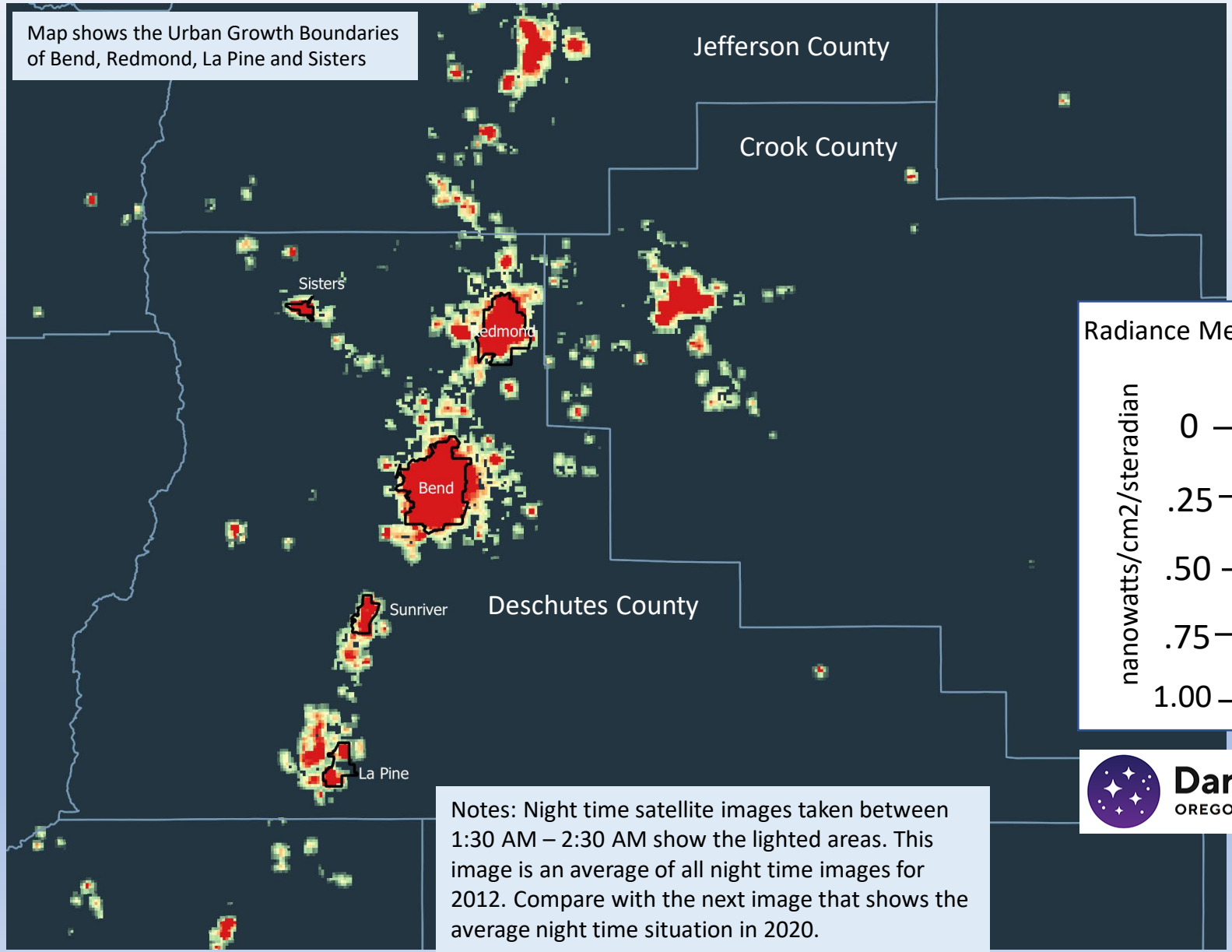
Night Time Satellite Image
2012 Annual Average

NASA VIIRS Day Night Band
Images taken 1:30 AM – 2:30 AM



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2020 Annual Average

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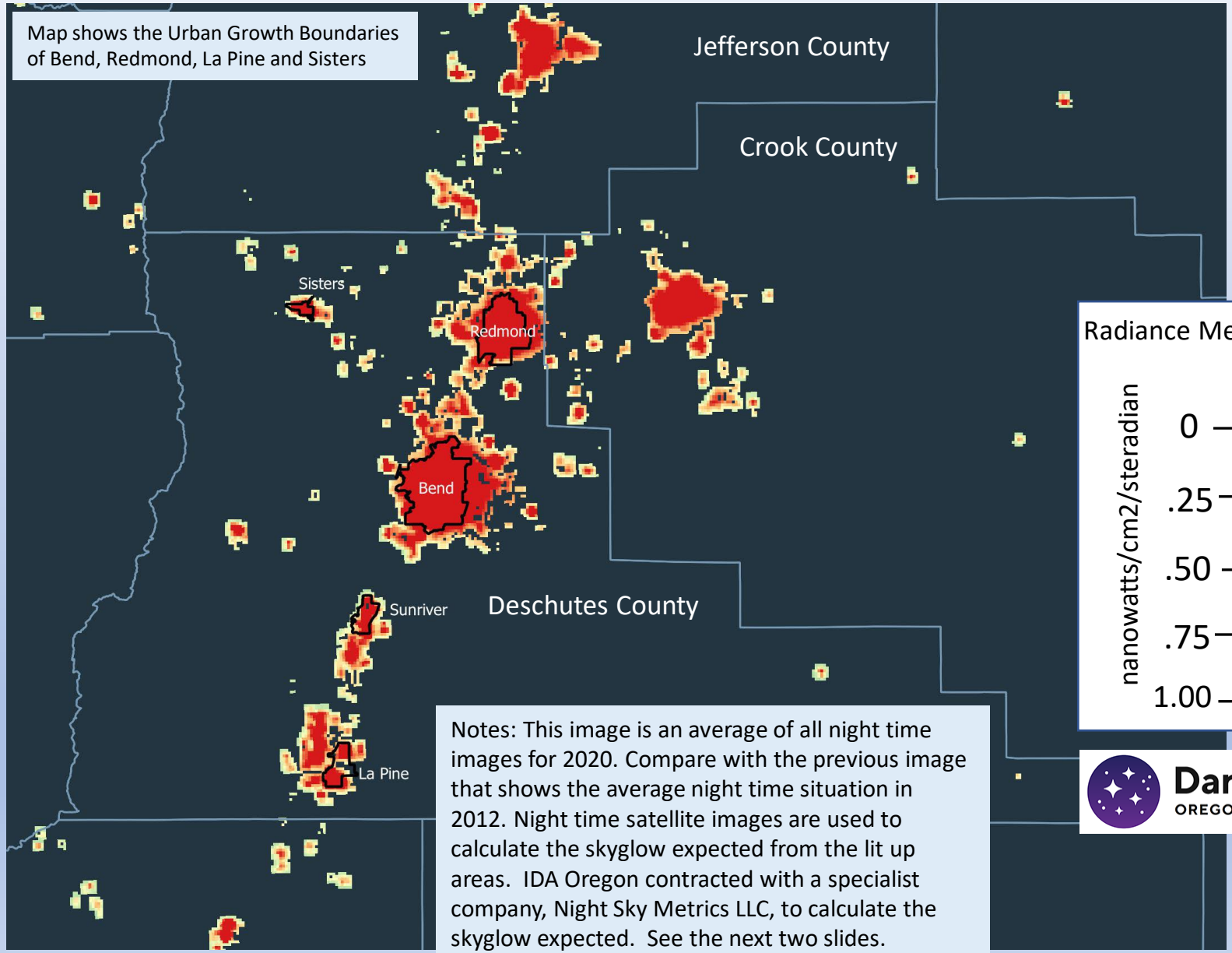
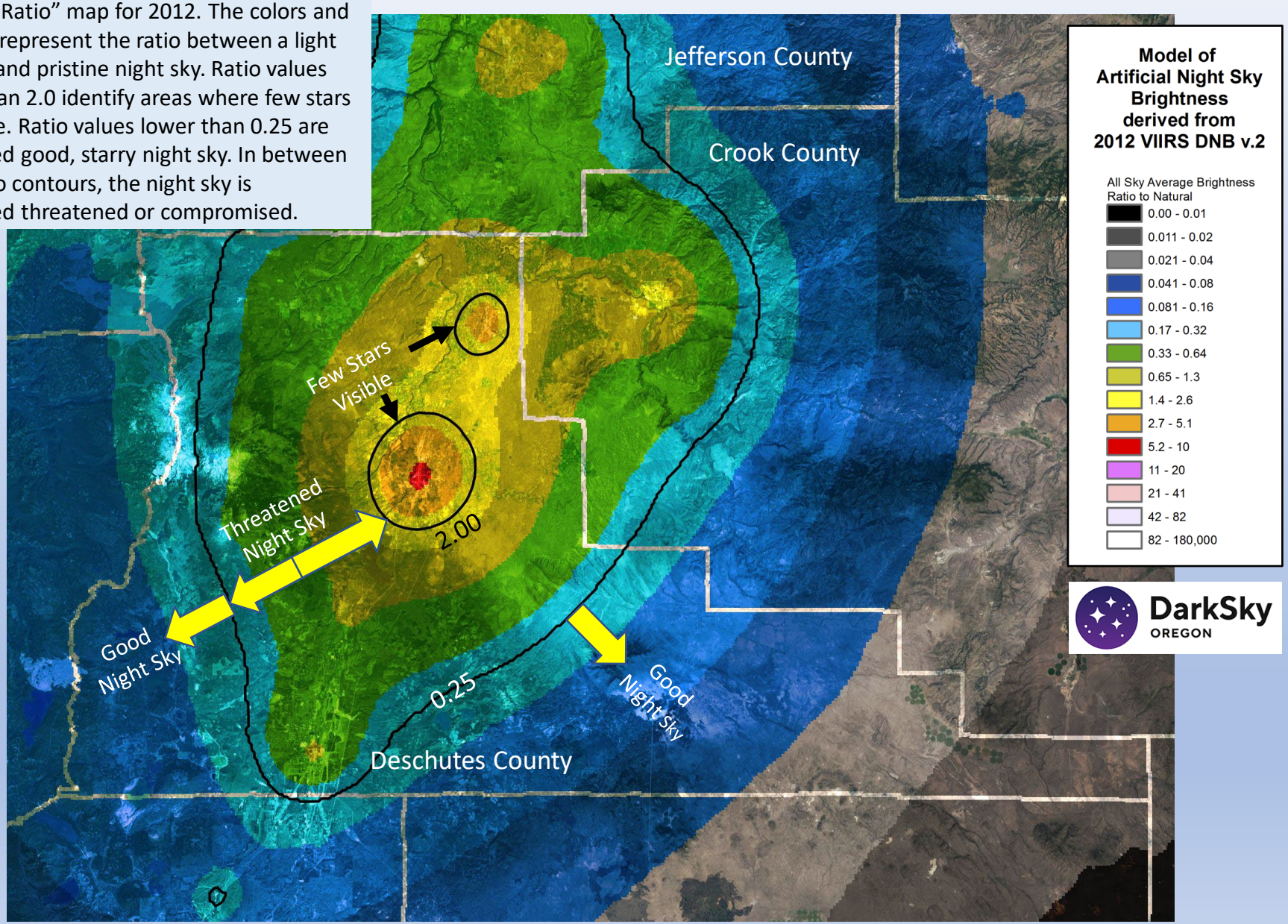


Notes: This image is an average of all night time images for 2020. Compare with the previous image that shows the average night time situation in 2012. Night time satellite images are used to calculate the skyglow expected from the lit up areas. IDA Oregon contracted with a specialist company, Night Sky Metrics LLC, to calculate the skyglow expected. See the next two slides.

