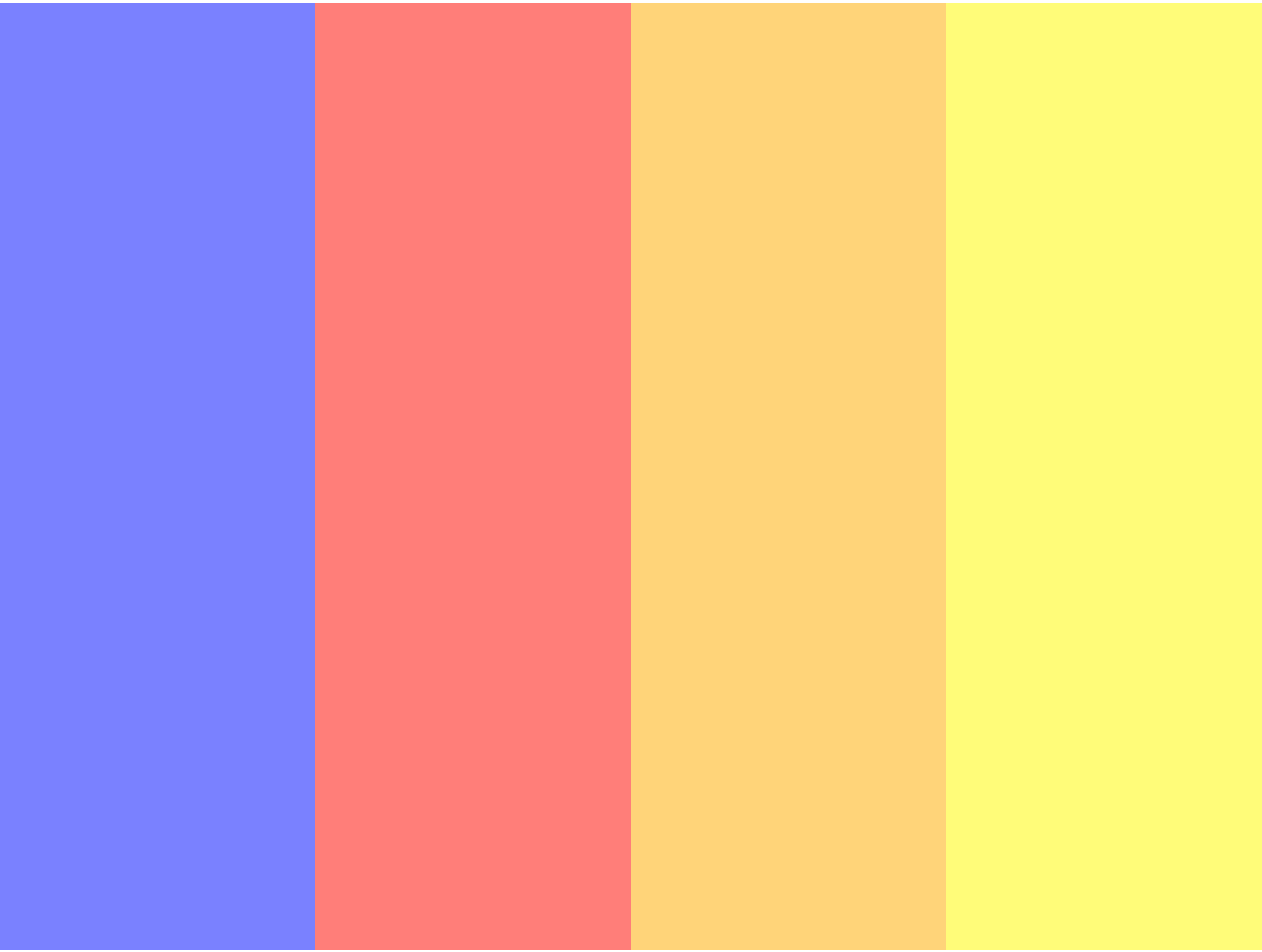
13th Radiance Workshop
Arup London Office
1-3 September 2014

