Idaho Power Company

Effects of Wind on CJ Strike Reservoir Headwater Elevation

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1/29/2013

Background

Idaho Power Company has been studying the effects of high wind speeds at CJ Strike Reservoir. Analyzing these occurrences helps the company make better water management decisions, interpret headwater data more effectively, and understand the reservoir's response to environmental factors. In response to collaborative meetings with the Technical Work Group, Idaho Power Company is exploring the potential of using headwater data to estimate change in storage. In order to understand the potential limitations of estimating reservoir storage based on headwater data, this analysis looks at wind as an influence on headwater data being collected.

Selection of Headwater Data

For the purposes of this analysis, the CJ Strike Reservoir headwater data that was used is from Idaho Power Company's gage at the plant intake. Data was collected in one minute time steps. This one minute data was then condensed into 60-minute averages. Additional graphs are provided to illustrate the differences between the Idaho Power Company and U.S. Geological Survey (USGS) headwater gages. This brief analysis shows that the gages are relatively close. The Idaho Power Company gage was chosen for this study because it provides one-minute data that can be averaged to dampen out errors.

Selection of Wind Data

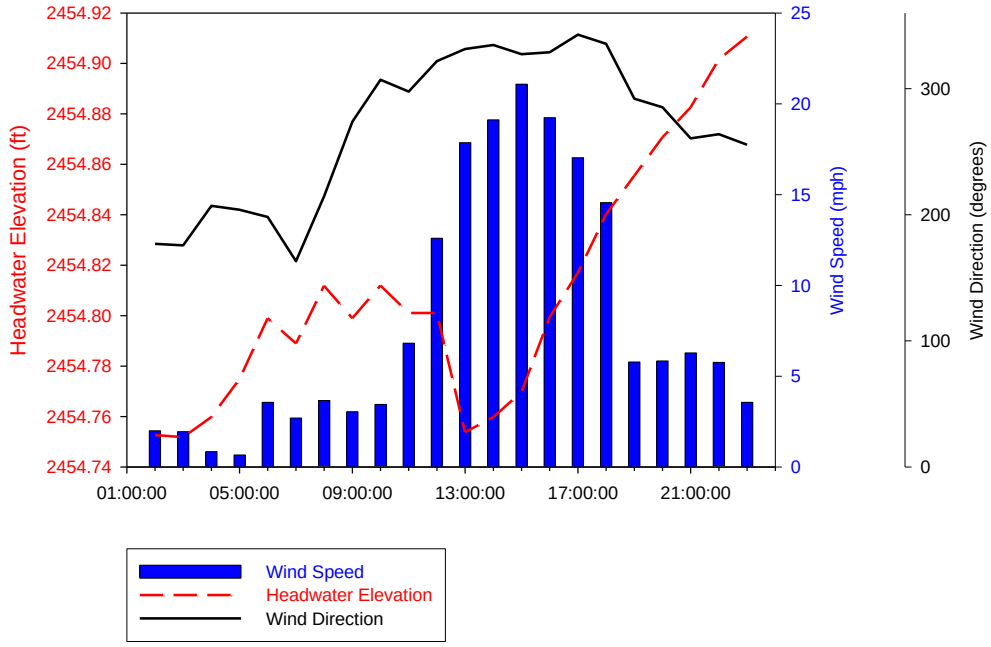
The headwater data was then plotted against wind speed and direction. The time stamp on both data sets was adjusted to Mountain Daylight Savings Time. Three wind gages were initially selected: Grandview, ID, Mountain Home, ID, and CJ Strike Reservoir. The data from the Idaho Power gage at the CJ Strike Dam was incomplete and had significant errors. For this reason data was used from the Grandview, ID wind gage. The hourly wind direction and wind speed data was provided by the U.S. Bureau of Reclamation's AgriMet Weather Network. The Mountain Home, ID gage is provided to give additional review of regional wind patterns. Melvin Kunkel, a meteorologist at Idaho Power Company, generated wind rose plots for CJ Strike, Grandview, and Mountain Home wind data.

Criteria for Selecting Wind Events

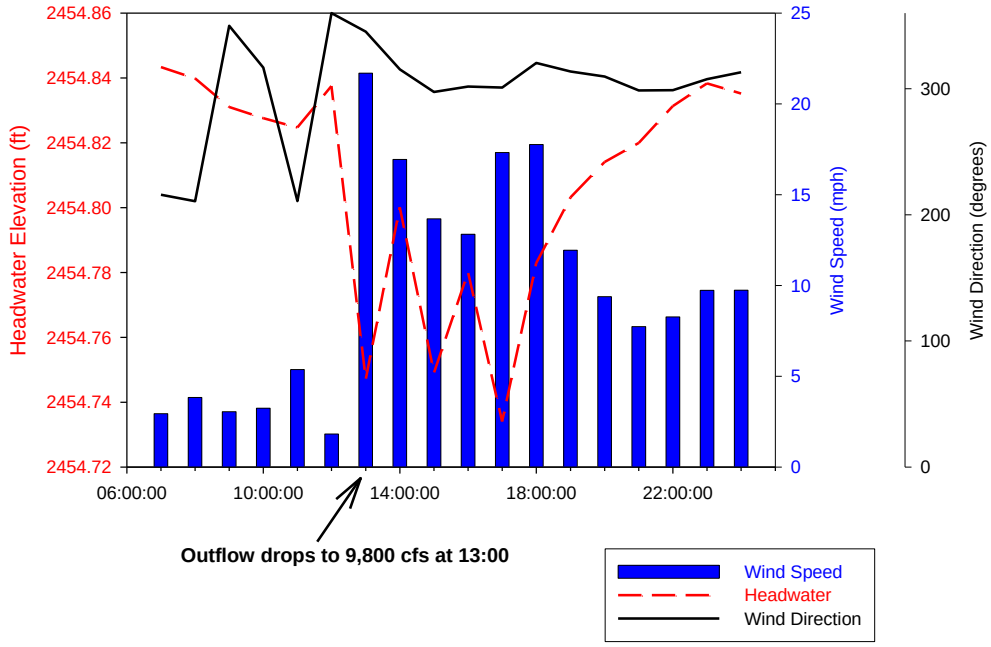
Ideally, we looked for periods of time with sustained, high wind speeds (wind event occurs for 2+ hours, speeds greater than 15 mph) and steady CJ Strike Reservoir inflow and outflow. These ideal conditions were difficult to find (as can be seen in the plots). These plots illustrate the typical wind events associated with CJ Strike Reservoir and the magnitude of effect that wind can have on Headwater measurements. It was noted that of all the wind events selected, none occurred during irrigation season.

CJ Strike Reservoir Headwater Data vs. Wind Speed and Wind Direction

CJ Strike Reservoir 2/5/11
(Inflow steady at 10,700 cfs. Outflow steady at 9,900 cfs.)

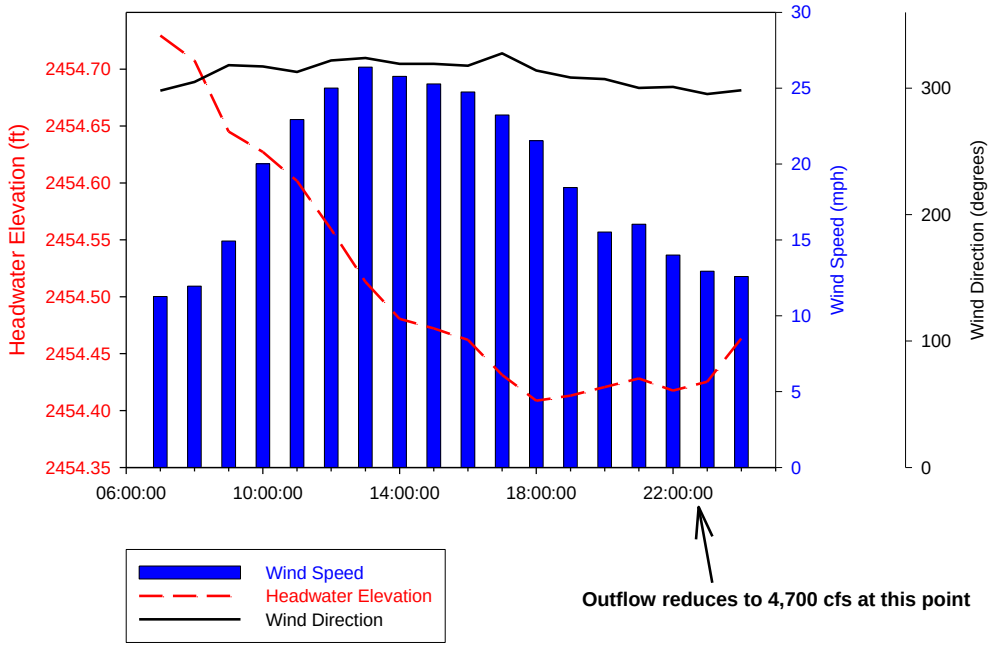


CJ Strike Reservoir 2/7/11
(Inflow stable at 10,700 cfs. Outflow steady at 11,200 cfs, then drops to 9,800 cfs)



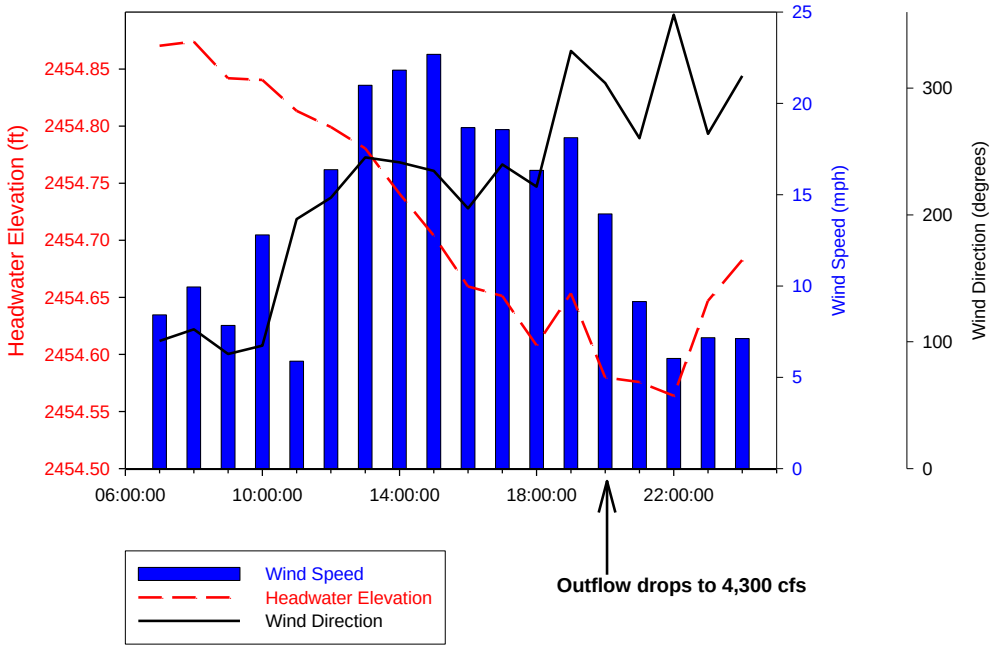
CJ Strike Reservoir 3/13/10

(Inflow steadily increases from 6,000 to 7,600 cfs between 6:00 and 15:00. Outflow elevated to 8,700 cfs, held constant, then reduces to 4,700 cfs.)

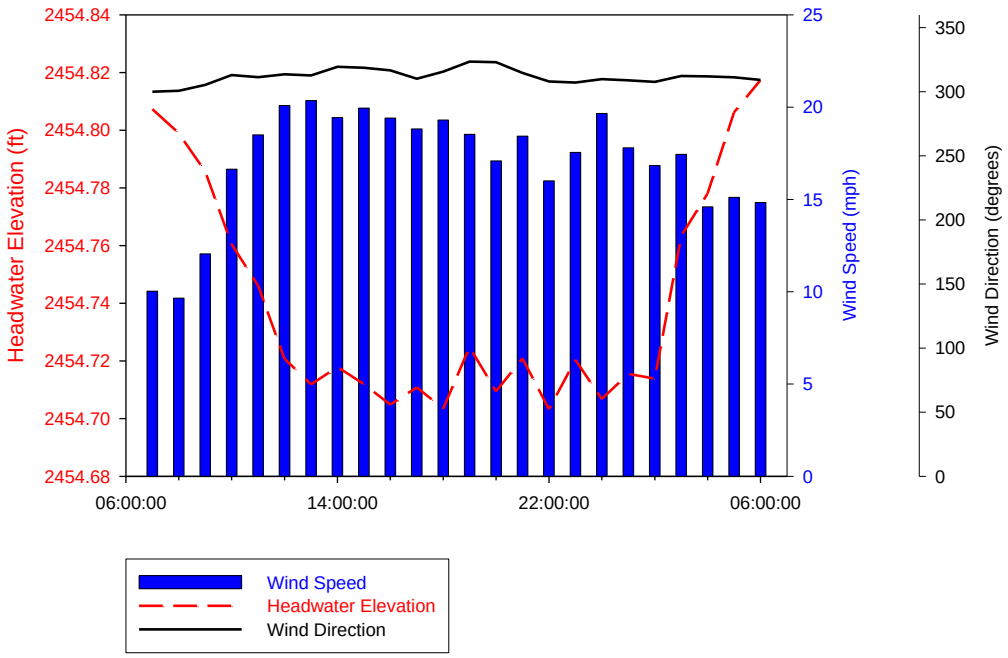


CJ Strike 4/27/10

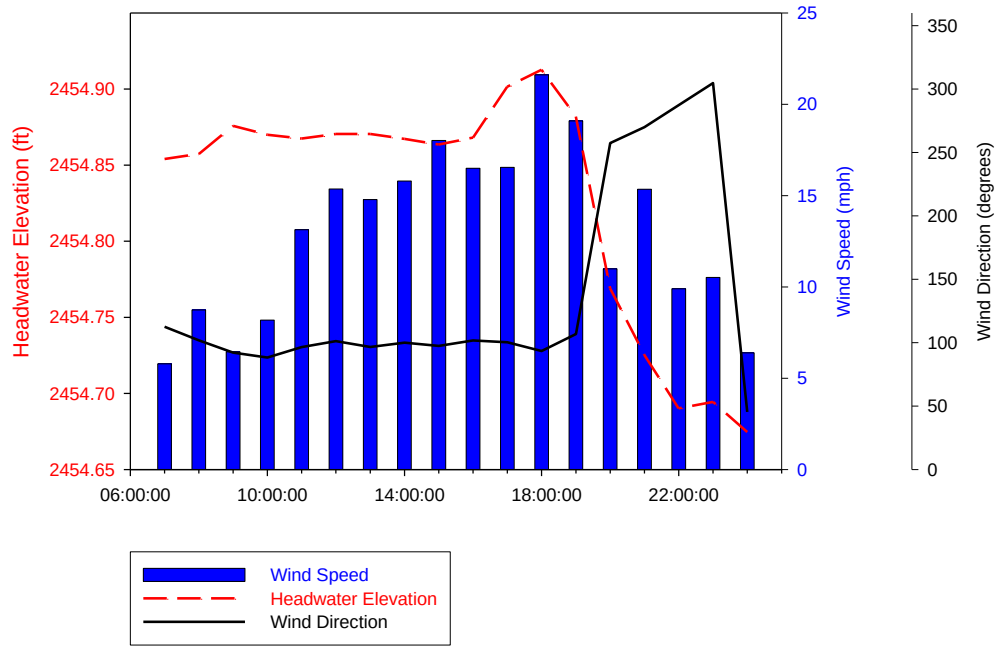
(Inflow stable at 7,300 cfs. Outflow steady at 8,300 cfs, drops to 4,300 cfs)



CJ Strike Reservoir 5/9/11
(Inflow stable at 19,700 cfs. Outflow steady at 19,000 cfs.)

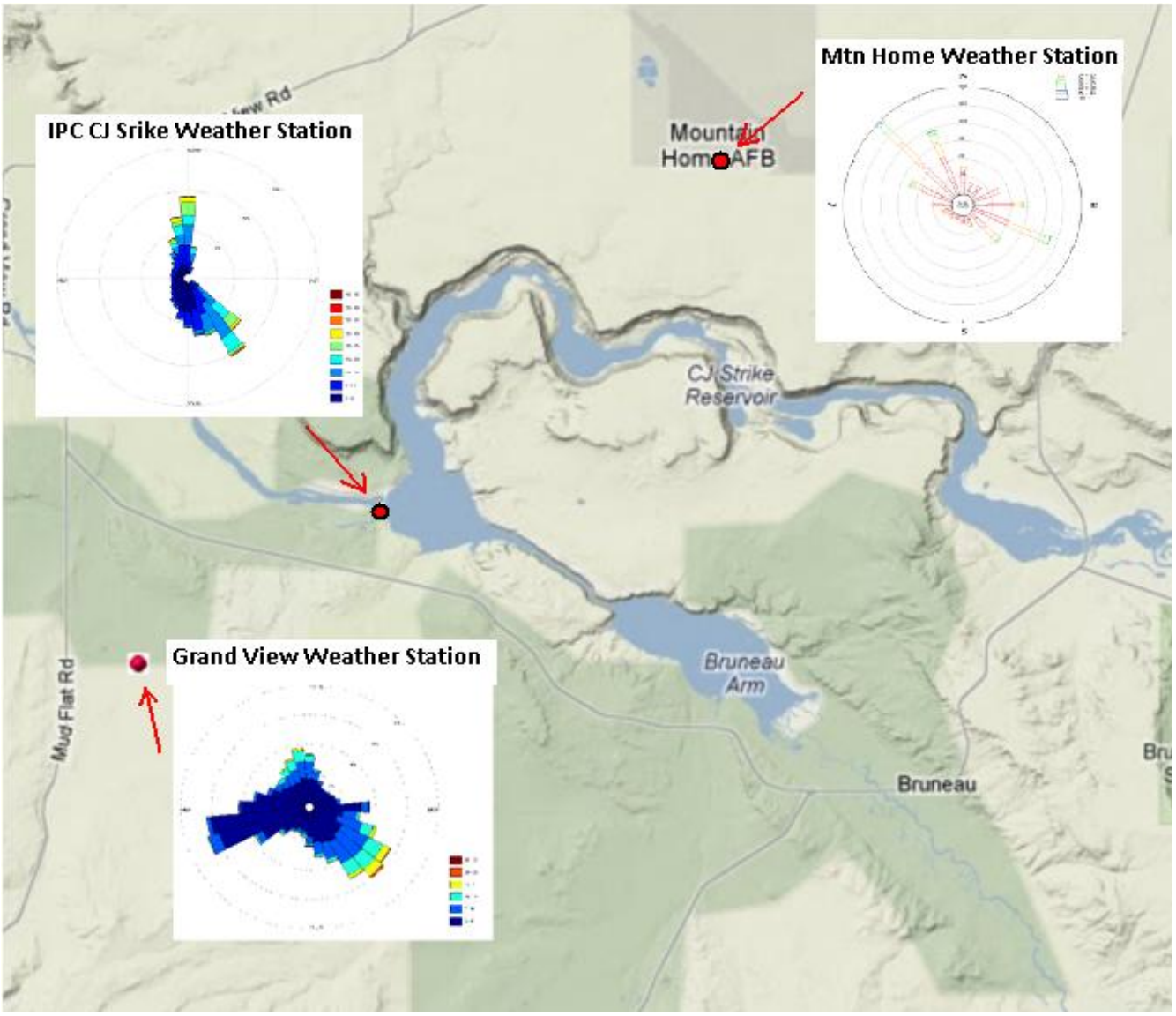


CJ Strike Reservoir 5/25/11
(Inflow steady at 27,200 cfs. Outflow steady at 27,000 cfs)



The above example shows wind effecting headwater readings by up to 0.2 feet. This is an extreme event that presents a good time period to examine closer for further analysis. We plan to look into in detail the effect of this wind event on the calculation of correcting Snake River near Murphy flows (removing Idaho Power operations) for 5 days before and after this event. This analysis should be complete for review at the March Technical Work Group Meeting.

Wind Rose Plots



Meteorologist Mel Kunkel's Analysis of Weather Station Orientation

The three weather stations used in this study sit in a wide valley located in southern Idaho on or near the Mountain Home Plateau that is bordered by the Danksin Mountains to the north and by the Snake River and Owyhee Mountains to the south. This wide valley runs in a NW to SE manner to the west of the stations and in a W to E direction east of the stations. This terrain tends to focus or channel the winds along these directions.

Mountain Home Weather Station

The Mountain Home weather station shows strong ESE winds November through March dominated by winds channeled up the Snake River Plain induced by conflicting synoptic-scale flows off the Aleutian Low and a weak high pressures system that sits over the southwestern United States during the cooler months of the year. During the remainder of the year, there is an opposite flow from the NW pushed by a semi-annual Pacific High pressure system that sits off the west coast and pushes the winds down the valley towards Mountain Home.

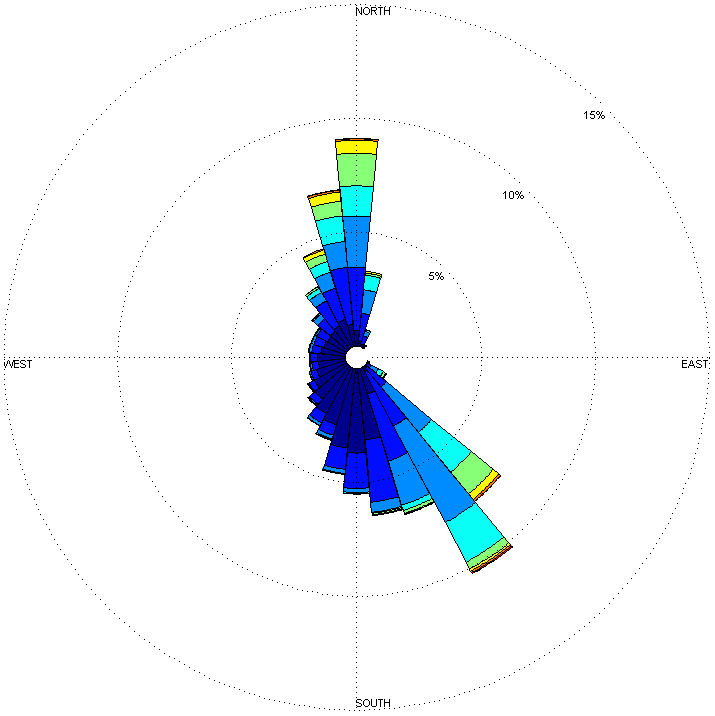
CJ Strike Dam Weather Station

Annual wind speeds and directions at the other stations are dominated by local terrain features as well as the semi-permanent pressure systems. The winds at the CJ Strike station receive nearly the same winds that the Mountain Home station does, but the winds are channeled by the terrain of the lake forcing the NW winds into a northerly wind that pushes down the northern stretch of the lake and the ESE winds are forced to a southeasterly direction as the winds come up the Bruneau Arm of the lake.

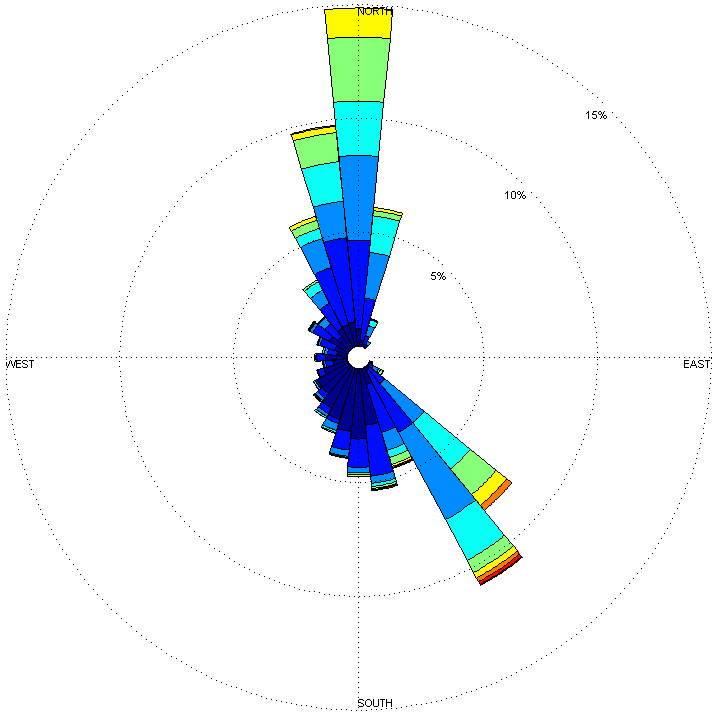
Grand View Weather Station

The winds at the Grand View weather station are more complex than the other two stations because of the complex terrain located SW through NW of the station. To the NW of the station is a small elevation rise which blocks winds from that direction forcing some winds to appear to come from the north, while to the SW a small drainage channels most of the westerly winds down off the Owyhee Mountains through the drainage to appear as a southwesterly wind. The winds of the cooler months are channeled less than the winds of the warmer months and exhibit a strong southwesterly flow. The winds as described represent average conditions, but transitory mesoscale systems throughout the year also affect the area bringing strong and shifting winds from alternate directions.

Wind Rose Plots - CJ Strike Dam Weather Station

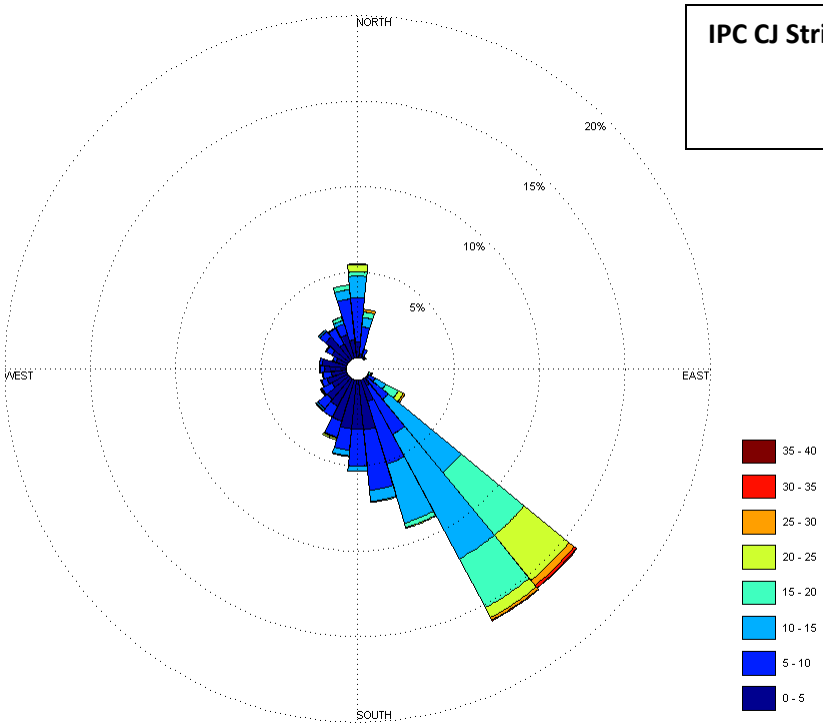


IPC CJ Strike Weather Gage
2012
All Weather Data

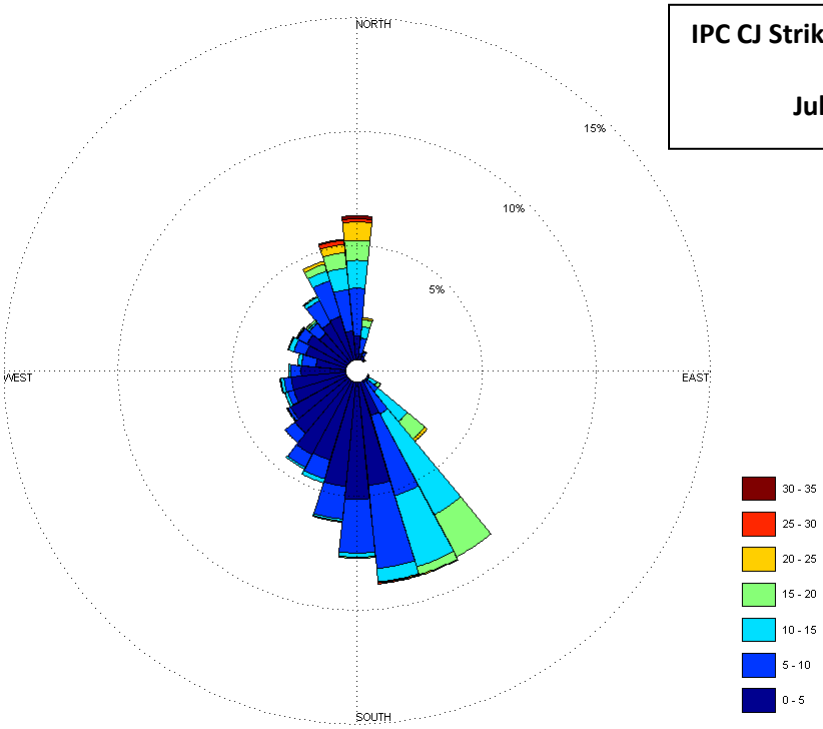


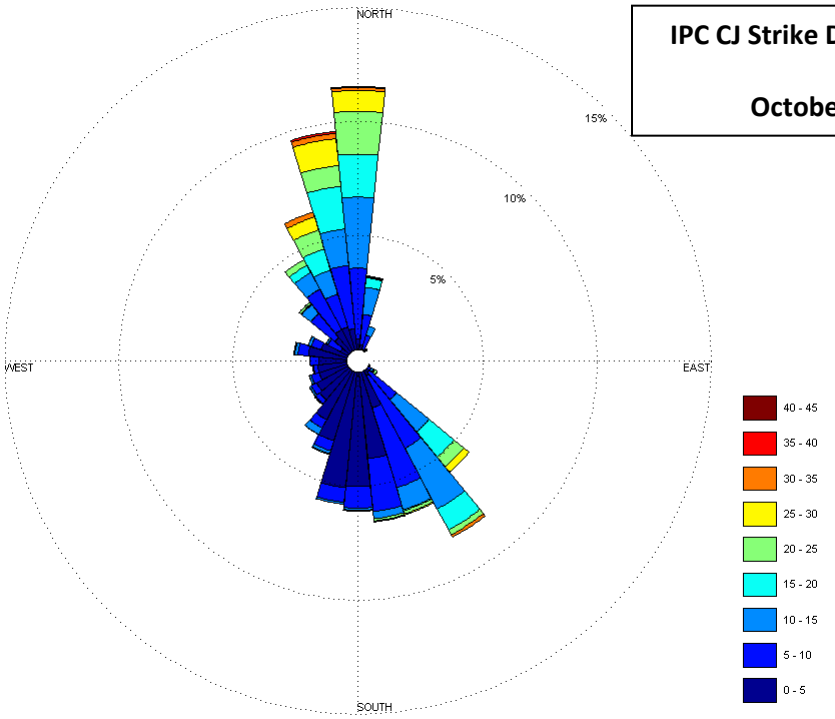
IPC CJ Strike Dam Weather Gage
2012
January-March

IPC CJ Strike Dam Weather Gage
2012
April-June

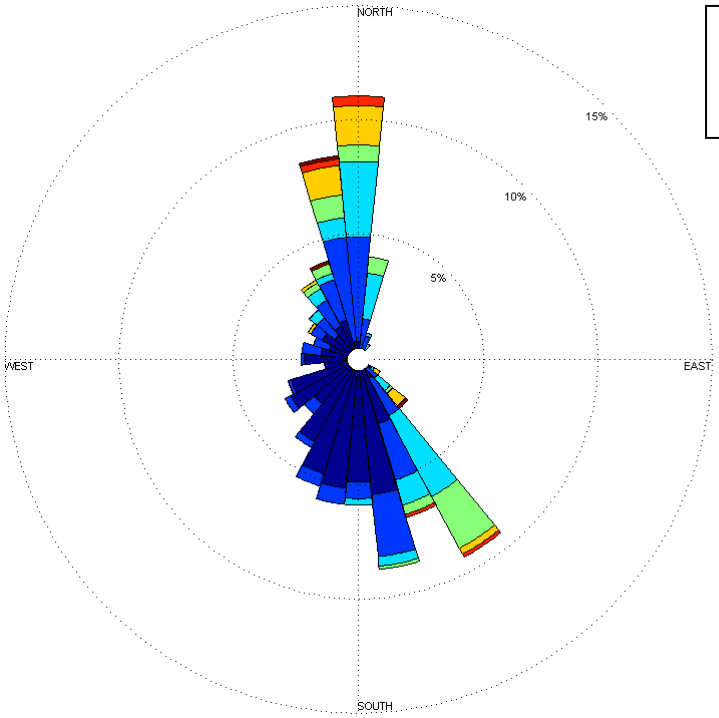


IPC CJ Strike Dam Weather Gage
2012
July-September



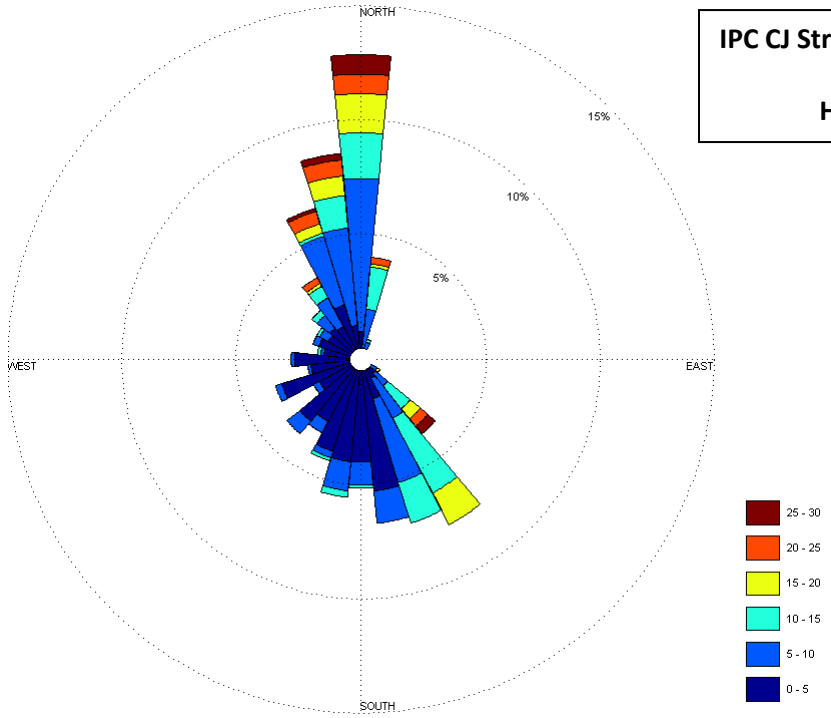


IPC CJ Strike Dam Weather Gage
2012
October-December

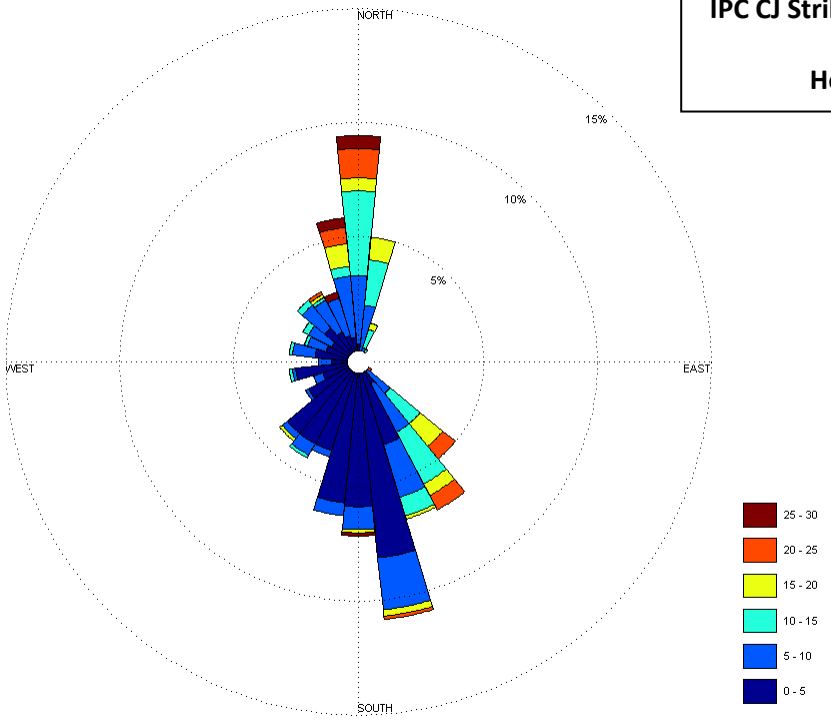


IPC CJ Strike Dam Weather Gage
2012
Hours 0:00-1:00

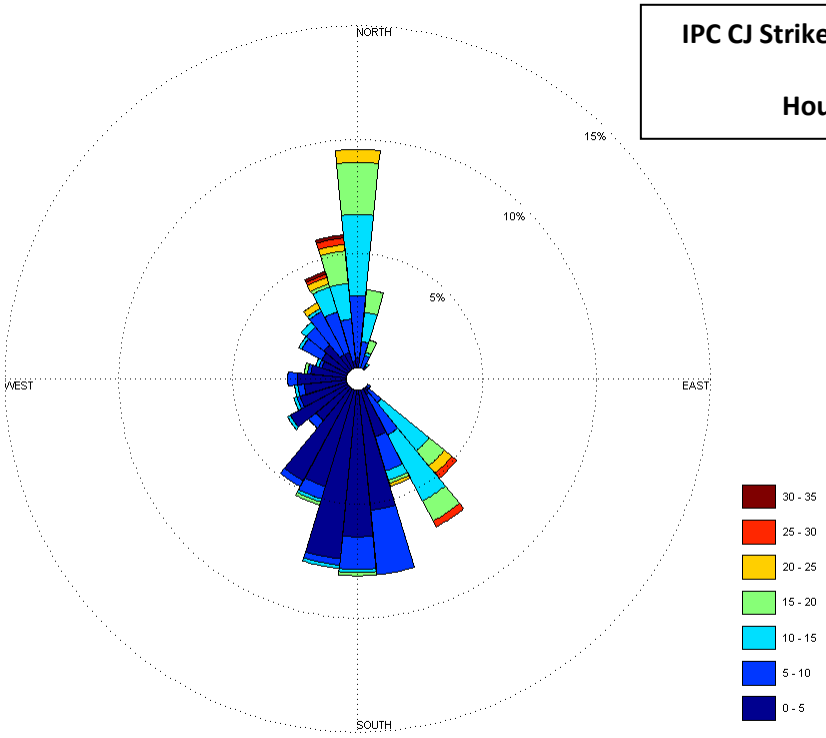
IPC CJ Strike Dam Weather Gage
2012
Hours 2:00-3:00



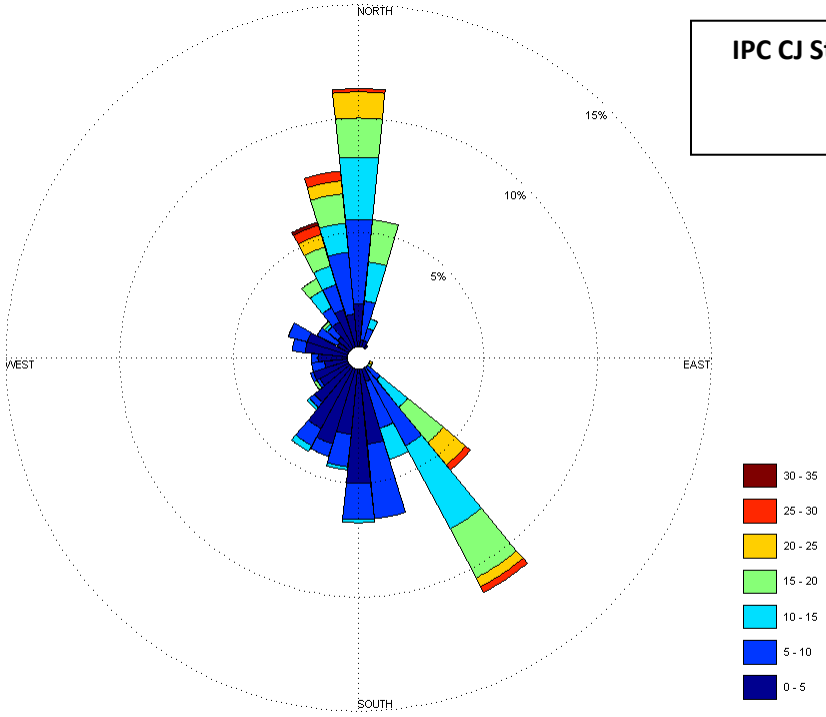
IPC CJ Strike Dam Weather Gage
2012
Hours 4:00-5:00



