Evaluation of Solmetric SunEye vs. Heat Source Insolation Measurements as a Means to Monitor Trends in Riparian Canopy

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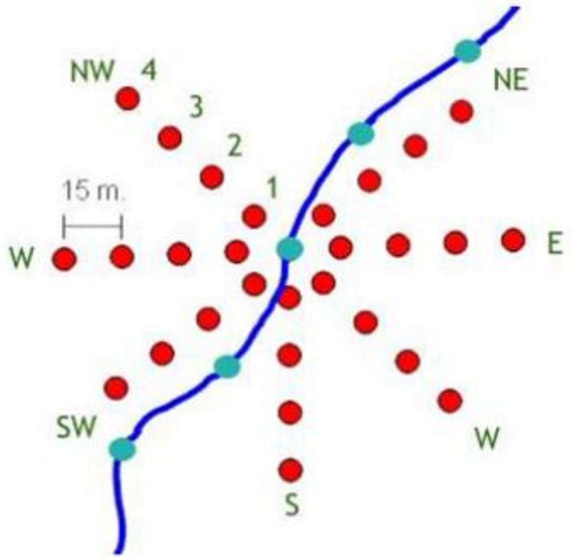
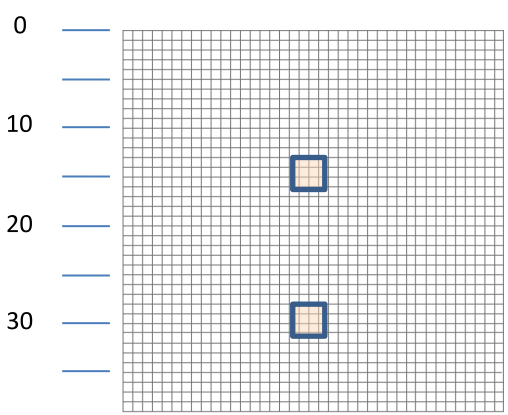
Heat Source Solar Modeling

SunEye Solar Modeling





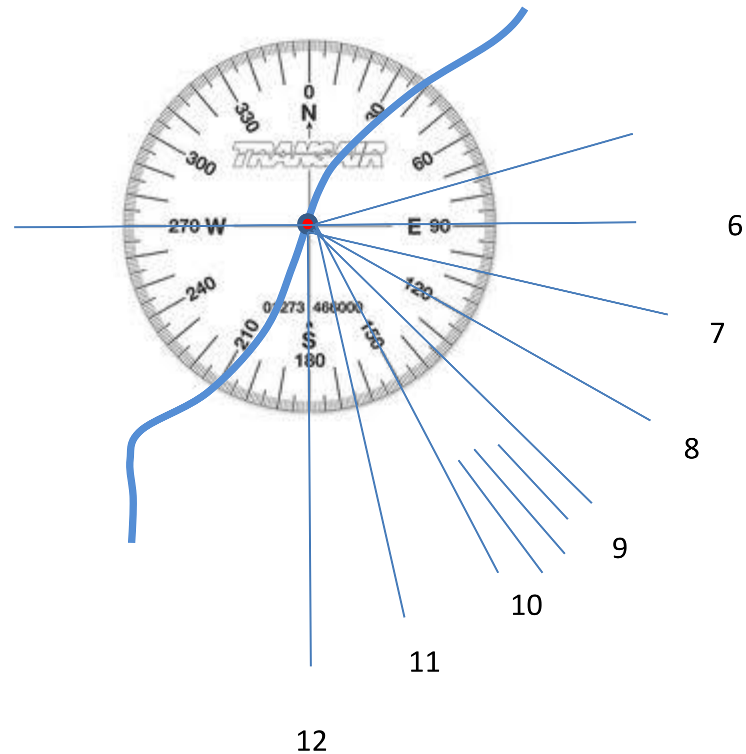
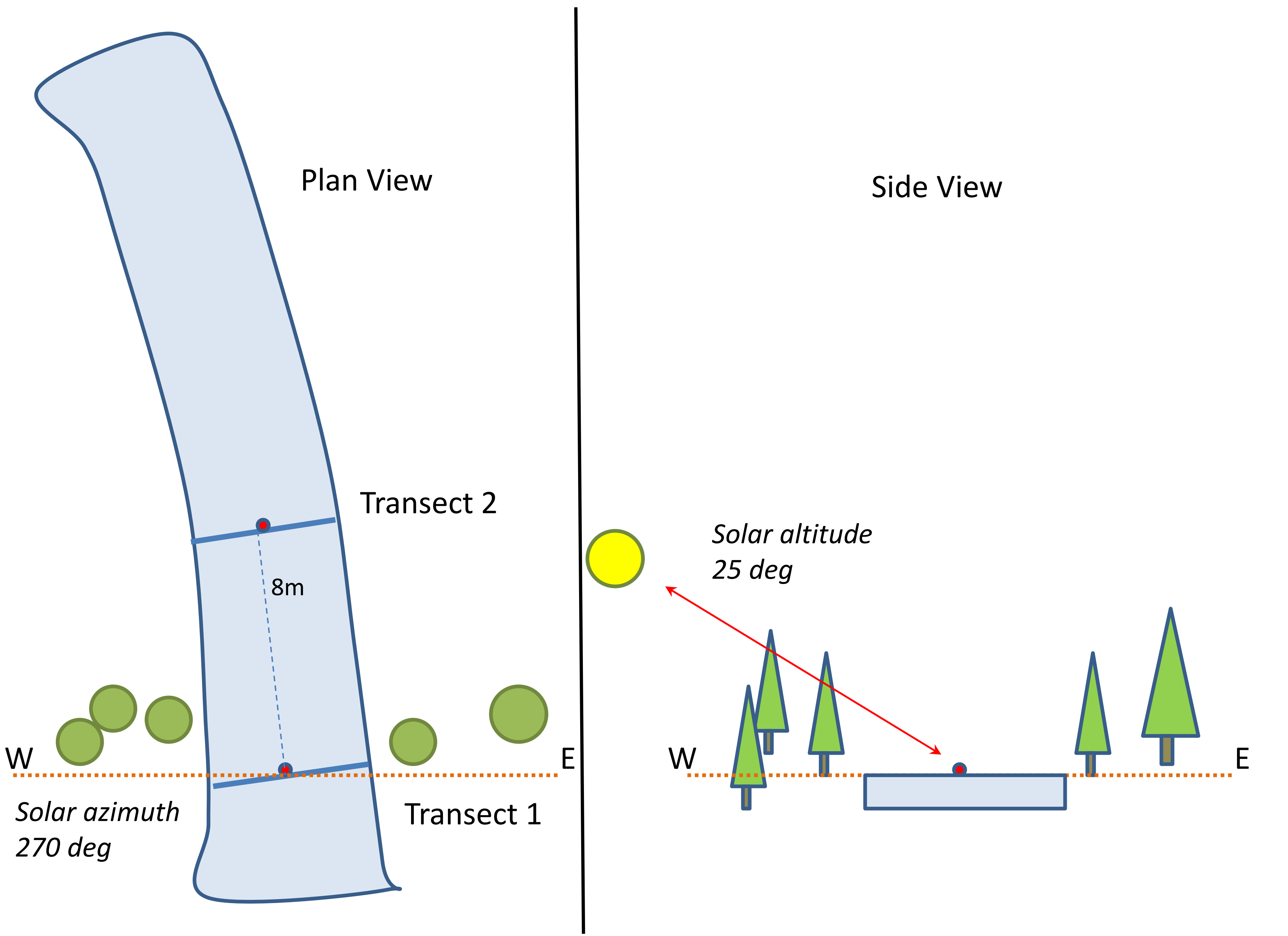