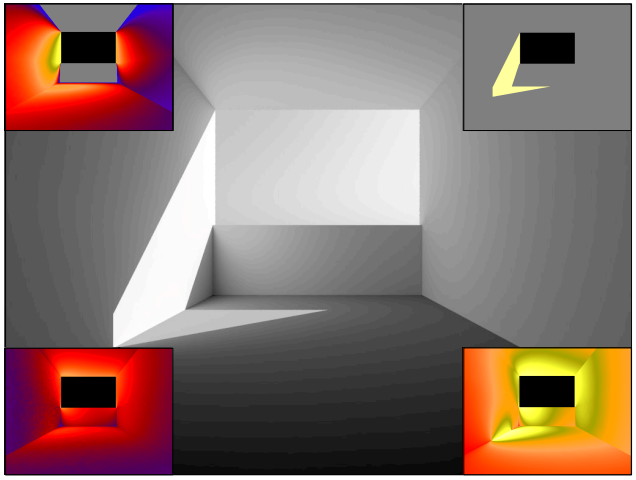
Is current modelling practice *fit-for-purpose* for daylight evaluation using CBDM metrics?

Eleonora Brembilla

John Mardaljevic
Francesco Anselmo



Why CBDM?



$$\times\ 365 \times 12 \times \left(\frac{60}{T_{step}}\right) = \mathrm{CBDM}$$

Why CBDM?

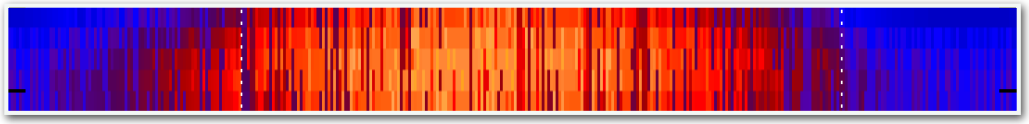
- Predicts absolute values of luminous quantities, e.g. illuminance, luminance, etc.
- Uses realistic sky and sun conditions.
- Founded on standardised climate files.
- Allows ‘holistic’ evaluation of daylighting combined with solar shading.

Projects where CBDM has been used:

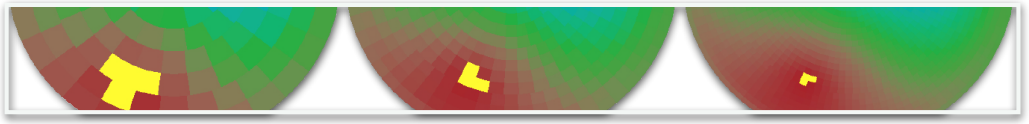
- Art Students League (New York) daylight injury study.
- Hermitage Museum (St. Petersburg) daylighting design and long-term exposure of art works.
- New York Times HQ Buildings evaluation and calibration of active daylighting systems.
- Performance of Serraglaze light redirecting material.
- Multi-climate evaluations for VELUX.
- Daylighting performance of school buildings.
- Prediction of ‘circadian potential’ and non-visual effects.

Why here at the Radiance Workshop?

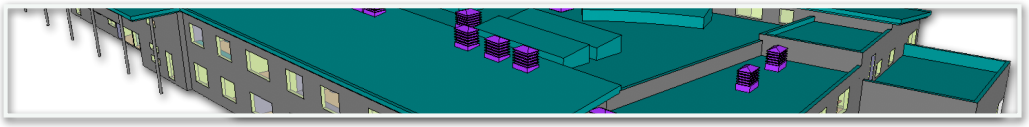
Climate files



Sky models



Building description



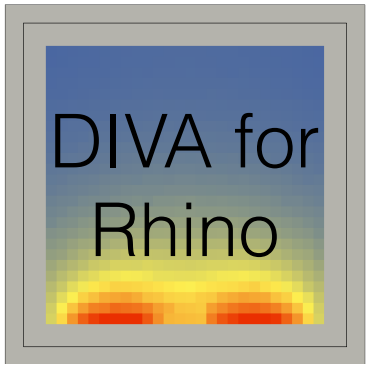
Simulation engines

Metrics and visualisation

Why here at the Radiance Workshop?

