Turbulence Measurement in Strangford Narrows

Queen's University Belfast

Dr Penny Jeffcoate

Dr Pal Schmitt

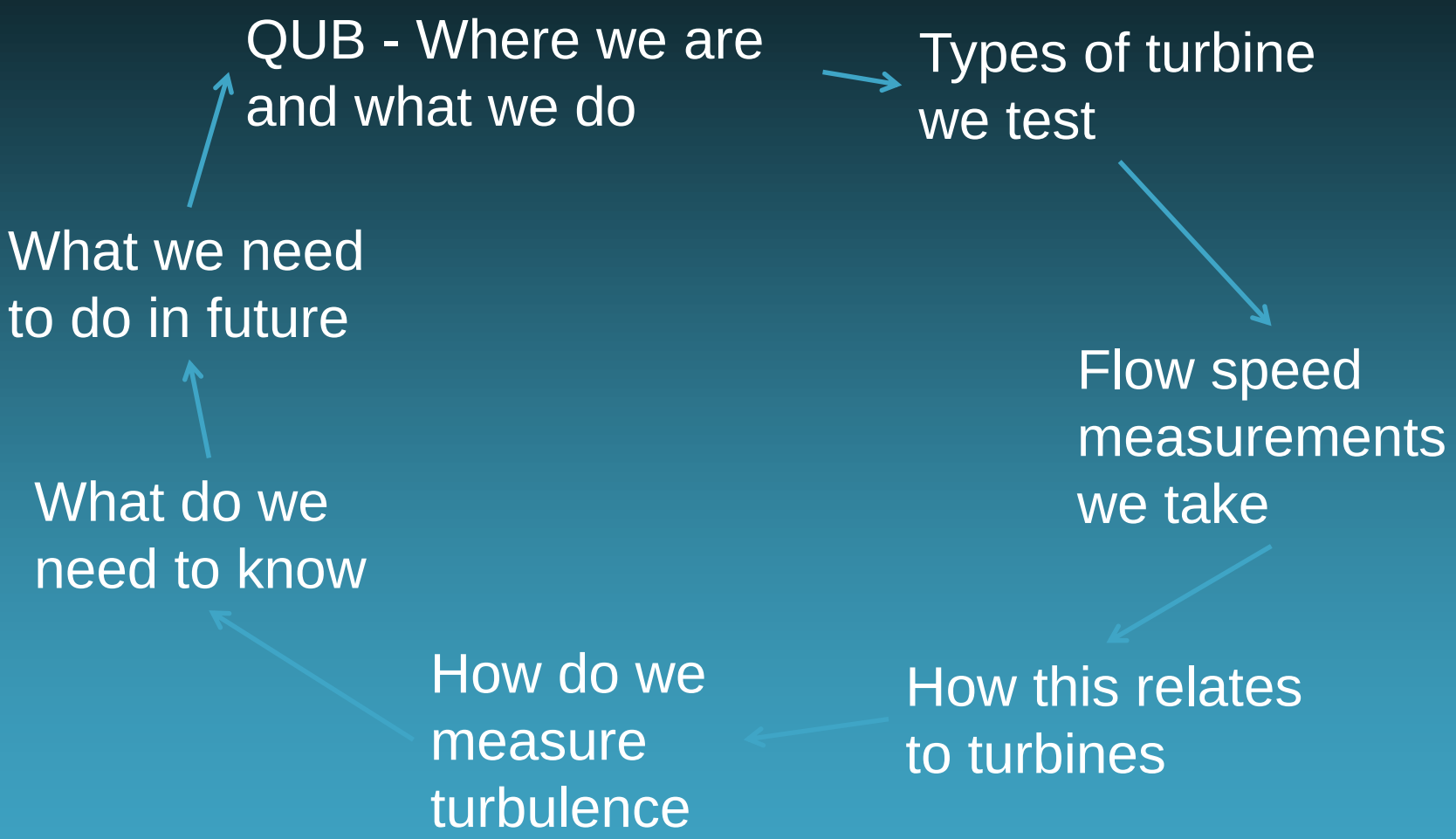
Dr Björn Elsässer

Hanna Torrens-Spence

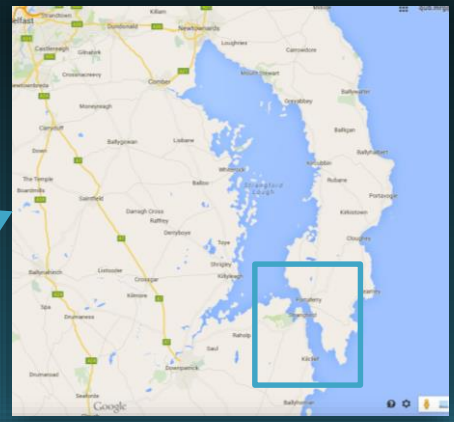
SPACE

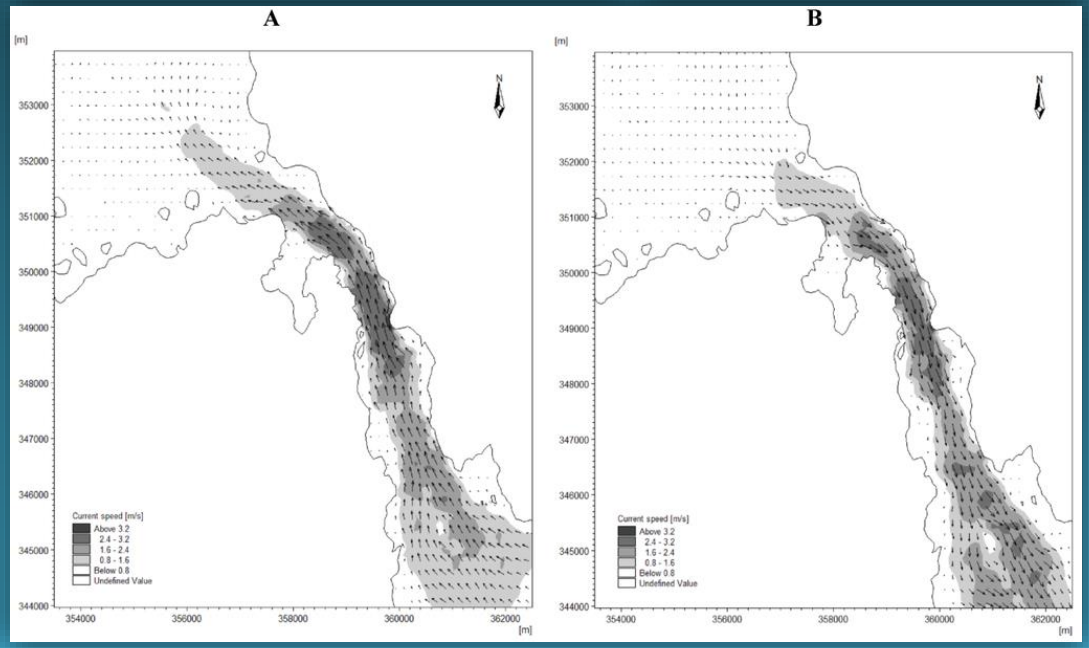
SCHOOL OF Planning Architecture & Civil Engineering

