

# The MAD-WRF solar irradiance nowcasting model: model overview and evaluation of the cloud initialization system

Pedro A. Jimenez

Greg Thompson

Jimmy Dudhia

Jared A. Lee



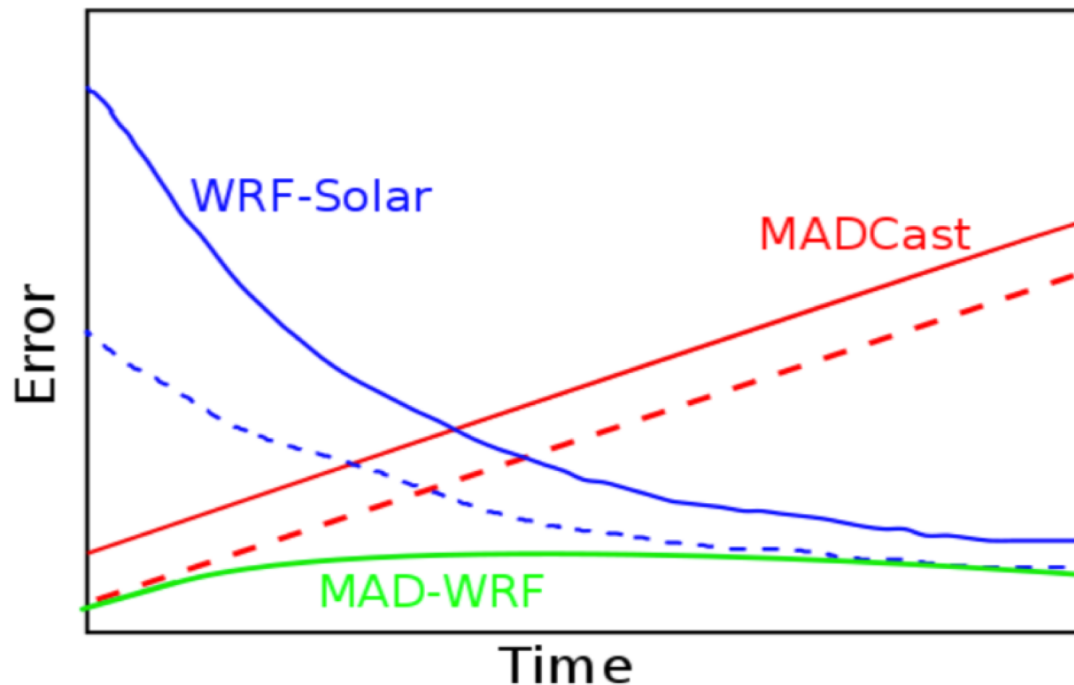
# GEO Vision for Energy

## GEO VENER is a GEO Initiative

- GEO: Improve availability, access and use of Earth observations
- Shared overall goal of using energy resources more efficiently
  - Using data and information for monitoring and forecasting energy sources; assessing and predicting impacts to energy processes; reducing risks to energy infrastructure; matching supply and demand; informing energy-policy planning across the world
- A GEO Vision for Energy (GEO-VENER) goal includes *“the availability and long-term acquisition of data from satellite and in-situ instruments and models to make possible the effective deployment, operation and maintenance of renewable energy systems and their integration in the grid”*.

# The MAD-WRF model

We are blending a satellite-based initialization system (MADCast) with a NWP-based nowcasting approach (WRF-Solar) to create an improved end-to-end solar irradiance forecast system called MAD-WRF.



