

Hayabusa2 sample capsule
landing in Woomera on Dec 6

Observations of the fireball
during its atmospheric flight

JAXA Hayabusa2 capsule retrieval team

First edition 1.1.1

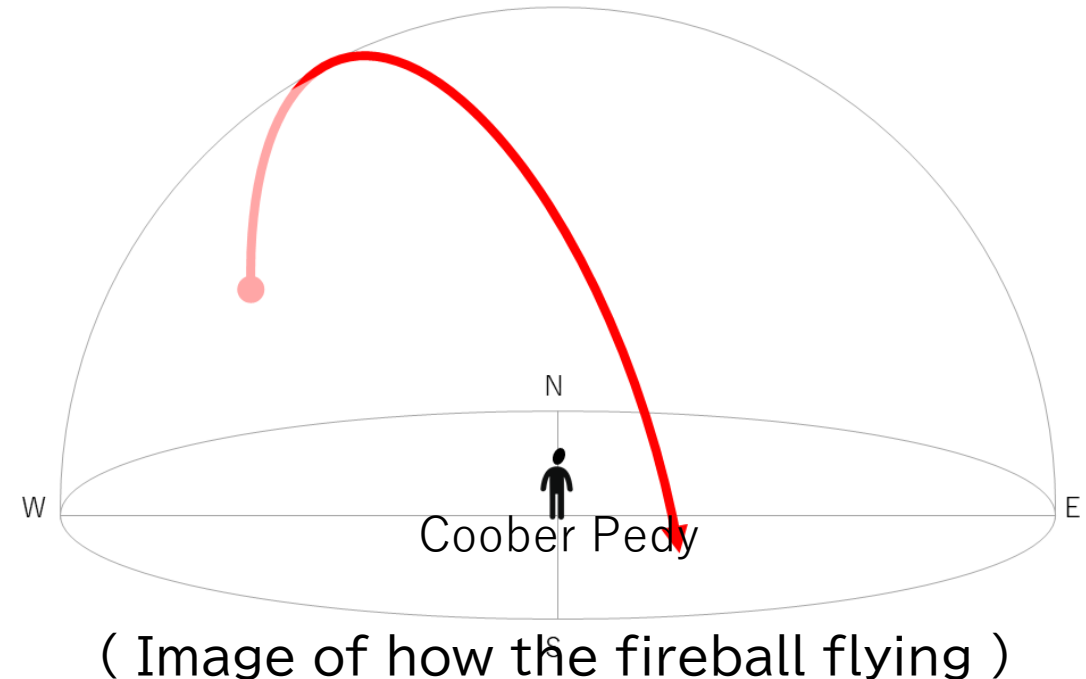
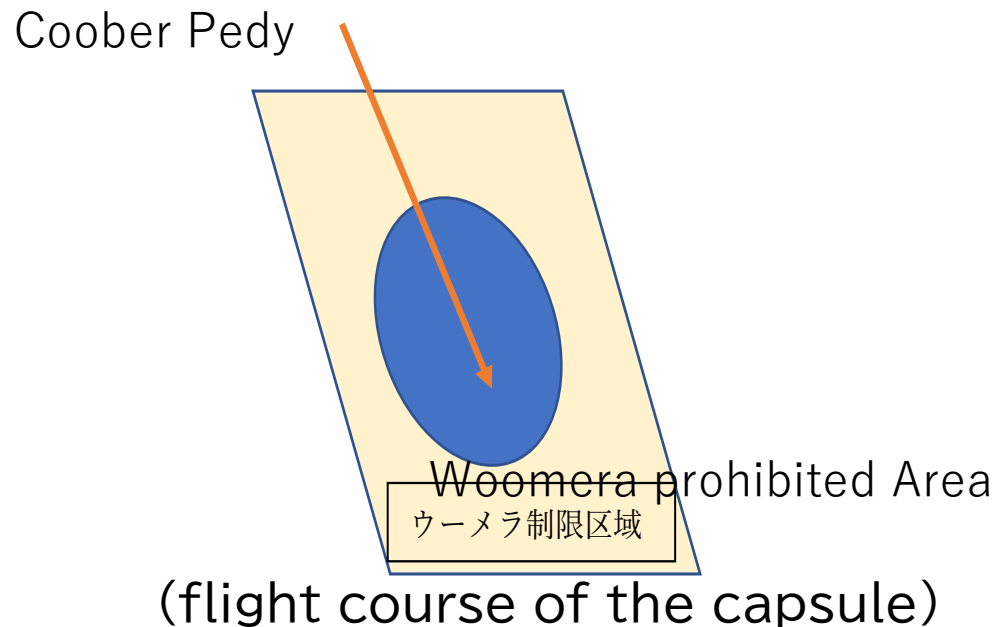
17/11/2020

