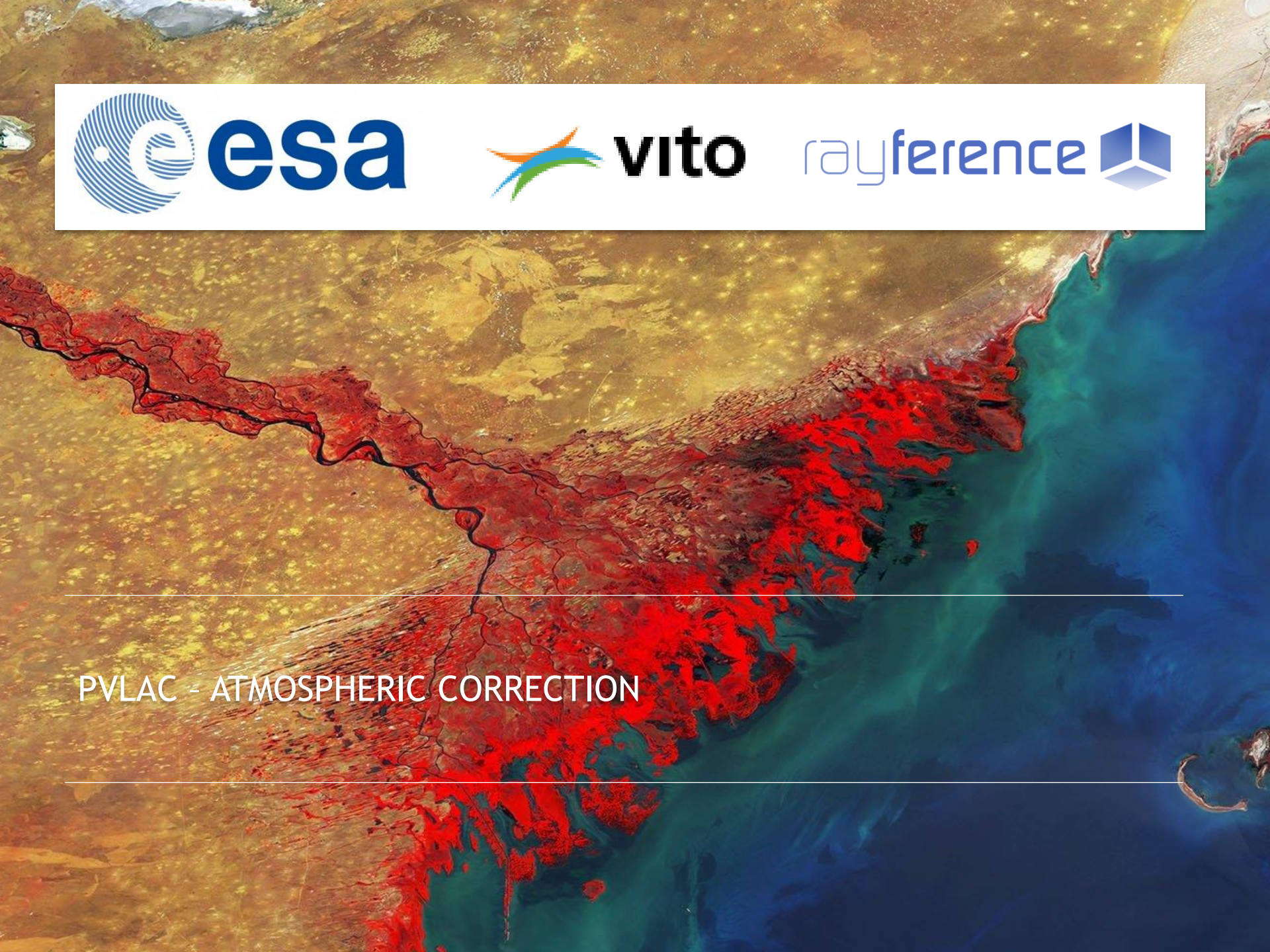


PVLAC - ATMOSPHERIC CORRECTION

OVERVIEW

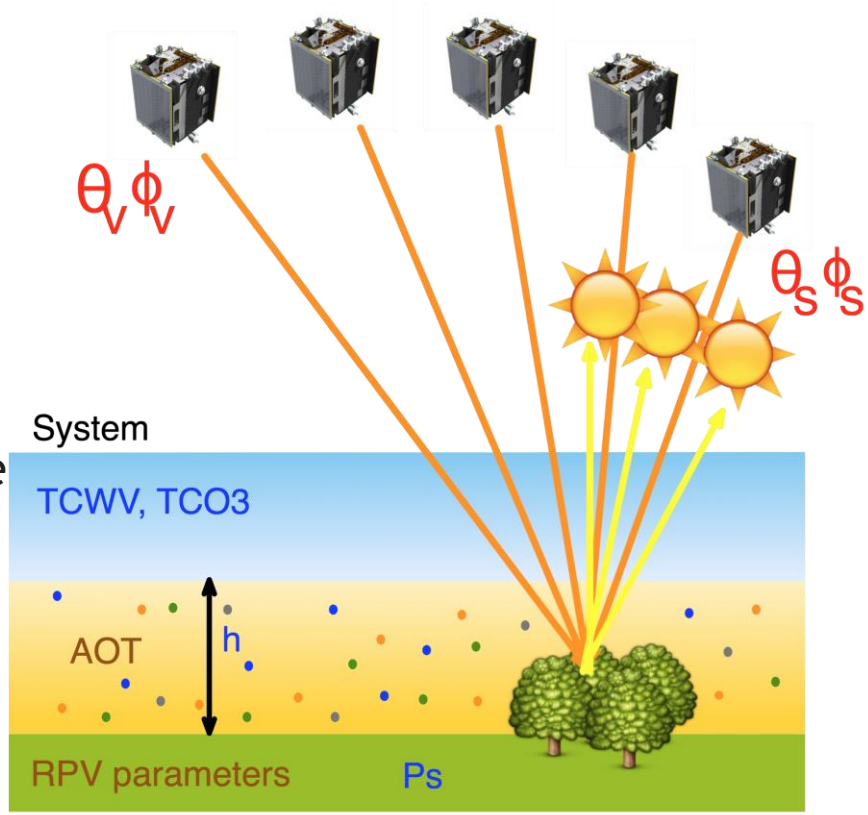
1. PV-LAC objective
2. CISAR concepts
    - » Algorithm overview
    - » New elements: spectral constraints on the surface
3. Results on PROBA-V observations
4. Quality indicator
5. Preliminary validation results against current retrieval
6. Next steps
7. Conclusion

1. PV-LAC OBJECTIVE

» The objective of this study is to perform a joint retrieval of surface reflectance and aerosol properties accounting for surface anisotropy and its coupling with the atmosphere

2. CISAR CONCEPTS

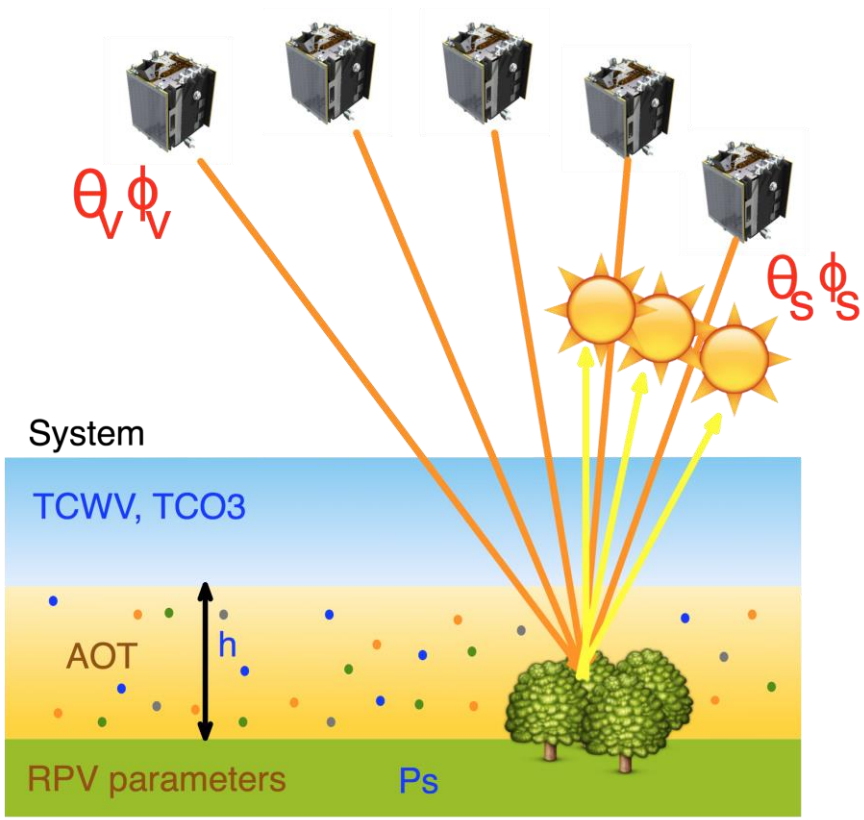
- CISAR is a generic algorithm on the inversion of a coupled surface-atmosphere radiative transfer model (FASTRE).
- The retrieval is based on an Optimal Estimation (OE) approach following the method proposed by Govaerts et al. (2010).
- The OE approach seeks the best balance between the information derived from the observations and prior knowledge.
- Retrieval uncertainty is also estimated based on the OE theory.
- CISAR product includes the BHR in the 4 PROBA-V bands and the AOD at 0.55µm.



