CSSP-Brazil project overview

Chris Jones

JULES Annual Conference, Exeter

26 June 2017

Outline

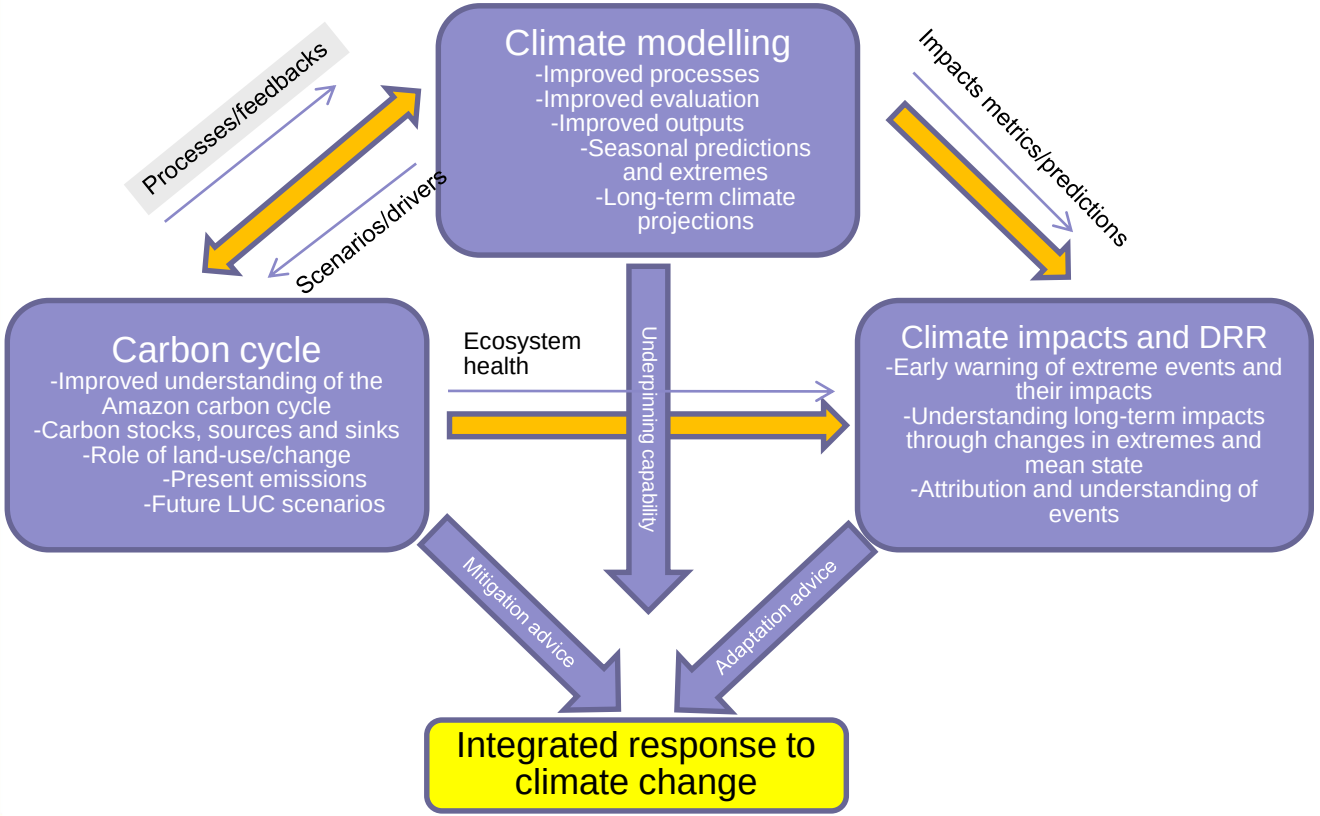
- Climate Science for Services partnership
  - Climate science which enables benefits to our partner country
  - Land-surface, hence JULES, is central to our aims

- Newton fund
  - Circa 10 people in the UK
  - Equivalent effort from Brazil science organisations