Skyglow Model 2012

All-Sky Average Light Pollution Ratio
Night Sky Metrics LLC

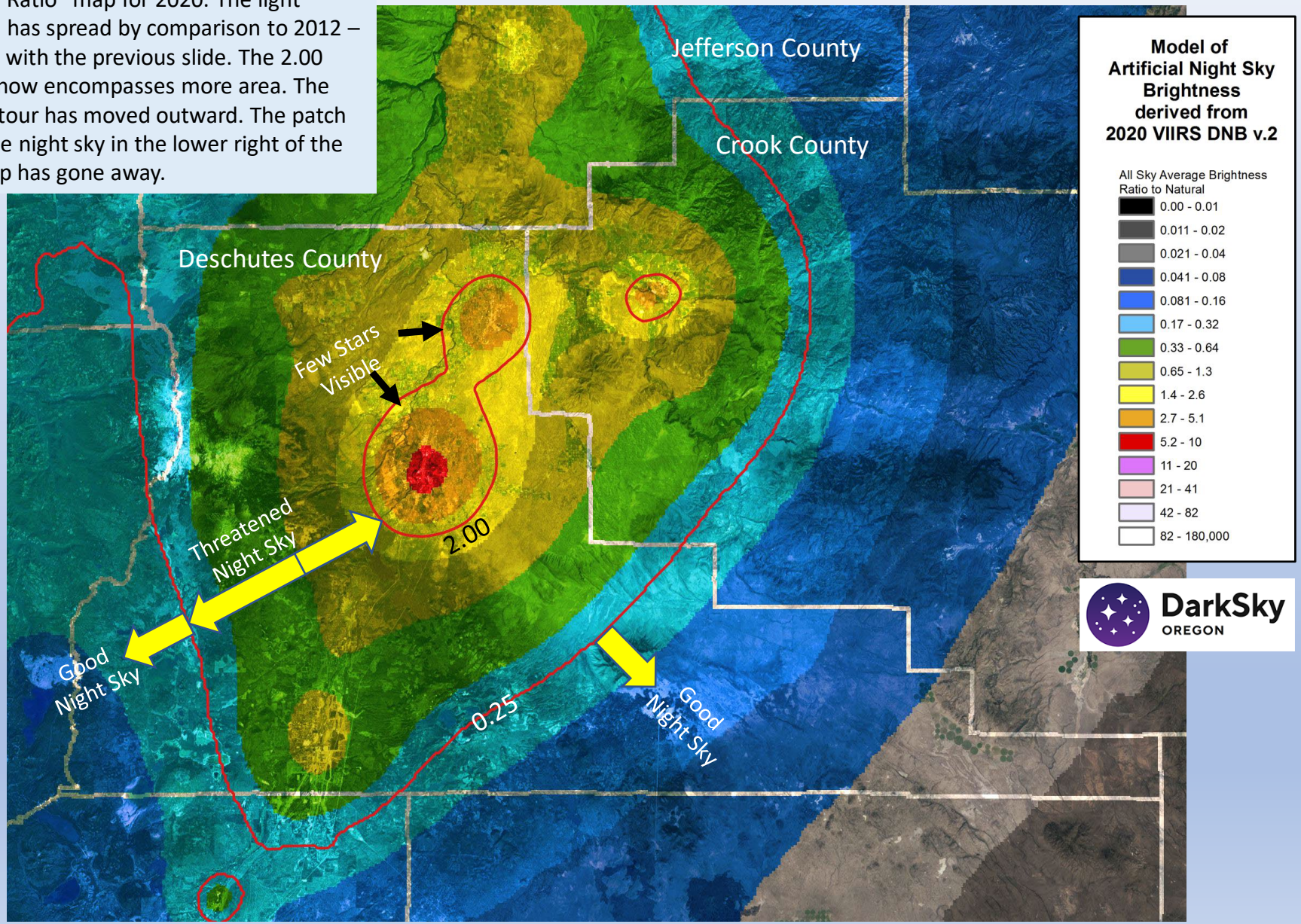
Notes: This is the "All-Sky Average Light Pollution Ratio" map for 2012. The colors and contours represent the ratio between a light polluted and pristine night sky. Ratio values higher than 2.0 identify areas where few stars are visible. Ratio values lower than 0.25 are considered good, starry night sky. In between those two contours, the night sky is considered threatened or compromised.



