

Uncertainties of 3MI's polarimetric measurements over inhomogeneous cloud scenes

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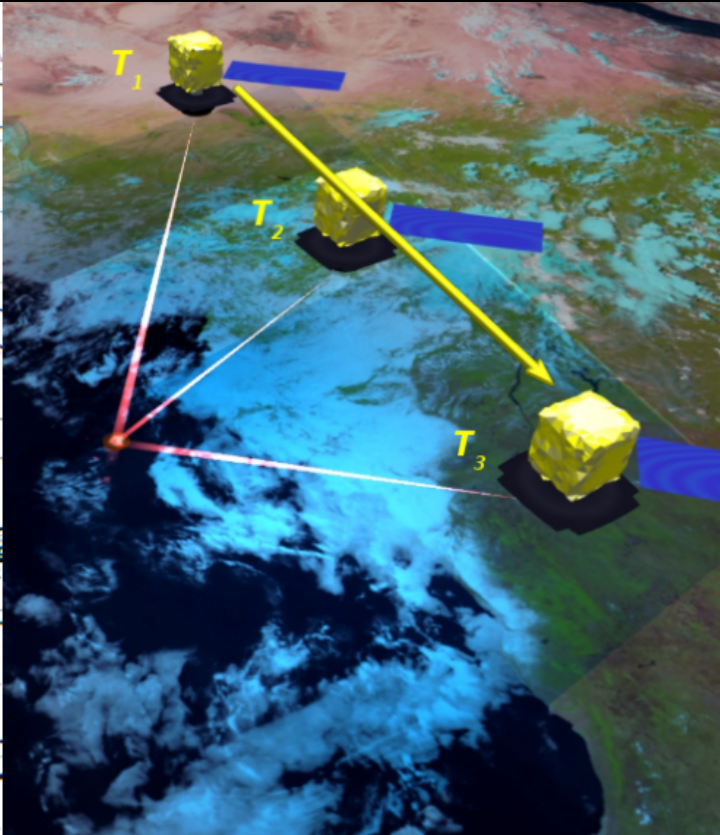
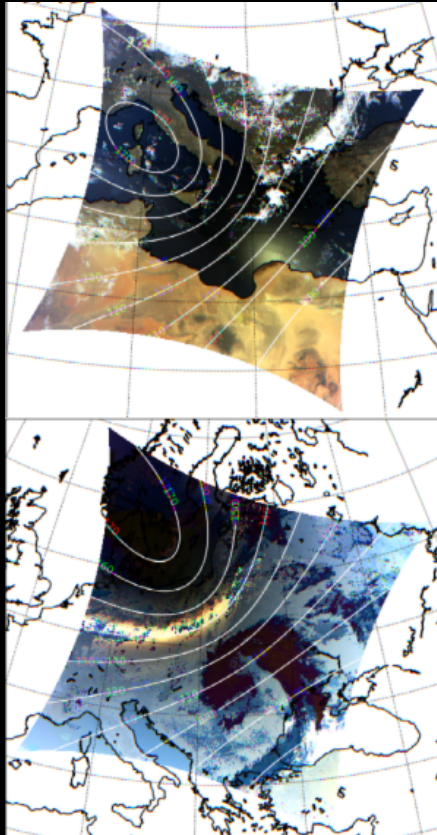
Université de Lille

6 November 2019



The 3MI sensor

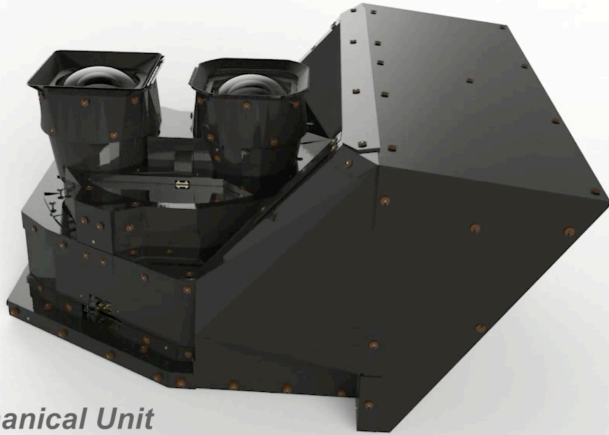
The **3MI** mission
for operational monitoring
of aerosols from EPS-SG



- A wide field of view radiometric imager based on POLDER / MODIS heritage
- Currently under implementation phase by ESA/EUMETSAT
- Will be Launched on METOP-SG, expected in 2022-2023

A wide field of view radiometric imager

 LEONARDO



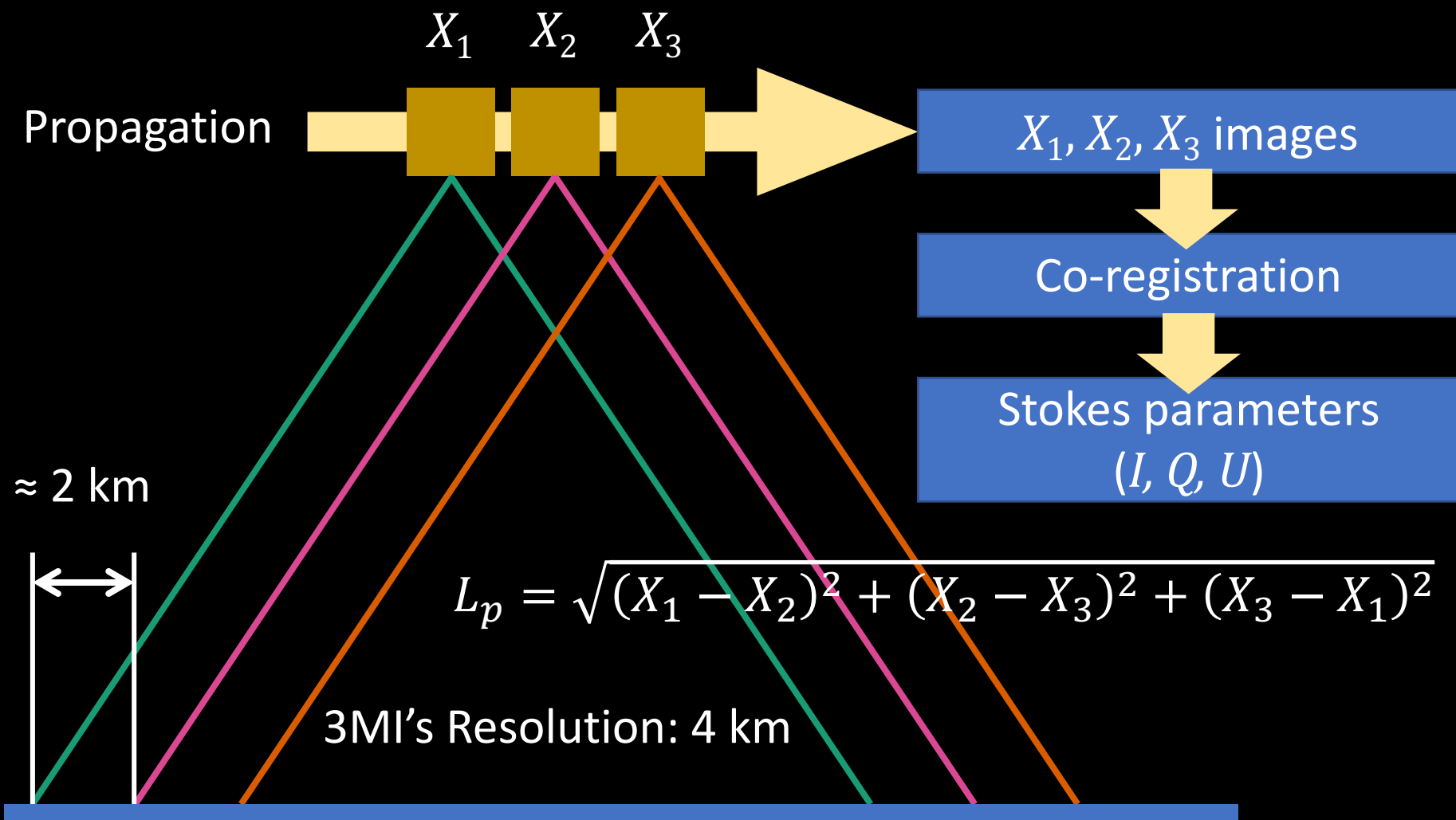
3MI Opto-Mechanical Unit



Filters Wheel Assembly

More at <http://www-loa.univ-lille1.fr/observations/spatiales.html?p=3MI>

(X_1, X_2, X_3) to (I, Q, U)



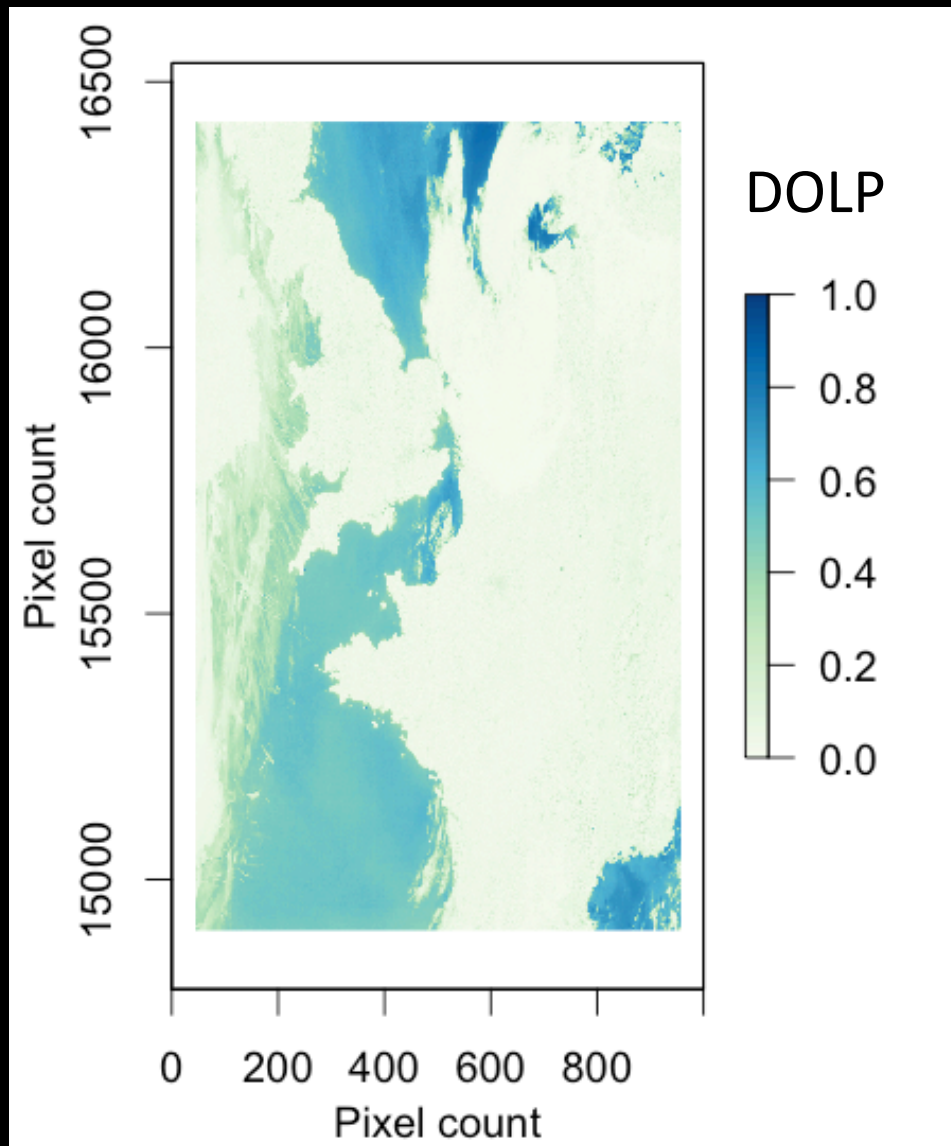
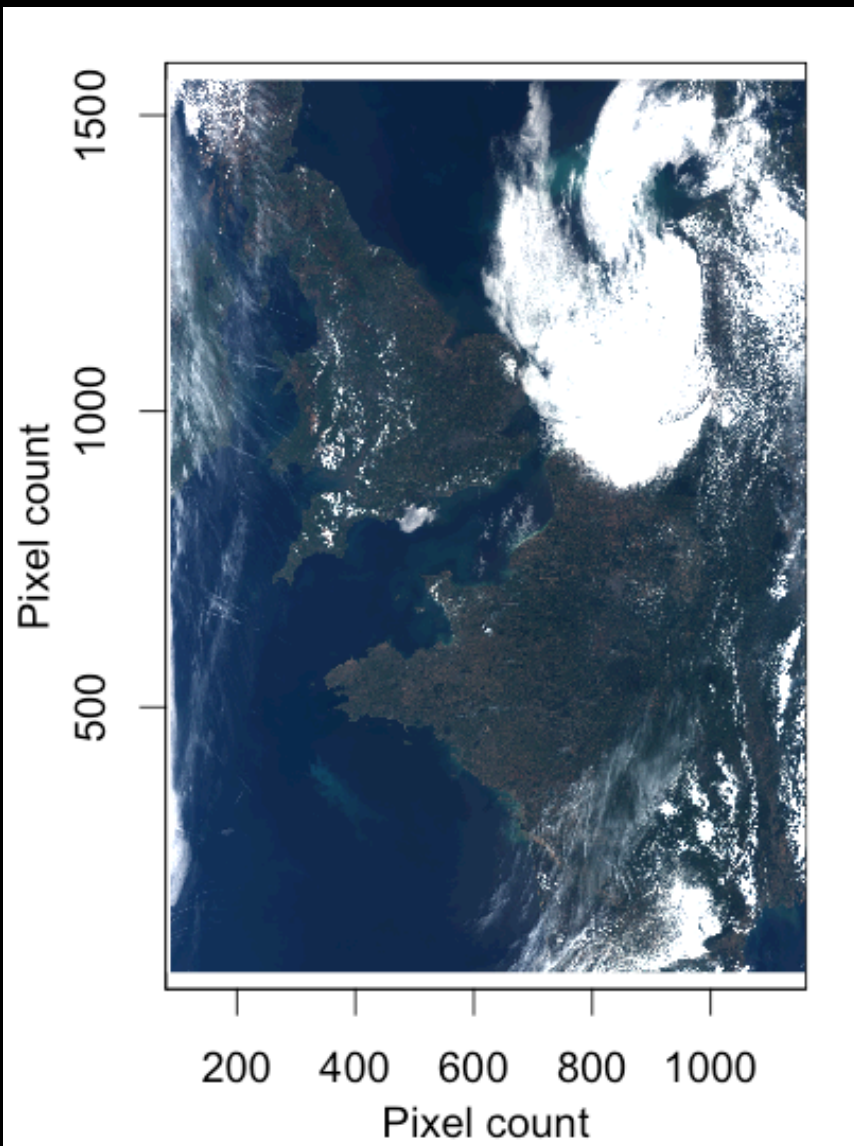
Objectives of the study

1. Evaluate the realistic magnitude of errors that are introduced by the co-registration (interpolation)
2. Find the measure of the anticipated error to predict the magnitude of errors

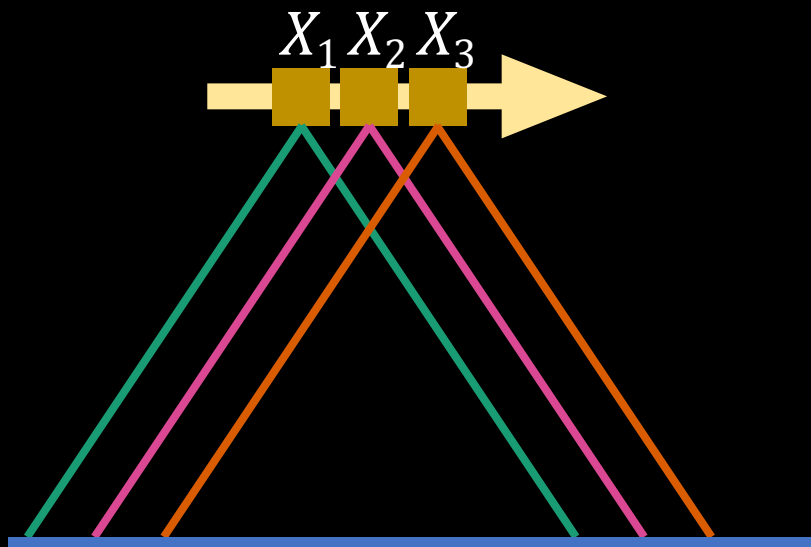
Spaceborne cloud polarimeter at higher resolution than 4 km
→ SGLI

Model based on the distribution theory in statistics

SGLI images: Color composit and DOLP



3MI Proxy Data



SGLI X_1 , X_2 , X_3 images

Interpolation

Co-registered
 X_1 , X_2 , X_3 images

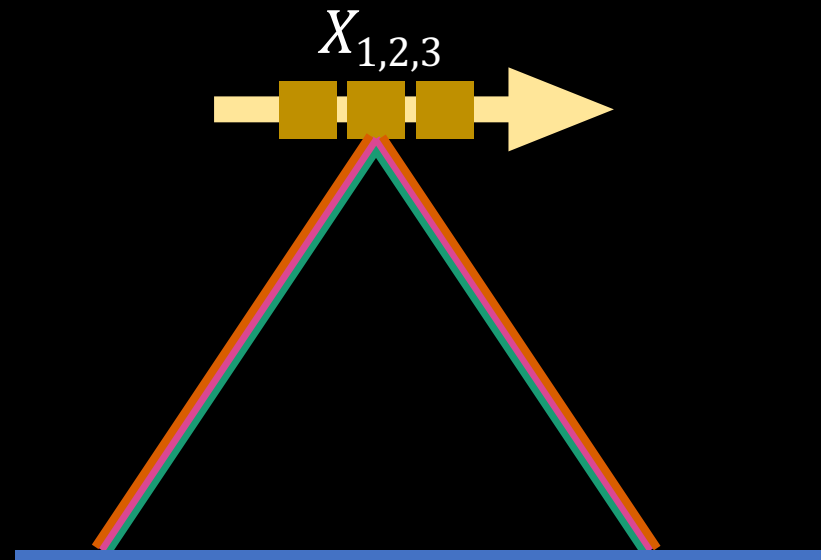
Stokes parameters
(I , Q , U)

