Meteorological forcing, ancillary data and evaluation methods as sources of errors and uncertainty in JULES

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With thanks to: Jaakko Ikonen, Kimmo Rautiainen, Riika Ylitalo, Jouri Pulliainen (FMI); Richard Essery (UoEdinburgh); Graham Weedon, Matt Pryor (Met Office)
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I think there is a problem with the snow module.

Hmmm....

Bla bla canopy_model = 4 bla bla
A few weeks later….

=> Problem traced to new switch in JULES *nml

How much of JULES’s performance is due to poor process representation and how much to poor implementation of JULES?
• **Choice 1: Site**
  Two sites in Finnish Lapland: Clearing + Forest, 2007-2012
• **Choice 2: Meteorological data**
  FMI AWS, WFDEI, NCEP CFSR/CFSv2
• **Choice 3: Ancillary data (LAI, snow-free albedo, canopy height, vegetation fraction)**
  In situ measurements, Met Office CAP
• **Choice 4: Performance metrics**
  uRMSE, RMSE, bias, R, $\sigma_M / \sigma_O$, variance (quantification of uncertainty)
• **Choice 5: Temporal scale of output**
  Hourly, daily, monthly, seasonally
• **Choice 6: JULES 3.0 to 4.1**

Menard et al., JHM, submitted
Conclusions

1. JULES does not produce significant bias and the modelled amplitude and seasonality correspond well to measurements at the studied site when provided with measured meteorological and ancillary data.

2. At times, performance metrics (RMSE, R, $\sigma_M/\sigma_O$, bias) of the NCEP and WFDEI members suggested that they performed well but they didn’t: “right results for the wrong reasons”.

![Graph showing $S_0$ for forest over years 2009 to 2012. The graph includes observations, JULES run with in situ data, and the ensemble range.]

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3. The ability of the model to reproduce the snow depth and water equivalent had a considerable effect on all of the other evaluated model outputs.

4. Model results significantly differed depending on the version of JULES used.
Since JULES 3.0

\[ l_{\text{snowdepth\_surf}} + \text{can\_model} = 4 \]
Since JULES 3.3.
l_snowdepth_albedo + l_spec_albedo
Final remarks…

• JULES performs well at this site but…
• …sometimes for the wrong reasons…
• …only if we know how to juggle with its logical switching.
• What are the implication for
  ➢ The JULES community?
  ➢ The published model results (e.g. global scale)?
  ➢ Funding?
➢ Should we focus on training or a “science” manual?