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Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "*Est modus in rebus*: analytical properties of multi-model ensembles" *by* S. Potempski and S. Galmarini

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First of all let us thank you very much for having carefully read out paper and for your excellent comments which could lead us easily to a very long and interesting discussion. We will answer here point by point your remarks.

**First remark**

The Maximum Entropy Principle (MEP) can be formulated as follows: "Among the pdf with known means and variances the normal distribution has maximum entropy." From the perspective of information theory the in principle says that "optimal" pdfs are Gaussian. In the paper our starting point is the minimization of the mean square error and MEP is not a pre-requirement, hence explicitly we assume we do not know the pdf.



As you say correctly: '. . . the knowledge of mean and variance (+ the maximum entropy principle) implies a Gaussian distribution, and they are the sufficient statistics for this kind of function'. We have only an editorial but, according to us, crucial objection to this statement: what you put in brackets should be written explicitly and not in passing as one of the necessary conditions that lead to the Gaussian distribution. We could include this principle should the knowledge of the pdf be strictly necessary to our analysis.

**Second remark**

We will take into account this remark in the final version of the paper to make the text clearer to the readers. Thank you for pointing us out a more agile organization of the text and of our argumentation of that concept.

**Third remark**

In this context, your interpretation is correct, that the uncertainty does not necessarily relates to wrong results but to yet new and different states of the system reproduced by the model. The penalization is based on the variance (or covariance in more general case), which can also stand as a measure of uncertainty. Thus the models which predicted larger number of different states is more penalized than the ones which predicted less, as in principle, the uncertainties of their results are larger. We agree with your elegant mathematical formulation. The remark on the Ockham's razor is very appropriate. Our search for the optimal organization of the information provided by different sources of model results is in compliance with the Ockham principles: *Pluralitas non est ponenda sine necessitate.* ('If not necessary do not consider multiple conditions') and *Frustra fit per plura quod fieri potest per pauciora* ('There is no need to do with many what can be done with few'). Similarly the necessity of investigating the minimum number of members and the effect on an ensemble of substracting one or more members fits very well with this other formulation of the principle: 'Do not multiply elements beyond necessity' (*Entia non sunt multiplicanda praeter necessitatem*). As

for the Ockham's razor principle according to us it is just a complementary expression of the sentence of Horace that we quote in the introduction. If you think about it, Horace says there is nothing beyond the optimal state while Ockham states that removal of unnecessary information leads to optimal condition. The Ockham principle is a good reference in this respect since our argument in the paper is exactly that more research is needed to better use the available information from the models. The principle is violated whenever the information is not optimally organized. The present practice of piling up model results in shear numbers to aim at an improvement of the results is complete against the Ockham principle. Our paper is just a humble attempt to convey among others this message. Thank you again for your stimulating comments.

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Interactive comment on Atmos. Chem. Phys. Discuss., 9, 14263, 2009.