# ENVIRONMENTAL LAYERS MEETING
# IPLANT TUCSON
# 2012-04-17

## Roundup
## Benoit Parmentier

# What I have been doing working on:

1) Producing LST monthly mean
 Python script (with IDRISI API but with GDAL in mind) to calculate:
- monthly mean
- Number of valid observation per day.

2) GAM prediction
- Some GAM predictions with interaction terms
- Including monthly mean LST and LC as variables
- Comparing results between models using LST daily mean and monthly mean.

3) Kriging and Co-kriging
- Kriging using tmax
- Co-kriging using tmax, Elev_SRTM, Eastness, Northness
- Co-kriging using tmax, LST_monthly
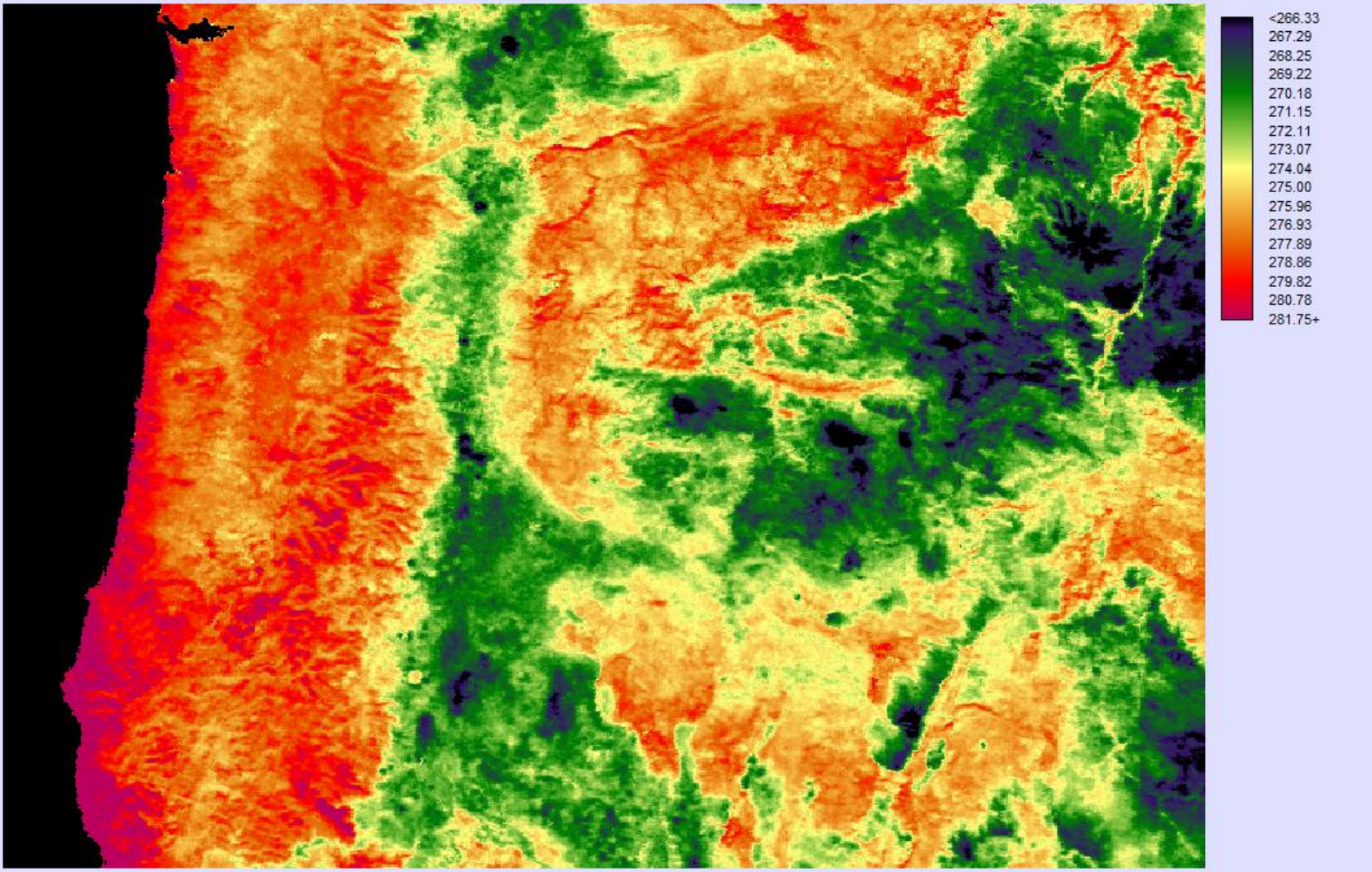
# 1) LST MONTHLY MEAN PRODUCTION

•Python script (with IDRISI API but with GDAL in mind) to calculate:
- Monthly mean
- Number of valid observation per day.
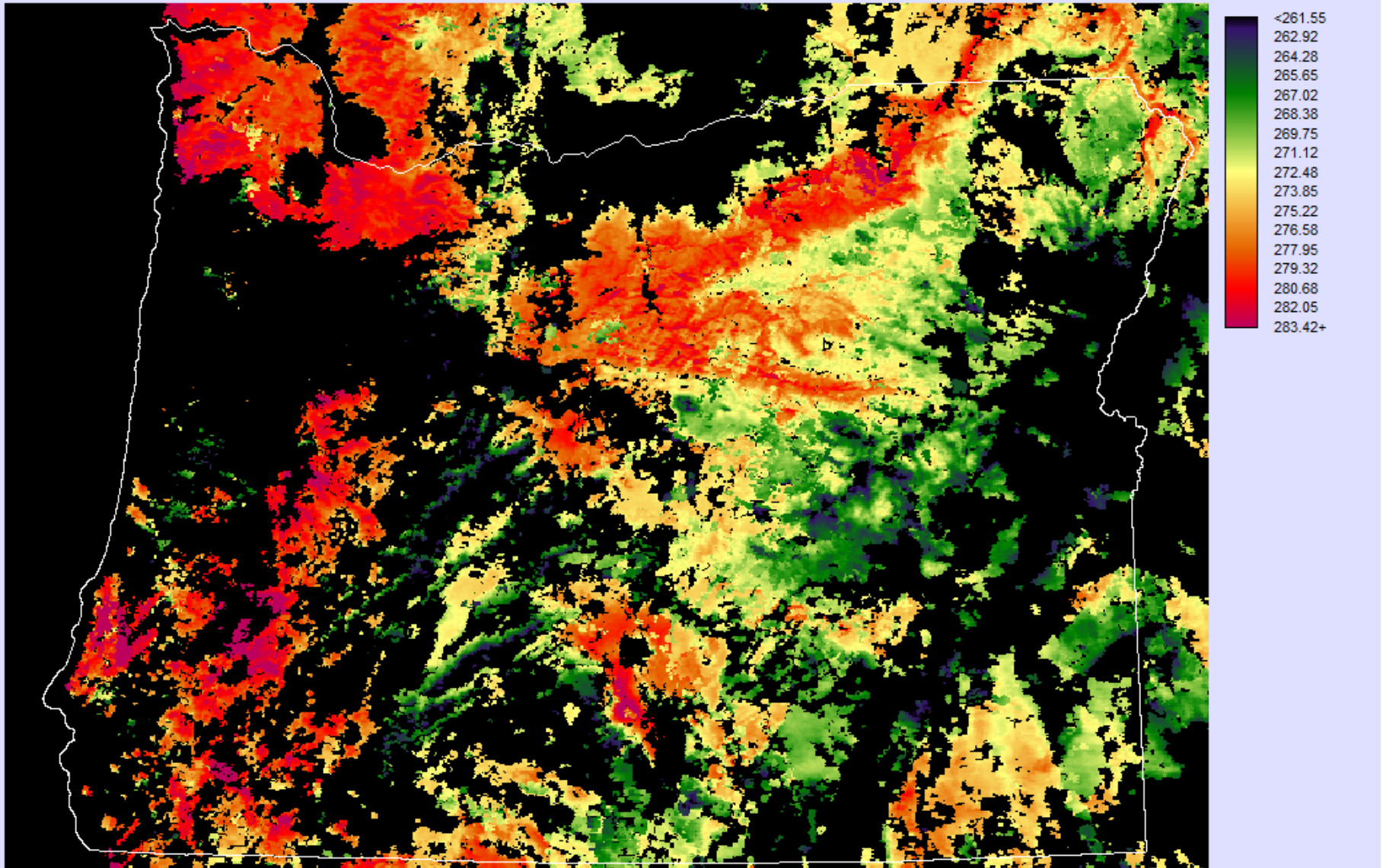
# WORKFLOW MONTHLY-DAILY MEAN CALCULATION

```
        ┌─────────────────────┐
        │   Downloading       │
        │   Missing Data      │
        │   Assessment        │
        └─────────────────────┘
                 │
                 ▼
        ┌─────────────────────┐              ┌─────────────────────┐
        │   MOD11A1           │─────────────▶│   Mosaic            │
        │   hdf               │              │   Reprojection      │
        └─────────────────────┘              └─────────────────────┘
                                                   │
                                    ┌──────────────┴──────────────┐
                                    ▼                             ▼
                          ┌─────────────────┐         ┌─────────────────┐
                          │   OR83M         │         │   QC flags      │
                          │   .rst          │         │   Level 1 and 2 │
                          └─────────────────┘         └─────────────────┘
                                    └──────────────┬──────────────┘
                                                   ▼
                                          ┌─────────────────┐
                                          │   Masking       │
                                          │   Low quality   │
                                          └─────────────────┘
                                    ┌──────────────┴──────────────┐
                                    ▼                             ▼
                          ┌─────────────────┐         ┌─────────────────┐
                          │  Monthly/Daily  │         │  Monthly/Daily  │
                          │  Mean           │         │  Valid Obs.     │
                          └─────────────────┘         └─────────────────┘
```
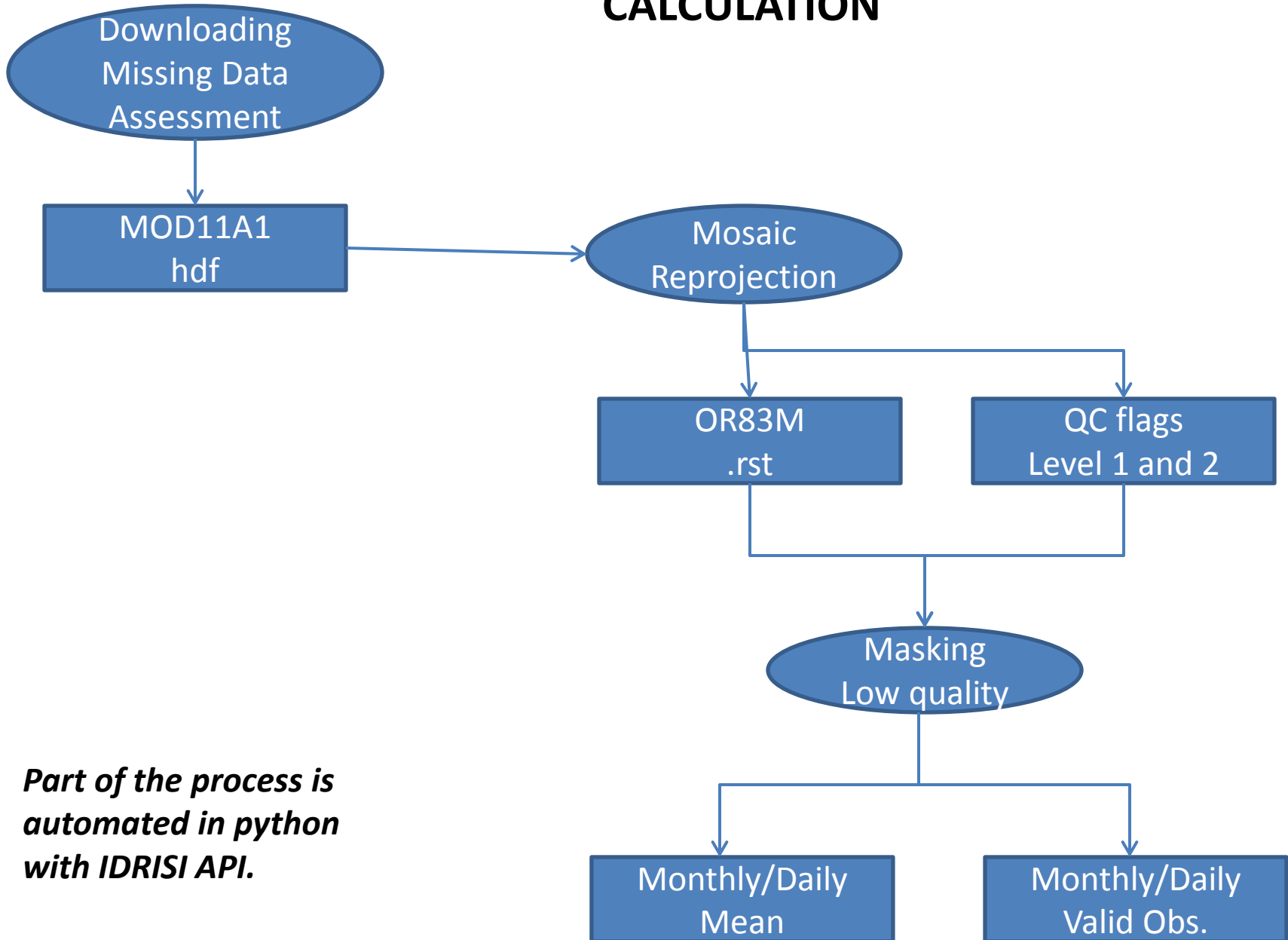
*Part of the process is automated in python with IDRISI API.*

# OREGON- MONTHLY MEAN FOR MONTH 01



| |
|---|
| <266.33 |
| 267.29 |
| 268.25 |
| 269.22 |
| 270.18 |
| 271.15 |
| 272.11 |
| 273.07 |
| 274.04 |
| 275.00 |
| 275.96 |
| 276.93 |
| 277.89 |
| 278.86 |
| 279.82 |
| 280.78 |
| 281.75+ |

mean_month1_rescaled.rst

# OREGON- DAILY MEAN FOR DOY 001



| | |
|---|---|
| | <261.55 |
| | 262.92 |
| | 264.28 |
| | 265.65 |
| | 267.02 |
| | 268.38 |
| | 269.75 |
| | 271.12 |
| | 272.48 |
| | 273.85 |
| | 275.22 |
| | 276.58 |
| | 277.95 |
| | 279.32 |
| | 280.68 |
| | 282.05 |
| | 283.42+ |

mean_day001_rescaled.rst

# OREGON-NUMBER OF VALID OBSERVATIONS FOR MONTH 01
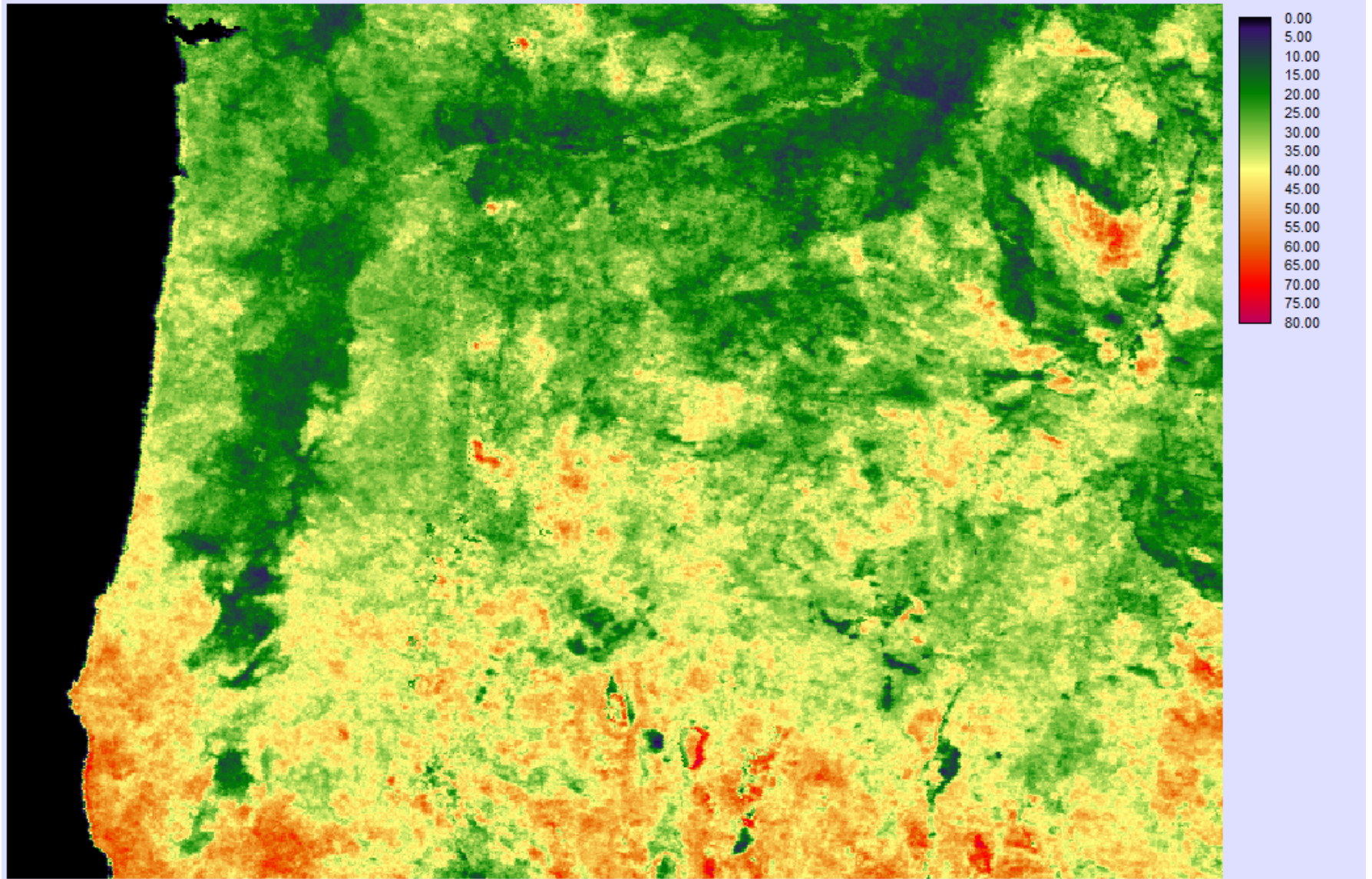
# OREGON-NUMBER OF VALID OBSERVATIONS FOR DAY 001



