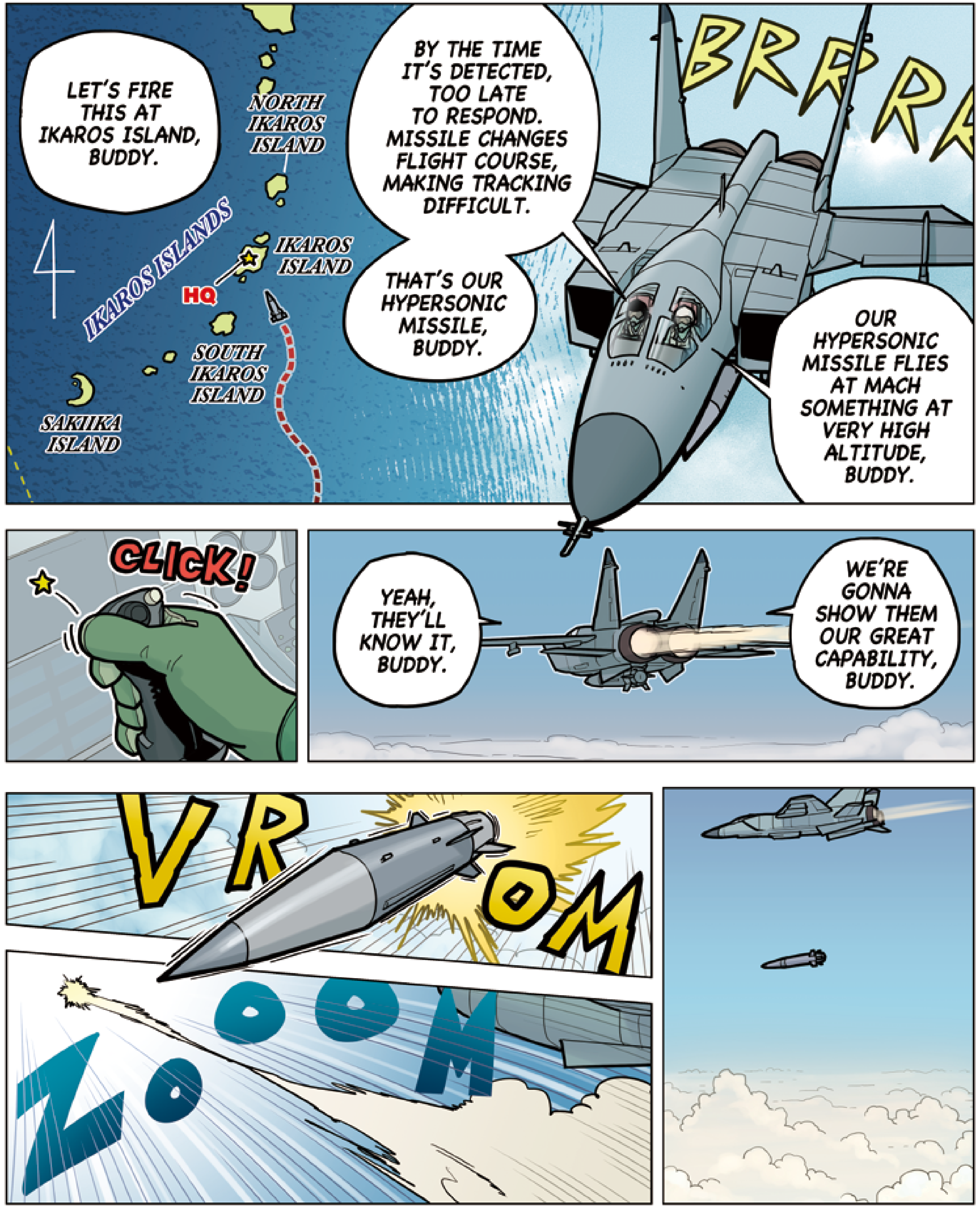
