

The TMT MASS System: Characterization and Application

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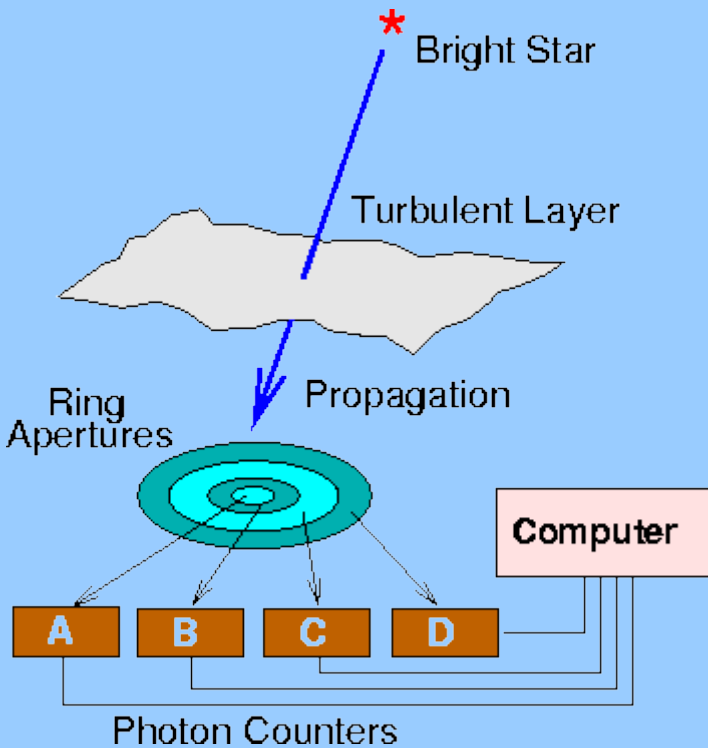
- * Outline of the MASS system
- * Sensitivity of MASS results on instrumental parameters
- * The Tololo campaign – its MASS part
- * Ground layer seeing deduced from MASS DIMM measurements

Multi Aperture Scintillation Monitor = MASS

Size of the “flying shadow” $\sim \sqrt{\lambda D}$
 D = Distance from turbulence layer

=> Low resolution turbulence profile

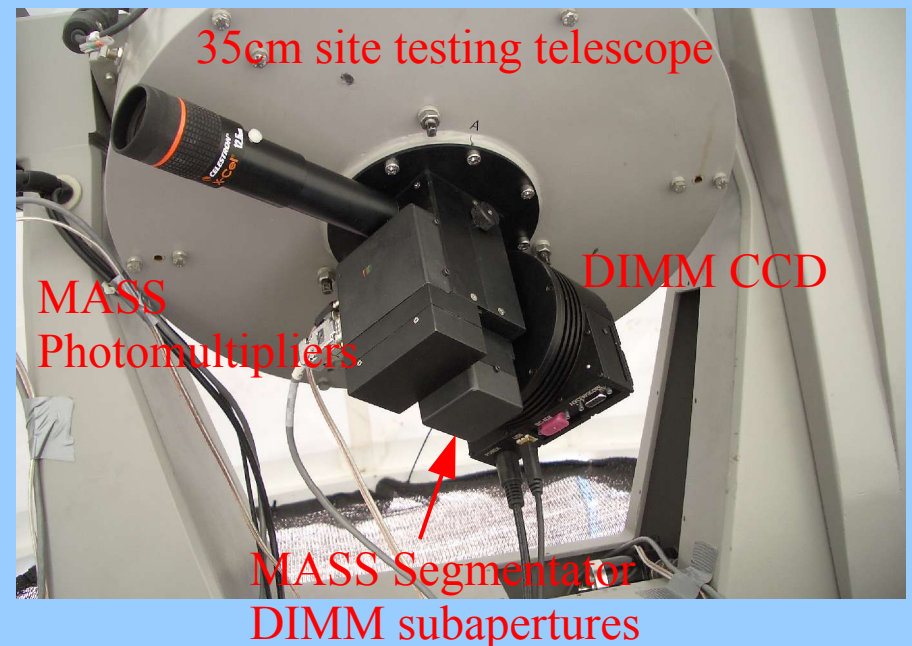
$$C_N^2(h) dh ; dh/h = 0.5$$
$$h = 0.5, 1, 2, 4, 8, 16 \text{ km}$$



From A. Tokovinin's MASS webpage
<http://www.ctio.noao.edu/~atokovin/profiler/index.html>
or
Tokovinin et al., 2003, MNRAS, 343, 891

The TMT site testing project employs combined MASS-DIMM units

- compact (see picture)
- rugged (no moving parts)

