What is the difference between standard time and solar time?

Apparent Solar Time (True Local Time):
When the Sun culminates at one location, which means it reaches its highest point for that day, it is exactly in the south as observed from that location and at this position it is exactly 12:00 hours apparent solar time or true local time.

Note: On the southern half of the globe the sun has its midday highest point in the north.

The East–West–Difference:
As seen from the Earth, the Sun circles once every day from east to west. For this reason its culmination at all locations east of your position will be earlier than for you and later at all locations to the west of your position. Even when the east–west–difference of two locations is only small, these places have a measurable different local time. For example: the eastern city periphery of the city of Norwich is only 10 arc minutes (an arc minute is 1/60 of a degree) away from the western city periphery. This minor distance leads to a difference of 40 seconds true local time.

Calculating Local Time Differences:
The difference of the true local time between two locations can be calculated from the difference of the degrees of longitude of these locations:

Of the 360 degrees of longitude of the whole Earth, the 0º line runs through Greenwich, London, and is called the prime meridian.

From that location, we count 180º positive to the west (0º to +180º) and 180º negative to the east (0º to –180º), added together 360º. To circle once around the Earth with its 360º, the Sun takes 24 hours. This means it takes the Sun one hour for 15º or 4 minutes for 1º. For example, if a place is located 2º further to the east, the midday highest point of the Sun happens 4 minutes earlier per degree of longitude, meaning, 4 x 2 = 8 minutes. If a place is located 20º further to the west, it happens by 4 x 20 = 80 minutes later.

An extreme example: The geographical longitude of Warsaw is –21º, that of Barcelona –2º, the difference is therefore 19º. In Warsaw the sun reaches its highest point 4 x 19 = 76 minutes earlier than in Barcelona, even though both cities have the same (standard) time of day (Central European Time).

The Annual Fluctuations of Solar Time:
Solar time varies not just with respect to the longitude of a place but also within a year. Compared with a precise clock, it can be shown that the Sun slows down slightly from the 12th February to the 15th May, and is slow by a total of 18 minutes. It then accelerates its course up to the 27th July by 10 minutes, up to the 4th November it slows down again by 23 minutes, and accelerates by 31 minutes up to the 12th February. This speeding up and slowing down is depicted in the equation of time loop on one side of the reading panel.

The duration of a solar day is therefore not constant. You could say that it breathes with two breaths annually. Our standard time, on the other hand, is a calculated mean time with a fixed length of day, from which the true local time can deviate by up to 16.5 minutes and with which it coincides only on the 16th April, 14th June, 2nd September, and the 25th December: that is at the lowest and the highest point as well as in the vicinity of the intersection point of the equation of time loop.

Well into the 19th century, people all over the world lived their lives according to the pulsating solar time which they read from nature. Every town and city had their own time and set their clocks according to the position of the Sun. Time differences were practically insignificant and were unnoticeable because travel in those days was quite a slow process.

Time of day and time zones:
With the arrival of rail travel, time zones as we know them today were introduced.. In these times zones you have a uniform, averaged and equal time – otherwise it would never have been possible to make functioning train time tables for larger regions. Zone times have a difference of 1 hour between them and are based on the true local time at locations with 0º, 15º, 30º, 45º, etc. geographic longitude. This local time is averaged in order to balance out the annual fluctuations of the Sun's course, and then applies for the whole time zone. The actual limits of the time zones do not just depend on the degrees of longitude but rather in a practical manner also on the boundaries of countries or states.

GMT and BST:
Greenwich mean time is the zone time used in the United Kingdom, Ireland, Portugal, the Canary Islands, the Faroe Islands, Burkina Faso, The Gambia, Ghana, Guinea, Guinea-Bissau, Iceland, Ivory Coast, Liberia, Mali, Mauritania, Sahrawi Arab Democratic Republic, Saint Helena, Ascension and Tristan da Cunha, Senegal, Sierra Leone, and Togo. It is sometimes used as a synonym for Coordinated Universal Time (UTC), but that is not quite correct as the two can differ by up to 0.9 seconds.

As the name implies, it is based on true local time in Greenwich, the location that defines the prime meridian. The furthest west location is Dakar in Senegal with 17.5º geographic longitude and the furthest east location is the eastern border of Mali at –5.5º. Therefore the GMT time zone spans 23 degrees of longitude, or a local time difference of 1 hour and 32 minutes.

The first 5 countries in the list also change their clocks during the summer and use British summer time (BST): They simply pretend that it is an hour later. Originally, the idea behind this was to save energy but this hope did not materialise. Nobody knows exactly why everybody goes to the trouble of changing the clocks every year. The most likely reason: daylight is prolonged for leisure time in the evening.

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