FINNISH METEOROLOGICAL INSTITUTE

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EUROPEAN COOPERATION
IN SCIENCE AND TECHNOLOGY

Hands on UV

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EuBrewNet Training School, Tuesday 8, 17:15 -18:00

Quadrennial Ozone Symposium 2016 4–9 September 2016 Edinburgh, United Kingdom

Outline

- 50 W lamp measurement
- How to get the responsivity of your Brewer?
- How to transfer the irradiance scale to your working lamps?
- Steps to make the reponsivity time series

Slides from the presentation of Julian Gröbner, PMOD-WRC, have been used:
http://kippzonen-brewer.com/wp-content/uploads/2014/10/BrewerUV-meas-and-cal_Grobner_17032014.pdf

pmod wrc

Measurement principle for spectral solar UV irradiance

$$I[Wm^{-2}nm^{-1}] = \frac{signal_{SUN}\ [photons \cdot s^{-1}]}{Responsivity\ [photons \cdot s^{-1} \cdot W^{-1} \cdot m^{2} \cdot nm]}$$

The Instrument responsivity is obtained by measuring the response of the instrument to a source with known radiation.

Typically a tungsten-halogen lamp with a calibration certificate

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We assume that the relationship is independent on the level of radiation e.g. the instrument is linear...

- Absolute calibrations: 1000W lamps, 200W, UL or XL routines
- Stability check: 50W and 200W lamps: QL, UL, XL routines

- Instructions for 50W lamp measurements in the Brewer Operator manual MKIII from K&Z.:

e.g., Lamp voltage 12,000 V ± 0.003 V
Warm the lamp around 10 minutes, until the voltage stay stable
Commands: hphg
pdxlhphgpf

In the place of xl can be ul or ql:

xl.rtn : double Brewers, step of 0,5nm/1,5nm ->xl16215.107: raw counts

ul.rtn : single Brewers, steps of 0,5/1,5nm-> ul16215.037:raw counts

ql.rtn: double/single Brewers, at 24/12 wavelengths->QL_d24.107: corrected intensities

Raw XL/UL data: scan of the lamp

```
Integration time is 0.2294 seconds per cycle
dt  2.7E-08
cy 1
le  158
ln 968
di  5
dh
15
03
16
Sodankyla
 67.3675
-26.633
 3.233369
pr
990DARK
 .125
 366.64
 2865
 98
 1042.03
 366.78
 2870
 164
 1074.9
 366.91
 2875
 229
```

XLJJJYY.nnn - Extended Lamp Scan

#	Example	Name
1	Integration time is 0.2294 seconds per cycle	Integration time
2	dt 3.4E-08	dead time
3	cy 1	number of slit mask cycles
4	le 154	Increments in the 290-325 nm region
5	ln 608	lamp serial number
6	di 5	distance between filament and PTFE diffuser
7	dh	data header
8	15	Day
9	01	Month
10	99	Year
11	Saskatoon	Location
12	52.108	Latitude
13	106.713	Longitude
14	3.43	PMT temperature (Volts)
15	pr	Pressure header
16	960 Dark	Pressure (milli bars) and Dark Count Header
17	1	dark count
18	960.8	decimal minutes since 00:00 hours
19	2865	Wavelength (Angstrom)
20	256	micrometer step number
21	121.1	raw counts
22		lines 18-21 repeat for wavelengths from 2865A to 3630A in 5A increments
...		
633	end	end of measurement

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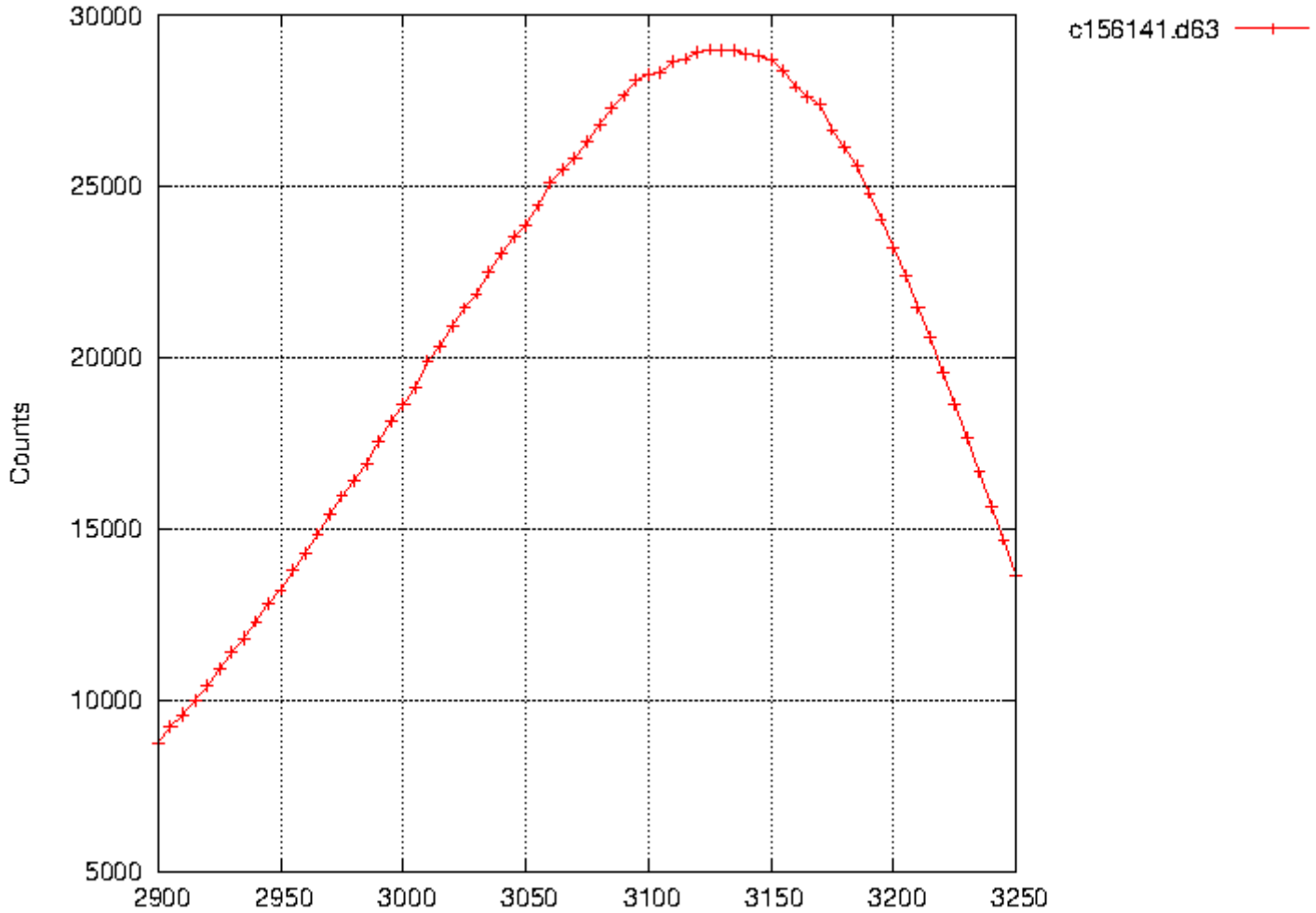
Example of corrected (dark counts & dead time) counts from Ulfiles



