

Caracterización atmosférica de los observatorios astronómicos de Canarias: una herramienta para proteger ciencia y inversión

Julio A. Castro-Almazán • Casiana Muñoz-Tuñón • Sebastián L. Hidalgo • Antonia M. Varela



Promoviendo sinergias entre grandes observatorios españoles I • La Palma, Octubre 2023



Una alternativa para TMT





Summary of the site testing results at the Roque de los Muchachos Observatory

Sky Quality Team*

www.iac.es/site-testing

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March-2016

Abstract

The characterization of the atmosphere for astronomical observations is a key project for the IAC. From nearly 30 years of systematic work including routine and intensive campaigns, a wide set of parameters characterizing the Canarian sites have been gathered. In this document we make a summary of them with a particular emphasis to those relevant for the Adaptive Optics at the ORM. The main result are: the seeing, isoplanatic angle, coherence time median values are $0.65'' \pm 0.5$, $2.74'' \pm 1.2$ and > 5 ms, respectively. The vertical distribution of the turbulence shows an important concentration of $\approx 65\%$ in the Boundary Layer. The results are supported by different techniques and measurements, including the more than 190,000 vertical profiles obtained at the ORM using a SCIDAR at the Jacobus Kapteyn Telescope. The ORM is an excellent site not only because of its atmospheric quality but also by the actions that have been adopted to protect and continuously characterize it.

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Una alternativa para TMT





On October 31st, 2016, the TIO Board of Directors selected the **Observatorio del Roque de Los Muchachos (ORM)**, in La Palma, on the Canary Islands (Spain) as the alternate site for TMT. This decision was based on:

- (1) The quality of the ORM site, which will support all TMT core science programs

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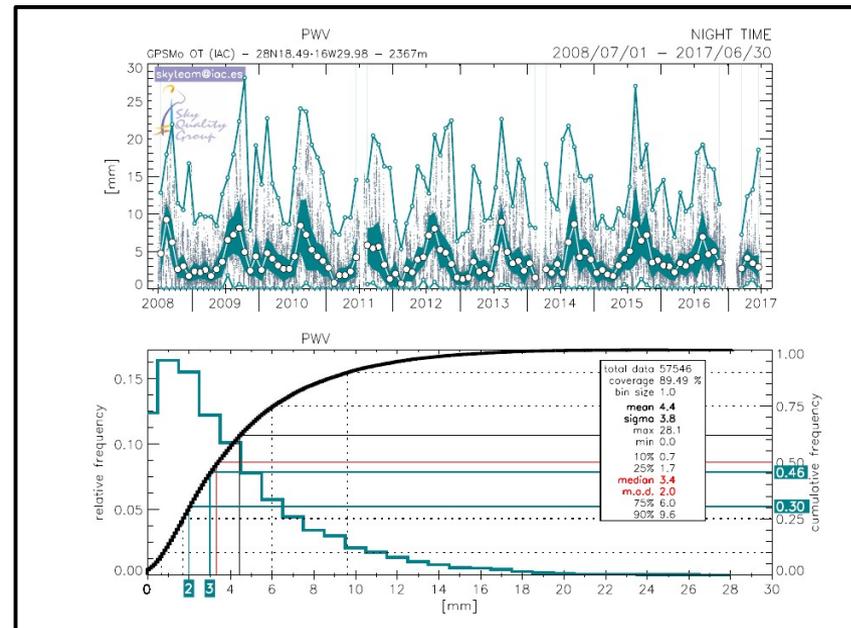
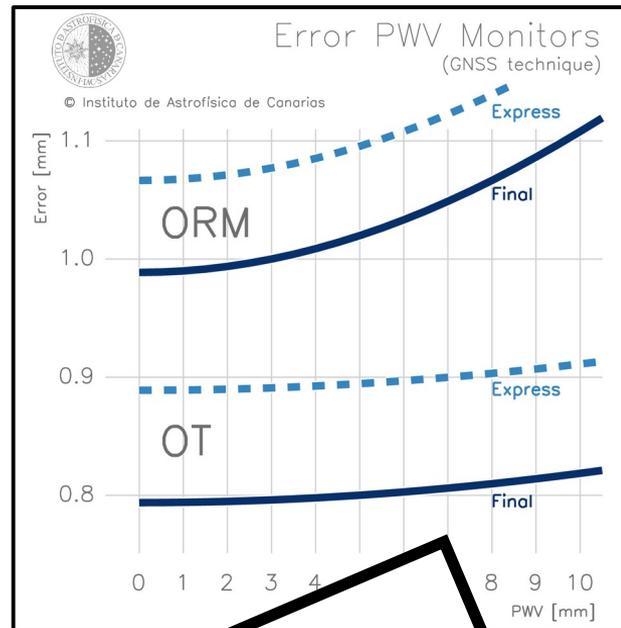
Una alternativa para TMT



Ganando la batalla interna



FIGURE 4.8: Barometer and GNSS antenna at LPAL station, in the roof of the Residence auxiliary buildings at the ORM.

