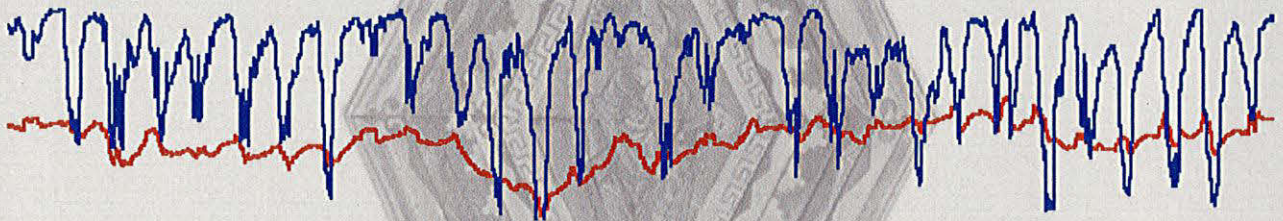


TOBIT CURTEIS ASSOCIATES

PETERBOROUGH CATHEDRAL



ENVIRONMENTAL MONITORING OF THE NAVE CEILING

OCTOBER 2003- OCTOBER 2005

36 Abbey Road Cambridge CB5 8HQ Tel 01223 501958 Fax 01223 304190
E-mail tc@tobit-curteis-associates.com Web www.tobit-curteis-associates.com

Tobit Curteis B.A.(Hons.) Dip. Conservation (Courtauld Institute) AMUKIC FIIC
VAT REG No. 636 9463 04

CONTENTS

1.0	Introduction.....	2
2.0	Lighting and Monitoring Programme.....	2
2.1	Lighting.....	2
2.2	Monitoring System.....	2
4.0	Summary Results.....	3
5.0	Discussion.....	4
6.0	Diagrams and Annual Data Charts	

Report No: PTB01.3

Date: 12th May 2006

Author: Tobit Curteis Associates
36 Abbey Road, Cambridge CB5 8HQ.
Tel 01223 501958 Fax 01223 304190

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3. This report does not constitute a formal specification for conservation treatment, building repairs or other work. Comments on the structure of the ceiling or the building are in general terms only. If any intervention or other measures are to be undertaken the advice of the appropriate professional adviser should be sought, and a formal specification prepared by them.

Acknowledgements

I would like to express my thanks to the Dean and Chapter of Peterborough Cathedral and in particular to the head verger, Nick Drewett, for his help and co-operation throughout the project. I am also grateful to the cathedral architect, Julian Limentani, and to the other members of the project team for their advice on many aspects of the monitoring programme. I am indebted to Richard Lithgow and Hugh Harrison for information regarding the conservation programme. Aspects of the system of environmental monitoring employed for the survey were developed at the Courtauld Institute of Art, Conservation of Wall Paintings Department and I would like to express my thanks for their generous advice and support in this area. Thanks are also due to Eltek Dataloggers Ltd for their work developing the linear measurement and light sensors.

1.0 INTRODUCTION

As part of the programme to conserve the 13th century painted wooden nave ceiling at Peterborough cathedral a programme of environmental monitoring has been undertaken since 1998.¹ This was principally concerned with variations in relative humidity and temperature above and below the ceiling and the possible dimensional response of the timbers.²

Following the completion of the treatment of the ceiling a programme of relighting has been carried out in the nave. In order to assess the possible effects of the lighting on the ceiling polychromy, the monitoring system was expanded to include light and UV radiation. The current report covers the period of monitoring from November 2003 to November 2005.

2.0 LIGHTING AND MONITORING PROGRAMME

2.1 Lighting

It is understood that prior to the recent work, the nave ceiling was lit by 1000W halogen lamps placed in alternate bays of the triforium. These were operated on an irregular basis by a coin operated switch and were turned on for services and major events.

The new lighting system was installed in 2004 and 2005, with luminaires fitted with 70w metal halide lamps mounted in each bay, facing across to the opposite side of the ceiling.³ The south side of the nave is understood to have been completed in December 2004 and the north side in March 2005. The lighting is used every day between approximately 9.30am and 6.30pm as well as for services and other events outside these times.

2.2 Monitoring System

Relative humidity (RH) and ambient temperature (AT) were recorded above and below bay 36 III, while UV and lux were recorded in bay 33 II. An external probe was situated on the north side of the nave roof in order to provide RH and AT control data. (*Diagram 1*) Data was logged on all channels at 30 minute intervals. Internal RH/AT probes were suspended in front of the ceiling surface from available fixing points. The UV/lux probe was inserted in a small hole in the ceiling so that the sensors were exposed to the light on the underside (painted side) of the ceiling. The external RH/AT probe was protected by a Stevenson screen.

The monitoring was carried out using an Eltek 1000RX1 telemetric logging system with TX7 transmitters. RH and AT were measured using Vaisala Humitter combined probes and ST was measured using EU-U-V2 thermistors.⁴ Lux and UV were measured with an Eltek GS-70 unit incorporating a Littlemore Scientific 763s sensor.⁵ The system was connected via a modem to a standard BT telephone line to allow remote interrogation. Downloading and analysis of data was carried out using Eltek Darca Heritage software.

3.0 SUMMARY RESULTS

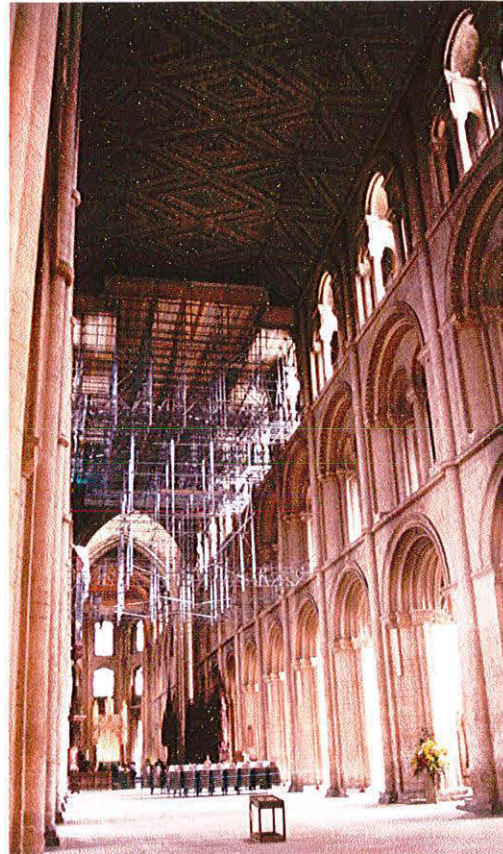


Figure 1. View of the ceiling during conservation

¹ The treatment of the ceiling and the timber structure was undertaken by the Perry Lithgow Partnership and Hugh Harrison Conservation

² Tobit Curteis Associates, *Peterborough Cathedral, Environmental Monitoring of the Nave Ceiling*, March 1998-May 2000

³ The specified lamps were Osram HCI-T 70/WDL and HCI-T 70/NDL

⁴ The published accuracy levels for the combined RH/AT probes are: HMG Z-1 RH +/- 3%, AT +/- 0.3°C.

⁵ The published accuracy levels for the sensors are lux 5% or 1lux and 1mW/M²

During 2004, when the halogen lamps were in place, the average daytime peak lux level was approximately 80, with occasional peaks over 200. This was similar to the data recorded in 2003. The proportion of UV radiation during this period rose from approximately $60\mu\text{w}/\text{lm}$ in the winter to just over $200\mu\text{w}/\text{lm}$ in the summer. The halogen lamps are known to produce between $49\text{--}127\mu\text{w}/\text{lumen}$ of UV radiation,⁶ although cover glass of the fittings may well suppress this. However, daylight, even through standard glass, contains a far higher proportion of UV radiation, possibly up to 6 times as much radiation, as tungsten lighting.⁷ Therefore it is likely that a significant part of the UV recorded is due to indirect daylight from the large clerestory windows, rather than from the lamps.

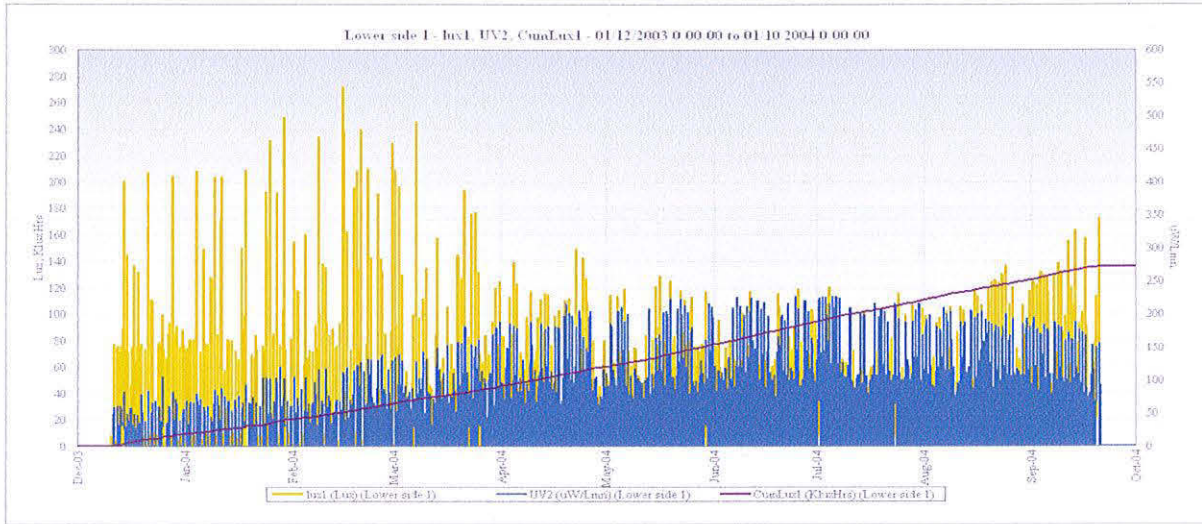


Chart 1. Lux, cumulative lux and UV conditions between December 2003 and October 2004

In 2005, when the new metal halide lamps were installed, the average peak lux level was approximately 120, with occasional peaks over 220. However, the proportion of UV radiation was lower with winter levels of approximately $60\mu\text{w}/\text{lm}$ rising to $120\mu\text{w}/\text{lm}$ in the summer. The Osram lamps used are mounted in UV filtering quartz envelopes, and it is likely that the cover glass in the lamp fittings would further reduce UV levels, albeit by a small amount.⁸ Therefore it appears that, as in the previous year, a significant proportion of the recorded UV is due to indirect daylight. However, the spectra for the metal halide lamps suggests that (depending on the filtering) they may contribute more UV by proportion than the previous lamps.

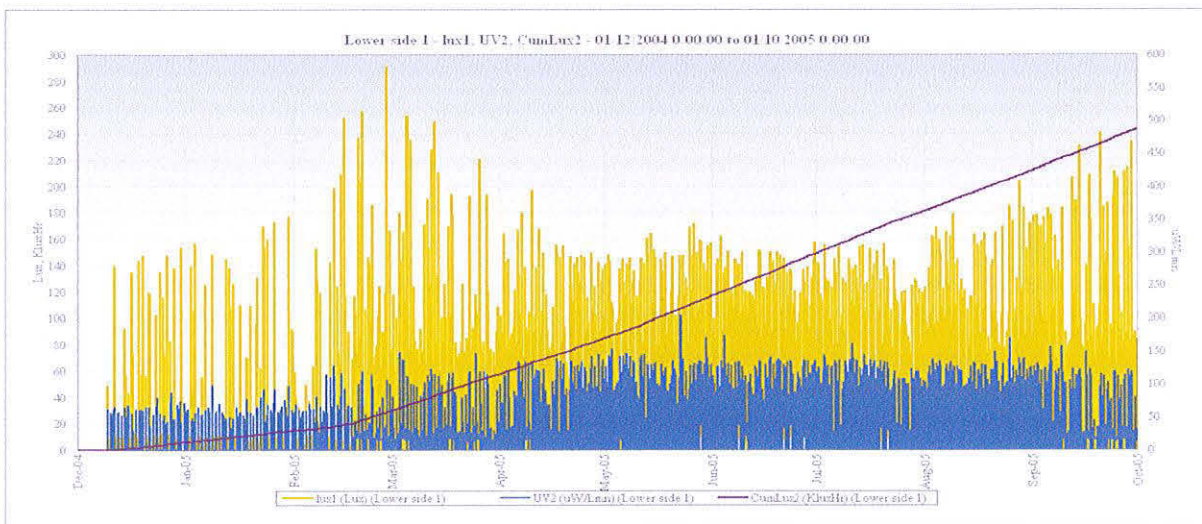


Chart 2. Lux, cumulative lux and UV conditions between December 2004 and October 2005

⁶ Cassar, M. *Environmental Management, Guidelines for Museums and Galleries*, London (1995), Datasheet 4

⁷ Thompson, G. *The Museum Environment*, London 1986 (2nd Ed)

⁸ It is understood that the cover glass is not specifically UV filtering glass. Pers. Com. Graham Phoenix, lighting designer

The lux hour exposures for December 2003-September 2004 was 135KluxHr compared to approximately 231KluxHr for the same period in 2004-2005 demonstrating the consistently higher level of exposure with the new lamps and lighting regime.

It was difficult to assess the effect of the lamps on the AT, as external diurnal conditions, and the cathedral heating system, played a greater role. Undoubtedly the heat of the lamps would have elevated the AT at the height of the ceiling, but the effect appeared to be limited.

4.0 DISCUSSION

The paint analysis undertaken during the conservation work suggested that the ceiling painting is generally fairly robust with little photosensitive material. It has also been exposed to daylight for over a century and so any photosensitive material that may once have existed would probably have deterioration a considerable time ago.

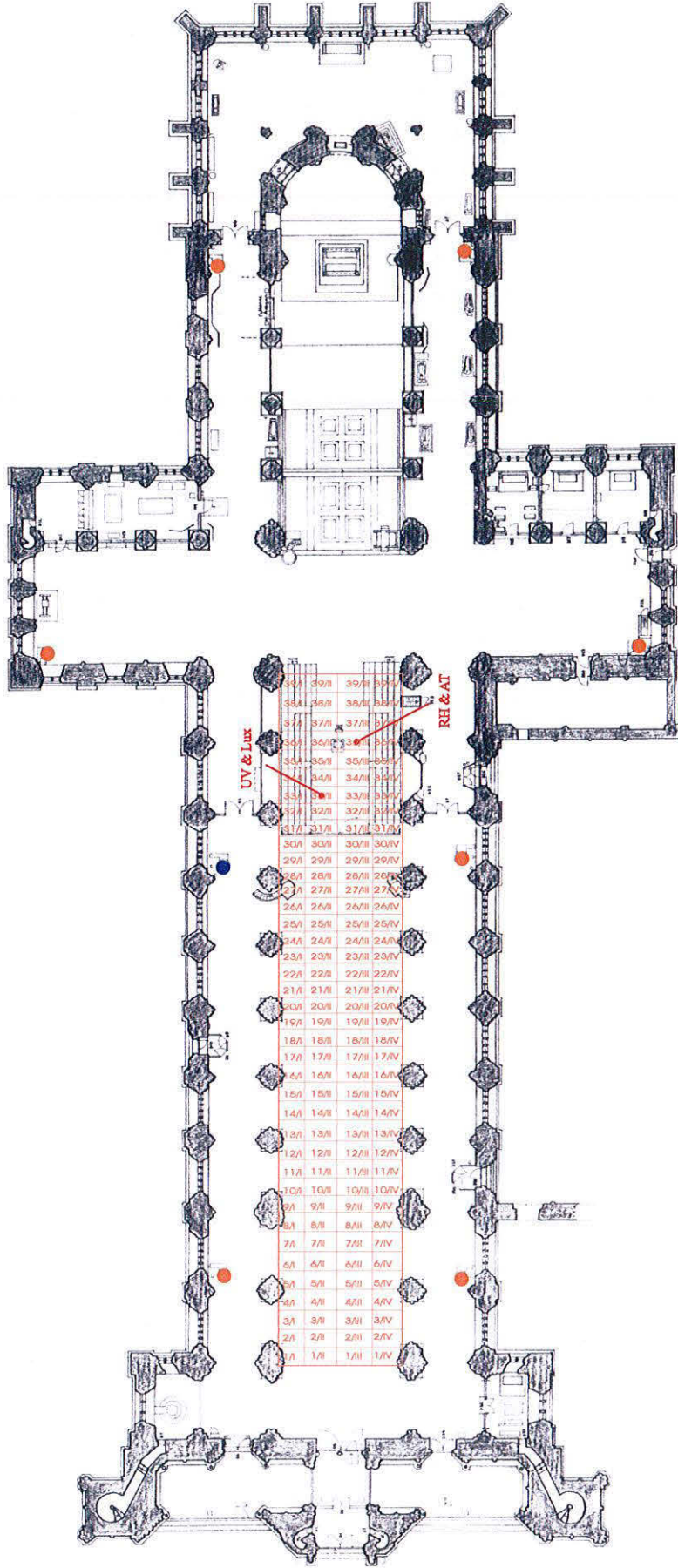
The lux levels generally recommended for moderately sensitive materials are 200 +/- 50 or a cumulative value of 650KluxHr and UV radiation below 75 $\mu\text{w}/\text{lm}$.⁹ Therefore, the lux levels recorded both before and after the new lamps were installed are significantly below the levels which would be a cause for concern. The UV levels are higher than those recommended for museum settings, but are still not excessive and given the fairly robust nature of the paint layers it is unlikely that they will cause significant damage.

While the management of the new lighting means that much of the recorded lux exposure is related to the lamps rather than daylight, the pattern of UV exposure suggests that this is largely associated with daylight, although the spectra for the new lamps suggests that they may be a contributory factor.

⁹ Op. Cit. Thompson

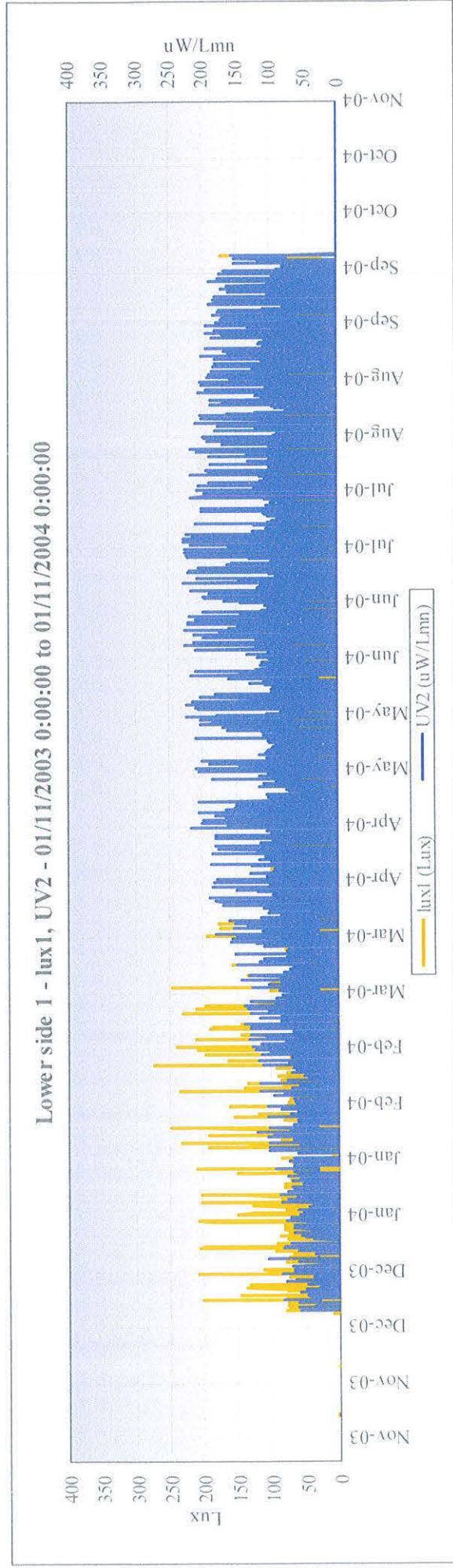
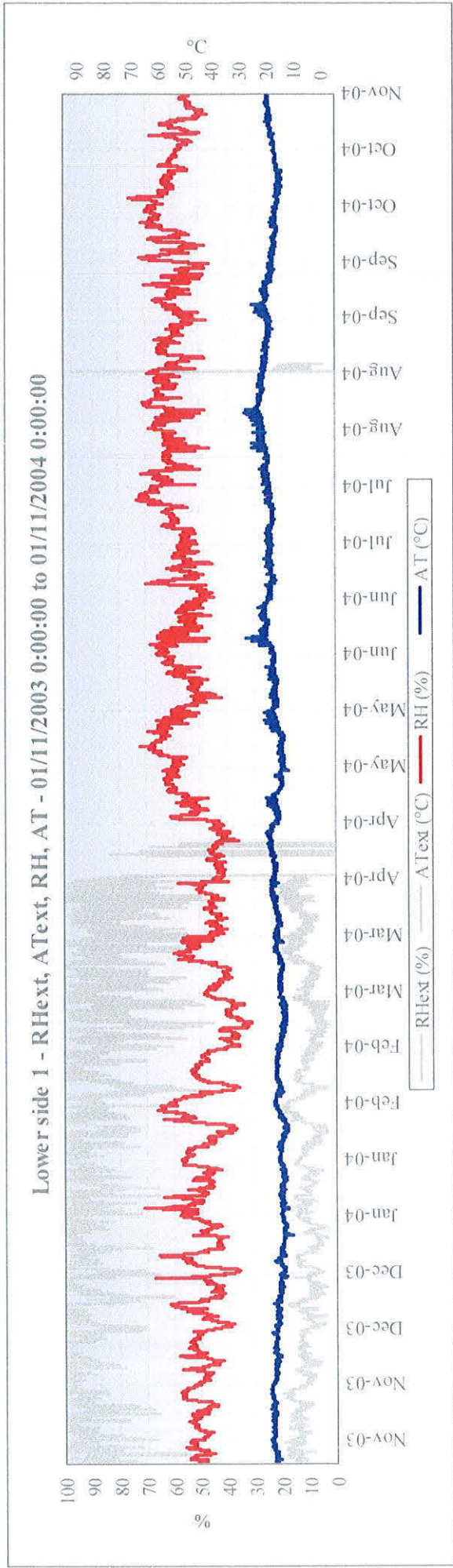
CHARTS & DIAGRAMS

Diagram 1

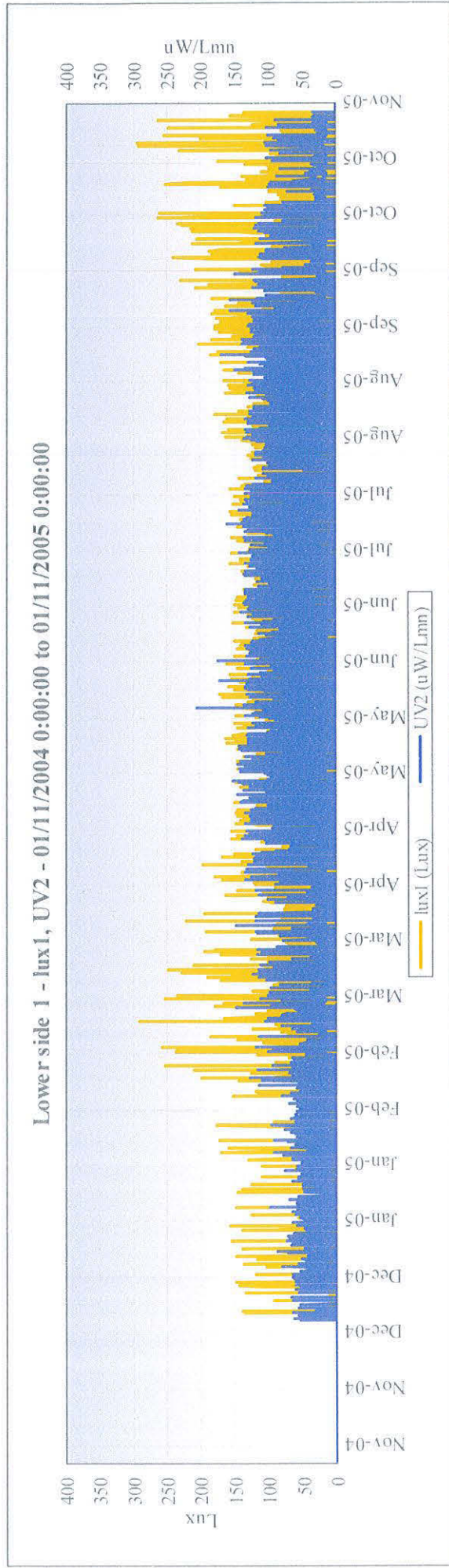
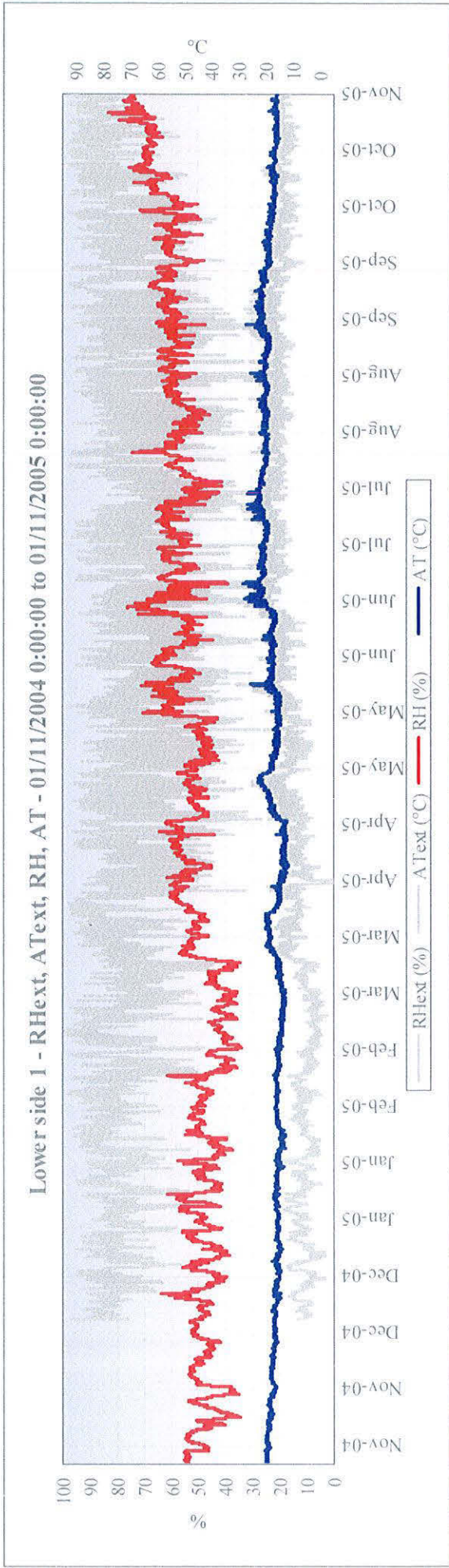


