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Atmospheric Chemistry and Physics Discussions

Interactive comment on "One year of ^{222}Rn concentration in the atmospheric surface layer" *by* S. Galmarini

S. Galmarini

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"One year of 222Rn concentration in the atmospheric surface layer" by S. Galmarini Anonymous Referee #2

"First, I find the author's analysis of the relationship between precipitation and surface radon emissions to be unconvincing, particularly the analysis of precipitation events shown in Figure 4. Figure 4 clearly shows that the reduction in peak radon concentrations and the disruption of its diurnal cycle occurred prior to the precipitation event that the author argues is the cause of the observed change in radon. I do not see how radon could be responding to an event that has not yet occurred. In this instance, I think that the wavelet analysis is confusing because the amplitude of the power at longer periodicities rises prior to the precipitation event itself. This cannot mean however, that an

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event can influence the past."

Yes, that is indeed the perception that is given by the figure the way in which it was presented to the reviewer. As a matter of fact the precipitation event does start earlier than the peak as emphasized by the new version of the figure. The wavelet analysis captures also large scales in connection to the whole event and what is more important the peak is recognized as significant. Normally sudden spike would give rise to large scale signals in the scalogram but they would not be considered significant (white contour).

"A second problem with the author's argument is the fact that Table 1 indicates that precipitation and radon are virtually uncorrelated with each other. The paper never explains the lack of a strong correlation. I think the small correlation shown in the table is probably due to the fact that no precipitation occurs on many days even though radon varies during those days. A better evaluation of the true effect of precipitation on radon concentrations might be obtained by calculating the correlation of radon and precipitation only for the subset of days during the year on which significant precipitation occurred.

Yes I agree with you on all your comments. I have inserted a new figure that represents the monthly breakdown of correlation coefficient. Things do not really improve. I decided then to add a discussion on the very same comments that you raised. Furthermore I decided not to conduct an analysis on shorter time window as I would still be left with the doubt on where to have the window starting and ending, precipitation events are too scattered.

"A second problem with the analysis is its attribution of short time scale features seen in the wavelet transforms to various physical processes without actually demonstrating a connection between the selected physical processes and changes in radon concentrations. For instance, on page 12904, an 8-hour timescale is identified in the January scalogram (Figure 3a). A claim is made that this timescale results from the formation

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and evolution of the nighttime boundary layer. However, this claim is never supported with any real evidence. The paper does not explicitly show that the boundary layer evolution at the time of the measurements actually occurred as described in the paper. The reader thus is left with only a plausible explanation, rather than one whose validity is actually demonstrated."

I realized that indeed more emphasis should have been given to a detailed analysis of the connection between data, wavelet and explanation. More evidence has been added. Unfortunately no data are available on the boundary layer depth that could be used to corroborate the arguments. However I believe that the evidence presented now transforms a plausible explanation into a very plausible one.

"Third, I was confused as to why the red noise spectrum shown in Figure 2 is an appropriate "null hypothesis," and would appreciate a few sentences of explanation here."

As requested a few sentences have been added. The red noise should be considered a null-hypothesis in the sense that allows identifying significant amplitude signals at long periods. In other words one is able to distinguish a true signal from the one of a red noise with auto-correlation values comparable to the one of the data analysed.

"Fourth, on page 12901, six energy peaks are identified in Figure 2b. I don't see the meaningfulness of the significant figures when the radon time series consists of 1 hour resolution data."

According to the theory the least significant frequency in a Fourier analysis is the Nyquist frequency (NF) that corresponds to 1/0.5 being  the distance in time between two consecutive samples. The periods showed by our analysis are much larger than the period associated to NF. Further to that we have confined our analysis to the period starting from 4 hours and above.

"Fifth, I am skeptical of the claim made on page 12910 that the exhalation rate of radon

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from the ground can be assumed to be constant because of the lack of precipitation events. It is my understanding that pressure variations can also produce variations in radon emission (e.g., Schery et al., "Factors affecting exhalation of radon from a gravelly sandy loam," J. Geophys. Res., 89, 7299-7309, 1984)."

This is stated explicitly in the paper, although the literature seems to be still debating the issue. All evidence I have found in the literature still outlines the need of abrupt and sudden changes of pressure (see paper for figures) which never occur in the year of reference and on top of that a strong dependence on the soil type. The citation reported by then referee has also been added to the paper as a further proof of the fact that more research is required on this issue.

"A final criticism is that Table 1 shows us the correlation between radon and various meteorological parameters that occurred during the year, but does not indicate the probability that the observed correlation occurred by chance. Without this number it is impossible to determine the significance of the presented correlations."

A significance test has been applied showing that the correlations in Table 1 are all plausible (99. %). Although this is a significant test for all time series correlated with radon we came to the conclusion (also thanks to a comment of reviewer #1) that in the case of precipitation it is an artifact due to the large number of data points. Furthermore we think that the weak anti-correlation with precipitation was caused by the fact that the series contains a large number of zero values. We have added the monthly evolution of the correlation coefficient hoping that more clear features could appear. This result demonstrates that the correlation analysis, for some variables, is not a suitable one.

Page 12897: "... where not investigated before." should be "... were not investigated before." Page 12913: "... where precisely connected..." should be "... were precisely connected..."

All typos have been corrected. Thank you.

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Interactive comment on Atmos. Chem. Phys. Discuss., 5, 12895, 2005.