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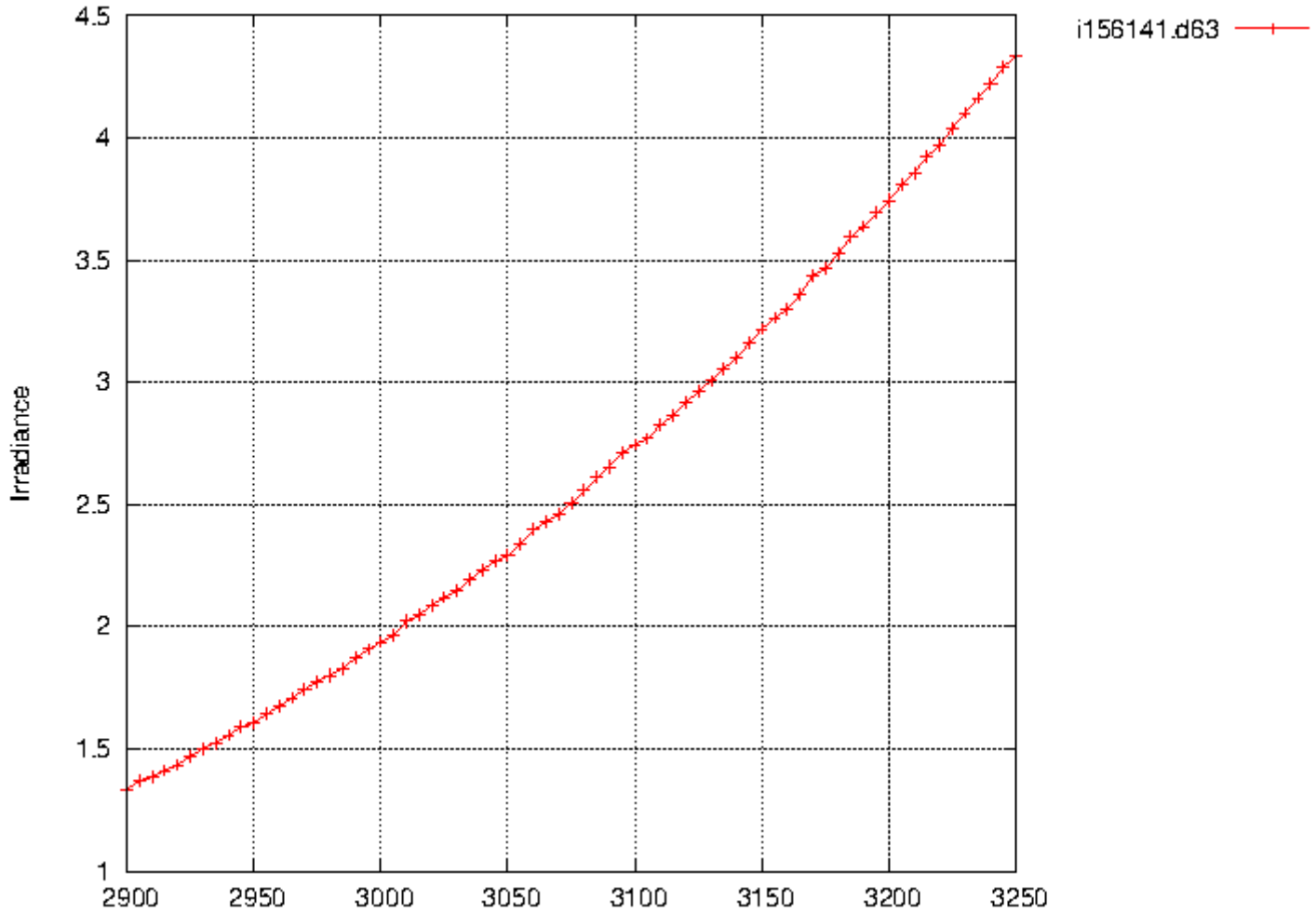
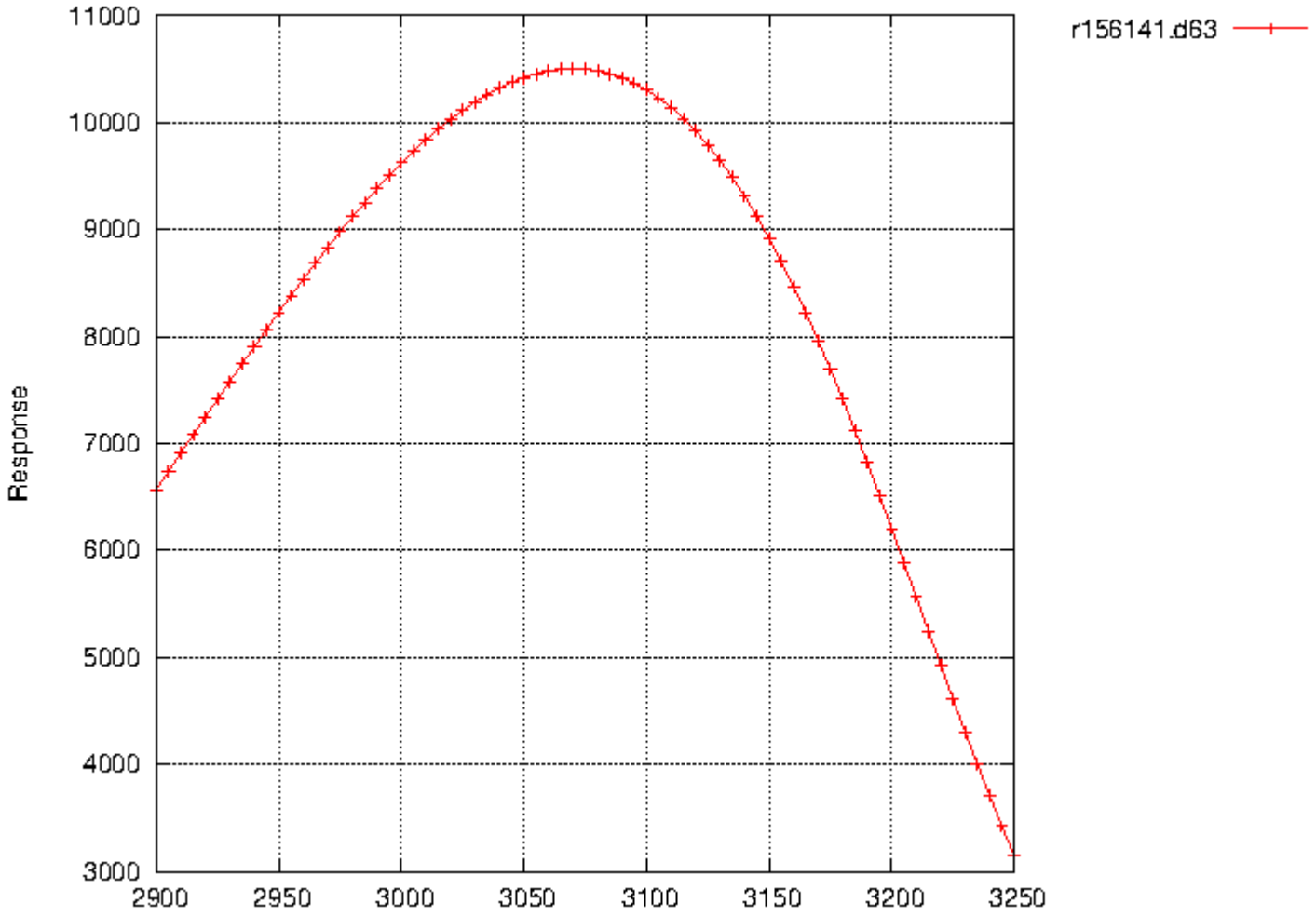
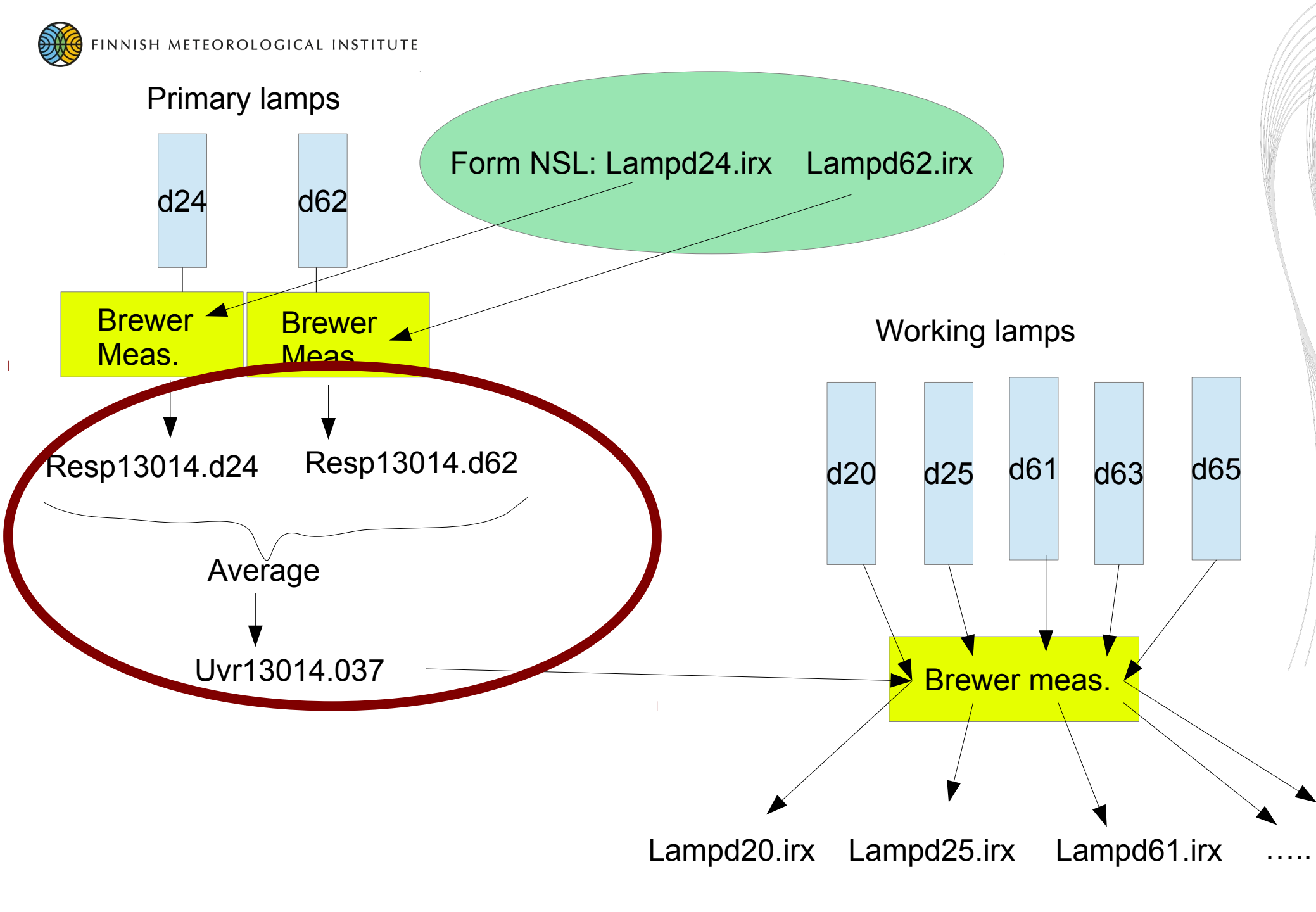
Example of known irradiance of the lamp d63

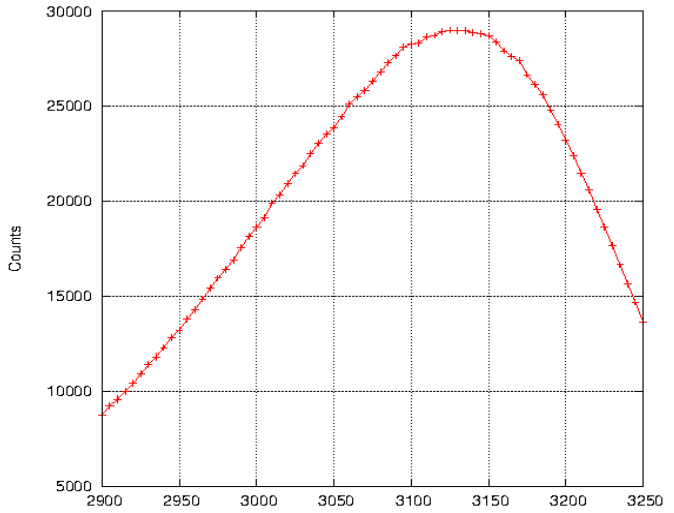


Example of obtained responsivity of the Brewer with the lamp d63




Primary lamps
d24
d62
Form NSL: Lampd24.irx
Lampd62.irx
Brewer Meas.
Brewer Meas
Working lamps
Resp13014.d24
Resp13014.d62
d20
d25
d61
d63
d65
Average
Uvr13014.037
Brewer meas.
Lampd20.irx
Lampd25.irx
Lampd61.irx
.....

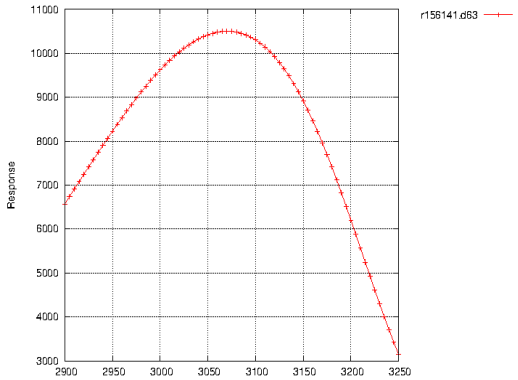
Responsivity= Lamp signal / Lamp irradiance



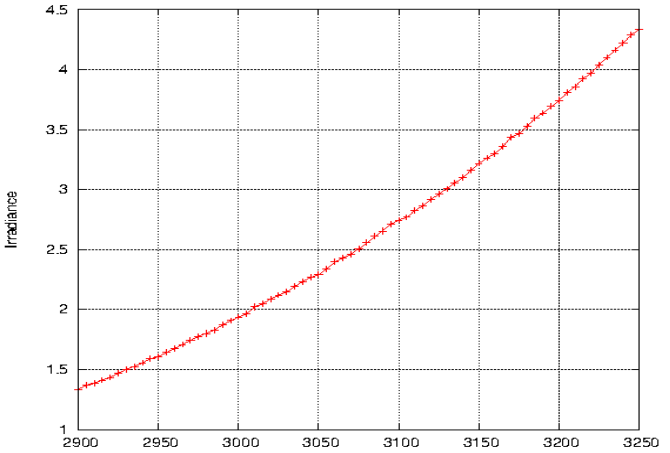
XI13014.d24
XI13014.d62

Responsivity ?

