

# Past, Present, and Future of HPC

National Weather Service

David Michaud / NWS NCEP Central Operations

U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Weather Service



# Wide Ranging Forecasts and Warnings: From the Sun to the Sea



**Space Weather**



**Winter Weather**



**Severe Weather: Tornadoes,  
Hail, Damaging Winds**



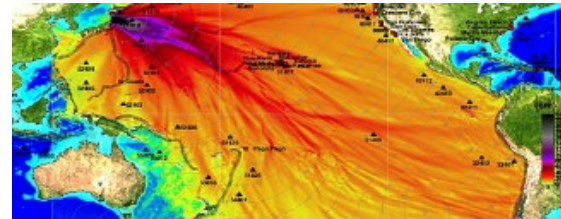
**Extreme Heat**



**Floods/Water**



**Fire**



**Tsunami Warnings**



**Drought**



**Aviation**



**Ocean Prediction**



**Tropical Weather**

**NWS ensures public safety, national security, and a robust American economy**

# NWS Operates in the Communities We Serve

122

Weather Forecast Offices

21

Center Weather  
Service Units

13

River Forecast  
Centers

9

National Centers for  
Environmental Prediction

7

National/Regional  
Headquarters

2

Tsunami Warning  
Centers

1

National Water Center



# Impact-Based Decision Support Services

Forecasts are Only the Beginning



Our  
forecasts &  
warnings:  
confidence,  
context, social  
science



Tabletops,  
feedback,  
engagement:  
Trusted  
connections with  
decision-making  
partners

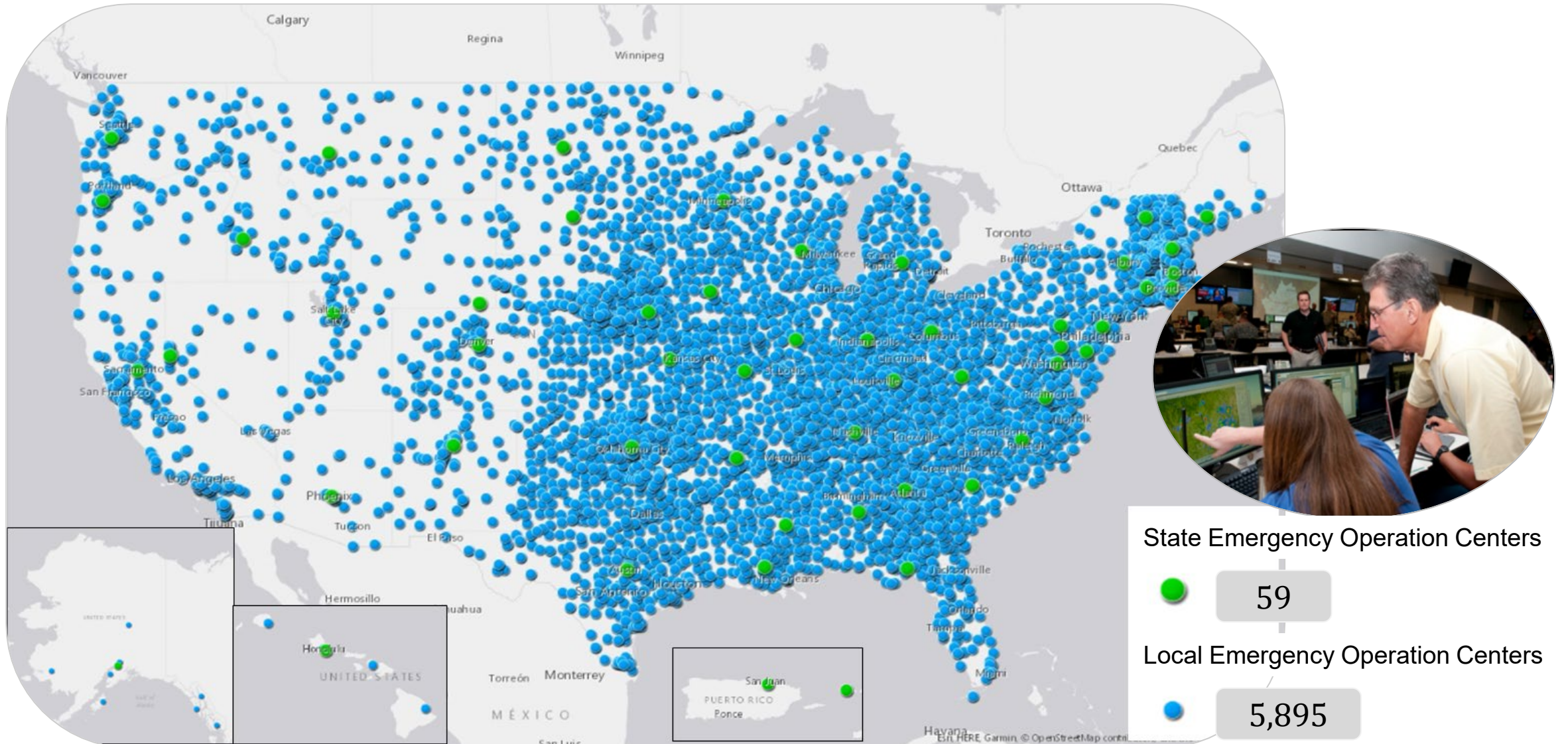


**Impact-based  
Decision  
Support  
Services**  
Actionable  
Environmental  
Intelligence



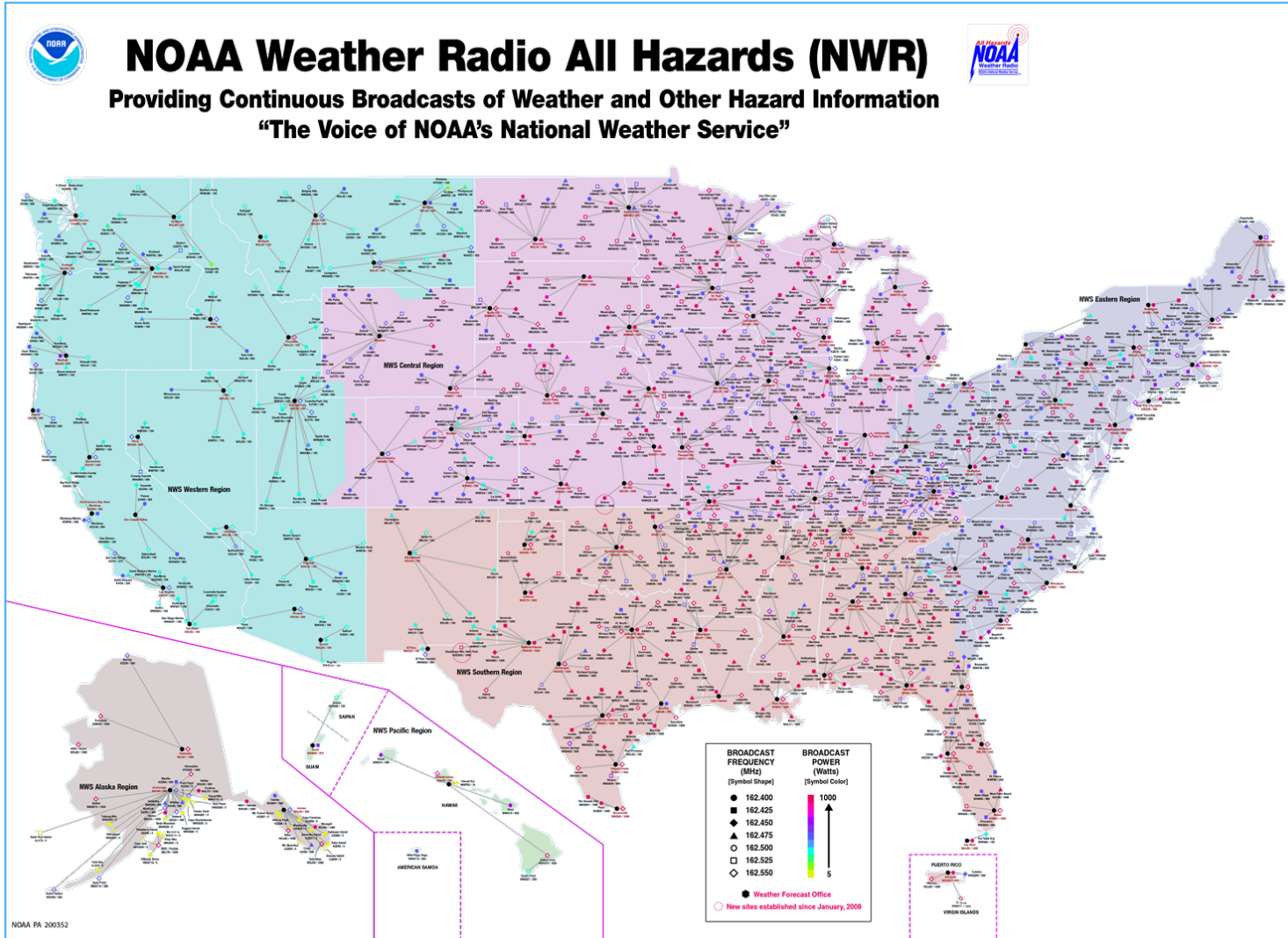


# Eye to Eye with Decision Makers

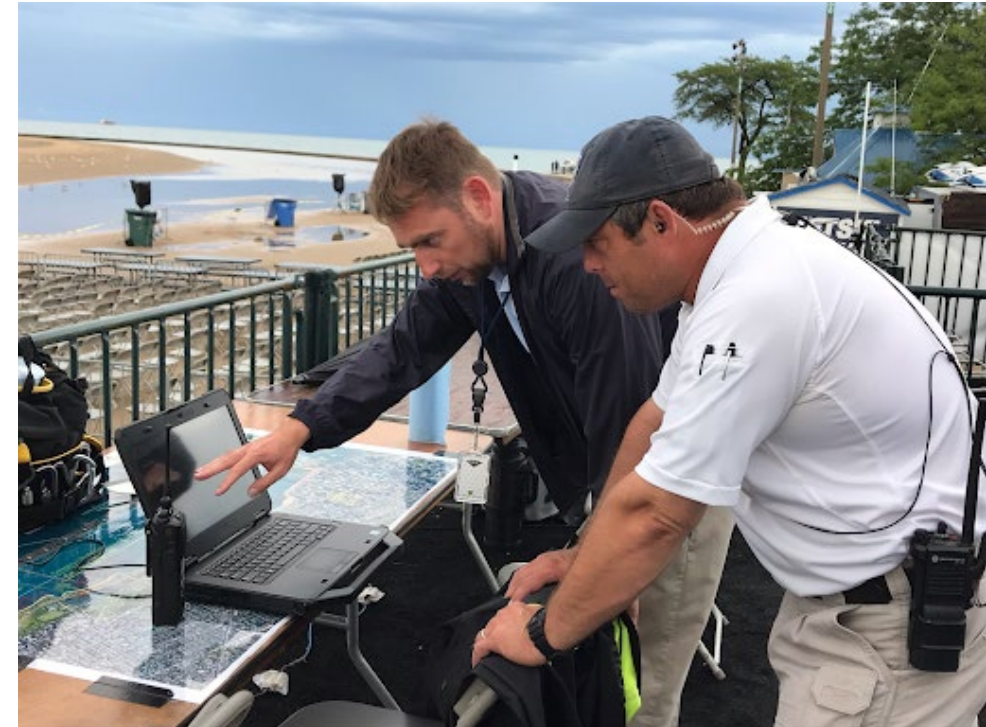




# Transforming Infrastructure and Operations



Infrastructure and technology that is mobile, flexible, and nimble to meet the forecasters’ where they need to best serve with decision makers



# National Weather Service: 155 Years Young

- 1870: Weather services established within U.S. Army Signal Service's Division of Telegrams and Reports
- 1890: U.S. Weather Bureau established as civilian agency
- 1902: American Marconi begins broadcasting U.S. Weather Bureau forecasts to mariners
- 1955: Joint Numerical Weather Prediction Unit formed  
U.S. Weather Bureau acquires last IBM-701  
(from spare parts) to operate NWP suite

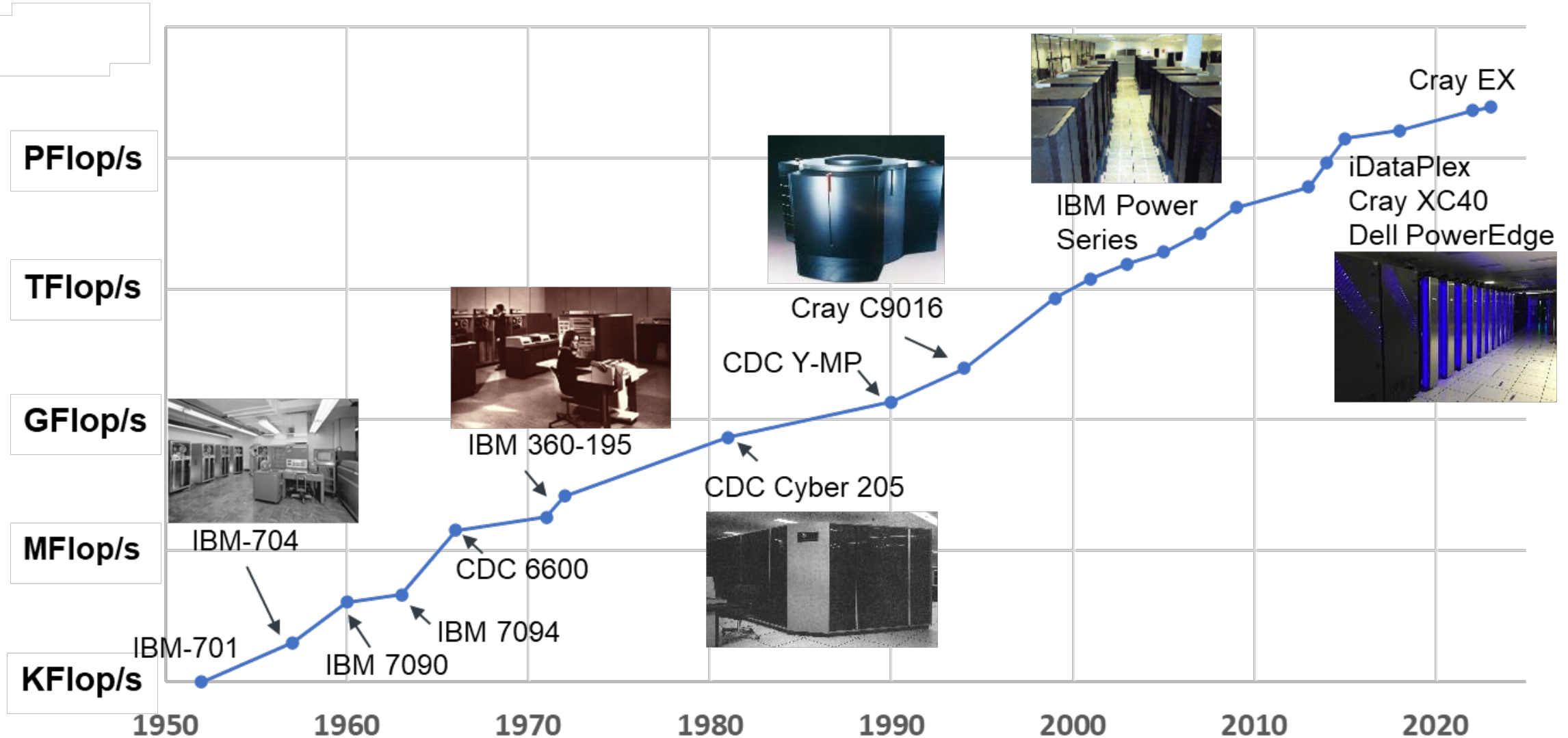
The "Bologna" connection!