Content


QUB - Where we are and what we do
Types of turbine we test
Flow speed measurements we take
How this relates to turbines
How do we measure turbulence
What do we need to know
What we need to do in future

QUB Test Site





Tidal Turbine Testing

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SeaGen - MCT

Evopod – Oceanflow Energy

STG - Schottel

DeepGreen - Minesto

Flow Measurement Methods

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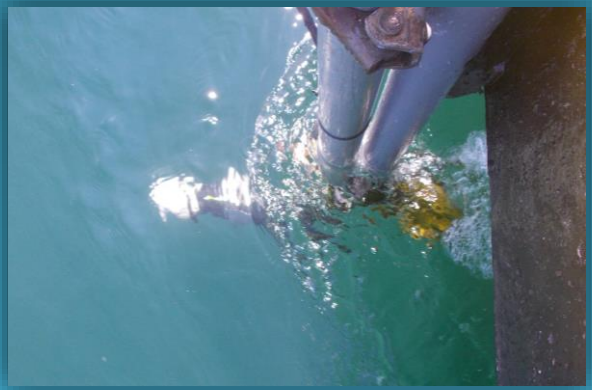
Aquadopp

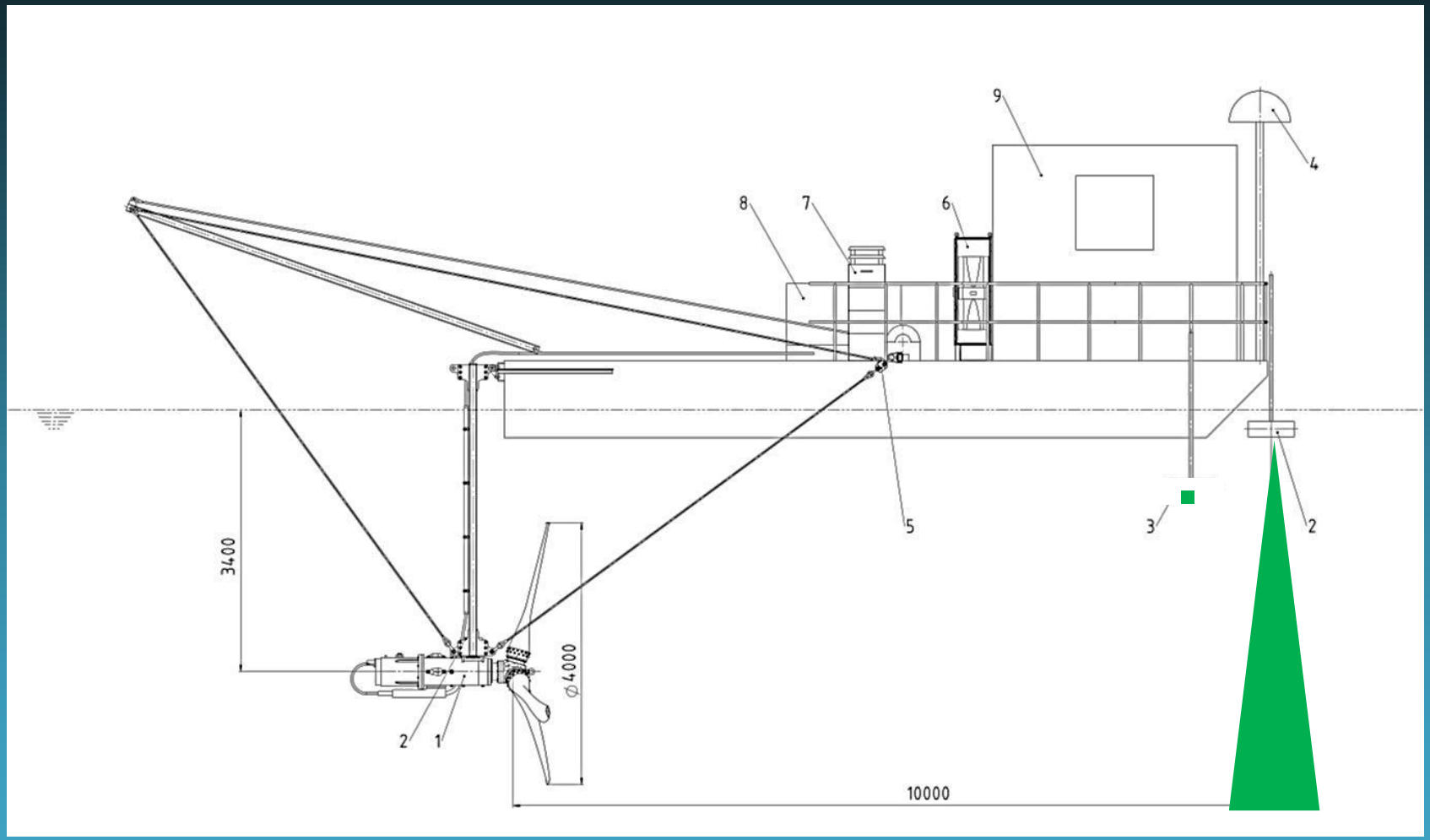
- 3-D measurement over full channel profile
- Averaged over bin, rotor, time
- Good for indication of full flow at location
- Used for inflow quantification for turbine
- Limited by averaging area