@ 1 km
0.865 μm

@ 4 km

Compare

Reference Data

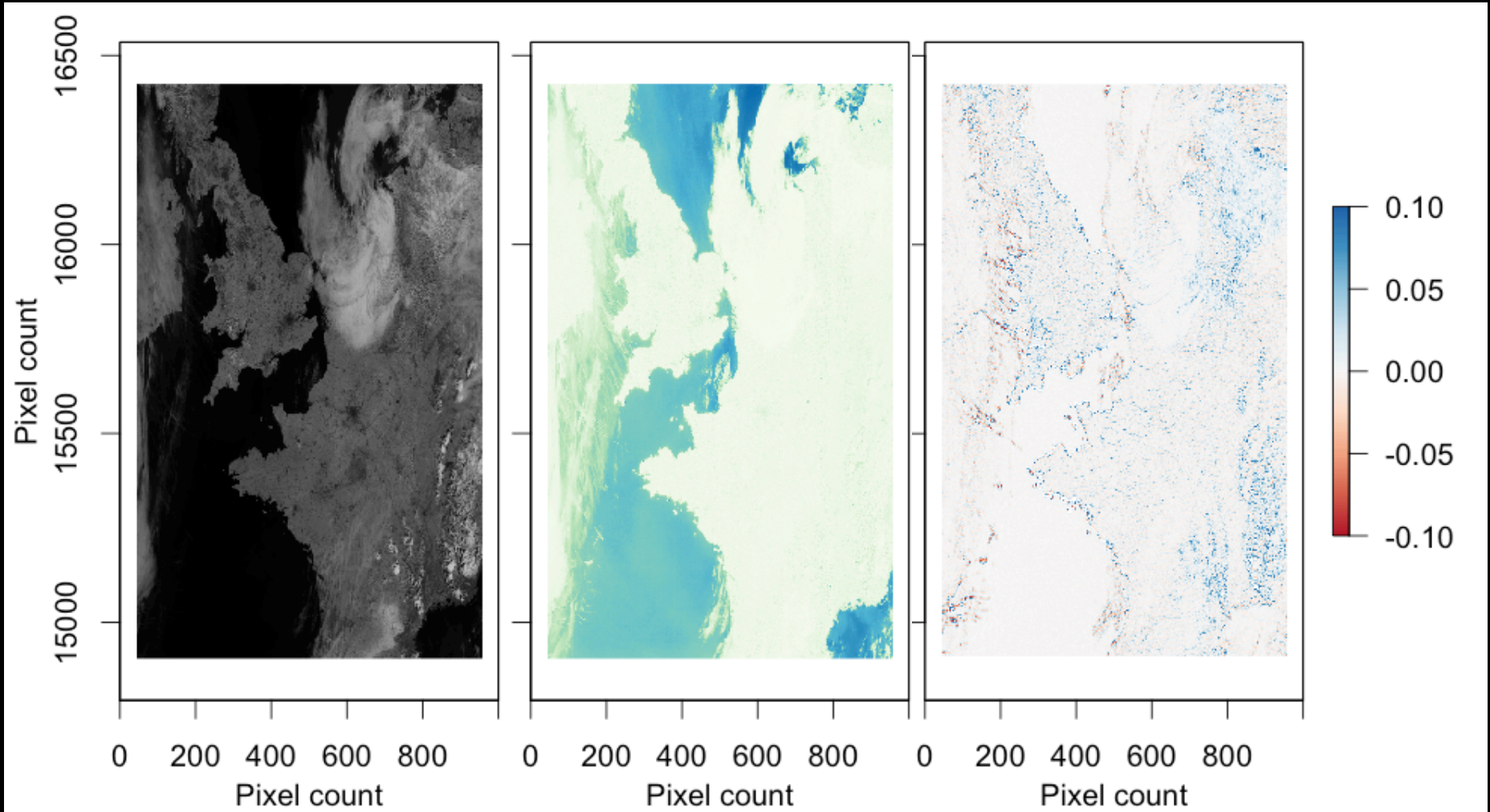


SGLI X_1 , X_2 , X_3 images

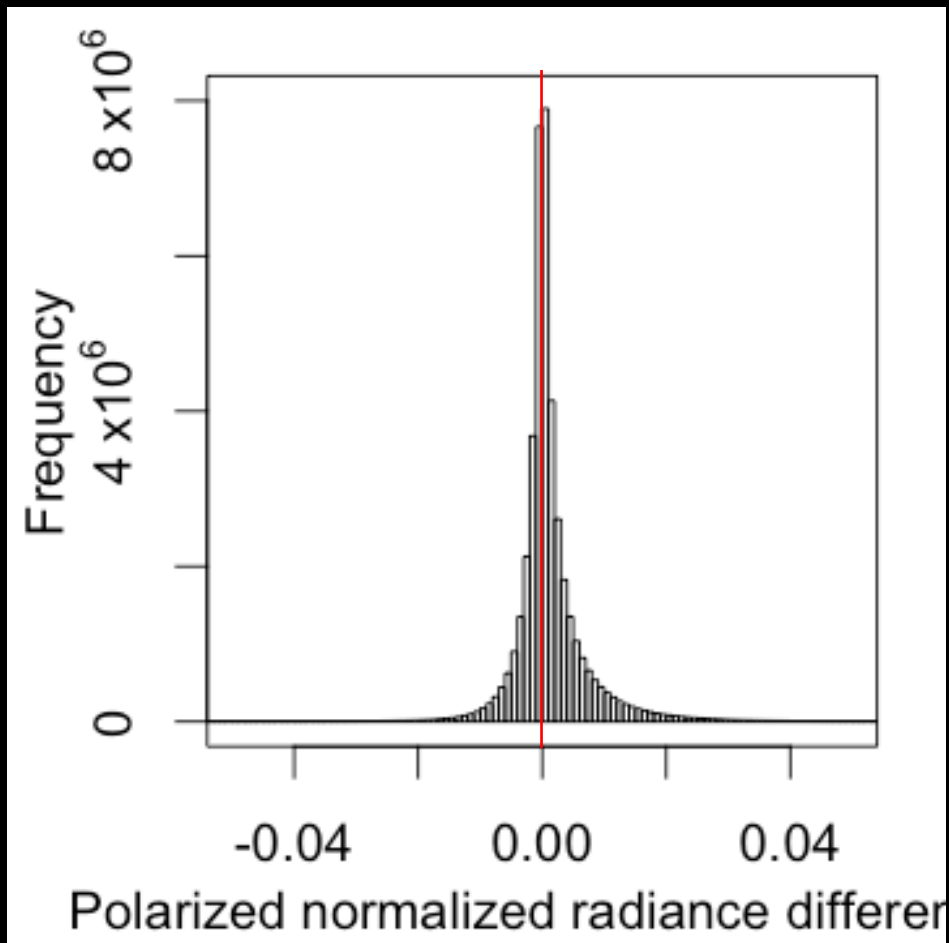
Co-registered
 X_1 , X_2 , X_3 images

Stokes parameters
(I , Q , U)

