



Comprehensive Characterization of Astronomical Sites

The VLT Dealing With The Atmosphere, A Night Operation point of view

Kislovodsk, Russia, 2010/October/04-09





Who are we



PARANAL Science Operation Department is composed by:

Astronomers

Staff astronomers (~27)

Postdoctoral fellows (~15)

Telescope Instrument Operators (19)

Data Handling Administrators (5)

Department Assistant (1)

Courtesy of Claudio Melo





What do we do?



Astronomers, TIOs, DHA

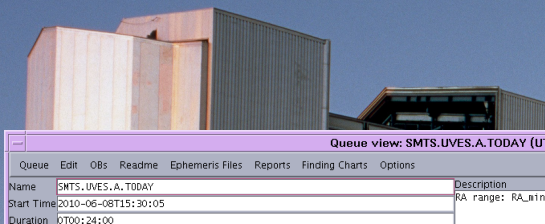
- Produce top-quality astronomical data by operating a suite of 9 telescopes and 14 instruments and related systems
- Maintaining & improving performances of instruments
- Monitoring instrument health
- Providing calibration files associated to science files
- Supporting preparation of astronomical observations (mainly in visitor mode)
- Delivering data to the user
- Working with engineering in troubleshooting, commissioning, technical intervention activities
- Developing, improving operations tools and procedures
- Interfacing with Garching partners: USD, QC, Instrumentation

Courtesy of Claudio Melo





Observing at Paranal



Observing Tool V.2.13 User=0 Server=wgsdbp.pl.eso.org:5000

Queues Reports Finding Charts Orang

Queue Id	Name	Size	Telescope
200170361	VINOS IFU Spec Phot HR 0...	38	UT3
200170365	VINOS IFU Spec Phot HR R...	38	UT3
200170367	VINOS IFU Spec Phot LR B...	38	UT3
200170368	VINOS IFU Spec Phot LR R...	38	UT3
200170366	VINOS IFU Spec Phot MR NEW	38	UT1
200170363	VINOS IFU Spec Phot HR Gr...	38	UT3
200128096	VINOS IMG Photon Std 10	19	UT3
200128007	VINOS IMG Photon Std 40	20	UT3
200163680	VINOS IMG z Photon STD	22	UT3
200135756	VINOS Maintenance	21	UT3
200159744	VINOS M55 NightCallib	1	UT1
200157020	VINOS M55 Spec Phot HR Blue	24	UT3
200157059	VINOS M55 Spec Phot HR 0...	24	UT3
200157071	VINOS M55 Spec Phot HR Red	24	UT3
	t LR Blue	23	UT3
	t LR Red	24	UT3
	t HR	16	UT3
	ts Eve...	20	UT3
	ts Mor...	20	UT3
	RNATIVE	0	UT1
		11	UT3
	LVN	37	UT3
		14	UT1
	td PQ	444	UT3
	op	160	UT3
	OP NEW	160	UT3
	Standards	592	UT3
	Std COH	24	UT1

Queue view: SMTS.UVES.A.TODAY (UT2)

Queue Edit Obs Readme Ephemeris Files Reports Finding Charts Options

Name	Description
SMTS.UVES.A.TODAY	RA range: RA_min=7.81 to RA_max=2.99
Start Time	2010-06-08T15:30:05
Duration	0T00:24:00
Telescope	UT2

Seeing	SkyTran	Airmass	FLI	MoonDis
2.000	3THN	5.000	1.000	30
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
0.800	2CLR	1.500	0.400	120
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30
1.800	3THN	2.000	1.000	30

OB Comment Instrument ProgID UsrP LastName Target RA

RA	Dec	Instrument	RankClass	UsrP	ExecTime	Seeing
53:55.900	-23:58:41.100	UVES	A	1	00:10:13.000	2.000
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
30:23.630	-18:19:56.000	UVES	A	1	01:59:59.000	0.800
44:27.070	-10:35:41.900	UVES	A	1	01:59:59.000	0.800
44:27.070	-10:35:41.900	UVES	A	1	01:59:59.000	0.800
44:27.070	-10:35:41.900	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800
52:15.700	-70:14:31.300	UVES	A	1	01:59:59.000	0.800

Observing Tool V.2.13 User=0 Server=wgsdbp.pl.eso.org:5000

Queues Reports Finding Charts Orang

OB ID	Status	OB Name	OB Comment	Inst Comment	Instrument	ProgID	LastName
480062	+	HD193291_S11t-0	*	*	XSHOOTER	085.B-0751(A)	Trager
480045	+	DGLE-5739C2_S11t-0	*	*	XSHOOTER	085.B-0751(A)	Trager
480045	+	DGLE-3267C3_S11t-0	*	*	XSHOOTER	085.B-0751(A)	Trager
480044	+	DGLE-3690C7_S11t-0	*	*	XSHOOTER	085.B-0751(A)	Trager

Rows: 4

OB Tree view

0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	1
0.800	2CLR	2
0.800	2CLR	2
0.800	2CLR	2





Due to the large number of instruments covering wavelengths from ultraviolet to the mid infrared with and without adaptive optics facilities, the Night Astronomers and TIOs have to know the atmosphere behavior at least statistically in order to optimize the programs to be observed during the night.





Instruments available in Paranal

VLT Instruments:

FORS (FOcal Reducer and Spectrograph), is multi-mode instruments that can be used for imaging in the visible and for low-resolution spectroscopy.

ISAAC (Infrared Spectrometer And Array Camera) is a cryogenic infrared imager and spectrometer, observing in the 1 to 5 μm range.

UVES (Ultra-violet and Visible Echelle Spectrograph) is the high-dispersion spectrograph of the VLT, observing from 300 nm to 1100 nm, with a maximum spectral resolution of 110 000.

NACO is an Adaptive Optics facility producing images as sharp as if taken in space.

VIMOS (Visible Multi-Object Spectrograph), a four-channel multiobject spectrograph and imager, allows obtaining low-resolution spectra of up to 1000 galaxies at a time.

FLAMES (Fibre Large Array Multi-Element Spectrograph) offers the unique capability to study simultaneously and at high spectral resolution hundreds of individual stars in nearby galaxies.

VISIR (VLT Imager and Spectrometer for the mid-InfraRed) provides diffraction-limited imaging at high sensitivity in the two mid infrared (MIR) atmospheric windows (8 to 13 μm and 16.5 to 24.5 μm).

SINFONI is a near-infrared (1 - 2.5 μm) integral field spectrograph fed by an adaptive optics module.

CRIRES (CRyogenic high-resolution InfraRed Echelle Spectrograph) provides a resolving power of up to 100 000 in the spectral range from 1 to 5 μm .

HAWK-I (High Acuity Wide field K-band Imager) is a near-infrared imager with a relatively large field of view.

X-shooter (a wide-band [UV to near infrared] spectrograph) is designed to explore the properties of rare, unusual or unidentified sources.

VLTI Instruments :

MIDI is a MID-infrared Interferometric instrument for photometry and spectroscopy

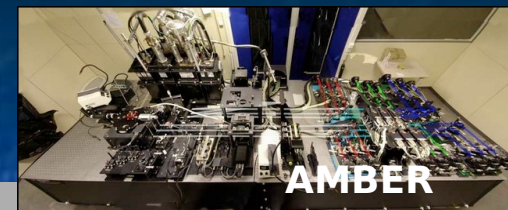
AMBER is a near infrared Astronomical



FORS



CRIRES



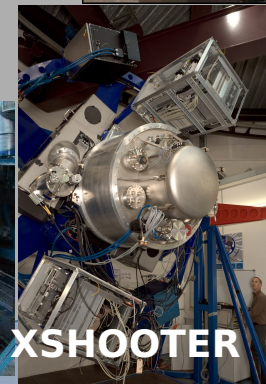
AMBER



UVES



FLAMES



XSHOOTER



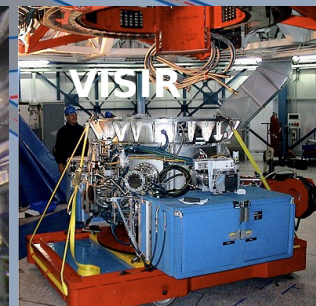
MIDI



ISAAC



VIMOS



VISIR



VISTA/VIRCAM



HAWK-I



NACO



SINFONI



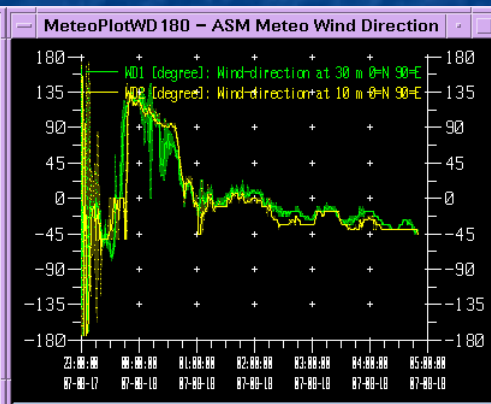
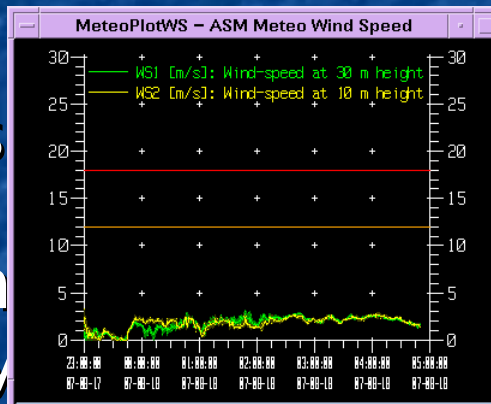
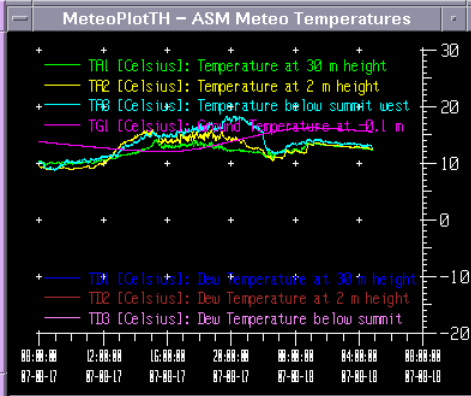
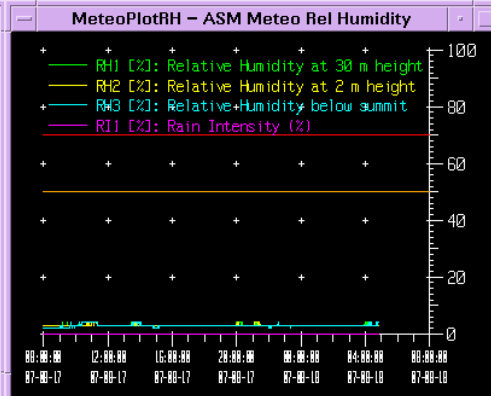
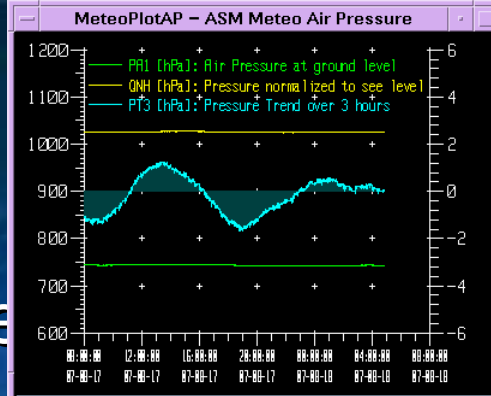


To help Astronomers and TIOs to take the best in real time decisions, we count with a set of tools that permit us to monitor the atmosphere and to adapt the observations according to the actual conditions and with a set of forecasted parameters that allow us to get an idea about the night conditions in advanced



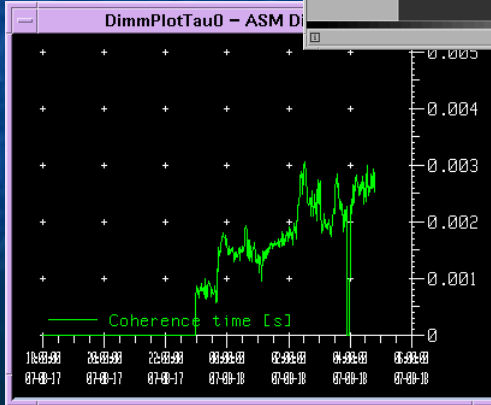


Some of the Atmospheric parameters that are delivered in real time by the ASM, including the all sky camera (MASCOT)



Camera: wgsat4-R1 Attached
X: 233.0
Y: 675.0
Value:
S:
Message List
Delay: 500
Name: 50
BaseName: MASCOT
Low: 471
High: 1007
Auto Set Cut Levels
Scale: 1x

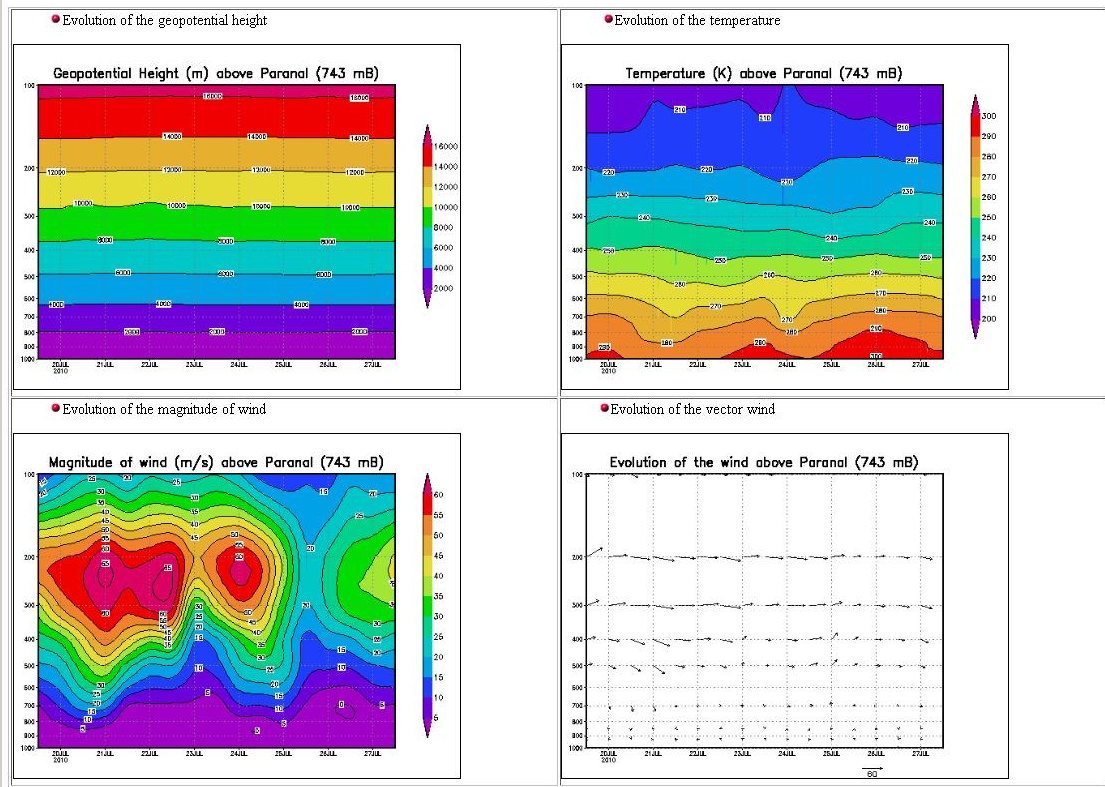
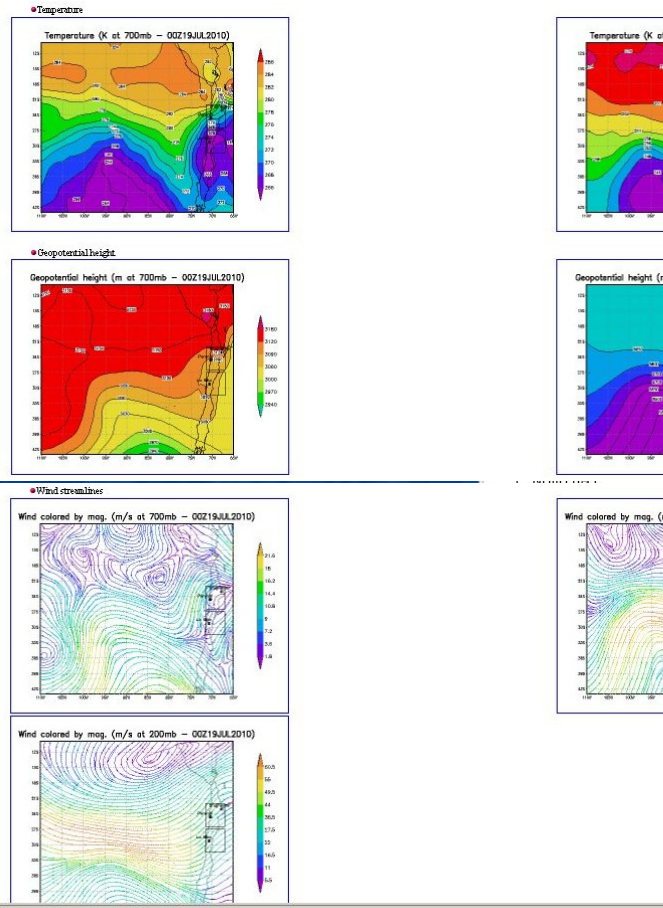
Camera view showing a starry sky image with a scale bar and orientation markers.



General predictions (short term) - Mozilla Firefox
 These predictions provides tendencies up to T+26H. The images are lat/lon projections of the region [65W to 110W]x[10S to 43S]. A click on the image outside the two rectangle regions outlined.

Paranal site (long term) - Mozilla Firefox
Long term predictions for Paranal
[HOME](#) [INDEX](#) [SEARCH](#) [HELP](#) [NEWS](#)

Here are the reconstructed radio profiles above the site of Paranal (70°W24',24S37'). On the y axis is the pressure level in mB and on the x axis the time with a 12 hour step.



Credits: the forecasts are work of ECMWF. Two type of grid are used: the first, with a step of 3 degrees, on [65W to 110W]x[10S to 43S], and the second use a step of .5 degree on [67W to 71.5W]x[22S to 26.5S] and on [67W to 71.5W]x[27S to 31.5S].

Some of the A forecasted



PWV

YOU WILL HEAR MORE ABOUT THIS IMPORTANT PARAMETER ON THE PRESENTATIONS OF F. KERBER AND A. OTAROLA

LA SILLA & PARANAL FORECAST - Mozilla Firefox

http://www.eso.org/gen-fac/pubs/astclim/forecast/meteo/ERASMUS/

LA SILLA & PARANAL FORECAST

Precipitable Water Vapour and Cloud Cover Forecasts for La Silla and Paranal Observatories

FORECAST MADE AT
18:00 UTC on July 19 2010

For the following forecast periods

18UT Analysis

18UT - 21UT 21UT - 00UT 00UT - 03UT 03UT - 06UT 06UT - 09UT
09UT - 12UT 12UT - 15UT 15UT - 18UT 18UT - 21UT 00UT - 03UT

(Click on time to view satellite image and forecast or launch the [Java forecast applet](#))

Text version (0 - 30 hours)
[La Silla](#) [Paranal](#)

Long - range outlook (2 - 8 days)

06 - 09 Hour Forecast - Mozilla Firefox

http://www.eso.org/gen-fac/pubs/astclim/forecast/meteo/ERASMUS/L_p_f3.html

06 - 09 Hour Forecast

2010.07.19 17:45 UTC

Forecast valid for 2010.07.20 00:00 UTC to 2010.07.20 03:00 UTC	Site	Moisture			Cloud Cover			
		Avg UTH	Sig UTH	PWV (mm)	%Total	%Opaque	%Transparent	Transp. Index
	Paranal	6.4	0.4	0.67	0	0	0	1.00
	La Silla	11.1	1.6	1.99	0	0	0	1.00



