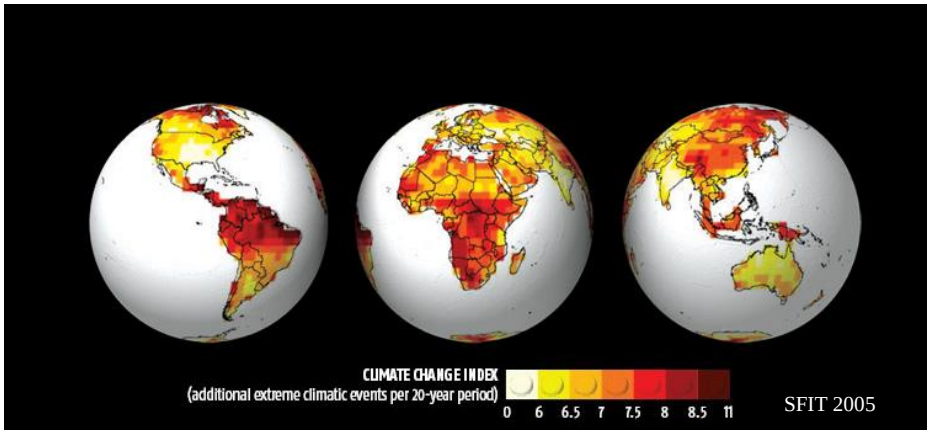
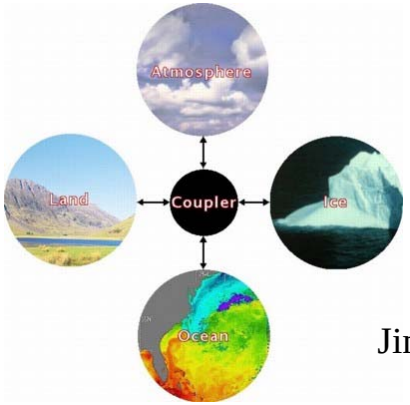
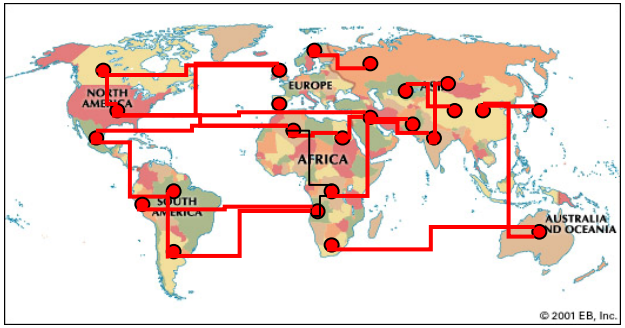


Modeling The Dynamics of Climate and Conflict



April 20, 2005
(Revised June 7, 2007)

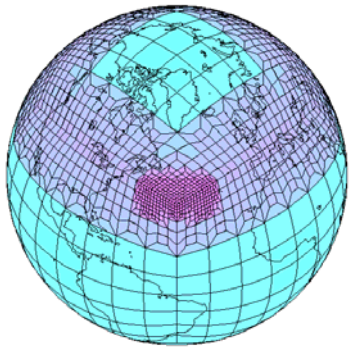


Simulation Leads:
George Backus,
Mark Boslough, Mark Taylor
Jim Strickland, Mgr.. jhstric@sandia.gov

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Agenda

- What we can do and have done
- Learning your needs
- Can we help?



Climate and Security

- Have been briefing and preparing to serve with the intelligence and defense community team to help in this mission since 2002.
- Have focused on the impacts of climate-change dynamics on conflict, destabilization, and security.
- Continued development of the required analytic capabilities to address combined security and climate interactions.

Previous Climate Security Work

- Dartmouth Resource Policy Center 1977 (Staff @ SNL)
- Interregional Modeling 1985 (SNL team)
- Cambridge University 1994 (SNL team)
- Aspen Economic Simulation (SNL) 1996/1997
- Climate and Security (SNL) 2003
- Climate and Conflict (SNL) 2004
- Societal Stability (SNL) 2005
- Economic Stability (SNL) 2005-2006
- Societal Evolution (SNL) 2006
- Societal Decisions (SNL) 2007
- DOE NCAR/SciDAC Dynamic Core (SNL) 1997-2007

Background/Partners

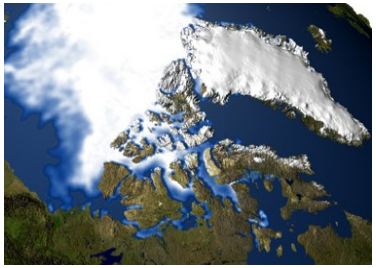
- Have partners for data and specialization (e.g. NCAR/ISSE, BP, Wall Street, Canada, European Union, PACOM, ARM, etc.)
- Some staff have 30 years of behavioral, societal, and economic analysis across many countries and policy domains.
- Provide the self-consistent, integrated, comprehensive, and coherent information for risk-informed decisions.

Working with the NIE Team

- Short-Term
  - Use our expertise for addressing climate-related security and conflict dynamics.
  - Incorporate matured (since 1974) staff competence in analyzing global dynamics and climate change impacts.
  - Can work with the community at SCI level, as required.
- Longer-Term
  - Integrate and use intelligence, engineering, defense, international proficiency with climate, behavioral, economics, social network, psychology, and anthropological analysis/modeling capability.
  - Emphasize Validation & Verification for decision-making under uncertainty.

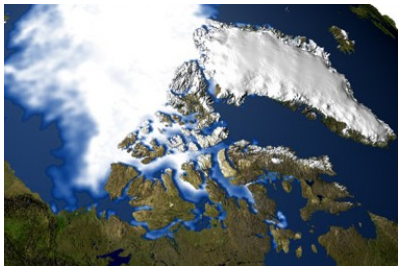
Simulating Climate/Security Dynamics

- Quantitative assessment using climate and behavioral socioeconomic models.
  - Conventional socioeconomic simulation tools do not contain the security issues/dynamics.
  - Need to capture critical resiliency and failed expectation dynamics that produce conflict realization.
  - Static perspective misses dynamically caused interactions
  - Generates early warning/leading indicators for political instability and false-alarms.
  - Requires regional socioeconomic and weather detail on a global scale.



Expanding Security Awareness

- Assess evolving nation-state societal, political, and financial instability (including terrorist exploitation).
- Model emerging threats and the countermeasures to manage them.
- Enumerate the potential evolution of conflict dynamics across regional boundaries.



- Analyze economic shifts and conflicts from Arctic-route trade expansion.
- Anticipate conditions to allow countermeasures that redirect the outcome away from catastrophic consequence.

Adapting to the Security Climate

- Assess technological requirements for geographically shifting threats, amid diminished efficacy of existing resources.
- Ascertain requirements for transformed military and political intervention needs.
- Provide tools for IC and military logistics in light of climate-change extremes.
- Assist the IC and military in studies and reports for strategic and tactical planning.

Time-Integrated Perspectives

- Migration can cause collapse or renaissance on either side of border, or can cause intra-national fracturing or international cascading.
- Disease vectors and rapid-collapse produce power voids where factional entities compete. Early slow dynamics can focus energies and limit other uses.
- Land-use feedback exacerbates local climate and cascading events.
- Financial market stability may be an early victim of climate-change.
- Mitigation efforts may be destabilizing.
- It is not what “happens” but what happens after what “happens” defines the outcome. Relative change is more important than absolute change.

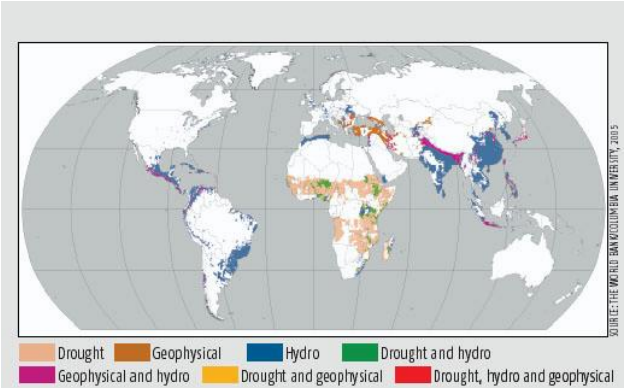
Analytical Convergence

- Atmospheric and Climate Studies, Security Studies, Conflict Studies, Economic Assessments
- Agent Based, System Dynamic, International Macroeconomic, Socioeconomic, And Climatological Simulation.
- Uncertainty Evaluation with Optimization
- Verification &Validation /Confidence Assessment/Falsifiability
- Consequence Evaluation and Unintended Consequence Avoidance
- Unrecognized Emergent Behaviors
- **Have all the component capabilities, but no authorization to integrate them.**

Backup Slides

A Changing Security Landscape

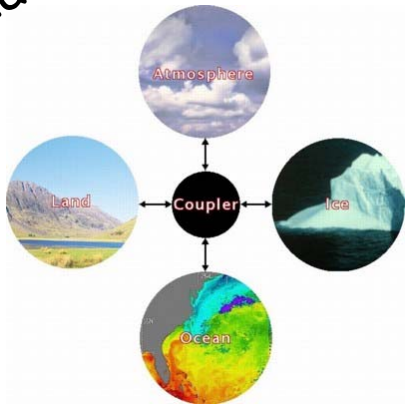
- US intervention resources may not be available:
  - Dramatic changes in extreme weather and weather variability will change the needs of the intelligence community: The current mix of equipment/resources will be suboptimal for the altered physical conditions of the engagement theater and will force changes in field tactics/contingences and the cost of interventions. (e.g., open Arctic and tempestuous Tropics).
  - Bases may no longer be useable for expected activities due to routine extreme-weather conditions (e.g. Guam).
  - Alliance partners (and their budgets) are preoccupied with climate-related disasters (e.g. Europe).



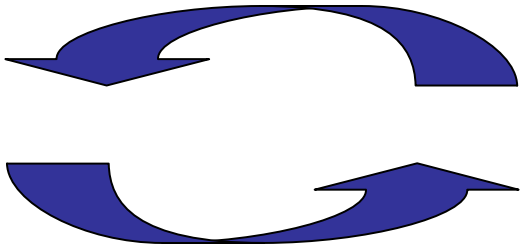
  - We expect climate-induced stresses to often dictate the location, type, and incidence of conflict with theater of operation and strategy changes due to climate-induced conditions (e.g. Chinese regional dominance).

Conflict Analysis Using Agents
Climate and Environmental Scarcity

Climate model

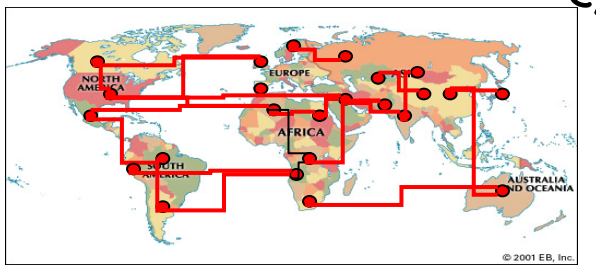


Social/Political/Economic feedback



Climatological feedback

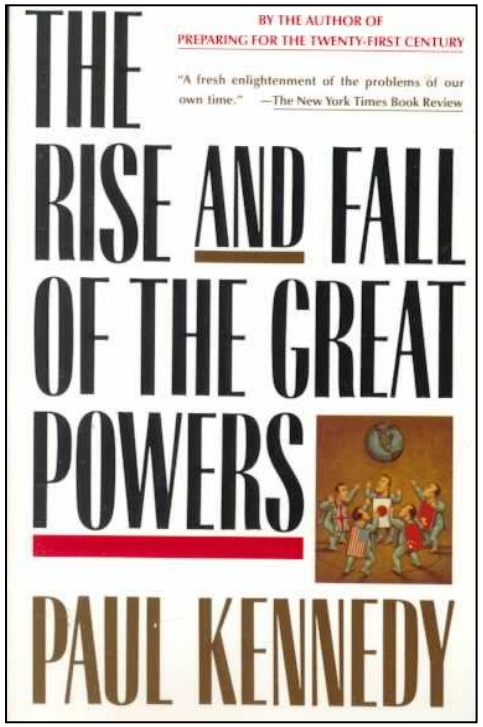
Conflict model



To achieve the level of detail needed for local/regional simulations that account for dynamic network structures:

Climate Models, Nation/State Agent models and GeoPolitical models can be combined on our massively parallel computational platforms to enable bi-directional feedbacks.

