Configuration management in JULES

Scope: Model simulations require four components: 1) the model code; 2) the model control files (switches and parameter values); 3) the driving data; and 4) ancillary data (including initial conditions and boundary conditions). Collectively, these are called the *model configuration*. Traceability of model developments and scientific results based on model simulations require clear documentation of model configurations.

> *The configuration is all of the switches and options a user selects when setting up a simulation. The JULES code structure sets all options in a set of namelists.*

A well-documented set of configurations will enable new users to run the model for their specific application, and to determine if the results make sense against published benchmarks. From that point, they can make developments or run simulations for scientific analysis.

In light of these challenges, it is beneficial to develop a well-documented strategy for configuration management in JULES. In the remainder of the document we will summarise:

1) What is a configuration?
2) How are configurations evaluated?
3) How should configurations be documented?
4) How are configurations shared?
5) The responsibility of JULES management.
6) The responsibility of JULES users

What is a configuration: See italicized definition above. Any configuration is dependent, in its development and assessment, on the driving and ancillary data it specifies. Therefore although these data might not be distributed with each configuration, their sources and nature (e.g. "global", "point", etc.) should be specified. When results from a model simulation are published, the data used to produce that simulation must be specified.

There are two types of configurations in JULES: 'Core' and 'Research-community'. Core configurations are routinely maintained and updated as part of each JULES release. These configurations are guaranteed to produce output that is bit-comparable between JULES versions. Examples of Core configurations are GL7 (Global Land version 7) and JULES-Carbon Cycle (which includes the settings used in the UK Earth System Model). In addition, Research-community configurations reflect specific research issues. They are intended for use by the JULES development and research community, but they are maintained on an *ad hoc* basis rather than routinely.

Users can contribute a new research-community configuration based on evaluation of the model over a particular region or including new developments. Examples of recent user-contributed configurations are those from JULES-Crop and for the 9 PFTs with trait physiology.

Note that in the past switches could be "hidden" - set to a default value without an entry in the relevant namelist. For the sake of transparency, this practice should be avoided. Although the default values are listed in the User's Guide, this can lead to confusion. Also, some default values are chosen to maintain backwards compatibility with previous model versions, regardless of what the recommended "science" setting would be. In the future, all "hidden"

switches should be populated in the namelists or in Rose. In the case of Rose suites, the trigger ignored syntax "!!" allows the user to see but not run with the settings.

Evaluation: Core configurations are routinely updated and maintained, but the process for routine evaluation is being developed. A good example is the UM general assessment that occurs every six months. During the general assessment, results are evaluated against a set of metrics to see where the model has improved or worsened, and to highlight areas needing improvement (these can be further addressed through community evaluation and process-based development groups/task forces). To carry out such evaluations in JULES, we would need:

1) A set of Core and commonly used Research-community configurations that are tested routinely and improved upon;
2) An evaluation package (there may be two stages to this: e.g. a simple evaluation based on diurnal-to-monthly values and a range of metrics covering carbon, heat and water budgets based on the iLAMB system, and a more process-oriented evaluation including diurnal cycle based on the LVT system);
3) A leadership team willing to gather once or twice a year to assess the results and determine the priorities for future model development (could be the module leaders or they could nominate suitable people from their themes).

If you are interested in contributing to routine evaluation of JULES configurations please contact Eleanor Blyth.

Documentation and sharing: Configurations should be well documented and explained, for a list of configurations and relevant links see the JULES website. Core configurations should be documented in scientific publications, and research publications should at least have links to evaluation (e.g. from conference presentations). Documentation on the website should include the evaluation of a configuration – either links to a published paper or a set of plots generated with the evaluation packaged mentioned above. Diagnostics can be added as new processes are added into the model.

Configurations should be made available as a Rose suite. This makes it easy for new users to copy the configuration and begin their own work. If a user wants to contribute a configuration, but is not familiar with Rose, they should seek some assistance, rather than not sharing the configuration. Ideally, institutions with a large number of JULES users will have a local JULES ambassador who is able to help new users. In the absence of such a person, the appropriate module leaders should be contacted.

Expectations of JULES management

JULES science module leaders should be aware of the developments on-going in their theme. and be able to recommend settings for a research configuration based on developments within the theme. The JULES management should ensure that updates to the configurations are clearly communicated with the user community via the JULES website. The expected results from a given configuration (+a model version, ancillary and driving data) should be clearly communicated so users know what to expect when they run the model. Currently, the JULES Science Committee is reviewing the set of Core configurations and updating the set of configurations released with new JULES versions.

Expectations of JULES users

Users are advised to base their simulations on established configurations. This will increase the traceability of their results and reduce confusion and frustration. Users should contribute to the documentation and evaluation of new configurations. It is a user's responsibility to

share a new configuration as explained above, and to alert module leaders of their developments.