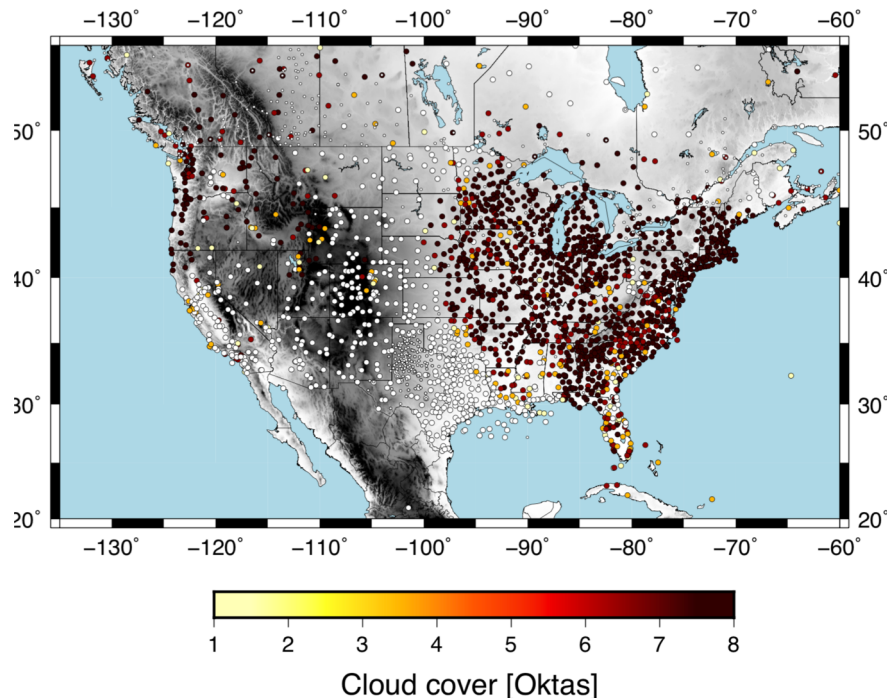
# Cloud initialization

- We have developed a cloud initialization parameterization
  - Relative humidity is used to estimate the cloud fraction
  - The hydrometeors (liquid and ice) are initialized assuming the clouds are adiabatic
- Use hydrometeors if available from the forecasts to create the initial and boundary conditions
- The three-dimensional cloud analysis is enhanced using GOES16 retrievals of the cloud mask and cloud top height and METAR observations of the cloud base height

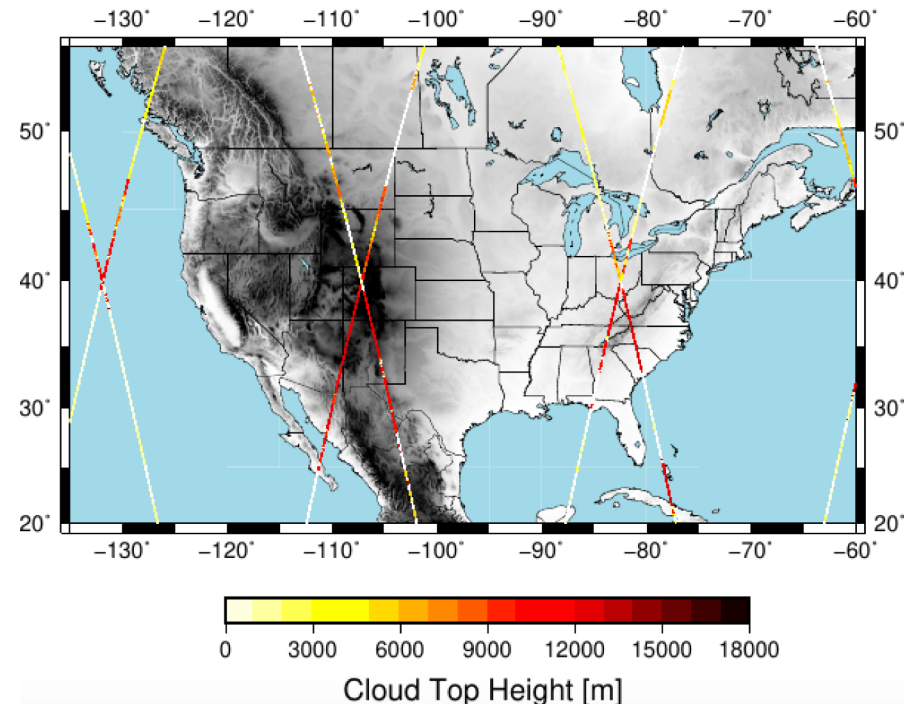
# Assessment of the cloud initialization parameterization

- Cloud analysis calculated for the 720 hours of April 2018
- HRRR **1h forecast** used to initialize WRF (9 km grid spacing)
- Validation against METAR observations and CALIPSO retrievals