- American Marconi was first subsidiary of British Marconi holding rights to Guglielmo Marconi's radio patents

First U.S. Weather Bureau HPC

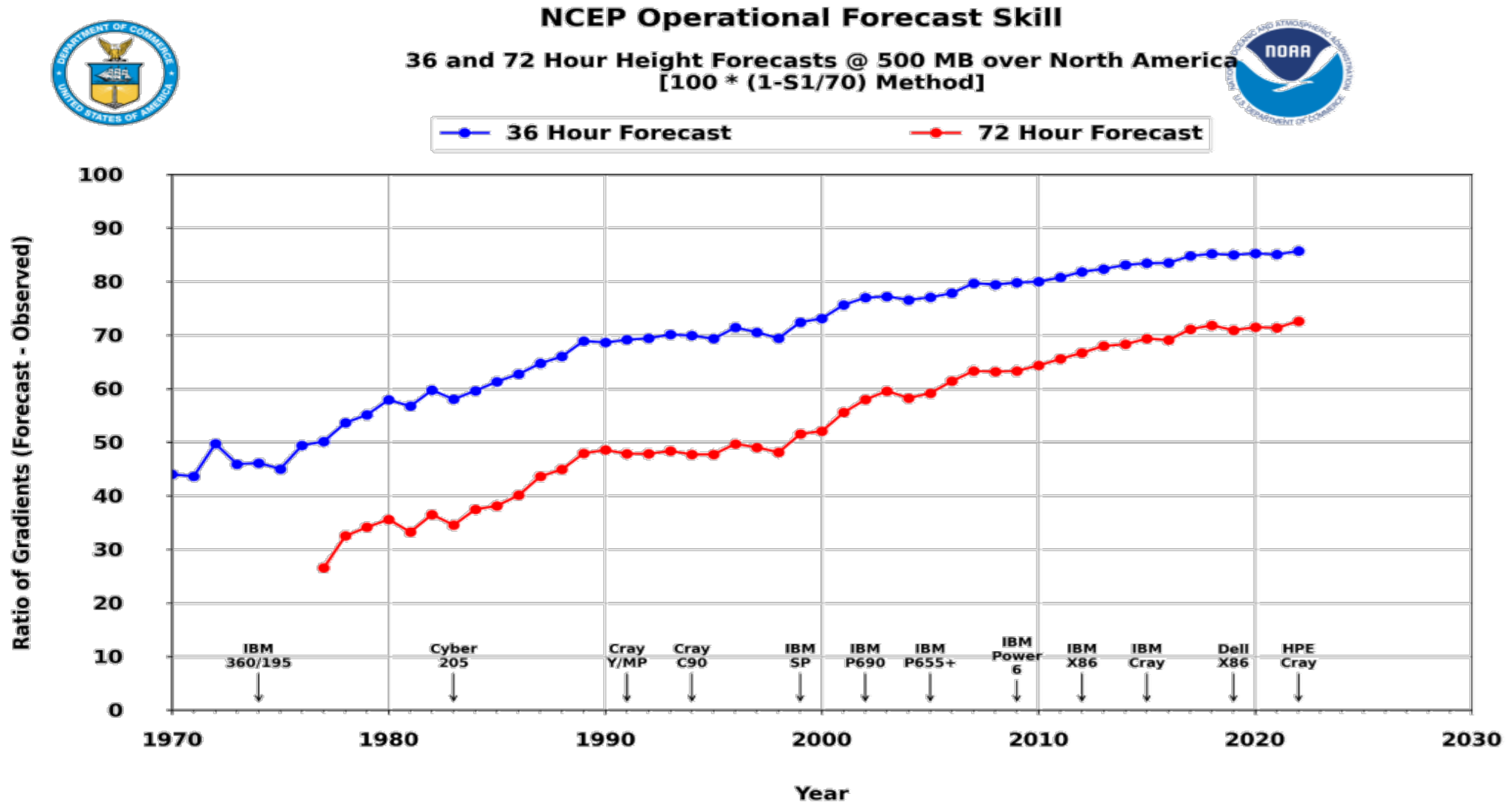
Content Delivery Network Traffic for Tsunami.gov website

# NWS Operational HPC Peak Performance Trend





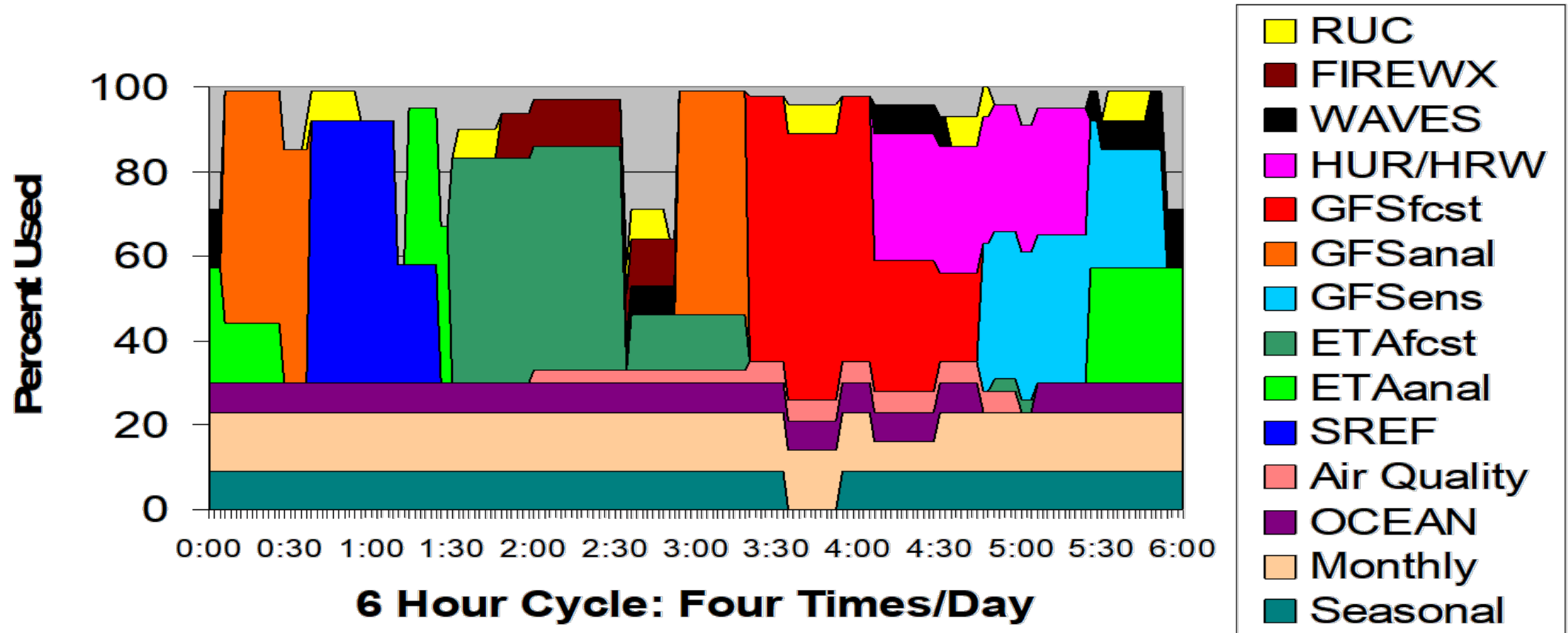
# Critical Role of HPC in Forecast Skill Improvement