<p>Site: Peterborough Cathedral</p> <p>Area: Plan (Base plan drawn by Julian Limentani)</p>	<p>Type: Probe and stove locations</p> <p>Date: October 2005</p>	<p>0m 10m 20m 30m</p> <p>TOBIT CURTEIS ASSOCIATES 36 Abbey Road, Cambridge, CB5 8HQ</p>	<p>Full use stove</p> <p>Occasional use stove</p> <p>Probe sites</p>
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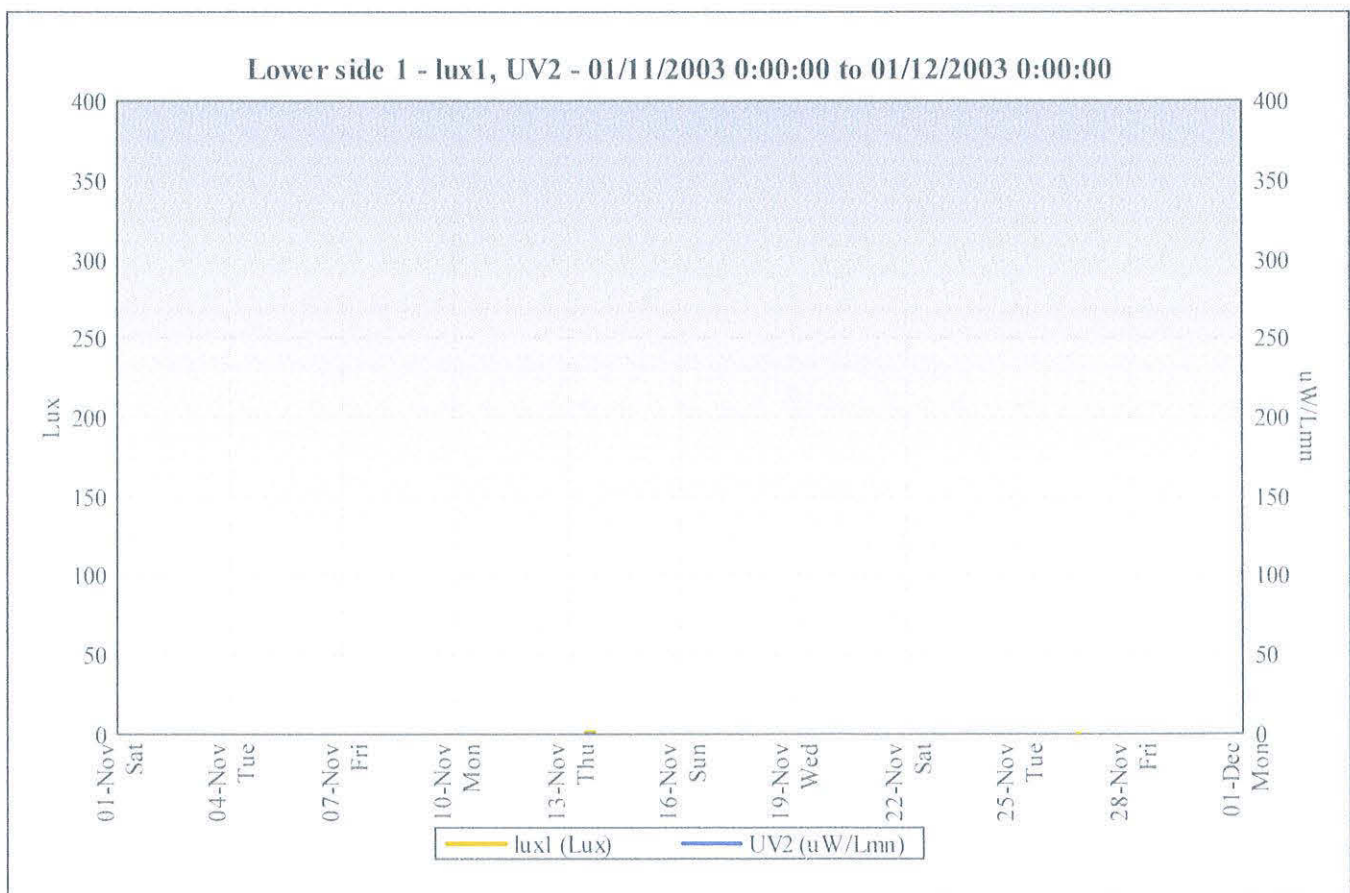
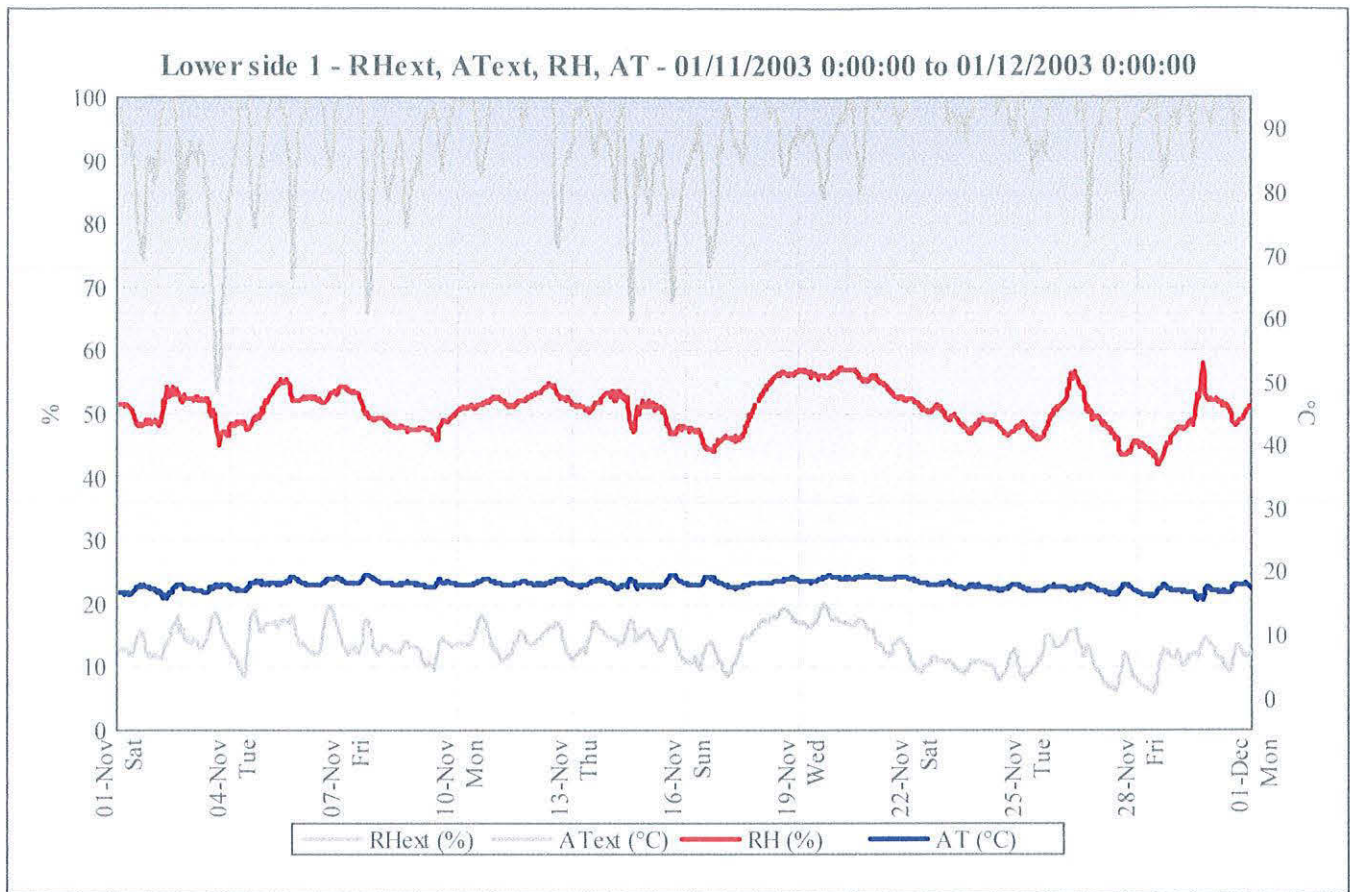
Peterborough Cathedral Nave Ceiling: East End



