HUI: Peruvian Automatic Weather Prediction Platform

CS Computer Science

Giordano Alvitez[1], Jose Leonidas Garcia[1], Ariana Villegas[1], Mauricio Pinto[1], Macarena Oyague[1], Victor Ostolaza[1], and Jorge Gonzalez[1]

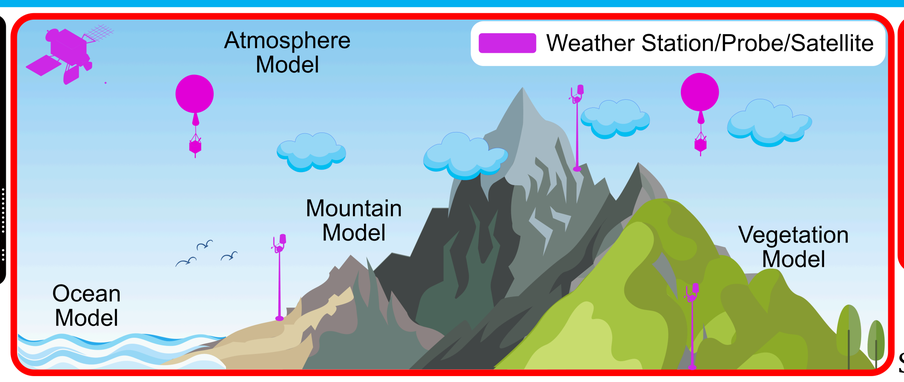
[1] UTEC UNIVERSIDAD DE INGENIERÍA Y TECNOLOGÍA

Pitch Video

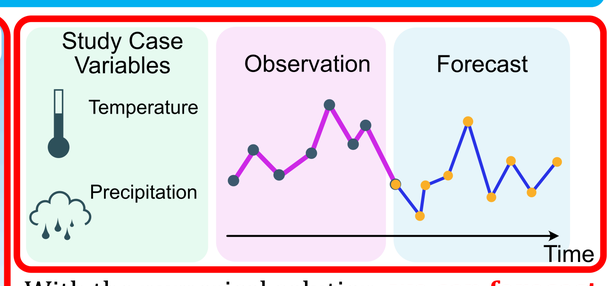
https://drive.google.com/file/d/1UahFEiNas_XrPLC0ulNf6-Kgl2CsNpeo/view?usp=sharing

1: Numerical Weather Prediction

We define a **specific study region** as a set of meshes with a **5 to 10 km resolution.**



There are two main models to study the Peruvian regions: **a) BRAMS and b) WRF.** A model represents the region with a set of partial differential equations. A numerical solver is used, for example, BRAMS and WRF use the **Finite Difference Method (FDM).**



With the numerical solution ,**we can forecast** future values **within the study region**. Standard study variables are **temperature and precipitation**. The forecasting results can be **verified with the measured data** from different observation sources. For example, we can predict El Niño related events.

3: Motivation

- **Peru has seasonal weather events** during the year.
- **Weather experts require scripting and manual file management** to obtain and analyze results in a single model.
- **No automatic platform** in the literature merges both accurate models BRAMS and WRF for weather studies on South America.

4: Our Goal

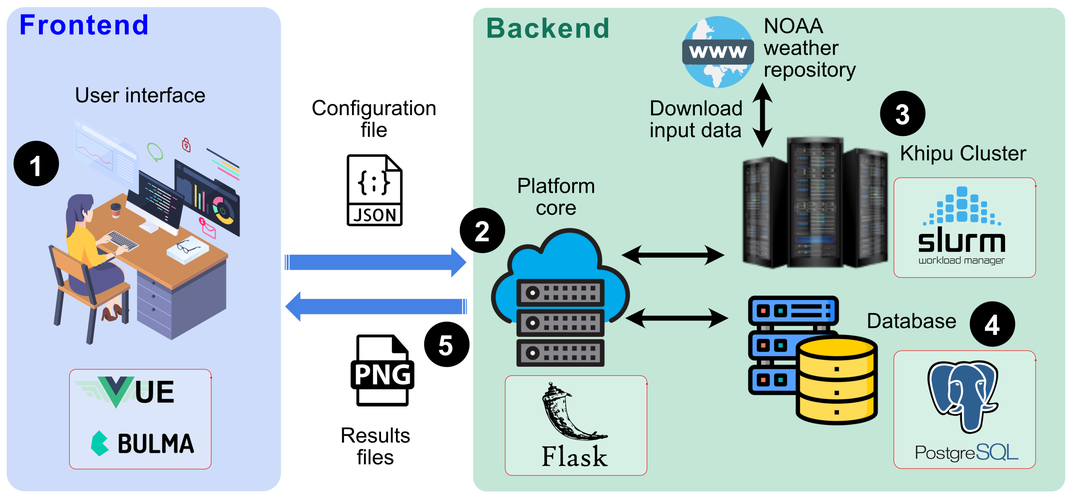
1. **Implement HUI:** Peruvian Automatic Weather Prediction Platform.
2. **Simplify the prediction process** with BRAMS and WRF to **enable future result verification** studies with measured data.

