

A vision and strategy to revamp Earth System Modelling (ESM) workflows at DKRZ

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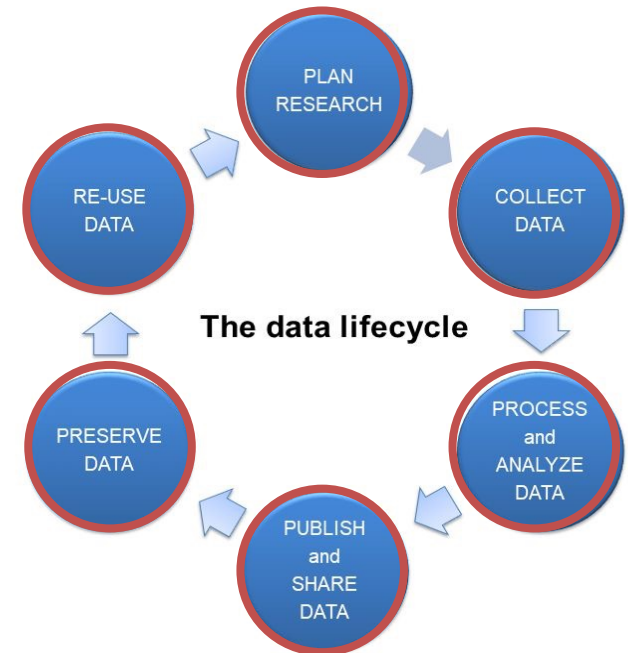
DKRZ

<https://www.dkrz.de/en/>

- DKRZ is a **topical IT-infrastructure provider** for Earth System Science (ESS)
 - 16.8 PFLOP HPC (CPU/GPU), 130PB disk
 - 300PB tape archive
- **Services tailored to the needs of ESS-researchers**
 - Model optimisation, web-based analysis, visualisation support, ...
 - Data management with FAIR in mind



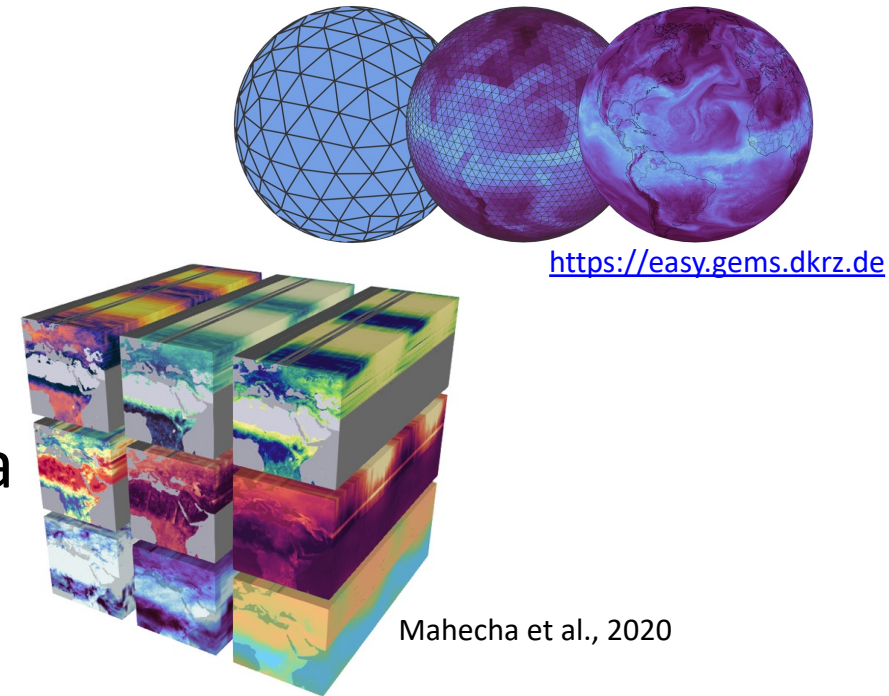
DKRZ building in Hamburg



With the (pre)-Exascale era approaching, future-proof ESS workflows have to be conceived and developed

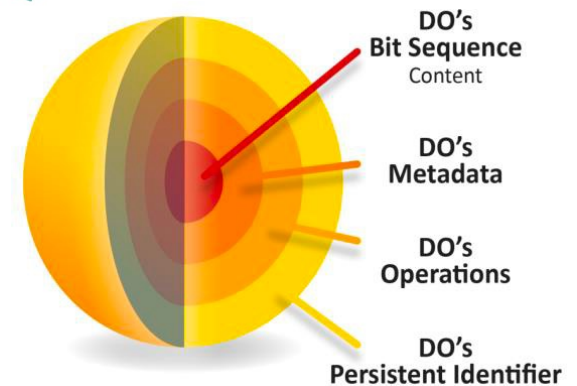
Components: the back end

- **HPC**
 - Performance of high-volume ESM simulations
 - High-performance data analytics
- **Multitude of storage types**
 - Local storage (disk, tape) cloud, federated data systems
 - Metadata-driven search and access
- **Provenance tracking and PID registration**
 - FAIR Digital Objects (FDOs) become reality



