

I. RESPONSE TO REVIEWER 2

RC2: 'Comment on angeo-2023-30', Anonymous Referee #2, 16 Nov 2023 The authors explore future multipoint techniques for constellation missions to estimate gradients of physical quantities. The analytical theory is well developed and comprehensive. I only have minor comments on the text as presented. The manuscript, however, contains no figures which this reviewer feels would greatly aid interpretation by readers who are less mathematical in their thinking and more visual. A few simple diagrams demonstrating the concepts and findings would greatly complement the existing text. If some figures are added and the minor points below are addressed, I would recommend publication.

Reply: We thank the reviewer for this suggestion. Diagrams will be provided to aid the reading by a wide audience.

Line 30: Change "of reconnections" to "in reconnection"

Reply: to be corrected

Lines 31-32: This states the reconstruction avoids assumptions, however, the underlying assumptions about the forms of gradients are omitted, e.g. that they are relatively consistent over the scales of the spacecraft separation.

Reply: Yes. This can be viewed as an assumption, as suggested the reviewer, for the method to successfully estimate the presupposed gradients of some physical field. It may also be viewed as a result of the method, for the method always estimates gradients over the spacecraft separation.

Lines 56-59: It would be good to explicitly mention that in practical applications measurements include noise which may then affect estimates of gradients.

Reply: Thanks. Errors of various origins will be mentioned explicitly here.

Line 70: change to "dipole (and higher-order moments)"

Reply: to be corrected

Lines 71-72: The magnetosheath is highly non-uniform over the scale of its thickness, so please be specific over what sorts of distances you are referring to.

Reply: The distinction and hence categorization between uniformity and variation are in principle artificial. In the text we were referring to the 100-200 MK background in the subsolar magnetosheath (See, e.g. Figs 2-6 of Dimmock et al. 2015 doi.org/10.1002/2014JA020734). Admittedly, the magnetosheath is highly turbulent, especially downstream of quasi-parallel shocks. Since the example of magnetosheath is not crucial for the present study, to make things simple we will remove this part.

Line 74: Are the wave fields really waves or just residuals? You mention they must have smaller scales, referring to their physical size, but do they not also need to have smaller amplitude fluctuations?

Reply: They are real waves whose amplitude can be large as compared with the variation of background field at the scale of spacecraft separation. If large-amplitude waves are retained during the estimation of gradients, the error caused by them could overwhelm the result. The estimation of the associated error is contained in Eq. 31. More discussion about waves will be added. One possible approach is to filter them before the estimation of gradients.

Line 77: It would be good to mention if the speed v needs to be chosen to be the same for all measurement points or if it can be allowed to vary.

Reply: Thanks. It will be mentioned that v is a constant to make figures in the matrix R (Eq. 12) of similar magnitude.

Line 80 (and throughout): "A" needs to change to "Appendix A"

Reply: to be corrected

Line 147: "a algebraic" change to "an algebraic"

Reply: will be corrected

Lines 197-203: This is almost identical to the previous paragraph, remove.

Reply: to be corrected
