

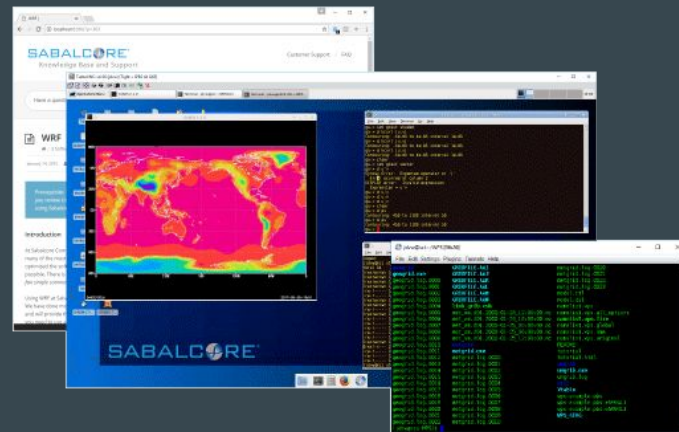
HPC in the Cloud Built for Atmospheric Modeling



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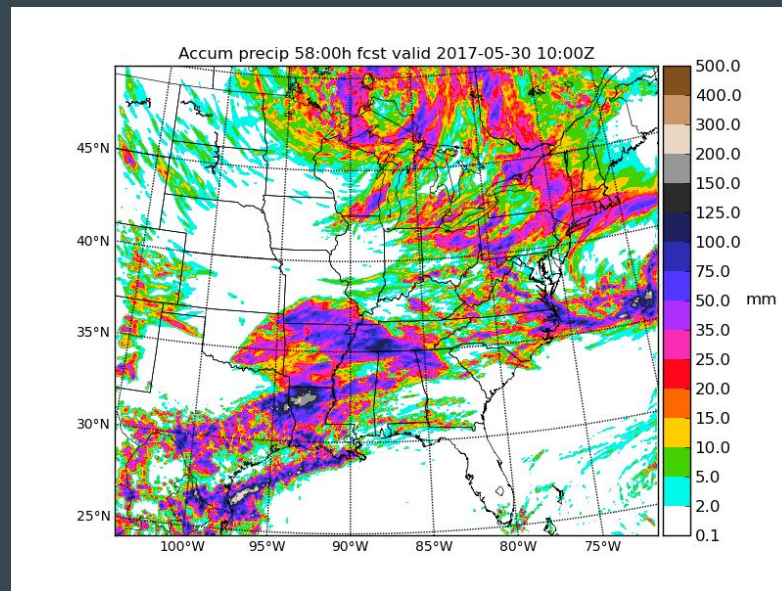
About Us

- HPC in the Cloud provider since 2000
- Focused on Engineering and Scientific application user base
- Serve the private-sector, academia, and government agencies
- Weather Modeling, CFD, FEA, Material Science, MD, Finance, Life Sciences, Image Processing, etc.
- 100% Bare-Metal hardware
- Single-Origin HPC provider



Atmospheric Research Applications

- WRF, WRF-Chem, WRFDA, NCAR Graphics
- COAMPS
- AERMOD
- CALMET/CALPUFF/CALWRF
- CAM_x
- SMOKE
- ADCIRC
- SWAN
- FVCOM

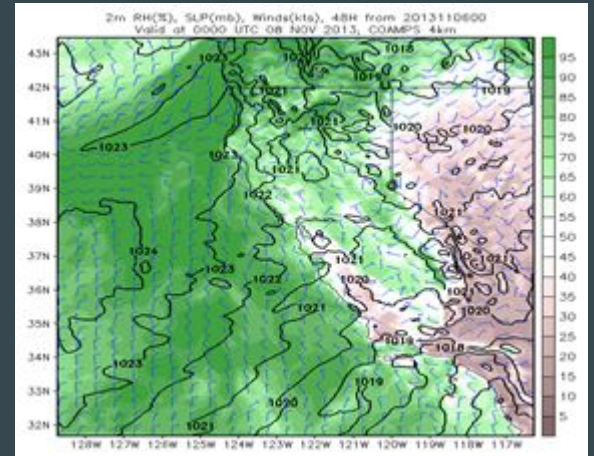


Clients: Department of Defense



Dedicated HPC in the Cloud Services

- Provided reliable support and resources at critical times
- ITAR compliance
- Dedicated HPC Cloud operations and maintenance
- COAMPS, WRF, NCAR Graphics
- Custom software stack
- Multi year support contract



