SAWEP Workshop
Wind Atlas for South Africa (WASA)

Cape Town, 4th March 2010

Wind measurements and analysis of wind data

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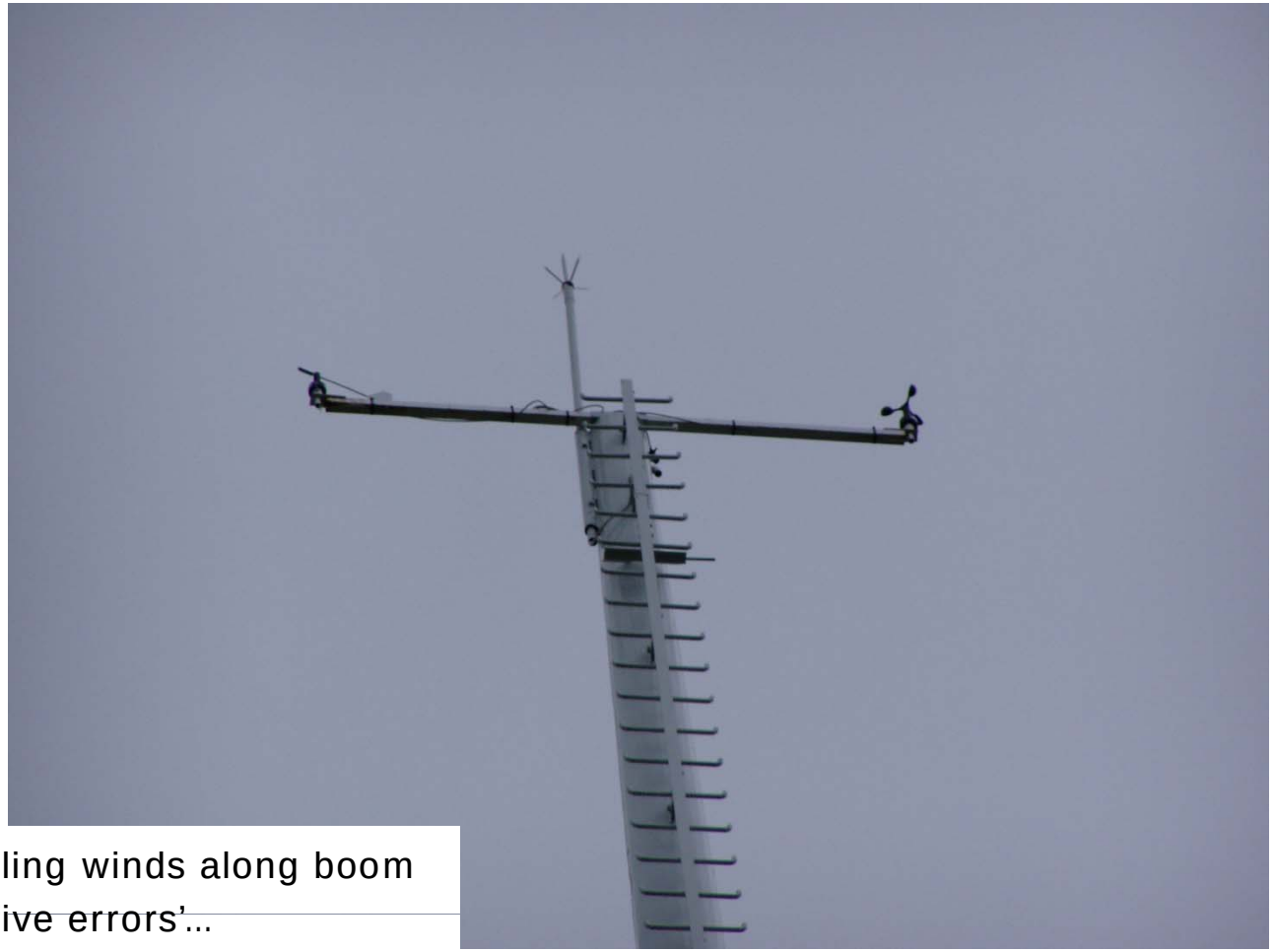
Sample met. mast



- Prevailing winds along boom
- Find ‘five errors’…

Cup anemometry 1(2)

- Tower effects (shadow)
  - lightning rod
- Boom and clamp effects
- Anemometer design
  - distance constant (l_0)
  - mech. and elec. construction
- Turbulent biases
  - u-bias $\propto (\sigma_U/U)^2$ (overspeeding)
  - v-bias $\propto (\sigma_V/U)^2$ (DP-'error')
  - w-bias $\propto (\sigma_W/U)^2$ (angular response)
  - stress-bias $\propto \langle uw \rangle / U^2$

Cup anemometry 2(2)

