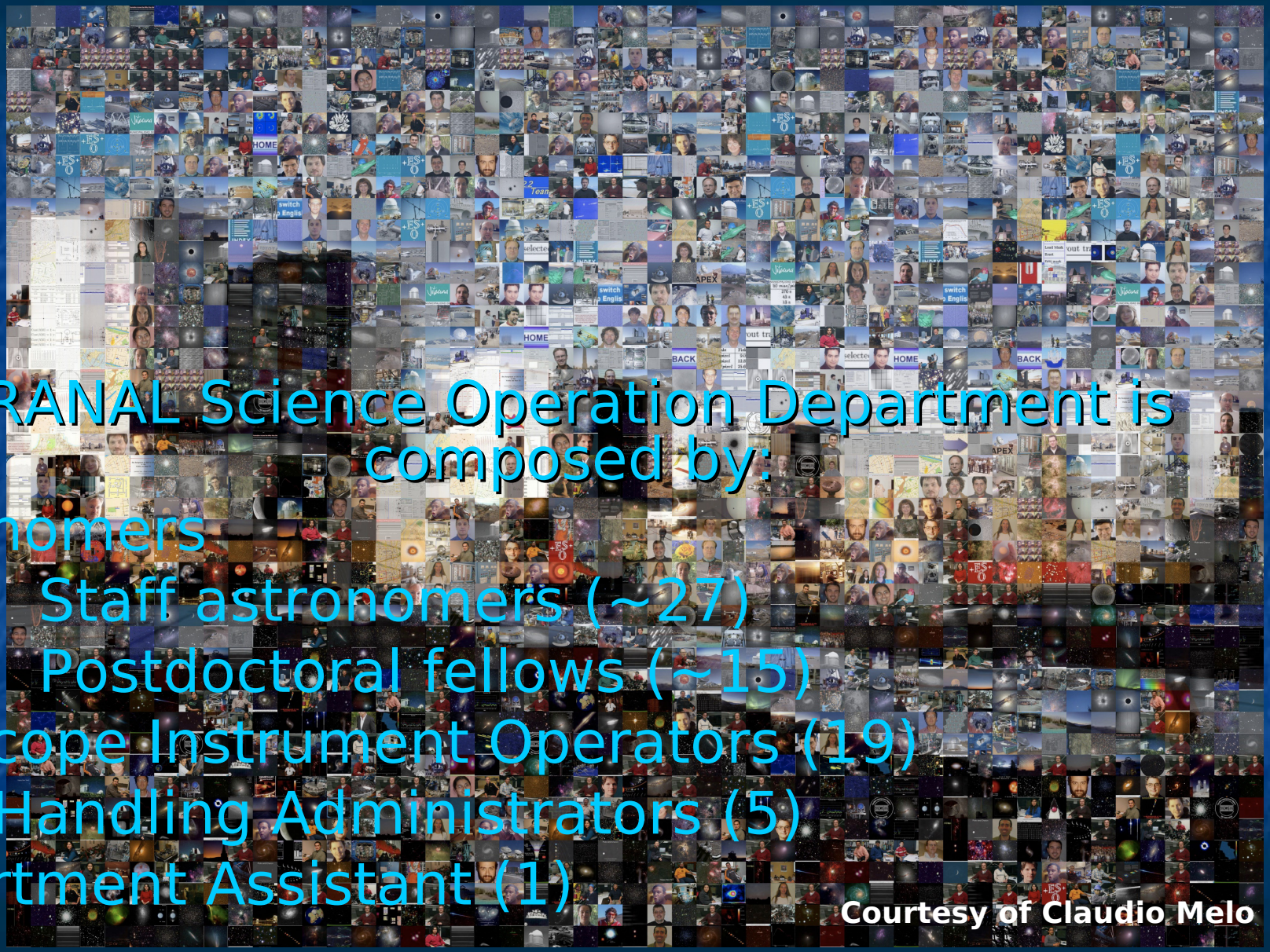
Comprehensive Characterization of Astronomical Sites

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

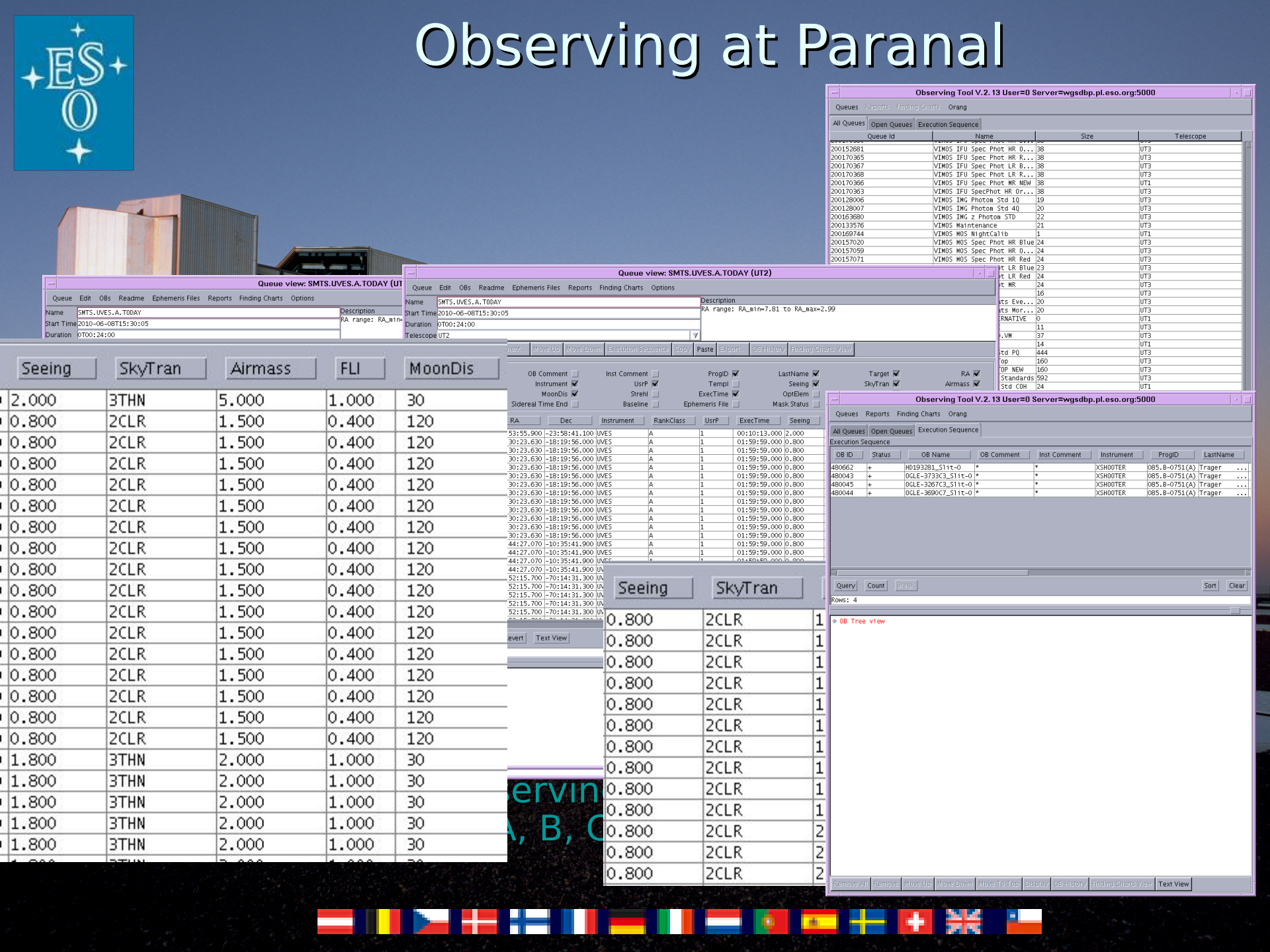
What do we do?

