

Alasdair Mac Arthur

GeoSciences, U. of Edinburgh

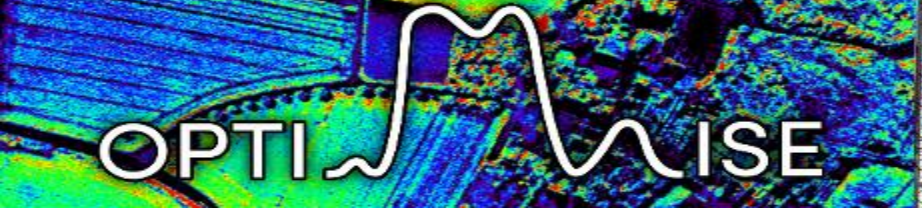
Field spectrometer calibration and characterisation standards

- Uncertainties and errors are associated with all physical measurement
- “spectroradiometric measurements are the least reliable of all physical measurements” Kostkowski, (1997)
- Kostkowski primarily discussing radiometric calibration (radiance ( $\text{W}\cdot\text{sr}^{-1}\cdot\text{m}^{-2}\cdot\text{nm}^{-1}$ ))



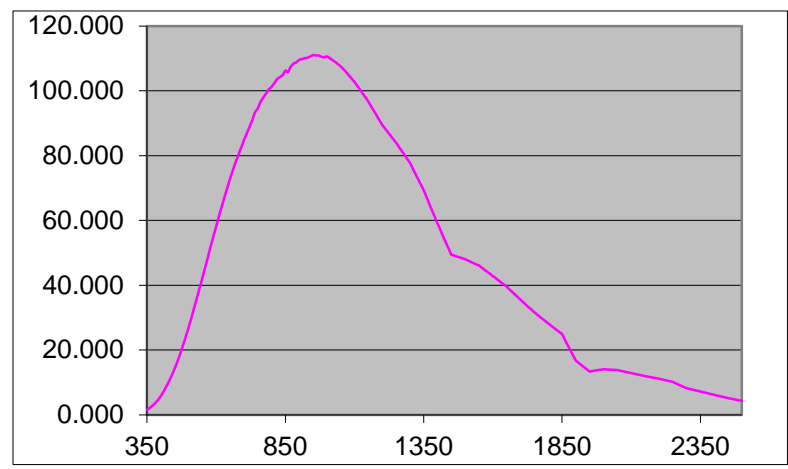
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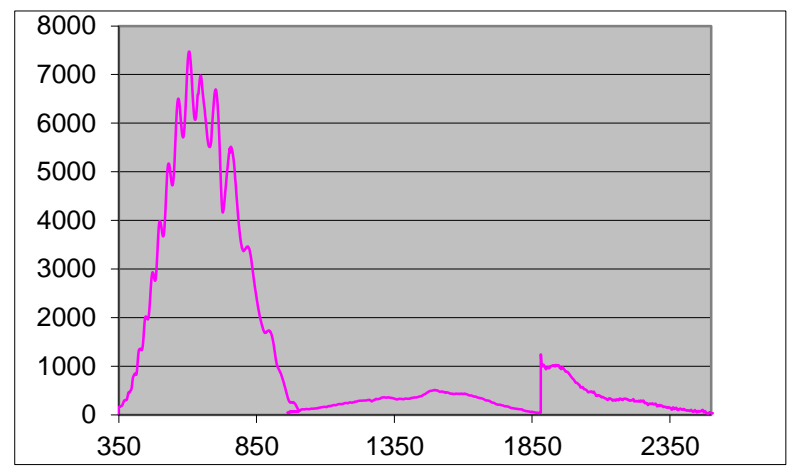


Calibration process:

