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Atmospheric Measurement Techniques Discussions

Interactive comment on "Exploration of machine learning methods for the classification of infrared limb spectra of polar stratospheric clouds" *by* Rocco Sedona et al.

Anonymous Referee #2

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In their paper, Sedona et al. explore the potential of applying machine learning methods to classify PSC observations of infrared limb sounders. To test their approach they use the Envisat MIPAS data for one Antarctic winter and one Arctic winter. Different ML techniques are tested and they find that all of them are suitable to retrieve information on the composition of PSCs, but that the random forest method seems to be the most promising one.

This is a very interesting study and deserves to be published in AMT. However, I have several major and minor comments that should be considered before publication.

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General comments and questions:
1. A discussion on the previous classical schemes based on the optical properties of PSCs (see Achtert and Tesche, 2014) in comparison to the ML methods is missing.

2. Are ML methods really better? What is the advantage? This needs to be discussed as well.

3. The number of self citations is to high. I know that this study builds on what has been done before, however, there are several occasions (see my specific comments) where other references could be used. It simply does not correct when the entire introduction is based on Spang et al. and Hoepfner et al. citations who are not only co-authors of this study but also not the only scientists working on this topic.

4. What result would you get or could you expect when other winters are considered? Do the ML methods work in the same way for all different kinds of winters (cold or warm, dynamically more or less active)?

5. Why have the two winters presented in this study been chosen?

Specific comments:
P2, L5-8: "……..MIPAS measurements are considered to be of great importance for the study of PSCs……." First of all, I would suggest to rephrase the sentence and to write either "are quite suitable for studying PSCs " or "MIPAS measurements have been used to study PSC processes." Second here the self citations could be avoided or at least decreased. It would be enough to cite the two recent papers by Spang et al. and Höpfner et al. (thus the 2018 papers). Even better would be if you would cite here some papers where MIPAS observations have actually been used to investigate PSCs and related processes as e.g Arnone et al. (2012), Khosrawi et al. (2018), Tritscher et

al. (2019).

P2, L9: "...ice PSCs are generally thicker than NAT and STS (Spang et al., 2016)". This is also something which is documented in the literature and where easily another citation could be picked than Spang et al. (2016).

P2, L13: Also here, there are many more adequate citations in this context available than Spang et al. (2018).

P2, L20: Also here, avoid self citations.

P2, L21ff: Add general references on the ML methods.

P2, L32: What is the motivation for picking these winters? Where these rather warm or cold winters? Where there special dynamical conditions observed during these winters?

P3, L6: Why 14.3 orbits? Usually the number of orbits are given without position after decimal point.

P3, L30-P4, 30: If you follow the approach given in Spang et al. (2016) it would be easier if you would simply state that at the begin of the section instead of reference Spang et al. (2016) after every few sentences.

P4, L4-6: Where do you get these different composition numbers from? Are they based on the MIPAS data or on literature values? This text part is really confusing and should be rephrased.

P9, L8: "It is found that ice and small NAT accuracies are higher than the ones

of STS". Where has this been found? In this study? If yes, be more clear. Otherwise, give the according references.

P9, L21: Also here other references than Spang et al. (2018) could be given here.

P11, Summary and Conclusions: Looking at the figures I would conclude that the results derived are quite different and that is hard to say which one performs best. Thus, I have bit trouble following your reasoning, that all ML methods are suitable for the classification and that the RF performs best.

Technical corrections:
P1, L2: enhance → improve

P1, L9: From the both → From both

P1, L21: repitition of "used". Please rephrase the sentence.

P6, L19: Rearrange sentence as follows: "An interesting characteristic of the RF clasifier is that it can give by calculating the Gini index (Ceriani and Verme, 2012) also a measure of the feature importance"

References:
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