

Implementing An Operational Ensemble Numerical Weather Modeling Forecast

Proposed Scope of Work



Prepared for: PacifiCorp

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Summary:

Working with NZO Cloud/PSSC Labs, ADS has designed and created a proposed numerical weather modeling framework that will allow PacifiCorp to efficiently run an ensemble of forecasts across all territories. This ensemble will be subselected from the Global Ensemble Forecast System (GEFS) while maintaining the full ensemble statistics that are relevant to the fire weather threat. The intelligent subselection methodology has been developed and tested by ADS over the past couple of years.

This proposed work is divided into four phases:

[Phase 1: Numerical Weather Model Hardware Design](#)

[Phase 2: Numerical Weather Model Installation, Testing, and Optimization](#)

[Phase 3: GEFS Subselection Ensemble Installation, Testing, and Optimization](#)

[Phase 4: Ensemble Analytics Installation, Testing, and Optimization](#)

The work has been tailored to meet urgent deadlines while still adhering to the high standards of Atmospheric Data Solutions, LLC. The estimated completion dates assume a purchase order is received by January 1, 2024.

Phase 1: Numerical Weather Model Hardware Design

Total Cost:

ADS will work with NZO Cloud/PSSC Labs to design a High-Performance Computing Cluster (HPCC) hardware framework consisting of three HPCCs with the goal of maximizing the numerical weather model ensemble member count and minimizing the wallclock runtime. This design will benefit from the ADS and NZO Cloud expertise in designing, building, and maintaining high-performance computing solutions for major IOUs across the western United States over the past decade.

Target ensemble count:

Existing HPCC (pacificpower, upgraded): 1 control member with wildfire fuels.

HPCC 1: 2, 3, or 4 members

HPCC 2: 2, 3, or 4 members

HPCC 3: 2, 2, or 4 members

Total ensemble members: 7, 9, or 13 depending on performance and validation.

PacifiCorp has asked to extend the forecast period for the control member from four (4) to five (5) days. ADS and NZO Cloud will determine what hardware enhancements to the **existing rockymtnpower HPCC** will be required to attain this while maintaining or reducing wallclock times.

Three (3) HPCCs of identical hardware are to be hosted at the following locations:

- NZO Cloud/PSSC Labs data center.
- DataBank data center.
- Disaster Recovery/Fail-over plan:
 - Maintenance kits for each HPCC will be provided and will address single points of failure on each HPCC.
 - Each HPCC will **NOT** act as a fail-over destination for the other.
 - The ensemble count will be reduced or fail if HPCCs are down.

HPCC hardware specifications:

- **See hardware specifications sent by NZO Cloud.**

ADS will assist NZO Cloud/PSSC Labs with testing and configuration.

ADS will attend conference calls to discuss and coordinate the procurement and delivery to data centers.

Estimated completion date: September 2023.

Phase 2: Numerical Weather Model Installation, Testing, and Optimization

Total Cost:

ADS will evaluate the HPCC operating system, gather software dependencies and prepare an installation plan based on the compilers. This may require installing and testing multiple compilers if the performance is not satisfactory. ADS will compile the identical WRF version as built on rockymtnpower with the exception of testing the later version of WRF with AOCC support. If the WRF AOCC support version proves to be most optimal, ADS will proceed with that implementation. ADS will then implement the same software/compiler environment across all three (3) HPCCs. ADS will perform multiple ensemble simulations on each HPCC to guarantee performance consistency for at least two (2) weeks to ensure the performance is stable. Ads will work NZO Cloud/PSSC Labs to troubleshoot any issues and further optimize the runs. When finished, the final optimized node and core count for each ensemble member will be reported and implemented in the operational WRF ensemble software.

Estimated completion date: September 2024.

Phase 3: GEFS Subselection Ensemble Installation, Testing, and Optimization

Total Cost:

ADS will design, build, test, and optimize the GEFS subselection software to be run on the master HPCC. The master HPCC will delegate ensemble member runs across all other HPCCs. Centralized monitoring software will be designed and built to monitor the progress and report any issues.

Estimated completion date: December 2024.

Phase 4: Ensemble Analytics Installation, Testing, and Optimization

Total Cost:

ADS will design, build, test, and optimize the ensemble analytics software to be run on the HPCC post-processing nodes. ADS will install the WRF portal analytics software on all system post-processing nodes. ADS will evaluate the post-processing performance while processing the full ensemble and determine if any optimization is needed.

Post-processing nodes are equipped with GPUs if needed. ADS will design, build, and optimize software to calculate the ensemble statistics from all members of the ensemble. ADS will determine how to gather member output from all HPCCs into a centralized location including the control wildfire fuels forecast member. The control member forecast will need to integrate wildfire fuel forecasts into the ensemble.

