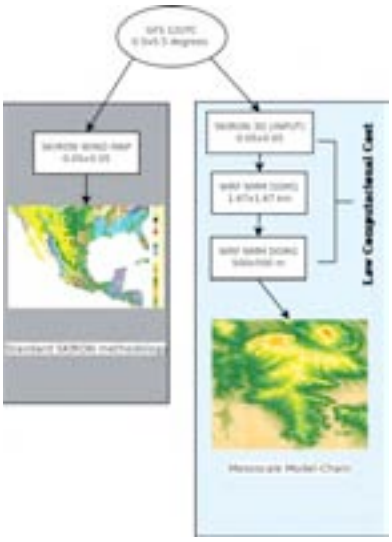
MESOSCALE MODEL-CHAIN

CENER developed a methodology to generate high-resolution wind resources maps to any region in the globe up to resolution of 500m x 500m and representative of the climatology of the region. This methodology is based on a **mesoscale model-chain (MMC)** approach that uses the Global

Forecasting System Data (GFS 0.5ºx0.5º horizontal resolution) as input to the mesoscale model SKIRON (5kmx5km) and finally the result from the SKIRON simulation is used as input to the WRF-NMM model (500mx500m).



MESOSCALE MODEL-CHAIN

The main synoptic-scale atmospheric patterns that govern one given region are calculated by applying a Principal Components Analysis (PCA) to long-term meteorological databases. The 365 days that better represent the climatology of the region are dynamically downscaled by the **mesoscale model-chain (MMC)** methodology (developed at CENER), employing state-of-the-art numerical weather prediction models (SKIRON + WRF-NMM), which allows the extraction of the relevant meteorological information for wind resource characterization.

The mesoscale models are configured for optimal simulation of wind, especially in mountainous areas.

1. Up to thirty years of long-term representation in the wind speed maps and its temporal characteristics can be obtained through the application of statistical and artificial intelligence methods in order to select 365 days that best represent the synoptic-scale atmospheric patterns which drives the local wind climate.
2. The selected days are simulated with CENER's standard methodology (SKIRON), using GFS (3 hours frequency) data as input and generating 5km x 5km outputs every hour;
3. The hourly outputs from the SKIRON simulation are used as input to two WRF-NMM nested domains, along with high-resolution topography (SRTM 90m) and land cover1.

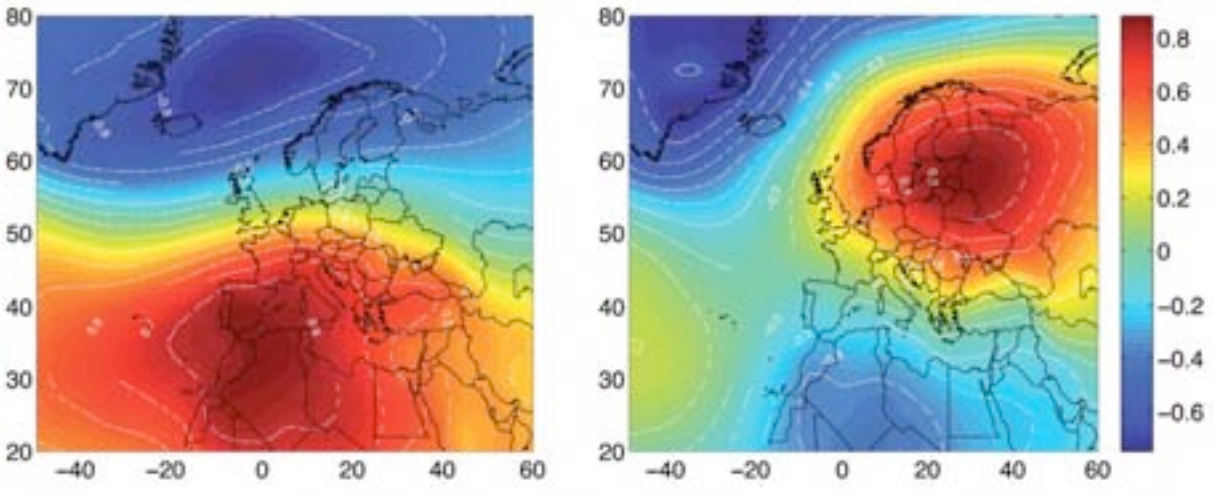


Figure 1: Example of two weather patterns, affecting the Iberian Peninsula, obtained by the PCA.

MAIN ADVANTAGES:

1. Lower computational resources required than typical high-resolution simulations.
2. High-Resolution initial conditions (topography (90mx90m) and land cover1).
3. Significant improvement in the results from all meteorological variables at several heights validated.

PRODUCTS GENERATED:

- High-Resolution wind resource assessment that represents the climatology of the region in the last 30 years;
- Hourly meteorological time series (wind speed, temperature, direct solar radiation, etc...);
- High-resolution wind and temperature vertical profiles;
- Average wind speed and wind power density at several heights;
- Average Weibull parameters.

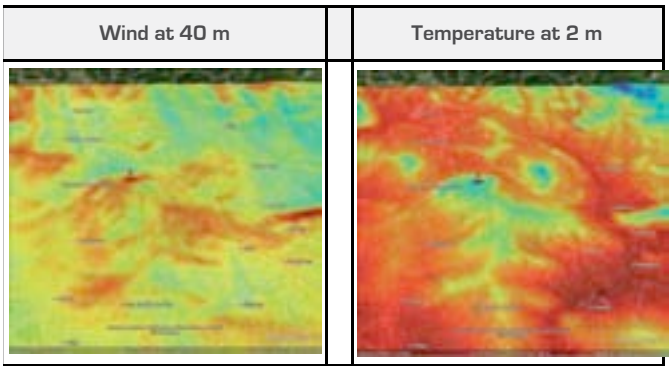
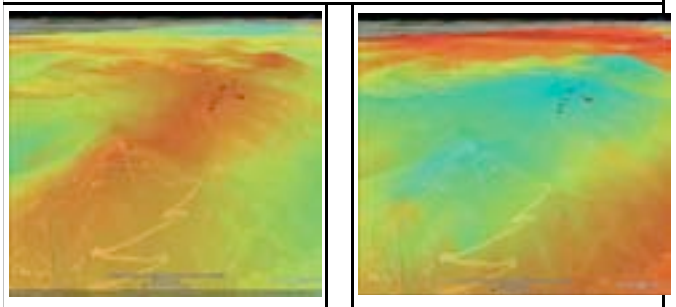


Figure 2: Wind Speed at 40 m (Left) and temperature at 2 m (Right) to the Sierra de Alaiz region.



Panoramic view of the wind at 40 m at the Alaiz-Las Balsas experimental wind farm (Left) and temperature at 2 m (Right).

1. Whenever it is available