Climate risk regarding multiple drought- and fire-associated hazards in the peatlands of Indonesian Borneo

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Introduction

- We quantify teleconnections of droughts in Indonesian Borneo in the past and future, using observational and CMIP6 data respectively.

Impacts

- Informs the potential of a systematic causal approach to statistical inference as a powerful tool to verify and explore atmospheric teleconnections.
- Enables seasonal forecasting to strengthen prevention and control of drought and fire multihazards over peatlands in Central Kalimantan.

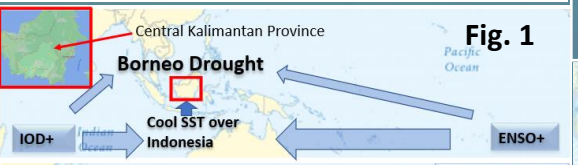

Fig. 1

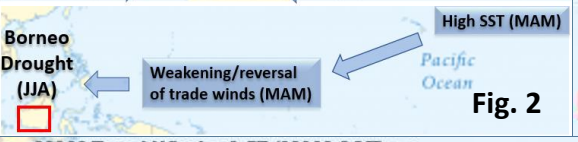

Fig. 2

Method

- Teleconnections of low rainfall anomalies in Indonesian Borneo are analysed and quantified using causal inference theory and causal networks.
- Causal hypotheses are first developed based on climate model experiments in literature (Hendon 2003, Ashok et al. 2001, Alexander et al. 2010) to construct a causal diagram (Fig. 1 and 2, with arrows indicating hypothesised causal relationships).
- The hypotheses are then tested by means of partial regression analysis (Pearl 2013) between seasonal time series of rainfall in Indonesian Borneo and its drivers for various time periods – Historical (1981 – 2014), Near Future (2021 – 2060) and Far Future (2061 – 2100), under SSP245 and SSP585 scenarios.
- Monthly time series are obtained by concatenating gridded datasets based on areal average. All time series are standardised and detrended. * $p < 0.001$

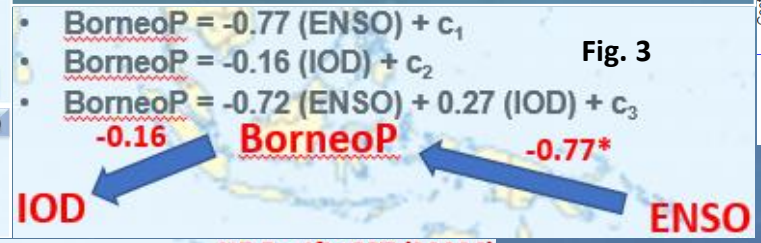

Fig. 3

Fig. 4

Results

- El Niño Southern Oscillation (ENSO) has a profound effect on rainfall in Indonesian Borneo, with its positive phase serving as a direct driver of low rainfall, while Indian Ocean Dipole (IOD) does not pose a significant effect (Fig. 3). There is no significant change of ENSO-Borneo rainfall relationship towards the future (Fig. 5).
- Through the wind-evaporation-SST feedback, elevated SST over the east of Hawaii during boreal spring weakens trade winds over equatorial Western Pacific and reduces dry season rainfall in Indonesian Borneo (Fig. 4). The driver may strengthen under a warming climate (Fig. 6).

Discussions

- The presence of robust teleconnections enables seasonal prediction of droughts in Indonesian Borneo with a lead-time of three months. Predictability may enhance in the future subject to strengthening of drivers.
- There are a few shortcomings of this method in representing ENSO dynamics, due to its cyclic and non-linear nature, low ratio of predictable component, and fast evolution during boreal spring.

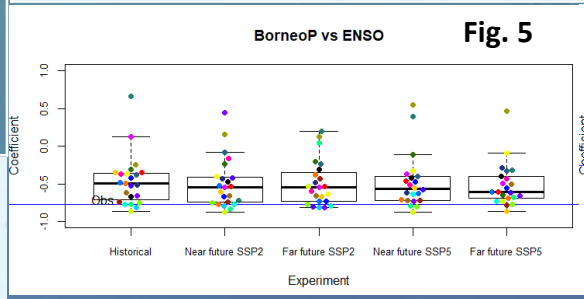

Fig. 5

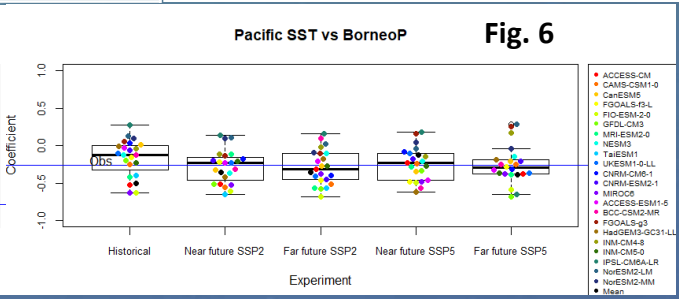

Fig. 6

Acknowledgement

This work forms a part of PhD thesis of the first author, who received full studentship award from UKRI Centre for Doctoral Training in Environmental Intelligence, University of Exeter.

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