MOPITT
(Measurements of Pollution in the Troposphere)
Version 6 Product User's Guide

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Last Revised September 6, 2013

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1 MOPITT Version 6 Product Highlights

This guide describes new product features in the MOPITT Version 6 (V6) Level 2 and Level 3 products for tropospheric carbon monoxide (CO). V6 product users should also consult the V5 User's Guide (also available on the MOPITT website) since the scientific content of the V5 and V6 products is very similar. Any updates to this document will be announced on the MOPITT News webpage at www.acd.ucar.edu/mopitt/news.shtml.

Major enhancements offered in the V6 product include:

- **Corrected geolocation (latitude and longitude) data. Details in Sec. 3.1.**
- **Use of the NASA MERRA ('Modern-Era Retrospective Analysis For Research And Applications') reanalysis product for meteorological fields and a priori surface skin temperatures instead of NCEP. Details in Sec. 3.2.**
- **Updated CO a priori. Details in Sec. 3.3.**
- **Distribution of V6 Level 2 and Level 3 products in HDF-EOS5 format. Details in Secs. 4.2 and 4.3.**

2 Review of Earlier MOPITT Products

Following the launch of Terra near the end of 1999, the MOPITT Version 3 product became available in 2000 [1]. This was the first satellite dataset for tropospheric CO featuring global coverage. This product was followed in 2009 by the Version 4 (V4) product [2]. Significant improvements first introduced in the V4 product included (1) temporally and geographically variable a priori for CO based on the chemical transport model MOZART, (2) representation of CO variability by log-normal statistics, (3) extension of the forward radiative transfer model MOPFAS to simulate much higher CO concentrations, and (4) improved observation-based a priori values for surface emissivity. Processing of the V4 product ended at the end of 2012. The V5 product became available in 2011 in three retrieval configurations: thermal infrared-only ('TIR-only'), near infrared-only ('NIR-only') and TIR/NIR. (The previous V3 and V4 products were TIR-only products.) V5 retrieval products also benefited from a new time-dependent radiative transfer model to reduce the influence of long-term instrumental degradation on retrieval biases (i.e., 'bias drift'). The V5 product has been validated [3].

3 Features of the MOPITT Version 6 Retrieval Algorithm

Improvements to the content of the V6 retrieval products are described in the following section. In this document, especially significant changes in the V6 product (with respect to both scientific content and format) are emphasized in **bold** text.

3.1 Geolocation Data

A small systematic error in the MOPITT geolocation values (latitude and longitude) was identified after the release of the V5 product. This geolocation error has been eliminated in the V6 product. The source of the bias was found to be a small misalignment between the MOPITT instrument and the Terra platform. A detailed report analyzing this effect is available on the MOPITT website Publications page (http://web3.acd.ucar.edu/mopitt/publications.shtml). This data quality issue should be considered particularly by researchers currently applying MOPITT V4 or V5 products to study CO concentrations on fine spatial scales (e.g., tens of km). In V6 data processing, this problem has been resolved by correcting the table in the Level 1 processor that defines the cross-track and along-track viewing angles for each unique pixel/track/stare position. Thus, geolocation biases have been eliminated in the V6 Level 1, 2, and 3 products.

3.2 Meteorological Fields

For each retrieval, the MOPITT retrieval algorithm requires temperature and water vapor profiles as well as a priori surface temperature values. In previous operational processors, meteorological data were derived from NCEP GDAS (Global Data Assimilation System) analysis products. **For V6 processing, meteorological profiles are derived from the NASA MERRA ('Modern-Era Retrospective Analysis For Research And Applications') reanalysis product (http://gmao.gsfc.nasa.gov/merra/) [4].** The following benefits are anticipated as a result of using MERRA rather than NCEP in MOPITT retrieval processing:

- **Generally higher quality retrieval results due to higher quality water vapor profiles; missing values in NCEP water vapor profiles were previously found to sometimes cause anomalous surface-level CO VMRs offshore California**
- **Higher quality retrieval results over land due to use of hourly-resolved MERRA surface skin temperatures instead of 6-hourly NCEP surface-level air temperatures (a proxy for surface skin temperature)**
- **Higher quality retrieval results due to higher horizontal and vertical spatial resolution in the meteorological fields; MERRA is produced at 1/2 by 2/3 degree (lat/lon) horizontal resolution on a 42-level pressure grid whereas NCEP GDAS products are produced at 1 degree horizontal resolution on a 26-level pressure grid**
- **Improved long-term consistency of retrieval products resulting from use of climate-quality reanalysis instead of output of meteorological forecasting system (NCEP/GDAS)**

3.3 A Priori

Like the V4 and V5 products, the V6 products rely on variable a priori to represent the geographical and seasonal variability of 'background' concentrations of CO. However, whereas for earlier products the a priori was based on a climatology for 1997-2004 and was simulated with the MOZART chemical transport model [2], **for V6 the CO a priori is based on a climatology for 2000-2009 simulated with the CAM-Chem model [5]**. The principal advantage of the new a priori is that is should represent global CO concentrations during the actual MOPITT mission (2000 to present) better than the MOZART climatology. Like the previous MOZART-based climatology, the new CAM-Chem-based climatology is gridded at one degree (lat/lon) horizontal resolution and monthly temporal resolution.

4 Product Format

Beginning with the MOPITT V6 products, the format of the archival Level 1, Level 2 and Level 3 data files is switching from HDF-EOS2, based on HDF4 libraries, to HDF-EOS5, based on HDF5

libraries. This represents a major format change and will require that MOPITT product users make major revisions to the tools which they may currently use for opening and reading the content of MOPITT Level 1, 2, or 3 products. HDF is a standard format for large datasets (http://www.hdfgroup.org/). The HDF-EOS format is an extension of HDF developed by the HDF-EOS group (http://hdfeos.org/index.php).

The reasons for switching from HDF-EOS2 to HDF-EOS5 are (1) expected maintainability and (2) consistency with other EOS satellite trace-gas products. HDF5 is a newer format compared to HDF4 and is less likely to become obsolete (i.e., unmaintained) in the near future. HDF5 is versatile, portable and compatible with a wide range of platforms. HDF-EOS5 is the standard format for all Level 2 and Level 3 products for the OMI, TES, and MLS instruments. Files distributed in the HDF-EOS5 format can be accessed with a wide range of software tools including IDL and MATLAB (http://www.hdfgroup.org/tools/earthscience.html).

4.1 Level 1 Data

Except for the correction of the geolocation data, as described above, the content of the Level 1 product files containing the MOPITT calibrated radiances is unchanged for V6. However, as described above, V6 L1 files are now distributed in the HDF-EOS5 format instead of the HDF-EOS2 format.

4.2 Level 2 Data

The contents of the V6 Level 2 product files are tabulated and compared with the contents of the V5 Level 2 files in Appendix A. **Two minor changes have been made to the contents of the Level 2 product files. First, the a priori total column value has been added; this quantity simply represents the vertically integrated a priori CO profile. Second, the diagnostic 'Water Vapor Climatology Content' has been deleted.** This diagnostic was included in previous products because of a data quality issue with the NCEP water vapor profiles. MERRA-based water vapor profiles are not affected by this issue, and so water vapor climatology plays no role in V6 Level 2 processing.

In addition, Level 2 filenames will no longer include the identifiers 'beta', 'prov' and 'val' to indicate product maturity. In the future, product maturity will be indicated to users through notices on the MOPITT website and through publications.

In the new HDF-EOS5 format, the content is organized within a directory tree. Within this tree, each data product has a specific path. The directory structure of V6 files can be viewed using common tools such as HDFView (http://www.hdfgroup.org/hdf-java-html/hdfview/). Appendix C provides an example of IDL code used to open and read the contents of V6 Level 2 data; this sample program is also available on the MOPITT website.

4.3 Level 3 Data

The contents of the V6 Level 3 product files are tabulated in Appendix B. An example script demonstrating the required IDL commands for opening and reading V6 Level 3 files is listed in Appendix D; this sample program is also available on the MOPITT website.

MOPITT Level 3 data files are produced in HDF-EOS5 format for both individual days and individual months, providing daily-mean and monthly-mean CO distributions and various diagnostics at a resolution of 1 degree (latitude and longitude) respectively. Daytime and nighttime MOPITT observations are processed separately in the Level 3 processing (based on solar zenith angle), and lead to separate daytime and nighttime products within each Level 3 HDF file. Retrieval sensitivity is generally greater for daytime overpasses than for nighttime overpasses, particularly over land. Typically, there exists a corresponding L3 product for each data field in the Level 2 Product. In addition, the number of Level 2 retrievals (or 'Number of Pixels') used as the basis of each Level 3 gridded value is also provided. Moreover, for each retrieved parameter, additional fields provide (1) the mean uncertainty of the Level 2 values and (2) the variability of the Level 2 values as represented by the standard deviation.

For optimum quality, filtering is applied to the Level 2 data in the process of producing Level 3 gridded values. For example, for grid cells overlapping coastline, Level 2 data within that grid cell will often include more than one surface type. Averaging Level 2 data characterized by significantly different averaging kernels, as would occur in this case, should generally be avoided. Other special cases are listed below, together with descriptions of the methods by which such data are processed. If any single surface type constitutes at least 75% of the Level 2 retrievals in a particular grid cell, only retrievals with that surface type are used as the basis of the Level 3 gridded value. If no single surface type constitutes 75% of the available Level 2 retrievals, all of the Level 2 data are retained in the L3 gridded value, and the surface index is set to 2 ('Mixed'). If the L2 retrievals in a particular L3 grid cell contain varying numbers of valid levels (usually because of varying topography), it is determined which case (i.e., number of valid levels) occurs most frequently. Only this subset of L2 retrievals are retained as the basis of the L3 gridded value.

5 Data Quality Issues and Analysis Methods

Relative to the V5 product, data quality has been improved in the V6 product as the result of the geolocation correction (as described in Sec. 3.1) and the use of MERRA meteorological fields instead of NCEP (as described in Sec. 3.2).

However, a new data quality issue has been discovered relating to pixel-dependent noise. The MOPITT instrument employs a linear array of four detector elements (i.e., 'pixels') which are scanned continuously across the track to form the MOPITT swath. A review of the performance of these four detector elements for Channel 7 over the full MOPITT mission has revealed that two of the detector elements (specifically Pixels 3 and 4) exhibit significant variations in instrumental noise. Although we believe that the effects of such noise variations are properly represented in the MOPITT retrieval algorithm, Level 2 retrievals for these two particular pixels may exhibit time-dependent variability with respect to the weighting of a priori information. As instrumental noise increases, retrievals become more strongly weighted by the a priori profile.

This effect could degrade the quality of Level 3 products, particularly for climate analysis. **Therefore, V6 Level 3 products are based exclusively on Pixels 1 and 2; these pixels consistently exhibit lower instrumental noise for Channel 7 compared to Pixels 3 and 4.** Users of the Level 2 product can effectively reproduce (or adapt) this type of filter using the 'SwathIndex' diagnostic which includes the pixel, stare, and track index for each retrieval.

Appropriate methods for analyzing MOPITT products and comparing to other datasets (such as model output) are discussed in Sec. 5 of the V4 User's Guide and Sec. 5 of the V5 User's Guide. **The use of the MOPITT averaging kernels (discussed in the V4 User's Guide) is particularly important when comparing MOPITT retrievals to either in-situ data or model output.** Both the V4 and V5

User's Guides are available on the MOPITT website.

6 References

[1] Deeter, M. N., et al. (2003). Operational carbon monoxide retrieval algorithm and selected results for the MOPITT instrument, J. Geophys. Res. 108, doi:10.1029/2002JD003186.

[2] Deeter, M. N., et al. (2010). The MOPITT version 4 CO product: Algorithm enhancements, validation, and long-term stability. J. Geophys. Res. 115, doi:10.1029/2009JD013005.

[3] Deeter, M. N., et al. (2013). Validation of MOPITT Version 5 Thermal-infrared, near-infrared, and multispectral carbon monoxide profile retrievals for 2000-2011. J. Geophys. Res. Atmos., 118, 6710–6725, doi:10.1002/jgrd.50272.

[4] Rienecker, M. M., et al. (2011). MERRA: NASA's Modern-Era Retrospective Analysis for Research and Applications. J. Climate, 24, 3624-3648, doi:10.1175/JCLI-D-11-00015.1.

[5] Lamarque, J.-F., et al. (2012). CAM-chem: description and evaluation of interactive atmospheric chemistry in the Community Earth System Model, Geosci. Model Dev., 5, 369-411, doi:10.5194/gmd-5-369-2012.

Appendices

A. Contents of V6 Level 2 Product Files (and corresponding V5 fields)

V5 HDF4 Product Label	*V6 HDF5 Product Path*	*Units*	*Dimensions[1]*
Geolocation Fields ('/HDFEOS/SWATHS/MOP02/Geolocation Fields/')			
Seconds in Day	'.../SecondsinDay'	s	ntime
Latitude	'.../Latitude'	deg	ntime
Longitude	'.../Longitude'	deg	ntime
Pressure Grid	'.../Pressure'	hPa	9
Data Fields ('/HDFEOS/SWATHS/MOP02/Data Fields/')			
A Priori CO Mixing Ratio Profile	'.../APrioriCOMixingRatioProfile'	ppbv	2,9,ntime
A Priori CO Surface Mixing Ratio	'.../APrioriCOSurfaceMixingRatio'	ppbv	2,ntime
N/A	'.../APrioriCOTotalColumn'	mol/cm^2	2,ntime
A Priori Surface Emissivity	'.../APrioriSurfaceEmissivity'		2,ntime
A Priori Surface Temperature	'.../APrioriSurfaceTemperature'	K	2,ntime
Cloud Description[2]	'.../CloudDescription'		ntime
DEM Altitude (m)	'.../DEMAltitude'	m	ntime
Degrees of Freedom for Signal	'.../DegreesofFreedomforSignal'		ntime
Level 1 Radiances and Errors	'.../Level1RadiancesandErrors'	W/m^2Sr	2,12,ntime[4]
MODIS Cloud DIagnostics	'.../MODISCloudDiagnostics'		10, ntime
Pressure Grid	'.../PressureGrid'	hPa	9
Retrieval Averaging Kernel Matrix	'.../RetrievalAveragingKernelMatrix'		10,10,ntime[3]
Retrieval Error Covariance Matrix	'.../RetrievalErrorCovarianceMatrix'		10,10,ntime
Retrieval Iterations[2]	'.../RetrievalIterations'		ntime
Retrieved CO Mixing Ratio Profile	'.../RetrievedCOMixingRatioProfile'	ppbv	2,9,ntime
Retrieved CO Surface Mixing Ratio	'.../RetrievedCOSurfaceMixingRatio'	ppbv	2,ntime
Retrieved CO Total Column	'.../RetrrievedCOTotalColumn'	mol/cm^2	2,ntime
Retrieved CO Total Column Diagnostics	'.../RetrievedCOTotalColumnDiagnostics'	mol/cm^2	2,ntime
Retrieved Surface Emissivity	'.../RetrievedSurfaceEmissivity'		2,ntime
Retrieved Surface Temperature	'.../RetrievedSurfaceTemperature'	K	2,ntime
Satellite Zenith Angle	'.../SatelliteZenithAngle'	deg	ntime
Signal Chi2	'.../SignalChi2'		ntime
Solar Zenith Angle	'.../SolarZenithAngle'	deg	ntime
Surface Index[2]	'.../SurfaceIndex'		ntime

V5 HDF4 Product Label	V6 HDF5 Product Path	Units	Dimensions[1]
Surface Pressure	'.../SurfacePressure'	hPa	ntime
Swath Index[2]	'.../SwathIndex'		3, ntime

[1] Array indices ordered according to IDL convention. ntime = number of retrievals (varies), ordered chronologically; for data fields including associated variability/uncertainty, first element is the parameter and second element is variability/uncertainty.

[2] Integer-valued product (all others floating point)

[3] Dimensions of Retrieval Averaging Kernel Matrix are ordered (nrow, ncolumn, ntime)

[4] First index of Level 1 Radiances and Errors corresponds to radiances/uncertainties; second index corresponds to channel (in sequence 7A, 3A, 1A, 5A, 7D, 3D, 1D, 5D, 2A, 6A, 2D, 6D).

B. Contents of V6 Level 3 Product Files

All Fields ('/HDFEOS/GRIDS/MOP03/Data Fields/')		
V6 HDF5 Product Path	**Units**	**Dimensions[1]**
'.../Latitude'	deg	nlat
'.../Longitude'	deg	nlon
'.../Pressure'	hPa	nprs
'.../Pressure2'	hPa	nprs2
'.../APrioriCOMixingRatioProfileDay'	ppbv	nprs,nlat,nlon
'.../APrioriCOMixingRatioProfileNight'	ppbv	nprs,nlat,nlon
'.../APrioriCOSurfaceMixingRatioDay'	ppbv	nlat,nlon
'.../APrioriCOSurfaceMixingRatioNight'	ppbv	nlat,nlon
'.../APrioriCOTotalColumnDay'	mol/cm^2	nlat,nlon
'.../APrioriCOTotalColumnNight'	mol/cm^2	nlat,nlon
'.../APrioriSurfaceEmissivityDay'	dim'less	nlat,nlon
'.../APrioriSurfaceEmissivityNight'	dim'less	nlat,nlon
'.../APrioriSurfaceTemperatureDay'	K	nlat,nlon
'.../APrioriSurfaceTemperatureNight'	K	nlat,nlon
'.../DEMAltitudeDay'	m	nlat,nlon
'.../DEMAltitudeNight'	m	nlat,nlon
'.../DEMAltitudeVariabilityDay'	m	nlat,nlon
'.../DEMAltitudeVariabilityNight'	m	nlat,nlon
'.../DegreesofFreedomforSignalDay'	dim'less	nlat,nlon
'.../DegreesofFreedomforSignalNight'	dim'less	nlat,nlon
'.../RetrievalAveragingKernelMatrixDay'	dim'less	nprs2,nprs2,nlat,nlon [3]