2. CISAR CONCEPTS

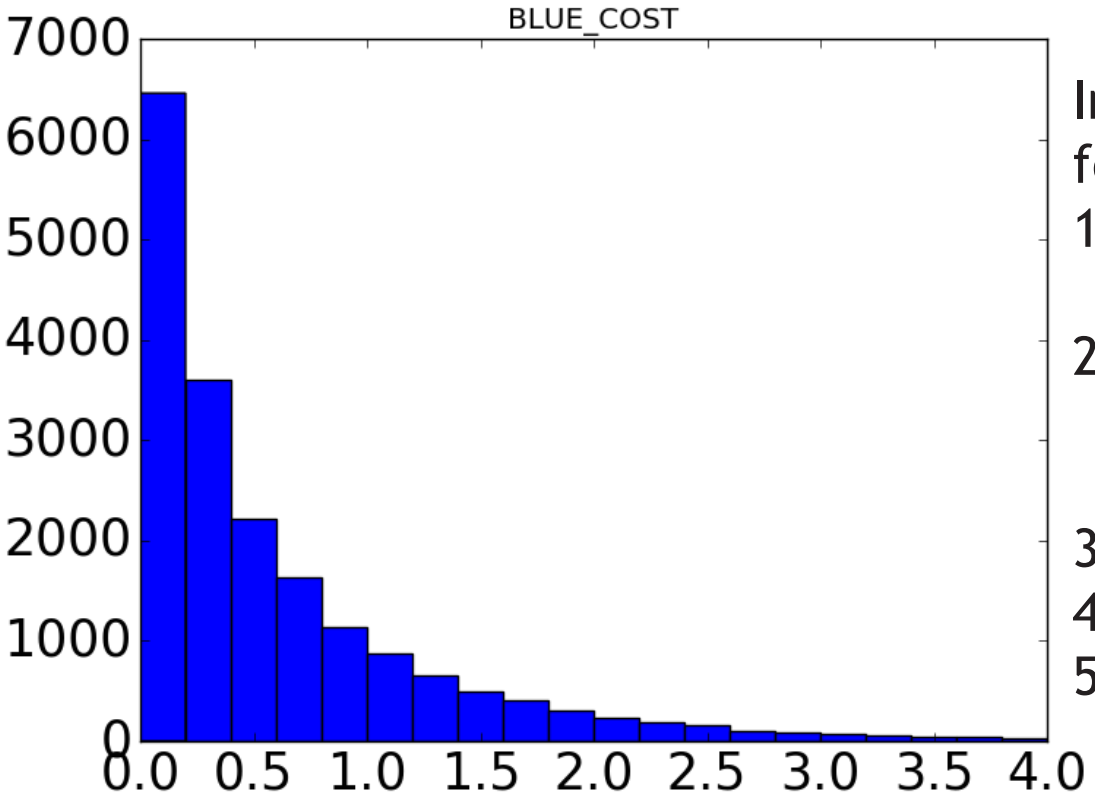
- The forward model simulates the TOA Bidirectional Reflectance Factor as a function of the viewing and illumination angles, the spectral band λ and the state of the atmosphere and underlying surface.

INVERSION PROCESS : find the value of x so that $Y_m(x) \approx Y_0 \pm \varepsilon$



Characterization of observation uncertainty is essential!

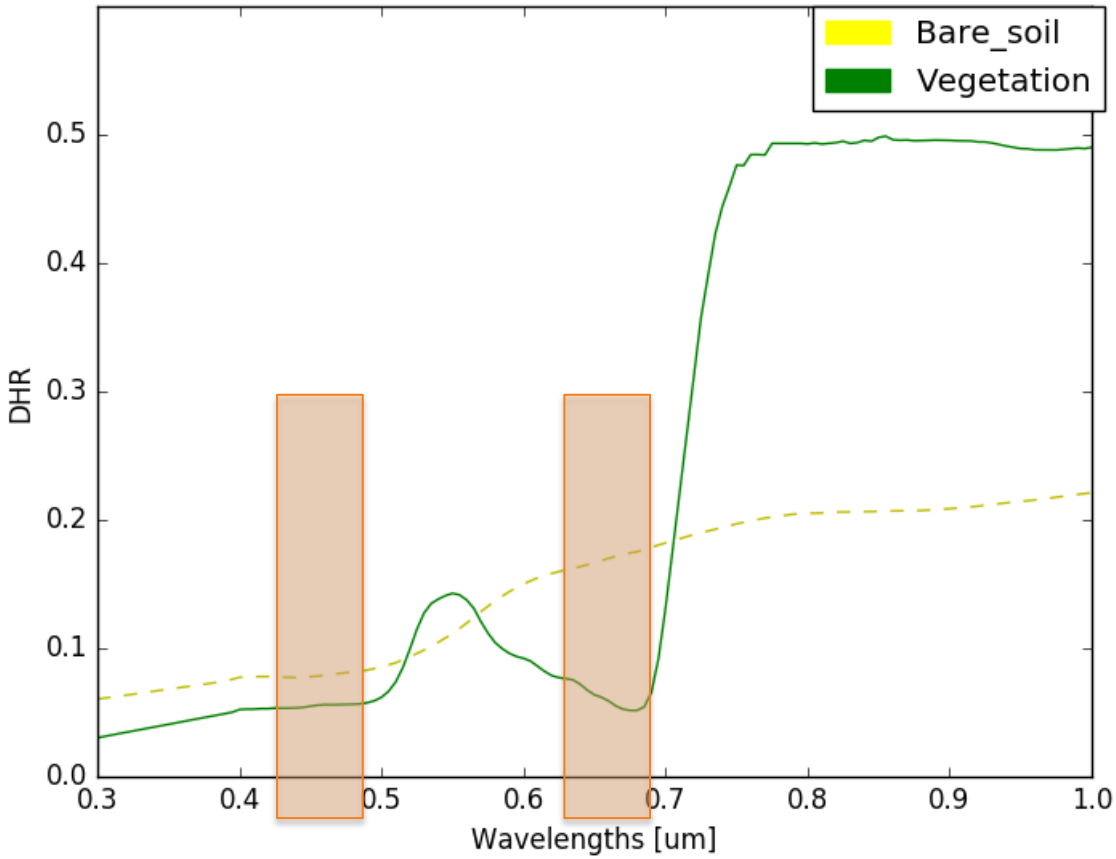
$$\frac{y_m - y_o}{e}$$



In the uncertainty ε the following terms are considered:

1. Differences in the visible and SWIR bands angles
2. Differences in the spectral response of the three cameras
3. Geometric uncertainty
4. Radiometric uncertainty
5. Model uncertainty

2.2 SURFACE CONSTRAINTS ON THE SURFACE

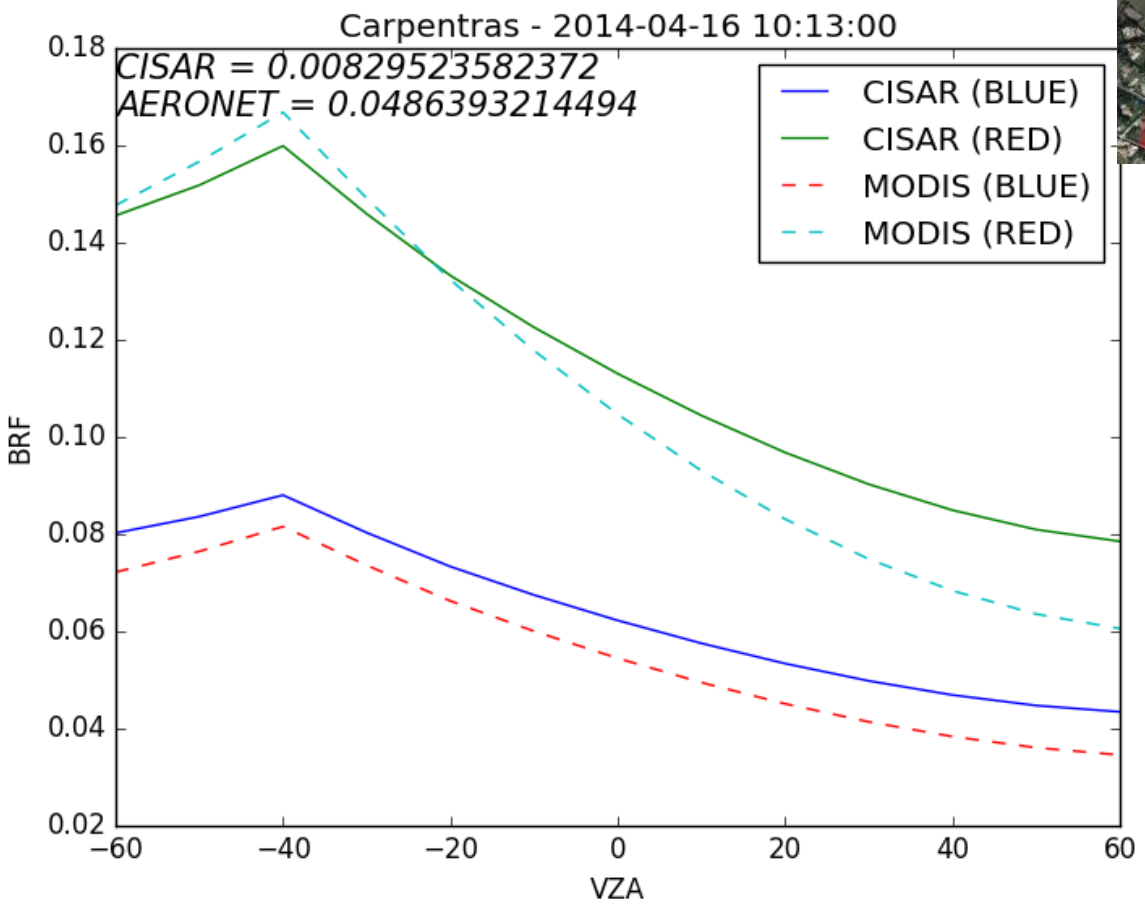


The surface anisotropy properties in the Blue and Red band are highly correlated.

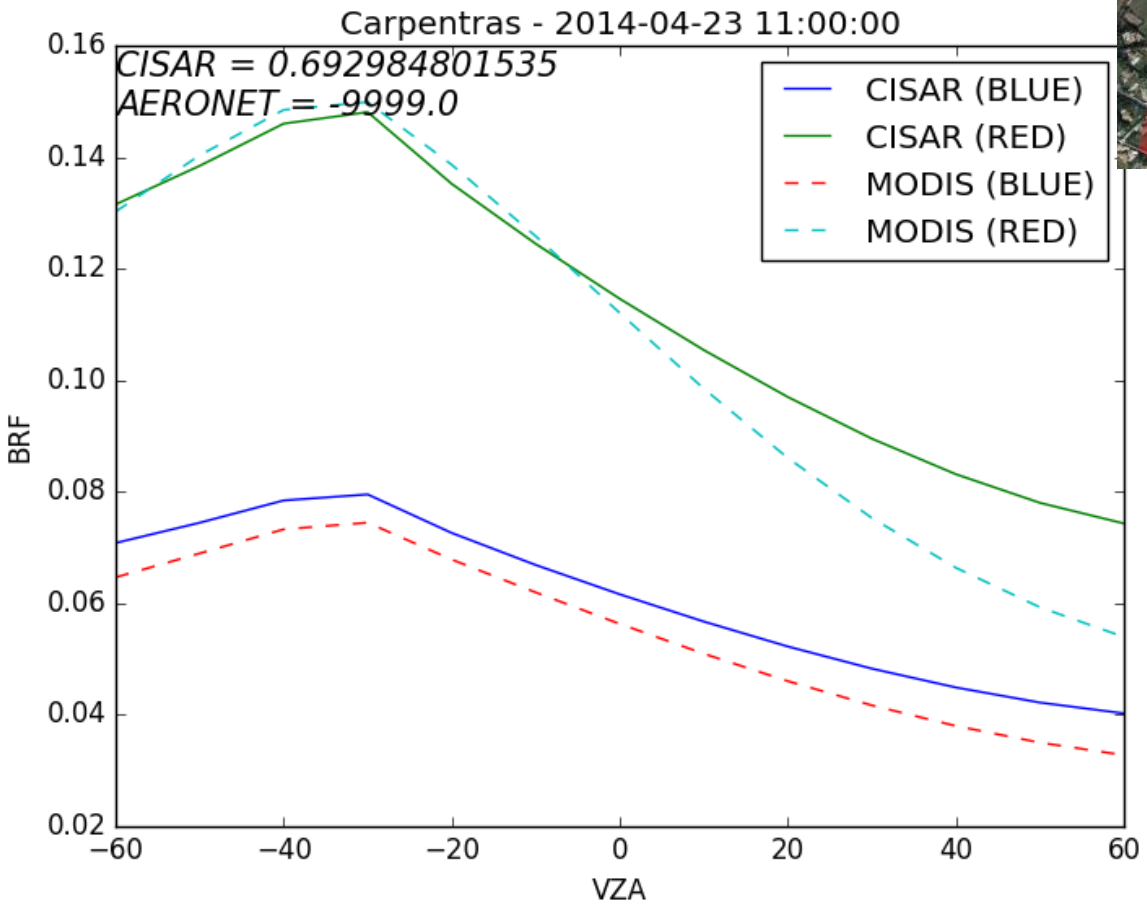
This is particularly true in the case of the vegetation, where the surface reflectance is expected to be comparable also in terms of magnitude in the BLUE and RED bands.

$$s = a * \left(\left| r_{0,BLUE} - r_{0,RED} \right| \right)$$

2.2 SURFACE CONSTRAINTS ON THE SURFACE



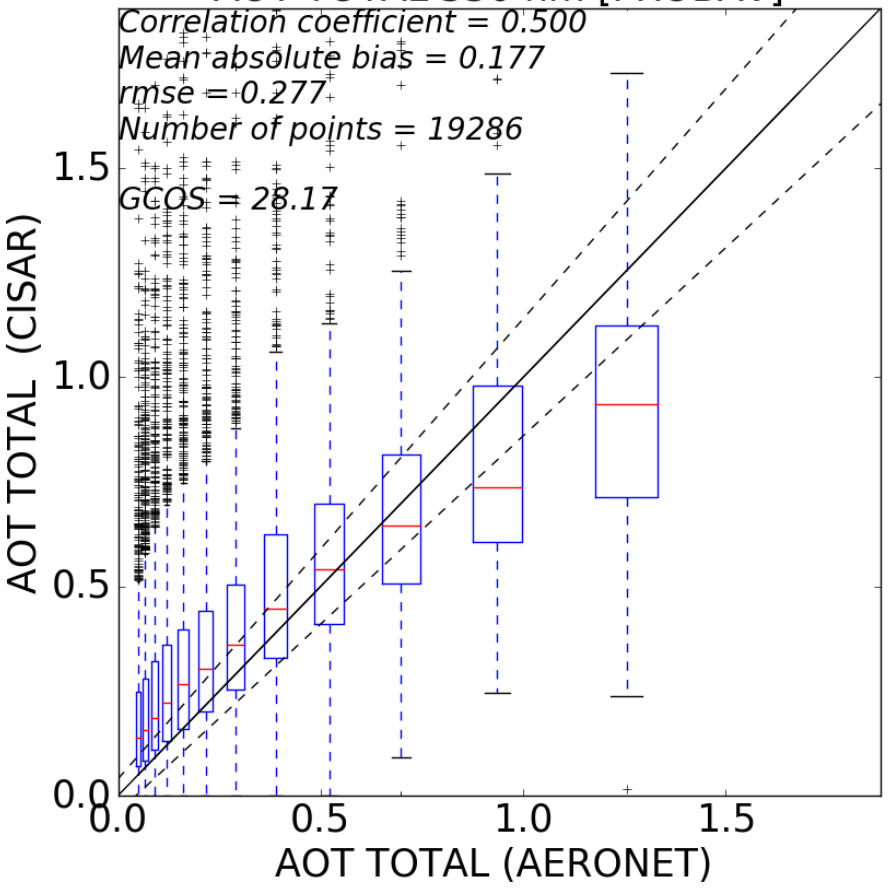
2.2 SURFACE CONSTRAINTS ON THE SURFACE



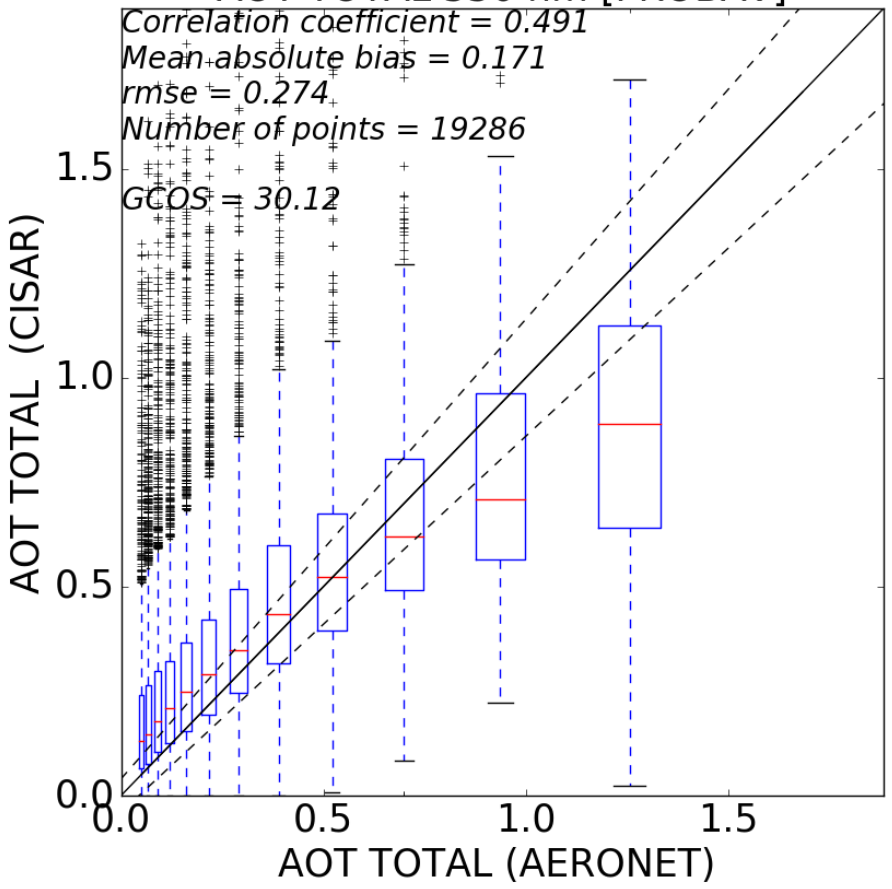
AERONET data is missing. Cloud contamination?

2.2 SURFACE CONSTRAINTS ON THE SURFACE

WITHOUT SRF CONSTRAINTS

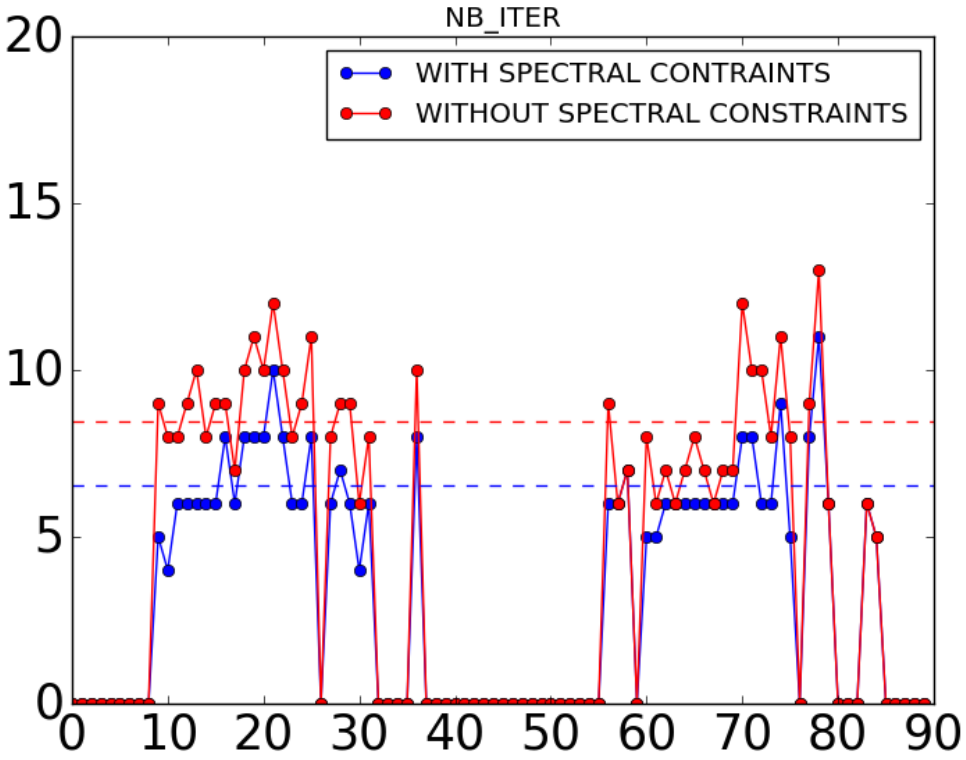


WITH SRF CONSTRAINTS



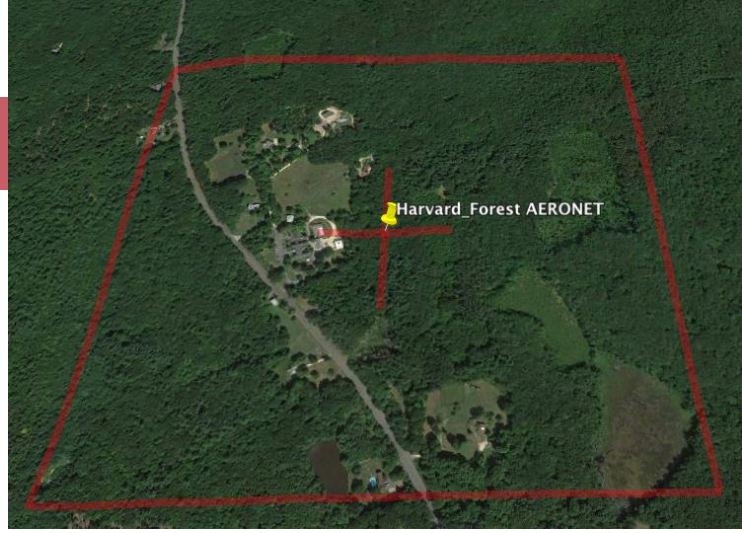
2.2 SURFACE CONSTRAINTS ON THE SURFACE

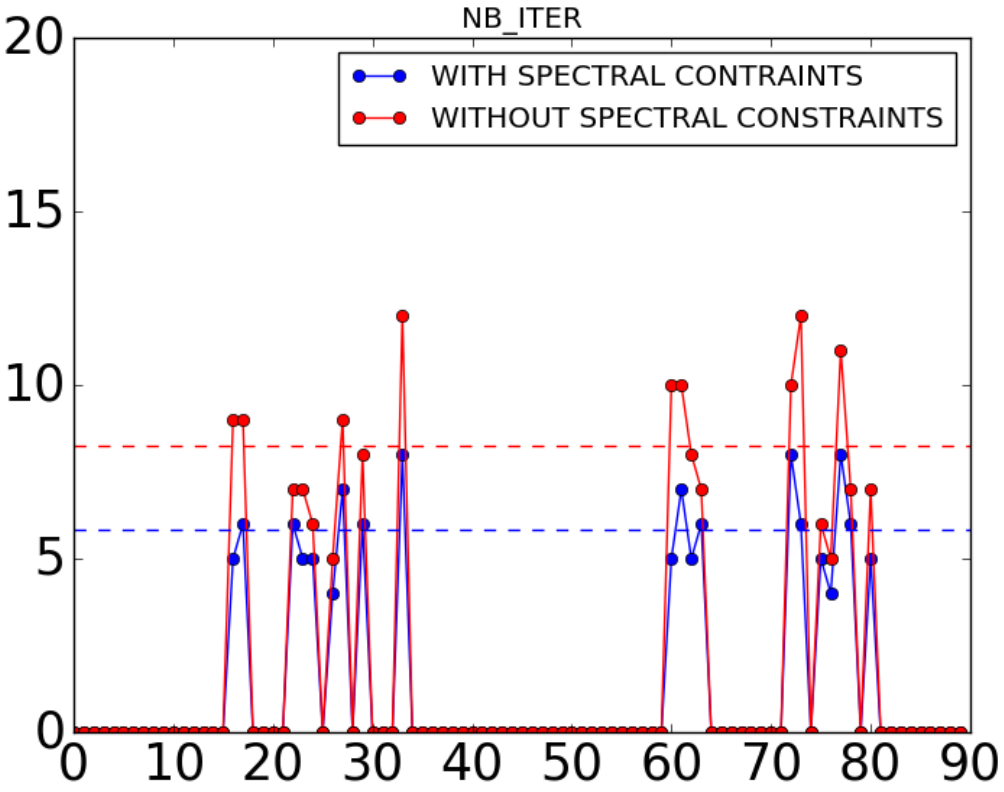
Carpentras, France



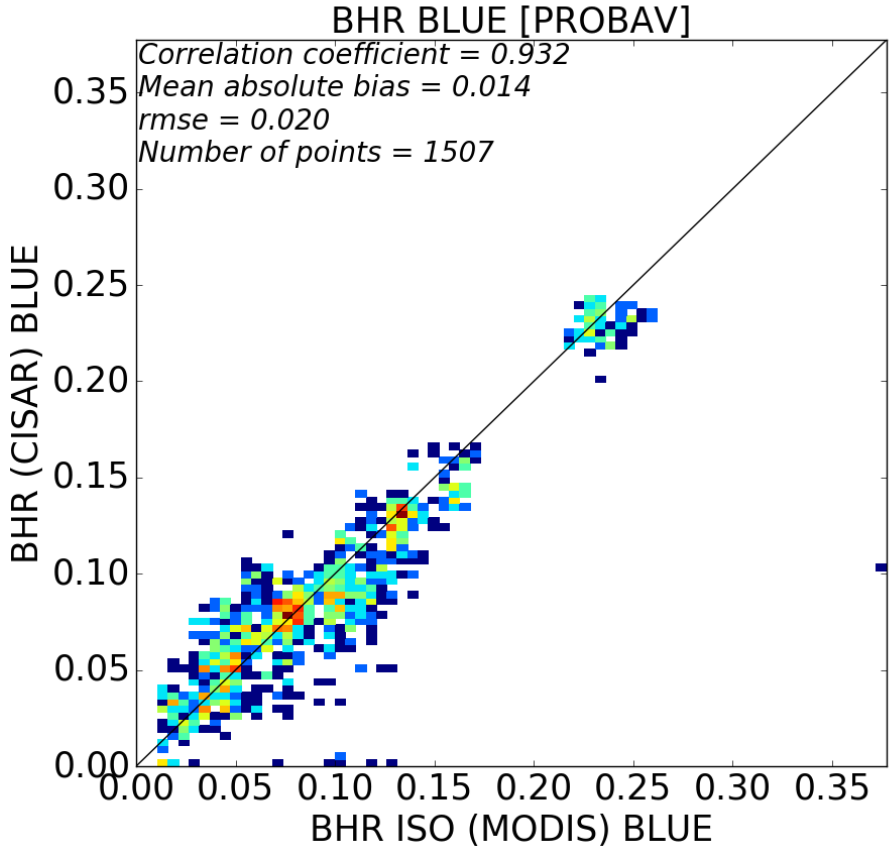
2.2 SURFACE CONSTRAINTS ON THE SURFACE

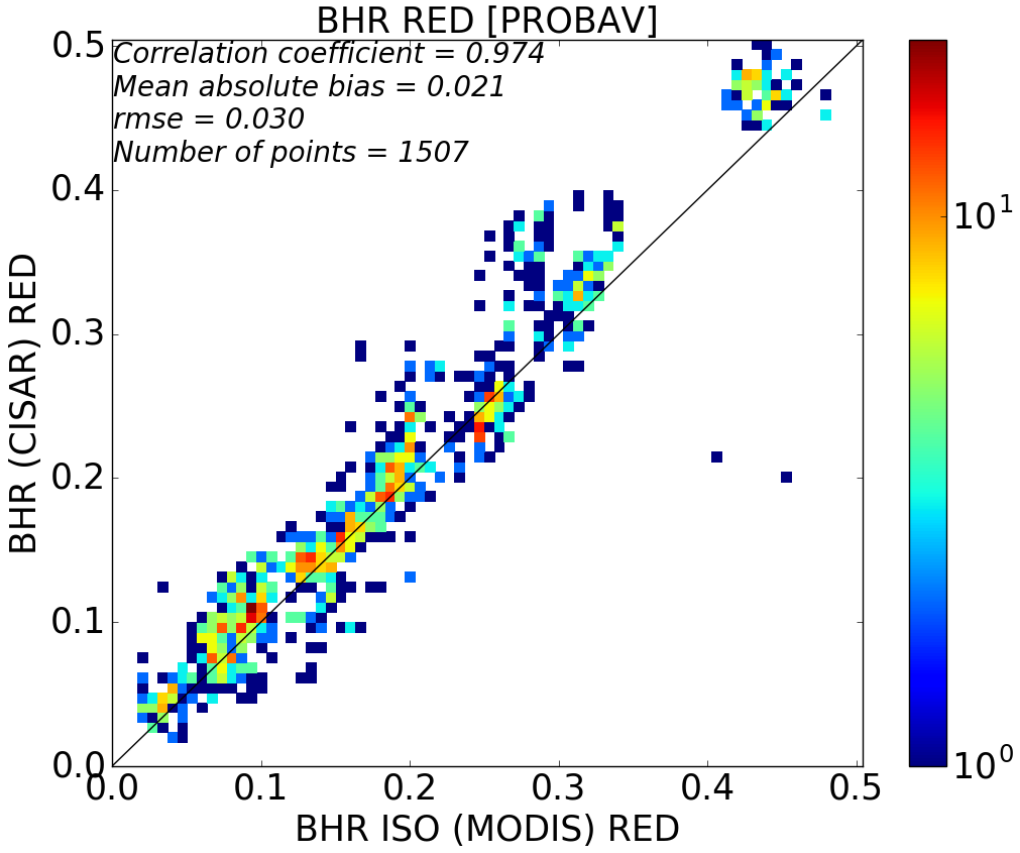
Harvard Forest, USA





3. RESULTS ON PROBA-V OBSERVATIONS





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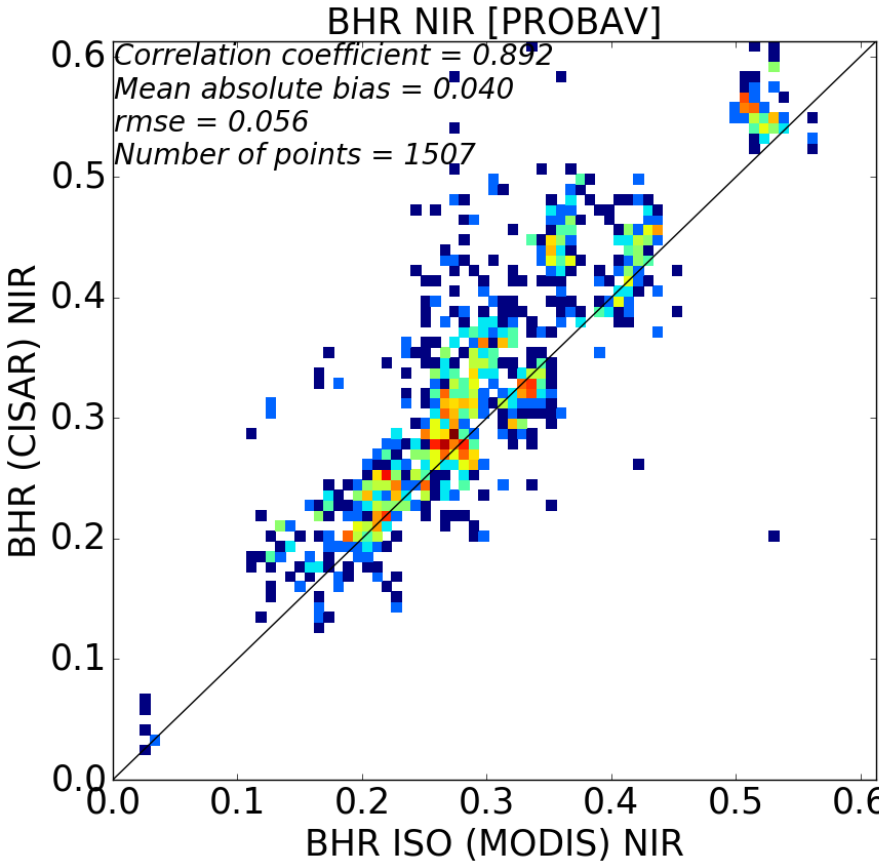

