CINWPR

CINWPR library is suitable for processing wind profile radar data that meet the common data format V1.2 of the Wind Profile Radar of the China Meteorological Administration(CMA). It currently contains three modules: RWP_READ, RWP_ANALYSIS and RWP_DRAW.

In [1]:
```
import os
import numpy as np
import xarray as xr
import warnings
import datetime
import matplotlib.pyplot as plt
```

RWP_READ

In [2]:
```
from CINWPR import RWP_READ
```

The RWP_READ module contains two classes Read_RWP_Data and Read_Muti_RWP_Data, which are suitable for reading single and multiple wind profile radar data respectively.

In [14]:
```
singal_file=RWP_READ.Read_RWP_Data('Z_RADA_I_58637_20220425000600_O_WPRD_LC_
```

Read_RWP_Data

The Read_RWP_Data class contains three functions: Get_data,Get_Radar_RAD_Model_info and Get_Radar_FFT_Model_info, which are used to read the basic data information of the data file respectively. Radar performance parameters and observation parameters in RAD file and FFT file. The class itself also contains some basic site information attributes.

In [ ]:
```
'''
singal_file.lat->浮点类型：站点纬度
singal_file.lon->浮点类型：站点经度
singal_file.height->浮点类型：测站海拔高度
singal_file.time->数据文件时间
singal_file.datatype->文件数据类型
'''
```

In [15]:
```
singal_file.Get_data(GMT=False)
#GMT参数默认为关闭状态，此时文件时间将为北京时，若将此参数打开将会返回世界时
```

Out[15]: xarray.Dataset

▸ Dimensions: (**Level_L**: 33, **Beam_num_L**: 5, **Level_M**: 32, **Beam_num_M**: 5)

▾ Coordinates:

Level_L	(Level_L)	int64	150 270 390 510 ... 37…
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1470 1710 1950 ... 84…
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5

▾ Data variables:

Velocity_spectr…	(Beam_num_L, Level_L)	float64	0.0 0.0 0.4 0.7 ... 0.3 0…
SNR_L	(Beam_num_L, Level_L)	float64	16.2 20.1 20.2 ... 12.8 …
Radial_velocity_L	(Beam_num_L, Level_L)	float64	-0.1 0.2 0.1 -0.4 ... 1.6…
Velocity_spectr…	(Beam_num_M, Level_M)	float64	0.4 0.5 ... -9.999e+03 …
SNR_M	(Beam_num_M, Level_M)	float64	19.6 22.8 ... -9.999e+…
Radial_velocity_M	(Beam_num_M, Level_M)	float64	-3.0 -4.0 ... -9.999e+0…

▾ Attributes:

Description : 站号:58637(028.4500,0117.9300) 站点高度:00150.0m 观测时间:2022-04-25 00:06:00(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据

In [16]:
```
Rad_Para,Obs_Para=singal_file.Get_Radar_RAD_Model_info(GMT=False)
```

In [17]:
```
Rad_Para
```

Out[17]:

	天线增益	馈线损耗	东波束-铅垂线夹角	西波束-铅垂线夹角	南波束-铅垂线夹角	北波束-铅垂线夹角	中波束(行)-铅垂线夹角	中波束(列)-铅垂线夹角	波束数	采样频率	发射波长	脉冲重复频率	脉冲宽度	水平波束宽度	垂直波束宽度	发…
Low	33	3.5	16.4	16.4	16.4	16.4	0.0	0.0	5	0	232	27777	0.8	3	3	2.(
Medium	33	3.5	16.4	16.4	16.4	16.4	0.0	0.0	5	0	232	10416	6.4	3	3	2.(

In [18]:
```
Obs_Para
```

Out[18]:

	时间来源	观测开始时间	观测结束时间	标校状态	非相干积累	相干积累	Fft点数	谱平均数	波束顺序标志	东波束方位角修正值	西波束方位角修正值	南波束方位角修正值
Low	计算机时钟	2022-04-25 00:00:00	2022-04-25 00:06:00	自动标校	24.0	100.0	256.0	24.0	ENRWS/	-27.0	-27.0	-27.0
Medium	未知时间来源	2022-04-25 00:00:00	2022-04-25 00:06:00	未知标校	26.0	40.0	256.0	26.0	ENRWS/	-27.0	-27.0	-27.0

In [20]:
```
singal_file=RWP_READ.Read_RWP_Data('Z_RADA_I_58637_20220425000600_P_WPRD_LC_
singal_file.Get_data(GMT=False)
```

Out[20]: xarray.Dataset

▶ Dimensions: (**Level**: 45)

▼ Coordinates:

Level	(Level)	float64	150.0 270.0 ... 8.67e+03 8.91e+03

▼ Data variables:

Wind_direction	(Level)	float64	274.0 123.0 ... -9.999e+03
Horizontal_speed	(Level)	float64	1.0 0.9 ... -9.999e+03 -9.999e+03
Vertical_speed	(Level)	float64	-0.0 0.1 -0.0 0.1 ... 0.0 0.0 0.0
Horizontal_confi…	(Level)	float64	100.0 100.0 100.0 ... 0.0 0.0 0.0
Vertical_confide…	(Level)	float64	100.0 100.0 100.0 ... 0.0 0.0 0.0
Vertical_CN2	(Level)	float64	1.2e-18 4.1e-16 ... 3.4e-20 2.4e-20

▼ Attributes:

Description : 站号:58637(028.4500,0117.9300) 站点高度:00150.0m 观测时间:2022-04-25 00:06:00(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:产品数据->实时采样高度产品数据

In [22]:
```
singal_file=RWP_READ.Read_RWP_Data('Z_RADA_I_58637_20220425000600_O_WPRD_LC_
singal_file.Get_data(GMT=False)
```

Out[22]: xarray.Dataset

▶ Dimensions: (**Beam_Num_L**: 5, **Level_L**: 33, **FFT_Point_L**: 256, **Beam_Num_M**: 5, **Level_M**: 32, **FFT_Point_M**: 256)

▼ Coordinates:

Beam_Num_L	(Beam_Num_L)	int64	1 2 3 4 5
Level_L	(Level_L)	int64	150 27…
FFT_Point_L	(FFT_Point_L)	float64	1.0 2.0…
Beam_Num_M	(Beam_Num_M)	int64	1 2 3 4 5
Level_M	(Level_M)	int64	1470 1…
FFT_Point_M	(FFT_Point_M)	float64	1.0 2.0…

▼ Data variables:

FFT_L	(Beam_Num_L, Level_L, FFT_Point_L)	float64	0.0036…
FFT_M	(Beam_Num_M, Level_M, FFT_Point_M)	float64	0.6714…

▼ Attributes:

Description : 站号:58637(28.45,117.93) 站点高度:150.0m 观测时间:2022-04-25 00:06:00(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->功率谱数据

In [23]:
```
Rad_Para,Obs_Para=singal_file.Get_Radar_FFT_Model_info(GMT=False)
```

In [24]:
```
Rad_Para
```

Out[24]:

	天线增益	馈线损耗	东波束-铅垂线夹角	西波束-铅垂线夹角	南波束-铅垂线夹角	北波束-铅垂线夹角	中波束(行)-铅垂线夹角	中波束(列)-铅垂线夹角	扫描波束数	采样频率	...	脉
Low	33	3.5	16.419998	16.419998	16.419998	16.419998	0.0	0.0	5	0	...	27
Medium	33	3.5	16.419998	16.419998	16.419998	16.419998	0.0	0.0	5	0	...	10

2 rows × 21 columns

In [25]:
```
Obs_Para
```

Out[25]:

	观测开始时间	时间来源	标校状态	波束方向改变	观测结束时间	非相干累计	相干累计	Fft点数	谱平均数	波束顺序标志	有效波束	东波束方位角修正值	西
Low	2022-04-25 00:00:00	计算机时钟	自动标校	0.0	2022-04-25 00:06:00	24.0	100.0	256.0	24.0	ENRWS/	5	-27.0	-2
Medium	2022-04-25 00:00:00	计算机时钟	自动标校	1.0	2022-04-25 00:06:00	26.0	40.0	256.0	26.0	ENRWS/	5	-27.0	-2

Read_Muti_RWP_Data

In [30]:
```
filelist[40:50]
```

Out[30]:
```
['Z_RADA_I_54399_20190910030244_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910030712_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910031143_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910031609_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910032039_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910032509_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910032939_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910033410_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910033840_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910034310_O_WPRD_LC_RAD.TXT']
```

In [31]:
```
list_file=RWP_READ.Read_Muti_RWP_Data(filelist[40:50])
```

The RWP_READ.Read_Muti_RWP_Data class contains only the Get_Muti_Data function and some basic data information.

In [ ]:
```
'''
list_file.lat->浮点类型：站点纬度
list_file.lon->浮点类型：站点经度
list_file.height->浮点类型：测站海拔高度
list_file.start_time->数据文件开始时间
list_file.end_time->数据文件结束时间
list_file.datatype->文件数据类型
list_file.state->多文件实时间均一性参量，若为1表示为非均匀数据，0表示为均匀数据
'''
```

In [33]:
```
list_file.Get_Muti_Data()
```

Out[33]: xarray.Dataset

▸ Dimensions: (**Time**: 10, **Level_L**: 30, **Beam_num_L**: 5, **Level_M**: 30, **Beam_num_M**: 5, **Level_H**: 30, **Beam_num_H**: 5)

▾ Coordinates:

Time	(Time)	float64	0.0 268.0 ... 2.1…
Level_L	(Level_L)	int64	150 270 390 51…
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1110 1230 1350…
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5
Level_H	(Level_H)	int64	3150 3390 3630…
Beam_num_H	(Beam_num_H)	int32	1 2 3 4 5

▾ Data variables:

Ori_Time	(Time)	<U19	'2019-09-10 03:…
SNR_H	(Time, Beam_num_H, Level_H)	float64	13.5 14.0 13.7 1…
Velocity_spectr…	(Time, Beam_num_M, Level_M)	float64	2.0 3.6 3.5 2.1 .....
Velocity_spectr…	(Time, Beam_num_H, Level_H)	float64	1.7 1.6 1.6 1.7 .....
SNR_M	(Time, Beam_num_M, Level_M)	float64	17.5 14.9 13.4 .....
Radial_velocity_M	(Time, Beam_num_M, Level_M)	float64	3.8 3.2 3.4 4.1 .....
Velocity_spectr…	(Time, Beam_num_L, Level_L)	float64	2.6 2.2 2.2 2.0 .....
SNR_L	(Time, Beam_num_L, Level_L)	float64	20.8 25.0 27.5 .....
Radial_velocity_H	(Time, Beam_num_H, Level_H)	float64	2.6 2.5 2.4 2.2 .....
Radial_velocity_L	(Time, Beam_num_L, Level_L)	float64	3.3 3.5 3.7 3.9 .....

▾ Attributes:

Description :	站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 03:02:44(BJT) 雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据
Start Time :	2019-09-10 03:02:44
End Time :	2019-09-10 03:43:10
State :	Inhomogeneous

In [45]:
```
filelist[-10:]
```

Out[45]:
```
['Z_RADA_I_58135_20220720230000_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720230600_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720231200_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720231800_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720232400_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720233000_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720233600_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720234200_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720234800_P_WPRD_LC_ROBS.TXT',
 'Z_RADA_I_58135_20220720235400_P_WPRD_LC_ROBS.TXT']
```

In [44]:
```
list_file.Get_Muti_Data()
```

Out[44]: xarray.Dataset

▶ Dimensions: (**Time**: 10, **Level**: 79)

▼ Coordinates:

