# Reply to the interactive comment by Anonymous Referee #2

Grey: Original reviewer comment.
Black: Reply.
Quotation marks: Text from manuscript.
Red: Changed text in manuscript.

The publication introduces several relevant improvements in the parameterisation process of the ISRF. The methodology for parameterising changes to the ISRF and the interaction with wavelength calibration are quite relevant, as previous missions suggest significant in-orbit changes of the ISRF over the mission (e.g. the article reference for "Azam, F., and Richter, A."). Also the paper provides various interesting possibilities for optimising ISRF parameterisation computational performance.
After having read the article I was wondering whether the super-Gaussian definition could be extended in a systematic way with additional terms for improving the accuracy of the ISRF in describing a measured response: stimuli such as tunable lasers enable very accurate measurements of the ISRF shape with high spectral resolution during on-ground calibration and potentially also during in-flight calibration. These high accuracy measurements are typically driven by demanding mission requirements on ISRF accuracy. For example for OMI/TROPOMI target accuracies for the parameterised ISRF were defined that require the parameterisation fit error to be within 1% of amplitude value within a spectral range covering 2-3 times FWHM. With such target accuracies, small asymmetries in the measured peak and wings of the ISRF then might lead to out-of-range fit errors when limiting the number of shape fit parameters to 4 as discussed for the asymmetric Gaussian. Adding additional shape parameters improves the accuracy. The challenge would then probably be to find additional shape parameters that have low correlation to the existing super-Gaussian parameters, and that would fit within the presented approach for describing changes..

**Reply**: We thank the reviewer for his/her positive feedback and proposals.
As, for some instruments, the addition of the shape parameter *k* in the Super Gaussian improved the parameterizations substantially (compared to a classical Gaussian), it would indeed be great to find a further extension by an additional parameter. However, we could not think of a single parameter (with low correlation to *w* and *k*) adding a new family of shapes to the Super Gaussian.
In addition, the stability of the ISRF fit during spectral calibration is quite sensitive to the number of parameters. Thus, we leave further modifications/extensions (perhaps tailored for specific instruments) to future studies.

If an analytical description of the ISRF does not meet accuracy requirements, and high-quality ISRF prelaunch measurements are available, an alternative approach might be to apply some tuning parameters (widening, sharpening) to the a-priori ISRF within the fit (e.g. Sun et al., AMTD, 2016). The formalism given in section 2.2. might be directly applied to such an empirical ISRF approach as well.

In the manuscript, we have modified the last paragraph of section 2.2 accordingly:

"In this section, the impact of ISRF changes is derived generally for any parameterization *P*. The SG *S*, however, is particularly suited for this approach due to the limited number of parameters, i.e. PAs, and the tangible meaning of the parameters *w* (width) and *k* (shape), and optionally $a_w$ (asymmetry).
The same would hold for a parameterization based on a measured ISRF tuned by e.g. widening or sharpening parameters as in Sun et al. (2016), which might be preferable if high-quality pre-launch measurements of the ISRF of satellite instruments are available and analytical parameterizations do not meet accuracy requirements."