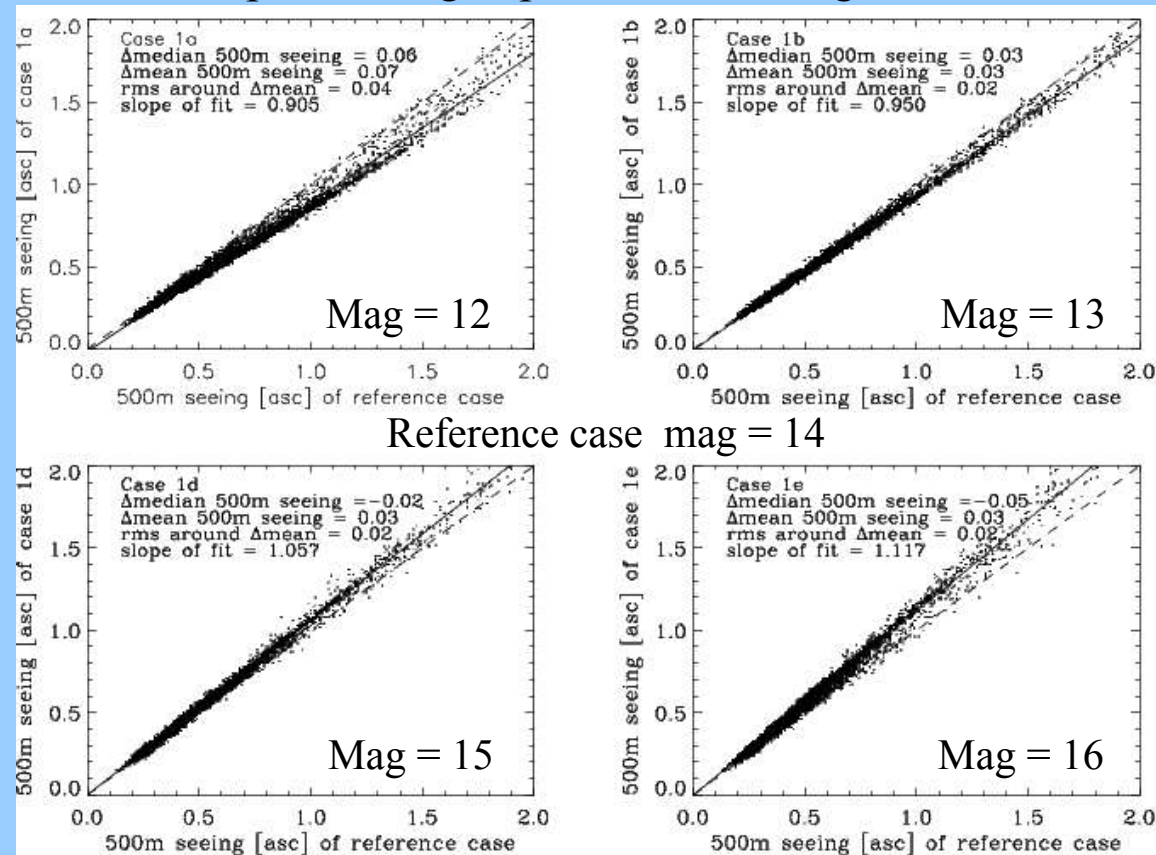


Dependence of MASS results on instrumental parameters

Employing the MASS processing software *atmos* (Kornilov et al. 2006, *priv. com.*) using one month of MASS data and reprocess them changing

- Instrument magnification
- PMT Poisson parameter
- PMT linearity
- Spectral response

Example: Seeing dependence on magnification



Conclusion:

If these parameters are well known (instrument monitoring) then

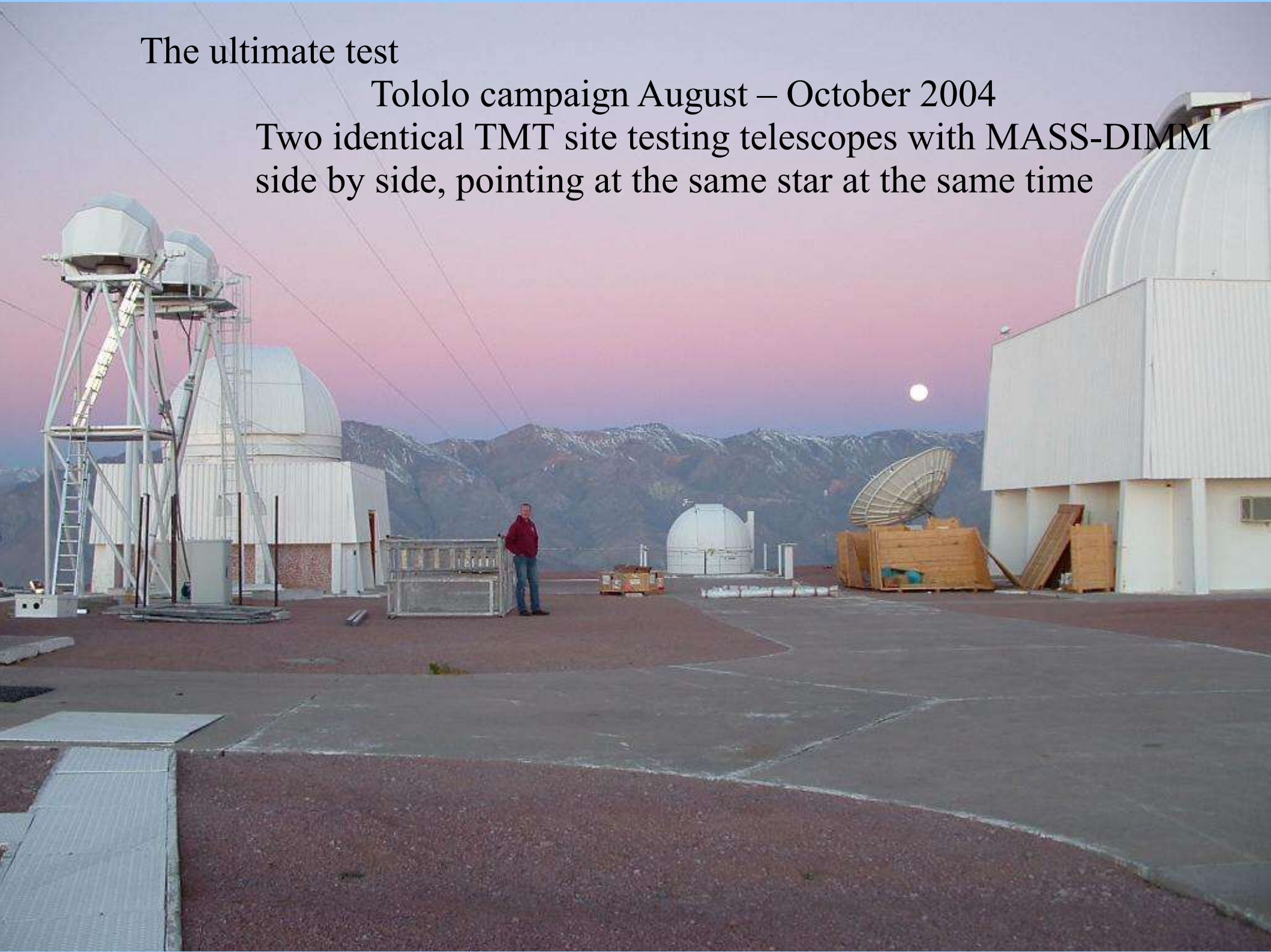
* The seeing accuracy is better than 0"06

* The $C_N^2(h) dh$ accuracy of each layer is better than 10^{-14}
(these are conservative numbers !)

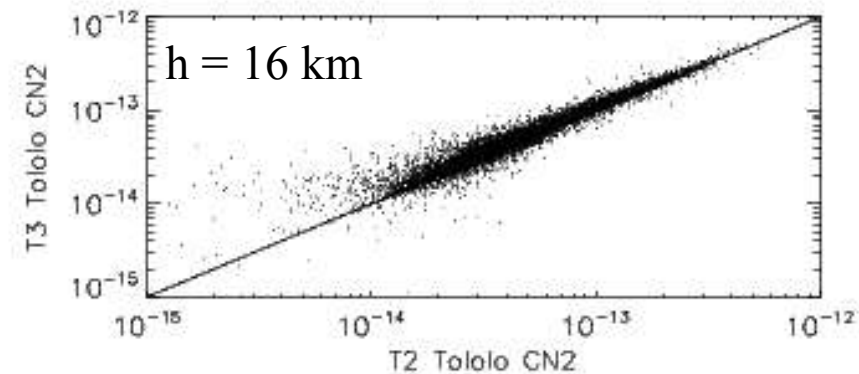
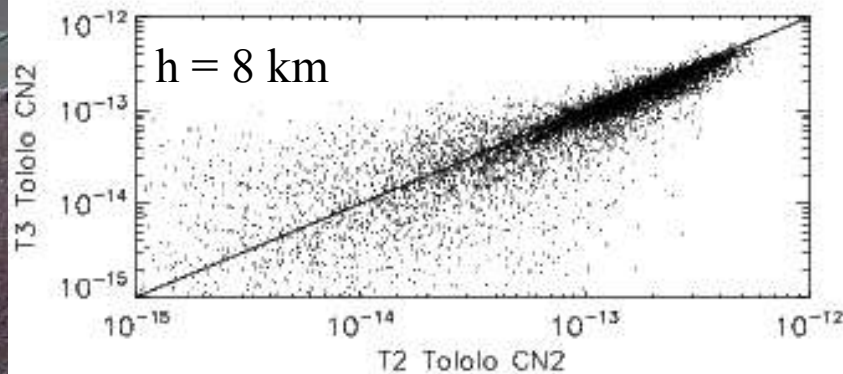
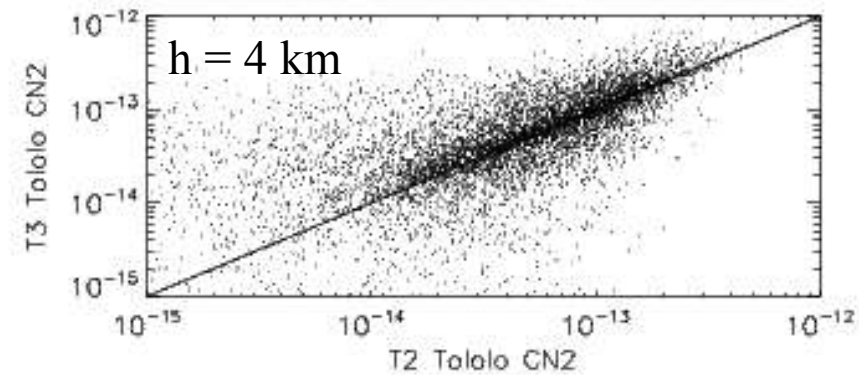
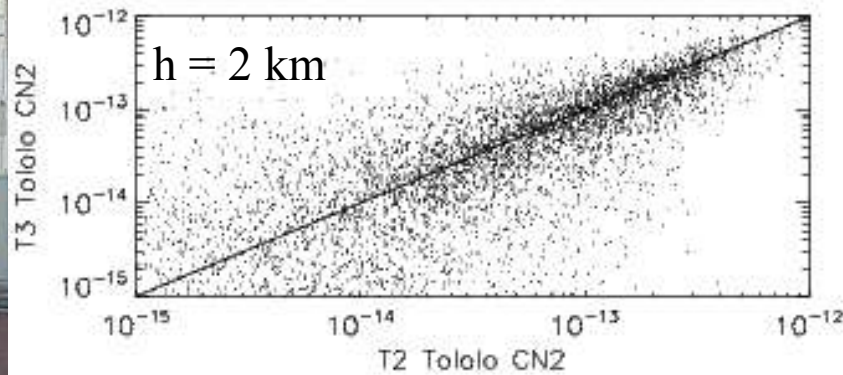
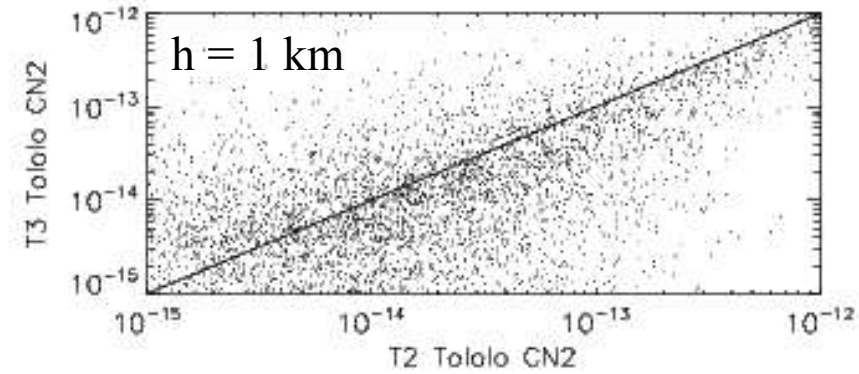
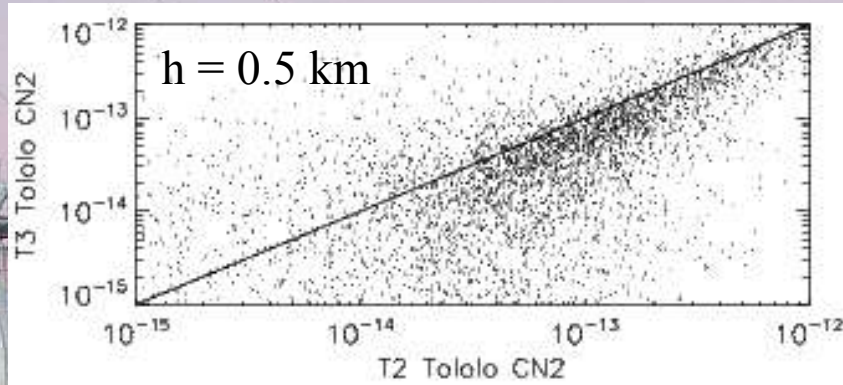
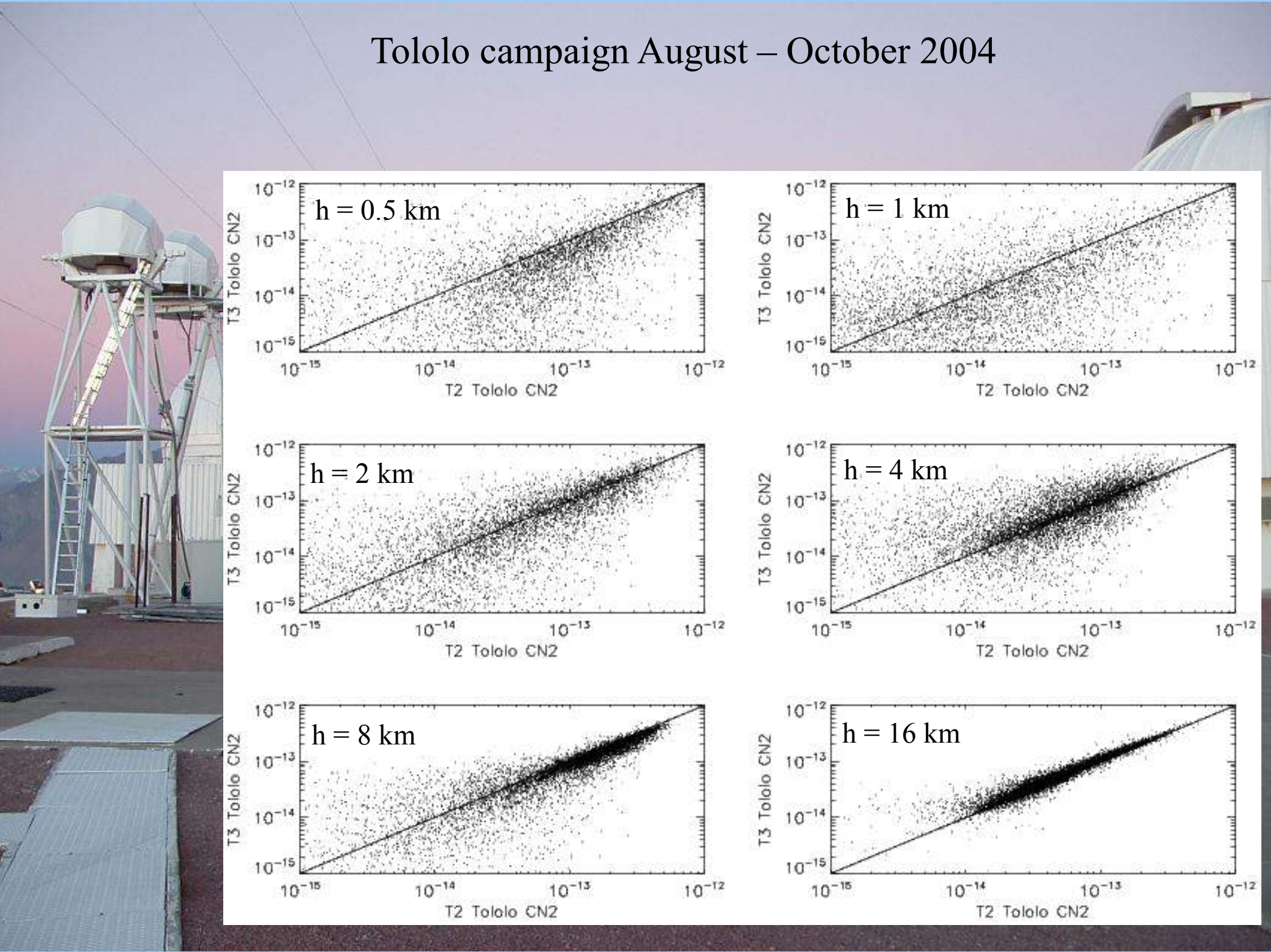
The ultimate test

