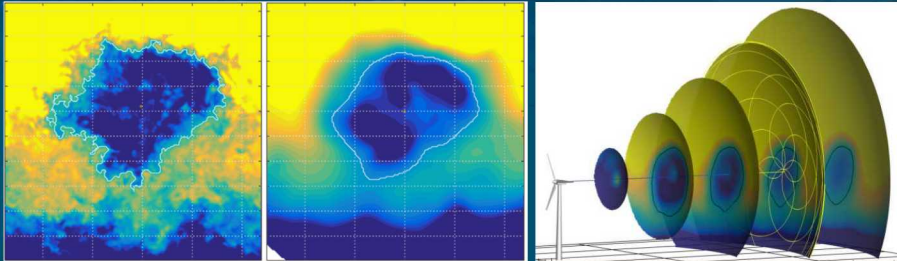


SAND2019-6827C

Tutorial on How to Use the SWiFT Facility Data Archive and Portal Data



PRESENTED BY

Alan Hsieh, Tommy Herges,
David Maniaci, and Brian Naughton
Wind Energy Science Conference 2019:
2019-06-20

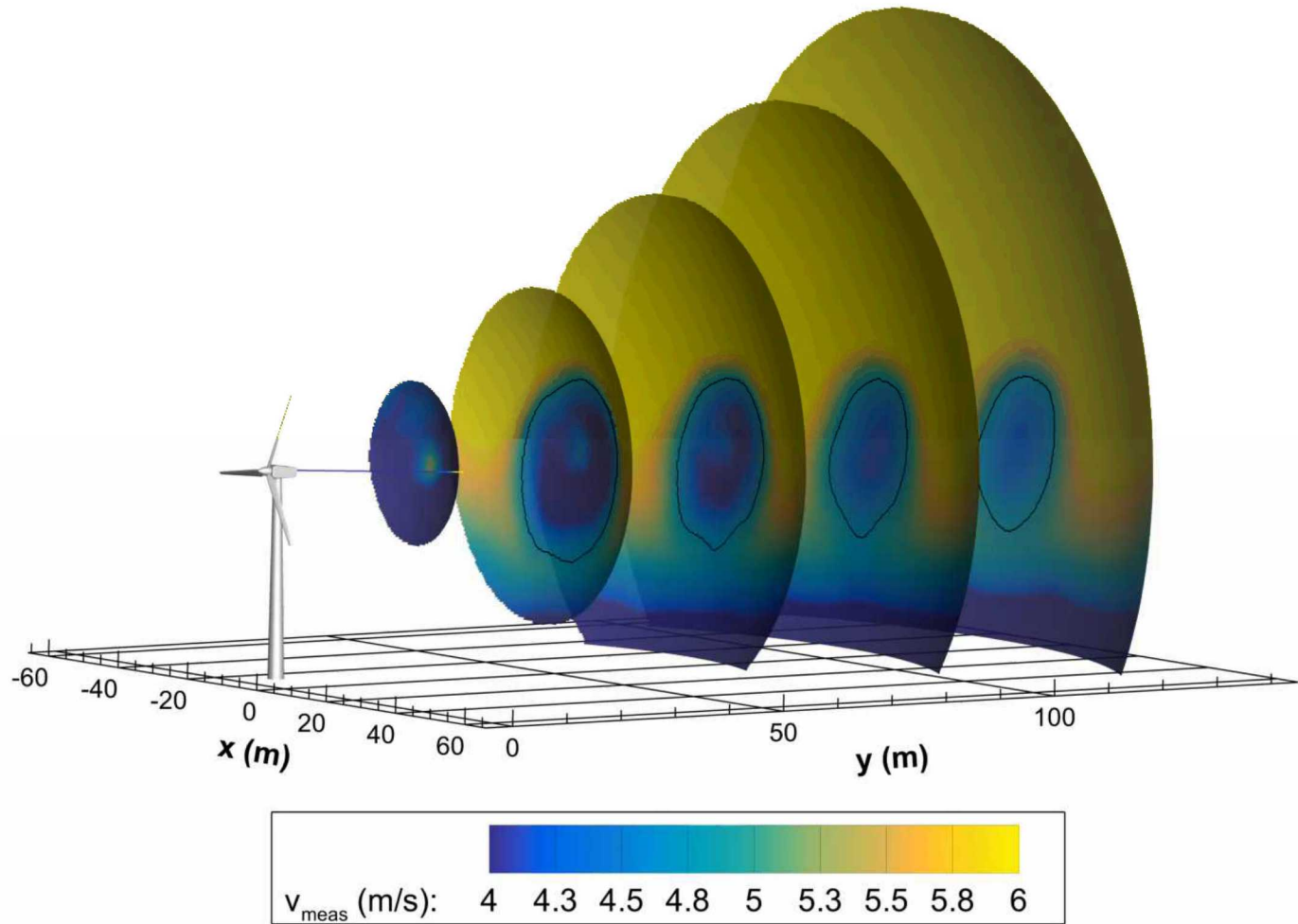
SAND2019-#### C

Funded by DOE Wind Energy
Technologies Office

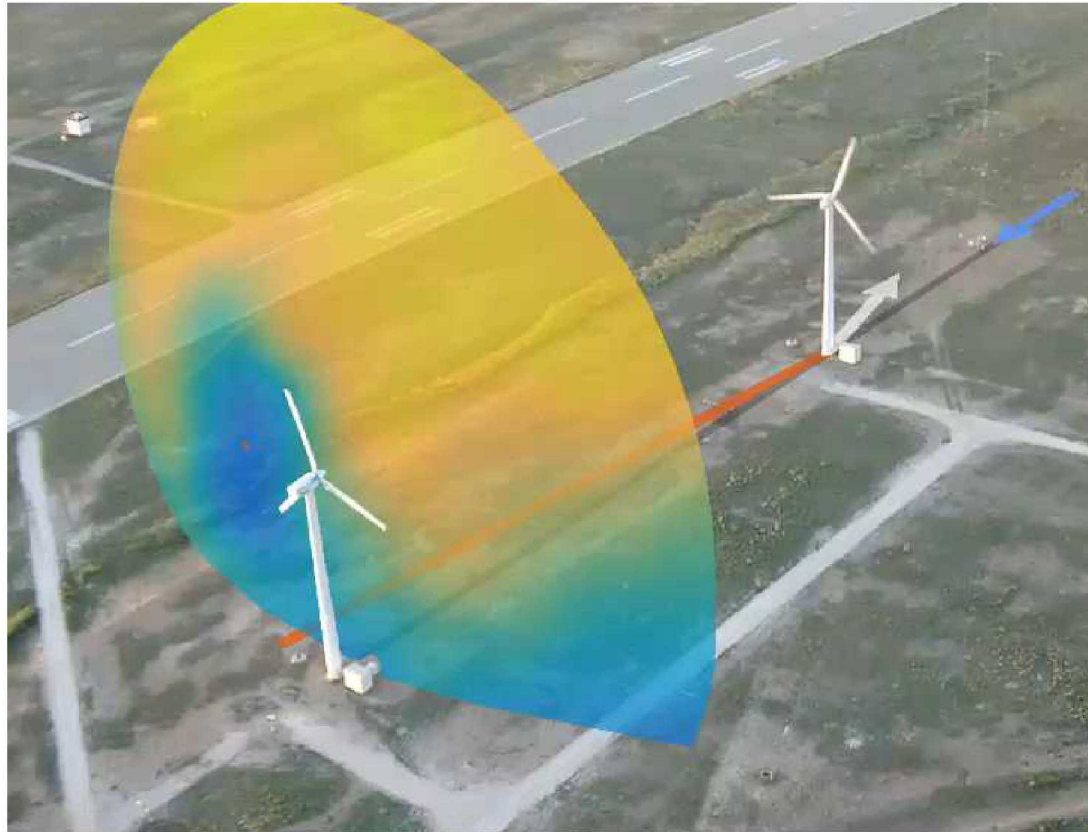
Introduction

- DOE WETO undertaking large verification and validation effort of high-fidelity models to improve modeling of wind turbine wakes
- High-quality measurements of wind turbine wakes required for validation
- DOE SNL/SWiFT facility is a unique open wind plant test site for studying wind turbine wakes and turbine-turbine interactions
- DTU SpinnerLidar capable of capturing wake at high spatial and temporal resolutions
- SpinnerLidar data released on DOE Atmosphere to Electors (A2e) Data Archive Portal (DAP)
- Data was quality controlled and quality assured:
 - Herges, T. and Keyantuo, P., Robust Lidar Data Processing and Quality Control Methods Developed for the SWiFT Wake Steering Experiment, Wake Conference 2019
- Discuss how to navigate DAP, sort lidar data, download
 - Navigate DAP webpage
 - Sort lidar data and download
 - Lidar data structure
 - Examples of what can be done with the data