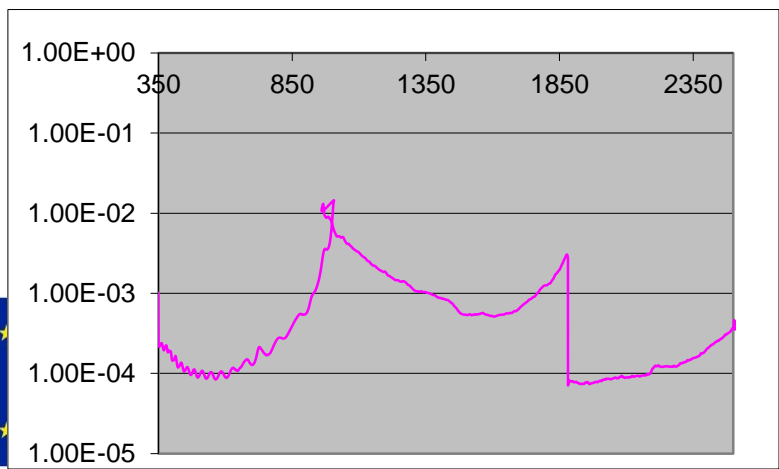
Calibration Lamp



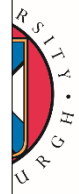
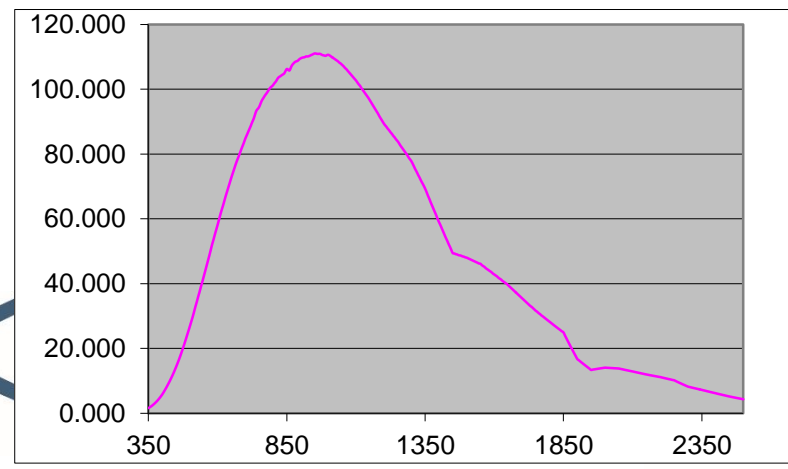
Raw DN Data

