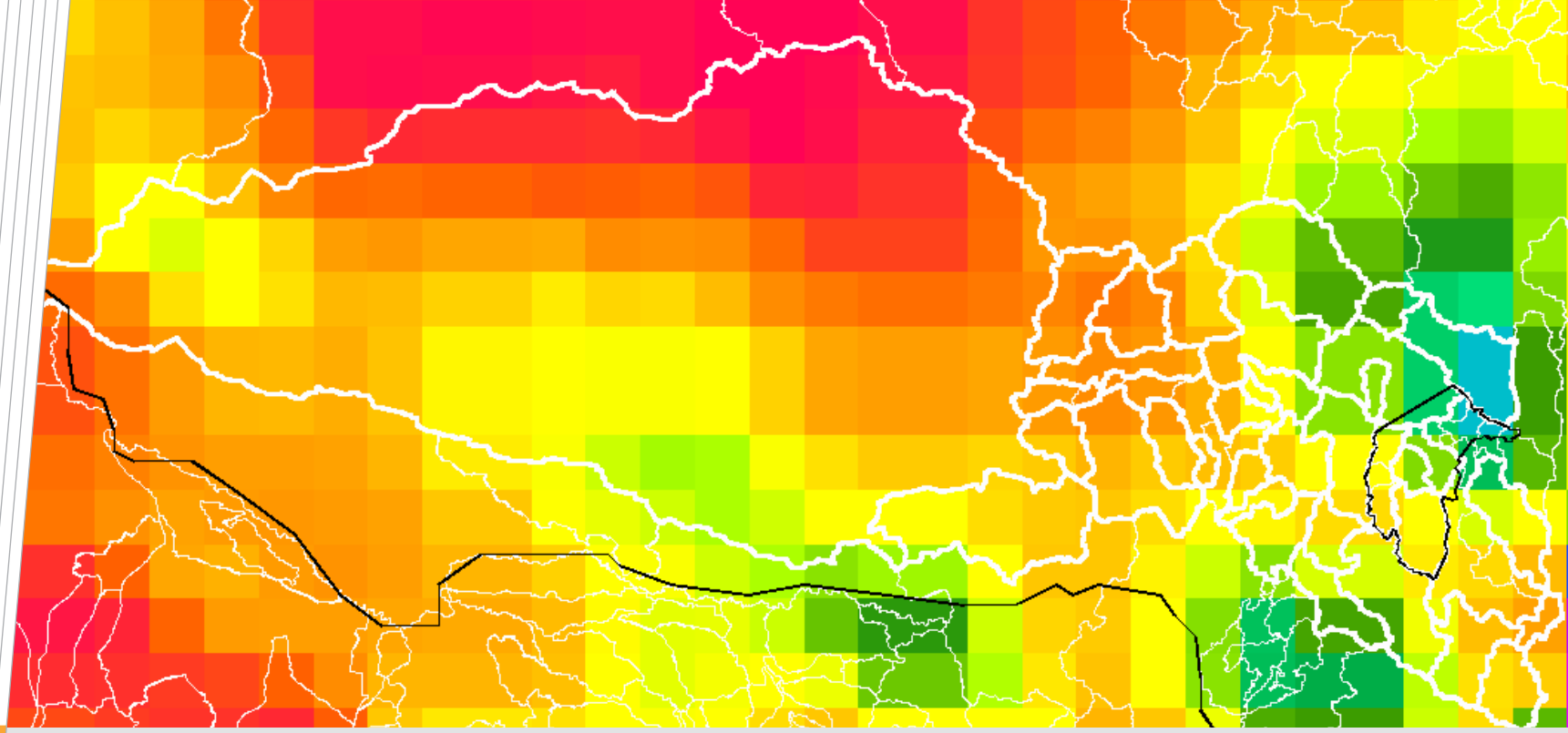

AWRA-L and CABLE modelled Tb using CMEM

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A water information R & D alliance between the Bureau of Meteorology and CSIRO's Water for a Healthy Country Flagship

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Microwave brightness temperature modelling

- Add microwave brightness temperature (Tb) modelling component to AWRA-L
  - Forward model Tb from AWRA-L top-layer surface soil moisture estimates
  - Observation model to assimilate Tb's (V/H polarisations)

- Investigation into use of satellite Tb as an indirect verification for modelled soil moisture estimates over large parts of the continent.
  - AWRA-L Vs CABLE surface soil moisture
  - MDB study area; Jan-Feb, Sep 2010
  - AACESS field campaign across MBG

Modelled soil moisture fields from:

CABLE

- ***C**ommunity (CSIRO?) **A**tmosphere-**B**iosphere-**L**and **E**xchange model*
- Land surface model (LSM)
  - Use in NWP models & GCM
- Feeds into:
  - BoM ACCESS coupled model
- Design principle:
  - Climate and earth system simulator modelling energy, water & carbon cycles
- Does hydrology well?
  - Okay, but getting better

  (**Haverd** & Cuntz, 2010: *J Hydrol., doi:10.1016/j.hydrol.2010.05.029*)

AWRA-L

- ***A**ustralian **W**ater **R**esources **A**ssessment model – **L**andscape*
- Hybrid LSM & lump catchment model
  - Focus on water balance
- Developed for:
  - BoM national water accounts
- Design principle:
  - Comprehensive spatial water balance, with national coverage & local usefulness
- Does hydrology well?
  - Yes, and getting better

  (**van Dijk** & Warren, 2010: *WfHC Tech Report*; vanDijk & Renzullo, 2011: *HESS, doi:10.5194/hess-15-39-2011*)

AWRA-L version 0.5

Spatial structure:

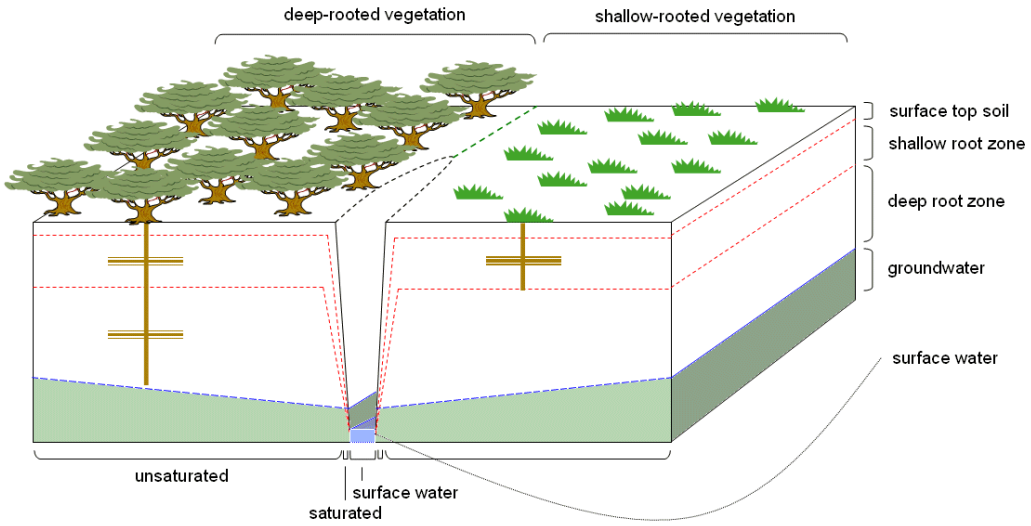
- grid based, variable resolution
- **daily time step**
- fractions of hydrological response units (HRUs)

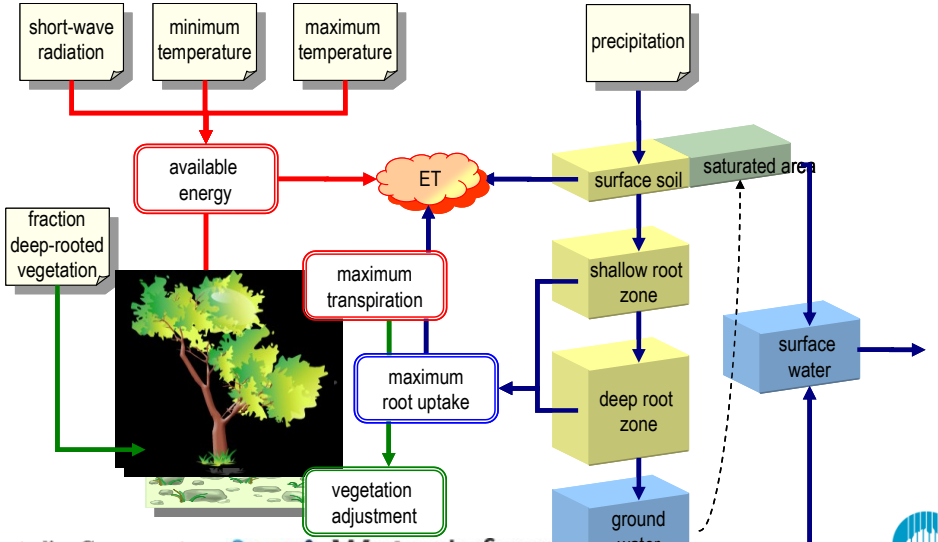
Forcing:

- precipitation & short-wave radiation (~5km blended station-satellite products)
- optional: other atmospheric variables (currently temperature)

Processes

- 3 unsaturated stores (simplified Richards' scheme)
- Linear groundwater and surface water stores
- ET: Penman-Monteith or Priestley-Taylor; limited by root water uptake
- Vegetation cover adjustment towards equilibrium (potential transpiration = water uptake)



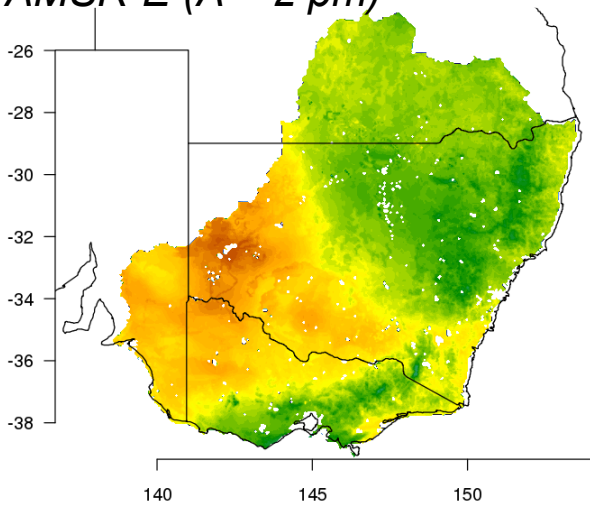


CMEM – *almost* off-the-shelf runs for MDB

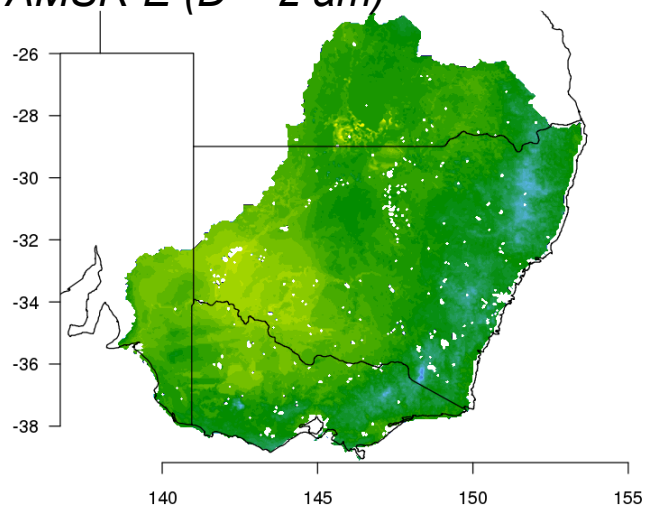
- Community Microwave Emission Model (CMEM)
  - ECMWF – M. Drusch, T. Holmes, P. de Rosnay, et al.
  - Built on LSMEM and L-MEB; Tb modelling 1-20 GHz
  - Attraction: one package to test different soil dielectric, surface roughness, & veg OD models
- Parameterisation for the Murray-Darling Basin (MDB)
  - Models (follows de Rosnay et al, 2009: *J Geophys. Res., **114**,D05108*)
    - Soil dielectric: Mironov et al. 2004
    - Veg opacity: Kirdyashev et al. 1979
  - Spatial inputs (static/slowly evolving)
    - % sand & clay – Soils atlas (McKenzie & Hook)
    - Geopotential: Enhanced STRM DEM (Gallant et al, CSIRO Land & Water)
    - Veg type: IGBP
    - Faction low & high veg: **Donohue** et al., 2009: *Glob. Change Biol.,* 15(4), 1025-1039
    - LAI: MOD15A2 – monthly averages
  - Dynamic inputs
    - Tair: Modelled from Tmin/max interoplated surfaces (AWAP)
    - CABLE - Tskin, Tsoil (x3), SM (x3) – soil layer thickness: 2.2, 5.8, 7 cm.