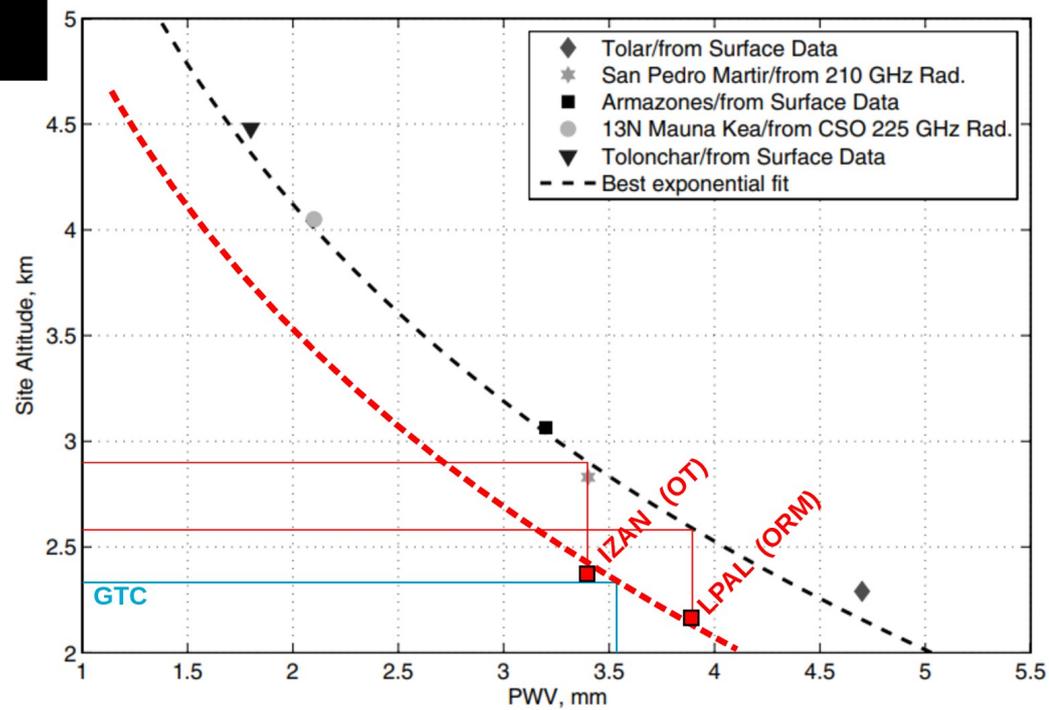


etcétera...

Precipitable Water Vapour at the Canarian Observatories (Teide and Roque de los Muchachos) from routine GPS

Julio A. Castro-Almazán^{a,b}, Casiana Muñoz-Tuñón^{a,b}, Begoña García-Lorenzo^{a,b}, Gabriel Pérez-Jordán^{a*}, Antonia M. Varela^{a,b}, and Ignacio Romero^{c,d}

Ganando la batalla interna



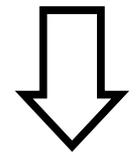
Ganando la batalla interna

Supplementary investigation of La Palma site

NAOJ ORM-study team

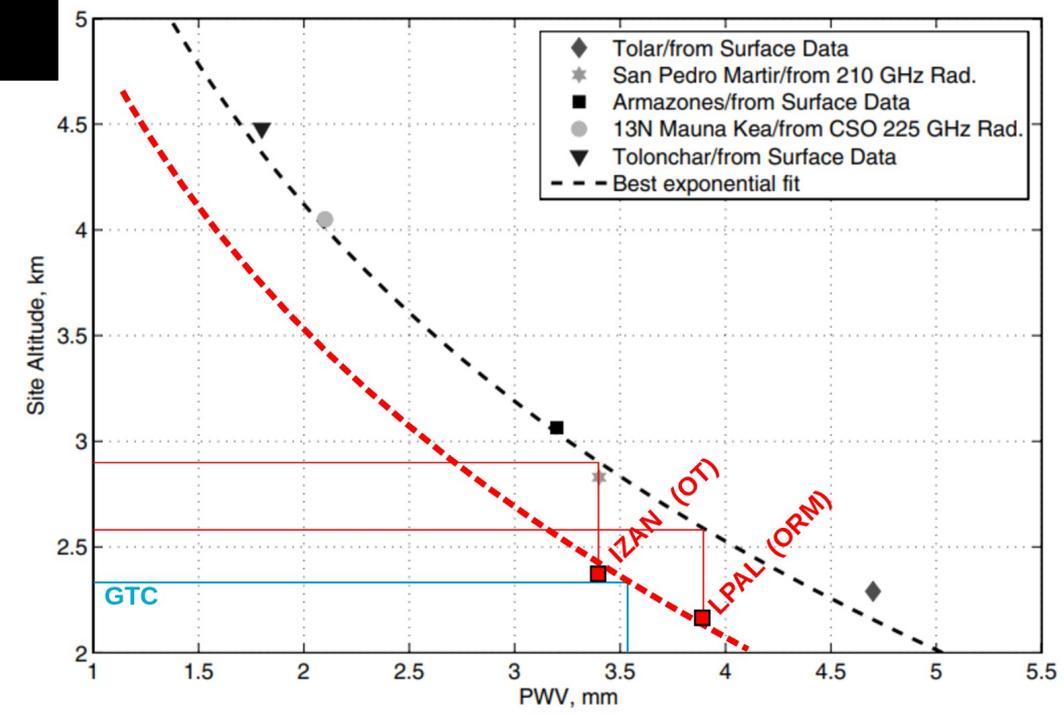
Shin Oya (Chair), Hirofumi Okita, Naruhisa Takato (Subaru Telescope, NAOJ)
 Masayuki Akiyama, Hajime Ogane (Tohoku University)
 Wako Aoki, Ikuru Iwata, Tomonori Usuda (TMT Project, NAOJ)

July 16, 2020



Probability of good PWV condition

The PWV of ORM is not as low as the superior higher-altitude site, MK13N. The percentile values at both MK and ORM sites are shown in Table 5. The difference is obvious in the worst PWV condition (90%-ile). However, an important point to be stressed here is that a good PWV condition (<2.1mm; median at the Maunakea site) is still available at ORM with lower probability (25%).



caracterización = competitividad

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- Atraer nuevas instalaciones
- Incrementar el valor de las instalaciones existentes

(gestión del tiempo de observación, colas, programas o decisiones en tiempo real)

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Investigación

Servicio

Largo plazo

Decisiones estratégicas

Priorizar precisión

Instalaciones futuras ++

Instalaciones existentes +

Corto plazo

Decisiones operacionales

Priorizar disponibilidad

++ Instalaciones existentes

+ Instalaciones futuras

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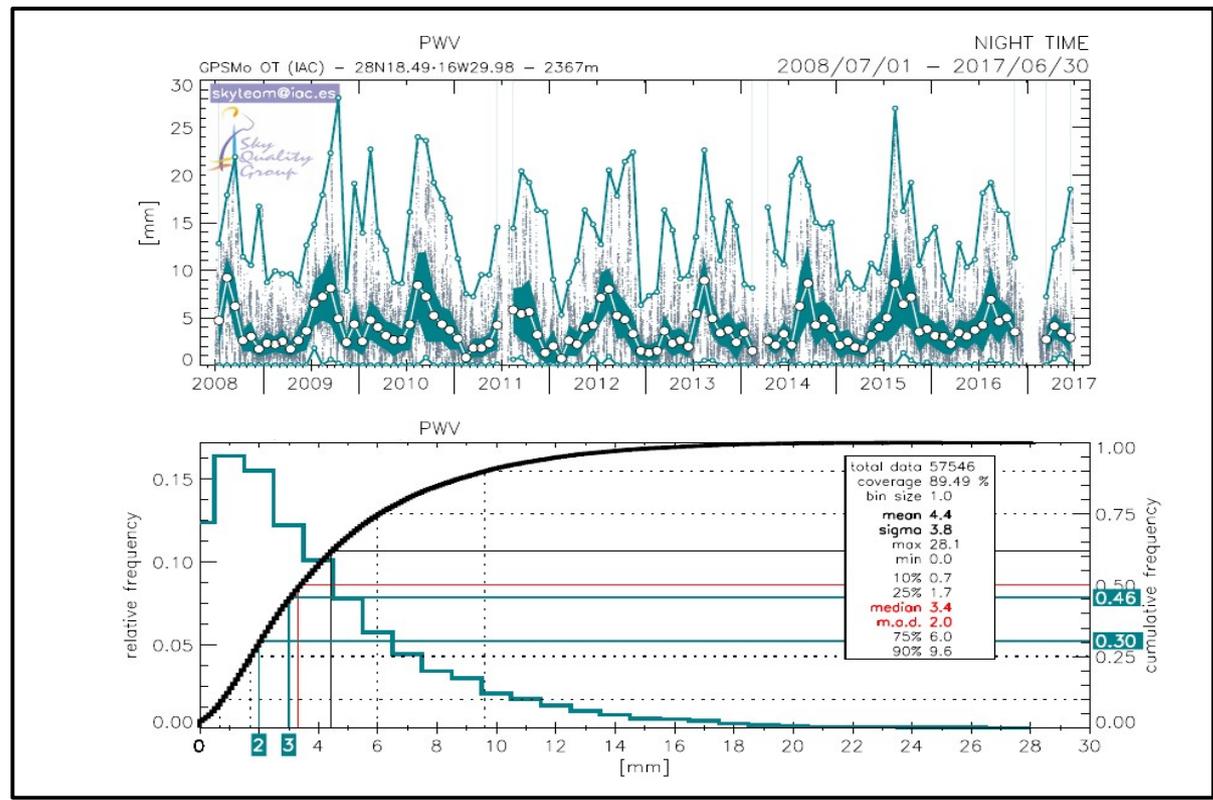
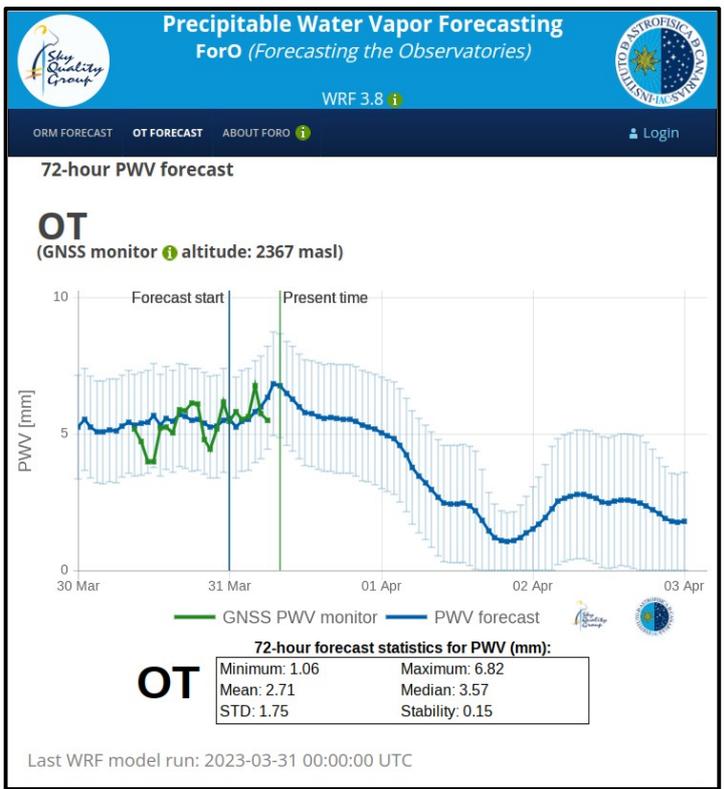
++ Instalaciones existentes

+ Instalaciones futuras

El compromiso de servicio no debe estar enfrentado al rigor

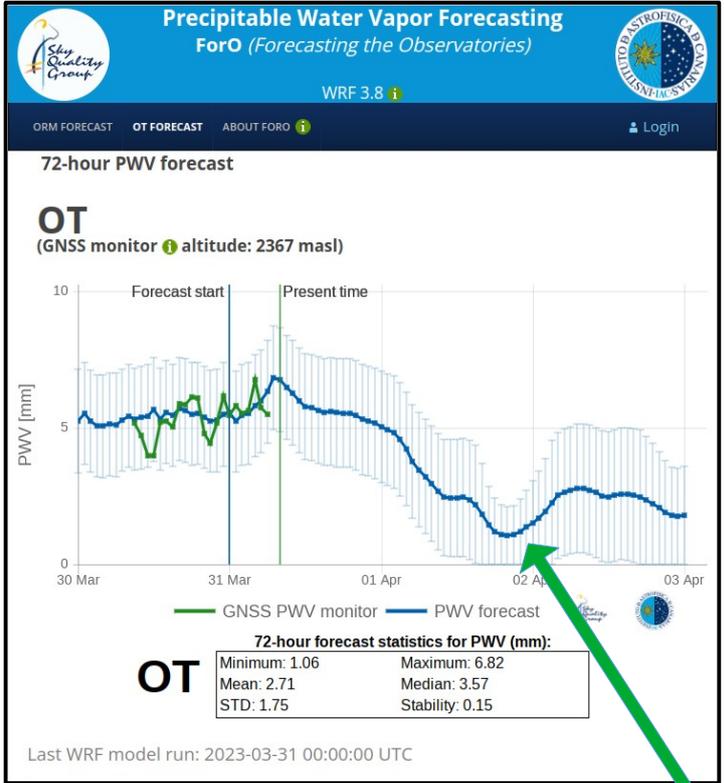
Monitoreo de servicio. Ejemplo: sistema de predicción

- MIR en TMT

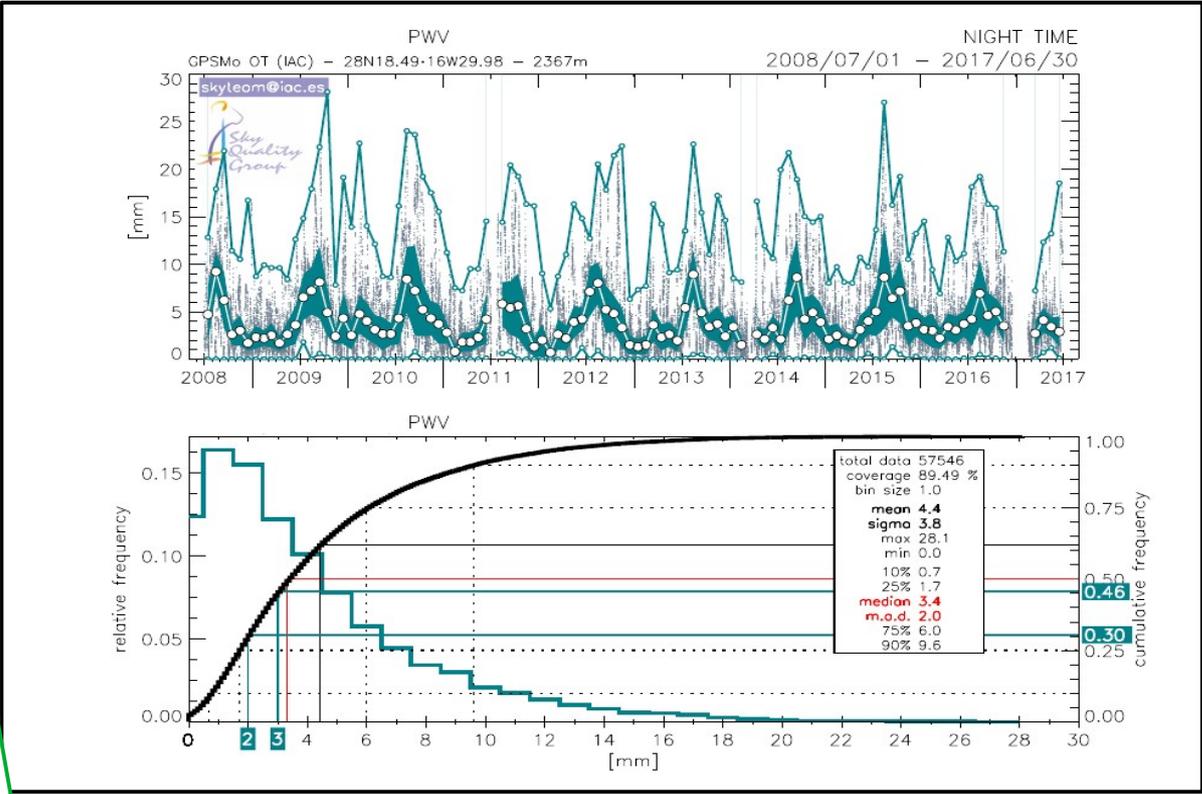


Monitoreo de servicio. Ejemplo: sistema de predicción

- MIR en TMT

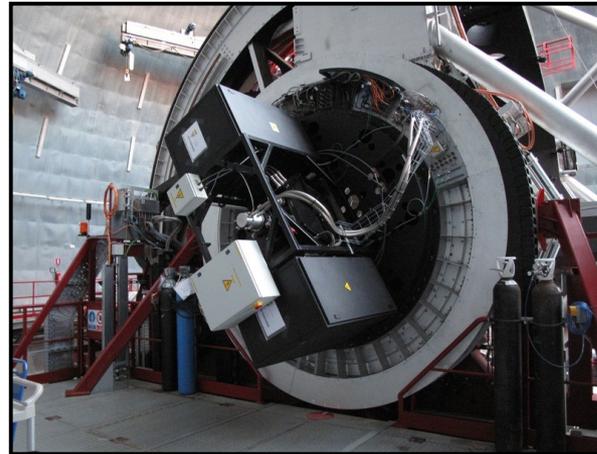
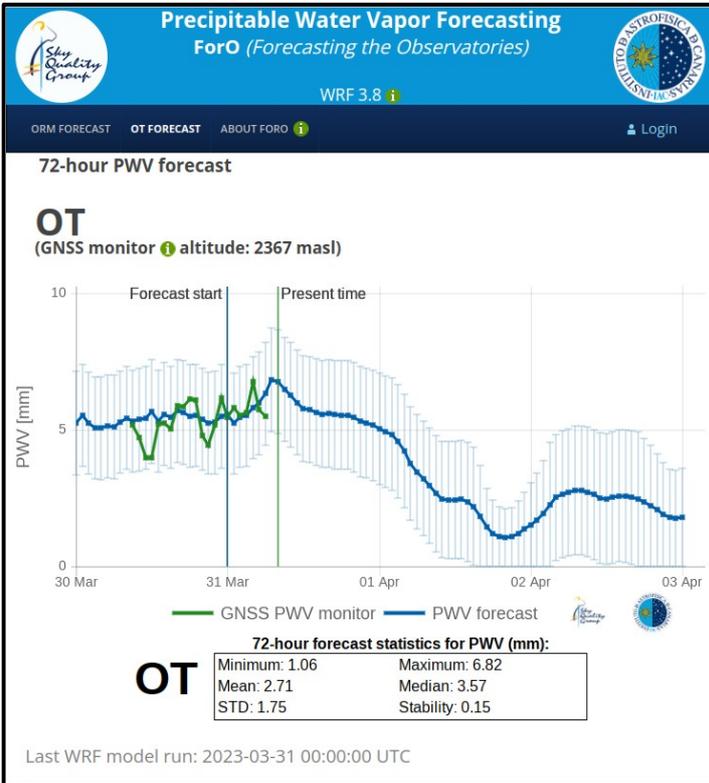


