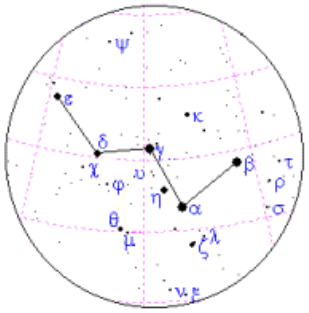


Wadhurst Astronomical Society Newsletter March 2018

2018 SUBSCRIPTIONS

Subscriptions to the Wadhurst Astronomical Society became due from the 1st of January 2018, but at the AGM it was reluctantly decided that an increase had become necessary. On March 1st they rise by £2 to £20 per adult and £27 for two family members at the same address. Members under 17 years of age and students remain free.

Subscriptions can be paid either by cheque made payable to Wadhurst Astronomical Society or as cash at the meetings or by post to:
John Wayte
Members Secretary
Wadhurst Astronomical Society
27 Pellings Farm Close
Crowborough
East Sussex
TN6 2BF

The Subscriptions can also be paid via electronic banking to:
Wadhurst Astronomical Society
Account Number **35104139**
Sort Code **60-22-15**
Putting your name as the **Reference** so we know who is paying.

WAS SUMMER VISIT 2018

The date of the WAS visit to the Royal Astronomical Society Library has been fixed for Tuesday May 22nd 2018 at 2:00pm and is expected to last between one and two hours. The address is Burlington House, Piccadilly, London W1J 0BQ. On arrival, go through the archway into the courtyard where you will see buildings belonging to a number of Learned Societies (Royal Academy of Arts, Royal Society of Chemistry and the Geological Society of London to name a few). The RAS entrance is on your left after having passed through the arch.

I suggest that we meet in the courtyard by 1:45pm so that we can enter as a group and go up to the Library.
The RAS are making no charge for our visit but I suggest that if each of us contributes two or three pounds we could buy a suitable gift for the Librarian who is giving up her time for us.

There are still a few places left if anyone else is interested in going so please let me know if you would like to join us, using the e-mail address at the end of this Newsletter.

Currently the following members and non-members are signed up to attend. Phil Berry, Geoff Rathbone, Ian and Margaret McCartney, Jim Cooper, John Lutkin, John Wayte, Brian Mills, Alan Goddard, Lawrence Muffett and Phil Parker. Please let me know as soon as possible if you won't be able to make it.

Brian Mills

MEETINGS

FEBRUARY MEETING

The February meeting was led by Phil Berry, the Secretary, who after welcoming members and visitors, said that some new books were now available in the library and invited members to have a look.

He mentioned the visit to the RAS library as detailed in Brian's note above.

Phil gave an update on the dark skies of Wadhurst. He said that they have secured a £20,000 grant towards improving the street lighting based on Phil's lighting survey done over several years. He said he was having a final meeting with the East Sussex County Council very soon to discuss the lighting.

Phil then said that last August the Society visited the Space Geodesy Facility at Herstmonceux with a guided tour by Doctor Graham Appleby. It was so interesting that we were delighted when he agreed to come and give a talk to us.

Measuring Sea Level from Space – The Role of Geodesy
Dr Graham Appleby

From the age of 16 Graham has had a strong interest in astronomy partly through the influence of Patrick Moore and this led him to apply for a job at the Royal Greenwich Observatory at Herstmonceux.

The Space Geodesy Facility has many important roles and measuring sea level from space is the one he has chosen to speak to us about.

The Space Geodesy Facility at Herstmonceux with the old Isaac Newton Dome in the distance. The main dome of the Facility houses the laser ranging equipment. The smaller dome to the left is an aircraft warning radar that shuts the laser off if an aircraft is detected

The facility is funded by the Natural Environment Research Council, NERC, through the British Geological Survey. The NERC run many research projects such as the Antarctic Survey.

Graham began by saying that something they recently found was that the sea level is not only rising but this rise is also accelerating.

The very accurate work on monitoring the sea level began in 1990 and already it is predicted that at the end of this century it could be 80 centimetres higher than it is now.

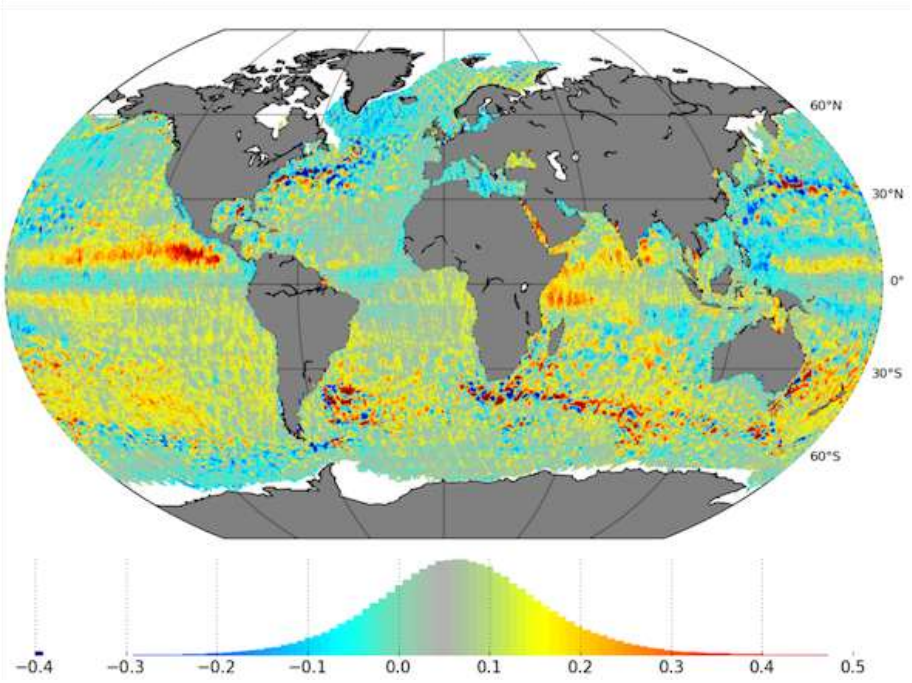
The main reasons for this was the oceans are expanding due to increasing heat and the melting of glaciers with global temperature 0.7^{o} C higher than long-term average.

We looked at modern coast-based tide gauges, which use a tube to take out the effect of waves. These gauges take into account barometric pressure; wind and temperature and also they also use GPS to monitor exactly where the tide gauge is because of possible land movement.

But Graham told us that the truly global solution is to use satellites.

Pulses of laser light are fired from the satellite at the surface of the sea with a radar accuracy of about 1 cm. The resulting data is scrambled because of the shape of the waves. The position of the satellite is known precisely by being tracked constantly by GPS and also being continually measured from the Earth using very short laser pulses, which bounce off special on-board reflectors to an accuracy of a few millimetres, which is where the SGF at Herstmonceux comes in.

We were shown a ‘snapshot’ of sea level in relation to the global mean.



Sea level relative to the global mean – Sentinel 3A - ESA

Many factors have to be taken into account to achieve the accuracy Graham spoke of. Tidal effects on sea level, gravity changes and even tidal effects of the Earth's crust are now precisely known. These have to be taken into consideration and have to be removed from the data to achieve the remarkable precision required.

Accurate details of the Earth's Reference Frame are an important need and we were told that there is now an internationally agreed Global Reference Frame achieved by modern geodetic techniques. Laser Ranging is one of the tasks carried out at Herstmonceux, to help track exactly the position of the satellites.

The laser being fired from the refracting telescope on the left, whilst the larger Cassegrain telescope receives the return laser photons

(From a photo taken during our visit in August)

Powerful laser pulses generated in the laboratory in the basement of the Facility are emitted at the rate of up to 2,000 shots a second from the refracting telescope on the left. The pulses are returned from a special reflector on the satellite which can be as far as 25,000 km away and received by the larger Cassegrain telescope. Graham said that at that distance only about one photon makes it back. When the photon is received, a counter is stopped with an accuracy of 5 pico-seconds. Special filtering methods are needed to remove the background sky. From this time measurement the distance to the satellite can be calculated.

The position of the reflector ball on the satellite has to be taken into consideration because the centre of the satellite cannot be directly ranged so tables are constructed using data from all the reflectors on the satellite to determine even more accurately its position.

All this helps to form the reference frame but the SGF has also to track satellites that could possibly come together and collide. Any data on re-entry and where space debris is going to land is vitally important. There are in fact many monitoring stations around the world.

An interesting fact is that one of the satellites the SGF uses is LAGEOS and we were told that the satellite was launched spinning and over time it has unexpectedly slowed because of the effect of the Earth's magnetic field causing drag.

Graham spent some time describing the various satellites carrying reflector balls used for ranging, from low orbit satellites to those up to 25,000 km.

He said that apart from the reference frame, the site at Herstmonceux was continually being ground-surveyed to an accuracy of 1 mm. Also, the site has an absolute gravity meter, which is being linked to other meters around the world.