**METAR**



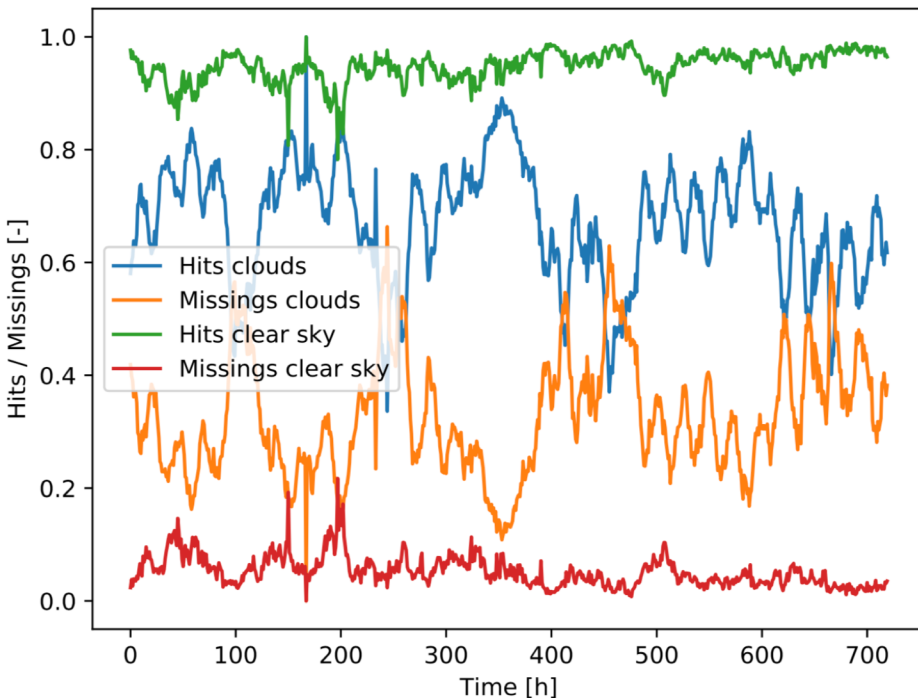
**CALIPSO**



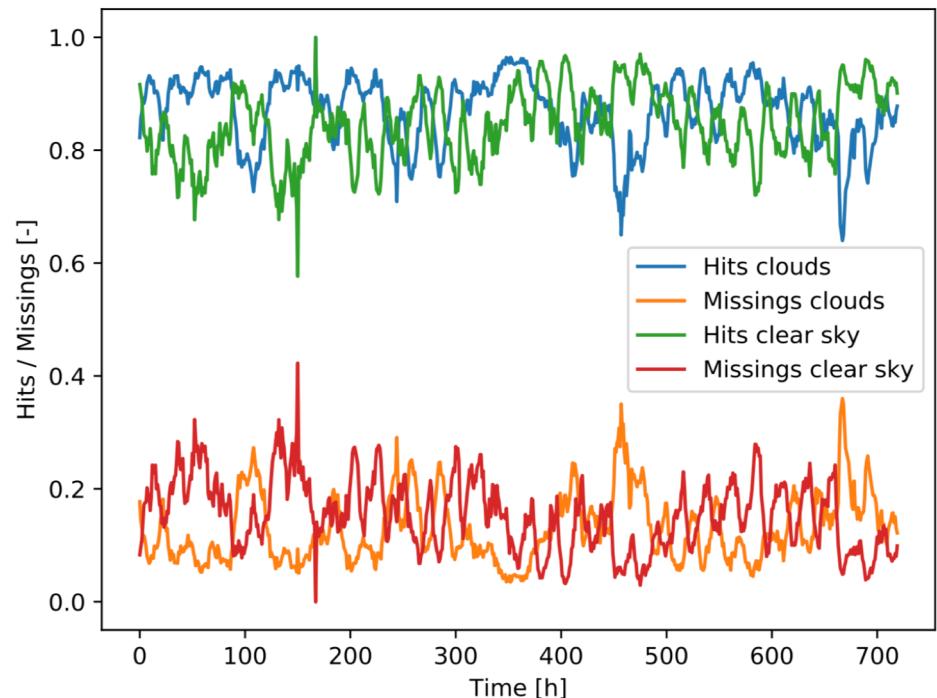
# Cloud initialization performance

**Validation against METAR stations**

HRRR 1h forecasts



HRRR 1h forecasts + cloud initialization parameterization

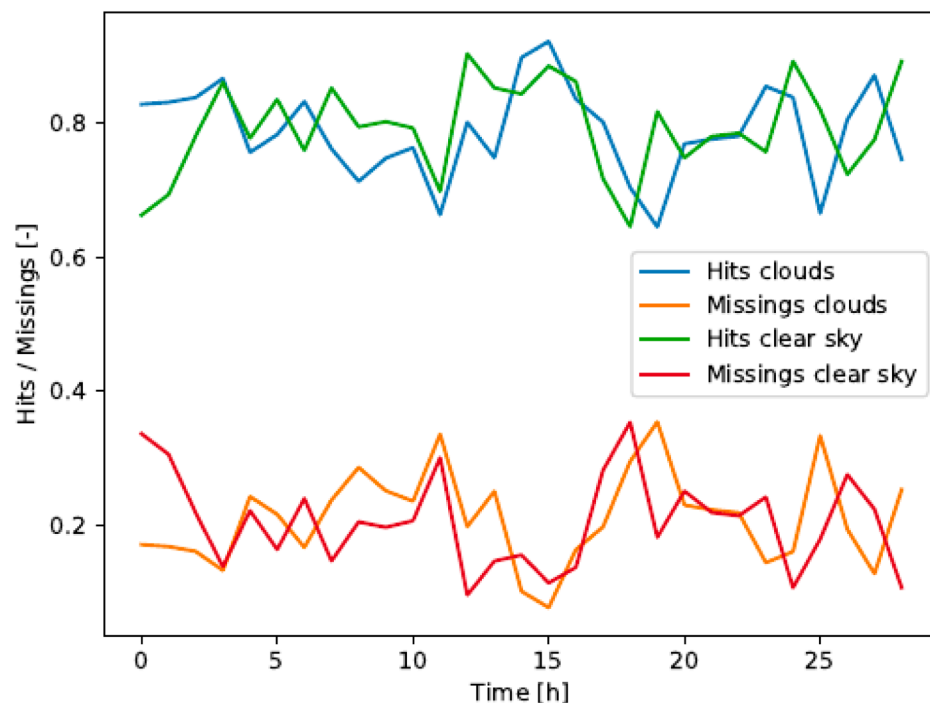
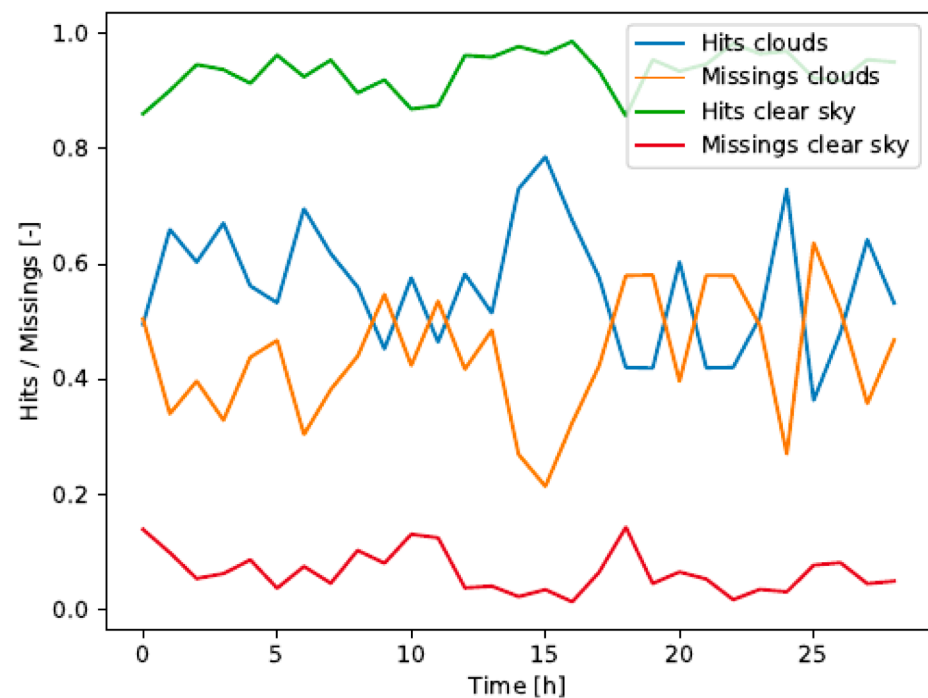


