LANDUSE CHANGE MODELING

Geog 220 – Winter 2001

Student Commentary

Are there rules in modeling?

Where does engineering end and fudging begin?

What does it mean to "cheat"?

These are tough questions, I believe. And for me they are all too relevant.
In the work I have been doing on See The Future sometimes putting in a
multiplier here and there simply makes the model work better. For instance,
the relationships that are set up in the immigration portion of the population
sector are presently softened by a mulitplier of .1. Now, there can be no
question that the fewer multipliers there are the more elegant the model is.
Therefore, for the sake of elegance alone I tried to get rid of the .1
multiplier and returned immigration to its regular rate.   I then attempted to
manipulate various other exponents already in place as well as the graph
variables (which predetermine the relationships. For instance, as living
groups per dwelling go up, there is a greater and greater effect on housing
construction, etc.). Nothing I do can recreate the results of simply
multiplying the outcome of all of the factors by .1. Nothing.
What is a modeler to do?

Is this wrong? Must the model be scrapped? It would be nice to streamline the
model as much as possible but not at the expense of its accuracy. What,
therefore, is the best course of action? What is more important: accuracy or
elegance? Perhaps I can make a graph variable that says as accuracy increases,
elegance decreases............

Subject: Heroes and Disasters

Most, if not all, models that I have read about make assumptions about the
future based on the past. This is certainly a reasonable assumption and no
attempt to decry it will be made here. However, a caveat may be in order.
Sometimes, in our efforts to model the future we may not look into the past
far enough to appreciate certain large-scale periodicities that may have a
pronounced effect on the domain. For instance, if there is a flood every 100
years and we only do research into the past 20 years and model ahead 20 years,
we may not realize that the time is drawing near for another great flood,
which changes everything. Of course, that is a simple and somewhat unlikely
scenario since something of such a regular occurrence would more likely be
accounted for in a model.

However, what of other, more random events? A giant earthquake? Rising sea
levels? Changing climates? These are elements that are modeled by
themselves but, to my knowledge, never integrated into other, more planning
oriented models involving traffic, land use and development. Sure, someone
may say somewhere how no model can account for everything; but maybe they

could try a little harder. Especially when modeling land use changes of
certain countries with unstable governments, the understanding that certain
individuals can wreak profound change must be understood and, somewhere, in
some model accounted for. In this country, sure enough, we have a system that
dampens the effects of any one individual, which is a good thing both for
democracy and for modelers. However, this does not leave modelers completely
off the hook. A president can have a discernible effect not only on
development but also on conservation (i.e., Reagan and Teddy Roosevelt). We
must not ignore the effect that our socio-political structure must inevitably
have on the landscapes we see around us. A strong corporate influence on
government will mean everything from more billboards on your drive to work to
greater development of corporate offices.

What about a recession? I know that research I have done for my Stella work
has shown that the real median income in the South Coast was lower in 1993
than in 1989. My model can not explain this because my model does not have a
Recession factor. Perhaps it should. If it does not then it assumes
something like that will not happen again in the next 40 years when, in fact,
it looks like it's happening now. (Despite the best efforts of Alan
Greenspan). This is really amounting to what some would say modelers need to
hear the least: "Be more comprehensive". Maybe they are already in over their
heads as it is, a la Lee. Nevertheless, someone somewhere needs to address
the effect of discrete punctuated events in time that can change everything.
Imagine those who have been modeling North West India, if any have been. How
obsolete are those models now, unless they took into account the very real
possibility of such a devastating earthquake? And what good are these models
to policy makers and authorities if they do not factor in the possibility of
such disasters? A modelers may argue that since these processes are nearly
impossible to predict than they have no right to be in the model. This may
be, but in that case, let the user add in an earthquake or two to at least see
the effect. That way, policy makers can investigate worst-case scenarios.

So this leaves us right where we always have been. Modelers have a tough job
in front of them if they expect to model things the way they really are and to
tell us all of the true possibilities of the way things can be. Coupling,
coupling and more coupling I think will be the wave of the future.

