Atmos. Meas. Tech. Discuss., 6, C2734–C2738, 2013
www.atmos-meas-tech-discuss.net/6/C2734/2013/

Atmospheric Measurement Techniques Discussions

Interactive comment on "Assimilating airborne gas and aerosol measurements into HYSPLIT: a visualization tool for simultaneous assessment of air mass history and back trajectory reliability" *by* S. Freitag et al.

S. Freitag et al.

freitag@hawaii.edu

Received and published: 27 September 2013

The authors would like to thank the reviewer (reviewer #2) for his/her thorough review and corrections that have helped improve our manuscript.

Specific remarks – major issues

1/ The reviewer encourages two modifications to the manuscript title which we adapt now. The new title will be "Combining airborne gas and aerosol measurements with

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

HYSPLIT: A visualization tool for simultaneous evaluation of air mass history and back trajectory consistency."

2/ We added three new references (Ding et al., 2009; Lawrence et al., 2003; O'Shea et al., 2013) to broaden the literature review provided in the introduction.

3/ Section 2 has been abridged wherever appropriate.

4/ The authors have employed HYSPLIT 4.9 in standard set-up with kinematic 3-D trajectories and stated that clearly in the manuscript in section 3.1 (page 5360, line 19). We have, however, altered the potentially misleading sentence in section 3.2 (page 5362, lines 25-27) since it is true that even in the absence of latent heat release in clouds radiative cooling although small will change the potential temperature of an air parcel. The revised text connecting limited vertical motion with tropospheric stability now also corresponds to the reference: "This reflects the fact that vertical motion is generally limited by the abundance of stable and quasi-horizontal tropospheric layers (Newell, 1999)."

5/ The reviewer raises concerns over the general representation of convection in HYSPLIT particularly regarding modeled rises illustrated in section 5. It is correct that convection is not computed or parameterized by the trajectory model since HYSPLIT only interpolates the utilized GDAS data to its internal terrain-following (σ) coordinate system (Draxler and Hess, 1997). On the other hand, since this interpolation occurs without altering the vertical resolution of the meteorological input, HYSPLIT is capable of presenting transport through convection and precipitation (see item 4 in specific remarks below) to the same degree of accuracy as provided by the meteorological input. In case of the GDAS data this is a rather crude cloud physics parameterization (Han and Pan, 2011) as we point out in section 3.2 (page 5365, line 1). In summary, the authors emphasize that the modeled rises illustrated are due to widespread deep convection parameterized in the GDAS data but that the vertical velocity should not be trusted since real parcel ascents will be poorly represented owing to convection and

AMTD
6, C2734–C2738, 2013

turbulent mixing in the cloud. We would also like to add that we believe the GDAS resolution to be too coarse to resolve localized convection.

6/ We have revised the first paragraph of section 6 to better emphasize that although quantitative error evaluations may be omitted for an "off-the-shelf" air history analysis utilizing our visualization routine they are recommend for a more thorough analysis of general HYSPLIT performance and possible limitations of the model for the time and location investigated.

Specific remarks – minor issues

1/ - 4/ Critical text passages have been revised as suggested and imprecise wording regarding GDAS precipitation and the trajectory model has been adjusted where it appears in the manuscript.

5/ The authors are aware that deformation, turbulence, and convection do not affect the accuracy of the trajectory computation itself as clearly stated in the introduction (e.g. page 5347, lines 15-20) but instead may limit the usefulness of the computed parcel path compared to the actual path the measured air mass took (total error/deviation, page 5361, lines 11-22). We, however, clarified misleading text passages in section 3.2 to better account for these differences. We now also mention lagrangian particle dispersion models (LPDM) in the introduction although we note that employment of these models still requires larger computational resources and might hence not be appropriate for an "off-the-shelf" air history analysis as discussed here. Additionally, the use of the word exact with regard to numerical error calculations is based on the statement "perfect numerical algorithms would yield identical starting/ending points" for a forward/backward test as found in the Fuelberg et al. (1996) study in their section 2.

6/ Table 2 has been updated with relative transport errors.

7/ The new Fig. 4 caption has been revised to: "Histograms and corresponding CDFs of measured CO (upper row) and CNhot (lower row) as obtained by classifying all back

AMTD
6, C2734–C2738, 2013

trajectories (data set T, column 1) and in-situ observations (data set M, column 2) into two distinct air mass groups. ITCZ and South American air masses are marked in red and black color, respectively. See section 4 for additional information."

Ding, A., Wang, T., Xue, L., Gao, J., Stohl, A., Lei, H., Jin, D., Ren, Y., Wang, X., Wei, X., Qi, Y., Liu, J. and Zhang, X.: Transport of north China air pollution by midlatitude cyclones: Case study of aircraft measurements in summer 2007, J. Geophys. Res., 2009, Vol. 114, pp. D08304.

Draxler, R. R. and Hess, G. D.: Description of the HYSPLIT 4 modeling system, NOAA Tech. Memo ERL ARL-224, NOAA Air Resources Laboratory, Silver Spring, MD, 1997, 24pp., http://1460 arlsun.arlhq.noaa.gov/documents/reports/arl-224.pdf.

Fuelberg, H. E., Loring, R. O., Watson, M. V., Sinha, M. C., Pickering, K. E., Thompson, A. M., Sachse, G. W., Blake, D. R., and Schoeber, M. R.: TRACE A trajectory intercomparison 2. Isentropic and kinematic methods, J. Geophys. Res.-Atmos., 1996, 101, 23927–23939.

Han, J. and Pan, H. L.: Revision of Convection and Vertical Diffusion Schemes in the NCEP Global Forecast System, Wea. Forecasting, 2011, 26, 520–533.

Lawrence, M. G., Rasch, P. J., von Kuhlmann, R., Williams, J., Fischer, H., de Reus, M., Lelieveld, J., Crutzen, P. J., Schultz, M., Stier, P., Huntrieser, H., Heland, J., Stohl, A., Forster, C., Elbern, H., Jakobs, H. and Dickerson, R. R.: Global chemical weather forecasts for field campaign planning: predictions and observations of large-scale features during MINOS, CONTRACE, and INDOEX, Atmos. Chem. Phys., 2003, Vol. 3, pp. 267-289.

O'Shea, S. J., Allen, G., Gallagher, M. W., Bauguitte, S. J.-B., Illingworth, S. M., Le Breton, M., Muller, J. B. A., Percival, C. J., Archibald, A. T., Oram, D. E., Parrington, M., Palmer, P. I. and Lewis, A. C.: Airborne observations of trace gases over boreal Canada during BORTAS: campaign climatology, airmass analysis and enhancement

AMTD

6, C2734–C2738, 2013

ratios, Atmos. Chem. Phys. Discuss., 2013, Vol. 13, pp. 14069-14114.

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 5345, 2013.