

A satellite image of a river valley with agricultural fields and a blue Planet Labs logo in the top right corner. The river is green and flows through a brown, hilly landscape. The logo is a blue circle with the text "PLANET LABS" in white.

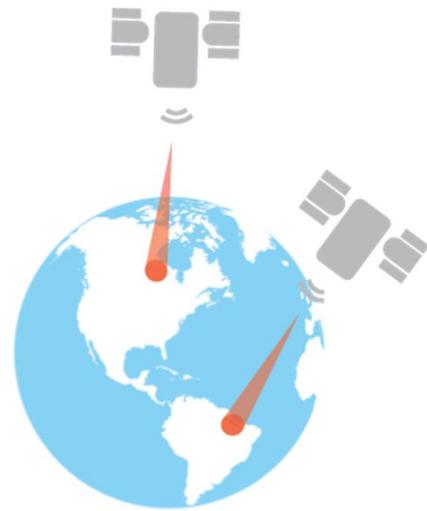
**PLANET
LABS**

Reconstruction of effective PSF from natural images

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Traditional Approach

- Tasking
- Low coverage
- Weeks to gain access
- Expensive



Planet Labs Approach

- Monitoring
- Global coverage
- Daily online delivery
- Affordable





NASA
LANDSAT8



PLANET LABS
DOVE



**Planet Labs helps you
detect and act on
change by imaging the
whole Earth everyday.**

**That means imagery
will most often be seen
and manipulated by
computers only.**



Challenges



Large mixed constellation



Need to make **quick** data-driven decisions



Need to automatically assess imagery

assessing image quality (IQ)

IQ depends multiple factors, **including the scene composition itself**

IQ is reflective of the **general imaging health of the system**

IQ is hard to measure and trend in **natural imagery**



resolving power | slanted edge method



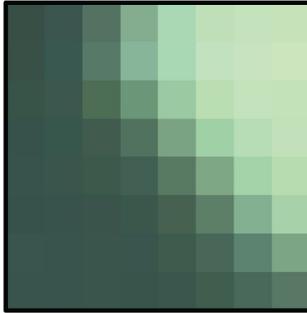
find edge
in the
image



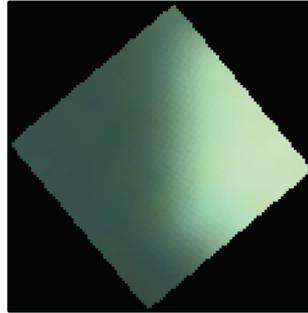
not production imagery

resolving power | slanted edge method

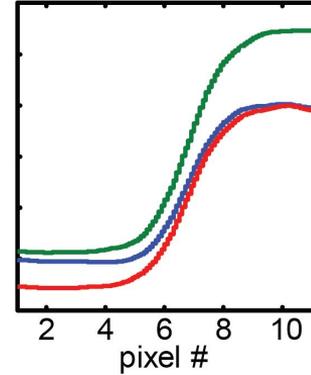
Original Image



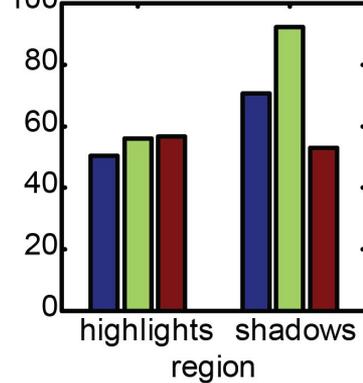
Aligned Edge



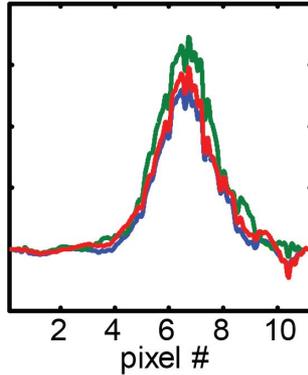
ESF=2.16



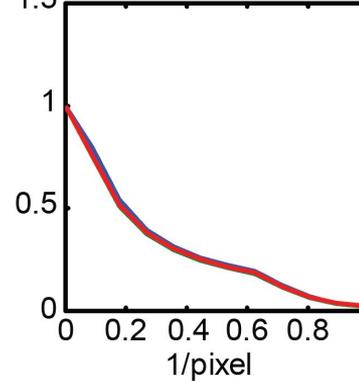
S/N Ratio



Edge spread function (ESF)



