GL GH CFD: Shear prediction example

Power Curve Working Group hosted by Vestas R&D, Aarhus 19 Sept 2013

Richard Whiting, Global Head of Practice, Energy

CFD at DNV GL Energy: *Operations/Set-up*

- **Most important point: Experience and knowledge management!**
  - As stated by Risø DTU after the Bolund Blind Test: ”The user is more important than the solver”
  - DNV GL Energy invests heavily in validation, knowledge management and training - Our expert users are more important than software or hardware
- **Software**:
  - In-house Java code automating CD-adapco’s STAR-CCM+, a flexible, general-purpose CFD solver (and general engineering simulations package)
  - In-house pre- and post-processing tools (mostly Excel-VBA)
  - GL GH retains full control and oversight of all simulation parameters
- **Hardware**:
  - In-house cluster with up to 624 cores dedicated to CFD

Shear: *Complex site, near shore, UK*

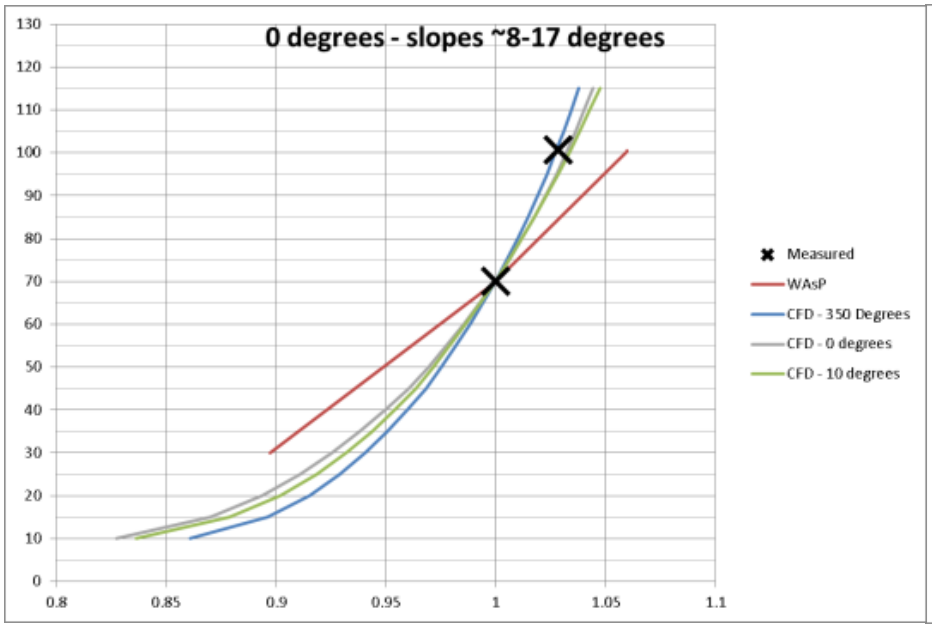
- Unidirectional wind rose
- Table below gives shear exponents and model errors on all site masts:

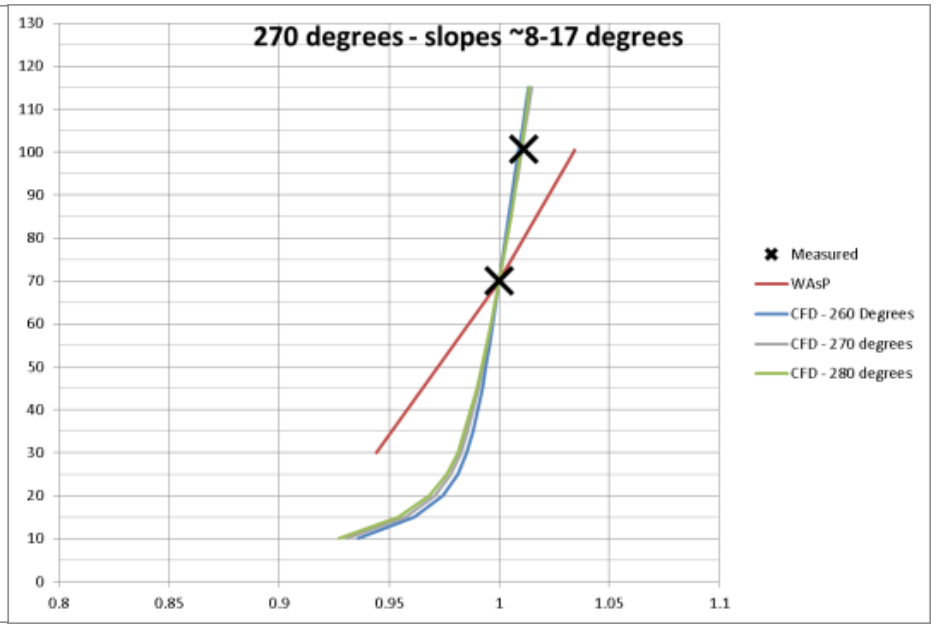
Mast Name	Meas	WAsP	WAsP Error	CFD	CFD Error
M1	0.06	0.1	67%	0.07	17%
M2	0.09	0.12	33%	0.09	0%
M3	0.06	0.1	67%	0.06	0%
M4	0.12	0.14	17%	0.11	8%
M5	0.12	0.15	25%	0.12	0%
M6	0.1	0.1	0%	0.08	20%
M7	0.12	0.14	17%	0.11	8%
M8	0.15	0.16	7%	0.14	7%
M9	0.14	0.15	7%	0.12	14%
Average			***27%***		***8%***

