

RSP UNCERTAINTY MODEL

1. REFLECTANCE UNCERTAINTY MODEL

Uncertainty due to noise:

$$(1) \quad \sigma_{R_I}^2(noise) = \left(\frac{r^2 \sigma'_{floor}}{\mu_s} \right)^2 + \frac{a' R_I r^2}{2\mu_s}$$

Uncertainty due to calibration:

$$(2) \quad \sigma_{R_I}^2(calibration) = \frac{\sigma_{lnK}^2}{16} R_P^2 + \sigma_{\alpha_c}^2 R_I^2$$

Total uncertainty:

$$(3) \quad \sigma_{R_I}^2 = \left(\frac{r^2 \sigma'_{floor}}{\mu_s} \right)^2 + \frac{a' R_I r^2}{2\mu_s} + \frac{\sigma_{lnK}^2}{16} R_P^2 + \sigma_{\alpha_c}^2 R_I^2$$

2. DEGREE OF LINEAR POLARIZATION (DoLP) UNCERTAINTY MODEL

Uncertainty due to noise:

$$(4) \quad \sigma_{DoLP}^2(noise) = 4 \left(1 + \frac{DoLP^2}{2} \right) \left(\frac{r^2 \sigma'_{floor}}{\mu_s R_I} \right)^2 + 2 \left(1 - \frac{DoLP^2}{2} \right) \frac{a' r^2}{\mu_s R_I}$$

Uncertainty due to calibration:

$$(5) \quad \sigma_{DoLP}^2(calibration) = \frac{\sigma_{lnK}^2}{2} \left[1 - DoLP^2 + \frac{DoLP^4}{2} (1 - 0.5 \sin^2 4\chi) \right] + \sigma_{ln\alpha}^2 DoLP^2$$

Total uncertainty:

$$(6) \quad \sigma_{DoLP}^2 = 4 \left(1 + \frac{DoLP^2}{2} \right) \left(\frac{r^2 \sigma'_{floor}}{\mu_s R_I} \right)^2 + 2 \left(1 - \frac{DoLP^2}{2} \right) \frac{a' r^2}{\mu_s R_I} \\ + \frac{\sigma_{lnK}^2}{2} \left[1 - DoLP^2 + \frac{DoLP^4}{2} (1 - 0.5 \sin^2 4\chi) \right] + \sigma_{ln\alpha}^2 DoLP^2$$

3. DEFINITIONS AND UNITS

Parameter	Value	Description
r	1.0	Solar distance, in astronomical units (AU)
σ'_{floor}	see table	Detector noise floor, with scaling for normalized radiance
μ_s	$\cos 45^\circ$	Cosine of the Solar Zenith Angle
a'	see table	Shot noise parameter, with scaling for normalized radiance
R_I	varies	Intensity reflectance
σ_{lnK}	0.0005	Relative gain coefficient characterization uncertainty
R_P	varies	Polarized reflectance
σ_{α_c}	0.03	Absolute radiometric characterization uncertainty
$DoLP$	0.15, 0.3	Degree of Linear Polarization, $DoLP = R_P R_I$
$\sigma_{ln\alpha}$	0.001	Polarimetric characterization uncertainty

Table of spectrally defined parameters

Wavelength (nm)	410	470	555	670	865	960	1590	1880	2260
$\sigma'_{floor} (\times 10^{-5})$	3.2	2.5	2.4	2.2	2.0	2.1	1.8	1.8	1.9
$a' (\times 10^{-9})$	23	12	4.5	3.7	3.7	6.8	18	6.6	8.2

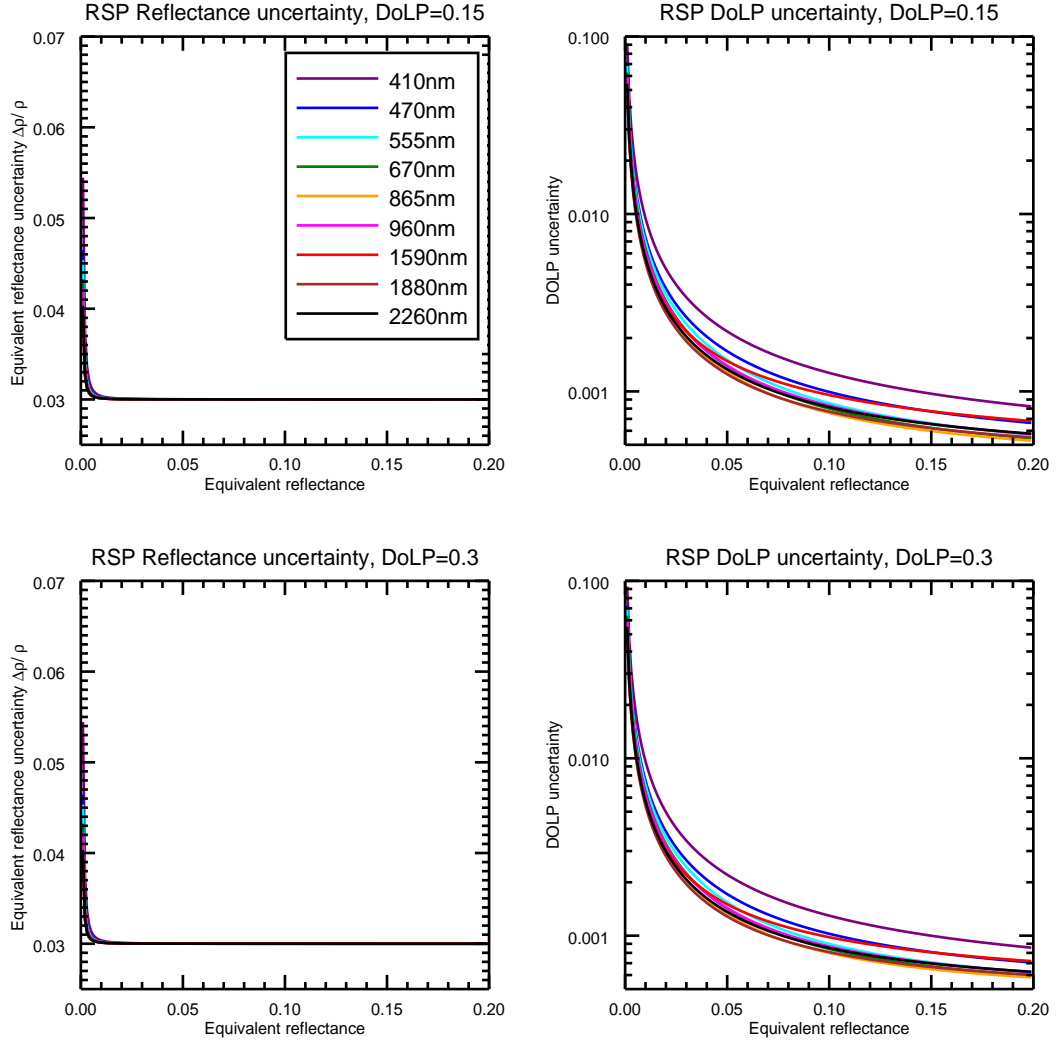


FIGURE 1. Simulated σ_{DOLP} and σ_{R_I} , assuming $\mu_s = \cos(45^\circ)$, $r = 1$.

4. SIMULATION