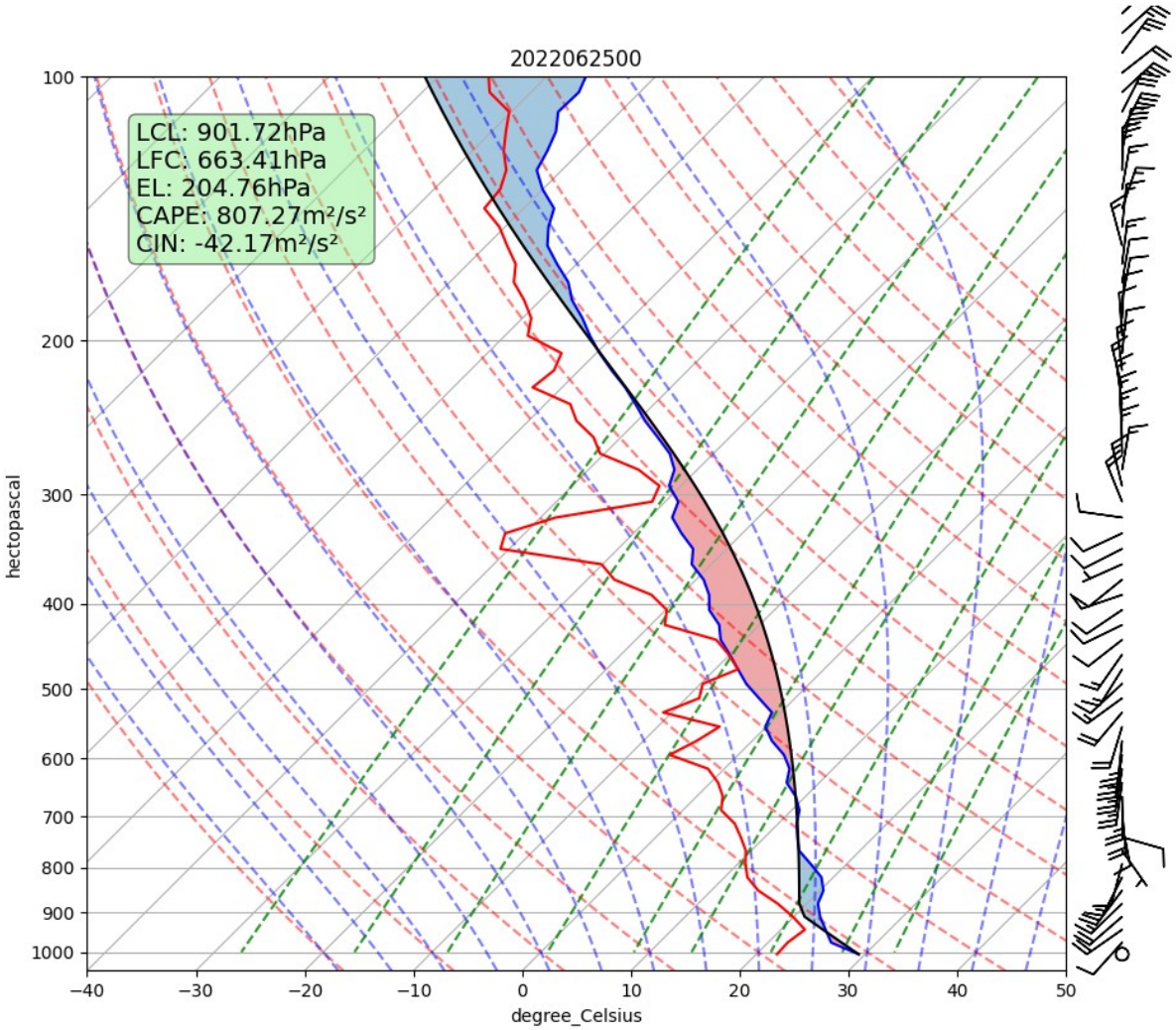
Synoptic Meteorology HW1

```
import numpy as np
import matplotlib.pyplot as plt
from metpy.plots import SkewT
from metpy.units import units
import metpy.calc as mpcalc

data = np.loadtxt('46757-2022062500.txt', delimiter=",", skiprows=2,
unpack='true')

h = data[1]
p = data[2]*units.hPa
t = data[3]*units.degC
td = data[5]*units.degC
ws = data[6]*1.9438*units.knots
wd = data[7]*units.degrees
prof = mpcalc.parcel_profile(p,t[0], td[0]).to('degC')
a,b,c,profm = mpcalc.parcel_profile_with_lcl(p,t, td)

lcl_p, lcl_t = mpcalc.lcl(p[0], t[0], td[0])
print('LCL:',lcl_p, lcl_t,"\n")

lfc_p, lfc_t = mpcalc.lfc(p, t, td, prof)
print('LFC:',lfc_p, lfc_t,"\n")

el_p, el_t = mpcalc.el(p, t, td, prof)
print('EL:',el_p, el_t,"\n")

cape, cin = mpcalc.cape_cin(p, t, td, prof)
print('CAPE & CIN:',cape, cin)

u,v = mpcalc.wind_components(ws,wd)

fig = plt.figure(figsize=(10,10))
skew = SkewT(fig,rotation=45)
skew.plot(p,t,color='b')
skew.plot(p,td,color='r')
skew.plot_barbs(p,u,v,xloc=1.057)
skew.plot_dry_adiabats(t0=np.arange(-20,151,10)*units.celsius)
skew.plot_moist_adiabats(t0=np.arange(-20,46,5)*units.celsius)
skew.plot_mixing_lines(pressure=np.arange(100,1001,20)*units.hPa)
skew.ax.set_title('2022062500')
skew.plot(p,prof,'k')
#skew.plot(p,profm,'k')
skew.shade_cape(p,t,prof)
skew.shade_cin(p,t,prof)
```

```
props = dict(boxstyle='round', facecolor='lightgreen', alpha=0.5)
skew.ax.text(0.05, 0.95, 'LCL: 901.72hPa\nLFC: 663.41hPa\nEL:
204.76hPa\nCAPE: 807.27m\u00b2/s\u00b2\nCIN: -42.17m\u00b2/s\u00b2',
transform=skew.ax.transAxes,fontsize=14, verticalalignment='top',
bbox=props)

plt.show()
```

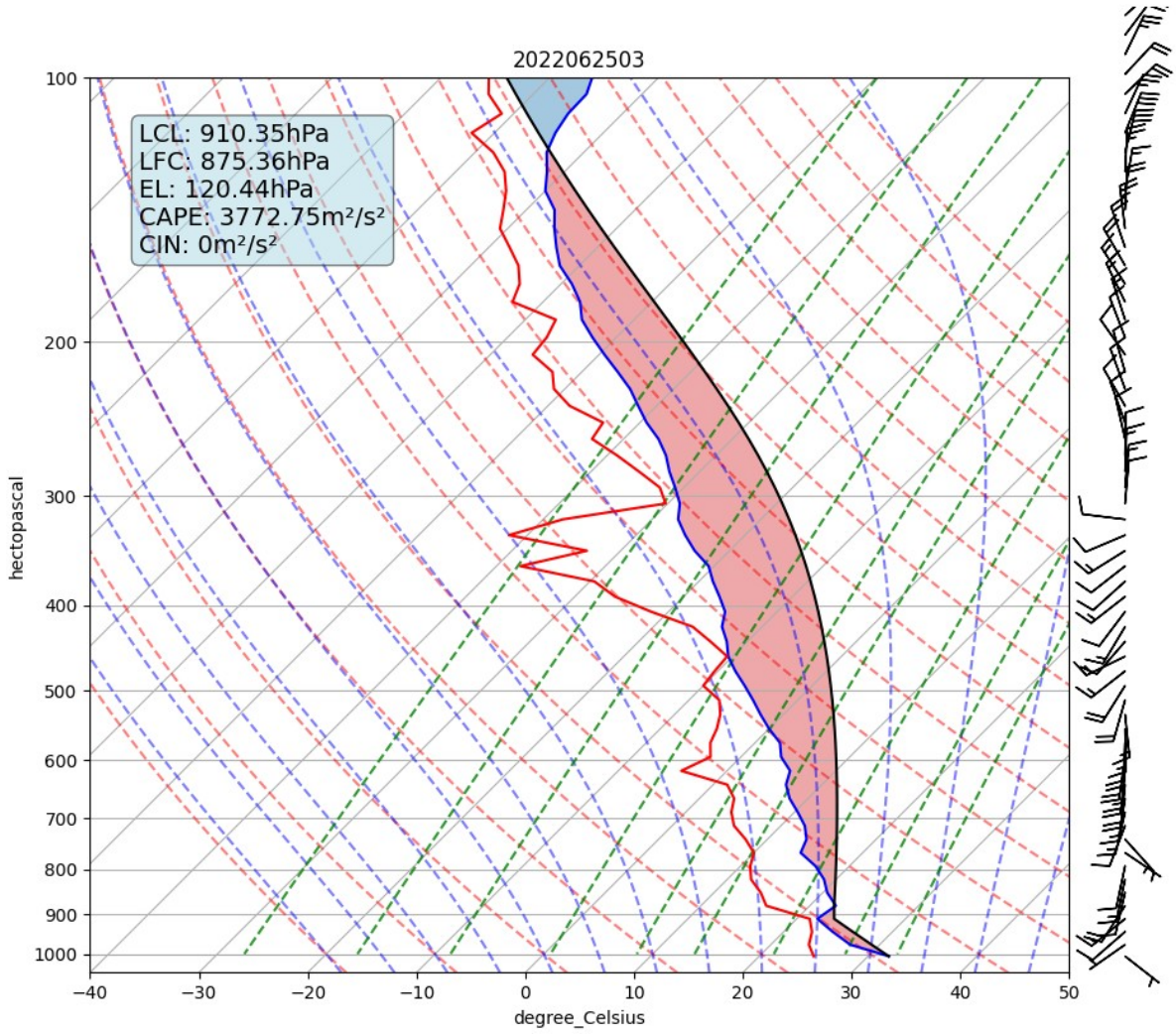
```
LCL: 901.7234789607713 hectopascal 20.128608257616747 degree_Celsius

LFC: 663.4132362352898 hectopascal 9.066190204286038 degree_Celsius

EL: 204.75569753061646 hectopascal -50.23976446776911 degree_Celsius

CAPE & CIN: 807.2666866296228 joule / kilogram -42.16740427166609
joule / kilogram
```



```
import numpy as np
import matplotlib.pyplot as plt
from metpy.plots import SkewT
from metpy.units import units
import metpy.calc as mpcalc

data = np.loadtxt('46757-2022062503.txt', delimiter=",", skiprows=2,
unpack='true')

h = data[1]
p = data[2]*units.hPa
t = data[3]*units.degC
td = data[5]*units.degC
ws = data[6]*1.9438*units.knots
wd = data[7]*units.degrees
prof = mpcalc.parcel_profile(p,t[0], td[0]).to('degC')
a,b,c,profm = mpcalc.parcel_profile_with_lcl(p,t, td)

lcl_p, lcl_t = mpcalc.lcl(p[0], t[0], td[0])
print('LCL:',lcl_p, lcl_t,"\n")

lfc_p, lfc_t = mpcalc.lfc(p, t, td, prof)
print('LFC:',lfc_p, lfc_t,"\n")

el_p, el_t = mpcalc.el(p, t, td, prof)
print('EL:',el_p, el_t,"\n")

cape, cin = mpcalc.cape_cin(p, t, td, prof)
print('CAPE & CIN:',cape, cin)



u,v = mpcalc.wind_components(ws,wd)

fig = plt.figure(figsize=(10,10))
skew = SkewT(fig,rotation=45)
skew.plot(p,t,color='b')
skew.plot(p,td,color='r')
skew.plot_barbs(p,u,v,xloc=1.057)
skew.plot_dry_adiabats(t0=np.arange(-20,151,10)*units.celsius)
skew.plot_moist_adiabats(t0=np.arange(-20,46,5)*units.celsius)
skew.plot_mixing_lines(pressure=np.arange(100,1001,20)*units.hPa)
skew.ax.set_title('2022062503')
skew.plot(p,prof,'k')
#skew.plot(p,profm,'k')
skew.shade_cape(p,t,prof)
skew.shade_cin(p,t,prof)

props = dict(boxstyle='round', facecolor='lightblue', alpha=0.5)
skew.ax.text(0.05, 0.95, 'LCL: 910.35hPa\nLFC: 875.36hPa\nEL:
120.44hPa\nCAPE: 3772.75m\u00b2/s\u00b2\nCIN: 0m\u00b2/s\u00b2',
```

```
transform=skew.ax.transAxes,fontsize=14, verticalalignment='top',
bbox=props)

plt.show()
```

```
LCL: 910.3587396070928 hectopascal 23.341471324321674 degree_Celsius

LFC: 875.3597957586942 hectopascal 22.04662295507372 degree_Celsius

EL: 120.43832070457056 hectopascal -73.58651395161836 degree_Celsius

CAPE & CIN: 3772.749358352257 joule / kilogram 0 joule / kilogram
```

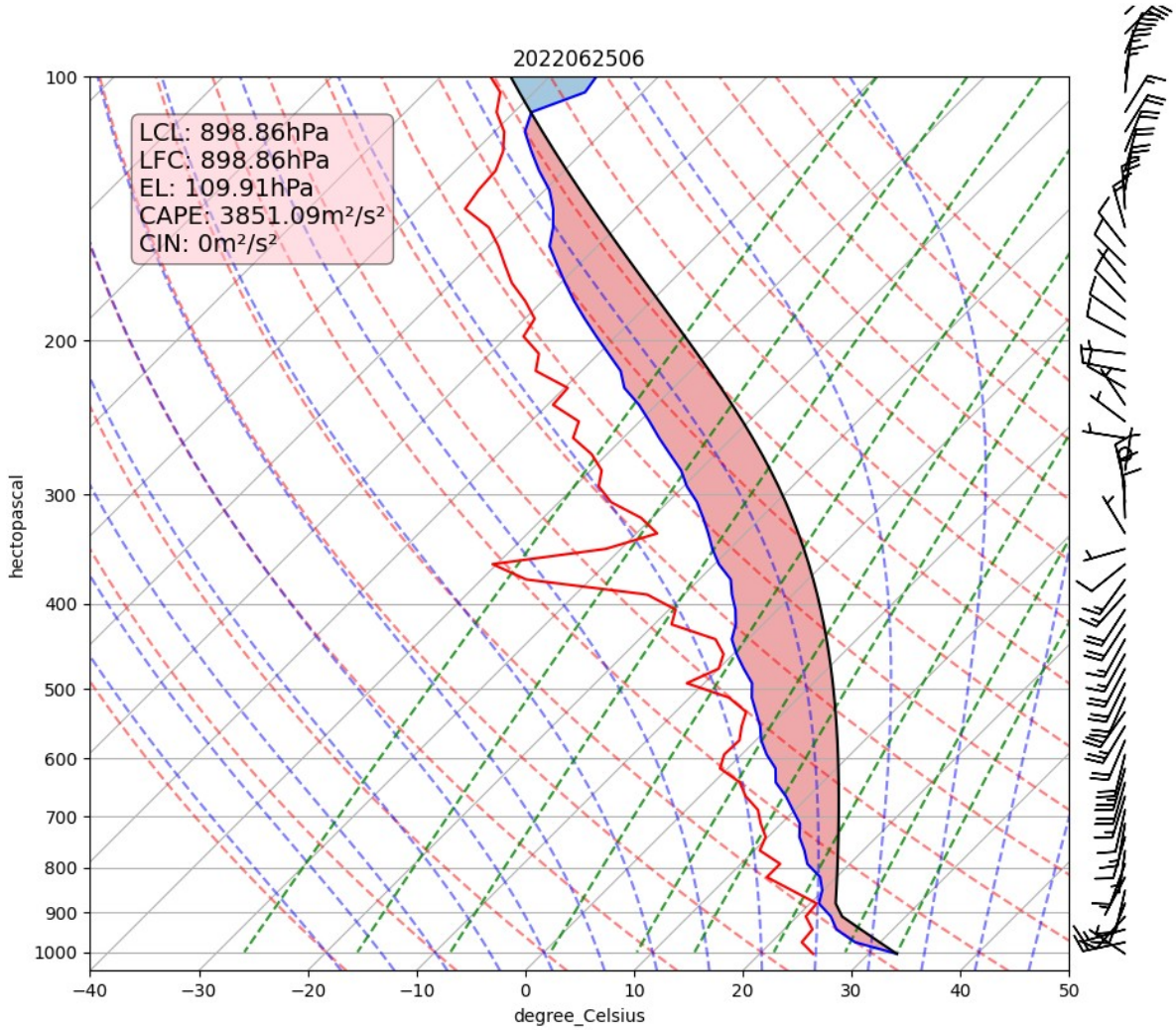



```
import numpy as np
import matplotlib.pyplot as plt
from metpy.plots import SkewT
```

```
from metpy.units import units
import metpy.calc as mpcalc

data = np.loadtxt('46757-2022062506.txt', delimiter=",", skiprows=2,
unpack='true')

h = data[1]
p = data[2]*units.hPa
t = data[3]*units.degC
td = data[5]*units.degC
ws = data[6]*1.9438*units.knots
wd = data[7]*units.degrees
prof = mpcalc.parcel_profile(p,t[0], td[0]).to('degC')
a,b,c,profm = mpcalc.parcel_profile_with_lcl(p,t, td)

lcl_p, lcl_t = mpcalc.lcl(p[0], t[0], td[0])
print('LCL:',lcl_p, lcl_t,"\n")

lfc_p, lfc_t = mpcalc.lfc(p, t, td, prof)
print('LFC:',lfc_p, lfc_t,"\n")

el_p, el_t = mpcalc.el(p, t, td, prof)
print('EL:',el_p, el_t,"\n")

cape, cin = mpcalc.cape_cin(p, t, td, prof)
print('CAPE & CIN:',cape, cin)

'''
def wsd2uv(ws, wd):
    wd = 270 - wd
    wd = wd /180 *np.pi
    x = ws * np.cos(wd)
    y = ws * np.sin(wd)
    return(x, y)
'''

u,v = mpcalc.wind_components(ws,wd)

fig = plt.figure(figsize=(10,10))
skew = SkewT(fig,rotation=45)
skew.plot(p,t,color='b')