**observe
HERE!!**



Monitoreo de servicio. Ejemplo: sistema de predicción

- MIR en TMT o CanariCam (GTC)
- Microondas en QUIJOTE o KISS

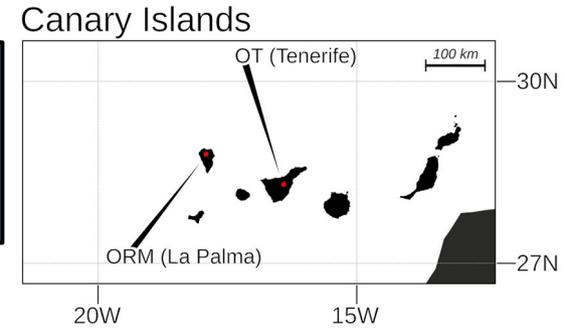


2018 → ForO Forecasting the Observatories

Precipitable Water Vapour

PWV

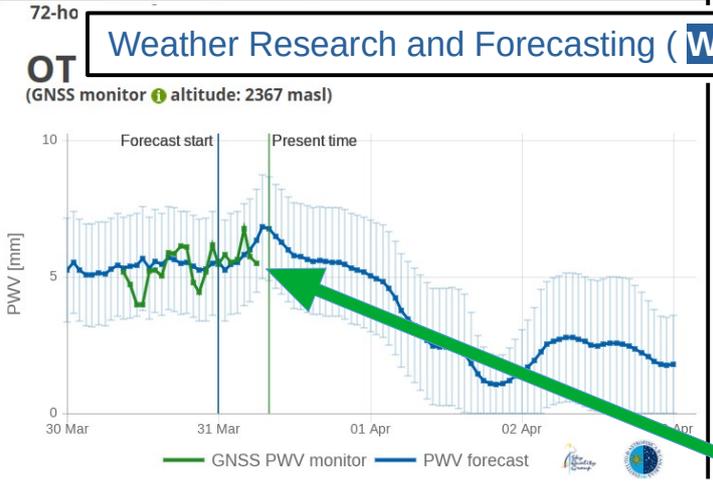
- 4 times a day
- 00H 06H 12H 18H
- 72h horizon
- $\Delta x=3\text{km}$



<https://dedo.ll.iac.es/ot>
<https://dedo.ll.iac.es/orm>



Weather Research and Forecasting (WRF 3.8)

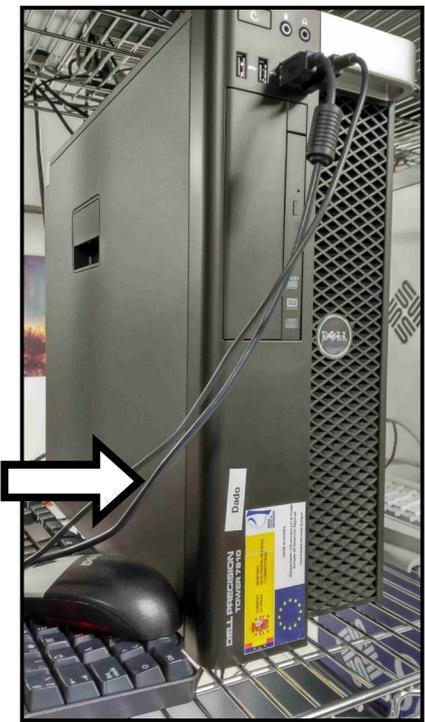
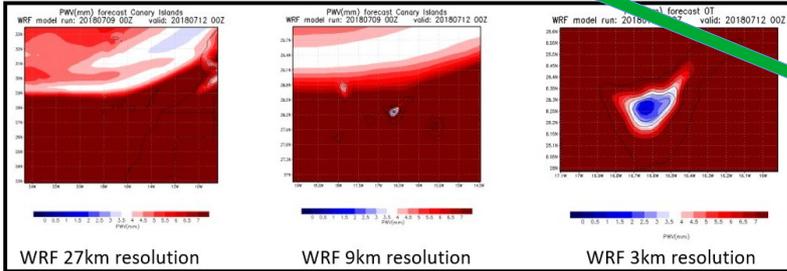


- ### Front-End
- Web server
 - DMZ location
 - Virtual machine
 - Ubuntu 16.04
 - Maria DB (mirror)

- ### Back-End
- WRF block
 - physical machine 24 cores
 - internal network
 - Fedora 26
 - Maria DB (main)

Monitor GNSS

OT
Last WRF model run:



The ESO's Extremely Large Telescope Working Groups
The Messenger 189 | 2022

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 Remco van der Burg¹
 Faustine Cantalloube²
 Elizabeth George¹
 Markus Kasper¹
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Since 2005 ESO has been working with its community and industry to develop an extremely large optical/infrared telescope. ESO's Extremely Large Telescope, or ELT for short, is a revolutionary ground-based telescope that will have a 39-metre main mirror and will be the largest visible and

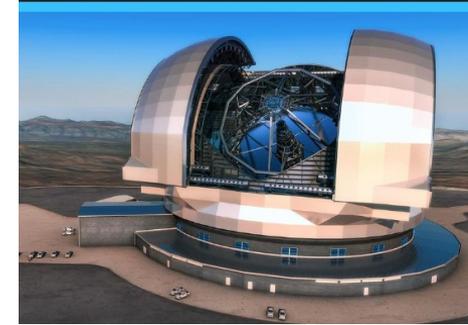
Astro-Weather Working Group @ESO

Astro-weather (coordinators: Julien Milli and Angel Otarola)

The goal of the Astro-weather WG was twofold. In the first place, it identified the meteorological and atmospheric variables to be monitored, taking into account the requirements of the telescope and each ELT instrument. All these variables were discussed and ranked in three categories according to their priority. In a second step, the WG identified the sensors or technological solutions that could be used to monitor these relevant meteorological and atmospheric variables.

como parte de la participación del IAC en

HARMONI for the ELT



La importancia de los grupos de trabajo y reuniones internacionales

ESO Astro-Weather Work Group

- “caracterizadores” y personal de operación.
- Identificar y priorizar los parámetros y técnicas más apropiadas

Congresos o reuniones.

- Problemas y soluciones en otros observatorios.
- Liderar.
- Sinergias y colaboraciones.

Acceso a fondos

- Exigencia de competitividad
- Demanda de tiempo o recursos de gestión

Caracterización. Círculo de competitividad

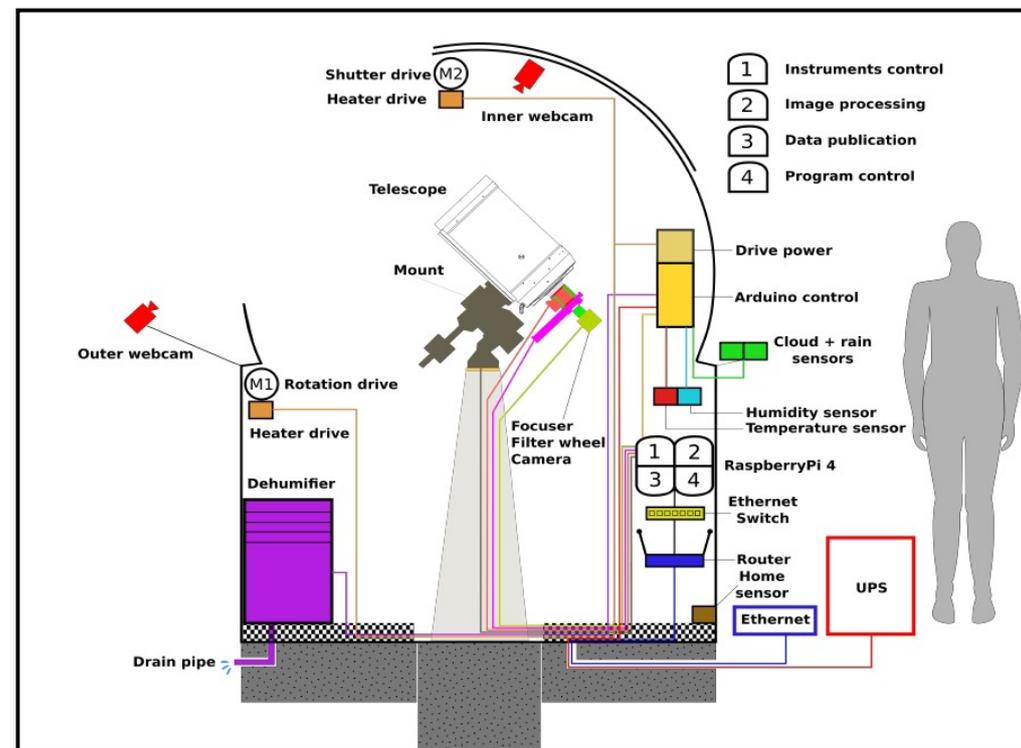
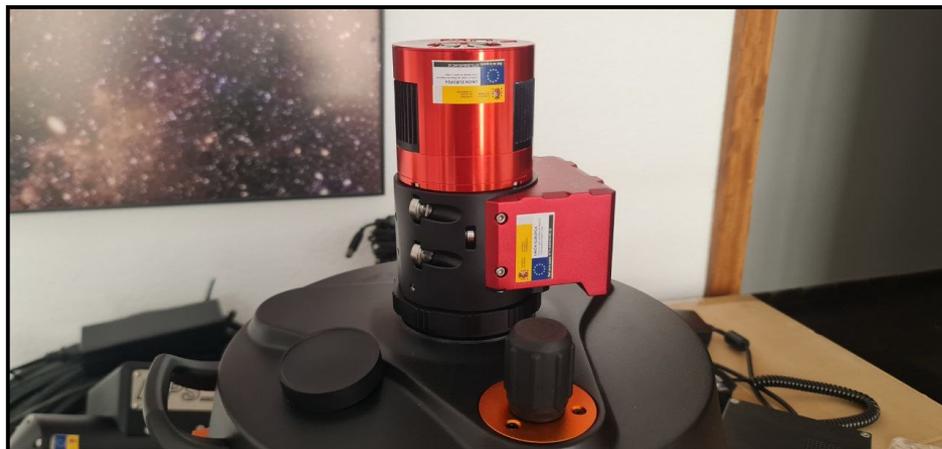




CANARIAN OBSERVATORIES EXTINCTION MONITORS (COXMO)

Extinction uncertainties (tolerance of 50%):

COXMo Extinction uncertainties (m mag·airmass ⁻¹)	Filter			
	J-C/SDSS			
	B	V/g'	R/r'	I/i'
dark	5	5	5	5
Moon				
grey	7	7	7	7
bright	9	9	9	9

