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Peat Surface Response to the 2018 European Drought Event. Evidence from InSAR and Levelling

Chris Marshall (1,2), Peter Gilbert (2), Henk Pieter Sterk (2), Andrew Bradley (1), Roxane Andersen (2), Lauren Parry (3), Andrew Sowter (4), Stuart Marsh (1), and David Large (1)

(1) Chemical and Environmental Engineering, University of Nottingham, Nottingham, United Kingdom (Christopher.Marshall@nottingham.ac.uk), (2) ERI, University of Highlands and Islands, Thurso, United Kingdom, (3) School of Interdisciplinary Studies, University of Glasgow, Dumfries, United Kingdom, (4) Geomatic Ventures Ltd, Nottingham, United Kingdom

Prolonged drought across Western Europe during the period May 2018-July August 2018 had substantial impact on UK peatland, triggering widespread drawdown of water tables, sphagnum bleaching and a series of large peatland fires. Whilst in the past the low frequency of such events allowed time for peatland recovery, recent climate predictions indicate that by 2050, the annual chance of temperatures at or in excess of 2018 will increase to around 50%. Periods of hydrological stress such as 2018 therefore provide an opportunity to examine the thresholds beyond which blanket peatlands are not able to recover hydrological function without significant adaptation or systemic change. Satellite remote sensing facilitated by the ESA Sentinel programme offers a reliable, cost-effective method to upscale these field observations to the landscape scale, improving our knowledge of how peatlands are likely to respond to changes in temperature and precipitation regimes in the future. Both field and satellite derived measurements of peat surface motion were collected from lowland and upland blanket peatland in the Flow Country (Caithness and Sutherland, UK) for the period Aug 2017-Dec 2018. The onset of drought conditions in May 2018 caused peat surface height to drop rapidly across the sites studied, peaking in Late June at between 2 and 10cm below previous summer values. This was accompanied by an associated drop in water level of between 10 and 20 cm and a 20-40% drop in surface (5cm depth) soil moisture. Greatest motion was observed in lowland pool areas (5-10cm) and least in upland plateau and peatland edge sites (1-2cm). The rapid decrease observed in pool areas appears to better maintain soil moisture, by tracking water levels. Recovery from the drought was initiated during September 2018. Upland peats recovered to their previous winter height by December 2018, (2 months later than the previous year). Recovery in the lowland peat surface has been subdued with 180 days (central areas) and 600 days (peatland edge) required at current rates of recovery. Satellite Radar (InSAR) measurements at the scale of the Flow Country shows that blanket peatland drought response may relate to position within meso-scale hydrological units whose surface behaves similarly. For example, upland peats show remarkably homogenous surface response to drought across large areas despite apparent diversity of peatland environments. Overall the evidence from the 2018 drought indicates that lowland peats, particularly peatland edges may be less resilient to drought conditions than the upland peats studied despite the upland peats poorer condition (numerous erosion features and dried pools). As peatland edges are the position where peatland expansion and contraction initiate, their apparent vulnerability to drought may be a threat to the proper hydrological functioning of this globally rare habitat and valuable C store.