| | |
|---|---|
| ■ | 0.00 - 0.99 |
| ■ | 1.00 - 1.99 |
| ■ | 2.00 - 2.99 |
| ■ | 3.00 - 4.00 |
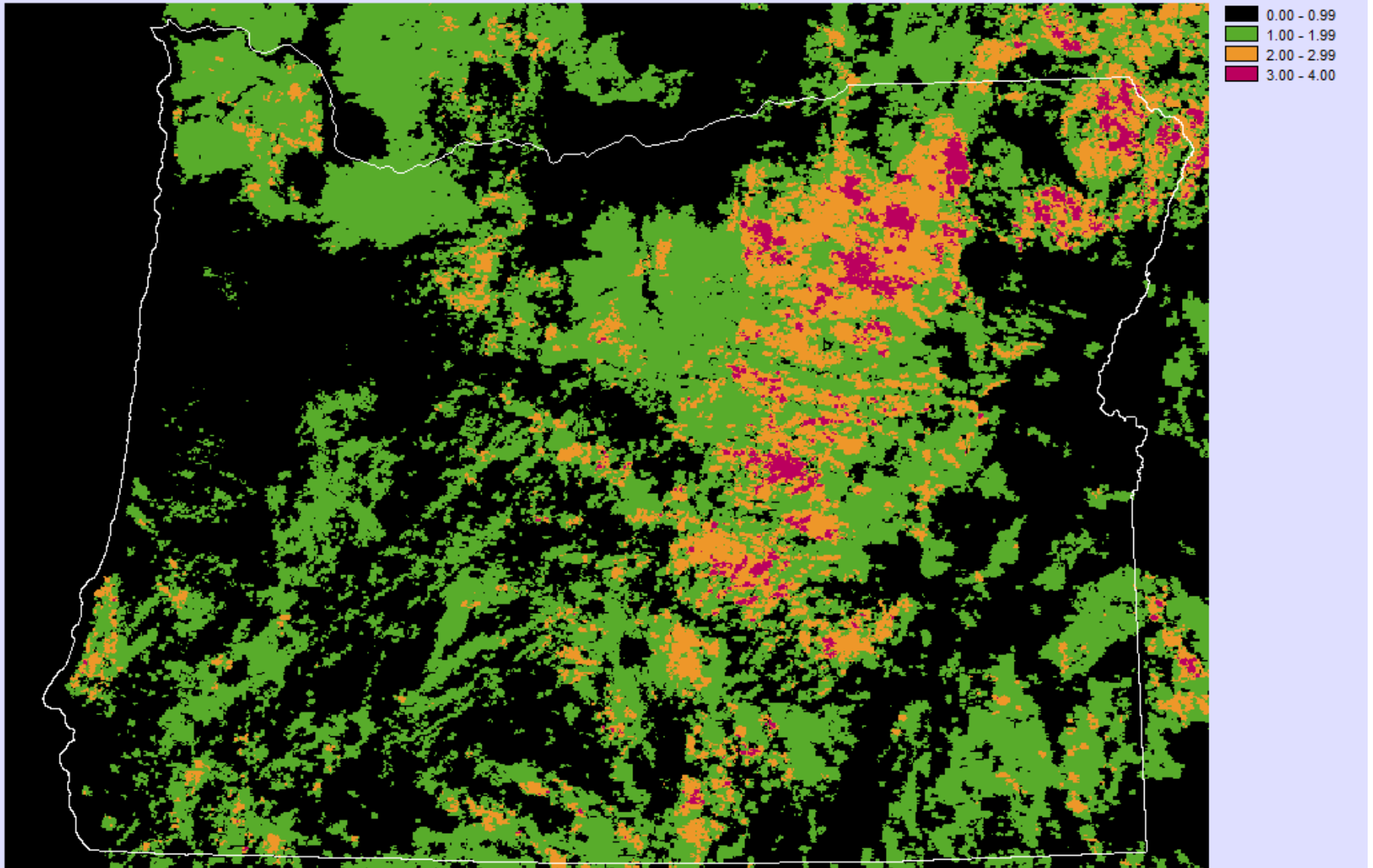
mean_day_valid_obs_001_Sum.rst

# OREGON- MONTHLY MEAN FOR MONTH 7



| | |
|---|---|
| | <292.95 |
| | 294.91 |
| | 296.87 |
| | 298.84 |
| | 300.80 |
| | 302.76 |
| | 304.72 |
| | 306.68 |
| | 308.64 |
| | 310.60 |
| | 312.56 |
| | 314.52 |
| | 316.49 |
| | 318.45 |
| | 320.41 |
| | 322.37 |
| | 324.33+ |
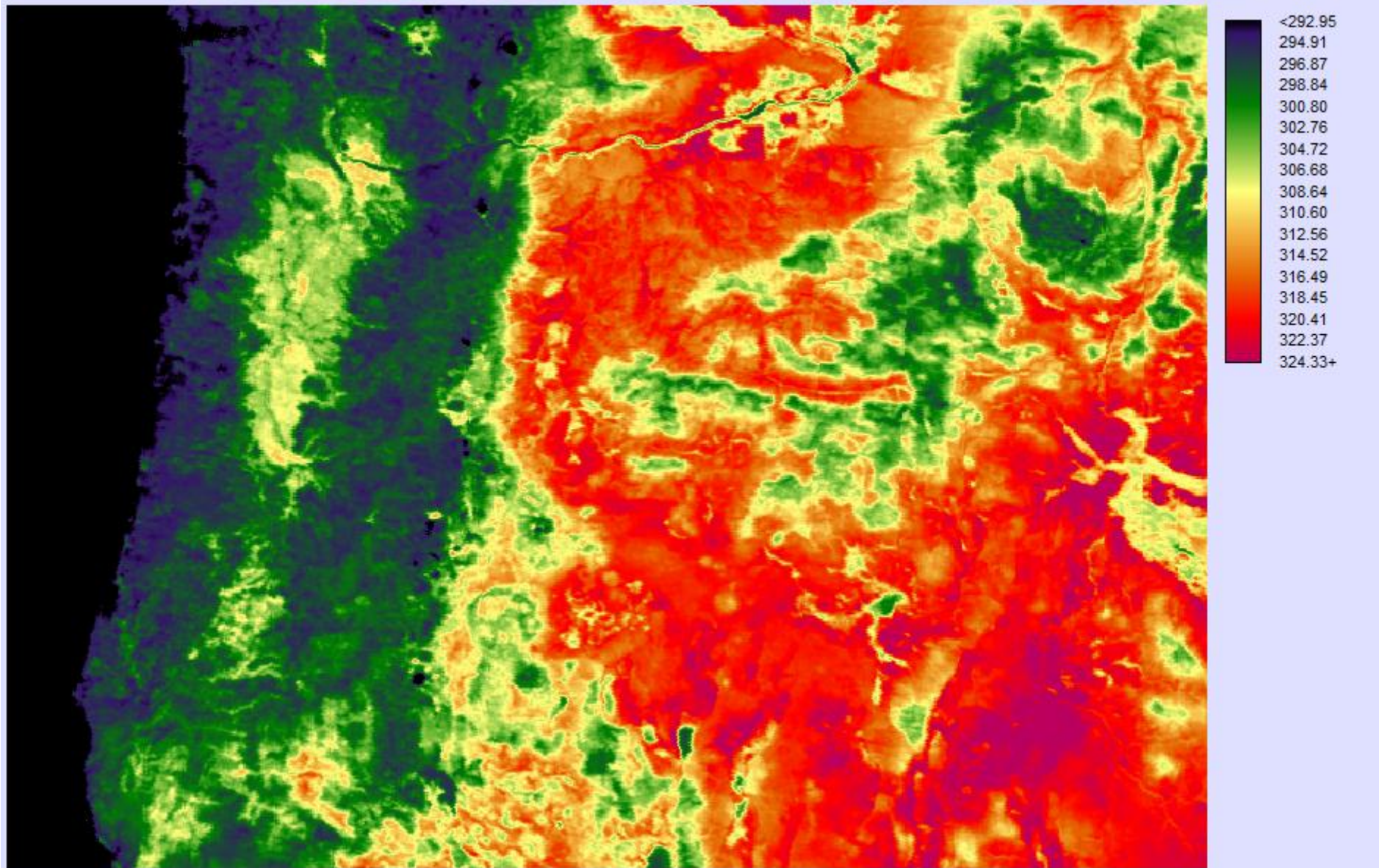
mean_month7_rescaled.rst

# OREGON- DAILY MEAN FOR DOY 182



| | |
|---|---|
| | <291.17 |
| | 293.20 |
| | 295.24 |
| | 297.27 |
| | 299.31 |
| | 301.34 |
| | 303.38 |
| | 305.41 |
| | 307.45 |
| | 309.49 |
| | 311.52 |
| | 313.56 |
| | 315.59 |
| | 317.63 |
| | 319.66 |
| | 321.70 |
| | 323.73+ |
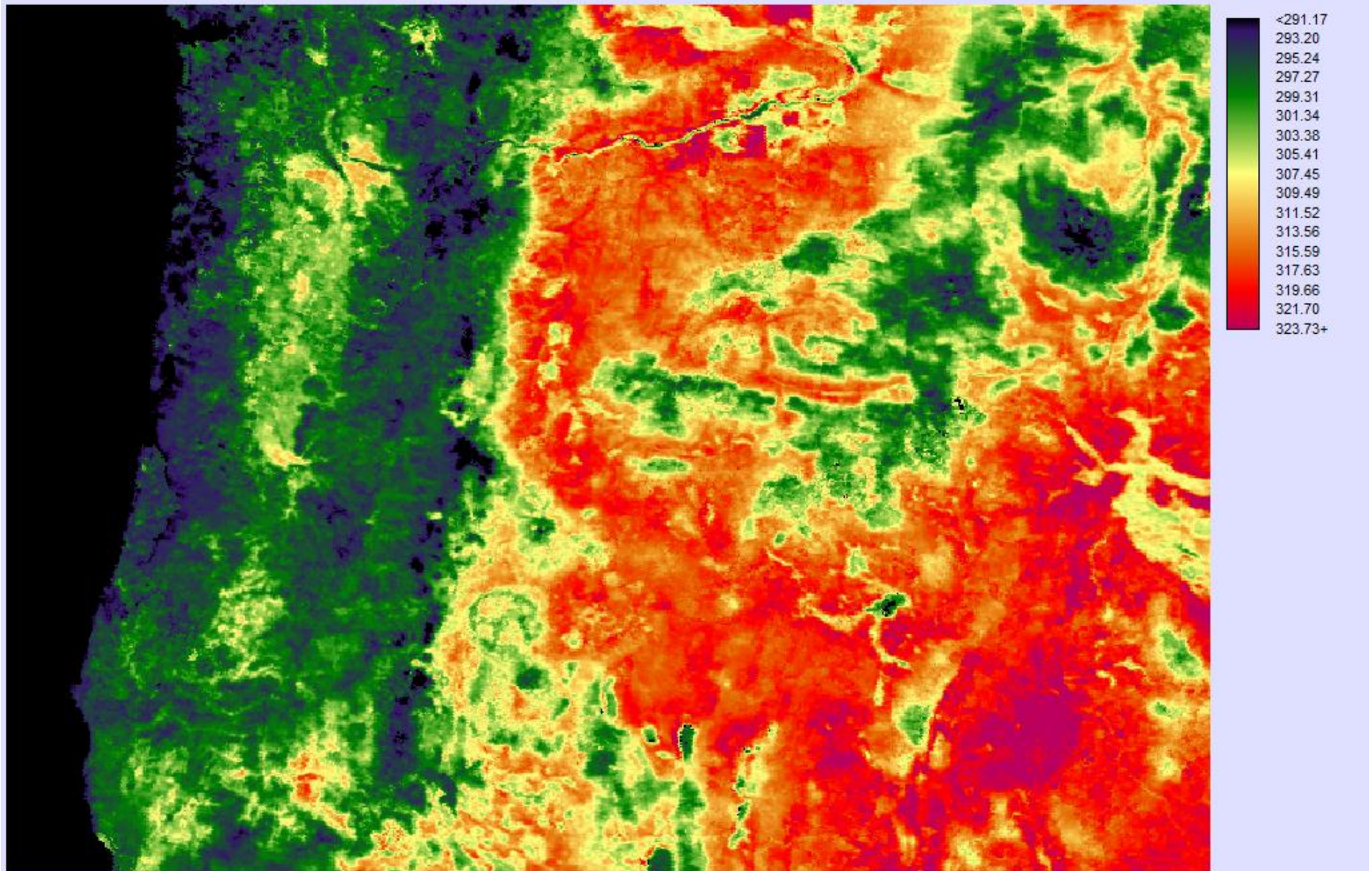
mean_day182_rescaled.rst