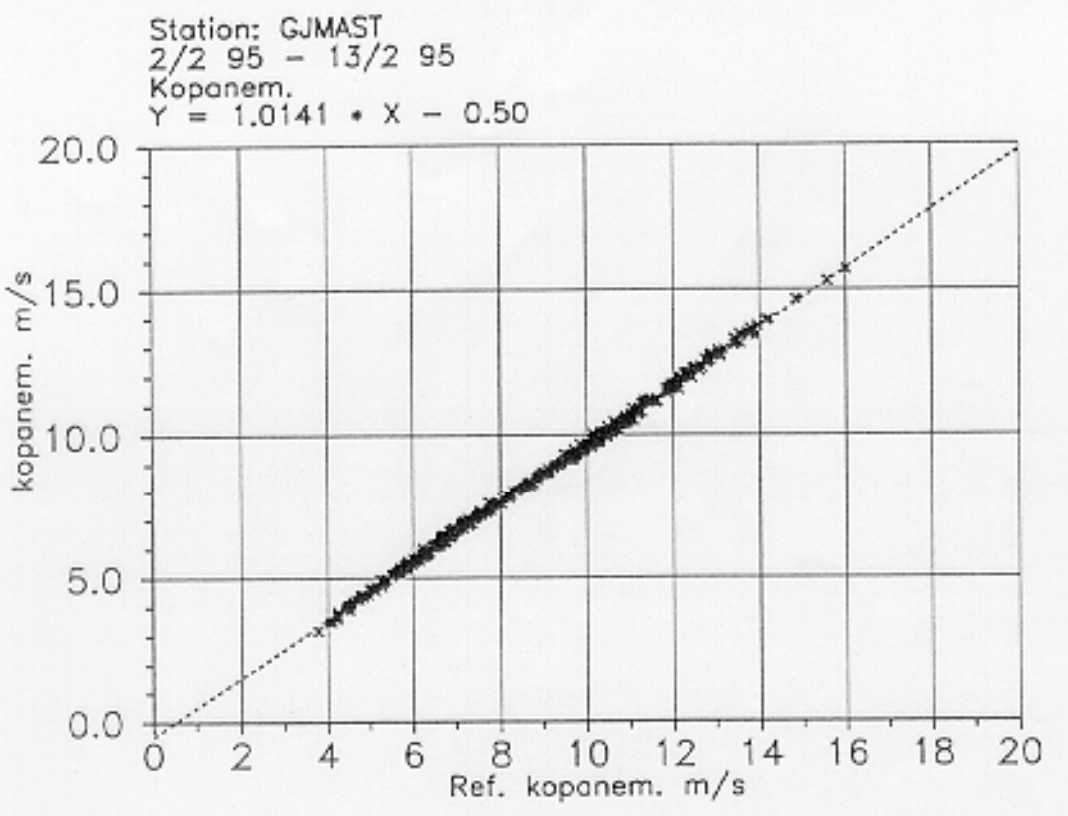
- Anemometer condition
  - long-term stability of output
  - maintenance/rehabilitation schedule

- Environmental conditions
  - sea spray, salt, dust, insects...
  - icing of instrument

- Calibration procedure
  - wind tunnel calibration (’laminar’)
  - atmospheric (in-situ, turbulent)
  - re-calibration at regular intervals

