Revision date: October 31, 2008

Pre-LBA ABLE-2A and ABLE-2B Expedition Data

Summary

The ABLE 2A and 2B (Atmospheric Boundary Layer Experiments) data consists of estimates of the rate of exchange of a wide variety of aerosols and gases between the Amazon Basin and its atmospheric boundary layer, and the processes by which these aerosols and gases are moved between the boundary layer and the free troposphere. The data are presented in gzipped ASCII text files in Global Tropospheric Experiment (GTE) format.

The ABLE-2 project consisted of two expeditions: the first in the Amazonian dry season (ABLE-2A, July-August 1985); and the second in the wet season (ABLE-2B, April-May 1987). The ABLE-2 core research data were gathered by NASA Electra aircraft flights that stretched from Belem, at the mouth of the Amazon River, west to Tabatinga, on the Brazil-Colombia border, from a base at Manaus in the heart of the forest. See Figure 1. These observations were supplemented by ground based chemical and meteorological measurements in the dry forest, the Amazon floodplain, and the tributary rivers through use of enclosures, an instrumented tower in the jungle, a large tethered balloon, and weather and ozone sondes.

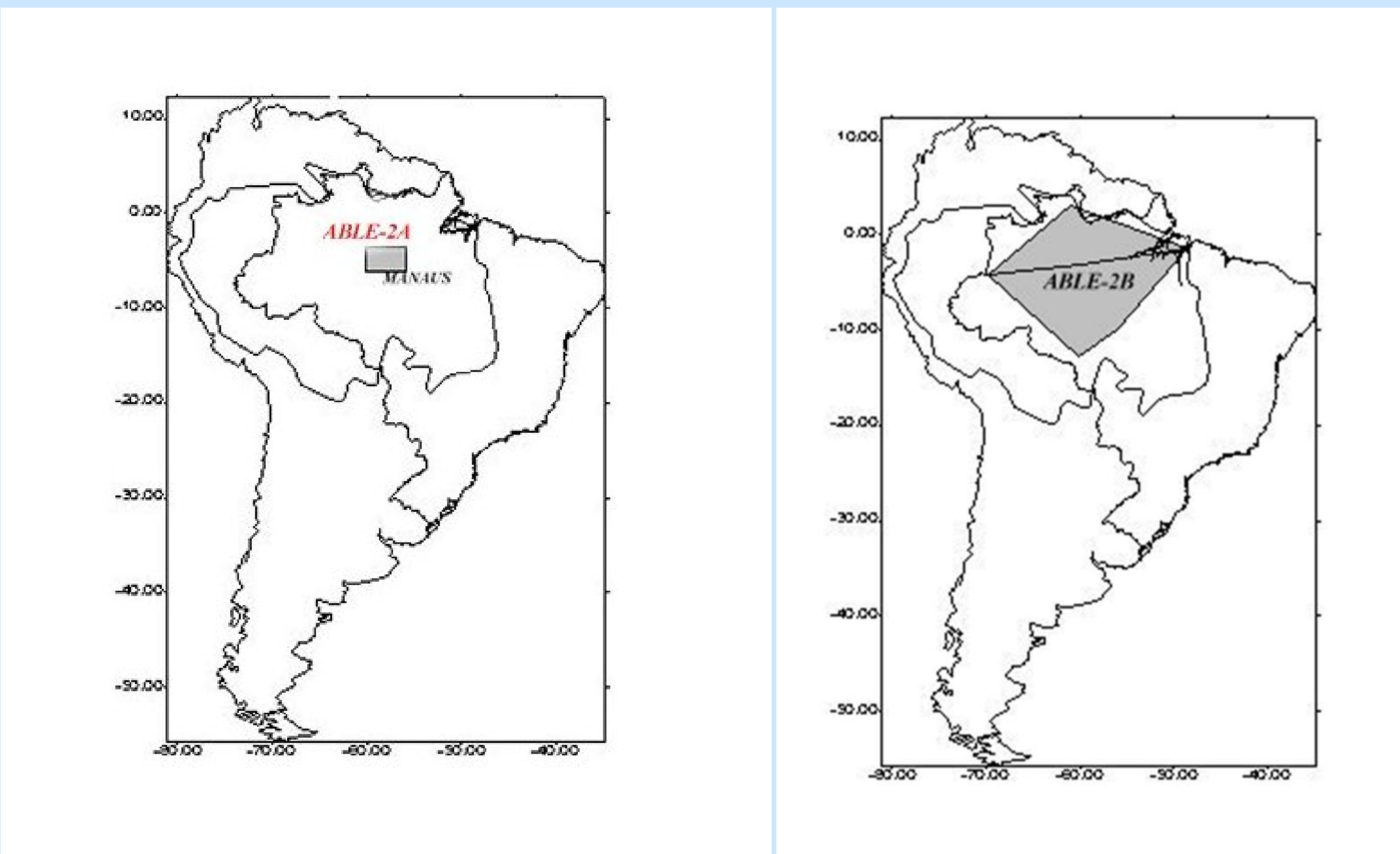

Figure 1. Area of ABLE-2A Expedition, dry season, July-August 1985 and Area of ABLE-2B Expedition, wet season, April-May 1987.

This study showed air above the Amazon jungle to be extremely clean during the wet season but air quality deteriorated dramatically during the dry season as the result of biomass burning, performed mostly at the edges of the forest. Biomass burning is also a source of greenhouse gases carbon dioxide and methane, as well as other pollutants (carbon monoxide and oxides of nitrogen). Amazonian ozone deposition rates were found to be 5 to 50 times higher than those previously measured over pine forests and water surfaces. The Amazon River floodplain is a globally significant source of methane, supplying about 12% of the estimated worldwide total from all wetlands sources. Over Amazonia, carbon monoxide is enhanced by factors ranging from 1.2 to 2.7 by comparison with adjacent regions due to isoprene oxidation and biomass burning. Over the rainforest individual convective storms transport 200 megatons of air per hour, of which 3 megatons is water vapor that releases 100,000 megawatts of energy into the atmosphere through condensation into rain.

The ABLE was a collaboration of U.S. and Brazilian scientists sponsored by NASA and Instituto Nacional de Pesquisas Espaciais (INPE) and supported by the Global Tropospheric Experiment (GTE) component of the NASA Tropospheric Chemistry Program.

The processed, quality controlled and integrated data in the documented Pre-LBA data sets were originally published as a set of three CD_ROMs (Marengo and Victoria, 1998) but are now archived individually.

Home page for GTE expeditions ABLE-2A and ABLE-2B: http://www-gte.larc.nasa.gov/gte_fld.htm#ABLE

Pre-LBA Data Set Collection Initiative

The Pre-LBA data set collection was dedicated to providing information to the LBA research community about existing data that have been collected in Amazonia during the 20 years prior to 1998. The main goal of this activity was to compile and document existing data sets in a consistent manner and make them available prior to the beginning of the LBA experiment.

The data set compilation efforts included satellite imagery, micrometeorological observations, near surface and upper-air atmospheric conditions, surface biophysical and hydrological measurements obtained from 1970s-1990s in a number of field experiments. Data were collected for several intensive field campaigns, during the rainy and dry seasons, and other periods that vary from short intensive field campaigns to several years worth of observations, measured sometimes with a time resolution of 5 minutes and 1 hour.

Citation:

Cite this data set as follows:

Harriss, R.C. 2008. Pre-LBA ABLE-2A and ABLE-2B Expedition Data. Data set. Available on-line [http://daac.ornl.gov] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A. doi:10.3334/ORNLDAAC/897.

The original CD-ROM citation is as follows:

Marengo, J.A., and R.L. Victoria. 1998. Pre-LBA Data Sets Initiative, 3 vols. [Pre-Large-Scale Biosphere-Atmosphere Experiment in Amazonia Data Sets Initiative, 3 vols.]. CD-ROM. Centro de Previsao de Tempo e Estudios Climaticos, Instituto Nacional de Pesquisas Espaciais (CPTEC/INPE) [Center for Weather Forecasting and Climate Study, National Institute for Space Research], Sao Paulo, Brazil.

Pre-LBA Data Set Collection Metadata

Project: GTE > Global Tropospheric Experiment

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Keywords

ABLE
CH4
CO2
DIAL
DIMETHYLSULFIDE
DMS
HALOCARBONS
HYDROCARBONS
IDN_NODE GSFC/LARC
N2O
NITRIC OXIDE
NMHC
NO
NOX
O3
SURFACE
UPPER AIR
WATER VAPOR FLUX

Temporal_Coverage

Start_Date: 1985-07-11
Stop_Date: 1987-05-13

Spatial_Coverage

Southernmost_Latitude: 10S
Northernmost_Latitude: 0
Westernmost_Longitude: 70W
Easternmost_Longitude: 50W

Location: BOUNDARY LAYER

Location: BRAZIL > Amazon

Location: EQUATORIAL

Location: SOUTH AMERICA

Location: TROPOSPHERE

Data_Center
Data_Center_Name: LARC > Langley Research Center, NASA
Data_Set_ID: ABLE2A
Data_Set_ID: ABLE2B

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Data Description

The ABLE-2 project consisted of two expeditions: the first in the Amazonian dry season (ABLE-2A, July-August 1985); and the second in the wet season (ABLE-2B, April-May 1987). The ABLE-2 core research data were gathered by NASA Electra aircraft flights that stretched from Belem, at the mouth of the Amazon River, west to Tabatinga, on the Brazil-Colombia border, from a base at Manaus in the heart of the forest. These observations were supplemented by ground based chemical and meteorological measurements in the dry forest, the Amazon floodplain, and the tributary rivers through use of enclosures, an instrumented tower in the jungle, a large tethered balloon, and weather and ozone sondes.

Expedition	Platform	Investigator	Measured Parameters / Methods / Data Files [Each entry (*) in this column has a corresponding compiled and compressed set of data files.] [File name syntax: Expedition_platform_investigator.zip] [Example: ABLE2A_aircraft_ANDREAE.zip]
ABLE-2A	**NASA Electra Aircraft**	ANDREAE	* SULFUR GAS/TRAPS
		GREGORY	* OZONE/CHEMILUMINESCENCE
		PROJECT	* NAV/MET
		RASSMUSSEN	* NON METHANE HYDROCARBONS/CRYOGENIC AIR SAMPLES
		SACHSE	* CO/IR LASER
		TALBOT	* AEROSOL CHEMISTRY/FILTERS PARTICULATE ORGANIC CARBON/FILTERS
		TORRES	* NITRIC OXIDE/CHEMILUMINESCENCE
	Ground Station	ANDREAE	* RAIN WATER CHEMISTRY/GROUND BASED SAMPLES
		FITZGARRALD	Data not included. See GTE ABLE-2A web site.
		GARSTANG	{ SURFACE FLUXES OF HEAT MOMENTUM AND WATER VAPOR/BLISSONDE * SURFACE FLUXES OF HEAT MOMENTUM AND WATER VAPOR/RAWINSONDE { SURFACE FLUXES OF HEAT MOMENTUM AND WATER VAPOR/TETHERED BALLOON
		ZIMMERMAN	Data not included. See GTE ABLE-2A web site.
ABLE-2B	**NASA Electra Aircraft**	ANDREAE	* Airborne Differential Absorption Lidar: Zenith IR Aerosol Relative Backscatter DMS/TRAPS
		GREGORY	* OZONE, CHEMILUMINESCENCE
		PEREIRA	* RADON 222/GRAB SAMPLES
		PROJECT	* NAV/MET
		SACHSE	* CO/IR LASER
		SINGH	* PAN, C2CL4/GC
		TALBOT	* AEROSOL CONCENTRATIONS/FILTERS
		WOFSY	* CO2/IR
	Ground Station	ANDREAE	* RAIN WATER CHEMISTRY/GROUND BASED SAMPLES
		NOBRE	* TEMPERATURE, WATER VAPOR/RAWINSONDE
		WOFSY	* CO2, NO, NOY, AND OZONE FLUX GRAB SAMPLES

Data Format

These data have been processed to conform to the GTE data archive format. The 1994 and 2000 GTE data formats are described in the companion documents:

- pwb-fmat_1994.pdf (ftp://daac.ornl.gov/data/lba/atmos_chemistry/ABLE/comp/pwb-fmat_1994.pdf) and
- gte_fmt_2000.pdf (ftp://daac.ornl.gov/data/lba/atmos_chemistry/ABLE/comp/gte_fmt_2000.pdf).

Example Data File in GTE Data Archive Format (MASULE03.A2A from ABLE2A_aircraft_ANDREAE.zip)

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 23
MASULE03.A2A
ANDREAE, M.O., MAX PLANCK INSTITUTE FOR CHEMISTRY
SULFUR GAS/TRAPS
ABLE 2-A
 85 , 7 , 18 , 95 , 6 , 23
 3
 9
 2
 2
 0
 0
DAY, JULIAN (GMT), 1, 0, 199., 199., -999, 0
START TIME, SEC (GMT), 1, 0, 48960., 61200., -99999, 0
STOP TIME, SEC (GMT), 1, 0, 52680., 64380., -99999, 0
SAMPLE MIDPOINT TIME, SEC (GMT), 1, 0, 50820., 62790., -99999, 0
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DMS, PPTV, 1, 0, 1.8, 9.1, -9.9, 0
DMS, NMOL/M3, 1, 0, 0.07, 0.36, -.99, 0
MeSH, PPTV, 1, 0, -99.9, -99.9, -99.9, 0
MeSH, NMOL/M3, 1, 0, -99.999, -99.999, -99.999, 0
THESE DATA HAVE BEEN PROCESSED TO CONFORM TO THE GTE DATA ARCHIVE FORMAT.
DMS : Dimethylsulfide, Mesh : Methyl mercaptan
 199., 48960., 52680., 50820., 15.5, 2.4,0.10,-99.9,-99.999
 199., 56520., 57180., 56850.,  0.5, 6.5,0.26,-99.9,-99.999
 199., 57360., 58380., 57870.,  0.5, 9.1,0.36,-99.9,-99.999
 199., 61200., 64380., 62790., 18.5, 1.8,0.07,-99.9,-99.999
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ABLE 2 Background and Results

Nowhere is the atmosphere-biosphere interaction more pronounced than within the atmospheric boundary layer--the lowest few hundred meters of the atmosphere. This layer of the atmosphere contains trace gases emitted by the biosphere, produced by industrial activity and combustion, or formed by atmospheric chemistry processes.

While in the atmosphere, such trace materials undergo photochemical reactions that influence the horizontal and vertical distributions of reaction products. Within the lower layers of the atmosphere, powerful dynamical processes are also at work. These processes mix the boundary layer air, bringing gases to the land surface and moving layers to the upper troposphere, where long-range transport takes place and local flux processes are transformed into globally significant effects.

Because of the great importance of trace-gas fluxes and their coupling to the global atmosphere, the first extensive GTE field studies were focused on these processes. The GTE/ABLE investigations have brought international research teams into some of the most important and sensitive ecosystems in the world. Their findings have already revised previous views of the atmosphere-biosphere interaction and the relative importance of different ecosystems in generating atmospheric change. The atmosphere often does not behave in accordance with predictions based on previous, more limited data; sometimes the differences are startling.

The tropical rain forest have long been recognized as key participants in the atmosphere-biosphere interaction. These vast, still essentially pristine regions, home to a wide array of plant and animal species, are now under assault by encroaching human development. However, the difficulty of access, the logistical barriers to scientific operations, and the lack of accurate instrumentation have prevented their comprehensive, systematic study until the ABLE projects.

The ABLE-2 project, carried out jointly by the United States and Brazil, brought new technology to bear on an investigation of the largest rain forest of all, the Amazon. The impetus for this work was Space Shuttle observations of elevated CO concentrations in the upper troposphere off the coast of Brazil-suspected to arise from a combination of biomass burning and oxidation of natural hydrocarbons, notably isoprene, emitted by the forest itself.

The ABLE-2 project consisted of two expeditions--the first in the Amazonian dry season (ABLE-2A, July-August 1985), and the second in the wet season (ABLE-2B, April-May 1987).

The ABLE-2 core research data were gathered by a series of instrumented Electra aircraft flights that stretched from Belem, at the mouth of the Amazon River, to Tabatinga, on the Brazil-Colombia border, from a base at Manaus, in the heart of the forest. These observations were supplemented by ground-based chemical and meteorological measurements in the dry forest, the Amazon floodplain, and tributary rivers through use of enclosures (for flux measurements), an instrumented tower in the jungle, a large tethered balloon, and weather and ozone sondes. At their peak, the ABLE-2 expeditions involved 60 U.S. scientists and more than 100 Brazilian scientists, working together in the spirit of international, interdisciplinary cooperation essential for the study of global change.

The enormous data base gathered by ABLE-2 will be analyzed by researchers around the world for many years to come. However, early results confirm that both the atmospheric chemistry and the meteorology over Amazonia must play significant roles in global atmospheric change. Among the most noteworthy of the initial findings are the following:

- *Seasonal degradation of Amazonian air quality*
  Air quality above the Amazon jungle is extremely clean during the wet season but deteriorates dramatically during the dry season as the result of biomass burning. (See Figure 2.) This degradation is caused mostly by burning at the edges of the forest. Under the worst conditions, trace-gas concentrations at aircraft altitudes approach those typically observed over industrialized regions. This is a spectacular example of long-range transport of pollution into a pristine environment.

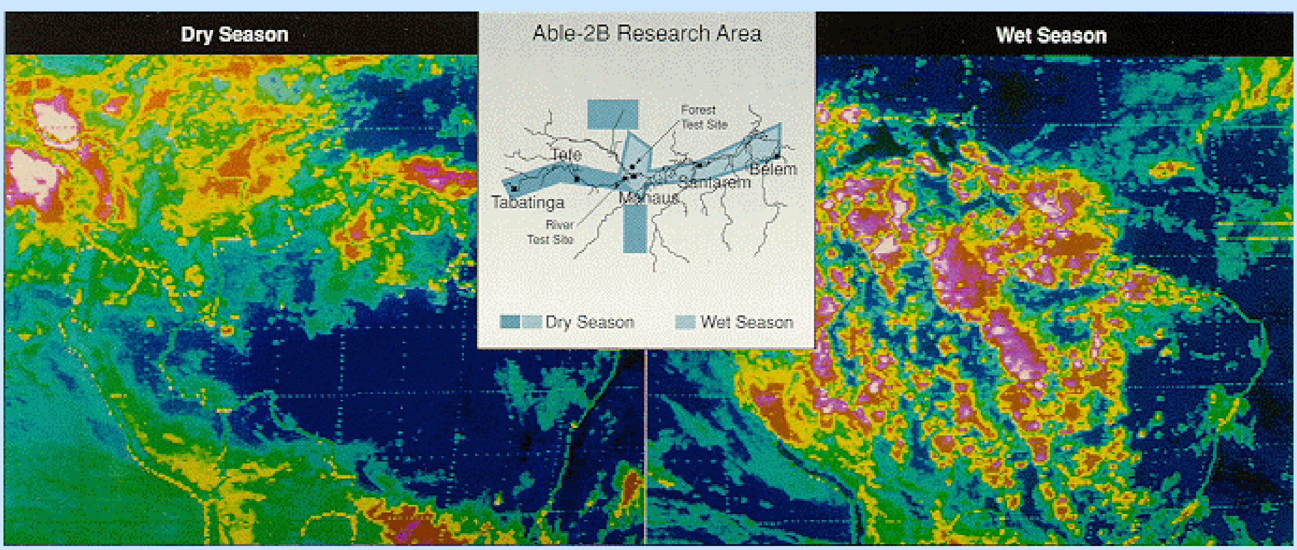

Figure 2. Dramatic Difference in Average Daily Cloud Cover Over Amazon Basin marks transition from dry to wet season, as shown in these environmental satellite images. (Red, yellow; high cloud. Light blue: little or no cloud cover.) ABLE-2 flights spanned the entire basin and obtained data during both seasons.

- *Combustive production of greenhouse gases*
  Biomass burning is also a copious source of such greenhouse gases as CO_2, and CH_4, as well as other pollutants (e.g. CO and oxides of nitrogen). Satellite observations during the dry season have detected some 6,000 fires at the peak of the burning, with associated haze covering millions of square kilometers. (See Figure 3.)

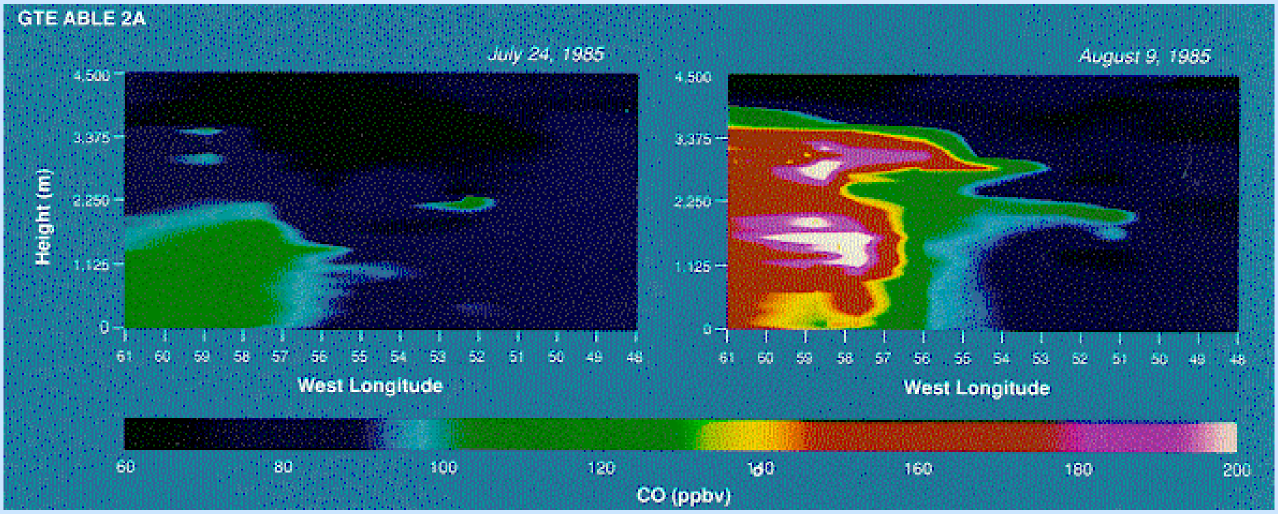

Figure 3. Effect of Biomass Burning is shown by variation of tropospheric carbon monoxide with height above Amazon rainforest and with longitude along Amazon River, as measured by ABLE-2A flights at the end of wet season (July) and beginning of dry season (August). Note enormous CO increase in August as a result of biomass burning.

- *Natural Sink for tropospheric ozone*
  The undisturbed rain forest is the most efficient sink for O_3 yet discovered.Amazonian O_3 decomposition rates were found to be 5 to 50 times higher than those previously measured over pine forest and water surfaces. The disappearance of such a strong ozone sink through deforestation would have global implications for atmospheric chemistry.
- *Methane emissions from Amazonian wetlands*
  The Amazon River floodplain is a globally significant source of methane, supplying about 12% of the estimated worldwide total from all wetlands sources.
- *Enhancement of tropospheric carbon monoxide*
  Over Amazonia, CO is enhanced by factors ranging from 1.2 to 2.7 by comparison with adjacent ocean regions. The major Amazonian sources of CO are isoprene oxidation and biomass burning; the latter probably accounts for the most of the CO enhancement observed by Space Shuttle instruments prior to ABLE-2.
- *Importance of atmospheric circulation over the rainforest*
  ABLE-2 studies of spectacular atmospheric circulations over Amazonia have shed new light on links between the Amazon regions and global circulation. Individual convective storms transport 200 megatons of air per hour, of which 3 megatons is water vapor that releases 100.000 megawatts of energy into the atmosphere through condensation into rain. Replacement of forest with wetlands or pasture is likely to have a large impact on this enormous furnace, with attendant effects on atmospheric circulation patterns, and hence climate.

The changes being produced by deforestation and biomass burning may accelerate the greenhouse effect through a positive-feedback mechanism involving the OH radical, as well as through direct changes in greenhouse-gas source and sink strengths. Most tropospheric trace gases are removed through reactions with OH; as biological combustion processes drive CO, CH_4, and other trace gases to higher aggregate levels, OH levels generally fall. There is thus less OH remaining to retard a growing accumulation of greenhouse gases.

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Data Access:

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