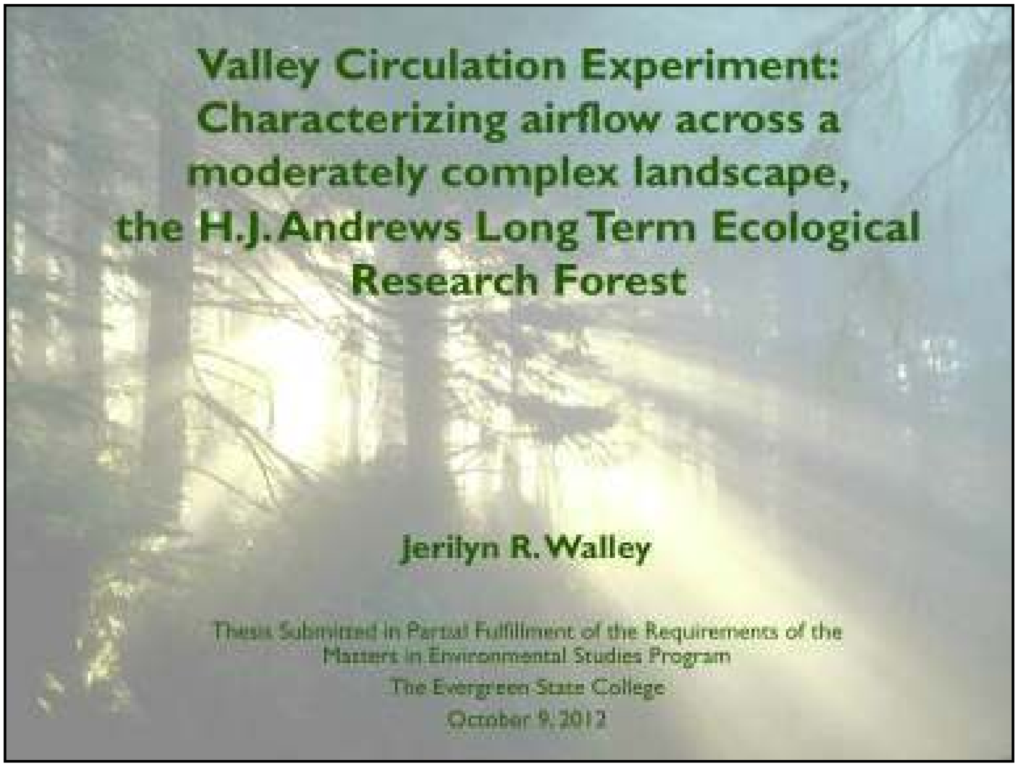
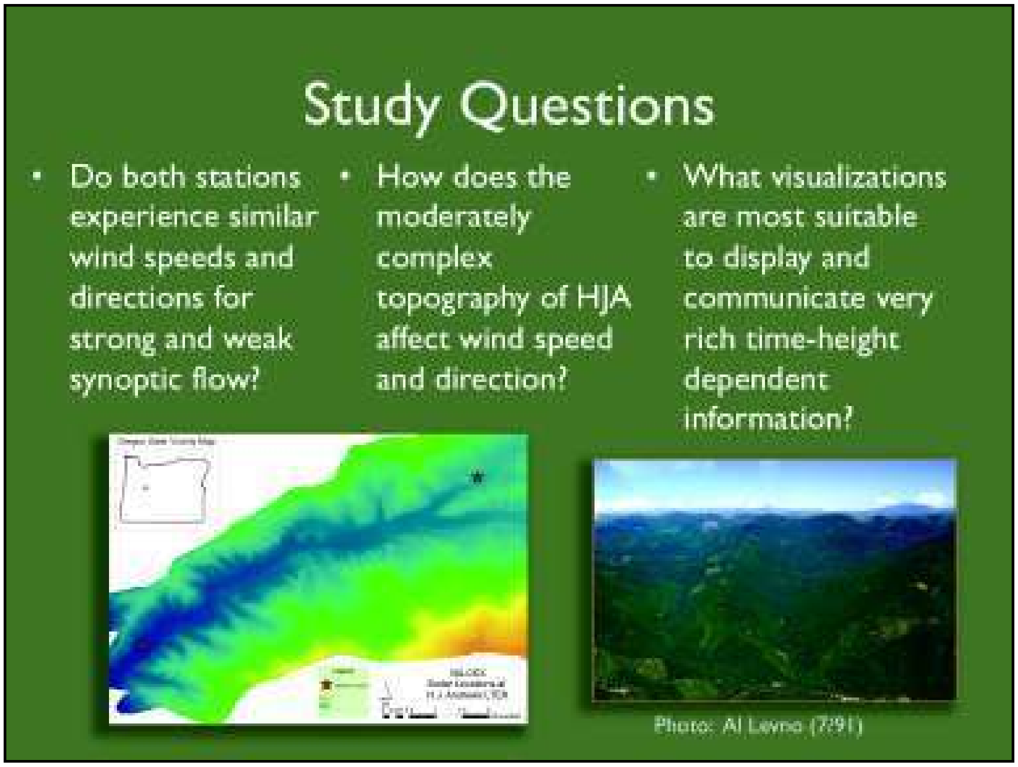


