A new approach to interpret aircraft spectral measurements of down/upward fluxes over vegetated areas during RACORO

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How to separate aerosol and surface contributions from measurements of surface reflectance over vegetated areas

Spectral up- and downward fluxes

aerosols

vegetation

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Approach is based on the Canopy Spectral Invariant Relationship

vegetation

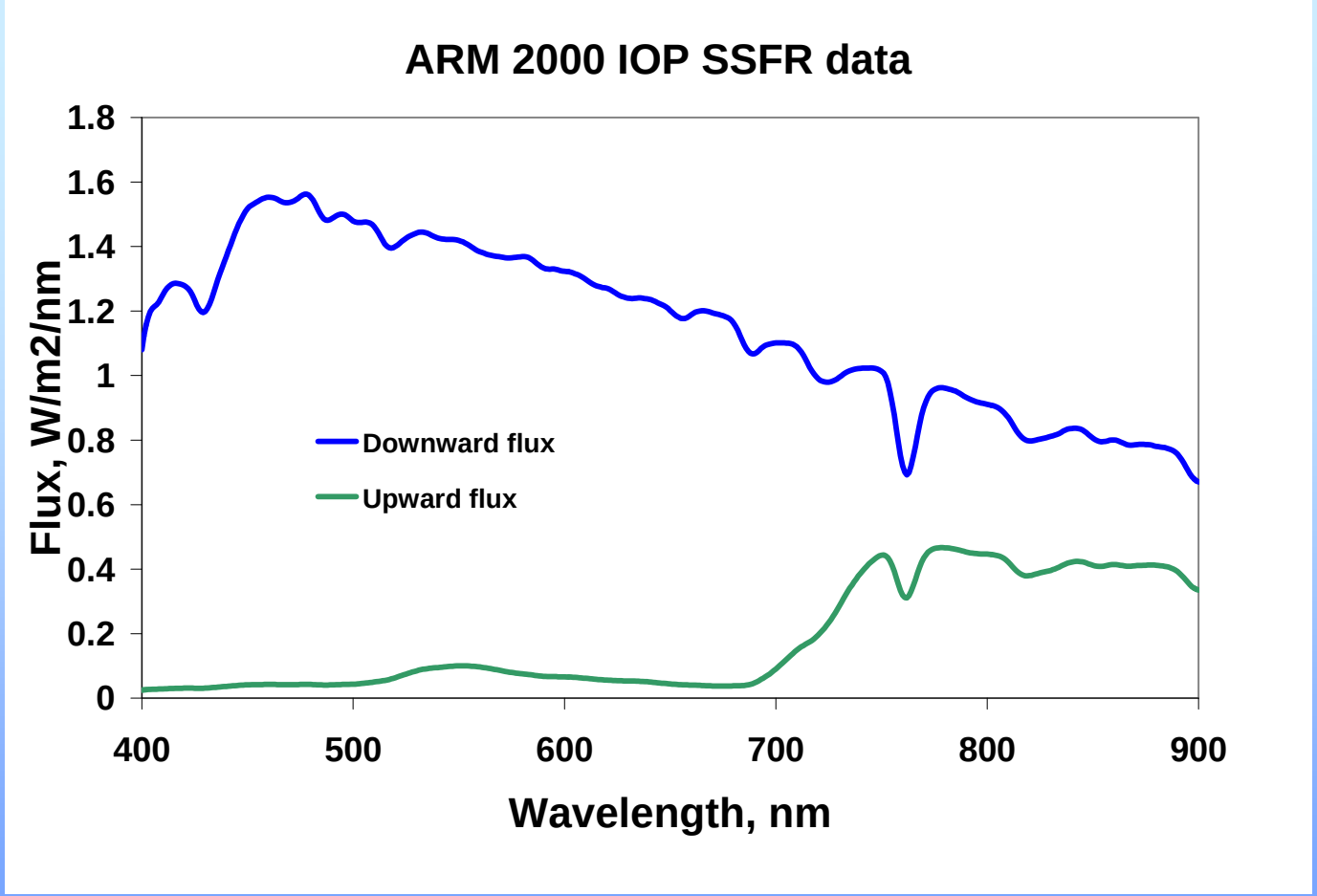
$$A_\lambda / \omega_\lambda = p\, A_\lambda + r$$