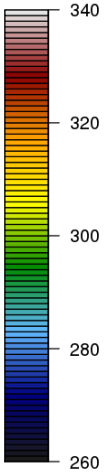
Modelled TbV – Jan & Feb 2010

AMSR-E (A ~2 pm)



AMSR-E (D ~2 am)



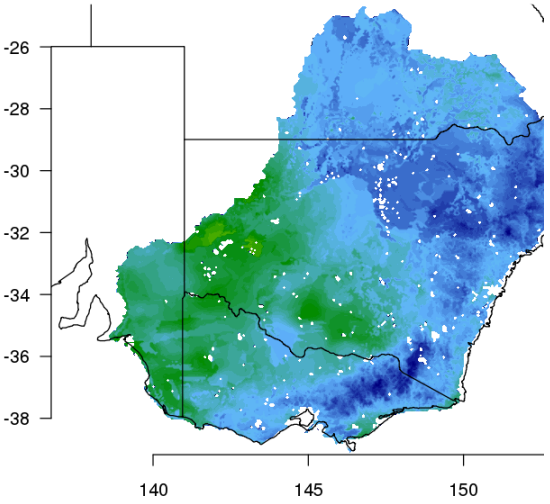


CMEM software (ECMWF)

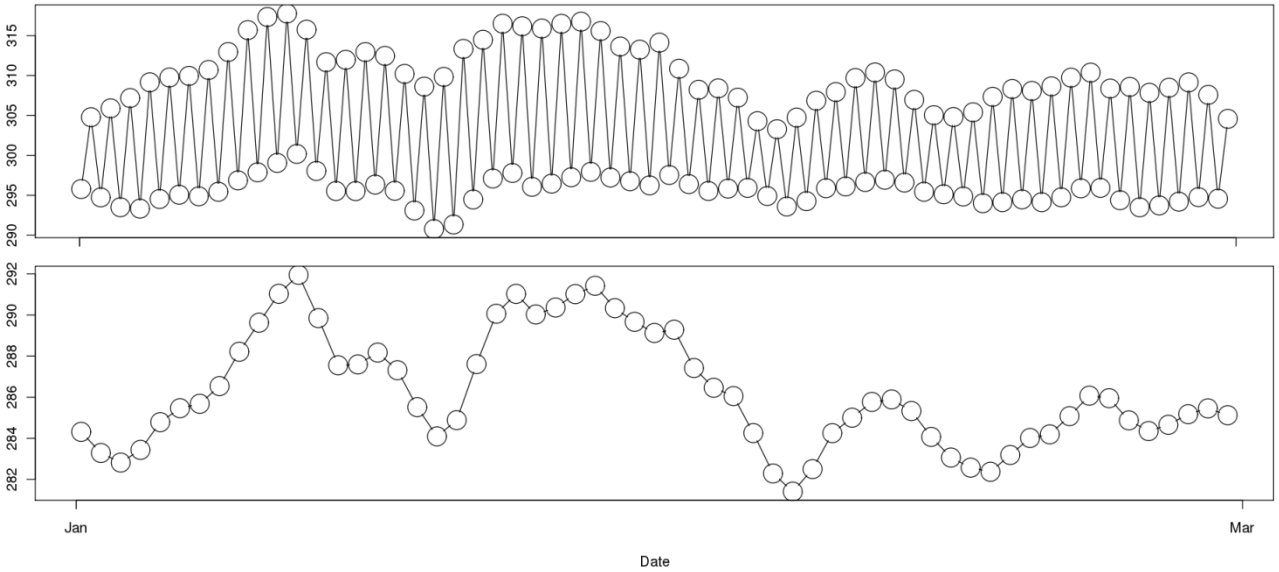
Vertically-polarized brightness Temperatures (Tb) from **CABLE** SM

