

## 'Brecks from Above': Using Aerial Photographs for Archaeology

By: Norfolk Historic Environment Service

### Using Airborne Lidar Data for Archaeology

Lidar is a survey method that uses pulses of laser to build up a 3-dimensional picture of the ground surface. This can include archaeological features when there is some sort of above-ground expression, typically surviving earthworks or structures, even when they are very low. Each laser pulse can produce several 'returns', for example from both the top of a tree canopy and from the ground below. This means that unlike conventional aerial photography, 'last return' lidar data can penetrate tree cover and show archaeological features surviving underneath.

However, it must be understood that lidar data is a 'representation' of the ground surface, not a perfect model, and processing the data and creating visualisations can introduce 'artefacts', 'smooth' features, or remove them entirely. A degree of caution is necessary, therefore, in interpreting what is visible, and checking of features on the ground is advisable wherever possible.

### Environment Agency Lidar

In England, the Environment Agency is the main holder of lidar data. Most of England has coverage, often from several years and at several resolutions. It can be accessed in two ways:

- **Downloading Environment Agency data:**
  - Go to the Survey Open Data website <http://environment.data.gov.uk/index.html>.
  - Click on 'Survey Data'.
  - On the map, navigate to the location you are interested in and click. A list of available data will appear at the bottom of the screen.



- In general, we have found the DTM (Digital Terrain Model) datasets more useful for archaeological survey than the DSMs (Digital Surface Models). This is particularly the case in wooded landscapes or heathland, as in DTMs vegetation covering the ground is stripped out. This does, however, have a 'smoothing' effect on the data, and DSMs can be useful or even preferable in open landscapes.
  - The Environment Agency's composite datasets are made up of the highest resolution data for each area (*i.e.* the 1m data will be of 1m resolution or higher), and these are the ones we generally use; however, clicking on the cross symbol next to the 'LIDAR Tiles' datasets will allow you to download datasets from a specific year.
  - Sliding the 'On / Off' switch next to each dataset will show the coverage.
  - To download your selected dataset, click on the green arrow to the far right. The datasets are quite large, and will download as a zip (compressed) file; to extract the files, select the downloaded folder in Windows Explorer (it will be called something similar to 'LIDAR-DTM-1M-TL88'), right click and select 'Extract All ...'.
  - The files will be extracted to a new, unzipped folder with the same name. In the folder there will be a series of files, each named with a four-figure grid reference (the southwest corner of the tile), a description of the type of data (DTM or DSM) and its resolution, and a .asc file extension, *e.g.* 't18287\_DTM\_1m.asc'. As there are gaps in coverage, don't be surprised if tiles are 'missing'; coverage of 2m resolution data is more complete than that for higher resolution data.
- **Using Relief Visualization Toolbox:**
    - The downloaded Environment Agency data consists of ASCII gridded data, which requires specialist software to view and manipulate. We use Relief Visualization Toolbox (RVT), which can be downloaded for free from <http://iaps.zrc-sazu.si/en/rvt#v>.
    - The creators of RVT request that you cite the following references when using visualisations created with their toolbox:
      - Kokalj, Žiga, Klemen Zakšek and Krištof Oštir, 2011. 'Application of sky-view factor for the visualization of historic landscape features in lidar-derived relief models, *Antiquity* 85 (327), 263–273.
      - Zakšek, Klemen, Krištof Oštir and Žiga Kokalj, 2011. 'Sky-view factor as a relief visualization technique, *Remote Sensing* 3, 398–415.

