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Atmospheric Measurement Techniques Discussions

Interactive comment on "Infrared emission measurements in the Arctic using a new extended-range AERI" *by* Z. Mariani et al.

Z. Mariani et al.

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Thank you for your suggestions, which have helped us improve the manuscript. We have responded to all comments below.

-The manuscript "Infrared Emission Measurements in the Arctic using a new Extended range AERI", by Z. Mariani, et al. describes a new instrument installed at the Canadian high-latitude observatory. This spectrometer supply calibrated down-welling radiance with spectral resolution 1 cm-1 in a wide spectral range. As such, it makes possible a very wide range of scientific applications. In respect of the atmospheric gaseous composition, for instance, its great advantage is a possibility of working during the polar night. Important scientific results from this team are pending. A necessary pre-requisite

for using this instrument is a careful investigation of its parameters and stability in laboratory and in the severe polar conditions. This paper generally satisfies requirements for technical notes of this type. Introduction section should be improved. A very interesting comparison of two instruments at different heights above sea level has been carried out. Please point out the height of the PERL Ridge lab (610 m) in the abstract (15 km of distance also should be specified) and in page 6414 line 4.

-> The height has been added in the abstract and on page 6414 in the first paragraph of Section 1.

-The E-AERI was operational during one year after October 2008. Nothing was said about its further fate. Is it operational now? What are the plans for using it in the Arctic? Where is it now? Where is P-AERI now? Will it be installed at zero level during the future research?

-> Additions to p. 6414 and in the abstract explain the E-AERI‘s future fate. On p. 6414: "In September 2009, the E-AERI was moved to the Zero-altitude PEARL Auxiliary Laboratory (0PAL), which is 15 km away from the PEARL Ridge Lab. Measurements of downwelling radiance from an altitude of 10 m continue to be taken at 0PAL to determine concentrations of tropospheric trace gases and investigate infrared cooling in the 20-μm region."

->Clarification of the P-AERI's current status has been added in parenthesis in p. 6416: "and was subsequently deployed in Summit, Greenland."

-Sections 2 and 3 are good, two tables are very helpful for operators. A reason for discrepancies between 2300 and 2400 cm-1 is not clear. Is the P-AERI evacuated or nitrogen-filled? Why CO2 is in E-AERI and not in P-AERI?

-> At wavenumbers where absorption by trace gases is too strong, (here, CO2) accurate calibration becomes impossible. Thus the radiances at such wavenumbers need to be recalculated as part of the processing. The E-AERI was operating under newer spectral processing software that accounts for this by having a stricter threshold than the threshold used in the P-AERI processing software, allowing larger noise spikes to remain in the P-AERI spectrum. We have now made the threshold for the P-AERI stricter to remove these noise spikes in Figure 5. We have added the following sentence, with a reference that provides much greater detail to this post-processing methodology, in Section 3.2, "Strong trace gas absorption can also cause large errors in calibrated sky spectra; these are removed as part of the processing discussed in detail by Rowe et al. [2011b]." As a result, Figure 5 has been updated with the newly re-processed P-AERI radiances.

-Investigation of cloud impact on the radiation budget is really important and the results presented are really not comprehensive. They may be considered just an illustration of usefulness of the instrument in the Arctic conditions. The same is valid for the investigation of the lower 610 m.

-> We agree that this investigation is an illustration of the usefulness of the instrument in Arctic conditions. Most notable is the ability to study the radiative impact of meteorological events unique to the Arctic at two altitudes. A comparison between the impact of clouds on downwelling radiance for the Arctic vs. the Southern Great Plains is provided in Section 4.1 to illustrate the crucial role clouds play in the Arctic's radiative budget.

-> A sentence has been added to the conclusion (Section 5) on p. 6429 that states the usefulness of these types of measurements: "This demonstrates the usefulness of the E-AERI and P-AERI measurements for investigating the impact of clouds on the Arctic radiation budget."

-> The last three sentences of the abstract have been reordered and changed to emphasize that the results presented here are an example of what is possible.

-Fig. 8 requires to be re-considered and probably be re-plotted. Red spots are tiny and hardly visible. Too long color scale obscures small variations during "normal" days. Try to limit the scale by -0.06 and +0.002; the case in February may be displayed

separately.

-> Fig. 8 has been re-plotted with a more limited scale. -0.06 to +0.002 is too fine of a scale (the figure becomes mostly red and almost no features can be distinguished), but a scale of -0.06 to +0.02 permits small variations to now be visible.

-The sections 4.3 and 4.4 are written not so well as the beginning of the paper. Which line is which in Fig. 9 (and also in Fig. 5)? Please specify by words in the figure caption, the legend is not legible.

-> The captions in Figures 5 and 9 have been changed to include descriptions of line colours; the line width has also been increased in the figure legends to make them easier to distinguish.

-I could not find "large negative residuals" in the 2200-2400 cm-1 region in Fig. 9d.

-> We recognize that the quoted 2200-2400 cm-1 region is incorrect; the text in Section 4.3 has been changed to read 1600-1800 cm-1 where the large (> 33%) residuals occur.

-Generally, it is difficult to understand Fig. 9: a mixture of EAERI vs P-AERI and measured vs calculated spectra.

-> The panels in Figure 9 have been labelled to provide clearer descriptions of what is plotted in each one.

-Explanation of differences by errors in radiosonde profiles is questionable. It can be excepted if you would not have these differences for accurate sondes (e.g., at positive temperatures in Wisconsin).

-> A more detailed explanation is provided on p. 6427. A clearer explanation of the simulation's sensitivity to changes in temperature and H2O (based on some additional model sensitivity studies) is now provided throughout the second-last paragraph of Section 4.3.

-Ice crystal impact (4.4) requires more detailed investigation.

-> The discussion in Section 4.4 has been expanded. Several new paragraphs have been added to explain the LBLRTM methodology and provide the longwave downwelling all-sky irradiances for both instruments. The longwave downwelling irradiance from the ice-crystal cloud (not just the increase in irradiance) is now provided as well. A new figure (Fig. 12) illustrating radiosonde temperature and relative humidity profiles is included, and a discussion of these profiles and the cloud's impact on brightness temperature has been included.

-A paragraph on SFIT-2 in conclusions looks not connected with the text of the paper; you did not have results and did not describe SFIT-2 in the study. It might be moved into the introduction as for future developments.

-> The description of SFIT-2 has been moved from the Conclusions section to the Introduction section.

-A note that is common for almost all figures: increase fonts, esp. on the axes. Resuming, this paper does not contain sound scientific results, but, nonetheless, is helpful as a technical note for a proper maintenance of the instrument.

-> All figures have had the fonts increased and labels redone.

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 6411, 2011.