Clients: Weather Analytics, LLC



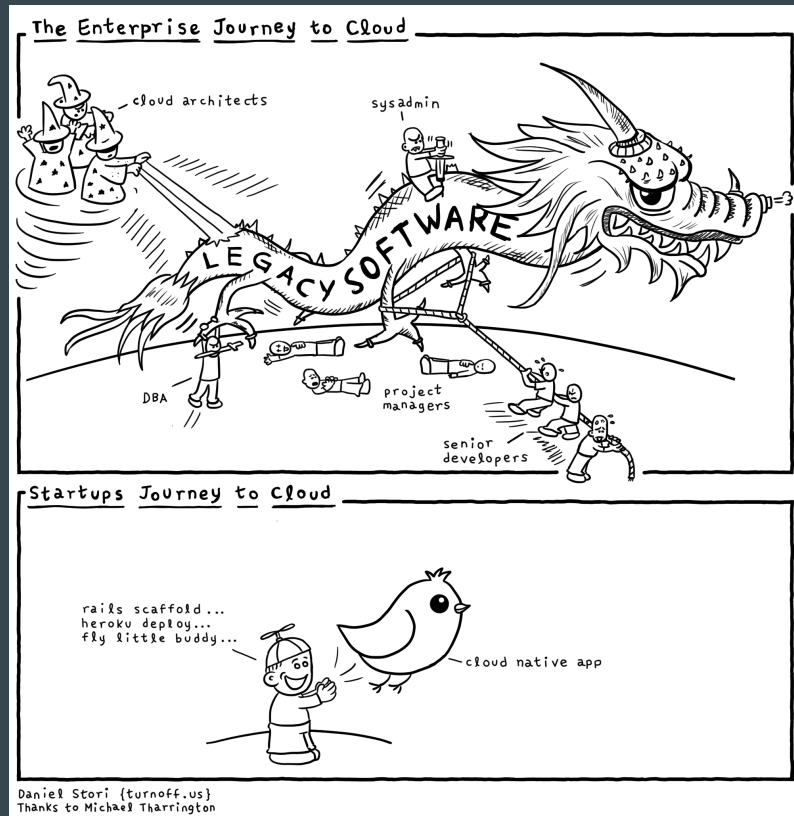
HPC On-Demand Services

- Risk mitigation and predictive analytics products
- On-Demand HPC for post-event hindcast analysis
- Custom WRF executables
- Workflow automation and production support
- Massive data storage and management

HPC Cloud Adoption Challenges

Your application was not built to run in the Cloud.

Choose a Cloud built to run your application.



HPC Cloud Adoption Challenges

- **Starting is hard**
- Everyone is different
- Performance is critical
- Where's my data??
- Steep learning curve
 - foreign environment
- Myriad of configuration options
 - which is ideal for your application?
 - what if you make the wrong choice?
- Managing Software Stack
 - compiler selection
 - supporting libraries and compatibility
 - optimization
- Job Execution
 - data staging
 - automation
 - monitoring / notification

HPC Cloud Adoption Challenges

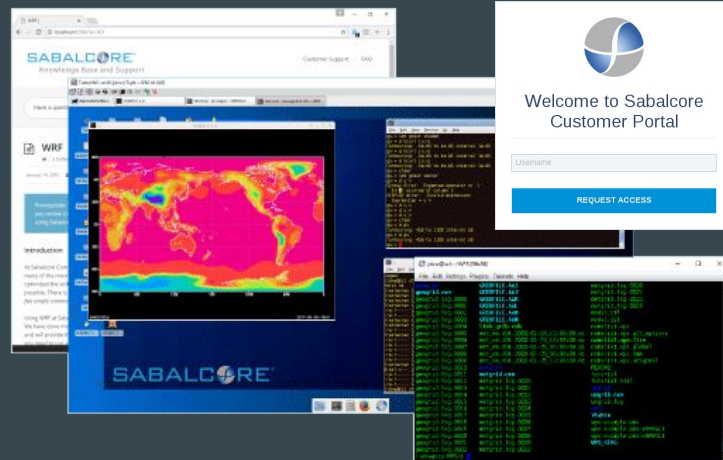
- Starting is hard
- **Everyone is different**
- Performance is critical
- Application requirements
 - software versions
 - customized or in-house code
 - performance, reproducible, or accurate
- Workflows
 - develop, test, and evaluate
 - automated/scheduled
 - unstructured approach
- Knowledge Level
 - HPC power-users
 - application only experts
 - hold my hand please

HPC Cloud Adoption Challenges

- Starting is hard
- Everyone is different
- **Performance is critical**
- High performance Infiniband interconnects
- High performance parallel filesystems
- Direct-attached storage domains
- Bare-metal cores
- Careful considerations
 - supporting libraries and versions
 - compiler vendor (Intel, Portland, GNU, etc)
 - build-time optimizations
 - message passing interface
 - network tuning
 - OS kernel tuning
 - parallel file-system tuning
 - application scalability