A_λ is surface albedo

ω_λ is single leaf albedo

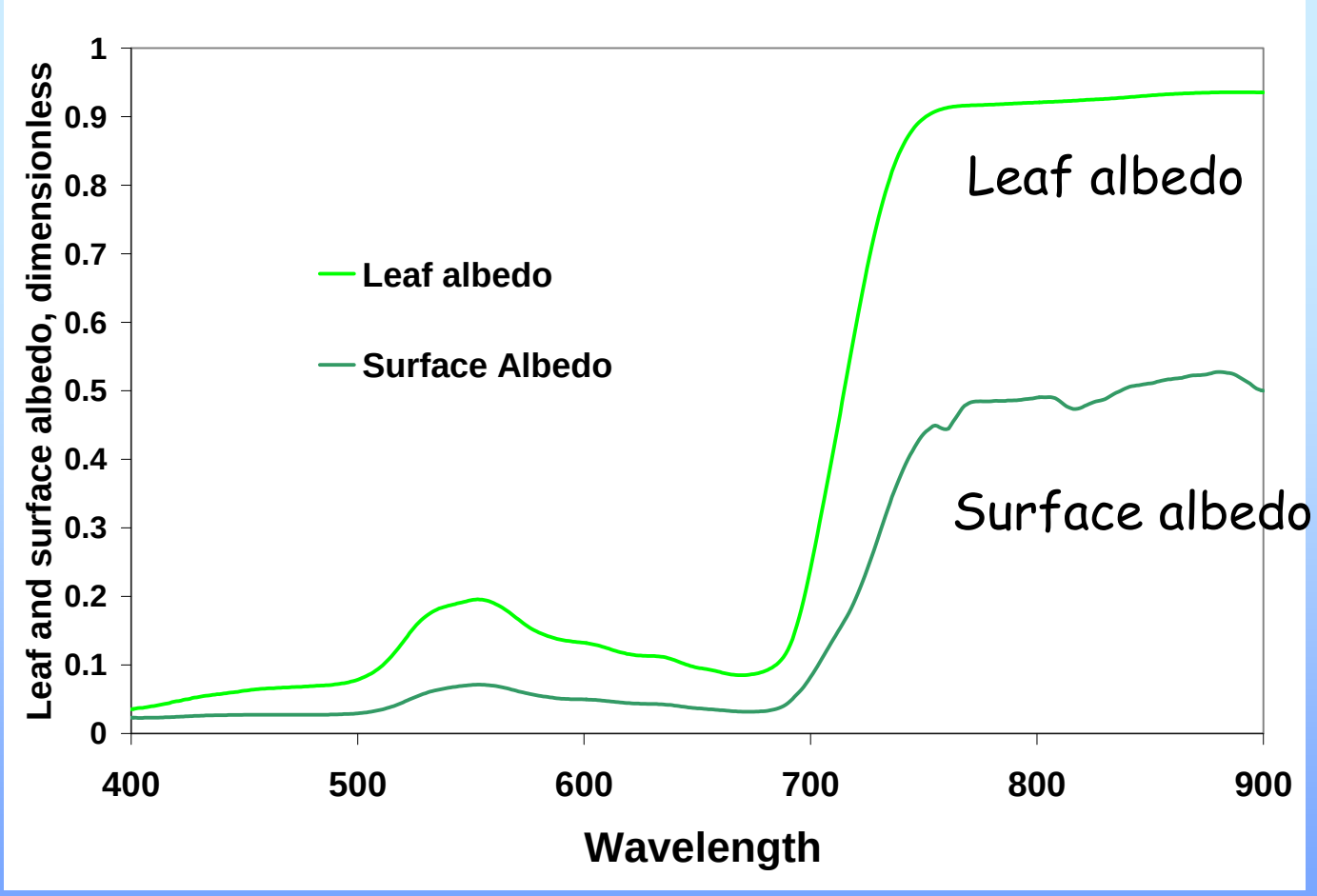
p & r are spectral invariant parameters