# Production Suite on HPC (2004)

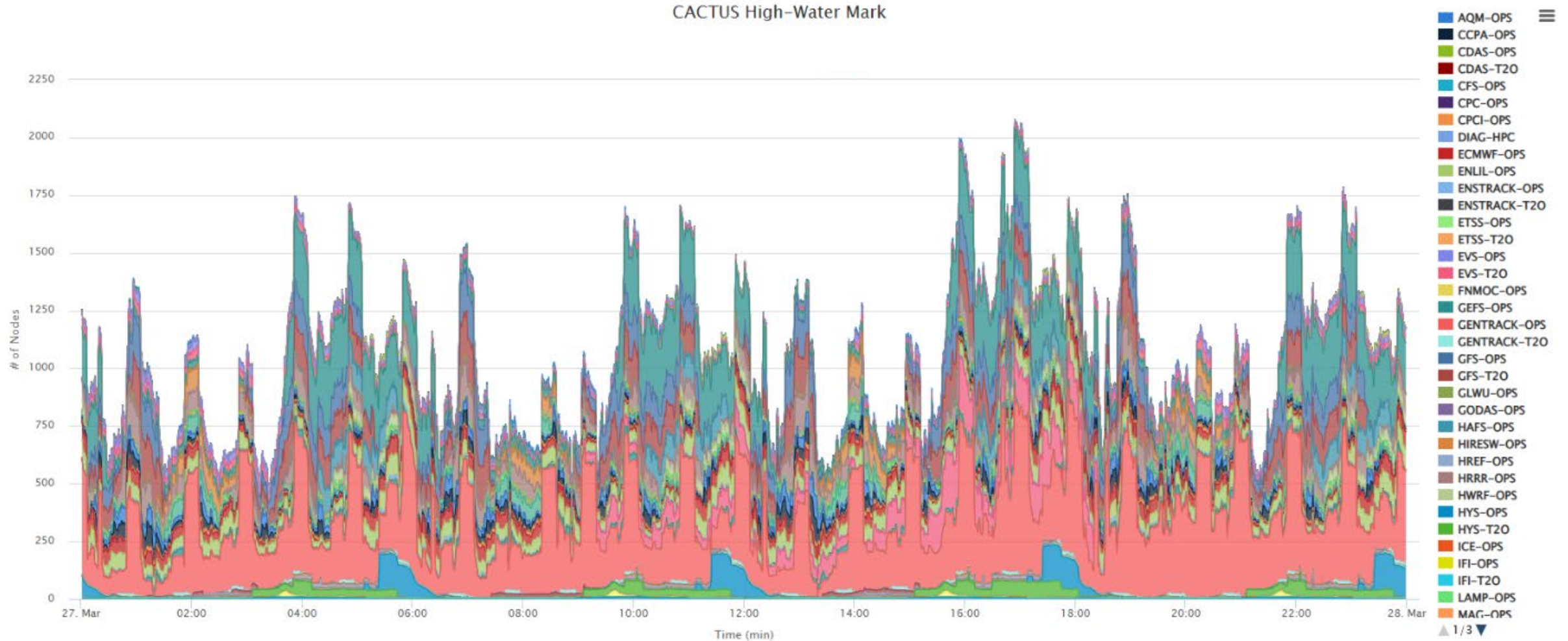
## NCEP Production Suite Weather, Ocean & Climate Forecast Systems

Version 3.0 April 9, 2004

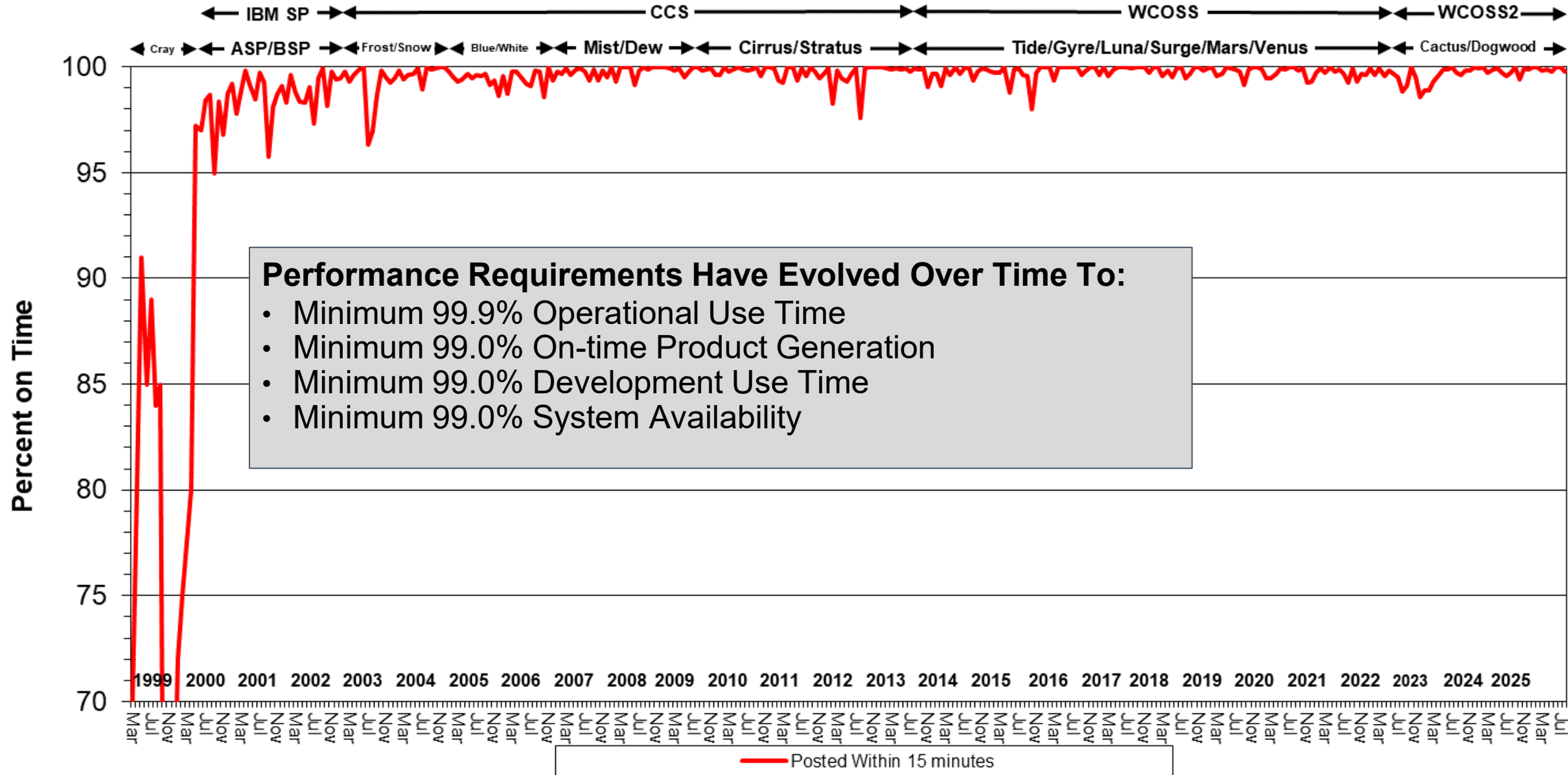




# Production Suite on HPC (Today)



# Product Generation Summary



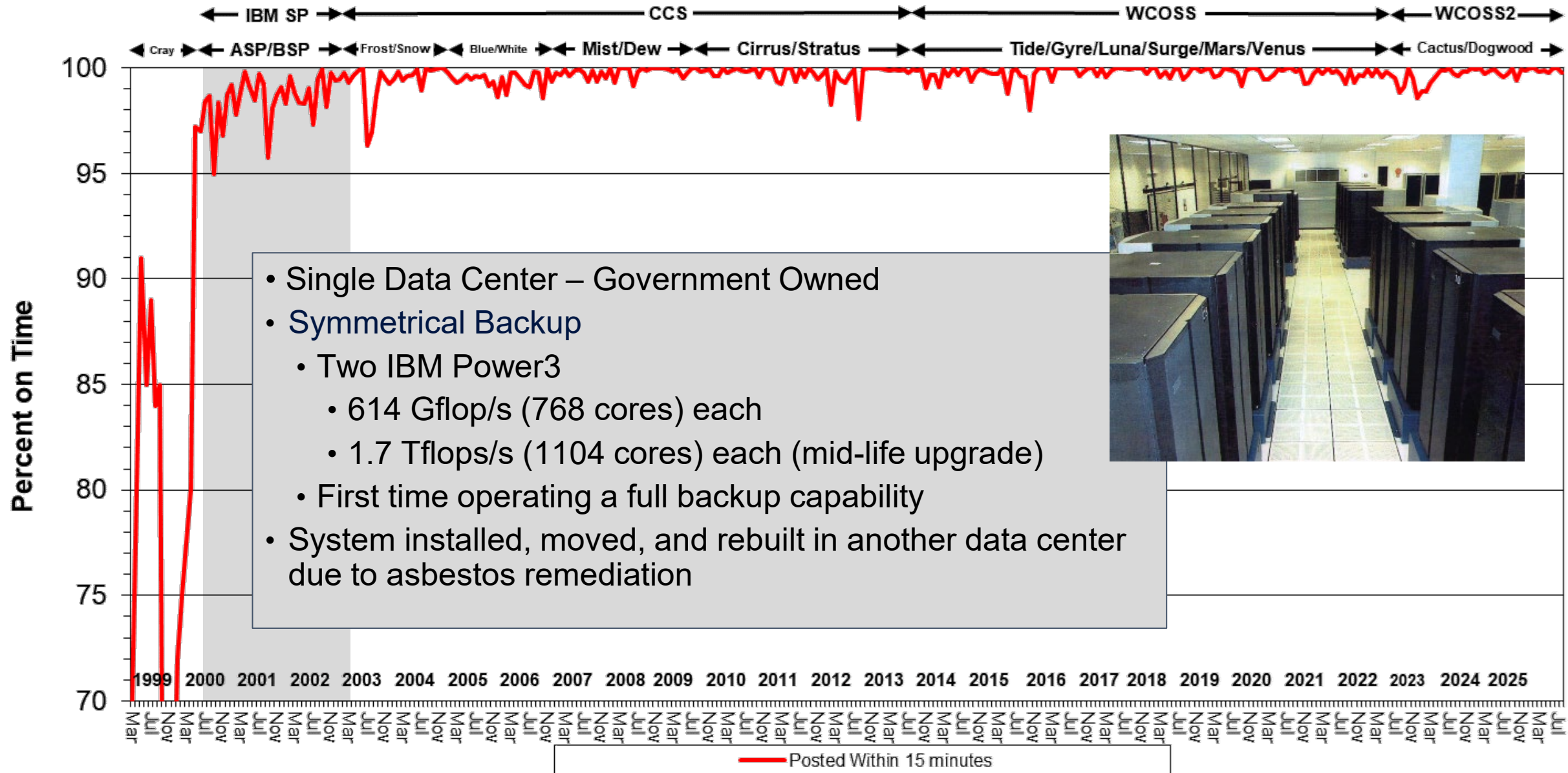


A horizontal timeline showing the evolution of climate models from 1970 to 2020. The timeline is marked with years at 10-year intervals. Models are represented by horizontal bars with arrows at both ends, indicating their active period. The models shown are: IBM SP (1970-1980), CCS (1980-2000), WCOSS (2000-2010), WCOSS2 (2010-2020), Cray (1970-1980), ASP/BSP (1980-1990), Frost/Snow (1990-2000), Blue/White (2000-2010), Mist/Dew (2010-2020), Cirrus/Stratus (2020-2030), Tide/Gyre/Luna/Surge/Mars/Venus (2030-2040), and Cactus/Dogwood (2040-2050).

Model Name	Start Year	End Year
IBM SP	1970	1980
CCS	1980	2000
WCOSS	2000	2010
WCOSS2	2010	2020
Cray	1970	1980
ASP/BSP	1980	1990
Frost/Snow	1990	2000
Blue/White	2000	2010
Mist/Dew	2010	2020
Cirrus/Stratus	2020	2030
Tide/Gyre/Luna/Surge/Mars/Venus	2030	2040
Cactus/Dogwood	2040	2050

