Transcontinental Australia Dark Sky Quality Survey

ALAN 2016
4TH INTERNATIONAL CONFERENCE
ON ARTIFICIAL LIGHT AT NIGHT

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CLUJ-NAPOCA, ROMANIA

Kellie Pendoley PhD
Ellen Boylen
Robert Ryan

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Objective and Outline

Objective

Quantify the impact of clouds on sky brightness in remote locations adjacent to populated areas.

Outline

- Methods; what, where, when, how
- Describe the data selected for processing
- Discuss some to the more interesting results

Methods – The Trip

- Using newly upgraded Sky42 cameras
- Started in Perth on 2 May 2016 and drove 5500 km to Brisbane via Uluru
- Collected Sky42 overnight images en-route,
- Sky42 positioned off the roadside
- **Sky42 survey location 8 – 10 km east of each town centre**

Camera Locations

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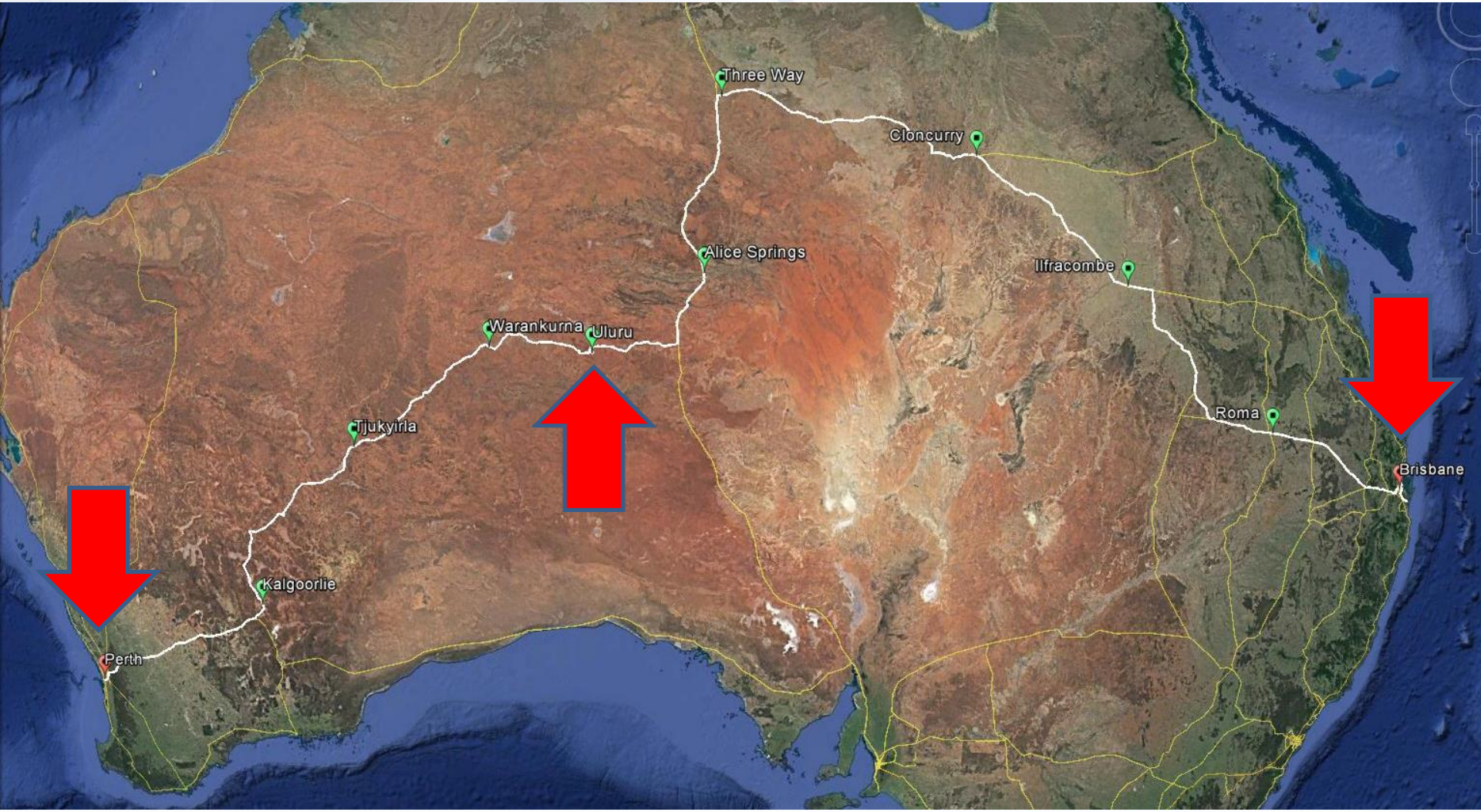