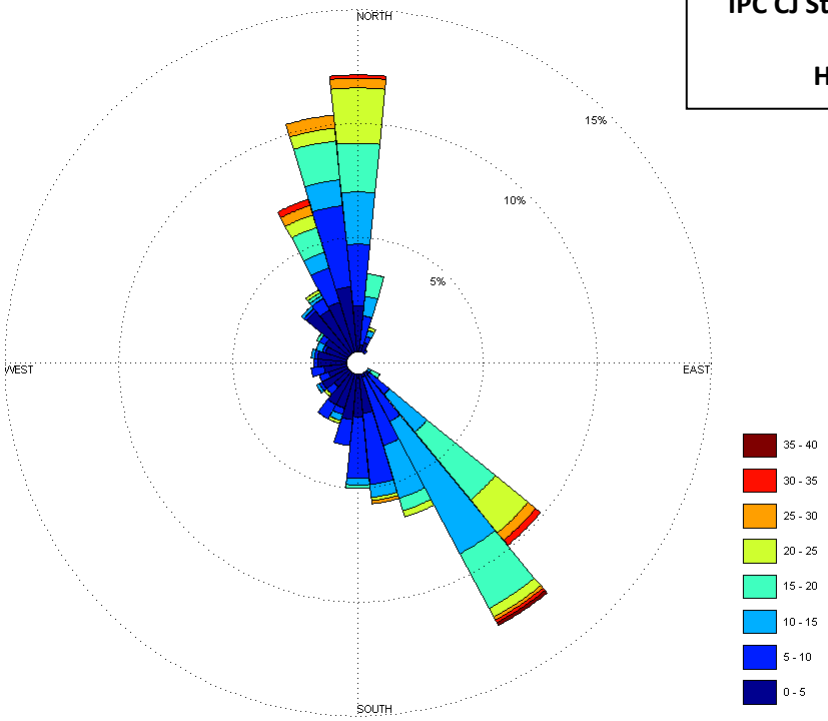
IPC CJ Strike Dam Weather Gage
2012
Hours 6:00-7:00



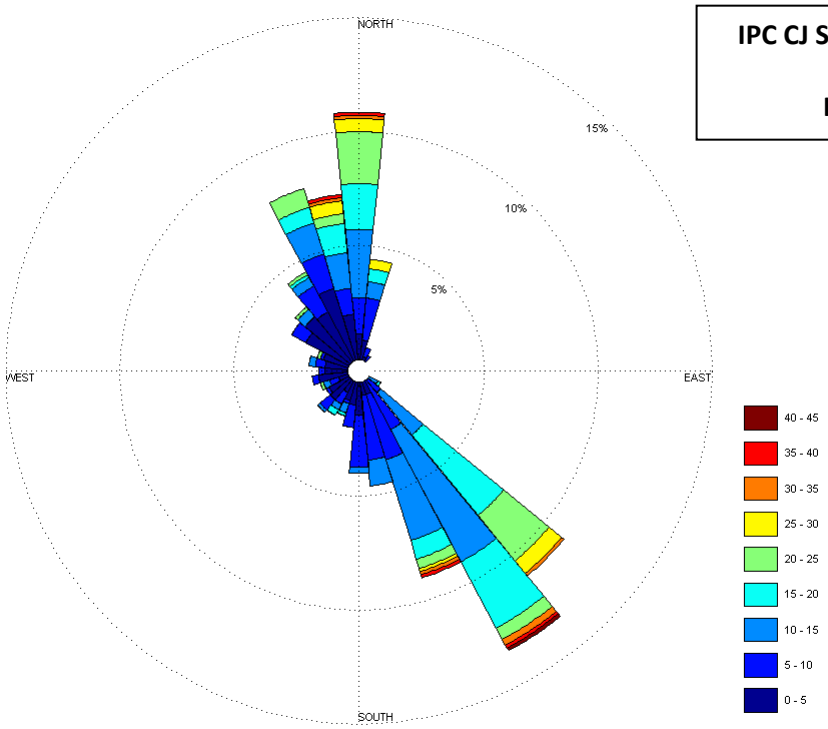
IPC CJ Strike Dam Weather Gage
2012
Hours 8:00-9:00



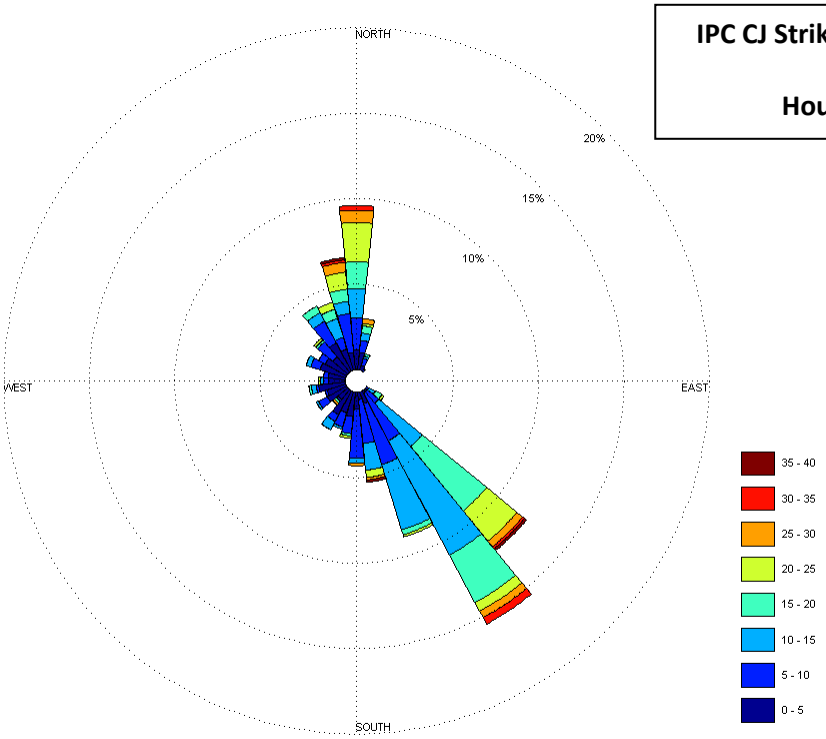
IPC CJ Strike Dam Weather Gage
2012
Hours 10:00-11:00



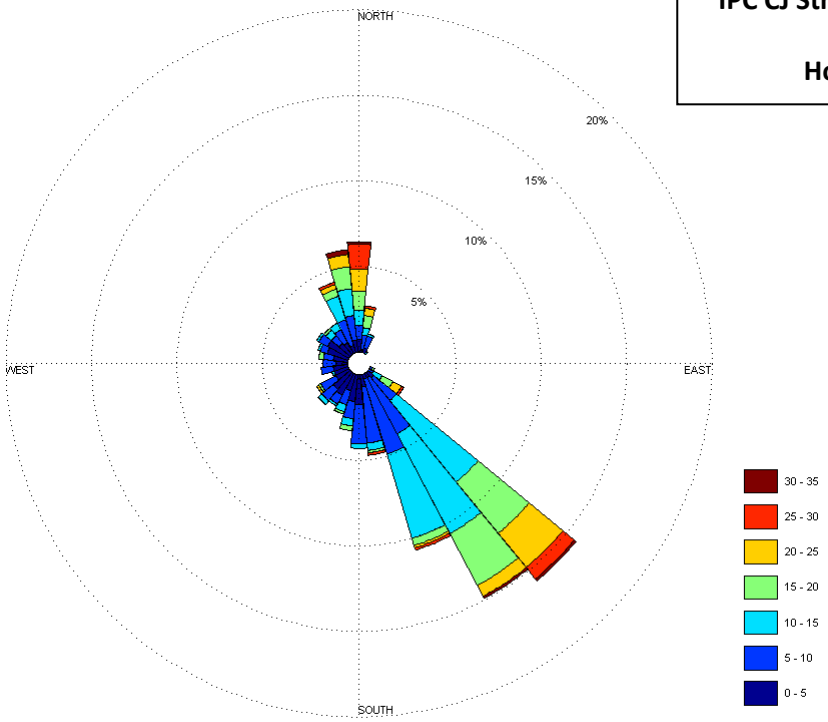
IPC CJ Strike Dam Weather Gage
2012
Hours 12:00-13:00



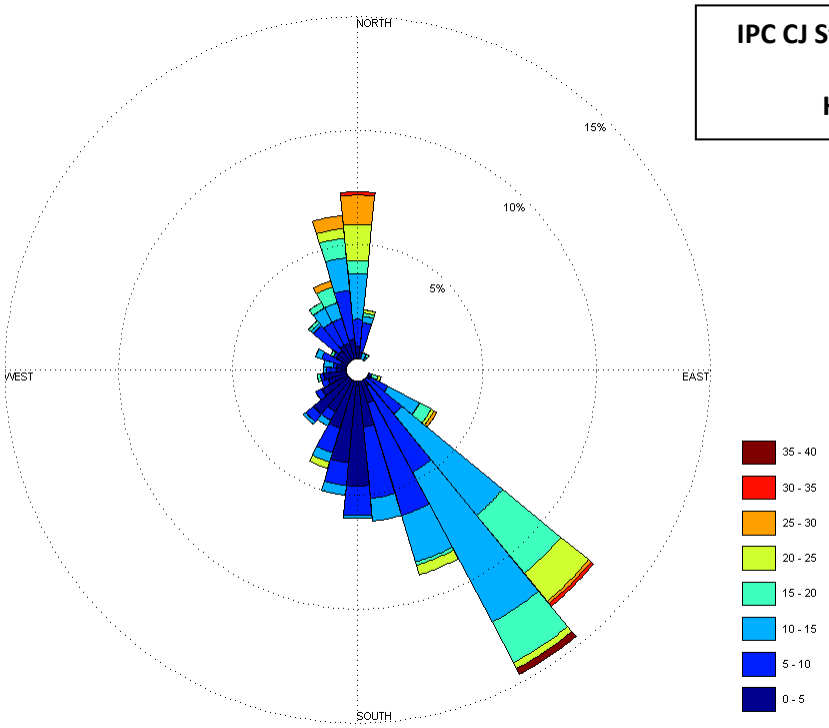
IPC CJ Strike Dam Weather Gage
2012
Hours 14:00-15:00



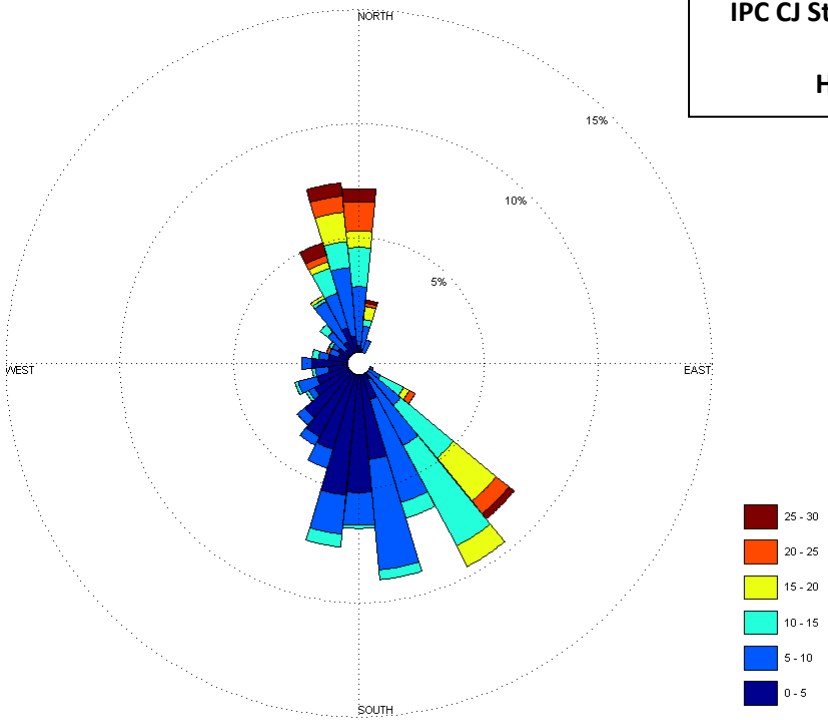
IPC CJ Strike Dam Weather Gage
2012
Hours 16:00-17:00



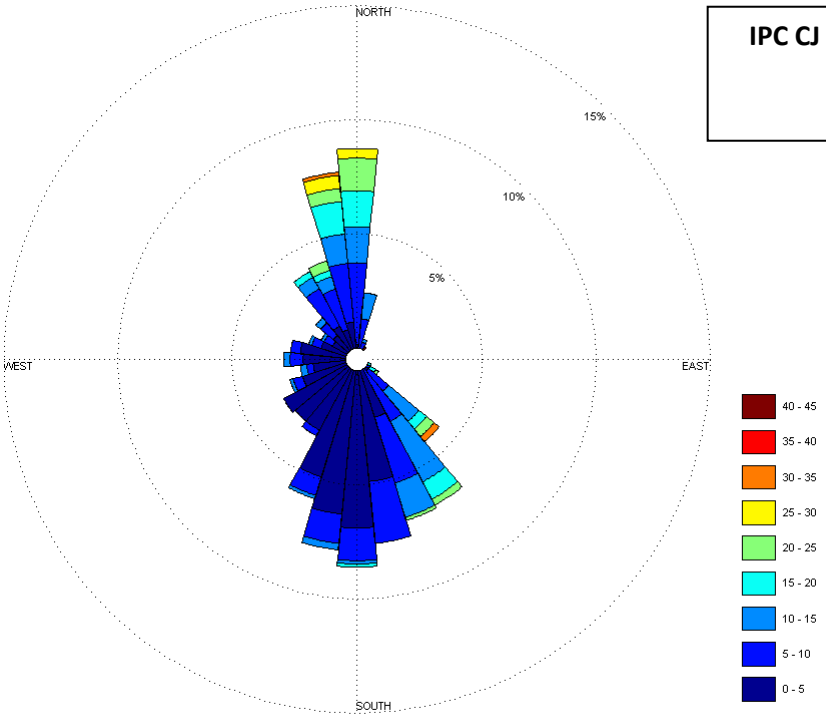
IPC CJ Strike Dam Weather Gage
2012
Hours 18:00-19:00



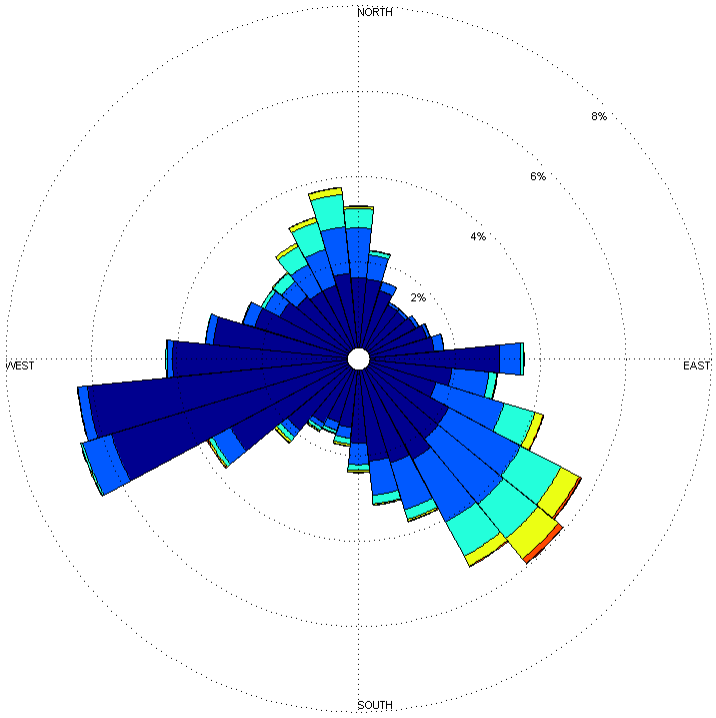
IPC CJ Strike Dam Weather Gage
2012
Hours 20:00-21:00



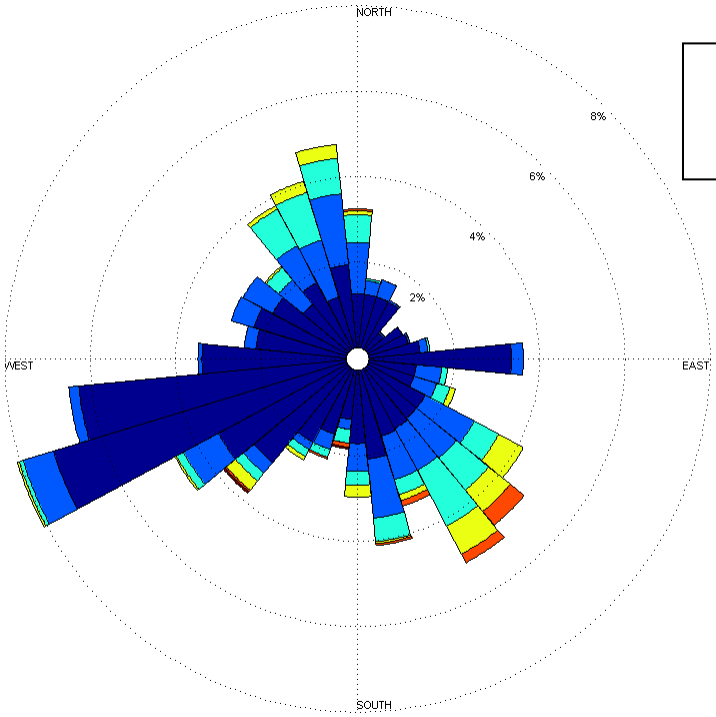
IPC CJ Strike Dam Weather Gage
2012
Hours 22:00-23:00



Wind Rose Plots – Grand View, ID Weather Station

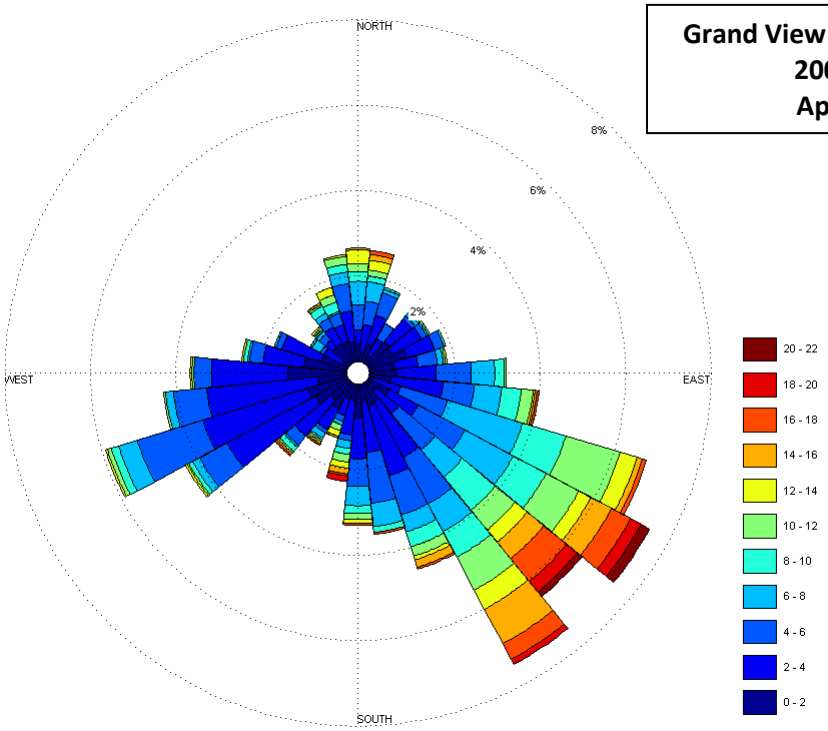


Grand View Weather Station
2009-2011
All Weather Data

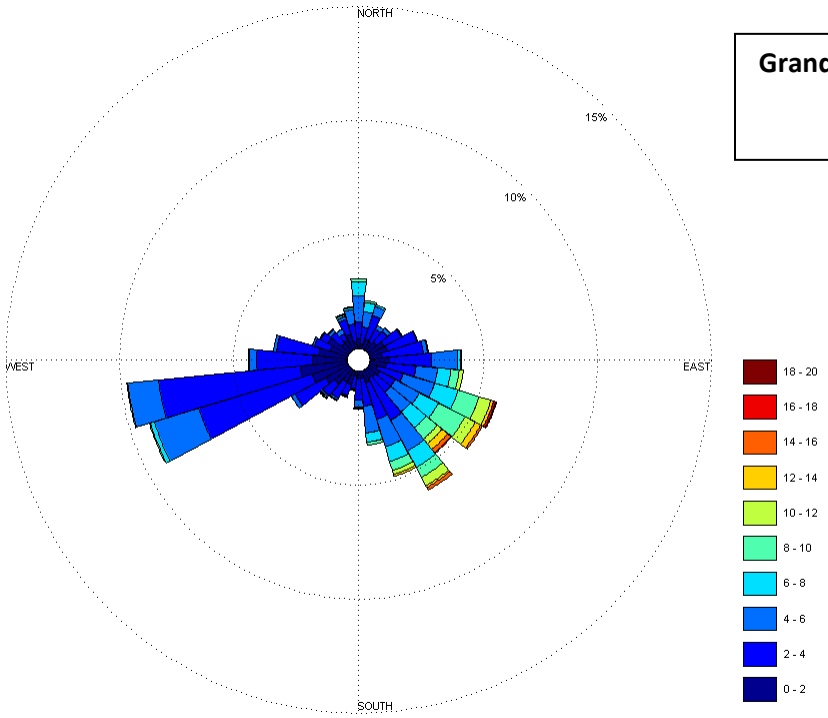


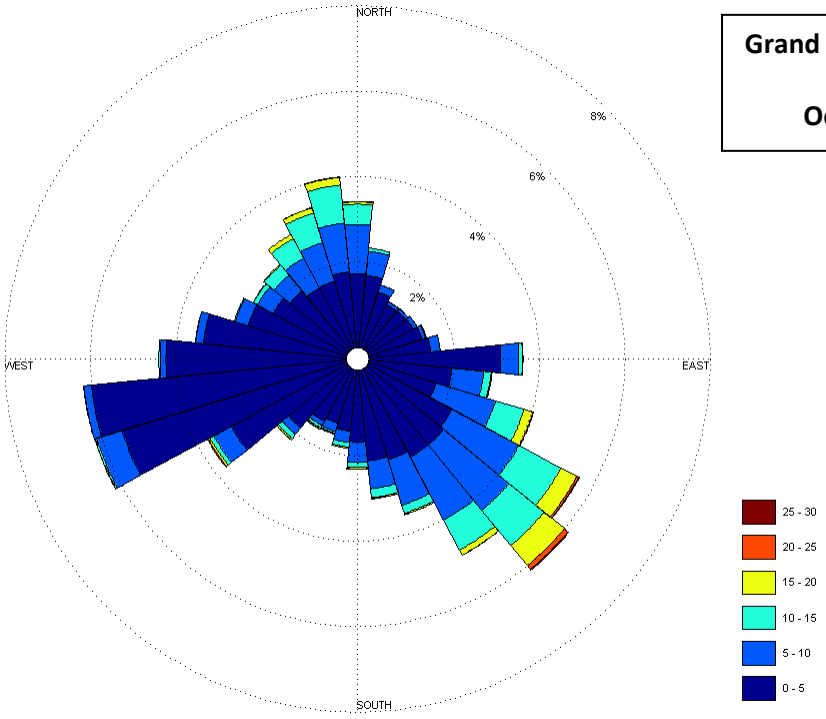
Grand View Weather Station
2009-2011
January-March

Grand View Weather Station
2009-2011
April-June



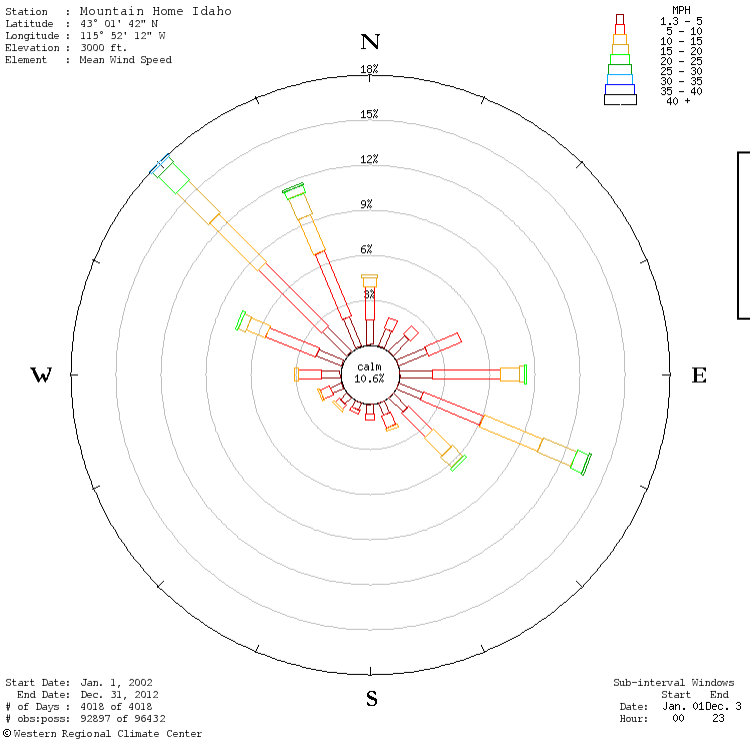
Grand View Weather Station
2009-2011
July-September





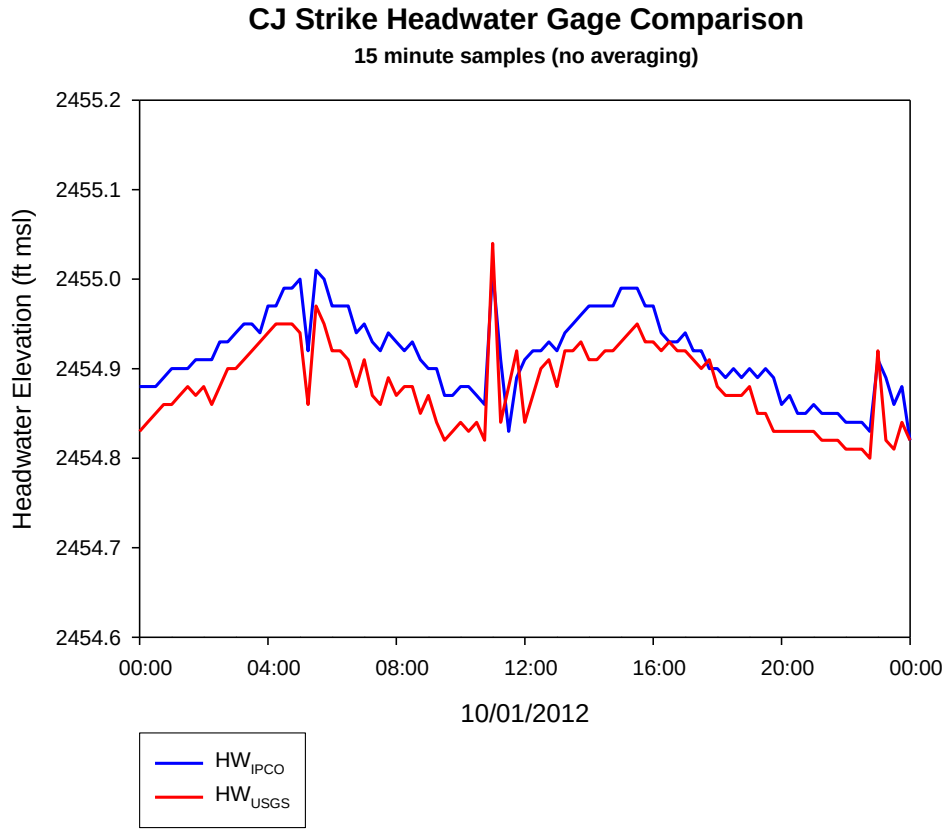
Grand View Weather Station
2009-2011
October-December

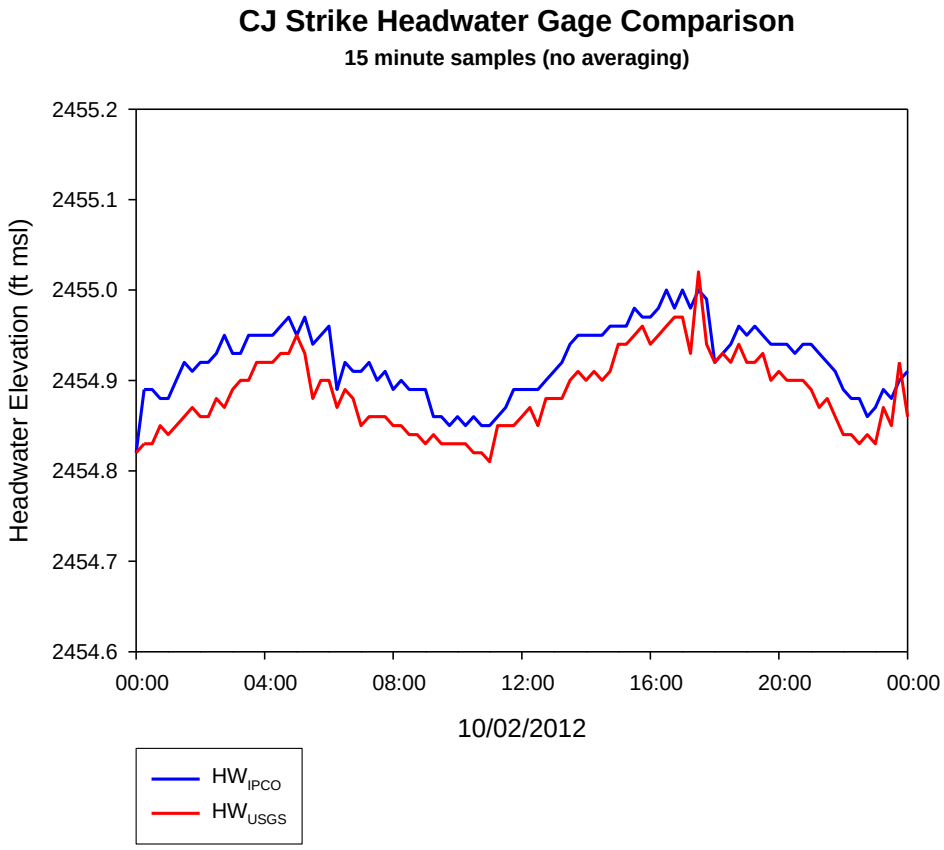
Wind Rose Plots – Mountain Home, ID Weather Station

