Towards Digital Preservation That is Environmentally Sustainable

Eric Chin, General Counsel & Chief Sustainability Officer
National Archives, National Library and Public Libraries, Singapore

On the one hand, climate change is a threat to digital preservation.

Disruption and content loss from climate-change induced fires, floods, energy shortages, civil unrest, cuts in preservation budgets, and about every other disaster scenario you can imagine!

On the other hand, digital preservation is also contributor to that climate change.

Digital preservation uses compute and storage servers. These *servers consume energy* and they *have an embodied carbon footprint*, and they need *(climate controlled) buildings and infrastructure* to house them, which also have a climate cost.

Matthew Addis, Chief Technology Officer at Arkivum
https://www.dpconline.org/blog/blog-matthew-addis-ipres23

Climate Change X Archives

Over **50 speakers** *shared on the following perspectives:*
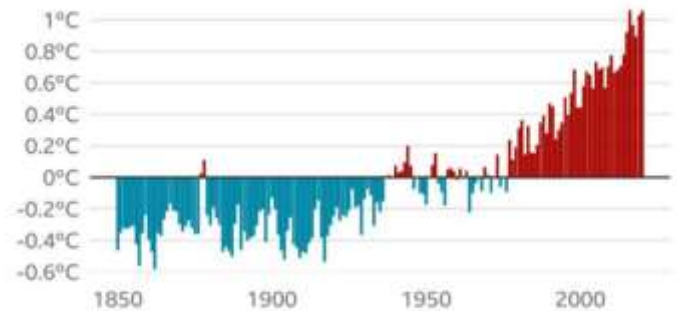

1.Impact of climate change on archives

2. Impact of archiving on climate change

3. Archiving the impact and supporting research

Impact of climate change on archives

Lorraine Finch Director LFCP, UK

The world is getting warmer
Annual mean land and ocean temperature above or below average, 1850 to 2020

Note: Average calculated from 1951 to 1980 data
Source: University of California Berkeley
BBC

World breaches key 1.5C warming mark for record number of days

COP28

By Matt McGrath, Mark Poynting, Becky Dale & Jana Tauschinski

The United Nation's Intergovernmental Panel on Climate Change (**IPCC**) released the latest agreed science accepted by 195 countries on 23 March 2023. The summary of the first finding in the report:

A.1 Human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming… https://report.ipcc.ch/ar6syr/pdf/IPCC_AR6_SYR_SPM.pdf

Impact of climate change on archives

Saw Nan Nwe, Deputy Director General, National Archives of Myanmar

Learnings from Cyclonic Storm Nargis in 2008

Public records were lost in Yangon, Pegu, Mon and Kayin.

Dr Heather Brown, Asst Dir Artlab Australia

"small events" exacerbated by climate change (e.g. mould and pests).

Impact of climate change on archives

Elena Gonnelli, PhD Student, University of Florence Italy and Lorenzo Sergi, PhD Student, University of Cagliari, Italy

During the 1966 flood of Florence, over 6 km of shelving and documents dating back to 3rd century were flooded in the Florence State Archives.

Disaster recovery work still continues until today! Problem of mould, mud sediments and other substances persist.
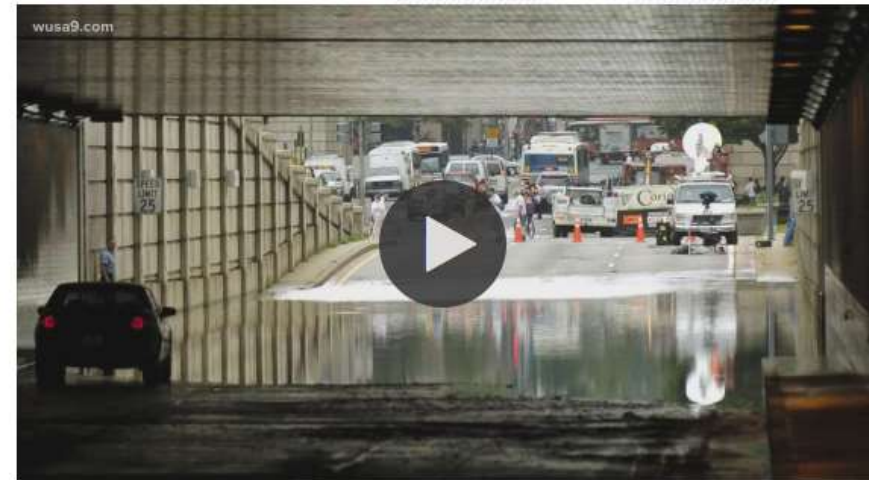
Impact of climate change on archives

In the United States, one way to consider the rate of change is to count the number of climate disaster events with losses exceeding US$1 billion The annual average from 1980 - 2022 was 8.1 events but the annual average from 2018 - 2022 is at 18. https://www.ncei.noaa.gov/access/billions/

Smithsonian says its treasures are threatened by floods, storms, and climate change – as Congress hears more alarms

Two of the Smithsonian's structures most at risk are the National Museum of American History and the National Museum of Natural History.

Author: Mike Valerio
Published: 9:01 PM EST December 15, 2021
Updated: 11:27 PM EST December 15, 2021

Impact of climate change on (especially South East Asia)

Prof. Benjamin P. Horton, Director, Earth Observatory of Singapore, Nanyang Technological University

By the *end of this century*, 1 billion people may be inundated by rising seas. 70% of them are on this map.

Humankind and our behaviour on releasing green house gases has set the wheels in motion. The rise will be 30 % higher in South-East Asia compared to the global average of about 1.3m.
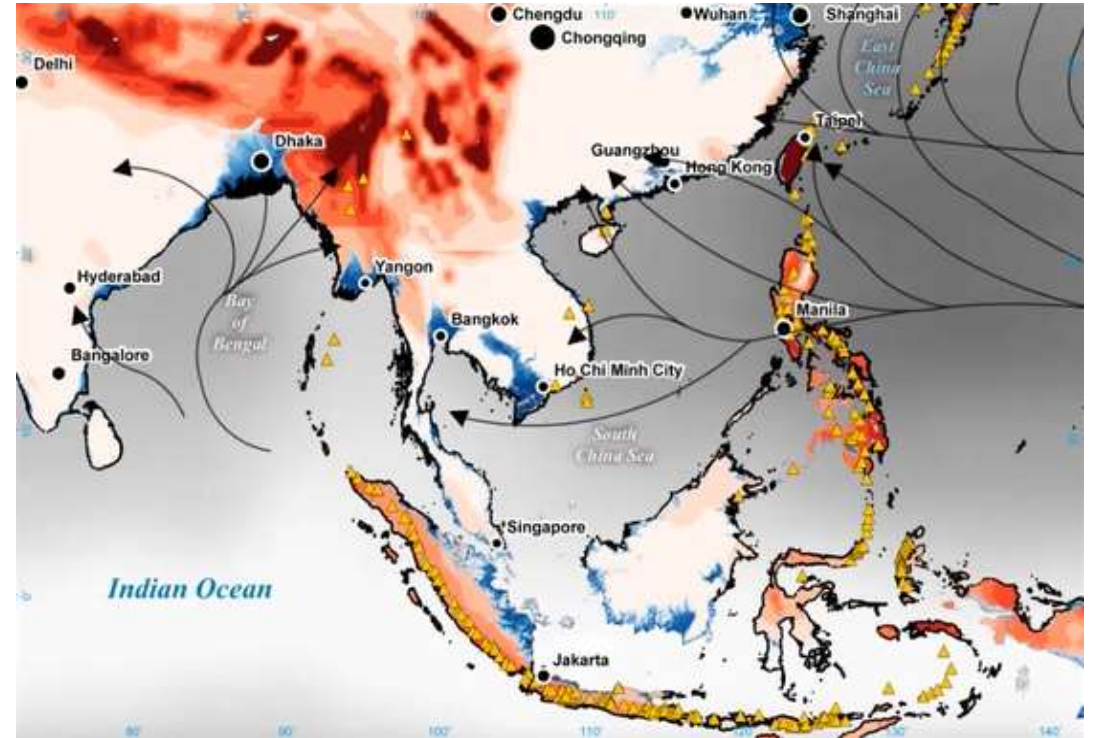
Impact of climate change and digitisation

