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Global chemical weather forecasts for field campaign planning: predictions and observations of large-scale features during MINOS, CONTRACE, and INDOEX

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Abstract. The first global tropospheric forecasts of O_3 and its precursors have been used in the daily flight planning of field measurement campaigns. The 3-D chemistry-transport model MATCH-MPIC is driven by meteorological data from a weather center (NCEP) to produce daily 3-day forecasts of the global distributions of O_3 and related gases, as well as regional CO tracers. This paper describes the forecast system and its use in three field campaigns, MINOS, CONTRACE and INDOEX. An overview is given of the forecasts by MATCH-MPIC and by three other chemical weather forecast models (EURAD, ECHAM, and FLEXPART), focusing on O_3 and CO. Total CO and regional CO tracers were found to be the most valuable gases for flight planning, due to their relatively well-defined anthropogenic source regions and lifetimes of one to a few months. CO was in good agreement with the observations on nearly all the flights (generally $r > 0.7$, and the relative RMS differences for the deviations from the means was less than 20%). In every case in which the chemical weather forecasts were primarily responsible for the flight plans, the targeted features were observed. Three forecasted phenomena are discussed in detail: outflow from Asia observed in the Mediterranean upper troposphere during MINOS, outflow from North America observed in the middle troposphere over northern Europe during CONTRACE, and the location of the "chemical ITCZ'' over the Indian Ocean during INDOEX. In particular it is shown that although intercontinental pollution plumes such as those observed during MINOS and CONTRACE occur repeatedly during the months around the campaigns, their frequency is sufficiently low (~10--30% of the time) that global chemical weather forecasts are important for enabling them to be observed during limited-duration field campaigns. The MATCH-MPIC chemical weather forecasts, including an interface for making customized figures from the output, are available for community use via http://www.mpch-mainz.mpg.de/~lawrence/forecasts.html.

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