



Development a prototype fire model for Hadley GCMs

Sergey Venevsky (SV), Richard Betts (RB), Chris Jones (CJ), Tomasz Kasikowski (TK), Yannick Le Page (YLP), Chris Huntingford (CH)

Climate Impacts & Terrestrial Ecosystems Group, Hadley Centre

29 June 2007 **Exeter**

Three parallel fire modelling activities



- Implementation of prototype fire model HADLEY-FIRE into HadCM3LC (SV,TK,RB,CJ) in fully coupled mode – started
- Implementation off-line version of HADLEY-FIRE in JULES using IMOGEN/Climate emulator for fine tuning (SV,TK,CH) – start in summer 2007
- Validation of temporal dynamics of HADLEY-FIRE against ATSR/MODIS (YLP,SV) -started

- Number of ignitions is constant in time and space. It is calculated from averaged estimate of SEVER-FIRE- 12 fires a year for $0.5^{\circ} \times 0.5^{\circ}$ grid cell
- Fires are not affecting vegetation
- Fire stops only due to weather conditions – no fire suppression
- Fuel threshold is determined by total fraction of vegetation in a cell

- INCORPORATED into HadCM3LC GCM
- STEP = 30 minutes
- SPATIAL RESOLUTION = $2.5^{\circ} \times 3.75^{\circ}$
- OUTPUT
 - Fire weather risk (0;1)
 - Area burnt (m^2)
- INPUT:
 - from the atmosphere module (HadAM): t_{max} , t_{dew} , Precip
 - from the hydrology module (MOSES): Unfrozen soil moisture in the upper layer: USM
 - from the vegetation module (TRIFFIDS): fractional distribution of five PFTs F_i

- FIRE RISK - directly taken from Reg-FIRM model (Venevsky, et.al., 2002). Same as in SEVER-FIRE and SPIT-FIRE

$$FR(t) = H(t_{\max}, t_{\text{dew}}, \text{USM})$$

- AREAS BURNT – simplified Rothermel equation scaled to total vegetated fraction of the cell

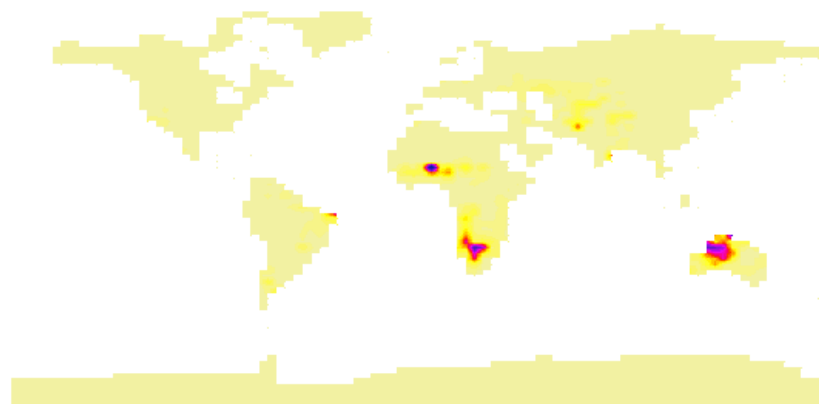
$$AB(t) = \sum F_i * FR(t) * N_{\text{ign}} * \pi/8 * U^2 (F_i, \text{USM}) * (30 \text{ min})^2$$