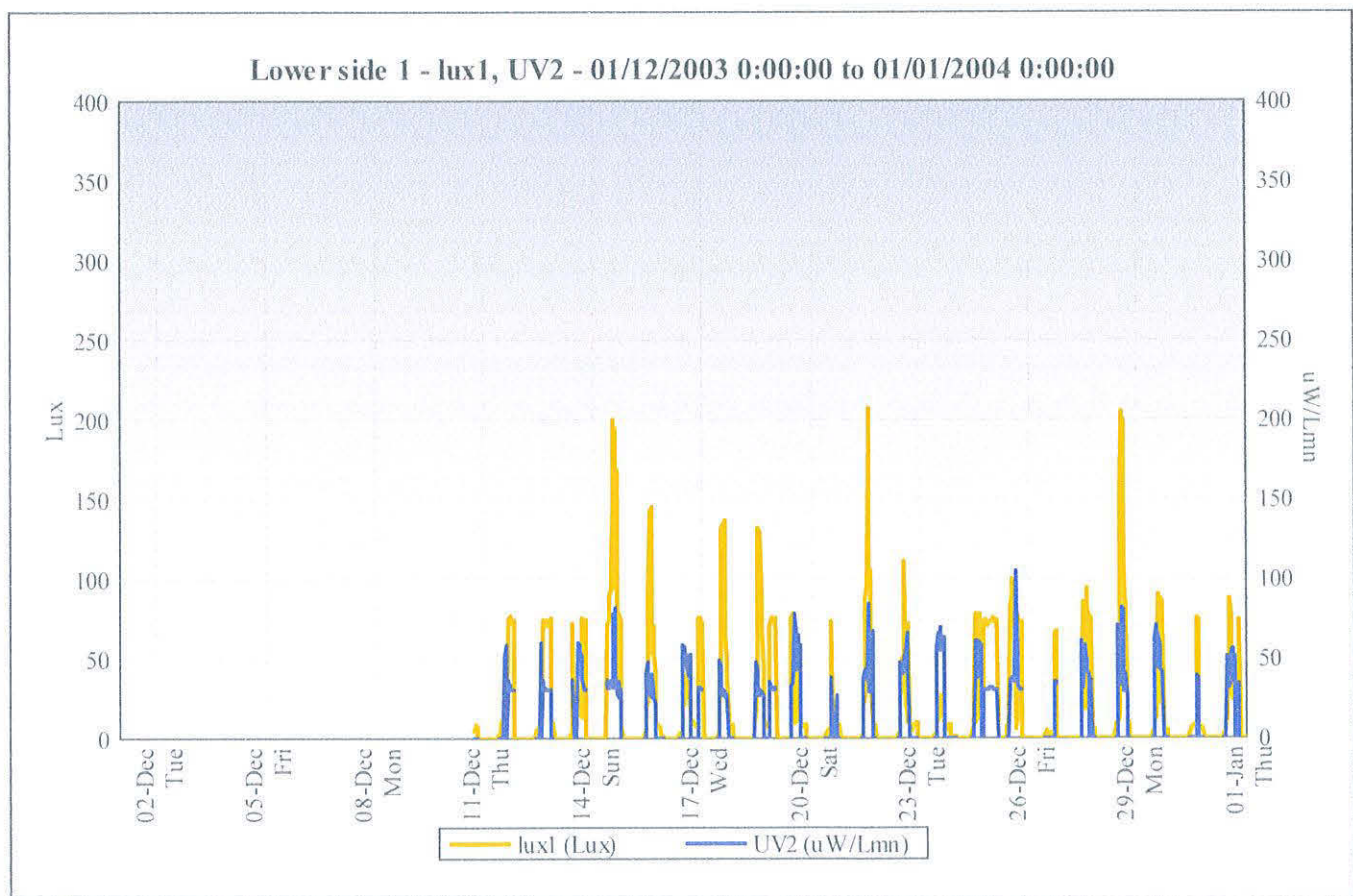
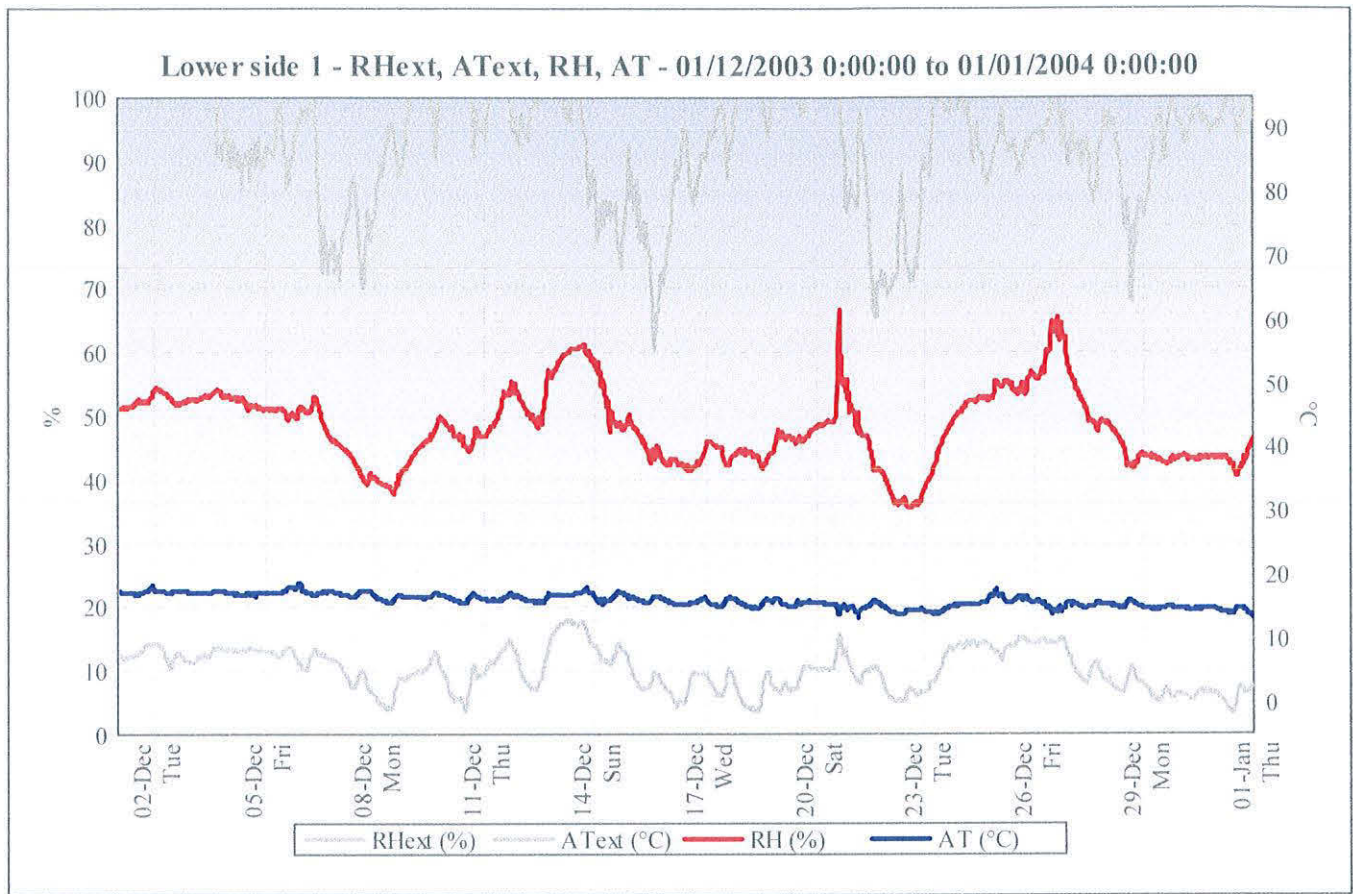
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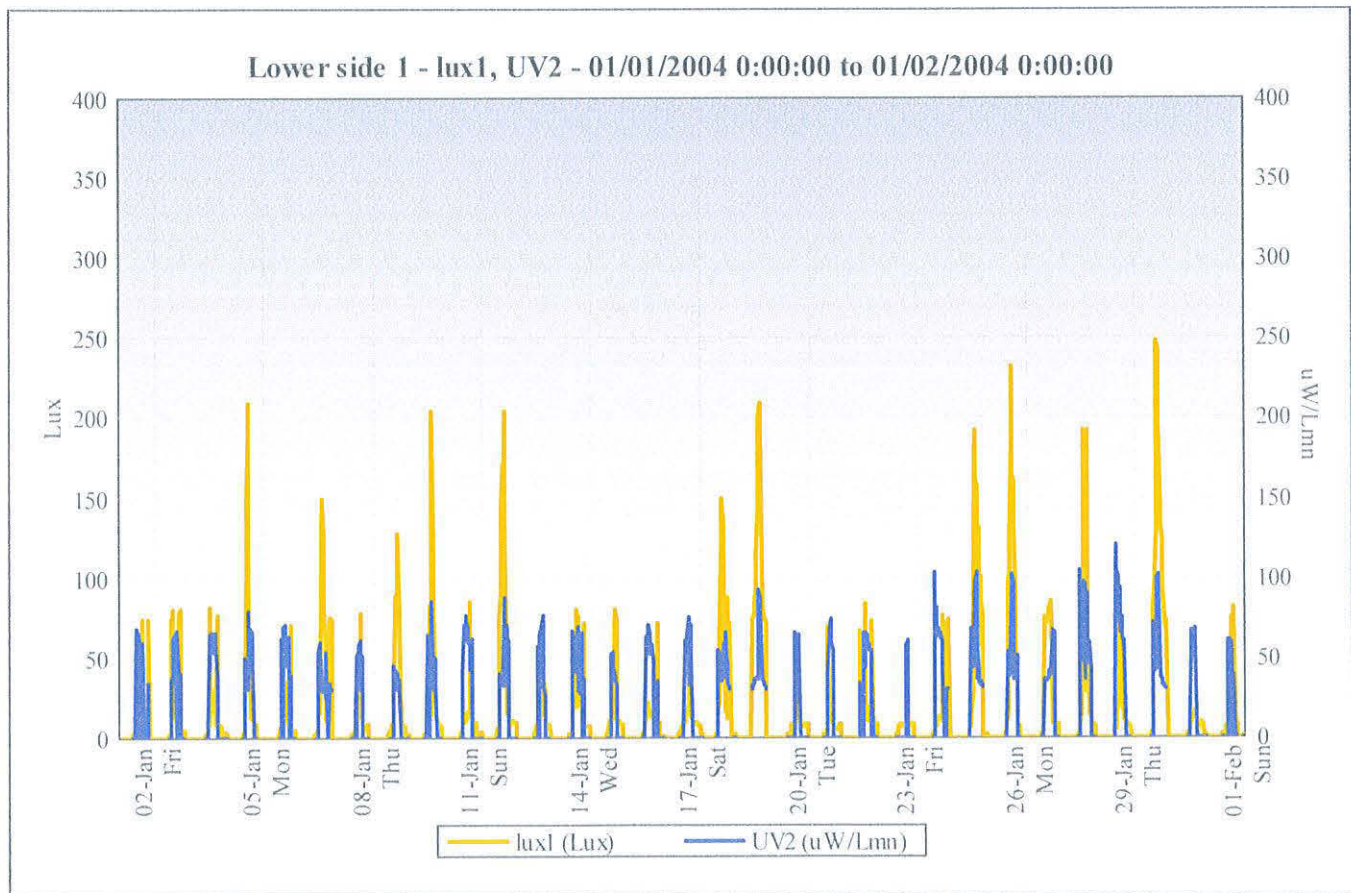
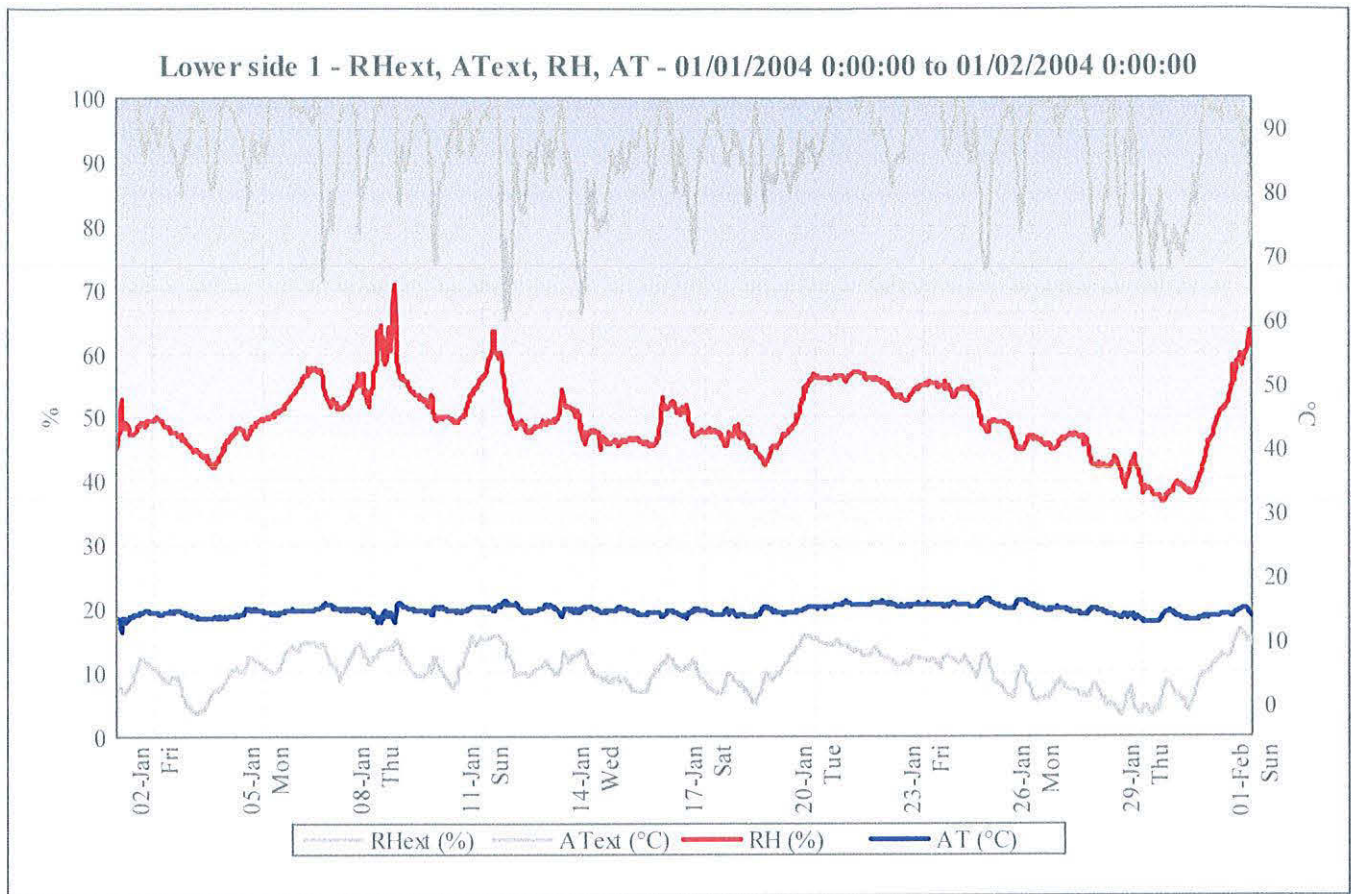
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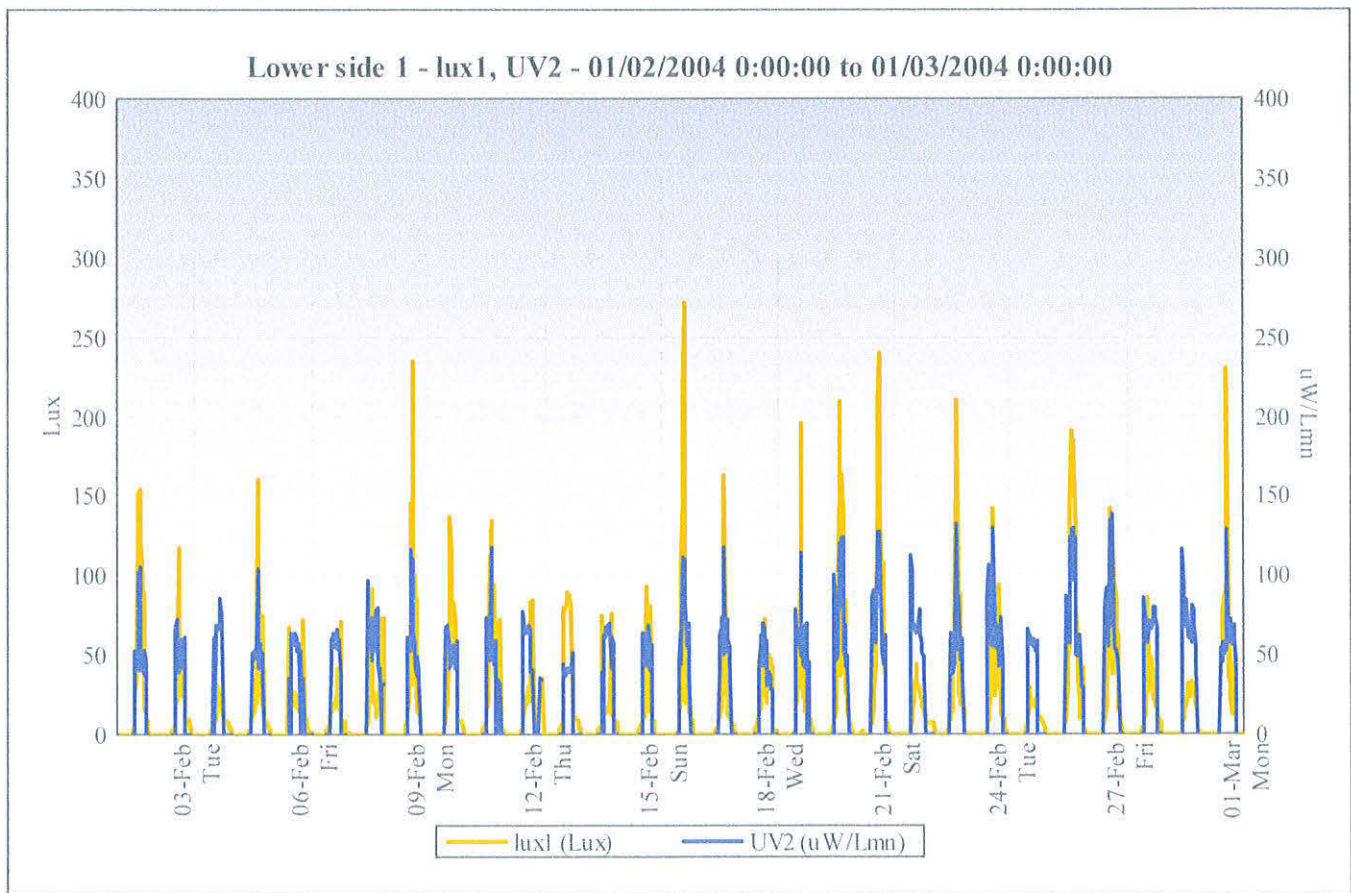
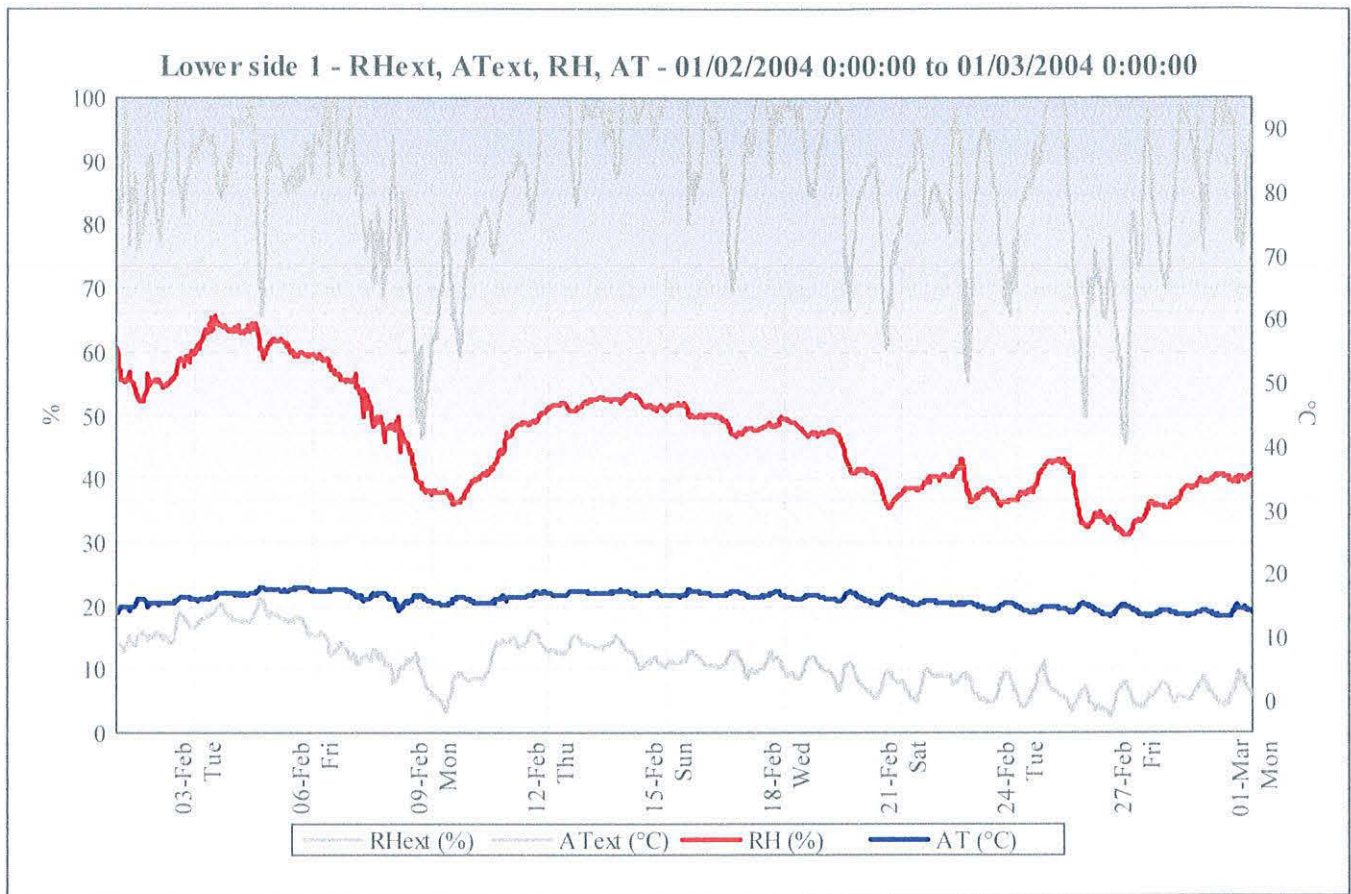
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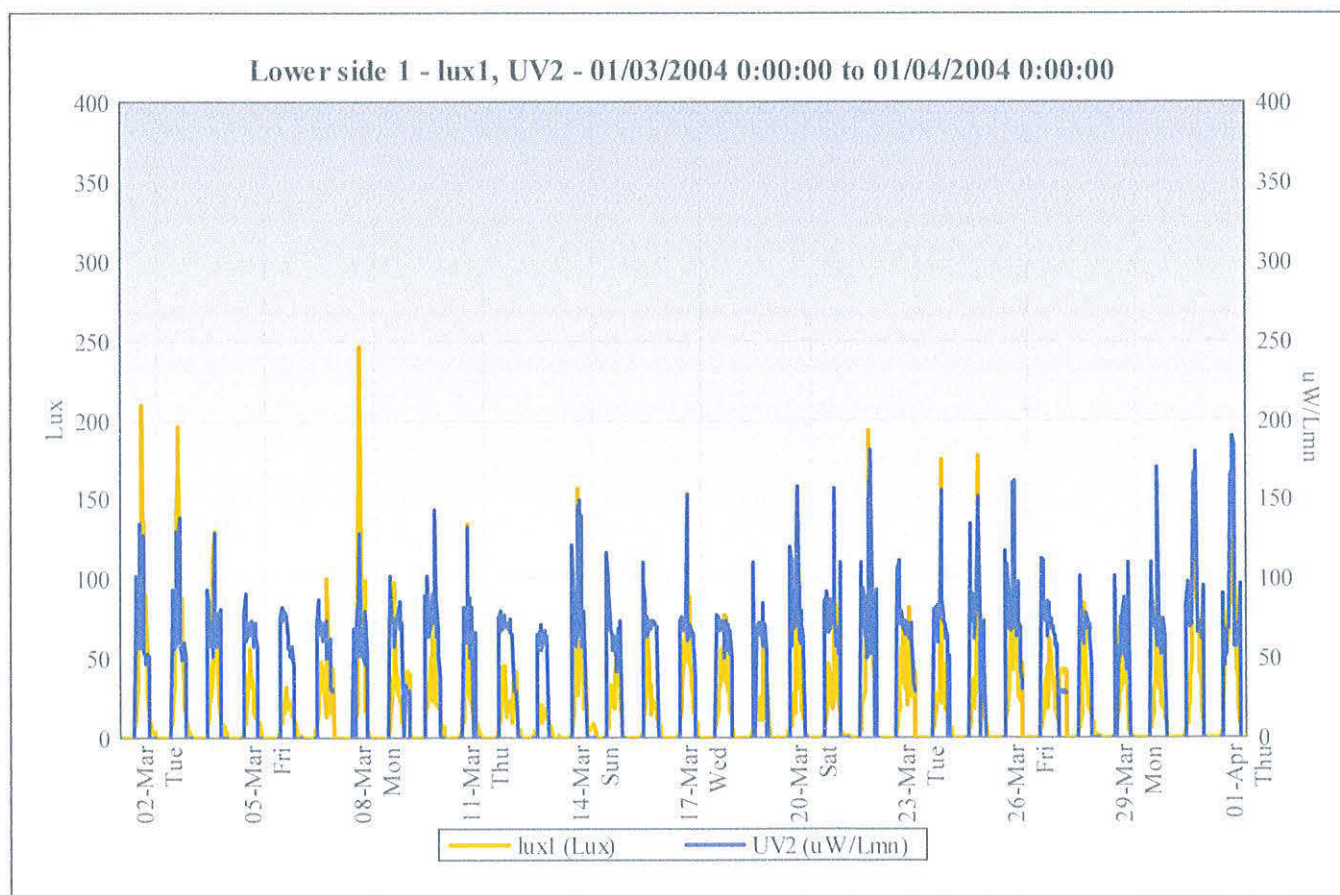
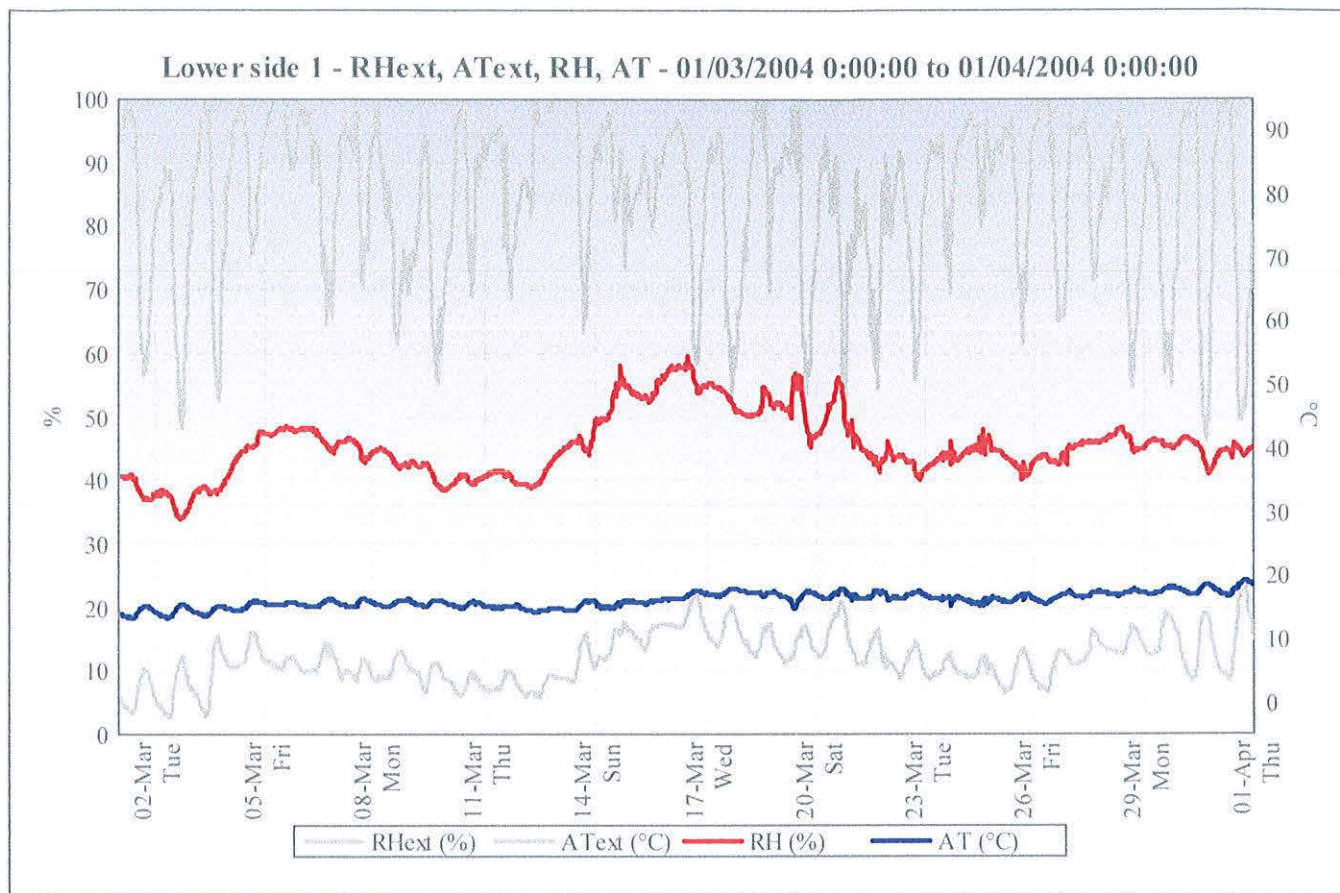
