



# Global Trends on ALAN

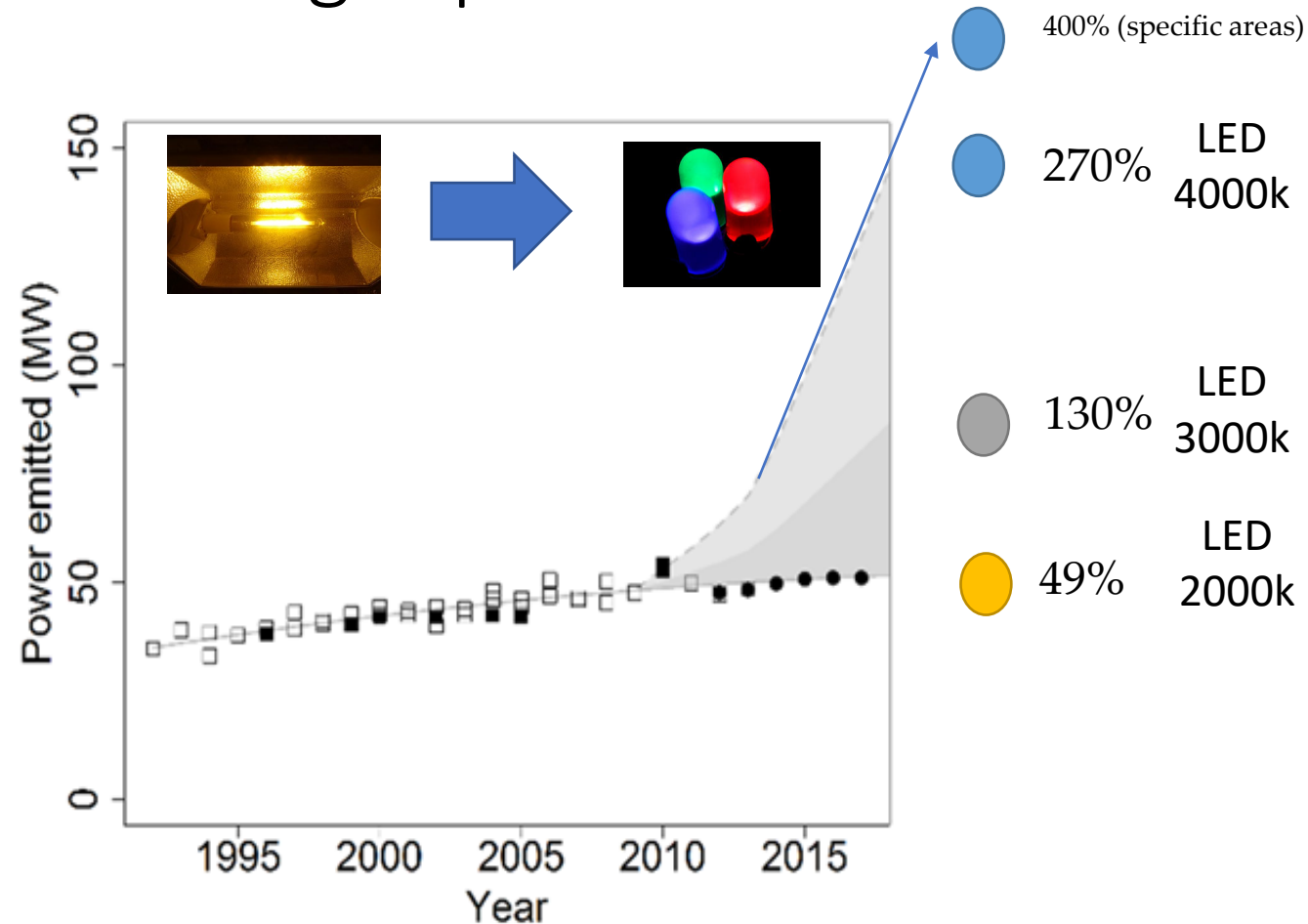
Alejandro Sánchez de Miguel



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# First estimation of global trends in nocturnal power emissions reveals acceleration of light pollution

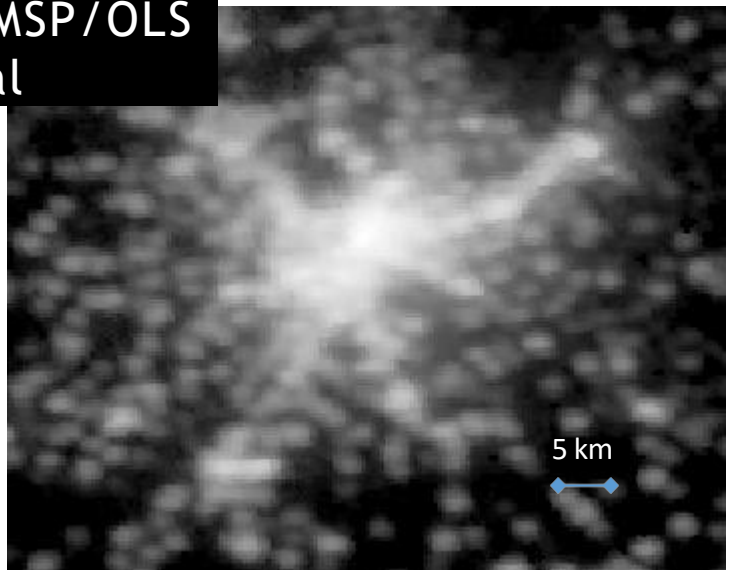


- Light pollution globally has grown at least 49% during the last 25 years, having major impact on the Earth ecosystem.
- Because of the lack of sensitivity of satellites to blue light from high CCT LEDs, this value is heavily underestimated.
- Projections for blue light emitted can be as high as 400% if most popular LEDs are of CCT 4000k on some regions.
- Even LED replacement to 3000 k would be contributing to a major increase of light pollution.

# COMPARING SATELLITE IMAGES

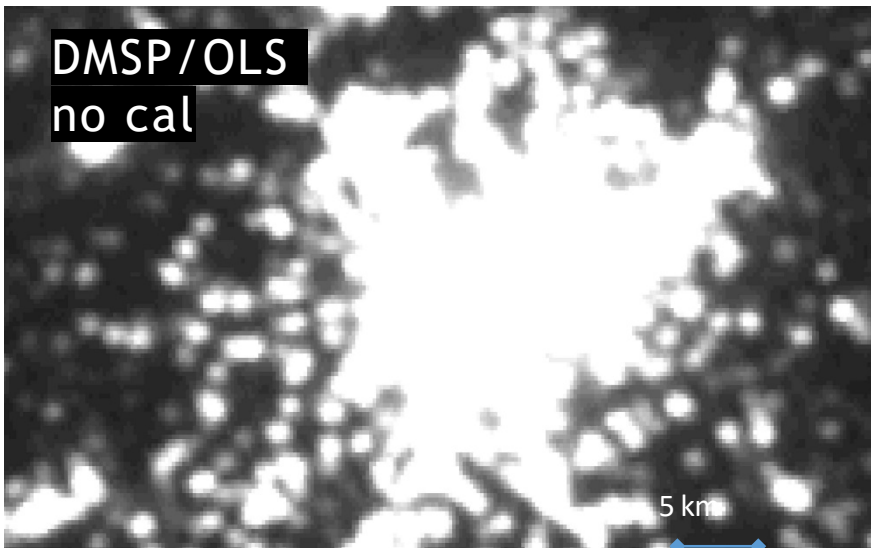
## DMSP + VIIRS + ISS

DMSP/OLS  
cal



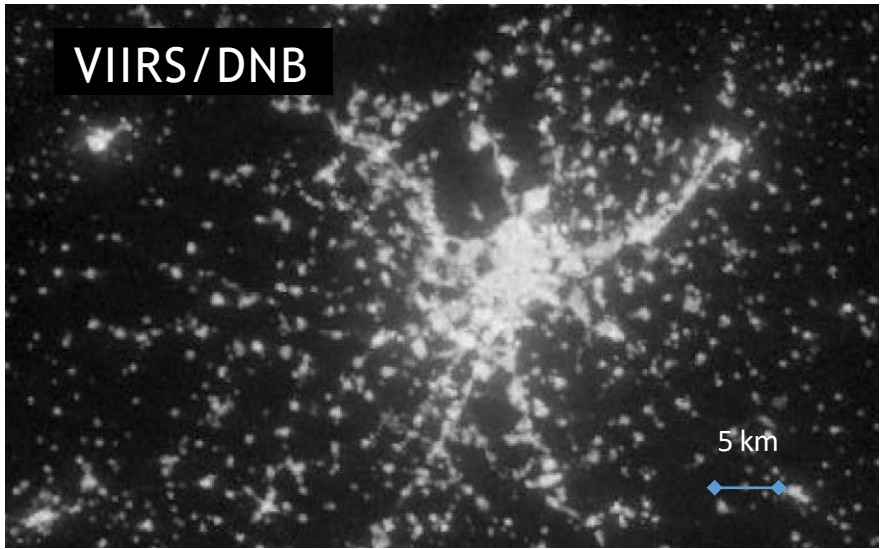
1996-2010

DMSP/OLS  
no cal



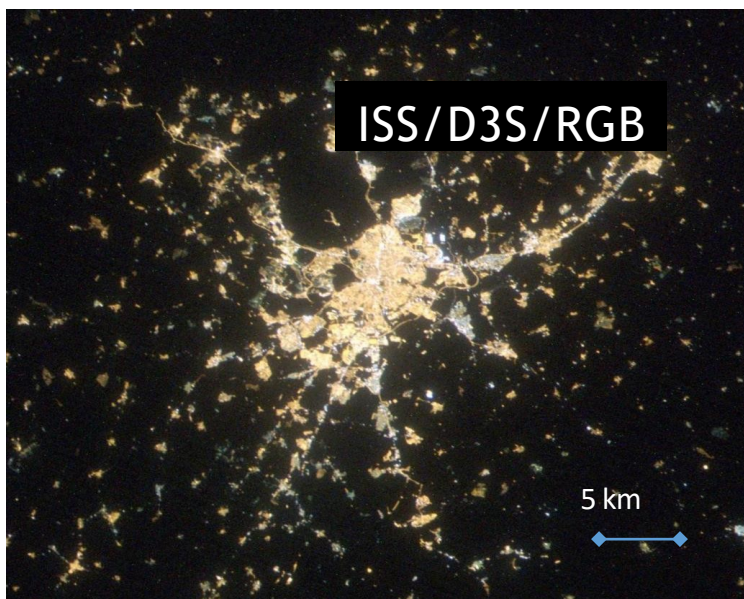
1992-2014

VIIRS/DNB



2012-2019

ISS/D3S/RGB



2003-2019

Madrid from  
space captured  
by 4 different  
satellites





SUNSET

Mapa Satélite

☐ T

☐ BG

☐ GR

☐ Layer 7

☐ 2021-2

☒ 2021

☐ 2020

☐ 2018-Lux

☐ 2018

☒ 2019

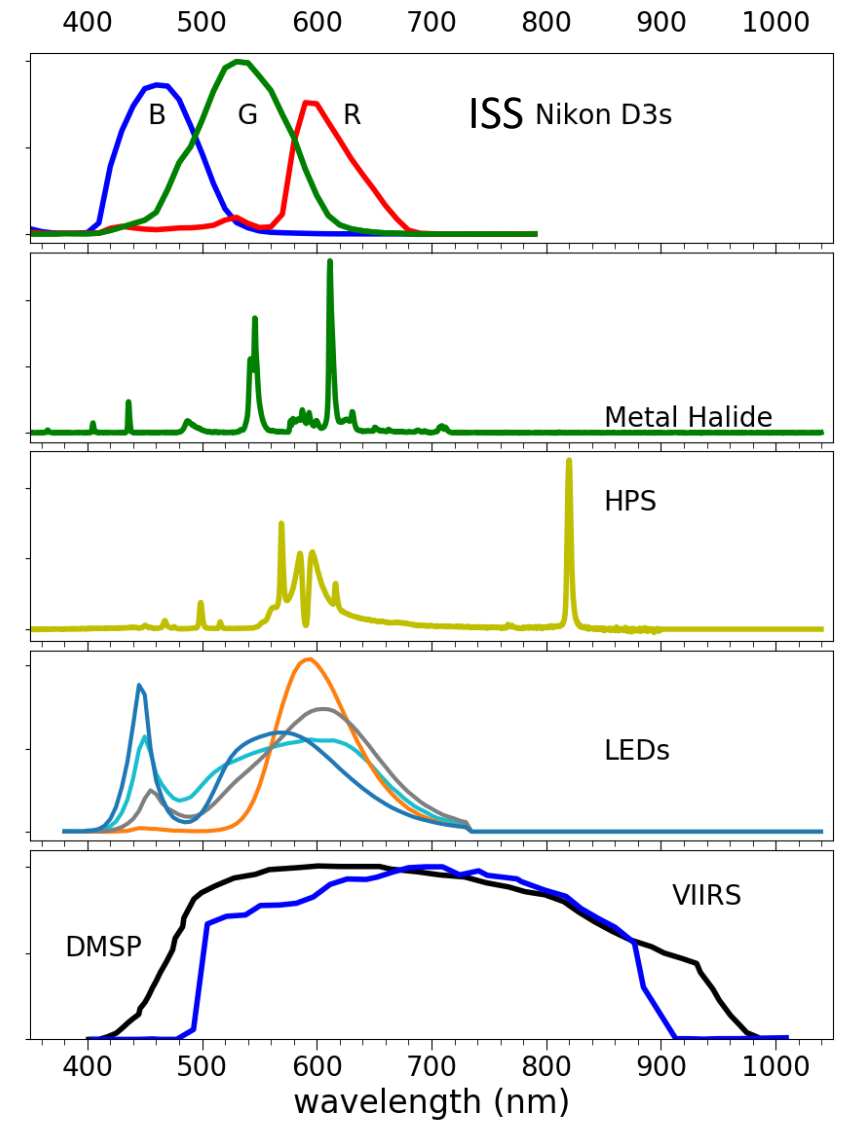
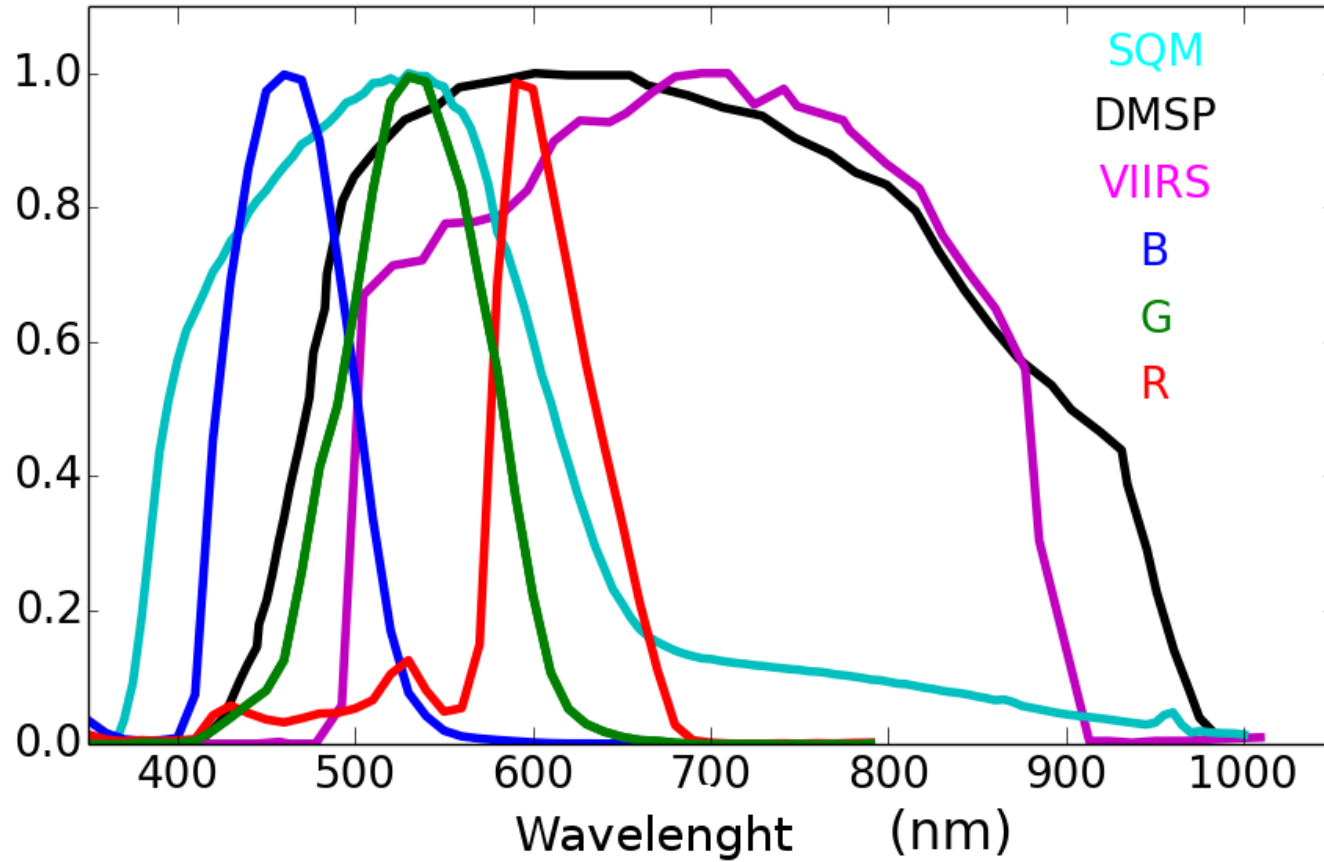




MIDNIGHT

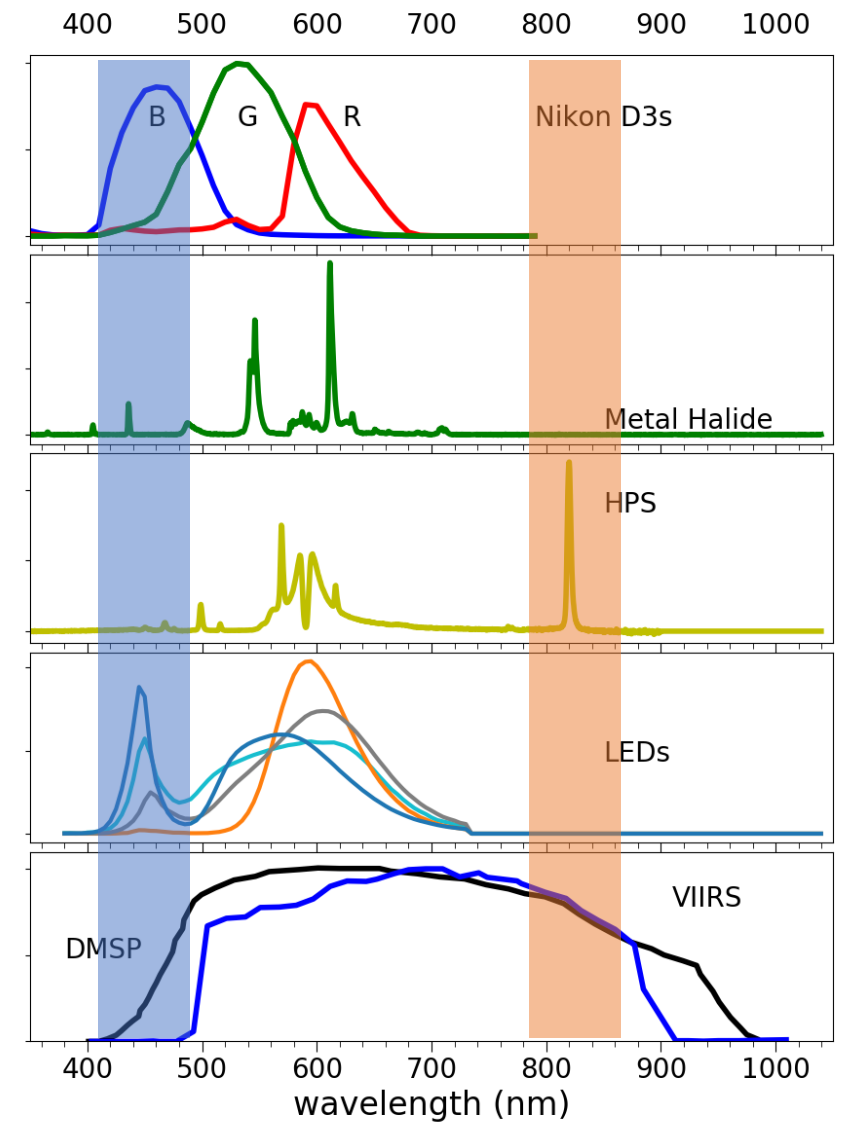
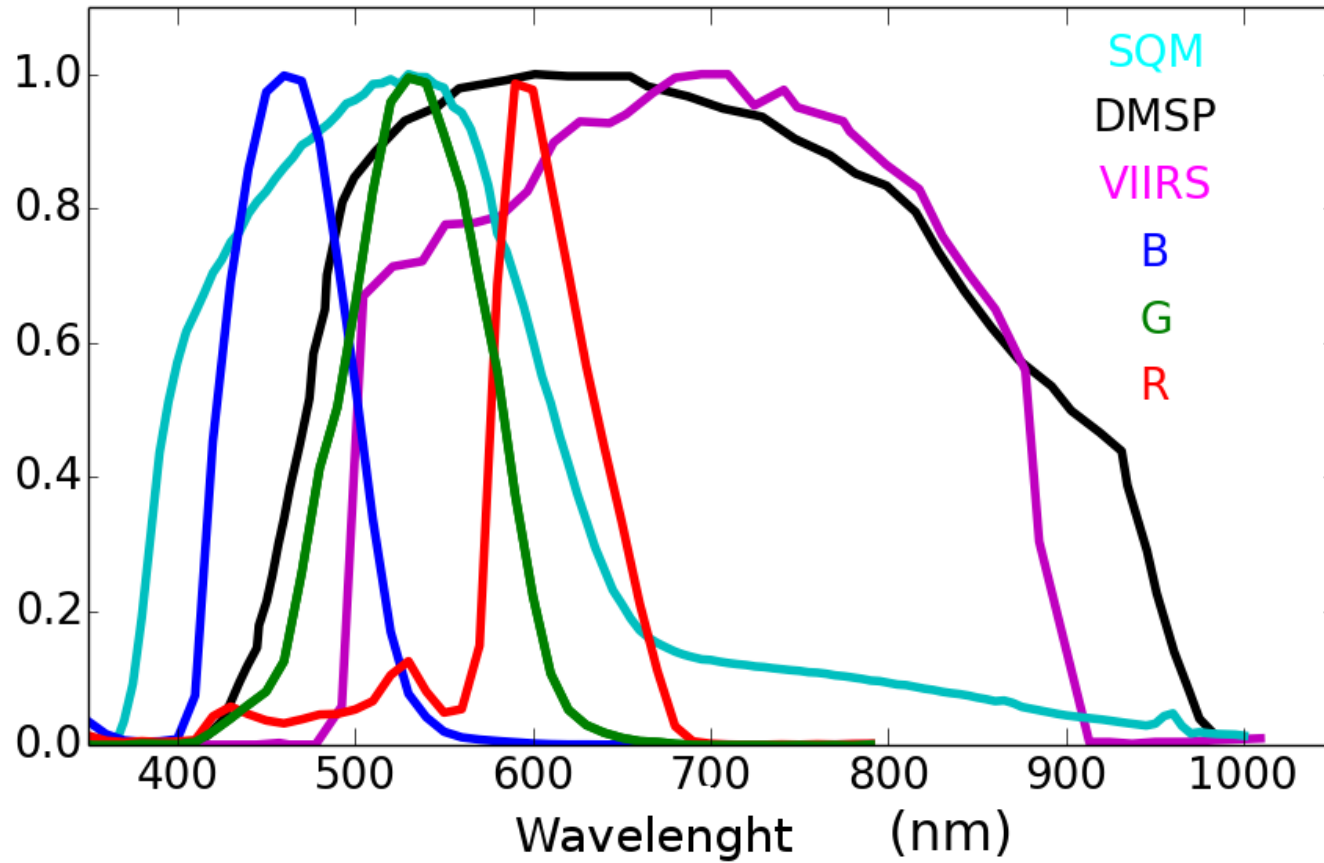


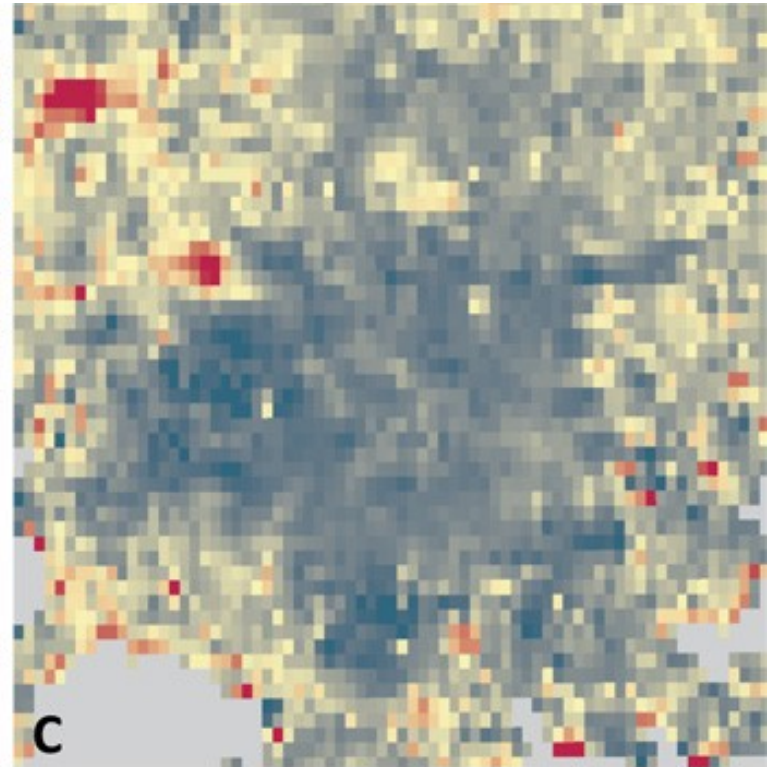
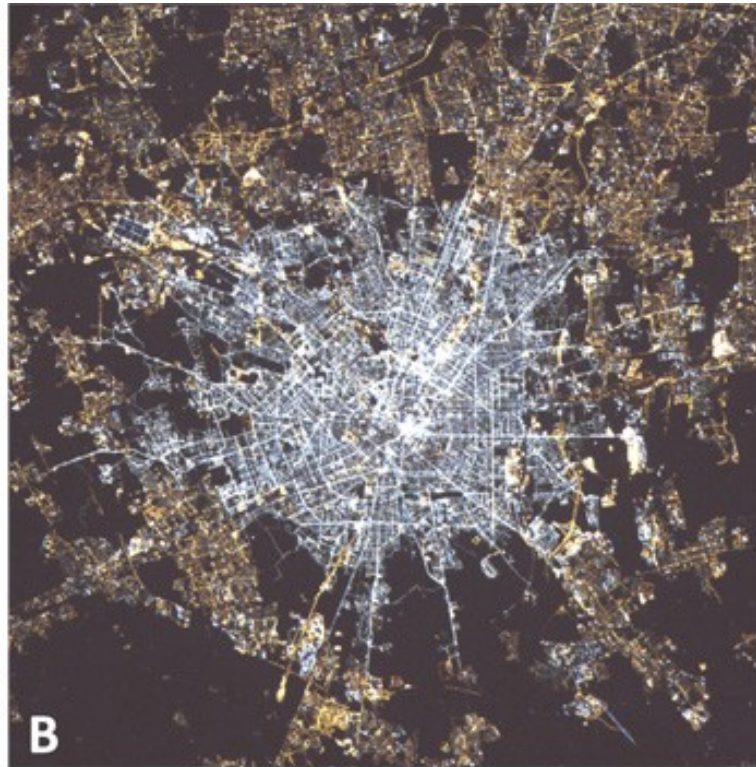
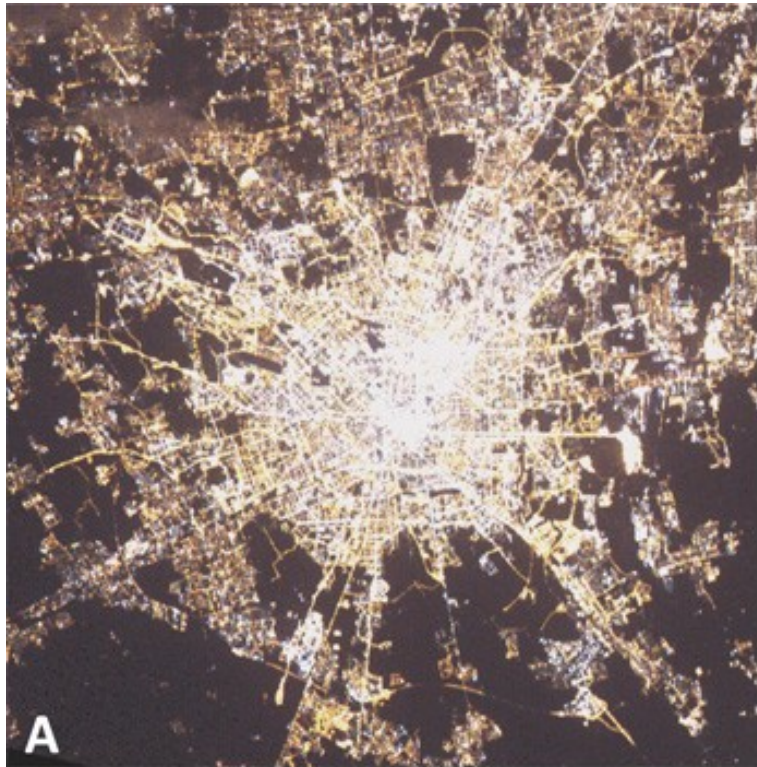
LED light sources have been responsible for many false and inaccurate measurements. To avoid inaccuracy in the future it is fundamental that only colour sensitive satellites are used.



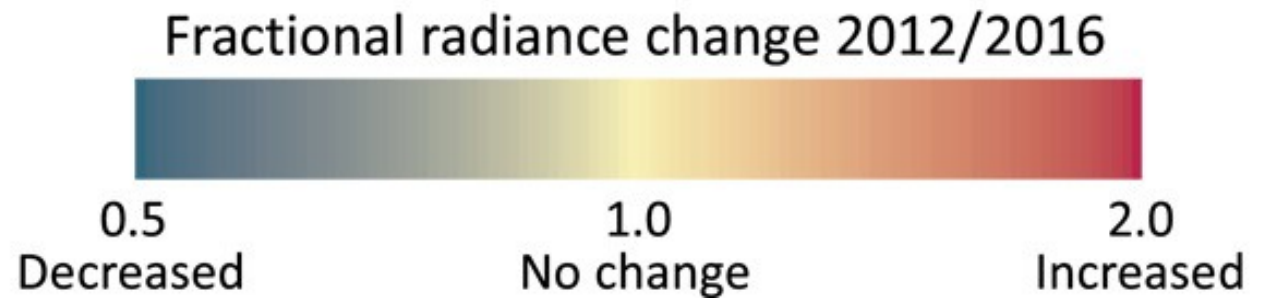
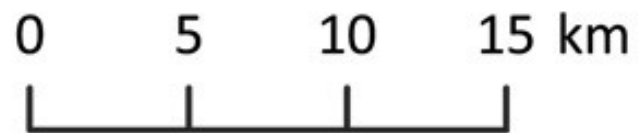


Satellites that are not colour sensitive, such as the DMSP and the VIIRS do not detect blue lights (such as many of the new LED streetlights worldwide) and detect spurious infrared lights





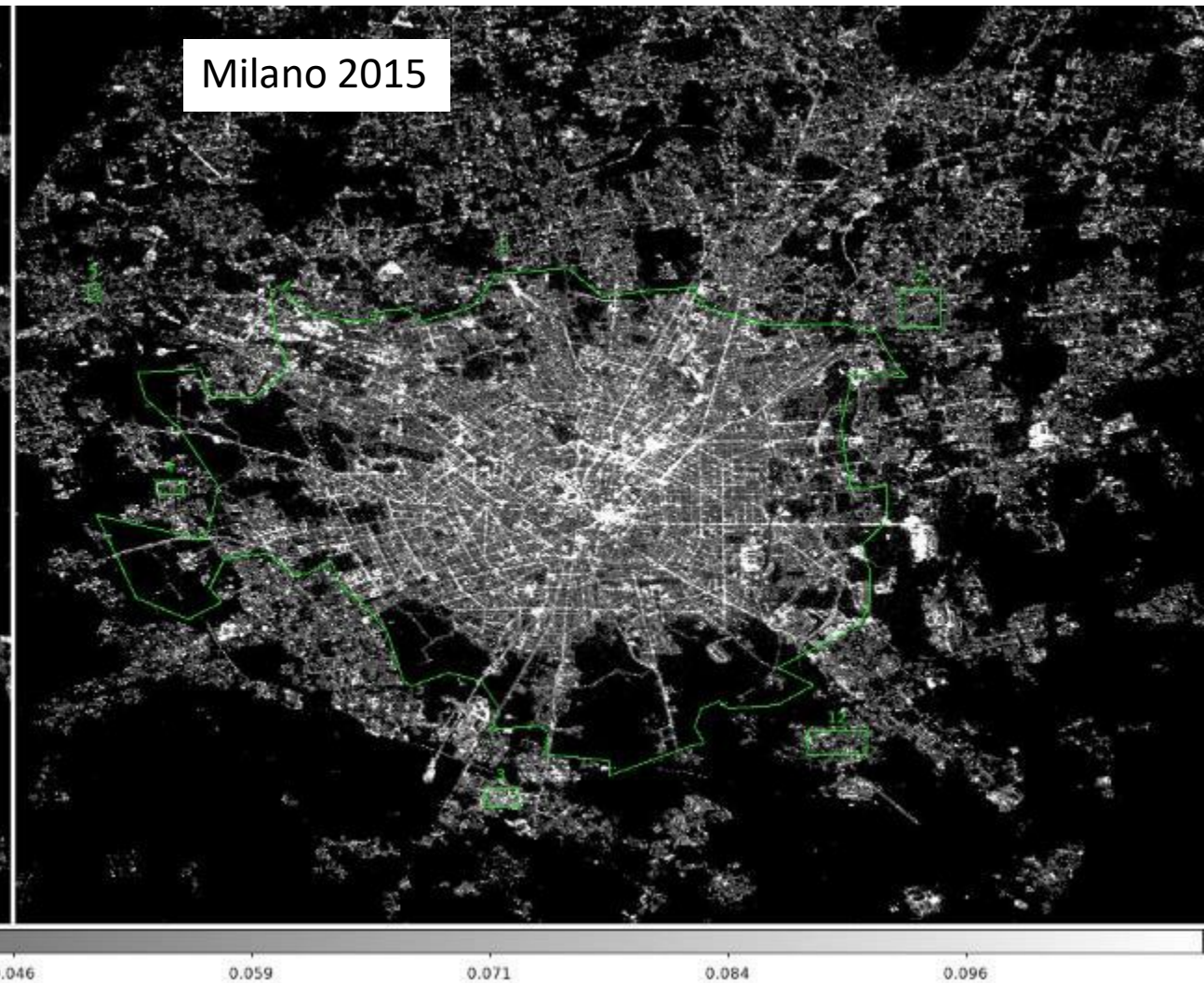
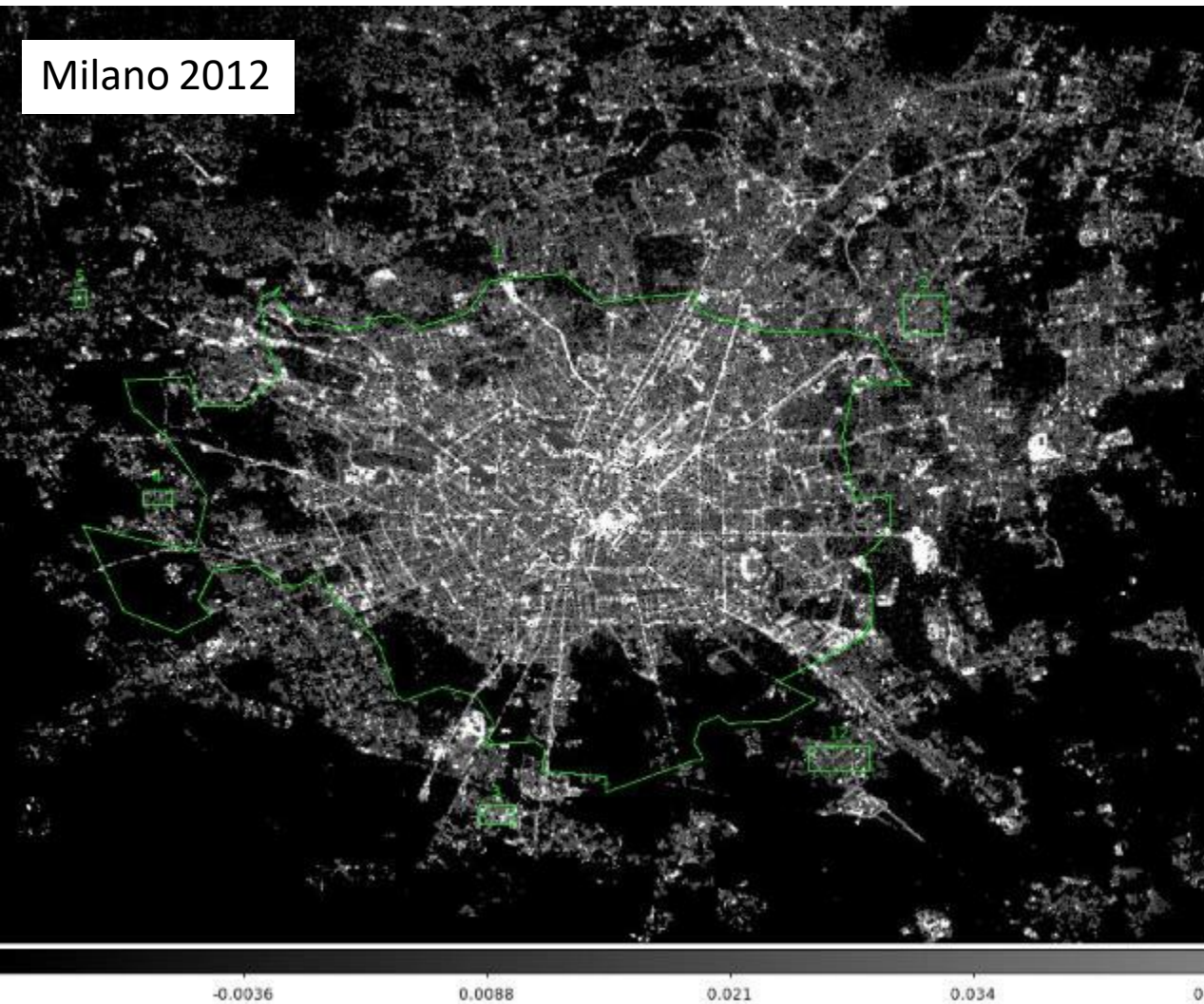
**Milan, Italy**





# Milano before and after: same large scale illumination level

Sánchez de Miguel, A. , Kyba, C. C., Aubé, M., Zamorano J., Cardiel, N., Tapia, C., ... & Gaston, K. J. (2019). Colour remote sensing of the impact of artificial light at night (I): The potential of the International Space Station and other DSLR-based platforms. *Remote Sensing of Environment*, 224, 92-103.





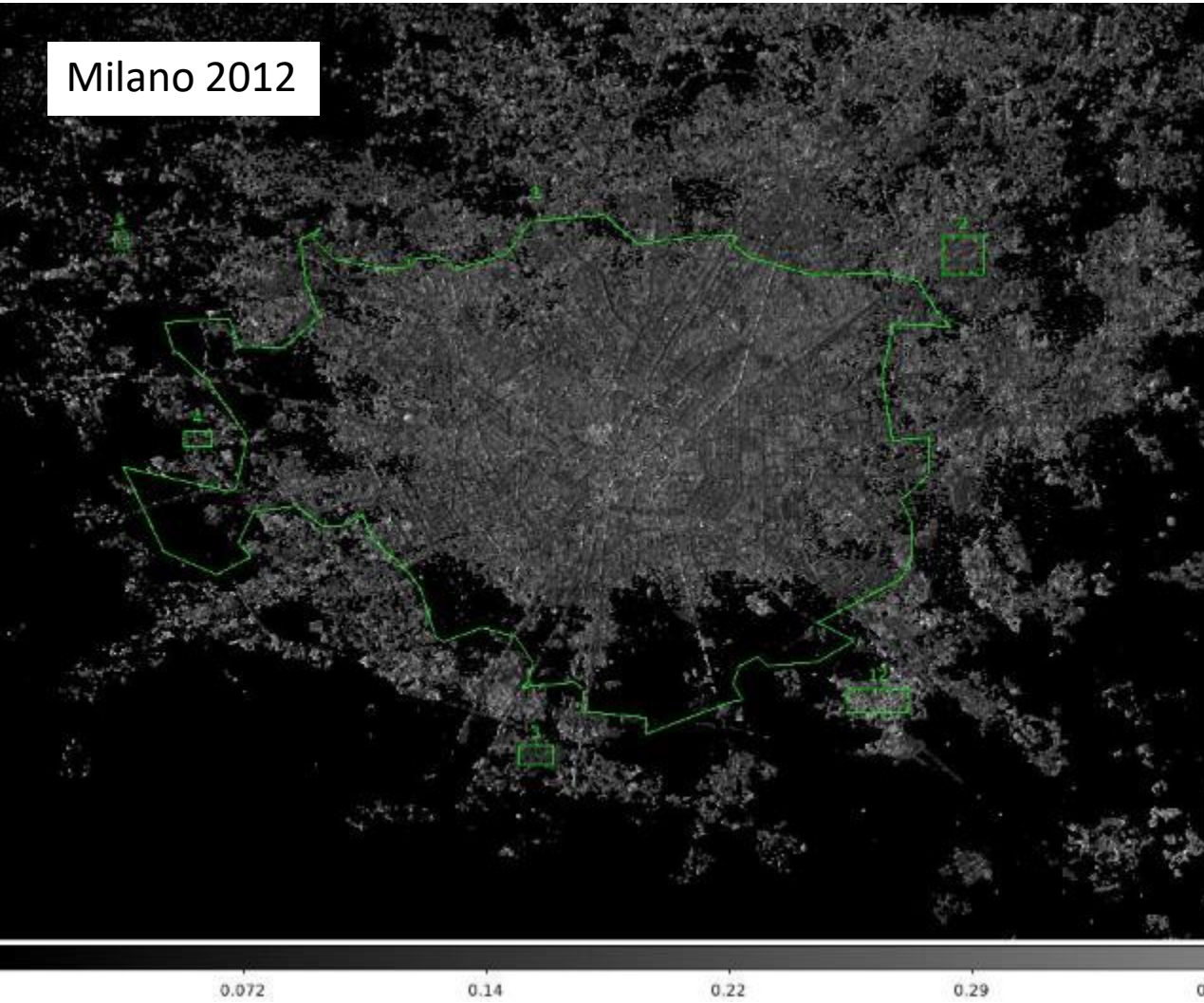
# No same color

MSI 37% higher

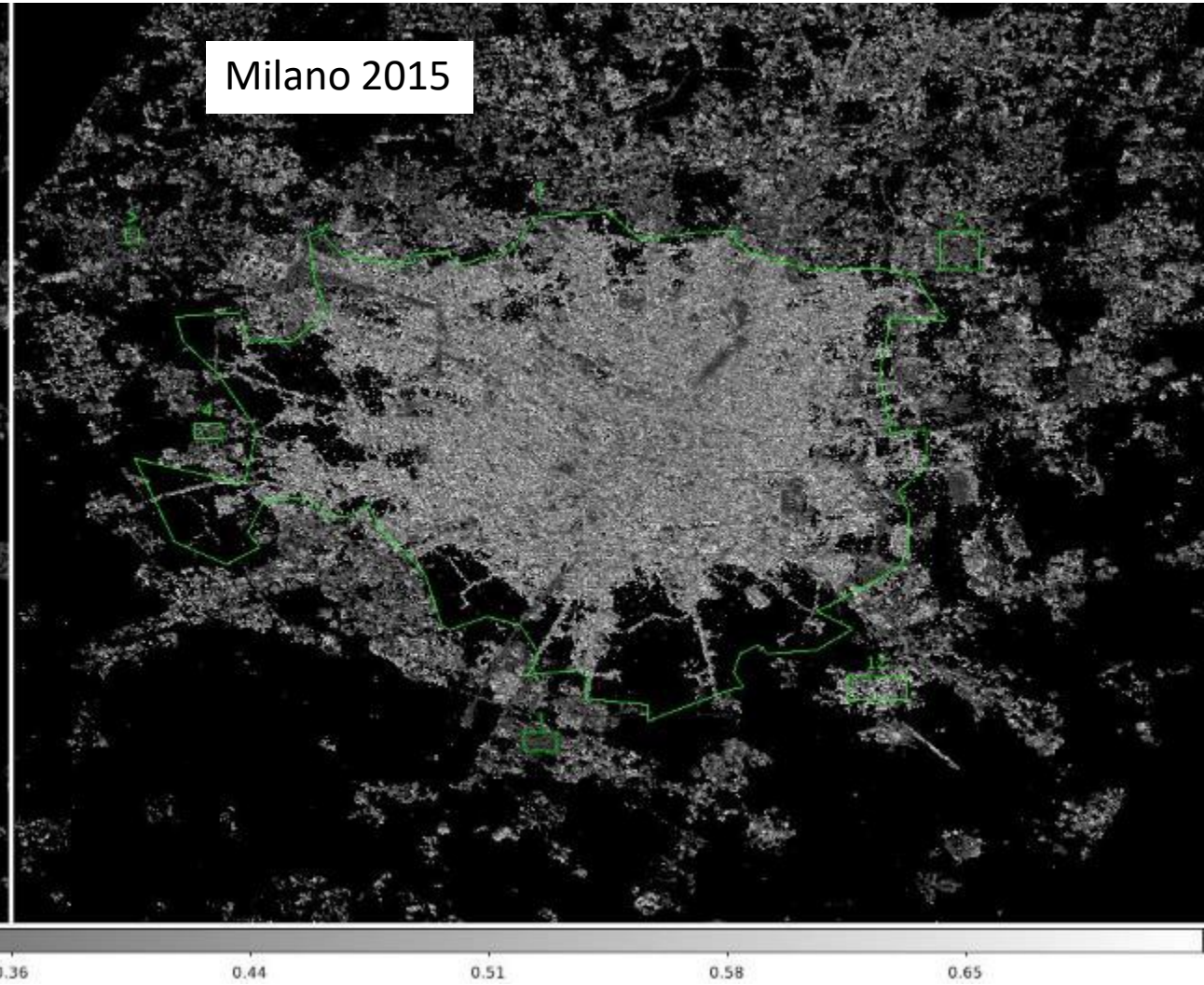
Health related

Melatonin suppression Impact

Milano 2012



Milano 2015





# No same impact

Impact increased by 27%

Health related

Melatonin suppression Impact

Milano 2012

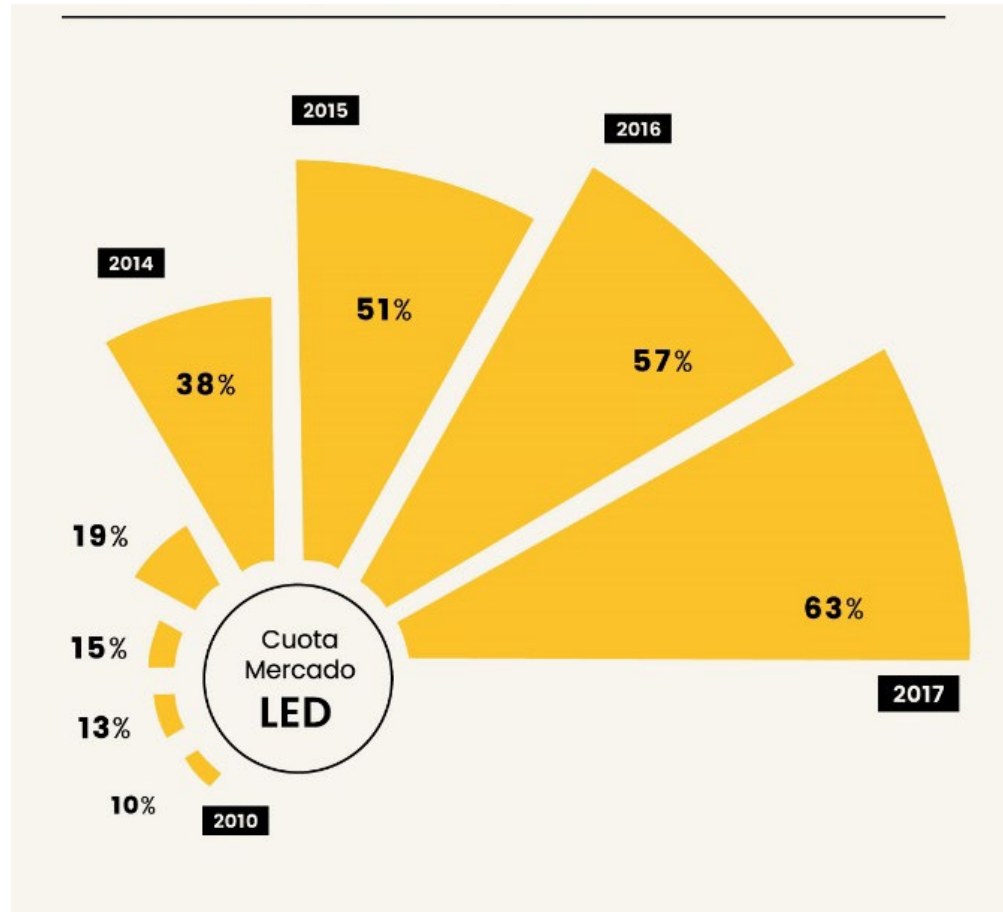


Milano 2015



0.0060 0.0120 0.0180 0.0240 0.0300 0.0360 0.0420 0.0480 0.0540

# LED lighting sales in Spain



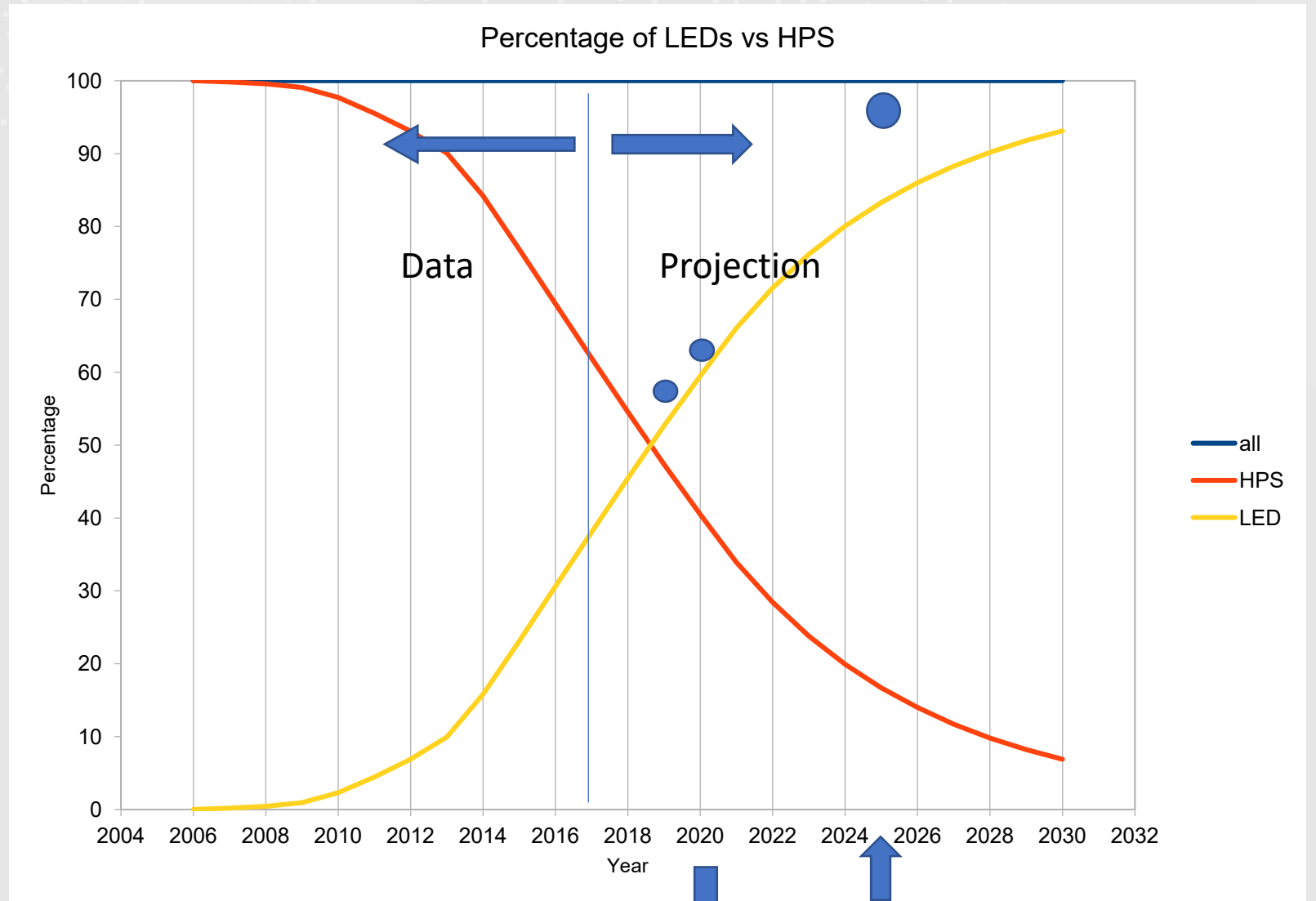
Source Smart lighting from Anfalum

# National Lighting Survey (UK)





# HPS to LED transition



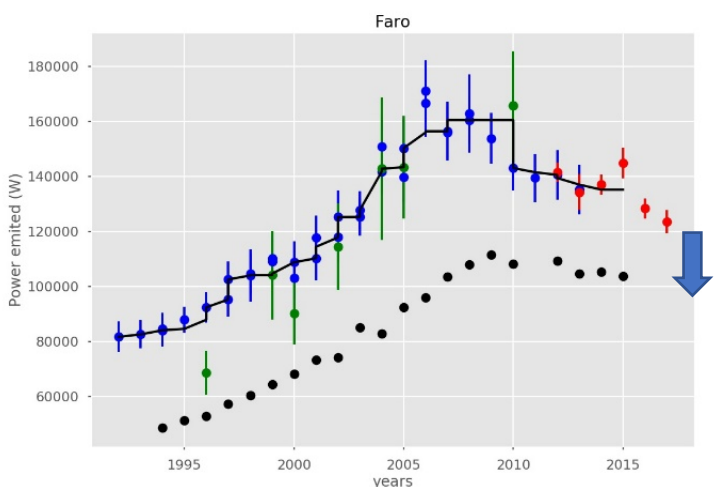
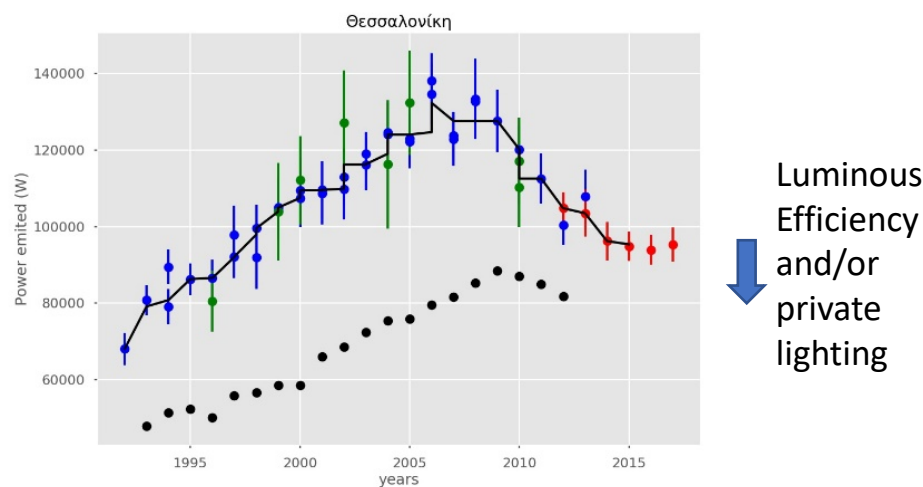
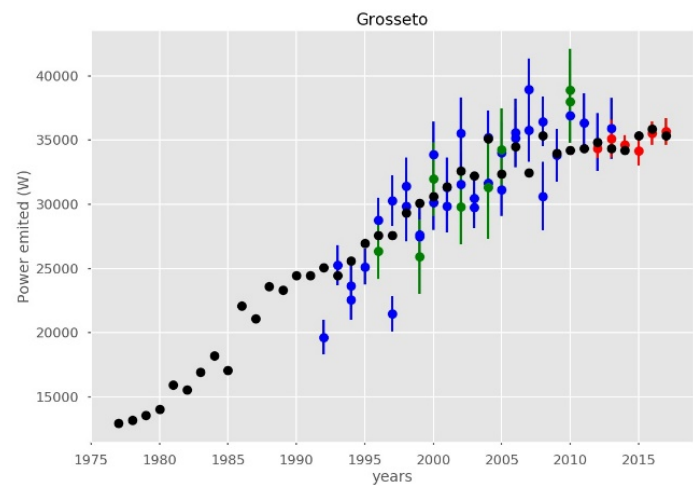
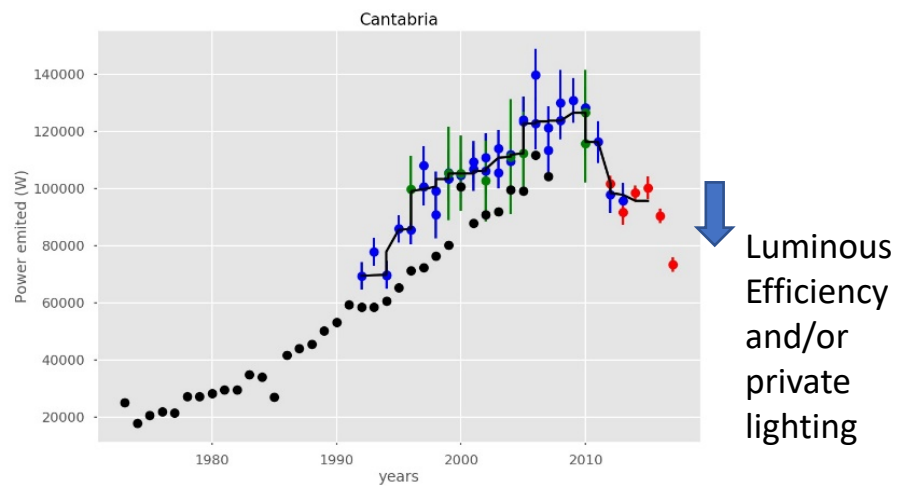
Lamp replacement at 24000 h

Year use 4100 h

No other considerations like stock out or subsidies

UK

Frost & Sullivan, LEDs to account for 98% of all lighting by 2025, press release by Julien Happich published online, April 25, 2017



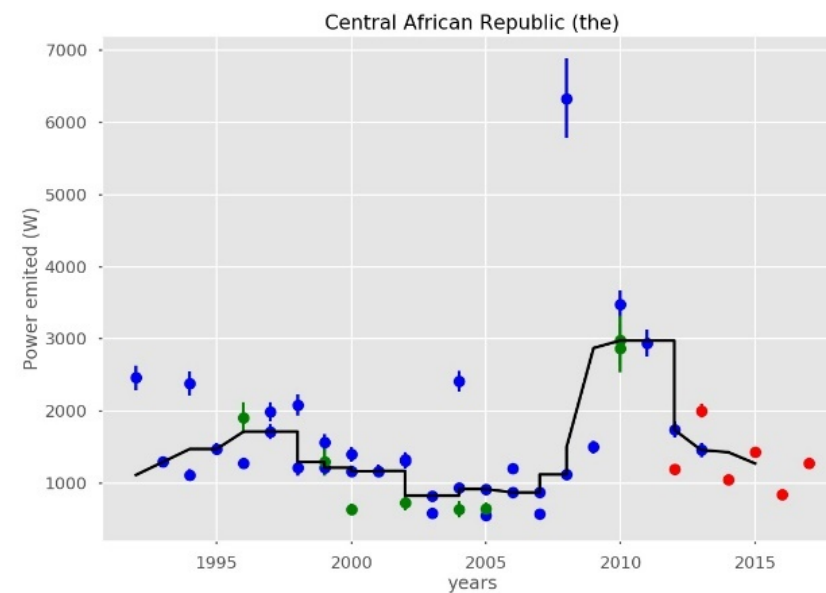
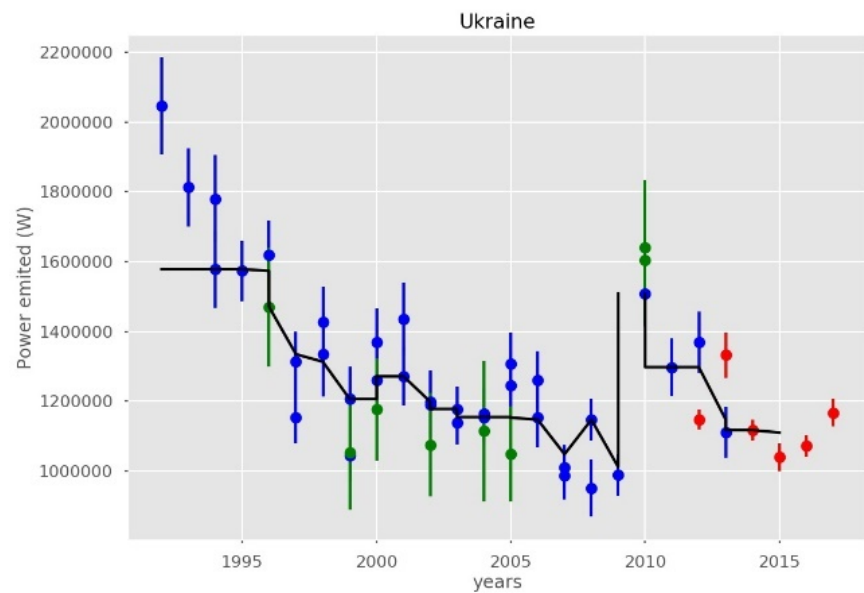
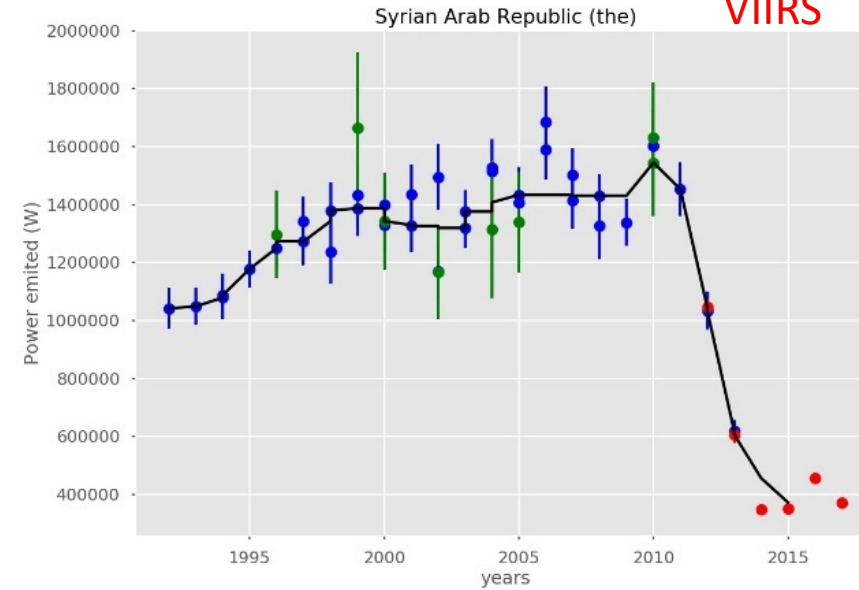
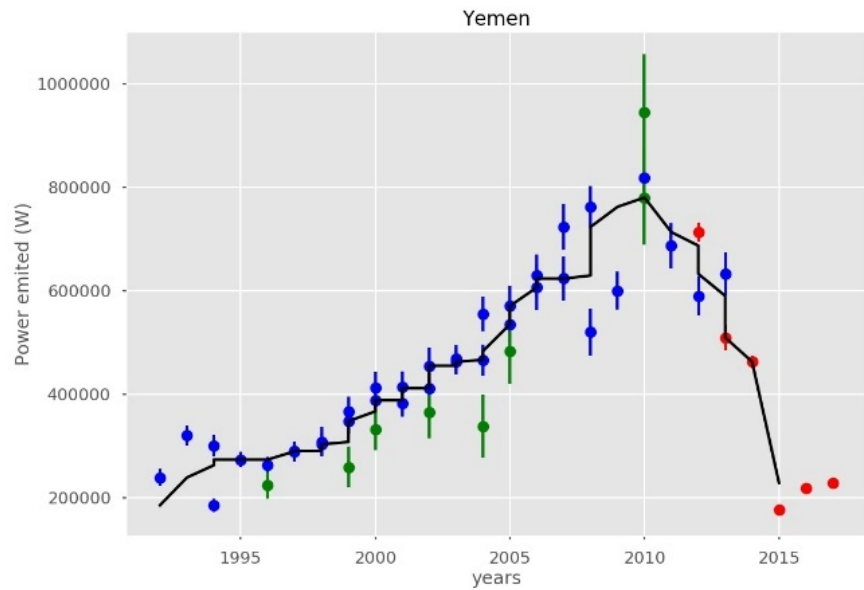
DMSP NON-CAL  
DMSP CAL  
VIIRS  
STREET LIGHTING