Skyglow Model 2020

All-Sky Average Light Pollution Ratio
Night Sky Metrics LLC

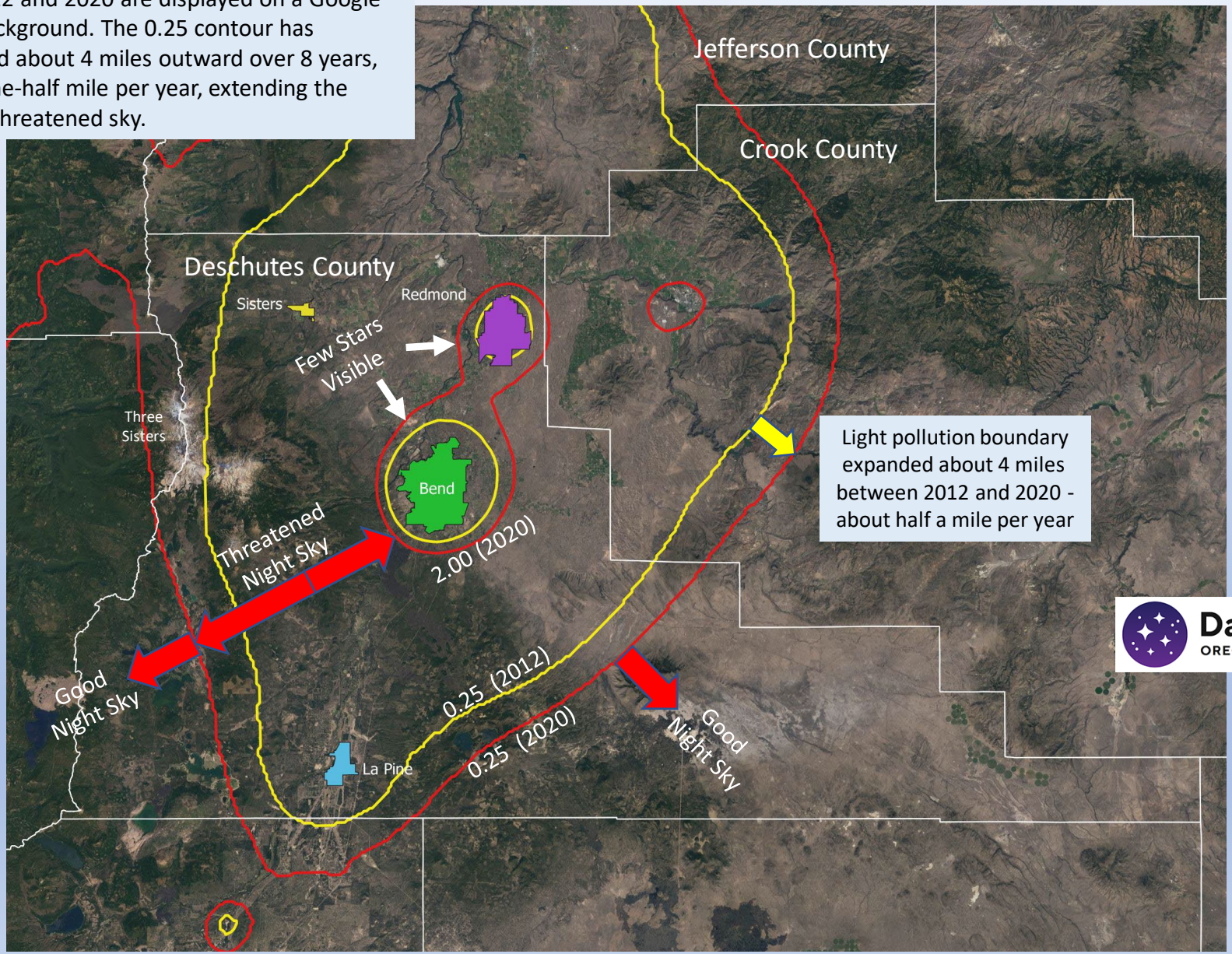
Notes: This is the "All-Sky Average Light Pollution Ratio" map for 2020. The light pollution has spread by comparison to 2012 – compare with the previous slide. The 2.00 contour now encompasses more area. The 0.25 contour has moved outward. The patch of pristine night sky in the lower right of the 2012 map has gone away.



