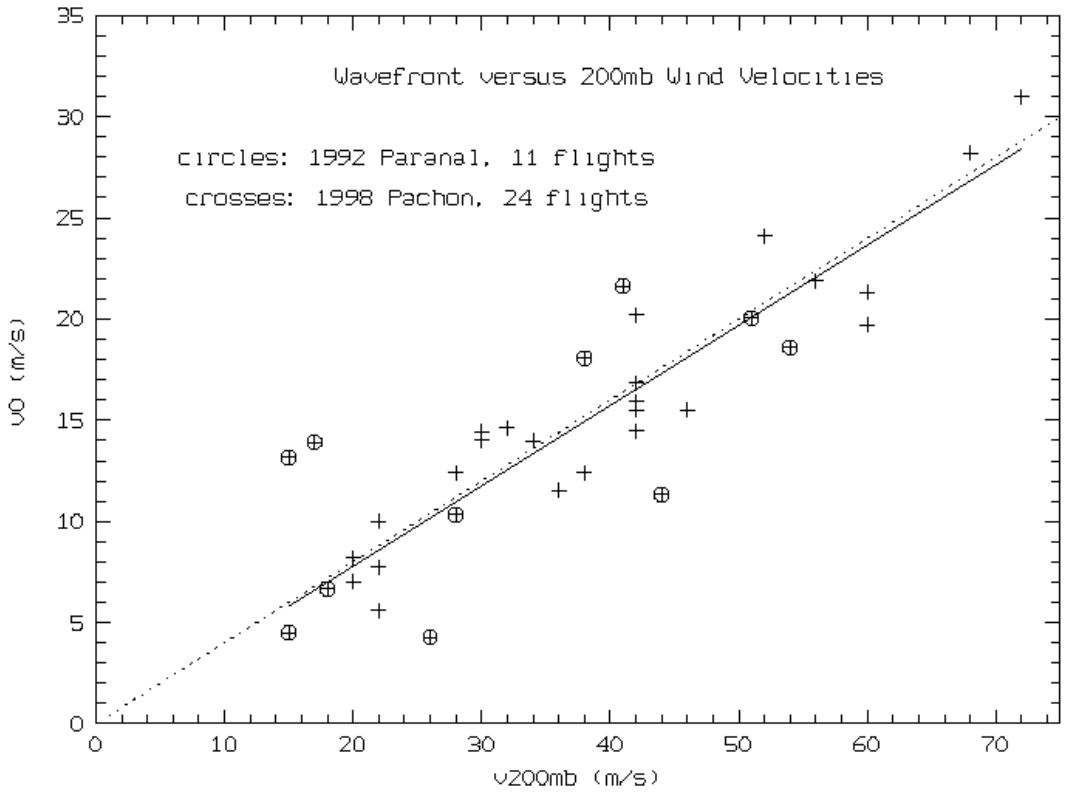
Routine Measurements at ESO Observatories

Marc Sarazin
European Southern Observatory

Rationale for Tau0 and Theta0

Comparison of wavefront velocity V0 and 200mb wind speed during Paranal and Gemini balloon campaigns

$V0 = 0.4\ V_{200mb}$

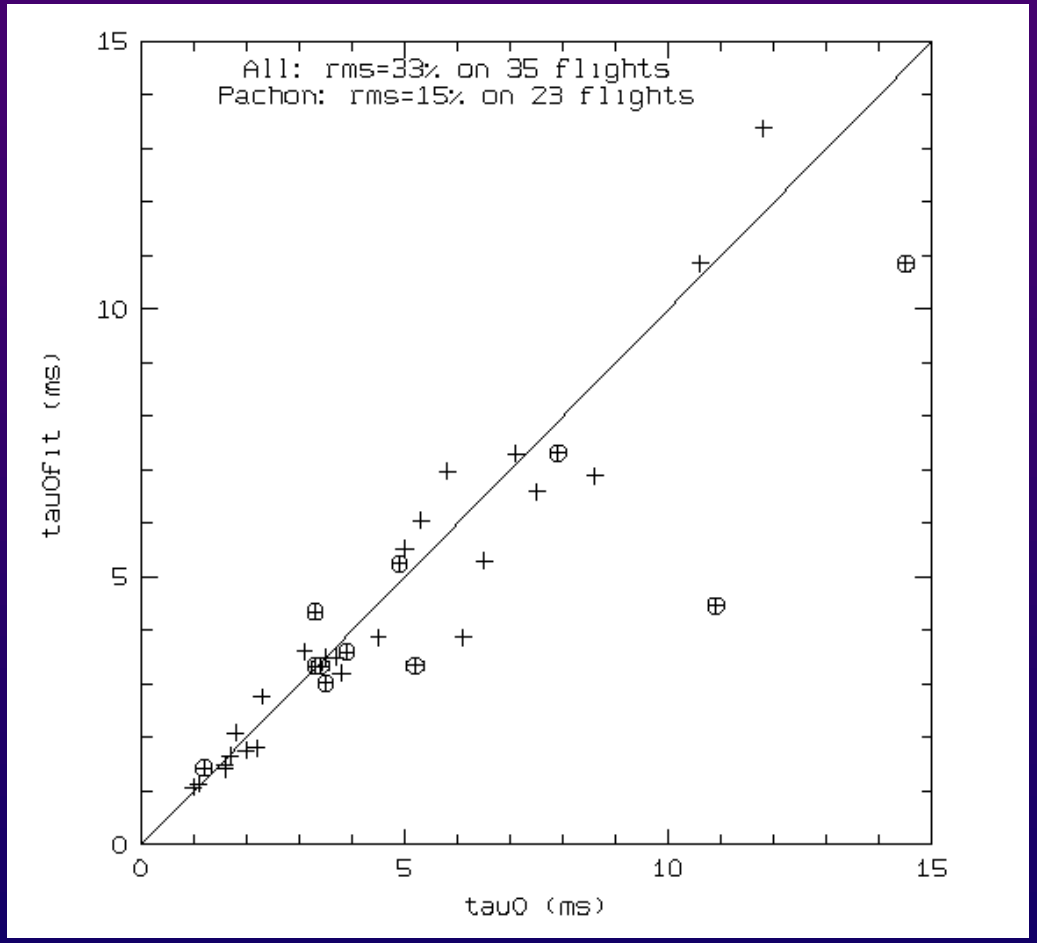


Rationale for Tau0 and Theta0

Estimate of the coherence time from 200mb wind velocity during Paranal and Gemini balloon campaigns

$V0_{fit} = Max(V_{ground}, 0.4\ V_{200mb})$

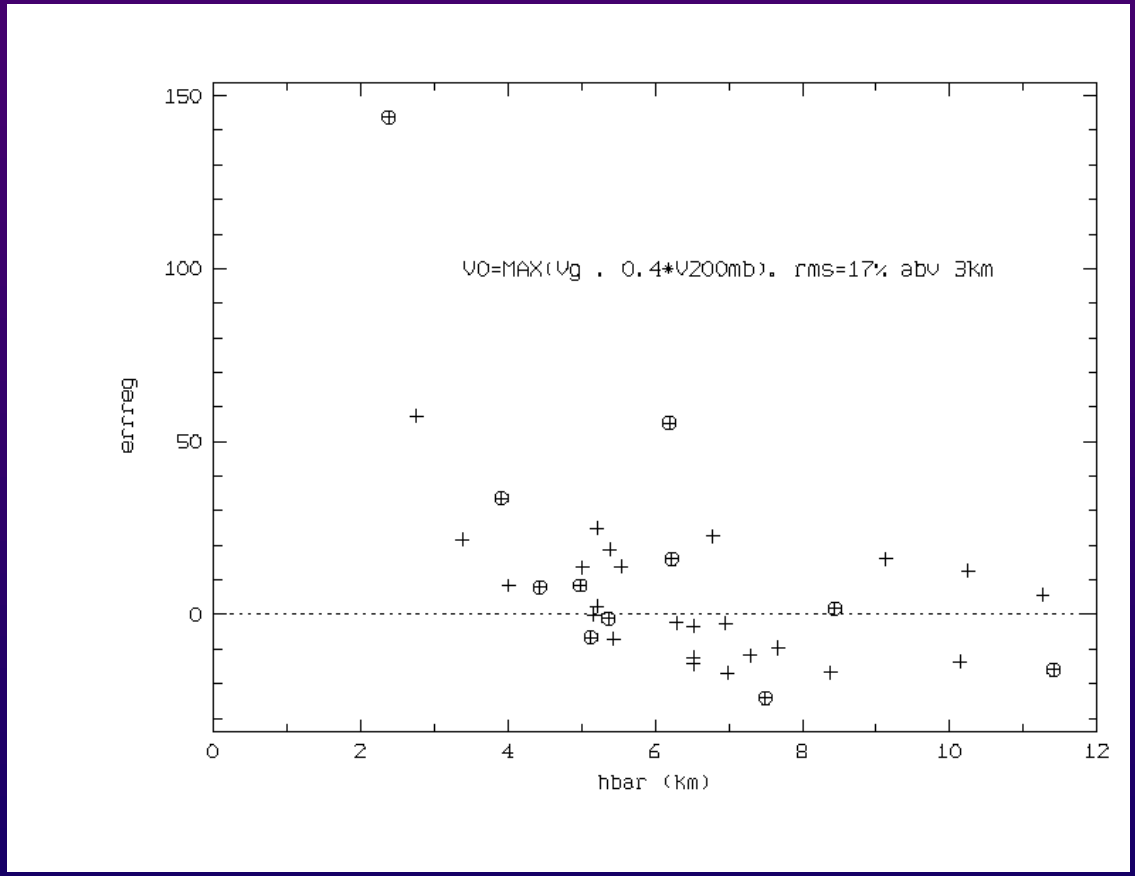
$Tau0_{fit} = 0.31\ r0 / V0_{fit}$



Rationale for Tau0 and Theta0

The error on the estimate of the coherence time from 200mb wind velocity increases when low level turbulence dominates (Paranal and Gemini balloon campaigns)

