

# Control quality of seeing measurements provided by the DIMMA\* at the ORM

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An automatic DIMM is installed near the GTC site. Data have been validated and the results presented in this document. Real time values are accessible at <http://www.iac.es/site-testing/DIMMA ORM>.

The comparison baseline spans from April to October 2012. Mean and median values in this period are 0.95" and 0.86" respectively.

## Introduction

Early in 2012 an Automatic DIMM was installed at the Las Moradas site (300m towards the west of GTC) at the ORM (hereafter DIMMA-ORM), see Figure 1.

The DIMMA-ORM system (hardware and software) is identical to the DIMMA-OT. Both are operated by the IAC telescope operators (TOTs) and controlled by the IAC Sky Quality Group ([http://www.iac.es/site-testing/DIMMA\\_OT](http://www.iac.es/site-testing/DIMMA_OT))\*\*.



Figura 1. Image of the DIMMA station at the Las Moradas (ORM) as seen from the webcam installed at the mast of the automatic meteorological station close to the DIMMA.

The DIMMA-ORM started operation in April 2012. The system and the software is based in the prototype (Vernin & Muñoz-Tuñón, 1995) updated in the FP6's project (Vernin et al., 2011; Vázquez-Ramió et al., 2012).

Here we present the preliminary results obtained from the analysis of data gathered from April to

October 2012. **Results obtained in this study validate seeing data provided by the DIMMA-ORM and allow us to make public the real-time seeing data.**

## Analysis of data

The first test we have to perform is concerning the number of accepted and rejected data. Reasons of rejection are mainly associated to a discrepancy between fwhml and fwhmt larger than 20%. This could be an indication of focus problems and/or conditions where the technique cannot be employed (see Vernin & Muñoz-Tuñón, 1995 for further details). Figure 2 shows the nightly number of data retrieved (n) from the DIMMA-ORM against those accepted (Ndata). Figure 3 shows the night percentage of accepted data. Results are summarized in Table 1.

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\*DIMMA: DIMM Automatic

\*\*You can also access through <http://www.iac.es/site-testing/> click on "REAL TIME DATA"

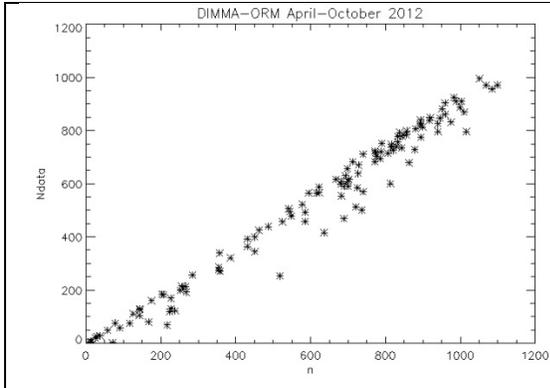


Figure 2. Nightly number of seeing measurements retrieved (n) against the number of accepted data (Ndata) after control requirements were applied.

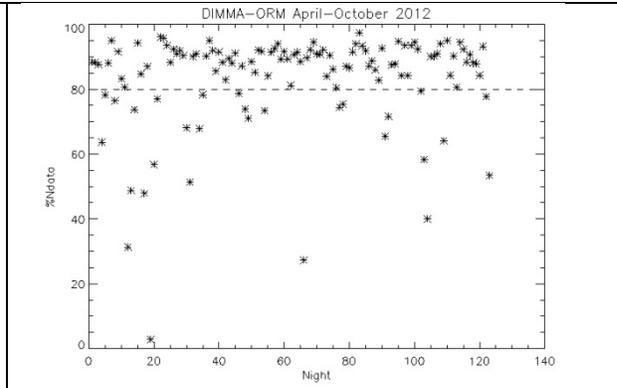


Figure 3. Nightly percentage of accepted data (%Ndata) after control requirements were applied

In Table 1 we present the monthly number of data (n) and the number and percentage of accepted data (Ndata and %Ndata respectively) after performing the control tests. The threshold criteria used is 80% (as in Vernin & Muñoz-Tuñón, 1995; Muñoz-Tuñón et al., 1997; Vernin et al., 2011; Vázquez-Ramió et al., 2012).

Month' 2012	n	Ndata	% Ndata
April	203	183	88%
May	5799	4637	80%
June	12122	9993	82%
July	20309	17267	88%
August	12831	11738	95%
September	14147	12215	86%
October	10049	8886	88%
<b>Total</b>	<b>75460</b>	<b>64919</b>	<b>86%</b>

Table 1. Monthly number of measured seeing data (n), accepted seeing data (Ndata) and its percentage (%Ndata) respect to the number of measured data.

In Figure 4 we show the statistical distribution (left) and the cumulative frequency (right) of the seeing data with the DIMM-ORM for the study period (April-October 2012).

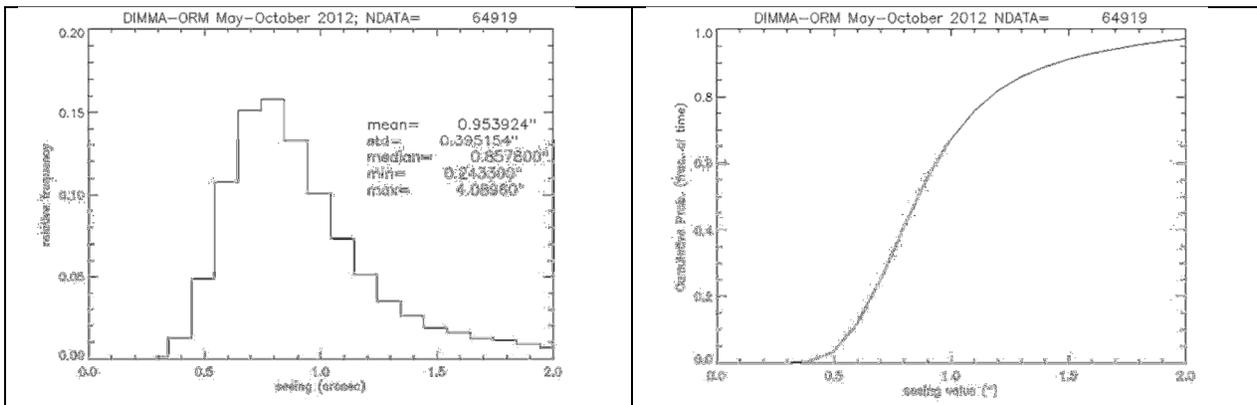


Figure 4. Statistical distribution (left) and the cumulative frequency (right) of the seeing data with the DIMM-ORM for the study period (April-October 2012).

In Table 2 we present the monthly statistical analysis for the sampling period.

Month	Ndata	Mean (")	std (")	Median (")	25%	75%	95%	Min (")
April	183	0.80	0.11	0.78	0.72	0.80	0.90	0.55
May	4637	0.98	0.35	0.90	0.35	1.10	1.70	0.35
June	9993	1.14	0.55	0.98	0.72	1.45	2.0	0.33
July	17267	0.95	0.37	0.87	0.72	1.10	1.70	0.32
August	11738	0.82	0.24	0.79	0.65	0.95	1.20	0.30
September	12215	0.90	0.28	0.84	0.70	1.05	1.40	0.37
October	8886	0.99	0.48	0.88	0.65	1.20	2.0	0.24
Total	64919	0.95	0.40	0.86	0.70	1.10	1.80	0.24

Table 2. Monthly statistics of seeing provided by the DIMMA-ORM from April to October 2012 (std is the standard deviation of the mean value).

### Comparison with the RoboDIMM data

Besides the IAC equipment, there are two more DIMMs installed at the ORM summit operated by the ING and TNG teams.

We have retrieved simultaneous seeing data provided by the RoboDIMM operated by the ING and located next to the WHT in order to be compared with those provided by the IAC DIMMA-ORM.

Unfortunately the TNG DIMM database is not public and could not be used. RoboDIMM seeing data are available via ING webpage <http://catserver.ing.iac.es/robodimm/>.

In order to avoid occasional disperse seeing values provided by the RoboDIMM we have selected for comparison seeing data smaller than 2" for both instruments. *Important to know is that very large seeing values can not be properly measured by DIMM devices unless a proper error estimation is done.* We have also rejected data that do not satisfy the criteria  $0.8'' < fwhm/fwhmt < 1.2''$  and we have to delete spurious null seeing data present in RoboDIMM database (5.1% of registered data).

The sample rate is 1data/30s and 1data/3min for the DIMMA-ORM and the RoboDIMM respectively.

In Figure 5 we show the number of data (top), the mean value (middle) and the median (bottom) of the seeing values provided by the DIMMA-ORM (blue) and the RoboDIMM (red) for the study period (April-October 2012). Error bars indicate the standard deviation of the mean.

Statistical comparison is summarized in Table 3. Results provided by two instruments are in good agreement.

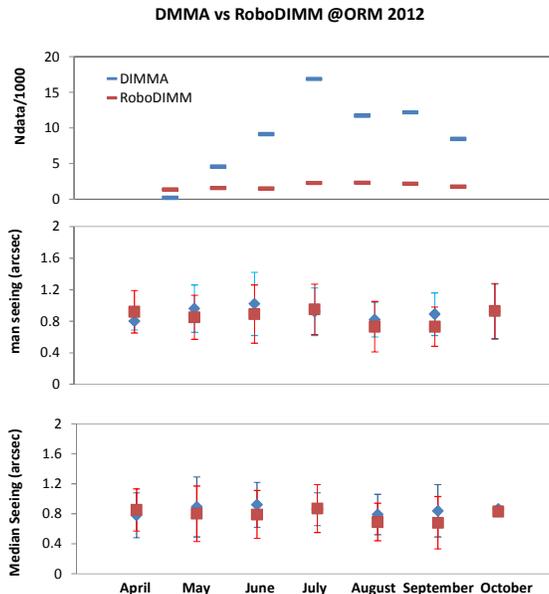


Figure 5. Number of data (top), mean value (middle) and median (bottom) seeing values provided by the DIMMA-ORM (blue) and the RoboDIMM (red) for the period of study (April-October 2012). Error bars indicate the standard deviation of the mean.

Month	Ndata		Mean (")		std (")		Median (")		Min (")	
	DIMMA	RD	DIMMA	RD	DIMMA	RD	DIMMA	RD	DIMMA	RD
Apr	183	1345	0.80	0.92	0.11	0.27	0.78	0.85	0.55	0.39
May	4557	1543	0.96	0.85	0.30	0.28	0.89	0.80	0.35	0.40
Jun	9139	1470	1.02	0.89	0.4	0.37	0.92	0.79	0.33	0.33
Jul	16879	2265	0.92	0.95	0.30	0.32	0.86	0.87	0.32	0.36
Aug	11707	2299	0.82	0.73	0.22	0.32	0.79	0.69	0.30	0.35
Sept	12179	2170	0.89	0.73	0.27	0.25	0.84	0.68	0.37	0.28
Oct	8458	1738	0.92	0.93	0.35	0.35	0.86	0.83	0.24	0.37
<b>Total</b>	<b>63102</b>	<b>12830</b>	<b>0.91</b>	<b>0.85</b>	<b>0.31</b>	<b>0.30</b>	<b>0.85</b>	<b>0.78</b>	<b>0.24</b>	<b>0.28</b>

Table 3. Monthly statistics of the seeing values provided by the DIMMA-ORM (DIMMA) against RoboDIMM (RD) from April to October 2012. The standard deviation of the mean is named std and Ndata is the number of accepted data.

## Conclusions

The data provided by the IAC DIMMA-ORM satisfy the conditions required to be robust and reliable. That means that the percentage of rejected data when the validation criteria are applied is negligible.

Although the RoboDIMM database seems to be less robust (with less data) and the seeing values rejected due to control requirements is larger (29%), for those simultaneous data the statistical results are consistent within errors.

These results validate seeing data provided by the DIMM-ORM and allow us to open the real time data through the Sky Quality Group webpage ([http://www.iac.es/site-testing/DIMMA\\_ORM](http://www.iac.es/site-testing/DIMMA_ORM)).

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## References

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[http://www.iac.es/proyecto/site-testing/DIMMA\\_ORM](http://www.iac.es/proyecto/site-testing/DIMMA_ORM)

[http://www.iac.es/proyecto/site-testing/DIMMA\\_OT](http://www.iac.es/proyecto/site-testing/DIMMA_OT)

<http://catserver.ing.iac.es/robodimm/>