Towards an assessment of photosynthesis from space: Upscaling of PRI reflectance

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Overview

- Remote Sensing of Gross Primary Production (GPP)
- Upscaling to stand-level measurements
- Spaceborne assessment of GPP
- Relevance toHyspIRI mission : Assessment of Biogeochemical cycles (VQ3)

Remote Sensing of GPP

Monteith (1972, 1977):

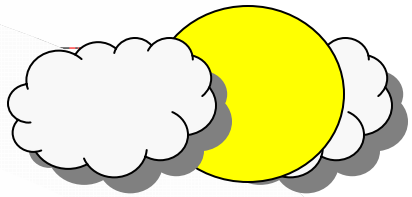
$$GPP = \varepsilon \times f_{PAR} \times PAR$$

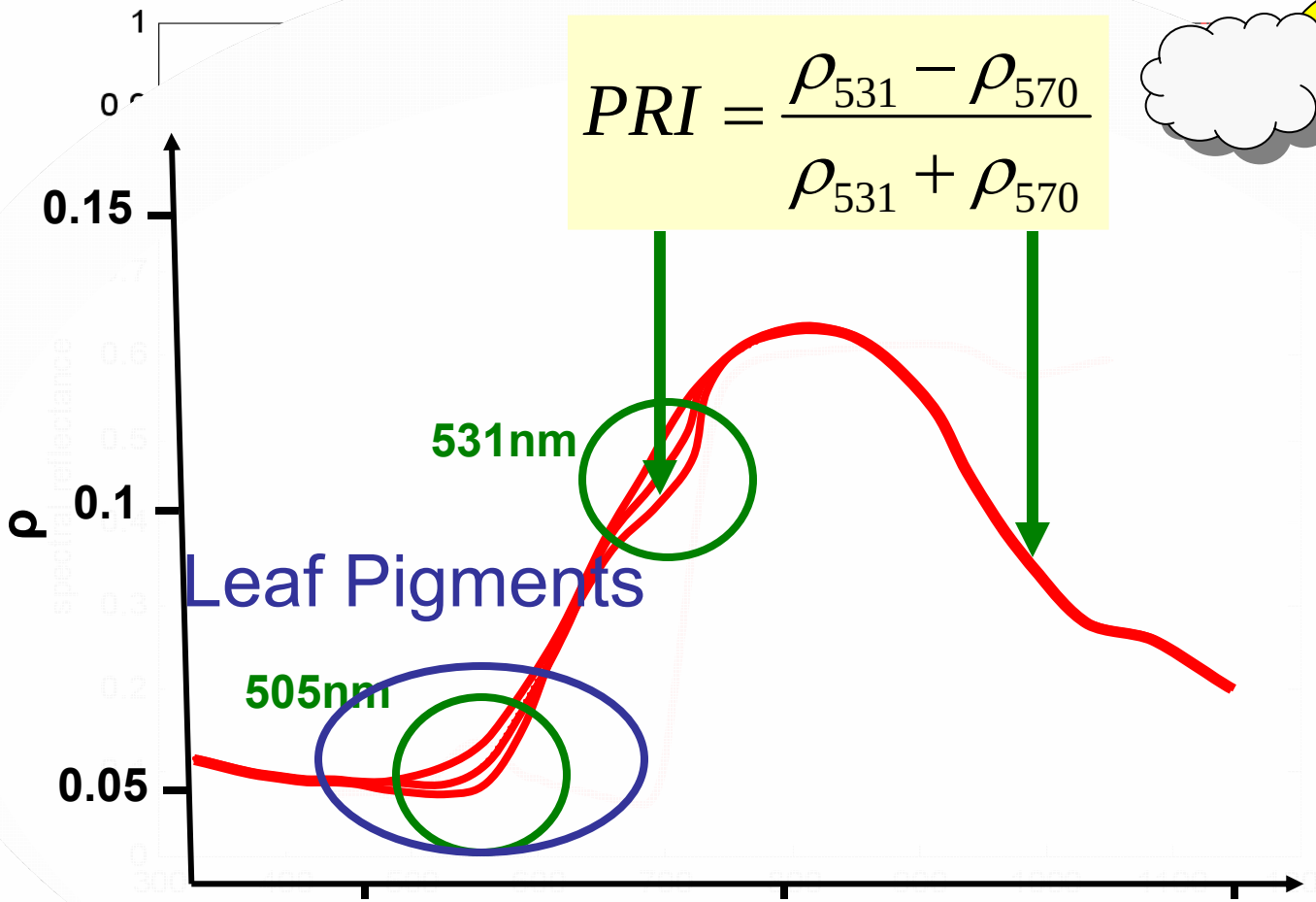
energy input available to system

efficiency, with which absorbed radiation energy gets used (light-use efficiency)

Leaf-level remote sensing of ε

$$PRI = \frac{\rho_{531} - \rho_{570}}{\rho_{531} + \rho_{570}}$$





Spectrum for a healthy leaf

Gamon et al., 1992, 1993 ….

Upscaling ε beyond leaf level

ρ_{PRI} α (ε, Q, BRDF, AOT , ζ)