# OREGON- MONTHLY MEAN FOR MONTH 7
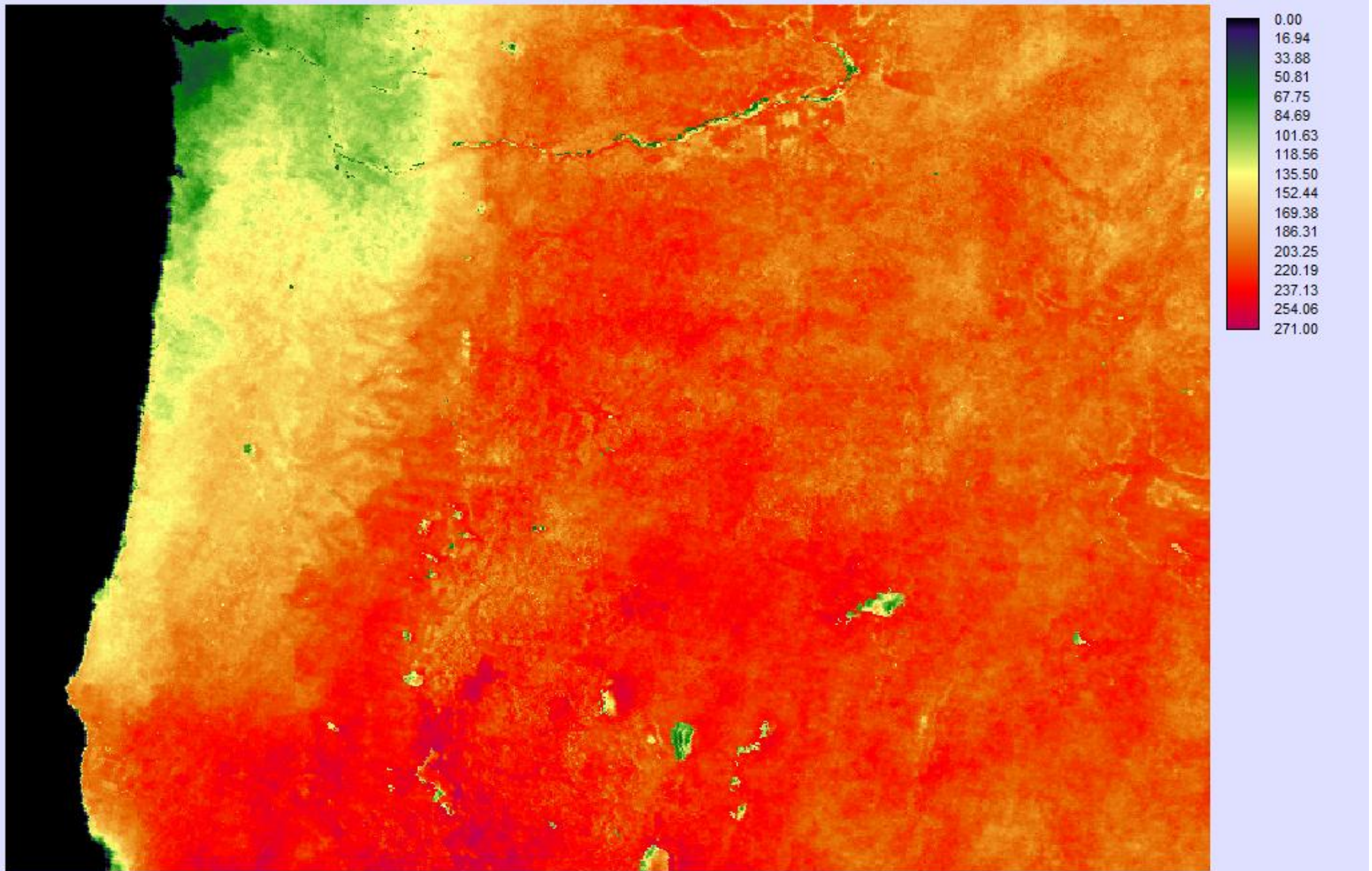


mean_month_valid_obs_7_Sum

# OREGON-NUMBER OF VALID OBSERVATION FOR DOY 182



Legend:
- 0.00 - 0.99
- 1.00 - 1.99
- 2.00 - 2.99
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 6.99
- 7.00 - 8.00
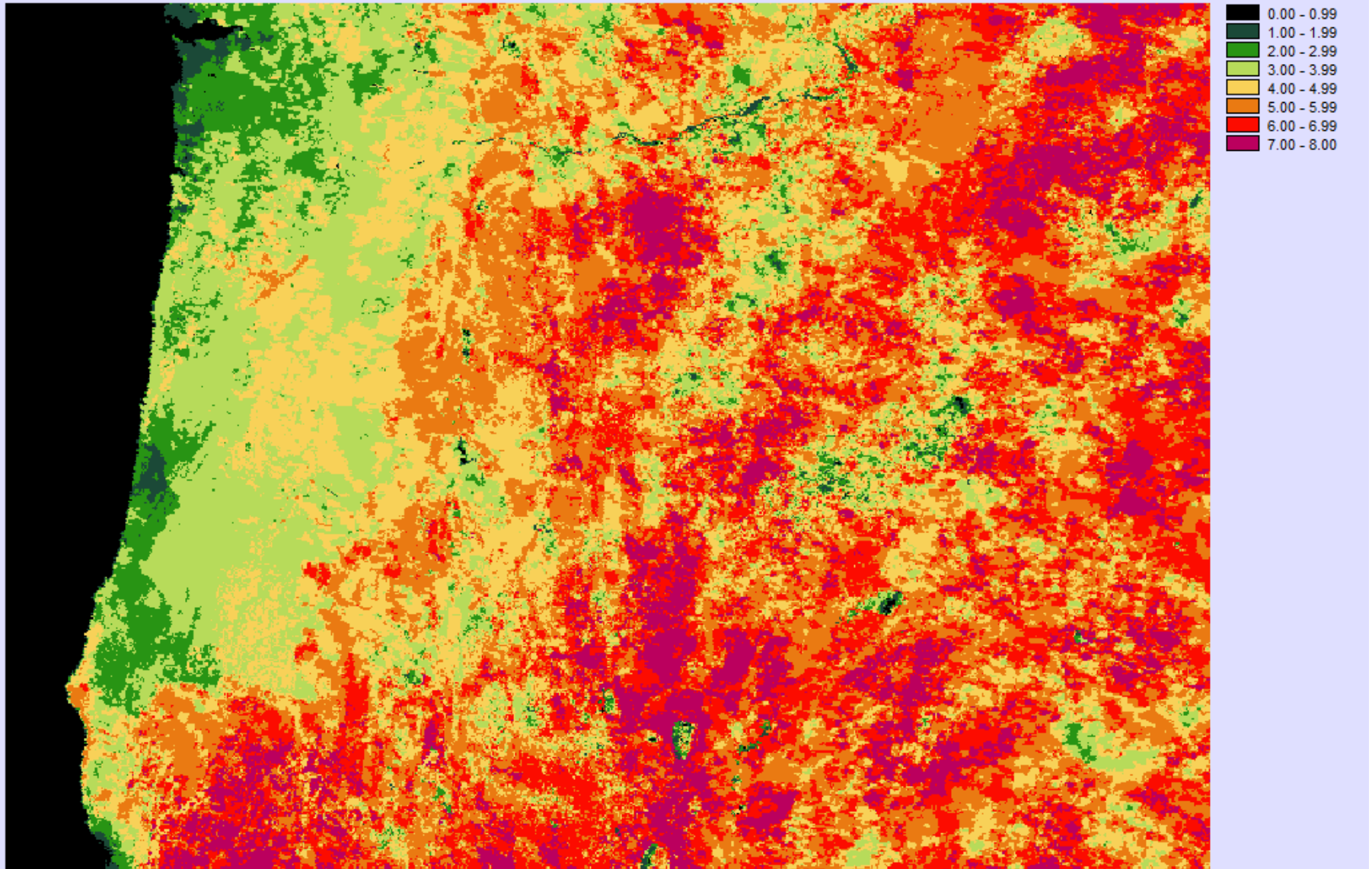
mean_day_valid_obs_182_Sum.rst

# 2)GAM PREDICTION USING LST AND LC

→GAM regressions:
- Some GAM predictions with interaction terms
- Including monthly mean LST and LC in the GAM regression

# LAND COVER CONSENSUS CATEGORIES

Table 5. Legend for the 10 aggregated land cover classes and the corresponding classes from the six individual global land cover legends. Modified from (Nakaegawa 2011).
[1]I added class 3 to 'forest' since it was missing in original table. The class 2 entry under 'shrub' is probably an error and so is removed.
[2]GlobCover class assignment needs to be finalized.
[3]Mosaic is composed of cropland and natural vegetation.

| Aggregated Classification class | Class No. | GLC2000[1] | UMD | MODIS | GlobCover[2] |
|---|---|---|---|---|---|
| Forest | 1 | 1,2,3,4,5,6,7,8 | 1,2,3,4,5,6 | 1,2,3,4,5,8 | 40,50,60,70,90,100,160,170 |
| Shrub | 2 | 9,10,11,12,14 | 7,8,9 | 6,7,9 | 110,120,130,150 |
| Grass | 3 | 13 | 10 | 10 | 140 |
| Crop | 4 | 16 | 11 | 12 | 11,14 |
| Mosaic[3] | 5 | 17,18 | | 14 | 20,30 |
| Urban | 6 | 22 | 13 | 13 | 190 |
| Barren | 7 | 19 | 12 | 16 | 200 |
| Snow | 8 | 21 | | 15 | 220 |
| Wetland | 9 | 15 | | 11 | 180 |
| Water body | 10 | 20 | 0 | 17 | 210 |

# GAM MODELS USED FOR THE ANALYSIS

Using monthly LST mean...