$H_{bar} = 0.314\, r_0 / \text{Theta0}$

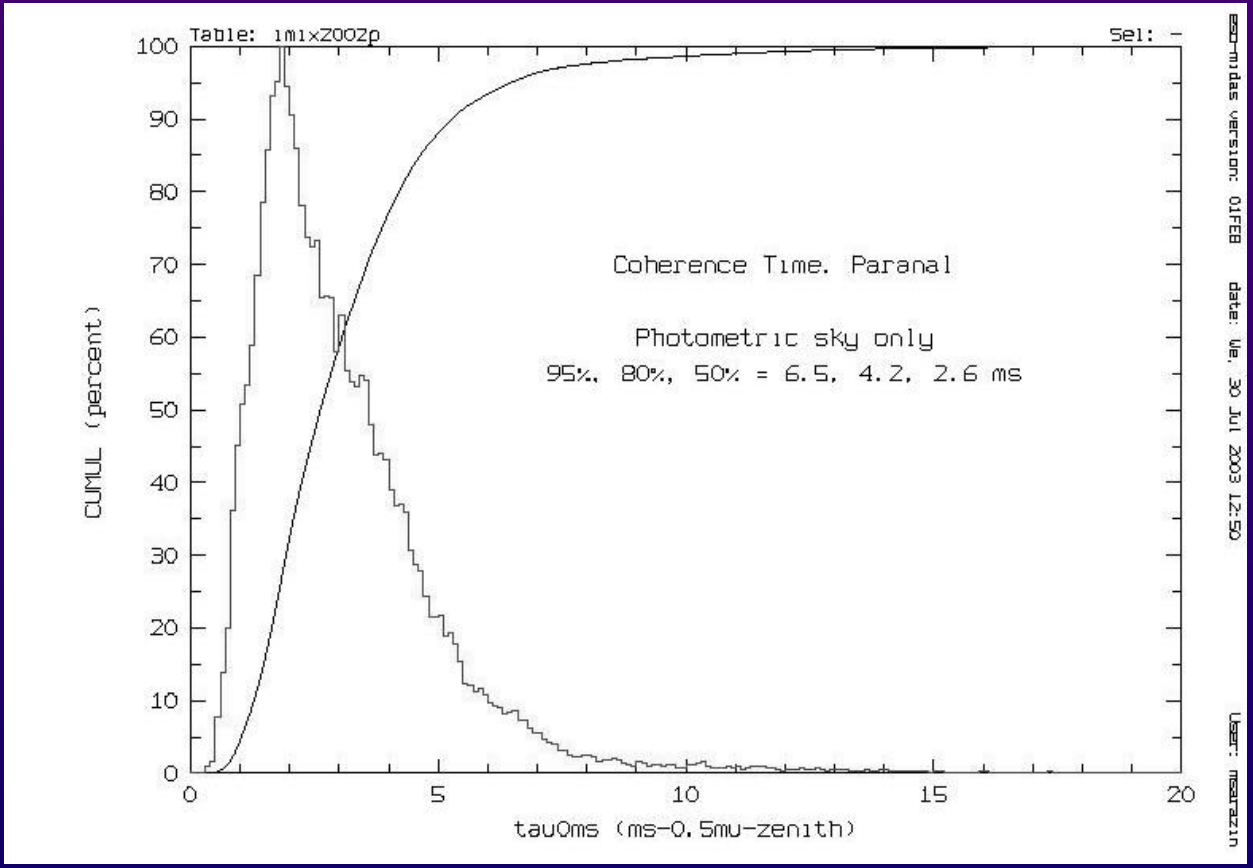


Statistics of Tau0 at Paranal

Paranal statistics 1999-2002

3.6, 3.6, 3.2, 2.6 ms

yearly median Tau0

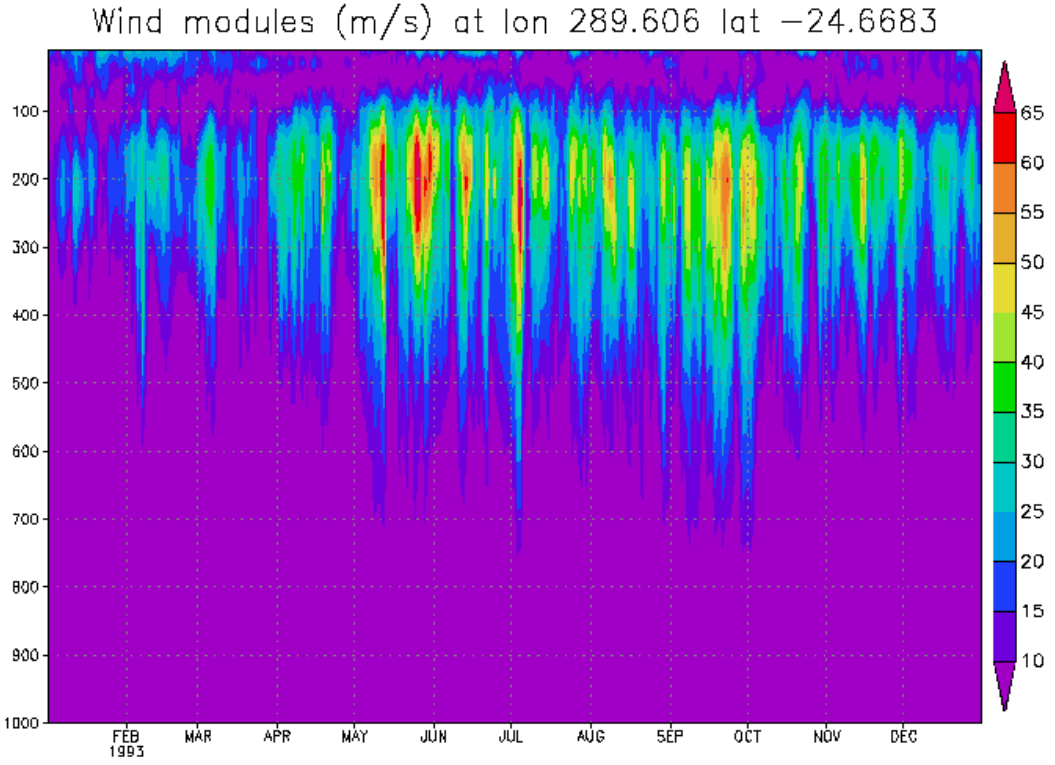


Statistics of Tau0 at Paranal

Paranal statistics 1999-2002

The strong seasonal trends of Tau0 are due to Jet Stream variability

80% of the dark time below 3ms in January, only 30% in June

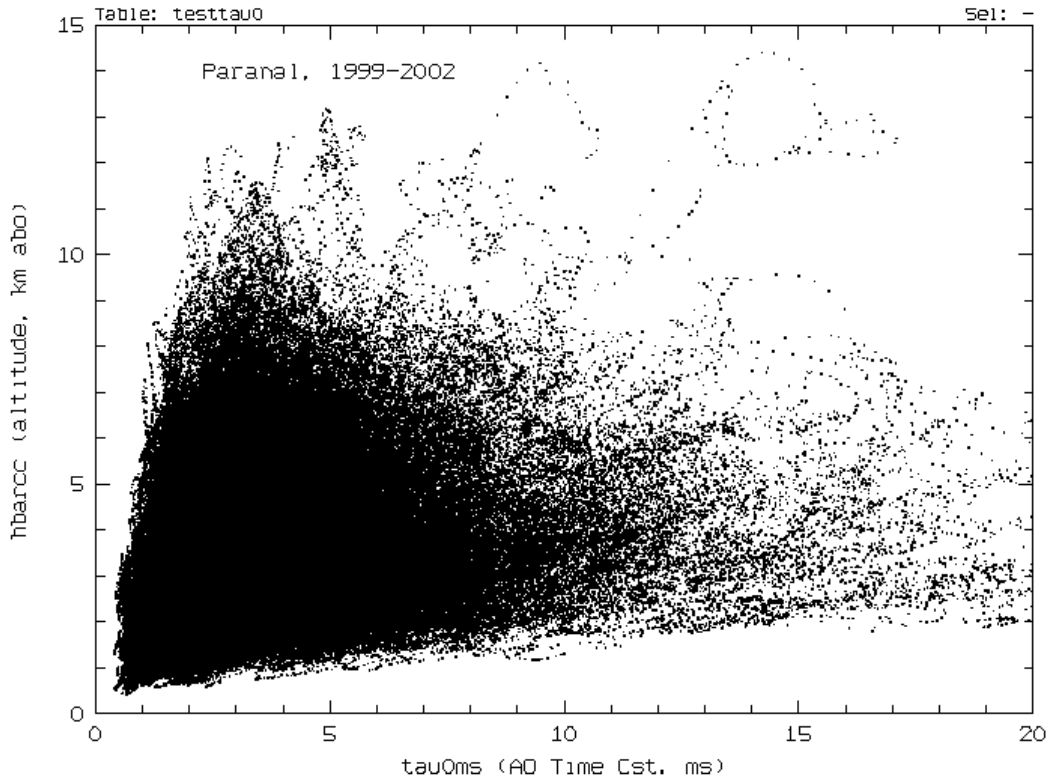


Statistics of Tau0 at Paranal

Paranal statistics 1999-2002

No obvious correlation between Tau0 and Hbar but a trend:

slow is low and high is fast

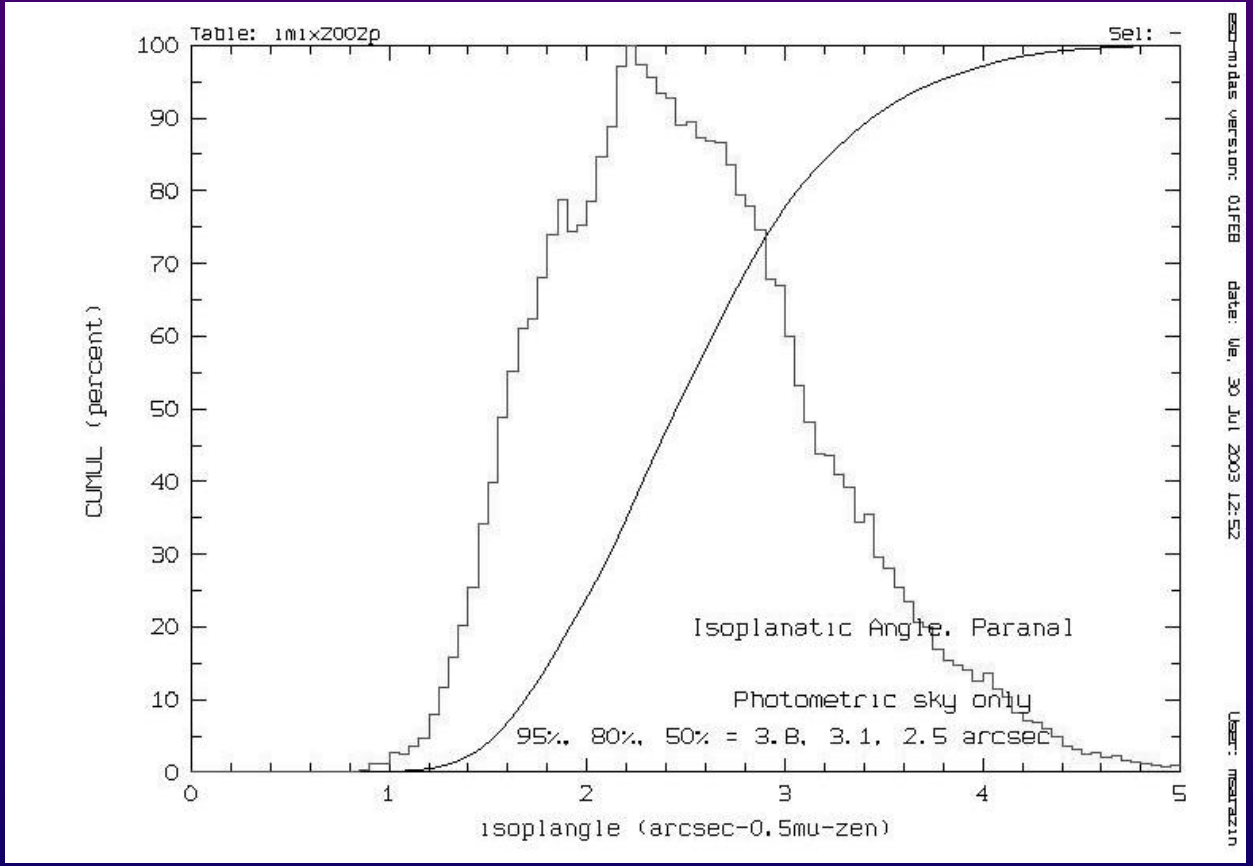


Statistics of Theta0 at Paranal

Paranal statistics 1999-2002

2.5, 2.6, 2.1, 2.5 arcsec yearly median Teta0

From 5ms exposure scintillation measured through 11cm DIMM circular aperture (Sarazin & Tokovinin, 2001)

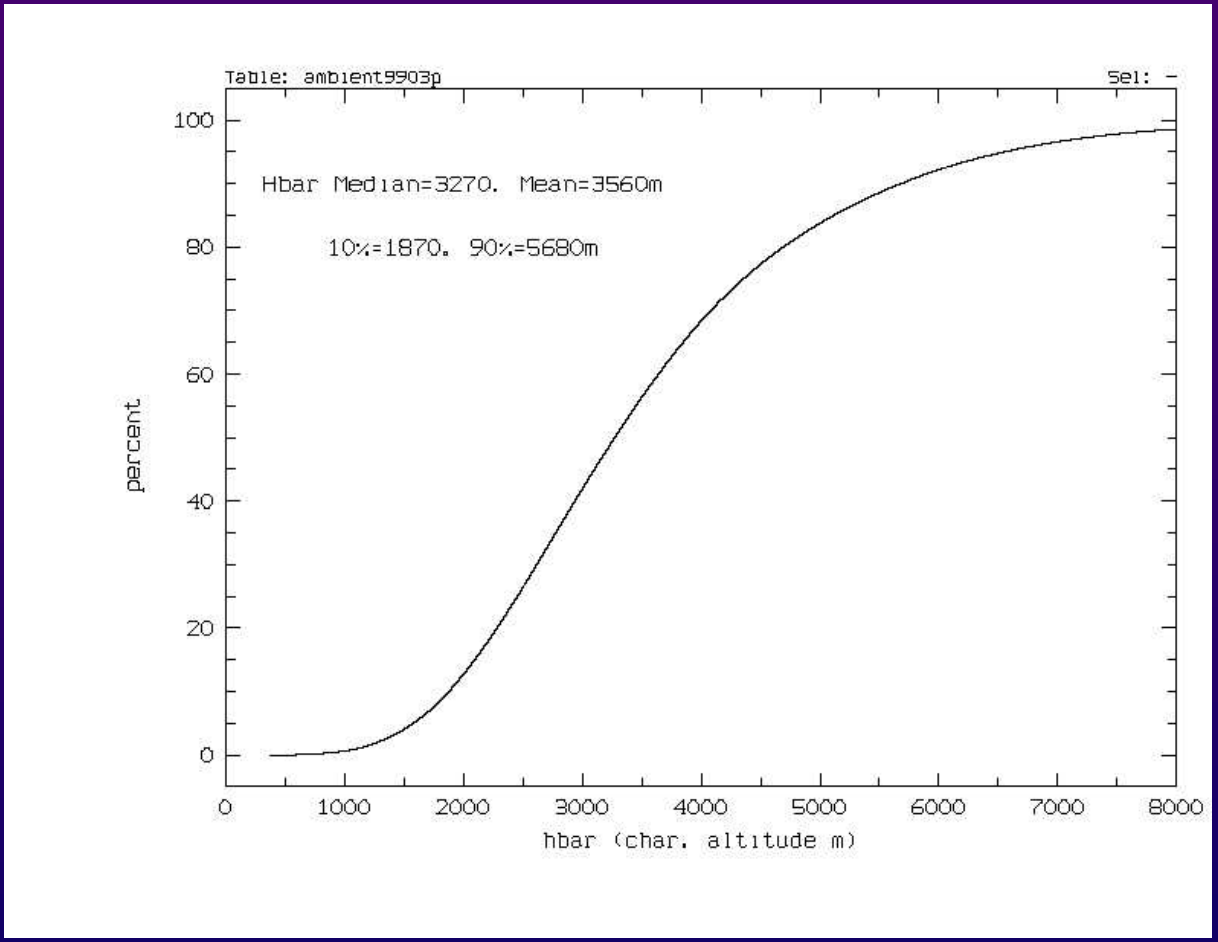


Statistics of Hbar at Paranal

Paranal statistics 1999-2003

Median Hbar of 3270m above site level
(to be compared to 3500m found at Mauna Kea from science image analysis by Rigaut, PASP 114 2002 Sep.)

$H_{bar} = 0.314\ r_0 / \theta_0$

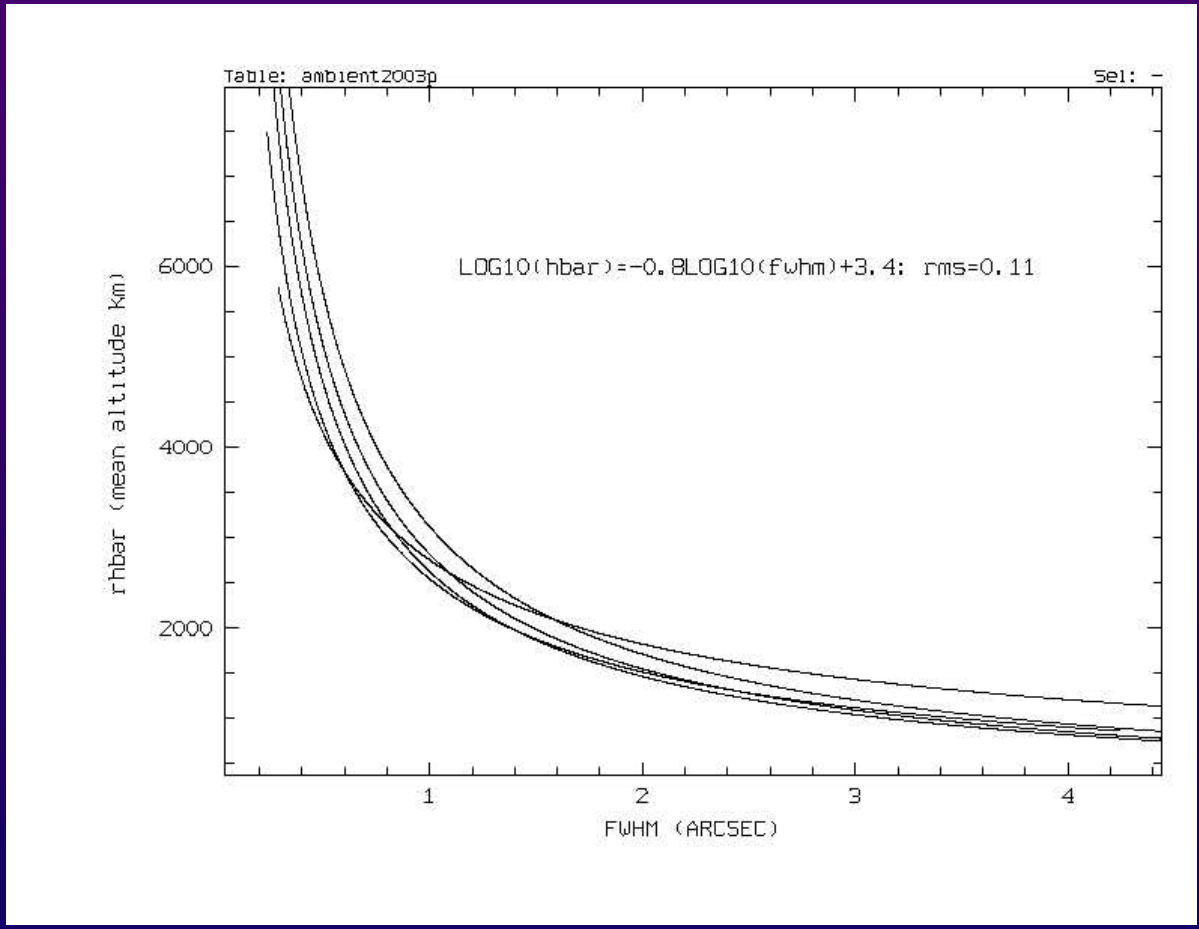


Statistics of Hbar at Paranal

Paranal statistics 1999-2003

Hbar is larger above Paranal in good seeing conditions

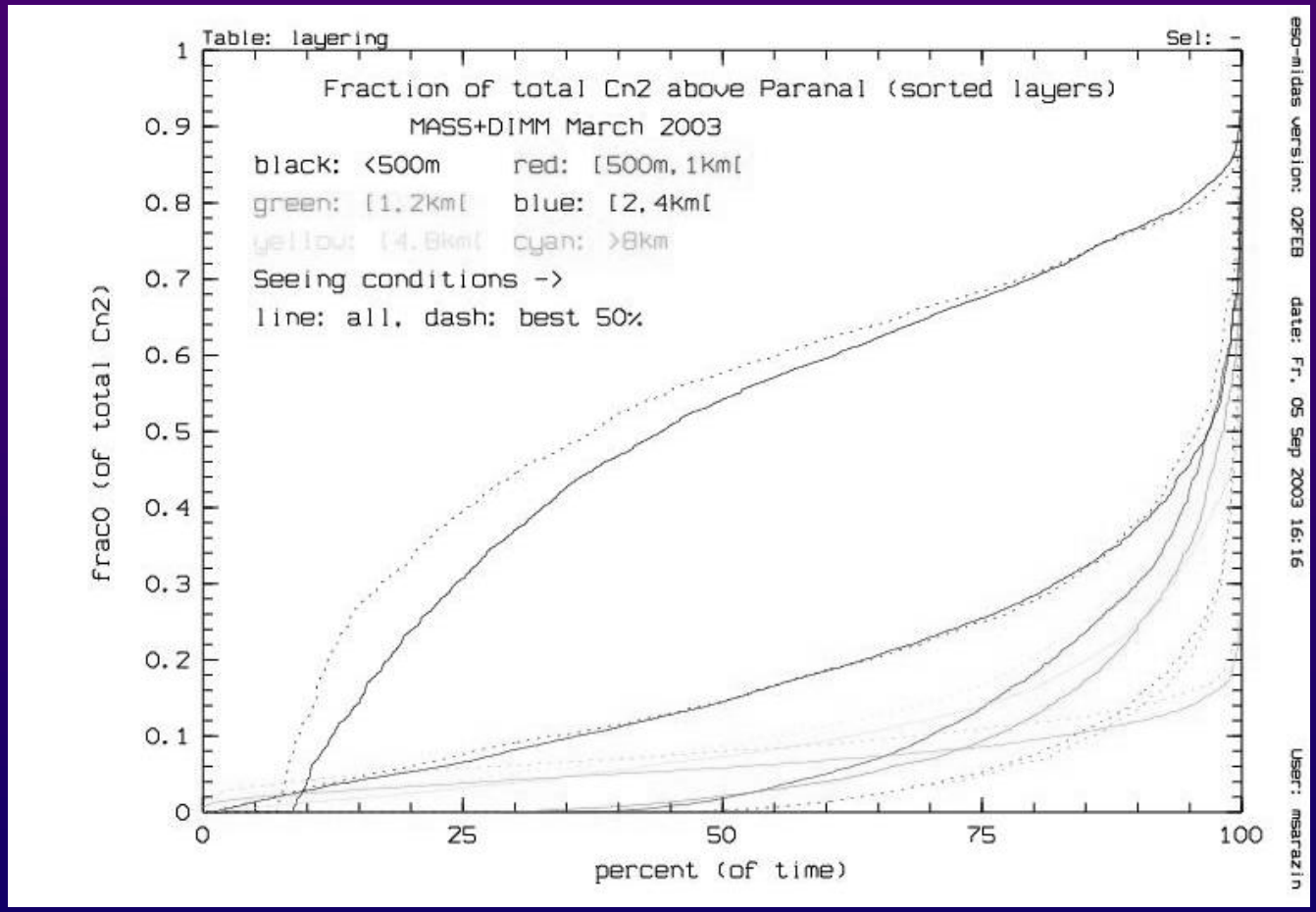
$H_{bar} = 0.314\ r_0 / \theta_0$



1st MASS statistics at Paranal

MASS Paranal statistics
10 nights in March 2003

The lowest 500m represent more than 60% of the total seeing
Less than 5% above 8km

