The more you learn, the more you'll want to know!

At the Electronic Navigation Research Institute (ENRI)

Let's Learn about ATM/CNS together

ENRI Electronic Navigation Research Institute

Character Introduction

Yuji Ozora

Aoi and Kaito's father.
He once wished to be a pilot, but is now a regular businessman.

Aoi Ozora(13)

1st grade junior high school student.
She is a sound-minded person, and a little bit precocious. She doesn't really like airplanes.

Kaito Ozora(11)

5th grade elementary school student.
He really likes vehicles and equipment. He wishes to be a pilot.

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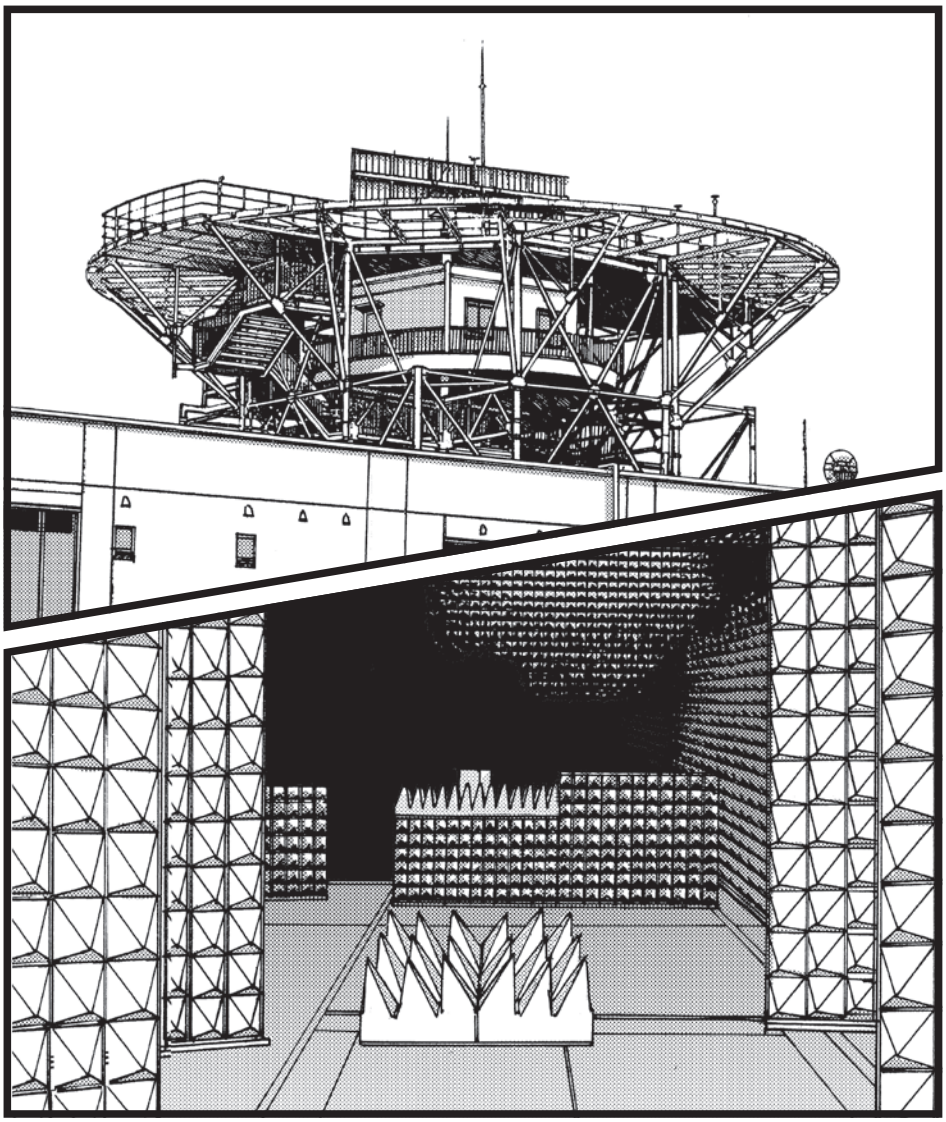
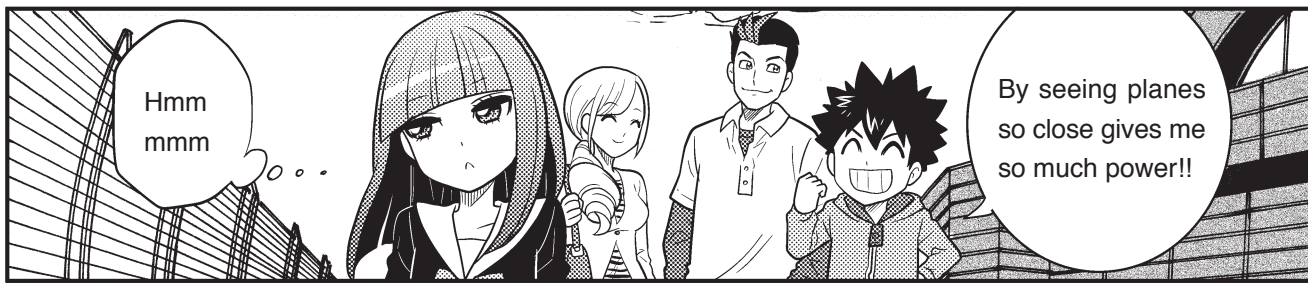
At the Electronic Navigation Research Institute (ENRI)

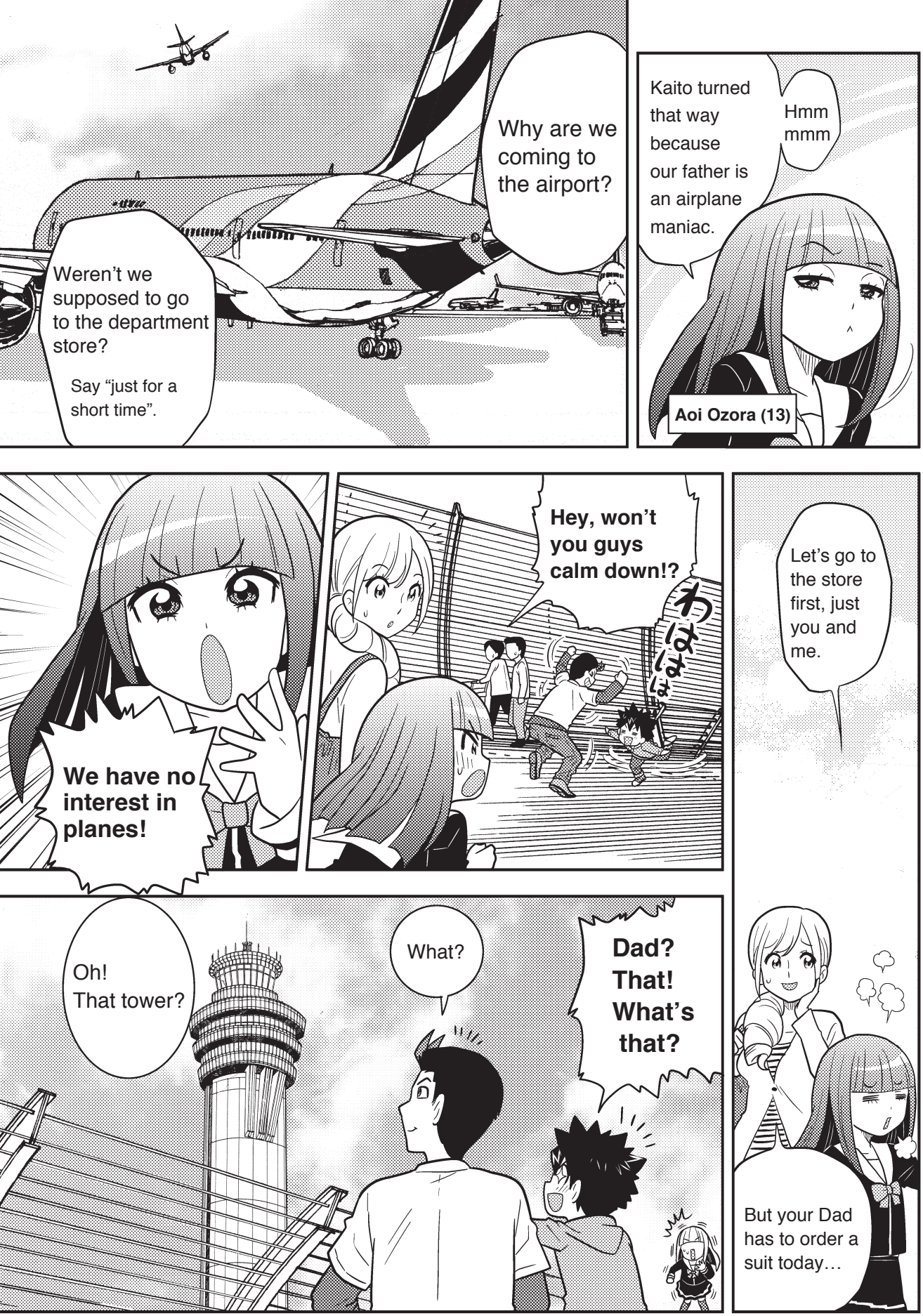