**mod1**<- tmax~ s(lat) + s (lon) + s (ELEV_SRTM)

**mod2**<- tmax~ s(lat,lon,ELEV_SRTM)

**mod3**<- tmax~ s(lat) + s (lon) + s (ELEV_SRTM) +  s (Northness)+ s (Eastness) + s(DISTOC)

**mod4**<- tmax~ s(lat) + s (lon) + s(ELEV_SRTM) + s(Northness) + s (Eastness) + s(DISTOC) + s(LST)

**mod5**<- tmax~ s(lat,lon) +s(ELEV_SRTM) + s(Northness,Eastness) + s(DISTOC) + s(LST)

**mod6**<- tmax~ s(lat,lon) +s(ELEV_SRTM) + s(Northness,Eastness) + s(DISTOC) + s(LST,LC1)

**mod7**<- tmax~ s(lat,lon) +s(ELEV_SRTM) + s(Northness,Eastness) + s(DISTOC) + s(LST,LC3)

GAM MODEL USING
MONTHLY MEAN LST (mod 4 to 7)
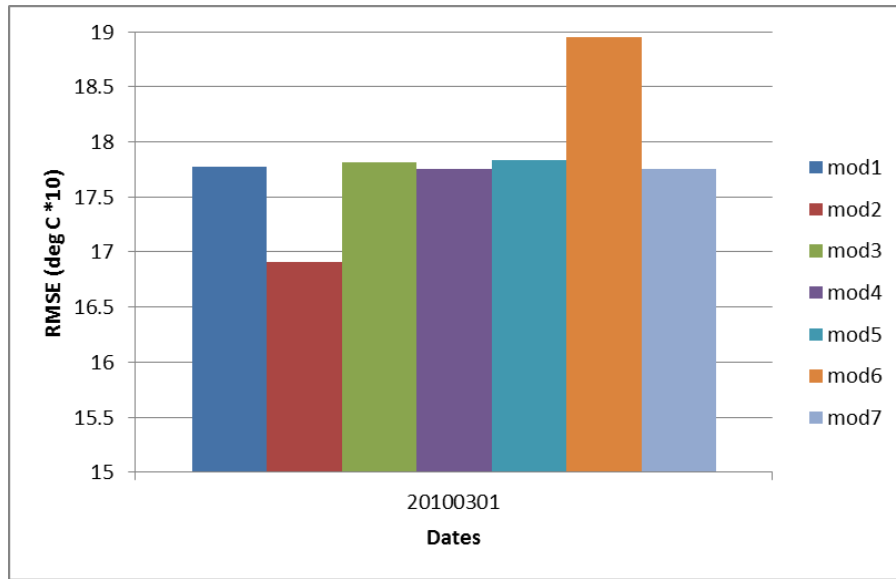
GAM MODEL USING
DAILY MEAN LST (mod 4 to 7)
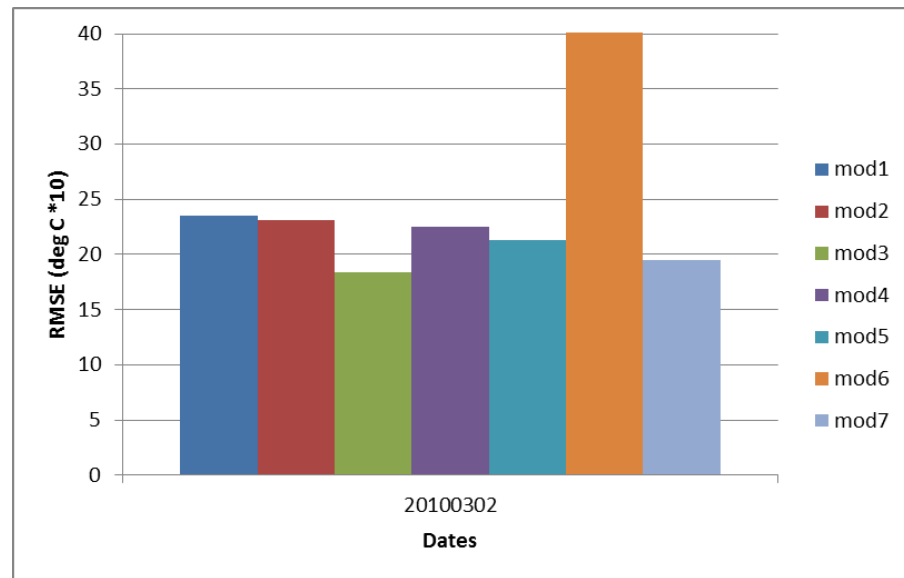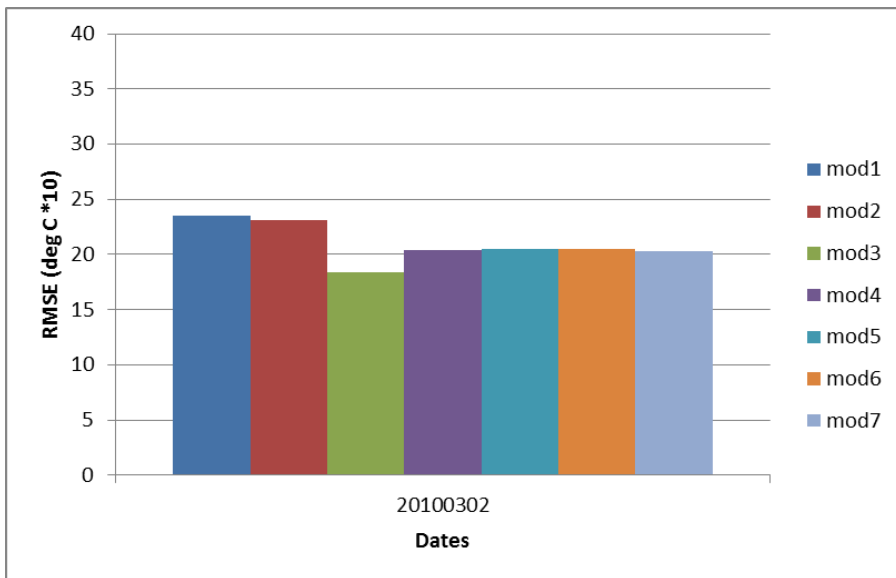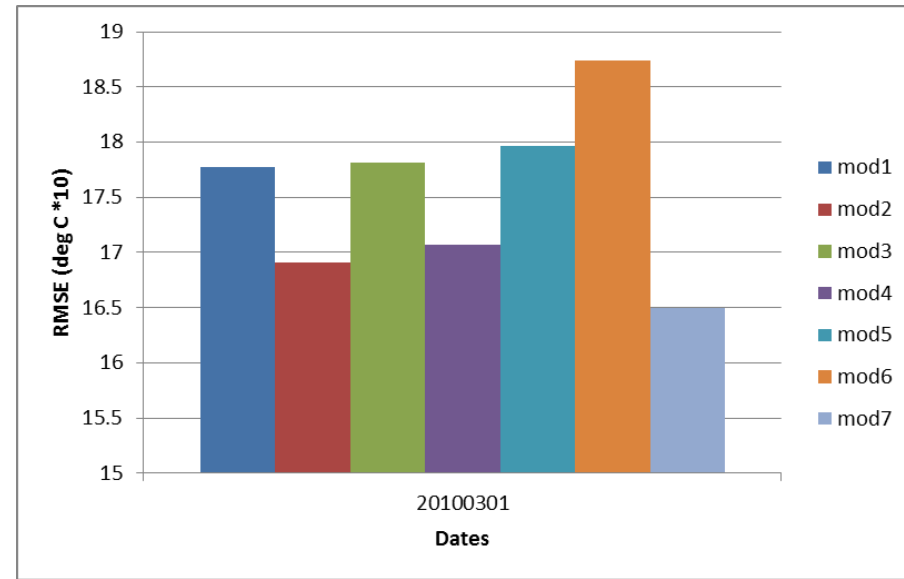
# GAM MODEL USING
## MONTHLY MEAN LST (mod 4 to 7)
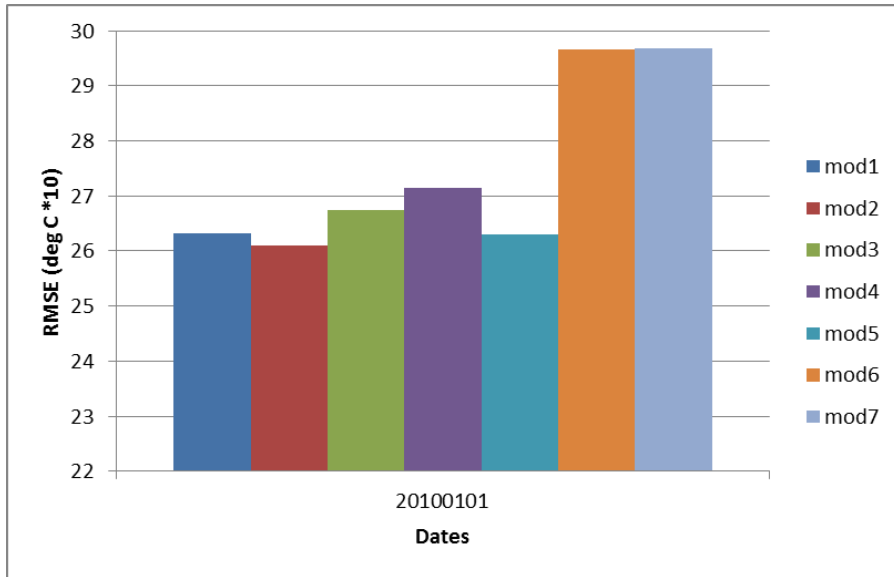
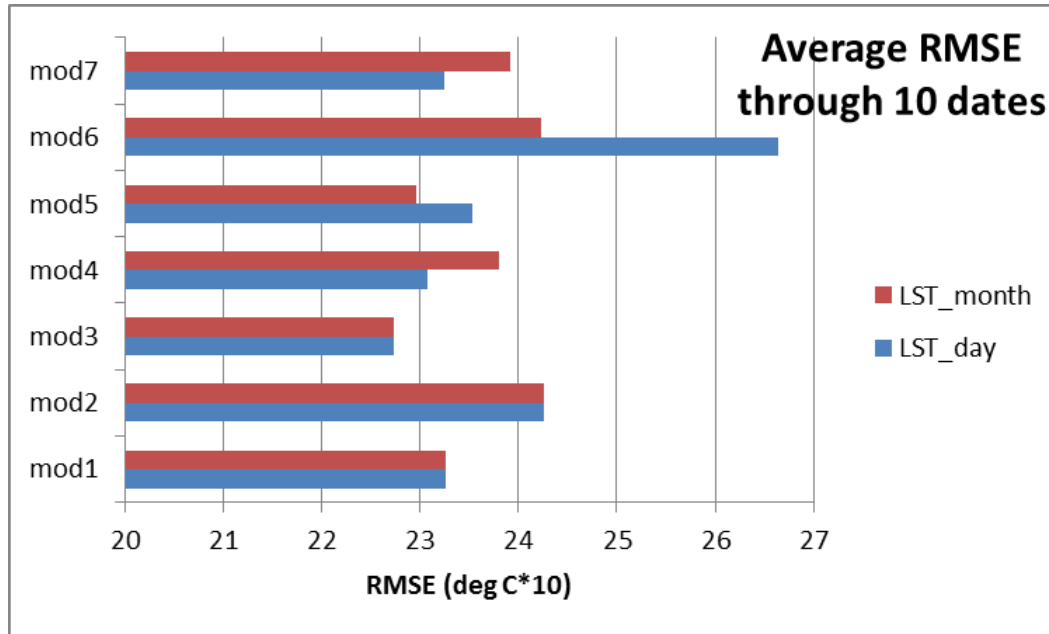# GAM MODEL USING
## DAILY MEAN LST (mod 4 to 7)
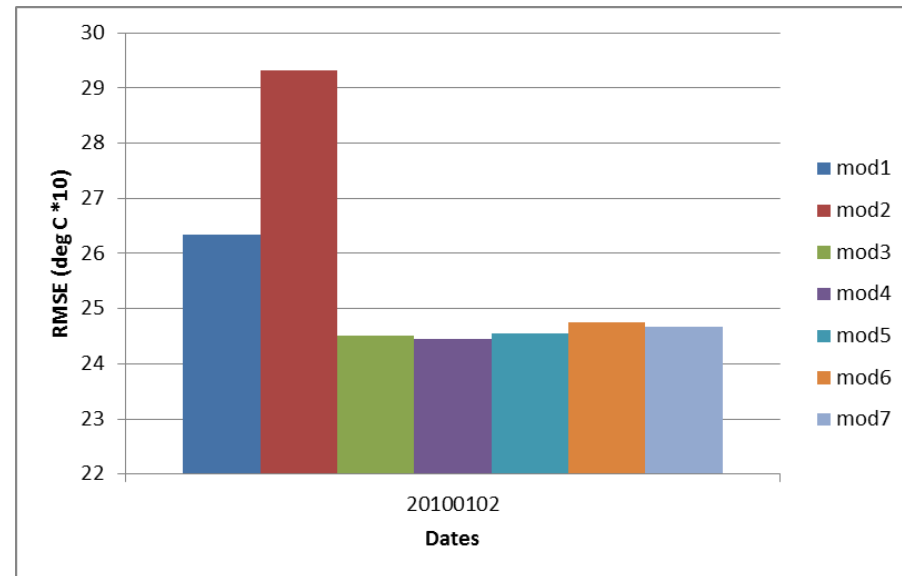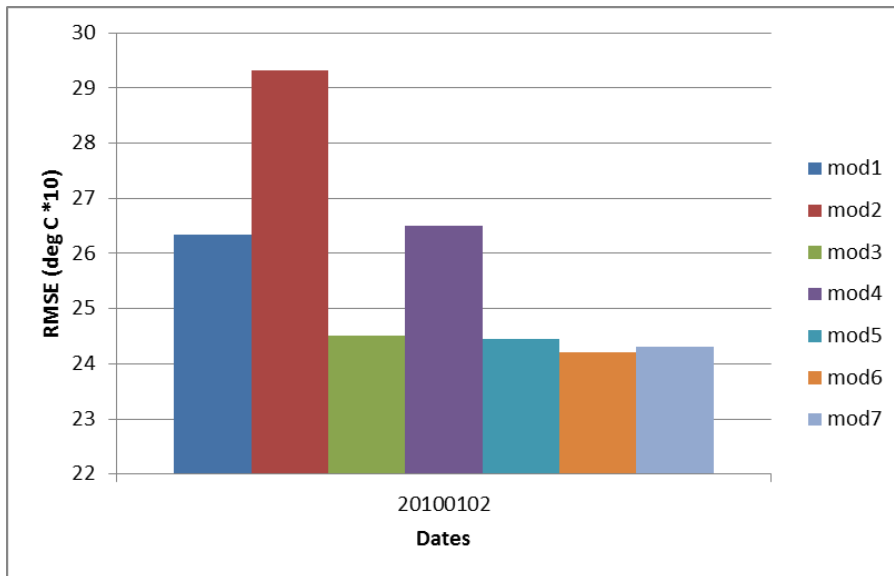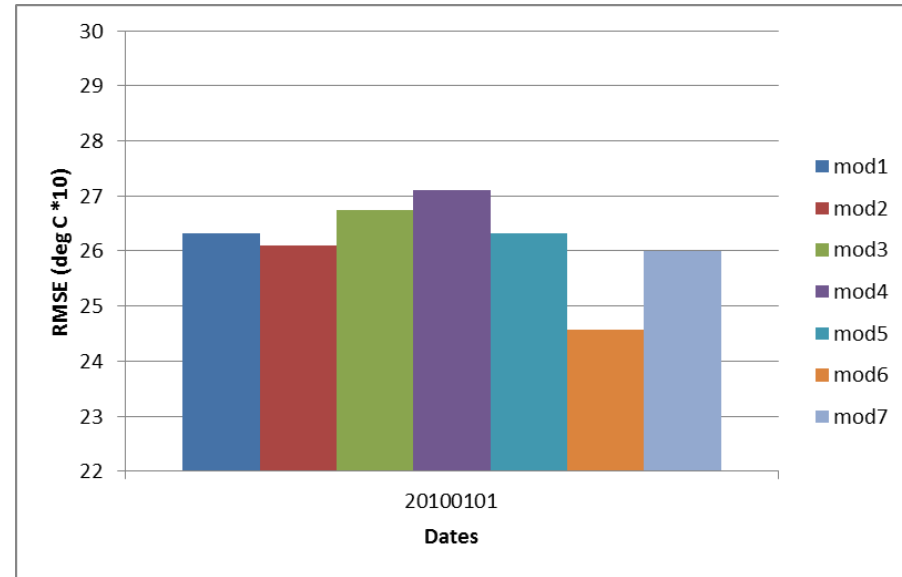
RMSE FOR ALL DATES AND MODELS USING MEAN LST DAY
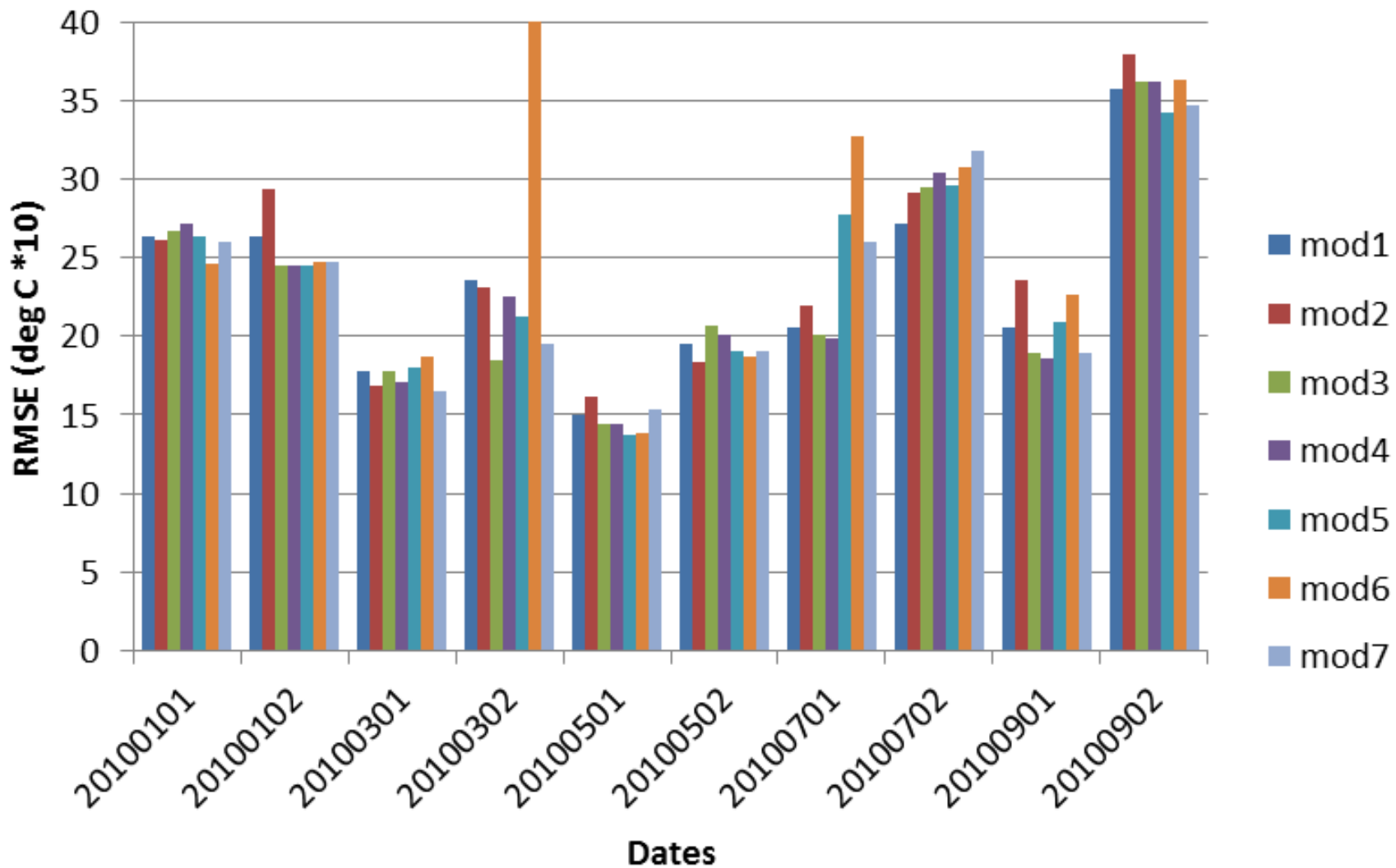
RMSE FOR ALL DATES AND MODELS USING MEAN LST MONTH
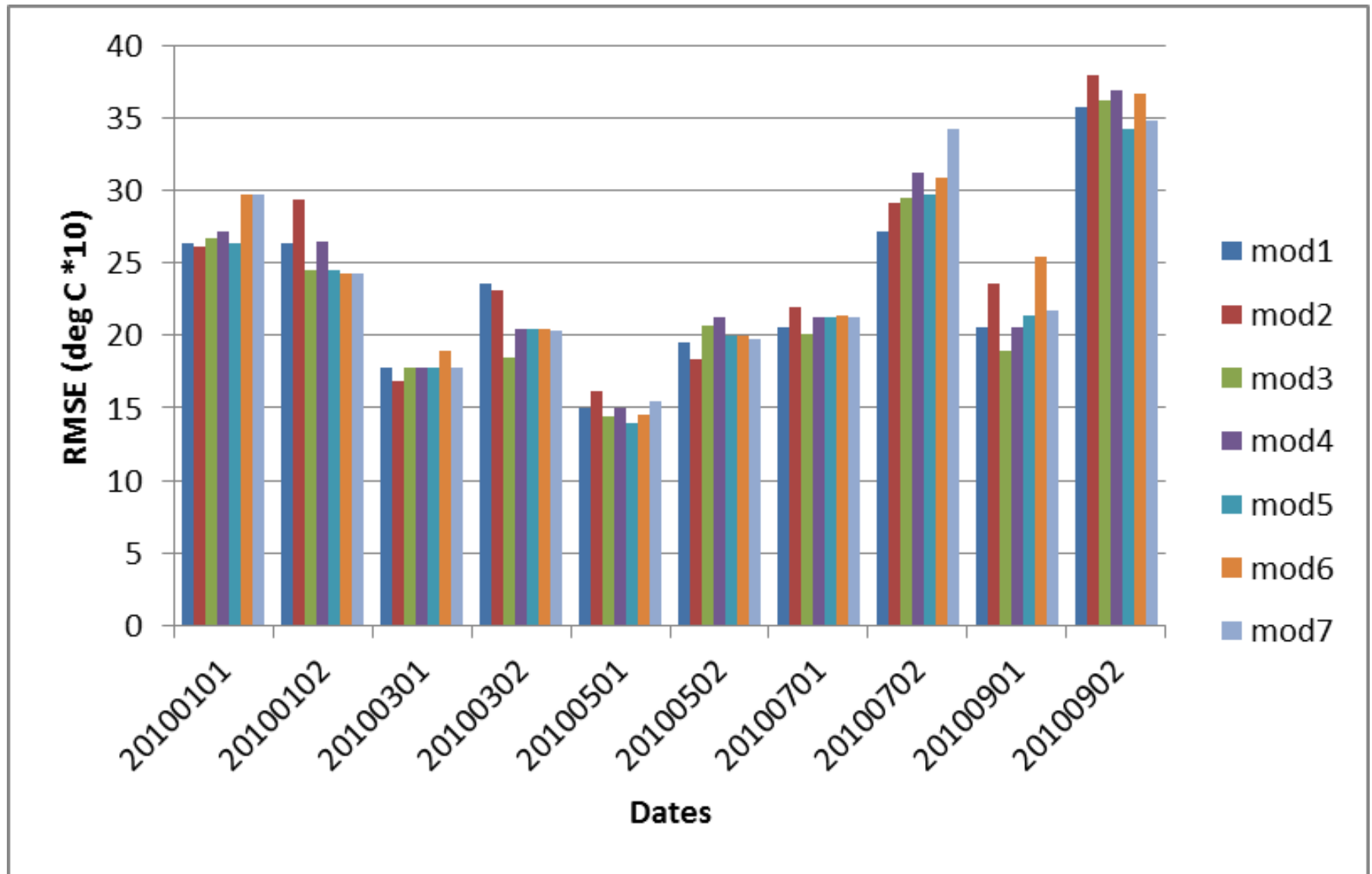
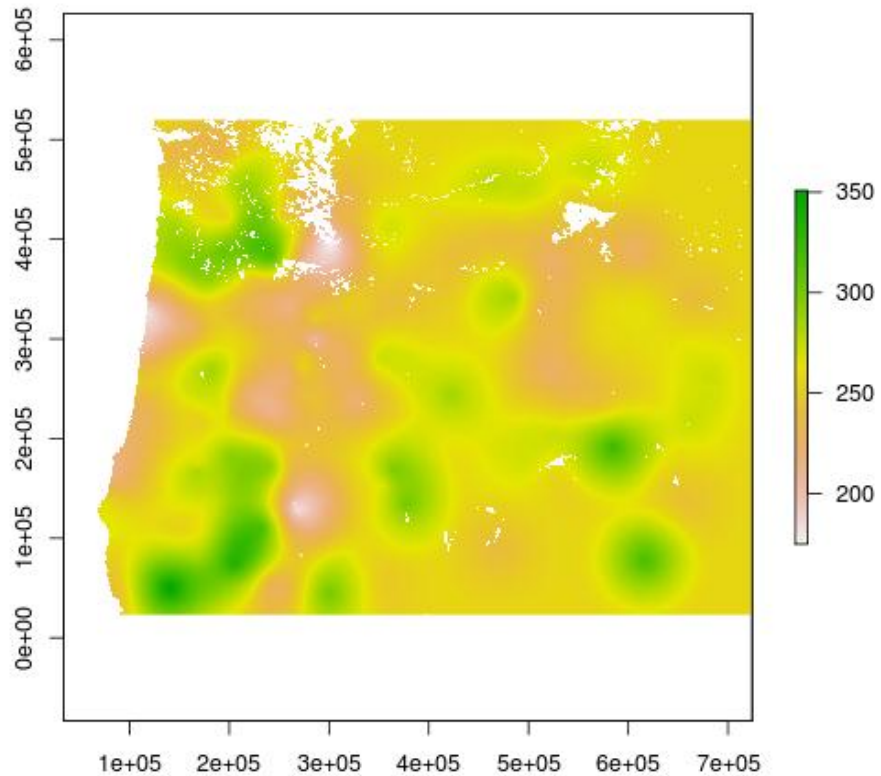# MEAN AND MEDIAN COMPARISON OF MODEL RUNS
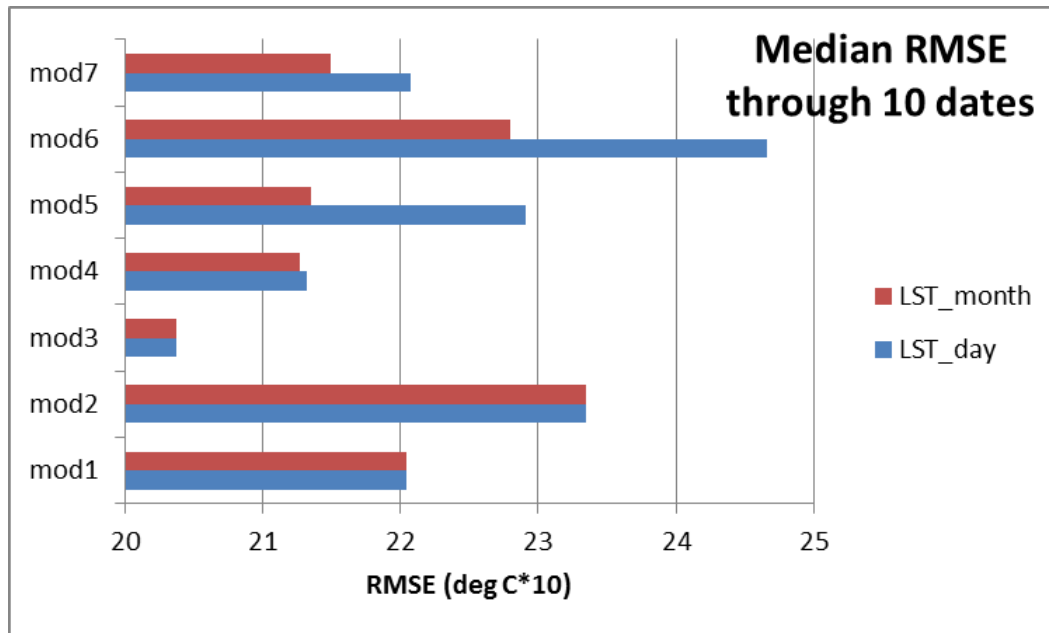
# 3)KRIGING AND CO-KRIGING