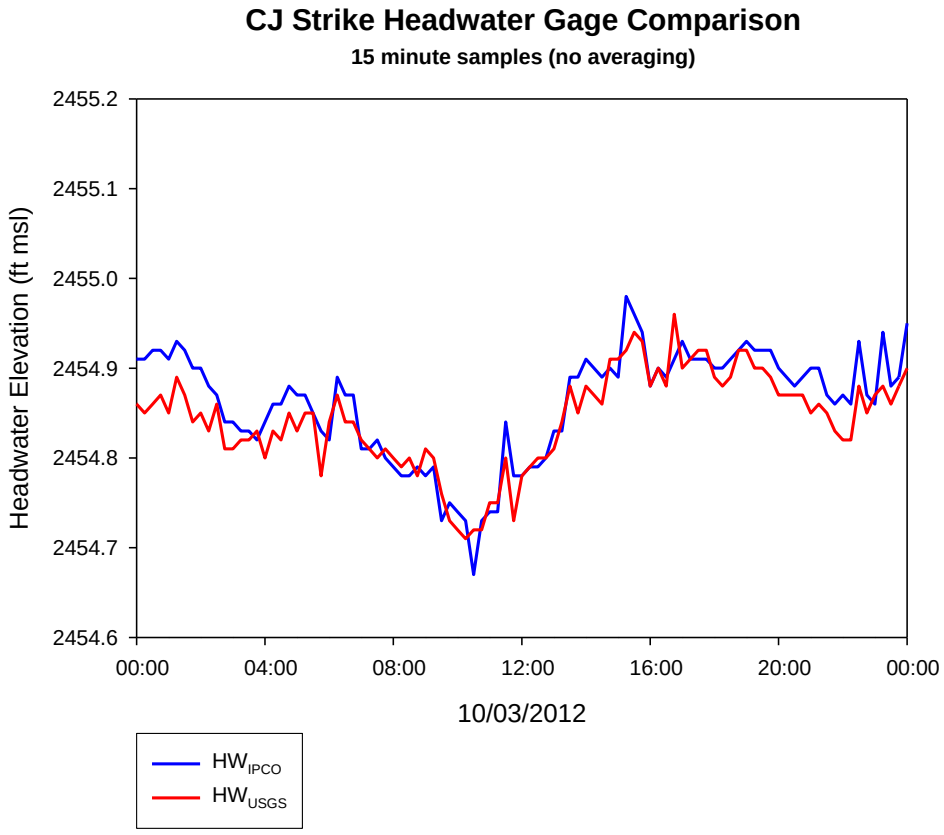


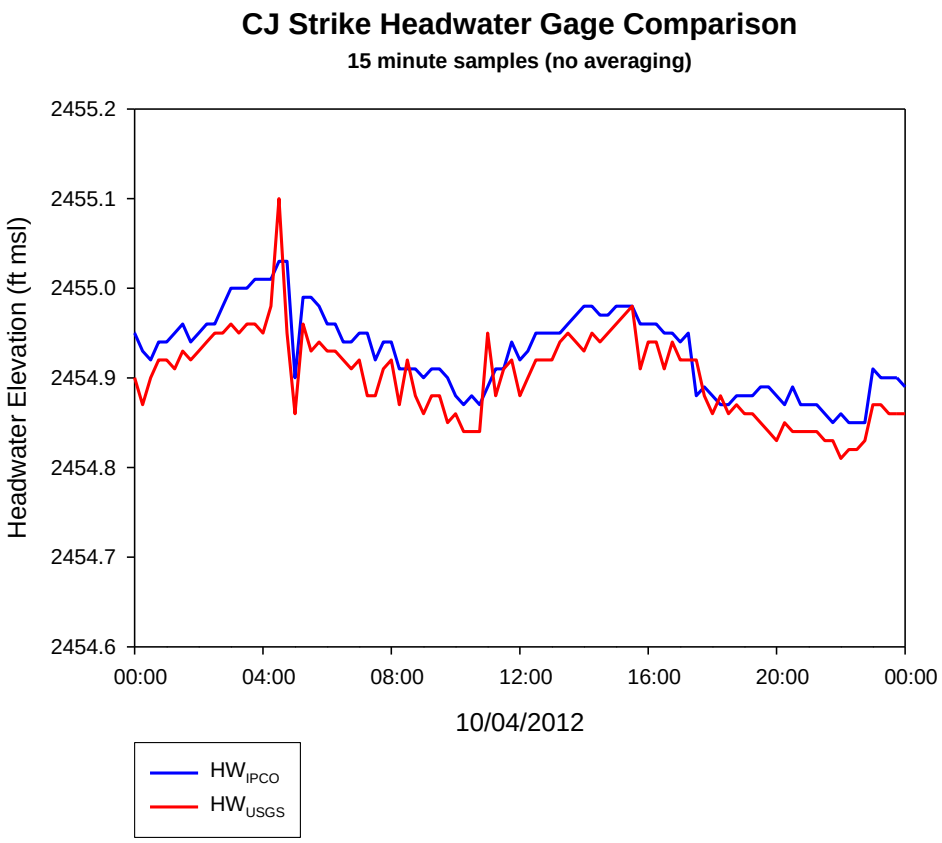
Mountain Home
Weather Station
2002-2012
All Weather Data

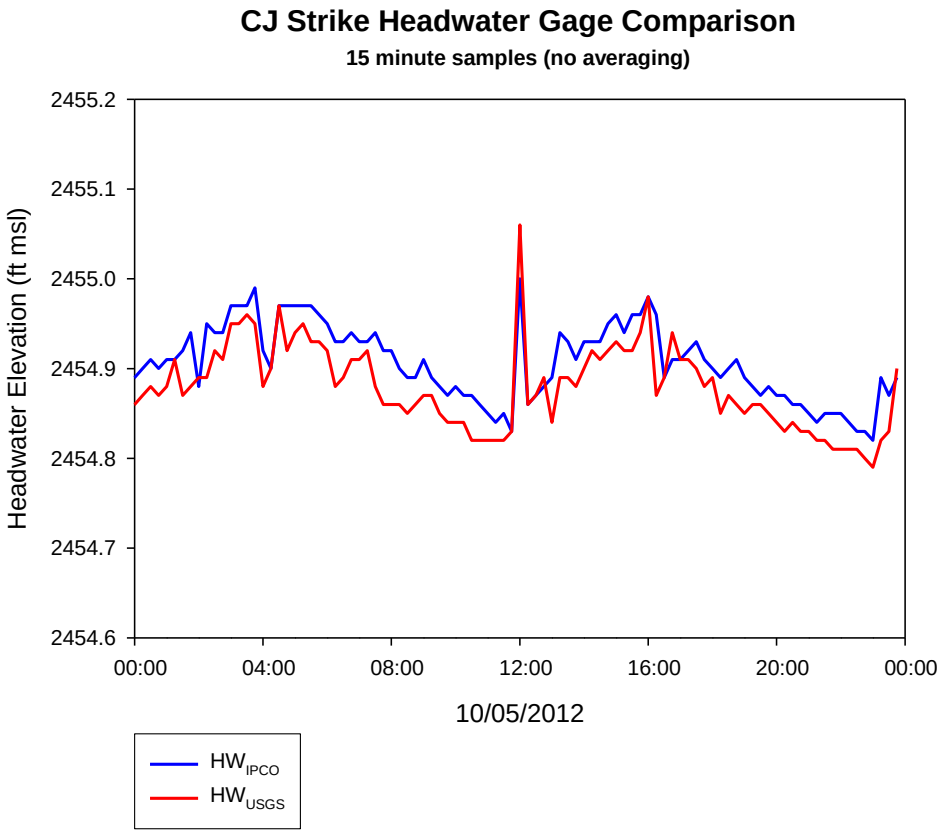
Comparison of Headwater Gages: USGS vs. IPCO

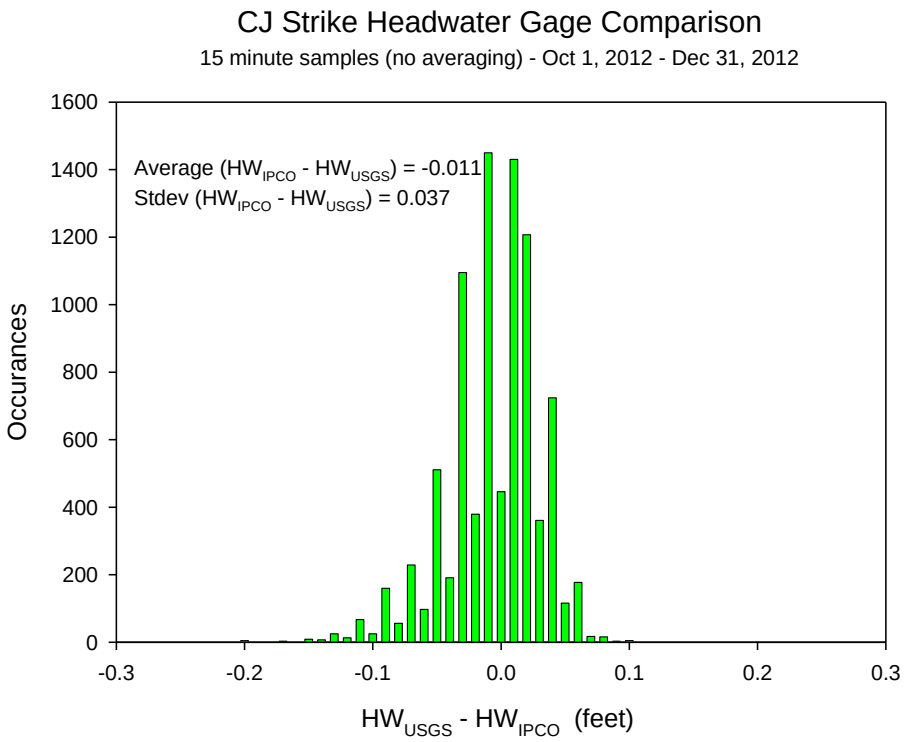



CJ Strike Headwater Gage Comparison
15 minute samples (no averaging)
Headwater Elevation (ft msl)
2455.2
2455.1
2455.0
2454.9
2454.8
2454.7
2454.6
00:00
04:00
08:00
12:00
16:00
20:00
00:00
10/02/2012
HW IPCO
HW USGS


CJ Strike Headwater Gage Comparison
15 minute samples (no averaging)
Headwater Elevation (ft msl)
2455.2
2455.1
2455.0
2454.9
2454.8
2454.7
2454.6
00:00
04:00
08:00
12:00
16:00
20:00
00:00
10/03/2012
HW IPCO
HW USGS


CJ Strike Headwater Gage Comparison
15 minute samples (no averaging)
Headwater Elevation (ft msl)
2455.2
2455.1
2455.0
2454.9
2454.8
2454.7
2454.6
00:00
04:00
08:00
12:00
16:00
20:00
00:00
10/04/2012
HW IPCO
HW USGS


CJ Strike Headwater Gage Comparison
15 minute samples (no averaging)
Headwater Elevation (ft msl)
2455.2
2455.1
2455.0
2454.9
2454.8
2454.7
2454.6
00:00
04:00
08:00
12:00
16:00
20:00
00:00
10/05/2012
HW IPCO
HW USGS


CJ Strike Headwater Gage Comparison
15 minute samples (no averaging) - Oct 1, 2012 - Dec 31, 2012
Average (HW_IPCO - HW_USGS) = -0.011
Stdev (HW_IPCO - HW_USGS) = 0.037
Occurances
1600
1400
1200
1000
800
600
400
200
0
-0.3
-0.2
-0.1
0.0
0.1
0.2
0.3
HW_USGS - HW_IPCO (feet)