Tololo campaign August – October 2004

Two identical TMT site testing telescopes with MASS-DIMM side by side, pointing at the same star at the same time



Tololo campaign August – October 2004

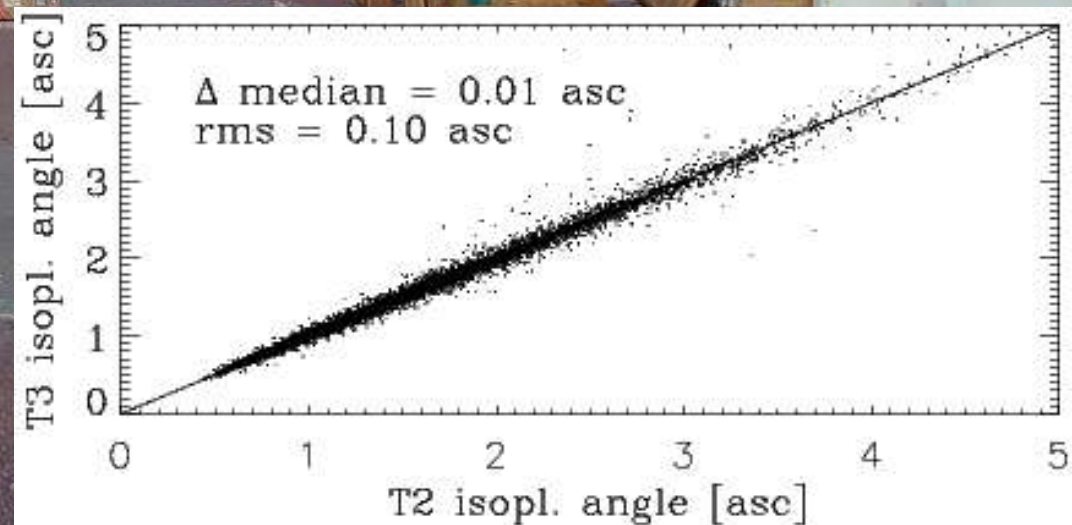
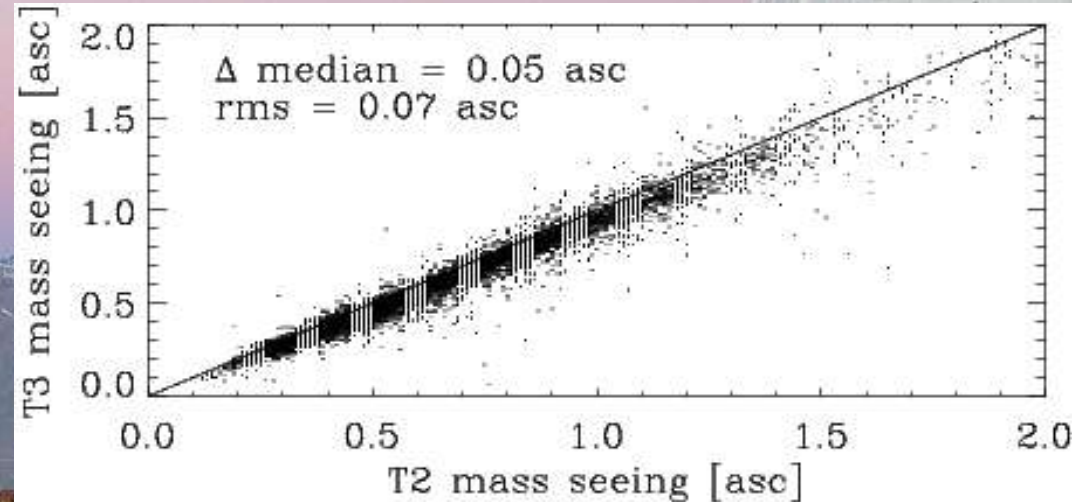


