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

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GEO Vison 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
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

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