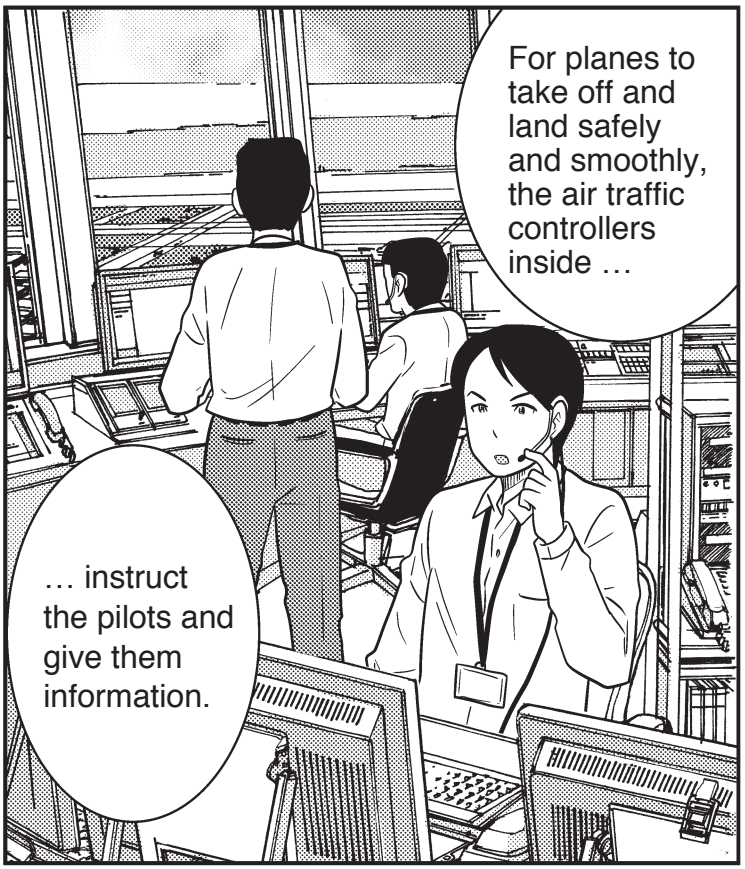

Wow!