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1. Expected flight course of the re-entered capsule

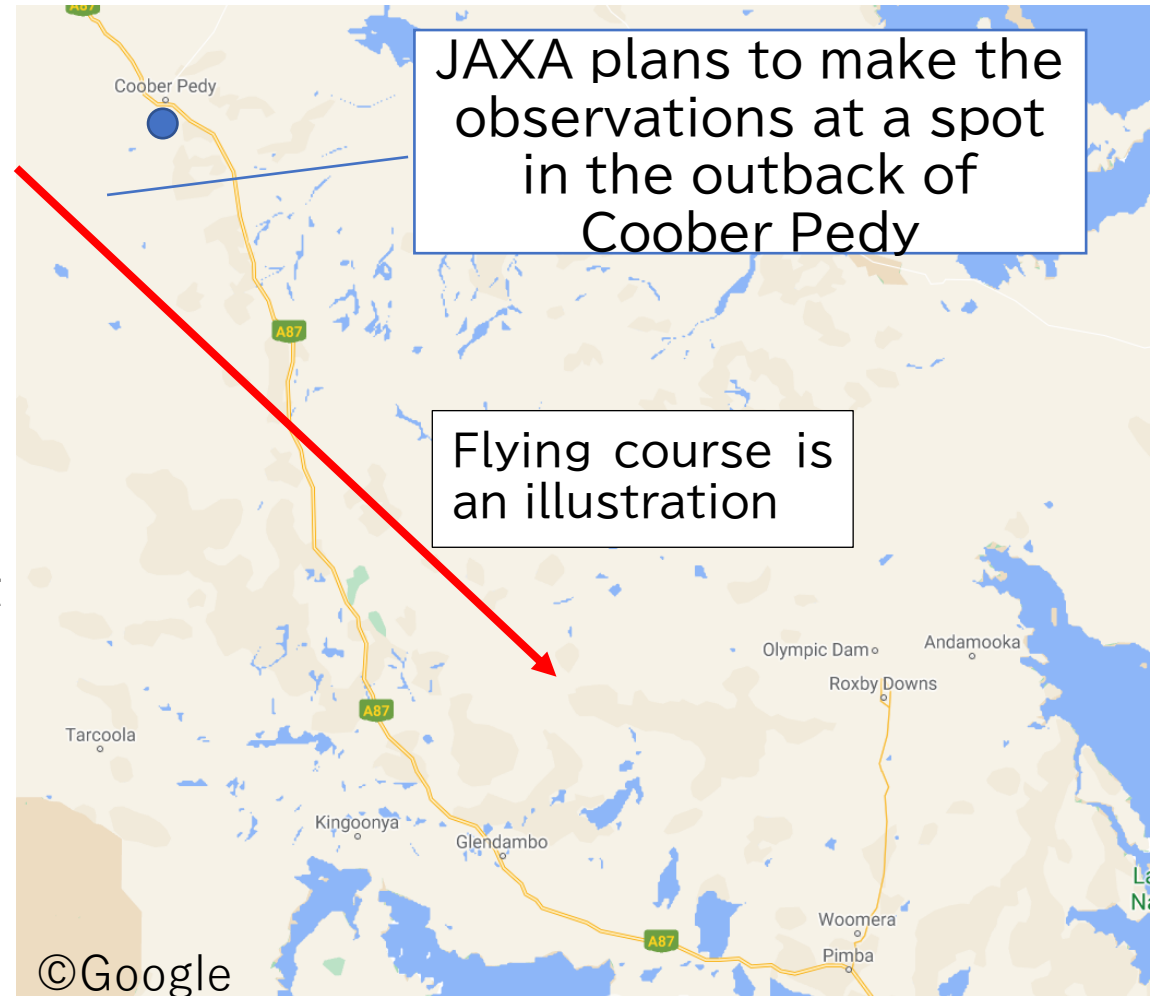
- The re-entry capsule will fly from the northwest direction and then land in the Woomera Prohibited area(WPA).
- Looking up from the area north of the WPA to the overhead (zenith) direction, you will be able to observe the fireball made by the flying capsule.



