

# The NCAR-Wyoming Supercomputing Center (NWSC): Computing Infrastructure for the Earth System Sciences

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*Presentation to the UW Board of Trustees*

*16 September 2010*



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# NWSC NCAR-Wyoming Supercomputing Center



For more information visit, [www.nwsc.ucar.edu](http://www.nwsc.ucar.edu)

## NWSC Partners:



## Architects, Contractors and Consultants:

H+L Architecture | Saunders Construction, Inc. | California Data Center Design Group | Rumsey Engineers | RMH Group  
Martin & Martin Consulting Engineers | Rider Levett Bucknall | Reliable Resources | E Cube, Inc.





Energy



Agriculture



Water  
Resources



Infrastructure



Severe Storms



Hurricanes



Climate Change



Solar Flares



Persistent Droughts



Displaced  
Populations



Ecosystem Damage



Infrastructure Damage

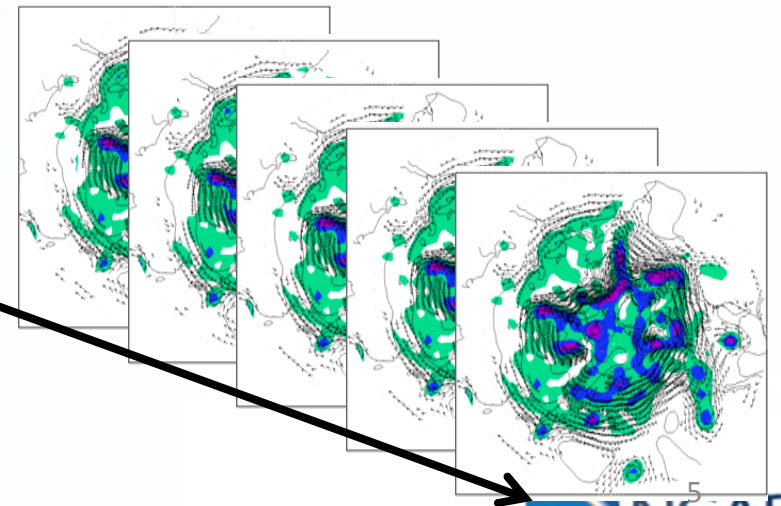
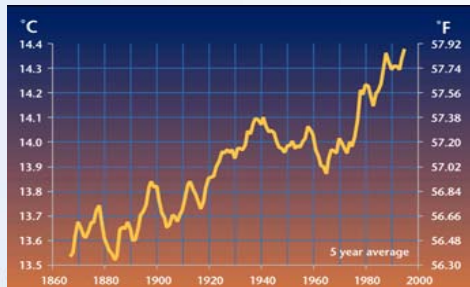
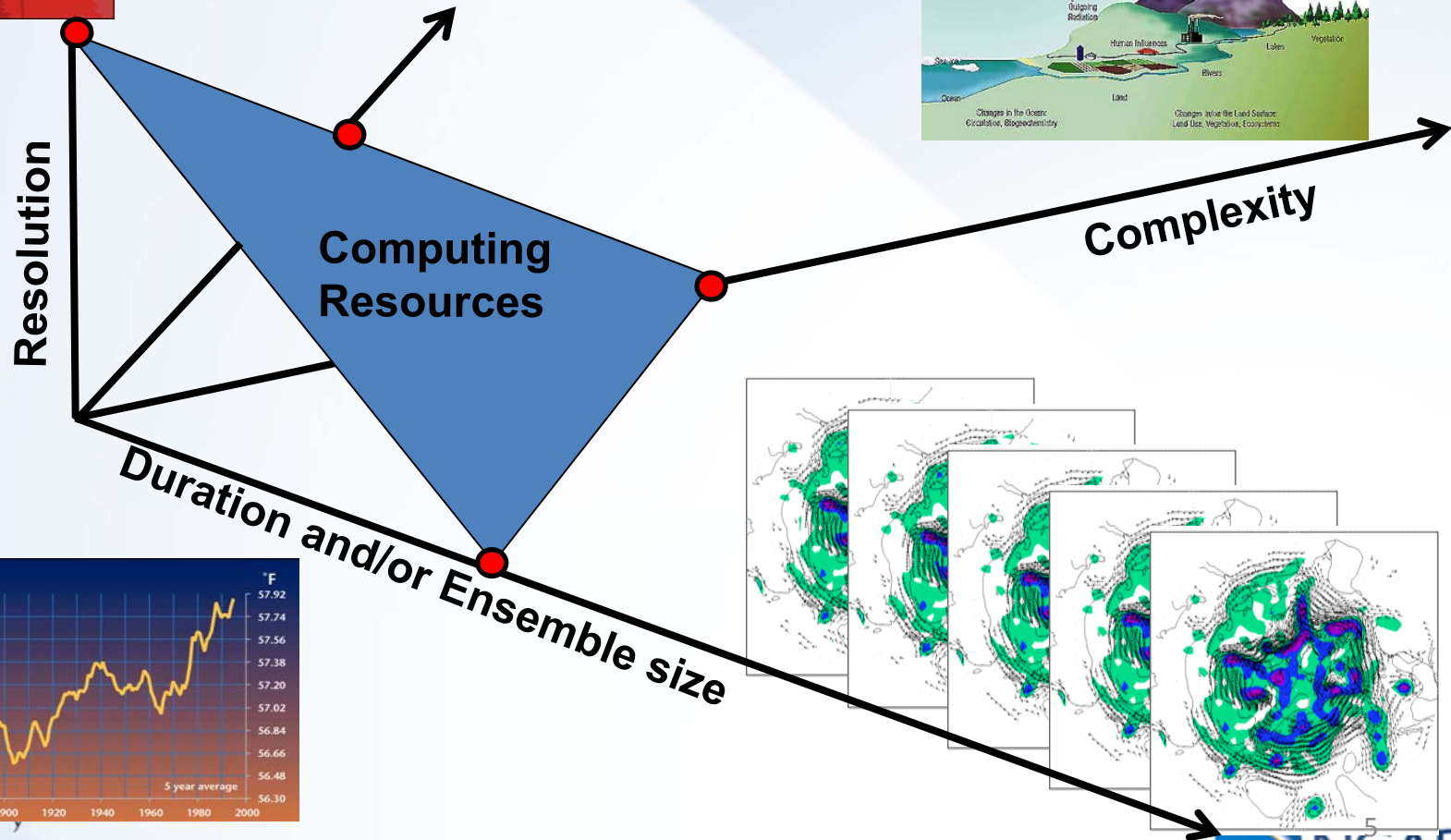
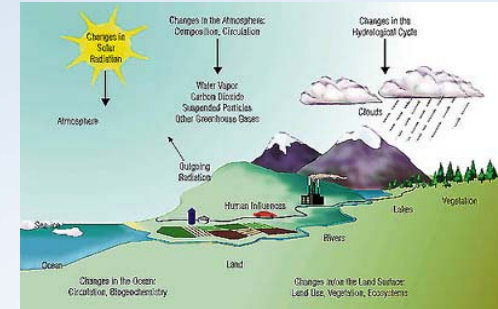
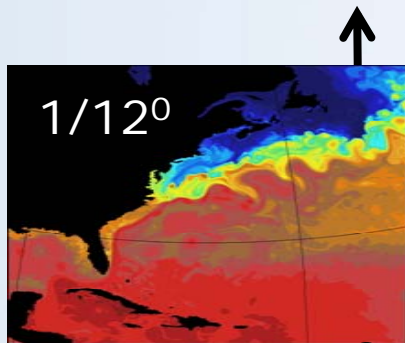
# Earth System Science Drivers

