**Title:** ACi-TGlob\_V1.0: A Global dataset of photosynthetic CO2 response curves of terrestrial plants.

**Authors and data compilers**

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**Abstract and keywords**

Global vegetation models (GVMs) are one of the major tools used to predict global forest carbon balance in future warmed climates. GVMs simulate land carbon exchange processes through the mechanistic (and/or empirical) representation of the underline processes such as photosynthesis and respiration and their responses to environmental drivers. Photosynthesis is one of the key component in GVMs therefore, robust representation of photosynthesis and its responses to environment is important in predicting future global carbon budget. Robust parameterization of photosynthesis in GVMs require data spanning geographically to represent species’ adaptive responses to their climate of origin, as well as temporally to represent acclimation responses to short-term changes in growth environment. Here we present 1) raw data to parameterize key photosynthetic biochemical parameters; maximum rate of ribulose-1,5-bisphosphate carboxylase-oxygenase (Rubisco) activity (*Vcmax*), potential rate of electron transport (*J*max) and rate of triose phosphate export from the chloroplast (*TPU*), 2) estimated *Vcmax*, *J*max and *TPU* parameter values for 141 plant species from 42 experiments conducted around the world. The database includes observations for most plant functional types (PFTs) from tropical rain forests to boreal forests and data from Arctic tundra. Site latitude ranged from 42°48' S to 71°16' N and mean annual growing season temperature ranged from 3 to 30°C. The dataset contains raw photosynthetic CO2 response curves (*ACi curves*) measured at different leaf temperature temperatures, and estimated parameters (*Vcmax*, *J*max and TPU) and their temperature response parameters. It includes data from different types of experiments (e.g. temperature warming experiments, CO2 enrichment experiments, drought experiments) allowing examination of parameter responses to environmental drivers. We expect that the data presented here will be useful for better parameterization and evaluation of GVMs thereby improve the predictions on future forest carbon balance.

Key words: Photosynthesis, Vcmax, Jmax, activation energy, global warming, trees, temperature, forests, acclimation, adaptation

**Metadata**

**Class I. Dataset descriptors**

**A. Dataset identity**

PPCGlob: Global dataset on plant photosynthetic capacity

**B. Dataset identification code**

PPCGlob V1.0

**C. Dataset description**

**1. Originators:** This study was initiated by Dushan P. Kumarathunge, Belinda E. Medlyn, John E. Drake and Mark G. Tjoelker at Hawkesbury Institute for the Environment, University of Western Sydney, Australia

**2. Abstract:**

Global vegetation models (GVMs) are one of the major tools used to predict global forest carbon balance in future warmed climates. GVMs simulate land carbon exchange processes through the mechanistic (and/or empirical) representation of the underline processes such as photosynthesis and respiration and their responses to environmental drivers. Photosynthesis is one of the key component in GVMs therefore, robust representation of photosynthesis and its responses to environment is important in predicting future global carbon budget. Robust parameterization of photosynthesis in GVMs require data spanning geographically to represent species’ adaptive responses to their climate of origin, as well as temporally to represent acclimation responses to short-term changes in growth environment. Here we present 1) raw data to parameterize key photosynthetic biochemical parameters; maximum rate of ribulose-1,5-bisphosphate carboxylase-oxygenase (Rubisco) activity (*Vcmax*), potential rate of electron transport (*J*max) and rate of triose phosphate export from the chloroplast (*TPU*), 2) estimated *Vcmax*, *J*max and *TPU* parameter values for 141 plant species from 42 experiments conducted around the world. The database includes observations for most plant functional types (PFTs) from tropical rain forests to boreal forests and data from Arctic tundra. Site latitude ranged from 42°48' S to 71°16' N and mean annual growing season temperature ranged from 3 to 30°C. The dataset contains raw photosynthetic CO2 response curves (ACi curves) measured at different leaf temperature temperatures, and estimated parameters (*Vcmax*, *J*max and TPU) and their temperature response parameters. It includes data from different types of experiments (e.g. temperature warming experiments, CO2 enrichment experiments, drought experiments) allowing examination of parameter responses to environmental drivers. We expect that the data presented here will be useful for better parameterization and evaluation of GVMs thereby improve the predictions on future forest carbon balance.

**Class II. Research origin descriptors**

**A. Overall project description**

**1. Identity:** Predicting the effect of temperature on plant growth

**2. Originators:** Dushan P. Kumarathunge, Belinda E. Medlyn, John E. Drake and Mark G. Tjoelker at Hawkesbury Institute for the Environment, University of Western Sydney, Australia

**3. Periods of study:** November 2015 – November 2018

**4. Objectives:**

This research project covered a major component of the PhD thesis of Dushan P. Kumarathunge under advisors Belinda E. Medlyn (principal advisor), John E. Drake and Mark G. Tjoelker (co-advisors). The primary objective of this project was to identify key mechanisms responsible for photosynthetic temperature acclimation and adaptation and develop models to represent photosynthetic temperature acclimation and adaptation in global vegetation models for improved prediction of the function of global forest ecosystems in a warming climate.

**5. Abstract:**

Temperature dependence of leaf photosynthesis (An-T response) is a key determinant in modelling plant growth. Hence, the way that any Global Vegetation Model (GVM) handles the An-T response is critical. It is known that there are differences in the optimum temperature for net photosynthesis (Topt) across species. However, it’s unknown how much each of the underlying component processes (biochemical, stomatal and respiratory) contribute to these differences in optimum. Additionally, it is unknown whether differences across species are largely genetic (adaptation) or plastic (acclimation). The primary objective of this project was to identify key mechanisms responsible for photosynthetic temperature acclimation and adaptation and develop models to represent photosynthetic temperature acclimation and adaptation in global vegetation models for improved prediction of the function of global forest ecosystems in a warming climate. The central hypothesis tested in this project was; Topt is more strongly related to species’ climate of origin than growth environment, and that all three photosynthetic component processes contribute to differences in Topt. To test this hypothesis, we compiled a global dataset of ACi curves measured at different leaf temperatures through published and unpublished sources. The project quantified key mechanisms responsible for temperature acclimation and adaptation of terrestrial plant photosynthesis. A detailed scientific description of this project and its key outputs can be found in Kumarathunge et al (2018).

**6. Sources of funding:** This research was supported by a Western Sydney University PhD scholarship to Dushan Kumarathunge. AR was supported by the Next Generation Ecosystem Experiments (NGEE Arctic) project which is supported by the Office of Biological and Environmental Research in the United States Department of Energy (DOE), Office of Science, and through the United States Department of Energy contract no. DE-SC0012704 to Brookhaven National Laboratory. KYC was supported by an Australian Research Council DECRA (DE160101484). DAW acknowledges an NSERC Discovery grant and funding from the Hawkesbury Institute Research Exchange Program. JU, LT and GW were supported by the Swedish strategic research area BECC (Biodiversity and Ecosystem Services in a Changing Climate; www.becc.lu.se). JQC was supported by the NGEE-Tropics, United States DOE. MDK was supported by Australian Research Council Centre of Excellence for Climate Extremes (CE170100023). MS was supported by a Earl S Tupper postdoctoral fellowship. AMJ and JMW were supported by the Biological and Environmental Research Program in the Office of Science, United States DOE under contract DEAC05-00OR22725. MAC was supported by United States DOE grant DE-SC-0011806 and USDA Forest Service 13-JV-11120101-03. Several of the Eucalyptus datasets included in this study were supported by the Australian Commonwealth Department of the Environment or Department of Agriculture, and the Australian Research Council.

