

# Height Systems in Australia

## Introducing the Australian Vertical Working Surface and AUSHYDROID

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### Which height do I use?

The connection of land and sea datums in Australia remains a challenge considering that we do not currently have a model of the vertical separation between the defined global Earth-centred reference frame and local maritime chart datums.

### Welcome to AVWS

The Australia Vertical Working Surface (AVWS) is a reference surface for heights that works on and offshore and forms part of the Australian Geospatial Reference System (Figure 1). AVWS is a model of gravity that provides the offset between the ellipsoid (common height reference used by Global Navigation Satellite Systems, GNSS in an Earth-centred frame) and the quasigeoid, and does not suffer from the same biases and distortions in the Australian Height Datum (AHD). AVWS heights can be computed directly from GNSS without needing to connect to survey mark infrastructure and has an accuracy of 4-8 cm, which presents an improvement on the accuracy previously available from AUSGeoid models (~8-13 cm).

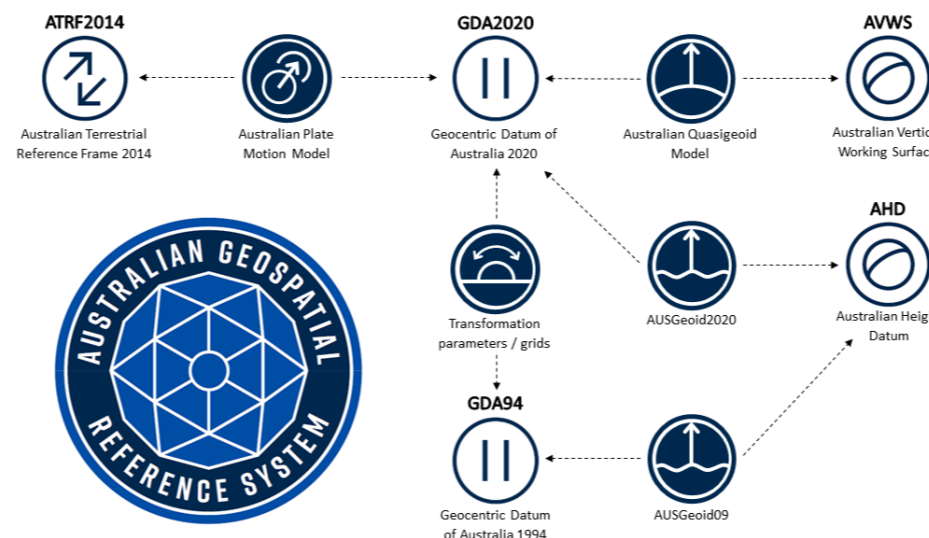
### What is a Quasigeoid?

The Australian Gravimetric Quasigeoid (AGQG) is a model of the gravity field across the Australian region and like the AUSGeoid model which is used to derive AHD heights, the AGQG model can be used to compute AVWS heights. The latest AGQG model (AGQG2017) was determined from ~1.8 million onshore gravity values provided in the Australian National Gravity Database, offshore satellite altimetry derived gravity anomaly values from Sandwell et al. (2014), the global gravity model (EGM2008), and the national digital elevation model DEMH1s. A detailed description of the procedure used to create the model is given in Featherstone et al. (2018).

An online tool is available to transform between ellipsoidal and AVWS heights and also provides uncertainty estimates

[\[https://geodesyapps.ga.gov.au/avws\]](https://geodesyapps.ga.gov.au/avws)

Figure 2 shows the different surfaces that heights can be observed to or derived from with respect to an ellipsoid, geoid or quasigeoid surface.



**Figure 1:** The Australian Geospatial Reference System is the collection of datums, reference frames and working surface used to define the latitude longitude, height, orientation and gravity across Australia.

### AUSHYDROID

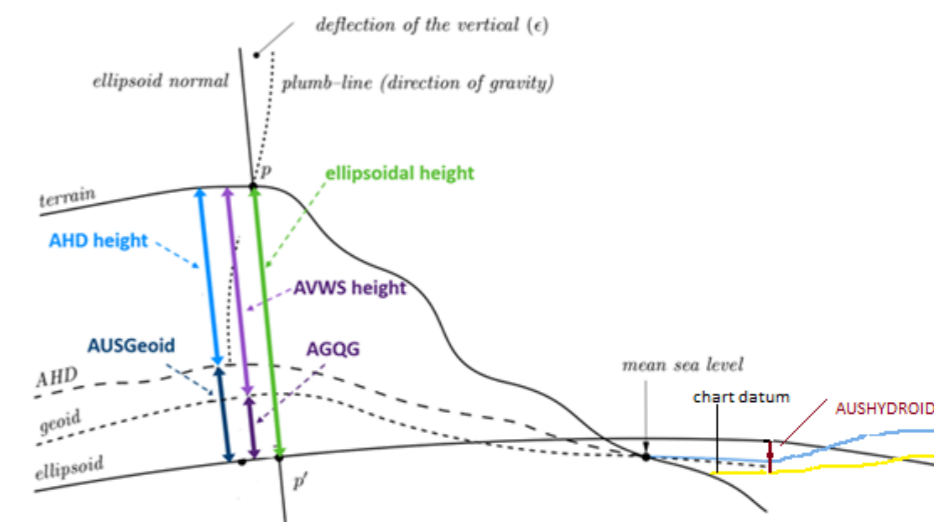
One of the complexities of hydrographic surveying is the relationship between chart datum and the reference ellipsoid. To allow for the reduction of this data to chart datum a new separation model is required to augment traditional tidal models. The new AUSHYDROID is intended to be a model of chart datum (lowest astronomical tide) and will be based in-part on AGQG2017, tide gauge data and models of the mean dynamic topography. It will provide a mechanism to reduce ellipsoidal heights from GNSS to chart datum to facilitate high accuracy surveys in the maritime environment.

AUSHYDROID will have a number of benefits that will contribute to Australia's blue economy including:

- Linking bathymetry and land based observations through a common reference frame;
- Enabling the definition of coastlines and inter-tidal zones on a national scale;
- Assist in defining maritime baselines, marine cadastres and claims of sovereignty; and
- Provide a baseline for sea-level rise estimates and climate change strategies for coastal infrastructure.

### Future Work

There are known issues that any model faces and that is no different for the existing models of gravity across Australia, particularly in coastal areas. To ensure the seamless integration of gravity data onshore and offshore, we are filling in the areas of interest with airborne gravity data. A large project to acquire airborne gravity data across Eastern Victoria is underway and a state-wide survey of NSW is being developed. AUSHYDROID is being established to maintain models that to relate land and sea datums in Australia's ocean regions.



**Figure 2:** The AGQG model (dark purple) enables users to convert ellipsoidal heights (green) to AVWS heights (light purple). The AUSGeoid model (dark blue) enables users to convert ellipsoidal heights (green) to derived AHD heights (light blue), ICSM, 2021.

### REFERENCES

- Featherstone, J. et al., (2018), The first Australian gravimetric quasigeoid model with location-specific uncertainty estimates, JoG, 92(2), 149-168.
- ICSM, (2021), AVWS Technical Implementation Plan, <https://www.icsm.gov.au/publications/australian-vertical-working-surface-technical-implementation-plan-v16>
- Sandwell, D. et al., (2014), New global marine gravity model from CryoSat-2 and Jason-1 reveals buried tectonic structure, Science, 346(6205), 65-67.