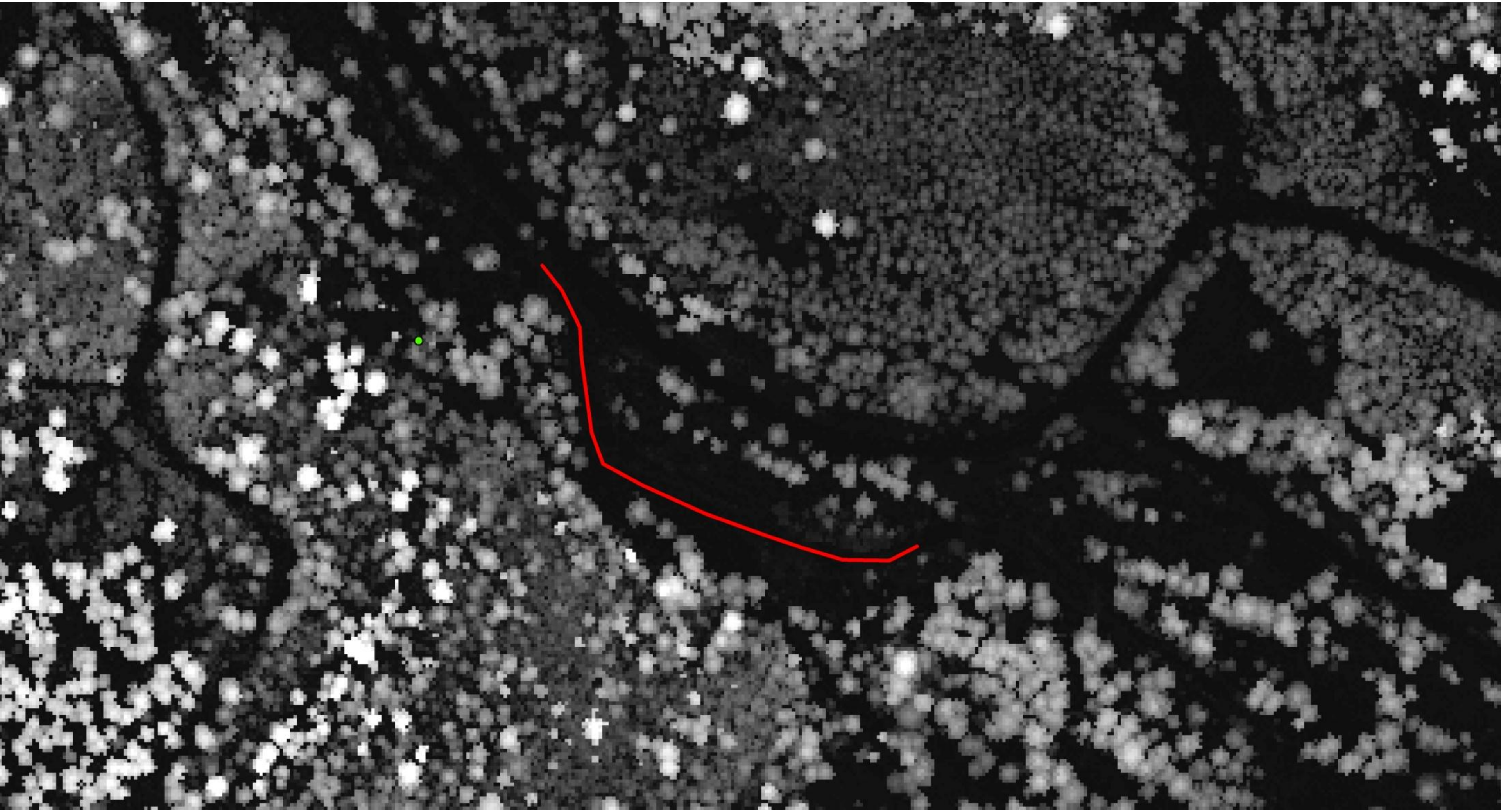
Figure 33 – Example of 50-meter stream nodes and TIR data points.


