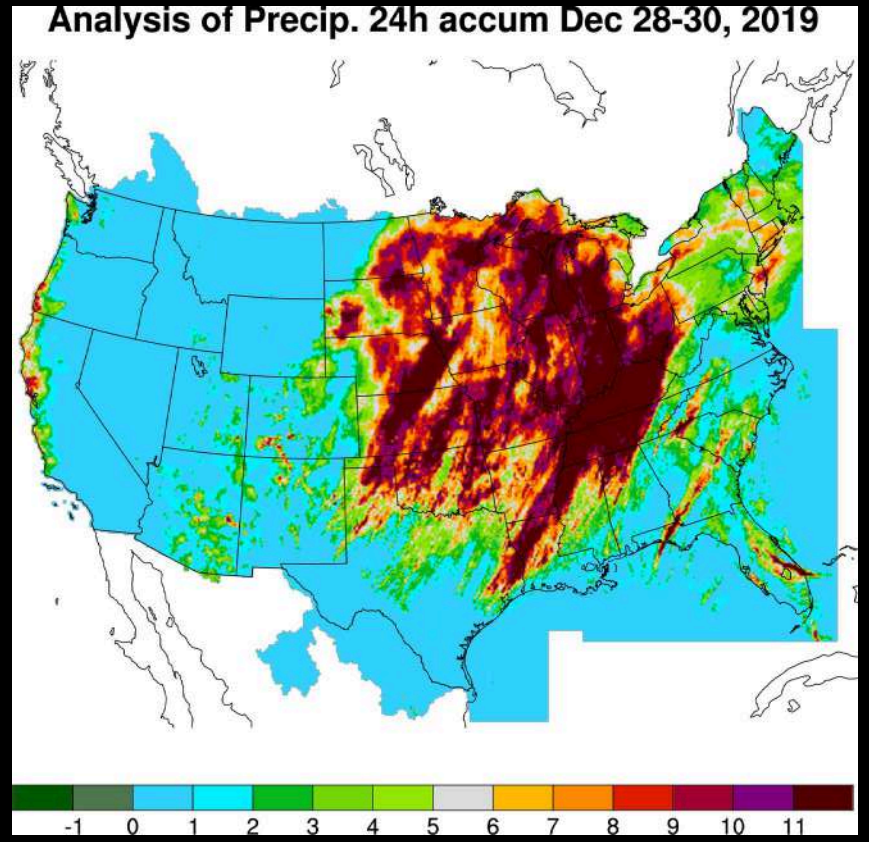
Two Heavy Snow Blizzard Events in the US

Nov 26-28, 2019



- Historically rare
- 171 km/h wind gust in Oregon
- 3-4 ft of snow in Western mountain ranges, and 2-3 ft of snow in NY and New England

Dec 28-30, 2019



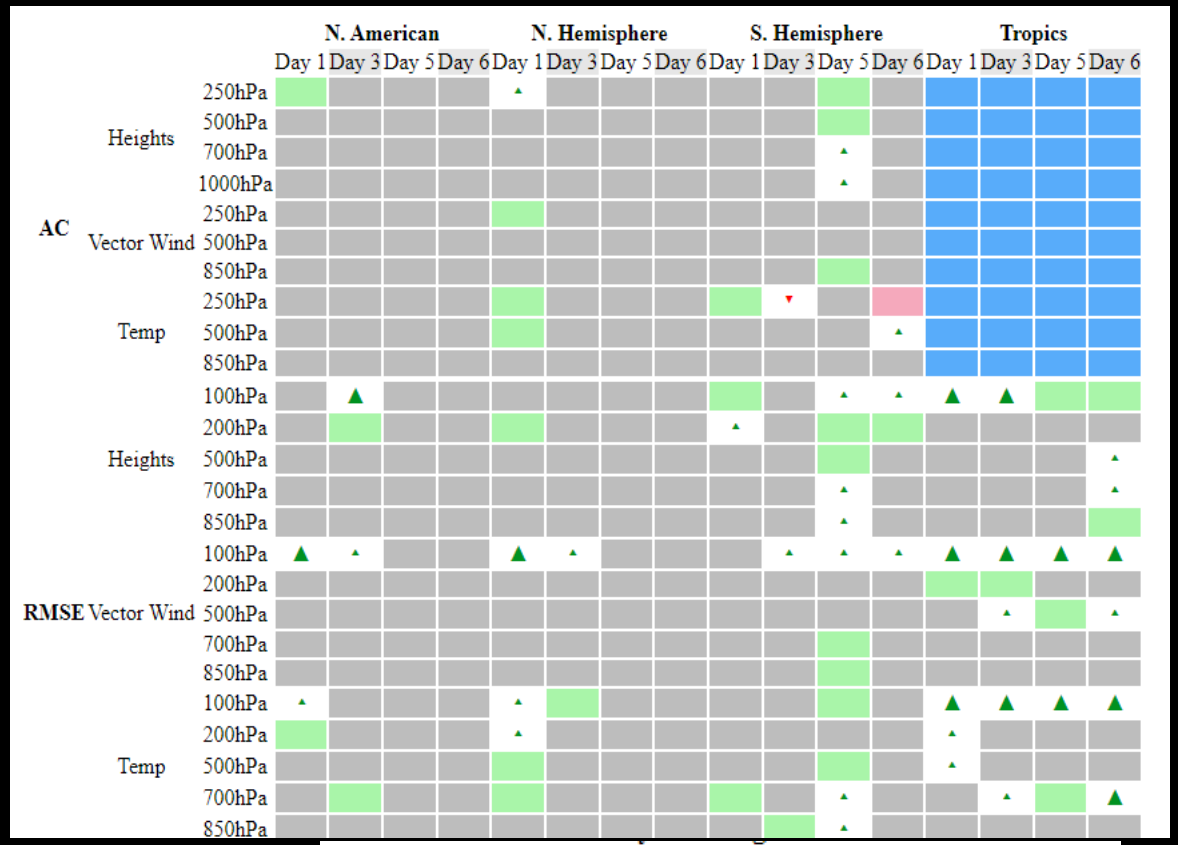
- 100 km/h wind gust in South Dakota
- 10 inches of snow in many areas of the Mid-west of the US

