A System Model of Fires in the Santa Monica Mountains
**Phil Gyford**
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Description

> Malibu … is the wildfire capital of North America and, possibly, the world. Fire
> here has a relentless staccato rhythm, syncopated by landslides and floods. the
> rugged 22-mile-long coastline is scourged, on the average, by a large fire (one
> thousand acres plus) every two and a half years, and the entire surface area of the
> western Santa Monica Mountains has been burnt three times over this century. At
> least once a decade a blaze in the chaparral grows into a terrifying firestorm
> consuming hundreds of homes in an inexorable advance across the mountains to the
> sea.
> *Ecology of Fear*, Mike Davis, pp97-99.

These fires are not a random event, and the potential is there for humans to play a
large part in controlling them. Before settlers arrived in the area the local inhabitants
regularly set fire to areas of the forest in a controlled attempt to burn away the vegetation
which accumulated. This dead biomass is a vital fuel for fires and destroying it on a regular
basis reduced the chance of accidental, and uncontrollable, fire breaking out. Since 1919
however, there has been an official policy of "total fire suppression," meaning that no fires
should be allowed at all. The growing levels of fuel increase the chances of fire breaking out
each year. And when fire does occur it's far more severe than it would otherwise be, thanks
to the large amount of fuel available. This behaviour is illustrated in the graph below.
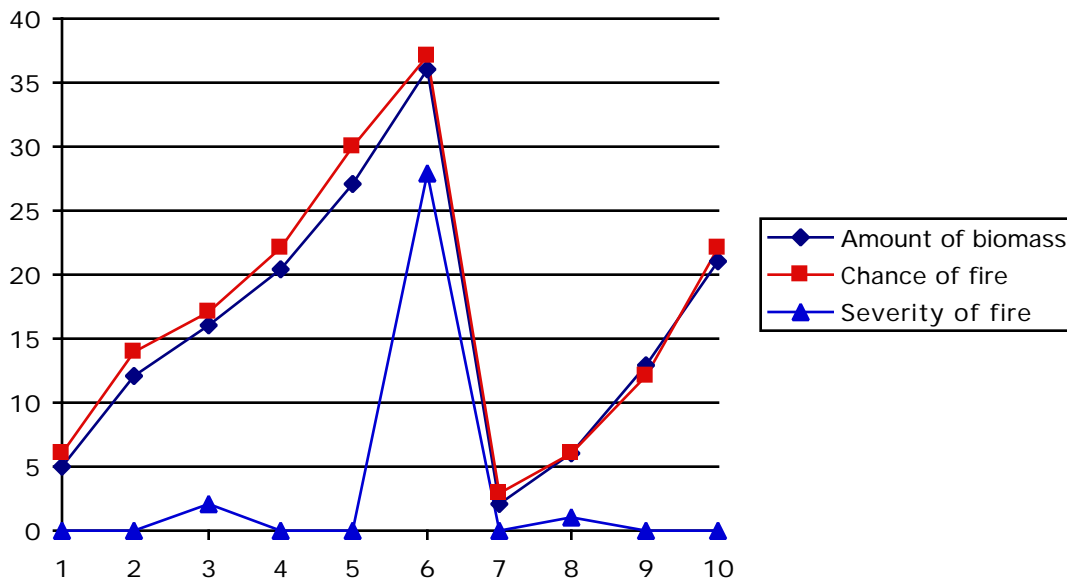
The increasing amount of building in the mountains also has an effect on disasters,
and not just due to the proximity of humans prone to accidentally starting fires. Fire-
fighters have a harder time reaching crucial locations due to the narrow winding roads
favoured by the mountains' inhabitants. Also, fire crews must concentrate not only on
controlling the fire as a whole but also saving individual houses, tasks which do not always
go hand in hand. While many properties have been destroyed over the decades, this has not
halted the urbanisation of this wilderness which has been free of any kind of fire-risk

zoning. In fact, the disasters only encourage more construction: each one will be followed by re-building with the aid of relaxed landuse regulations and even the fire code. The worst fires will cause the area to be declared a federal disaster area bringing in tax relief and low-interest loans.

The Model
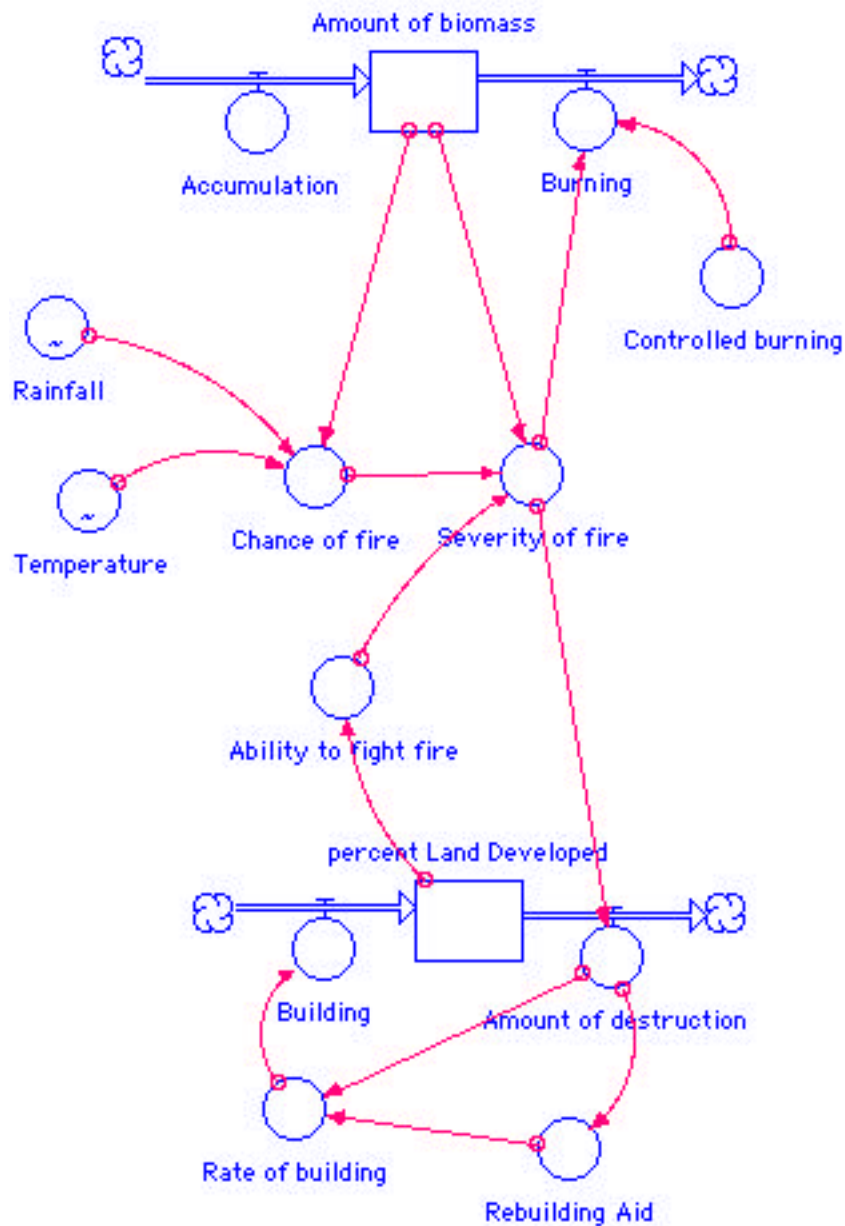
Equations

Amount_of_biomass(t) = Amount_of_biomass(t - dt) + (Accumulation - Burning) * dt
        INIT Amount_of_biomass = 0
        INFLOWS:
            Accumulation = 1
        OUTFLOWS:
            Burning = Controlled_burning+Severity_of_fire

percent_Land_Developed(t) = percent_Land_Developed(t - dt) + (Building - Amount_of_destruction) * dt
        INIT percent_Land_Developed = 1
        INFLOWS:
            Building = Rate_of_building
        OUTFLOWS:
            Amount_of_destruction = IF (Severity_of_fire > 1) THEN (Severity_of_fire) ELSE (0)

Ability_to_fight_fire = 1-(percent_Land_Developed/200)

Chance_of_fire = (((Temperature/13)-Rainfall/75)+Amount_of_biomass)*RANDOM(0,0.02,1)

Controlled_burning = 0

Rate_of_building = 0.05+ Amount_of_destruction + Rebuilding_Aid

Rebuilding_Aid = Amount_of_destruction * RANDOM (0,0.1,3)

Severity_of_fire = IF (Chance_of_fire > 1) THEN (Chance_of_fire * (Amount_of_biomass - Ability_to_fight_fire)) ELSE (0)

Rainfall = GRAPH(MOD(TIME/1,12))

0	1	2	3	4	5	6	7	8	9	10	11
67	75	57	20	3	0	0	4	5	6	45	45

Temperature = GRAPH(MOD (TIME/1,12))

0	1	2	3	4	5	6	7	8	9	10	11
14	14	13	14	15	16	18	19	19	18	16	16

Graphs

Note: y-axis scales are not equal.

Controlled_burning = 0

Graph 1 (Untitled) — Time — 8:16 pm 1999-11-26

Controlled_burning = 0.5

Graph 1 (Untitled) — Time — 12:13 pm 1999-12-02
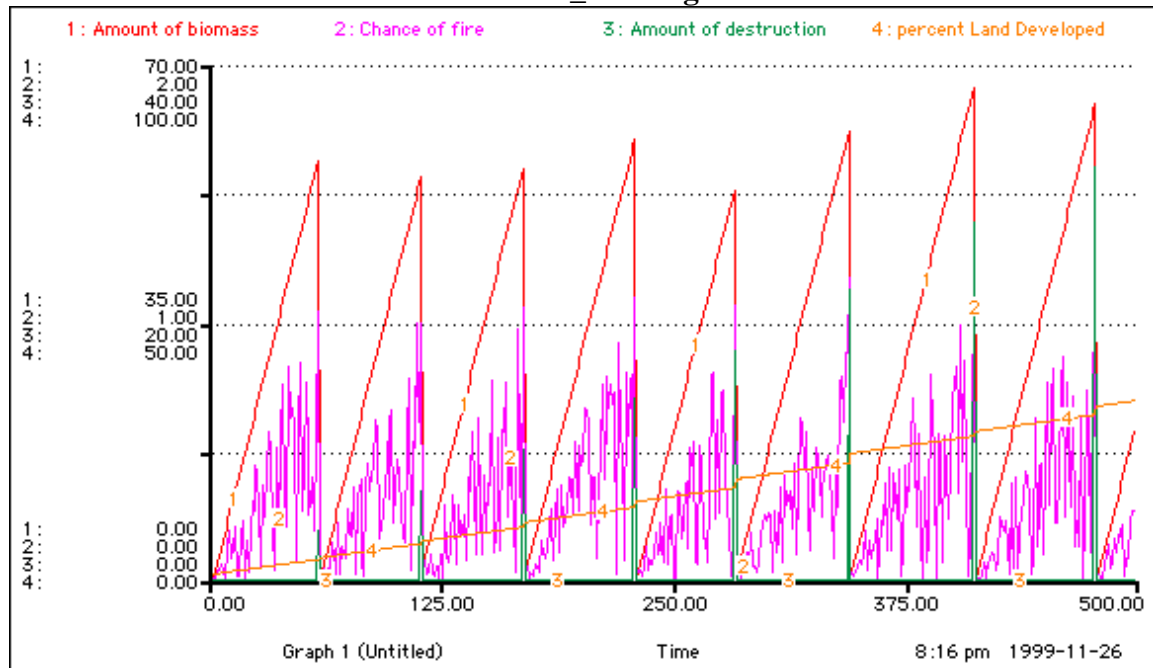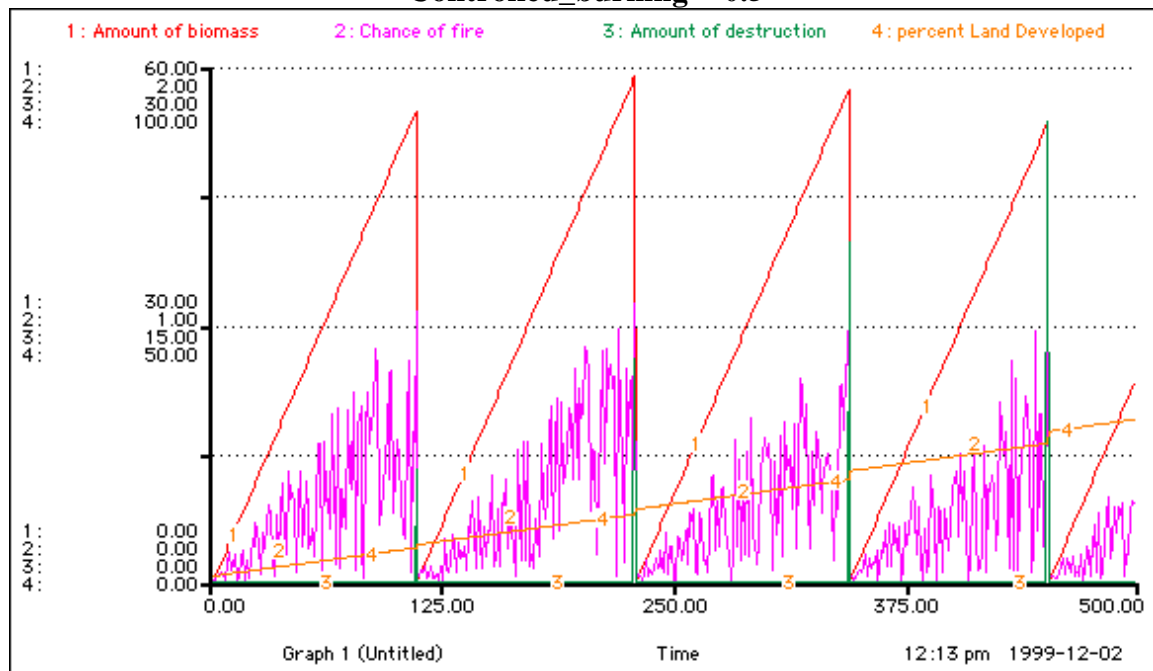
Controlled_burning = 1.0
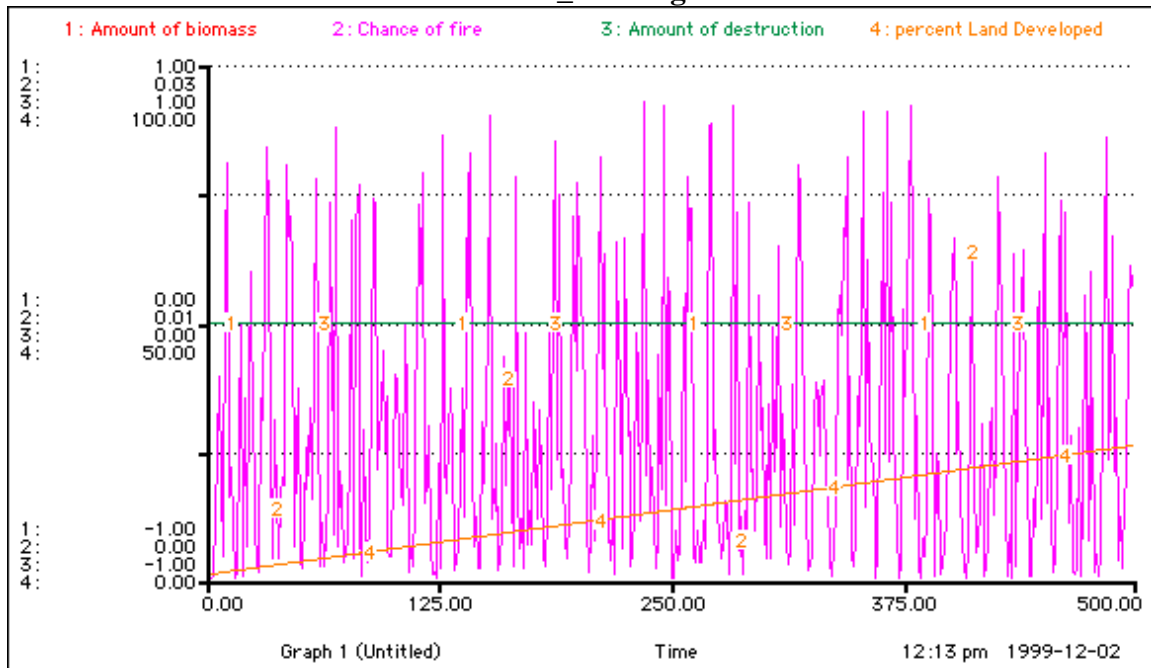
Notes
• Each time interval equals one month, with rainfall and temperature appropriate to the region.
• The frequency of controlled burning should be set between 0 and 1, 0 being the current "total fire suppression" policy and 1 being a completely efficient system of frequent control.
• The amount of land developed will increase steadily over time to simulate the gradual urbanisation of the area. Severe fires will give a net boost to growth thanks to rebuilding aid.