Plan View
Transect 2
8m
W
E
Solar azimuth
270 deg
Transect 1
Side View
Solar altitude
25 deg
W
E

Upper Grande Ronde site dsgn4-000009, Transect 1 to Transect 11

Upper Grande Ronde site dsgn4-000009, Transect 11 to Transect 21

Upper Grande Ronde site dsgn4-000009, Transect 1 to Transect 21
shown with LiDAR canopy data



$$\text{Effective Shade (\%)} = \frac{\text{(Potential daily direct beam solar)} - \text{(Daily direct beam solar at stream surface)}}{\text{(Potential daily direct beam solar)}}$$

$$\text{Solar Access (\%)} = 1 - \text{Effective Shade (\%)} =$$

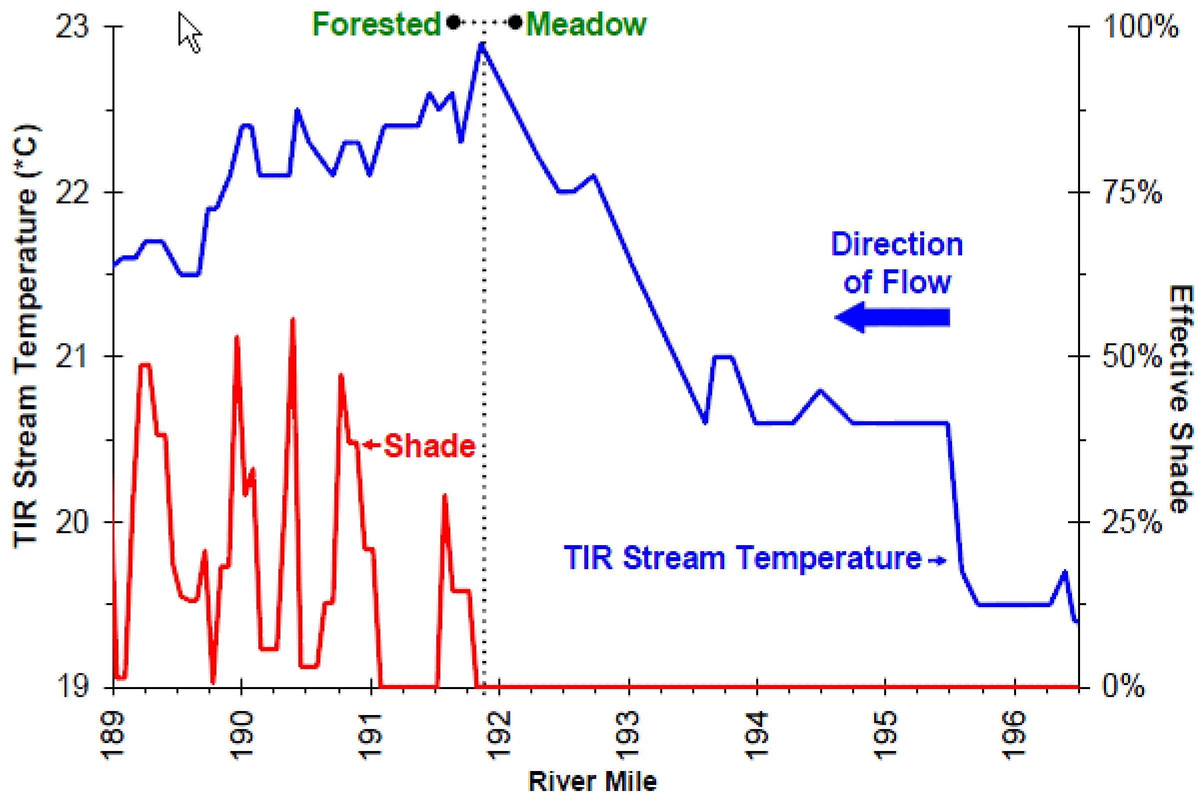


FIGURE 1.4
TIR derive stream temperature data and effective shade modeling indicate that 3°C stream heating corresponds to reduced shade distributions. Reduced rates of stream heating are apparent in the shaded (forested) downstream reach (Vey Meadow, Grande Ronde River, Oregon).

SunEye Daily Solar Access -Calculation for Aug 1-31 and Sept 1-20, 2012 vs. Heat Source solar access for 2010 based on LiDAR

SunEye

	Aug 1-31	Sept 1-20
T1	70.22	75.06
T2	61.52	47.53
T3	70.01	66.77
T4	67.20	71.25
T5	80.07	79.54
T6	86.02	76.52
T7	85.20	76.51
T8	52.33	43.53
T9	79.17	70.48
T10	64.70	53.34
T11	78.21	76.23
Mean	72.24	66.98

Heat Source

Insolation above stream surface as % of potential

	Aug 1-31	Sept 1-20
Rkm91.5	58.13%	34.84%
Rkm91.6	76.09%	47.66%
Rkm91.7	56.97%	47.66%
Rkm91.8	77.02%	75.49%
Rkm91.9	75.95%	74.04%
Mean	68.83%	55.94%

Insolation below stream surface as % of potential

		Aug 1-31	Sept 1-20
Rkm91.5		72.03%	44.48%
Rkm91.6		95.48%	94.20%
Rkm91.7		70.30%	59.99%
Rkm91.8		95.62%	95.30%
Rkm91.9		95.23%	94.33%
	Mean	85.73%	77.66%

Comparison of SunEye solar access data in two years at three transects of site dsgn4-000009 in the Upper Grande Ronde

2011

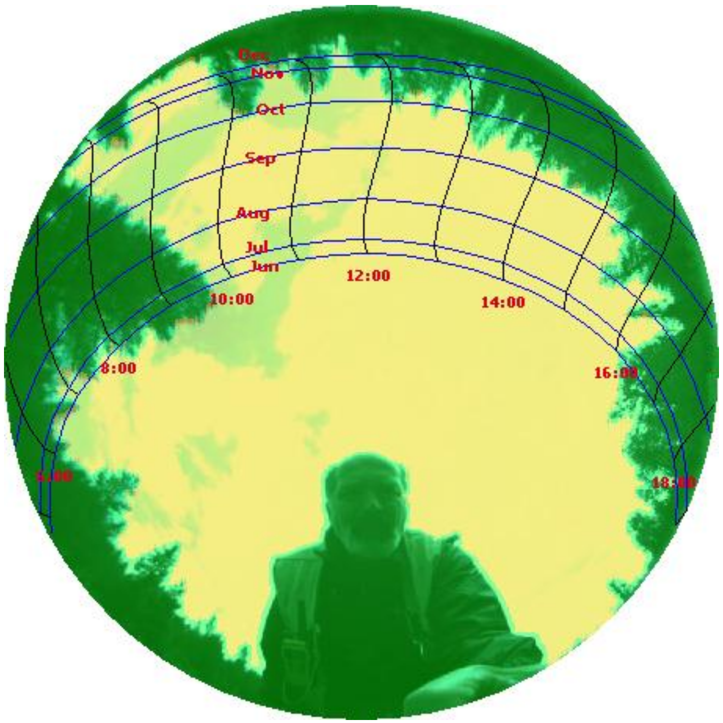
	Aug 1-31	Sept 1-20
T1	69.69	74.33
T3	77.82	68.32
T5	82.71	79.39
Mean	74.88	72.53

2012

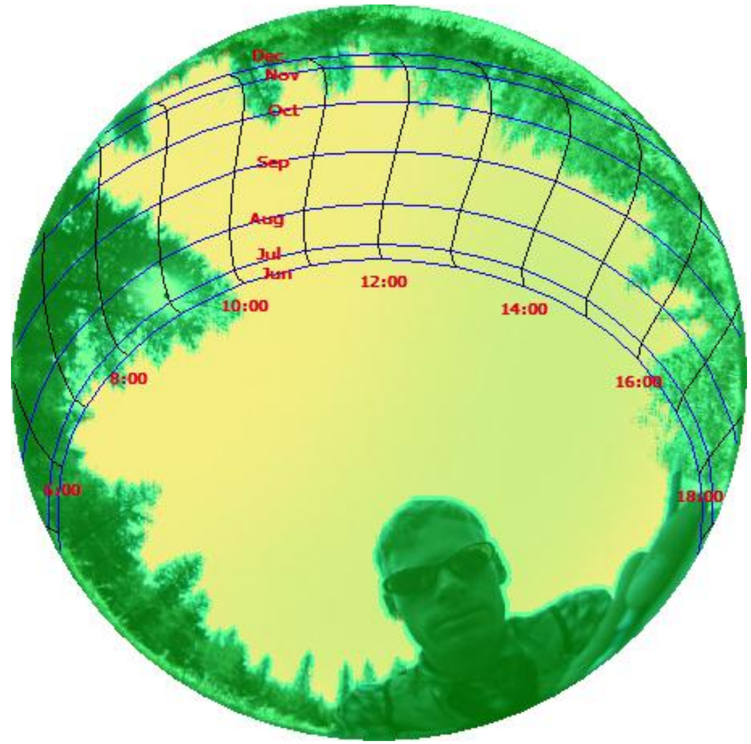
	Aug 1-31	Sept 1-20
T1	70.22	75.06
T6	86.02	76.52
T11	78.21	76.23
Mean	72.24	66.98

