



# ESA Sentinel-2 Radiometric Uncertainty Tool

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## Level 1

### Key points:

- ◆ Uses a model of the instrument and processing chain to obtain uncertainty estimates.
- ◆ Provides the level 1C radiometric uncertainty per pixel and associated metadata.
- ◆ Reduces the amount of data that needs to be transmitted to Sentinel-2 users.

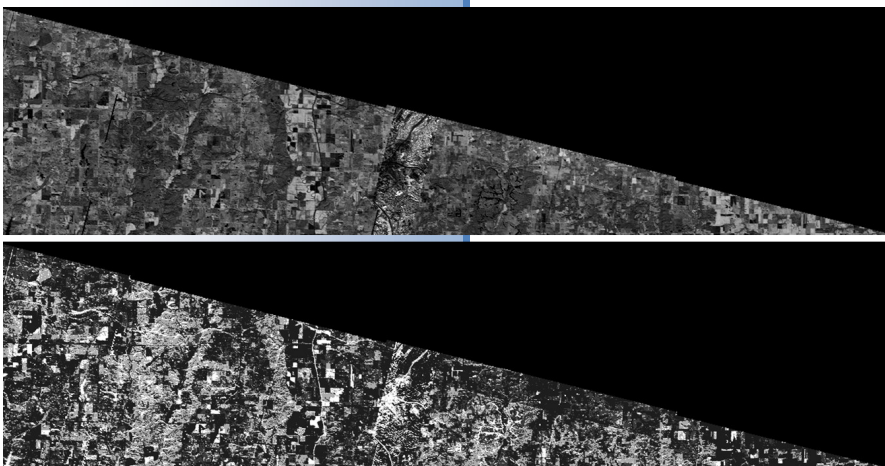
## Executive summary

The ESA Sentinel-2 Radiometric Uncertainty Tool (S2-RUT) was developed in order to document and characterise the radiometric uncertainty of Sentinel-2 level 1C products (top-of-atmosphere (TOA) orthorectified radiance/reflectance). The purpose of this is to allow Sentinel-2 data users to obtain radiometric uncertainty estimates (per pixel) retrospectively, thereby reducing the amount of data transmitted to the user.

To ensure traceability of the final product, knowledge of both the instrument calibration, characterisation and the full processing

model uses best practice methodologies set out in the Guide to the expression of Uncertainty in Measurement (GUM) and QA4EO guidelines. For each of the steps, the main uncertainty contributions have been estimated. A final value per pixel is provided as the combination of all the uncertainty sources.

The prototype tool has been designed for the data processors and data users alike. The tool is flexible and can be configured to incorporate different levels of uncertainty (if new information is made available). Another issue with per-pixel uncertainty estimates is the volume of data produced. The S2-RUT allows this to be reduced through processing of specific bands. In addition, future improvements, such as consideration of the location of the pixel in the sensors field-of-view (by incorporating the effect of the resampling), have been suggested for the next iteration.



**Figure 1.** Sentinel-2 level 1C reflectance product derived from synthetic data. Top shows band 9 reflectance, the bottom shows the resultant uncertainty image.

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chain are required to provide a final, cumulative uncertainty.

In recent years there has been a move away from global uncertainty estimates; users now require per-pixel uncertainty values. The S2-RUT provides this through modelling of the instrument and processing chain. The