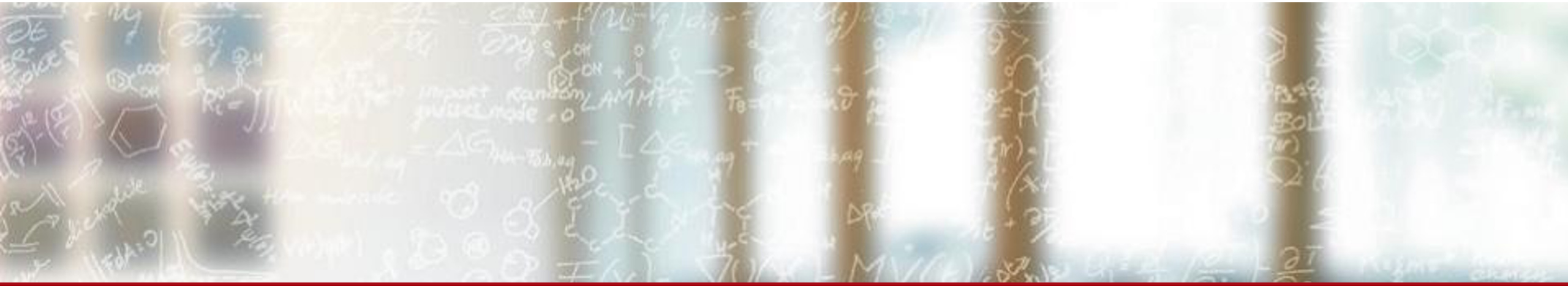
CSCS
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

ETH zürich



The Swiss National Supercomputing Centre (CSCS)

Joost VandeVondele

Deputy Director, The Swiss National Supercomputing Centre (CSCS), ETH Zurich

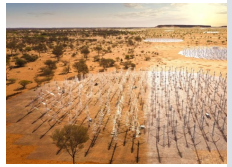
CSCS: the ALPS research infrastructure (RI)

CSCS develops and operates a high-performance computing and data research infrastructure that supports world-class science in Switzerland.

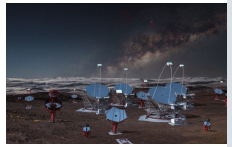
A RI connected to experiment, computational science, and the world

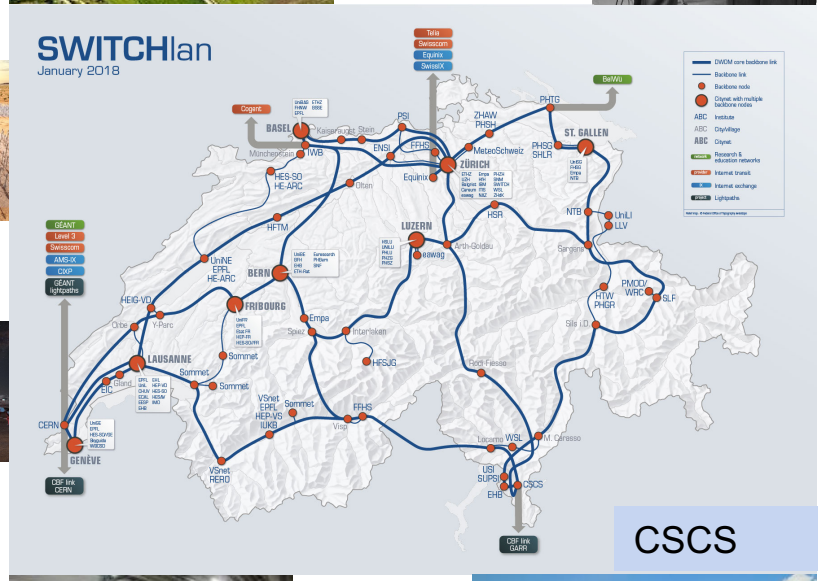
PSI

MCH



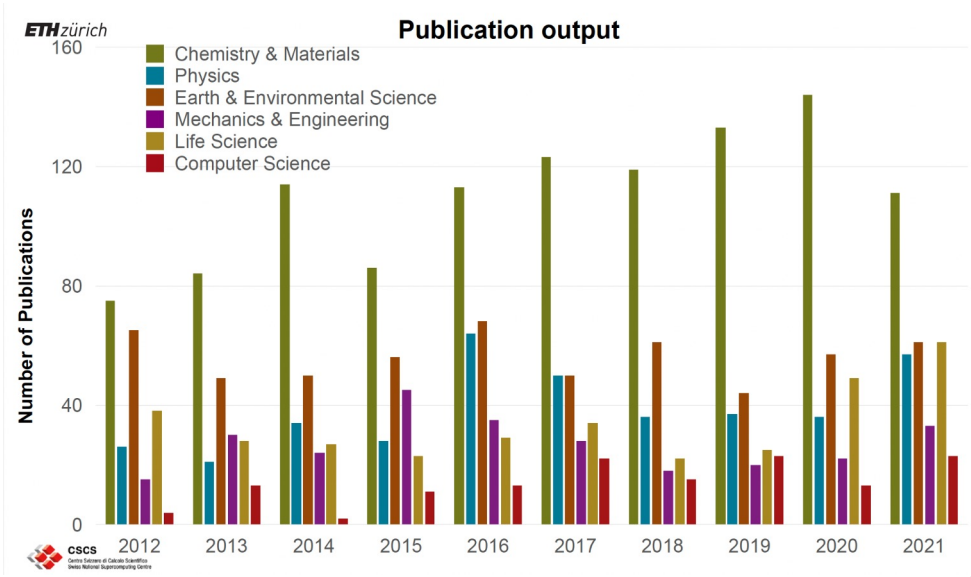
SKA / CTA

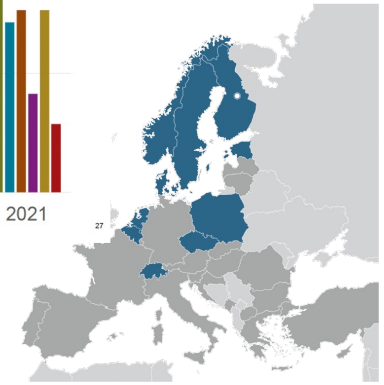




CSCS

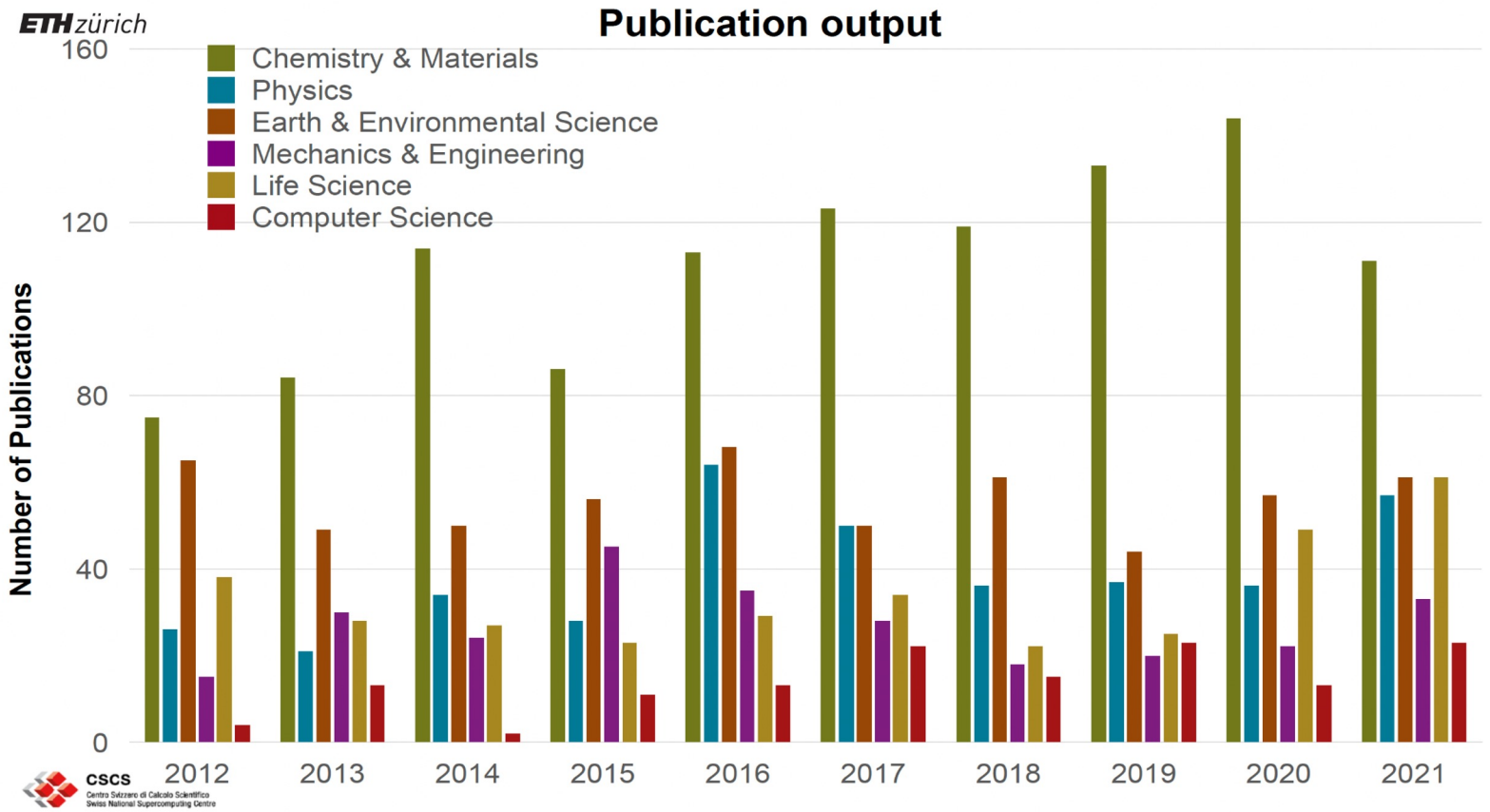
CERN





User Program & PASC, and Partnerships

The **User Lab (User Program & PASC)** provides access to resources and knowhow based on a *peer review process* and are the funded through the HPCN initiative and ETHZ by the Swiss Government