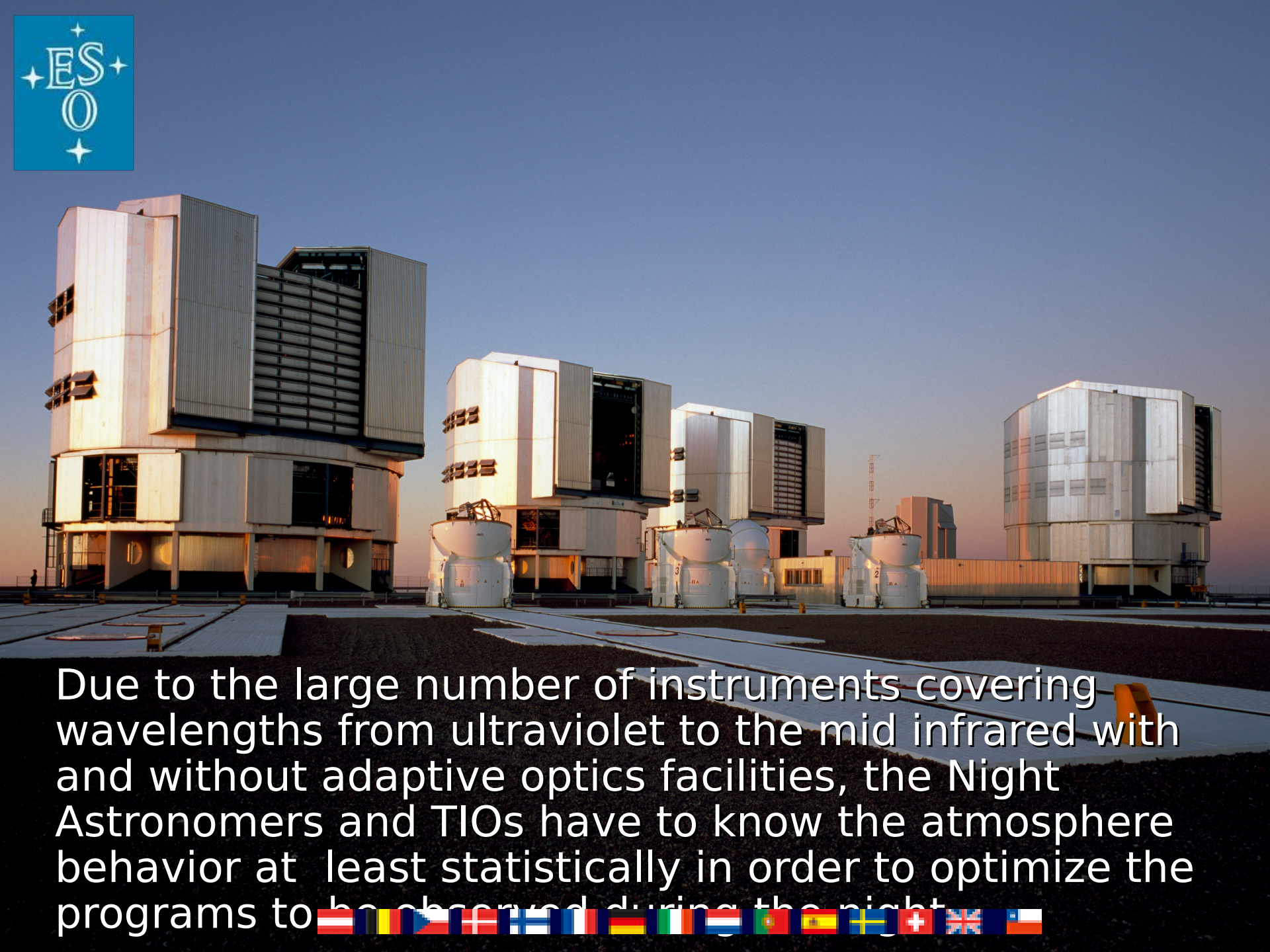
Courtesy of Claudio Melo

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

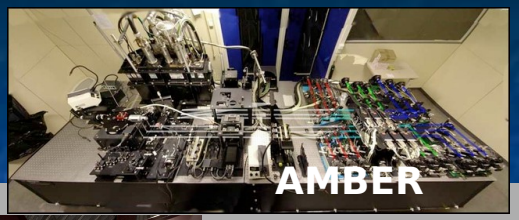
Observing at Paranal

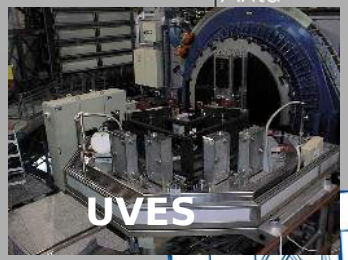


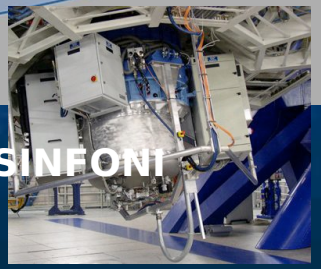


Due to the large number of instruments covering wavelengths from ultraviolet to the mid infrared with and without adaptive optics facilities, the Night Astronomers and TIOs have to know the atmosphere behavior at least statistically in order to optimize the programs to be observed during the night

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.

