

## SITE TESTING IN THE NORTHWEST OF ARGENTINA

Pablo Recabarren (1,2,5), Diego García Lambas (1,2), Hernán Muriell (2), Federico Stasyszyn (1), Victor Renzi (1), Ruben Vrech (1), José Viramonte (2,4) and Marc Sarazin (3).

(1) *IATE-Observatorio Astronómico de Córdoba, Argentina.* (2) *CONICET, Argentina.* (3) *ESO, Germany.* (4) *Instituto Geonorte-UNS, Argentina.* (5) *Facultad de Ciencias Exactas, Fisicas y Naturales, U.N.Cba., Argentina.*

### *Abstract:*

We present different results of the characterization of the Tolar Grande - Macon Range site in the North-West of Argentina. This project is being developed by the IATE Group of Córdoba Observatory in collaboration with ESO in the framework of the E-ELT project. We present and discuss one year of image quality measurements with MASS and DIMM, three years of meteorological data and detailed studies of seismic activity and geo-technical aspects as well as diverse logistic issues.

### *Geographic description*

The NW of Argentina between, 23° 15' and 24° 30' South latitude and 65° 30' and 67° 30' West longitude, Known as Puna region, is a high plateau ranging between 3000 and 4000 m. There are several mountain ranges with peaks reaching more than 6000 m.

### *General facilities of the area*

*Salta* is the main city, comparable or larger than the Chilean Calama and Antofagasta. Salta provides facilities and infrastructure such as airports, universities, communications, electric power stations, hotels, car and truck rentals, shopping centers, etc.

*San Antonio de los Cobres:* is the main town of our interest area (3781 m.a.s.l., 3200 inhabitants) through a 120 km paved road from Salta.

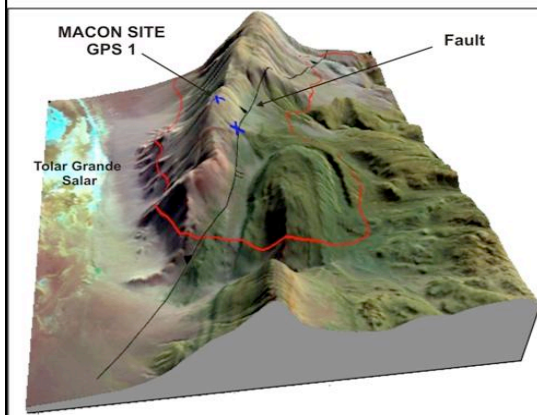
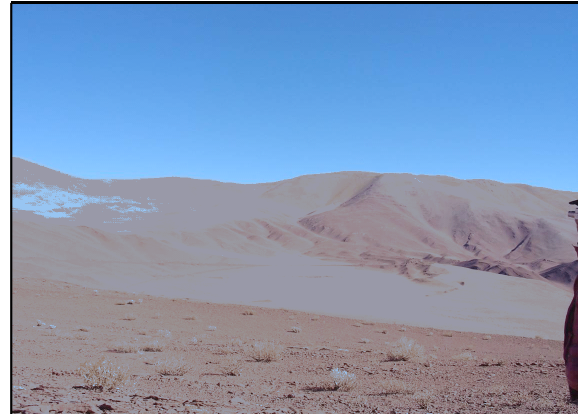
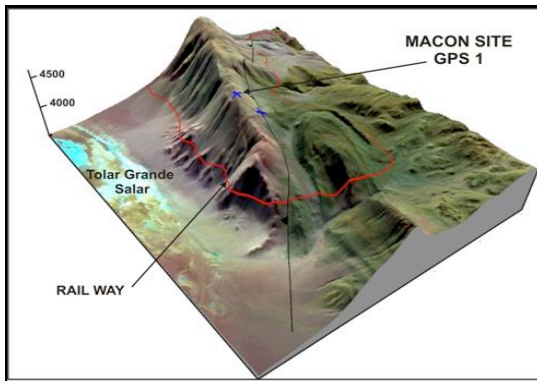
*Tolar Grande:* Small town of 175 inhabitants (3550 m.a.s.l) close to the site: Macón Range 320 km away from Salta (200 from San Antonio de los Cobres through a non paved road in good conditions. *A railway track from Salta City to Antofagasta (Chile) through San Antonio de los Cobres, Tolar Grande and Socompa pass.*

### *The Candidate Site (Macón Range)*

Four candidate locations were preliminary selected after GOES satellite images, NIMBUS data analysis, analysis of tectonic and geographical issues as well as several exploration trips to the area. Macón Range: Toward the East of Arizaro Salt Flat, there is the Macon Range, at 5450 m.a.s.l. extends from the southeast of Mount Rincon, in the Chilean border to the South East of Tolar Grande Town, at the East of the middle of Arizaro salt flat. Macon Range runs in north to south direction and there are no comparable altitudes to the west near 50 km.

Macón range has several features that make it suitable for large observational developments. The combined facts of wind regularly from the WNW and E directions, the North- South layout of the Macon range and the presence of the large Arizaro Salt Flat at the West of Macón and Pocitos Salt flat at the East, provides particular configuration that strongly suggest a laminar wind regime on the top of the ridge.

Tolar Grande (which offers several facilities) is located between the Macon Range and the Arizaro Salt Flat.



*Left: Macón Range (the red line represents the railway track. Right: View of Macón site from the east.*

#### *Cloud Covering & Extinction*

GOES 8 images from years 1999 to 2002, were analysed. The cloud covering distribution at local time 21, 00, 03 and 06 hs. (Local Time = UTC + 3hs.) indicates that approximately 83 % of night time is cloud free. During the 2 year campaigns in Tolar Grande it was observed clear sky during more than 90% of the time. Clouds disturbed MASS operation in 6 nights out of 152. Nimbus-7 TOMS satellite data indicates that the region is not affected by dust, with extinction estimates better than those derived for Chajnantor plateau.

#### *Light Pollution*

Light pollution is negligible in the area of interest and it is not expected to change significantly in decades.

#### *Meteorological results*

Weather parameters are obtained every each 10 minutes, since January 2004.

#### *Water Vapor*

Atmospheric Opacity at 210GHz (Instituto Argentino de Radioastronomía). Results correspond to one year of measurements (April 2004 to April 2005).

#### *Geological and Geotechnological Characteristics*

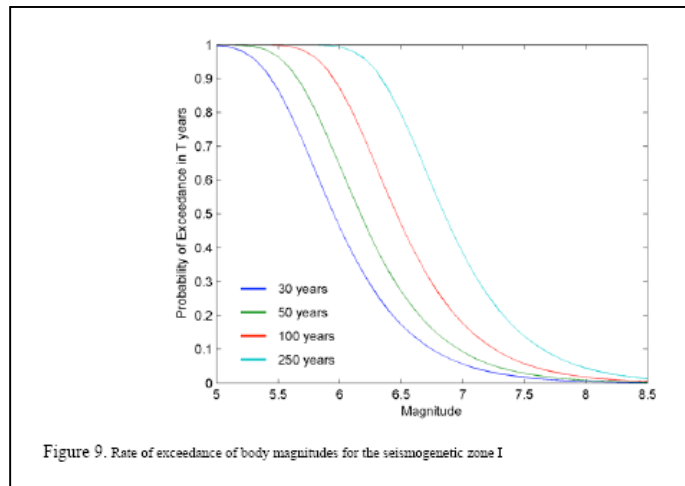
The Cerro Macón granitoid is part of the Basement of the Puna. Considering the characteristics of the rock (Fresh granitic rock with diaclases) the admissible tension is around 35 kg/cm<sup>2</sup>.

The recent detritical cover is very poor or inexistent. The microscopic and chemical analysis of this sediment shows no presence of salt crystals and does not detect the

presence of SO<sub>4</sub>, in consequence they consider the soil is not aggressive to the cement. The granitic clast on Macon does not show a typical desert pavement or ventifact form. The absence of eolic sedimentary deposits, salt minerals and desert pavement and ventifact forms at the top of Macón, suggests that the wind do not have the possibility of transporting sedimentary material from the Arisaro salt flat.

*Seismic Activity*

The seismicity in the Puna Plateau is quite different than the one of the forearc region, being the later closer to the subduction trench of the Nazca Plate below the South American Plate. The west mountain range acts like an effective dumper of the seismic waves, especially to the secondary ones. There is a low superficial seismicity. Mostly the seismicity is owed to the subduction phenomena, so the focuses have depths of more than 100 km. The seismic hazard is defined in terms of peak accelerations: the peak acceleration is 0.19 g. The study gives quite lower values of the seismic loads than those of the forearc region.