skew.plot(p,td,color='r')
skew.plot_barbs(p,u,v,xloc=1.057)
skew.plot_dry_adiabats(t0=np.arange(-20,151,10)*units.celsius)
skew.plot_moist_adiabats(t0=np.arange(-20,46,5)*units.celsius)
skew.plot_mixing_lines(pressure=np.arange(100,1001,20)*units.hPa)
skew.ax.set_title('2022062506')
skew.plot(p,prof,'k')
#skew.plot(p,profm,'k')
skew.shade_cape(p,t,prof)
```

```
skew.shade_cin(p,t,prof)

props = dict(boxstyle='round', facecolor='pink', alpha=0.5)
skew.ax.text(0.05, 0.95, 'LCL: 898.86hPa\nLFC: 898.86hPa\nEL:
109.91hPa\nCAPE: 3851.09m\u00b2/s\u00b2\nCIN: 0m\u00b2/s\u00b2',
transform=skew.ax.transAxes,fontsize=14, verticalalignment='top',
bbox=props)

plt.show()
```

```
LCL: 898.8608744712087 hectopascal 23.0540362947973 degree_Celsius

LFC: 898.8608744712087 hectopascal 23.0540362947973 degree_Celsius

EL: 109.90878218345517 hectopascal -78.35571369477893 degree_Celsius

CAPE & CIN: 3851.0890787360086 joule / kilogram 0 joule / kilogram
```



Discussion

圖中粉色虛線為乾絕熱線，藍色虛線為濕絕熱線，粉色陰影為 CAPE，藍色陰影為 CIN。

觀察 CIN 的變化，取絕對值後由圖一的 42 轉變為 0，推測低層大氣隨時間逐漸變得較不穩定，但沒有觀察到因地表平流及冷卻可能造成的逆溫現象。 CAPE 在 03 時及 06 時面積較大，表氣塊不穩定度較高，上升運動強。

06 時所計算出來之舉升凝結高度及自由對流溫度同為 898.86hpa，是為對流凝結高度 CCL。

風向方面，0 時至 6 時此地區垂直方向上的各空氣層的方向分布大致相同，近地表吹西風至西南風，為海風的方向。而越往越高層風向漸轉為北風，再轉向西北風。