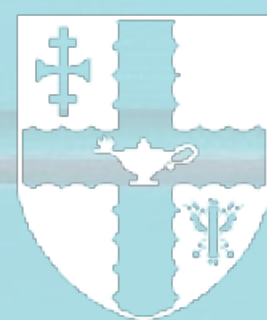


Meteorological data for Climate-Based Daylight Modelling

Eleonora Brembilla

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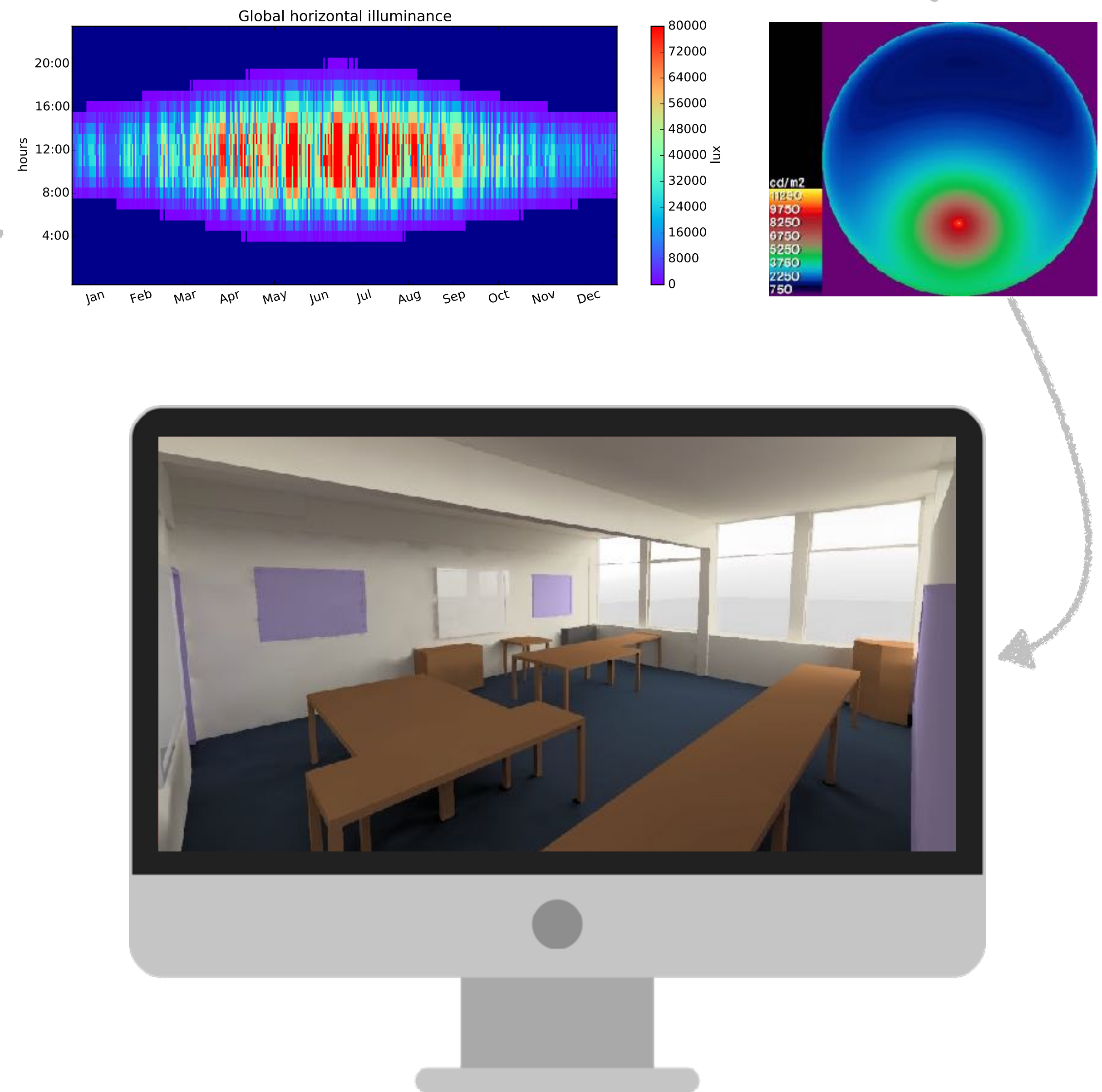
Loughborough
University



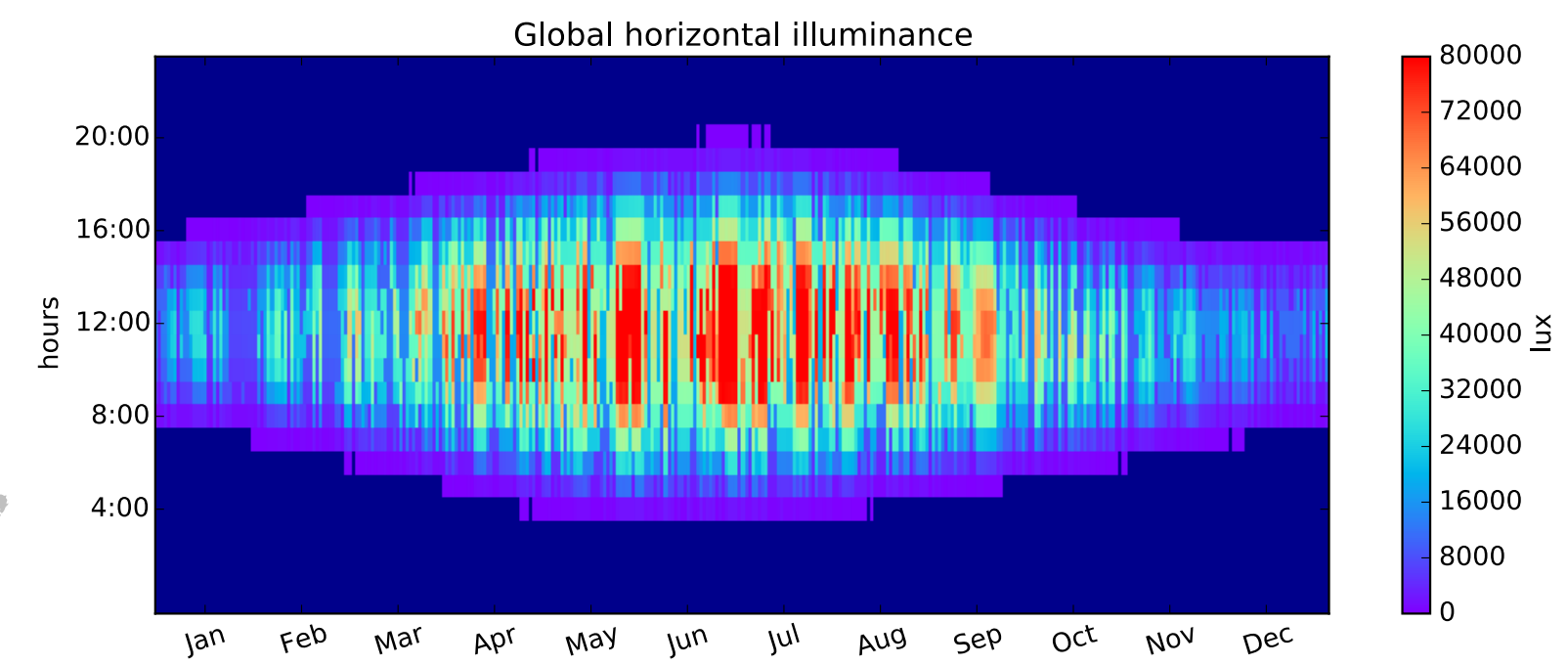
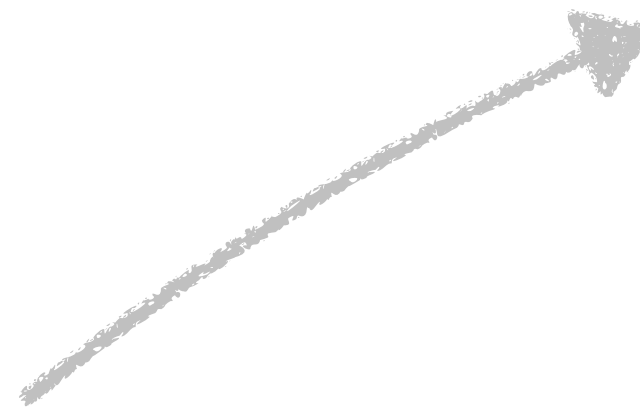
Climate-Based Daylight Modelling:

The assessment of the luminous conditions within the built environment that makes use of representative climate data to recreate realistic sky luminance distributions, at hourly or sub-hourly consecutive steps, by means of physically accurate lighting simulation tools.

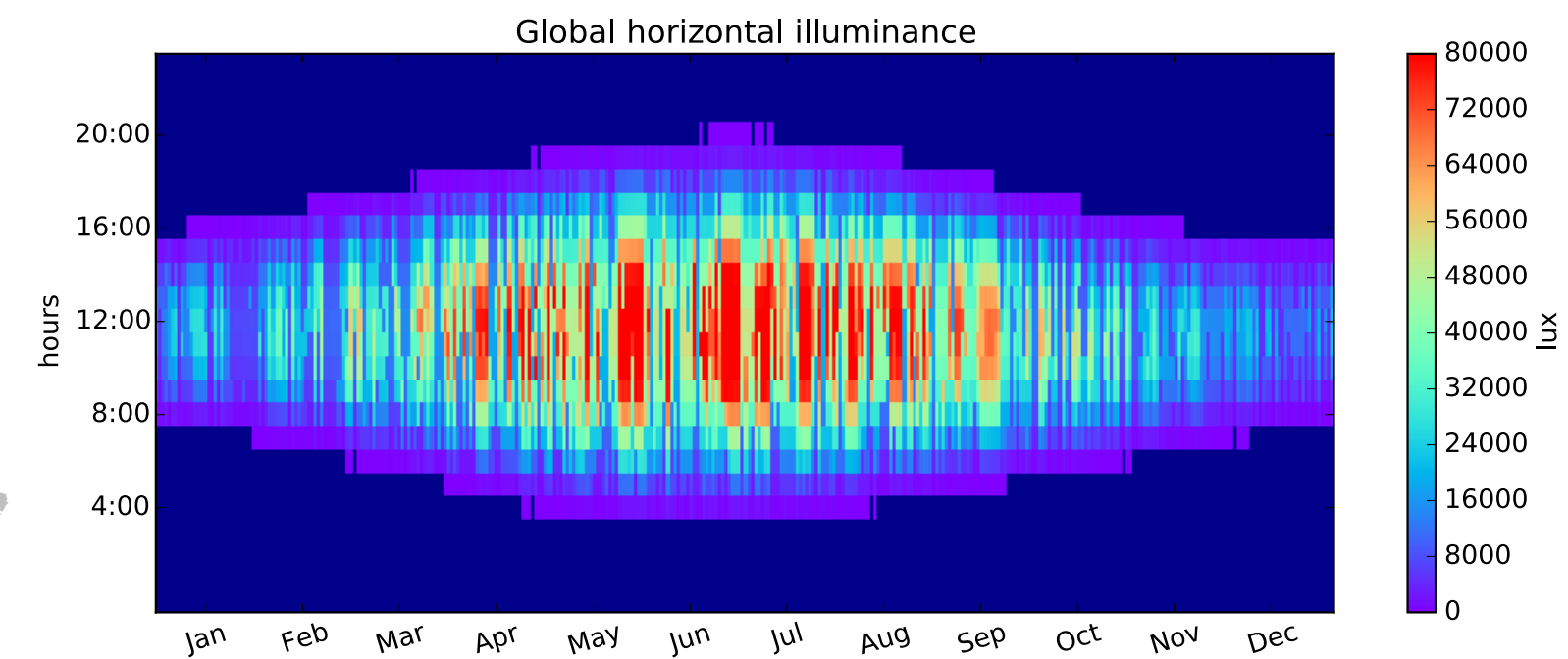
e.g. Radiance



representative climate data



For Building Performance Simulation applications: EPW (EnergyPlus Weather) format

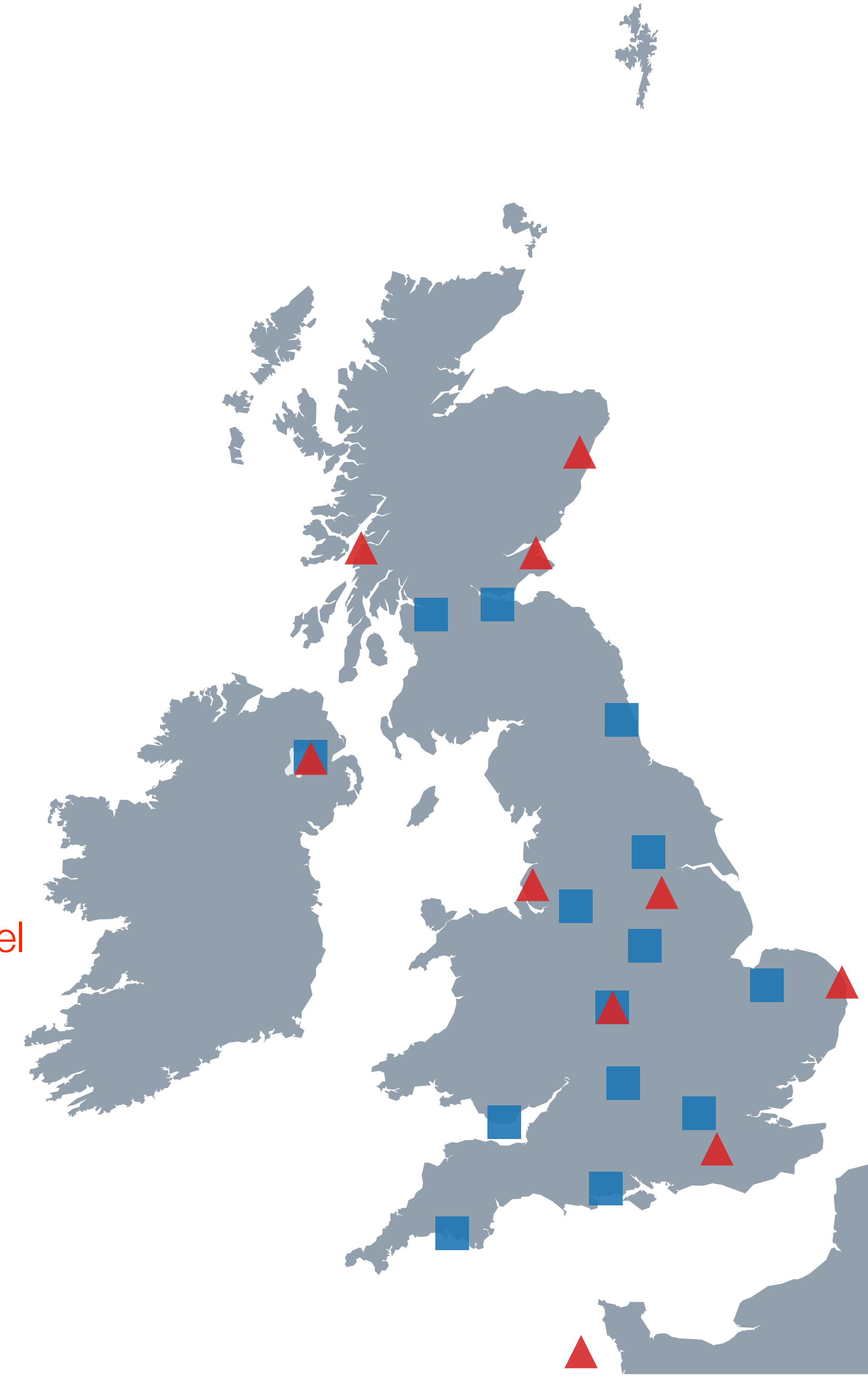
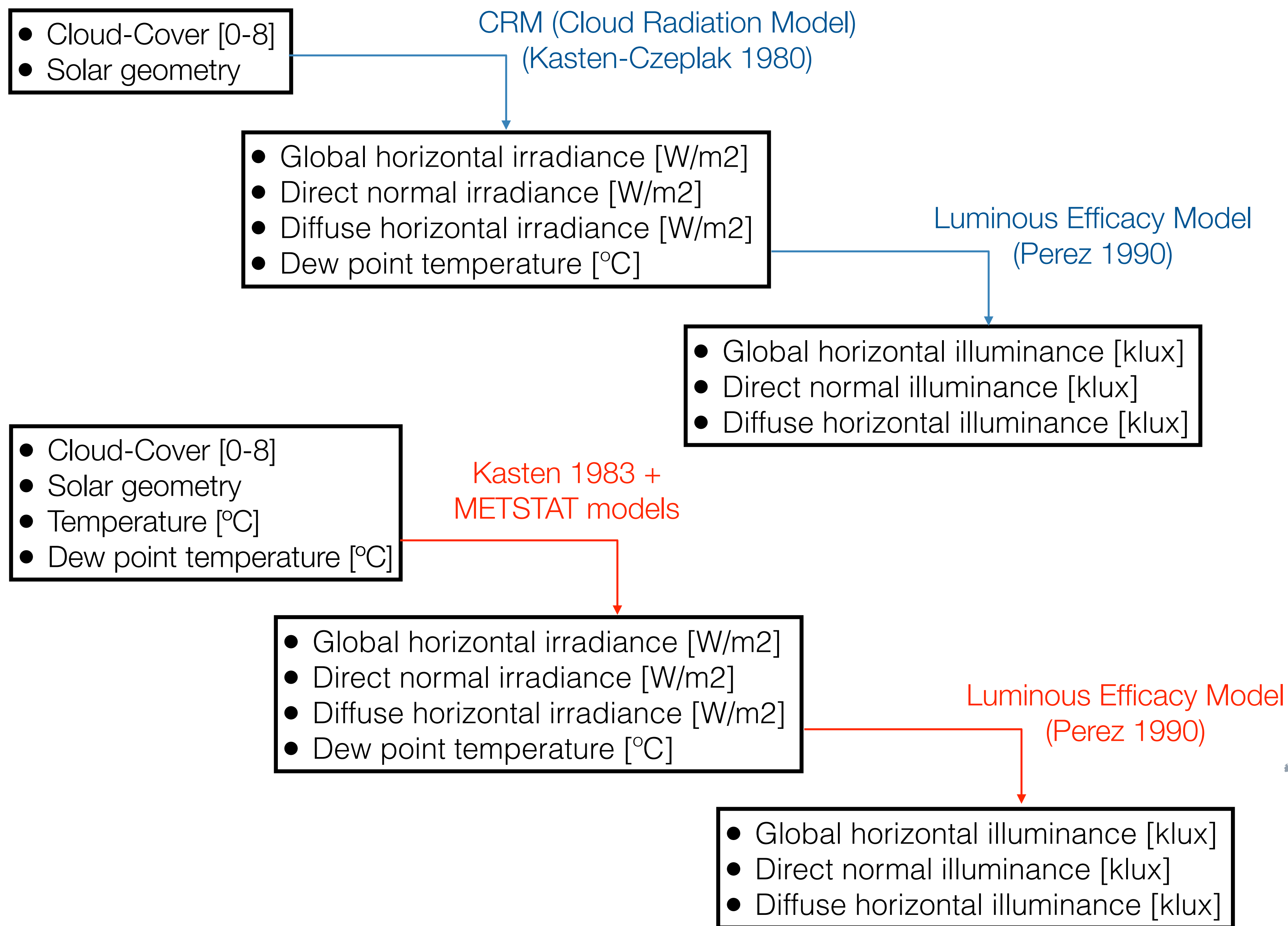