- http://www.metoffice.gov.uk/research/collaboration/newton/cssp-brazil

Structured into 3 Work packages

Land surface is crucial to all of them



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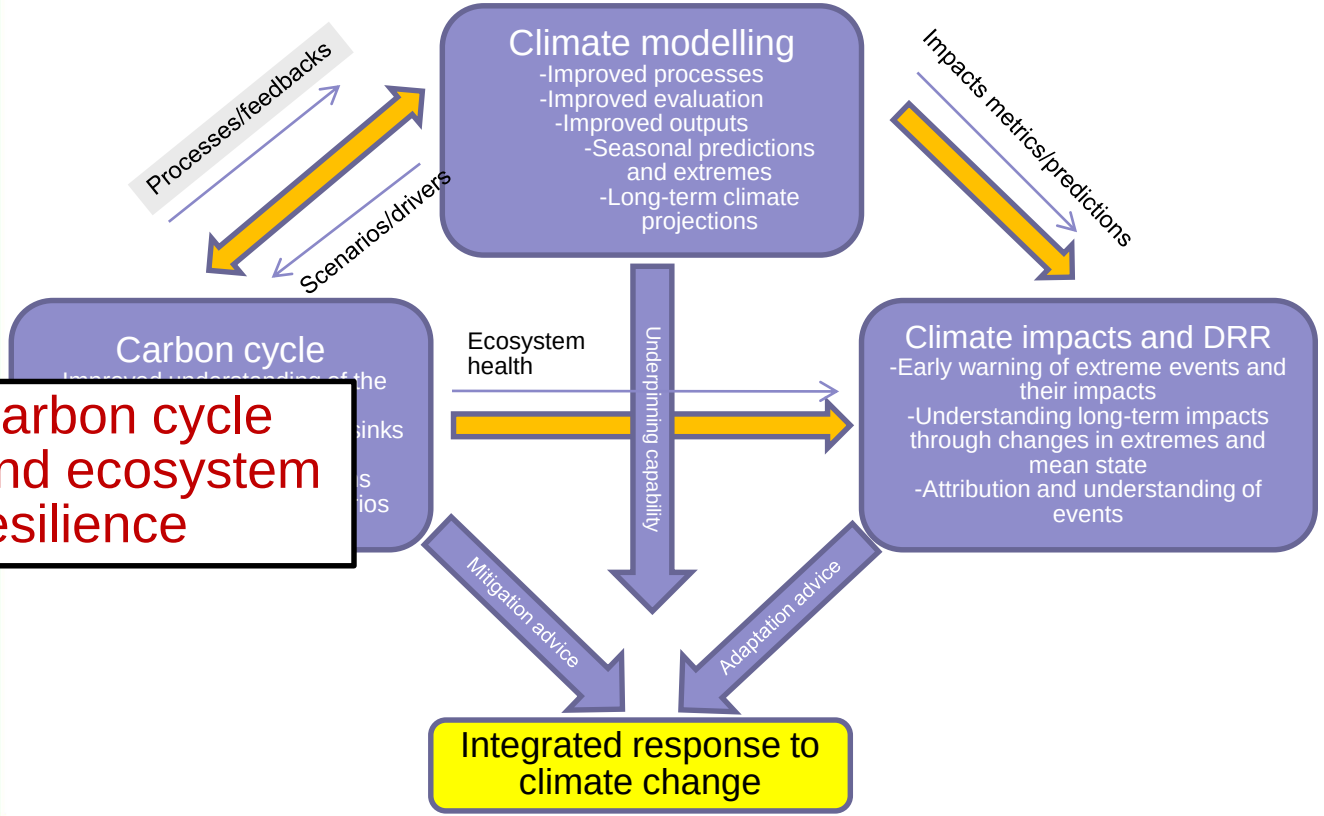

Carbon cycle and ecosystem resilience

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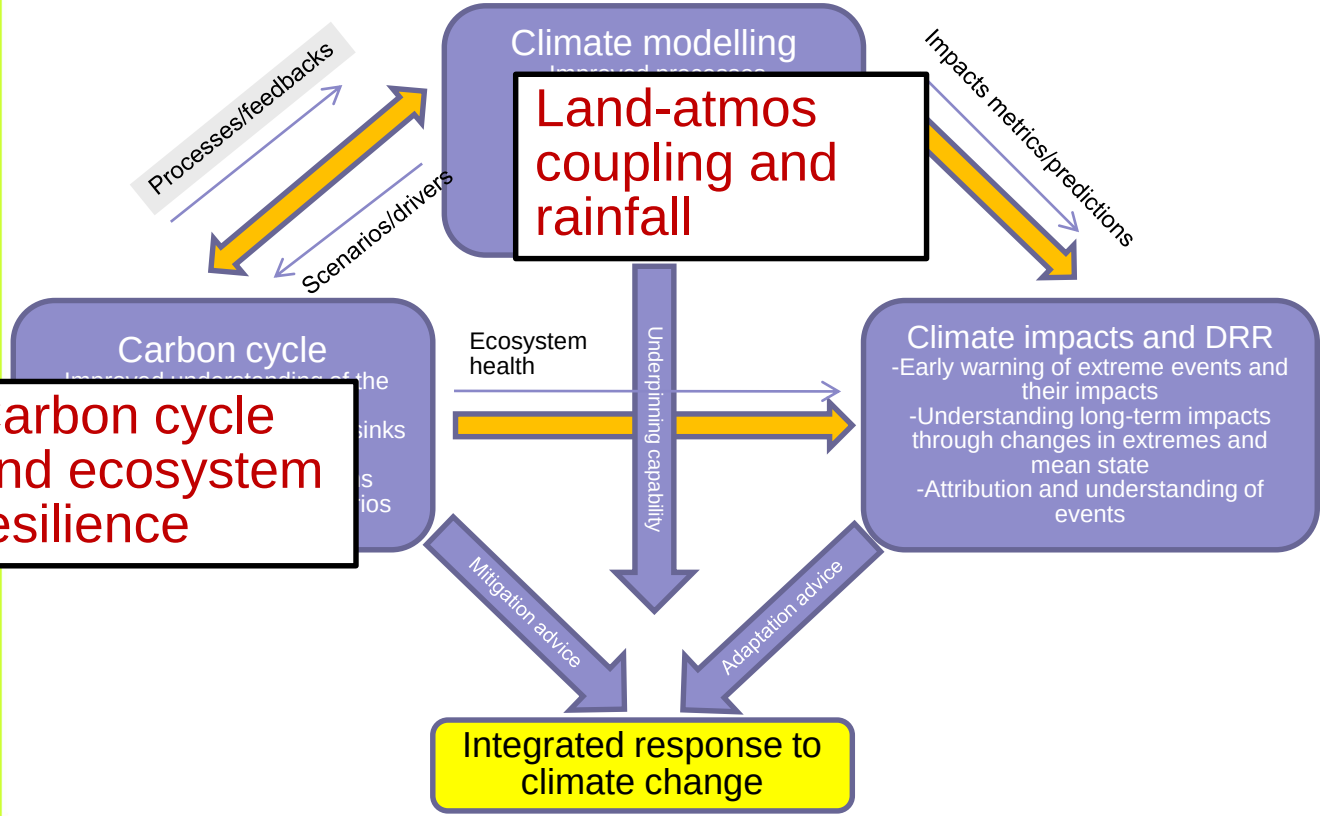

