



Field measurements of turbulence at tidal energy sites

Jim Thomson (UW)

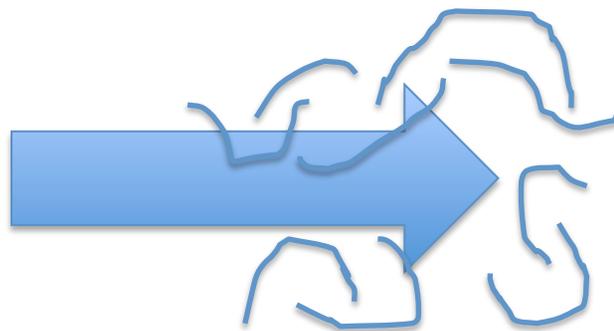
Brian Polagye (UW), Marshall Richmond (PNNL),

Vibhav Durgesh (PNNL), Eric Nelson (NREL), Levi Kilcher (NREL)



What do we want to know?

- Turbulence intensity, $I_u = \frac{\sigma_u}{\langle u \rangle}$
- Turbulence spectra, $TKE(f)$
- Extreme values, u_{max}



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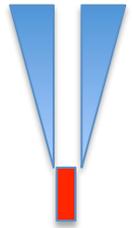


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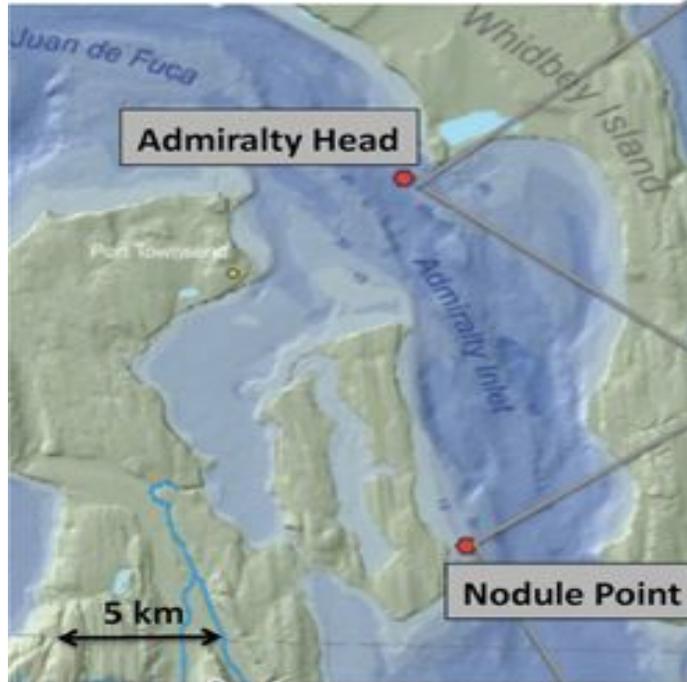
What can we measure?

- Acoustic Doppler Current Profilers (ADCP)
 - Temporal noise
 - Spatial aliasing
- Acoustic Doppler Velocimeters (ADV)
- Other options