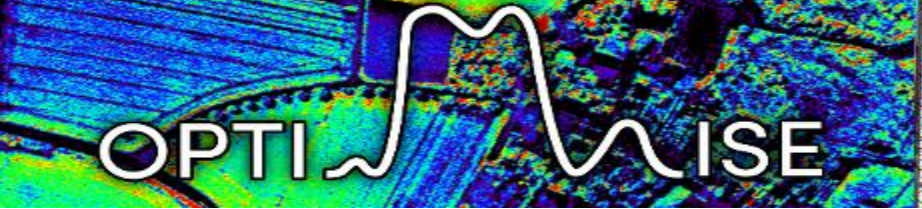


Radiance Calibration File

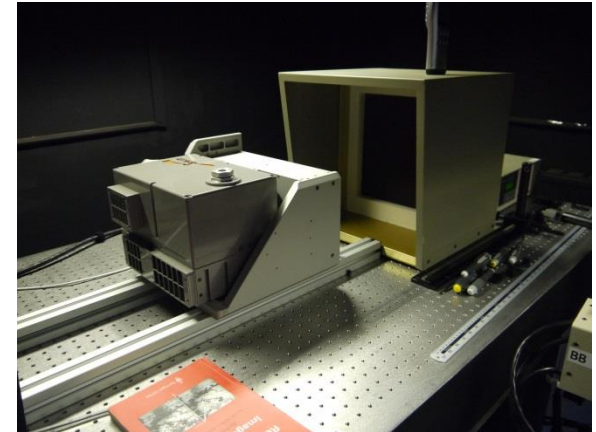
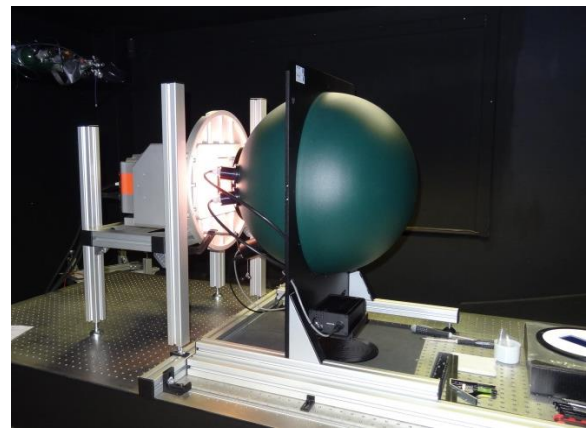
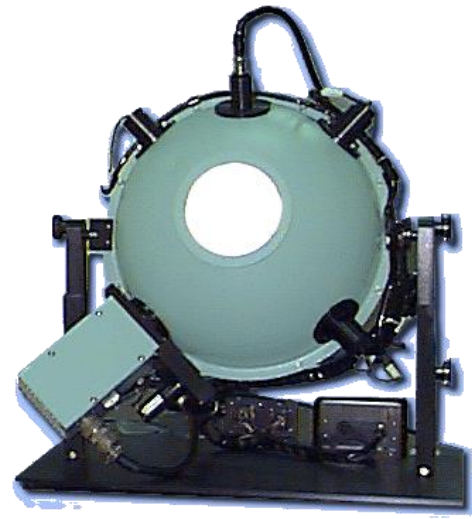