Good afternoon and thanks Judy for that wonderful introduction. Thanks for coming to hear about my thesis work - the Valley Circulation Experiment (ValCEX) – my study of airflow at H.J. Andrews Long Term Ecological Research Forest. The aim of VALCEX was to improve understanding of the valley-scale circulation patterns and to determine the structure and dynamics of wind between Lookout and McRae Valleys.

First, a little background - surface wind, also called micro-scale, usually the lower kilometer, often behaves differently from what is most commonly considered weather. Micro-scale wind phenomena impacts a wide variety of ecological and human processes - it carries pollution, pollen, seeds, insects, gases, and moisture. A better understanding of micrometeorology helps more precisely estimate carbon sequestration and evapotranspiration rates from tall vegetation.

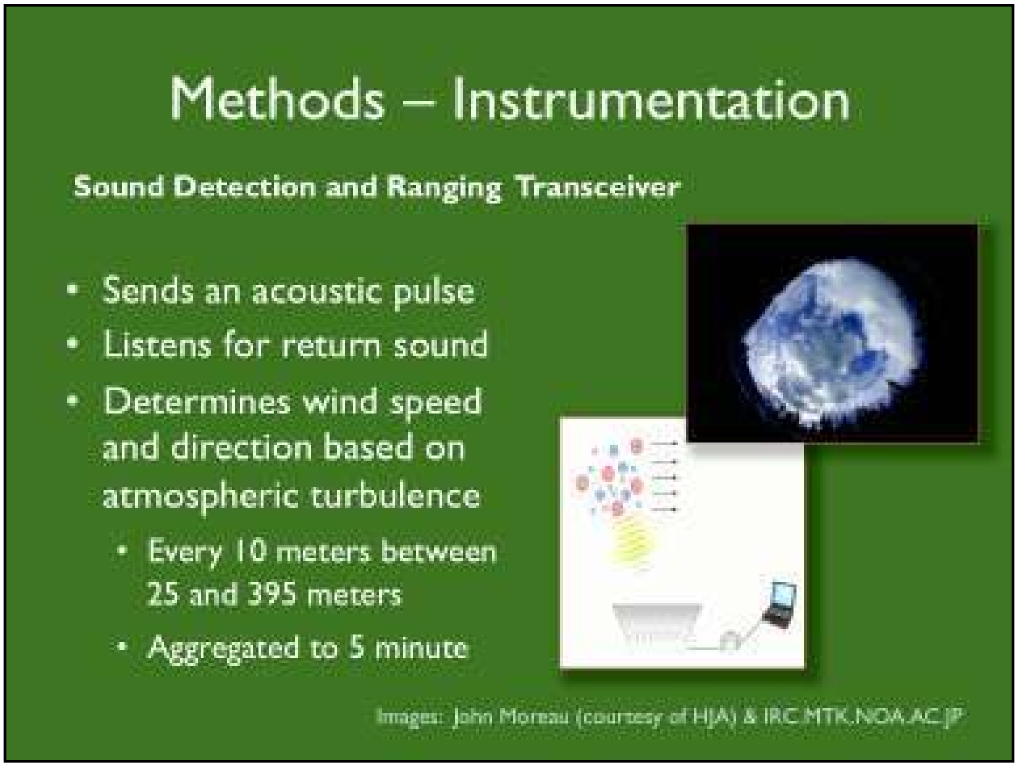
There is limited understanding of how topography influences weak-wind transport – current forecast models and tools don't often apply to the micro-scale and the instrumentation I used has developed in the last 20 years. Many studies of this type focus on smooth topography, whereas the HJA is considered a moderately complex topography.

Two terms that are important to this study are Synoptic Forcing and Valley Jet. Synoptic scale is what most of us generally think of as weather – it's the fronts, troughs and ridges in the upper-atmosphere that force meso and micro scale phenomena, for this study it's defined as wind speeds above 5 m per second for more than 12 hours. A Valley Jet – as defined in this study is a nocturnal band of wind that moves faster than those above and below at approximately 100 m above ground level.

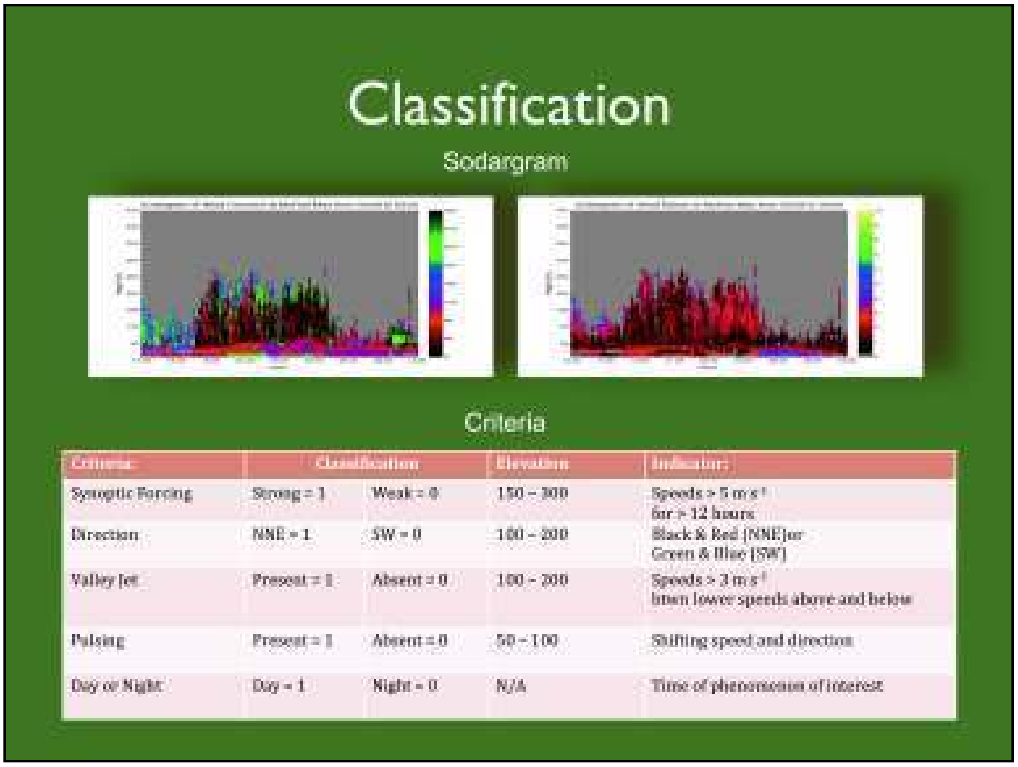


My research questions are: Is the larger-valley airflow – on the scale of 6 km – coupled or de-coupled? How does the complex topography of HJA affect wind speed and direction? And how to intuitively understand and communicate this very data-rich, time-height dependent information with visualizations. This presentation focuses on the first question.

The SODARs are located here – at Primet – HJAs primary meteorology station near headquarters and up in the McRae Valley – about here.



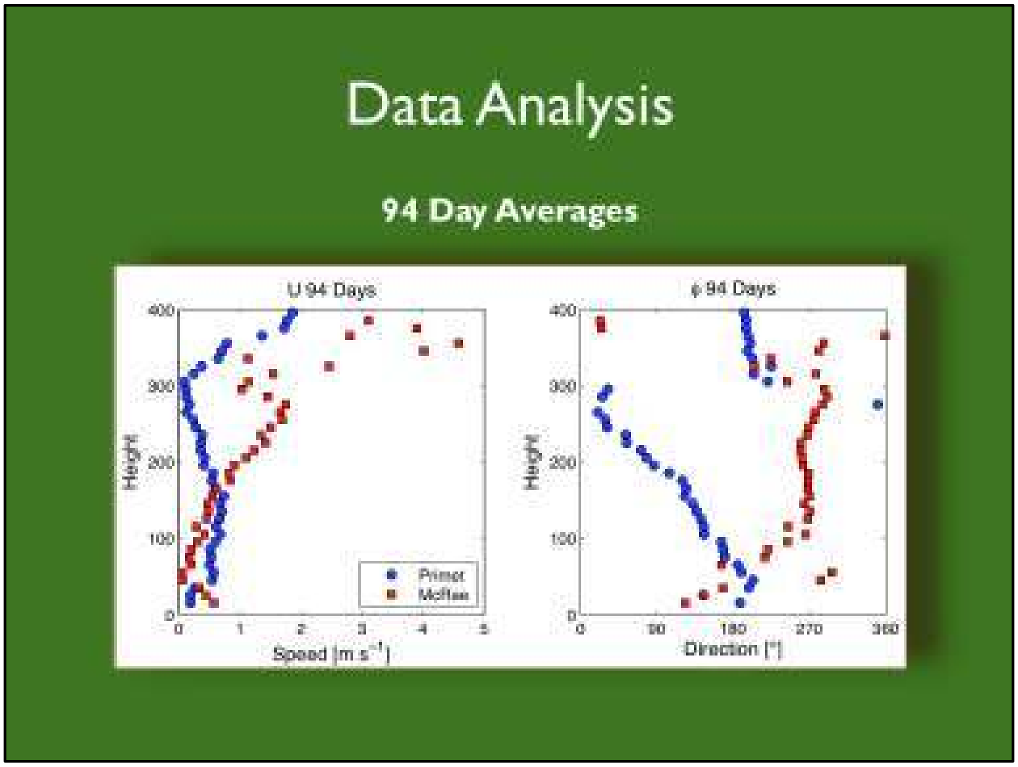
Now about the instrumentation, a SODAR is a speaker array and antenna that emits short acoustic pulses into the atmosphere. The acoustic waves are backscattered at temperature differences – turbulence - in the air. The antenna receives the backscattered signals and digital processing evaluates speed and direction. The duration between emission and reception provides height information about the area being evaluated. It works on the Doper effect – the change in frequency of a sound wave as it moves towards or away from a source. In this study, each SODAR is taking measurements every 10 meters starting at 15 going up to 395 meters every 8-10 seconds. Luckily, the Sodar aggregates the data to 5 minutes. The data are location dependent and kinda like looking at the atmosphere through a straw.



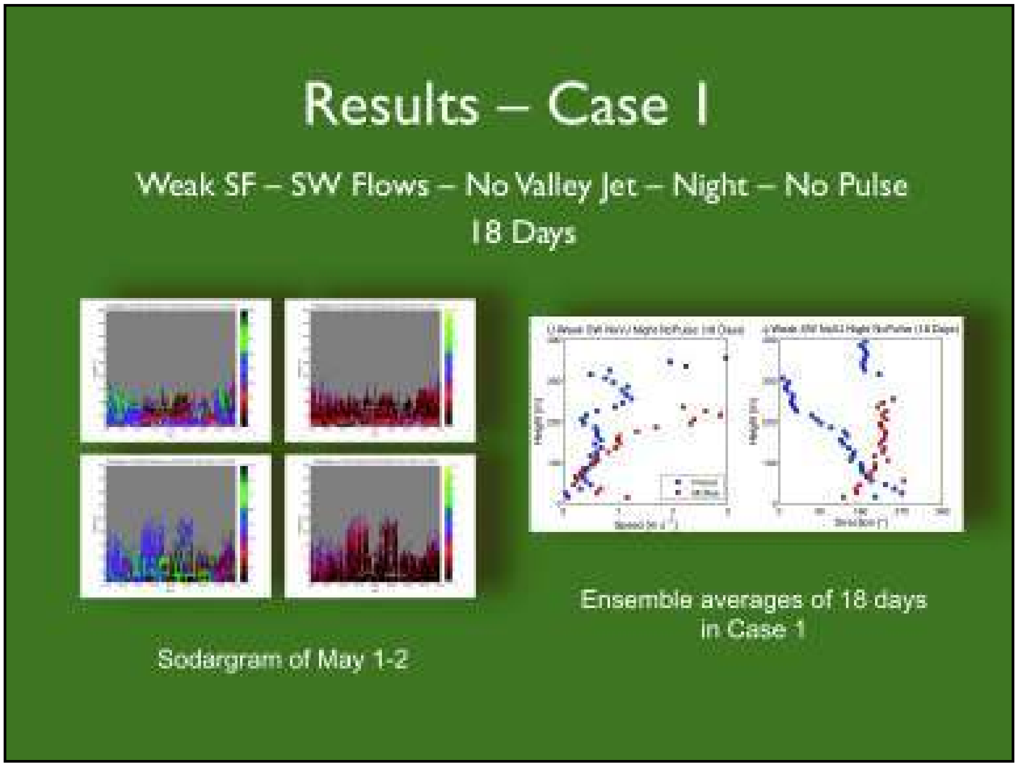
Criteria:	Classification		Elevation	Indicator:
Synoptic Forcing	Strong = 1	Weak = 0	150 – 300	Speeds > 5 $m\,s^{-1}$ for > 12 hours
Direction	NNE = 1	SW = 0	100 – 200	Black & Red (NNE) or Green & Blue (SW)
Valley Jet	Present = 1	Absent = 0	100 – 200	Speeds > 3 $m\,s^{-1}$ btwn lower speeds above and below
Pulsing	Present = 1	Absent = 0	50 – 100	Shifting speed and direction
Day or Night	Day = 1	Night = 0	N/A	Time of phenomenon of interest

For analysis a sodargram – a visual representation of a 24 hour period – from noon to noon – was created for each of 94 days – between March 13 and June 15 – for each location. The sodargram shows either wind speed (right) or direction (left), with time on the X-axis and heights on the Y-axis. The classification used inductive analysis of the sodargrams.

