

Earth Engine App ‘ST-Mapper’

Overview

Due to more frequent and intensifying heat waves the issue of urban heat islands obtains more and more public attention. Surface temperatures are affected by the modification of land surfaces, but it is often difficult to understand and foresee the impact of past and ongoing land-use changes on the microclimatic landscape. With Google Earth Engine we created a ST-mapper application that allows to examine the distribution of surface temperatures and track changes over time. The app can be used to discover newly formed urban heat islands and visualizes the cooling effect of natural vegetation. The sample application featured here maps surface temperature in Xiong’an New Area, an area 400 km south of Beijing that has been assigned in 2017 to become the new deputy capital city of China.

The ST-mapper App runs on any desktop web browser, and also on Apple’s Safari web browser on mobile phones.

Data

The data for the app is obtained from Landsat and MODIS satellites, that have been collecting free-to-use thermal infrared imagery for more than 20 years. The data from Landsat 7 and Landsat 8 satellites are combined in the ST-mapper app, due to the similarities of their thermal infrared sensors. Scenes with more than 40% cloud cover are removed from the data set.

Table 1: Satellites used for Surface Temperature Mapping in the ST-mapper App

Satellite	Time period available	Spatial Resolution of Thermal Infrared Sensor	Overpass Frequency	Approximate View Time
Landsat 7	1999 – today	60 m	16 days	11 am
Landsat 8	2013 – today	100 m	16 days	11 am
Modis Terra	2000 – today	1 km	Twice daily	11 am, 11 pm

Detailed Instructions

Selection of Satellite Product

The user can select the following products in the Select Menu in the upper right corner of the screen (Figure 1):

- **Landsat 7/8.** By default, the ST-Mapper App displays Landsat7/8 ST-trend data when starting the app. This is the product with the highest spatial resolution. Landsat 7 and 8 satellites pass over Xiong’an New Area approximately at 11 am.
- **MODIS Day.** Product with lower spatial but higher temporal resolution. Can be used to validate the ST-patterns identified with the Landsat 7/8 product. The overpass time is almost identical to Landsat 7/8 (11 am).
- **MODIS Night.** Based on the same sensor as the MODIS Day product but considering only the late-evening (11 pm) view-times.