➡ Billing effect

➡ Billing effect



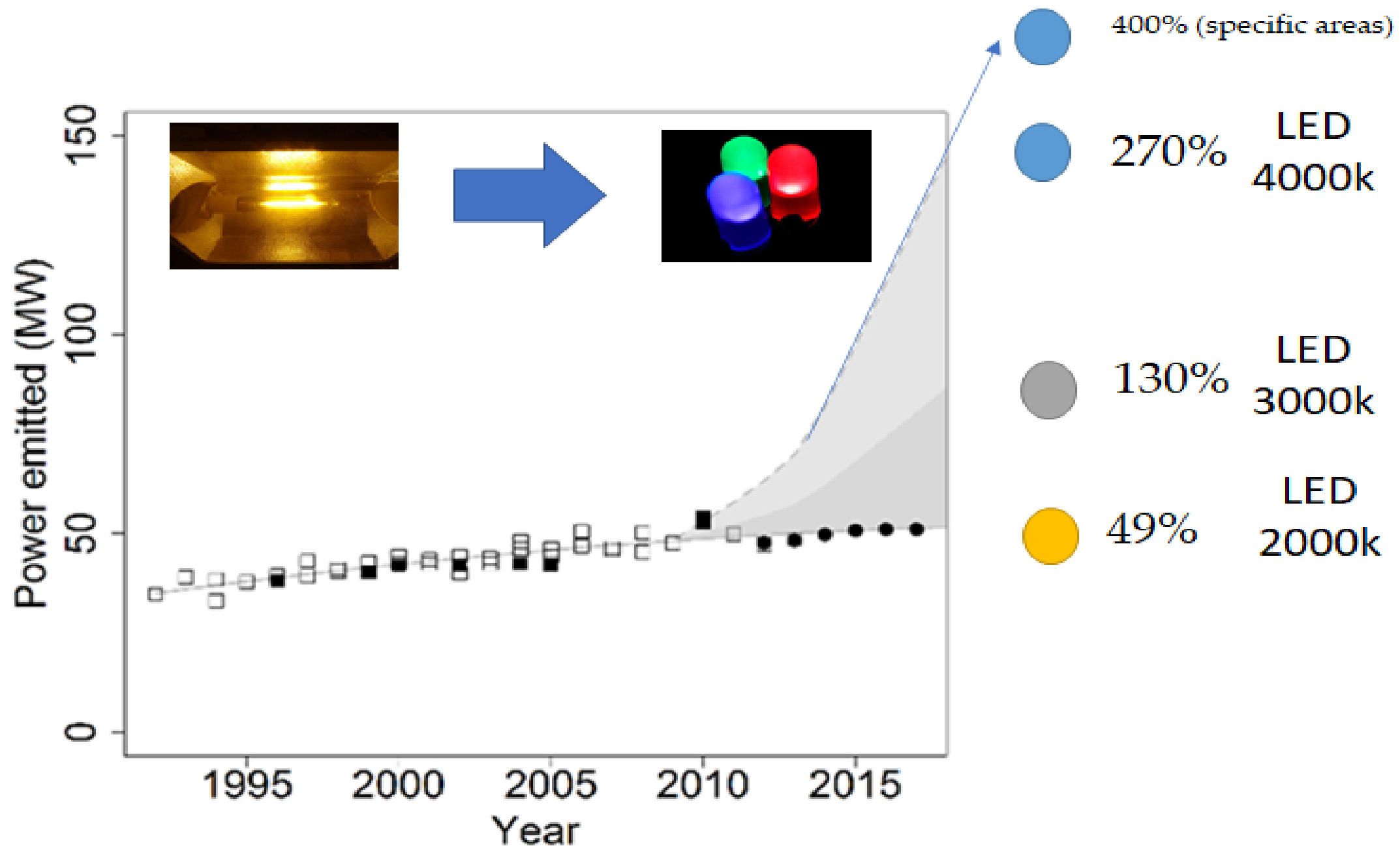
# Conflict zones



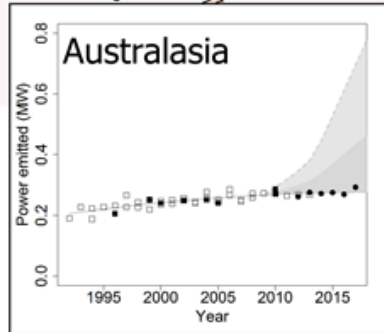
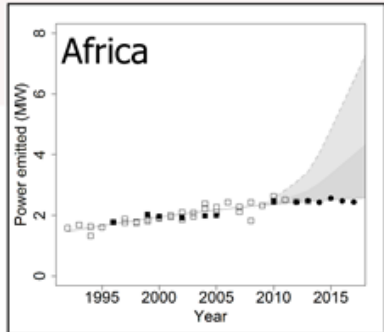
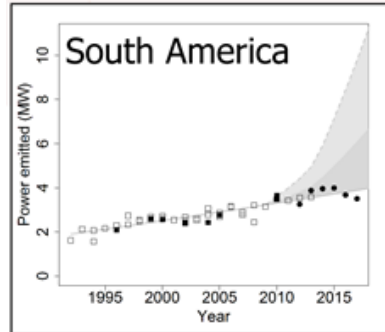
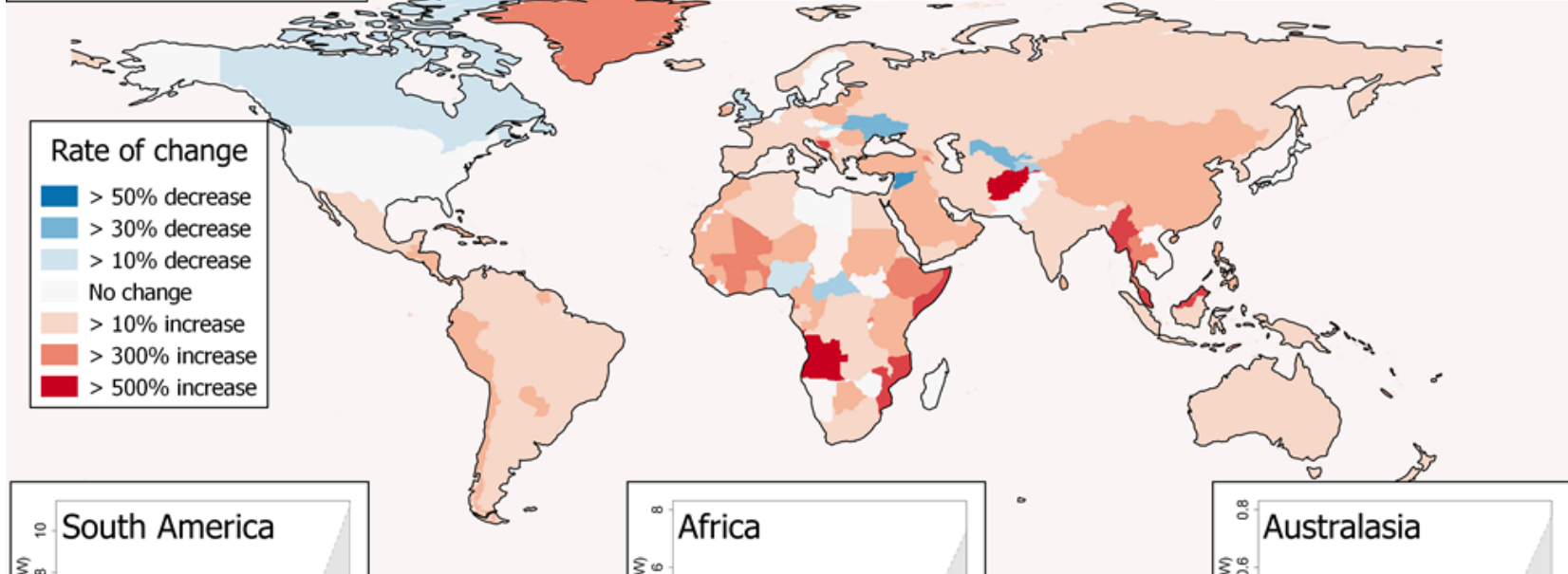
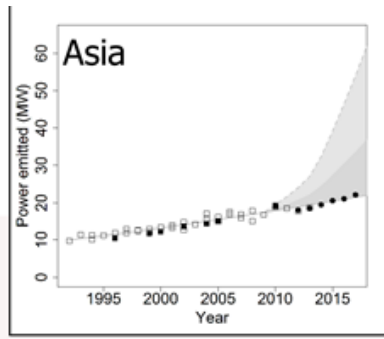
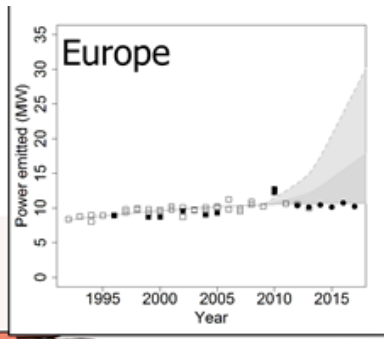
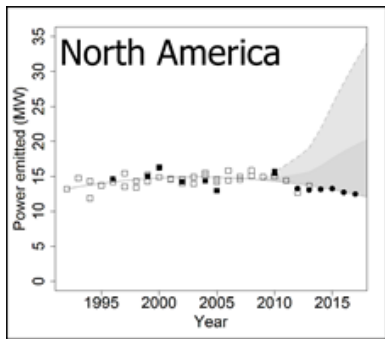
DMSP NON-CAL  
DMSP CAL  
VIIRS

# Results







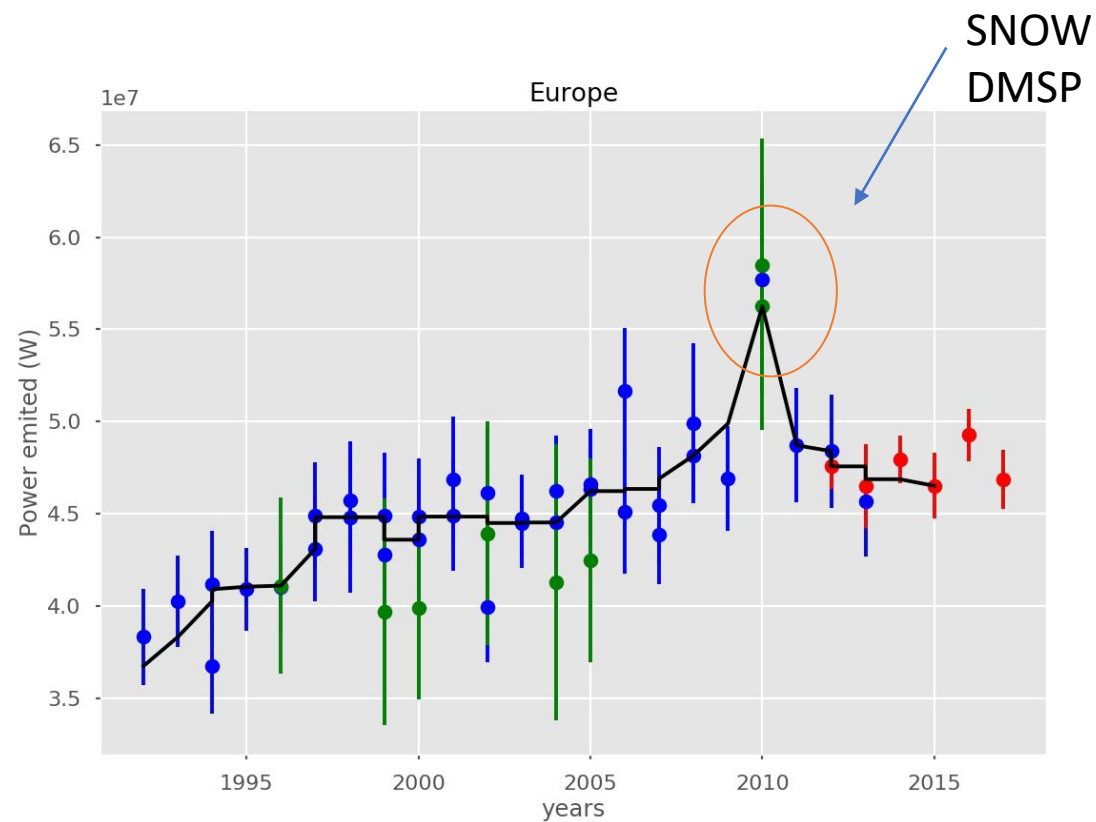
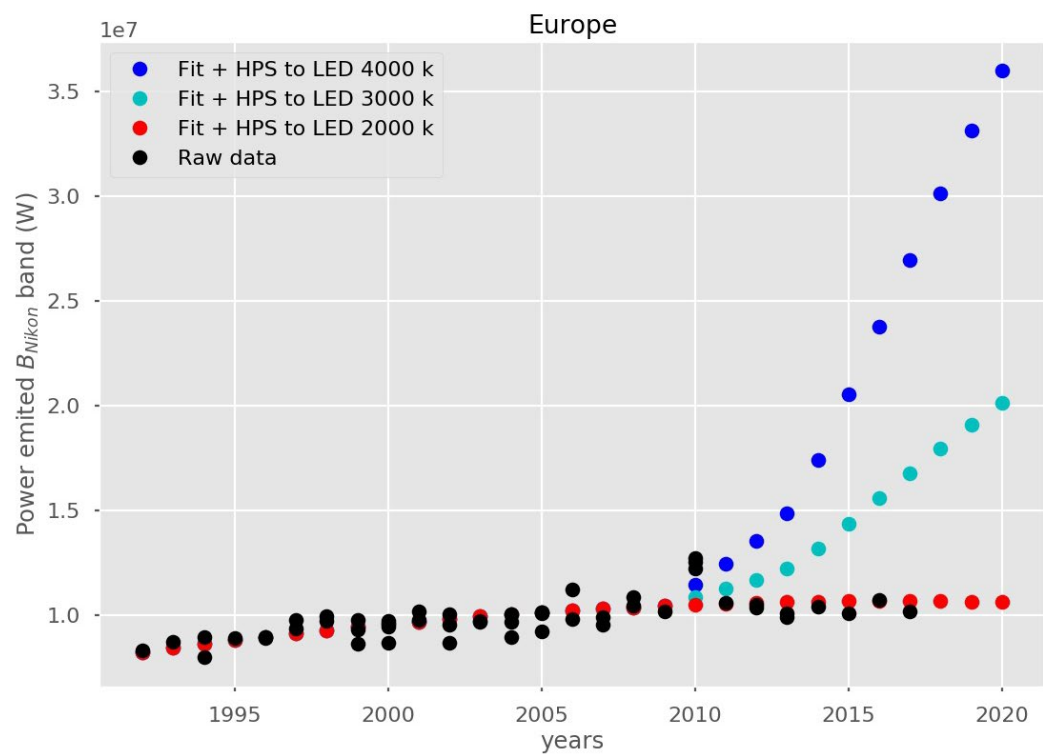








# Europe



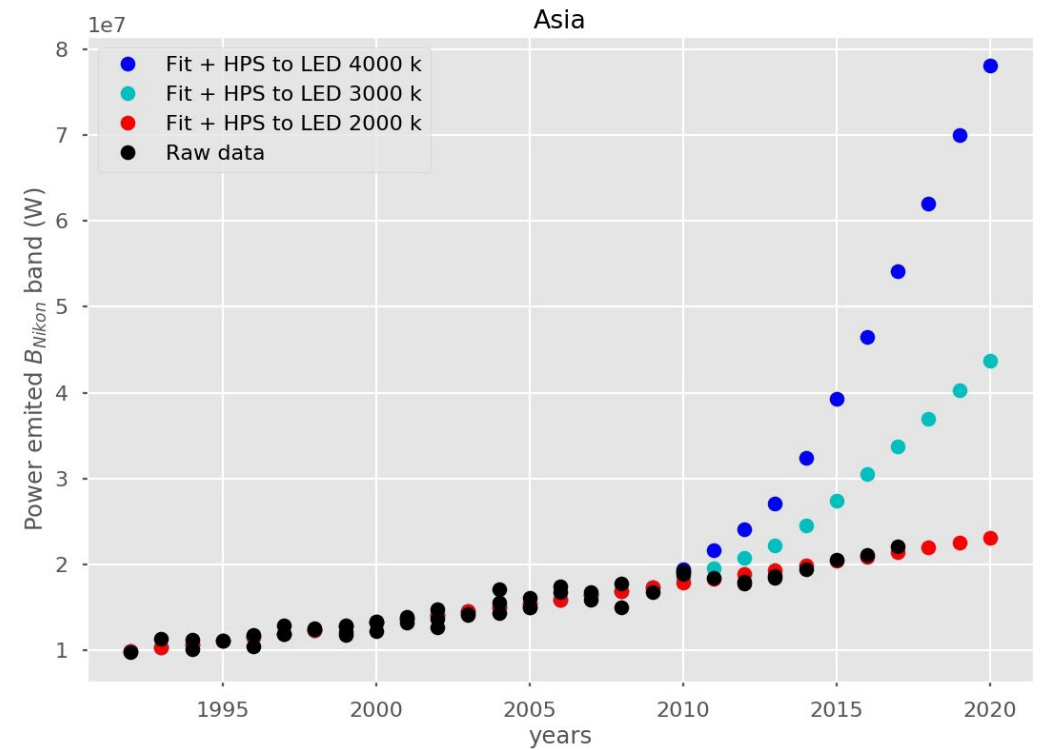
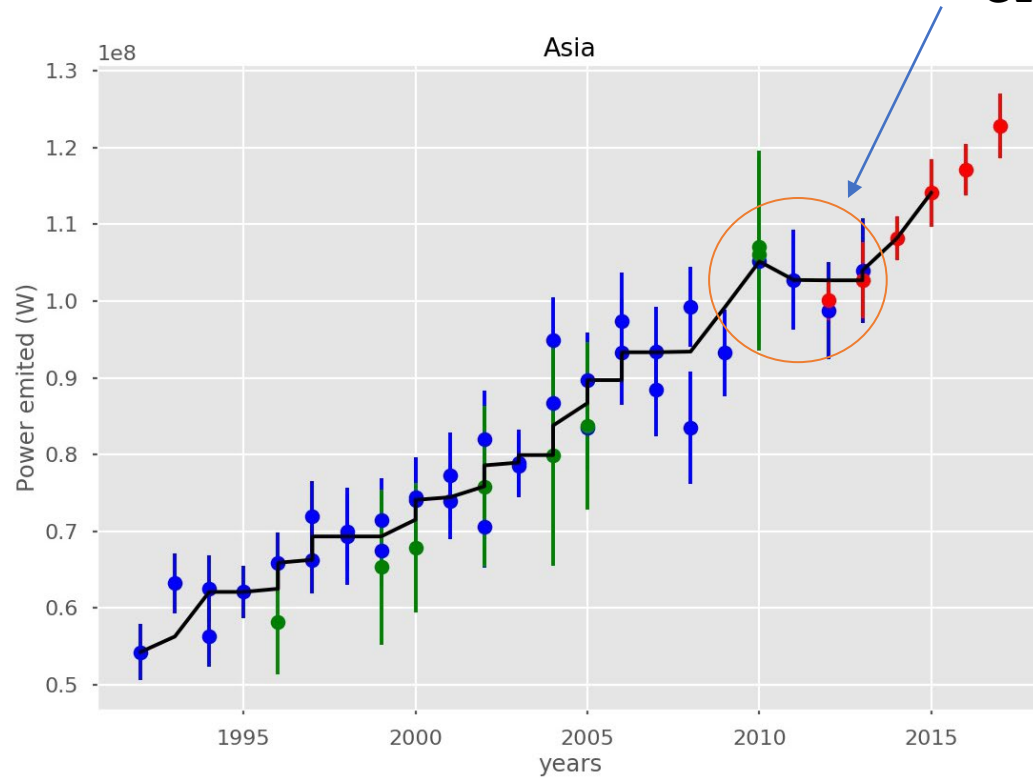