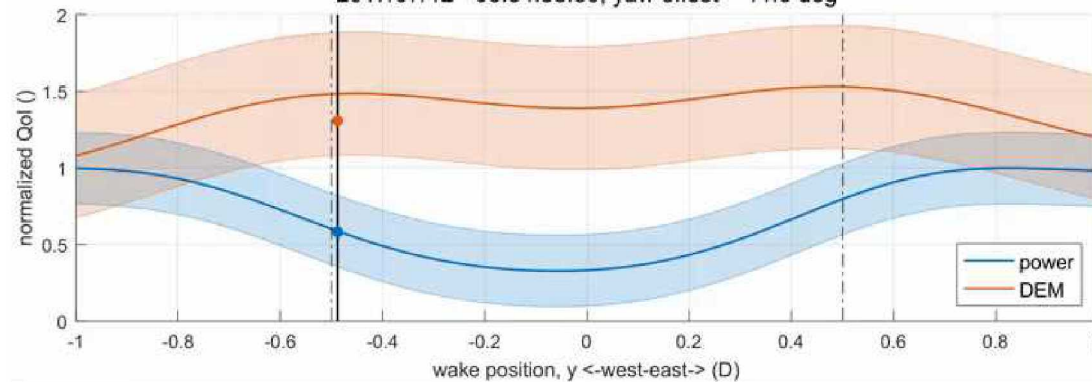
DTU SpinnerLidar Scan Pattern



DTU SpinnerLidar at SWiFT Facility



2017/07/12 - 06:54:38.80, yaw offset = 11.6 deg



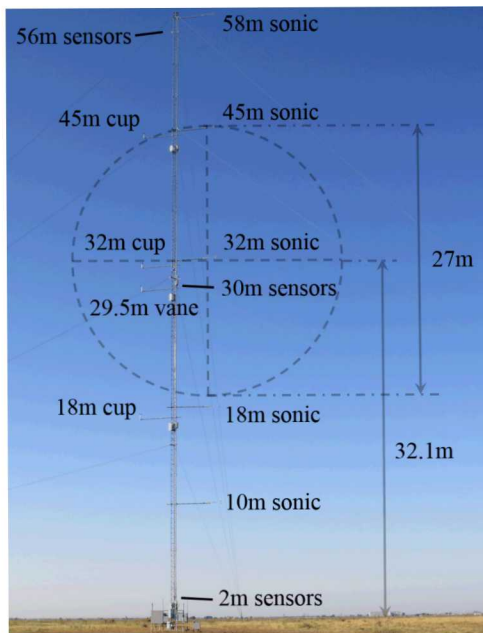
SWiFT Facility Overview

SWiFT facility created to:

- Measure wind plant flows and turbine-turbine interactions
- Perform prototype testing of innovative rotor technology

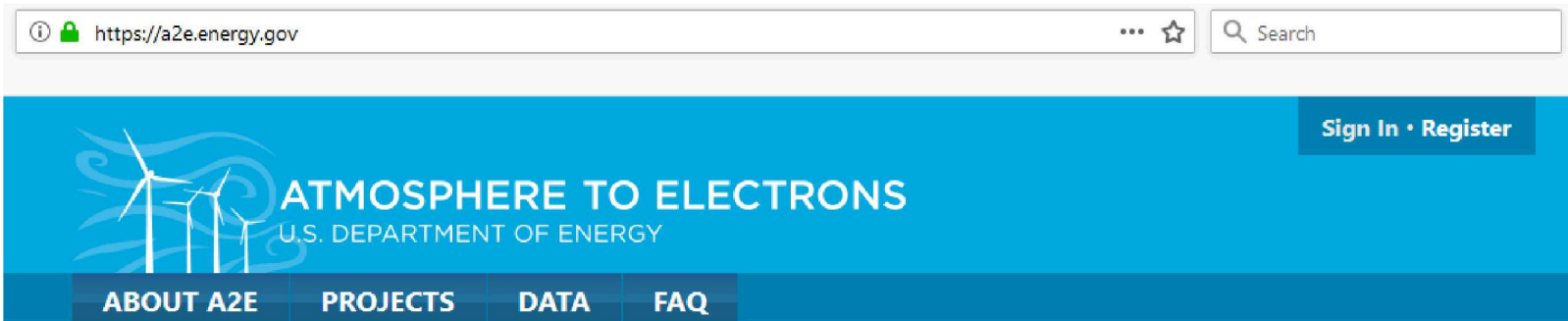
Wake steering experiment sought to quantify wake deflection vs. yaw offset and the corresponding effects on a two-turbine system