Spectral Radiance





Calibration process:



Radiance sources

Black body



Irradiance source



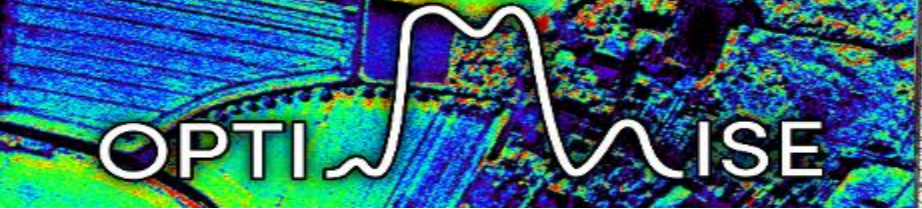
Monochromator

Plus selection of line lamps

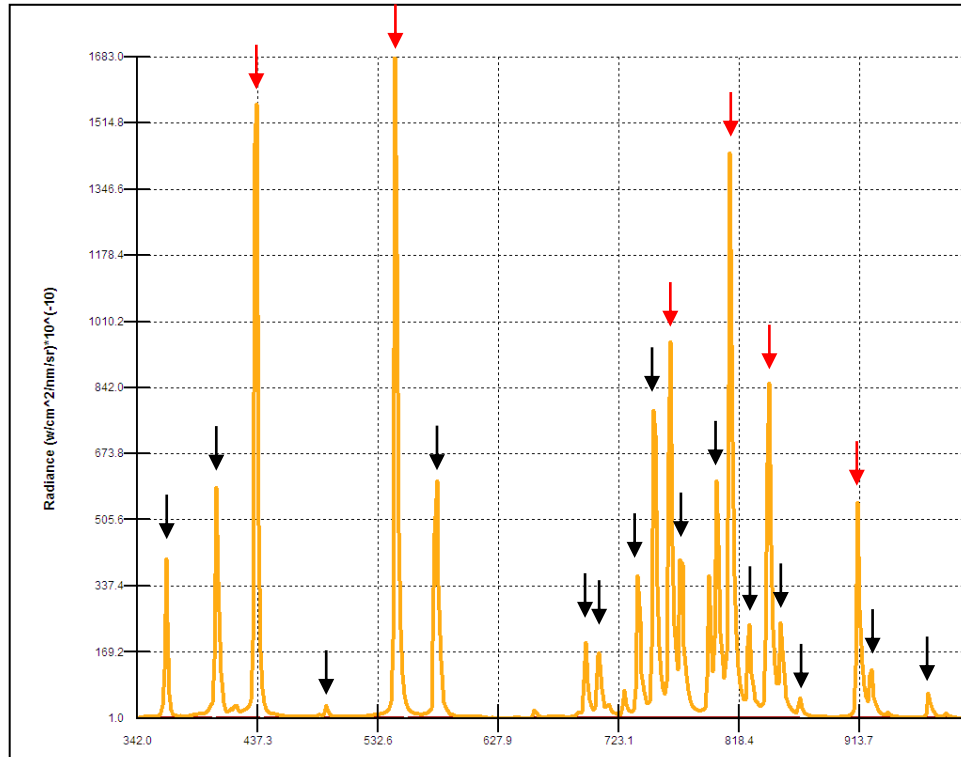
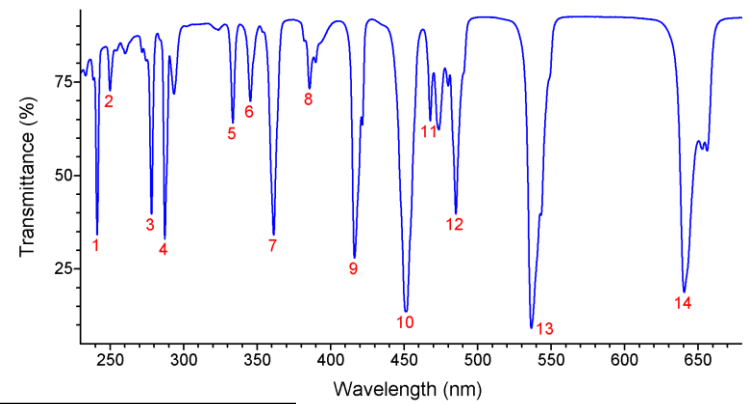


