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**PROBA-V QUALITY WORKING GROUP #5**  
**ANGULAR NORMALISATION**  
ESA ESRIN, 10/MAY/2017

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# Review of semi-empirical BRDF models performance on Proba-V and Spot-Vgt time series.

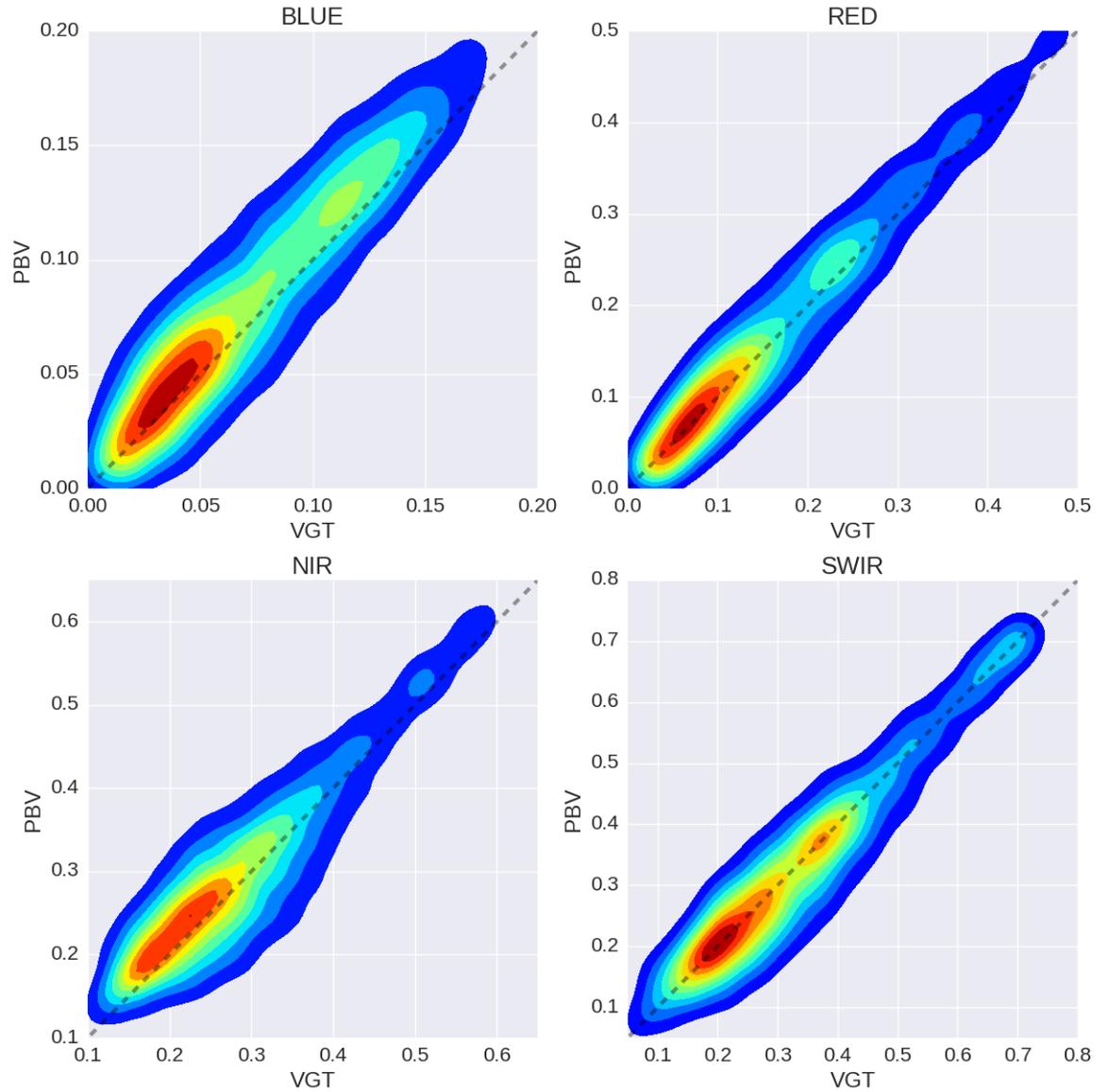


- Exploring the relation between VGT-PBV angular normalised reflectances.
- Can the BRDF model found for PBV data replicate VGT observations ?

# ALL SAMPLE

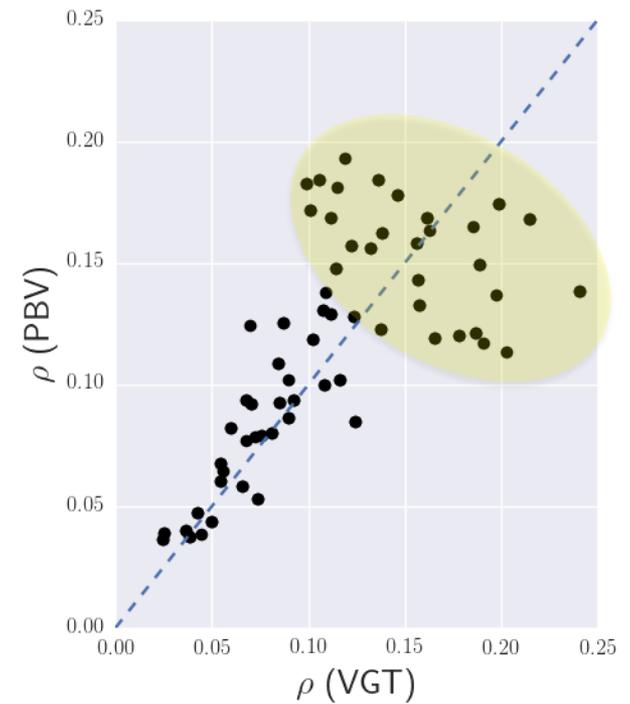
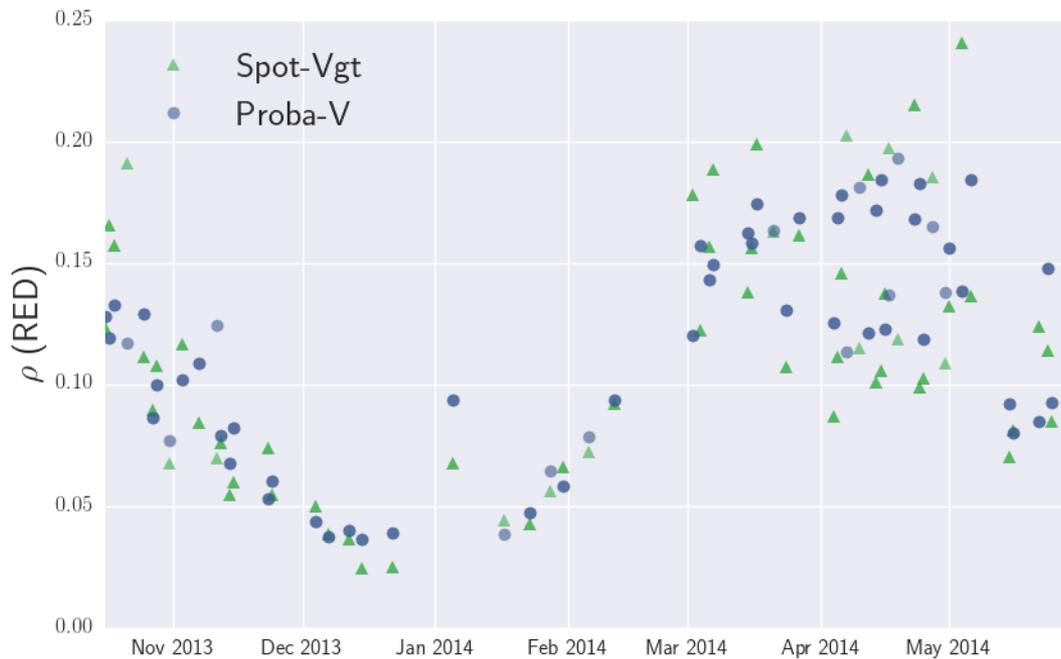
445 Belmanip2 sites

S1 Nobs=30903



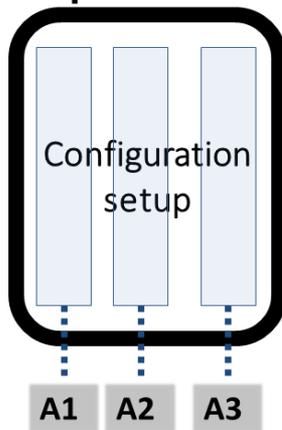
## LOOKING AT INDIVIDUAL SITES

El Saler-Sueca ES  
(lat,lon)=(39.275,-0.315)

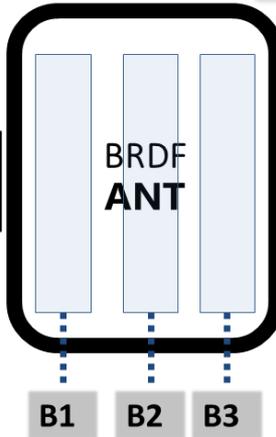


Scatter is associated to directional effects

# ANGULAR NORMALISED TOC (ANT)



$\rho_c$



$\rho_n$

$$\frac{\rho_{n(NIR)} - \rho_{n(RED)}}{\rho_{n(NIR)} + \rho_{n(RED)}}$$



- Semi-empirical BRDF models:
- Roujean
  - RPV4 (JRC)
  - Modis
  - Modis +HotSpot (Maignan+2004)

- A1 - Compositing
- A2 - SM filtering
- A3 - Observations weighting
- B1 - BRDF model
- B2 - Inversion
- B3 - Normalization

# ANGULAR NORMALISED TIME SERIES

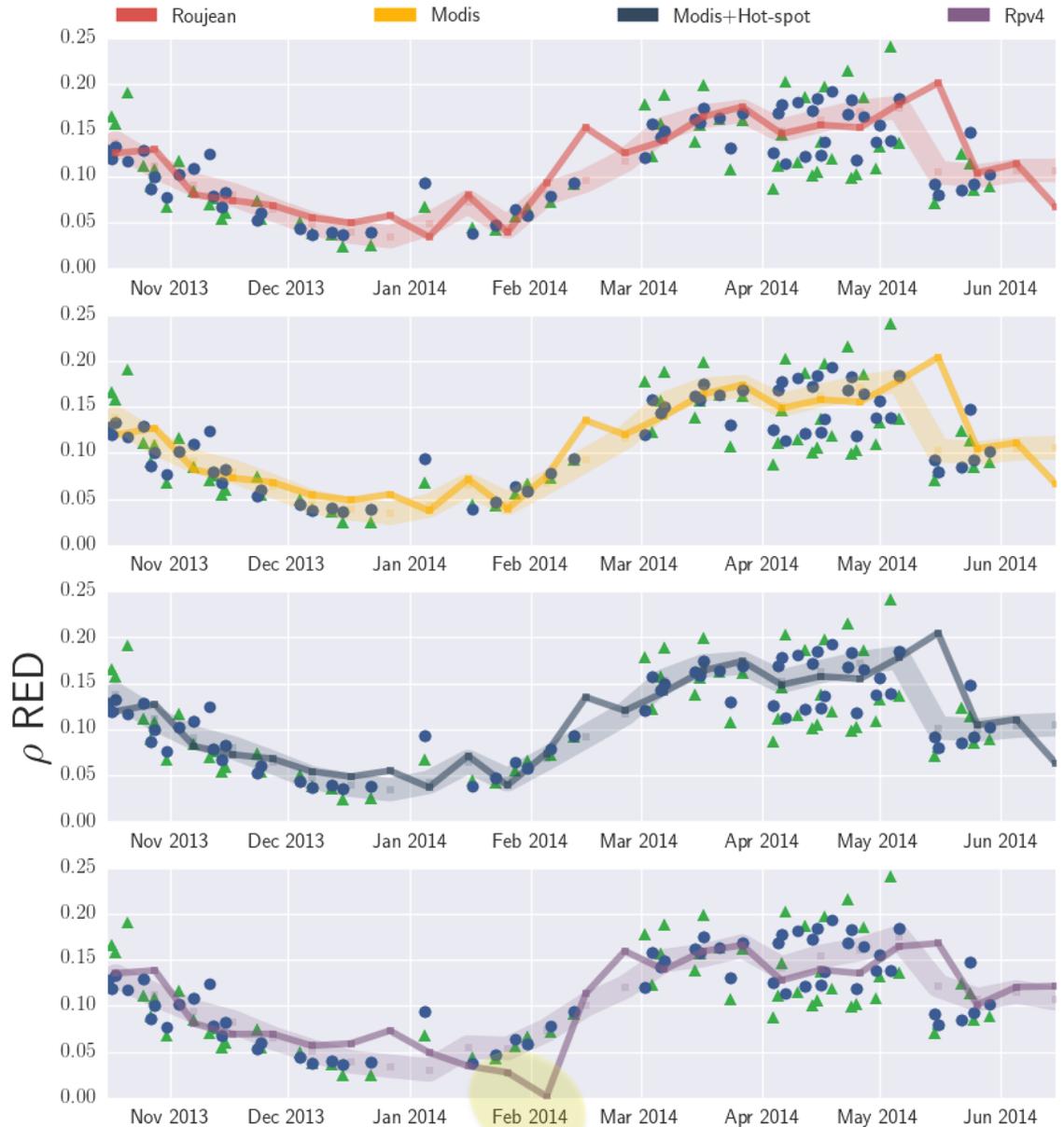
 VGT

 PBV

 ANT VGT

 ANT PBV

At first glance all 4 models show similar performances.



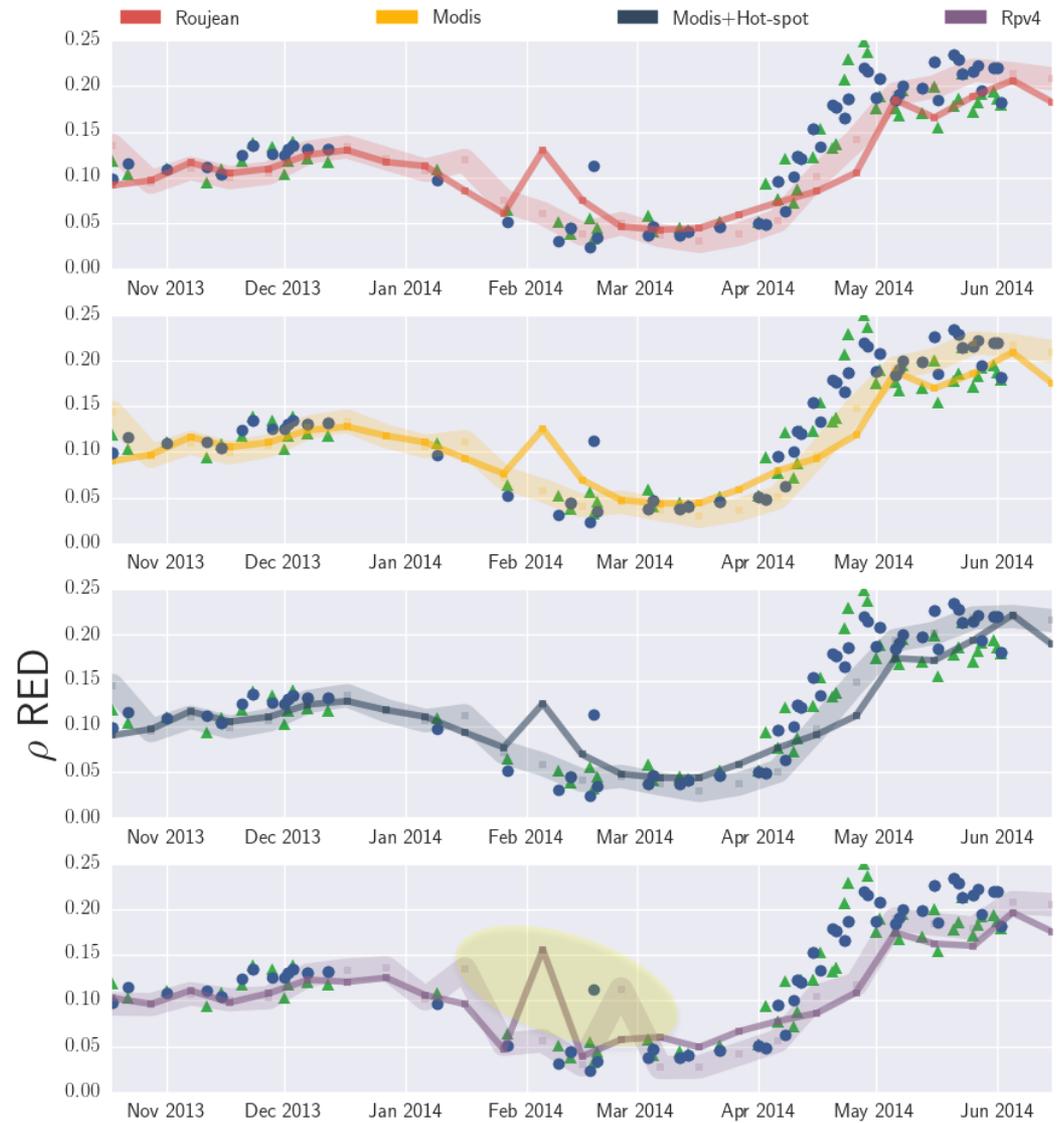
## ANGULAR NORMALISED TIME SERIES

 VGT

 PBV

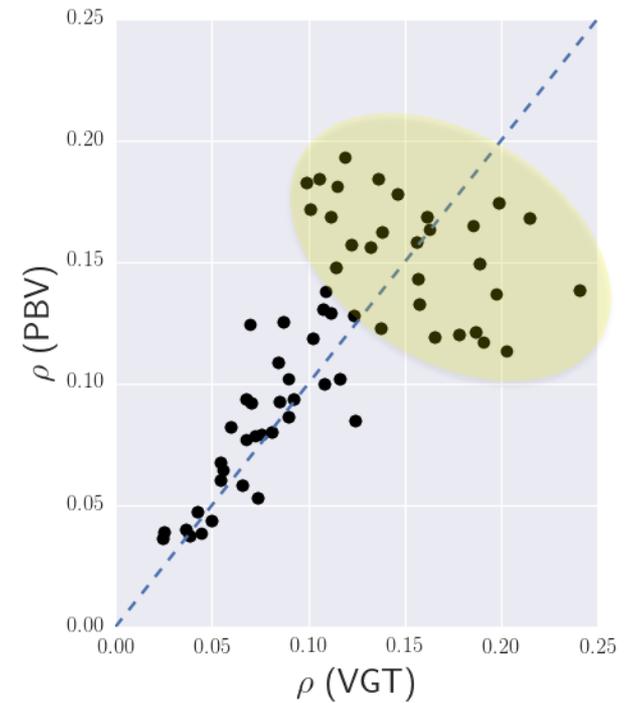
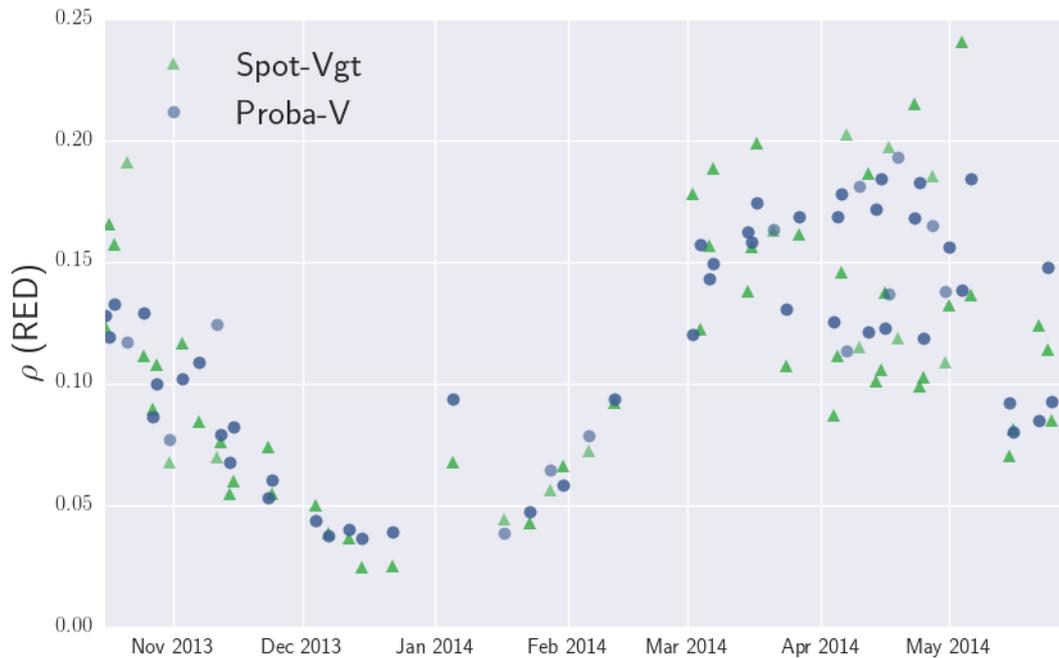
 ANT VGT

