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IMAGING

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Making marine image data FAIR

Images are indispensable in scientific research, serving as core evidence across disciplines such as biology, materials science, medicine, and environmental monitoring. Yet, despite their centrality, image data often remain locked in proprietary formats, stored without sufficient metadata, and isolated from the broader data ecosystem. This severely limits their long-term value, reproducibility, and potential for reuse. The emerging concept of Image FAIR Digital Objects (iFDOs) directly addresses these challenges by applying the FAIR principles (Findable, Accessible, Interoperable, and Reusable) to scientific image data in a structured, standardized, and machine-actionable form.

An iFDO is more than just an annotated image. It is a digital object that contains rich metadata but not the image file itself. The structured metadata includes provenance information, persistent identifiers, and defined relationships to the image data and other digital objects (e.g., publications, instruments, software workflows). This encapsulation ensures that image data can be accurately interpreted and reused by both humans and machines, even years after their initial creation while remaining operational.

In this presentation, we introduce the iFDO concept and its foundational elements, drawing on community-driven efforts. We outline how the iFDO approach enhances interoperability by aligning image metadata with existing standards, supports automated image processing pipelines, and facilitates compliance with Open Science and data stewardship mandates.

We also discuss the practical implications of implementing iFDOs within research infrastructures, data repositories, and domain-specific workflows. Particular attention is given to challenges in metadata harmonization, tooling integration, and governance, as well as opportunities for extending iFDOs into AI-ready formats that support FAIR AI. The iFDO model offers a scalable path toward turning scientific images from opaque pixel arrays into trustworthy and richly contextualized digital assets.

By adopting iFDOs, research communities can radically improve the findability, usability, and longevity of image data - enabling not only better science today, but also unlocking the potential for cross-disciplinary innovation and automated discovery in the future.

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