Statistical agreement between two MASS systems

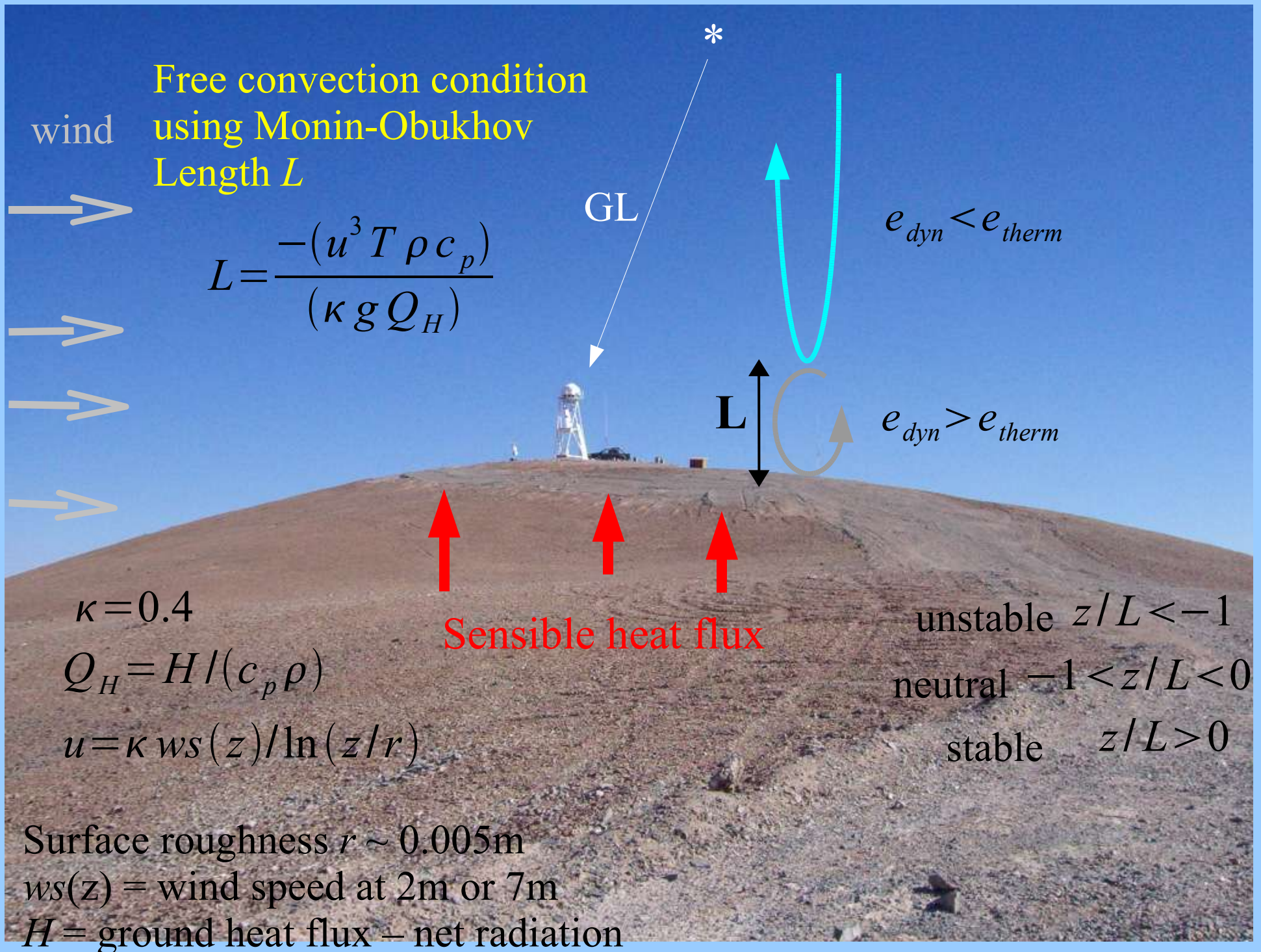
- Seeing (500m – inf) $0''05$
- Isoplanatic angle $0''01$

- Individual layers ≥ 4 km
 $C_N^2(h) dh$ $10e-14$

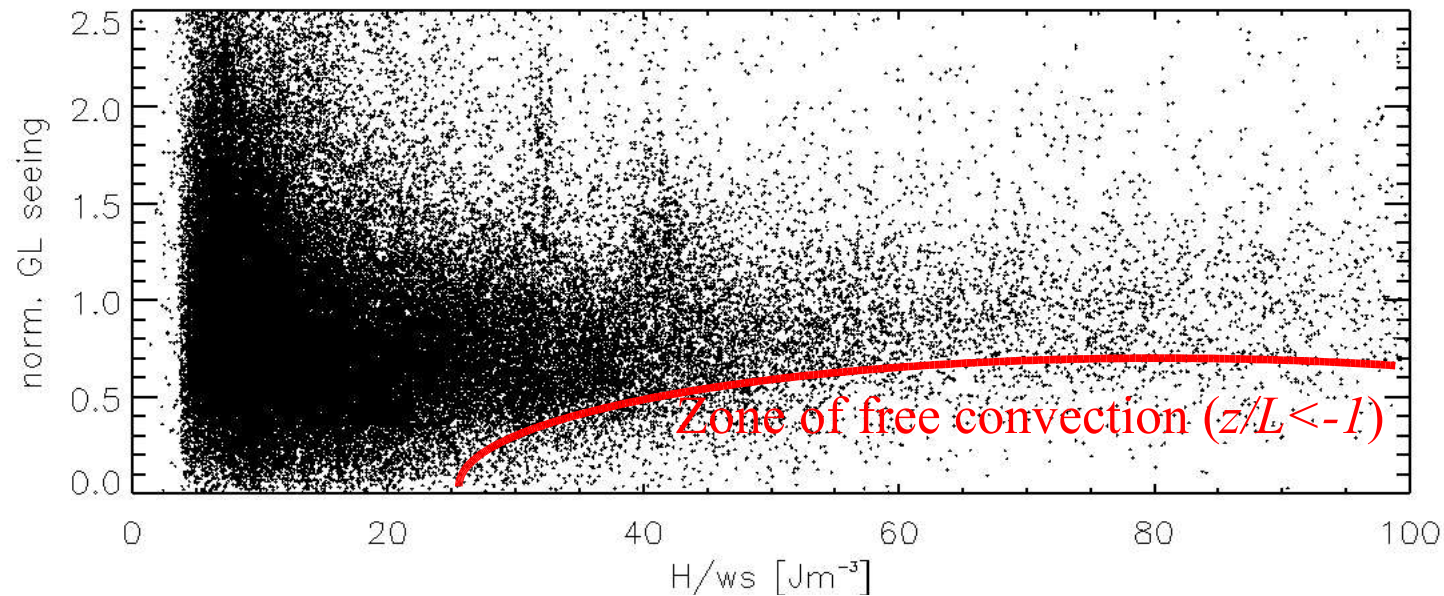
- Individual layers < 4 km
poor agreement