- Characterize wake shape, velocity deficit, turbulence, and dynamics under various conditions



A2e Data Archive Portal

- A2e Data and projects located at:



- Description of different A2e projects located under the Projects tab
 - SWiFT facility wake data is under the Wake project discription

WAKE

Wake Steering Experiment

Planned for May through September 2016, Sandia National Laboratories and the National Renewable Energy Laboratory will execute a joint experimental campaign examining wind farm control at the Scaled Wind Farm Technology (SWiFT) facility, hosted at Texas Tech University in Lubbock, Texas. The experimental campaign will be conducted in two phases. In Phase I, an Offset Controller (OC) will be applied to the upwind wind turbine. This controller applies an offset to a nacelle-based wind direction sensor used for aligning the turbine to the wind direction to achieve a prescribed misalignment to the wind. In Phase II, the controller will be replaced by a Wake Steering Controller (WSC) that uses a look-up table based on the FLOW Redirection and Induction in Steady-state (FLORIS) model to find offsets that produce a desired amount of wake steering. The data collected during both phases will be used to perform initial verification and validation studies on controls-oriented models, such as FLORIS, as well as higher-fidelity wind plant analysis models, such as Simulator fOR Wind Farm Applications (SOWFA). Target data include inflow, wake, and turbine performance and loads.

[Read More »](#)

A2e Wake Steering Experiment Project Page

<https://a2e.energy.gov/projects/wake>



Search

WAKE

Wake Steering Experiment

Overview

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Primary Contact(s)

Brian Naughton

Sandia National Laboratories

Scott Schreck

NREL



3

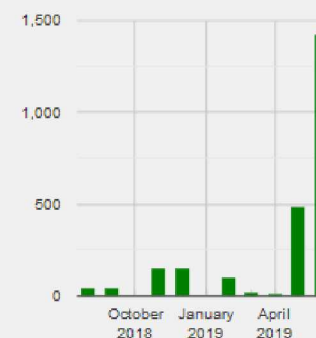
Datasets



1.5 K

Files Stored

Downloaded File Count



Accessing Data

- Data is located under **Browse Data** or under the **Data** tab at the top of the page next to the Projects tab

Objective

This experimental campaign at SWIFT aims to demonstrate the capability of wake steering control to improve total wind turbine array power production. In addition, the public dataset produced by this project will be available to perform preliminary verification and validation studies on computational models, including FLORIS and SOWFA.

Instruments

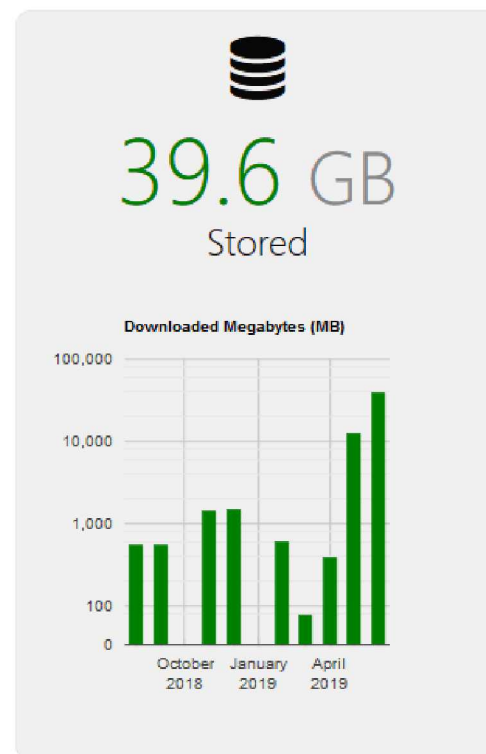
Primary:

SWiFT wind turbine. The upwind SWiFT turbine known as (WTGa1) will be the primary instrumented research turbine to collect power and loads data.

SWiFT met towers. Two upwind SWiFT meteorological towers (METa1 and METb1) will collect inflow data.

DTU SpinnerLidar. A customized research scanning lidar from the Technical University of Denmark, installed in the upwind turbine nacelle (cover housing the turbine's generating components) and facing downwind, will characterize the wake.

External Resource: <http://swift.sandia.gov> 



 Browse Data

Accessing Data

- Data page shows the three data assets: SpinnerLidar, turbine, and met data
- Must create account and sign in to request data

Data can be downloaded after [signing in](#) and using the **Request Data** button on individual dataset pages found below.

NOTE: proprietary or otherwise restricted data will *only* be visible/accessible to authorized users who have [signed in](#).

Visualization

Search ...

Project

wfip2 205

uae6 30

xpia 26

wfip1 22

mmc 16

cwp 12

buoy 4

wake 3

wake 3

impowr 2

lees 1

3 dataset(s)

Project: wake X Clear all filters

wake / lidar.z01.b0

Lidar • DTU SpinnerLidar • Reviewed Data

★ 1,428 files • 39 GB • mat • Updated 2 months ago

wake / turbine.z01.b0

Wind Turbine • SWiFT southeast - WTGa1 • Reviewed Data

★ 17 files • 7 MB • mat • Updated 2 years ago

wake / met.z01.b0

Surface Meteorological Station • SWiFT southwest • Reviewed Data

★ 17 files • 199 MB • mat • Updated 2 years ago

Date Range

2016-12-16 → 2017-07-11

wake / lidar.z01.b0

Lidar • DTU SpinnerLidar • Reviewed Data

Purpose

Scaled Wind Farm Technology (SWiFT) Facility meteorological tower (MET), turbine, and Technical University of Denmark (DTU) SpinnerLidar data acquired on 20161216 UTC during a neutral atmospheric boundary layer inflow at a single focus distance of 2.5 D (D=27 m).

Data Quality

Data information is provided in uploaded documentation: *SWiFT Wake Steering Instrumentation and Data Processing* (PDF).

Data Summary & Access

Project

wake

Dataset Name

lidar.z01.b0

File Type(s)

mat

File Count

1,428

Total Size

39 GB

Start Date

2016 12 16

End Date

2017 07 11

Last updated 1 month ago.

Request Data

Please [sign in](#) to request data.

Request Data Range and Download Method

- Specify the date range for data of interest
- Spread sheet of 10 min bin characteristics will be provided to search for data cases of interest

wake/lidar.z01.b0
Data Request

Before downloading data you must submit a request for it. This is necessary since some data is archived on tape, and is not immediately available. Once your request has been processed, the data will be available to download on the [data orders page](#).

Select Files

Search for files by date, and then select files to include in the request. The date search is based on the date found in file names, and a file may contain data beyond the day indicated by its name. **This dataset goes from 2016-12-16 to 2017-07-11.**

2017-07-07 → 2017-07-08 Search for Files

82 files (2 GB) found between 2017-07-07 and 2017-07-08

File Type Name contains: Search by filename

<input checked="" type="checkbox"/>	Filename	File Type	File Size	Date
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.024000.mat	mat	16MB	2017-07-07 at 02:40 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.025000.mat	mat	26MB	2017-07-07 at 02:50 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.030000.mat	mat	27MB	2017-07-07 at 03:00 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.031000.mat	mat	24MB	2017-07-07 at 03:10 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.032000.mat	mat	27MB	2017-07-07 at 03:20 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.033000.mat	mat	25MB	2017-07-07 at 03:30 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.034000.mat	mat	25MB	2017-07-07 at 03:40 AM
<input checked="" type="checkbox"/>	lidar.z01.b0.20170707.035000.mat	mat	26MB	2017-07-07 at 03:50 AM

- Check data files for data request
- Follow link to **My Orders**
- Select download method
- Suggested citation provided for use of data

ABOUT A2E PROJECTS DATA FAQ

A2E / MY PROFILE / MY ORDERS / ORDER DETAILS

Dataset
wake/lidar.z01.b0

Date Range
2017 07 07 2017 07 07

File Count / Size
10 file(s) 246 MB

Citation
Click to select all
Atmosphere to Electrons (A2e). 2017. wake/lidar.z01.b0. Maintained by A2e Data Archive and Portal for U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. DOI: 10.21947/1349890. Accessed: 14 Jun 2019.

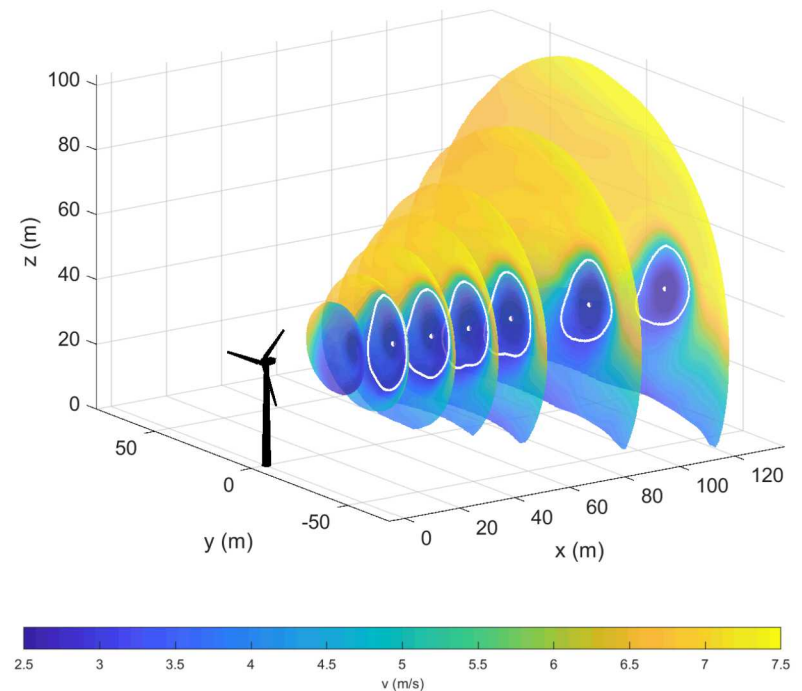
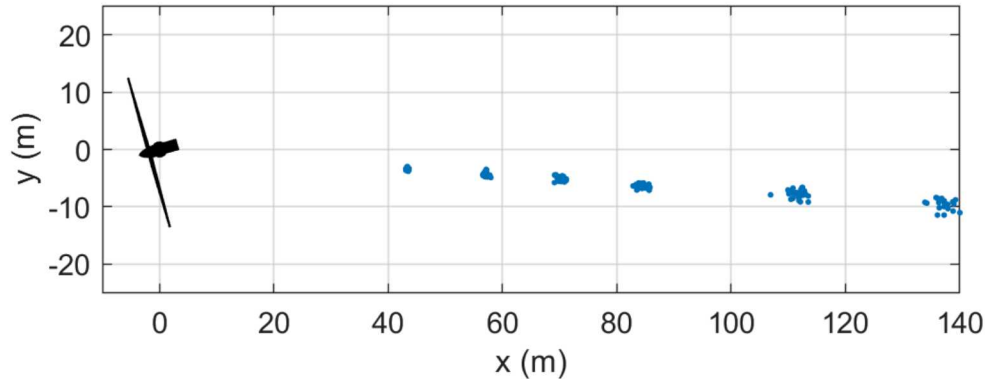
How would you like to download the data?

File Links Zip Script SFTP

Downloading ... 7% 6.74 MB/s a few seconds Cancel

Examples of How the Data Can be Used

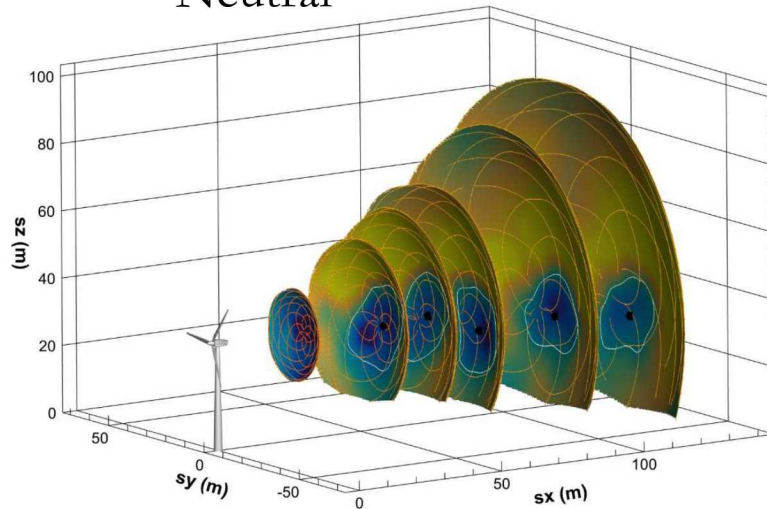
- Example file from 2017-07-08 at 07:40:00 UTC
 - 15.9° yaw offset with 6.2 m/s wind speed at low TI of 0.03
 - Shows wake deflection of the wake from 1.5D to 5D
 - Wake position has little fluctuation due to low TI inflow
 - Average wake position over 10 min file
 - Wake outlined to match the area of the rotor