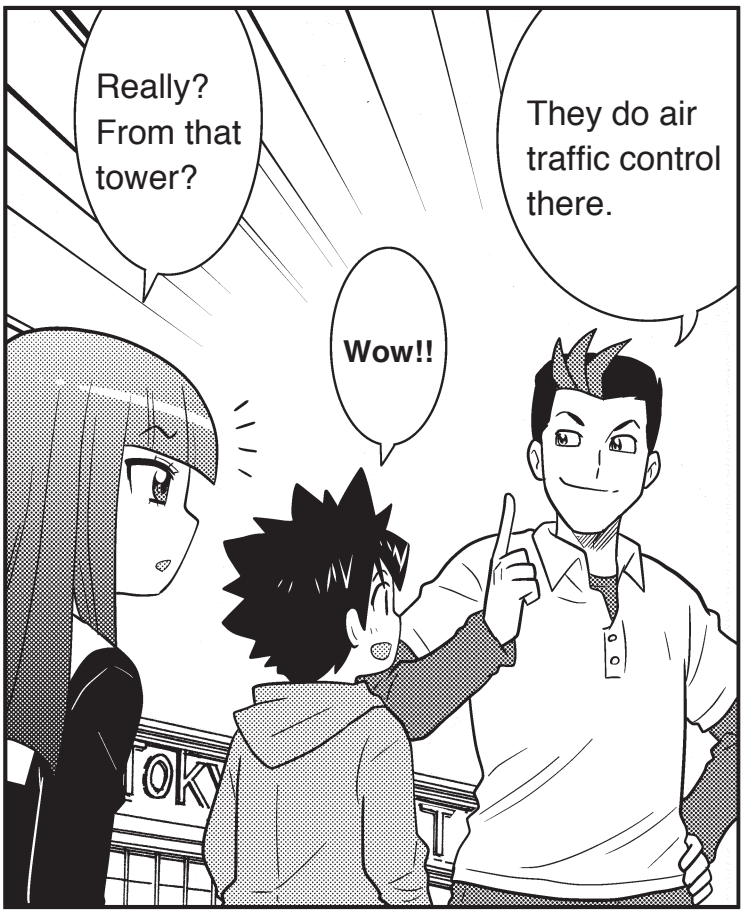

Hmm
mmm
By seeing planes so close gives me so much power!!

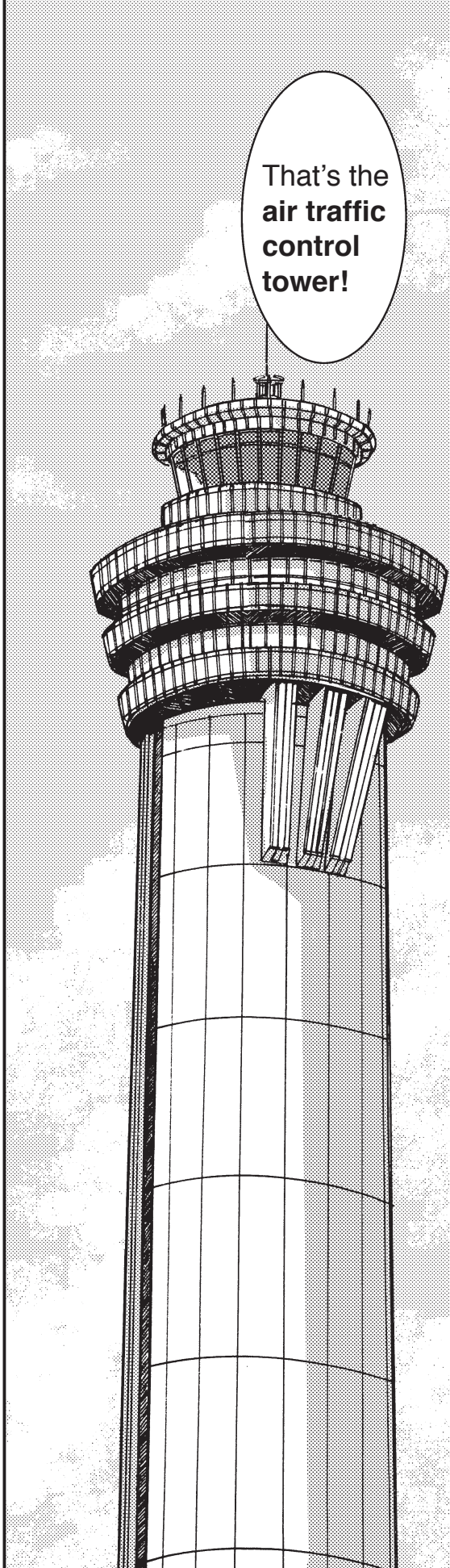

Oh really! That's the dream I couldn't carry out!
I'm going to be a pilot when I grow up!
Yuji Ozora

