In [1]:
```
import xarray as xr
import numpy as np
from matplotlib import pyplot as plt

from pyzome.basic import zonal_mean, meridional_mean
```

In [2]:
```
# Direct link to data: https://www.ncei.noaa.gov/data/sudden-stratospheric-warming-compendium/access/SSWC_v1.0_varFull_ERAi_d20130106_s20121107_e20130307_c20160701.nc

# Other files available at (want files with "varFull" in the name): https://www.ncei.noaa.gov/data/sudden-stratospheric-warming-compendium/access/
# Further details about these reanalysis data subsets are at: https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00960#OnlineAccess


ds = xr.open_dataset('/home/zdl/Downloads/SSWC_v1.0_varFull_ERAi_d20130106_s20121107_e20130307_c20160701.nc')
ds
```

Out[2]:

xarray.Dataset

▸ Dimensions: (**timeEv60**: 121, **lon**: 144, **lat**: 73, **pres**: 37, **theta**: 10, **sfcLon**: 512, **sfcLat**: 256, nv: 2)

▾ Coordinates:

timeEv60	(timeEv60)	object	2012-11-07 00:00:00 ... 2013-03-...	
lon	(lon)	float32	-180.0 -177.5 ... 175.0 177.5	
lat	(lat)	float32	-90.0 -87.5 -85.0 ... 87.5 90.0	
pres	(pres)	float32	1.0 2.0 3.0 ... 950.0 975.0 1e+03	
theta	(theta)	float32	1e+03 850.0 700.0 ... 350.0 330.0	
sfcLon	(sfcLon)	float32	-180.0 -179.3 ... 178.6 179.3	
sfcLat	(sfcLat)	float32	-89.46 -88.77 ... 88.77 89.46	

▸ Data variables: (22)

▸ Attributes: (29)

In [3]:
```
## If you do not want to download data to disk, you could also stream the data into
## memory from the internet if you have h5netcdf installed in your environment.
## The time this takes will depend on your network speed.
## Just uncomment the following code.

# import io
# import urllib.request

# url = 'https://www.ncei.noaa.gov/data/sudden-stratospheric-warming-compendium/access/SSWC_v1.0_varFull_ERAi_d20130106_s20121107_e20130307_c20160701.nc'
# request = urllib.request.Request(url)

# with urllib.request.urlopen(request) as response:
#     ds = xr.open_dataset(io.BytesIO(response.read()))

# ds
```

In [4]:
```
# These files contain a lot of data we don't necessarily need.
# Let's also simplify the variable names.

ds = ds[['uwndFull_TS','vwndFull_TS','tempFull_TS','geopFull_TS']]

ds = ds.rename({'timeEv60':'time',
                'lat':'latitude', # pyzome currently expects dimensions named latitude and longitude
                'lon':'longitude',
                'uwndFull_TS':'u',
                'vwndFull_TS':'v',
                'tempFull_TS':'T',
                'geopFull_TS':'Z'})
ds
```

Out[4]:

xarray.Dataset

▸ Dimensions: (**time**: 121, **pres**: 37, **latitude**: 73, **longitude**: 144)

▾ Coordinates:

time	(time)	object	2012-11-07 00:00:00 ... 2013-03-...	
longitude	(longitude)	float32	-180.0 -177.5 ... 175.0 177.5	
latitude	(latitude)	float32	-90.0 -87.5 -85.0 ... 87.5 90.0	
pres	(pres)	float32	1.0 2.0 3.0 ... 950.0 975.0 1e+03	

▾ Data variables:

u	(time, pres, latitude, longitude)	float32	...	
v	(time, pres, latitude, longitude)	float32	...	
T	(time, pres, latitude, longitude)	float32	...	
Z	(time, pres, latitude, longitude)	float32	...	

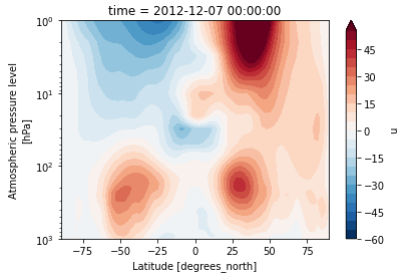
▸ Attributes: (29)

In [5]:
```
uzm = zonal_mean(ds.u)
Tzm = zonal_mean(ds.T)

T_6090 = meridional_mean(Tzm, 60, 90) # polar cap average of temperatures from 60-90N
```

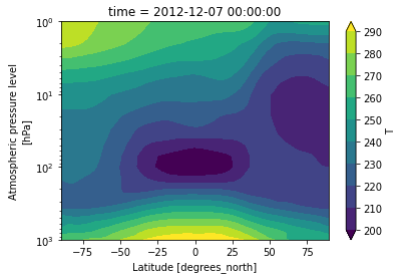
In [6]:
```
fig = plt.figure(0)

# Try varying the index of the time. 60 should be the date of
# a sudden stratospheric warming.
uzm.isel(time=30).plot.contourf(levels=np.arange(-60,60,5))
plt.gca().invert_yaxis()
plt.gca().set_yscale('log')
```



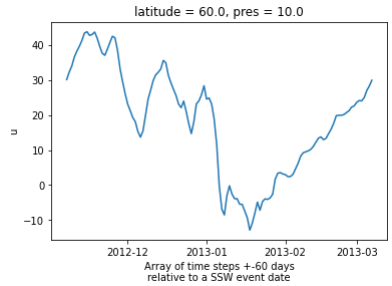
In [7]:
```
fig = plt.figure(0)

# Try varying the index of the time. 60 should be the date of
# a sudden stratospheric warming.
Tzm.isel(time=30).plot.contourf(levels=np.arange(200,300,10))
plt.gca().invert_yaxis()
plt.gca().set_yscale('log')
```



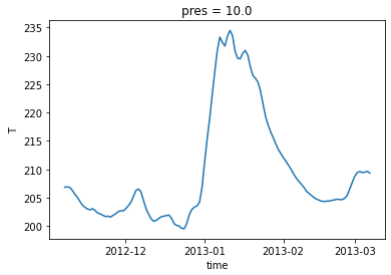
In [8]:
```
# Zonal mean zonal wind plot at 10 hPa, 60N
uzm.sel(latitude=60,pres=10).plot()
```

Out[8]:
```
[<matplotlib.lines.Line2D at 0x7f027d577730>]
```



In [9]:
```
# Polar cap temperature plot at 10 hPa
T_6090.sel(pres=10).plot()
```

Out[9]:
```
[<matplotlib.lines.Line2D at 0x7f027c1ce7f0>]
```



In [ ]: