iGEE: Mapping and Deriving Land Surface Temperature (LST) and Landcover (NDVI & NDBI) in Australia

~ Developed by GISail, RMIT

User Manual

1 Introduction

iGEE is a web tool- SaaS application that provides free and open earth observation datasets on Australian land surface temperature and landcover changes. The idea supports SDG research, climate change actions and governments decision making, so that stakeholders can easily assess what is happening to Australian cities and communities, starting with data on urban heat islands effect as a priority environmental issue.

For this purpose, a dedicated interface built iGEE: Mapping and Deriving Land Surface Temperature (LST) and Landcover (NDVI & NDBI) in Australia (Figure 1). The web tool was jointly developed by RMIT GISail research group and Australian Urban Research Infrastructure Network (AURIN). Our iGEE web tool contributes to SDGs 3 (Good Health and Wellbeing), SDGs 10 (Reducing Inequality), SDGs 11 (Sustainable Cities & Communities), SDGs 13 (Climate Action), and SDGs 15 (Life on Land).

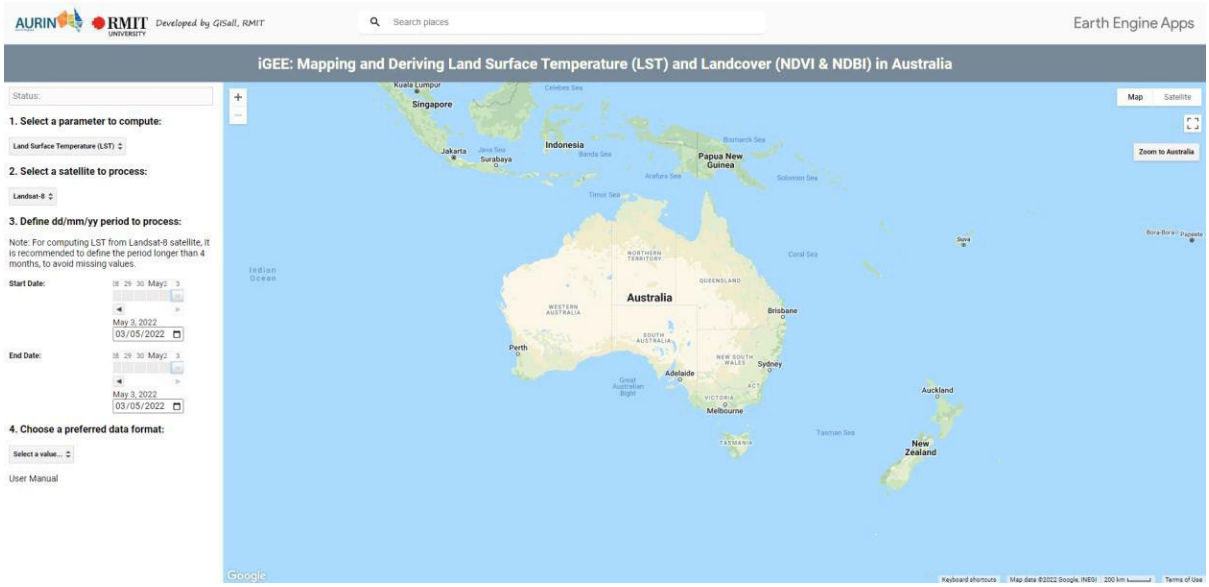


Figure 1. iGEE: Mapping and Deriving Land Surface Temperature (LST) and Landcover (NDVI & NDBI) in Australia interface.

2 Overview of iGEE

iGEE is operational on Google Earth Engine platform, directly accessing Earth Engine User Interface API to leverage Landsat, Sentinel and MODIS satellite data to calculate and download Land Surface Temperature (LST) and Landcover (NDVI & NDBI) parameters in Australia. The user manual provides user instructions for operating iGEE application. The link to the tool - www.gisonmeta.com.

The iGEE tool operates using Landsat 8, Sentinel-2, and MODIS satellite data to derive LST and Landcover parameters as shown in Table 1.