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- Erbium and holmium oxide panels
- Line lamps (mercury, argon, sodium, etc)
- ...



**Major Peaks**

Mercury Emission Lines

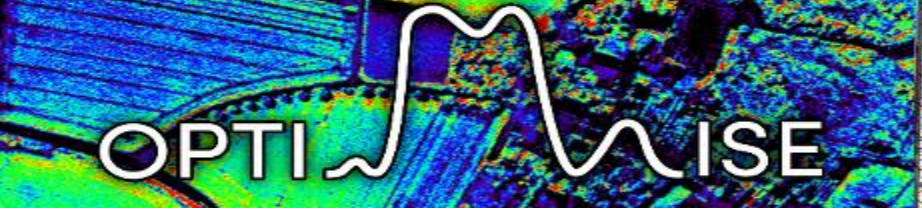
|         |          |
|---------|----------|
| 365.0nm | 491.6nm  |
| 404.7nm | 546.1nm  |
| 435.8nm | 578.1nm* |

Argon Emission Lines

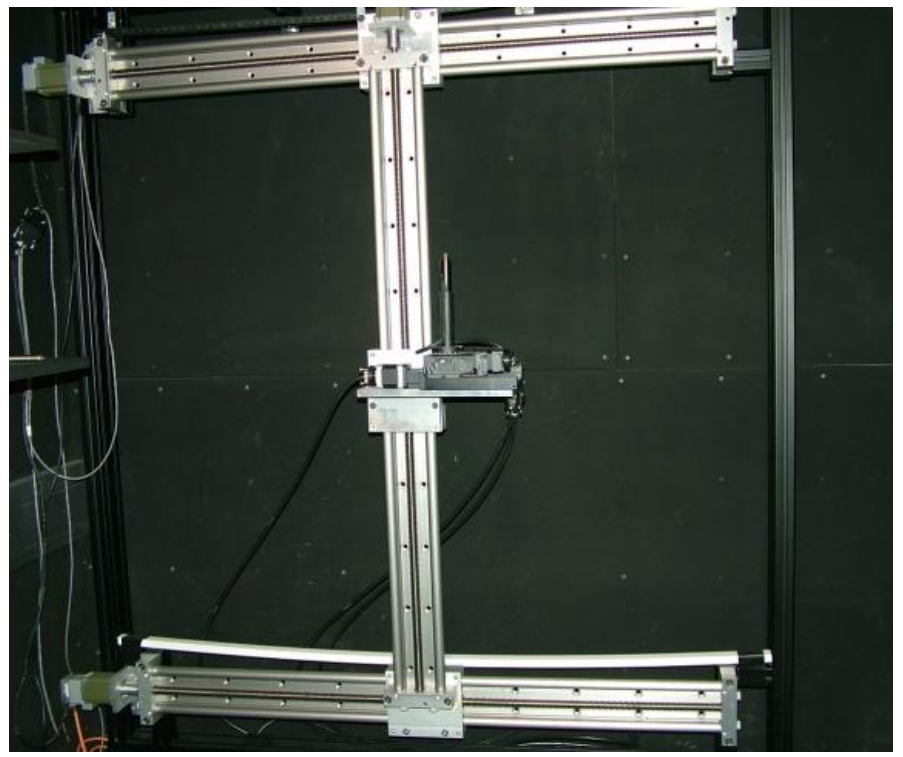
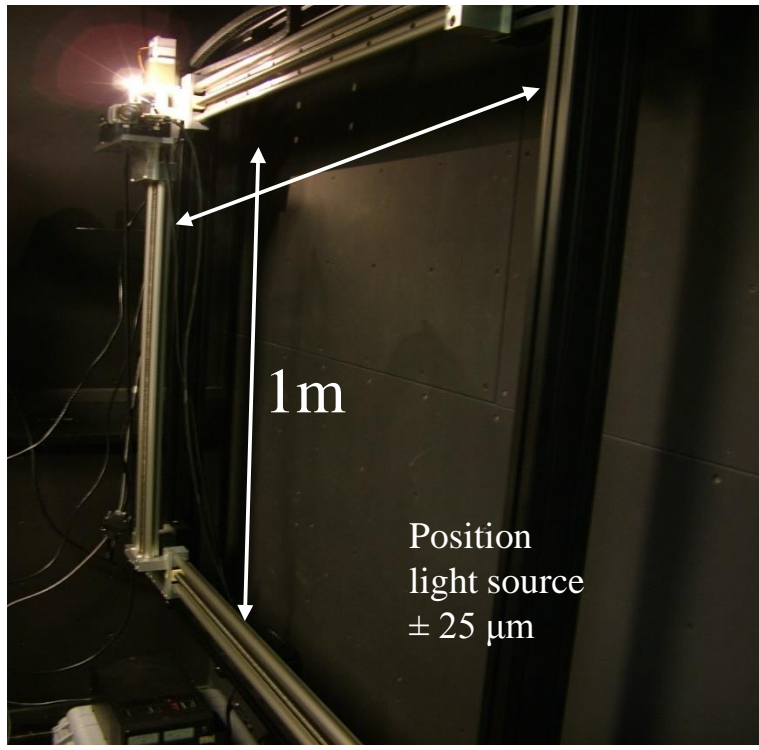
|          |          |
|----------|----------|
| 696.5nm  | 826.5nm  |
| 706.7nm  | 841.8nm* |
| 738.4nm  | 852.1nm  |
| 750.9nm* | 866.8nm  |
| 763.5nm  | 912.3nm  |
| 772.4nm  | 922.4nm  |
| 801.1nm* | 965.8nm  |
| 811.1nm* |          |

\* denotes doublet, (aλ<sub>1</sub>+bλ<sub>2</sub>)  
where a & b are relative intensities





