

Showcasing successful global research infrastructure collaborations

Session 21 | Main room | 9.15-10.00AM



**Inmaculada
Figueroa**

*Deputy Director General
for International Consortia,
Organizations and
Research Infrastructures
at the Ministry of Science,
Innovation, and
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Satoshi Matsuoka

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Center for
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Dr Kate Thibault

*Science Lead for
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Ecological
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Program*



**Sylvain
Charbonneau**

*President and CEO
of the Canada
Foundation for
Innovation*



Rory Fitzgerald

*Director of the
European Social
Survey, European
Research
Infrastructure
Consortium (ESS ERIC)*

Global Exascale and Beyond Supercomputing Infrastructure



Satoshi Matsuoka, Director Riken R-CCS
ICRI Panel Presentation
Dec 5th, 2024, Brisbane, Australia

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- **1. Global Supercomputing Infrastructure and Partnerships – Current status quo**
- **2. Breakthrough Science on the Infrastructure --- International Team using multiple ‘Exascale’ supercomputer wins the prestigious *ACM Gordon Bell Prize***
- **3. Collaborations in new high performance computing paradigms --- AI for Science, Quantum-HPC Hybrid**
- **4. Collaborations in building the future – International Collaborations beyond ‘exascale’ towards ‘zettascale’ AI & HPC**

Overview of Japanese HPCI

Oct. 2024

Courtesy: RIST
(translated to English
and modified)

HPCI: High Performance Computing Infrastructure

Connects state-of-the-art supercomputers and storage at universities and research institutes in Japan via the high-speed network SINET6, enabling their integrated use and making them widely available to industry and academia.

Tier 2 Systems

11+2 Organizations (Oct. 2023-)

To support diverse needs by Arm(same as Fugaku), x86, GPU, and vector systems

Flagship System

Riken CCS
"Fugaku"
(CPU: Arm)



Hokkaido Univ.
Grand Chariot(CPU:x86)
Polaire (CPU:x86)



AIST
ABCI 2.0 (GPU)



Tohoku Univ.
AOBA-A (Vector)
AOBA-B (CPU: x 8 6)
AOBA-S (Vector) 2023/8~



Univ. of Tsukuba
Cygnus (GPU)
Pegasus (GPU)



Joint Center for Advanced HPC
(JCAHPC) · The Univ. of Tokyo
Wisteria/Odyssey (CPU:Arm) → Miyabi (GH200+x86)



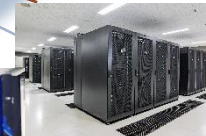
Osaka Univ.
OCTOPUS (CPU:x86/GPU)
SQUID (CPU:x86/GPU/Vector)



Riken CCS
HPCI Shared Storage (West)



The Univ. of Tokyo
Wisteria/Aquarius (GPU)
/HPCI Shared Storage (East)



Inst. of Statistical Mathematics
Data Assimilation Supercomputer
(CPU:x86)
2023.10~



Kyushu Univ.
Genkai (CPU:x86
+GPU)



Kyoto Univ.
Camphor3
(CPU:x86)
2023.10~



Nagoya Univ.
Supercomputer "Flow"
Type I (CPU:Arm)
Type II (GPU)



Inst. of
Science Tokyo
TSUBAME4.0 (GPU)
2024.4-



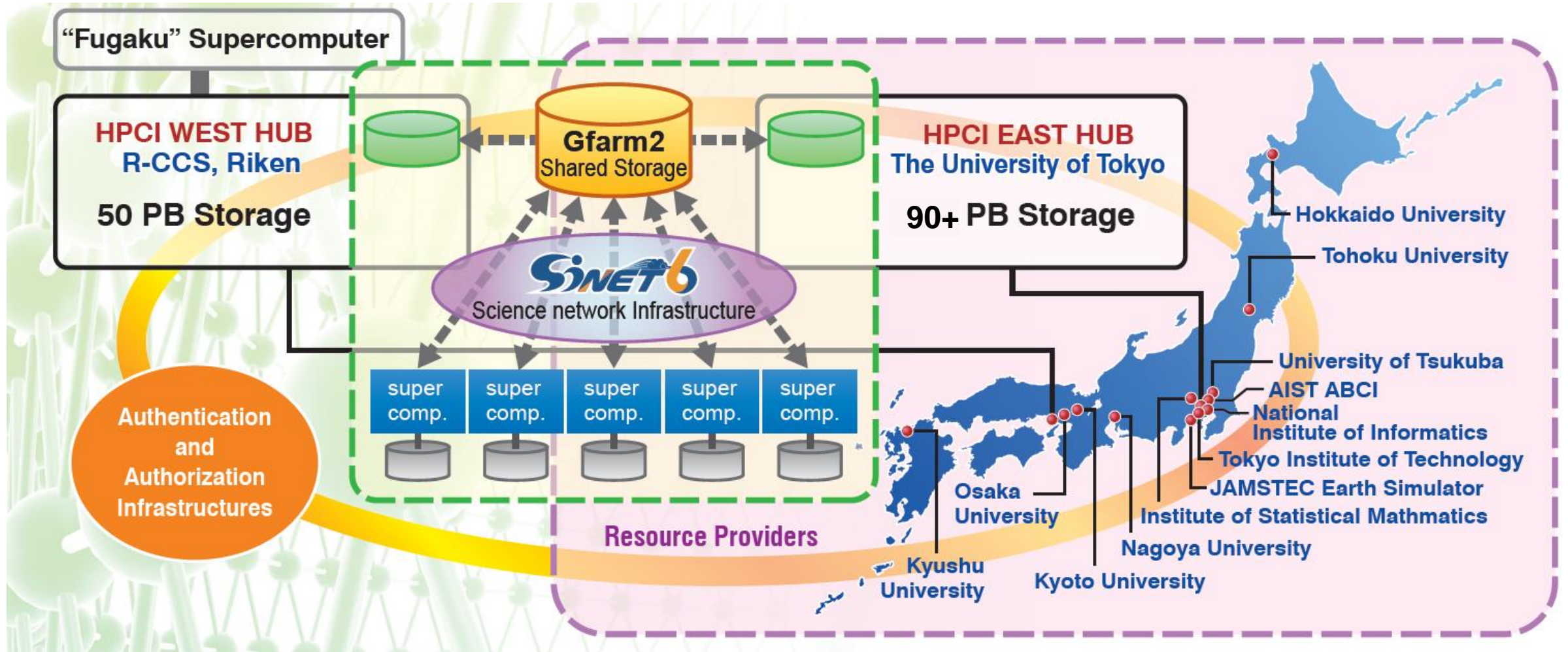
JAMSTEC
Earth Simulator (ES4)
(Vector / CPU:x86)

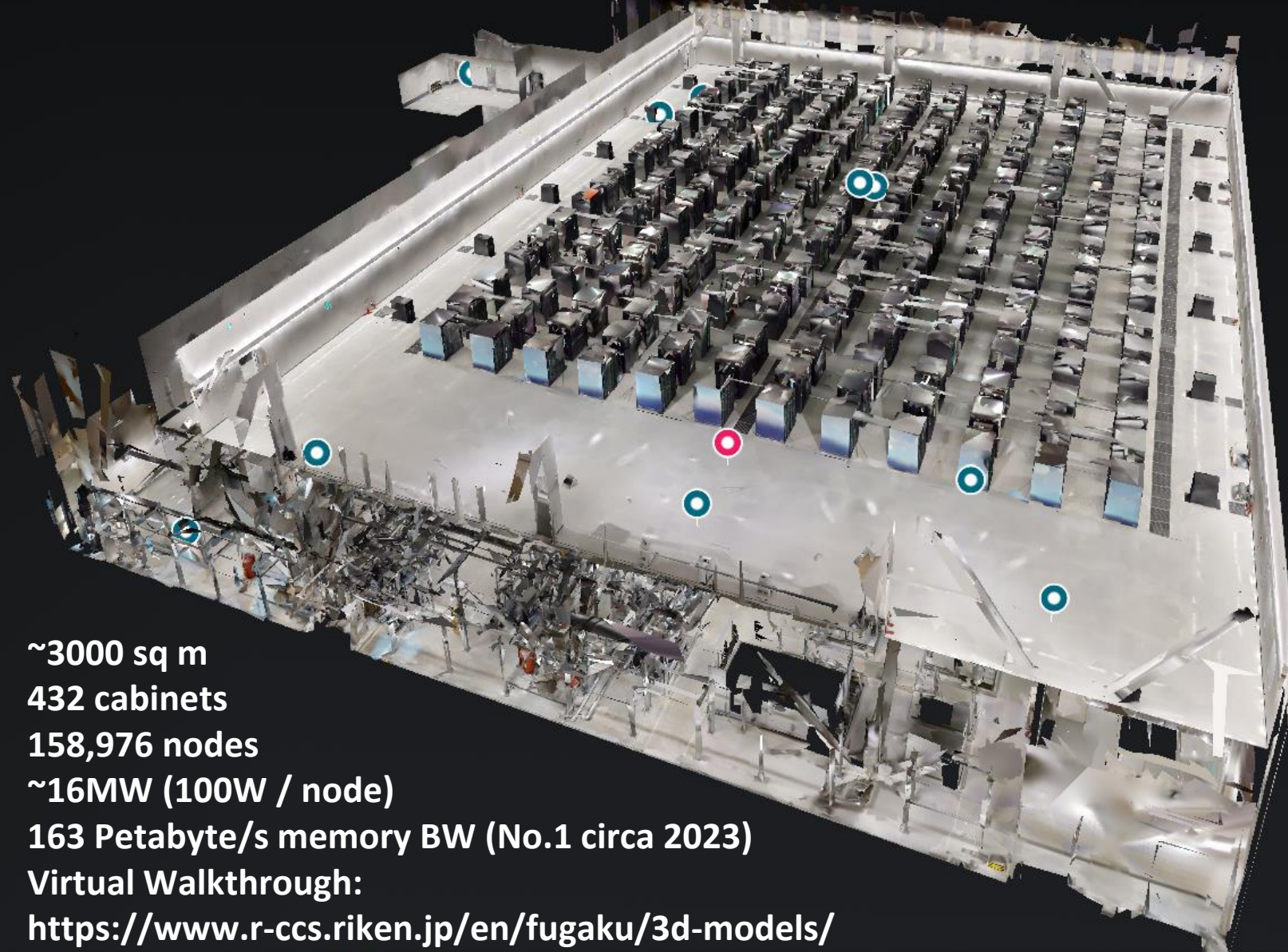
May 22, 2024

Japanese HPCI (2/2)

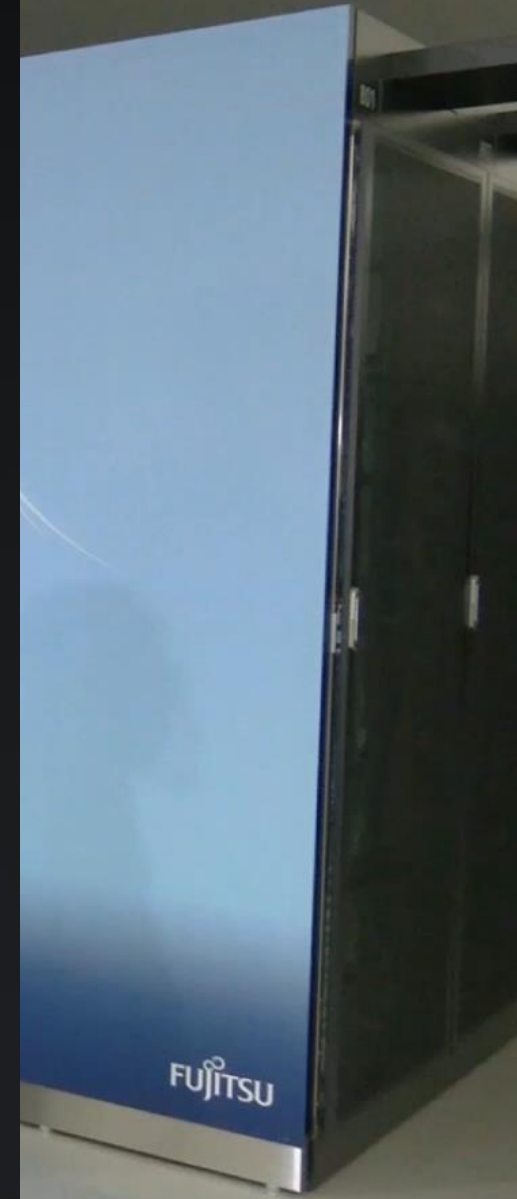
HPCI High Performance Computing Infrastructure

<https://www.hpci-office.jp/folders/english>





~3000 sq m
432 cabinets
158,976 nodes
~16MW (100W / node)
163 Petabyte/s memory BW (No.1 circa 2023)
Virtual Walkthrough:
<https://www.r-ccs.riken.jp/en/fugaku/3d-models/>



Major achievements of Fugaku

#1 in major benchmark rankings: TOP500 and HPL-AI (Jun.2020-Nov.2021), Graph500 and HPCG (Jun.2020-)

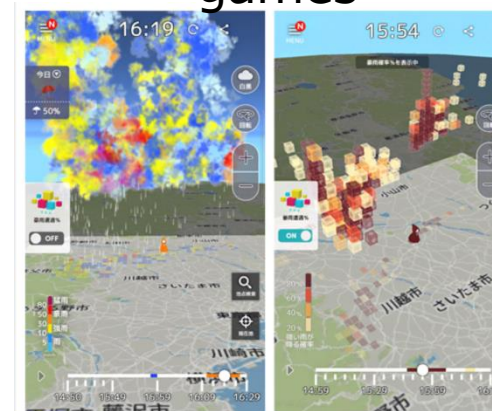
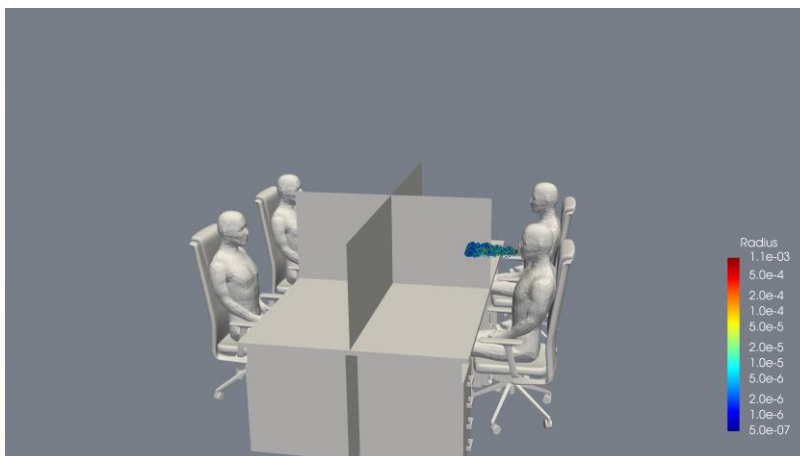
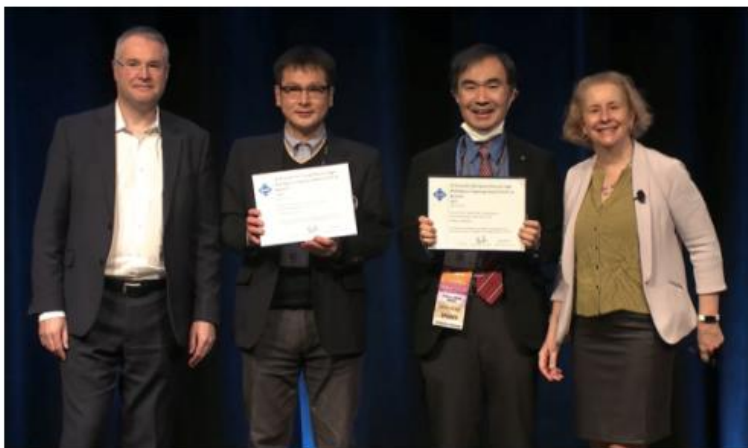


#1 in MLPerf HPC (Nov.2021-)



ACM Gordon Bell Special Prize for HPC based COVID-19 research (Nov.2021), also 2022

Weather forecasting trial for “guerrilla downpour” in TOKYO2020 Olympic/Paralympic games



今回の実証実験で表示される「3D雨雲ウォッチ」アプリイメージ

“Fugaku” Users are from worldwide

- Foreign Users uses through joint projects with Japanese institutions or projects leaded by foreign institutions

- Non-Japanese Users 740 [Apr. 2024]

(from 60 countries)

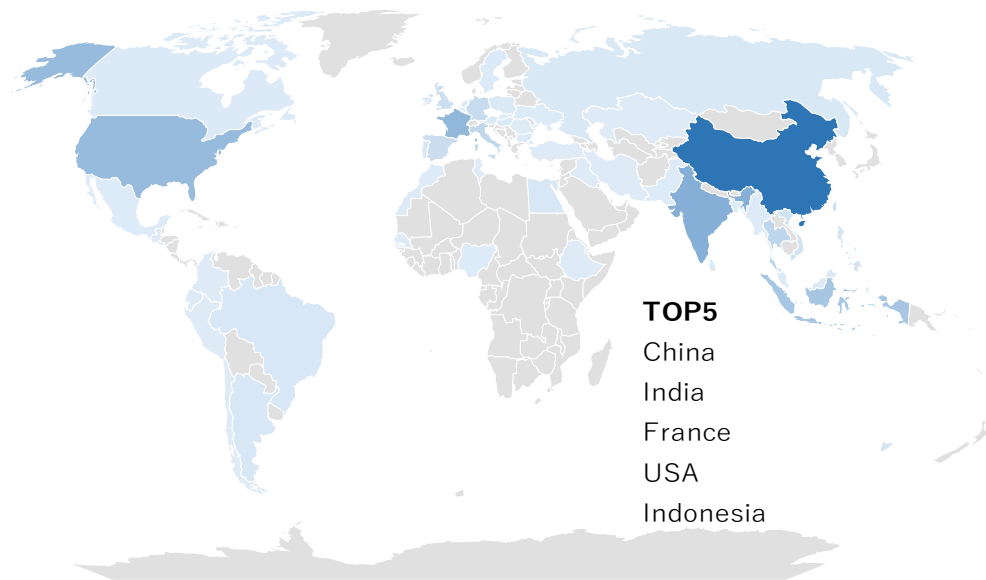
→ 19.8% of all users

- Projects leaded by foreign institutions

29 [FY 2022]

(8 countries: Singapore, France, USA, UK, etc.)

Map of Nationality [Non-Japanese]



(Apr. 2024)

<User Guide (English) >

<https://www.r-ccs.riken.jp/en/fugaku/user-guide/User Guide | RIKEN Center for Computational Science RIKEN Website>

Global Exascale & Pre-Exascale Supercomputers



Europe
HPC6 (Eni s.p.a., Italy)
Alps (CSCS, Switzerland)
Lumi (CSC, Finland)
Leonardo (CINECA, Italy)

Asia/Japan
Fugaku (Riken)

North America/United States
El Captain (LLNL)
Frontier (ORNL)
Aurora (ANL)
Eagle (Microsoft Azure)
Toulmne (LLNL)

Top 10 machines on the Top500-HPL
ranking, Nov. 2024 edition
(58.4% of the entire Top500-HPL capacity)

ADAC

Accelerated Data Analytics and Computing Institute

Purpose

The Accelerated Data Analytics and Computing Institute has been established to explore potential future collaboration among Oak Ridge National Laboratory, the Swiss Federal Institute of Technology, Zurich (ETH/CSCS), Tokyo Institute of Technology, Argonne National Laboratory, CSC – IT Center for Science, Forschungszentrum Jülich, Lawrence Livermore National Laboratory, The National Computational Infrastructure (NCI) of the Australian National University, RIKEN Center for Computational Science, The University of Tokyo's Information Technology Center's Supercomputing Research Division, and National Institute of Advanced Industrial Science and Technology, Department of Information Technology and Human Factors. Consistent with their respective missions, the Participants seek to collaborate and leverage their respective investments in application software readiness in order to expand the capability of running on accelerated architectures. The ADAC organizations manage HPC centers, accelerated supercomputers and provide key HPC capabilities to academia, government, and industry to tackle some of the world's most complex and pressing scientific problems.

Focus Areas & Working Groups

ADAC will focus on multiple objectives spanning performance, hardware, and applications, including:

- Adapting important scientific and engineering applications to hybrid accelerated architectures.
- Partnering with HPC vendors to evaluate architecture diversity.
- Enabling collaborative scientific efforts in hybrid accelerated data and compute.
- Ensuring sustainability and portability of critical applications.
- Promoting energy efficiency of scientific applications, system software, and facility operations.
- Sharing best practices regarding the operation, management, and procurement of HPC resources.



15th ADAC Symposium & Workshop, September 30 – October 4, 2024

Events

17th ADAC Symposium & Workshop, September 1-5, 2025

[LEARN MORE](#)

EU-Japan Alliance in HPC

Hpc Alliance for Applications and supercoMputing Innovation: the Europe - Japan collaboration

[Learn more](#)



About Us

HANAMI wants to promote scientific projects involving both Europe and Japanese institutes, and will assist the researchers to access supercomputers in both Japan and Europe. HANAMI embeds leading research institutes and supercomputing centers to tackle exascale area and beyond.

[Learn more](#)



Scientific Areas



Climate and Weather Modeling



Materials Science



Biomedical Sciences

Breakthrough Research via Global Exascale Infra

(slides courtesy Luca Fedeli, CEA, France)

We need to use ultra-short, ultra-intense femtosecond laser pulses

- PW laser system

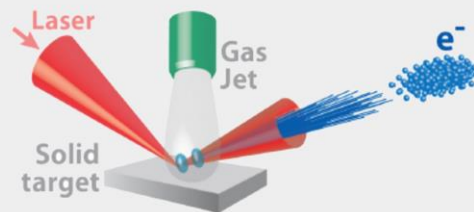


Ultra-short focused at

Up to the p striking Au

eters ranging human hairs

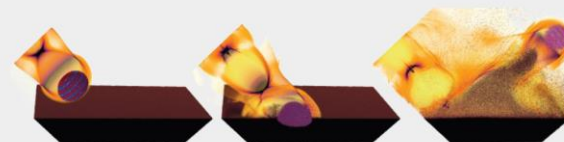
We propose an approach that should give us high-charge, high-quality, ultra-short electron beams



high quality



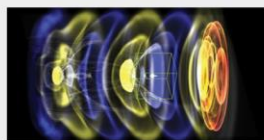
high charge



these beams could be suitable for FLASH radiobiology experiments

WarpX: an open-source Particle-In-Cell code for the exascale era

30+ contributors



Open-source & available on Github
Documentation: ecp-warpX.github.io/

We run on top supercomputers:

- Frontier (OLCF, USA)
- Fugaku (Riken, JP)
- Summit (OLCF, USA)



ACM GORDON BELL PRIZE

presented by John West (ACM)

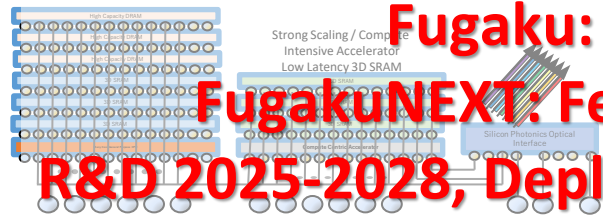
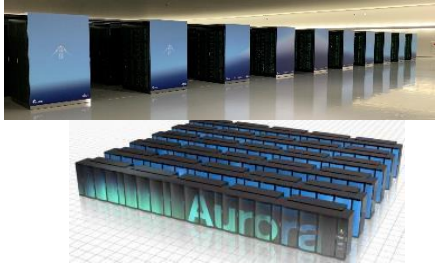
Pushing the Frontier in the Design of Laser-Based Electron Accelerators with Groundbreaking Mesh-Refined Particle-In-Cell Simulations on Exascale-Class Supercomputers

University of Paris Saclay, Lawrence Berkeley National Laboratory, ARM, Bullions, National Institute of Advanced Technology, CEA, RIKEN

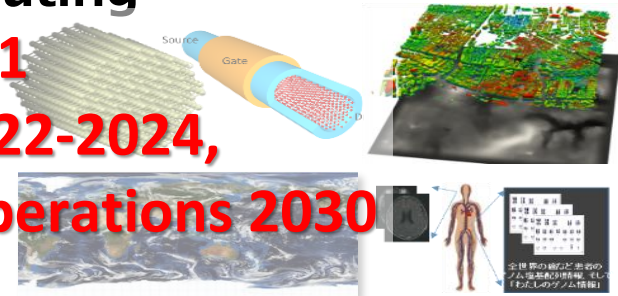
Riken R-CCS Strategy for Innovation by Computing Infrastructure

Future of Science 'of' and 'by' Computing

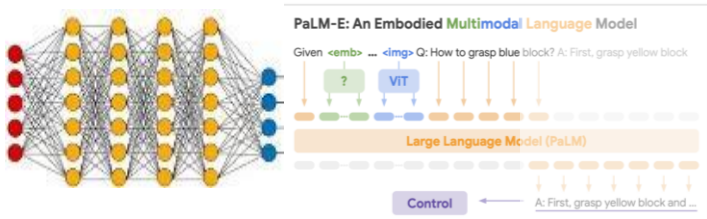
- Science **of** High Performance Computing (towards 'Zettascale')



Fugaku: Current up to 2031
FugakuNEXT: Feasibility Study 2022-2024,
R&D 2025-2028, Deployment ~2029, Operations 2030
'Zettascale' @ 40MW

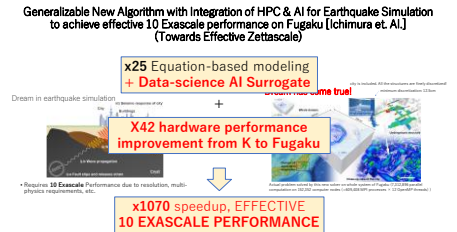
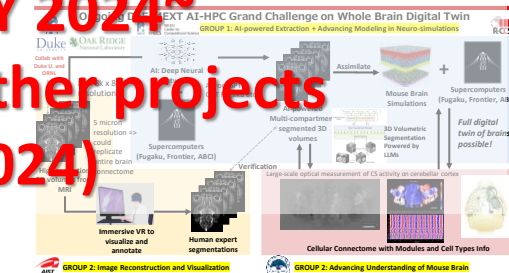


- Science **of** High Performance AI

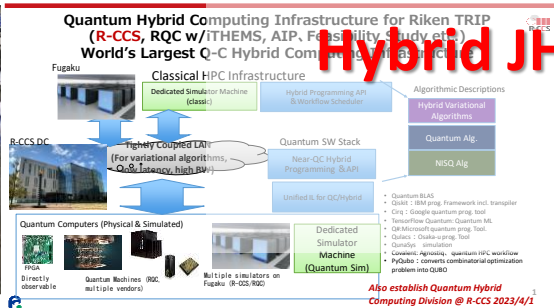


Riken AI for Science FY 2024~
including TRIP-AGIS and other projects
(Started April 1, 2024)

- Science **by** High Performance AI (AI for Science) w/HPC Simulations

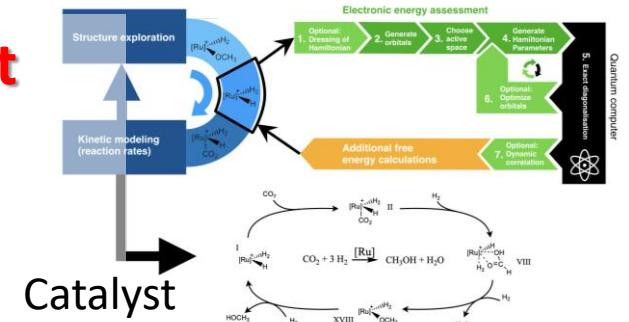


- Science **of** Quantum-HPC Hybrid Computing



Hybrid JHPC-Quantum Infrastructure Project
Deployment FY2023~2027
(Started Nov. 1, 2023)

- Science **by** Quantum-HPC Hybrid Computing





DOE-MEXT MoU on HPC/AI
 David Turk (DoE Deputy Secretary)
 Masahito Moriyama (MEXT Minister)



ANL-Riken MOU AI4S
 Paul Kerns & Rick Stevens (ANL)
 Makoto Gonokami, Makiko Naka, Satoshi Matsuoka &
 Makoto Taiji (Riken)

Trillion Parameter Consortium

TPC Goals

- **Building an open community** of researchers creating state-of-the-art large-scale generative AI models for science and engineering,
- **Incubating, launching, and facilitating** coordination and collaboration for specific projects building such models, and
- **Creating a global network** of resources and expertise to facilitate teaming and training of next-generation AI researchers.

TPC Operating Principles

- Transparency
- Fairness, and
- Ethical AI practices, including

TPC goals and principles align with scientific and government guidelines, promoting transparency, mitigating bias, ensuring trustworthiness, protecting privacy, fostering collaboration, and embracing adaptability in our AI development.

Nov/19/2021



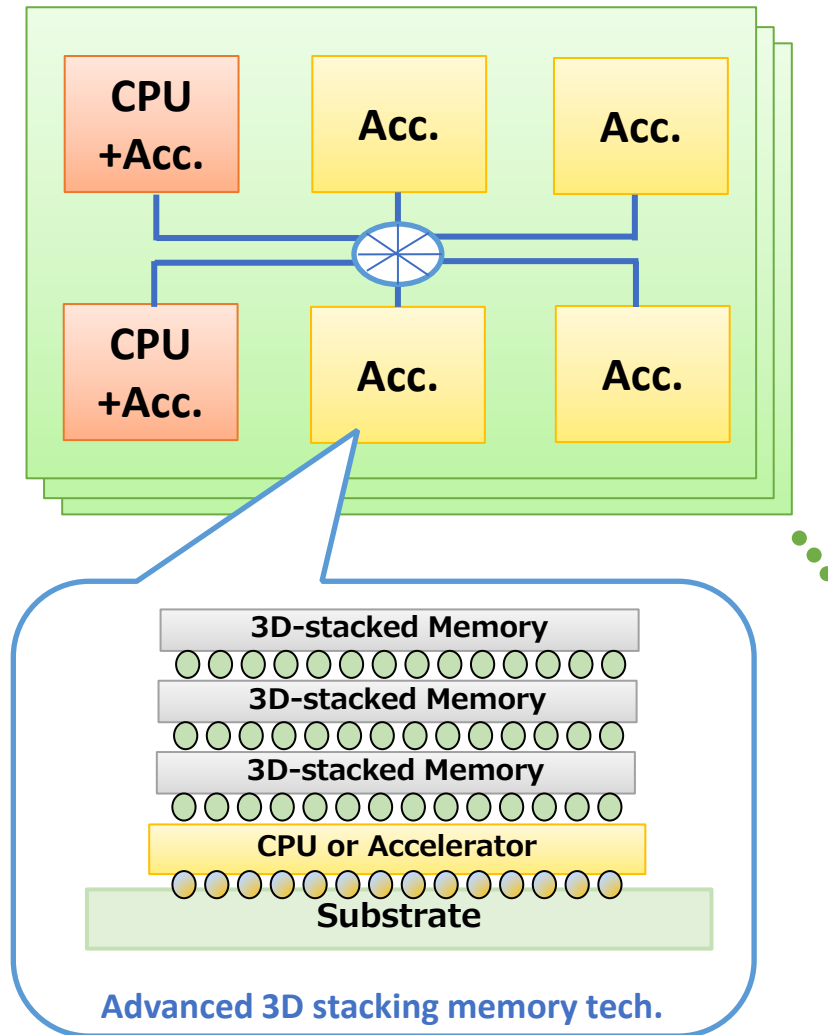
AI4S Trillion Parameter Consortium

Riken as Founding Member
 Makoto Taiji (representative), Satoshi Matsuoka
 (Founding member) etc.

TPC Hackathon in Kobe Mar 5-7, 2025
Please join!

Next-Generation 'FugakuNEXT' – 2029 deployment, 2030 operations (tentative plan) – 'Zettascale' AI &HPC for Science

JP-based CPU + accelerator with advanced
3D stacking memory technology



- **Heterogeneous node architecture**

- CPU + GPU/DPU-like accelerator
- High memory BW by 3D stacking memories
- Expected peak node performance
 - About 200-2000TFLOPS (DP)
 - About 4-40PFLOPS (FP16/BF16 for AI)
 - 40-600TB/s (Memory BW)

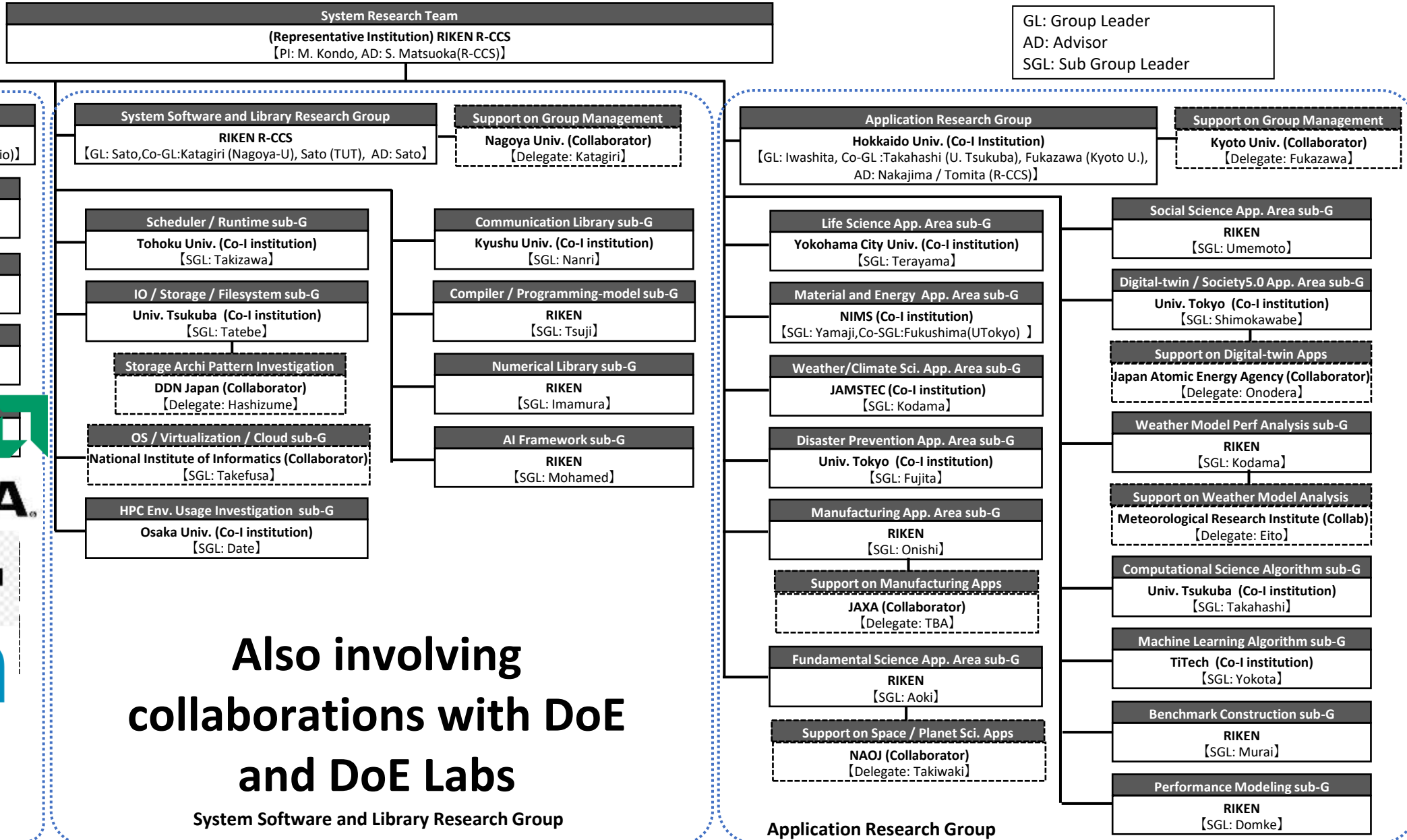
- **Mix of scale-up and scale-out network**

- Good for both AI & HPC workloads

System target: More than 5-10x effective performance improvement in HPC applications and more than 50EFLOPS AI training performance (100~200 EFLOPS Peak => Towards Zettascale) With AI Surrogates, another 10x or more speedup? (Total 100x~ speedup c.f. Fugaku?)

Riken's 'FugakuNEXT' Feasibility Study FY2022-2024

International Partnership in Next Generation Supercomputing R&D



Also involving collaborations with DoE and DoE Labs

Architecture Research Group

System Software and Library Research Group

Application Research Group

Katherine M. Thibault, Ph.D.
NEON Science Lead
5 December 2024

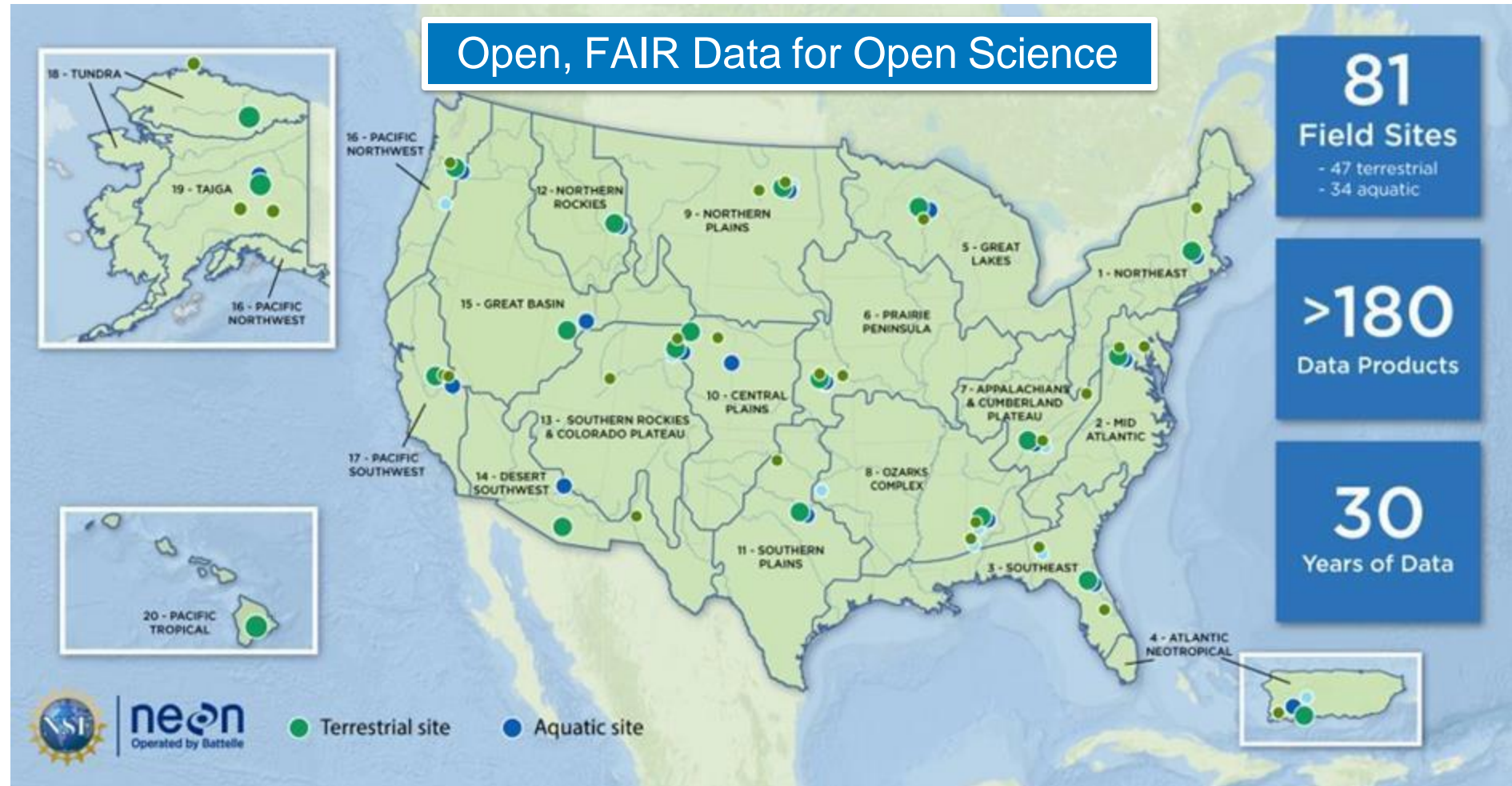


U.S. National Ecological Observatory Network

ICRI 2024 Session 21: Showcasing successful global research infrastructure collaborations

What is the National Ecological Observatory Network (NEON)?

- A US NSF large facility
- A continental-scale observatory
- Designed to enable understanding and forecasting of the effects of climate and environmental change



Standardized, collocated methods: Airborne remote sensing, automated instruments, & observational sampling

NEON contributions



Data

- Open, FAIR, and free data (>180 products)
- ✓ Observations and samples of flora, fauna, and soil
- ✓ Remote sensing data – camera, lidar, hyperspectral
- ✓ Time series data from >16,000 automated sensors



Specimens & Samples

- Archived for life of NEON for research and educational use
- >70 sample types across taxa and ecosystems
- > 500K samples to date, >3M planned
- > 10,000 specimen images (beetles, plants, fish, algae, etc.) to date



Community & Workforce Development

- Support of information & data management standards
- Interoperability with other datasets
 - ✓ FLUXNET, GBIF & more
- Training, user support
 - ✓ Sampling protocols
 - ✓ Code packages & data tutorials



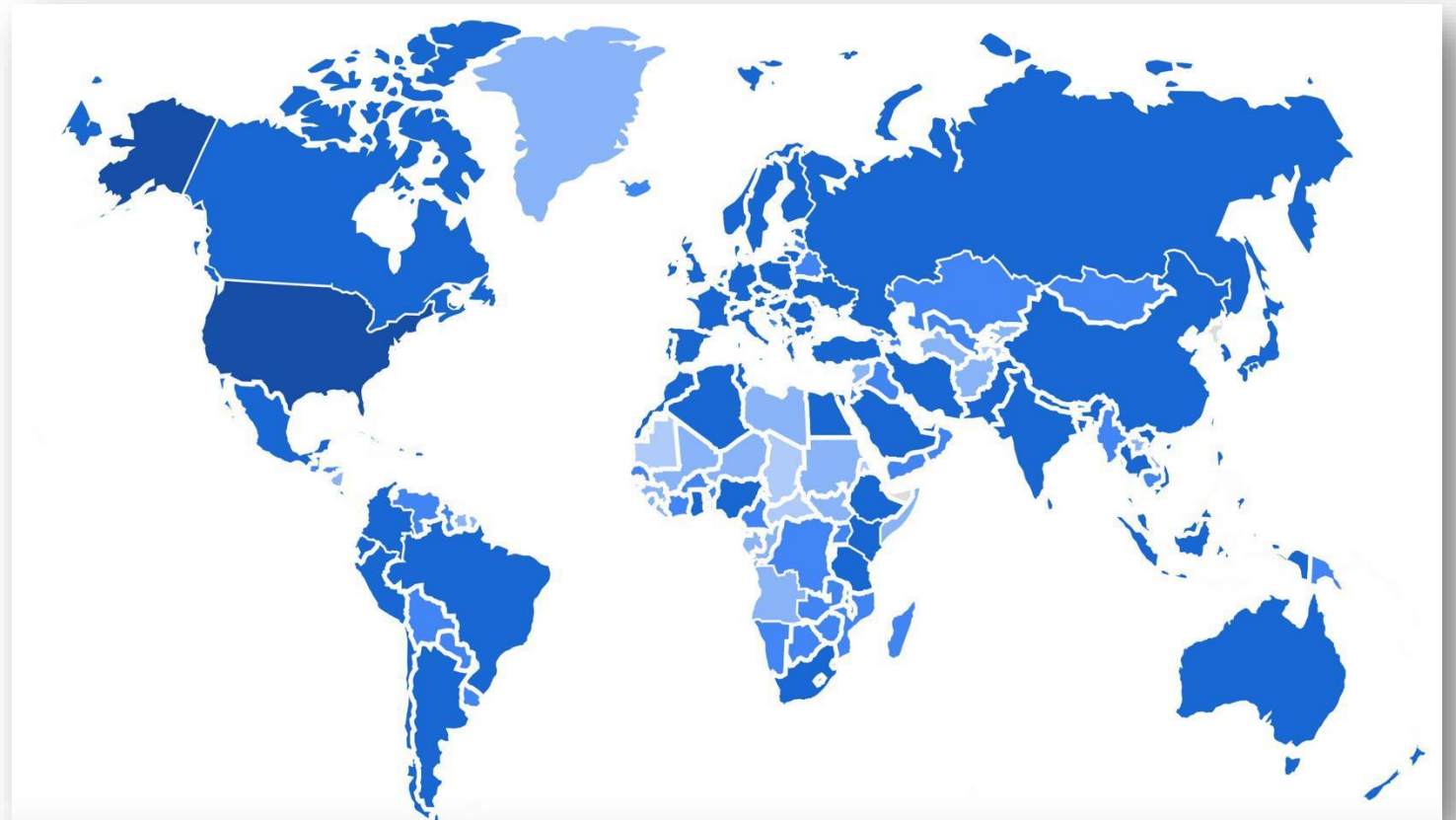
Research Infrastructure

- Research Support Services Program
 - ✓ Field sampling
 - ✓ Sensor infrastructure
 - ✓ Remote sensing
 - ✓ Mobile platform
 - ✓ NEON experts
 - ✓ Field site coordination

NEON's Global Reach

Global distribution of visitors to NEON's website

Country	% Usage
United States	44.0
India	7.0
United Kingdom	4.5
Germany	4.1
Canada	4.1
Australia	2.4
China	2.2
France	2.2
Italy	1.5
Netherlands	1.5



October 2024

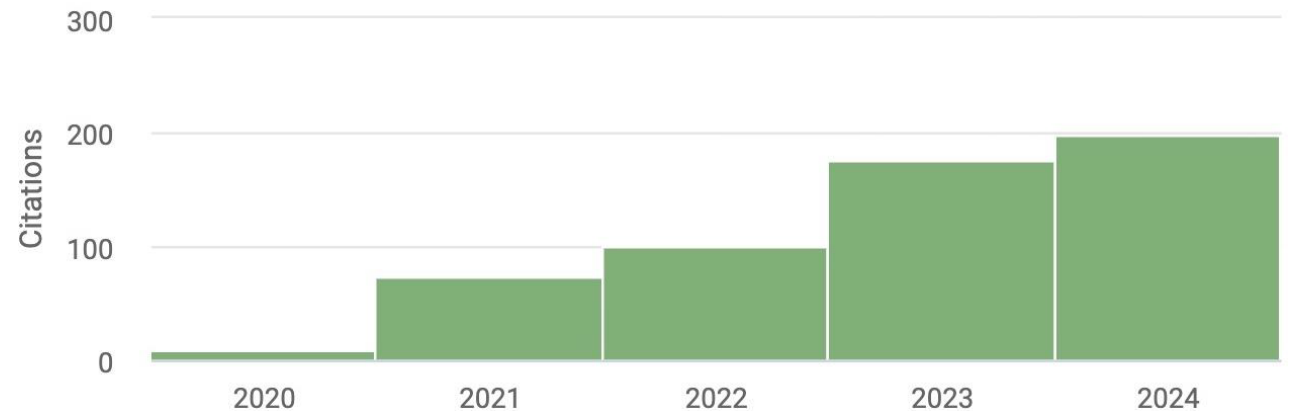
Increasing NEON impact through global collaboration - US DOE AmeriFlux and FLUXNET



- NEON data products shared with AmeriFlux and FLUXNET – discoverable and interoperable with the global data landscape
- ONEFlux (Open Network-Enabled Flux) processing codes
 - globally, collaboratively developed
 - used to deliver gap-filled NEON data products from the AmeriFlux portal

Increasing NEON impact through global collaboration - Global Biodiversity Information Facility

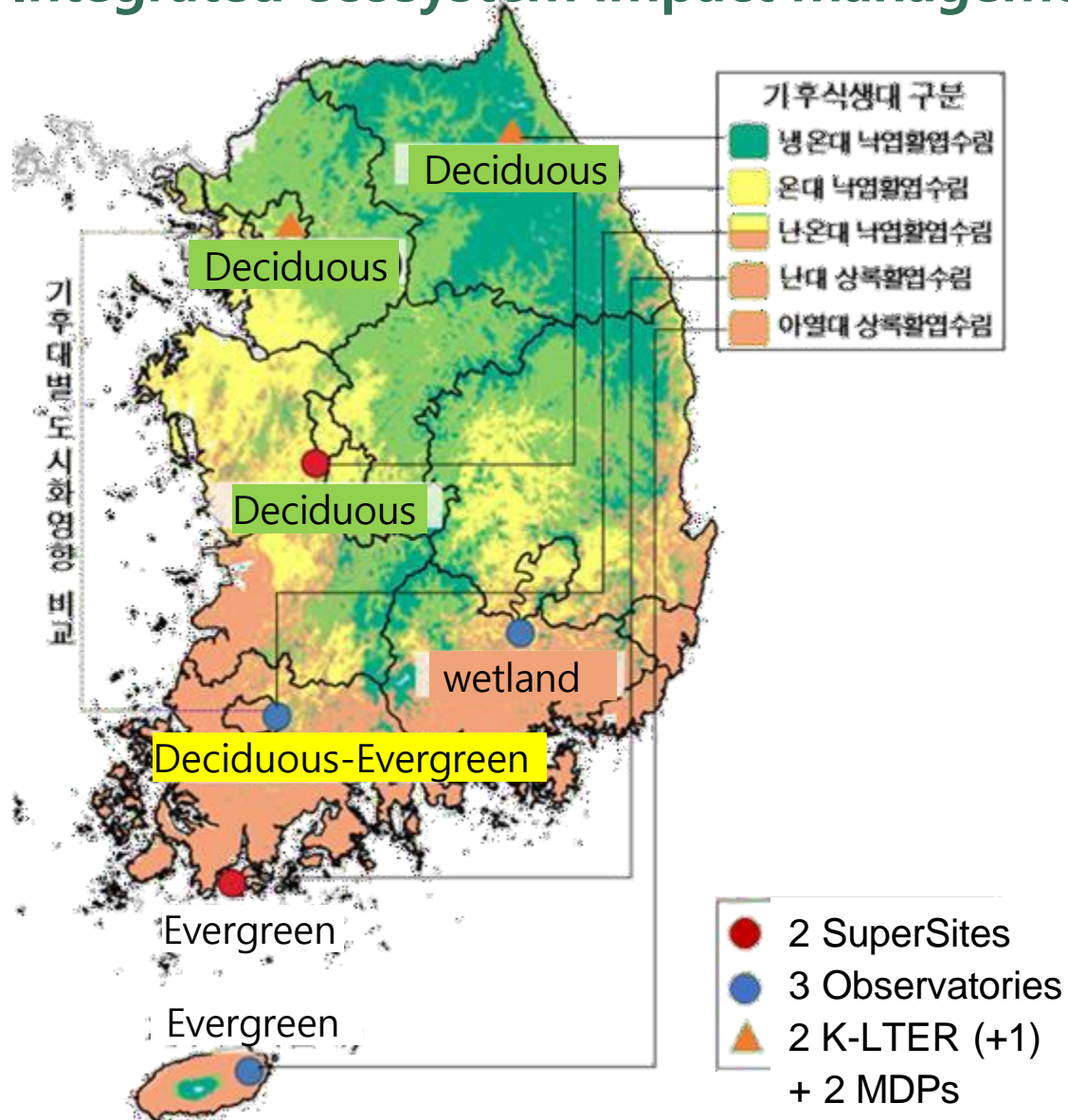
- >1M georeferenced occurrence records across 52 datasets
- ~11K georeferenced images
- 555 citations that include NEON records



Images courtesy of gbif.org

New research infrastructure for Korea – in progress

Integrated ecosystem impact management system for climate change adaptation

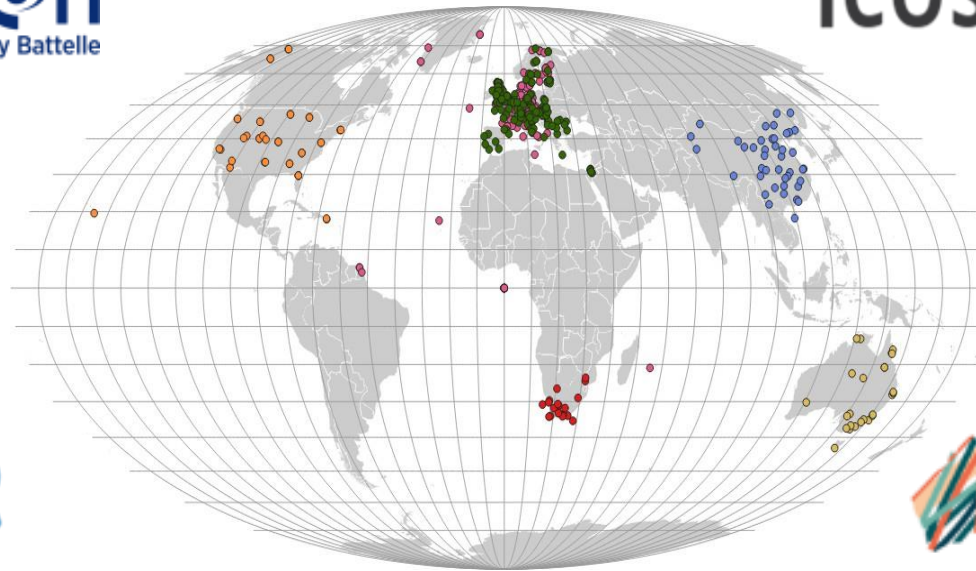


- Objective: To analyse and predict ecosystem responses and variability due to climate change, and to prepare ecosystem conservation and data-based climate adaptation measures,
- Project 1) Establish a national (international) standard ecological data collection infrastructure based on automated observation,
- Project 2) Establish a platform to integrate and analyse ecosystem and climate change monitoring information from related ministries.

Project period: 2023~2028



Collaboration Framework around Grand Challenge: Global Ecosystem Research Infrastructure (GERI)



Accelerating Research through International Network-to-Network Collaborations
(NSF 2301655): *Harmonizing Data to Address Ecological Drought*



neon
Operated by Battelle

720.746.4844 | neonscience@battelleecology.org | neonscience.org

CANADA FOUNDATION FOR INNOVATION
FONDATION CANADIENNE POUR L'INNOVATION

Ensuring success of global research infrastructure collaborations

Sylvain Charbonneau
President and CEO

December 5, 2024

INNOVATION
Canada Foundation for Innovation Fondation canadienne pour l'innovation

About us



Established in 1997 as an independent, federally funded organization.



We fund multidisciplinary research infrastructure in universities, colleges, research hospitals and non-profit organizations.



Our objectives:

- Support economic growth and job creation
- Increase Canada's capability for world-class research
- Support the development of highly qualified personnel
- Promote productive networks and collaboration among all sectors



Our 40:60 funding model injected \$25 billion into Canada's research infrastructure.



CFI-Funding Programs

Innovation Fund

John R. Evans Leaders Fund

College Fund

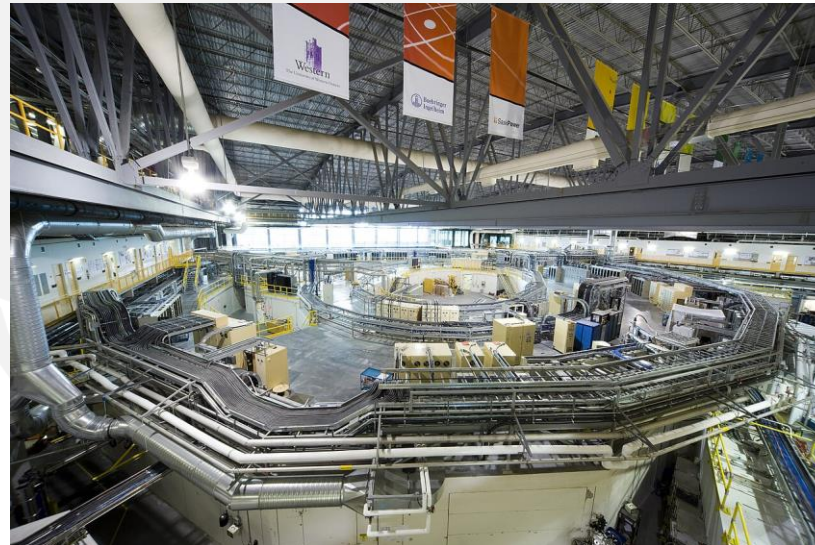
Major Science Initiatives (MSI) Fund (19 in total)

Biosciences Research Infrastructure Fund

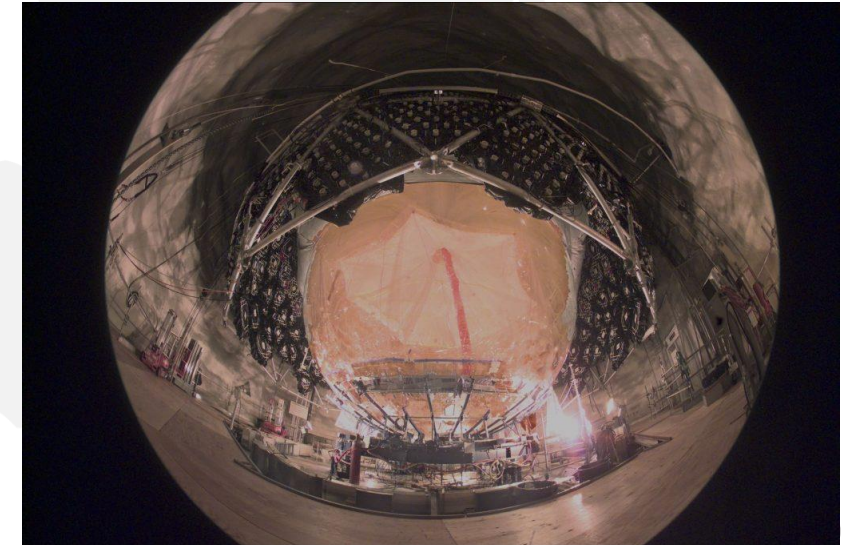
Northern Fund

- **1,524 jobs supported**
- **33,000 research outputs generated**
- **65,000 users worldwide**

CCGS Amundsen research icebreaker



Canadian Light Source



SNOLAB (Neutrino Observatory)

International engagement



CFI's international activities are shaped by:

- Legislation, contribution agreements and ministerial authorities
- Federal priorities and direction, including targeted funding

We encourage Canadian institutions to pursue international partnerships

International partnerships are admissible under our current program architecture:

- No restrictions on where infrastructure is located, but must be under the control of an institution eligible for CFI funding
- Most international projects are funded through our Innovation Fund and the Major Science Initiatives Fund



Ensuring success

Be engaged

- Estimate the resources needed to support a partnership
- Understand your legal authorities and capacity to support international programming
- Align your international activities with your mandate

Be selective

- Consider your country's foreign and trade policies
- Ensure compatibility of roles and mandates
- Seek compatibility and complementarity of research goals, practices and infrastructures
- Strive for commonalities in programming or priority science areas

Be patient

- Remember that worthwhile international partnerships take time and resources to both implement and reap benefits





Developing international research infrastructure in the social sciences

Professor Rory Fitzgerald

Director, European Social Survey ERIC

City, St George's University of London

5 December 2024

ICRI, Brisbane

europeansocialsurvey.org

ESS is a European Research Infrastructure Consortium (ESS ERIC)



European Social Survey Research Infrastructures



Four collaborating research infrastructures (RI's) generate high quality data which allow for the interconnected developments in people's lives to be better understood.

European Social Survey infrastructure: Overview

- **Academic cross-national survey**
Measuring public attitudes and behavior
- **11 rounds completed**
Every two years since 2002/03 -
in 39 participating countries
- **Face-to-face interviews R1-11**
The questionnaire lasts one-hour and
has been translated into 50 languages
- **Over 500,000 interviews completed**
Data collection by range of providers
- **All data free for non-commercial use**
Available to download from the ESS Data
Portal in a range of file formats for statistical
software programmes
- **Bottom-up initiative**
Scientists across Europe collaborated to
establish the ESS
- **ERIC status**
Awarded in 2013 providing stability and
sustainability. 28 Members
- **Over 235,000 registered users**
More than 65% students; 20,000+ active
downloaders/year
- **6,585 academic publications**
Journal articles, books, working and conference
papers that analysed our data have been
published (2003-22)

Participating countries (2002-24)

11 ROUNDS

1. Belgium
2. Finland
3. France
4. Germany
5. Hungary
6. Ireland
7. The Netherlands
8. Norway
9. Poland
10. Portugal
11. Slovenia
12. Spain
13. Sweden
14. Switzerland
15. United Kingdom

10 ROUNDS

16. Austria
17. Czechia
18. Estonia

8 ROUNDS

19. Denmark
20. Israel
21. Lithuania
22. Slovak Republic

7 ROUNDS

23. Bulgaria
24. Cyprus
25. Italy

6 ROUNDS

26. Greece
27. Iceland
28. Ukraine

5 ROUNDS

29. Croatia
30. Latvia
31. Russia

3 ROUNDS

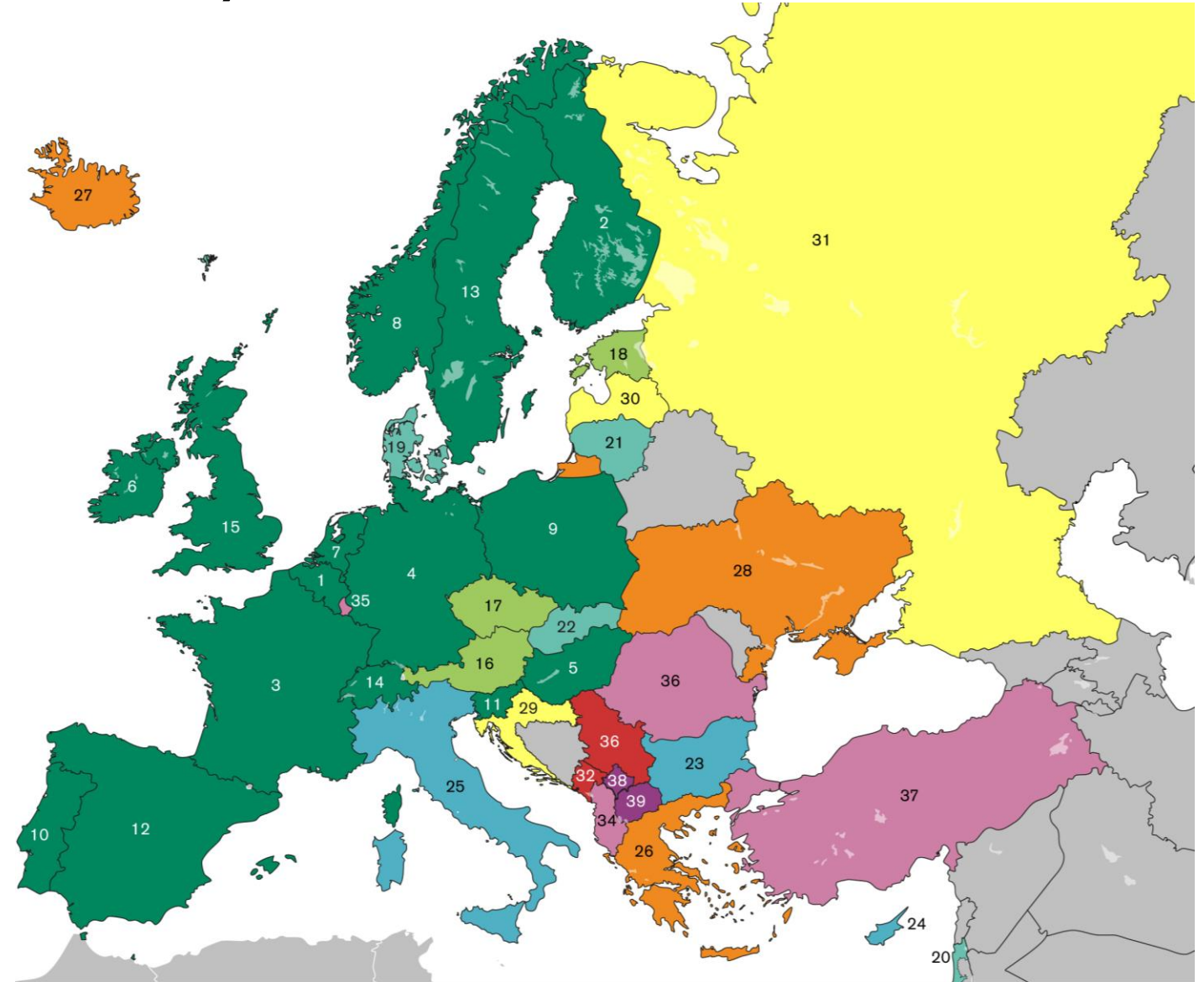
32. Montenegro
33. Serbia

2 ROUNDS

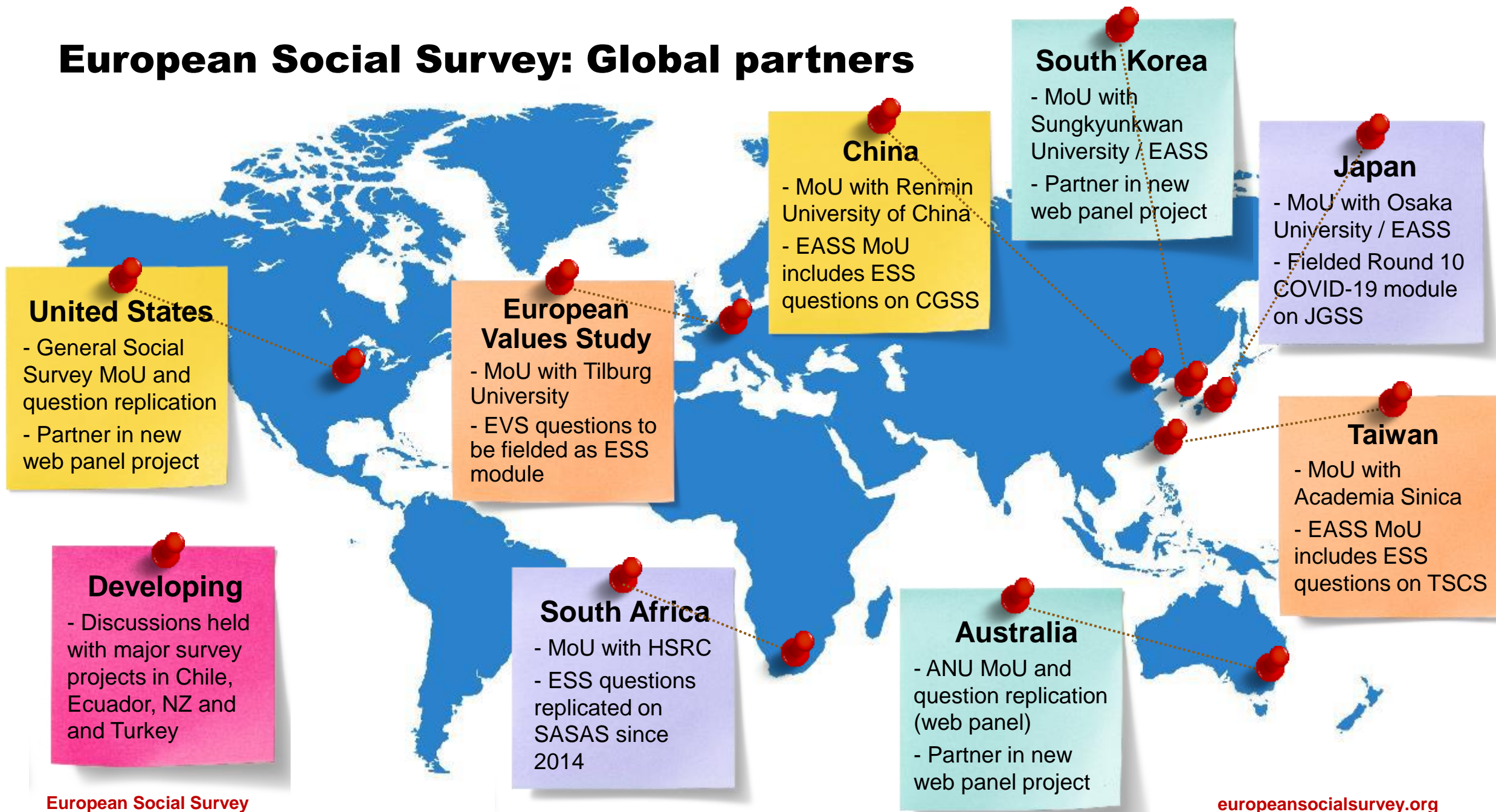
34. Albania
35. Luxembourg
36. Romania
37. Turkey

1 ROUND

38. Kosovo
39. North Macedonia



European Social Survey: Global partners



Scoping a web panel that extends beyond Europe

European Social Survey HQ

City St George's, University of London // UK



National Opinion Research Center (NORC)

At the University of Chicago // US



Social Research Centre

Australian National University // Australia



Australian National University

Survey Research Centre

At Sungkyunkwan University // South Korea



Lessons learnt

Collaboration

- Social science RI requires a collective approach
- National champions crucial
- Engage all funders continually (scientists, funders)
- Ensure constant consultation and discussion
- Be patient and listen!

Rigor

- Cross-national comparisons require rigorous methods
- Strong central coordination is essential in distributed RIs
- Transparency required at all stages crucial

Structure

- Ensure effective communication is supported
- Have clear lines of accountability
- Legal instruments like ERIC regulation create stability