

The National Renewable Energy Centre of Spain -CENER- is a technology centre specialized in applied research and development as well as the promotion of renewable energies. CENER is divided into six departments: Wind Energy, Photovoltaic Solar Energy, Solar Thermal Energy, Biomass Energy, Bioclimatic Architecture and Renewable Energy Grid Integration.

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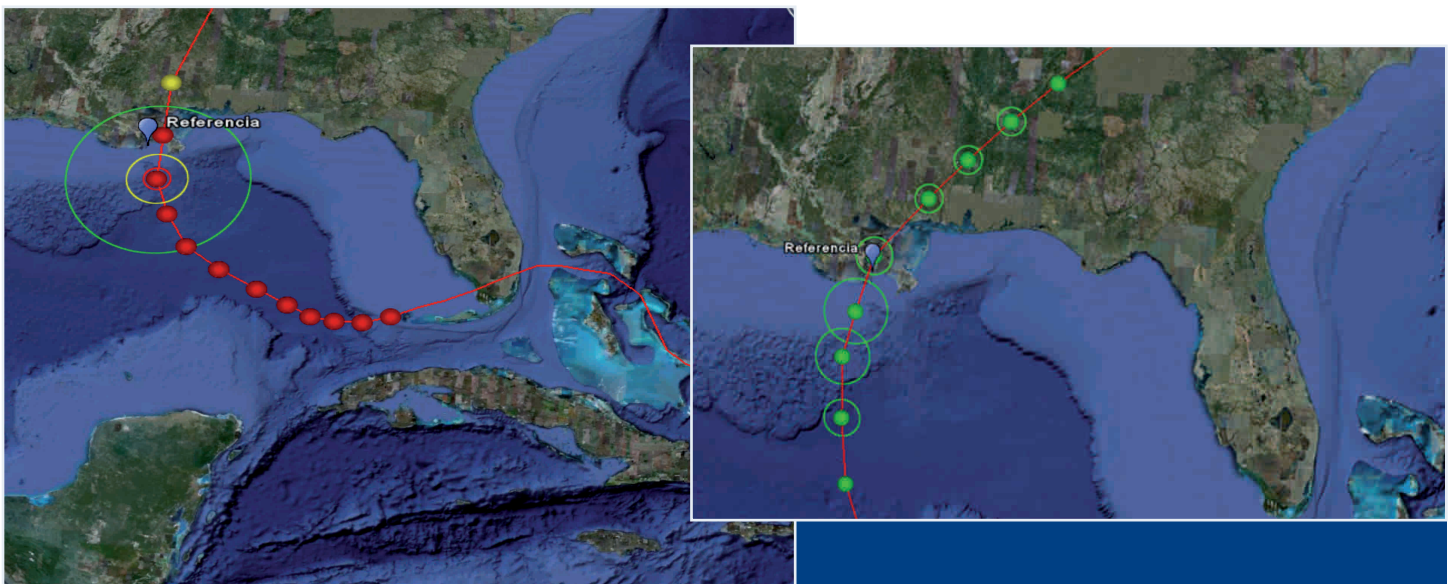


## ExWIND: CALCULATION OF EXTREME WIND SPEED PROBABILITY IN HURRICANE AREAS



CENER has developed an innovative methodology to calculate the probability of extreme winds in tropical areas affected by hurricanes and tropical storms: **ExWIND**. Traditional statistical methods for extreme wind speeds based on short periods of measurements are not valid in tropical areas where your measurement campaign could not represent properly the probability of extreme wind speeds. ExWIND methodology and software is based on existing databases of hurricanes and tropical storms paths and associated winds. After a selection of historic events that affected the area of interest a extrapolation of the registered extreme winds is done to the site of the wind farm; a time series of extremes for the wind farm site is build and finally a statistical treatment is applied to obtain the probability of extreme wind speeds at the site of the wind farm. All the calculations are done without local measurements.

- Probability of extreme wind speeds with a selectable recurrence period.
- All tropical areas are covered.
- No local measurements needed.
- Validation of the methodology possible if long-term wind speed measurements are available in the area of interest.