- Next slide looks at only M3
- Nearby elevation difference at M3 ~150 m over 1 km -> slopes 8-17°

Shear: *One mast, sample directions*

- Black crosses = measurement, red = WAsP, blue/green = DNV GL CFD
- Picking two random sectors:

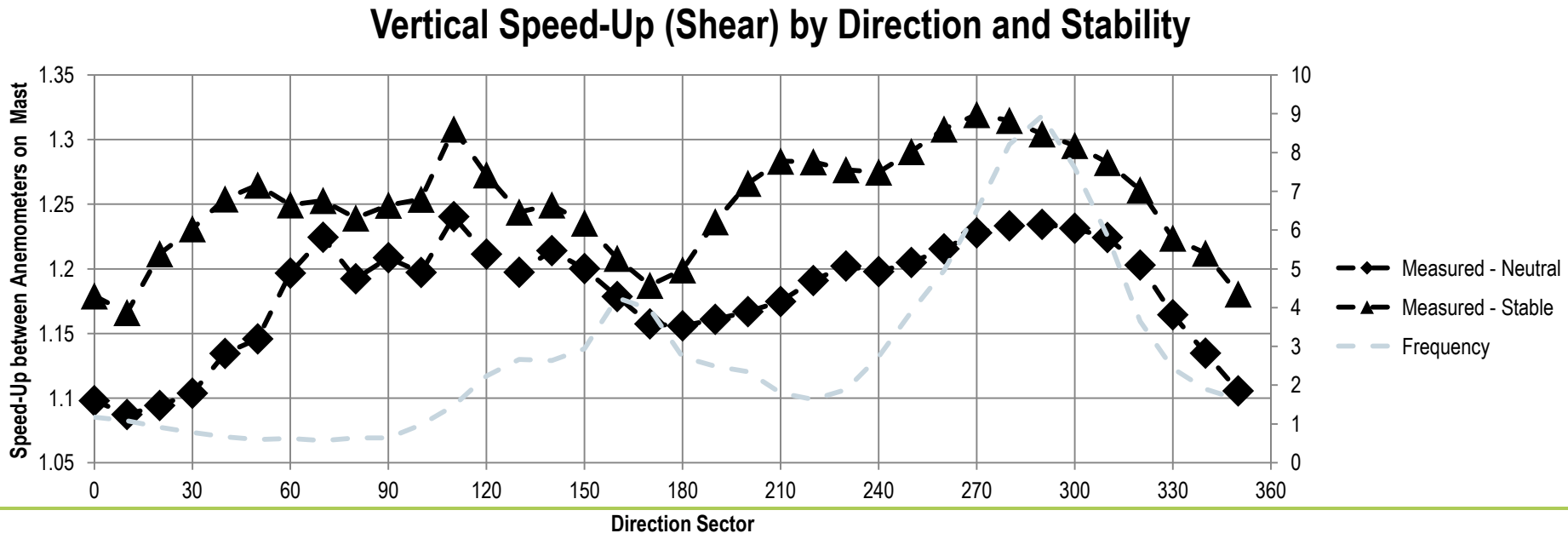




- Most sectors are similar to the two examples above

Extra site: *Complex, forested, stability affected USA*

- W and S main wind directions
- 1 mast
- Slopes 8-17°
- Forest “everywhere”
- Stability important – shear change with stability levels:



Extra site: *CFD matches shear well, stability captured*

- CFD run with neutral and stable stratification