Comparison of ACCESS1.3 results with the new CABLE2.0 implementation (benchmarking tests)

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This document provides a brief summary of the benchmark tests performed with the CABLE2.0 version in ACCESS.

1. Simulations

Two sets of atmosphere only (AMIP style) simulations were performed for the period 1978 to 1997 (20 years) using the same setup as described in Kowalczyk et al. (submitted to AMOJ). Both simulations use ACCESS with the newly released CABLE2.0 version:

- CABLE2.0 with standard optical leaf properties, which we denote 2.0A (note that we used a trial version (revision 95) of CABLE2.0 for this simulation)

- CABLE2.0 with optical leaf properties (transmission and reflectance) that are better calibrated for the snow-free soil albedo used by ACCESS, which we denote 2.0A_opt

The simulations are compared with the ACCESS1.3 atmosphere only simulation (1.3A) from Kowalczyk et al. (submitted to AMOJ). Note that 1.3A was analysed over a slightly longer period, from 1978-2005.

2. Results

The main focus of the comparison is on seasonal mean precipitation and screen level temperature biases and on the mean surface albedo. Biases are calculated by comparing modelled fields with the ERA interim reanalysis product.

2.1. Comparison 1.3A vs. 2.0A

The comparison of the seasonal precipitation bias for DJF and JJA is shown in Figs. 1 and 2, respectively. Over most of the land areas the bias is the same for the two versions. There are small changes in some of the equatorial regions. For example, 2.0A produces a slightly larger dry bias (0.5-2mm/day) over parts of the Indian Ocean around Singapore/Indonesia/Papua New Guinea in DJF, but also a slightly smaller dry bias (0.5 to 2 mm/day) over other areas such as in the Pacific, east of the Philippines. A smaller wet bias (0.5-4mm/day) occurs over Mexico, the Gulf of Mexico and the Caribbean Sea in JJA for 2.0A.

The seasonal mean screen level temperature biases are shown in Figs. 3 and 4. The overall pattern is similar for both ACCESS versions. However, 2.0A produces a larger warm bias (up to 2 ˚C) over most of north and east Asia in DJF. Most of Antarctica is warmer in 2.0A, which reduces the cold bias by up to 2 ˚C. During JJA 2.0A shows a smaller warm bias for most of Europe, Asia and North America by up to 1.5 ˚C. Over Antarctica the temperature bias increases slightly (up to 1 ˚C) in 2.0A, some areas show a larger cold bias and some areas show a larger warm bias.

The seasonal mean surface albedo is almost identical for 1.3A and 2.0A.

2.2. Comparison 1.3A vs. 2.0A_opt

The seasonal precipitation bias fields for versions 2.0A and 2.0A_opt are very similar (Figs. 1 and 2). There are some small differences in Australia. In 2.0A_opt Eastern Australia is slightly wetter and Western Australia slightly drier in DJF. However, overall there is very little difference in precipitation biases between either 2.0A or 2.0A_opt and 1.3A.

The seasonal mean screen level temperature biases for 1.3A and 2.0A_opt are shown in Figs. 3 and 4. The increase in the warm bias over North and East Asia for DJF produced by 2.0A is smaller in 2.0A_opt and similar to the bias in 1.3A. 2.0A_opt shows a similar DJF cold bias in Antarctica relative to 1.3A, which is up to 2 ˚C larger than in 2.0A. In JJA, there is a reduction in the warm bias for most of the land in the northern hemisphere in 2.0A_opt, further improving the 2.0A simulation compared to 1.3A. Antarctica shows again regions with a slightly increased warm bias, but also regions with a decreased cold bias.

An increase in surface albedo for vegetated land areas by about 0.01 to 0.04 can be observed in 2.0A_opt in Fig. 5 for JJA, particularly in tropical regions, SE Asia and mid-high northern latitudes. The surface albedo in 1.3A and 2.0A is quite low and a re-calibration of the optical leaf properties (transmission and reflectance) is responsible for the increase in albedo for 2.0A_opt. The surface albedo in 2.0_opt is still somewhat lower than that of simulation 1.0A (Kowalczyk, submitted to AMOJ).

3. Summary

Overall, the 2.0A and 2.0A_opt results are very similar to each other and also similar to the 1.3A results as given by Kowalczyk et al. (submitted to AMOJ). Small differences could be identified in the seasonal mean precipitation and temperature bias fields. In both versions, 2.0A and 2.0A_opt, the seasonal mean temperature bias over equatorial South America and Africa was reduced for DJF in comparison to 1.3A. The warm temperature bias over land in the Northern hemisphere for JJA is reduced in 2.0A and even more in 2.0A_opt, which is encouraging.

The major difference between both, 1.3A and 2.0A, and 2.0A_opt is in the surface albedo. It was noted in Kowalczyk et al. (submitted to AMOJ) that the surface albedo in CABLE is generally lower than in MOSES. However, the re-calibration of the optical leaf parameters in 2.0A_opt led to an increase in the albedo for vegetated areas. We recommend that the re-calibrated optical leaf properties be used in preference to the ones used for the ACCESS1.3 CMIP5 simulations.

References

Kowalczyk, E. A., L. Stevens, R.M. Law, M. Dix, Y.P. Wang, I.N. Harman, K. Haynes, J. Srbinovsky, B. Pak and T. Ziehn (2012). The land surface model component of ACCESS: description and impact on the simulated surface climatology. Submitted to AMOJ

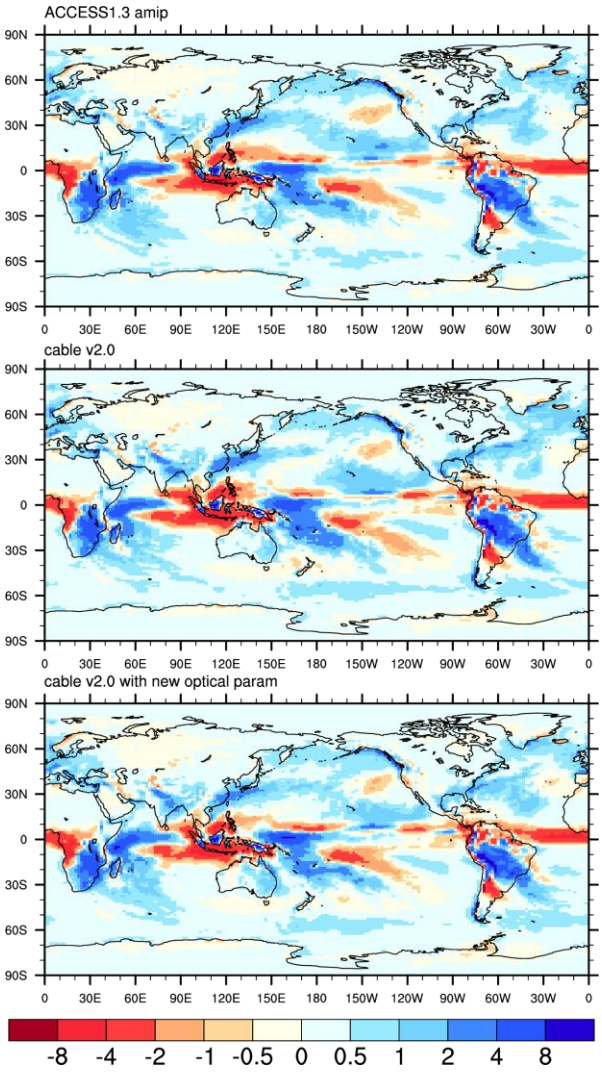

Figure 1: Seasonal mean precipitation biases (mm/day) for ACCESS1.3 (top), ACCESS with CABLE2.0 (middle) and ACCESS with CABLE2.0 and new optical leaf properties (bottom) for DJF.

