Spatially Varying Parameters for CSIRO AWAP Modelling

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1) AWAP Model Mask Compared to the Geodata Topo 2.5M Land Mask (Slides 2-3)
2) Surface albedo from AVHRR (Slides 4-5)
3) Soil properties from the Digital Atlas of Australian Soils (Slides 6-10)
4) Vegetation Cover Fraction from SeaWiFS FAPAR (Slides 11-23)

For further information see:

Raupach MR, Briggs PR, Haverd V, King EA, Paget M, Trudinger CM (2009) Australian Water Availability Project (AWAP), CSIRO Marine and Atmospheric Research Component: Final Report for Phase 3. CAWCR Technical Report No. 013, Centre for Australian Weather and Climate Research (Bureau of Meteorology and CSIRO), Melbourne, Australia, 67 pp.

Available at: http://www.cawcr.gov.au/publications/technicalreports/CTR_013.pdf

1) AWAP Model Mask Compared to the Topo 2.5M Land Mask

Although it is intended to be continental in scope, AWAP modelling is limited to areas of Australia for which a complete parameter set is available. In practice these limits are defined by the 0.05° rasterised version of the Digital Atlas of Australian Soils (McKenzie and Hook, 1992; McKenzie et al. 2000) which does not define soil properties for salt lakes, salt pans, inland water*, and some coastal features. For comparison, the AWAP Australian model mask is shown here (in black) as an overlay on a standard definition of the Australian continent (Topo 2.5m) at 0.05° resolution. Cells shown in yellow are land that is not modelled by AWAP.

Most AWAP graphics are plotted with the original Geodata Topo 2.5M 2003 ‘framework’ vector layer to show the true location of the coastline and state boundaries. Geodata Topo 2.5M is not included here but can be obtained from Geoscience Australia.

*Note that although Lake Argyle is a substantial area of inland water, it is not excluded because its creation between 1971 and 1973 post-dates the original soil maps and classifications on which the DAAS is based (Northcote et al. 1960-1968 and Stace et al. 1968). Model results for the area of Lake Argyle should be treated as erroneous.

References

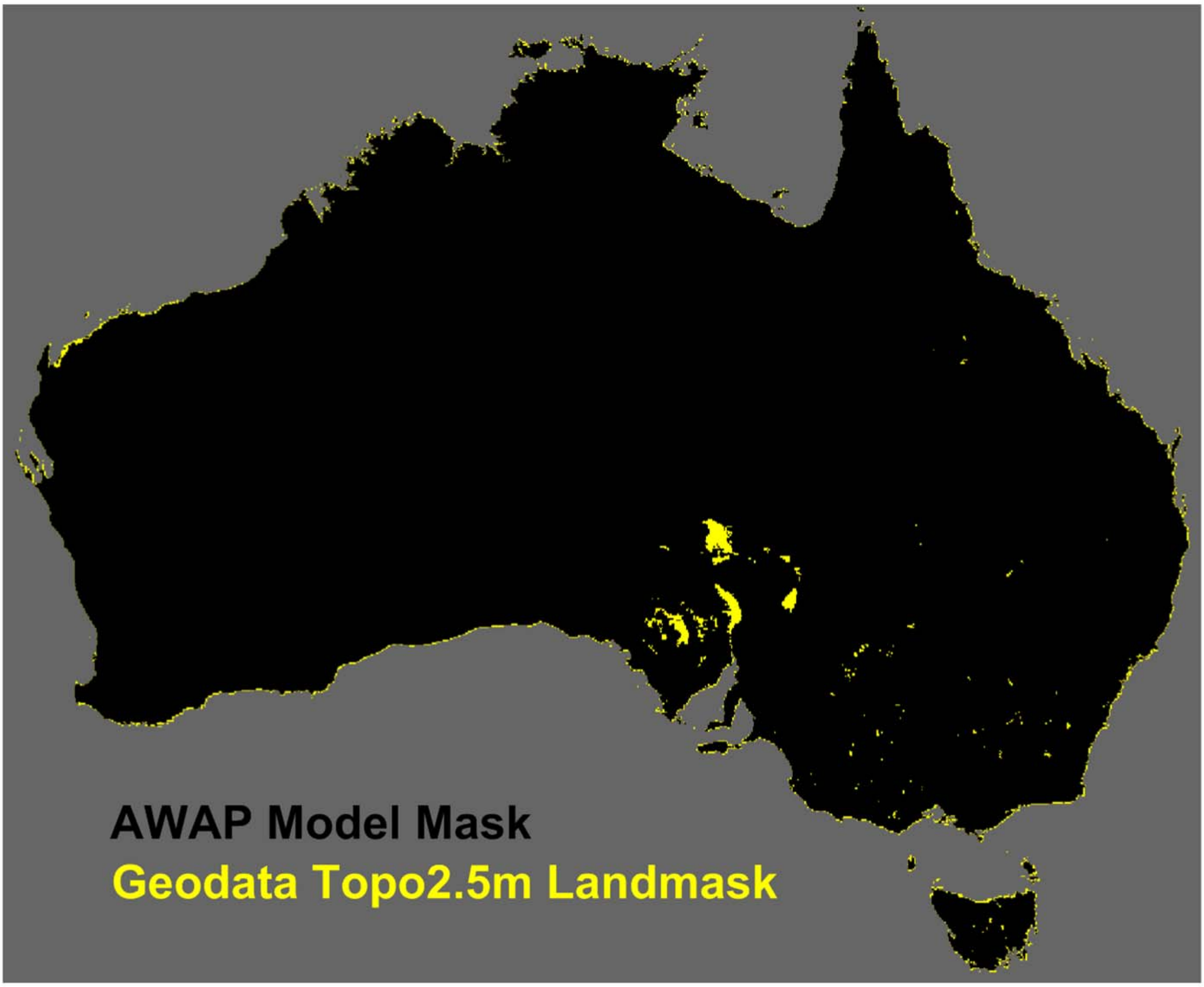
McKenzie N, Hook J (1992) Interpretations of the Atlas of Australian Soils: Consulting report to the Environmental Resources Information Network (ERIN). 94/1992, CSIRO Division of Soils, Canberra, 7 pp.

McKenzie NJ, Jacquier DW, Ashton LJ, Cresswell HP (2000) Estimation of soil properties using the Atlas of Australian Soils. CSIRO Land and Water Technical Report 11/00, CSIRO Land and Water, Canberra, Australia, 24 pp.

Northcote KH, Beckmann GG, Bettenay E, Churchward HM, Van Dijk DC, Dimmock GM, Hubble GD, Isbell RF, McArthur WM, Murtha GG, Nicolls KD, Paton TR, Thompson CH, Webb AA, Wright MJ (1960-1968) Atlas of Australian Soils, Sheets 1 to 10. With explanatory data. CSIRO Australia and Melbourne University Press, Melbourne.

Stace HCT, Hubble GD, Brewer R, Northcote KH, Sleeman JR, Mulcahy MJ, Hallsworth EG (1968) A handbook of Australian soils. Rellim Technical Publications for the CSIRO and the International Society of Soil Science, Glenside, South Australia, 435 pp.

AWAP Model Mask Compared to
The Geodata Topo 2.5M Land Mask



2) Surface Albedo from AVHRR

Mean annual shortwave albedo (surface reflectivity) is used in AWAP as part of the calculation of available energy during daylight hours. The data were supplied (on 17 Sept 2004) by Ian Grant at the Bureau of Meteorology, and are the average of monthly data for the period 1994-1999 derived from AVHRR. The original data were supplied at 0.25° resolution and were resampled to 0.05° for AWAP modelling. The other important surface radiative property, emissivity, is set to a uniform value of 1.

