

One-second Digital Elevation Model for Australia

Water for a Healthy Country

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Australian Government
Bureau of Meteorology

National Research
FLAGSHIPS
Water for a Healthy Country



The one-second Digital Elevation Model project has developed consistent elevation datasets from shuttle radar topographic mission data, targeting hydrological applications at a resolution of approximately 30 metres across the Australian continent.

Transforming Australia's water resources information

The need to accurately monitor, assess and forecast the availability, condition and use of Australia's water resources is now more important than ever.

The past decade of severe drought and recent extreme climatic events in Australia pose significant challenges to the management of Australia's water resources as we attempt to deal with an ever-increasing demand for water. The Water Information Research and Development Alliance is transforming the way Australia manages water resources, by bringing together the research and development expertise of CSIRO's Water for a Healthy Country Flagship in water and information sciences, and the Bureau of Meteorology's operational role in hydrological analysis and prediction.

Objective

One of the foundations of a robust framework for continental water accounting is a reliable and consistent digital elevation model (DEM) across the entire continent.

The DEM terrain data set is fundamental in helping the Bureau of Meteorology to consistently:

- define catchment boundaries
- determine contributing areas
- support modelling in floodplains, including inundation volume and surface water/groundwater interactions.

Key research areas

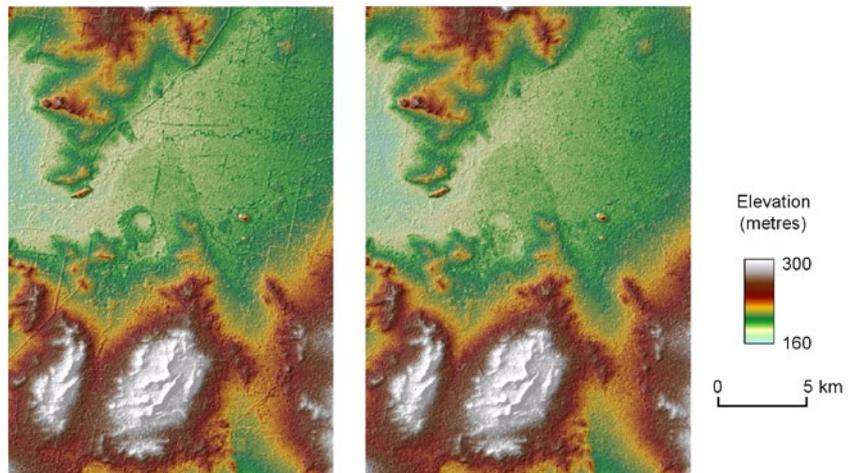
The DEM project has delivered a series of related elevation models, derived from the one second (~30 metres) shuttle radar topographic mission (SRTM) data. These include:

- a cleaned digital surface model (DSM) that includes the effects of vegetation and constructed features
- a bare-earth DEM
- a smoothed DEM (DEM-S)
- a hydrologically enforced DEM (DEM-H)

As foundation datasets, DEMs will be progressively revised and improved.

The DEM-H will be used to produce a refined version of the Bureau of Meteorology's Australian Hydrological Geospatial Fabric (Geofabric).

The DEM project has also developed a 'conflation' tool that identifies corresponding features in two different representations of a stream network, based on their position within the water catchment hierarchy. This automated tool is a significant advance on previous methods, which relied on spatial proximity without considering the network topology. It supports the transfer of attribute information between different realisations of the stream network, and allows comparisons of the drainage network structures derived from different DEMs. This tool provides a tremendous productivity gain over existing, manually intensive methods of resolving data inconsistencies.



> One-second DEM near Culcairn in New South Wales showing the topography with vegetation (DSM, left) and without vegetation (DEM, right).

Delivering outcomes

The DEM is based on the SRTM satellite data collected by NASA during its 2000 space shuttle mission.

To clean up the SRTM DEM of Australia, we have:

- removed systematic striping that affects most of the continent
- filled holes in the data
- removed the elevation offsets due to vegetation
- selectively smoothed the data to reduce noise
- enforced mapped river networks into the model.

By removing most of the effects of vegetation and noise on elevation across the continent, CSIRO researchers have produced the most detailed DEM across the whole of Australia's topography ever made. The vegetation removal process has also resulted in a spin-off vegetation offset map. The map is related to vegetation height and density, and may be useful for calculating biomass and contributing to carbon accounting.

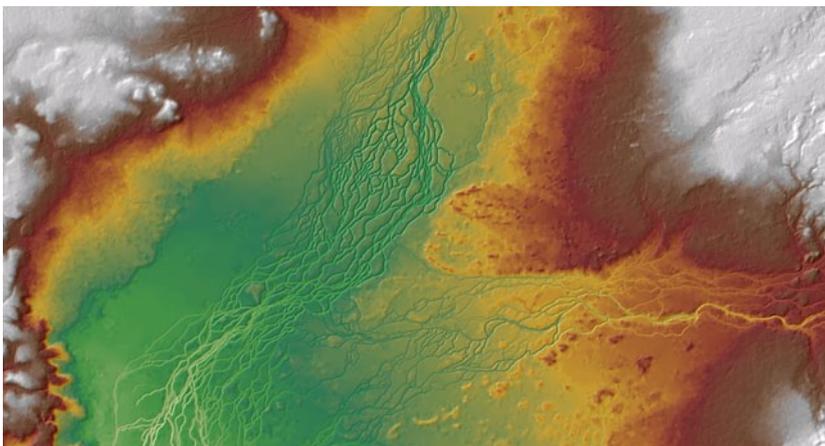
Selective smoothing of the bare-earth DEM has dramatically reduced

noise levels, and provides a sound basis for calculating measures of local shape – such as slope and curvature – as well as more complex terrain analysis techniques.

The hydrological enforcement, performed using ANUDEM software provided by our ANU project partner, ensures that all mapped streams are represented in DEM-H as continuously descending paths. Channel networks and catchment boundaries will be extracted from DEM-H to create a refined version of the Geofabric database (see Sustainable Water Information Models factsheet).

The conflation tool allows the extensive stream attribution attached to the current version of the Geofabric, which is based on the nine-second DEM, to be transferred to the refined version based on the one-second DEM-H. The tool streamlines the conflation process, and allows rapid and repeated updates of the Geofabric as new streamline or elevation data is incorporated into the DEM.

The one-second DEM dataset is licensed and managed by a project collaborator, Geoscience Australia.



> Topography and channel networks in DEM-H at the junction of the Thomson and Barcoo Rivers where they join to form Cooper Creek in south western Queensland.

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

Partners

From 2008 to 2013, the Water Information Research and Development Alliance is delivering the scientific and research innovation required by the Bureau to fulfil its national water information mandate. Through a strategic investment of \$50 million over five years, more than 40 researchers are focusing on several challenging areas. These include large-scale information architectures, earth observation, hydrological modelling, water accounting, water resource assessment and water forecasting.

Other partners in the DEM project include:

- Geoscience Australia
- Defence Imagery and Geospatial Organisation
- Australian National University

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Find out more about the Water Information Research and Development Alliance at www.csiro.au/partnerships/WIRADA.html

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CSIRO and the Flagships program

Australia is founding its future on science and innovation. Its national science agency, CSIRO is a powerhouse of ideas, technologies and skills. CSIRO initiated the National Research Flagships to address Australia's major research challenges and opportunities. They apply large scale, long term, multidisciplinary science and aim for widespread adoption of solutions.