 ANT PBV

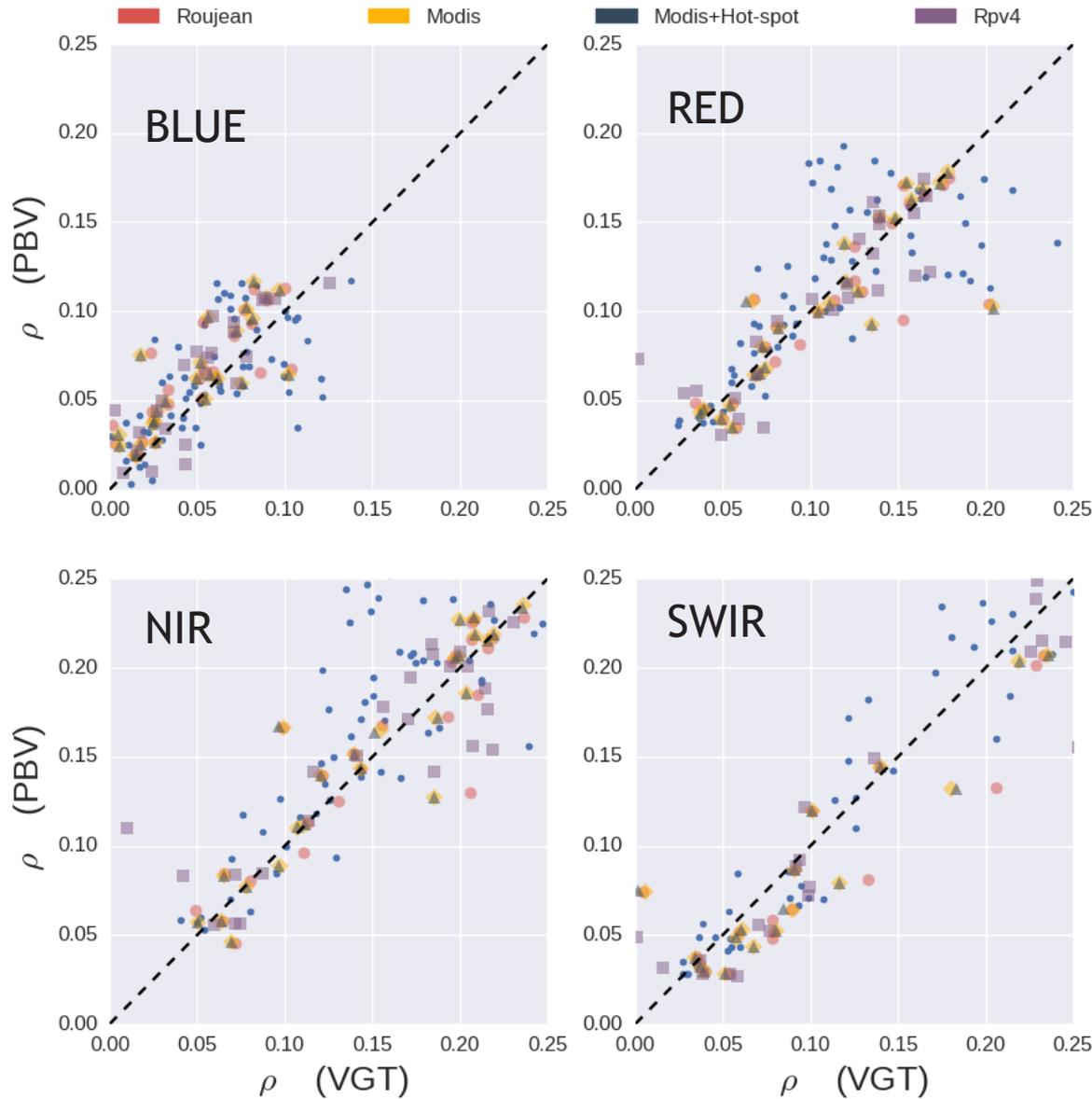


## LOOKING AT INDIVIDUAL SITES

El Saler-Sueca ES  
(lat,lon)=(39.275,-0.315)



Scatter is associated to directional effects



## LINEAR RELATION

Reduced scatter in angular normalised reflectances .

Thus, stronger linear relation between angular normalised reflectances

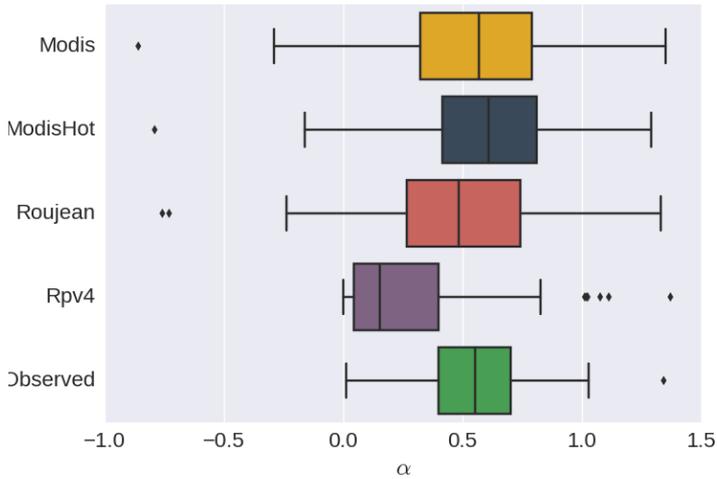
$$\rho_{PBV} = \alpha \rho_{VGT} + \beta$$