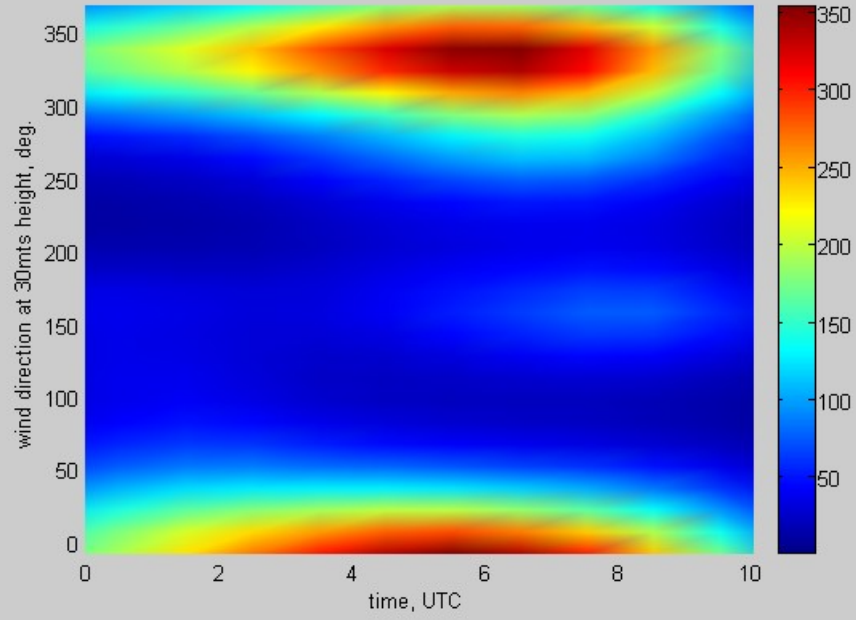
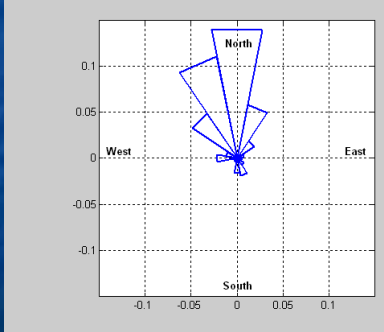
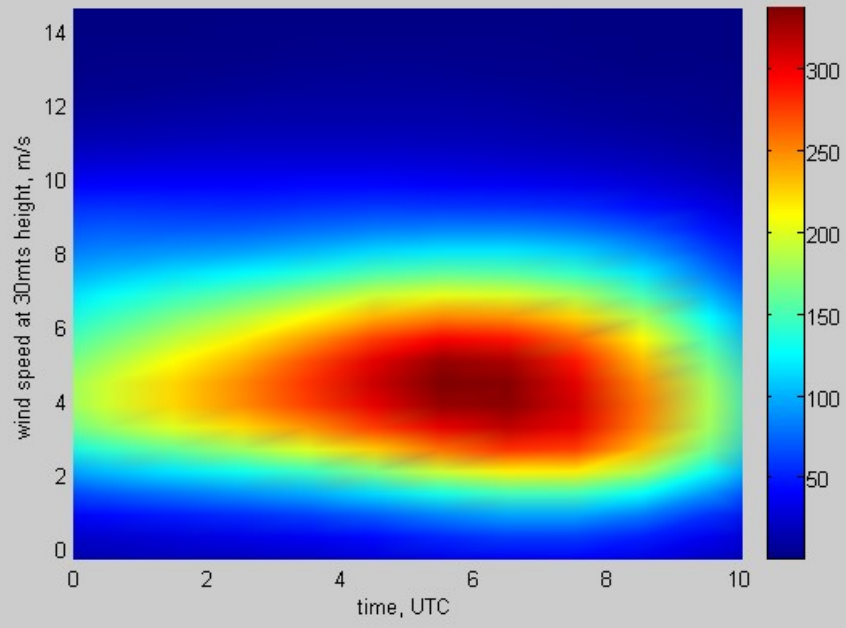
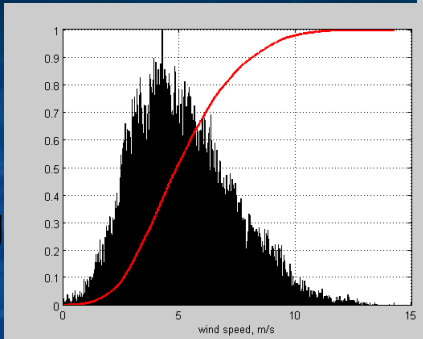


All these tools plus the knowledge of some characteristics behavior of some key parameters like seeing make life a little bit easy for Astronomers and TIOs



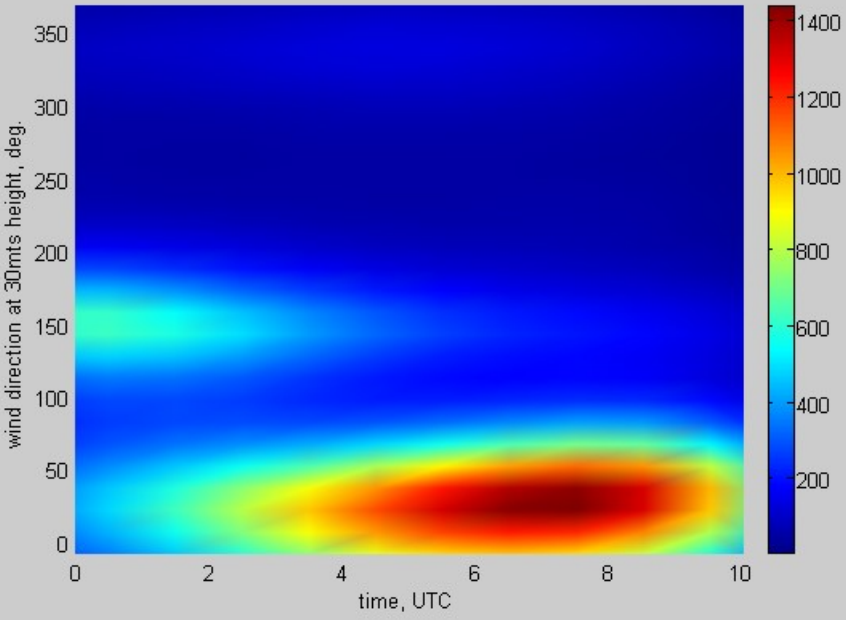
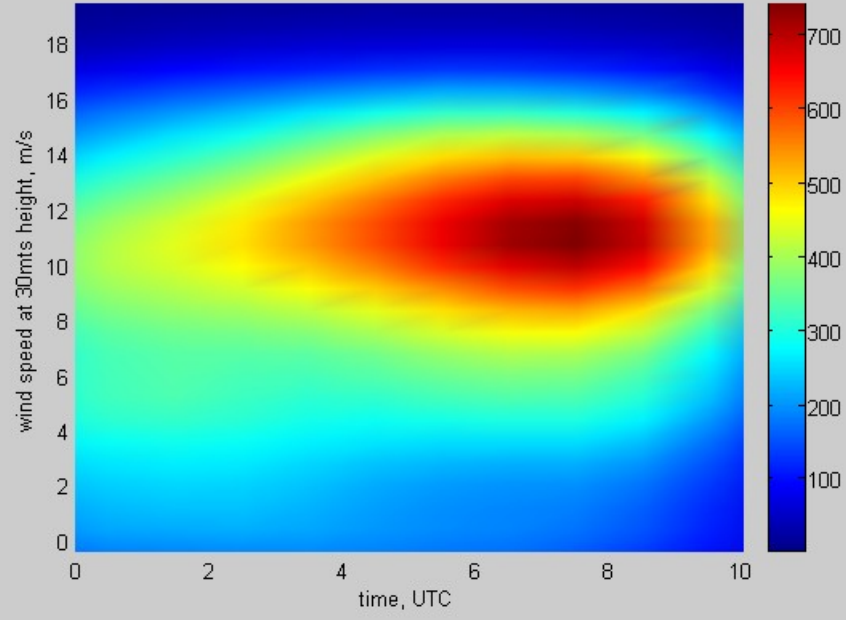
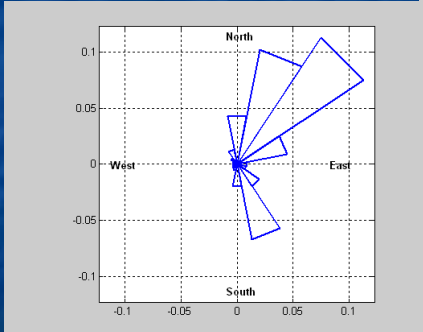
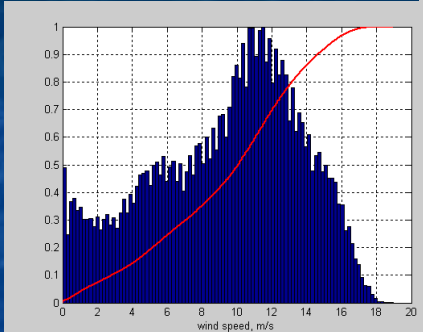


