

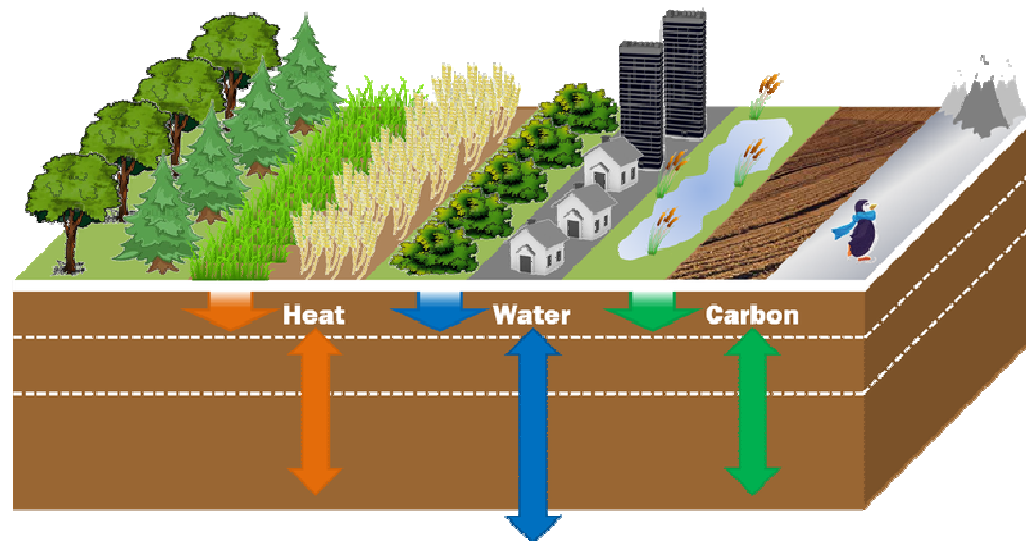


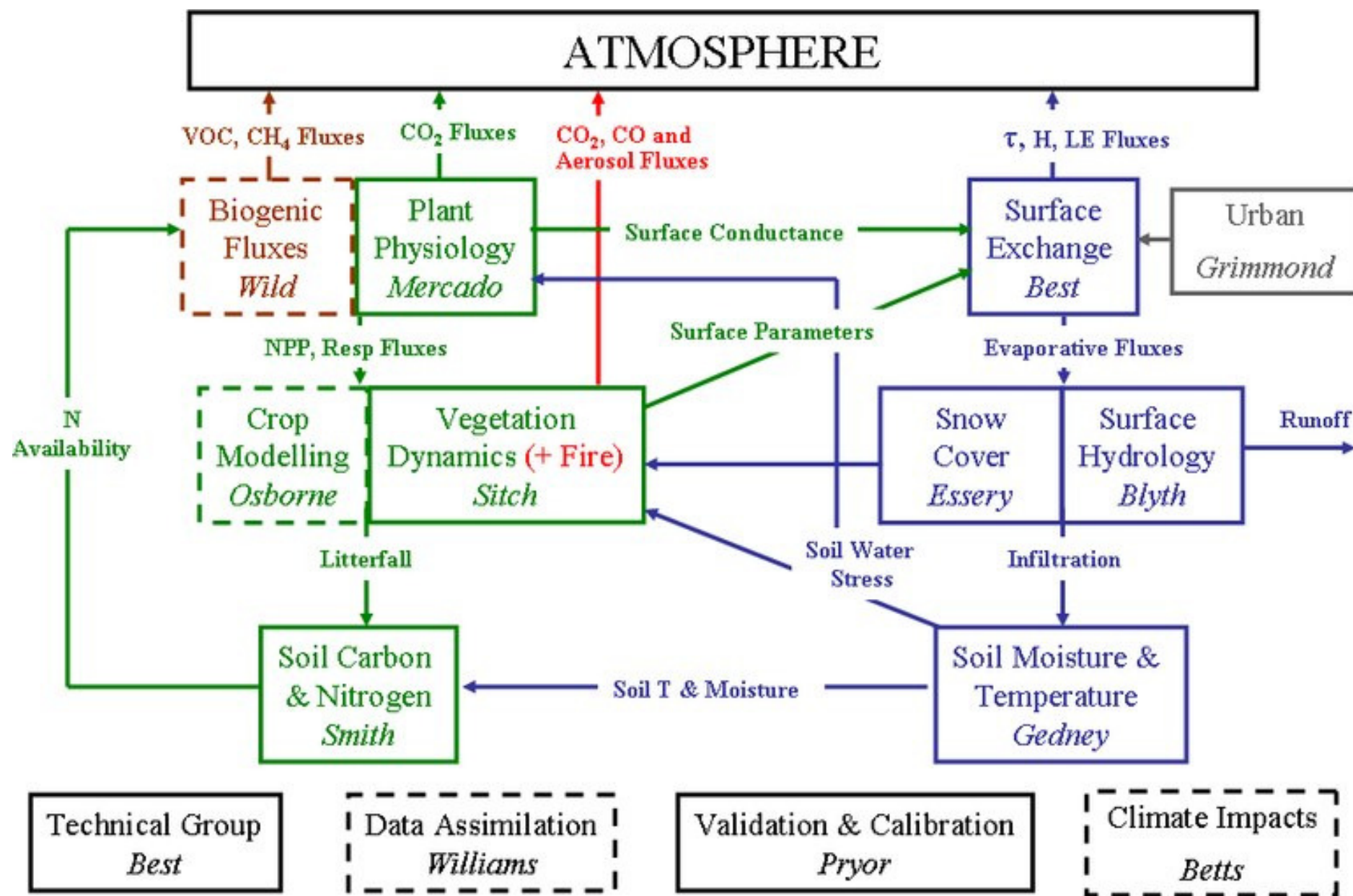
JULES

Joint UK Land
Environment Simulator

19-20 June 2013

University of Edinburgh







Version releases
Matt Pryor



JULES Version 3.1

Release notes

See <https://jules.ichmr.org/software-and-documentation/jules-v3.1>

- **Directory structure changed to be more logical and allow for a cleaner separation between control, initialisation, I/O and science code**
- **New I/O framework**
 - Code modularised and simplified
 - Data can be input on any time-step and interpolated down to the model time-step
 - NetCDF is now the only supported binary format, ASCII files for single points only
- **Monolithic run control file replaced by several smaller Fortran namelist files**
- **Other changes**
 - Structures are now used for dimensioning variables
 - Move to a new implicit solver - `sf_impl2` is now used rather than `sf_impl`
 - Density of fresh snow prescribed by a new variable (`rho_snow_fresh`)
 - Various bug fixes



JULES Version 3.2

Release notes

See <https://jules.jchmr.org/software-and-documentation/jules-v3.2>

- **Standard Configurations**
- **Improvements to output**
 - Concept of the ‘capture point’ of a variable
 - New CF convention `cell_bounds` and `cell_methods` attributes
 - Units attribute updated to be compliant with UDUNITS2
 - CF convention `coordinates` attribute added to all output variables