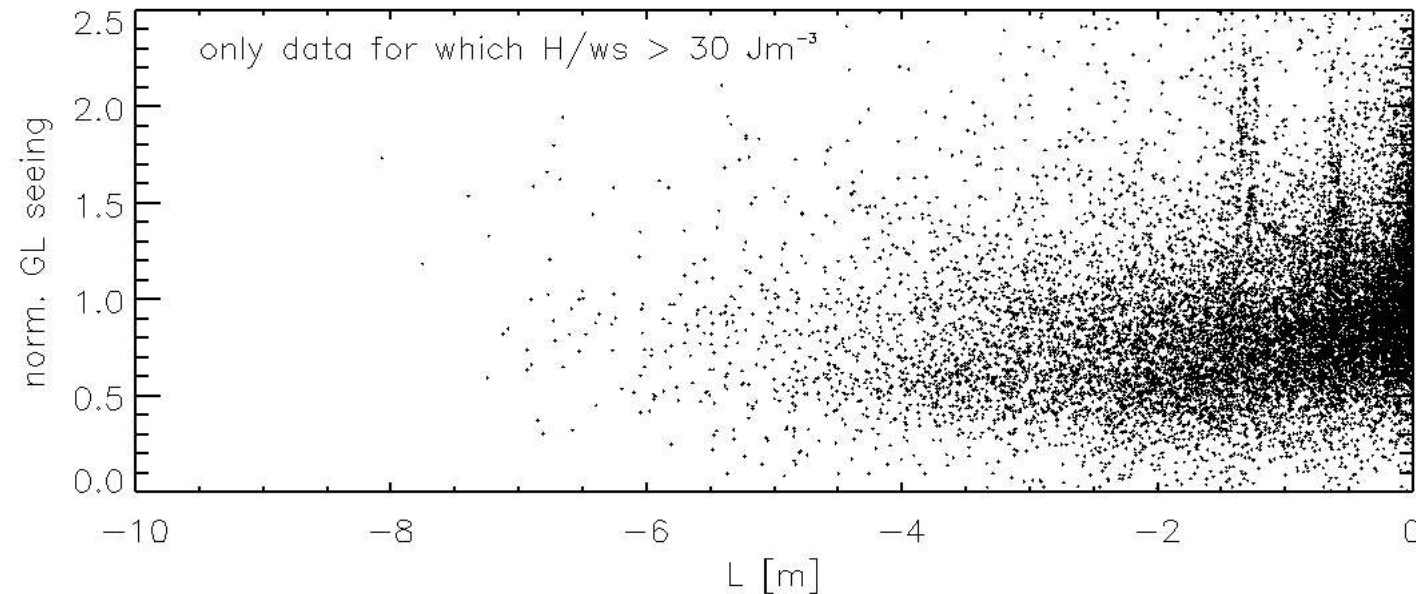
Using MASS and DIMM to trace the seeing from 0-500m (GL)



General dependence of the GL seeing on the ground sensible heat flux and wind speed



Sensible heat flux
divided by
wind speed
 H/ws



$H/ws > 30 J/m^3$
 $\Rightarrow |L| < \sim 5$ m

Els & Vogiatzis (2006)
Els & Vogiatzis (2007)

In agreement with CFD simulations (-> talk by K. Vogiatzis on Thursday, session 4)