Big Data
High Performance Computing and Communication Resources

David L. Michaud
Deputy Director, High Performance Computing and Communications
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http://www.cio.noaa.gov
Big Data Is NOT New


National Oceanographic and Atmospheric Administration

3.5 billion observations per day from NOAA sensors

"The Tank" 24-hour Ring Buffer

6-Hour Update Cycle

Global Atmospheric Model (HIRAM)

HPC Models

Other High Res Specialized Models:
- Hurricane (3 Km)
- Thunderstorms
- Tornadoes
- Fire Weather
- Ocean Models
- Volcanic Ash
- Etc.

15 million information products per day

Forecast & Warning Guidance to Public and Private Sector Forecasters

National Weather Service Data Stream
NOAA High Performance Computing Capabilities & Locations

**Research and Development (R&D) HPC Systems**
- Boulder, CO – Development HPC System
  - 348 TF

**Future Operational HPC Systems**
- Fairmont, WV – Backup Ops HPC System – 74 TF
- Development HPC System – 383 TF

**Operational HPC Systems**
- Princeton, NJ – Climate Post-Processing & Analysis
- Gaithersburg, MD – Primary Ops HPC System
  - 74 TF
- Reston, VA (Future)
  - Primary Ops HPC System
  - 208 TF

**Orlando, FL (Future)**
- Backup Ops HPC System
  - 208 TF

Oak Ridge, TN – Research HPC System
- 1,800 TF
### Operational Supercomputing

<table>
<thead>
<tr>
<th>Currently Operational</th>
<th>Go-Live End of FY13</th>
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<tbody>
<tr>
<td><strong>Location</strong></td>
<td><strong>Location</strong></td>
</tr>
<tr>
<td>• Primary</td>
<td>• Primary</td>
</tr>
<tr>
<td>– Gaithersburg, MD (IBM provided facility)</td>
<td>– Reston, VA (IBM provided facility)</td>
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<tr>
<td>• Backup</td>
<td>• Backup</td>
</tr>
<tr>
<td>– Fairmont, WV (GFE NASA IV&amp;V facility)</td>
<td>– Orlando, FL (IBM provided facility)</td>
</tr>
<tr>
<td><strong>Systems Configuration</strong></td>
<td><strong>Systems Configuration</strong></td>
</tr>
<tr>
<td>• Identical Systems (per site)</td>
<td>• Identical Systems (per site)</td>
</tr>
<tr>
<td>– IBM Power 6/P575/AIX</td>
<td>– IBM iDataPlex/Intel Sandy Bridge/Linux</td>
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<tr>
<td>– 73.9 trillion calculations/sec</td>
<td>– 208 trillion calculations/sec</td>
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<tr>
<td>– 5,314 processing cores</td>
<td>– 10,048 processing cores</td>
</tr>
<tr>
<td>– 0.8 petabytes of storage</td>
<td>– 2,059 trillion bytes of storage</td>
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</tbody>
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**Performance Measures**

- Highly Reliable / Highly Available
  - Minimum 99.0% Operational Use Time
  - Minimum 99.0% On-time Product Generation
  - Minimum 99.0% Development Use Time
  - Minimum 99.0% System Availability
# R&D Supercomputing

## Development HPC
### Systems Configuration
- **Zeus - Fairmont, WV** (GSA Leased Space)
  - Focused on Weather Development
  - SGI ICE8400 / Intel Westmere / Linux
  - 383 TF / 27,096 cores
  - 50PB Hierarchical Storage / IBM HPSS
- **Jet - Boulder, CO** (NOAA Skaggs Facility)
  - Focused on Hurricane Forecast Improvement
  - Aspen/Appro Whitebox / Intel / Linux
  - 348 TF / 27,216 cores
- **Princeton, NJ** (GFDL/Princeton Facility)
  - Climate Post-Processing and Analysis
  - 16 Analysis Nodes / Dell / 16 core Intel Xeon
  - 75 Post Processing Nodes/Dell/8 core Intel Xeon
  - 40PB Hierarchical Storage / SGI pDMF

## Research HPC
### Systems Configuration
- **Gaea - Oak Ridge, TN** (Oak Ridge National Lab)
  - Focused on Climate Research
  - Cray XE6 / AMD Interlagos (x86) / Linux
  - 1.1 PF / 120,320 cores
  - Focused on Engineering Next Generation Code
  - Cray XK6 / AMD (x86) and Nvidia GPU / Linux
  - ~200 TF
- **Titan - Oak Ridge, TN** (Oak Ridge National Lab)
  - Focused on Engineering Next Generation Code
  - Cray XK7 / AMD (x86) and Nvidia GPU / Linux
  - ~500 TF

### Performance Measures
- Minimum 97.0% System Availability
- Minimum 99.0% Data Availability
What is N-Wave?

- NOAA high bandwidth, low latency network connecting scientists to HPC
- Built using 10Gbs wave division multiplexed fiber-optic links supplied by national Research and Education network community including Internet2 and university run regional network consortiums
Technical Challenges

- Readiness for next generation of compute technology
  - Algorithms/Design of models to scale
  - Considerations for I/O bandwidth compared to compute
  - Knowledge and training of greater R&D community

- Resiliency – More prone to issues as systems and data grow
  - Silent data corruption
  - Integrity issues in end-to-end data movement
  - Built-in Error handling
  - Reliability in product generation and delivery

- Where does data live? / Tools to better exploit it?
  - Remote vs. local analytics
  - Services-based dissemination
  - Homogeneous view of heterogeneous data sources