All Fields ('/HDFEOS/GRIDS/MOP03/Data Fields/')		
'.../RetrievalAveragingKernelMatrixNight'	dim'less	nprs2,nprs2,nlat,nlon [3]
'.../RetrievedCOMixingRatioProfileDay'	ppbv	nprs,nlat,nlon
'.../RetrievedCOMixingRatioProfileNight'	ppbv	nprs,nlat,nlon
'.../RetrievedCOMixingRatioProfileMeanUncertaintyDay '	ppbv	nprs,nlat,nlon
'.../RetrievedCOMixingRatioProfileMeanUncertaintyNight '	ppbv	nprs,nlat,nlon
'.../RetrievedCOMixingRatioProfileVariabilityDay '	ppbv	nprs,nlat,nlon
'.../RetrievedCOMixingRatioProfileVariabilityNight '	ppbv	nprs,nlat,nlon
'.../RetrievedCOSurfaceMixingRatioDay'	ppbv	nlat,nlon
'.../RetrievedCOSurfaceMixingRatioNight'	ppbv	nlat,nlon
'.../RetrievedCOSurfaceMixingRatioMeanUncertaintyDay '	ppbv	nlat,nlon
'.../RetrievedCOSurfaceMixingRatioMeanUncertaintyNight '	ppbv	nlat,nlon
'.../RetrievedCOSurfaceMixingRatioVariabilityDay '	ppbv	nlat,nlon
'.../RetrievedCOSurfaceMixingRatioVariabilityNight '	ppbv	nlat,nlon
'.../RetrievedCOTotalColumnDay'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnNight'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnMeanUncertaintyDay'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnMeanUncertaintyNight'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnVariabilityDay'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnVariabilityNight'	mol/cm^2	nlat,nlon
'.../RetrievedCOTotalColumnDiagnosticsDay'	dim'less	nlat,nlon
'.../RetrievedCOTotalColumnDiagnosticsNight'	dim'less	nlat,nlon
'.../RetrievedSurfaceTemperatureDay'	K	nlat,nlon
'.../RetrievedSurfaceTemperatureNight'	K	nlat,nlon
'.../RetrievedSurfaceTemperatureMeanUncertaintyDay'	K	nlat,nlon
'.../RetrievedSurfaceTemperatureMeanUncertaintyNight'	K	nlat,nlon
'.../RetrievedSurfaceTemperatureVariabilityDay'	K	nlat,nlon
'.../RetrievedSurfaceTemperatureVariabilityNight'	K	nlat,nlon
'.../RetrievedSurfaceEmissivityDay'	dim'less	nlat,nlon
'.../RetrievedSurfaceEmissivityNight'	dim'less	nlat,nlon
'.../RetrievedSurfaceEmissivityMeanUncertaintyDay'	dim'less	nlat,nlon
'.../RetrievedSurfaceEmissivityMeanUncertaintyNight'	dim'less	nlat,nlon
'.../RetrievedSurfaceEmissivityVariabilityDay'	dim'less	nlat,nlon
'.../RetrievedSurfaceEmissivityVariabilityNight'	dim'less	nlat,nlon
'.../SatelliteZenithAngleDay'	deg	nlat,nlon
'.../SatelliteZenithAngleNight'	deg	nlat,nlon
'.../SignalChi2Day'	dim'less	nlat,nlon

All Fields ('/HDFEOS/GRIDS/MOP03/Data Fields/')		
'.../SignalChi2Night'	dim'less	nlat,nlon
'.../SignalChi2VariabilityDay'	dim'less	nlat,nlon
'.../SignalChi2VariabilityNight'	dim'less	nlat,nlon
'.../SolarZenithAngleDay'	deg	nlat,nlon
'.../SolarZenithAngleNight'	deg	nlat,nlon
'.../SurfaceIndexDay' [2]	dim'less	nlat,nlon
'.../SurfaceIndexNight' [2]	dim'less	nlat,nlon
'.../SurfacePressureDay'	hPa	nlat,nlon
'.../SurfacePressureNight'	hPa	nlat,nlon
'.../NumberofPixelsDay' [2]	dim'less	nlat,nlon
'.../NumberofPixelsNight' [2]	dim'less	nlat,nlon

[1] Array indices ordered according to IDL convention. Standard values for nlat, nlon, nprs and nprs2 are 180, 360, 9, and 10, respectively.

[2] Integer-valued product (all others floating point).

[3] **The dimensions of the four-dimensional Retrieval Averaging Kernel Matrix Day and Retrieval Averaging Kernel Matrix Night products are ordered in IDL as (nrow, ncolumn, nlat, nlon).**

C. Sample IDL Code for Opening and Reading V6 Level 2 files

```
pro example_v6_lev2

; 8/30/2013

; Merritt Deeter (mnd@ucar.edu), MOPITT/NCAR Project Leader

; sample IDL code for opening and reading MOPITT Version 6 Level 2 files

; note different paths for 'Geolocation Fields' and 'Data Fields'

infile = 'MOP02T-20030101-L2V16.2.1.he5'

print, infile

print, 'open hdf5 file'
file_id = H5F_OPEN(infile)

; read latitudes into variable 'moplat'
print, 'read latitudes'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/SWATHS/MOP02/Geolocation Fields/Latitude')
moplat = H5D_Read(dataset_id)
```

```
H5D_CLOSE, dataset_id

; read longitudes into variable 'moplon'
print, 'read longitudes'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/SWATHS/MOP02/Geolocation Fields/Longitude')
moplon = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read retrieved profiles into variable 'rtvprofl'
print, 'read retrieved CO profiles'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/SWATHS/MOP02/Data Fields/RetrievedCOMixingRatioProfile')
rtvprofl = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read averaging kernel matrices into variable 'avkrn'
print, 'read AK matrix'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/SWATHS/MOP02/Data Fields/RetrievalAveragingKernelMatrix')
avkrn = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

H5F_CLOSE, file_id

; print lat and lon of first retrieval
print, moplat(0), moplon(0)
; print retrieved profile of first retrieval (fixed-levels only, surface retrieval missing)
print, rtvprofl(0,0:8,0)
; print AK matrix for first retrieval
print, avkrn(0:9,0:9,0)

return
end
```

D. Sample IDL Code for Opening and Reading V6 Level 3 files

```
pro example_v6_lev3

; 8/30/2013

; Merritt Deeter (mnd@ucar.edu), MOPITT/NCAR Project Leader

; sample IDL code for opening and reading MOPITT Version 6 Level 3 files

; contents of V6 daily and monthly L3 files are identical - following IDL code can be used
; for either type of L3 file

infile = 'MOP03JM-200610-L3V94.2.3.he5'

print, infile
```

```
print, 'open hdf5 file'
file_id = H5F_OPEN(infile)

; read latitude grid into variable 'latgrid'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/Latitude')
latgrid = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read longitude grid into variable 'longrid'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/Longitude')
longrid = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read gridded surface pressure (daytime) values into variable 'psfc_dy'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/SurfacePressureDay')
psfc_dy = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read gridded CO retrieved CO profiles (daytime) into variable 'cortv_dy'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/RetrievedCOMixingRatioProfileDay')
cortv_dy = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read gridded CO retrieved surface-level CO (daytime) into variable 'cosfcrtv_dy'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/RetrievedCOSurfaceMixingRatioDay')
cosfcrtv_dy = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

; read averaging kernel matrices (daytime) into variable 'ak_dy'
dataset_id = H5D_OPEN(file_id, '/HDFEOS/GRIDS/MOP03/Data Fields/RetrievalAveragingKernelMatrixDay')
ak_dy = H5D_Read(dataset_id)
H5D_CLOSE, dataset_id

H5F_CLOSE, file_id

; print lat and lon of grid cell at 0.5 degs N, 0.5 deg E
print, latgrid(90), longrid(180)
; print gridded surface pressure at 0.5 degs N, 0.5 deg E
print, psfc_dy(90,180)
; print gridded CO profile at 0.5 degs N, 0.5 deg E
print, [cosfcrtv_dy(90,180),cortv_dy(0:8,90,180)]
; print gridded AK matrix at 0.5 degs N, 0.5 deg E
print, reform(ak_dy(0:9,0:9,90,180),10,10)

return
end
```