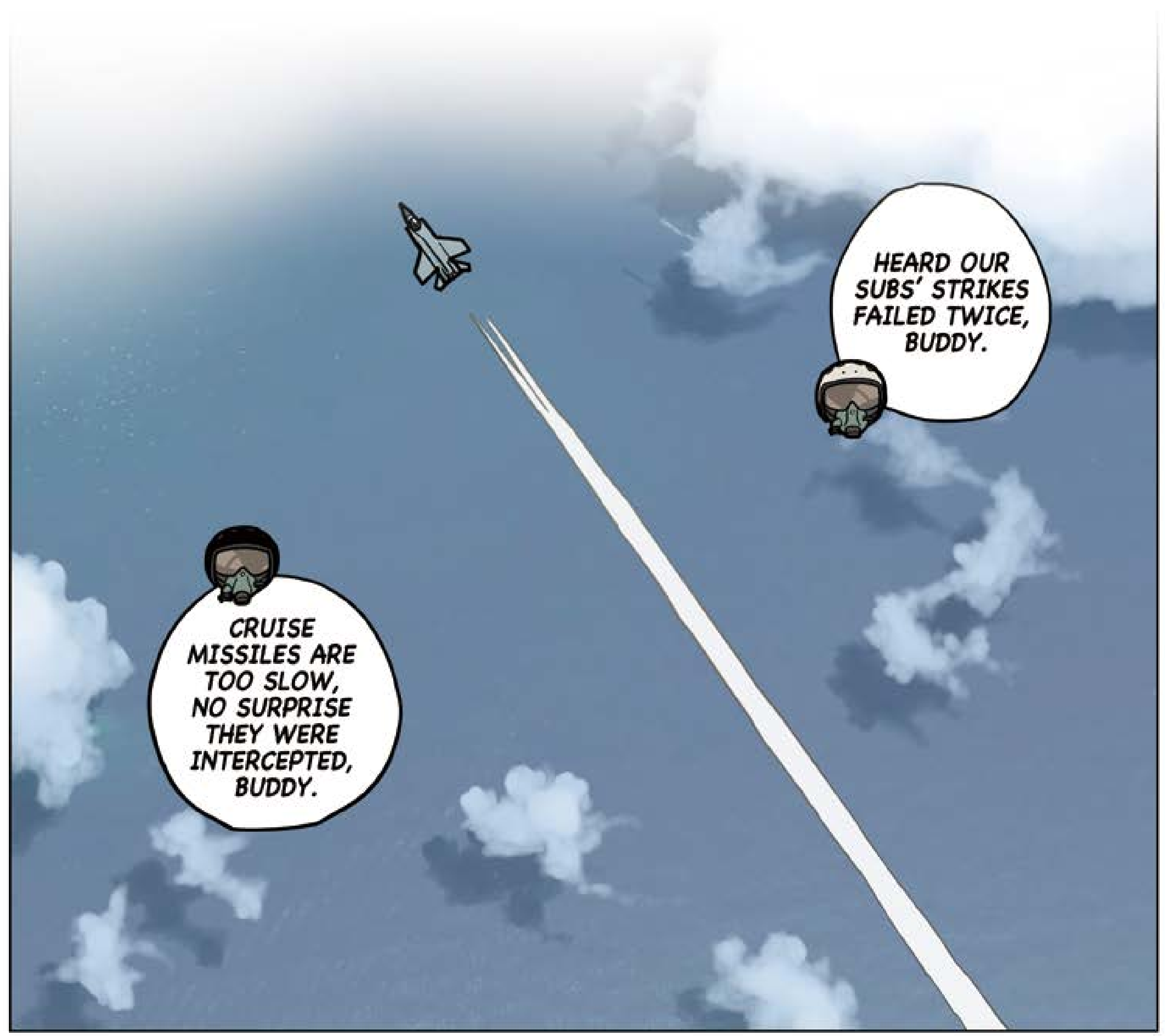
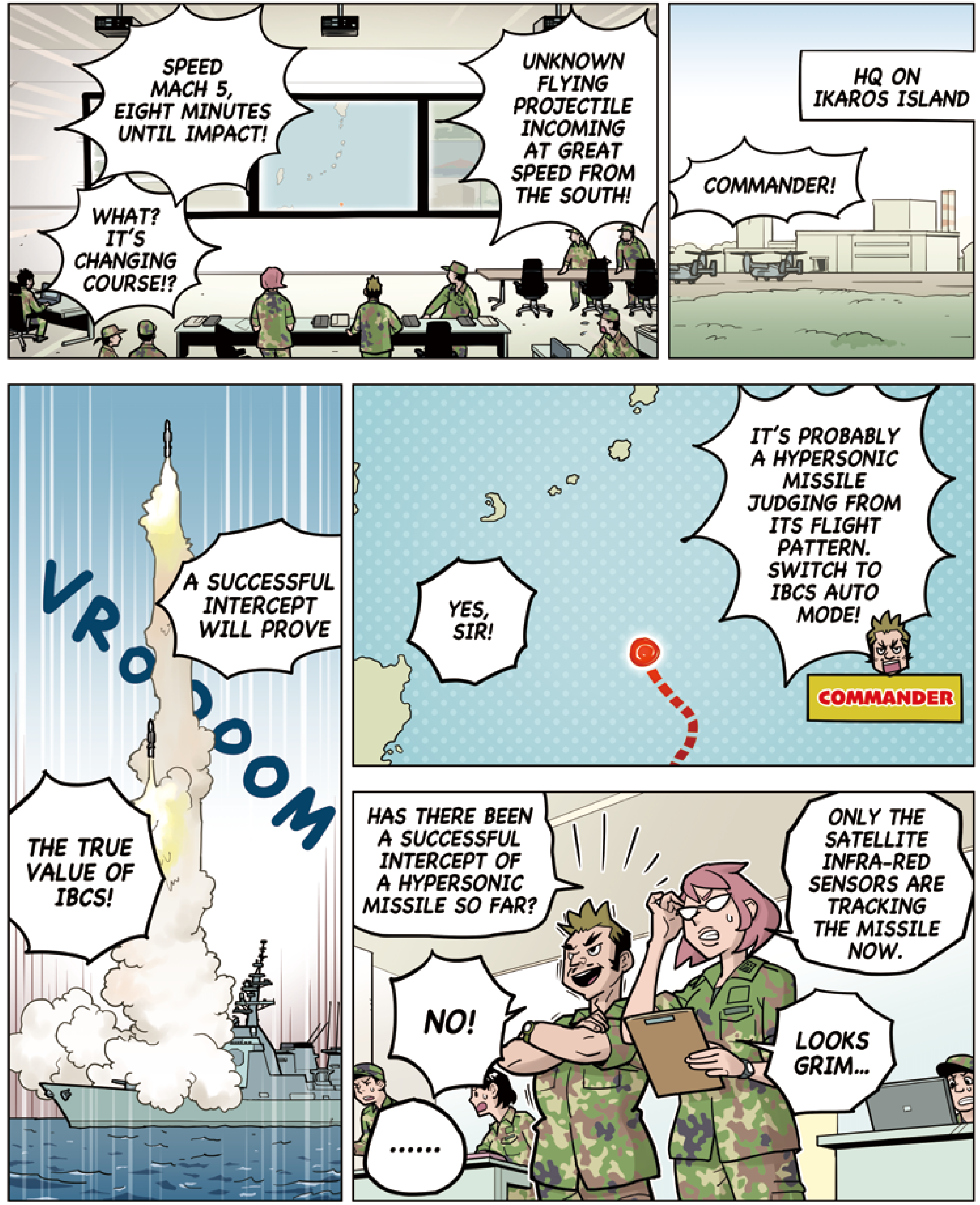
