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Reanalysis / Open source data

In order to assess the preliminary wind potential across the globe, the reanalysis data plays a vital role in capturing the long term climatology and wind speed trends. There are various satellite sources like NCEP/NCAR, MERRA, ERA, GFS, CFSR etc. which are available at various temporal resolutions of 1h, 3h or 6h etc. and at different spatial resolution of between 50-250 kms. These data sets can be analysed to identify the potential zones while setting up an on-site measurement campaign.

Broadly, the open source data available are:

Modern-Era Retrospective Analysis for Research and Application (MERRA)

The Modern Era Retrospective-Analysis for Research and Applications (MERRA) is the product of NASA Global Modelling and Assimilation Office (GMAO) that uses computer models and data assimilation techniques to enhance NASA's program of Earth Observations.

MERRA2 is an update version of the original MERRA dataset with advancements in the assimilation system of modern hyperspectral radiance and microwave observations with GPS-Radio Occultation datasets. Advancement in both the GEOS-5 model and the GSI assimilation system are introduced in MERRA-2.

Like the other data sets, MERRA2 is also available in mesh-grid format with a spatial resolution of 0.5degree latitude × 0.625degree longitude (about 50 km in the latitudinal direction) which is same as of in previous assimilation model of MERRA.

The output files are available in netCDF-4/HDF-5 format at a more frequency rate than the conventional 6-hourly analyses. MERRA2 has two-dimensional diagnostics (surface fluxes, single level meteorology, vertical integrals and land states) which are produced at hourly output intervals.

Extensive three-dimensional 3-hourly atmospheric diagnostics on 42 pressure levels are also available at coarser resolution of 1.25 degree. The Goddard Earth Sciences Data Information Services Center (GES DISC) provides utilities for users to access and subset the MERRA data products.

MERRA-2 data are available at MDISC, managed by the NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC).

For more information, please log on to: **MERRA2 (<http://gmao.gsfc.nasa.gov>)**

European Centre for Medium-Range Weather Forecasts (ECMWF)

ECMWF is an independent intergovernmental organisation supported by 34 member states[^] which is a research institute as well as round the clock operational service provider for producing numerical weather predictions for its members.

The meteorological services are available to its members which are reproduced by the supercomputer technology, HPCF for weather forecasting installed in 1978 which is still one of the advanced computing machines in Europe and Member areas. ECMWF is based in Reading, UK and has a sponsorship department in the UK Government, the Department for Business, Innovation and Skills.

ECMWF's assimilation system carries 40 million observations a day from more than 50 different instruments on satellites, and from many ground-based and airborne measurement systems.

ECMWF uses its forecast models and data assimilation systems to 'reanalyse' archived observations, creating global data sets of the atmosphere, land surface, and oceans. Reanalysis data are used for monitoring climate change, for research and education, and for commercial applications.

Recently ECMWF reanalysis have products out like ERA-Interim which is a global reanalysis of recorded climate observations from 1979 till present. The data assimilation system is based on a 2006 release of the IFS (Cy31r2).

The dataset provides the global climate reanalysis data with 4 dimensional variation analysis (4D-Var) at a 12-hour analysis period in a mesh-gridded format with a spatial resolution of approximately 0.7 degrees (~80 km -T255 spectral) and at 60 atmospheric levels from the surface up to 0.1 hPa. The data coverage extends from 89.5S to 89.5N and 0E to 359.3E.

Another product by ECMWF is ERA5 dataset, which eventually will cover the period January 1950 to near real time. ERA5 dataset so far released covers the period 2008-present.

ERA5 was produced using 4DVar data assimilation in CY41R2 of ECMWF's Integrated Forecast System (IFS), with 137 hybrid sigma/pressure (model) levels in the vertical, with the top level at 0.01 hPa. Atmospheric data are available on these levels and they are also interpolated to 37 pressure, 16 potential temperature and 1 potential vorticity level(s). "Surface or single level" data are also available, containing 2D parameters such as precipitation, 2m temperature, top of atmosphere radiation and vertical integrals over the entire atmosphere. The IFS is coupled to a soil model, the parameters of which are also designated as surface parameters, and an ocean wave model.

For more information, please log on to:

ECMWF (<http://www.ecmwf.int>)

<https://software.ecmwf.int/wiki/display/CKB/ERA5+data+documentation#ERA5datadocumentation-Spatialgrid>

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Global Forecast System (GFS)

The Global Forecast System (GFS) is also a numerical weather prediction model produced by the National Centers for Environmental Prediction (NCEP). The data set output covers the entire globe running four times a day and produces forecasts for up to 16 days in advance, but with lesser spatial resolution post 10 days. The horizontal resolution of the model output is approximately 13 km for the first 10 days and 27 km for next 16 days.

Vertically the model output is divided into 64 layers and it produces the forecast at every hour for the first 120 hours, three hours for the next 10 days and 12 hourly for the next 16 days.

The GFS model is an integral model of four separate representations i.e. An atmosphere model, an ocean model, a land/soil model, and a sea ice model, for accurate weather predictions. Gridded data are downloadable from National Operational Model Archive (NOAA) and Distribution System (NOMADS). The output dataset is available as GRIB2 file format.

For more information, please log on to: **GFS (<https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/global-forecast-system-gfs>)**

Climate Forecast System Reanalysis (CFSR)

The CFSR is a third generation reanalysis product of NCEP. The assimilation dataset is available from 1979 till present and can be free downloaded from NOAA Earth System Research Laboratory. The data set output covers the entire globe running with integrated model of atmosphere, ocean, land surface and sea ice designed to perform as the best weather prediction model. The CFSR incorporates the atmospheric and oceanic parameters while generating the 6 hourly guess fields. The spatial resolution of CFSR global atmosphere data is approximately 38 km at a vertical resolution of 64 levels. The global oceanic data set is available at 0.25° at the equator, extending up to a global 0.5° beyond the tropics, with 40 vertical levels. The global land surface model has 4 soil levels where as the global sea ice model has 3 levels. The CFSR atmospheric model contains observed variations in carbon dioxide (CO₂), together with changes in aerosols and other trace gases and solar variations. With these variable parameters, the analyzed state will include estimates of changes in the Earth system climate due to these factors. The data is provided in netCDF format.

For more information, please log on to: **NCEP-CFSR (<https://www.esrl.noaa.gov/psd/data/gridded/data.cfsr.html>)**

National Centers for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR)

NOAA/ESRL Physical Sciences Division (PSD) carries out weather and climate research to understand and observe the Earth's physical environment, and to improve weather and climate forecasts at global level

NCEP/NCAR have cooperated in a project denoted "Reanalysis" to produce a record of global analyses data of atmospheric fields. The NCEP/NCAR Reanalysis data set is regularly updated and available globally from 1948 till present in a mesh-gridded dataset that represents the state of the Earth's atmosphere, incorporating observations and numerical weather prediction (NWP) model.

The datasets is available at vertical height of 10 meters above sea level (m.a.s.l) with a spatial resolution of coverage of 2.5° latitude x 2.5° longitude. The data available is at a temporal resolution of four hourly, daily and monthly with coarse resolution.

The dataset is available in NetCDF and GRIB file formats.

For more information, please log on to: **NCEP/NCAR**
(<https://www.esrl.noaa.gov/psd/data/gridded/data.ncep.reanalysis.derived.html>)

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