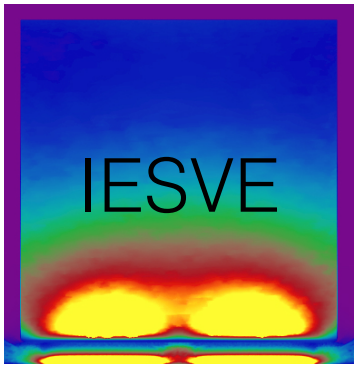
Simulation engines

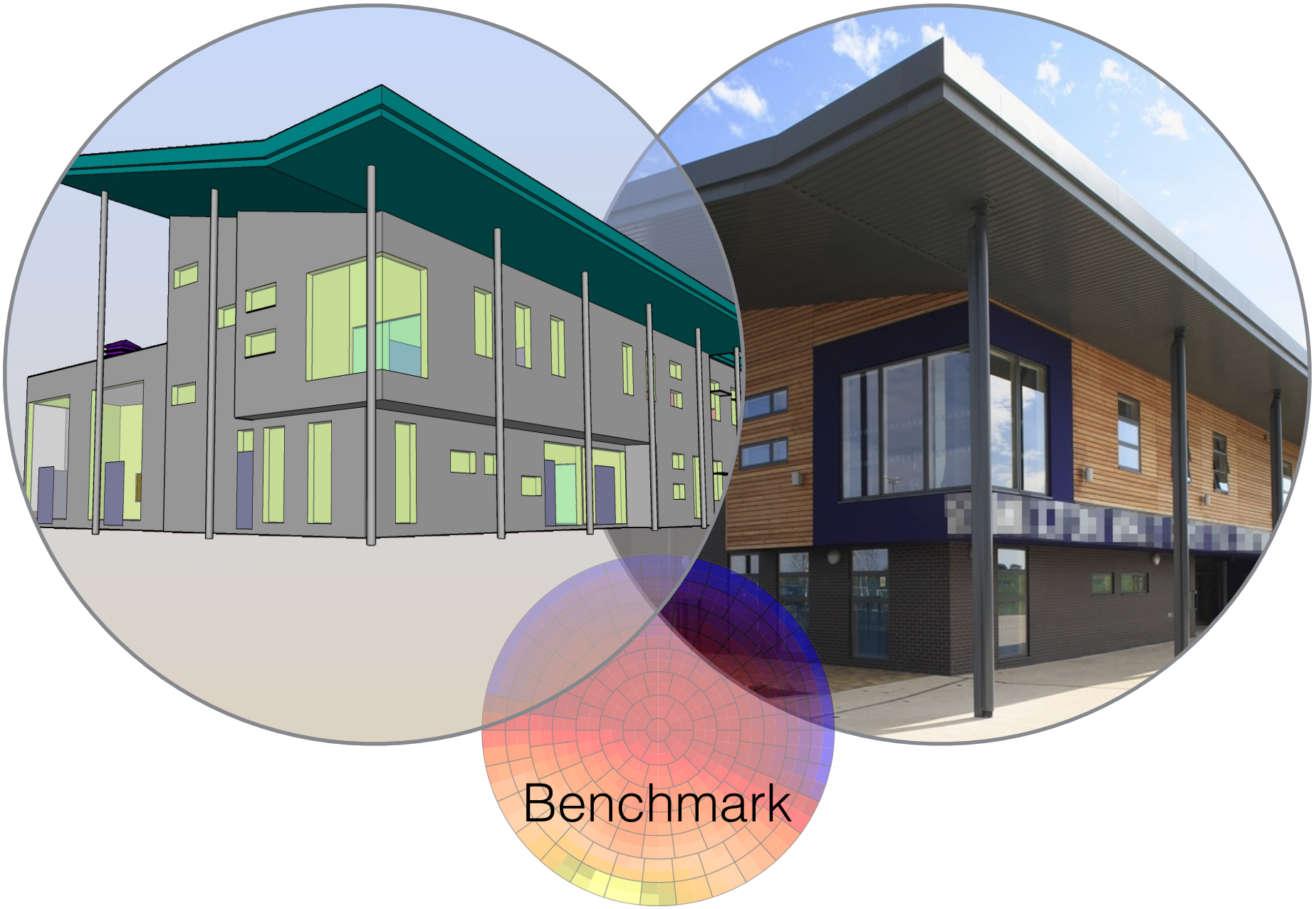
Sensitivity Analysis
+
Inter-model comparison



