

Remote Sensing Information for forest/land surface modeling

Spectral indexes

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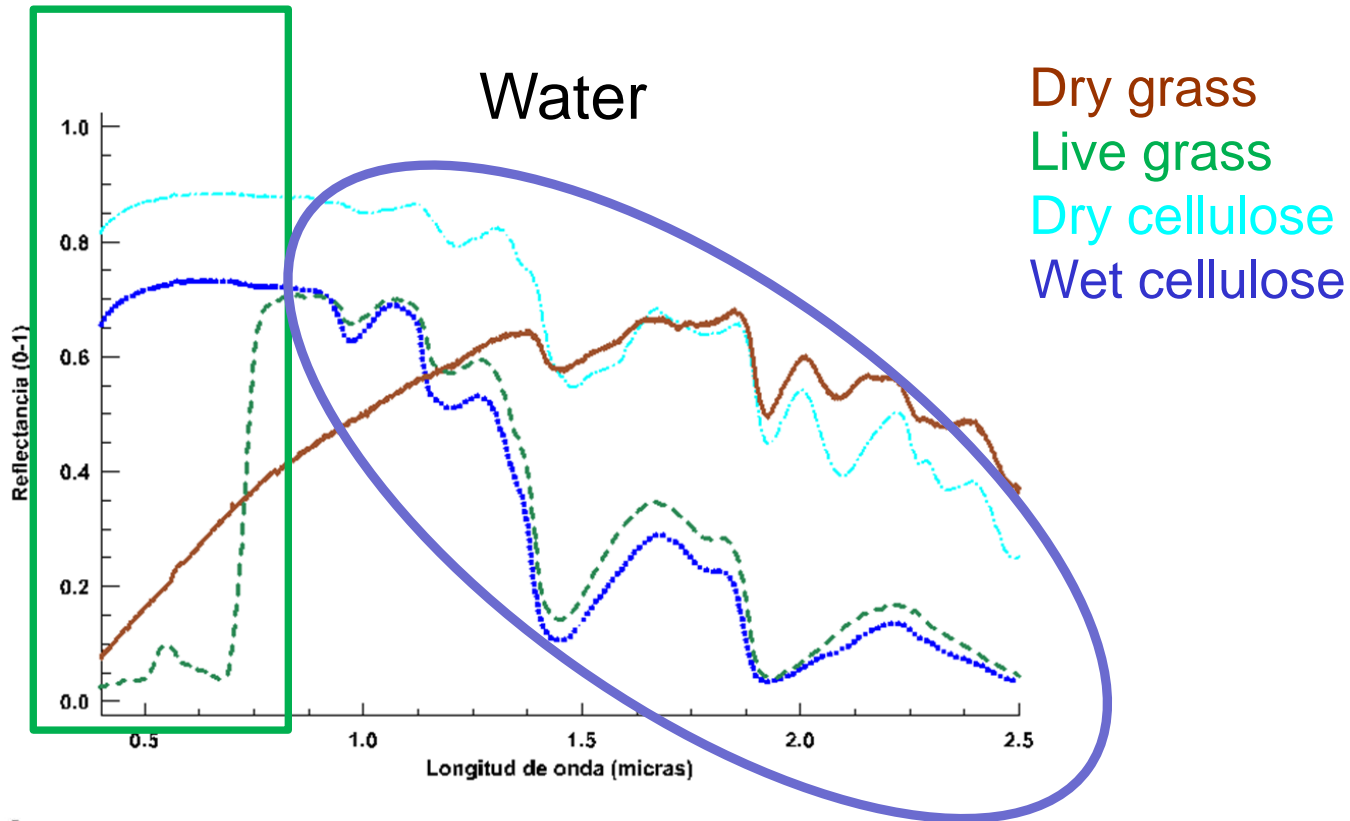
- Remote Sensing Information is commonly used for forest/land surface modeling.
- In most of the cases NDVI is used to assess ecosystems from remote sensors
- Reasons:
 - It is very intuitive, (on a physiological basis). It correlates with LAI, GPP,
 - It is available and easily acquired
- However: It is based on the VIS/NIR part of the EMS, it does not provide information about other parts of the reflectance spectrum

Is there more information we could use???