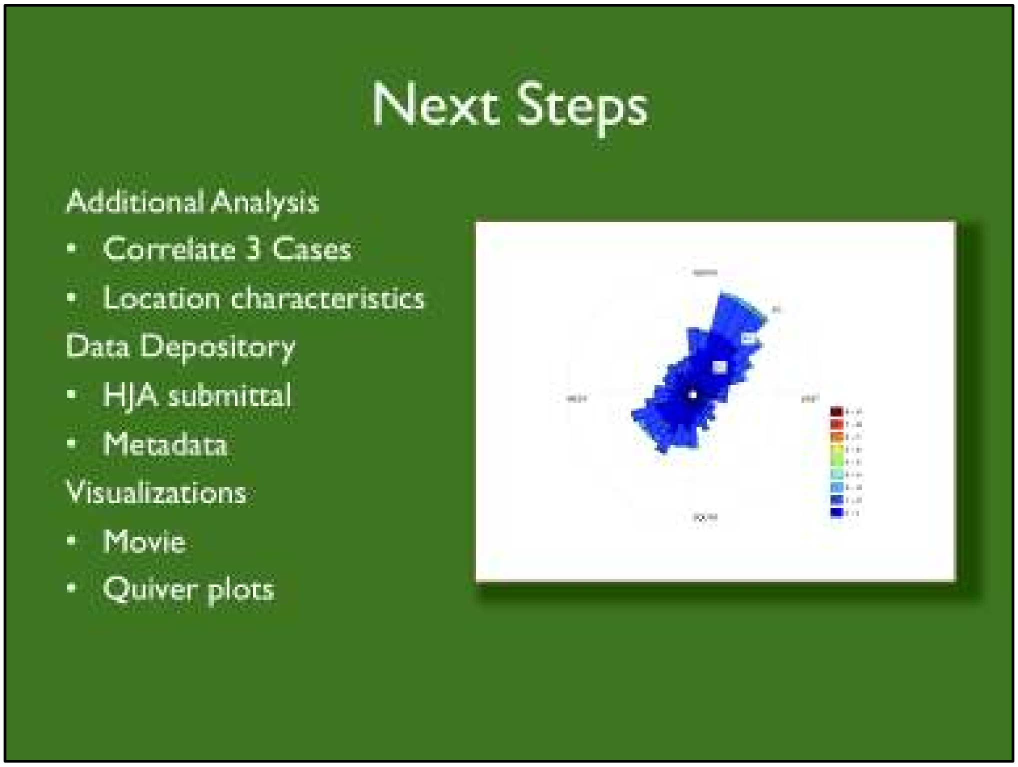
Each 24 hour period was classified using five independent criteria: Strong or Weak Synoptic Forcing, Wind direction either north north east or south west, presence/absence of a valley jet, presence or absence of pulsing speeds and directions which occur primarily at Primet and if the phenomena of interest was during the night or day. When McRae and Primet experienced different patterns, the classification was based on phenomena at Primet.



The graphs show the 94 day averages - Wind speeds in the McRae Valley are generally very slow, below 1 m s^{-1} at lower elevations, above 205 m – speeds increase McRae having the strongest winds aloft – however these are still relatively slow. Directional averages show a disconnect between Primet and McRae, with averages at Primet being South at lower elevations and changing to east between 100 and 200 m agl and north-northeast above 200 m agl. While at McRae, flows at below 100 m agl vary between south and west, moving to from the west between 100 and 300 m agl, above 300 m agl, flows again vary between south, southeast and north. However, when the cases are applied, a very different story immerges.



The most common case was Weak Synoptic Forcing, SW flow, no valley jet and no pulse with 18 days meeting these criteria. The set of sodargrams on the right is from a day that met these criteria – May 1-2 – and are included as an example of what I used to perform the classification. These 18 days were ensemble averaged and plotted using Matlab. In this case, Primet and McRae Valley, show similar wind speeds – between 0 and 1 meter per second at elevations between 15 and 175 m agl – which is pretty common for these valleys. Flows for both stations are disconnected and range from West-southwest to North for Primet and are generally from the south in the McRae Valley.



There are analysis that I have done that I don't have time to go into today and additional analysis I would like to do. I have done the analysis in MATLAB – a programming language designed to process large data sets. I would like to correlate the three most common cases to definitively show the relationship – however – the data has many null values – and so far – I'm struggling with the correlations due to those. I have also created a geodatabase of elevations in the valley – and will do a more detailed analysis of each location – answering the second question – how does the topography influence airflow in the valley. Also, as the research was performed at a LTER – the data will submitted to HJA for use by other researchers – to do this – the data needs to be formatted and meta-data prepared. Lastly, I have created an animation of the flows – in the form of a wind rose – combining direction and speed – starting at 15 meters and running up to 395 meters – so its like moving up the air column. The visualization is very cool – let's see if it works.