Contaminación Lumínica en España 2012

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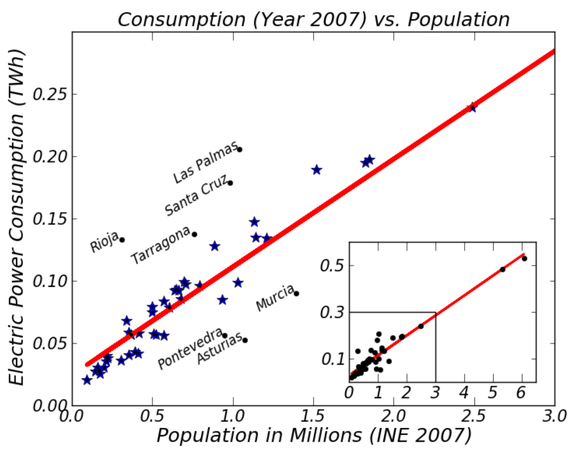
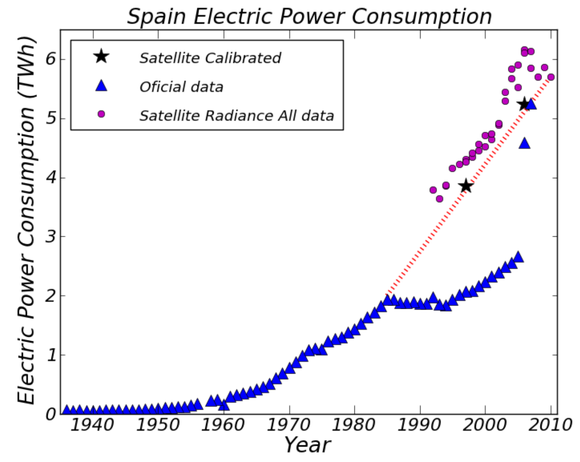
Evolution of electric power consumption from DMSP-OLS satellite data



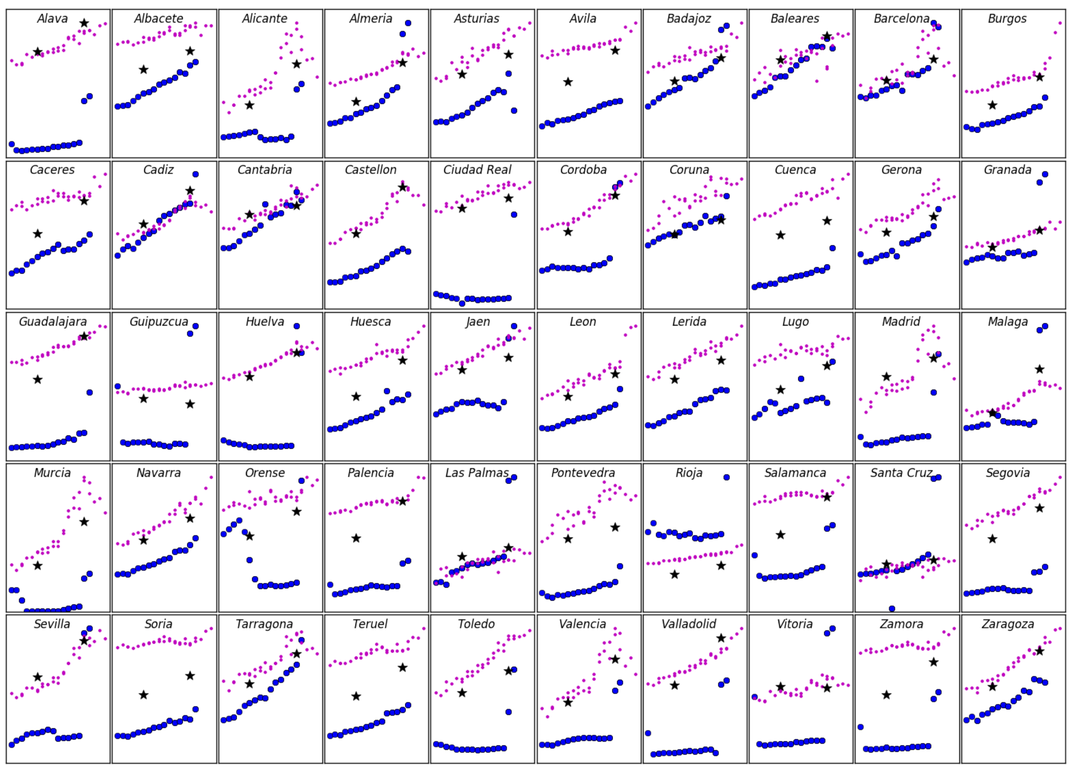
Electric power consumption on public lighting shows a clear correlation with population of spanish provinces although some of then lie outside the linear trend.
The complete range of values, including Madrid and Barcelona, is shown in the inset.