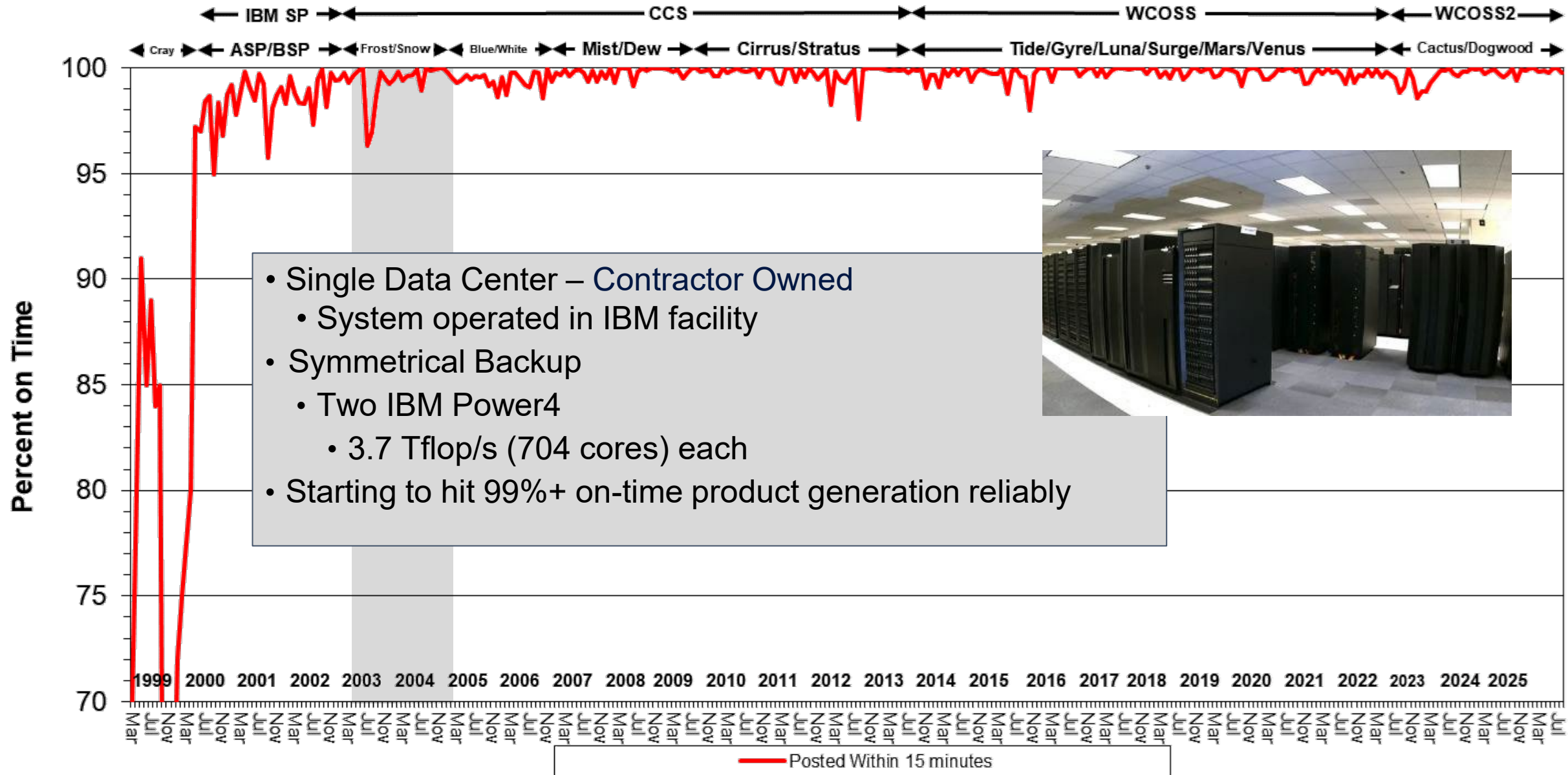


# Product Generation Summary

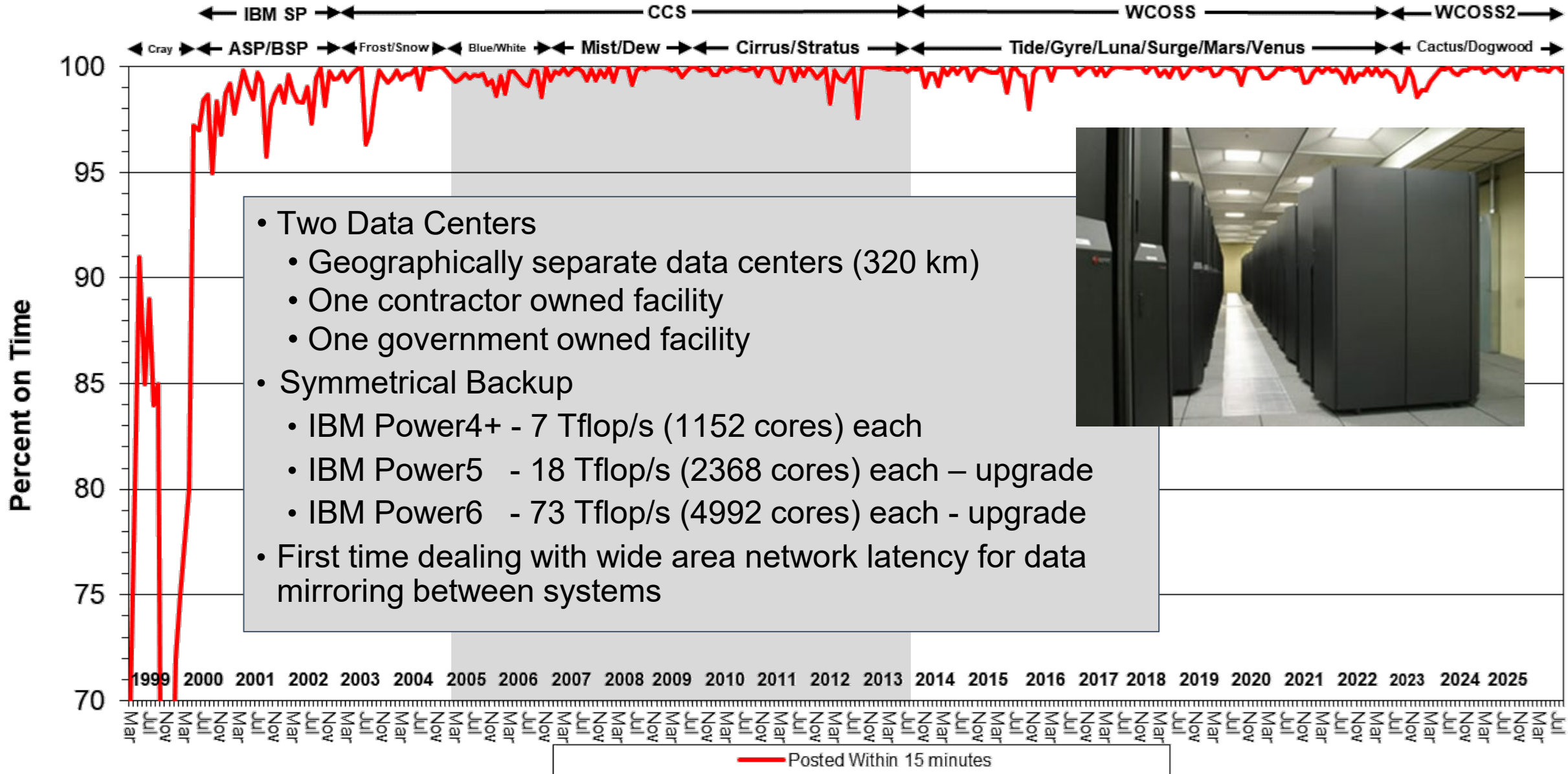




# Product Generation Summary

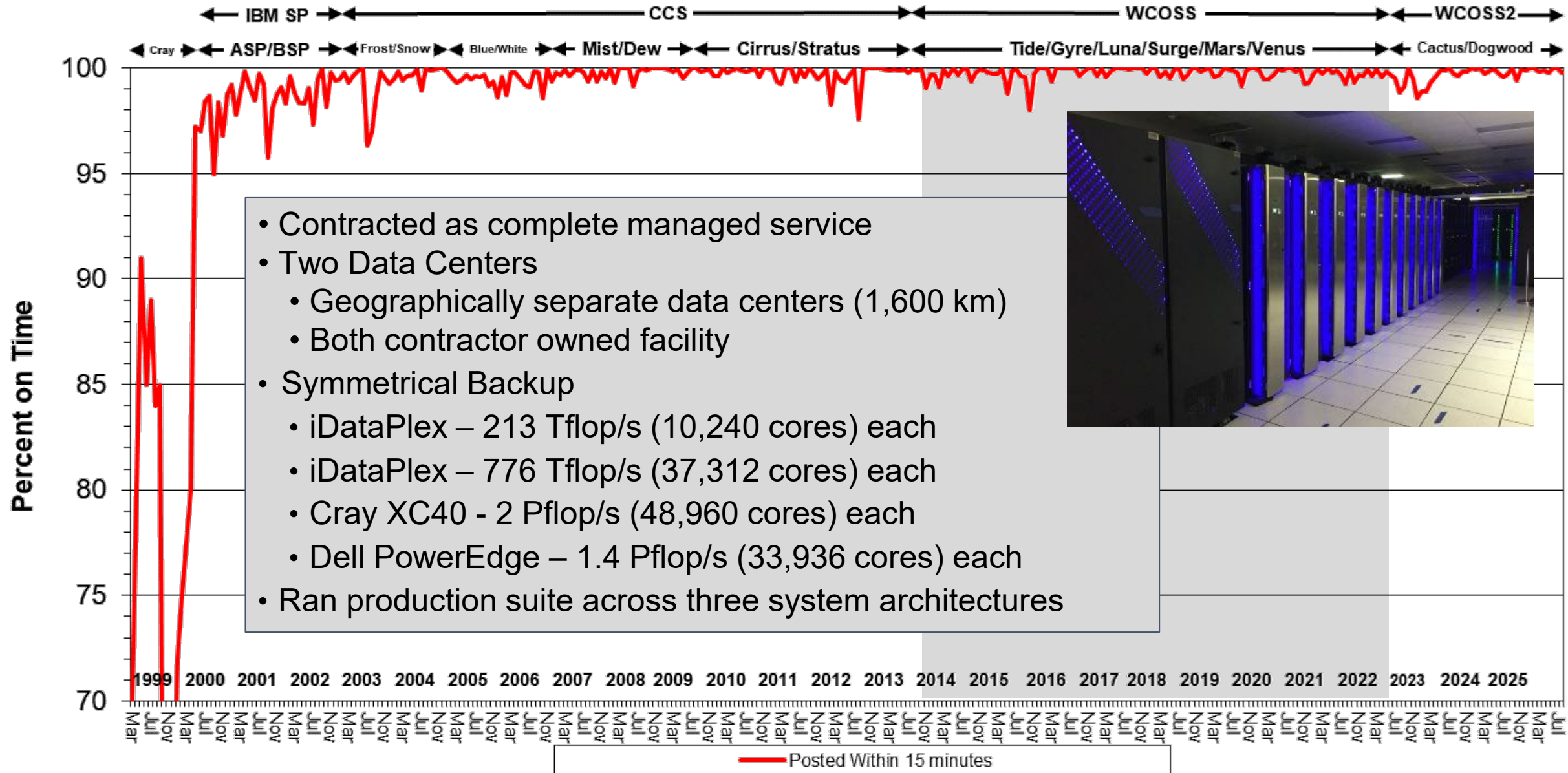


# Product Generation Summary

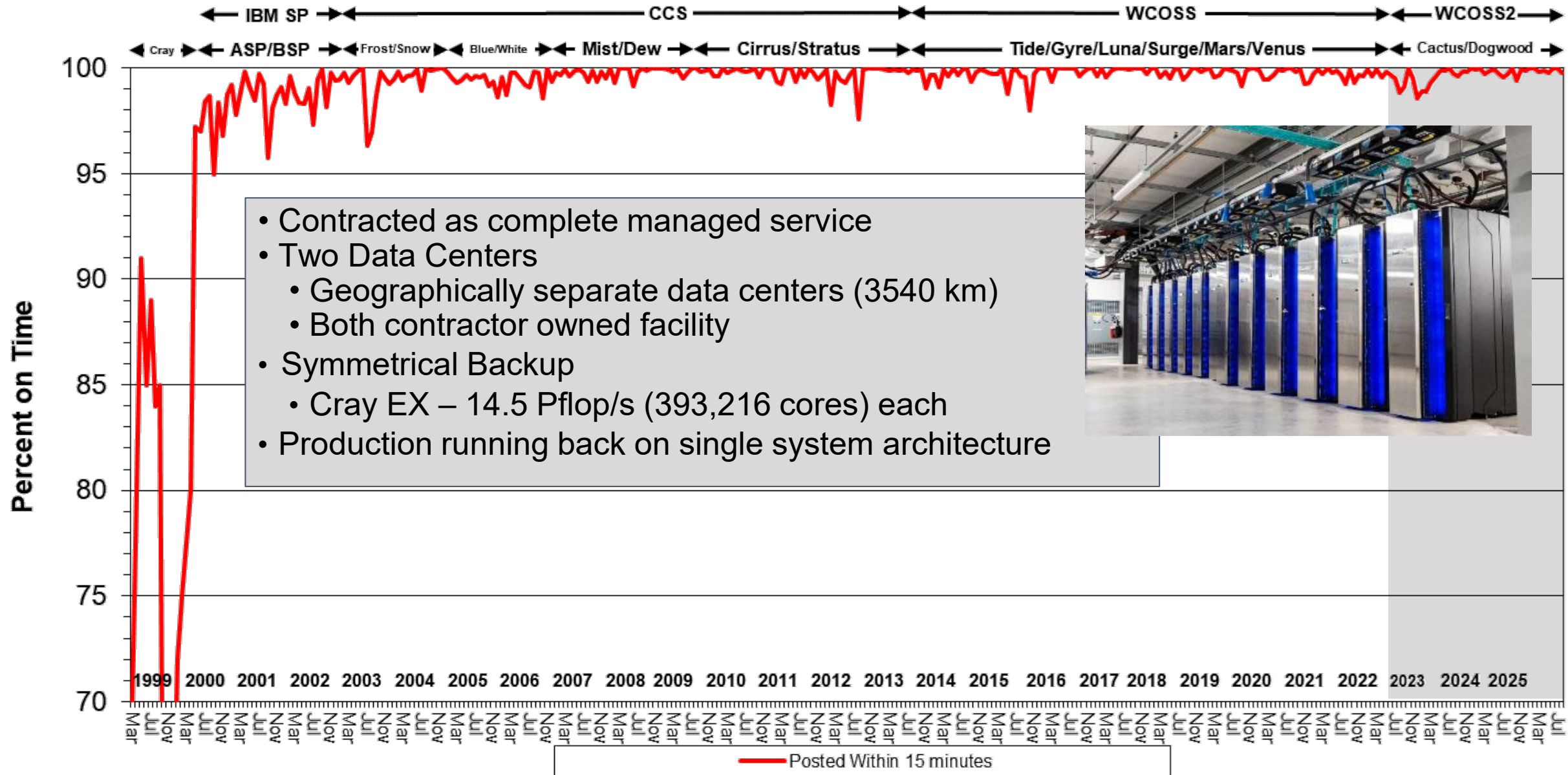




# Product Generation Summary



# Product Generation Summary

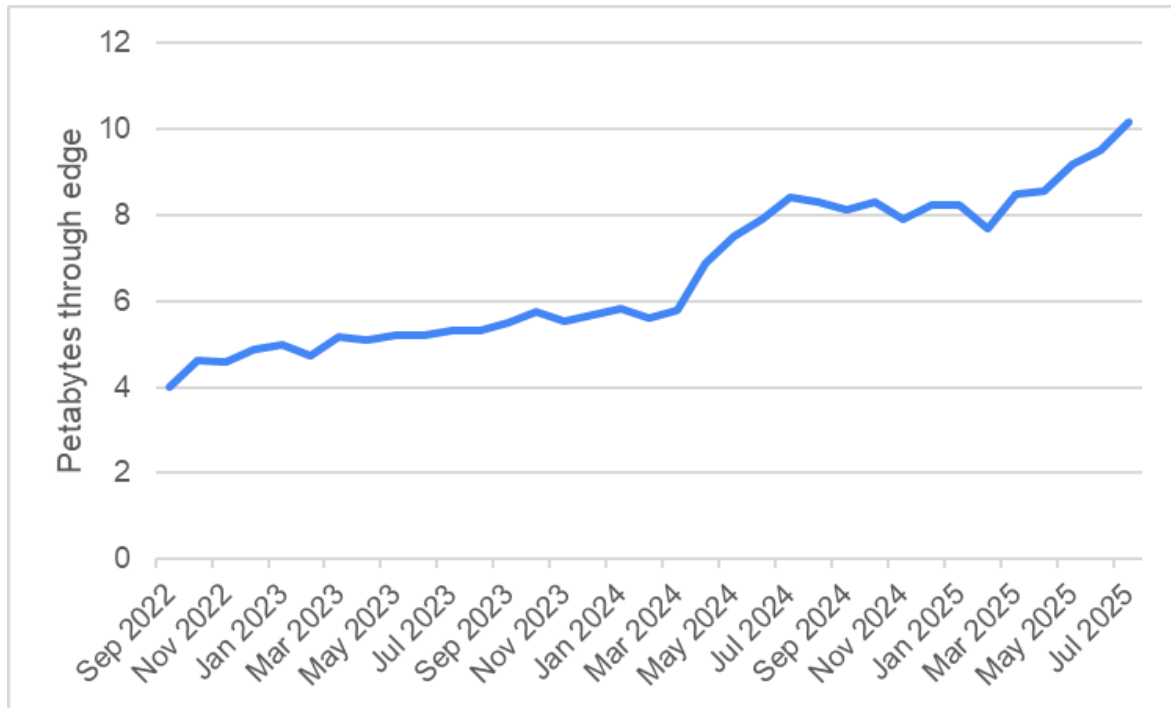


# Capacity Served and Demand for Products

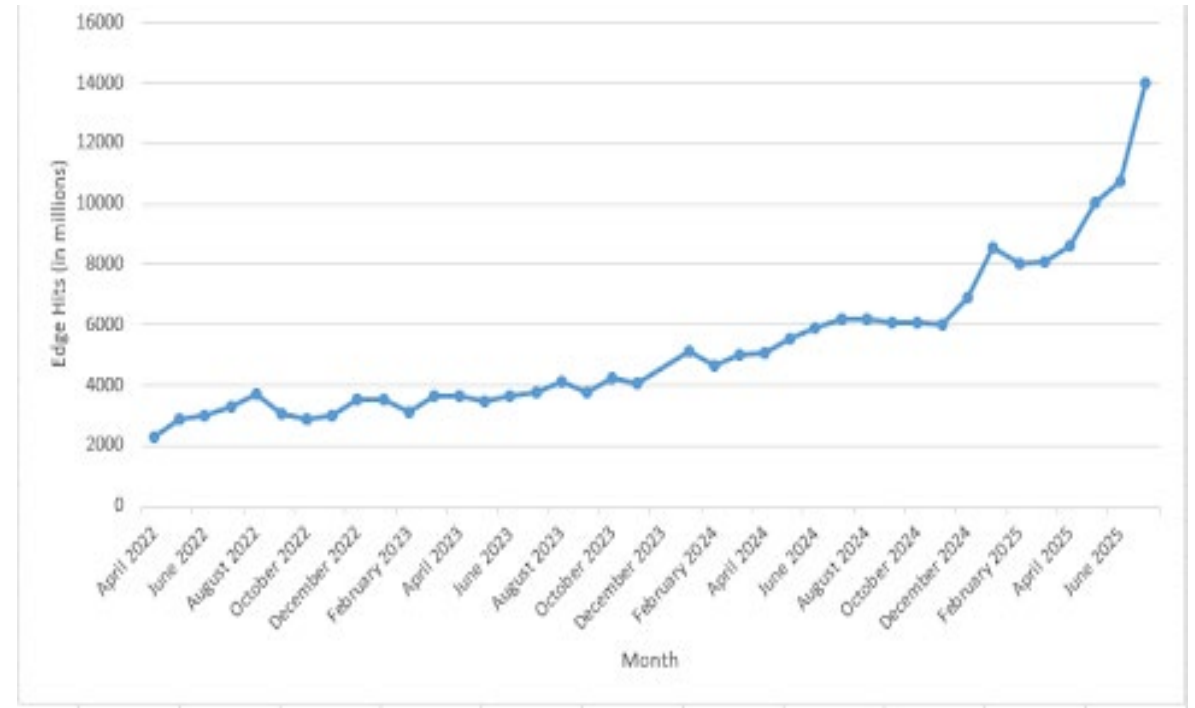
## NWS Dissemination Services

- Geographically separate data centers with cloud content delivery services
- Approximately a quarter of applications migrated to the cloud
- Serving over 10 petabytes per month approximately 50% offloaded to the cloud
- Serving nearly 37 billion hits per month approximately 80% offloaded to the cloud

Data served from NWS Dissemination Services



NWS API Web Service on NWS Dissemination Services

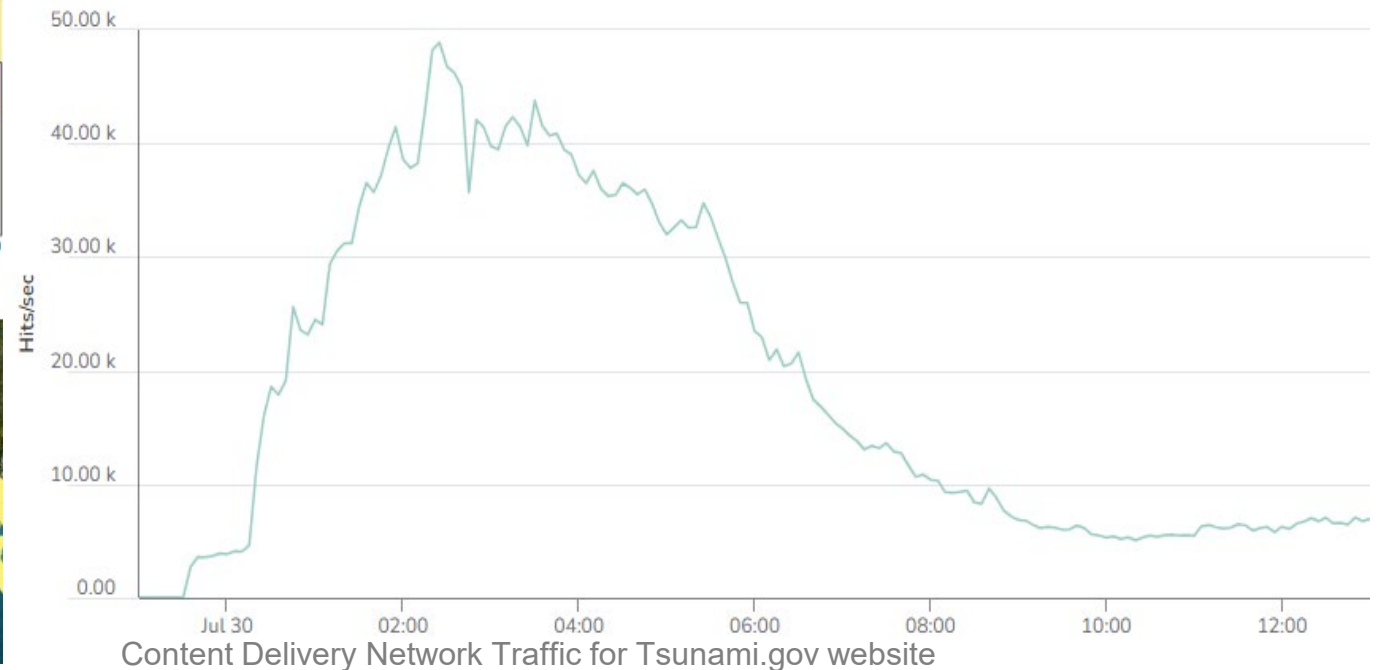
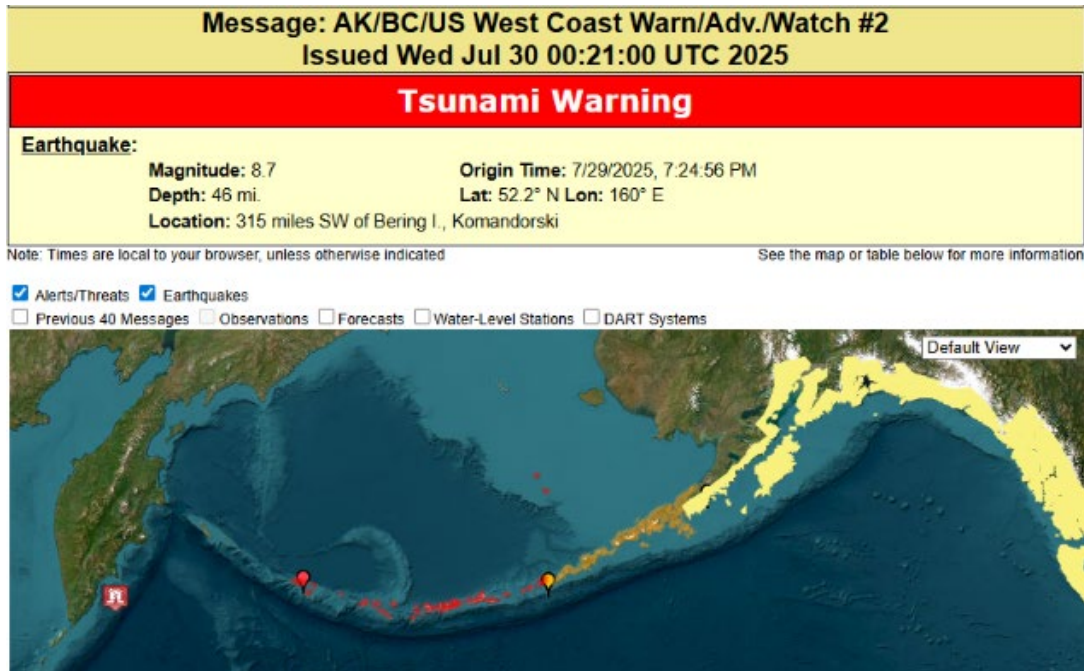




# Significant On-Demand Event Based Loads

## July 29-30, 2025 Tsunami Event – tsunami.gov

- Typical day
  - On-premises servers receive about 2.5 million hits per day
- During event
  - On-premises servers received 9.1 million hits in 12 hours
  - Nearly 1 billion hits in 12 hours off-loaded to the cloud



# Looking Ahead...



## AI & MACHINE LEARNING INTEGRATION

Experimental AI Global and  
Limited-area Ensemble  
forecast system (EAGLE)



## CLOUD HPC & AS-A-SERVICE

On-Demand/Event Driven  
HPC on Cloud



## DATA-CENTRIC ARCHITECTURES

Optimizing data movement  
across mission critical  
applications and large scale  
computing



A high-resolution satellite image of Earth from space, showing the Americas and the Atlantic Ocean. The Earth's surface is detailed with landmasses, oceans, and cloud cover. The background is a deep blue space filled with numerous stars.

# Questions?