SunEye Comparison Between Years

Transect 1
Dsgn4-000009
2011

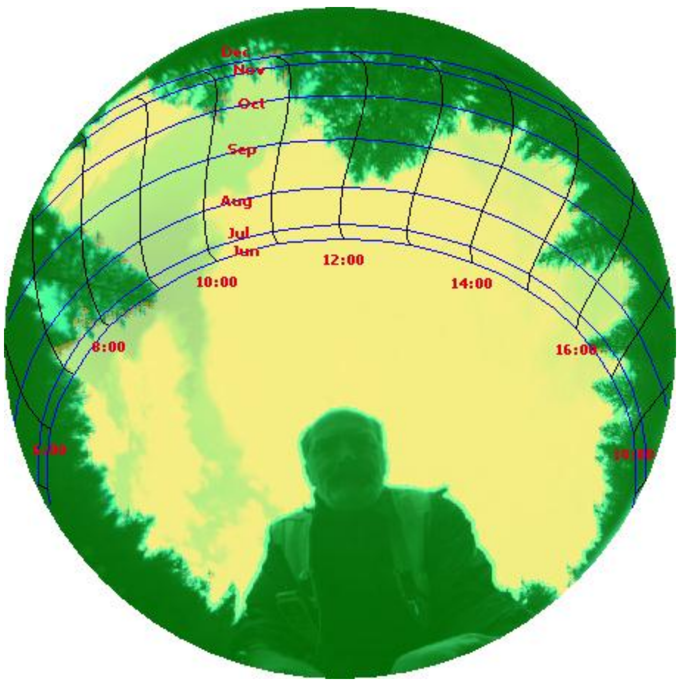


Transect 1
Dsgn4-000009
2012

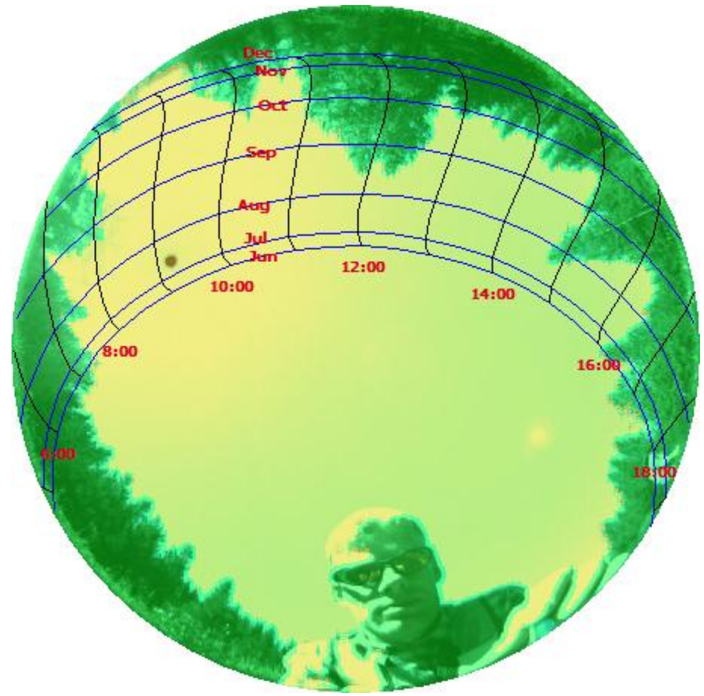



Transect 1

Transect 11
Dsgn4-000009
2011

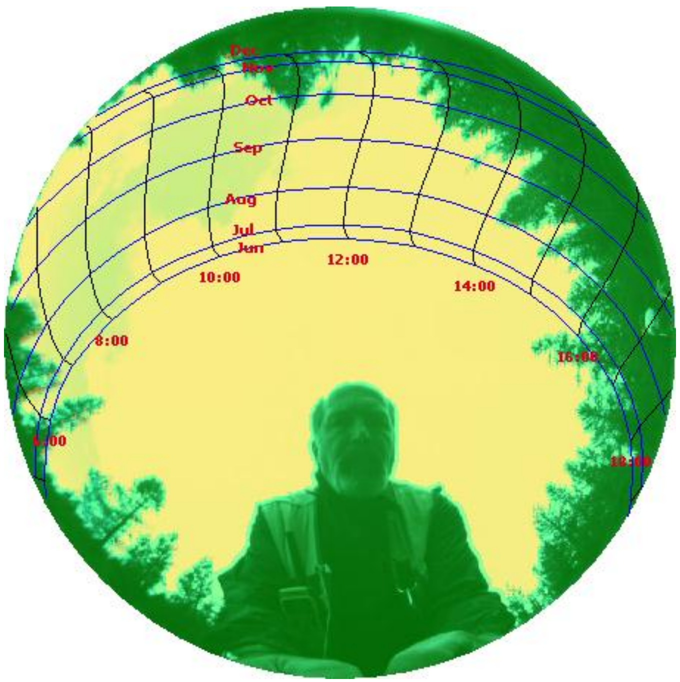


Transect 11
Dsgn4-000009
2012

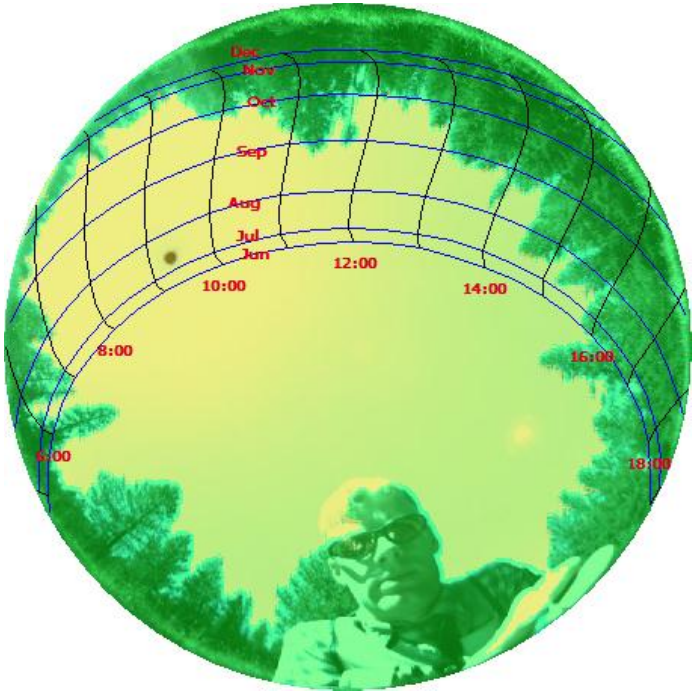



Transect 11

Transect 21
Dsgn4-000009
2011

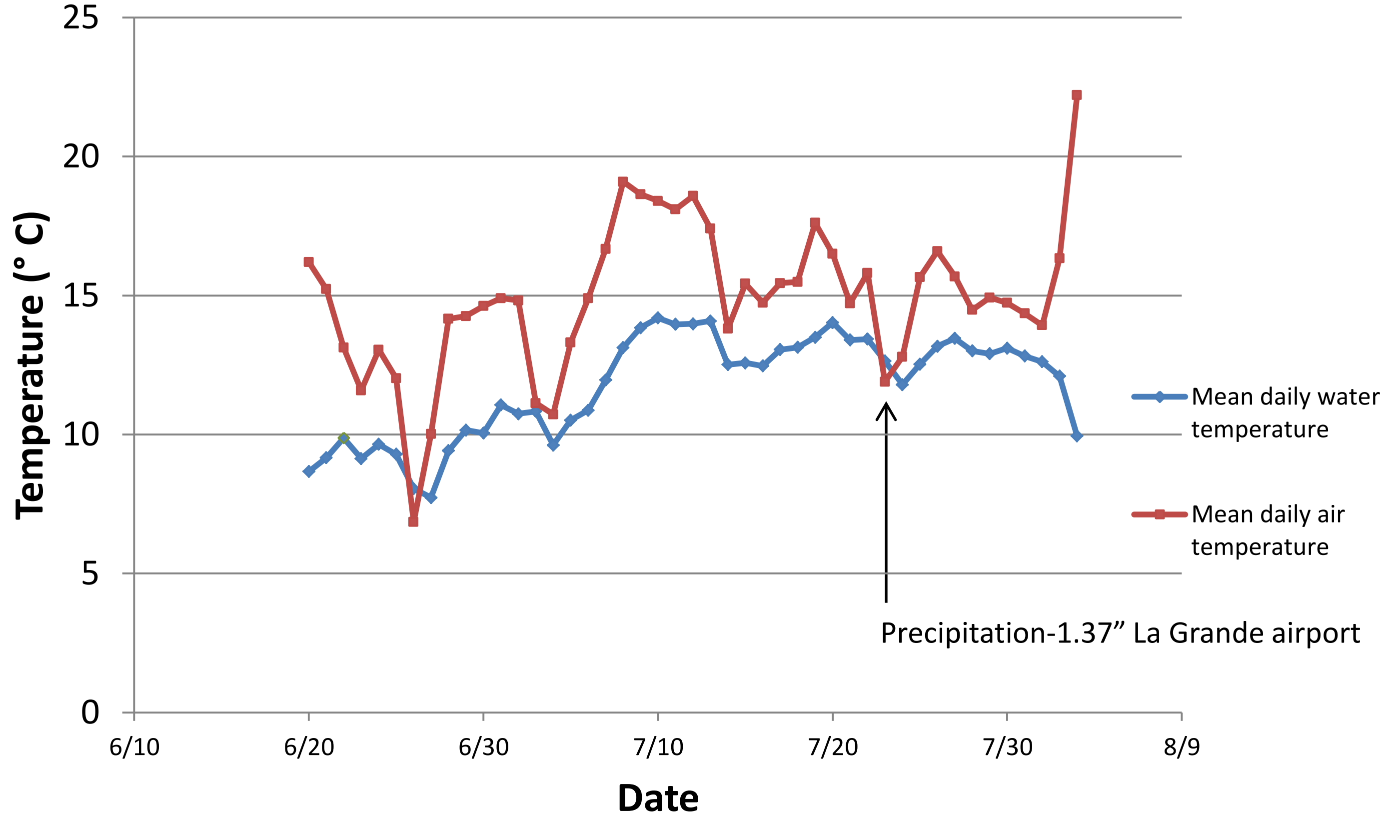


Transect 21
Dsgn4-000009
2012



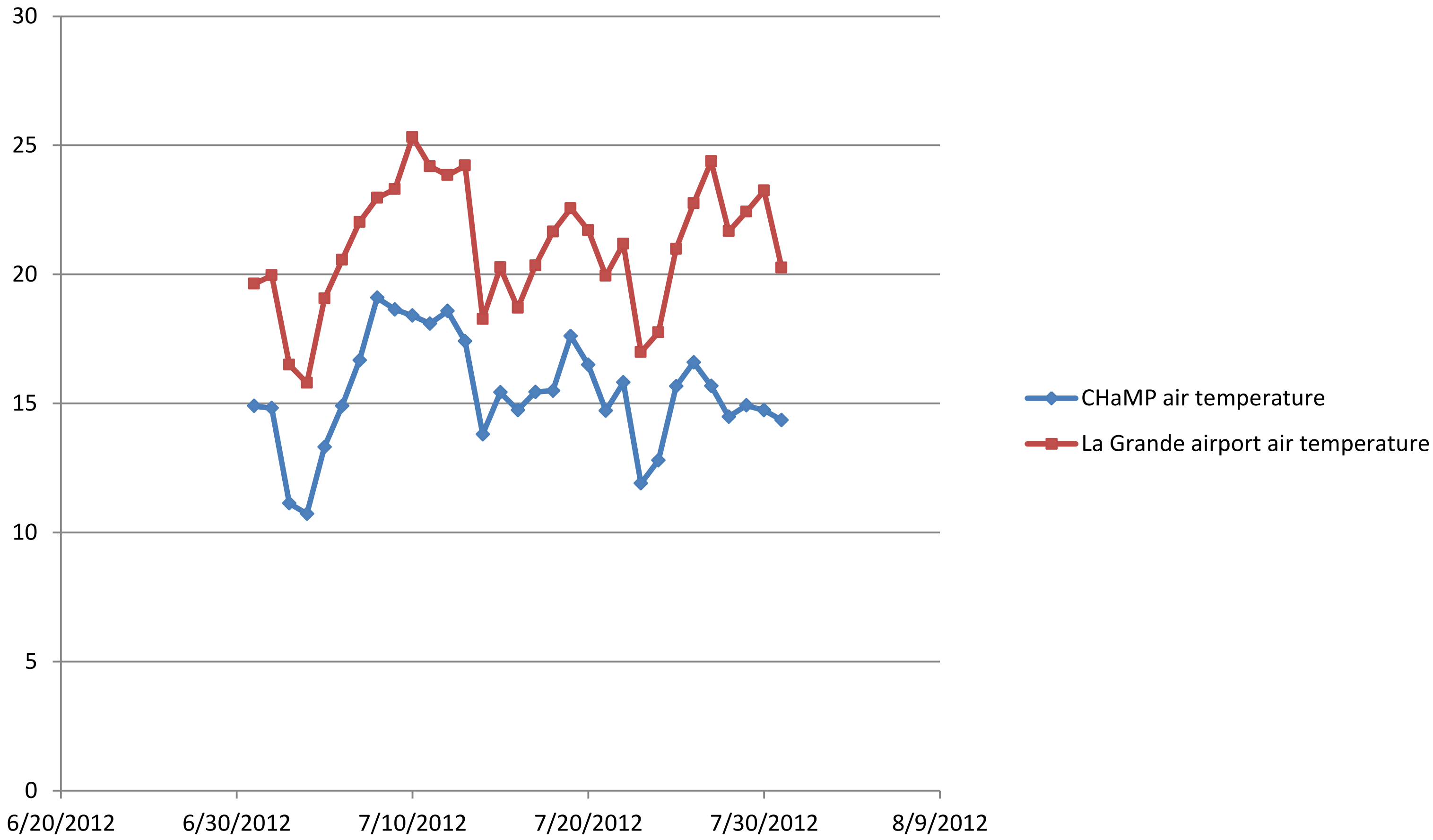

Transect 21

Water Temperature and Air Temperature
Site dsgn4-000009; Year 2012



Water vs air temperature.xlsx

Comparison between CHaMP air temperature data for July 2012 at dsgn4-000009 and the La Grande airport data from NOAA



Water vs air temperature.xlsx

Mean July air temperature

dsgn4-000009	15.4 ºC
La Grande Airport	21.0 ºC
Adiabatic lapse rate	9.6 ºC/1000 m

begin data		4:15	4:30	4:45	5:00	5:15	5:30	5:45	6:00	6:15	6:30	6:45	7:00	7:15	7:30	7:45
1-Aug	Shading			0	0	0	0	0	0	0	0	0	0	0	0	0
