Supporting Information for

Evaluating the Model Representation of Asian Summer Monsoon UTLS Transport and Composition using Airborne In Situ Observations

Warren P. Smith[1], Laura L. Pan[1], Douglas Kinnison[1], Elliot Atlas[2], Shawn Honomichl[1], Jun Zhang[1], Simone Tilmes[1], Rafael P. Fernandez[3], Alfonso Saiz-Lopez[4], Victoria Treadaway[5,6], Karina E. Adcock[7], Johannes C. Laube[8], Marc von Hobe[8], Corinna Kloss[8], Silvia Viciani[9], Francesco D'Amato[9], C. Michael Volk[10], Fabrizio Ravegnani[11]

1 Atmospheric Chemistry Observations & Modeling Laboratory, National Center for Atmospheric Research, Boulder, Colorado, USA
2 Department of Atmospheric Sciences, Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami, Miami, Florida, USA
3 Institute for Interdisciplinary Science (ICB), National Research Council (CONICET), FCEN-UNCuyo, Mendoza, Argentina
4 Department of Atmospheric Chemistry and Climate, Institute of Physical Chemistry Blas Cabrera, CSIC, Madrid, Spain
5 Cooperative Institute for Research in Environmental Sciences, University of Colorado Boulder, Boulder, Colorado, USA
6 NOAA Chemical Sciences Laboratory, Boulder, Colorado USA
7 Centre for Ocean and Atmospheric Sciences, School of Environmental Sciences, University of East Anglia, Norwich, United Kingdom
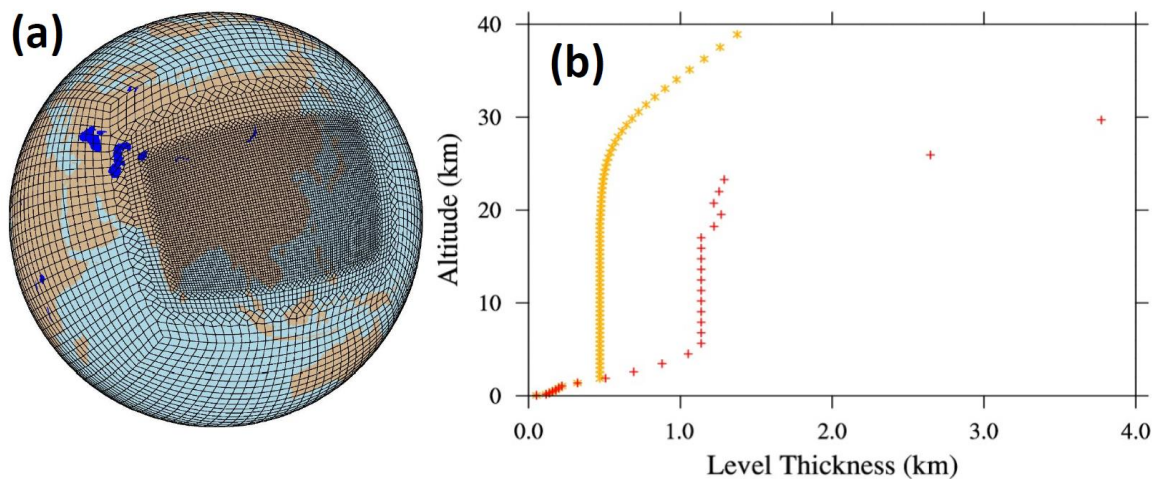8 Institute for Energy and Climate Research (IEK-7), Forschungszentrum Jülich GmbH, 52425 Jülich, Germany
9 National Research Council - National Institute of Optics (CNR-INO), Sesto Fiorentino, Italy
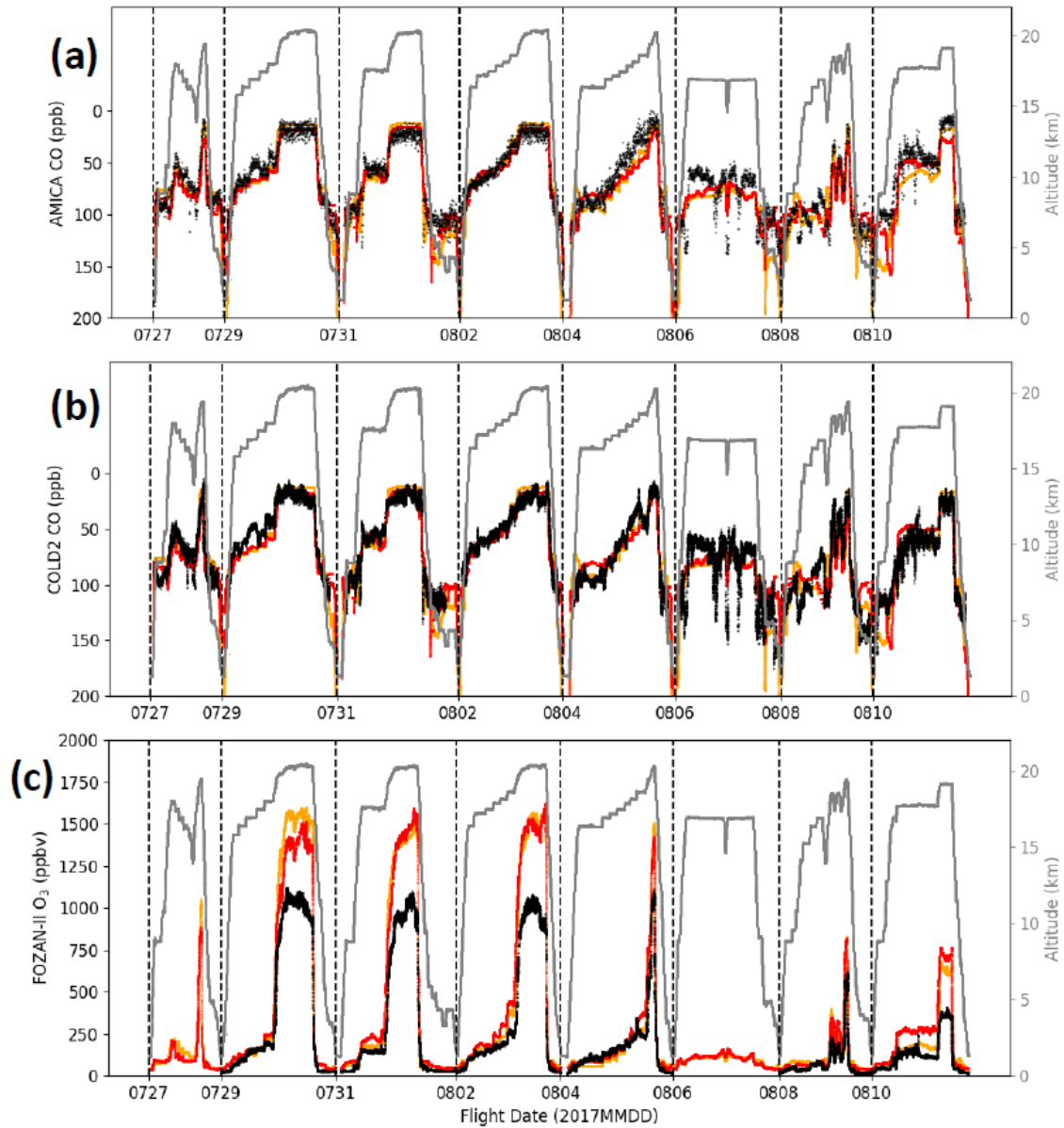10 University of Wuppertal, Wuppertal, Germany
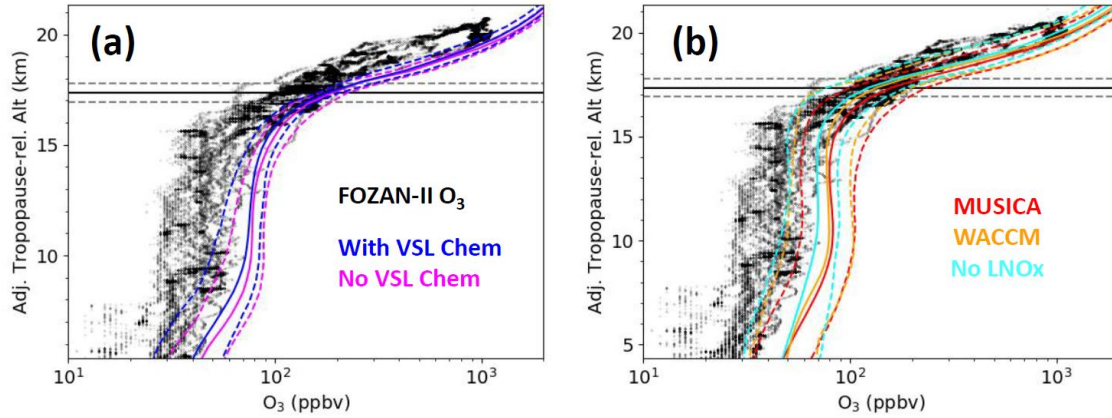11 Institute of Atmospheric Sciences and Climate, Bologna, Italy
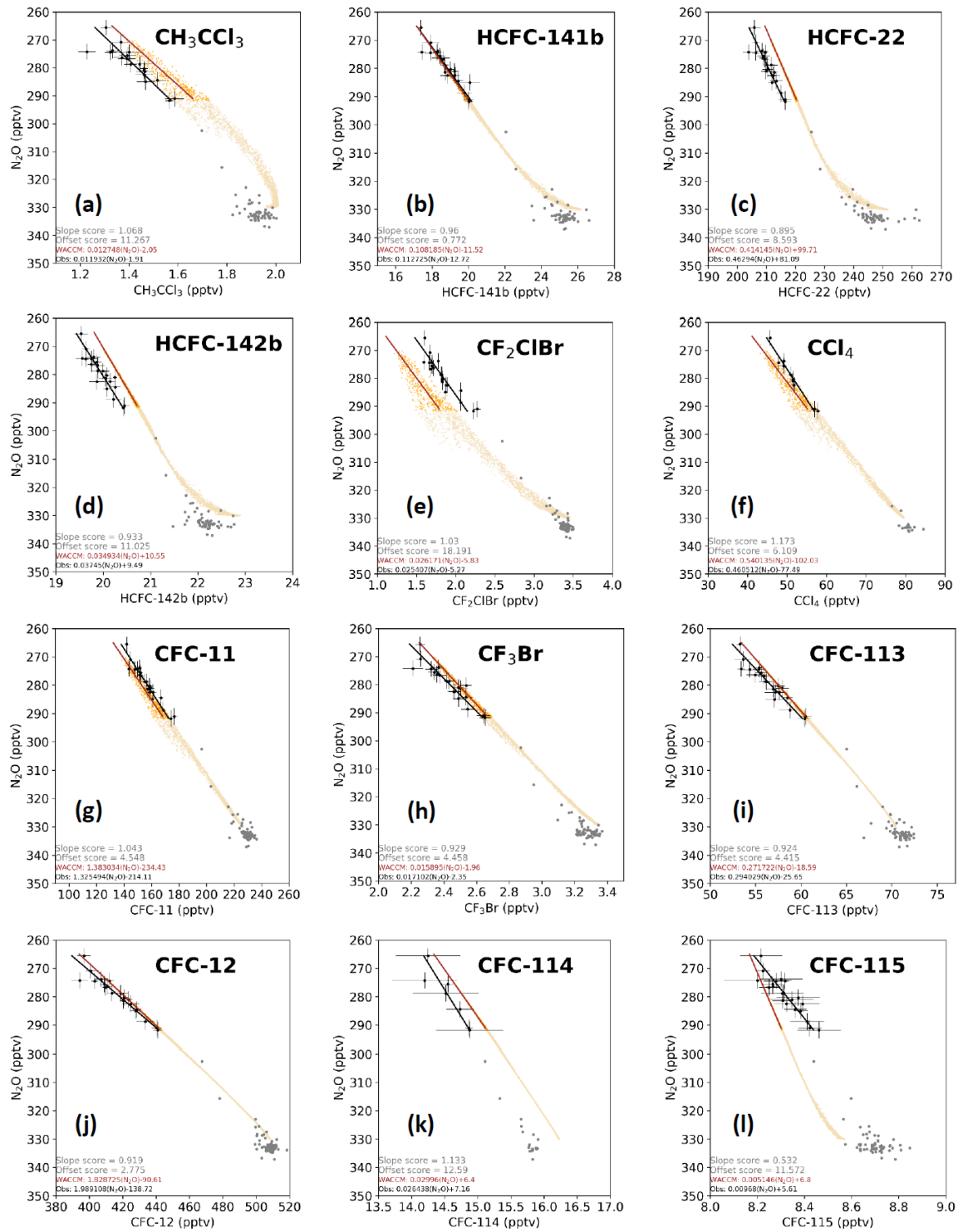
Contents of this file

(a)

(b)

Figure S1: (Left) An image depicting the horizontal grid structure for the MUSICA simulation analyzed herein. This grid mesh was originally developed for forecasting application during an airborne field campaign, the Asian summer monsoon Chemical and Climate Impact Project (ACCLIP), which took place in summer 2022. (Right) The thickness of each model layer in the analyzed (orange, 110 total levels) WACCM and (red, 32 total levels) MUSICA simulations.

Figure S2: Time series of observed and model CO and ozone mixing ratios interpolated in space and time to StratoClim flight tracks from the (red) MUSICA and (orange) WACCM simulations. Black dots show (a) AMICA CO, (b) COLD2 CO and (c) FOZAN-II ozone. Gray lines show the aircraft altitude. Note y-axes for CO are flipped.

Figure S3: As in Figure 3, but for sensitivity runs which explore the model ozone high bias, and with dashed lines to indicate the 5th and 95th percentiles for the models. The left panel shows sensitivity runs for the inclusion of very short-lived (VSL) chemistry. We note that these are free-running simulations with prescribed SSTs which are not nudged to analysis like the WACCM and MUSICA runs in this study, they are only used to assess the relative impact of VSL chemistry. The right panel shows sensitivity to a CAM-Chem simulation (in cyan) where lightning NOx production is disabled.

Figure S4: As in Figure 8, but using N_2O as the chemical vertical coordinate.