- Severe Weather
  - Hurricane Track and Intensity
  - Eyewall Precipitation and Winds
  - Probabilistic Forecasts
- Climate Change
  - Decadal Climate Prediction
  - Regional Climate Change Effects
  - Probability of Extreme Events
- Clouds – major source of error
  - Global Cloud Resolving Models
  - Super-parameterization scheme
  - Better Cloud Parameterizations



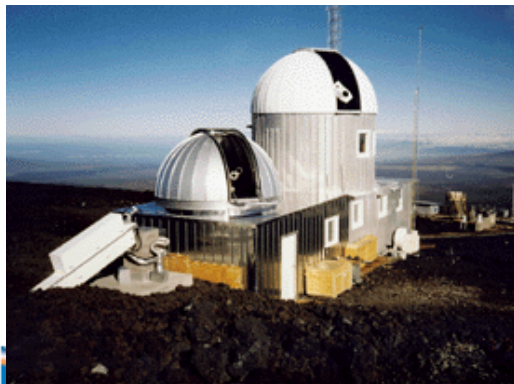


# Balancing Science Goals with Computing Power



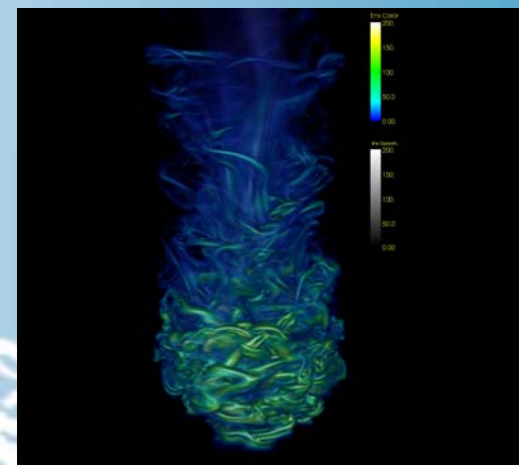
NCAR's founding mission is "... to provide, or arrange for provision of facilities for the scientific community as a whole whose initial cost and upkeep lie beyond the capability of individual universities or research groups."

*Preliminary Plans for a National Institute for Atmospheric Research,*  
1959, NCAR Blue Book



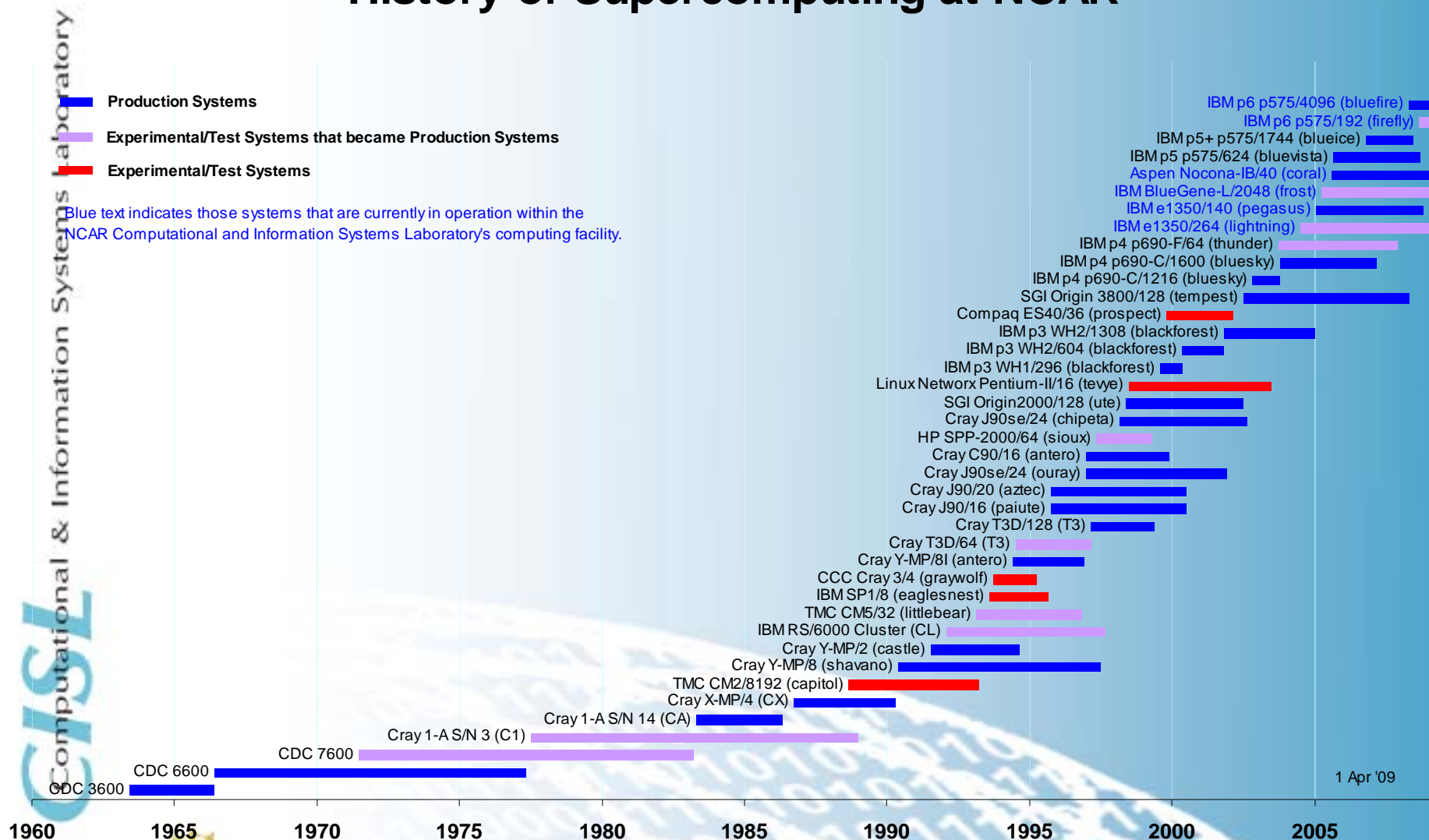
# The NCAR Computational and Information Systems Laboratory (CISL) Mission