Time	(Time)	float64	0.0 360.0 ... 2.88e+03 3.24e+03
Level	(Level)	float64	150.0 270.0 ... 1.815e+04 1.839e+04

▼ Data variables:

Ori_Time	(Time)	<U19	'2022-07-20 23:00:00' ... '2022-...
Vertical_speed	(Time, Level)	float64	0.0 0.0 -0.0 ... -0.0 -0.0 -0.0
Horizontal_speed	(Time, Level)	float64	4.9 5.2 5.1 5.4 ... 0.0 0.0 0.0 0.0
Horizontal_confi…	(Time, Level)	float64	100.0 100.0 100.0 ... 100.0 100.0
Vertical_confide…	(Time, Level)	float64	100.0 100.0 100.0 ... 100.0 100.0
Vertical_CN2	(Time, Level)	float64	6.2e-16 1.1e-14 ... 2.3e-16 7.4e-16
Wind_direction	(Time, Level)	float64	330.4 330.3 327.9 ... 296.2 302.4

▼ Attributes:

Description :	站号:58135(033.4836,0118.2083) 站点高度:00020.2m 观测时间:2022-07-20 23:00:00(BJT) 雷达类型:L波段 边界层风廓线雷达 数据类型:产品数据->实时采样高度产品数据
Start Time :	2022-07-20 23:00:00
End Time :	2022-07-20 23:54:00
State :	Inhomogeneous

In [62]:
```
filelist[-10:]
```

Out[62]:
```
['Z_RADA_I_58637_20220425230600_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425231200_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425231800_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425232400_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425233000_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425233600_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425234200_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425234800_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220425235400_O_WPRD_LC_FFT.BIN',
 'Z_RADA_I_58637_20220426000000_O_WPRD_LC_FFT.BIN']
```

In [63]:
```
list_file=RWP_READ.Read_Muti_RWP_Data(filelist[-10:])
list_file.Get_Muti_Data()
```

Out[63]: xarray.Dataset

▶ Dimensions: (**Time**: 10, **Beam_Num_L**: 5, **Level_L**: 33, **FFT_Point_L**: 256, **Beam_Num_M**: 5, **Level_M**: 32, **FFT_Point_M**: 256)

▼ Coordinates:

Time	(Time)	float64	…
Beam_Num_L	(Beam_Num_L)	int64	…
Level_L	(Level_L)	int64	…
FFT_Point_L	(FFT_Point_L)	float64	…
Beam_Num_M	(Beam_Num_M)	int64	…
Level_M	(Level_M)	int64	…
FFT_Point_M	(FFT_Point_M)	float64	…

▼ Data variables:

Ori_Time	(Time)	<U19	'…
FFT_M	(Time, Beam_Num_M, Level_M, FFT_Point_M)	float64	…
FFT_L	(Time, Beam_Num_L, Level_L, FFT_Point_L)	float64	…

▼ Attributes:

Description :	站号:58637(28.45,117.93)　站点高度:150.0m　观测时间:2022-04-25 23:06:00(BJT) 雷达类型:L波段 边界层风廓线雷达　数据类型:观测数据->功率谱数据
Start Time :	2022-04-25 23:06:00
End Time :	2022-04-26 00:00:00
State :	Inhomogeneous

RWP_ANALYSIS

The RWP_ANALYSIS module contains two classes Get_Product and Get_Muti_Product, which are suitable for analyzing and processing single wind profile radar data and multiple wind profile radar data respectively.

In [3]:
```
from CINWPR import RWP_ANALYSIS
```

In [5]:
```
import os
os.chdir(r'D:\54399')
```

In [6]:
```
import numpy as np
```

In [8]:
```
filelist=os.listdir()
```

In [9]:
```
wind,spect,eddy=RWP_ANALYSIS.Get_Product('Z_RADA_I_54399_20190910030244_O_WP
```

```
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
0: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  if Time_P_num==0:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
2: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif Time_P_num==1:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
4: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif Time_P_num==2:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
2: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  if correction_num==0:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
4: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==1:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
6: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==2:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
8: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==3:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_ANALYSIS.p
y:347: RuntimeWarning: invalid value encountered in power
  model_eddy_dissipation_rate[:,:-1]=((model_turb_broadening[:,:-1])**(3/2))*
((4*math.pi/kolmogorov_const)**(3/2))*((model_para_J[:,:-1])**(-3/2))
```

In [10]:
```
wind
```

Out[10]: xarray.Dataset

▶ Dimensions: (**Level_L**: 30, **Level_M**: 30, **Level_H**: 30)

▼ Coordinates:

Level_L	(Level_L)	int64	150 270 390 510 ... 3390 3510 3630
Level_M	(Level_M)	int64	1110 1230 1350 ... 4350 4470 4590
Level_H	(Level_H)	int64	3150 3390 3630 ... 9630 9870 10110

▶ Data variables: (15)

▼ Attributes:

Description : 站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 03:02:44(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据

In [11]:
```
spect
```

Out[11]: xarray.Dataset

► Dimensions: (**Level_L**: 30, **Beam_num_L**: 5, **Level_M**: 30, **Beam_num_M**: 5, **Level_H**: 30, **Beam_num_H**: 5)

▼ Coordinates:

Level_L	(Level_L)	int64	150 270 390 510 ... 3390 3510 3630
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1110 1230 1350 ... 4350 4470 4590
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5
Level_H	(Level_H)	int64	3150 3390 3630 ... 9630 9870 10…
Beam_num_H	(Beam_num_H)	int32	1 2 3 4 5

► Data variables: (15)

▼ Attributes:

Description : 站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 03:02:44(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据

In [12]:
```
eddy
```

Out[12]: xarray.Dataset

▶ Dimensions: (**Level_L**: 30, **Beam_num_L**: 5, **Level_M**: 30, **Beam_num_M**: 5, **Level_H**: 30, **Beam_num_H**: 5)

▼ Coordinates:

Level_L	(Level_L)	int64	150 270 390 510 ... 33…
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1110 1230 1350 ... 43…
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5
Level_H	(Level_H)	int64	3150 3390 3630 ... 96…
Beam_num_H	(Beam_num_H)	int32	1 2 3 4 5

▼ Data variables:

Eddy_dissipatio…	(Beam_num_L, Level_L)	float64	0.00401 0.002158 ... -…
Brunt_Vaisala_f…	(Beam_num_L, Level_L)	float64	0.001081 0.0008316 ..…
Vertical_eddy_d…	(Beam_num_L, Level_L)	float64	1.143e+03 1.041e+03…
Eddy_dissipatio…	(Beam_num_M, Level_M)	float64	nan 0.006157 ... nan -…
Brunt_Vaisala_f…	(Beam_num_M, Level_M)	float64	nan 0.0008977 ... nan …
Vertical_eddy_d…	(Beam_num_M, Level_M)	float64	nan 2.547e+03 ... nan …
Eddy_dissipatio…	(Beam_num_H, Level_H)	float64	0.0002405 0.0001779 …
Brunt_Vaisala_f…	(Beam_num_H, Level_H)	float64	0.0001869 0.0001619 …
Vertical_eddy_d…	(Beam_num_H, Level_H)	float64	2.295e+03 2.262e+03…

▼ Attributes:

Description : 站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 03:02:44(BJT)
雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据

In [13]:
```
filelist[:5]
```

Out[13]:
```
['Z_RADA_I_54399_20190910000300_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910000728_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910001158_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910001629_O_WPRD_LC_RAD.TXT',
 'Z_RADA_I_54399_20190910002058_O_WPRD_LC_RAD.TXT']
```