Indah Novita Sari, Lecturer, Archives and Records Program Study Universitas Gadjah Mada, Indonesia; Titi Susanti, Lecturer, Universitas Gadjah Mada and Rina Rakhmawati, Lecturer, Universitas Gadjah Mada

Digitisation of family records for rural Punukan village in Yogyakarta to preserve family records in advance of anticipated disaster

UNIVERSITAS GADJAH MADA

Extreme Climate Change in 2022

Anomali dan Suhu Udara Rata-rata Indonesia Bulan Agustus (87 Stasiun Pengamatan)

Sources: Meteorology, Climatology, and Geophysical Agency (2022)

Digitization of family records by Archives and Records Program Study UGM

Impact of climate change and born digital records

Mary Grace P Golfo-Barcelona, Assistant Professor, University of the Philippines School of Library and Information Studies

Ifagaos rice terraces declared a UNESCO world natural heritage but is in the endangered list.

Need to urgently archive cultural heritage (rituals, dances, chants, incantations, traditional objects, costumes and oral traditions)

Data everywhere but how much is ROT

It is estimated that 175 Zettabytes* of digital data

will be created in 2025

*One **ZettaByte** (ZB)

= one thousand million TeraBytes (TB)
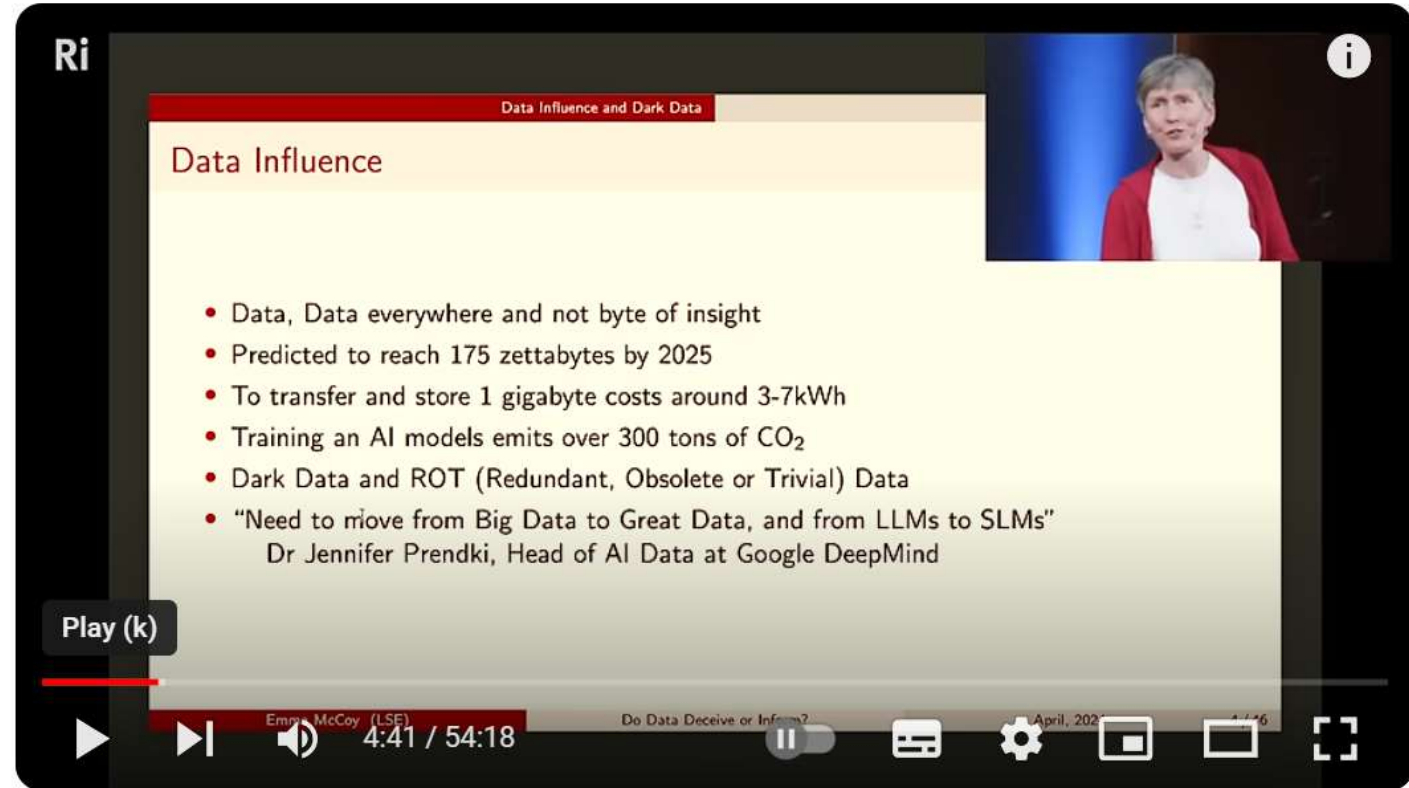
How data deceives and informs us - with Emma McCoy