Vector

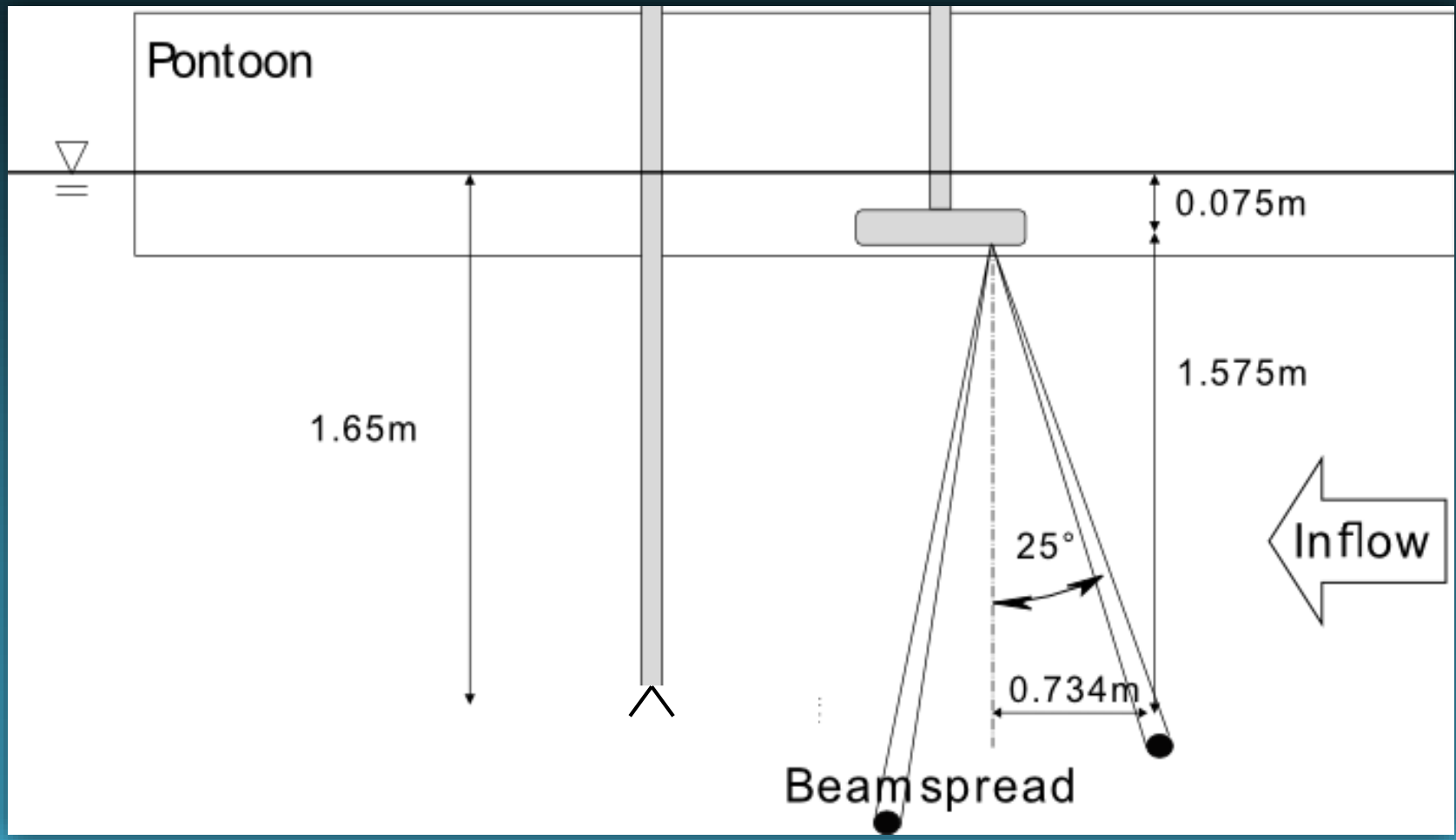
- 3-D point measurement
- Averaged over time
- Good for high frequency and accuracy
- Limited by area of sample
- Limited by mounting method



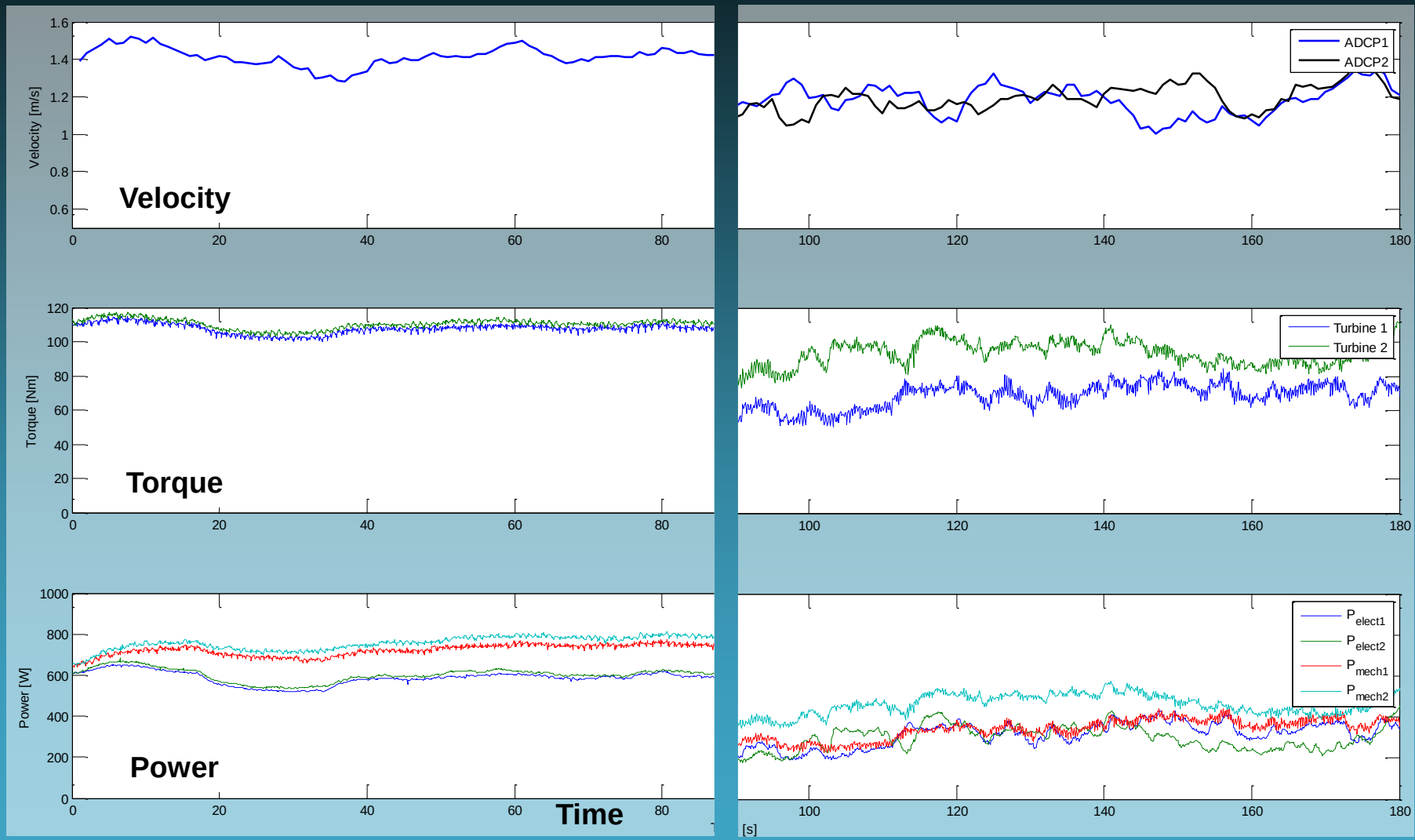
Flow Measurement Methods



Turbulence Measurement Methods



Comparative time traces



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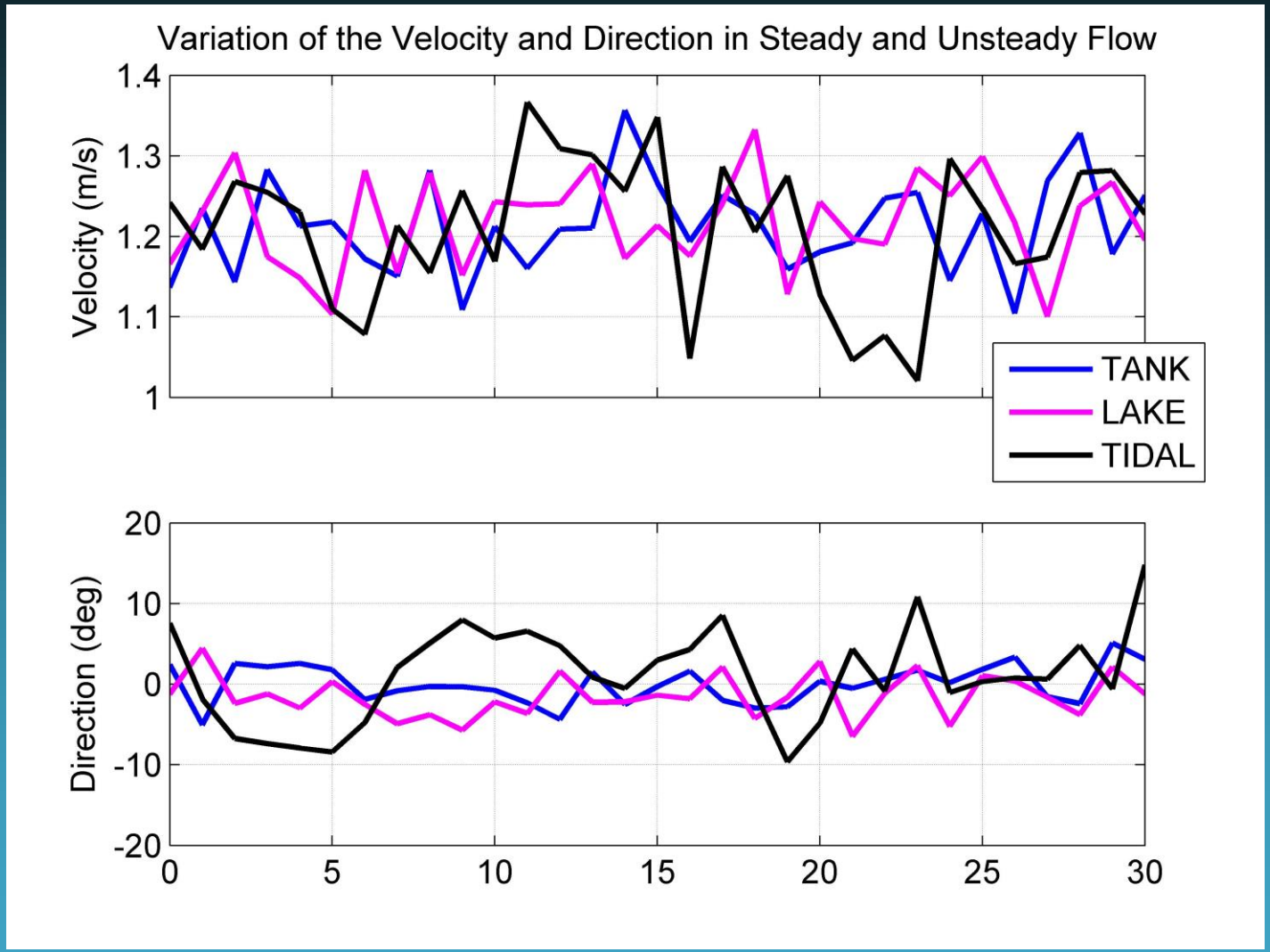

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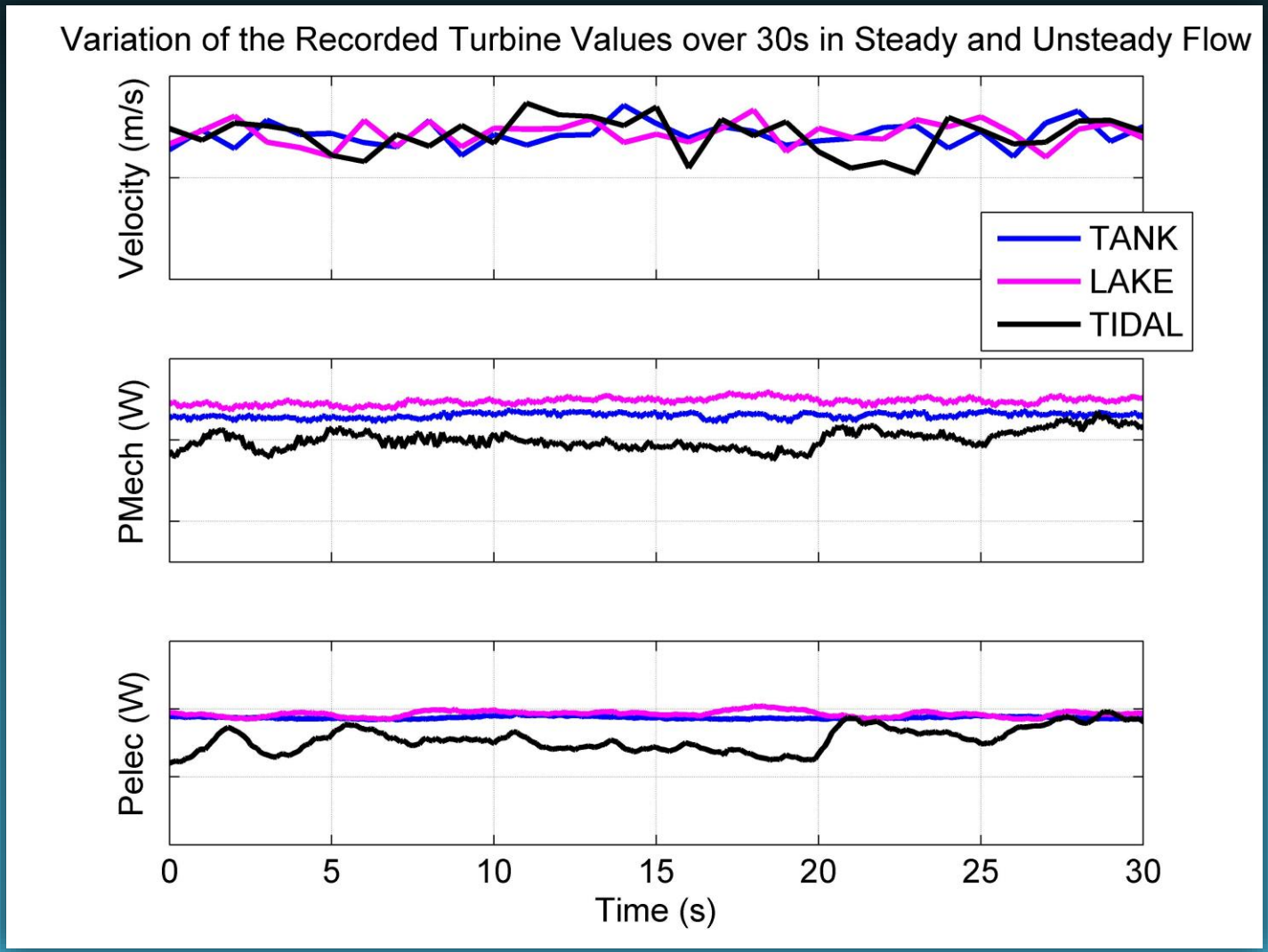

Turbulence Measurement Results

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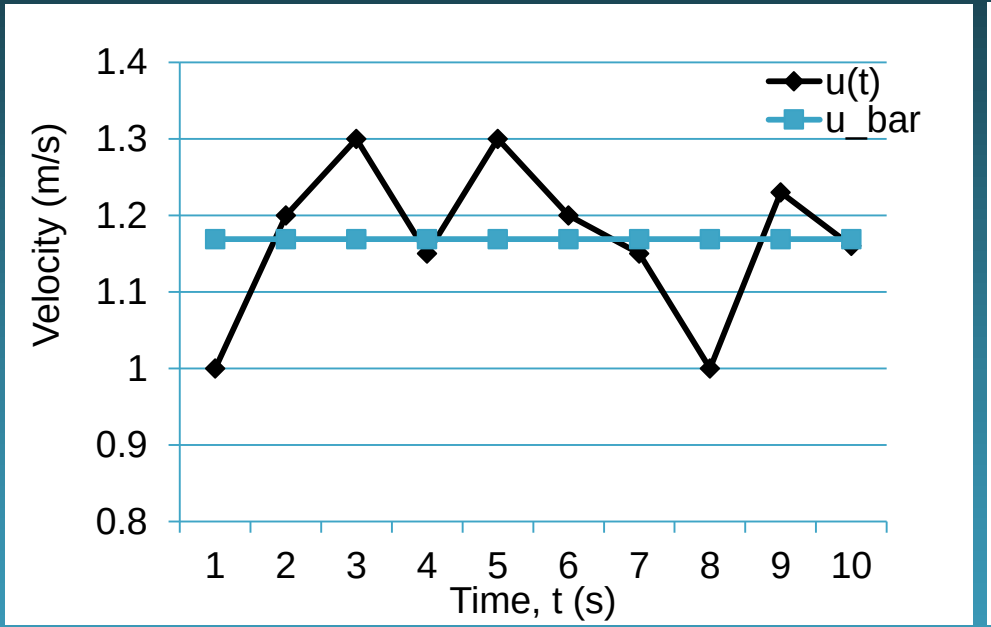
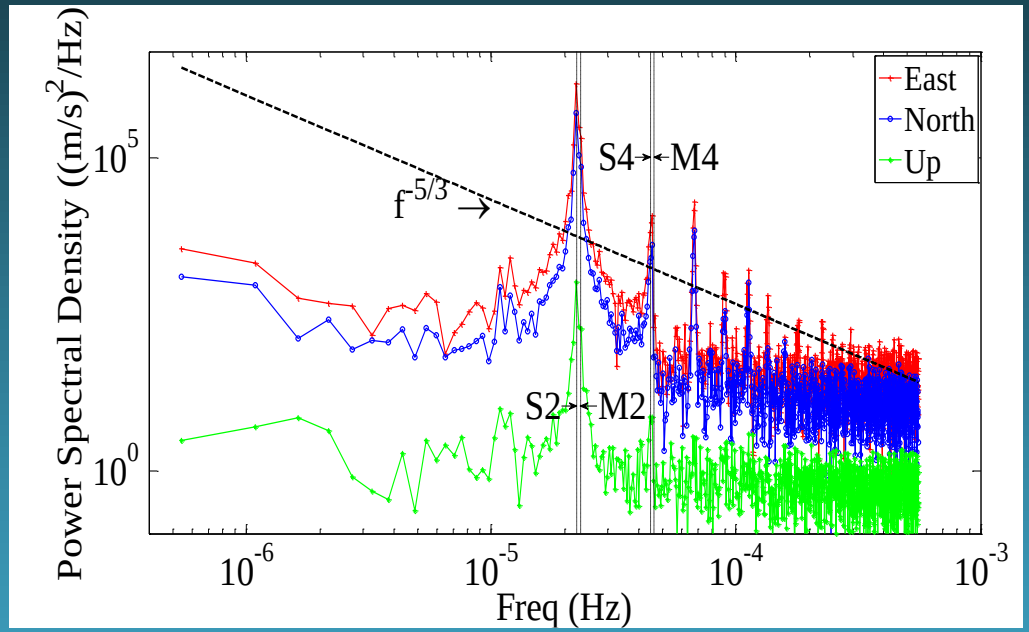
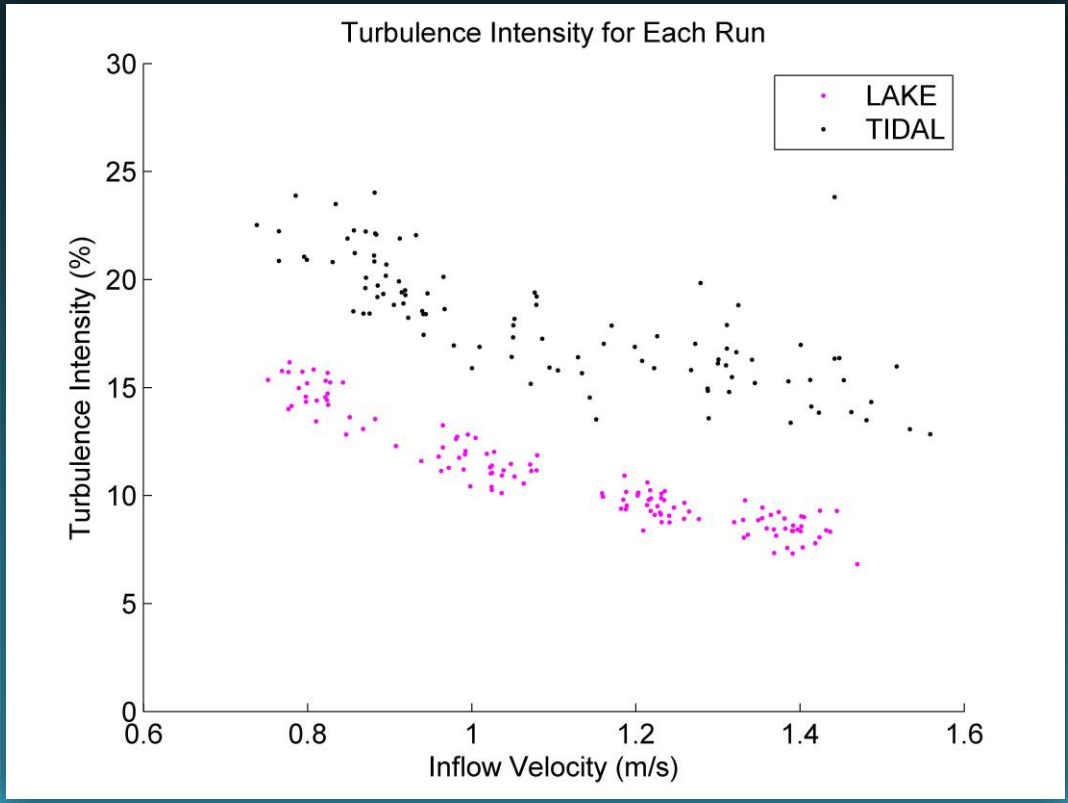
Reynolds Decomposition



