The Seeing and Turbulence Profile at Las Campanas Observatory: GMT Site Testing Progress Report

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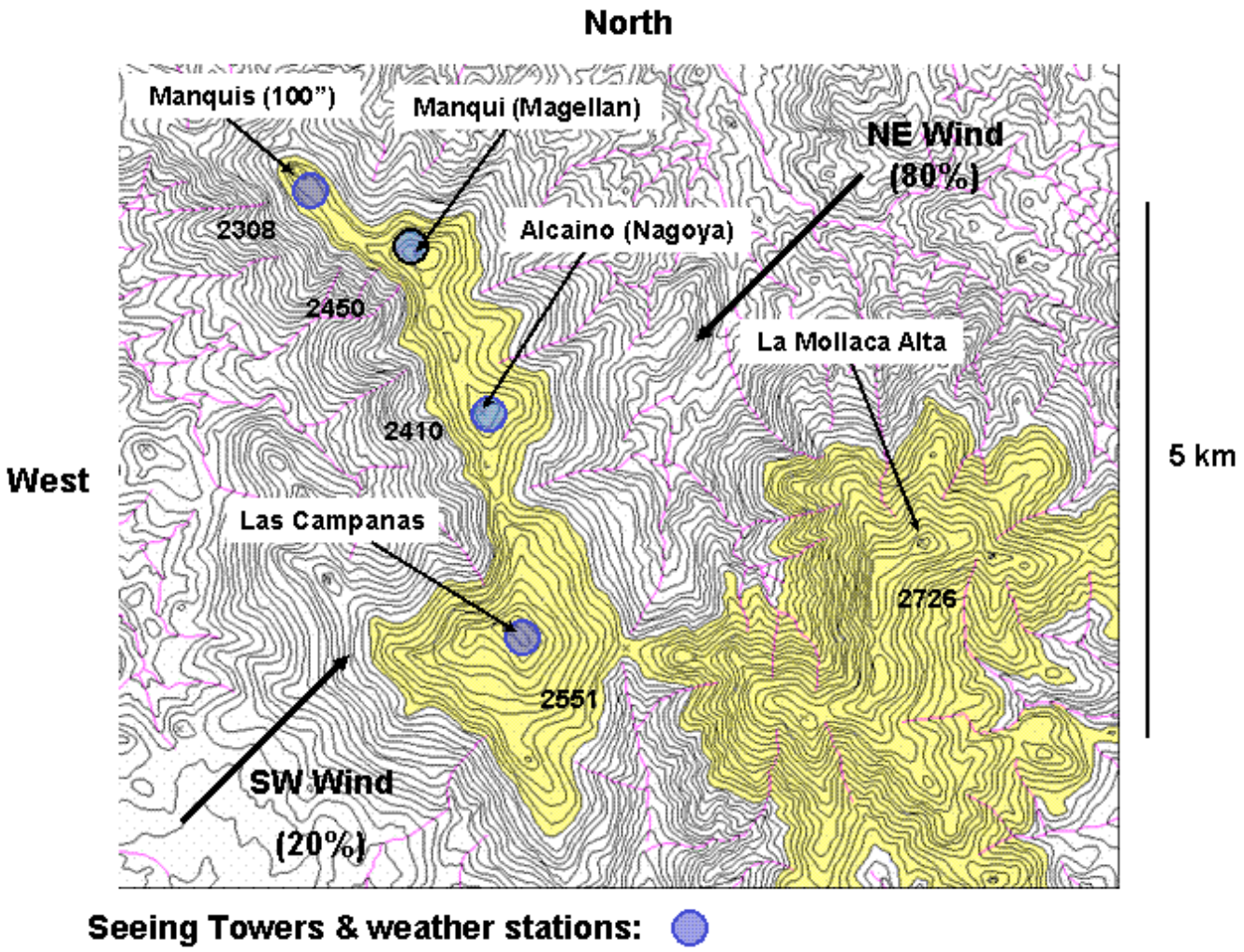
- Overview of GMT Site Testing Program
- Review of LCO Properties
- Preliminary Seeing and TP results