Regional Climate Impacts and Economic Resilience

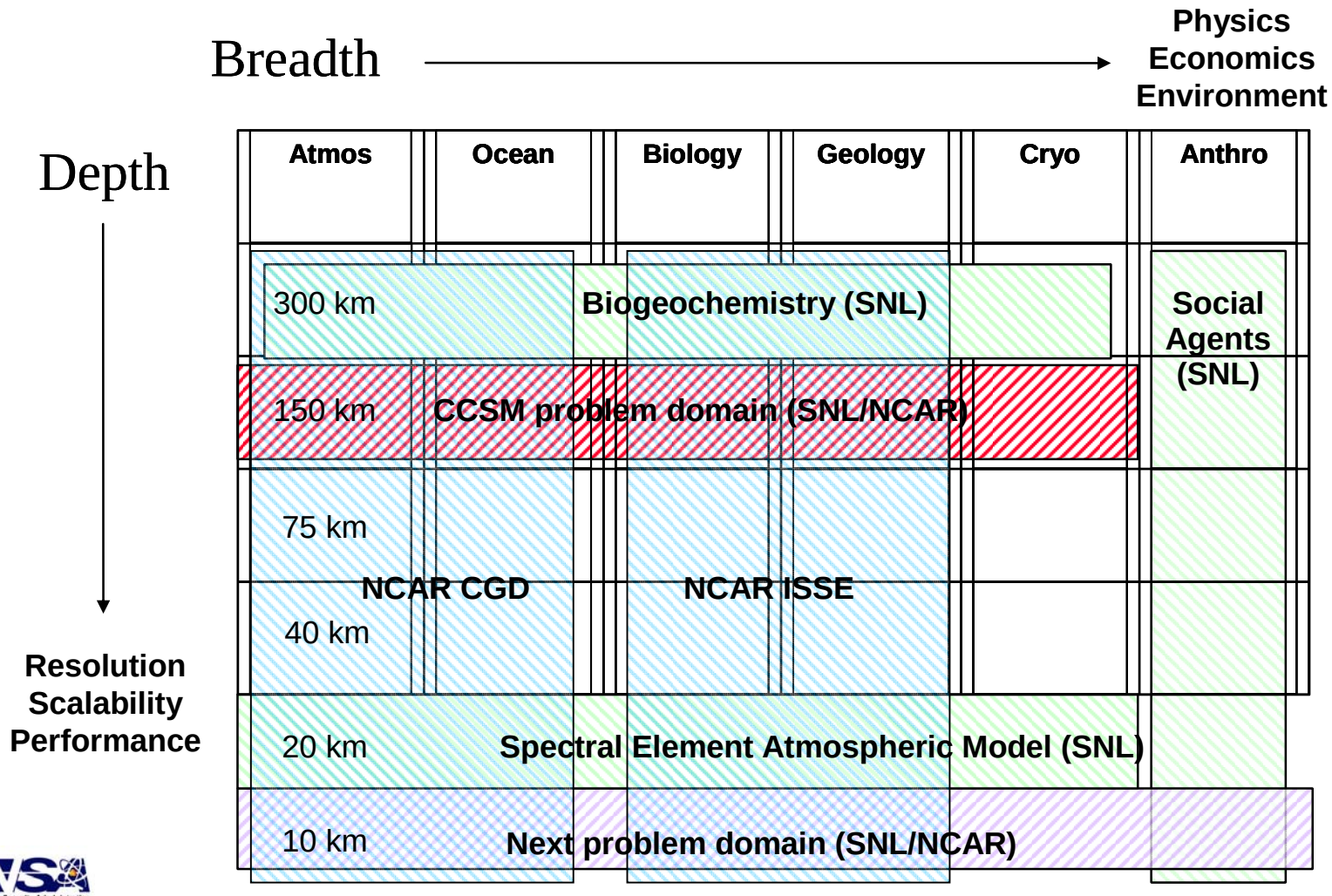


".. if a state overextends itself strategically--by, say, … the waging of costly wars--it runs the risk that the potential benefits from external expansion may be outweighed by the great expense of it all -- a dilemma which becomes acute if the nation concerned has entered a period of relative economic decline."

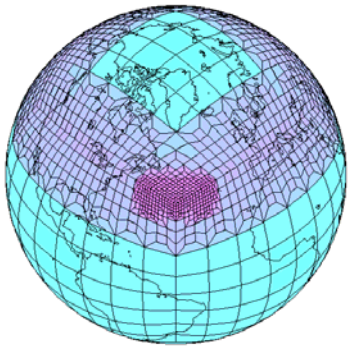
Paul Kennedy, The Rise and Fall of the Great Powers

History validates that Great Powers fall not by military might, but by the loss of economic sustainability. Climate change presents such as risk. In a tightly globalized world, local economic disruptions causes conflicts that become international threats.

Coverage: SNL/NCAR initiative has depth and breadth

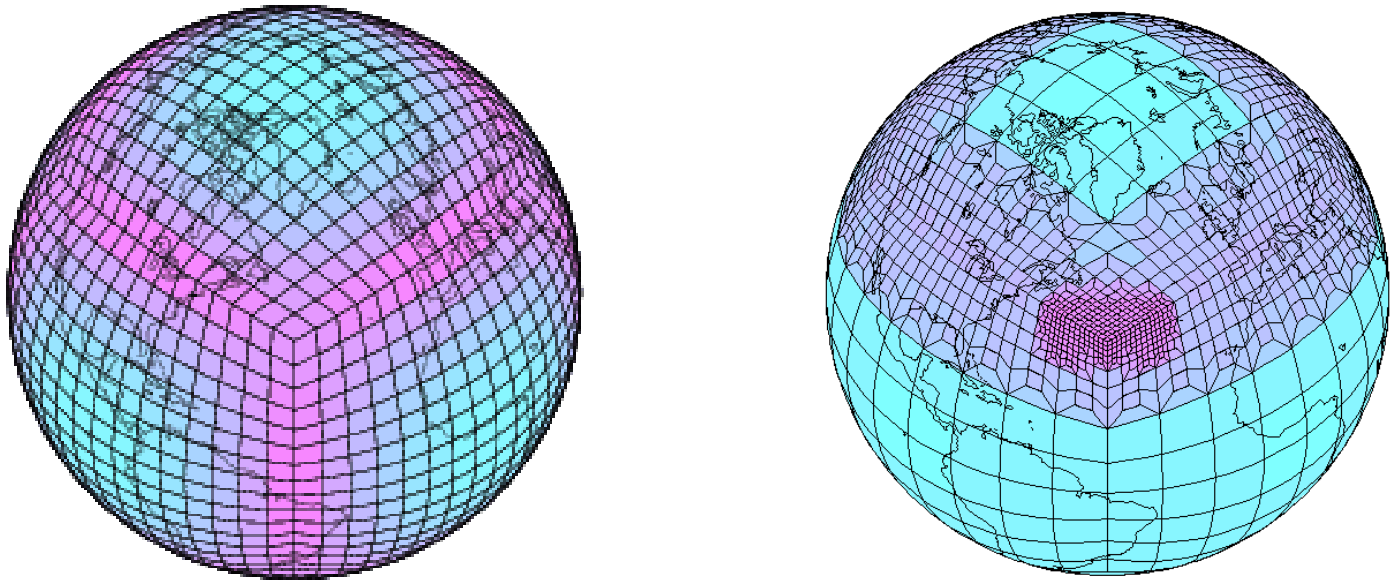


Improved Forecasting



- Currently, even DoD only has regional models with adequate geographical resolution coupled to a global model at lower resolution.
- The new 10 KM resolution dynamical core at Sandia can be used for global high-resolution weather forecasting as well as for climate.
- Global-level analyses avoid low resolution errors in the boundary conditions for regional models.
- With high-resolution global weather capabilities, any part of the globe can be continuously evaluated – as resources or personnel move across “regional” boundaries.
- This capability can provide end-to-end mission weather along all the logistic and “supply chain” aspects of the mission (globally and over time) for both planning and operations.

SNL Climate-Societal Modeling can focus on local events causing global affects



SNL Adaptive Mesh Refinement and “Cubed Sphere” Simulation

A Modeled Agent