Spectral reflectance in the optical domain

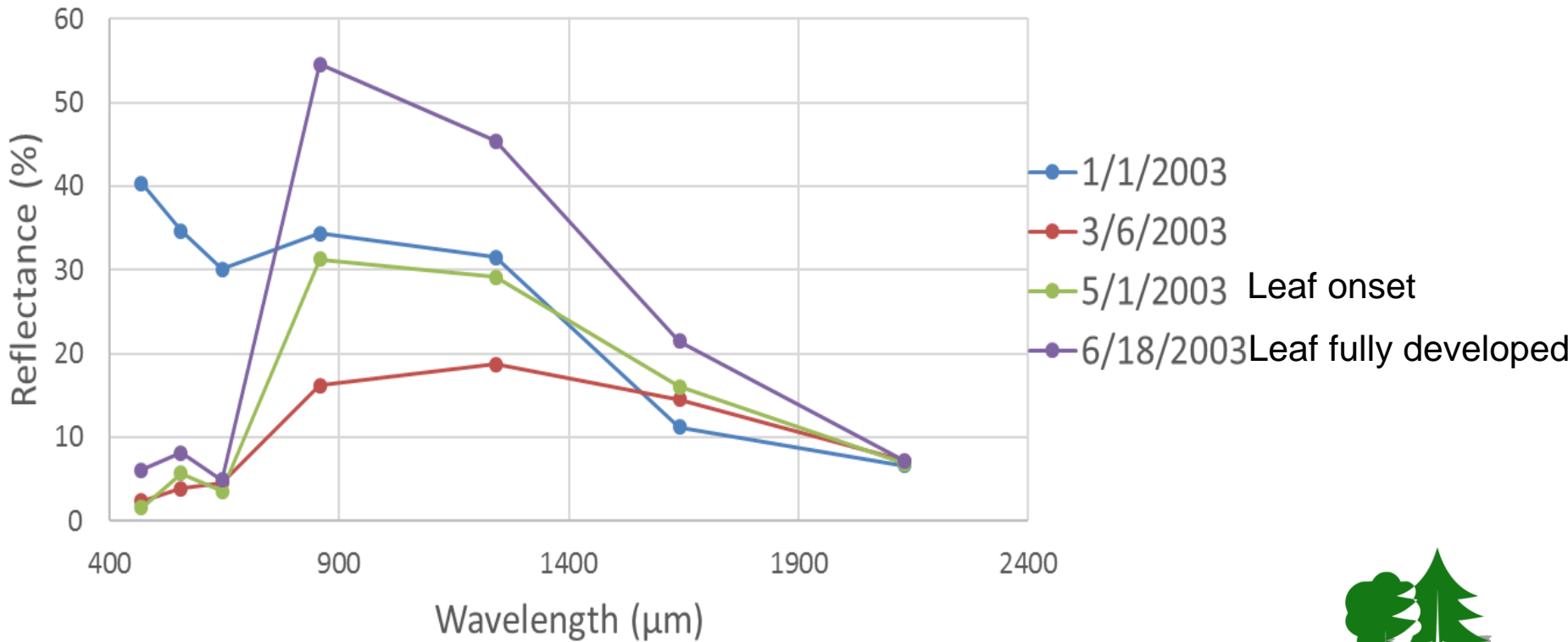
Effect of pigments and moisture

Pigments



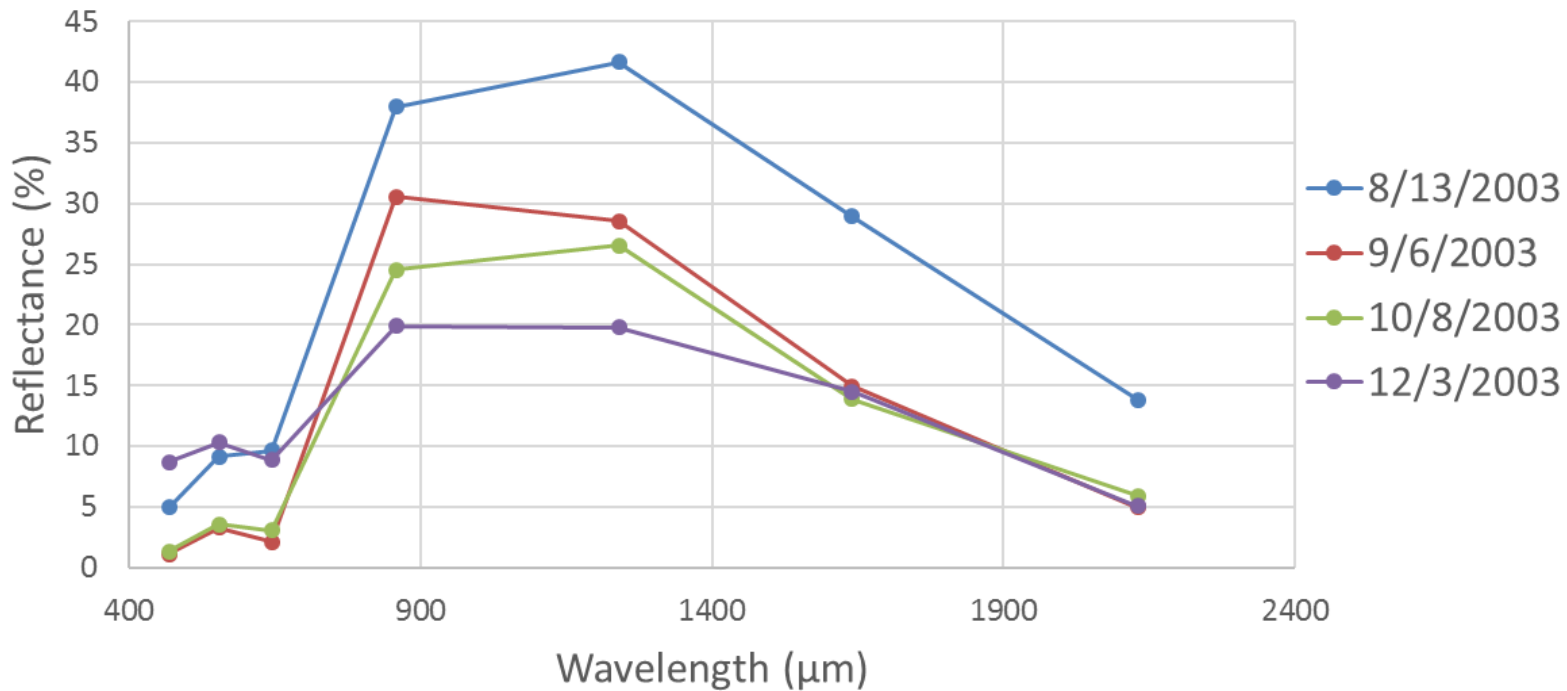
Reflectance spectra in a deciduous forest. *Fagus sylvatica* in Soro

Transition from winter to early summer



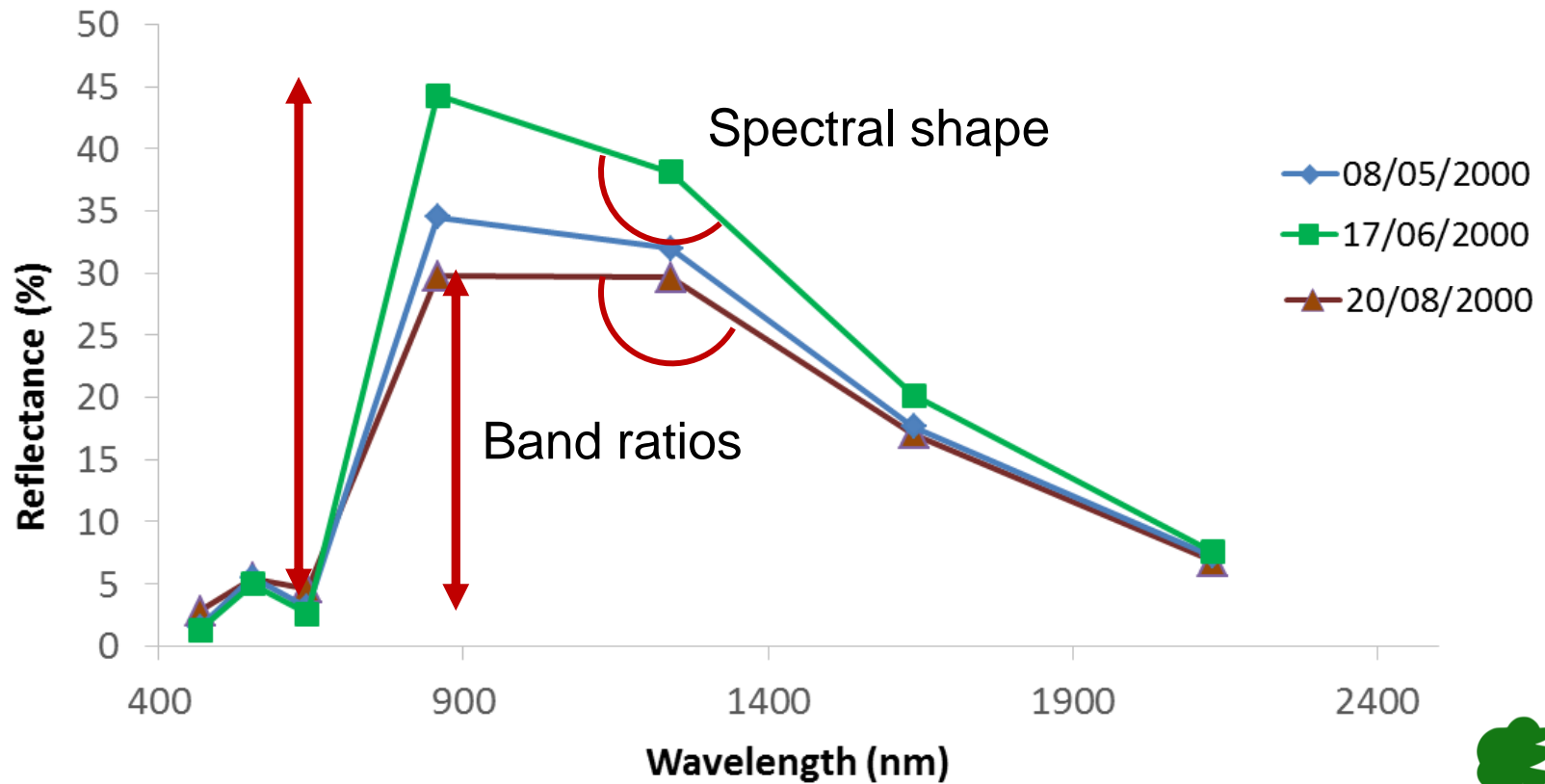
Reflectance spectra in a deciduous forest. *Fagus sylvatica* in Soro

