The 36th International Symposium on Remote Sensing of Environment,
11 – 15 May 2015, Berlin, Germany, ISRSE36-523

Sensor requirements for biodiversity research. The role of spatial and spectral resolution in mapping habitat of zoological communities.

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THEME: BIOD – Forests, biodiversity and terrestrial ecosystems

KEY WORDS: spatial resolution, spectral resolution, habitat mapping, hyperspectral, multispectral, biodiversity

ABSTRACT:

Modelling forest habitat types is of crucial importance for biodiversity research on landscape scales. Substantial progress has been made in the development of remote sensing based habitat mapping, for which a multitude of different sensor systems have been employed. Yet, researchers frequently face the decision which remote sensing data to acquire for a particular modelling task. There is no general understanding on how fundamental sensor characteristics such as spectral and spatial resolution interplay in determining mapping success.

Based on airborne hyperspectral data we developed a modelling framework for the identification of both sufficient and optimal sensor characteristics for a given modelling task with respect to spectral and spatial resolution of optical imagery. To this end, we simulate a spatial resolution gradient and a spectral resolution gradient. Furthermore, we simulate different space-borne sensors to evaluate the practical relevance of the simulated sensor systems.

The focus of our study lays on mapping habitat for different zoological communities in montane mixed forest stands in the Bavarian Forest national park in Germany. Habitats are defined for continuous gradients of community similarity obtained by means of multivariate ordination of zoological ground survey data and are subsequently modelled using random forest regression.

We show that optimal sensor choice is primarily driven by an appropriate spatial resolution. In terms of spectral resolution multispectral sensor systems perform equally well as hyperspectral data. However, overall model quality depends on the organism group under investigation and their functional properties such as habitat fidelity.

The presented approach allows us to estimate optimal sensor set-ups or the expected increase in model accuracy if transitioning from less suitable data to more suitable data making this a valuable tool to support the definition of sensor requirements for future missions in an objective, data-driven way.

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