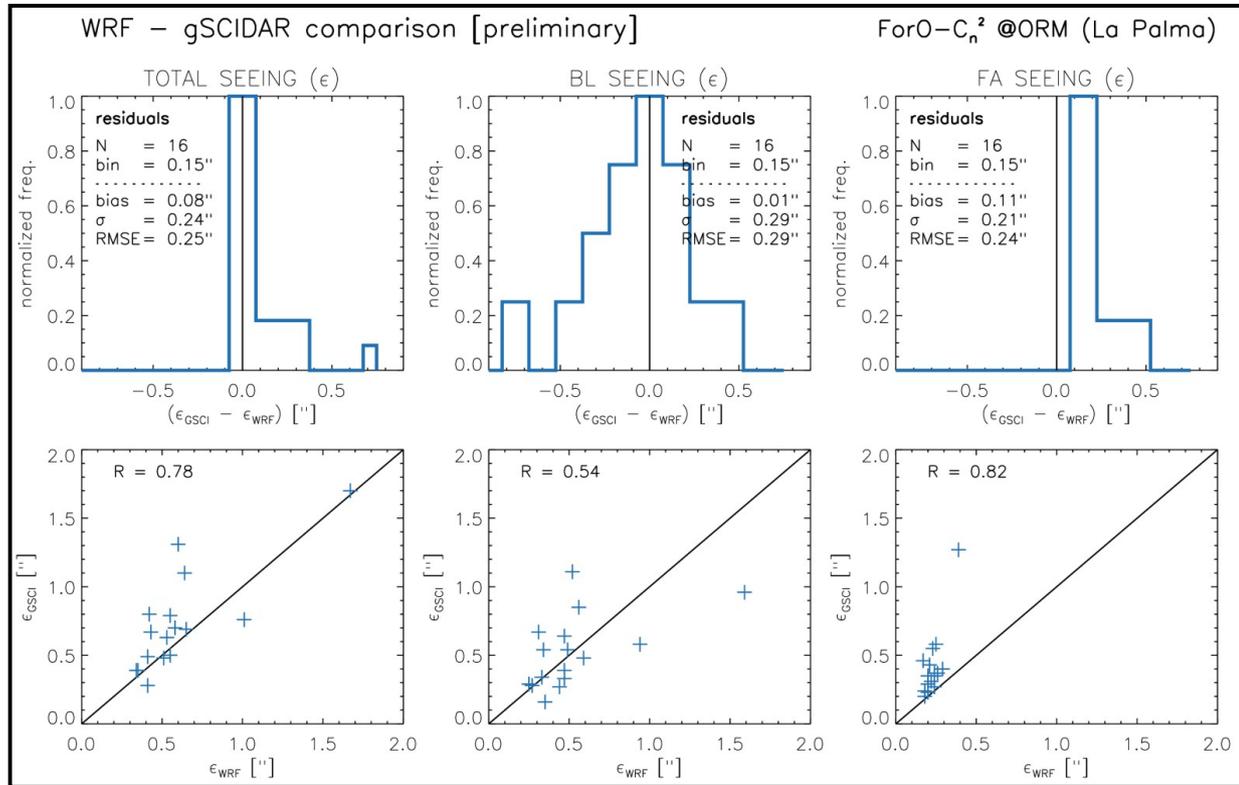
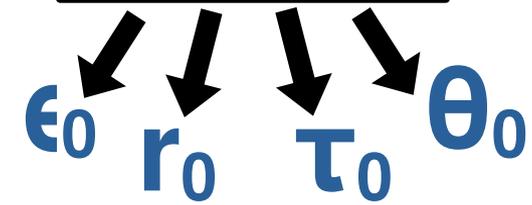


ForO-C_n²

Optical Turbulence



C_n² (h)



ForO-C_n²

- Independent module in ForO (*not interfering with the PWV predictions*)
- Conserves ForO architecture, HW and functionalities

Phases:

- WRF setup
- WRF parametrization/validation
- Implementation
- Release

new ASTMON PhAllSky



Browser address bar: <http://161.72.232.46:50003/control/controlserv/>

PhAllSky - Sky Team

Log Out

PhAllSky JKT Control

by Sky Team

System info

Weather
Temperature: 8.90 C Humidity: 45.00 %

Dome/Mount pointing
Dome pointing: UNKNOWN
Mount type: EQ_GEM
Mount pointing: LAT: 28.761054, LONG: -17.87785

CCD
CCD Gain: High CCD FAN: Full CCD BINNING: FRAME_DARK
1x1 CCD temperature: -10.2 FRAME:

Filters
Filters: U B V R OII
CURRENT FILTER: U

Board
Board type: KTA225

Update info

start/stop the servers
server_msg: ON server_power: ON server_indi: ON server_flask: ON

start/stop the programs
OBSERVING: IDLE PROCESSING: OFF UPDATING: OFF

switch ON/OFF

Dome/Mount
DOME: UNKNOWN MOUNT: OFF

Camera
CAMERA: ON FOCUSUP: OFF
FILTER: UNKNOWN FOCUSDOWN: OFF

Devices
HEATER: OFF FAN_L: UNKNOWN USB_HUB: UNKNOWN
DEHUMIFIER: UNKNOWN FAN_U: OFF SENSOR1: OFF

Nuevos espectrómetros de polvo para ORM y OT

We started considering a **clean room dust counter** similar to that on TNG but we finally selected an **Optical Particle Sizer**

- Reduced inlet flow rate: improved sensibility.
- Two orders up in Saturation level
- 16 configurable channels vs just 5

Requerimientos especiales para el diseño del tomamuestras

(trabajo en marcha)