Aeolus Wind Assimilation Experiments

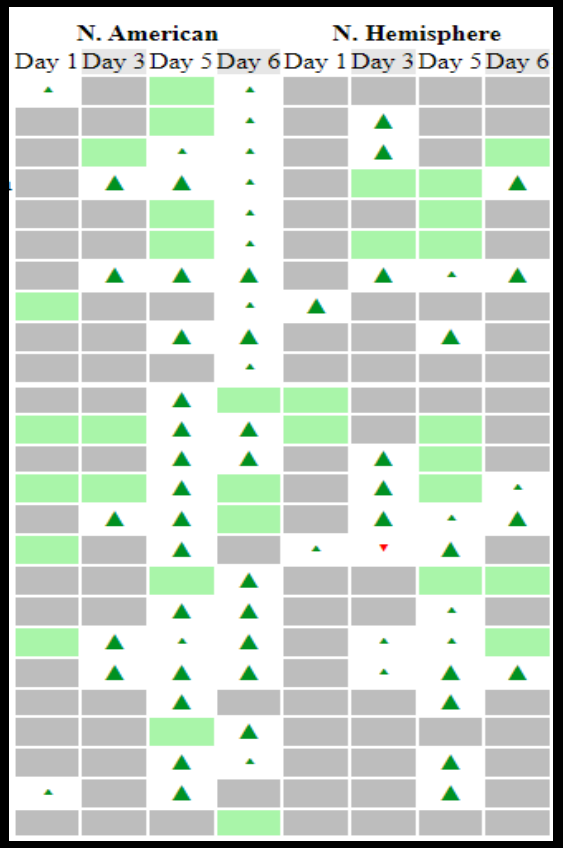
- NOAA operational data assimilation system, FV3GFS v15.2 / v16.0 (4DEnVar).
- Global assimilation experiments for Nov 20 – Dec 31, 2019, at C384 (25km)/L64 resolution.
- BASE : Aeolus winds monitored
- AEOLUS : Aeolus winds (Rayleigh clear/Mie cloudy) assimilated
- An additional NOAA bias correction is applied to the innovations of O-B.

Aeolus Impact on Forecast Skills (AEOLUS vs BASE)

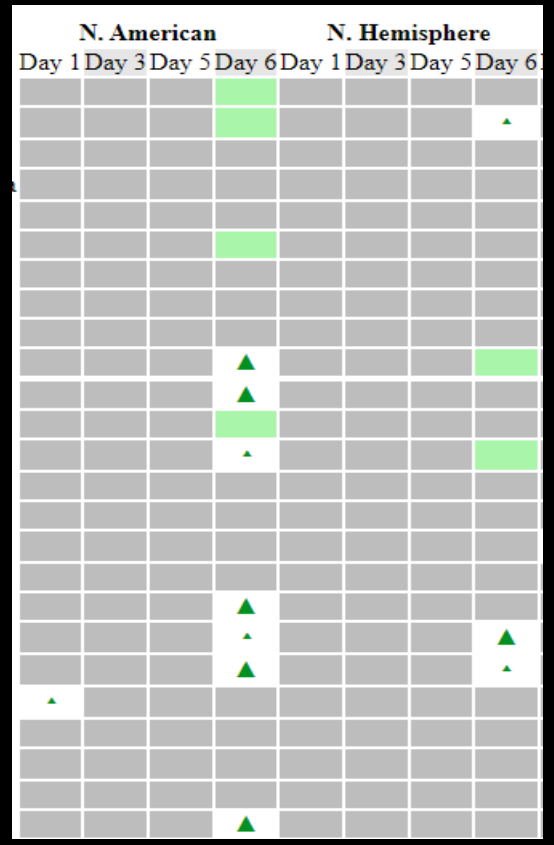
Nov 20-Dec 31



Nov 26-28



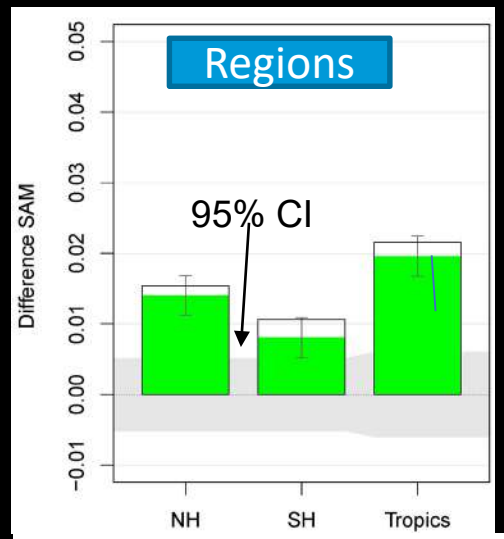
Dec 28-30

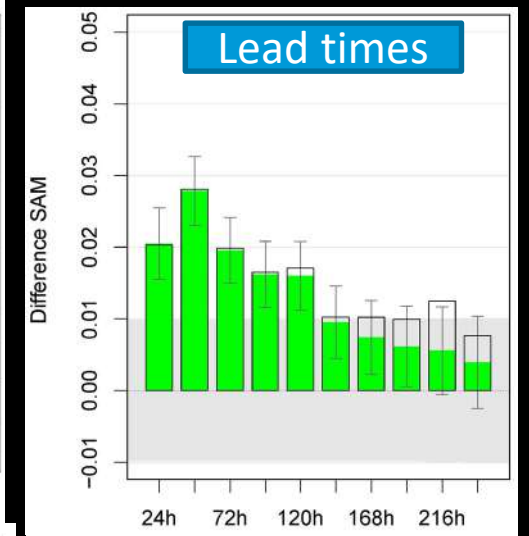


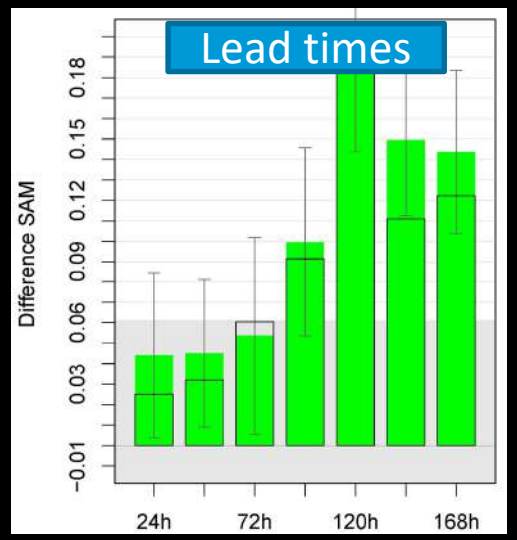
- Aeolus winds show stronger positive impact on medium-range forecasts of the storm events.

