METHODS COMPARISON

FOR THE PRODUCTION OF

INTERPOLATED CLIMATE LAYERS FOR USE IN SPECIES MODELING:

Interpolation of maximum temperature in Oregon.

11-01-2012

Additional analyses

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UPDATED ANALYSIS: 11/05/2012

I. **Using all stations for the monthly time step**

II. **Simplified models**

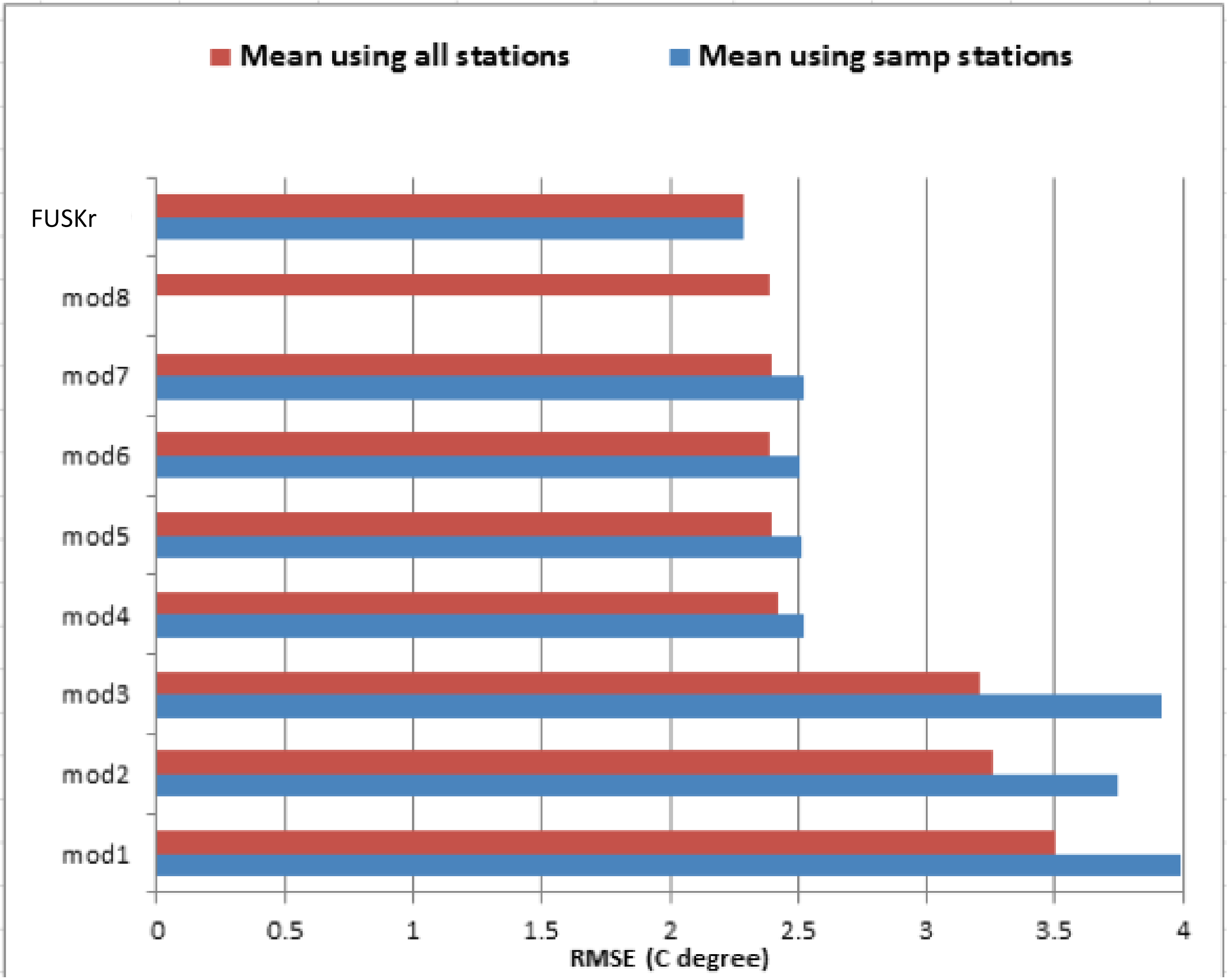
III. **Screening of LST**

PART I:

INTERPOLATION USING ALL MONTHLY STATION FOR MONTHLY TIME STEPT

COMPARISON OF CAI AND FUSION WITH EARLIER RESULTS

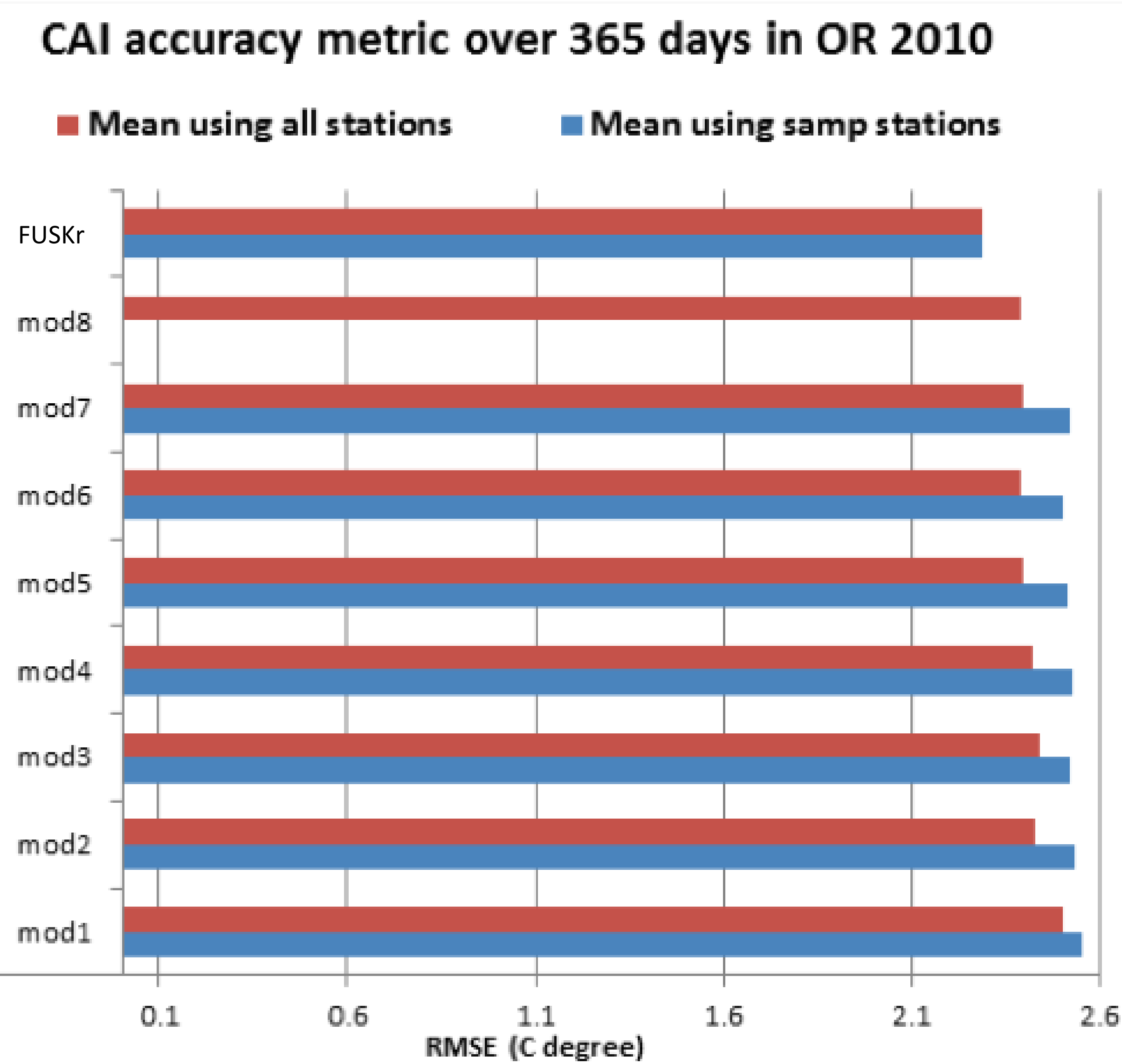
COMPARISON BETWEEN FUS WITH ALL STATIONS (red) AND DAILY STATIONS (SAMP in blue)



- Slight improvement when using more stations monthly for the fusion method using GAM.
- Adding more station has more impact for models with fewer covariates (mod1, mod2 and mod2
- Note that Fusion with Kriging for bias modeling remains the "best".

Model 1 to model 8 use GAM with covariates to model the bias surface. Models are described In GAM1.

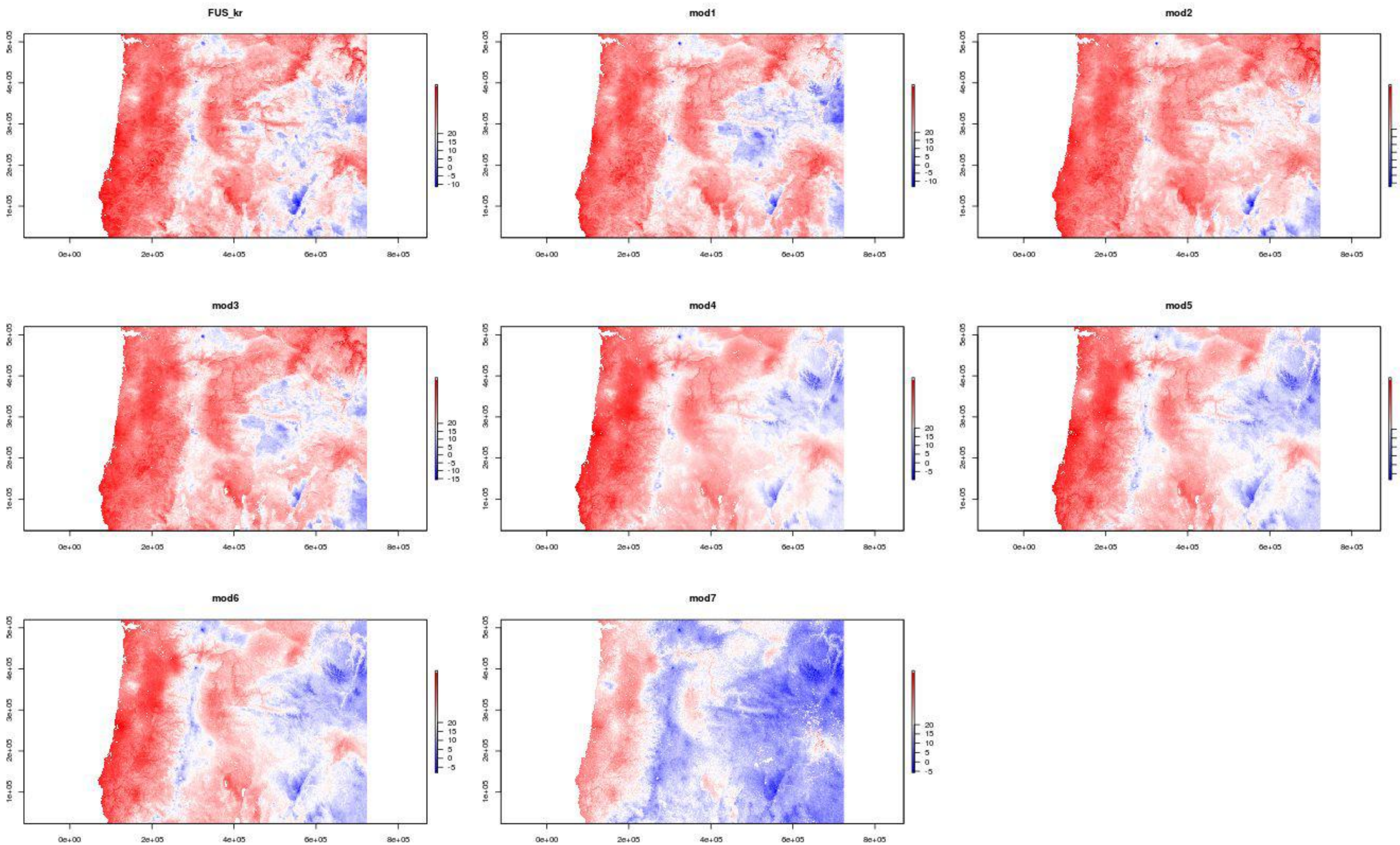
COMPARISON BETWEEN CAI WITH ALL STATIONS (red) AND DAILY STATIONS (SAMP in blue)