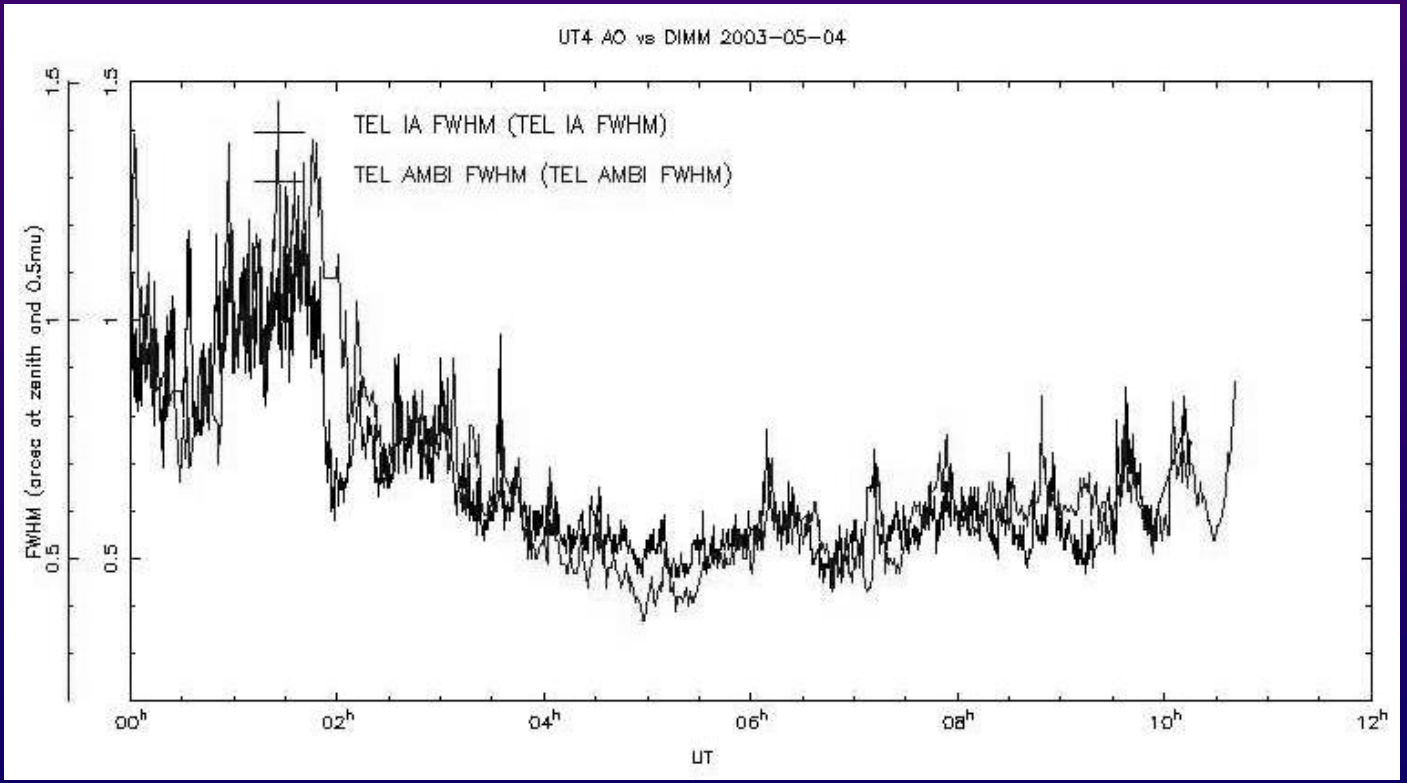


What do we know about the Outer Scale

Marc Sarazin
European Southern Observatory

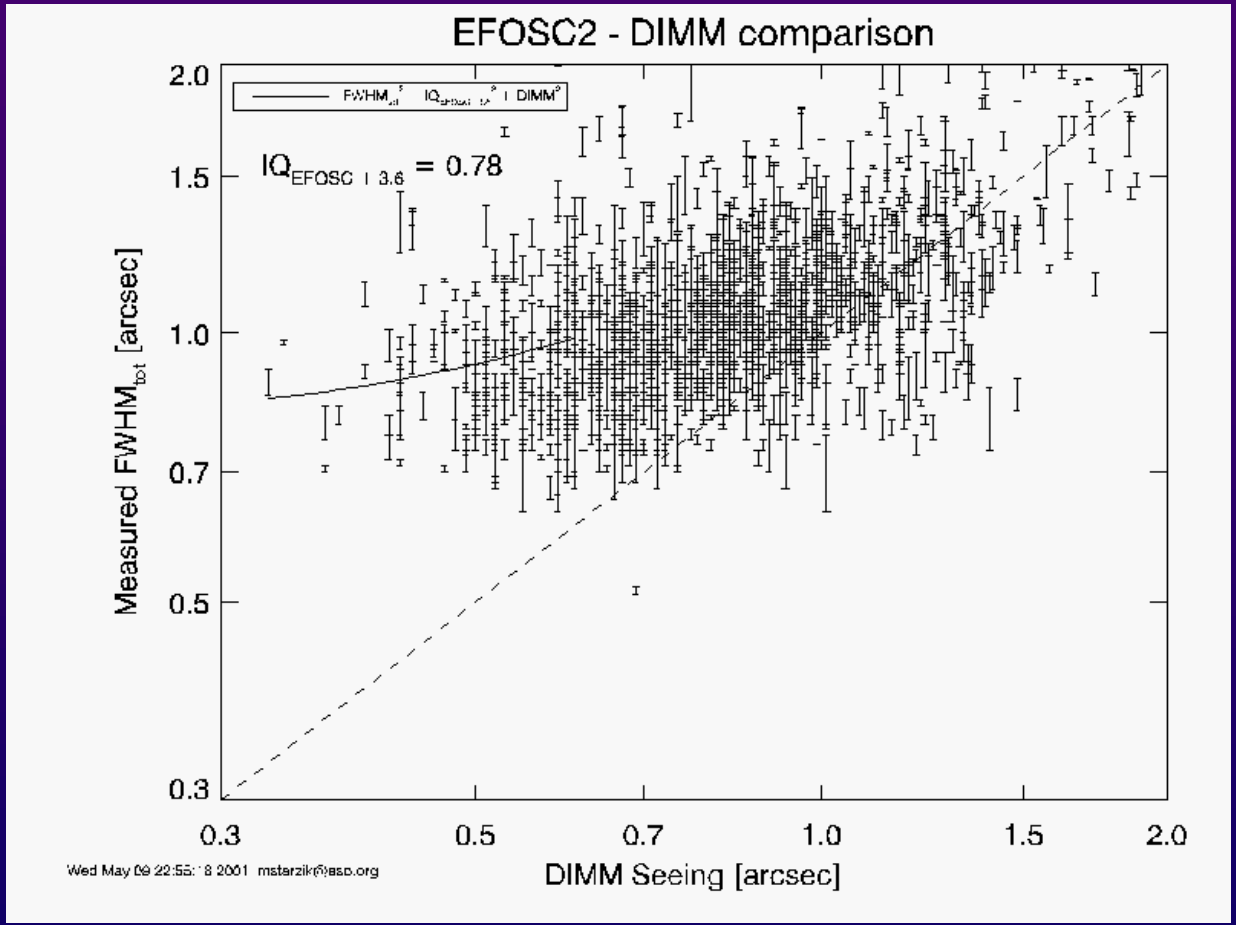
What do we know about the Outer Scale

- The DIMM seeing compares well with UT Active Optics SH individual FWHM in the visible