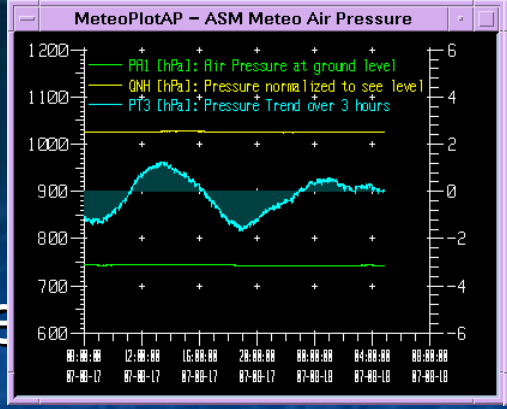
VLTI Instruments :

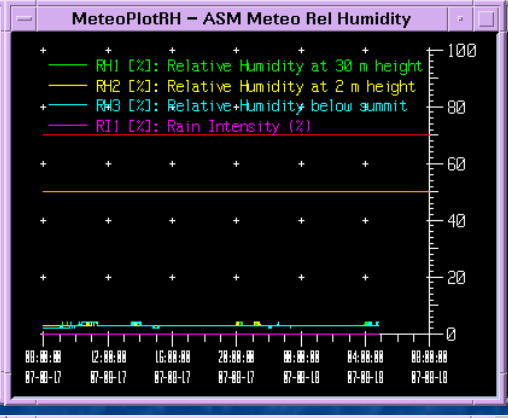
MIDI is a MID-infrared Interferometric instrument for photometry and spectroscopy

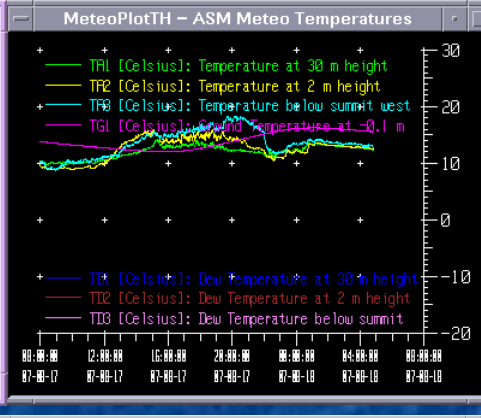
AMBER is a near infrared Astronomical

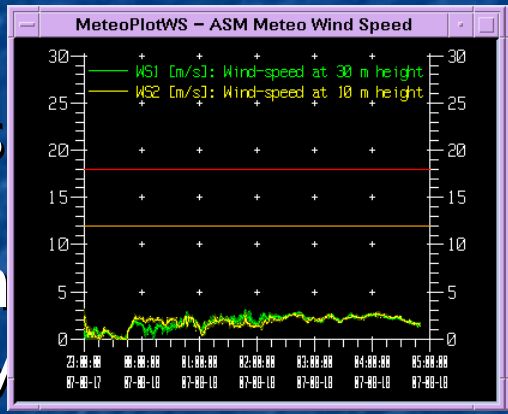
To help Astronomers and TIOs to take the best in real time decisions, we count with a set of tools that permit us to monitor the atmosphere and to adapt the observations according to the actual conditions and with a set of forecasted parameters that allow us to get an idea about the night conditions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

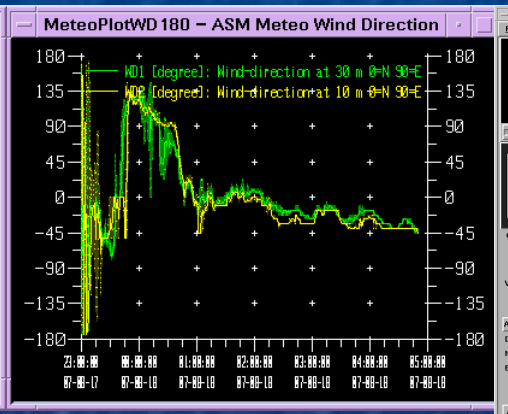
Some of the Atmospheric parameters that are delivered in real time by the ASM, including the all sky camera (MASCOT)

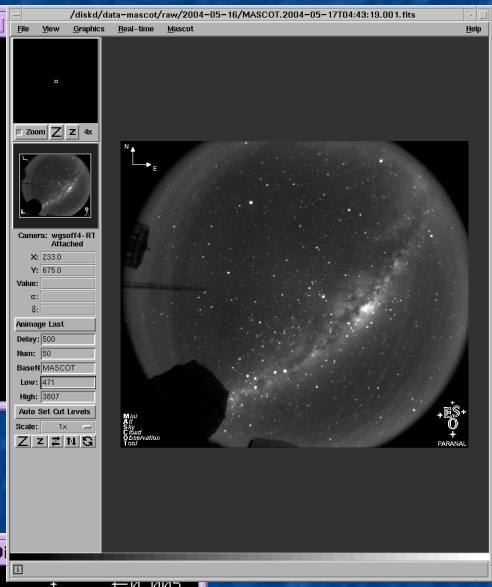


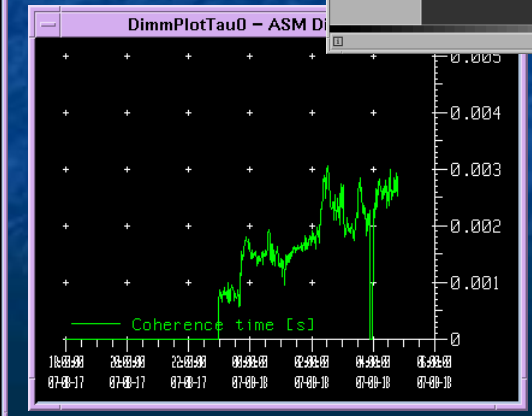












Mozilla Firefox

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http://www.eso.org/gen-fac/pubs/astclim/forecast/meteo/verification/weather_watch.update

NAVISION Remedy AUTREP Paranal Intranet SCIOPS Control Asistencia Meteorological Foreca... meteo_apex PWV monitor The ESO Sky Calendar... La Silla P

http://www.es..._watch.update

General predictions (short term) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://w4.hq.eso.org/gen-fac/pubs/astclim/forecast/meteo/ECMWF/short2/

General predictions (short term)

These predictions provides tendencies up to T+36H. The images are lat/lon projections of the region [65W to 110W]x[10S to 43S]. A click on the image outside the two rectangles regions outlined.

Temperature

Temperature (K at 700mb – 00Z19JUL2010)

Geopotential height

Geopotential height (m at 700mb – 00Z19JUL2010)

Wind streamlines

Wind colored by mag. (m/s at 700mb – 00Z19JUL2010)

Wind colored by mag. (m/s at 200mb – 00Z19JUL2010)

Done

Paranal site (long term) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://w4.hq.eso.org/gen-fac/pubs/astclim/forecast/meteo/ECMWF/long2/paranal_long.html

Paranal site (long term)

Long term predictions for Paranal

HOME INDEX SEARCH HELP NEWS

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

Evolution of the geopotential height

Geopotential Height (m) above Paranal (743 mB)

Evolution of the temperature

Temperature (K) above Paranal (743 mB)

Evolution of the magnitude of wind

Magnitude of wind (m/s) above Paranal (743 mB)

Evolution of the vector wind

Evolution of the wind above Paranal (743 mB)

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].

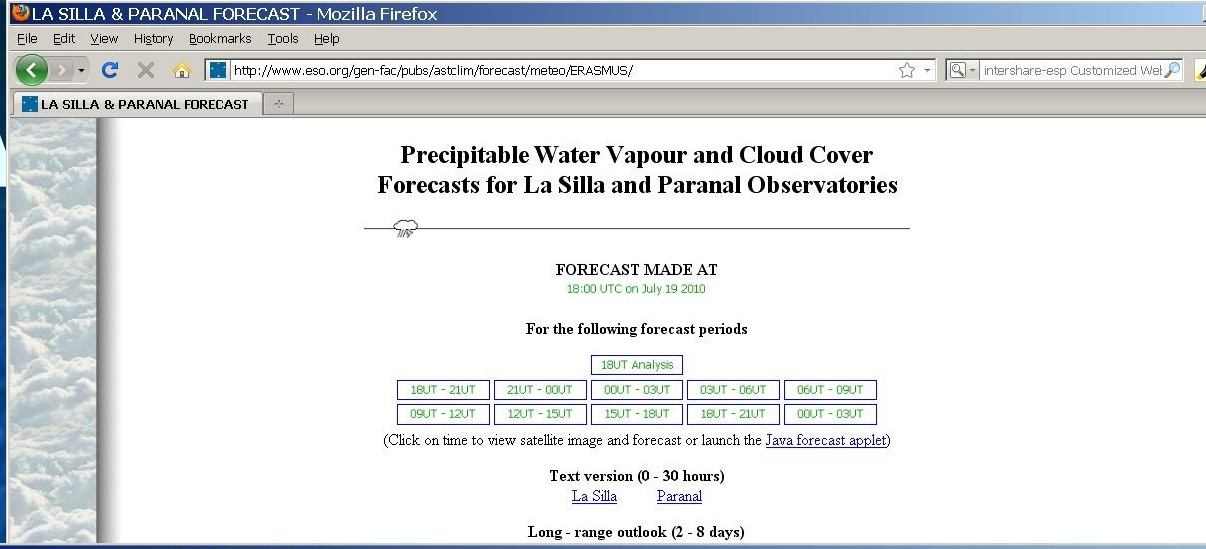
Done

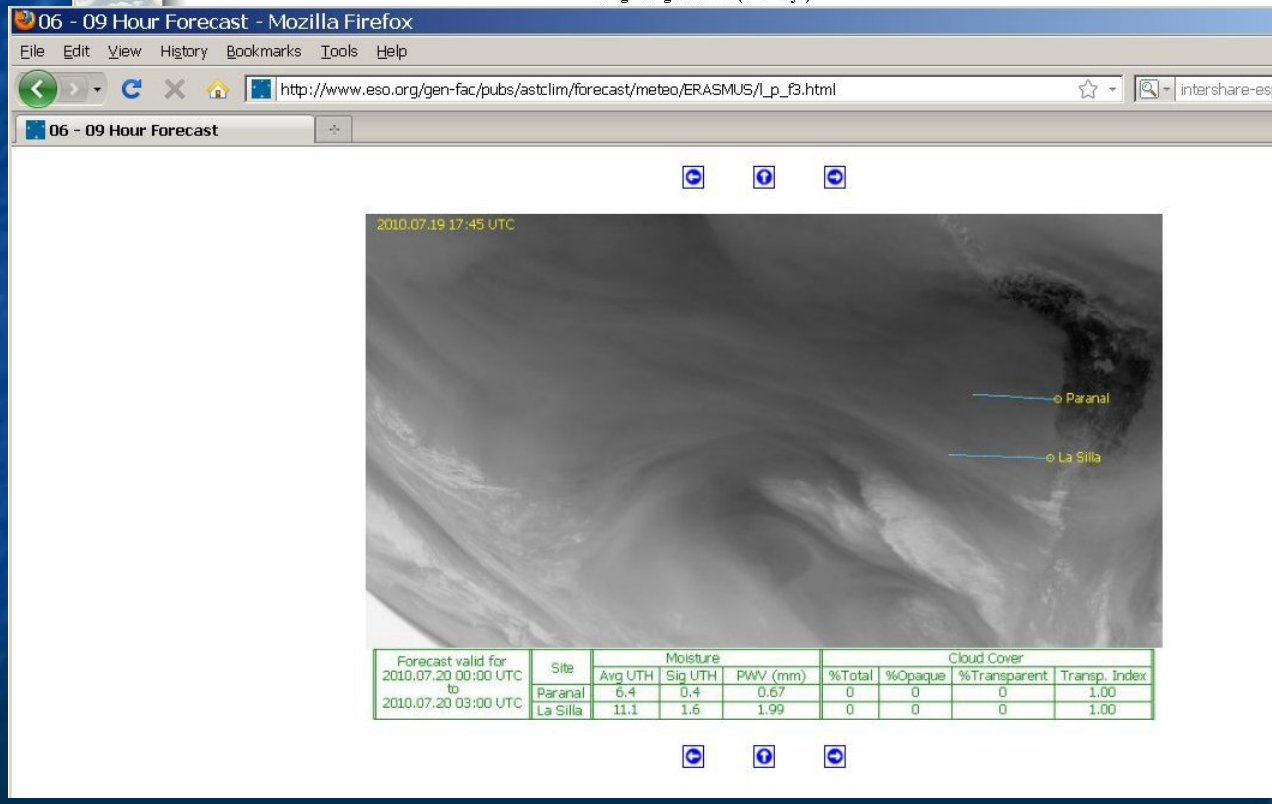
Done

Some of the A
forecasted

PWV

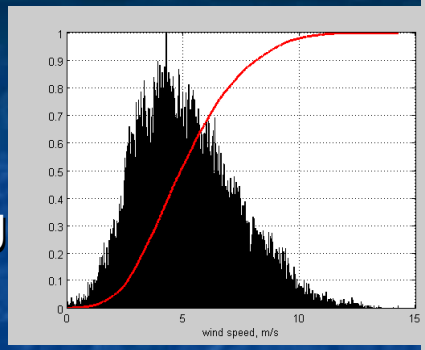
YOU WILL HEAR MORE ABOUT THIS IMPORTANT PARAMETER ON THE PRESENTATIONS OF F. KERBER AND A. OTAROLA

