Clear sky 2018 june 5th camera 2 sw-vers. 2

In [1]:
```
import matplotlib
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import csv
import bisect
import datetime
from scipy import interpolate
from matplotlib.dates import DateFormatter

# User defined functions
from load_data_from_csv import *
```

Remarks: Highly dynamic sky with different cloud layers and different cloud directions

Import Data

In [2]:
```
day = '2018-06-05'   # select day of observation ('2018-10-12' : camera 2, sw-ve
rs. 3)
s_time = ' 07:00:00' # beginning of observation
e_time = ' 20:00:00' # end of observation
start = day + s_time
end   = day + e_time
```

Weather station at Luzern Switzerland

In [3]:
```
luz_csv = r'../weather_data/irradiation_luz_2017_2018.csv'

df = process_LUZ(luz_csv)
df.set_index(df.datetime, inplace=True)
df_lu = df['gre000z0']        # 10 min mean in W/m²
lu_rad = df_lu.loc[start:end]    # set distinct observation day

#lu_rad.head(n=2)
```

Clear Sky solar irradiance from SODA using McClear model

Source: http://www.soda-pro.com/web-services/radiation/cams-mcclear (http://www.soda-pro.com/web-services/radiation/cams-mcclear)

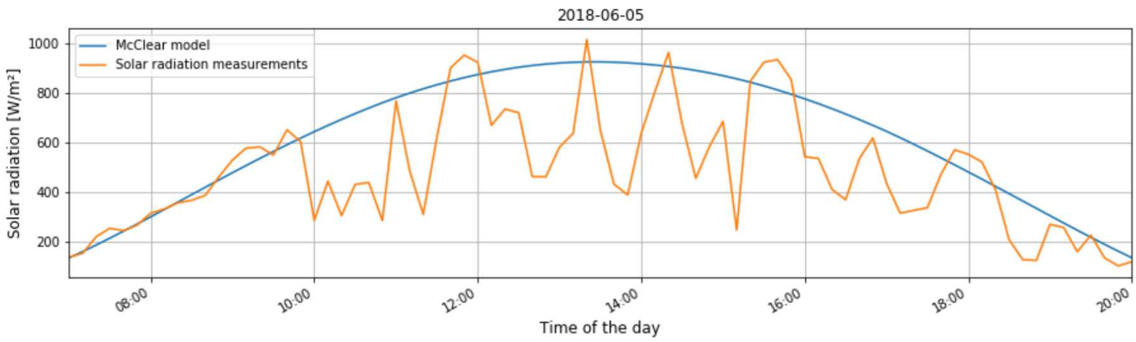
In [4]:
```
soda_csv = r'../weather_data/irradiation_soda_2017_2018_1min.csv'

df = process_SODA(soda_csv)
df_soda = df['Clear sky GHI']*60       # given in units of Wh/m²
mc_rad = df_soda.loc[start:end]        # set distinct observation day

#mc_rad.head(n=2)
```

Load relative luminance from images

In [5]:
```
calc_csv = r'../lumi_data/20180605_cam2_luminance.csv'

df_calc = process_LUMI(calc_csv)
lum_hdr = df_calc['lum_hdr']            # mean luminance from HDR image
lum_hdr_m = df_calc['lum_hdr_m']        # mean luminance from masked HDR image fro
m raw data
lum_jpg_m = df_calc['lum_jpg_m']        # mean luminance from masked HDR image bui
ld from three jpg exposures

#lum_hdr.head(n=2)
```

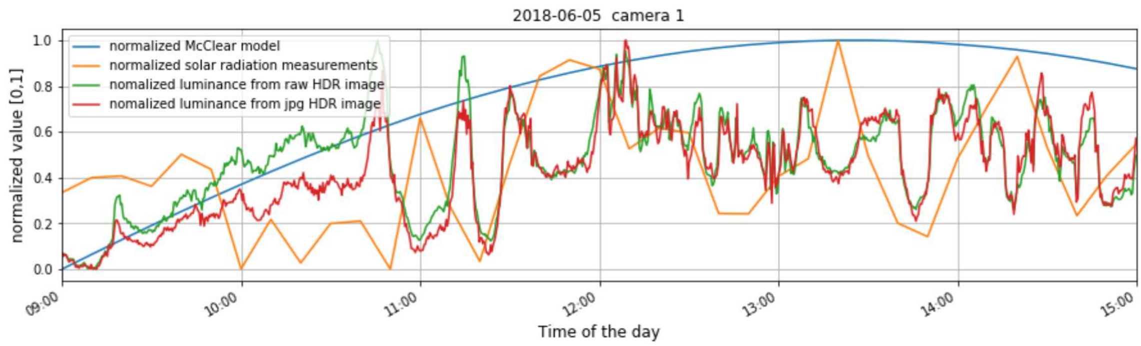
Pyranometer measurements vs. McClear model