5-km resolution

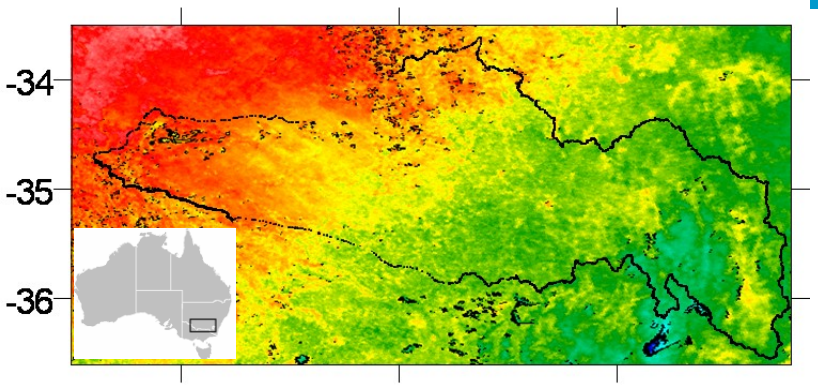
MIRAS (~6 am)



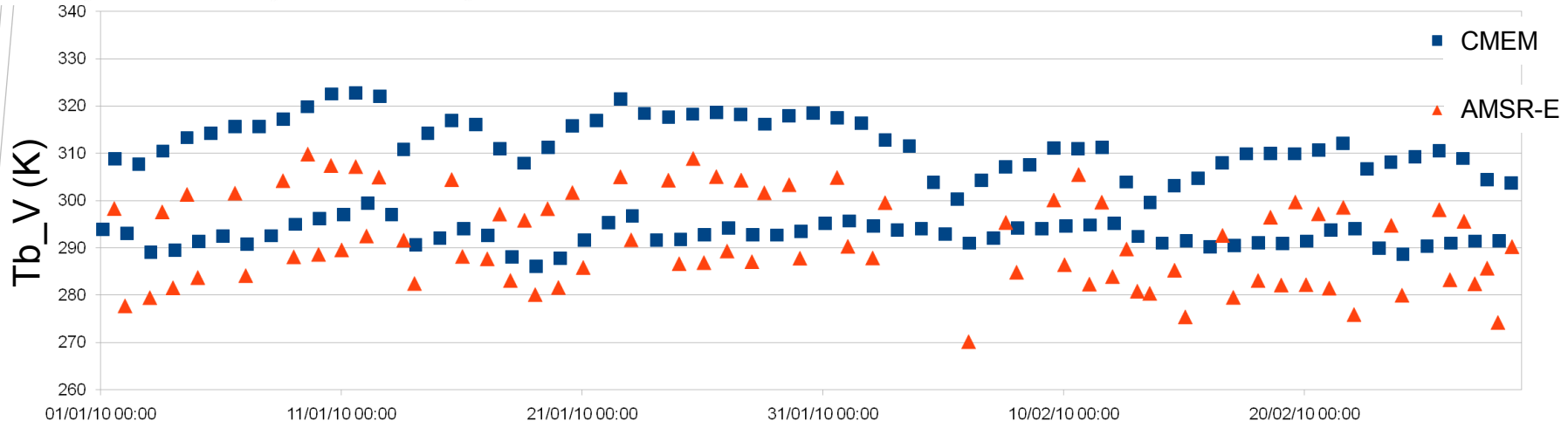
1 Jan – 28 Feb 2010



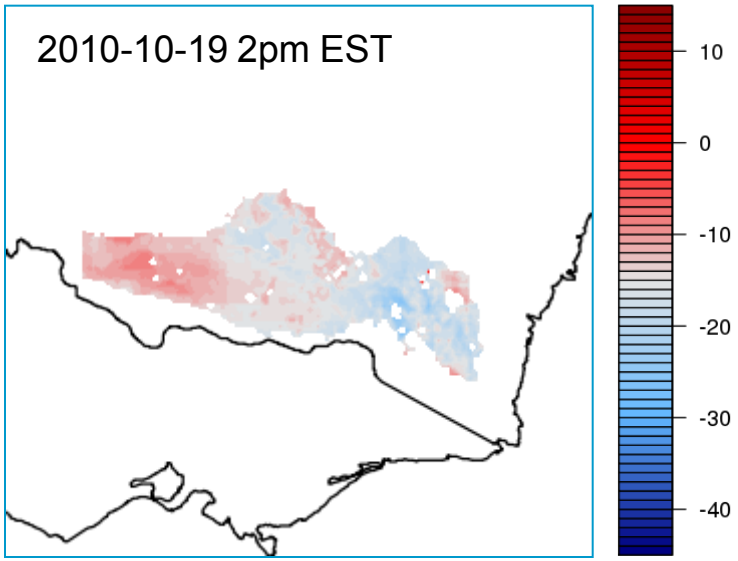