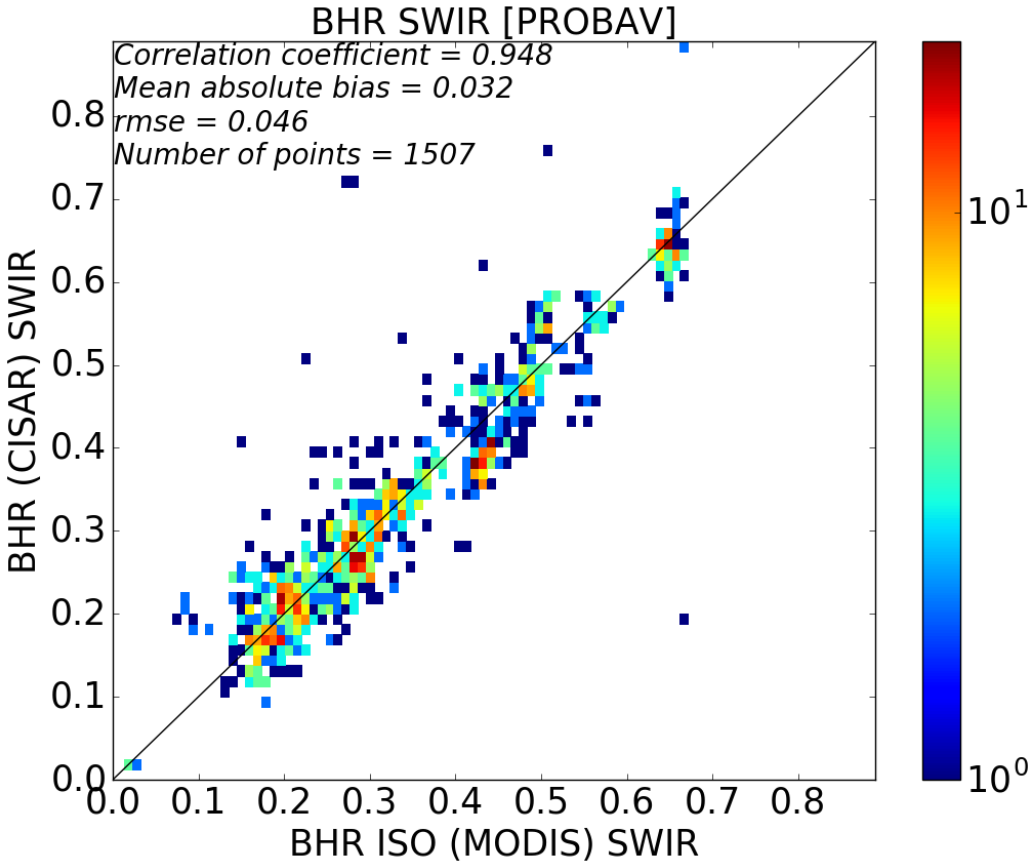

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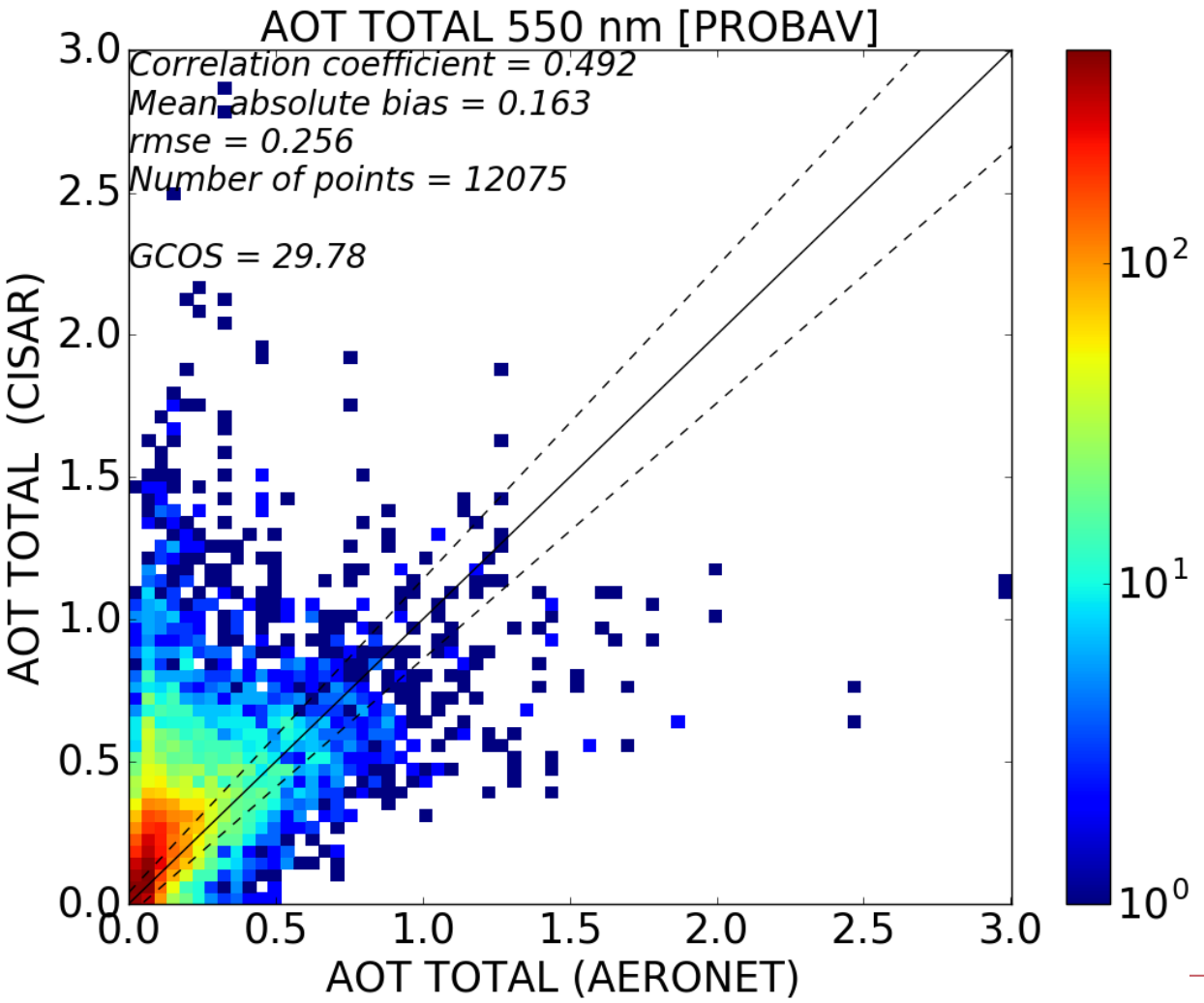
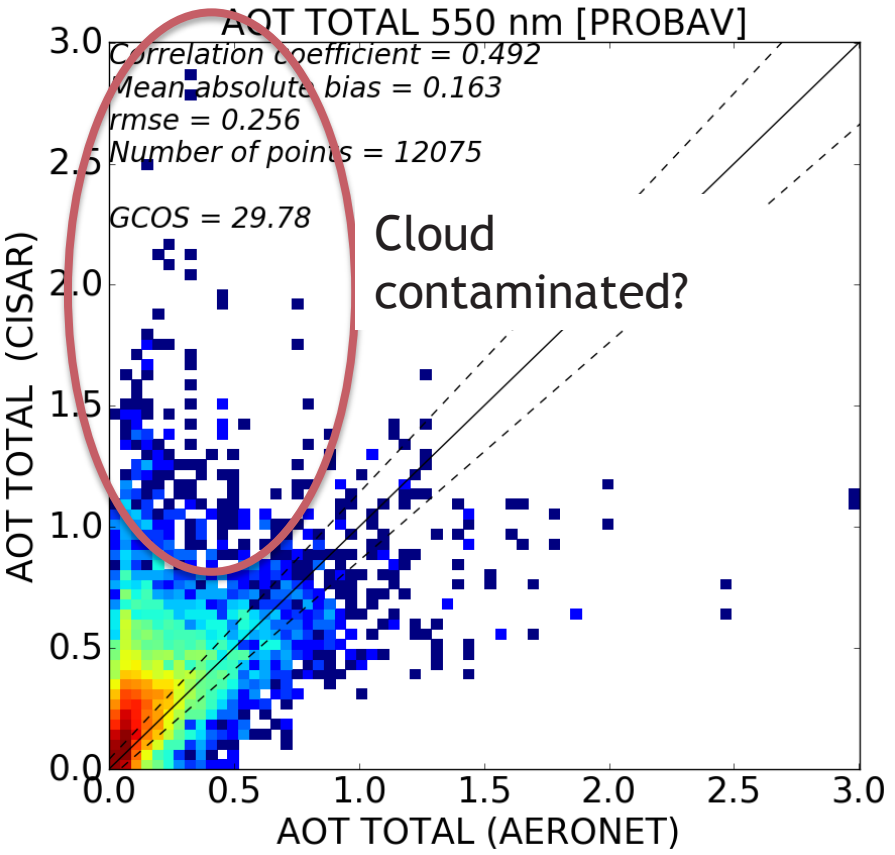
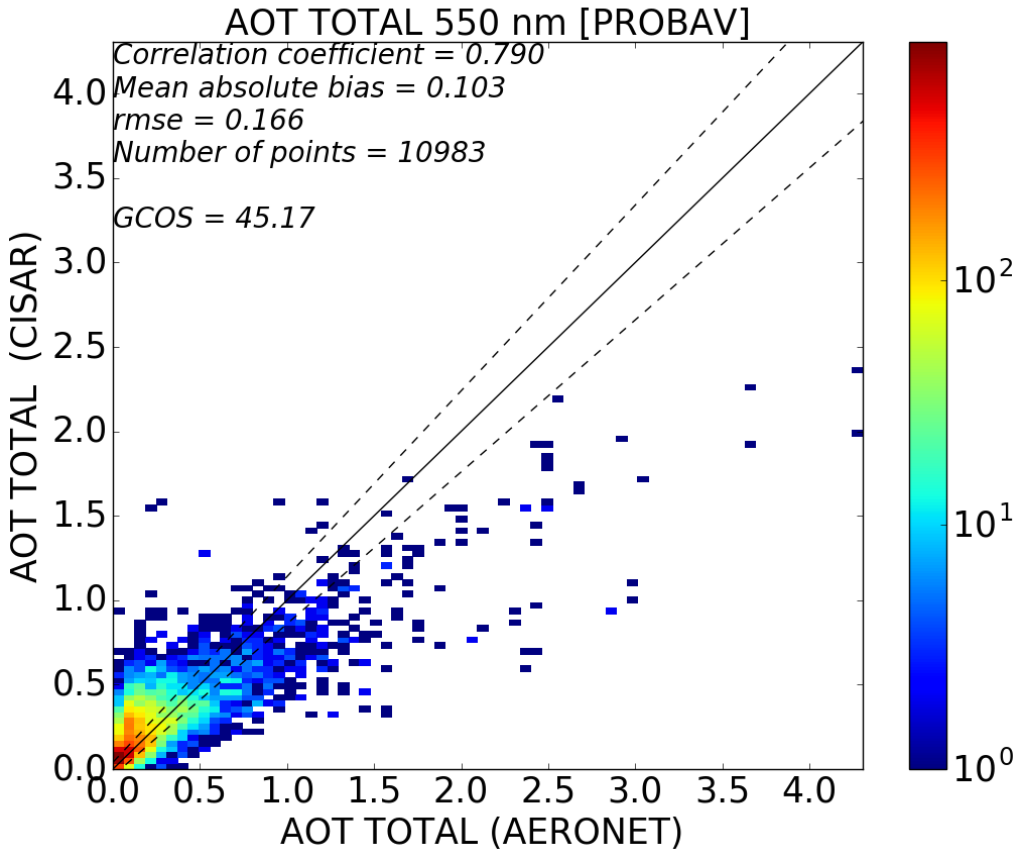


3. RESULTS ON PROBA-V OBSERVATIONS

OBSERVATIONS



SIMULATED DATA



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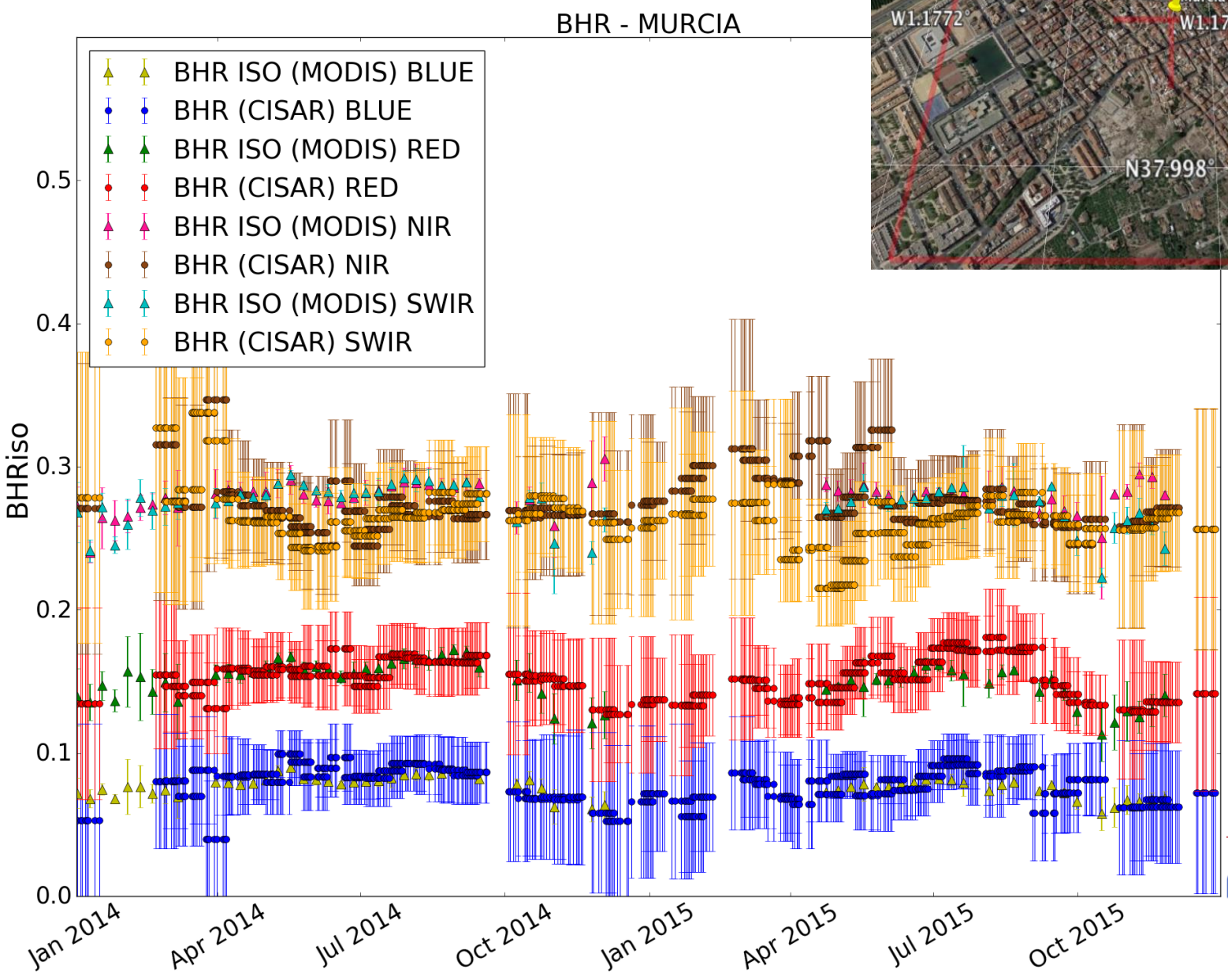
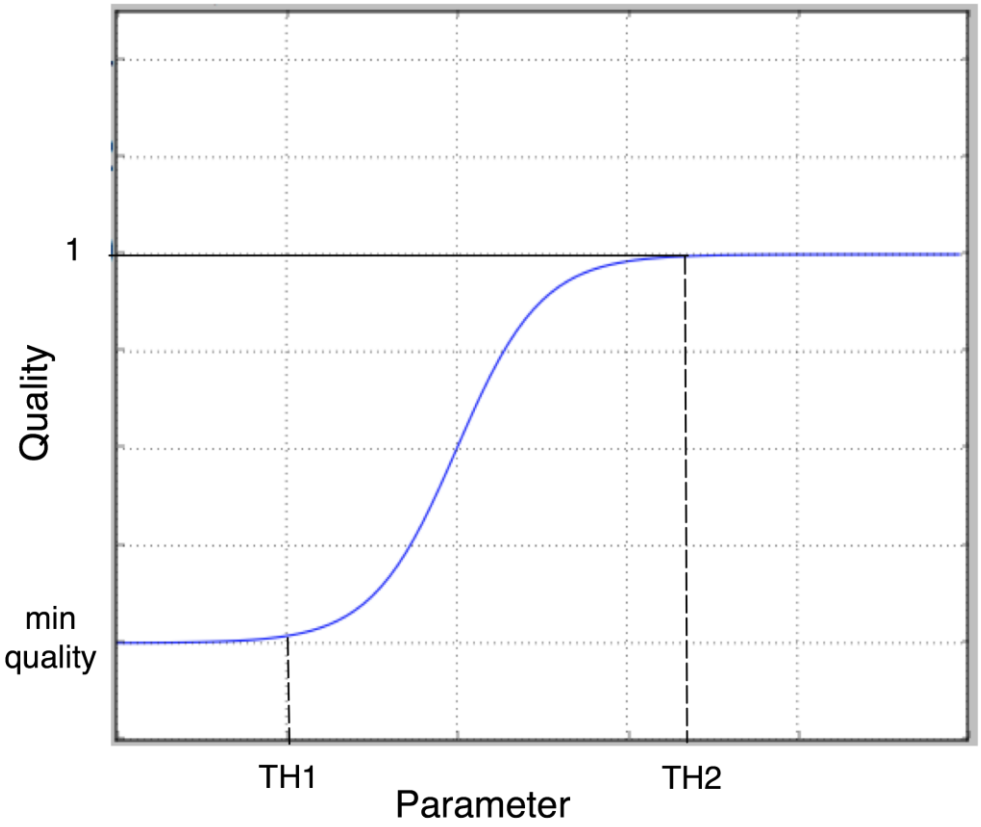


