**Work package 1.01 and 1.02**

# Study guide for short course on

# Advanced Remote Sensing for Geothermal Exploration template

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## Development and use

This course was developed under the GEOCAP project in 2016 by contributors from the Dutch-Indonesia University partners of ITB, UGM and ITC. It is part of the train-the-trainers effort of the workpackages 1.01 and 1.02. After successfully completing this specific train-the-trainer course, all participants can make use of this material in their own teaching.
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## Abstract


This course covers advanced remote sensing methods in early stage geothermal exploration. It will show the potential of the datasets and methods in giving fast, reproducible information for large areas, but it will also help the participants understand the uncertainties and limitations of the different remote sensing techniques.


## Target group

This course aims at academia (teachers; Masters and PhD students) and industrial professional that have already a working knowledge of the use of remote sensing in early stage geothermal exploration. The course participants have to have followed an introduction level course on geothermal systems to be able to link the remote sensing results to the geologic system. Working knowledge with GIS or other spatial software is recommended.

## Content

In this advanced level course, we will build on the basic remote sensing knowledge of the participants and focus on advanced methods, like spectral analysis, thermal data analysis and active methods like SAR RADAR and LiDAR data. Examples of different datasets are given, some publically available, others commercially available or restricted. This will allow the participants to see examples of the type of information that can be extracted from the different remote sensing data layers, as well as the limitations of these datasets.
A special effort is made to show also examples from other parts of the world but link the technique back to the specific circumstances of Indonesia. Sensors, datasets and processing techniques are discussed in the Indonesian context whenever feasible. Where possible, this course will use open source / freely available software tools to allow the participants to continue their work after the course has finished.

Some of the topics included are:

- Spectral satellite data (e.g. ASTER) acquisition, processing and classification for mapping of geothermal alteration
- Thermal infrared image (e.g. ASTER) acquisition, processing and interpretation for mapping of thermal hotspots
- RADAR data (e.g. ALOS PALSAR and SENTINEL-1A) acquisition, processing, detection, and geological interpretation for geothermal surface manifestation.
- LiDAR data acquisition, processing and interpretation

## Learning outcomes

At the end of this course the participants will be able to:

- List the different advanced remote sensing techniques for geothermal exploration
- Explain advantages and disadvantages of the treated datasets and techniques for the Indonesian context
- Download, process, and interpret the datasets independently for a different study area.

## Study load

| Activity | Number of hours |
|---|---|
| Self-study of the materials and the assignments | |
| Lectures | 15 |
| Supervised practicals | 25 |
| Project based learning | |
| Preparation for assessment | |
| Field work | |
| **Total** | **40** |

## Course structure

The course aims to be given in 5 consecutive days of 8 hours, or an equivalent duration spread over a number of weeks. The total material is slightly longer than 5 days which allows the participants to specialize by selecting a number of exercise or a mini project that they are personally interested in.

## Teaching and learning methods

The theory is presented in lectures, which is then put to practice in supervised practicals. The participants get to work in more detail on a dataset of choice during the mini-project of Friday morning. They will present their findings in a short presentation on Friday afternoon.

## Assessment

A pre- and post-test will be held for this course.

## Study materials

The study materials are a digital version of all materials (power points, exercises, data) as well as the software which do not require licensing (HypPy, SNAP, QGIS…).

## Teaching materials

The material consists of power point presentations (with presenters notes), exercise instructions and model answers (including a set of final processing results).