*Seeing and turbulence measurements*

Measurements were obtained in the two sites: Tolar Grande Town 3550 m.a.s.l. and Macon ridge, 4609 m.a.s.l. In Tolar Grande, turbulence profiles were determined with ESO-MASS. In Macon ridge, weather parameters and atmospheric opacity at 210 HGz were also determined. Seeing measurements are obtained with the ESO-DIMM. Six MASS campaigns were performed covering the period 3/10/2005 – 4/28/2006, comprising 158 nights.

Five DIMM measurement campaigns in Macon range were developed simultaneously to MASS measurements in Tolar Grande village. We obtained 30 nights of DIMM measurements in the period 5/30/2005 – 4/28/2006.

*Seeing and turbulence main results*

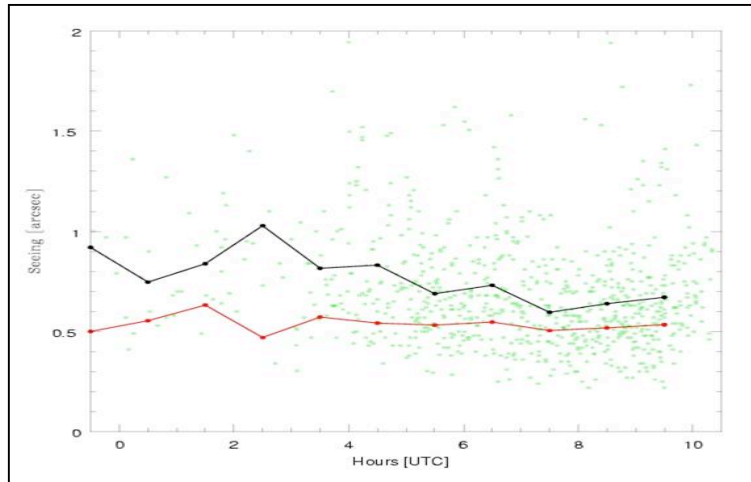
*DIMM seeing in Macón:*

Mean = 0.70, Median = 0.55. (Paranal during the same days: Mean = 1.03, Median = 0.82).

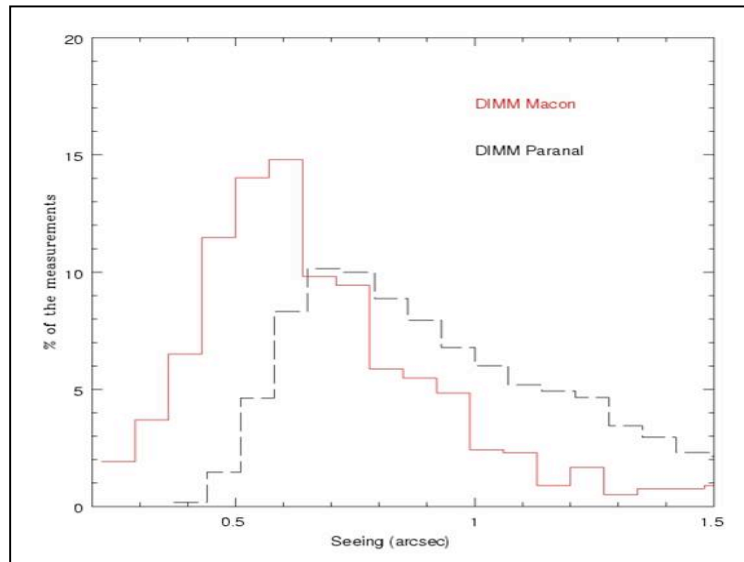
*DIMM seeing in Macón (4609 m.a.s.l.) vs. MASS seeing in Tolar Grande (3550 m.a.s.l.):*

The results indicates similar distribution of values. Nevertheless, MASS tends to underestimate DIMM measurements at Macón.

*MASS at Tolar Grande:* Free seeing : Mean = 0.61, Median = 0.52



*DIMM at Macón. Read: median values, Black: mean values.*



*DIMM Macón vs. DIMM Paranal for the same days.*

### *The Next Step*

#### *New Equipment and measurements*

- C11 carbon fiber telescope.
- Robotic mount.
- MASS-DIMM instrument.
- 5m Tower & robotic enclosure.
- New meteorological weather station.
- Equipped container for human occupation.
- Access road to candidate site (12 km).
- MASS-DIMM measurements will be taken continuously in the Macón Range at 4650 m during a period of (at least) 12 months.