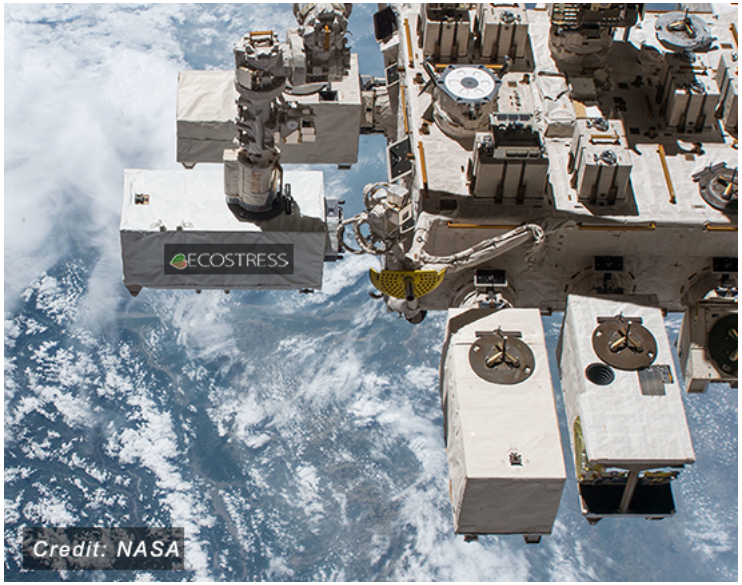
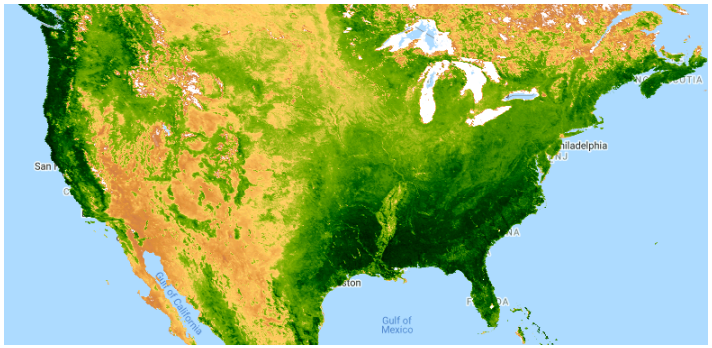
Understanding Diurnal Cycles of Plant Water Use and Carbon Uptake with Existing and New Products Based on ECOSTRESS, MODIS, and FLUXNET



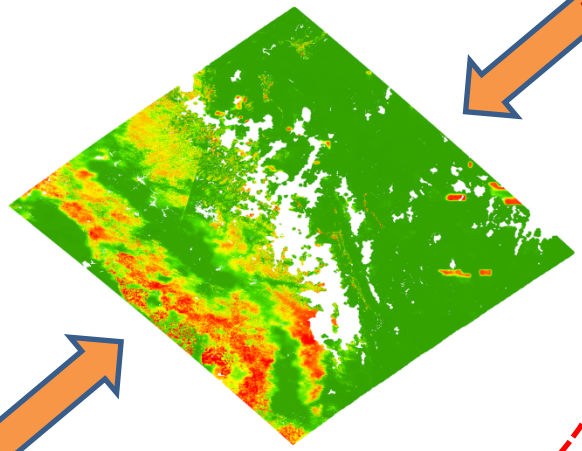
Jingfeng Xiao (PI), **Xing Li** (Post-doc)
University of New Hampshire