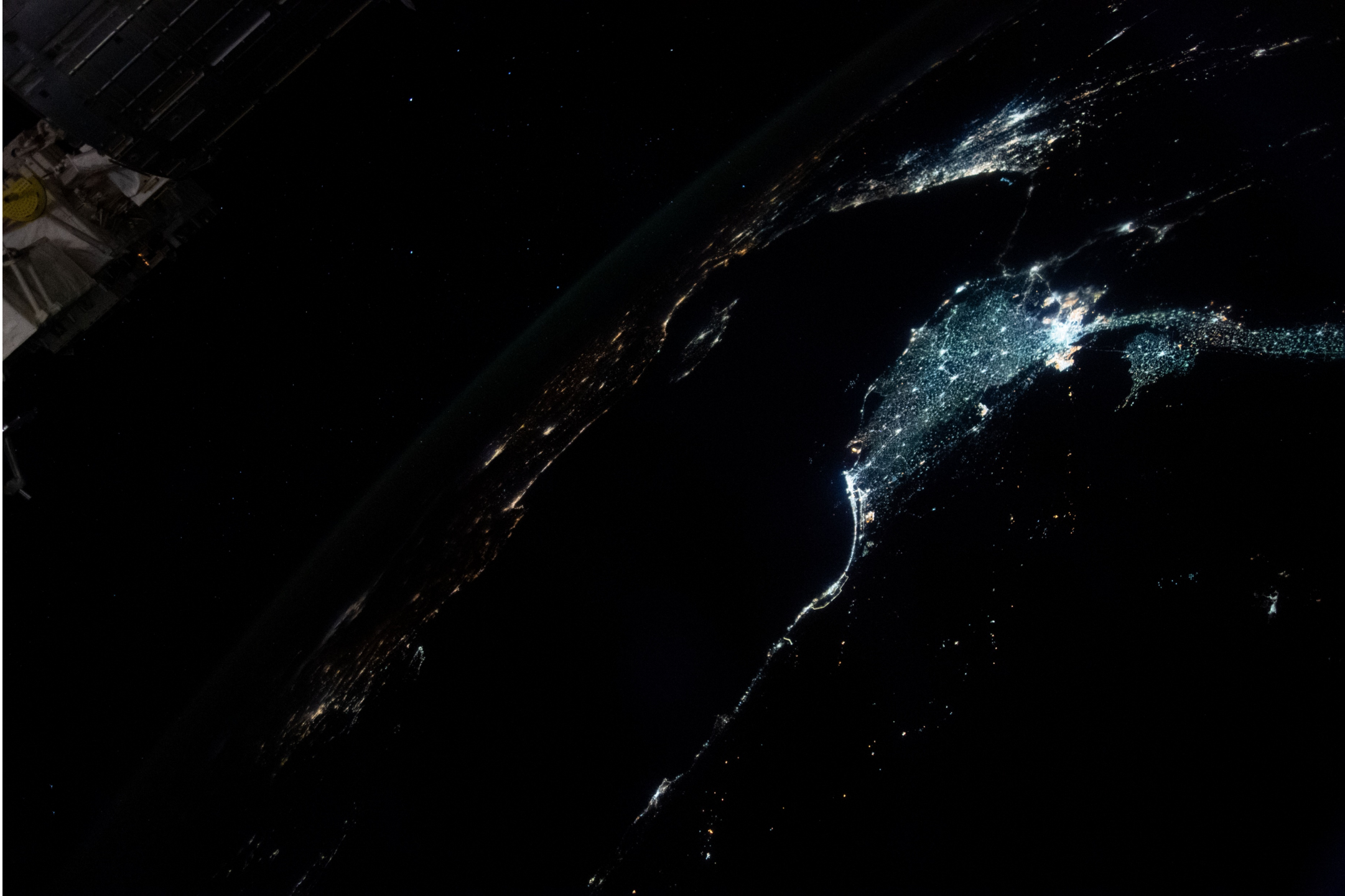


# Asia

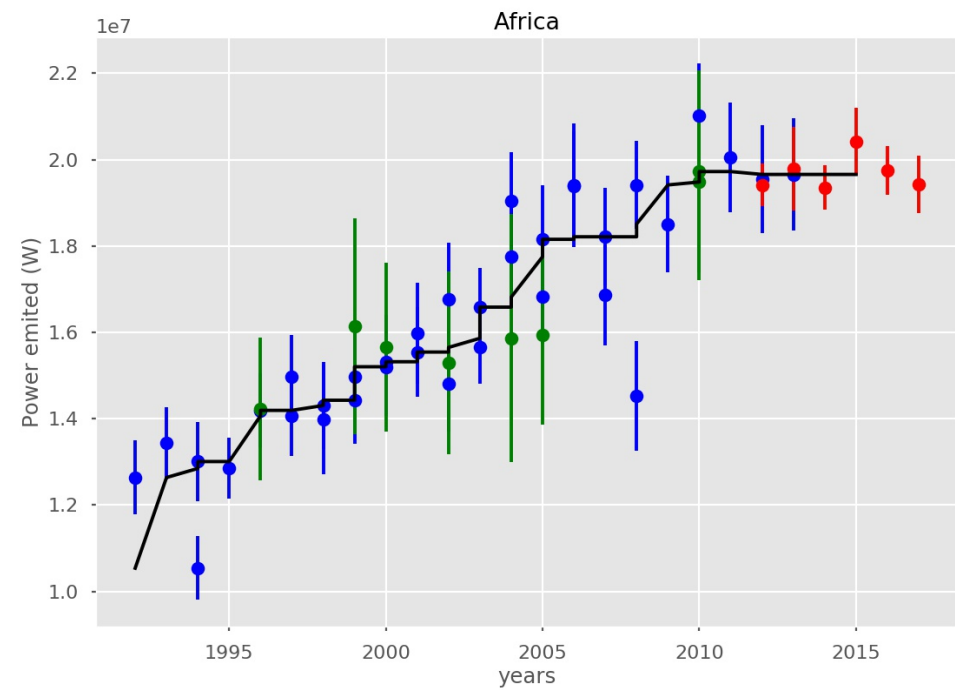
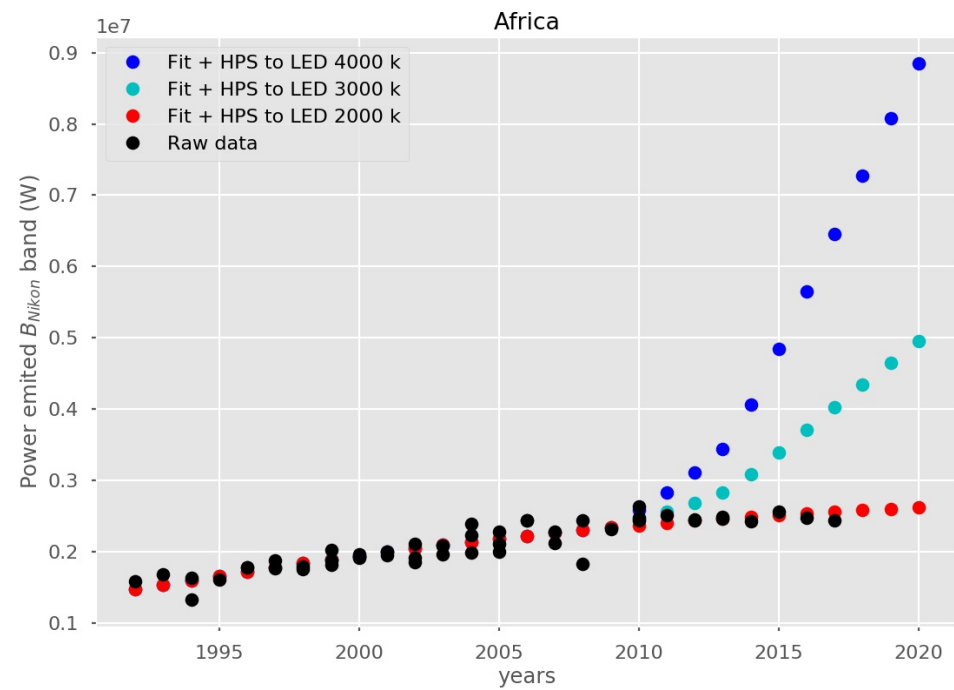
GLOBAL ECONOMIC CRISIS







# Africa



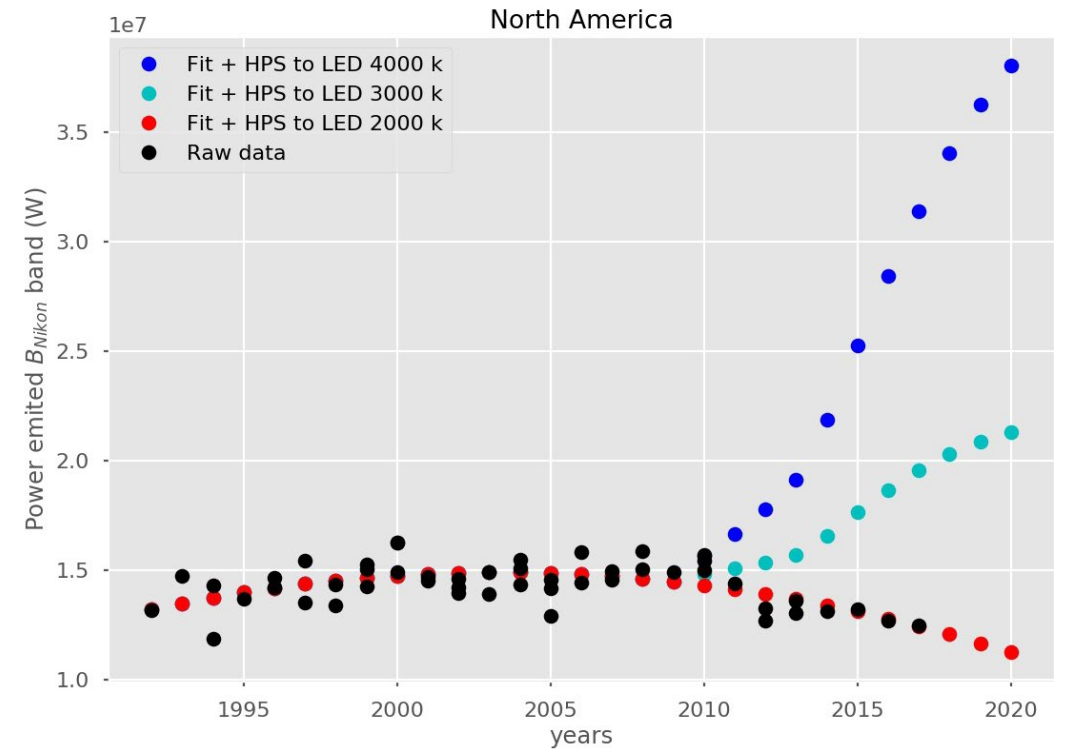
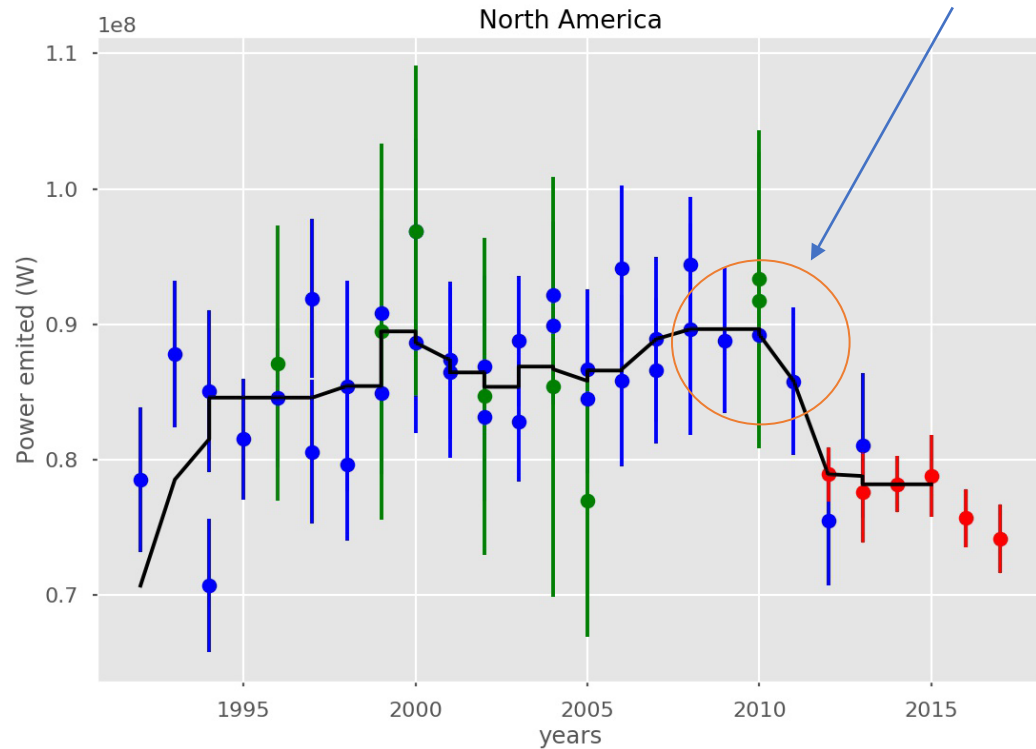






# North America

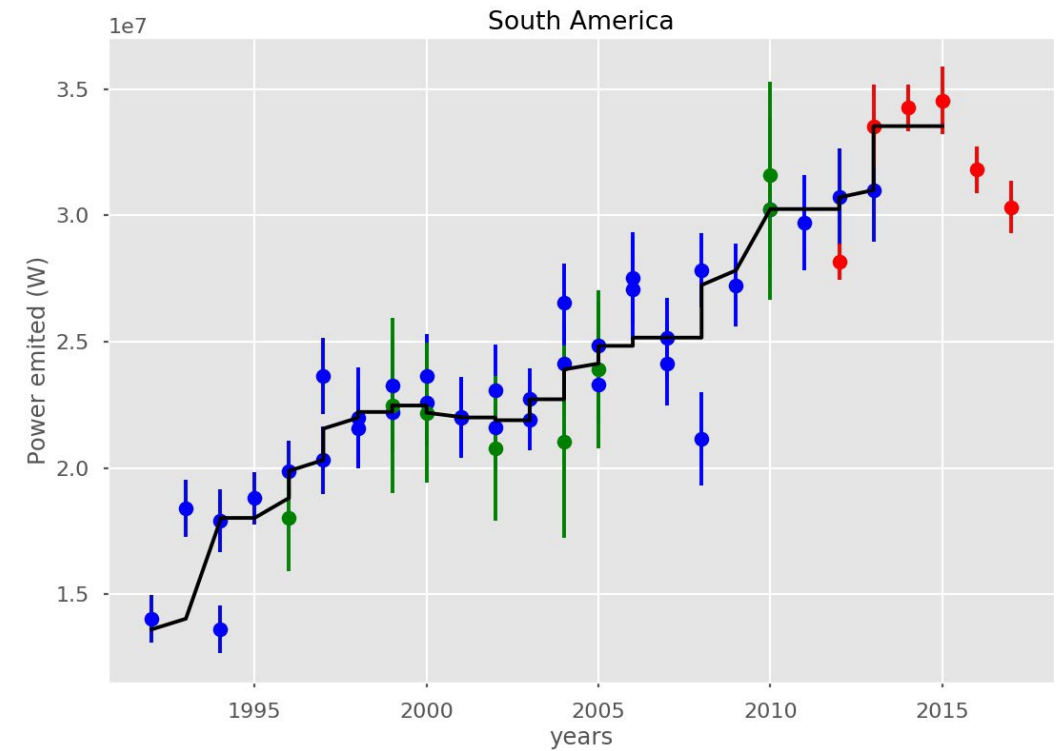
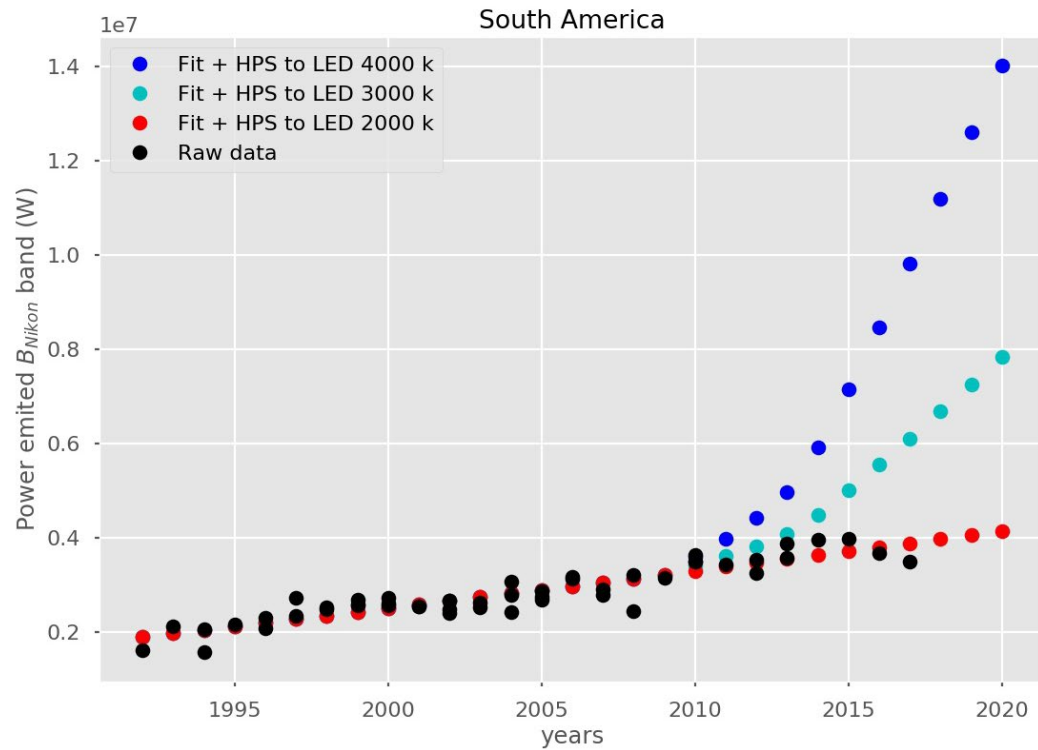
GLOBAL ECONOMIC CRISIS







# South America



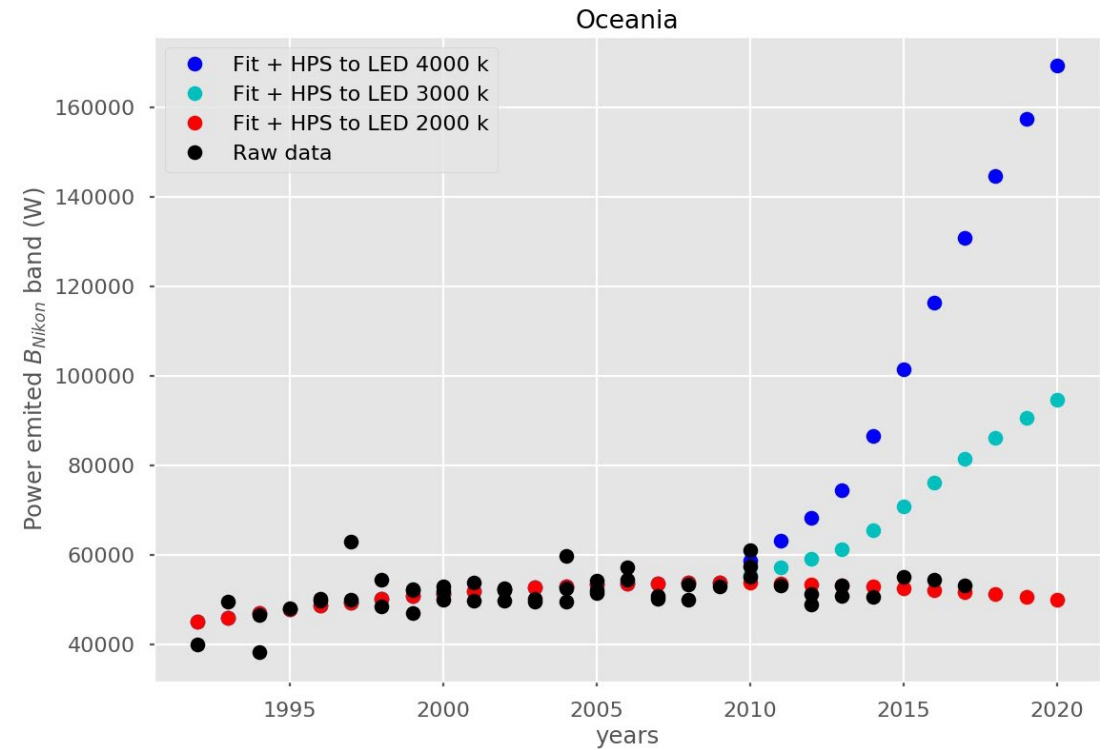
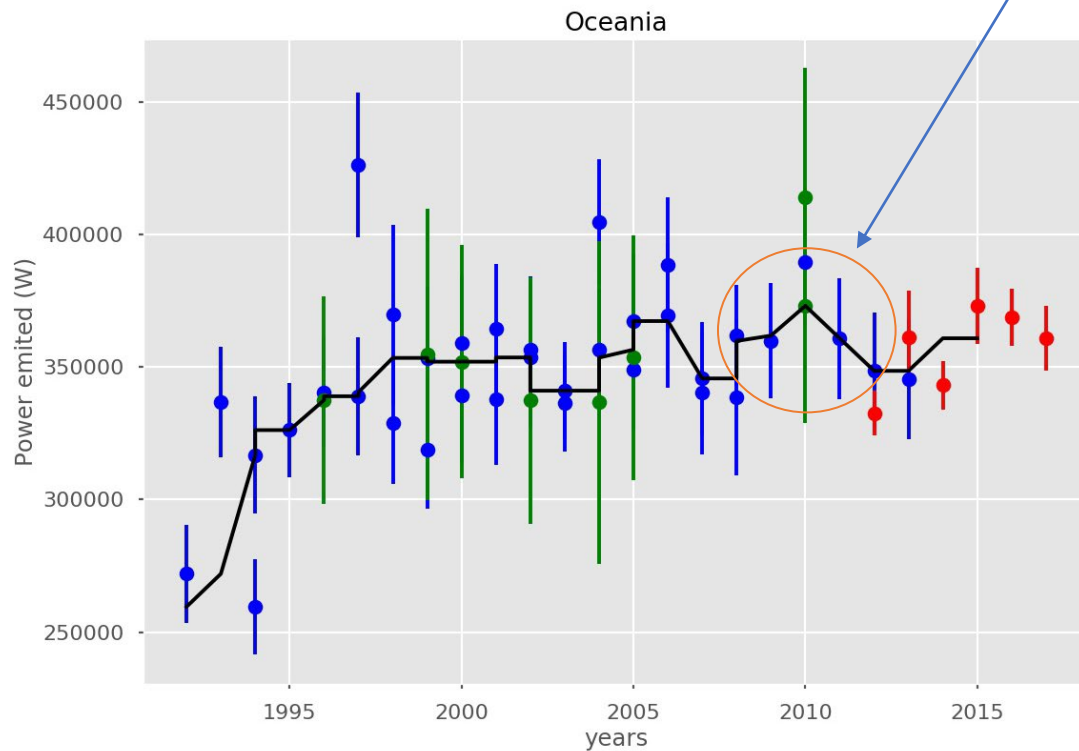






# Oceania

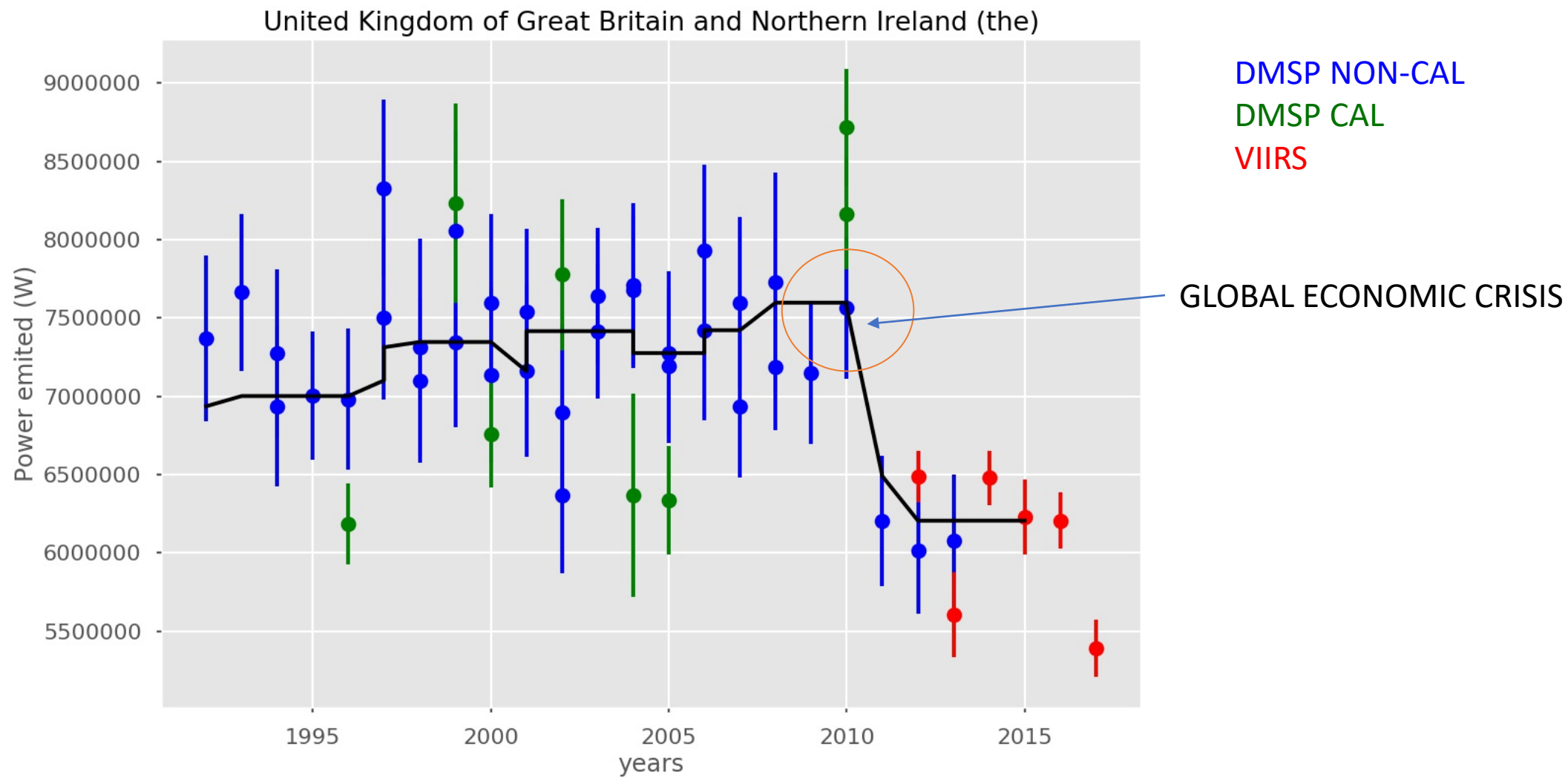
GLOBAL ECONOMIC CRISIS?