In [6]:
```
matplotlib.rcParams['timezone'] = 'Europe/Zurich'

fig = plt.figure(1, figsize=(15,4))
mc_rad.plot(label='McClear model')
lu_rad.plot(label='Solar radiation measurements')

plt.xlabel('Time of the day', fontsize=12)
plt.ylabel('Solar radiation [W/m²]', fontsize=12)
plt.legend(loc='upper left')
plt.grid(b=None, which='major', axis='both')
plt.title(day)
fig.autofmt_xdate()
formatter = DateFormatter('%H:%M')
#formatter.set_tzinfo(timezone('Europe/Zurich'))
plt.gcf().axes[0].xaxis.set_major_formatter(formatter)
```



Plot with normalized data for 2018-10-12 from 9:00 to 15:00

In [7]:
```
# Set appropriate timezone
matplotlib.rcParams['timezone'] = 'Europe/Zurich'

day = '2018-06-05'   # day of observation ('2018-10-12' : camera 2, sw-vers. 3)
s_time = ' 09:00:00' # beginning of observation
e_time = ' 15:00:00' # end of observation
start = day + s_time
end   = day + e_time

lu_rad = df_lu.loc[start:end]     # weather station
mc_rad = df_soda.loc[start:end]   # McClear model

#print(lu_rad.head(n=5))
#print(lum_hdr.head(n=5))

lu_rad_n  = ((lu_rad-lu_rad.min())/(lu_rad.max()-lu_rad.min()))
mc_rad_n  = ((mc_rad-mc_rad.min())/(mc_rad.max()-mc_rad.min()))
lum_hdr_n = ((lum_hdr-lum_hdr.min())/(lum_hdr.max()-lum_hdr.min()))
lum_jpg_n = ((lum_jpg_m-lum_jpg_m.min())/(lum_jpg_m.max()-lum_jpg_m.min()))

fig = plt.figure(2, figsize=(15,4))
mc_rad_n.plot(label ='normalized McClear model')
lu_rad_n.plot(label ='normalized solar radiation measurements')
lum_hdr_n.plot(label='nomalized luminance from raw HDR image')
lum_jpg_n.plot(label='nomalized luminance from jpg HDR image')

plt.xlabel('Time of the day', fontsize=12)
plt.ylabel('normalized value [0,1]', fontsize=12)
plt.legend(loc='upper left')
plt.grid(b=None, which='major', axis='both')
plt.title(day + '  camera 1')
fig.autofmt_xdate()
formatter = DateFormatter('%H:%M')
plt.gcf().axes[0].xaxis.set_major_formatter(formatter)
```

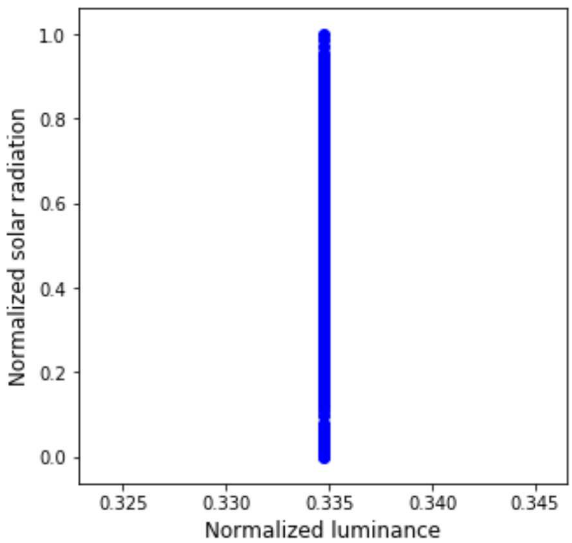


Scatterplot mean luminance from HDR images vs. pyranometer measurements

In [27]:
```
fig = plt.figure(3, figsize=(5,5))

day = '2018-06-05'   # day of observation ('2018-10-12' : camera 2, sw-vers. 3)
s_time = ' 09:00:00' # beginning of observation
e_time = ' 15:00:00' # end of observation
start = day + s_time
end   = day + e_time

lu_rad_f  = lu_rad_n.asfreq(freq='24.15S')
lu_rad_ip = lu_rad_f.interpolate(method = 'linear')

print('lu_rad_ip:{} lum_hdr_n:{}'.format(lu_rad_ip.size,lum_hdr_n.size))

plt.xlabel('Normalized luminance', fontsize=12)
plt.ylabel('Normalized solar radiation', fontsize=12)

plt.scatter(x=lu_rad_ip, y=lum_hdr_n, marker='o', color='blue')
```

```
lu_rad_ip:895 lum_hdr_n:895
```

Out[27]: <matplotlib.collections.PathCollection at 0x26b6c1bc2e8>



In [9]:
```
#lum_hdr_n_new = pd.DataFrame(lum_hdr_n)
#lum_hdr_n_new.head()

#lu_rad_n_new = pd.DataFrame(lu_rad_n)
#lu_rad_n_new.tail()

#lum_hdr_n_new_resample = lum_hdr_n_new.resample('10min').mean()
#lum_hdr_n_new_resample.tail()

#plt.figure(10,figsize=(5, 5))
#plt.scatter(x=lum_hdr_n_new_resample.lum_hdr,y=lu_rad_n_new[0:-1].gre000z0, mar
ker='o')

#len(lum_hdr_n_new_resample)
#len(lu_rad_n_new[0:-1])
```