First Light Imaging

Green House Gas detection & observation from space in the SWIR band

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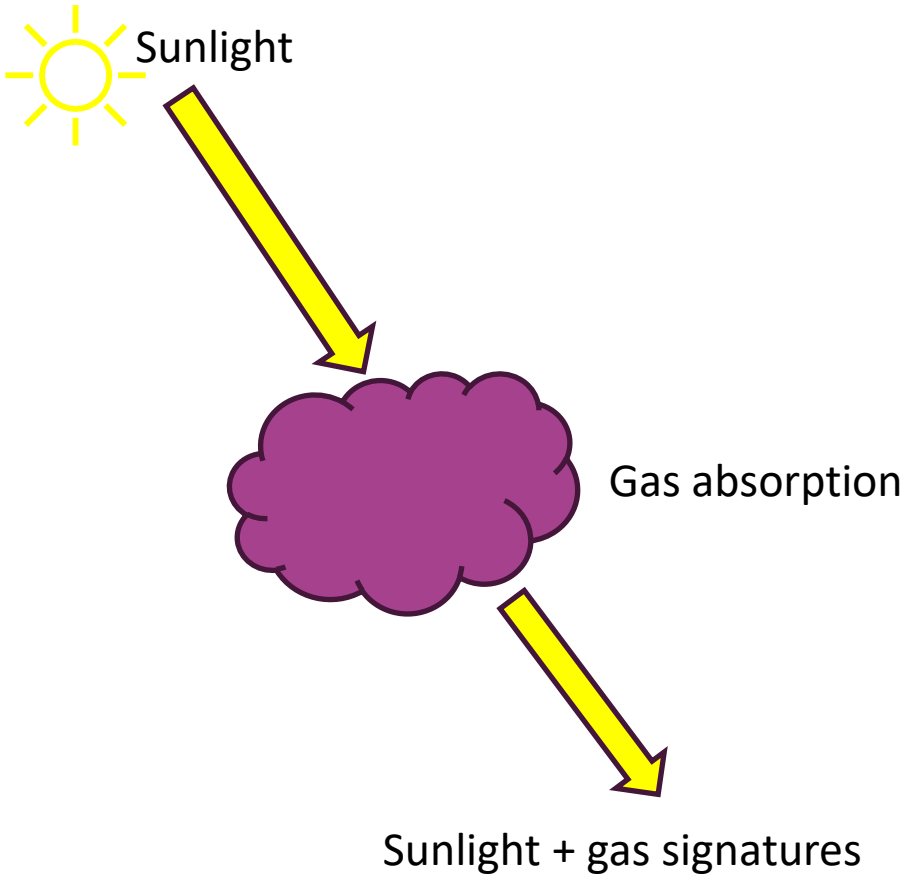
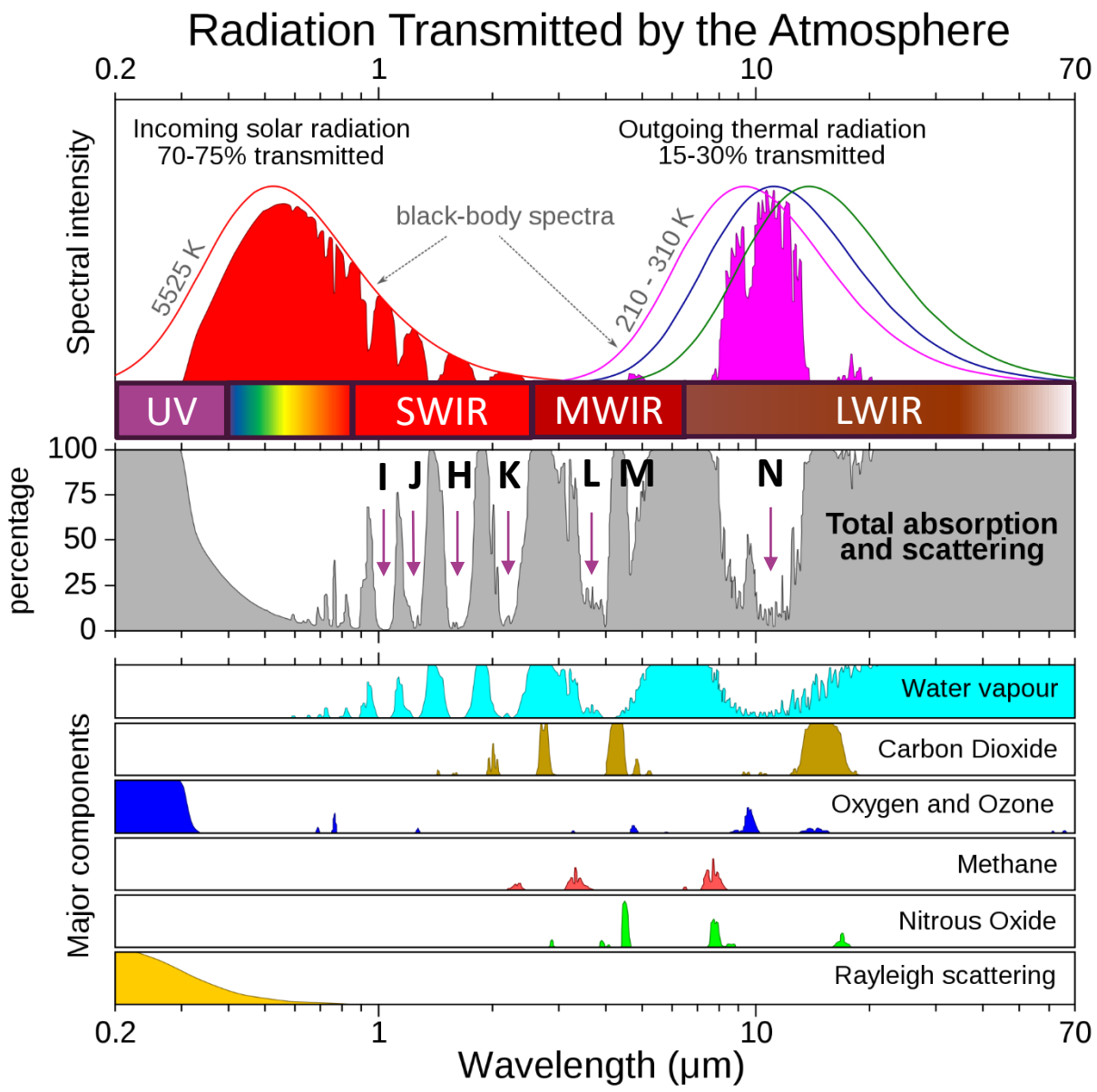
Gas detection principle

