Pollutec 2023, 10 to 13 October 2023 (Lyon, France)

EVEREST for Atmospheric applications

http://www.everest-h2020.eu
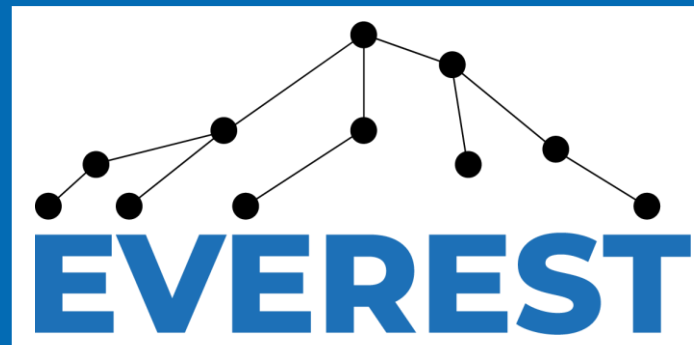
EVEREST: Big Data Analytics on FPGA

Project Coordinator: C. Hagleitner, IBM
Scientific Coordinator: C. Pilato, POLIMI
Web: everest-h2020.eu
LinkedIn: EVEREST Project
Facebook: @EVERESTH2020

EVEREST
DESIGN ENVIRONMENT
FOR EXTREME-SCALE BIG DATA ANALYTICS
ON HETEROGENEOUS PLATFORMS

IBM · POLITECNICO MILANO 1863 · cima RESEARCH FOUNDATION · VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER · NUMTECH

Big data applications with **heterogeneous data sources**

Three use cases

EVEREST SDK

💡 Collection of **interoperable and open-source tools** to match target system, application workflow, and data characteristics
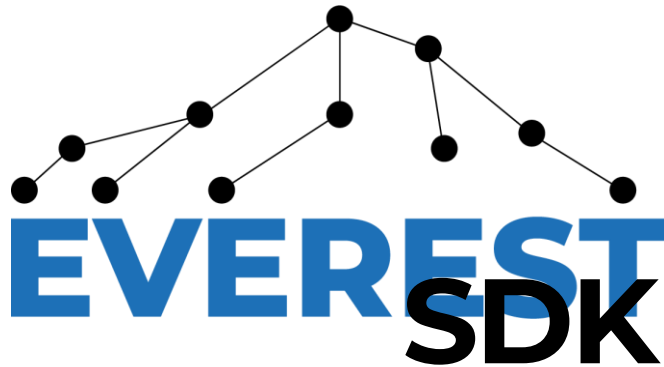
| Compilation	Runtime
◉ Unified hardware generation flow based on **MLIR** to support multiple input flows ◉ Combination of **high-level synthesis** and **specialized memory architectures**	◉ Automatic **allocation** of target nodes and virtual machines ◉ **Autotuning** to match the application and the underlying hardware

FPGA-based architectures to accelerate selected kernels

CPU-based infrastructure

+

Two FPGA-based clusters
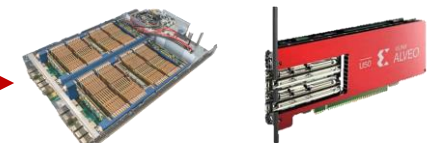
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EVEREST Use Cases

Accelerated computationally-intensive kernels **+** **Heterogeneous** data sources

Renewable energy production prediction

★ Improve **quality of the predictions** by combining weather models and plant info

Weather prediction modelling (WRF)

Air-quality monitoring of industrial sites

★ Improve the **response time of predictions** by combining weather models and site actions

★ **Accelerate kernels** to execute more tests and create more (or more precise) models
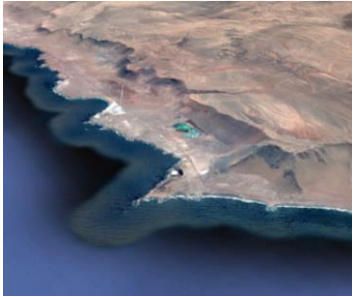
Traffic modeling for intelligent transportation

★ Improve the **overall performance of traffic simulation**

EVEREST for NUMTECH Atmospheric applications

Context

Hills, land use

Measured and/or predicted meteorological data

Industrial site data

Sources characteristics, Buildings

Continuous emissions monitoring system, Analyzers,...

plum'air

(dispersion code)
Operational server

Outputs

Real time pollution maps and hourly forecast for the next days

Information and alerts by email/sms

Reporting, statistics, ...

Plum'air system is a NUMTECH decision tool for industry to:

- Know its atmospheric impacts in real time

- Generate environmental report (daily, monthly, annually impact report, …)

- Identify on which sources or process act to reduce its impact in future

- Communicate with neighbors

- **Adapt its atmospheric impact based on forecast (weather and emission)**
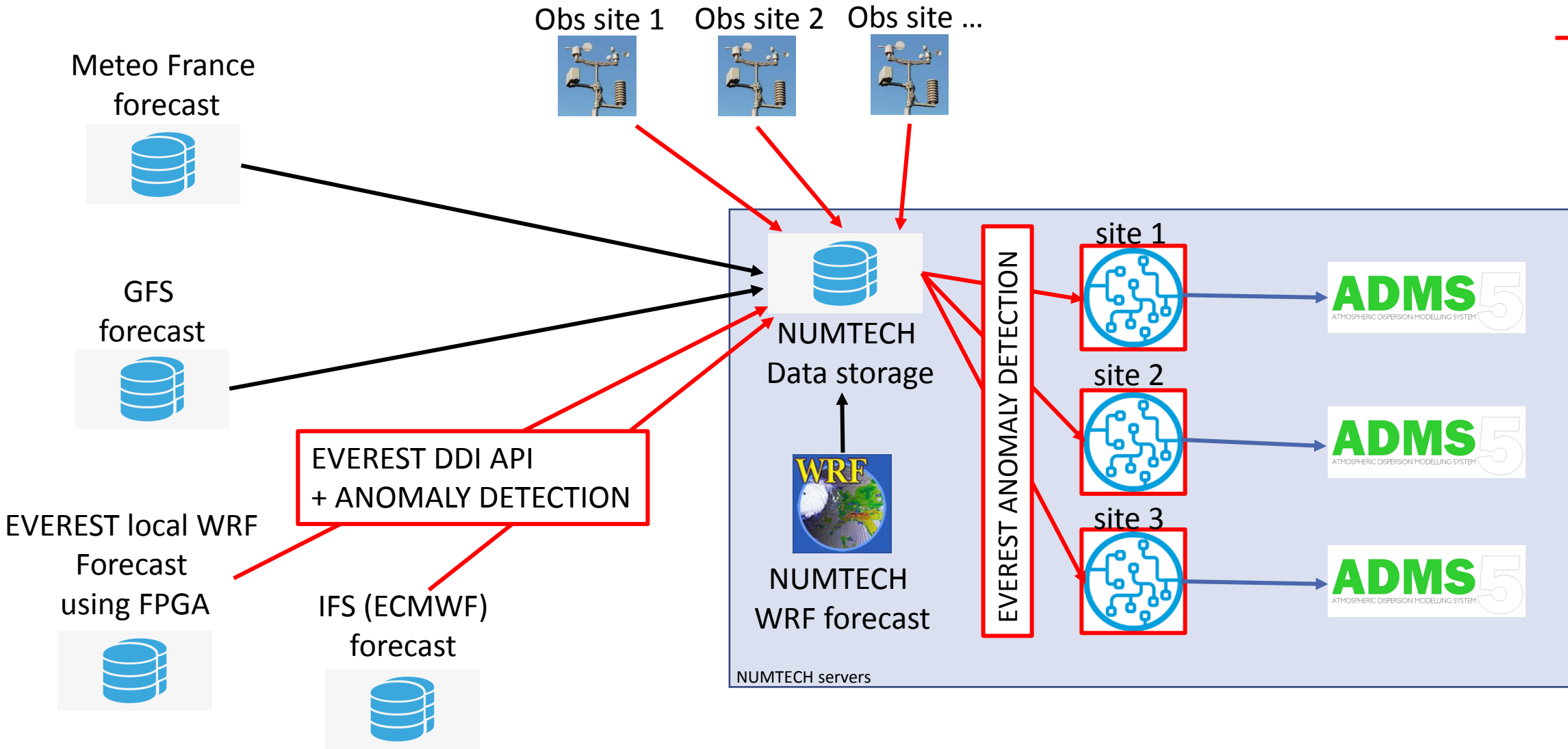
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EVEREST for NUMTECH Atmospheric applications

Objectives

- Accelerate weather forecast simulations using heterogeneous execution (HPC cluster, FPGA acceleration, cloud computing) in a secure environment