Innovative Optical Tools For Proximal Sensing  
Of Ecophysiological Processes

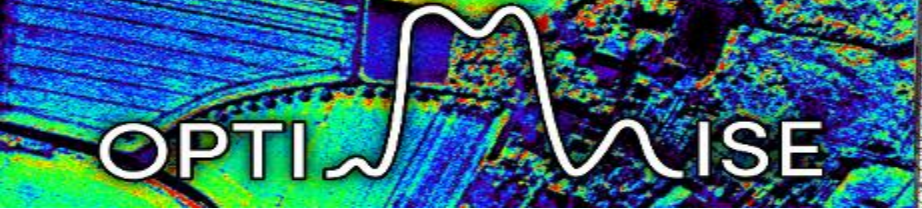


DRF measurement frame



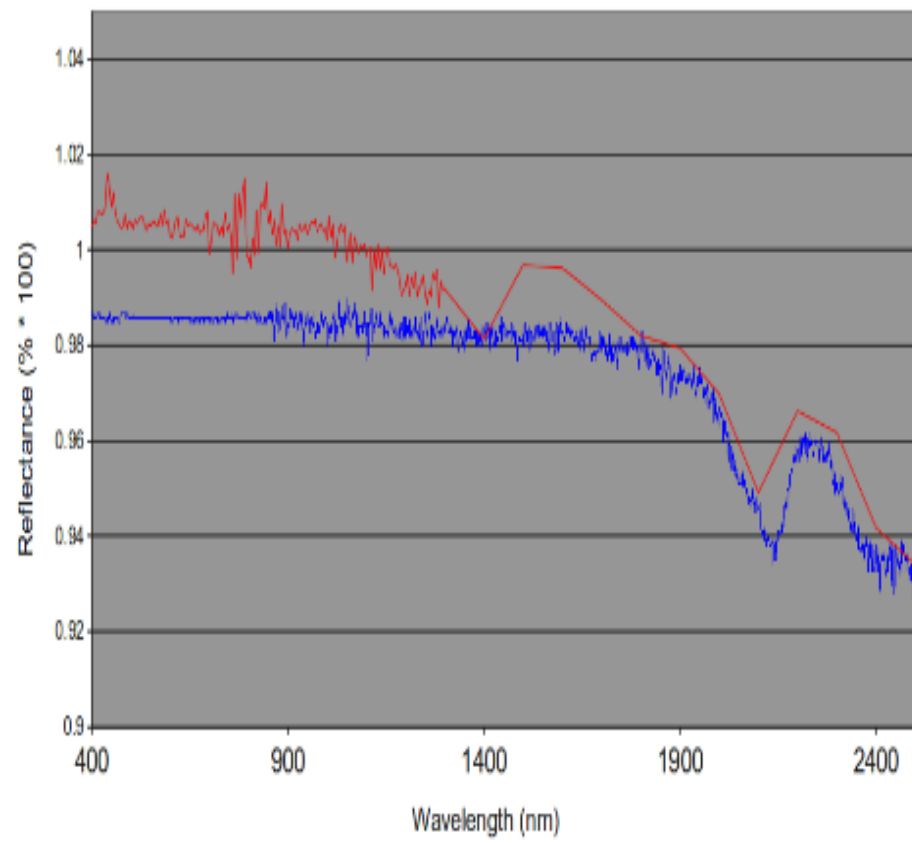
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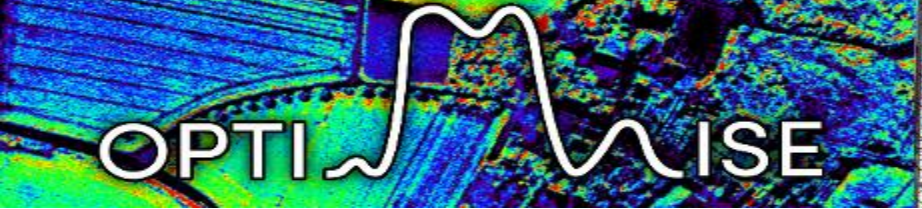
Two different national standards institutes two different calibration files

Spectralon Panel Calibration - Certificate E05090223  
Spectralon Panel Calibration - Certificate 45230-2-1