Upon finishing my review of the CIPEC document, I am even more amazed on the
complexity of the issues underlying Land-Use Change Modeling. The authors do
a gallant job evaluating and presenting the 19 models chosen, which could
have been done just as successfully with other criteria and a completely
different set of equally comprehensive and scientifically sound modeling
efforts (example Martin's scenarios presented last week). Is it possible
that Land-Use Modelers have taken on a task and role that is impossible to
accomplish? As stated in the conclusion, they most pay "particular attention
to implicit and explicit temporal, spatial, and human decision-making scale
and complexity and the interactions between scale and complexity …… need to
consider the relative significance of different drivers - demography;
technology; economy; political and social institutions; culturally
determined attitudes, beliefs, and behavior; and information … its flow all
with in the context of policy makers…." Has this become the role of
presidents, dictators, profits or deities? The key concept presented was in
the closing statement that suggests the only way to accomplish this level of

complexity is through an "open source approach" where "many eyeballs and brains" from many different disciplines and cultural backgrounds can fluidly work towards an integrated multi-purpose solution. It will be interesting to see how this approach develops and the products forthcoming. In addition, I look forward to a careful review of the EPA evaluation this week.

A couple of general comments/observations:
Why was SLEUTH, Keith Clarke's model, only mentioned once outside of the Table 3 sequence?
Although I thought the series of plots to be interesting and a strong effort to graphically compare all the evaluated models I found them only partially successful at presenting the insight and clarity desired. For the amount of space and paper, I thought another mechanism might have been more successful.
Please correct me if I am wrong but isn't TM imagery 185x178 km2?

Below are some general comments on the CSIPEC Report.

I stumbled over the CSIPEC Report's decision making complexity dimension. While I could see how the spatial and temporal scales have a nested quality (e.g. a series of time-steps corresponds to a duration), I didn't see that holding true with human decisions. Perhaps I'm nitpicking. But I'm thinking of situations where communication is a problem (such as 19th century California and communication between an absentee landlord, a property's superintendent, and labor). Each of these can be seen as separate agents, operating in slightly different domains. And the ability of each agent to manifest the decision in the hierarchy will have many constraints (communication being one example). So that the final decision that is manifested may not reflect the decision of the absentee landlord. At the very least, I think we have to be careful about the smallest scale of our "agents" if we are not to omit some interesting social aspects of land use.

But then I catch myself falling into ranks with the CSIPEC Report, and its running interest in complex models. It seemed like there was more discussion on complexity for complexity's sake rather than whether complex models are actually more accurate. But here's my dilemma: on one hand, I don't see the need to model everything, but rather I think a good model might address a specific problem, yet on the other hand, model omission can narrow our perception of the complexity of land use/landscape change. And then there's the practical issues. For instance, how does the availability of data constrain model complexity? Are we identifying drivers, or available data? Are models generally idiographic, or relevant to diverse regions?

Finally, I think that Helen's discussion of ontology provides a good structure for comparing various models that would have enhanced the CSIPEC Report's angle. I didn't feel like I gained much "under the hood" knowledge from the report (e.g. how the models actually work), though that might reflect my limited background in the subject.

Knowing very little about formal models and modeling, I cannot find fault with what seems a thoughtful and systematic approach to their evaluation in chapter 4 of the CIPEC Review and Assessment of Land Use Change Models. The selected criteria of spatial, temporal, and human decision-making complexity seem ingeniously intuitive (with the benefit of explanation). Likewise, it is no surprise that there is ambiguity in defining social drivers, and that decision mismatching at spatial and temporal scales create a number of inconsistencies in comparing such different models.

Beyond that initial acknowledgment of complexity, I quickly became lost in the descriptions of model types. I can only vaguely relate to a comparison between a 'mechanistic GIS simulation' and a 'statistical/econometric model without spatial complexity'; one might show me maps while the other I might expect to proffer an array of statistically generated graphs. Any effort to compare the two would seem courageous. Happily, I have seen the Cellular automata model, but again, the details of an item by item comparison with other model types are unclear to me. Of 'dynamic systems models', 'general systems frameworks', and 'dynamic approaches', I am clueless. These terms evoke nothing specific in my experience. I look forward to some form of enlightenment.

I wanted to add to the e-mail discussion about the CIPEC and EPA Reports of Land-Use Modeling, so here are some thoughts:

It seems to me that a very important reason for modeling land-use change is being able to predict the future under alternative scenarios. One of these scenarios is an ecologically sound scenario. In other words, we, as a society, realize that it is our best interest to maintain the ecological integrity of the planet, and adjust our lifestyles and actions accordingly. It is apparent that if society keeps going as is, then it is unlikely that we will realize an ecologically sound scenario. However, there is always that hope. So, what would such a scenario look like?

WE DON'T KNOW, AND WE HAVE NOT MODELED IT EITHER.

None of the land-use models even attempt to model such a scenario. The California Urban and Biodiversity Analysis (CURBA) model just throws a few very crude environmental protection policies into the mix and evaluates their impact on biodiversity.

It seems that if these are the best land-use change models in the world, that they would have the ability to be normative, and to do so in an ecologically sound manner. Likely, what this would entail is creating a biogeographic or landscape ecology module that would integrate into the larger model, thereby affecting the outputs. The landscape requirements of ecological integrity are fuzzy, but they can be modeled.

So, I have three questions:

1) Is it appropriate for land-use change models to have a normative, and ecologically sound "switch" as I have described?

2) If so, why hasn't this been done yet? (What are the hurdles?) (If no, why not?)

3) Finally, I know there must be many models out there like the BMAS (Biodiversity Management Areas Selection) model of our Dept.. What are some of these other models, and are any of them feasible for integration with the models we have read about? How so?

Looking forward to Monday eve.

Perhaps one reason we do not know what a utopian future looks like is because so many people have so many different visions. Some picture a pristine wilderness where human beings live simply in loincloths picking berries while others see people living in technologically advanced societies apart from nature, leaving it pristine but without human beings. And everything else in between. Some talk of an "attainable future" and others talk of "a truly utopian future." Inevitably, modelers tend to be scientists who, at least ostensibly, try to remain neutral on what the future should look like. Given that, it becomes difficult when those who would like to use models for normative purposes ask scientists, who pretend neutrality, to create such a model. Furthermore, there are some serious challenges in front of modelers to accomplish the ecologically sound scenario.

1) They must have a vision of what an ecologically sound scenario actually looks like in such a way that users of the model will agree with them. This is not easy because, as mentioned before, not all users have the same vision of an ecologically sound scenario.

2) Do scientists really know how to get from where we are now to where we will have to be to achieve this ecologically sound scenario? Do we need to stop cutting down all trees or just some? Some environmentalists will say we must stop cutting down all trees while others will say that is too extreme and not necessary for an ecologically sound scenario (ESS). Scientists will admit that we still do not fully understand the way the earth works, how it's all connected. Therefore, some could argue that no matter what we do global warming will continue. It seems a far easier thing to model the effects of a normative policy on a region than to predict confidently the series of events necessary to achieve a normative outcome of such an extreme nature. Also, once numbers are revealed (for instance, people should use 10% as much power as they have now, ride their bikes everywhere, etc.) they are probably things that most of us already know will make for a more sustainable planet but a model will have little advice on the adroit political maneuvering necessary to convince rich Americans to kill their televisions and ride their bikes.

Lastly, getting back to what I was saying earlier, scientists want to be seen as impartial. Therefore, the minute they create a model saying this is what we HAVE to do to achieve a GOOD world, then they could be accused of scientific bias. Conservative organizations can create their own "scientific" model which shows that we only need to reduce by 5% instead of 50, etc. The entire scientific integrity of the modeling process could be called into question when normative outcomes are such an explicit component of its creation.

Nevertheless, I agree with John that it would be a good idea if somebody made one anyway.