Joshua Fisher (Collaborator), JPL

Continent



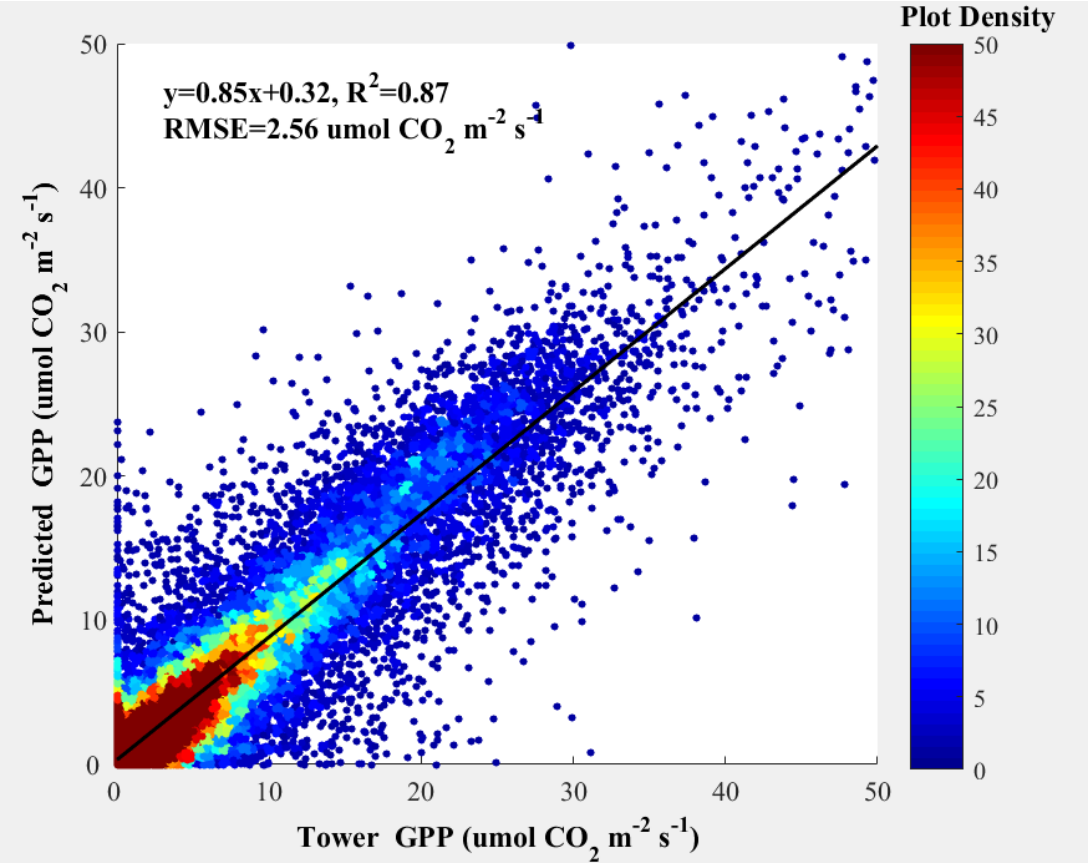
Region

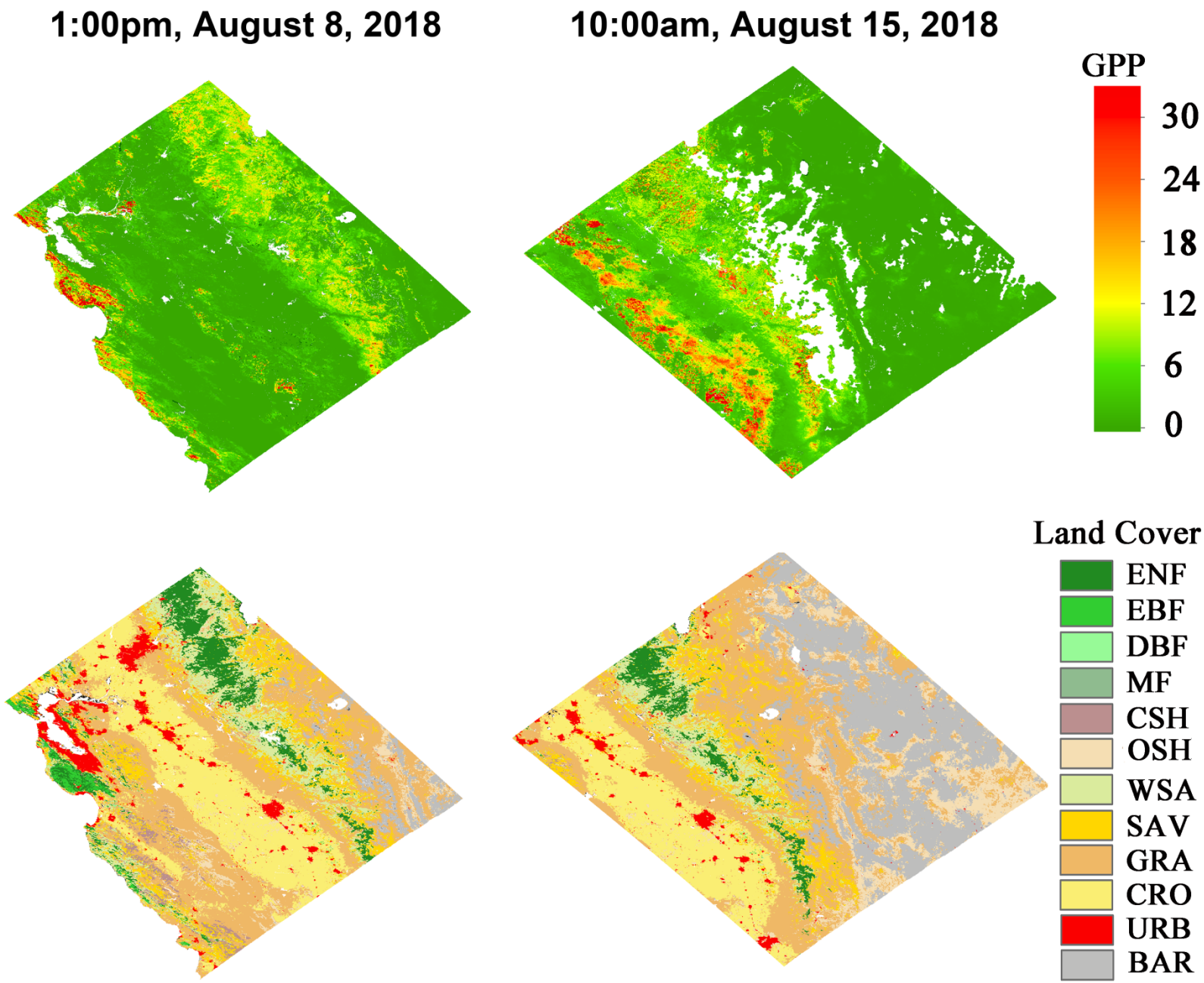


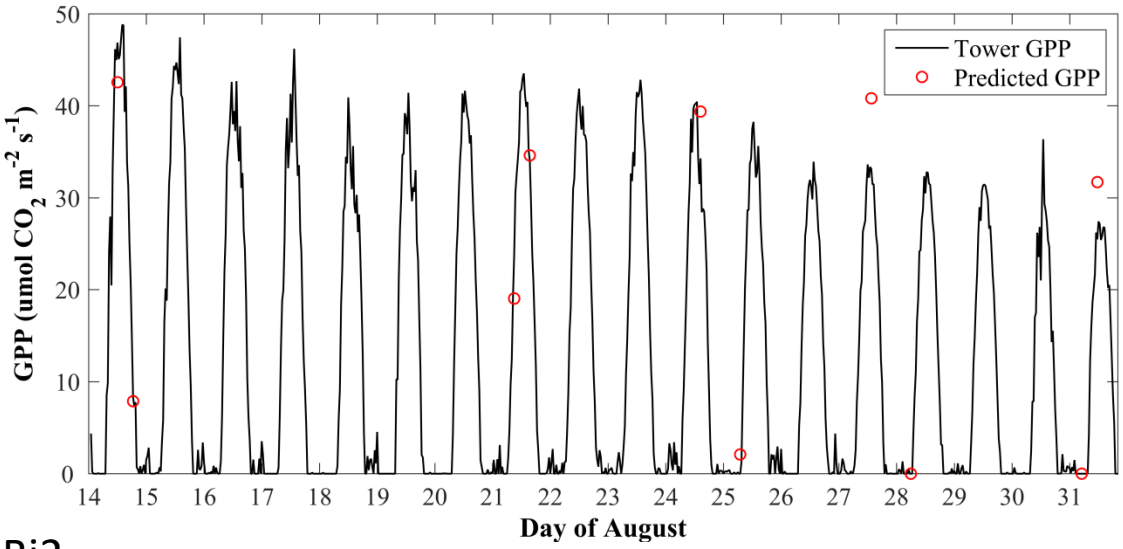
Ecosystem

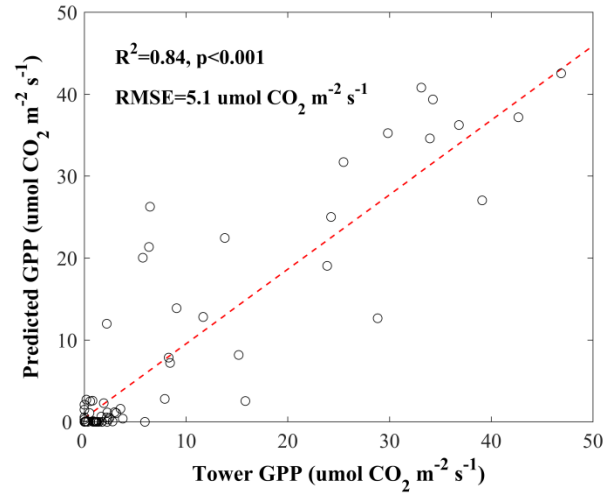
Task 1: Generate two new ECOSTRESS products – an instantaneous GPP product and an instantaneous WUE product

- ECOSTRESS
- FLUXNET
- Other satellite data
- Reanalysis

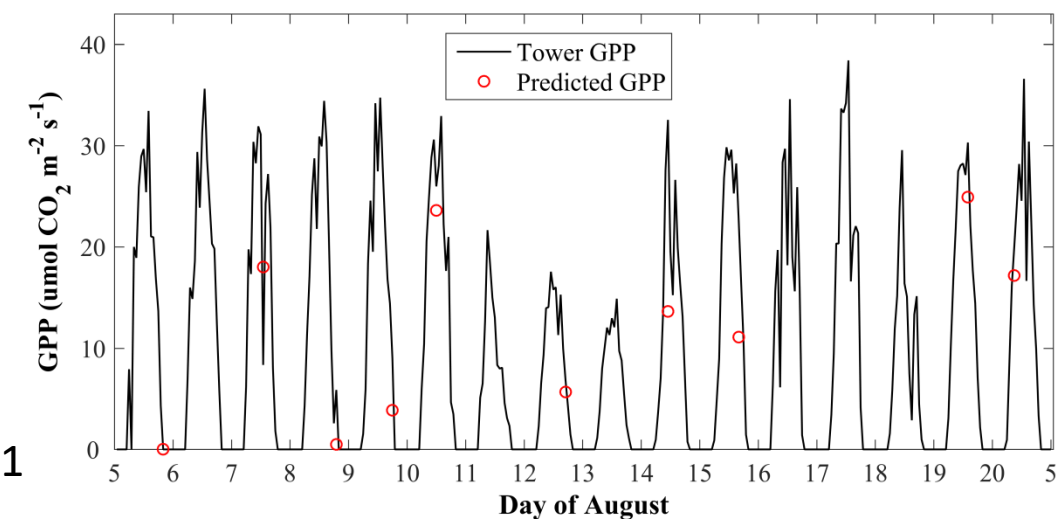


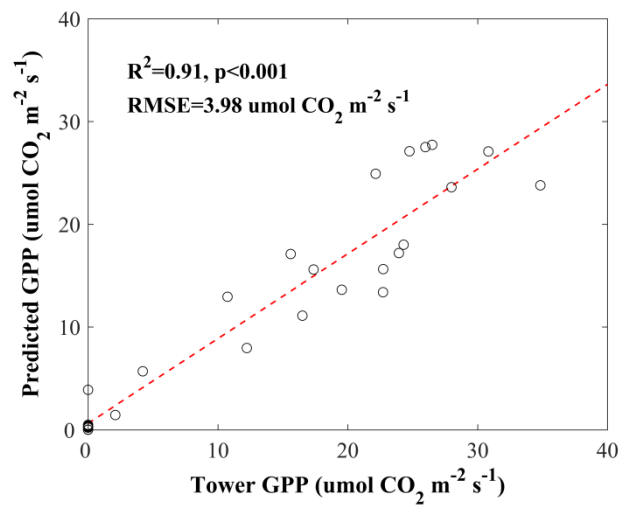

1:00pm, August 8, 2018
10:00am, August 15, 2018
GPP
30
24
18
12
6
0
Land Cover
ENF
EBF
DBF
MF
CSH
OSH
WSA
SAV
GRA
CRO
URB
BAR