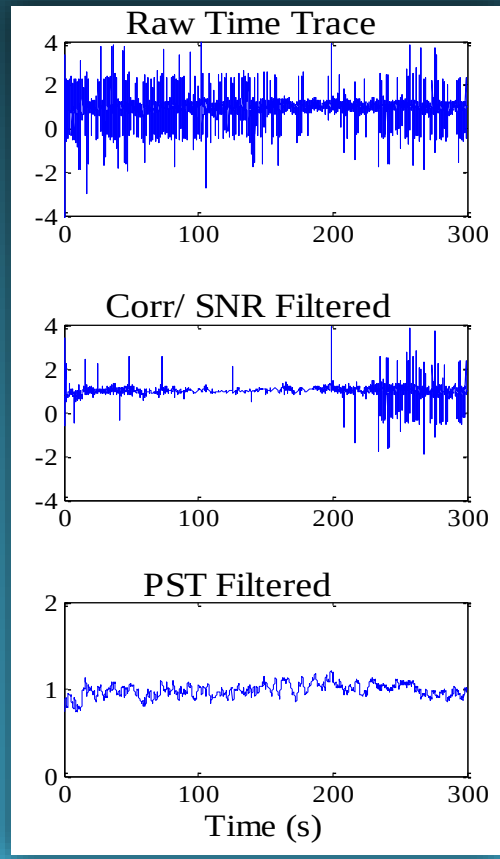
Spectral Analysis



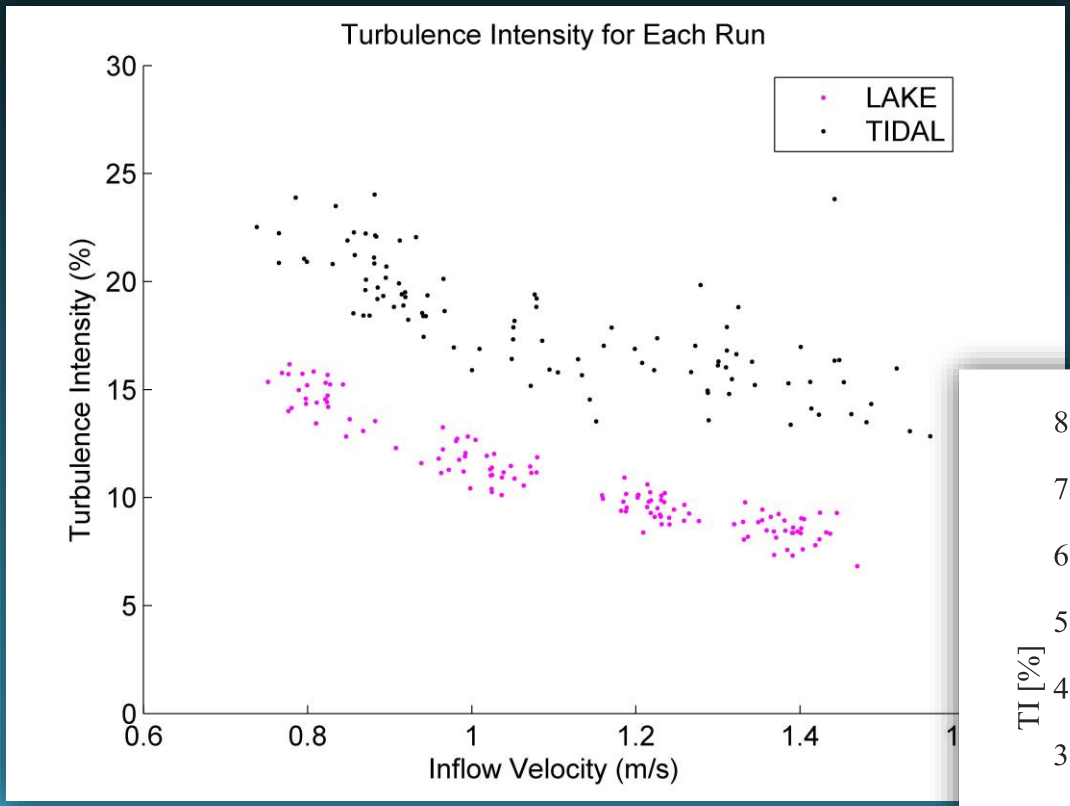
Turbulence Intensity



Aquadopp at hub height for TTT (1.5m)