- In RVT, you need to first convert the ASCII data into a geotiff. Add the relevant file using the 'Add file(s)' button, and then click on 'Convert' in the 'Converter' tab.
  - RVT can then produce up to nine different visualisations from the geotiff, including some of those most commonly used for archaeological surveys using lidar. Add the newly created tiff file by clicking on the 'Add file(s)' button, and then select which visualisations you want on the 'Visualization' tab. The parameters for each visualisation can be adjusted; see the RVT manual for information about the different visualisations and what effect changing the parameters will have. In general, the default parameters are about right for archaeological purposes. **NB. There is a known fault with the software, which is that it often crashes when producing the 'PCA of hillshading' visualisation, so be wary about selecting this option.**
  - When you are happy with your selections and parameters, click on 'Start'.
  - The toolbox will create a tiff file for each visualisation, in some cases with an 8 bit version as well. These can be opened like any other image file; for mapping purposes, they do not need any rectification.
- **Using Environment Agency jpegs:**
    - Alternatively, jpegs of the Environment Agency data are available on Flickr <https://www.flickr.com/photos/environmentagencyopensurveydata/albums/>. However, jpegs contain less information than the original data; judicious use of photo editing software, for example, may allow archaeological features to be seen and mapped more easily. Crutchley and Small 2016 (full reference below) contains further information on this topic.

## Breaking New Ground lidar:

- As part of the Breaking New Ground Landscape Partnership Scheme, supported by the Heritage Lottery Fund, the Forestry Commission and Forest Research led a project to survey upwards of 150 sq km of Thetford Forest and Kings Forest in the Brecks. More information can be found on the Breaking New Ground website <http://www.breakingnewground.org.uk/news/revealing-the-hidden-landscape-of-the-brecks/>
- The air photo interpretation team are using this new data, alongside conventional aerial photographs, as part of their 'Brecks from Above' survey.
- Volunteers for Breaking New Ground projects can request jpegs of the data for specific areas from the BNG team or via your project co-ordinator. If you are interested in volunteering for the 'Discovering the Archaeological Landscape of the Brecks' project, please contact Claire Bradshaw ([claire.bradshaw@norfolk.gov.uk](mailto:claire.bradshaw@norfolk.gov.uk); tel: 01362 869296; see <http://www.breakingnewground.org.uk/our-projects/a-future-for-all/discovering-the-archaeological-landscape-of-the-brecks-training-programme/>).
- It is hoped that the Breaking New Ground lidar will eventually be made available via the Norfolk and Suffolk Historic Environment Records.

## Copyright, acknowledgements and referencing

- As with aerial photographs, it is important to ensure that any lidar data you use is properly referenced and acknowledged, with copyright statements if necessary.
- For any survey using lidar, make a note of the source of your lidar data (Environment Agency or Forestry Commission, for example), the type of data (DTM, DSM), its resolution (1m, 2m, etc.) and, where known, the date it was flown.
- The source of the original data should be acknowledged in any reports or the captions for any images. Whoever flew and/or paid for the data to be created is effectively the owner of that data.
- Any visualisations produced from the data, which 'add value' to the original data, belong to the creator of the visualisation, so they too should be credited.
- As stated above, the creators of RVT request that you cite the following references when using visualisations created with their toolbox:
  - Kokalj, Žiga, Klemen Zakšek and Krištof Oštir, 2011. 'Application of sky-view factor for the visualization of historic landscape features in lidar-derived relief models, *Antiquity* 85 (327), 263–273.
  - Zakšek, Klemen, Krištof Oštir and Žiga Kokalj, 2011. 'Sky-view factor as a relief visualization technique, *Remote Sensing* 3, 398–415.

## Further resources:

- Crutchley, S. and Crow, P., 2010. *The Light Fantastic: Using Airborne Laser Scanning in Archaeological Survey*, Historic England. Downloadable from <https://historicengland.org.uk/images-books/publications/light-fantastic/>
- Crutchley, S. and Small, F., 2016. *Rapid Desktop Reconnaissance: Trial Use of Lidar for Monument Recording*, Historic England. Downloadable from <http://research.historicengland.org.uk/Report.aspx?i=15437>.
- Information and links can be found on the Historic England website <https://historicengland.org.uk/research/approaches/research-methods/airborne-remote-sensing/lidar/>.

