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CENTRE FOR **Landscape** and **Climate Research**
DEPARTMENT OF **Geography**

Modelling carbon dioxide flux at an intensively cultivated lowland peatland in East Anglia, UK

Hao Wang

Including work by Mark Richards, Douglas Clark, Jörg Kaduk, Heiko Balzter, Alex Cumming, Ross Morrison, Jo Smith, Pete Smith and others

hw173@le.ac.uk

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Outline

- Research Questions
- Methods
- Initial Results
- Conclusions

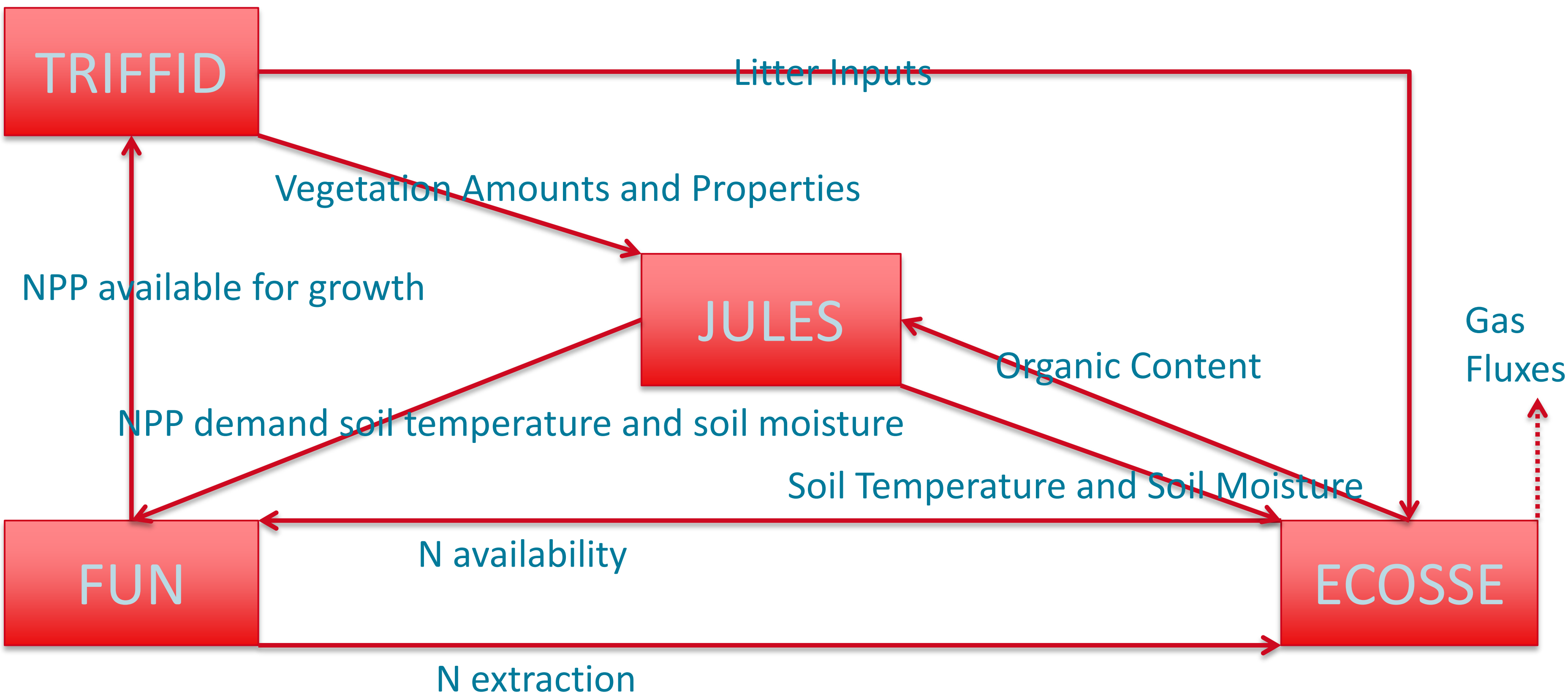
Research questions

- Can a state-of-the-art land surface model (JULES) be improved by coupling dedicated soil GHG and nitrogen exchange simulation models such as ECOSSE and FUN, when validated with flux tower measurements?
- Which variables in JULES-ECOSSE produce the strongest correlations with carbon dioxide flux?
- Which meteorological factors are correlated with the carbon dioxide flux from the soil?

Method-Why do model coupling

- Land surface models simplify the physical processes in nature, and help to make predictions about ecosystem's behaviour;
- Although JULES is a widely use model which can run on flexible scales, it cannot simulate the GHGs emissions from wetlands well;
- ECOSSE simulates the emissions of GHGs from the soil, including CO_2,NO_2 and CH_4, meanwhile FUN simulates plant nitrogen uptake;
- Model coupling could enhance the simulated parameters, and the comparison between theoretical models and measurements from field experiments may develop new hypothesis.

Method-Model coupling rationale

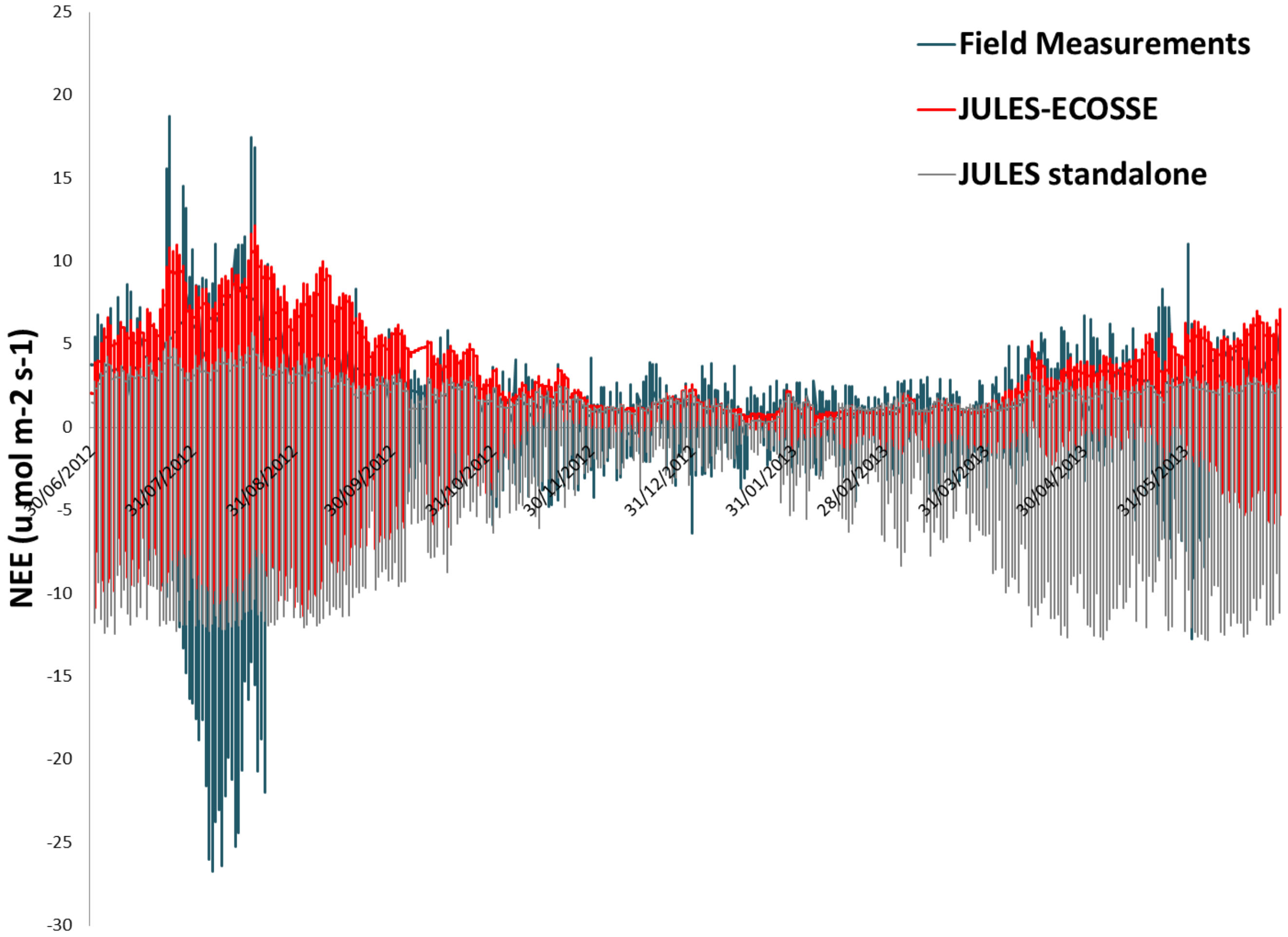


JULES-ECOSSE-FUN model structure (Clark,2011)

Method-Eddy covariance measurements

Eddy covariance (EC) flux tower in Rosedene Fens

Initial results-Model performance



Correlation Coefficient:
JULES standalone: 0.53
JULES-ECOSSE: 0.67
JULES-ECOSSE-FUN: 0.65

Initial results-different scenarios

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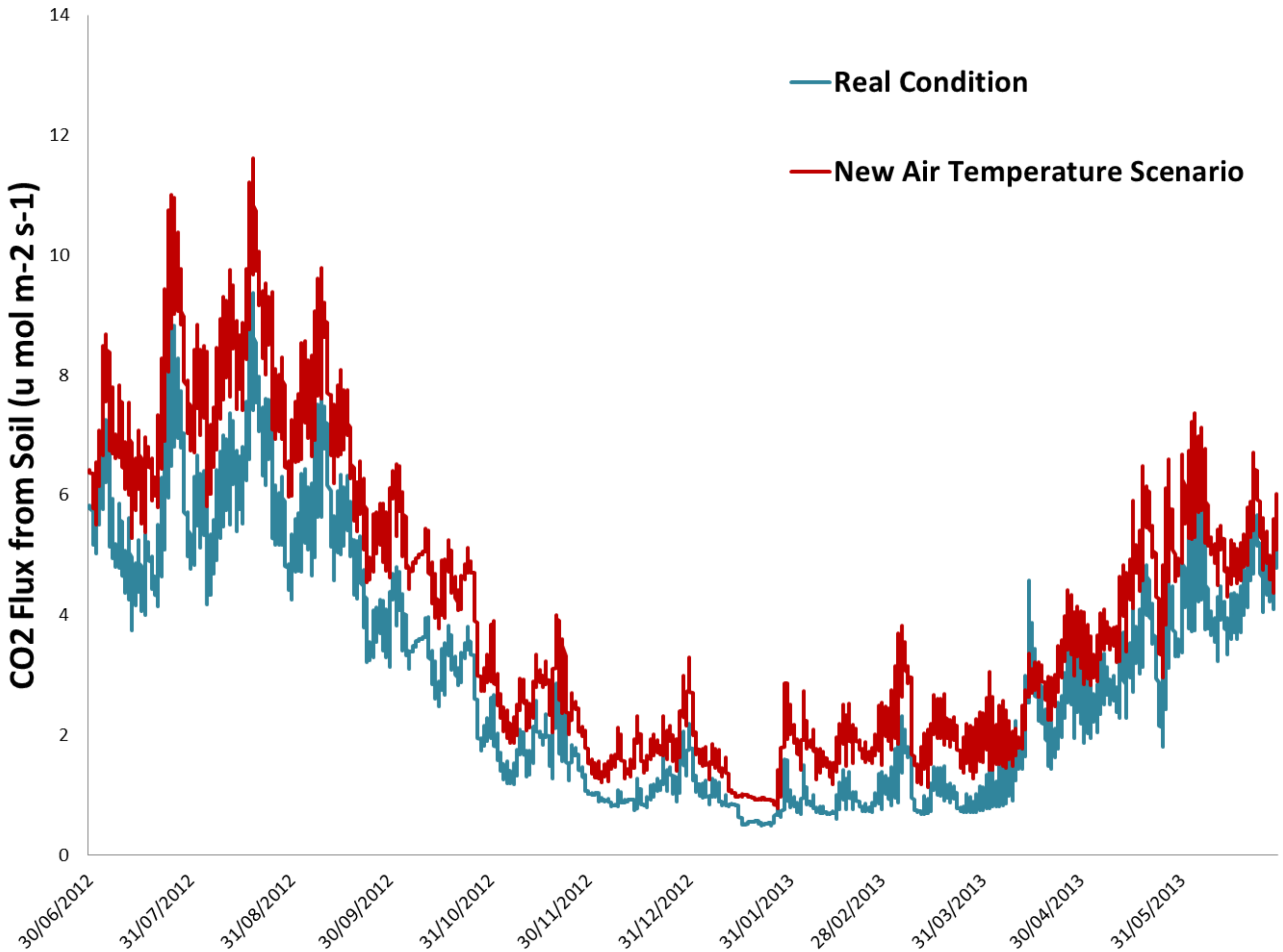
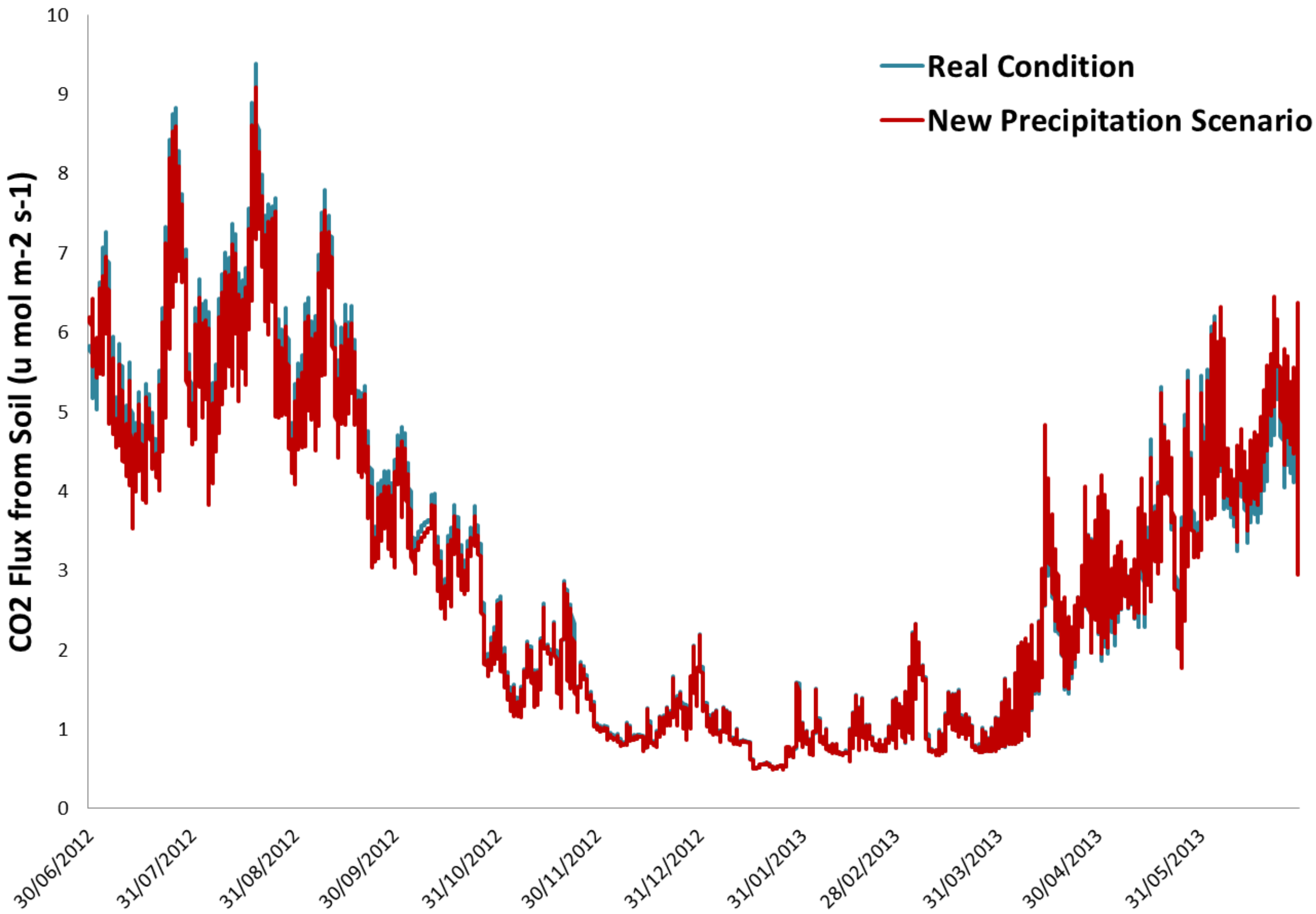
Initial results-meteorology impact-air temperature



Blue: CO_2 flux from soil with the field measured climate condition;
Red: CO_2 flux from soil with an increased air temperature scenario

Initial results-meteorology impact-precipitation



Blue: CO_2 flux from soil with the field measured climate condition;
Red: CO_2 flux from soil with an increased precipitation scenario

Initial results

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Conclusion

- JULES-ECOSSE and JULES-ECOSSE-FUN have the better performance than JULES standalone on simulating CO_2 flux at lowland peatland;
- The most relevant meteorology factor controlling the annual CO_2 flux of lowland peatland is the air temperature. Even so, Couwenberg et al. (2011) illustrated the water table and vegetation type are the key factors for gas exchange rates of peatland, which need to be proved later;
- Since Rosedene is an intensively cultivated peatland, it is hard to set up the leaf area index, and other soil parameters, which may lead to the uncertainties for model simulations;
- The impacts of precipitation rate need more accurate soil parameter optimizations.

Future work

- The impacts of soil moisture and the mean water table on CO_2 flux will be analysed;
- The point scale results will be scaled up to the entire East Anglia, using the soil map and meteorology data with 1 km resolution.

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Thank You!