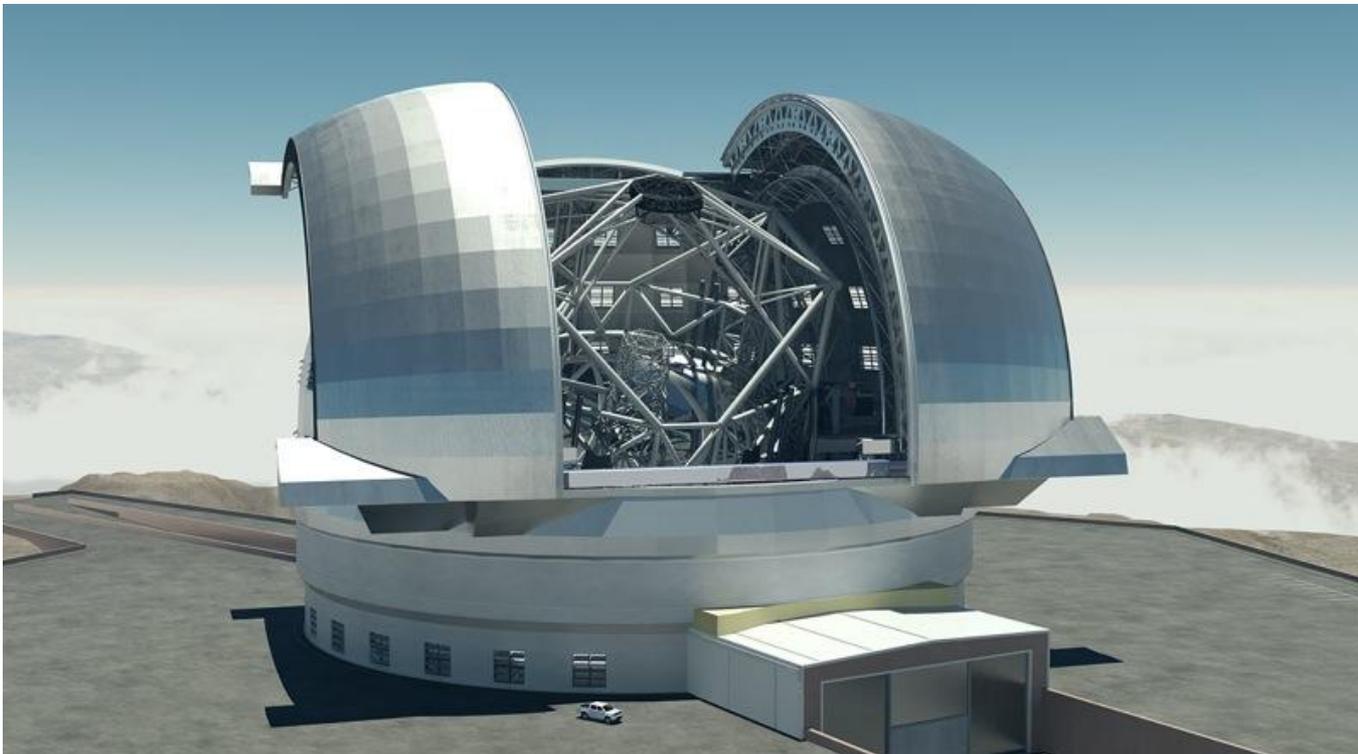


THE E-ELT SITE TESTING IN NORTHERN CHILE AND ARGENTINA

GIANLUCA LOMBARDI





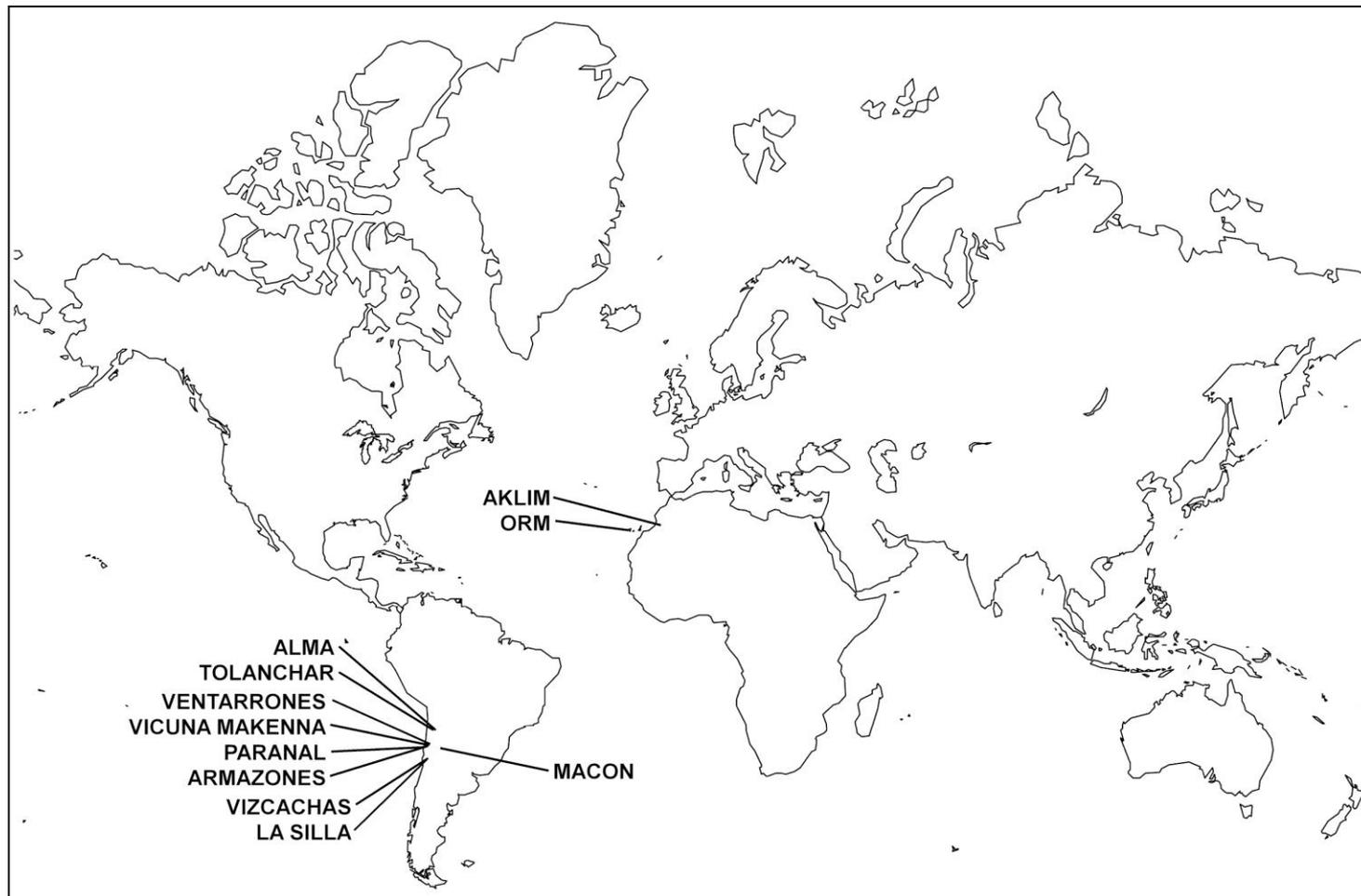
PLEASE BE INFORMED...

As per instructions of the Director General, the E-ELT Site Testing data are still strictly confidential, which basically means that talks given can show the sites and the methodology, but not any result.

Thanks for your understanding.