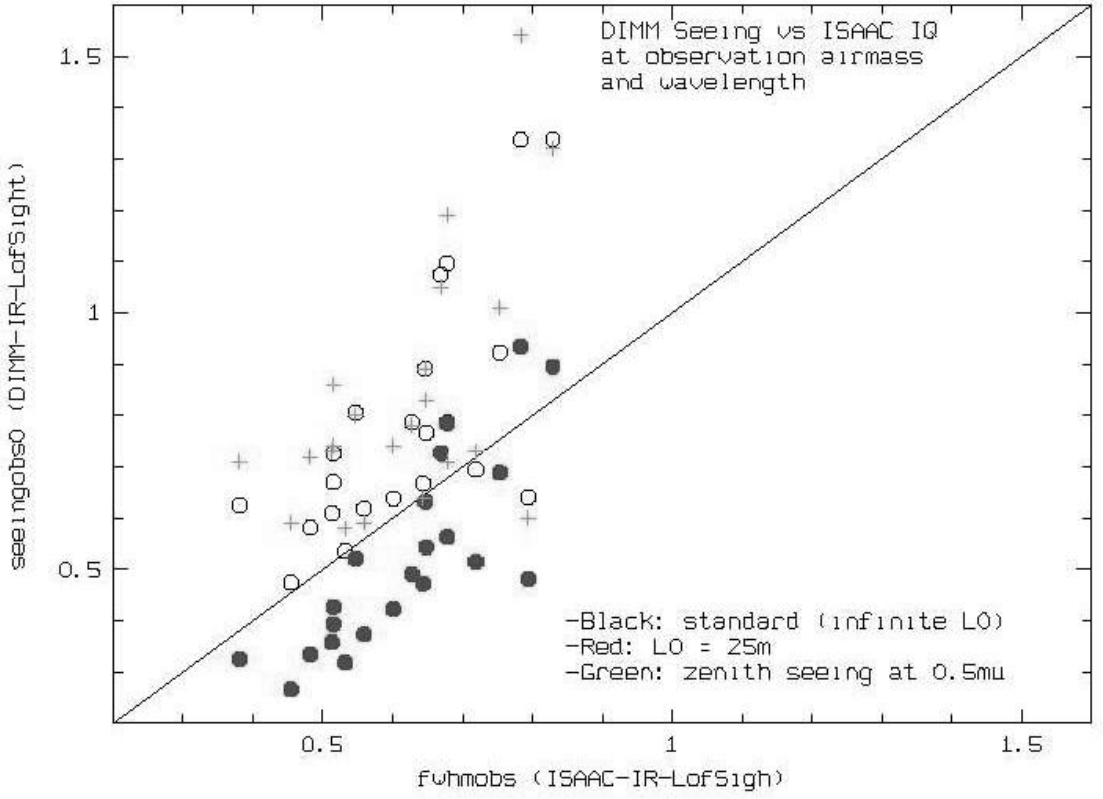
What do we know about the Outer Scale

- The DIMM seeing compares well with science image quality in the visible (0700-0501)



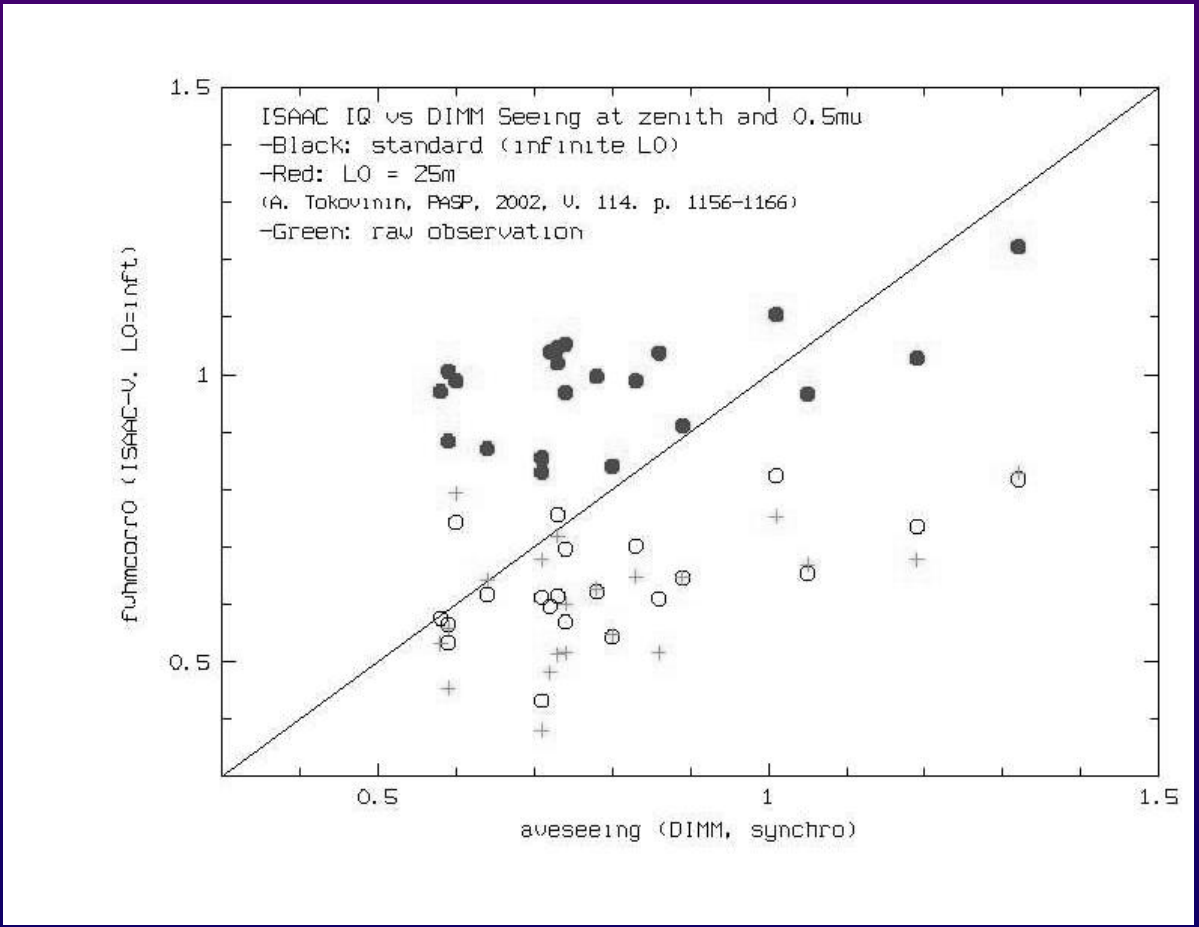
What do we know about the Outer Scale

- The DIMM seeing is systematically larger than the FWHM of UT Infrared science images