LCO: The GMT Baseline Site

- The GMT SWG deems that LCO has the potential to meet all of the GMT science goals
- LCO is a developed site with a 30 year history of excellence
  - Light pollution is negligible and should stay that way for decades to come
  - Quality of the seeing is as good or better than that at any other developed site in Chile
  - Weather pattern has been stable over the past 30+ years
- The GMT site testing effort is concentrated on identifying the best peak within LCO in terms of seeing and wind speeds.
- Quantifying the potential impact of PWV on GMT mid-infrared science requires more precise characterization of the PWV properties of LCO.
- In mid-2008 the data will be assembled in a report that will form the basis of the GMT site selection

Sites Within the LCO Property



LCO Site Characterization

- An extensive site testing program has been underway at LCO for ~2 years to identify the best available location for the GMT
  - Meteorological data (pressure, temperature, wind, and humidity)
  - Seeing measurements
  - Turbulence profiling of the free atmosphere
  - PWV monitoring
  - Cloud cover and light pollution monitoring
- Historical data from 30 years of operation at LCO provide insight on the long-term stability of the site

Summary of Properties of LCO

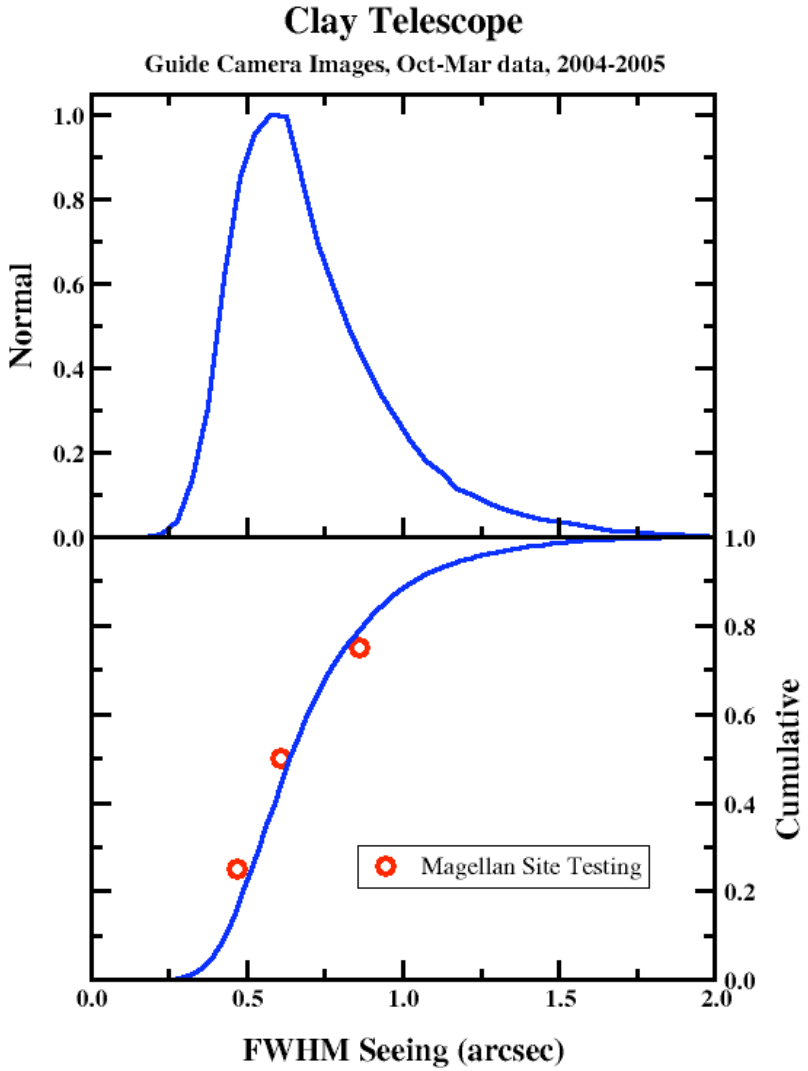
- Negligible light pollution
- Median seeing values that range from 0.6-0.7″ FWHM
  - Best seeing images recorded to date have FWHM ~ 0.2″
  - The seeing has evolved little during the last 25 years
- Average photometric fraction is 60-65%, with ~85% of the potential observing time useful
- Prevailing wind is from the NE ~80% of the time, and from the SW the remaining ~20%
- Fraction of observing time lost to high winds is < 5%
- PWV levels lowest in winter when median is ~2.5 mm

Seeing: Historical Data

- Magellan Telescopes Site Survey tested three sites at LCO (Manquis Ridge, Manqui, & Campanas Peak) during all but the winter season.
- Seeing at Manquis Ridge was found to be slightly worse (0.05″ ± 0.02″) than that at Manqui
- Seeing at Campanas Peak was inferred to be similar to that at Manqui and Alcaino was not considered as it was occupied.