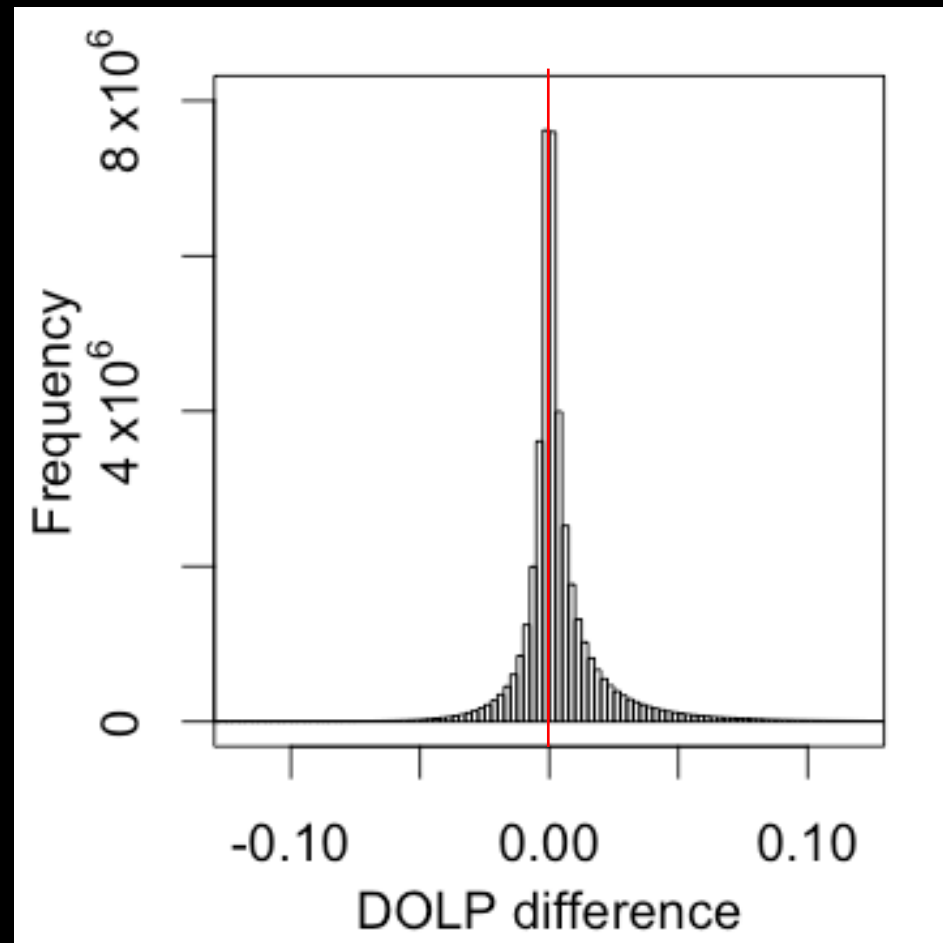
Intensity, DOLP, and Δ DOLP



Proxy - Reference

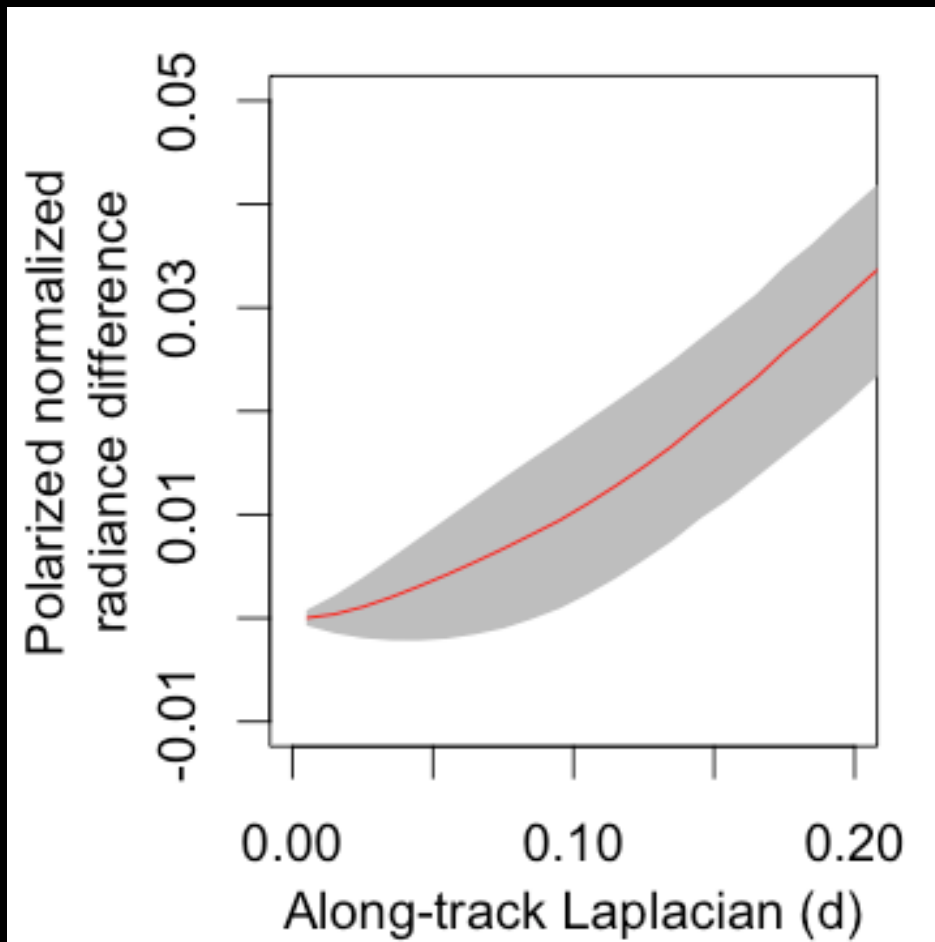


ΔL_p

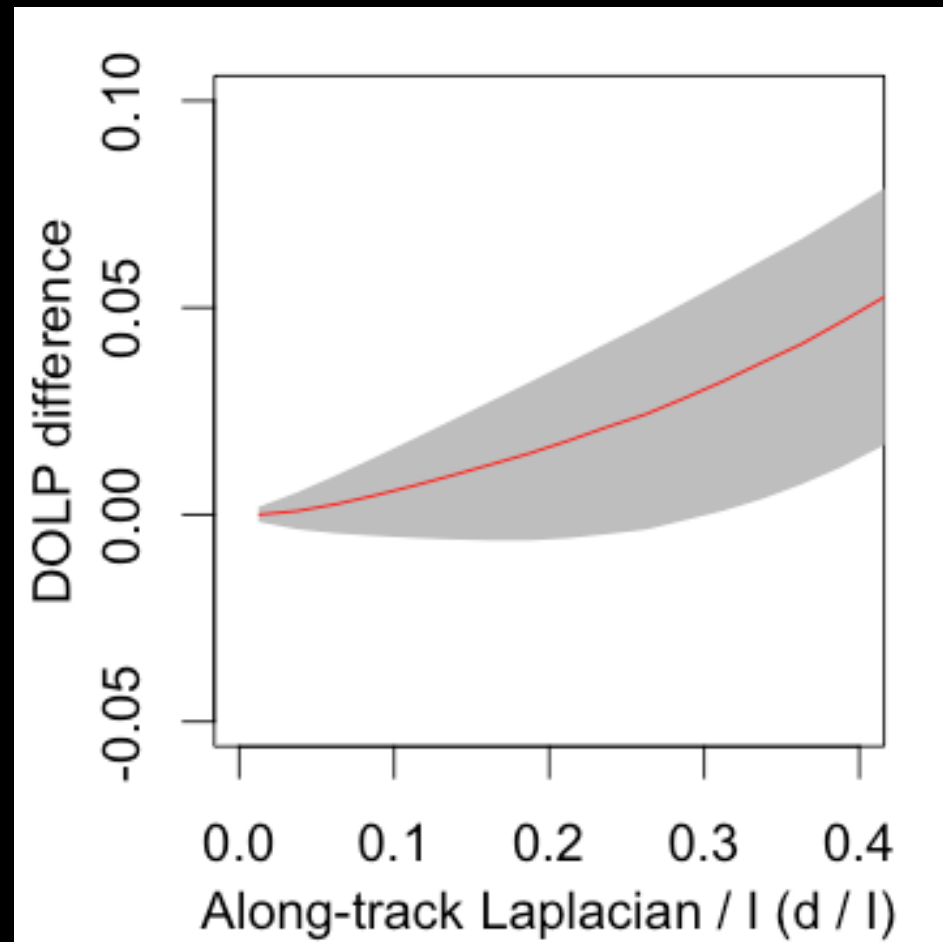


$\Delta DOLP$

Proxy – Reference (Along-track Laplacian)