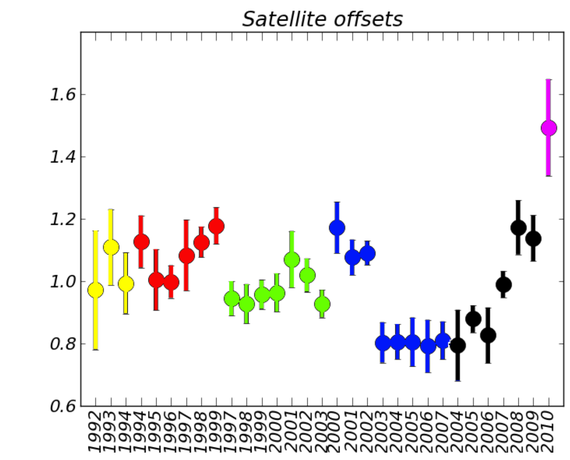


Official statistics on electric power consumption on public lighting for the past years are not reliable. The estimated values, using DMSP-OLS data, is represented with a red dashed line.
The growth is around 4% per year.
Black stars mark our measures for Spain on calibrated DMSP-OLS images (Elvidge et al. 1999, Ziskin et al.2010)

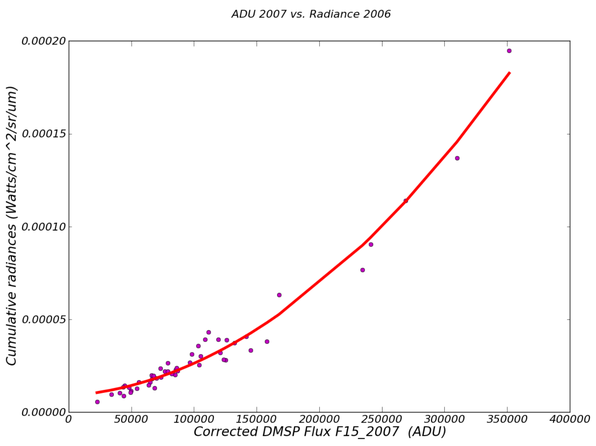
Evolution 1992 to 2010 for each spanish province.
In violet we show an estimate of the electric power consumption on public lighting using DMSP-OLS data calibrated as shown in previous plots.
Blue points represents official data on public lighting.

The jump from 2005 to 2007 is due to a revision of the counting method after our work (Sánchez de Miguel & Zamorano SEA 2008).
The evolution of some big urban areas seems to decrease in the last years.

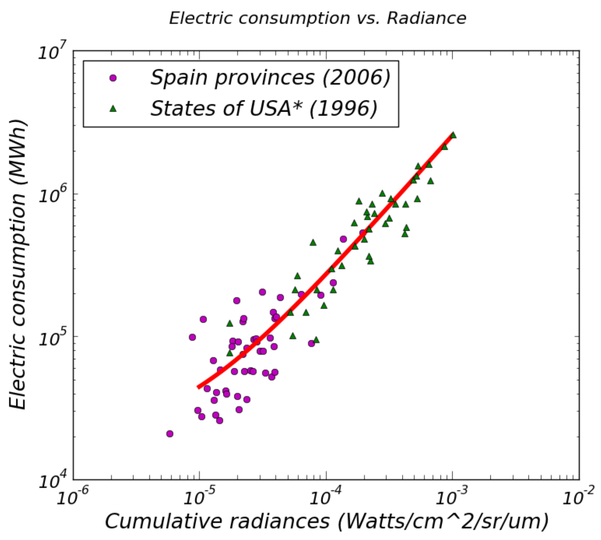




Radiance calibrated maps are available for 1996 and 2007.
RAW data from DMSP-OLS for several satellites and dates has be rescaled using the values for each spanish province.
These values allow us to study the evolution of the light emitted to the space for each province or region.



Coefficients to transform from RAW data (ADU) to radiance (W/cm2/sr/um) could be obtained for each satellite and date.
The plot shows an example of the calibration of 2006 values to DMSP F15 (2007).