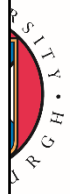
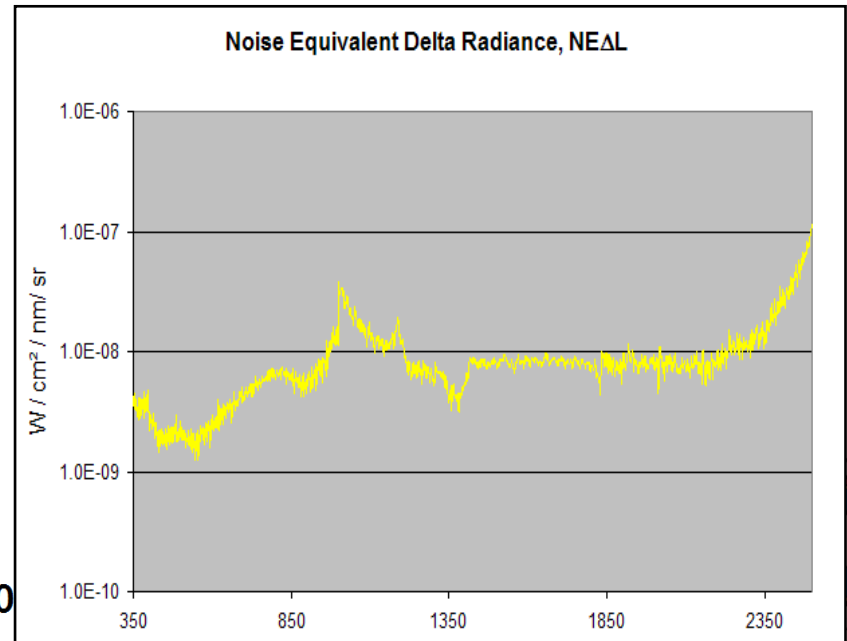
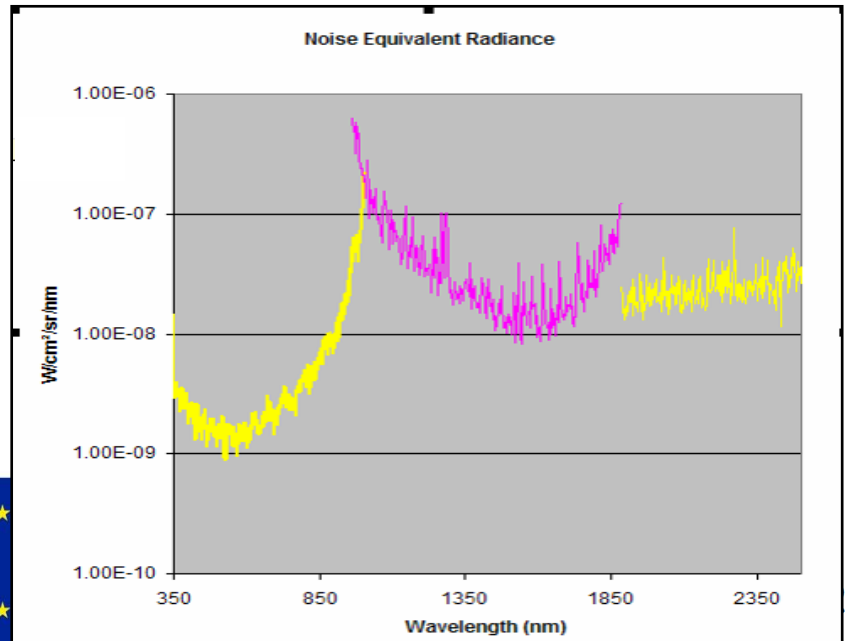
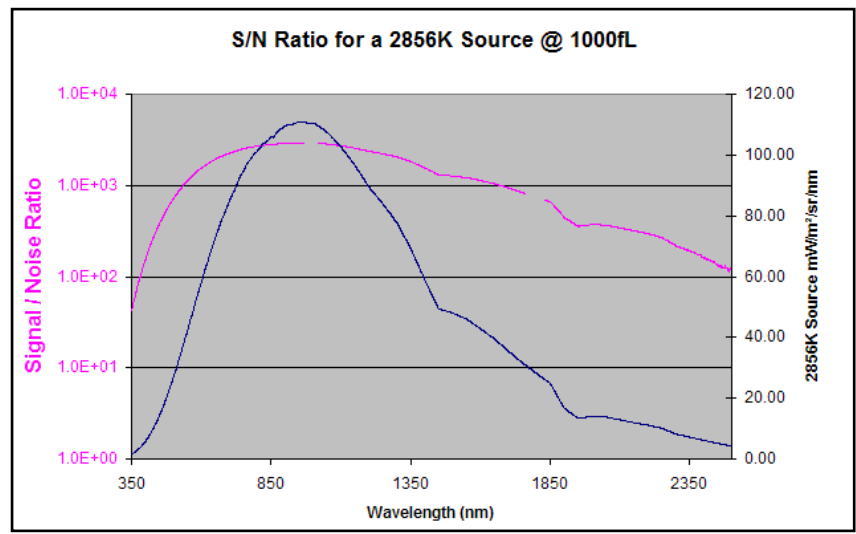


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Need to characterise spectrometer noise



Then there was:

- Fiducial Reference Measurements (FRM)
- Calibration replicability (precision)
- Calibration uncertainty
- Calibration stability
- Temperature dependant response
- Response linearity
- Stray light
- ...



.....we have hardly started!



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