Magellan Telescopes Site Testing: Oct 1988-May 1989				
		Quartiles		
Site	**# Nights**	**25%**	**50%**	**75%**
Manquis Ridge	61	0.47″	0.61″	0.86″
Manqui	61	0.44″	0.59″	0.80″

Seeing: Clay Telescope Guide Camera



- Image quality of the Magellan Clay 6.5 m telescope as measured from guide camera images indicates that the seeing at Manqui hasn't changed significantly since the Magellan Site Testing measurements made 15 years ago
- These data indicate that the seeing is ~0.1″ better in the summer half of the year than the winter half

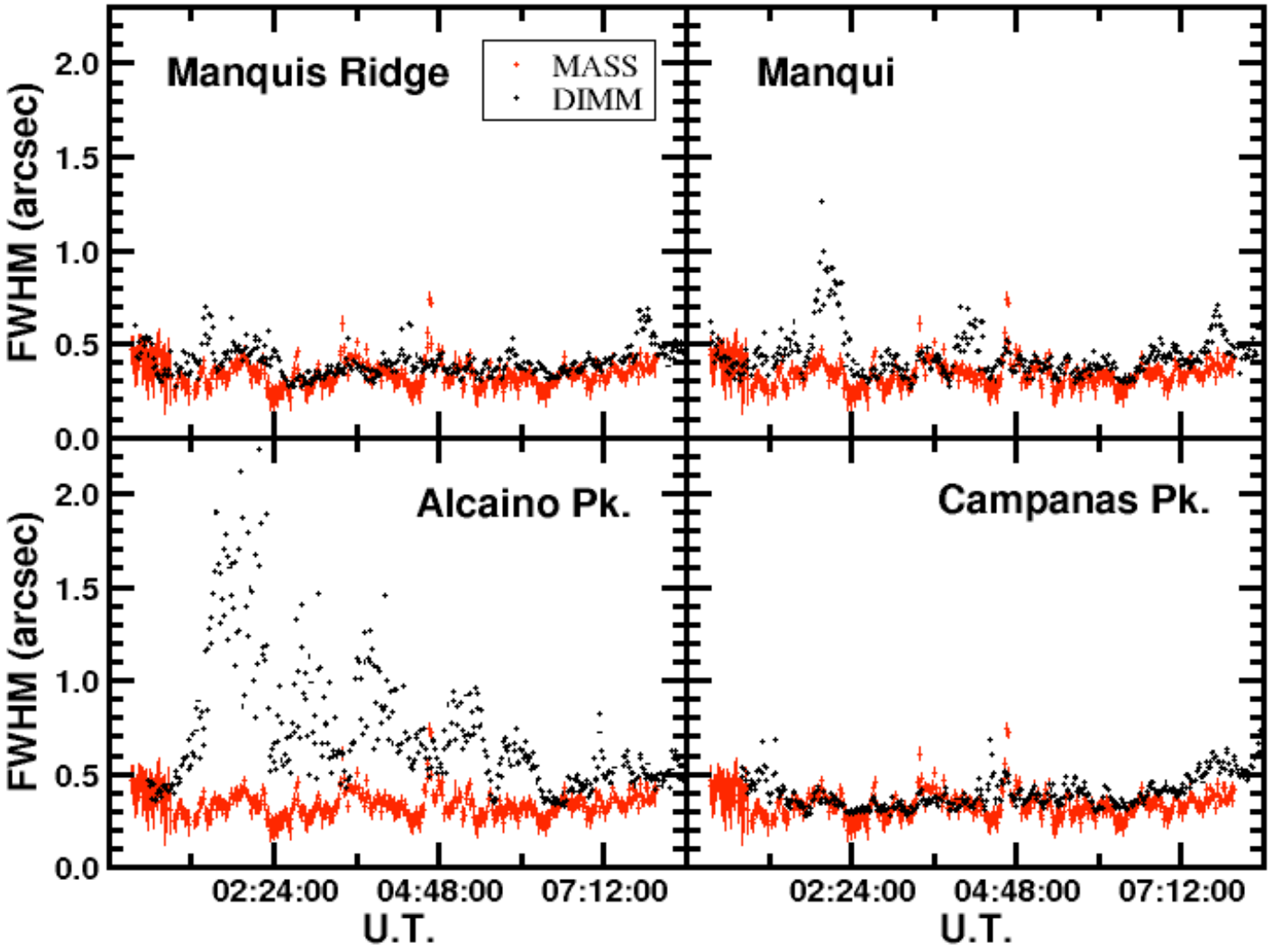
Seeing Statistics Update

Location	Dates	Number Nights	FWHM 25%	FWHM 50%	FWHM 75%
Manquis Ridge	Apr 05 - Dec 06	314	0.55	0.68	0.86