Admiralty Inlet measurements

Thomson et al, JOE, in press



AWAC



ADV

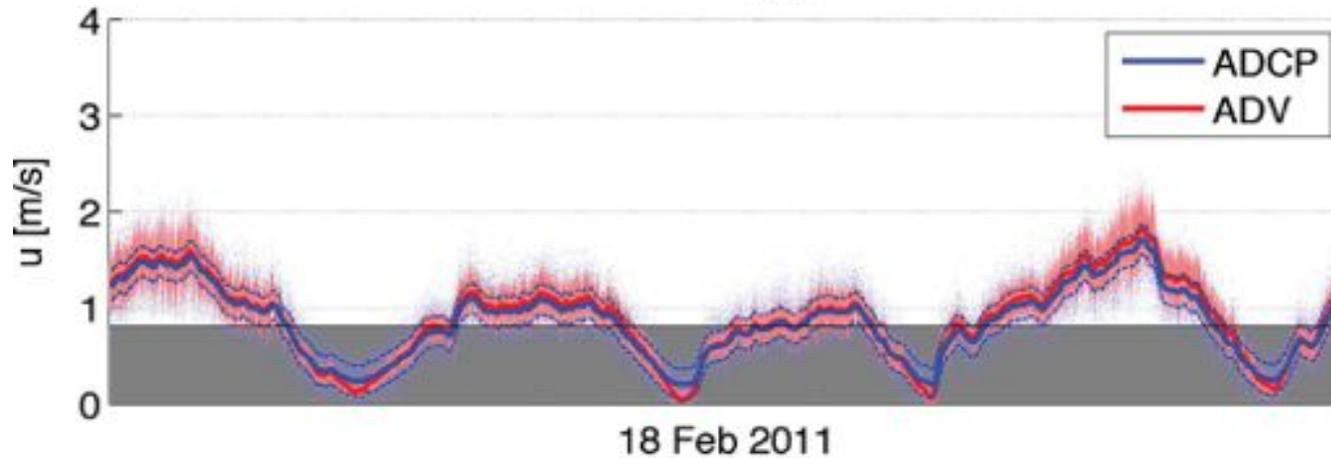
ADCP

Tidal Turbulence Tripod

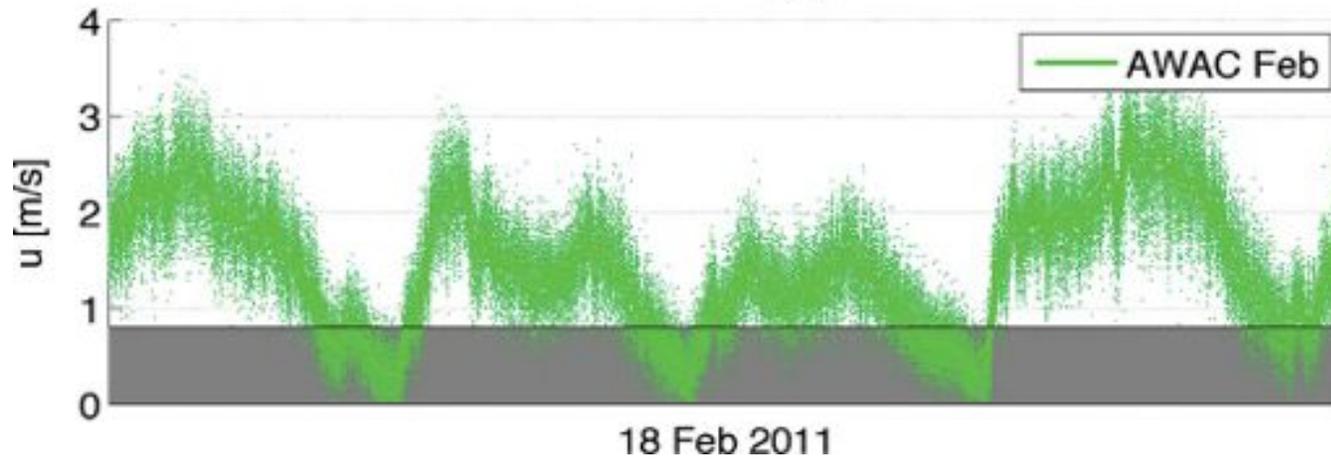


Raw time series