$$\alpha \rightarrow 1.0$$

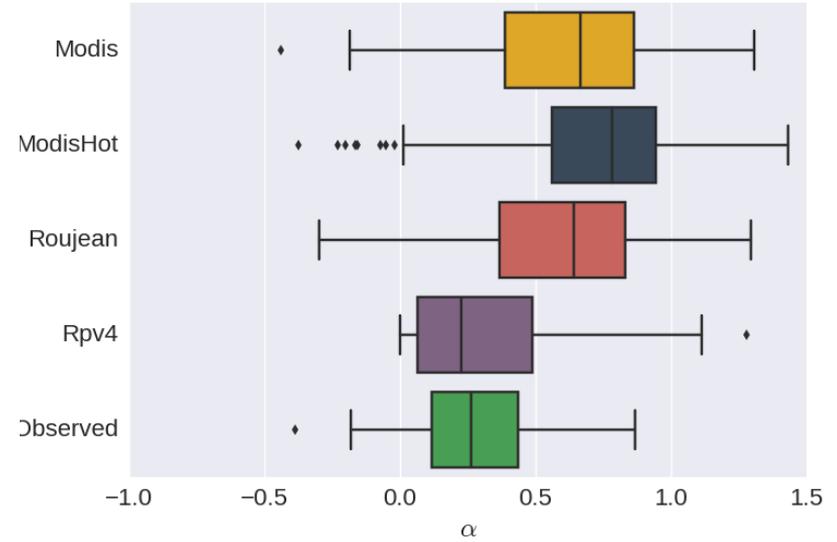
# LINEAR RELATION

$$\rho_{PBV} = \alpha \rho_{VGT} + \beta$$

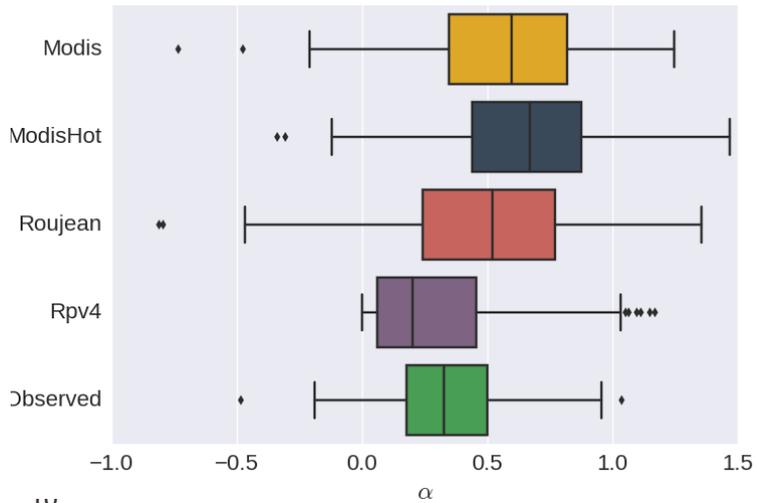
BLUE



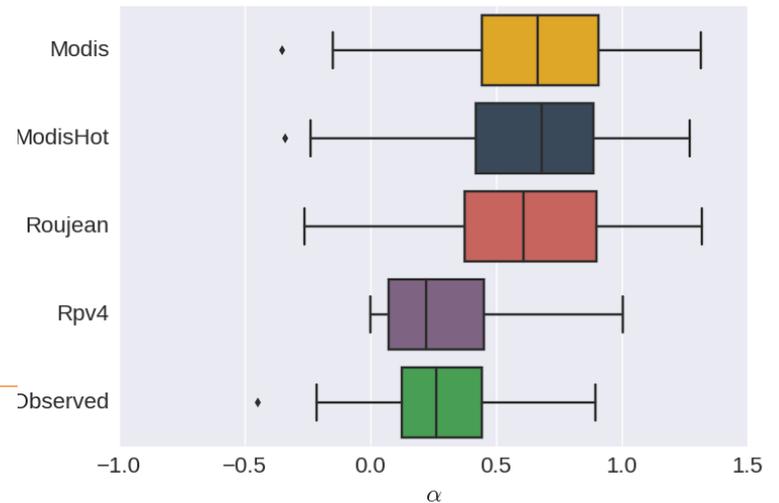
NIR



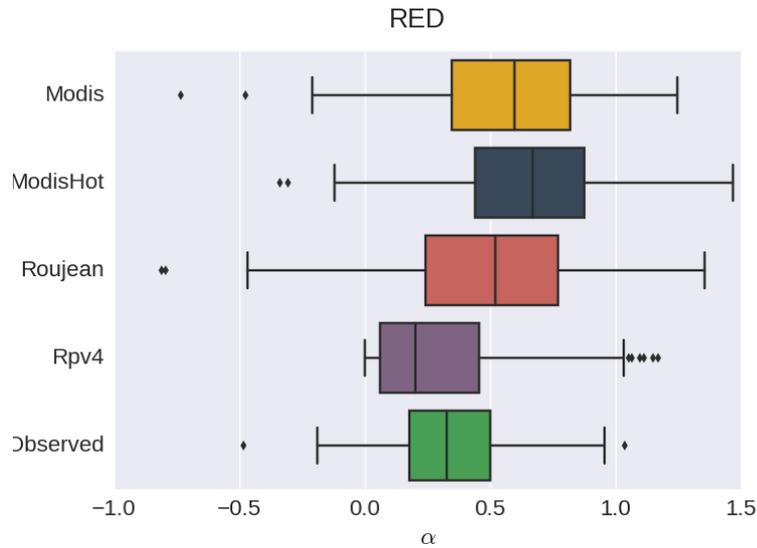
RED



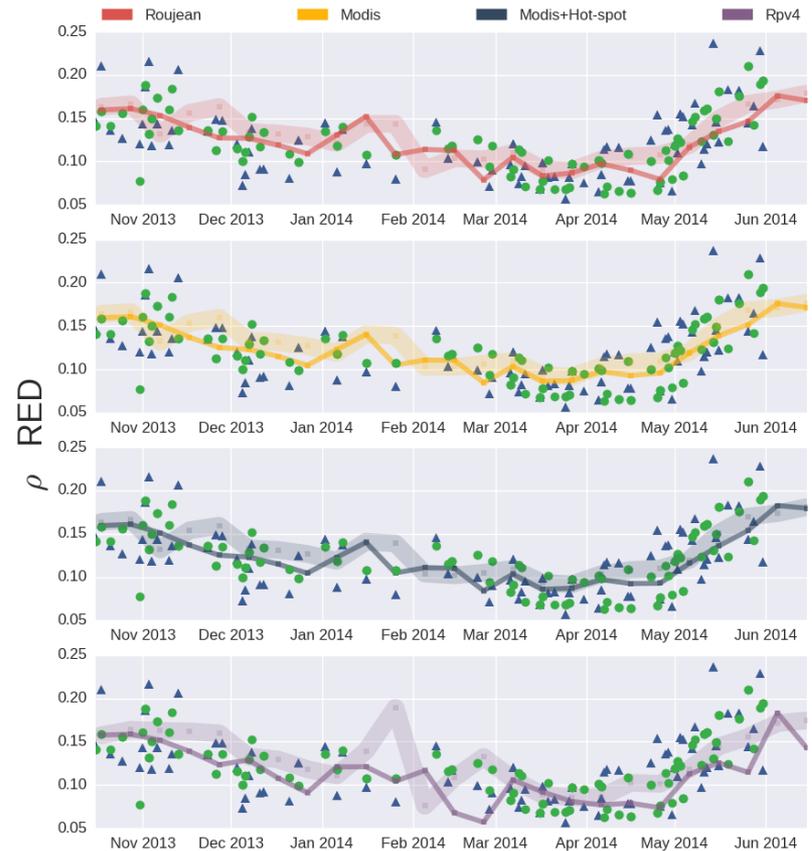
SWIR



# LINEAR RELATION



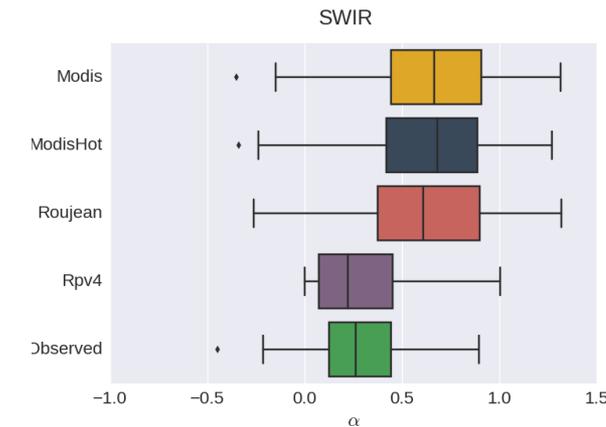
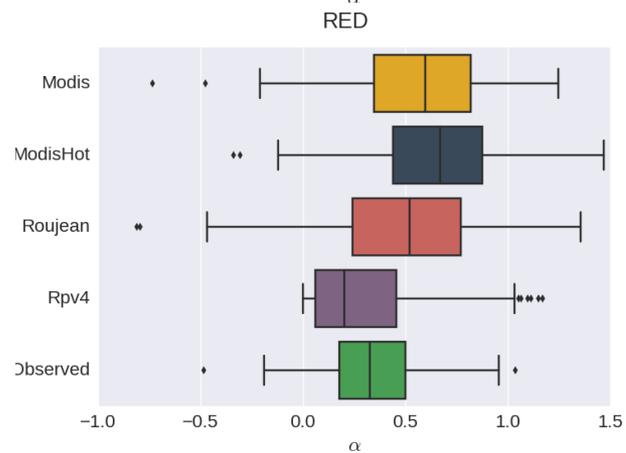
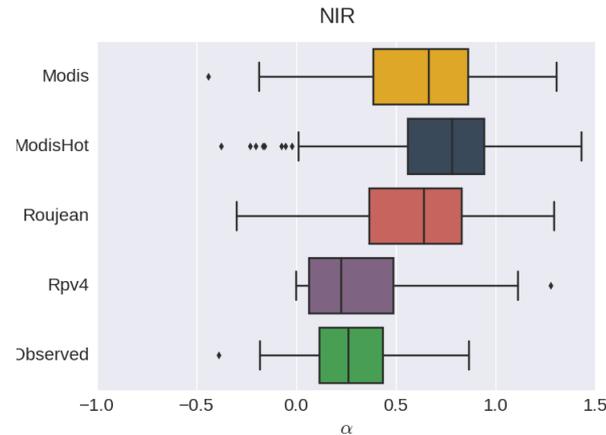
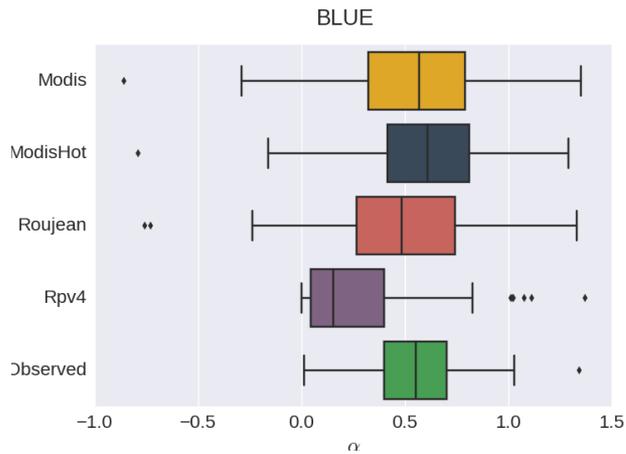
RPV4: low values of fitted slope due to presence of outliers