The Crew

A WORLDWIDE VIEW



SITES IN NORTHERN CHILE AND ARGENTINA



THE REGION OF PARANAL (CHILE)

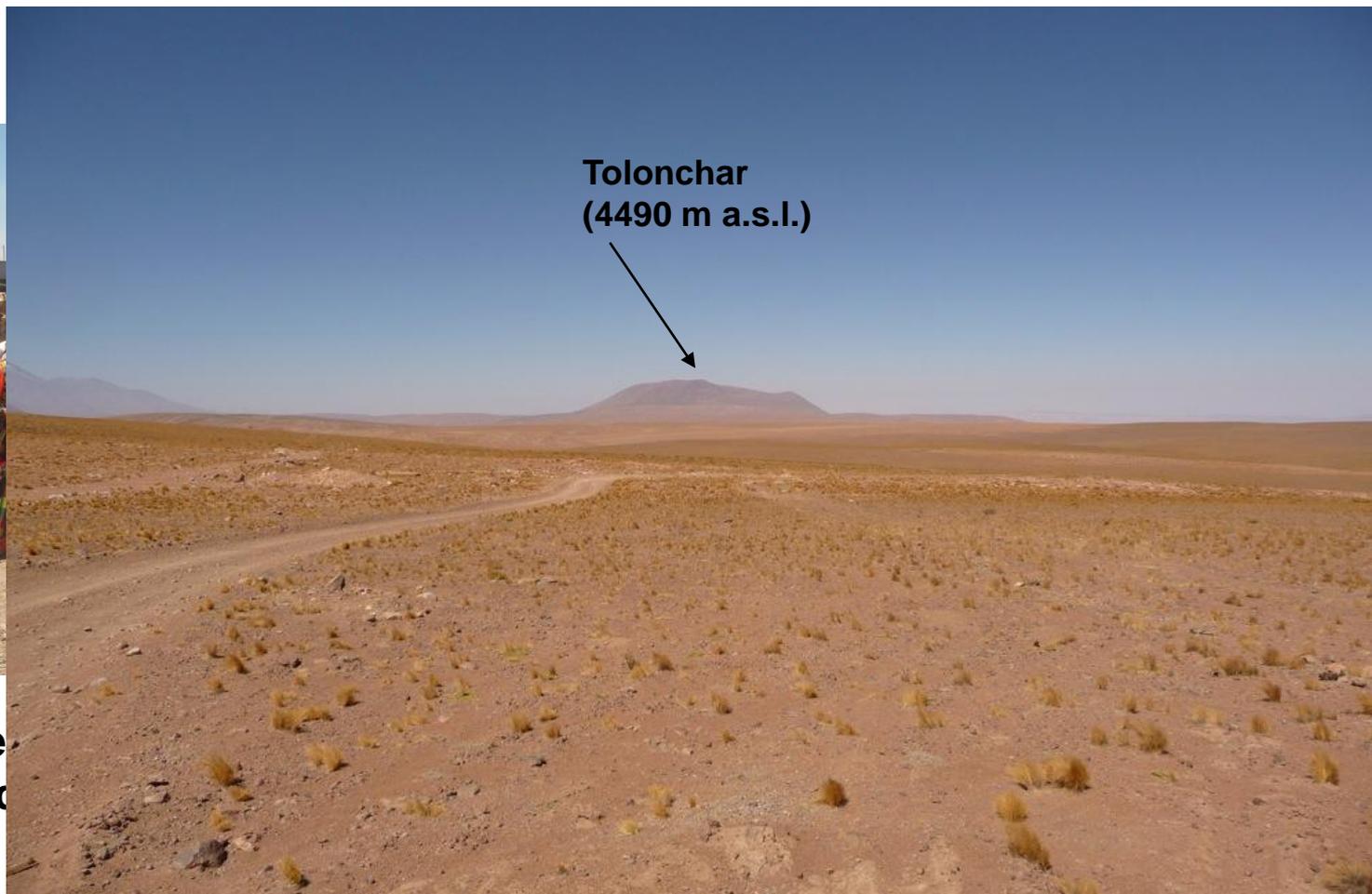


View from

THE REGION OF SAN PEDRO DE ATACAMA (CHILE)



Socaire
San Pedro



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THE REGION OF THE MACON (ARGENTINA)



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MAIN ACTIONS

1. MASS-DIMM PROTOTYPES ALIGNMENT AT PARANAL OPTICAL LAB

2. INSTRUMENTS TEST AND CALIBRATION ON SKY

2.1 MASS-DIMM TEST AND CALIBRATION

2.1.1 MASS-DIMM WITH FP6 IAC DIMM (ON ROBOTIZED TELESCOPES)

2.1.2 MASS-DIMM WITH SAI TURDIMM (ON PORTABLE AND ROBOTIZED TELESCOPES)

2.1.3 SAI TURDIMM AND MASK (ON PORTABLE TELESCOPES)

2.2 CALIBRATION OF SEVERAL LUSCI PROTOTYPES

2.3 WEATHER SENSORS CALIBRATION

3. ASTRONOMICAL SITE MONITOR INSTALLATION

3.1 POWER GENERATION, RADIO LINK, WEATHER TOWER, MASS-DIMM TOWER

3.2 TELESCOPE, COLLIMATIONS AND ALIGNMENTS, MASS-DIMM, POINTING MODEL

3.3 SUPERVISOR FOR ROBOTIZED OPERATIONS

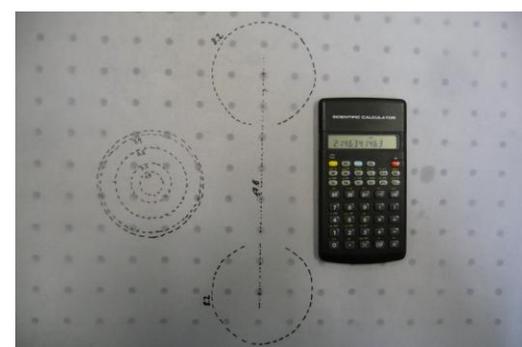
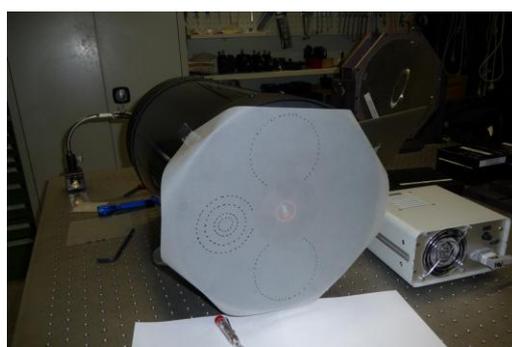
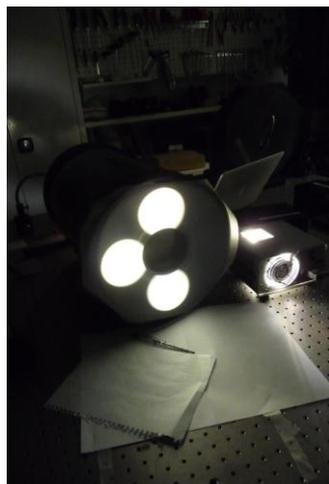
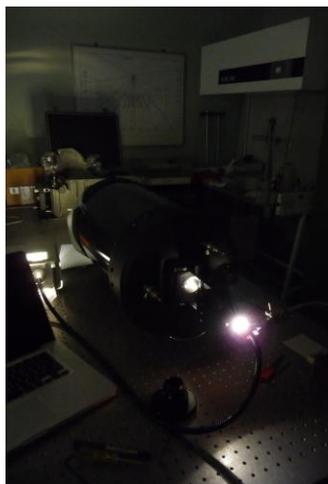
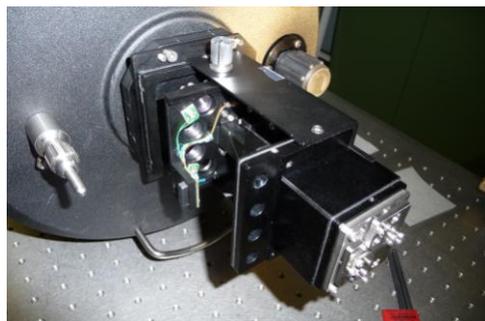
4. CAMPAIGNS ON SITE

