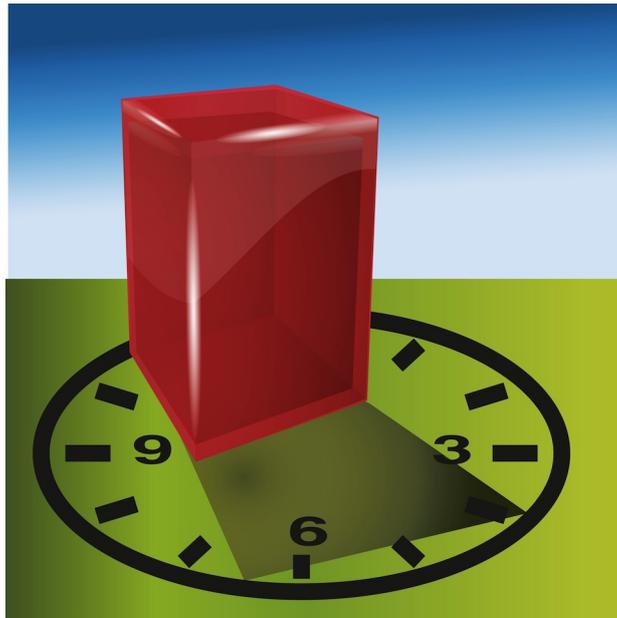


Shadow Calc 3 User Guide



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1 What it's all about

Shadow Calc helps you to calculate hours of shadow for any place on earth and at any time of the year. A location (e. g. your balcony) is in shadow if some object (e. g. the house opposite) obstructs the sun. Whether and how long the balcony is in shade depends on the exact location of the house, its relative height to the balcony and the time of the year.

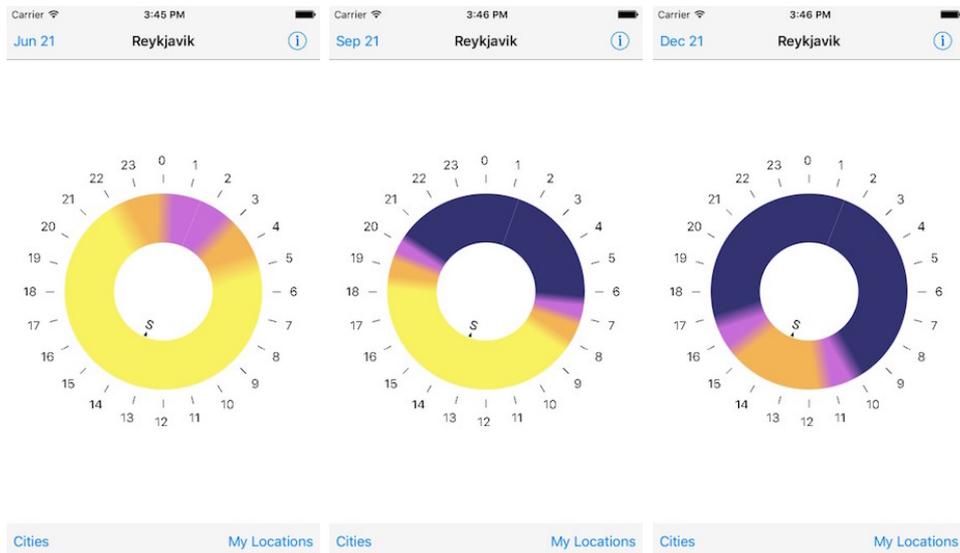
Shadow Calc takes a simplified view of this scene that nevertheless gives you very good results for most situations:

- A location of interest (shaded or not), determined by its coordinates and elevation.
- An obstruction determined by the coordinates of an arbitrary number of locations. For *Shadow Calculation* the exact elevation from sea level is not relevant; what counts is only the height in relation to your location of interest.

Shadow Calc calculates all the relevant solar data for a given location and time (by default your current time and location is selected). Therefore besides calculation of shadow you may use it to visualize the distribution of different intervals of solar altitude, i. e. day, night, twilight and dawn, at any day of the year.

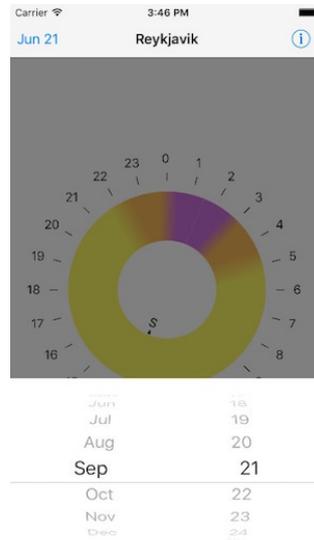
2 The Graphics

The graphics to visualize the distribution of daylight, night, shadow etc. are very simple: A clock with 24 hours, a ring of colors representing the different intervals of the day and a compass that adjusts to the clock to show the relation between time and solar direction:

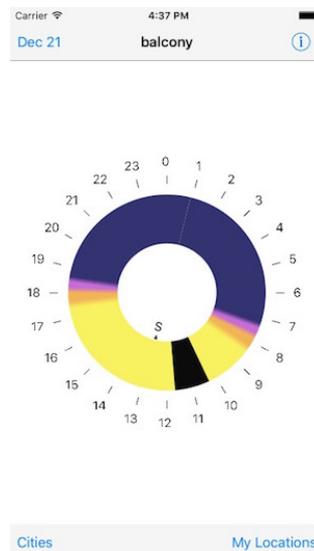


In the screenshots you see the distribution of daylight without shadow for Reykjavík in June, September and December. In summer it never gets really dark although the sun sets around midnight and rises shortly before 3 a. m.; in winter the sun rises after 11 a. m. at but you never get full daylight. One easily sees the relatively long intervals of dawn and twilight typical for the north. At midday around half past one local time the sun is exactly in the south.

You change the date simply by touching the date on the upper left of this screen:

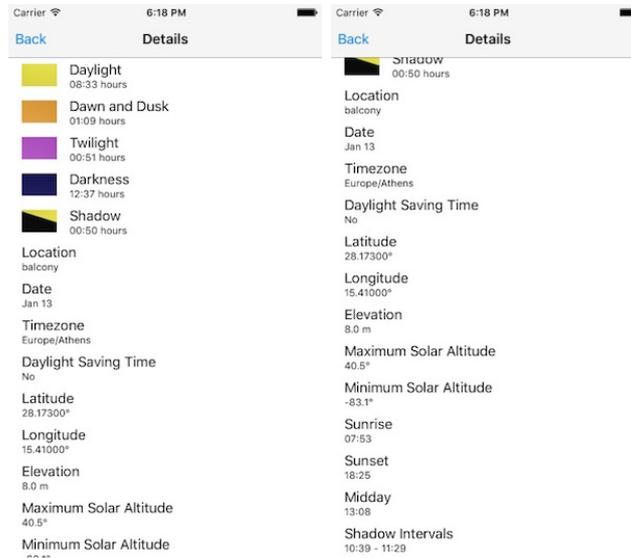


For calculation of shadow you define an object obstructing the sun (see section 5), e. g. a single tree (i. e. left end is equal to right end) or a more extended object like a house or a row of trees:



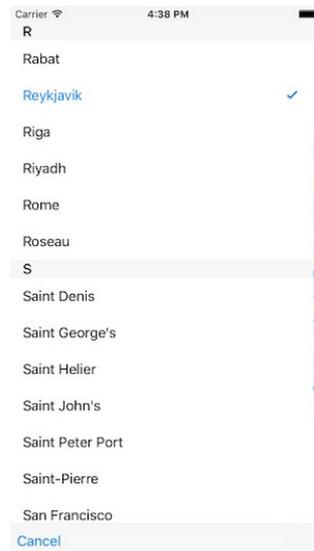
3 The Info Page

If you tap the info button in the navigation bar at the top of the screen, you'll see a detailed description of all relevant data:



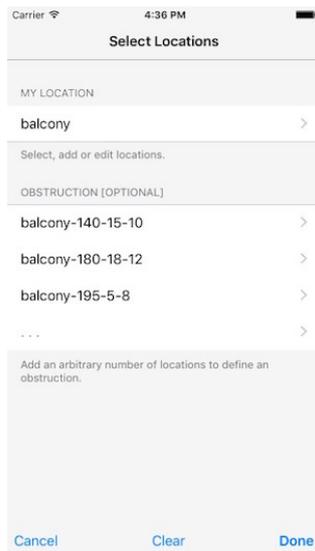
4 Select a City

Sometimes one is not concerned about shadow but simply wants to know solar data of, say, the next holiday destination. To this end select from a list of more than 250 locations, mainly major cities and capitals:

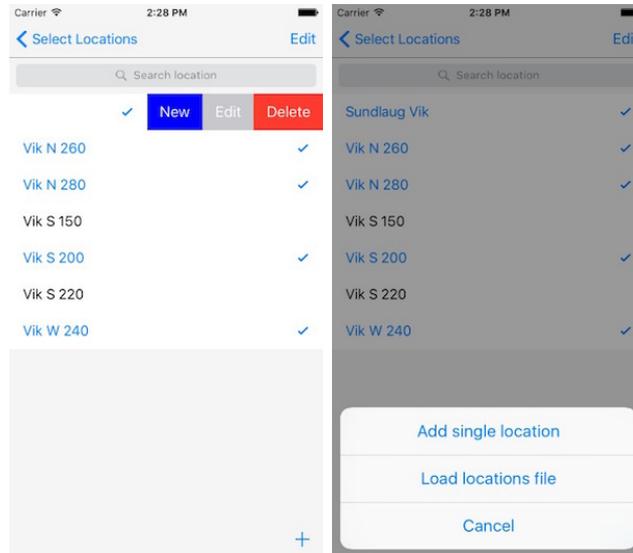


5 Define Locations and Obstructions

For selection and definition of your own locations follow “My Locations” on the start screen. On the next screen you assemble locations for shadow calculation.



In fact there is no difference between a location and an obstruction except its purpose. You select locations from a list that is initially empty, where you can add, modify or delete items. You may add either single locations relative to an existing one (see Section 8), single new locations or import locations from a GPX- or KML-file (see Section 7):



If, adding a single location, you use the keyboard for data input it is irrelevant which coordinate format you choose: it will be recognized automatically (see Section 6 for supported formats). This is especially useful if you copy the data from some external source (another GPS device or a maps application like Google Earth). Just type what you see. It is not necessary to type symbols for units like // for seconds or ° for degree; just type the numbers, then the units are complemented automatically.

When you supply elevation for an obstruction remember that for Shadow Calculation, only the relative height to your location counts. I. e. if the elevation of your balcony is 10 m above the ground and the house is 25 m high the relative height is 15 m. The effect is the same as with a balcony on the ground (0 m) and a house 15 m high.

6 Settings

In the settings app on your device you may somewhat customize *Shadow Calc*:



Sorting

As already mentioned you define an obstruction using an arbitrary number of locations. By default these locations may be in any order and will be sorted for you. There might be situations where you don't want this. In this case you may disable sorting in the settings. Then locations will be taken in exactly the order you define.

Keyboard

Shadow Calc comes with a custom keyboard that makes it easier to enter coordinates. If you prefer the standard keyboard, select here.

Coordinate formats

Select your preferred coordinate format. The three most common formats are supported (all designating the same latitude and longitude):

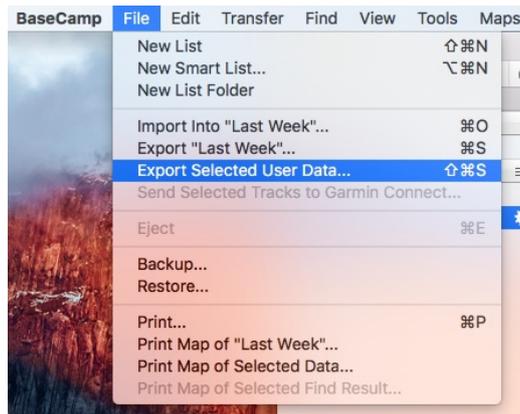
Degree Decimal	$\pm 49.12345^\circ$
Minutes Decimal	$\pm 49^\circ 7.407'$
DMS (Degree Minutes Seconds)	$\pm 49^\circ 7' 24.4''$

Units

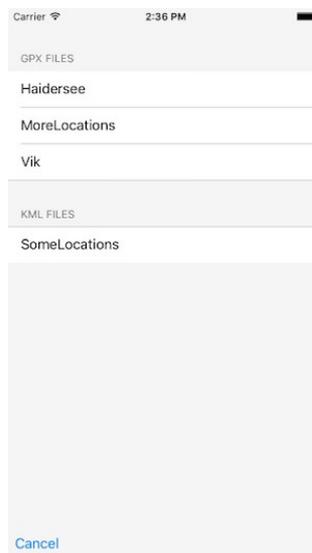
Select either feet or meter as the unit for distance and elevation.

7 Importing location files

Using tools like Garmin Basecamp you may collect locations on a map and export data to a GPX- or KML-file:



With iTunes these files can be imported into *Shadow Calc*:

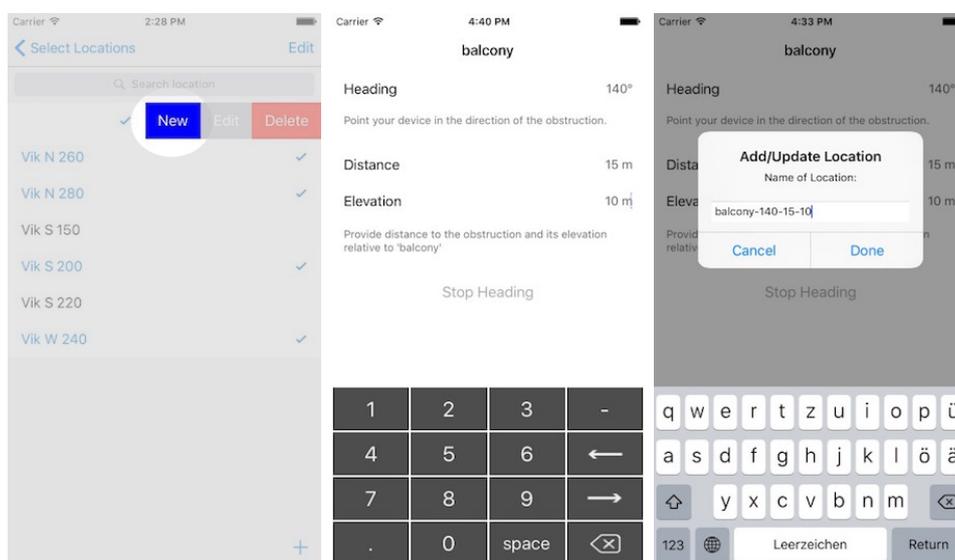


This is a very comfortable way to provide locations.

In addition *Shadow Calc* saves all your locations in a backup file called “MyLocations.gpx” every time you close the app. You have access to this file via iTunes.

8 Relative Locations

When defining an obstruction you can either select it from your list of locations or you create a new one on the basis of an existing location, say “balcony”. The latter I call a “relative location”. You only provide direction (optionally using the inbuilt compass of your device), distance and elevation relative to “balcony” to set its coordinates:



In Section 9 it is explained in detail why this is a very useful way to create new locations.

9 On Accuracy

You’ll find an indicator for accuracy of the Location Services just beside the button “Current Location” (see input panel for coordinates page 5). The accuracy needed depends on the situation: If the obstruction is far away, say a few hundred meters, a GPS accuracy of 5 to 10 meters might be enough. If the obstruction is nearby an accuracy of significantly less than 5 meters is necessary to get good results. The indicator consists of six bars: Zero bars

means Location Services are turned off or temporarily unavailable, six bars indicates a maximum of accuracy. In detail:

number of bars	accuracy
0	Location Services not available
1	≥ 100 m
2	< 100 m
3	< 50 m
4	< 20 m
5	< 10 m
6	< 5 m

Usually you will not get more than 5 bars, i. e. an accuracy of at best 5 meters. Therefore, if you plan to calculate shadow for an obstruction 20 meters away (say the house opposite), you have to be very lucky to get good results using the built in GPS. Figure 1 illustrates the situation:

L designates our location and O the obstruction. L and O are d meters apart and the best accuracy you can expect is r_1 and r_2 at L and O respectively. Then L' and O' might be our location and the obstruction as provided by our GPS. Therefore shadow at location L' will be calculated when the sun deviates from the true direction by angle α . Since

$$\tan(\alpha) = \frac{r_1 + r_2}{d},$$

this means that for $r_1 = r_2 = 5$ and $d = 20$

$$\alpha = \text{atan}(1/2) \approx 26.5^\circ$$

Figure 2 gives you an idea what this means regarding the calculated time of shadow. The graph shows solar direction during daylight hours in Greenwich. Around 9 o'clock a mismeasurement of the solar direction of 10° results in a

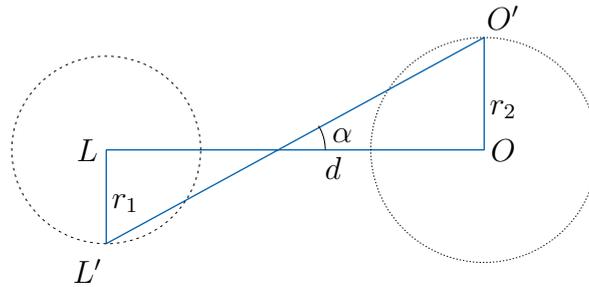


Figure 1: Illustration of the consequences of inaccurate location data.

miscalculated time of one hour too soon or too late. The 26.5° of the example is therefore a disaster for shadow calculation!

So what can you do in the case of small scale shadow calculation (i. e. $r/d \approx 0.1$ or greater)?

- If possible use an excellent GPS device (e. g. Garmin S62) and give it some time to locate enough satellites.
- Maybe you can find your locations of interest in every detail on a map (like Google Earth). Then use coordinates given there.
- You will possibly get the best results using the method of relative locations (see section 8) based on only one GPS measurement. In this case the accuracy is irrelevant. For more details on this method look at the “tips and tricks” on the light-and-shadow homepage.

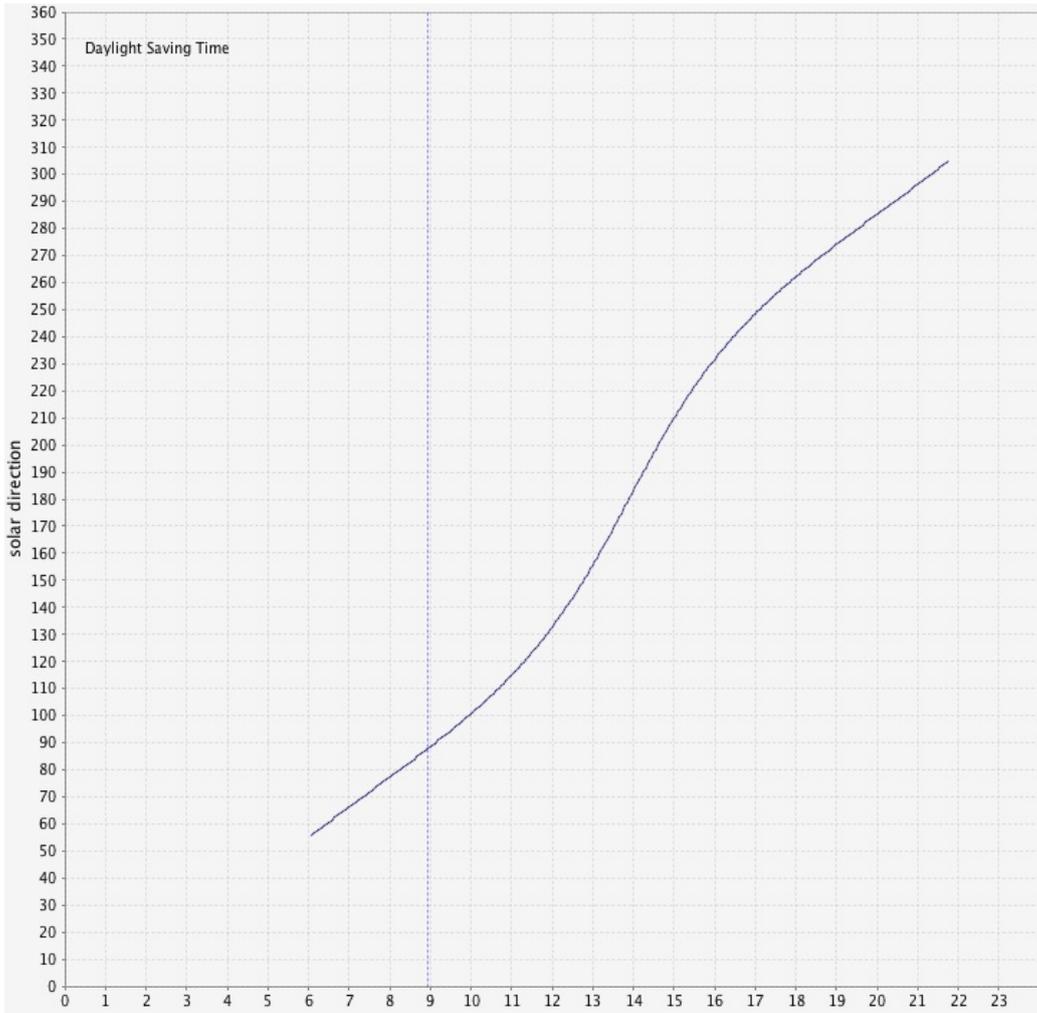


Figure 2: Solar direction graph Greenwich in May.