Compare 2012 and 2020 Models

All-Sky Average Light Pollution Ratio
Night Sky Metrics LLC

Notes: The light pollution ratio contours from both 2012 and 2020 are displayed on a Google Earth background. The 0.25 contour has expanded about 4 miles outward over 8 years, about one-half mile per year, extending the zone of threatened sky.



The skyglow calculations are conservative – the reality is worse because:

Reality #1 Satellite doesn't see the blue in the spectrum of white lights

- Many lights such as white LEDs emit a significant amount of blue light in their spectrum
- Blue light scatters more than green, yellow and red parts of the visible spectrum
- However, the satellite does not see the blue visible light from each lamp

Reality #2 Satellite pixels are large and may not pick up sparse lights

- There are many widely separated lights in rural areas which contribute to skyglow
- The satellite looks with large pixels – about 500 meters x 500 meters
- The satellite may not be sensitive enough to see the widely separated lights

Reality #3 Satellite images exclude cloudy nights, but clouds multiply the skyglow

- Cloudy nights are excluded from the satellite images
- Clouds reflect back downward the artificial light at night coming up from the ground
- Glow downward from clouds is 10x or more brighter than skyglow during clear nights

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These Skyglow Models -

Are based on

- All-Sky light pollution - not just at the zenith, but entire hemisphere, down to horizon
- Cloud-free night time satellite images from NASA's VIIRS Sensor
- Model of light scattering by the atmosphere
- Atmosphere characteristic of Western US desert areas
- Distance to light sources calculated via Geographic Information System
- No topographic blocking or highlighting
- Calibration by National Park Service measurements of hemispheric sky luminance and zenith sky luminance measurements

$$ALR = \frac{\text{Sky Luminance} - \text{Pristine Sky Luminance}}{\text{Pristine Sky Luminance}}$$

$$ALR = \frac{\text{Sky Luminance} - 250 \text{ micro Candelas/meter squared}}{250 \text{ micro Candelas/meter squared}}$$

The method is described in this publication: "A simplified model of all-sky artificial sky glow derived from VIIRS Day/Night band data", 2018.
https://www.researchgate.net/publication/324789721_A_simplified_model_of_all-sky_artificial_sky_glow_derived_from_VIIRS_DayNight_band_data

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How can we minimize light pollution? -- Adopt the Five Principles for Responsible Outdoor Lighting

Notes: These five principles are the cornerstone of responsible outdoor lighting. They emphasize outdoor lighting for safety and quality of life – by preventing light trespass, by eliminating over-lighting which produces sharp dark shadows and glare, by encouraging smart lighting and warm colored light which is more beneficial to the ecosystem than blue-rich white light. Deschutes County can improve night time safety and quality of life by adopting these principles.

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