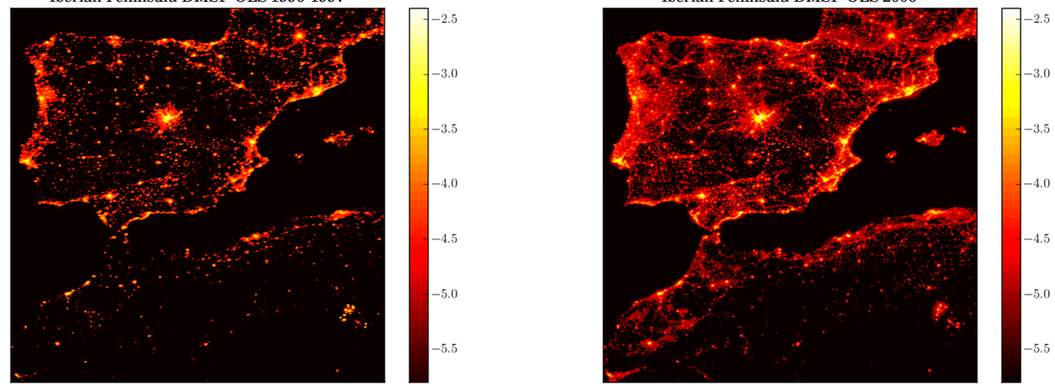
The electric power consumption on public lighting versus DMSP-OLS radiances for spanish provinces and USA states follow a similar trend.

The red line represents the fit to spanish data. USA states data was divided by a factor of 100 since they refer to total electrical power consumption.

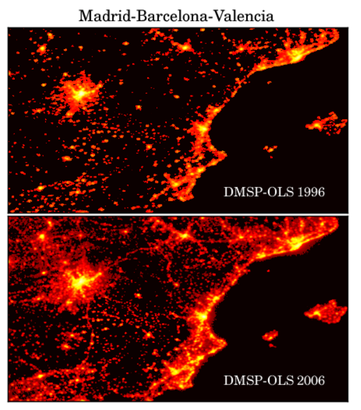
DMSP-OLS data can be used to estimate the past electric power consumption on public lighting and its evolution.

It seems that the electric power consumption on public lighting is slowing down on provinces dominated by big urban areas while on some provinces with medium-sized cities continues their wild growth.

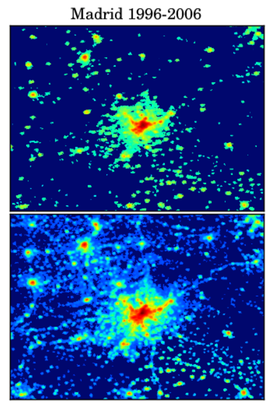
The study of the relationship between consumption and the amount of light emitted to the space will inform us about the quality of public lighting.



Evolution of the amount of light detected from space (1996-2006) with radiance calibrated data from DMSP-OLS satellite. The display scale is logarithmic and coded in units of W/m2/sr/um



Evolution of the light detected by DMSP-OLS from Madrid area



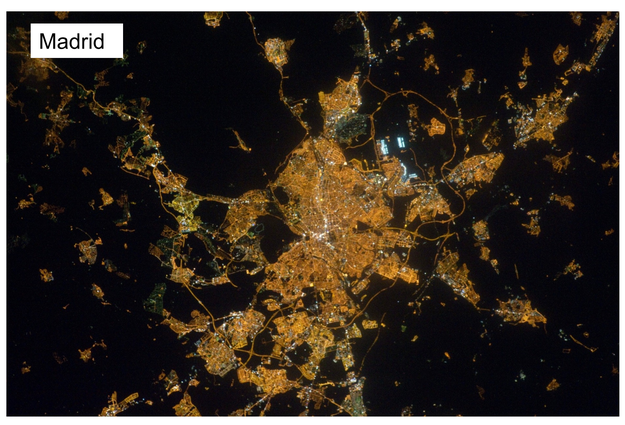
A detail of the Iberian peninsula including the big urban areas of Madrid, Barcelona and Valencia

Light pollution using pictures taken from ISS

Mosaic of Iberian peninsula with ISS pictures.
We have corrected the original pictures from distortion before the final alignment.

ISS pictures taken at night have better resolution and provide color information which is useful to characterize the type of luminaries. Both sides of Spain-Portugal border shows different lamp types.

RAW original pictures are necessary because JPEG compression lost information on intensity and color. The displayed pictures of Valencia, Barcelona and Madrid are predominantly yellow-orange due to the Sodium Lamps of public lighting.



It is easy for Madrid citizens to find the area of their homes and the main features of this Madrid at night picture taken from ISS

They include Barajas International Airport (blue-white lights at NE) and the Santiago Bernabéu soccer stadium.

The protected forest area of Monte de El Pardo is completely black as seen from space.

CREDITS:

ISS original images provided by the Image Science and Analysis Laboratory NASA-Johnson Space Center "The Gateway to Astronaut Photography of Earth"

DMSP-OLS data from NOAA Earth Observation Group (EOG) at National Geophysical Data Center (NGDC)