

CAMANCHACA-SPEC

Spectral Covariance Modeling Framework for Coastal Atmospheric Systems

Author: Máximo Quezada Arriagada

Institution: Meqatec SpA

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Abstract

This technical report presents the conceptual and methodological framework of CAMANCHACA-SPEC, an internal R&D initiative focused on multivariate spectral modeling of coastal atmospheric systems. The approach integrates high-dimensional data representations, covariance structure analysis, and exploratory predictive modeling techniques to characterize spatial variability patterns in remote sensing datasets.

1. Introduction

Coastal atmospheric systems exhibit complex spatial variability that can be partially characterized through multispectral remote sensing data. CAMANCHACA-SPEC proposes a quantitative framework for analyzing multiband spectral structures using covariance-based descriptors.

2. Theoretical Framework

Given a multiband observation vector $X = (x_1, x_2, \dots, x_n)$, the spectral covariance matrix Σ is defined as $E[(X - \mu)(X - \mu)^T]$. Derived metrics include determinant analysis, eigenvalue distribution, and multidimensional dispersion indices to evaluate structural variability in high-dimensional spaces.

3. Methodological Overview

The methodological workflow includes data acquisition and preprocessing, spectral vector construction, local covariance estimation, extraction of structural descriptors, exploratory predictive modeling, and performance validation.

4. Development Stage

The project is currently in pilot development phase, focusing on methodological validation, robustness testing, and reproducibility assessment.

5. Strategic Vision

CAMANCHACA-SPEC represents a foundational line of applied data science research within Meqatec SpA, aimed at integrating advanced quantitative methods into environmental and atmospheric system modeling.