

DGINS 2021 -Official Statistics from Satellite imagery

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Prologue...

Some of our output











Introduction – CSO Remote Sensing and Satellite Imagery Group

Introduction

The CSO and Satellite Imagery

- CSO has a major focus on secondary and "big" data sources satellite data a key example of this
- Eurostat/UN drive for satellite statistics
- In early 2019, CSO Satellite Imagery Group was set up around 15 members from different areas of the office
 - A mixture of experienced practitioners and those with an interest in producing official statistics from satellite imagery
 - Objective: Can official statistics be produced from satellite imagery?



Introduction

Four Areas of Interest

- Initial vegetation index feasibility work
- Light emission statistics released
- Gas emission statistics Sentinel-5P
- Transport statistics (shipping) collaborative work with CSO Transport, ICHEC and Statistics Flanders
 - Also uses AIS (shipping transponder) data





2. Artificial Light Statistics



How light statistics are produced

The data collection and analysis process

- NASA VIIRS-DNB satellite data downloaded
 - Light emissions statistics from 2012 onwards
- VIIRS-DNB is an instrument on the Suomi-NPP satellite
- Data has been pre-processed for quality by NOAA
- The satellite data on light emissions is geocoded
- CSO overlays the light emissions data with OSI maps
- Statistics are validated then produced



NASA Suomi-NPP Satellite





The data source

VIIRS-DNB dataset has the following attributes

- Monthly dataset from US NOAA
- Latitude and longitude of measurements
 - 1km x 1km grid resolution
- 2. The average monthly composite cloud-free radiance figure (measures light emissions)
- 3. The number of cloud free days in each month
- 4. Built in quality assurance cloud removal

Derivation of output

CSO derives output from the dataset in following steps:

- So we have monthly cloud free data
- The satellite imagery is then overlayed with OSI map boundary files (counties etc) in R
- Summary light emission statistics are generated in R
- R mapping tools were then used
- R advantage is open source can be run on a desktop PC
- No commercial/specialist software used
- Results are validated refer to Deep Sky reserves

Light emissions by County





County level statistics

Counties with high and low levels of emissions

Ta	ble 2: Light emissions (nW/		
County	January 2015 light emissions	January 2019 light emissions	Change in emissions
DUBLIN	14.678	11.531	-27.30%
LOUTH	2.275	1.695	-34.20%
KILDARE	2.079	1.494	-39.20%
KERRY	0.766	0.576	-33.00%
MAYO	0.79	0.545	-45.00%
LEITRIM	0.772	0.516	-49.60%



Light emissions by Electoral Division Average Light Emissions by Electoral Division, January 2019





Electoral Division level statistics

Top 5 electoral divisions for artificial light emissions

ED	Electoral Division	COUNTY	January 2015	January 2019
268115	PEMBROKE WEST A	DUBLIN	195.582	156.42
268111	PEMBROKE EAST B	DUBLIN	133.821	122.251
268141	ROYAL EXCHANGE B	DUBLIN	152.25	103.88
268116	PEMBROKE WEST B	DUBLIN	90.747	100.383
268140	ROYAL EXCHANGE A	DUBLIN	138.228	98.657





3. Gas emissions



Nitrogen Dioxide NO2 Sentinel 5P

We chose NO2 as the gas for our emissions project

- NO2 emissions are of considerable public interest
- Sentinel-5P NO2 data is freely available via the Copernicus Hub (7km x 7km)
- Our aim was to produce statistics for NO2 levels in Ireland using the Sentinel-5P data using R.
- We are workign with the EPA and with other agencies in seeing how applicable these results are
- Ground measurement is best but role for satellites



Example output – NO2 map Northern Europe







4. Lessons Learned

Lessons learned

Remember the following

- Satellite measurement is a powerful and frequent source of data with an immense coverage area
- However, the usual limitations of a satellite apply limited resolution and the complications that inevitably follow when attempting to measure a ground based phenomenon from the air
- Atmospheric effects must also be considered.
- Validation is very important





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