Polar Meteorology Group, Byrd Polar and Climate Research Center, The Ohio State University, Columbus, Ohio

Microphysics of Summer Clouds in Central West Antarctica Simulated by Polar WRF and AMPS*

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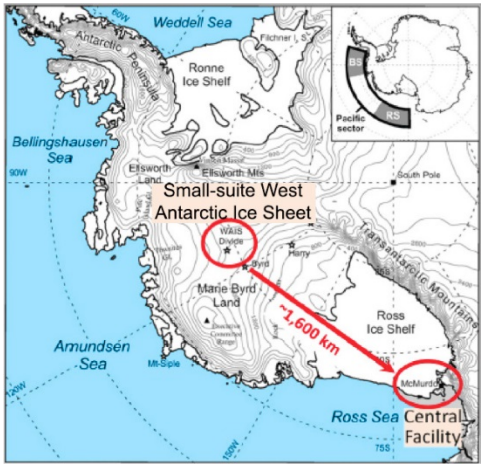

*article acp-2018-1251 recently revised

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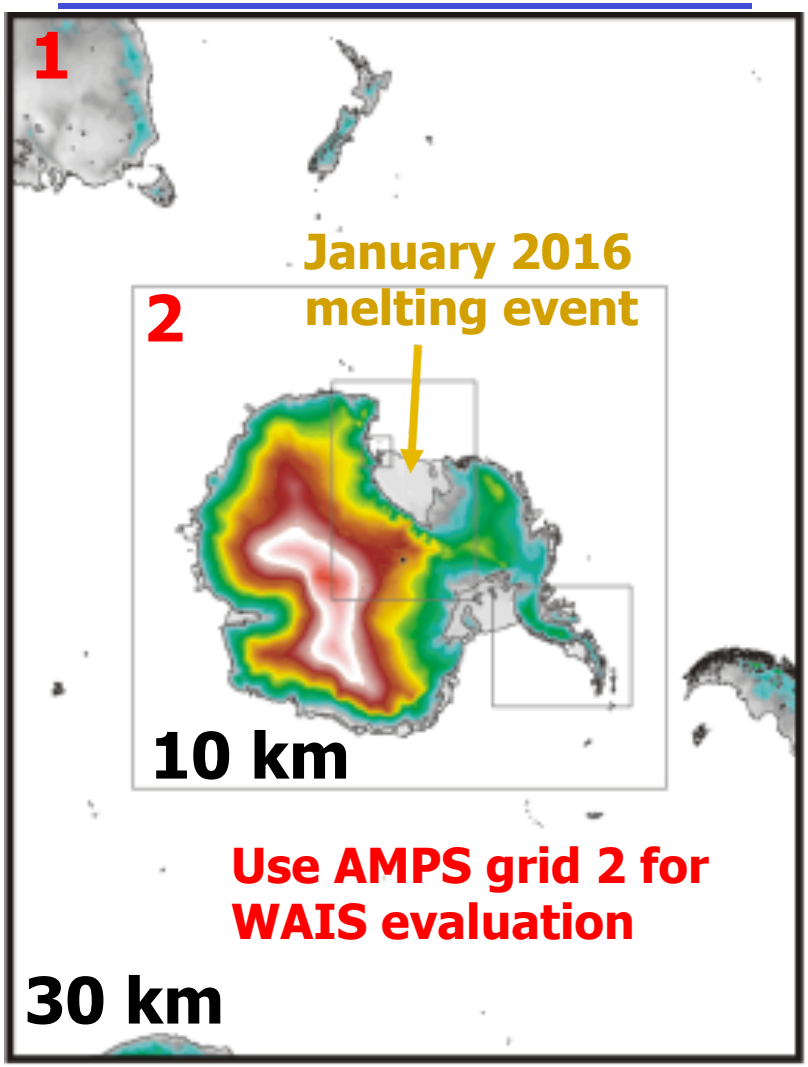
2019 ARM/ASR PI Meeting 10-13 June 2019

NCAR

AMPS GRIDS



The Antarctic Mesoscale Prediction System (AMPS)

- Adapted numerical weather prediction system for Antarctica
  - Polar WRF (Weather Research and Forecasting Model)
  - Variable resolution to 0.9 km
- Priority Mission: U.S. Antarctic Program (USAP) Weather Support (clouds important for aircraft!)

Use December 2015 and January 2016 AMPS forecasts and WAIS observations

National Science Foundation

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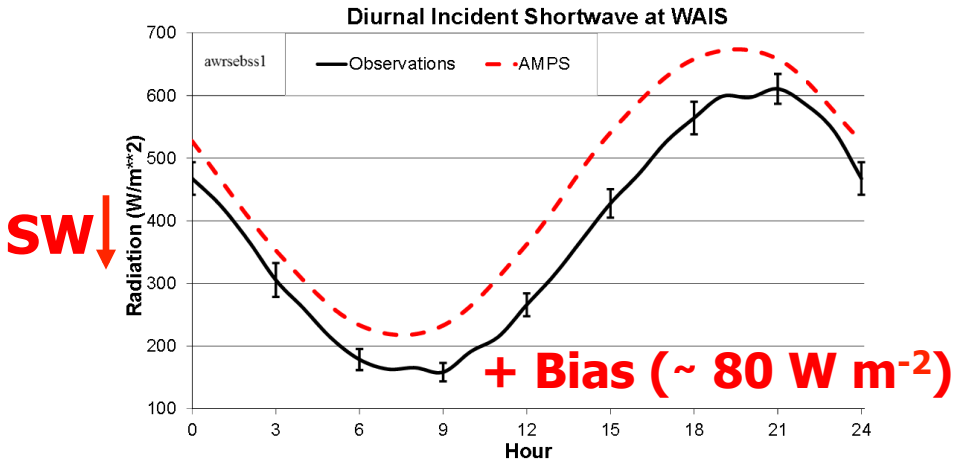
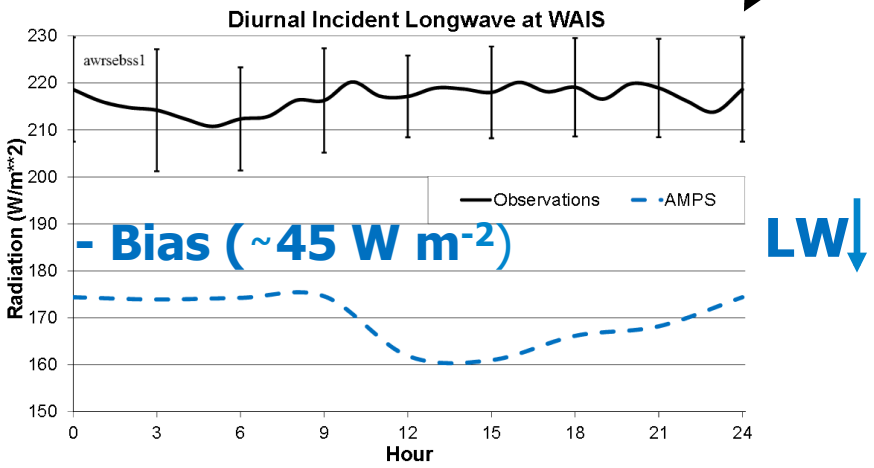
Test West Antarctic Summer Results for AMPS with WAIS Observations

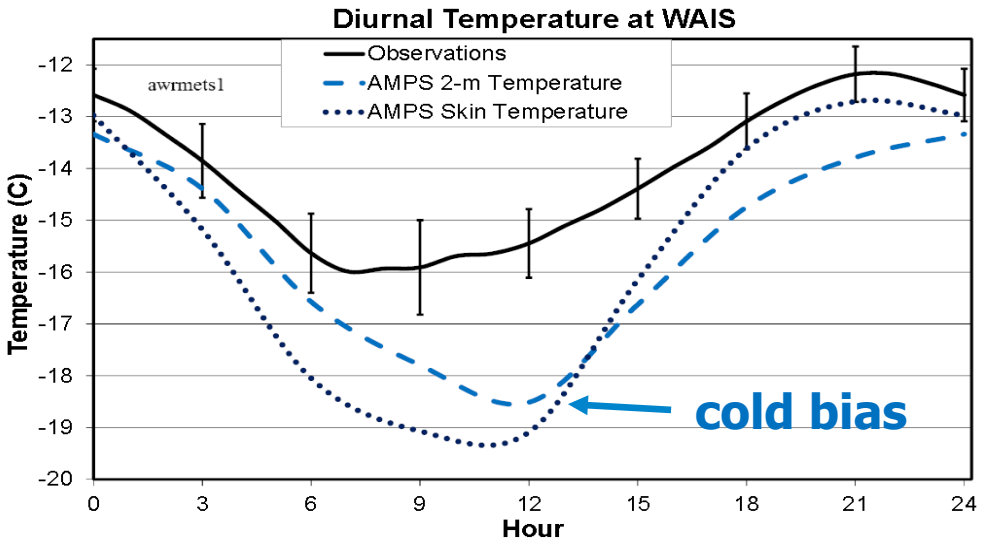
Surface Energy Balance: Excess shortwave and deficit in longwave → Cloud deficit?

t-test

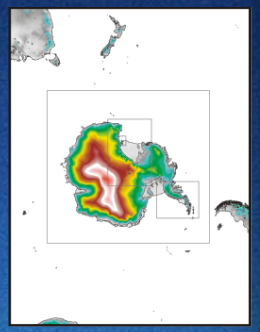




AMPS shows biases suggesting a better Antarctic cloud simulation is needed



Test Microphysics Schemes vs. WAIS Observations



PWRF 3.9.1 on AMPS Grid 2 (10 km) with ERA-I I.C. + B.C. (AMPS uses GFS)

WRF Single-Moment 5-Class (same as AMPS)

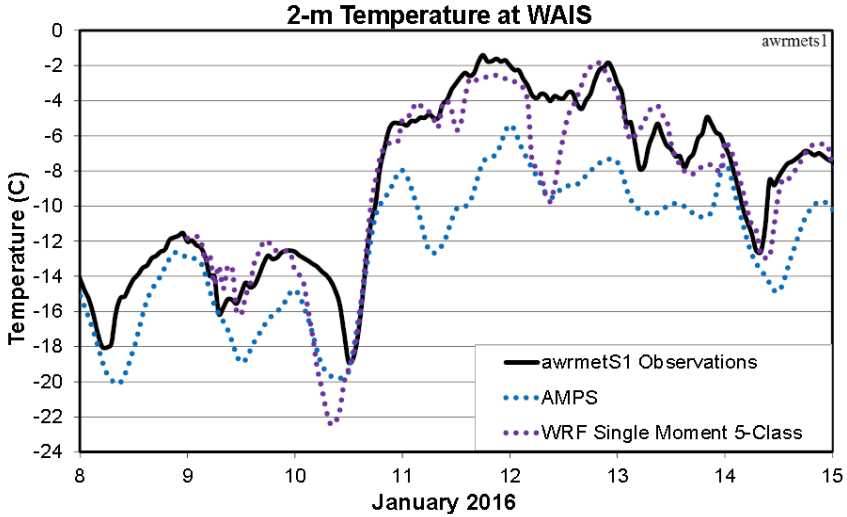
Morrison 2-Moment (slight polar modifications)

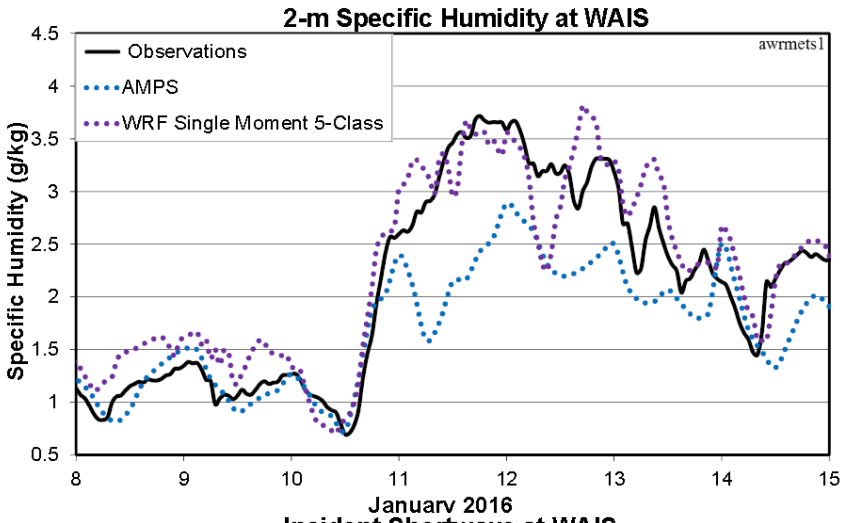
Thompson-Eidhammer Aerosol Aware

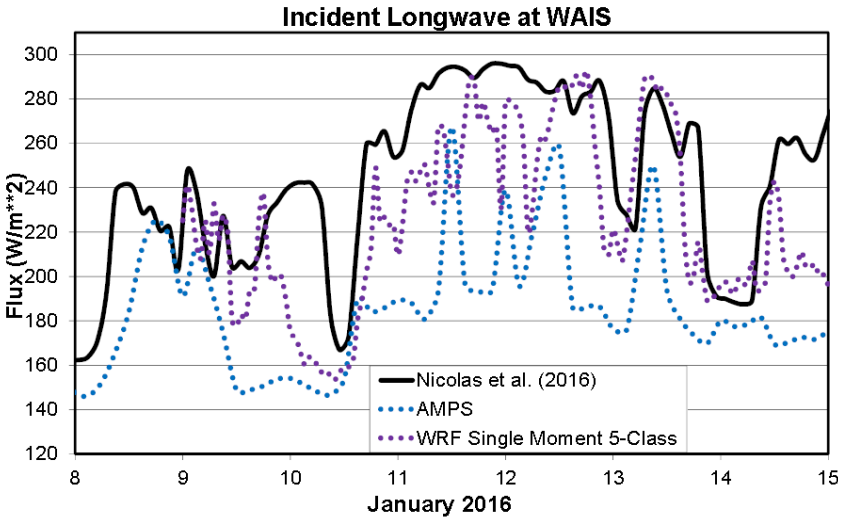
Morrison-Milbrandt P3 (avoids arbitrary cloud and precipitation categorization)

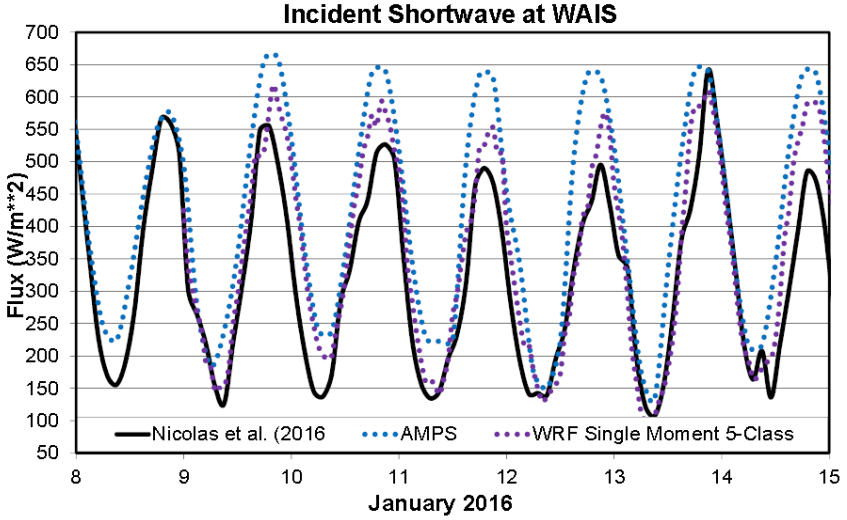
ERA-Interim best source for I.C. and B.C.

Near Surface Fields at WAIS 8 – 15 January 2016









PWRF 3.9.1: SW and LW biases remain, but are reduced in magnitude due to ERA-I. Temperature and humidity biases are largely removed. Can use PWRF 3.9.1 to explore Antarctic cloud biases (AMPS linked).

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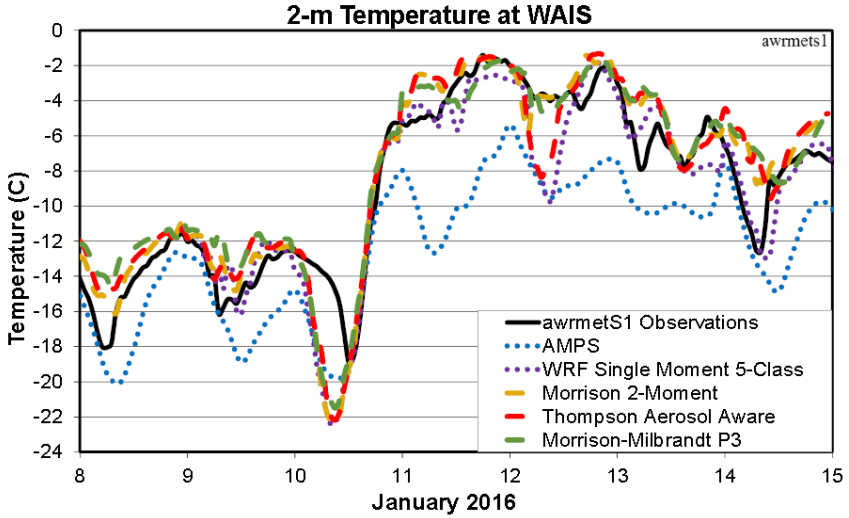
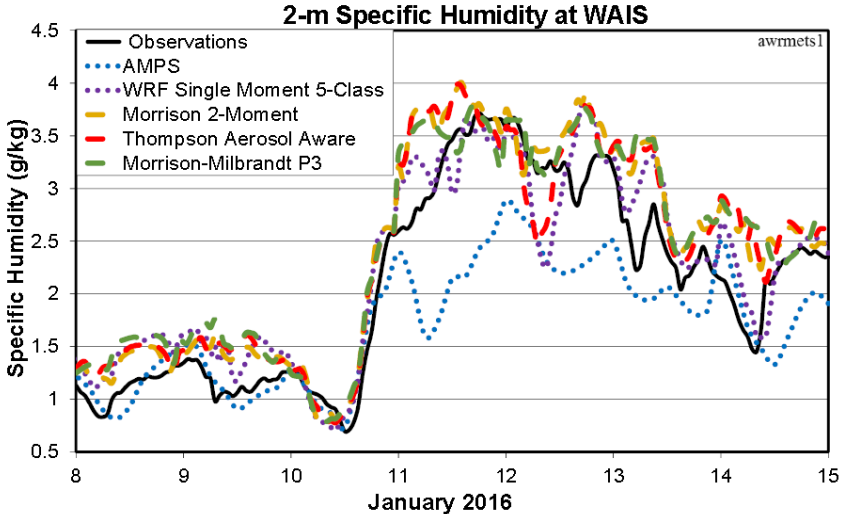
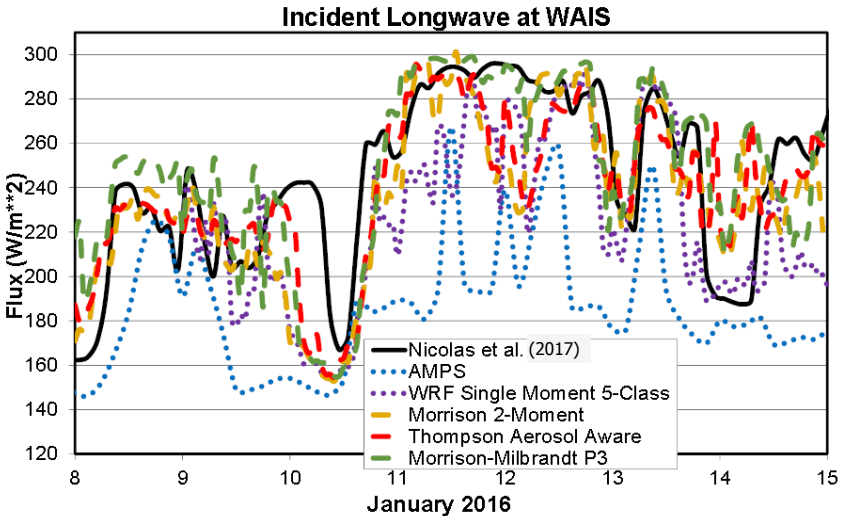
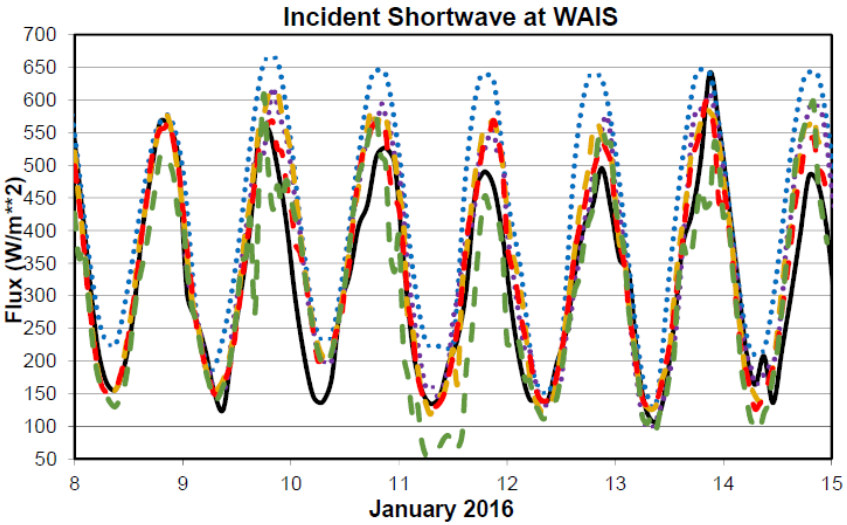
Near Surface Fields at WAIS 8 – 15 January 2016

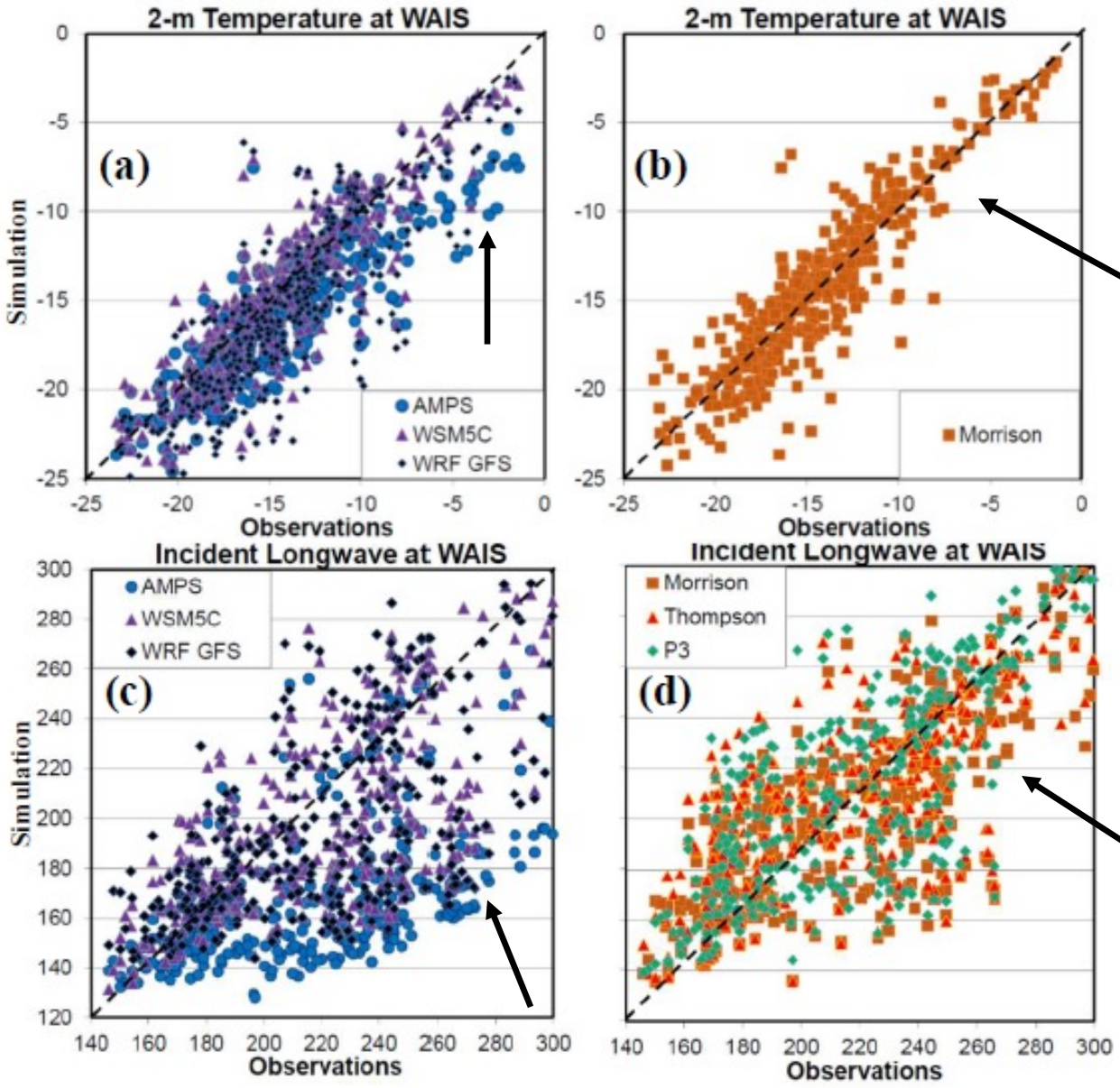








Run with more advanced microphysics schemes: Warm bias in 2-m T?
Schemes increase LW and reduce SW radiation – positive result!

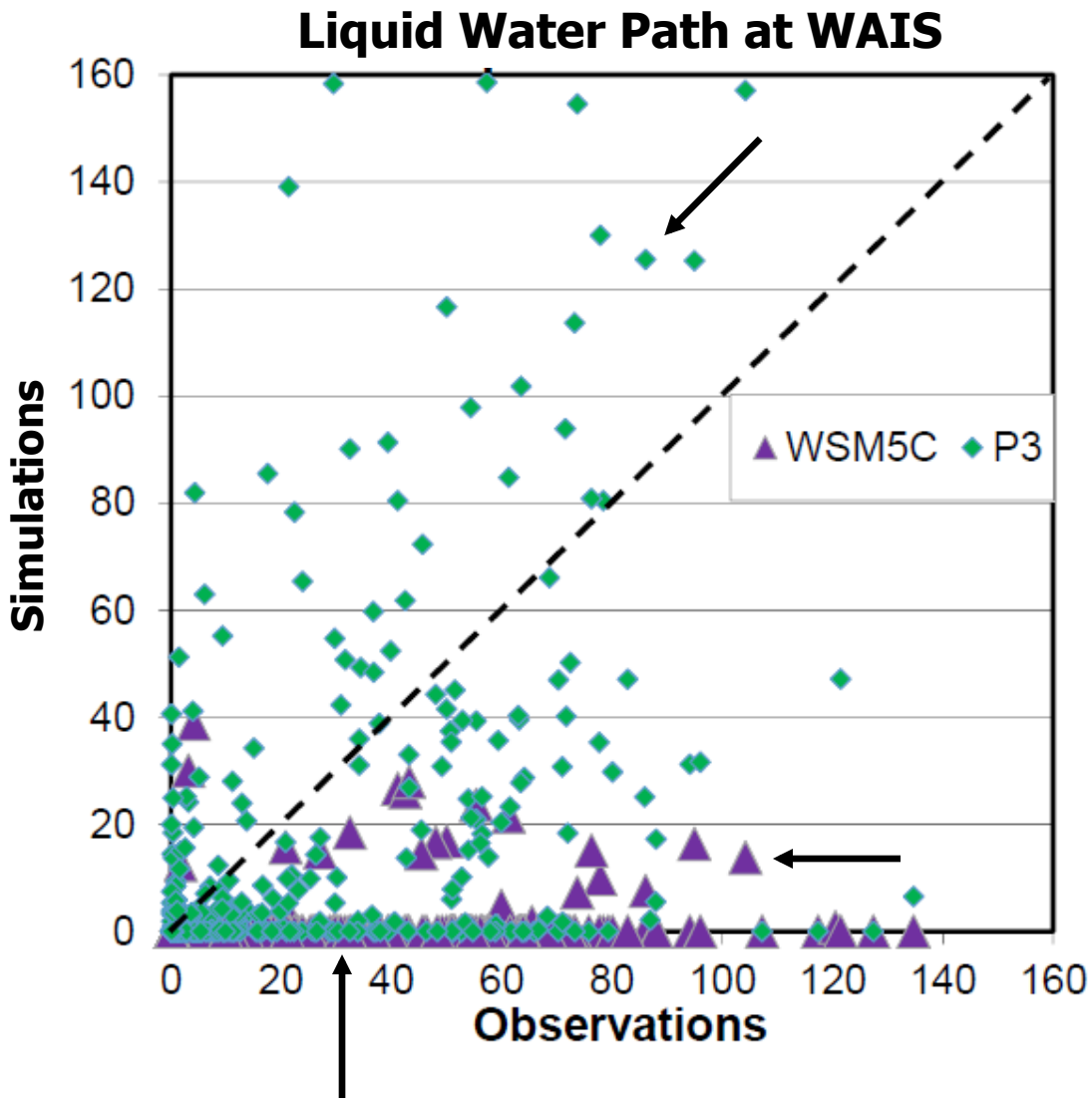


AMPS with WRF Single-Moment 5 Class is too cold, especially at warm temperatures

Polar WRF with Morrison microphysics is reasonable

WSM5C runs show too little downwelling longwave for cloudy skies

Two-moment runs show reasonable downwelling longwave.

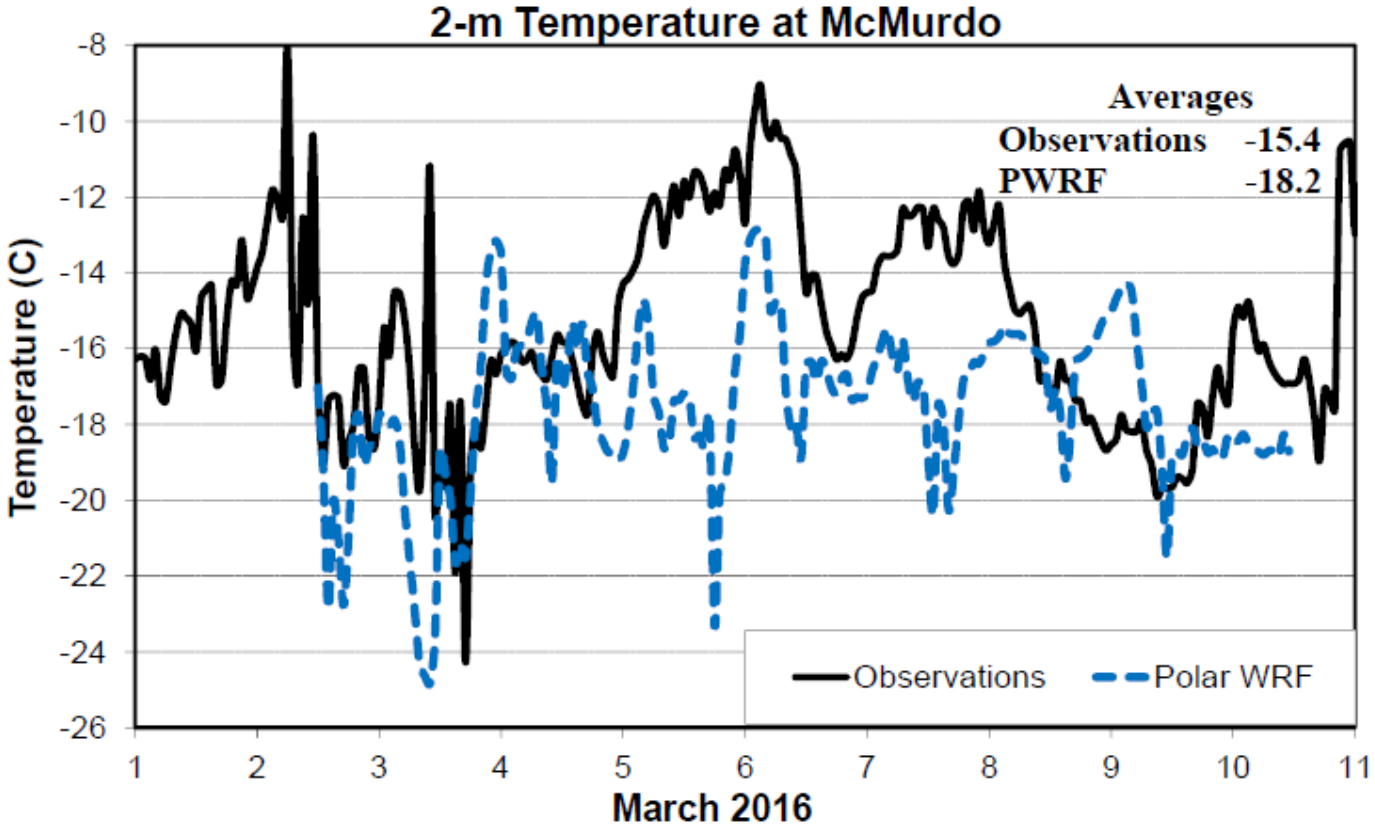


Many cases when cloud water is observed very little cloud water is simulated.

Simulations with the WRF Single-Moment 5 Class microphysics produce too little cloud water.

Simulations with double-moment microphysics produce more cloud water, yet still not enough.

March 2016 Case of Meoscale Cyclone at McMurdo: Polar WRF



Model at 370 m res. unable to capture local cyclone feature

Need McMurdo cases with a large-scale structure

Summary of AMPS and PWRF Findings with the AWARE Project

Liquid water deficit in AMPS clouds

Cloud radiative effect of AMPS clouds is too small

More advanced microphysics schemes increase the simulated liquid water and increase the cloud radiative effect

Which microphysics scheme is best? – not certain

Need to work more on simulating cloud water at colder temperatures.

Clouds are critical for improving AMPS forecasts