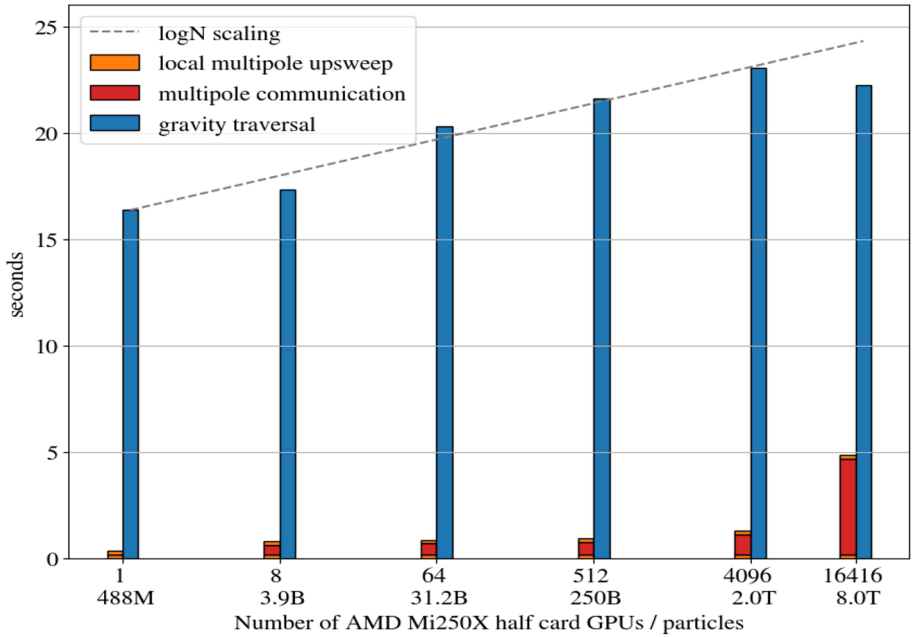


Educating and moving communities along: The Platform for Advanced Scientific Computing (PASC)

Example: hydrodynamics and gravity
for astrophysics and cosmology

- PASC project, 2nd round / 8 years
- Essentially code started from scratch, GPU acceleration/portability.
- Full Size runs on LUMI-G (16416 GPUs)
- Won Europe largest (22MGPUh) allocation on LUMI-G

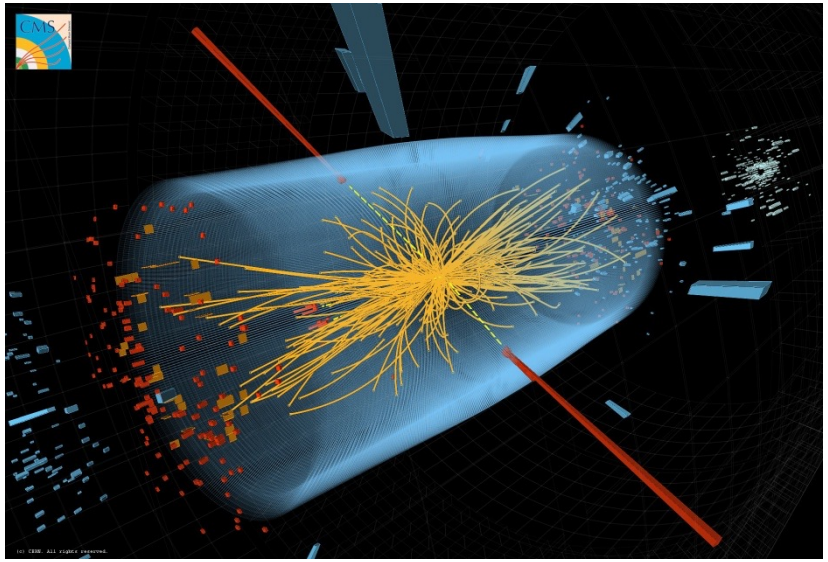
- The broad availability and quality of HPC software developed in Switzerland
- Performance on CSCS infrastructure (GPU-accelerated supercomputing platforms)
- HPC software engineering competence in Swiss academic institutions
- Plays a crucial role in the co-design of CSCS' supercomputing infrastructure
- in its fifth cycle (HP2C: 2009, PASC: 2013, 2017, 2021, 2025)



Sebastian Keller, Aurélien Cavelan, Rubén Cabezon, Lucio Mayer, Florina M. Ciorba

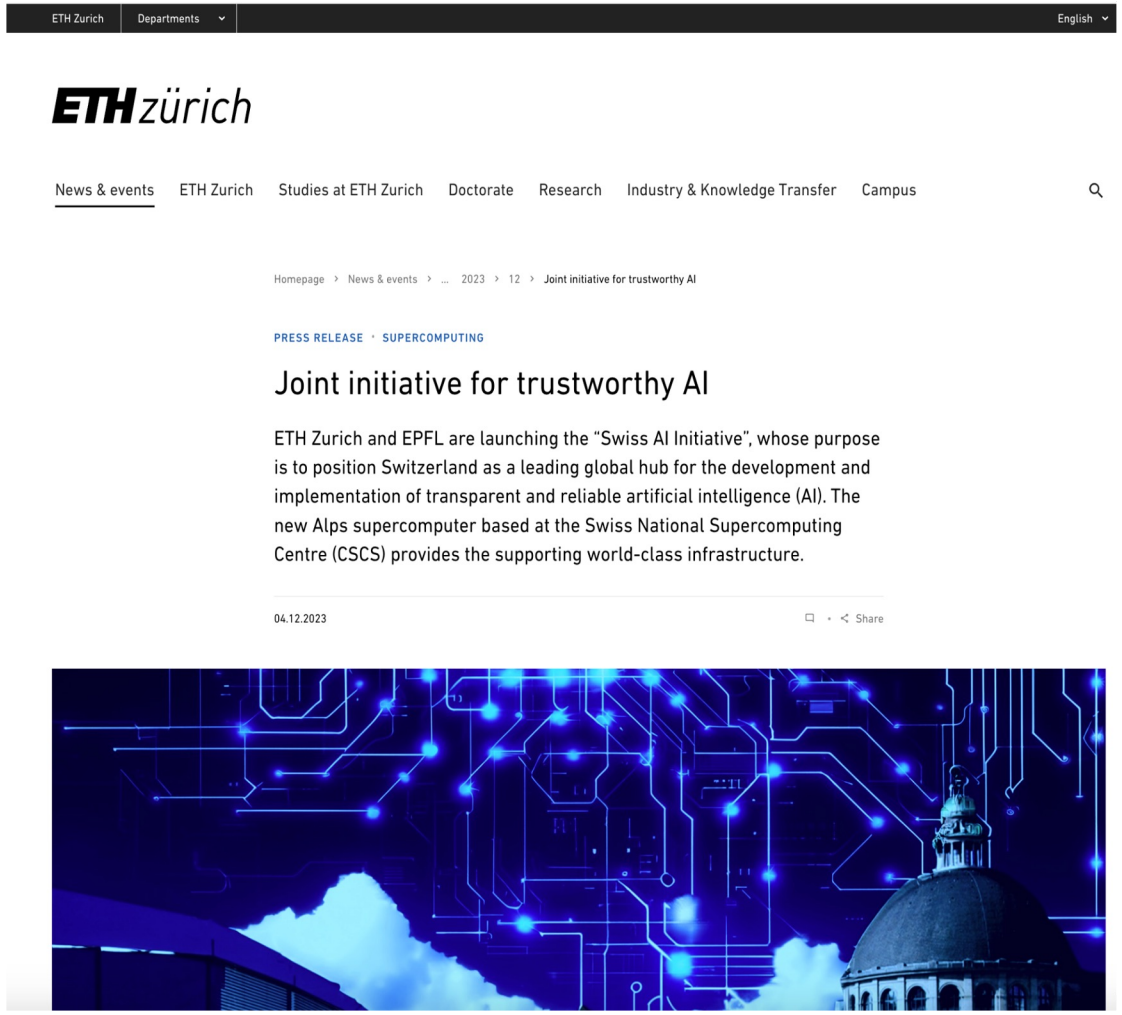
CHIPP - Analysis of data from the Large Hadron Collider (LHC)

Swiss Institute of Particle Physics

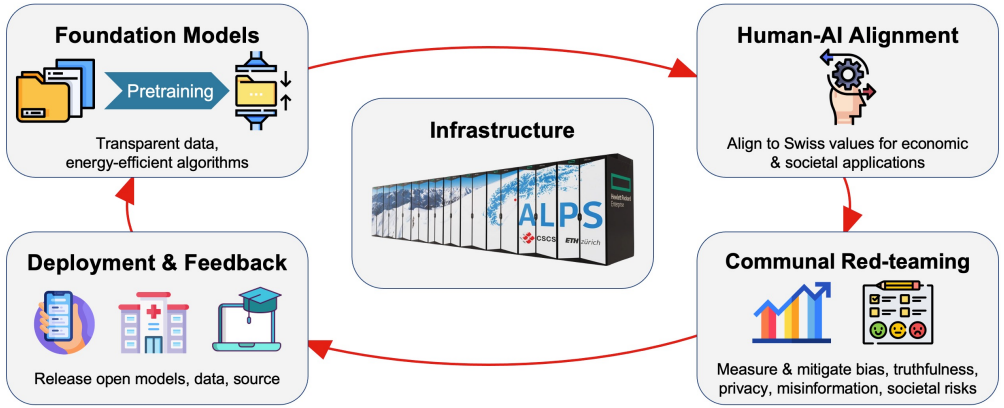


- Swiss particle physics community in the context of the **Large Hadron Collider (LHC)** at CERN. The goal of LHC is to help understand the building blocks of our Universe by particle collisions.
- On behalf of CHIPP, CSCS operates a mid-size Tier-2 grid site for three of the four detectors: ATLAS, CMS and LHCb.
  - Currently ~10 PB of storage, ~250 compute nodes
- This grid site is the first in the world to be fully running with HPC resources and have front-end services to be fully kubernetesised
  - (Seamlessly) migrating into Alps

The Swiss AI initiative



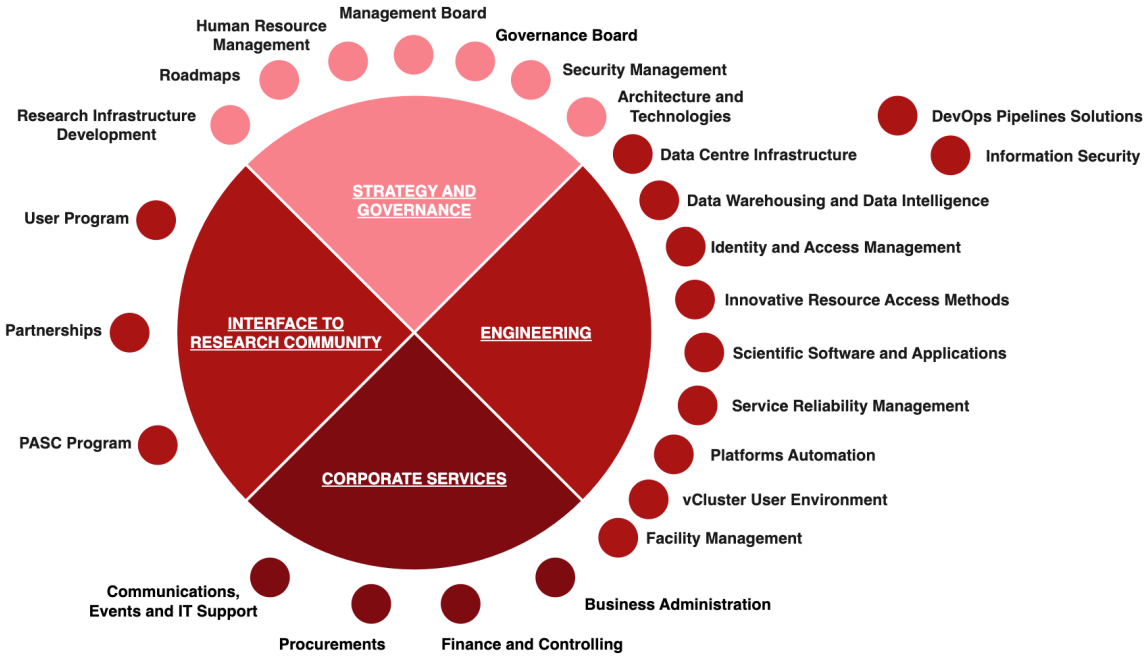
Guiding Principles: Trust, Openness, Collaboration



Develop capabilities, know-how & talent to build trustworthy Generative AI aligned with Swiss values

Make these resources available for the benefit of Swiss society and global actors

CSCS is a world-class agile engineering organization



130 Employees, 30 nationalities

Introduce CSCS people in this meeting today (Thomas, Pablo, Nur, Mauro, Maxime, Kasia, Maria Grazia, Prashanth), more staff will join in person or online for the panel discussion.

Conclusions

- CSCS mission is to enable world-class science in Switzerland
- With Alps, CSCS has deployed a world-class AI capable supercomputer that ofter cloud-native functionality
- Infrastructure is key to modern AI and foundational models, and the Swiss AI initiative unites and will generate top talent in AI
- People are key, employing, educating and enabling.

ETH zürich

Alps Research Infrastructure

Thomas C. Schulthess

OUR MISSION (since 2015)

"We develop and operate a high-performance computing and data research infrastructure that supports world-class science in Switzerland."

The research infrastructure (User Laboratory) is open to scientists worldwide

The issues with digitalisation and data in science

BIG DATA ANALYTICS

FAIR DATA

EDI

GRID COMPUTING

DATA LAKES

OPEN RESEACH DATA

EOSC: CLOUD OR COMMONS?

EOSC-PORTAL

EOSC-NODES

Important considerations when dealing with digital data:
(e.g. ask what ChatGPT says about Big Data)

1. Velocity
2. Volume
3. Veracity
4. Variety
5. Value

But we don't know how big — prepare the infrastructure for/with most ambitious/experienced

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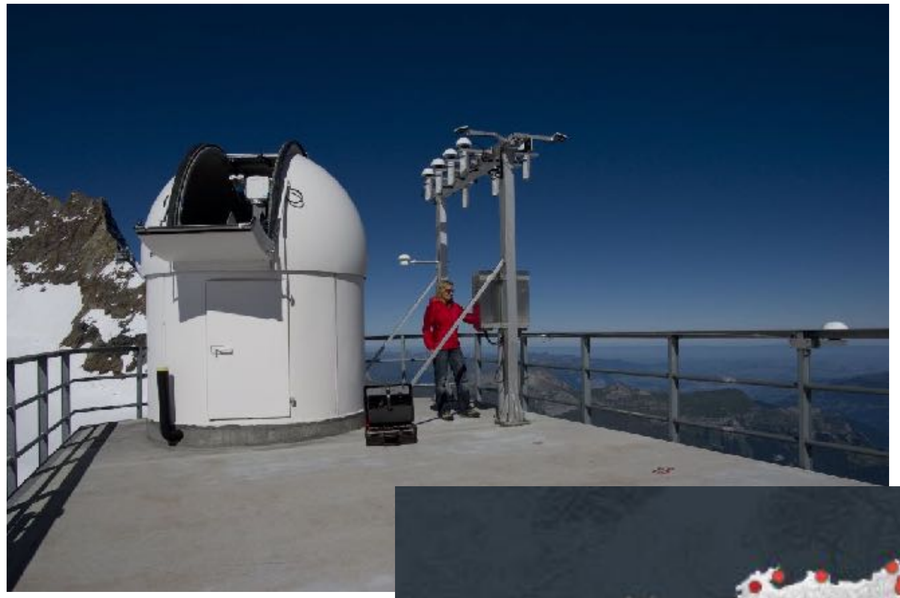
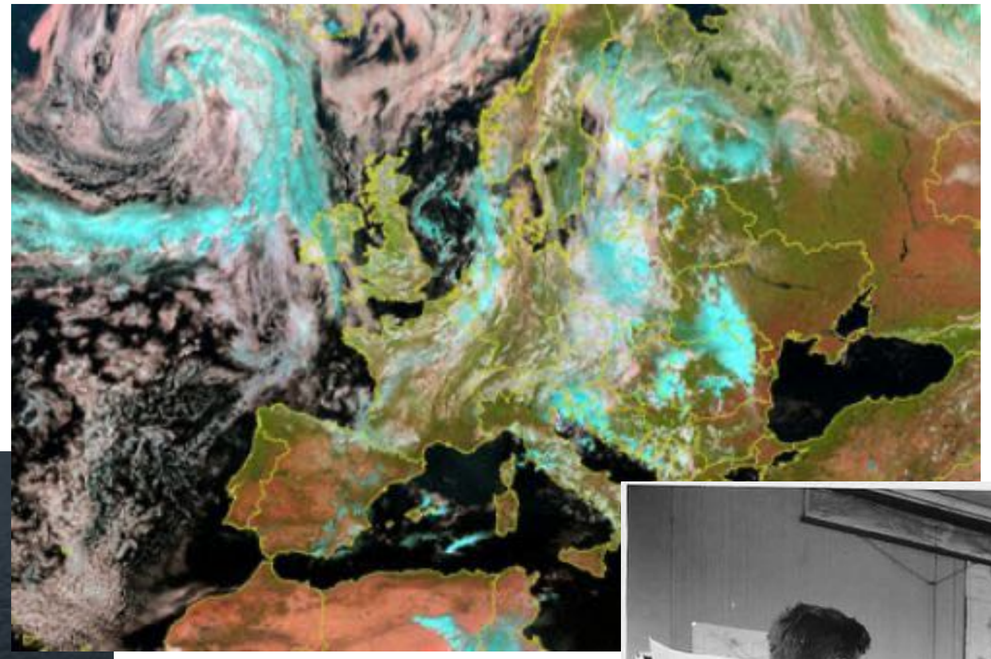
MeteoSwiss