ε = Physi

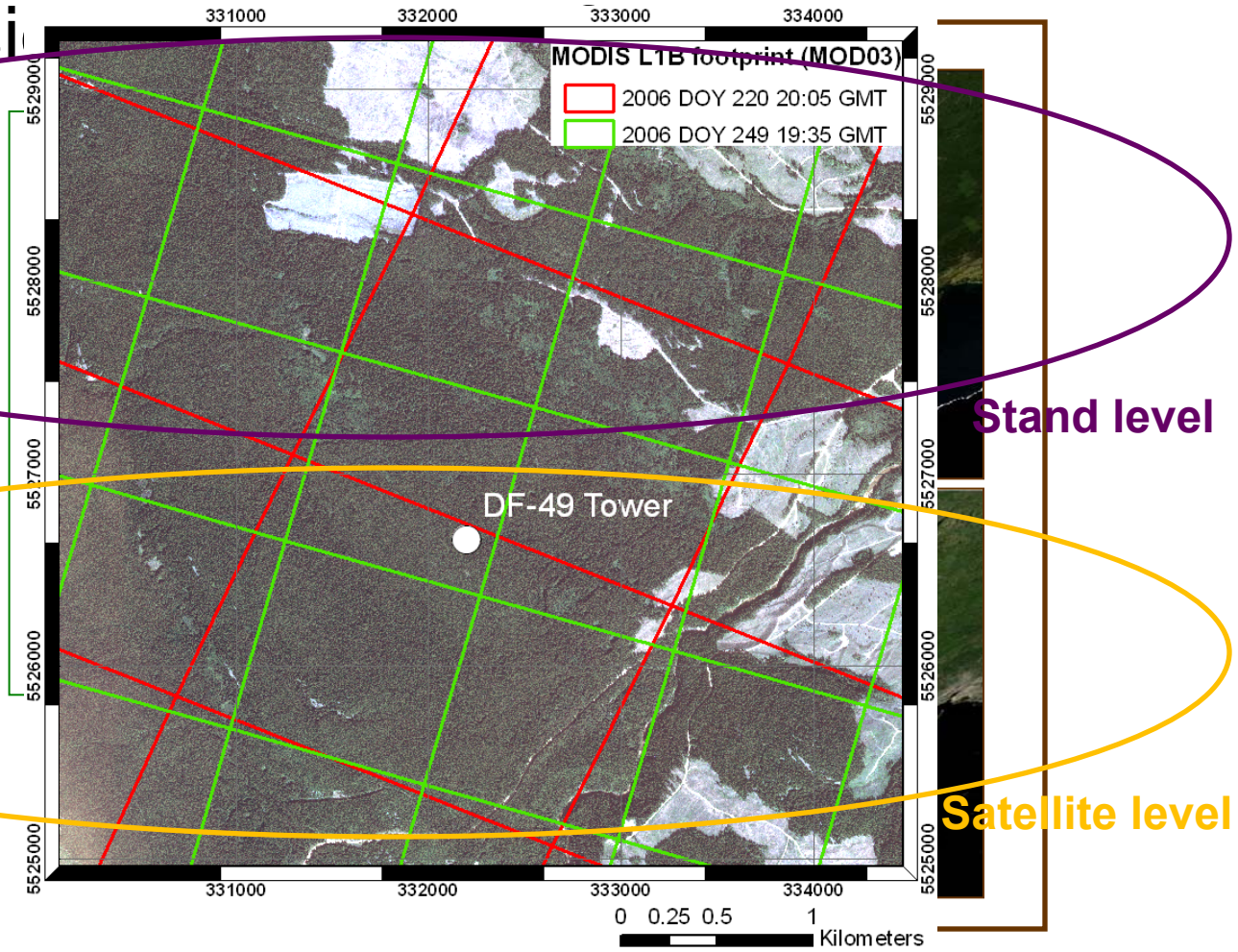
Q= s

BRD

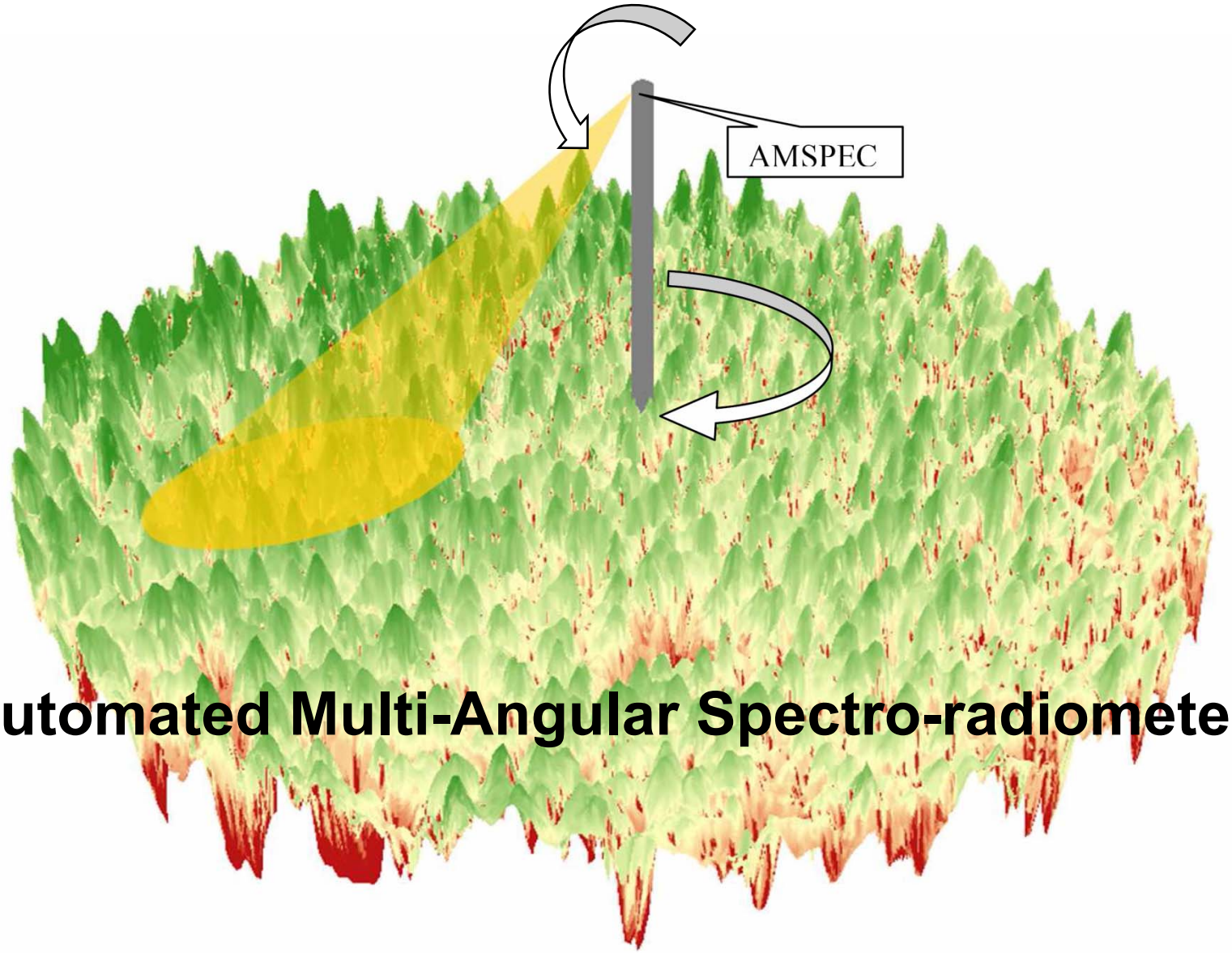
fur

AOT

ζ=Fc



I. Stand level remote sensing of ε

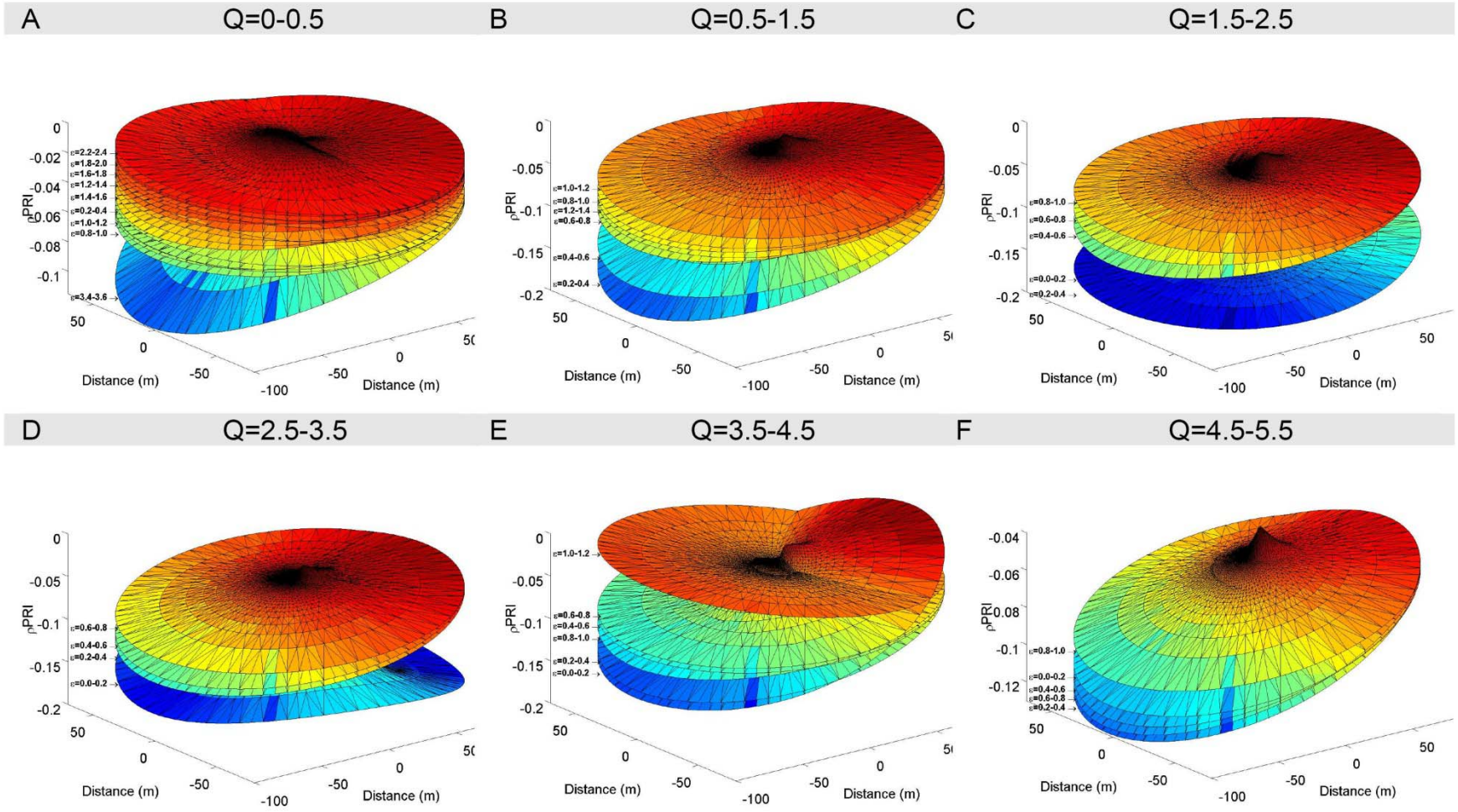


Automated Multi-Angular Spectro-radiometer

AMSPEC system

@
dth
set

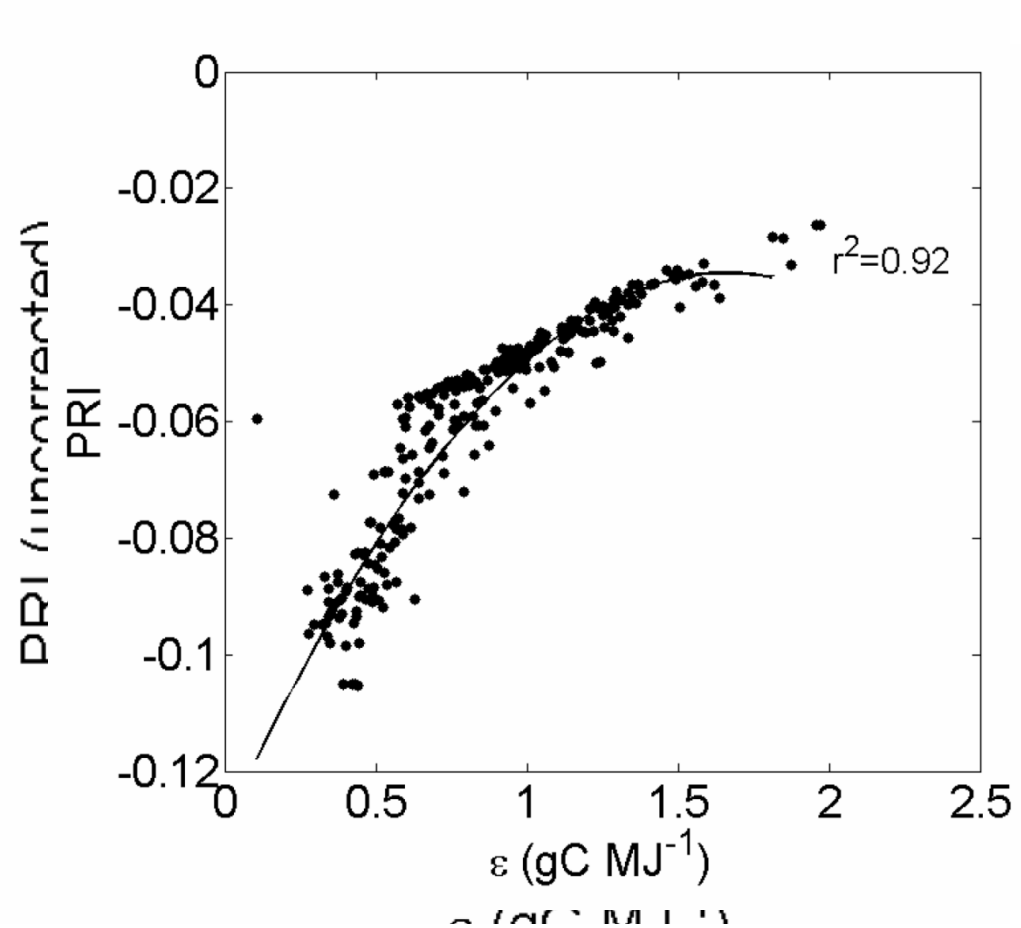
Establishing BRDF surfaces for strata



BRDF models developed for observations made under different Q and ε conditions (strata)

Hilker et al., 2008 Remote Sens. Environ., 112

Modeling stand level ε (2006)