The site has a hydrogen-maser clock that is used around the facility and is also used to compare with the GPS system clocks.

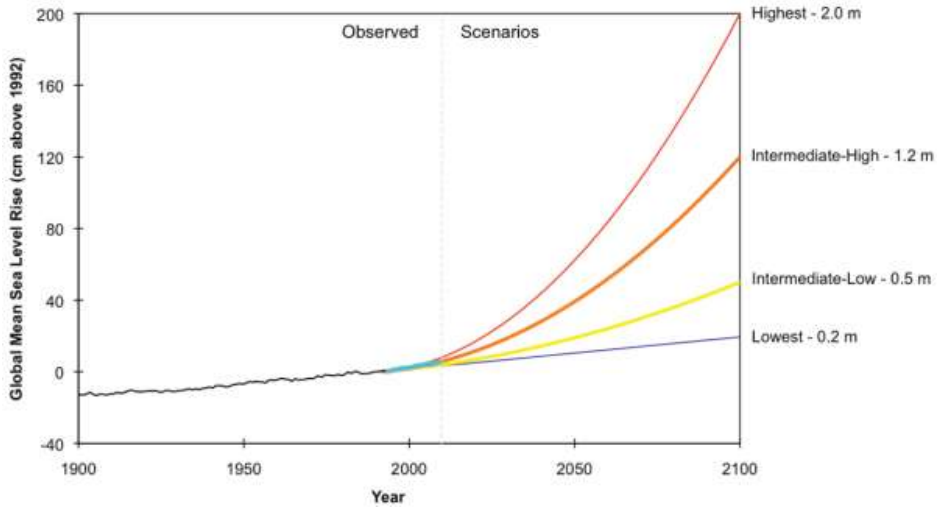
To improve the accuracy of the reference frame, laser-ranging stations not only continually check their own accuracy but they are also checking the results of each other.

All these measurements are used in calculating the height of sea level over a period of time to obtain millimetre accuracy.

Then Graham talked about the changes on land height. During the ice age the midlands and up to Scotland were covered to a depth of 2 km and the land depressed. Now it is found that the land is 'bouncing back' at the rate of about 1 mm a year. In the south it is found to be sinking by about 0.4 mm a year. The global effect is that the earth is becoming less flattened and this is changing its rotation to a very small degree. New laser ranging stations are being built in higher latitudes to help monitor the effects of earth flattening.

Plate tectonics also plays a part in calculations. Graham said that Europe is moving slowing away from the Americas due to the spreading mid-Atlantic trench. But Australia is having to take much more account because they are moving at the rate of 7 cm a year! One interesting effect of this is that Australian farmers using GPS to control their automatic combine harvesters need to be aware of the changes.

Finally, Graham talked about predications of sea level rises in the future and how they might affect people living in low lying and coastal areas.



Sea level predictions to 2100 - NOAA

The Space Geodetic Facility at Herstmonceux is funded by the NERC and Graham said that since our visit last August, the Facility has had to submit reports on their work and contribution generally and the result has been that they now have been granted funding for the future.

MARCH MEETING

21 March 2018 – A welcome return by William Joyce whose subject this time is "Asteroids & Comets"

Meetings will take place at Uplands College, Lower High Street, Wadhurst and are held in classrooms IL5 and IL6 which are in the blue walled classroom block at the far end of the drive from the main gate and up by the tennis courts. Signs will direct you. There is car parking near the block although this needs to be cleared before 2230. The postcode is TN5 6AZ.

Meetings begin at 1930 prompt although members are invited to arrive anytime after 1900, as this is a good time to exchange ideas and discuss problems and also help set things up before the meeting starts.

Anyone is welcome but non-members are asked if they wouldn't mind contributing £3 towards costs.

FUTURE MEETINGS

18 April 2018 – Barry Soden returns to enlighten us on “Daylight Skies”

16 May 2018 – Colin Stuart tells us “ How to Weigh the Universe”

20 April 2018 – Our Chairman, Brian Mills FRAS takes “SOFIA and Airborne Observing” as his subject.

SKY NOTES FOR MARCH 2018

Planets

Mercury reached superior conjunction (on the opposite side of the Sun to the Earth) on February 17th, so it is only now appearing in the evening skies. It will reach greatest elongation east on March 15th when it will put on the best evening display of 2018. Fig 1 shows its position that evening when it will be 11° high in the west with the Sun 6° below the horizon. Fortunately, a much brighter Venus will be 3° south of Mercury which should aid identification considerably. Following elongation, the smallest planet moves back into the solar glare reaching inferior conjunction on April 1st.

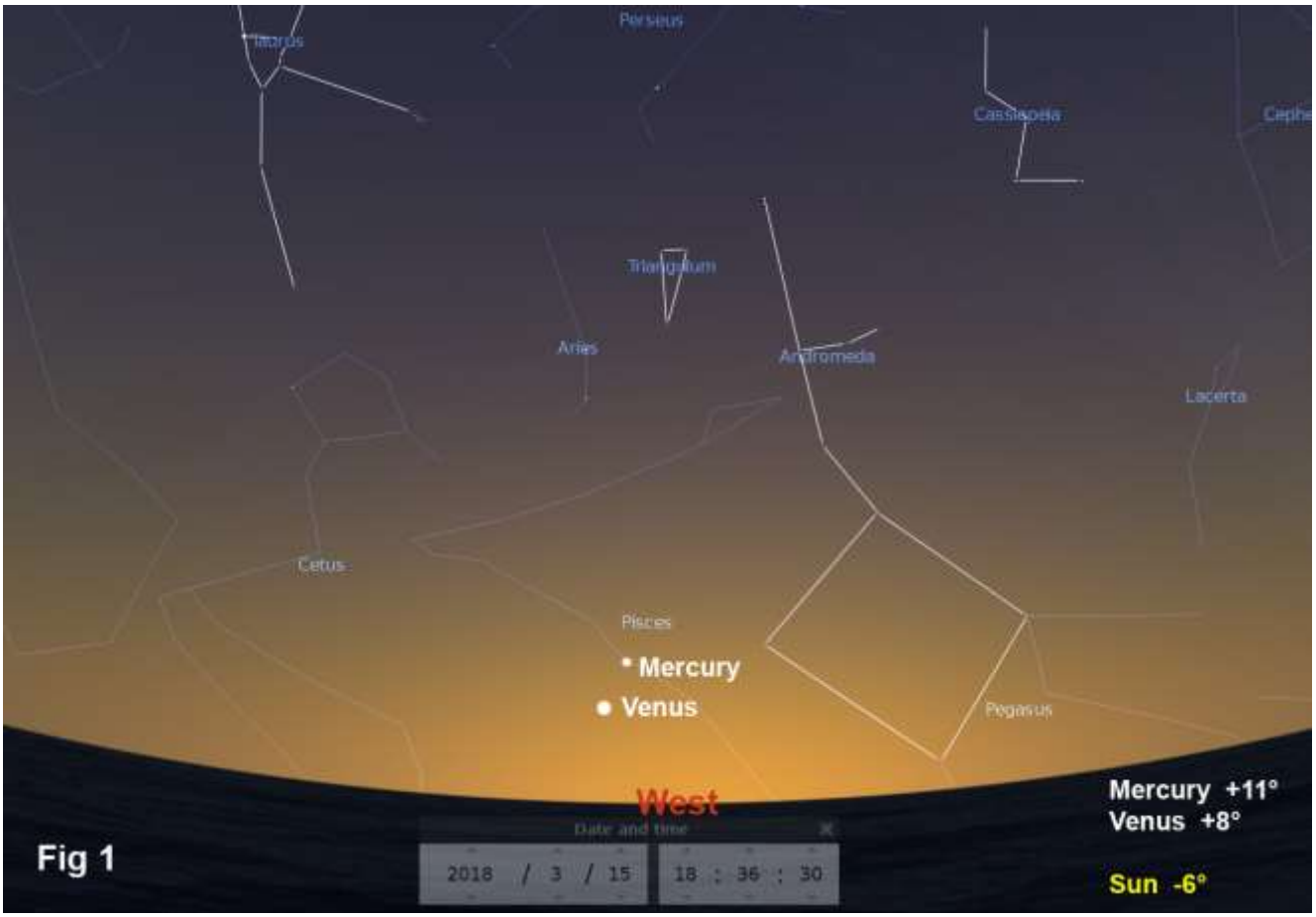


Fig 1

Venus is also now an evening object having passed through superior conjunction in early January although its progress is more gradual than Mercury. At the beginning of March, Venus sets an hour after the Sun although by the end this has grown to almost two hours. On the last day of the month Venus is due west at an altitude of 16° at the time of sunset. Its brightness is -3.9 so it should become obvious as soon as the Sun is out of the way. If you sweep for either Mercury or Venus, do make sure that the Sun has already set so that you don’t inadvertently catch a glimpse of sunlight.

Earth reaches the Vernal (spring) Equinox on March 20th at 16:15. At that moment in time the Sun, travelling along the ecliptic, crosses the celestial equator moving north. This is referred to as the “First Point of Aries” although precession of the equinoxes has moved it westwards into Pisces. This point of intersection is also known as the “ascending node”. At the Autumnal Equinox, which occurs in September, the Sun crosses the celestial equator moving south, a point we call the “descending node”.

The point where these two “great circles” (ecliptic and celestial equator) cross is also of importance for astronomical reference because it provides the starting point for one of the two celestial coordinates, right ascension, that we use to locate objects in the sky. Altitude above or below the celestial equator (declination) is measured in degrees, positive going north and negative going south with the celestial poles being +90° and -90° respectively. It follows that any object with negative declination, i.e. below the equator, is going to have limited visibility and may well be impossible to see from the UK. Declination provides one co-ordinate (height above or below the equator) but what about measuring east or west to provide the other? As I said above we use the First Point of Aries as the starting point, which we refer to as 0h (zero hours) right ascension. We then count eastwards one hour for every 15° which after 23h brings us back to 0h again (24 x 15 ° = 360°).

Mars rises into the morning skies at 02.45 GMT at the beginning of the month amongst the stars of southern Ophiuchus. The planet continues its speedy easterly movement and crosses the border into neighbouring Sagittarius on the 12th after which it passes between the Lagoon and Triffid Nebulae on the 19th and 20th March. The red planet is growing in both size and brightness as it approaches opposition, something that only happens every two years. To be more precise it happens, on average, every 780 days which is the planets *synodic* period. This is the time taken for Mars to return to the same position relative to two other bodies, in this case the Earth and Sun at the time of opposition. Fig 2 shows the position of Mars in mid March with the Sun 6° below the horizon; though don't forget it is moving briskly eastwards.

