



Vegetation changes during Early Jurassic global warming with impacts on oceanic anoxia

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Global warming and oceanic oxygen deficiency during the Early Jurassic Toarcian Oceanic Anoxic Event (T-OAE; ~183 million years ago) is associated with mass extinction in the oceans linked to volcanic activity. However, the effects of this warming event on land-based ecosystems have remained poorly understood. Here we present spore-pollen and marine palynological data from Yorkshire, UK, that reveal substantial changes in vegetation on land and plankton communities in the oceans. Forest ecosystems shifted from a diverse mixture of conifers, seed ferns, ferns and lycophytes, to a low-diversity community dominated by cycads and *Cerebropollenites*-producers during the event. After temperatures returned to normal, forest ecosystems recovered, however the dominant tree groups were notably different after the event, signifying long-term consequences for continental ecosystems. In the oceans, dinoflagellates disappeared – this is a widespread signal noted from several localities previously – and the warming led to massive algal blooms and eutrophication in shelf seas. The substantial initial ecosystem response on land compared to the relatively minor marine response at the Pliensbachian/Toarcian boundary (before the T-OAE) suggests that the early stages of warming were more severe on the continents than in the oceans.