Methods – Data Processing

- Excluded images with rain drops, car headlights, dawn or dusk
- Processed images using Sky Quality Camera software (Euromix - Mohar)
- Used images collected between 2000hrs and 0400 hrs
- Used a drone to capture regional characteristcs

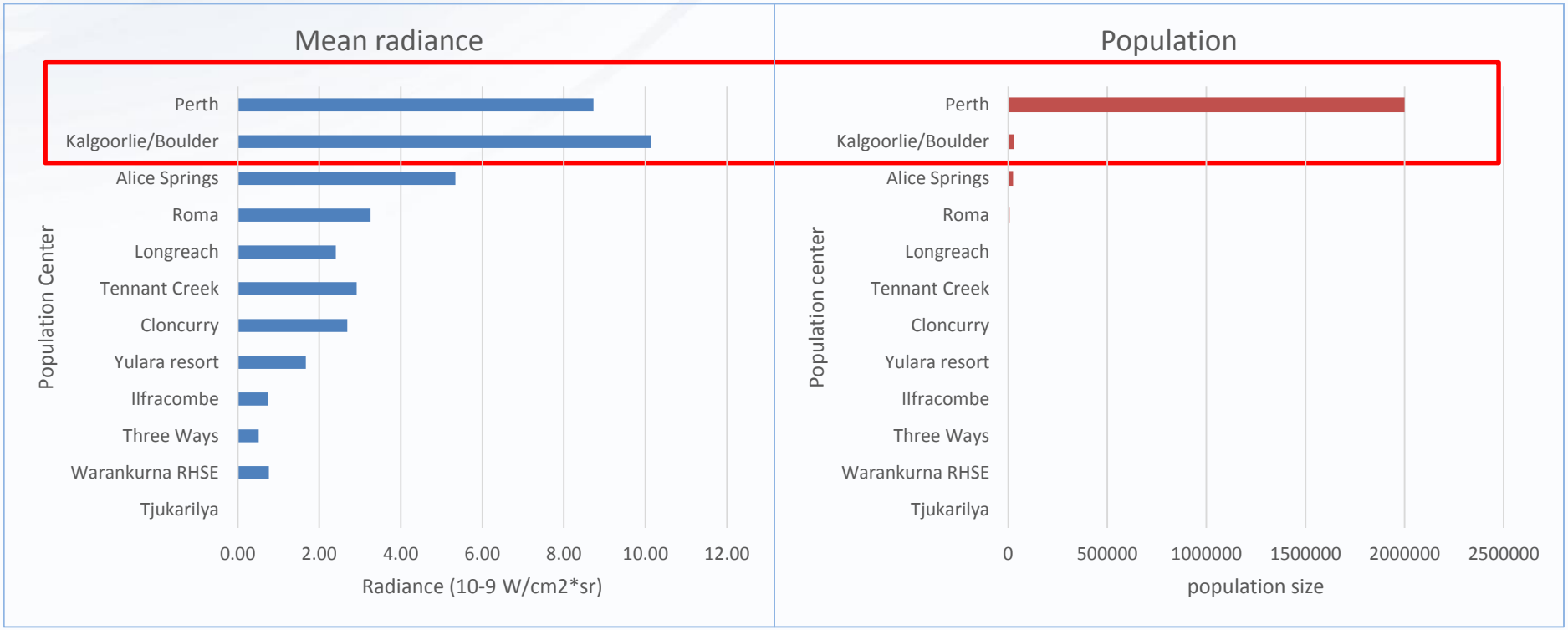
Methods – Data Processing

- Used mean radiance (VIIRs) of nearby towns to;
  - To quantify light relative to population size, and
  - Identify the most light polluted towns*
- Used mean radiance for each camera location to quantify light looking down on the site.
- Software calculated an average zenith illuminance value to quantify light looking up from the camera location.
- Used Sky42 whole of sky (0°- 90°) Luminance (mcd/m^2) to quantify 'whole of sky' light from horizon to horizon, to capture light from nearby towns looking sideways
- Developed a Star Visibility "Okta" scale

*(Jurij Stare, www.lightpollutionmap and NOAA National Geophysical Data Centre).