Optical Particle Sizer

Model 3330



Nueva estación Meteorológica para OT con estándares WMO

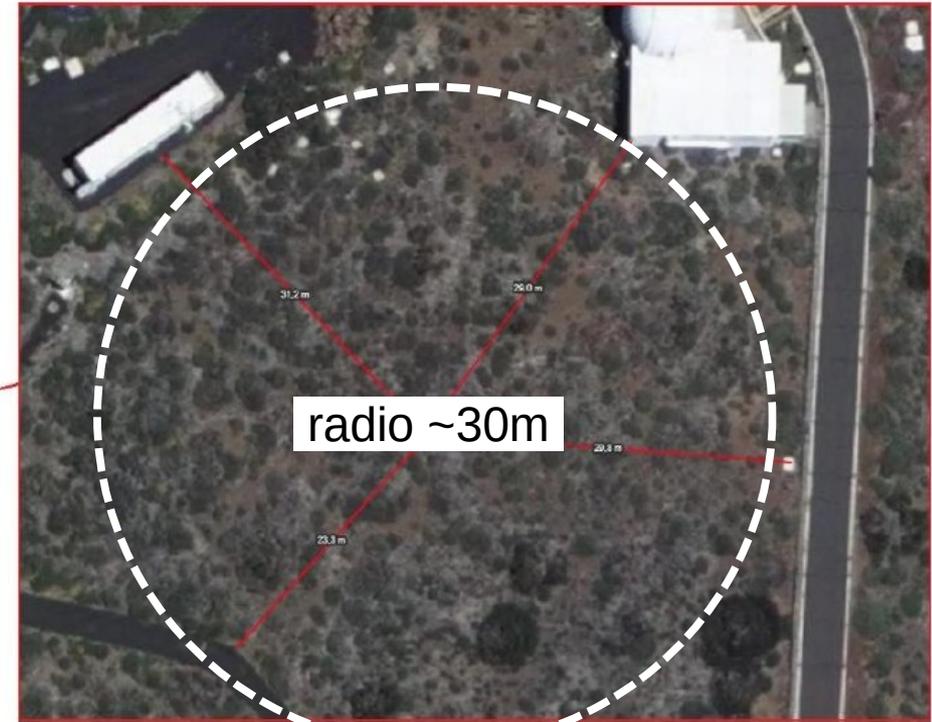
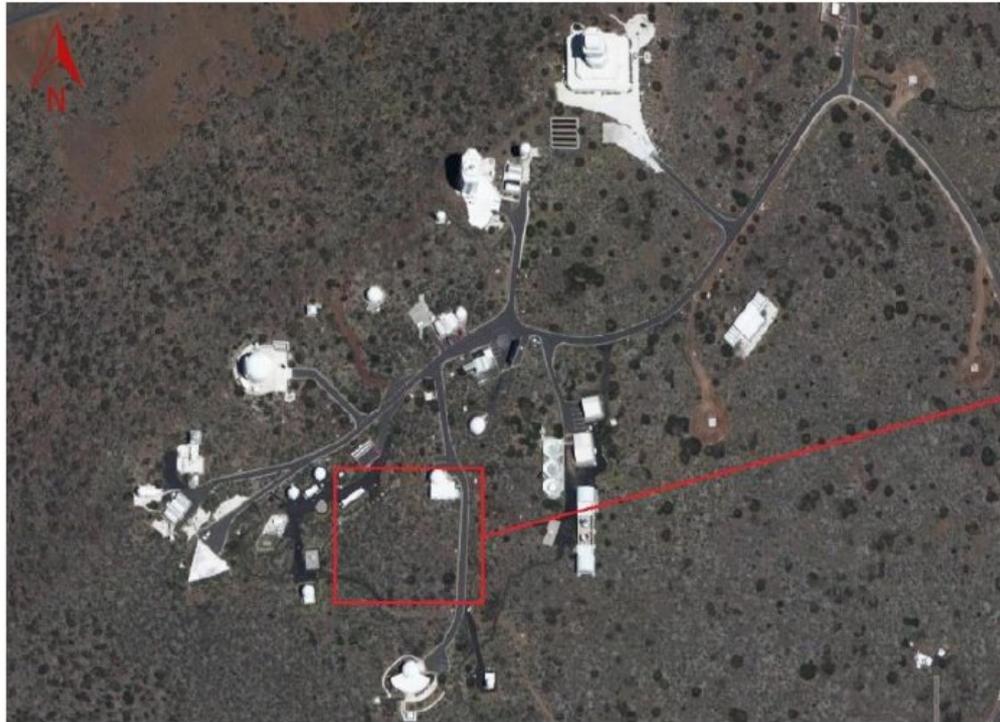


Figure 2. Provisional location of the AWS-OT.

DIMMA



DIMMA



UERRA - Reanálisis climático regional

Publications of the Astronomical Society of the Pacific, 133:105002 (13pp), 2021 October

<https://doi.org/10.1088/1538-3873/ac2a6c>

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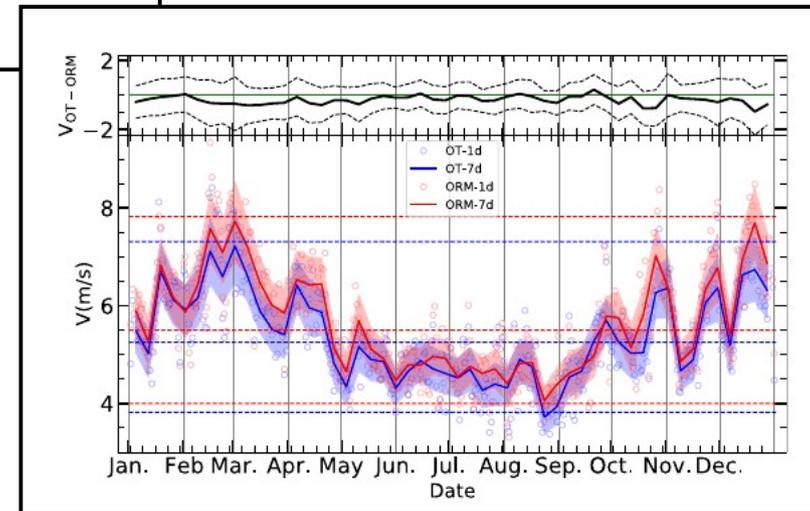
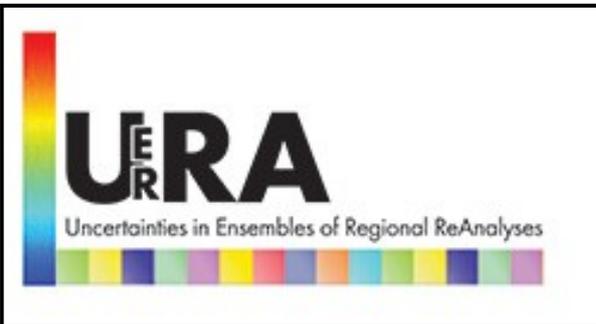
Canarian Observatories Meteorology; Comparison of OT and ORM using Regional Climate Reanalysis

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Received 2021 April 9; accepted 2021 September 27; published 2021 October 19



Conclusions

- **Caracterización = Competitividad**

- Atraer nuevas instalaciones e instrumentos
- Incrementar valor de instalaciones existentes

Gestión del tiempo de observación y colas

Selección de programas

Decisiones operacionales en tiempo real

- Caracterización de **investigación** **AND** Caracterización de **servicio**

Investigación → parámetros → instrumentos → medidas → investigación

- Grupos de trabajo internacionales

- **NEW:**

COXMo, ForO-Cn2, PhAllSky (new ASTMOM), Optical Particle Sizer, UERRA, etc...



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La Palma, Octubre 2023

SKY QUALITY TEAM



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