

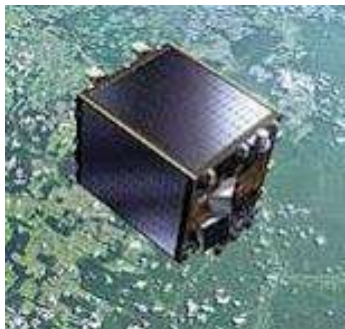
# Validation of seasonal time series of remote sensing derived LAI for hydrological modelling

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*Satellite and airborne imagery have different spectral, spatial and temporal resolutions.  
How does this affect the calculation of vegetation indices and hydrological modelling?*



- ProbaV
  - Multispectral (4 bands)
  - 100m spatial resolution
  - revisit time 1 day



- Landsat 8
  - Multispectral (11 bands)
  - 30m spatial resolution
  - revisit time 16 days



- Deimos
  - Multispectral (3 bands)
  - 22m spatial resolution
  - revisit time 3 days



- APEX
  - Hyperspectral
  - 2m spatial resolution
  - revisit time: 1 per 2 years

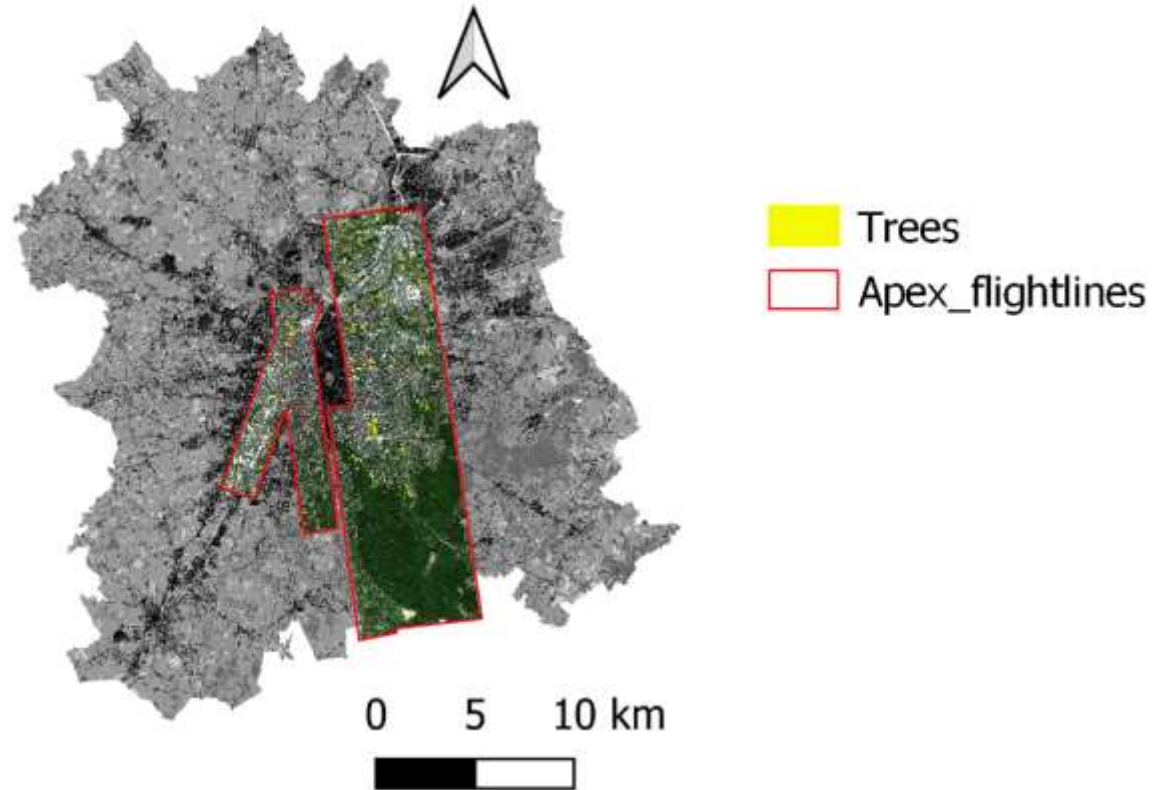
### *Leaf Area Index (LAI) using the SUNSCAN device*

- Sunscan measurements strategy
  - 8 measurements around tree stem
  - 1m below canopy
  - 1m away from stem



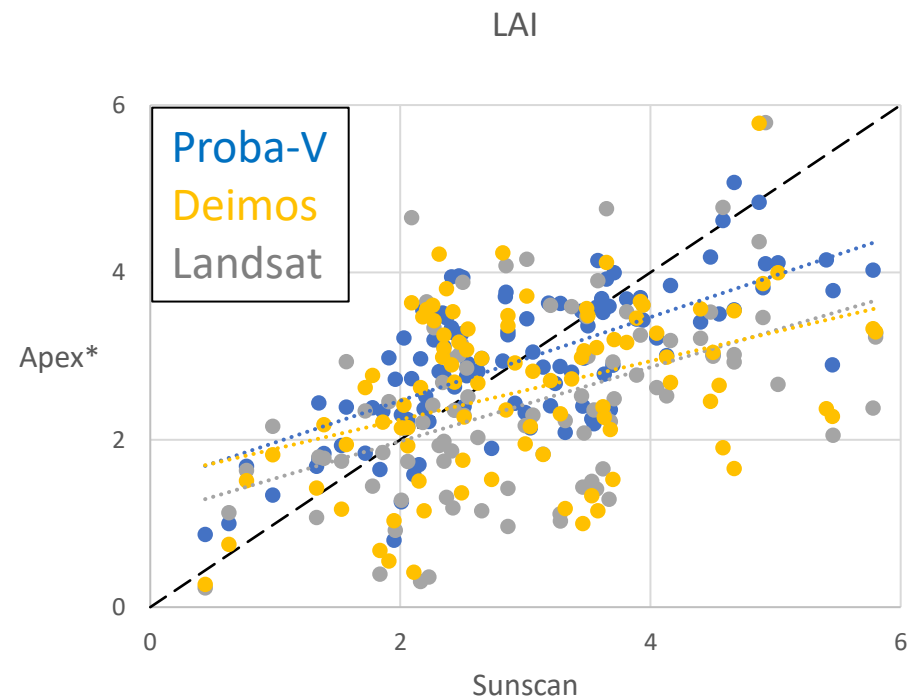
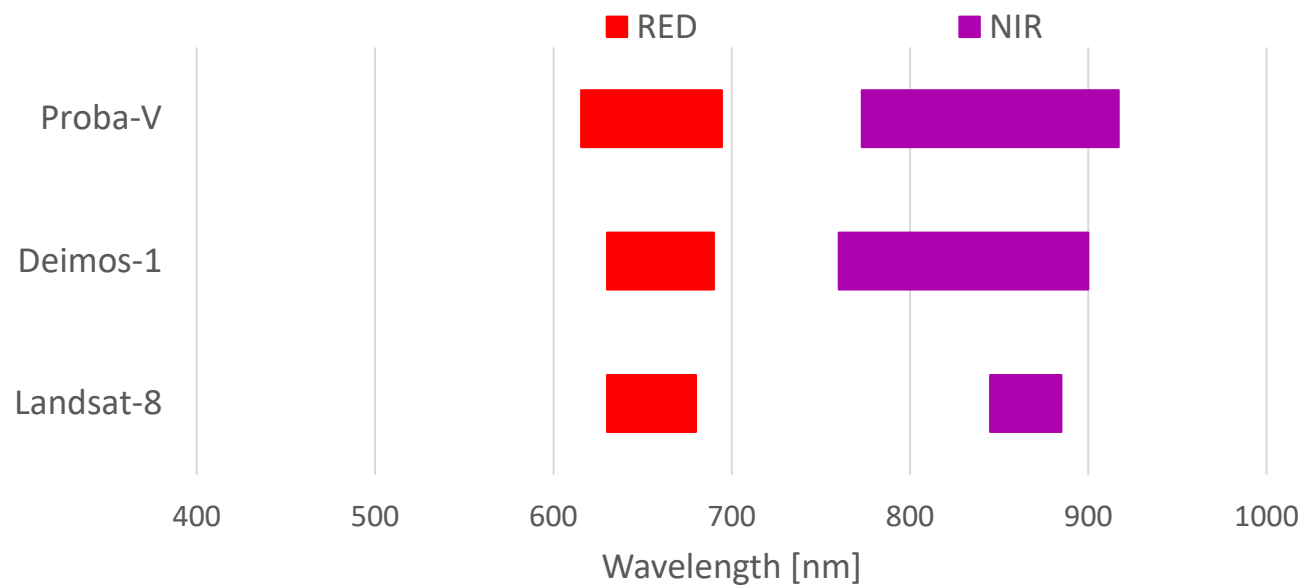
## STUDY SITE

*Satellite, airborne and ground-truthing data is collected for Brussels, Belgium. In red the airborne imagery is delineated. In yellow the locations of the Sunscan measurements for 106 urban trees are indicated.*



## SPECTRAL DIFFERENCES IN SATELLITE DATA

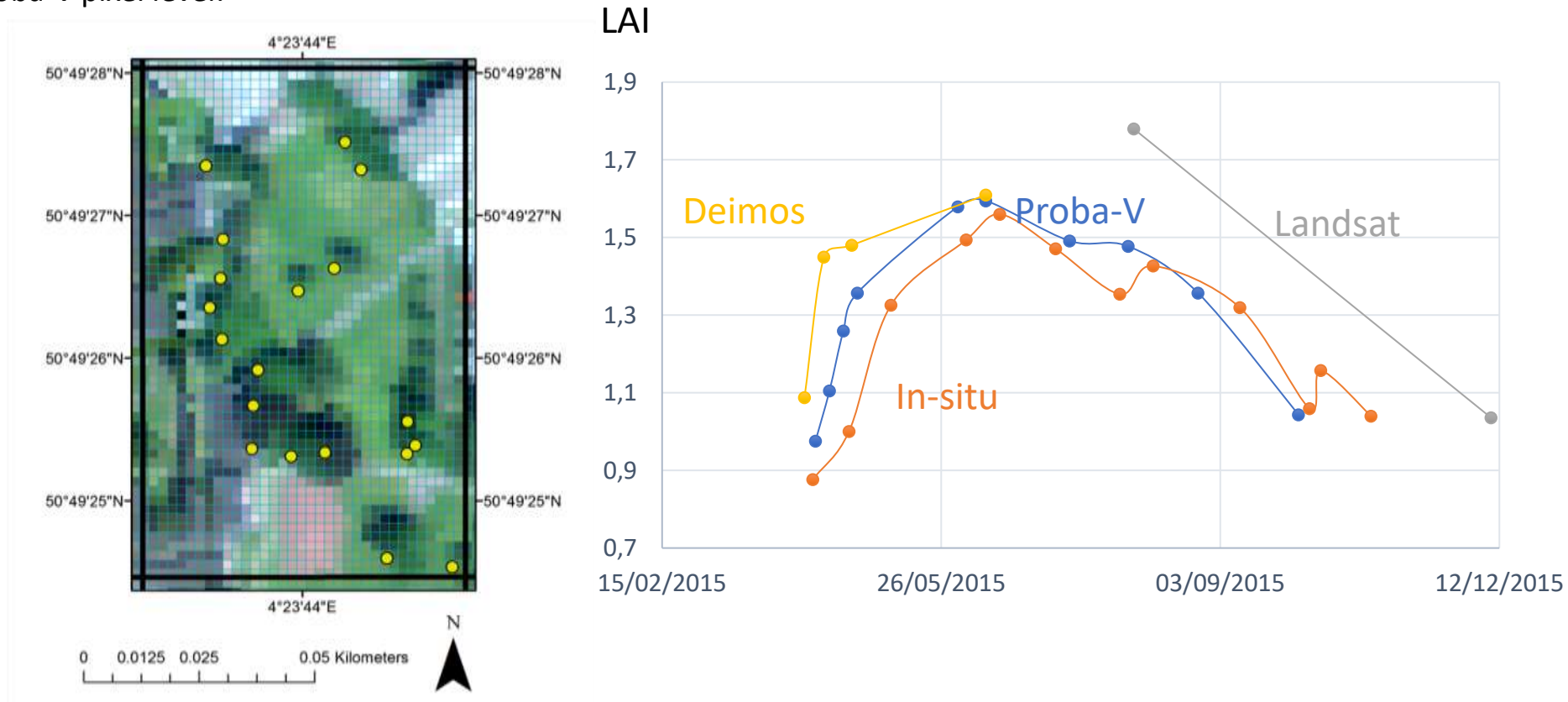
*Spectral differences in RED and NIR bands (figure on the left side) lead to differences in the LAI (indicated on the scatterplot for 106 trees measured in Brussels).*



\* The NDVI calculated from the APEX image uses the Red and NIR bandranges of Proba-V, Deimos and Landsat respectively. The spatial resolution remains 2m.

*Seasonal LAI measurements (2015): The higher revisit time of Proba-V and Deimos are crucial for matching the seasonal curve of tree LAI in Brussels.*

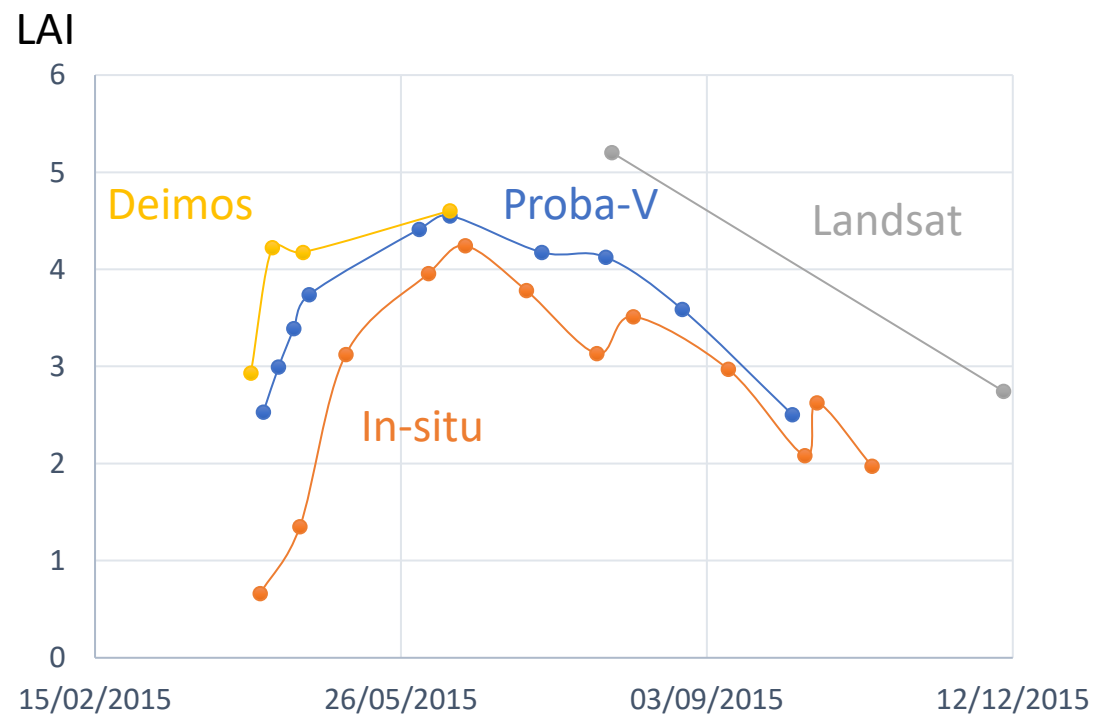
- At Proba-V pixel level:



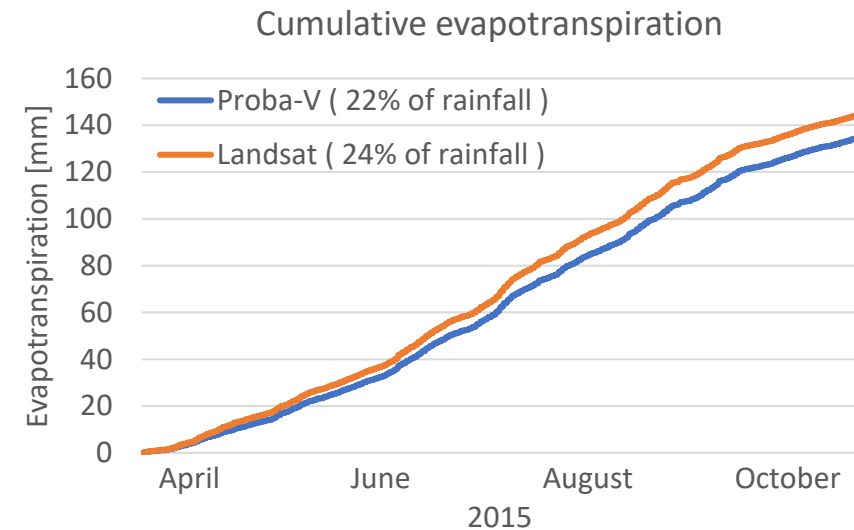
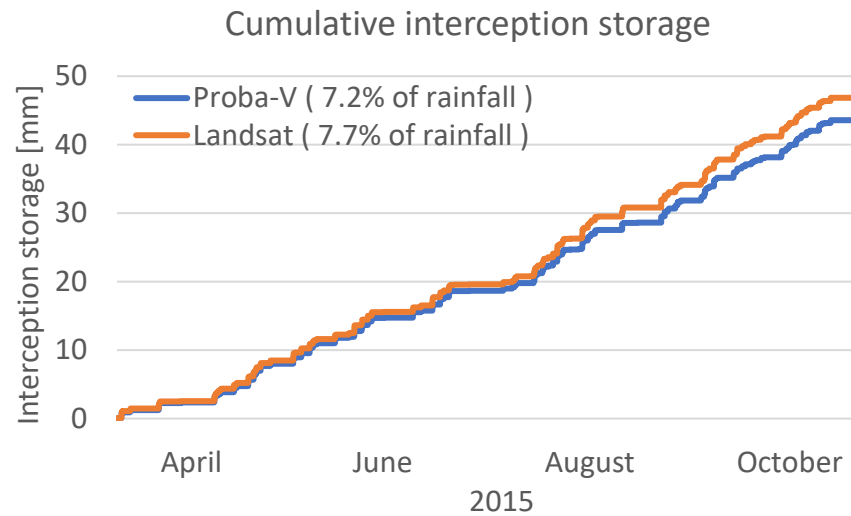
## MULTI-RESOLUTION VALIDATION

*Seasonal LAI measurements (2015): Pixel unmixing is important to get the right order of magnitude for LAI values of trees in urban areas ([Wirion et al., 2017](#)).*

- At tree fraction level:



*The cumulative interception storage and evapotranspiration show that differences in the LAI from satellite imagery can reach differences in the hydrological response. The absolute difference for the cumulative fluxes is small (< 1% for interception storage, 2% for evapotranspiration) however differences are time/event specific.*