Tower GPP
Predicted GPP
GPP (umol CO2 m-2 s-1)
Day of August

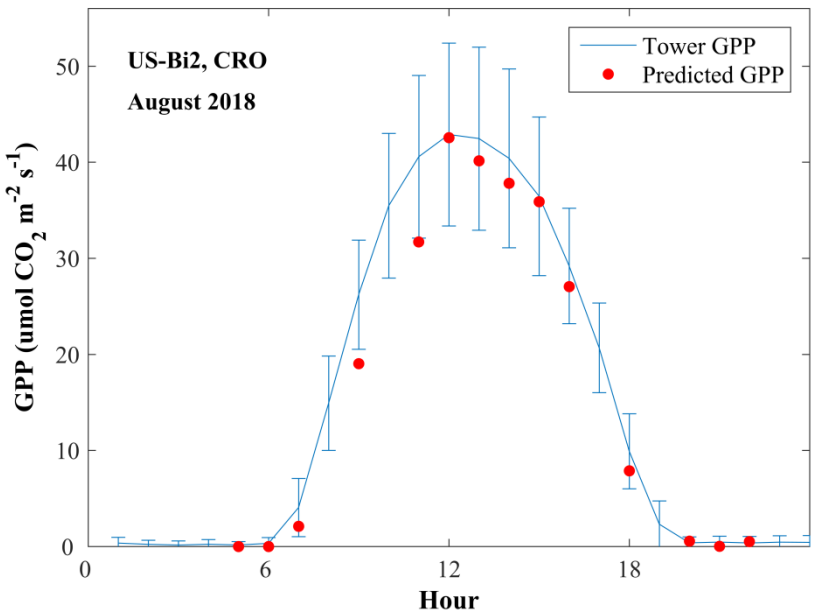

R2=0.84, p<0.001
RMSE=5.1 umol CO2 m-2 s-1
Predicted GPP (umol CO2 m-2 s-1)
Tower GPP (umol CO2 m-2 s-1)

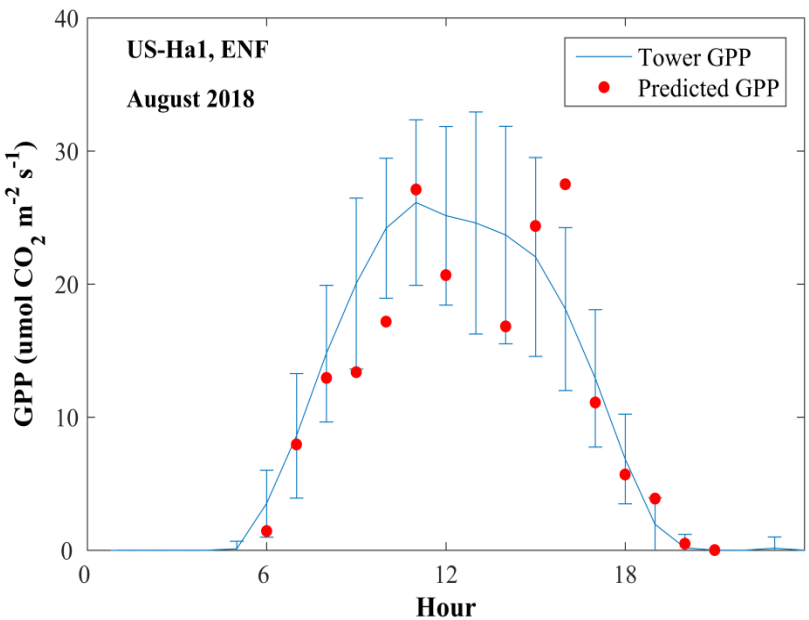
US-Bi2

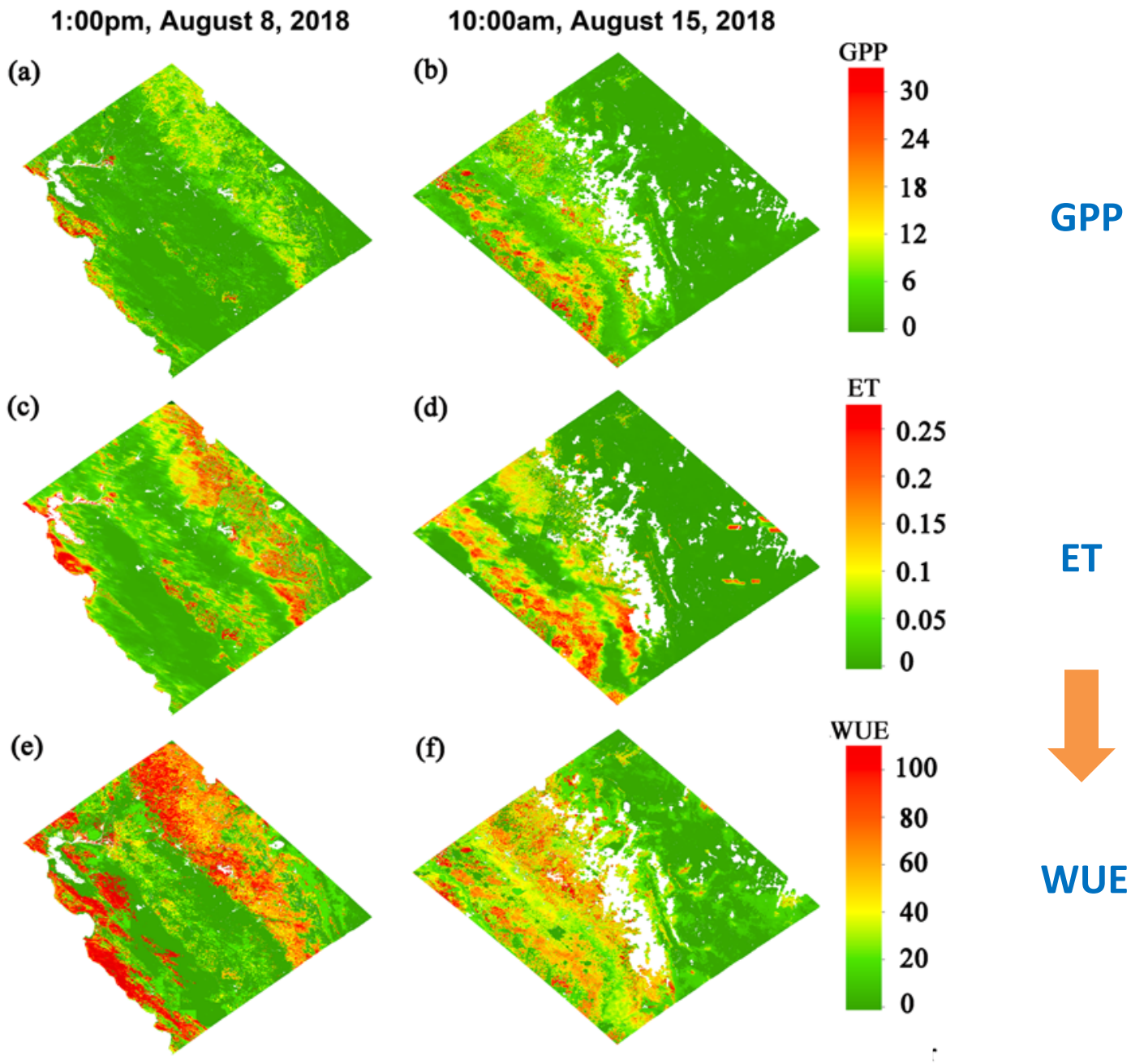

Tower GPP
Predicted GPP
GPP (umol CO2 m-2 s-1)
Day of August


R2=0.91, p<0.001
RMSE=3.98 umol CO2 m-2 s-1
Predicted GPP (umol CO2 m-2 s-1)
Tower GPP (umol CO2 m-2 s-1)