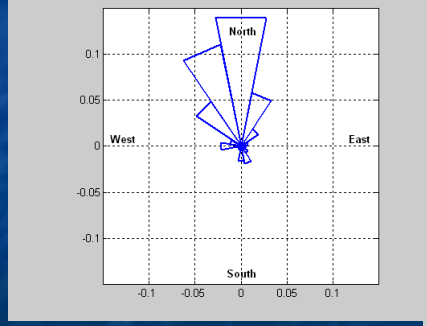


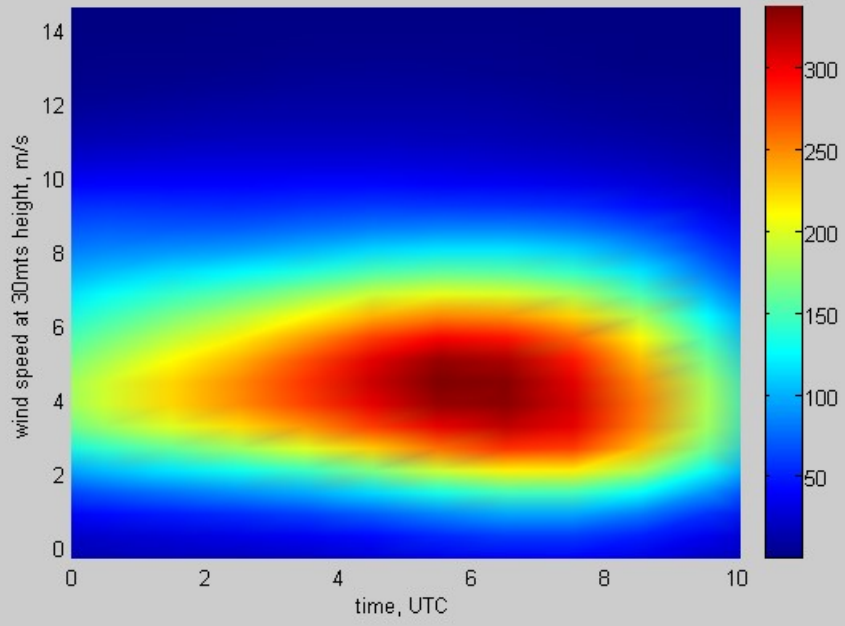


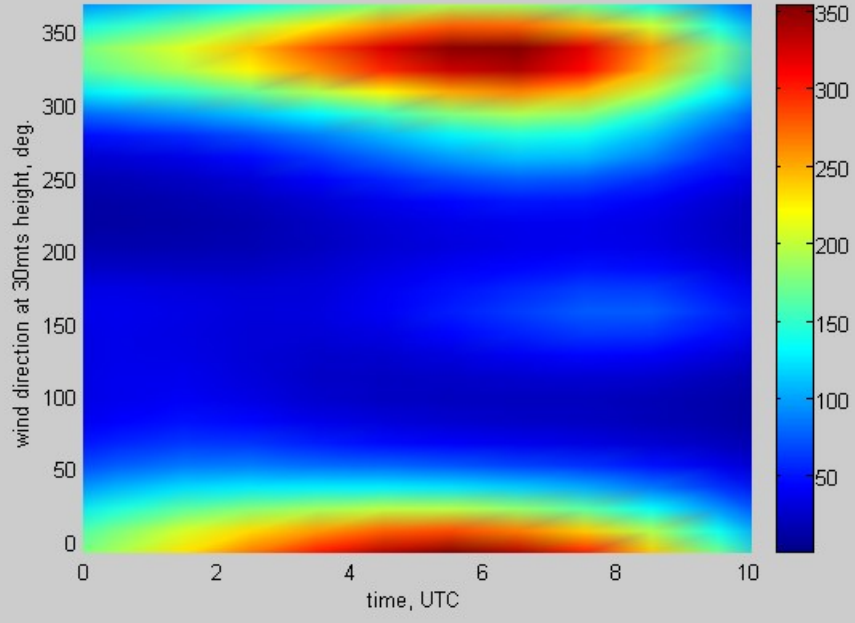

All these tools plus the knowledge
of some characteristics behavior
of some key parameters like
seeing make life a little bit easy
for Astronomers and TIOs