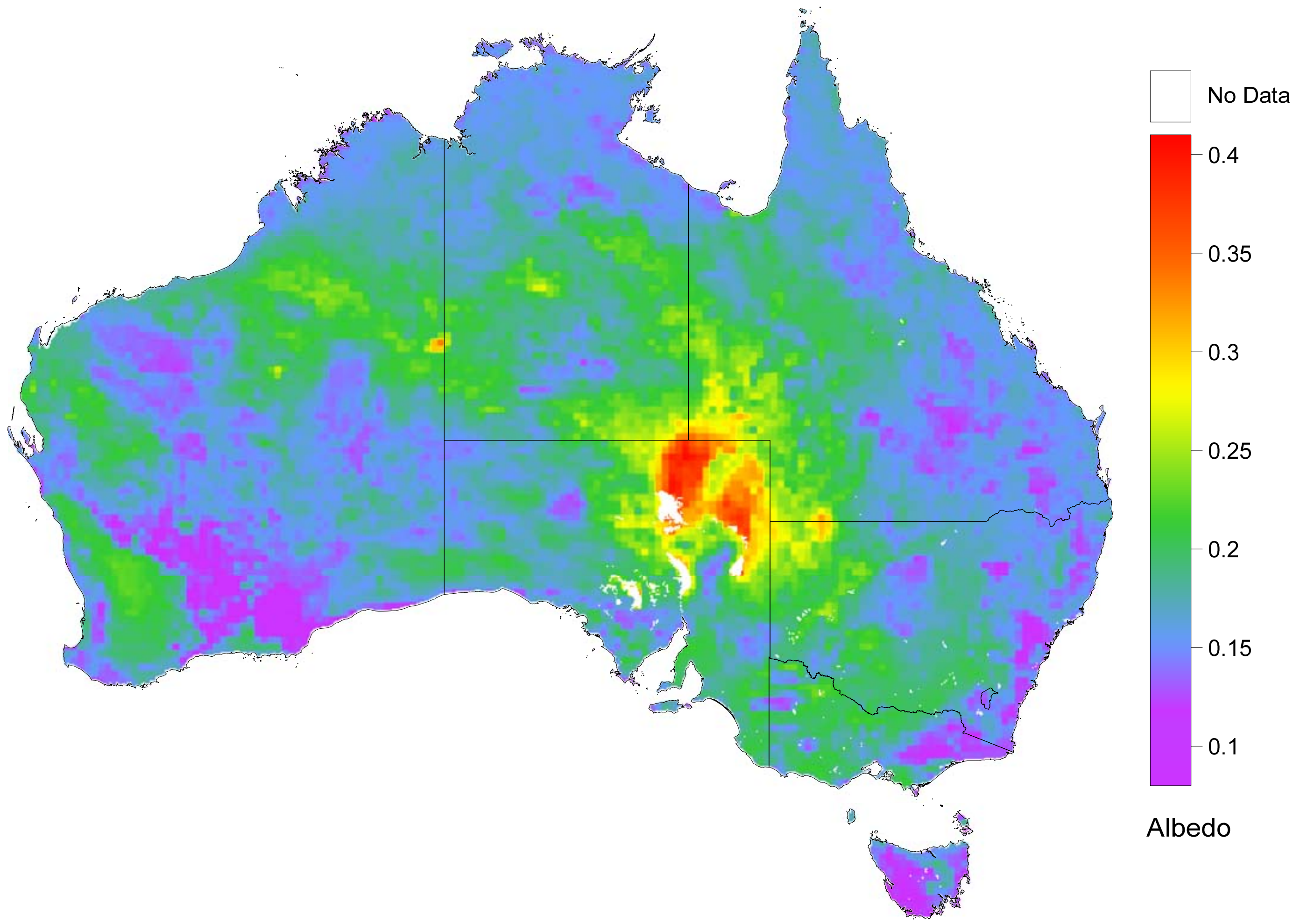
All-sky shortwave albedo is an average of direct and diffuse albedos appropriate for clear skies, where the direct albedo is an average appropriate for all solar zenith angles over a month. The differences between clear sky and diffuse or “white-sky” albedos (also calculated) are almost always less than 0.01 (Ian Grant, Bureau of Meteorology, pers. comm., 17 Sept 2004). The data are currently unpublished, but were created using standard methods. The atmospheric correction was done as described in Dilley et al. (2000) with the BRDF dynamically modelled using a method based on that described by Schaaf et al. (2002) for application to MODIS (Grant, pers. comm., 22 June 2005).

References

Dilley AC, Edwards M, O'Brien DM, and Mitchell RM. 2000. Operational AVHRR processing modules: atmospheric correction, cloud masking and BRDF compensation. Aspendale: CSIRO Division of Atmospheric Research. (CSIRO Atmospheric Research internal paper; 14). 24 p.

Schaaf CB, Gao F, Strahler AH, Lucht W, Li XW, Tsang T, Strugnell NC, Zhang XY, Jin YF, Muller JP, Lewis P, Barnsley M, Hobson P, Disney M, Roberts G, Dunderdale M, Doll C, d'Entremont RP, Hu BX, Liang SL, Privette JL, Roy D (2002) First operational BRDF, albedo nadir reflectance products from MODIS. *Remote Sensing of Environment* **83**:135-148

Mean Annual All-Sky Shortwave Albedo
1994-1999 from AVHRR



3) Soil Properties from the Digital Atlas of Australian Soils

Spatially explicit soil properties for the upper and lower soil layers are based on the McKenzie and Hook (1992) and McKenzie et al. (2000) interpretations of the 725 soil profile forms (types) mapped in the Digital Atlas of Australian Soils (DAAS) (Northcote et al. 1960-1968). To match the spatial grid of the forcing meteorology, the 1:2,000,000 scale DAAS is rasterised, assigning the dominant soil type within each 0.05° grid cell, reducing the number of discrete soil types across the continent to 300. Pedotransfer functions (McKenzie and Hook 1992; McKenzie et al. 2000) are then used to assign physical soil properties to the upper and lower layers (A and B horizons) of each soil type.

Spatially explicity properties used for AWAP modelling are the soil layer thicknesses and saturated volumetric water content. In AWAP, saturated hydraulic conductivities are set to a uniform value of 0.016 for the upper layer and 0.0008 for the lower layer.

References

McKenzie N, Hook J (1992) Interpretations of the Atlas of Australian Soils: Consulting report to the Environmental Resources Information Network (ERIN). 94/1992, CSIRO Division of Soils, Canberra, 7 pp.

McKenzie NJ, Jacquier DW, Ashton LJ, Cresswell HP (2000) Estimation of soil properties using the Atlas of Australian Soils. CSIRO Land and Water Technical Report 11/00, CSIRO Land and Water, Canberra, Australia, 24 pp.

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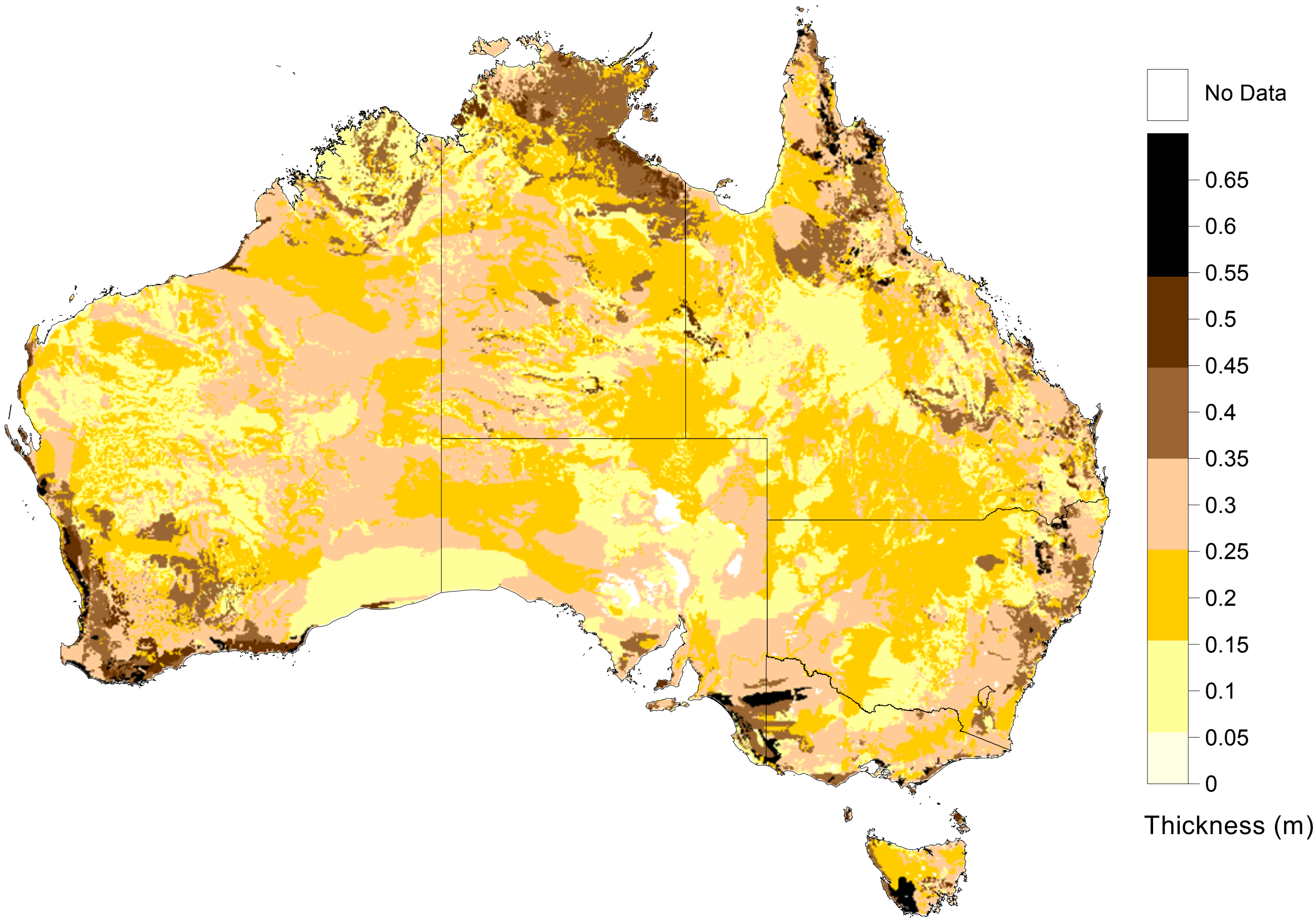
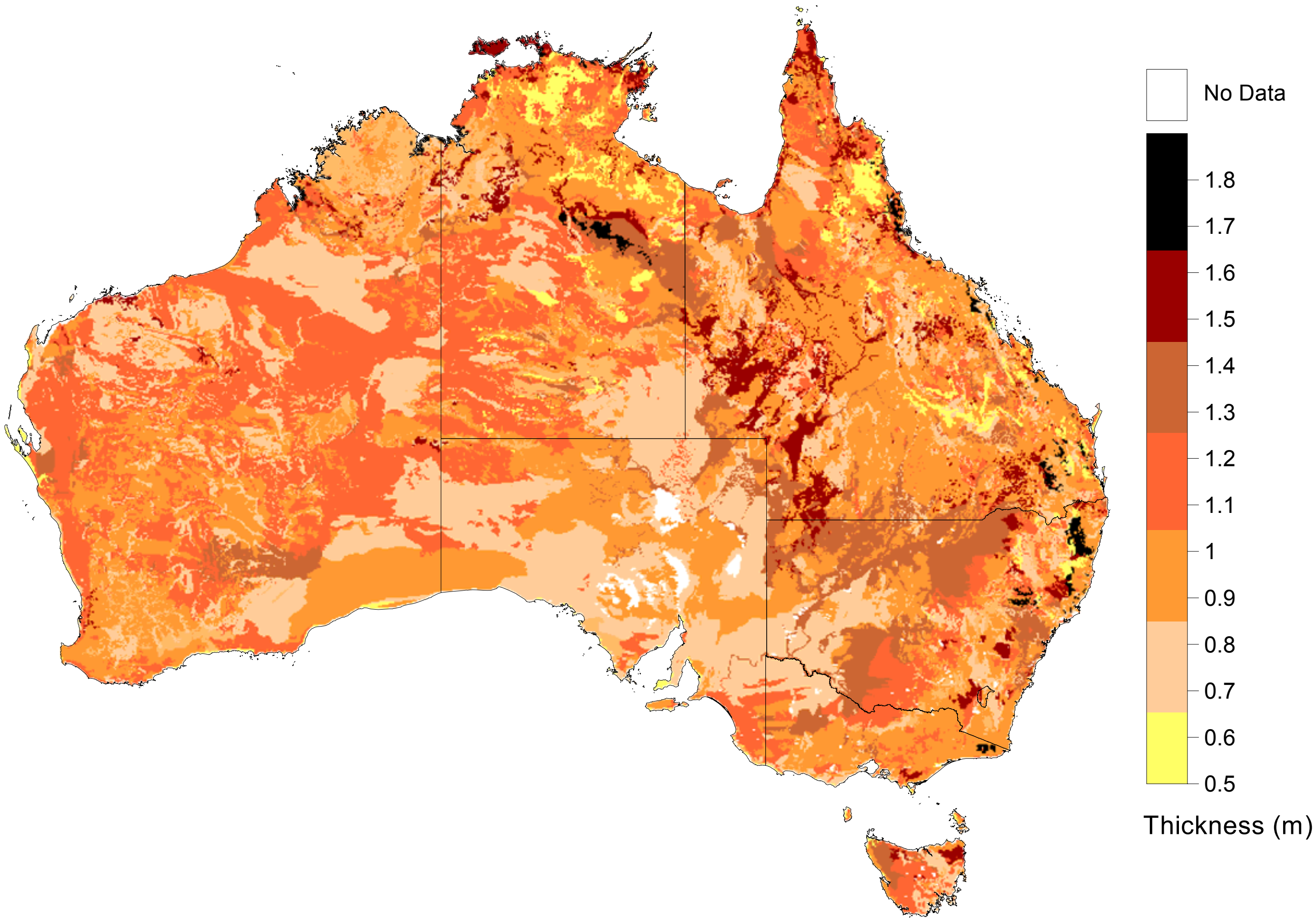
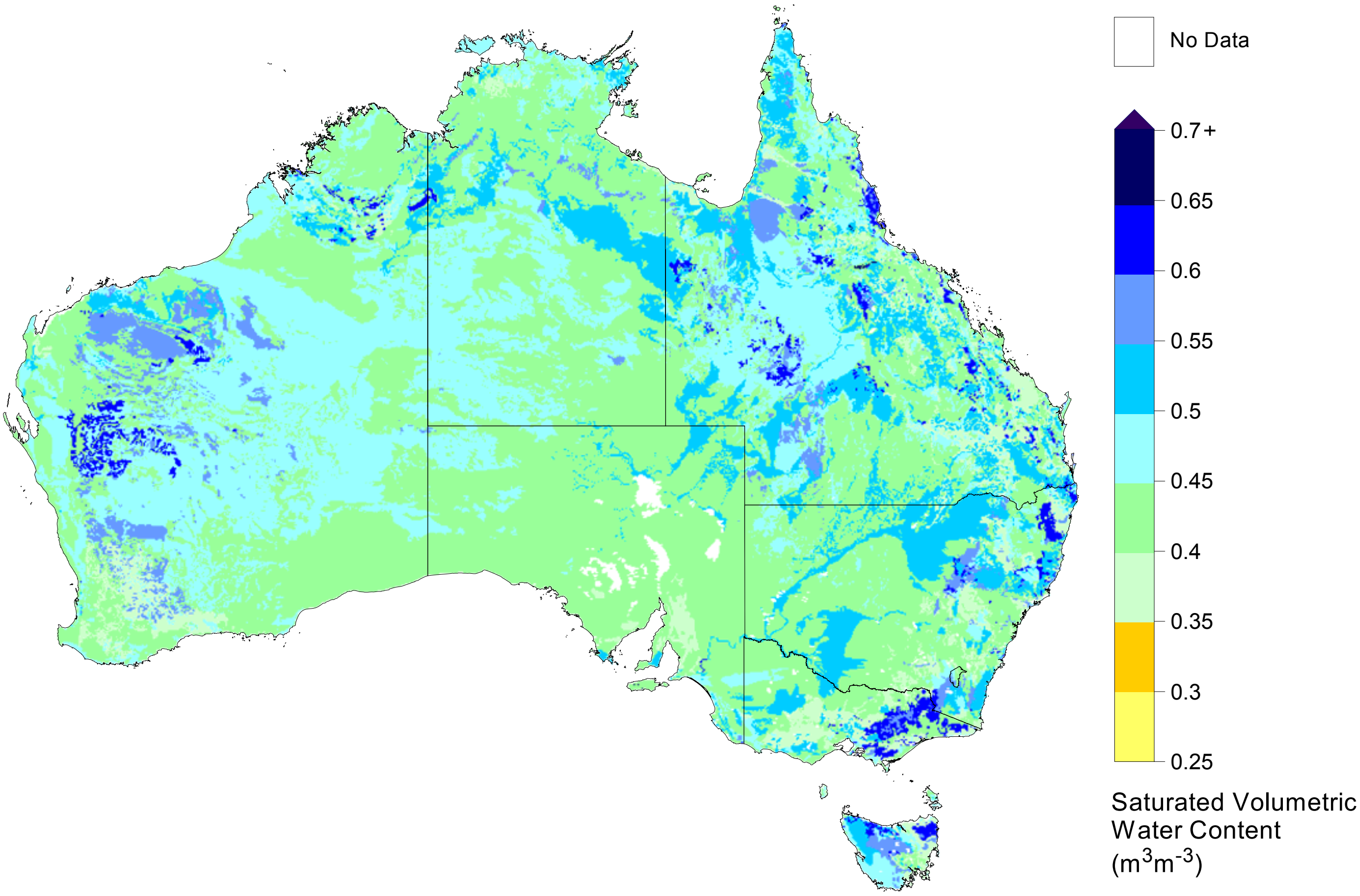
Thickness - Upper Soil Layer



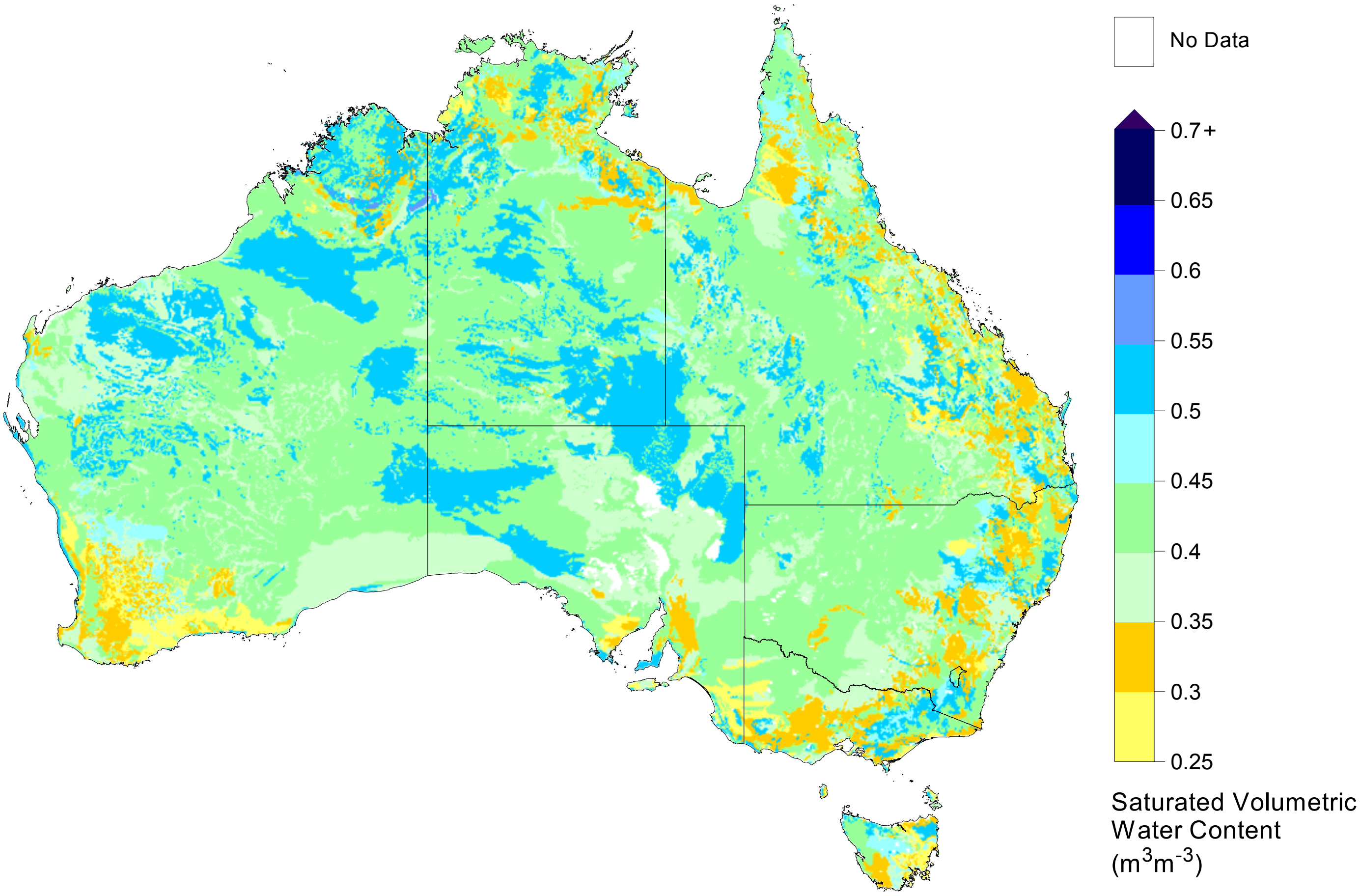
Thickness - Lower Soil Layer



Saturated Volumetric Water Content
Upper Soil Layer



Saturated Volumetric Water Content
Lower Soil Layer



4) Vegetation Cover Fraction from SeaWiFS FAPAR

In AWAP, the vegetation cover fraction (v) is used to attenuate the Priestley-Taylor evaporation rate in the calculation of energy-limited transpiration rates (Raupach et al. 2009). It is calculated at run-time from a spatially explicity monthly climatology of FAPAR (full years 1998-2005) from the SeaWiFS satellite using the equation:

$$v = \frac{1-\exp\left(c_{PAR}\ \mathrm{FAPAR}\right)}{1-\exp\left(c_{PAR}\right)}$$

where c_{PAR} is a coefficient of order −2. Both v and FAPAR are constrained to the interval from 0 to 1.

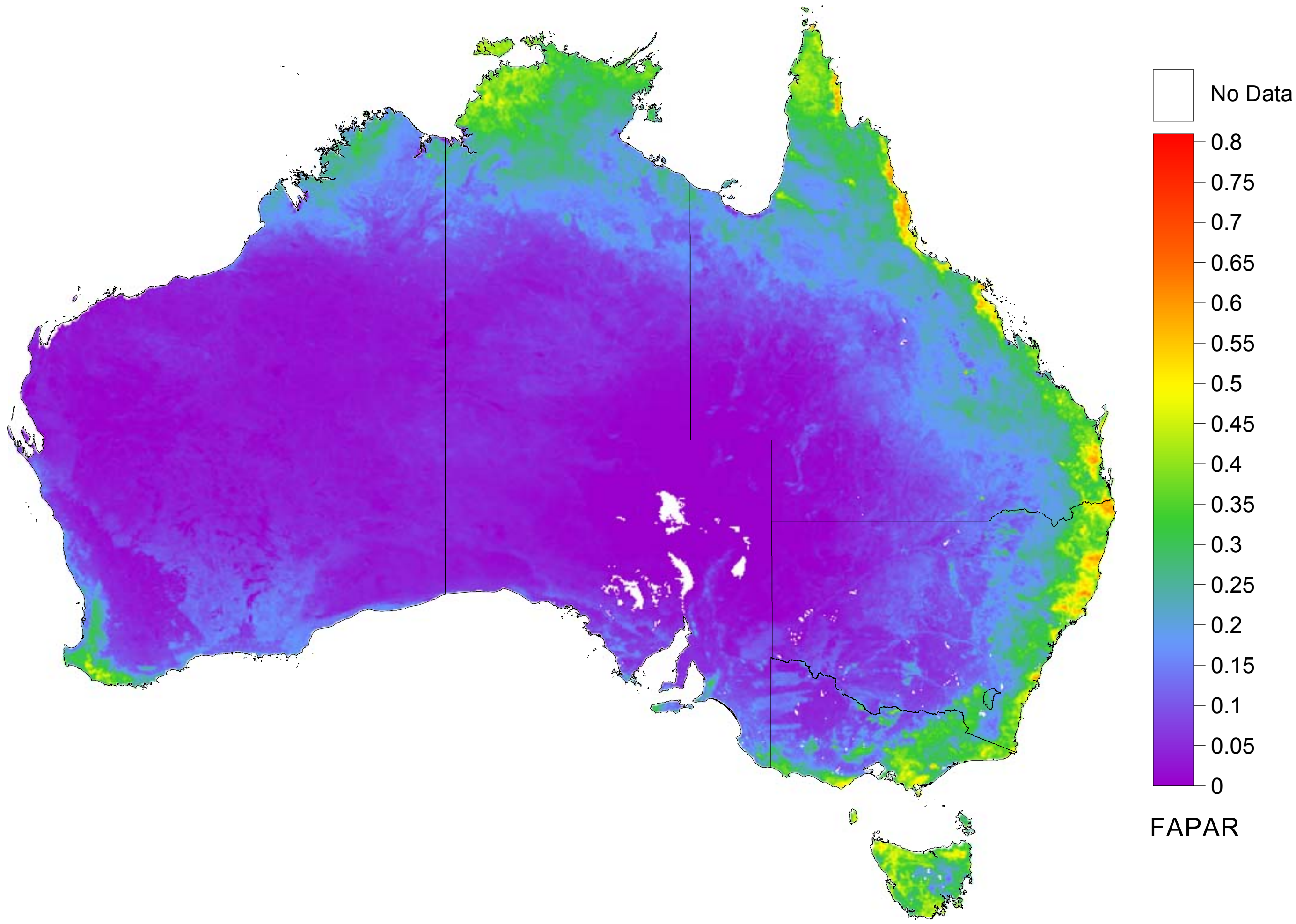
FAPAR from SeaWiFS is a derived product available globally at 2.5 minutes (~0.04°) spatial and monthly time resolution (Gobron et al. 2002). It has been resampled (by area-weighted averaging) to 0.05° resolution for use in AWAP. For further information see Raupach et al. 2009, particularly appendix sections A2 and C2.

References

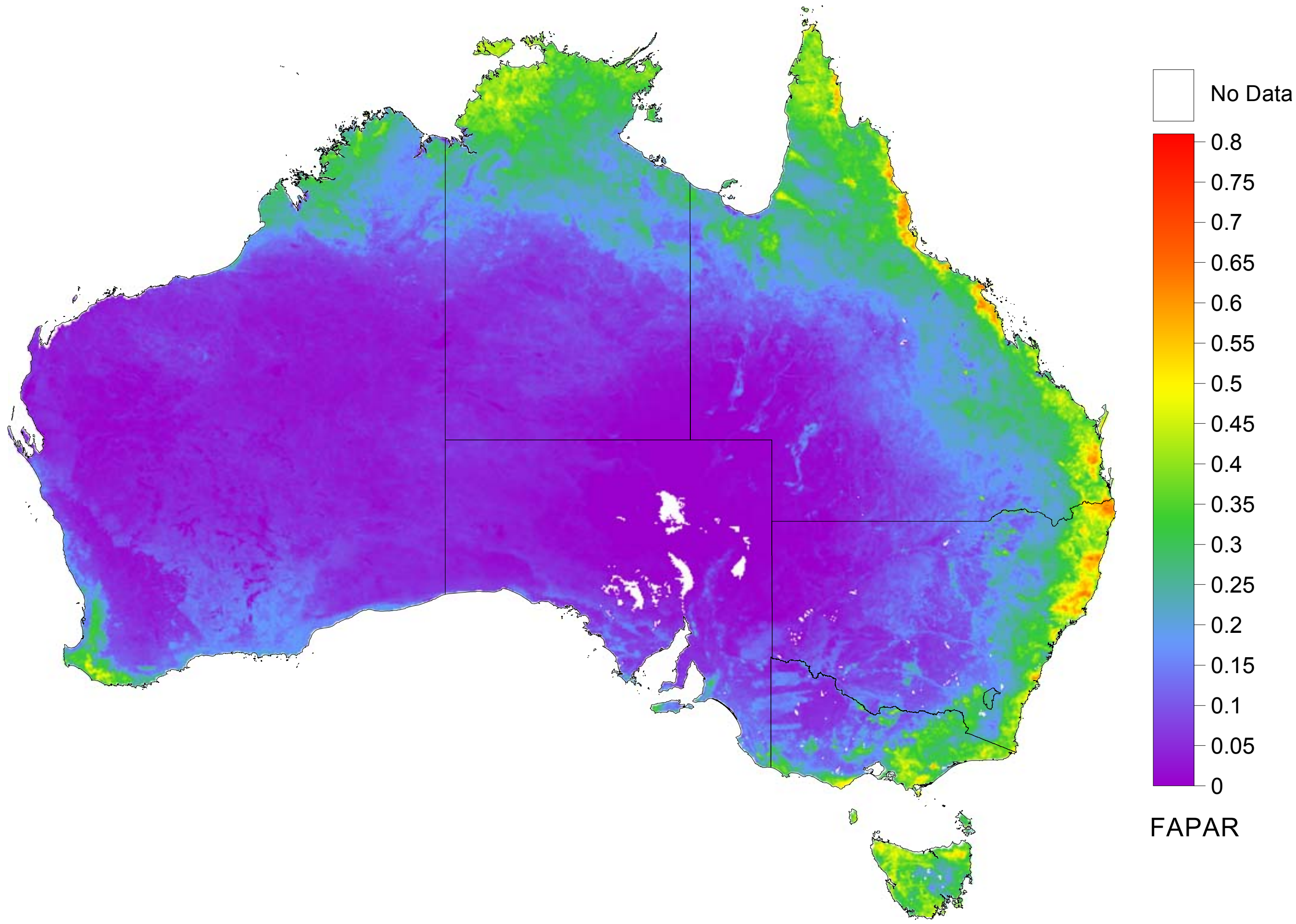
Gobron N, Pinty B, Mélin F, Taberner M, Verstraete MM (2002) Sea Wide Field-of-View Sensor (SeaWiFS) - an optimized FAPAR algorithm - theoretical basis document. JRC Publication No. EUR 20148 EN, Institute for Environment and Sustainability, Ispra, Italy, 20 pp.