Comparison with AMSR-E Tb's



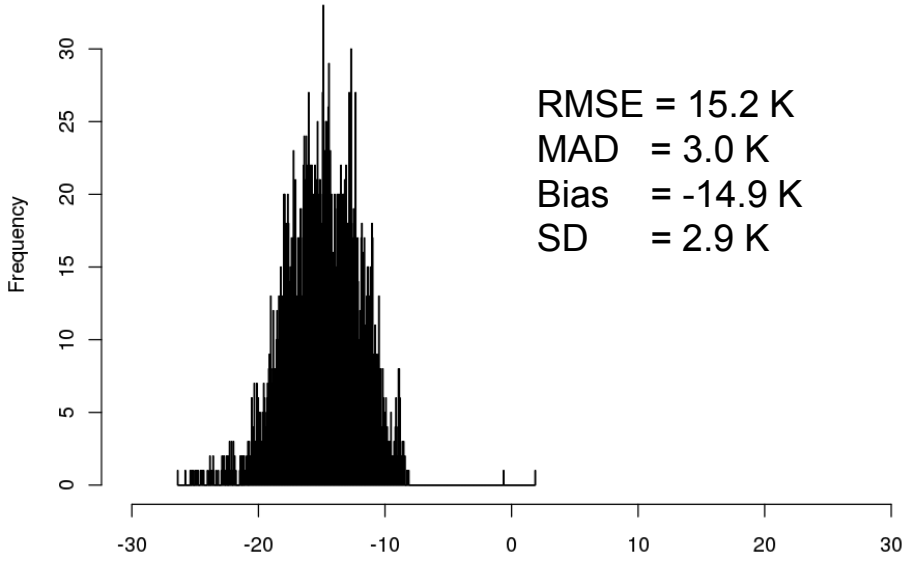
Catchment average Tb (modelled & observed) for Murrumbidgee 1 Jan – 28 Feb 2010