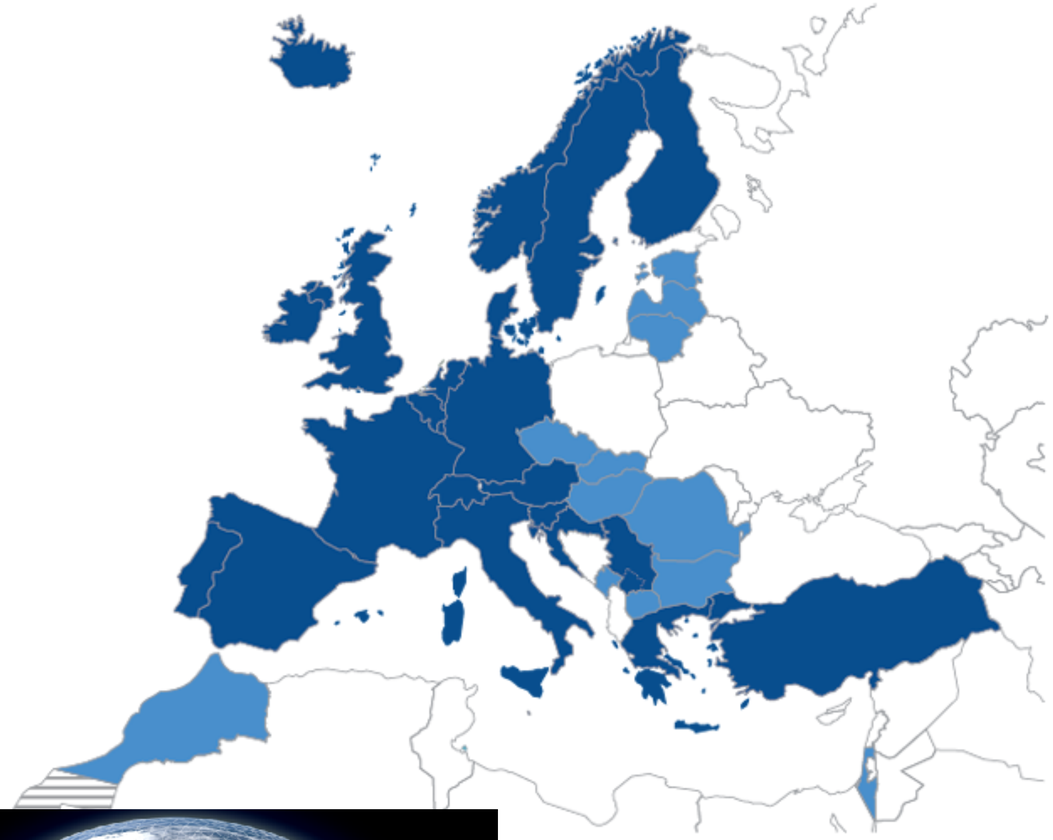
Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology MeteoSwiss

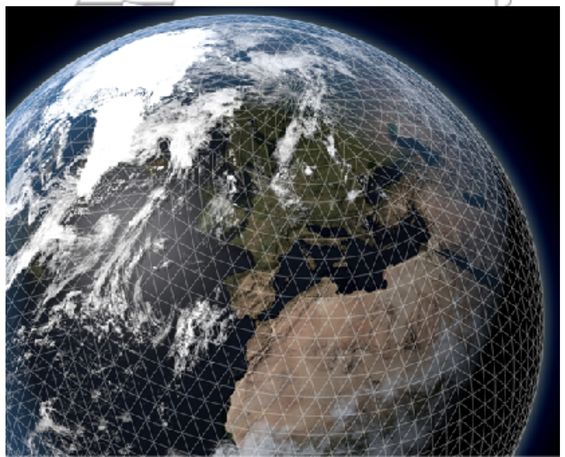




Source: meteoswiss.admin.ch

European Center for Medium-Range Weather Forecasts





adapted from Schär, ETH Zürich

ECMWF

An independent intergovernmental organization established in 1975

Switzerland was founding member of ECMWF among 18 countries

Today the worldwide leading numerical weather prediction center

Provides input data for the weather predictions of MeteoSwiss

CSCS
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

ETH zürich

MENU

USER PORTAL

1 / 3

World's Most Powerful AI-Capable Supercomputer

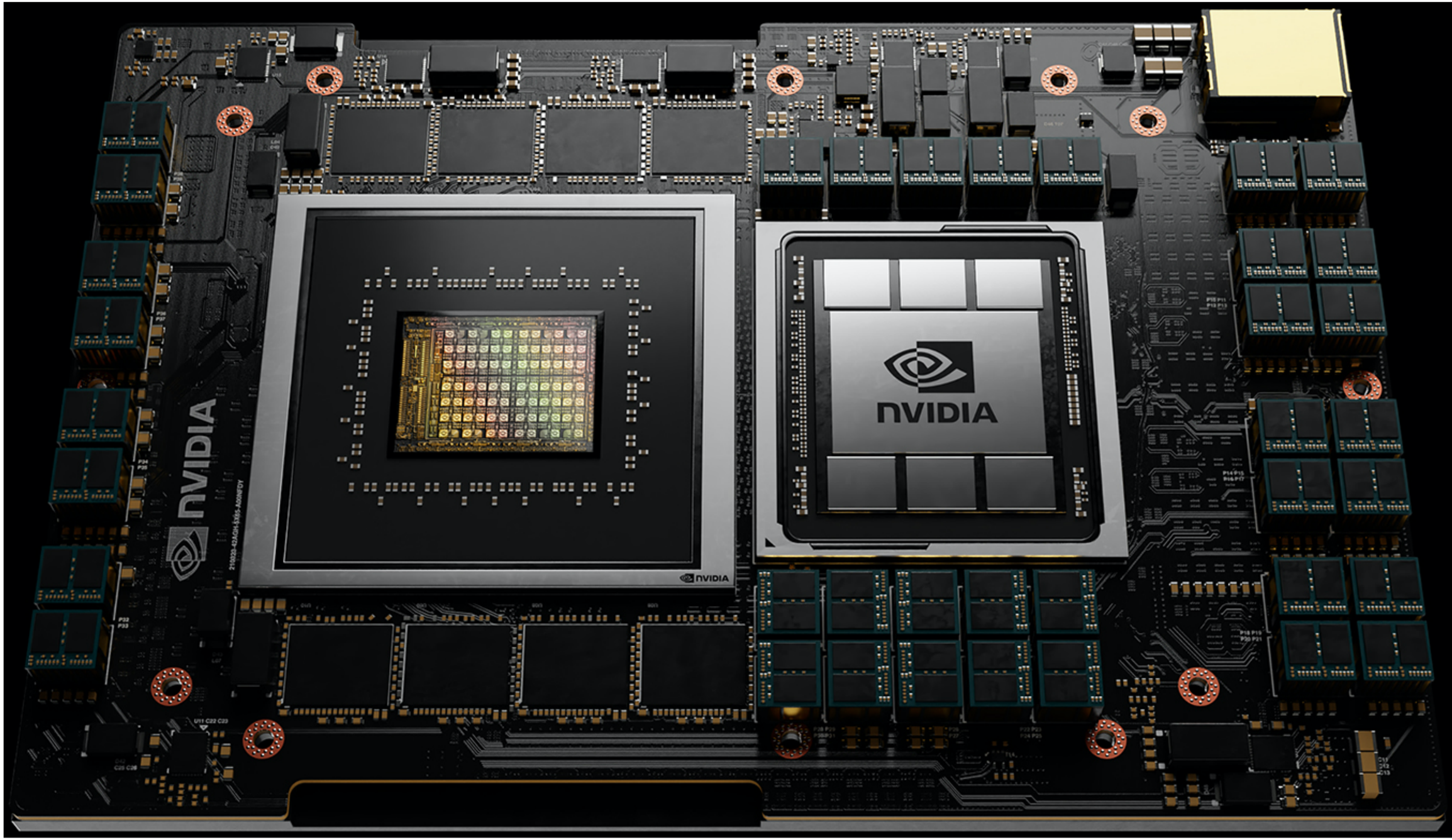
CSCS, Hewlett Packard Enterprise and NVIDIA Announce World's Most...

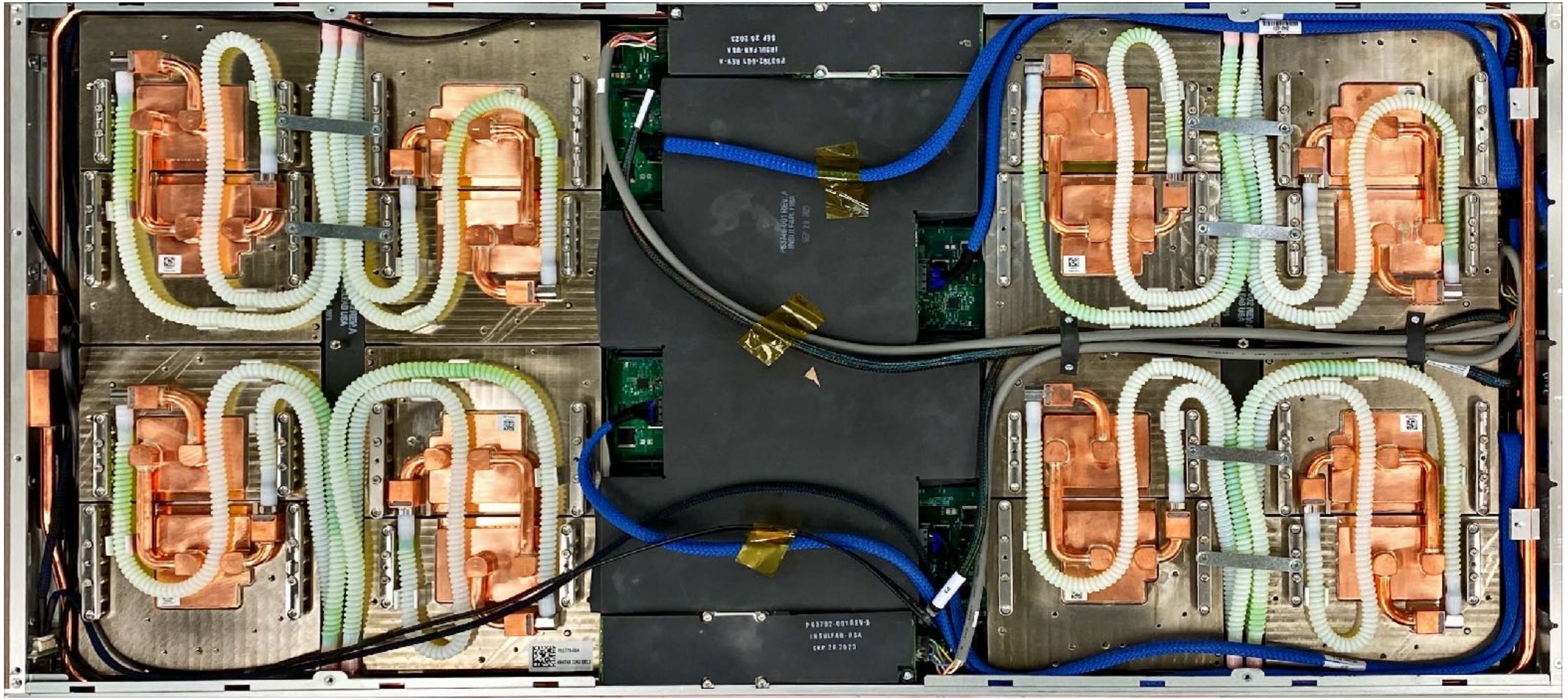
12.04.2021

"Alps" system to advance research across climate, physics, life sciences with 7x more powerful AI capabilities than...

MORE

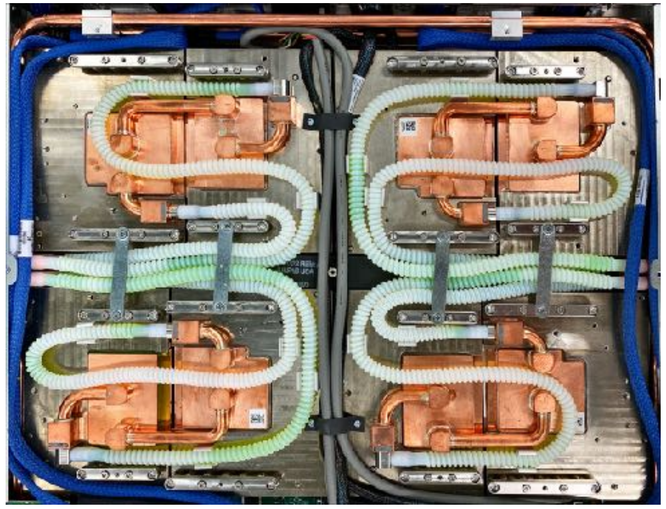
MORE SCIENCE


NVIDIA
NVIDIA
NVIDIA



Power: ~8kW

Alps: 2,688 nodes or 10,752 GH200 Superchips



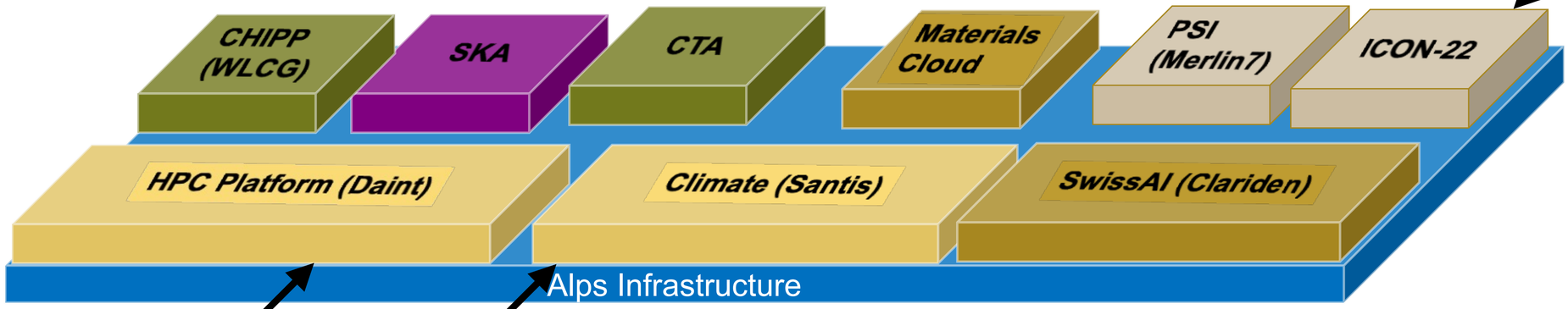
Cray-Shasta slingshot network

Power envelope: 10 MW

ALPS

Alps: beyond traditional supercomputing

NWP
MeteoSwiss



User Program (HPCN)

XCLAIM

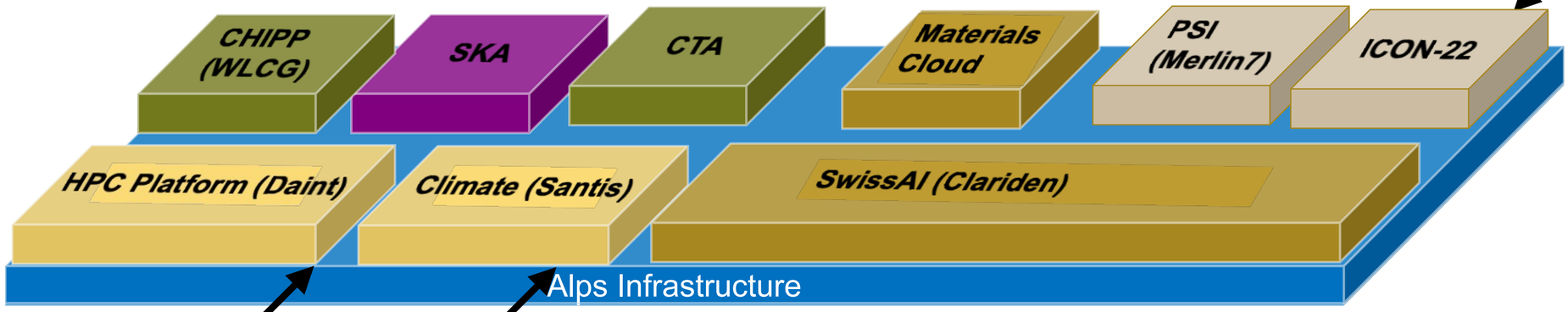
C2SM
Center for Climate Systems Modeling

EPFL AI Center

ETH AI CENTER

Alps: elasticity to (e.g.) prioritise AI work

NWP
MeteoSwiss



User Program (HPCN)

XCLAIM

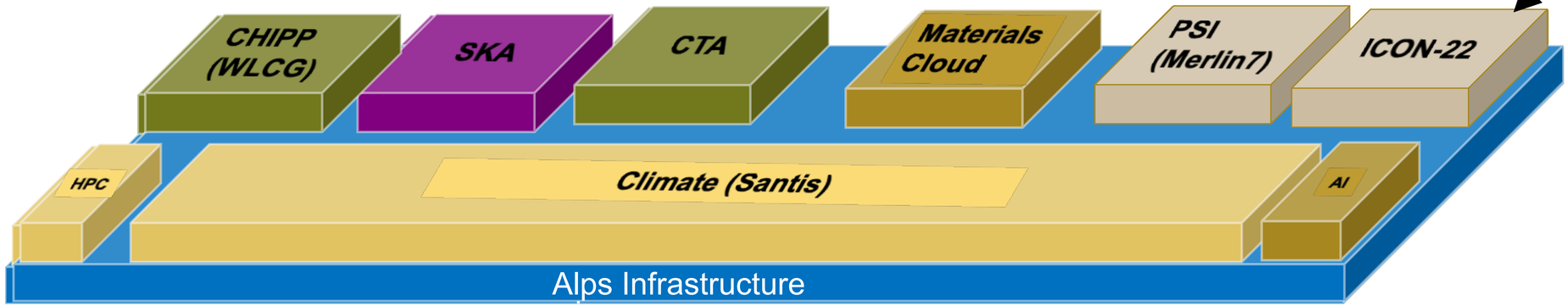
C2SM
Center for Climate Systems Modeling

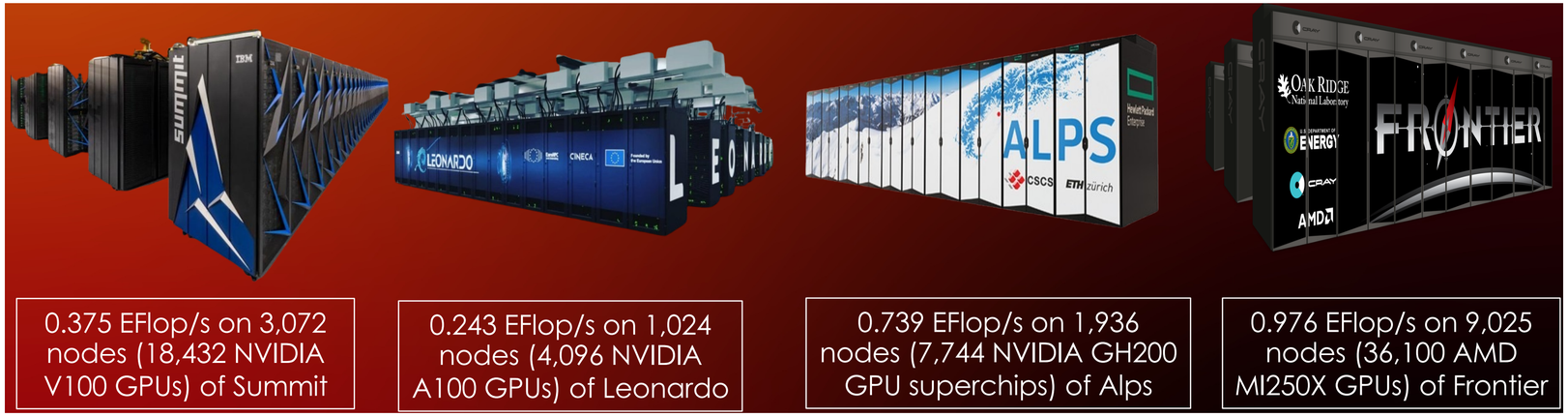
EPFL AI Center

ETH AI CENTER

Alps: supporting Gordon Bell Prize winner SC24

NWP
MeteoSwiss





0.375 EFlop/s on 3,072 nodes (18,432 NVIDIA V100 GPUs) of Summit

0.243 EFlop/s on 1,024 nodes (4,096 NVIDIA A100 GPUs) of Leonardo

0.739 EFlop/s on 1,936 nodes (7,744 NVIDIA GH200 GPU superchips) of Alps

0.976 EFlop/s on 9,025 nodes (36,100 AMD MI250X GPUs) of Frontier

Courtesy of David Keyes, KAUST

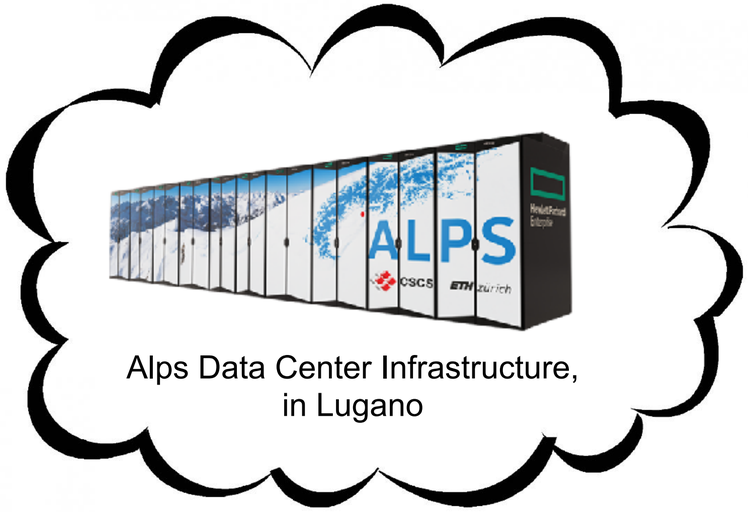
ALPS

ALPS

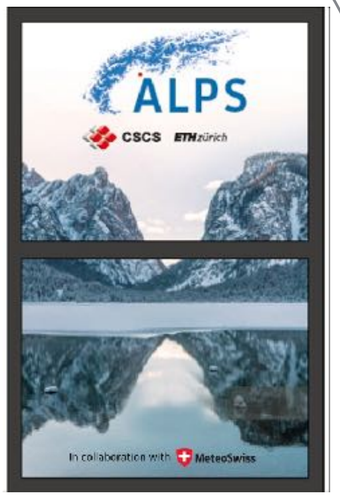
ALPS

Alps data hyper-cube at ECMW in Bologna

IFS running @ ECMF in Bologna



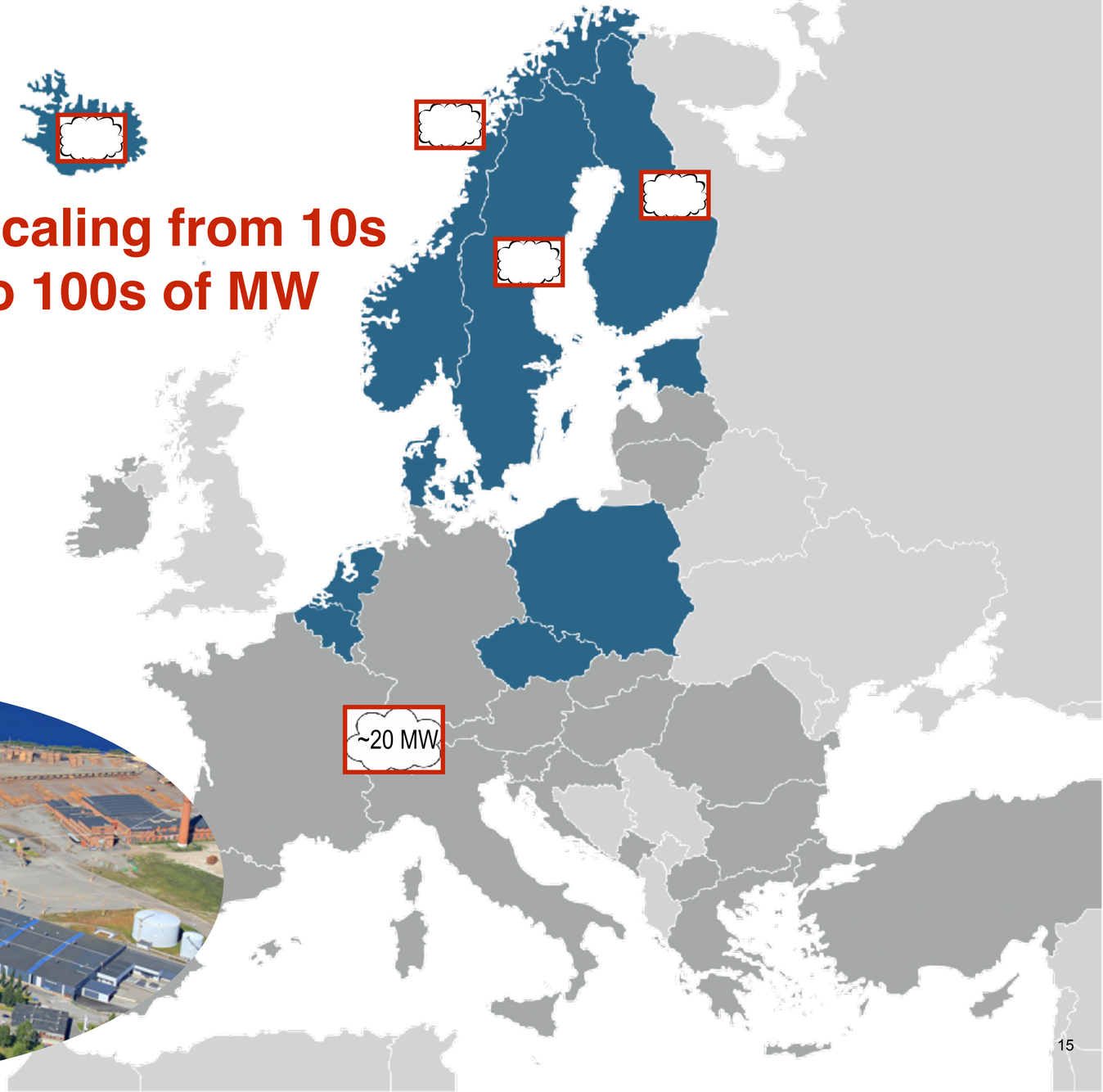
Alps Data Center Infrastructure,
in Lugano