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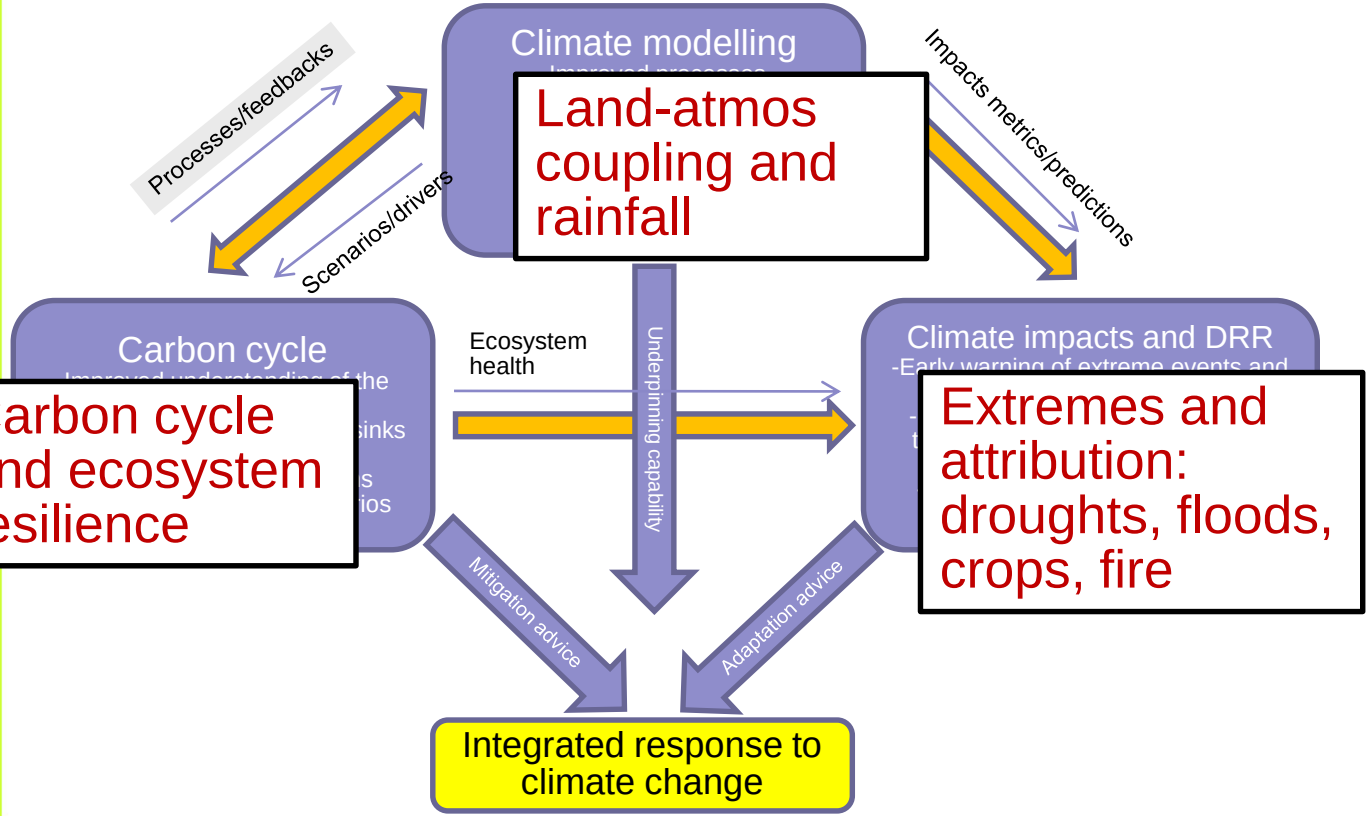

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Brazilian partner institutes

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Amazon forest research

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Weather and climate modelling