4. QUALITY INDICATOR (ON GOING)

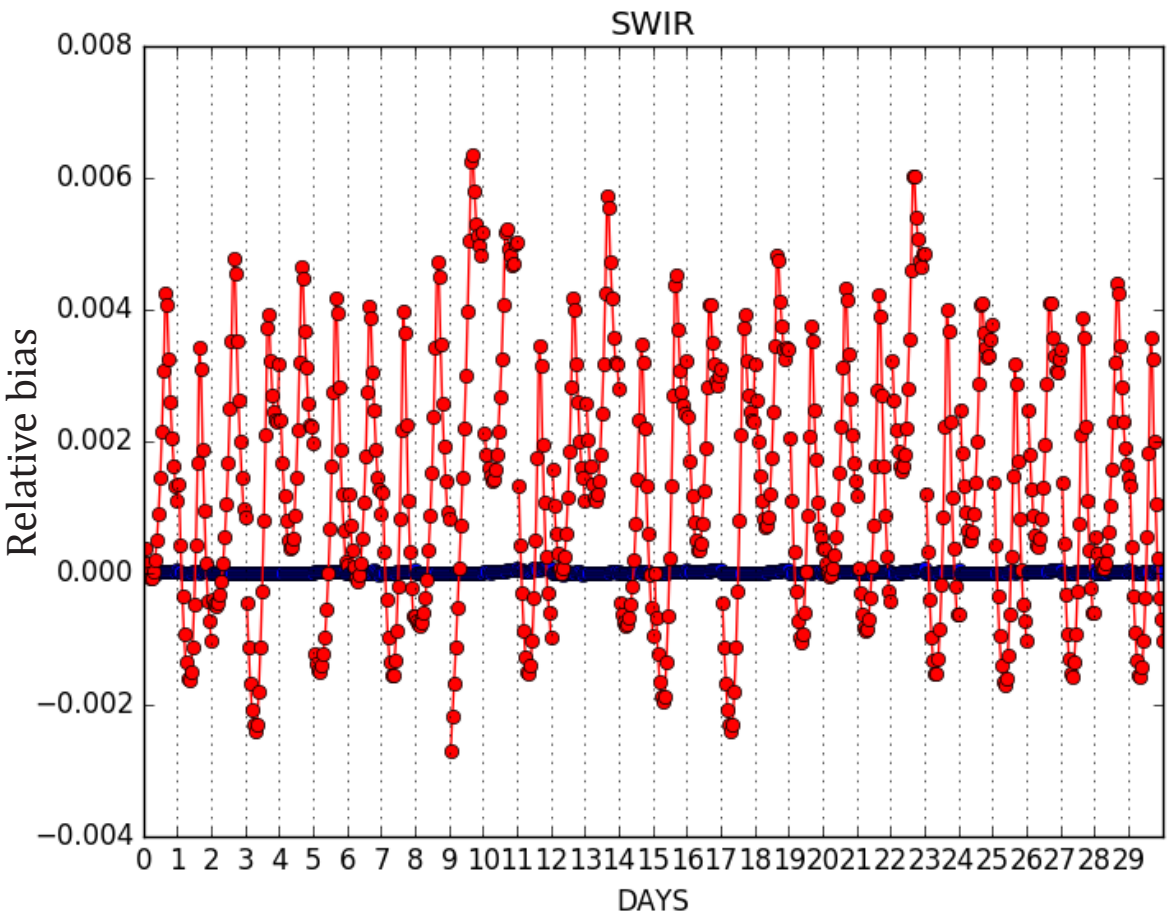
Potential parameters considered to develop the new quality indicator are:

- Relative bias
- Entropy
- Jacobian
- Sigma posterior
- Number of iterations

Non linear threshold definition



4.1 QUALITY INDICATOR: RELATIVE BIAS



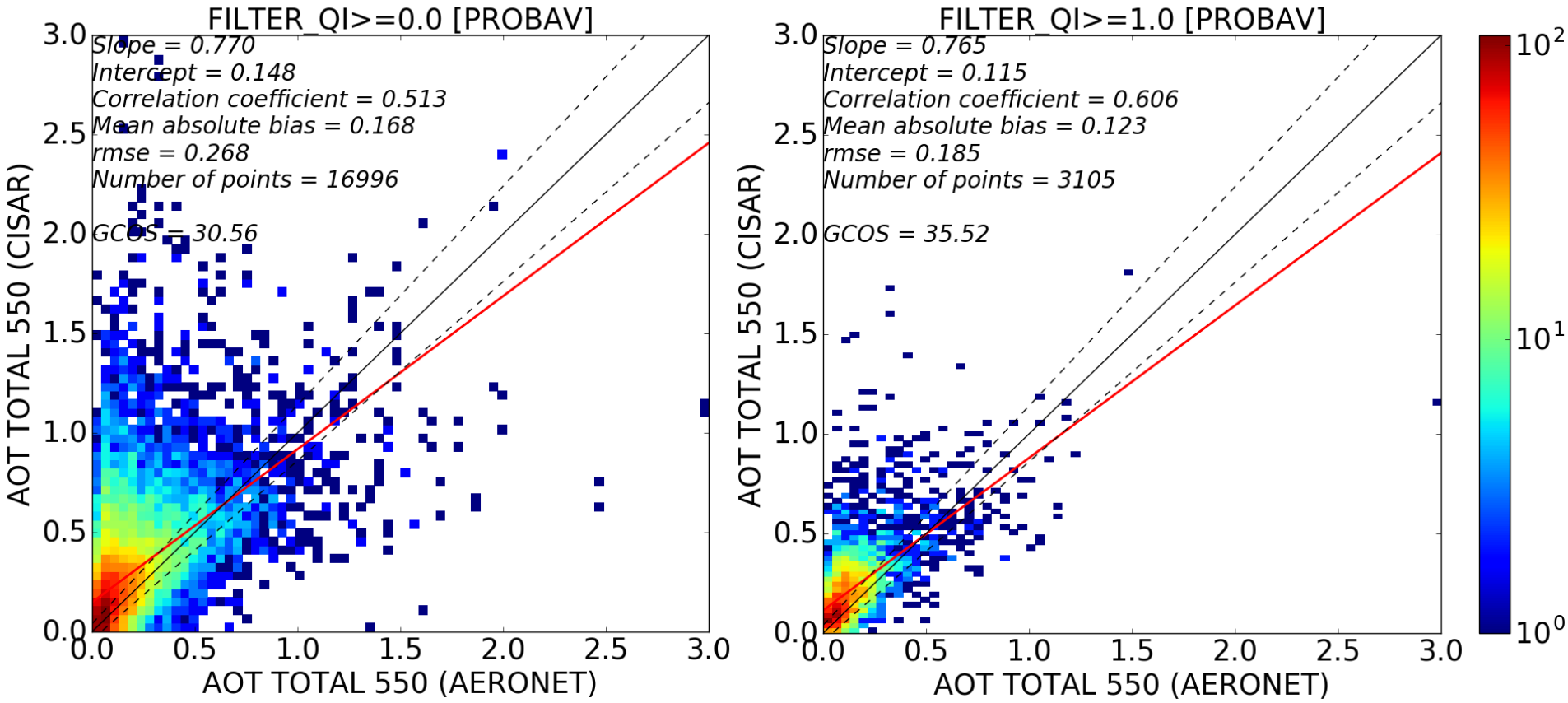
$$rel\_bias = \frac{brf\_output - brf\_input}{brf\_input}$$

Simulations:

- Principal plane
- Dark surface
- Instantaneous mode

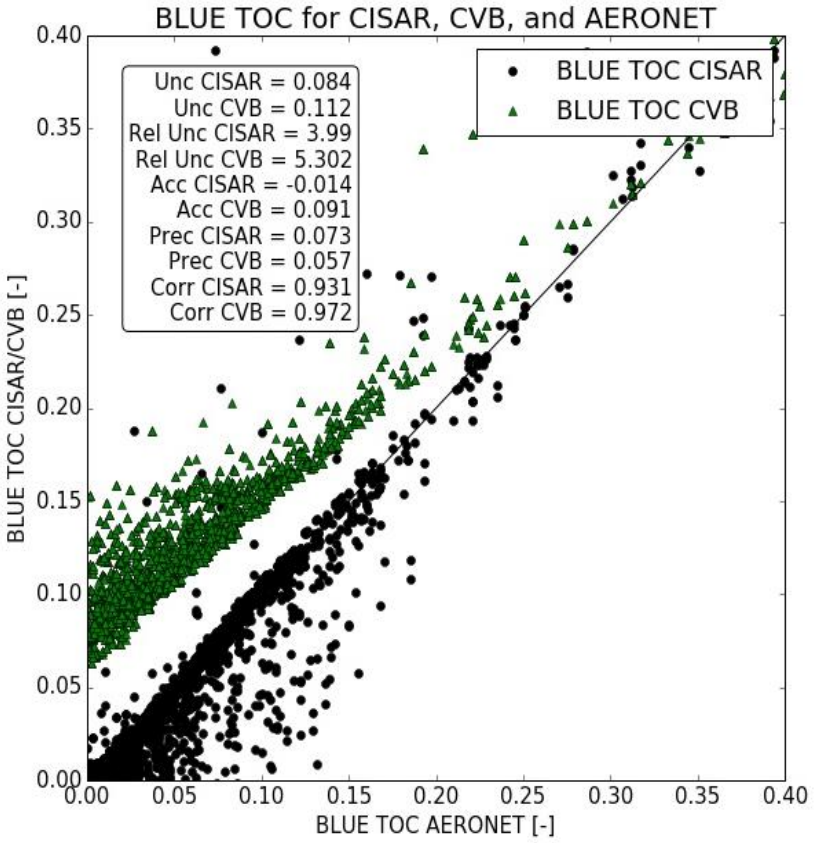
4.1 QUALITY INDICATOR: RELATIVE BIAS

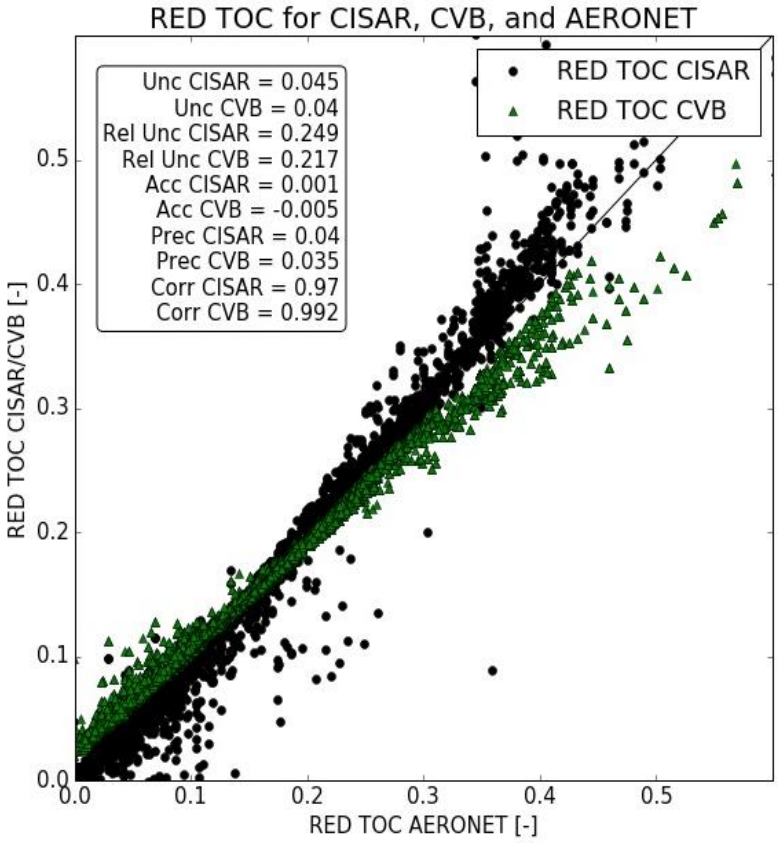
ALL STATIONS



5. PRELIMINARY VALIDATION AGAINST CURRENT PROCESSING

TOC reflectances calculated using SMAC, but with different AOT inputs: black dots denote CISAR AOT, green triangles denote the CVB AOT.





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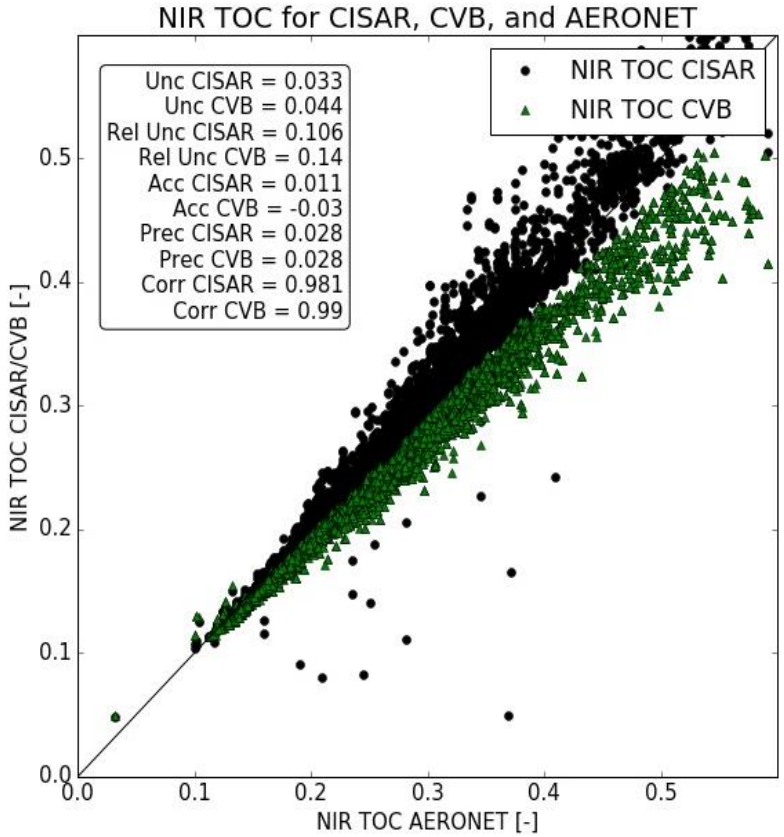

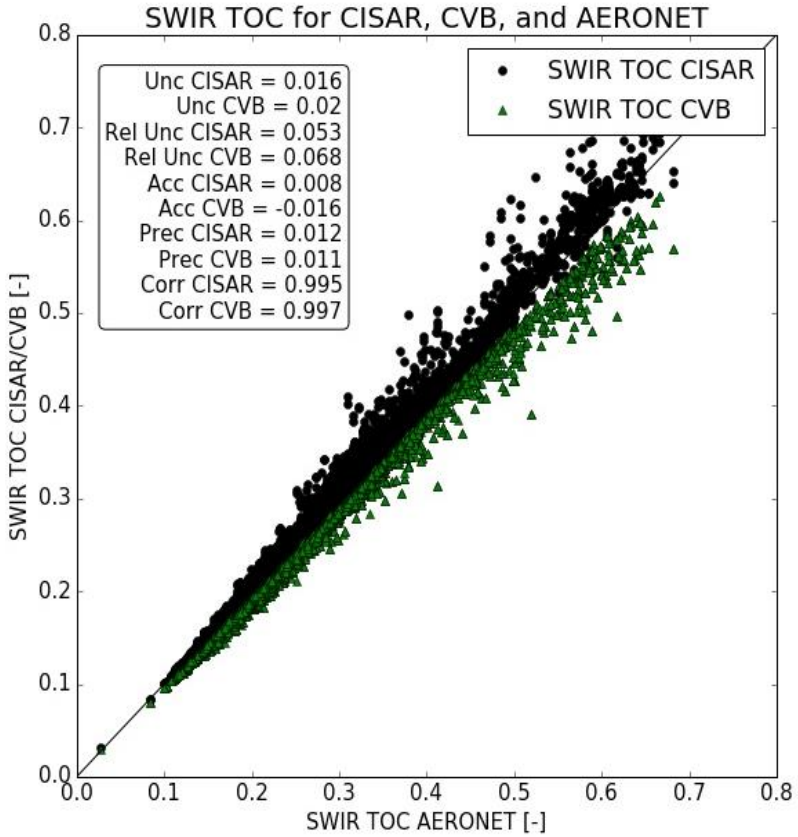

6. NEXT STEPS

- Include better definition of radiometric uncertainty.
- Improve the definition of the sigma of the surface spectral constraints. This might be done dynamically, with a smaller uncertainty on vegetated targets .
- Test the impact of the layer height climatology from Stephan Kinne (already implemented and ready to be tested)
- Implement climatology on aerosol type (again from Stephan Kinne)
- Finalise quality indicator

7. CONCLUSIONS

- The implementation of the spectral constraints improves the retrieval. It also reduces the number of iteration on vegetated targets.
- A new quality indicator is under development, accounting for parameters such as the residual, the Jacobian and the uncertainty reduction.
- The validation will have to be performed only on good quality data.
- TOC reflectance calculated with SMAC using CISAR AOT retrieval as input show better agreement with TOC reflectance calculated from AERONET compared to the TOC reflectance calculating considering the CVB AOT as input.