Alps Data Hypercube
in Bologna

ECMWF MARS archive in Bologna

LUMI is a consortium that has deployed the first EuroHPC pre-exascale supercomputer



International Computing and AI Network (ICAIN)

The Vision of ICAIN

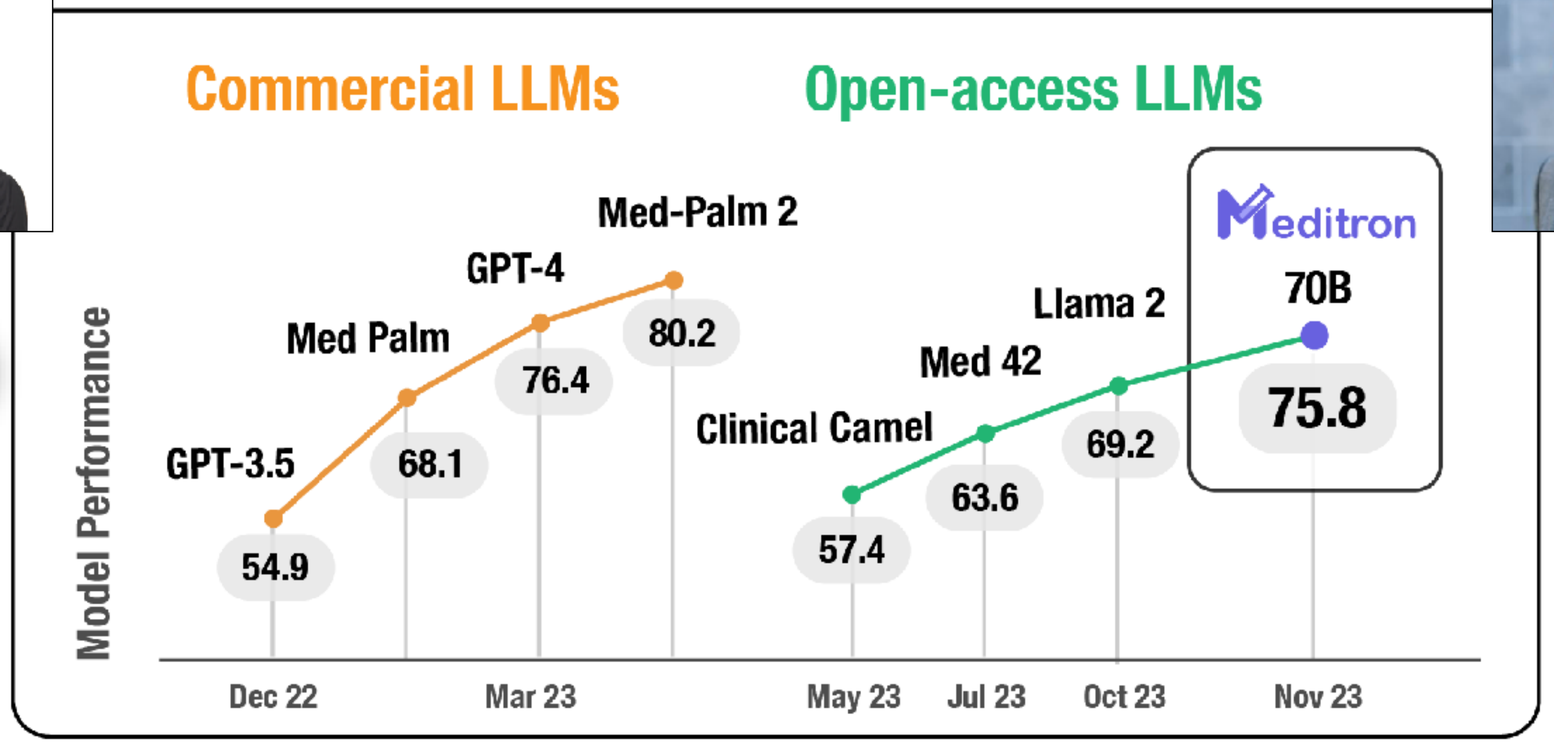
We envision a world where cutting-edge AI capabilities are harnessed to their fullest potential in pursuit of the United Nations Sustainable Development Goals, such as:

- Eradicating poverty in all its forms
- Achieving global food security and sustainable agriculture
- Combating climate change and its far-reaching impacts

The Values of ICAIN

- **Equity:** Democratizing global AI technology access
- **Sustainability:** Harnessing global supercomputing for sustainability
- **Safety:** Anticipating and mitigating potential risks

Meditron: LLM for clinical applications



As we speak: Swiss AI Initiative is training 70B parameter LLM base on fully open data

Nudging imperfect foundation with (moove) Massive Open Online Validation and Evaluation