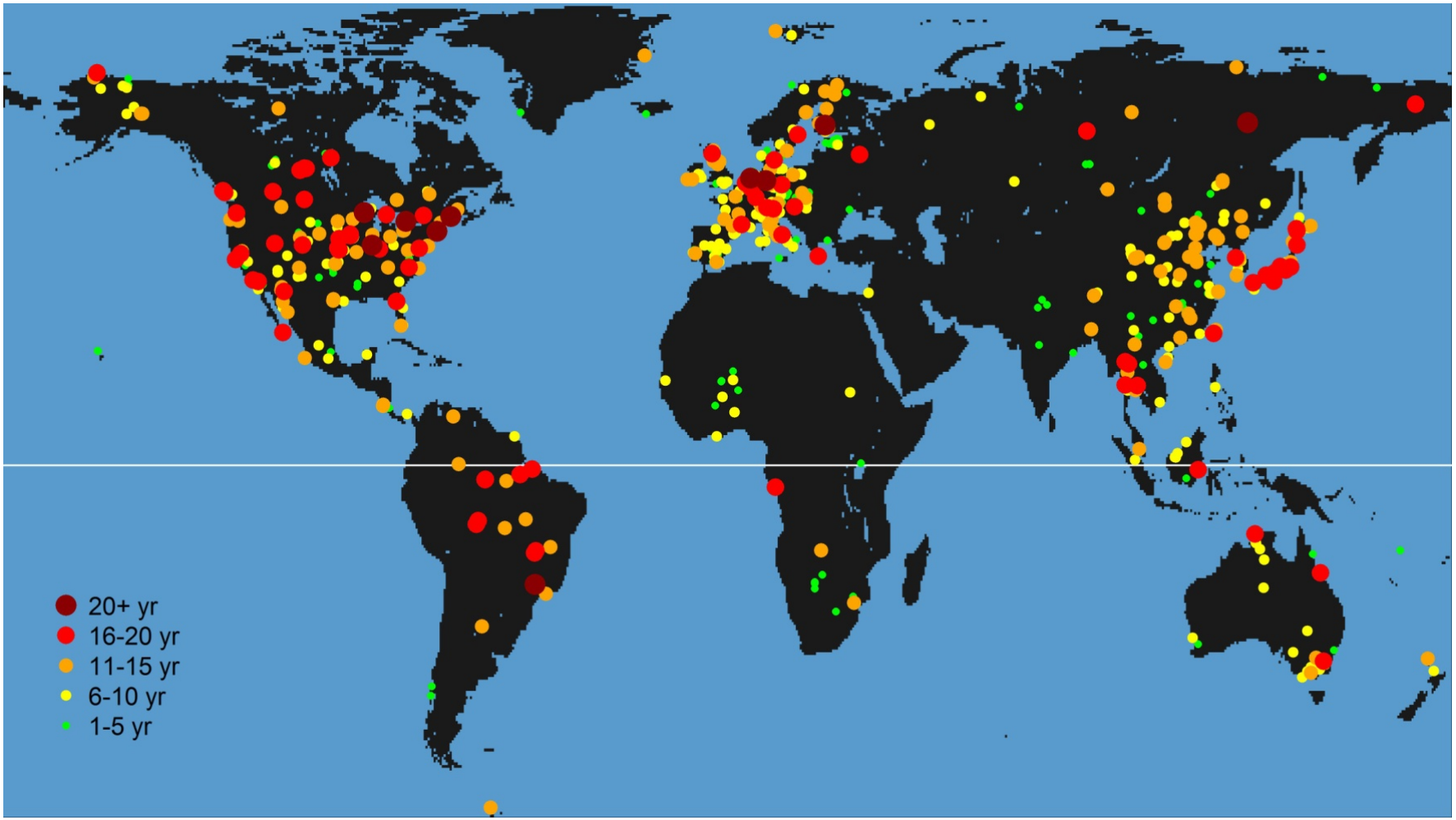
US-Ha1


US-Bi2, CRO
August 2018
Tower GPP
Predicted GPP
GPP (umol CO2 m-2 s-1)
Hour
0
10
20
30
40
50
0
6
12
18

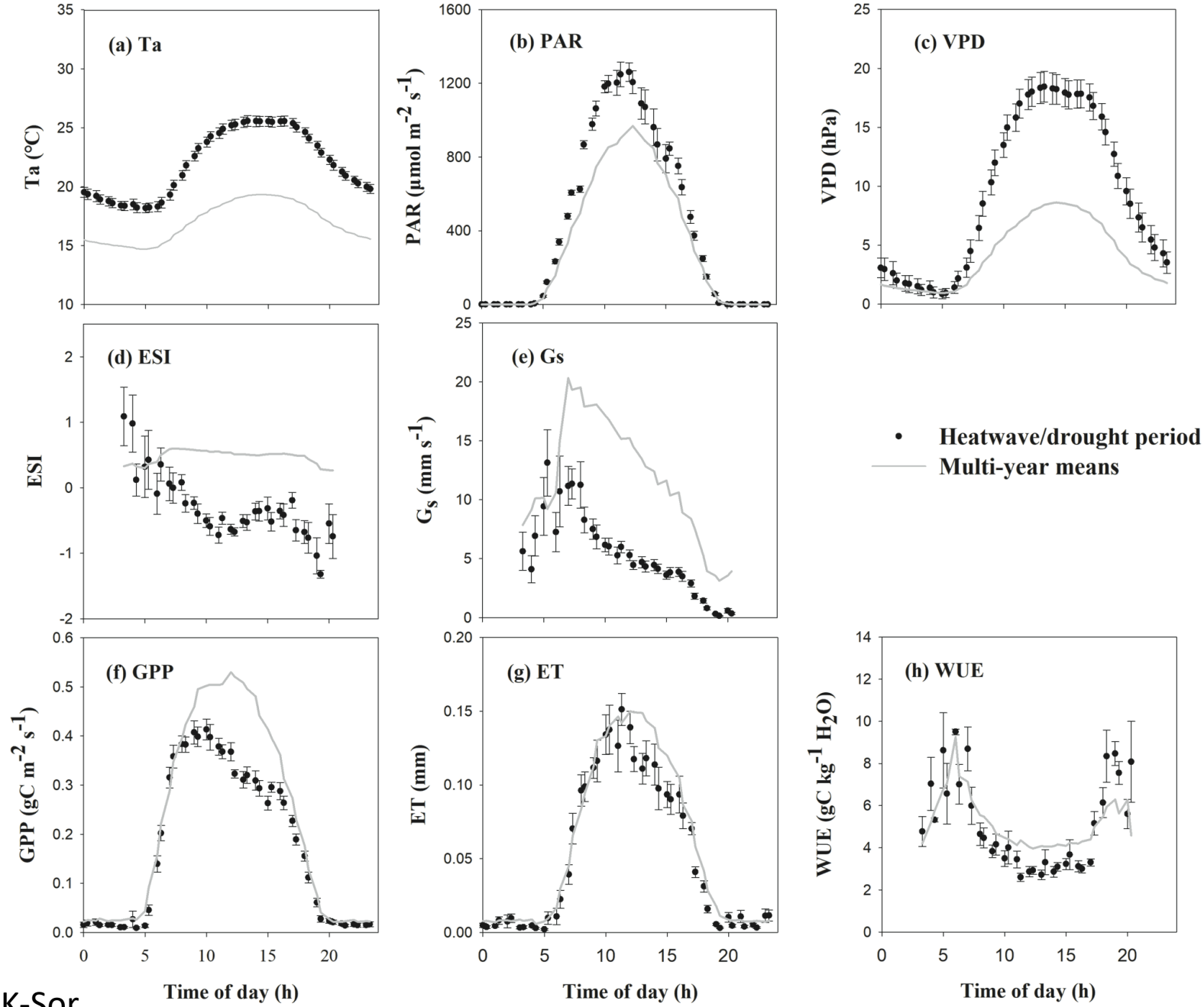

US-Ha1, ENF
August 2018
Tower GPP
Predicted GPP
GPP (umol CO2 m-2 s-1)
Hour
0
10
20
30
40
0
6
12
18