4.1 EXPLORATIVE PRELIMINARY CAMPAIGNS FOR NEW POTENTIAL SITES

4.2 LUSCI CAMPAIGNS DURING EACH LUNATION SINCE OCTOBER 2008

4.3 SURFACE LAYER INVESTIGATION (IN PARTICULAR AT PARANAL)

MASS-DIMM ALIGNMENT AT PARANAL OPTICAL LAB



MASS-DIMM ALIGNMENT AT MACON



MASS-DIMM ALIGNMENT AT PARANAL OPTICAL LAB

DIMM CHANNEL GEOMETRY

THEORETICAL RATIO OF THE VARIANCE LONGITUDINAL/TRANSVERSAL
(DOES NOT DEPEND ON SEEING IN FULLY DEVELOPED TURBULENCE):

$$R_v = (1 - 0.541 \cdot S^{-1/3}) / (1 - 0.811 \cdot S^{-1/3}) \quad \text{where } S = \text{Base/Size}$$

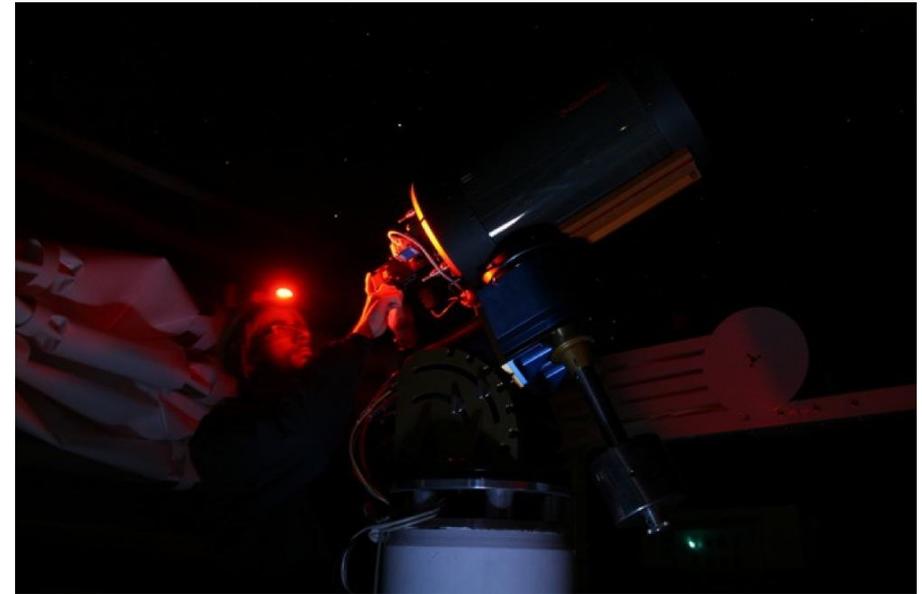
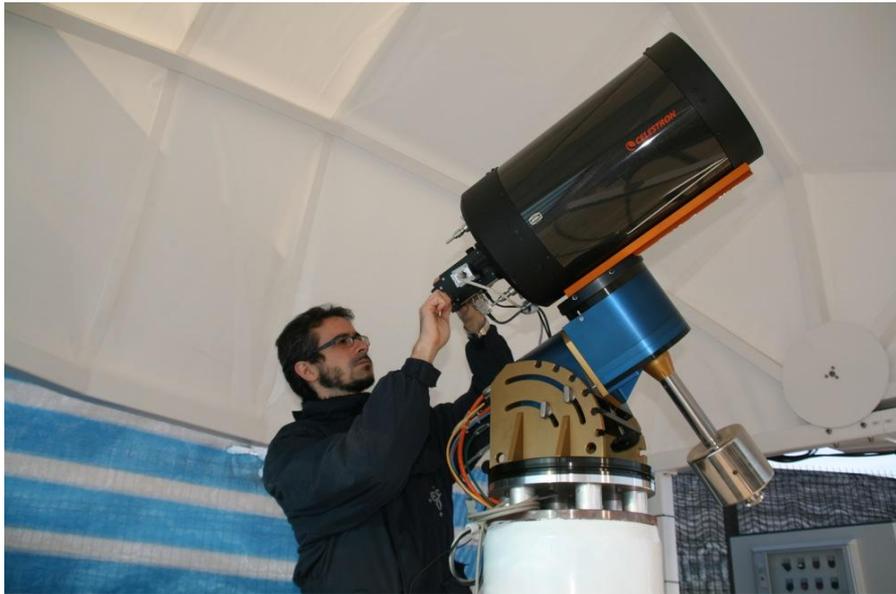
	BASE / SIZE [cm]	Rv	SQRT(Rv)
MASK	19.0 / 8.0	1.52	1.23
MD21	18.6 / 8.9	1.58	1.26
MD22	19.0 / 9.0	1.57	1.25

MASS CHANNEL GEOMETRY

	A diam. A/1.27 [mm]		B diam. B/2.15 [mm]		C diam. C/3.85 [mm]		D diam. D/5.50 [mm]		AVG. MAGNIF.
MD21	21	16.6	34	15.8	61	15.8	84	15.3	15.9
MD22	18	14.2	35	16.3	61	15.8	85	15.5	15.5

INSTRUMENTS TEST AND CALIBRATION ON SKY

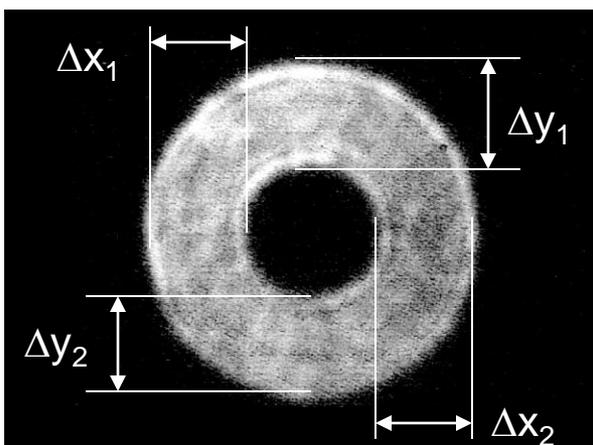
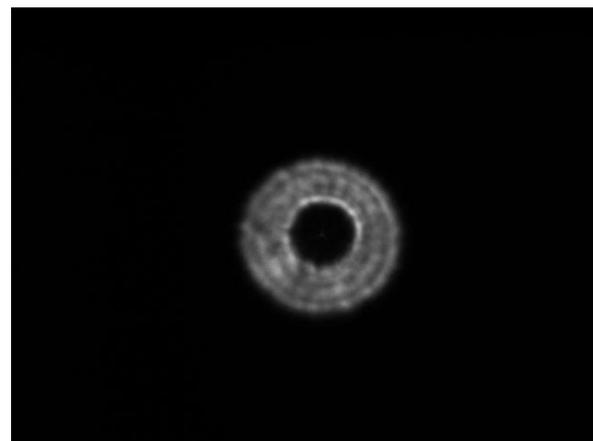
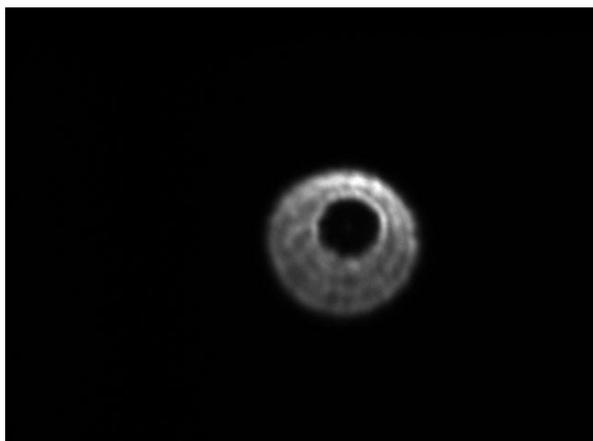
TELESCOPE PREPARATION... installation in daytime to work in nighttime