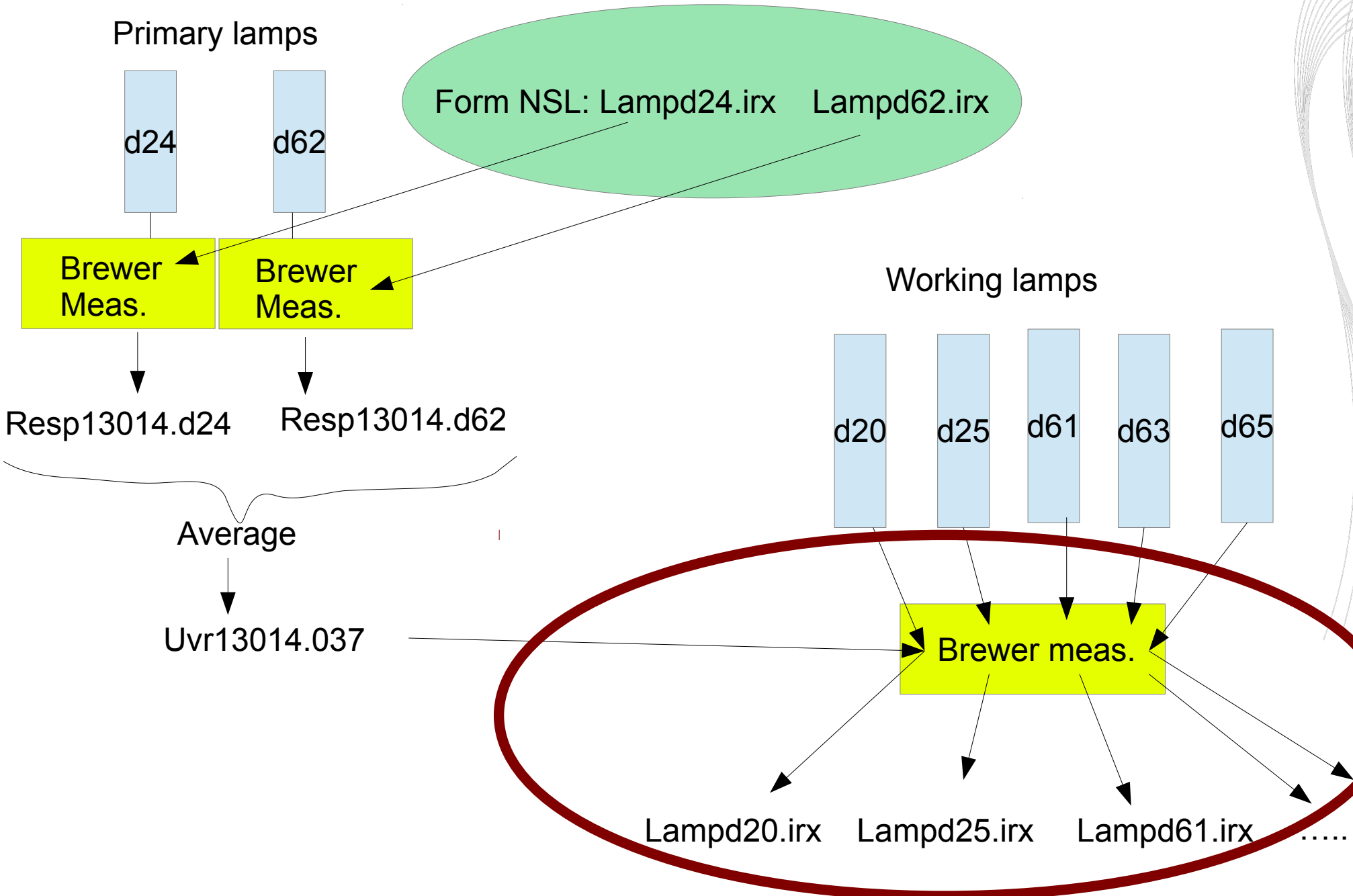
=



resp13014.d24
resp13014.d62



Lampd24.irx
Lampd62.irx


Primary lamps
d24
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Form NSL: Lampd24.irx
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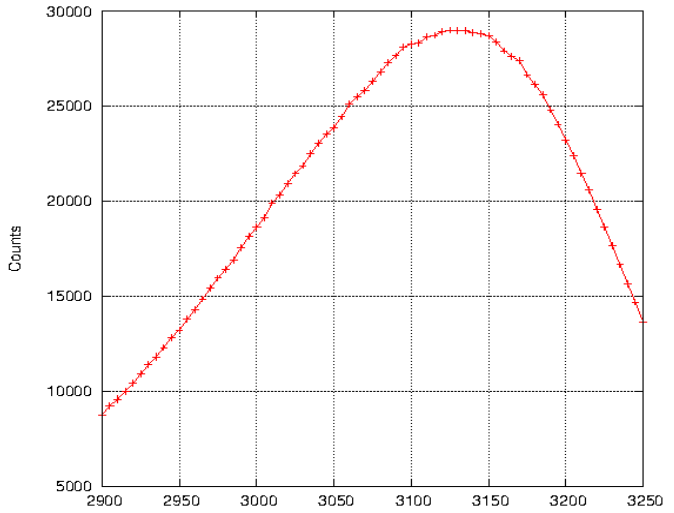
Irradiance= Lamp signal / Responsivity

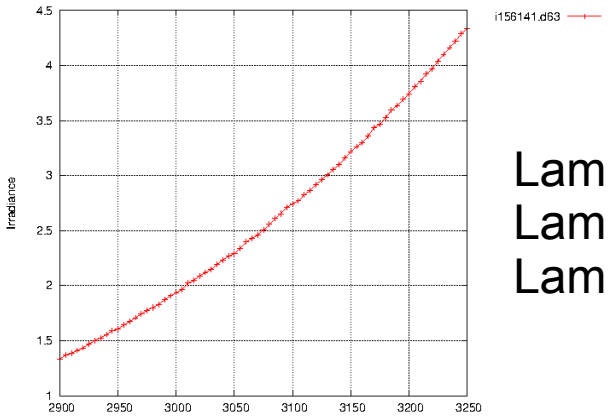


XI13014.d20
XI13014.d25
XI13014.d61

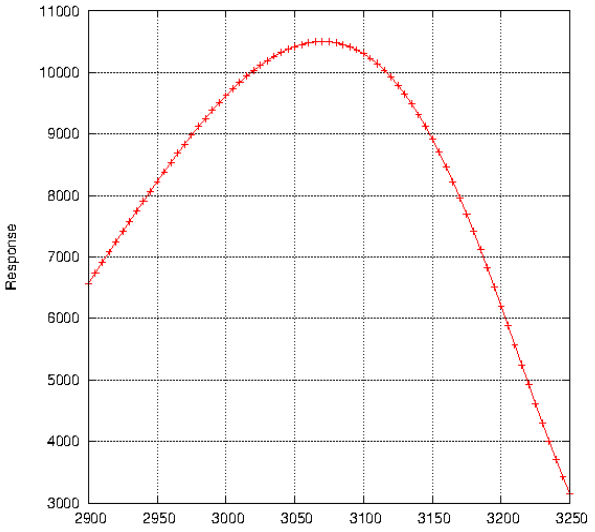
Irradiance of working lamps

=

=



Lampd20.irx
Lampd25.irx
Lampd61.irx



Uvr13014.037
=average of
Resp13014.d24
And
Resp13014.d62

Responsivity time series

Now that I have an irradiance file LampXXX.irx for each lamp:
Primary lamps and working lamps,

