U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING

SUBJECT: LONG-TERM CLIMATE MODELING

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RENO, NEVADA
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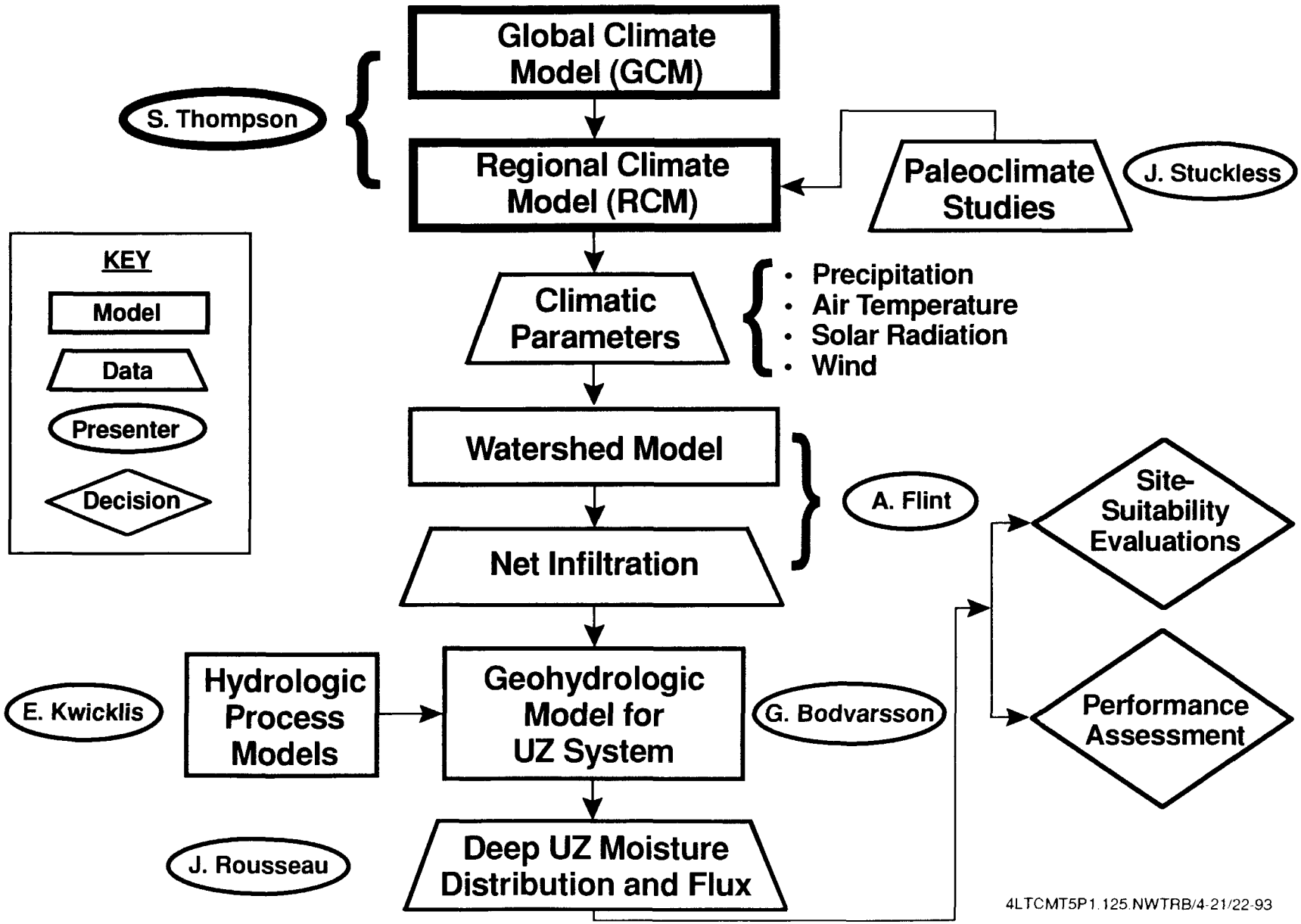
Example Model Hierarchy



Outline

Study Purpose and Objectives

Value and Limitations of Predictive Models

Current Model Basis

Study Approach

Current Program Status

Study Purpose and Objectives

Purpose:

- **To provide estimates of future climate conditions in the Yucca Mountain region for use in estimating the effects of future climate on hydrologic conditions**

Study Purpose and Objectives

(Continued)

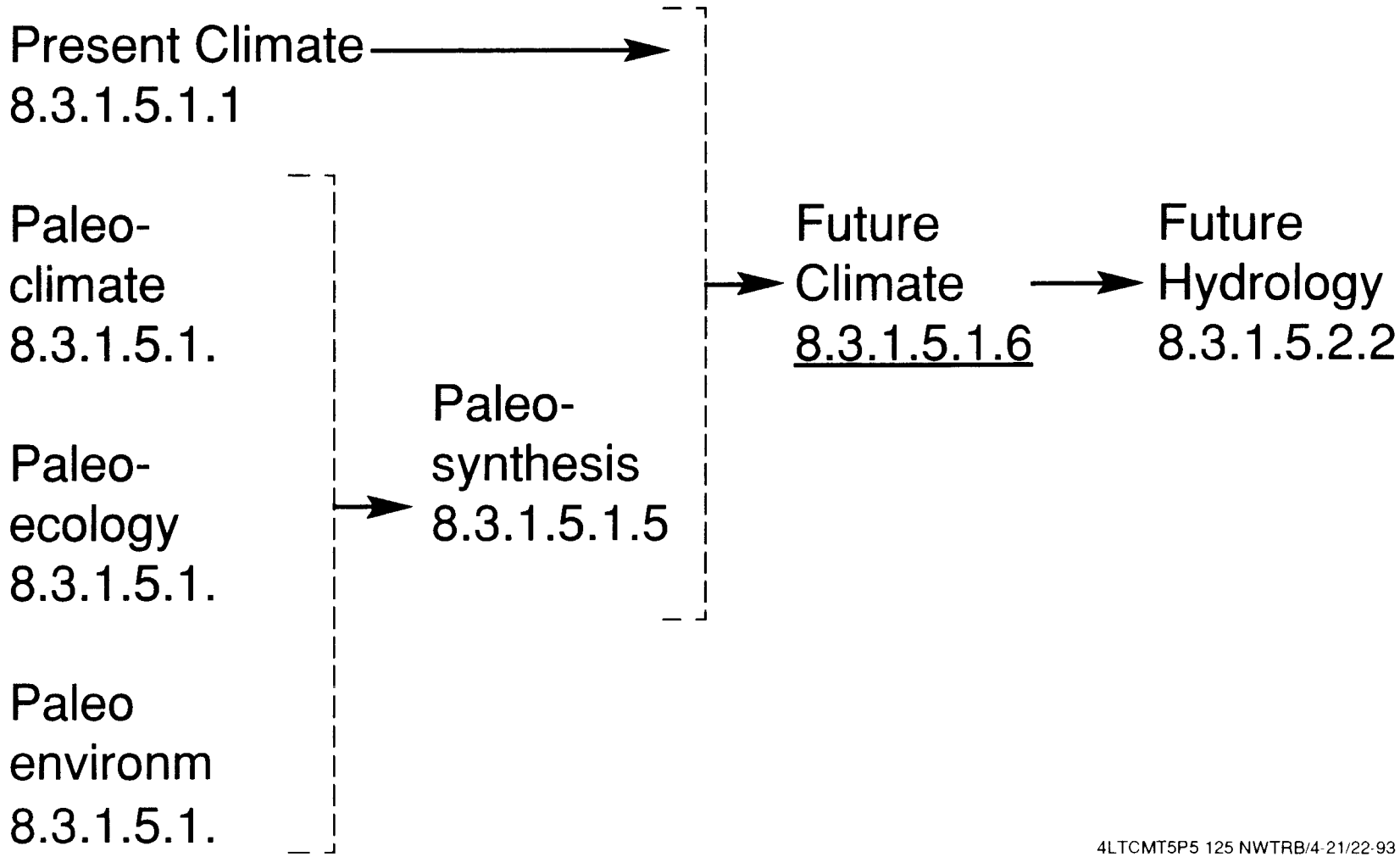
Objectives:

- To establish the validity of numerical climate models on both global and regional scales;
- To identify future climate scenarios that may impact post-closure repository performance through their effect on future hydrologic conditions; and
- To use these models to provide estimates of climate conditions for the next 100,000 years, with an emphasis on the next 10,000 years.

Study Purpose and Objectives

(Continued)

SCP Interfaces



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Value and Limitations of Predictive Models

Value of Predictive Modeling:

- Modeling used to build confidence in anticipated performance
- Scientific method used for validating hypotheses and for reaching consensus on natural-system driving forces
- Identifies unanticipated phenomenological behavior

Value and Limitations of Predictive Models

(Continued)

Limitations of Predictive Modeling

- Will not yield "guaranteed answers"
- Limited simulation period because of intense computational demands
- Model uncertainty; i.e., spatial resolution, precipitation simulation

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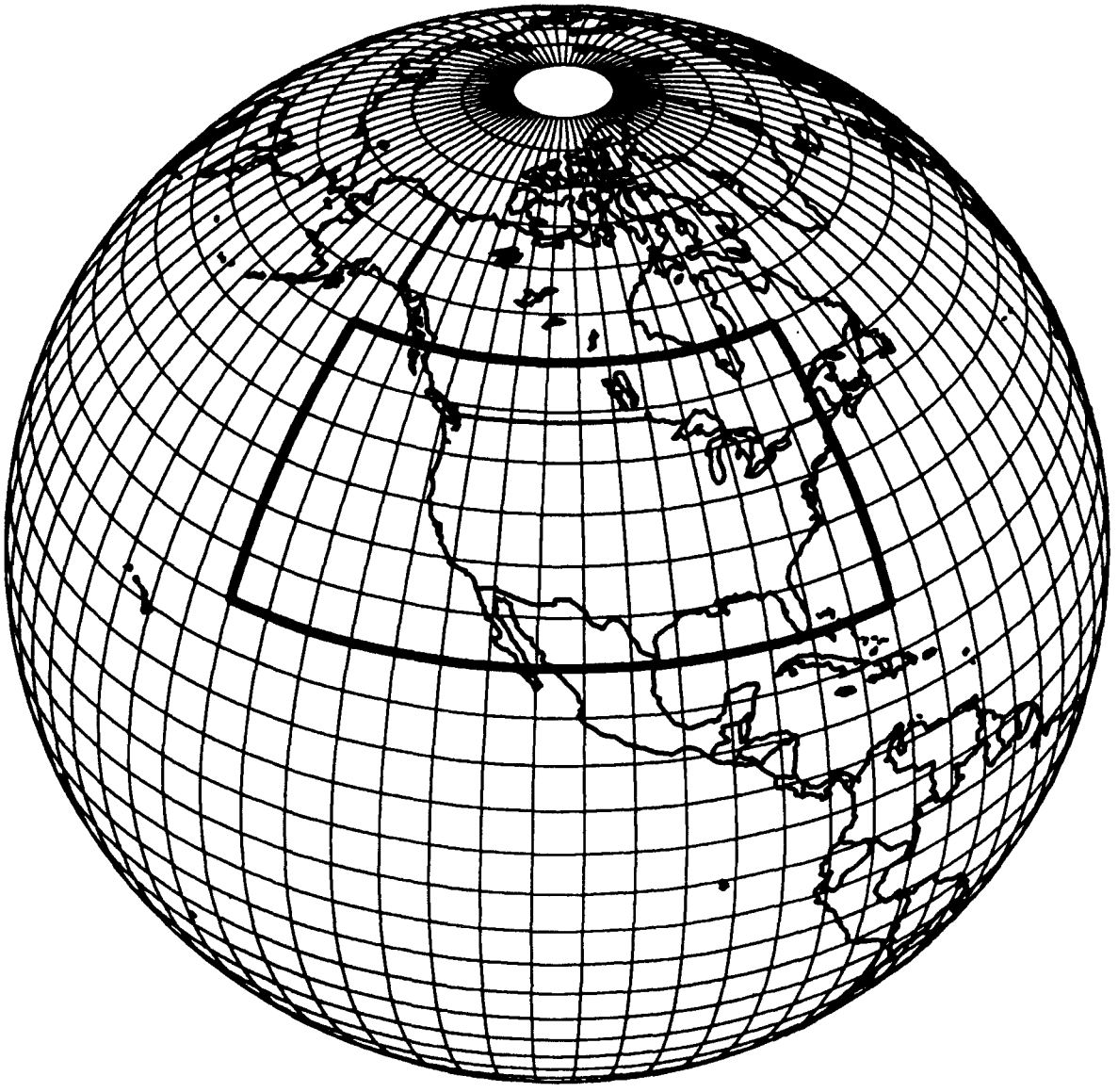
Current Model Basis

Global Climate Model (GCM: GENESIS):

- Global ENvironmental and Ecological Simulation of Interactive Systems
- ~ 500 km grid spacing
- Provides boundary conditions to regional model via one-way link

Global Climate Model (GCM) Grid Mesh and Regional Domain



Current Model Basis

(Continued)

Regional Climate Model (RCM: MM4-BATS):

- Mesoscale Model 4 - Biosphere Atmosphere Transfer Scheme
- 60 km grid spacing
- Resolves important topographic features better than global model
- Includes vegetation and subsurface water transport effects

Regional Climate Model (RCM)
Grid Mesh

4LTCMT5P 125.NWTRB/4-21/22-93

Current Model Basis

(Continued)

Model Output:

- **Model Variables:**
  - Temperature, precipitation, wind, solar and infrared radiation, soil moisture, runoff

- **Output format:**
  - Time series of gridded data covering a few years with hourly resolution

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Study Approach

Phased Approach with iterative evaluation of results and incorporation of developments in climate modeling

- **Planning and Controls**
  - Issue Study Plan
  - Implement Quality Assurance Controls
  - Initiate Advisory Board
- **Testing of one-way GCM --> RCM Interface**
- **Current/Paleo Climate Model Validation Analysis**
- **Future Climate Analysis**

Study Approach

(Continued)

Scenario selection

- Assume future climate can be represented as a finite set of states; selections from this set are called "future climate scenarios"
- Selections are based on paleoclimate, current climate, and modeling and theoretical information
- Selection biased towards those anticipated to yield higher precipitation (examples: Ice age, global warming, super El-Niño)
- Reasonable range of scenarios, subject to limitations of available computer resources

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Current Program Status

- Transitioning Pacific Northwest Laboratory (PNL) global climate work into consolidated future-climate work at Sandia National Laboratories (SNL)
- Completing SCP 8.3.1.5.1.6 Study Plan
- Implementing improved contract and quality controls
- Completed preliminary validation of RCM with current regional observations