The Pointing Model definition is done between the end of the twilight and the early night

INSTRUMENTS TEST AND CALIBRATION ON SKY

TELESCOPE OPTICAL QUALITY DEFINITION: *COLLIMATION (NO MASS-DIMM)*



INSTRUMENTS TEST AND CALIBRATION ON SKY

TELESCOPE OPTICAL QUALITY DEFINITION: *FOCUSING (WITH MASS-DIMM)*



INSTRUMENTS TEST AND CALIBRATION ON SKY

MASS-DIMM: *PIXEL SCALE DEFINITION*



DOUBLE STAR TARGET

Δx_i = horizontal stars separation in [pixel]

Δy_i = vertical stars separation in [pixel]

$\Delta\varphi$ = known stars separation in [arcsec]

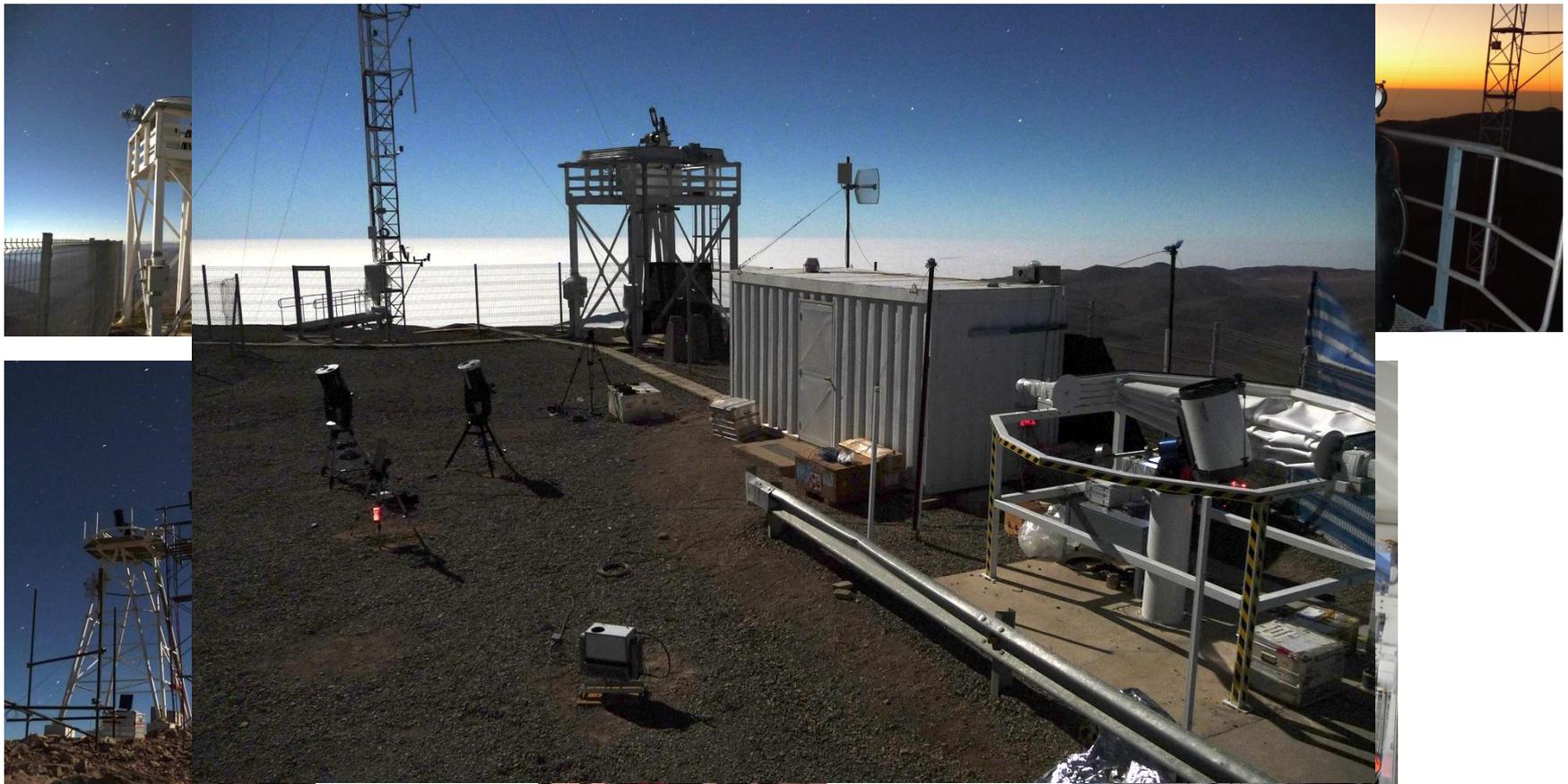
$$\xi_1 = \Delta\varphi / \text{SQRT}(\Delta x_1^2 + \Delta y_1^2)$$

$$\xi_2 = \Delta\varphi / \text{SQRT}(\Delta x_2^2 + \Delta y_2^2)$$

$$\xi_2 = (\xi_1 + \xi_2) / 2$$

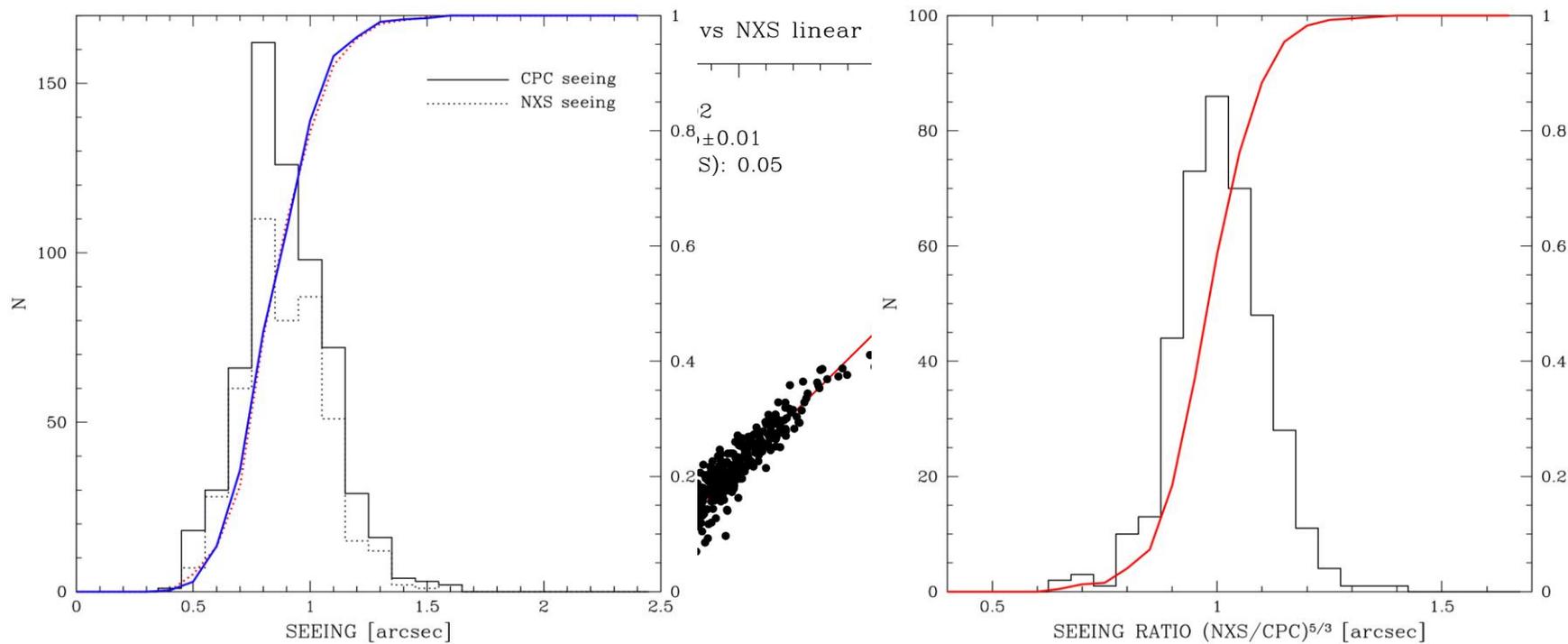
INSTRUMENTS TEST AND CALIBRATION ON SKY

PORTABLE DIMM AND PORTABLE MASS-DIMM CALIBRATIONS



INSTRUMENTS TEST AND CALIBRATION ON SKY

PORTABLE DIMM AND PORTABLE MASS-DIMM CALIBRATIONS

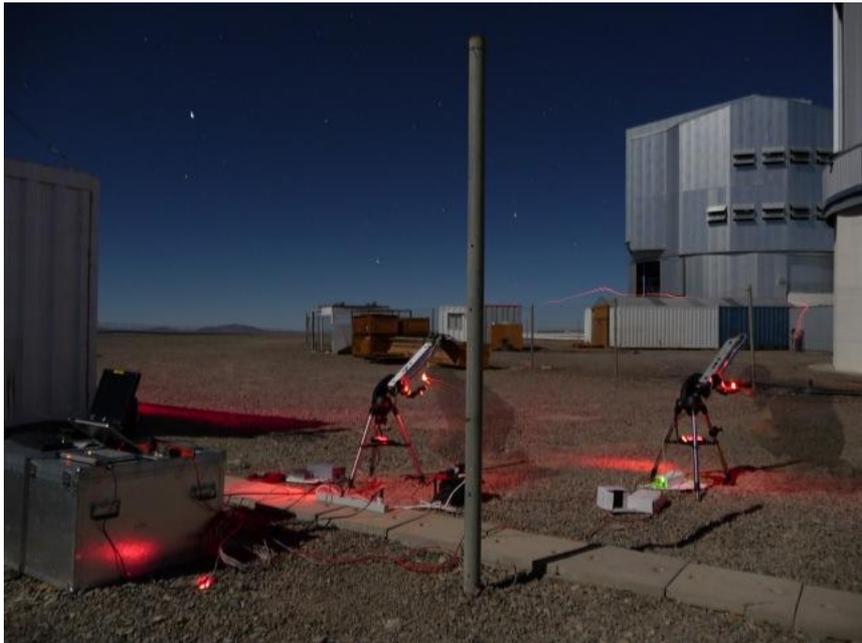


	MIN	25%	50%	75%	MAX
CPC	0.49"	0.83"	0.93"	1.07"	1.68"
NXS	0.49"	0.82"	0.92"	1.07"	1.69"

	MIN	25%	50%	75%	MAX
Simult. data	0.66"	0.97"	1.03"	1.10"	1.41"

INSTRUMENTS TEST AND CALIBRATION ON SKY

LUSCI AND WEATHER SENSORS



ASTRONOMICAL SITE MONITOR INSTALLATION

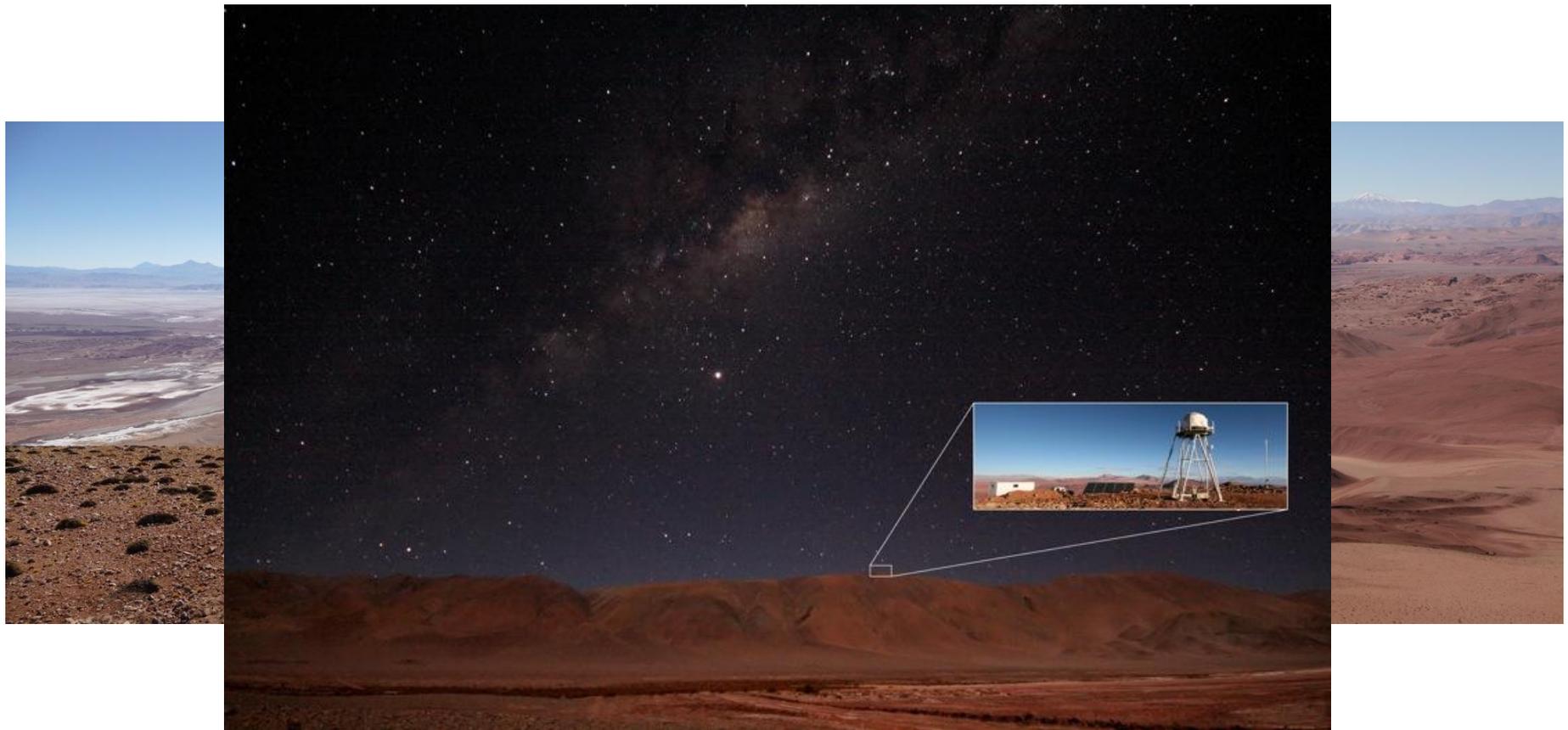


REMEMBER THE MAP!



A FAST VIEW OF THE MOUNTAINS

MACON (4650 M A.S.L.)