Star Visibility Scale

Code	Description
0	• **all stars are visible**, • Milky Way bright and colourful • No clouds present
2	• **stars are washed out**, • Milky Way monotone, • <half the sky covered with cloud
4	• **only brightest stars visible through cloud**, • Milky Way either very faint or absent, • half the sky covered with cloud
6	• **few brightest stars (<10) visible through cloud**, • Milky Way absent, • > half the sky covered with cloud
8	• **no stars visible** • completely overcast


Mean radiance
Perth
Kalgoorlie/Boulder
Alice Springs
Roma
Longreach
Tennant Creek
Cloncurry
Yulara resort
Ilfracombe
Three Ways
Warankurna RHSE
Tjukarilya
Population Center
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Radiance (10-9 W/cm2*sr)
Population
Perth
Kalgoorlie/Boulder
Alice Springs
Roma
Longreach
Tennant Creek
Cloncurry
Yulara resort
Ilfracombe
Three Ways
Warankurna RHSE
Tjukarilya
Population center
0
500000
1000000
1500000
2000000
2500000
population size

Urban and Industrial light sources in Kalgoorlie boulder area

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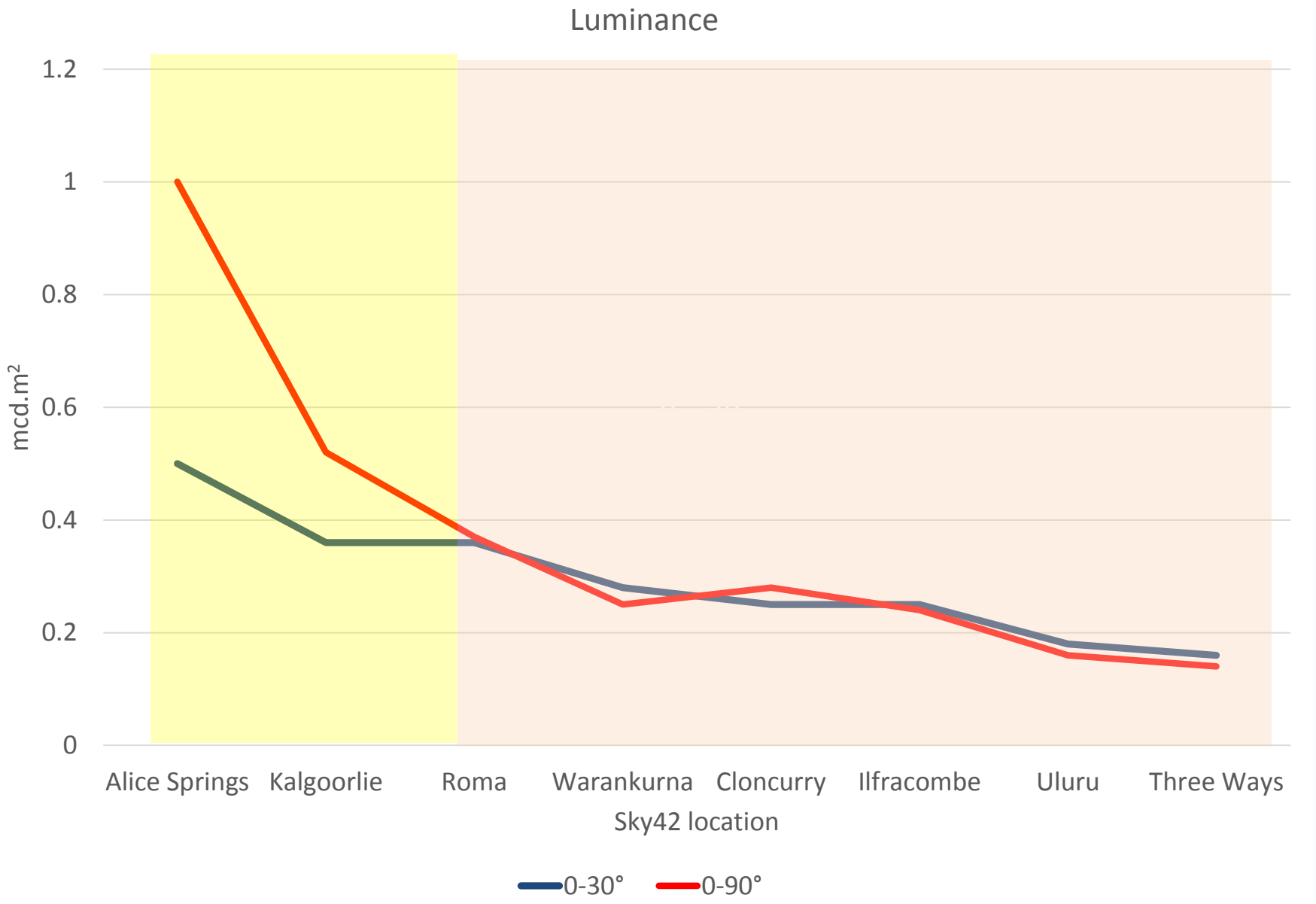
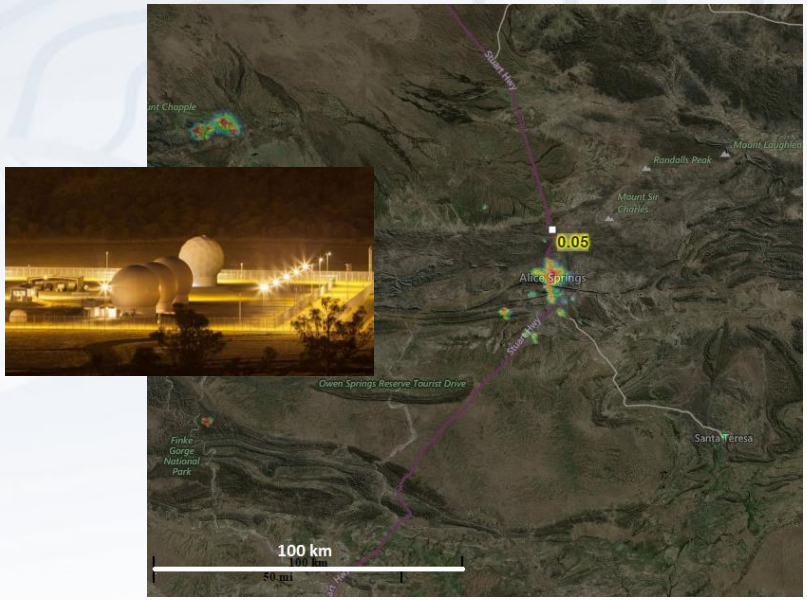
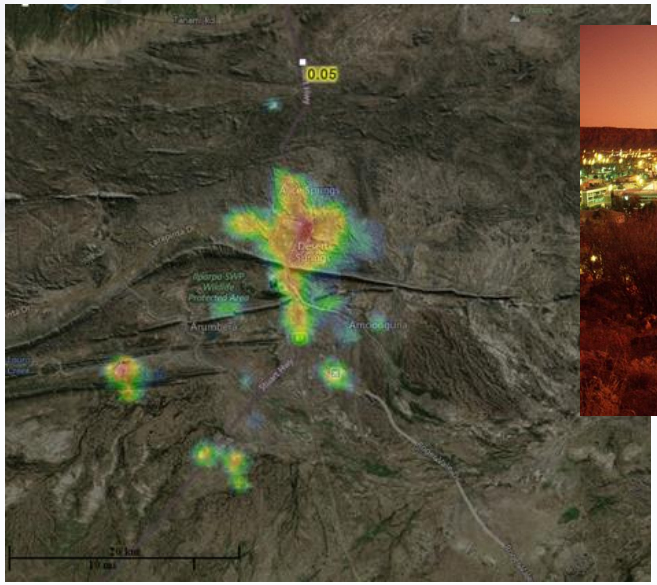
Local town name	Sky 42 luminance mcd/m2 Looking up	VIIRs radiance W/cm2 Looking down
Alice Springs	0.5	0
Kalgoorlie	0.36	0
Roma	0.36	0
Warankurna	0.28	0
Tjukarilya	0.26	0
Cloncurry	0.25	0
Ilfracombe	0.25	0
Uluru	0.18	0
Three Ways	0.16	0

