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Review of Long-term Wetland Monitoring Using the Landsat Archive: Focus on Opportunities for Essential Variables Derivation

Quentin Demarquet*, Sébastien Rapinel*, Simon Dufour* & Laurence Hubert-Moy*

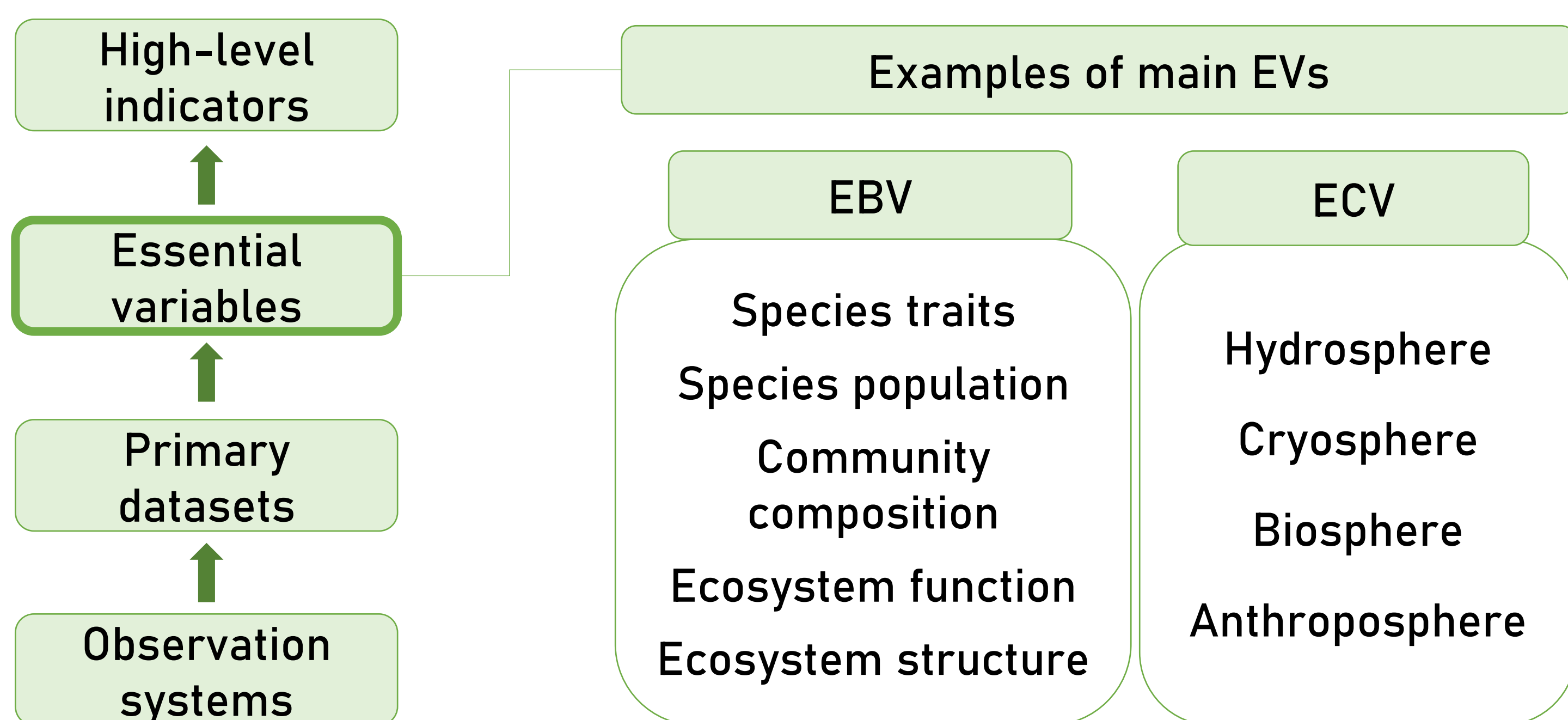
Contact: quentin.demarquet@univ-rennes2.fr

*Université Rennes 2 - LETG, UMR 6554 CNRS, Rennes, France

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Context and objectives

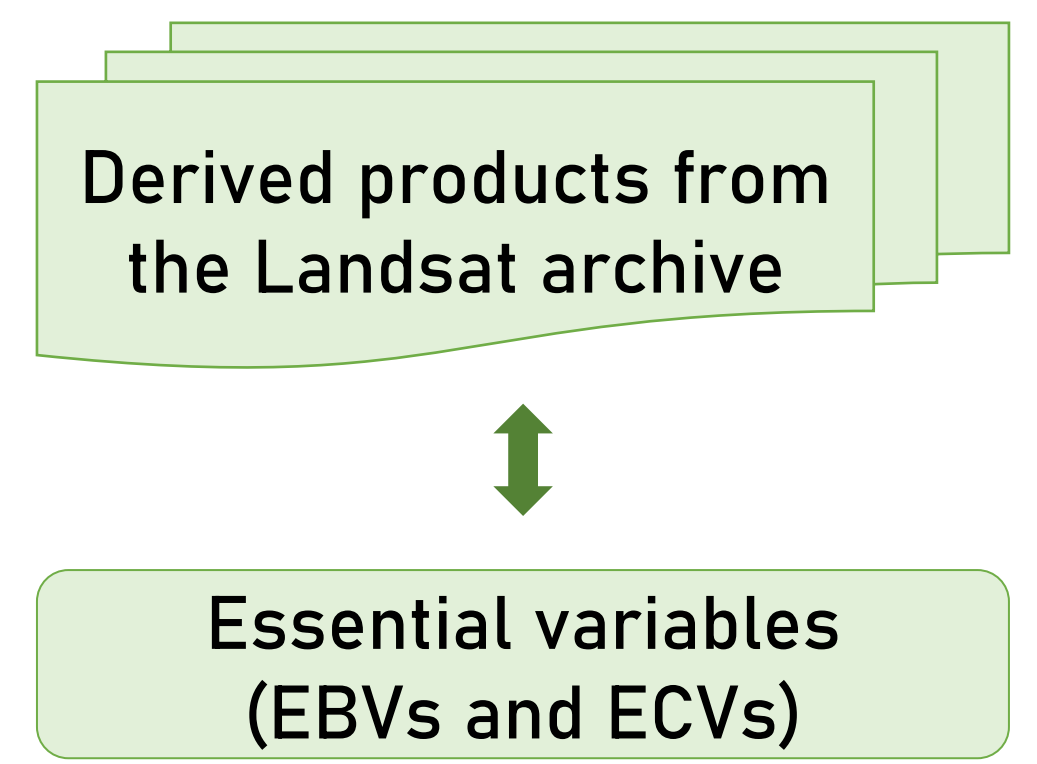
- Wetlands are complex ecosystems showing high spatiotemporal variability in structure and functions
- Essential Variables (EVs), including biodiversity and climatic variables (EBVs and ECVs), are a key concept for providing spatially and temporally standardized information for wetland monitoring
- As the longest high-resolution Earth Observation program available on a global scale since 1972, the Landsat archive is a valuable source of remote sensing data for long-term wetland monitoring



Essential Variables concept and examples (adapted from Fernández et al. 2020)

Methodology

- Systematic review of 351 articles
- For each article, search for a match between Landsat products and EVs



Results

- 100% of reviewed articles derived at least one EBV
- 93% of reviewed articles derived at least one ECV

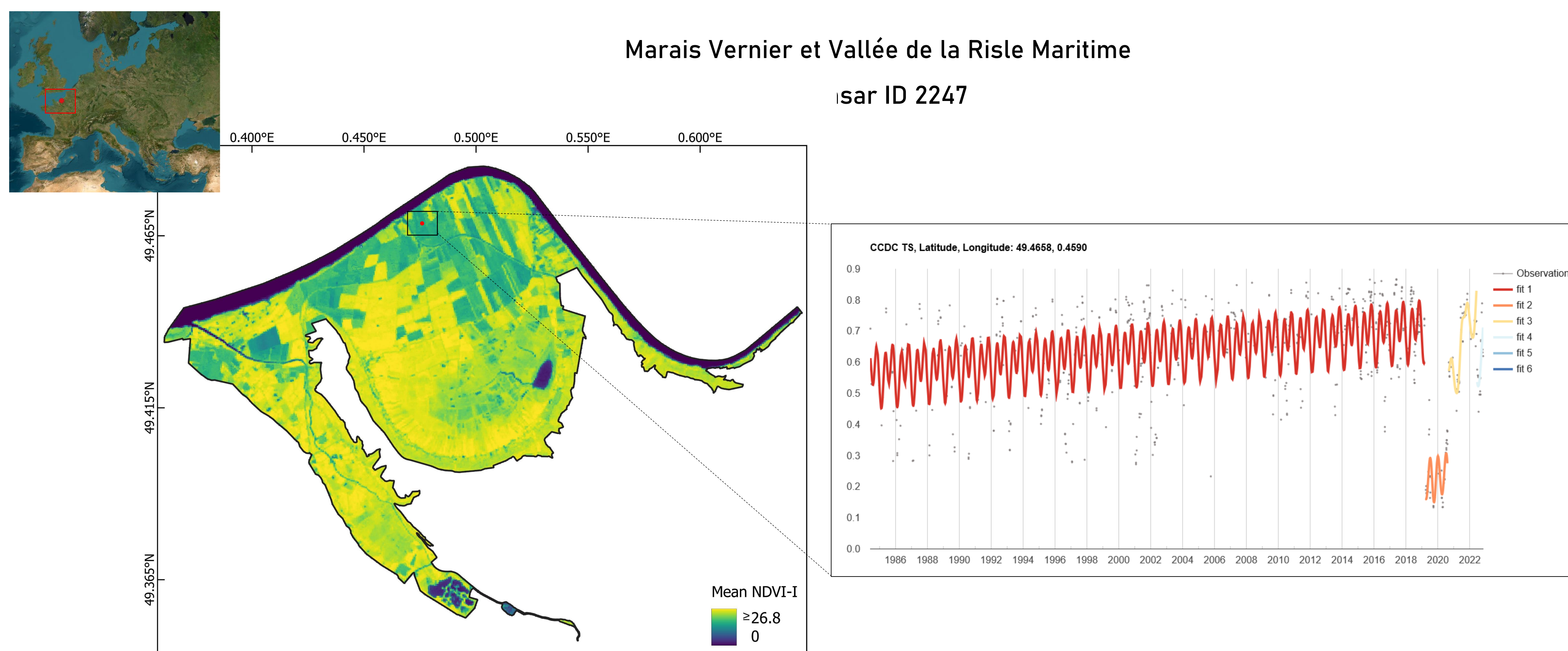
	Derived	Not derived
EBV	Habitat structure Ecosystem physiology Spatial configuration Species composition	Species phenology Species morphology Species abundance Community diversity
ECV	LULC Lakes Soil Moisture Above-Ground Biomass	River discharge Permafrost Leaf Area index Soil carbon

Examples of derived and not-derived EBVs/ECVs from the Landsat archive

What is the value of the Landsat archive to provide EVs for long-term wetland monitoring?

Example of application

- EBV Ecosystem physiology derived from Landsat archive during the 1984-2021 period on a Ramsar wetland site
- NDVI-I: Integral Normalized Difference Vegetation Index (sum of NDVI values during a year)
- Proxy of annual net primary productivity (ANPP)



Map of NDVI-I averaged over the study period (left) and plot of NDVI time series extracted from the Landsat archive (right)

For further information



Conclusion and perspectives

- Great potential of the Landsat archive in deriving EVs to improve wetland monitoring in the long term:
 - High temporal hindsight (50 years) and global coverage
 - High spatial resolution (30m) and medium temporal resolution (16 days, up to 8)
- Opportunity to monitor under-investigated biomes (e.g. boreal)
- Advances in artificial intelligence allow new pathways for analyzing dense Landsat time series
- Some EVs cannot be derived from Landsat because of incompatible characteristics (e.g. scale, spatiotemporal resolution)