- 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

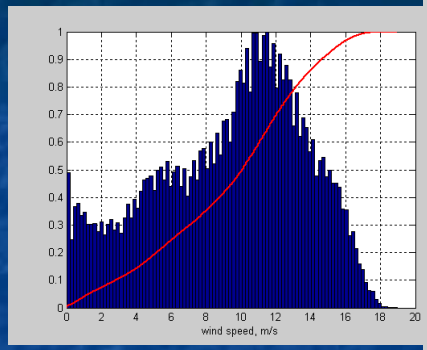


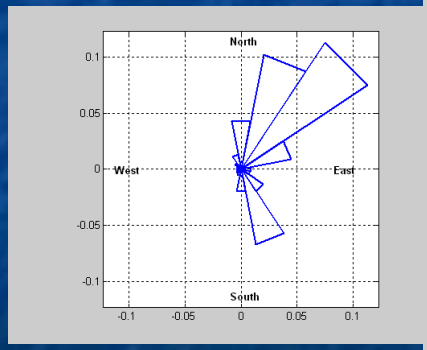


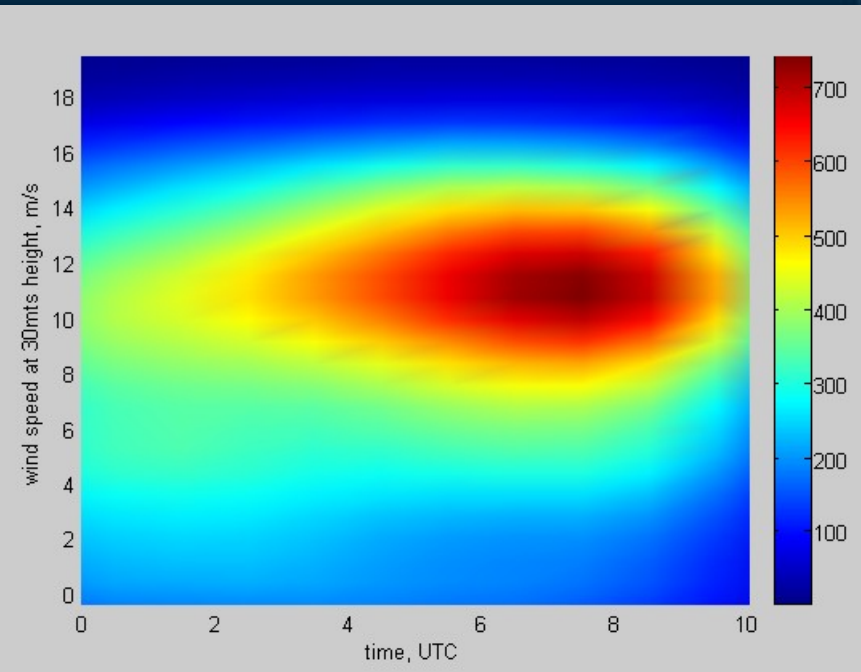


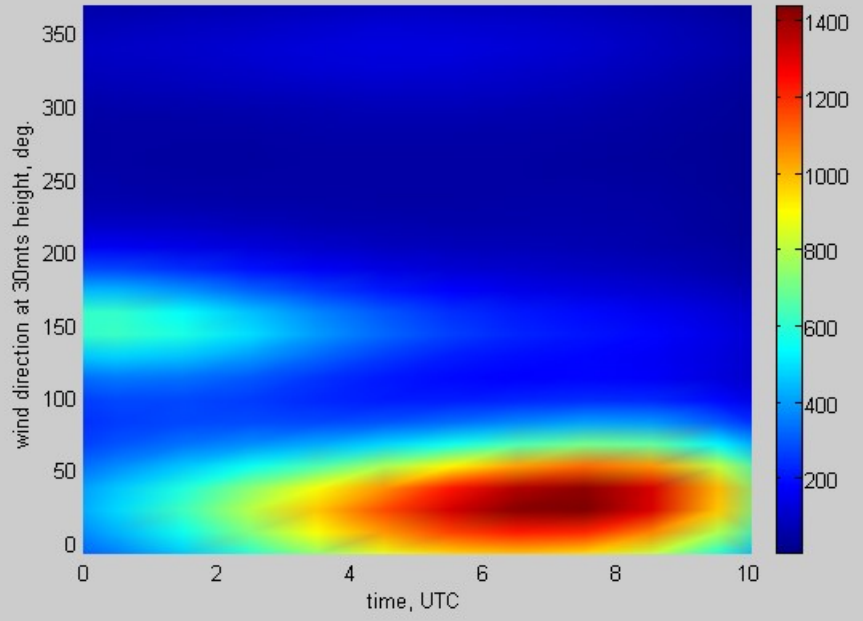


- Wind coming from NNE-NE usually brings bad seeing (seeing > 1.5”). Astronomers put programs with more relaxed constrains (class B or C

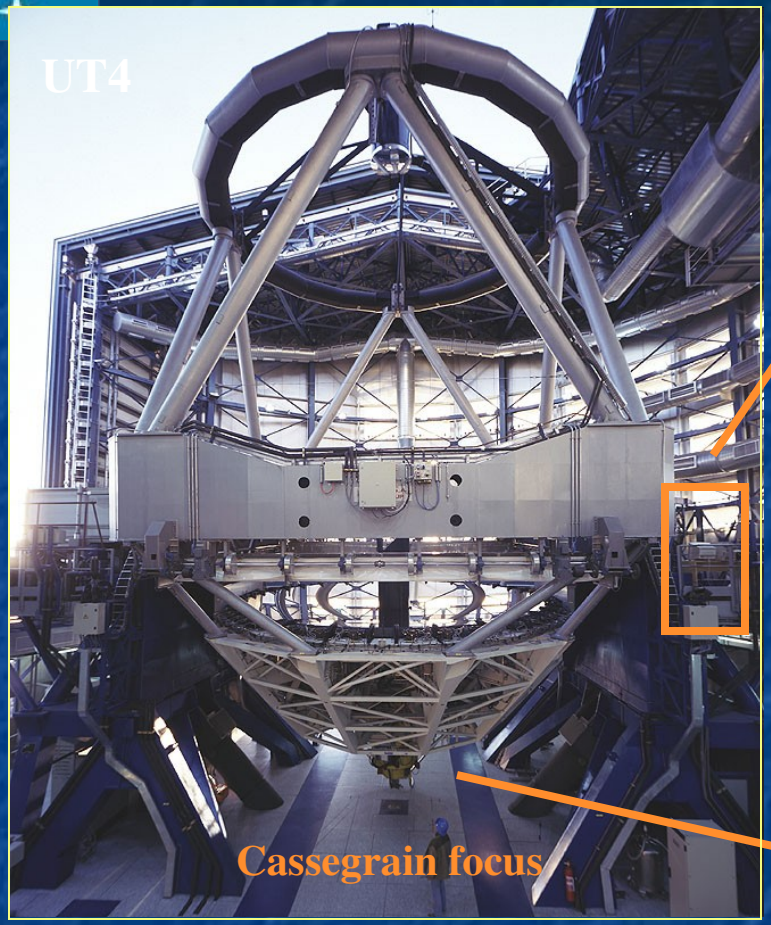




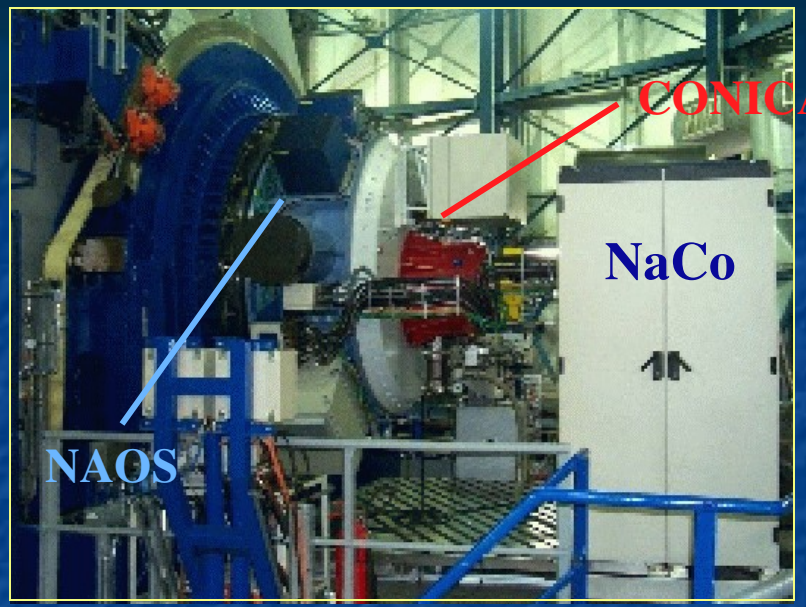


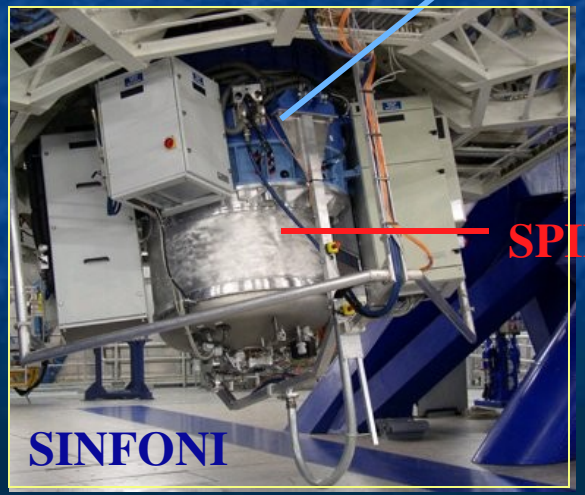


Dealing with Adaptive Optic



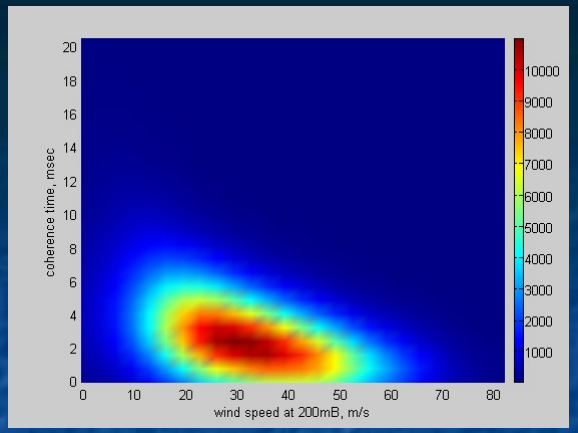
Nasmyth Focus

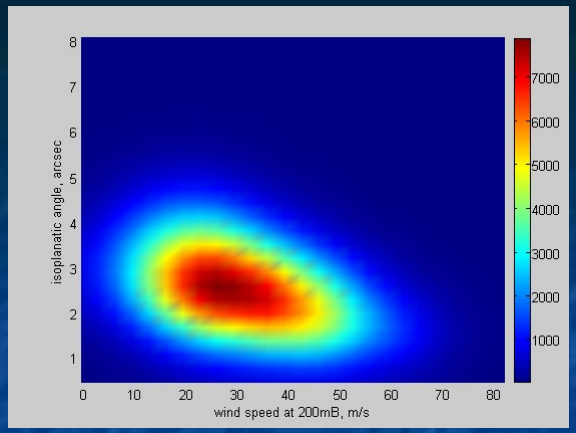


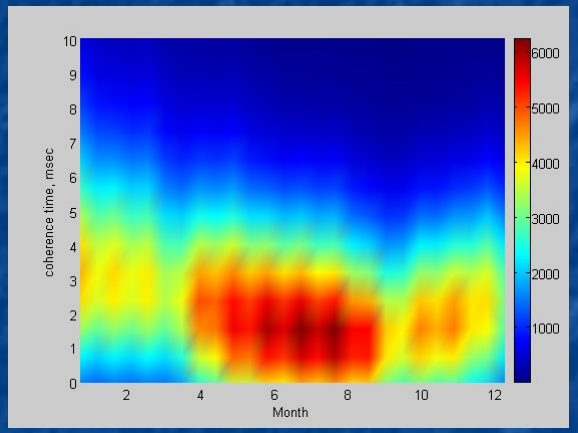


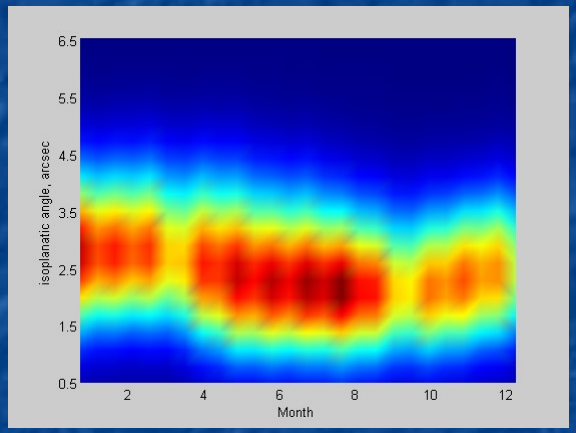
Astronomers and TIOs driving instruments with AO facilities know or should know about coherence time and isoplanatic angle too

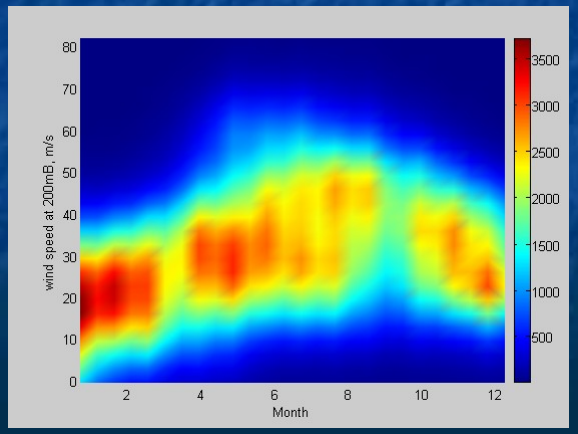
- It is known that Coherence time and Isoplanatic angle are directly correlated with the jet stream (wind speed at 200mB) at Paranal. From the data collected along the years, AO astronomers know that is very hard to execute AO programs in winter time (June-July mainly)