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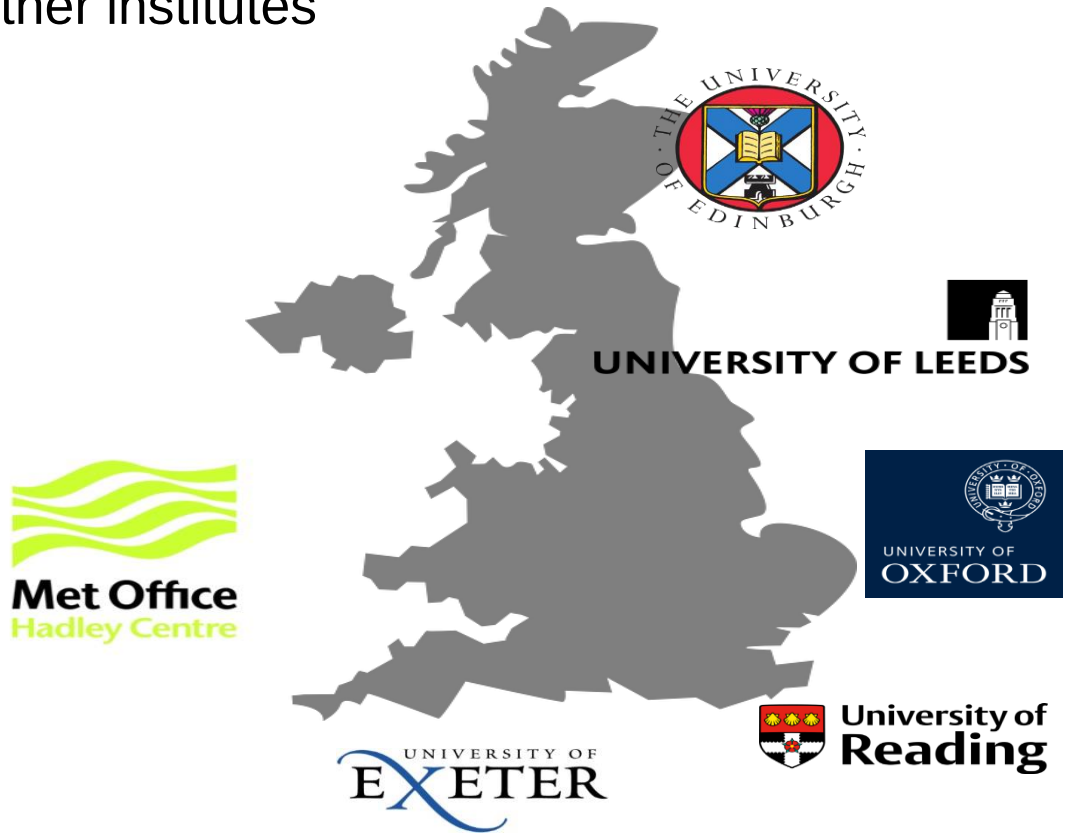
Natural hazard warning

UK partner institutes



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Example results so far

Global methane budget

Brazil biomes

Stomatal response and future rainfall changes

Global carbon and methane budgets

- Annual carbon budget (CO2) and methane
  - JULES modelling feeds into both (TRENDY)

Earth System Science Data
The Data Publishing Journal

doi:10.5194/essd-2016-25

Discussion papers

Abstract | Assets | Discussion | Metrics

Review article

20 Jun 2016

The Global Methane Budget: 2000–2012

Marielle Saunois[1], Philippe Bousquet[1], Ben Poulter[2], Anna Peregon[1], Philippe Ciais[1], Josep G. Canadell[3], Edward J. Dlugokencky[4], Giuseppe Etiope[5], David Bastviken[6], Sander Houweling[7,8], Greet Janssens-Maenhout[9], Francesco N. Tubiello[10], Simona Castaldi[11,12], Robert B. Jackson[13], Mihai Alexe[9], Vivek K. Arora[14], David J. Beerling[15], Peter Bergamaschi[9], Donald R. Blake[16], Gordon Brailsford[17], Victor Brovkin[18], Lori Bruhwiler[4], Cyril Crevoisier[19], Patrick Crill[20], Charles Curry[21], Christian Frankenberg[22], Nicola Gedney[23], Lena Höglund-Isaksson[24], Misa Ishizawa[25], Akihiko Ito[25], Fortunat Joos[26], Heon-Sook Kim[25], Thomas Kleinen[18], Paul Krummel[27], Jean-François Lamarque[28], Ray Langenfelds[27], Robin Locatelli[1], Toshinobu Machida[25], Shamil Maksyutov[25], Kyle C. McDonald[29], Julia Marshall[30], Joe R. Melton[31], Isamu Morino[25], Simon O'Doherty[32], Frans-Jan W. Parmentier[33], Prabir K. Patra[34], Changhui Peng[35], Shushi Peng[1], Glen P. Peters[36], Isabelle Pison[1], Catherine Prigent[37], Ronald Prinn[38], Michel Ramonet[1], William J. Riley[39], Makoto Saito[25], Ronny Schroeder[29,40], Isobel J. Simpson[16], Renato Spahni[26], Paul Steele[27], Atsushi Takizawa[41], Brett F. Thornton[20], Hanqin Tian[42], Yasunori Tohjima[25], Nicolas Viovy[1], Apostolos Voulgarakis[43], Michiel van Weele[44], Guido van der Werf[45], Ray Weiss[46], Christine Wiedinmyer[28], David J. Wilton[15], Andy Wiltshire[47], Doug Worthy[48], Debra B. Wunch[49], Xiyan Xu[39], Yukio Yoshida[25], Bowen Zhang[42], Zhen Zhang[2,50], and Qiuan Zhu[51]

Review status
A revision of this discussion paper was accepted for the journal Earth System Science Data (ESSD).

