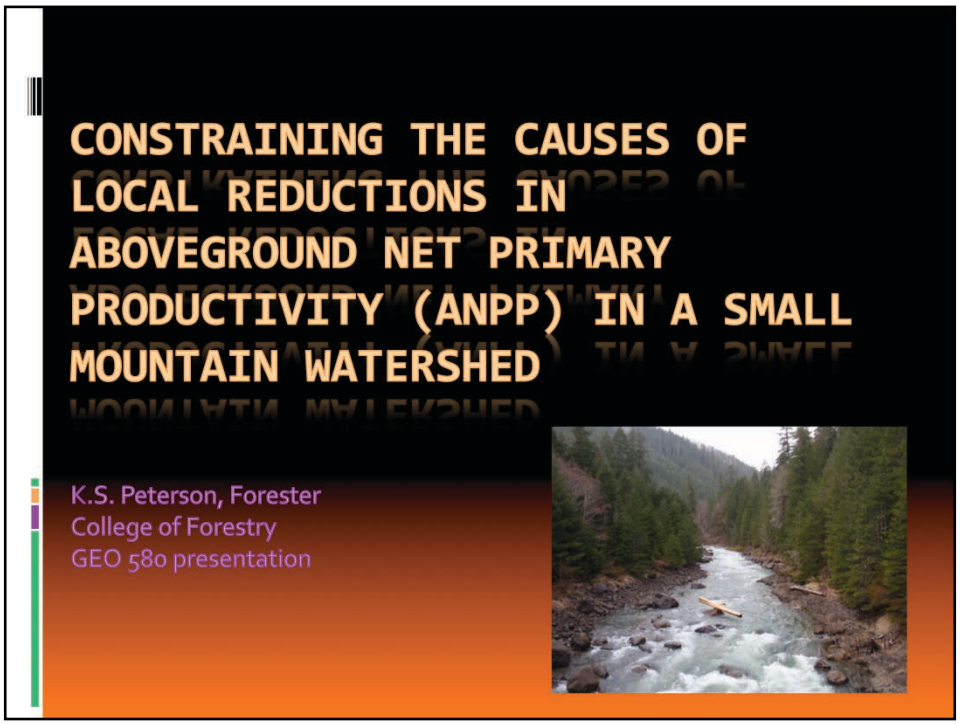
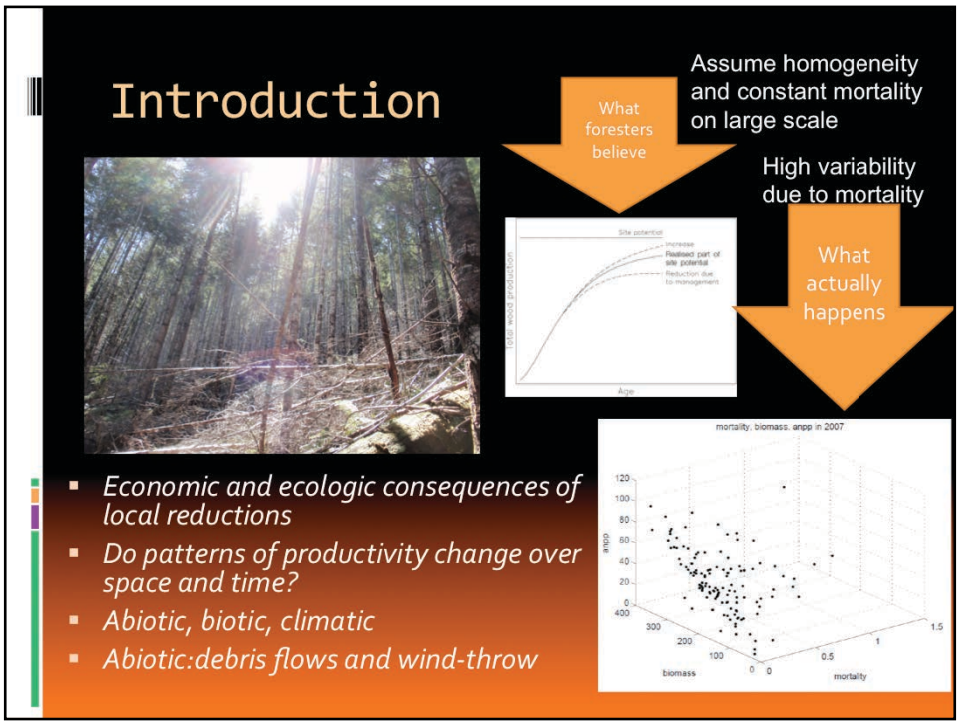