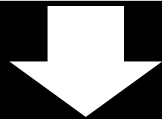
$$\Delta L_p$$



$$\Delta DOLP$$

Simulation of the errors

Random number generator

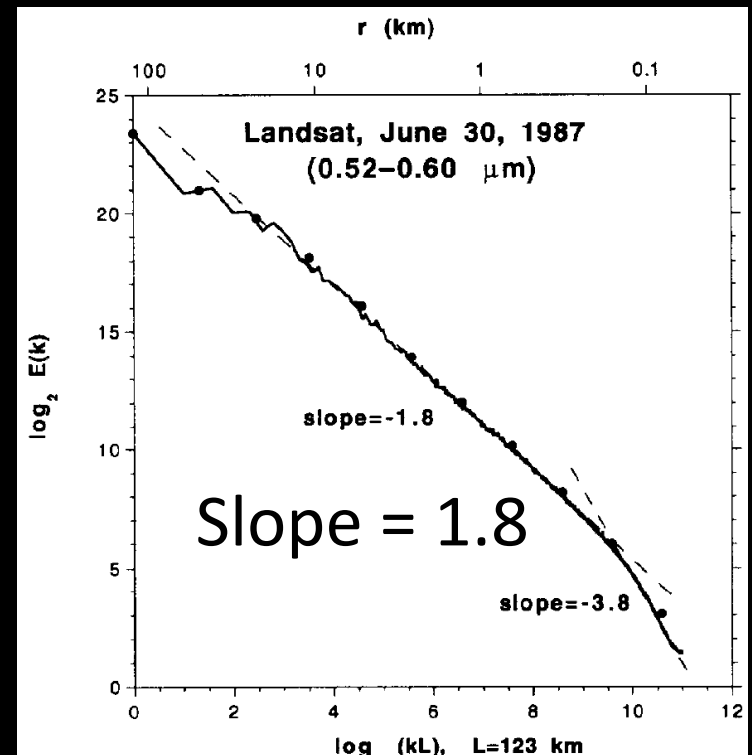


Distribution theory from
the interpolation formulae



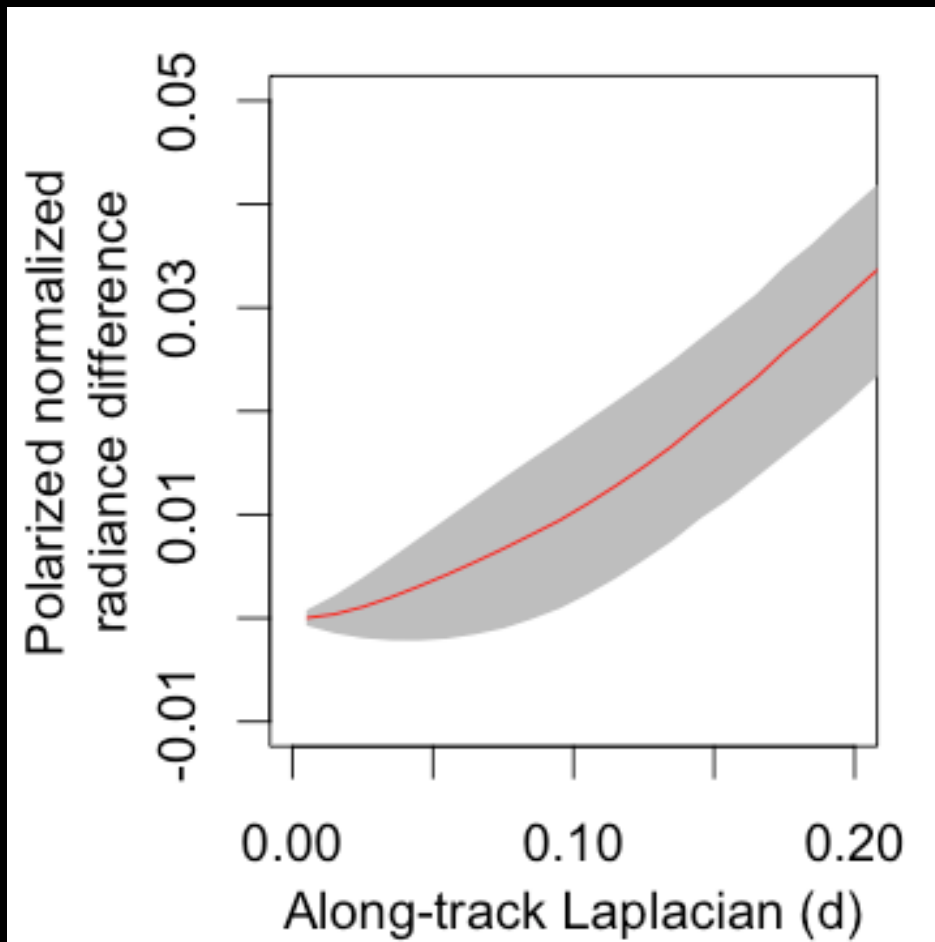
Error estimation

← Correlation On/Off

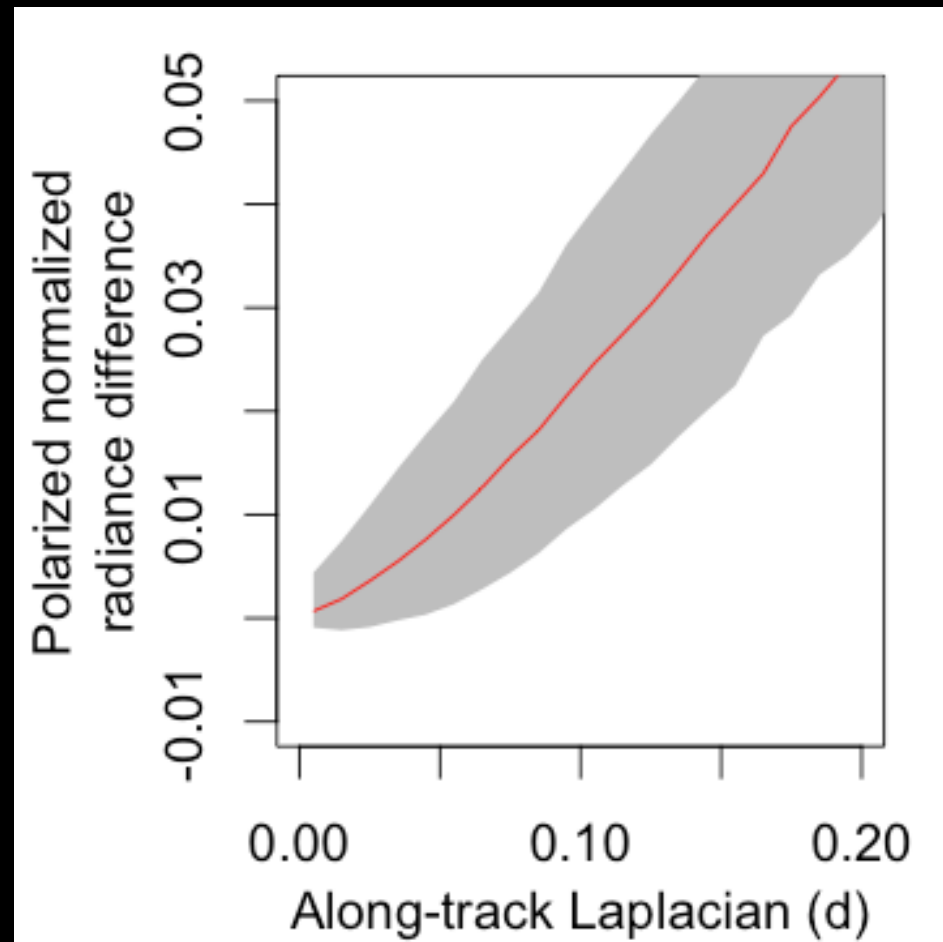


Marshark et al., 1995

Proxy – Reference (Uncorrelated)

