In [2]:
```
import windrose
from windrose import WindroseAxes
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from gwpy.time import tconvert
from scipy import stats
import seaborn as sns
%matplotlib inline
```

In [2]:
```
plt.rcParams["figure.figsize"] = (10,6)
plt.rcParams['figure.dpi'] = 300
```

In [3]:
```
def Constrain(df1,df2,s,e):
    t_i=to60(s)
    t_f=to60(e)
    return (df1.merge(df2, left_index=True, right_index=True)).loc[t_i:t
_f]
```

In [4]:
```
def to60(d):
    t = tconvert(d)
    return (int(t/60)*60)
```

In [5]:
```
CSSpeed = pd.read_csv("CS_MPS_ALL.csv").sort_values("Time (GPS)").set_in
dex("Time (GPS)")
CSDir = pd.read_csv("CS_DEG_ALL.csv").sort_values("Time (GPS)").set_inde
x("Time (GPS)")
EXSpeed = pd.read_csv("EX_MPS_ALL.csv").sort_values("Time (GPS)").set_in
dex("Time (GPS)")
EXDir = pd.read_csv("EX_DEG_ALL.csv").sort_values("Time (GPS)").set_inde
x("Time (GPS)")
EXRot = pd.read_csv("EX_RY_ALL.csv").sort_values("Time (GPS)").set_index
("Time (GPS)")
MXSpeed = pd.read_csv("MX_MPS_ALL.csv").sort_values("Time (GPS)").set_in
dex("Time (GPS)")
EXFSpeed = pd.read_csv("Speed_2_ALL.csv").sort_values("Time (GPS)").set_
index("Time (GPS)")
STS_X = pd.read_csv("STS_X_ALL.csv").sort_values("Time (GPS)").set_index
("Time (GPS)")
STS_Y = pd.read_csv("STS_Y_ALL.csv").sort_values("Time (GPS)").set_index
("Time (GPS)")
```

In [28]:
```
df = Constrain(EXSpeed, EXDir,'June 1 1990',"Aug 1 2020")
EXSpeedDirFiltered = EXSpeed.loc[(df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']<135) & (df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']>45)]
EXSpeedOtherDir = EXSpeed.drop(EXSpeedDirFiltered.index)
EXSpeedDirNX = EXSpeed.loc[(df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']<225) & (df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']>135)]
EXSpeedDirY = EXSpeed.loc[(df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']<315) & (df['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']>225)]
EXSpeedSENE = EXSpeedOtherDir.drop(EXSpeedDirNX.index)

df2 = Constrain(CSSpeed, CSDir,'June 1 1990',"Aug 1 2020")
CSSpeedDirFiltered = CSSpeed.loc[df2[(df2['H1:PEM-CS_WIND_ROOF_WEATHER_DEG.mean']<135) & (df2['H1:PEM-CS_WIND_ROOF_WEATHER_DEG.mean']>45)].index]
CSSpeedOtherDir = CSSpeed.drop(CSSpeedDirFiltered.index)

df3 = Constrain(CSSpeed, EXDir,'June 1 1990',"Aug 1 2020")
CSDF = CSSpeed.loc[(df3['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']<135) & (df3['H1:PEM-EX_WIND_ROOF_WEATHER_DEG.mean']>45)]
```

Wind Info

In [7]:
```
def WindRose(starttime,endtime,speeddf,dirdf,binmin,binmax):
    #convert start and end time strings to GPS time rounded to 60
    t_i = to60(starttime)
    t_f = to60(endtime)

    #take the intersection of the two indicies (since there may be missing data points or extra parameters placed on one or the other)
    n = sorted(set(dirdf.loc[t_i:t_f].index) & set(speeddf.loc[t_i:t_f].index))

    #series consisting of speed/direction values
    wd = dirdf.loc[n].iloc[:,0]
    ws = speeddf.loc[n].iloc[:,0]
    ax = WindroseAxes.from_ax()

    #ax.contourf(wd, ws, normed=True,nsector=24,bins=np.arange(binmin, binmax,2))
    ax.bar(wd, ws, normed=True,nsector=20,bins=np.arange(binmin, binmax,2))
    ax.set_xticklabels(['-Y', '', '+X', '', '+Y', '', '-X', ''])
    ax.set_legend()
```

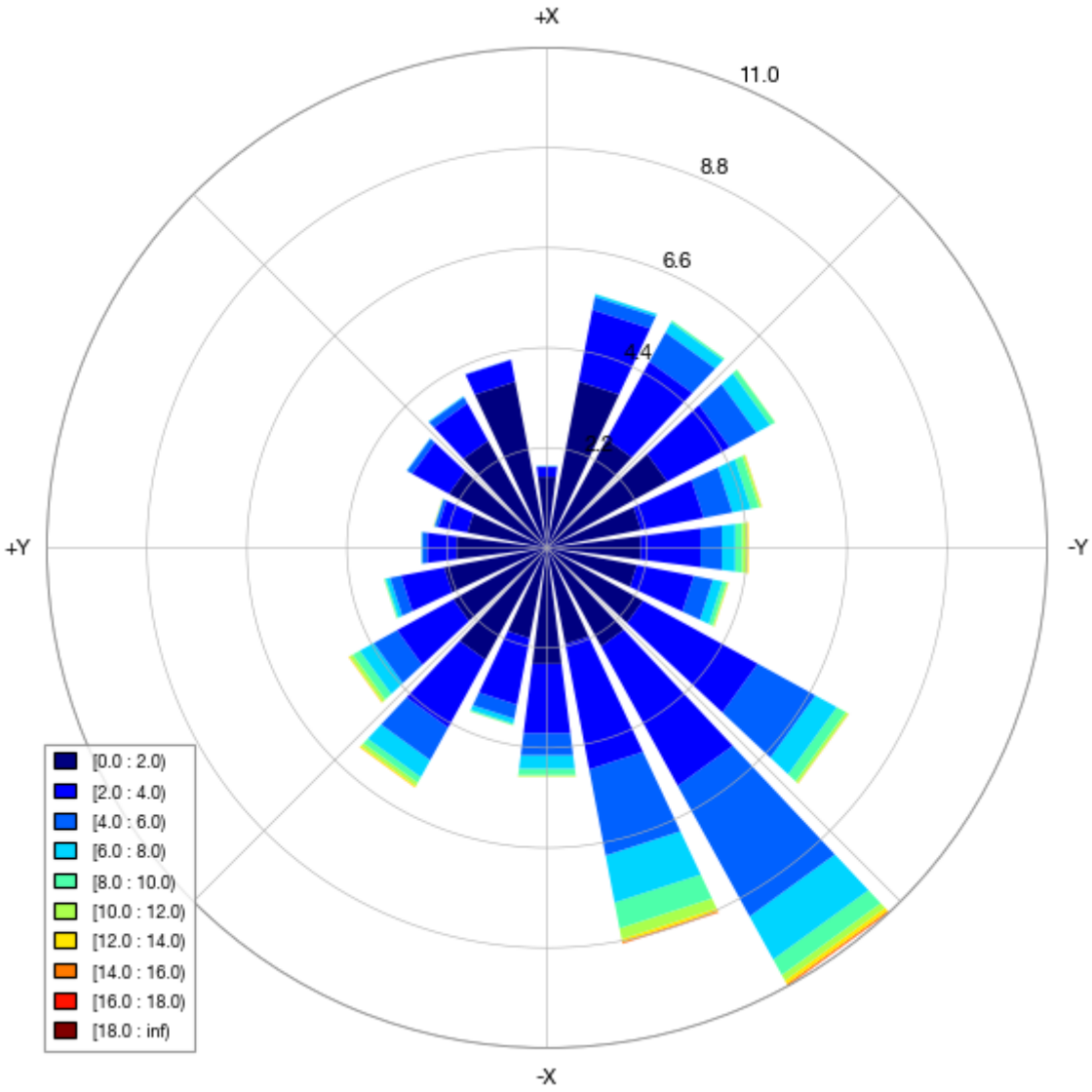
In [8]:
```
def CPT(starttime, endtime, speeddf, dirdf):
    t_i = to60(starttime)
    t_f = to60(endtime)

    #take the intersection of the two indicies (since there may be missi
ng data points or extra parameters placed on one or the other)
    n = sorted(set(dirdf.loc[t_i:t_f].index) & set(speeddf.loc[t_i:t_f].
index))

    #series consisting of speed/direction values
    wd = dirdf.loc[n].iloc[:,0]
    ws = speeddf.loc[n].iloc[:,0]
    ax = WindroseAxes.from_ax()

    ax.contourf(wd, ws, normed=True,nsector=4,bins=np.arange(0, 24,4))
    df = pd.DataFrame(ax._info['table'], index=["<4m/s","4-8m/s","8-12m/
s","12-16m/s","16-20m/s",">20m/s"], columns=["+X","-Y","-X","+Y"])
    df['total']=list(df.sum(axis=1))
    df.loc['total'] = list(df.sum(axis=0))
    return df
```

