

3.4.9 Rotated grids

Switch:	RTD
Origination:	WAVEWATCH III (MetOffice)
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The rotated grid is a latitude-longitude (lat-lon) grid and is obtained by rotating the North Pole along a longitude λ_p to a new position at latitude ϕ_p in the standard latitude-longitude system. The new pole position is chosen so that the model domain of interest may be placed around the rotated equatorial area for a evenly-spaced lat-lon mesh. For this reason the rotated grid is also known as *Equatorial grid*. For instance, the North Atlantic and European wave (NAEW) model used in the UK Met Office uses a rotated pole at 37.5N, 177.5E so that London, UK (~51.5N 0.0E) is almost on the rotated equator. This rotated grid allows a much more evenly spaced lat-lon mesh in the NAEW domain than the standard lat-lon grid in the same area.

In WAVEWATCH III, the rotated grid is implemented with minimum changes to the original lat-lon grid. In fact, the rotated grid is treated just like the standard lat-lon grid inside the model. To set up and run a rotated grid model configuration, users should choose the regular lat-lon grid along with the RTD switch. The rotated pole position is set using the PLAT and PLON variables under the namelist ROTD in the input file **ww3_grid.inp** (see Sect. G.1.1). If the pole is set as PLAT = 90.0, PLON = -180.0, the grid is treated as a standard lat-lon system.

Model input files, like wind, current and ice files should be mapped on to the rotated grid. For convenience of nesting in standard lat-lon grid frameworks, boundary conditions data provided to and output from the rotated grid use spectra referenced to a standard grid north and standard lat-lon grid points values, which are converted into rotated grid lat-lon inside WAVEWATCH III. The list of 2D spectral output locations in **ww3_shel.inp** or **ww3_shel.nml** are also specified in standard lat-lon. When the boundary conditions are applied to a model on a standard lat-lon grid, the RTD switch is not required in compiling the executables for that model.

Output of spectra at boundary points to one-way nested inner grids are transferred as described in Appendix B. Output b.c. may be defined in the input file (see **ww3_grid.inp**, Sect. G.1.1) as a sequence of straight lines given in coordinates of the inner grid. If the inner grid is rotated, it's pole position must be defined as the values of the array elements BPLAT(n) and

BPLON(n) under namelist ROTB. The array index n is the index (1:9) of the boundary conditions file `nestn.ww3`.

Model directional and x-y vector outputs from a rotated grid can be converted to a standard grid north reference by setting the UNROT variable in the `ww3_grid.inp` namelist ROTD to True. With this set, for point outputs lat-lon locations all directional values such as wind direction, current direction and 2D spectra are converted into standard lat-lon orientation. Functions to de-rotate gridded fields are applied in `ww3_ounf`, `ww3_outf` and `ww3_grib`. When running `ww3_ounf` and `ww3_ounp`, the resulting netCDF files will include a variable attribute `direction_reference`, which describes whether a standard (True North) or rotated grid directional reference frame has been used. Gridded netCDF files generated by `ww3_ounf` also include `standard_latitude` and `standard_longitude` two-dimensional arrays that describe location of the rotated model cell centres in the standard lat-lon reference frame.

Six subroutines are provided in module `w3servmd.ftn` for rotated grid conversion:

W3SPECTN	Turns wave spectrum anti-clockwise by AnglD
W3ACTURN	Turns wave action(k,nth) anti-clockwise by AnglD
W3THRTN	Turns direction parameters anti-clockwise by AnglD
W3XYRTN	Turns x-y vector parameters anti-clockwise by AnglD
W3LLTOEQ	Convert standard into rotated lat/lon plus AnglD
W3EQTOLL	Reverse of w3lltoeq, but AnglD unchanged

These subroutines are self-contained and can be extracted outside the model for pre- or post-processing of rotated grid files. Some conversion tools have been developed based on these subroutines but have not been included in WAVEWATCH III yet. Refer to the regression test `regtests/ww3_tp2.11` for an example of a rotated grid model (NAEW). Users may find more information in `smc_docs/Rotated_Grid.pdf` or contact Jian-Guo Li for help (Jian-Guo.Li@metoffice.gov.uk).