Climate Regime Variability in the EPS Signal Framework

"A Conceptual EPS Perspective on Climate-Regime Variability"

Author	Michael A Jones
Email	Michael.jones@paleotech.com.au
ORCID account	https://orcid.org/0009-0000-4314-9073
Institution / Affiliation	PaleoTech Pty Ltd, Adelaide, South Australia, Australia
Department	PaleoTech Research Initiative
Date	26 March 2026
Submission Status	This is a non-peer-reviewed preprint.
Document control	PT-EPS-001 | Version 1.3 | Defensive publication

The Earth Proxy System (EPS) framework proposes that variability within the coupled Earth system may manifest through distributed proxy observations appearing across multiple environmental domains. EPS therefore provides a conceptual observational structure for interpreting relationships between environmental observations and Earth-system variability.

The Earth Proxy System (EPS) Signal Framework is introduced as a conceptual observational perspective on relationships between distributed environmental proxy indicators and variability within the coupled Earth system.(MAJones, 2026).

Abstract

The Earth Proxy System (EPS) Signal Framework proposes that variability within the coupled Earth system may be reflected through distributed proxy observations across multiple environmental domains. This paper extends that framework to the climate-regime domain and presents a conceptual observational perspective on how planetary influences, coupled Earth-system interactions, environmental proxy signals, and climate-regime variability may be discussed within a common interpretive structure.

EPS is presented here as an interpretive framework, not as a disclosed analytical method, predictive model, or computational forecasting system. Its purpose is to provide structured conceptual language for discussing how observations across atmospheric, oceanic, hydrological, geophysical, cryospheric, biospheric, isotopic, and related domains may correspond with climate-regime behaviour, persistence, and transition. By treating proxy indicators as potentially linked expressions of coupled Earth-system processes, the framework supports interdisciplinary discussion of climate regimes while preserving confidentiality over undisclosed implementation details.

Concept	Climate regimes are treated within EPS as large-scale, interpretable expressions of coupled Earth-system variability rather than isolated single-domain phenomena.
Role in series	This paper functions as the climate-regime domain note within the broader EPS publication family.

1. Introduction

Climate regimes emerge from coupled interactions among atmospheric circulation, ocean dynamics, hydrology, cryosphere processes, geophysical conditions, and external forcing contexts. Observable variability in temperature, rainfall, pressure, wind, ocean structure, and related indicators often reflects these broader interactions.

Within the EPS framework, such observations are not treated as isolated measurements alone, but as potentially distributed expressions of wider Earth-system behaviour. This perspective is especially relevant to climate regimes, which commonly involve recurring large-scale patterns, persistence over time, and transitions between different states.

EPS is presented here as a conceptual observational perspective on climate-regime variability. It is intended to organise cross-domain observations within a coupled Earth-system context while preserving confidentiality over undisclosed analytical and implementation methods.

2. Motivation for the climate-regime domain

Climate regimes are a useful EPS domain because they are recurrent, large-scale, and interpretable forms of Earth-system variability. Regimes such as ENSO, the Southern Annular Mode, or other circulation patterns often show recognisable phases, persistence, transition behaviour, and geographically distributed environmental expression.

At the same time, climate-regime observations are often examined within disciplinary silos, which can limit interpretation of cross-domain relationships and lead–lag structure. EPS is motivated by the need for a high-level conceptual framework capable of organising such observations within a coupled Earth-system setting without disclosing proprietary analytical pathways, feature engineering, signal transforms, predictive logic, or implementation methods.

3. Conceptual Earth-system context

Earth-system science recognises the Earth as a coupled dynamic system involving interactions among atmosphere, ocean, cryosphere, hydrology, lithosphere, biosphere, and related processes. Climate regimes within this context are not merely isolated atmospheric patterns; they are often coupled expressions of broader system organisation.

Within EPS, planetary influences may form part of the wider forcing context, while internal Earth-system interactions shape the emergence, persistence, and transition of regime behaviour. Environmental proxy records are therefore considered potential observational expressions of these interacting processes.

4. Multi-regime Earth-system variability

Climate-regime variability may emerge through interactions among multiple Earth-system regimes operating across different temporal and spatial scales. Relevant domains may include atmospheric circulation regimes, ocean circulation variability, hydrological cycles, cryospheric behaviour, and selected geophysical disturbances that alter boundary conditions or environmental context.

Accordingly, EPS treats climate-regime variability as potentially multi-scale, lagged, and state-dependent. Different observational domains may reflect different aspects of regime structure, persistence, or transition, and no single proxy indicator is assumed to describe complete system behaviour on its own.

5. Examples of climate regimes

The El Nino-Southern Oscillation (ENSO) provides a familiar example of coupled atmosphere–ocean variability in which Pacific Ocean temperatures, atmospheric pressure gradients, convection, and rainfall patterns interact across broad regions and timescales. ENSO illustrates how climate regimes may be expressed through multiple distributed observations rather than a single variable alone.

The Southern Annular Mode (SAM) provides another example. Variability in the latitudinal position and strength of the Southern Hemisphere westerlies can influence rainfall, temperature, and circulation patterns across Australasia and other regions. SAM demonstrates how circulation-regime variability may have geographically distributed environmental expression.

These examples show why climate regimes are a useful conceptual domain for EPS: they involve persistence, transition, coupling, and broad observational footprint.

6. Planetary influences in scope

Within EPS, planetary influences are treated as contextual or possible forcing influences rather than singular asserted causes. Depending on the application, this context may include:

• solar variability
• orbital forcing associated with Milankovitch-scale structure
• axial and rotational dynamics
• lunar gravitational interactions
• geomagnetic and solar–terrestrial coupling

These influences are included conceptually because they may interact with Earth-system processes affecting energy distribution, circulation behaviour, and longer-horizon variability.

7. Interacting Earth-system processes

Climate-regime behaviour emerges through interactions among internal Earth-system processes, including:

• atmospheric circulation dynamics
• ocean circulation and heat transport
• hydrological interactions
• cryospheric influences and feedbacks
• selected lithospheric or geophysical context where relevant

Within EPS, these coupled processes provide the interpretive setting in which environmental observations may correspond with regime emergence, persistence, or transition.

8. Environmental proxy signal domains

Environmental proxy indicators relevant to climate-regime variability may arise across multiple observational domains, such as:

• atmospheric indicators
• oceanic indicators
• hydrological indicators
• cryospheric indicators
• geophysical or isotopic indicators
• hybrid or multi-domain proxy records

Different domains may reflect different aspects of regime behaviour. EPS therefore treats distributed observations as potentially complementary rather than interchangeable.

9. EPS-C1: conceptual climate-regime chain

The climate-regime chain below presents the high-level conceptual pathway used in this paper. It is intended as an interpretive structure, not as a disclosed analytical workflow.

Planetary influences

↓

Coupled Earth-system processes

↓

Distributed environmental proxy signals

↓

Climate-regime variability

Within EPS, proxy observations are interpreted as possible expressions of coupled Earth-system state and behaviour rather than as direct one-to-one measures of a single process.

10. Research questions

Several research questions may be examined within the EPS climate-regime domain:

1. How may distributed environmental proxies reflect interactions occurring across atmospheric, oceanic, hydrological, and related domains?

2. To what extent may proxy observations correspond with regime persistence, regime transition, or lead–lag structure?

3. How might planetary influences interact with coupled Earth-system processes associated with climate-regime variability?

4. How may different observational domains express different aspects of the same broader climate-regime state?

11. Future research directions

Future work may examine relationships among proxy indicators arising across atmospheric, oceanic, hydrological, geophysical, cryospheric, biospheric, and isotopic domains. It may also explore additional lead–lag structure across climate regimes and regime transitions, and assess how distributed proxy behaviour varies by timescale, region, and application context.

Further research may consider how EPS conceptual constructs interface with established Earth-system science, teleconnection analysis, proxy interpretation, and broader interdisciplinary observational studies.

12. Interdisciplinary relevance

EPS may be relevant to climate science, geophysics, hydrology, environmental science, palaeoclimate interpretation, and broader Earth-system science. Its principal value is as a common conceptual language for discussing distributed environmental observations in relation to coupled system behaviour.

By providing a structured interpretive framework rather than a narrow single-domain theory, EPS may help organise cross-disciplinary discussion of climate regimes, environmental variability, regime transitions, and broader Earth-system interactions.

13. Conceptual scope and limitations

The EPS Signal Framework is presented here as a conceptual observational framework. It does not prescribe specific analytical algorithms, predictive models, feature-engineering methods, signal-extraction methodologies, thresholds, calibration logic, or computational forecasting systems.

This document is intended to place the disclosed EPS climate-regime conceptual framework into the public record for defensive-publication purposes while preserving confidentiality over undisclosed implementation details. Copyright in the expression, layout, and branded presentation of this document is reserved. Specific analytical methods, algorithms, transforms, scoring logic, software, and implementation details remain confidential unless separately disclosed.

Accordingly, EPS should be interpreted as a structured conceptual framework describing possible relationships between distributed environmental observations and climate-regime variability, rather than as a complete operational model.

14. Conclusion

The Earth Proxy System (EPS) Signal Framework provides a conceptual observational framework for interpreting how distributed proxy indicators may correspond with climate-regime variability within the coupled Earth system. Its contribution lies not in disclosing a specific predictive method, but in establishing a structured conceptual language linking planetary influences, coupled Earth-system interactions, distributed proxy observations, and climate-regime behaviour.

As a defensive publication, this document places the disclosed EPS climate-regime framework, terminology, and conceptual relationships into the public record while preserving confidentiality over specific analytical and implementation pathways.

References

- **IPCC (2019):** Climate Change and Land.
  IPCC viewed March 2026.

  IPCC (2019): The Ocean and Cryosphere in a Changing Climate.
  IPCC viewed March 2026.

- **IPCC (2021):** Climate Change 2021: The Physical Science Basis.
  Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press and Intergovernmental Panel on Climate Change viewed March 2026.

- **NASA Earth Science (2020):** Milankovitch (Orbital) Cycles and Their Role in Earth's Climate.
  NASA viewed March 2026.

- **NASA Earth Science Division (2025):** Earth Science.
  NASA viewed March 2026.

- **NASA Earth Science Research (2026):** Earth System Science Research.
  NASA viewed March 2026.

- **NOAA Climate Prediction Center (CPC) 2012:** Climate Weather Linkage: Teleconnections.
  NOAA viewed March 2026.

- **NOAA National Centers for Environmental Information (NCEI) (2016):** What Are Proxy Data?
  NOAA viewed March 2026.

- **NOAA Ocean Service (2024a):** What Are Tides?
  NOAA viewed March 2026.

- NOAA Ocean Service **(2024b):** What Causes Tides?
  NOAA viewed March 2026.

- **NOAA Space Weather Prediction Center (2026):** Geomagnetic Storms.
  NOAA viewed March 2026.

Glossary of key terms

Term	Definition
Earth Proxy System (EPS) Signal Framework	A conceptual observational framework proposing that distributed environmental proxy indicators may correspond with variability within the coupled Earth system.
Climate-regime variability	Variability associated with recurring large-scale patterns of atmosphere–ocean behaviour and related environmental expression across regional or global scales.
Climate regime	A large-scale pattern of atmospheric and oceanic circulation influencing regional or global climate variability, for example ENSO or the Southern Annular Mode.
Regime persistence	The tendency for a climate regime or regime phase to remain established over a period of time rather than changing immediately.
Regime transition	A change in climate-regime state, phase, or structure arising through coupled Earth-system interactions and potentially reflected through distributed observations.
Ocean–atmosphere coupling	The linked interaction between oceanic and atmospheric processes through which circulation, heat, pressure, and convection may co-evolve.
Distributed climate proxy	An environmental observation or proxy record that may reflect broader climate-regime behaviour when interpreted within a coupled Earth-system context.
Proxy signal	The interpreted pattern, expression, or indication arising from one or more environmental proxy indicators.
Environmental proxy indicator	A measured variable or natural record that may provide indirect observational evidence of Earth-system processes or conditions.
Coupled Earth system	The interconnected Earth system formed through interactions among atmospheric, oceanic, lithospheric, cryospheric, hydrological, and biospheric processes.

Term	Definition
Planetary influences	External or large-scale physical influences that may affect Earth-system dynamics, including solar variability, orbital forcing, lunar interactions, or geomagnetic processes.
Earth-system variability	Observable change in environmental conditions arising from interactions within the coupled Earth system.
Circulation regime	A recurring large-scale circulation pattern that shapes atmospheric or oceanic behaviour across broad regions and timescales.
Observational perspective	An interpretive approach that treats environmental observations as possible expressions of broader Earth-system behaviour rather than outputs of a disclosed analytical model.