• Kriging using tmax:
→ Co-kriging using tmax, Elev_SRTM, Eastness, Northness
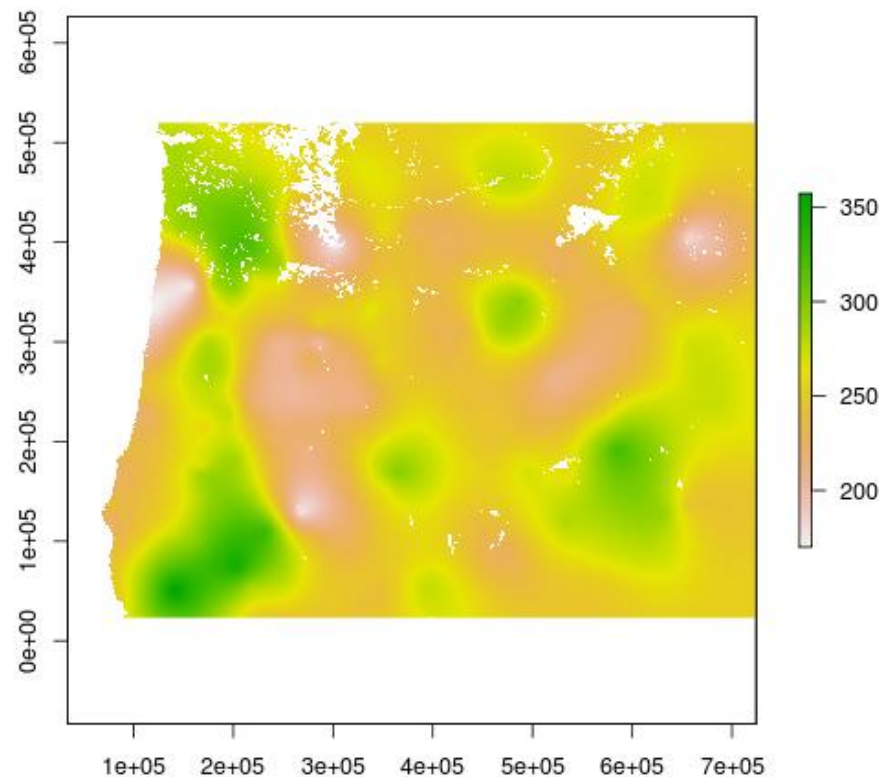→ Co-kriging using tmax, LST_monthly