- Slight improvement when using more stations for CAI method.
- Note that Fusion with Kriged surface for bias remains the "best".
- Models perform similarly with a range of about 2.3 to 2.6 RMSE.

Model 1 to model 8 use GAM with covariates to model the bias surface. Models are described FUS1 and CAI1 (see previous slide).

FUSION with sampled Daily observation for monthly step FOR JAN 3 2010

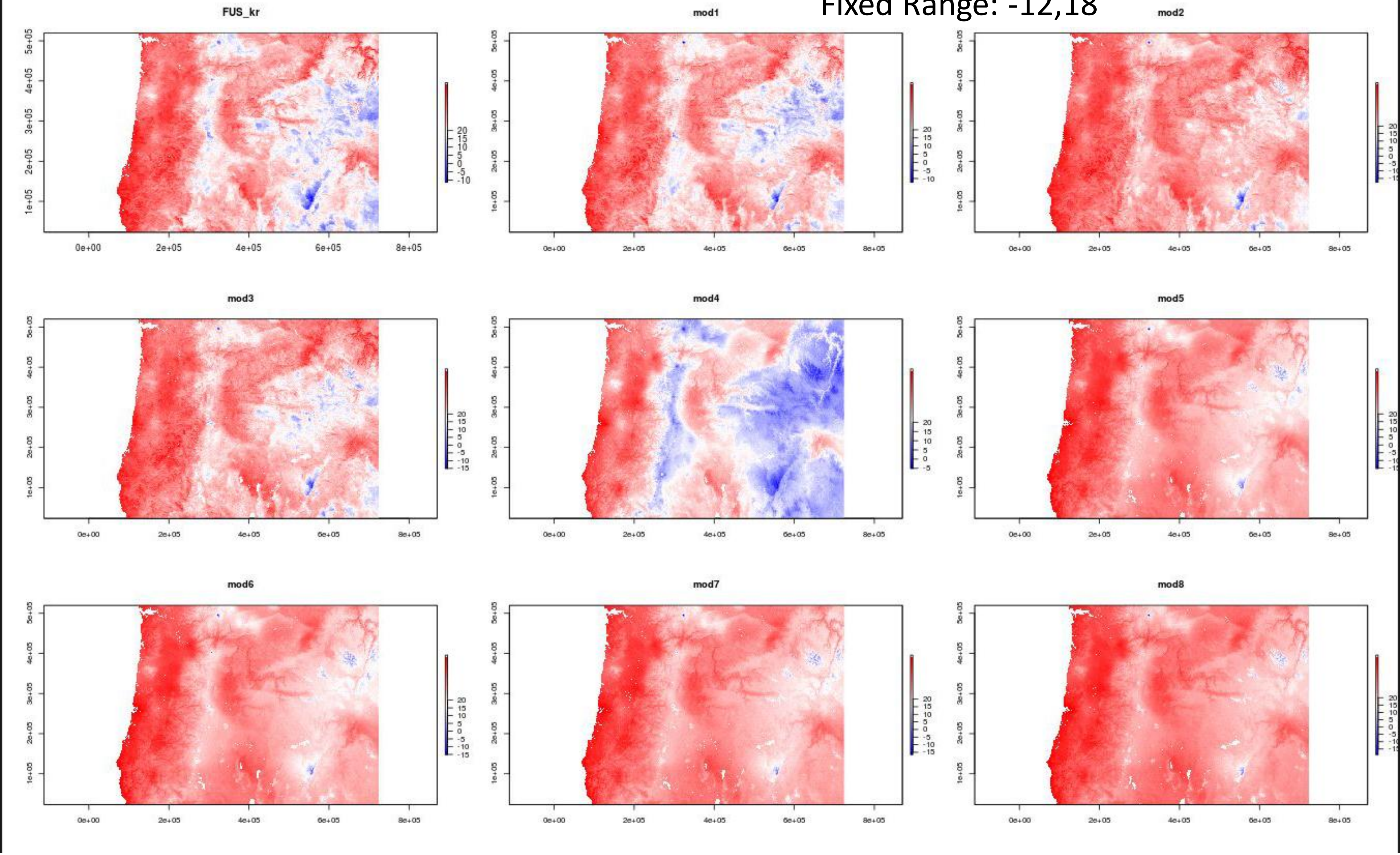


Average RMSE
For 365 dates:

	FUS_kr	mod1	mod2	mod3	mod4	mod5	mod6	mod7	mod8
avg	2.29	3.99	3.75	3.92	2.53	2.51	2.51	2.52	NA
sd	0.65	1.16	0.97	1.04	0.63	0.63	0.63	0.63	NA

FUSION all: Adding more observation for monthly step FOR JAN 3 2010

Fixed Range: -12,18



Average RMSE
For 365 dates:

	FUS_Kr	mod1	mod2	mod3	mod4	mod5	mod6	mod7	mod8
avg	2.29	3.50	3.26	3.20	2.42	2.40	2.39	2.39	2.39
sd	0.65	0.85	0.78	0.70	0.64	0.64	0.64	0.64	0.64

COMPARISON BETWEEN CAI AND FUSION WITH ALL STATION MODELS USED IN CAI AND FUSION

FUS1 GAM

Model	Functional form
Fus_kr	Fusion with simple kriging
Mod1	LST_bias ~ f(lat) + f(lon) + f(ELEV_SRTM)
Mod2	LST_bias ~ f(lat,lon)+ f(ELEV_SRTM)
Mod3	LST_bias ~ f(lat) + s (lon) + s (ELEV_SRTM) + s (Northness)+ s (Eastness) + f(DISTOC)
Mod4	LST_bias ~ f(lat) + s (lon) + f(ELEV_SRTM) + f(Northness) + s (Eastness) + f(DISTOC) + f(LST)
Mod5	LST_bias ~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)
Mod6	LST_bias ~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)+f(LC1)
Mod7	LST_bias ~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)+f(LC3)
Mod8	LST_bias ~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST) + f(LC1,LC3)

CAI1 with GAM

Model	Functional form
CAI_kr	CAI with simple kriging
Mod1	TMax ~ f(lat) + f(lon) + f(ELEV_SRTM)
Mod2	TMax~ f(lat,lon)+ f(ELEV_SRTM)
Mod3	TMax~ f(lat) + s (lon) + s (ELEV_SRTM) + s (Northness)+ s (Eastness) + f(DISTOC)
Mod4	TMax~ f(lat) + s (lon) + f(ELEV_SRTM) + f(Northness) + s (Eastness) + f(DISTOC) + f(LST)
Mod5	TMax~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)
Mod6	TMax~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)+f(LC1)
Mod7	TMax~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST)+f(LC3)
Mod8	TMax~ f(lat,lon) +f(ELEV_SRTM) + f(Northness,Eastness) + f(DISTOC) + f(LST) + f(LC1,LC3)

PART II: SIMPLIFIED MODELS OF COVARIATES

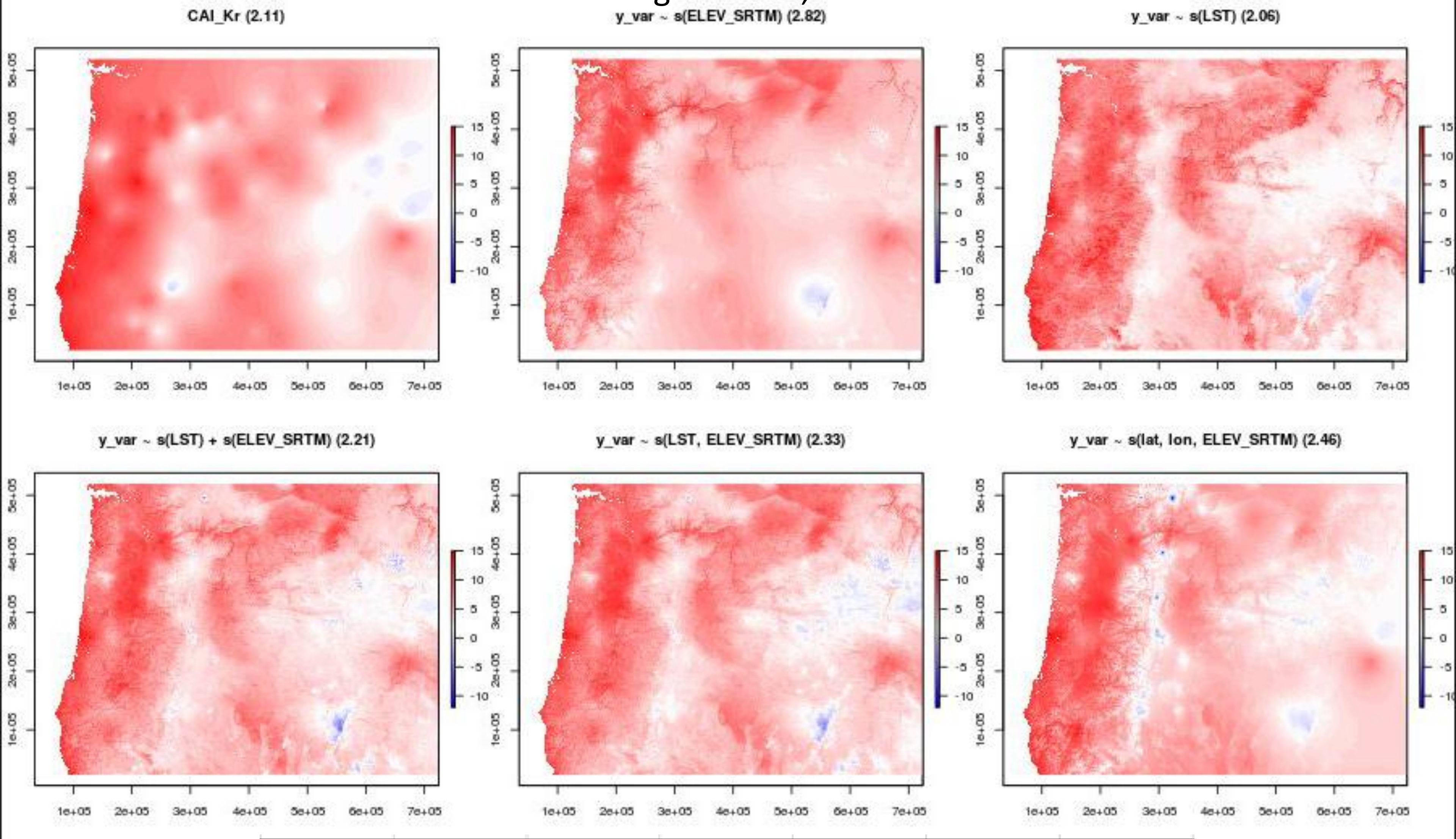
CAI, modeling of monthly Tmax using ELEV_SRTM and LST as covariates.