Nodule Point, $z_{\text{hub}} = 4.7 \text{ m}$



Admiralty Head, $z_{\text{hub}} = 8.1 \text{ m}$



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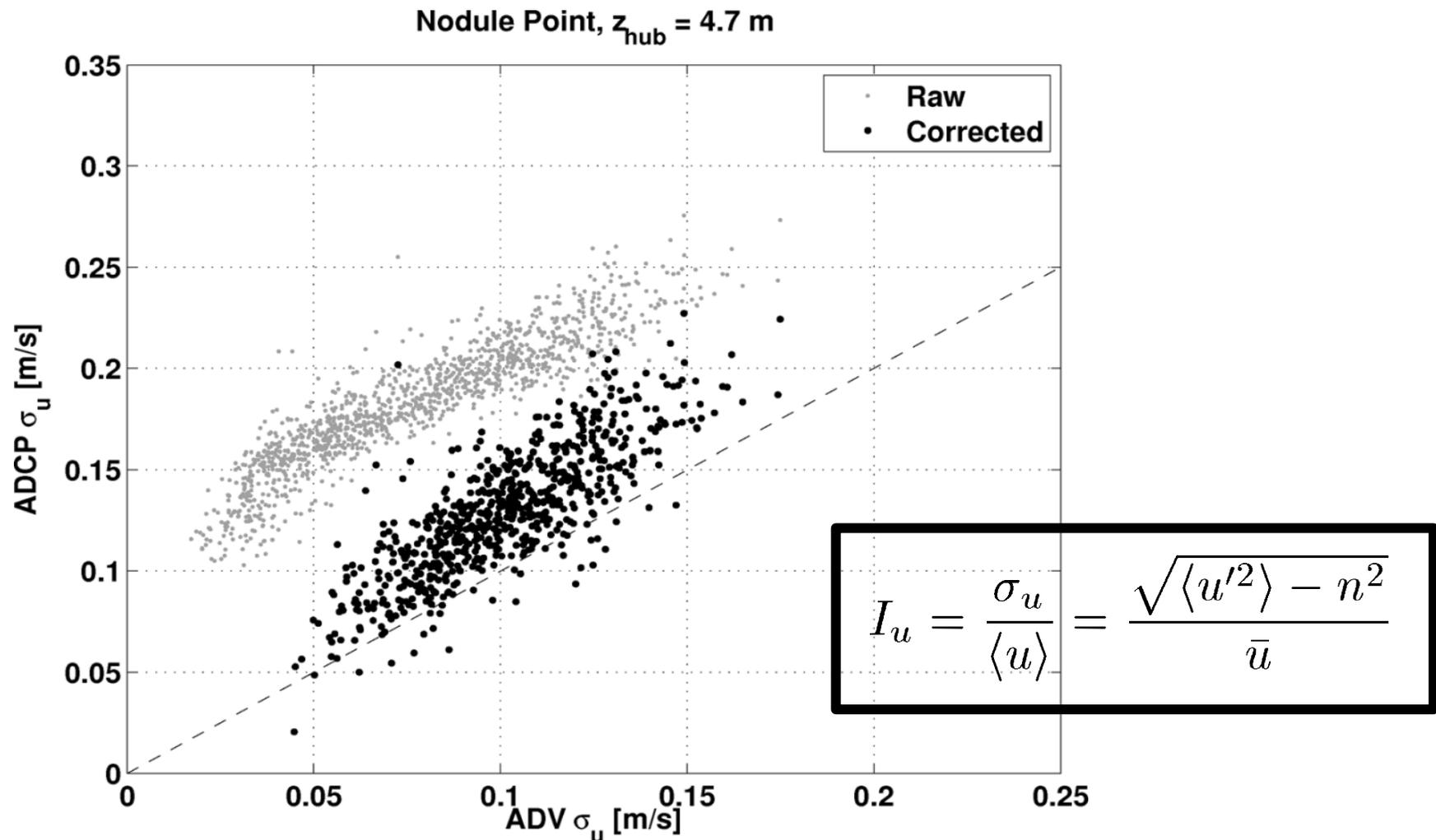