**B. Specific subproject description**

**1. Experimental site description**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Table 1. Individual dataset information | | | | | | | |
| **Dataset name** | **Site type** | **Geography**  **(latitude, longitude)** | **Climate** | | | **Reference** | |
| **Mean growing season temperature (°C)1** | **Mean maximum temperature of the warmest month (°C)1** | **Mean annual precipitation**  **(mm)1** |  |
| Dillaway DBF spp, USA-IL | Common garden managed by the University of Wisconsin-Madison | Illinois, USA  (37.0, -88.0) | 13.3 | 29.9 | 1198 | Dillaway and Kruger (2010) |
| Dillaway DBF spp, USW-WI (N) | Common garden managed by the University of Wisconsin-Madison | Northern Wisconsin, USA  (45.0, -89.0) | 13.2 | 26.3 | 808 | Dillaway and Kruger (2010) |
| Dillaway DBF spp, USW-WI (S) | Common garden managed by the University of Wisconsin-Madison | Southern Wisconsin, USA  (43.0, -89.0) | 12.8 | 28.8 | 826 | Dillaway and Kruger (2010) |
| Lin Eucalypt spp, AU-NSW | Common garden managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Lin et al. (2013) |
| Vårhammar EBF spp, Rwanda | Managed arboretum | Rwasave, Rwanda  (-2.47, 29.20) | 20.7 | 27.5 | 1231 | Vårhammar et al. (2015) |
| Rainforest, Puerto Rico | Tropical rain forest | Puerto Rico  (18.31, -65.73) | 24.0 | 29.8 | 1300 | Alida C. Mau and Molly A. Cavaleri  Unpublished data |
| Black Spruce, USA-MN | Evergreen needle leaf forest - Boreal | Minnesota, USA  (47.50, -93.45) | 25.8 | 12.2 | 684 | Jensen et al. (2015) |
| Shrub, USA-AK | Arctic tundra | Utqiagvik, Alaska  (71.28 -156.65) | 7.7 | 3.1 | 116 | Rogers et al. (2017) |
| Loblolly Pine, US-NC | Evergreen needle leaf forest - Temperate | North Carolina, USA  (35.96, -79.08) | 31.4 | 14.6 | 1165 | David Ellsworth, Unpublished data |
| Eucalypt Woodland, AU-NSW | Evergreen broadleaf woodland | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Crous and Ellsworth, Unpublished data |
| Semi-arid Woodland, AU-WA | Semi-arid Woodland | Kalgoorlie WA, Australia  (-30.19, 120.65) | 34.5 | 18.6 | 273 | Fürstenau Togashi et al. (2017) |
| Hinoki Cypress, Japan | Managed plantation forest | Tsukuba, Japan  (36.05, 140.11) | 30.1 | 13.7 | 1274 | Han et al. (2006) |
| Japanese Beech,  Japan | Climate controlled growth chambers managed by the Tohoku University, Japan | Mt Hakkoda, Japan  (38.15, 140.30) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Onoda et al. (2005) |
| Red Pine, Japan | Evergreen needle leaf forest - Temperate | Fujiyoshida, Japan  (35.45, 138.8) | 26.0 | 11.8 | 1791 | Han et al. (2004) |
| Rainforest understorey, Puerto Rico | Tropical rain forest | Puerto Rico  (18.31, -65.73) | 24.0 | 29.8 | 4000 | Kelsey R. Carter and Molly A. Cavaleri Unpublished data |
| Rainforest, Panama (A) | Tropical rain forest | Gamboa, Panama  (8.99, -79.54) | 26.9 | 32.6 | 1824 | Slot and Winter (2017) |
| Rainforest, Panama (B) | Tropical rain forest | Gamboa, Panama  (8.99, -79.54) | 26.9 | 32.6 | 1824 | Slot and Winter (2017b) |
| Maritime Pine, France | Evergreen needle leaf forest - Temperate | Bordeaux, France  (44.0, 0.58) | 26.7 | 12.6 | 750 | Medlyn et al. (2002) |
| Mongolian Oak, Japan | Deciduous broadleaf forest | Tomakomai, Japan  (42.66, 141.6) | 23.8 | 12.3 | 1157 | Hikosaka et al. (2007) |
| Rainforest, Brazil | Tropical rain forest | Manaus, Brazil  (-2.63, -60.12) | 32.7 | 27.2 | 2198 | Tribuzy (2005) |
| Rainforest, Au-QLD | Tropical rain forest | Daintree, QLD, Australia  (-16.10, 145.44) | 31.3 | 24.4 | 2056 | Kelly (2014) |
| Savanna Eucalypt, AU-NT | Tropical savanna | Darwin, NT, Australia  (-14.16, 131.39) | 37.8 | 27.4 | 1130 | Cernusak et al. (2011) |
| Norway Spruce, Sweden | Evergreen needle leaf forest - Boreal | Skogaryd, Sweden  (58.38, 12.15) | 20.1 | 9.4 | 771 | Tarvainen et al. (2013) |
| Scots Pine, Sweden | Evergreen needle leaf forest - Boreal | Rosinedalsheden, Sweden  (64.16, 19.75) | 20.1 | 8.5 | 581 | Tarvainen et al. (2017) |
| Subalpine Eucalypt, AU-NSW (A) | Sub alpine evergreen broadleaf forest - Temperate | Tumbarumba NSW, Australia  (-35.66, 148.15) | 22.9 | 8.5 | 1542 | Medlyn et al. (2007) |
| Subalpine Eucalypt, AU-NSW (B) | Sub alpine evergreen broadleaf forest - Temperate | Tumbarumba NSW, Australia  (-35.66, 148.15) | 22.9 | 8.5 | 1542 | Medlyn et al. (2007) |
| Scots Pine, Finland | Evergreen needle leaf forest - Boreal | Mekrijarvi, Finland  (62.78, 30.96) | 20.4 | 8.4 | 624 | Wang et al. (1996) |
| *Eucalyptus tereticornis* provs AU-NSW | Climate controlled glasshouse managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Javier Cano and John E. Drake, Unpublished data |
| Pinus sylvestris provs, USA-WI | Climate controlled glasshouse managed by the University of Wisconsin-Madison | Madison, Wisconsin, US  (43.07, -89.4) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Mark G. Tjoelker, Unpublished data |
| *Corymbia calophylla* provs, AU-NSW | Climate controlled glasshouse managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Aspinwall et al. (2017) |
| Ghannoum Eucalypt spp, AU-NSW | Climate controlled glasshouse managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | Experiment in a controlled environment. See table 2 for detailed climate information | | | (Ghannoum et al. 2010) |
| Dreyer DBF spp,  France | Managed nursery | Nancy, France  (48.69, 6.18) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Dreyer et al. (2001) |
| *Eucalyptus saligna*, AU-NSW | Whole tree chambers managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Yan Shih Lin, Unpublished data |
| *Eucalyptus globulus*, AU-NSW | Whole tree chambers managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Crous et al. (2013) |
| *Eucalyptus tereticornis*, AU-NSW | Whole tree chambers managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Kristine Crous, Unpublished data |
| *Eucalyptus parramattensis*, AU-NSW | Whole tree chambers managed by the Western Sydney University, Australia | Richmond NSW, Australia  (-33.62, 150.74) | 17.1 | 28.9 | 900 | Dushan Kumarathunge, Unpublished data |
| Eucalyptus globulus, AU-TAS | Plantation forest | Hobart, Tasmania  (-42.81 146.61) | 18.4 | 8.5 | 1397 | Battaglia et al. (1996) |
| Black Spruce (Canada) | Climate controlled growth chambers managed by the University of Toronto, Ontario, Canada | Toronto, Canada  (49.11 -74.61) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Way and Sage., (2008) |
| Silver Birch | unknown | Mekrijarvi, Finland  (62.78, 30.96) | Experiment in a controlled environment. See table 2 for detailed climate information | | | Wang K-Y, Unpublished data |
| Monterey pine | Plantation forest | Christchurch, New Zeland  (-42.52 172.45) | 18.1 | 8.2 | 1539 | Walcroft *et al*., (1997) |
| Smith C3 spp, IN, USA | Climate controlled growth chambers managed by the Purdue University, West Lafayette, IN, USA | West Lafayette, IN, USA | Experiment in a controlled environment. See table 2 for detailed climate information | | | Smith and Dukes, (2017) |
| 11960-1990 mean 30 seconds resolution WorldClim climatology data (Hijmans et al., 2005) | | | | | | |

**2. Sampling design**

**a. Design characteristics**

Data were measured on at least three (or more) randomly selected replicate individuals of the same species or different species (depend on the individual dataset). In all cases, upper canopy sun-lit leaves were sampled for gas exchange measurements. In most of the datasets gas exchange measurements were done in attached leaves, however, in some datasets, detached leaves were used. The database includes data for most plant functional types (PFTs) including broadleaf deciduous trees (both boreal and temperate); broadleaf evergreen trees (both temperate and tropical); needleleaf evergreen trees (both boreal and temperate); and Arctic tundra. It includes data from different types of experiments (e.g. temperature warming experiments, CO2 enrichment experiments, drought experiments; Table 1). The database contained a total of 5113 ACi which cover 141 tree species from 38 experiments conducted around the world, with 15 sites from Australia, six sites from North America, one site from South America, three sites from Central America, five sites from Europe, one site from Africa and four sites from Asia (Fig. 1). Site latitude ranged from 42°48' S to 71°16' N and mean annual growing season temperature (long-term average temperature of months where mean monthly temperature is above 0°C) ranged from 3 to 30°C.

**b. Permanent plots:** Permanent plots were not established

**c. Data collection periods:** please refer to the Table 1

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Table 2.** List of species, seed source location and measurement settings. Treatments column shows specific growth temperature, growth CO2 concentration and watering treatments whenever implemented in different datasets. We recommend users to refer to the original publications given in Table 1 for each datasets for more detailed explanation on different treatments. Unless specially mentioned, plants were grown under natural light conditions. In datasets where specific treatments not implemented, plants were grown under natural environmental conditions of the experimental site. | | | | | | | | | | |
| **Dataset** | **Species** | **Seed source location**  **latitude longitude** | **Measurement PPFD**  **(µmol m-2s-1)** | **Measurement temperature**  **range (◦C)** | **Growth temperature**  **range (◦C)** | **Treatments** | **Data collection periods** | **Age of plants** | **Data type** | **Instrument used** |
| Dillaway DBF spp, USA-IL | *Betula papyrifera*  *Liquidambar styraciflua*  *Populus deltoides*  *Populus tremuloides* | 45.0 -89.0  38.0 -84.0  43.0 -89.0  43.0 -89.0 | 1800 | 21 – 37 | 30.6 | Natural environmental conditions | August 2007 | saplings | ACi-T | Licor 6400 |
| Dillaway DBF spp, USW-WI (N) | *Betula papyrifera,*  *Liquidambar styraciflua,*  *Populus deltoides,*  *Populus tremuloides* | 45.0 -89.0  38.0 -84.0  43.0 -89.0  43.0 -89.0 | 1800 | 21 – 37 | 18.7 | Natural environmental conditions | August 2007 | saplings | ACi-T | Licor 6400 |
| Dillaway DBF spp, USW-WI (S) | *Betula papyrifera,*  *Liquidambar styraciflua,*  *Populus deltoides,*  *Populus tremuloides* | 45.0 -89.0  38.0 -84.0  43.0 -89.0  43.0 -89.0 | 1800 | 21-37 | 22.5 | Natural environmental conditions | August 2007 | saplings | ACi-T | Licor 6400 |
| Lin Eucalypt spp, AU-NSW | *Eucalyptus cladocalyx*  *Eucalyptus crebra*  *Eucalyptus dunnii*  *Eucalyptus melliodora*  *Eucalyptus saligna*  *Eucalyptus tereticornis* | -33.03 138.75  -33.61 150.81  -28.41 153.02  -35.11 147.37  -30.37 152.10  -30.04 150.73 | 1500 | 15 – 36 | 8.8 – 25.3 | Natural environmental conditions | August 2008  November 2008  February 2009 | saplings | ACi-T  An-T | Licor 6400 |
| Vårhammar EBF spp, Rwanda | *Carapa procera,*  *Entandrophragma excelsum*  *Hagenia abyssinica,*  *Cedrela serrata,*  *Eucalyptus maidenii*  *Eucalyptus microcorys* | -2.47 29.20  -2.47 29.20  -2.47 29.20  34.08 73.47  -36.56 149.65  -30.58 152.62 | 1800 | 20 – 40 | 19.4 | Natural environmental conditions | July – August 2011 | saplings | ACi-T | Licor 6400 |
| Rainforest understory, Puerto Rico | *Prestoea montana*  *Psychotria brachiate*  *Piper glabrescens*  *Rourea surinamensis*  *Miconia prasina* | 18.18 -65.73 | 800 | 20 – 40 | 24.0 | Natural environmental conditions | March – August 2014 | mature | ACi-T | Licor 6400 |
| Black Spruce,  USA-MN | *Picea mariana* | 47.50 -93.45 | 1700 | 2 – 50 | 5.3 – 17.5 | Natural environmental conditions | June, September 2010  July, October 2011  May, June, October 2012  April, July, August 2013 | mature | ACi-T | Licor 6400 |