Models (CAI3)	**Functional form**
Mod1	Tmax~ f(ELEV_SRTM)
Mod2	Tmax~ f(LST)
Mod3	Tmax~ f(LST) + f(ELEV_SRTM)
Mod4	Tmax~ f(LST,ELEV_SRTM)
Mod5	Tmax~ f(lat,lon,ELEV_SRTM)

CAI3: SIMPLIFIED MODELS-MAPS FOR JAN 3 2010

*in parenthesis:RMSE

Range: -11.93,14.82

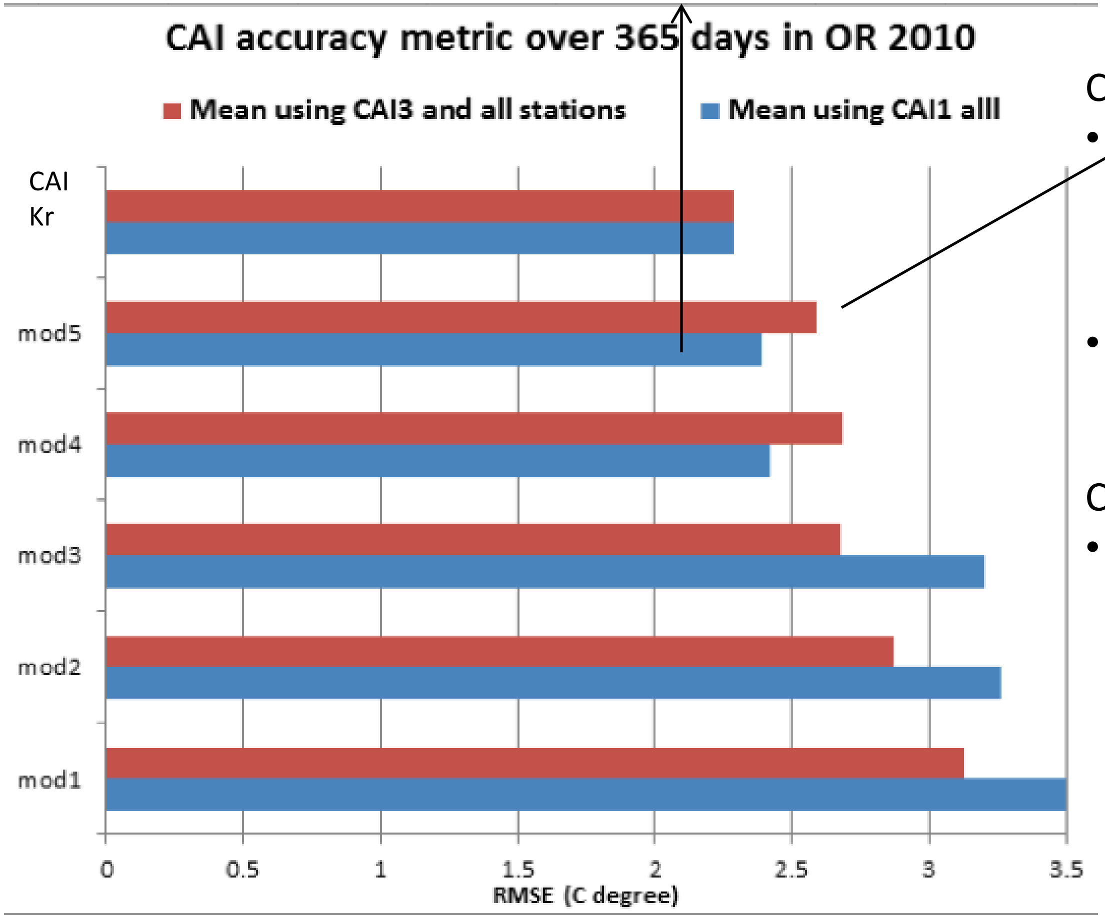


Average RMSE
For 365 dates:

	CAI_Kr	mod1	mod2	mod3	mod4	mod5
avg	2.29	3.13	2.87	2.68	2.69	2.59
sd	0.65	0.73	0.61	0.62	0.62	0.64

CAI3: SIMPLIFIED MODELS

models	CAI1 alll station (in blue)	CAI 3 simplified models, all station (in red)
mod1	Tmax~ f(lat) + f(lon) + f(ELEV_SRTM)	Tmax~ fELEV_SRTM)
Mod2	Tmax~ f(lat,lon) + f(ELEV_SRTM)	Tmax~ f(LST)
Mod3	Tmax~ f(lat) + f(lon) + f(ELEV_SRTM) + f (Northness) + f (Eastness) + f(DISTOC)	Tmax~ f(LST) + f(ELEV_SRTM)
mod4	Tmax~ f(lat) +f(lon) + f(ELEV_SRTM) + f (Northness) + f (Eastness) + f(DISTOC)+ f(LST)	Tmax~ f(LST,ELEV_SRTM)
mod5	Tmax~ f(lat,lon) + f(ELEV_SRTM) + f (Northness,Eastness) + f(DISTOC)+ f(LST)	Tmax~ f(lat,lon,ELEV_SRTM)



CAI3:

- **CAI with Kriging has the lowest mean RMSE (2.29C)** with the second best being three way model corresponding to WorldClim (mod5).
- Model including only elevation (mod1 has Higher RMSE but lower than when

CAI1:

- When using many covariates (CAI1): the best model presented here is model5 which include aspect, lat-lon and distance to ocean (DISTOC) as additional variables.

PART III: Screening of extreme values in space and time…

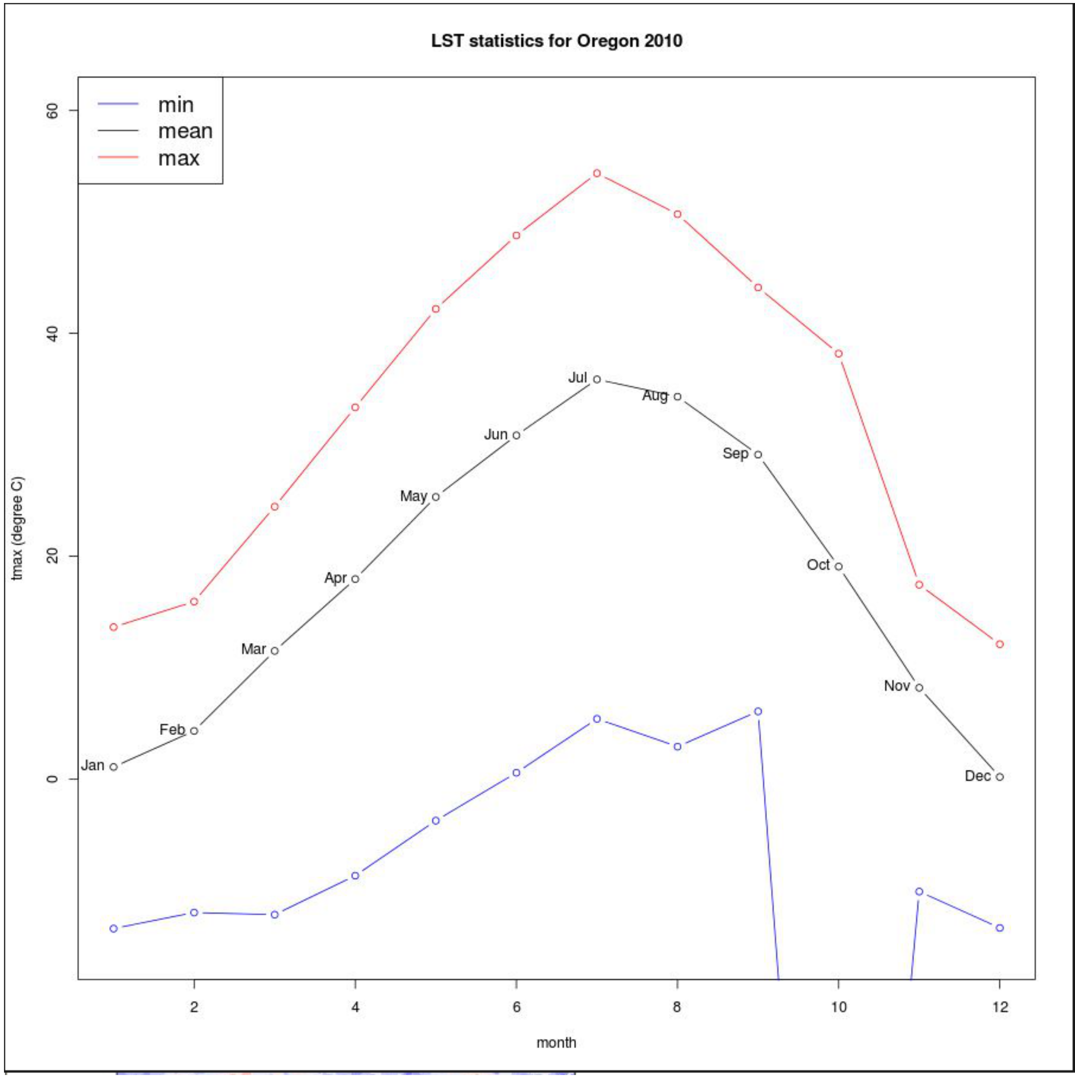
Analysis of LST, Tmax (monthly), LST bias to detect extreme values in space and time.

