

Space Weather: Here Comes Hubble...

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History has shown that every ten years or so, earth comes under attack from high amounts of **space weather**- and we're about to embark on the next cycle.

Wait, there's weather in space?

Yep, but not in the conventional sense. That big ball of burning energy we call the Sun does more than provide us with the light and warmth we all seek on vacation.

It also constantly spews gas and particles into space, in what is known as the **solar wind**. These particles are charged with electricity, and are flung towards earth at up to a million miles an hour.

Luckily for us, our atmosphere and the earth's magnetic field acts like a shield. But sometimes these determined particles **make it through to our atmosphere**. When that happens we are often treated to the spectacular light shows we know as auroras. If you fly at high latitudes at night, chances are you have been lucky enough to see them. Sadly space weather can have more serious consequences for aviation than struggling to capture that illusive insta shot on your trusty iPhone 4.



An Aurora – the only good thing about space weather.

Like the earth weather we're used to, **space weather is changeable** – its severity depends on what is happening on the sun.

Its surface is a busy place – hot gases are constantly on the move as powerful magnetic fields twist and turn. When things get especially rowdy, **a storm occurs** and the solar wind gets stronger. Occasionally these storms produce a **solar flare** – essentially the sun burps, and sends significant amounts of radiation towards earth. This is where the trouble can occur.

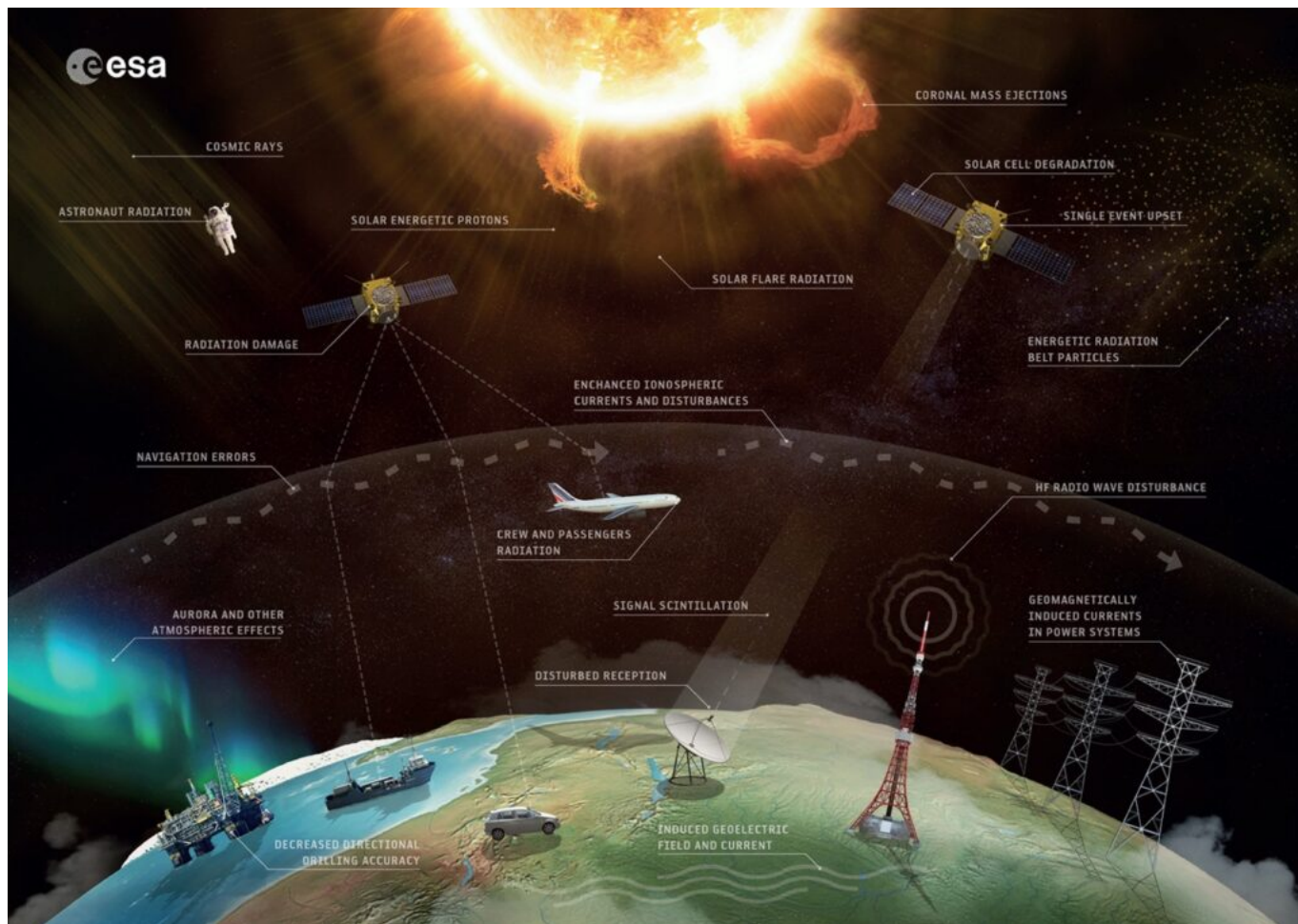
What kind of trouble?

Communications. During solar events, **HF and satellite** communications can be disrupted. In severe cases, even disabled. There may be effects on **CPDLC and ADS-C services**. Line of sight VHF is less likely to be impacted, but that does not help much when you're over the middle of the ocean.

Systems. Some of your aircraft's systems are sensitive to radiation storms. Space weather may induce **sudden electrical failures** that can range broadly from insignificant to 'ruin your day.' Systems that rely on **magnetism** can also be affected

Navigation. The sun's particles disrupt the upper layers of the atmosphere, which can interfere with GNSS signals from satellites. You guessed it – the result is **unexpected position errors**. If it gets really bad, the signal may be lost all together. We're using RNAV based approaches more than ever these days, and the likelihood of not having ground based aids as a backup is increasing.

The Body. During these storms, you can be exposed to unusually high levels of **ionising radiation** (the nasty one for humans, think Chernobyl). As a general rule, the higher you fly or the higher the latitude, the more exposed you are. The effects of this on crew is the subject of ongoing studies. But the more you can **avoid higher exposure** levels the better.



The broad effects of a solar flare.

What can we do about it?

Here's the best news: **space weather is predictable**. And ICAO are onto it.

Solar monitoring has improved significantly in recent years. A number of countries have joined forces to create three agencies responsible for issuing **ICAO Space Weather Advisories (SWX)** around the clock.

Space Weather Advisories have a standardised format, and are **not the same thing as a SIGMET**.

They are only issued whenever space weather conditions get bad – essentially **moderate and severe impacts**, and only when operations **above FL250** are affected. They are activated for comms, GNSS and radiation interference, so seeing an SWX advisory during your pre-flight briefing is a pretty good indicator to **have a closer look**.

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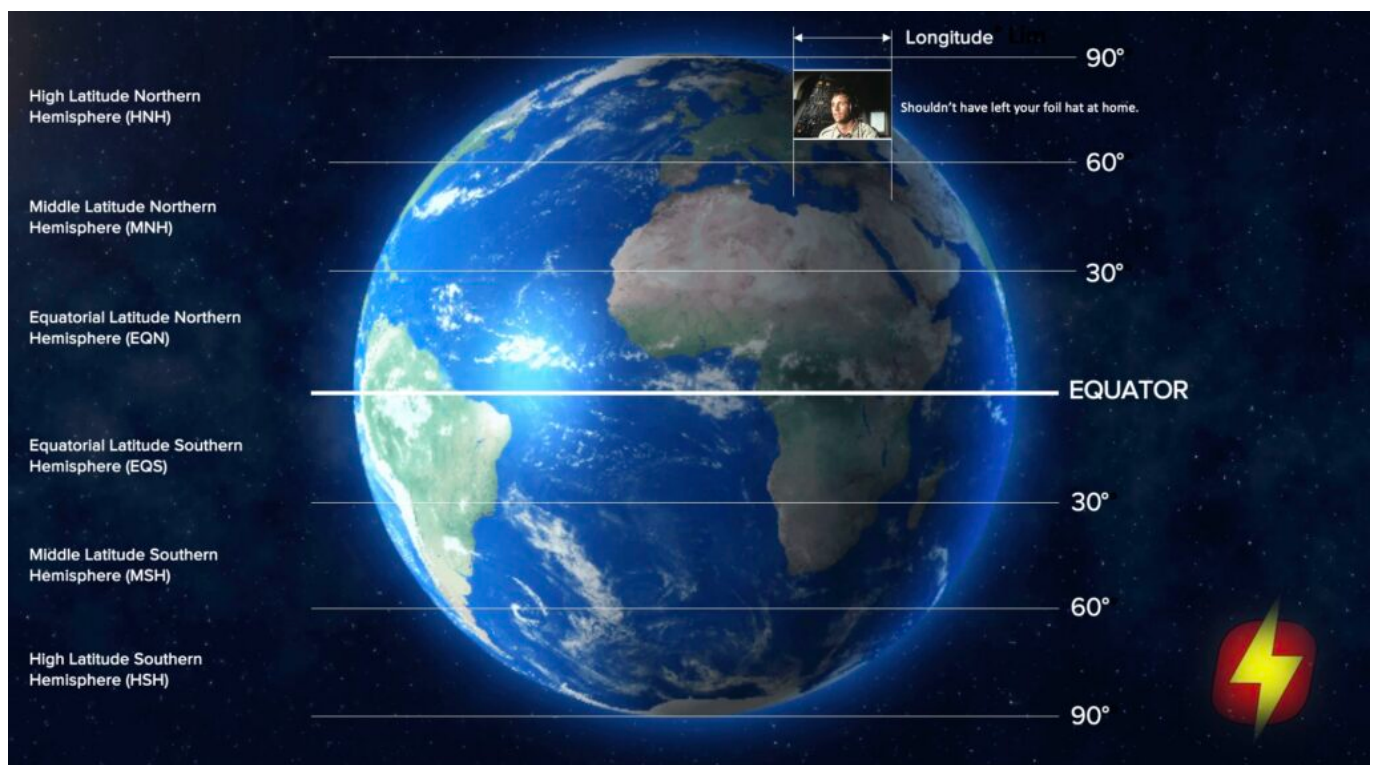
FNXX01 KWNP 020100
SWX ADVISORY
DTG:                20190502/0100Z
SWXC:               SWPC
ADVISORY NR:        2019/59
NR RPLC:            2019/58
SWX EFFECT:         GNSS MOD
OBS SWX:            02/0100Z HNH HSH E18000-W18000
FCST SWX + 6 HR:    02/0700Z HNH HSH E18000-W18000
FCST SWX + 12 HR:   02/1300Z HNH HSH E18000-W18000
FCST SWX + 18 HR:   02/1900Z NO SWX EXP
FCST SWX + 24 HR:   03/0100Z NO SWX EXP
RMK:                IONOSPHERIC STORM CONTINUES TO CAUSE LOSS-OF-LOCK
                    OF GNSS IN AURORA ZONE. THIS ACTIVITY IS
                    EXPECTED TO SUBSIDE IN THE FORECAST PERIOD

NXT ADVISORY:       20190502/0700Z=

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Example of a SWX Advisory, this time for GNSS outages.

They predict the effect of space weather at six hourly intervals across a twenty four hour period. To define the areas affected, SWX advisories effectively draw a box. They divide the world into six bands of latitude, and tell you how wide the box is with longitude. **Still confused?** A picture always helps...



Beware the square!

For a full briefing, **the FAA** has recently published a helpful information bulletin which explains how Space Weather Advisories work in more detail. And if you're really brave, more info can also be found in ICAO Doc 10100.

Some other useful stuff:

- **NASA's** frequently asked questions on space weather.
- **The Center for Disease Control and Prevention** - and their work on radiation exposure risk.