

Use of satellite products to predict maize price changes from production shocks located in the Corn Belt

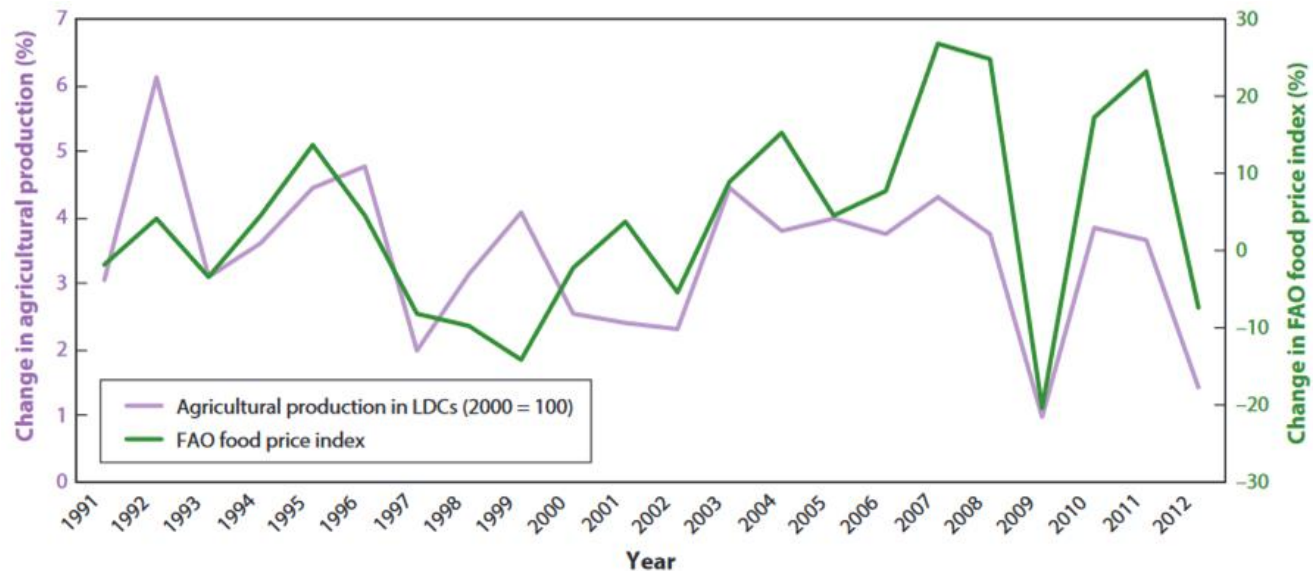
TESTE Florian
PhD student

Paris-Saclay University
Atos



Context

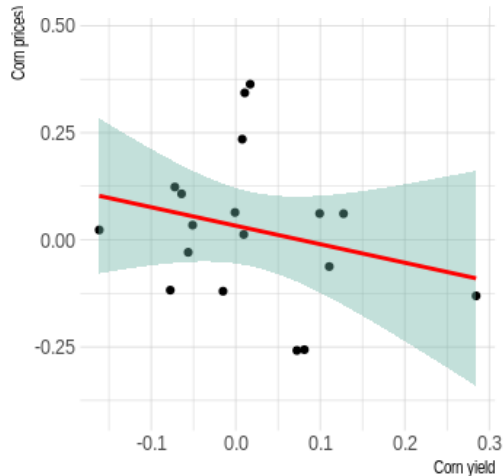
Annual changes in international food prices are closely related to agricultural production in developing countries. (Headey and Martin, 2016)



Context

- Regional corn production in the US strongly impact the corn prices (Zelingher et al., 2021).

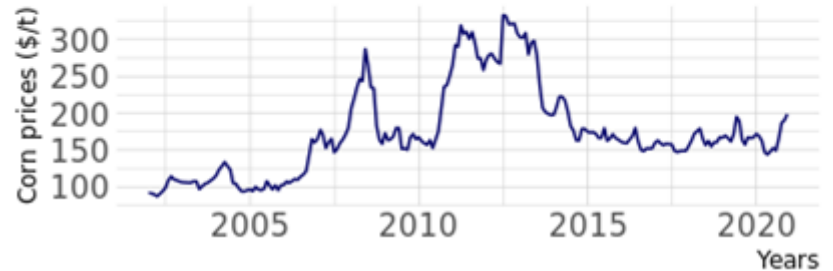
US corn yield & corn price



US Corn yields (2002-2020)

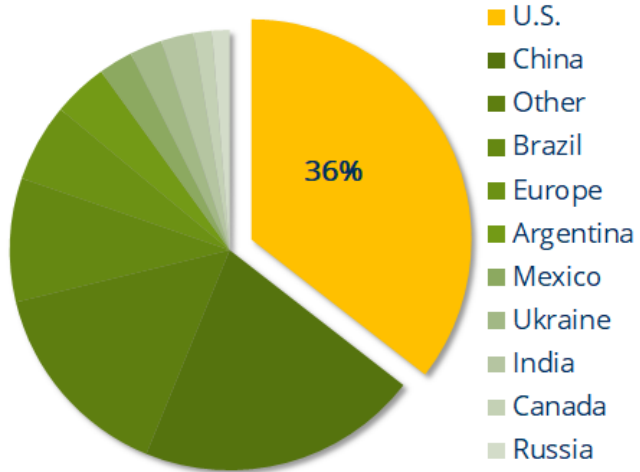


Corn prices (2002-2020)