Raupach MR, Briggs PR, Haverd V, King EA, Paget M, Trudinger CM (2009) Australian Water Availability Project (AWAP), CSIRO Marine and Atmospheric Research Component: Final Report for Phase 3. CAWCR Technical Report No. 013, Centre for Australian Weather and Climate Research (Bureau of Meteorology and CSIRO), Melbourne, Australia, 67 pp.

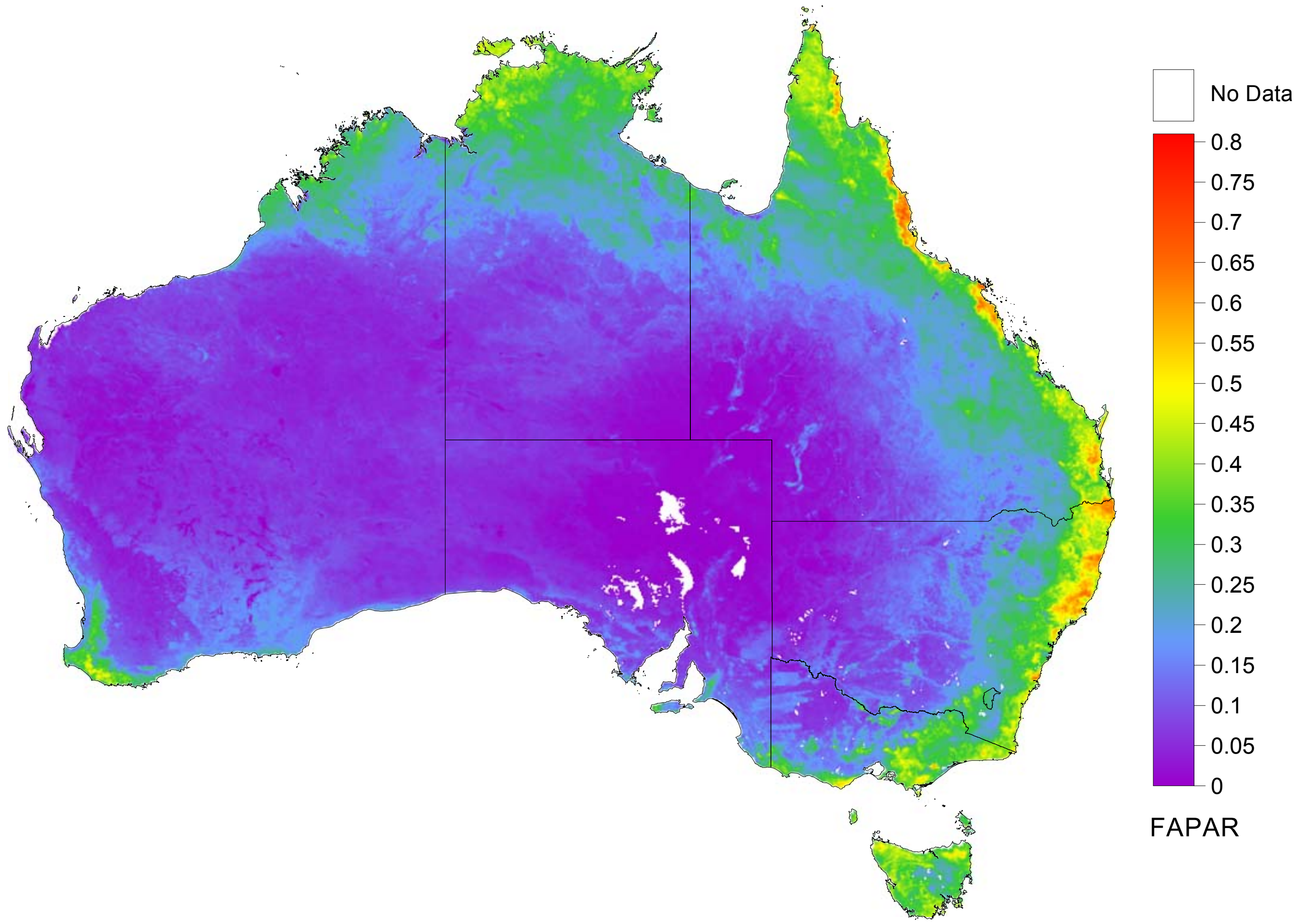
Mean January FAPAR from SeaWiFS 1998-2005



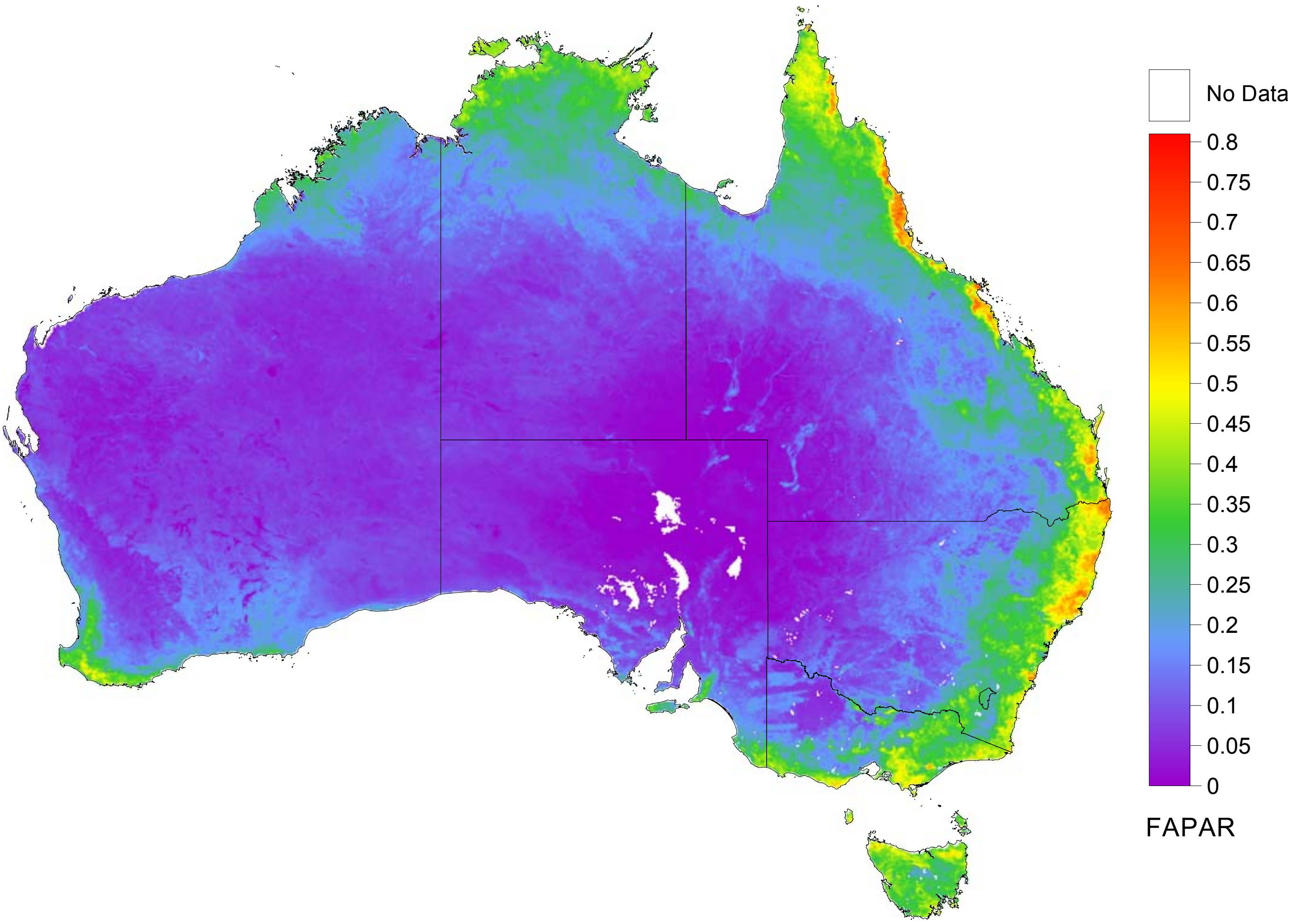
Mean February FAPAR from SeaWiFS 1998-2005



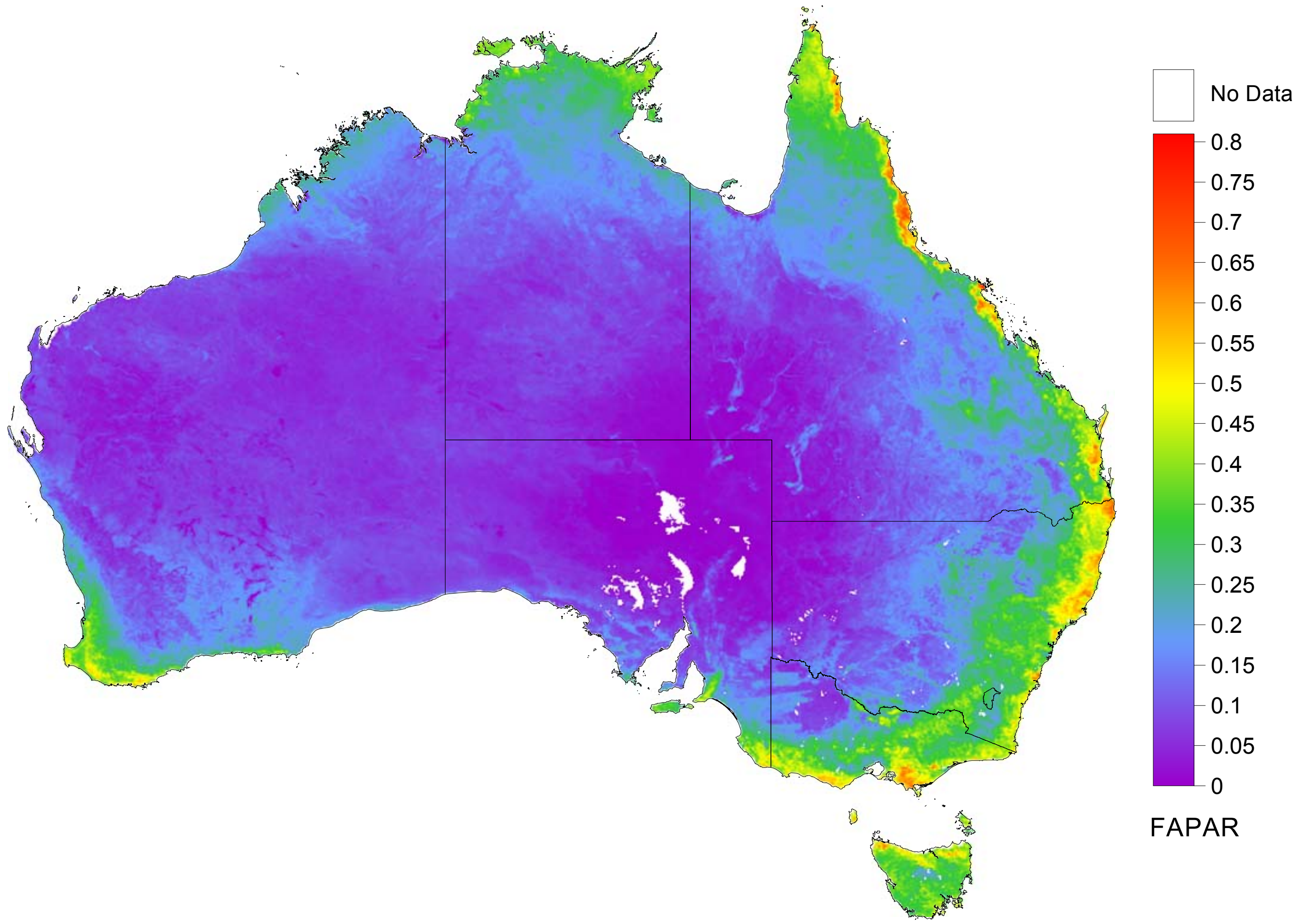
Mean March FAPAR from SeaWiFS 1998-2005



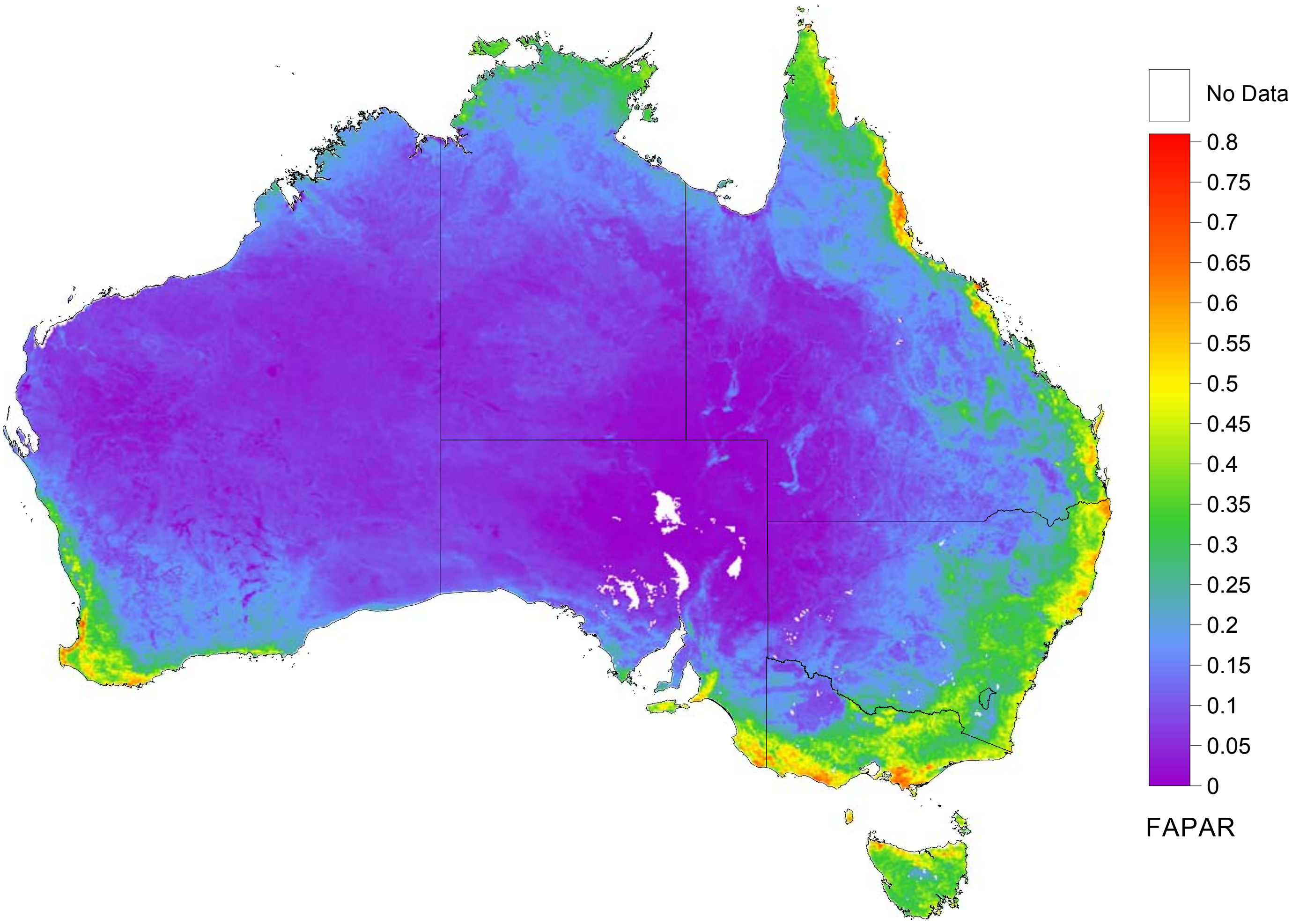
Mean April FAPAR from SeaWiFS 1998-2005



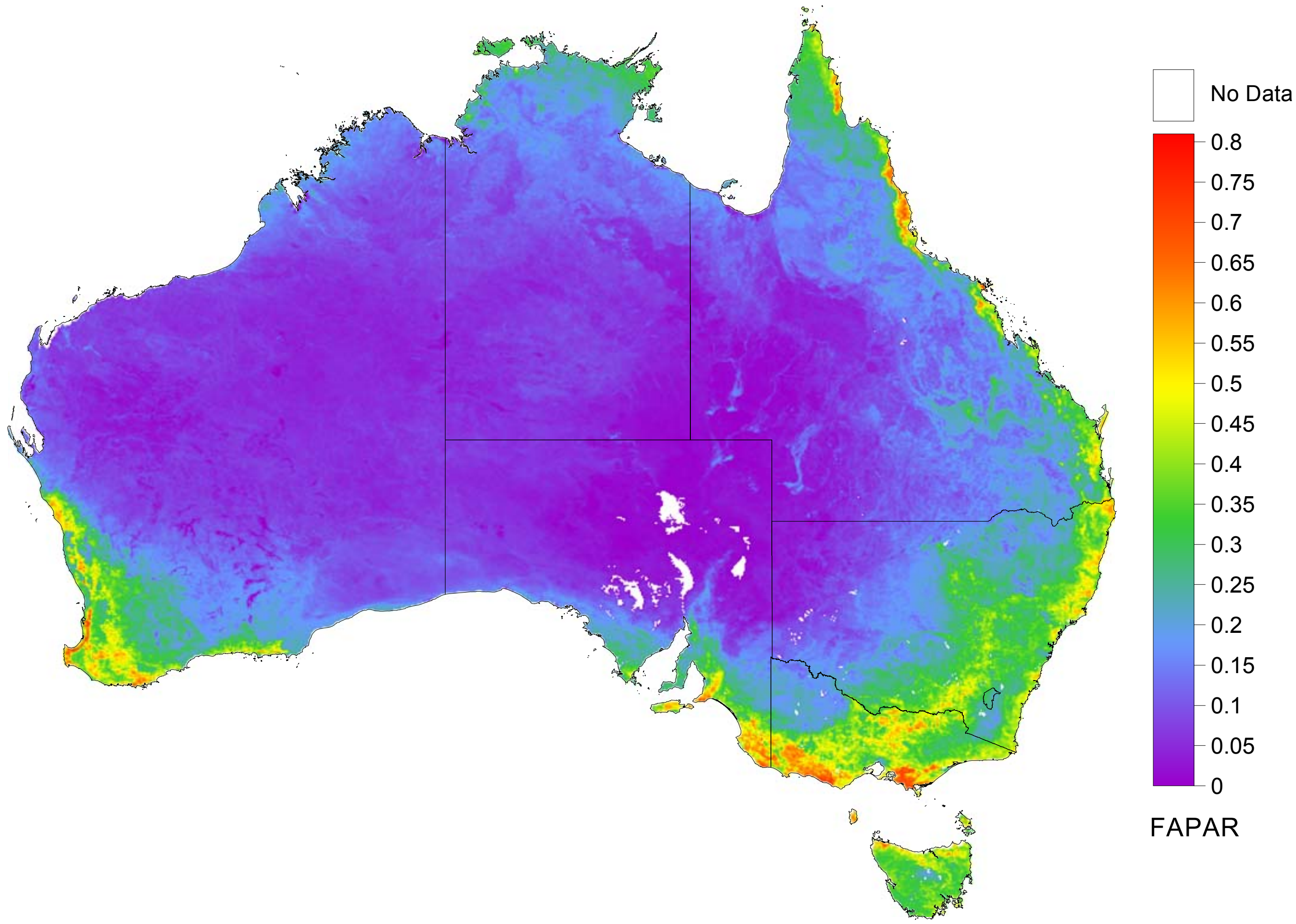
Mean May FAPAR from SeaWiFS 1998-2005



