CyberGeo

Thoughts on cyberinfrastructure for the geosciences, emphasizing aspects complementary to high-performance computing

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Motivation

- Convert cyberinfrastructure (CI) from concept to action, maximizing benefits for GEO
- Close gap between CI for supercomputing and CI in other (softer) dimensions
- Subtext: encourage inclusion of Unidata-like activities in plans/budgets for CI

Cyberinfrastructure Definitions

- **CI as underlying foundation (functionality)**
  - Well tested, dependable & adaptable
- **CI as a system of public works (common good)**
  - Transparent, standardized & low-cost or free
- **CI as a socio-technical environment (evolution)**
  - Emphasis upon ongoing, participatory design
    - *"Deep & enduring changes are not technological but social & cultural in their core"*
    - *"Computers, different from passive technologies, can be extended in ways the designers did not foresee"*

      - Gerhard Fischer (paraphrased)

Setting a Direction

A Proposed CyberGeo Statement of Purpose:

To establish a reliable, socio-technical environment that leverages creativity & learning in the geosciences.

Underlying assumption: NSF/GEO intends to foster & support cyberinfrastructure projects & programs—which I've dubbed "CyberGeo"—that benefit the geosciences.

Some Guiding Principles

- **Leveraged Activities:** some highly specialized (leading edge); others nearly universal (multi-disciplinary)
- **Dual Priorities:** technologies that A) serve large parts of GEO or B) enable advances otherwise unachievable
- **Evolving Boundaries:** experimental/discipline-specific concepts (via abstraction & engineering) ➲ infrastructure
- **Central versus Distributed Activity:** an evolving balance—many functions that now are best performed in a large, central facility eventually will become well-matched to desktop or departmental systems

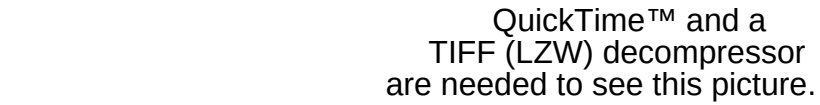
More Guiding Principles

- **Elevating Semantics:** general cyberinfrastructure trend ➲ ever-higher levels of meaning embedded in tools & data flows
- **Transcending the Disciplines:** common abstractions (IDV, LDM, NetCDF, CDM, GALEON, e.g.) enable & support interdisciplinary advances…
- **Standards/Transparency/Openness:** international standards/certifications; policies on accessibility & use…
- **Other Principles?**

Strategic Questions

- **How might a broad concept of CyberGeo be converted to program activities that**
  - Are practical & effective (in an NSF & GEO context)?
  - Yield the full promise of cyberinfrastructure?
- **The answer proposed here:**
  - Define "full promise" as 5 classes of activity that should be enhanced by cyberinfrastructure
  - Drawing on GEO history & promising experiments, lay out specific services & technologies that
    - *Represent reasonable units of work*
    - *Cover all classes of CI-enhanced activity*

Coverage Map

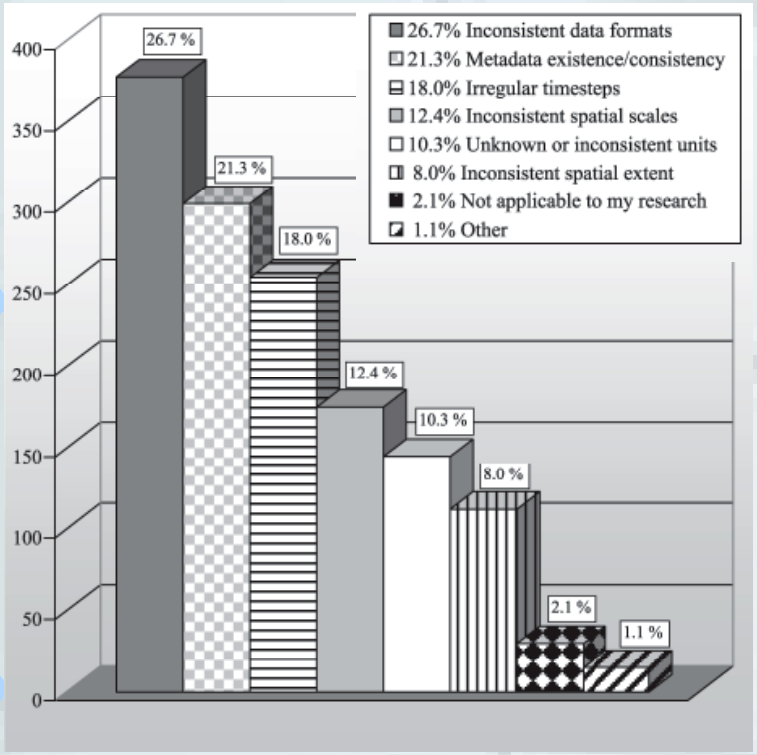


Classes of CI-Enhanced Activity

1. **Earth-Systems Observation**
   - Extending the measurements of the earth system
2. **Earth-Systems Simulation**
   - Enhancing models/theories of earth-system processes
3. **Data Analysis & Synthesis**
   - Quantitatively linking observation, theory & perception
4. **Scholarly Communication**
   - Exchanging/reusing/enriching the artifacts of science
5. **Learning & Decision Making**
   - Building scaffolds for cognition

End-to-End Use Cases

- Extreme events
- Multidisciplinary studies of water, volcanoes...
- Data repurposing
  - Data-access methods
    - *Encapsulation*
    - *Web services...*
  - Metadata
    - *Higher semantics*
    - *Polymorphism...*



Coverage Map

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TIFF (LZW) decompressor
are needed to see this picture.

Some Questions for Discussion

- Is this complementary to other CI reports?
- Should it be less Unidata-centric and, if so, what are the best steps for getting there?
- Is the services/technologies granularity OK?
- Should services/technologies be sequenced or prioritized and, if so, by what means?
  - Individually or as a package?
  - In workshops or focus groups?
- Should this address programmatic issues?