3-Phase Method

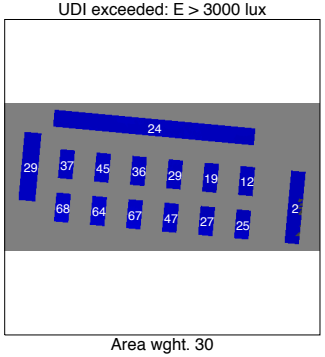
5-Phase Method





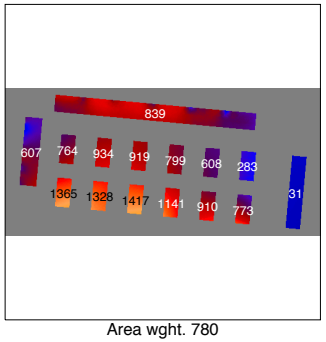
Benchmark

UDI exceeded: E > 3000 lux



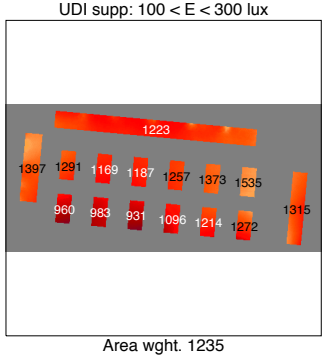
Area wght. 30

UDI auto: 300 < E < 3000 lux



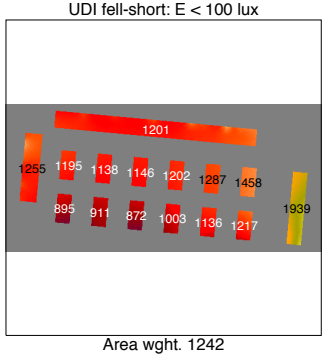
Area wght. 780

UDI supp: 100 < E < 300 lux



Area wght. 1235

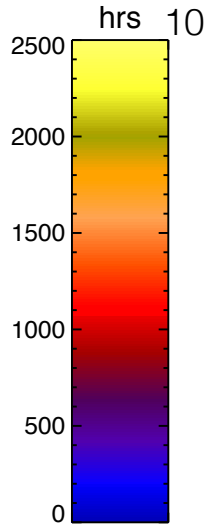
UDI fell-short: E < 100 lux



Area wght. 1242

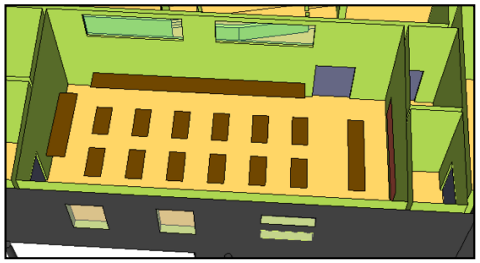
Daylight Autonomy

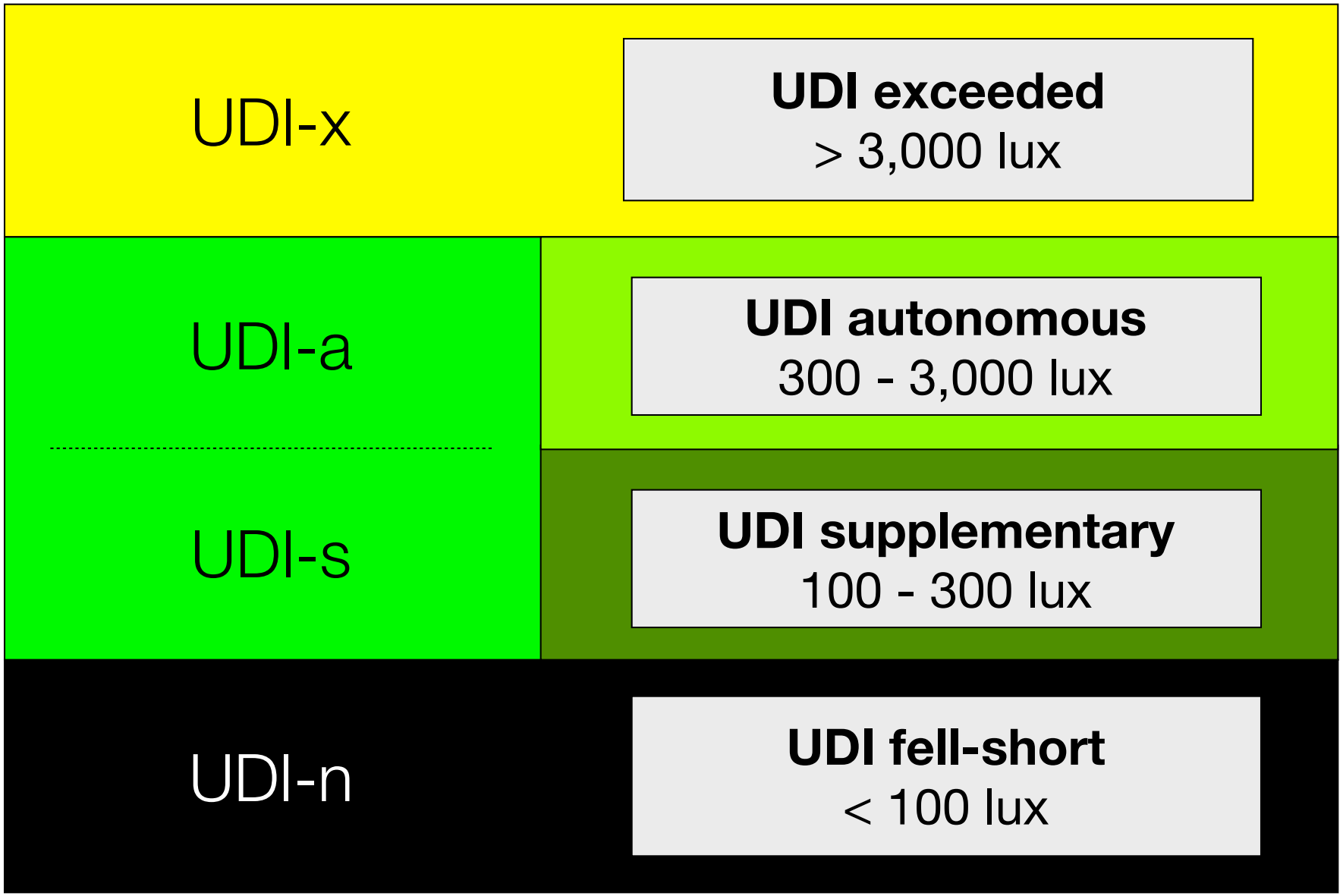
DA

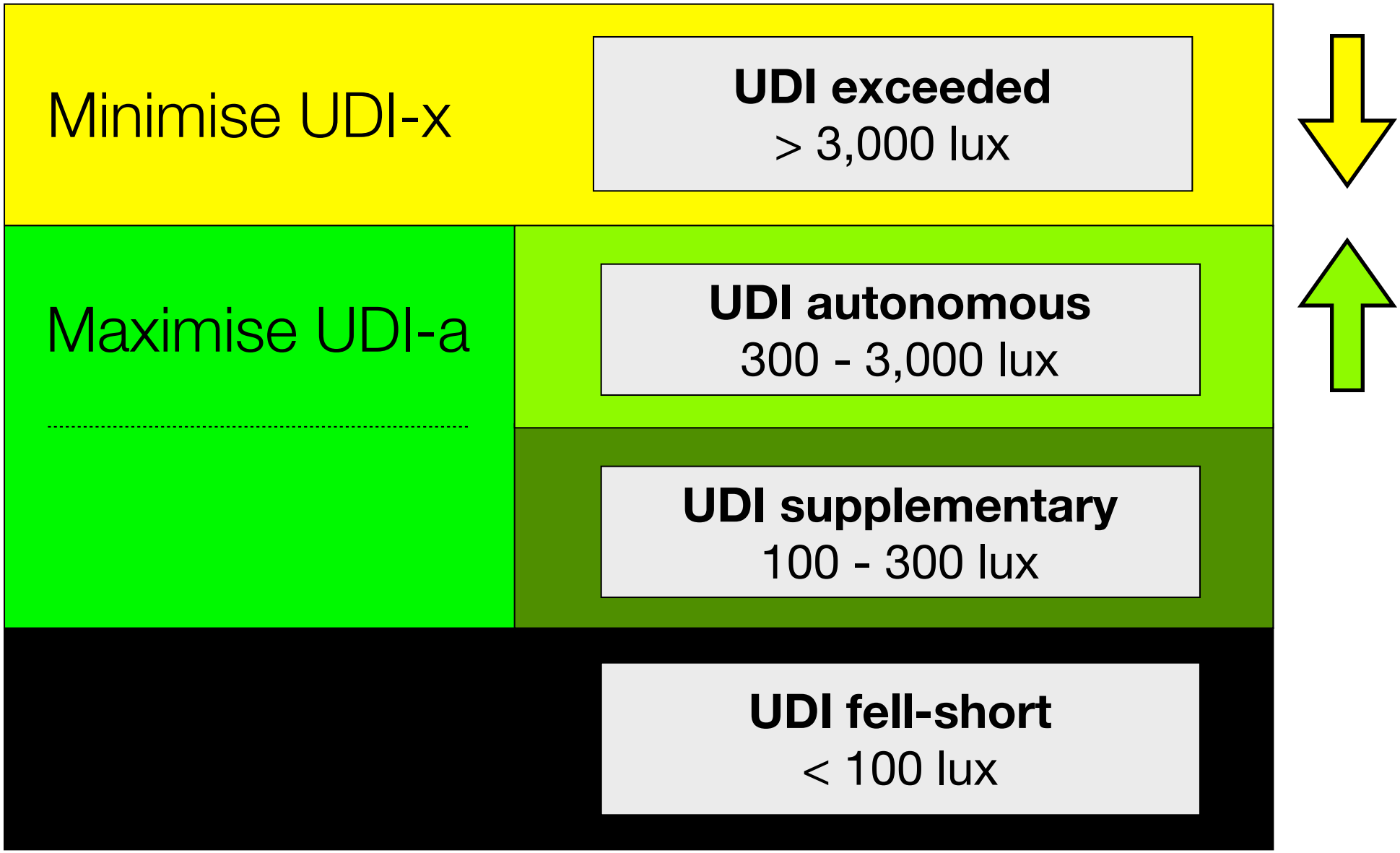


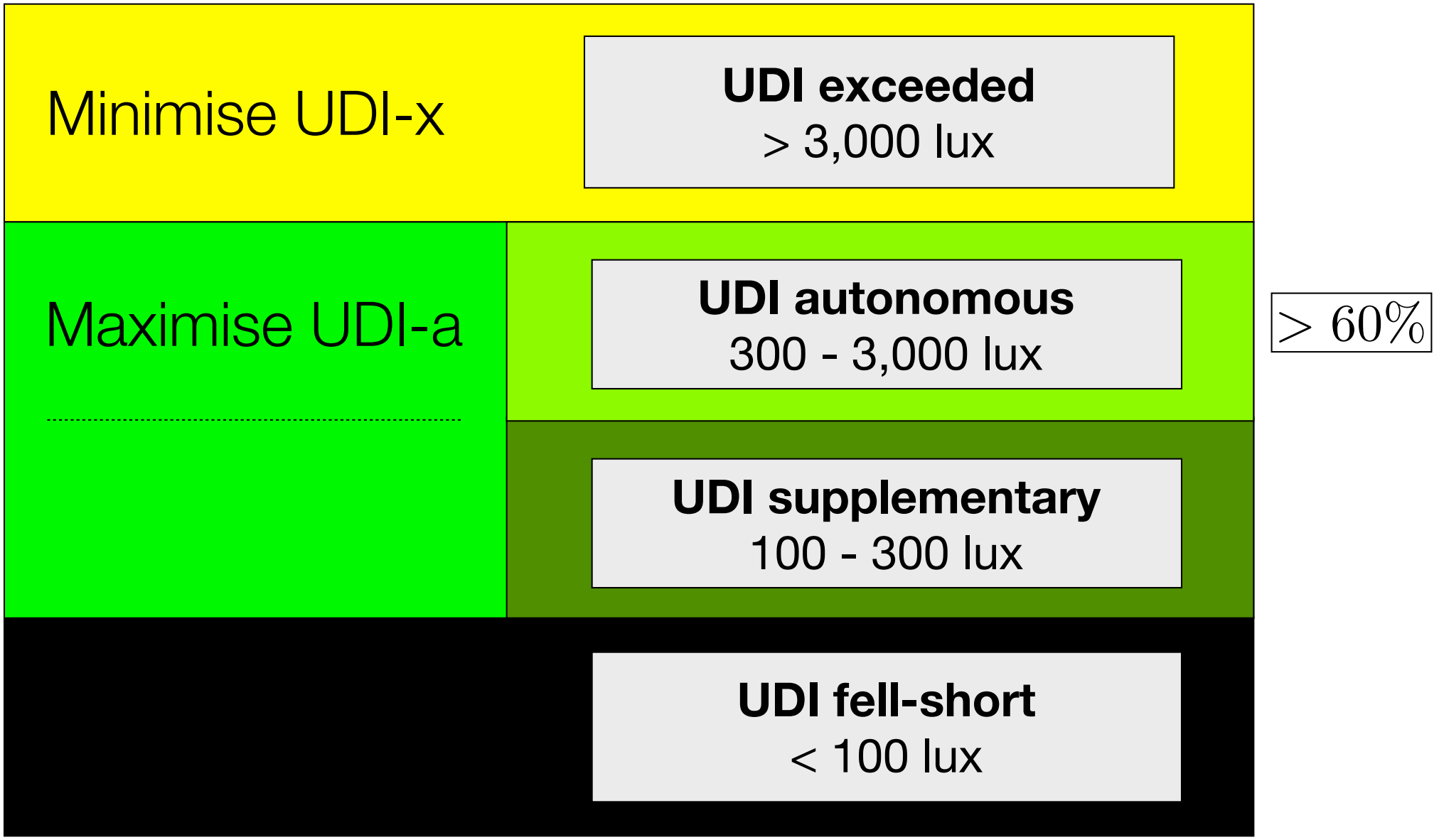
Useful Daylight Illuminance