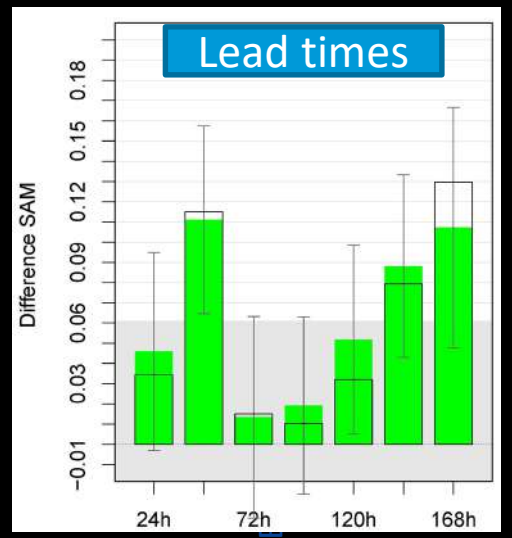
Forecast Summary Assessment Metrics (AEOLUS vs BASE)

Nov 20-Dec 31 (Global) Aug 2 - Sep 16, 2019, verified vs FV3GFS analysis Nov 26-28 (NA) Dec 28-30 (NA)



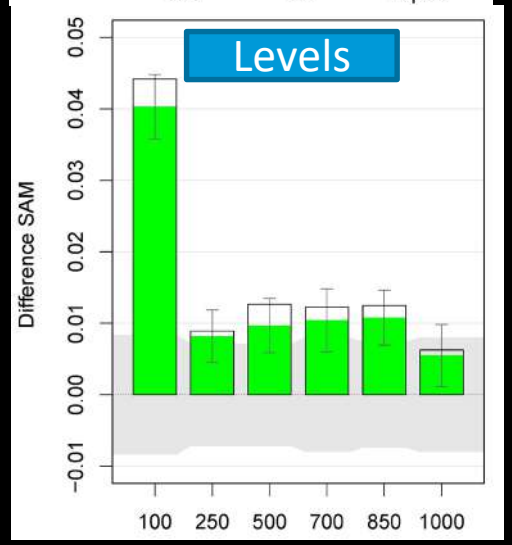


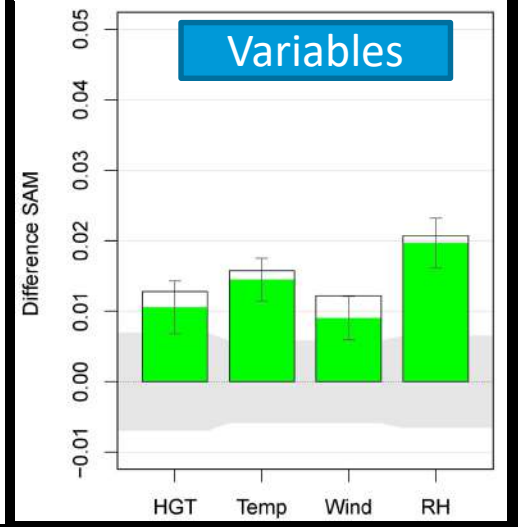




Better

Worse

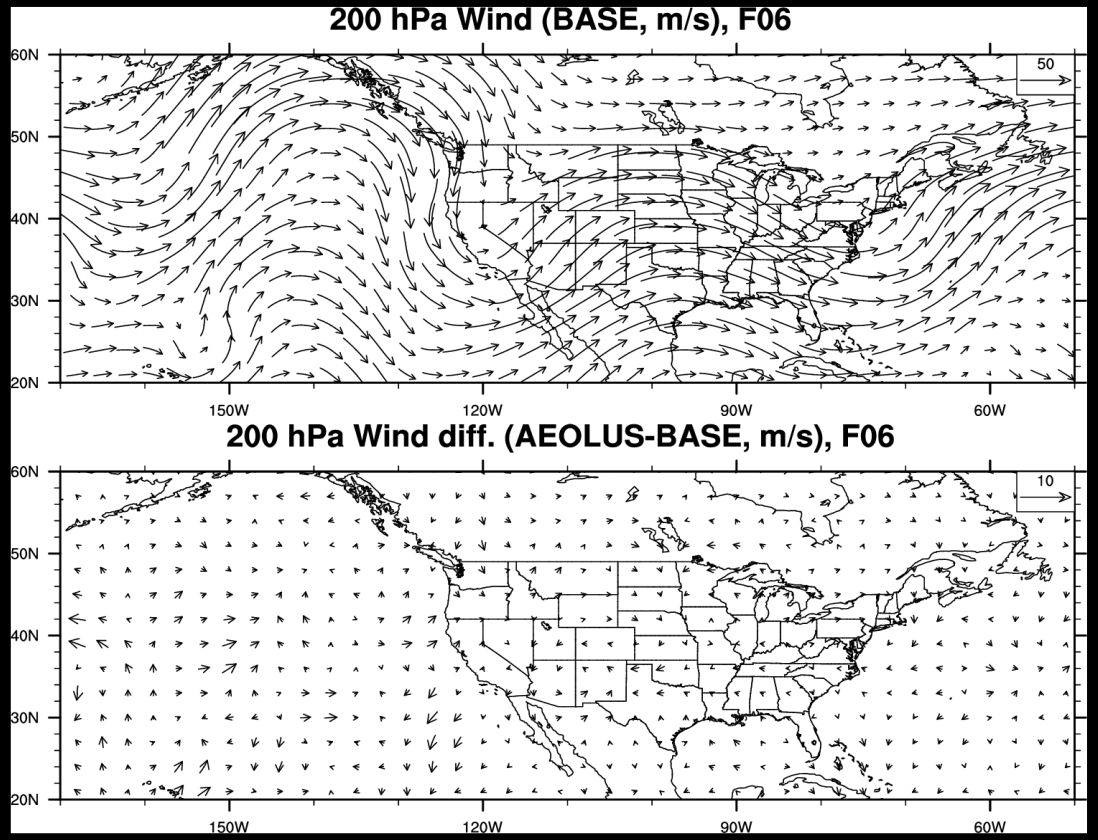


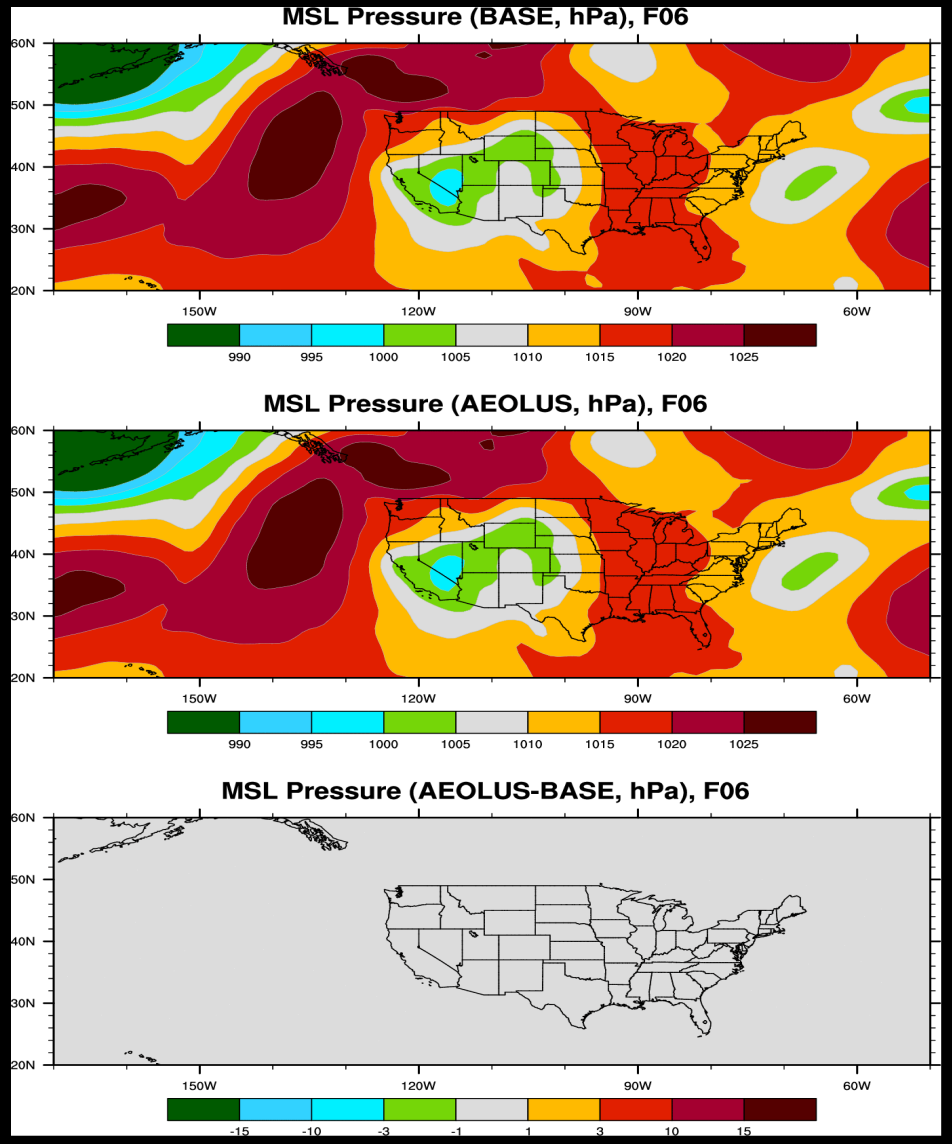


Better

Distributions of SAMs > 0.0 for positive impact.

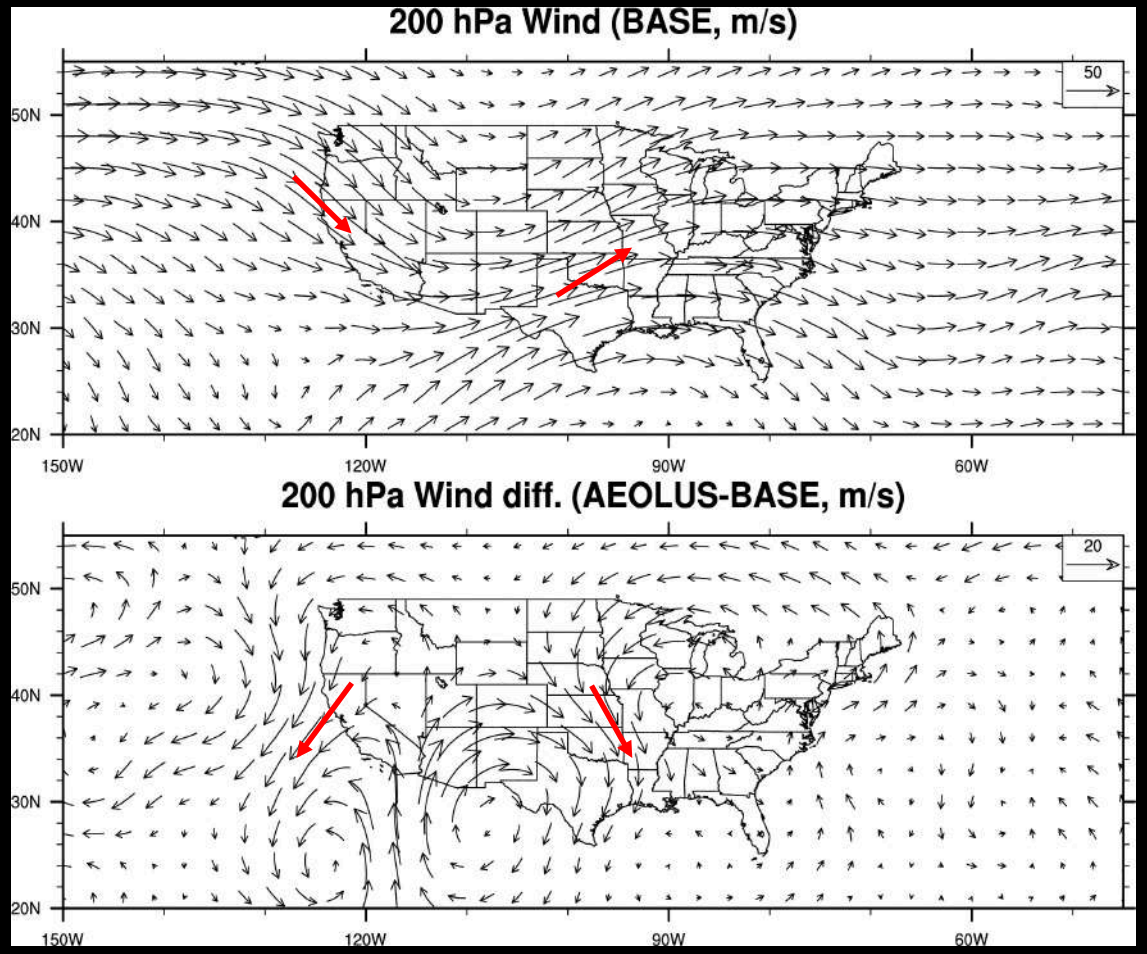
7-Days Forecast of 200 hPa Wind and MSL Pressure (from Nov 20, 2019)

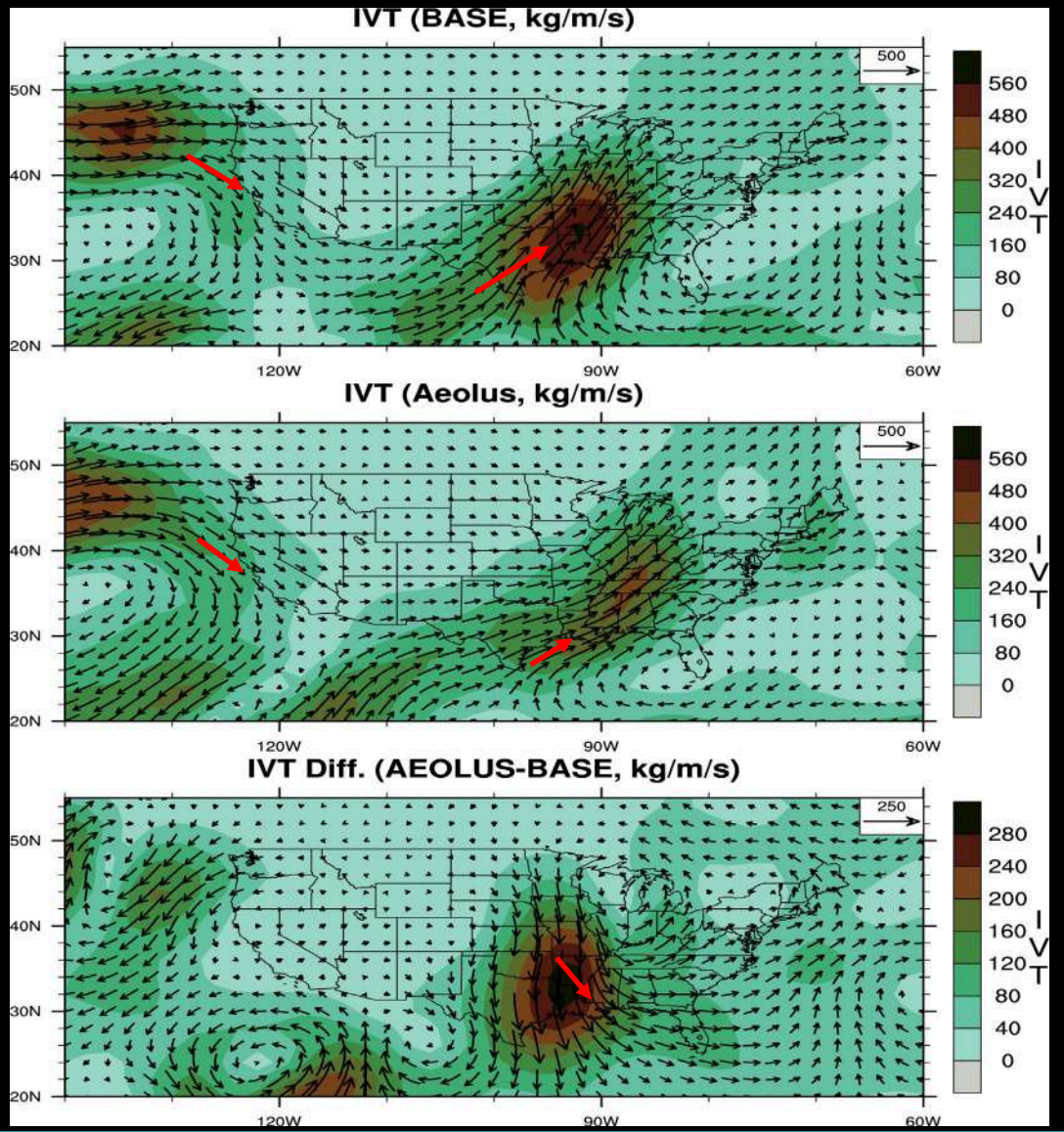




Aeolus impact propagates from Pacific to the West-coast and interior of US (animation)

Day-7 Forecast of Wind and Integrated Water Vapor transportation
(Nov 26-28, 2019)

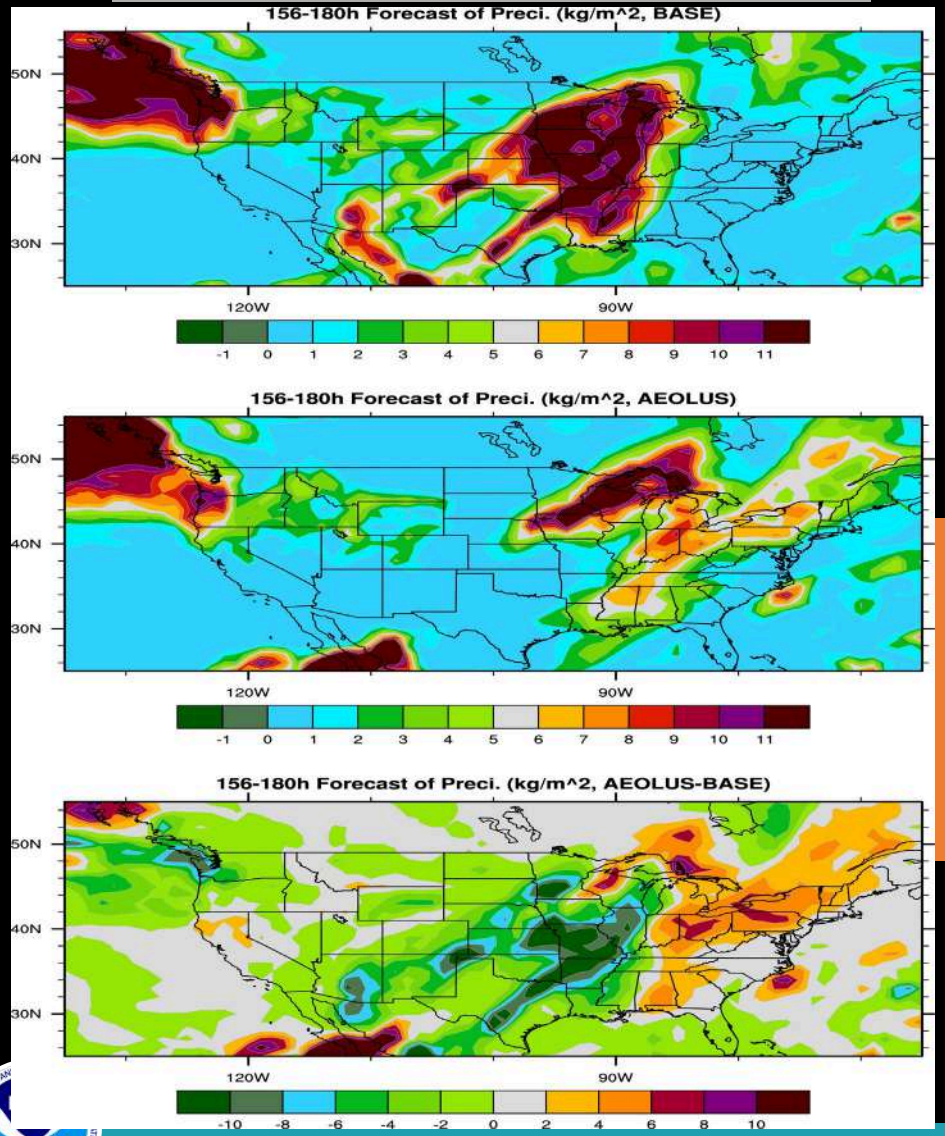


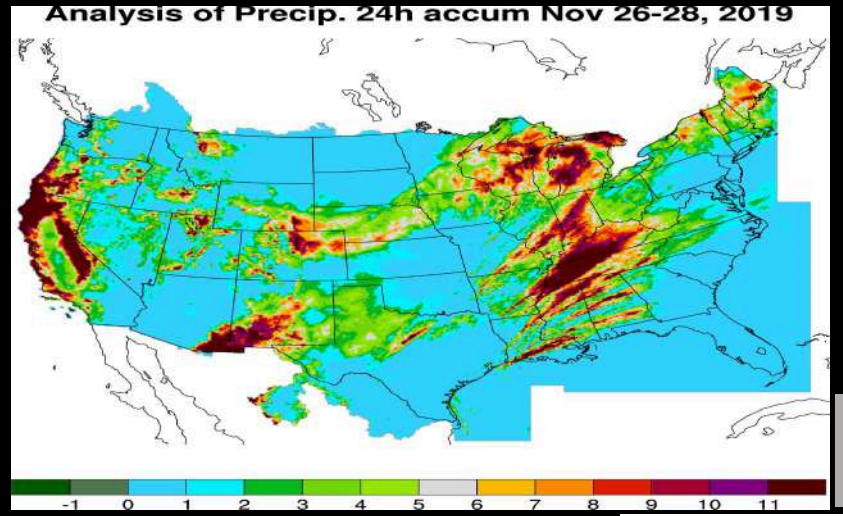


Aeolus leads to weaker moisture transportation to the West-coast and interior of US

Day-7 Mean Precip Forecast (Nov 26-28 2019, AEOLUS vs BASE)