| Arctic tundra, USA-AK | *Arctagrostis latifolia*  *Arctophila fulva*  *Dupontia fisheri*  *Carex aquatilis*  *Eriophorum angustifolium*  *Petasites frigidus*  *Salix pulchra* | 71.28 -156.65 | 2000 | 5 – 25 | 3.1 | Natural environmental conditions | July, August 2012  July 2013  July 2014  July 2015 | mature | ACi-T | Licor 6400 |
| Loblolly Pine, US-NC | *Pinus taeda* | 35.96 -79.08 | 1800 | 10 – 35 | 11.8 – 26.4 | Natural environmental conditions | December 1998  August 1999 | mature | ACi-T | Licor 6400 |
| Eucalypt Woodland, AU-NSW | *Eucalyptus tereticornis* | -33.62 150.74 | 1800 | 25 – 42 | 17.1 | Natural environmental conditions |  | mature | ACi-T | Licor 6400 |
| Semi-arid Woodland, AU-WA | *Eucalyptus clelandii*  *E. salmonophloia*  *E. salubris,*  *E. transcontinentalis,*  *Eremophila scoparia,*  *Acacia aneura,*  *Acacia. hemiteles*  *Callitris columellaris* | -30.19 120.65 | 1800 | 20 – 35 | 21.9 | Natural environmental conditions | March-April 2013  August-September 2013 | mature | ACi-T | Licor 6400 |
| Hinoki Cypress, Japan | *Chamaecyparis obtusa* | 36.05 140.11 | 1100 | 15 – 30 | 11.9 | Natural environmental conditions | April 2004  October 2004 | seedlings | ACi-T | Licor 6400 |
| Japanese Beech,  Japan | *Fagus crenata* | 40.63 140.85 | 1000 - 2000 | 15 – 35 | 15.9 – 25.3 | Natural environmental conditions | May 2002  August 2002  October 2002 | seedlings | ACi-T | Licor 6400 |
| Red Pine, Japan | *Pinus densiflora* | 35.45 138.8 | 1100 | 15 – 30 | 11.8 | Natural environmental conditions | May 2001  July 2001  November 2001 | mature | ACi-T | Licor 6400 |
| Tropical forest, Puerto Rico | *Dacryodes excels*  *Castilla elastica* | 18.31 -65.73 | 600 - 800 | 20 – 35 | 24.0 | Natural environmental conditions | July 2015 | mature | ACi-T | Licor 6400 |
| Rainforest, Panama (A) | Calophyllum longifolium  Ficus insipida  Garcinia madruno  Lagerstroemia speciose | 8.99 -79.54 | 1500 | 22 – 42 | 26.9 | Natural environmental conditions | November 2016 – January 2017 | mature | ACi-T | Licor 6400 |
| Rainforest, Panama (B) | *Anacardium excelsum*  *Apeiba membranacea*  *Brosimum utile*  *Carapa guianensis*  *Cordia bicolor*  *Garcinia madruno*  *Guatteria dumetorum*  *Manilkara bidentate*  *Miconia minutiflora*  *Protium panamense*  *Simarouba amara*  *Tachigali versicolor*  *Tapirira guianensis*  *Terminalia amazonia*  *Tocoyena pittieri*  *Vantanea depleta*  *Virola multiflora*  *Vochysia ferruginea*  *Astronium graveolens Castilla elastica*  *Cecropia peltata*  *Chrysophyllum cainito Ficus insipida*  *Luehea seemannii*  *Macrocnemum roseum Nectandra cuspidata*  *Pittoniotis trichantha*  *Schefflera morototoni*  *Spondias mombin*  *Zuelania guidonia* | 8.99 -79.54 |  |  |  | Natural environmental conditions |  |  | An-T | Licor 6400 |
| Maritime Pine, France | *Pinus pinaster*  prov. Landes  prov. Tamjout | 44.0 0.58  35.14 5.25 | 1400 | 15 – 35 | 6.7 – 20.9 | Natural environmental conditions | July 1999  September 1999  November 1999  January 2000  March 2000  June 2000  October 2000 | mature | ACi-T | Walz-CMS system |
| Mongolian Oak, Japan | *Quercus crispula* | 42.66 141.6 | 1000 | 10 - 30 | 12.3 – 17.5 | Natural environmental conditions | June 2001  August 2001  September 2001  June 2002  August 2002  September 2002 | mature | ACi-T |  |
| Rainforest, Brazil | *Peltogine excels*  *Protium sp*  *Ocotea sp.*  *Diospyrus praetermissa*  *Tachigali mimercophyla*  *Jacaranda copaia*  *Licania micheli*  *Ocotea sp.*  *Quaruba branca*  *Miratinga perebea*  *Bertholletia excels*  *Tetragastris panamensis*  *Crysophillum sp.*  *Abuta panurensis*  *Macherium sp.*  *Tetracera amazonica*  *Brosimum parinarioides*  *Guarea sp.*  *Pouteria erythrochrysa*  *Pouteria anomala*  *Couepia longipondula*  *Micropholis guyanensis*  *Eschweilera coriacea*  *Bellucia dichotoma*  *Zygia racemosa*  *Pouteria williamii*  *Licania octandra* | -2.63 -60.12 | NA | 25 – 42 | 25.8 – 27.8 | Natural environmental conditions | June – November 2001  March 2004 | mature | ACi-T | Licor 6400 |
| Rainforest, Au-QLD | *Argyrodendron peralatum Syzygium graveolens* | -16.10 145.44 | 1000 | 25 – 40 | 24.3 – 27.5 | Natural environmental conditions | April 2011  July 2011 | mature | ACi-T | Licor 6400 |
| Savanna Eucalypt, AU-NT | *Eucalyptus tetrodonta* | -14.16 131.39 | 2000 | 25 – 40 | 27.1 | Natural environmental conditions | September 2008 | mature | ACi-T | Licor 6400 |
| Norway Spruce, Sweden | *Picea abies* | 58.38 12.15 | 1047 | 13 – 33 | 9.3 | Natural environmental conditions | June, September 2009  June 2010 | mature | ACi-T | Licor 6400 |