Nudging through use

Meditron

moove

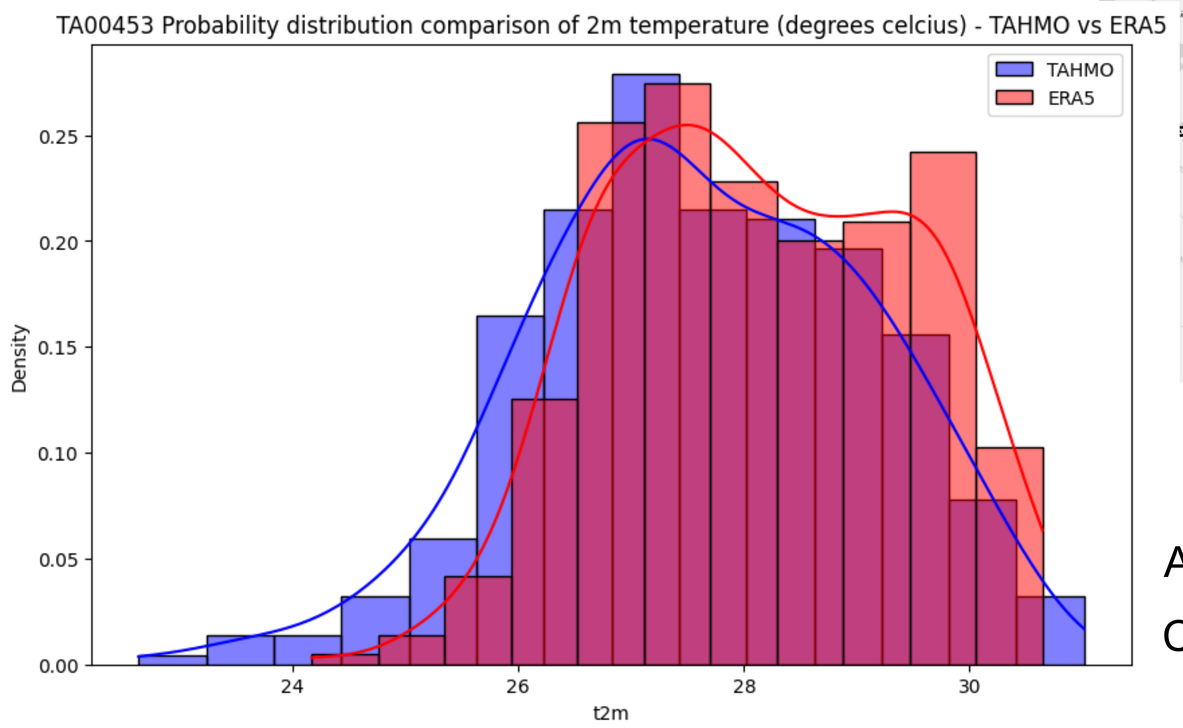
Source: Annie Hartley

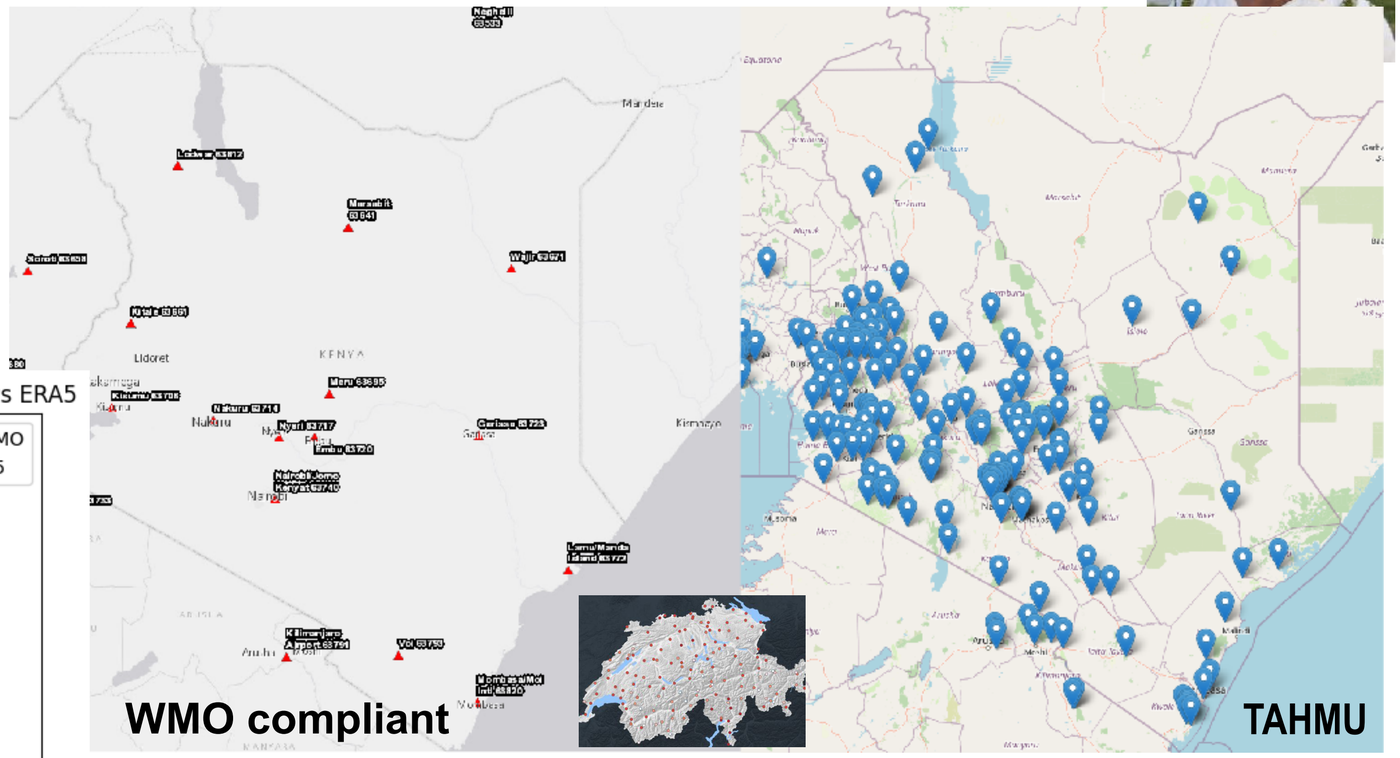
How?

- DPO
- RLHF
- RAG
- Finetuning

Climate and Agriculture

Early diagnosis of plant diseases through spectroscopy





AI models (e.g. Graphcast) trained with ERA5 data

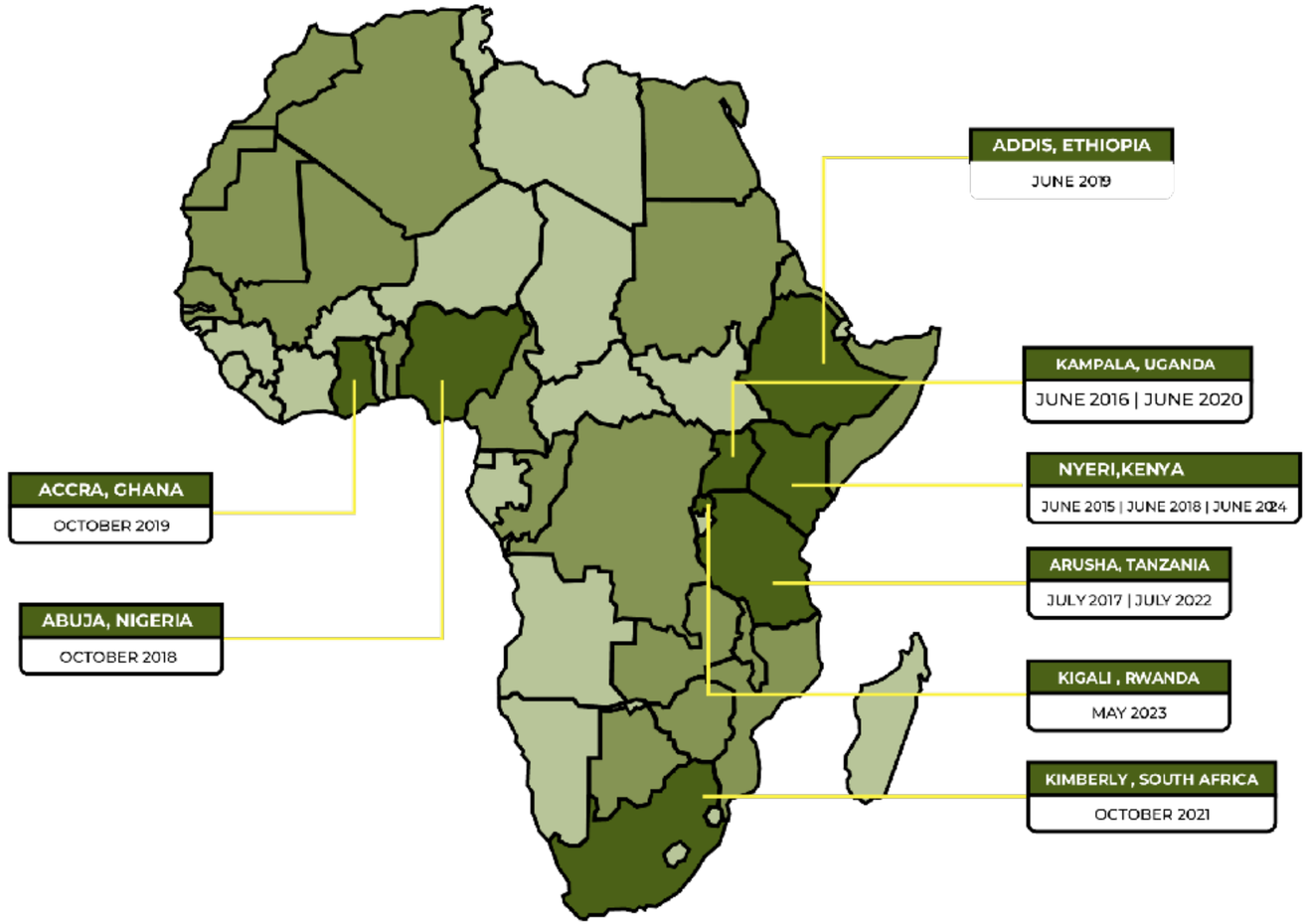
Comparing (ERA5) reanalysis data with TAHMU data

Data Science Africa

Grassroots capability building organisation

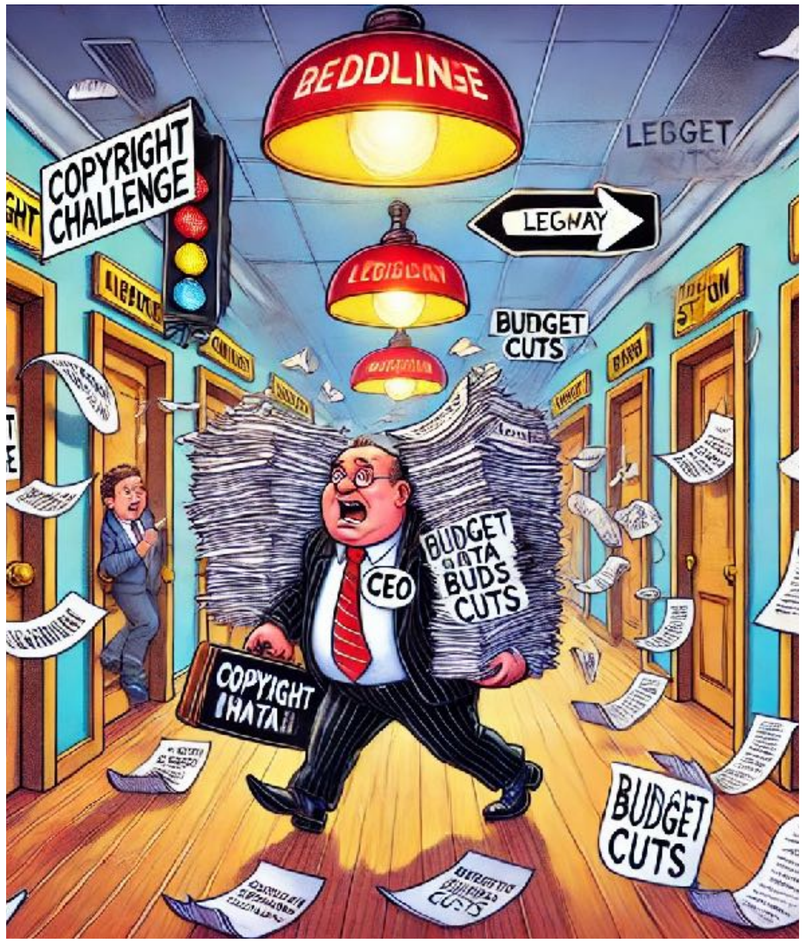
- By Africa
- Student focus
- About solutions
- Sustainable and inclusive
- Agility

June 2024, Nyeri Kenya



The opportunity has implications …

- Budget to fund cost of electricity and future investments
  - 90 GiWh in 2025 -> CHF 20.7 Mio.
  - Alps would cost CFH 400 Mio. if we hadn't placed the order in 2020
- Legislative and societal handling of artificial intelligence
  - Copyright and data protection
  - Bridging academic research and commercial applications of AI



Source: DALL-E

Thank you to the teams at CSCS, HPE and NVIDIA, as well as our partners, and thank for your interest