Emma Mc Coy Vice-President and Pro-Vice Chancello (Education) LSE
https://www.youtube.com/watch?v=J3atpFVRL0k

Slide content shown in video:

Data Influence

- Data, Data everywhere and not byte of insight
- Predicted to reach 175 zettabytes by 2025
- To transfer and store 1 gigabyte costs around 3-7kWh
- Training an AI models emits over 300 tons of CO_2
- Dark Data and ROT (Redundant, Obsolete or Trivial) Data
- "Need to move from Big Data to Great Data, and from LLMs to SLMs"
  Dr Jennifer Prendki, Head of AI Data at Google DeepMind

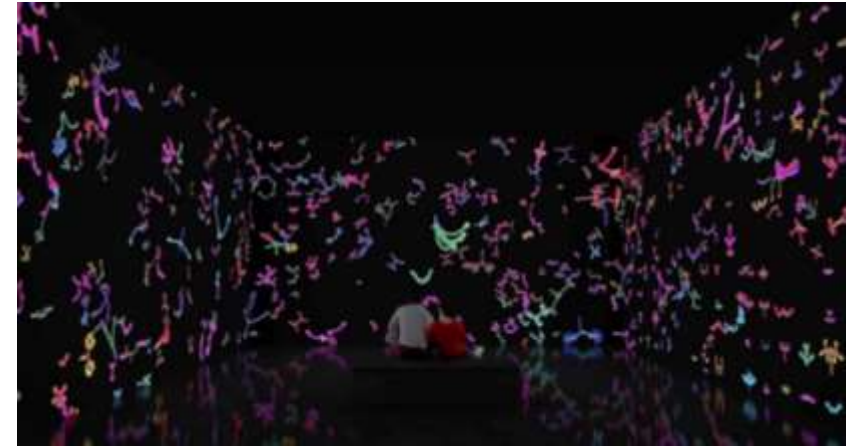# R$_2$OT = Rubbish, Redundant, Obsolete & Trivial

e.g. Deepfake video discussing investment opportunities

What exactly is ROT and who decides

Dr Eugenia S. Kim Artist/Researcher,HK

If the carbon footprint of making content accessible is very high is it worth preserving the content?

Dr Annet Dekker, Assistant Professor Archival and Information Studies, University of Amsterdam, Netherlands

Challenges in preserving digital arts.
The idea of save everything may have become outdated.

Digital preservation and climate change

Jan Zastrow, Archivist Independent Consultant

"The myth of sustainable digital preservation", which relies on cloud storage server farms.

Commentary: Where do data centres fit into Singapore's vision of green growth?

Though Singapore will be selective about building new data centres due to environmental concerns, we still need them when we are producing more data than ever before, says a business observer.

Kent Chow

23 Mar 2022 06:06AM

David Gairetta (Gairetta Associates), Teo Redondo, Libnova & Ahmed Asim, National Archives of Maldives

Using Cloud - major providers moving to using renewable energy but recycling of equipment is not efficient at the moment

Dashboard to monitor & predict GHG implications of preservation activities

Digital preservation and climate change

Linda Tadic, CEO Digital Bedrock, USA

Mitigate the high carbon emissions from digital preservation through:

Appraisal policy – what do we really need to keep? (the good and bad in centralised digital repositories)

File resolution (number of formats)

