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One year of vertical wind profiles measurements at a Mediterranean coastal site of South Italy

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Abstract

To exploit wind energy both onshore and offshore in coastal area the effect of the coastal discontinuity is important. The shape of the vertical wind profiles and the related c parameter of the Weibull distribution are impacted by the atmospheric internal boundary layers developing from the coast along the wind direction. Here, we present first results: one year of vertical wind speed and direction profiles, monitoring programme at a South Mediterranean coastal site with a wind Lidar ZephIr (ltd). Daily variation of wind speed and direction vertical profiles, vertical Weibull wind distribution c parameter and wind rose are here showed.

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1. Introduction

The actual trend in developing specific new and advanced turbines for different operating conditions requires a deep analysis and understanding of the conditions in which a wind power plant will operate over its lifetime. The aim is to develop more cost-effective turbine designs in order to gain more wind energy with a longer lifetime and in specific operating environments.

This is the main reason why developing projects for wind farms need high quality databases under a wide range of atmospheric conditions or high resolution models that could resolve the effect of the coastal discontinuity in the surface properties.

New parametrizations are important and high quality databases are also needed for their formulation. Ground based remote sensing devices such as lidars in [1, 2] have been shown to be functional for studying the evolution of the vertical wind structure coastal atmospheric boundary layer both on- and offshore. Furthermore, concerning wind energy in [3, 4] detailed statistical analysis of Weibull distribution and parameter detection was conducted comparing/integrating wind measurement and forecasts.

Here, we present results from a unique dataset in the Mediterranean region, a year of vertical profiles of wind speed U and direction DIR, recorded at a site located in the Italian Calabria Region, Central Mediterranean area. We show the characterization of wind profiles for one year according to the time of the day to transition periods night/day and day/night classified relating the local scale, i.e. the breeze circulations, to the large scale conditions.

2. Experimental site and dataset

2.1. Experimental site

The experimental site is located in Calabria Region, at about 600m from the coastline at the west end of the only sea-to-sea valley around 30 km wide (the narrowest part of the region along west-east direction).

Calabrian region is a mountainous peninsula located at the southern tip of the Italian peninsula. It is about 50 km wide and elongated 300 km in the north south direction in the Central Mediterranean (Figure1). The experimental area is flat and at the end of a west-east valley (the Marcellinara gap) that crosses the peninsula acting as a connecting channel between the Tyrrhenian and Ionian seas and surrounded by mountains.

This location is a natural laboratory to study land-sea interaction in complex terrain. The coastal flow is characterised by the interaction between synoptic winds and sea-breeze circulation. The synoptic wind comes usually from the west [5, 6].

Furthermore, sea breeze and land breeze act in phase with upslope and down-slope winds to determine stronger and more persistent breeze system.

Fig. 1. Experimental site.