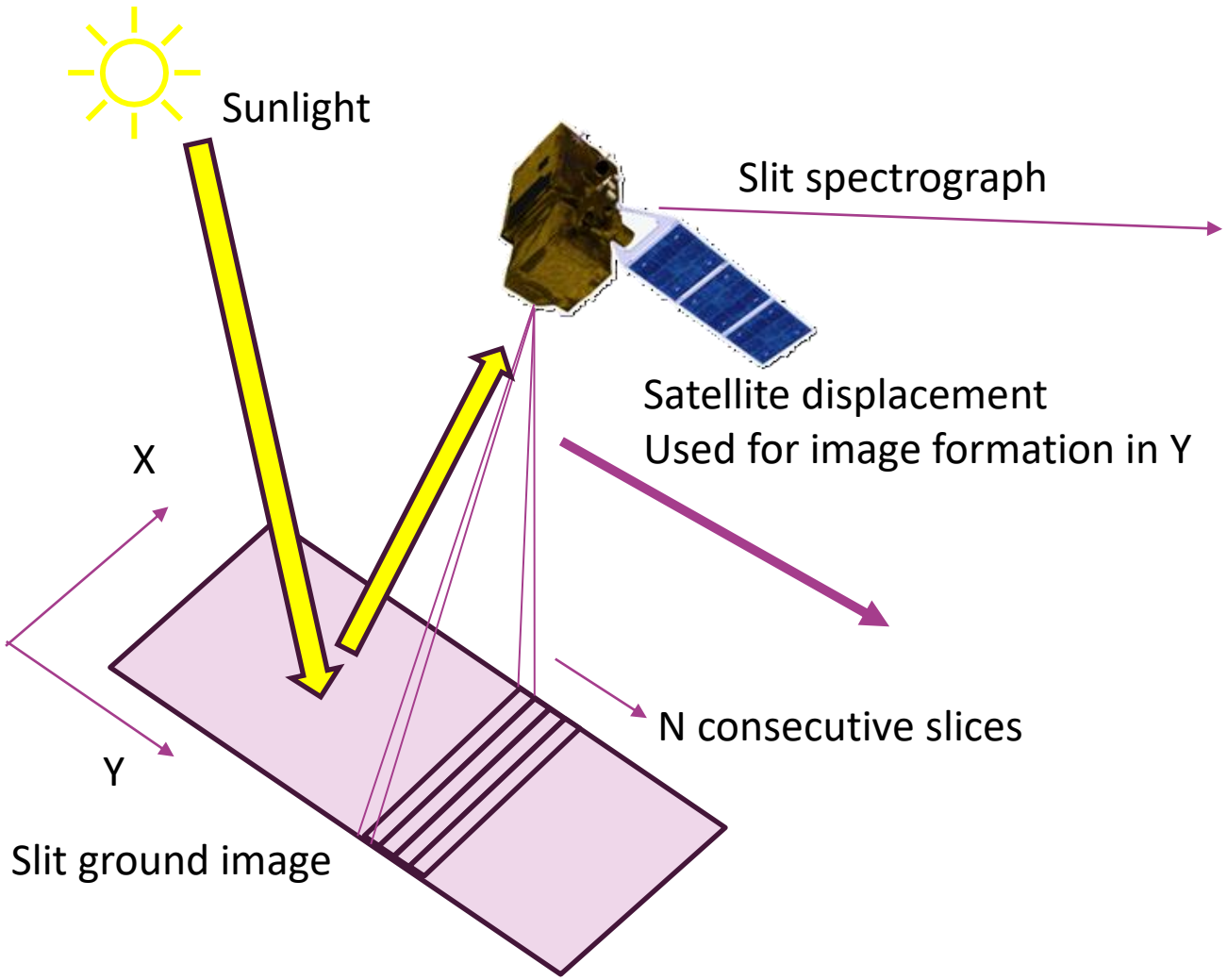


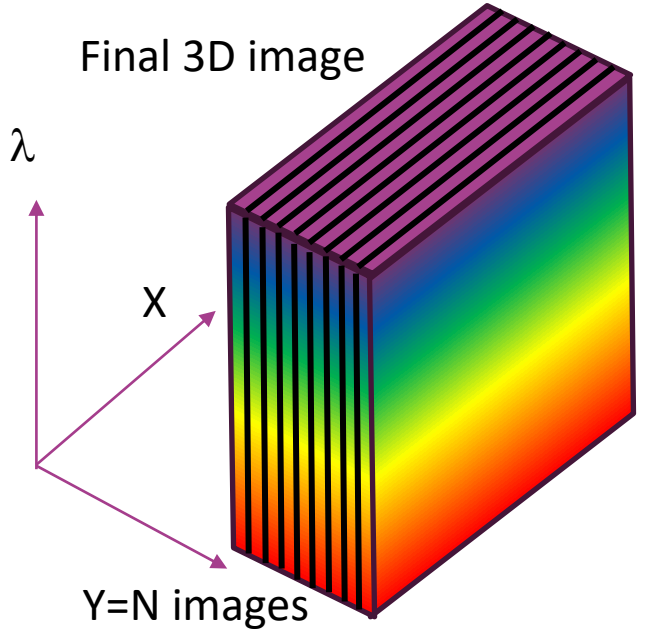


Hyperspectral Earth observation

So called
« pushbroom » imager

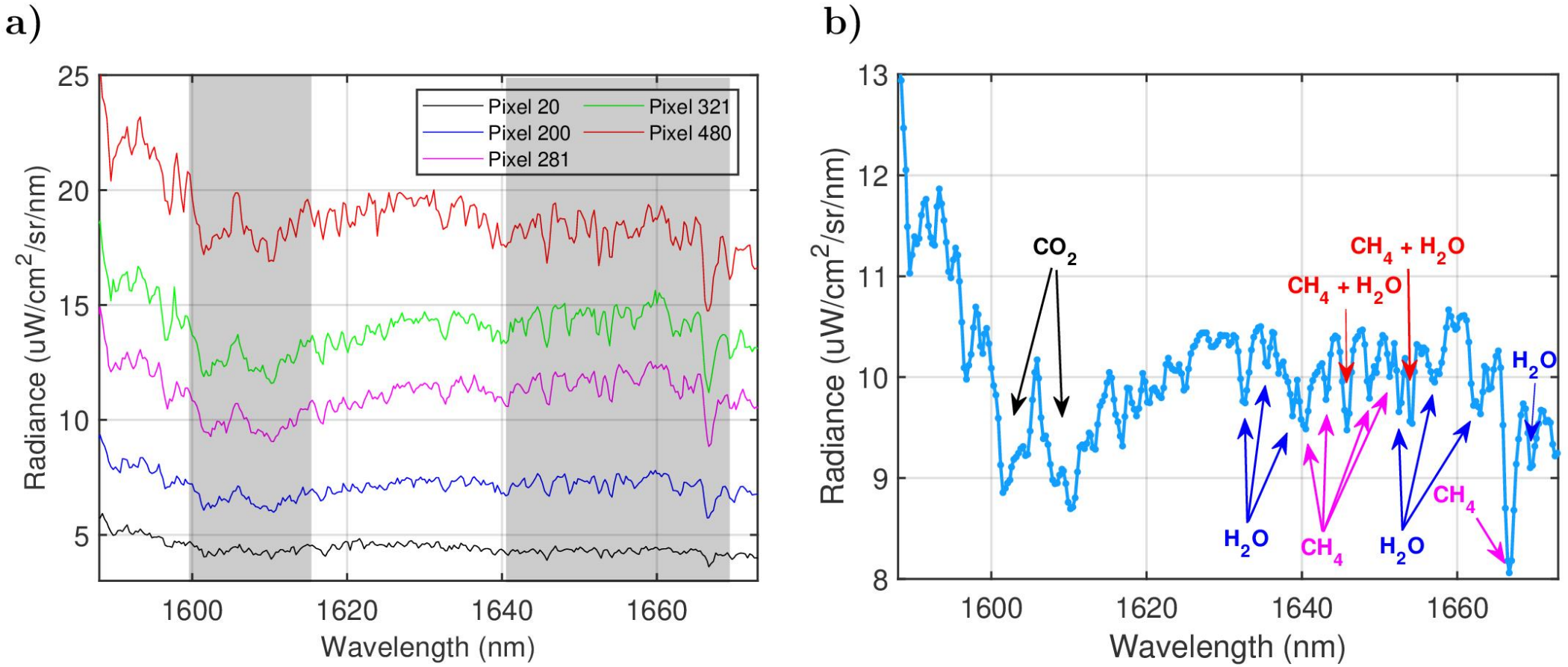
See for example:
Naif Alsalem et al.
Optics Continuum
Vol. 2, No. 11 / 15 Nov 2023
https://doi.org/10.1364/OPTCON.494570





J band GHG spectral detection

Alsalem et al.



High spectral resolution permits species disentenglement
Absorption depth gives concentration
High spatial resolution enhances detectivity (less dilution)

Optical considerations

Diffraction limit

- Angular

$$\theta = 1.22 \times \frac{\lambda}{D}$$

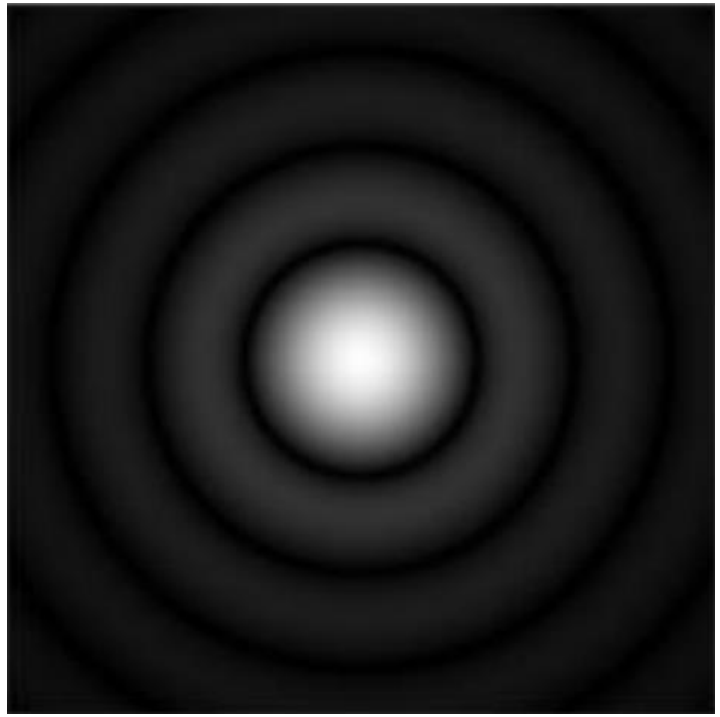
wavelength

Telescope diameter

- Ground resolution

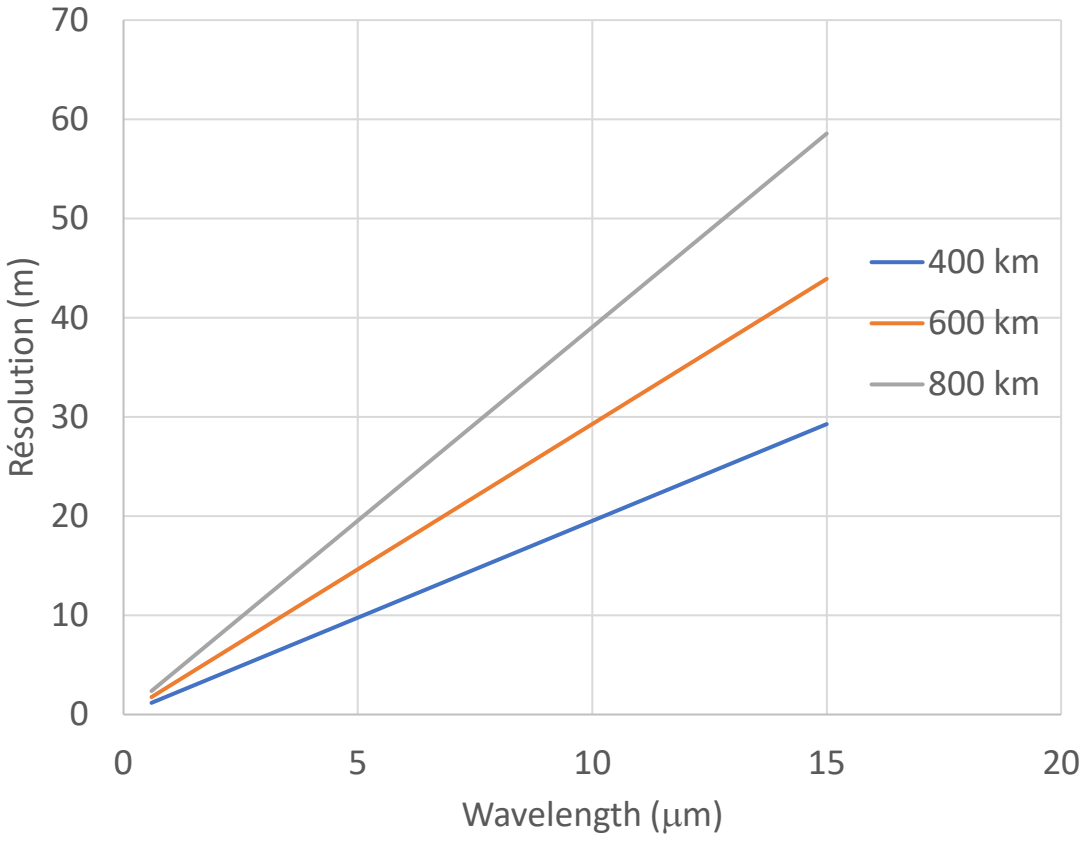
$$\mathrm{R} = \theta H = 1.22 \times H \times \frac{\lambda}{D}$$