ARM 2000 IOP SSFR data



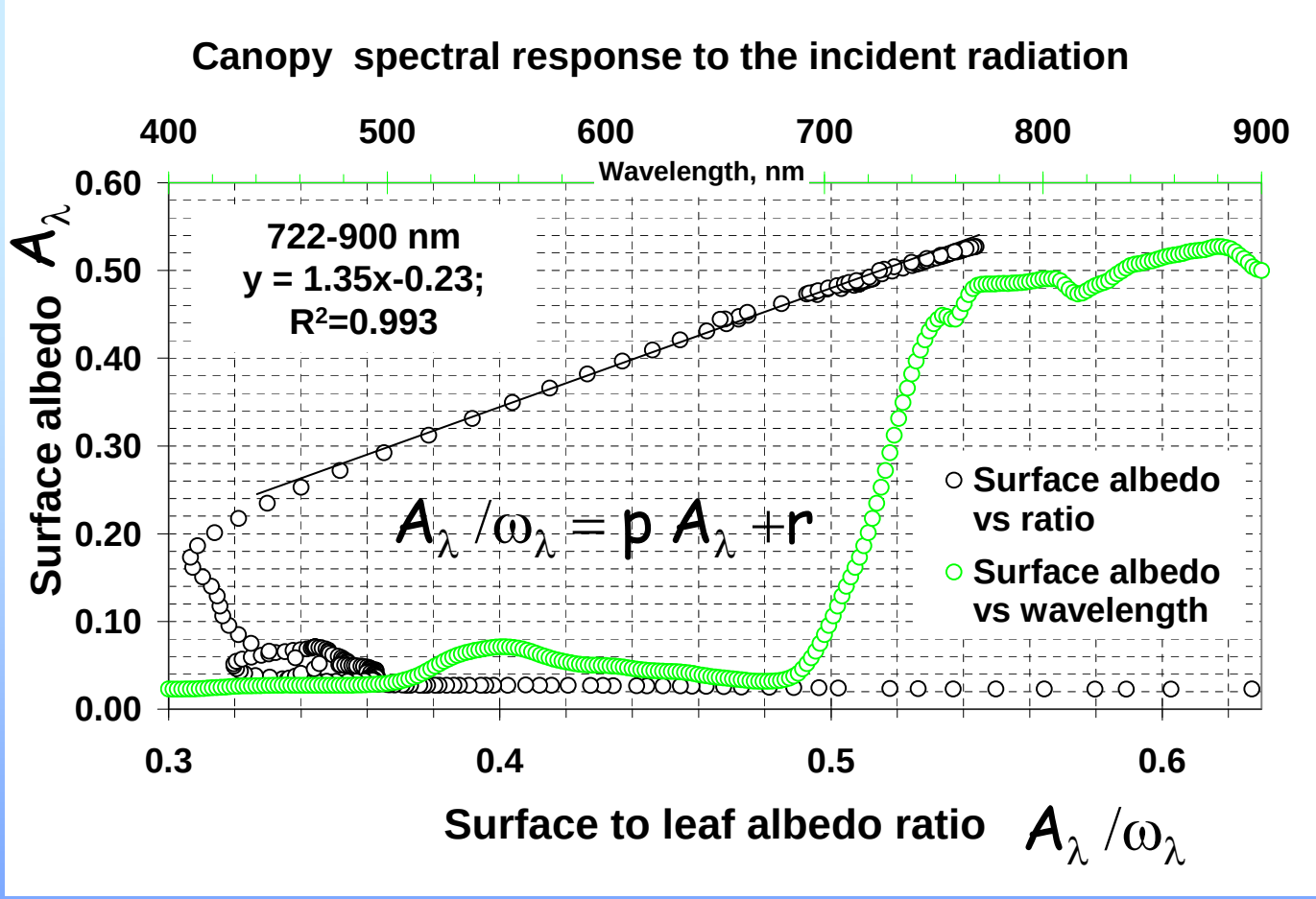
Up- and downward spectral fluxes measured under clear sky conditions