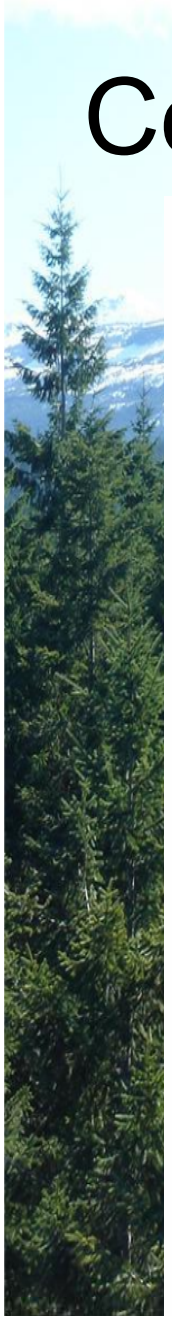


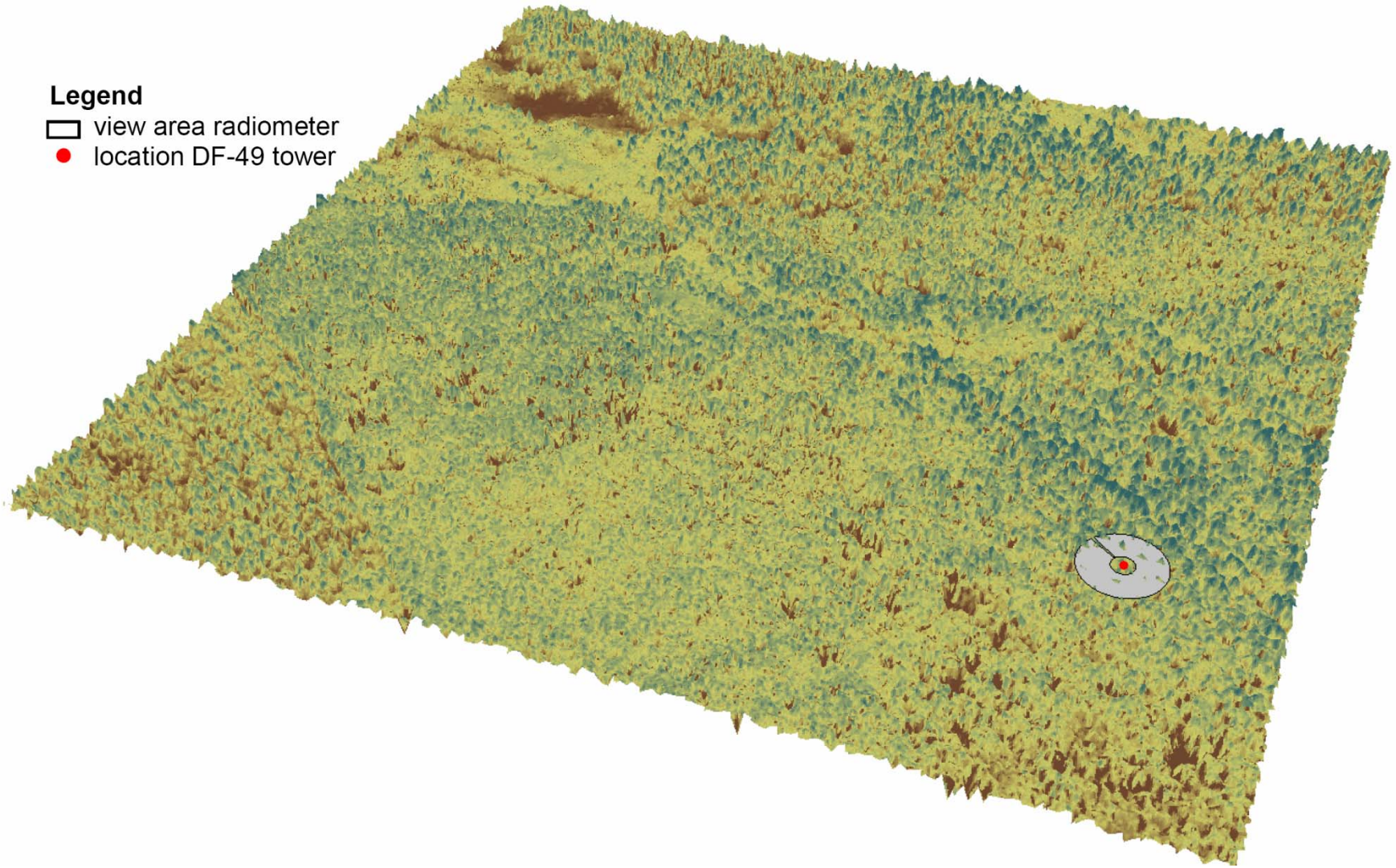
Accounting for stand level effects

Hilker et al., 2008 Remote Sens. Environ., 112

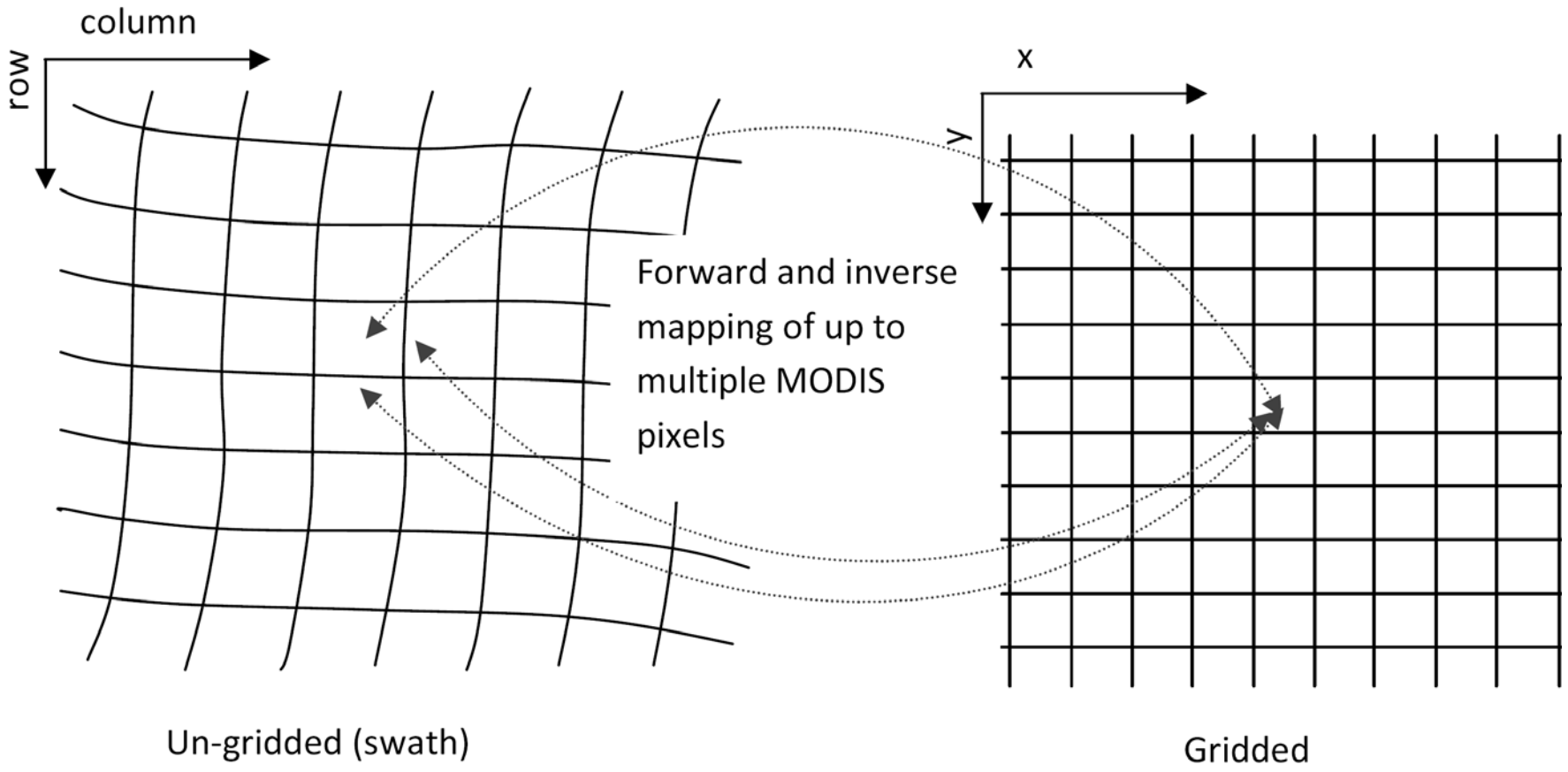
II. Landscape level:

