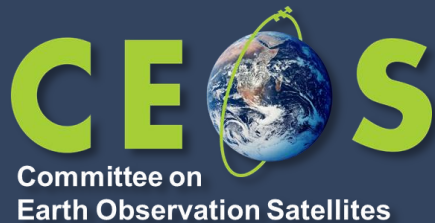


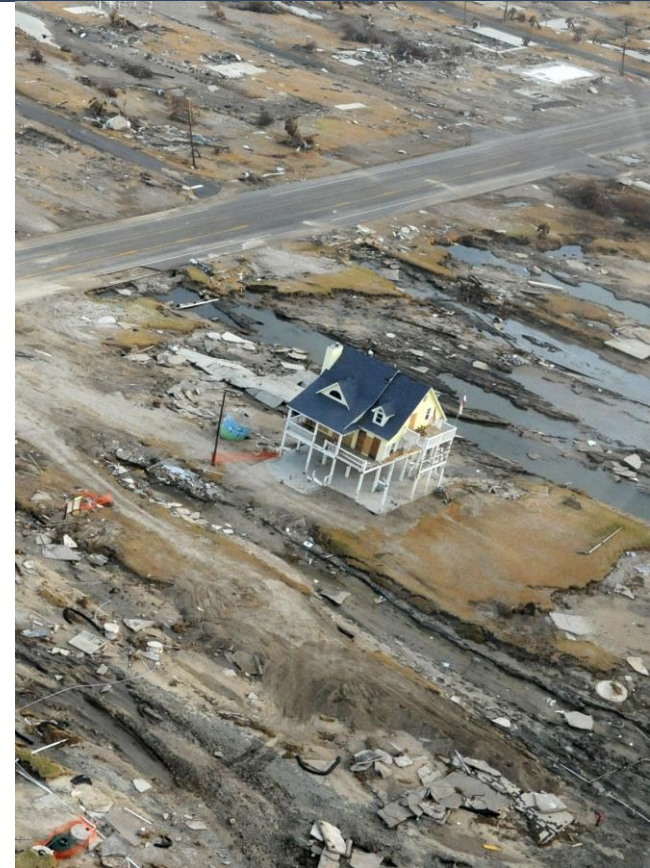
Data Resilience Discussion



Alex Leith
Data Resilience
Agenda Item 9.1
WGISS-61
16-20 March, 2026
Dehradun, India

1. Definitions
2. Components of resilience
3. Case studies
4. Conclusion

Note that there will be opportunities for interaction and discussion throughout



A definition of the word



From the Cambridge Dictionary

resilience | BUSINESS ENGLISH

resilience

noun [U]

UK  /rɪˈzɪliəns/ US  /rɪˈzɪljəns/

(also formal **resiliency**)

Add to word list 

the quality of being able to return quickly to a previous good condition after problems:

- *The **resilience** of the economy has come as a surprise to some.*

(Definition of **resilience** from the Cambridge Business English Dictionary © Cambridge University Press)

From Miriam Webster Dictionary

resilience noun

re·sil·ience ri-'zil-yən(t)s

[Synonyms of resilience >](#)

- 1** : the capability of a body to recover its size and shape after **deformation** caused especially by compressive stress
| the *resilience* of rubber
| Cold temperatures caused the material to lose *resilience*.
- 2** : an ability to recover from or adjust easily to **misfortune** or change
| The rescue workers showed remarkable *resilience* in dealing with the difficult conditions.
| Analysts pointed to consumer confidence as a sign of the economy's *resilience*.

IBM says:

Data resiliency refers to an organization's ability to recover from [data breaches](#) and other types of data loss, immediately enact business continuity plans, effectively recover lost assets and aggressively protect that organization's data moving forward.

<https://www.ibm.com/think/topics/data-resiliency>

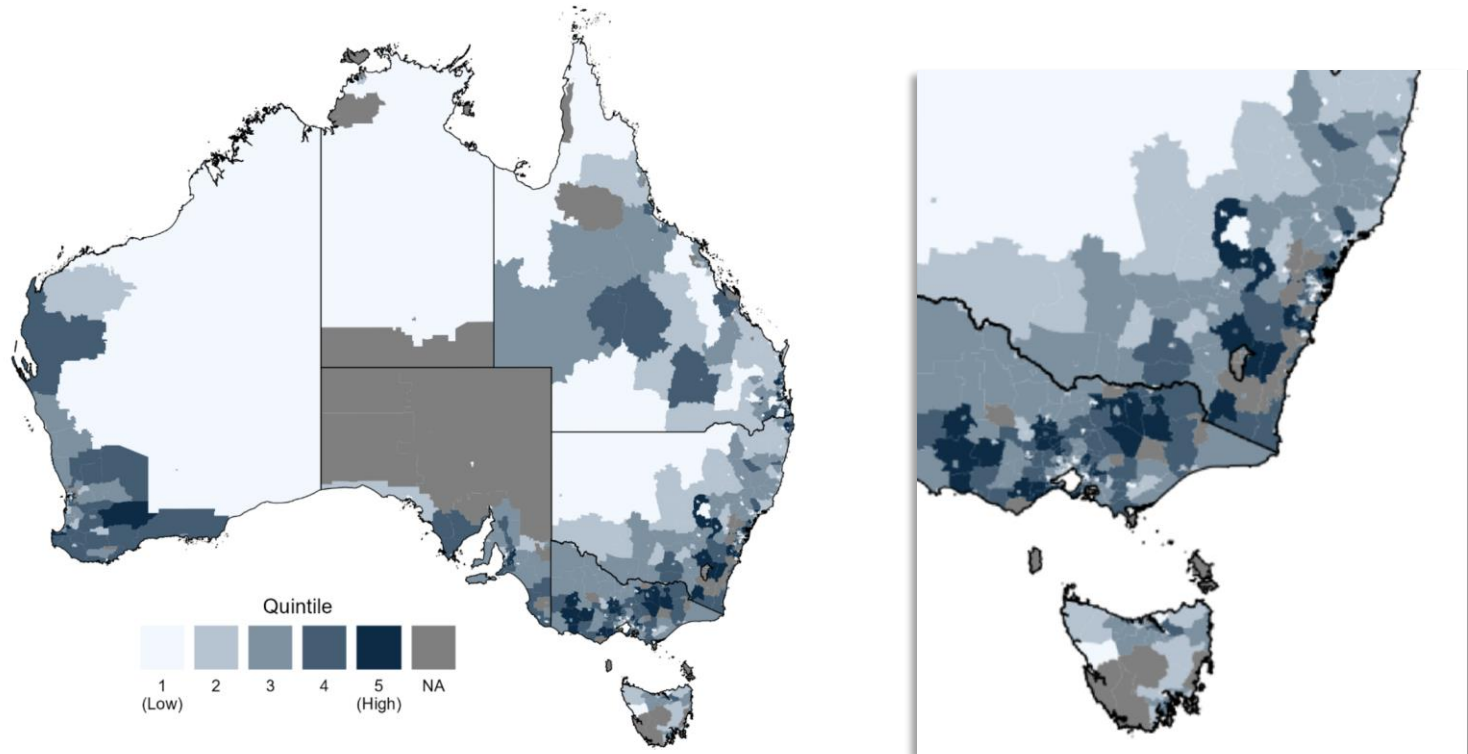
- ❖ An Australian report measured community resilience in a range of factors, below:
 - ***Social capital***: medical access, volunteering rates, English language proficiency, age structure
 - ***Human capital***: education level, developmental vulnerability
 - ***Physical capital***: Rates of home ownership, renting; density
 - ***Financial capital***: Employment-to-population ratio, low-income households, unemployment rate
- ❖ It notes that adding natural capital would be helpful

<https://treasury.gov.au/sites/default/files/2024-03/p2024-495252-02-exploring-community.pdf>

Resilience index map



Figure 4.1 Resilience index, by quintiles

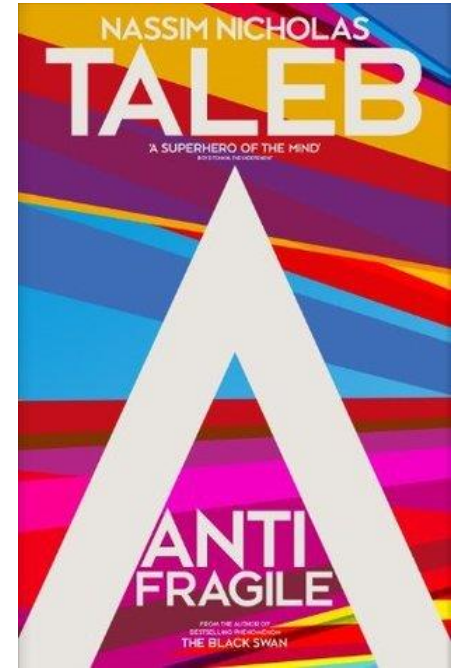


Source: Treasury analysis.