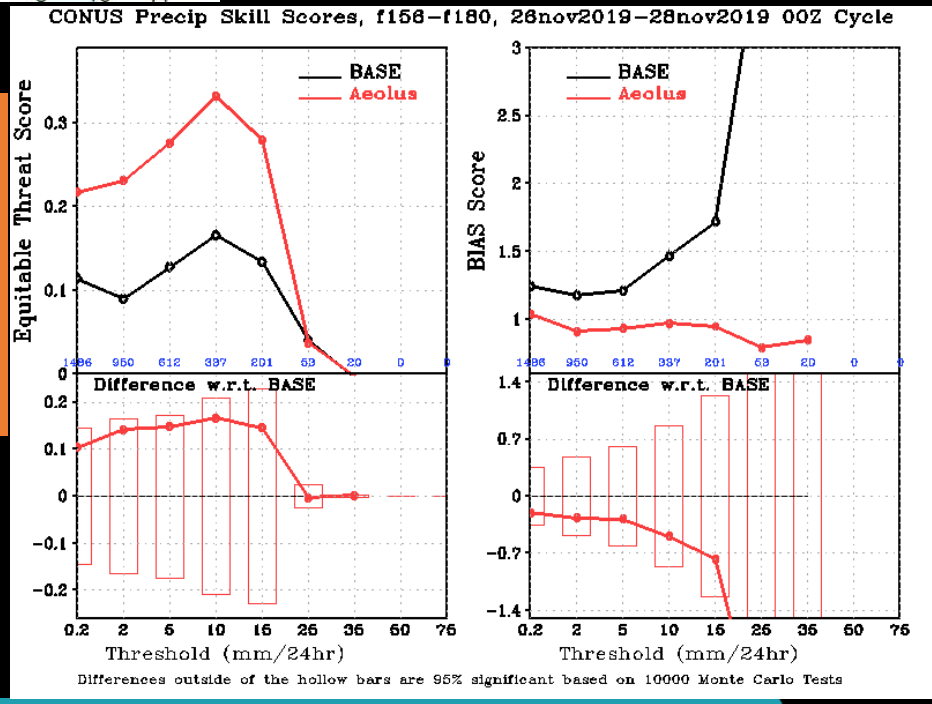
Mean 24h Precip accumulation



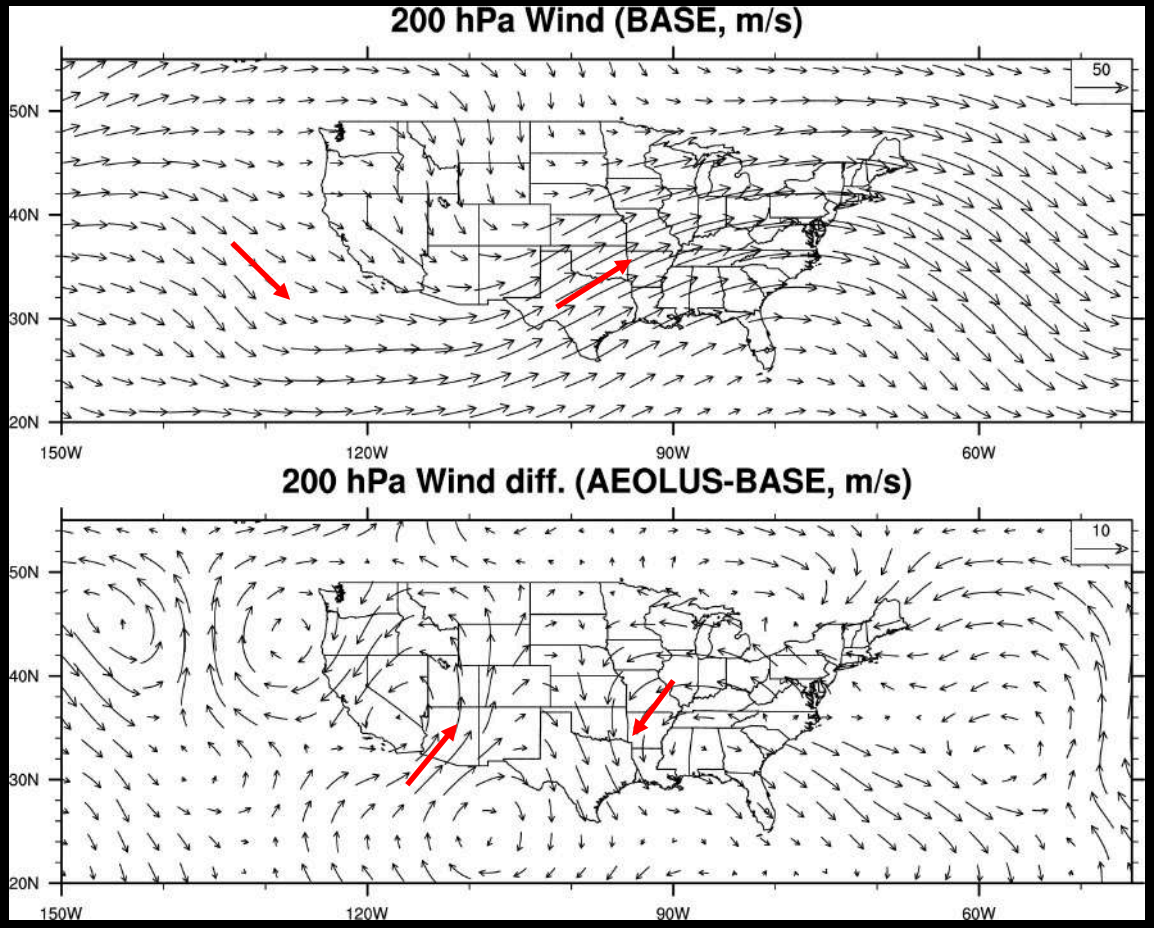


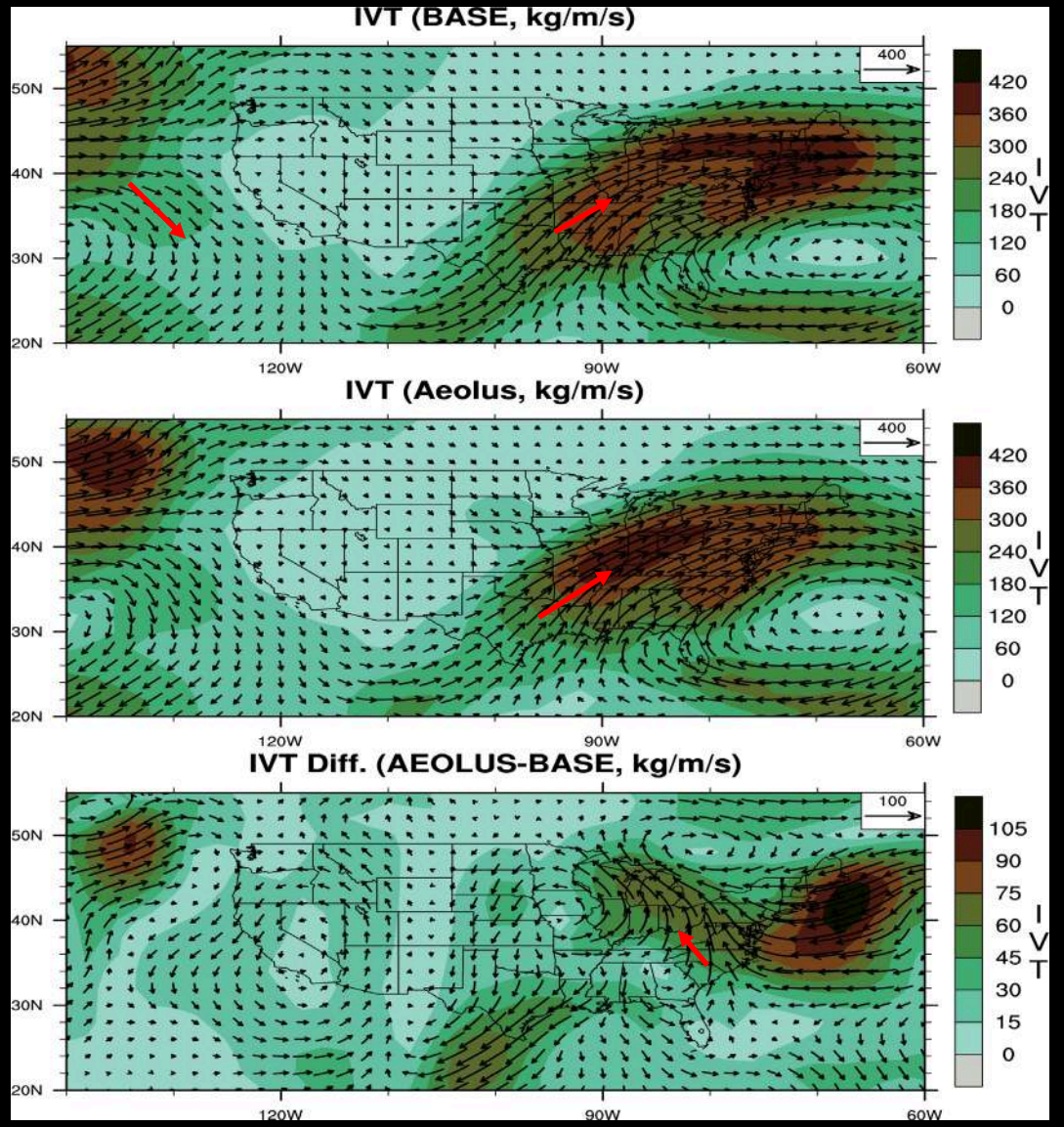
Aeolus winds improve precipitation forecast skill (location and amount) in the CONUS domain (scores closer to 1.0)

CONUS Precip Skill (ETS and Bias)



Day-6 Forecast of Wind and Integrated Water Vapor transportation
(Dec 28-30, 2019)

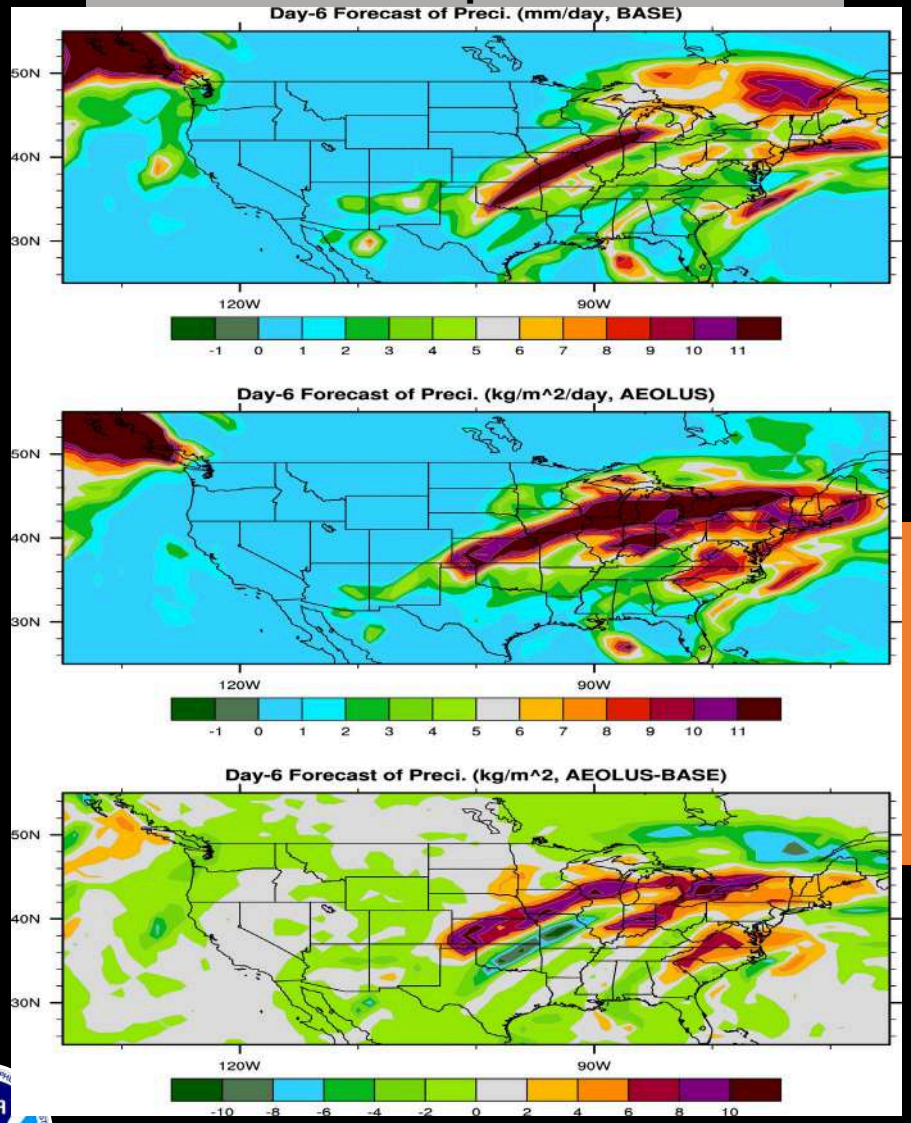


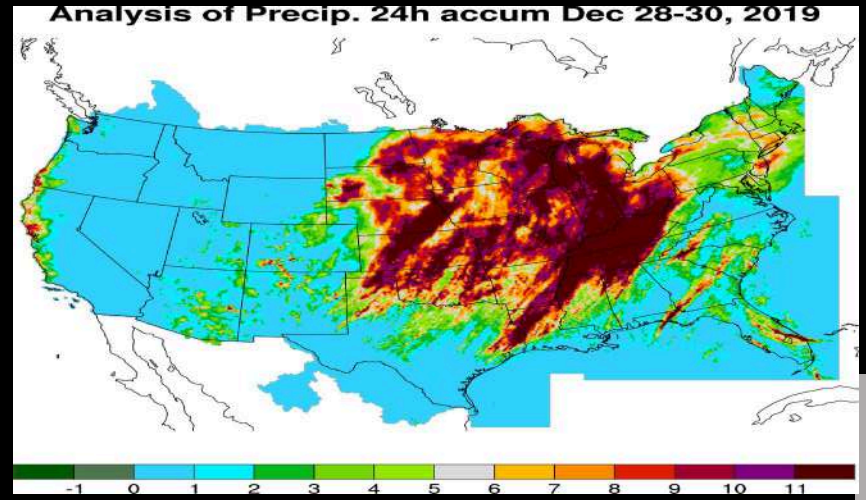


Aeolus leads to stronger moisture transportation to the East part of US

Day-6 Mean Precip Forecast (Dec 28-30 2019, AEOLUS vs BASE)

Mean 24h Precip accumulation





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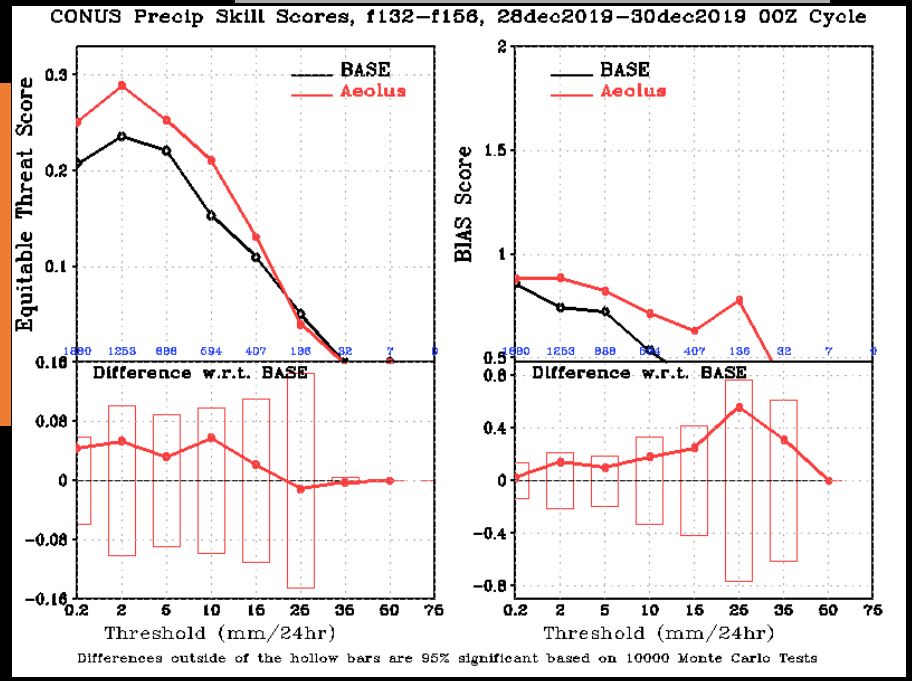

Summary

- Aeolus winds improves medium-range forecast of the extreme winter storms.
- Aeolus winds show impact on moisture transportation from Pacific/Gulf Mexico into the US.
- This suggests that Aeolus winds can have significant positive impact on medium-range forecast of extreme weather even in radiosonde-dense regions like the US.