Satellite altitude

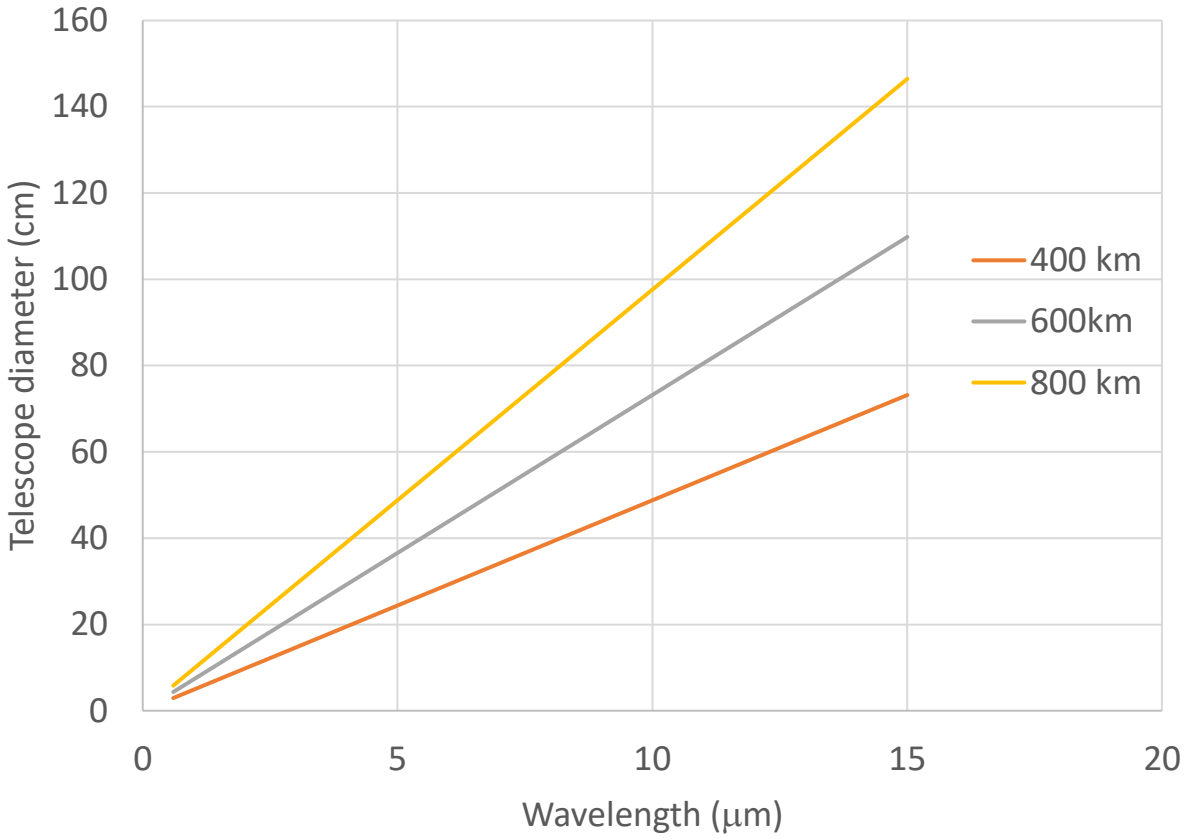


Diffraction limit

Theoretical spatial resolution limit for a 25cm telescope at variuous LEO altitudes (400 to 800km)