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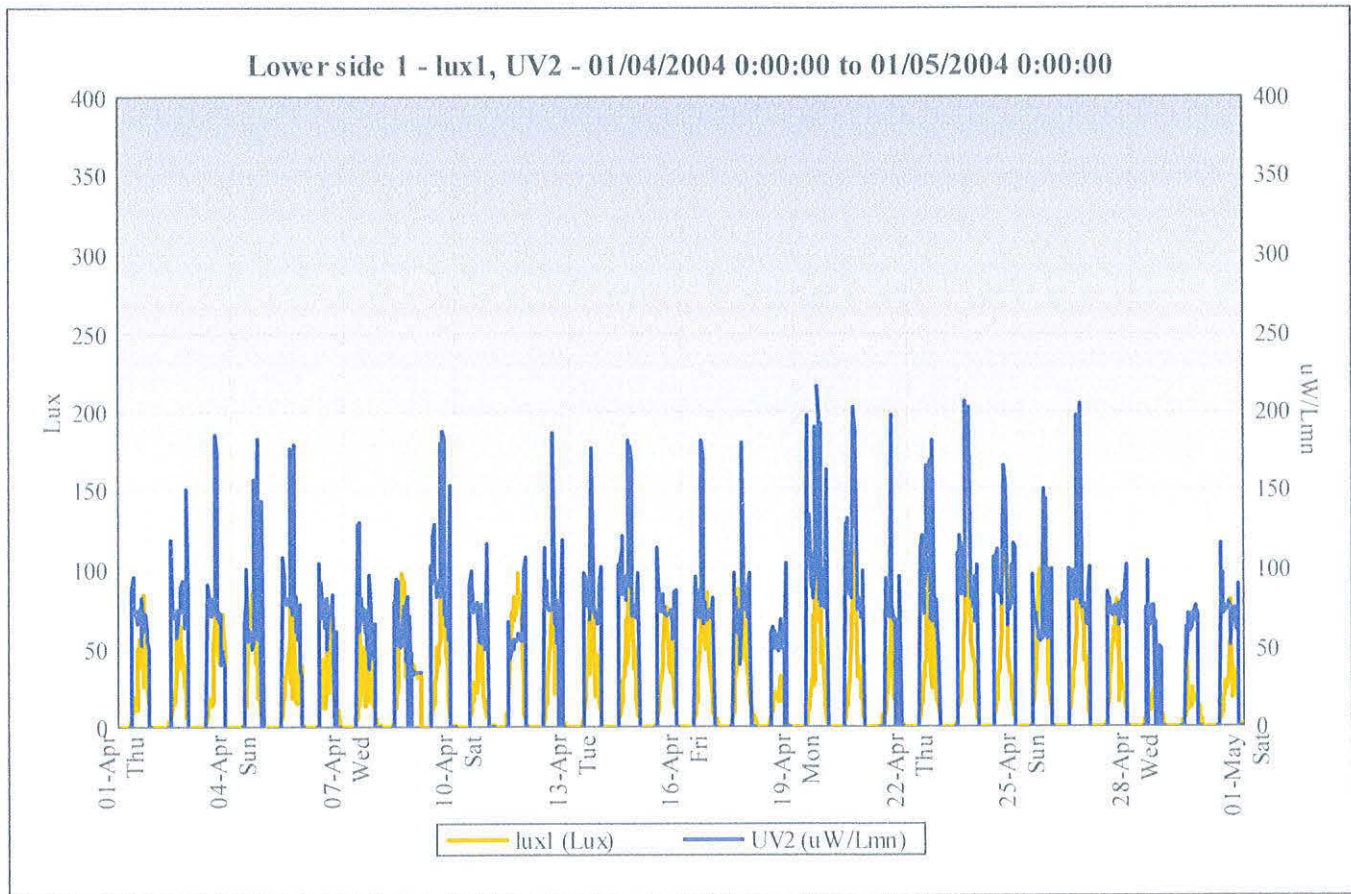
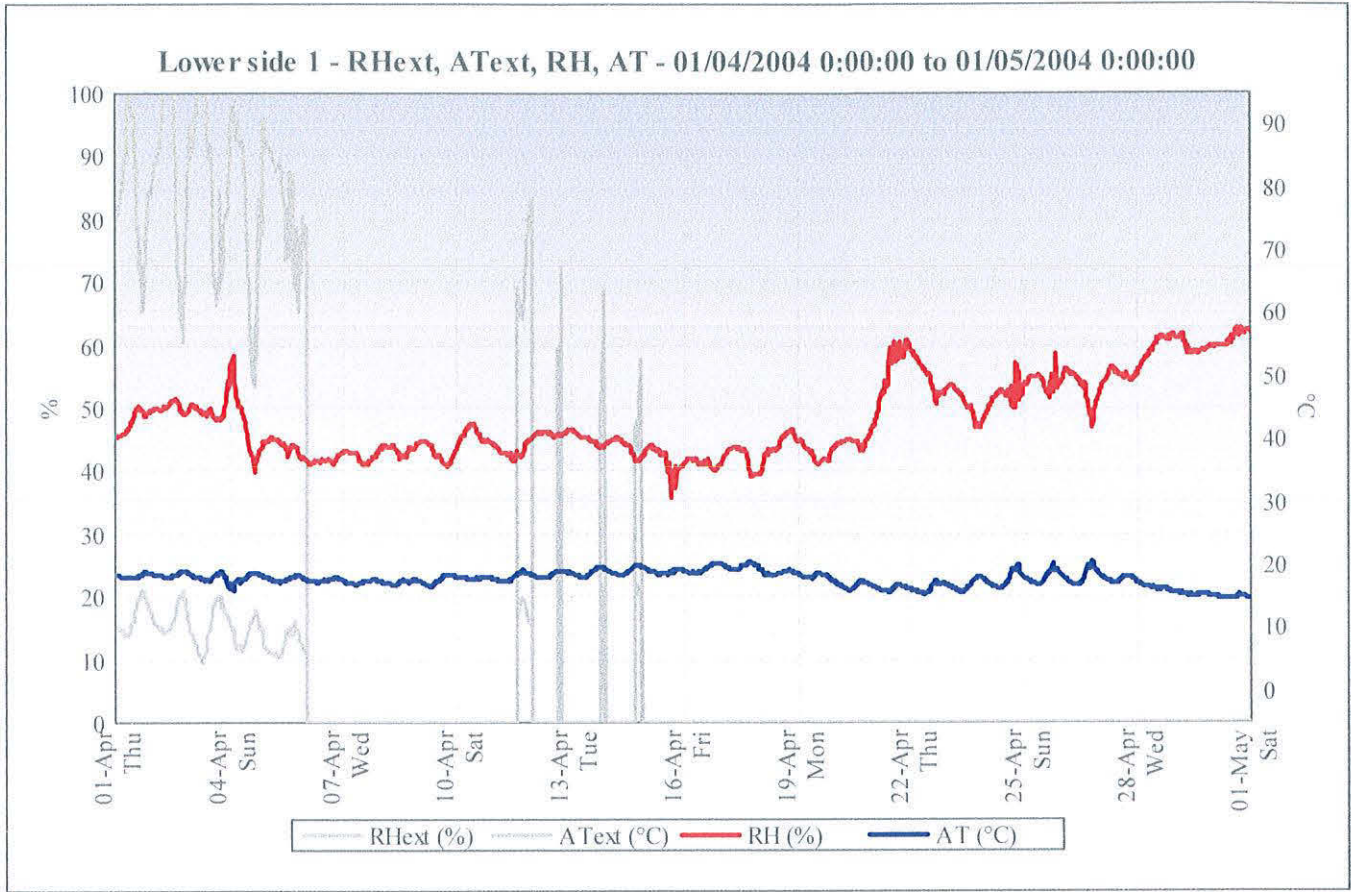
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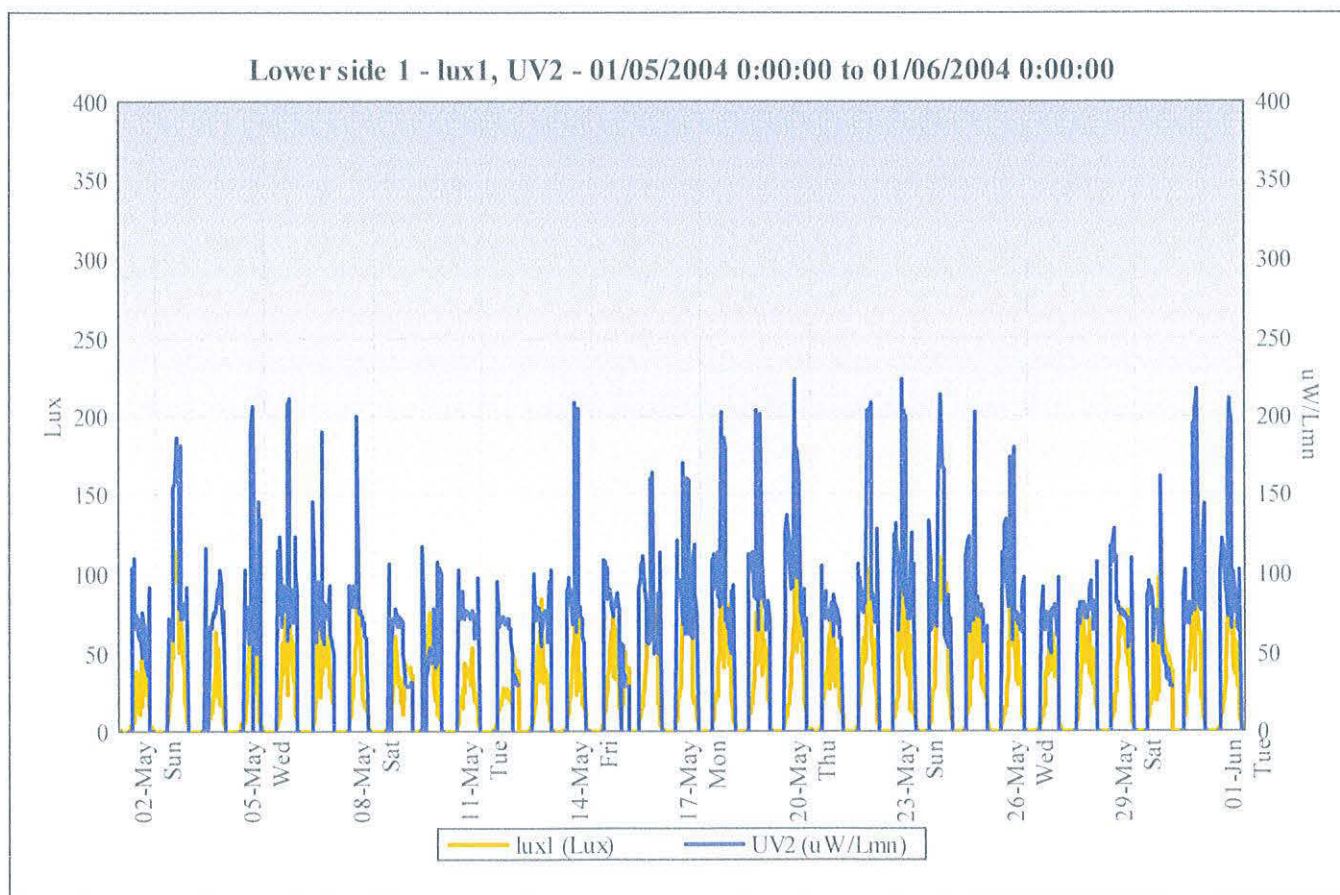
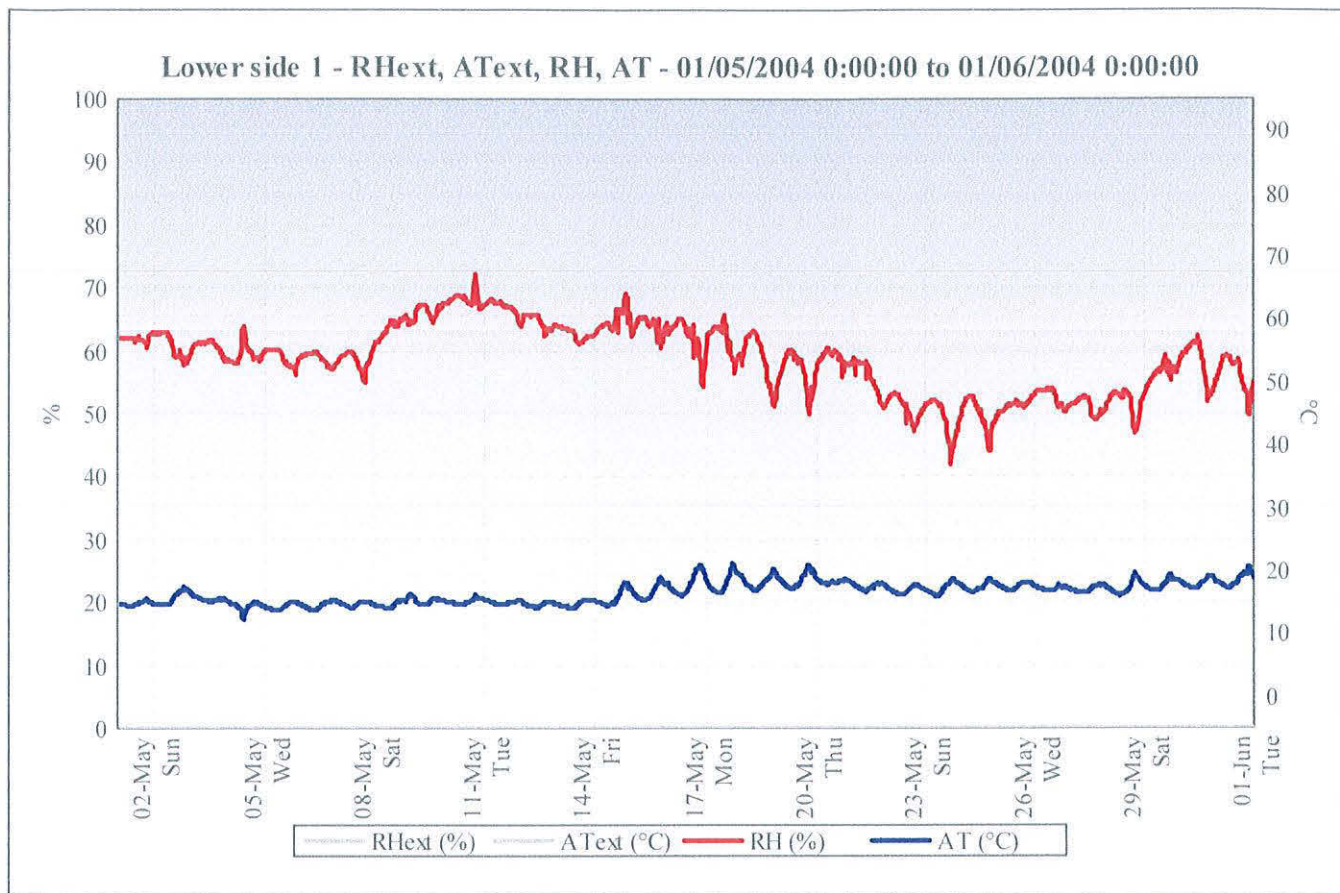
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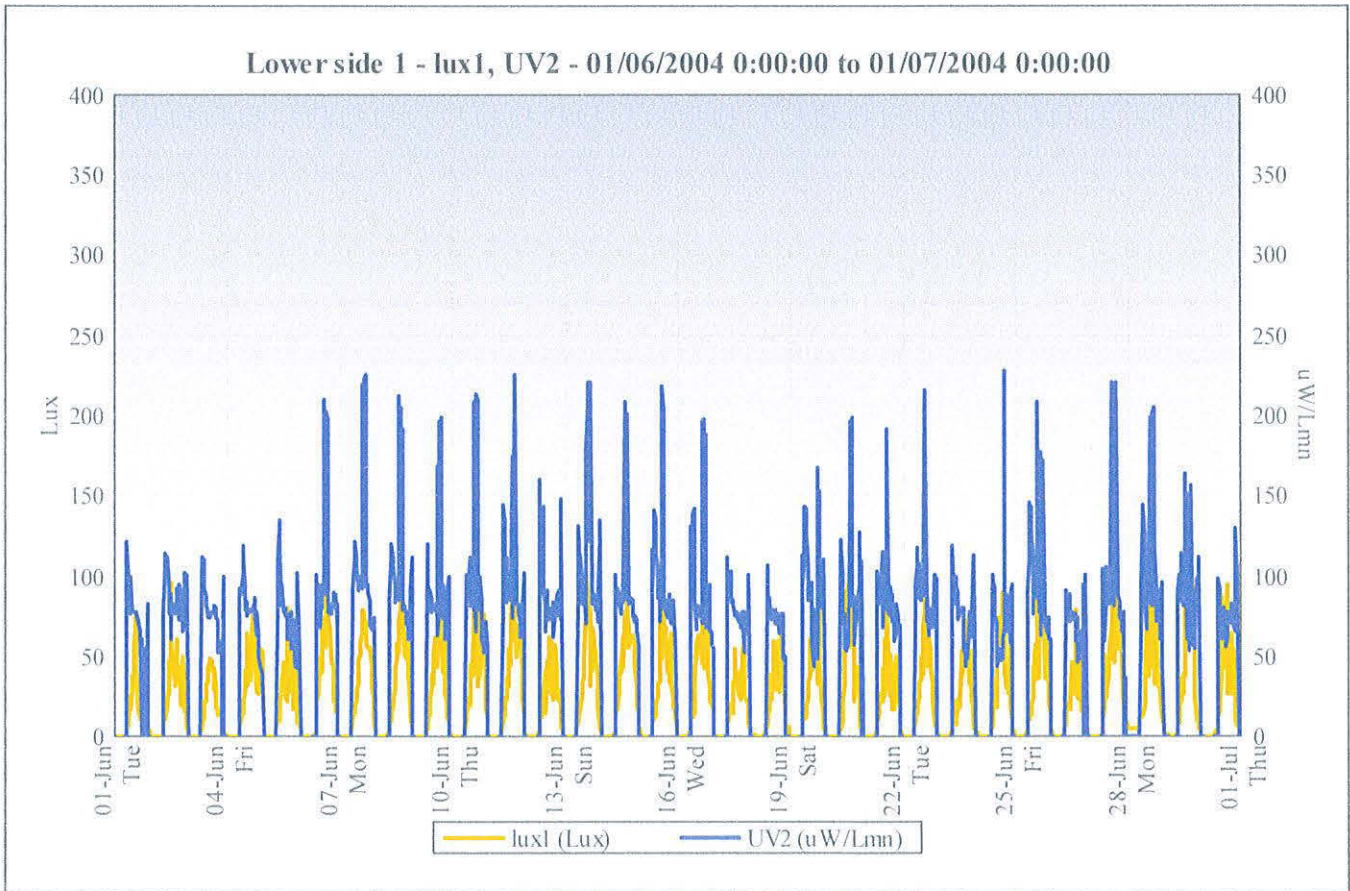
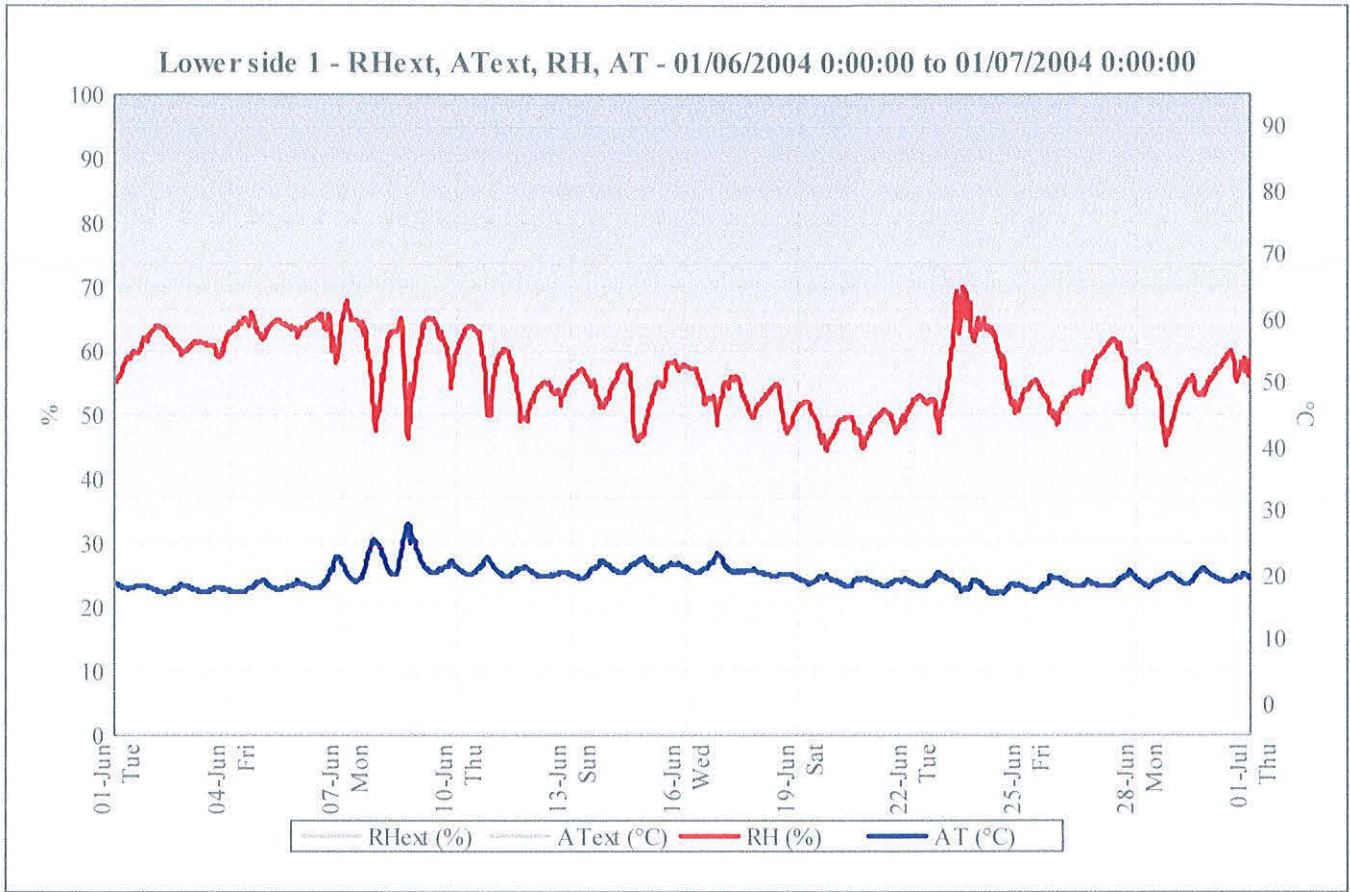
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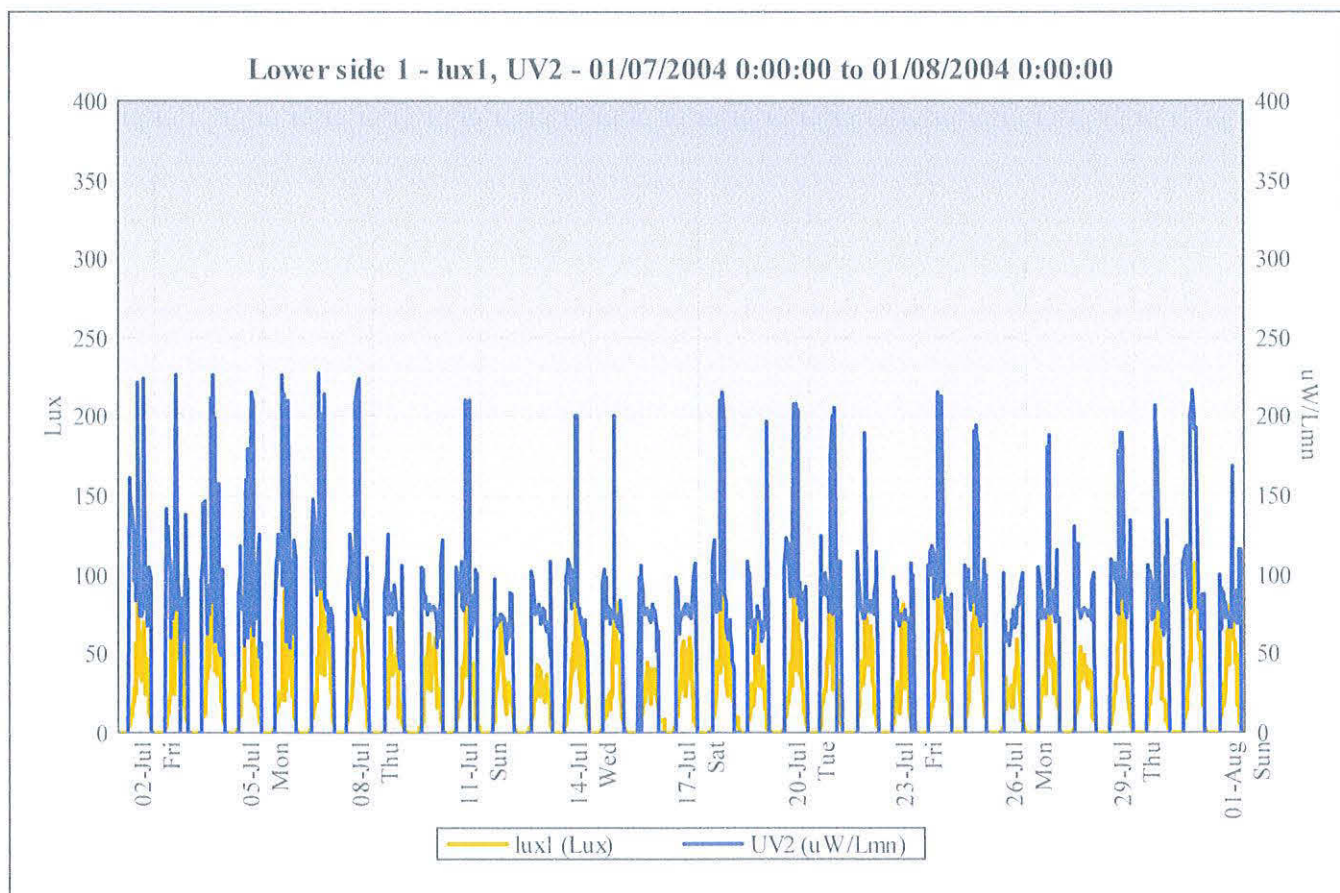
