Influence of an optimal stomatal conductance scheme in the Australian Community Climate and Earth Systems Simulator (ACCESSv1.3)

Jatin Kala (1) and Martin De Kauwe (2)*
(1) ARCCSS, UNSW, Sydney, Australia
(2) Macquarie University, Sydney, Australia
** Corresponding Author: J.Kala@unsw.edu.au*

1. Background:

- Stomatal conductance (g_s) controls the fluxes of carbon and water between vegetation and the atmosphere
- g_s parameterization in CABLE is based on the Leuning et al. (1995) scheme
  - Like most traditional g_s schemes, there is no differentiation between model parameters as a function of plant functional types (PFTs)
- Medlyn et al. (2011) have proposed a new g_s model which is based on the optimization approach:
  - Stomata adapt to maximize carbon gain whilst minimizing water loss
  - Model parameters vary per PFT and derived from observational studies

2. Simulations:

- ACCESSv1.3 AMIP-style simulations with prescribed SSTs (1950 to 2001)
  - Simulations with default Leuning and new Medlyn schemes
    - 5 ensembles each, starting 1 year apart

3. Results:

- Use of the Medlyn scheme results in a statistically significant decrease in latent heat flux over large parts of Northern Europe and North America during the boreal summer (JJA) (Figure 1(a))
  - This is consistent with global offline results (De Kauwe et al. 2014)
- This results in a relatively small but statistically significant reduction in total precipitation (Figure 1(c), bottom left panel)
- The reduction in latent heat is accompanied by an increase in maximum and minimum temperatures (Figures 1 (c) and (d)) up to 1°C
- Higher temperatures during DJF do not always correspond with a reduction in latent heat
  - More analysis underway

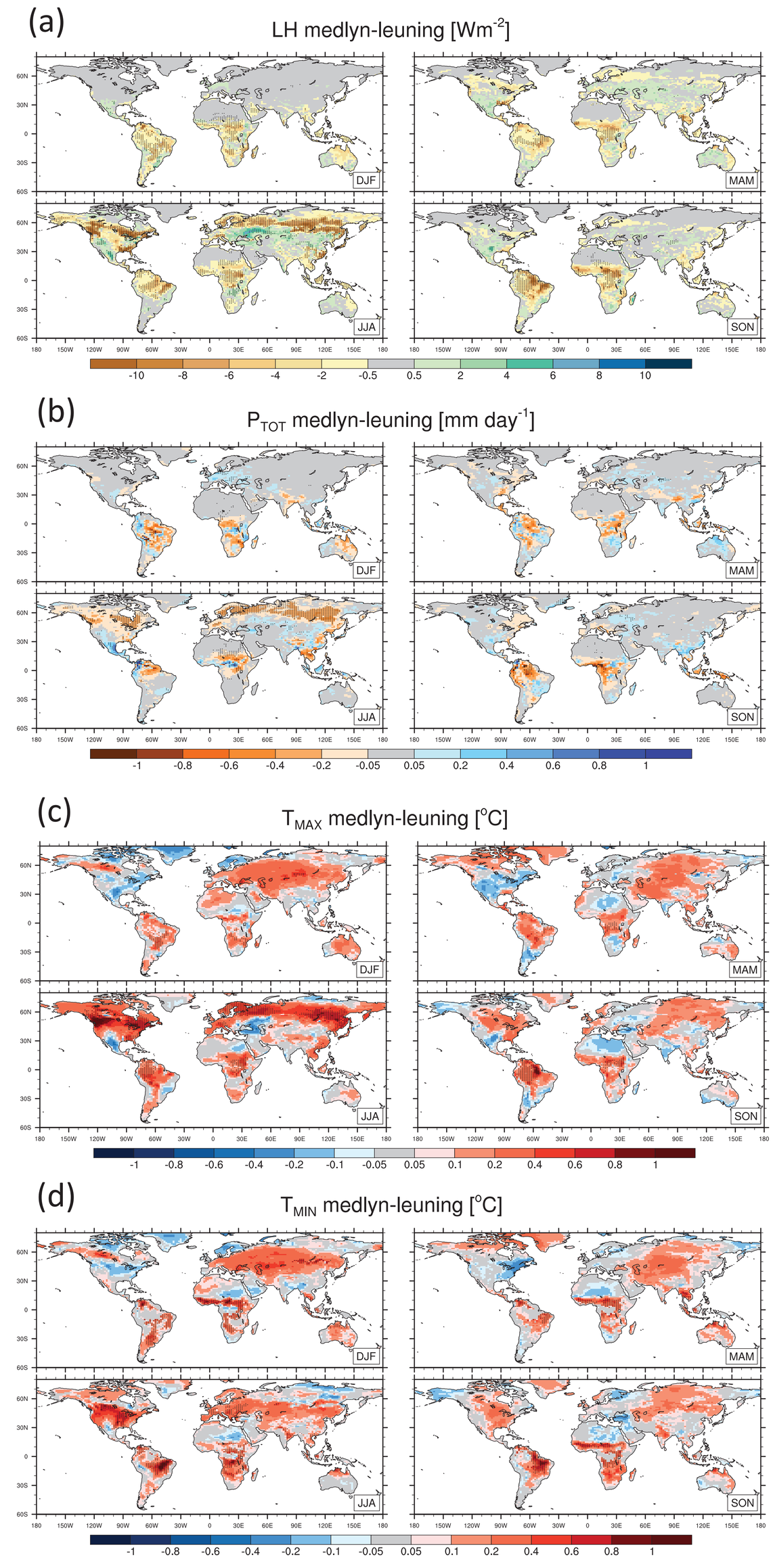

Fig 1: Seasonal differences (1960-2001) in (a) latent heat flux (LH), (b) precipitation (P_{TOT}), (c) maximum temperature (T_{MAX}), and (d) minimum temperature (T_{MIN}) between ACCESS simulations using the Medlyn and default Leuning (Medlyn – Leuning) g_s parameterizations. Stripping shows statistically significant differences.

De Kauwe et al (2014) A test of an optimal stomatal conductance scheme within the CABLE land surface model. Geosci. Model Dev. Discuss., 7, 6845-6891
Leuning et al (1995) A critical appraisal of a combined stomatal-photosynthesis model for C3 plants. Plant Cell Environ. 18, 339-355.
Medlyn et al (2013) Reconciling the optimal and empirical approaches to modelling stomatal conductance. Glob. Change Biol. 17, 2134-2144