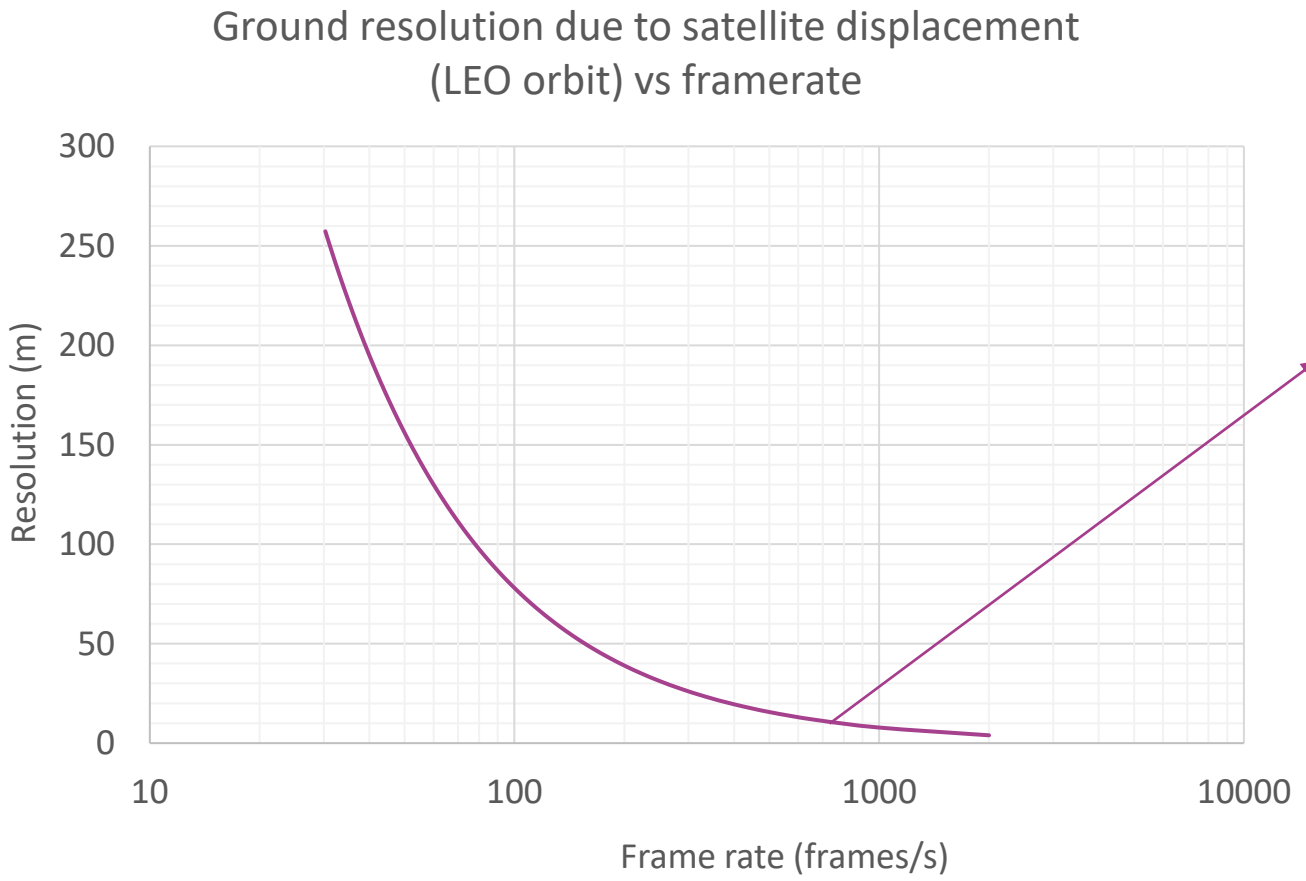


Necessary telescope diameter (cm) for a 10m ground resolution for varoius LEO altitudes (400 to 800km)



Acquisition speed impact on ground resolution

In the case of an hyperspectral imager, the satellite displacement x acquisition speed gives the Y ground resolution



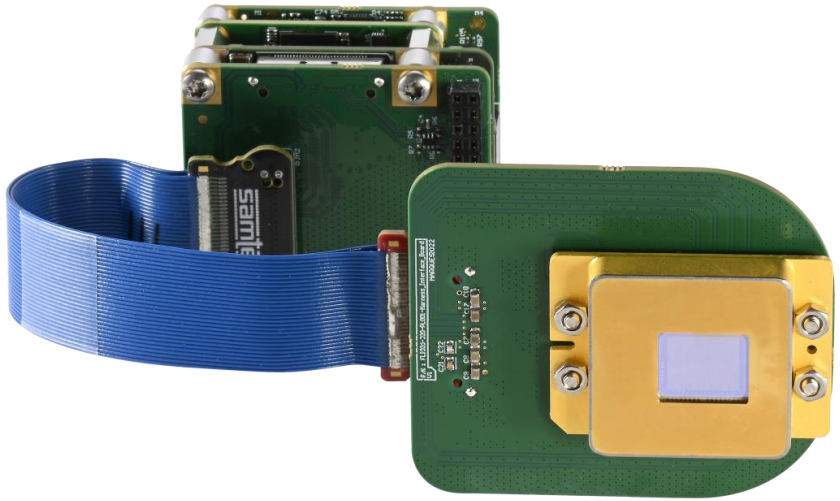
10m ground resolution (sentinel resolution) needs ~700 FPS

Conclusions

- Hyperspectral imaging is **more favorable in the SWIR** for high spatial resolution (among some other advantages)
- Longer wavelengths lead to high size and costly optics, high weight and additional launch costs. **Not compatible with cubesats.**
- Acquisition speed brings also a spatial resolution limit and **a high framerate (>500 FPS) is mandatory** for ~10m ground resolution and higher

What First Light Imaging can do

C-RED New Space



For more info visit: www.first-light-imaging.com

- **SWIR sensitivity from 0.9 to 1.7 (or 2.2 µm)**
  - Actual theoretical ground resolution of 6m with a 25cm telescope
  - Sensitivity to the 1.6um CO_2 and CH_4 absorption bands
- **Acquisition speed of 600FPS full frame**
  - Higher speed if cropped (less spectral bands), up to KHz framerates
  - Not limiting for pushbroom hyperspectral imager applications
- **Low noise, low cost, customizable and many other features !**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