WRF-Solar / MADCAST

Source code

- The community version of WRF-Solar is integrated in the official WRF release. Please refer to the WRF-Solar website for further information: https://ral.ucar.edu/projects/wrf-solar
- MADCast source code

Model Identifier and version number

- WRF-Solar / MADCast
- WRF-Solar version 1.2.1 / MADCast v1.0

Citation information

- Title
  - WRF-Solar
- Abstract
  - WRF-Solar is a specific configuration and augmentation of the Weather Research and Forecasting (WRF) model designed for solar energy applications. Recent upgrades to the WRF model contribute to making the model appropriate for solar power forecasting, and comprise 1) developments to diagnose internally relevant atmospheric parameters required by the solar industry, 2) improved representation of aerosol-radiation feedback, 3) incorporation of cloud-aerosol interactions, and 4) improved cloudradiation feedback.
- Author(s)
  - Pedro A. Jimenez, Josh Hacker, Jimy Dudhia, Sue Haupt, Jose Antonio Ruiz-Arias, Chris A. Gueymard, Gregorey Thompson, Trude Eidhammer, Aijun Deng, Yu Xie and Manajit Sengupta
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  - Pedro A. Jimenez
- Creation Date
  - September 27, 2016
- Modification Date
- Identifier Code
  - DOE Solar Technology Transfer
- Use Constraints
  - None

- Title
  - MADCast
- Abstract
  - The Multi-sensor Advection Diffusion nowCast (MADCast) model (MADCast) assimilates infrared pro files using the Multivariate Minimum Residual (MMR) scheme to infer the presence of clouds. MMR has been implemented in the Gridpoint Statistical Interpolation system (GSI). Once GSI has generated the three dimensional cloud fields, the clouds are advected and diffused by a modified version of the Weather Research and Forecasting (WRF) model.
- Authors(s)
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  - Pedro A. Jimenez
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- Use Constrains
  - None

Distribution Information

- Distributor
  - "UCAR/NCAR - RAL - WSAP"
- Code URL
  - wrfsolar-v1.2.4.tar.gz
  - WPS-WRF-Solar-v1.2.1.tar.gz
  - MADCast source code
- Info URL
  - WRF-Solar / MADCast (this page)

Model description

- WRF-Solar:
  - WRF-Solar are augmentations to WRF in support of solar energy applications (Jimenez et. al 2016). The model developments focus on the representation of the cloud-aerosol-radiation system. Main developments include:
    - A parameterization of the aerosol direct effect (Ruiz-Arias et al. 2014; Lee et al. 2016)

        - Implementaiton of the cloud-aerosol representation that accounts for the aerosol indirect effects (Thompson and Eidhammer, 2014; Thompson et al. 2015) as well as the aerosol direct effect.
        - A shallow cumulus parameterization that accounts for the effects of unresolved clouds in the shortwave irradiance (Deng et la. 2014; Jimenez et al. 2016; Lee et al. 2016).
        - A Fast All-sky Radiation Model for Solar applications (FARMS) to calculate surface irradiances every model time step (Xie et al. 2016).
- MADCast:
    - MADCast is a nowcasting that provides analysis of the cloud field and predicts the surface irradiance (Auligne 2014a; 2014b; Descombes et al. 2014). MADCast assimilates infrared profiles using the Multivariate Minimum Residual (MMR) scheme to infer the presence of clouds. MMR has been implemented in the Gridpoint Statistical Interpolation system (GSI). Once GSI has generated the three dimensional cloud fields, the clouds are advected and diffused by a modified version of the Weather Research and Forecasting (WRF) model.

Intended use

- WRF-Solar:
    - Numerical weather prediction model specifically designed to provide specialized numerical forecast products for solar power applications (Jimenez et. al 2016).
- MADCast:
    - MADCast is a nowcasting system to predict cloudiness and surface irradaince (Auligne 2014a; 2014b; Descombes et al. 2014).

Key assumptions

- WRF-Solar:
    - WRF and thus WRF-Solar integrate the Euler equations to perform a forecast. A detailed description of the method used by WRF to integrate the Euler equations is described in Skamarock et al. (2008). The method uses a time-split integration scheme wherein meteorologically significant modes are integrated using a longer time step than the high-frequency acoustic modes that are integrated over smaller time steps to maintain numerical stability.
- MADCast:
    - MMR is the mathematical core of MADCast. A complete description of the MMR scheme can be found in Auligne (2014a; 2014b). MMR is inspired by the minimum residual technique by Eyre and Menzel (1989) and is especially suitable for exploiting the large number of channels from hyperspectral infrared sounders.

Documentation and References

- Installation documentation including hardware and software requirements
    - WRF-Solar:
        - WRF-Solar can run in high performance computers, desktop computers or even a laptop. No special requirement is needed. No special requirements are needed in terms of hardware. The computer should run under Linux or Mac operating systems and have a Fortran and C compiler and the NetCDF libraries installed. The installation of other libraries maybe necessary to decode GRIB2 format and the process is described in the WRF compilation tutorial.
        - The WRF online tutorial provides detailed information to install and run WRF and thus WRF-Solar.
    - MADCast:
        - MADCast can be run in a laptop, a standard desktop or a high performance computer. No special requirements are needed in terms of hardware. The computer should run under Linux or Mac operating systems and have a Fortran and C compilers as well as the NetCDF and the LAPACK libraries installed.
        - MADCast requires the installation of a modified version of the Gridpoint Statistical Interpolation (GSI) system (GSI online tutorial) and a modified version of WRF (WRF online tutorial). Both codes can be downloaded from this website.
        - MADCast installation step by step:
            - Create a ~/Code directory in your home directory.
            - Download the madcast source code and untar the file.
            - Untar the GSI GSI_cldfra.tar.gz and the WRF WRFV3.6_cldfra.tar.gz tarballs in your ~/Code directory, compile according to the README.cldfra and the GSI and WRF user guides. Also see GSI_MMR_notes.pptx.
            - Untar the test case data cldfra_case.tar.gz in your project directory and run the test case according to the README.cldfra.
            - Set-up the post-processing (Verif_cldfra.tar.gz). Also see Post-processing_MADCast.pptx.
- User guide
    - WRF-Solar:
        - WRF User's Guide and WRF-Solar User's Guide.
    - MADCast:
        - WRF User's Guide and GSI User's Guide.
- Technical notes
    - WRF-Solar:
        - Chapter 3 of the Sun4Cast system technical note.
    - MADCast:
        - MADCast technical note.