1-Aug	Insolation (W/m^2)			0	11.417	11.417	11.417	11.417	36.314	36.314	36.314	36.314	65.9	65.9	65.9	65.9
Shading x insolation				0	0	0	0	0	0	0	0	0	0	0	0	0

8:00	8:15	8:30	8:45	9:00	9:15	9:30	9:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45
0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1
85.485	85.485	85.485	85.485	119.034	119.034	119.034	119.034	132.915	132.915	132.915	132.915	132.45	132.45	132.45	132.45
0	0	0	0	0	0	0	119.034	132.915	132.915	132.915	132.915	132.45	132.45	132.45	132.45

12:00	12:15	12:30	12:45	13:00	13:15	13:30	13:45	14:00	14:15	14:30	14:45	15:00	15:15	15:30	15:45
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
165.482	165.482	165.482	165.482	134.451	134.451	134.451	134.451	116.637	116.637	116.637	116.637	98.613	98.613	98.613	98.613
165.482	165.482	165.482	165.482	134.451	134.451	134.451	134.451	116.637	116.637	116.637	116.637	98.613	98.613	98.613	98.613

16:00	16:15	16:30	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	18:45	19:00	19:15
1	1	0	0	0	0	0	0	0	0	0	0	0	0
37.474	37.474	37.474	37.474	48.016	48.016	48.016	48.016	0	0	0	0	0	0
37.474	37.474	0	0	0	0	0	0	0	0	0	0	0	0

Comparison of calculations of insolation (W/m^2) for site dsgn4-000009, Transect 1, August 1, 2012 and solar access

	Potential insolation (W/m^2)	Above Stream (W/m^2)	Solar Access
SunEye	4737	3316	70.01%
Heat Source	7825	6696	85.57%

Conclusions: Solar Radiation Measurements

1.The SunEye is a means of gathering high quality solar input data
2.Alternatives—could use LiDAR remote sensing data to assess effective shade (solar access) comprehensively throughout the stream network
3.Measurements are repeatable from year to year using the SunEye and can be used to measure changes in effective shade
4.Currently, Heat Source water temperature modeling assesses insolation based on a 50-m point spacing on the stream and analysis of topographic DEM and LiDAR data to calculate solar input that is then expressed at 100-m intervals.
5.SunEye data is precise if based on reproducible instrument orientation (180 degrees) and tilt. Make sure that no time-of-day constraints are set as a windowed solar access or use the daily solar access values instead of dailywindowed solar access.
6.SunEye insolation data is based on TMY3 regional climate data, accounting for cloud cover and other factors.
7.The SunEye appears to give insolation values that are similar to Heat Source computations and the solar access information in both methods is very similar. Consequently, the SunEye is a good means to detect whether improvements in riparian canopy at a site are occurring.
8. Insolation data is essential in Heat Source to model spatially continuous water temperature trajectories. The Heat Source model can predict new water temperature trajectories that would occur if reductions in insolation occur on a reach.
9. The spatial distribution of water temperature at a stream network scale allows estimates of salmonid survival and abundance by reach.