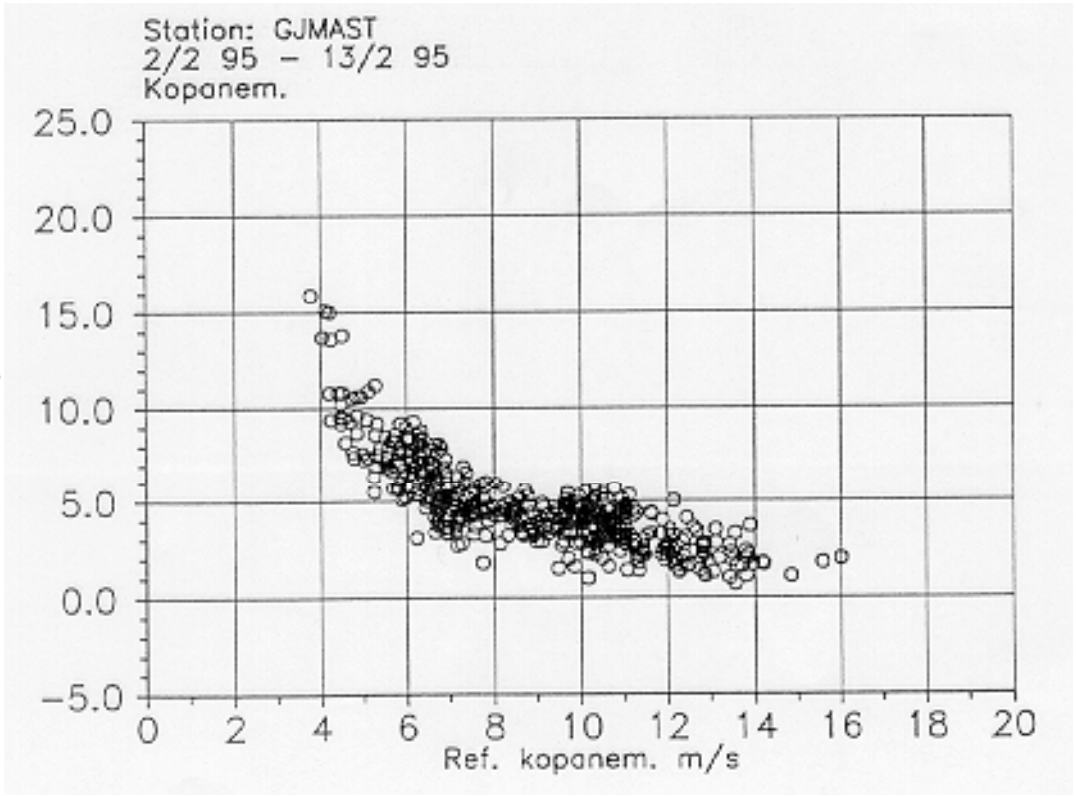
- Anemometer siting

Anemometer calibration 1(2)



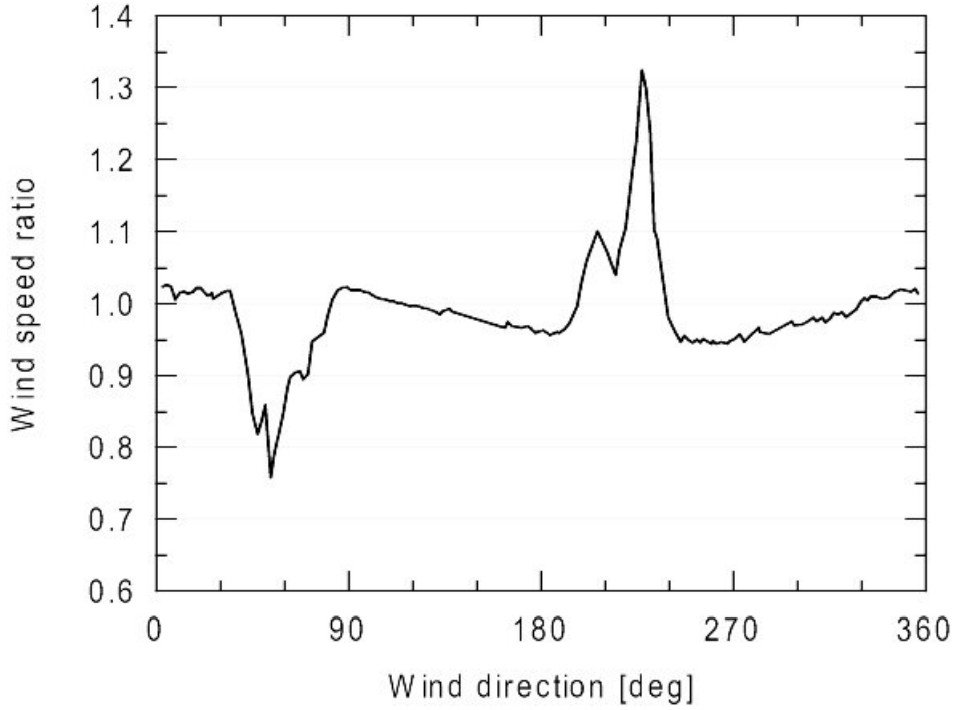
Generic calibration vs. reference anemometer: “looks good”?

Anemometer calibration 2(2)