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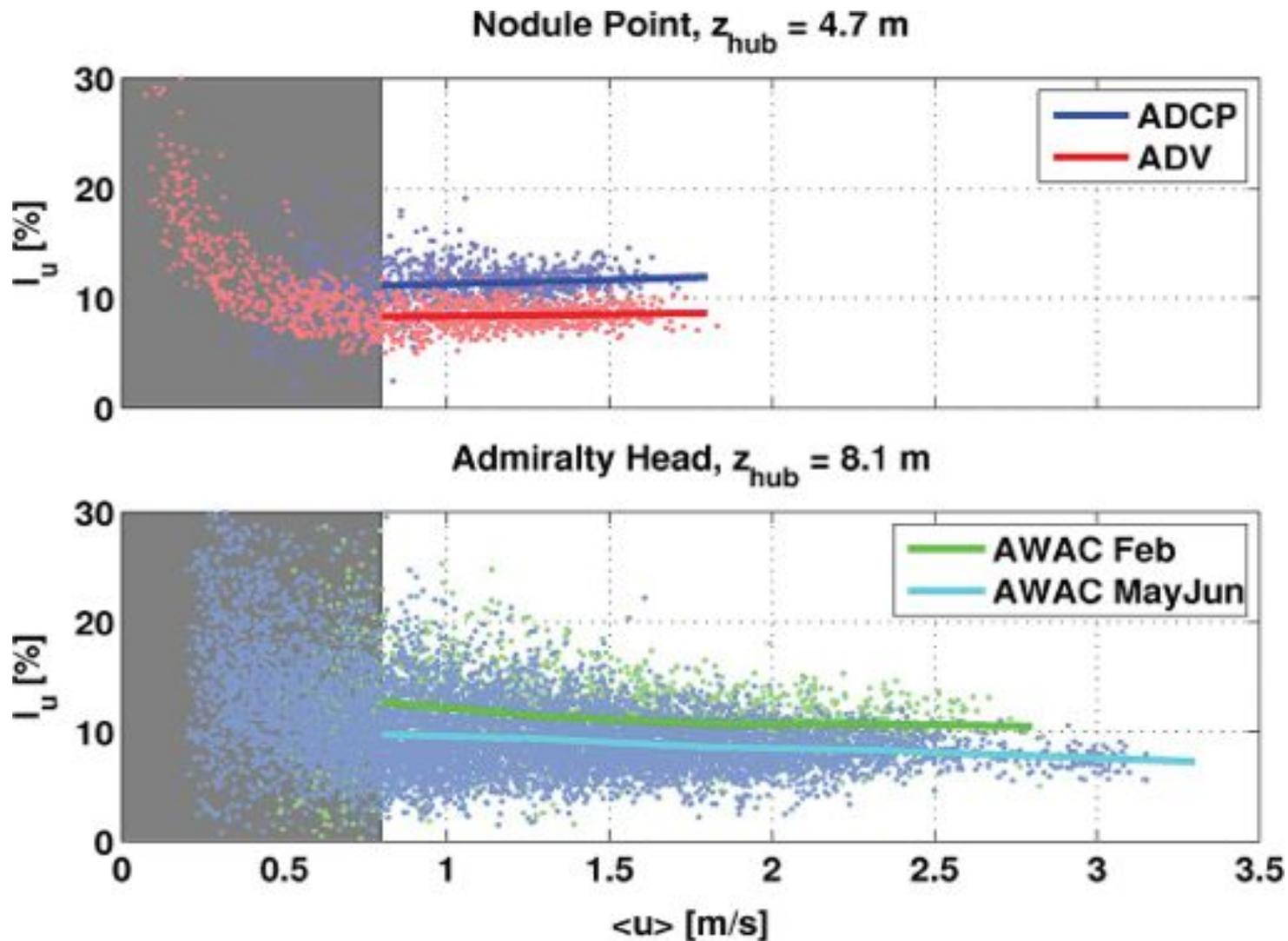
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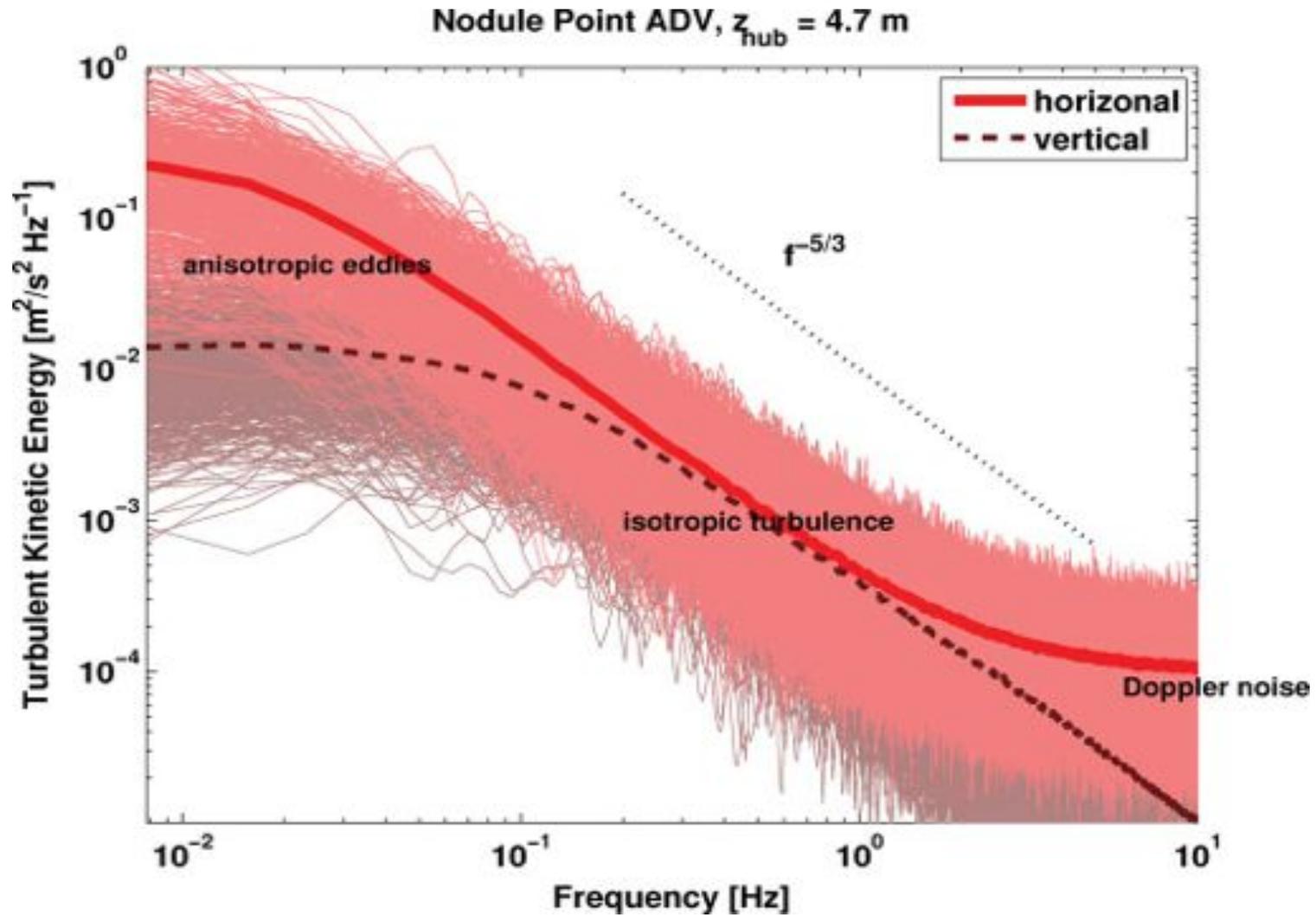
ADCP vs ADV: std dev of currents