Comparing Amspec /MODIS footprint

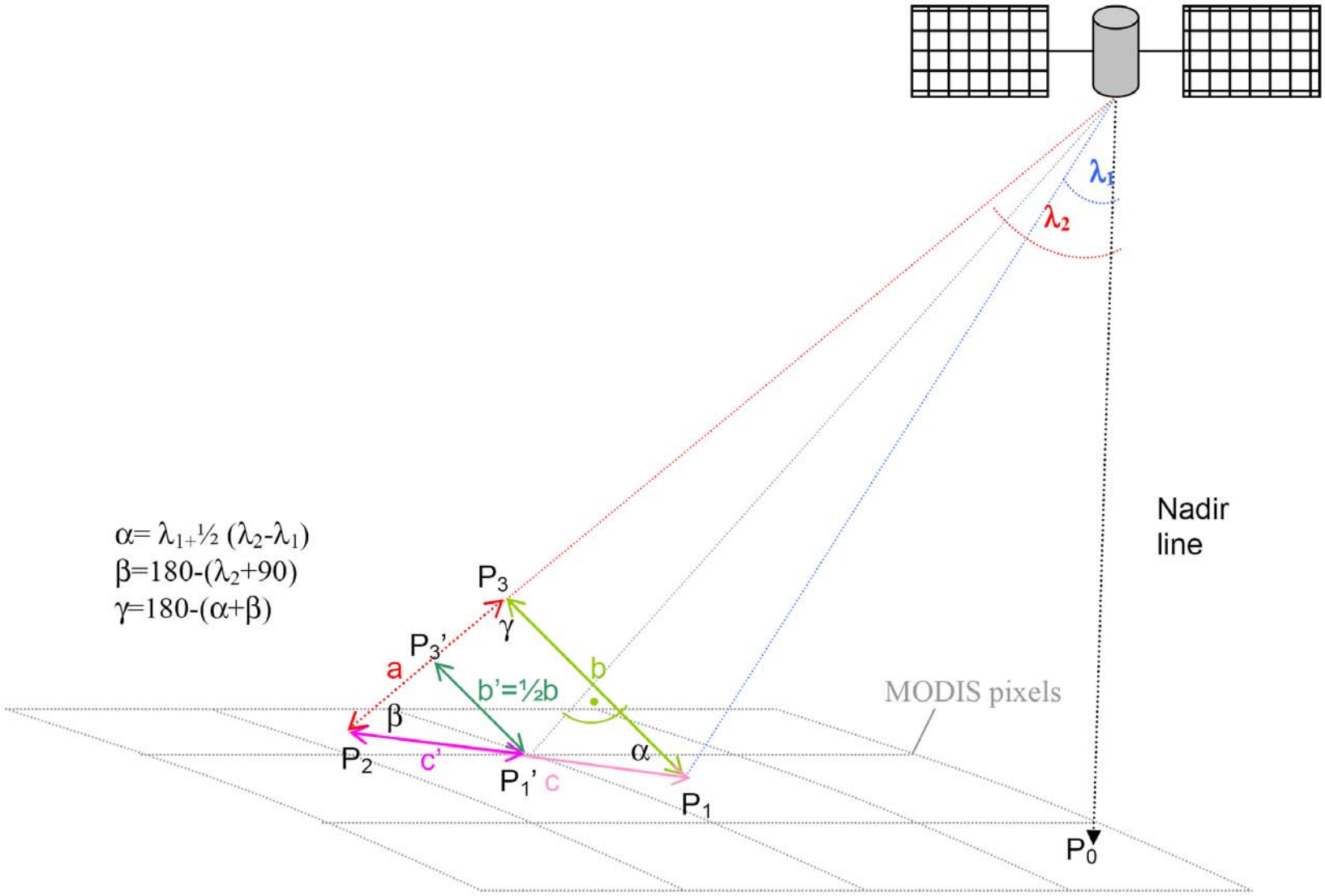




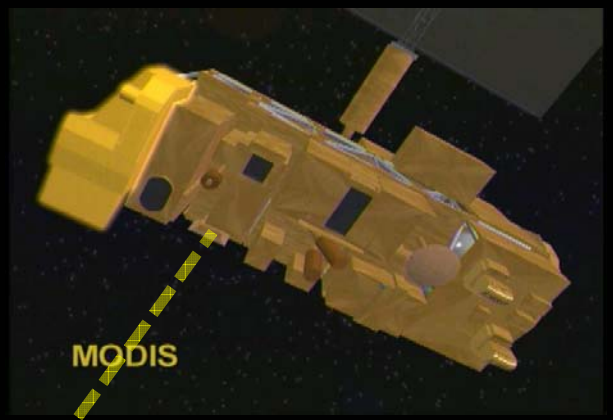
MODIS footprint

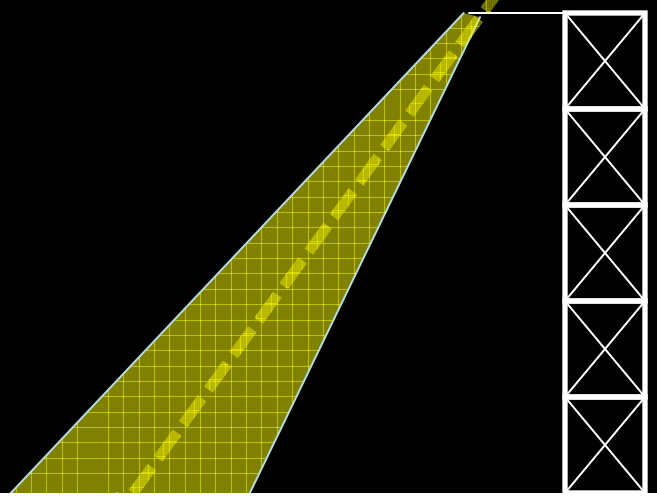


Determining MODIS footprint



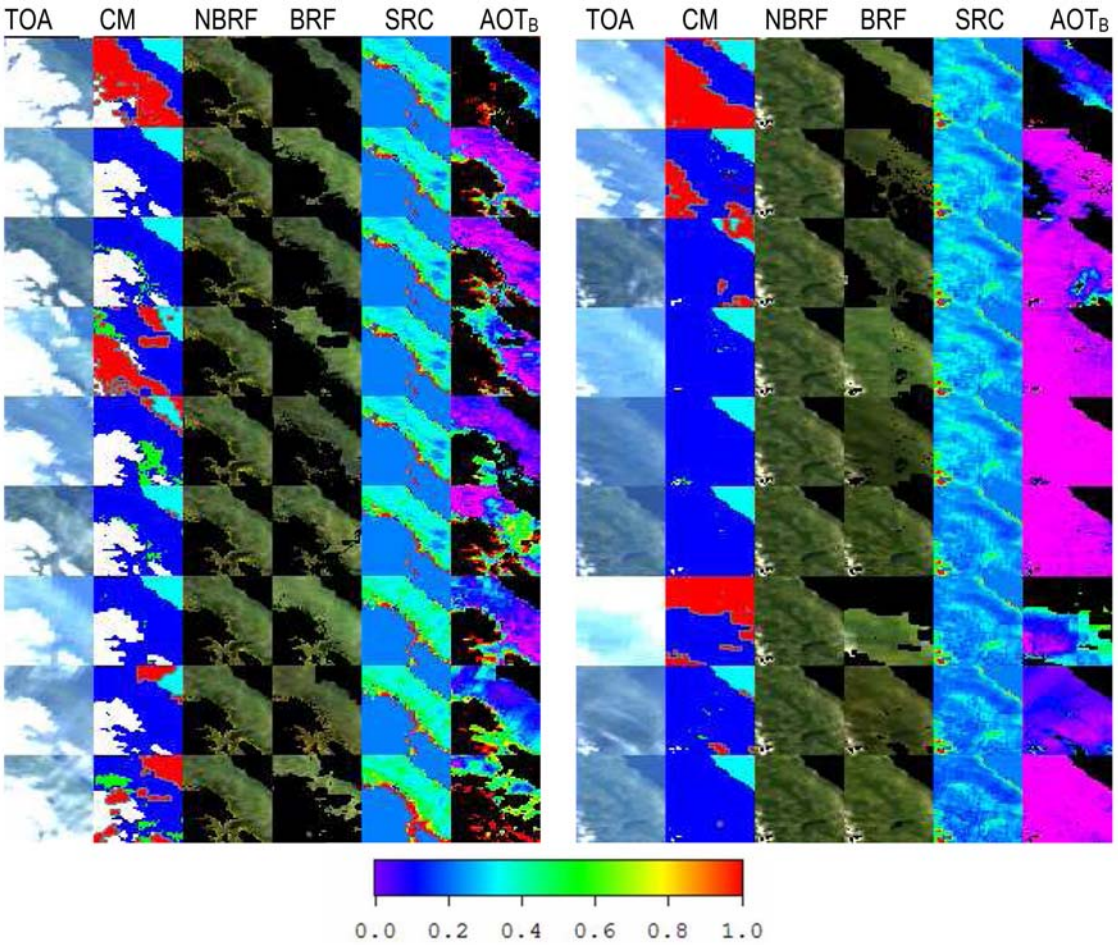
Adjusting viewing geometries