- To support, enhance, and extend the *capabilities for transformative science* to the university community and the broader scientific community, nationally and internationally
  - *Provide capacity and capability supercomputing*
  - *Develop and support robust, accessible, innovative and advanced services and tools*
  - *Create an Earth System Knowledge Environment*





# History of Supercomputing at NCAR



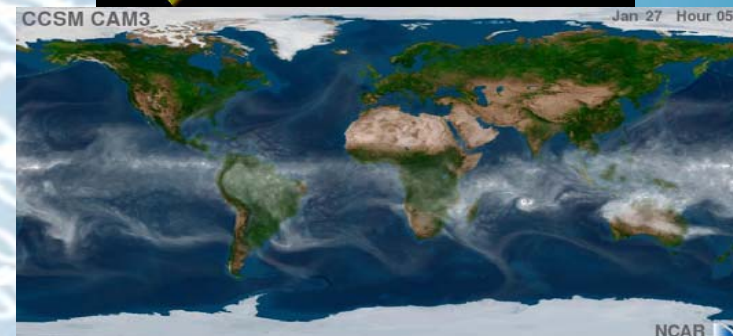
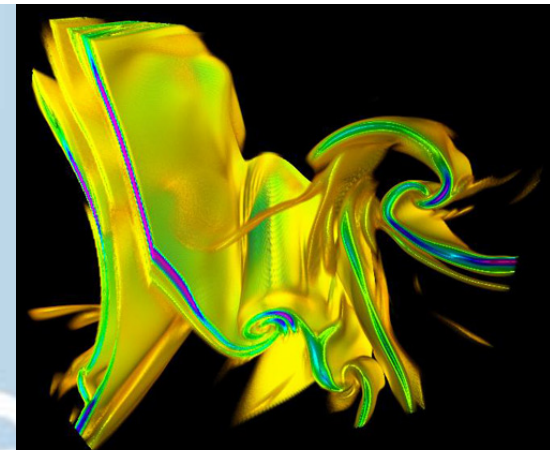
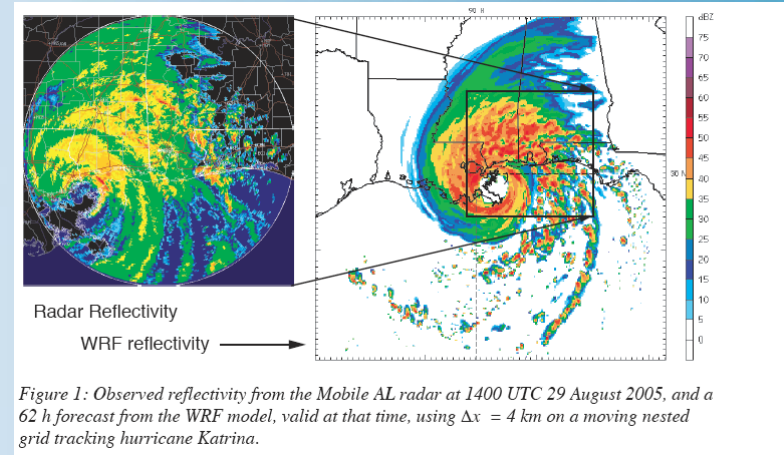
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# Capability Computations

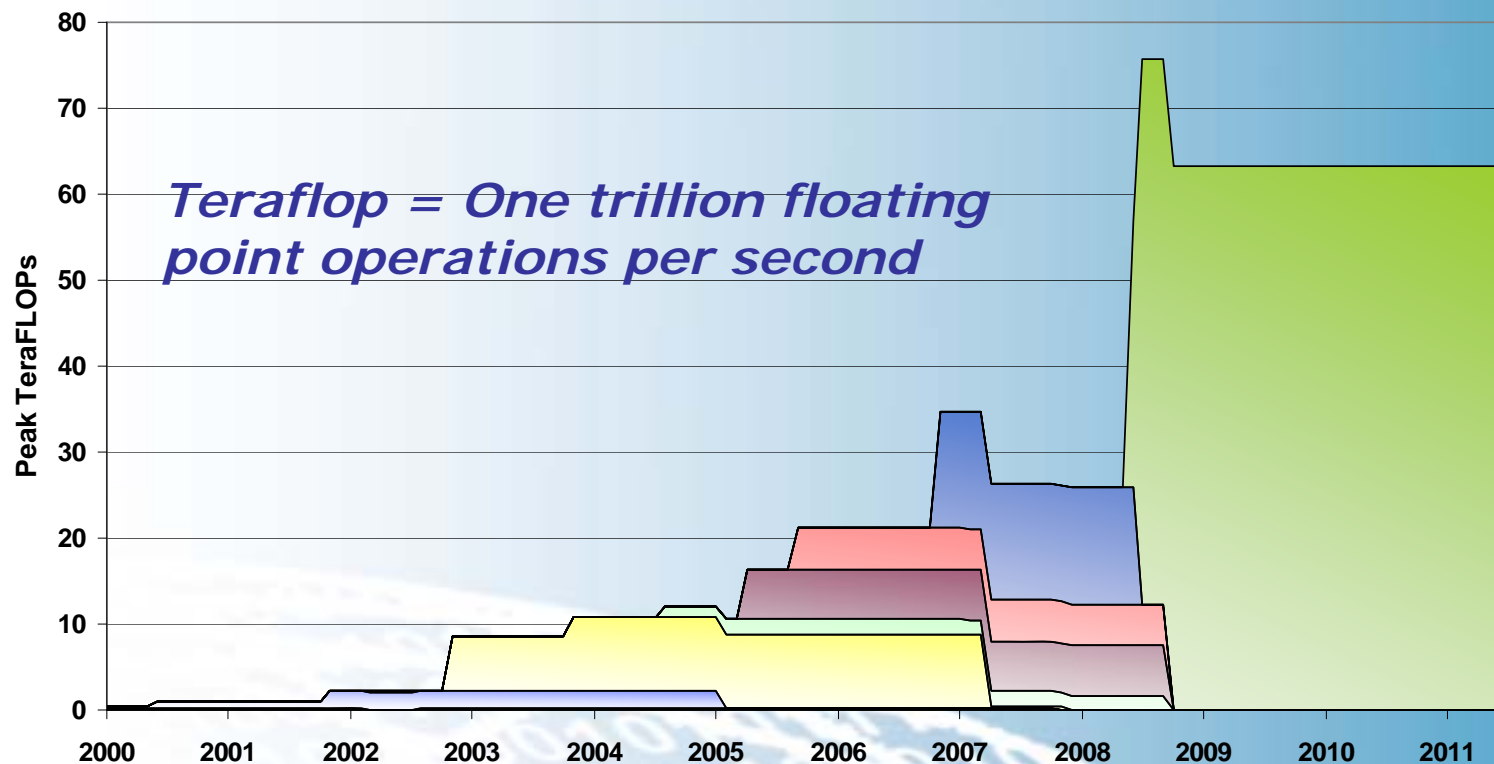
- **On-Demand Computing**
  - *Spring U.S. Weather Forecasts*
  - *Field Programs Support*
  - *Hurricane Forecasting*
  - *Climate Campaigns (IPCC)*
- **Breakthrough Science Computations**
  - *Climate Model Development*
  - *Retrospective High Resolution Hurricane Modeling*
  - *Ocean Physics*
  - *Turbulent Flows at Ultra-High Resolution*



# Computing Capacity (peak TFLOPs) at NCAR

Supercomputing Power at NCAR

All Others POWER3 POWER4 Linux  
BG/L POWER5 POWER5+ POWER6



WRF 1.0

CCSM 2.0

WRF 2.0

CCSM 3.0

WRF 2.1

NRCM  
Simulations

WRF 2.2

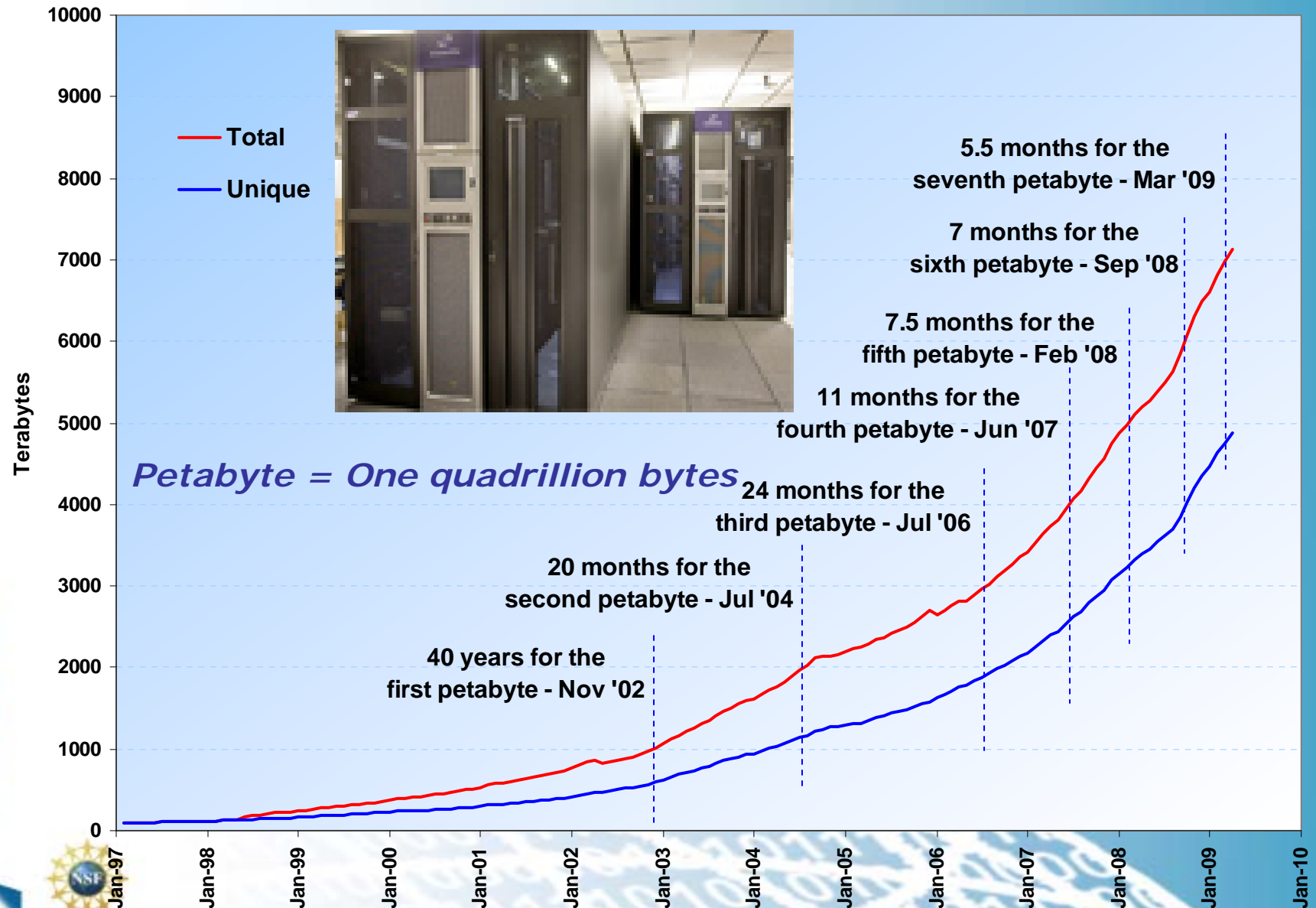
CCSM 4.0

IPCC AR4  
Simulations

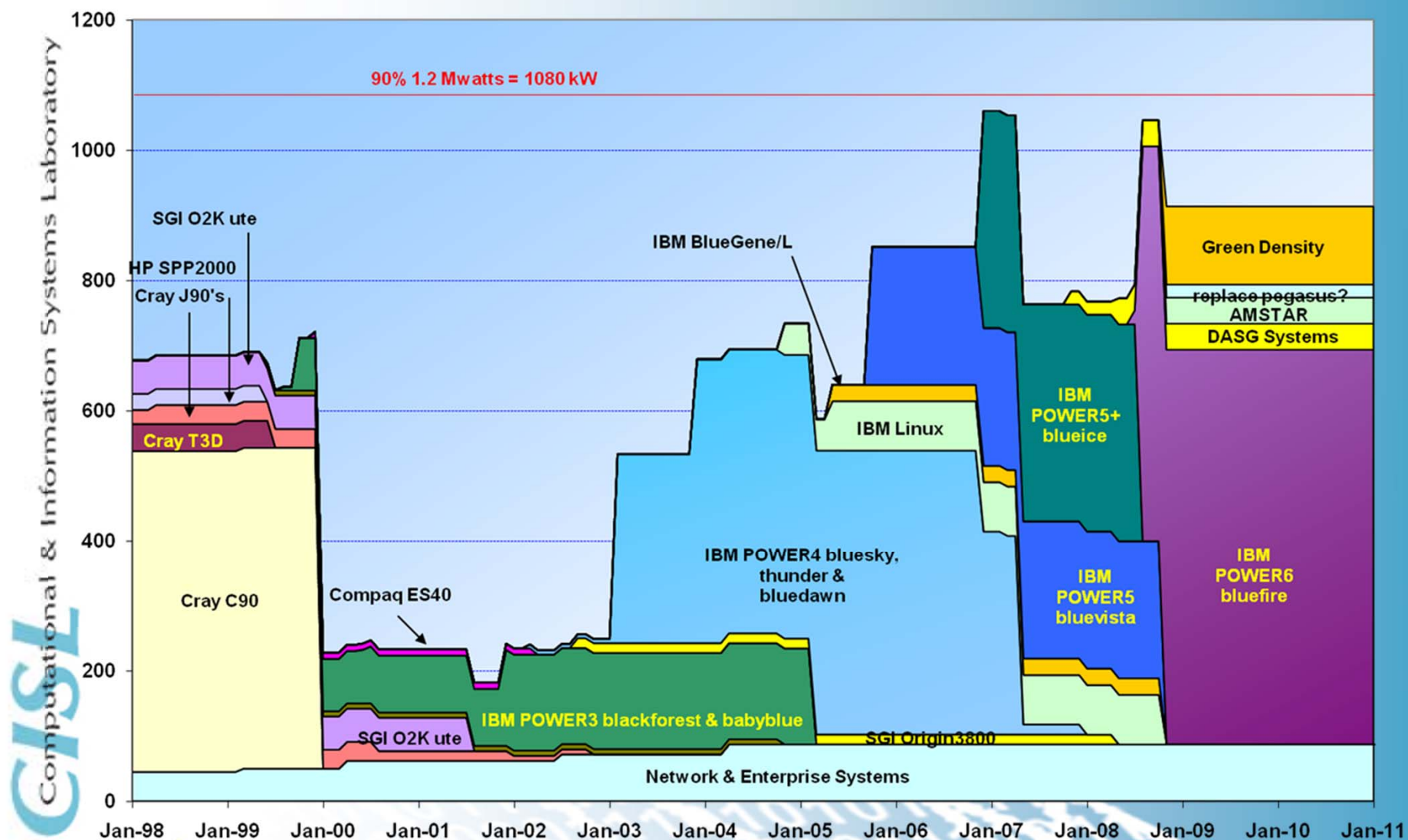
IPCC AR5  
Simulations



# NCAR MSS - Total Data in Archive



# CISL Computer Facility Power Consumption (Measured kW)



CISL

Computational & Information Systems Laboratory



NCAR



## The NWSC – A Facility to Meet HPC Needs of the Earth System Sciences

- Focus on the construction of a world-leading, energy efficient facility that is modular and flexible to meet community computing and data storage requirements.
  - *Maximally energy efficient* to reduce carbon footprint and operational expenses (OPEX)
  - *“Right sized”* to constrain capital expenses (CAPEX) supporting 4-5 MegaWatts (MW) of computing load
  - *Expandable* to accommodate future growth in community computing needs.

## Design Highlights

- Total facility size of 165,000 gross square feet (GSF)
- LEED Gold certification achievable
- Focus on sustainability, including:
  - Compressor-free cooling for majority of the year, waste heat recycling, harvesting of natural light, use of locally sourced building materials whenever practicable, minimum of 10% of power from locally generated renewable energy
- Total available power load for first raised floor module of 4.5 MegaWatts (MW)
  - Will achieve higher power load than original target value (4 MW) due to efficiency of design

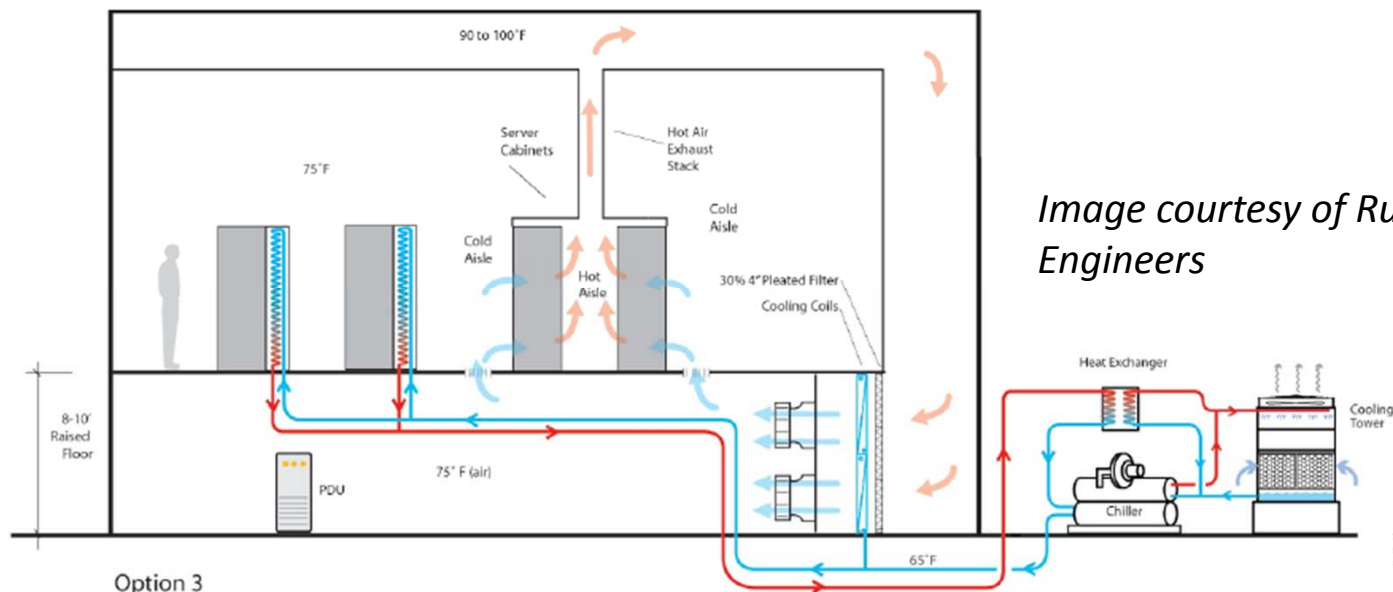


Image courtesy of Rumsey Engineers



# NWSC NCAR-Wyoming Supercomputing Center



*Image courtesy of H+L Architecture*



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*Image courtesy of H+L Architecture*



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# NWSC NCAR-Wyoming Supercomputing Center



June 20



July 2



September 2010

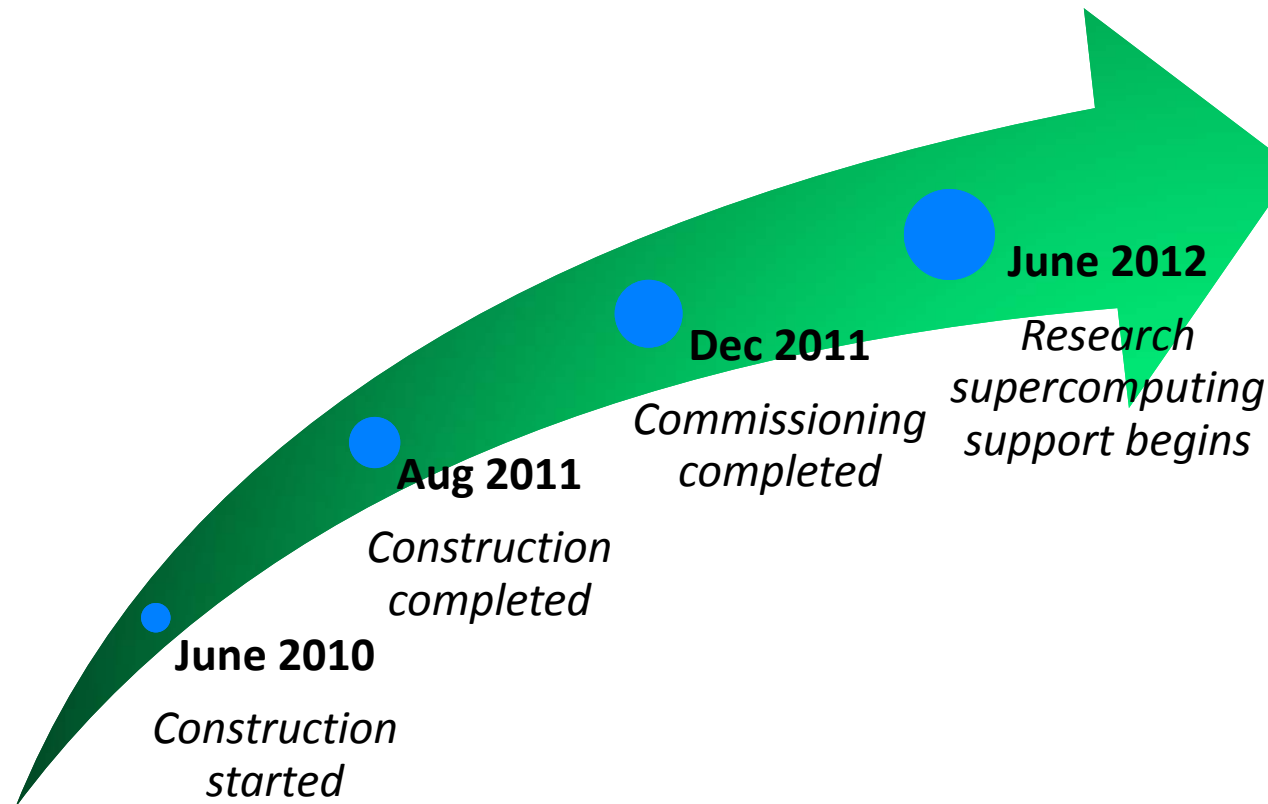
*Photos courtesy of Gary New (NCAR/CISL)*



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## Project Timeline



Thank you

*For more information please visit  
[www.nwsc.ucar.edu](http://www.nwsc.ucar.edu)*