- Increase performance of local weather and air-quality forecasts based:
  - 3DVAR Assimilation of new observations and use of IFS forecast
  - Use of machine learning approach (ensemble aggregation forced by local observations)
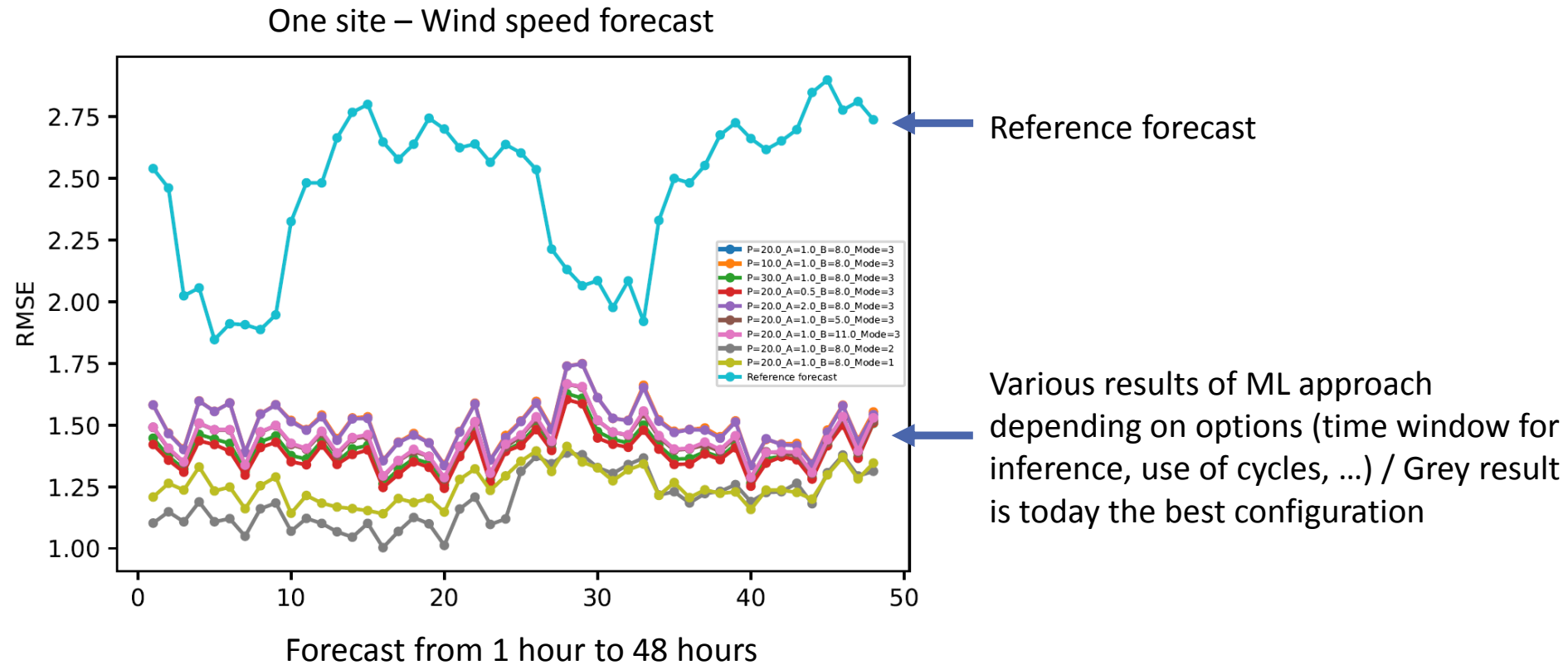
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EVEREST implementation for NUMTECH

Some results

Example of results on wind speed forecast

(Low RMSE = better forecast)

One site – Wind speed forecast

Reference forecast

Various results of ML approach depending on options (time window for inference, use of cycles, …) / Grey result is today the best configuration

Legend:
- P=20.0_A=1.0_B=8.0_Mode=3
- P=10.0_A=1.0_B=8.0_Mode=3
- P=30.0_A=1.0_B=8.0_Mode=3
- P=20.0_A=0.5_B=8.0_Mode=3
- P=20.0_A=2.0_B=8.0_Mode=3
- P=20.0_A=1.0_B=5.0_Mode=3
- P=20.0_A=1.0_B=11.0_Mode=3
- P=20.0_A=1.0_B=8.0_Mode=2
- P=20.0_A=1.0_B=8.0_Mode=1
- Reference forecast

Forecast from 1 hour to 48 hours

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More informations

https://everest-h2020.eu/

https://www.linkedin.com/company/everest-h2020/

https://twitter.com/project_everest

https://www.facebook.com/EVERESTH2020/

https://www.youtube.com/channel/UCEs_oTeDiVZiMmaIQCekr-Q

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Thanks!