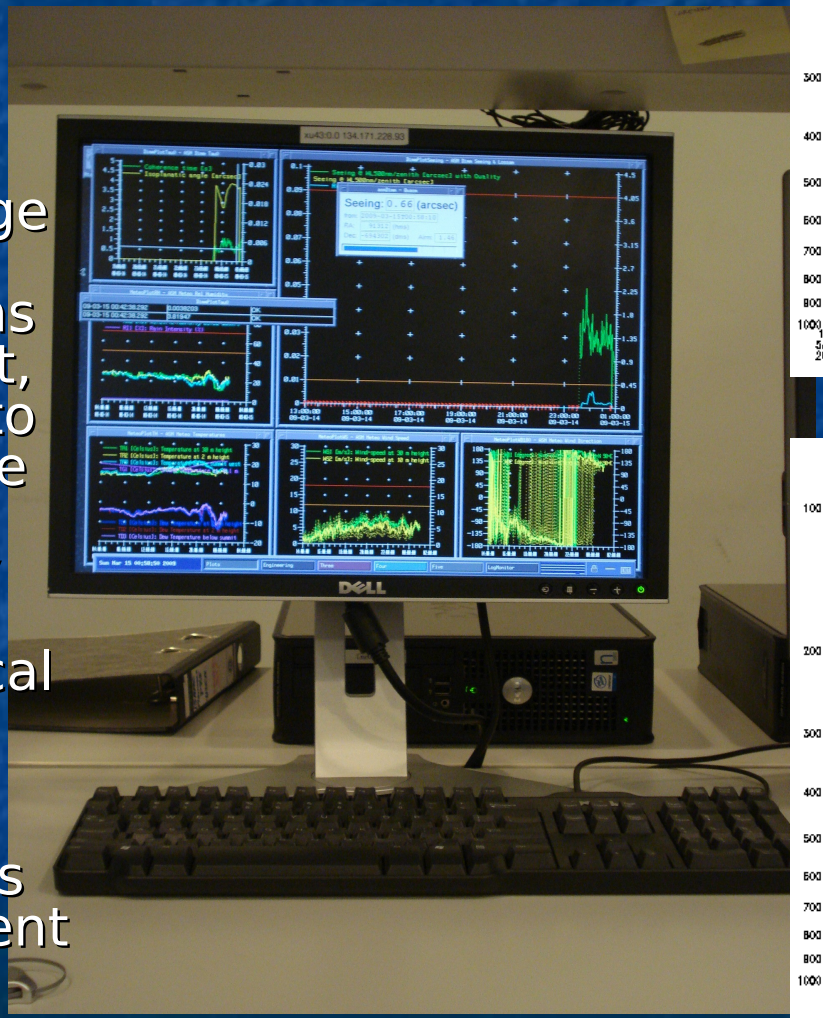


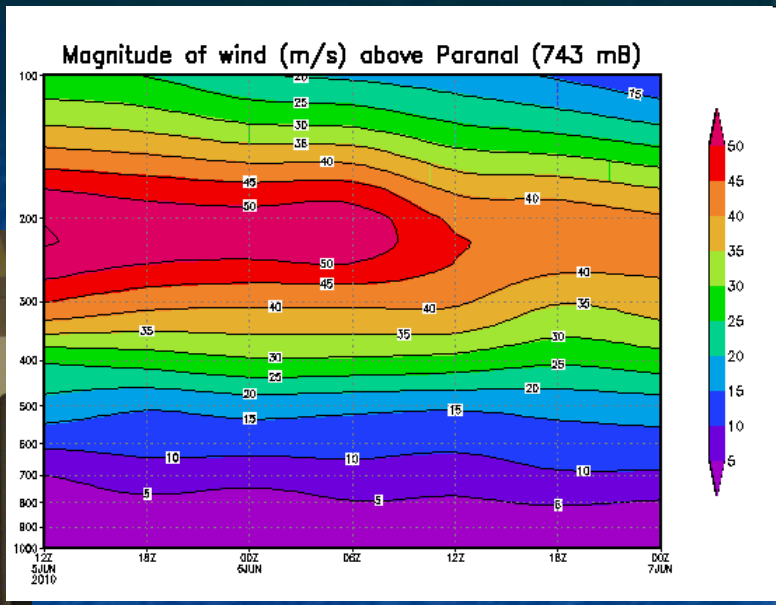


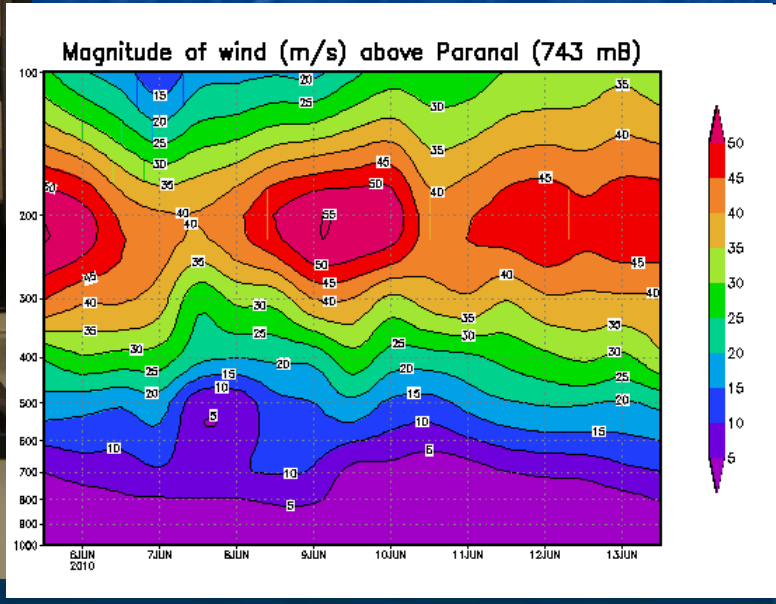




But again, they can check the forecast on the web page to schedule AO programs for the night, in addition to the real time information provided by the ASM (Astronomical Site Monitoring) a.k.a Astronomers Entertainment Panels







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):
- T0 < 3ms 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 T0 use a 14x14 configuration even at low frequency
- Good seeing(<0.6”) but short T0 use a 7x7 configuration at the highest possible frequency
- All good use a 14x14 configuration at the highest possible frequency
- All bad go to sleep

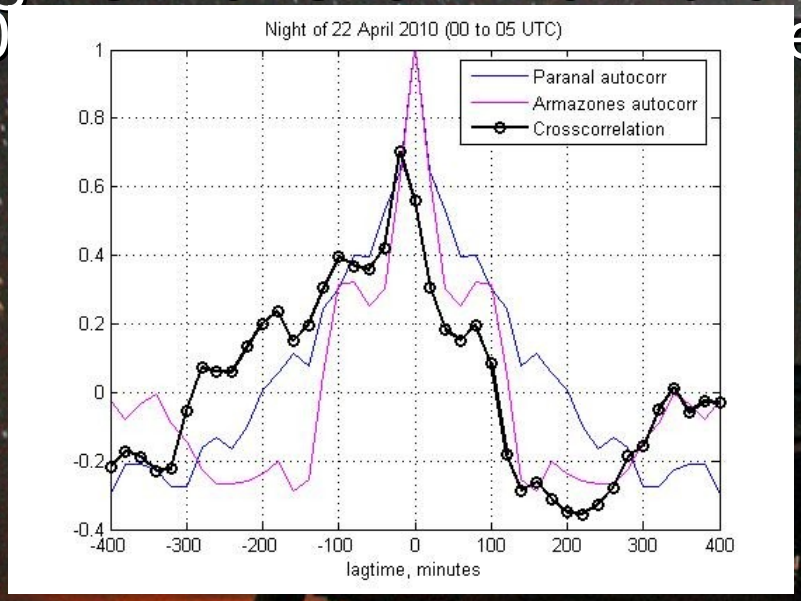
THE INTERFEROMETER CASE (VLTI)

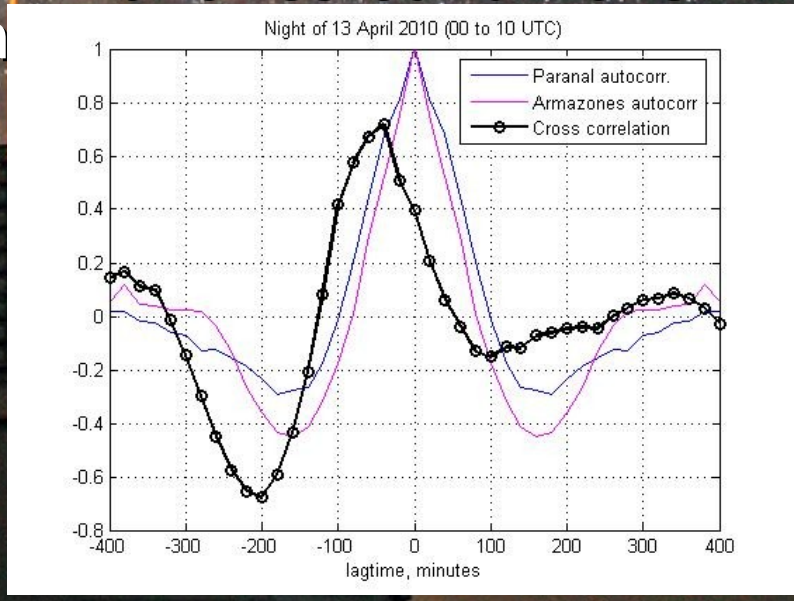
For VLTI Astronomers the Coherence Time is one or the more important parameter they have to deal, followed by the Precipitable Water Vapor if the are using a mid infrared instrument like MIDI

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 ence tra





- THANK YOU VERY MUCH