1:00pm, August 8, 2018
10:00am, August 15, 2018
(a)
(b)
(c)
(d)
(e)
(f)
GPP
30
24
18
12
6
0
ET
0.25
0.2
0.15
0.1
0.05
0
WUE
100
80
60
40
20
0
GPP
ET
WUE

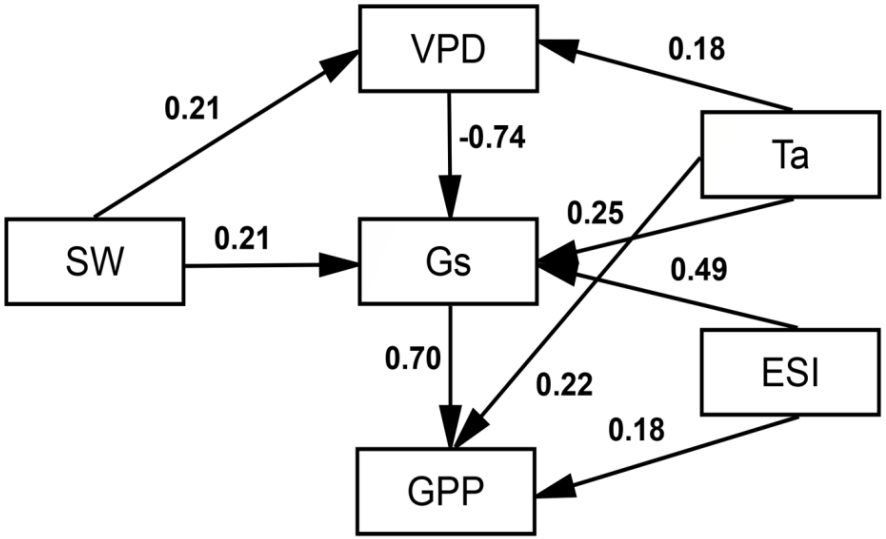
Task 2: Examining diurnal cycles of canopy conductance, plant water use, and photosynthesis and effects of water stress at ecosystem scale



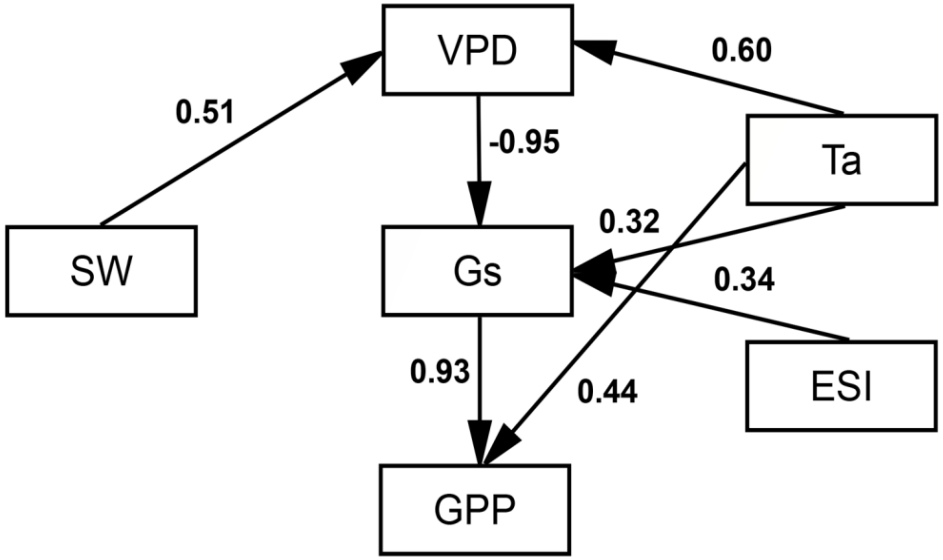
(from the FLUXNET website)


(a) Ta
Ta (°C)
(b) PAR
PAR (µmol m-2 s-1)
(c) VPD
VPD (hPa)
(d) ESI
ESI
(e) Gs
Gs (mm s-1)
Heatwave/drought period
Multi-year means
(f) GPP
GPP (gC m-2 s-1)
(g) ET
ET (mm)
(h) WUE
WUE (gC kg-1 H2O)
Time of day (h)
Time of day (h)
Time of day (h)