# PBV-VGT ANGULAR NORMALISE LINEAR RELATION

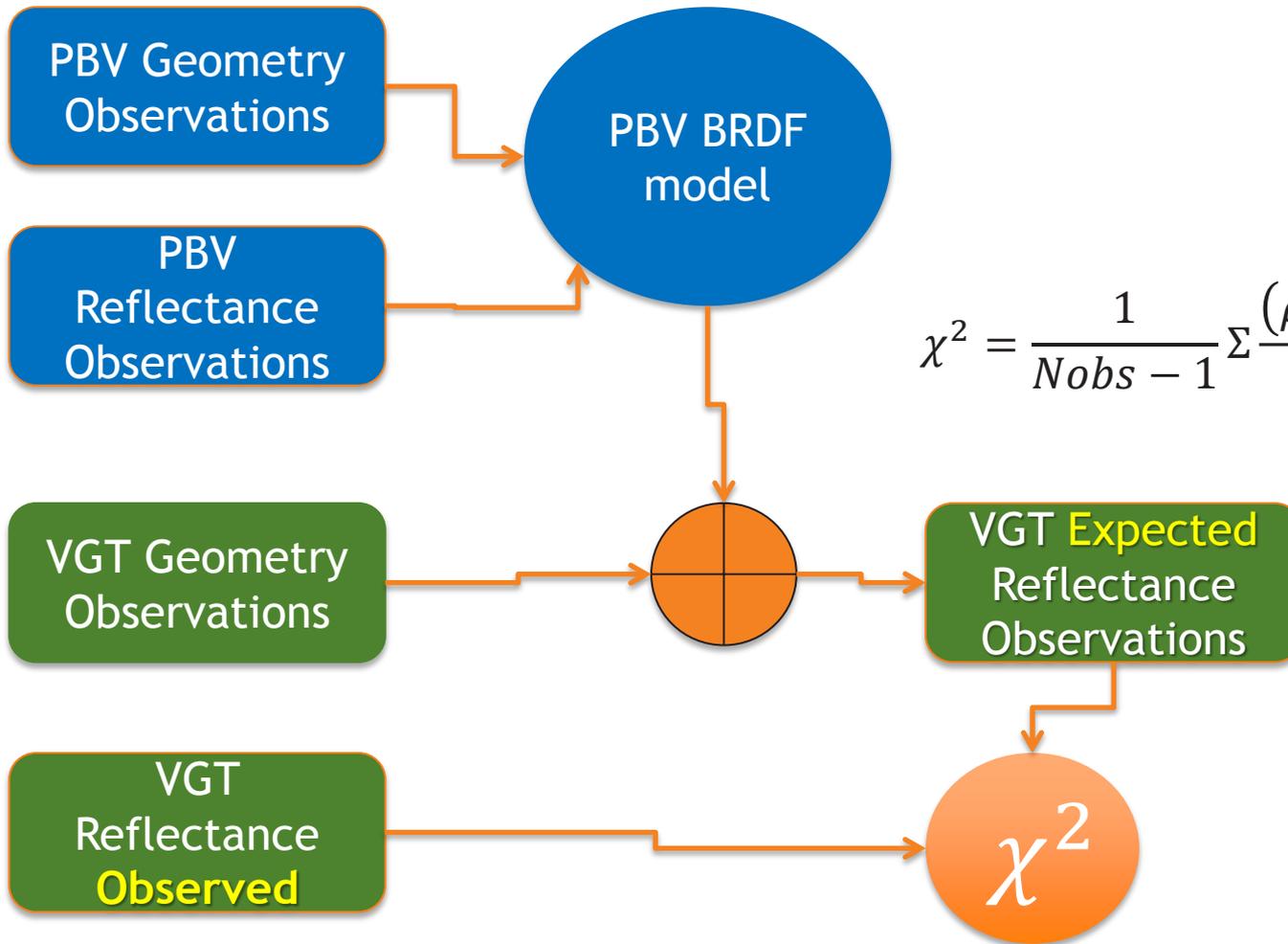
$$\rho_{PBV} = \alpha \rho_{VGT} + \beta$$