Ensemble statistics will be stored in NetCDF4 format files. Transmission software will be built to send the reduced ensemble statistics output to the necessary destinations.

Calculate hourly ensemble statistics on a grid: Mean, Max, Min, and Standard Deviation for the following near-surface or surface weather variables:

- Temperature 2m AGL
- Relative Humidity 2m AGL
- Dewpoint 2m AGL
- HDWI
- MHDWI (Requires DFM/ERC)
- Near-surface vapor pressure deficit (Max in lowest 500m AGL)
- Wind Gust 6m AGL (ADS gust parameterization)
- Wind Speed and Direction:
 - 10m AGL
- Incoming Shortwave Radiation
- Hourly rainfall amount
- Hourly snowfall amount:
 - SWE
 - Snowfall Depth (using Kuchera Ratio)

Estimated completion dates: July 2025.

Ensemble Framework Maintenance and Support:

Total Cost:

Atmospheric Data Solutions provides 24/7 active support for all software, data feeds, and hardware with a maximum 4-hour response. ADS is the single point of contact with any support questions or issues. If the issue is determined to be a result of hardware, ADS will work with PSSC Labs/NZO Cloud to remedy the situation.

The ADS support costs \$/year/HPCC or \$ per year. If all 5 years of support and maintenance are prepaid, the cost is \$.

Total project cost: (includes 5-years of support)

Figures:

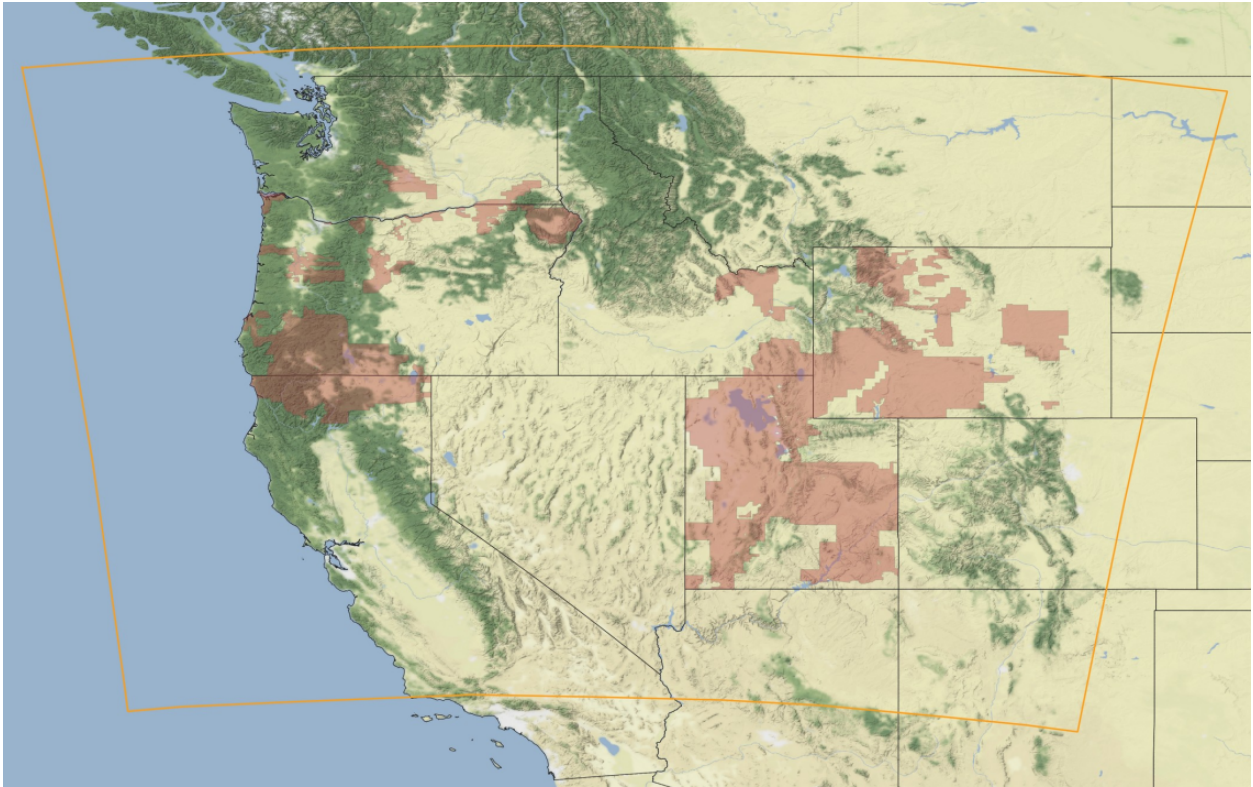


Figure 1: The existing WRF innermost 2km resolution domain. This domain will not change.