The Earth’s climate and weather system is a highly dynamic and complex environment. Monitoring and predicting meteorological conditions with a high accuracy and reliability is, therefore, a challenging task. Water vapour (WV) has a strong influence on the Earth’s weather and climate systems due to the large energy transfers in the hydrological process. However, it remains poorly understood and inadequately (spatially and temporally) measured, especially in the southern hemisphere where ground-based data are very sparse and only limited meteorological information is available.

In recent years, ground-based and space-borne Global Positioning System (GPS) observations have been used to attain atmospheric parameters with a high accuracy and spatial resolution. By combining these complementary GPS atmospheric sounding techniques, 3D WV fields may be reconstructed using tomographic inversion methods. This will provide an invaluable input for weather forecasting and significantly improve Australian Numerical Weather Prediction (NWP) models.

The tomographic reconstruction process consists of retrieving the scalar field of WV values within a three-dimensional grid of voxels, from the values integrated along the ray paths. This research uses the GPSnet CORS network data within Victoria, Australia to construct a 3D WV field by determining the SWD estimates of each satellite-receiver link. GPS RO atmospheric sounding data from UCAR is also used as a-priori values within the model.

Optimal algorithms, data processing strategies and integration of data for the 3D reconstruction of WV fields will be investigated using multi-sensor measurements from ground, air and space based systems.