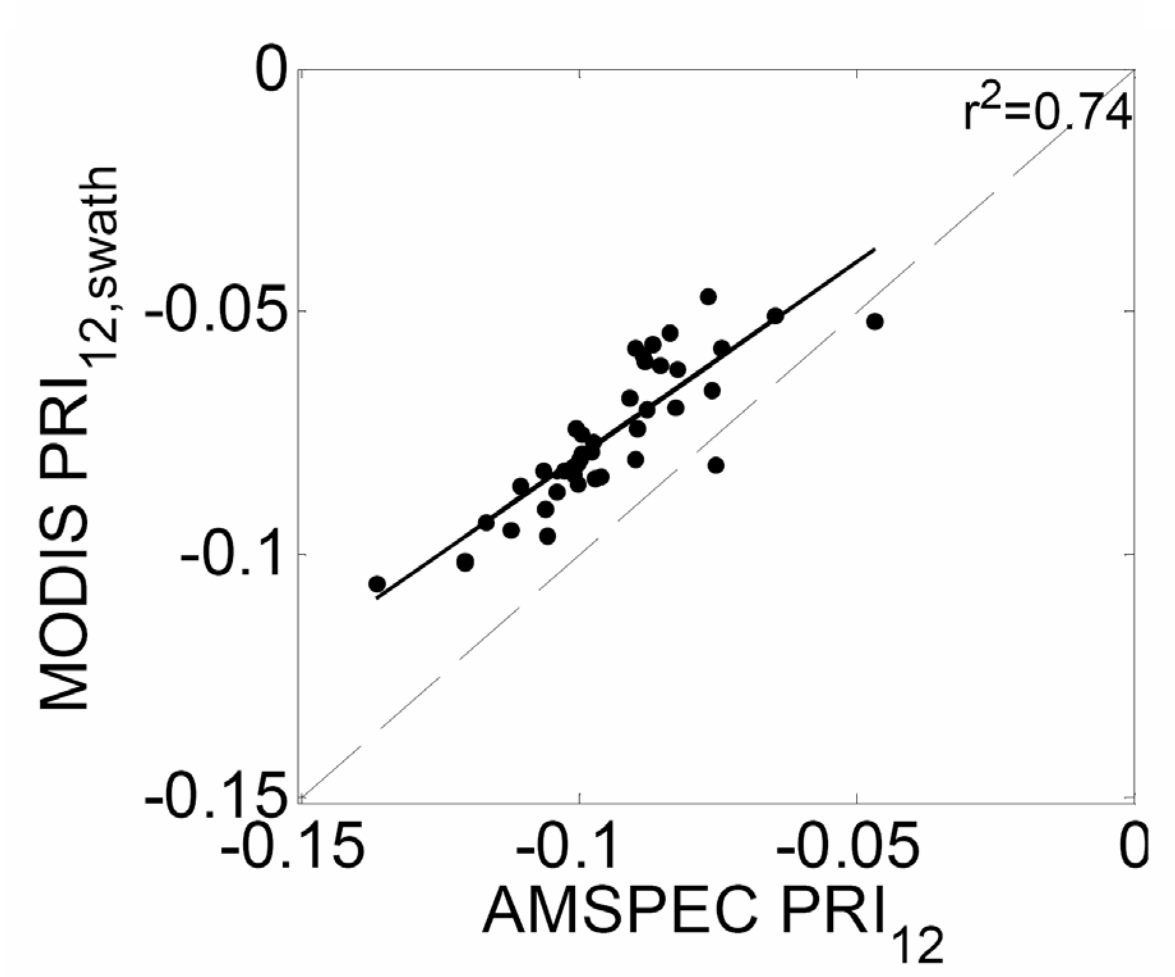


Adjusting geometry of AMSPEC to that of each satellite overpass

Multi-angular implementation of atmospheric correction (MAIAC)



Landscape level ε (2006)



Swath data; multi-angular AC implementation (MAIAC)