In [14]:
```
Wind_Data_Structure,Spectral_Data_Structure,Eddy_Data_Structure=RWP_ANALYSIS
```

```
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
0: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  if Time_P_num==0:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
2: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif Time_P_num==1:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:18
4: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif Time_P_num==2:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
2: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  if correction_num==0:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
4: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==1:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
6: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==2:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_READ.py:19
8: FutureWarning: elementwise comparison failed; returning scalar instead, bu
t in the future will perform elementwise comparison
  elif correction_num==3:
C:\Users\lenovo\.conda\envs\Python37\lib\site-packages\CINWPR\RWP_ANALYSIS.p
y:347: RuntimeWarning: invalid value encountered in power
  model_eddy_dissipation_rate[:,:-1]=((model_turb_broadening[:,:-1])**(3/2))*
((4*math.pi/kolmogorov_const)**(3/2))*((model_para_J[:,:-1])**(-3/2))
```

In [15]:
```
Wind_Data_Structure
```

Out[15]: xarray.Dataset

▸ Dimensions: (**Time**: 5, **Level_L**: 30, **Level_M**: 30, **Level_H**: 30)

▾ Coordinates:

Time	(Time)	float64	0.0 268.0 538.0 809.0 1.078e+03
Level_L	(Level_L)	int64	150 270 390 510 ... 3390 3510 3630
Level_M	(Level_M)	int64	1110 1230 1350 ... 4350 4470 4590
Level_H	(Level_H)	int64	3150 3390 3630 ... 9630 9870 10110

▸ Data variables: (16)

▾ Attributes:

Description :	站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 00:03:00(BJT) 雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据
Start Time :	2019-09-10 00:03:00
End Time :	2019-09-10 00:20:58
State :	Inhomogeneous

In [16]:
```
Spectral_Data_Structure
```

Out[16]: xarray.Dataset

▸ Dimensions: (**Time**: 5, **Level_L**: 30, **Beam_num_L**: 5, **Level_M**: 30, **Beam_num_M**: 5, **Level_H**: 30, **Beam_num_H**: 5)

▾ Coordinates:

Time	(Time)	float64	0.0 268.0 538.0 809.0 1.078e+03
Level_L	(Level_L)	int64	150 270 390 510 ... 3390 3510 …
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1110 1230 1350 ... 4350 4470 4…
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5
Level_H	(Level_H)	int64	3150 3390 3630 ... 9630 9870 1…
Beam_num_H	(Beam_num_H)	int32	1 2 3 4 5

▸ Data variables: (16)

▾ Attributes:

Description :	站号:54399(039.9869,0116.2903) 站点高度:00046.9m 观测时间:2019-09-10 00:03:00(BJT) 雷达类型:L波段 边界层风廓线雷达 数据类型:观测数据->径向数据
Start Time :	2019-09-10 00:03:00
End Time :	2019-09-10 00:20:58
State :	Inhomogeneous

In [17]:
```
Eddy_Data_Structure
```

Out[17]: xarray.Dataset

▸ Dimensions: (**Time**: 5, **Level_L**: 30, **Beam_num_L**: 5, **Level_M**: 30, **Beam_num_M**: 5, **Level_H**: 30, **Beam_num_H**: 5)

▾ Coordinates:

Time	(Time)	float64	0.0 268.0 538.0 …
Level_L	(Level_L)	int64	150 270 390 51…
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	1110 1230 1350…
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5
Level_H	(Level_H)	int64	3150 3390 3630…
Beam_num_H	(Beam_num_H)	int32	1 2 3 4 5

▾ Data variables:

Ori_Time	(Time)	<U19	'2019-09-10 00:…
Eddy_dissipatio…	(Time, Beam_num_L, Level_L)	float64	0.01452 nan na…
Vertical_eddy_d…	(Time, Beam_num_L, Level_L)	float64	528.0 nan nan .....
Eddy_dissipatio…	(Time, Beam_num_H, Level_H)	float64	nan 0.0001606 ....
Brunt_Vaisala_f…	(Time, Beam_num_M, Level_M)	float64	0.0003741 0.00…
Vertical_eddy_d…	(Time, Beam_num_M, Level_M)	float64	1.011e+03 1.99…
Brunt_Vaisala_f…	(Time, Beam_num_L, Level_L)	float64	0.003028 nan .....
Eddy_dissipatio…	(Time, Beam_num_M, Level_M)	float64	0.0004244 0.00…
Brunt_Vaisala_f…	(Time, Beam_num_H, Level_H)	float64	nan 0.0001578 ....
Vertical_eddy_d…	(Time, Beam_num_H, Level_H)	float64	nan 2.15e+03 .....