The tool provides two options for deriving the Land surface temperature (LST) of Australia. Firstly, using Landsat Surface Reflectance, which is the atmospherically corrected surface reflectance from the Landsat OLI/TIRS sensors containing 5 visible and near-infrared (VNIR) bands and 2 short-wave infrared (SWIR) bands with the spatial resolution of 30 m. Secondly, using MODIS Aqua Land Surface Temperature and Emissivity 8-Day Global 1km which has a spatial resolution of 1000m. The landcover parameters (NDVI and NDBI) are derived using Sentinel-2 which carries a multispectral imager with a swath of 290 km and a spatial resolution of 10 m.

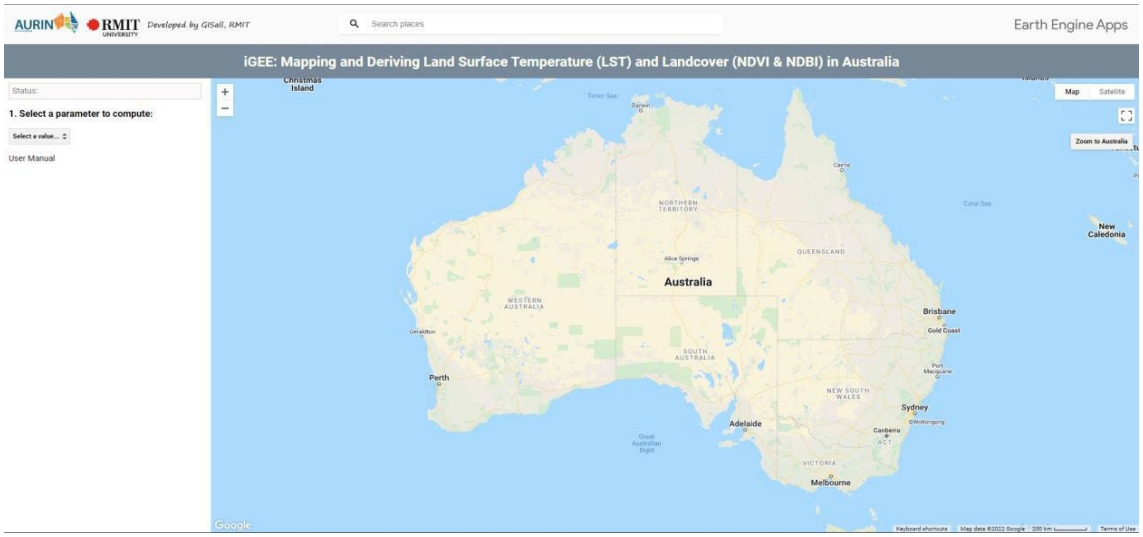
The tool offers date range selection in form of dd/mm/yyyy along with study area selection at a National scale (whole Australia) or Greater Capital City Statistical Area Name (GCC Name). The GCC covers 7 capital cities along with their regional areas, namely, Greater Sydney and Rest of NSW, Greater Melbourne and Rest of VIC, Greater Adelaide and Rest of South Australia, Greater Brisbane and Rest of Queensland, Greater Perth and Rest of Western Australia, Greater Darwin and Rest of Northern Territory, and Greater Hobart and Rest of Tasmania. Polygon-based Statistical Area Level 1 (SA1s) boundaries were used to compute fine-scale, local-level values for LST and landcover parameters. The data was obtained from Australian Bureau of Statistics, which represent the smallest geographic units for disseminating Australian census data, which contain a population between 200-800 people, which an average of 400 people. The user can also select their preferred data download format, i.e., Vector-based CSV or Raster-based GeoTIFF to process the download.

Table 1. LST and Landcover datasets description and formats

Datasets	Spatial resolution (m)	Time period	Spatial Coverage	Satellite image
LST/ UHI -Landsat	30	2013-03-18 - present	National scale	USGS Landsat 8 Level 2, Collection 2, Tier 1
LST/UHI –MODIS	1000	2002-07-04 - present	National scale	MYD11A2.006 Aqua Land Surface Temperature and Emissivity 8-Day Global 1km
NDBI	10	2015-06-23 - present	National scale	COPERNICUS/S2_HARMONIZED
NDVI	10	2015-06-23 - present	National scale	COPERNICUS/S2_HARMONIZED

3 Getting started with iGEE

i. Start application: In a web browser (preferred Google Chrome), paste the link to direct to iGEE interface, www.gisonmeta.com. The platform with display the selection tools on left panel and a map centered to Australia on the right.



ii. Set up parameters to compute: User needs to select different tools to compute LST or Landcover parameters. For example, the following steps are explained to compute LST from MODIS at a national scale.

a. Select a value: It gives the option to select three parameters to be computed.