2. Information for observing the fireball

(If observing near Coober Pedy)

- The fireball appearance time is assumed to be between 3:30 am and 4:30 am on December 6 (Australia local time). The exact time will be announced later.
- The fireball will begin to appear in the northwest, pass overhead, and lower its altitude to land in the southeast.
- It will be visible as a bright point of light for about 90 seconds, and the speed of movement is fastest when it is passing overhead.
- Observations can be made in any open area.
- Note that A87 Stewart Highway will be closed after 22:00 local time on December 5th.



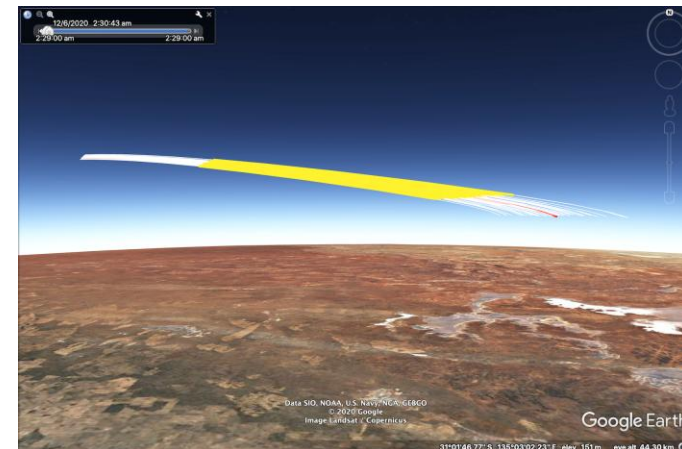
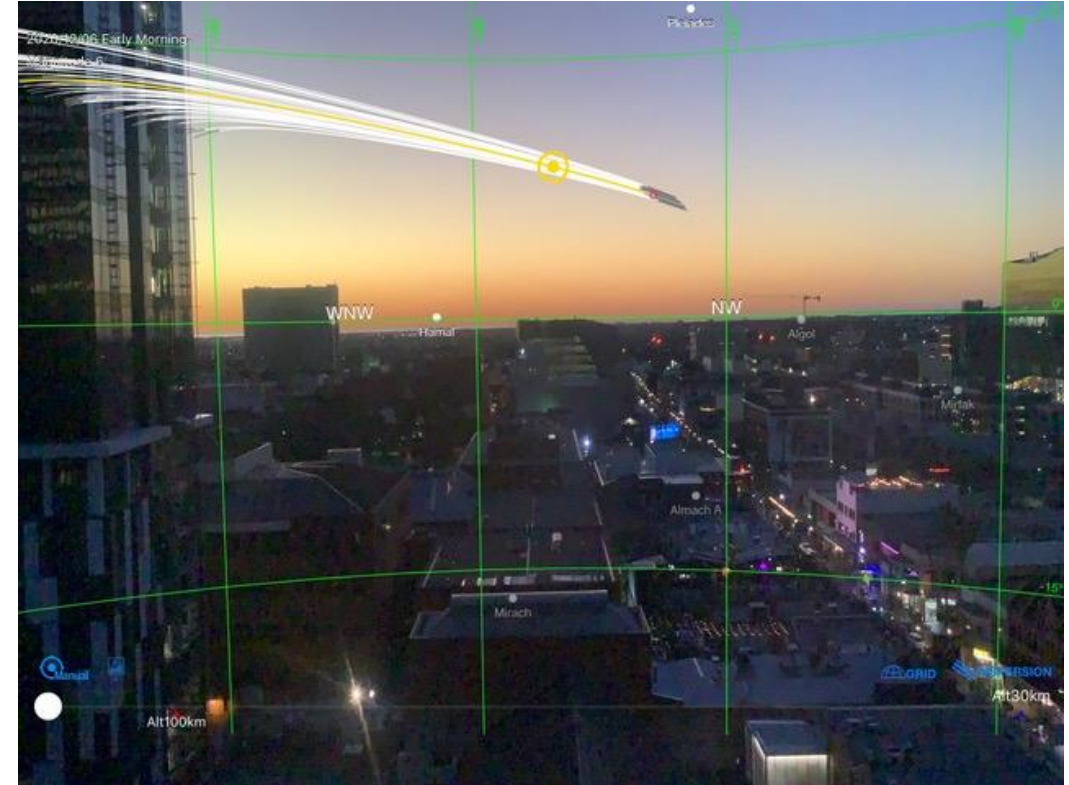
3. Support by the AR application for iOS