# Cloud initialization performance

Validation against CALIPSO retrievals

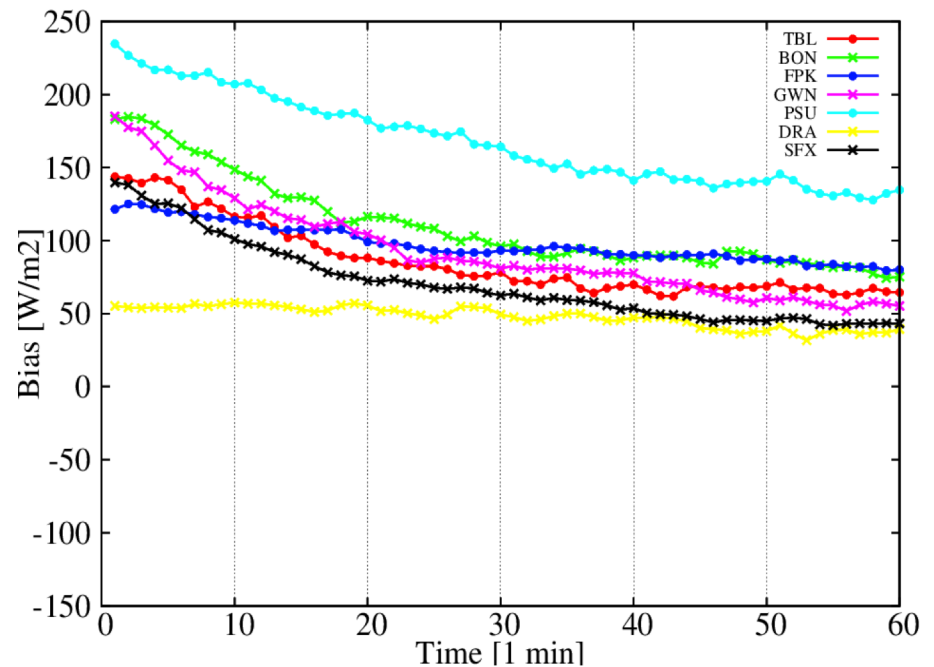
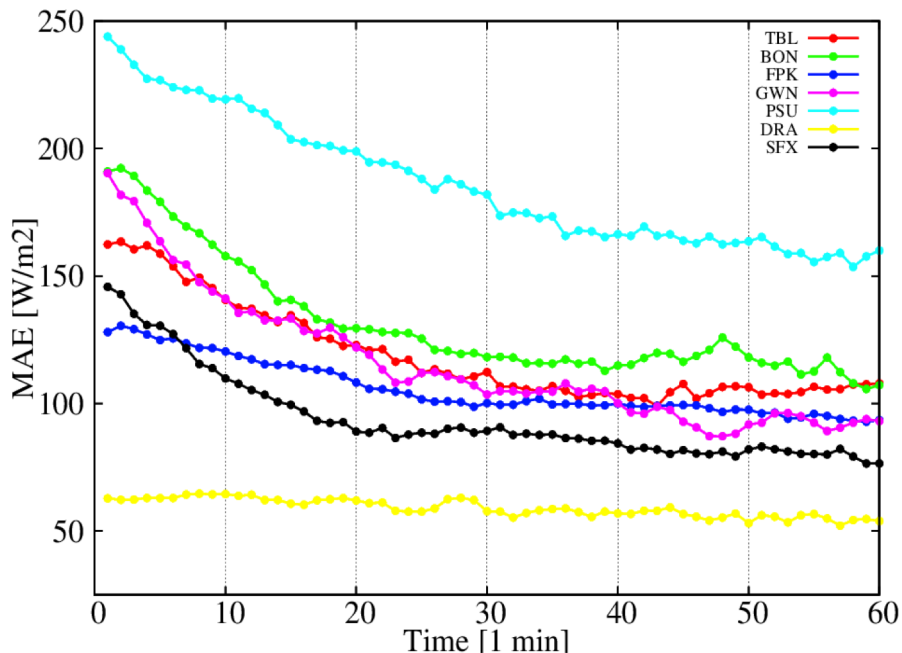
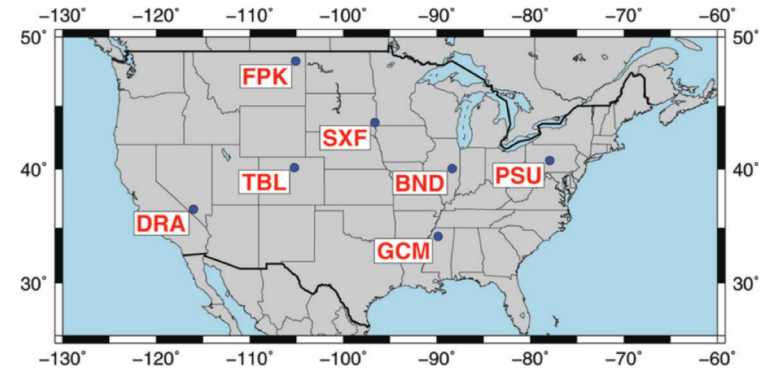
HRRR 1h forecasts