Surface and leaf albedo



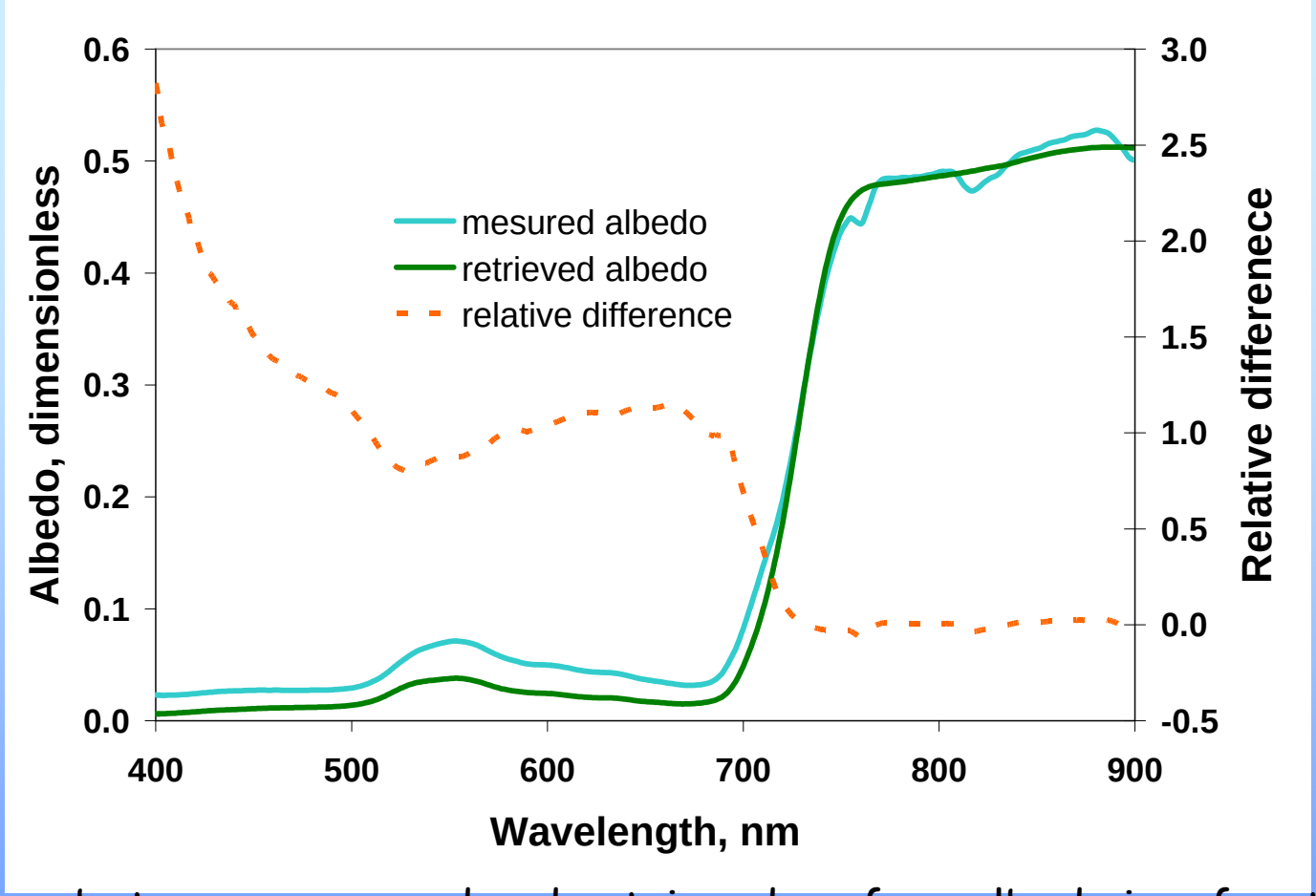
- Surface albedo is calculated as the ratio between meas. up- and downward fluxes.
- The spectral albedo of a green healthy leaf is quite stable though it can vary with leaf age

Retrieved surface albedo



- If the vegetated surface is illuminated by a parallel beam, the surface albedo can accurately be approx. by a linear function of the surface to leaf albedo ratio.
- Given slope and intercept, the spectral surface albedo for the condition of direct illumination can be obtained.

Difference between measured and retrieved surface albedo



The difference between measured and retrieved surface albedo is a function of

- single scattering albedo, ω_o
- scattering anisotropy, g
- aerosol optical depth, τ

Summary

Idea and results:

Use spectral measurements of up- and downward fluxes during RACORO flights over vegetated surface under clear sky conditions to

- retrieve surface spectral albedo for direct illumination only;
- determines the ratio of the direct to total flux at the surface;
- separate aerosol and surface contributions to surface reflectance.

Technique:

Canopy Spectral Invariant Relationship

Limitations:

- only above vegetated surface;
- only under clear conditions;
- not clear yet how to retrieve aerosol properties.

Reference:

Schull, M. A., S. Ganguly, A. Samanta, D. Huang, N. V. Shabanov, J. P. Jenkins, J. C. **Chiu**, A. **Marshak**, J. B. Blair, R. B. Myneni, and Y. **Knyazikhin**, 2007: Physical interpretation of the correlation between multi-angle spectral data and canopy height. *Geoph. Res. Lett.*, 34, L18405, doi:10.1029/2007GL031143.