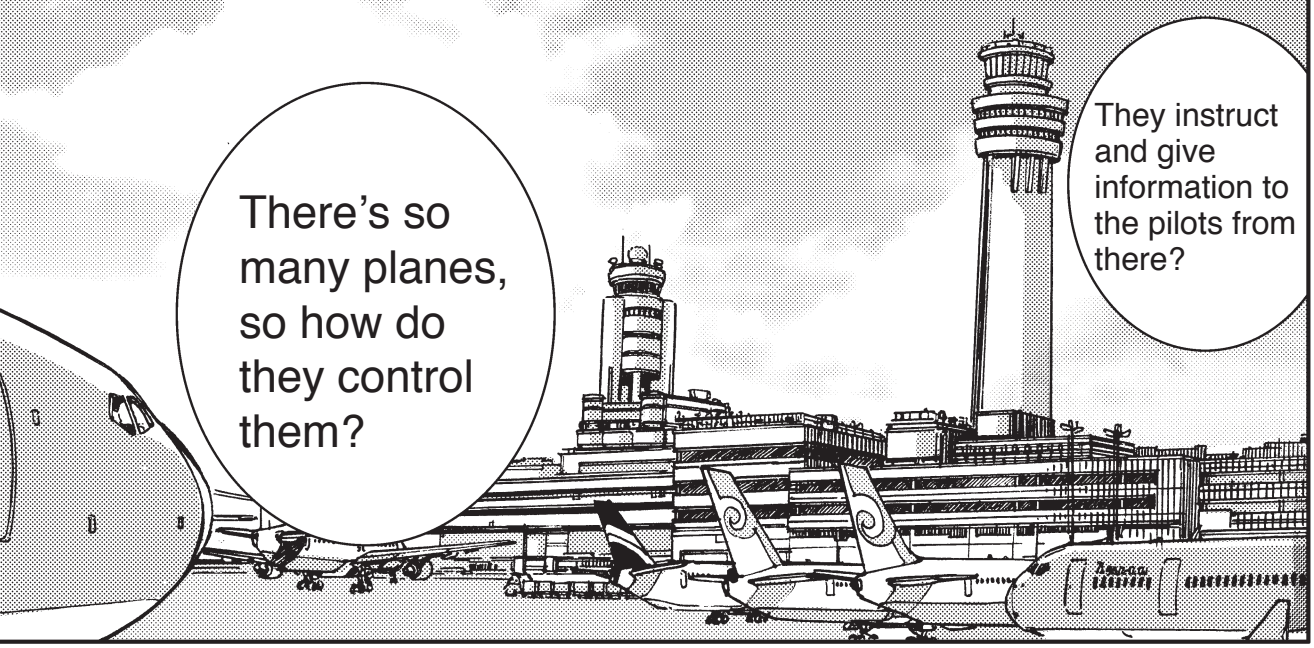

Even though it's that big, it can fly more than 10,000 kms at a speed of around 1,000 kms per hour.
Big passenger planes are amazing!
Kaito Ozora (11)


Why are we coming to the airport?
Weren't we supposed to go to the department store?
Say "just for a short time".
Kaito turned that way because our father is an airplane maniac.
Hmm mmm
Aoi Ozora (13)
We have no interest in planes!
Hey, won't you guys calm down!?
わはは
Let's go to the store first, just you and me.
Oh! That tower?
What?
Dad? That! What's that?
But your Dad has to order a suit today…

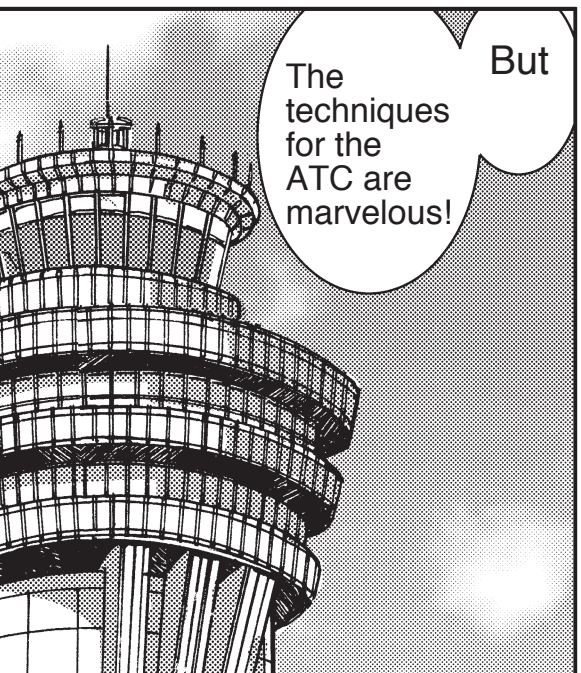

For planes to take off and land safely and smoothly, the air traffic controllers inside …
… instruct the pilots and give them information.

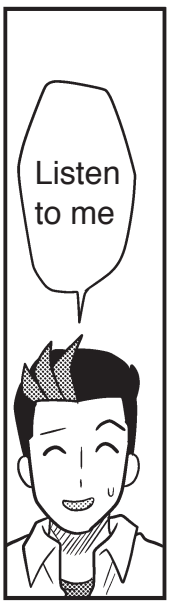

Really? From that tower?
They do air traffic control there.
Wow!!


That's the **air traffic control tower!**


There's so many planes, so how do they control them?
They instruct and give information to the pilots from there?