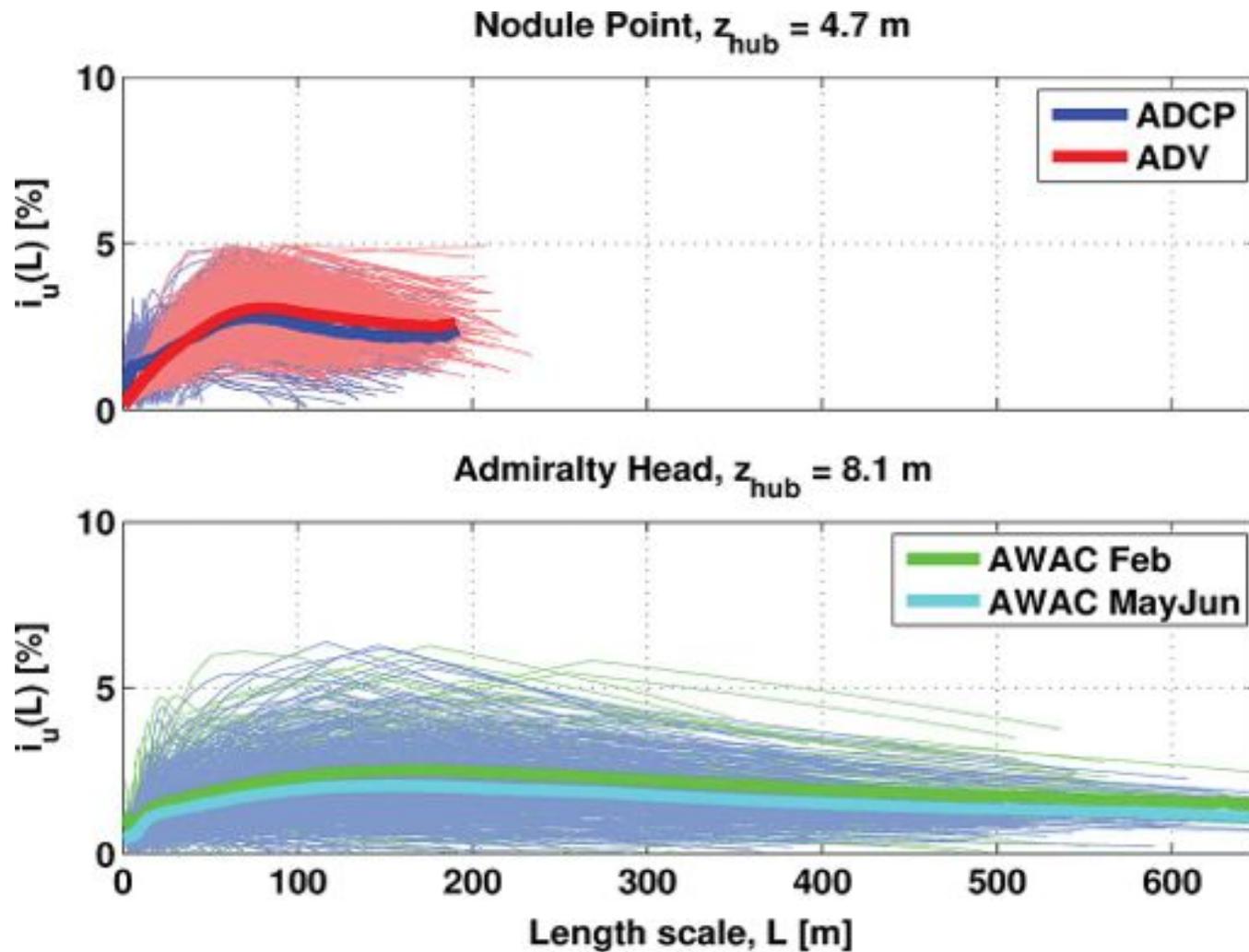
Turbulence intensities



Turbulence spectra (time scales)



Fractional intensity (length scales)



$$L = \frac{\bar{u}}{f}$$



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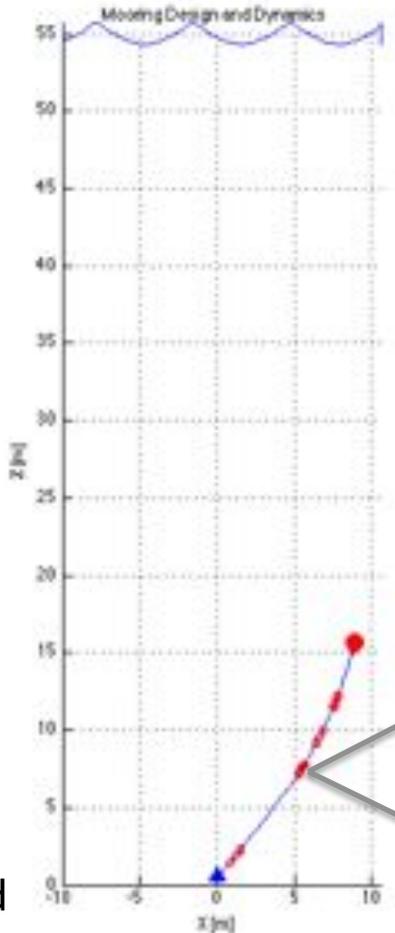
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Now what?

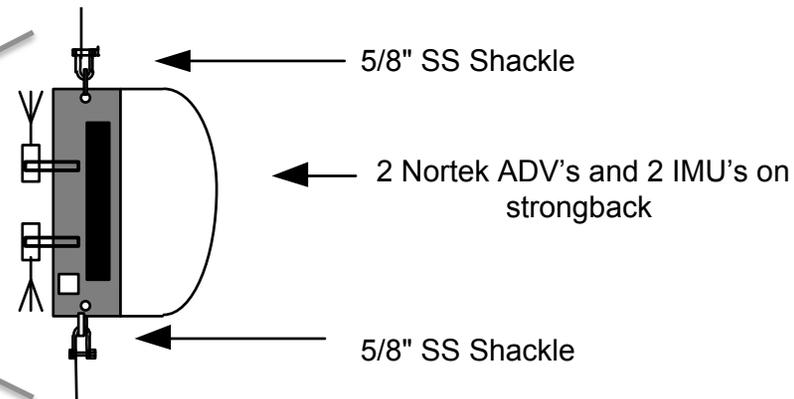
Tidal Turbulence Mooring

Surface



- Get ADVs farther above seabed
- Potential for mooring 'blow down'
- Potential for anchor drag
- Potential for motion contamination