Manqui	Apr 05 - Dec 06	318	0.53	0.65	0.83
Alcaino	Apr 05 - Dec 06	290	0.50	0.63	0.80
LCP	Sept 05 - Dec 06	288	0.52	0.63	0.78

MASS/DIMM: First Year Results

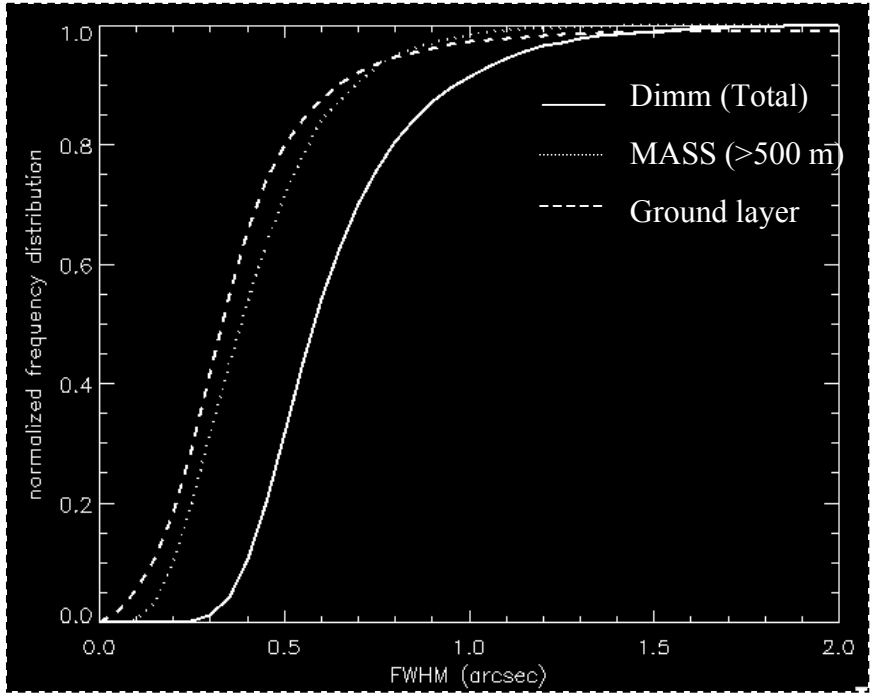
- Reprocessing required with new Turbina version to remove an over estimation of seeing at high seeing values due to the effect of strong scintillation
- Strong scintillation affects the turbulence profile by over-estimating turbulence and spreading turbulence to lower levels
- MASS/DIMM ground layer detection correlated (but not 1 to 1) with GLAO experiments at Magellan
- GLAO results - On the best nights - RMS image size reduction of 30% over a 7' separation. On a typical night - 10% reduction to a V image (Athey et al. 2006)