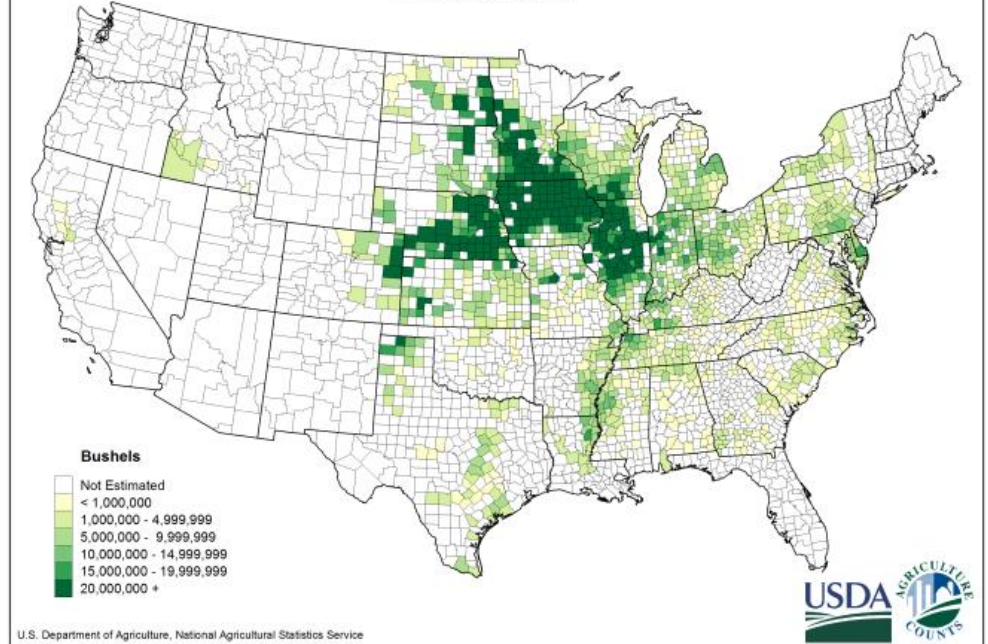


Context

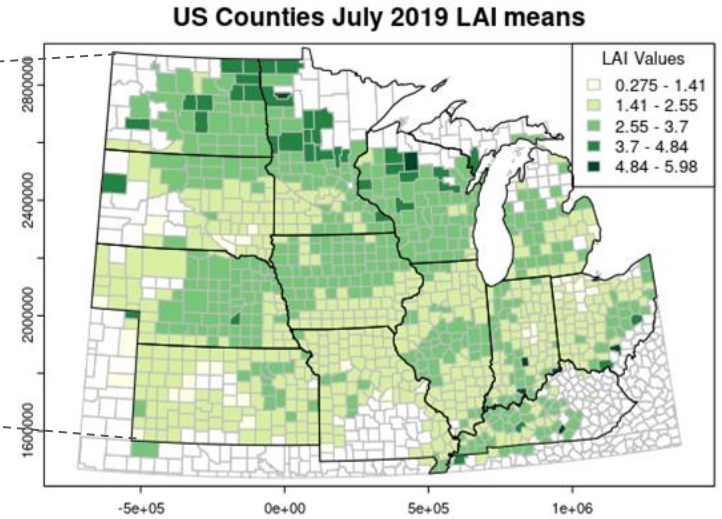
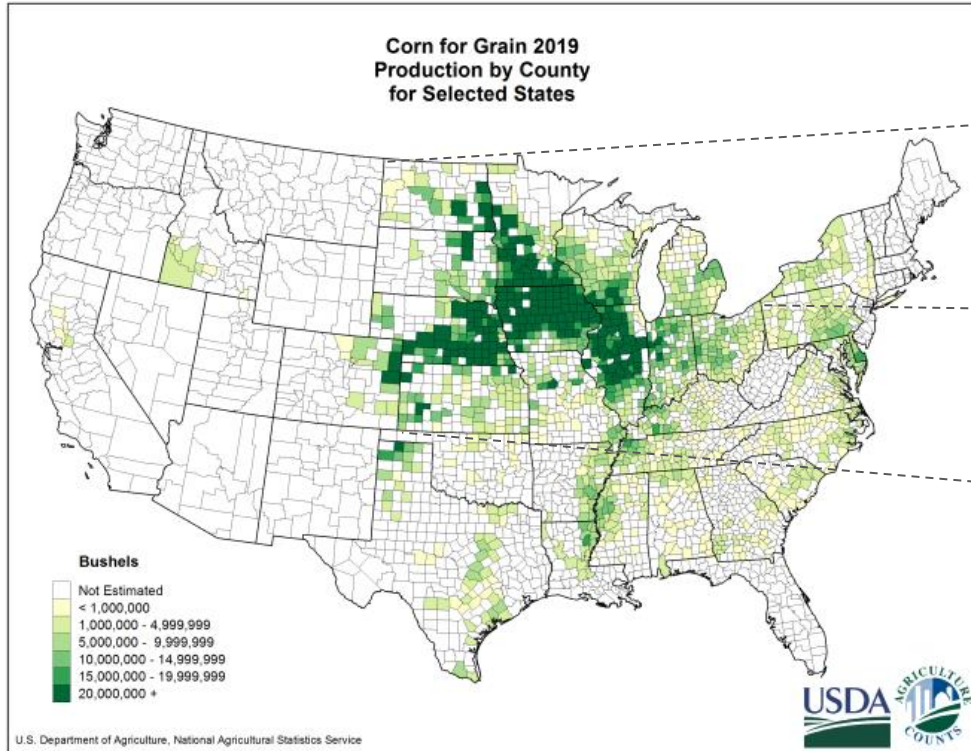
World Corn Production (2018 USDA)