Ideally  $\alpha \sim 1.0$



1. Modis + Hot-spot
2. Modis
3. Roujean
4. Rpv4

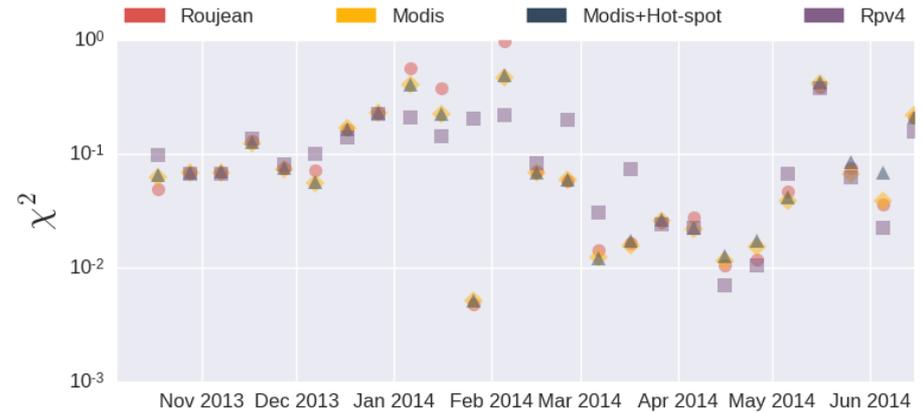
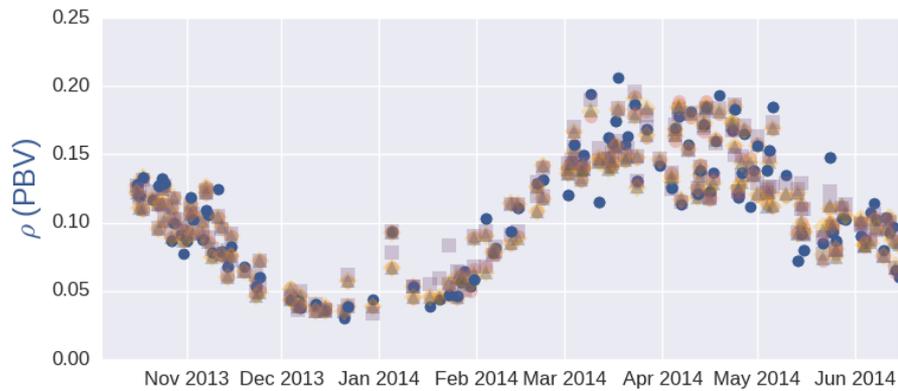
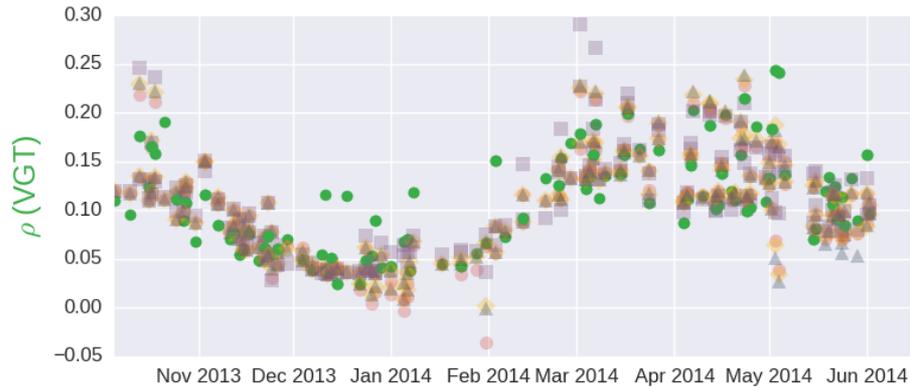
# VGT PBV XMATCH



$$\chi^2 = \frac{1}{N_{obs} - 1} \sum \frac{(\rho_{observed} - \rho_{expected})^2}{\rho_{observed}}$$

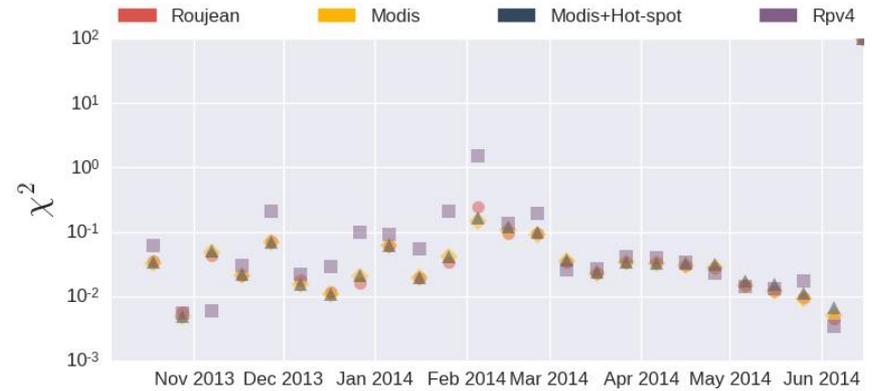
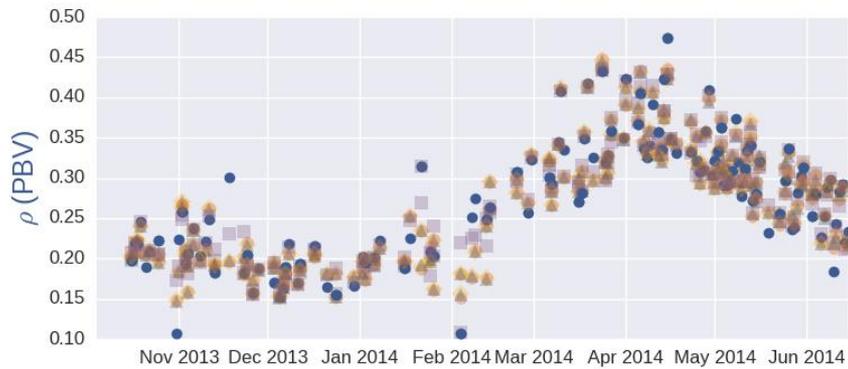
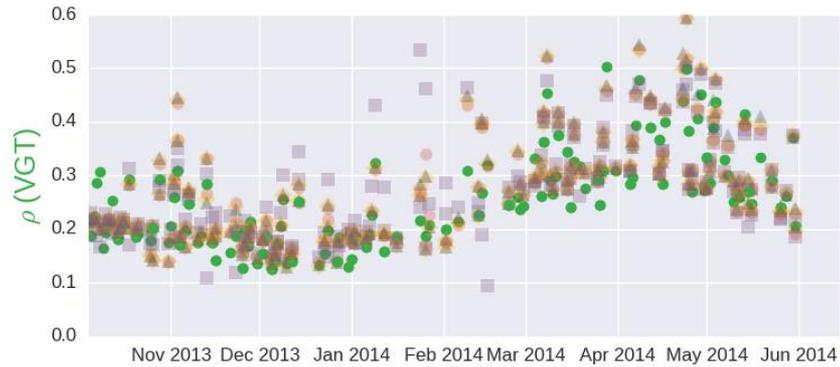
# VGT PBV XMATCH

