JULES Surface Module Updates
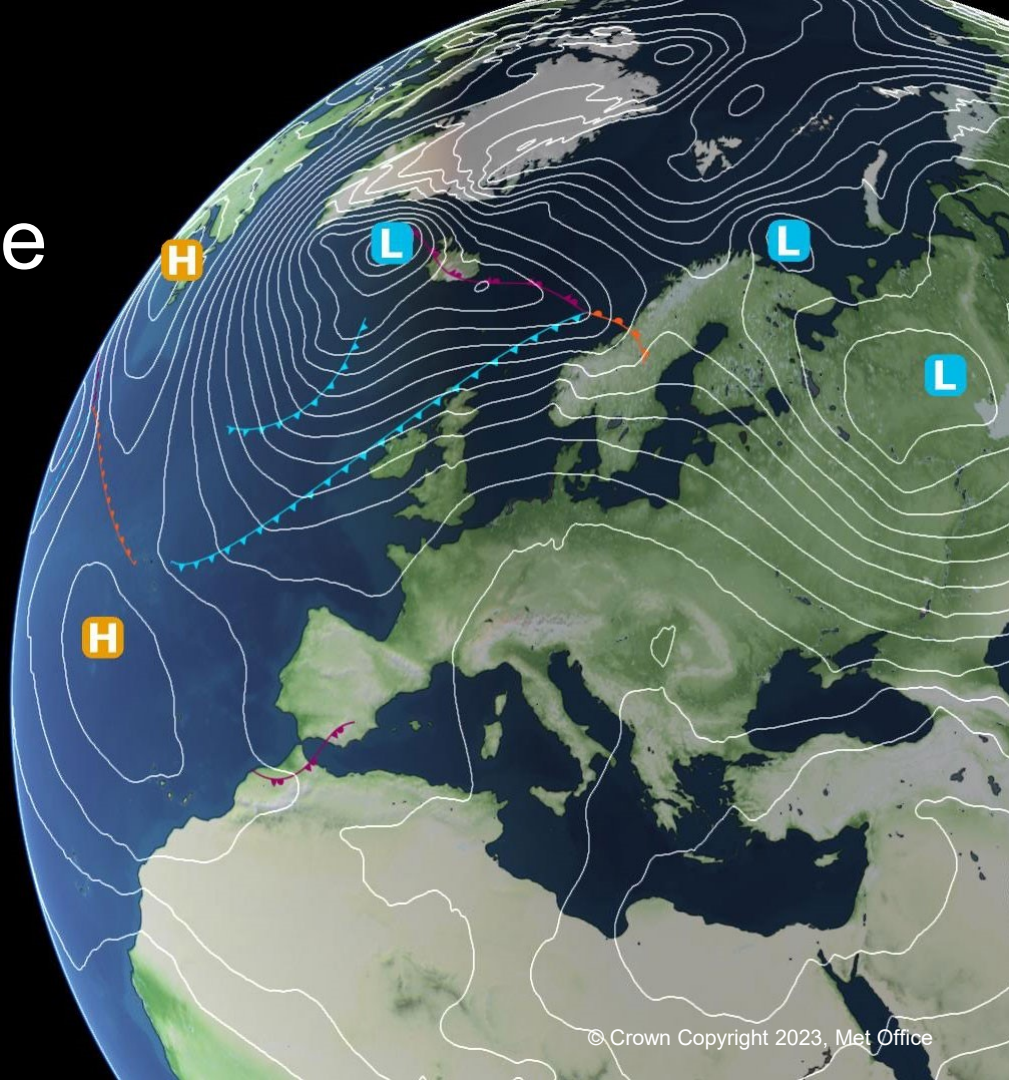
JULES Annual Science Meeting 2024

John Edwards, Rich Ellis

# Topics

- Anthropogenic Heating

- Snow

- Ancillary Data

Urban anthropogenic heat

Met Office

Katty Huang, Andy Wiltshire, Maggie Hendry, Andy Hartley

What was done?

- New urban anthropogenic heat option (Flanner 2009): added diurnal cycle and latitude-dependent seasonal cycle
  - JULES ticket #1371, pending LFRic debugging

- Apply MORUSES urban roof-canyon representation in global UKESM simulations (N96 resolution, ~135km)

- Morphology parameters for MORUSES upscaled from empirical relationship (Bohnenstengel et al. 2011) calculated using 1-km urban fractions
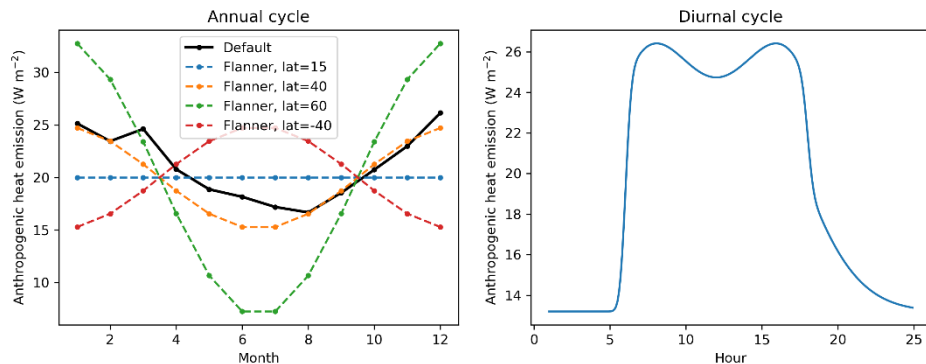
Impact on urban-rural T difference (all model grids with urban fraction > 1%)
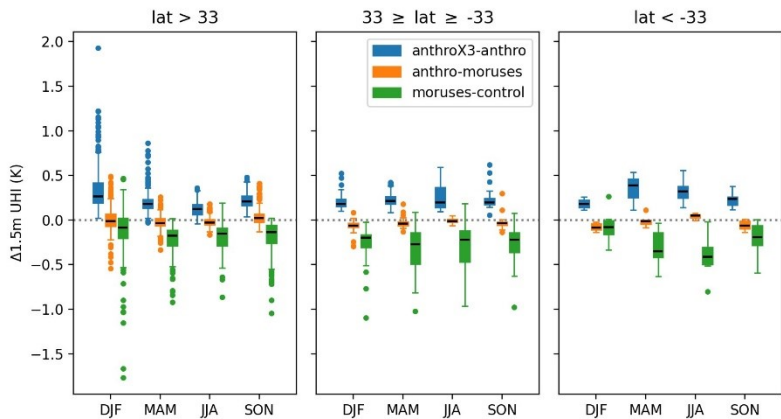
- Urban heat island (UHI): difference in T between urban and non-urban tiles of the same model grid

- Minimal impact on the global median, but more geographical variability (orange boxplots)

- MORUSES produces significantly lower urban temperatures than 1-tile urban scheme (green boxplots)

UKESM AMIP simulations

Name	Urban representation	Anthropogenic heat	Baseline anthropogenic heat
control	1-tile	Fixed annual cycle	-
moruses	MORUSES	Fixed annual cycle	-
anthro	MORUSES	Flanner (2009)	20 W m^{-2}
anthroX3	MORUSES	Flanner (2009)	60 W m^{-2}

Snow

- Long-standing issue of negative snow in JULES: Occasionally up to -1.5 kgm^{-2}
  - Incorrect formulation of melting – main issue
  - Negative interception by an overloaded canopy
- "Fixed" under ticket https://code.metoffice.gov.uk/trac/jules/ticket/1396
  - L_fix_neg_snow → .T.
- Two outstanding issues
  - Branch passed all tests, but subsequent crashes on some compilers and at single precision reported. Numerical issue
  - Associated move from melting rates to increments is not quite right
  - Both will be fixed under https://code.metoffice.gov.uk/trac/jules/ticket/1516
  - (Also needs a change in LFRic)
- Further development of the snow scheme planned in the near future

Ancillary Data - Mainly for users of the UM

- Land cover, leaf area index, canopy height… in gridded runs

- Historically generated by the Central Ancillary Programme (CAP)

- CAP has been replaced by ANTS

- Using ANTS there is ongoing work to improve gridded ancillary data for use in JULES. Topics include…
  - Wider range of land-cover data, e.g. CORINE over Europe
  - Support for the17-tile ESM configuration
    - We have UM ancillaries for 17 tiles
    - Standard testing in prospect

C3 Vegetation in the UKV from CORINE on 17 tiles

Natural   Crop   Pasture