Figures in this section will be generated with the following parameters

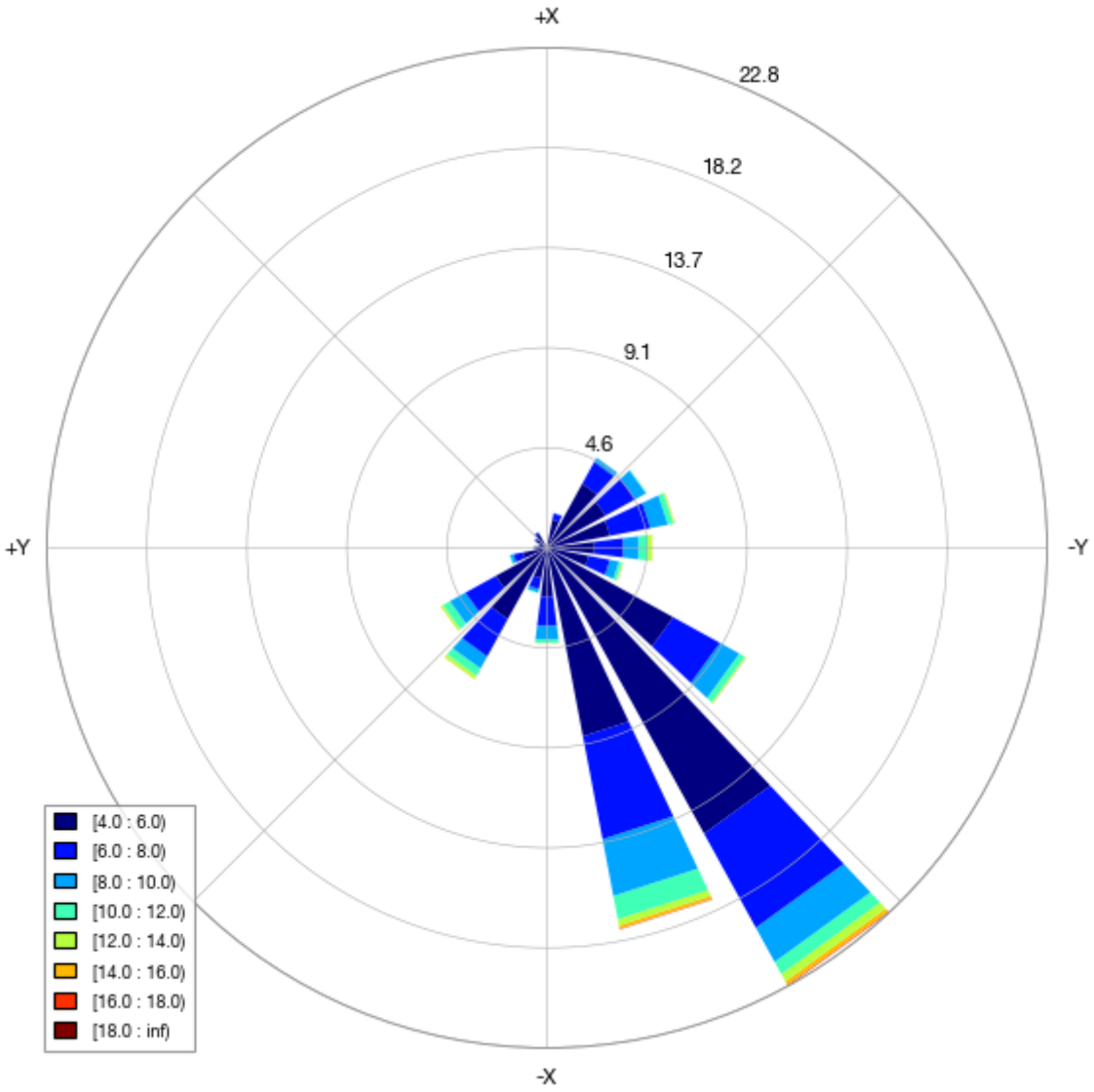
In [9]:
```
starttime = "Jan 1 2019 00:00:00"
endtime = "Jan 1 2020 00:00:00"
```

End-X

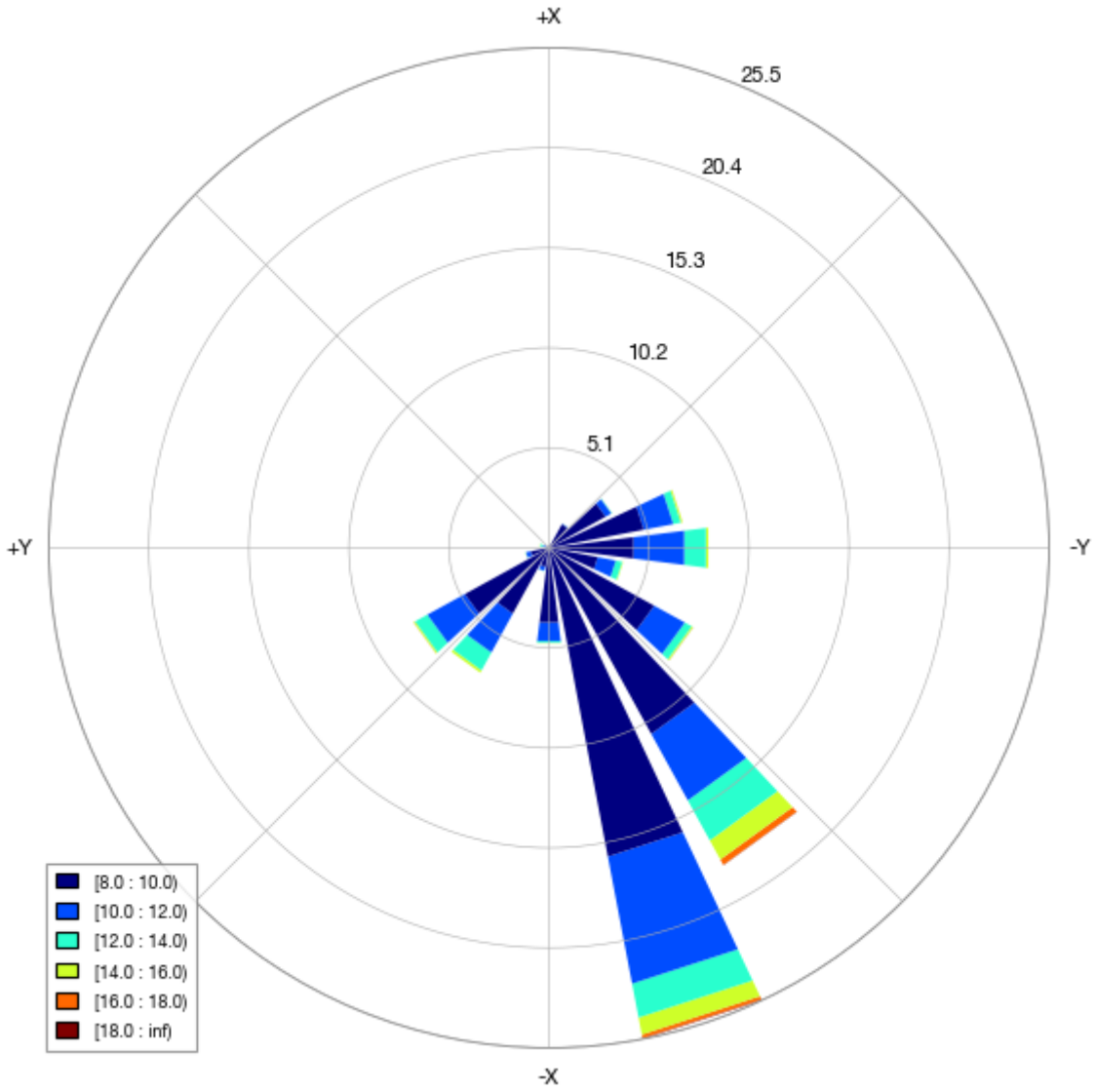
In [10]:
```
WindRose(starttime, endtime, EXSpeed, EXDir, 0, 20)
```



In [11]:
```
WindRose(starttime, endtime, EXSpeed, EXDir, 4, 20)
```



In [12]:
```
WindRose(starttime, endtime, EXSpeed, EXDir, 8, 20)
```



In [13]:
```
%%capture
ProbTableX = CPT(starttime, endtime, EXSpeed, EXDir)
```

In [14]:
```
ProbTableX
```

Out[14]:

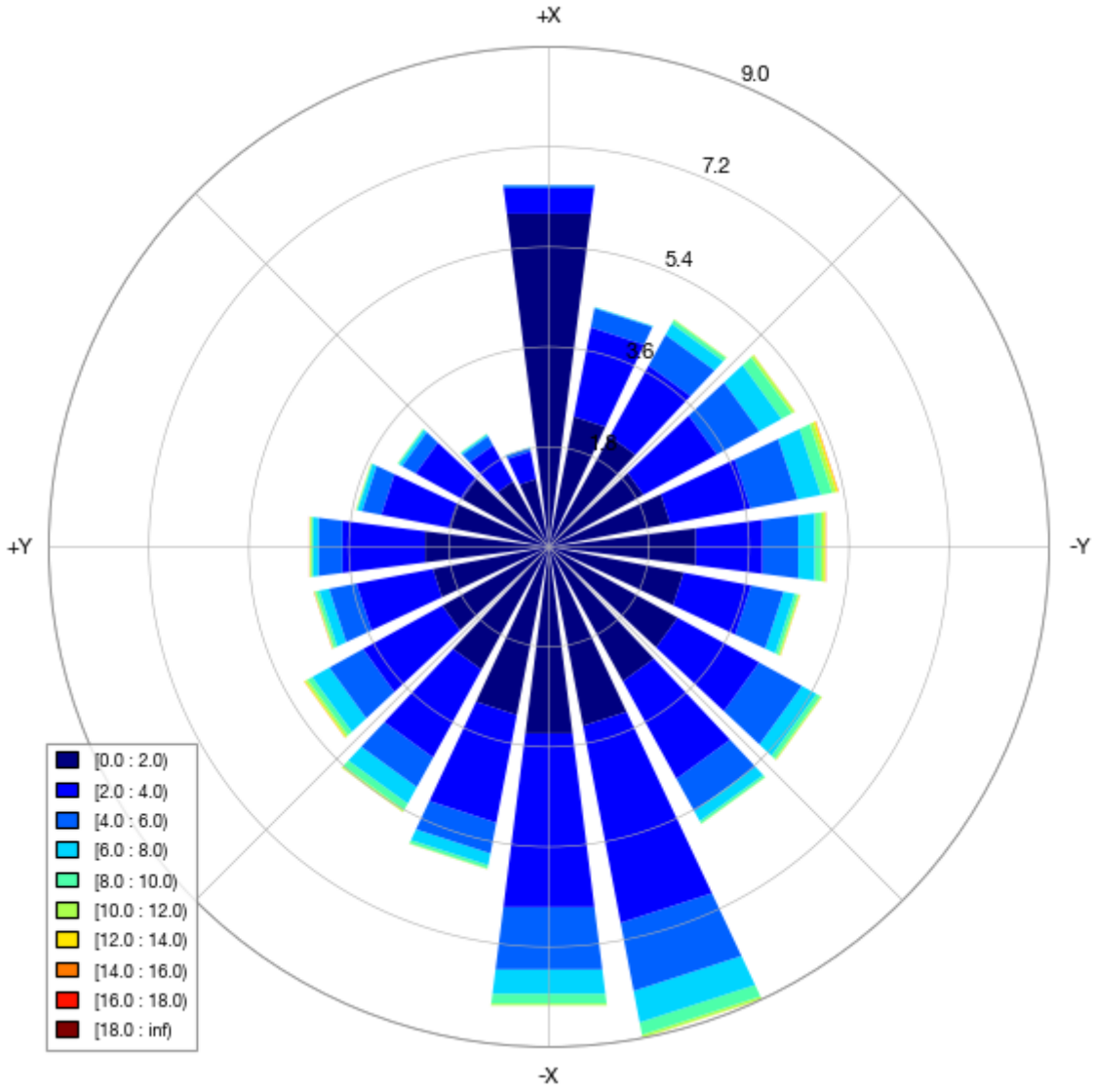
	+X	-Y	-X	+Y	total
<4m/s	19.564332	20.007307	22.985969	15.441319	77.998927
4-8m/s	1.546035	5.451937	9.764470	1.628617	18.391058
8-12m/s	0.062793	1.025235	1.783506	0.311681	3.183214
12-16m/s	0.000381	0.095331	0.267916	0.042052	0.405680
16-20m/s	0.000000	0.000571	0.020170	0.000381	0.021121
>20m/s	0.000000	0.000000	0.000000	0.000000	0.000000
total	21.173540	26.580380	34.822030	17.424049	100.000000

direction indicates the direction the wind is blowing **towards**

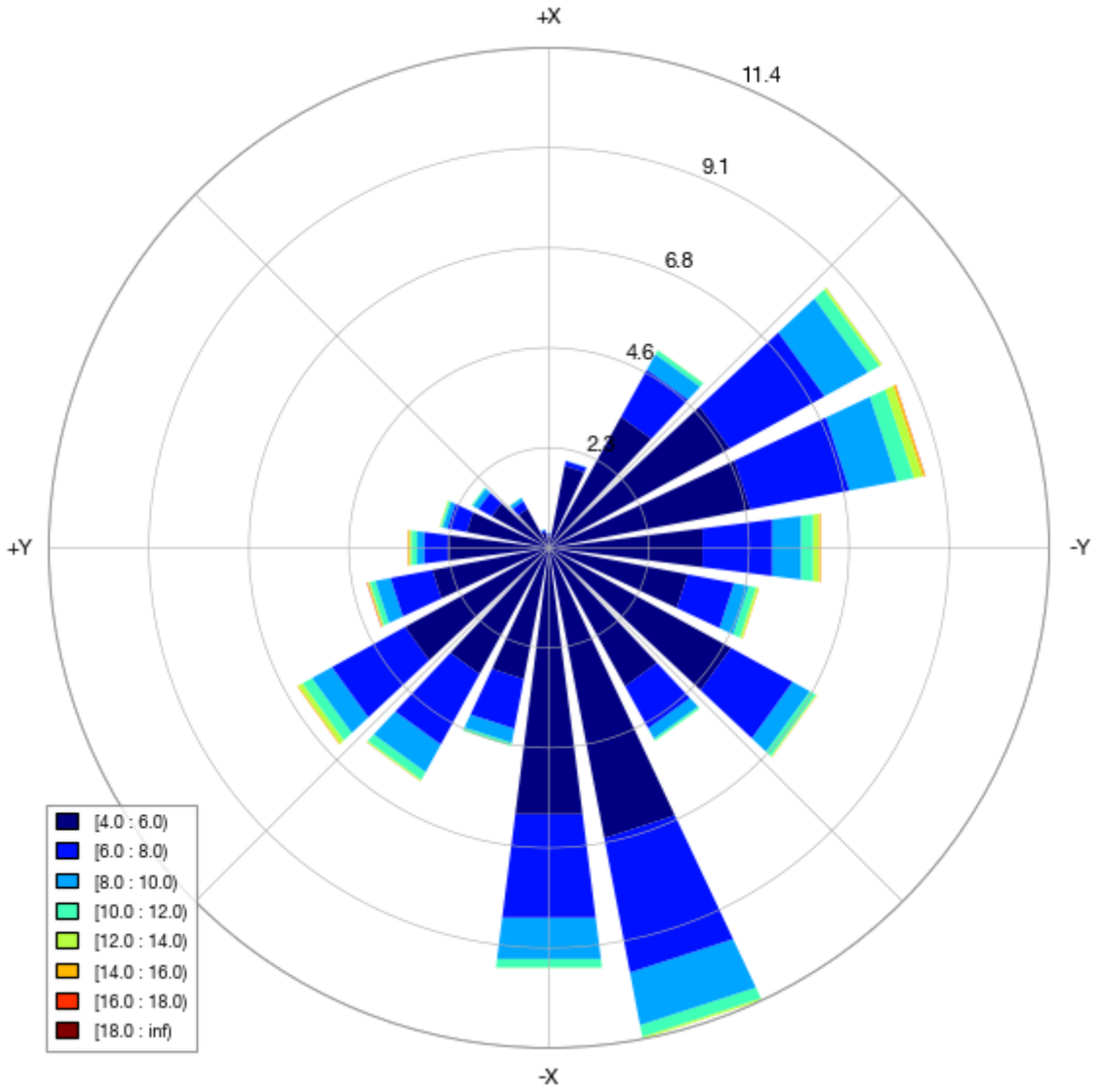
-Y is the direction we are protected against

Corner Station

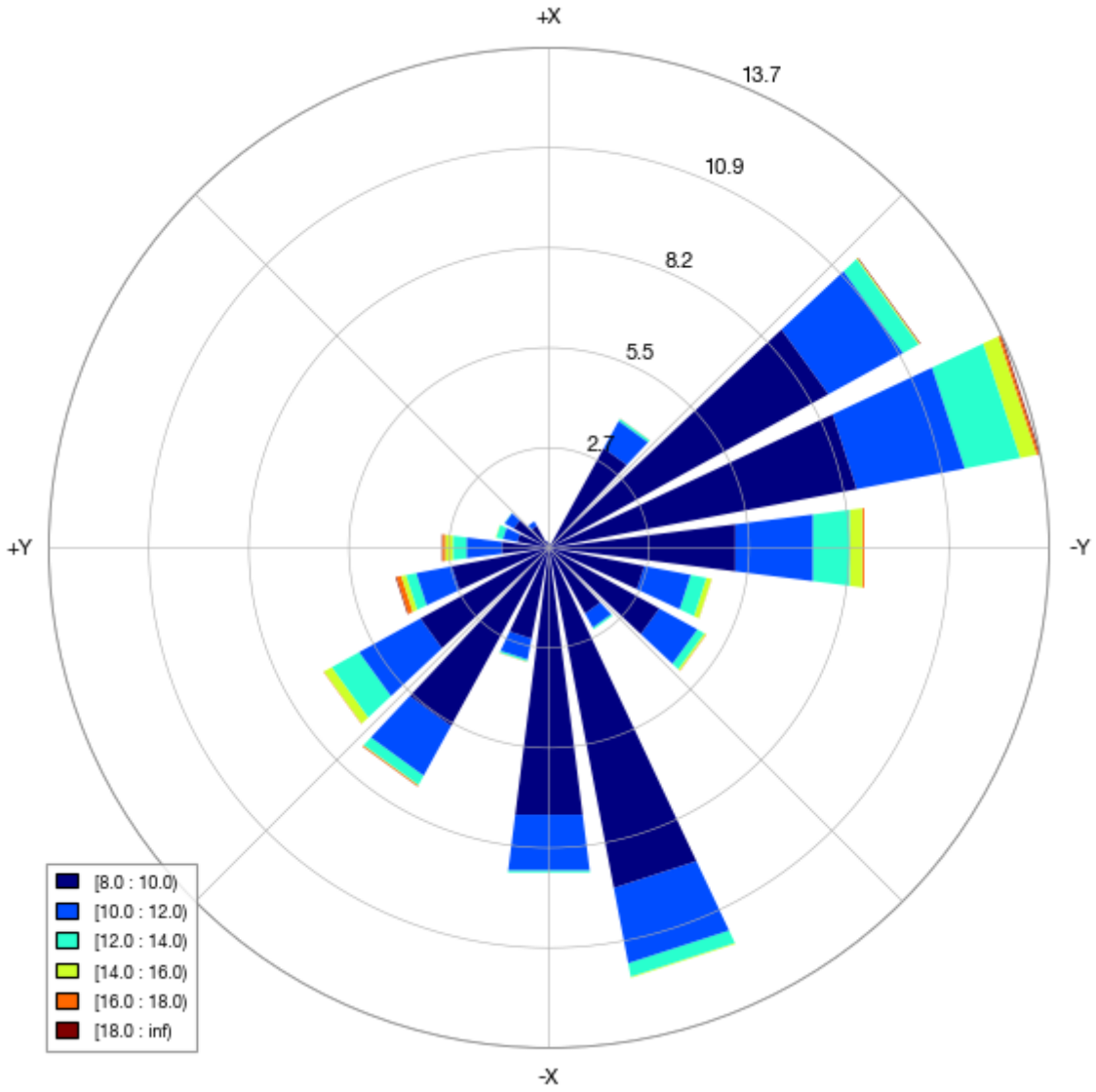
In [15]:
```
WindRose(starttime, endtime, CSSpeed, CSDir, 0, 20)
```



In [16]:
```
WindRose(starttime, endtime, CSSpeed, CSDir, 4, 20)
```



In [17]:
```
WindRose(starttime, endtime, CSSpeed, CSDir, 8, 20)
```

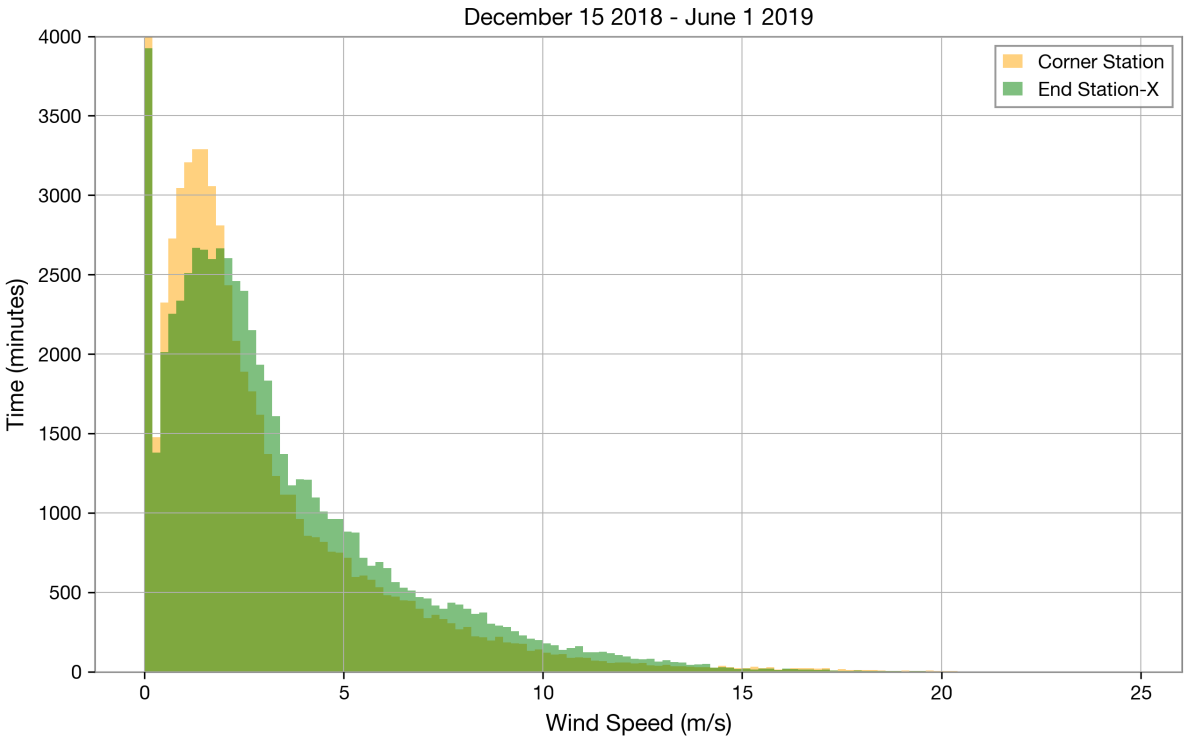


At the corner station we see that most high speed wind blows in the -Y direction but at EX we see most high speed wind blowing in the -X direction. This could be due to a variety of factors but we won't have a good sense of what's happening until we can get a free stream sensor installed.

CS vs EX Wind

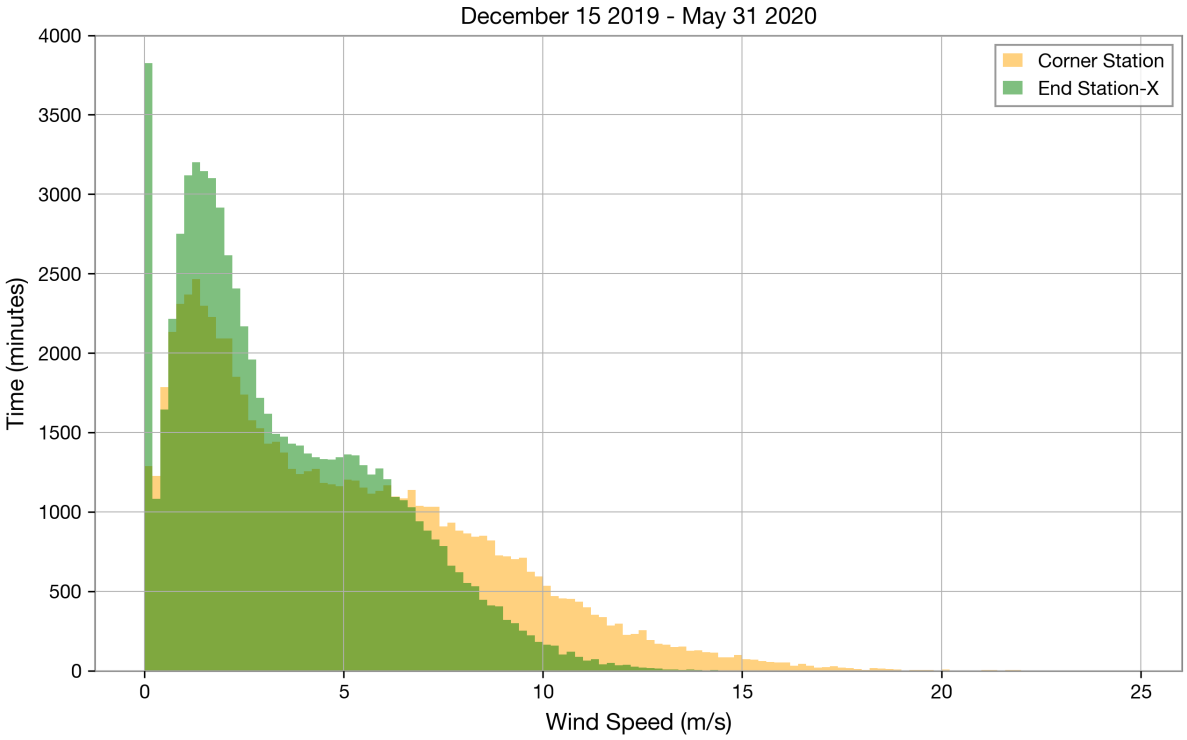
In [18]:
```
starttime1= 'December 15 2018'
endtime1= 'June 1 2019'
starttime2='December 15 2019'
endtime2='May 31 2020'
```

In [19]:
```
plt.hist(CSDF.loc[to60(starttime1):to60(endtime1)],bins=np.arange(0,25,.
2), color = 'orange', alpha=0.5,label = "Corner Station")
plt.hist(EXSpeedDirFiltered.loc[to60(starttime1):to60(endtime1)],bins=np
.arange(0,25,.2), color = 'green', alpha=0.5,label="End Station-X")
plt.xlabel('Wind Speed (m/s)')
plt.ylabel('Probability Density')
plt.ylim(0,4000)
#plt.yscale('log')
plt.ylabel('Time (minutes)')

plt.legend()
plt.title("December 15 2018 - June 1 2019")
plt.show()
```



Before the installation of the fence, the distribution of wind coming from the SW at CS and EX are relatively similar wind wind speed tending to be slightly higher at EX

In [20]:
```
plt.hist(CSDF.loc[to60(starttime2):to60(endtime2)],bins=np.arange(0,25,.
2), color = 'orange', alpha=0.5,label = "Corner Station")
plt.hist(EXSpeedDirFiltered.loc[to60(starttime2):to60(endtime2)],bins=np
.arange(0,25,.2), color = 'green', alpha=0.5,label="End Station-X")
plt.xlabel('Wind Speed (m/s)')
plt.ylabel('Time (minutes)')
#plt.yscale('log')
plt.legend()
plt.ylim(0,4000)

plt.title("December 15 2019 - May 31 2020")
plt.show()
```

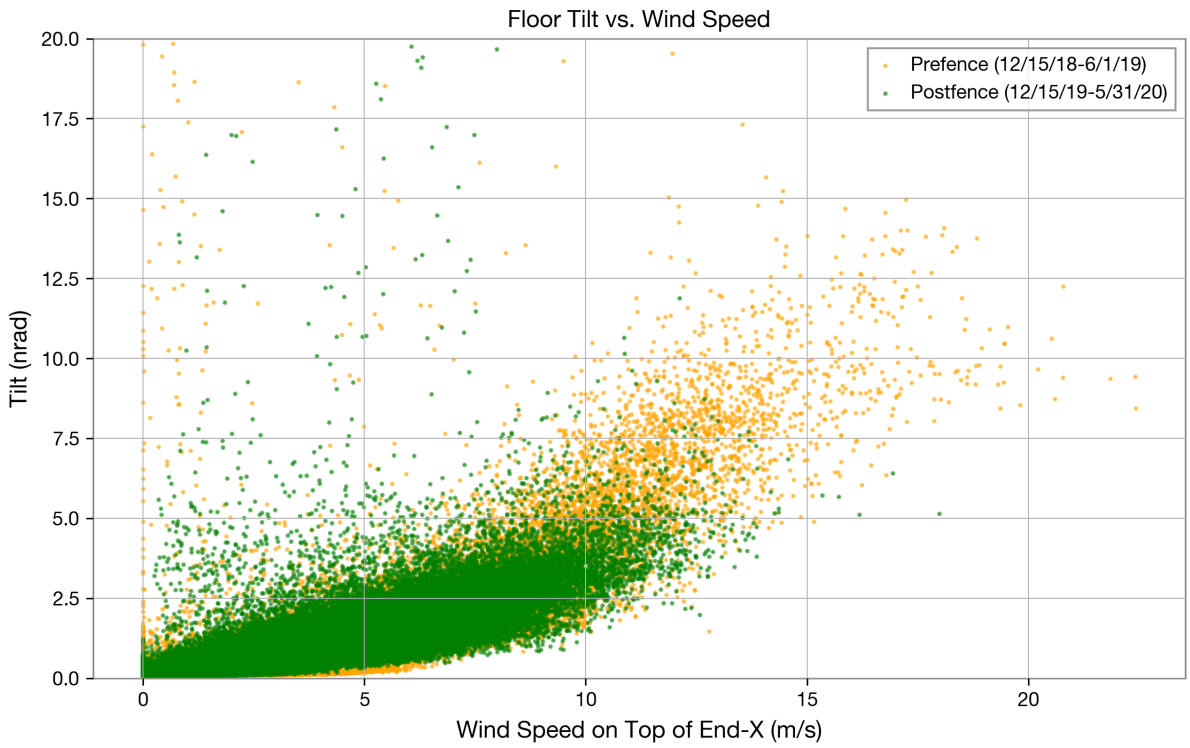


After the fence went up, there was a reduction of fast wind from the SW, at CS compared to EX despite a general increase in high wind

Looking at Tilt

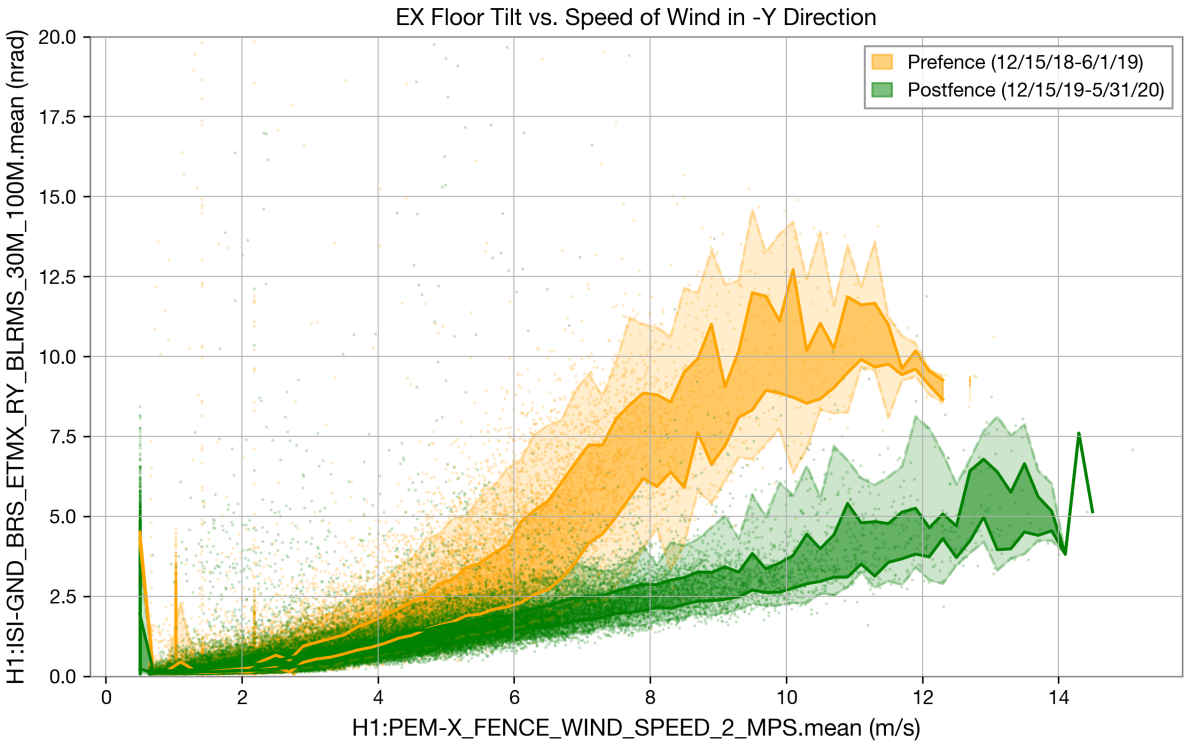
In [21]:
```
n = sorted(set(EXSpeedDirFiltered.index)&set(EXFSpeed.index))
predf = Constrain(EXSpeed.loc[n],EXRot,starttime1,endtime1)
postdf = Constrain(EXSpeed.loc[n],EXRot,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]

plt.scatter(X1,Y1, color = "orange",alpha=.5,label="Prefence (12/15/18-6/1/19)",s=2)
plt.scatter(X2,Y2, color = "green",alpha=.5,label="Postfence (12/15/19-5/31/20)",s=2)
plt.ylim(0,20)
plt.legend()
plt.title('Floor Tilt vs. Wind Speed')
plt.ylabel('Tilt (nrad)')
plt.xlabel('Wind Speed on Top of End-X (m/s)')
```

Out[21]:
```
Text(0.5, 0, 'Wind Speed on Top of End-X (m/s)')
```



In [22]:
```
n = sorted(set(EXSpeedDirFiltered.index)&set(EXFSpeed.index))
predf = Constrain(EXFSpeed.loc[n],EXRot,starttime1,endtime1)
postdf = Constrain(EXFSpeed.loc[n],EXRot,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]


blist1 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.05) for b in blist1]
Phigh1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.95) for b in blist1]

blist2 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.05) for b in blist2]
Phigh2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.95) for b in blist2]

plt.plot(blist1,Plow1, '--',color='orange',alpha=.2)
plt.plot(blist1,Phigh1,'--', color='orange',alpha=.2)
plt.plot(blist2,Plow2,'--' ,color='green',alpha=.2)
plt.plot(blist2,Phigh2,'--' ,color='green',alpha=.2)

blist3 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.25) for b in blist1]
Phigh3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.75) for b in blist1]

blist4 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.25) for b in blist2]
Phigh4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.75) for b in blist2]

plt.plot(blist3,Plow3,color='orange')
plt.plot(blist3,Phigh3, color='orange')
plt.plot(blist4,Plow4 ,color='green')
plt.plot(blist4,Phigh4 ,color='green')

plt.fill_between(blist1, Plow1, Phigh1, color = "orange",alpha=.2)
plt.fill_between(blist2, Plow2, Phigh2, color = "green", alpha=.2)
plt.fill_between(blist1, Plow3, Phigh3, color = "orange",alpha=.5,label=
"Prefence (12/15/18-6/1/19)" )
plt.fill_between(blist2, Plow4, Phigh4, color = "green",alpha=.5,label=
"Postfence (12/15/19-5/31/20)")
plt.legend()

plt.scatter(X1,Y1, color = "orange",alpha=.25,s=.2)
plt.scatter(X2,Y2, color = "green",alpha=.25,s=.2)

plt.ylim(0,20)

plt.xlabel(X1.name + ' (m/s)')
plt.ylabel(Y1.name + ' (nrad)' )
plt.title("EX Floor Tilt vs. Speed of Wind in -Y Direction")
```

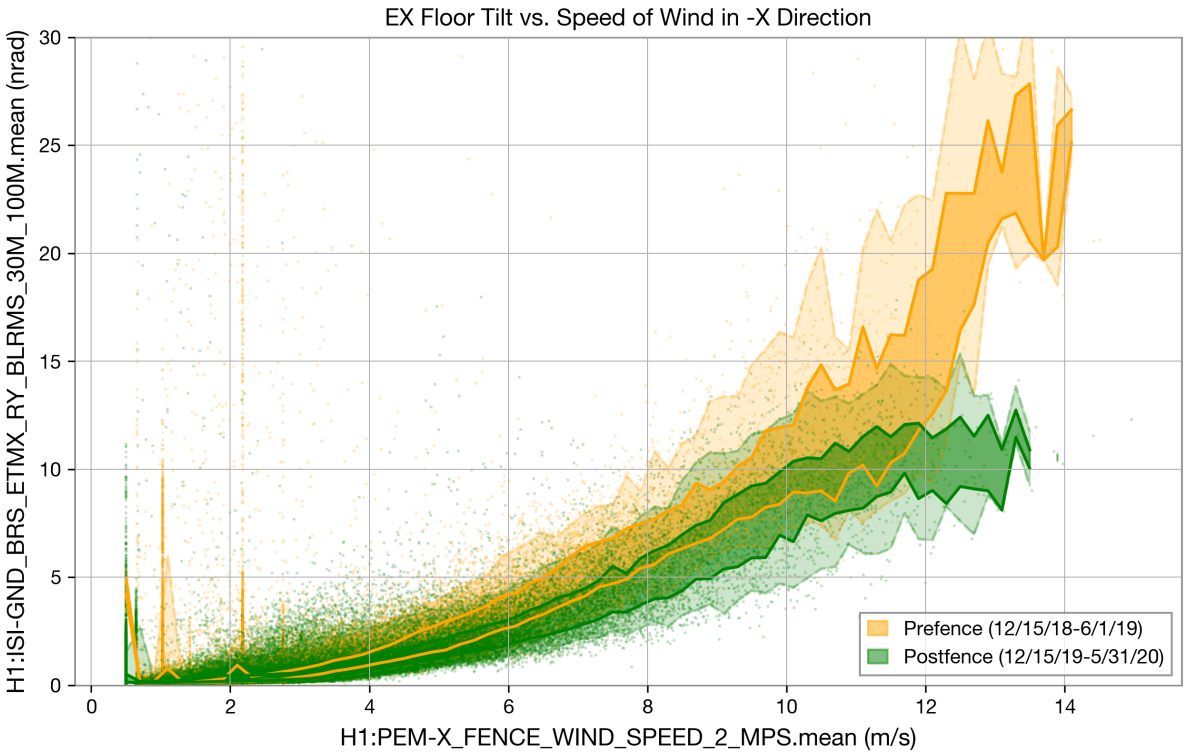
Out[22]: Text(0.5, 1.0, 'EX Floor Tilt vs. Speed of Wind in -Y Direction')