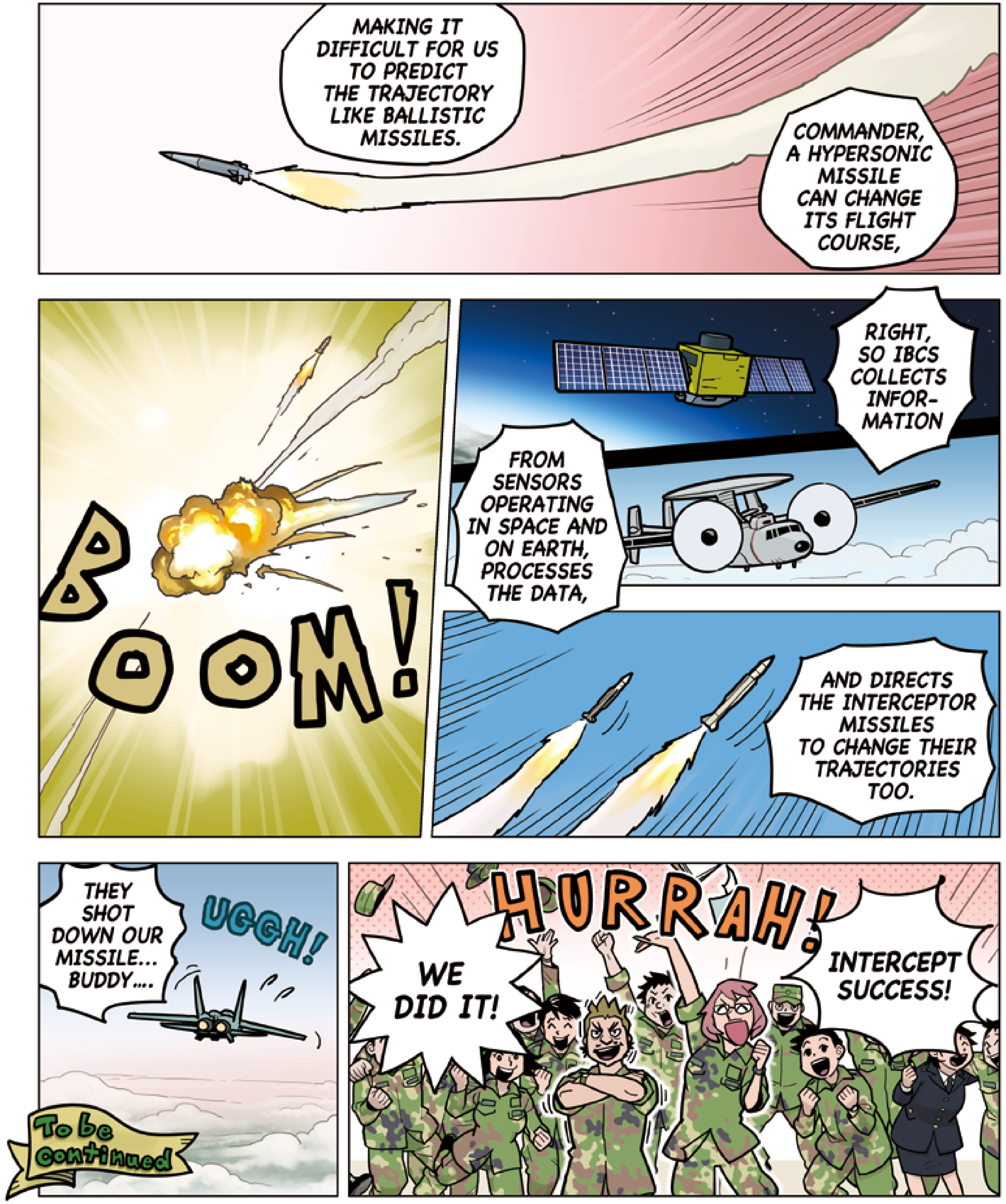


Episode 3:
Shoot the Hypersonic Missile!

The westernmost island of the Ikaros Islands, Sakiika Island, located near to the border, has suffered damage from enemy missile attacks. These missiles could have been intercepted if the SAM unit had been connected to IBCS. The Ikaros Defense Force now expands IBCS-connected defense capabilities to units across the islands, building a robust defense network to prepare for the next strike.




HQ ON IKAROS ISLAND
COMMANDER!
UNKNOWN FLYING PROJECTILE INCOMING AT GREAT SPEED FROM THE SOUTH!
SPEED MACH 5, EIGHT MINUTES UNTIL IMPACT!
WHAT? IT'S CHANGING COURSE!?
IT'S PROBABLY A HYPERSONIC MISSILE JUDGING FROM ITS FLIGHT PATTERN. SWITCH TO IBCS AUTO MODE!
COMMANDER
YES, SIR!
HAS THERE BEEN A SUCCESSFUL INTERCEPT OF A HYPERSONIC MISSILE SO FAR?
ONLY THE SATELLITE INFRA-RED SENSORS ARE TRACKING THE MISSILE NOW.
LOOKS GRIM...
NO!
......
A SUCCESSFUL INTERCEPT WILL PROVE
THE TRUE VALUE OF IBCS!
VROOOOOM


COMMANDER, A HYPERSONIC MISSILE CAN CHANGE ITS FLIGHT COURSE,
MAKING IT DIFFICULT FOR US TO PREDICT THE TRAJECTORY LIKE BALLISTIC MISSILES.
RIGHT, SO IBCS COLLECTS INFOR-MATION
FROM SENSORS OPERATING IN SPACE AND ON EARTH, PROCESSES THE DATA,
AND DIRECTS THE INTERCEPTOR MISSILES TO CHANGE THEIR TRAJECTORIES TOO.
BOOM!
HURRAH!
INTERCEPT SUCCESS!
WE DID IT!
THEY SHOT DOWN OUR MISSILE... BUDDY....
UGGH!
To be continued

IBCS connects space and earth

Intercepting hypersonic weapons in the near future!?

The scenarios of the previous two episodes showed how incoming cruise missiles were detected and tracked by radars and intercepted by surface-to-air missiles (SAM) under the control of IBCS. In this episode, it was a hypersonic weapon flying at Mach 5 that was intercepted. Hypersonic weapons have recently emerged as a new and increasing threat, following ballistic and cruise missiles.

Difference between Ballistic Missiles and Hypersonic Weapons

Ballistic missiles, once fired toward a target and accelerated to a predetermined speed at a predetermined elevation angle, will then continue on a ballistic flight according to the laws of physics. The higher the acceleration speed, the longer the range. How would this look like from the interceptor's point of view?

First, satellites on geostationary orbit above the equator use infrared sensors to detect a launch and general direction of flight of the ballistic missile. Next, land-based or shipboard radars stationed in the direction toward which the missile is expected to fly take over tracking. Once the missile's flight path is determined, the point of impact can be predicted. Interceptor missiles are then launched to meet the ballistic missile's predicted flight path, and are guided at the end by infrared sensors or radars to adjust aim to hit the target.

A hypersonic weapon, however, flies differently. Although there are various types of hypersonic weapons, they can be divided into two major categories: (1) types that place an unpowered projectile atop a rocket booster to launch, which glides to its target after detaching from the rocket; and (2) types that have its own power source such as a scramjet engine, which after accelerating to hypersonic speeds by rocket booster, flies with its own engine to its target.

For example, the C-HGB (Common Hypersonic Glide Body), a hypersonic weapon being developed for the U.S. Army and Navy, is the former type. The projectile attached to the tip is the same for both services, but the rocket booster for acceleration is different.

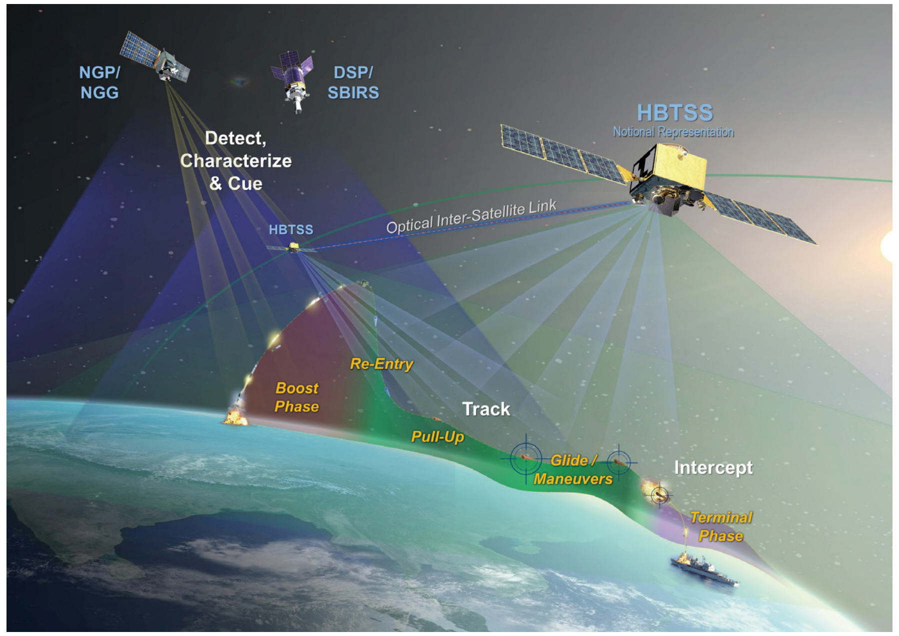
Examples of the latter include the HAWC (Hypersonic Air-breathing Weapon Concept) or HACM (Hypersonic Attack Cruise Missile) being developed for the U.S. Air Force. The missile depicted in this episode also falls into this category.

Hypersonic weapons are the same as ballistic missile insofar as they reach hypersonic speeds, but the complexity of the flight trajectory is quite different. The trajectory is not a simple ballistic flight, and it is thought that it can change course during flight. This makes the flight path of a hypersonic weapon more difficult to predict than that of a ballistic missile, which in turn makes it more difficult to detect, track, and intercept.

In addition, because of their high flight speed of Mach 5 or higher, detection and tracking by radar cannot be done in the same way as for conventional air threats. Because the object is moving very fast, the tracking beam must be controlled so that it is emitted in step with the target. If the tracking beam is emitted in the same manner as against conventional airborne threats, it may get left behind.

HBTSS Satellites Produce Time for Response

Therefore, efforts are already underway by the U.S. to prepare new means of detection and tracking in order to counter hypersonic weapons. Early warning satellites that detect the launch of ballistic missiles are in geostationary orbits above the equator at a high altitude of 36,000 km. To detect and track hypersonic weapons, infrared sensors are to be mounted on satellites orbiting at a lower altitude. Since the target is flying long distances and the satellites to detect and track it are also orbiting the earth, it is impossible for a single satellite to keep tracking the target. Therefore, the idea is to have multiple satellites in orbit and network them, which will detect and track the target in relay.



Intercepting a Hypersonic Missile in This Episode

A Northrop Grumman graphic depicts an image of how hypersonic weapons would be intercepted. It shows a hypersonic missile being launched, reentering the atmosphere, gliding and manuevering, before being shot down by a surface-to-air missile (SAM) from a cruiser. Interception of hypersonic weapons, said to be more difficult than ballistic missiles, requires many elements and layers: 1) Satellites (such as the Next Generation Overhead Persistent Infrared Polar (NGP) / Next Generation OPIR GEO (NGG) or Defense Support Program (DSP) / Space-Based Infrared System (SBIRS) satellites), at high orbit to detect, identify, and direct, 2) satellite constellations at low orbit (such as the Hypersonic and Ballistic Tracking Space Sensor (HBTSS) satellites) to detect the heat signals of hypersonic weapons emitted during launch and flight, 3) a network, or IBCS, to integrate the obtained data to create and transmit fire control level tracks, and 4) interceptors (effectors) such as SAMs. (Image: Northrop Grumman)

One such concept is the Hypersonic and Ballistic Tracking Space Sensor (HBTSS), which Northrop Grumman is developing under contract with the U.S. Missile Defense Agency (MDA). The development contract was awarded at the beginning of 2021, and the CDR (Critical Design Review) was completed in November of the same year, so there is no actual product yet.

In this episode, the HBTSS satellites detected an incoming hypersonic weapon and downlinked the data to IBCS. HBTSS is designed to cover the entire globe by constantly orbiting multiple satellites, so that it can begin detecting and tracking incoming threats before they enter the coverage area of ground-based or shipborne radars. This allows the interception response to start earlier, thereby increasing the time available for interception.

In addition, since HBTSS features sensors on satellites flying in low orbit, it can track a target from a closer distance than a geostationary satellite flying at a higher orbit. This is expected to improve the accuracy of detection and tracking. Therefore, if multiple satellites can be used to simultaneously detect and track targets from different directions, accuracy should be further improved. In addition, if radar can also be used to track hypersonic weapons in flight, information from the radar can also be incorporated into IBCS.