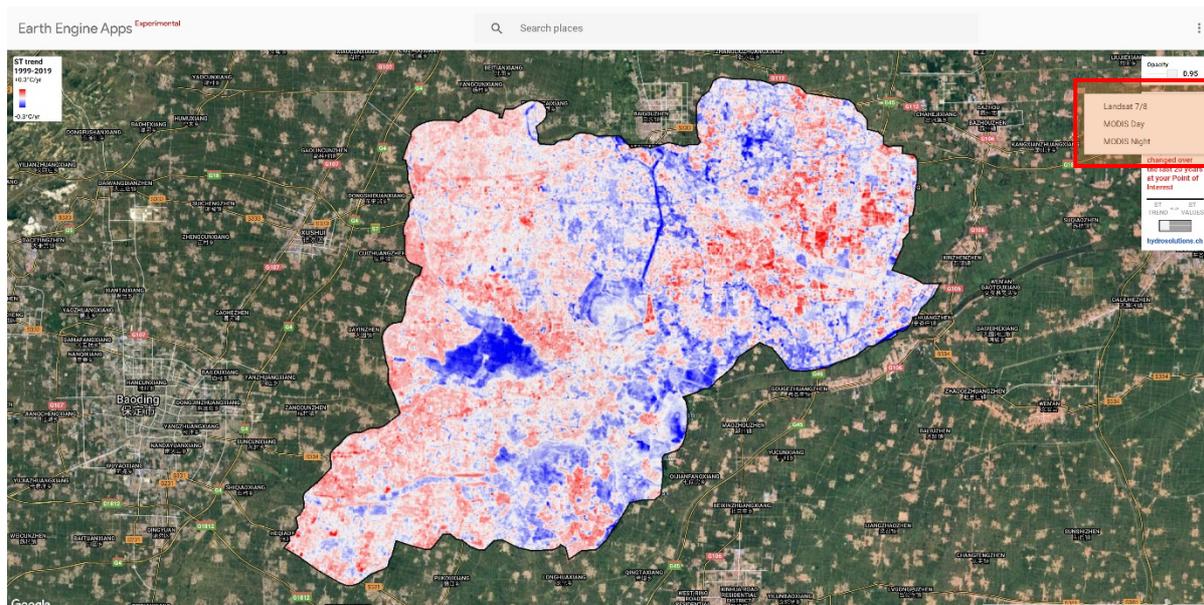


Figure 1: Sensor selection

Analysis of surface temperature trends

By clicking on the map, the user can analyze all available data for a given pixel. The calculated 20-year trend is displayed in the upper-right corner of the screen and compared to the average trend over entire Xiong'an New Area (Figure 2). The trend is calculated based on the Sen's Slope, which is a method for robustly fitting a line to a sample of points. By clicking on 'SHOW DATA' the user can view all available annual data points that were used to calculate the trend. The annual data points are standardized April-October mean surface temperatures. All available daily data points from a given year have first been standardized according to the month of the year.

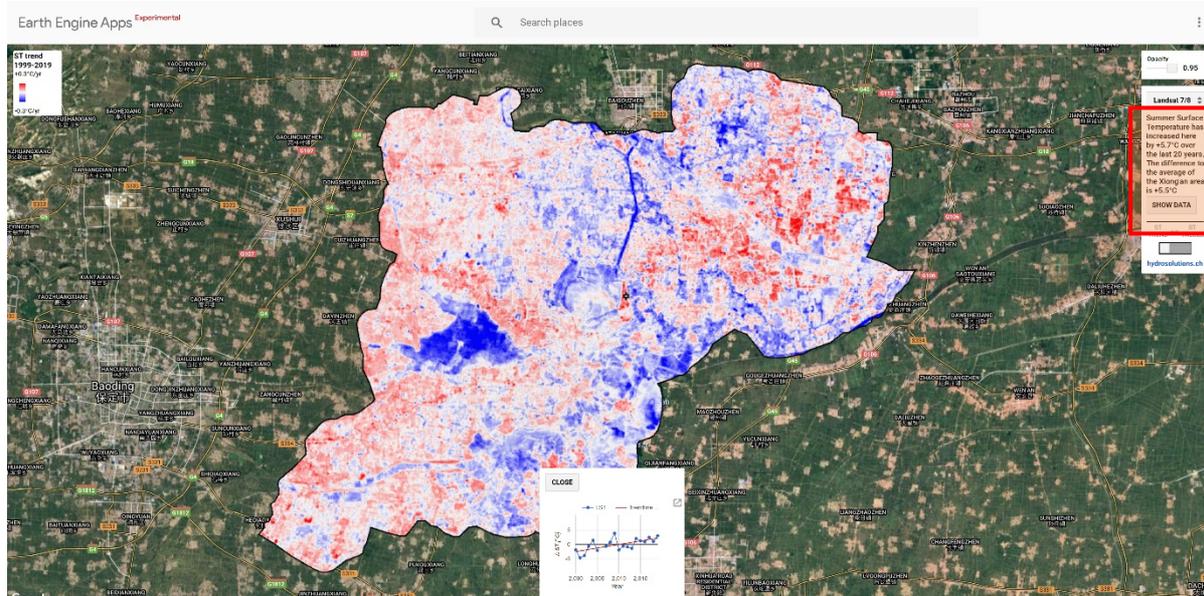


Figure 2: ST-Trend analysis.

Analysis of surface temperature values

Switch to the analysis of ST-values (rather than ST-trends) using the slider in the upper-right corner of the screen (Figure 3). The user will now see by default the 20-year average ST values when clicking on the map. The 'SHOW DATA' button now leads to a time-series plot showing every available ST data point for the selected pixel. Click on the icon to download the figure as a PNG or to download the time-series data in text format (CSV file).

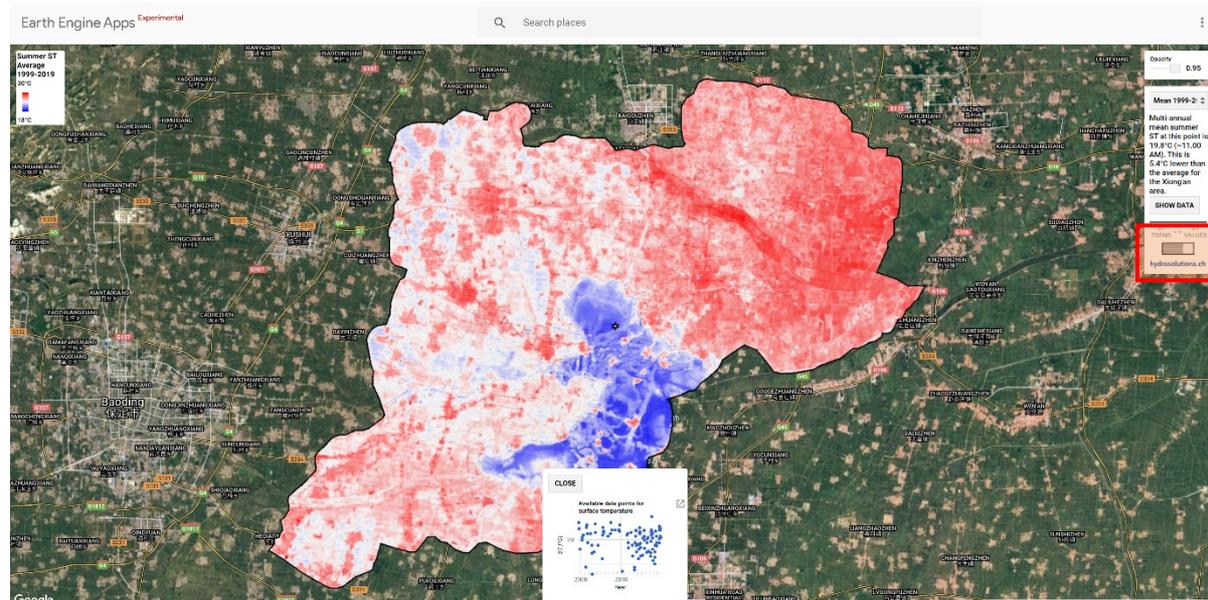


Figure 3: Switch to ST-values analysis.

In the ST-analysis mode, the user can choose to display and analyze any available ST image from a given sensor (Figure 4). To display the ST-images from other sensors, the slider first needs to be set back to the 'ST-trend' position, and consequently a different product can be selected (Figure 1).

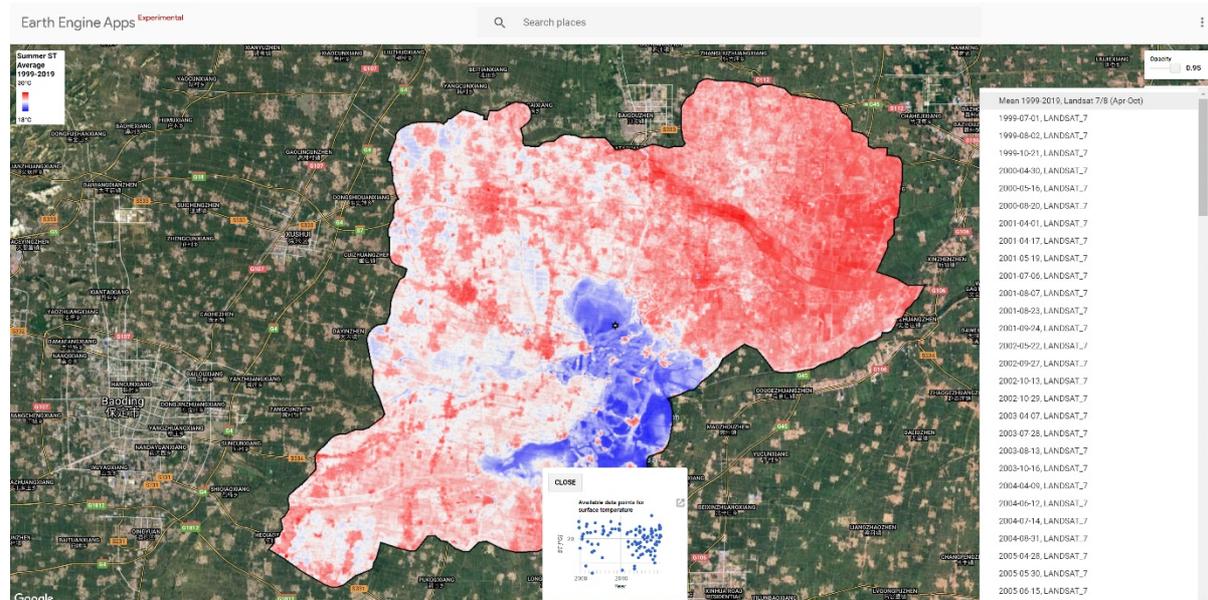


Figure 4: Selection of available ST-images