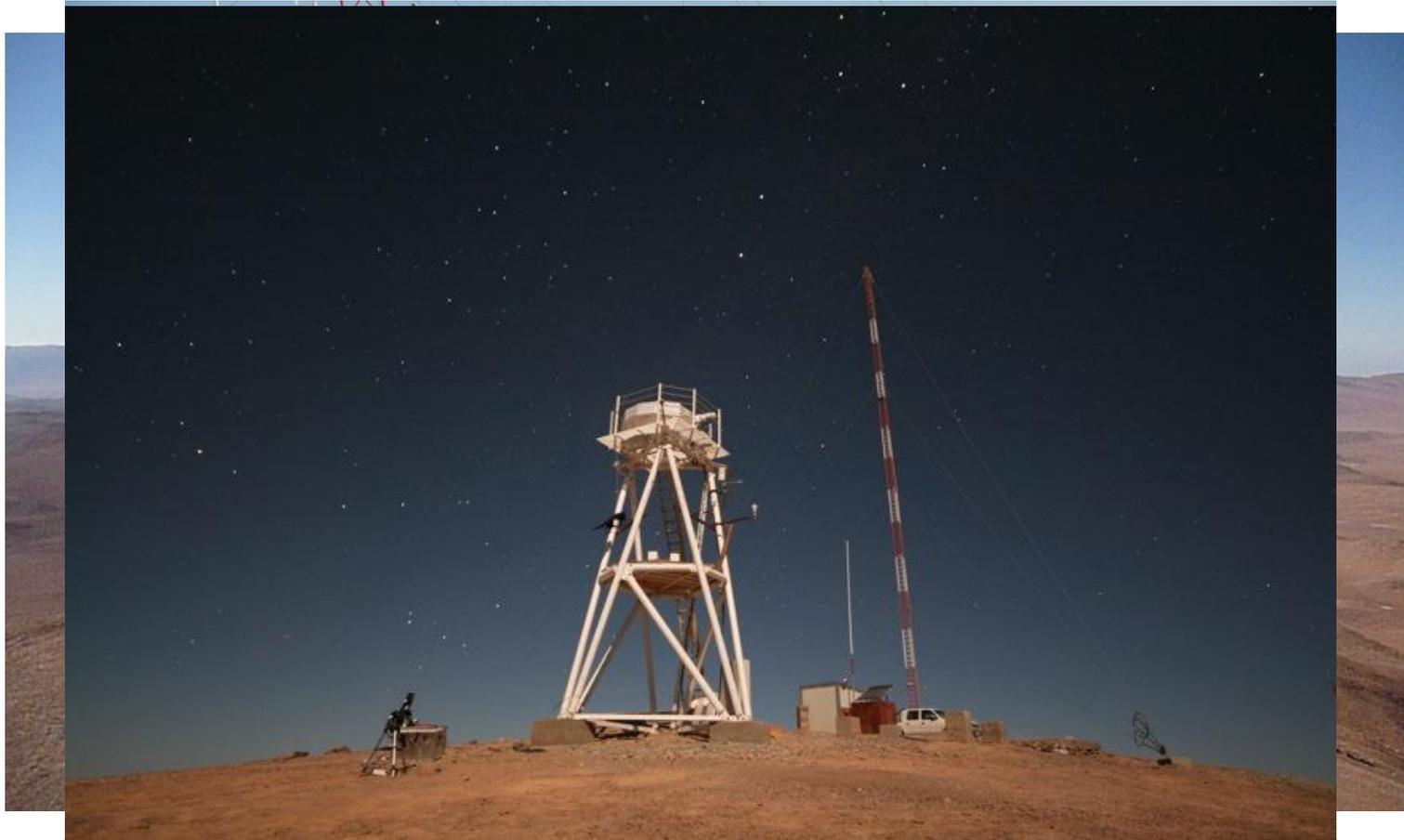
A FAST VIEW OF THE MOUNTAINS

VENTARRONES (2830 M A.S.L.)



A FAST VIEW OF THE MOUNTAINS

ARMAZONES (3060 M A.S.L.): THE HOME OF THE E-ELT



EXPLORING NEW POTENTIAL SITES

VICUÑA MACKENNA (never tested before!): VERY FIRST EXPLORATION



EXPLORING NEW POTENTIAL SITES

VICUÑA MACKENNA (never tested before!): VERY FIRST EXPLORATION



EXPLORING NEW POTENTIAL SITES

VICUÑA MACKENNA (never tested before!): VERY FIRST EXPLORATION



EXPLORING NEW POTENTIAL SITES

VICUÑA MACKENNA: SECOND CAMPAIGN (9-13 May 2009)



EXPLORING NEW POTENTIAL SITES

TOLONCHAR (ex TMT site)



LUSCI CAMPAIGNS

LuSci observations have been performed at sites about 10 days around Full Moon since October 2008

Moon illumination $\geq 80\%$

Airmass ≤ 2.0

Observations are stopped when:

wind speed is > 12 m/s (high flux fluctuations)

relative humidity $> 60\%$ (condensation on DIMM telescope)

LuSci measurements are considered reliable only when retrieved simultaneously with DIMM and MASS.

This is a standard requirement in order to calculate the Surface Layer contribution to the Ground Layer.

LuSci requires an operator. Therefore the number of sites to be monitored during each lunation were limited by the available man power. Typically we visited 2 sites per lunation.

At the present only Paranal and Armazones are still monitored.



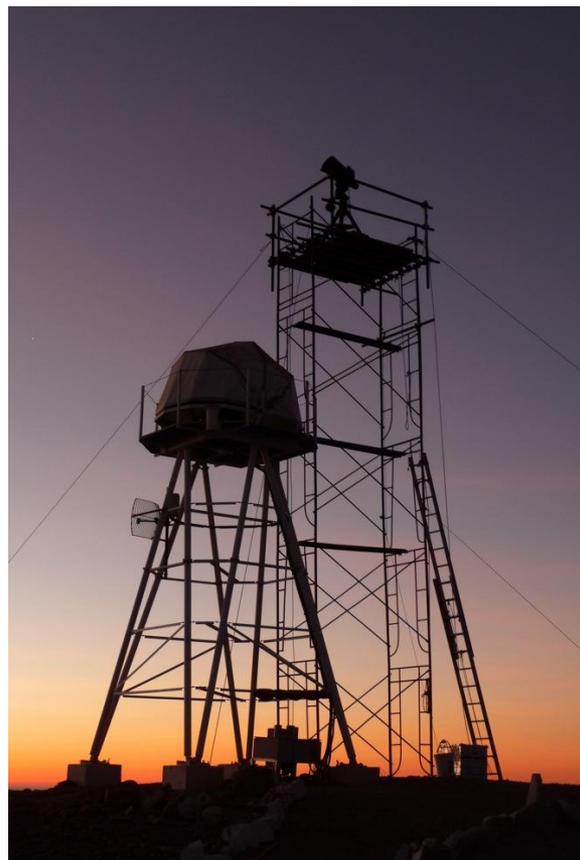
LUSCI CAMPAIGNS

	N. OF NIGHTS	STATUS
PARANAL	76	still ongoing
VENTARRONES	33	future uncertain
ARMAZONES	56	still ongoing
VICUÑA MACKENNA	5	terminated
TOLONCHAR	11	terminated