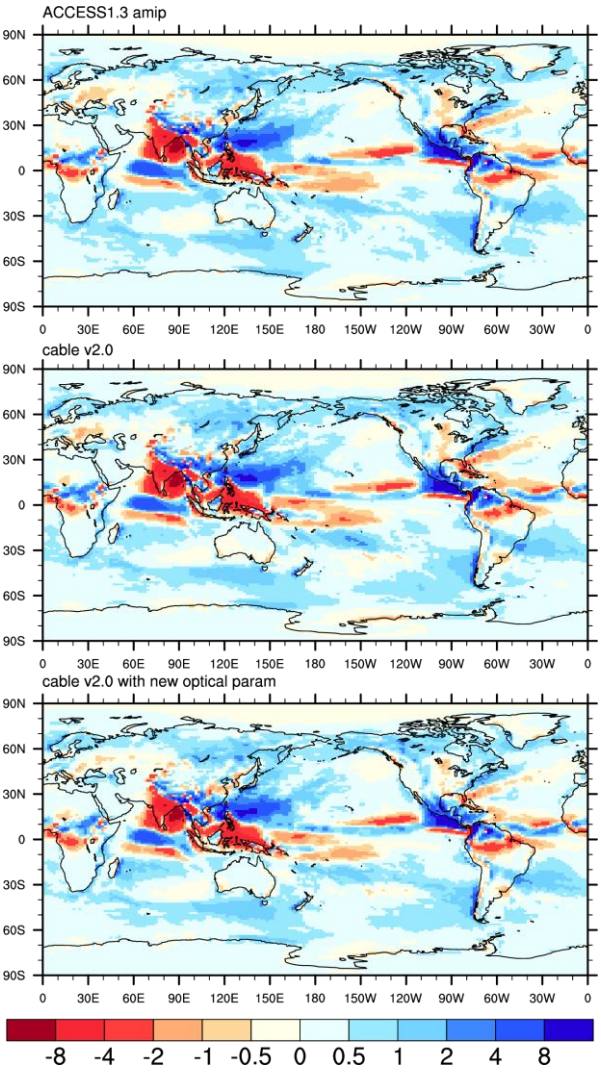

Figure 2: Seasonal mean precipitation biases (mm/day) for ACCESS1.3 (top), ACCESS with CABLE2.0 (middle) and ACCESS with CABLE2.0 and new optical leaf properties (bottom) for JJA.

