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**THE UNIVERSITY OF EDINBURGH**

**SCHOOL OF GEOSCIENCES**

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*BY*

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**Abstract**

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**List of abbreviations**

EU European Union

LUC Land-use change

SPE Socio-politico-economic

SUC Soviet Union collapse

**Introduction**

Land-use, as defined by human use of land (Meyer and Turner, 1992), is undoubtedly an

important part of all civilisations due to the provision of natural resources (Foley et al., 2005;

Turner et al., 2007). Human-driven land-use change through urbanisation, deforestation and

agricultural expansion has placed pressure on the functioning of several ecological processes

such as carbon cycling, as well as ecosystems themselves (Foley et al., 2005; Turner et al.,

2007). Since 1850, roughly 35% of anthropogenic carbon dioxide (CO2) emissions have

resulted directly from human land-use, altering the global carbon cycle (Foley et al., 2005;

Turner et al., 2007). Natural habitat destruction through land conversion is also one of the

largest threats to terrestrial biodiversity, causing extinctions and range reductions (Foley et

al., 2005; Jetz et al., 2007). However, habitat loss such as forest loss and habitat

fragmentation have both proven to also have possible positive effects, including increased

population size (Fahrig, 2017; Daskalova et al., 2018).

Habitat fragmentation and destruction has primarily occurred through changes in agricultural

practices (Foley and Ramankutty, 1999), with croplands and pastures covering over 40% of

Earth’s land surface (Foley et al., 2005). Expansion is made possible through technologies

produced during the ‘Green Revolution,’ an agricultural revolution during the mid-twentieth

century that increased global food production (Foley et al., 2005). However, modern practices

may be compromising long-term ecosystem services (e.g. air quality and nutrient cycling) for

short-term yield increases (Foley et al., 2005). Scientists are therefore concerned with

mitigating against the negative effects of land-use change (Foley and Ramankutty, 1999).

Countries appear to follow similar trajectories of changing land-use regimes, moving from

subsistence to intensive agriculture at differing rates, depending on their socio-economic

contexts (Lambin et al., 2001; Foley et al., 2005). However, a study in Ethiopia indicates that

not all countries follow this pattern, as Ethiopia experienced deintensification within a changing

socio-economic environment (Reid et al., 2000). Rapid socio-economic changes are said to

accelerate land-use change, with land abandonment rates high with regulation change and

the establishment of new institutions (Prishchepov et al., 2013). Agricultural abandonment,

defined as the cessation of agricultural activities, is linked with a shift towards more intensive

agriculture, with smaller farms more likely to be abandoned (Prishchepov et al., 2013). With

rapid shifts in the socio-economic environment, Latvia proves as an ample study site to

examine the common land-use trajectory.

Satellite imagery has often been used in studies aiming to quantify influence of socioeconomic

events on land-use change (Reid et al., 2000; Prishchepov et al., 2012). However,

satellite imagery cannot show land-use specifically, instead depicting land cover, which

indicates solely the type of land (e.g. water, forest etc.). Algorithms must therefore be

developed to effectively categorise land-use types. Such studies (Reid et al., 2000;

Prishchepov et al., 2012) only consider the impacts of one socio-economic event, rather than

several over time. Analysing if the signature of multiple socio-economic shifts can be detected

through land cover change could shed light into the importance of socio-economic events as

drivers of agricultural transitions on a country-scale.

In this study, I will focus on Latvia due to its quick-changing socio-economic status, making it

an appropriate case study to examine if land-use change can be linked to socio-economic

events. The two events I will examine are (1) the Soviet Union collapse in 1991 and (2) the

addition of Latvia to the European Union (EU) in 2004. After the Soviet Union, there was an

increase in abandoned land, tree cutting and percent coverage of protected areas

(Prishchepov et al., 2013). After joining the EU, the share of large farms (intensive) increased,

while the share in small farms (extensive) decreased (Csaki and Jambor, 2009). Ultimately,

this type of analysis could be replicated for other countries to outline the impacts of shifting

economic status on land-use and thus, have implications for wider aspects such as ecosystem

services, the economy and human movement and urbanisation across Europe and globally.

**Objectives**

This study aims to investigate the importance of SPE events as drivers of land-use

change in Latvia through the use of satellite imagery. Although the importance of SPE

events on land-use change is acknowledged (Prishchepov *et al.*, 2012), it remains

unclear whether a recognisable, country-scale signature is left on the landscape. Using

satellite imagery, pixel-scale analysis can be completed to determine specific land cover

transitions over time, potentially unveiling a link between socio-economic events and land-use

change. My findings will give insight into the homogeneity, or lack thereof, of the effects of

socio-economic events on a country-scale. Results will reveal the transition patterns between

each land-use type, including extensive, intensive and abandoned land. Ultimately, my study

will uncover the importance of socio-economic events as a driver of land-use change in Latvia,

permitting predictions about land-use under changing socio-economic conditions to be made.

**Methods**

To answer my three research questions, I constructed a classification of land-use change in Latvia in Google Earth Engine (SOURCE). My workflow diagram, depicting the key steps to this process, can be seen in Figure 1. All code can be found in Appendix X.

**Figure 1** – Workflow diagram, created on Microsoft PowerPoint.

**Classification background**

**Training data**

**Random Forest classification**

**Classification accuracy and error**

**Statistical analyses**