Chlorophyll/phytomass ratios for monitoring desertification of interior steppes of Siberia and Mongolia

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The United Nations Convention (1994) urges human intervention to mitigate the effects of global warming, particularly on expected desertification. Climatic trends over the last 60 years in steppe regions in the south of Siberia show that winter temperature increased by 3o C in the post-industrial period and already significantly prolonged an average growing season. A warming climate should cause steppe expansion. According to global warming of the IS92a scenario of the Hadley Centre, steppes of southern Siberia are predicted to expand by 30% at the expense of the forests by the end of the current century. The desertificated steppes should expand twofold near the Russian-Mongolian border (Tchebakova et al., 2003). Rates of desertification can be remotely monitored based on NDVI imagery using a strong correlation between a chlorophyll index (the amount of chlorophyll on an unit area) and NDVI (Waring, Running,1998).The chlorophyll index should decrease along a dryness gradient with decreasing phytomass due to a strong direct correlation between them.Our goal is to specify chlorophyll/phytomass ratios and chlorophyll index changes in time during the growing season in real steppes and those in space for different steppe types: real steppes, dry and desertificated steppes across interior Siberia and Mongolia. For our temporal study, above-ground phytomass was sampled bi-weekly from May to September across 20 habitats (5 samples per a habitat). For our spatial study, above-ground phytomass was sampled (1-5 samples per each habitat) during peak phytomass in August-early September of 2004 across different steppe types of interior Siberian and Mongolian regions: real steppes (Shira in Hakasia; Hatgal in Mongolia), dry steppes (Uvs-Nuur in Tyva; Muren and Hustai in Mongolia), and desertificated steppes (Kosh-Agach in Altai). Chlorophyll content was found for each sample by a conventional technique using a colorimeter KFK. Temporally, the chlorophyll index changed from 0 in early spring to 0.5 g m -2 in summer in Hakasian real steppes and highly correlated to green phytomass ($R2 = 0.8$). Spatially, the chlorophyll index changed along the dryness gradient: 0.25-0.5 g m -2 in real steppes, to 0.1-0.2 g m -2 in dry steppes and less than 0.1 g m -2 in desertificated steppes. So, a value of the chlorophyll index less than 0.1 g m -2 may be accepted as a marker of the desertification border. When recalculated into phytomass through a ratio chlorophyll/phytomass, it gives 45 g m -2 of phytomass which is close to a limit of green phytomass production over dry lands. This limit corresponds to an NDVI value 0.07 (Zolotokrylin, 2003) and can be remotely monitored in a warming climate.