Home
Online Library ACP
Recent Final Revised Papers
Volumes and Issues
Special Issues
Library Search
Title and Author Search
Online Library ACPD
Alerts & RSS Feeds
General Information
Submission
Review
Production
Subscription
Comment on a Paper

Volumes and Issues | Contents of Issue 21

Atmos. Chem. Phys., 9, 8235-8246, 2009
www.atmos-chem-phys.net/9/8235/2009/

Clouds, photolysis and regional tropospheric ozone budgets

A. Voulgarakis[1,*], O. Wild[2], N. H. Savage[3], G. D. Carver[1], and J. A. Pyle[1]
[1]Centre for Atmospheric Science, University of Cambridge, UK
[2]Lancaster Environment Centre, Lancaster University, UK
[3]Met Office, Exeter, UK
[*]now at: the NASA Goddard Inst. for Space Studies & Columbia Univ., Center for Climate Systems Res., New York, USA

Abstract. We use a three-dimensional chemical transport model to examine the shortwave radiative effects of clouds on the tropospheric ozone budget. In addition to looking at changes in global concentrations as previous studies have done, we examine changes in ozone chemical production and loss caused by clouds and how these vary in different parts of the troposphere. On a global scale, we find that clouds have a modest effect on ozone chemistry, but on a regional scale their role is much more significant, with the size of the response dependent on the region. The largest averaged changes in chemical budgets (±10–14%) are found in the marine troposphere, where cloud optical depths are high. We demonstrate that cloud effects are small on average in the middle troposphere because this is a transition region between reduction and enhancement in photolysis rates. We show that increases in boundary layer ozone due to clouds are driven by large-scale changes in downward ozone transport from higher in the troposphere rather than by decreases in in-situ ozone chemical loss rates. Increases in upper tropospheric ozone are caused by higher production rates due to backscattering of radiation and consequent increases in photolysis rates, mainly $J(NO_2)$. The global radiative effect of clouds on isoprene, through decreases of OH in the lower troposphere, is stronger than on ozone. Tropospheric isoprene lifetime increases by 7% when taking clouds into account. We compare the importance of clouds in contributing to uncertainties in the global ozone budget with the role of other radiatively-important factors. The budget is most sensitive to the overhead ozone column, while surface albedo and clouds have smaller effects. However, uncertainty in representing the spatial distribution of clouds may lead to a large sensitivity of the ozone budget components on regional scales.

Final Revised Paper (PDF, 679 KB) | Discussion Paper (ACPD)

Citation: Voulgarakis, A., Wild, O., Savage, N. H., Carver, G. D., and Pyle, J. A.: Clouds, photolysis and regional tropospheric ozone budgets, Atmos. Chem. Phys., 9, 8235-8246, 2009. Bibtex | EndNote | Reference Manager

Search ACP
Library Search
Author Search

News
Sister Journals AMT & GMD
Public Relations & Background Information

Recent Papers
01 | ACPD, 19 Nov 2009: Tropospheric photooxidation of CF_3CH_2CHO and $CF_3(CH_2)_2CHO$ initiated by Cl atoms and OH radicals
02 | ACP, 19 Nov 2009: Regional N_2O fluxes in Amazonia derived from aircraft vertical profiles
03 | ACP, 19 Nov 2009: Application of φ-IASI to IASI: retrieval products evaluation and radiative transfer consistency
04 | ACPD, 18 Nov 2009: