

PseudoNetCDF v3: A new interface and useful examples

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Overview

PseudoNetCDF development began in 2006 at UNC. Many things have changed, and everything is easier. Simple core functions enable easy analyses or can be combined to make complex analyses.

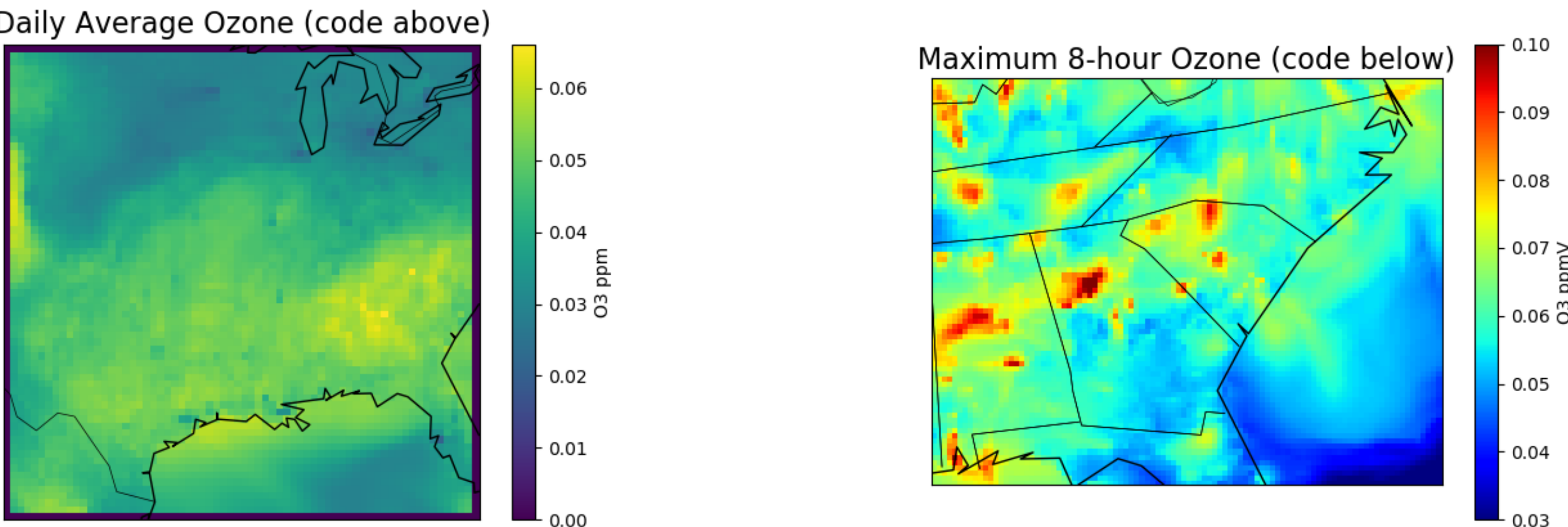
- How to:
- `pncopen` : Returns CMAQ, CAMx, GEOS-Chem, MOZART4, or WRF file
 - `sliceDimensions` : slices or windows file variables
 - `applyAlongDimensions` : applies functions over dimensions
 - `ll2ij`, `time2t`, `interpSigma` : convert between coordinates and indices
 - `plot` : easy access plotting functionality via matplotlib
 - `more` : `mask`, `insertDimension`, `copyVariable`, ...

Common Imports for All Examples

```
import pandas as pd
import numpy as np
import matplotlib as mpl
import matplotlib.pyplot as plt
import PseudoNetCDF as pnc
```

Plotting Maps Is Easy and Powerful

```
path = 'CAMx.v6.40.midwest.36.12.noMPI.20020603.avrg.grd01'
xf = pnc.pncopen(path, format='uamiv') # open CAMx uamiv file
ax = xf.plot('O3') # implicit time averaging
ax.set_title('Daily Average Ozone (code above)', fontsize=16)
ax.figure.savefig('O3.png')
```



```
def mda8(hourly):
    nhrs = 8
    a8 = np.convolve([1./nhrs]*nhrs, hourly, mode='full')
    return a8[nhrs-1:].reshape(-1, 24).max(1)

path = 'CCTM_ACONC_v52_cb6r3_intel17.0_SE52BENCH.20110701.nc'
qf = pnc.pncopen(path, format='ioapi').subsetVariables(['O3'])

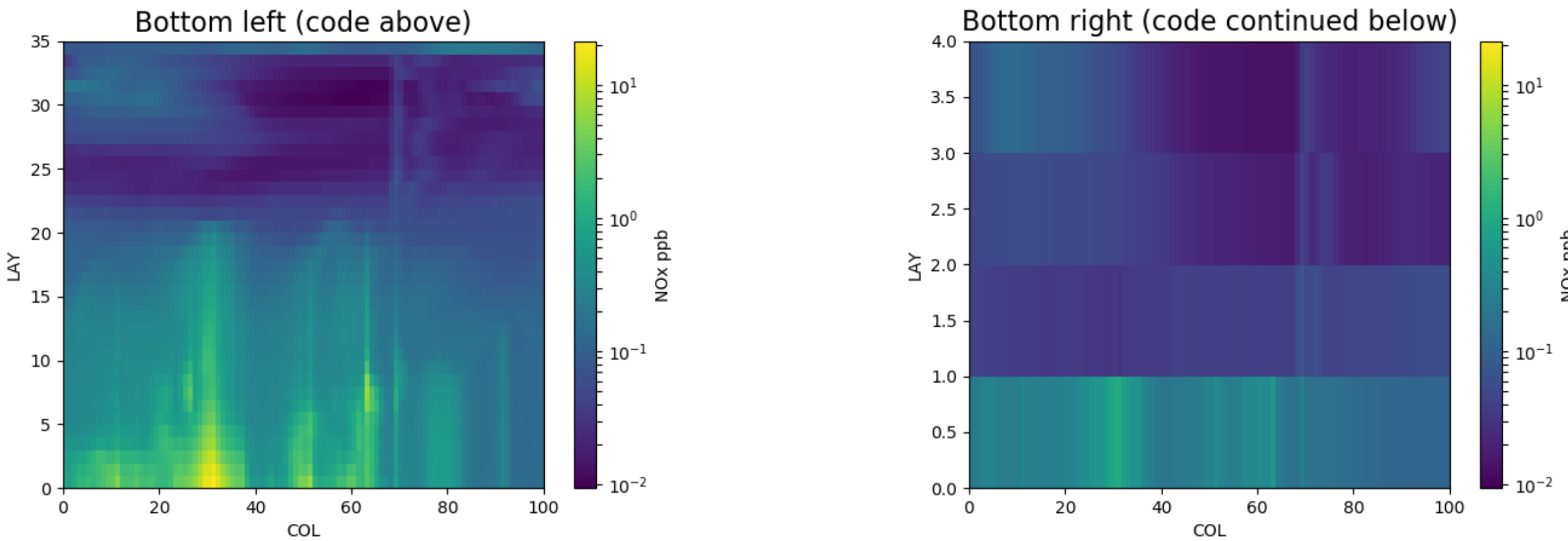
wqf = qf.sliceDimensions(ROW=slice(1, -1), COL=slice(1, -1))
mqf = wqf.applyAlongDimensions(TSTEP=mda8)

opts = dict(cmap='jet', vmin=0.03, vmax=0.1)
ax = mqf.plot('O3', plot_kw=opts, map_kw=dict(states=True))
ax.set_title('Maximum 8-hour Ozone (code below)', fontsize=16)
ax.figure.savefig('O3_custom.png')
```

Subsetting, Expressions, and Vertical Interp

```
path = 'CCTM_CONC_v52_cb6r3_intel17.0_SE52BENCH.20110701.nc'
inpf = pnc.pncopen(path, format='ioapi')
# Use short aliases to get row 40 NO and NO2
rf = inpf.subset(['NO', 'NO2']).slice(ROW=40)
# Calculate NOx
ef = rf.eval('NOx=(NO[:]+NO2[:])*1000; NOx.units="ppb"')

opts = {'norm': mpl.colors.LogNorm()}
ax = ef.plot('NOx', plottype='COL-LAY', plot_kw=opts)
ax.set_title('Bottom left (code above)', size=16)
```



```
# collapse to arbitrary 4 layer structure
zf = ef.interpSigma([1, .75, .5, .25, 0], vgtop=5000)
plt.close()
ax = zf.plot('NOx', plottype='COL-LAY', plot_kw=opts)
ax.set_title('Bottom right (code continued below)', size=16)
ax.figure.savefig('NOx.newZ.png')
```

Sonde Evaluation

```
from glob import glob
path = 'CCTM_CONC_v52_cb6r3_intel17.0_SE52BENCH.20110701.nc'
qf = pnc.pncopen(path, format='ioapi').subsetVariables(['O3'])

paths = glob('data/hu???_2011_07_??_18.l100')
sfs = [pnc.pncopen(path, format='l100') for path in paths]

lon, lat = sfs[0].variables['longitude'], sfs[0].variables['latitude']
i, j = qf.ll2ij(lon, lat)

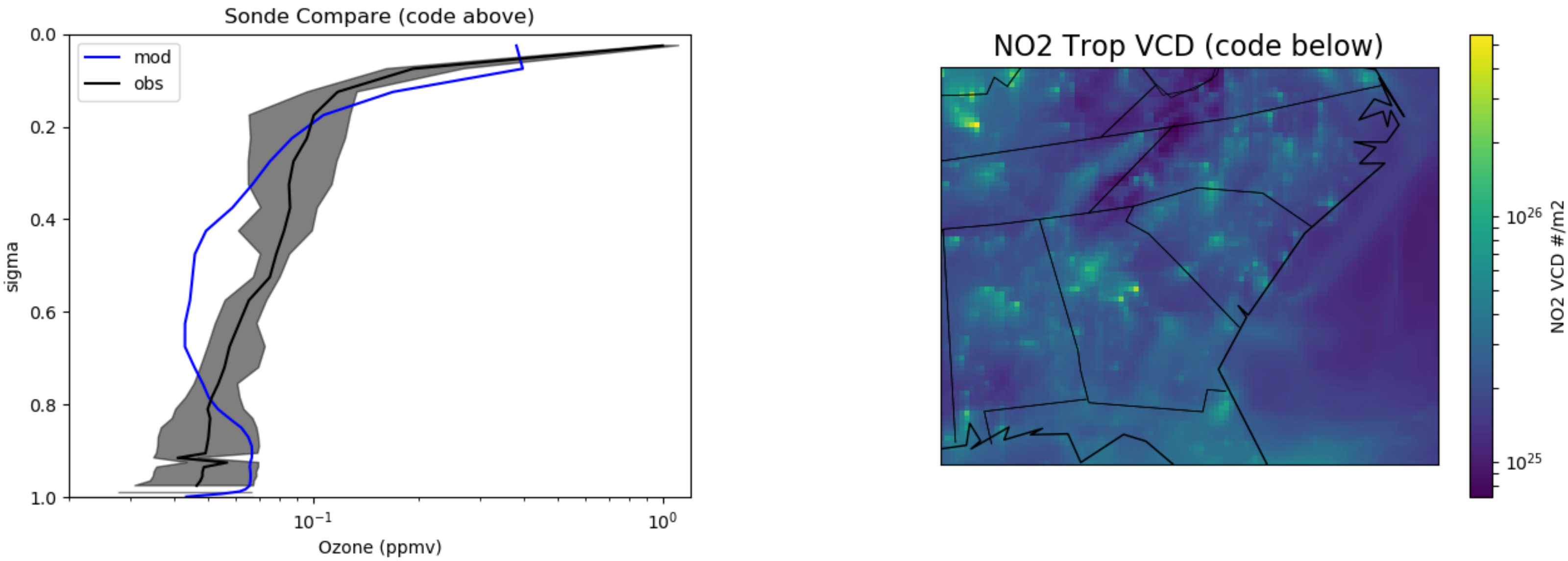
qsf = qf.apply(TSTEP='mean').slice(TSTEP=0*j, ROW=j, COL=i, newdims=('site',))

sqfs = [sf.avgSigma(qf.VGLVLS, vgtop=qf.VGTOP).mask(less=0) for sf in sfs]

so3 = np.ma.masked_less([sqf.variables['O3'][0] for sqf in sqfs], 0)

z = (qf.VGLVLS[1:] + qf.VGLVLS[-1]) / 2

ax = plt.gca(
    ylabel='sigma', xlabel='Ozone (ppmv)',
    xscale='log', xlim=(.02, 1.2), ylim=(1, 0)
)
ax.plot(qsf.variables['O3'][0], z, label='mod', color='blue')
ax.plot(so3.mean(0), z, color='k', label='obs')
ax.fill_betweenx(y=z, x1=so3.min(0), x2=so3.max(0), color='k', alpha=.5)
ax.set_title('Sonde Compare (code above)')
plt.legend()
ax.figure.savefig('sonde.png')
```



Vertical Column Density (like Satellites)

```
path = 'CCTM_CONC_v52_cb6r3_intel17.0_SE52BENCH.20110701.nc'
cf = pnc.pncopen(path, format='ioapi').subsetVariables(['NO', 'NO2'])

mpath = 'METCRO3D_110701.nc'
mf = pnc.pncopen(mpath, format='ioapi').subsetVariables(['DENS', 'ZF', 'ZH'])
mf.copyVariable(cf.variables['NO2'], key='NO2')

vf = mf.eval("""DZ=ZF*1; ZF[:, :1:] = ZF[:, :1:] - ZF[:, :-1];
NO2MOL = NO2 * DENS / 0.287 * 2 * DZ * 6.022e23
""")
# approximate tropospheric top layers 0 to 29 (fortran 1 to 30)
vcdf = vf.sliceDimensions(LAY=slice(0, 30)).applyAlongDimensions(LAY='sum')
# plotting not shown, figure above
```

More Information

On Your Computer

- `pydoc` PseudoNetCDF
- `python` 'help' function

Online (below)

- github.com/barronh/pseudonetcdf
- pseudonetcdf.readthedocs.io

3.0.1

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PseudoNetCDF User's Guide

About

The key value of PseudoNetCDF is netcdf-like access to complex data formats in the air quality field.

PseudoNetCDF was created to provide netcdf-like (see netCDF4) access air quality data written in other formats. The interface was designed based on Scientific.io.netcdf and netcdf4-python. Then it grew to provide meta-data aware spatial and temporal processing, some inspired by xarray and pandas.

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See also Byeong-Uk Kim's poster and Barry Baker's MONTET