ENVIRONMENT

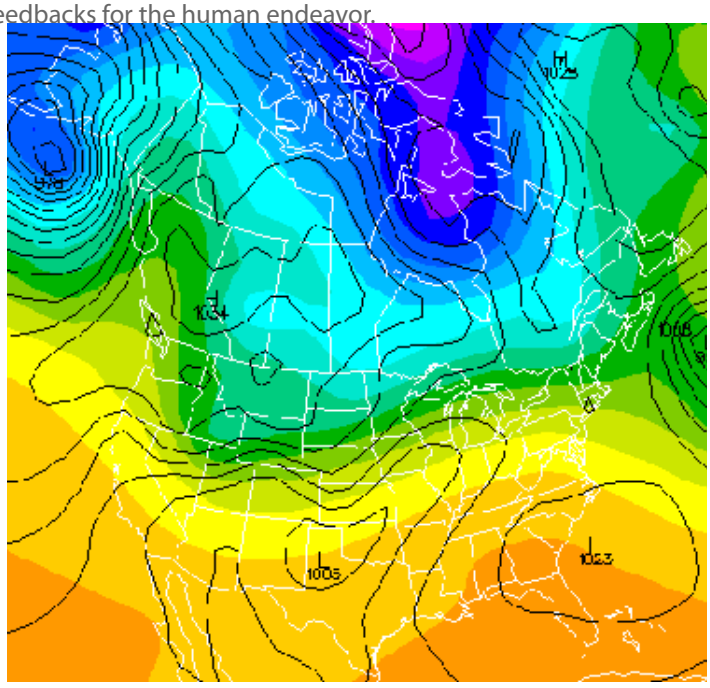
The biosphere is the living part of Earth. It is arguably the planet's most complex system, with an almost infinite number of dynamic interactions between its life forms and external interactions with the Earth's physical processes including the oceans and our atmosphere. In an era of dramatic changes in land use and other human activities, it is imperative that we understand how the biosphere is changing in response to human and other actions. Humans depend on a diverse set of biosphere services, other living creatures and crops, for food, fiber, and fuel, as well as the stewardship of air and water. Perturbations of these components have and will adversely affect human endeavors across the globe.

Our understanding of the biosphere does not match our increasingly sophisticated understanding of Earth's physical and chemical systems at regional, continental, and global scales. The biosphere is orders of magnitude more complex than any physical systems we know and can model. Supercomputing can start to enable us to understand the complexity of the world we exist in. Failure to improve our understanding and the affects or our existence on this planet will at the least severely impact out economy and our competitiveness in the global market; at the worst it could threaten our species' existence. These challenges involve:

- Understanding and predicting the way ecosystems work and respond to changes, especially at large scales;
- Understanding how ecosystem processes feed back to alter biosphere processes, including climate and hydrology; and
- Understanding the implications of these processes and feedbacks for the human endeavor.

Specifically we need to be able to model:

- Climate change affects
- Land use impacts
- Invasive species
- Biogeochemistry and ecohydrology
- Biodiversity
- Disease ecology.



We must be able to extrapolate relationships between drivers (climate change, land use change and biological invasions) and ecological and economic consequences.

The ability to forecast these effects is analogous to the National labs' ability to design and test systems to protect our nation from its enemies. This ability was spearheaded by the use of sophisticated models and supercomputing. Our ability to understand and survive our world's changing biosphere rest on those same tools and experience – sophisticated models and supercomputers to enable them.

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