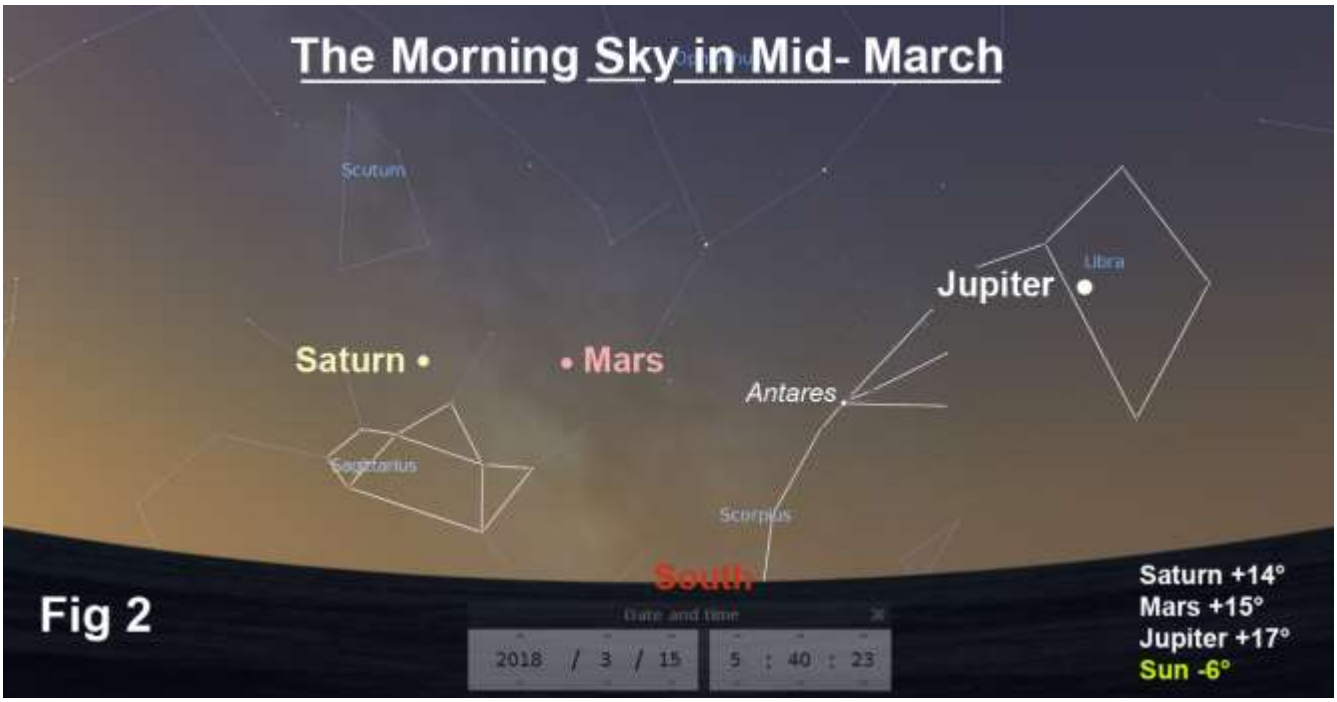


Fig 2

Jupiter will soon be classed as an evening object because at the beginning of March it rises within a few minutes of midnight. It spends the month in Libra although it reaches its first stationary point on the 9th after which it moves retrograde (east to west). The giant planet is living up to its name as its apparent size increases to 42" (42 arc seconds) whilst it grows in brightness to magnitude -2.3. It will reach opposition on May 9th.

Saturn, as you can see from Fig 2, is a morning object amongst the star fields of Sagittarius, just north of the "Teapot" asterism. It rises at 04:00 GMT at the beginning of the month, only improving by an hour at the end due to the change to BST. It will be late May before the ringed planet graces the evening skies once again, with opposition following swiftly on June 27th. Saturn never attains the brightness of Venus or Jupiter, which explains why it is the planet most likely to be mistaken for a star. By the end of March it shines at +0.5 and has an apparent diameter of 16.4" (16.4 arc seconds). A waning crescent Moon is nearby on the morning of 11th.

Lunar Occultations

In the table below I've listed events for stars down to magnitude 7.0 that mostly occur before midnight although there are many others that are either of fainter stars or occur at more unsociable hours. DD = **d**isappearance at the **d**ark limb, RD = **r**eappearance at the **d**ark limb and RB = **r**eappearance at the **b**right limb. The column headed "mm" (millimetres) shows the minimum aperture telescope required for each event.

The Moon visits the Hyades cluster once again with an occultation of Aldebaran occurring late at night when the star is just over 3° in altitude. However, the prediction software suggests that only a very moderate aperture is required to see the brightest star in Taurus disappear behind the dark limb of the Moon. A good west-north-west horizon will be needed. **Times are in GMT unless otherwise stated.**

Mar.	Time	Star	Mag	Phase	Altitude °	% illumination	mm
1st	06.09	Regulus	1.4	DD	4	99	40
22nd	20.19	ZC 667	5.0	DD	33	30	40
22nd	23.38	Aldebaran	0.9	DD	3	31	40
23rd	22.43	ZC 832	4.3	DD	21	42	40
23rd	23.19	ZC 836	5.7	DD	16	42	40
29th	22.13 BST	ZC 1645	6.7	DD	41	97	90
29th	23.12 BST	ZC 1648	6.9	DD	44	97	100
30th	21.45 BST	ZC 1758	6.9	DD	29	99	120

Phases of the Moon for March

Full	Last ¼	New	First ¼
2nd	9th	17th	24th
31st			

ISS

Below are details for passes of the International Space Station (ISS) this month where its brightness is in excess of -2.0. The details of other passes, including those visible between midnight and dawn, can be found at www.heavens-above.com. Please remember that the times and directions shown below are for when the ISS is at it's ***maximum*** elevation, so you should go out and look at least five minutes beforehand. **Times are in BST.**

Mar.	Time	Mag.	Alt°	Az.		Mar.	Time	Mag.	Alt°	Az.
25th	20:25	-2.1	17°	SE		29th	20:07	-3.5	48°	SSE
26th	21:09	-3.4	42°	SSE		29th	21:43	-3.6	71°	WNW
27th	20:16	-2.8	29°	SSE		30th	20:51	-3.9	90°	WNW
27th	21:51	-2.5	36°	WSW		31st	21:35	-3.9	79°	N
28th	21:00:13	-3.9	67°	SSE						

Iridium Flares

The flares that I've listed are magnitude -2.5 or brighter although there are many more that are fainter or occur after midnight. If you wish to see a complete list, or obtain timings for somewhere other than Wadhurst, go to www.heavens-above.com . When one of these events is due, it is sometimes possible to see the satellite before and after the "flare" although, of course, it will be much fainter then. **Times are in GMT unless otherwise stated.**

Mar.	Time	Mag	Alt°	Az.°		Mar.	Time	Mag	Alt°	Az.°
7th	18.40	-7.5	57°	160° (SSE)		17th	19.58	-6.4	26°	3° (N)
12th	20.30	-5.9	12°	3° (N)		19th	19.45	-2.8	30°	3° (N)
13th	20.24	-4.3	15°	3° (N)		29th	19.53 BST	-7.6	47°	356° (N)
14th	20.17	-4.9	18°	3° (N)		30th	19.47 BST	-4.6	49°	356° (N)

The Night Sky in March (Written for 22.00hrs GMT mid month)

In the north, the Great Bear lies close to the zenith meaning that the interesting pair of galaxies M81 and M82 are both high in the sky (75°) and almost on the meridian. M81 is known as "Bode's Galaxy" after the German astronomer, Johann Elert Bode who discovered it in 1774. M81 is a spiral galaxy whilst M82 appears to be something far more interesting. It is a galaxy where star formation is occurring at a prodigious rate – ten times more quickly than in our own Milky Way, and is thought to have been initiated by an interaction with its neighbour M81. Both galaxies are easy objects in binoculars or small telescopes and are favourites with imagers due to the high surface brightness of M81 in particular.

Below Ursa Major to the east of the meridian we find Ursa Minor and Draco whilst to the west lies Cassiopeia. Cepheus straddles the meridian and below it, Deneb in Cygnus is just beginning its climb towards the zenith.

Looking due east we find Arcturus, the brightest star in Boötes, the herdsman, at an altitude of almost 30°. The star can always be found, if it is above the horizon, by imagining a curved line through the tail of the Great Bear and continuing it further until it passes first through Arcturus and then through Spica. Hercules, Virgo and Corona Borealis, that will soon become summer constellations, have all now fully risen bringing with them some of the best globular clusters that the northern hemisphere has to offer.

To the south, the tiny constellation of Leo Minor that lies between the feet of the Great Bear and Leo is on the meridian. Below it Leo itself is approaching the meridian whilst the faint group of stars that makes up Cancer has already passed its best. South of Cancer is the head of Hydra (the water snake) whose body twists and turns towards the south-eastern horizon. Riding on the back of the water snake are the constellations of Corvus (the crow) and Crater (the cup).
Towards the west, the brilliant winter groups are preparing to leave the stage. Despite that the celestial twins are still 60° in altitude and Capella is still 50° high. However, if you look earlier in the evening (between 7:00 and 7:30) the winter constellations can still be seen almost at their best. Objects such as the Pleiades and the Orion Nebula are still well positioned if you want to use your DSLR to take some inspiring images.

British Summer Time (BST) Begins

Don't forget that clocks go forward by one hour on Sunday March 25th at 02:00. British Summer Time remains in place until Sunday October 28th at 01:00.

Brian Mills FRAS

SPACEPLACE - NASA

This article is provided by NASA Space Place.
With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.
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What Is the Ionosphere?
By Linda Hermans-Killiam

High above Earth is a very active part of our upper atmosphere called the ionosphere. The ionosphere gets its name from ions—tiny charged particles that blow around in this layer of the atmosphere.

How did all those ions get there? They were made by energy from the Sun!

Everything in the universe that takes up space is made up of matter, and matter is made of tiny particles called atoms. At the ionosphere, atoms from the Earth's atmosphere meet up with energy from the Sun. This energy, called radiation, strips away parts of the atom. What's left is a positively or negatively charged atom, called an ion.

The ionosphere is filled with ions. These particles move about in a giant wind. However, conditions in the ionosphere change all the time. Earth's seasons and weather can cause changes in the ionosphere, as well as radiation and particles from the Sun—called space weather.