Transition from late summer to winter



Senescence

Spectral indexes to quantify change



Spectral indexes

Spectral indexes	Based on ratios	Based on spectral shape
	$NDVI = \frac{R_{NIR} - R_R}{R_{NIR} + R_R}$	The angle at a specific spectral band. Provide information on three bands
VIS/NIR spectral region	NDVI EVI	AR ANIR
SWIR spectral region	NDWI	ANIR AS1 AS2

Spectral indexes based on ratio

Index	Equation	Reference
Normalized Difference Vegetation Index (NDVI)	$NDVI = \frac{R_{NIR} - R_R}{R_{NIR} + R_R}$	Tucker (1979)
Normalized Difference Water Index (NDWI)	$NDWI = \frac{R_{NIR} - R_{SWIR1}}{R_{NIR} + R_{SWIR1}}$	Gao (1996)
Enhance Vegetation Index (EVI)	$EVI = \frac{R_{NIR} - R_{RED}}{R_{NIR} + C_1 \times R_{RED} - C_2 \times R_{BLUE} + L}$	Huete et al. (2002)

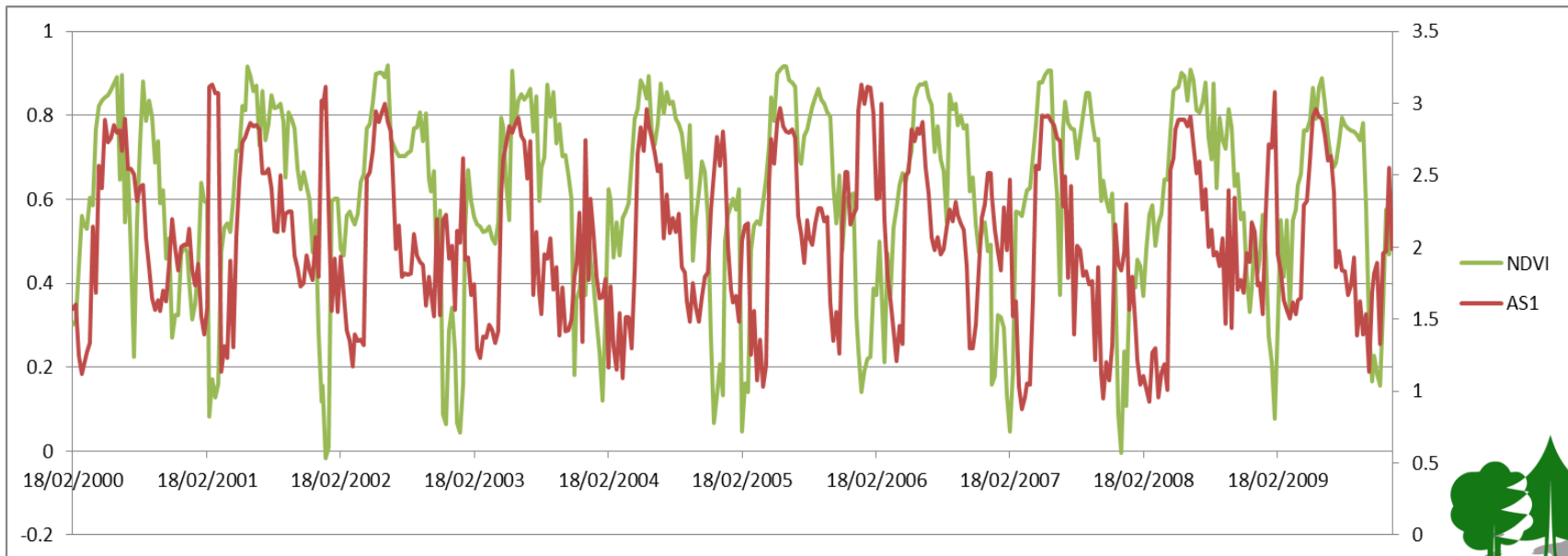
Spectral indexes based on spectral shape

Index Name	Equation	Reference
ANIR (Angle in NIR)	$ANIR = \cos^{-1} \left(\frac{a^2 + b^2 - c^2}{2ab} \right)$	Palacios-Orueta et al. (2012)
AR (Angle in RED)	The same concept centered in the Red band	Khanna et al. (2007)
AS1 (Angle in SWIR1)	The same concept centered in the SWIR1 band	Palacios-Orueta et al. (2012)
AS2 (Angle in SWIR2)	The same concept centered in the SWIR2 band	Palacios-Orueta et al. (2012)
SANI	$SANI = AS1 \times \frac{R_{SWIR2} - R_{NIR}}{R_{SWIR2} + R_{NIR}}$	Palacios-Orueta et al. (2006)
SASI	$SASI = AS1 \times R_{SWIR2} - R_{NIR}$	Khanna et al. (2007)

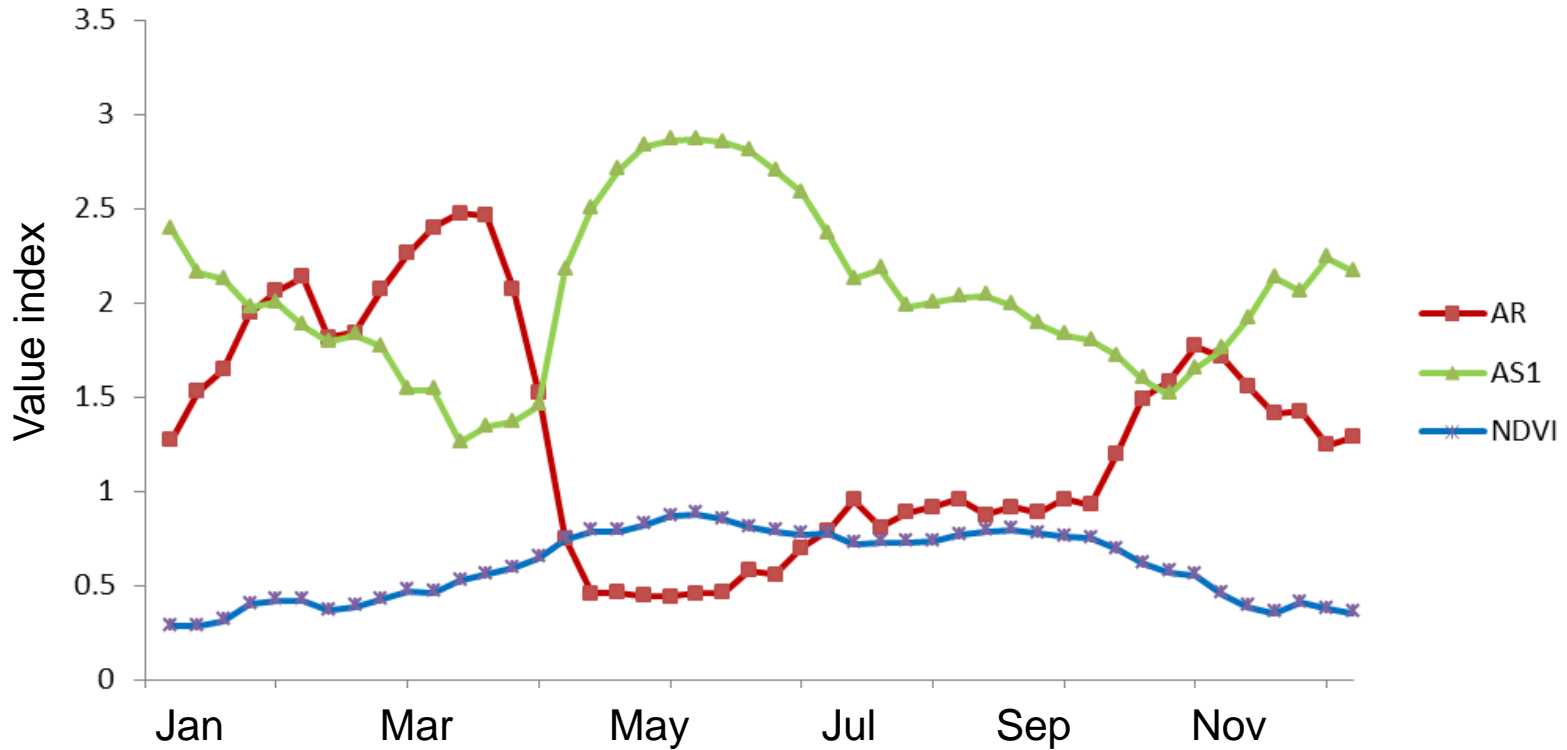
Assessment of the Information content of the Spectral indexes

What do they show??

- Dynamics → intra-annual cycles as indicators of land surface and vegetation changes
- Values → specific phenological transitions
- Stability of processes happening at the land surface



Annual evolution of three spectral indexes



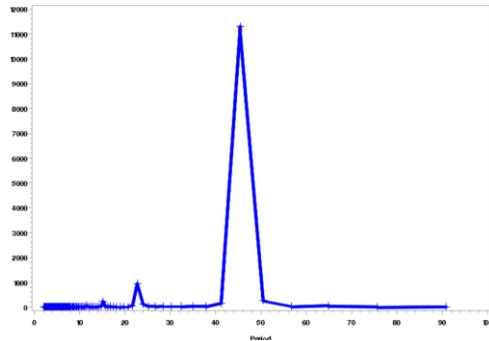
NDVI values: between -1 and 1
 AE and ANIR values: 0 and 3.14



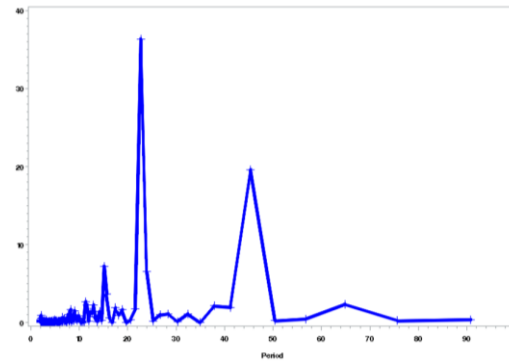
Intra-annual dynamics assessment of indexes

Are the annual average values representative?