DK-Sor

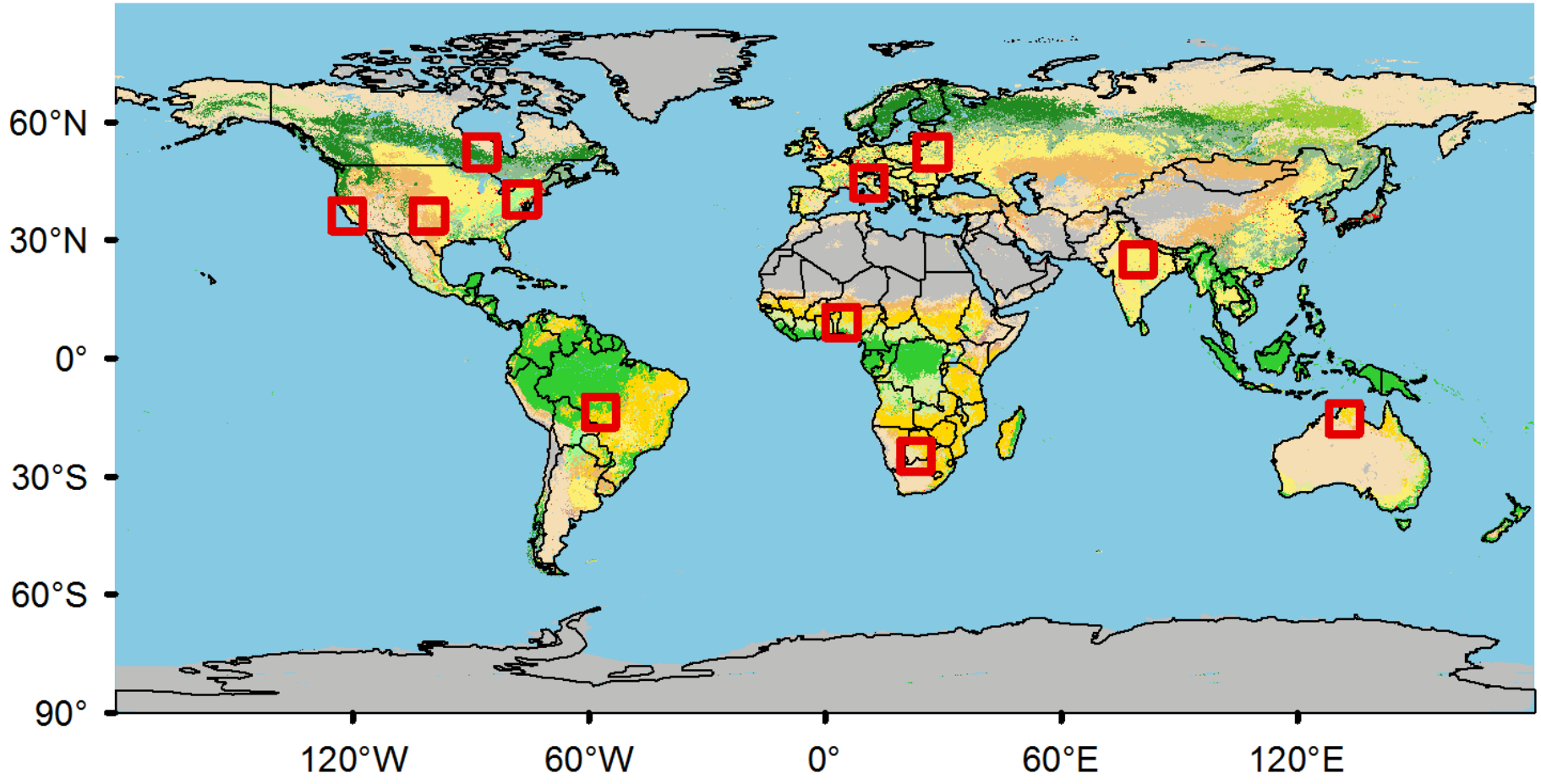


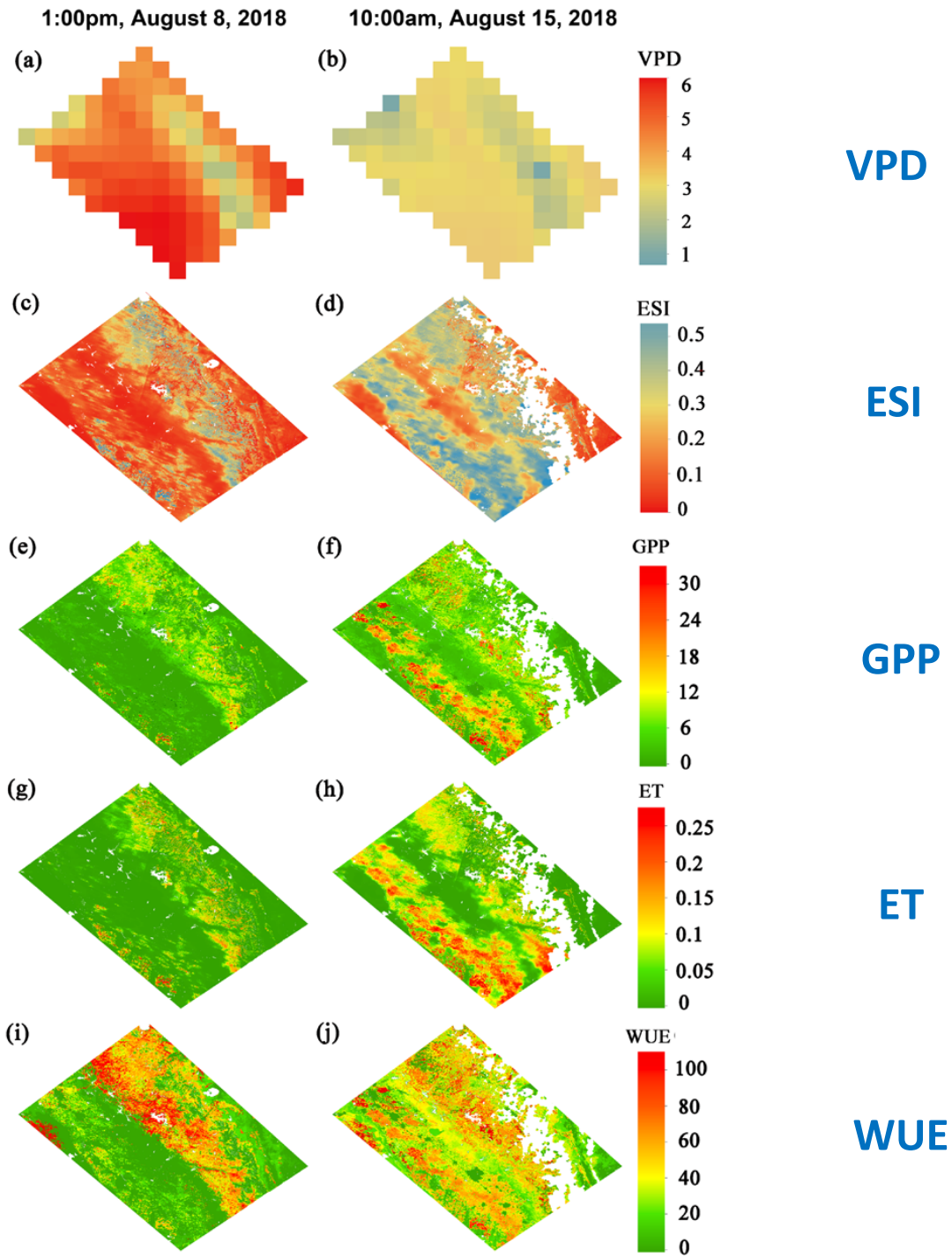
(a) US-Ne3 (cropland)



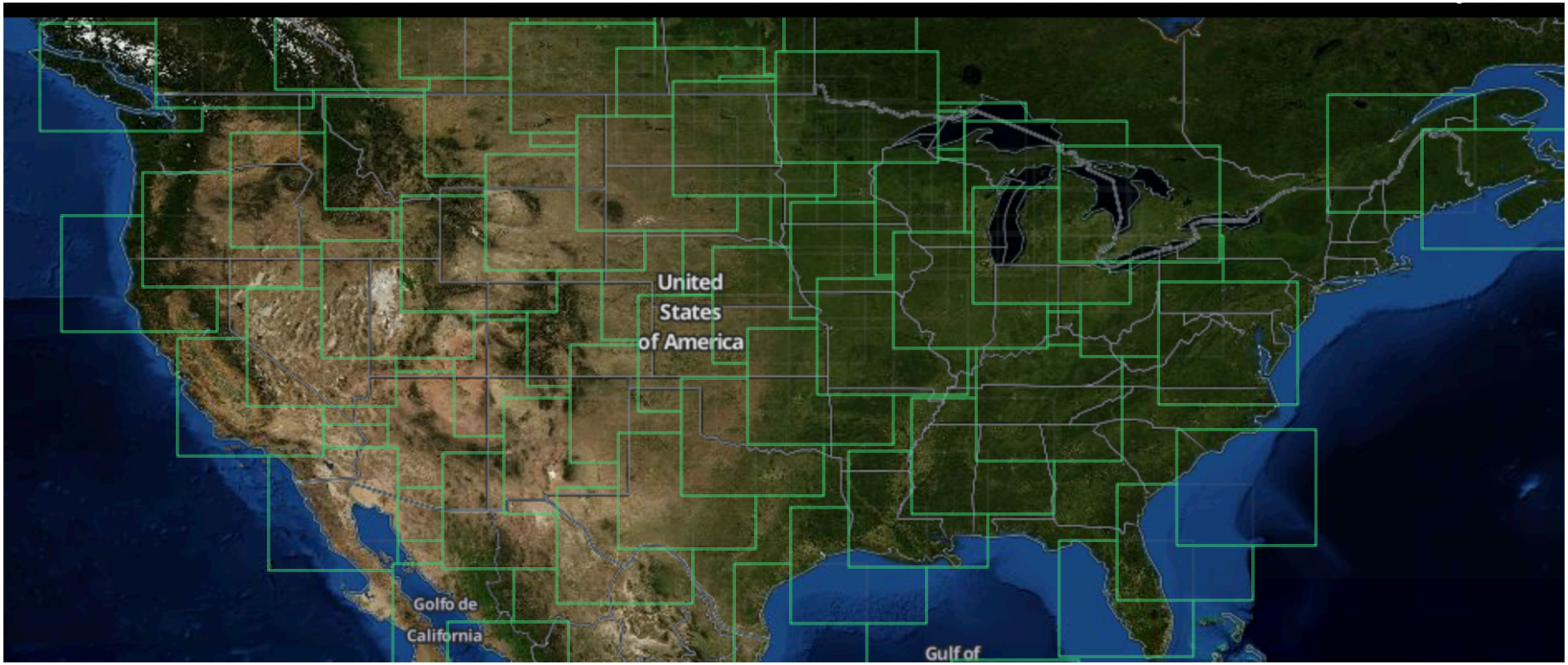
(b) US-SRG (grassland)