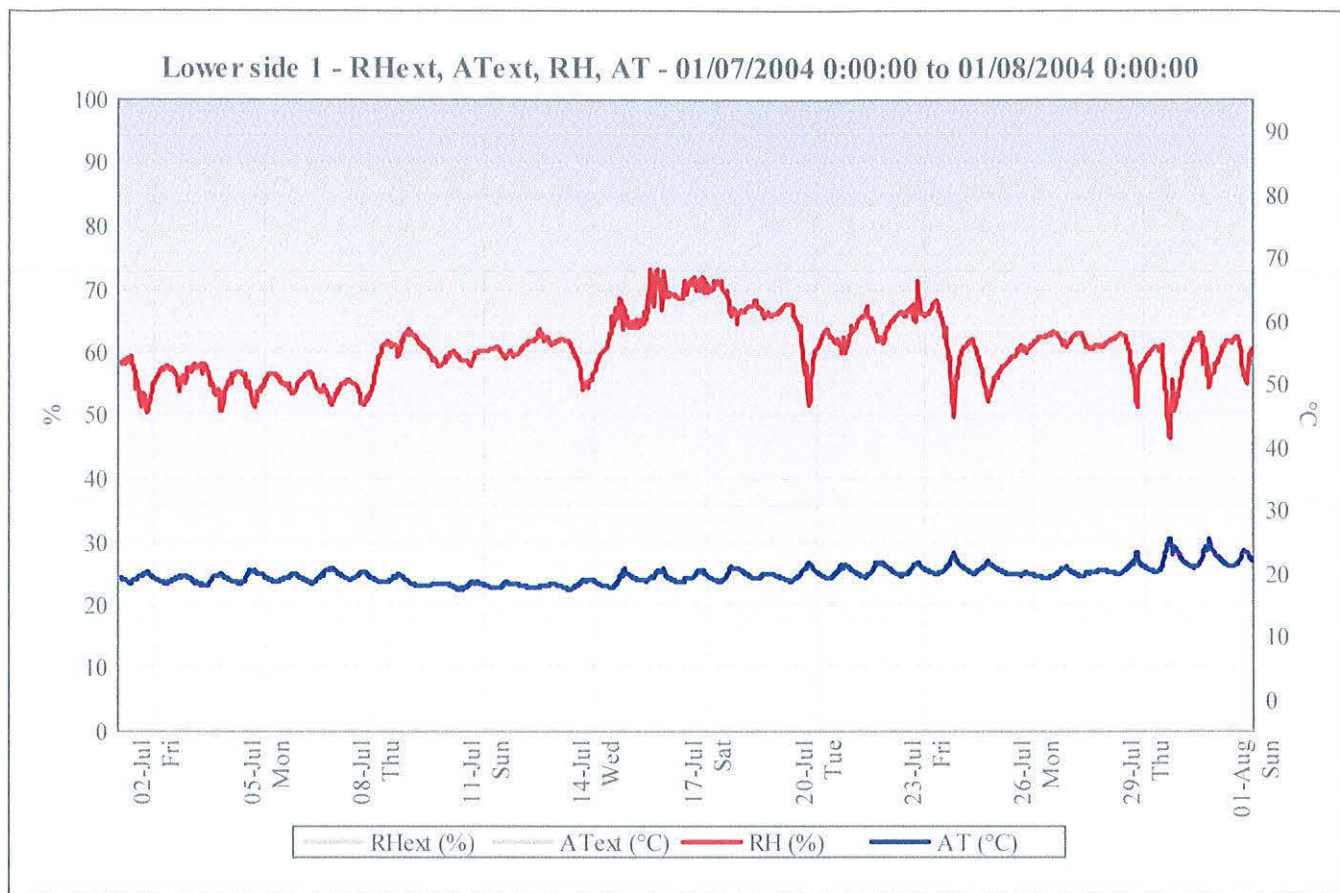
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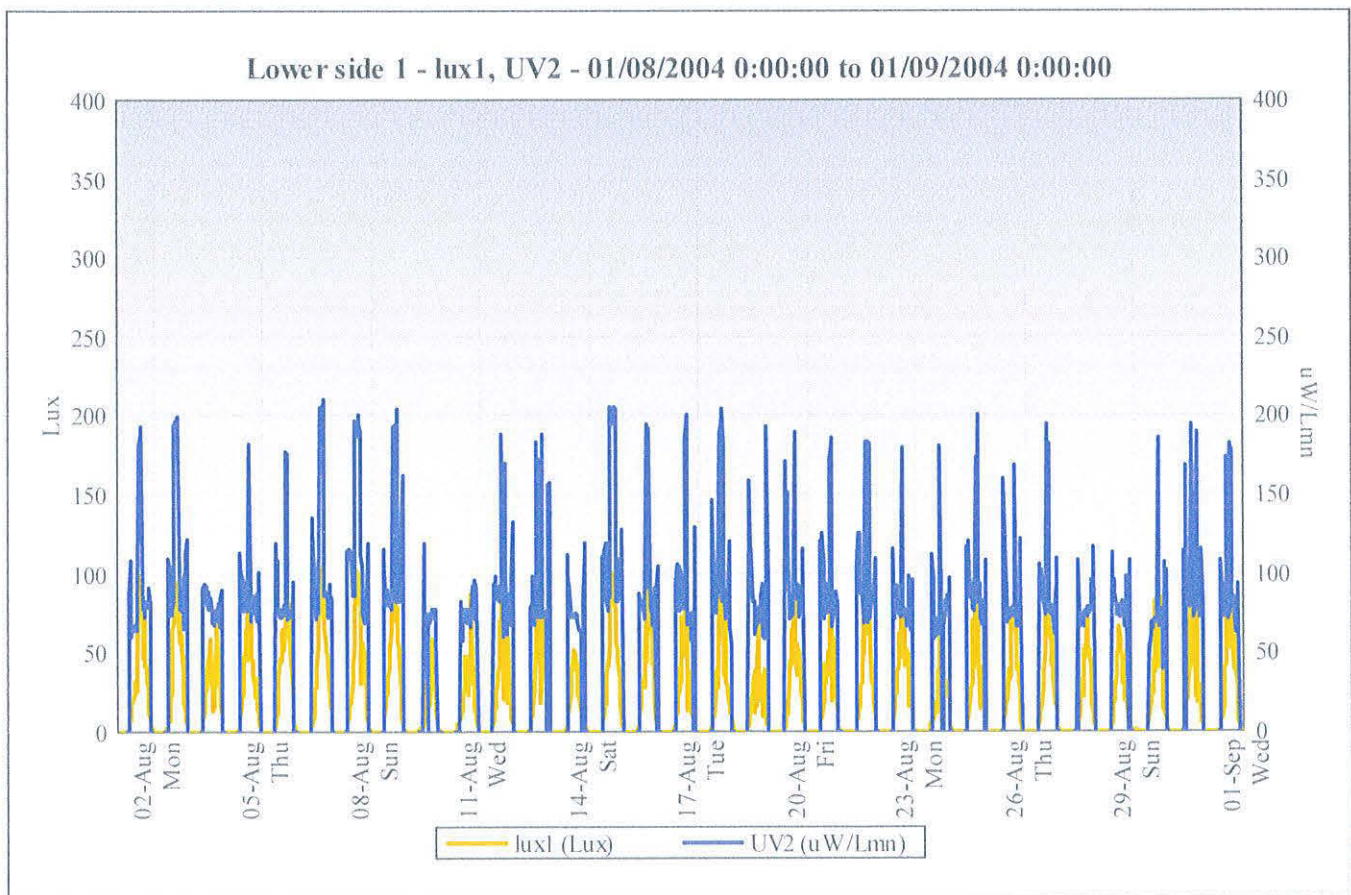
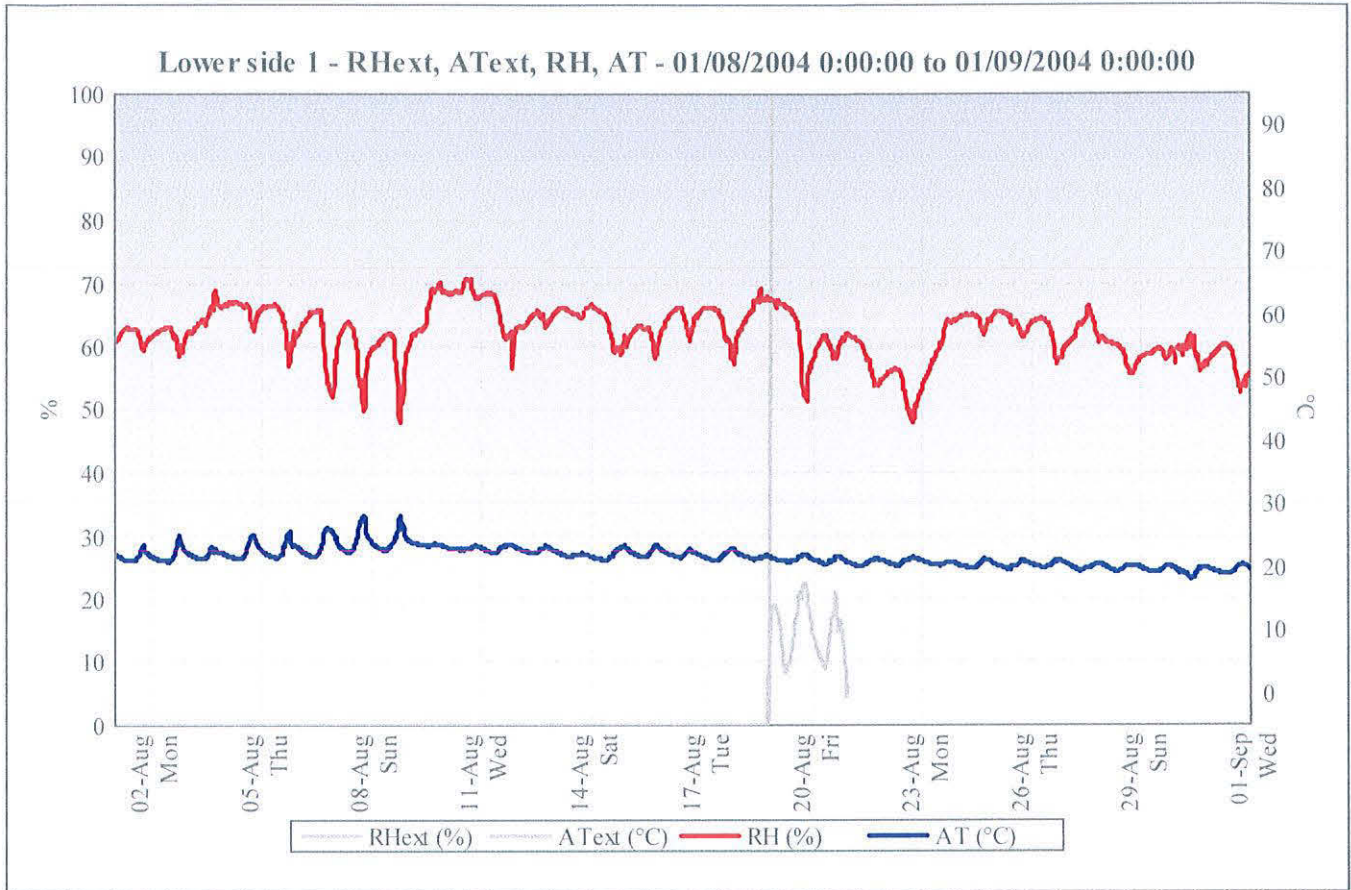
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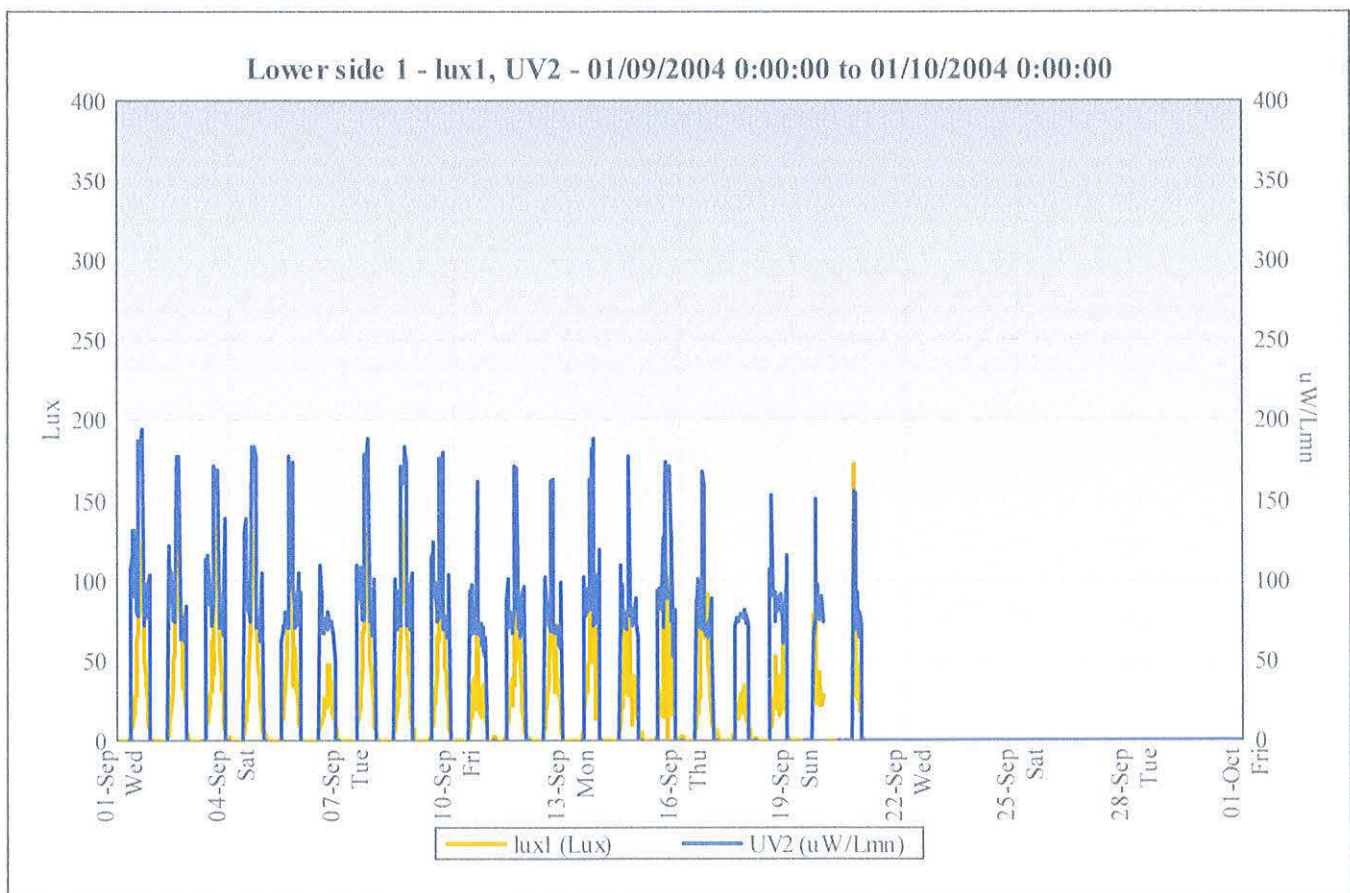
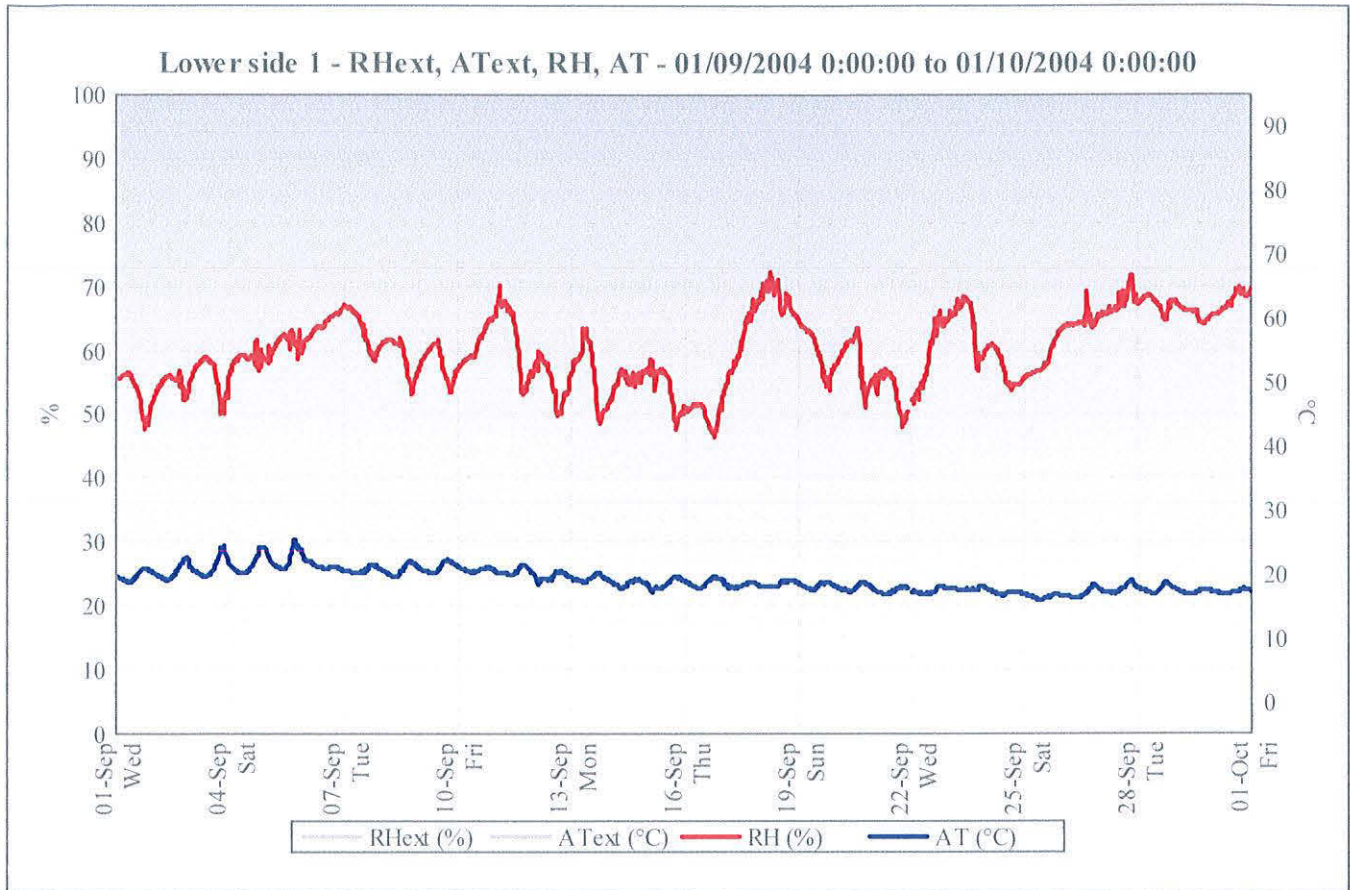
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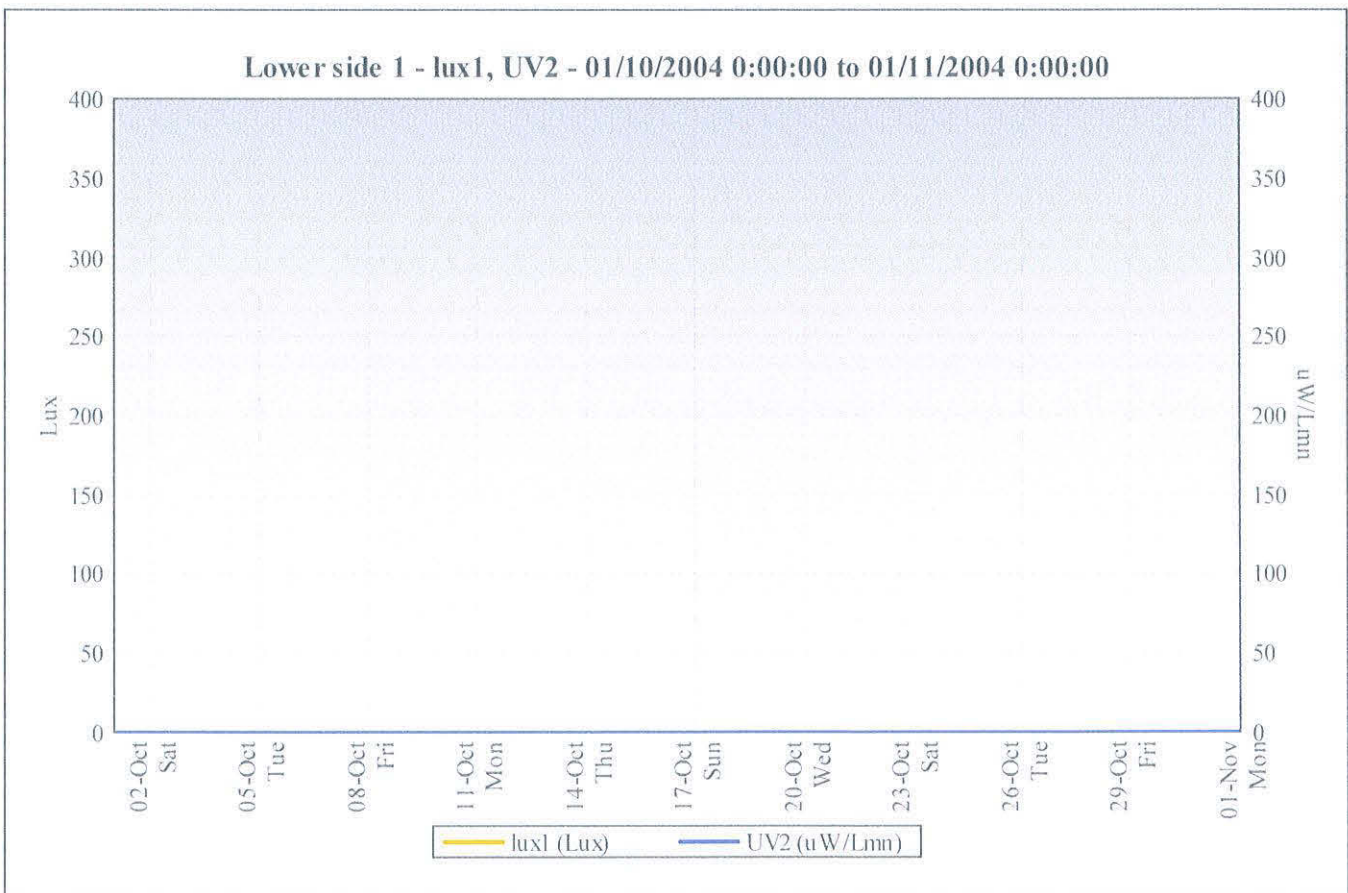
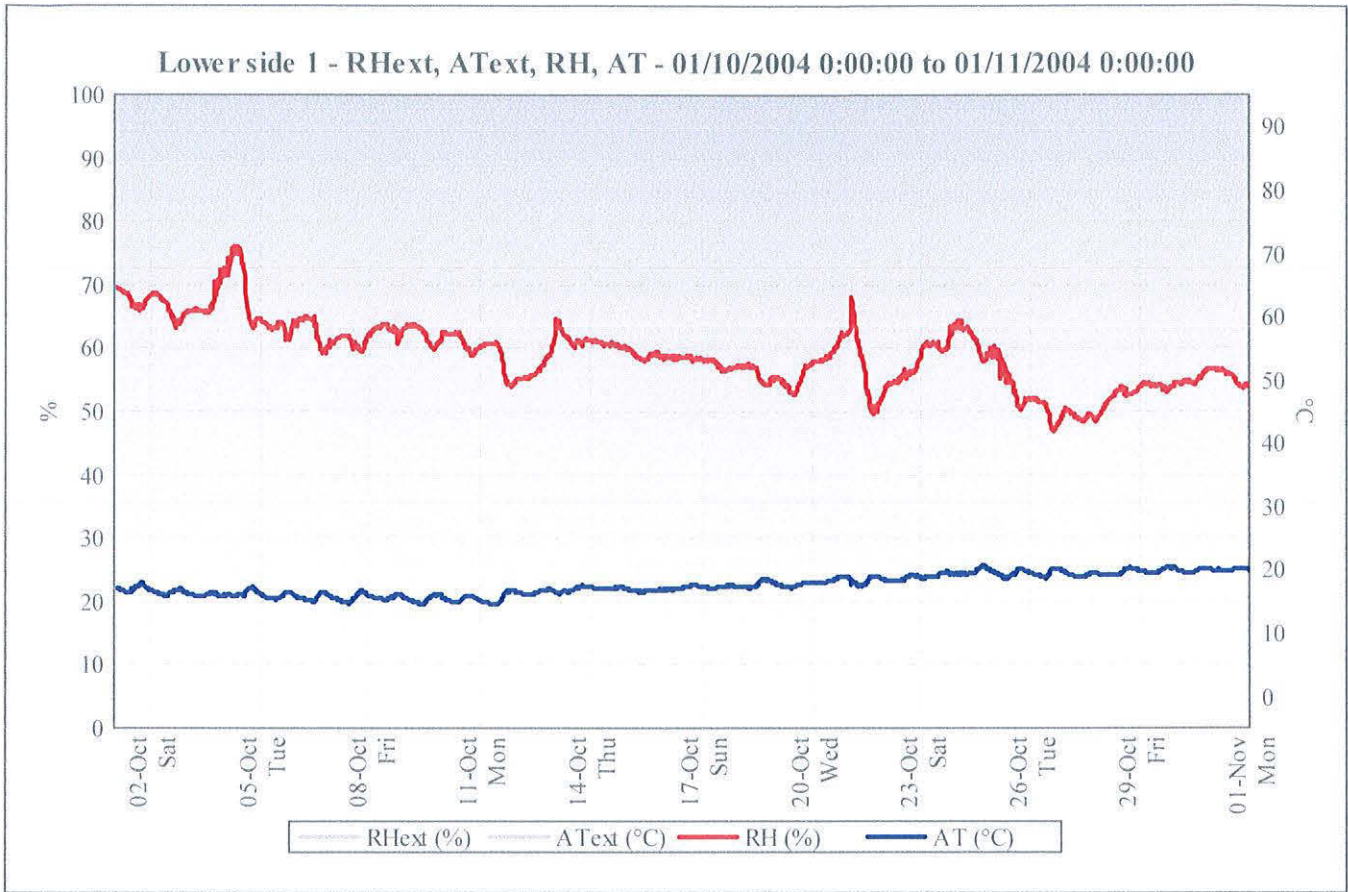
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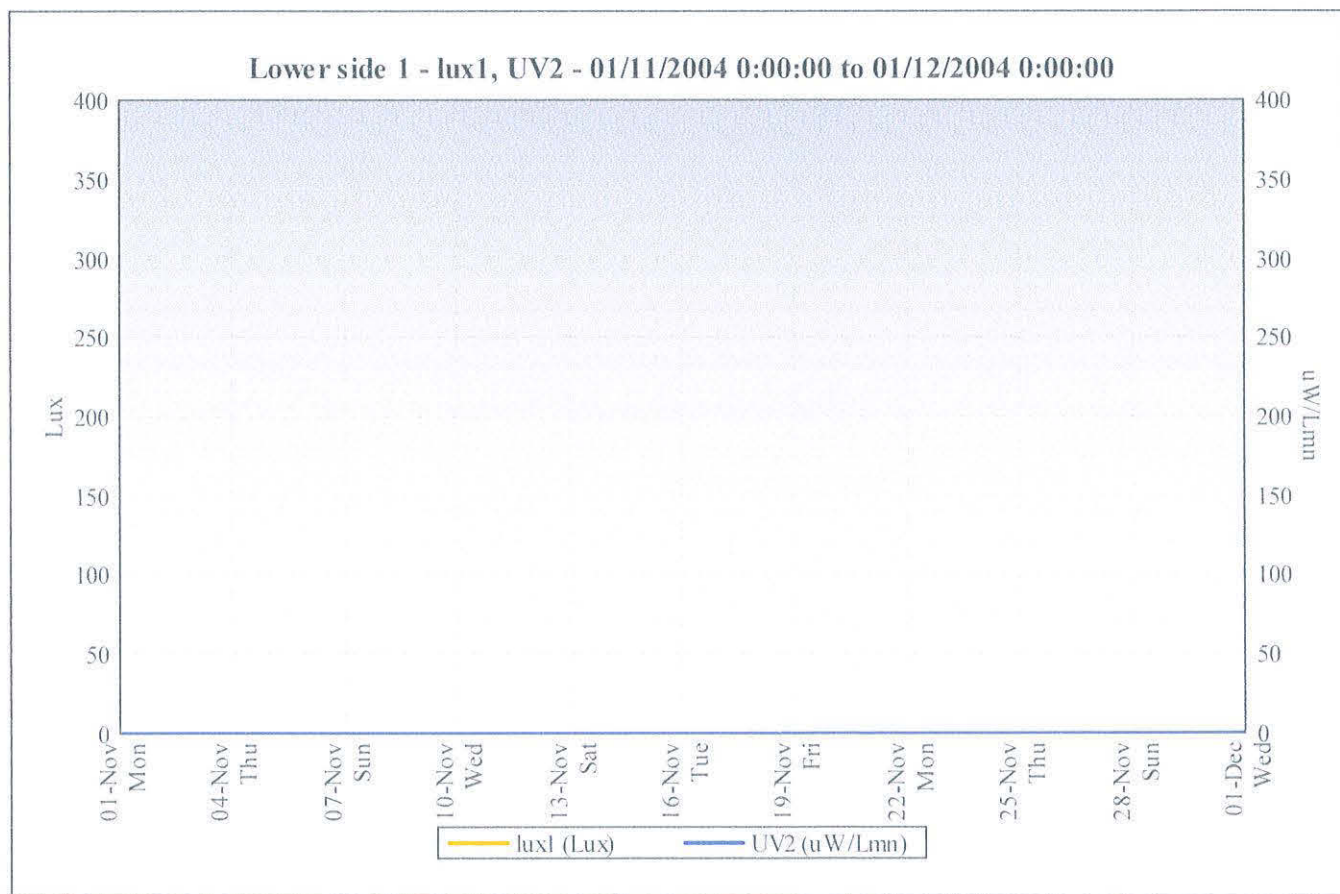