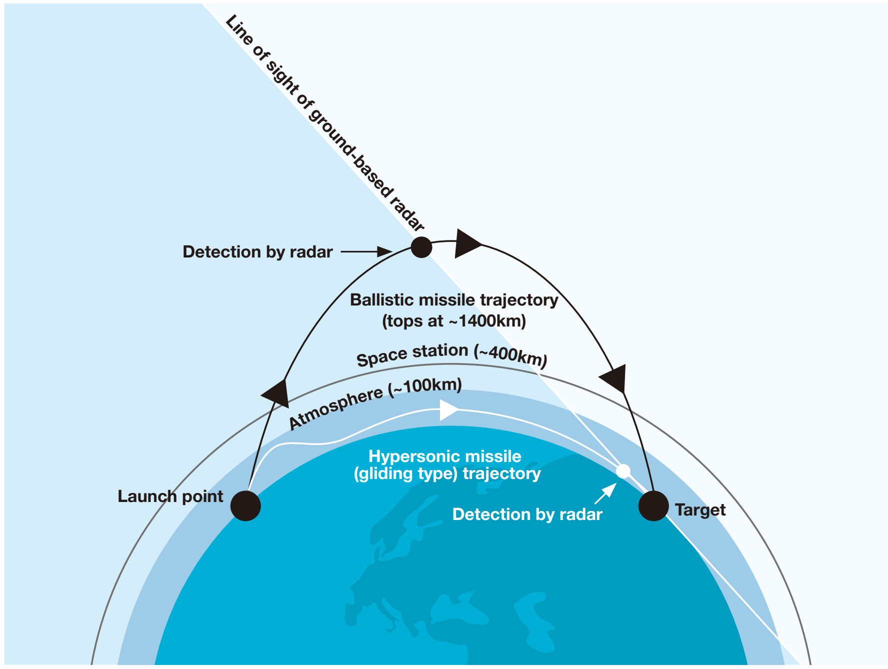
The expectation is that by obtaining highly accurate detecting and tracking data by utilizing various sensors in this way, i this data can be fed to the interceptor missiles, thereby increasing the possibility of interception. If all goes as planned, it may become possible to fire only one interceptor missile, instead of firing two interceptor missiles at one target in case one misses the target.

New Effectors to Counter New Threats in the Near Future?

In this episode, the RIM-174 SM-6 manufactured by Raytheon Missiles & Space is used as the effector to intercept the hypersonic projectile. In reality, however, no final decision has yet been made by the U.S. on what to use to counter hypersonic weapons. This should be seen as only one example.

Of the equipment in this episode, IBCS is the only one that already exists. Both HBTSS and the interceptor missile are still in development or conceptual stages - their further development is awaited. Development of effectors to counter hypersonic weapons is underway in the U.S. with two contractors including Northrop Grumman having been down-selected to continue developing a Glide Phase Interceptor (GPI) in June 2022. Previously, various possible solutions had also been proposed, such as Raytheon's SM-3 HAWK, Lockheed Martin's Dart, a ship-based version of THAAD, and Boeing's Hyvint.

Hypersonic missile vs ballistic missile trajectories



Left: Photo of the Department of Defense's C-HGB launch. (Photo credit: U.S. Navy)
Above: An illustration of a gliding hypersonic projectile. The main body, or "bullet," of C-HGB is a glider without its own propulsion (but with rudders), and is launched by a rocket-like booster to an altitude of approximately 100km. Then it glides at a hypersonic speed of over Mach 5 to the target. When flying at hypersonic speed, compressed air ahead of the projectile creates extreme heat. (Illustration: U.S. Army)

The hypothetical fighter jet and hypersonic weapon in this episode were based on the MiG-31 fighter and Kh-47M2 "Kinzhal," an air-launched hypersonic missile (carried under the fuselage). The missile is estimated to have a scramjet engine and flies more than hundreds of kilometers at hypersonic speed toward its target. (Photo credit: Toshiharu Suzusaki)