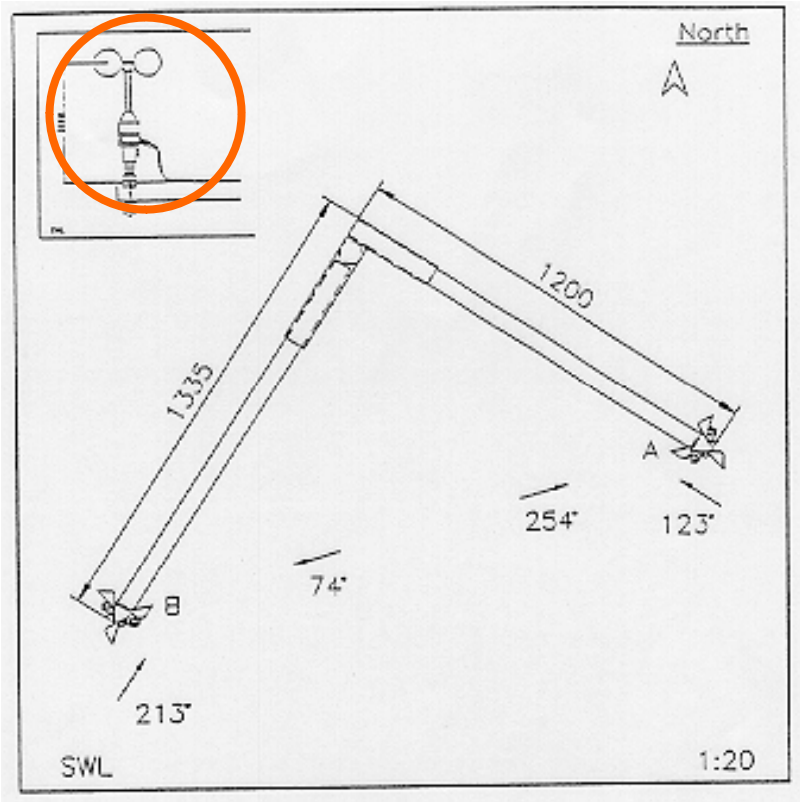
% difference can be significant! Solution: Individual Calibrations

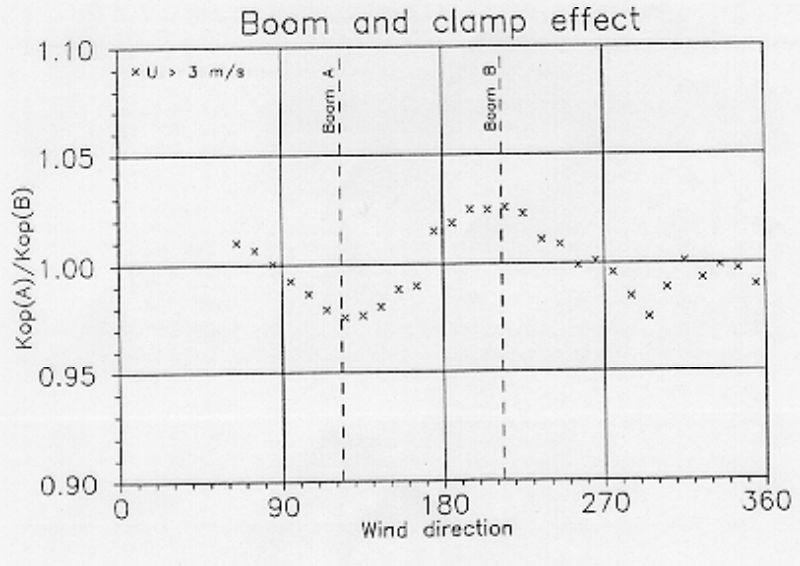
Tower shadow



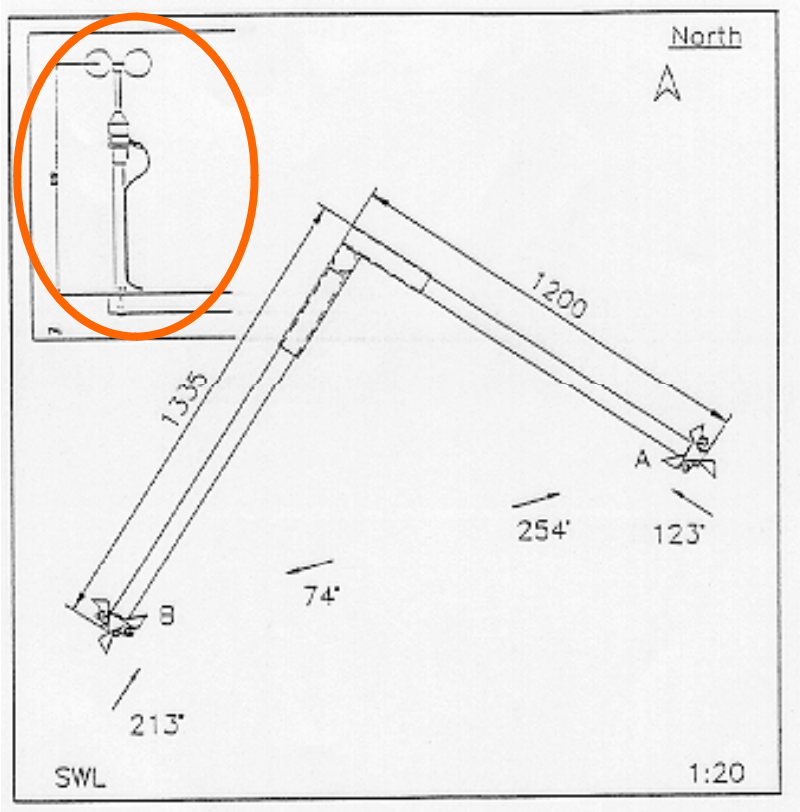
- Triangular lattice tower with side length 1.2 m
- two cups mounted on 2.5-m booms on opposite sides of the tower.