| Scots Pine, Sweden | *Pinus sylvestris* | 64.16 19.75 | 1500 | 15 – 35 | 15.4 | Natural environmental conditions | August 2013 | mature | ACi-T | Licor 6400 |
| Subalpine Eucalypt, AU-NSW | *Eucalyptus delegatensis* | -35.66 148.15 | 1500 | 12 – 32 | 11.9 | Natural environmental conditions | November 2001  February 2002  May 2002 | mature | ACi-T  An-T | Licor 6400 |
| Scots Pine, Finland | *Pinus sylvestris* | 62.78 30.96 | 1200 | 5 – 32 | 14.0 | Natural environmental conditions | July 1998 | mature | ACi-T | Licor 6400 |
| Eucalyptus tereticornis provs AU-NSW | *Eucalyptus tereticornis*  prov. temperate  prov. sub-tropical  prov. tropical | -35.39 150.07  -26.57 152.05  -15.5 145.14 | 1500 | 18 – 42 | 18 – 35.5 | Six growth temperature treatments   1. 18°C 2. 21.5°C 3. 25°C 4. 28.5°C 5. 32°C 6. 35.5°C   [CO2] = 400 ppm | February 2016 | seedlings | ACi-T | Licor 6400 |
| Pinus sylvestris provs, USA-WI | *Pinus sylvestris*  prov Haguenau  prov Suprasl  prov Spala  prov Sumpberget  prov Ostrovskij  prov Prusacka Rijeka | 48.81 7.78  53.2 23.36  51.61 20.2  60.18 15.86  57.83 28.15  44.08 17.35 | 1500 | 15 – 37 |  |  |  | seedlings | An-T | Licor 6400 |
| *Corymbia calophylla* provs, AU-NSW | *Corymbia calophylla*  prov Cape Richie  prov Boorara  prov Mogumber  prov Gingin | -34.6 118.74  -34.73 116.21  -31.1 116.05  -31.34 115.89 | 1800 | 20 – 40 | 26 .0 | Two growth temperature treatments   1. 26°C 2. 32°C | July 2014 | seedlings | ACi-T | Licor 6400 |
| Ghannoum Eucalypt spp, AU-NSW | *Eucalyptus saligna,*  *Eucalyptus sideroxylon* | -30.57 152.15  -32.99 147.89 | 1500 | 15 – 43 | 22.0 | Two growth temperature treatments  Ambient - 26°C  Elevated - 30°C  Three [CO2] treatments  Sub-ambient – 280 ppm  Ambient – 400 ppm  Elevated – 640 ppm |  | seedlings | An-T | Licor 6400 |
| Dreyer DBF spp,  France | *Acer pseudoplatanus*  *Betula pendula*  *Fagus sylvatica*  *Fraxinus excelsior*  *Juglans regia*  *Quercus petraea*  *Quercus robur* | 46.37 5.96  52.5 7.23  50.24 5.05  50.2 3.72  47.02 6.74  48.55 0.08  48.55 0.08 | 1500 | 10 – 40 | 17.3 | Natural environmental conditions under 45% transmitted global irradiance | July 1994  July 1995 | seedlings | ACi-T | Licor 6400 |
| Eucalyptus saligna, AU-NSW | *Eucalyptus saligna* | -30.43 152.04 | 1800 | 18 – 36 | 17.7 – 22.6 | Two [CO2] treatments  Track ambient  Elevated – ambient +240 ppm  Two watering treatments  Wet – well watered  Dry - | January 2009  November 2008 | saplings | ACi-T | Licor 6400 |
| *Eucalyptus globulus*, AU-NSW | *Eucalyptus globulus* | -38.8 143.59 | 1800 | 17 – 41 | 19.7 – 24.9 | Two temperature treatments  Track ambient  Elevated – ambient +3.5°C  Two [CO2] treatments  Track ambient  Elevated – ambient +240 ppm | December 2010  February 2011  August, September 2011 | saplings | ACi-T | Licor 6400 |
| Eucalyptus tereticornis, AU-NSW | *Eucalyptus tereticornis* | -33.62 150.74 | 1800 | 20 – 42 | 14.4 – 22.6 | Two temperature treatments  Track ambient  Elevated – ambient +3.5°C | September 2013  January 2014  April 2014  May 2014 | saplings | ACi-T | Licor 6400 |
| Eucalyptus parramattensis, AU-NSW | *Eucalyptus parramattensis* | -33.62 150.74 | 1800 | 17 – 42 | 15.1 – 18.0 | Two temperature treatments  Track ambient  Elevated – ambient +3.5°C | July 2016  October 2016 | saplings | ACi-T | Licor 6400 |
| Eucalyptus globulus, AU-TAS | *Eucalyptus globulus* | -42.81 146.61 | 1500 | 10 – 35 | 10.3 – 14.8 | Natural environmental conditions | October 1993  November 1993  February 1994  April 1994  December 1994 | saplings | An-T | Licor 6400 |
| Black Spruce (Canada) | *Picea mariana* | 49.11 -74.61 | NA | 10 - 40 | 19 - 27 | Two temperature treatments  Ambient  Elevated – | 2005 | seedlings | ACi-T | Licor 6400 |
| Silver Birch | *Betula pendula* | 52.5 7.23 | 1200 | 5 - 32 | unknown | Natural environmental conditions | July 1998 | unknown | ACi-T | Licor 6400 |
| Monterey pine | *Pinus radiata* | -42.52 172.45 | 1000 | 8 – 30 |  | Natural environmental conditions |  | seedlings | ACi-T | Licor 6400 |
| Smith C3 spp, IN, USA | *Acer rubrum*  *Betula alleghaniensis*  *Betula papyrifera*  *Cedrela odorata*  *Cucumis sativa*  *Elymus Canadensis*  *Glycine max*  *Oryza sativa*  *Pinus nigra*  *Pinus pinaster*  *Pinus pinea*  *Pinus sylvestris*  *Poa pratensis*  *Tamarindus indica*  *Triticum aestivum*  *Ulmus americana* | Exact seed source locations were unknown. | 1200 | 14 – 50 | 15 – 35 | Five growth temperature treatments (15, 20, 25, 30 and 35°C)  [CO2] = 400 ppm |  | seedlings | ACi-T | Licor 6400 |

