Earth & Environmental Systems Modeling

2. Innovative and Emerging technologies: ML/AI, Digital Earth, Exascale and Quantum Computing, Advanced Software Infrastructures

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Challenge: data movement & storage

Strength: AI and exascale enable very high resolution and/or very fast runs

Problem: Computers can't write data fast enough or archive enough

Solutions:

1. Do analysis inside the simulation, only write aggregate statistics
2. Data compression
3. Make simulations fast enough to re-run rather than archiving data

Challenge: DOE is just getting spun up on AI

Strength: DOE has many AI experts doing many things

Problem: Unclear which strategies are best

Solutions:

1. Don't focus on a single approach (easy since DOE is federated)
2. Develop metrics/intercompare methods (an extension of PCMDI/CMIP)
3. Collaborate with/follow private industry

Problem: Need to connect people with research questions to AI experts

Solution: Coordinate/connect across DOE (via meetings, proposal calls, etc)

Challenge: Actionable Science Requires Quantified Uncertainty

Strength: DOE is a world leader in UQ

Problem: Need to propagate uncertainty from many sources

Solutions:

1. **Increase DOE emphasis on UQ**
2. **Use AI models to characterize initial condition and parametric uncertainty**
3. **Continue autotuning research**