Seabed



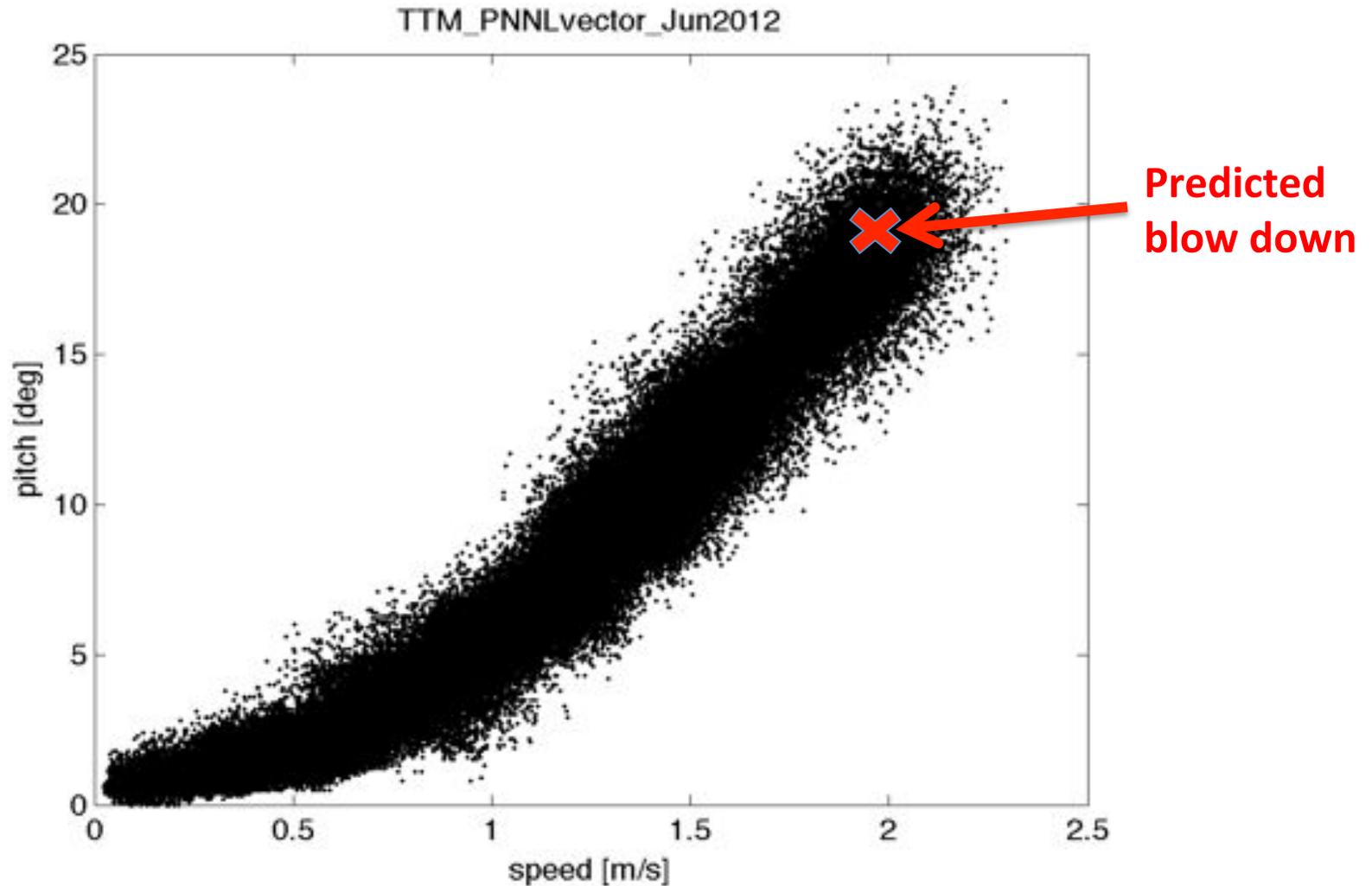
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Mooring results (preliminary)