For example, user chooses Land Surface Temperature (LST).

b. Select a satellite to process: Once the parameter is selected, user need to select a satellite value to compute. To calculate LST, two satellites will be displayed: Landsat and MODIS and To calculate NDVI/ NDBI, Sentinel-2 will be displayed.

For example: user chooses Landsat.

c. Define dd/mm/yy period to process: The input format is yyyy/mm/dd. Click the calendar icon to select the time range. The scroll bar is set to change the 'dd'. User needs to set a 'Start date' and 'End date' to define the time period. Once selected the time period will be displayed in form of dd/mm/yyyy.

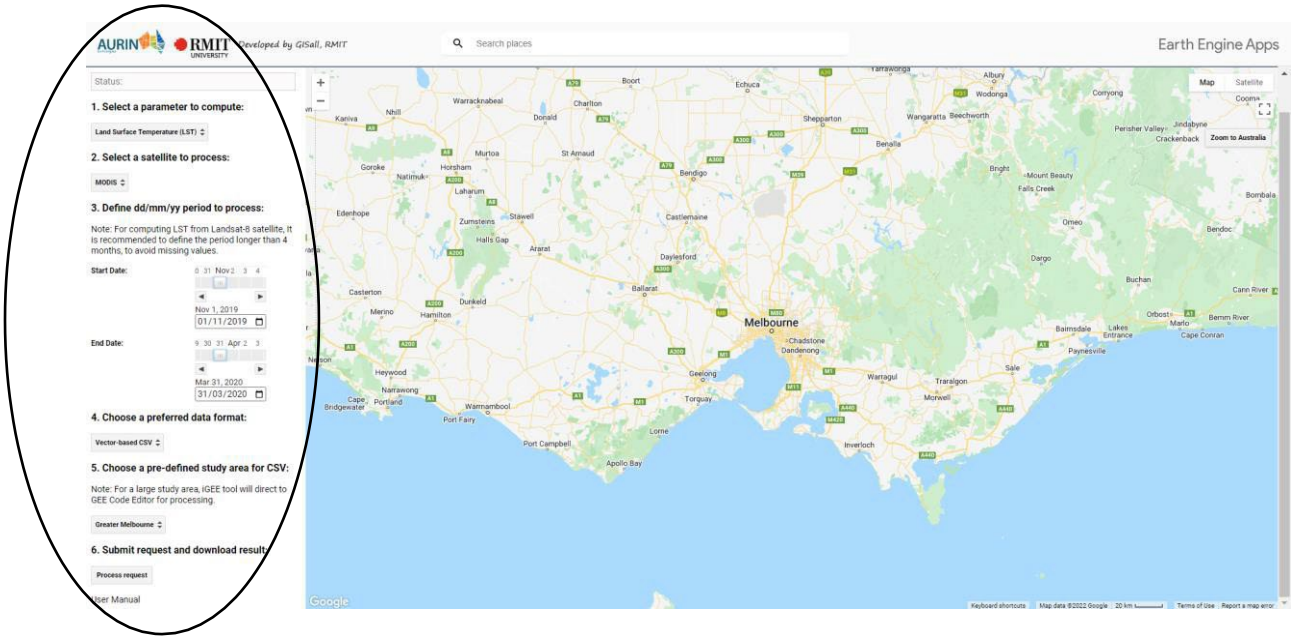
For example: User chooses 01/11/2020 as start date and 31/03/2021 as end date. (Note: This time range indicated the summer months in Australia for 2020).

d. Choose a preferred data format: The data format allows the user to download either in vector form or raster format. In this tool, user can download vector data in form of CSV and raster data in form of GeoTIFF.