I can calculate the responsivity measured using every lamp:

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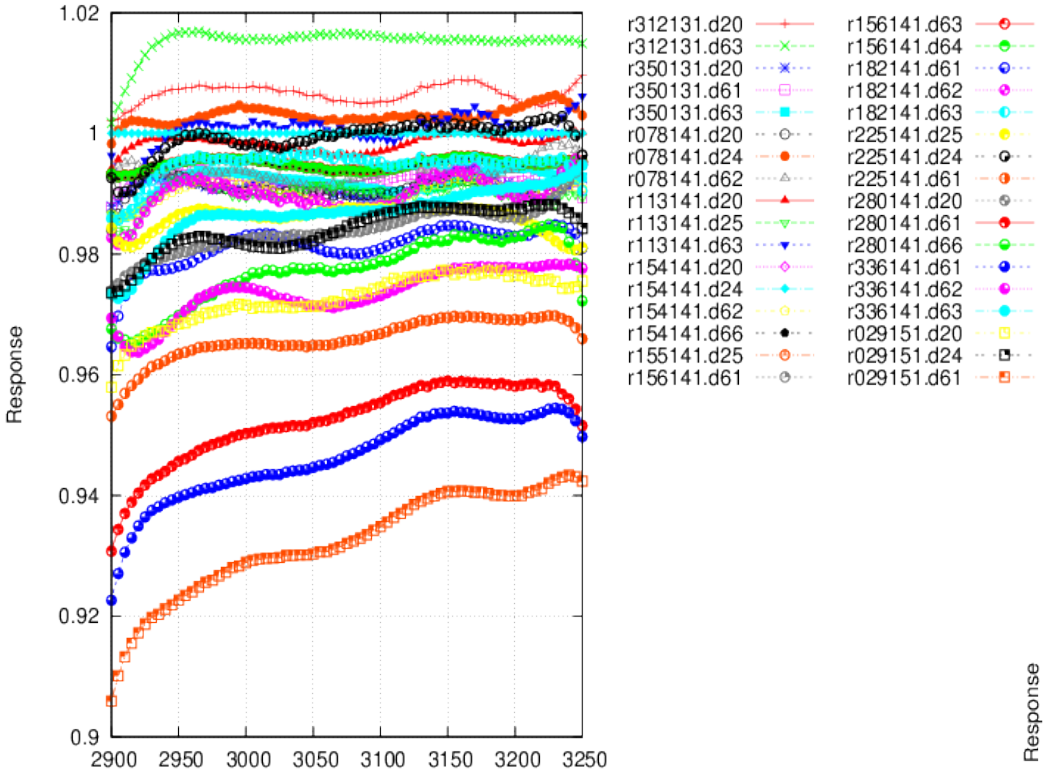
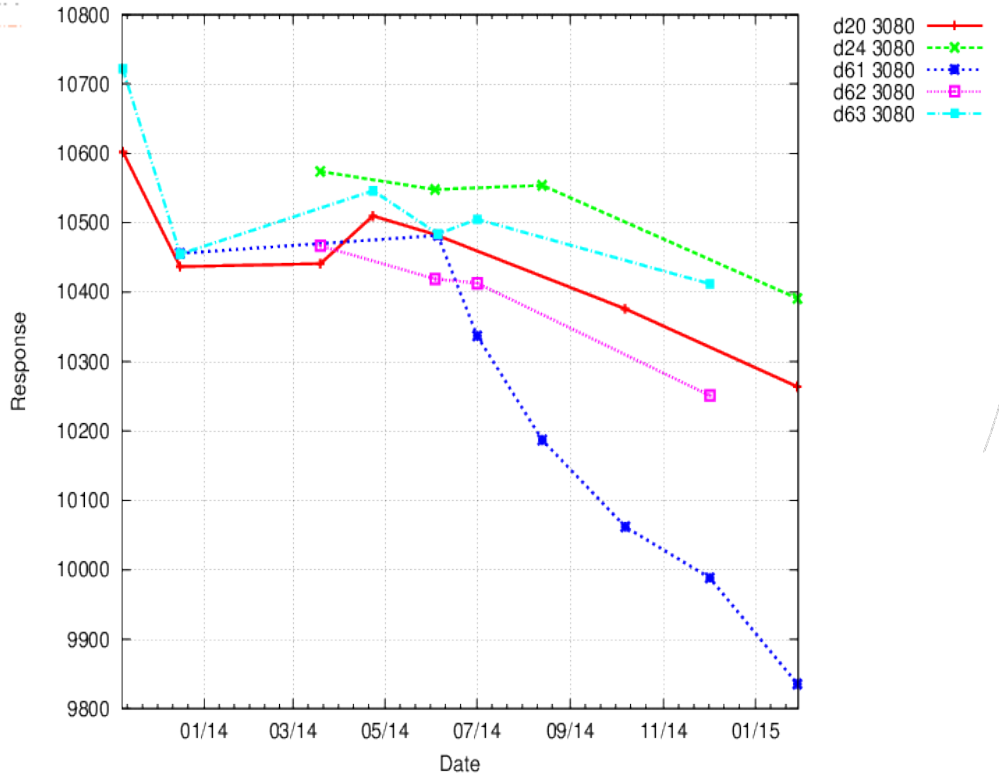
Responsivity time series