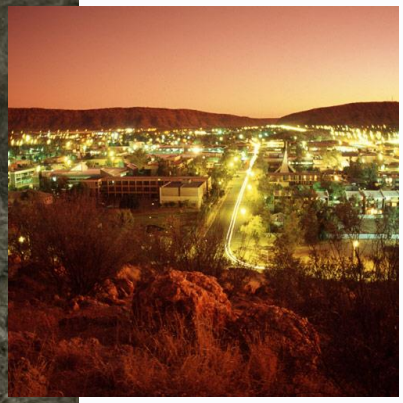
0 - 30° vs 0 - 90°

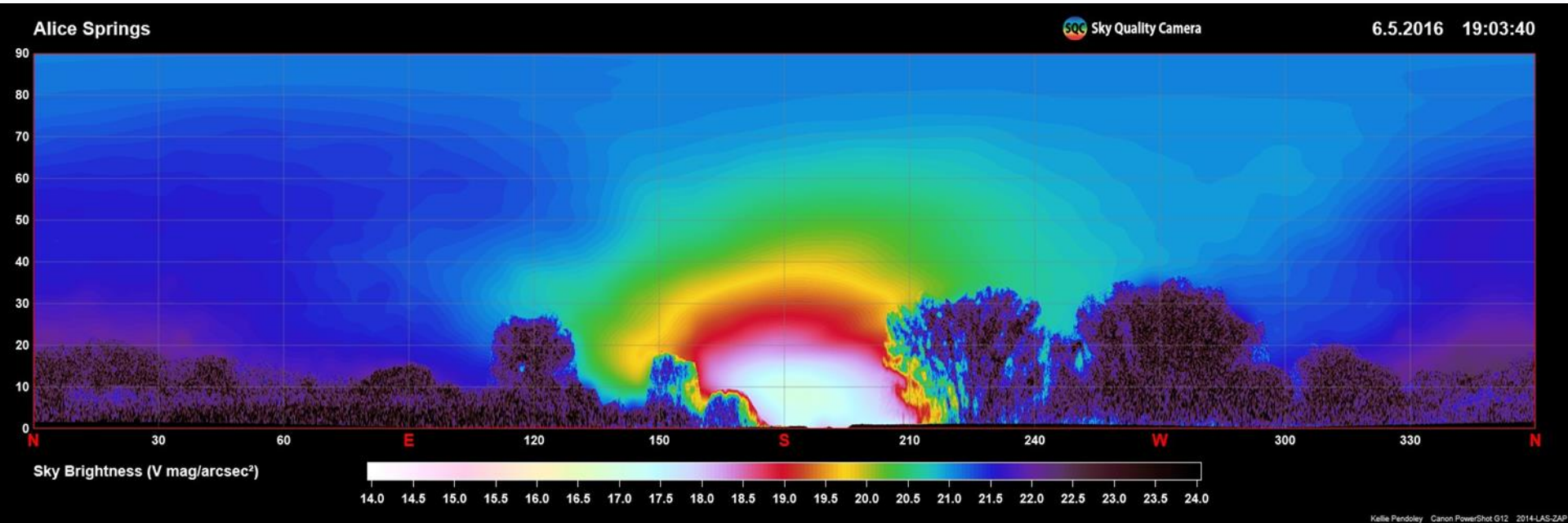

Luminance
1.2
1
0.8
0.6
0.4
0.2
0
mcd.m²
Alice Springs
Kalgoorlie
Roma
Warankurna
Cloncurry
Ilfracombe
Uluru
Three Ways
Sky42 location
0-30°
0-90°