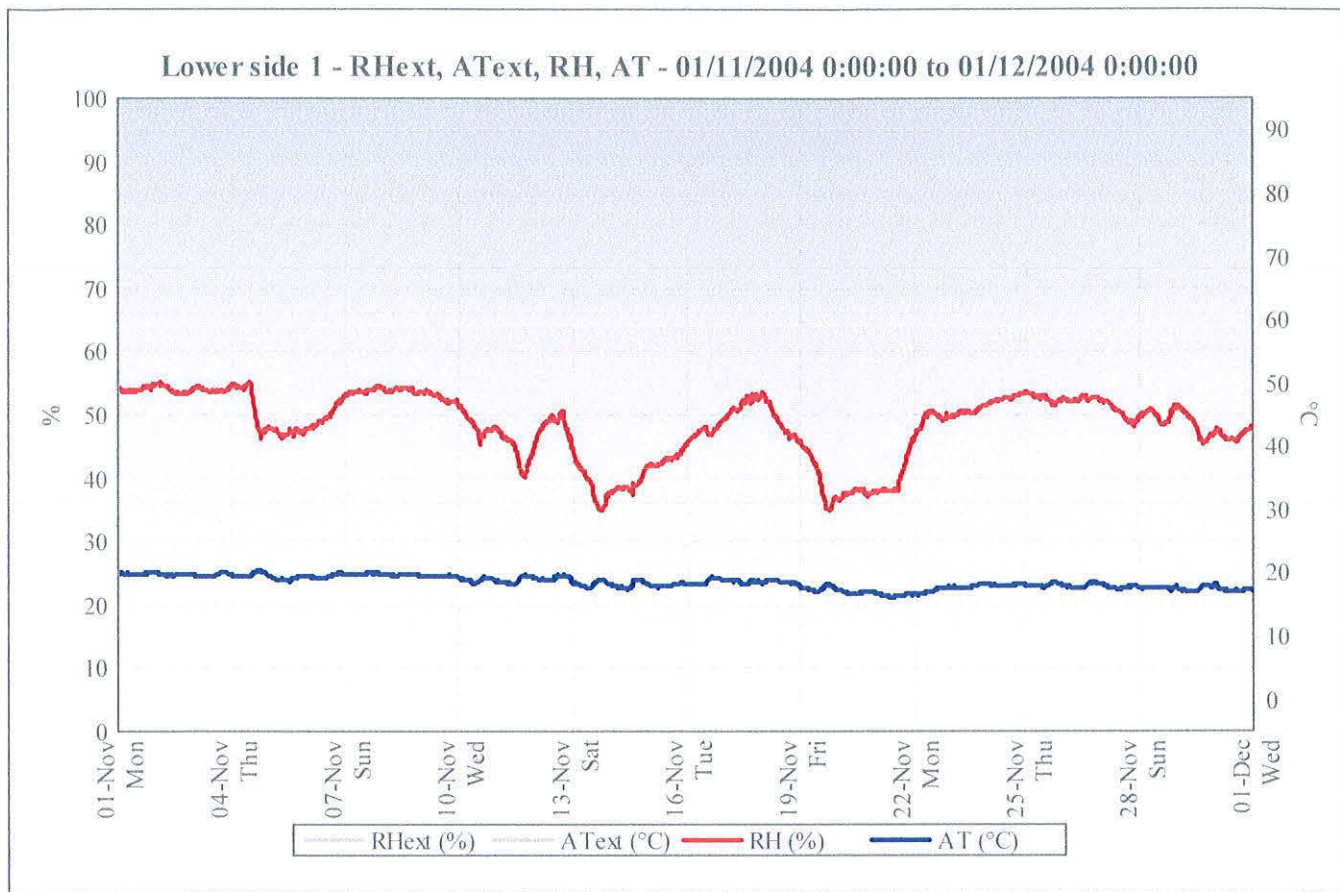
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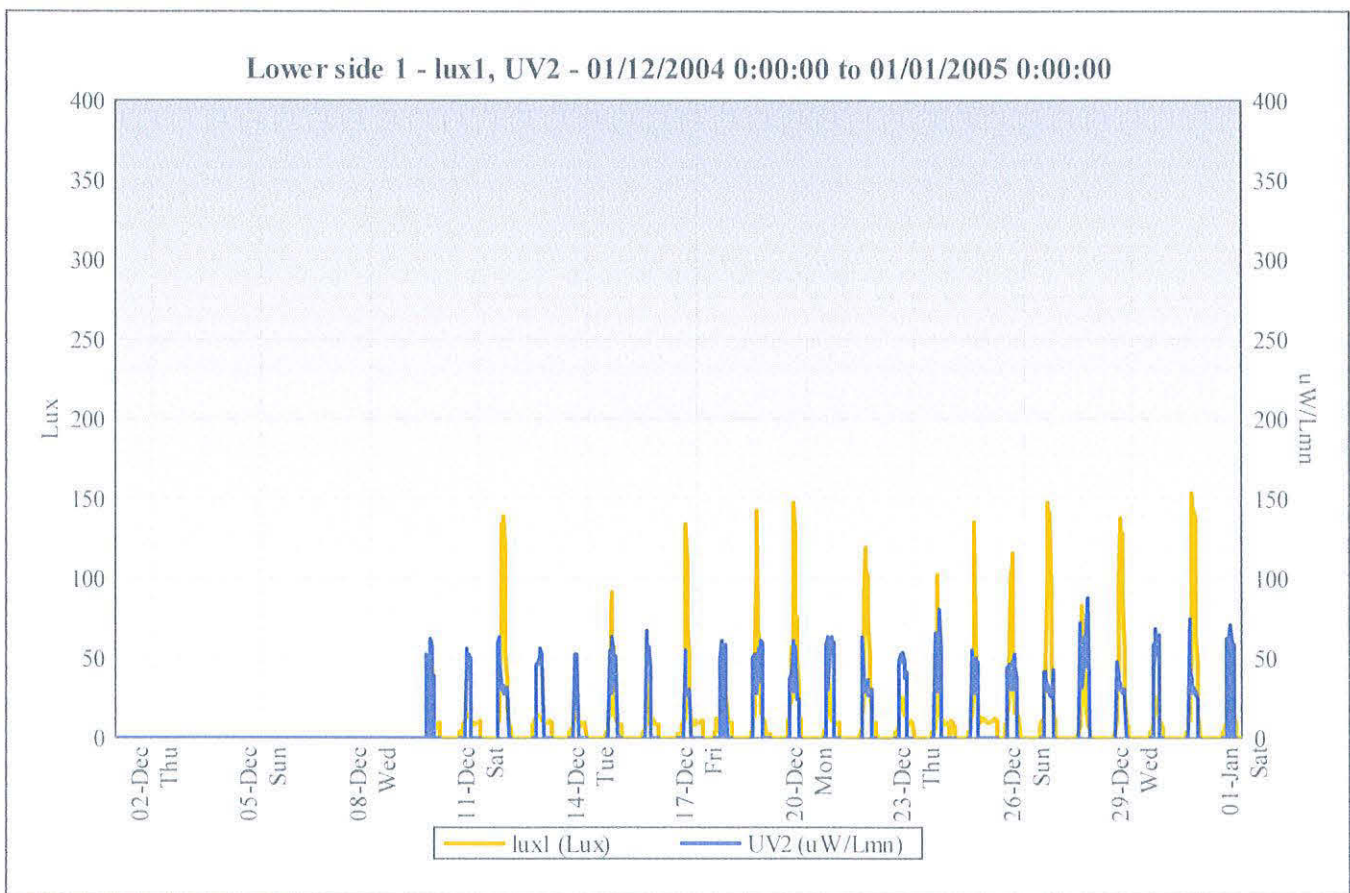
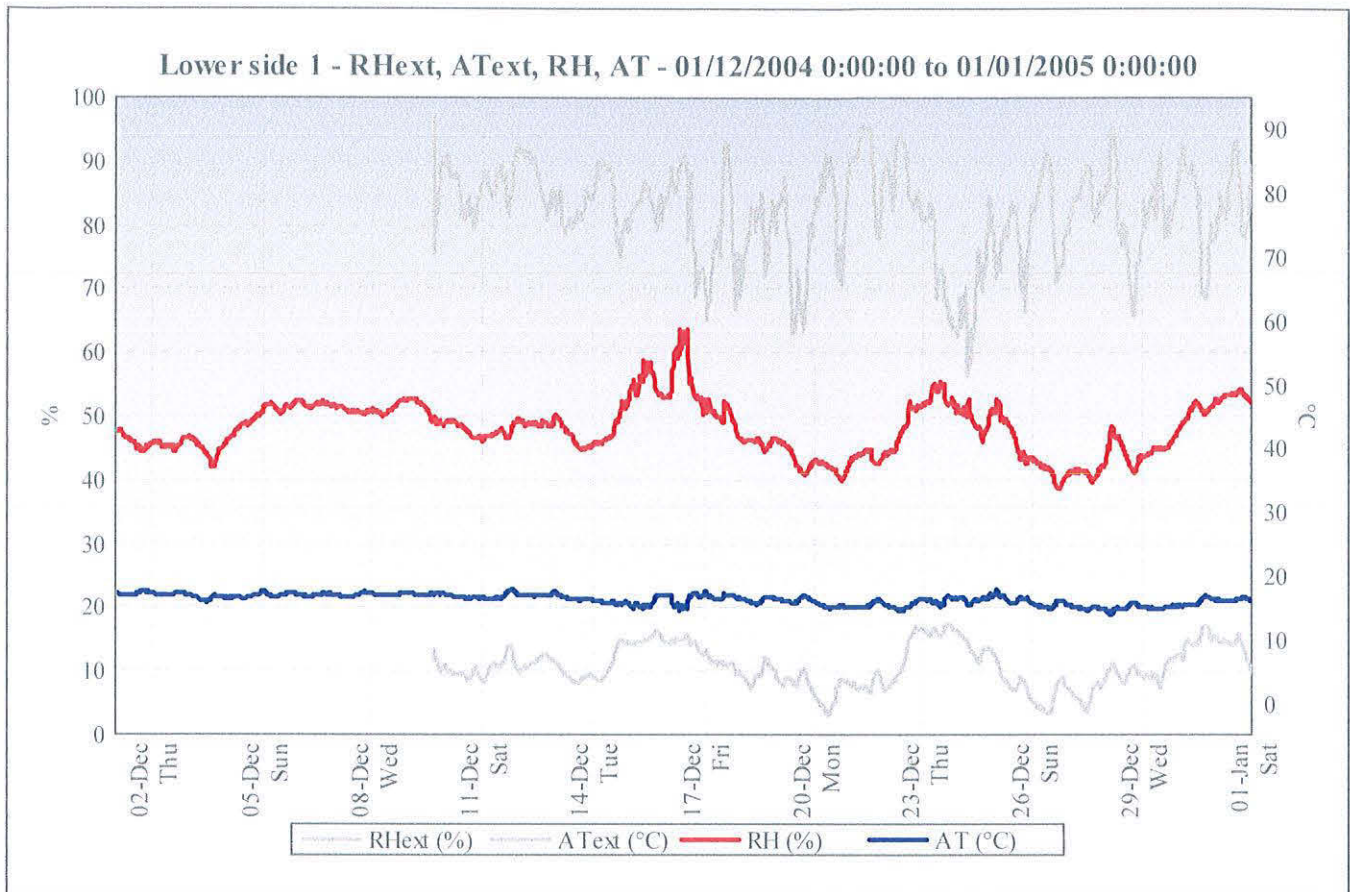
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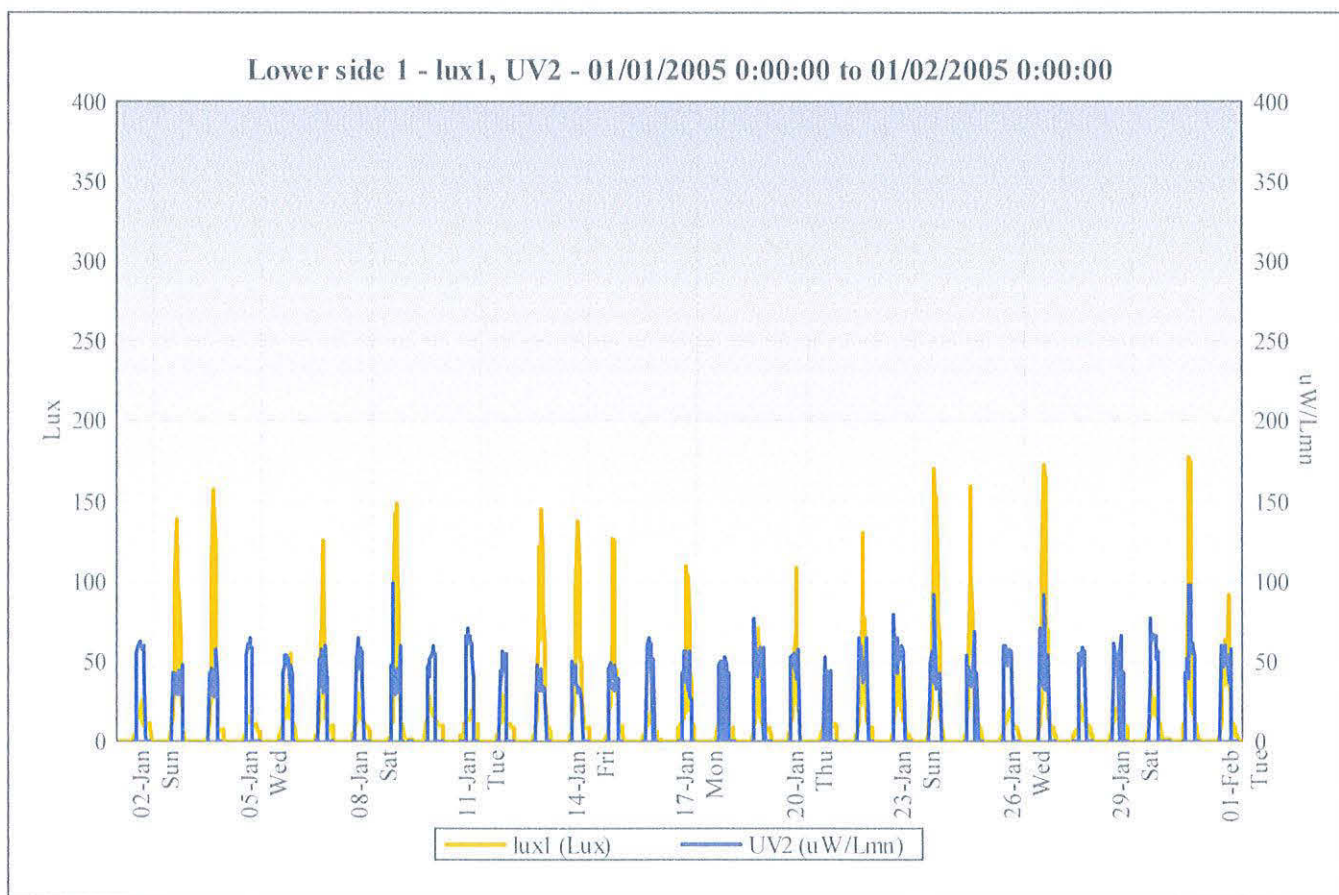
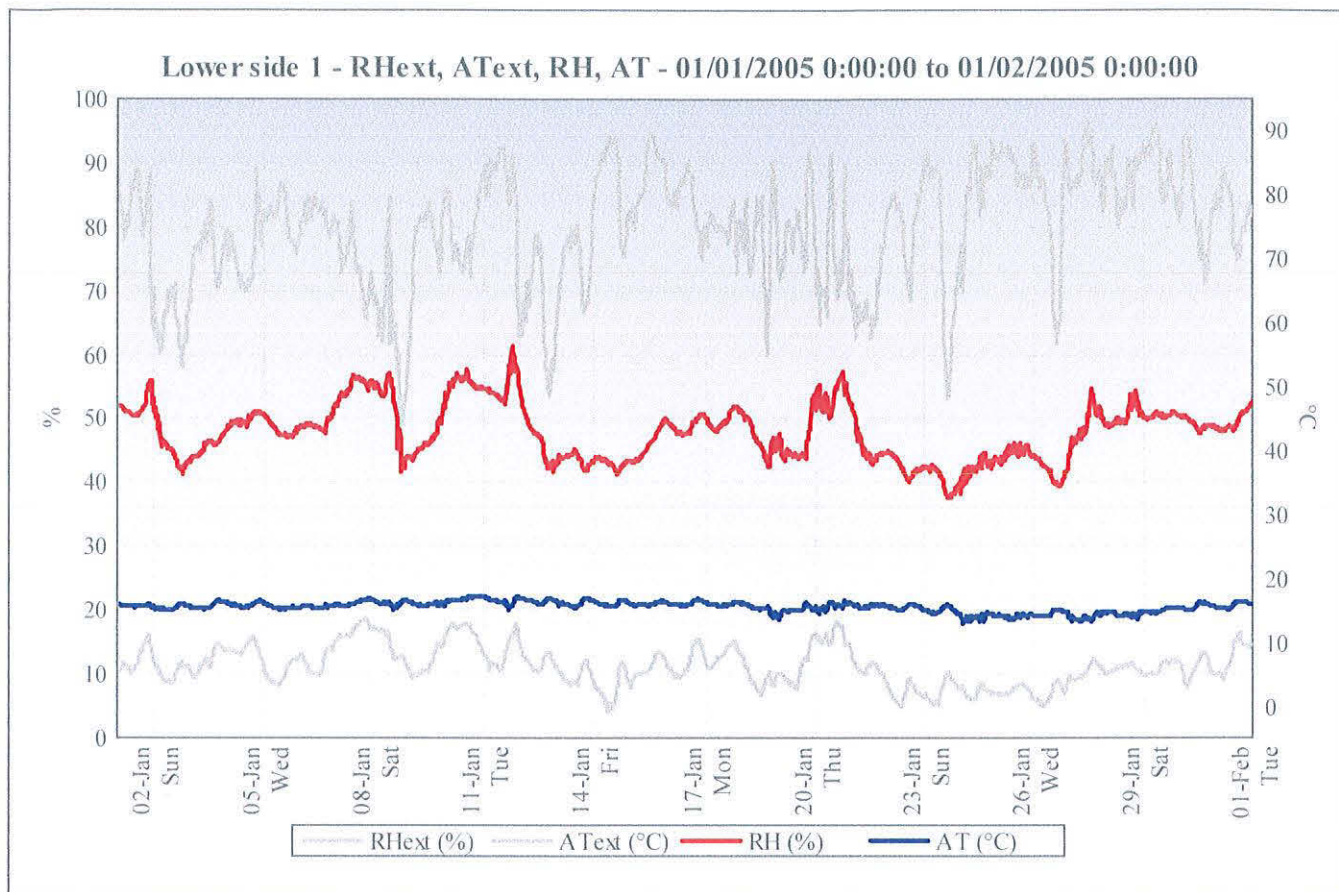
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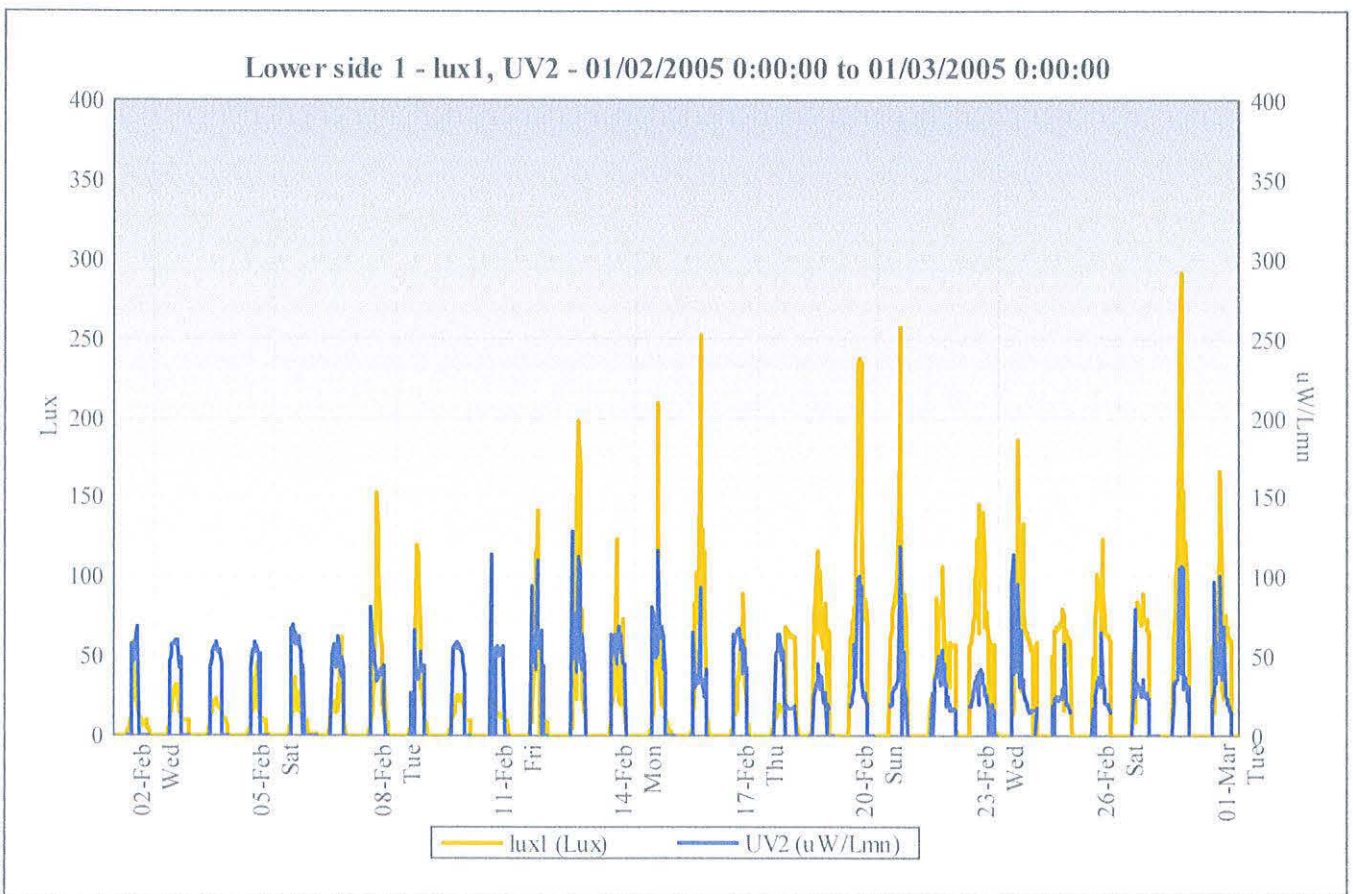
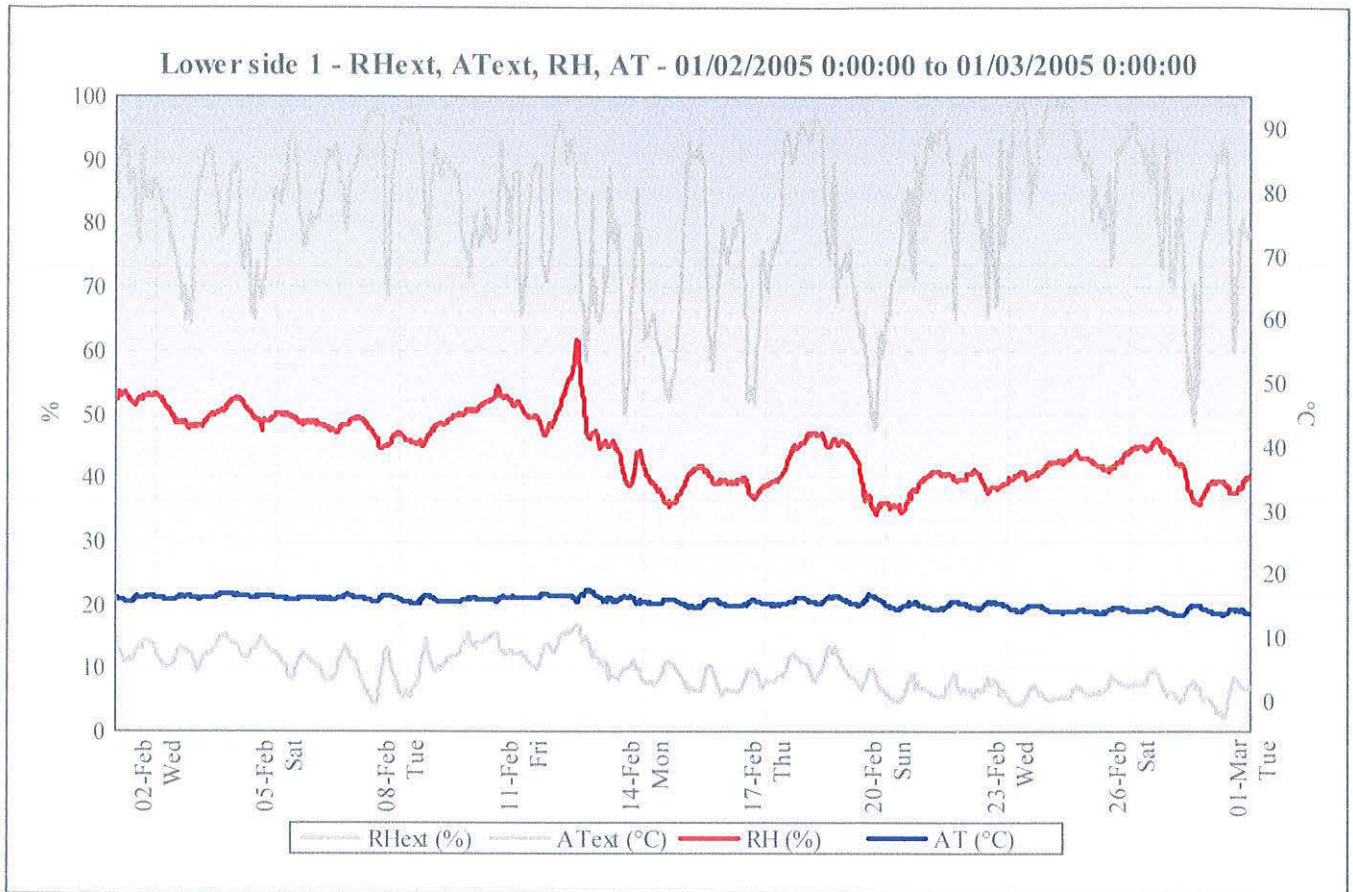
