Desertification mapping based ARIMA model and Landsat time series

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Abstract

Desertification models do not include analyses of rainfall, temporality, field visits and projection scenarios. The objective is to evaluate desertification under levels of vegetation, soil and albedo, construct forecast models and analyze its variability with time and rainfall. Landsat TM was used for NDVI, TGSI and albedo between 2000 and 2008 in dry and rainy periods in Irauçuba Centro Norte (ICN) and in the National Forest of Sobral (FLONA). Desertification levels and indices of 30 pixels were quantified and their means were inputs in the ARIMA model. The results showed vegetation and albedo at different levels of desertification. The medium desertification class of NDVI increased by 18% at ICN and the low desertification class of albedo increased by 3%. TGSI showed the class severe at ICN and FLONA. The AR(3) model indicated reduction in NDVI, while MA(1) for TGSI and albedo showed severe and low level. ARMA(2,1) showed optimistic scenario of recovery for pixels with desertified NDVI and Albedo of FLONA. The AR(3) model for TGSI of FLONA showed a reduction of 0.0006504 in 70 years. Anthropic practices and climate were responsible for the desertification of ICN, while FLONA was shown to be non-desertified, but NDVI and TGSI were affected by the anthropic practices. Therefore, desertification showed different levels at ICN, rainfall and time affected vegetation and albedo at ICN and FLONA. ARMA(2,1) models showed that the prospects of desertification reversal are greater for FLONA.

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PROJECTION: UTM
DATUM: WGS - 84
ZONE: 24 SOUTH

4A ICN

2000FS 2000FC 2001FC
2003FS 2004FS 2004FC
2005FS 2005FC 2006FS
2007FC 2008FS 2008FC

4B National Forest of Sobral

2000FS 2000FC 2001FC
2003FS 2004FS 2004FC
2005FS 2005FC 2006FS
2007FC 2008FS 2008FC

Legend
- 0.00 - 0.15
- 0.15 - 0.25
- 0.25 - 0.40
- 0.40 - 0.50
- 0.50 - 0.75

5A ICN

2000FS 2000FC 2001FC
2003FS 2004FS 2004FC
2005FS 2005FC 2006FS
2006FC 2007FC 2008FS 2008FC

5B National Forest of Sobral

2000FS 2000FC 2001FC
2003FS 2004FS 2004FC
2005FS 2005FC 2006FS
2006FC 2007FC 2008FS
2008FC

Legend
- -0.5 - -0.30
- -0.30 - -0.20
- -0.20 - -0.10
- -0.10 - 0.00
- 0.00 - 0.20
- 0.20 - 0.30

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$Y_t^{NDVI\_IGN} = -1.1155Y_{t-1} - 1.0992Y_{t-2} - 0.8735Y_{t-3} + \varepsilon_t$

Model: AR(3)
ACCURACY
ME: 0.0104
RMSE: 0.0103
MAE: 0.0192
MPE: 7.7122
MAPE: 15.6808
MASE: 0.3027

$Y_t^{NDVI\_FLONA} = 0.3276 + 0.6497Y_{t-1} - 0.5832Y_{t-2} + \varepsilon_t - 0.9996\varepsilon_{t-1}$

Model: ARIMA(2,1)
ACCURACY
ME: 0.0910
RMSE: 0.1020
MAE: 0.0730
MPE: 4.5121
MAPE: 27.3048
MASE: 0.4663

$Y_t^{TGSI\_IGN} = 0.2289 + \varepsilon_t - 0.9996\varepsilon_{t-1}$

Model: MA(1)
ACCURACY
ME: 0.0036
RMSE: 0.0258
MAE: 0.0183
MPE: 4.5229
MAPE: 9.6944
MASE: 0.4560

$Y_t^{TGSI\_FLONA} = -0.8814Y_{t-1} - 0.7642Y_{t-2} - 0.7035Y_{t-3} + \varepsilon_t$

Model: AR(3)
ACCURACY
ME: 0.0022
RMSE: 0.0442
MAE: 0.0296
MPE: 7.9485
MAPE: 22.4699
MASE: 0.5805

$Y_t^{ALBEDO\_IGN} = 0.1134 + \varepsilon_t - 0.9999\varepsilon_{t-1}$

Model: MA(1)
ACCURACY
ME: 0.0004
RMSE: 0.0213
MAE: 0.0173
MPE: 7.8918
MAPE: 18.4797
MASE: 0.3941

$Y_t^{ALBEDO\_FLONA} = 0.0516 + 0.6199Y_{t-1} - 0.5480Y_{t-2} + \varepsilon_t - 0.9999\varepsilon_{t-1}$

Model: ARIMA(2,1)
ACCURACY
ME: 0.0005
RMSE: 0.0031
MAE: 0.0027
MAPE: 1.4151
MAPE: 3.4626
MASE: 0.5284

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