The Bureau
of Meteorology

# Past, present and future of HPC at the Australian Bureau of Meteorology

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Bureau of Meteorology

- Weather, water, climate, ocean and space

- Large area coverage – Australian mainland, Tasmania, Antarctica, Indian and Pacific oceans

- Many Australians get weather information and warnings direct via our website and phone apps
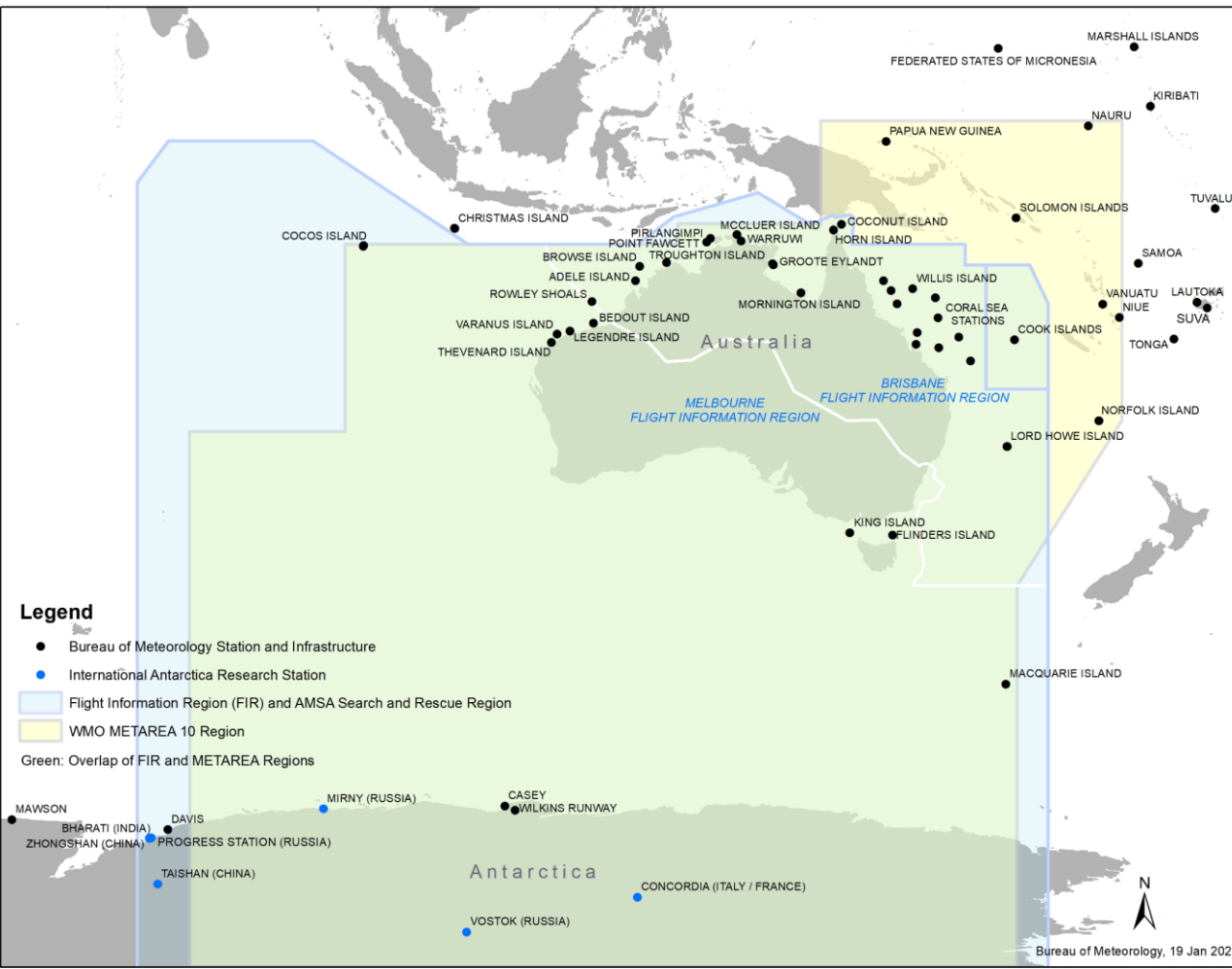
The past (since 20th ECMWF HPC workshop 2023)

- Decommissioned Australis - Cray XC40 (~2200 nodes Intel Haswell) and associated Lustre storage
  - 9 years in production
  - Consistently >99.9% per month availability for production
- Decommissioned Aurora - Cray CS400 (~40 nodes Intel Broadwell) and associated GPFS storage
- Decommissioned very old tape robot
- Exited co-located data centre

The present – Australis II

- Cray XC50 and CS500 in two-halves for high availability

- ~2000 nodes, Intel Skylake

- 4x 5 PB Lustre filesystems – two tuned for bandwidth, two tuned for smaller files
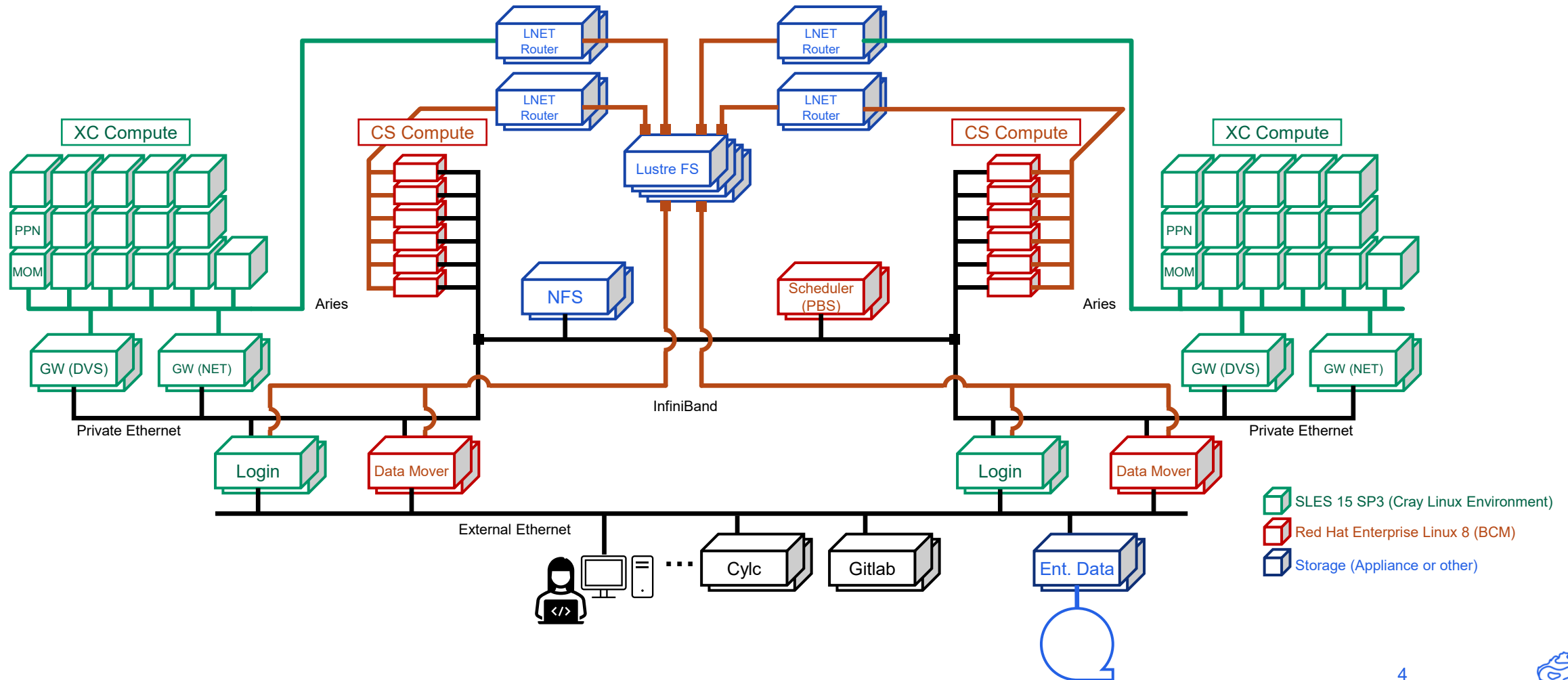
The present – Gadi

- Research, external collaboration and proof of concept work on Australia's National Computational Infrastructure (NCI) system Gadi

- Research work transitioning to operations is ported to internal Bureau of Meteorology systems

- Research data sharing with universities and partners

- ~10% share of ~5000 node HPC system

- Mix of Intel Cascade Lake, Intel Sapphire Rapids, Nvidia Volta, Nvidia Ampere

The present – Australis II surrounding infrastructure

- New datacentre "EDC" (commercial, co-located)
- New network with better security features
- Managed file transfer service
- Mobius (Gitlab CI)
- Kit (Artifactory with internal conda-forge mirror)

The present – models and applications

- ACCESS global, global ensemble, city (x7), city ensemble (x7) and seasonal – all Unified Model based

- OceanMAPS global ocean model

- AUSWAVE global wave model

- IMPROVER probabilistic multi-ensemble blend is the primary data source for public weather forecasts

- Dispersion models

- Storm Surge

- SIMPLER – abstract sources and destinations from models consuming and producing data

- Mixed workload on HPC
  - Big and small models
  - Pre and post processing
 - Production and non-production

SIMPLER
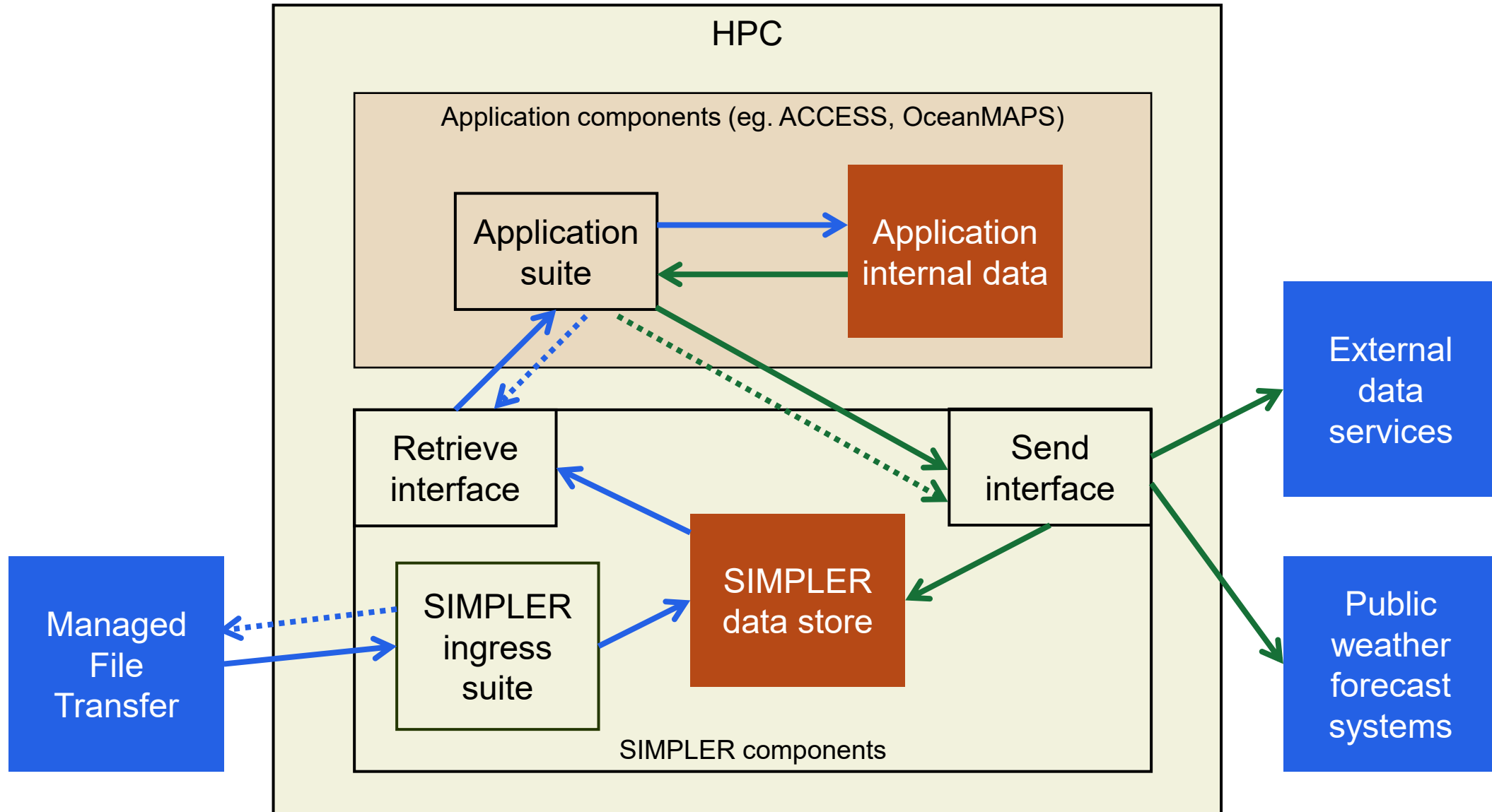
The near future - Sentinel

- Cray EX4000 in two halves for high availability