HRRR 1h forecasts + cloud  
initialization parameterization



# WRF-Solar performance

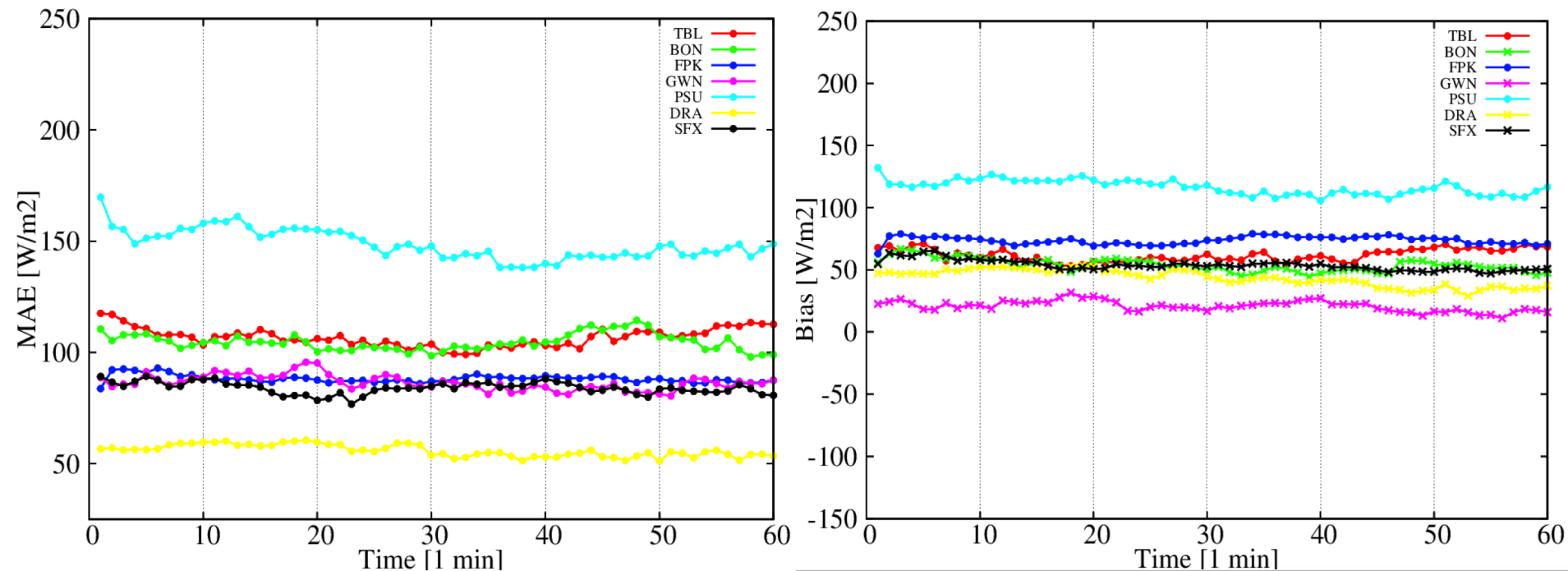
- NO hydrometeors
- NO cloud initialization parameterization





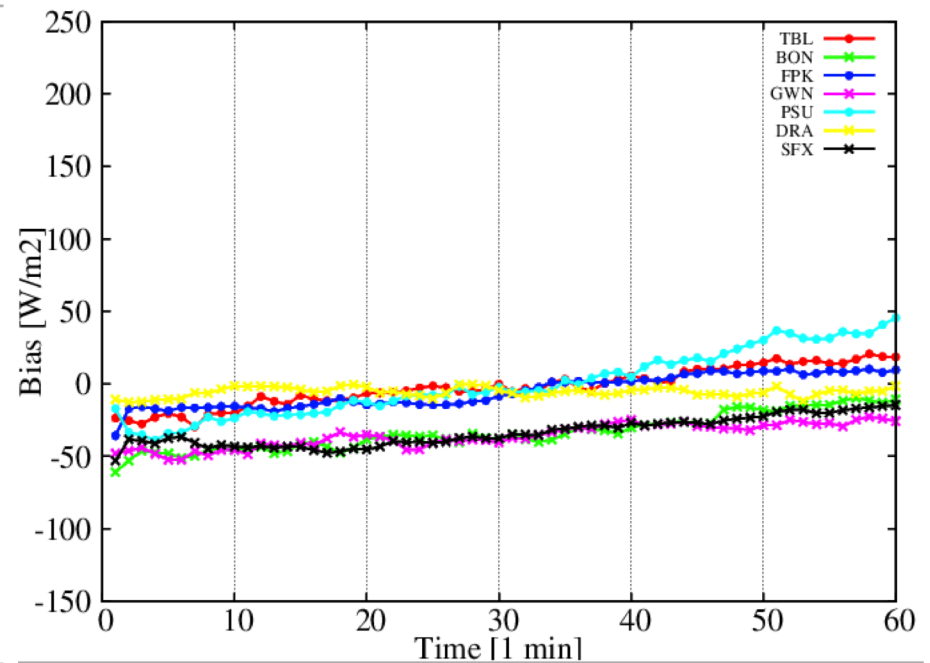
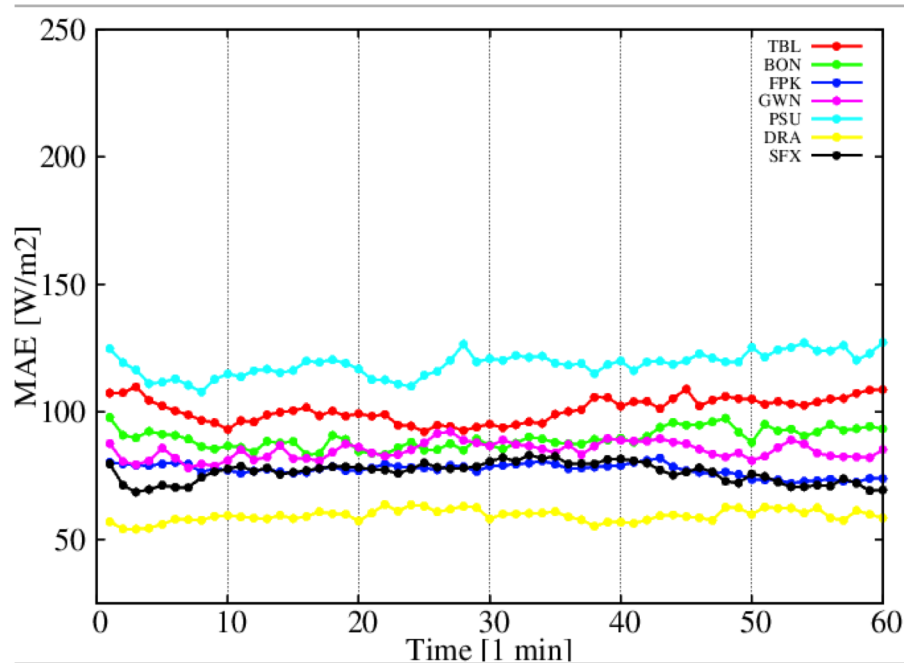
# WRF-Solar performance