Belmanip 0 (lat,lon) = (39.276,-0.315) --- RED



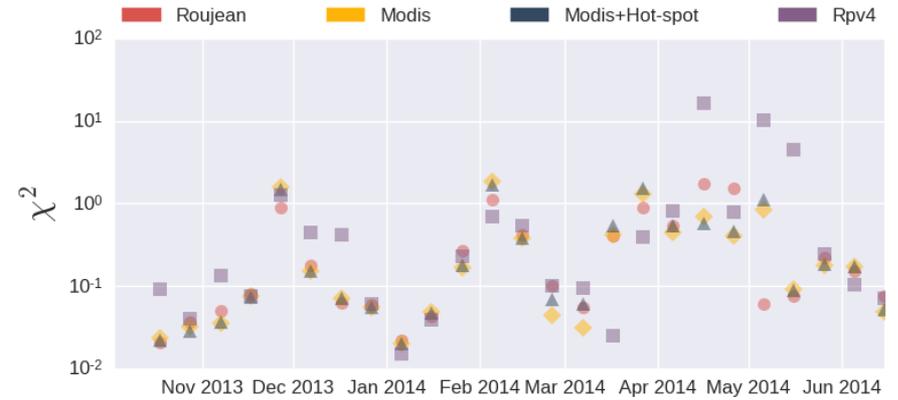
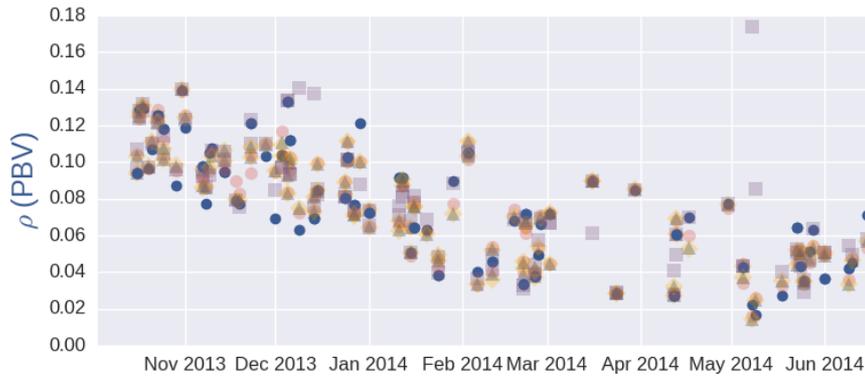
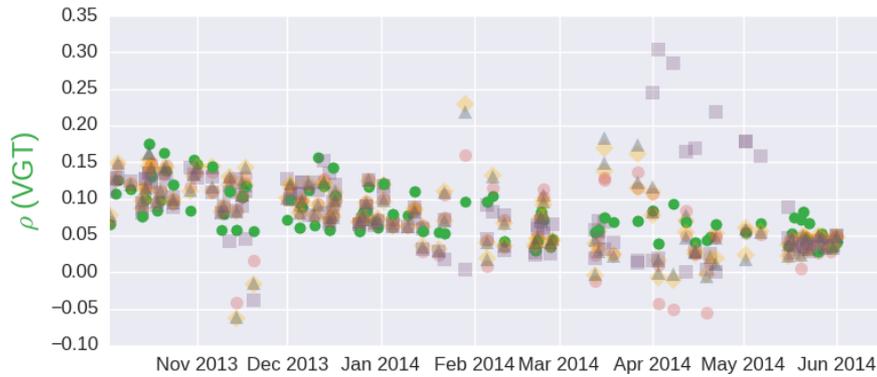
# VGT PBV XMATCH

Belmanip 225 (lat,lon) = (35.092,-1.001) --- NIR



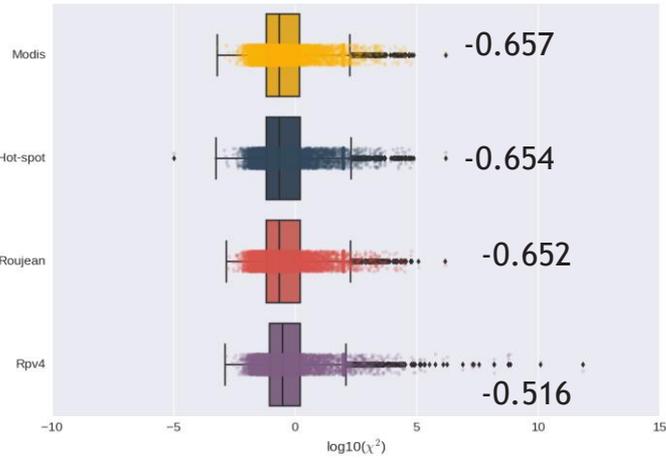
# VGT PBV XMATCH

Belmanip 39 (lat,lon) = (-3.314,-41.488) --- RED

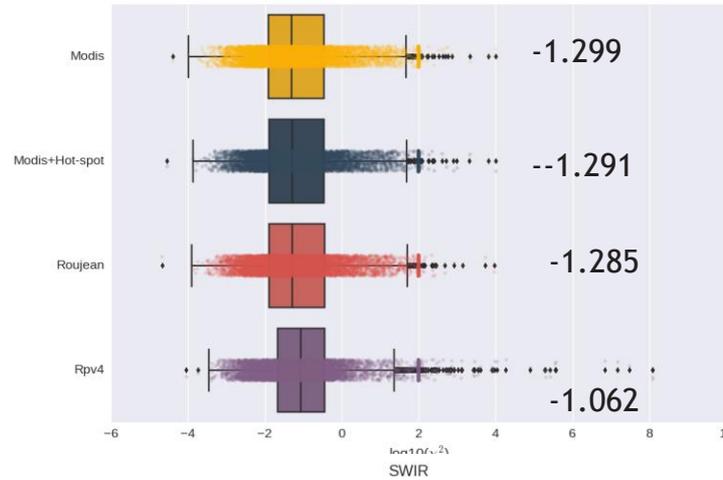


# VGT PBV XMATCH

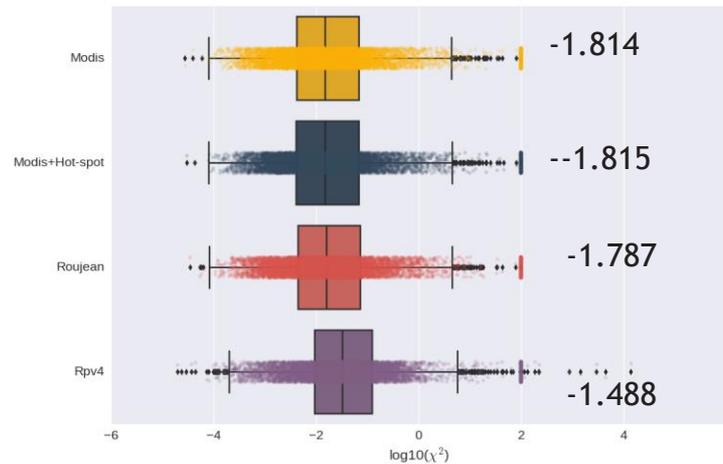
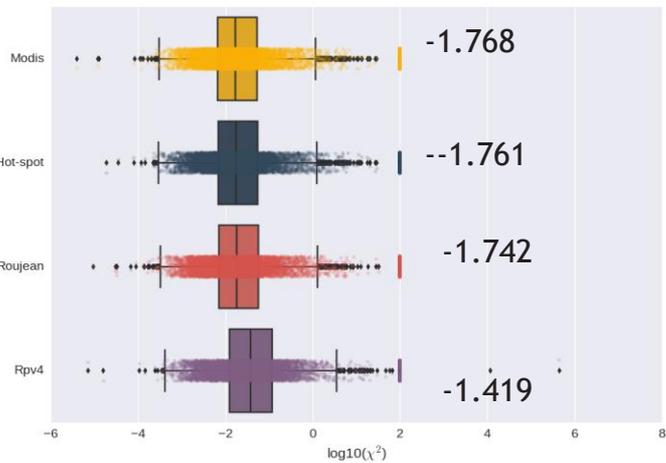
BLUE



RED



1. Modis
2. Modis + Hotspot
3. Roujean
4. Rpv4



## Summary

- The semi-empirical model used by Modis and its enhanced version (including a term to model the Hot-spot) arise as the best ranked methods in our analyses.

The above result is consistent with a BRDF model benchmark study using POLDER data (Maignan+2004).

Using Modis kernels allows a comparison with the MCD43 Modis product. The latter is used in BRDF correction for high spatial resolution sensors as Sentinel-2 (Claverie + 2015)



## Ongoing Work

PBV QWG4

Experimenting with other kernels (e.g. Ross-Thick Li-Sparse, RPV-4parameters) ✓

BRDF model discrimination based on reproducibility of VGT observations. ✓

Explore alternatives aiming to provide NRT products (e.g. Kalman filter)

Tests on images. ✓



# BRDF KALMAN FILTER

