Examination on the Efficacy of Noah-Multiparameterization (Noah-MP) as a New Land Model in Earth Systems Modeling

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What is an Earth Systems Model?

Earth Scientists use many different tools at their disposal to help them make predictions, test hypotheses, and . These tools are as follows:

Direct Measurements

Indirect Measurements

When it comes to modeling, there are two basic types:

Mathematical Models

Physical Models

An Earth Systems model is an example of a mathematical model that divides the Earth’s atmosphere, ocean, land and sea ice into many grid-boxes. They include numerical descriptions of the energy cycle, carbon cycle, and the water cycle (driven by the energy cycle).

What is Noah-MP?

Noah-Multiparameterization (Noah-MP) is a computer model that deals with energy water, and carbon cycles over land. Multiparameterization means that many different “schemes” were included in the development of Noah-MP. These schemes are empirical equations based on physical experiments. These schemes include Runoff schemes, Soil hydrology schemes, Vegetation dynamics (e.g. plant photosynthesis, respiration, and related nitrogen cycle). The parameters in Noah-MP are vegetation type (i.e. stomatal conductance), and soil type (i.e. hydraulic parameters).

How Does Noah-MP Work?

- Take data from a site like the Amazon Rain forest
- Wind speed/direction, Temp., Humidity, etc.
- Spin up data by copying it
- Run Noah-MP model
- Ten years worth of data for many variables is outputted
- Analyze data

Results an Discussion

Figure 5—Latent heat flux is the portion of net radiation that is partitioned for evapotranspiration

Figure 6—Sensible heat flux is the portion of net radiation that is partitioned for heat used to heat up the lower atmosphere

Figure 7—Net radiation is the total absorbed energy by the land surface (energy from the sun and near-infrared radiation from the atmosphere)

In general, the model produced data that was either overestimated or underestimated compared to the observed data. This can be seen in the graphs above. Latent heat flux (QFX) was overestimated and sensible heat flux (FSH) was underestimated. However, since these two variables are each components in the total Net Radiation, they averaged out to produce data that was quite similar to the observed data. This pattern of over and underestimation was produced in the other outputted variables as well.

Conclusions

Noah-MP is well on its way to becoming a viable tool for Earth Scientists to use. The over and underestimations of the data indicate the error(s) may be consistent and, therefore relatively easy to fix (e.g. change tree root depth to make it more dynamic). More regions need to be tested. And the same regions need to be tested again with different data (to test resistance to drought, etc.). This data only represents a small portion of the work that needs to be done. It has been coupled with the National Center for Environmental Prediction (NCEP) for weather prediction and short-term climate predictions.

References