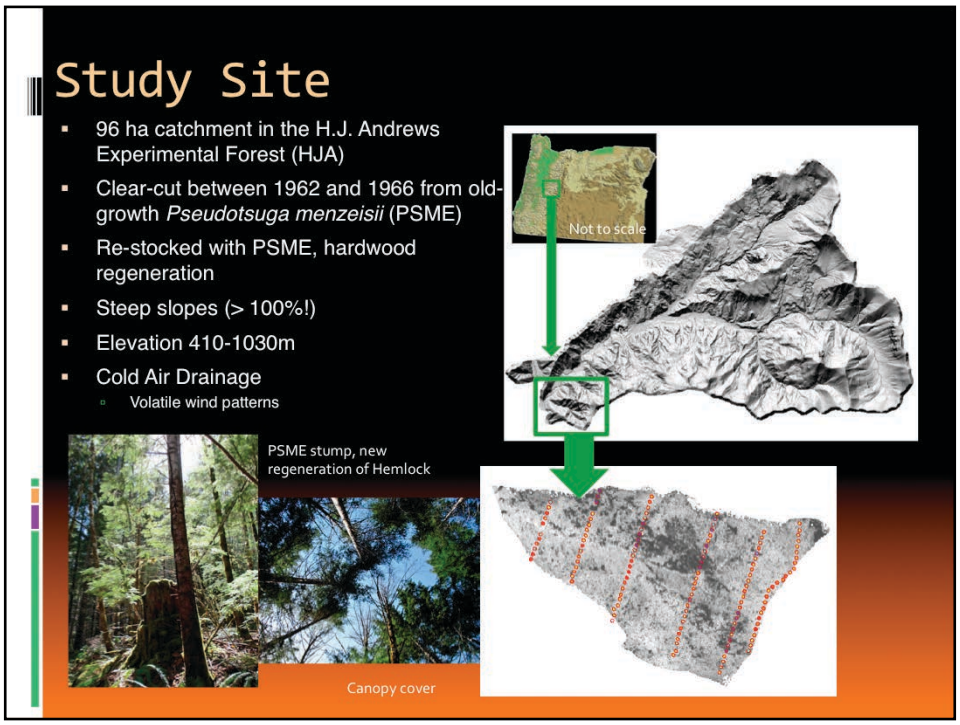
My topic title is kind of lengthy, but essentially I wanted to ask a pretty direct question: is there a way that we can use spatial analysis to find areas where reductions in productivity occur due to a limited set of causes? The causes that I focused on for this analysis were disturbances.

Now in a way this is like making a susceptibility map, except for one small detail– this is looking at where disturbances could have happened in the past in order to explain patterns that we see today. As such, it involves interpreting and interpolating historical data. And it involves using information about the landscape to build models of susceptibility. And it involves coming up with a way to visualize the intersection of these.

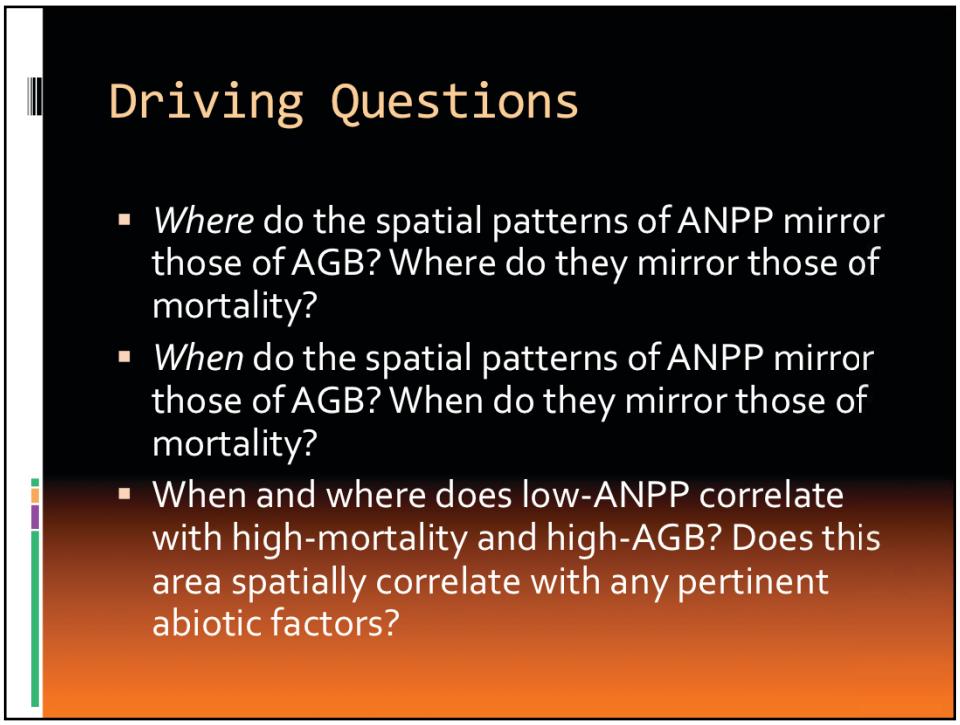


So why do we care about productivity. The forests of the pacific northwest are very rich, and powerful for sequestering carbon and providing various ecosystem services. When we want to know about how "sequestering" these forests are, we often make a large-scale estimate of their biomass based on their productivity. Which means that we're relying on our interpretations of a set of fixed curves like this one here– these curves say that a stand will grow along a fixed trajectory, although maybe management or a fertilization may increase it. However, in reality, especially somewhere like the pacific northwest where the terrain is steep, the growth trends of plants are not so direct. Mortality may occur in a heterogeneous way, and the results is that it drives down productivity. Here we see that for many sites ANPP and biomass increase together, but there's also a good number of sites with high mortality and lower ANPP and biomass. It is with these sites we are concerned. Large scale estimates do not capture the dynamic of these sites, but they may be a signficant portion of the forest environment.

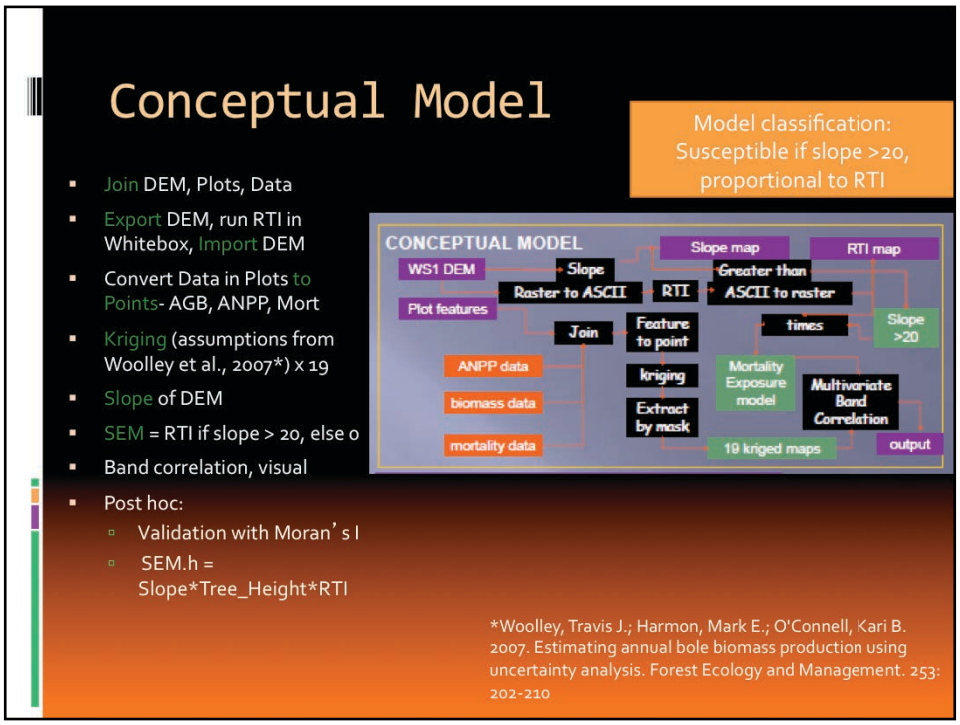
I'll show you in a minute what I found this looks like in space, but for now the question you should ask yourself is– why does this happen? The answer is that there's really three sets of factors for why productivity can change– abiotic factors, such as disturbances, biotic factors, such as succession, and climatic factors, such as climate change. In this analysis, I wanted to create a model that could highlight areas prone to disturabnces, particularly debris flows and wind throw, and visualize that model in conjunction with historical data on ANPP, biomass, and mortality, in order to identify sites that I thought could have had reduced productivity due to these events. This is useful for reducing the uncertainty in producitivy models.



So where I work is at the HJ Andrews Forest in Oregon which is kind of over here in the Willamette, and I work on watershed 1, which is actually a "clear cut." Now this landscape as you can see is pretty deeply dissected– there are steep slopes and a huge elevational gradient, and there's also this very strong wind pattern coming through called a "cold air drainage". So this landscape is volatile on multiple accords, and to make it more unstable it's also this young developing forest. On this clear cut there was replanting of douglas-fir trees, and some hemlcok and hardwood are grwoing abck naturaly. For 27 years, there ahs been a forest inventory– essentially counting the stems of trees and measuring them– conducted on this site, and with the help of a set of allometric– scaling equations– I can convert 86000 tree diameter measurements into measurments of mass.



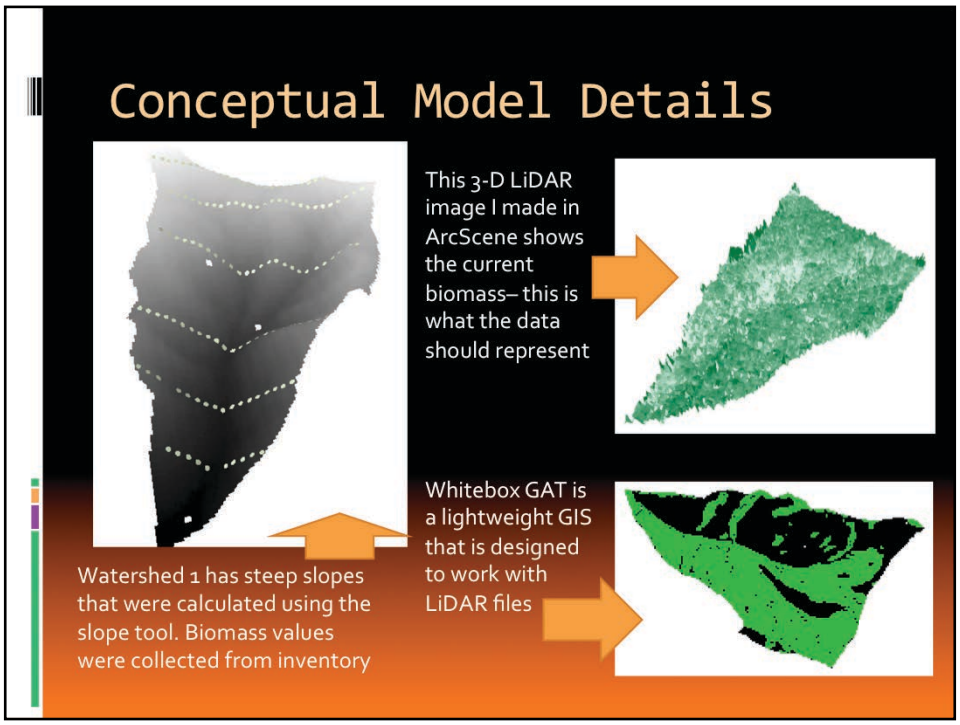
So there were really three big questions we need to answer for this analysis– first: where do patterns of ANPP mirror those of AGB– that is, thinking back to this 3 d graph, where is the pattern what we could consider "normal" and where is it what we might consider "different?"
Second, when does this happen? Does the whole watershed incur these patterns at one time? Or does it happen over multiple times on a smaller scale?
And so the pattern I'm really looking for is when ANPP is low (reduced), biomass is high, and mortality is high. And if this pattern occurs, is it spatially correlated with factors that make a site suceptible to our kinds of disturbances?



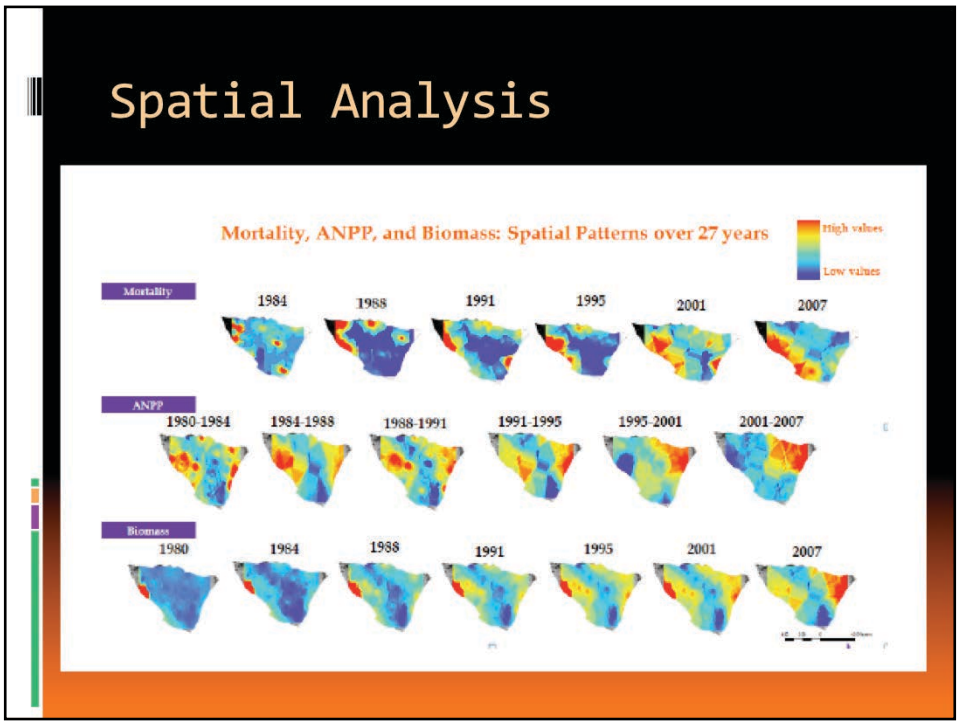
JUMP BACK TO NEXT SLIDE

So what did I do? Well there is kind of two parts. First, I had to map the permenant plot data onto the watershed **JUMP**. This meant I needed to interpolate from those transects you saw before to the watershed basis. So I joined the data to the plots (a feature class mapped previously in the database and adjusted the plots to fit the steep aspect of our site). Then I used some assumptions of spatial coherence from the literature (essentailly, that since these plots are transects we should stick with a sphere to avoid aliasing) and created 19 maps of ANPP, biomass, and mortality. What should the biomass look like? **JUMP** For clarity if clipped (extract by mask) the data to the watershed boundaries. To look at potential abitic factors, I used the literature tof ind some thresholds. Essentially, slope > 20 degrees was shown to be a big one in multiple papers. I also saw that the relative terrain index (RTI)– this is essentially the TPI like we did in lab 3, but includes a component of directionality associated with how the watershed opens, is indicative of exposure and disturbance events. I have a module for this in another GIS Program called whitebox, so I just exported my DEM to the whitebox, processed the RTI, and brought it home again. **JUMP**Then I used raster calculator to put the two together. Now. I knew these wouldn't be great correlates, but what I really wanted was to know whether or not my directionality was okay, so I used the multivariate band correlation to look at the correlation between the two rasters and to see if when mortality increased, susceptibility increased and when ANPP decreased, susceptibility increased.

Output was also validated in GIS, and in the field. And also I made a second model which I think is pretty informative, although there are some loose ends to tie up.

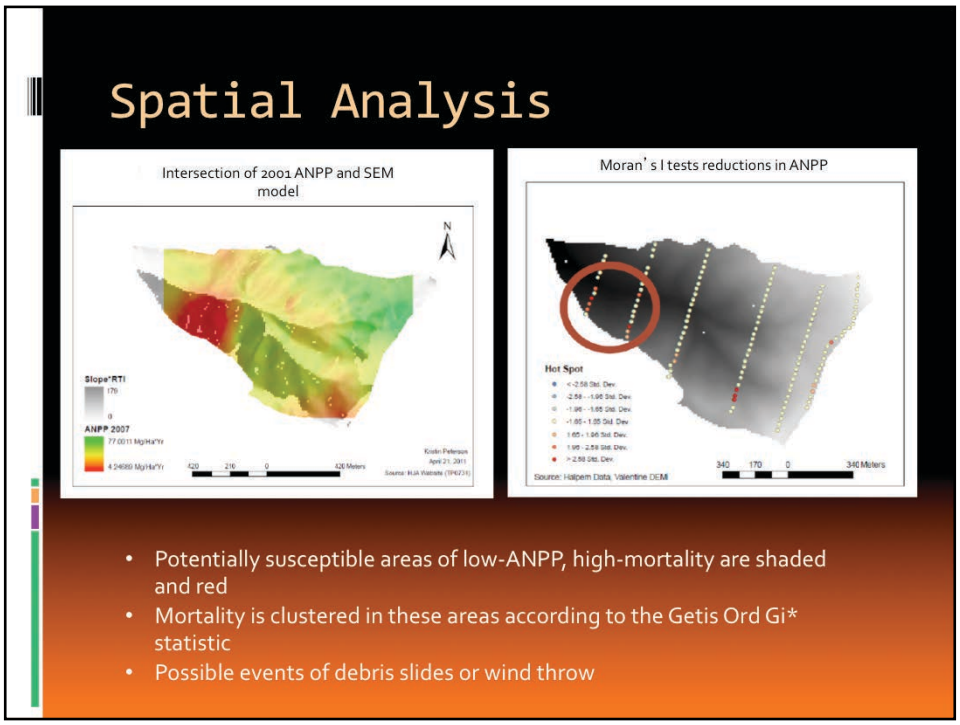


Okay so if you're curious about why I had to adjust the plots, it's because WS1 has some really steep slopes
Biomass is pretty varied.



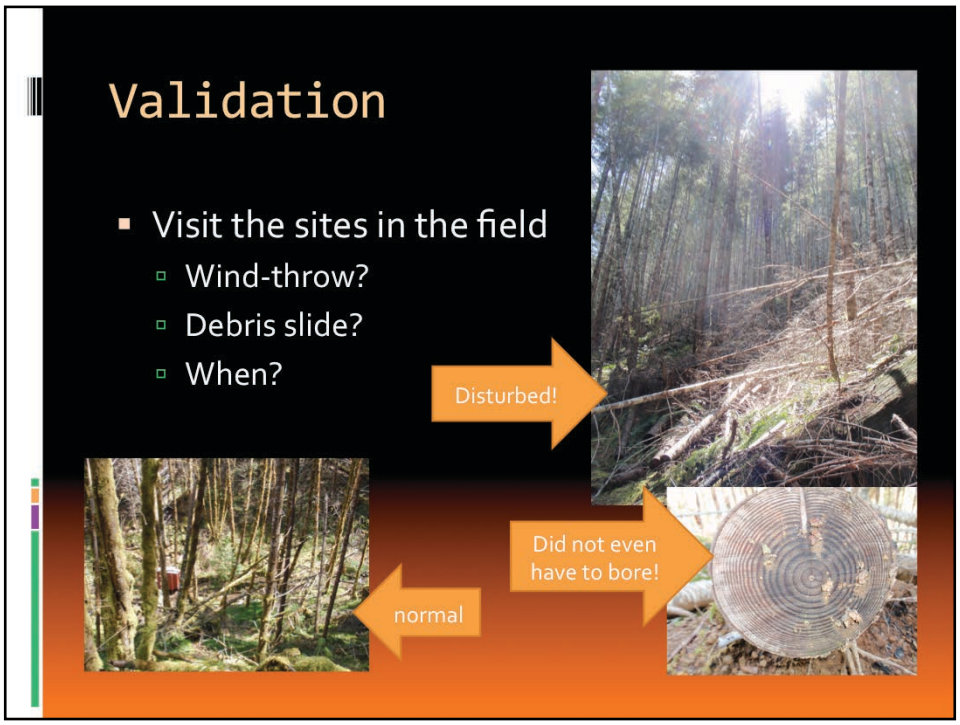
And this is what I got from the kriging when I finished it– wow it took forever. So we can see on the bottom here that biomass is increasing over time, as we' d expect from the clear cut. But we can see above that that the pattern of ANPP does not follow the expected "productivity mirrors biomass" trend that foresters think about, instead, it seems to decrease, especially on this north facing slope here, at least relative to the tail up here. And mrotality begins pretty localized but most recently looks like the inverse of ANPP.

But let me point to you this, the pattern that I was lookig for– in 2001, we see that there is high mortality, low ANPP, and high biomass, and that this event looks pretty local in both space and time– this site has the potential from the data alone to be a disturbance? But was that site susceptible to disturbance according to the characteristics?



Yes, we see that the shaded area, which is the most susceptible, encompasses this spot. In my paper, which I have made available on the website, you can also see that the moratlity characteristics were okay.

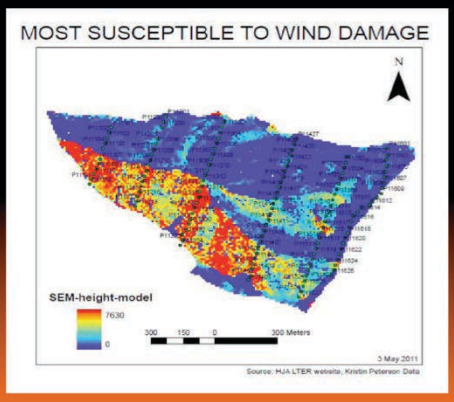
But of course the suseptibilit is pretty broad and I'm looking for a localized event. So I tested to see if the reductions in ANPP generating this event were localized, and they were, according to Moran's I. That gives a little more support to the fact that whatever casued the reductiosn in ANPP here isn't occuring on a broad scale on this slope. Of course, this isn't the best validation, because the kriging itself requires that spatial autocorrelation. So I best go to the field.



I visited the site in the field and lo! It was disturbed.

Futures

- SEM.h model includes LiDAR height data
- 20 random sites will be validated



WATERSHED 1.