- Hydrometeors from HRRR
- NO cloud initialization



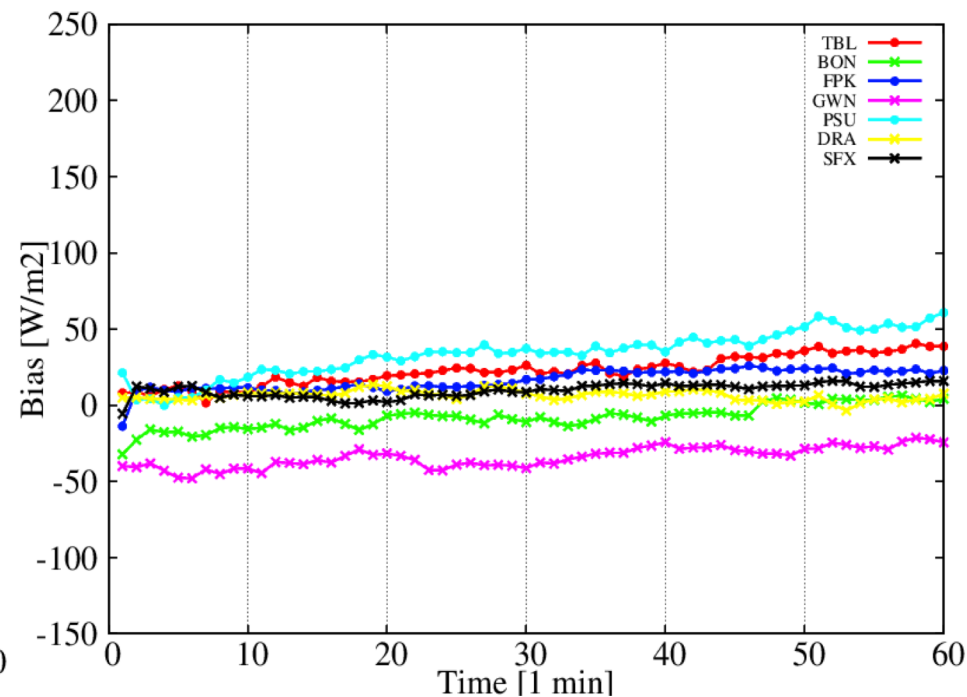
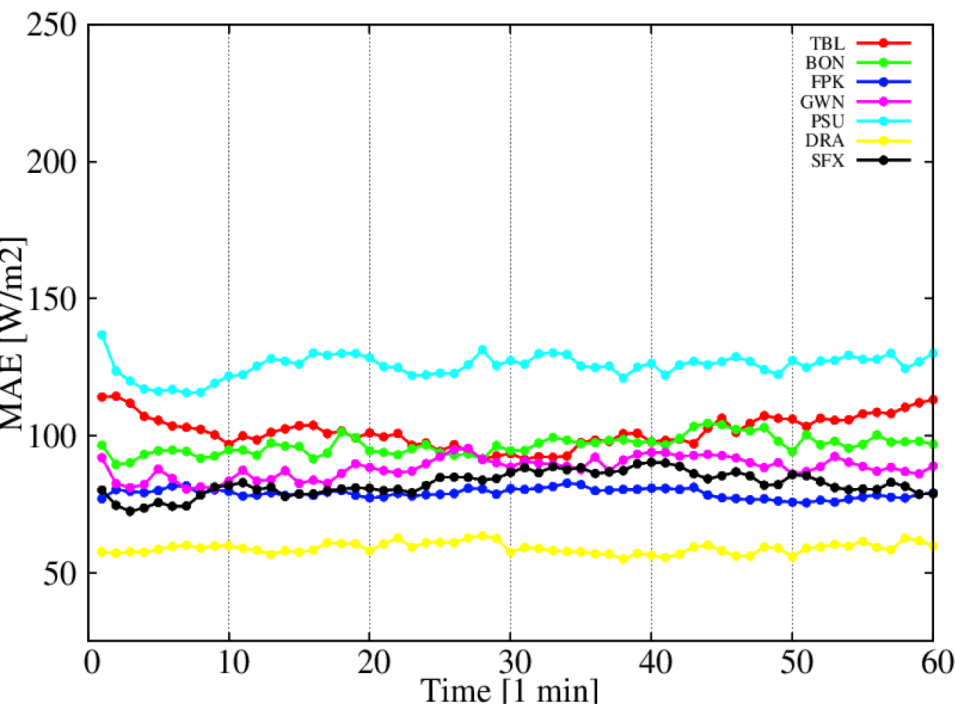
# WRF-Solar performance

