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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Smoke-charged vortices in the stratosphere generated by wildfires and their behaviour in both hemispheres: comparing Australia 2020 to Canada 2017" *by* Hugo Lestrelin et al.

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This is an excellent paper, I enjoyed to read it. However, it can still be improved!

The improvement deals with a better consideration of recent literature on stratospheric smoke observations. The respective lack motivated me (as lidar specialist) to write this small review letter. I hope you enjoy my suggestions!

Please check Baars et al., ACP, 2019!

The unprecedented 2017–2018 stratospheric smoke event: decay phase and aerosol properties observed with the EARLINET Holger Baars, Albert Ansmann, Kevin Ohneiser, Moritz Haarig, Ronny Engelmann, Dietrich Althausen, Ingrid Hanssen, Michael Gausa, Aleksander Pietruczuk, Artur Szkop, Iwona S. Stachlewska, Dongxiang Wang, Jens Reichardt, Annett Skupin, Ina Mattis, Thomas Trickl, Hannes Vogelmann, Francisco Navas-Guzmán, Alexander Haefele, Karen Acheson, Albert A. Ruth, Boyan Tatarov, Detlef Müller, Qiaoyun Hu, Thierry Podvin, Philippe Goloub, Igor Veselovskii, Christophe Pietras, Martial Haeffelin, Patrick Fréville, Michaël Sicard, Adolfo Comerón, Alfonso Javier Fernández García, Francisco Molero Menéndez, Carmen Córdoba-Jabonero, Juan Luis Guerrero-Rascado, Lucas Alados-Arboledas, Daniele Bortoli, Maria João Costa, Davide Dionisi, Gian Luigi Liberti, Xuan Wang, Alessia Sannino, Nikolaos Papagiannopoulos, Antonella Boselli, Lucia Mona, Giuseppe D'Amico, Salvatore Romano, Maria Rita Perrone, Livio Belegante, Doina Nicolae, Ivan Grigorov, Anna Gialitaki, Vassilis Amiridis, Ourania Soupiona, Alexandros Papayannis, Rodanthi-Elisaveth Mamouri, Argyro Nisantzi, Birgit Heese, Julian Hofer, Yoav Y. Schechner, Ulla Wandinger, and Gelsomina Pappalardo Atmos. Chem. Phys., 19, 15183–15198, https://doi.org/10.5194/acp-19-15183-2019, 2019.

These authors show an overview of European lidar network observations of the smoke in 2017. They discuss different lofting possibilities. . .. They found many apparently ascending structures. Maybe part of these ascending structures can now be explained by the development of smoke-charged vorticities. Please check, and discuss. . .!

Next paper....

Hu, Q., Goloub, P., Veselovskii, I., Bravo-Aranda, J.-A., Popovici, I. E., Podvin, T., Haeffelin, M., Lopatin, A., Dubovik, O., Pietras, C., Huang, X., Torres, B., and Chen, C.: Long-range-transported Canadian smoke plumes in the lower stratosphere over northern France, Atmos. Chem. Phys., 19, 1173–1193, https://doi.org/10.5194/acp-19-1173-2019, 2019.

This is a nice paper from the very tough French lidar group in Lille. They describe the beginning of the smoke evolution in western Canada in August 2017 in large detail and show measurements over northern France. Should be mentioned (referenced) in the introduction.

Regarding the introduction of your paper:

Page 1-2. Introduction section: The reader, not too familiar with the topic, may get the impression that the smoke self-lifting aspect was introduced by Khaykin et al, 2018, 2020. Yes these authors did a great job concerning the discussion on lofting of smoke. But the basic papers that triggered all this are from Boers et al (2010) and de Laat et al. (2012). You may adjust your introduction... and state that.

Boers, R., de Laat, A. T., Stein Zweers, D. C., and Dirksen, R. J.: Lifting potential of solar-heated aerosol layers, Geophys. Res. Lett., 37, L24802, doi:10.1029/2010GL045171, 2010.

de Laat, A. T. J., Stein Zweers, D. C., Boers, R., and Tuinder, O. N. E.: A solar escalator: Observational evidence of the self-lifting of smoke and aerosols by absorption of solar radiation in the February 2009 Australian Black Saturday plume, J. Geophys. Res., 117, D04204, doi:10.1029/2011JD017016, 2012. And there is this paper of Torres et al, JGR, 2020 .

And in the recent paper of Torres et al. (2020) there is strong focus on lofting of smoke as well.

Torres, O., Bhartia, P. K., Taha, G., Jethva, H., Das, S., Colarco, P., Krotkov, N., Omar, A., and Ahn, C.: Stratospheric Injection of Massive Smoke Plume from Canadian Boreal Fires in 2017 as seen by DSCOVRâĂŘEPIC, CALIOP and OMPSâĂŘLP Observations, Journal of Geophysical Research: Atmospheres, 125, e2020JD032579, https://doi.org/10.1029/2020JD032579, 2020a.

That paper should also be mentioned, I think!

Finally, we (Ohneiser, Ansmann et al. . .) published the first (!) paper on the Australian 2020 smoke. You are probably not aware of it. No problem! And we already needed the self-lifting effect to find agreement with the HYSPLIT trajectories and our lidar observations. And we saw the bubble vortex KOOBOR over Punta Arenas, Chile, from 20-27 January 2020, the lifting rate was about 1 km per day, ... all this can be found in that paper. The paper should also be mentioned in your article.

Ohneiser, K., Ansmann, A., Baars, H., Seifert, P., Barja, B., Jimenez, C., Radenz, M., Teisseire, A., Floutsi, A., Haarig, M., Foth, A., Chudnovsky, A., Engelmann, R., Zamorano, F., B\"uhl, J., and Wandinger, U.: Smoke of extreme Australian bushfires observed in the stratosphere over Punta Arenas, Chile, in January 2020: optical thickness, lidar ratios, and depolarization ratio sat 355 and 532$\sim$nm, Atmos. Chem. Phys., 20, 8003-8015, https://doi.org/10.5194/acp-20-8003-2020, 2020.

Last question: Why did the 2017 smoke ended up at about 23 km? Baars et al. (2019) argued ...because of the Brewer Dobson circulation and the phase of QBO to that time (August-October 2017)? Is that the right answer?

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2020-1201, 2020.