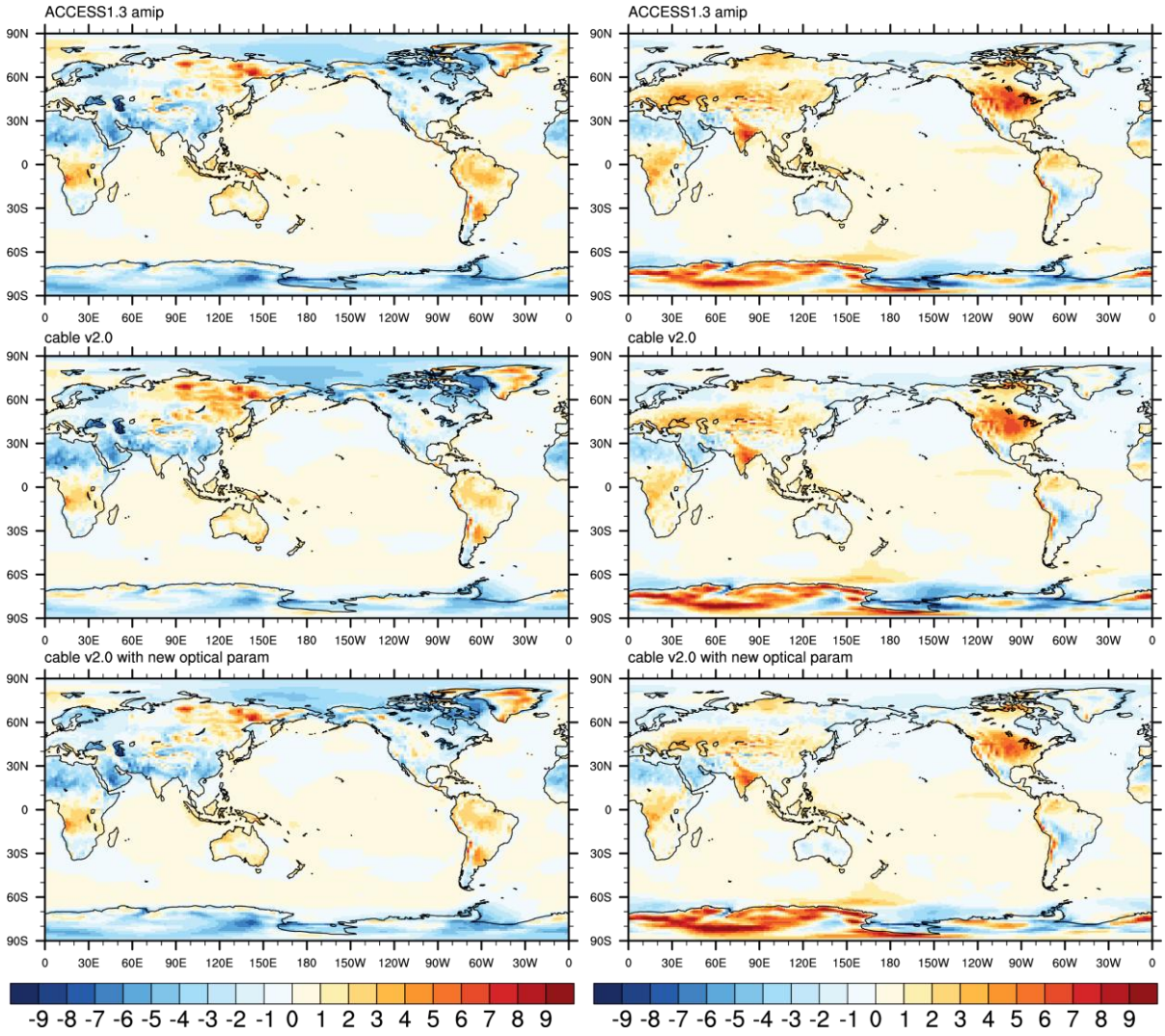

Figure 3: Seasonal mean screen temperature biases (˚C) for ACCESS1.3 (top), ACCESS with CABLE2.0 (middle) and ACCESS with CABLE2.0 and new optical leaf properties (bottom) and for DJF.

Figure 4: Seasonal mean screen temperature biases (˚C) for ACCESS1.3 (top), ACCESS with CABLE2.0 (middle) and ACCESS with CABLE2.0 and new optical leaf properties (bottom) for JJA.

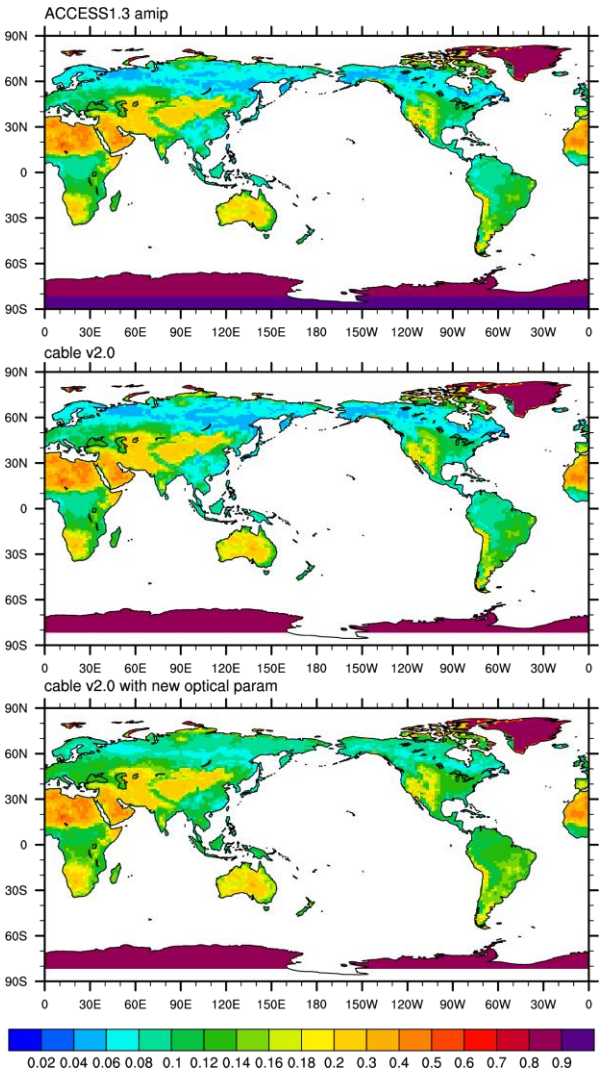

Figure 5: Seasonal mean surface albedo for ACCESS1.3 (top), ACCESS with CABLE2.0 (middle) and ACCESS with CABLE2.0 and new optical leaf properties (bottom) for JJA.