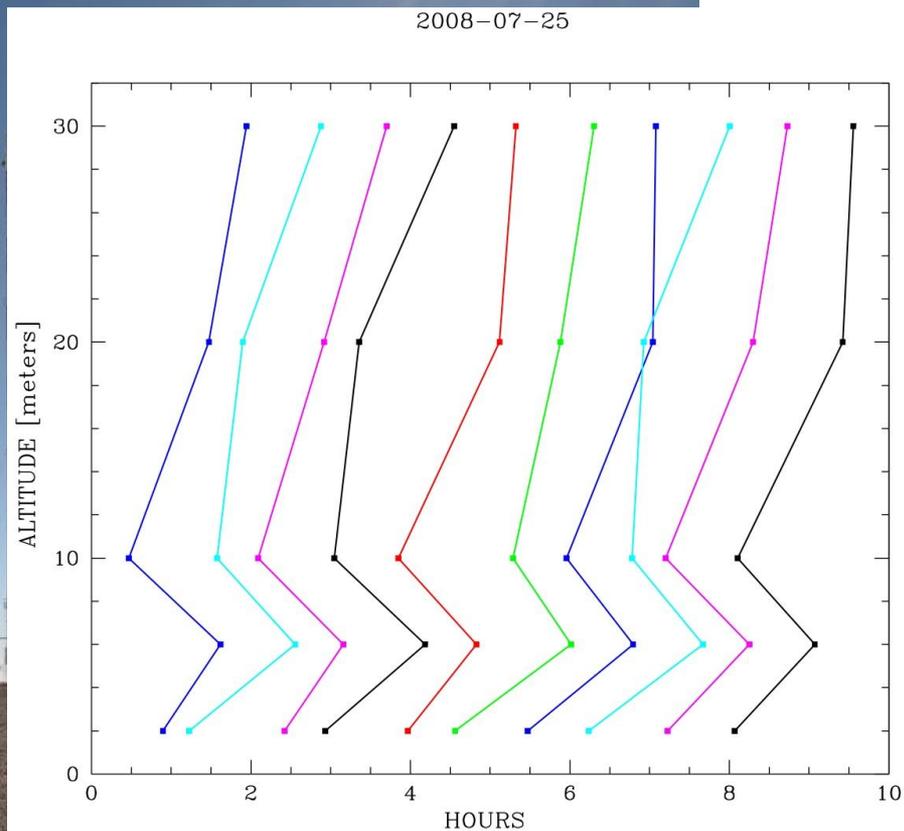
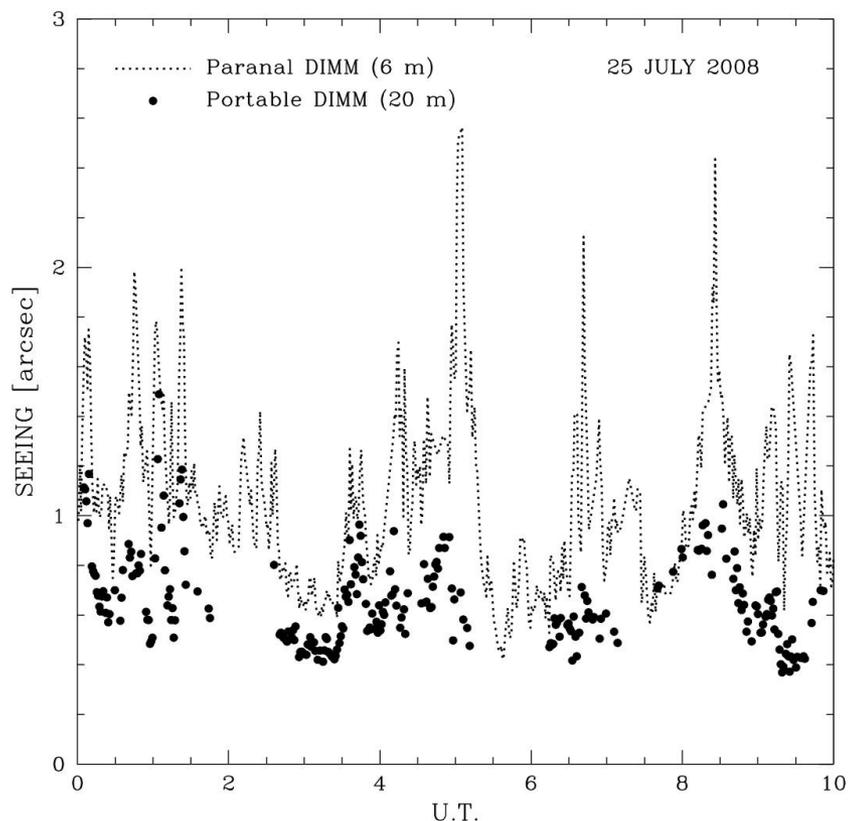
CATCHING THE SURFACE LAYER

AT SITES



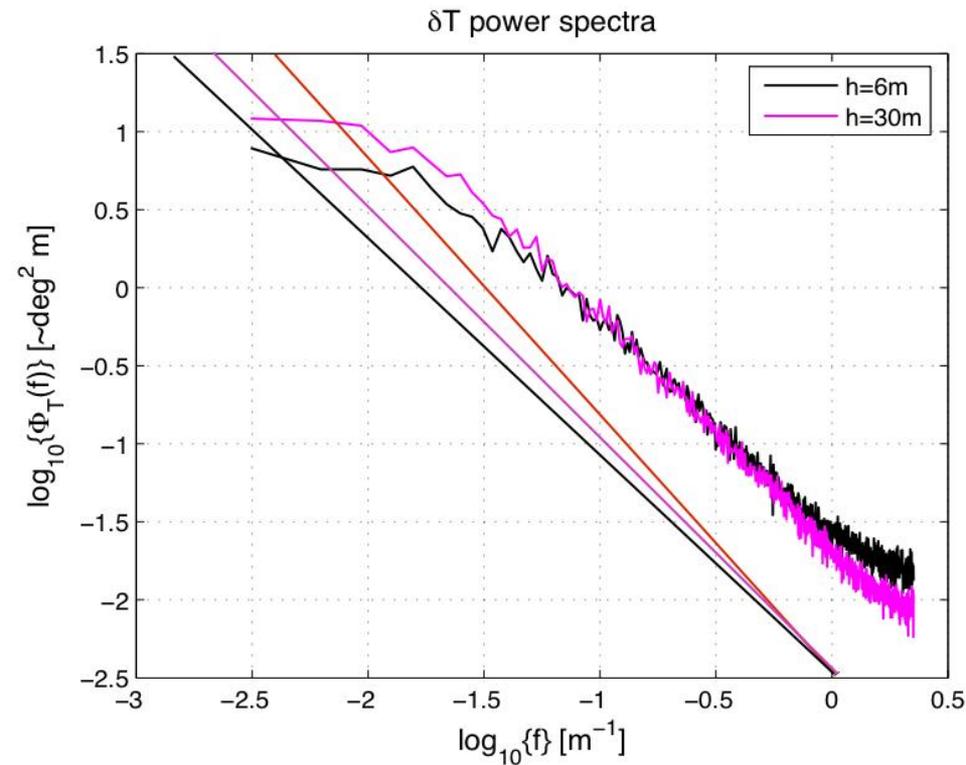
CATCHING THE SURFACE LAYER

AT PARANAL > THE ELEVATED DIMM EXPERIMENT



CATCHING THE SURFACE LAYER

AT PARANAL > THE ELEVATED DIMM EXPERIMENT



H [m]	N	μ = 2/3	μ < 2/3	μ > 2/3
6	71	14.1%	78.9%	7.0%
10	64	23.4%	71.9%	4.7%
20	70	25.7%	74.3%	0.0%
30	74	37.8%	62.5%	0.0%

μ statistics from 14 to 22 July 2008 measurements.

Spatial power spectra of the temperature fluctuations.
Data from 14 July 2008.