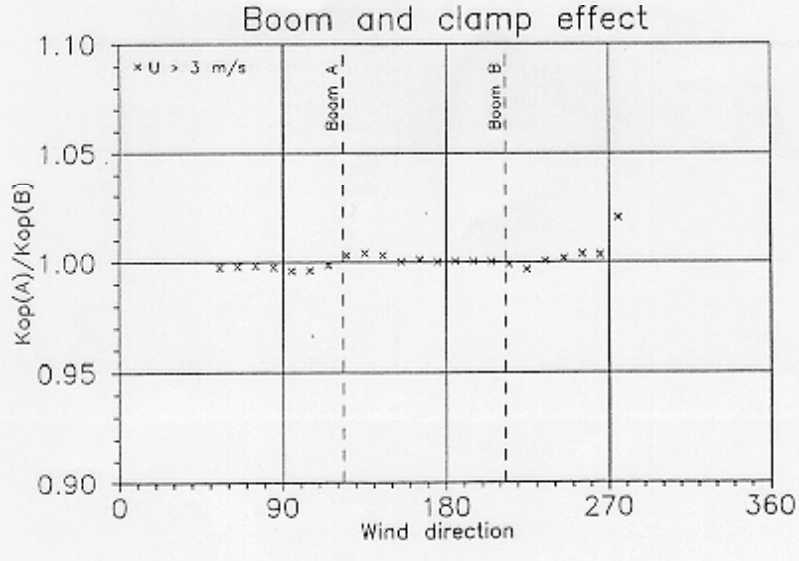
Boom and clamp effect 1(2)





Boom and clamp effect 2(2)

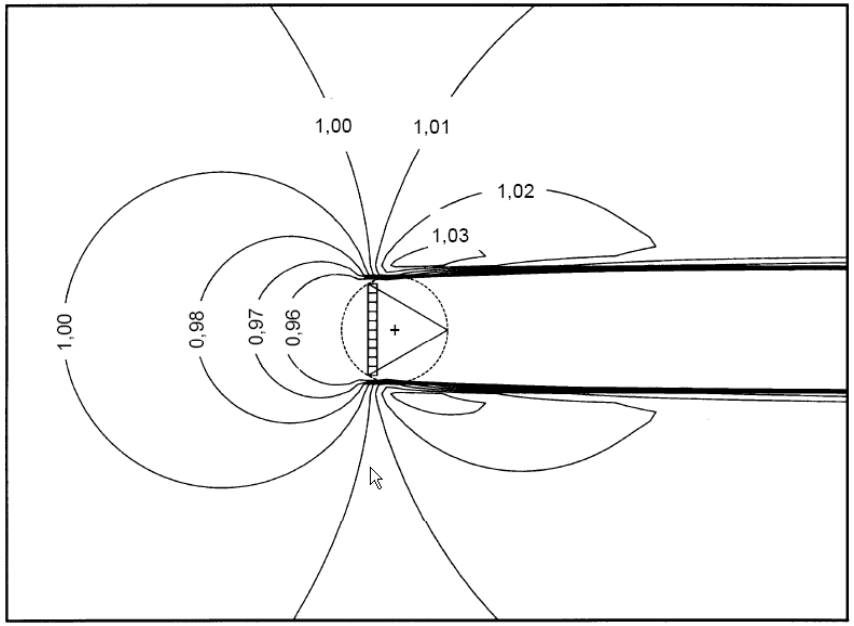




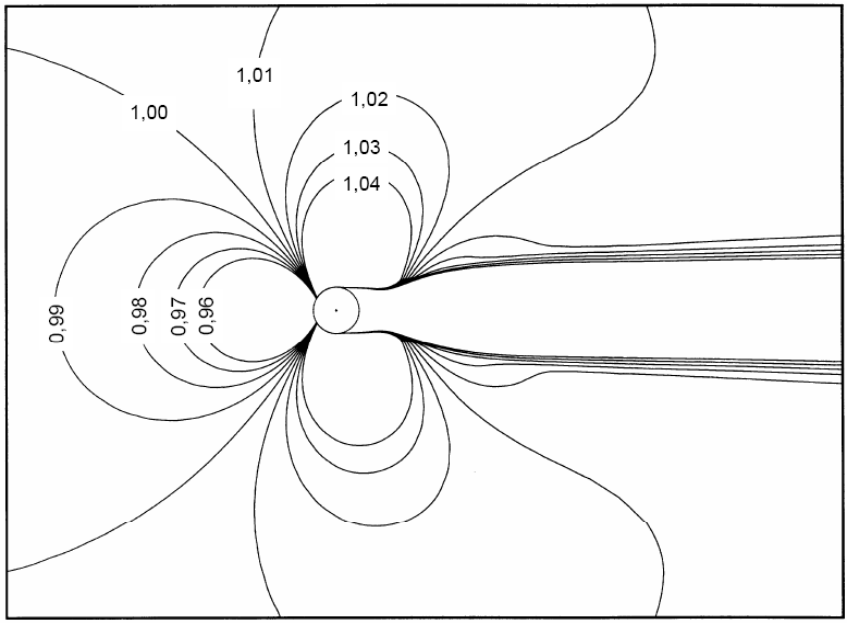
Cup rotor should be > 12-15 boom diameters above boom!