Gridded, AC using single orbit algorithm

Hilker et al., 2009 Remote Sens. Environ., *in press*

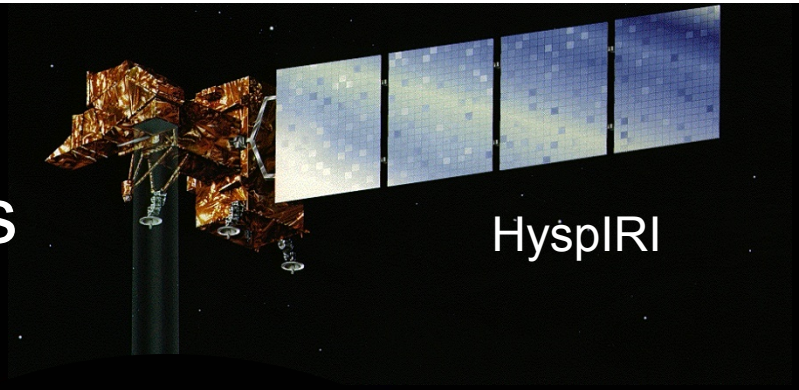
Using HyspIRI for sensing PRI

- VISWIR provides hyperspectral

Spatial and spectral specifications are highly suitable to sense ε from space

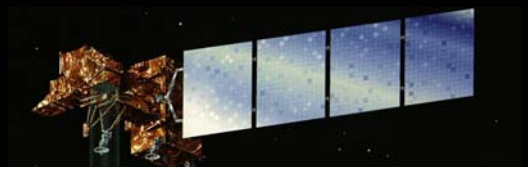
- Pointing ability facilitates multi-angular observations and atmospheric correction

Temporal resolution: 24 days



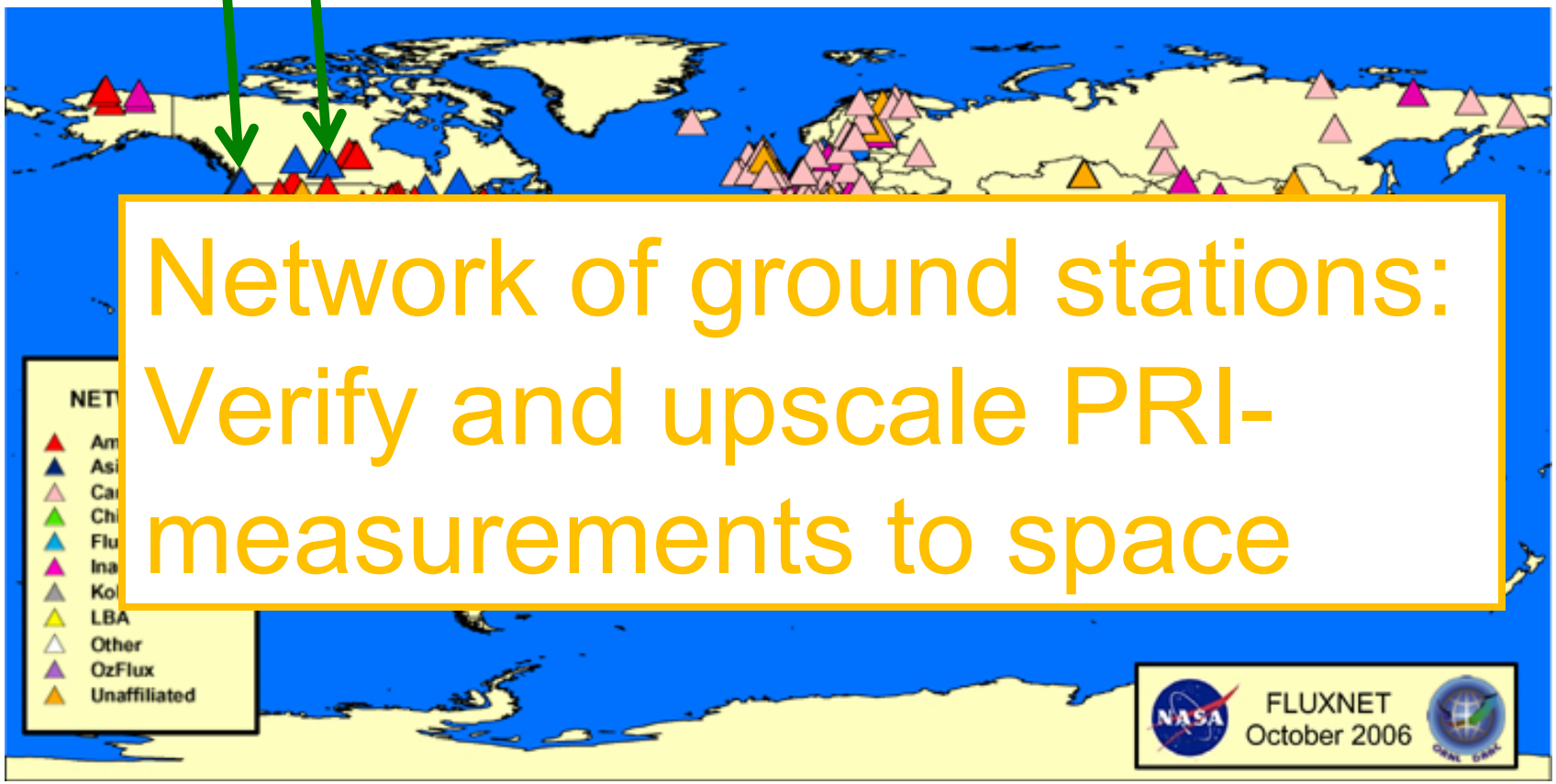
Combining high spatial and temporal resolution satellites

MODIS or MODIS-like



Global Assessment of GPP

Current Amspec sites



> 400 flux tower sites, spatially discrete observations (image credit NASA)

Conclusions

- Remote sensing of stand level ε is possible when carefully considering BRDF
- Spaceborne observations require multi-angle atmospheric correction
- Suggested network of ground based stations can help verifying PRI
- HyspIRI mission will be highly useful to observe fine scale changes in PRI
- Temporal resolution of HyspIRI very useful for seasonal trends, can be complemented

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