We see a clear reduction in tilt now tilt very rarely gets >7.5 whereas previously that amount of tilt was reached consistently with wind >8m/s

In [24]:
```
n = sorted(set(EXSpeedDirNX.index)&set(EXFSpeed.index))
predf = Constrain(EXFSpeed.loc[n],EXRot,starttime1,endtime1)
postdf = Constrain(EXFSpeed.loc[n],EXRot,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]


blist1 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.05) for b in blist1]
Phigh1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.95) for b in blist1]

blist2 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.05) for b in blist2]
Phigh2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.95) for b in blist2]

plt.plot(blist1,Plow1, '--',color='orange',alpha=.2)
plt.plot(blist1,Phigh1,'--', color='orange',alpha=.2)
plt.plot(blist2,Plow2,'--' ,color='green',alpha=.2)
plt.plot(blist2,Phigh2,'--' ,color='green',alpha=.2)

blist3 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.25) for b in blist1]
Phigh3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.75) for b in blist1]

blist4 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.25) for b in blist2]
Phigh4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.75) for b in blist2]

plt.plot(blist3,Plow3,color='orange')
plt.plot(blist3,Phigh3, color='orange')
plt.plot(blist4,Plow4 ,color='green')
plt.plot(blist4,Phigh4 ,color='green')



plt.fill_between(blist1, Plow1, Phigh1, color = "orange",alpha=.2)
plt.fill_between(blist2, Plow2, Phigh2, color = "green", alpha=.2)
plt.fill_between(blist1, Plow3, Phigh3, color = "orange",alpha=.5,label=
"Prefence (12/15/18-6/1/19)" )
plt.fill_between(blist2, Plow4, Phigh4, color = "green",alpha=.5,label=
"Postfence (12/15/19-5/31/20)")
plt.legend()

plt.scatter(X1,Y1, color = "orange",alpha=.25,s=.2)
plt.scatter(X2,Y2, color = "green",alpha=.25,s=.2)

plt.ylim(0,30)

plt.xlabel(X1.name + ' (m/s)')
plt.ylabel(Y1.name + ' (nrad)' )
plt.title("EX Floor Tilt vs. Speed of Wind in -X Direction")
```

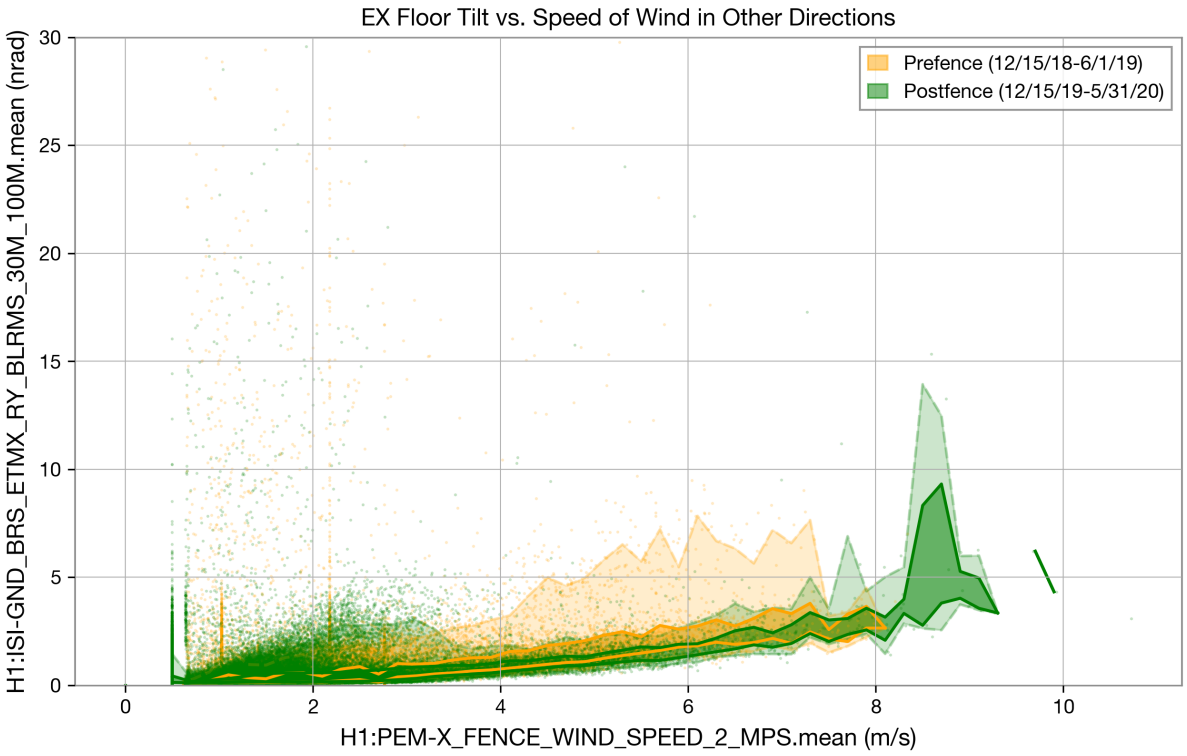
Out[24]: Text(0.5, 1.0, 'EX Floor Tilt vs. Speed of Wind in -X Direction')



We see some slight reduction in tilt for wind from the NW, this is likely due to other improvments made in 2019. Wind from the NW still remains problematic.

In [29]:
```
n = sorted(set(EXSpeedSENE.index)&set(EXFSpeed.index))
predf = Constrain(EXFSpeed.loc[n],EXRot,starttime1,endtime1)
postdf = Constrain(EXFSpeed.loc[n],EXRot,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]


blist1 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.05) for b in blist1]
Phigh1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.95) for b in blist1]

blist2 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.05) for b in blist2]
Phigh2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.95) for b in blist2]

plt.plot(blist1,Plow1, '--',color='orange',alpha=.2)
plt.plot(blist1,Phigh1,'--', color='orange',alpha=.2)
plt.plot(blist2,Plow2,'--' ,color='green',alpha=.2)
plt.plot(blist2,Phigh2,'--' ,color='green',alpha=.2)

blist3 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.25) for b in blist1]
Phigh3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.75) for b in blist1]

blist4 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.25) for b in blist2]
Phigh4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.75) for b in blist2]

plt.plot(blist3,Plow3,color='orange')
plt.plot(blist3,Phigh3, color='orange')
plt.plot(blist4,Plow4 ,color='green')
plt.plot(blist4,Phigh4 ,color='green')



plt.fill_between(blist1, Plow1, Phigh1, color = "orange",alpha=.2)
plt.fill_between(blist2, Plow2, Phigh2, color = "green", alpha=.2)
plt.fill_between(blist1, Plow3, Phigh3, color = "orange",alpha=.5,label=
"Prefence (12/15/18-6/1/19)" )
plt.fill_between(blist2, Plow4, Phigh4, color = "green",alpha=.5,label=
"Postfence (12/15/19-5/31/20)")
plt.legend()

plt.scatter(X1,Y1, color = "orange",alpha=.25,s=.2)
plt.scatter(X2,Y2, color = "green",alpha=.25,s=.2)

plt.ylim(0,30)

plt.xlabel(X1.name + ' (m/s)')
plt.ylabel(Y1.name + ' (nrad)' )
plt.title("EX Floor Tilt vs. Speed of Wind in Other Directions")
```