- NO hydrometeors
- Cloud initialization parameterization activated



# WRF-Solar performance

- Hydrometeors from HRRR
- Cloud initialization parameterization activated

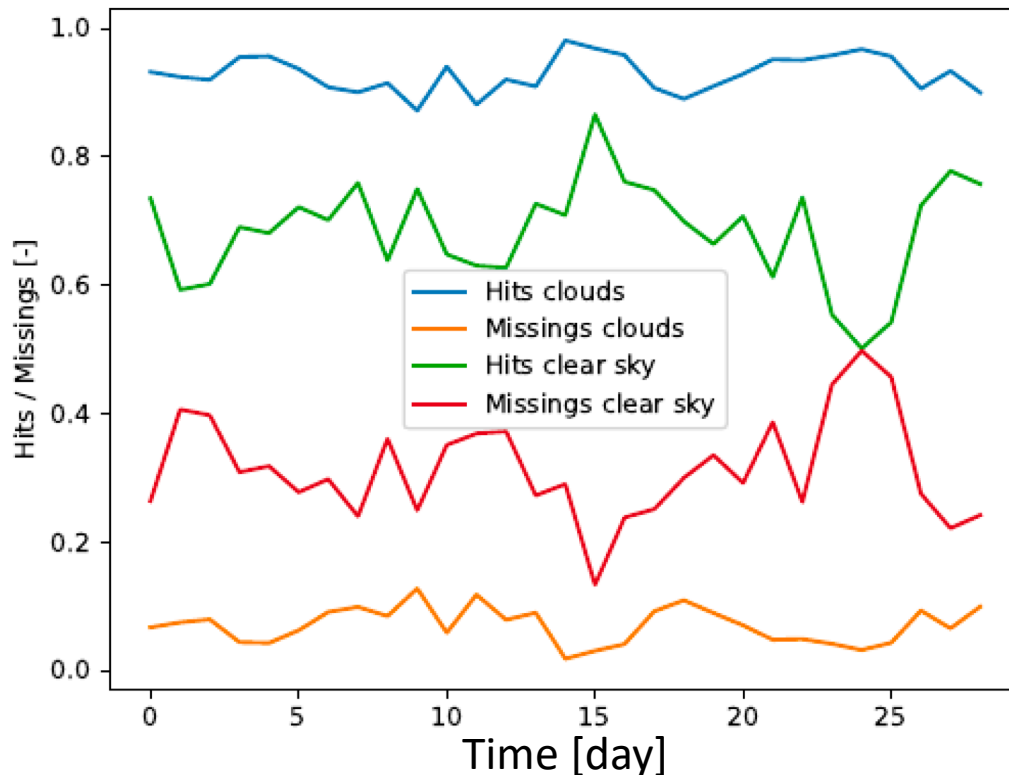


# On going work

- Impose GOES16 cloud mask + cloud top height retrievals
- Impose cloud base height from METAR observations

GOES16 ACHA L2 product

## Validation against CALIPSO retrievals



# Conclusions

- We are in the process of building the MAD-WRF nowcasting system
- We have improved the 3D cloud analysis with a cloud initialization parameterization
- We are in the process of imposing the cloud mask and cloud top height from GOES16 retrievals and the cloud base height from METAR stations

jimenez@ucar.edu