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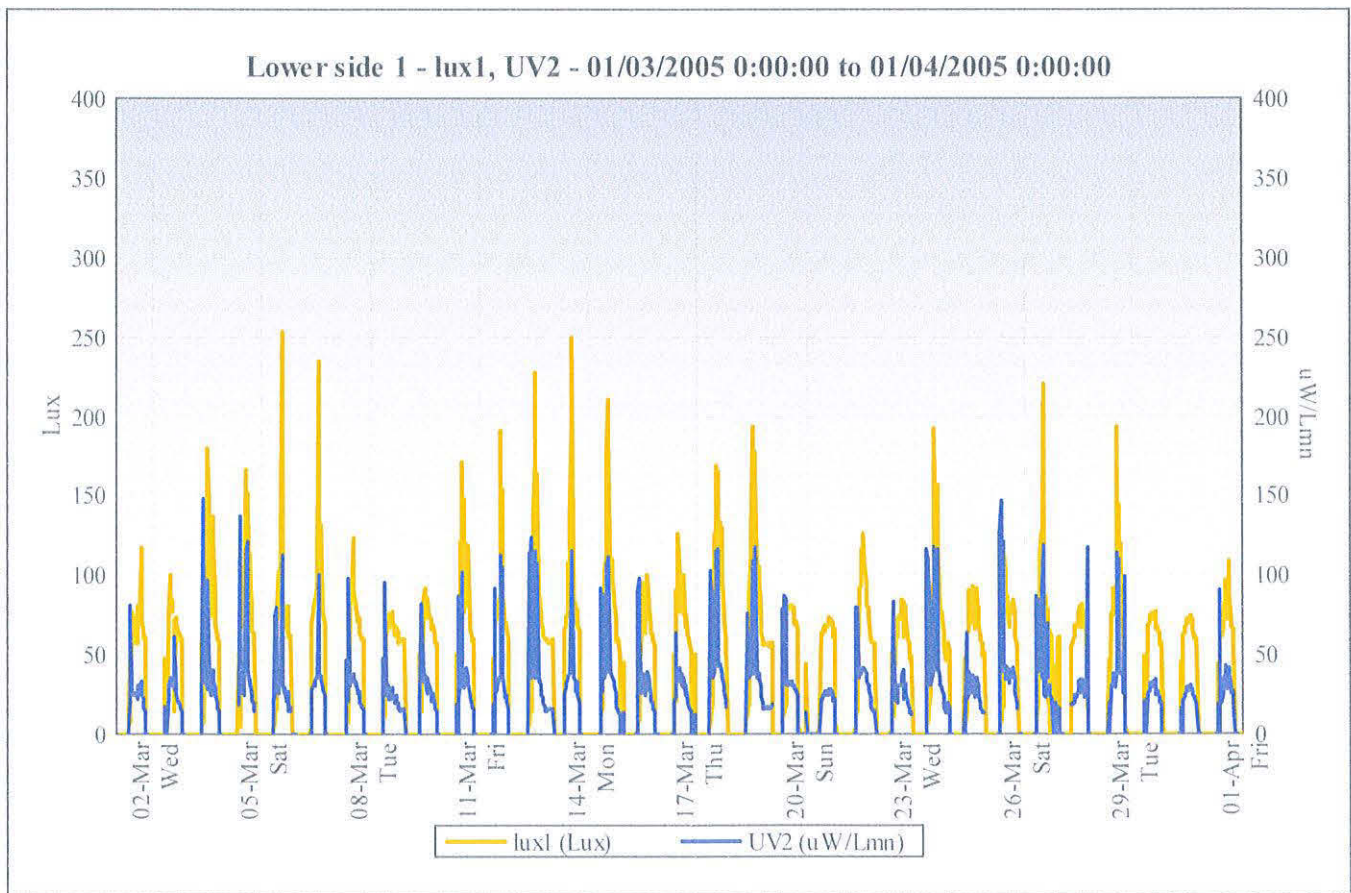
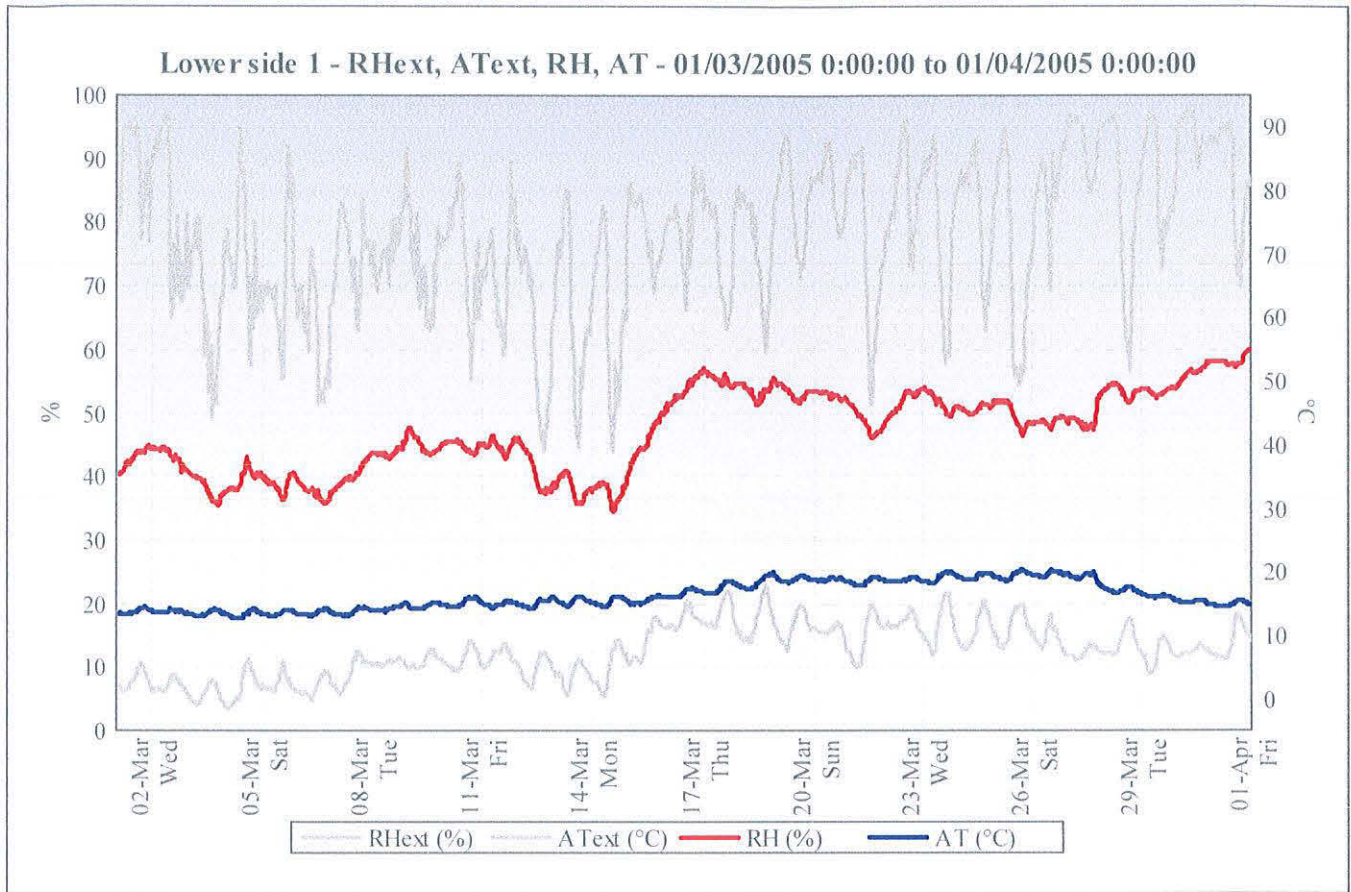
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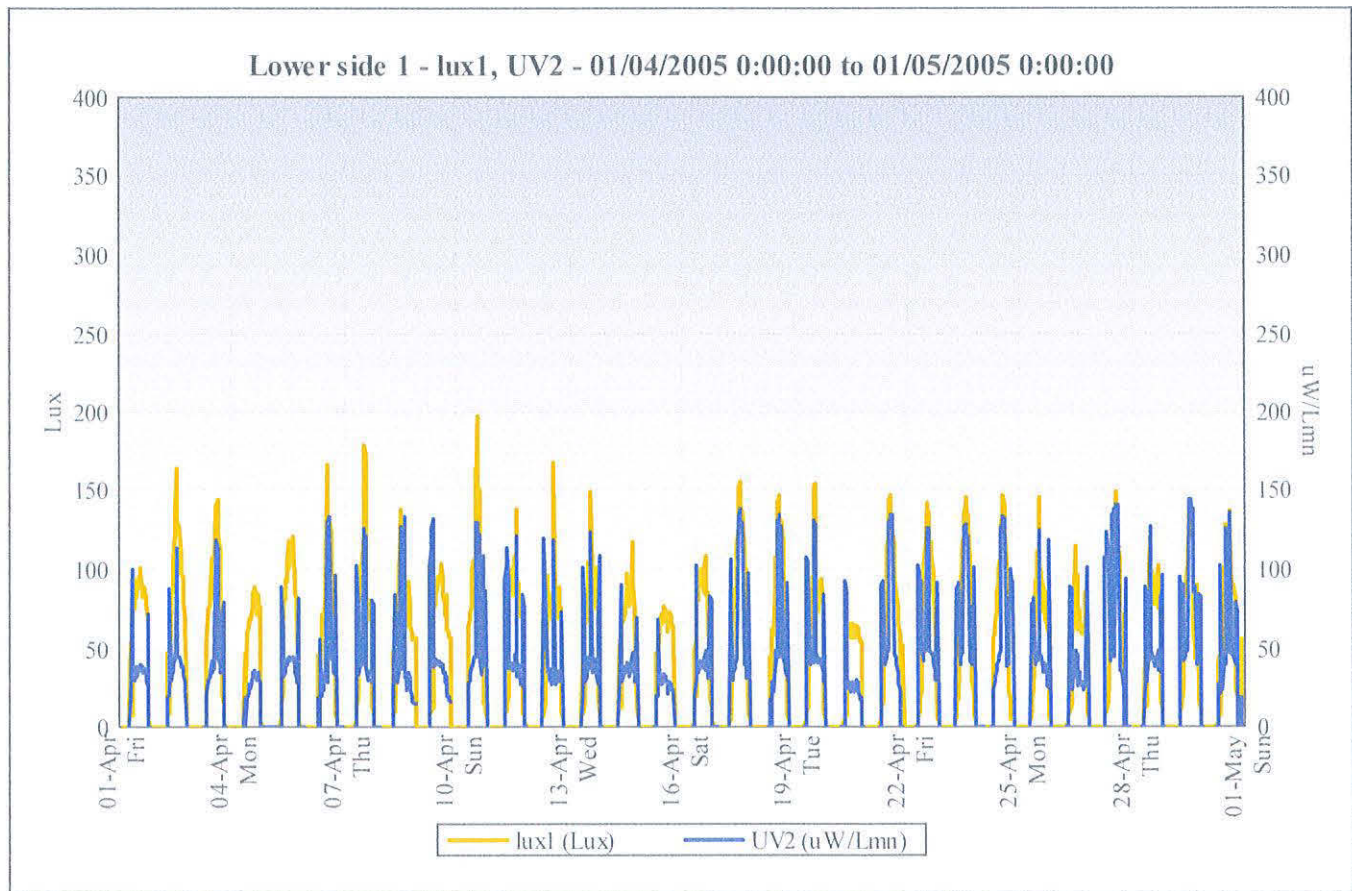
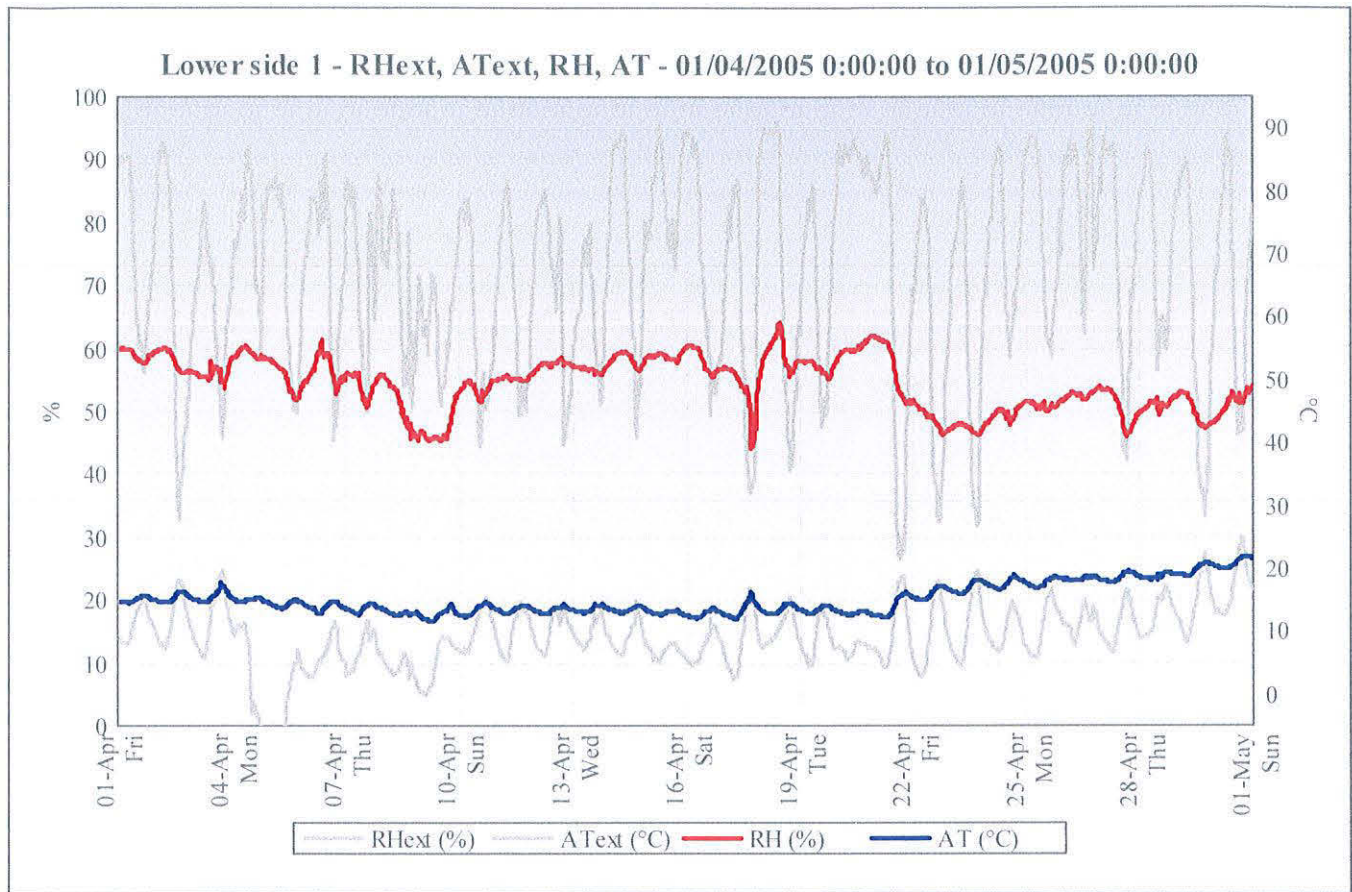
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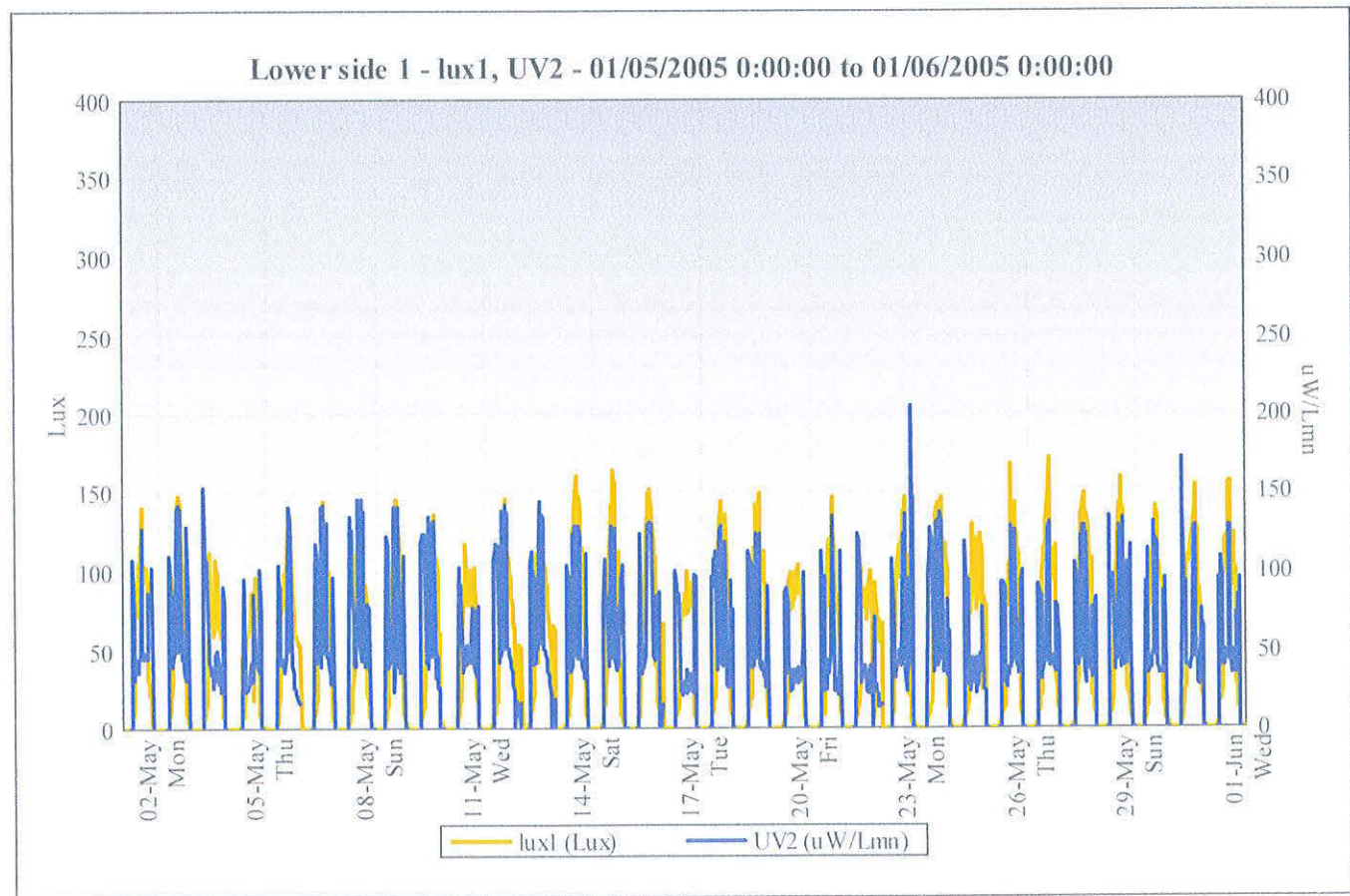
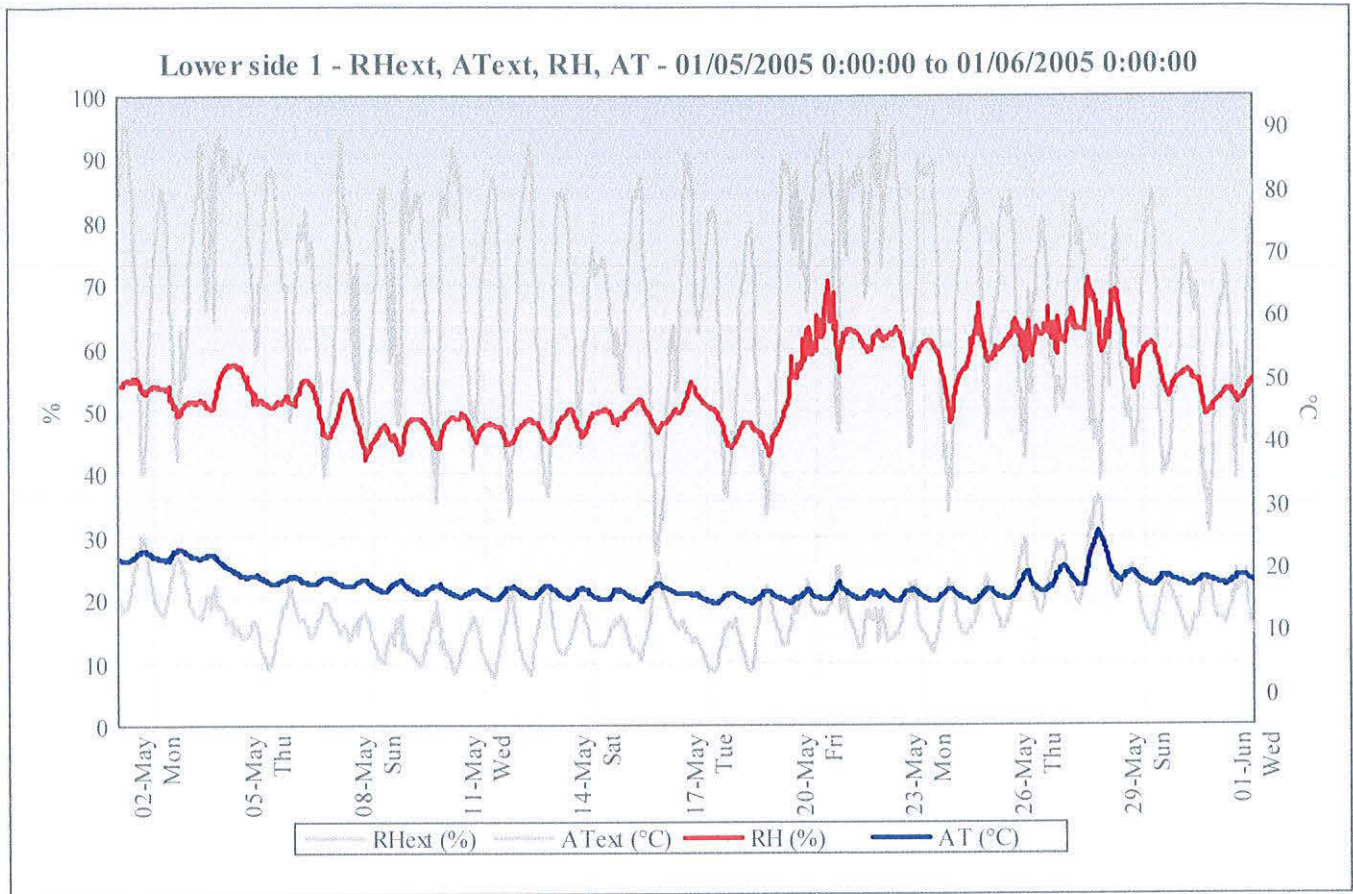
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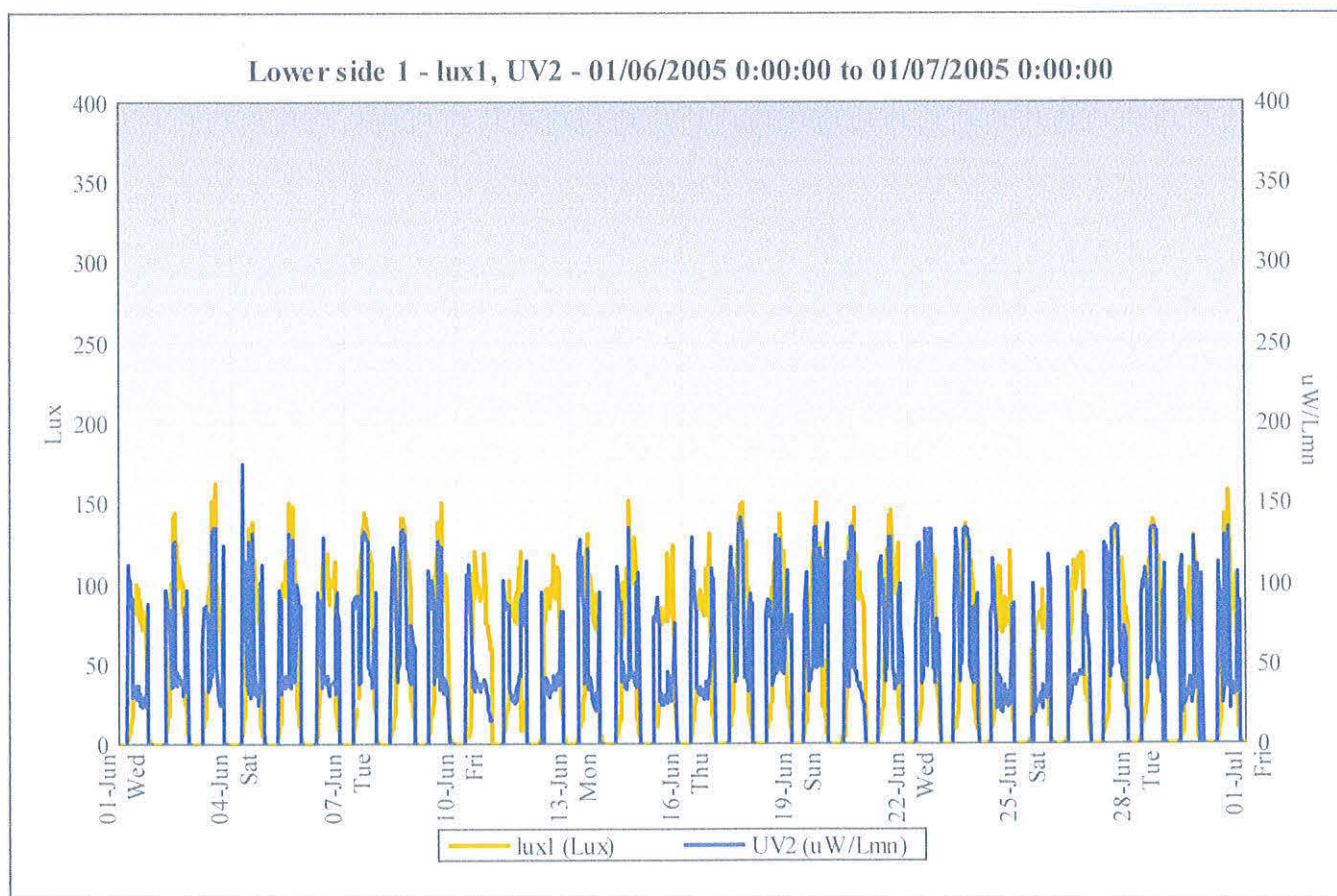