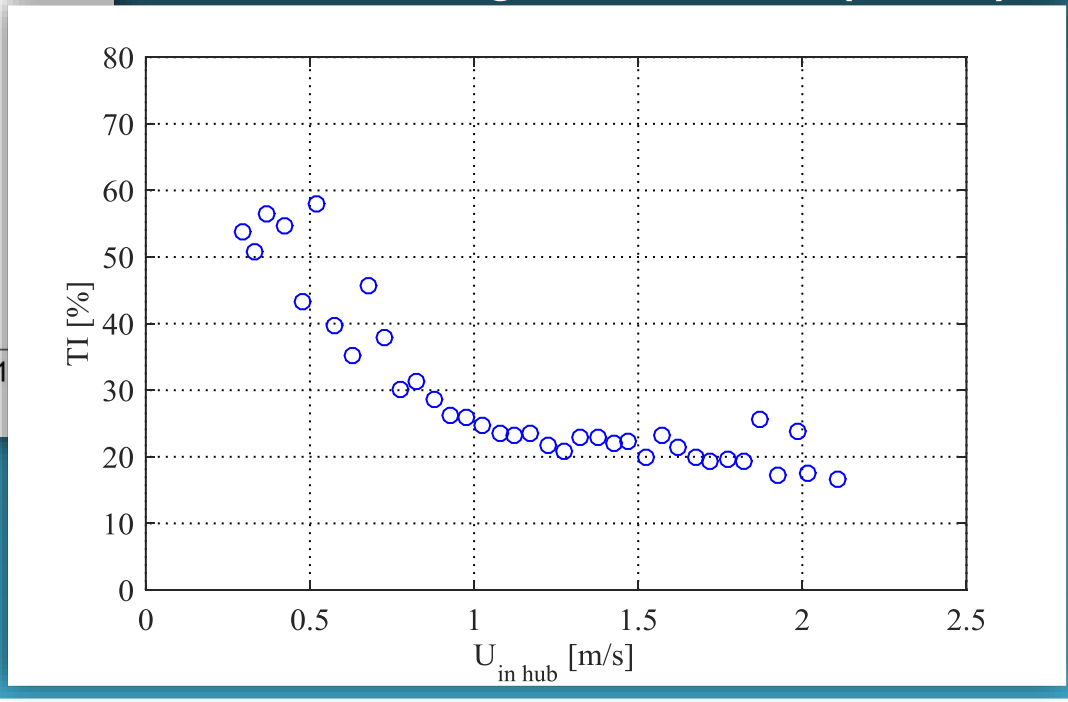


Turbulence Intensity

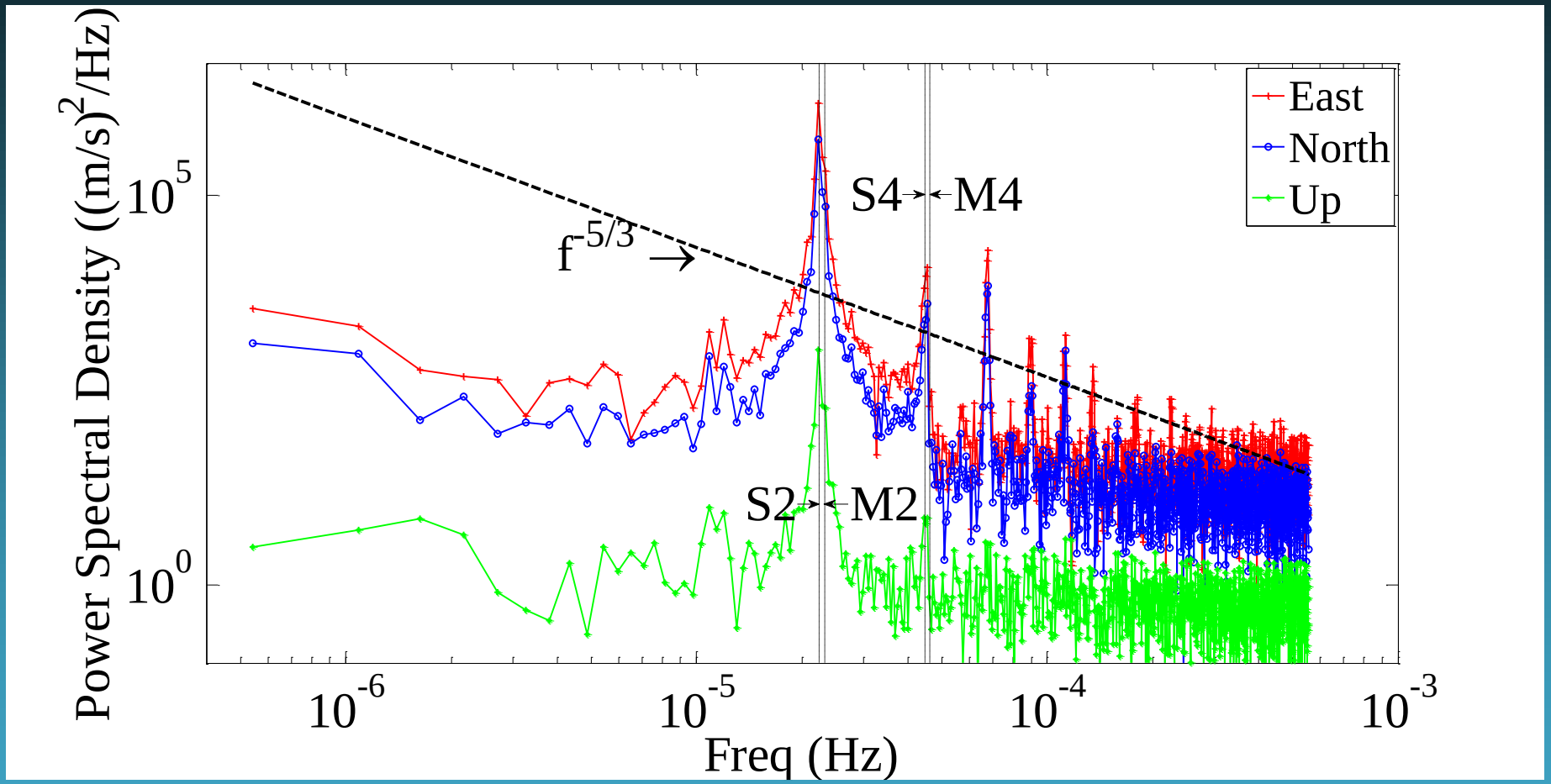


Aquadopp at hub height for TTT (1.5m)

Aquadopp at hub height for STG (3.4m)