MTF50=0.18



not production imagery



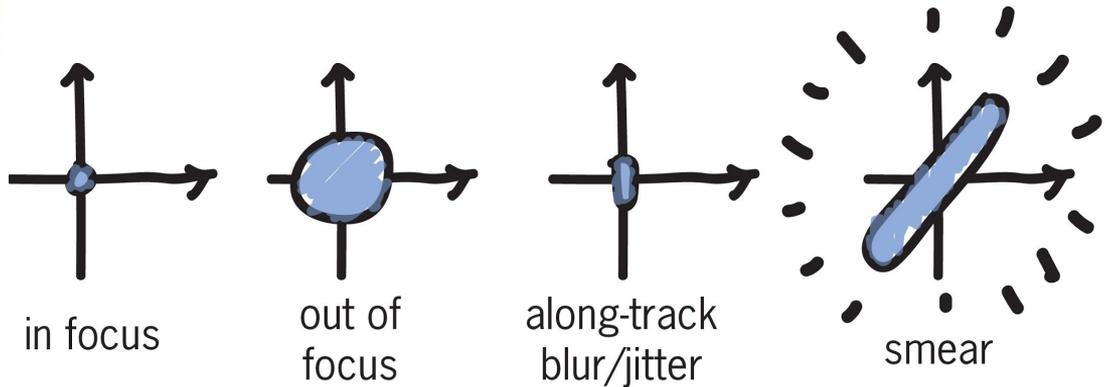
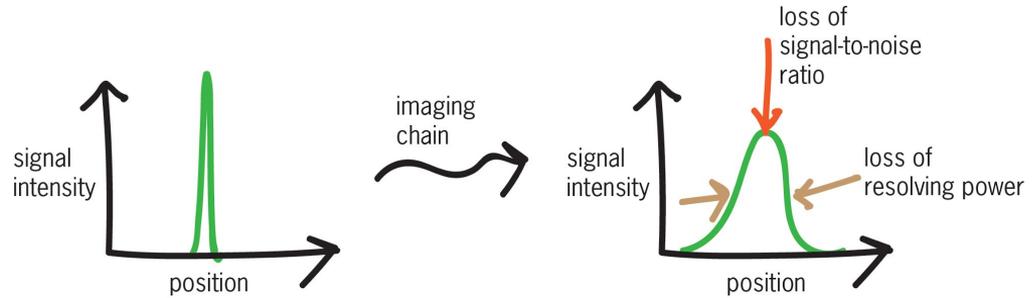
resolving power | **slanted edge method**

Pros | easy to validate and interpret

Cons | not representative of the entire field, not computable for all images, sensitive to human bias, sensitive to SNR, does not capture aberrations



point-spread functions provide a better model of resolving power



resolving power | back to the gradients

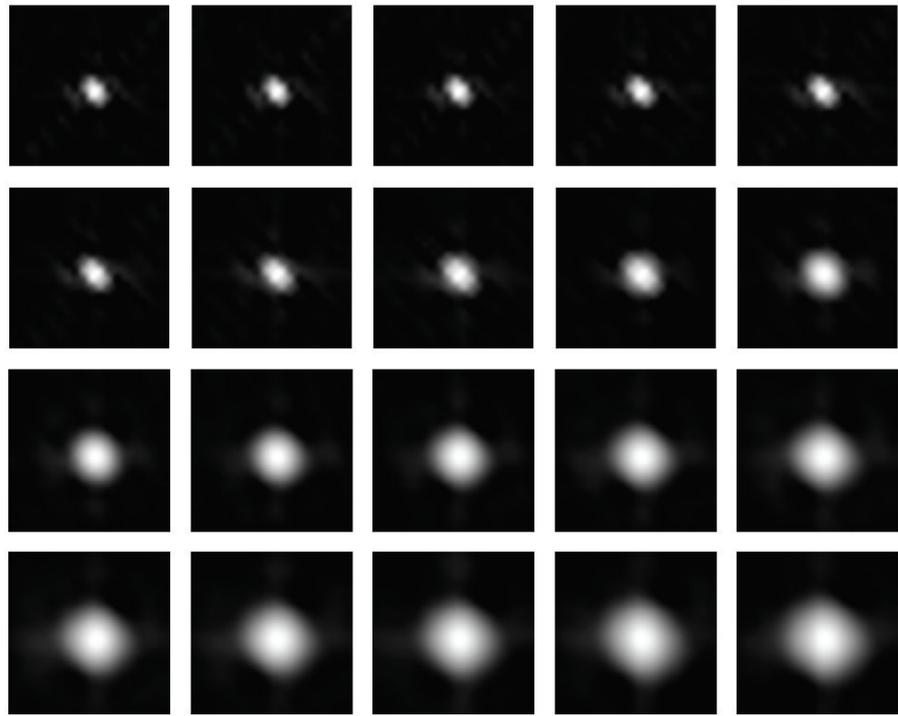
$$I_{\text{measured}} = I_{\text{latent}} \otimes \text{PSF}$$