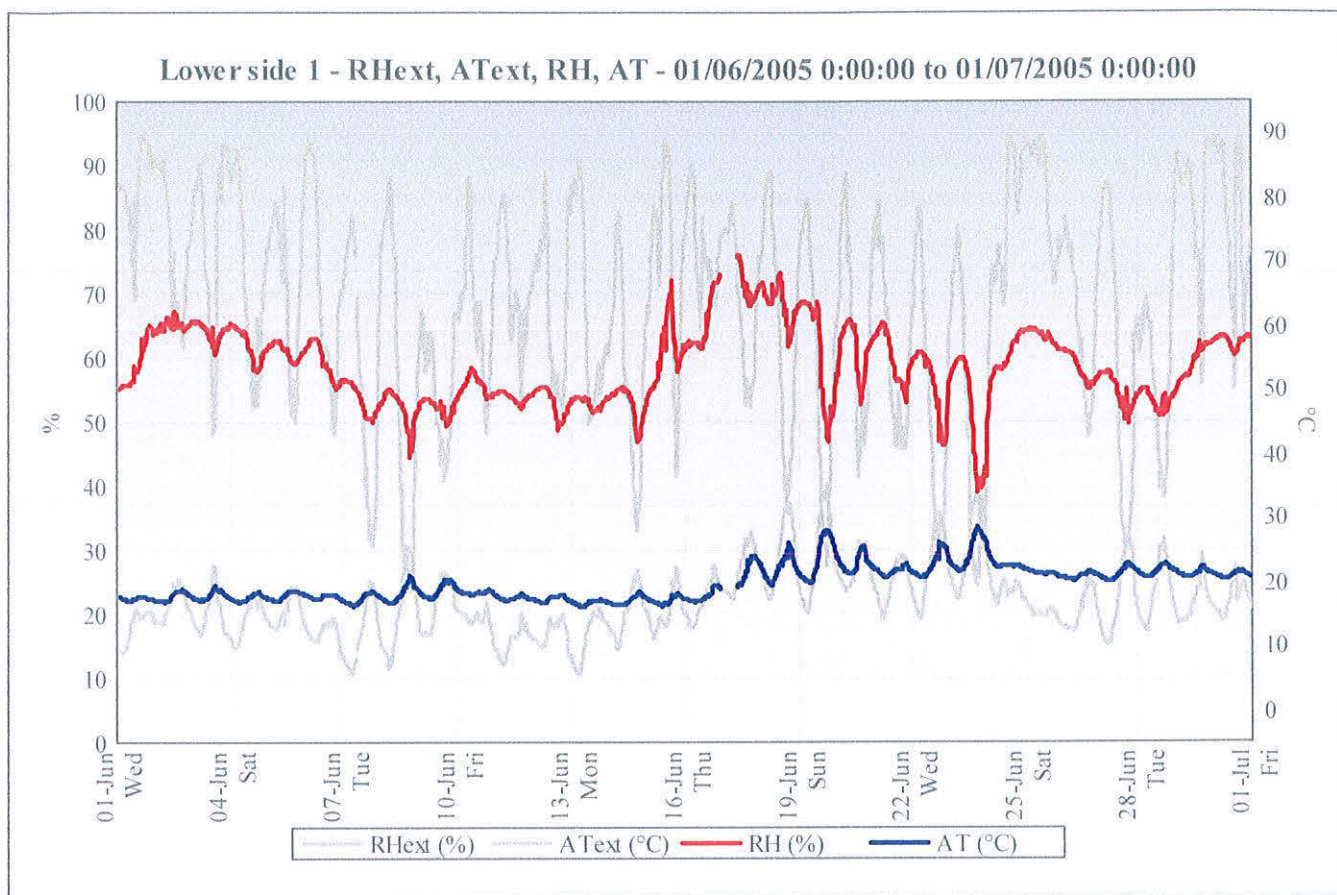
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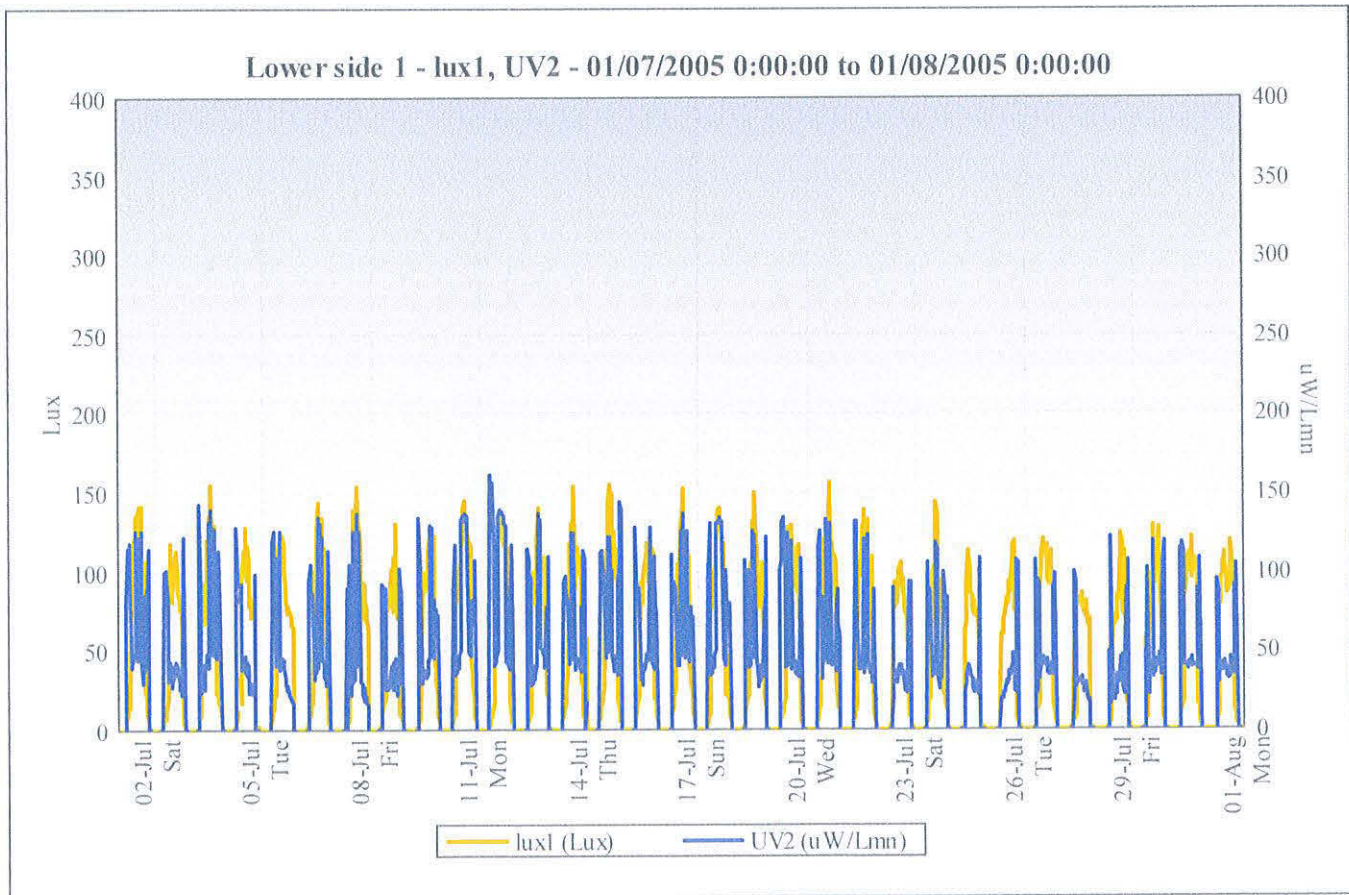
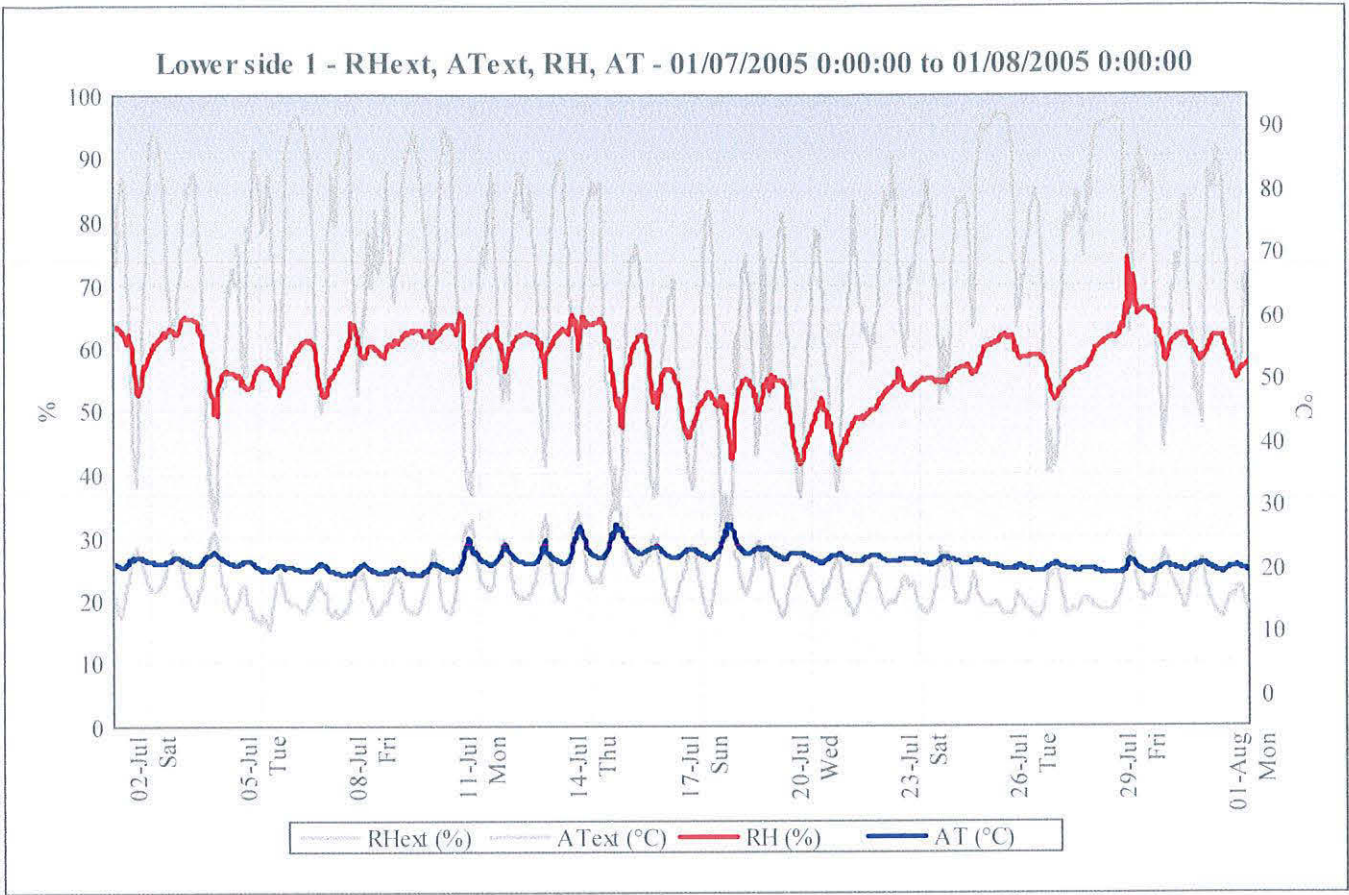
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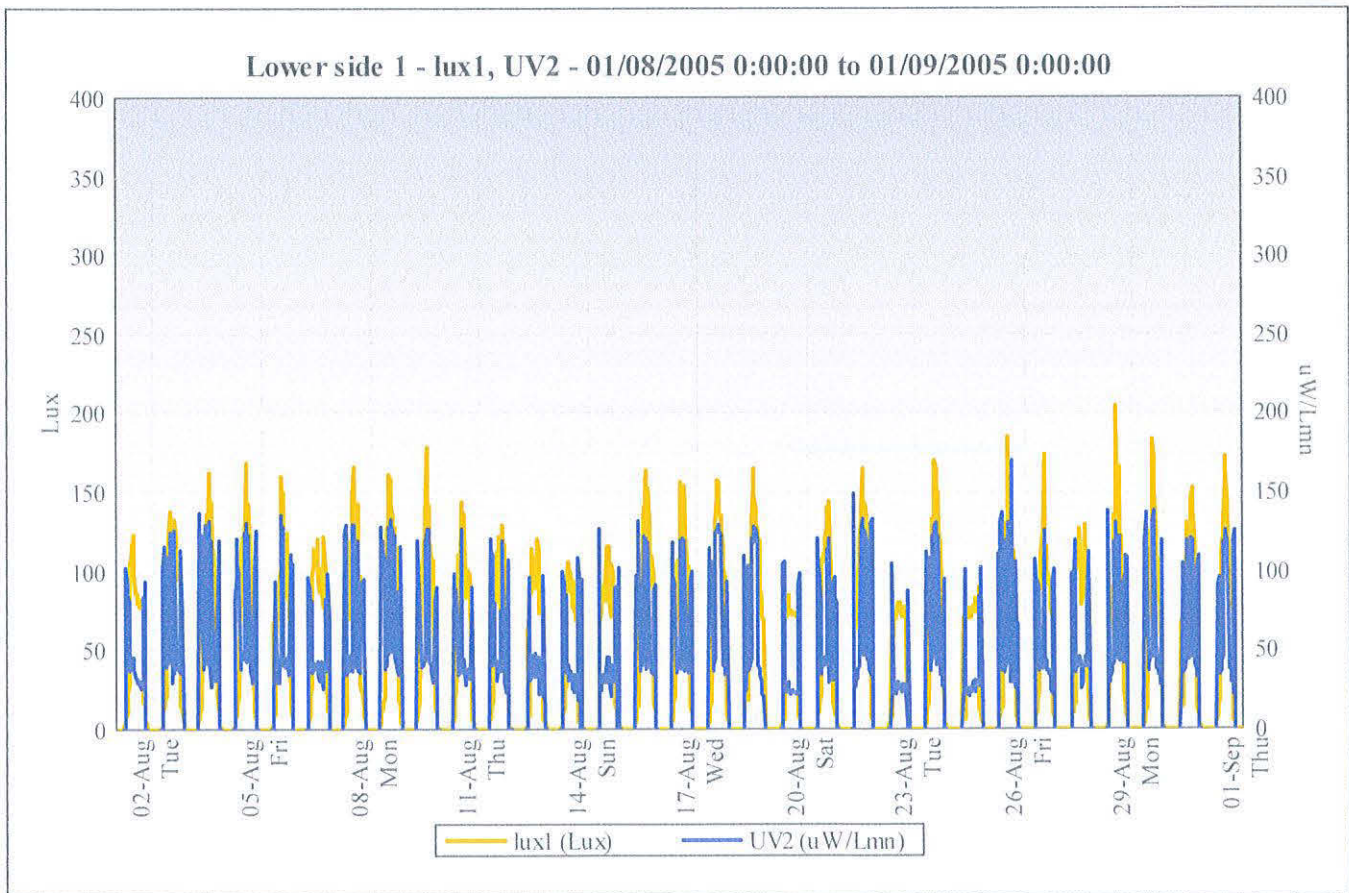
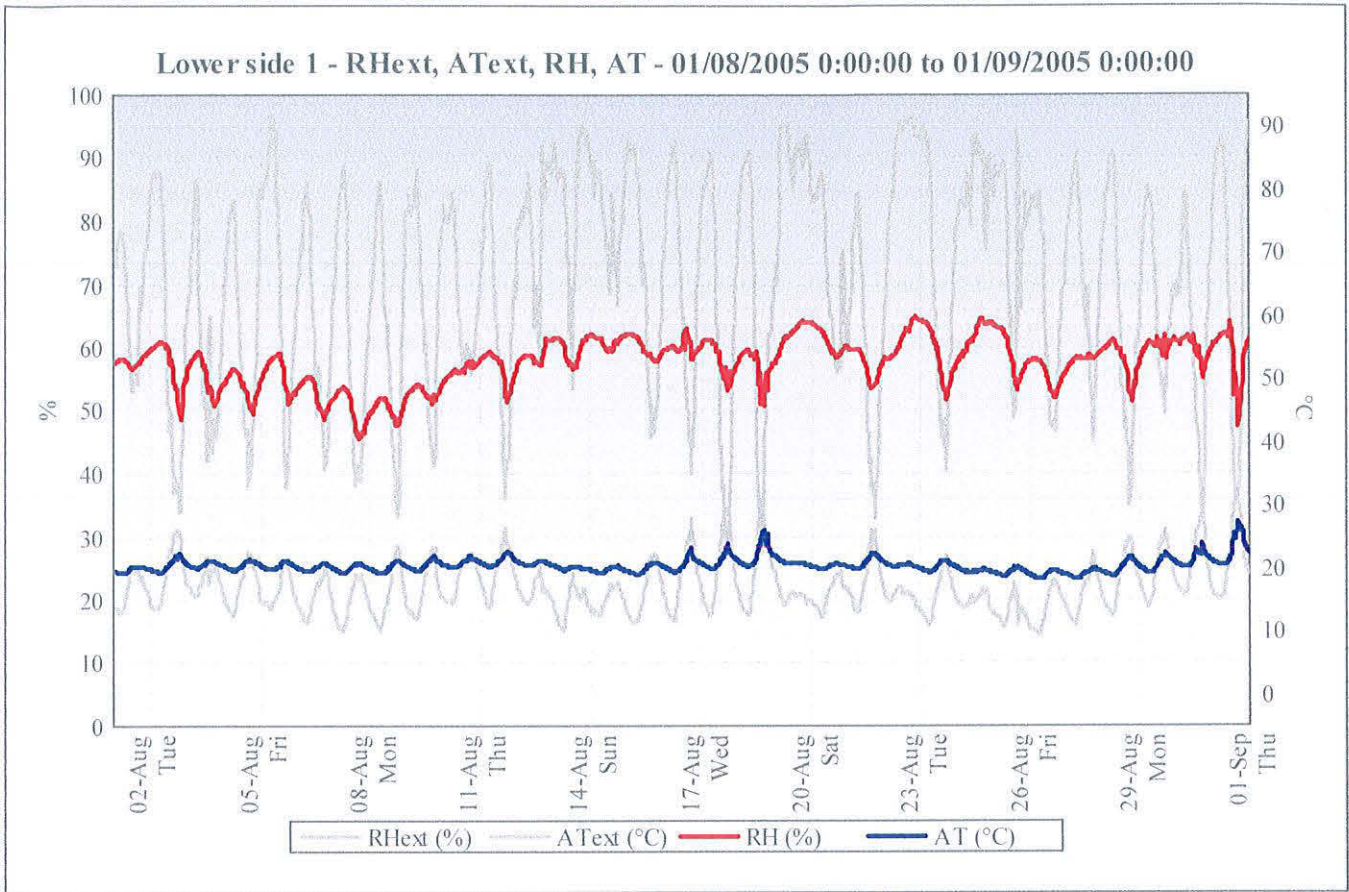
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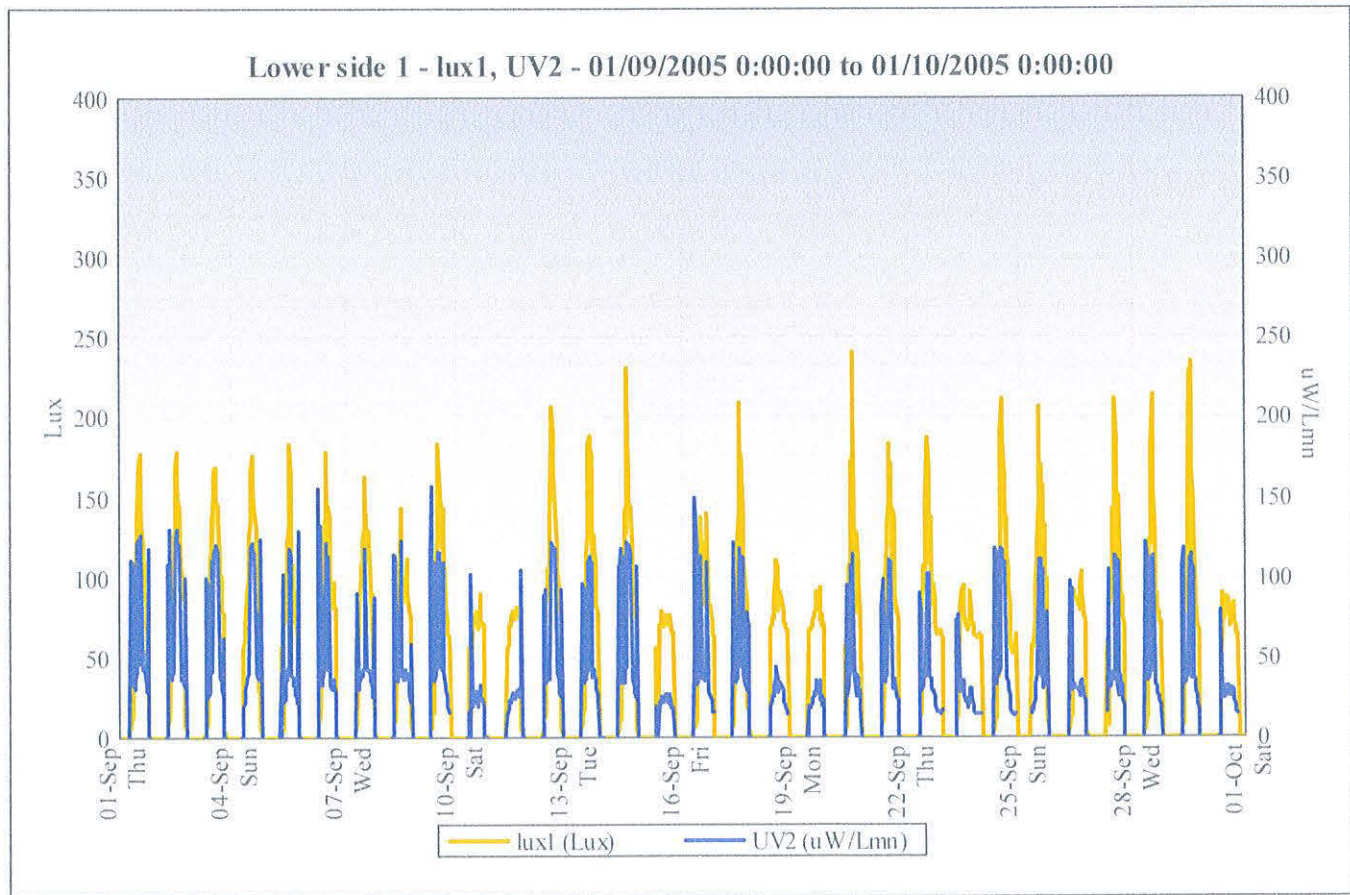
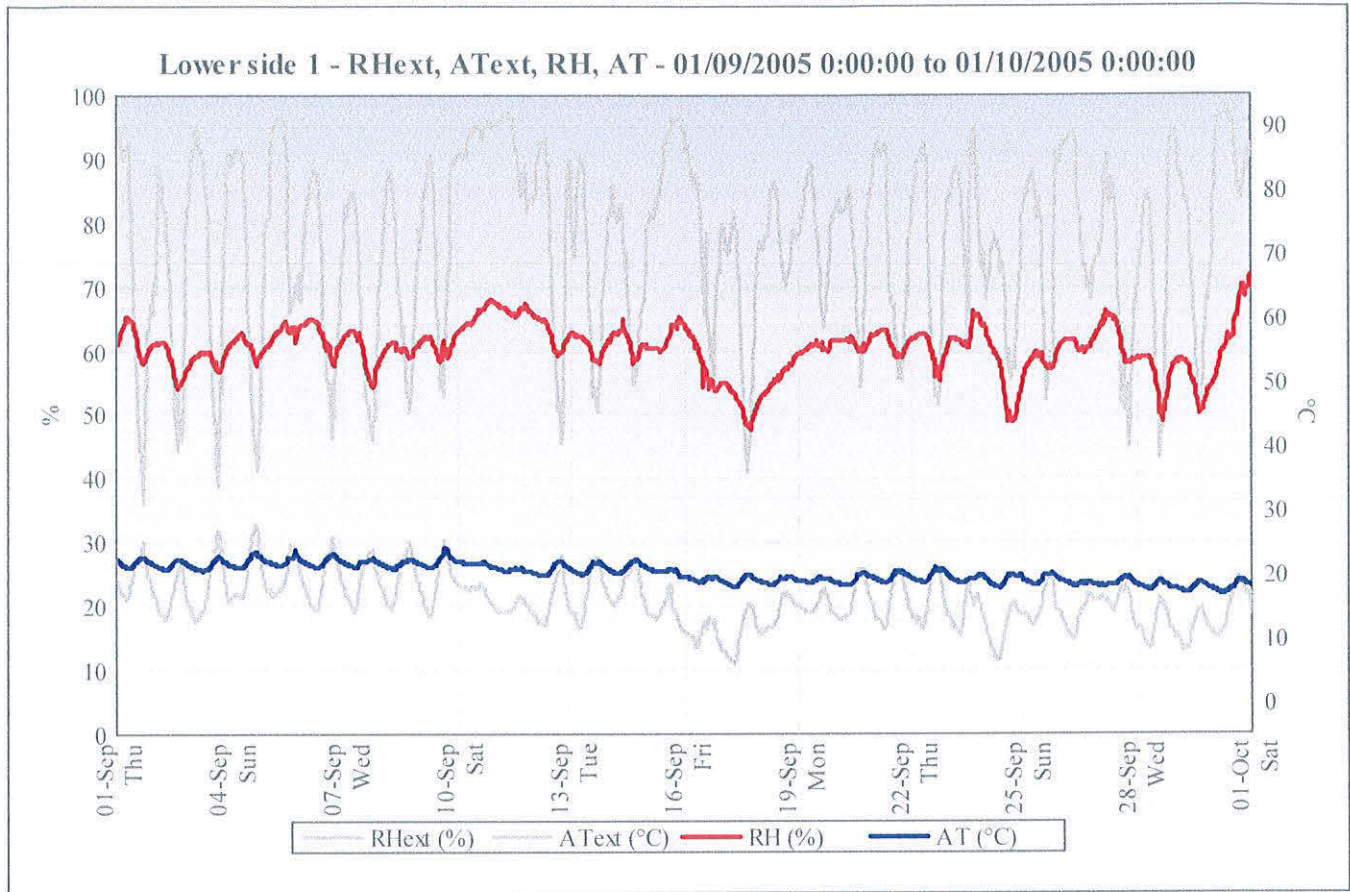
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