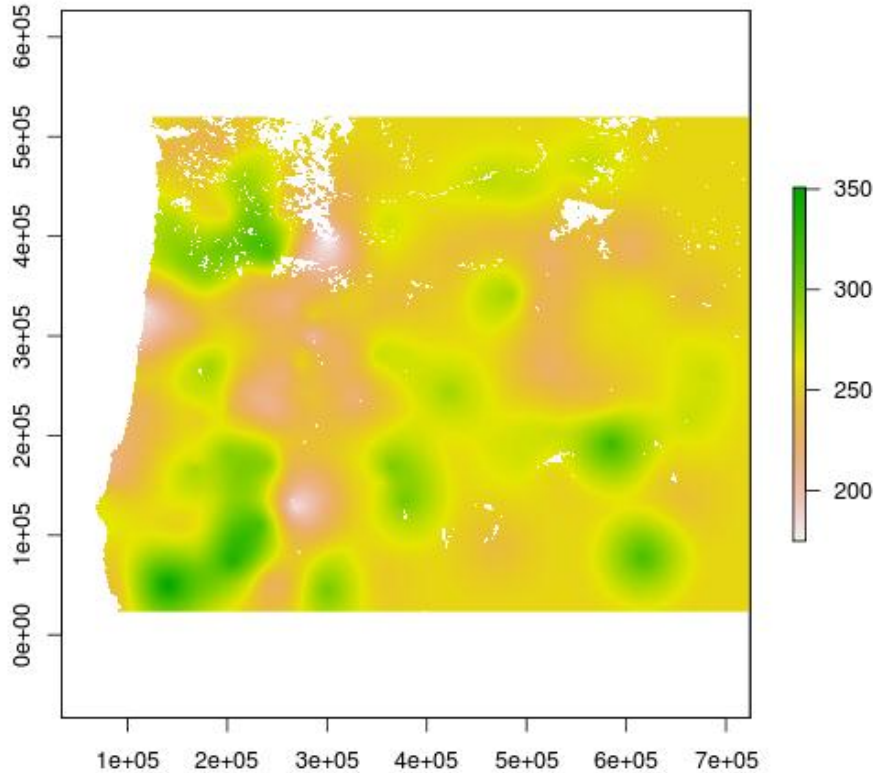# RUN 10: KRIGED AND CO-KRIGED SURFACE FOR DAY 20100902



tmax~ tmax

tmax~ tmax,ELEV_SRTM, Eastness, Northness
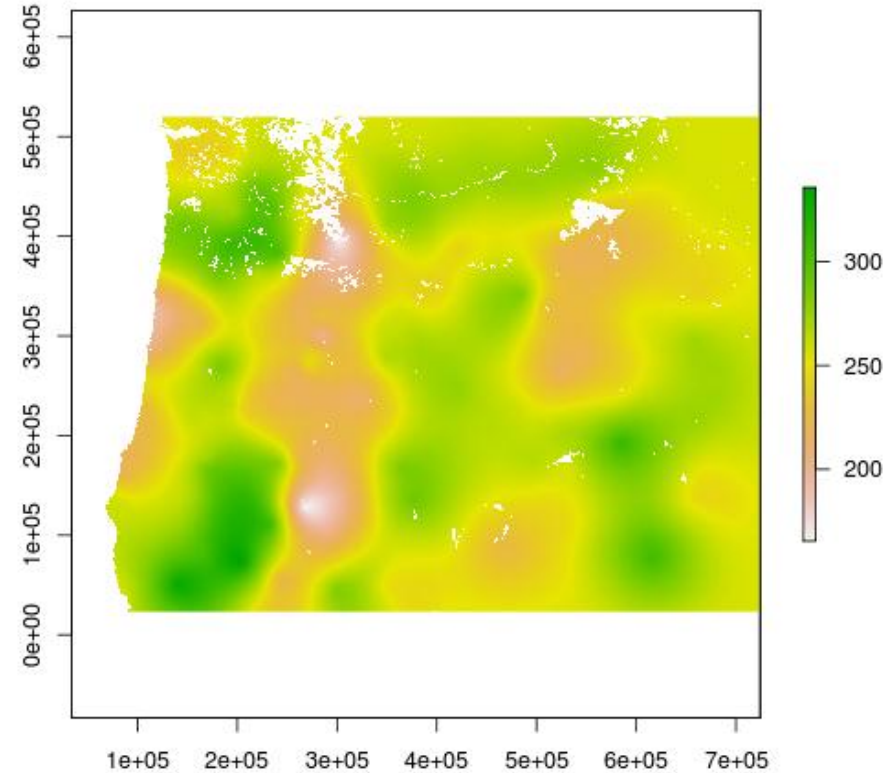
# RUN 10: KRIGED AND CO-KRIGED SURFACE FOR DAY 20100902

**Tmax Kriging for date 20100902**

**Tmax cokriging for date 20100902**



tmax~ tmax

tmax~ tmax,LST,ELEV_SRTM

RMSE: 23.19 using 121 observations.

RMSE: 21.55 using 121 observations.

RMSE USING KRIGING AND CO-KRIGING WITH 30% RETAINED FOR VALIDATION
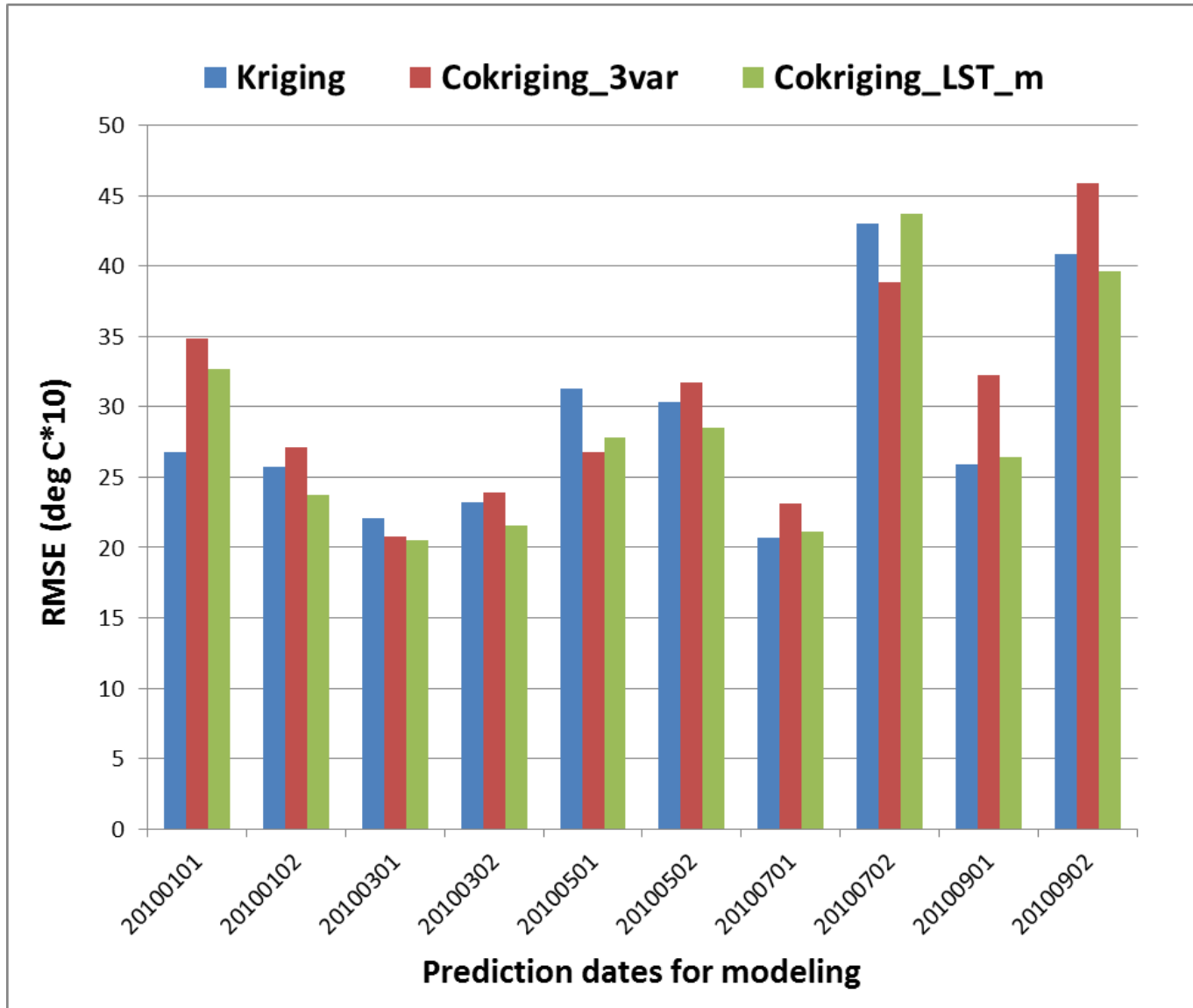
# What's next..?

1) GWR validation and comparison with Kriging

2) Influence of sampling on results
- GWR
- Prediction

3) Continue GAM prediction using LST and Land Cover

4) Continue to experiment with Kriging and Co-kriging

5) Producing LST mean using a moving window?

6) Documenting the analysis and think more carefully about the results by reading more about the methods.