Earth System Science Data
The Data Publishing Journal

doi:10.5194/essd-2016-51

Discussion papers

Abstract | Discussion | Metrics

Review article

12 Oct 2016

Global Carbon Budget 2016

Corinne Le Quéré[1], Robbie M. Andrew[2], Josep G. Canadell[3], Stephen Sitch[4], Jan Ivar Korsbakken[2], Glen P. Peters[2], Andrew C. Manning[5], Thomas A. Boden[6], Pieter P. Tans[7], Richard A. Houghton[8], Ralph F. Keeling[9], Simone Alin[10], Oliver D. Andrews[1], Peter Anthoni[11], Leticia Barbero[12], Laurent Bopp[13], Frédéric Chevallier[13], Louise P. Chini[14], Philippe Ciais[13], Kim Currie[15], Christine Delire[16], Scott C. Doney[17], Pierre Friedlingstein[18], Thanos Gkritzalis[19], Ian Harris[20], Judith Hauck[21], Vanessa Haverd[22], Mario Hoppema[21], Kees Klein Goldewijk[23], Atul K. Jain[24], Etsushi Kato[25], Arne Körtzinger[26], Peter Landschützer[27], Nathalie Lefèvre[28], Andrew Lenton[29], Sebastian Lienert[30], Danica Lombardozzi[31], Joe R. Melton[32], Nicolas Metzl[28], Frank Millero[33], Pedro M. S. Monteiro[34], David R. Munro[35], Julia E. M. S. Nabel[27], Shin-ichiro Nakaoka[36], Kevin O'Brien[37], Are Olsen[38], Abdirahman M. Omar[38], Tsuneo Ono[39], Denis Pierrot[12], Benjamin Poulter[40,41], Christian Rödenbeck[42], Joe Salisbury[43], Ute Schuster[4], Jörg Schwinger[44], Roland Séférian[16], Ingunn Skjelvan[44], Benjamin D. Stocker[45,46], Adrienne J. Sutton[37,10], Taro Takahashi[47], Hanqin Tian[48], Bronte Tilbrook[49], Ingrid T. van der Laan-Luijkx[50], Guido R. van der Werf[51], Nicolas Viovy[13], Anthony P. Walker[52], Andrew J. Wiltshire[53], and Sönke Zaehle[42]

Review status
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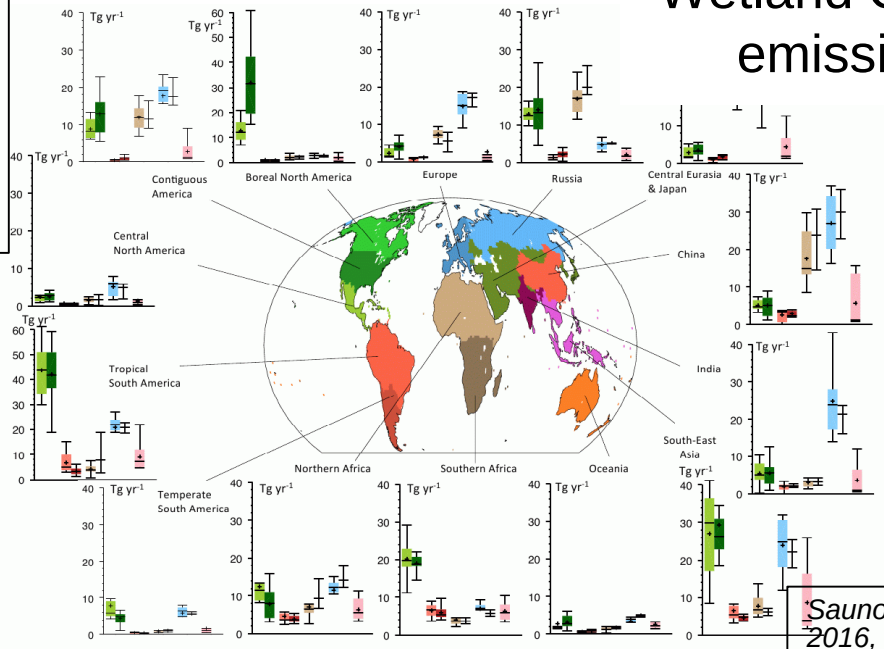
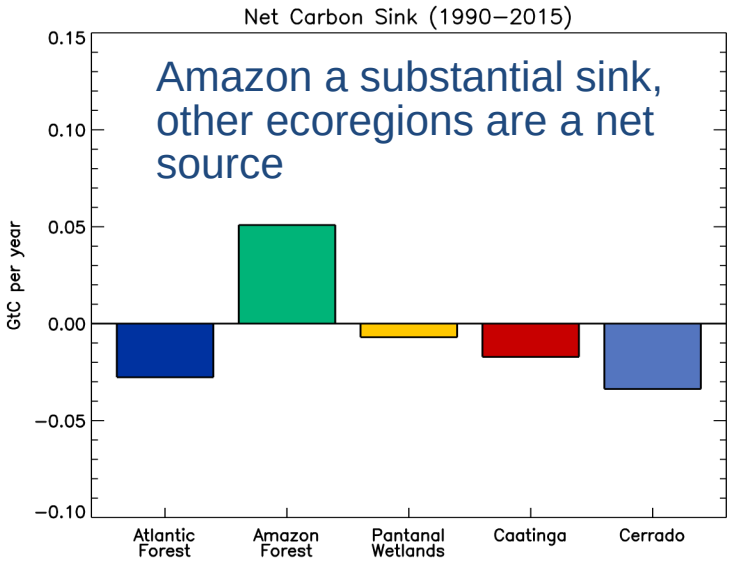
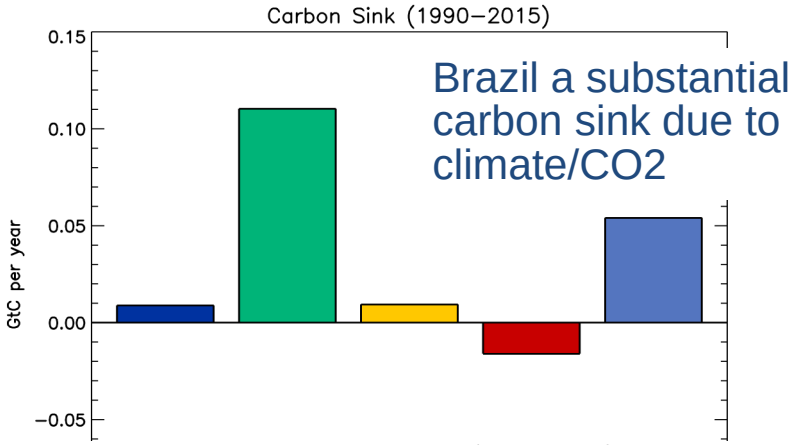
Wetland CH4 emissions

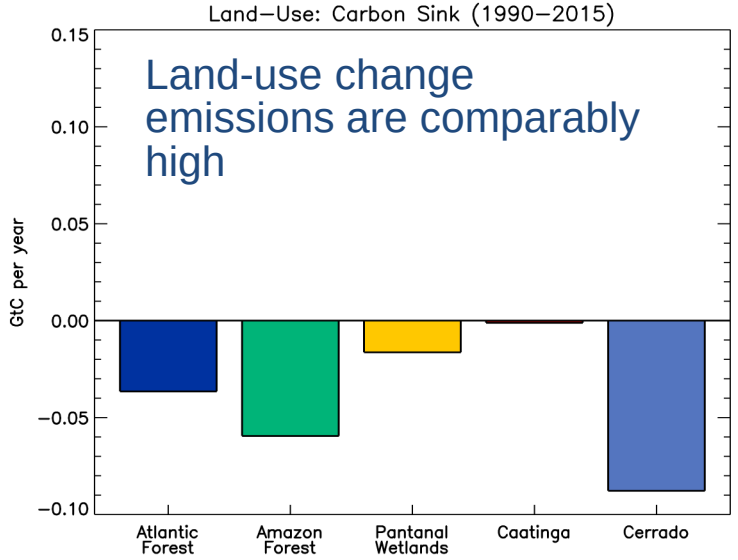


Saunois et al., 2016, ESSDD

1990-2015 Carbon budgets







1990-2015 Carbon budgets

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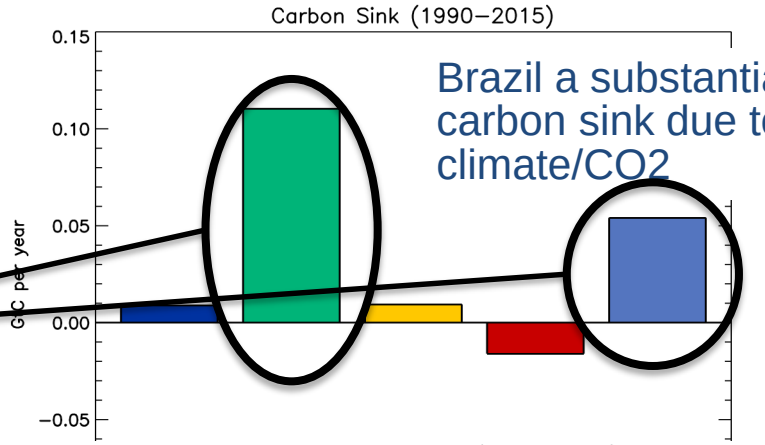
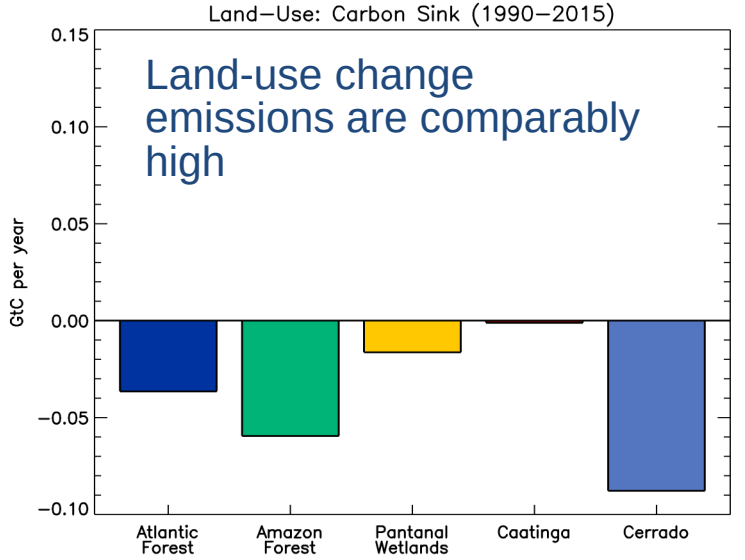
CO2 fertilisation a key uncertainty to constrain

Amazon a substantial sink, other ecoregions are a net source



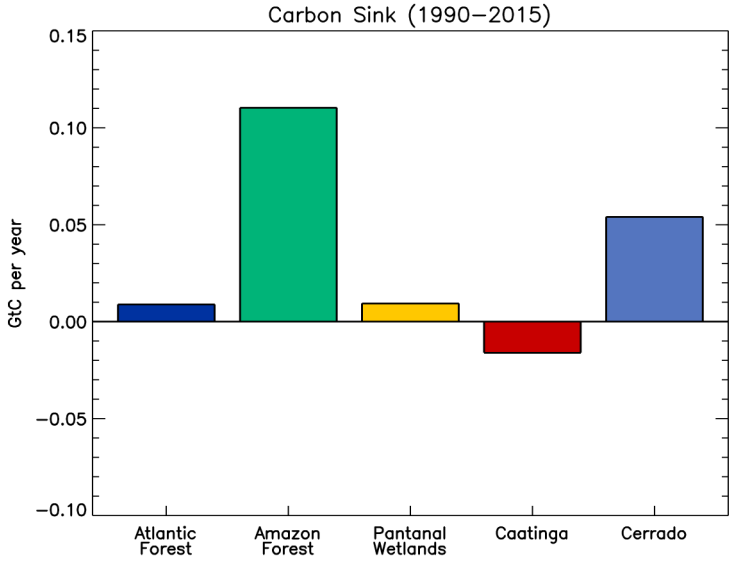
Brazil a substantial carbon sink due to climate/CO2



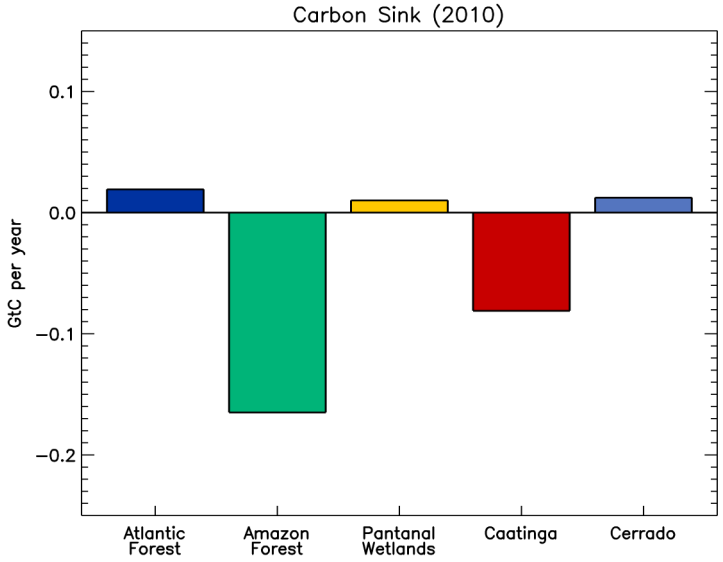
Land-use change emissions are comparably high

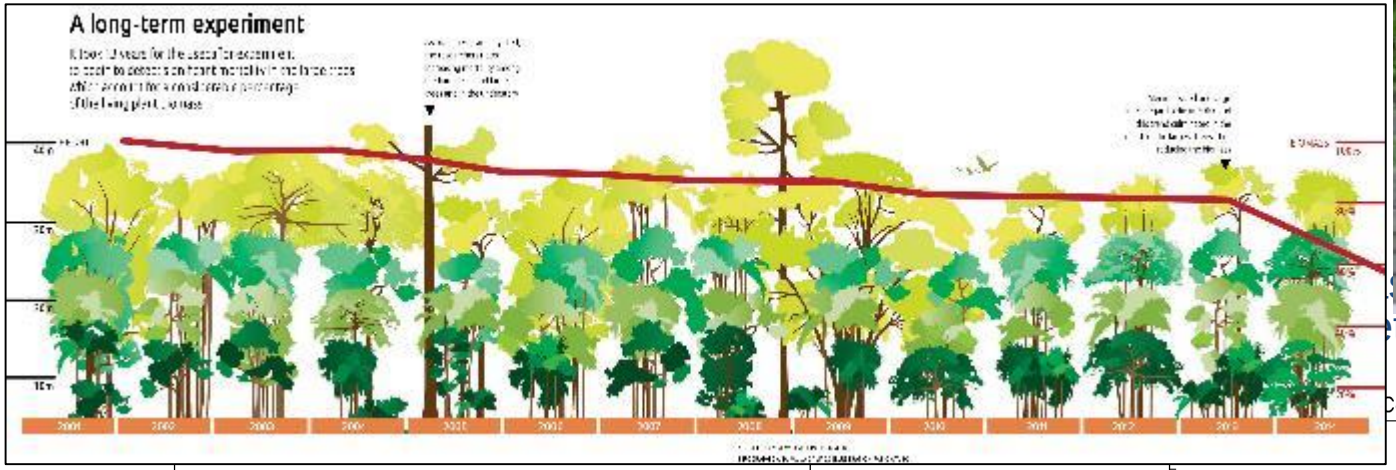
Drought Vulnerability: 2010

Long-term average carbon sink

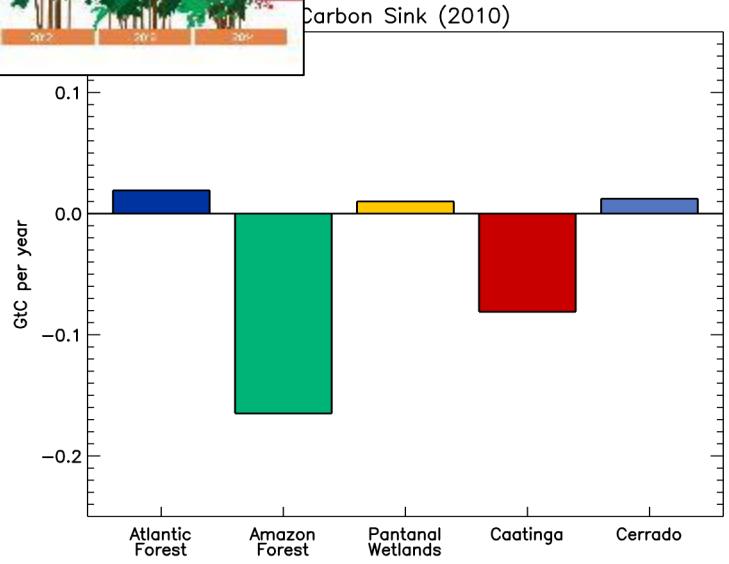


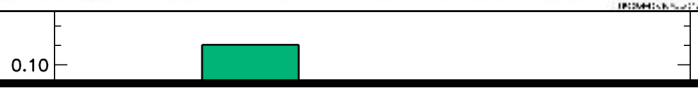
2010 massively reduced sink – net emitter of carbon





t emitter of carbon



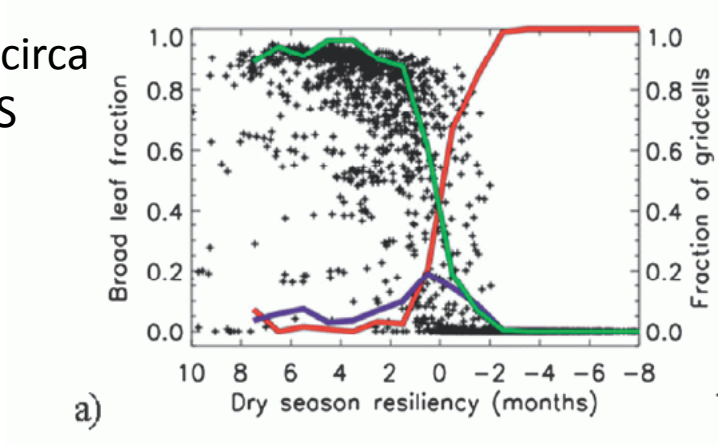


- Right for wrong reason?
- Do models achieve this via carbon balance, not tree mortality?

- Veg dynamics/demography / size/mortality modelling
- Tie in with droughting experiments
  - University of Exeter project

Coupled modelling

- Resilience of Amazon forest?
  - Major dieback in HadCM3LC (circa 2000), but not in HadGEM2-ES (circa 2010). Why?



- Amazon closer to this threshold than other tropical forests
- "Dry Season Resilience"
  - An observable measure of how close to dieback a forest is

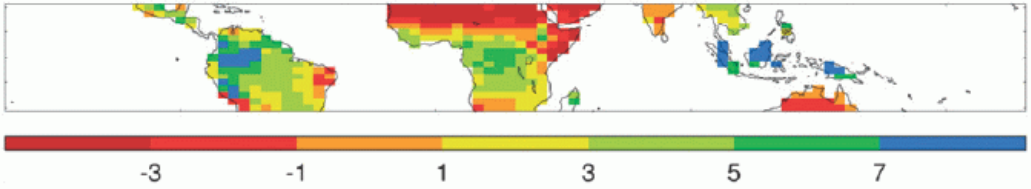


FIG. 4. Present-day DSR (calculated using observed temperature, dry season length, and CO_2 concentration).

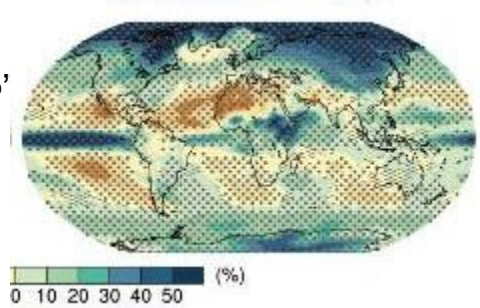
Peter Good et al., 2011, J. Clim

Coupled modelling

- Better constrained changes in rainfall

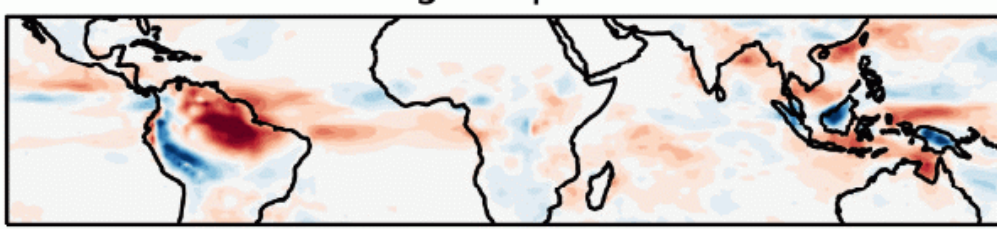
- IPCC assessed Amazon rainfall changes as "*inconsistent model response*"

IPCC AR5 WG1 Box 12.1



- Key output required for Brazil, and tropical forests

- Evaporation of water from vegetation directly affects rainfall



- Different response to different climate forcing
  - CO_2, aerosols, land-use all have different effects on climate
  - Stomatal response may be *THE* key driver of rainfall changes over some tropical land

in-situ and remote-sensed obs and model evaluation: U. Edinburgh / U. Leeds

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Impacts modelling

WP3. Climate Impacts and DRR

- Crop model contribution to international study on future agriculture and climate

AgMIP The Agricultural Model Intercomparison and Improvement Project

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summary

- WP1: Carbon cycle modelling
  - JULES central to UK research
  - vegetation mortality/dynamics
    - Links to moisture stress PEG
  - Wetlands, CH4
    - Importance of hydrology / soil properties
- WP2: Coupled modelling
  - Land-atmosphere coupling and rainfall
  - JULES within HadGEM / UKESM
- WP3. Climate Impacts and DRR
  - JULES impacts configuration
  - Fire (cuts across to WP1)

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