1. Calculate the individual responses with each lamp.



308 nm



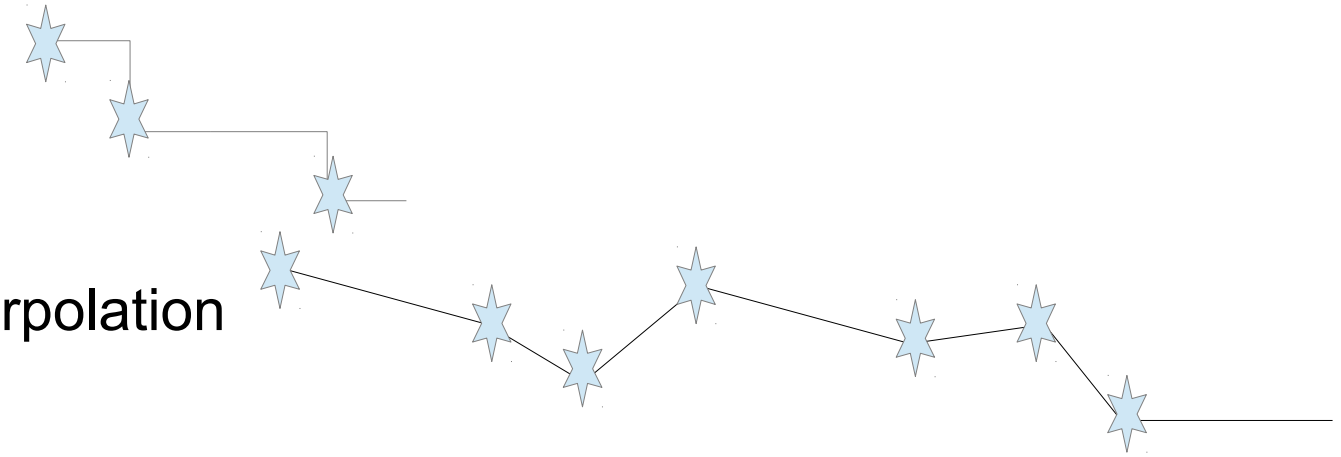
2. Choose good measurements

Daily responsivity

1. Stepwise

Or

2. Linear interpolation



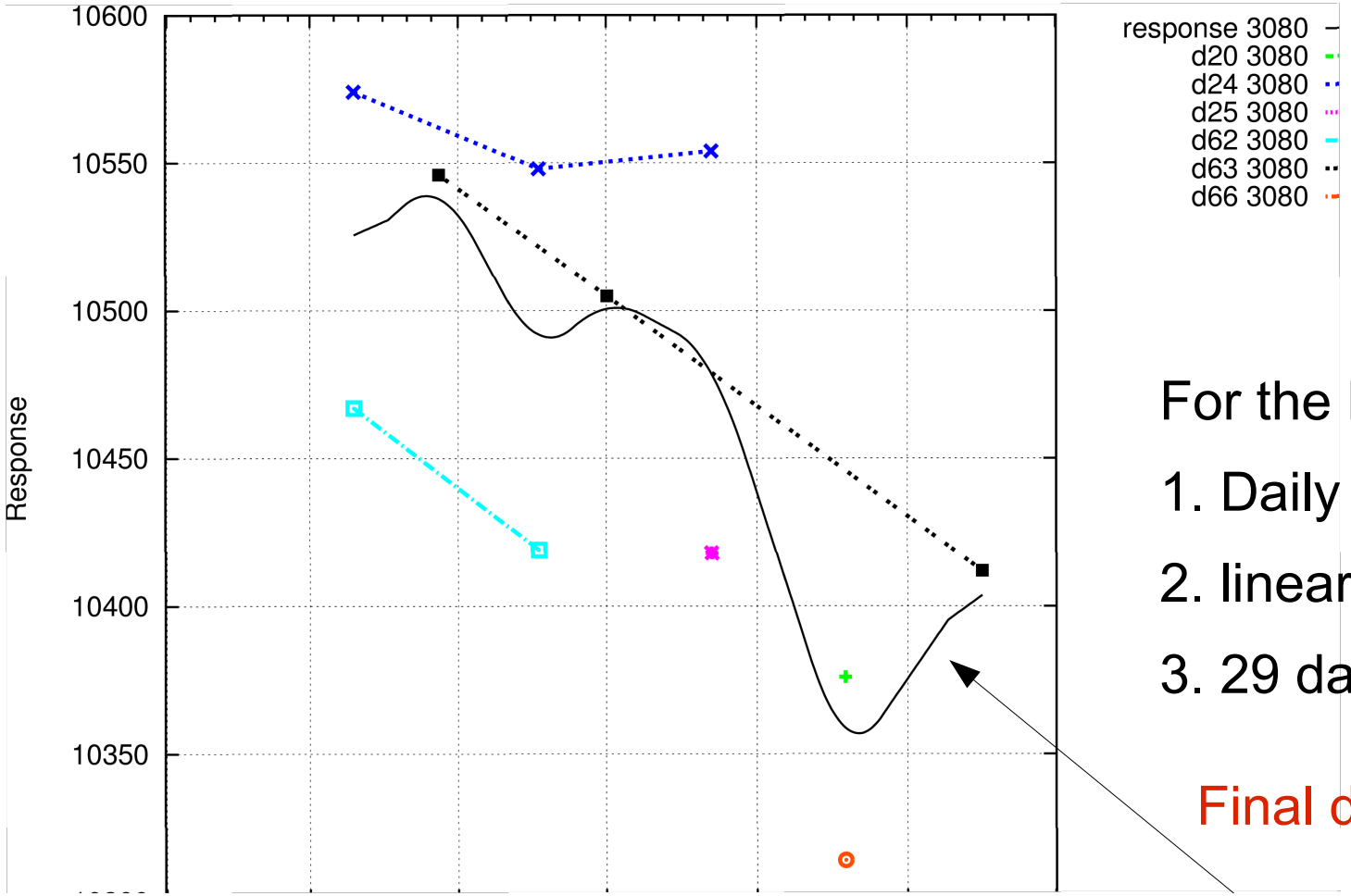
If you choose the linear interpolation:

Once you have only the good measurements left, you have to either

a) make daily average first and then a linear interpolation

Or

b) Make a linear interpolation and then calculate the daily average

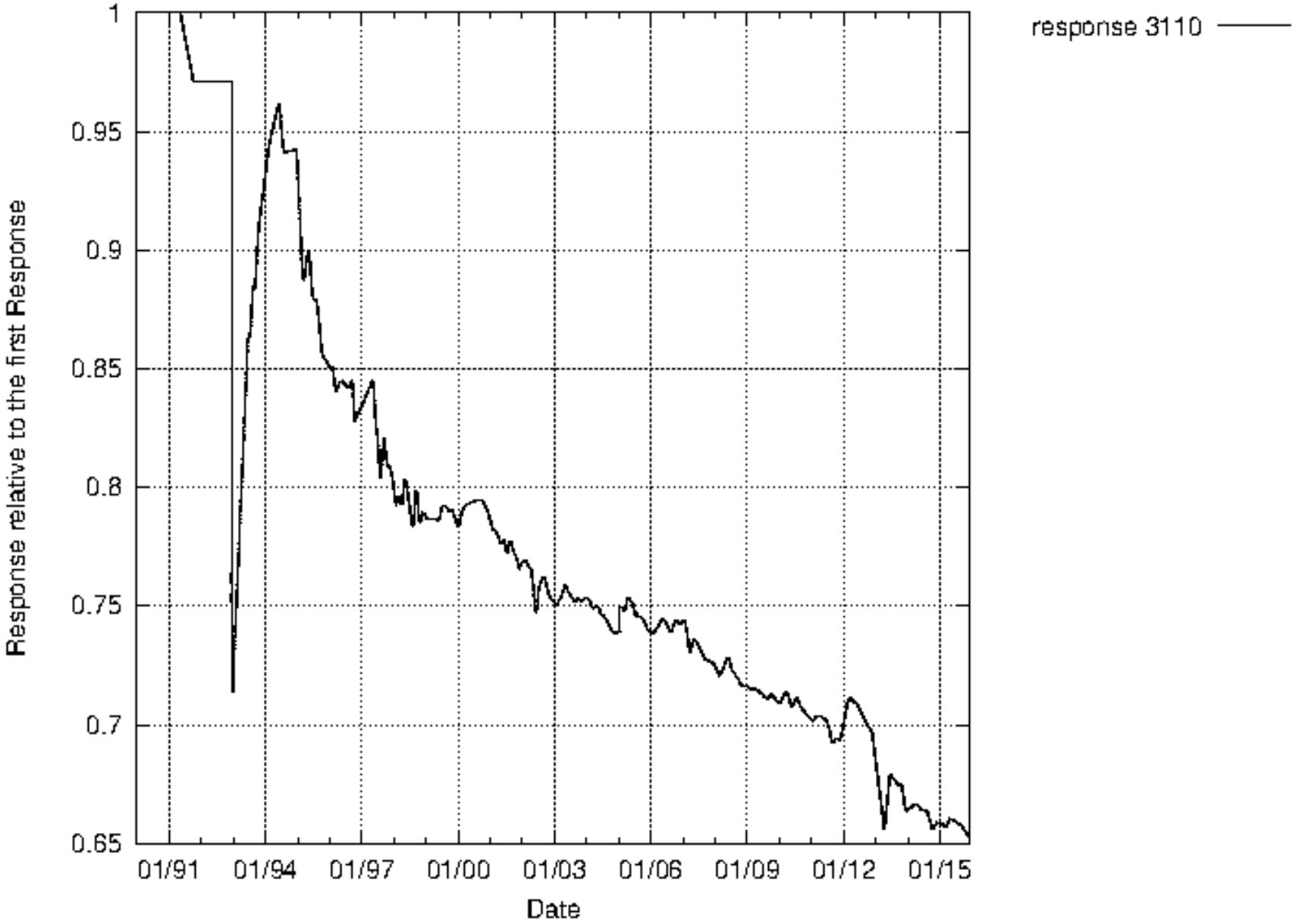


For the Brewer#037:

1. Daily average
2. linear interpolation
3. 29 day moving average

Final daily responsivity

Response time series of the Brewer#037 at 311 nm 1990-2015



Litterature

Heikkilä, A., Lakkala, K., Mäkelä, J.S., Meinander, O., Kaurola, J., Koskela, T., Karhu, J. M., Karppinen, T., Kyrö, E., de Leeuw, G: In search of traceability: two decades of calibrated Brewer UV measurements in Sodankylä and Jokioinen, Geosci. Instrum. Method. Data Syst. Discuss., doi:10.5194/gi-2015-40, in review, 2016.

Lakkala, K., Suokanerva, H., Karhu, J. M., Aarva, A., Poikonen, A., Karppinen, T., Ahponen, M., Hannula, H.-R., Kontu, A., and Kyrö, E.: Optical laboratory facilities at the Finnish Meteorological Institute – Arctic Research Centre, Geosci. Instrum. Method. Data Syst., 5, 315-320, doi:10.5194/gi-5-315-2016, 2016.

Webb, A., Gardiner, B., Martin, T., Leszcynski, K., Metzdorf, J.,and Mohnen, V.: Guidelines for Site Quality Control of UV Mon-itoring, Global Atmosphere Watch Report No. 126, World Meteorological Organization (WMO), Geneva, 39 pp., 1998.

Webb, A., Gardiner, B., Leszczynski, K., Mohnen, V., Johnston, P.,Harrison, N., and Bigelow, D.: Quality Assurance in Monitoring Solar Ultraviolet Radiation: the State of the Art, Global Atmosphere Watch Report No. 146, World Meteorological Organization (WMO), Geneva, 45 pp., 2003.

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