- **Biogenic Volatile Organic Compound (BVOC) emissions**
 - Federica’s code for isoprene emissions has been implemented and extended to include monoterpene, acetone and methanol emissions diagnostics.
- **Ability to build JULES using FCM make**
- **Various bugs fixed**



JULES Version 3.3

Release notes

See <https://jules.jchmr.org/software-and-documentation/jules-v3.3>

- **Ability to run JULES in parallel**
 - Uses MPI; NetCDF must be compiled to allow parallel I/O (not the default)
- **Changes to documentation**
 - Documentation now provided in HTML and PDF format; HTML docs on the web (<http://www.jchmr.org/jules/documentation/>)
 - Both formats built from same reStructuredText (a markup language) files using the Sphinx documentation generator
 - reStructuredText is a plain text format, meaning that it can be version controlled
 - PUMA repository refactored so that configurations, documentation and examples are in a separate project to the core Fortran code
- **Other changes**
 - I/O changes - improvements to logging; can specify namelist directory as an argument
 - Several bug fixes and small changes to the numerics



JULES

**Joint UK Land
Environment Simulator**

Surface exchange, urban, cal/val
Martin Best



Surface Exchange

- Plans:
 - Multiple-source tile scheme
 - Variable blending height
 - Consistent surface turbulence
 - Canopy scheme



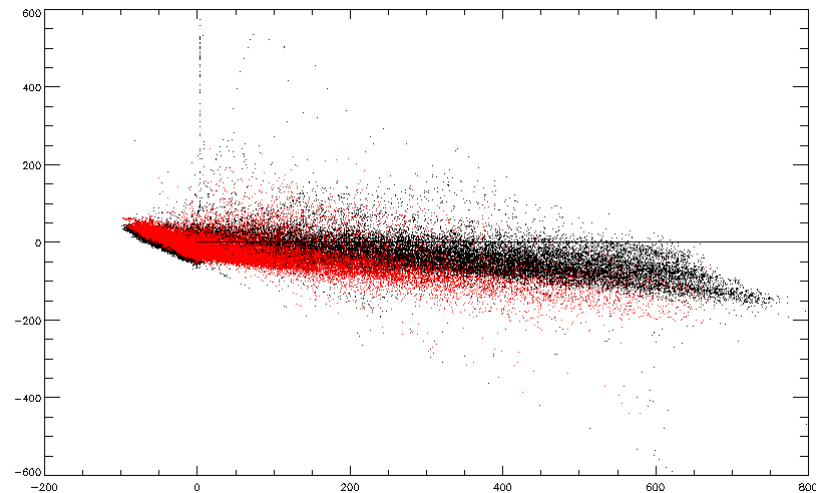
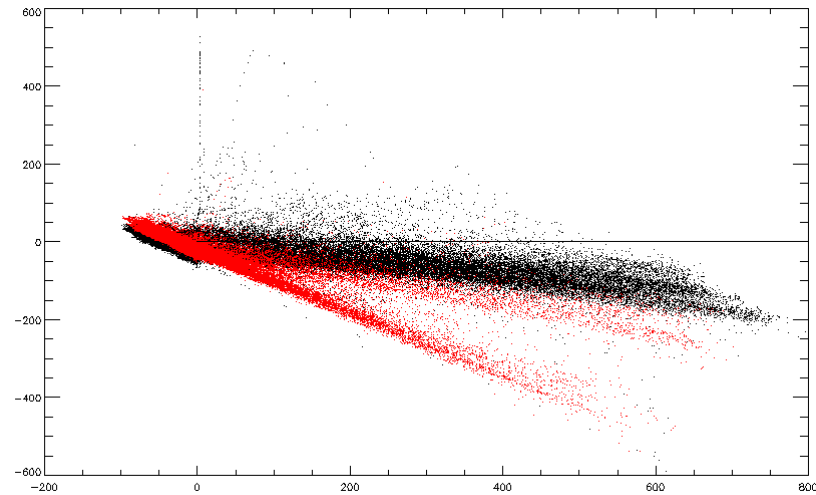
Urban (Leader: Sue Grimmond)

- Urban working group set up
- 20 members!
 - Range of institutes:
 - ❖ Met Office
 - ❖ Reading
 - ❖ King's College London
 - Range of interests:
 - ❖ Observations
 - ❖ Point modelling
 - ❖ Performance of UKV
 - ❖ Climate impacts
 - ❖ Applied science
- First meeting held at Met Office on 22/01/2013
- Next meeting on 05/07/2013 at King's College London
 - Topic: model evaluation of London

Validation and calibration

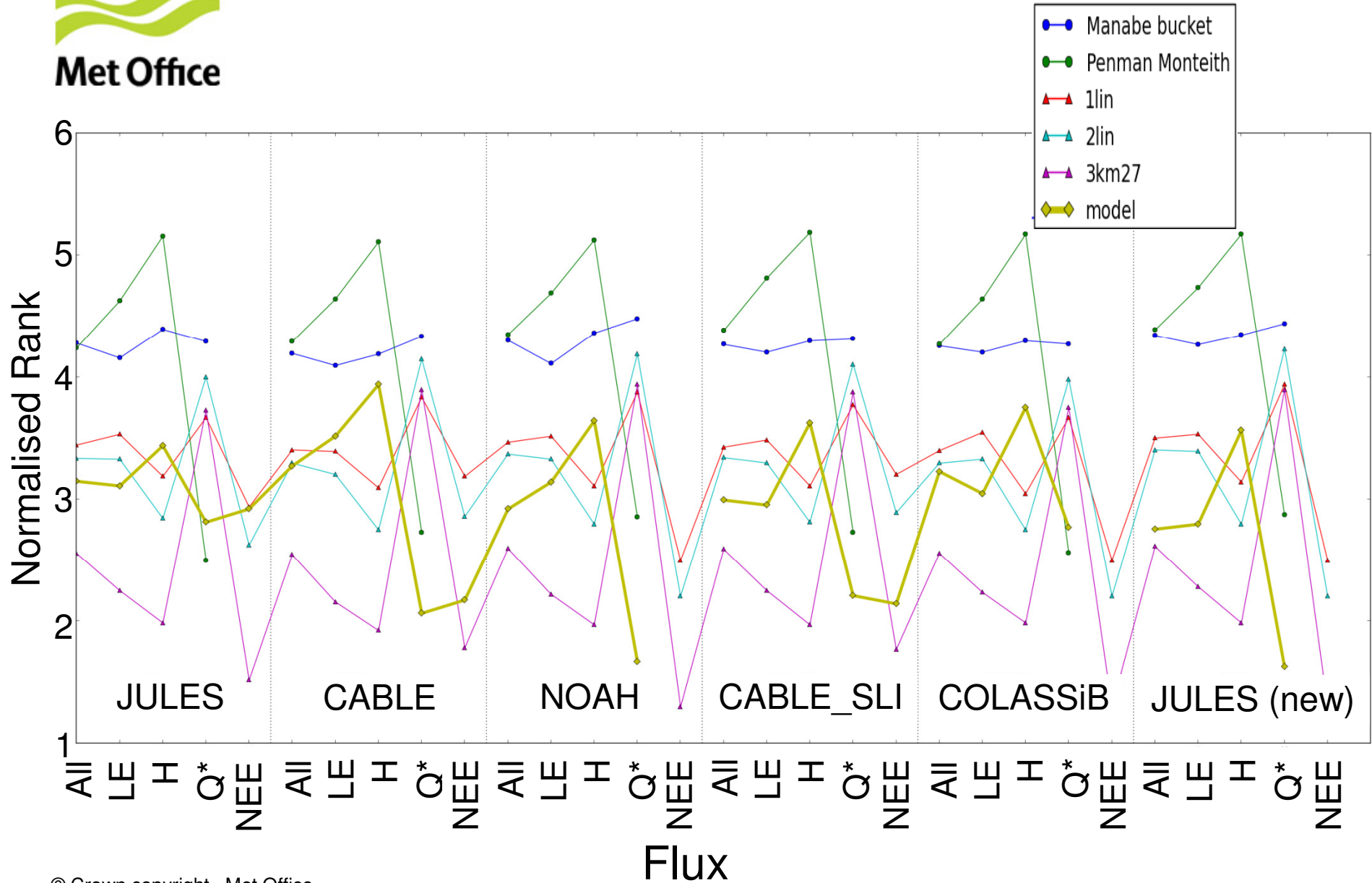
- Coupled evaluation working group being established
 - Global evaluation against point observations and satellite data
 - 12 people interested in contributing
 - Initial analysis on albedo, LST, Soil moisture, LAI

Harvard Forest





Validation and calibration





JULES

**Joint UK Land
Environment Simulator**

Snow

Richard Essery

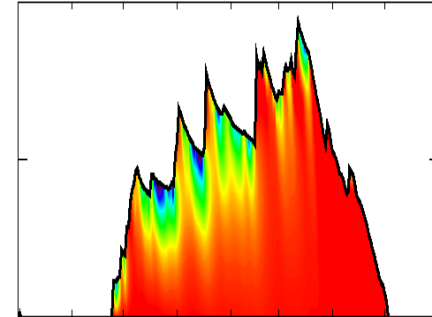
JULES snow module options

Single-layer, fixed density, dry snowpack

```
&JULES_MODEL_LEVELS nsmax = 0
```

or multi-layer with liquid water retention

```
&JULES_MODEL_LEVELS nsmax > 0
```



Single snow store per tile

```
&JULES_SWITCHES can_model = 3
```

or separate ground and canopy snow stores

```
&JULES_SWITCHES can_model = 4
```

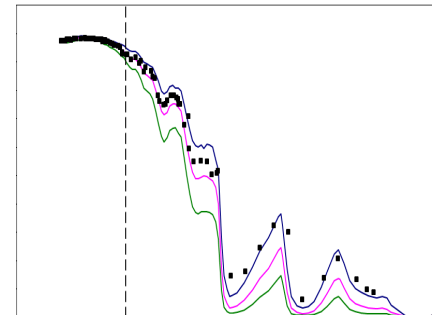


Diagnostic broadband snow albedo

```
&JULES_SWITCHES l_spec_albedo = F
```

or prognostic spectral albedo

```
&JULES_SWITCHES l_spec_albedo = T
```



JULES snow activities

Processes:

Snow physics

Essery et al. (2013), *Adv. Water Resour.*, **55**, 131 – 148

Snow and vegetation

Cécile Ménard PhD thesis and work at FMI

NERC snow-veg-atmosphere project (Edinburgh, Durham, Northumbria)

EHFI arctic response project (Edinburgh, CEH)

Coupling to glacier ice

Jeff Ridley, Andy Wiltshire (Met Office)

FirnMICE (Jessica Lundin, University of Washington)

Evaluation:

Comparison with GlobSnow – Steve Hancock

January 2012 JULES meeting presentation

Hancock et al. (2013), *Remote Sensing of Environment*, **128**, 107–117

For Austria

Parajka et al. (2010), *Journal of Geophysical Research*, **115**, D24117

For Norway

Dagrun Vikhamar-Schuler, 2012 EGU presentation



JULES

**Joint UK Land
Environment Simulator**

Hydrology
Nic Gedney

JULES HYDROLOGY MODULES – Eleanor Blyth & Nic Gedney

After survey of JULES users, we created this table:

	Code development	Evaluation	Application	Process studies
Groundwater	Richie Ellis (CEH) Ana Mijic (Imperial) Chris Jackson (BGS) Andrew Ireson (Canada)		Ana Mijic (Imperial) Chris Jackson (BGS)	
Routing, lateral flows, wetlands and inundation	Doug Clark (CEH) Heather Ashton (MO) Nic Gedney (MO)		Simon Dadson (Oxford) Toby Marthews (Oxford) Garry Hayman (CEH) Graham Weedon (MO) Neil MacKellar (South Africa) Impacts Team (MO)	
Irrigation, dams and impact on crops	Doug Clark (CEH) Nic Gedney (MO) Rutger Dankers (MO)		Ana Mijic (Imperial)	
Soil resistance, interception and soil hydraulics	Anna Verhoef (Reading)	Eleanor Blyth (CEH) Heather Ashton (MO)		Emma Robinson (CEH)
Snow		Steve Hancock (Swansea) Dagrun Vikhamar Schuler (Norway)		Richard Essery (Edinburgh)
Organic and chalk soils	Nic Gedney (MO) Christina Bakopoulou (Imperial)			
Soil freezing and permafrost			Cecile Menard (Finland) Andrew Ireson (Canada) Eleanor Burke (MO)	
Effect of hydrology on vegetation		Becky Oliver (CEH)	Steve Hancock (Swansea) Margriet Groenendijk (Exeter) Karina Williams, Nicky Stringer (MO)	

- We think this is unfinished, i.e. there are more people that can/could go on here
- We will feed this back to the people to check they agree with their placement
- There are cross-over activities between the columns, e.g. code development naturally includes evaluation



JULES

**Joint UK Land
Environment Simulator**

Biogenic fluxes
Oliver Wild

Biogenic Fluxes in JULES

Biogenic emissions to the atmosphere

- What is emitted?
 - C_5H_8 (isoprene), $C_{10}H_{16}$ (monoterpenes)
 - CH_3OH , CH_3CHO , $HCHO$, CH_3COCH_3 , CH_4 , CO ,...
 - Global total: ~ 1150 TgC/yr
- Why is this important?
 - Climate and Air Qual impacts from O_3 , CH_4 , aerosol
 - Feedback on plant growth, from O_3 , N dep, hv flux
 - Role in biogeochemical cycles needs quantifying...



MEGAN emission scheme

- Empirical, observation-based emission factors for 20+ bVOC species from key PFT

Guenther et al., 2006

Process-based approach

- More physical and interactive, based on plant physiology, main focus on isoprene

Pacifico et al., 2011

O_3 damage

Sitch et al., 2007

CO_2 inhibition

Young et al., 2009

Biogenic Fluxes in JULES

Towards a fully-integrated approach

- Status: process-based bVOC emissions in standard code (from v3.2)
- Consistent treatment across all bVOC still needed
- Not all code available in version of JULES in the UM yet...

Emission needs

- Soil emissions of NO_x needed to represent N-cycling, O₃, etc.; link with Soil C and N module
- Impacts of fires: needs separate module coupled to fire model to cover NO_x, VOC, CO, aerosol, etc
- Consistency of links to canopy treatment and radiation

Deposition processes

- Fluxes out of atmosphere to veg or soil: O₃, N, aerosol, etc.
- Flux-based approach needed to assess impacts: e.g., O₃ damage, N fertilization
- Would be valuable to have this as a fundamental component of JULES...



JULES

**Joint UK Land
Environment Simulator**

Plant physiology
Lina Mercado

Plant physiology

Photosynthesis & stomatal conductance

- Accounting for soil moisture stress effects on photosynthesis and stomatal conductance (Anne Verhoef & Pier Luigi Vidale, U Reading)
Effects of biochemistry, g_s and g_m (Vidale et al. 2013)
- Adjustment to photosynthesis parameters, Catherine Van den Hoof U Reading), SWELTER-21 project (in review, Agric Forest Met).
- Model comparison at forest sites : JULES vs Ctessel, Andrea Manrique Sunen (PhD, U Reading)
- Inclusion of Medlyn et al. (2011) stomatal conductance model
(Becky Oliver CEH Wallingford and Lina), Collaboration with B. Medlyn to param model for all pfts.

Tropics

Jules application to the Amazon

- Farquhar photosynthesis + Bernacchi Temperature responses parameterisations
- Inclusion of N-P limitation to photosynthesis
- In situ derived data for parameterisation of $R_d - T$, V_{cmax-T} , J_{max-T}
- G_s model, Medlyn et al. 2011
- (L. Mercado, Becky Oliver CEH Wallingford)

Modelling O₃ uptake

- Using latest observations to parameterise Sitch et al. (2007) model including gs model from Medlyn et al (Becky Oliver, CEH Wallingford, Eclairé project , EU FP7)
- Improving O₃ uptake model with focus on crops: reparameterisation of Sitch et al. (2007) (Felix Leung, PhD U Exeter)
- Improving O₃ uptake model in Jules (Richard Falk, PHD CEH Wallingford-Uexeter)

N cycling in JULES

FUN-ECOSSE in JULES : Code is running and being tested at Duke Forest (D.Clark, S. Liddicoat, CEH –Met Office)



JULES

**Joint UK Land
Environment Simulator**

Vegetation dynamics and disturbance
Stephen Sitch

Vegetation Dynamics and Disturbance

Competition and PFTs

RED – Reduced Ecosystem Demography, Jon Moore (UExe)

PFTs and plant traits, JWCRP, Anna Harper (UExe)

High Latitudes

-Permafrost-vegetation dynamics, Eleanor Burke (Met Office)

-C3 graminoid / inundation tolerant wetland PFT (grasses, rushes and sedges), Becky Oliver(CEH)

-Sphagnum moss PFT, Richard Coppell, Uleeds

JULES veg impacts on extreme climatic events across Africa (Toby Marthews, UOxford)

Phenology (Steve Hancock, UNewcastle)

JULES versus EO albedo leading to improved JULES phenology, particularly moisture response, Steve Hancock, UNewcastle, previously Uswansea

Vegetation Dynamics and Disturbance

Drought Mortality, Hydraulic failure/Carbon Starvation, Lucy Rowland (UEdin/UExe), Brad Christoffersen (UEdin), David Galbraith (ULeeds)

Fire

-Implementation of a flexible structure for implementing wildfires in JULES

-Including various fire risk models in the module, Richard Gilham (Met Office)

-An implementation of SPITFIRE, exploration of alternative formulations for some processes (Imogen Fletcher UExe, Ioannis Bistinas ULisbon, Greencycles II MC-ITN)

- SPITFIRE (Alan Spessa, Open Uni)

Forest Management / LULCC

LUC4C EU-FP7 PDRA (UExe)

Gina Tsarouchi, Imperial College, impacts LUC on hydrological processes over India



JULES

**Joint UK Land
Environment Simulator**

Data assimilation

Mat Williams



JULES

**Joint UK Land
Environment Simulator**

Crops

Tom Osborne

JULES meeting, Edinburgh 2013 – *Crops* theme update (Tom Osborne)

- Tom Osborne (Uni of Reading) evaluation of JULES-crop wheat, soybean and maize parameterisations at AMERIFLUX sites (Soybean example next slide) .
- Pete Falloon, Jemma Gornall (Met Office) global runs, not in JULES-Impact.
- Karina Williams and Kate Halladay (Met Office) are working on getting the JULES-crop (and linked irrigation) code into the JULES trunk.
- Karina is also going to be using J-C with seasonal forecasts in the EU EUPORIAS project.
- Laura Burgin might be looking at using J-C with the large "Durban" climate model ensemble for RCP8.5, as an internal sabbatical.
- Adam Burwell (Uni. of Leeds CASE PhD with Met. Office). Comparison between GLAM and JULES-crop for the case of wheat in India.
- Gina Tsarouchi (Imperial College PhD) UK-India project. Intends to dynamically couple JULES with the crop model InfoCrop in order to dynamically simulate crop growth, development and its interactions with the land surface.
- Emily Black (Uni. of Reading) Sugar cane modelling, paper published.
- Nic Gedney (Met Office) Developing, and now implementing, an irrigation model, together with crop calendars.
- Possible meeting Autumn 2013