Corn for Grain 2019
Production by County
for Selected States

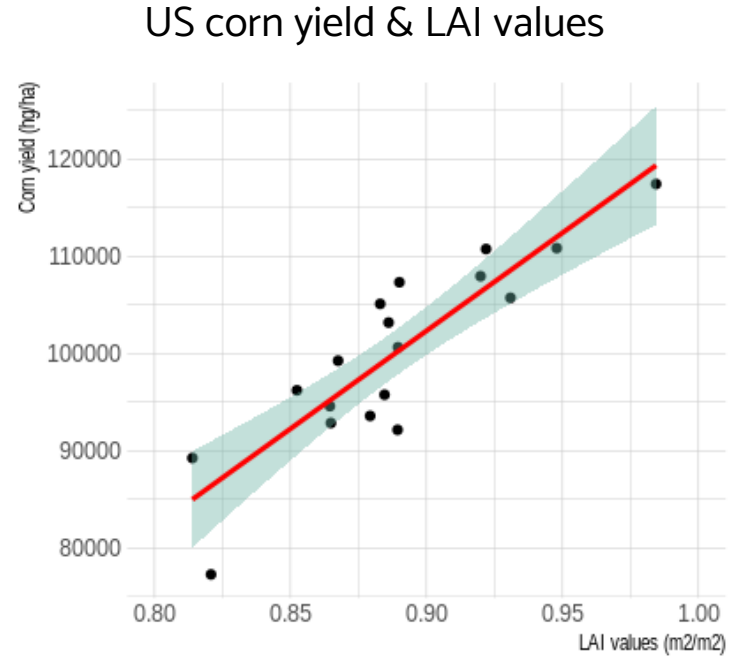


Context



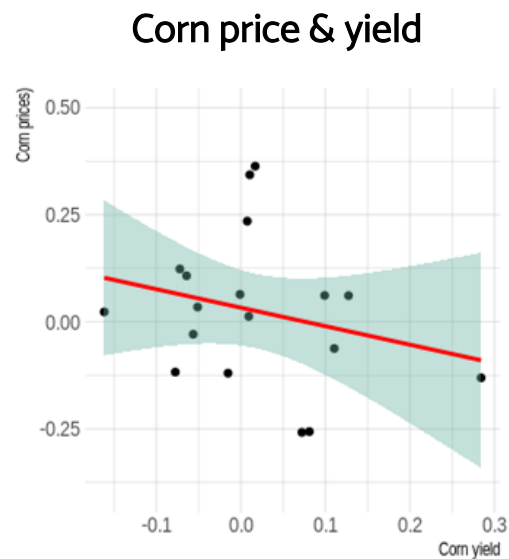
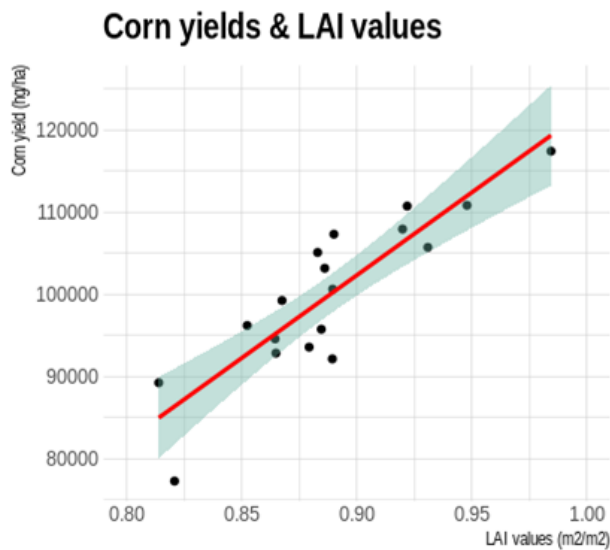
Context

- Strong relations between the Leaf area index (LAI) & crop yield (Doraiswamy et al., 2005)



Context

- Predict the impact of production on prices based on satellite images available during the season



Satellite products

Sensor types

Passive sensor: LANDSAT series, Sentinel-2, MODIS...

Active Sensor: Sentinel-1, SMAP, GEDI...



Passive | Sensors detect only what is emitted from the landscape, or reflected from another source (e.g., light reflected from the sun).



Active | Instruments emit their own signal and the sensor measures what is reflected back. Sonar and radar are examples of active sensors.

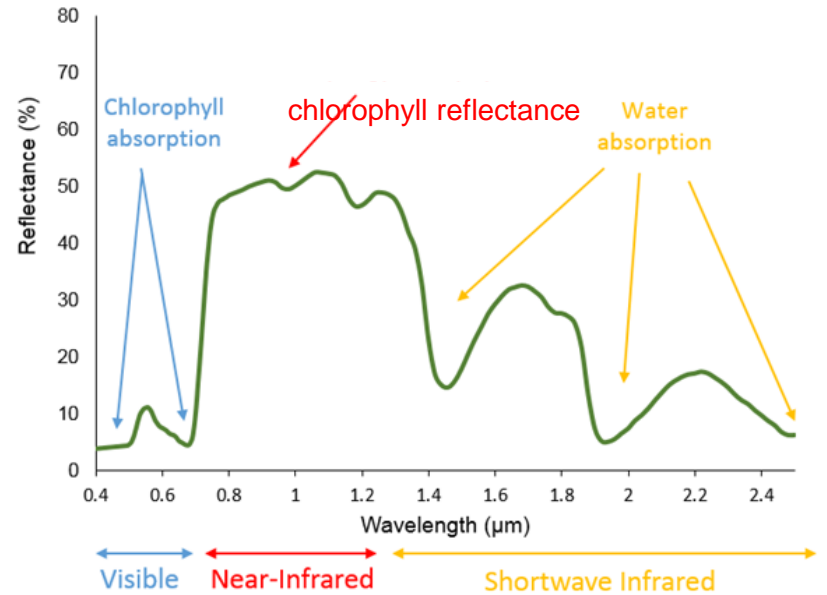
Satellite products

Crop monitoring



Vegetation Index: NDVI, EVI, WDRVI, NDWI...

Biophysical parameters: LAI, fAPAR..



Satellite products

Data providers



Public sector: ESA, EUMETSAT, NASA, JAXA, DLR..

Commercial sector: Planet, Spire, ICEYE

Online access and computing:
Google Earth Engine/ AWS / Mundi

Data download



Python libraries

Sentinelhub
Modispy
Landsatxplore

R packages

Sen2r
Modistsp

Download and preprocess MODIS

- R package devoted to automatizing the creation of time series of raster images derived from MODIS Land Products data, developed by Busetto and Ranghetti, 2016.

```
library(MODISrsp)  
MODISrsp()
```

Download and preprocess MODIS

Spatio/temporal options

Menu

Product and Layers

Spatial/Temporal options

Output Format and Folders

Run MODISsp

Save Options

Load Options

Quit MODISsp

MODISsp v.2.0.8

Temporal Extent

Temporal Range

2000.01.01

to

2020.12.31

Date Range Type

Full

Output Projection

Output Projection

User Defined

MODIS Sinusoidal

5070

Change

Output Resolution

Native

Resampling Method

near

Spatial Extent

Selection Method

☐ Select Tiles

☐ Select Bounding Box

☒ Load From Spatial File

☐ Draw On Map

Spatial file

/home/florian/Documents/PhD/Donnees/Corn_belt_states/Corn_belt_states/Corn_belt_states.shp

Browse

+

-

Leaflet | © OpenStreetMap contributors, CC-BY-SA

Download and preprocess MODIS

Output parameters

Menu

Product and Layers

Spatial/Temporal options

Output Format and Folders

Run MODISstp

Save Options

Load Options

Quit MODISstp

MODISstp v.2.0.8

Download Method

Download Method ?

User Name ?

Password ?

Downloader ?

http

http

Output Options

Output Format ?

Compression ?

Save Time Series As ?

Apply Scale/Offset ?

Modify NoData Values ?

GTiff

LZW

☒ R RasterStack
☐ GDAL VRT
☐ ENVI Meta Files

Yes

No

Output Folders

Main Output Folder ?

Output Folder for storage of original MODIS HDF ?

/home/florian/hdd/MODIS

Browse

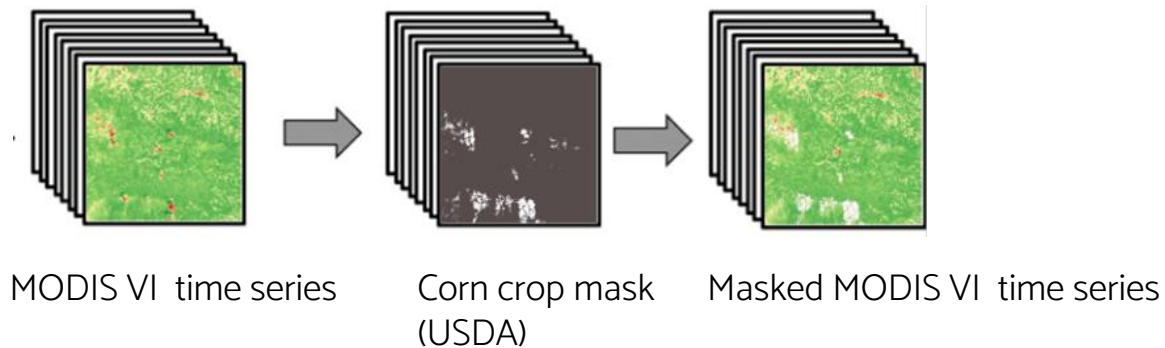
Reprocess

Delete HDF

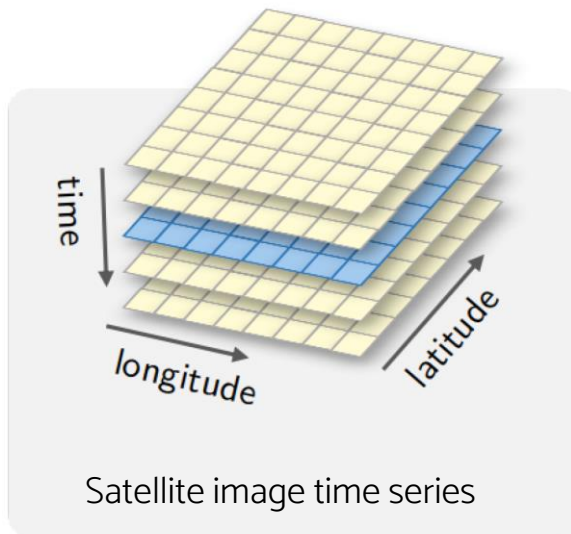
Yes

No

Satellite image time series

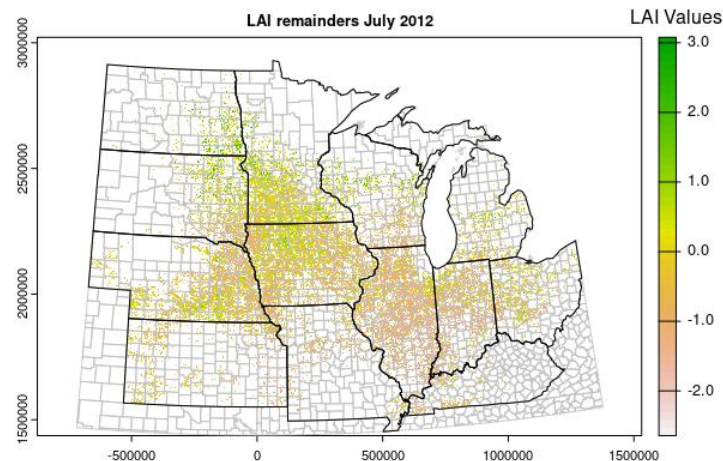


Satellite image time series

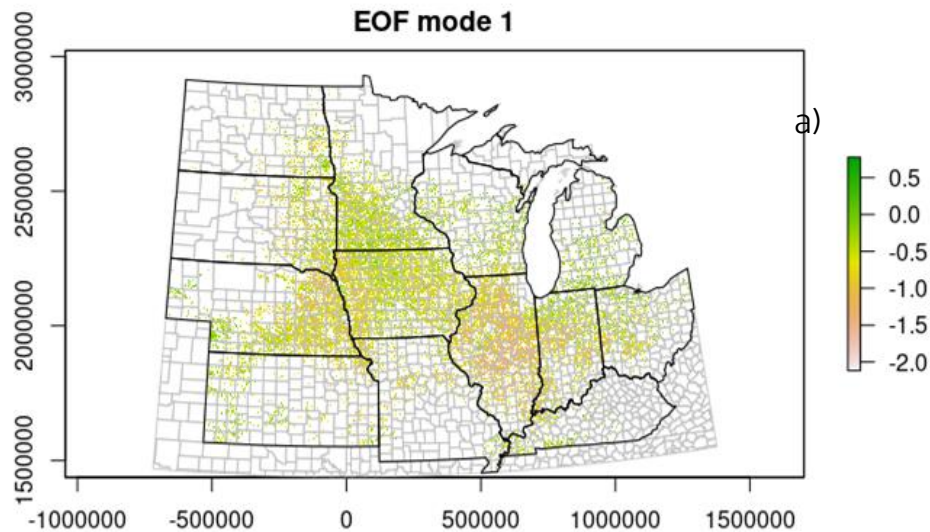


y_t observed data at time t ,
 T_t trend component,
 S_t seasonal component,
 R_t remainder component

$$y_t = S_t + T_t + R_t$$

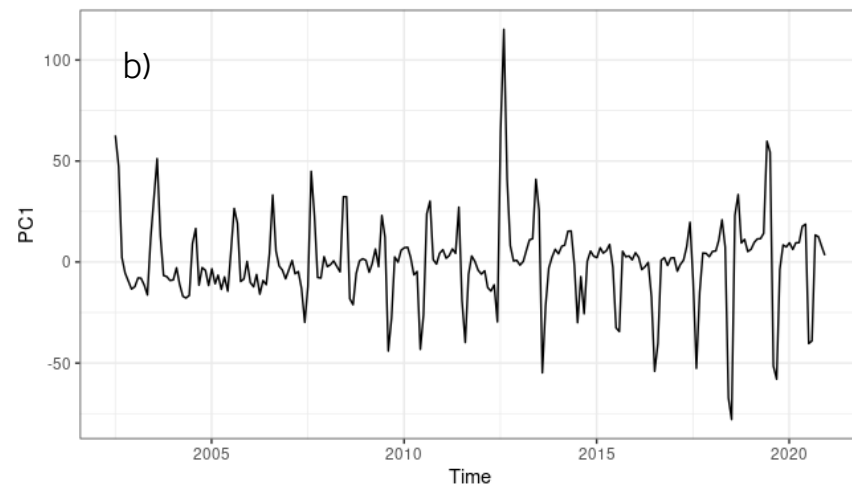


EOF Analysis



a) First EOF (EOF1).

b) PC time series of the first mode



Perspectiv e

- Canonical correlation analysis (CCA)
- Multichannel singular spectrum analysis
- Wheat (Ukraine)
- Soybean (US, Brazil)
- Corn (China)

Thank you !

References

Busetto L, Ranghetti L. MODISsp: An R package for automatic preprocessing of MODIS Land Products time series. Computers & Geosciences 2016;97:40–8. <https://doi.org/10.1016/j.cageo.2016.08.020>.

Doraiswamy PC, Sinclair TR, Hollinger S, Akhmedov B, Stern A, Prueger J. Application of MODIS derived parameters for regional crop yield assessment. Remote Sensing of Environment 2005;97:192–202. <https://doi.org/10.1016/j.rse.2005.03.015>.

Headey DD, Martin WJ. The Impact of Food Prices on Poverty and Food Security. Annu Rev Resour Econ 2016;8:329–51. <https://doi.org/10.1146/annurev-resource-100815-095303>.

Zelingher R, Makowski D, Brunelle T. Assessing the Sensitivity of Global Maize Price to Regional Productions Using Statistical and Machine Learning Methods. Frontiers in Sustainable Food Systems 2021;5.