Alice Springs – cloudy night









Three Ways: remote dark area and little cloud

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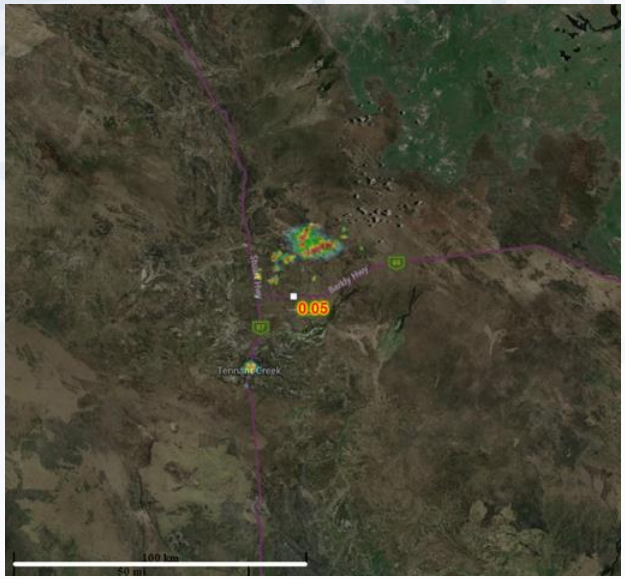
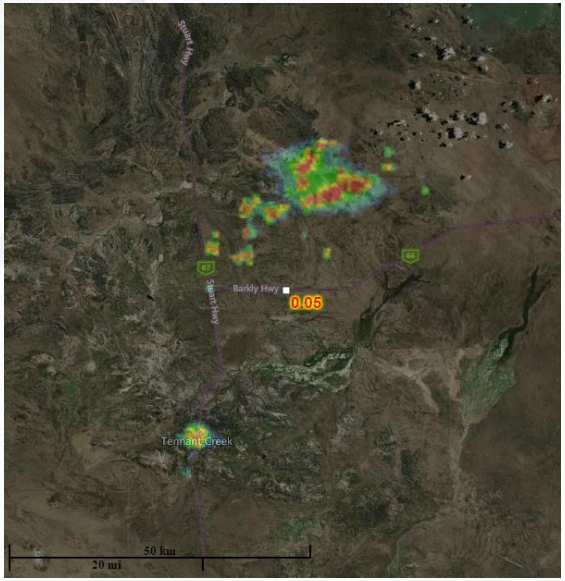
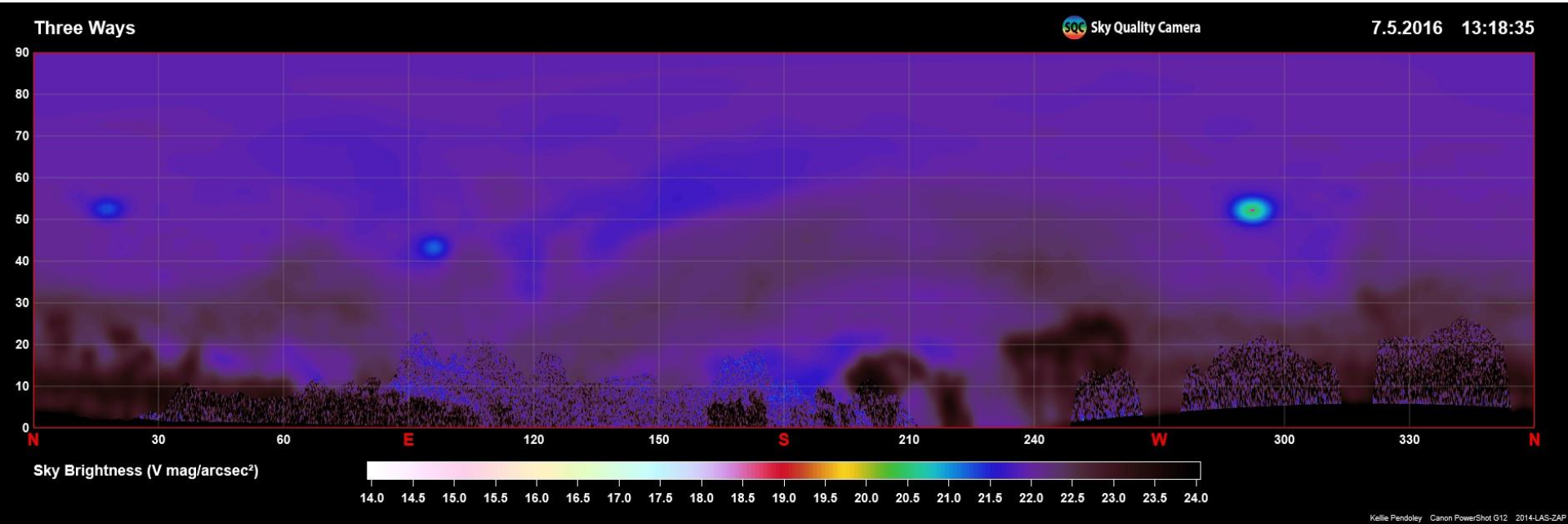
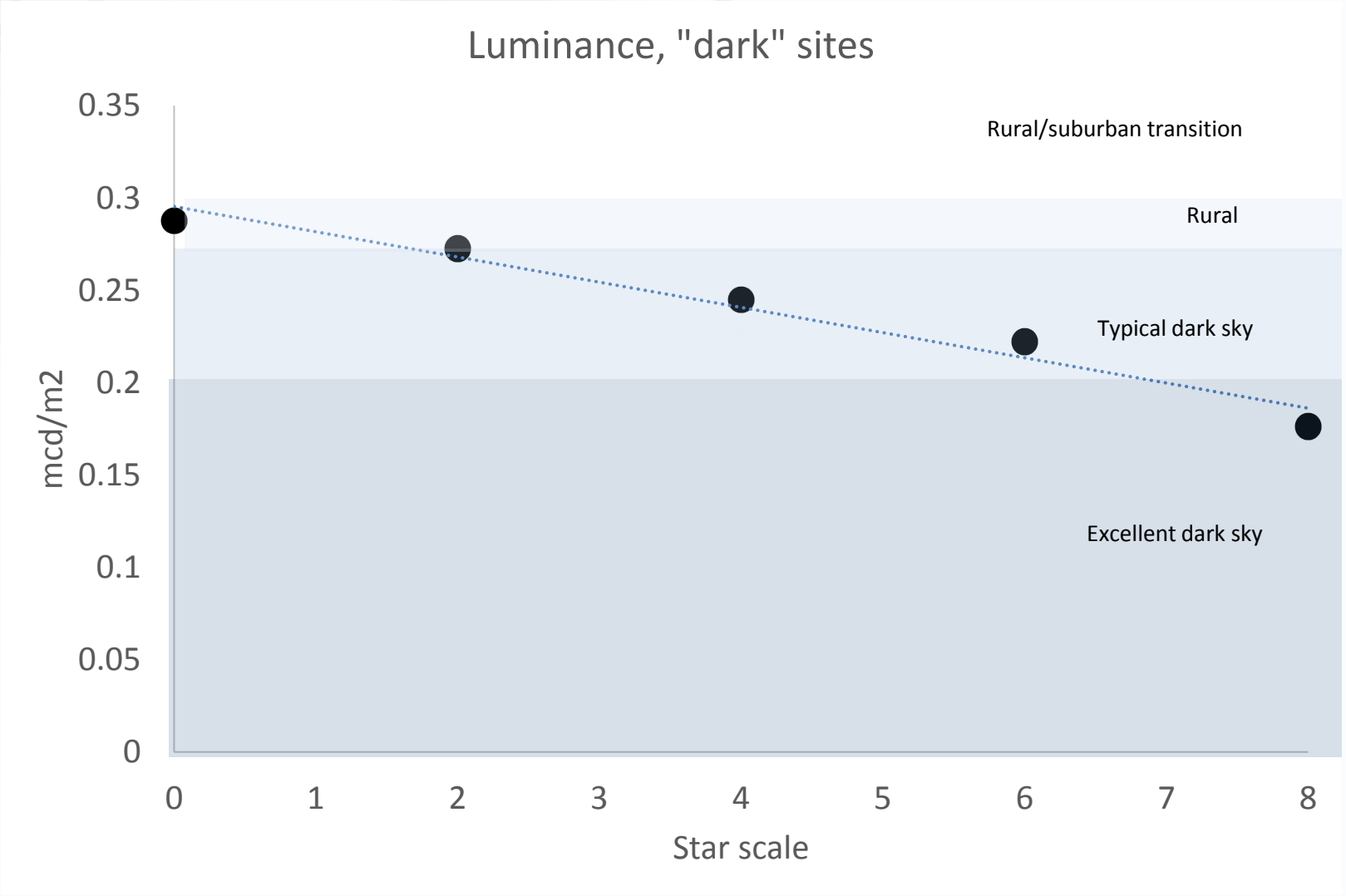


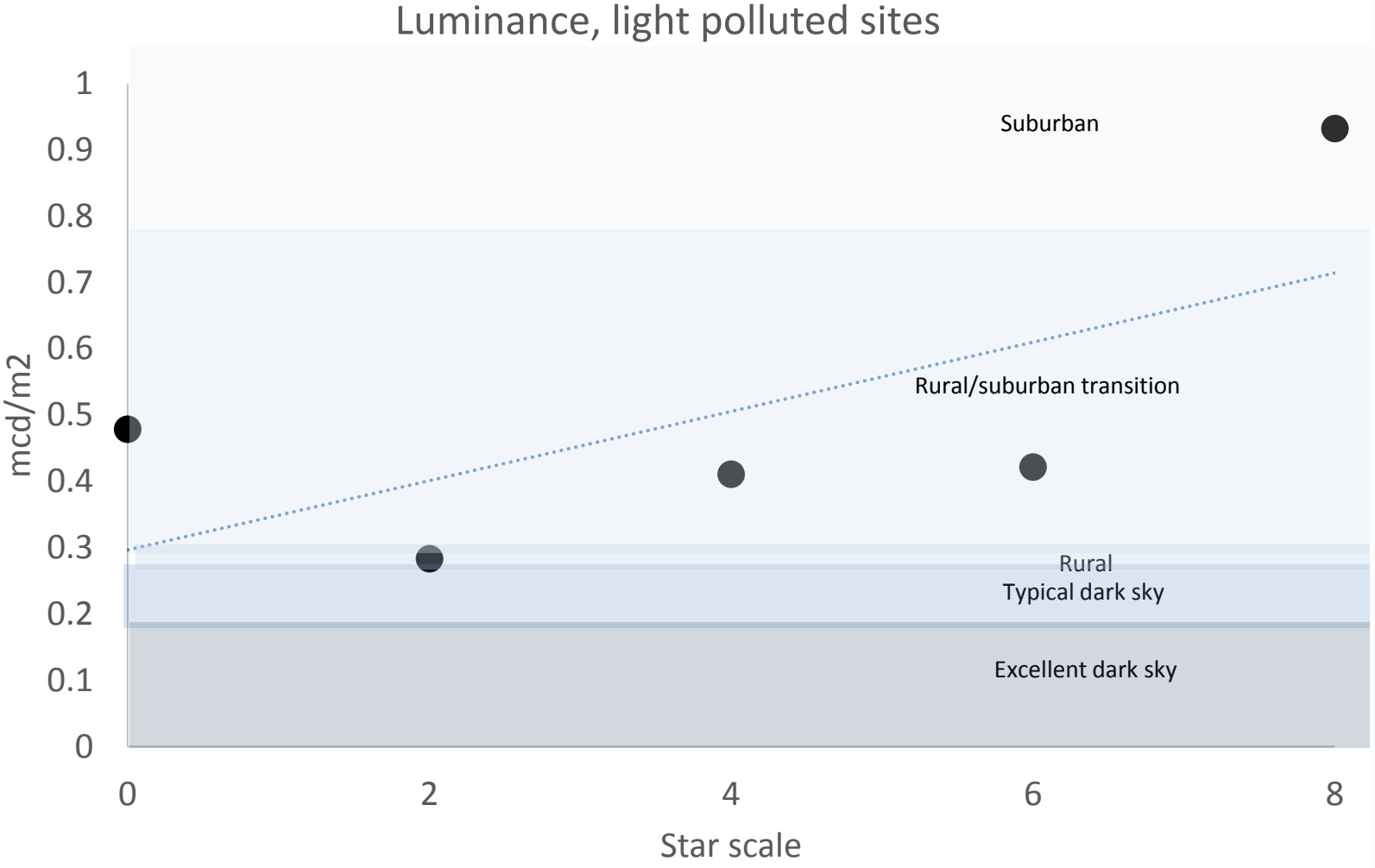




Star scale vs Luminance – Dark Sites



Star scale cover vs Luminance –Light polluted Sites



Conclusions

- The use of our modified Bortle Scale, the Star Scale, worked well
- Remote mine sites can produce brighter radiance than a large city due to the use of metal halide and mercury vapour lights in mines vs HPS in urban areas. Indicative of what LEDS are likely do to urban areas.
- Established a relationship between increasing cloud cover and increasing sky brightness across multiple sites and levels of sky brightness
- Clear skies are brighter than all except completely overcast skies
- The VIIRS radiance data (looking down) does not account for sky glow on the horizon (looking sideways)
- The VIIRS data did not detect two of our more remote sites (Tjukarilya and Three Ways)
- It would be useful to measure zenith values along a transect through one of the isolated towns to compare with the VIIRS data and try to model the sky glow dome

Questions