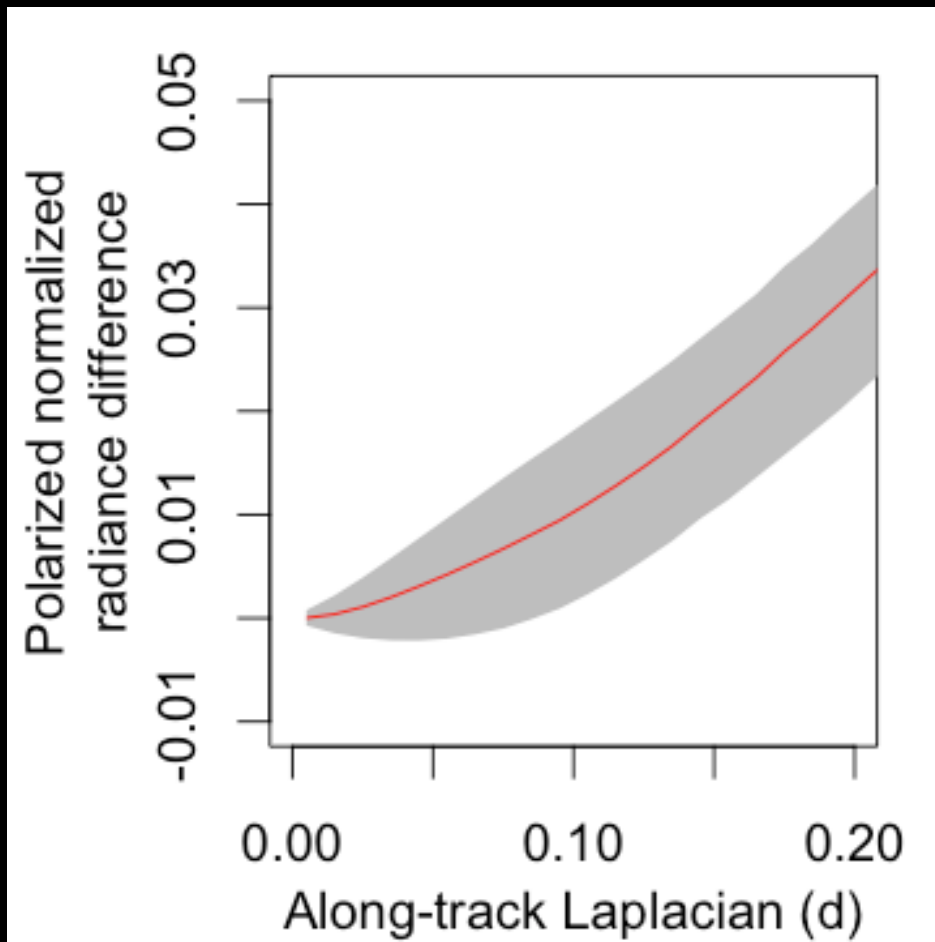


ΔL_p Proxy-Reference

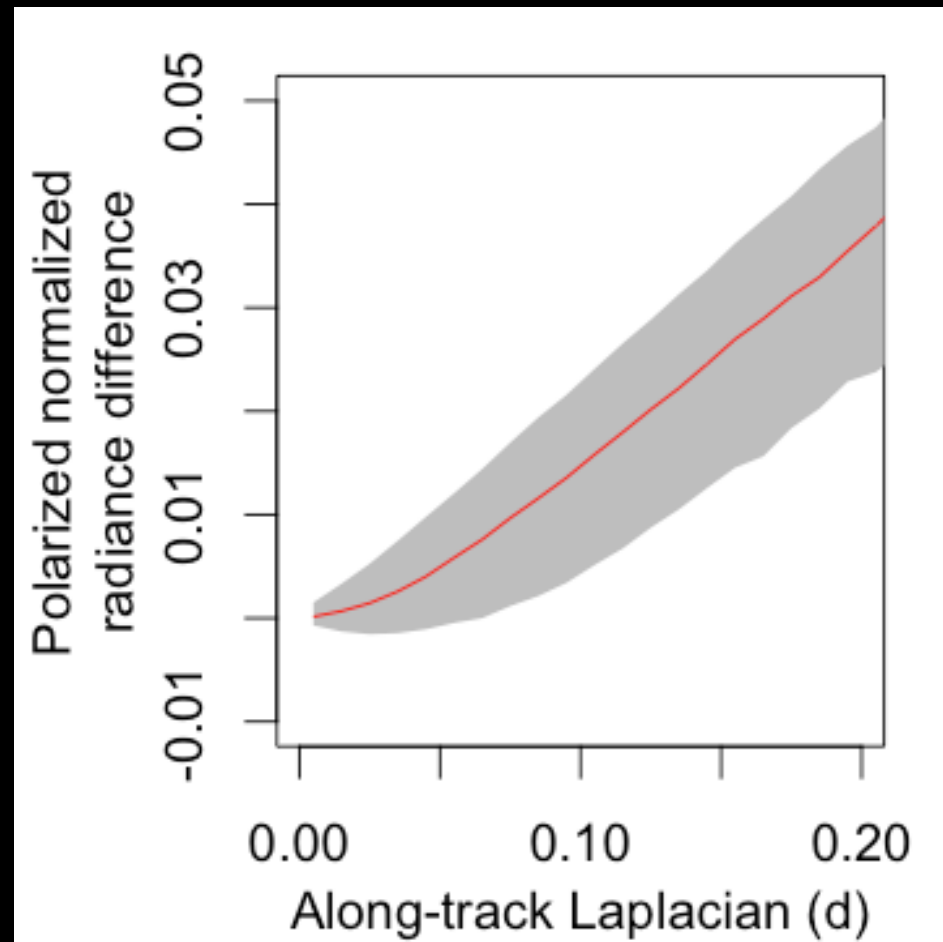


ΔL_p Simulation

Proxy – Reference (Correlated)



ΔL_p Proxy-Reference



ΔL_p Simulation

Conclusions

- Over clouds, the magnitude of the errors introduced by the interpolation is $|\Delta L_p| < 0.015$ or $|\Delta DOLP| < 0.05$
- The distribution of ΔL_p and $\Delta DOLP$ are skewed to the right
- The magnitude of the errors are predictable with the statistical theory, particularly with the spatial correlation
- These results are helpful to provide quality information for every pixel in 3MI Level 1B product