LST STATISCICS FROM IMAGES

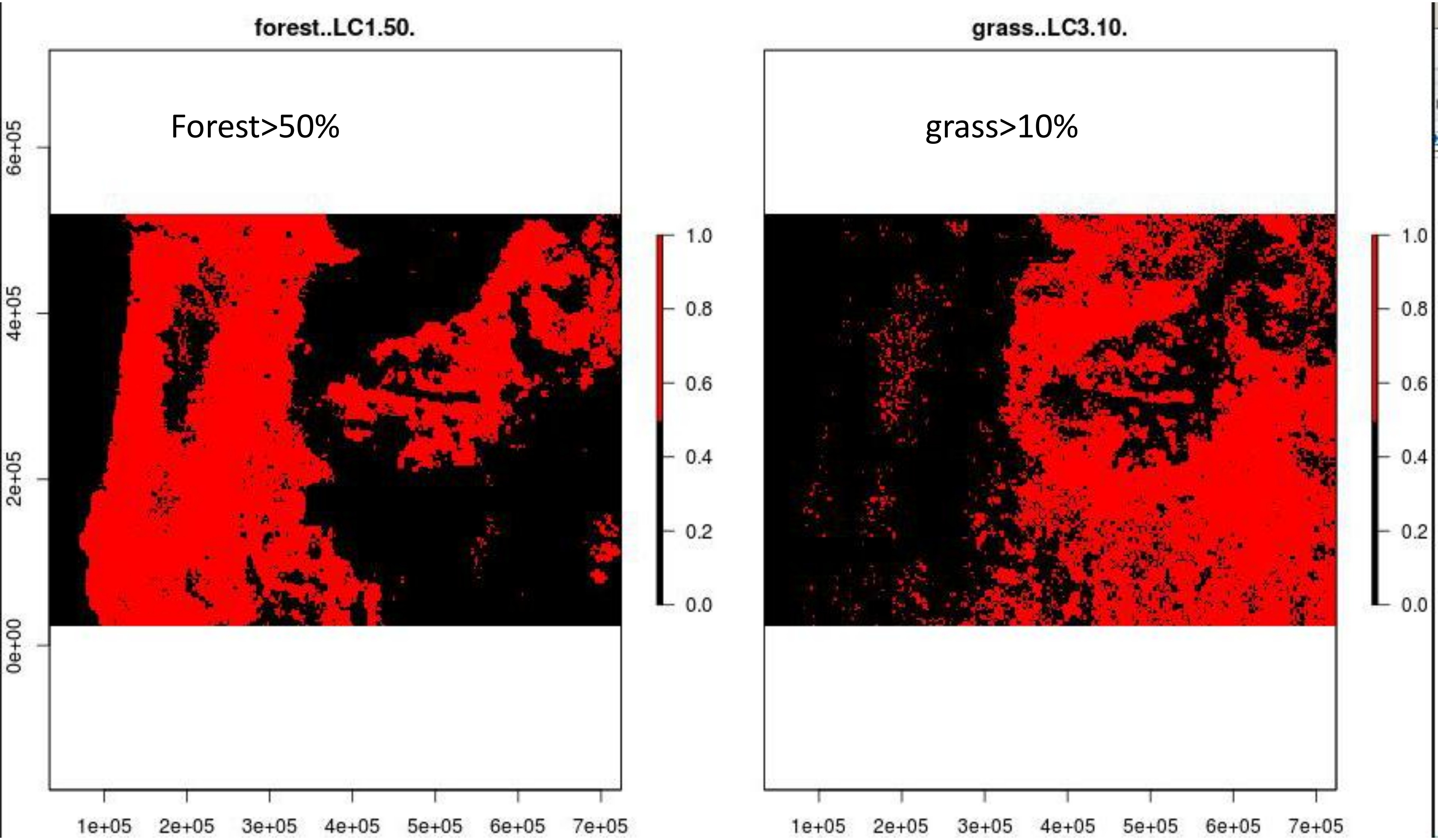
- Statistics show that screening is needed for Oct 2010 LST image because its minimum value (-80C) does not follow the expected temporal pattern.

- Variability is the highest in summer with peak of standard deviation at 9.24C in July when the mean is the highest.

	row.names	min_values	max_values	mean_values	sd_values
1	Jan	-13.4258997	13.63272	1.0776955	3.675844
2	Feb	-11.9909937	15.92453	4.3129347	4.093666
3	Mar	-12.1752893	24.44559	11.4947797	5.010748
4	Apr	-8.6800195	33.35834	17.9455053	6.593789
5	May	-3.7420618	42.19107	25.3136717	7.280559
6	Jun	0.5594519	48.78748	30.8430454	8.210558
7	Jul	5.3999976	54.37076	35.8670969	9.241359
8	Aug	2.8999976	50.69645	34.3121028	8.442812
9	Sep	6.0661658	44.11356	29.1146272	6.575432
10	Oct	-88.6400110	38.18000	19.0651518	4.567670
11	Nov	-10.1062280	17.43656	8.1888230	2.659000
12	Dec	-13.3681299	12.09998	0.1852424	3.338995

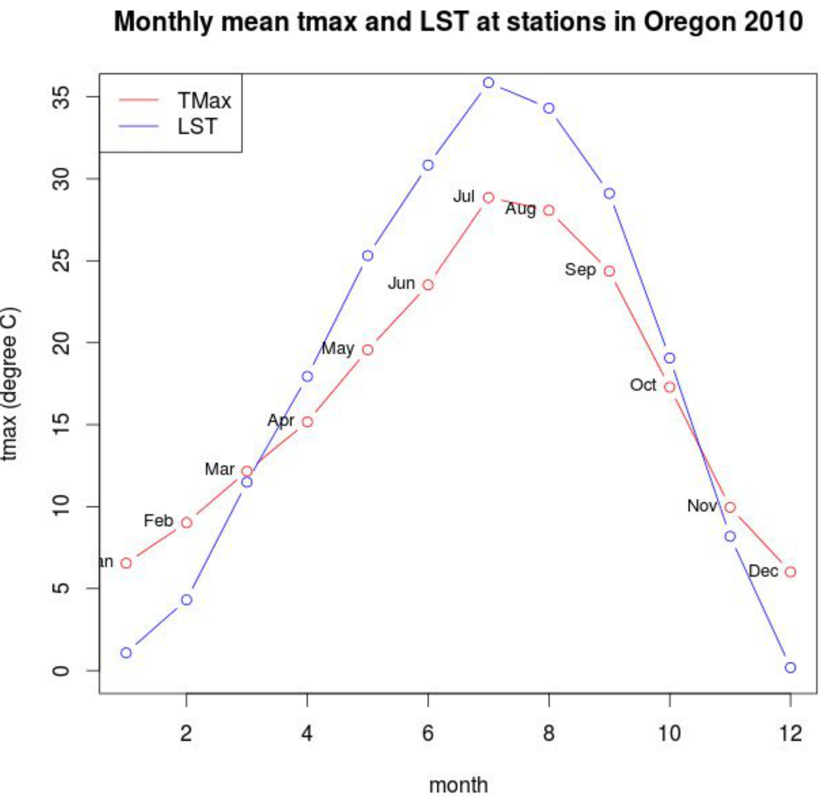


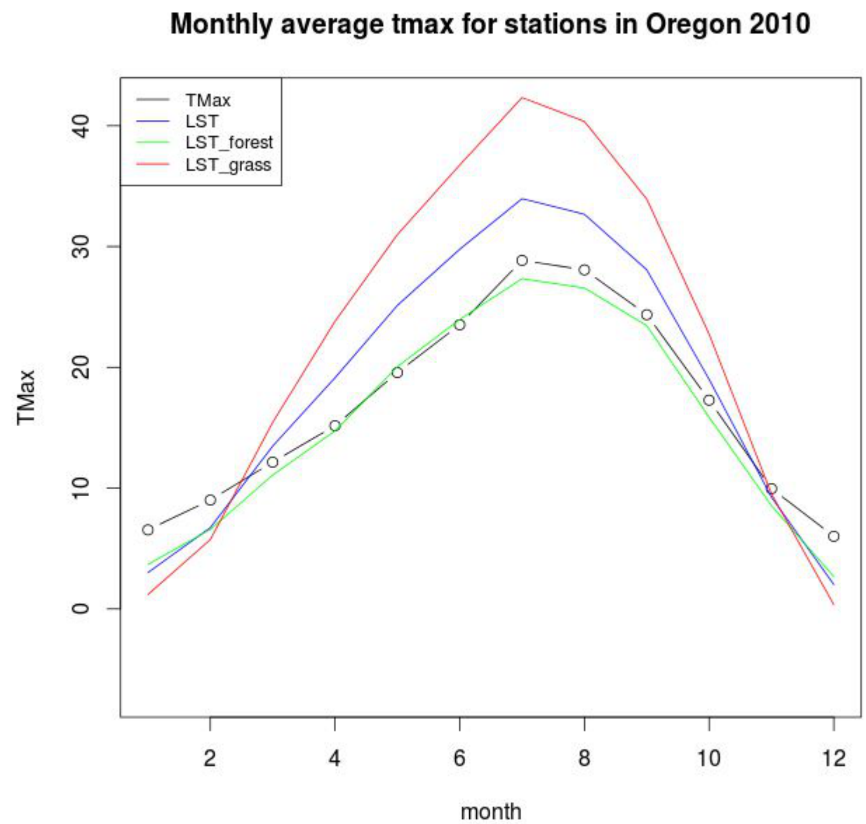
LST BIAS AND LAND COVER



Overlap: ~10,000pixels or less than 4%

LST AND BIAS: TEMPORAL PROFILES





Plots of monthly mean at station show that on average that LST is less than Tmax in Winter and greater than Tmax in summer.

Bias is also influenced greatly by land cover types with:

- LST showing slightly lower temperature than Tmax in summer for forest cover
- LST showing strongly higher temperature than Tmax in summer for grass cover.

MAIN CONCLUSIONS FOLLOWING THE UPDATED ANALYSIS (ON NOV. 3, 2010

1. There is a slight improvement (decrease of 0.1-0.2 C in RMSE) when more stations are used for the monthly surface estimation.

2. When ELEV_SRTM and LST were screened, results changed slightly on average. Screening may need to be adjusted so that it does not lead to station loss.

3. Spatial and temporal patterns in LST images “make sense” but LST seem to have more seasonality with stronger bias in Summer in particular in basin areas with low vegetation.

4. When using simplified model for the modeling of Tmax climatology, RMSE values were higher but the spatial pattern more sensible than for CAI+Kriging because of the spatial detail.

5. CAI+Kriging and GAM+Kriging remain the “best” method based on the average RMSE over 365 dates. We note however that the gap between methods decreased when more stations were added in monthly time step. It appears the number of station is the most critical factor (need to show this, fits with the literature).