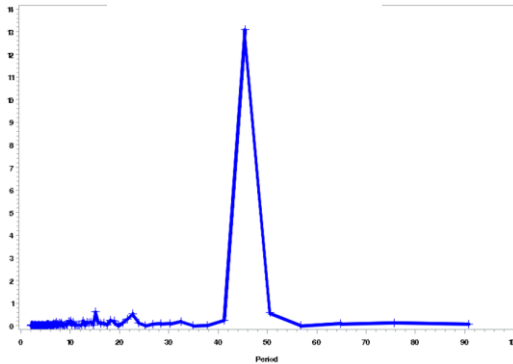
GPP



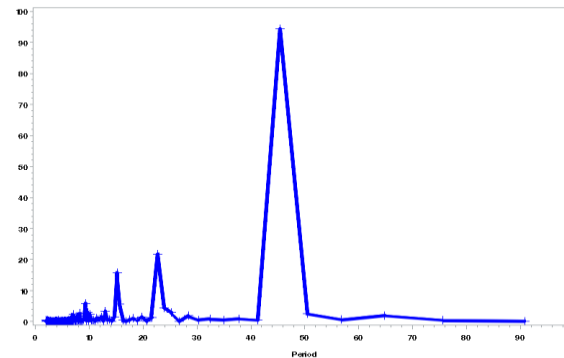
AS1



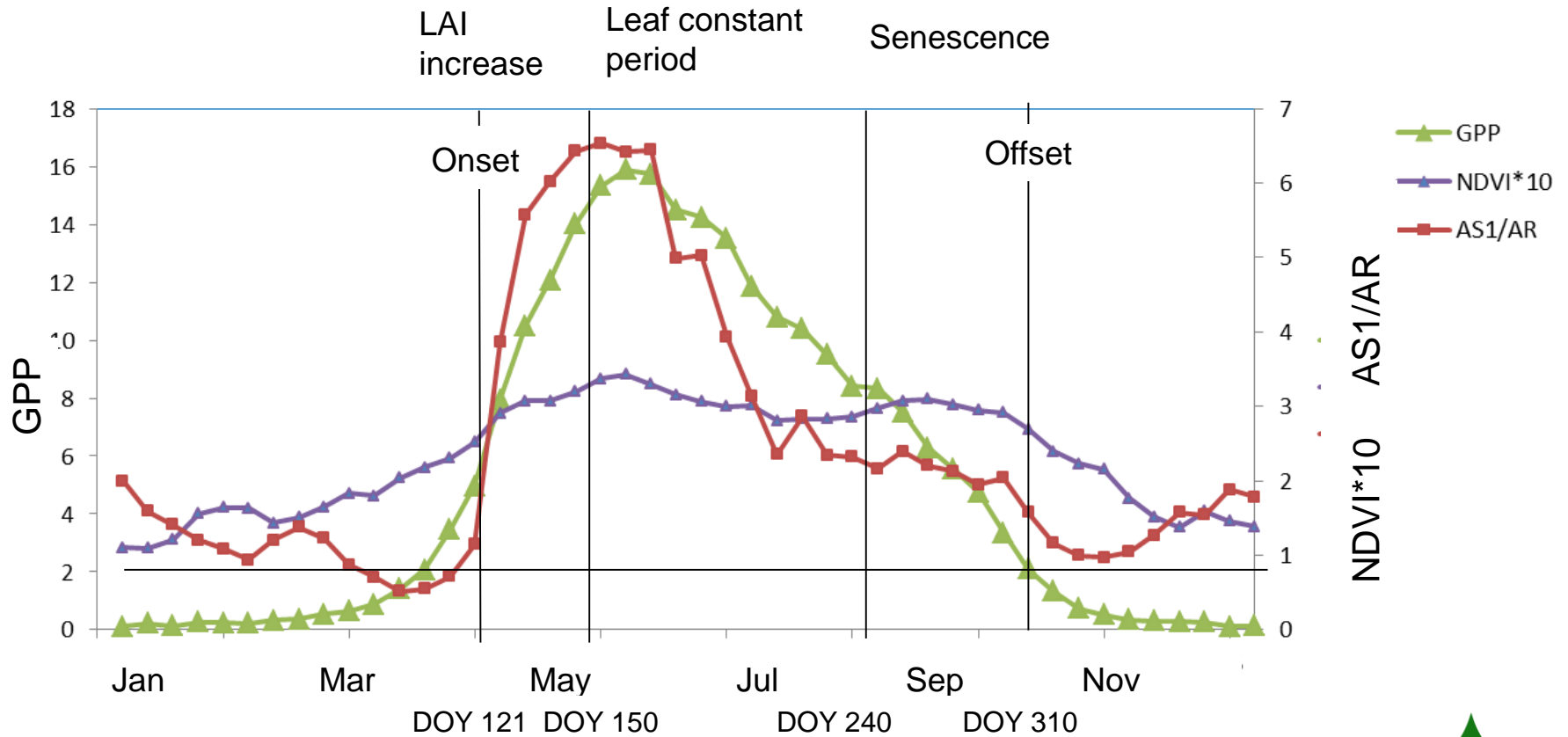
NDVI



AR



Phenological transitions Identified



Transitions dates are from Wang et al. (2005)

Concluding Remarks

- Spectral reflectance behaves consistently in the whole optical range
- Spectral shape indexes provide detailed information about phenological events
- They are included in the PROFOUND database, if you need help for interpretation, you can contact me