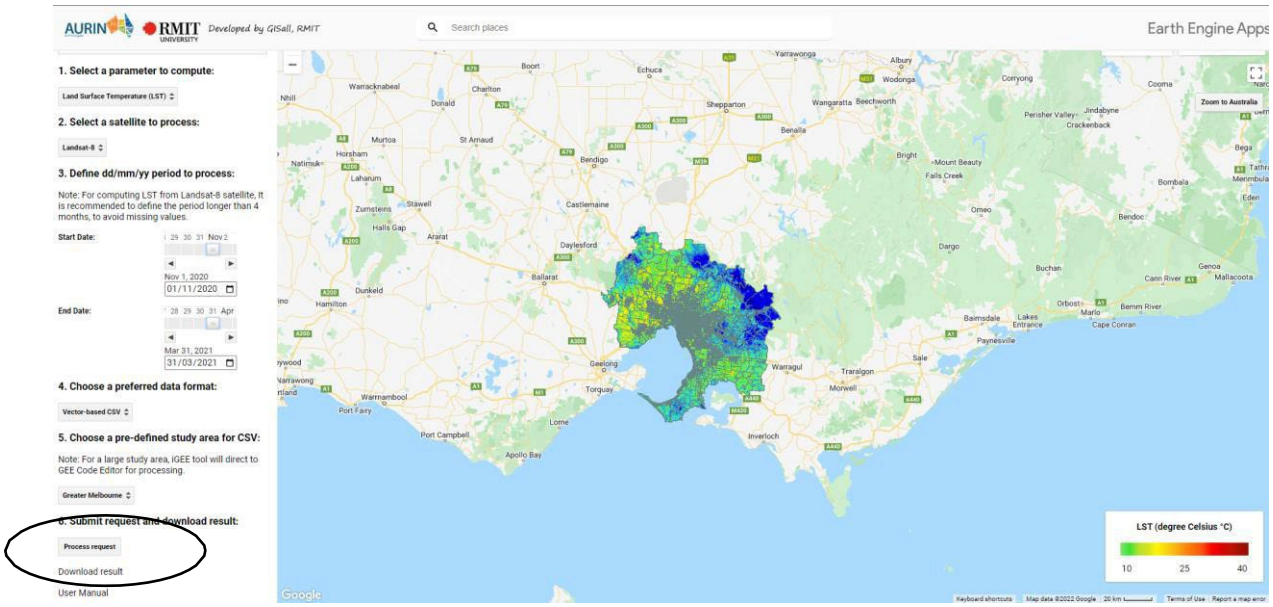
For example: User chooses Vector-based CSV.

e. Choose a pre-defined study area for CSV: User can define any area as listed in the drop-down menu, which will navigate to area selected.

For example: User chooses Greater Melbourne.



iii. Submit request and download result: Once all the parameters are selected, user needs to click process request to direct the tool for computation. It will automatically calculate the mean value for each SA1s and display the result on the right panel. Once the computation finishes, the 'Download result' option will appear on the left panel. User needs to click on it to download the csv file to local disk. The csv file will show eleven columns, with mean value of fine-scale SA1s, for each GCC chosen as the study area.



4 iGEE application for Heat Vulnerability assessment

Our team have also developed a python-based desktop application to calculate Integrated Heat Vulnerability Index (iHVI) for any cities and area at a fine scale of Statistical Area 1 (SA1), Australia. The iHVI toolkit allows users to construct heat sensitivity, heat adaptive capability indicators, and composite heat vulnerability index, which enables modelling of the relationships between heat, environmental and socioeconomic factors with data downloaded using iGEE web tool.

More information can be found:

1. iHVI: AN OPEN-SOURCE TOOLKIT FOR CONSTRUCTING INTEGRATED HEAT VULNERABILITY
   INDEX IN AUSTRALIA : https://www.int-arch-photogramm-remote-sens-spatial-inf- sci.net/XLVIII-4-W5-2022/175/2022/isprs-archives-XLVIII-4-W5-2022-175-2022.pdf
2. Link for downloading the iHVI toolkit: https://github.com/IGEE-IHVI/iHVI-app

5 Contact

Inquires on the software, and comments on the design and functionalities of the applications should be sent to the dedicated e-mail address **chayn.sun@rmit.edu.au** (Royal Melbourne Institute of Technology).

6 Acknowledgements

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