The highest probability to get super seeing (seeing < 0.5") is when the wind comes from NNW-N with a speed of 2 to 8 m/s, in this case, the Astronomer put programs that require this conditions into the execution sequence. Usually, these are the hardest programs to execute and the highest ranked too, so in this case they have the highest priority to be executed



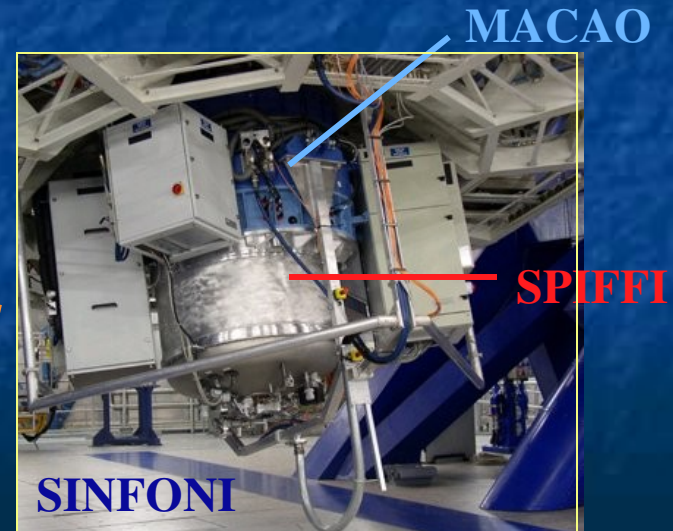
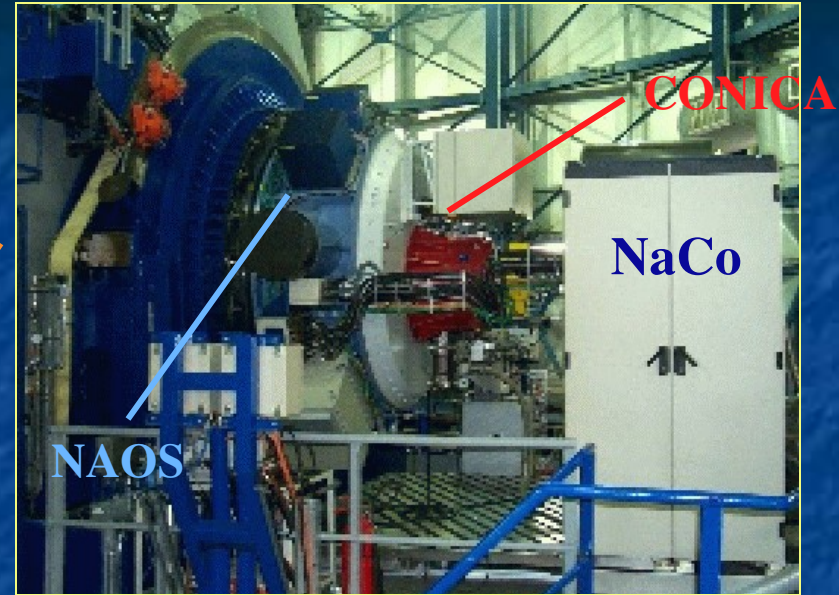


■ Wind coming from NNE-NE usually brings bad seeing (seeing > 1.5"). Astronomers put programs with more relaxed constraints (class B or C)