5: HUI High-Level Architecture

HUI platform has two components:

a) **Frontend** is the **visible part to the user** and **allows the creation of interactive configurations**. It also shows the results obtained from the weather models. Implemented using frameworks such as Vue and Bulma.

b) **Backend** is the invisible part of the platform and **orchestrates and handles the computation workload.** It provides **three main services:** a) core management, b) execution, and c) database. Implemented using frameworks and software such as Flask, Slurm and PostgreSQL.



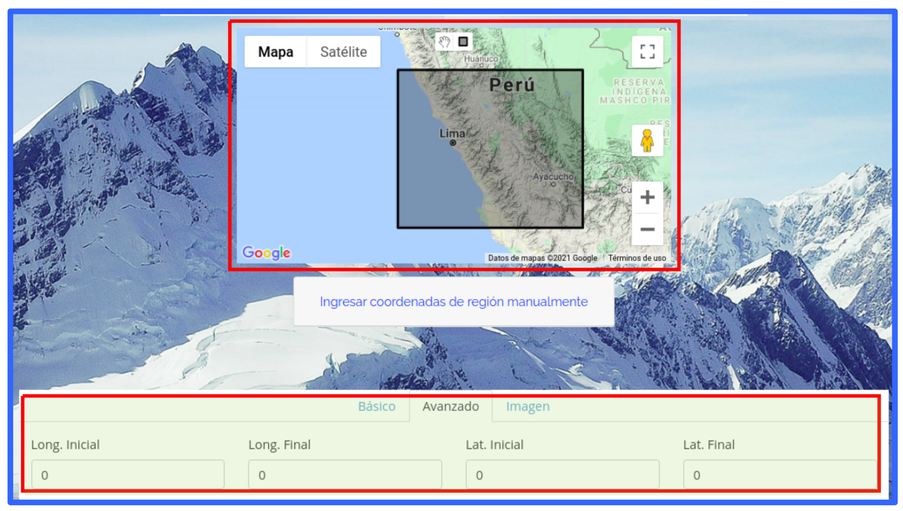
HUI operation has five main steps:

1. First, the **user defines a configuration** for the desired weather study using the Frontend interface.
2. Platform **main core sends directives to the HPC** system for the weather model execution.
3. Weather input files are downloaded to start the execution. **The model execution can require several hours** to finish and is managed as a queue.
4. Once the **execution completes, the database is updated** to register the user configuration and organize the previously downloaded input files.
5. Platform allows **generating plots from the results.** Those plots can be visualized in the user interface.

6: Platform Overview: User Perspective

HUI allows the user to:

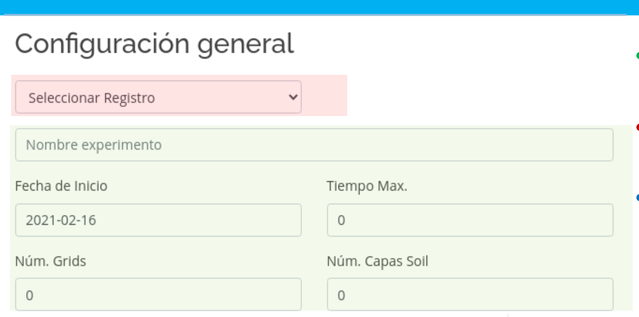
1. Set weather simulation parameters as an **interactive form to define variables.**
2. **Automatic management** of the execution and the results with a database, checking for previous configurations and existing running jobs on the system.
3. **Automatic results plotting** in the user interface prediction images.



Users can set the coordinates by:

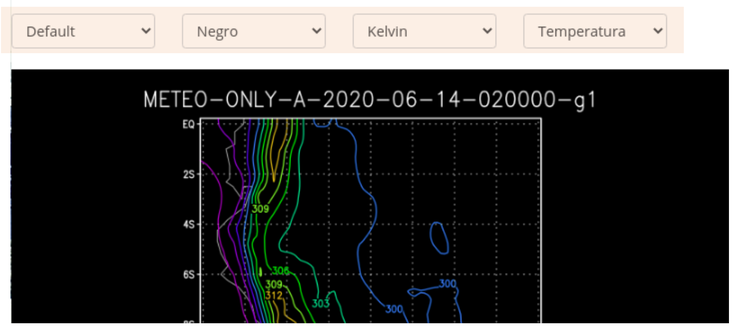
a) **Selecting an area in the map**

b) **Setting them on a form with numeric values.**

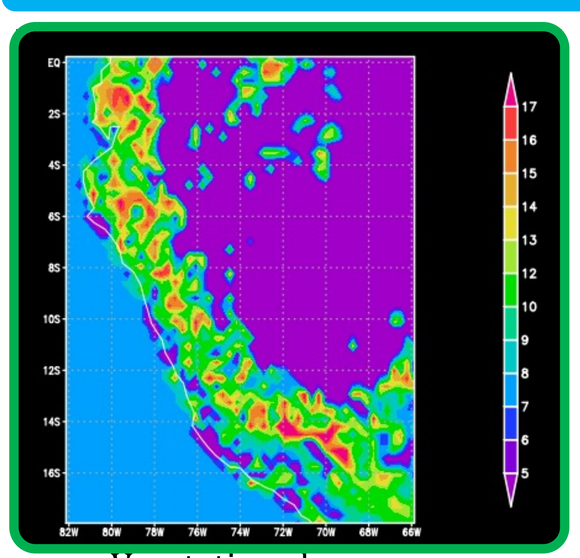


When the model execution is completed, **the user can plot the results.** Automatic plotting parameters allow changing **line color, background color, units and the desired variable** (e.g., temperature, precipitation, relative humidity, pressure).

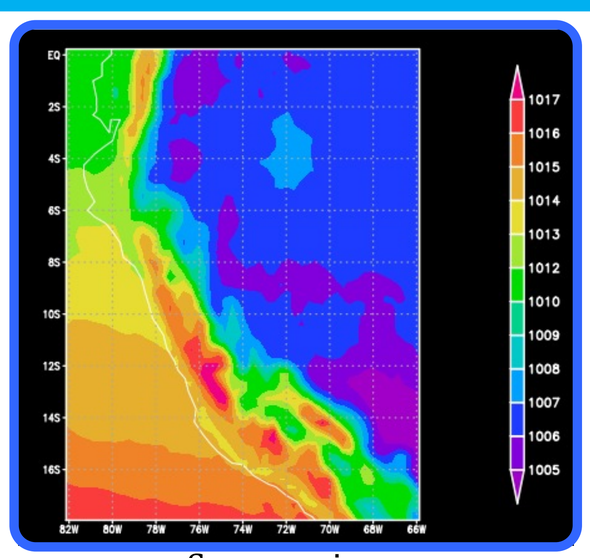
- **Additional variables can be defined** according to the desired experiment.
- Also, template-based configurations are available from previous experiments.
- **Black box approach** for the weather model execution. The user can be notified if an error occurred.



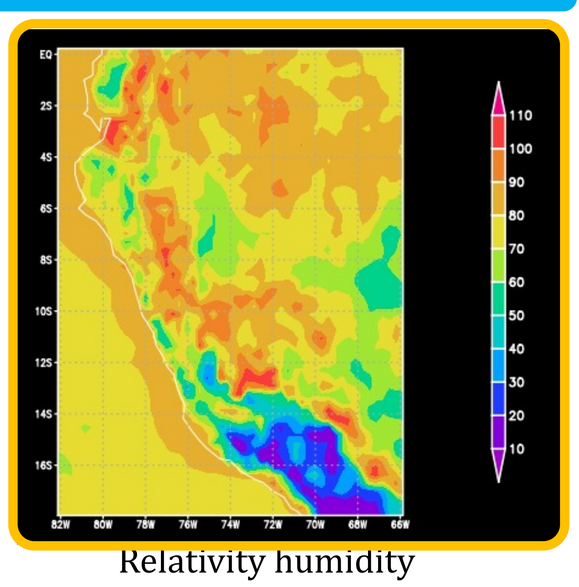
7: Simulation Results with BRAMS model



Vegetation classes



Sea pression



Relativity humidity

The results were obtained with input data from February-2020 and depict three-day forecasting. **As shown in the first plot**, the Amazon region has a uniform type of vegetation. **The plot in the middle** shows a higher sea pressure on the Peruvian coast. **The third plot shows** high humidity according to the summer.

8: Future Work and Conclusion

Future Research Directions

1. **Add WRF model support**
   - Current platform only supports BRAMS execution
   - Extend the platform to different queue managers such as CondorHT and Torque.
2. **Result verification**
   - Compare time series of forecast data versus the measured data from weather stations.
   - Define templates for easy simulation and analysis.
3. **Implement a result platform for the public**
   - Create a platform with simplified results for divulgation to the general public.

Conclusion: HUI platform helps critical research in Peruvian weather events. Future studies with HUI can alleviate the dramatic effects on the population's daily activities.