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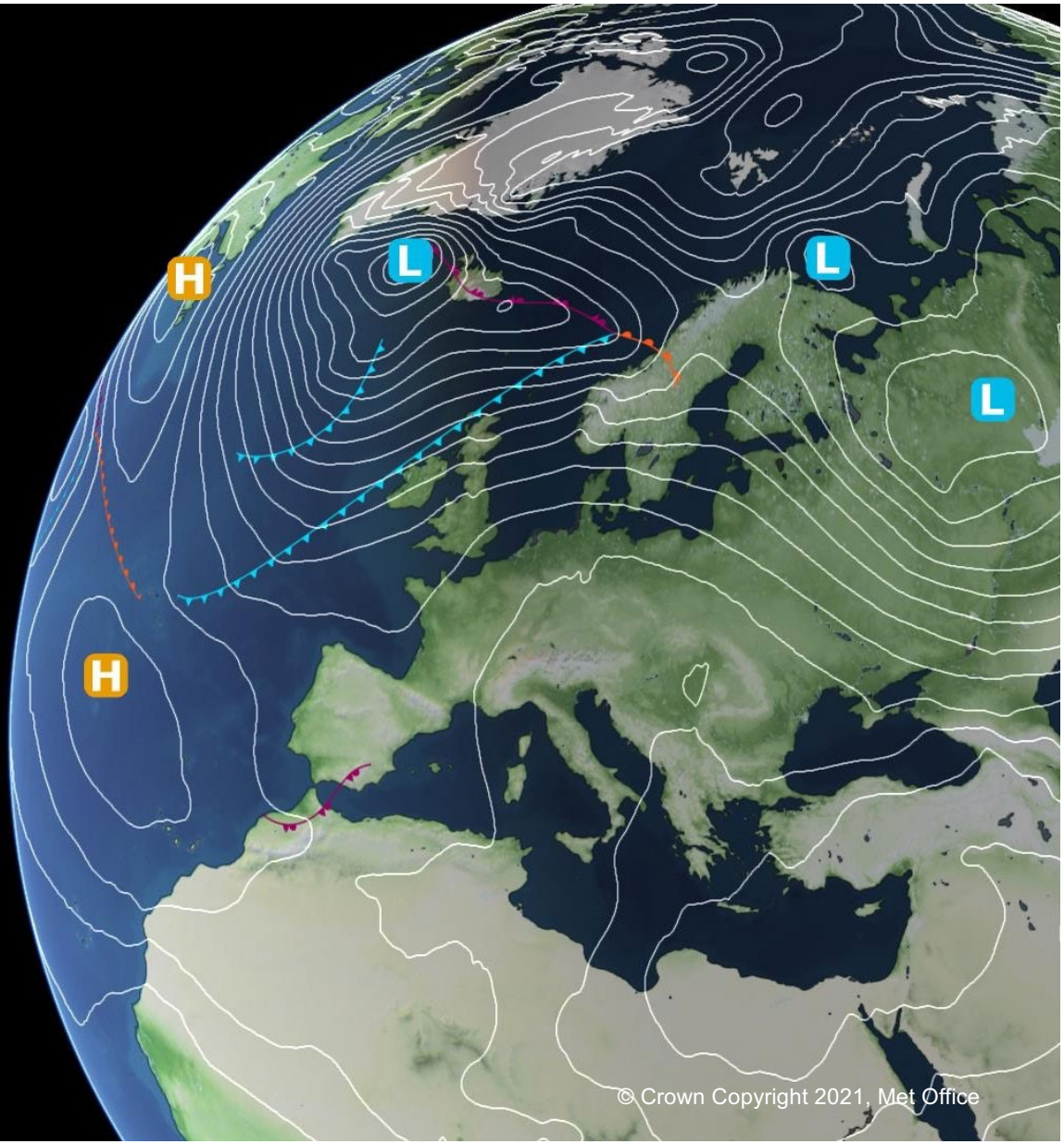
N-cycle coupling with Terrestrial C-cycle

Eddy Robertson

UKESM2 UKCA Planning

26 March 2021



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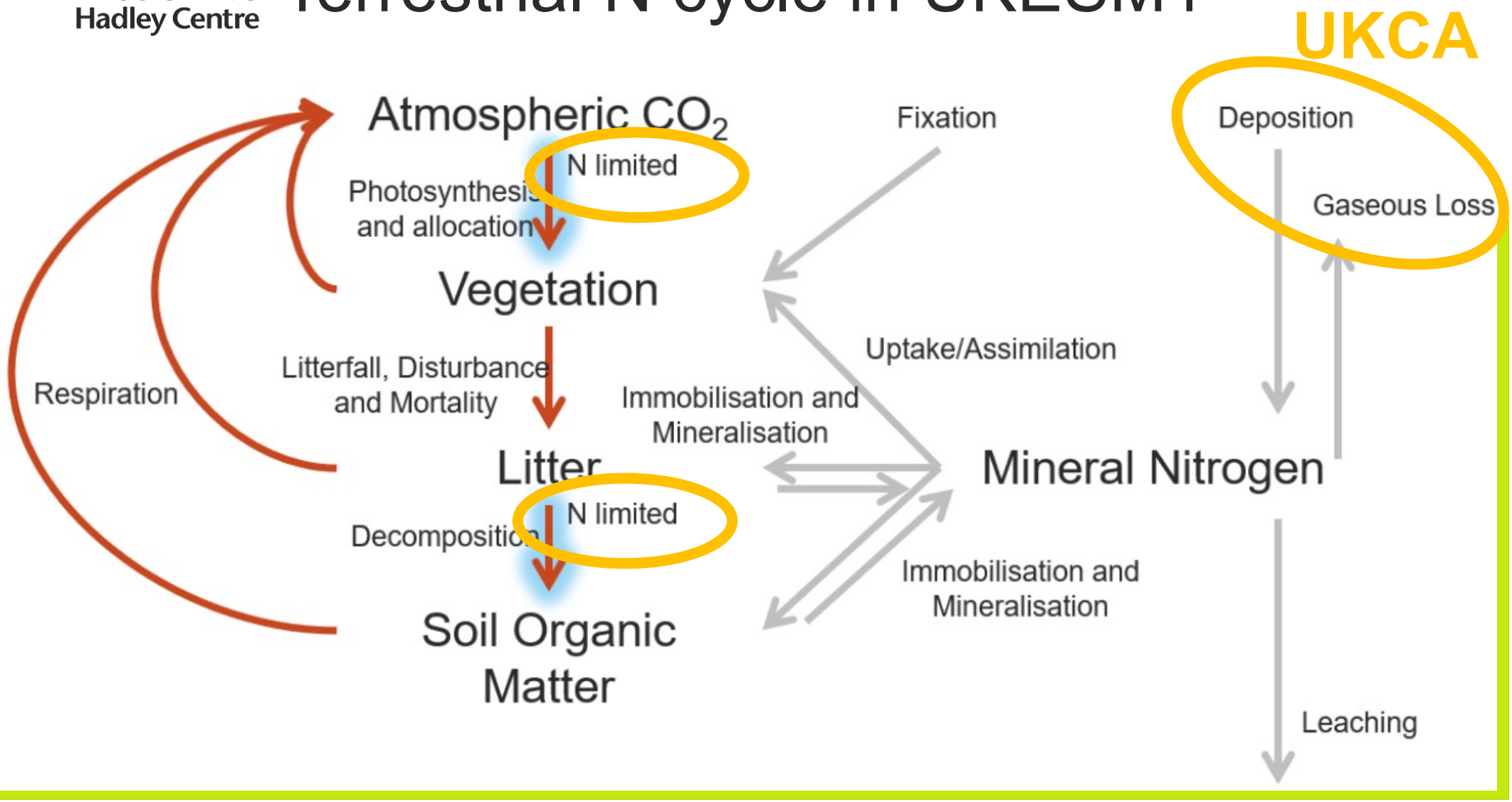
Description of the JULES-ES (UKESM1) terrestrial nitrogen scheme:

Wiltshire, A. J., Burke, E. J., Chadburn, S. E., Jones, C. D., Cox, P. M., Davies-Barnard, T., Friedlingstein, P., Harper, A. B., Liddicoat, S., Sitch, S. A., and Zaehle, S.: JULES-CN: a coupled terrestrial Carbon-Nitrogen Scheme (JULES vn5.1), Geosci. Model Dev. Discuss. [preprint], https://doi.org/10.5194/gmd-2020-205, in review, 2020.

https://gmd.copernicus.org/preprints/gmd-2020-205/gmd-2020-205.pdf

Terrestrial N cycle in UKESM1



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UKESM2 Land Developments

Vegetation-fire interactions

Temperature acclimation

Permafrost

- Organic soils ancillary
- More and deeper soil levels
- Vertically varying soil properties
- Vertically resolved soil carbon and nitrogen pools

Limitation of productivity by soil-moisture availability

- Improved parameterisation of limitation
- Deeper soil levels (improved simulation of available soil moisture)

(Further understanding/tuning of land-N scheme)

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Potential Couplings

Land can easily make use of UKCA nitrogen deposition

Could potentially supply N-emissions

Fire nitrogen emissions that conserve nitrogen

Permafrost nitrogen emissions

Could test the impacts of radiative N_2O feedbacks in IMOGEN

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Potential Issues

Is land-surface sensitive to deposition?

Will atmospheric-coupling help constrain land-N, or will poorly constrained land emissions lead to unrealistic feedbacks?

How will the coupled system be spun-up?

- Now we have plant-soil nitrogen coupling the land surface is very slow to spin-up
- For UKESM1, 10s of thousands of years of spin-up were done in JULES, before further spin-up in UKESM
- We are hoping to improve our spin-up methodology for UKESM2

Fire emissions do not currently conserve carbon or nitrogen.

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Is land-surface sensitive to deposition?