where U is the rate of frontal spread

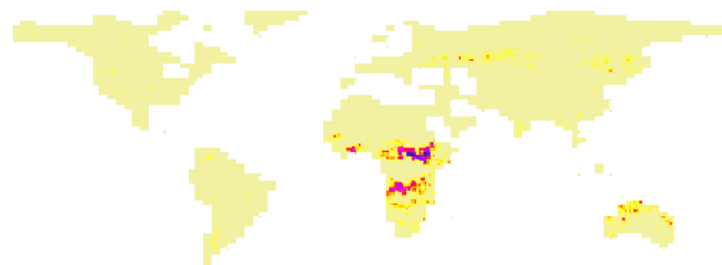
Comparison against GBA-2000



HADLEY-FIRE

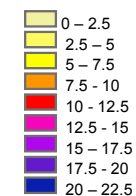


GBA-200

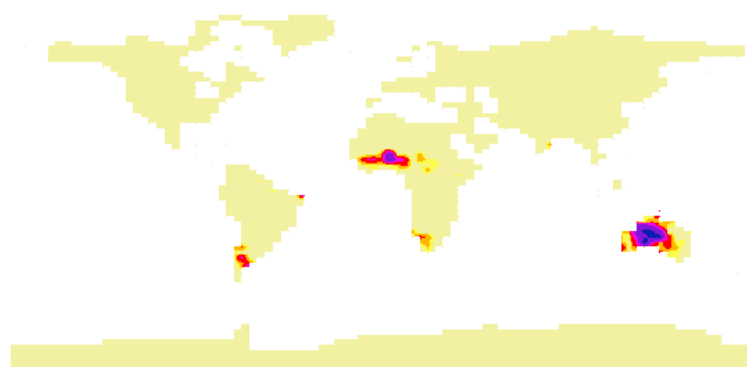


Averaged
correlation 0.16

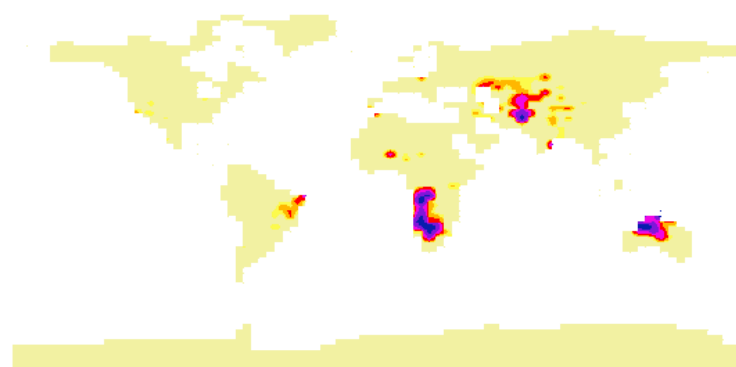
Area burnt (% of grid cell)



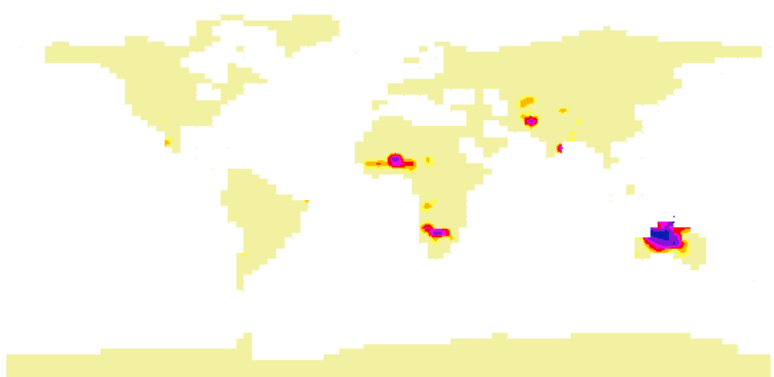
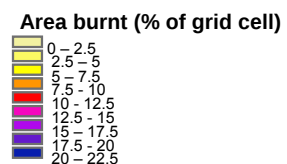
Simulated seasonal distribution of areas burnt: current climate



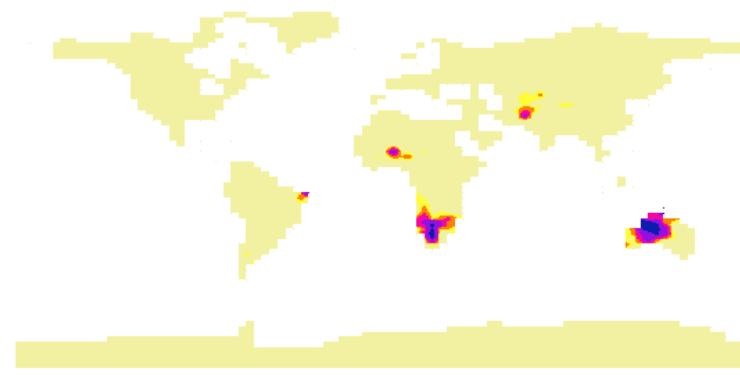
DJF



MAM

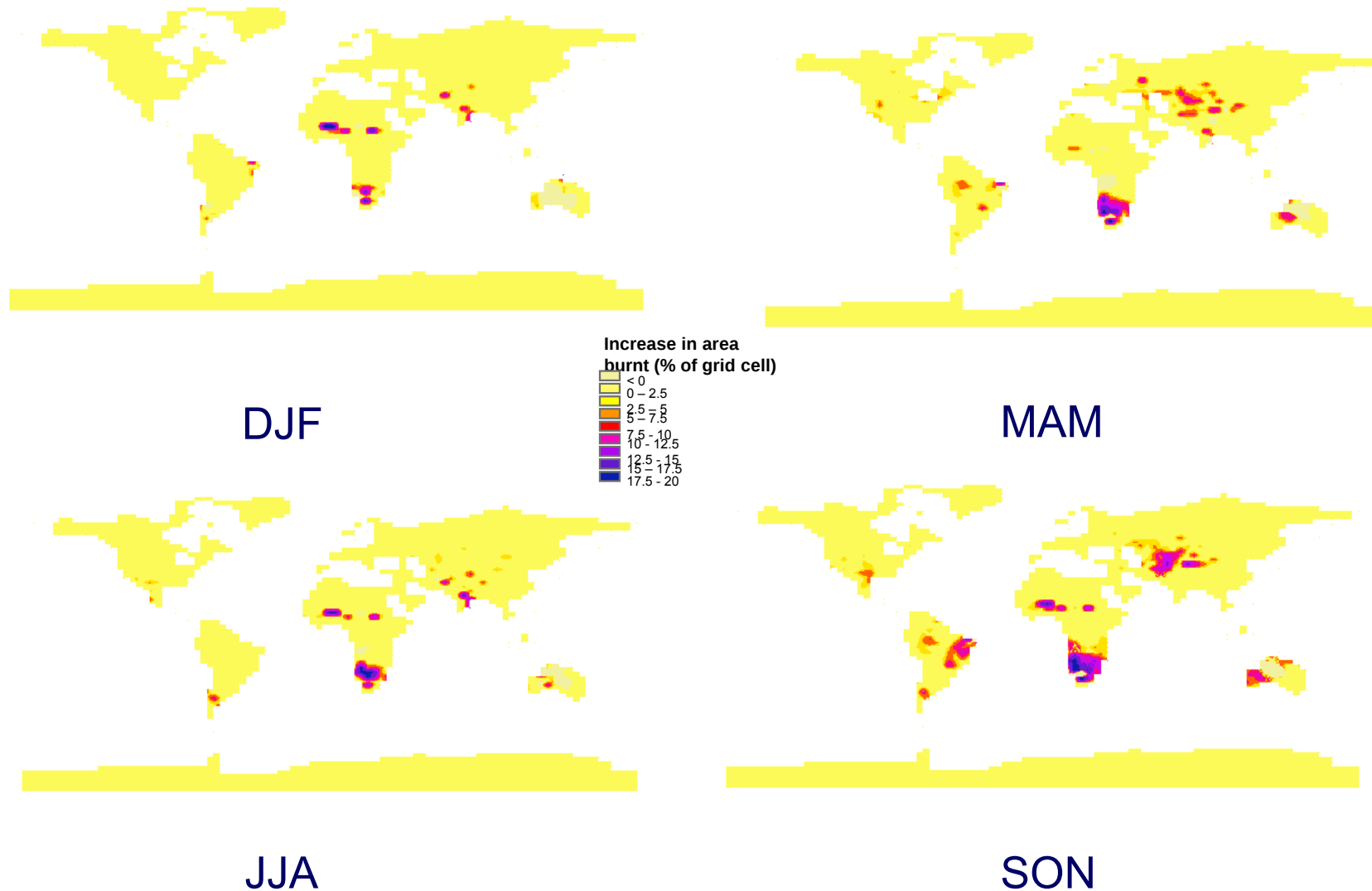


JJA

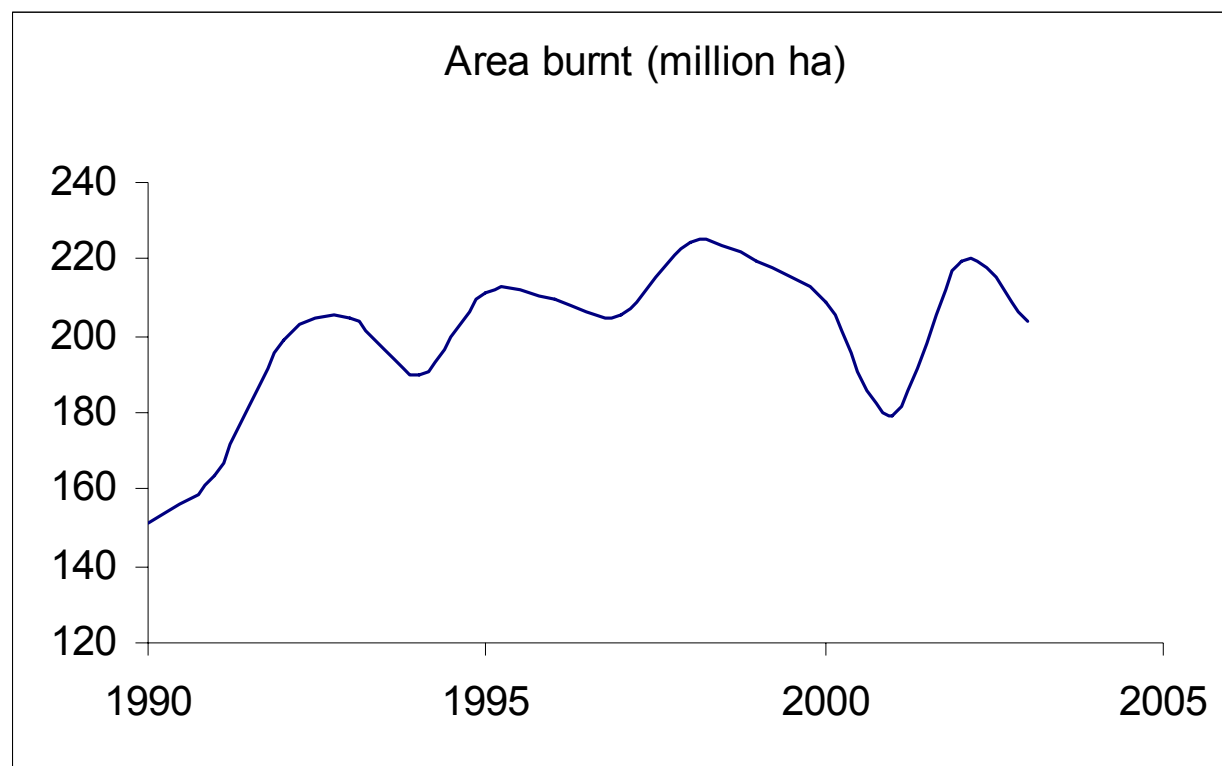


SON

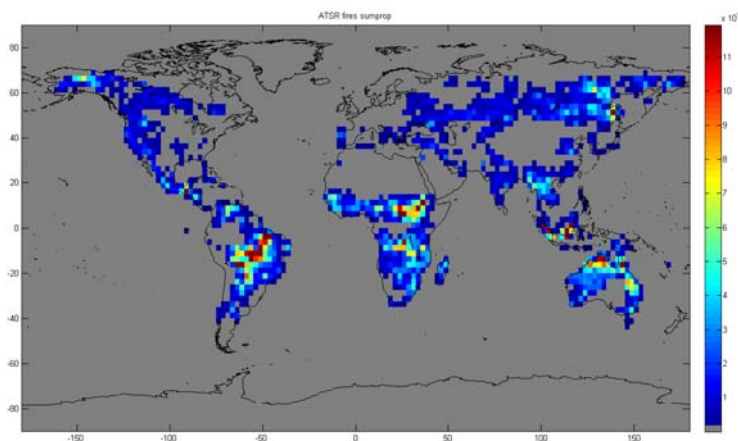
Change of burnt areas: 2CO₂ climate



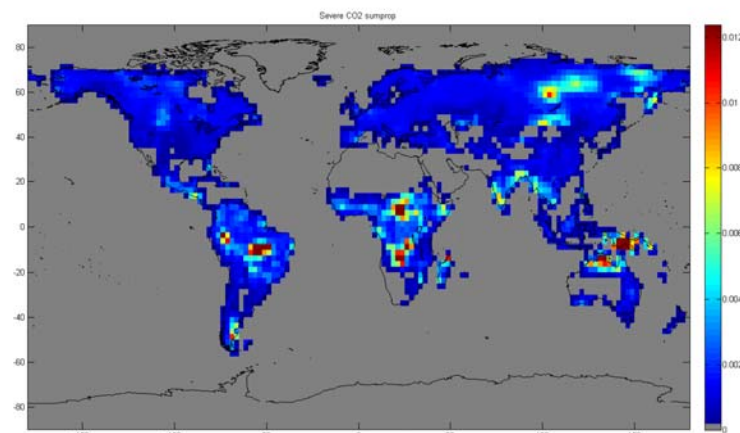
Inter-annual variability



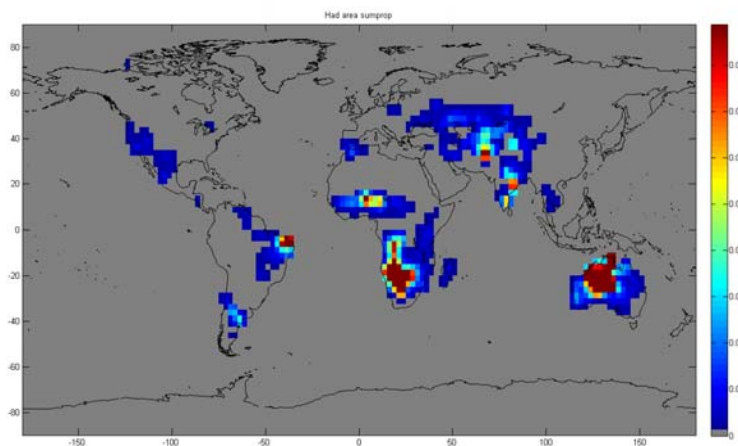
Comparison of key fire regions for different models



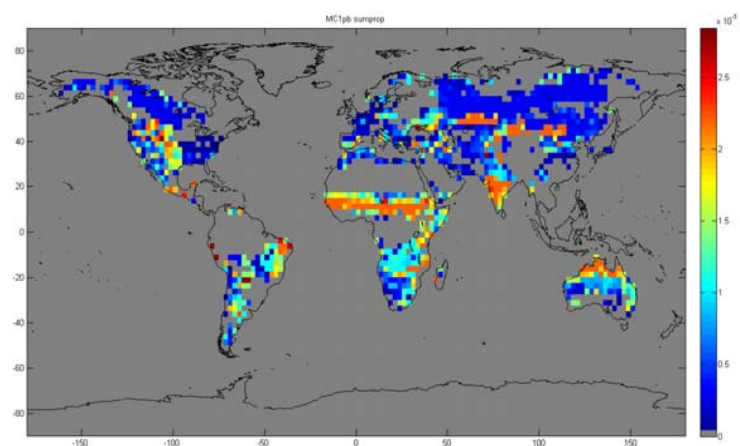
ATSR



SEVER-FIRE



HADLEY-FIRE



MC 1

- Implementation of fire risk and areas burnt into HadCM3LC in uncoupled mode with vegetation and constant ignitions– started. Delivery – summer 2007
- Implementation of carbon and aerosol emissions in uncoupled mode with vegetation – Delivery end of 2007
- Coupling of HADLEY-FIRE with TRIFFIDS vegetation model Delivery - spring 2008
- Implementation of lightning ignitions in coupled mode – end of 2008
- Implementation of human ignitions in coupled mode – summer of 2009

This activities will take part in parallel with implementation of HADLEY-FIRE in HADCM3LC and will take the same steps (see previous slide) with an approximate time lag 4 months.

Thus this will be the first prototype JULES fire model fully tested within LSS and GCM. It can be further changed to more sophisticated fire model