▾ Attributes:

Description :	站号:54399(039.9869,0116.2903)　站点高度:00046.9m　观测时间:2019-09-10 00:03:00(BJT) 雷达类型:L波段 边界层风廓线雷达　数据类型:观测数据->径向数据
Start Time :	2019-09-10 00:03:00
End Time :	2019-09-10 00:20:58
State :	Inhomogeneous

RWP_DRAW

In [2]:
```
from CINWPR import RWP_DRAW
```

At present, this module only contains this unique function draw_time_height_section, to be used to automatically give the data time-height profile information, the following is the main parameters of this function, the rest parameters see the file source code.

In [ ]:
```
'''
ax为画图画布;
time_list为时间轴，应为datatime形式的列表数据;
height_arr为高度轴：应为numpy.array形式数据;
draw_data为所需绘制的数据，应为numpy.array形式;
draw_levels为绘制的数据的levels数组;
colorbar_ticks为colorbar标签说明;
time_interval为时间ticks间隔，以秒计算
height_interval为高度间隔，以米(m)为单位，根据国内常见风廓线雷达的垂直高度分辨率推荐尝试
data_declaration为填色数据说明，用于colorbar说明，格式为：'数据名称(数据单位)';
color为填图颜色默认为：cmaps.BlAqGrYeOrReVi;
timelabel为时间轴说明标签，默认为当地标准时间(LST);
beam_direction为波束方向说明;
'''
```

In [3]:
```
Spect_Data_Structure=xr.open_dataset('D:/Qingdao_Spect_20220901.nc')
```

In [4]:
```
Spect_Data_Structure
```

Out[4]: xarray.Dataset

▸ Dimensions: (**Time**: 283, **Level_L**: 20, **Beam_num_L**: 5, **Level_M**: 98, **Beam_num_M**: 5)

▾ Coordinates:

Time	(Time)	float64	0.0 300.0 ... 8.5…
Level_L	(Level_L)	int64	120 240 360 48…
Beam_num_L	(Beam_num_L)	int32	1 2 3 4 5
Level_M	(Level_M)	int64	240 480 720 ... …
Beam_num_M	(Beam_num_M)	int32	1 2 3 4 5

▾ Data variables:

Ori_Time	(Time)	object	...
Shear_broadeni…	(Time, Beam_num_L, Level_L)	float64	...
Resodia_Noise_L	(Time, Beam_num_L)	float64	...
Turbulent_spect…	(Time, Beam_num_L, Level_L)	float64	...
Turbulent_spect…	(Time, Beam_num_M, Level_M)	float64	...
Resodia_Noise_M	(Time, Beam_num_M)	float64	...
Doppler_spectr…	(Time, Beam_num_M, Level_M)	float64	...
Beam_broadeni…	(Time, Beam_num_M, Level_M)	float64	...
Beam_broadeni…	(Time, Beam_num_L, Level_L)	float64	...
Doppler_spectr…	(Time, Beam_num_L, Level_L)	float64	...
Shear_broadeni…	(Time, Beam_num_M, Level_M)	float64	...

▾ Attributes:

Description :	站号:54857(036.2283,0120.1250)　站点高度:00012.0m　观测时间:2022-09-01 00:00:07(BJT) 雷达类型:P波段 对流层II型风廓线雷达　数据类型:观测数据->径向数据
Start Time :	2022-09-01 00:00:07
End Time :	2022-09-01 23:55:07
State :	Inhomogeneous

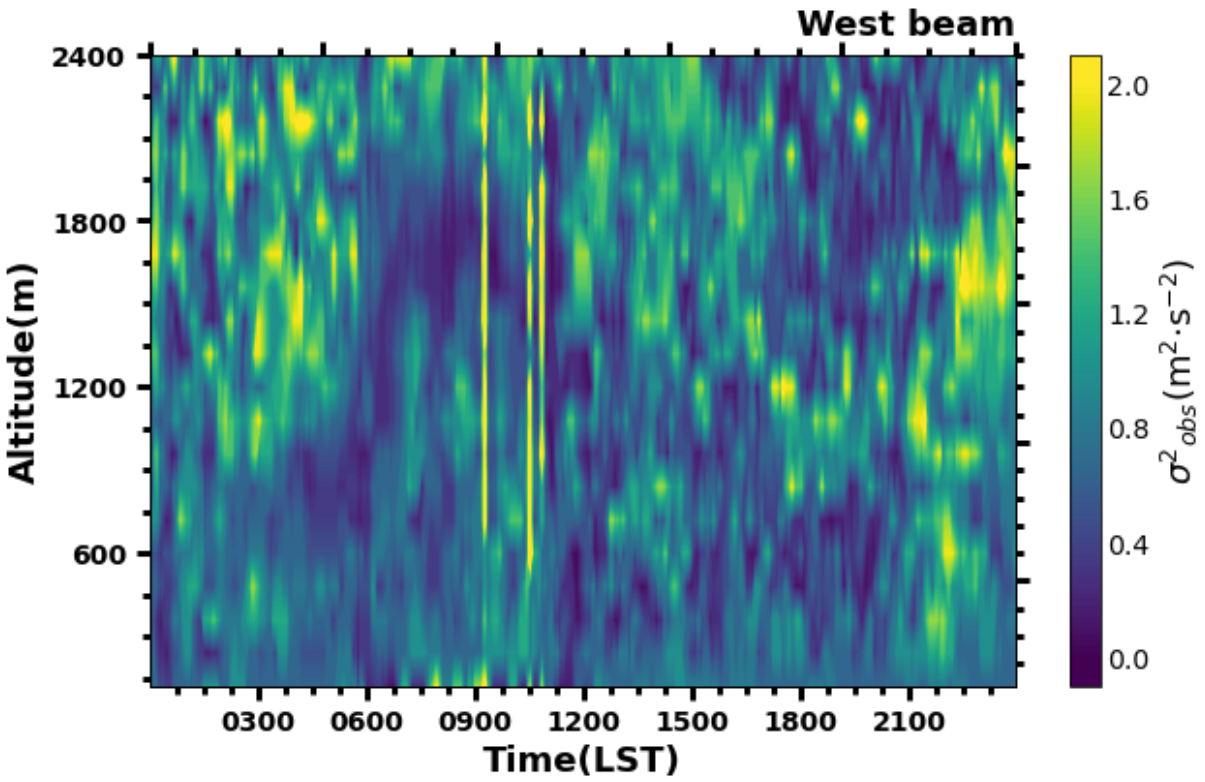
In [5]:
```
heights=np.array(Spect_Data_Structure['Level_L'[:]])
```

In [6]:
```
standard_formaet='%Y-%m-%d %H:%M:%S'
time_format_list=[]
for ori_time_str in list(np.array(Spect_Data_Structure['Ori_Time'][:])):
    time_format_list.append(datetime.datetime.strptime(ori_time_str,standarc
```

In [7]:
```
data_declaration=r'$\sigma$$^2$$_{obs}$'+'(m$^2$·s$^{-2}$)'
```

In [8]:
```
fig,ax1=plt.subplots(figsize=(10,6),nrows=1,ncols=1)
plt.subplots_adjust(wspace=0.2,hspace=0.15)
ax1.spines['top'].set_visible(False)
ax1.spines['right'].set_visible(False)
```

```
RWP_DRAW.draw_time_height_section(ax=ax1,time_list=time_format_list,height_a
```



In [ ]: