

Title: Synchronization Breakdown and Climatic Turbulence: A Multilayer Oscillatory Model of Earth's Current Transition Phase

Abstract: This paper proposes an integrative oscillator-based framework to interpret the current climate crisis and its cross-domain impacts. We argue that recent global developments can be understood as symptoms of a multilayer phase desynchronization, spanning solar forcing, atmospheric instability, biological dissonance, technological mismatch, and psychosocial fragmentation. Drawing from existing climate science, circadian physiology, and systems theory, we present evidence for a high-turbulent regime characterized by entropy amplification, phase decoherence, and thermodynamic inefficiency. Our model suggests an imminent bifurcation: toward either systemic collapse or emergent re-synchronization.

1. Introduction: From Global Warming to Global Desynchronization

The discourse around climate change remains predominantly centered on anthropogenic greenhouse gas emissions. However, recent patterns—accelerated warming, non-linear weather anomalies, and widespread socio-biological dysregulation—suggest deeper systemic mechanisms at play. We hypothesize that Earth is currently in a high-turbulent phase of oscillator desynchronization across multiple layers of natural and human systems (cf. Konstapel & GPT, 2025).

2. The Oscillatory Model: Layers and Phase Coherence

We define Earth's climate system as a multilayered oscillatory structure (L1–L19), where each layer—from quantum fluctuations (L1) to planetary culture (L19)—maintains internal rhythmicity and phase relationships. Phase coherence between layers determines systemic resilience, thermodynamic efficiency, and anticipatory capacity. Disruptions propagate non-linearly through synchrony breakdown, producing turbulence, entropy leakage, and emergent phenomena.

2.1 Theoretical Foundation in Complex Oscillatory Systems

Recent advances in climate oscillation theory demonstrate that Earth's climate exhibits significant interactions between processes operating on different time scales, including El Niño/Southern Oscillation cycles. Oscillations are intrinsic to closed systems such as Earth and can sustain periodic changes under constant illumination, with dominant periodicities arising naturally from system timescales. This supports our multilayer framework where relaxation oscillators feature interplay between fast relaxation dynamics and slow destabilization processes.

The climate system displays abrupt transitions triggered by changes in the amplitude or time scale of environmental oscillations, affecting ecosystems and climate elements including terrestrial systems, Arctic sea ice and monsoons. Dynamic synchronization processes occur naturally in complex climate networks, with oscillators constantly interacting with low- and high-frequency forcings through coupling of temporal frequencies.

3. Evidence for High-Turbulent Transition (2020–2025)

3.1 Climatic Oscillations and Thermodynamic Nonlinearity

- Accelerated warming trend: +1.19°C (2014–2023), peaking at +1.43°C in 2023 ([Le Monde, 2024](#)).
- Increased extreme events: heat and rainfall extremes increase 2x–3x under +4°C warming ([IPCC AR6, 2023](#)).
- Climate entropy and chaos signatures confirmed ([Altintan et al., 2019](#)).
- Short-term projections dominated by internal variability ([Deser et al., 2022](#)).

Enhanced Evidence for Feedback Loop Amplification:

Many feedback loops significantly increase warming due to greenhouse gas emissions, with 27 global warming accelerators identified as amplifying feedback loops that may not be fully accounted for in climate models. Positive feedback loops create cascading effects where climate change causes impacts that result in even more climate change, potentially leading to irreversible tipping points. These include permafrost methane release, ice-albedo feedback, and disrupted ocean circulation patterns.

3.2 Chronodisruption and Biological Desynchronization

- Circadian disruption linked to increased risk of cancer, obesity, cardiovascular disease ([Haus & Smolensky, 2006](#)).
- Shift workers: +50% cancer risk ([Straif et al., 2007](#)).
- Sleep structure altered by climate-induced temperature shifts ([Obradovich et al., 2017](#)).
- Seasonal core body temperature shifts observed in >93,000 individuals ([Kräuchi et al., 2021](#)).

Enhanced Evidence for Temperature-Circadian Coupling:

Climate change challenges adaptive associations between endogenous clocks and temperature, with changes in environmental conditions disrupting circadian rhythms and posing risks to population viability. Thermal environment significantly affects human sleep and circadian rhythm, with heat exposure increasing wakefulness and decreasing REM sleep. Temperature cycles can entrain circadian rhythms, with organisms able to learn from temperature whether it is day or night while maintaining temperature compensation.

Temperature serves as an important synchronizer capable of modifying cellular circadian rhythms, with disruptions in these rhythms associated with cardiovascular disease, metabolic syndrome, and mental health disorders. The circadian system modulates metabolic heat production to generate body temperature rhythm, challenging homeothermy through a relationship between circadian rhythms and metabolism.

3.3 Ecosystem Phenological Desynchronization

New Evidence Section:

Global analysis reveals that the relative timing of key life cycle events of interacting species has changed significantly over the past 35 years, with estimated changes in phenology and synchrony greater in recent decades than before major climate change. Climate warming changes the phenology of many species differently, with plants showing stronger phenological advances than pollinators, though overall plant-pollinator interactions are becoming more synchronized as plants respond more strongly to climate change.

A 40-year study across 213 species showed that species are shifting phenologies at dissimilar rates because they respond to different climatic factors, which are shifting at dissimilar rates, with plants

advancing spring phenology faster than average temperature increases. Plant phenological synchrony increases under rapid within-spring warming, with temporal convergence of phenological events showing significant correlation with warming speed.

3.4 Sociocultural Desynchronization

- Decrease in shared seasonal structures: weakening of cultural rhythms (cf. Eliade, 1949; McWhinney, 1997).
- Crisis-based governance replacing cyclical planning (cf. Gunderson & Holling, 2002).
- Absence of collective rituals to process planetary distress (cf. Turner, 1969).

Enhanced Evidence for Social Rhythm Disruption:

Social rhythm irregularity is related to increased reporting of health problems, depression, anxiety, and stress, while greater regularity correlates with better overall health and positive mental health across multiple cultures. Disruption of social zeitgebers can lead to decreased cognitive performance, negative mood, and episodes of mental illness, with stressful life events triggering depressive episodes by disrupting social and biological rhythms.

Modern lifestyle changes have resulted in unprecedented changes in light exposure timing and duration, potentially desynchronizing circadian rhythms, with increased prevalence of disrupted circadian rhythms strongly correlating with increased incidence of mood disorders. Social acceleration and desynchronization between political practices and economic systems creates increasing temporal disconnection in protest movements and social change efforts.

4. Bifurcation Paths: Collapse vs. Emergent Coherence

We model two future trajectories:

- **Path A: Phase Re-synchronization** through ritual, design, ecological realignment, and technological resonance (cf. Havel, 1991; Alexander, 2001).
- **Path B: Decoupling and Collapse**, marked by persistent incoherence, resource inefficiency, cognitive dissonance, and systemic failure (cf. Tainter, 1988).

4.1 Enhanced Mechanistic Understanding

Climate tipping points occur when positive feedback loops cross thresholds leading to large, often irreversible changes, with the system transitioning from predictable patterns to profoundly different states. Without regulating action of negative feedback loops, positive loops can spiral out of control, creating irreversible changes in the climate system.

However, biological systems demonstrate temperature compensation mechanisms that maintain robust rhythms across broad temperature ranges, suggesting adaptive capacity exists within oscillatory systems. Climate oscillators can exhibit synchronization phenomena and may be entrained by external forcing, offering pathways for managed re-synchronization.

5. Conclusion: Toward Rhythmic Reconstitution

Climate is not merely a matter of degrees but of degrees of coherence. What we face is not just warming, but a **collapse of resonance**—a drift from synchronized planetary awareness into fragmented local extremes. A systemic intervention must operate across all layers: atmospheric, physiological, infrastructural, and symbolic.

5.1 Intervention Framework

The evidence suggests three critical intervention points:

1. **Atmospheric Re-synchronization:** Climate system forcings, feedbacks, and tipping points require coordinated response across multiple timescales
2. **Biological Rhythm Restoration:** Interpersonal and social rhythm therapy demonstrates that stabilizing daily rhythms can prevent mood episodes and improve quality of life
3. **Cultural Temporal Realignment:** 2024 cultural shifts toward celebrating diversity and digital identity must be coupled with recognition of temporal synchronization needs

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