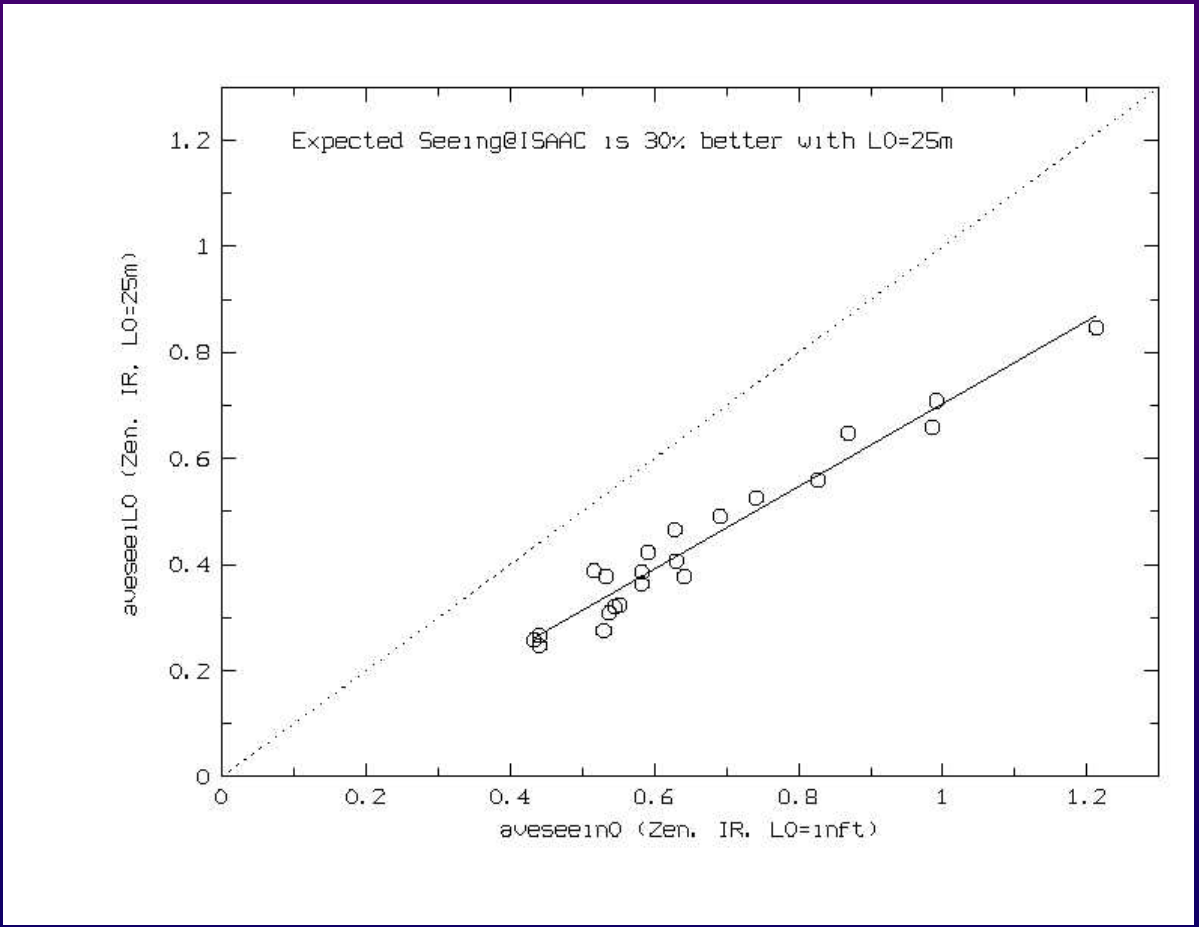
What do we know about the Outer Scale

- The DIMM seeing has thus to be corrected for finite outer scale for IR observations



What do we know about the Outer Scale

- The IR site seeing is 30% better with 25m outer scale than with infinite outer scale on a 8m telescope

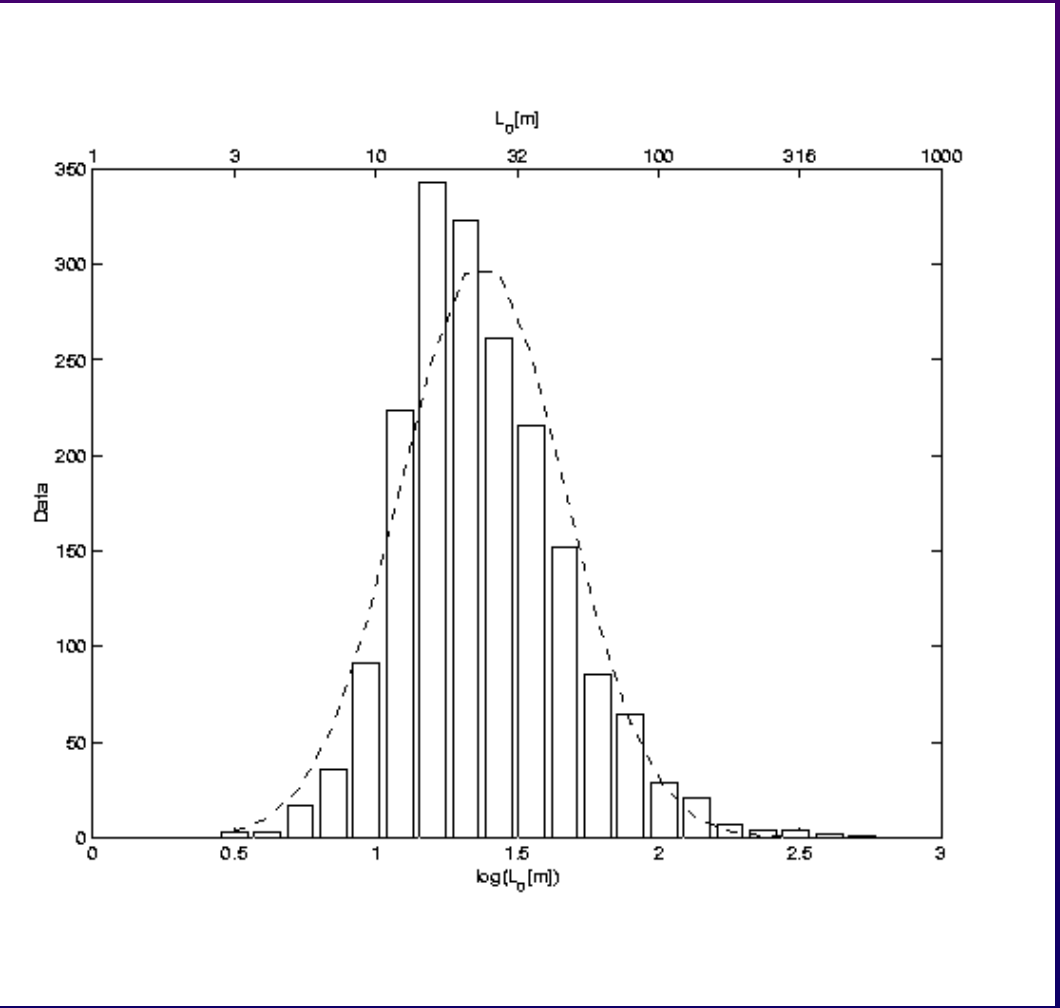


What do we know about the Outer Scale

- The definition of the outer scale is model dependent
- Different monitoring techniques give different results
  - Balloon borne Ct2 sensors: metric
  - Wave front Tilt correlation (GSM): decametric
  - Interferometer phase correlation: hectometric, even kilometric
- The 8m class telescopes confirm the decametric hypothesis
  - Keck tilt variance deficit (L0 <50m, Gleckler, 1994)
  - VLT-UT NACO closed loop (T. Fusco)

What do we know about the Outer Scale

- The outer scale has similar distribution at all sites (GSM data)



What do we need to know about the Outer Scale

- Are individual layers outer scales different from L0 measured at the ground?
- Is the outer scale larger at higher altitudes? Smaller close to the ground?
- What is the temporal behavior of L0 during the lifetime of a turbulent layer:
  - Turbulence recently triggered, reaching the well developed status
  - Isotropic Kolmogorov
  - Injection stopped, cascading out
- Is the von Karman model still OK for a 100m aperture?