UDI




UDI-x
UDI exceeded
> 3,000 lux
UDI-a
UDI autonomous
300 - 3,000 lux
UDI-s
UDI supplementary
100 - 300 lux
UDI-n
UDI fell-short
< 100 lux


Minimise UDI-x
UDI exceeded
> 3,000 lux
Maximise UDI-a
UDI autonomous
300 - 3,000 lux
UDI supplementary
100 - 300 lux
UDI fell-short
< 100 lux


Minimise UDI-x
UDI exceeded
> 3,000 lux
Maximise UDI-a
UDI autonomous
300 - 3,000 lux
UDI supplementary
100 - 300 lux
UDI fell-short
< 100 lux
> 60%

Sabre Trust Kindergarten / Arup - Ghana 2012

Sabre Trust Kindergarten / Arup - Ghana 2012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إستدامة
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green building council australia


BSi
British Standards


CIBSE


GREEN BUILDING COUNCIL
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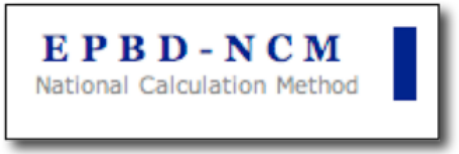
LEADERSHIP IN ENERGY & ENVIRONMENTAL DESIGN


E P B D - N C M
National Calculation Method

Climate-based daylight metrics (UDI) in the Priority Schools Building Programme (2013)

Wish-list

- Quality assured inputs
- Accurate definition of the metrics
- Supported CBDM software - multiple vendors
- Design intent versus operational performance
- Affordable, ‘smart’ illuminance sensors
- Data on daylight recorded by BEMS
- Daylight in residential dwellings

References:

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J. Mardaljevic, J. Christoffersen, and P. Raynham. *A Proposal for a European Standard for Daylight in Buildings*. Lux Europa, Krakow, PL, 17–19 September, 2013.

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Images credits:

J Mardaljevic, Why CBDM, CBDM report

A McNeil, The 3-Phase Method tutorial

C Ochoa et al., Daylight simulation engines

N Drosou, School building

Sabre Trust, Kindergarten classrooms in Ghana

Loughborough University

EPSRC
Engineering and Physical Sciences Research Council

Thank you!

Eleonora Brembilla
PhD Student
E.Brembilla@lboro.ac.uk

Supervisors:
J Mardaljevic
F Anselmo