Tiered storage policy based on how often access is needed – online to offline

Reduce frequency of fixity tests

Hardware that is energy efficient

Repair and upgrade rather than buy new

Proper disposal of e-waste

Clean(er) energy data centres (Power Usage Effectiveness)
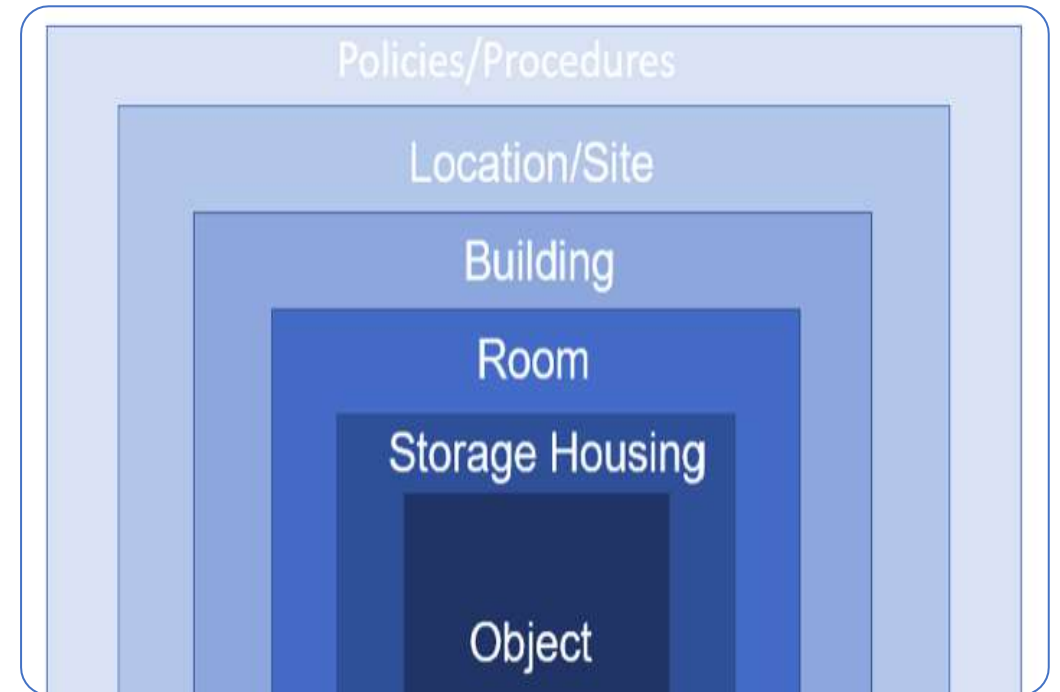
Digital preservation and climate change

Kelly McCauley Krish, Senior Preventive Conservator, National Museum Cardiff, UK

Optimal environment:

One that achieves the best possible preservation of collections with the least possible consumption of energy

https://www.straitstimes.com/tech/tech-news/google-s-latest-data-centre-raises-its-investment-in-singapore-to-676-billion

"The average temperature in our data centres is about 27 deg C."

Digital preservation and climate change

iPRES 2023: The 19th International Conference
on Digital Preservation, Champaign-Urbana, IL, US.

CALCULATING THE CARBON FOOTPRINT
OF DIGITAL PRESERVATION
A Case Study

Mikko Tiainen
Juha Lehtonen
Heikki Helin
Johan Kylander

CSC – IT Center for Science
Finland

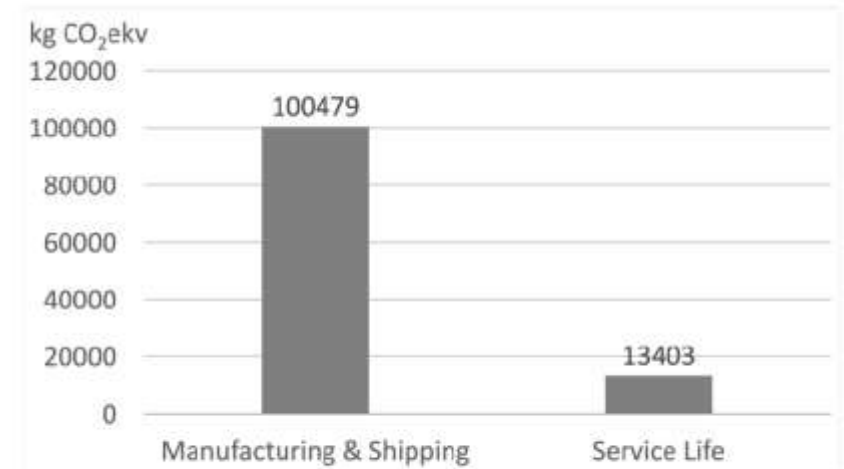| Component	Annual carbon footprint kg CO_2ekv
Ingest	3520
Spinning disk storage	9460
Magnetic tape storage (LTO-8)	4532
Magnetic tape storage (LTO-9)	3092
Dark Archive	273
Human resources	292
Total annual carbon footprint	**21169**

Figure 3. Manufacturing and shipping create a large carbon footprint compared to the service life.

Digital preservation and climate change

Dr Koh Tieh Yong, Associate Professor, School of Science and Technology, Singapore University of Social Sciences

A clear audit on the carbon footprint of archival methods is important …

- Conversion from physical to electronic archives
  - For all the advantages mentioned
  - E.g. old weather charts

- Conversion from electronic to physical archives
  - "Un-digitalise": reduce carbon footprint!

(The mighty microfilm?)

Digital preservation and climate change

Hilary Jenkinson

That an archivist's primary duty is the physical and moral defence of the records in his or her care.

Amy Cawood, Group Secretary, Archives and Records Association (UK and Ireland)

In the ARA Code of Ethics:
'Insofar as it is within their power to do so, members [of the ARA] should minimise the adverse effects of their work on the environment'.

AI and climate change

Forget the Magnificent Seven. These AI plays are red hot

A Google search requires 0.3 watt-hours of electricity on average, while a ChatGPT request typically consumes about 2.9 watt-hours, according to the International Energy Agency. Factoring in that there are about 9 billion searches a day, nearly 10 terawatt-hours of additional electricity a year would be required if search engines fully implement AI. The agency predicts AI-related electricity demand will increase at least tenfold by 2026.

AI and climate change

(Please do not misquote me because of the previous slide)

I emphasis that there is definitely a place and need for AI

e.g. from intense data computational analysis to derive deep insights that would take a human years of reading and trying to piece hard to see linkages together

to

simply pulling out key data sets from digital records

However, rushing to use AI on all platforms, tools and products is questionable.

2021-22 Performance

Indicator	GGC target 2021-25	Our target 2021-22	Our target baseline year	Change against the new baseline 2017-18 for 2021-22	Change compared with 2020-21 (+/-%)
Greenhouse gas emissions (kgCO$_2$e)	-58%	-65%	2017-18	-40%	+9%
Operational waste	Less than 5% waste to landfill	Zero waste to landfill	2017-18	0%	0%
	Reduce overall waste generated by 15%	-30%*	2017-18	-37%	
	Increase recycling rate to at least 70% overall waste	Increase recycling rate	2017-18	-15%	
Paper	-50%	-50%	2017-18	-78%	
Water	Reduce water consumption by at least 8%	-25%	2017-18	-35%	
Domestic flights taken	-30%	-30%	2017-18	-97%	

* We have set its own target for waste reduction beyond the previous 25% GG
2009-10 baseline, to aspire towards 30% reduction in waste generated.

** Calculation is not possible as the increase is from 0.

Indicator	2021-22	2021-22 per FTE employee^	2020-21	2020-21 per FTE employee^
Greenhouse gas emissions – Scopes 1-3 (tCO$_2$e)	1,672	3.05	1,637	3.2
Energy used (MWh)	7,835	14.2	6,940	13.7
Waste produced* (tonnes)	68	0.12	21	0.04
Water used (m3)	12,272	22.2	15,486	30.5
Domestic flights taken (kg/CO$_2$e)	187	0.33	0	0
International flights distance travelled (miles)	2,381	0.43	0	0

* Excludes one-off construction and refurbishment projects waste, to enable meaningful comparison.

^ Average FTE throughout financial year 2021-22.

[The National Archives' Annual Report 2021-2022](#)

International Council on Archives
Climate Change Working Group

How archives can develop strategies to achieve better environmental sustainability

How climate change affects archives and what can be done to prepare for this

How the environmental impact of archival operations can be reduced

How archives document climate change and enable research to understand and mitigate it

eric_chin@nlb.gov.sg

The views expressed in this presentation are my own and may not reflect the position of my parent organisation.