



## **New research uncovers the crucial role HPC can play in wine production within the Spanish region of La Rioja**

University Masters project uses atNorth's Gompute HPC platform to understand how the architecture, environment and climatization of a wine cellar can impact operations

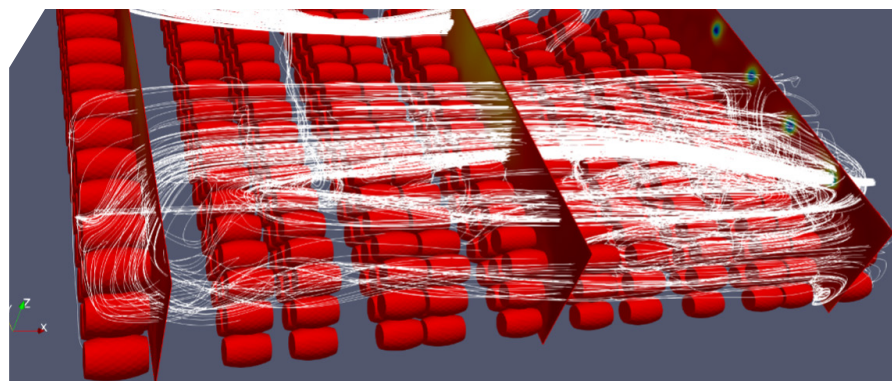
## The influencing factors behind wine production

In 2023, INTA aeronautical engineer, Héctor Gómez, undertook a final Master's project in industrial mathematics. The project was initially presented to the Universidade de Vigo Prof. Dra., Elena Martín Ortega, by production consultancy, Breton Engineering, as the company explored the construction of a new wine cellar in the viticultural region of La Rioja.

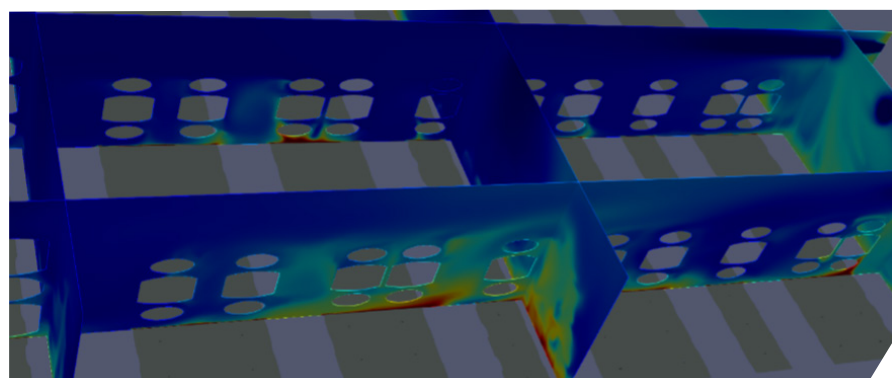
The project was designed to learn more about the impact that the architecture, environment, and climatization within the wine cellar could have on La Rioja's operations. During the wine development process, it is common to lose a small percentage of production due to evaporation in the oak barrels. Though this can range due to environmental factors like humidity control, temperature fluctuation and room architecture, **the average annual loss of wine** is about 3.5% according to the Consejo Regulador.

Studies related to the environmental impact on wine loss are quite rare. However, after noticing that up to 10% of wine production was being lost due to evaporation within La Rioja's wine barrels, Breton Engineering invited Gómez and Martín Ortega to lead research and analysis into the room climatization of the La Rioja wine cellar.

The research relied on CFD analysis to provide accurate predictions of evaporation rates under different conditions, process high volumes of data and run high performance computing simulations. With such complex requirements, they turned to the atNorth Gcompute High Performance Computing Platform to model future room architecture and provide accurate calculations of the barrel room climatization.



Air circulation inside the wine cellar



Moisture content of air inside the wine cellar

**This was the first project I faced which involved the need for such high computational power required to calculate the high volume of fluid involved. It was also my first experience with cluster computing and remote calculations, which quickly proved to have a profound impact on CFD analysis and predictive modelling capabilities. While there were some learnings with new software and systems, the atNorth Gcompute platform was so straightforward and the team very supportive, making the entire process seamless.**

**Prof. Elena Martín Ortega**  
Universidade de Vigo



## Balancing art and science - HPC's role in the wine aging process

CFD simulations along with HPC can play a crucial role in calculating wine loss during the aging process, offering winemakers precise, real-time insights into the factors that contribute to evaporation and volume loss. By running the opensource CFD software openFOAM on Gompute's HPC platform, the research team could process vast amounts of these insights and data quickly without a timely and costly installation process. The team leveraged the pre-installed openFOAM versions on the Gompute HPC cluster along with their specifications. **Combining predictive modelling with this detailed analysis can have a massive economic impact on production, reducing the annual loss in wine volume while stabilizing subsequent revenue opportunity to generate jobs and income in the region.**

## HPC enables faster time to insights to improve wine production practices

From the beginning, the project was focused on the cellar's temperature, air humidity and air flow as the most significant factors in determining the rate of evaporation within the barrels. Objectives were aimed at minimizing losses by regulating environmental conditions, improving air climatization and maintaining optimal temperature control to enable more efficient, sustainable operations.

With a tight timeframe for the project, Gómez and Martín Ortega set out to redefine this area of research, contributing new knowledge and deeper understanding of the factors at play with wine production and the overall aging process.

The atNorth Compute HPC platform was pivotal to supporting the project's computational power needs while providing the precision, customization, and efficiency needed to carry out the research.

Using HPC for CFD analysis and modelling has helped optimize cellar climate conditions to prevent excessive wine loss. La Rioja producers can use the resulting insights to minimize resource waste, reduce operational costs and determine the most cost-effective way to achieve consistent sustainable practices without compromising wine quality or the environment.

As La Rioja continues to lead the way in adopting innovative approaches, the region also sets a benchmark for the industry where art, science and technology converge to continue to create a sustainable future for wine production.

**Due to the scarce nature of research into this area, finding and learning from existing studies into wine loss production added complexity and time to the project. However, because we had full access to the Gompute platform, its team and resources, we were able to continue our important research into the factors contributing to wine production loss in a reasonable timeframe.**

**Prof. Elena Martín Ortega**  
Universidade de Vigo

**“ This research uncovers potential of CFD analysis in conjunction with HPC and its potential ability to revolutionize the wine production industry, offering a pathway to both economic and environmental sustainability. On the one hand, the project has the ability to impact revenue costs and even offer greater profitability while on the other, it has shown its potential to impact the future of sustainability within wine production. High-performance computing is becoming integral to our global society, offering an incredibly novel approach to solving everyday business challenges, such as wine production loss.**

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