representative climate data

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- ▶ Global horizontal irradiance [W/m²]
 - ▶ Direct normal irradiance [W/m²]
 - ▶ Diffuse horizontal irradiance [W/m²]
-
- ▶ Global horizontal illuminance [klux]
 - ▶ Direct normal illuminance [klux]
 - ▶ Diffuse horizontal illuminance [klux]





0

1

2

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7

8

(9)



CRM (Cloud Radiation Model) (Kasten-Czeplak 1980)

Baseline Surface Radiation Network (BSRN)

- 1-min time step
- Global horizontal and direct normal irradiance [W/m²]
- 2 UK locations: Camborne and Lerwick
- 2001-present

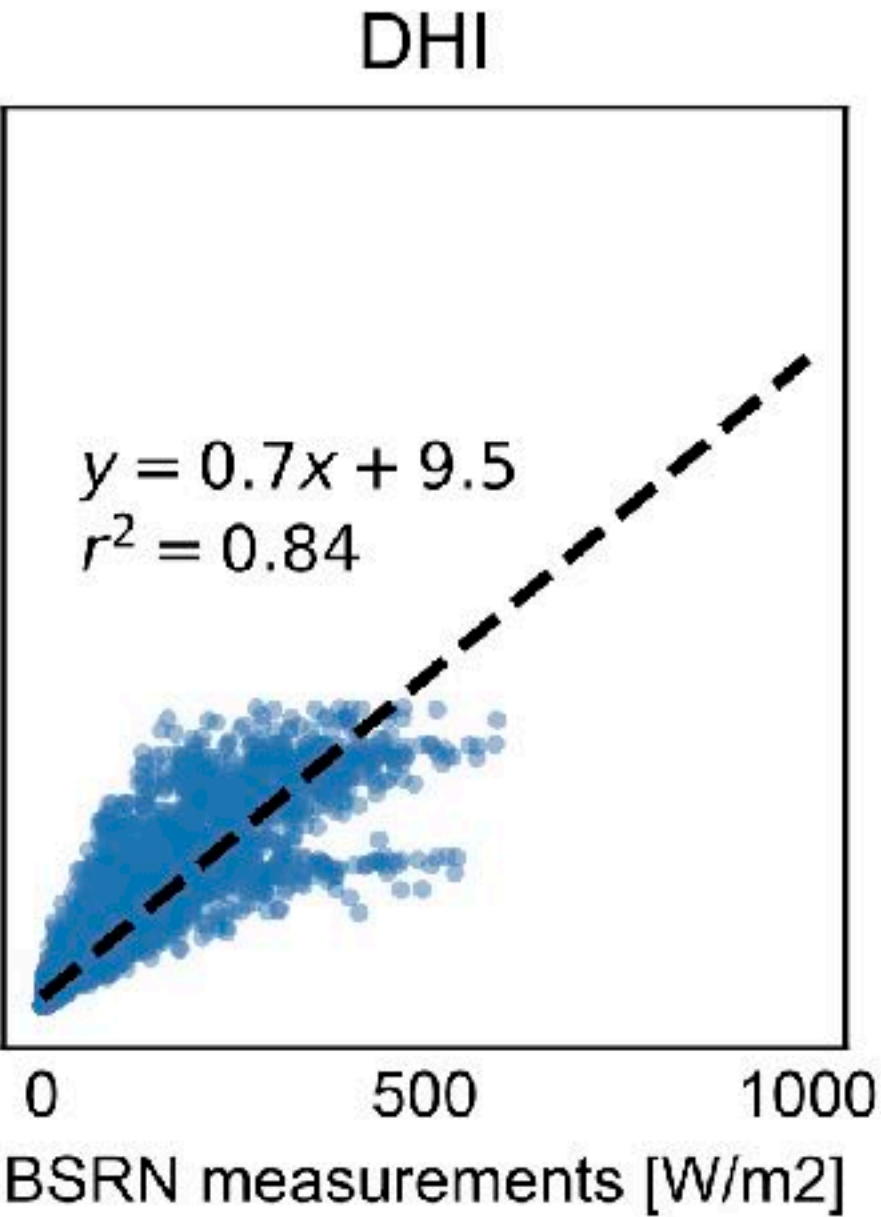
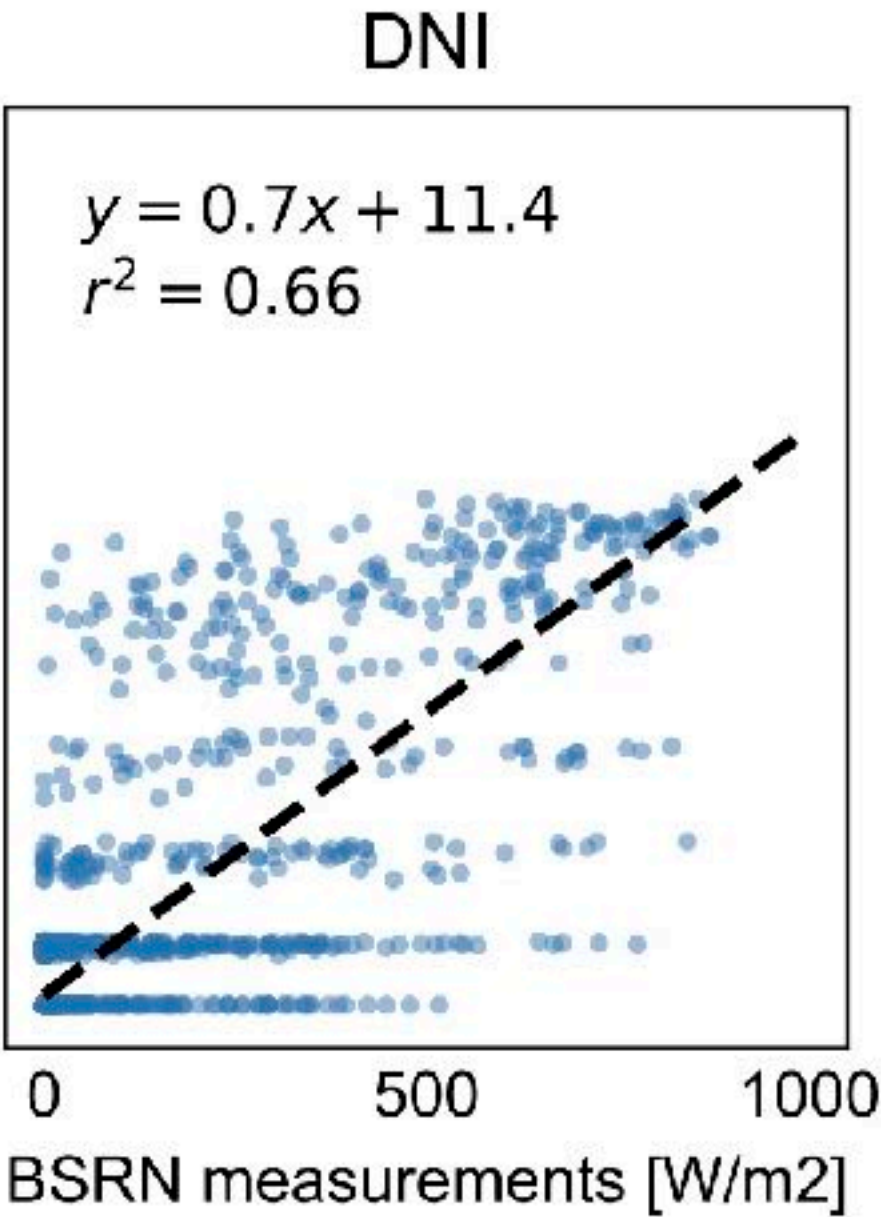
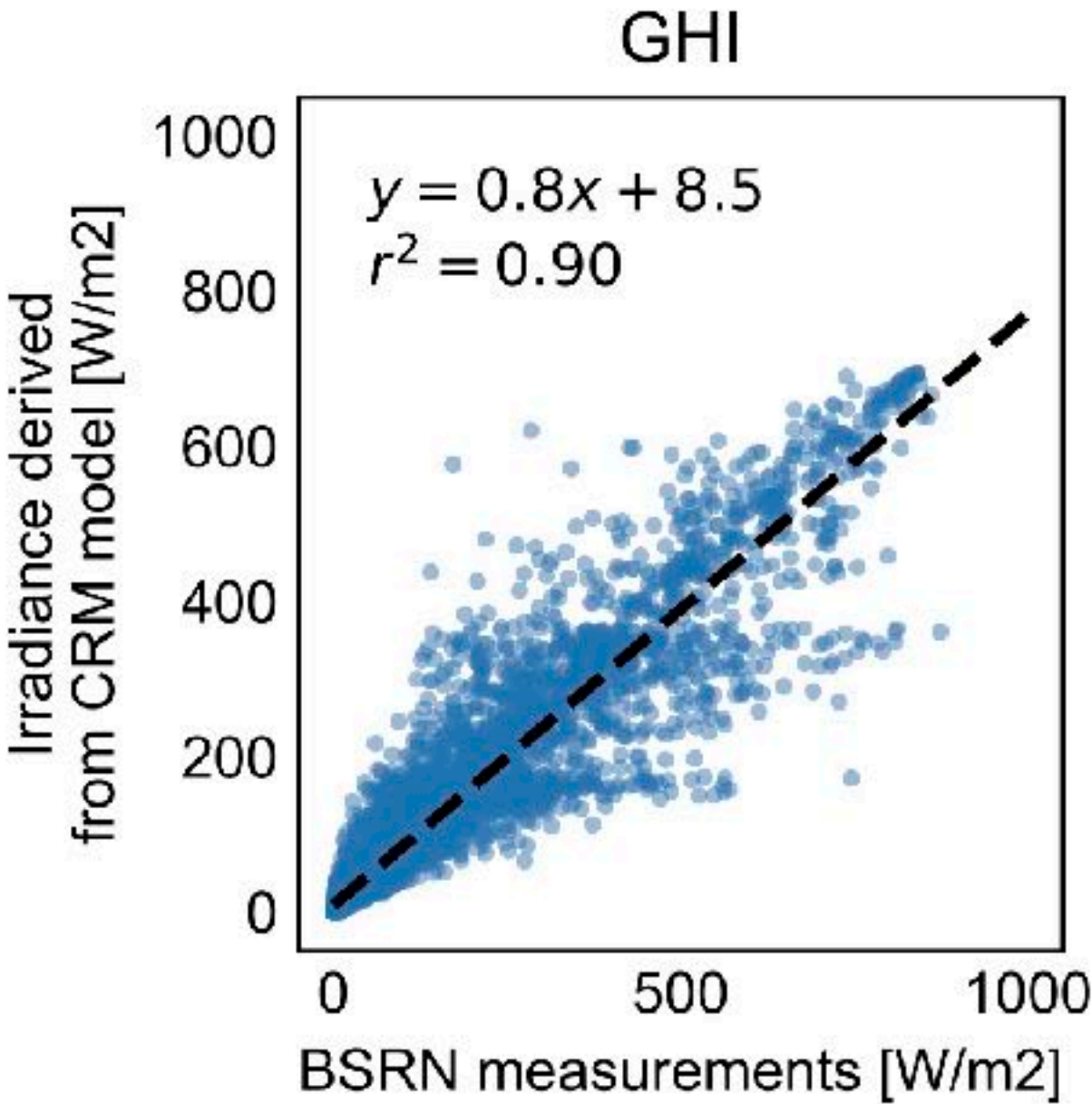
MIDAS (Met Office from CEDA)

- Hourly time step
- Cloud Cover [0-9]



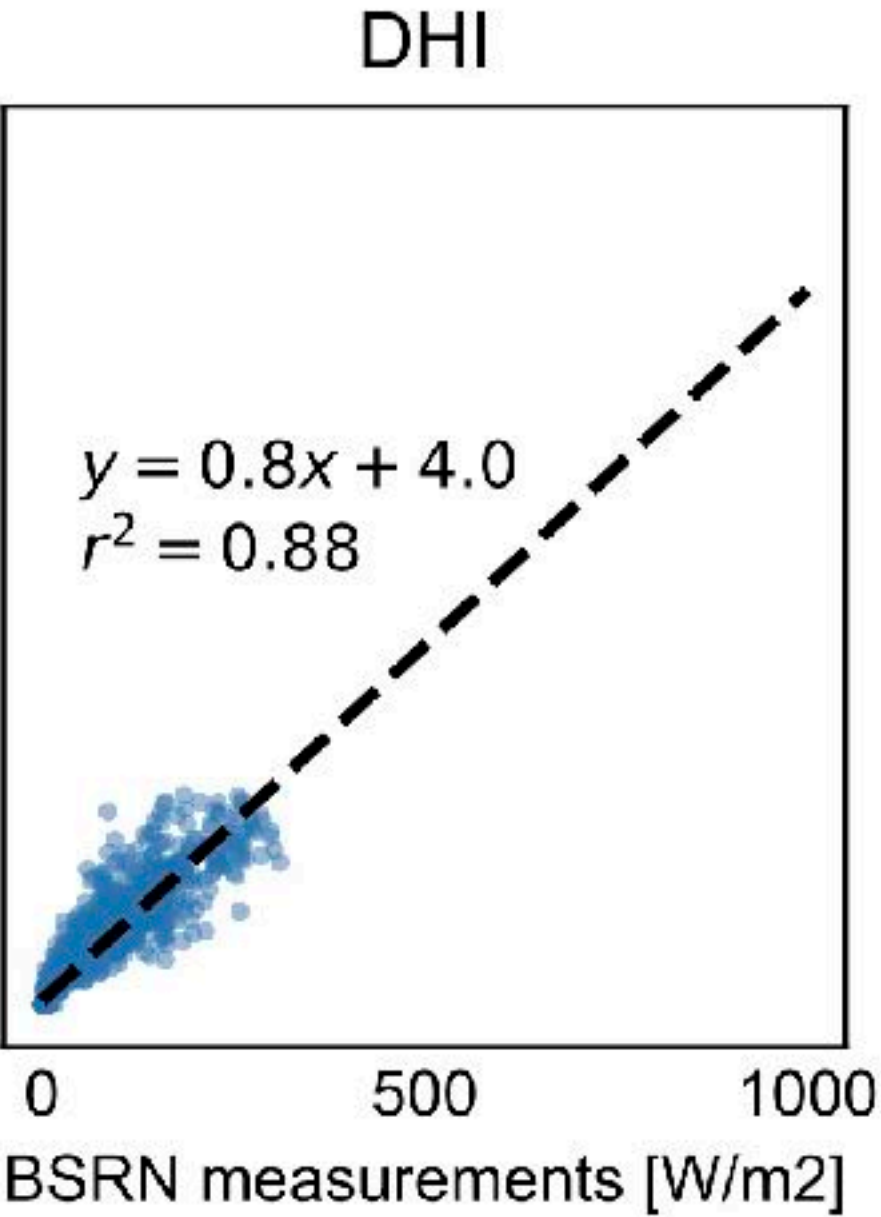
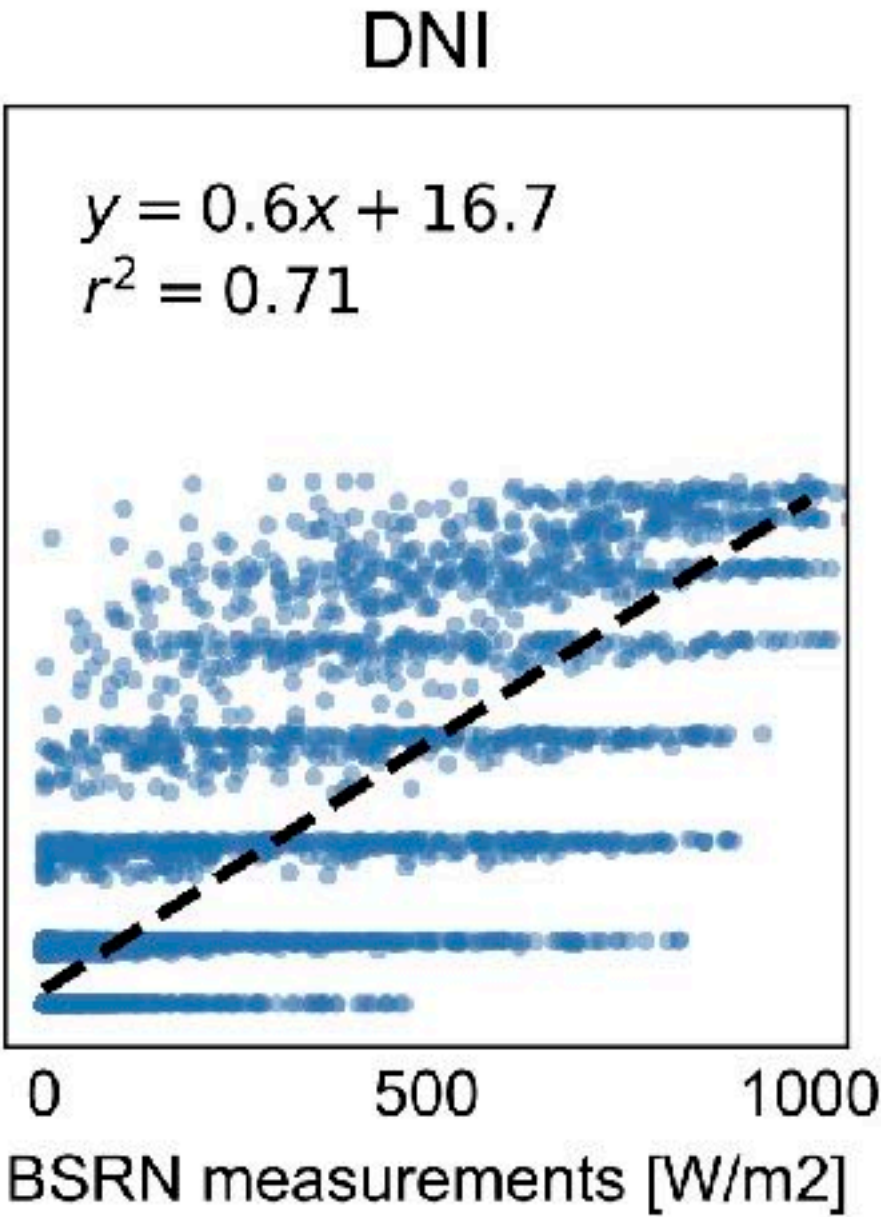
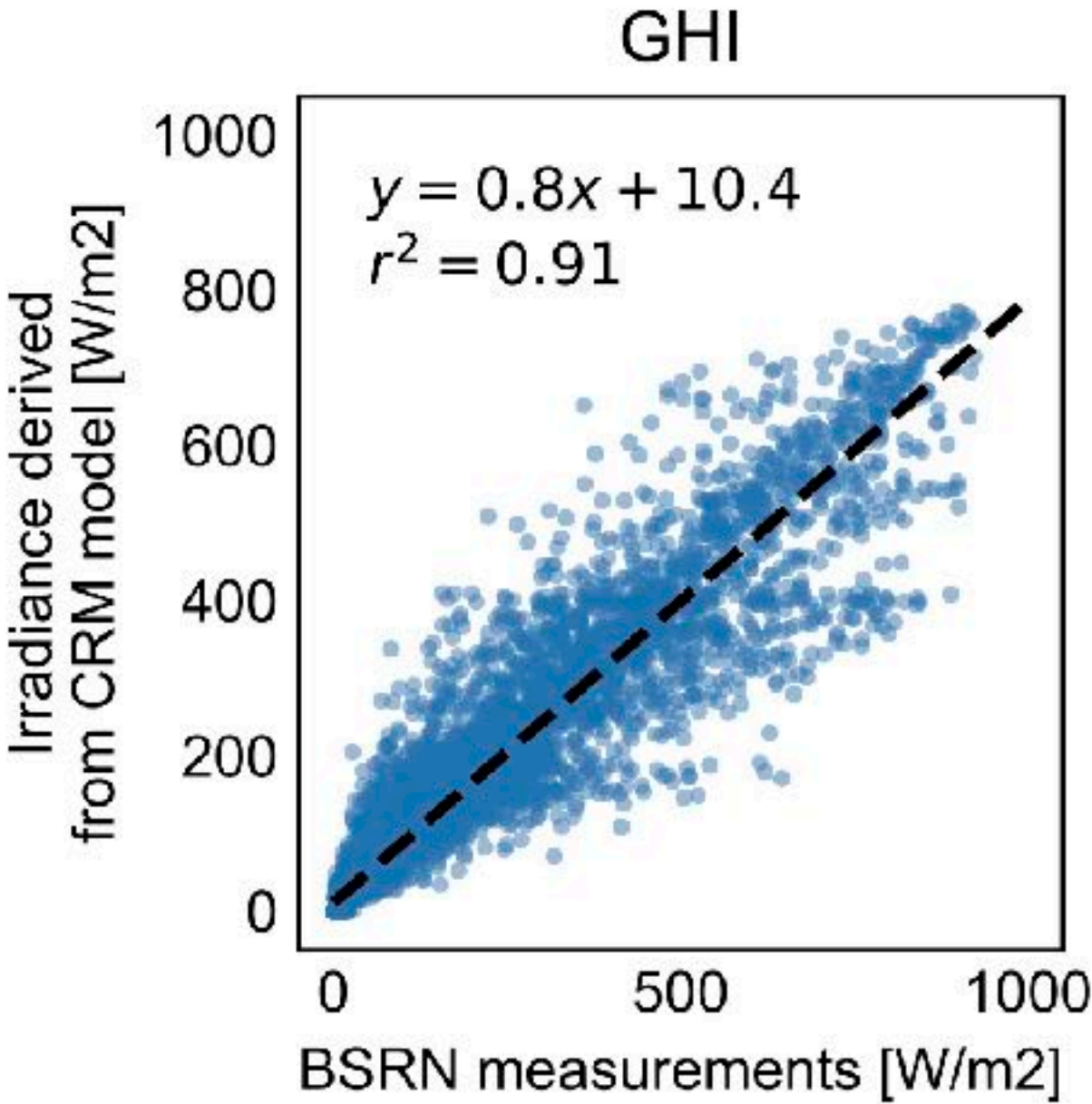
Lerwick 2016