Visualization of hurricane paths and areas of influence

- Calculations based on databases with more than 150 years of records
- Risk reduction when exploring new countries in tropical areas
- A software with automatic reports, visualization of hurricane paths and areas of influence has been developed



### Cálculo de la probabilidad de impacto de ciclones:

Estimación basada en los últimos 153 años

Número de impactos de Tormenta Tropical	38
Probabilidad de impacto de 1 Tormenta Tropical	19.3744 %
Probabilidad de impacto de algun Tormenta Tropical	21.9926 %
Número de impactos de Huracan 1-2	5
Probabilidad de impacto de 1 Huracan 1-2	3.1629 %
Probabilidad de impacto de algun Huracan 1-2	3.2152 %
Número de impactos de Huracan 3-4-5	0
Probabilidad de impacto de 1 Huracan 3-4-5	0.0000 %
Probabilidad de impacto de algun Huracan 3-4-5	0.0000 %

Datos para el basemap:

5	FERN	29.500	-89.500	52.916	11.000	0.000	ID	Atlantico Norte
5	FERN	30.100	-89.600	72.525	11.000	0.000	ID	Atlantico Norte
6	FERN	30.300	-90.000	81.014	11.000	0.000	ID	Atlantico Norte
6	FERN	29.900	-90.300	44.393	11.000	0.000	ID	Atlantico Norte
6	FERN	29.500	-90.500	45.259	11.000	0.000	ID	Atlantico Norte
11	BOB	29.100	-90.600	75.313	30.000	986.000	H1	Atlantico Norte
31	JUAN	28.900	-90.300	78.446	25.000	980.000	TS	Atlantico Norte
31	JUAN	29.300	-89.100	95.991	28.000	978.000	TS	Atlantico Norte
8	BERYL	30.400	-90.300	95.367	11.000	1010.000	ID	Atlantico Norte
8	BERYL	29.700	-89.700	35.940	14.000	1009.000	ID	Atlantico Norte
8	BERYL	29.700	-89.400	63.629	16.000	1007.000	TS	Atlantico Norte
8	BERYL	29.400	-89.200	83.614	18.000	1005.000	TS	Atlantico Norte
9	BERYL	29.300	-89.100	95.991	21.000	1002.000	TS	Atlantico Norte
9	BERYL	29.600	-89.500	52.424	21.000	1001.000	TS	Atlantico Norte
9	BERYL	30.100	-90.400	68.280	21.000	1002.000	TS	Atlantico Norte
10	FLORENCE	29.700	-89.700	35.940	28.000	988.000	TS	Atlantico Norte
18	DANNY	28.900	-90.200	75.874	25.000	997.000	TS	Atlantico Norte
18	DANNY	29.200	-89.900	43.205	30.000	992.000	H1	Atlantico Norte
18	DANNY	29.500	-89.400	62.520	32.000	990.000	H1	Atlantico Norte
20	HERMINE	29.200	-90.900	93.014	16.000	1001.000	TS	Atlantico Norte
11	ALLISON	30.000	-90.500	65.194	16.000	1003.000	SS	Atlantico Norte
5	BERIHA	29.300	-89.200	86.824	16.000	1008.000	TS	Atlantico Norte
5	BERIHA	29.600	-89.700	33.108	16.000	1008.000	TS	Atlantico Norte
26	ISIDORE	29.100	-90.300	57.893	25.000	984.000	TS	Atlantico Norte
26	ISIDORE	30.000	-89.900	49.550	25.000	985.000	TS	Atlantico Norte
1	BILL	30.400	-90.300	95.367	21.000	998.000	TS	Atlantico Norte
10	MATTHEW	29.400	-90.900	85.505	14.000	1000.000	ID	Atlantico Norte
6	CINDY	29.600	-90.000	5.107	23.000	994.000	TS	Atlantico Norte
28	KATRINA	28.500	-89.600	43.350	51.000	923.000	H3	Atlantico Norte

### References:

- Correia P., Lozano S. Probabilistic forecast of extreme weather conditions: Determination of the cyclone impact probability. Proceedings of the European Wind Energy Conference 2009. Marseille (France)
- Powel, M.D., S.H. Houston, and T.A. Reinhold. Hurricane Andrew's Landfall in South Florida, Part I: Standardizing measurements for documentation of surface wind fields. Wea. Forecast. V.11, 1996