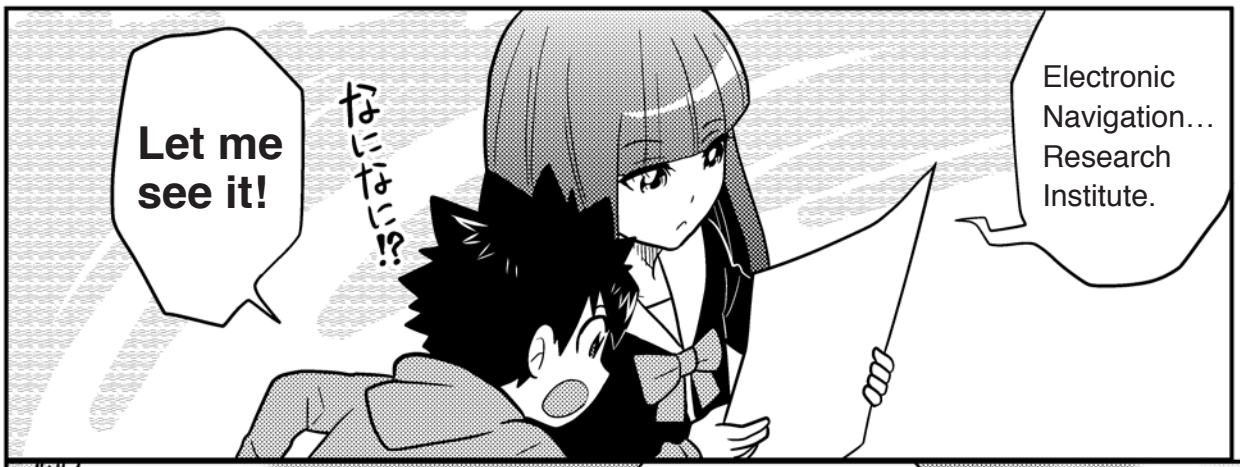

What?
And they fly so high,
so how do they keep them safe?


But
The techniques for the ATC are marvelous!

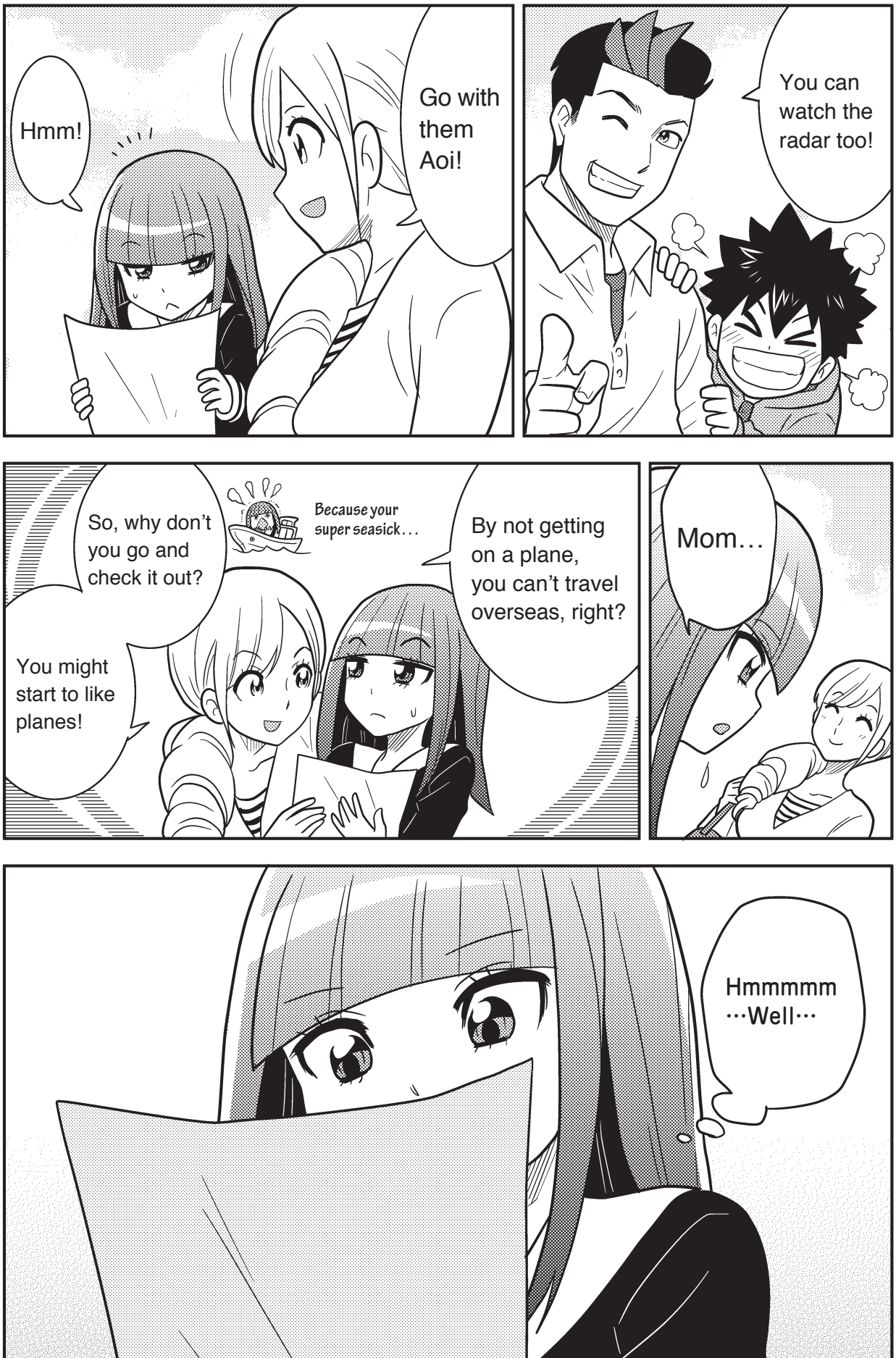

Listen to me


That's pretty scary!

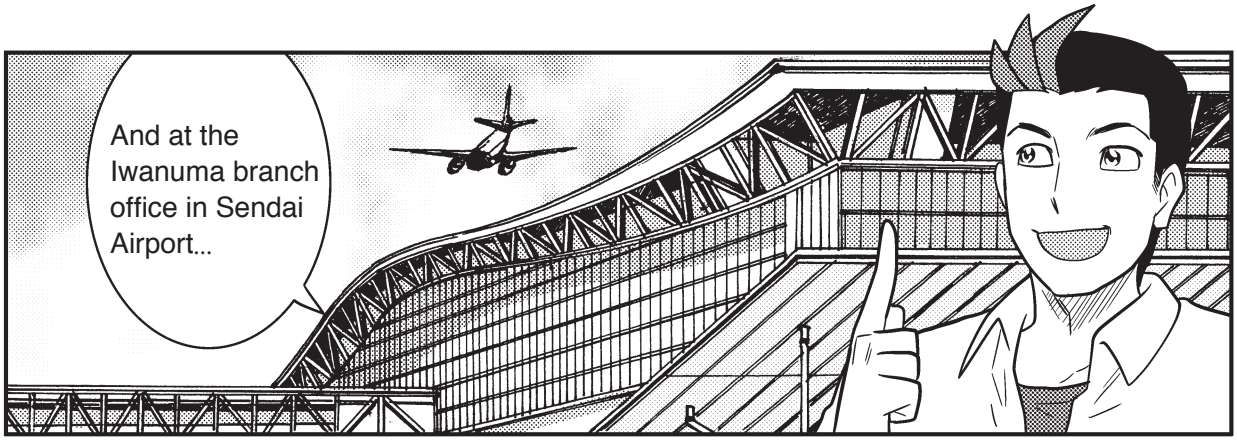

The Electronic Navigation Research Institute will be open to the public!
So let's go!
研究施設一般公開
公開時間 10:00～16:00
Don't you want to know about their wonderful techniques?


Let me see it!
なになに!?
Electronic Navigation… Research Institute.

