Comment on "Modeling of the interactions between forest vegetation, disturbances, and sediment yields" by Erkan Istanbulluoglu et al.

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[1] I commend *Istanbulluoglu et al.* [2004] for their contribution to our understanding of sediment flux in forested watershed in response to fire and timber harvest. However, three aspects of the modeled scenarios strongly bias the results toward overestimating erosion and sediment delivery from fires and underestimating it from timber harvest.

[2] *Istanbulluoglu et al.* [2004] commendably caution against extrapolation of their results and note that there are many other possible permutations to the scenarios they modeled. However, these major sources of bias are worth noting. They also provide an important context for assessing their comparative estimates of sediment flux from fire and timber harvest.

[3] Roads and landings were completely ignored in the modeling of sediment flux in response to timber harvest. Roads are inextricably linked to timber harvest and vastly elevate surface runoff and surface and mass erosion in a persistent fashion, as legions of field studies have documented [e.g., *Furniss et al.*, 1991]. Typically, a significant amount of a road network is hydrologically connected to streams via stream crossings, gullies, and other drainage features [*Wemple et al.*, 1996; *La Marche and Lettenmaier*, 2001], which transfer these impacts to streams with considerable rapidity and efficiency.

[4] These connections between streams and roads significantly increase drainage density. *Wemple et al.* [1996] documented that roads increased drainage density by 21–50%. By omitting roads as an intrinsic aspect of timber harvest, the modeling by *Istanbulluoglu et al.* [2004] underestimates the effect of timber harvest on drainage density and sediment yield.

[5] Second, it was explicitly assumed that fire does not occur in conjunction with timber harvest. This is clearly not a reflection of reality. Although there is some debate about the effects of timber harvest on fire size and severity, it is generally conceded that timber harvest does not prevent high-severity fire. Even carefully executed fuel reduction measures, which differ from timber harvest in effects on forest structure, are unlikely to reduce fire severity in many forest types in the northern Rockies [*Schoennagel et al.*, 2004]. Studies have documented that timber harvest appears to increase fire severity in some situations [*Odion et al.*, 2004]. Over the time periods investigated by *Istanbulluoglu et al.* [2004], some level of high-severity fire is a near certainty in harvested landscapes. This underscores that timber harvest will combine with fire to affect sediment flux. Treating fire and timber harvest as mutually exclusive serves to underestimate erosion and sediment yield in logged watersheds.

[6] Last, the effect of postfire water-repellent soils on infiltration rates is probably overestimated. *Istanbulluoglu et al.* [2004] treat water-repellent soils as impervious. In contrast, field measurements of infiltration rates in water-repellent soils range from about 25 to 98 mm hr^{-1} [*Wondzell and King*, 2003], which is far from impervious. In treating water-repellent soils as impervious, the modeling considerably overestimates the increase in surface runoff, surface erosion, and channel erosion in response to wildfire.

[7] *Istanbulluoglu et al.* [2004] also assume a fairly high extent of water repellency in response to fire: 40–90% of the area affected by stand-replacing fire, based on unpublished data from a single fire. Little is known about the extent and contiguity of water repellency triggered by fires because very few studies exist with enough resolution to reasonably determine the extent and cause of water repellency in the postfire environment [*Beschta et al.*, 2004]. Such soil conditions can occur naturally. As *Istanbulluoglu et al.* [2004] note, little is known about the spatial contiguity of these soil conditions after fire. There is considerable potential that the assumed extent of fire-induced water repellency is an overestimate of what naturally occurs, resulting in consequent overestimation of surface runoff and erosion after fire.

[8] In aggregate, these obvious sources of bias combine to overestimate postfire effects and underestimate timber harvest effects on sediment flux in the results of *Istanbulluoglu et al.* [2004]. This also skews the comparison of the effects of these two modeled scenarios on sediment flux.

References

Beschta, R. L., J. J. Rhodes, J. B. Kauffman, R. E. Gresswell, G. W. Minshall, J. R. Karr, D. A. Perry, F. R. Hauer, and C. A. Frissell (2004), Postfire management on forested public lands of the western USA, *Conserv. Biol.*, *18*, 957–967.

Furniss, M. J., T. D. Roelofs, and C. S. Yee (1991), Road construction and maintenance, in *Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats*, *Spec. Publ. 19*, edited by W. R. Meehan, pp. 297–323, Am. Fish. Soc., Bethesda, Md.

Istanbulluoglu, E., D. G. Tarboton, R. T. Pack, and C. H. Luce (2004), Modeling of the interactions between forest vegetation, disturbances, and sediment yields, *J. Geophys. Res.*, *109*, F01009, doi:10.1029/2003JF000041.

0148-0227/05/2004JF000240$09.00

La Marche, J. L., and D. P. Lettenmaier (2001), Effects of forest roads on flood flows in the Deschutes River, Washington, *Earth Surf. Processes Landforms*, *26*, 115–134.

Odion, D. C., E. J. Frost, J. R. Strittholt, H. Jiang, D. A. DellaSala, and M. A. Moritz (2004), Patterns of fire severity and forest management in the Klamath Mountains, northwestern California, USA, *Conserv. Biol.*, *18*, 927–936.

Schoennagel, T., T. T. Veblen, and W. H. Romme (2004), The interaction of fire, fuels, and climate across Rocky Mountain forests, *BioScience*, *54*, 661–676.

Wemple, B. C., J. A. Jones, and G. E. Grant (1996), Channel network extension by logging roads in two basins, western Cascades, Oregon, *Water Resour. Bull.*, *32*, 1195–1679.

Wondzell, S. M., and J. G. King (2003), Postfire erosional processes in the Pacific Northwest and Rocky Mountain regions, *For. Ecol. Manage.*, *178*, 75–87.

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