	GHI	DNI	DHI
MBE [rMBE]	-15 W/m ² [12%]	-8 W/m ² [4160%]	-6 W/m ² [19%]
RMSE [rRMSE]	62 W/m ² [138%]	91 W/m ² [29491%]	42 W/m ² [132%]



Camborne 2016

	GHI	DNI	DHI
MBE [rMBE]	-17 W/m ² [1.27%]	-25 W/m ² [2441%]	-2 W/m ² [7%]
RMSE [rRMSE]	69 W/m ² [81.43%]	124 W/m ² [21000%]	23 W/m ² [92%]



Luminous Efficacy Model (Perez 1990)

Public Health England (PHE)

- 5-min time step
- Global horizontal illuminance [klux] and UV index
- 9 UK locations
- 2013-present

MIDAS (Met Office from CEDA)

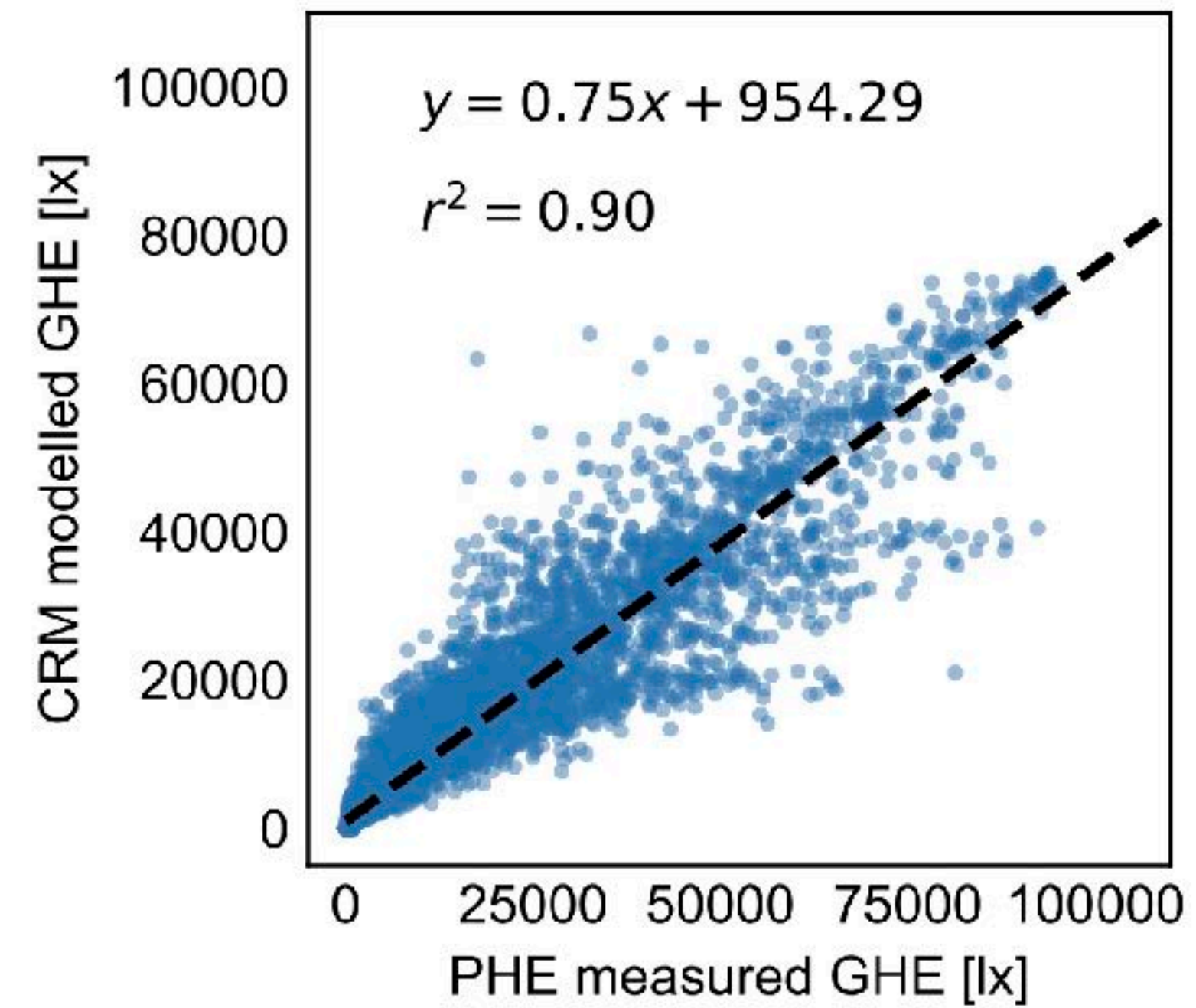
- Hourly time step
- Cloud Cover [0-9]



Lerwick 2016

MBE = -1826.01 lx
rMBE = 7.05%

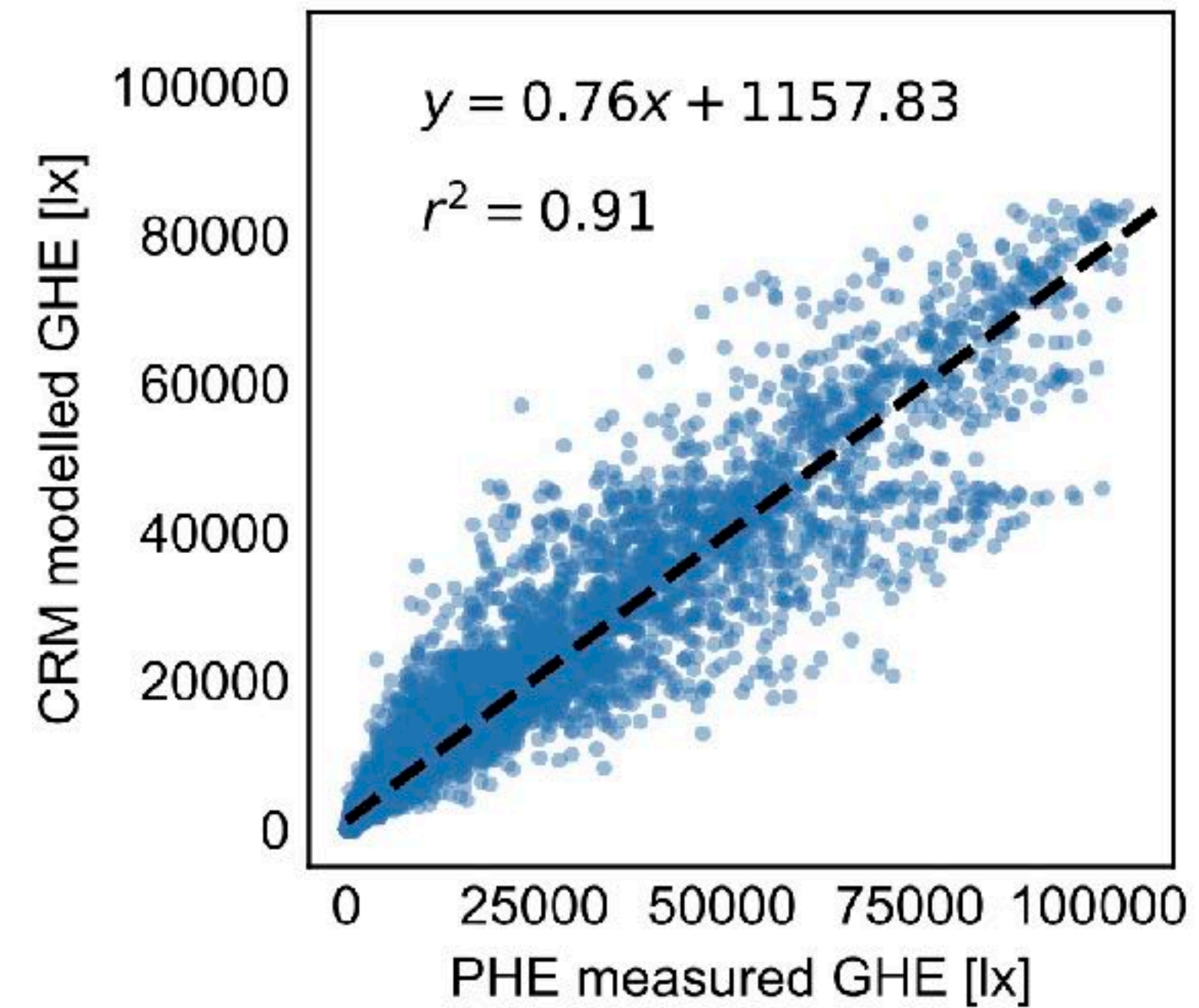
RMSE = 6900.16 lx
rRMSE = 88.47%



Camborne 2016

MBE = -2127.89 lx
rMBE = 0.48%

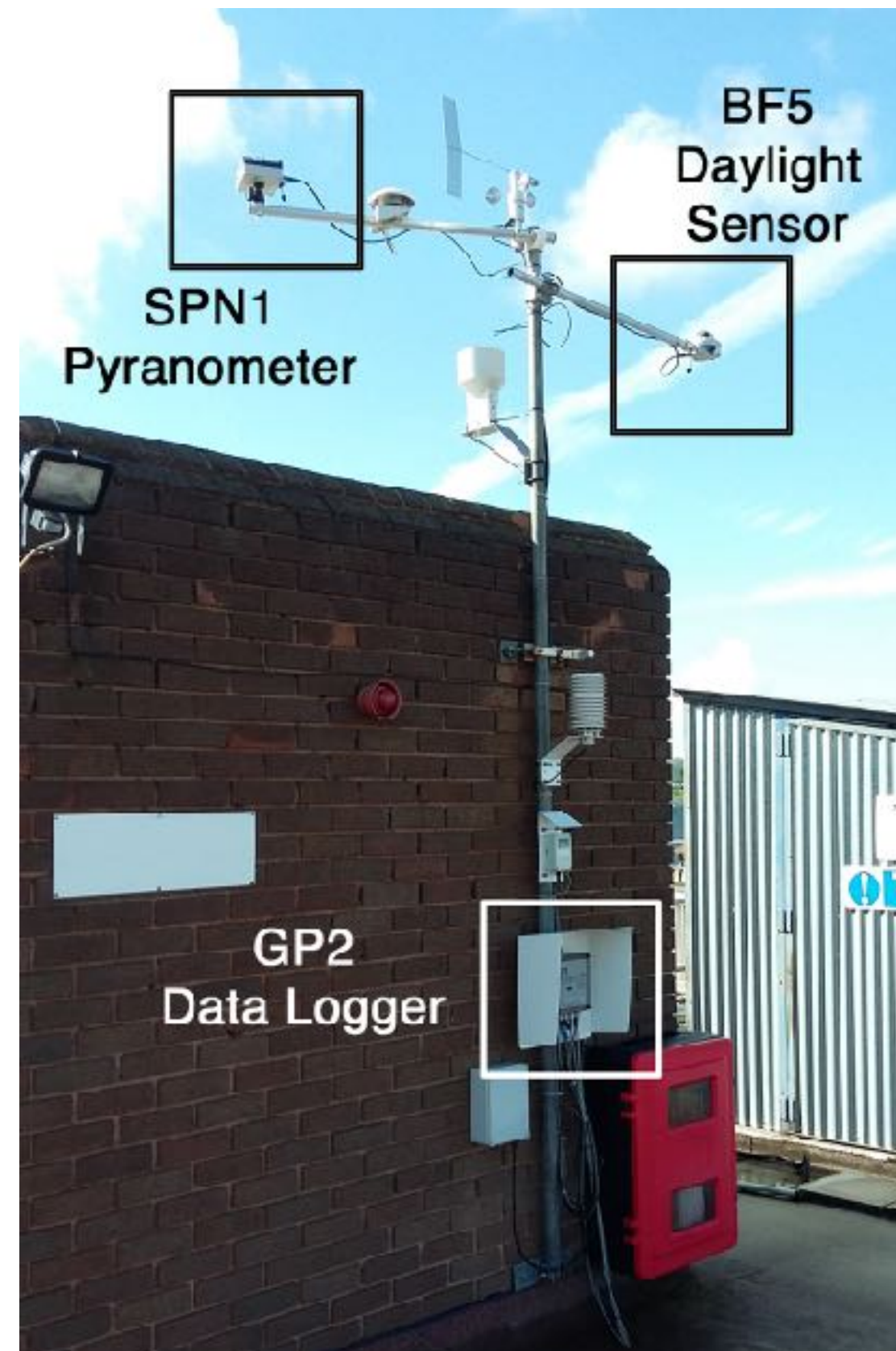
RMSE = 7732.98 lx
rRMSE = 72.98%



Loughborough University Delta-T measurements

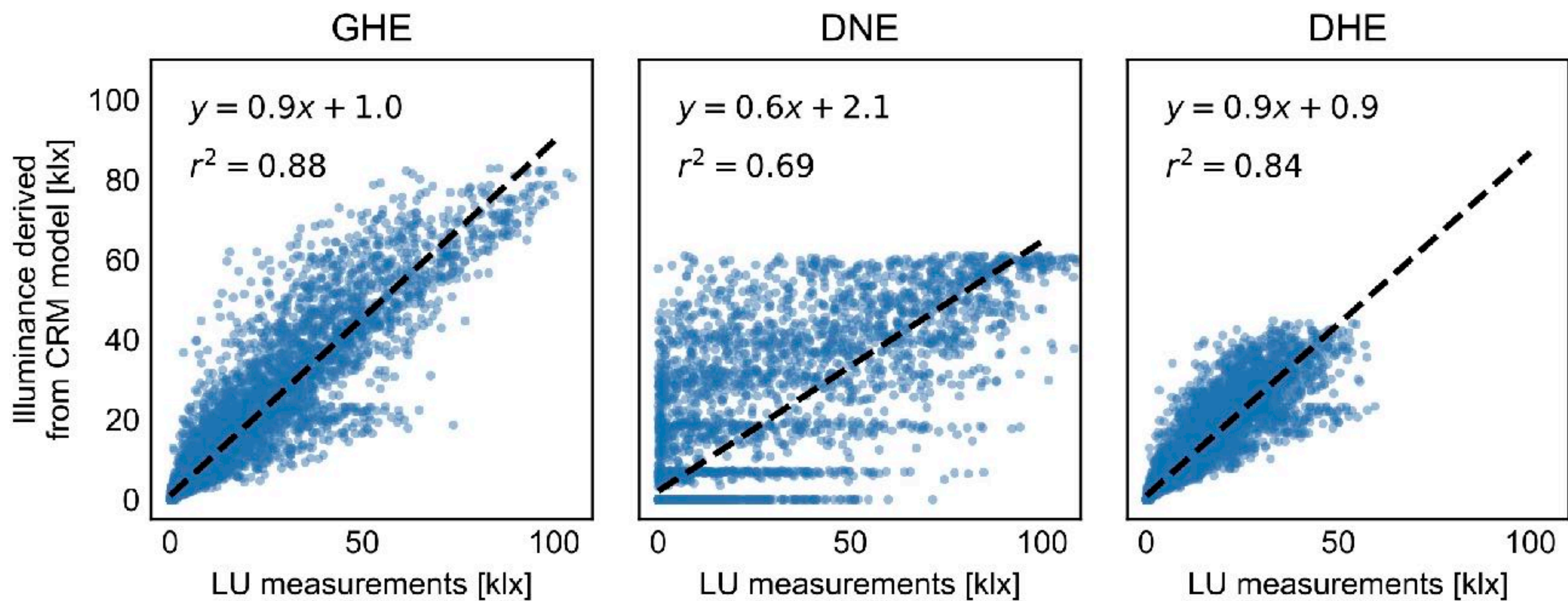
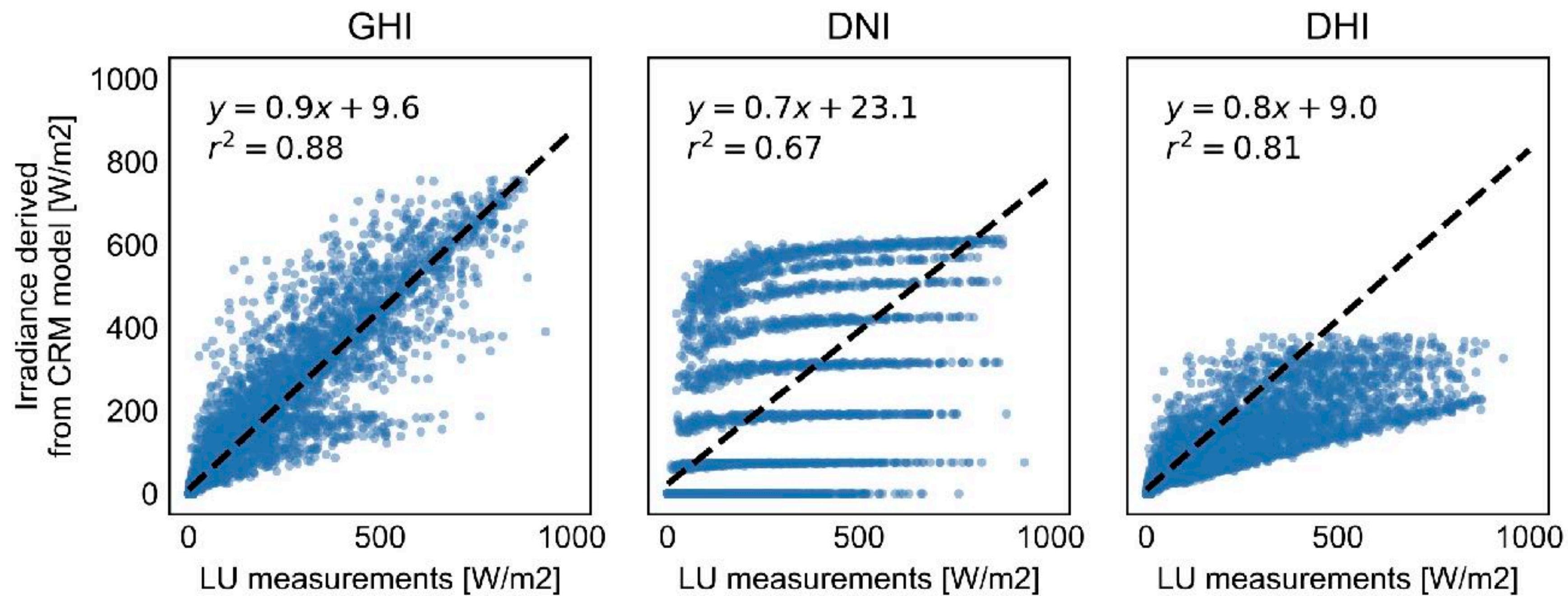