$$|\nabla I_{\text{measured}}| \stackrel{\text{IR}}{\approx} |\nabla I_{\text{latent}}| \otimes \text{PSF}$$

$$\min \| |\nabla I_{\text{measured}}| - |\nabla I_{\text{latent}}| \otimes |\nabla \text{PSF}| \|_2$$

resolving power | a heuristic resolution metric

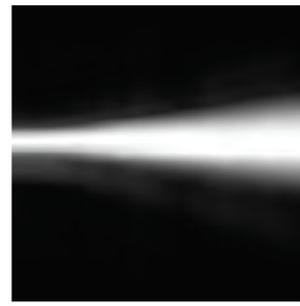
add blur to a natural image



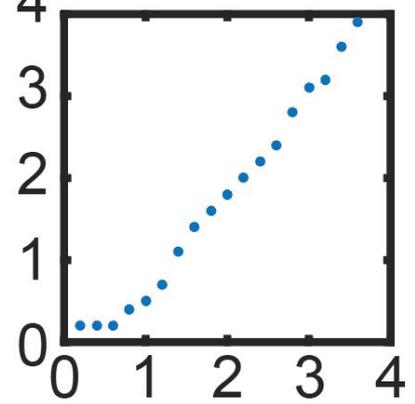
LSF



ESF



measured blur (px)

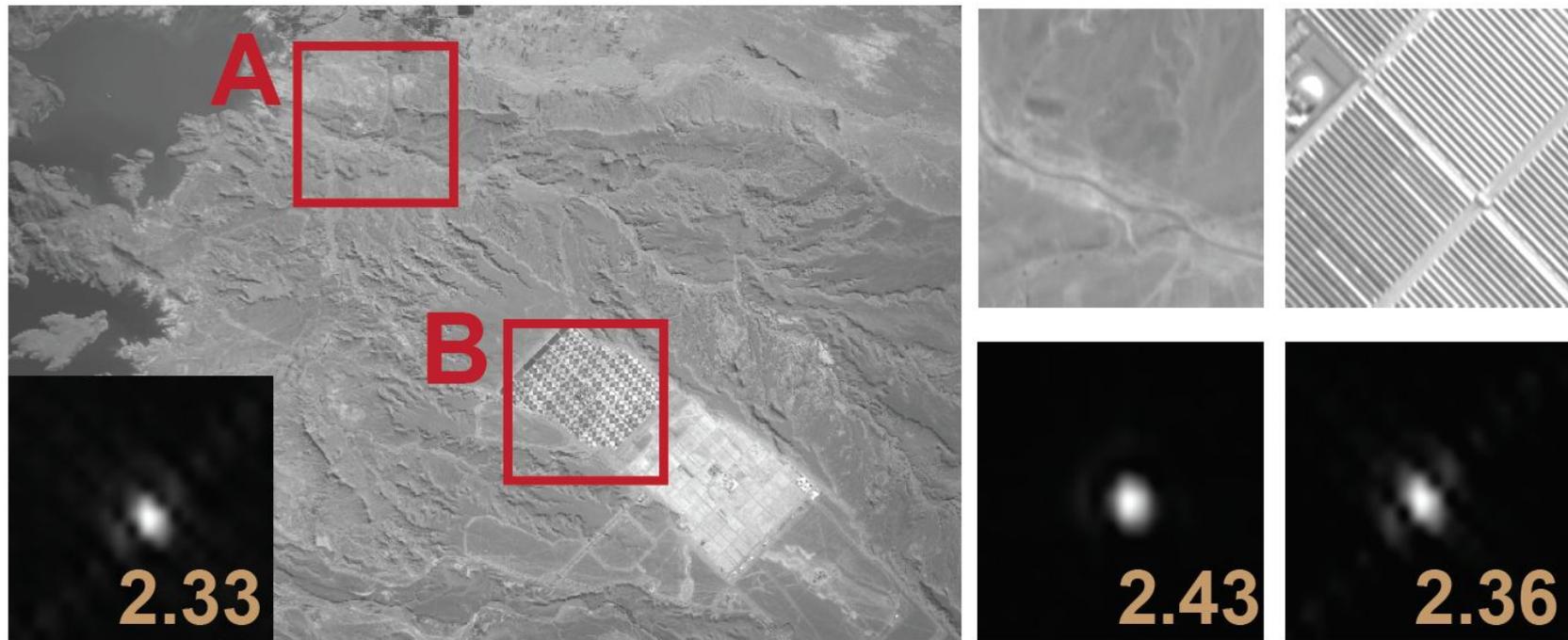


added blur (px)

not production imagery



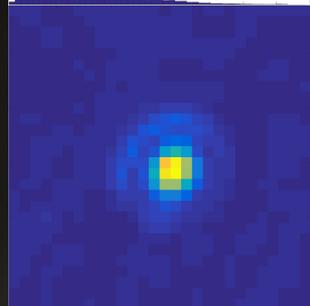
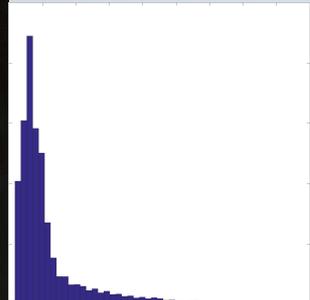
testing robustness to scene composition



not production imagery

PS0

Bayingolin
Prefecture,
Xinjiang, China

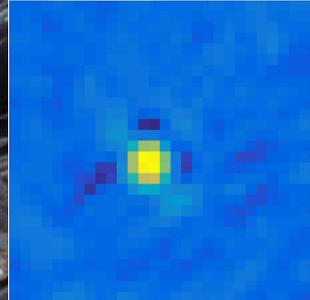


not production imagery

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PS2

Southern District,
Botswana

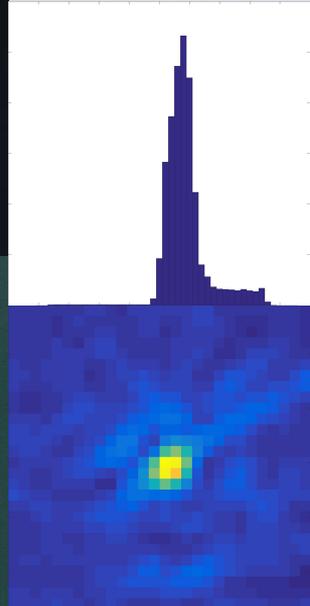


not production imagery



PS2

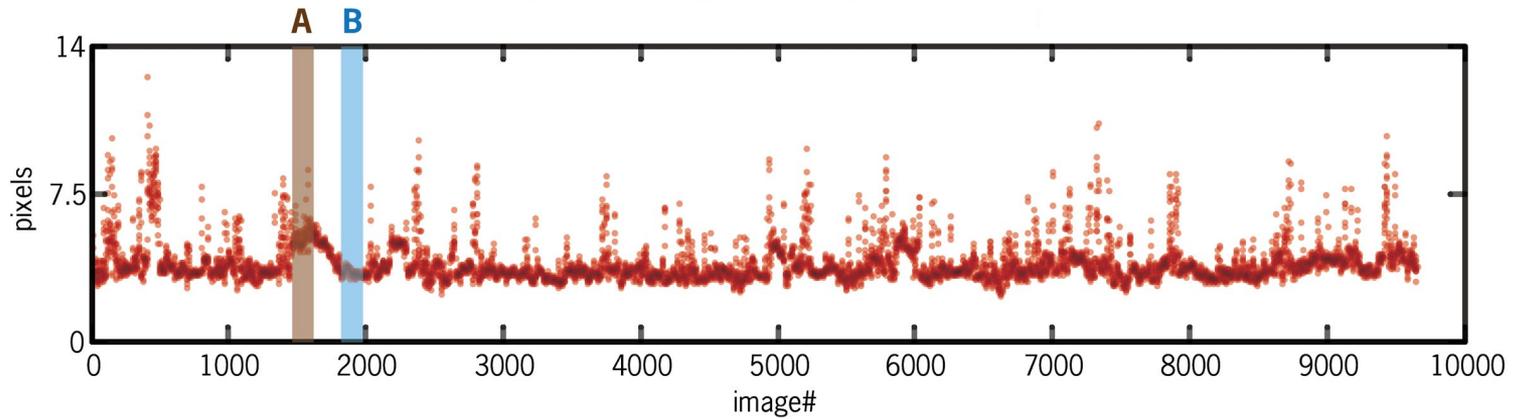
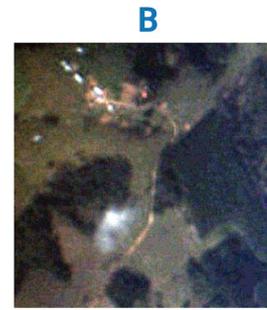
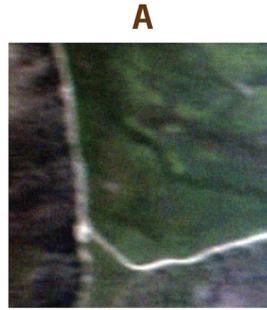
Incheon, South
Korea



not production imagery



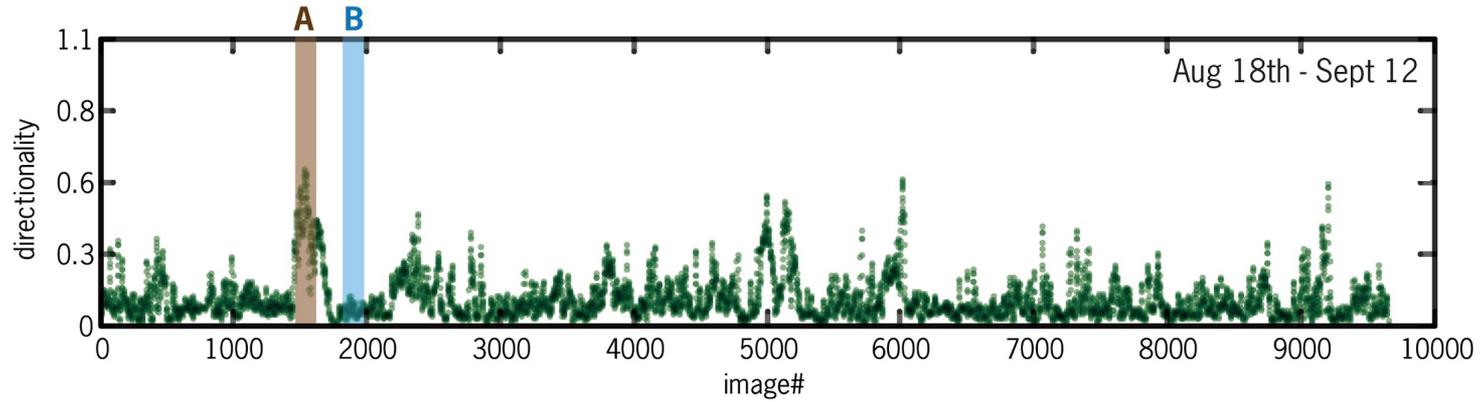
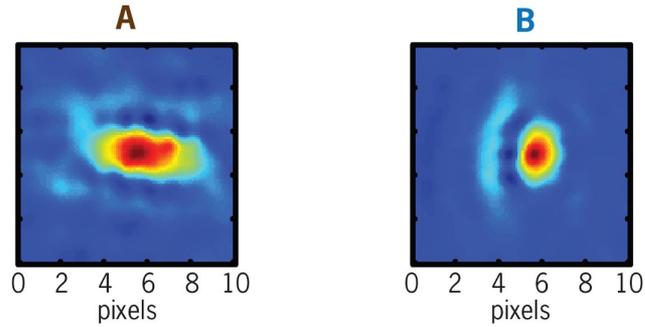
PSF trending at work



not production imagery



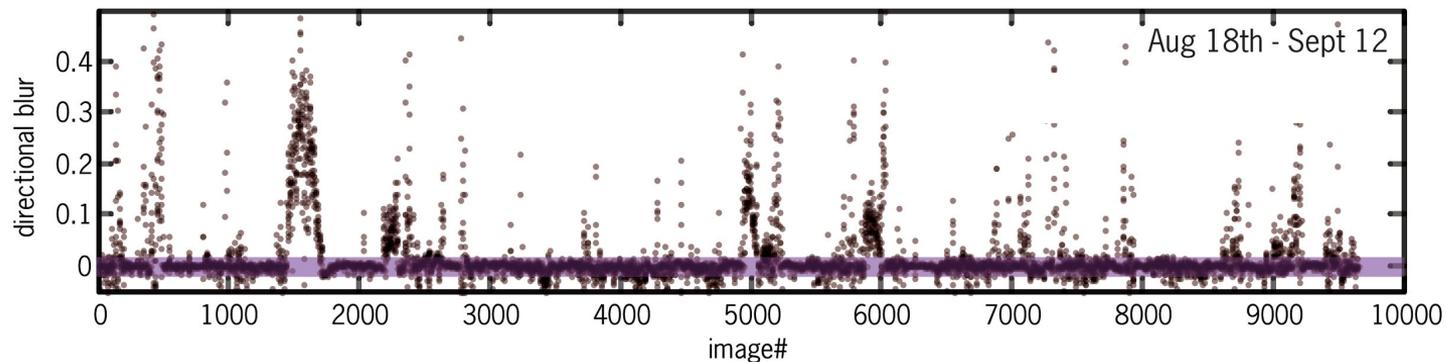
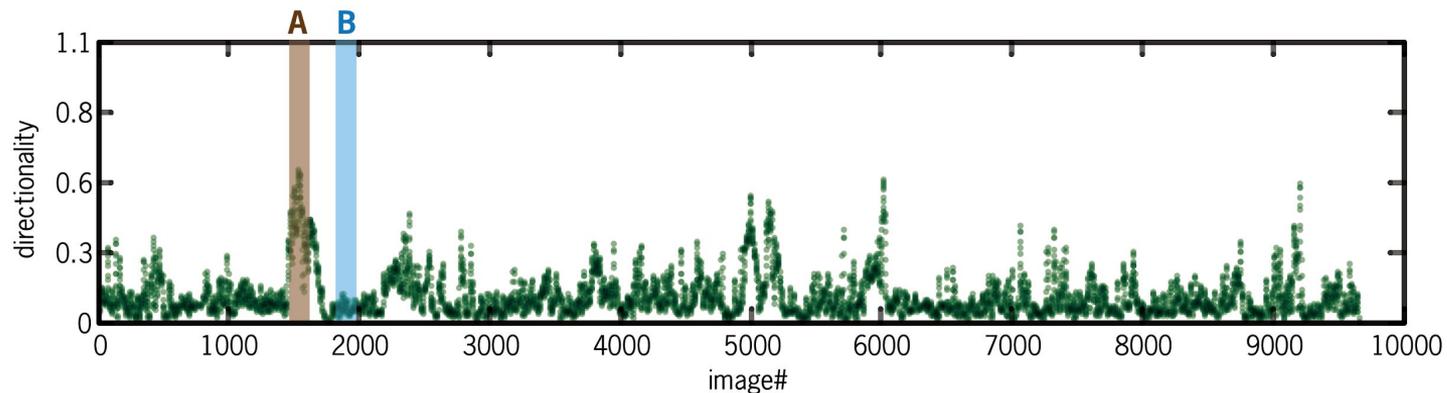
PSF reconstruction at work



not production imagery



accounting for directionality



not production imagery



resolving power | **PSF reconstruction overall**

Pros | 2-dimensional, can be computed for any image, automatable, good for trending, informs reconstruction, can be computed for any portion of the imaging field

Cons | heuristic, needs calibration and validation



Next steps

improve, calibrate & validate

automate

share



Practical uses of PSFs

IQ Trending

**Image Quality Equations
(NIIRS)**

**Image Reconstruction
(MTF-based sharpening)**



towards a **rastermetrics** toolkit

crowdsourced sharpness, contrast, brightness
noise, gradients, edges, SNR **measurement science**

github.com/planet-labs/rastermetrics

contact me at ignacio at planet.com