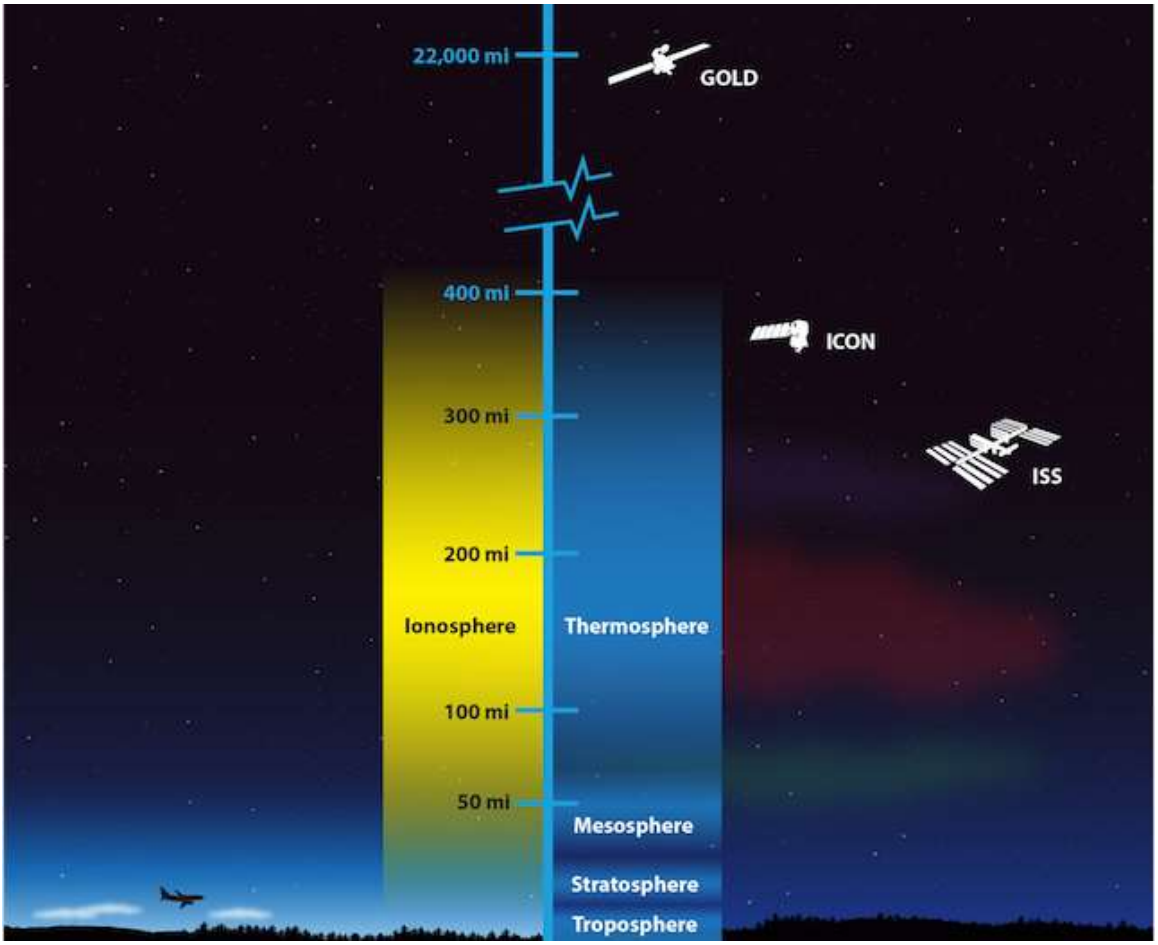
These changes in the ionosphere can cause problems for humans. For example, they can interfere with radio signals between Earth and satellites. This could make it difficult to use many of the tools we take for granted here on Earth, such as GPS. Radio signals also allow us to communicate with astronauts on board the International Space Station, which orbits Earth within the ionosphere. Learning more about this region of our atmosphere may help us improve forecasts about when these radio signals could be distorted and help keep humans safe.

In 2018, NASA has plans to launch two missions that will work together to study the ionosphere. NASA's GOLD (Global-scale Observations of the Limb and Disk) mission launched in January 2018. GOLD will orbit 22,000 miles above Earth. From way up there, it will be able to create a map of the ionosphere over the Americas every half hour. It will measure the temperature and makeup of gases in the ionosphere. GOLD will also study bubbles of charged gas that are known to cause communication problems.

A second NASA mission, called ICON, short for Ionospheric Connection Explorer, will launch later in 2018. It will be placed in an orbit just 350 miles above Earth—through the ionosphere. This means it will have a close-up view of the upper atmosphere to pair with GOLD's wider view. ICON will study the forces that shape this part of the upper atmosphere.

Both missions will study how the ionosphere is affected by Earth and space weather. Together, they will give us better observations of this part of our atmosphere than we have ever had before.

To learn more about the ionosphere, check out NASA Space Place: https://spaceplace.nasa.gov/ionosphere



This illustration shows the layers of Earth's atmosphere. NASA's GOLD and ICON missions will work together to study the ionosphere, a region of charged particles in Earth's upper atmosphere. Changes in the ionosphere can interfere with the radio waves used to communicate with satellites and astronauts in the International Space Station (ISS). Credit: NASA's Goddard Space Flight Centre/Duberstein (modified)

CONTACTS

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We welcome Ian McCartney to the Committee.

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Secretary & Events	Phil Berry 01580 291312
Treasurer	John Lutkin
Membership Secretary	John Wayte
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Committee Members	Jim Cooper Eric Gibson Ian McCartney

Wadhurst Astronomical Society website:
www.wadhurstastro.co.uk

SAGAS website:
www.sagasonline.org.uk

Any material for inclusion in the April 2018 Newsletter should be with the Editor by March 28th 2018