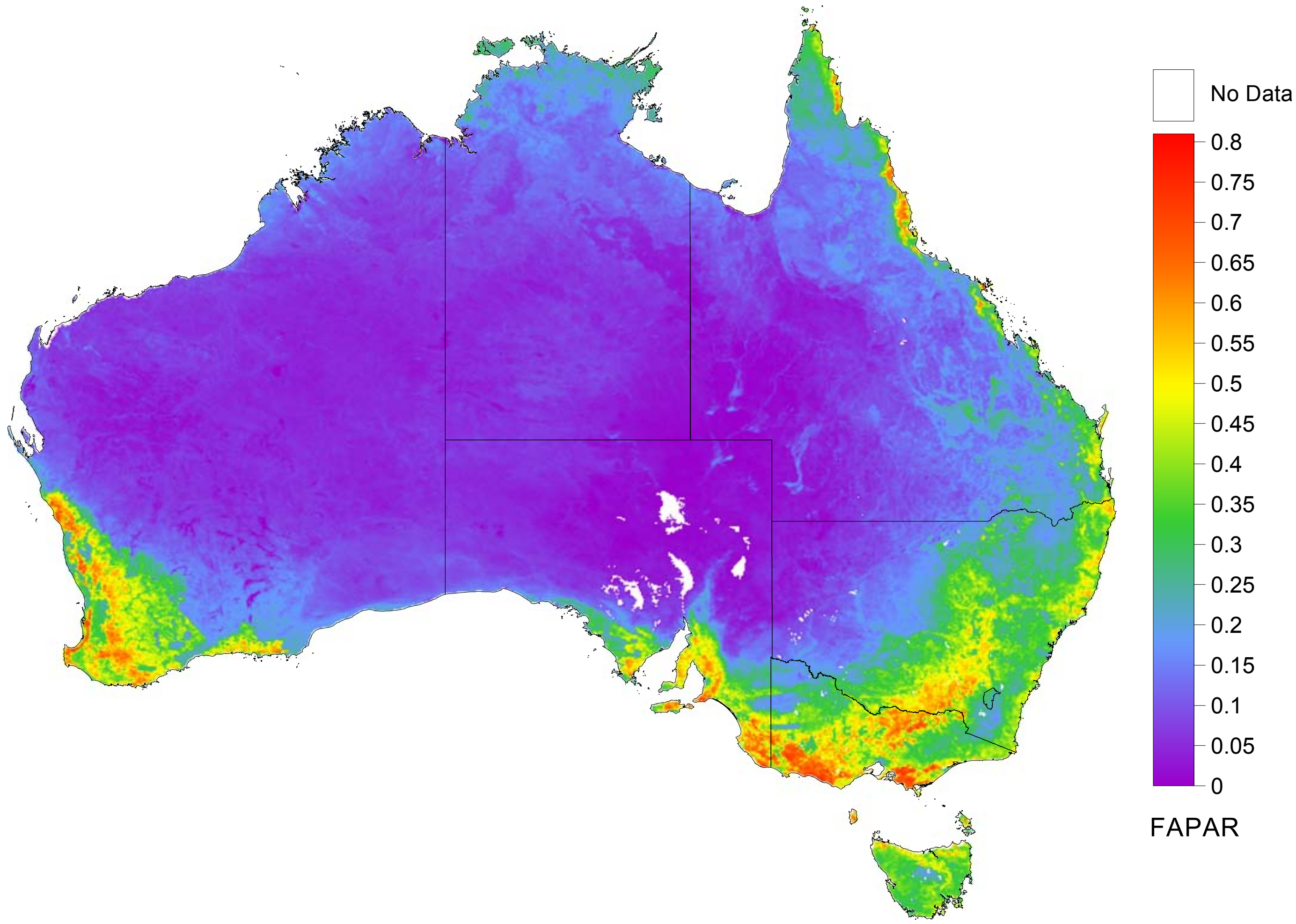
Mean June FAPAR from SeaWiFS 1998-2005



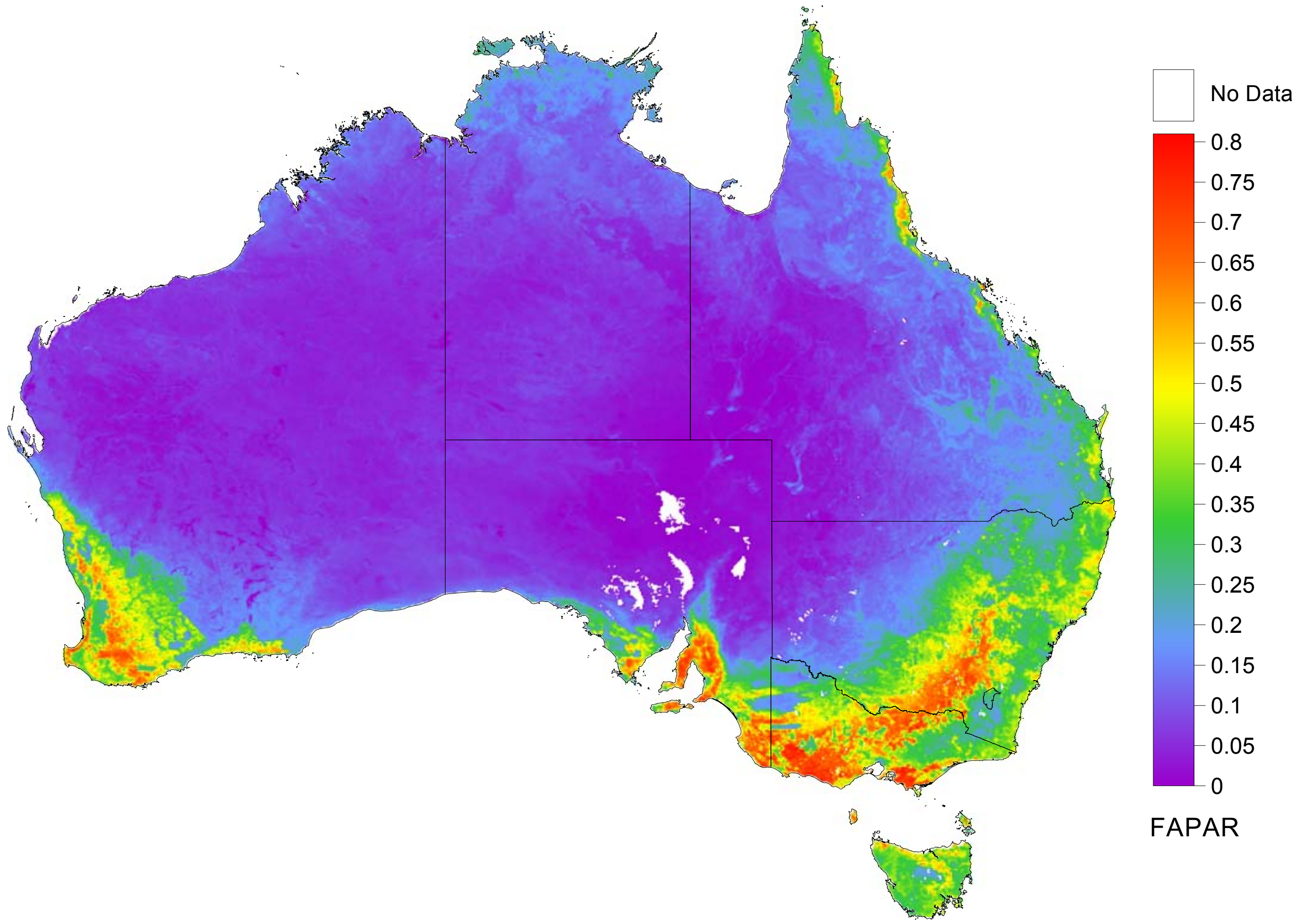
Mean July FAPAR from SeaWiFS 1998-2005



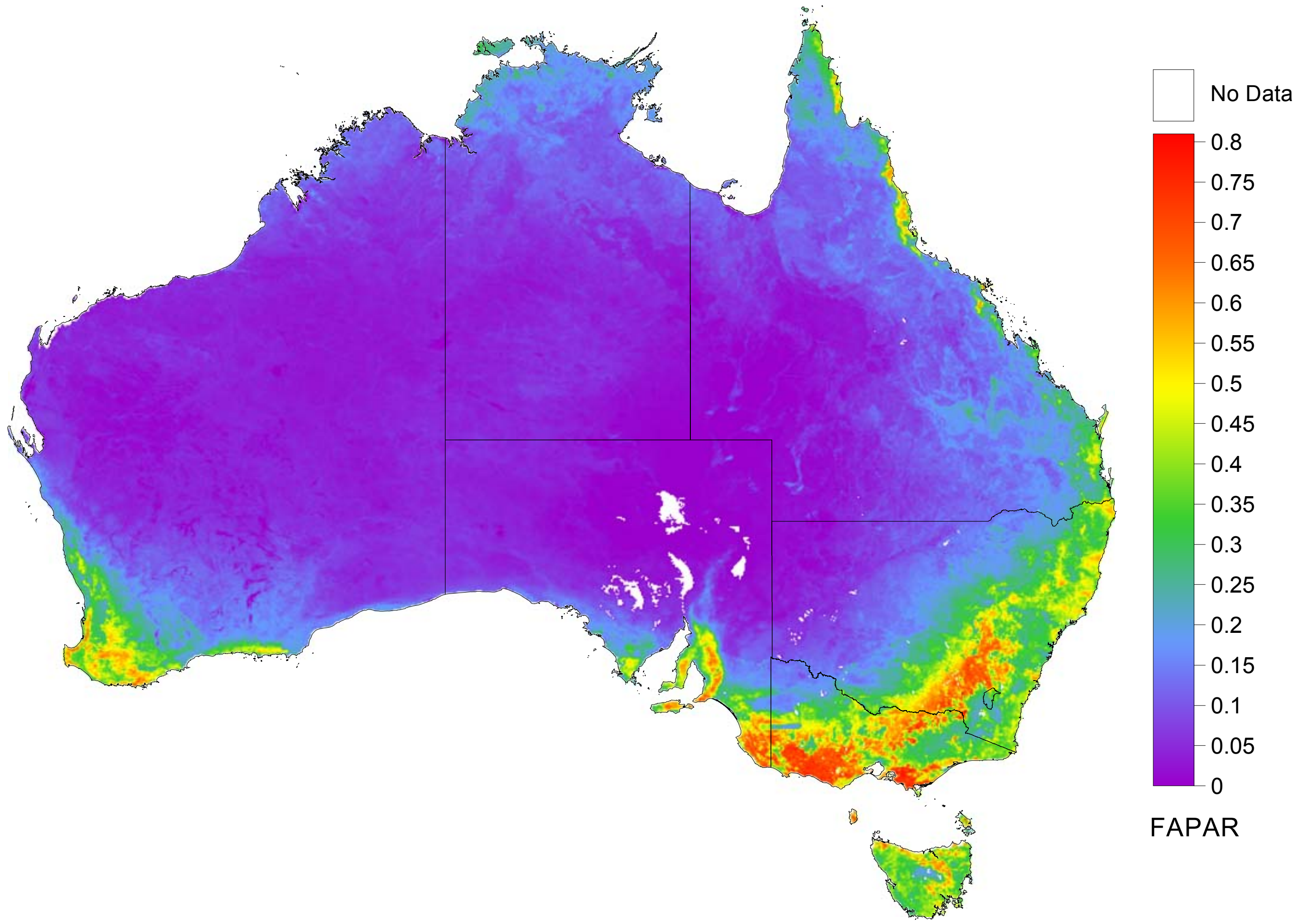
Mean August FAPAR from SeaWiFS 1998-2005



