Investigating Post Los Conchas Fire Erosion and Potential Control Methods

New Mexico
Supercomputing Challenge
Final Report
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Executive Summary

The recent Los Conchas Fire swept through the Jemez mountains and utterly decimated several slopes. The purpose of the model is to model erosion caused by a lack of vegetation post-fire, and also to simulate the effects of reseeding on this erosion. The model was written in the java programing language, and modeled pre-fire, post-fire, and post-fire with reforestation efforts. The model used Enhanced USEL model, the standard used in modeling erosion used by the US Forestry Department. Each test was simulated for a period of twenty years. The principle factor that changed between iterations of the program was the amount of vegetation, this was found to increase at a rate of 1.5% naturally and 3% with reforestation until it reached pre-fire levels. The results of the model showed that it took twelve years to stabilize erosion back to pre-fire erosion levels. This was roughly halved with reforestation to taking six years to stabilize. Conclusions drawn from this model were that the fire caused erosion levels to spike about 1000 tons per acre a year, and that this took 12 years to stabilize. Reforestation efforts roughly cut this in half, and allowed the forest to return to healthy conditions faster. The longer the forest is destabilized with increase erosion, the more ecological damage is done.

Problem

The recent Los Conchas Fire has harshly impacted the ecological wellness of the burned region by erosion. The heat of a fire changes the chemistry of the soil to make it hydrophobic, which decrease the soil's ability to absorb water. Since the soil cannot absorb the water, the water flows downhill and picks up the soil. The lack of vegetation in severely burned areas also increase erosion because the soil is no longer held together by the fibrous roots of the vegetation. Our problem is to model this erosion, along with erosion while selected control methods (reforestation, fiber rolls on sensitive slopes, etc).

Method

The Enhanced USEl model was used with the java programing language to program a model used to simulate erosion. The Enhanced USEL model uses the factors R, LS, K, P, C to calculate erosion. All these are then multiplied together to get a final erosion number, as expressed in tons per acre per year. These factors were found to have the values of 57, 12, .16, 77, and 32, respectively. The variable C, which represents the vegetation cover, was the only factor that changed pre and post- fire. The way the model calculated erosion was by multiplying the factors together, as per the Enhanced USEL model, logging the result, and the recalculating the value of C to simulate regrowth. After this was done twenty times, the C value was reset to a value reflective of either pre or post fire, and the process was repeated. The difference between the multiple instances of the process was the rate of regrowth, which varied depending on if or if not reforestation was taking place. After three instances were ran, the program terminated with an output of the received data.

Results

Pre-Fire erosion was about 3,414 tons per acre per year. Post-Fire, this spiked to 4,588 tons per acre per year. This decreased at a rate of 107 tons an acre a year until leveling off at pre-fire conditions. With reforestation efforts, this rate was about doubled at 215 tons per acre per year. For visual resources, see the References section.

Conclusions

The model showed that prior to the Los Conchas Fire, there was approximately 3,414 tons of erosion per acre per year.
The first year after the fire, the erosion was 4588 tons per acre per year (Fig. 3), which was about a 34% increase from the pre-v fire conditions, or 1174 tons per year more than pre-fire. With natural conditions, the simulation showed that i t took eleven years after the fire for the forest to stabilize the erosion, and with reforestation efforts, it only took 6 years to stabilize.
This shows that with reforestation, the annual erosion dropped about twice as fast as it would have naturally.
The hypothesis was supported by the results, the annual erosion rose by around 34% after the fire, and reforestation approximately halved this amount and the time it took for the erosion to stabilize.

Resources

Text Resources

Nyhan, John W., Steven W. Koch, Randy G. Balice, and Samuel,R. Loftin.(2001). *Estimations of Soil Erosion in Burnt Forest,Areas of the Cerro Grande Fire in Los Alamos, New Mexico*.*LANL.gov*. LANL. Web. 12 Jan.
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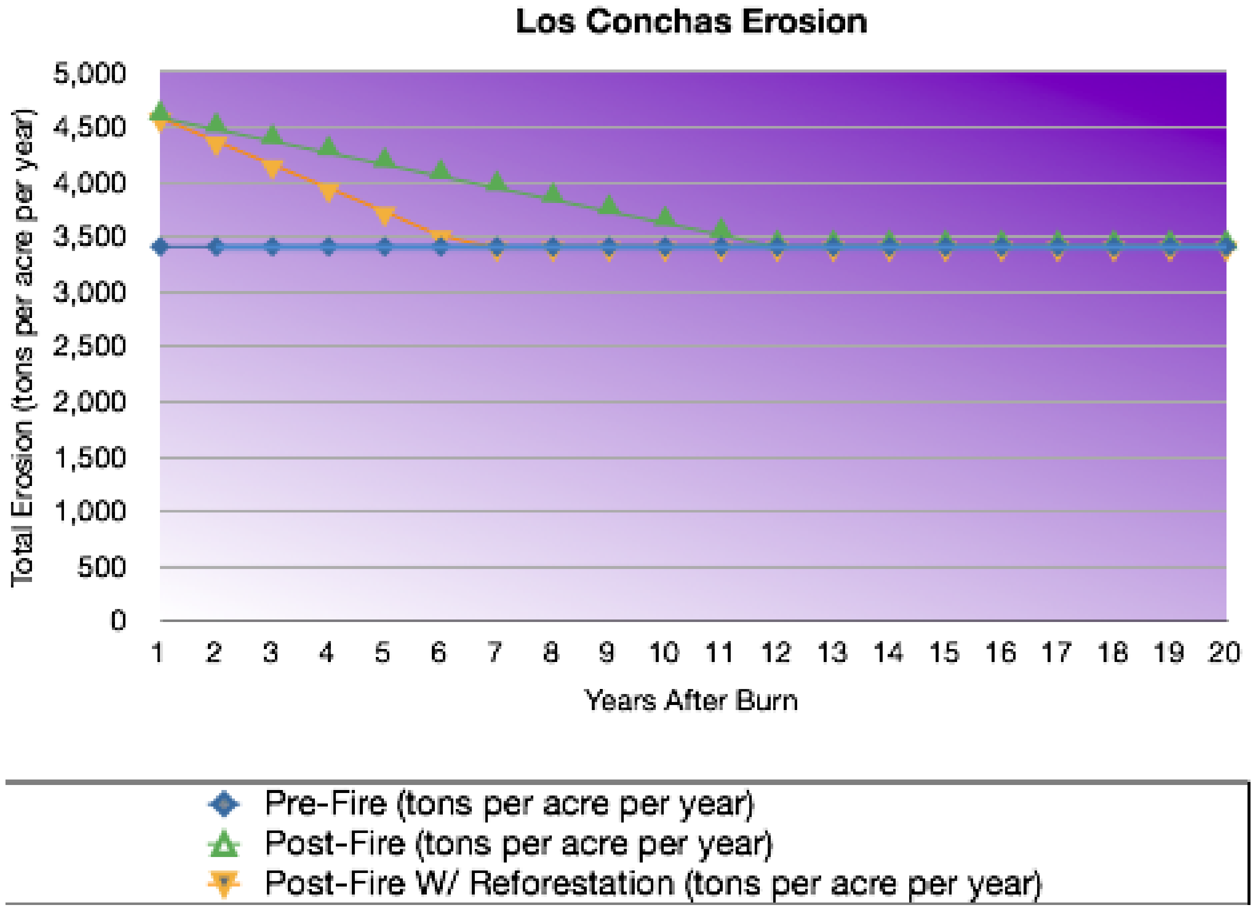

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"InciWeb the Incident Information System: Las Conchas Burned Area Emergency Respon Maps." *InciWeb the Incident Information System: Current Incidents*. Web. 18 Jan. 2012. <http://www.inciweb.org/incident/maps/2406/>.

Valles Caldera Geological Map. Digital image. *Valles Caldera National Preserve*. VCNP.gov. Web. 2012. <http://vallescaldera.com/wp-content/uploads/2009/03/mapshadedgeologic.jpg>.

Figures

Year	Pre-Fire (tons per acre per year)	Post-Fire (tons per acre per year)	Post-Fire W/ Reforestation (tons per acre per year)
1	3,414	4588	4588
2	3,414	4481	4374
3	3,414	4374	4161
4	3,414	4268	3948
5	3,414	4161	3734
6	3,414	4054	3521

Year	Pre-Fire (tons per acre per year)	Post-Fire (tons per acre per year)	Post-Fire W/ Reforestation (tons per acre per year)
7	3,414	3948	3,414
8	3,414	3841	3,414
9	3,414	3734	3,414
10	3,414	3627	3,414
11	3,414	3521	3,414
12	3,414	3414	3,414
13	3,414	3,414	3,414
14	3,414	3,414	3,414
15	3,414	3,414	3,414
16	3,414	3,414	3,414
17	3,414	3,414	3,414
18	3,414	3,414	3,414
19	3,414	3,414	3,414
20	3,414	3,414	3,414

Achievements

The most significant achievement of this project is the use of coordinating the cost versus reward of reforestation efforts in the burned area. Also, to date there has been no known supercomputing project done on simulating erosion caused by a fire. By be able to analyze the cost and reward of reforestation, groups can decide if reforestation would be worth the cost, and if so, how much would provide the best cost to reward ration.

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