- ~900 nodes, Intel Sapphire Rapids, about double cores per node of Australis II XC50
- Similar core count to Australis II but +50% potential PFLOPs
- 2x 5PB Lustre filesystems

- Disaster recovery for production, otherwise available for research workload

The near future – Sentinel surrounding infrastructure

- Second new datacentre "FDC" (also commercial co-located)
  - Physically separated (interstate, hundreds of km) from EDC
  - Dedicated private fibre link between sites
- Dell PowerScale high reliability clustered storage for warm start and other recovery data, external to both HPC systems
- New Spectra Logic tape robot with migration of data from previous robot via Versity

Data Centre A - EDC

Data Centre B - FDC

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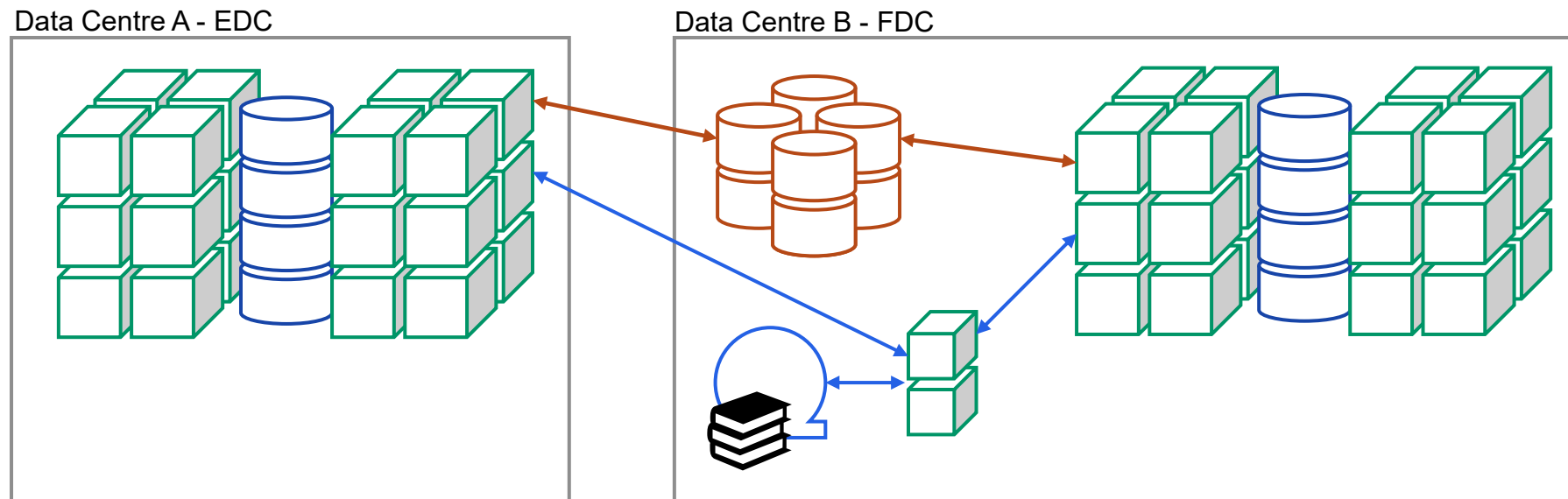
The near future – models and applications

- National Analysis System (NAS)
  - Unified Model based hourly cycling analysis, variety of observation fittings

- ACCESS-A/AE
  - Unified Model at ~2km resolution covering Australian continent and surrounds, with ensemble

- AI/ML models
  - Currently on Gadi

- SIMPLER
  - Expand role to standardise data and metadata
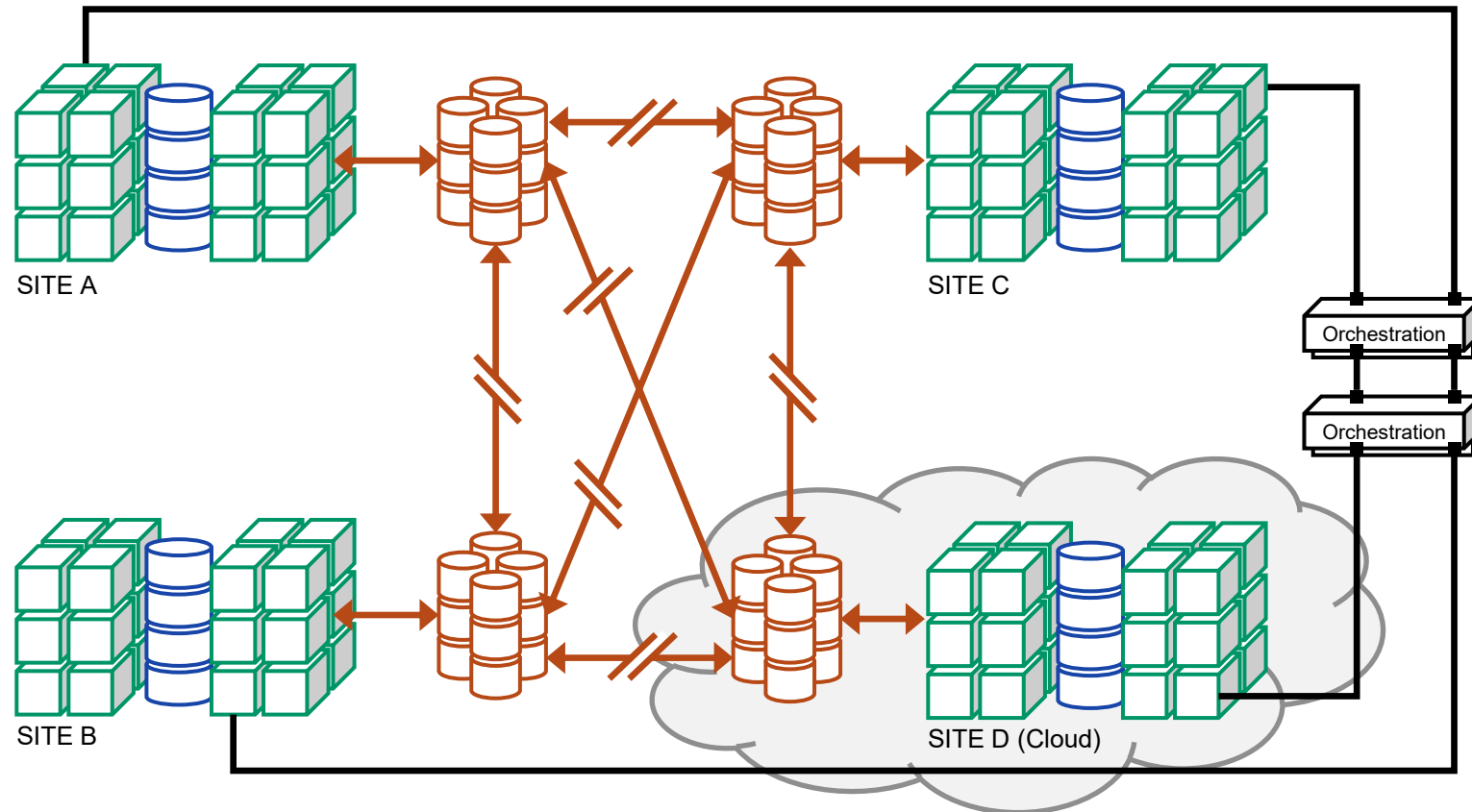
The future – HPC Plan 2025-29

Six major topics:

- Investment planning
- Model enablement
- Data management
- Support services
- Disaster recovery
- Environmental sustainability

The future

- Enterprise data fabric for sharing between HPC sites and large scale data distribution to forecast systems
- Data catalogue built on Zarr datasets

The future

- Maintaining disaster recovery capability across HPC upgrade cycle

- Expect HPC systems to be more diverse
  - Visualisation and data analysis
  - Support AI/ML models in production
  - Future role of large language models in public weather forecasts and warnings?

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Thank you