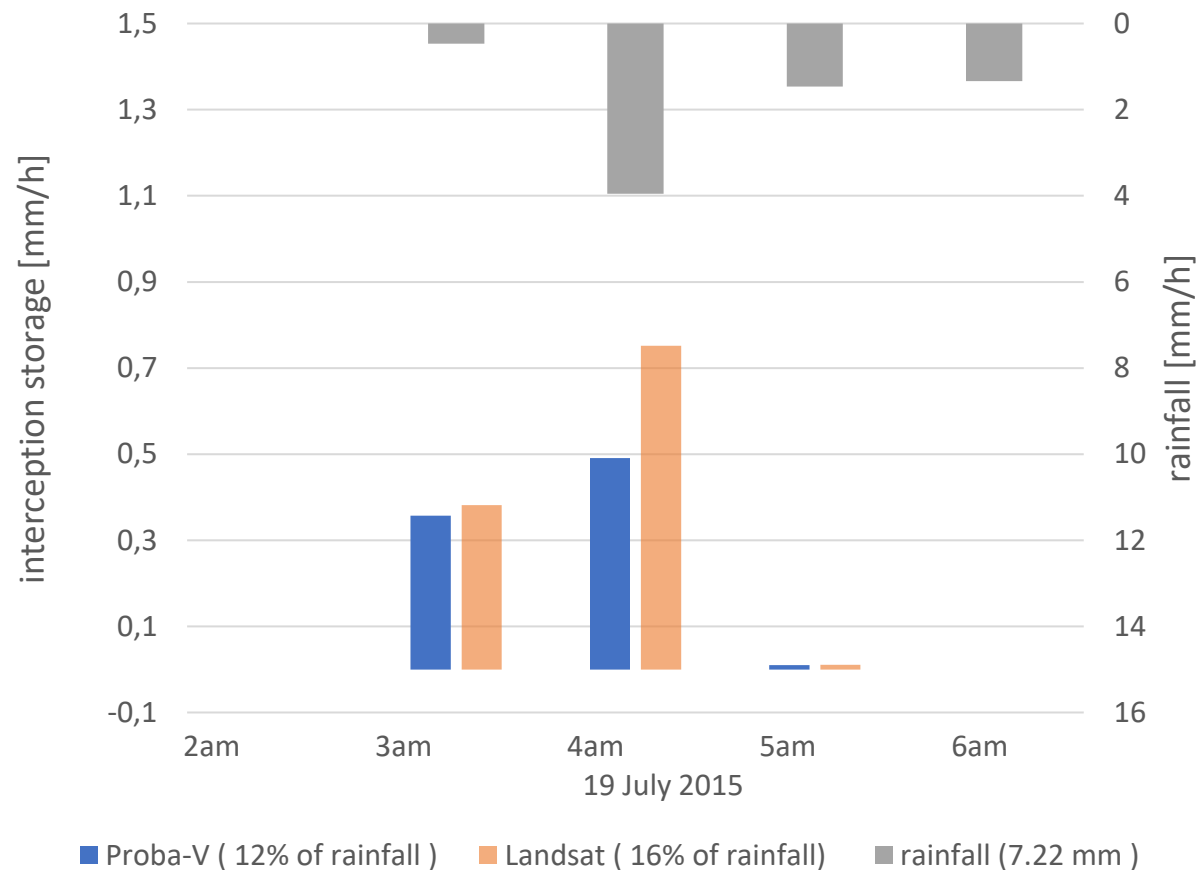


\* As the Deimos LAI values are similar to Proba-V, the hydrological response comparison is only shown between Proba-V and Landsat. As for Landsat we only have 2 images (August and December) we use a sine function to simulate the vegetation season (of the year 2015). For Proba-V the images are used for the simulations and the LAI is interpolated linearly between each image ([Wirion et al., 2017](#))



## HYDROLOGICAL RESPONSE

*For specific events the differences in interception storage can go up to 4% which is a lot considering that the average interception storage for a tree at this location is 10% of the rainfall.*



### Conclusions

- LAI:
  - Spectral differences of satellite bands lead to differences in LAI
- Seasonal LAI:
  - Proba-V shows the best representation of the in-situ measurements → high temporal resolution is critical
  - The revisit times for Landsat and Deimos are too low for seasonal LAI in Belgium
  - Pixel unmixing is important in urban areas in order to get the right magnitude for LAI.
- Hydrological response
  - The cumulative differences in the hydrological response are relatively low, however event specific differences can be important.

### Outlook

- Does combining satellite imagery signals lead to more consistency in time series for hydrological modelling?
  - [BELHARMONY Project](#)