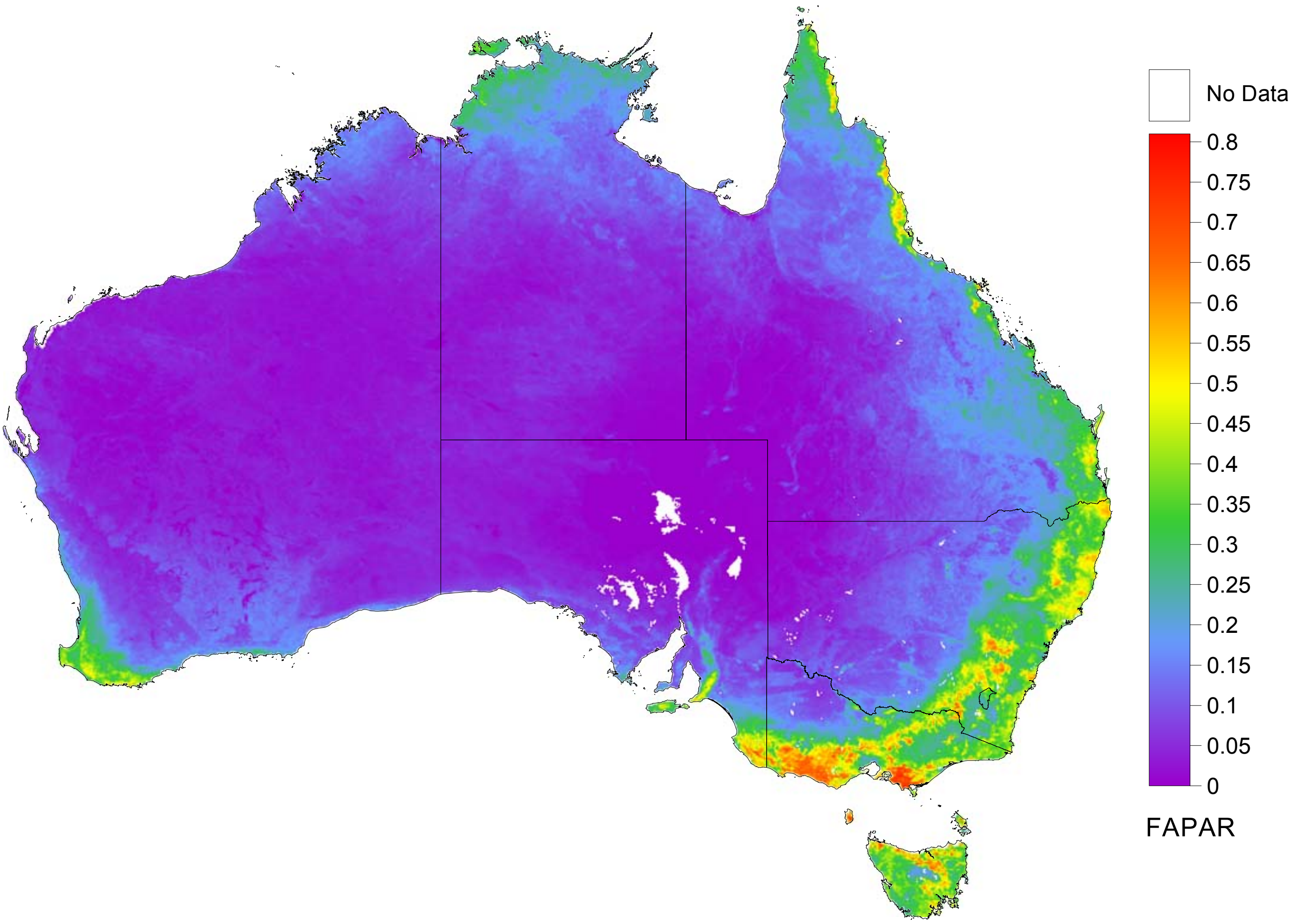
Mean September FAPAR from SeaWiFS 1998-2005



Mean October FAPAR from SeaWiFS 1998-2005



Mean November FAPAR from SeaWiFS 1998-2005



Mean December FAPAR from SeaWiFS 1998-2005