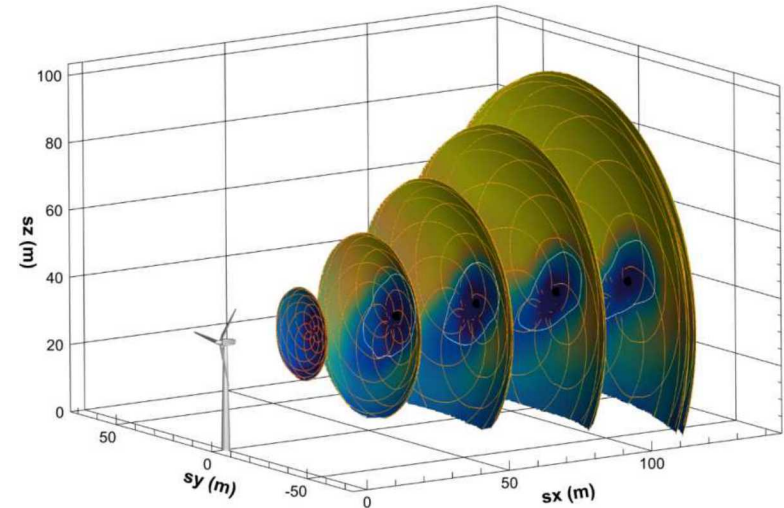
Examples of How the Data Can be Used

- Look at impact of inflow on wake shape

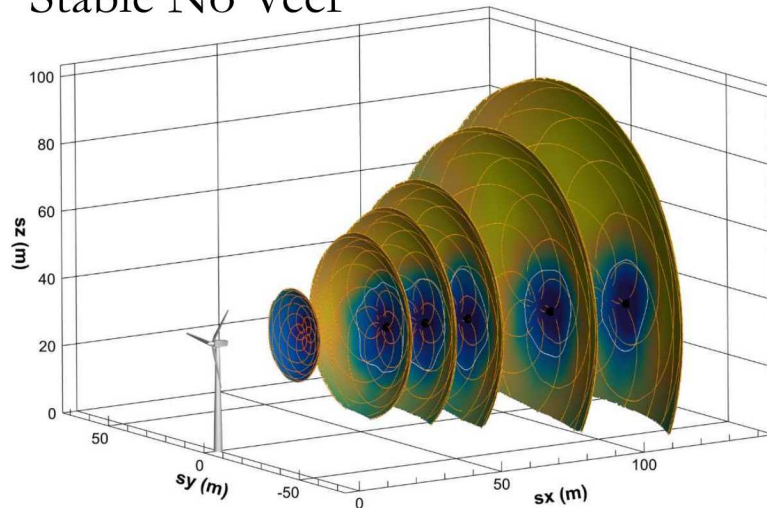
Neutral



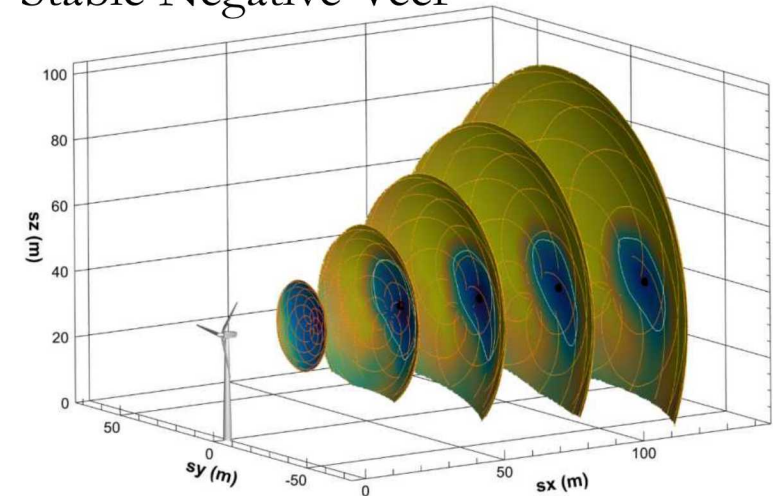
Stable Positive Veer



Stable No Veer

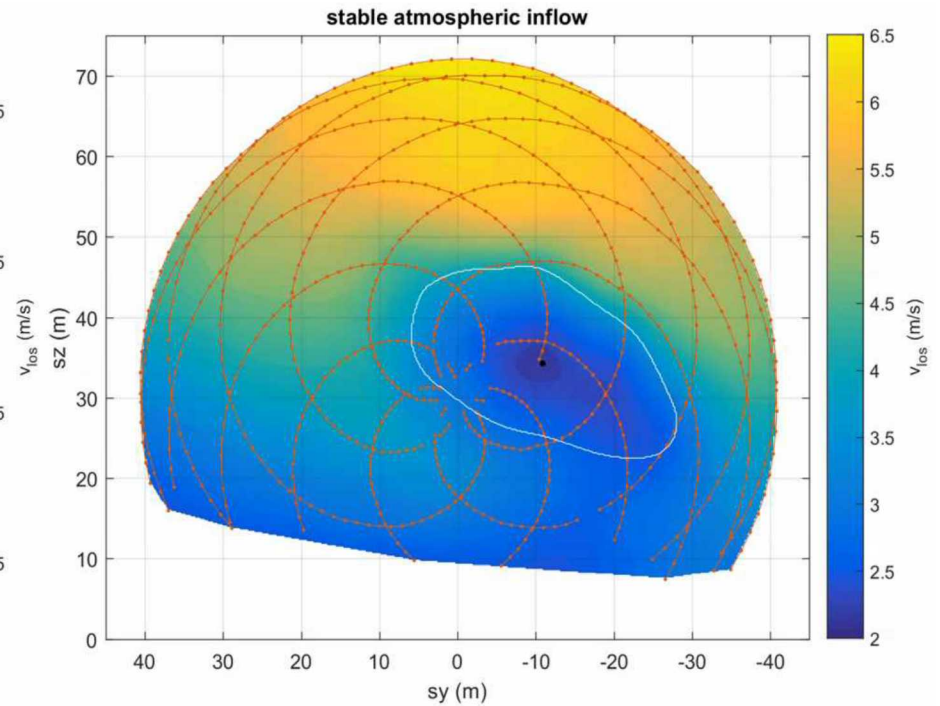
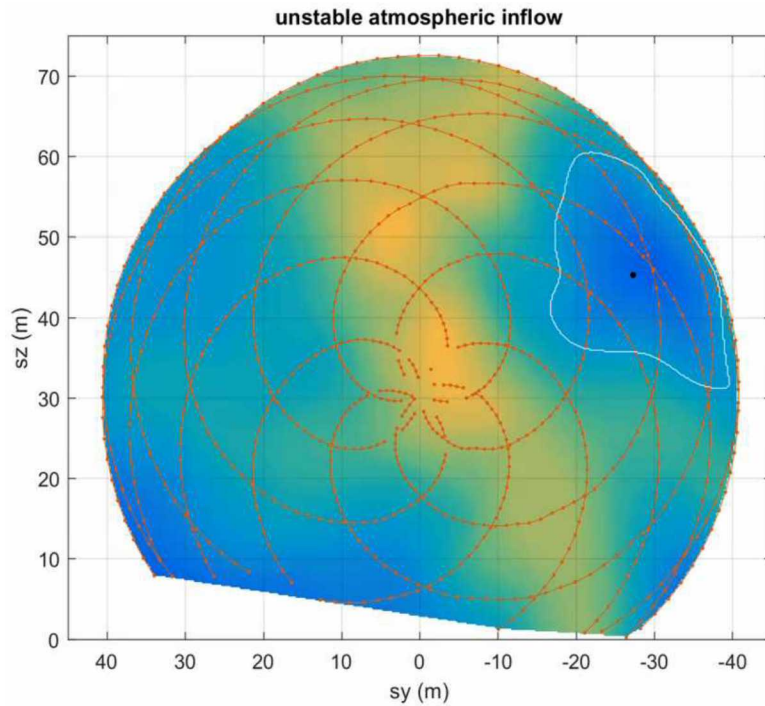


Stable Negative Veer



Examples of How the Data Can be Used

- Look at impact of inflow on wake position fluctuations



Conclusion

- SWiFT wake steering experiment complete with quality met, turbine, and lidar wake data
- Data has been quality controlled and quality assured
- Fully open source turbine and Fast models available
- Data released for open use
- Wake data currently being used as part of the IEA Task 31 WakeBench SWiFT benchmark
- All SWiFT facility Wake Steering lidar data is currently available on DAP
 - Additional documentation to be added along with met and turbine data
 - 10 min bin database will be added shortly

The complete Wake Steering SpinnerLidar dataset available for download at a2e.energy.gov

Questions?

Thanks!