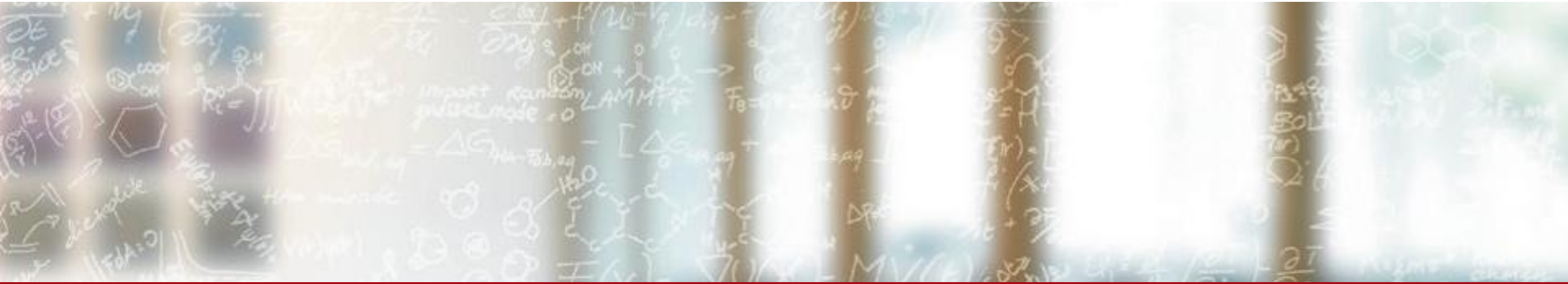**CSCS**
Centro Svizzero di Calcolo Scientifico
Swiss National Supercomputing Centre

esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER
AND CLIMATE IN EUROPE

ETH *zürich*

Introduction to containers on HPC with the Sarus container engine

Summer School on Effective HPC for Climate and Weather

Alberto Madonna, CSCS

August 27, 2020

Table of Contents

1. Introduction to Sarus (30 min)

2. Tutorial / live demo (45 min)

- Slides and code available at https://github.com/eth-cscs/containers-hands-on

- *Disclaimer: This material reflects only the author's view and the EU-Commission is not responsible for any use that may be made of the information it contains*
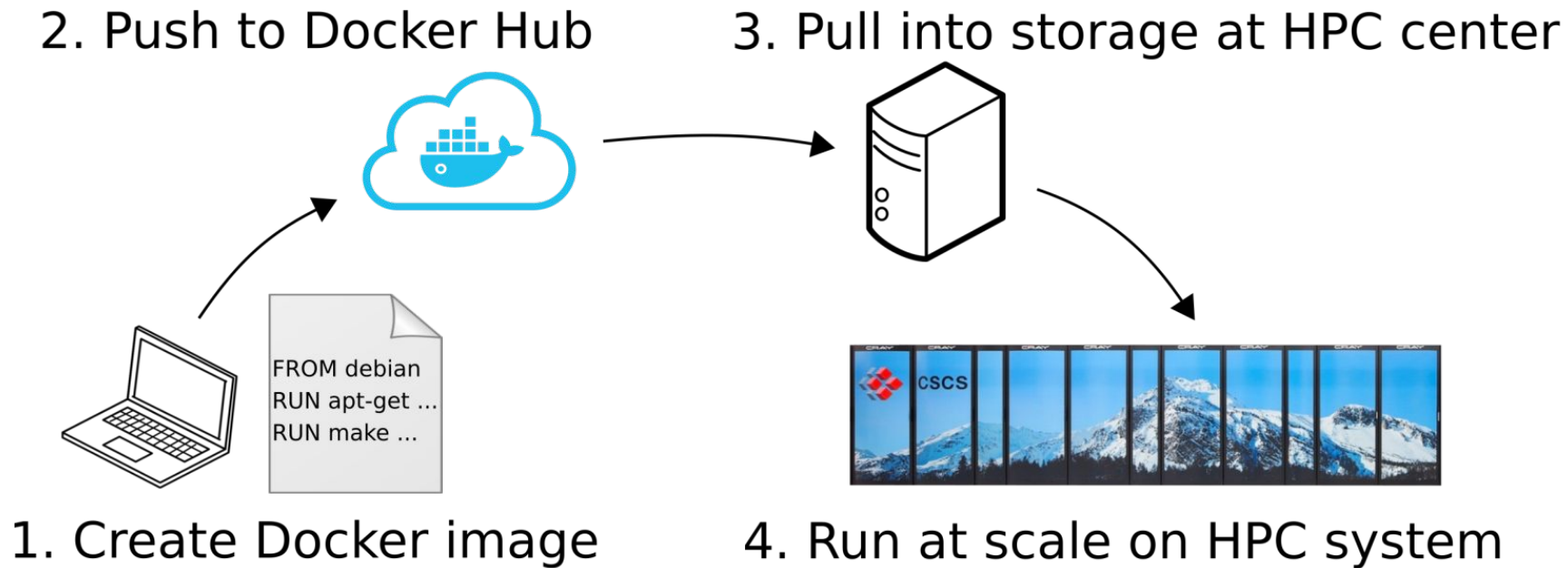
Docker and HPC: not a good fit

- Security model assumes root privileges

- No integration with workload managers

- Missing support for diskless nodes

- Very limited support for kernel bypassing devices (e.g. accelerators and NICs)

- No adequate parallel storage driver

cscs

esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER
AND CLIMATE IN EUROPE

ETH zürich

Sarus container engine

- OCI-compatible container engine engineered by CSCS

- Designed for the requirements HPC

- Consistent UX with Docker: small learning curve

- Transparent native performance through hooks

- Enables use of standard, open, upstream components on HPC systems

- Extensible architecture encourages vendor engagement and improves maintainability

cscs

esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER
AND CLIMATE IN EUROPE

ETHzürich

Typical user workflow at CSCS

2. Push to Docker Hub

3. Pull into storage at HPC center

```
FROM debian
RUN apt-get ...
RUN make ...
```

1. Create Docker image

4. Run at scale on HPC system

Highlights of Sarus from a user perspective

- Consistent experience
  - With Docker: closely resembling CLI
  - With host environment: env variables, uid/gid, file permissions

- Pull images from Docker registries (e.g. Docker Hub, NVIDIA NGC)

- Import images from local tar archives (no cloud upload required)

- Integration with the workload manager (Slurm)

- Native performance from GPUs and high-speed interconnects

- Access to parallel filesystems inside containers

Sarus CLI

- Sarus

```
# pull image
$ sarus pull [options] <image>[<:tag>]

# load image
$ sarus load [options] <file> <image>

# show list of images
$ sarus images

# remove image
$ sarus rmi <image>[<:tag>]

# run container
$ sarus run [options] <image>[<:tag>]
<command> <args>
```

- Docker

```
# pull image
$ docker pull [options] <image>[<:tag>]

# load image
$ docker load [options] -i <file>

# show list of images
$ docker images [options] [repo[<:tag>]]

# remove image
$ docker rmi [options] <image> [image...]

# run container
$ docker run [options] <image>[<:tag>]
<command> <args>
```

cscs

esiwace
CENTRE OF EXCELLENCE IN SIMULATION OF WEATHER
AND CLIMATE IN EUROPE

ETHzürich

Live demo!

Piz Daint: our host for the demo

- Flagship system for the Swiss National HPC Service, installed at CSCS Lugano
- #10 in the June 2020 TOP500 list
- Hybrid Cray XC40/XC50 supercomputer
  - 5704 hybrid nodes: Intel Xeon E5-2690 v3 + NVIDIA Tesla P100
  - 1813 multicore nodes: 2 x Intel Xeon E5-2695 v4
- Cray Aries high-speed interconnect
- OS: Cray Linux Environment

Further reading

- Sarus user documentation:
  https://sarus.readthedocs.io/en/latest/user/user_guide.html

- Sarus on GitHub: https://github.com/eth-cscs/sarus

- Slides and Lab material: https://github.com/eth-cscs/containers-hands-on

- Lab intro video: https://youtu.be/dv74sFb3cVc

- Contact: alberto.madonna@cscs.ch

The ESiWACE1/2 projects have received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No **675191** and No **823988**

Disclaimer: This material reflects only the author's view and the EU-Commission is not responsible for any use that may be made of the information it contains
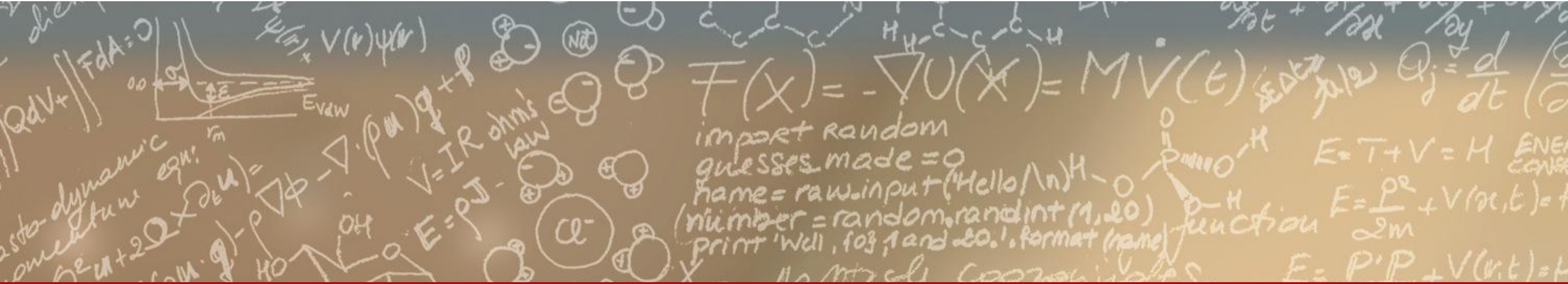
Thank you for your attention.