Examples of Differing Ground Layer



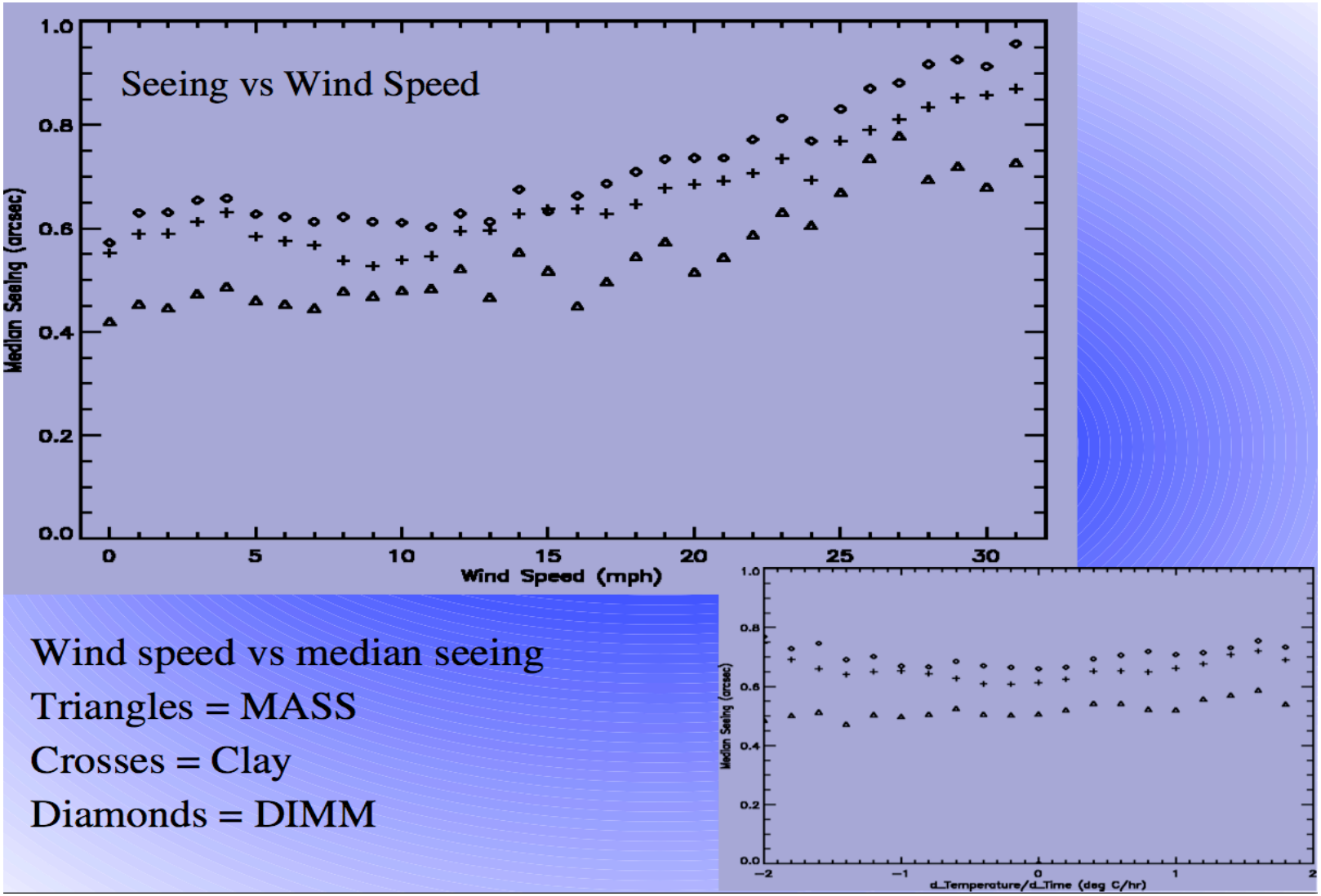
MASS/DIMM: First 1.5 Years Results

- 307 nights of concurrent data with MASS/DIMM
- Ground layer calculated at each matching time from seeing converted into turbulence integrals
- In median conditions ground layer contributes ~40-50% of the total turbulence integral.



Percentile	DIMM	MASS	GL
25	0.52	0.32	0.28
50	0.63	0.42	0.38
75	0.79	0.57	0.68

Correlation with Meteorological Data



Echelle measurements of PWV

- http://www.ociw.edu /lco/site testing/pwv/echelle.html
- Fractional populations in energy levels corresponding to wavelengths between 5900-7300 Å are temperature insensitive over temperatures found in Earth's atmosphere (Brault et al 1975)
- Allows robust measurement of PWV without detailed model atmosphere.
- Thomas-Osip et al. 2007 PASP