Forum Teratec 2022
Unlock the future !

1st Hackaton HPC

Kick-off Webinar

Friday 7th October

Teratec en partenariat avec arm aws CGG EDF UC IT

14-15 JUNE | ECOLE POLYTECHNIQUE

Forum Teratec 2022
Unlock the future !

1st Hackaton HPC

Teams registration

September - October 2022

Kick-off webinar

7 Octobre 2022 : 16h00 – 17h30

Getting to know the platform

Remote and free access

Hackathon

From monday november 8th 9h00 to Monday december 5th 9h00

Approximately 48 hours spread out as you wish

Teratec en partenariat avec arm aws CGG EDF UCIT

Forum Teratec 2022
Unlock the future !

Agenda

16:00 : Welcome by Hervé Mouren, managing director,**Teratec**

16:10 : Presentation of the codes and industrial issues :

- 16:10: Code Saturne: Cyril Baudry, Yvan Fournier, **EDF**
- 16h25 : Seismic core : Florent Pautre and Patrick Demichel, **CGG**
- 16h40 : Telemaq code : Boris Basic, **EDF**

16h55 : Presentation of the platform and support :

- Gilles Tourpe, **AWS**
- Conrad Hillairet**, ARM,**
- Jorik Remy**, UCIT**

17h15 : Questions / Answers

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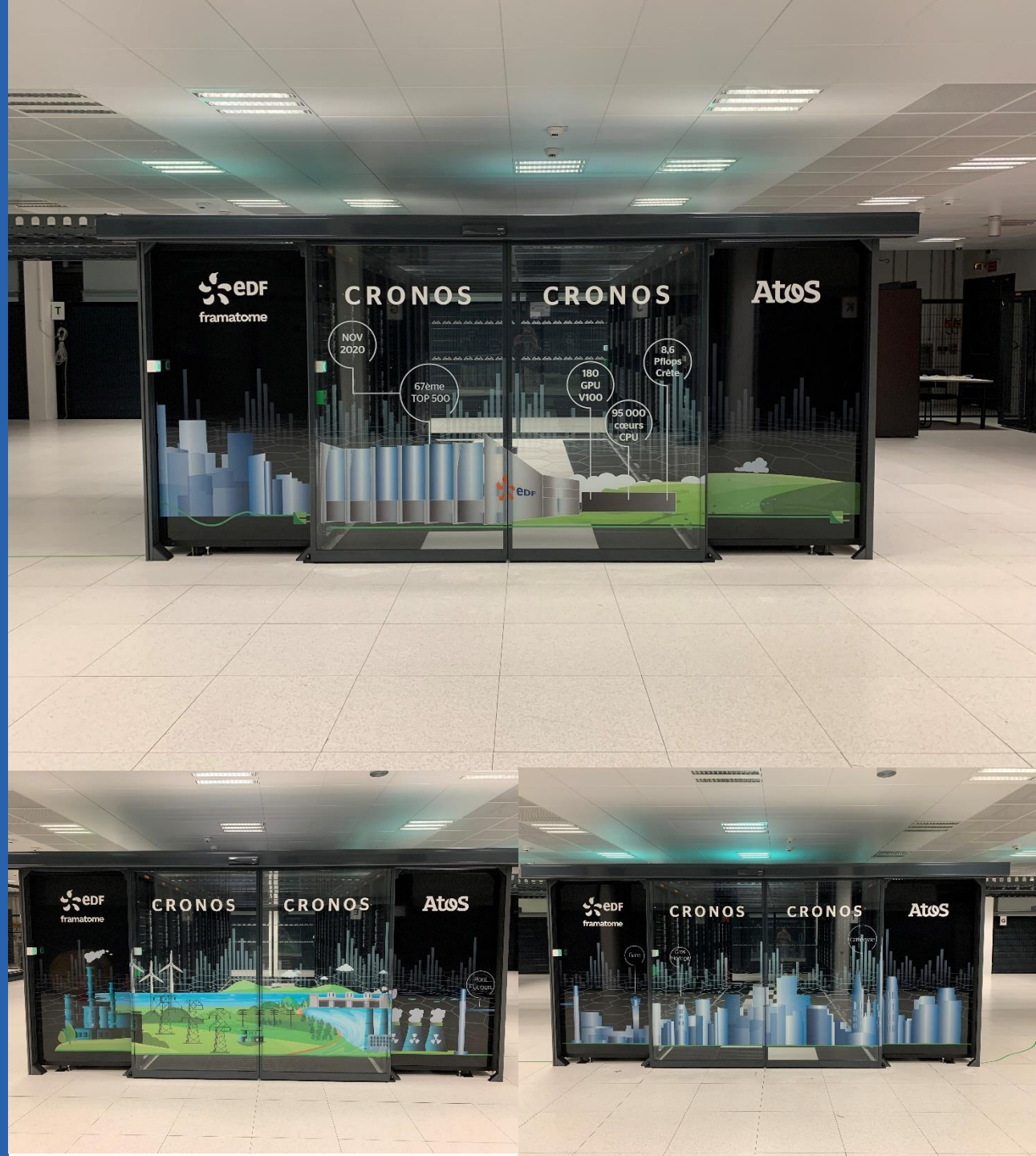
Introduction to Code_Saturne

Numerical simulations with an open-source CFD solver

Cyril Baudry

Scientific Information System Architect – HPC expert

2022/10/07



EDF IN BRIEF

- **EDF GROUP PRESENTATION**

AIM:

Be the leading electricity company and global leader for low-carbon energy production.

WORLD'S No. 1 ELECTRICITY COMPANY

Particularly well established in Europe, especially France, the United Kingdom, Italy and Belgium, the Group's energy production, marked by the rise in renewable energy, relies on a diversified low-carbon energy mix based on nuclear power.

LEADER IN LOW-CARBON PRODUCTION

No. 1 producer of nuclear electricity in the world

No. 1 producer of renewables in Europe

No. 3 European operator of energy services

EDF COVERS ALL ELECTRICITY ACTIVITIES

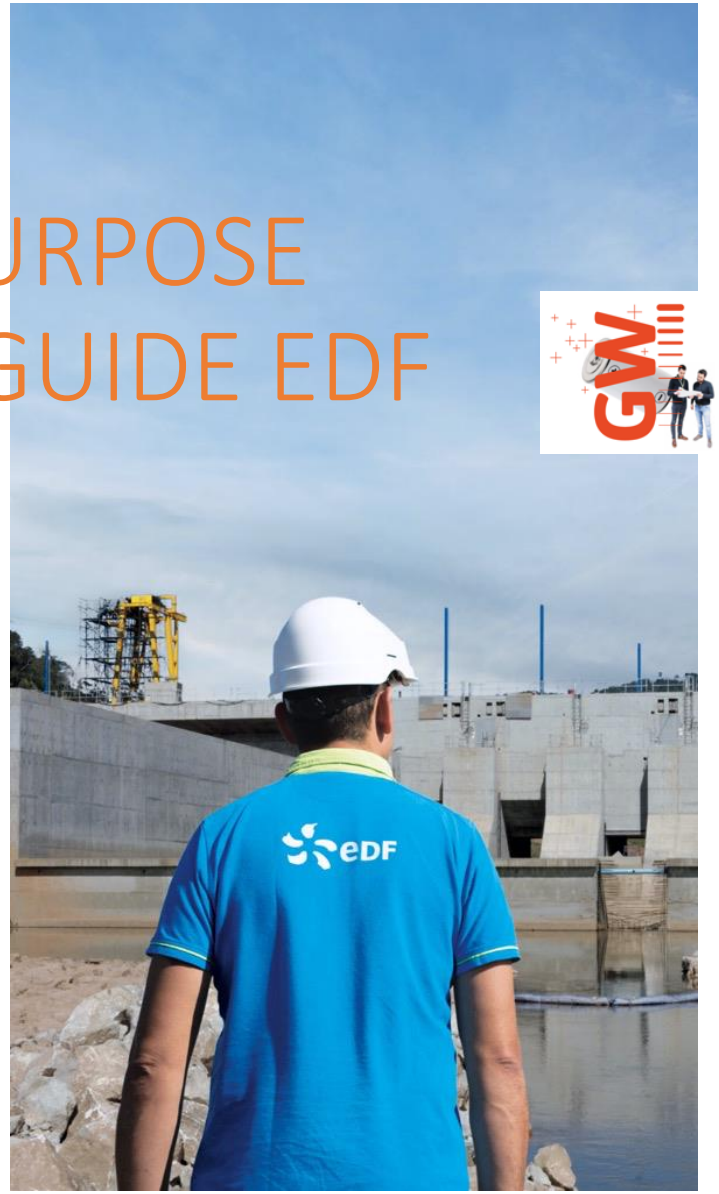
Generation

Transmission and distribution

Supply

Energy services

A PURPOSE TO GUIDE EDF



"Build a net zero energy future with electricity and innovative solutions and services, to help save the planet and drive wellbeing and economic development"

OUR STRATEGIC PROJECT

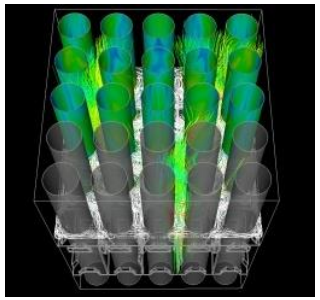
Stepping up a gear to build a carbon-neutral energy future

The EDF group undertook a major commitment in 2020 by including its raison d'être in its articles of association. This decision places equal importance on decarbonising energy and the economy in general, safeguarding the environment and supporting growth. Pursuing a pathway to achieve carbon neutrality by 2050 has motivated us to ramp up the targets we set to reduce our direct and induced CO2 emissions by 2030. We stepped up our CAP 2030 strategy accordingly, as we need to go even further and faster to fulfil our commitments.

EDF POLICY : SOME CONTEXTUAL ELEMENTS TO INTEGRATE

- Plants operated over 40 – 100 years
  - Guarantee safety, minimize environmental footprint
  - Maintain assets
- Fast changing operating conditions
  - More competitive markets,
  - Tougher regulations, ageing, environment
- New business models and services
  - Data science, Open Data, Artificial Intelligence, Blockchain, ….
  - Cloud computing
  - Smart meters
- Energy Transition
  - Diversified energy mix (nuclear, renewables,…)
  - Products and services, energy-saving solutions, help customers to manage their consumption
  - A dual digital and energy transition for both society and the economy

Figure 2 : Emprise et bathymétrie du modèle 3D.

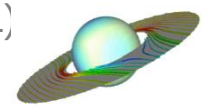
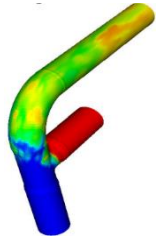


EDF is active in **all areas** of energy from **generation** to **trading** and **network management.**

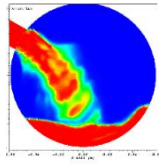
Codes developped at EDF R&D

… a know-how in the state of international art and accessible by all thanks to the Open Source !

- *Code_Saturne* ((i.e. SALOME-CFD)
  - general usage single phase CFD, plus specific physics
  - property of EDF, open source (GPL)
  - http://www.code-saturne.org

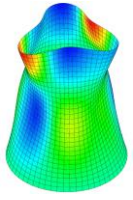



- NEPTUNE_CFD '*(i.e. SALOME-CFD)*
  - multiphase CFD, esp. water/steam
  - property of EDF/CEA/AREVA/IRSN

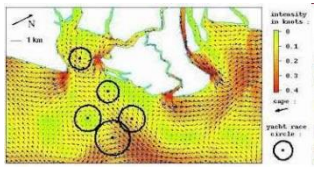


- SYRTHES
  - thermal diffusion in solid and radiative transfer
  - property of EDF, open source (GPL)
  - http://rd.edf.com/syrthes

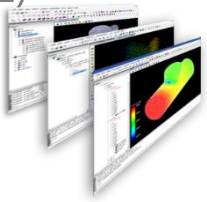
- *Code_Aster* *(i.e. SALOME-MECA)*
  - general usage structure mechanics
  - property of EDF, open source (GPL)
  - http://www.code-aster.org



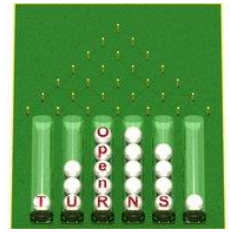
- TELEMAC system *(i.e. SALOME-Hydrau)*
  - free surface flows
  - Many partners, mostly open source (GPL, LGPL)
  - http://www.opentelemac.org



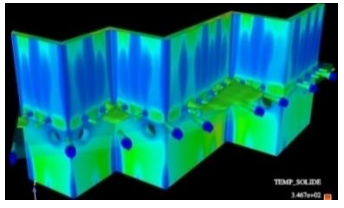
- SALOME platform
  - integration platform (CAD, meshing, post-processing, code coupling)
  - property of EDF/CEA/OpenCascade, open source (LGPL)
  - http://www.salome-platform.org



- Open TURNS
  - tool for uncertainty treatment and reliability analysis
  - property of EDF/CEA/Phimeca, open source (LGPL)
  - http://trac.openturns.org

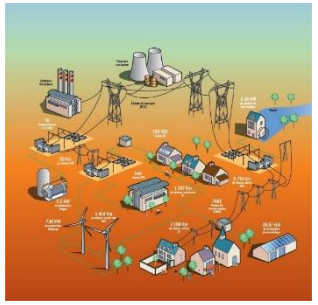


- and many others…
  - Neutronics, electromagnetism
  - Component codes, system codes
  - Optimization codes,…




Main domains of HPC applications (both Physical Simulation and Data Analysis)

ENERGY PRODUCTION (Nuclear, Renewable, Hydraulic, Thermal, Environment)

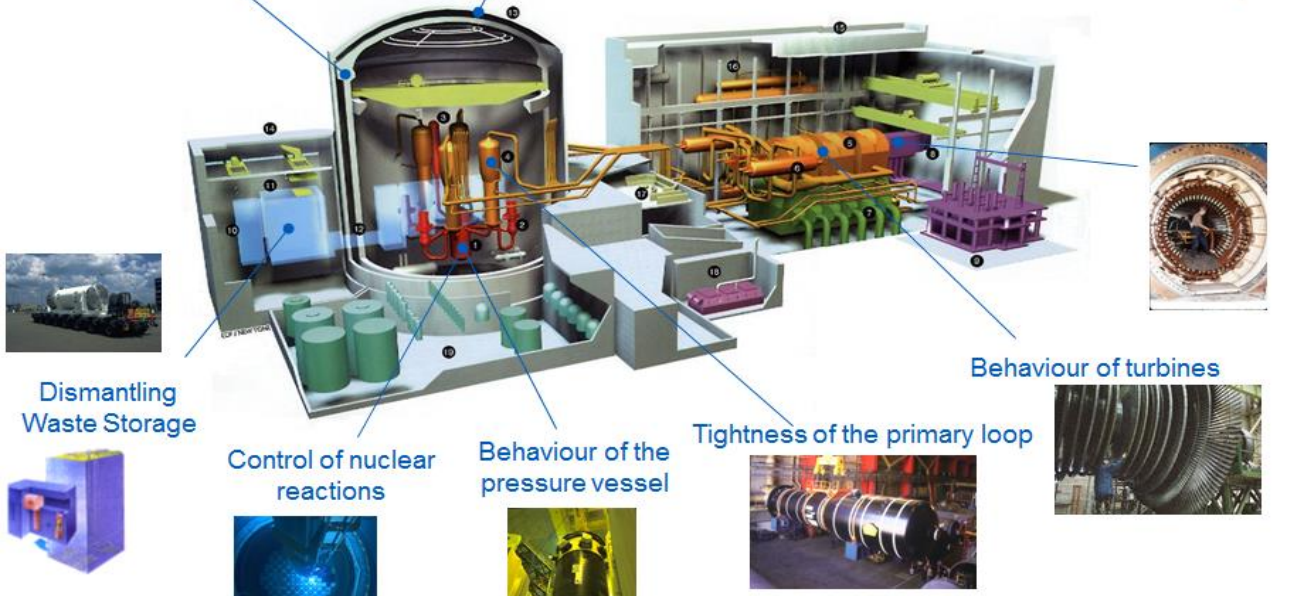


Network / Smarties (smart-grids, smart-cities)

Marketing

Energy Management

Nuclear : a particular domain



- Guarantee safety
- Improve performances/costs
- Maintain assets
- Face unexpected events
- Ageing issues…

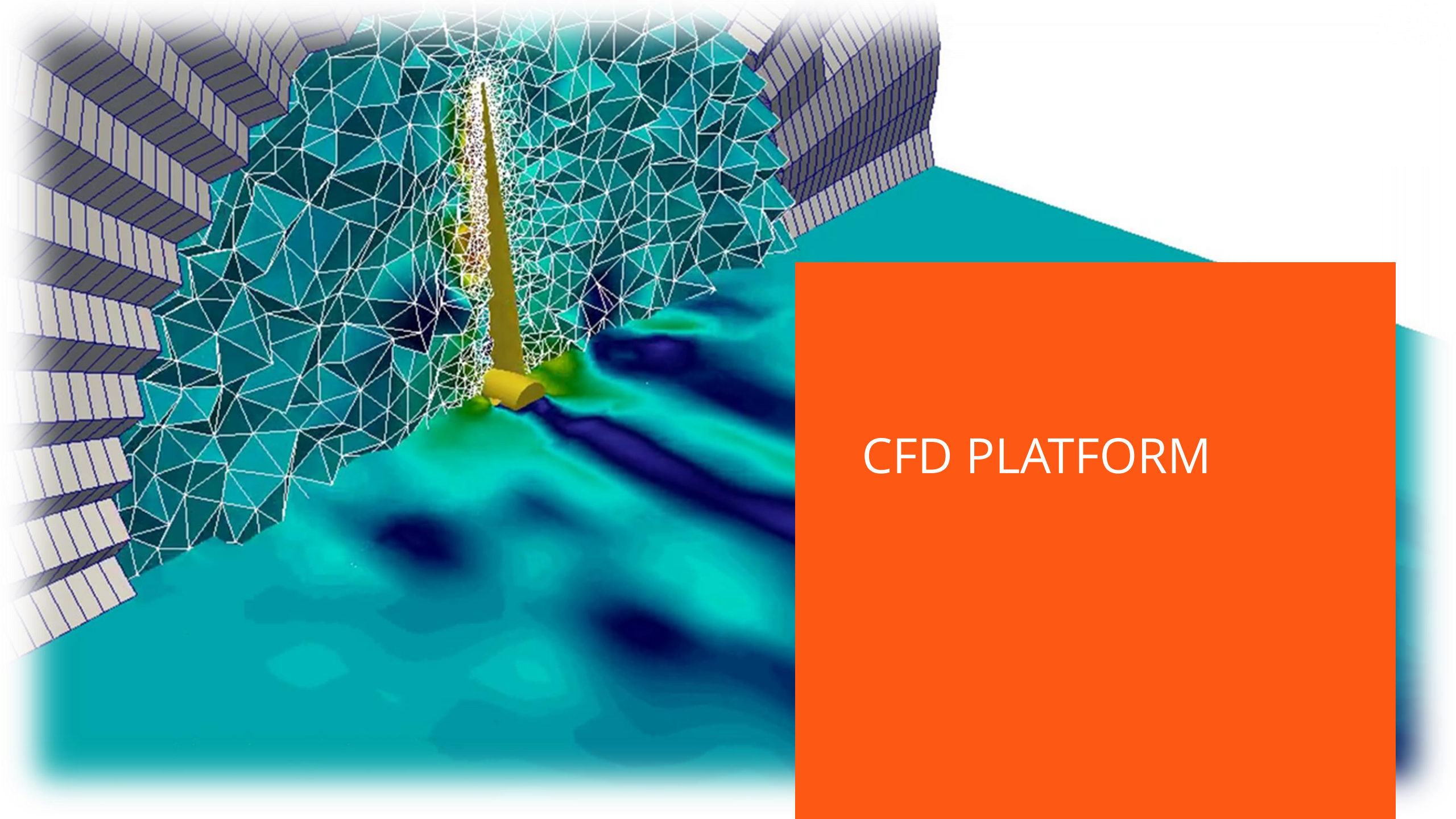
Benefits of the HPC :

- ✓ Less simplifying assumptions
- ✓ More information
- ✓ More calculation scenarios
- ✓ Take into account incertainties

code_saturne

FLUID SIMULATION
CFD SOFTWARE

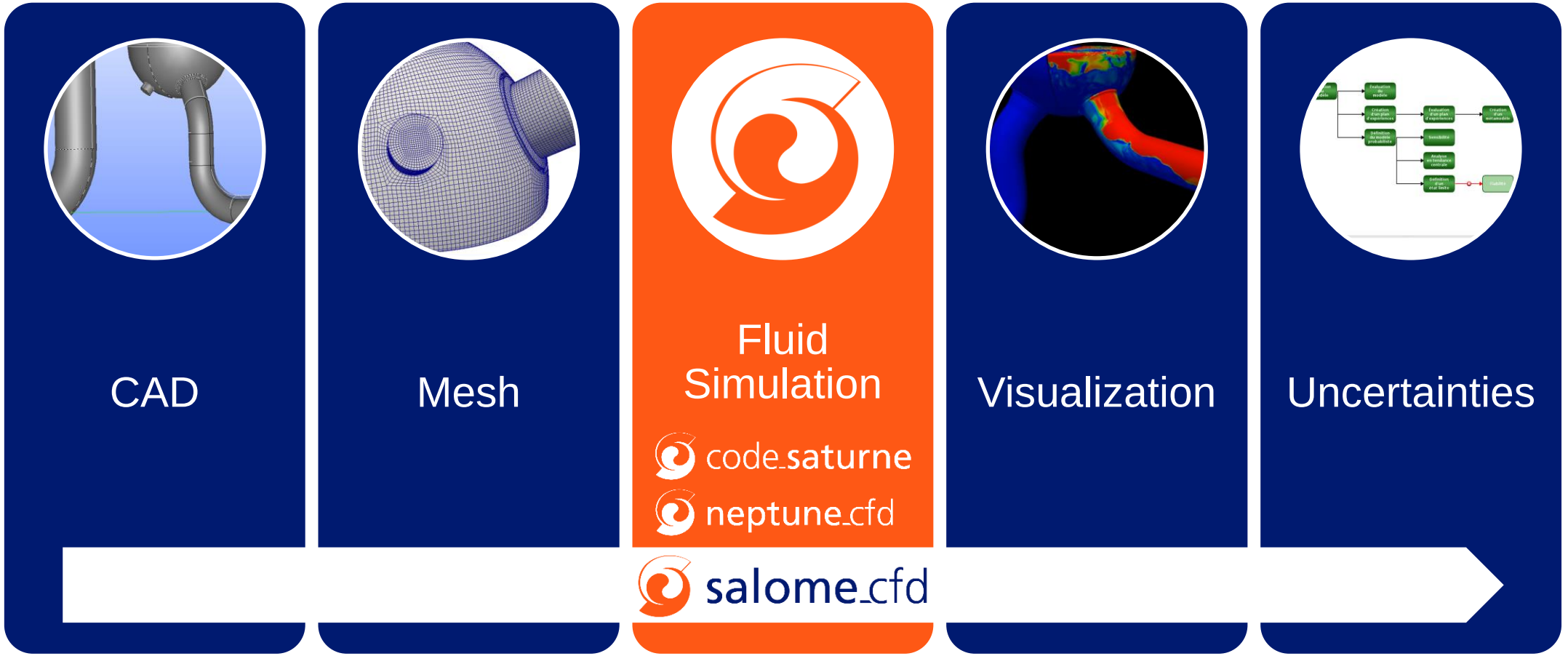
EDF



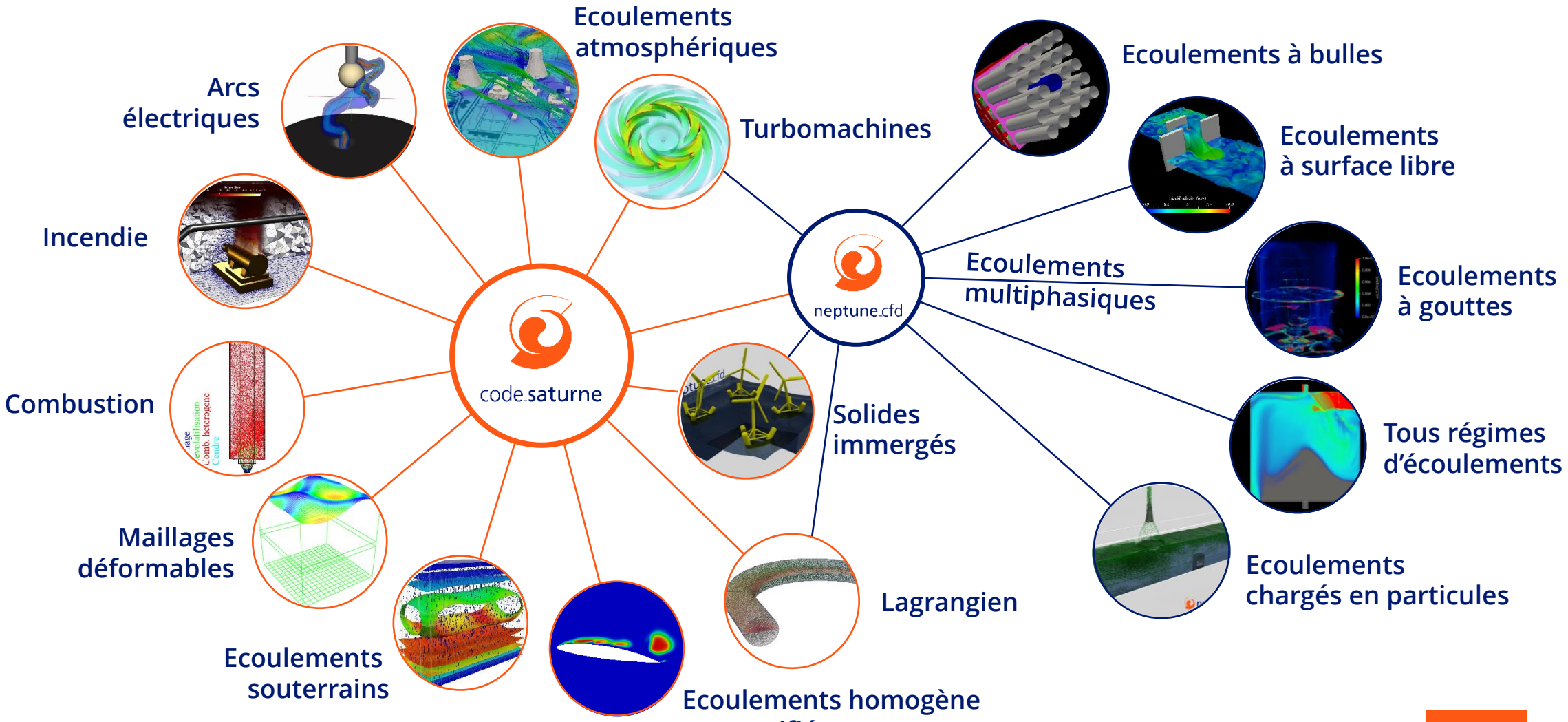
CFD PLATFORM

INTEGRATION INTO THE SALOME ENVIRONMENT

code_saturne and neptune_cfd are at the heart of the salome_cfd platform which makes it possible to carry out numerical simulations in fluid dynamics



FIELDS OF APPLICATION

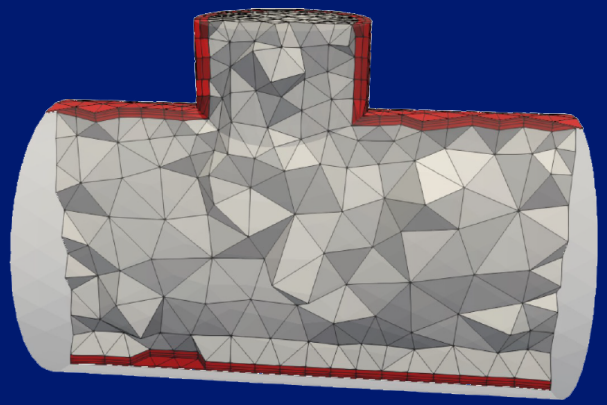


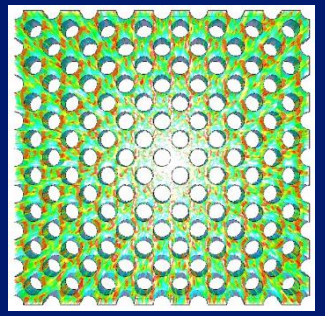
PERFORMANCE, QUALITY, USE CASE

STUDIES PERFORMANCE

1. HPC Capabilities

- Hybrid MPI / OpenMP parallelism
- Parallel preprocessor (joining and mesh modification)
- Parallel mesh modifications (joining, boundary layers, refinement, …)
- Parallel data extraction

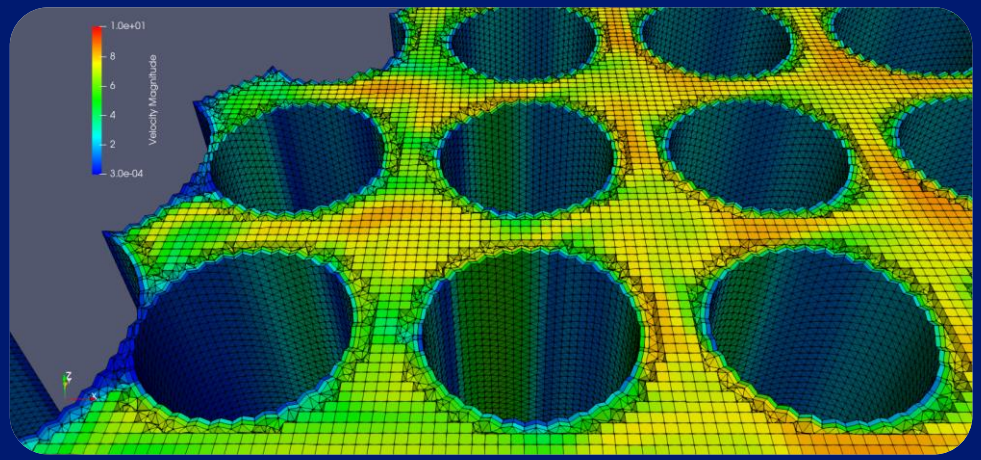




Scalability tests :
65 000 cores
3,2 billion cells
50 000 cells per core

2. Quality and mesh

- Domain partitioning
- Pre-processing: operations on the meshes and associated visualization
- Visualization of quality criteria and marking of "bad cells"

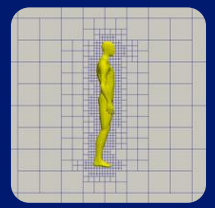


STUDIES PERFORMANCE

3. Solids immersion

- Development of a porous preprocessor
- Immersion of solid structures
- Quasi-automatic meshing step
- Dynamic refinement

STL import

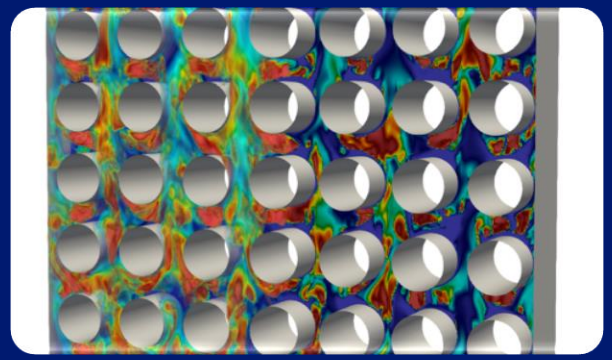


Immersion

Porosity reconstruction

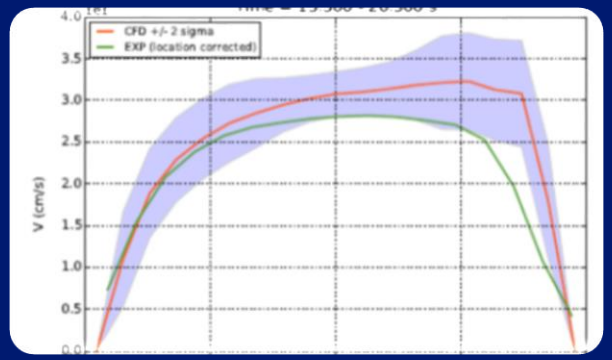
4. Fluid-Structure Interactions

- Integrated approach (ALE, immersion of solids)
- code_aster coupling
- Single and two-phase flows



5. Uncertainties quantification

- Definition of input/output via code_saturne notebook
- Definition of an experimental plan, launching of calculations and post-processing of results in OpenTURNS (salome)



Code_Saturne ecosystem

code_saturne
- EDF property
- GNU GPL License

neptune_cfd
- EDF, CEA, Framatome, IRSN property
- Licensing agreements

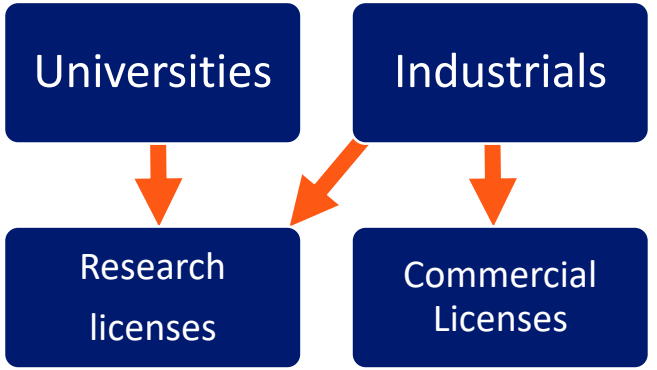
Wide use of Code_Saturne at EDF on HPC:

- Wide range of application
- Constant search to optimize scalability and Flops/watt (GPU, ARM, …)
- Reporting on energy consumption of studies (under progress)

Code_saturne and exascale:

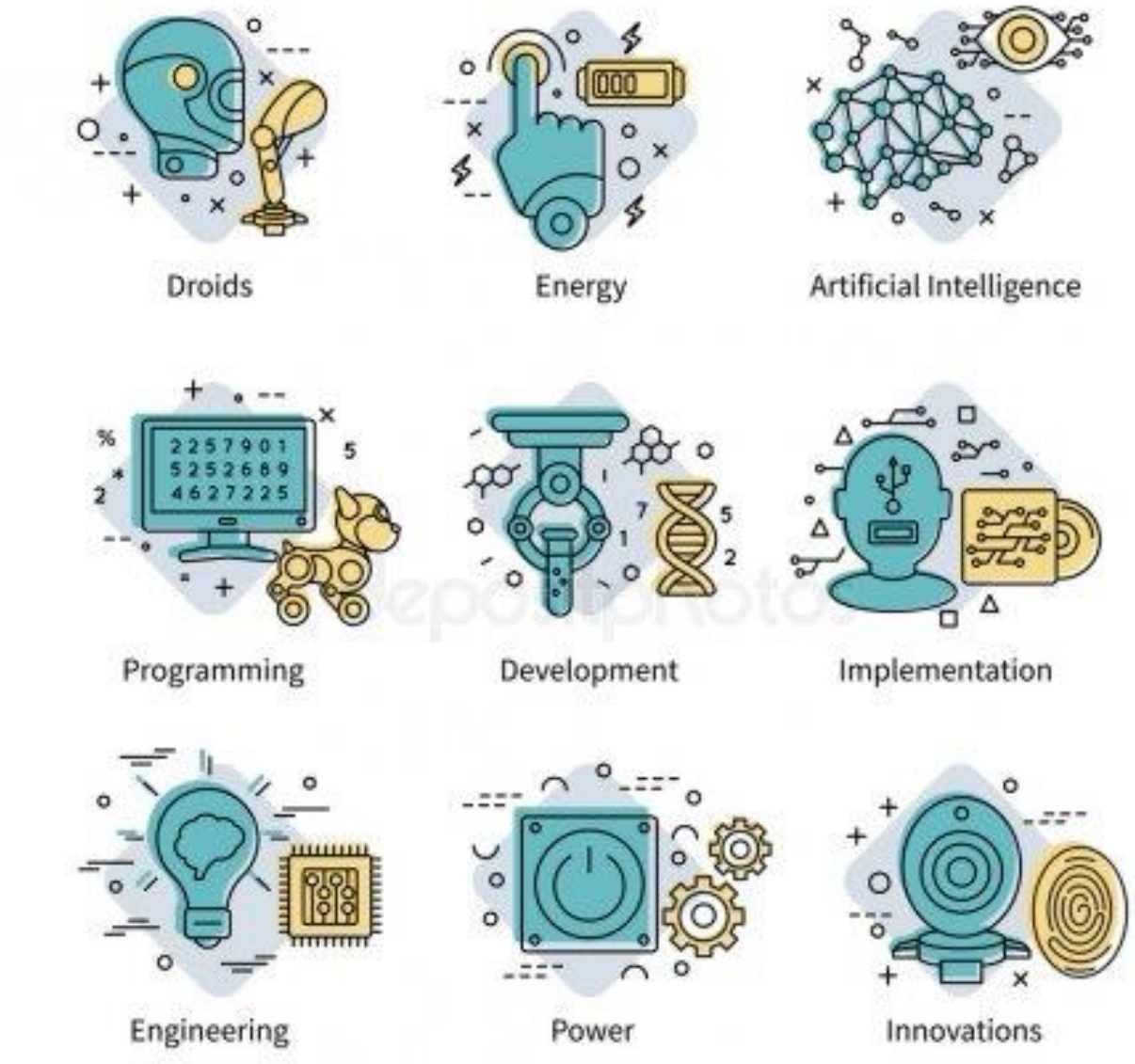
- Tests on european HPC (IDRIS, CALMIP, TGCC, ARCHER, …)
- Up to 64 billion cells on 288,000 cores (Checkpoint files 100 TB)
- Try for 512 billion cells…
- Testing
- 3rd Isambard Hackathon : testing both NEPTUNE_CFD and multiple compilers on the new ARM a64fx (used on Fugaku, 1st top 500, 9th Green 500)

Partnerships :



https://teratec.eu/library/pdf/forum/2022/A3_05_Herve_Neau_IMFT_Forum_Teratec_2022.pdf

Energy needs modelization, simulation … and more and more artificial intelligence !



Thanks you for your attention

CGG – TERATEC HPC HACKATON -ARM

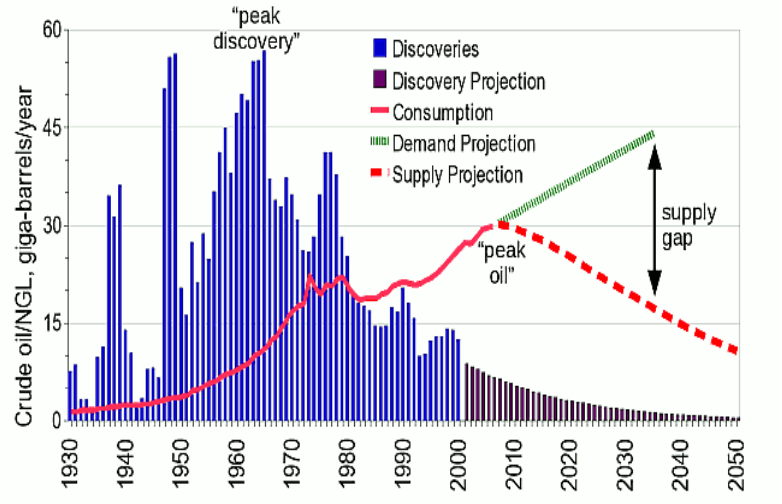
Introduction to seismic imaging and stencil's algorithm

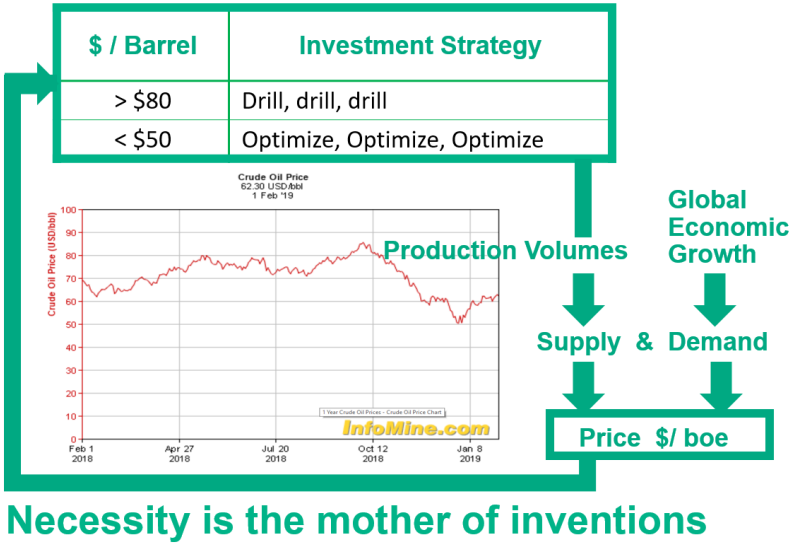
cgg.com

CGG

SEISMIC IMAGING

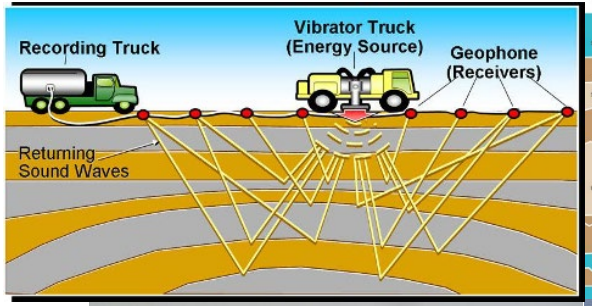
Why seismic imaging is needed?

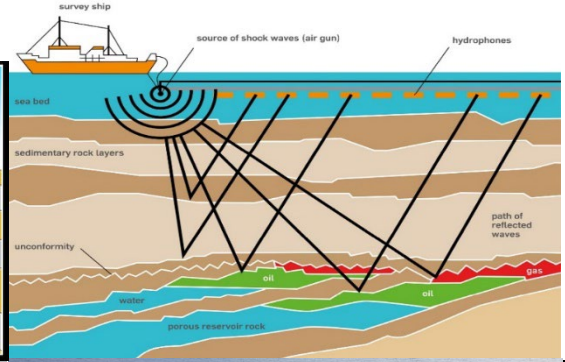


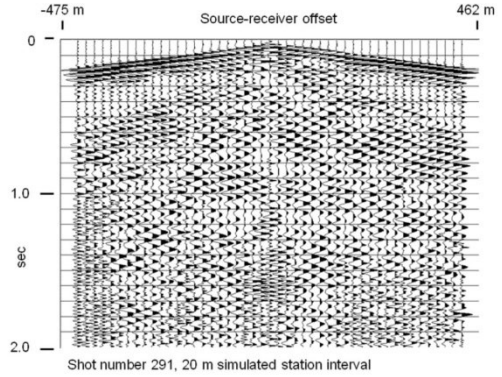


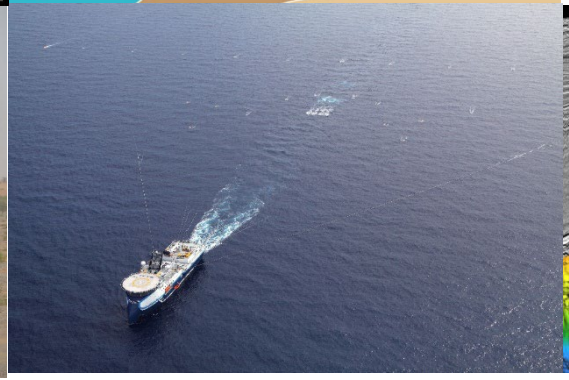
HPC is a fundamental tool to help to improve discovery, minimize cost and risks.
Drilling price = 10x Seismic exploration and imaging price

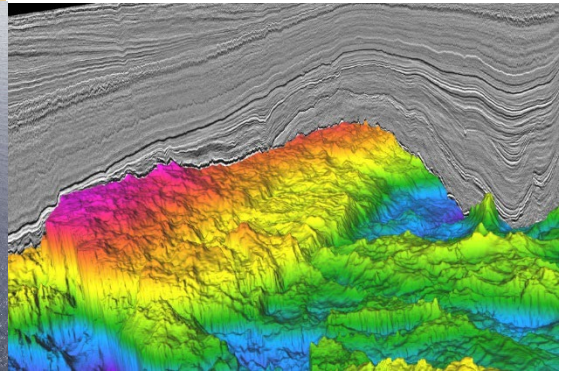
Land and Marine acquisition: seismic surveys



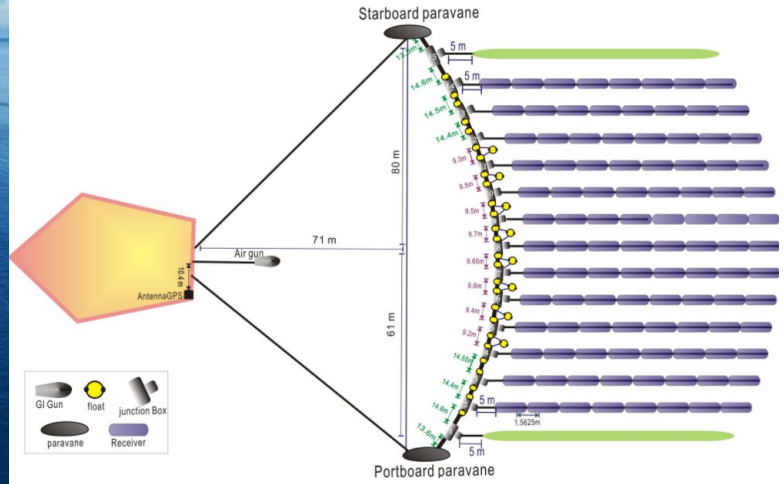






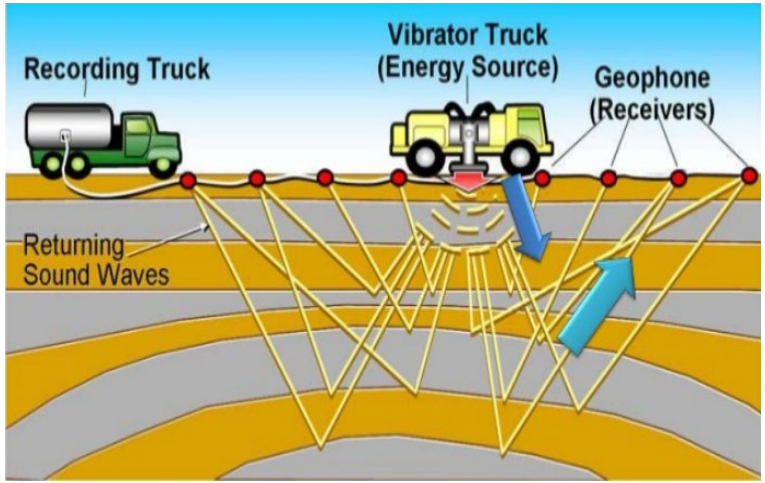


Offshore acquisition

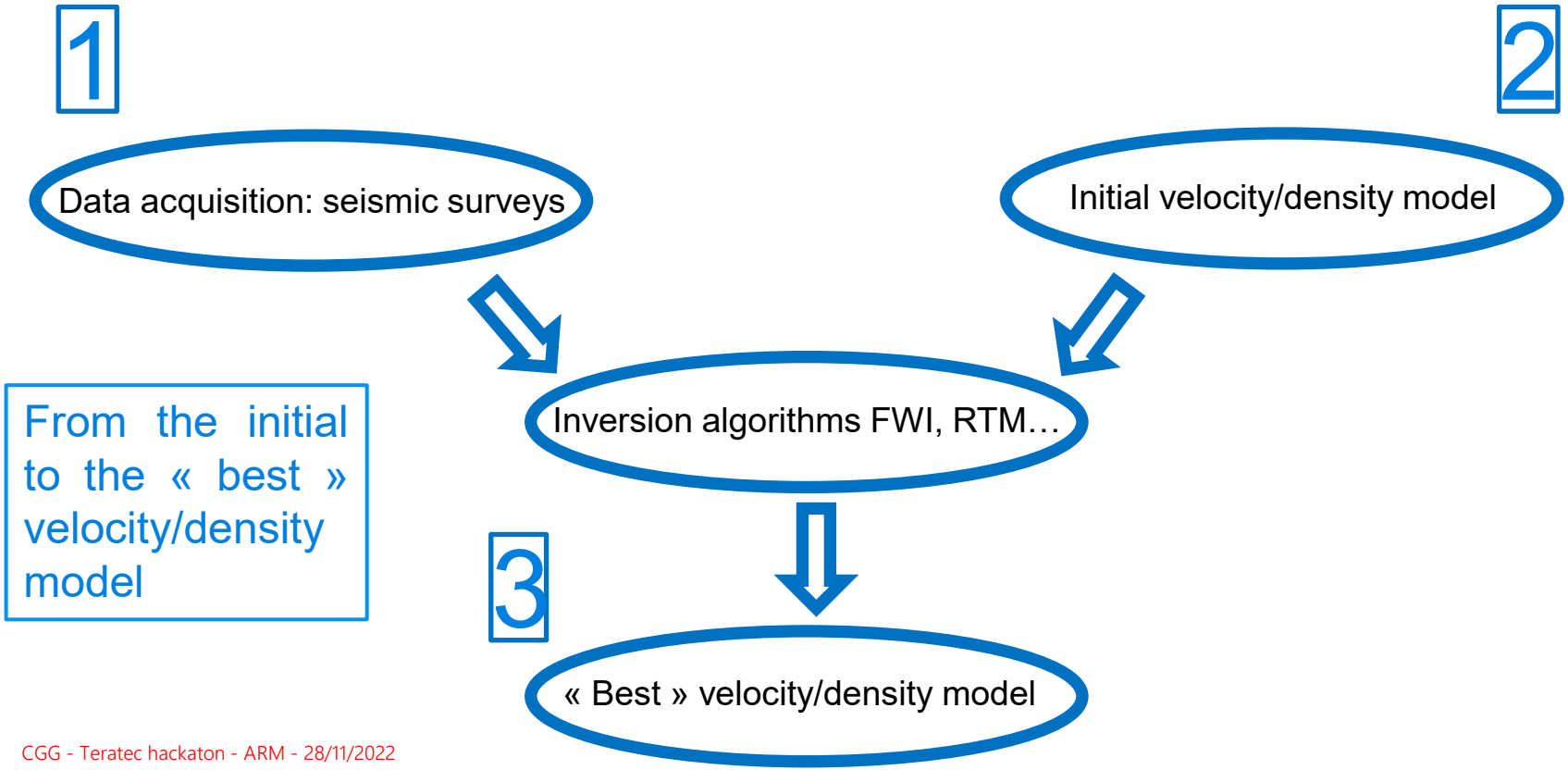


Because of the length of the cables (approx. 10km), the boat can’t stop easily!

Onshore acquisition



What is seismic IMAGING ?



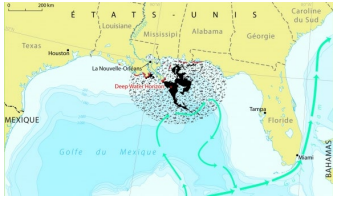
From the initial to the « best » velocity/density model

Initial Velocity Model Building

Geologist → Where should I start looking ?

\+

Experts → Restrict area and depth

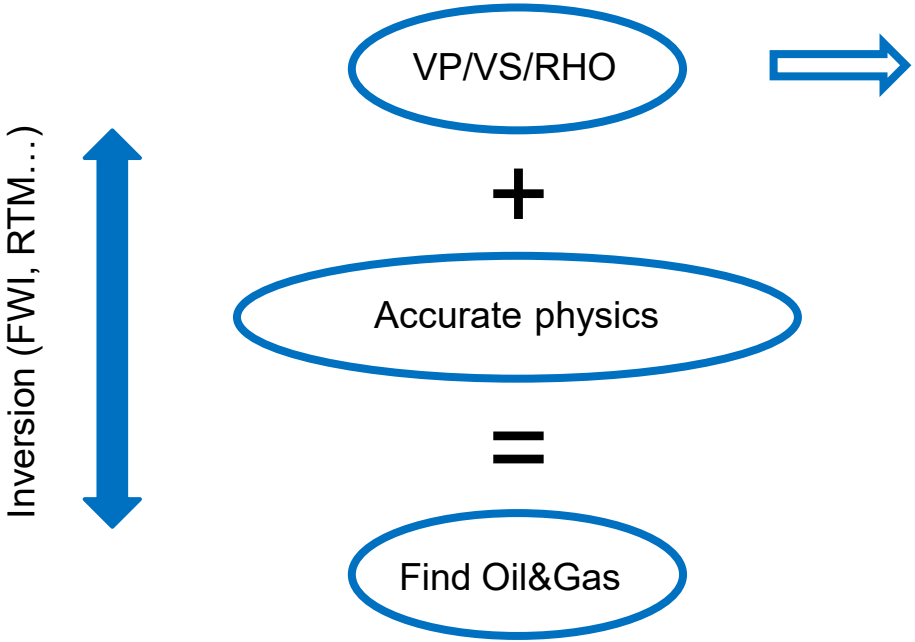


Deepwater horizon (BP) :
Water depth: 1259 meters
Vertical drilling depth: 10685 meters

\+

Geophysicist → Physical parameters VP/VS/RHO → **Initial velocity/density model**

Why do I need an accurate velocity/density model ?

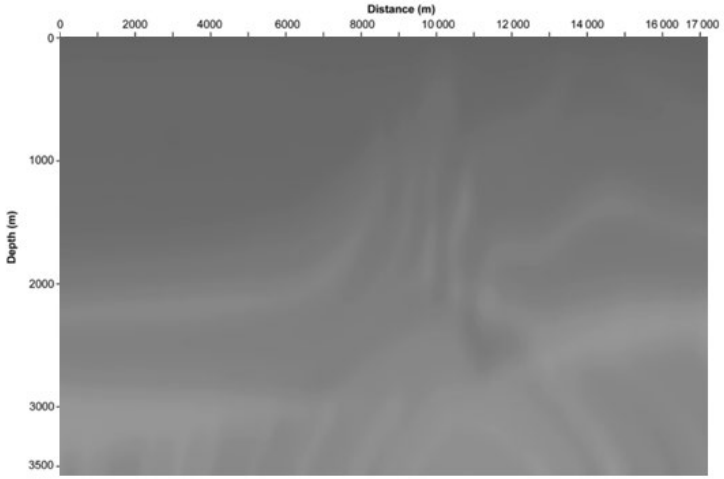


Type of formation	P wave velocity (m/s)	S wave velocity (m/s)	Density (g/cm^3)	Density of constituent crystal (g/cm^3)
Scree, vegetal soil	300-700	100-300	1.7-2.4	-
Dry sands	400-1200	100-500	1.5-1.7	2.65 quartz
Wet sands	1500-2000	400-600	1.9-2.1	2.65 quartz
Saturated shales and clays	1100-2500	200-800	2.0-2.4	-
Marls	2000-3000	750-1500	2.1-2.6	-
Saturated shale and sand sections	1500-2200	500-750	2.1-2.4	-
Porous and saturated sandstones	2000-3500	800-1800	2.1-2.4	2.65 quartz
Limestones	3500-6000	2000-3300	2.4-2.7	2.71 calcite
Chalk	2300-2600	1100-1300	1.8-3.1	2.71 calcite
Salt	4500-5500	2500-3100	2.1-2.3	2.1 halite
Anhydrite	4000-5500	2200-3100	2.9-3.0	-
Dolomite	3500-6500	1900-3600	2.5-2.9	(Ca, Mg) CO_3 2.8-2.9
Granite	4500-6000	2500-3300	2.5-2.7	-
Basalt	5000-6000	2800-3400	2.7-3.1	-
Gneiss	4400-5200	2700-3200	2.5-2.7	-
Coal	2200-2700	1000-1400	1.3-1.8	-
Water	1450-1500	-	1.0	-
Ice	3400-3800	1700-1900	0.9	-
Oil	1200-1250	-	0.6-0.9	-

Tell me your speed and I will tell you who you are…

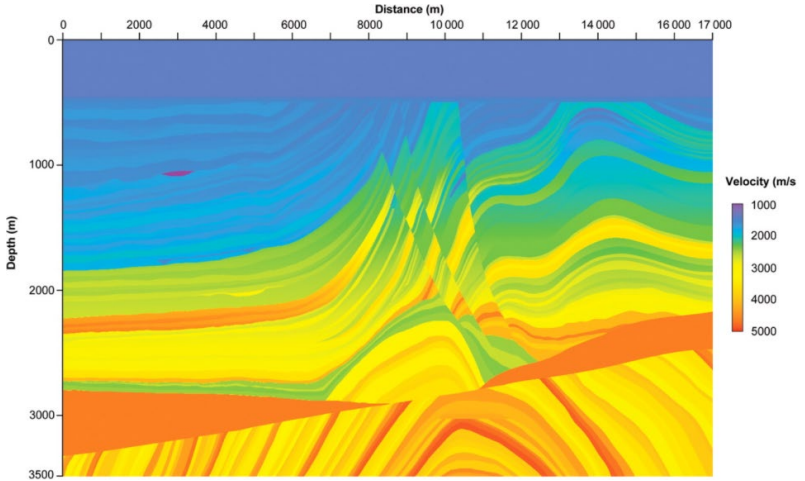
Real vs Initial velocity/density model

Initial velocity/density model



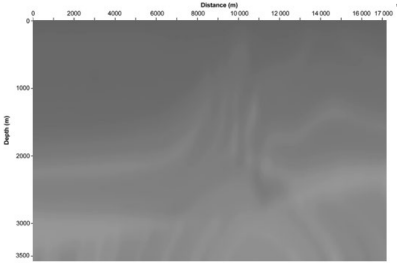
How do we get there ?

Real velocity/density model

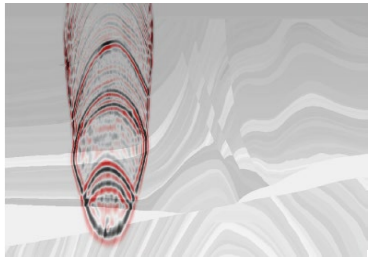


Inversion algorithms FWI, RTM…

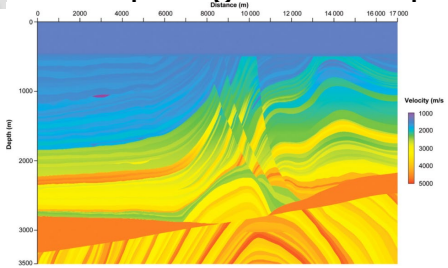
Start with initial velocity/density model



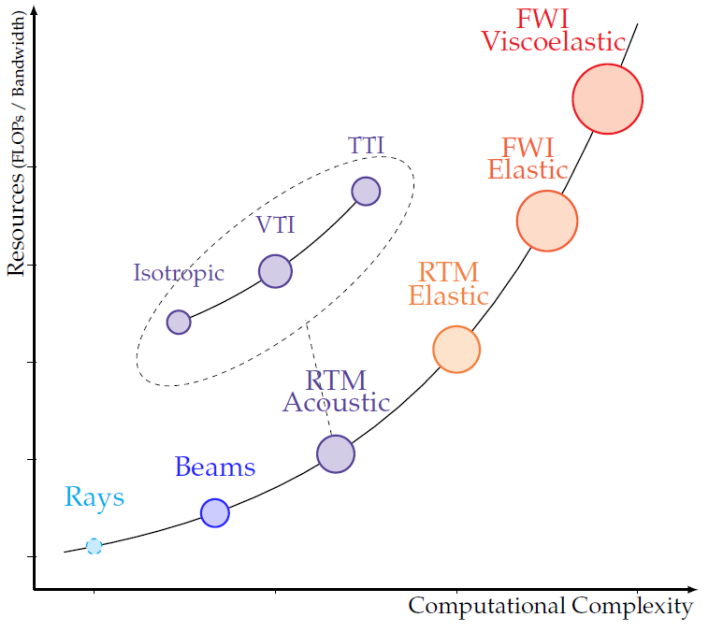
Propagate waves and record data « numerically »

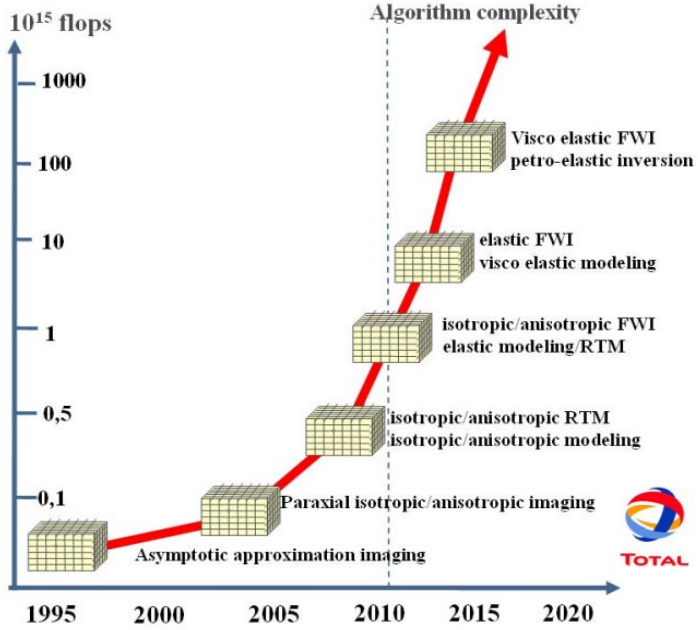


Compute differences between data acquisition (surveys) and numerical data
+ Compute gradient + update velocity/density model



Exponential increase in compute required!



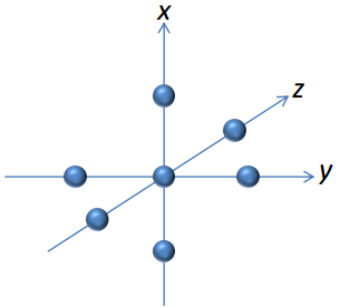


Algorithmic complexity and corresponding computing power

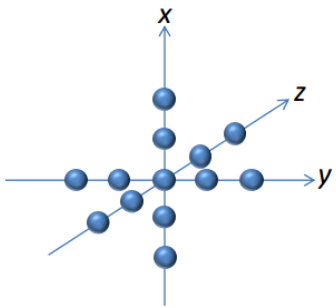
STENCIL

Stencil operators

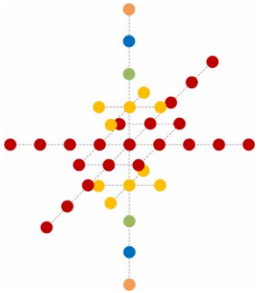
Stencil Order	Extent	Memory Accesses/Elem.	Flops/Elem.
2	3×3×3	8	8
4	5×5×5	14	15
6	7×7×7	20	22
8	9×9×9	26	29
10	11×11×11	32	36
12	13×13×13	38	43

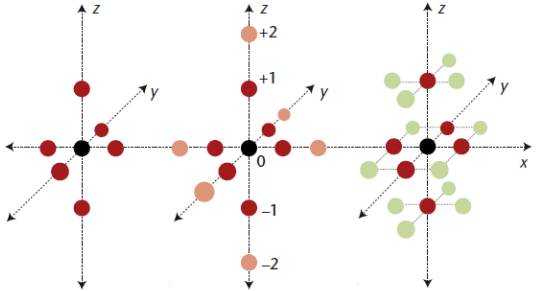


(a) 2nd order stencil



(b) 4th order stencil

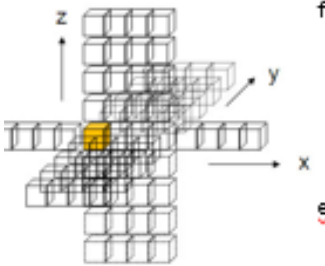


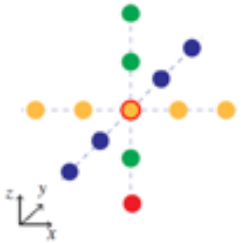


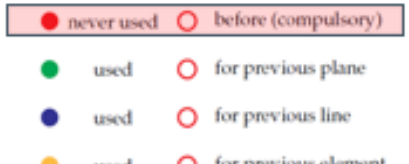
Stencils are workhorse in many HPC kernels, dominant in seismic industry

Pseudocode and modeling of a kernel

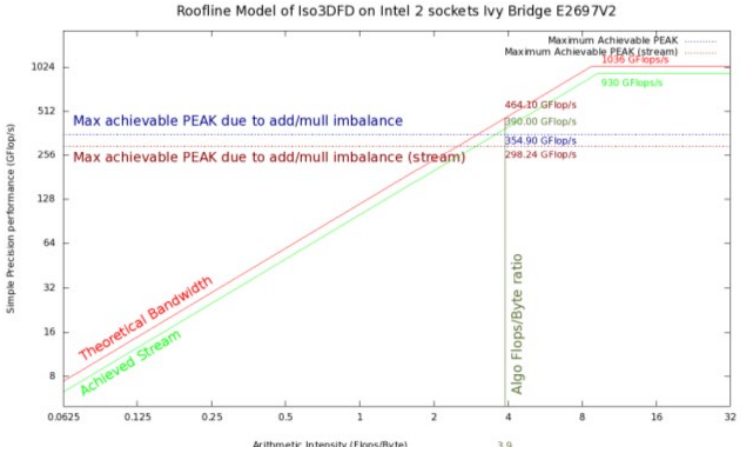
```
timesteps=1..1000
nz=1..800
ny=1..1200
nx=1..1600
order=2

float S[nx,ny,nz]   // Source       array
float D[nx,ny,nz]   // Destination  array
float C[nx,ny,nz]   // coefficients array
for t in [1..timesteps]
        for z in  [order+1..nz-order]
                for y in [order+1..ny-order]
                        for x in [order+1..nx-order]
                                D[x, y, z] = S[ x   . y   . z+1 ]*coeff1 + S[ x   . y   . z+2 ]*coeff2
                                           + S[ x   . y   . z-1 ]*coeff1 + S[ x   . y   . z-2 ]*coeff2
                                           + S[ x   . y+1 . z   ]*coeff1 + S[ x   . y+2 . z   ]*coeff2
                                           + S[ x   . y-1 . z   ]*coeff1 + S[ x   . y-2 . z   ]*coeff2
                                           + S[ x+1 . y   . z   ]*coeff1 + S[ x+2 . y   . z   ]*coeff2
                                           + S[ x-1 . y   . z   ]*coeff1 + S[ x-2 . y   . z   ]*coeff2
                                           + S[ x   . y   . z   ]*coeff0 + C[ x   . y   . z   ]
                        endfor x //  13 MUL SP + 13 ADD SP ; can use 13 FMA
                                 //  if well implemented only RED is compulsory then comes from DRAM
                                 //  Green and Blue come from recent accesses; L1+L2 and LLC if large enough
                endfor y
        endfor z
        swap(S&,D&)
endfor t

// per point : 26 flops ; 4 bytes C ; 4 bytes S ; 4 bytes D = 16 bytes on DRAM bus : 11 streams
// kernel is memory bound ; flops/bytes ratio = 26/12 = 2.2
```

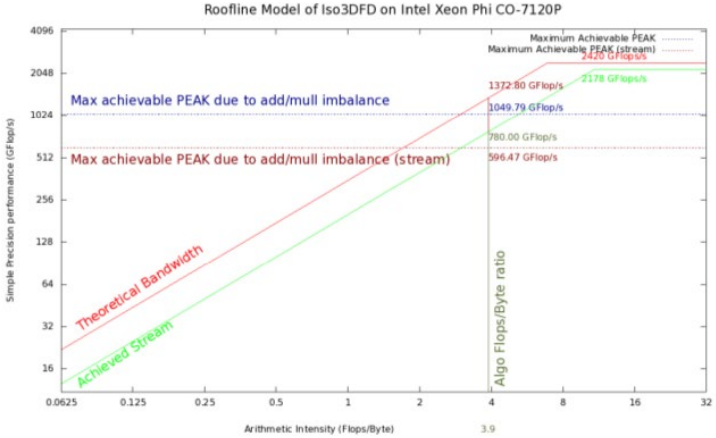


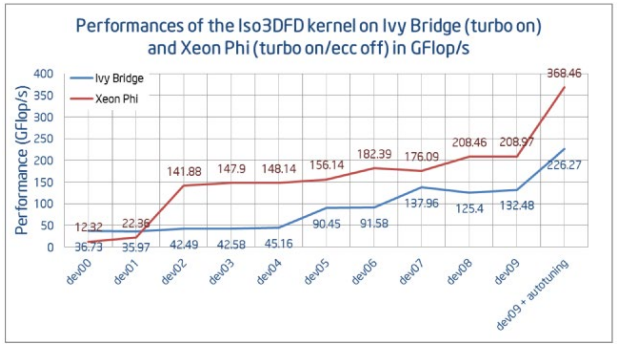




Roofline model and academic experiments







IVY : peak 1036 GFlops : effective 226 Gflops

Ratio peak/effective = 5 = 20% efficiency

KNC : peak 2420 Gflops : effective 368 Gflops

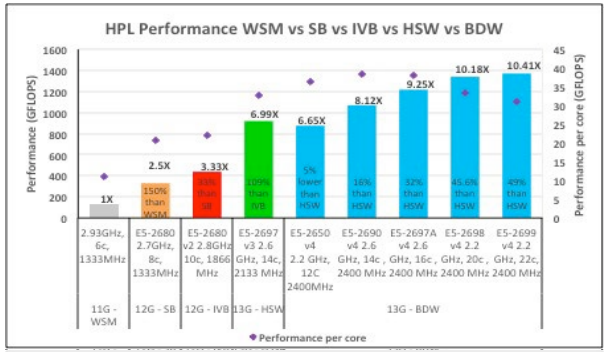
Ratio peak/effective = 6.6 = 15% efficiency

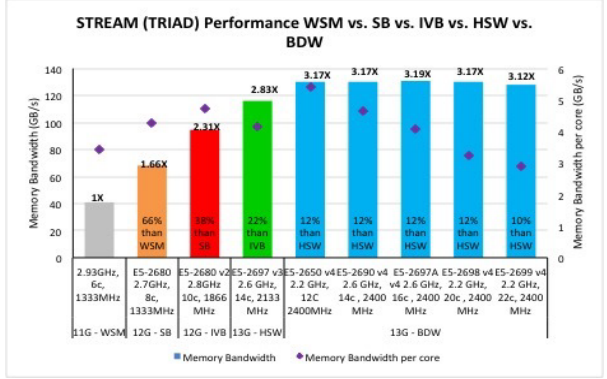
Stencils are memory bound

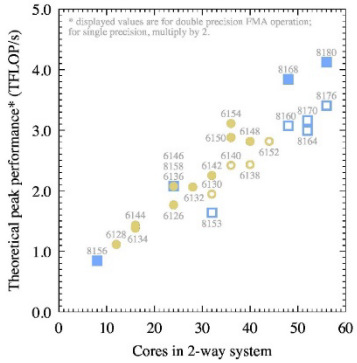
http://www.techenablement.com/characterization-optimization-methodology-applied-stencil-computations/

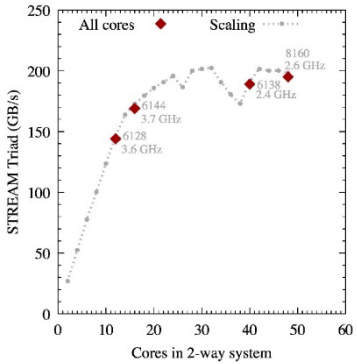
Trend in Gflops and Bandwidth of latest Xeon

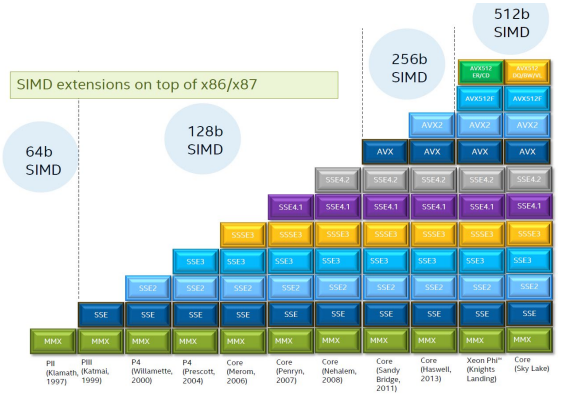
Memory bandwidth vs Gflops imbalance continue to grow







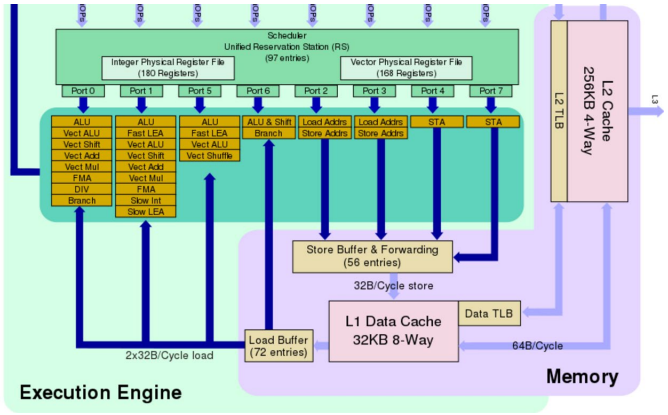


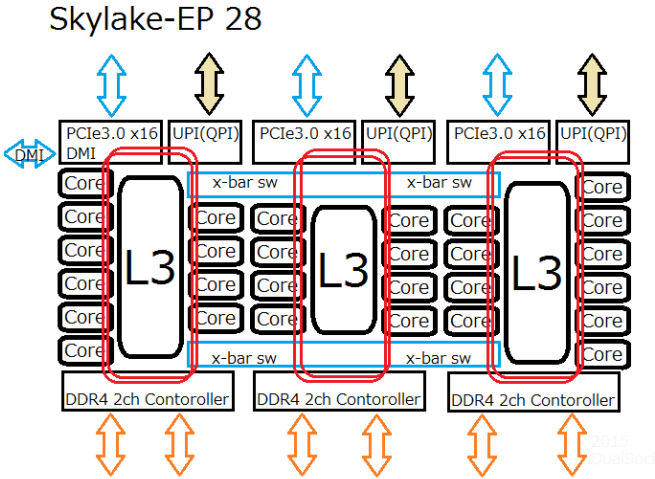


Names	Memory Clock	I/O Bus Clock	Transfer Rate	Theoretical Bandwidth
DDR-200, PC-1600	100 MHz	100 MHz	0.2 GT/s	1.6 GB/s
DDR2-800, PC2-6400	200 MHz	400 MHz	0.8 GT/s	6.4 GB/s
DDR3-1600, PC3-12800	200 MHz	800 MHz	1.6 GT/s	12.8 GB/s
DDR4-3200, PC4-25600	400 MHz	1600 MHz	3.2 GT/s	25.6 GB/s

https://colfaxresearch.com/xeon-2017/

Skylake socket





AVX 512 = 2 FMA/cycle = 64 SP/cycle
28 cores = 2.6 Tflops SP at 2.0Ghz
L1 and L2 can deliver 128 GB/s at 2.0 Ghz

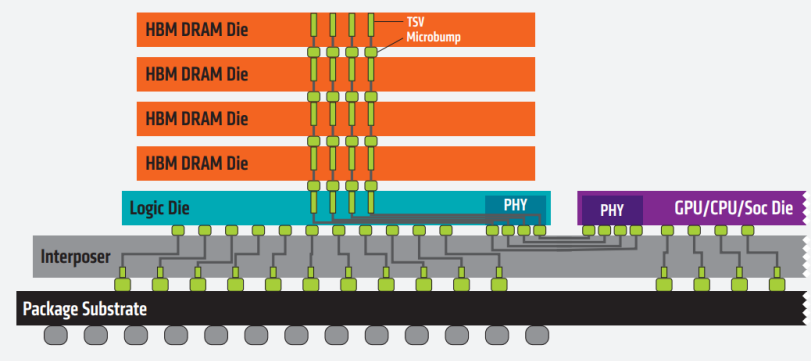
Bandwidth DRAM =
64bits*2400MTS*6channels/8bits

Effective 90% ~ 100 GB/s per **socket**

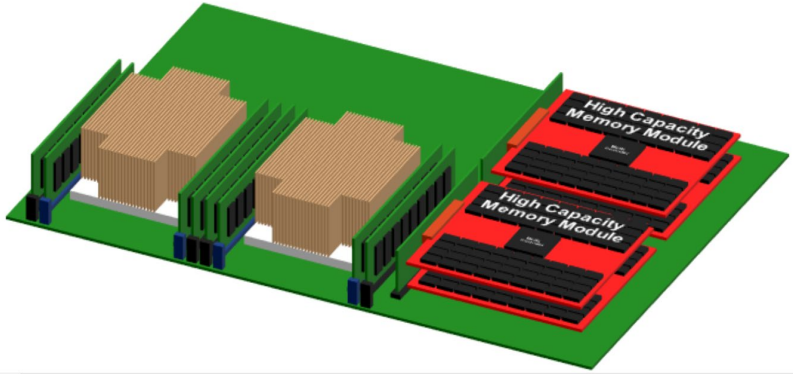
Need 26 flops per byte to cover the memory bandwidth

Options for multicores architectures

DDR4/3	HBM2	HBM3	DDR5
28nm	14nm	7nm	7nm
• 3200Mbps • x16 – x72-bits • 1-4 Ranks • DFI 4.0	• 2000Mbps • 1024-bit • 2.5D design architecture	• Expected 4000Mbps • Complex design architectures	• Expected 4800 – 6400Mbps



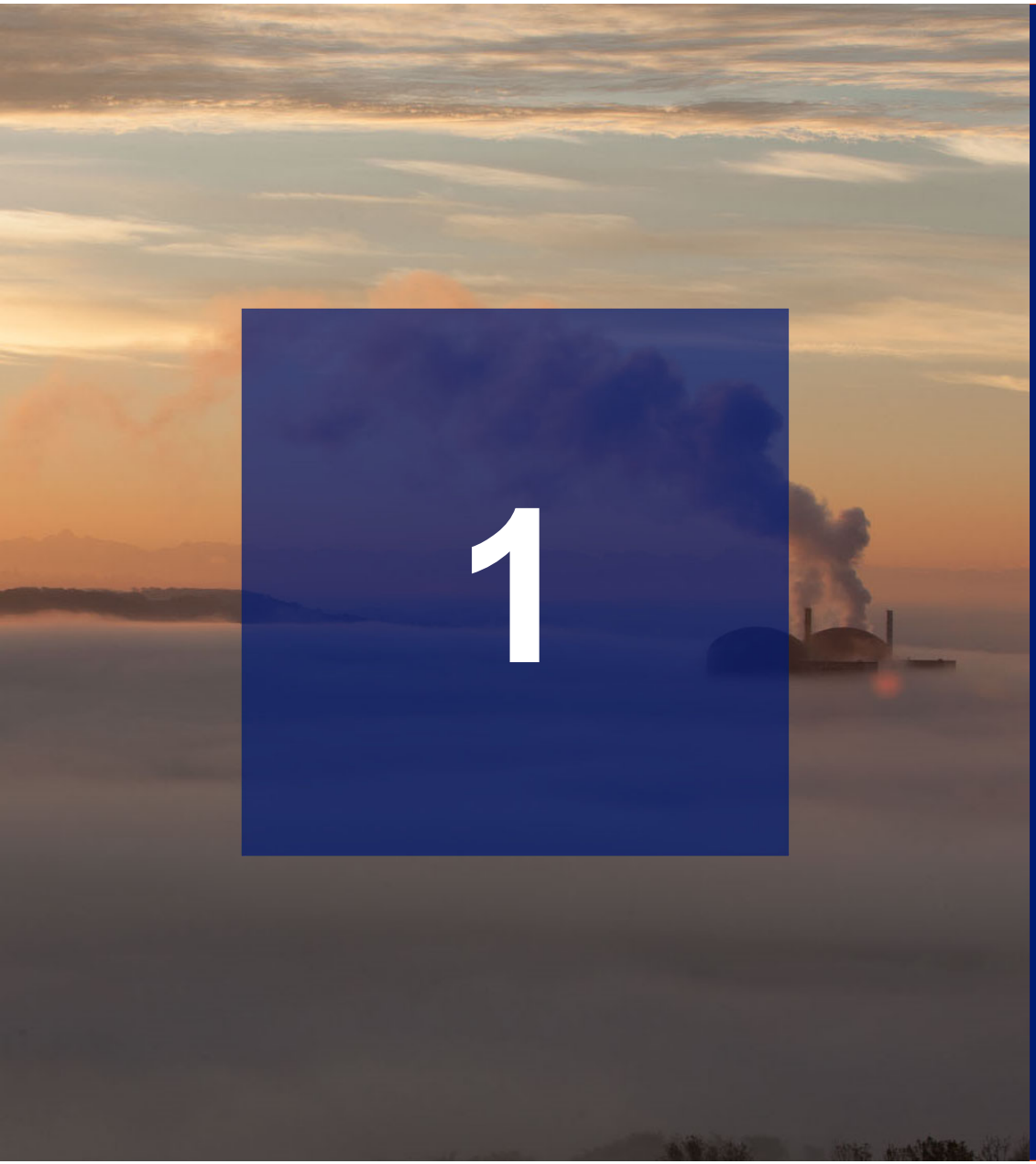
- DDR5 and 8 channels per SOC will deliver 250GB/s/SOC
- HBM2 can deliver 300GB/S per stack
- HBM3 can deliver 500GB/s per stack
- High capacity with SCM
- O&G need
  - High bandwidth to cover flops
  - High capacity for IO in memory



Thank you, and good luck for ARM porting!


TELEMAC

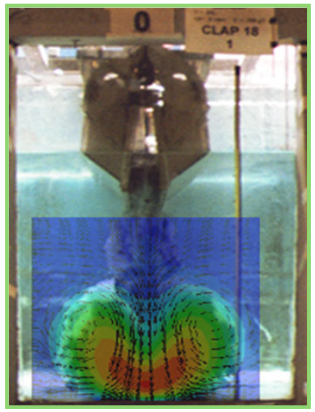
Content

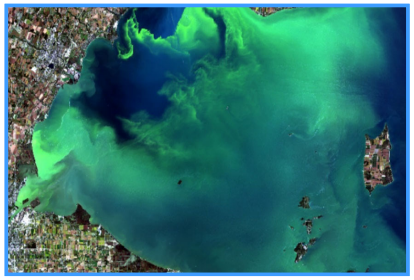


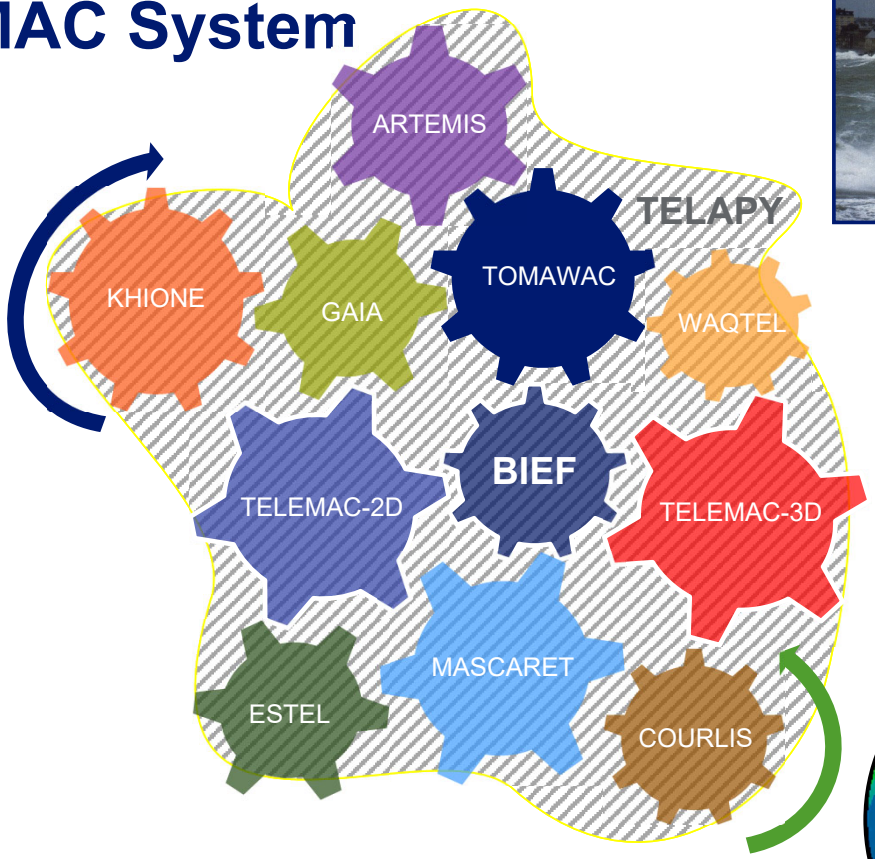
1

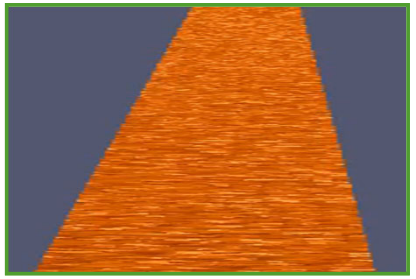
Introduction

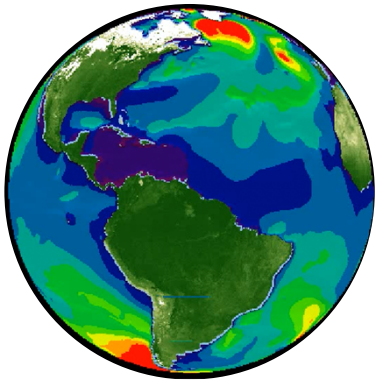
The TELEMAC System











The Telemac Consortium *(1 of 2)*

Successful codes: a binding agreement

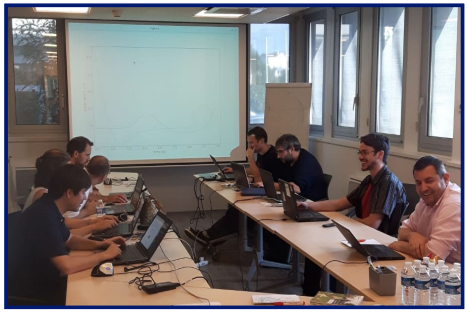
- ✓ **EDF**
- ✓ HR Wallingford (UK)
- ✓ BAW (Germany)
- ✓ ARTELIA (France)
- ✓ CEREMA (France)
- ✓ Daresbury Laboratories (UK)
- ✓ CERFACS (France)

executive

scientific

- ✓ Yearly hackathons to improve the code => leveraging of expert resources
- ✓ Telemac Users Conference => capitalising on research carried out elsewhere
- ✓ Meetings of the scientific comittee => maintaining state of the art codes

- ✓ **EDF remains the leader on these codes**



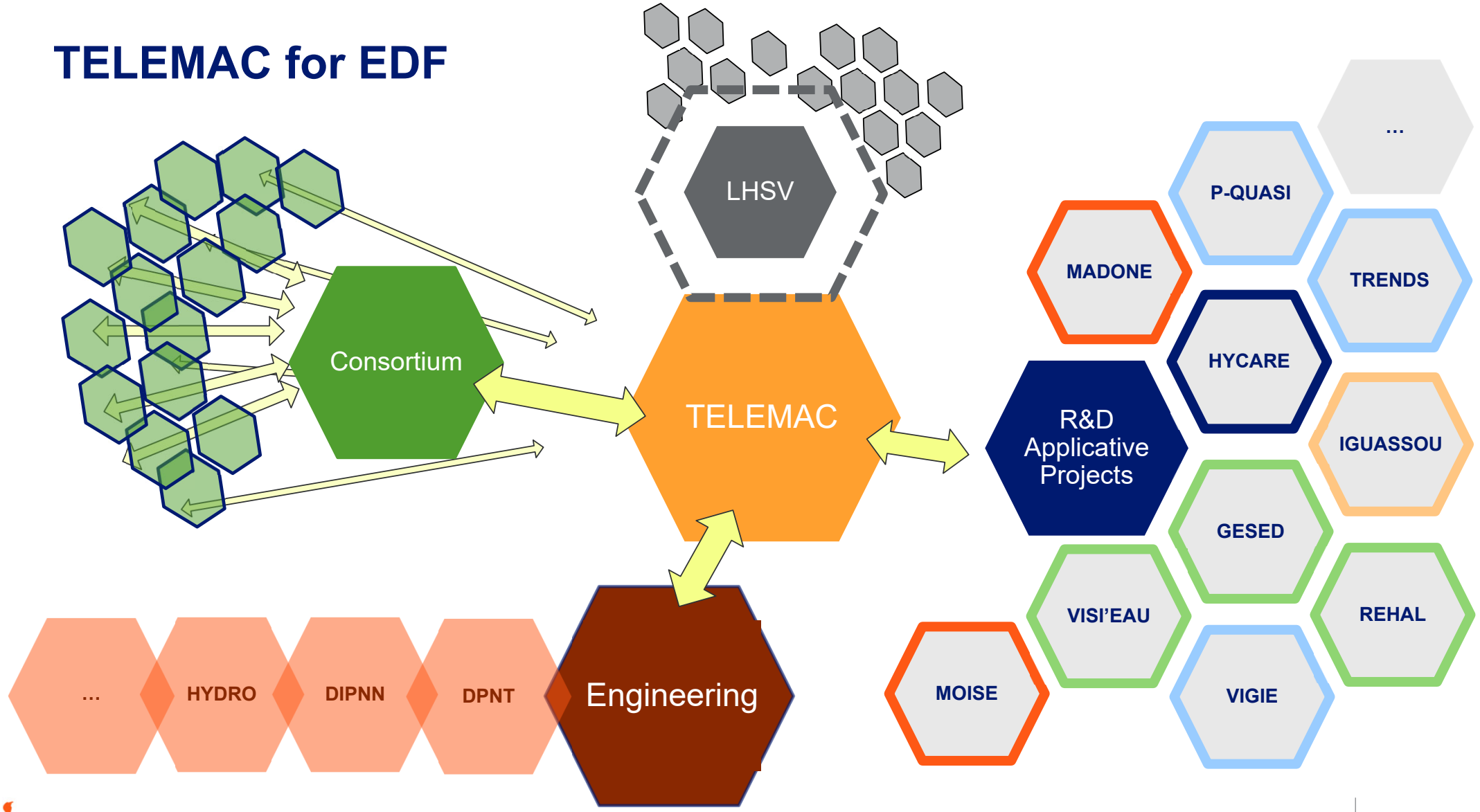
The Telemac Consortium *(2 of 2)*

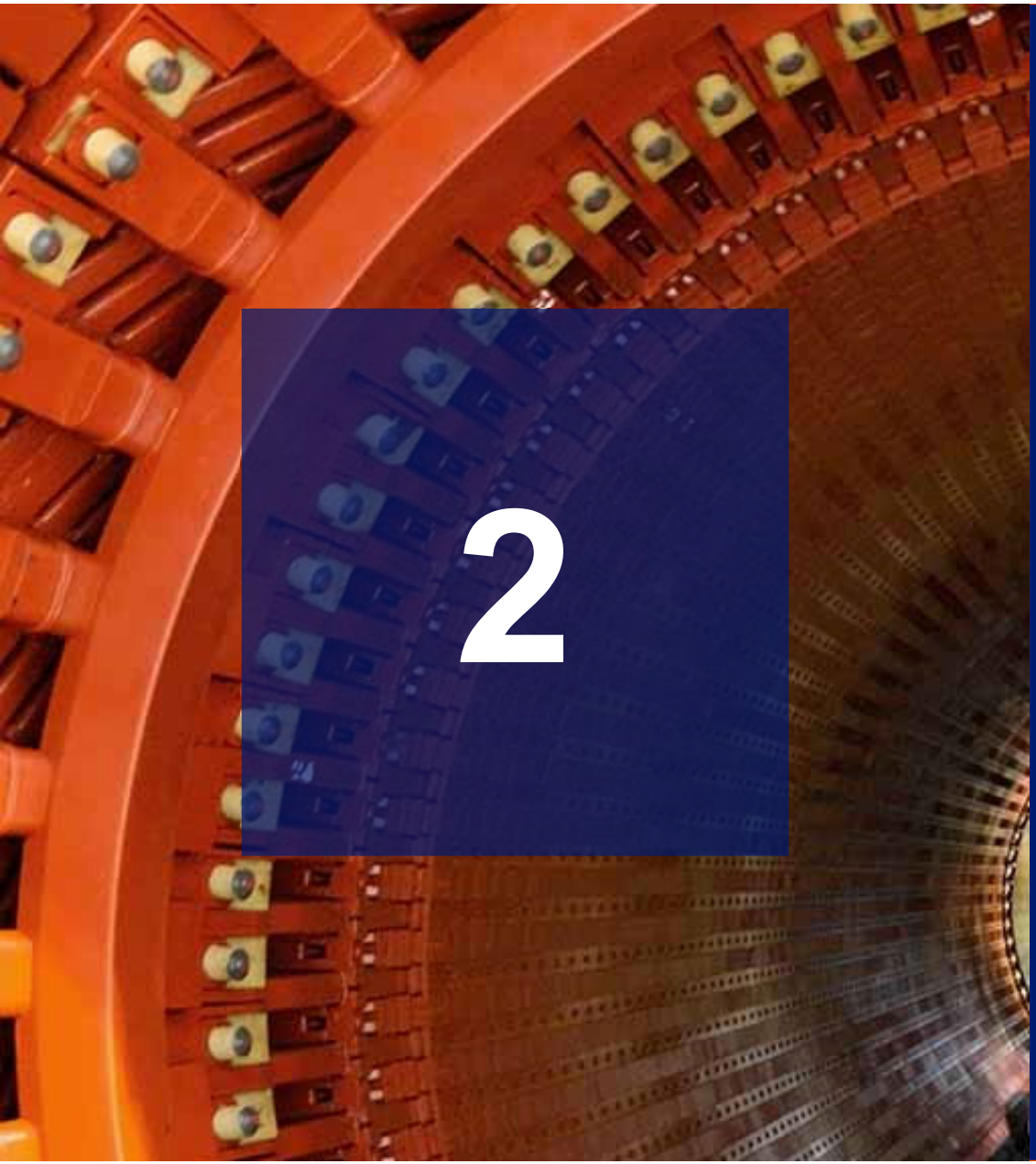
Impact

- ✓ The creation of a dedicated website at www.opentelemac.org
- ✓ An active Forum of close to 10,000 questions

- ✓ From 300 commercial licenses in 2009 to almost 2,500 active users in 2019 (12k total)
- ✓ In the last 10 years, additions of 5 modules, 3-way coupling, a python environment, an API, and all through parallelism, … and much more …

TELEMAC for EDF

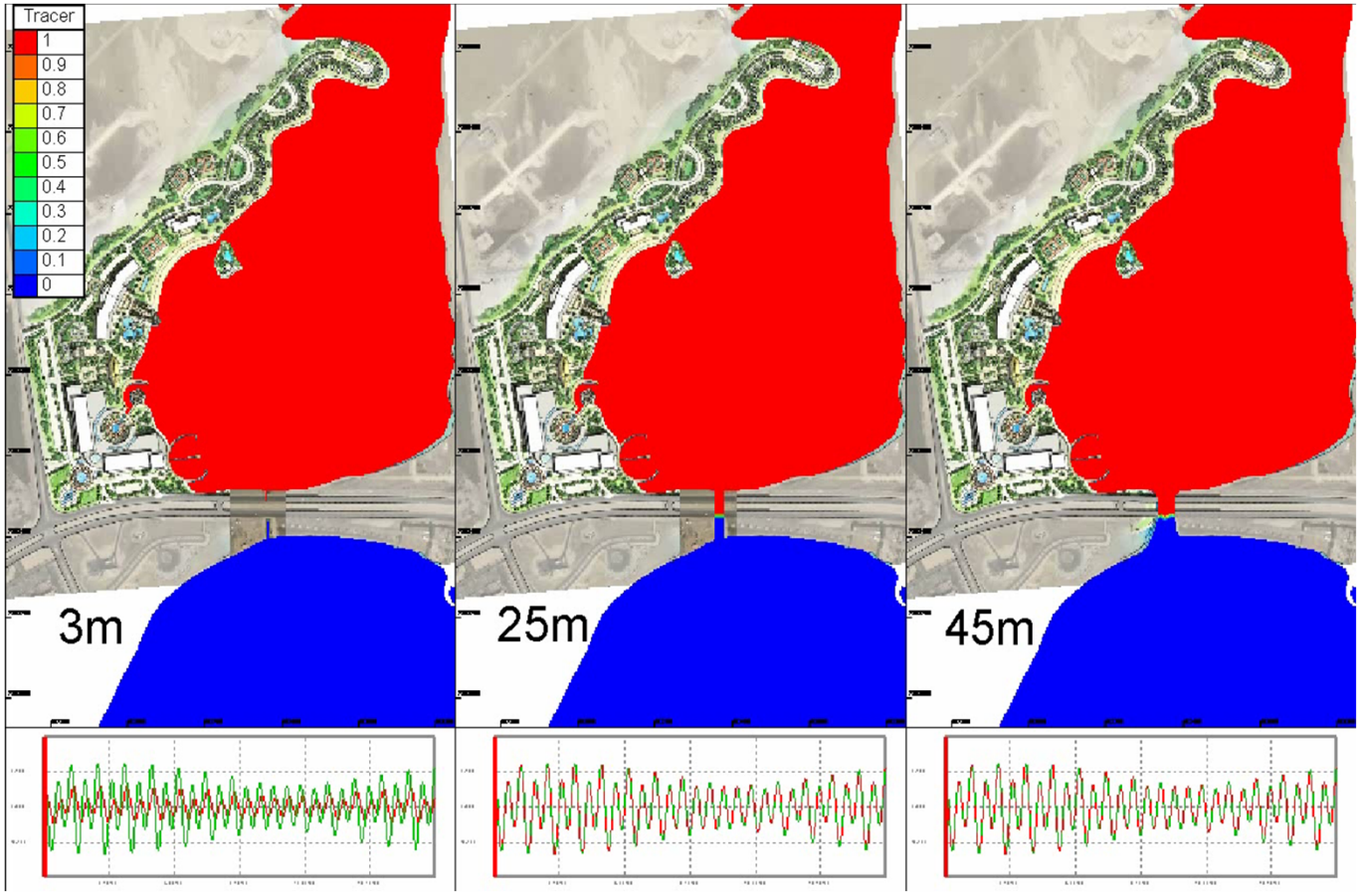




2

The TELEMAC system and its applications

The TELEMAC system and its applications



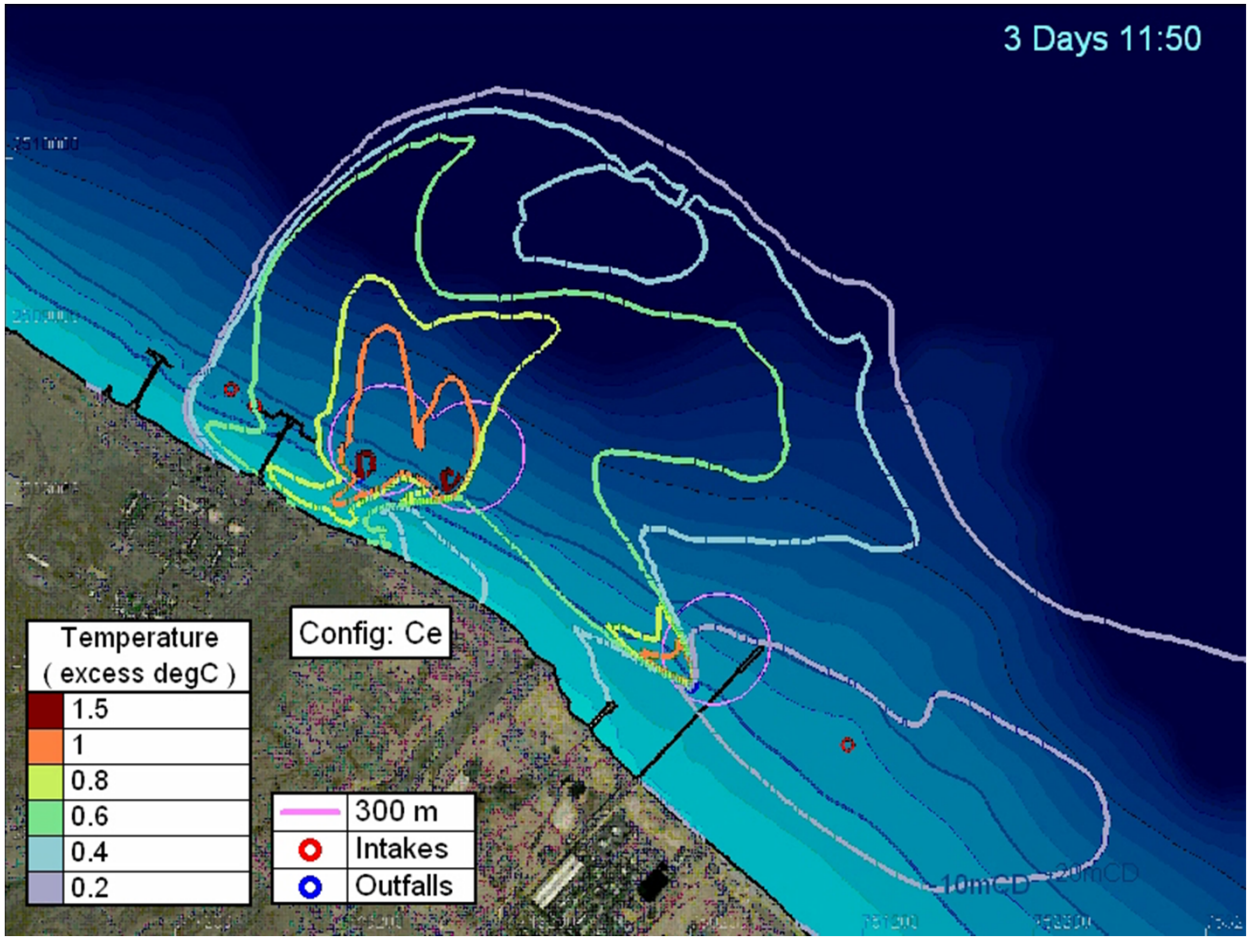
Water Quality, – Flushing (UAE)

Design of culvert width

HR Wallingford
Working with water

EDF

The TELEMAC system and its applications



Thermal Recirculation (Oman)

Combination of inlet / outfalls configurations

HR Wallingford
Working with water

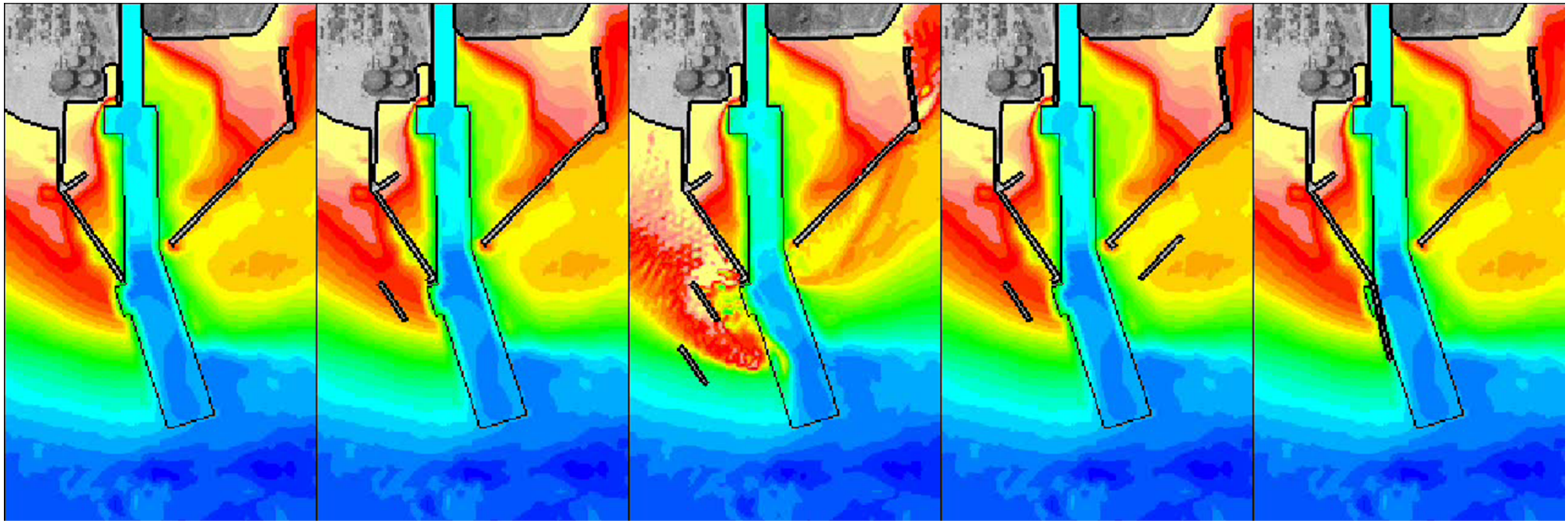
EDF

The TELEMAC system and its applications

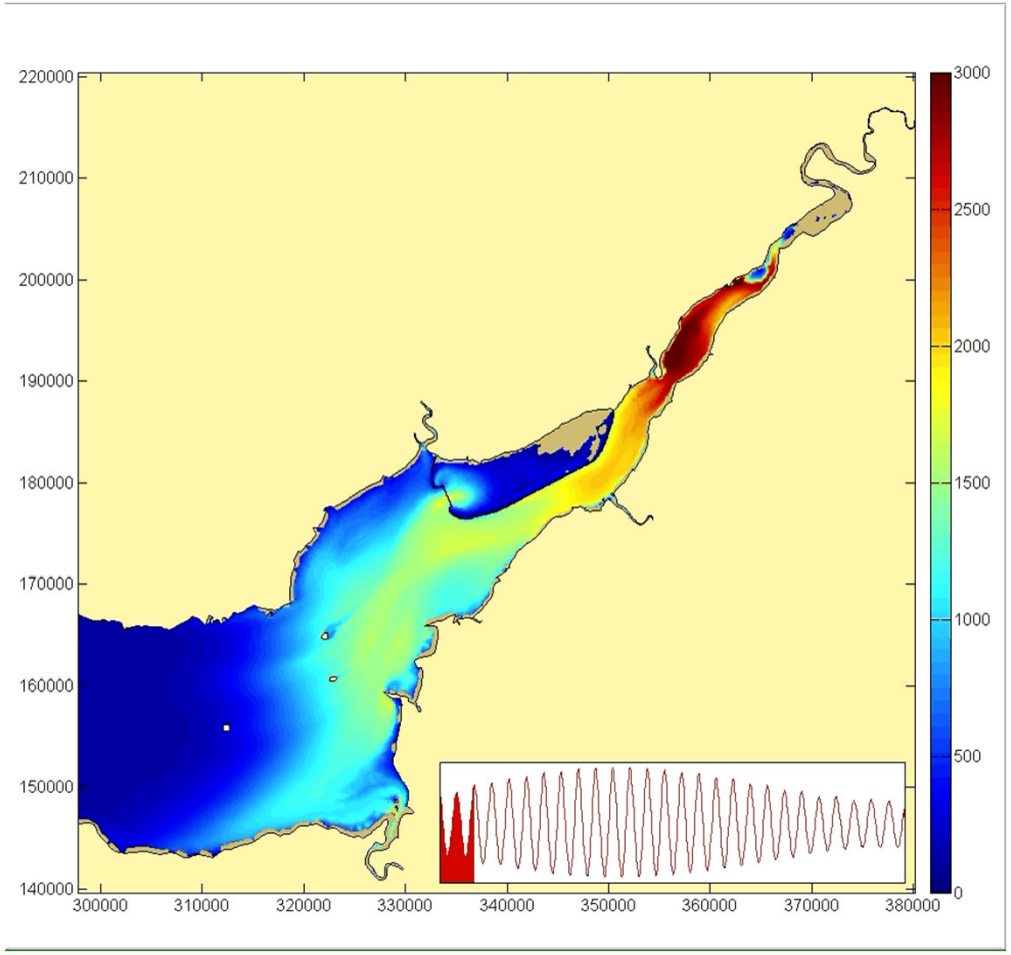
Sand bank movement (Canada)

Design of port Layout for navigation / dredging planning

Government of Canada / Gouvernement du Canada



The TELEMAC system and its applications



Sediment erosion, deposition, transport in estuaries (UK)

Sediment budget impact evaluation due to tidal lagoon and barrages

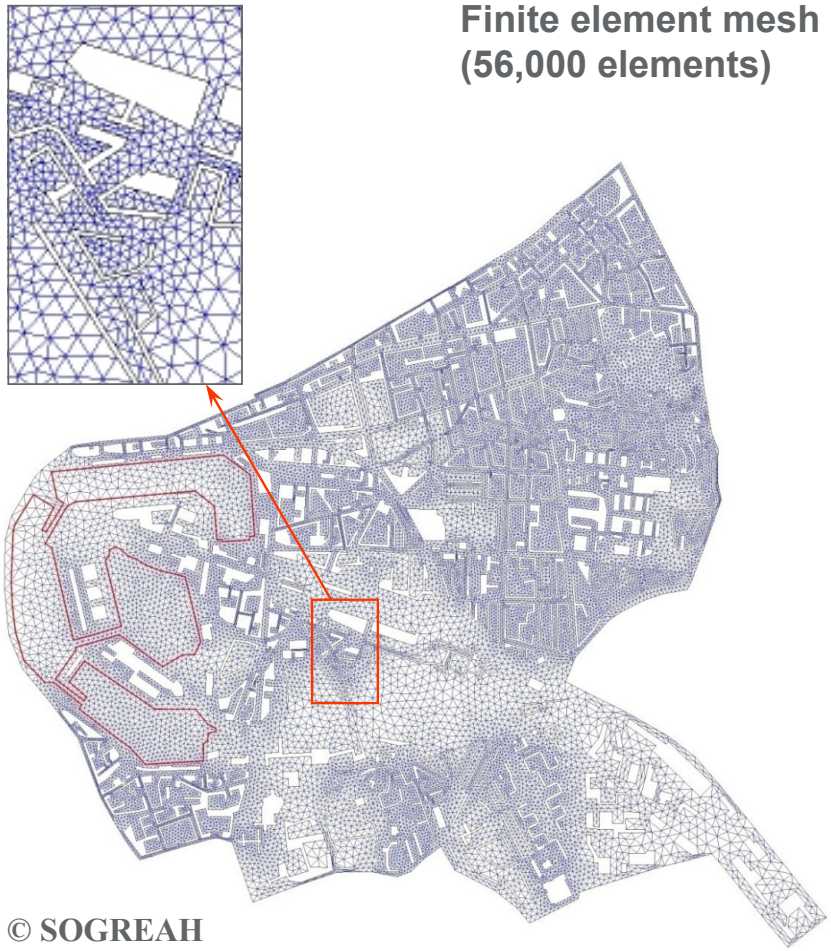
HR Wallingford
Working with water

EDF

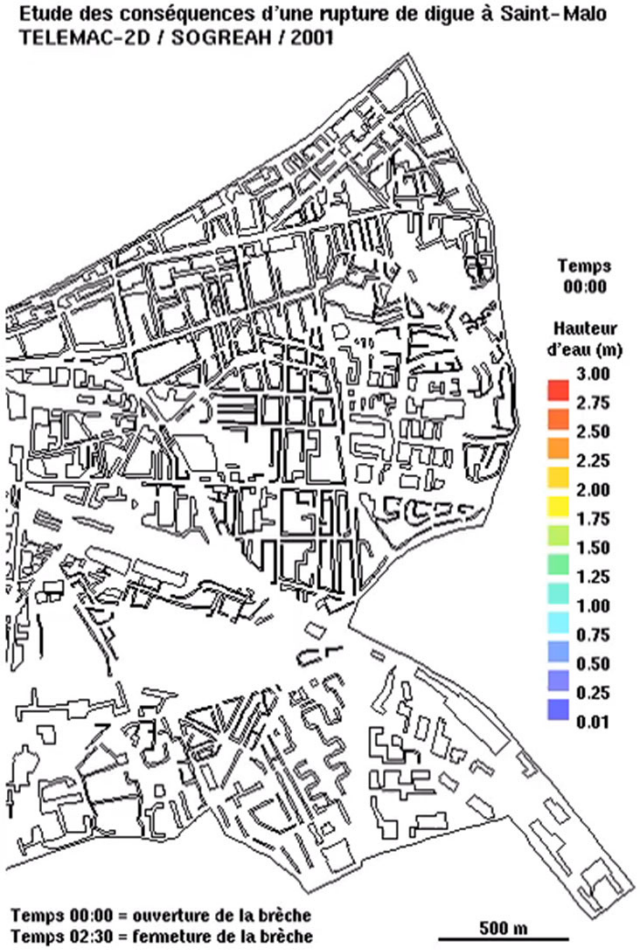
The TELEMAC system and its applications

Flooding (France)

"would be" urban flooding of Saint-Malo



Finite element mesh (56,000 elements)



The TELEMAC system and its applications

Government of Canada / Gouvernement du Canada

Dam breaches / Floods

The Malpasset dam

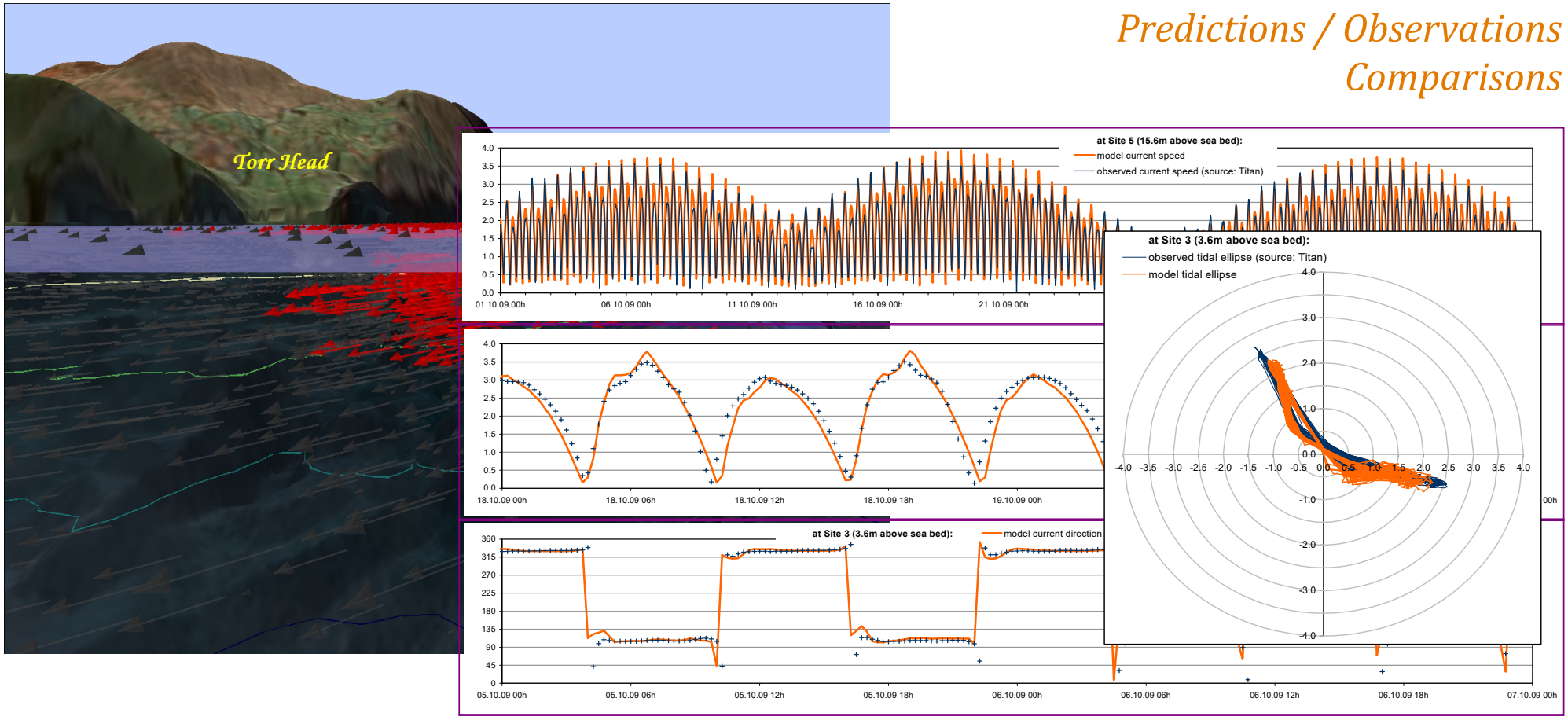
- *48 million m3*
- *December 2, 1959*
- *433 dead.*

EDF

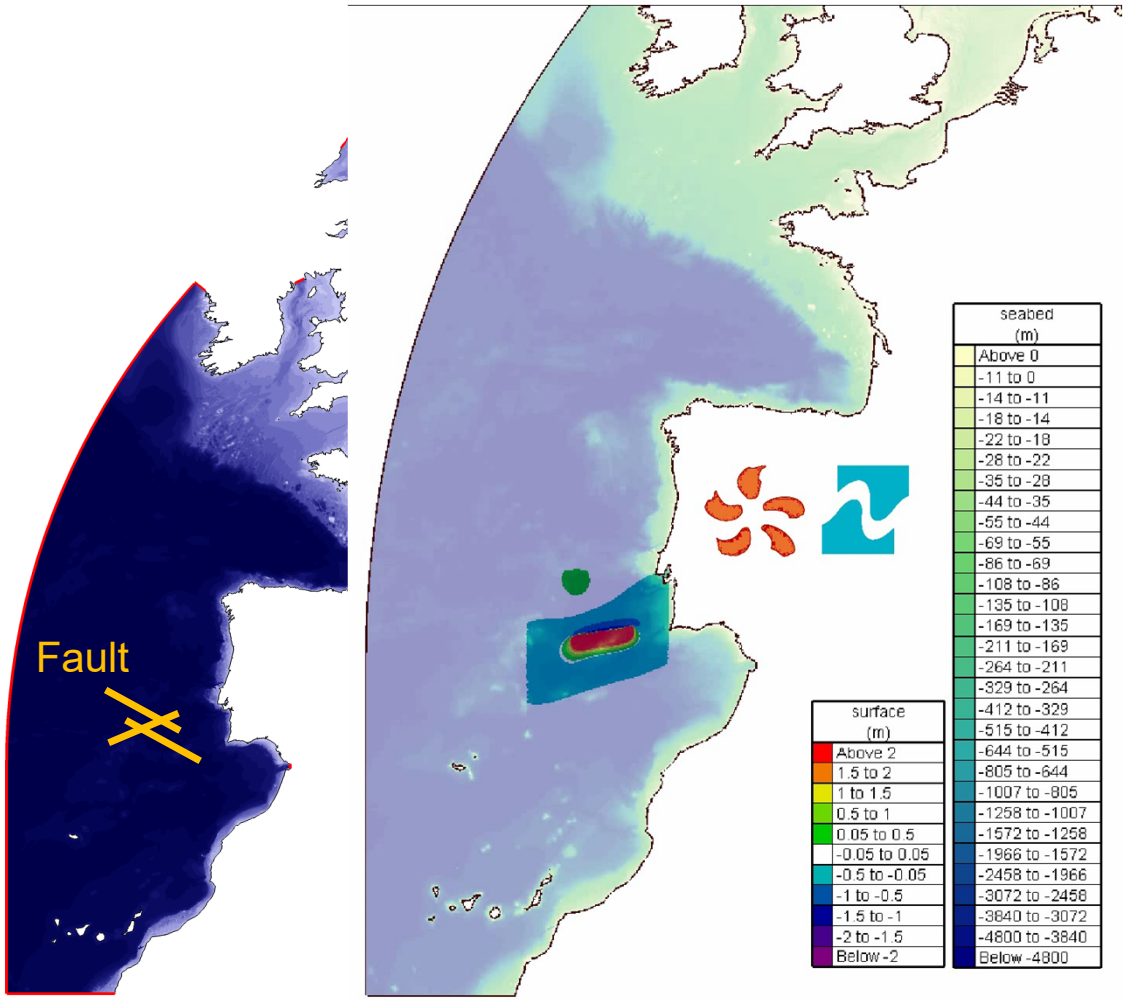
The TELEMAC system and its applications

Hydro - Renewable

Predictions / Observations Comparisons



The TELEMAC system and its applications



Tsunami propagation

- *Correct boundary conditions*
- *Correct energy conservation*
- *Tsunami predictor (Okada)*
- *Global tidal model (TPXO)*
- *Spherical coordinates*

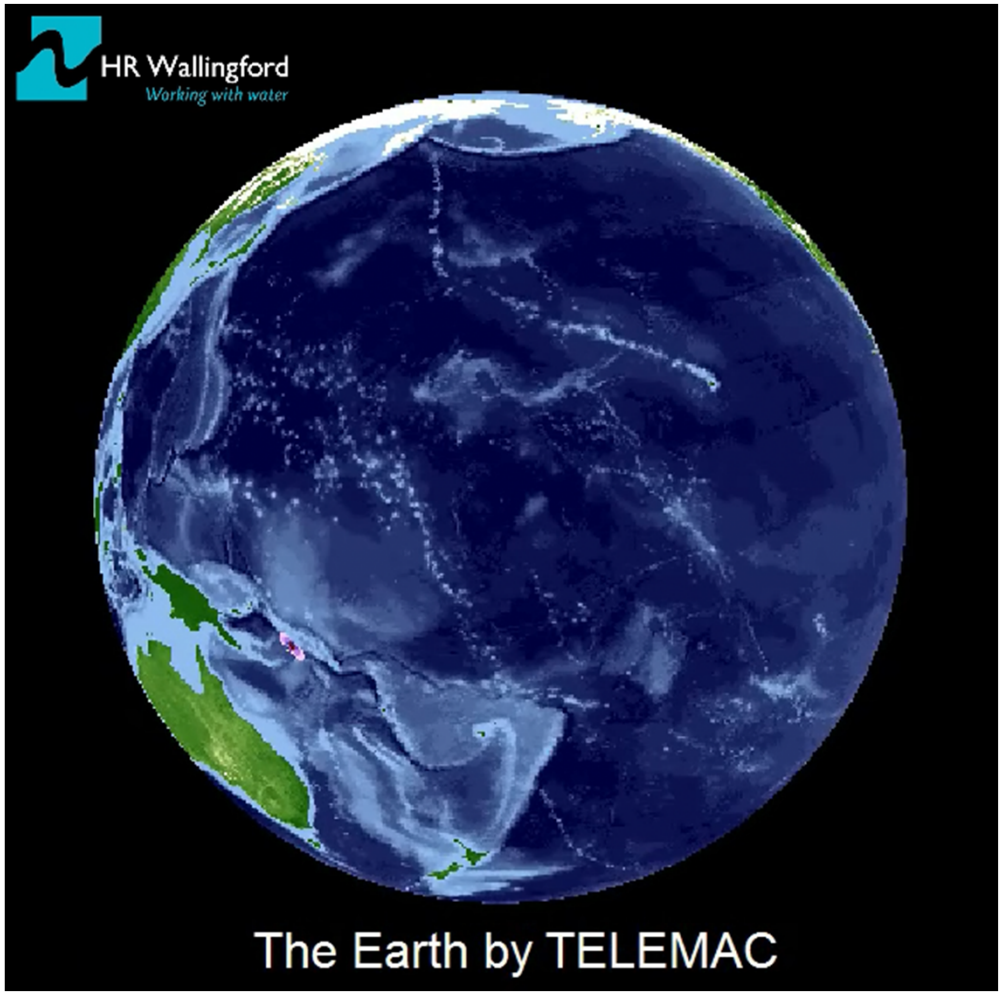
The TELEMAC system and its applications

Performance

- *"coarse" resolution: 3km*
- *time step 1 min*
- *24 hours run in less than 5 hrs on 36 compute-cores*

Tsunami triggered every 2 hours

Solomon Islands 2007, Tohuku 2011, Sumatra 2004, Makran/Balochistan 1945, Greece 1956, Lisbon 1755, Dominican Republic 1946, Ecuador/Colombia 2016, then Tohuku 2011 and Valvidia 1960 (simultaneously) and Kamchatka 1952.

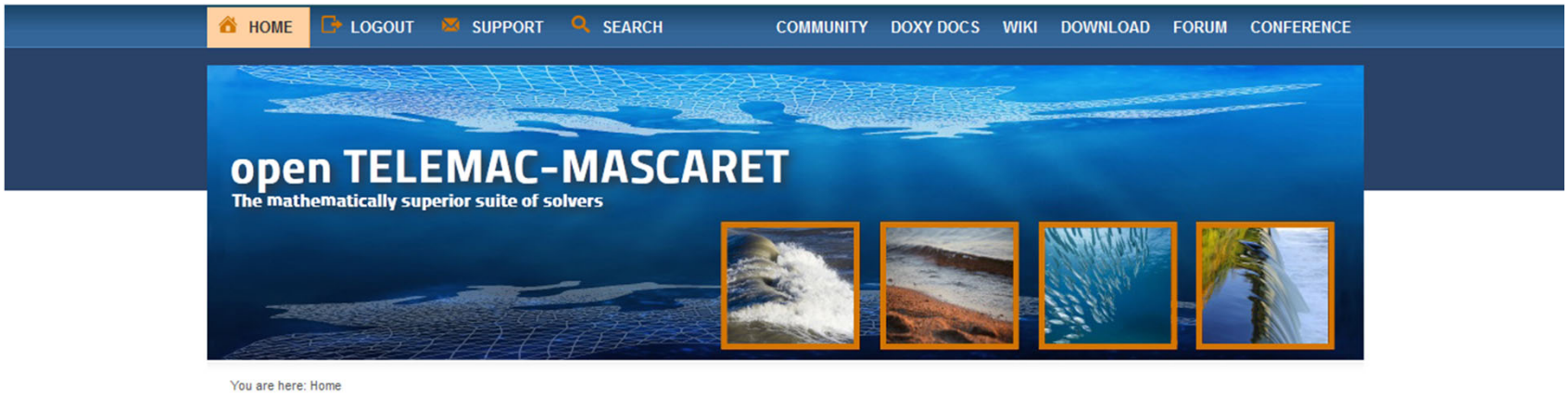


3

Open source and management

Open source and management (1 of 3)

www.opentelemac.org



https://gitlab.pam-retd.fr/otm/telemac-mascaret

- ✓ Entire source code and its version and tracking control system
- ➢ Transparency, Traceability, Quality Assurance, …

git

GitLab

EDF

Open source and management (2 of 3)

www.opentelemac.org

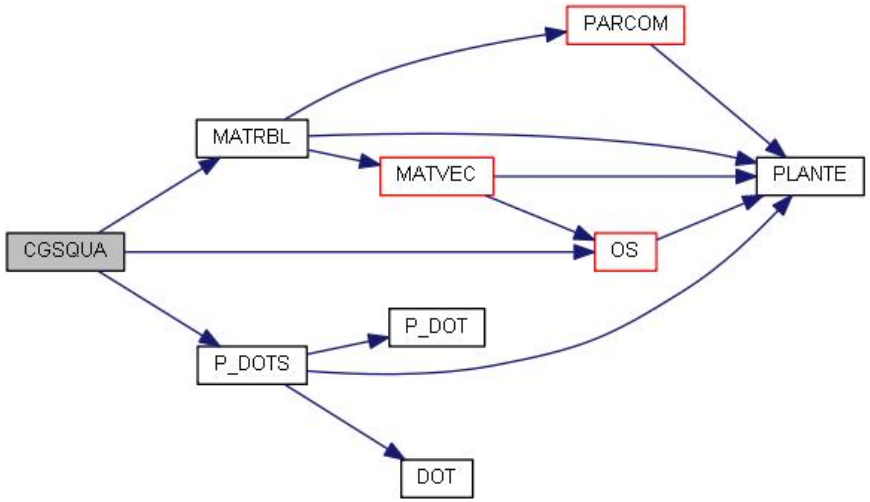
- ✓ Close to 35,000 messages
- ✓ More than 10,000 users

FORUM

DOWNLOAD

DOXY DOCS

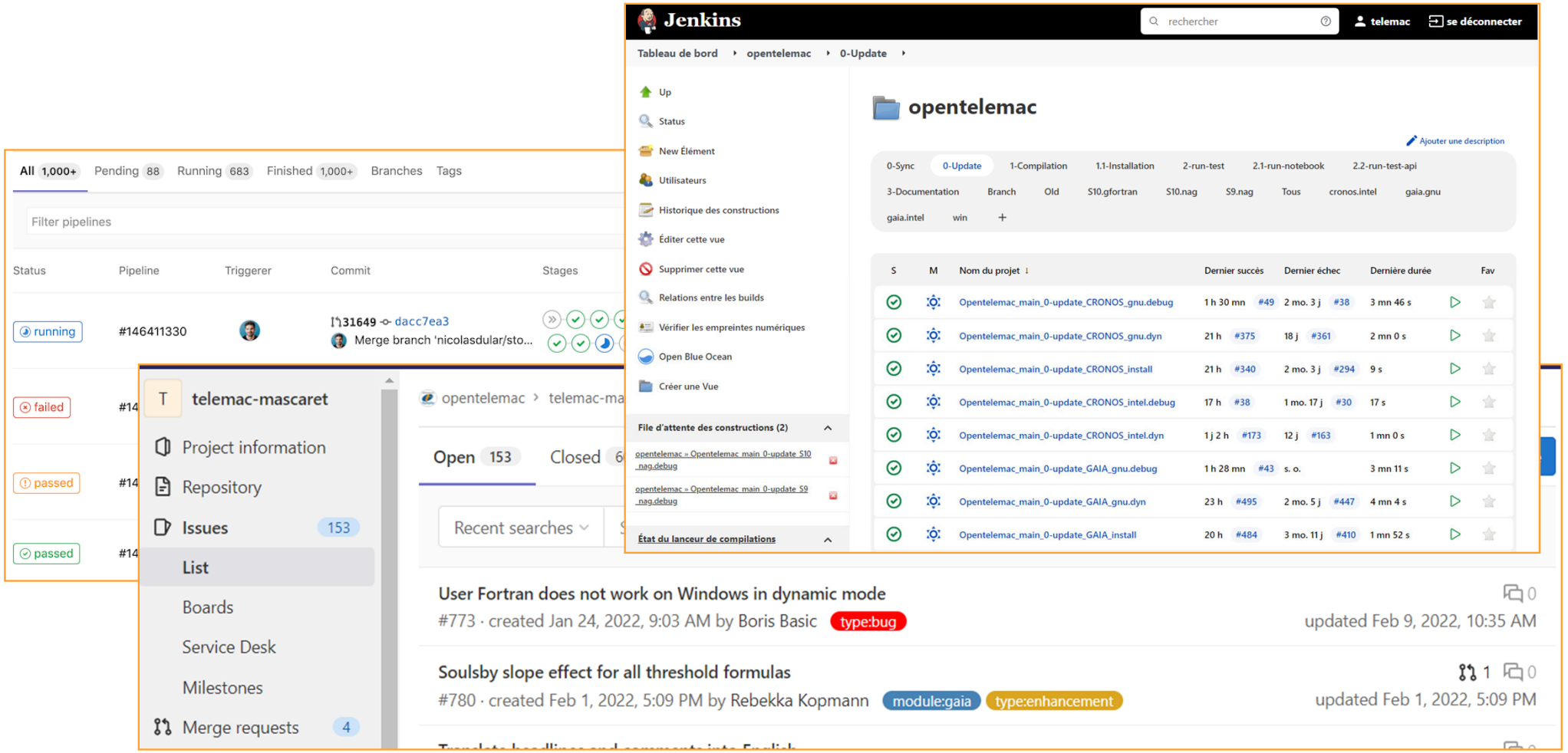
- ✓ Entire source code
- ✓ 150+ example and test cases ready to use
- ➢ Growing community of users and scientists



docs / wiki.opentelemac.org

- ✓ Source code documentation
- ✓ Call and Caller Graphs
- ✓ …

Open source and management (3 of 3)



High Performance Computing on AWS

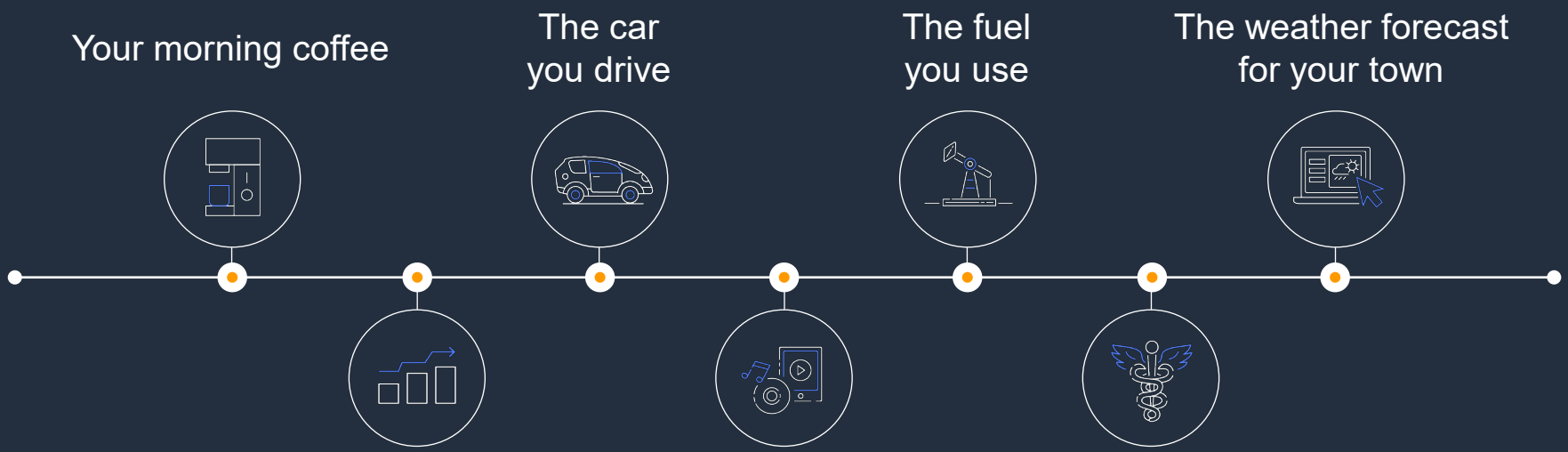
Topics

HPC on AWS and Hackathon objectives

UCit Hackathon platform presentation

Arm tools and processors

HPC impacts your life every day



Only 20%* of HPC workloads run in the cloud

On-premises HPC infrastructure limits engineers, scientists, and researchers from getting timely results and insights to answer the world's biggest questions

Lost productivity and longer time to results

72.8% of organizations that use HPC reported delayed or canceled HPC jobs*

Lost innovation

Questions are left **unasked**, experiments are left **undone**, and potential revenue is **left** on the table

Outdated technology

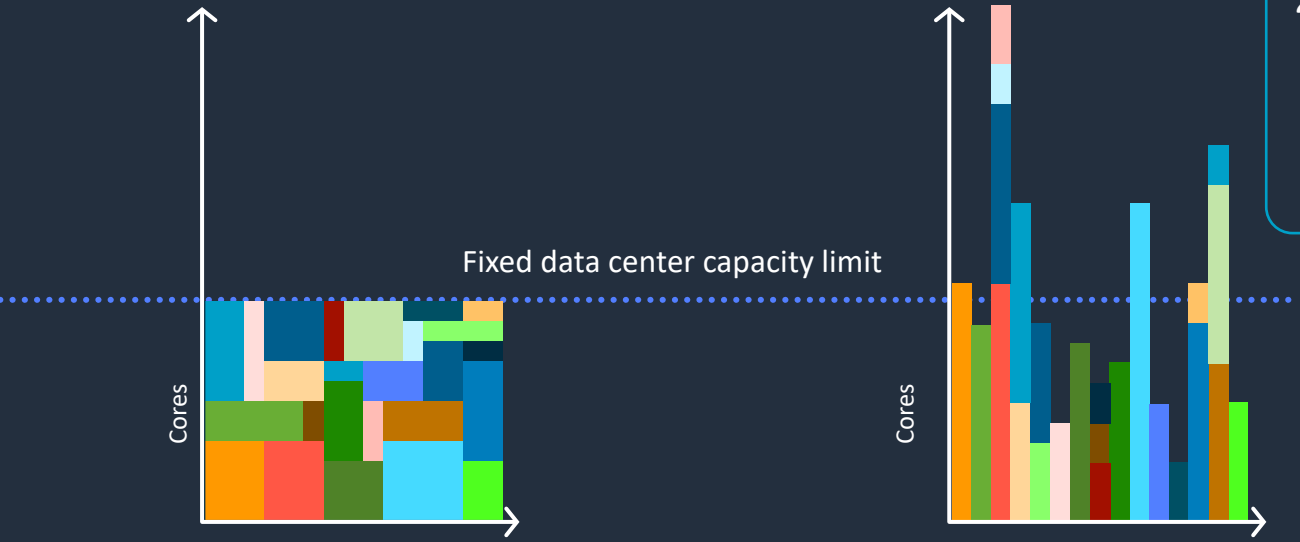
Almost **20%** of the useful life of new technology/ hardware is **lost** in the procurement process

Technical debt

Adapting **newer algorithms** to meet the requirements of an **existing infrastructure** = delays and **subpar** performance

*Source: Hyperion Research

What if you could escape the bounds of on-premises?



*"For every $1 spent on HPC, businesses see $507 in incremental revenues and $47 in incremental profit." **

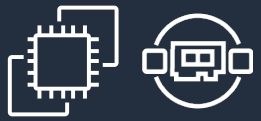
- Finite capacity
- Queues
- Engineering bottlenecks

- ✓ Elasticity
- ✓ Agility
- ✓ Evolving ecosystem of services (e.g. AI/ML)

*Source: Hyperion ROI Study (http://www.hyperionresearch.com/roi-with-hpc/)

aws

Key services that enable HPC on AWS

Compute & networking	Management	Storage	Batch processing	Visualization
				
Amazon EC2 Elastic Fabric Adapter (EFA)	AWS ParallelCluster EnginFrame	Amazon FSx for Lustre	AWS Batch	NICE DCV

Run your HPC workloads with the price performance you expect and the security you demand

HPC needs scale

VirtualFlow

2.2M+ vCPUs to analyze billions of cancer proteins

1.1M vCPUs to accelerate seismic processing workload by 150X

Descartes Labs

9.95 petaflop high-performance LINPACK (HPL) benchmark to rank #50 on the TOP500

aws

Hackaton – ambition/course of the hackathon

Provide students with a Cloud native HPC infrastructure to access AWS Graviton3 processor built using ARM Noeverse-V1 architecture

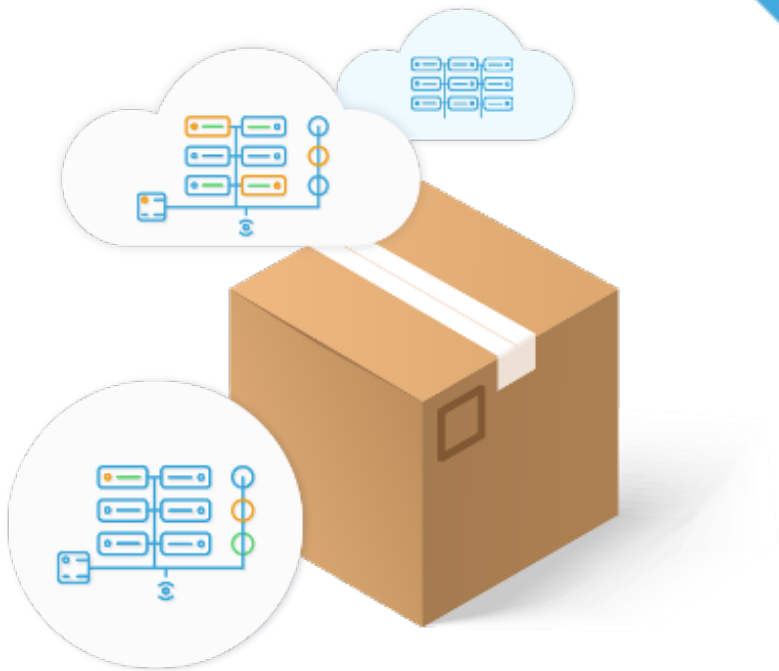
Give them a first hand experience on using new processors, new tools to optimize a mini-app (Stencil code) and port a production grade code on a HPC Cloud based infrastructure

All teams – Code optimization on CGG Stenci code (50% of the evaluation, recommended duration: 30% of the hackaton)

Then, either porting of Code Telemac3D or Code Saturne from EDF R&D (rest of the hackathon duration)

UC IT

Hackathon HPC



UC IT

Founded in 2015
Headquartered in Montpellier

Teratec

Joined Teratec in 2017
We apply Data Science to HPC Data

aws partner network

Select
Consulting
Partner

Public Sector Partner

AWS Partner since 2018
We help clients in their HPC Cloud Journey

HPC Cloud Journey

Consulting

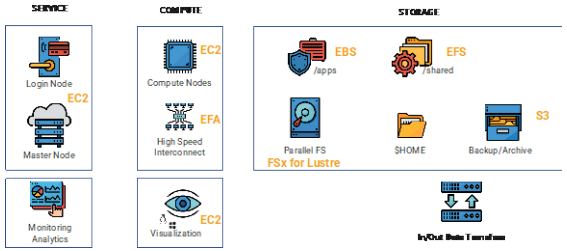
ANALYZE IT

Identify HPC Workloads and their On-Premises Behaviour

WORKCLOUD

Understand the appropriate Move to Cloud Strategy

Build



HPC Reference Architecture

CCME

Prototype / Test / Benchmark

Integration & Move-to-Cloud

Run

CCME

CCME Support & Professional Services

Cluster-in-a-Box : For An easy AWS Cloud Journey

UCit manage it for You

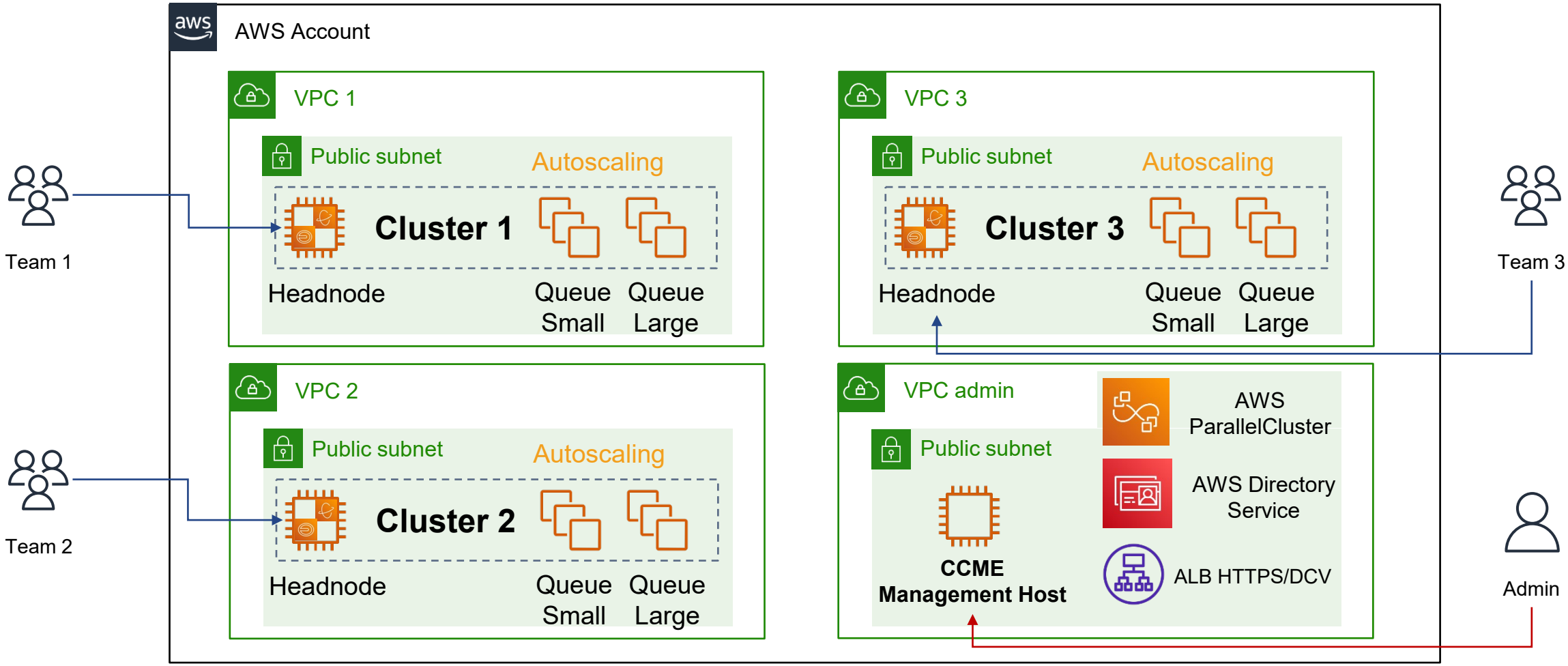
Cost & Budget under Control

Simple Access throuh SSH or a Web Portal

Your HPC Cluster of CHOICE on AWS…

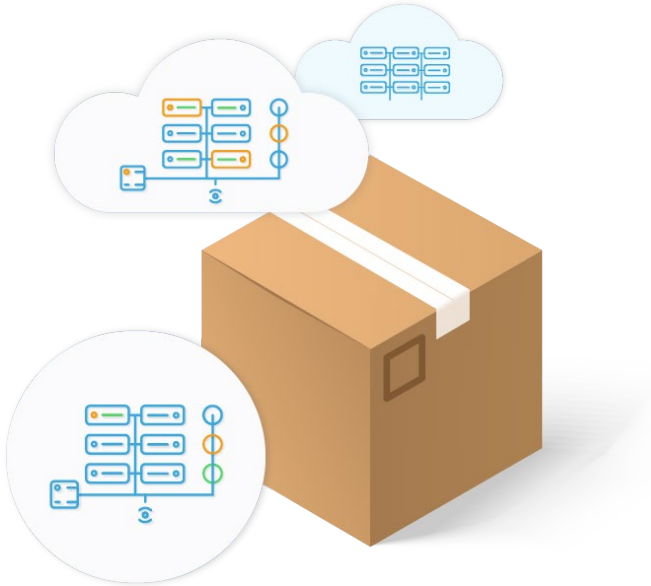
Video Presentation & Details

Hackathon : The Architecture



Cluster available for each team

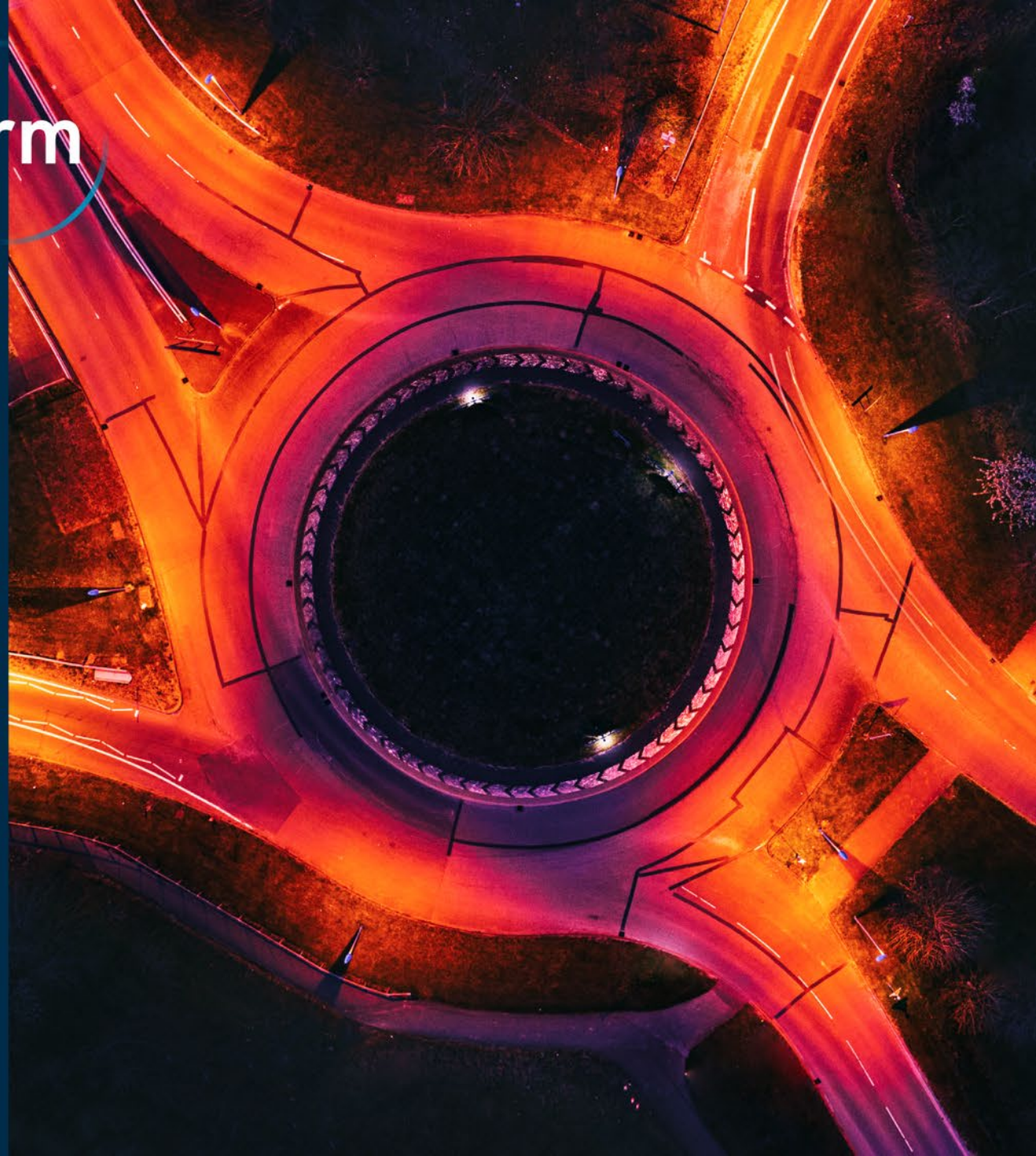
- Each cluster is fully isolated from the others (network, accounts…)
- Job scheduler: SLURM
- Compute: 2 partitions
  - Small: c7g.4xlarge (4 vCPUs, 32 GiB) – limit 4 instances
  - Large: c7g.16xlarge (64 vCPUs, 128 GiB) – limit 4 instances
  - ➢ 272 vCPUs available
- Storage: Shared NFS – 500GiB
- Remote access
  - SSH connection to frontend node through login/password
  - Web portal EnginFrame + remote desktop on frontend node



The Hackathon Box

Thanks

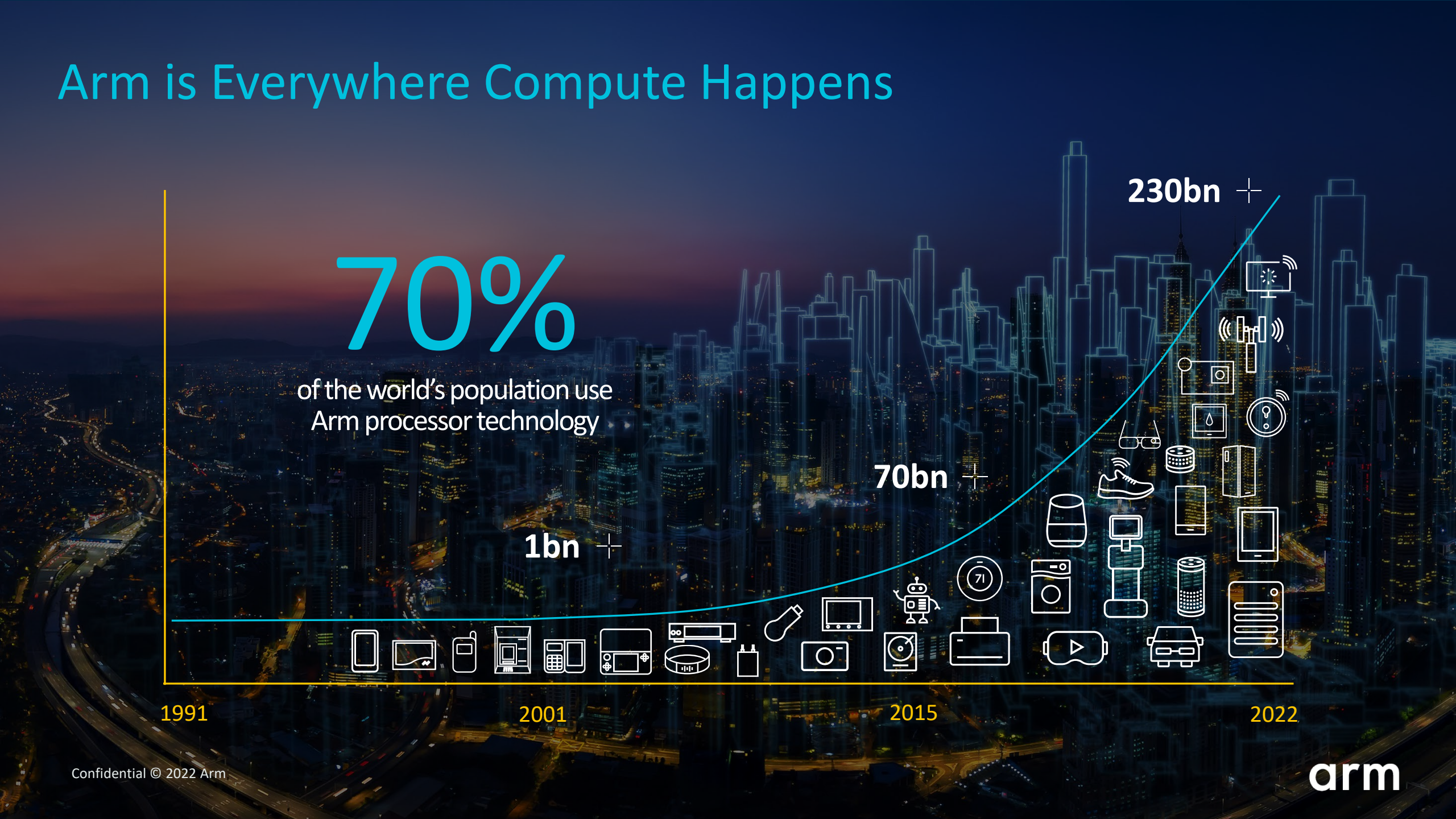
Teratec Hackathon



Conrad Hillairet - Staff HPC Engineer

7th October 2022

Arm is Everywhere Compute Happens



arm

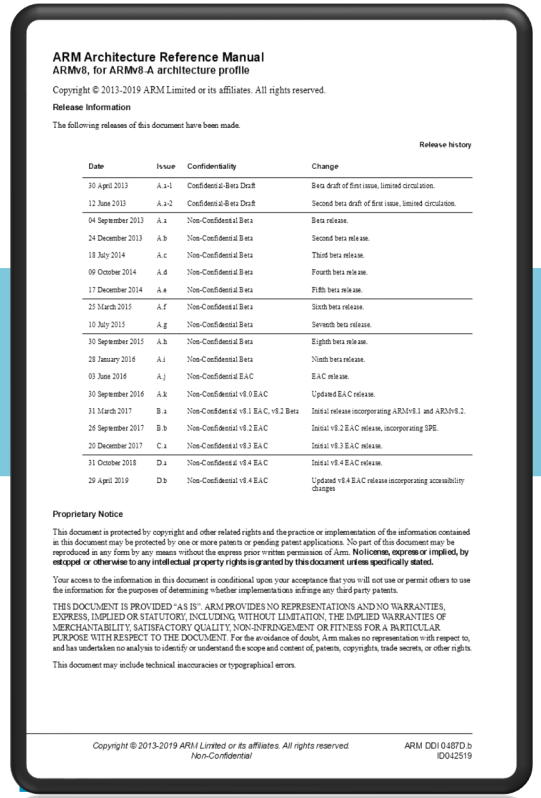
CPU Engagement Models with Arm

Arm IP is the basic building block for extraordinary solutions.

Core License

- Partner licenses complete microarchitecture.
- CPU differentiation via:
- Configuration options.
- Wide implementation envelope with different process technologies.

Arm IP

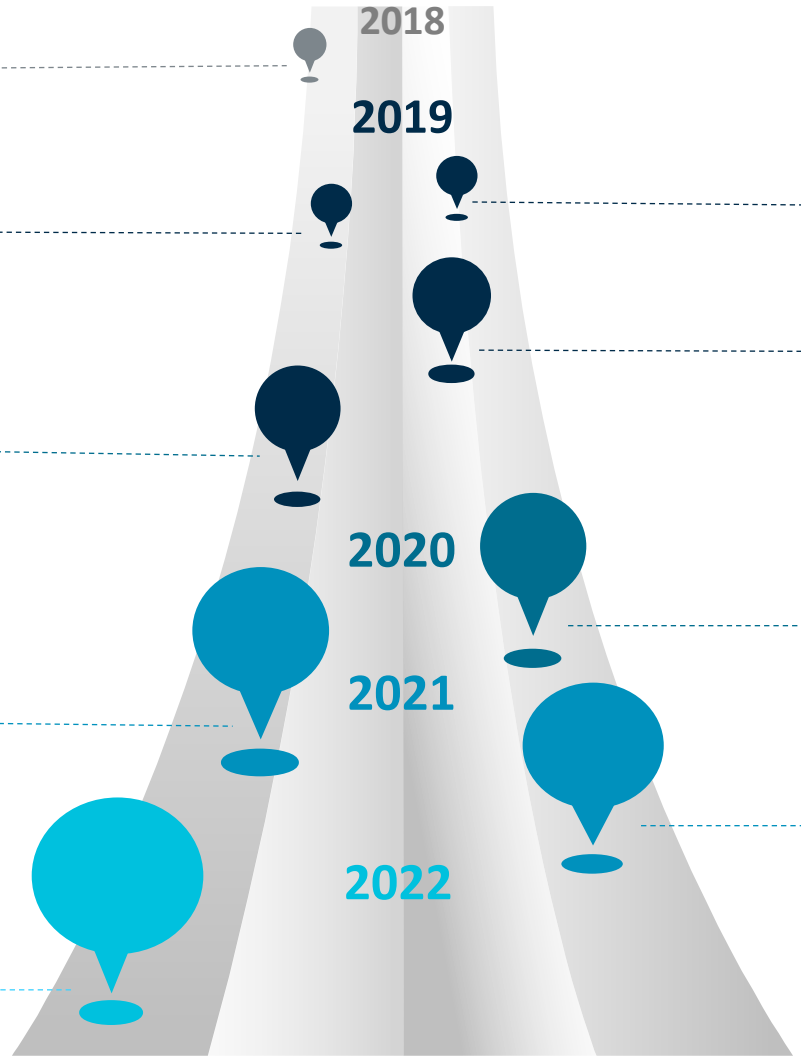


Architecture License

- Partner designs complete microarchitecture.
- Clean room, scratch.
- Maximum design freedom:
- Directly address needs of the target market.
- Arm architecture validation preserves software compatibility


arm NEOVERSE
The Cloud to Edge Infrastructure Foundation
for a World of 1 Trillion Intelligent Devices

Arm Neoverse Momentum in Servers & HPC



Arm Neoverse Announced

AWS announced 2nd Generation Arm-based Graviton2 Server CPU

EPI Zeus License

Arm launches the Neoverse V1 and N2 CPUs

NVIDIA announces Arm "Grace" CPU Superchip

Neoverse N1 & E1 Platform announced

Ampere announced industry's 1st 80-Core Server SoC (128 Altra Max)

Fujitsu Fugaku Riken #1 on Top500

AWS announces the Graviton3 CPU and C7g instance family on V1

AWS Graviton3

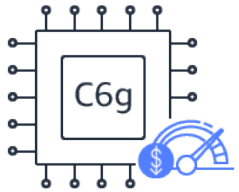
Hardware based on Arm technologies

Graviton2 Processor

Frequency
2.5 GHz

Peak Flops
1280 GFlops

Peak Memory B/W
204 GB/s



Many core
architecture
64 cores

Non-NUMA

7 nm

Arm Neoverse N1

Graviton3 Processor

Frequency
2.6 GHz

Peak Flops
2662 GFlops

Peak Memory B/W
307 GB/s

Many core
architecture
64 cores

Non-NUMA

Energy
efficiency
5 nm

Arm Neoverse V1

Compilers, Tools and Support

Server & HPC Development Solutions from Arm

Commercially supported tools for Linux and high performance computing

- **Code Generation**
  - *for Arm servers*

arm COMPILER FOR LINUX

- arm C/C++ Compiler
- arm Fortran Compiler
- arm Performance Libraries

+

- **Performance Engineering**
  - *cross platform, scalab*

arm FORGE

- arm DDT — *Debugger*
- arm MAP — *Profiler*
- arm PERFORMANCE REPORTS — *Reporting*

=

Server & HPC Solution

for Arm servers

arm ALLINEA STUDIO

Commercially Supported Toolkit for applications development on Linux

- C/C++ Compiler for Linux
- Fortran Compiler for Linux
- Performance Libraries
- Performance Reports
- Debugger (DDT)
- Profiler (MAP)

- ACFL & ArmPL 22.1
- Arm Forge 22.1

Documentation

Have a look to the manuals

- Get started on Arm Guide https://developer.arm.com/documentation/102841/0100
- Arm Fortran Compiler https://developer.arm.com/documentation/101380/2210
- Arm C/C++ Compiler https://developer.arm.com/documentation/101458/2210
- Arm Performance Libraries https://developer.arm.com/documentation/102620/0100
- Arm Forge Map & DDT https://developer.arm.com/documentation/101136/22-1

GNU compilers are a solid option

With Arm being significant contributor to upstream GNU projects

- GNU compilers are first class Arm compilers
  - Arm is one of the largest contributors to GCC
  - Focus on enablement and performance
  - Key for Arm to succeed in Cloud/Data center segment
- GNU toolchain ships with Arm Allinea Studio
  - Best effort support
  - Bug fixes and performance improvements in upcoming GNU releases
- GCC 11.2.0

MPI

Parallel Programming

- Out-of-the-box support since 3.1.2 (currently 4.1.4)
- Provided by default on AWS EC2 c7g instances
- Upstream contributions
- Used inhouse
- Active development from Arm and Arm partners

Support

How can I get some help during the event ?

- Via Slack
  1. Join the AHUG Slack Workspace
     - You may receive an invitation prior to the event
     - Link available here https://a-hug.org/contact/
  2. Join the **teratec-hackathon-hpc** slack channel
     - Send a private message to Conrad Hillairet
  3. Ask your questions:
     - In the slack channel
     - Using private message to Conrad Hillairet or Steve Messenger
- Email
  - conrad.hillairet@arm.com
  - messteph@amazon.co.uk

Thank You
Danke
Gracias
Grazie
谢谢
ありがとう
Asante
Merci
감사합니다
धन्यवाद
Kiitos
شكرًا
ধন্যবাদ
תודה

Hackaton – Prizes for the winning team

Will have a Arm based design processor

The winning team university will get a AWS Voucher to keep using AWS HPC services for up to 12 month.

Details to be discussed with the university HPC stream responsible.