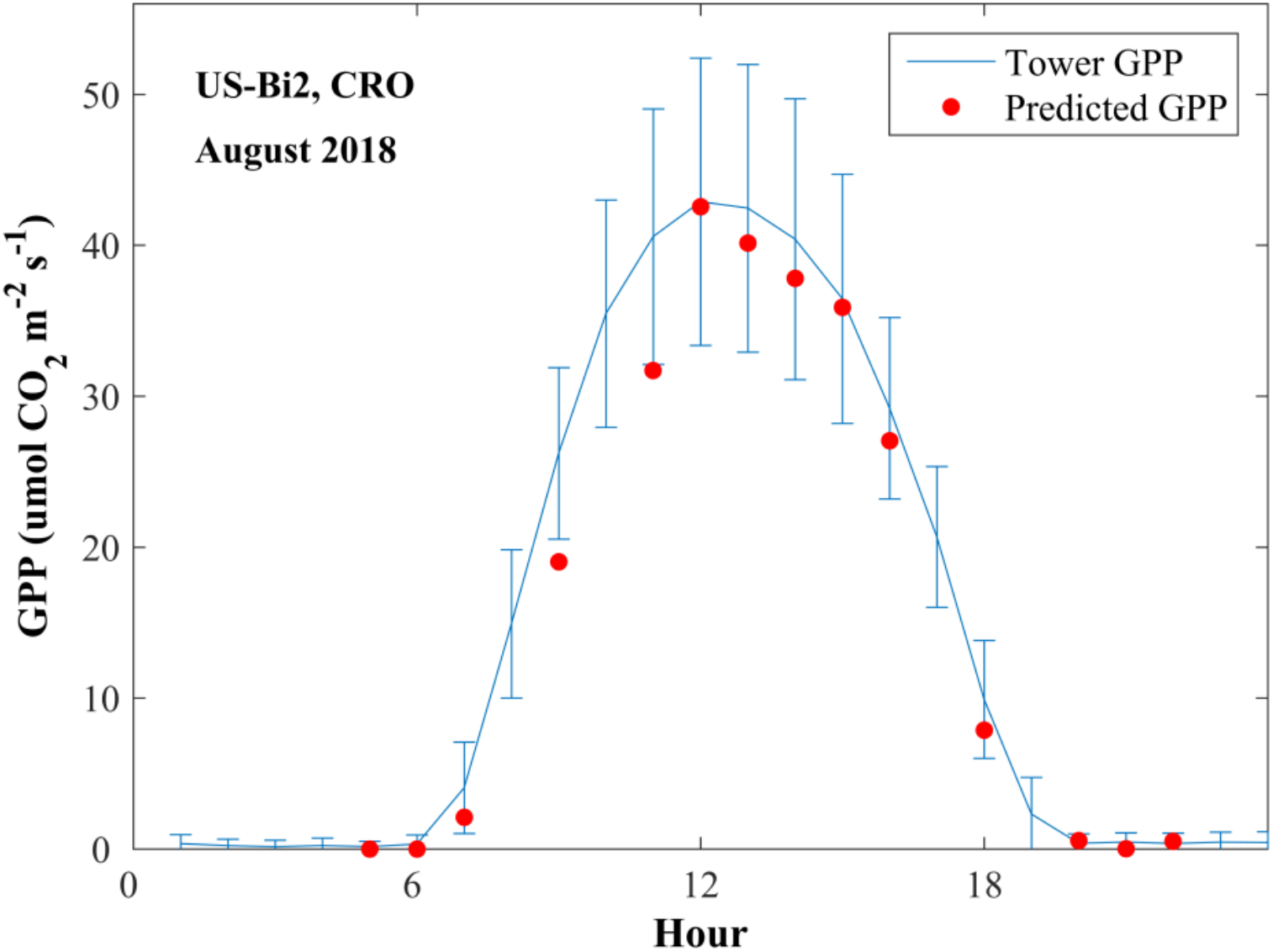
Task 3: Exploring diurnal cycles of plant water use, water stress, and carbon uptake at the regional scale using existing and new ECOSTRESS data products