Flow distortion according to IEC 61400-12-1 standard

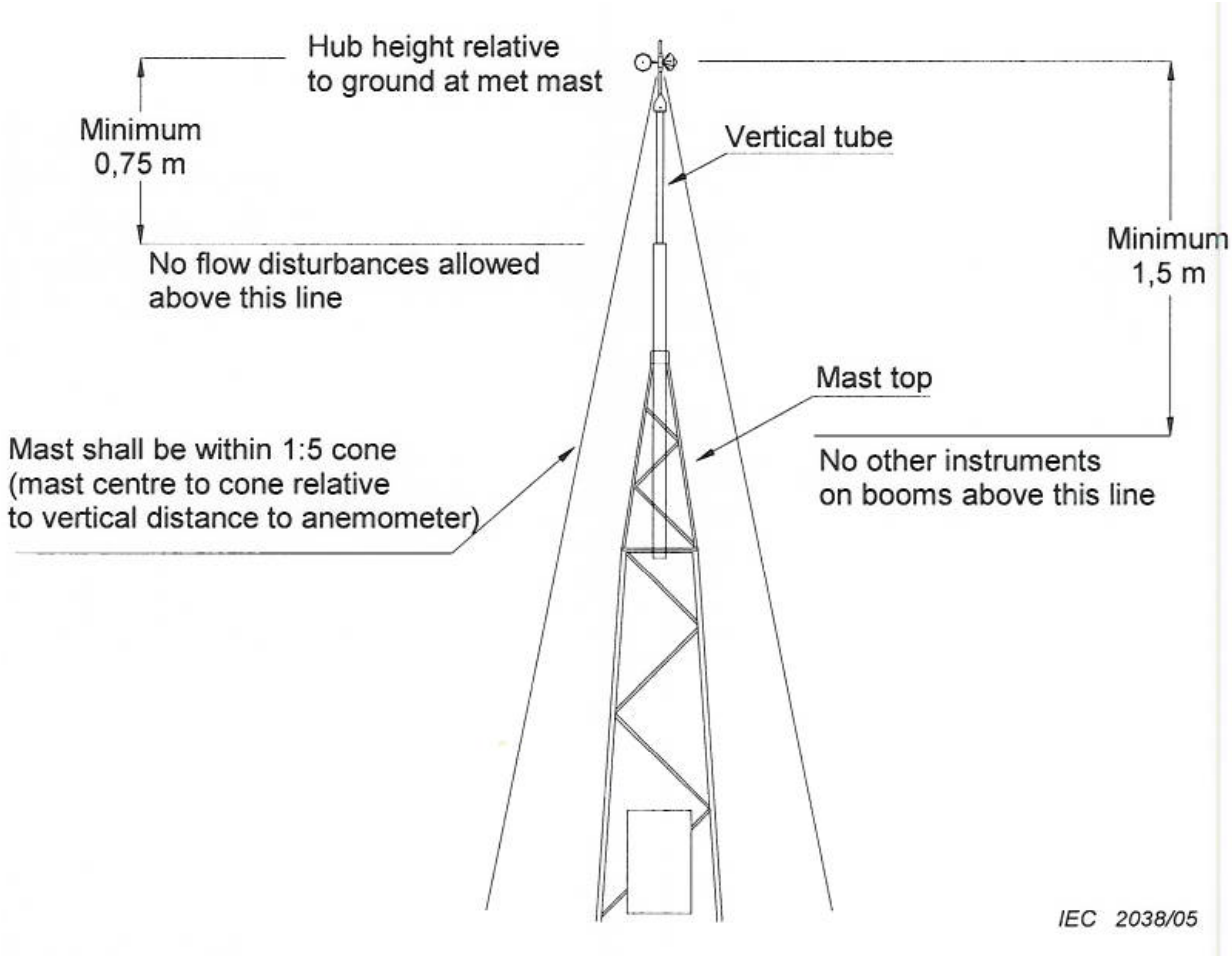
Triangular lattice mast
Optimum boom direction @ 90°



Cylindrical tubular mast
Optimum boom direction @ 45°



Met. mast top arrangement – IEC



Sample met. masts

25-m lattice mast

Top-pole

70-m lattice mast

The GIGO principle

- This universal principle for computer models (and many other aspects of life ;-) states:

  Garbage In = Garbage Out

  or in math terms:

  Garbage Out = (Garbage In)^n

- Unfortunately, the exponent for wind energy models is:

  n = 1.5-3

- 'Garbage' or not – it's difficult to make accurate, reliable, long-term wind measurements!

... and finally a few rules-of-thumb to remember

Wind measuring issues

- Cup anemometer rotors should be
  > 12-15 boom diameters above boom
- Boom lengths
  lattice mast: > 3-5 mast side widths
  tubular mast: > 6 mast diameters
- Boom orientation
  lattice mast: 45°-90° from prevailing
  tubular mast: 45° from prevailing wind
- Uncertainty of wind measurements is
  really still 1–3% (or worse)

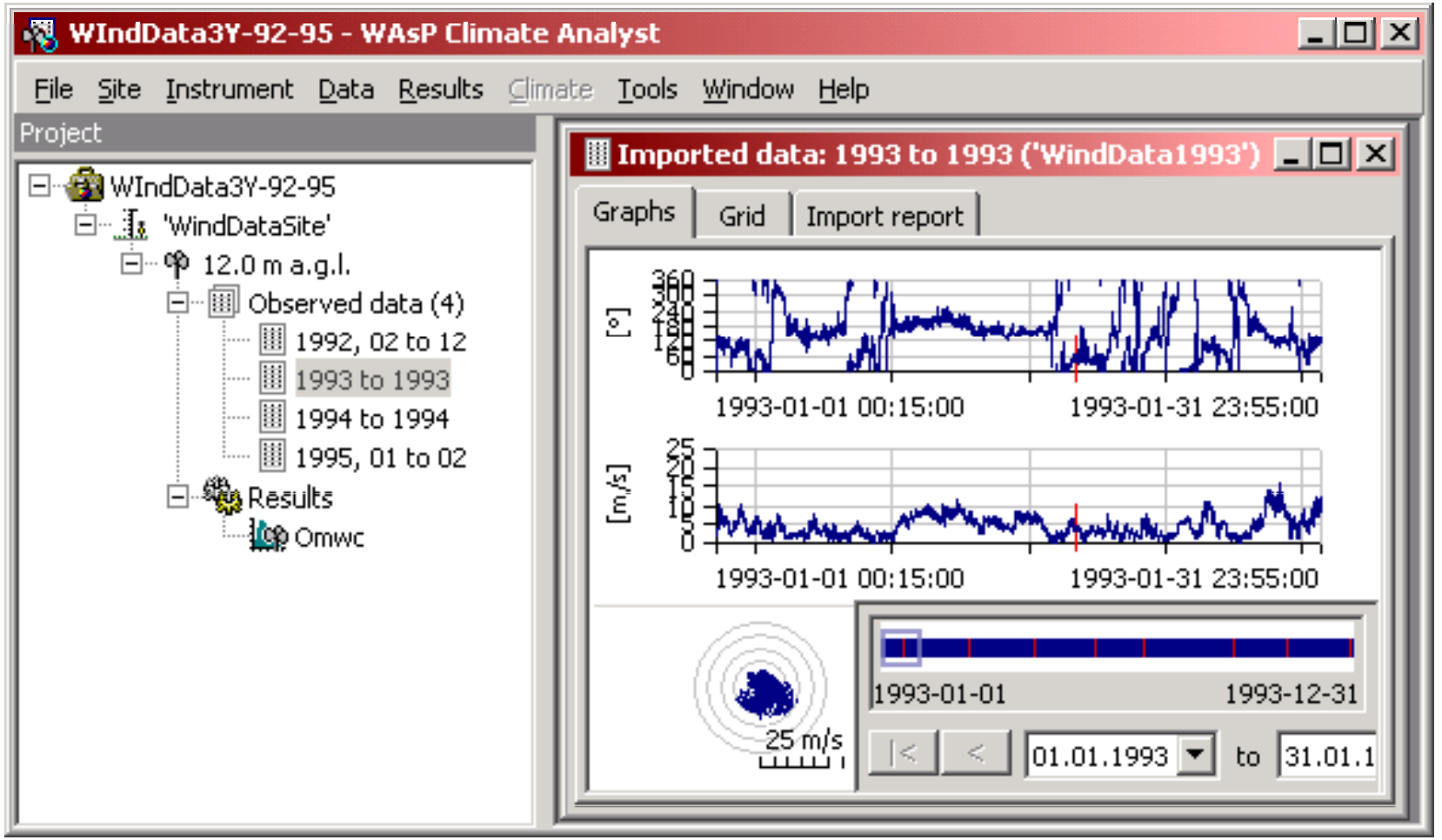
Quality of wind data

- The wind data must be accurate
  - equipment design and specifications
  - calibration of sensors (anemometers)
  - careful mounting of sensors on mast

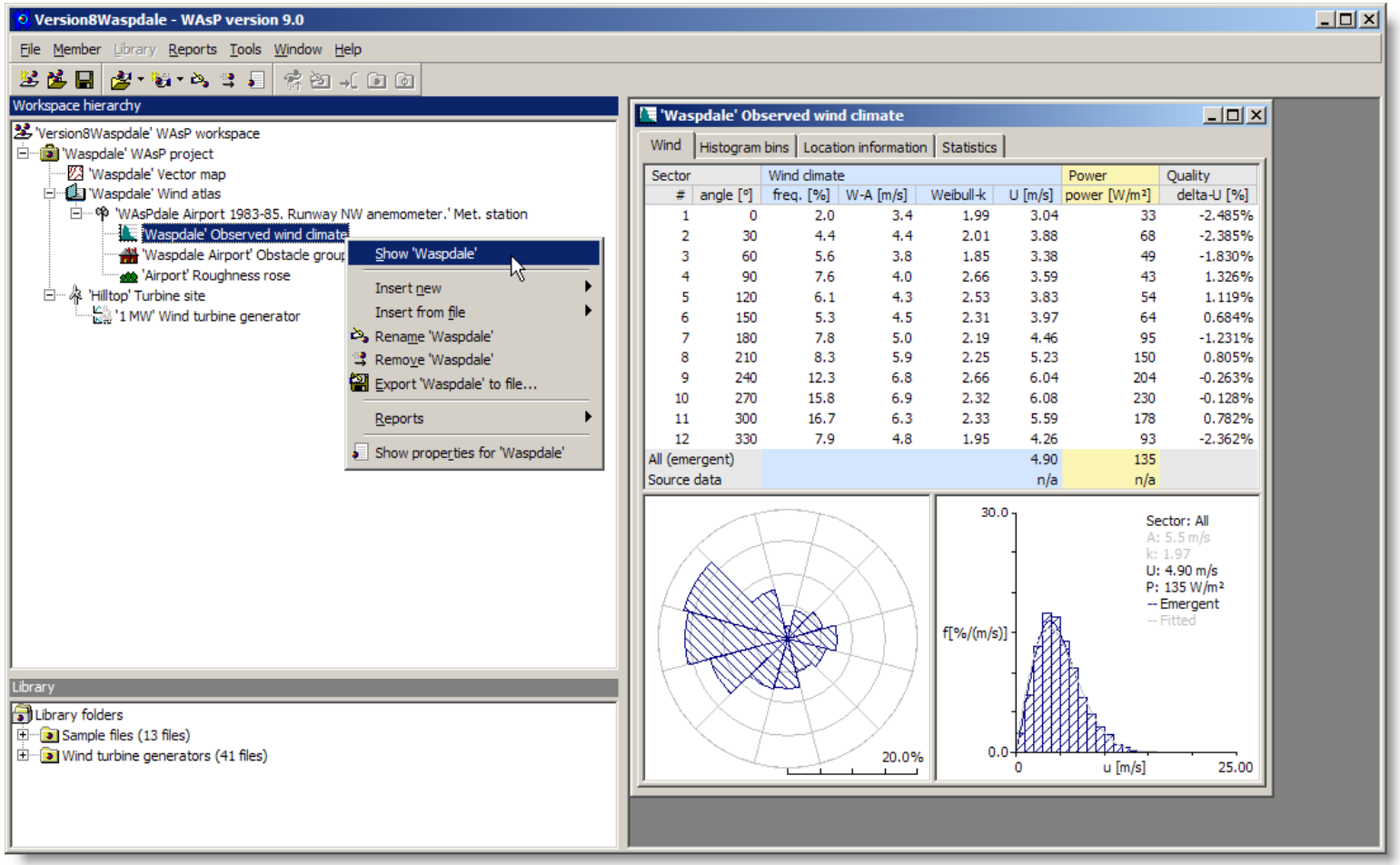
- The wind data must be representative
  - data collection for > 1 year
  - data statistics for a number of full years (no seasonal bias – cut if necessary!)
  - data recovery > 90% (missing data distributed randomly)
  - careful siting of mast (similarity principle)

- The wind data must be reliable
  - verification of sensor outputs (QA)
  - O&M (rehabilitation and recalibration)
  - redundant sensors, long-term, wind index, ...

Climate Analyst details (1) – hierarchy



WAsP – the OWC view



The OWC file (*.tab, now *.owc)