Dealing with Adaptive Optic

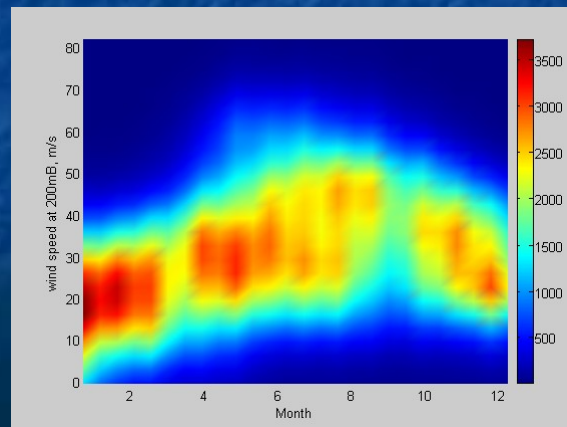
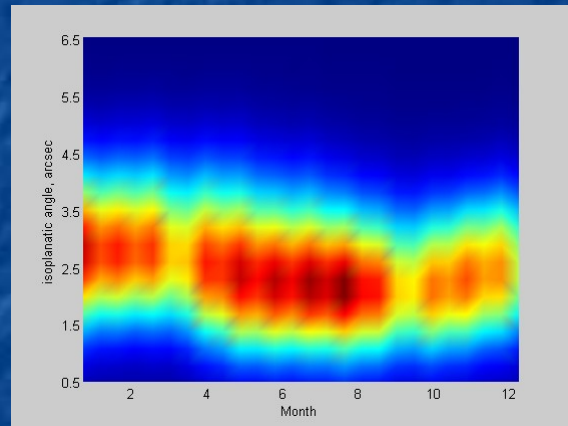
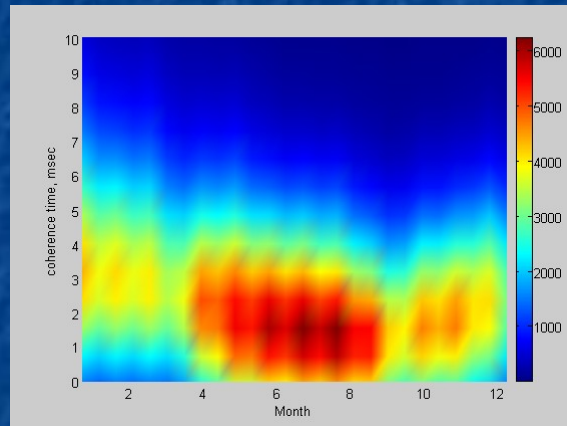
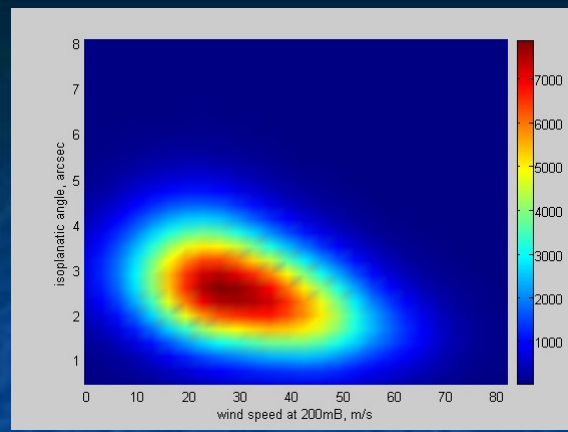
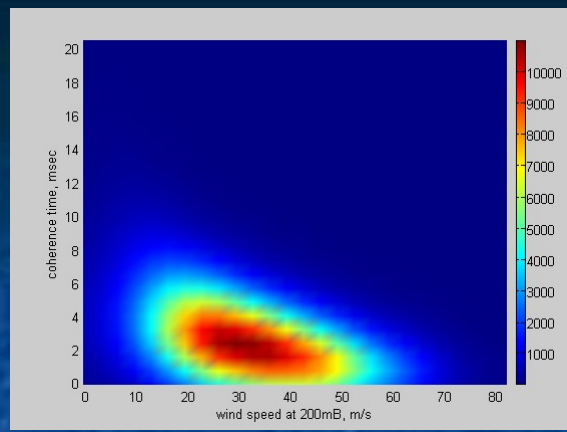


Astronomers and TIOs driving instruments with AO facilities know or should know about coherence time and isoplanatic angle too



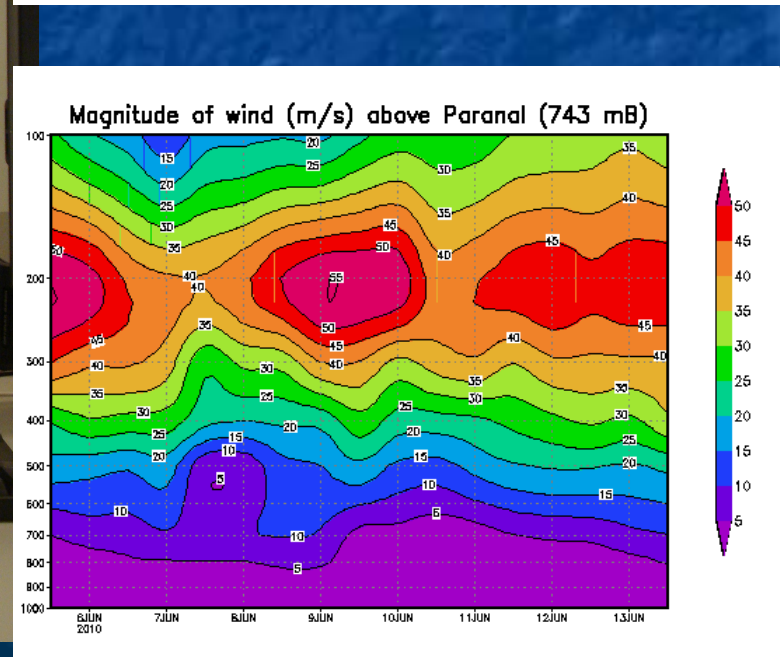
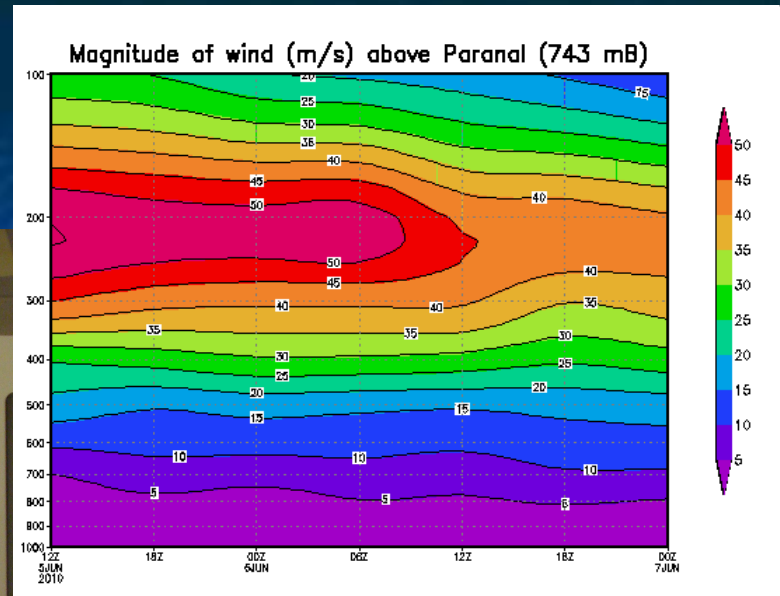