**3. Research methods**

**a. Field/laboratory**

**Leaf gas exchange measurements**

Measurements were made using a portable photosynthesis system with standard leaf chambers, in most cases the Licor 6400 (Licor Biosciences, Lincoln, NE, USA) although some measurements were made with the Walz-CMS system (Walz, Effeltrich, Germany). Measurements were started at ambient CO2 level (360-400 ppm; depending on the year of data collection) and changed stepwise through a series of subambient (40-400 ppm) to superambient saturating CO2 concentrations (400-2000 ppm). However, in few datasets, measurements were started at lowest (~50 ppm) CO2 level and changed to saturating CO2 levels stepwise. Measurements were completed at saturating irradiance levels (Table 2) using internal LED light source. Relative humidity inside the leaf chamber was attempted to between 40-80%, however, this varied among datasets due to differences in environmental conditions. The same measurement protocol was repeated on the same leaf at different leaf temperatures.

**Estimation of plant photosynthetic capacity**

We estimated plant photosynthetic capacity by fitting the ACi curves using Farquhar et al. (1980) biochemical model of photosynthesis (referred to as FvCB hereafter). The model represents leaf net photosynthesis rate as the minimum of three rates; the Rubisco carboxylation limited photosynthetic rate, the RuBP-regeneration limited photosynthetic rate, and the triose phosphate utilization limited rate. We used the *fitacis* function within the *plantecophys* R package (Duursma 2015) in R version 3.3.2 (R Development Core Team, 2016) to estimate the key parameters of the FvCB model; maximum rate of ribulose-1,5-bisphosphate carboxylase-oxygenase (Rubisco) activity (*Vcmax*), potential rate of electron transport (*J*max) and rate of triose phosphate export from the chloroplast (TPU). We assumed the Bernacchi et al. (2001) kinetic constants for the temperature response of Michaelis–Menten coefficients of Rubisco activity and CO2 compensation point in the absence of mitochondrial respiration. We used photosynthetic photon flux density values (PPFD) measured inside the leaf cuvette in ACi curve fittings whenever available (see Table 2), but assumed a fixed value of 1800 µmol m-2s-1 for datasets where PPFD measurements were not available. We assumed default *fitacis* parameter values for quantum yield of electron transport; *α* (0.24 mol mol-1) and the curvature of the light response curve; *θ* (0.85; unitless) for all datasets. In our ACi curve routine, we did not account for the variations in mesophyll conductance (*gm*) as there were insufficient data to quantify *gm*. Therefore, the estimated parameters, *V*cmax and *J*max, are apparent values. The R code used to fit ACi curves publicly available through a git repository at https://bitbucket.org/Kumarathunge/photom