- 1-min time step
- Global and diffuse horizontal illuminance [klux] and irradiance* [W/m²]
- 2 UK locations: Loughborough and Ickworth
- 2015-present

* Loughborough only



● LU





MIDAS (Met Office from CEDA)

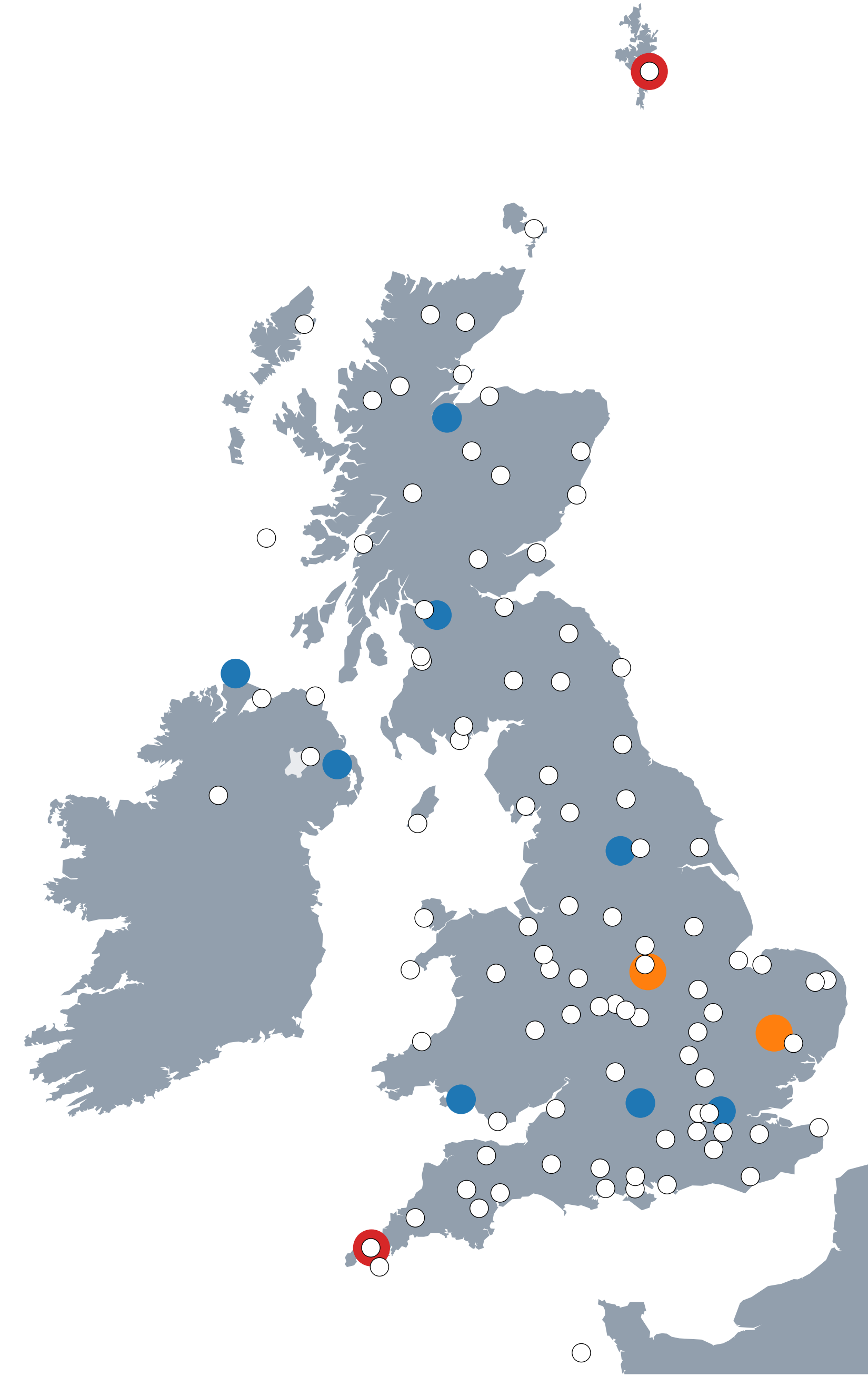
- Hourly time step
- Global horizontal irradiance [W/m²]
- 95 UK locations
- ~1980s - today