- Toriningen will release an application "Reentry AR" that displays the capsule's predicted trajectory seen from any location via AR (supervised by JAXA).
- Please use it while you construct your fireball observation plan.
- Using this app, you can display the predicted trajectory of the fireball from any point that you specify.
- Available on iOS. (sorry not for Android OS)
- Free of charge.

Reentry AR Download site

<https://apps.apple.com/us/app/reentry-ar/id1536701365>

- Right figure:
Example of display (appearance) in the AR
Upper : Example of composition with actual scenery
Lower : Example of synthesis with Google Earth



4. Precautions upon the observations

[Regarding capsule luminosity and Moon age of the day]

The moon rises (age 20: waning gibbous), so it will not be a fully dark night.

The brightness of the fireball is uncertain, but it is estimated to be equivalent to a maximum of minus 7 to 9 magnitudes.

Please refer to the next page to learn more how bright it will be.

Unlike the first HAYABUSA reentry, it will be a single point of fast moving light.

Please refer to this document and arrange the observation location and photography method that matches best with your purpose.

A flash has no effect. Never use it as it will interfere with observations by others.

(Reference) Apparent magnitudes of major celestial bodies

• Full moon ... **-12.7 magnitude**



(Approximately 30 times the difference in brightness)



• Hayabusa2 capsule fireball
... **-7 → -9 magnitude**



(Approximately 100 times the difference in brightness)



• Venus (the brightest celestial body except for the Sun and Moon)
... **-4 magnitude**



(Approximately 7.5 times the difference in brightness)



• Sirius (the brightest star)
... **-1.8 magnitude**

4. Precautions for the observations

[About observing/shooting location]

It is cold at night, and nocturnal animals are expected, so please take care with the cold weather and your safety, and be mindful to prepare what you need to bring with you.

Moving at night would be dangerous, so it is highly recommended that you move before dark and stay until dawn if you choose to observe from a spot in the out-back.

There are some Aboriginal sanctuaries that you are not allowed to trespass. You can remove the risk by arranging your observation spot during daytime.

Please refrain from interfering with each other when setting observation spots.

We appreciate your cooperation and understanding.

5. JAXA's operation related to the fireball

- JAXA will carry out optical observations (for capsule trajectory reconstruction) and film recording (for relaying the image/movie to the central studio in Japan for global distribution via internet).
- The details of JAXA's observation site will be determined after the observation team arrives in Coober Pedy.
- Due to travel restrictions by COVID-19, only the minimum necessary number of people required to perform the pre-fixed plan will be at the site.
- We are sorry, but during the fireball observation/shooting, we cannot assign any JAXA's expert for answering your questions.

6. How to get the latest information

- We will keep you informed via our website. The URL will be announced later.
- Please be aware that internet access is not available everywhere. In the middle of the A87 highway and outside the town area, you might find yourself outside coverage.
- As soon as the separation of the capsule is confirmed, it will be announced on the JAXA webpage and the most precise time for the appearance of the fireball will be known at the same time. It is highly recommended that you enable your internet access at least until the time of the capsule separation (the evening of December 5).
- A predicted fireball appearance time will be notified in advance. The announcement upon capsule separation will be the final revision to the time.