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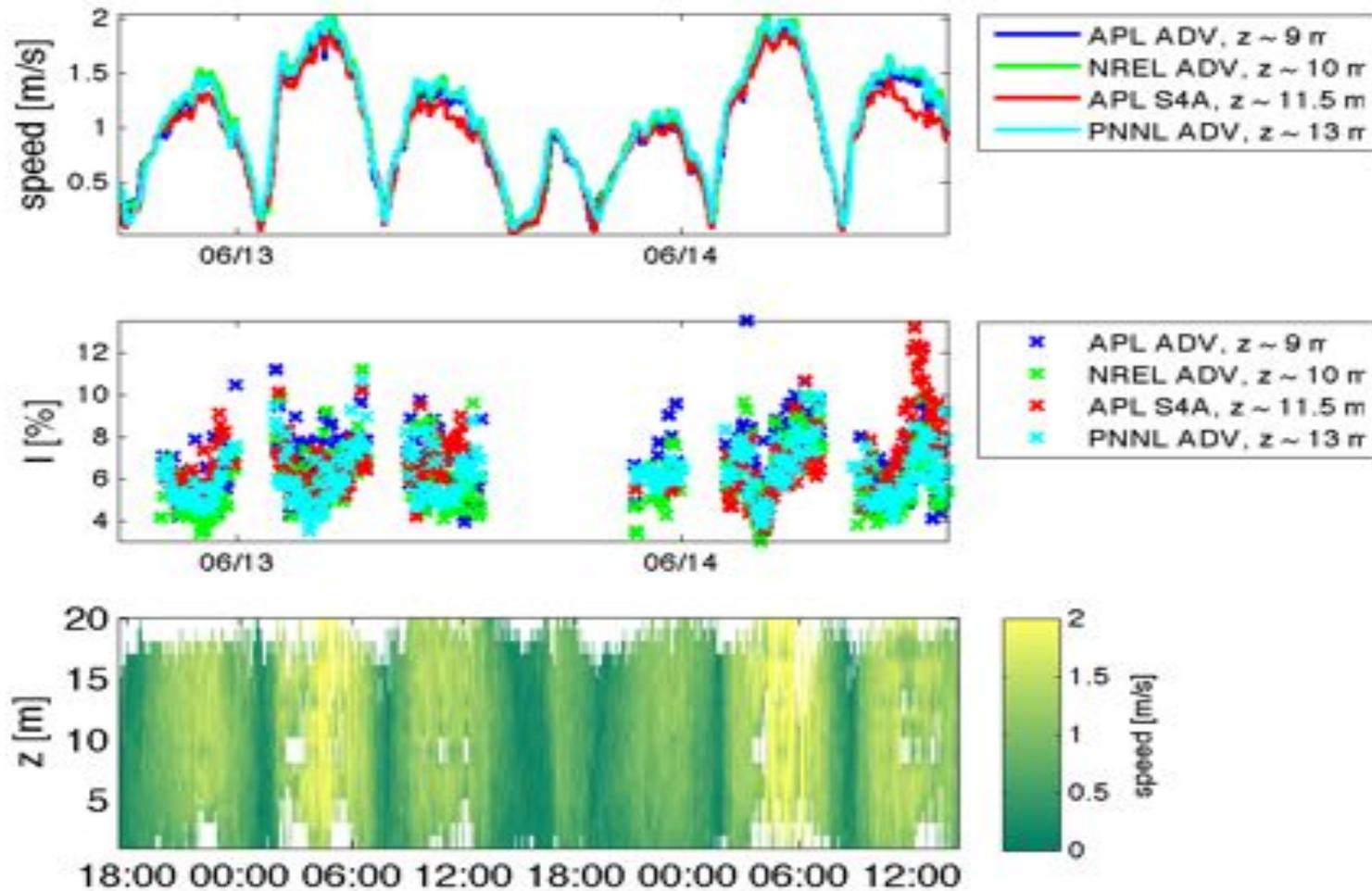
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Mooring results (preliminary)



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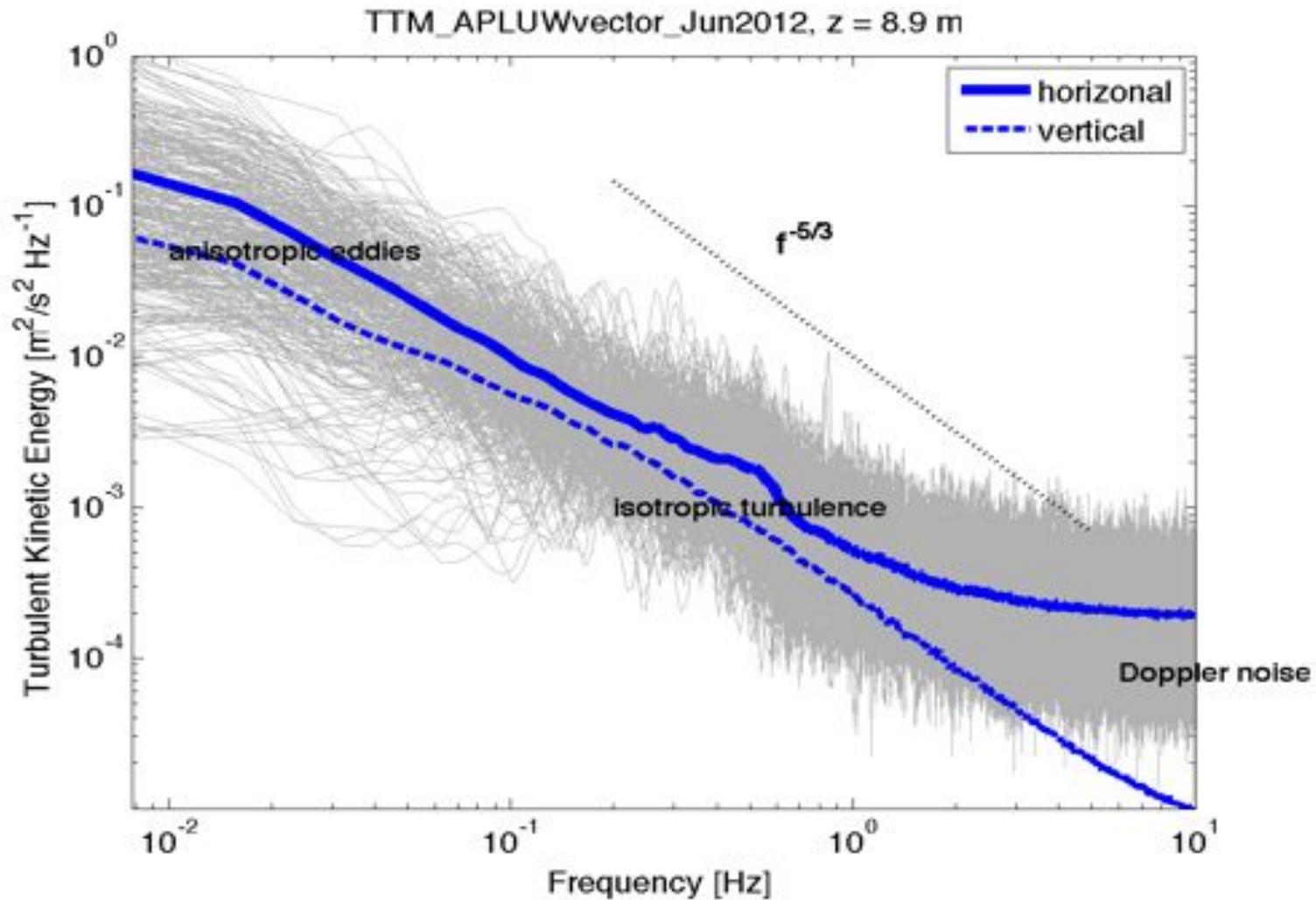
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Mooring spectra (preliminary)



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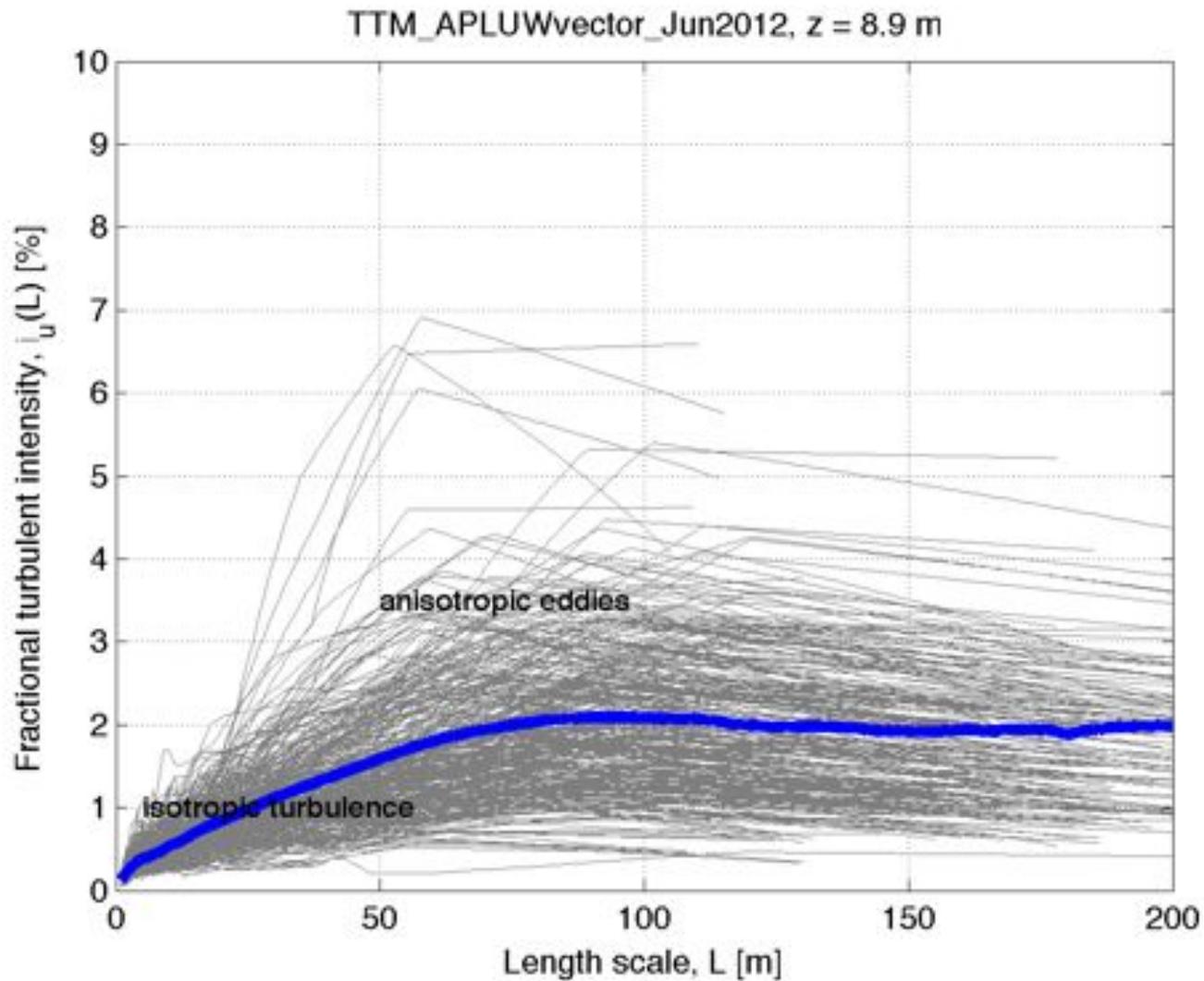
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Mooring length scales (preliminary)



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Next steps

- Large scale bistatic Doppler ('uber' ADV)
- Wake measurements
- Coherence
- Frozen assumption (Taylor's hypothesis)
- **More sites!**

Arrays



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