Comparison with AMSR-E Tb's

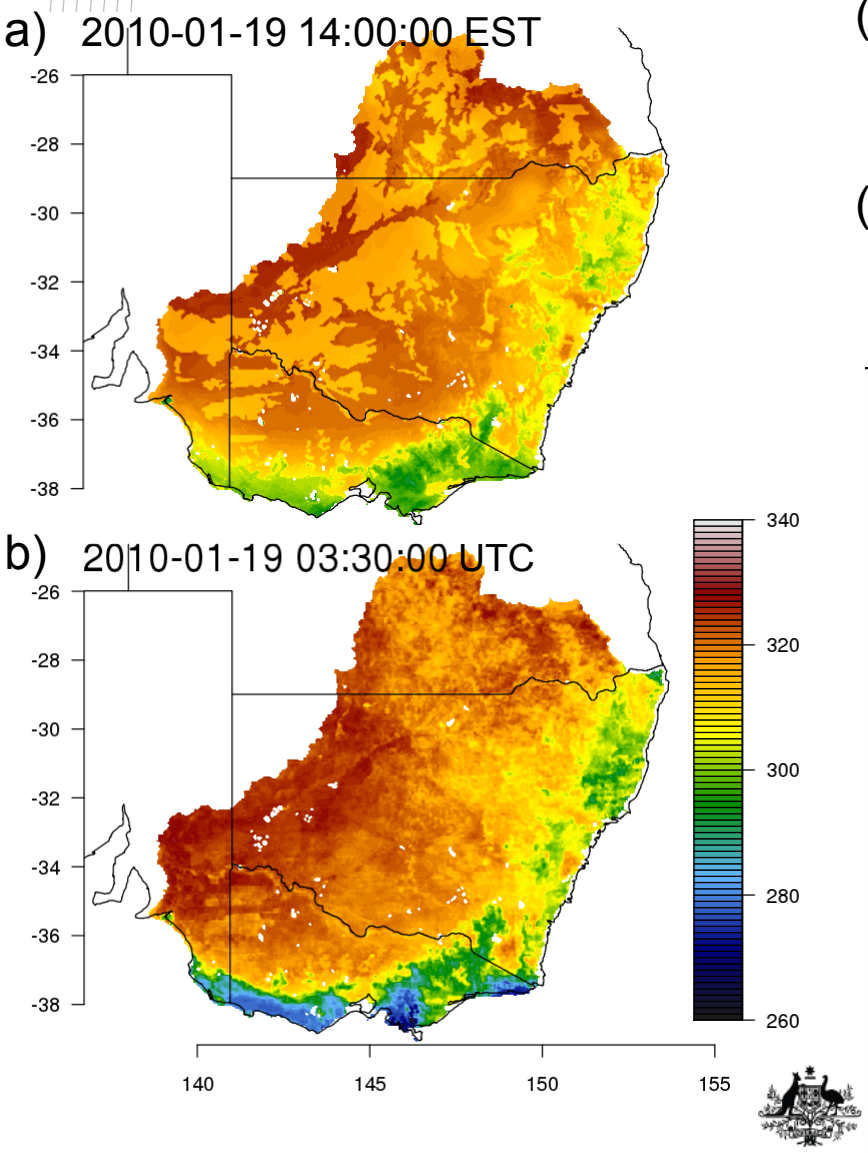


Difference in AMSR-E & CMEM modelled Tb_V



RMSE = 15.2 K
MAD = 3.0 K
Bias = -14.9 K
SD = 2.9 K

Land surface temperature

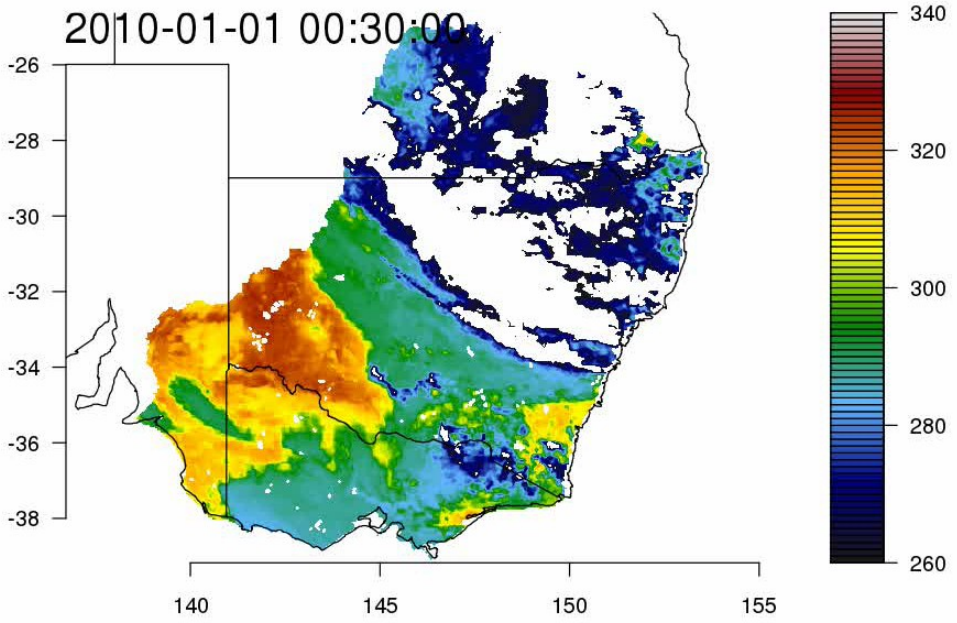


(a) CABLE LST

- Complete/continuous coverage
- Hindered by “poor” model inputs

(b) MTSAT-1R LST

- Retrieved product
- Gappy in spatial & temporal coverage



Microwave brightness temperature modelling

- Next steps
  - CMEM modelled Tb from AWRA-L soil moisture
  - Process AMSR-E and MIRAS Tb observations
  - Experiment with some different inputs (e.g. MTSAT-1R LST's) and parameterisations
  - Comparisons with *in situ* (modelled L-band Tb) & PLMR across the Murrumbidgee
- Down the track …
  - Sensitivity to different static & dynamic model inputs
    - Soil profile temperature and moisture fields
  - Strip down CMEM components for incorporation into AWRA-L