Velocity Spectra



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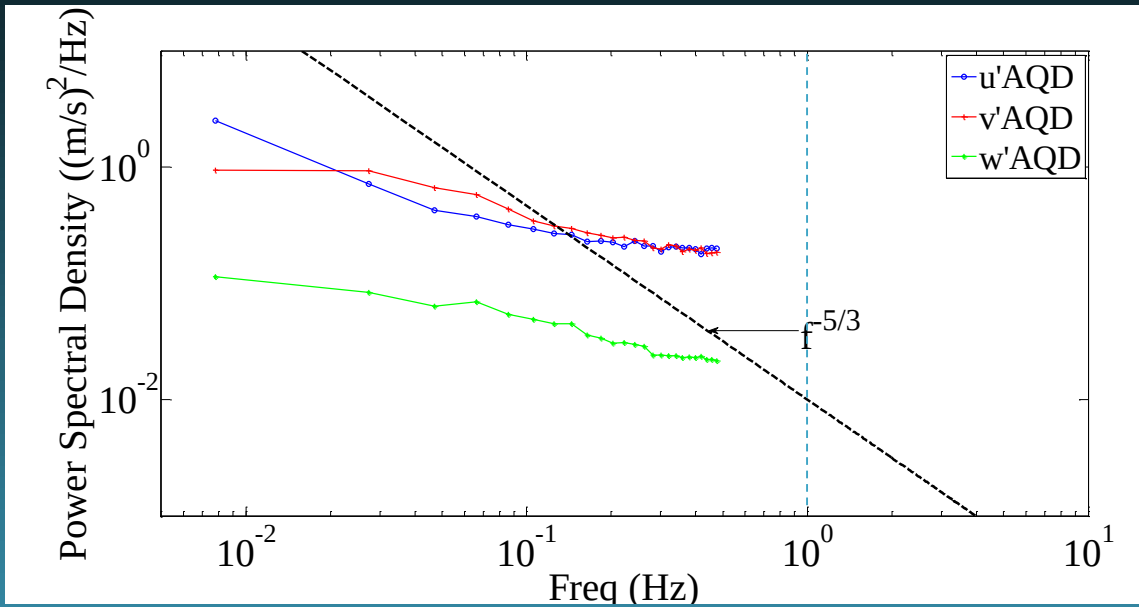
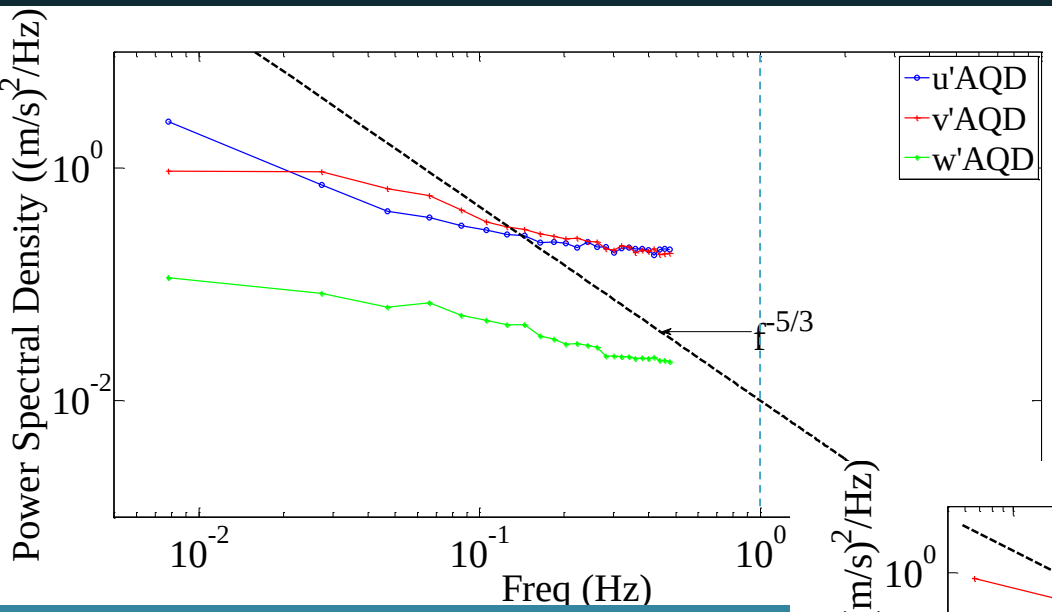
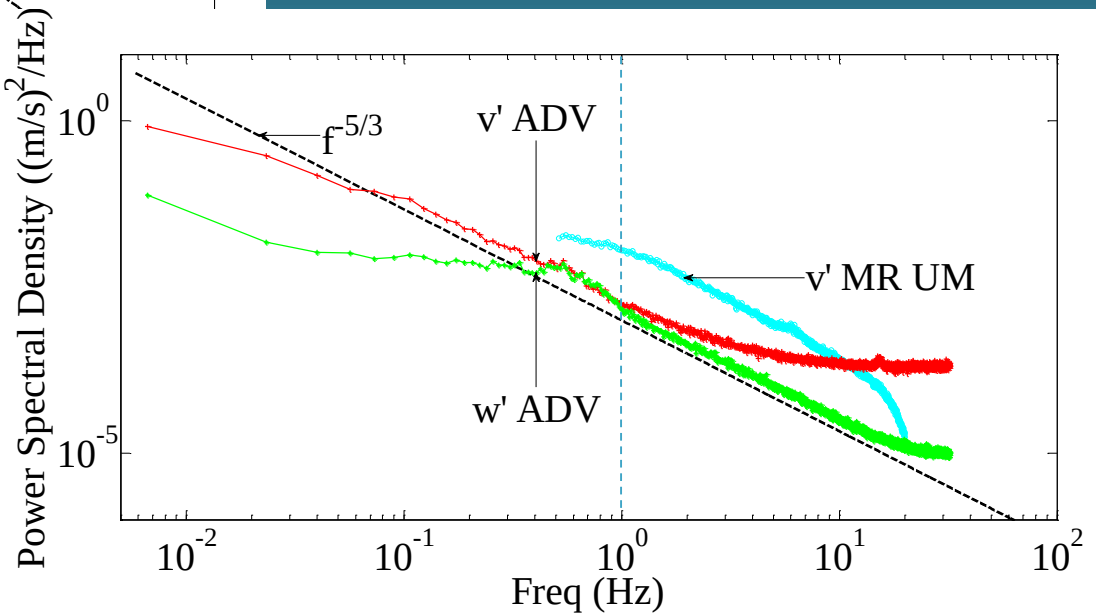


Velocity Spectra





Summary

What do we need to do for a deployment?

- Measure velocity over full channel – for IEC site characterisation
- Measure power-weighted velocity over rotor – for IEC power performance
- Measure turbulence intensity at hub height – for IEC site characterisation

What do we need to do for high accuracy measurements?

- Turbulence intensity in different directions
- Velocity spectra at high frequencies
- Turbulence intensity and spectra at hub height and high frequency
- Identification of ‘useful’ turbulence and ‘parasitic’ turbulence