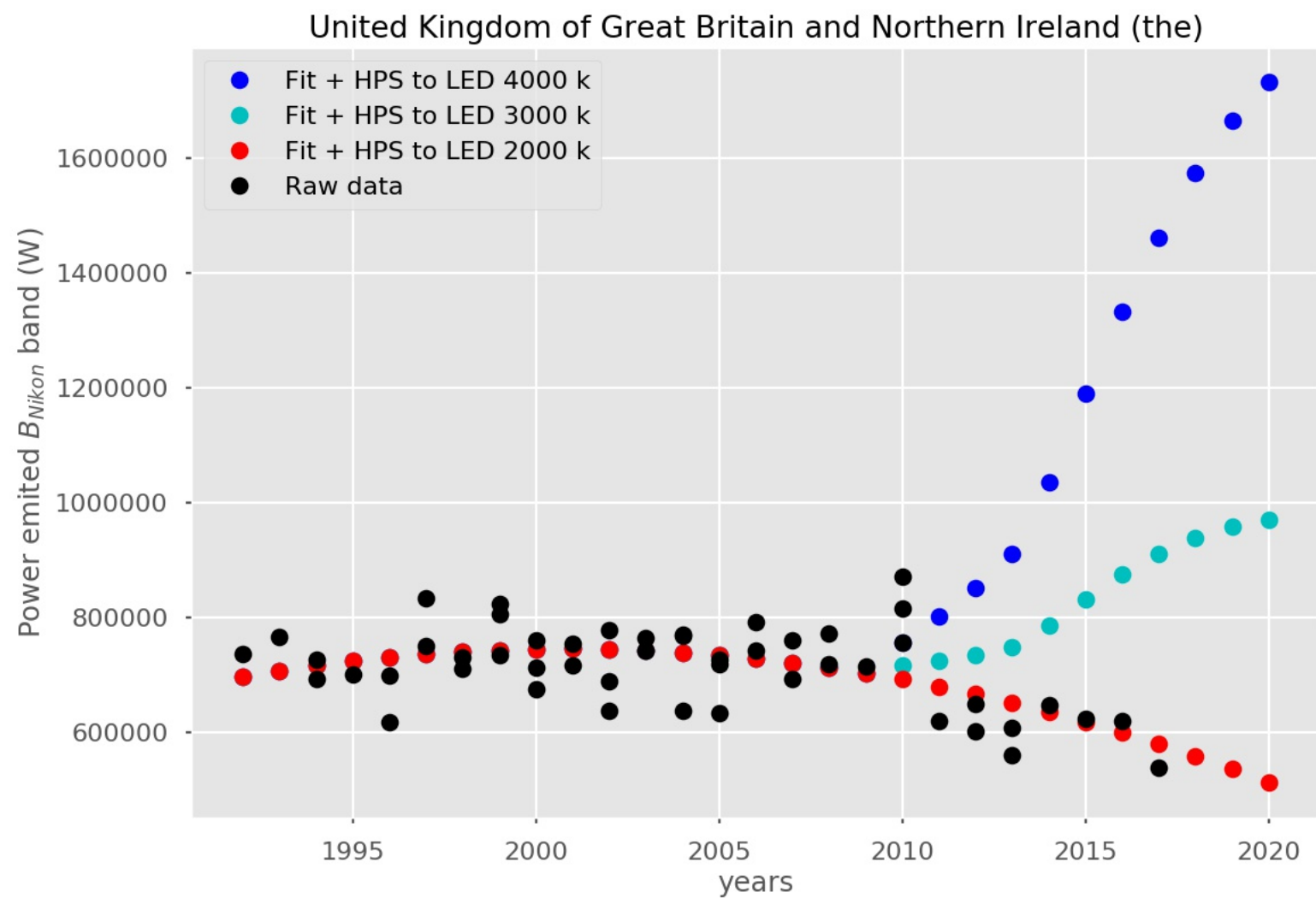






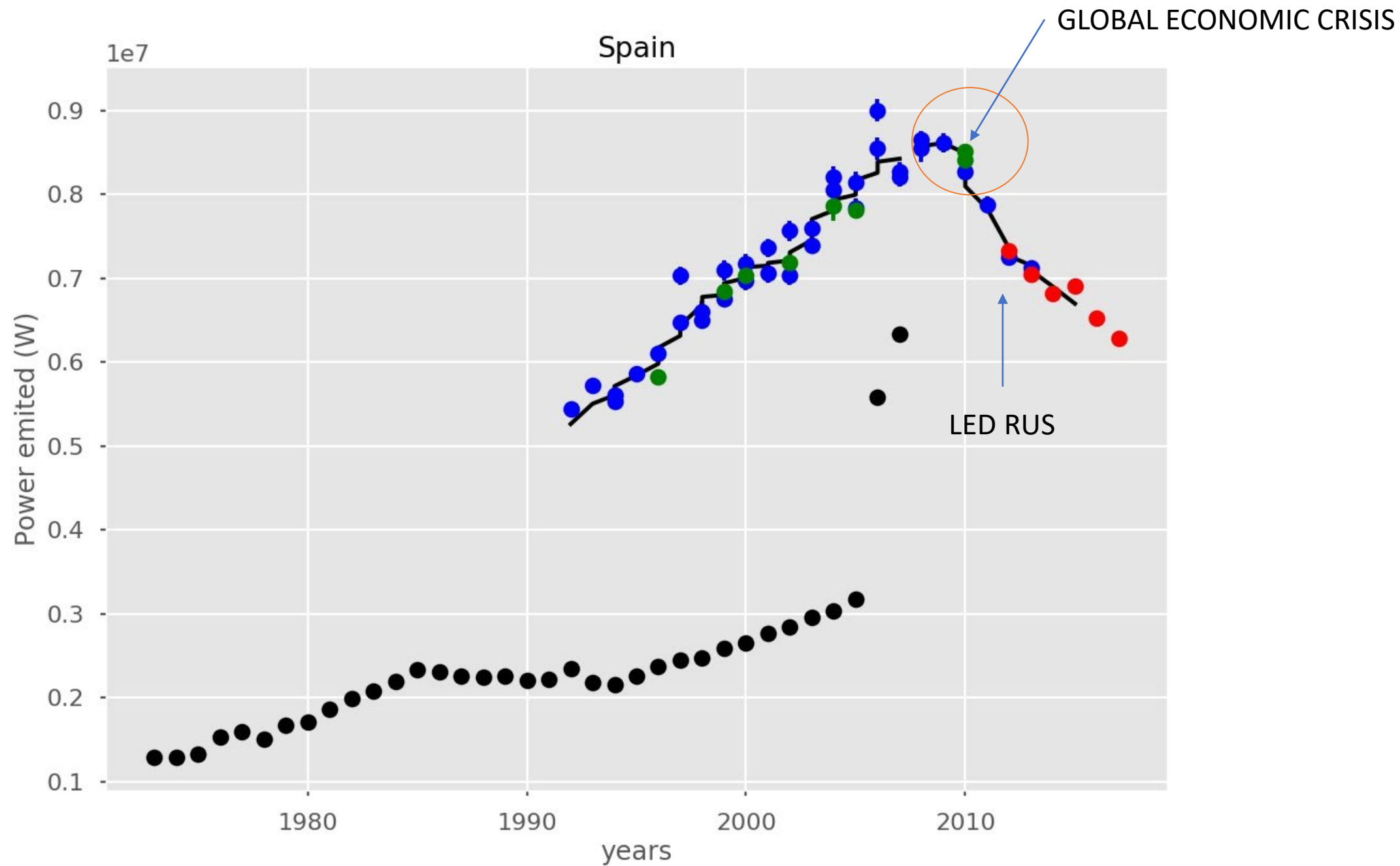






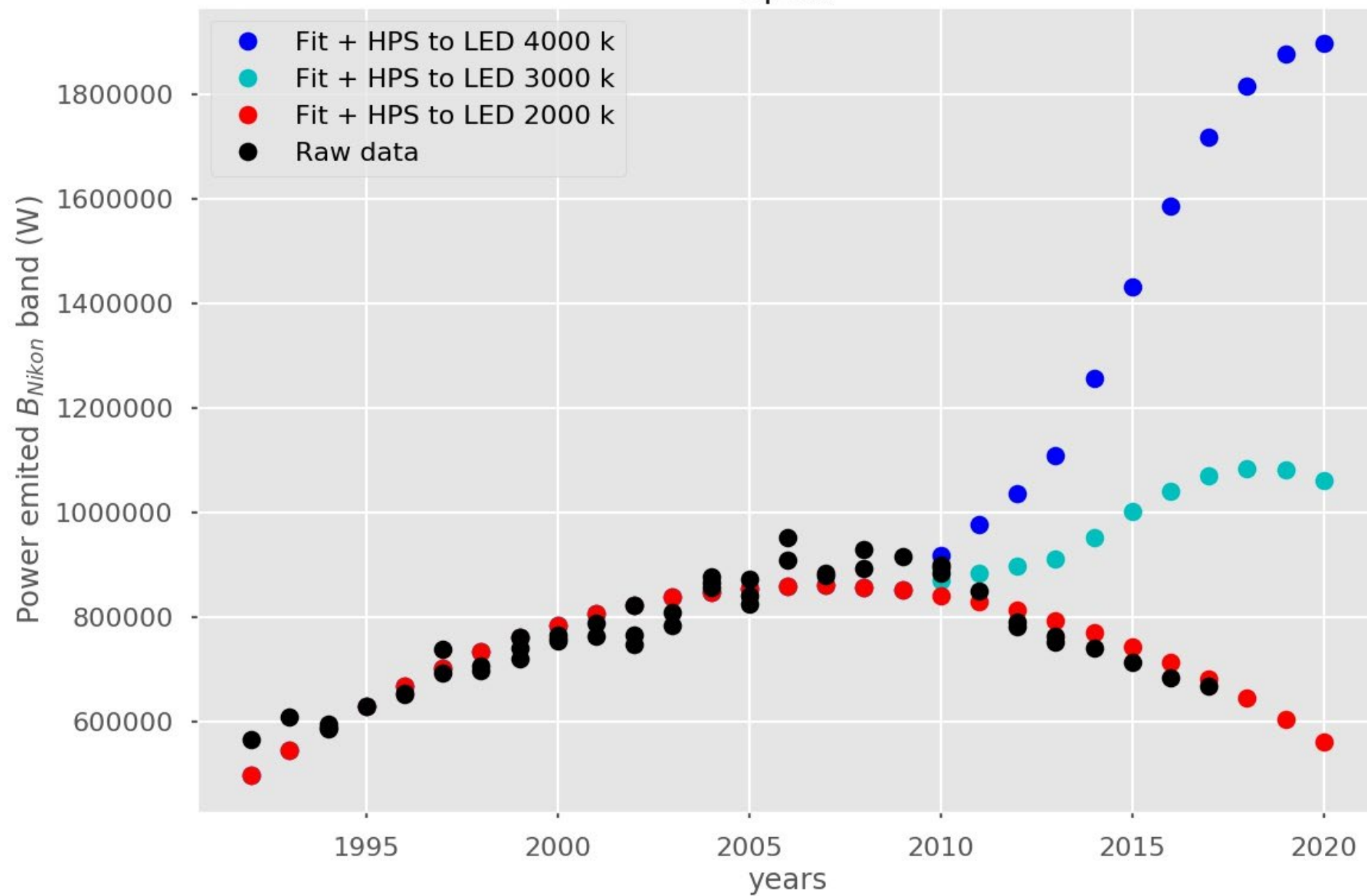








# Spain

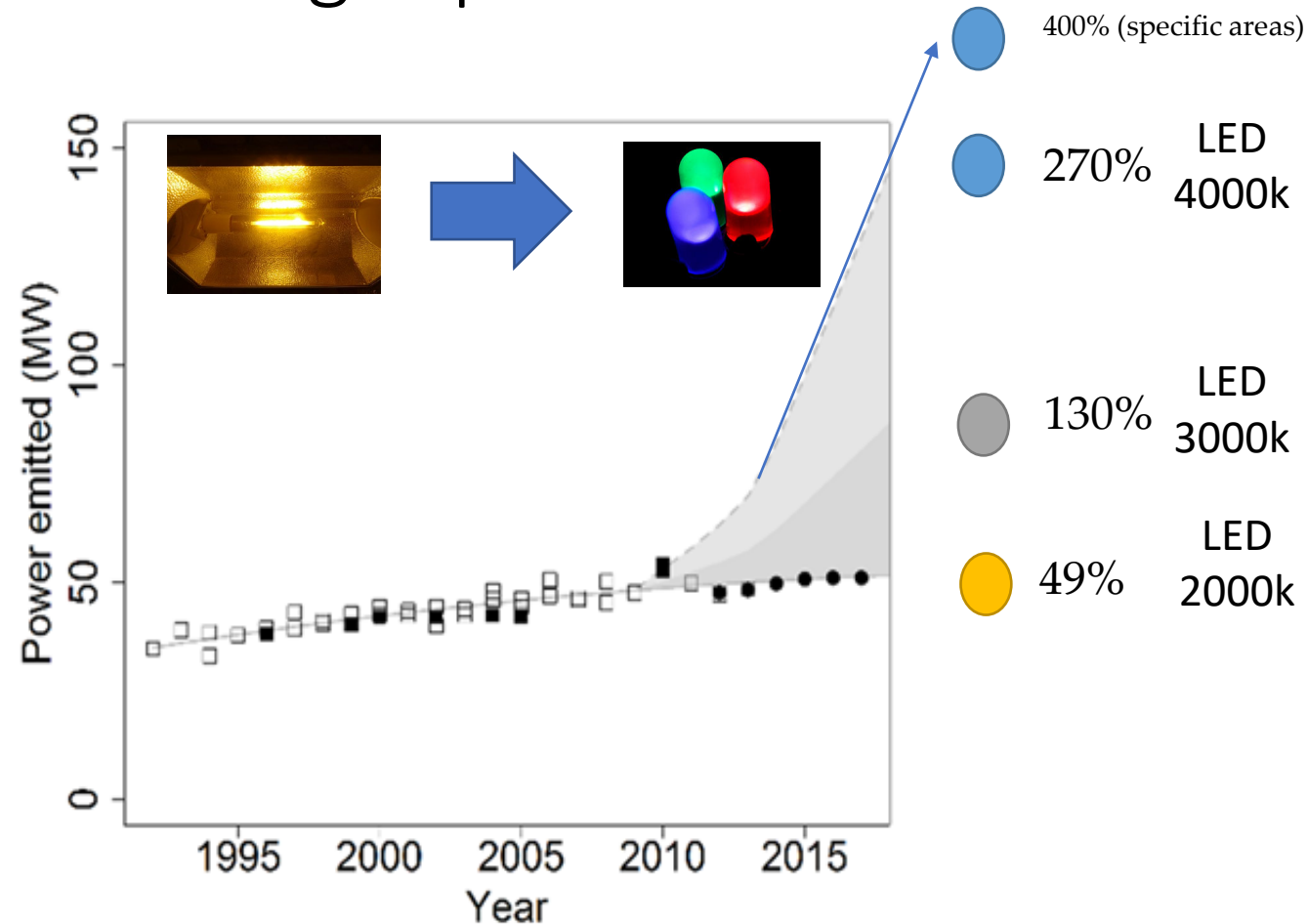
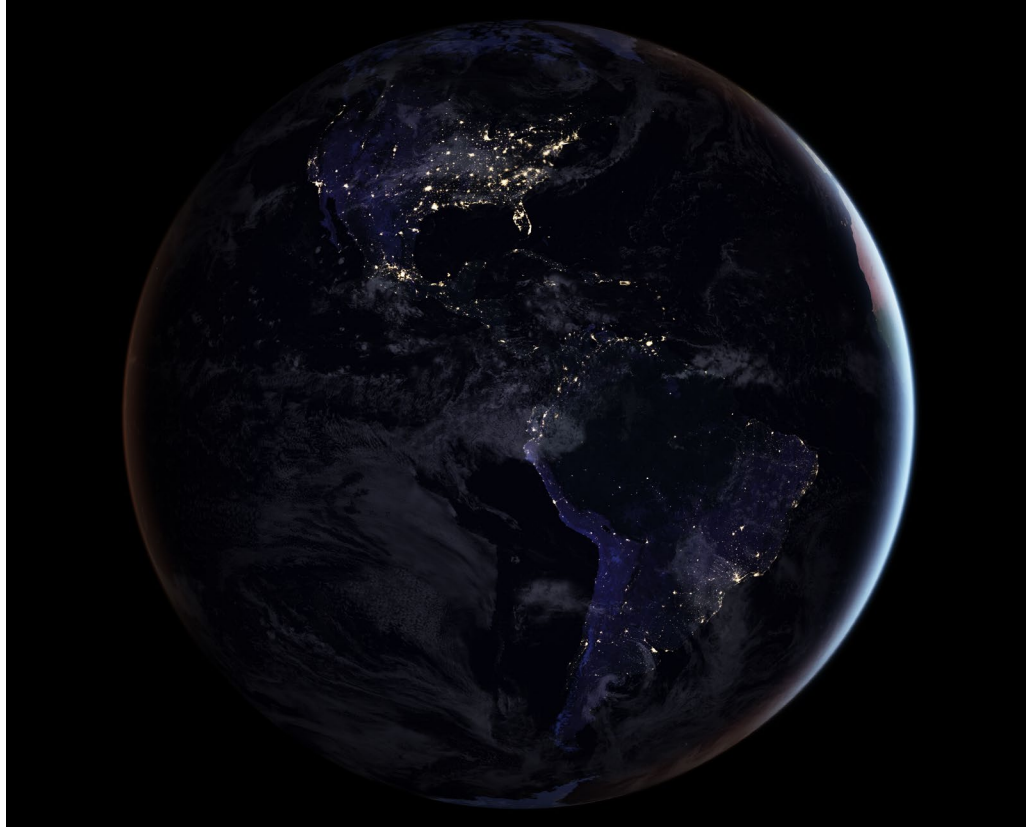




# Conclusions



# First estimation of global trends in nocturnal power emissions reveals acceleration of light pollution



- Light pollution globally has grown at least 49% during the last 25 years, having mayor impact on the Earth ecosystem.
- Because of the lack of sensitivity of satellites to blue light from high CCT LEDs, this value is heavily underestimated.
- Projections for blue light emitted can be as high as 400% if most popular LEDs are of CCT 4000k on some regions.
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We need colour information  
NOW



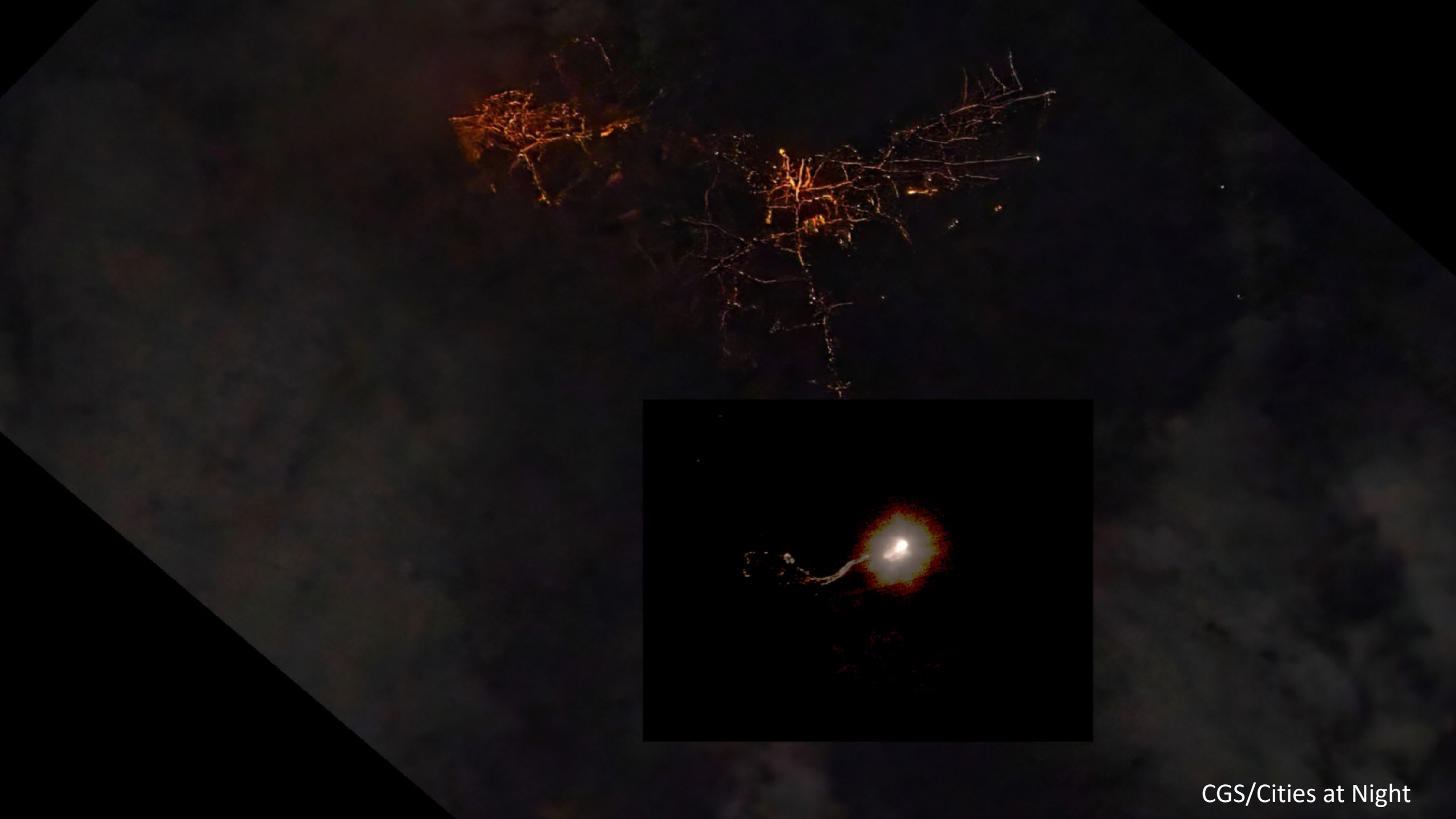
ISS data, new satellites and  
ground data





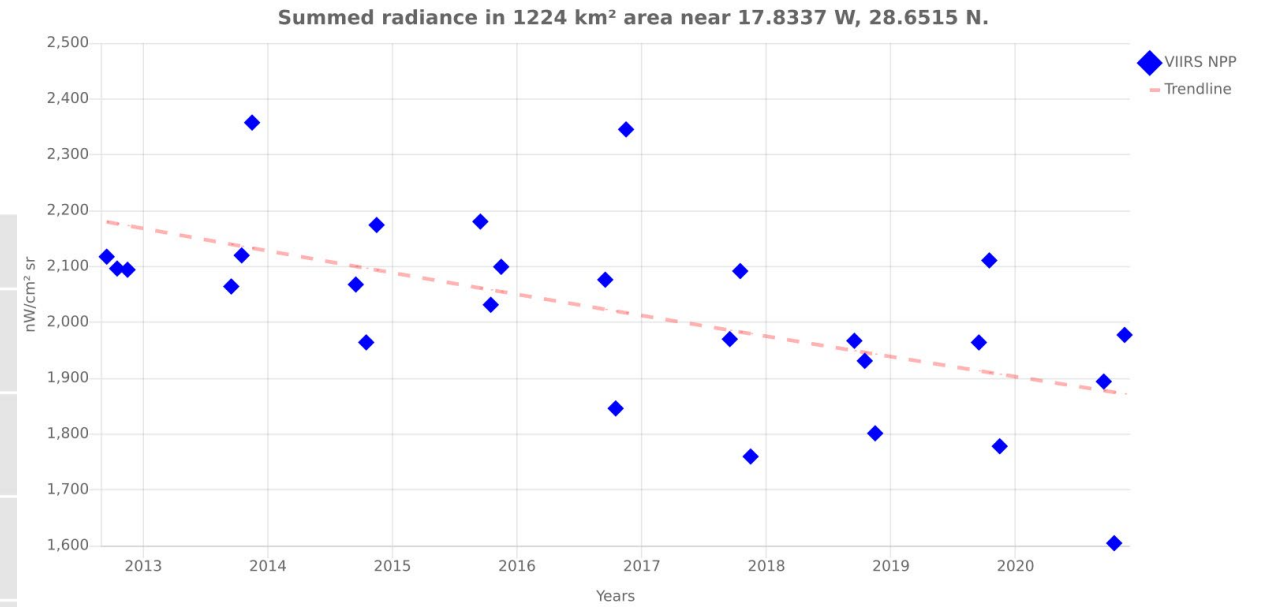
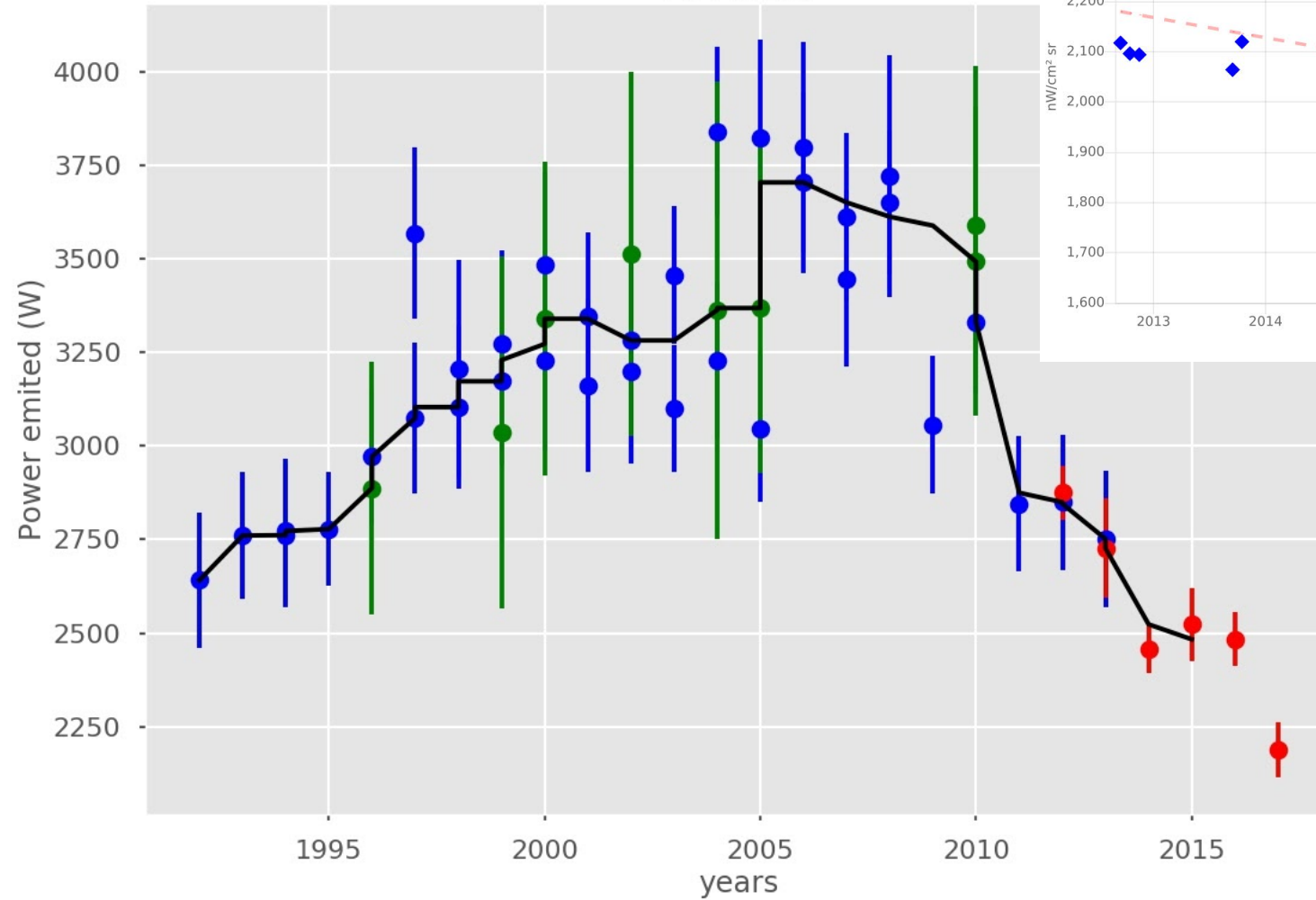


Thomas Pesquet





# La Palma





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