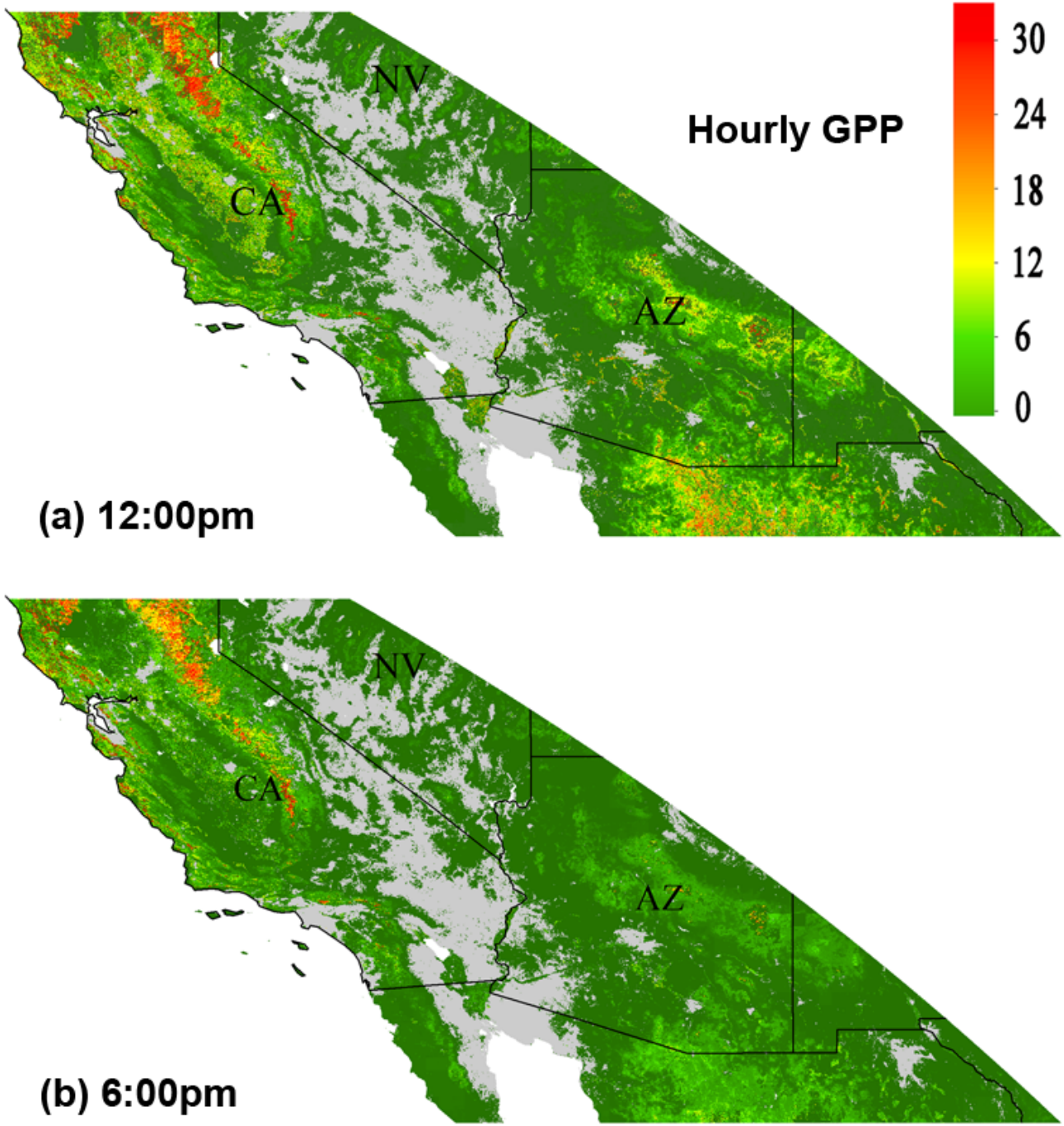


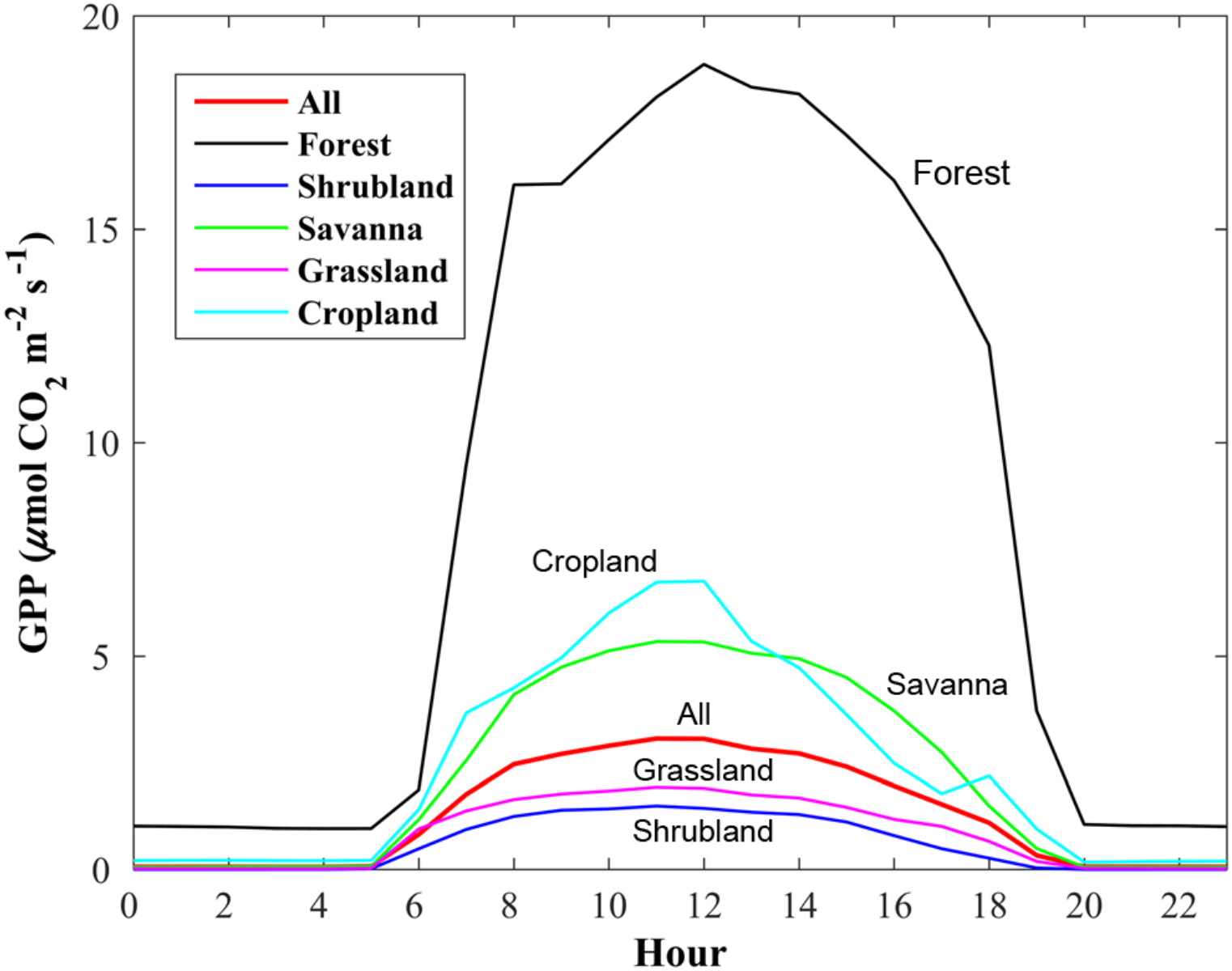

1:00pm, August 8, 2018
10:00am, August 15, 2018
(a)
(b)
VPD
6
5
4
3
2
1
VPD
(c)
(d)
ESI
0.5
0.4
0.3
0.2
0.1
0
ESI
(e)
(f)
GPP
30
24
18
12
6
0
GPP
(g)
(h)
ET
0.25
0.2
0.15
0.1
0.05
0
ET
(i)
(j)
WUE
100
80
60
40
20
0
WUE

Task 4: Examine how plants use water and how water stress regulates photosynthesis over the diurnal cycle integrating existing and new ECOSTRESS products and temporally continuous products




US-Bi2, CRO
August 2018
Tower GPP
Predicted GPP
GPP (umol CO2 m-2 s-1)
Hour
0
10
20
30
40
50
0
6
12
18

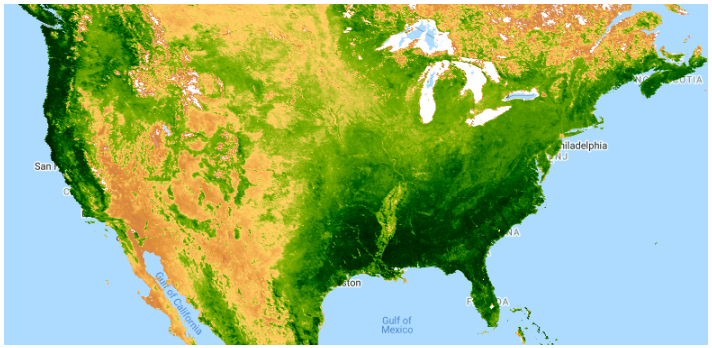

NV
CA
AZ
Hourly GPP
30
24
18
12
6
0
(a) 12:00pm
NV
CA
AZ
(b) 6:00pm


All
Forest
Shrubland
Savanna
Grassland
Cropland
Forest
Cropland
Savanna
All
Grassland
Shrubland
GPP (μmol CO2 m-2 s-1)
Hour
0
5
10
15
20
0
2
4
6
8
10
12
14
16
18
20
22

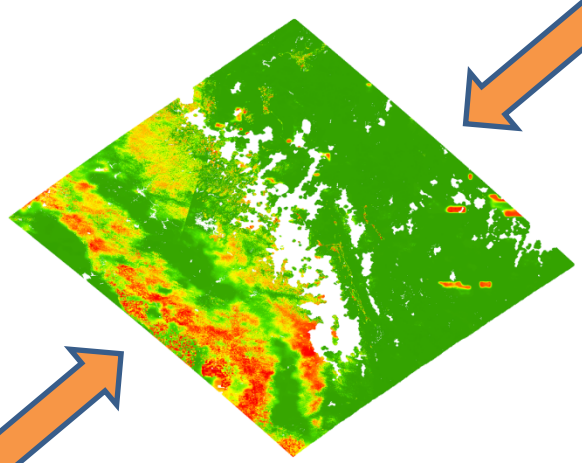
Work plan and outcomes for Year 1:

- Make progress as planned
- Present results at NACP and AGU
- Submit two manuscripts

Continent



Region



Ecosystem

Acknowledgements:

- NASA ECOSTRESS (80NSSC20K0167)
- ECOSTRESS Mission Team, data providers