OVERVIEW

At 2.72 million km², Kazakhstan is more than one-third the size of the contiguous US or roughly equal in area to all of Western Europe, including the British Isles. It is bordered by China on the east, Kyrgyzstan and Uzbekistan on the south, the Caspian Sea and a small section of Black Sea to the west, and Russia in the north. Since the abrupt institutional changes surrounding the disintegration of the Soviet Union in the early 1990s, Kazakhstan has reportedly undertaken extensive land-cover changes[1].

Few details are known, however, about the pace or extent of land cover change, due to the collapse of regional environmental monitoring networks in the early 1990s. Marked decreases in livestock and meat production accompany increases in productive rangelands, as measured by vegetation indices. Decentralization and associated privatization of agricultural production following institutional change are expected to increase agricultural output[2].

To be able to assess the significance of changes in vegetation indices, it is necessary to examine the observational record and to place this episode within the larger context of interannual climatic variability and landscape dynamics. We used a standard global dataset to characterize the expected and actual spatial-temporal dynamics of the vegetated land surface.

Data Source
- Pathfinder AVHRR Land (PAL) maximum Normalized Difference Vegetation Index (NDVI)
- Growing Degree Day models
- Temperature data
- Land Cover Land Use Change

A: Identification of agricultural subsets
Two areas are chosen near the city of Kyzylorda (48° 51’ N 65° 32’ E) 1 an irrigated rice area; located next to the Syr-Darya river in the middle of the desert. 2 a desert area which is used to test for deviations and trend due to satellite artifacts.

B: Time series analysis
Wilcoxon's test:
Average NDVI in the irrigated area is significantly higher after institutional change than before (p<0.05).
Average NDVI in the desert area is significantly lower in the second time period.

C: Growing Degree Day models
Simple linear regression has been applied with the NDVI as response variable and GDD as explaining factor.

D: Principal Component Assessment
Principal components are developed for both areas. First 8 eigenvectors explain >99% of the variation. PC1 and PC2, explaining 89% of the variation, are shown in the second image for the irrigated and desert area. The irrigated area shows a more regular pattern after institutional change.

Conclusions
We have shown four ways (Wilcoxon, seasonal-corrected time series, bioclimatological model, PCA) to analyze NDVI time series data and assess for significant differences among areas or time periods.

Some patterns in NDVI data are consistent across years and geographic areas while others are not. Our results show that high climatic variability in the desert compared to the irrigated area is characteristic and most likely a consequence of socio-economic changes.

Indigenous knowledge system is an important source of information for understanding and predicting changes in landcover with sufficient accuracy.

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