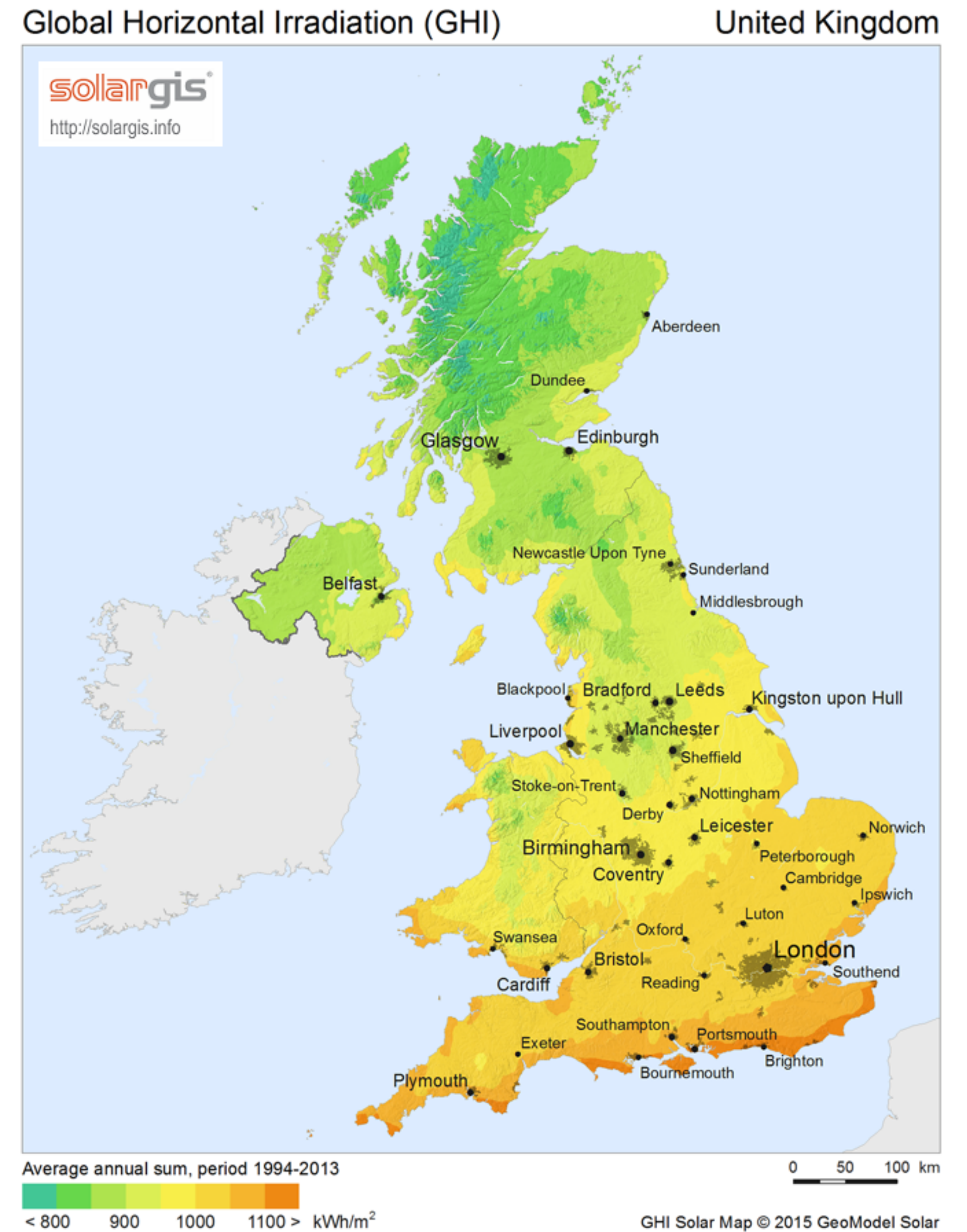
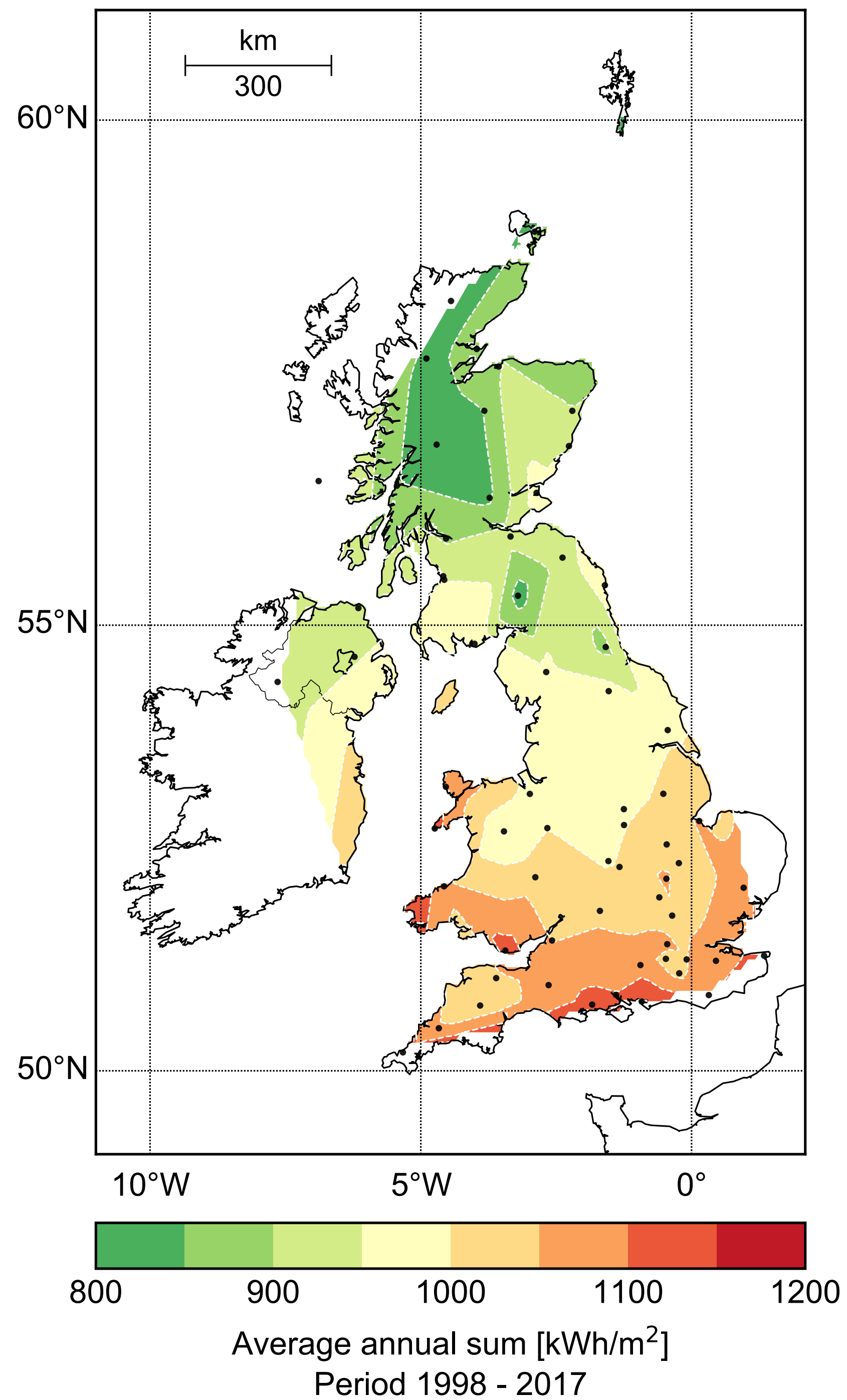


Diffuse horizontal irradiance / Direct normal irradiance

Erbs model (in gendaylit already)

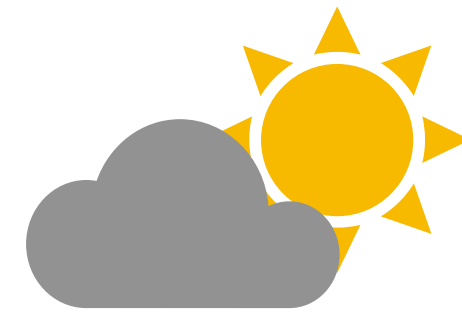
Reindl model (Jones and Reinhart, 2017)





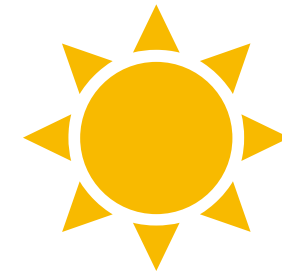
CBDM within Building Performance Simulation

► Typical climate



► Expected design performance

► Extreme climate conditions



► Resilience / Worst case scenarios

► Future climate projections



► Climate change adaptation



Thank you!

Any question?