Solutions: Simple

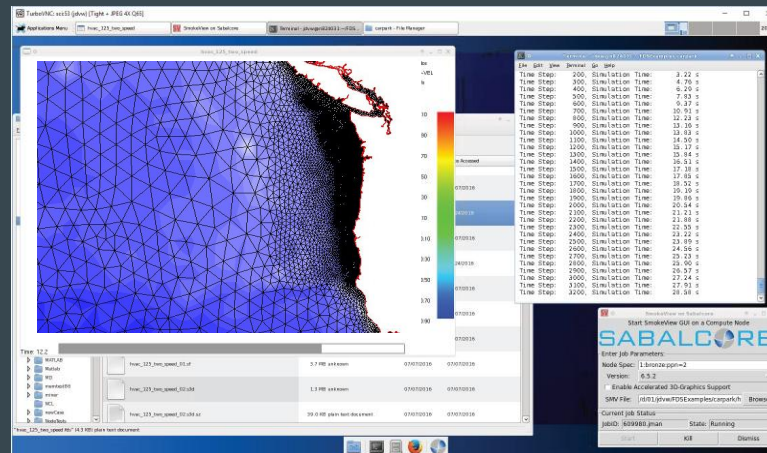
- Familiar environment
 - Works just like an in-house HPC facility or private cluster
- Managed software stack
 - Easily switch software packages or versions
- Experienced technical support (system and applications)
- Tutorials get you up and running in minutes



```
sabalcore:~ $ uname
Linux
sabalcore:~ $ vi wrf.pbs
sabalcore:~ $ qsub wrf.pbs
sabalcore:~ $ qstat
```

Solutions: Flexible

- Command-line and GUI
 - terminal or remote desktop access
- Many software versions installed
 - 20+ WRF combinations (versions, compilers, models)
 - request a custom installation
- Build your own software
 - several compiler options
 - interactive jobs
- Pre-Post processing online or on-desk
- Automation and custom scripting



```
sabalcore:~ $ module load WRF/3.8.1
sabalcore:~ $ mpiexec ./wrf.exe
sabalcore:~ $ module load WRF/3.6.1
sabalcore:~ $ mpiexec ./wrf.exe
```

Solutions: Powerful

- Already optimized at the software and hardware level
 - applications have been expertly compiled
 - benchmarked for speed
- Infiniband
 - low-latency interconnect
 - superior scaling for large number of cores
 - critical for applications like WRF
- Direct-attached Storage Domain
 - High performance parallel file systems
 - handles large application level I/O loads
- Intel Xeon processors



CCU v8.01a - Atmospheric Modeling Cluster

- ~4800 cores (demand driven)
- Dual Intel Xeon E5-2667v4 Broadwell-EP 3.2GHz
- 37.5 TB RAM, 8GB per core
- 1 TB SSD local scratch drive
- Infiniband EDR Interconnect
 - 100 Gbps throughput per port
 - ultra-low latency
- BeeGFS parallel file system
 - 80 Gbps sustained I/O
 - Scalable to 1.5PB

Our Data Centers

| | |
|------------|---|
| Tampa East | <ul style="list-style-type: none">● N+1 Redundancy● SSAE-16 SOC 1 Type 1 certified● SSAE-16 SOC 2 Type 1 certified● ISAE-3402● NIST 800-171 and ITAR controls● AWS S3 Direct Connect, Internet-2 |
| Orlando | <ul style="list-style-type: none">● N+1 Redundancy● SSAE-16 SOC 1 Type 1 certified● SSAE-16 SOC 2 Type 1 certified● ISAE-3402● NIST 800-171 and ITAR controls● FISMA (high) and FedRAMP Capable |

What's Next

- Can our applications be re-designed for the Cloud?
 - Decouple the execution kernel and user interface (MVC or server-client model)
 - Decentralize data locality and deduplication
- Is this feasible?
- **Choose a Cloud built to run your application**



Questions & Answers

“We would like to thank Sabalcore’s team for the excellent, high-quality services (and support) provided since last year.”

Dr.-Ing. Paulo B., WRF user, Federal University of Rio Grande do Sul, Brazil, January 2016

“I ran my tests and the results were amazing. I got my code to run 3 times faster. You did a very good job compiling the code for me.”

Wiktor w., Rockseis, Norway, December 2015

“Jobs are running nicely now! Thanks for all the help today! Great service!”

Havard M., Senior Engineer, Norway, August 2016

“Thank you and I do appreciate the diligence in helping us..“

Martin P., Director, sensor manufacturing, UK, August 2016

“I will definitely recommended [Sabalcore] in the future to anyone interested in HPC.”

Chris C., Software Developer, Netherlands, March 2016

HPC On-Demand

- Simple pricing: pay only for what you use
- Scale to 1000+ cores per job
- Schedule automated daily jobs
- 100 GB storage included
- Bandwidth included
- Remote Visualization included
- Technical support included
- Simple to learn and get started
- Ideal for flexible requirements

Dedicated HPC in the Cloud

- Dedicated compute nodes and networks
- Customize HPC designed for specific application and workload
- Scalable and off-loadable to On-Demand Service
- Technical support included
- Bandwidth included
- Special connectivity available (e.g. P2P, AWS Direct Connect, Internet2)
- Ideal for time-critical and large production workloads