**Growth temperature during measurements (Tgrowth)**

We defined as the mean air temperature for the 30 days prior to gas exchange measurements (Kattge and Knorr 2007). We derived *Tgrowth* using on-site measured daily air temperature for most of the datasets. For datasets where real-time meteorological data was not available, we extracted *Tgrowth* values from the original publications.

**Climate data for experimental sites and species seed source location**

For each experimental site, mean growing season temperature (months with air temperatures greater than 0°C) and mean annual precipitation were obtained using 30″ resolution WorldClim climatology data (Hijmans et al. 2005). Similar procedure wad applied to extract climate data for each species’ seed source location.

**b. Instrumentation**

**Leaf gas exchange:** Licor 6400 portable photosynthesis machine (Licor Biosciences, Lincoln, NE, USA) and Walz-CMS system (Walz, Effeltrich, Germany) (Table 2).

**4. Project personnel:** Dushan P. Kumarathunge (principal investigator), Belinda E. Medlyn (principal project supervisor), John E. Drake (co project supervisor) and Mark G. Tjoelker (co project supervisor).

**Class III. Dataset status and accessibility**

**A. Status**

**1. Latest update:** 8-October-2018

**2. Last archive date:** 8-October-2018

**3. Metadata status:** Metadata are complete to last update

**4. Data versification:** Wevisually inspected each and every ACi curve included in this dataset for quality. All estimated parameters were checked for quality and units

before, during, and after compilation of the final dataset.

**B. Accessibility**

**1. Storage location and medium:** The dataset will be posted as Supporting Information to this Data Paper published in *Ecology.* In addition, the dataset can be accessed through the Western Sydney University Library (*doi will be given after acceptance*) and at <https://bitbucket.org/Kumarathunge/aci-tglob>

**2. Contact person:** Dushan P. Kumarathunge ([d.kumarathunge@westernsydney.edu.au](mailto:d.kumarathunge@westernsydney.edu.au) / [dkumarathunge@gmail.com](mailto:dkumarathunge@gmail.com)) and Belinda E. Medlyn ([b.medlyn@westernsydney.edu.au](mailto:b.medlyn@westernsydney.edu.au))

**3. Copyright restrictions:** We please ask that you cite this article when using this dataset. Problems related to the dataset can be reported at [d.kumarathunge@westernsydney.edu.au](mailto:d.kumarathunge@westernsydney.edu.au) / dkumarathunge@gmail.com

**4. Proprietary restrictions:** There are no proprietary restrictions for using this dataset.

**5. Costs:** There are no costs associated with using this dataset.

**Class IV. Data structural descriptors**

**A. Dataset file**

**1. Identity**

ACi-TGlob\_V1.0.csv

The dataset containing individual ACi curves. The column “Curve\_Id” contains a unique identification number for each ACi curve in the dataset that link raw ACi data to the fitted parameters. Variable description is given in ACi-TGlob\_V1.0\_metadata.csv.

ACi-TGlob\_V1.0\_metadata.csv.

Variable description and units of each column of ACi-TGlob\_V1.0.csv

PPC-TGlob\_V1.0.csv

The dataset containing fitted *Vcmax*, *Jmax*, *TPU* and Rd for each ACi curve in the ACi-TGlob\_V1.0 dataset. The column “Curve\_Id” contains a unique identification number corresponding for each raw ACi curve of the ACi-TGlob\_V1.0 dataset. Variable description is given in PPC-TGlob\_V1.0\_metadata.csv

PPC-TGlob\_V1.0\_metadata.csv

Variable description and units of each column of PPC-TGlob\_V1.0.csv

**2.Size**

ACi-TGlob\_V1.0.csv :19 MB

ACi-TGlob\_V1.0\_metadata.csv :3 KB

PPC-TGlob\_V1.0.csv :15 MB

PPC-TGlob\_V1.0\_metadata.csv :1 KB

**3.Format and storage mode:** All files are stored as plain text comma separated values files (.csv) format. Files can be directly downloaded from following locations

1. Western Sydney University Library: *link will be given after acceptance*

2. <https://bitbucket.org/Kumarathunge/aci-tglob>

To download the dataset, I recommend that user clone this repository into an Rstudio project. The user will also need git. The code within " download\_ACi-TGlob\_V1.0.R" will download the raw data file with relevant metadata, place them in the "Data" folder, and fit Farquhar et al. (1980) biochemical model of C3 photosynthesis.

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