Green Wave
April 09, 2025

Motivation

- Hunter Gatheres hunted large herbivores
- Large Herbivores like fresh green in the spring
- Spring is later in northern latitudes
- Herbivores move with the „green wave“

Goals

- Parameterize annual greening curve
- Predict spring green up for paleoclimate conditions

Identify predictors:

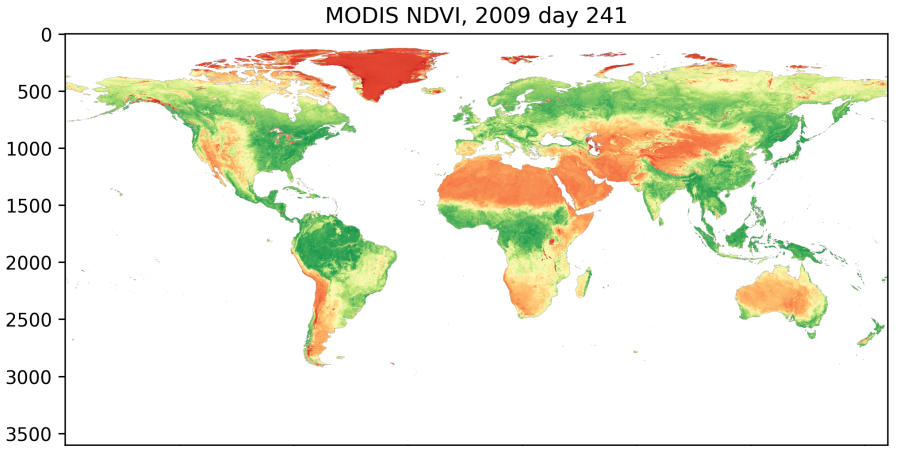
Annual time series of:

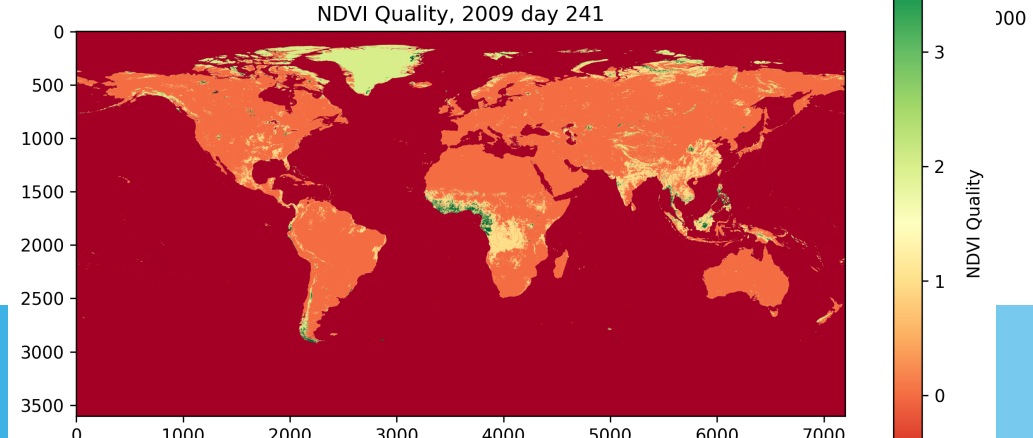
- Insolation
- Precipitation
- Temperature

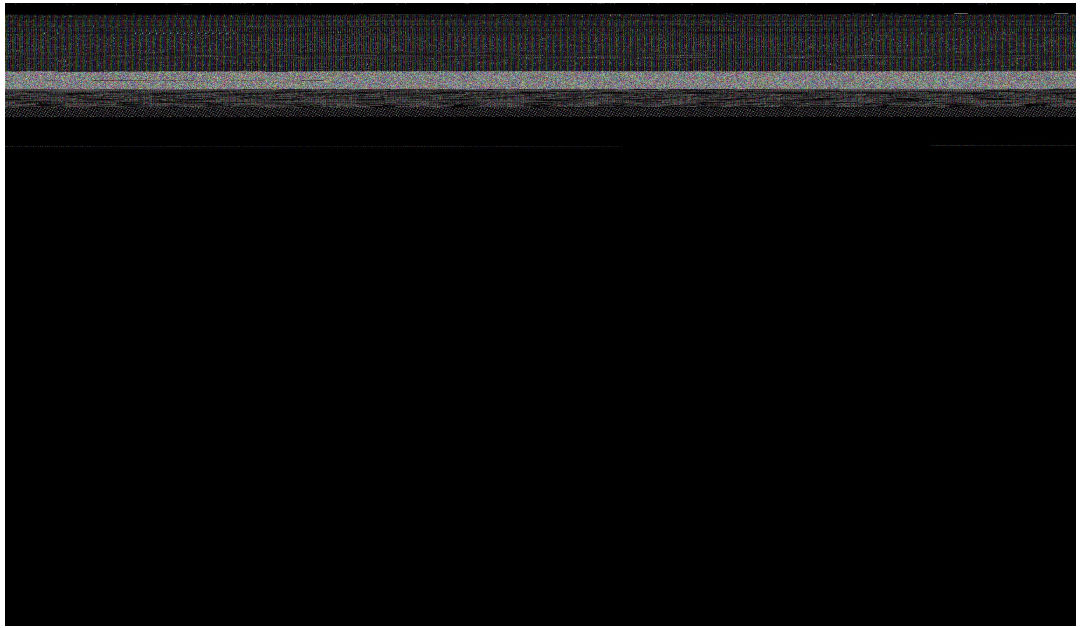
Vegetation

Vegetation Data

- MODIS NDVI Data (2000-2024)
- Satellite spectrography data
- $$NDVI = \frac{NIR - Red}{NIR + RED}$$
- Temporal Resolution 16 days
- Global coverage
- Spatial resolution 0.5 degree
- (higher resolution available)

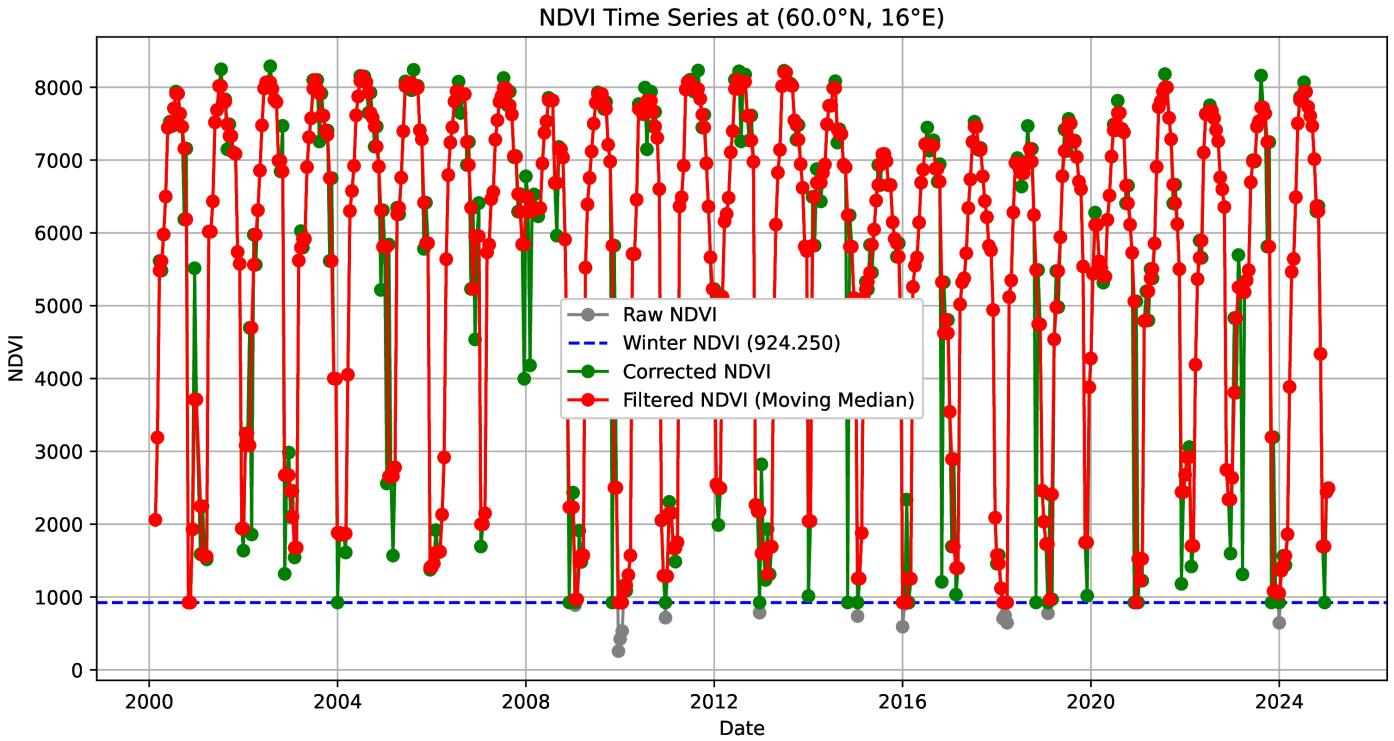


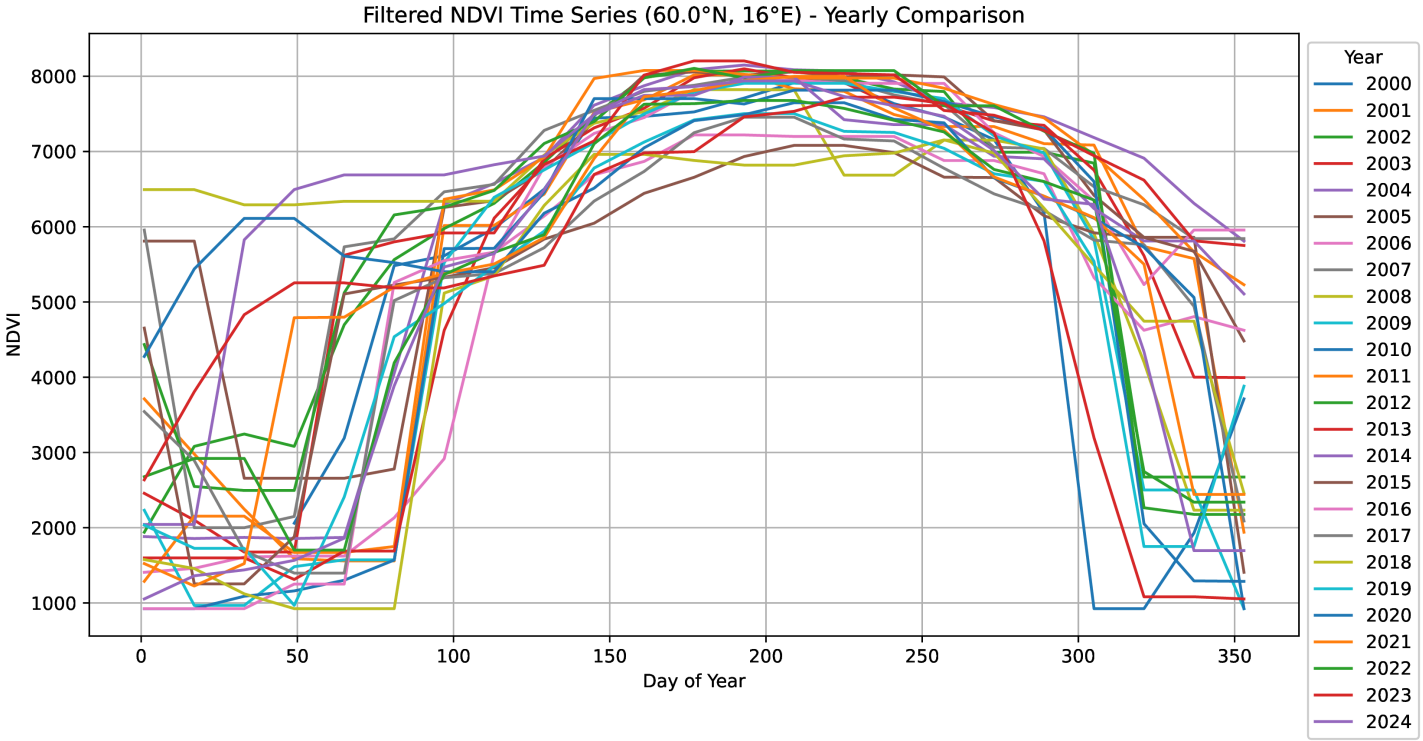




Clip low outliers to 2.5% quantile

Moving Median Filter,
Window size 3

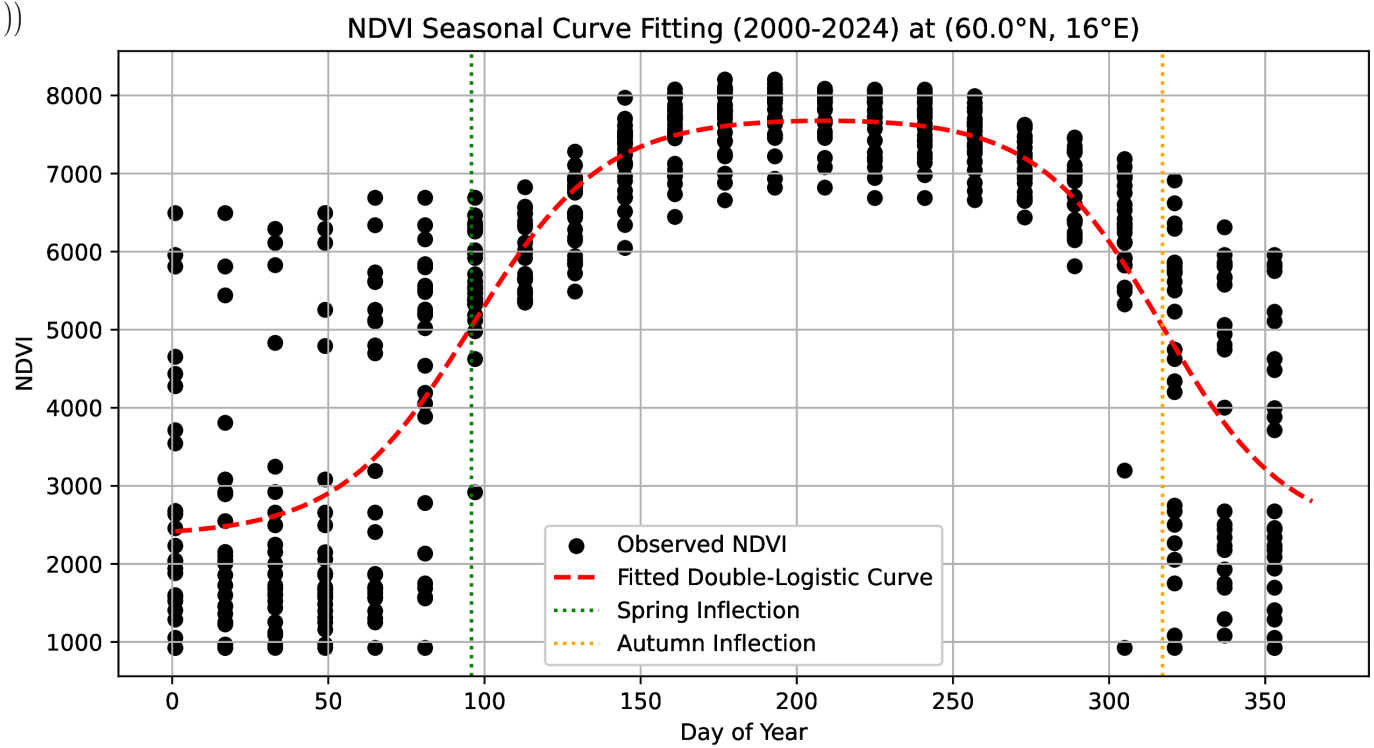



Filtered NDVI Time Series (60.0°N, 16°E) - Yearly Comparison
NDVI
Day of Year
Year
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024

$$NDVI(t) = b + scale \cdot (\sigma((t - t_s)c_s) - \sigma((t - t_a)c_a))$$

Shows good fit for temperate regions with distinct spring + autumn

Extract day of max. derivative (IRG) from the model



Drawbacks & Next steps

Issues:

- Precipitation-limited regions (e.g. Mediterranean)
- Southern Hemisphere “inversion”

Next steps:

- Explore alternate cyclical models
- Incorporate precipitation data to detect moisture-driven
- Seasonality
- Eventually integrate paleoclimate and orbital forcing for mid-Holocene