Note: Some areas are reported as NA (Not Available) due to limited data.

Nicholas Taleb, in his book, says:

Antifragility is beyond resilience or robustness. The resilient resists shocks and stays the same; the antifragile gets better.





What do we mean by resilience?

Components of resilience



- ❖ Standards and specifications
- ❖ Replication and redundancy
- ❖ Diversity with interoperability



- ❖ **Quality:** CEOS-ARD PFS
- ❖ **Policy:** ISO 19115 Geospatial Metadata, OGC Standards
- ❖ **Interface:** STAC & STAC API, Open Search
- ❖ **Architecture:** GeoJSON, Cloud Optimised Geotiff, Zarr

Most important is that they are *open specifications*, with multiple implementations, allowing for redundancy in tools

- ❖ **Redundancy:** (3-2-1, 3 backups, 2 places, 1 air-gapped)
- ❖ **Replicas:** institutional, like DLR, or private, like Google
- ❖ **Regional:** network (ingress and/or egress) costs can be high
- ❖ **Reliable:** uptime, availability, consistency, timeliness
- ❖ **Resilient:** A resilient data source underpins resilient services

- ❖ Multiple sensors means less sensitivity to failure in one
- ❖ Interoperability baseline could lead to “plug and play”
- ❖ Considering interoperability in development of decision ready data will make repeatability easier
- ❖ Small differences in data quality/or ARD processing can change results significantly
- ❖ Ensuring interoperable data at the quality level will aid in delivering resilient analyses

- ❖ NASA's SEDAC, a major Earth and social science data repository running for nearly 30 years with 300 datasets and 210,000 users, was abruptly defunded in 2025, with little notice.
- ❖ Harvard Dataverse's CAFE collection, which had independent endowment funding and was mirrored in Canada's Borealis system, providing the redundancy that government infrastructure lacked.
- ❖ Generalist repositories proved essential as a safety net, but rescuing data without domain-specific expertise risks losing critical knowledge about dataset strengths, weaknesses, and fitness for use.
- ❖ The article challenges the international data community to step up, including through anticipatory mutual support agreements, as some governments move away from open data as a public good.

<https://datascience.codata.org/articles/10.5334/dsj-2026-009>

- ❖ Jed's main point is that we lack institutions capable of consolidating and harmonising data at global scale. He says *"opening data is not enough"*.
- ❖ **Unicorns** (venture-backed data monopolies) aren't the answer to global data challenges. They're profit maximisers, so they're conflicted.
- ❖ **Show Ponies**, most public sector data platforms, look great but don't exist as part of a natural ecosystem. Often built with time-bounded funding.
- ❖ The proposed alternative is **Gazelles**, small, fast, wild, and travelling in herds. Governed by nonprofits or trusts so they can't be owned
- ❖ Real-world Gazelle examples already exist, including 2i2c (Jupyter Hubs for research communities), Common Crawl (open web data repository), First Street Foundation (climate risk data), and Radiant Earth's own Source Cooperative

<https://radiant.earth/blog/2024/01/unicorns-show-ponies-and-gazelles/>



What are other important considerations for resilience?

Case study: USGS Landsat



- ❖ You can access from USGS direct (S3, in US)
- ❖ From Microsoft Planetary Computer (Azure, in Europe)
- ❖ From Copernicus Data Space Ecosystem (CSDE in Europe)
- ❖ From many others...
- ❖ Ideally, it's possible to simply switch STAC catalogs, and your analysis will work on the other source

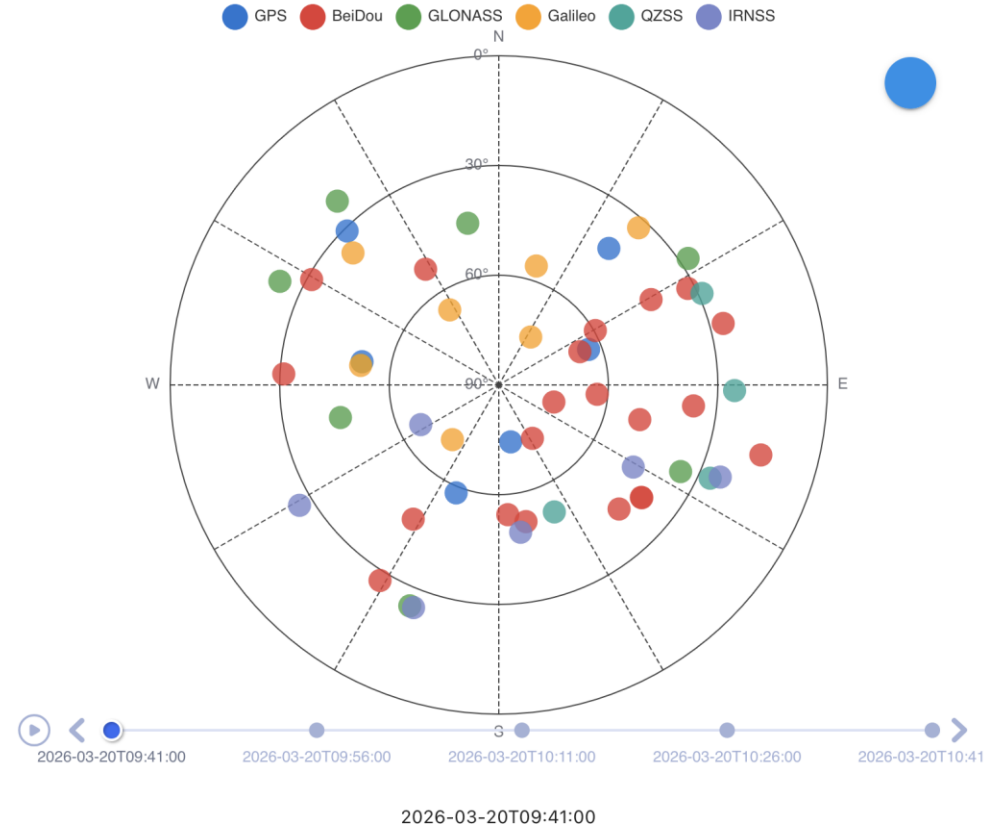
Case study: GNSS



❖ There are four operational constellations:

- GPS
- GLONASS
- Galileo
- BeiDou
- (Also IRNSS, QZSS)

❖ All can be received with your mobile phone!



CARLA SERTIN

SECURITY MAR 10, 2026 11:22 AM

GPS Attacks Near Iran Are Wreaking Havoc on Delivery and Mapping Apps

Delivery apps are glitching and navigation routes are changing abruptly thanks to electronic warfare disrupting the satellite signals that power everything from missiles to your ride home.



- ❖ WMO's Information System's GTS pre-dates the internet
- ❖ They note that migrating to the internet will provide increased resilience
- ❖ WIS 2.0 principles include simpler data exchange, open standards and cloud-ready solutions
- ❖ Shift to “publish/subscribe” method of distribution
- ❖ Global master copy of data, which all others subscribe to.

a collaborative system of systems using web architecture and open standards to provide simple, timely and seamless sharing of trusted weather, water and climate data and information through web services

<https://www.ecmwf.int/en/newsletter/176/computing/wis-20-wmo-data-sharing-21st-century>

- ❖ Resilience for geohazard supersites
- ❖ Surface reflectance quality and consistency
- ❖ Shoreline decision ready data
- ❖ Surface inundation, including multiplatform data
- ❖ Vocabularies for climate data records



Are there other existing use-cases that we should explore?



- ❖ Resilient data means that the work we do is less likely to be interrupted by changes in availability
- ❖ It means that data itself is less likely to be interrupted.
- ❖ Resilient data is supported by interoperability handbook recommendations
- ❖ We have examples from other domains around the design of resilient systems
- ❖ The interoperability demonstrators provide an opportunity to demonstrate the opportunity provided by resilient data