Out[29]: Text(0.5, 1.0, 'EX Floor Tilt vs. Speed of Wind in Other Directions')

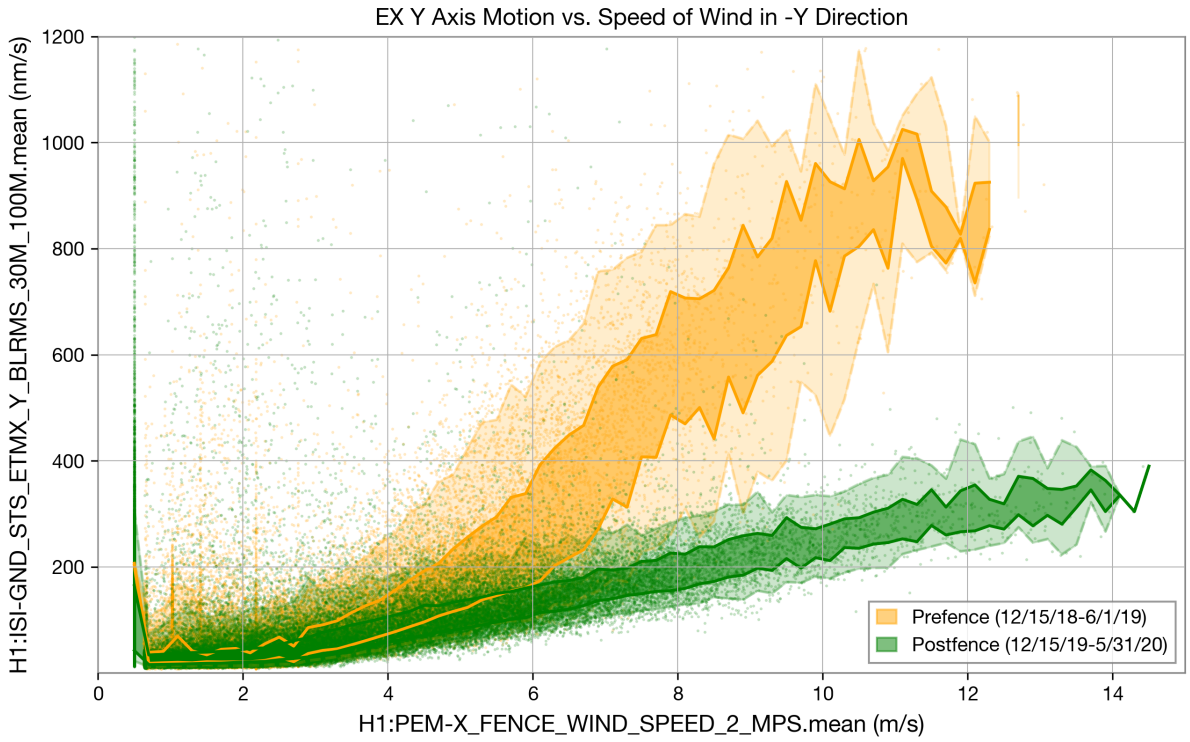


For wind coming from diretions other than the SW and NW the vast majority of the wind is low speed, even at higher speeds the tilt remains relatively low though

In [25]:
```
n = sorted(set(EXSpeedDirFiltered.index)&set(EXFSpeed.index))
predf = Constrain(EXFSpeed.loc[n],STS_Y,starttime1,endtime1)
postdf = Constrain(EXFSpeed.loc[n],STS_Y,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]


blist1 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.05) for b in blist1]
Phigh1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.95) for b in blist1]

blist2 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.05) for b in blist2]
Phigh2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.95) for b in blist2]

plt.plot(blist1,Plow1, '--',color='orange',alpha=.2)
plt.plot(blist1,Phigh1,'--', color='orange',alpha=.2)
plt.plot(blist2,Plow2,'--' ,color='green',alpha=.2)
plt.plot(blist2,Phigh2,'--' ,color='green',alpha=.2)

blist3 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.25) for b in blist1]
Phigh3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.75) for b in blist1]

blist4 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.25) for b in blist2]
Phigh4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.75) for b in blist2]

plt.plot(blist3,Plow3,color='orange')
plt.plot(blist3,Phigh3, color='orange')
plt.plot(blist4,Plow4 ,color='green')
plt.plot(blist4,Phigh4 ,color='green')



plt.fill_between(blist1, Plow1, Phigh1, color = "orange",alpha=.2)
plt.fill_between(blist2, Plow2, Phigh2, color = "green", alpha=.2)
plt.fill_between(blist1, Plow3, Phigh3, color = "orange",alpha=.5,label=
"Prefence (12/15/18-6/1/19)" )
plt.fill_between(blist2, Plow4, Phigh4, color = "green",alpha=.5,label=
"Postfence (12/15/19-5/31/20)")
plt.legend()

plt.scatter(X1,Y1, color = "orange",alpha=.25,s=.2)
plt.scatter(X2,Y2, color = "green",alpha=.25,s=.2)

#plt.yscale('log')
plt.ylim(1,1200)
plt.xlim(0,15)


plt.xlabel(X1.name + ' (m/s)')
```

```
plt.ylabel(Y1.name + ' (nm/s)' )
plt.title("EX Y Axis Motion vs. Speed of Wind in -Y Direction")
```

Out[25]: Text(0.5, 1.0, 'EX Y Axis Motion vs. Speed of Wind in -Y Direction')



In [26]:
```
n = sorted(set(EXSpeedOtherDir.index)&set(EXFSpeed.index))
predf = Constrain(EXFSpeed.loc[n],STS_Y,starttime1,endtime1)
postdf = Constrain(EXFSpeed.loc[n],STS_Y,starttime2,endtime2)

X1=predf.iloc[:,0]
Y1=predf.iloc[:,1]
X2=postdf.iloc[:,0]
Y2=postdf.iloc[:,1]


blist1 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.05) for b in blist1]
Phigh1 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.95) for b in blist1]

blist2 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.05) for b in blist2]
Phigh2 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.95) for b in blist2]

plt.plot(blist1,Plow1, '--',color='orange',alpha=.2)
plt.plot(blist1,Phigh1,'--', color='orange',alpha=.2)
plt.plot(blist2,Plow2,'--' ,color='green',alpha=.2)
plt.plot(blist2,Phigh2,'--' ,color='green',alpha=.2)

blist3 = [(1+i*2)/10 for i in range (int(X1.max()/.2))]
Plow3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.25) for b in blist1]
Phigh3 = [Y1.loc[(X1>=b-.1)&(X1<b+.1)].quantile(.75) for b in blist1]

blist4 = [(1+i*2)/10 for i in range (int(X2.max()/.2))]
Plow4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.25) for b in blist2]
Phigh4 = [Y2.loc[(X2>=b-.1)&(X2<b+.1)].quantile(.75) for b in blist2]

plt.plot(blist3,Plow3,color='orange')
plt.plot(blist3,Phigh3, color='orange')
plt.plot(blist4,Plow4 ,color='green')
plt.plot(blist4,Phigh4 ,color='green')



plt.fill_between(blist1, Plow1, Phigh1, color = "orange",alpha=.2)
plt.fill_between(blist2, Plow2, Phigh2, color = "green", alpha=.2)
plt.fill_between(blist1, Plow3, Phigh3, color = "orange",alpha=.5,label=
"Prefence (12/15/18-6/1/19)" )
plt.fill_between(blist2, Plow4, Phigh4, color = "green",alpha=.5,label=
"Postfence (12/15/19-5/31/20)")
plt.legend()

plt.scatter(X1,Y1, color = "orange",alpha=.25,s=.2)
plt.scatter(X2,Y2, color = "green",alpha=.25,s=.2)

#plt.yscale('log')
plt.ylim(0,1200)
plt.xlim(0,15)

plt.xlabel(X1.name + ' (m/s)')
plt.ylabel(Y1.name + ' (nm/s)' )
plt.title("EX Y Axis Motion vs. Speed of Wind in Other Directions")
```

Out[26]: Text(0.5, 1.0, 'EX Y Axis Motion vs. Speed of Wind in Other Directions')