Perdigão

Coplanar Lidar Analysis Data Report

NCAR Earth Observing Laboratory

Carol Costanza and Joshua Gebauer

Version dated 1 November 2021

NATIONAL CENTER FOR ATMOSPHERIC RESEARCH
P.O. Box 3000
BOULDER, COLORADO 80307-3000

OVERVIEW

This document describes coplanar lidar analysis data derived from two German Aerospace Center (DLR) scanning lidars deployed during the Perdigão field project. In the event that information from this document is used for publication or presentation purposes, please provide appropriate acknowledgement to NSF and NCAR/EOL and make reference to the citation below.

Contacts:
Dataset Author: Carol Costanza, costanza@ucar.edu; Joshua Gebauer, jgebauer@ucar.edu
Data Manager: Carol Costanza
Data Report Contributor: Matthew Paulus

NCAR / Earth Observing Laboratory
P.O. Box 3000
3090 Center Green Drive
Boulder, CO 80301, USA

Websites:
Perdigão Homepage: https://www.eol.ucar.edu/node/11767
Perdigão data archive: https://data.eol.ucar.edu/master_lists/generated/perdigao/
DLR Operations at Perdigão: http://www.pa.op.dlr.de/PERDIGAO2017/index.html
Perdigão Field Catalog: http://catalog.eol.ucar.edu/perdigao/

Dataset Version Control:

Version	Date	Author	Change Description	Data Status
1.0	1 Nov. 2021	C. Costanza	Initial Release	Final

Citations:
If these data are used for research resulting in publication, please acknowledge EOL and NSF and include the following citation in your paper as appropriate:

- Costanza, C., Gebauer, J. 2021. Perdigao: Coplanar Lidar Analysis Data. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.26023/2T1J-W8KJ-N60D. *Access date should be included in the citation.*

DATASET DESCRIPTION

Perdigão was a large-scale, multi-national, multi-agency field campaign conducted in and around a valley formed by a double ridge outside of the town of Perdigão, Portugal. Operations were centered in Alvaiade. Participating institutions included the University of Porto, Denmark Technical University, the Portuguese Institute for Sea and Atmosphere (IPMA), the German Aerospace Center (DLR), the National Science Foundation (NSF), University of Notre Dame, University of Colorado at Boulder, University of Oklahoma, Cornell University, University of California at Berkeley, and the U.S. Army Research Lab. The primary goal of the field campaign was to study boundary layer flows over two parallel mountain ridges in order to improve the understanding of turbulent processes and numerical modelling capabilities of winds, turbulence, and boundary layer structure over complex terrain. The DLR deployed three Leosphere Windcube 200S scanning lidars located at 7°43′52.12″W 39°42′52.31″N, 7°44′48.49″W 39°42′35.50″N, and 7°44′6.41″W 39°42′44.83″N (Figure 1).

Figure 1. Satellite map of double ridge (yellow lines) making up the Perdigão project domain. The locations of the three DLR scanning lidars are shown in blue balloon icons.

The data used for the coplanar analysis was obtained from the University of Porto Perdigao Field Experiment archive (re3data.org), covering the Intensive Operations Period (IOP) between 1 May and 15 June 2017. Some days in this period were not suitable for coplanar analysis and

are therefore omitted. Table 1 below (Wildmann 2018) shows the lidar parameters generally used during this period.

Lidar Parameter	
Physical resolution	25 m
Range gate spacing	10 m
Angular resolution	0.5° / 1°
Accumulation time	500 ms
RHI duration	1-2 min
Averaging interval	5 min

General Technical Specifications for Windcube Lidars:

https://www.vaisala.com/sites/default/files/documents/WEA-ERG-ProductSpotlight-WindCubeScan-B211907EN-A_0.pdf

DATA PROCESSING

Data was collected by DLR across three wind lidars. Only the DLR85 and DLR86 lidars final netCDF files were used for this coplanar analysis. These were the two lidars at the tops of the west and east ridges of the valley. Generally, grids of both RHI scans from each lidar are first created. Then those grids are used for the coplanar analysis where azimuth and elevation angles and radial velocities are mapped where there are two data points in the same grid box. First, a filter of cnr<-25 and cnr>-7 is done to filter out radial velocity with poor signal. Then a system of linear equations is solved to get the ‘u’ and ‘w’ values in the grid box, where ‘u’ is the wind velocity along the RHI scans, and ‘w’ is the vertical wind velocity component. Thus, you get the 2D wind field along the RHI scan and vertically (Figure 2). Finally, the uncertainties are calculated for ‘u’ and ‘w’.

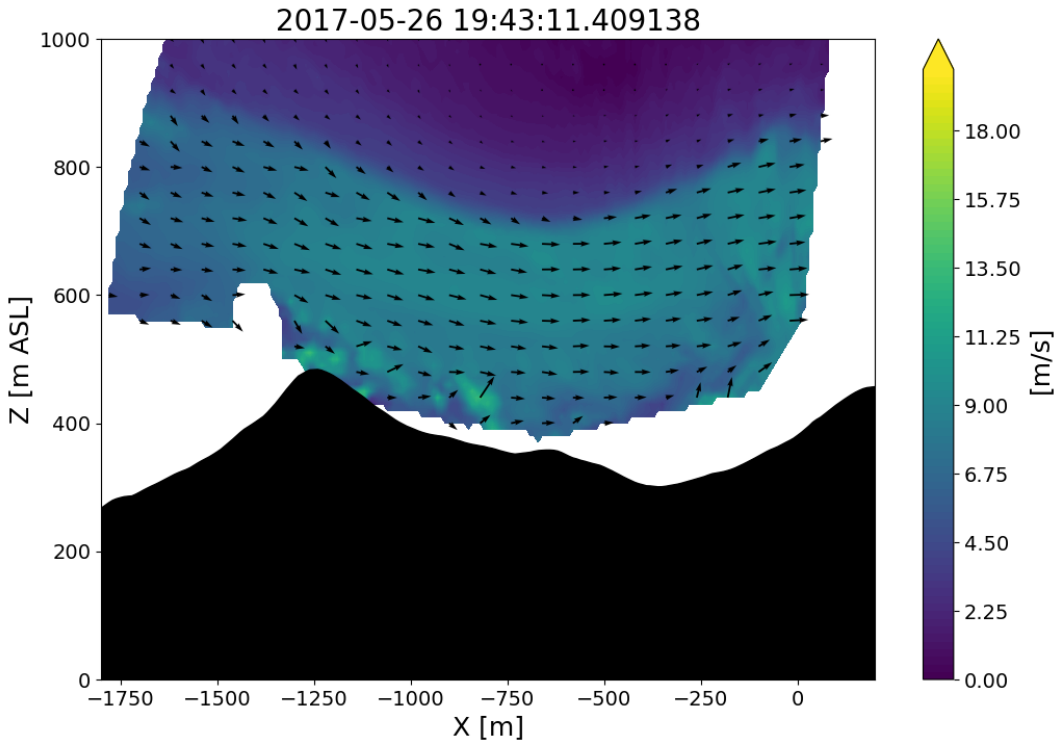

Figure 2. Plot of Coplanar winds where wind barbs represent the ‘u’ and ‘w’ wind across the valley. Winds are in units of m/s.

DATA FORMAT

These data are available in the form of daily NetCDF files. The file names include the date in the YYYYMMDD format. NaNs are marked for missing or poor quality data. An example of a file header is shown in Figure 3 below.

```
netcdf coplanar_20170519 {
dimensions:
        x = 351 ;
        z = 301 ;
        time = 699 ;
variables:
        double base_time ;
                base_time:long_name = "Epoch time" ;
                base_time:units = "s since 1970/01/01 00:00:00 UTC" ;
        double time_offset(time) ;
                time_offset:long_name = "Time offset from base time" ;
                time_offset:units = "s from base time" ;
        double u(time, z, x) ;
```

```
                u:long_name = "Horizontal coplanar wind" ;
                u:units = "m/s" ;
        double w(time, z, x) ;
                w:long_name = "Vertical coplanar wind" ;
                w:units = "m/s" ;
        double u_uncertainty(z, x) ;
                u_uncertainty:long_name = "Uncertainty in u-wind retrieval" ;
                u_uncertainty:units = "m/s" ;
        double w_uncertainty(z, x) ;
                w_uncertainty:long_name = "Uncertainty in w-wind retrieval" ;
                w_uncertainty:units = "m/s" ;
        double x_coord(z, x) ;
                x_coord:long_name = "x coordinate from Lidar 1 position" ;
                x_coord:units = "m" ;
        double z_coord(z, x) ;
                z_coord:long_name = "z coordinate from sea level" ;
                z_coord:units = "m ASL" ;

// global attributes:
                :_NCProperties = "version=2,netcdf=4.7.3,hdf5=1.10.4" ;
                :lidar1_lat = 39.7145302036377 ;
                :lidar1_lon = -7.73114488551366 ;
                :lidar1_alt = 458.2 ;
                :lidar2_lat = 39.7124520296182 ;
                :lidar2_lon = -7.73511385290554 ;
                :lidar2_alt = 323.2 ;
}
```

Figure 3. Coplanar DLR lidar analysis final netCDF header with dimensions, variables, and units

DATA REMARKS

Data available for the following days:

May 2017 days - 03,04,05,07,08,09,10,11,12,13,16,17,19,20,21,22,23,25,26,27,29,30

June 2017 days - 07,11,12

REFERENCES

re3data.org: Perdigao Field Experiment; editing status 2020-03-20; re3data.org - Registry of Research Data Repositories. http://doi.org/10.17616/R31NJMN4 last accessed: 2021-02-01

Wildmann, N., Vasiljevic, N., and Gerz, T.: Wind turbine wake measurements with automatically adjusting scanning trajectories in a multi-Doppler lidar setup, Atmos. Meas. Tech., 11, 3801–3814, https://doi.org/10.5194/amt-11-3801-2018, 2018.