<https://easy.gems.dkrz.de>

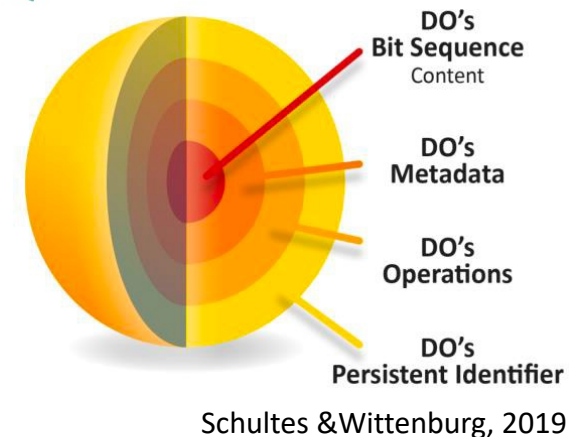
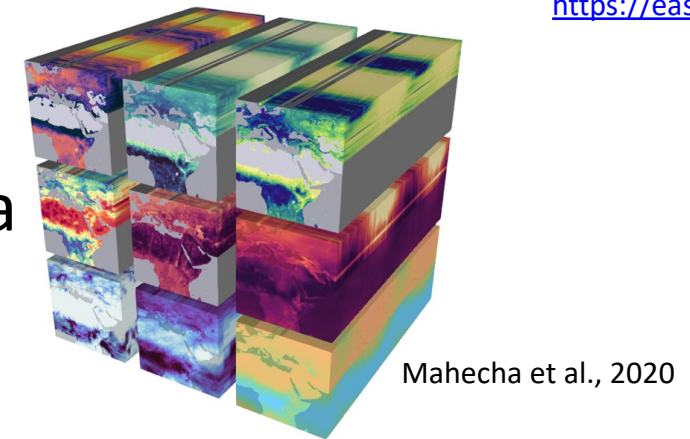
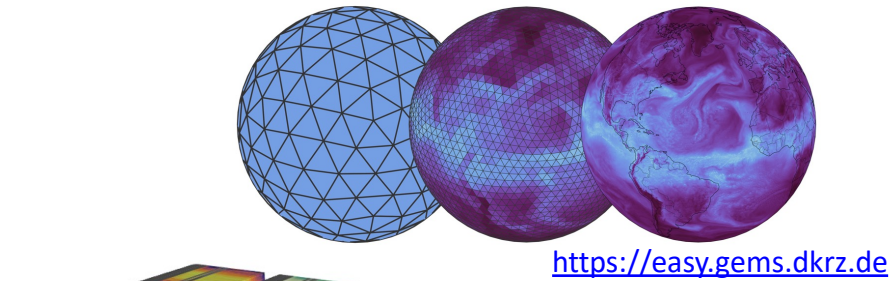
Mahecha et al., 2020



Schultes & Wittenburg, 2019

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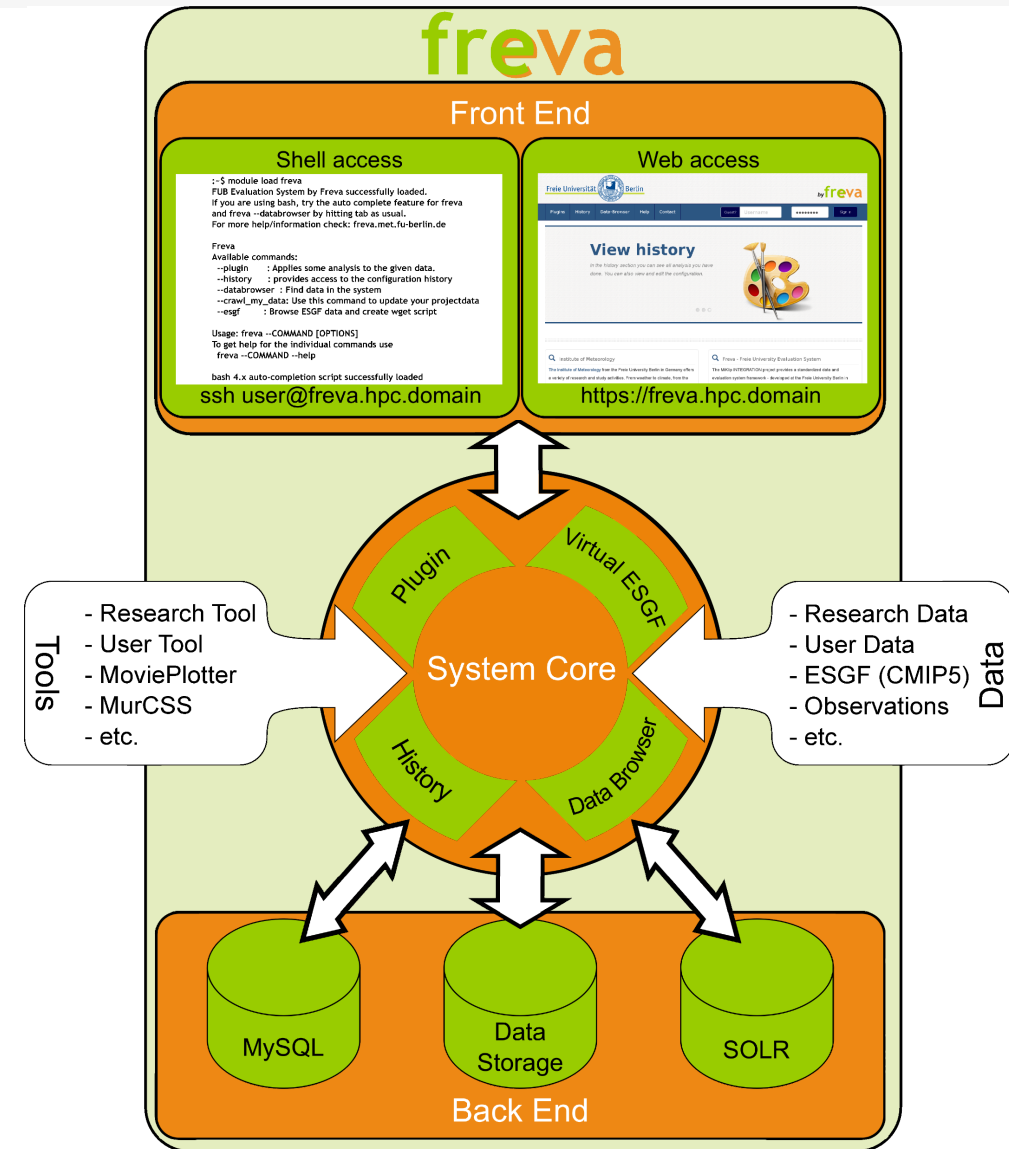
Having all this working together needs orchestration

Components: the front-end and orchestration

freva

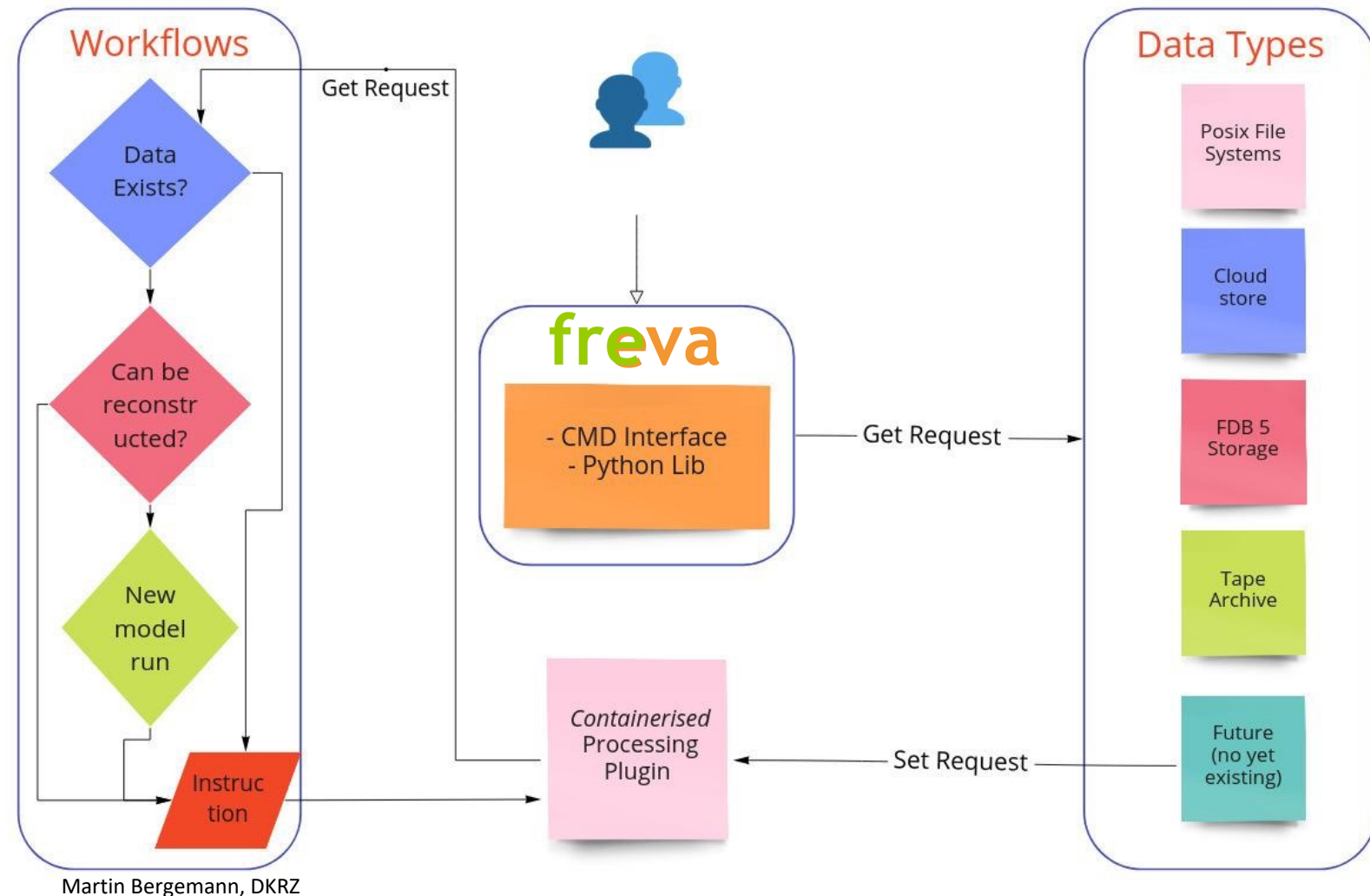
*Software infrastructure for standardized **data and tool** solutions in Earth system science. Freva runs on **high performance computers** to handle **customizable** evaluation systems of research projects, institutes or universities.*

See [Kadow et al. \(2021\)](#) or [DKRZ Documentation](#) for more details



Components: the front-end and orchestration

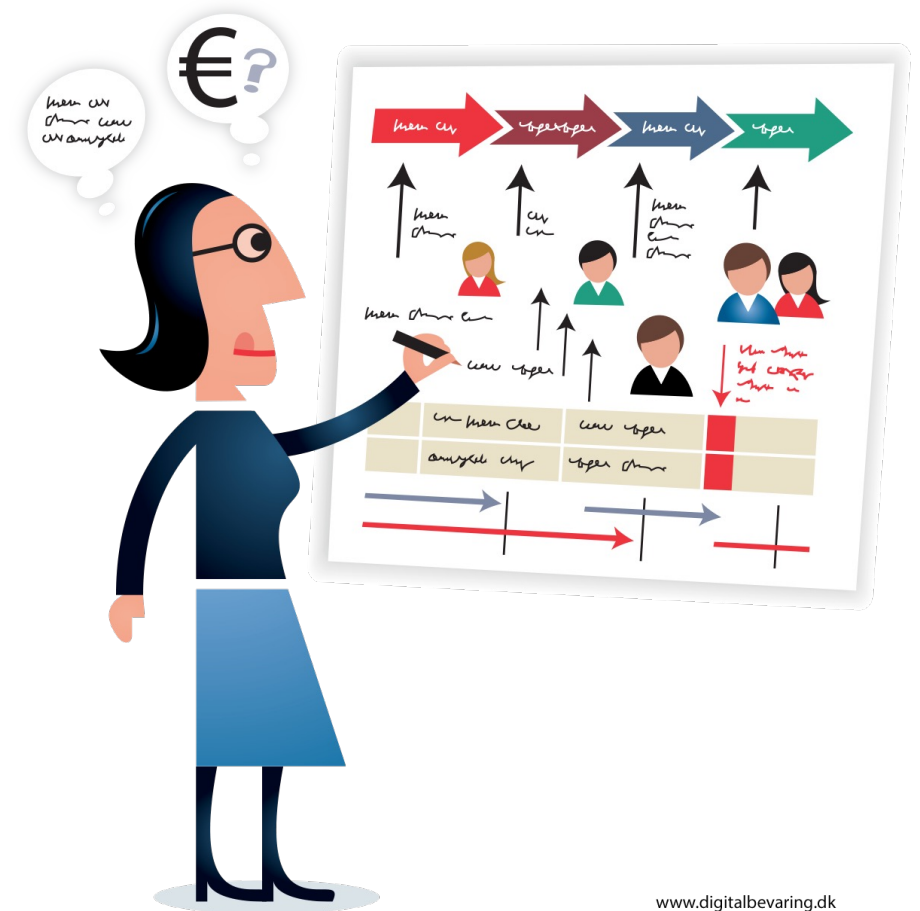
ESM workflow orchestrated by freva@DKRZ



- **Future developments / extensions will include automated model execution and intelligent data enquiries**
- Provenance documentation already included in freva
 - FAIR digital objects ([FDOs](#)) at the push of a button become reality

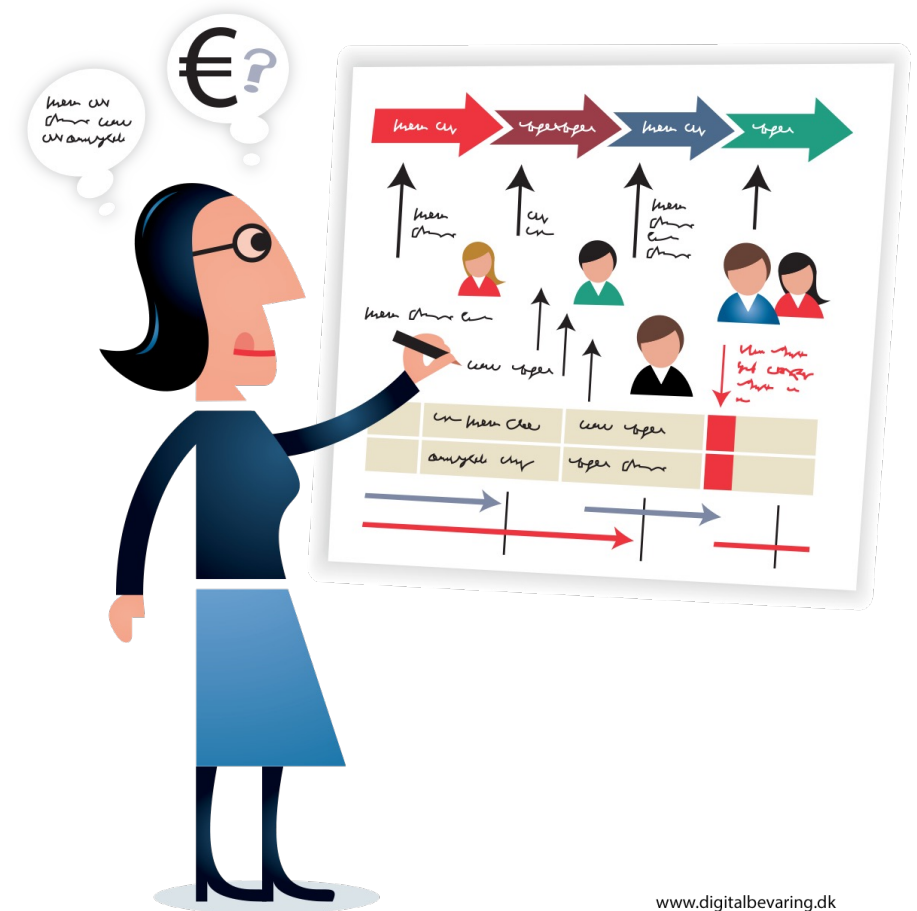
Message2Go

- ESM research in the (pre)-Exascale era needs new approaches to handle the data challenge
- DKRZ develops user-friendly and efficient ESM data workflows in close collaboration with expert scientists and model developers
- Substantial resources are required to make it work... 💰 💰 💰



Message2Go

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Thanks!

References

- **Mahecha, M. D., et al.:** Earth system data cubes unravel global multivariate dynamics, *Earth Syst. Dynam.*, 11, 201–234, <https://doi.org/10.5194/esd-11-201-2020>, 2020.
- **Schultes, E., Wittenburg, P.** (2019). FAIR Principles and Digital Objects: Accelerating Convergence on a Data Infrastructure. In: Manolopoulos, Y., Stupnikov, S. (eds) *Data Analytics and Management in Data Intensive Domains. DAMDID/RCDL 2018. Communications in Computer and Information Science*, vol 1003. Springer, Cham. https://doi.org/10.1007/978-3-030-23584-0_1
- **Kadow, C., et al.,** 2021. Introduction to Freva – A Free Evaluation System Framework for Earth System Modeling. *Journal of Open Research Software*, 9(1), p.13.
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- <https://fairdo.org>