It is known that Coherence time and Isoplanatic angle are directly correlated with the jet stream (wind speed at 200mB) at Paranal. From the data collected along the years, AO astronomers know that is very hard to execute AO programs in winter time (June-July mainly)





But again, they can check the forecast on the web page to schedule AO programs for the night, in addition to the real time information provided by the ASM (Astronomical Site Monitoring) a.k.a Astronomers Entertainment Panels





NACO Strategies

- AO Astronomers have developed some strategies in order to get the best performance according to the conditions when they are using the adaptive optics facilities, below an example for the Naos Conica instrument
- Best strategy for observations (to get the best SR):
- $T_0 < 3\text{ms}$ is a bad value and one should not expect the best correction except at the highest frequency of the WFS and if the seeing is reasonably good.
- No so good seeing ($>0.6''$ & $<1.0''$) & long T_0 use a 14×14 configuration even at low frequency
- Good seeing ($<0.6''$) but short T_0 use a 7×7 configuration at the highest possible frequency
- All good use a 14×14 configuration at the highest possible frequency
- All bad go to sleep





THE INTERFEROMETER CASE (VLT)

For VLT Astronomers the Coherence Time is one of the more important parameters they have to deal with, followed by the Precipitable Water Vapor if they are using a mid infrared instrument like MIDI

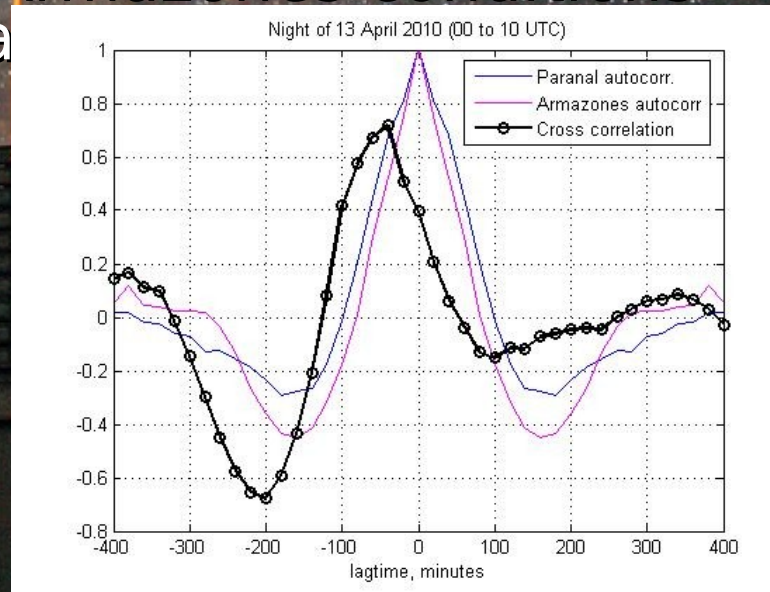
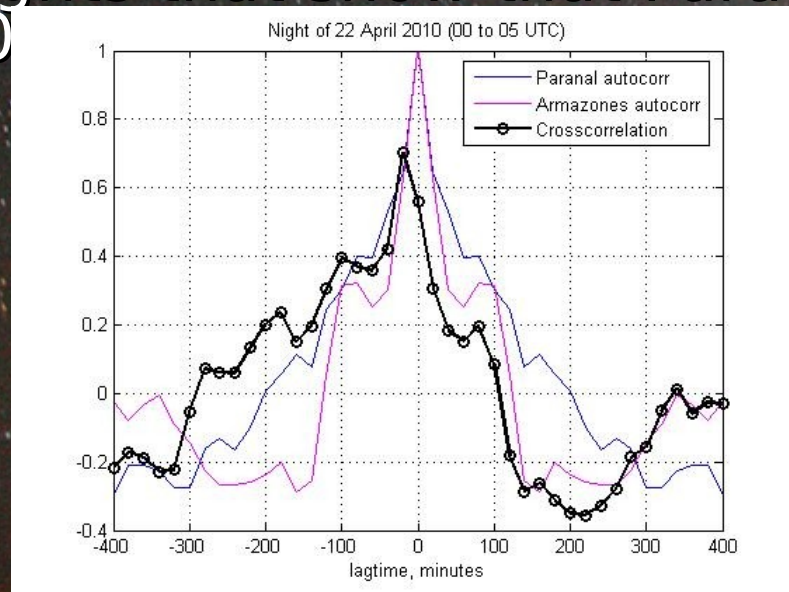




AND FOR THE FUTURE?

As conclusion we can say that for Science Operation is very important to have tools that forecast all the atmospheric conditions more and more accurate. Some option that should be study is to have a kind of mass-dimm network around the observatory, some kilometers away.

Below an Armazones-Paranal seeing crosscorrelation for 2 nights that show that Paranal got Armazones conditions 20





■ THANK YOU VERY MUCH

