WRF-Solar User's Guide

The direct and diffuse irradiance are calculated in Dudhia's, RRTMG, Goddard and new Goddard shortwave radiation parameterizations. The direct normal irradiance (DNI) is stored in the SWDDNI variable and the diffuse in the SWDDIF varaible. Add a h in the IO column in the rows of the registry file containing these variables to add the direct and diffuse irradiance to the standard WRF output.

To activate the direct aerosol effect set aer_opt = 2 in the physics part of the WRF namelist. At a minimum the user needs to provide the aerosol optical depth (AOD) at 550 nm. Two options are available 1) constant value, and 2) variable read via auxiliary file(s) in WRF I/O API-conforming netCDF format. Then select the primary aerosol type with aer_type. Normally, using a rural type of aerosol is the best choice (aer_type = 1). In addition, indicate in the namelist how to calculate the Agnstrom exponent, single scattering albedo and assymetry parameter. Three options are available 1) constant values, 2) fields read from the auxiliary input, and 3) parameterize them based on the AOD at 550 nm and the predominant aerosol type. Take a look to he README.namelist file in the WRF run directory (the aer_opt and related variables) for more details on how to select these options.

WRF-Solar incorporates a high resolution monthly aerosol climatology over North America. You need to place the geog_data directories herein provided in the same directory of the static data processed by Geogrid. There is a monthly climatology for three aerosol variables 1) AOD at 550 nm 2) Angstrom exponent, and 3) single scattering albedo. The climatological data is processed by WPS and available to use it in WRF. To activate it set aer_opt = 2 as well as the rest of its options as described in the previous paragraph. The climatological aerosol data is used if WRF does not find files to read via the auxiliary input.

To activate the effects of unresolved clouds on shortwave radiation, set shcu_physics = 4. The Cu parameterizaion should be turned off since the WRF-Solar shallow cumulus scheme also accounts for deep convection. It is not recommended going beyond 9 km grid spacing since at these resolutions WRF starts to explicitly resolve deep convection.

A couple of options are available to have surface irradiances updated in between calls to the shortwave parameterization. Setting swint_opt = 1 interpolates the irradiance in between calls to the shortwave radiation parameterization. The parameterization keeps constant the concentration of hydrometeors and estimates the clear sky irraiance. By setting swint_opt = 2 the Fast All-sky Radiation Model for Solar applications (FARMS) scheme is activated. FARMS computes the surface irradiance every model time step and stores the valus in SWDOWN2, SWDDNI2 and SWDDIF2 variables. This option uses the current atmospheric state, including hydrometeors, to calculate the surface irradiance.

To output high resolution time series, every model time step, at selected locations use the tslist capability of WRF. This requires an ascii file with the lat and lon of the sites to output the high resolution time series (see README.tslist file in the run directory). WRF-Solar adds the surface irradiances, direct, diffuse and GHI to the standard tslist output (last columns in the .TS files).

To activate the aerosol indirect effects set the microphysics option to 28. Documentation on how to run this parameterization can be found here:
http://www2.mmm.ucar.edu/wrf/users/wrfv3.6/mp28.html
The standard way to run the parameterization is using the climatological concentrations of the water- and ice-friendly aerosols as described in the previous link. In addition, the water- and ice-friendy aerosols can be initialized with concentrations with time stamps. The concentrations of the water- and

ice-friendly aeresols (QNWFA_WPS and QNIFA_WPS variables) are read in WPS intermediate format in Metgrid. The documentation to write in intermediate format is provided in the following link: http://www2.mmm.ucar.edu/wrf/OnLineTutorial/Basics/IM_files/
In order to use aresols with time stamps the user needs to set , use_aero_icbc = .true., and use_aero_icbc_clim = .false. in the physics part of the namelist.

Setting the microphysics to 28 and aer_opt = 4 also accounts for the aerosol direct effect in order to fully couple the cloud-aerosol-radiation system.