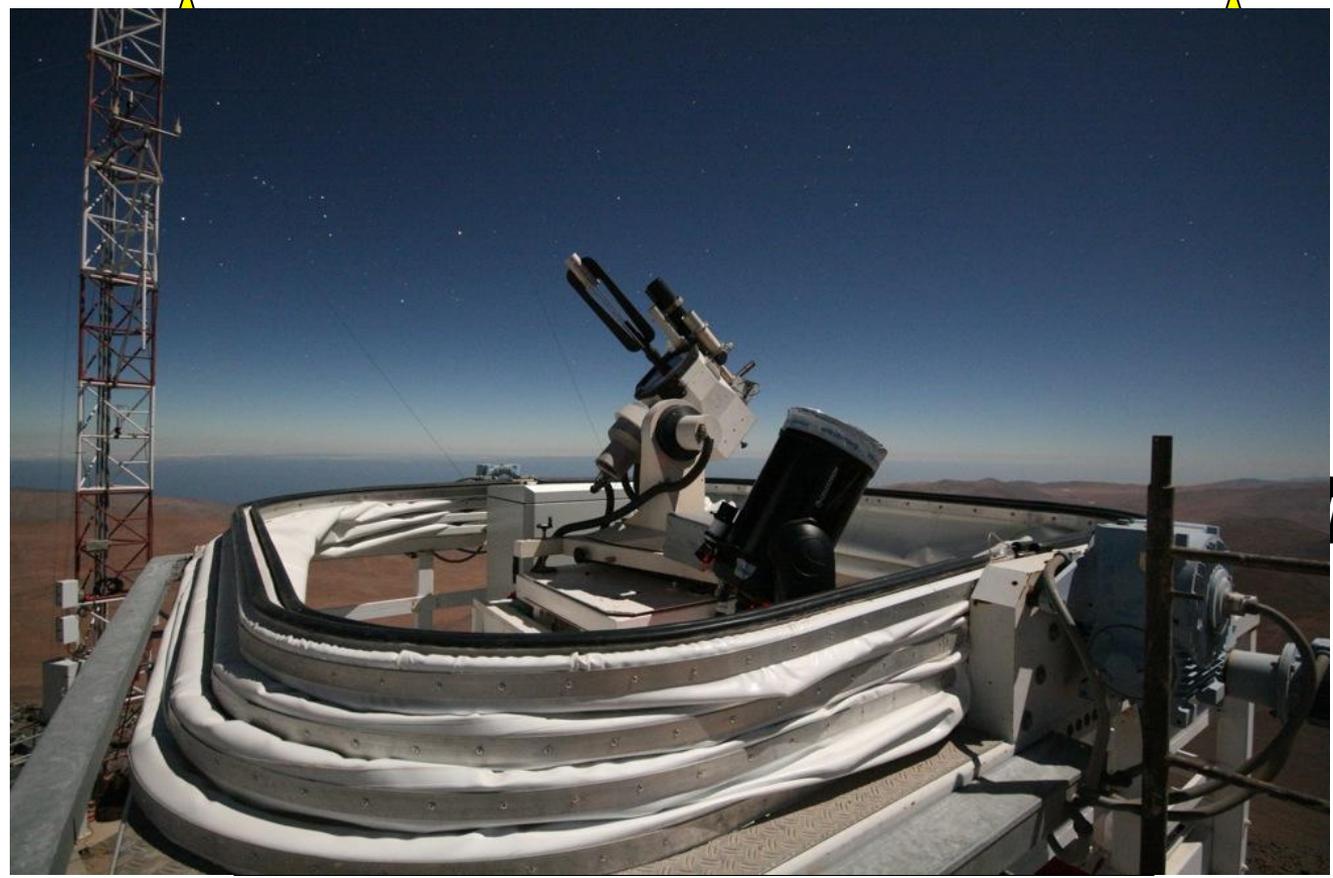
Lombardi et al. 2010, SPIE Proc.

CATCHING THE SURFACE LAYER

AT PARANAL > THE NORTH DIMM EXPERIMENT (9-15 MARCH 2009)

SOUTH ←

→ NORTH

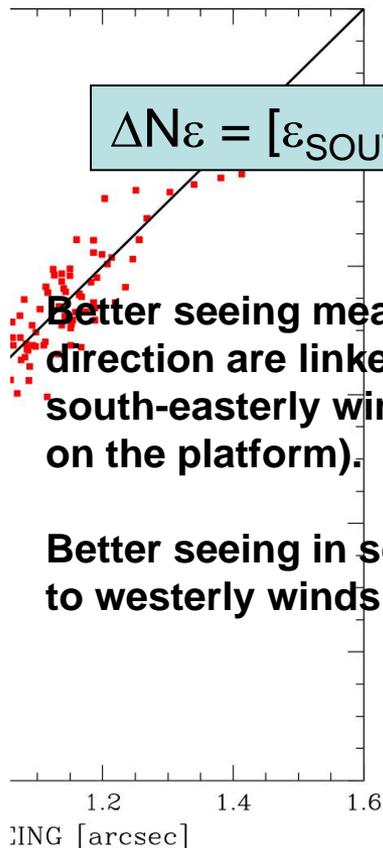
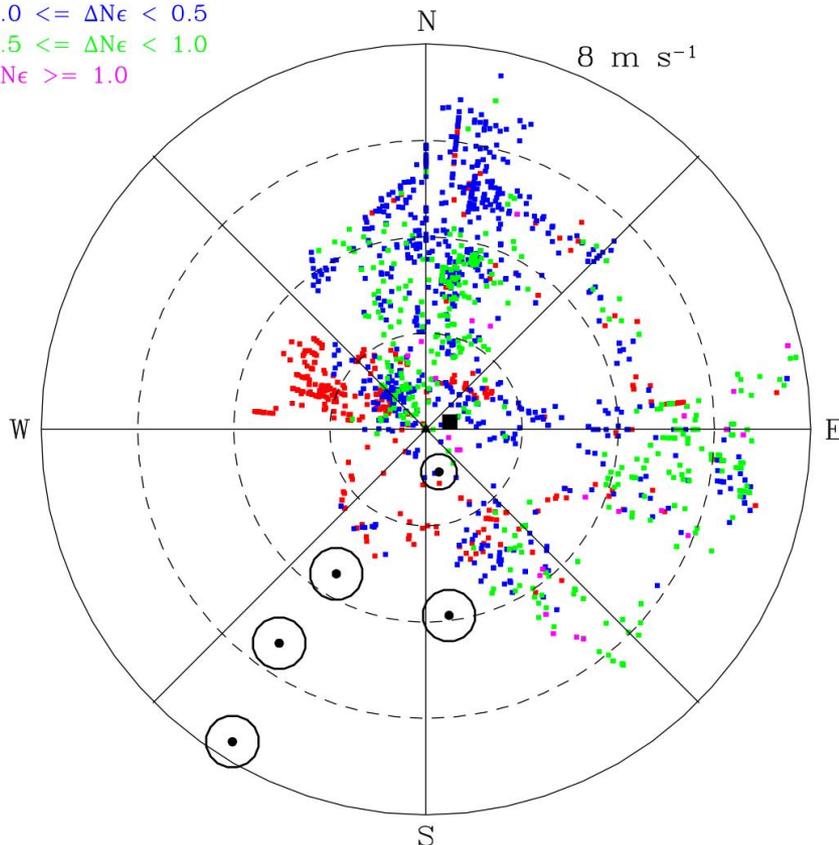


VIIIIIIIIIND!!!

CATCHING THE SURFACE LAYER

AT PARANAL > THE NORTH DIMM EXPERIMENT (9-15 MARCH 2009)

$\Delta N_\epsilon < 0.0$
 $0.0 \leq \Delta N_\epsilon < 0.5$
 $0.5 \leq \Delta N_\epsilon < 1.0$
 $\Delta N_\epsilon \geq 1.0$



Better seeing measurements in north direction are linked to north-easterly and south-easterly winds (the SL is present on the platform).

Better seeing in south direction correspond to westerly winds (no SL on the platform).

Lombardi et al. 2010, SPIE Proc.

THAT'S ALL, THANK YOU!



Ventarrones, 12 January 2009

TO BE CONTINUED...