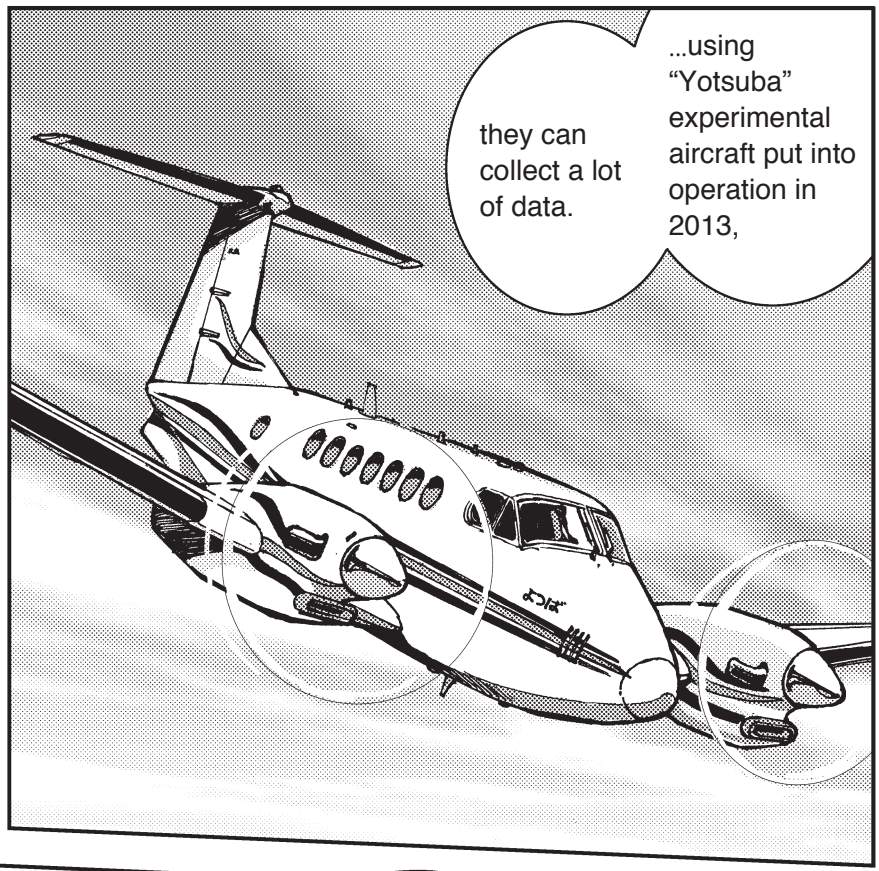

And they research and test aircraft there!
They use cutting-edge techniques to make aircraft fly safely, comfortably and smoothly.
It's open to the public only once a year!

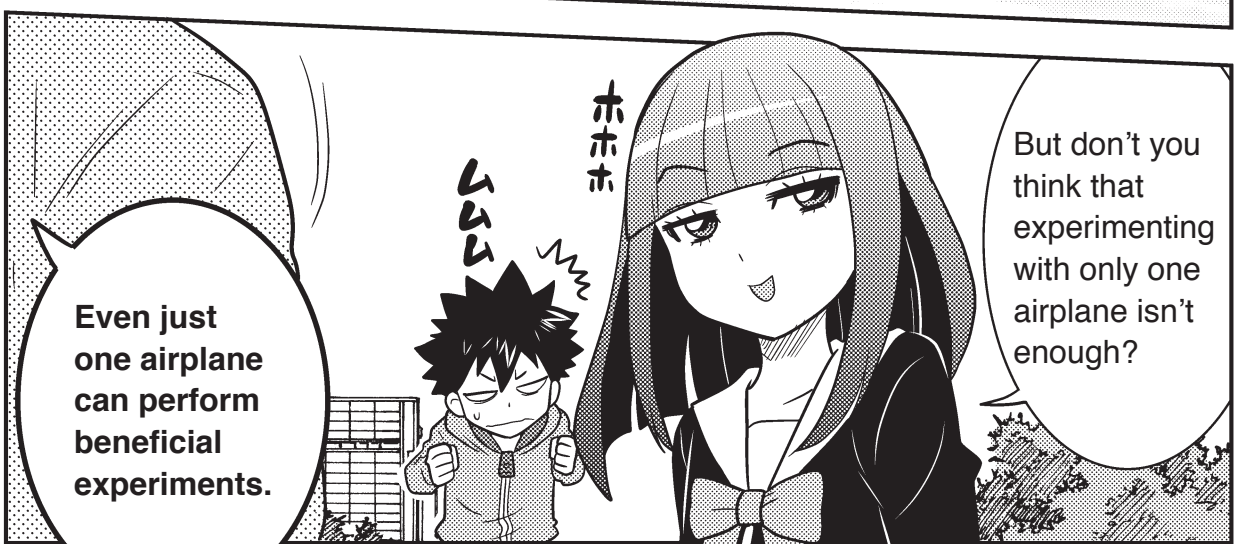

Hmm!
Go with them Aoi!
You can watch the radar too!
So, why don't you go and check it out?
You might start to like planes!
Because your super seasick…
By not getting on a plane, you can't travel overseas, right?
Mom…
Hmmmmm …Well…

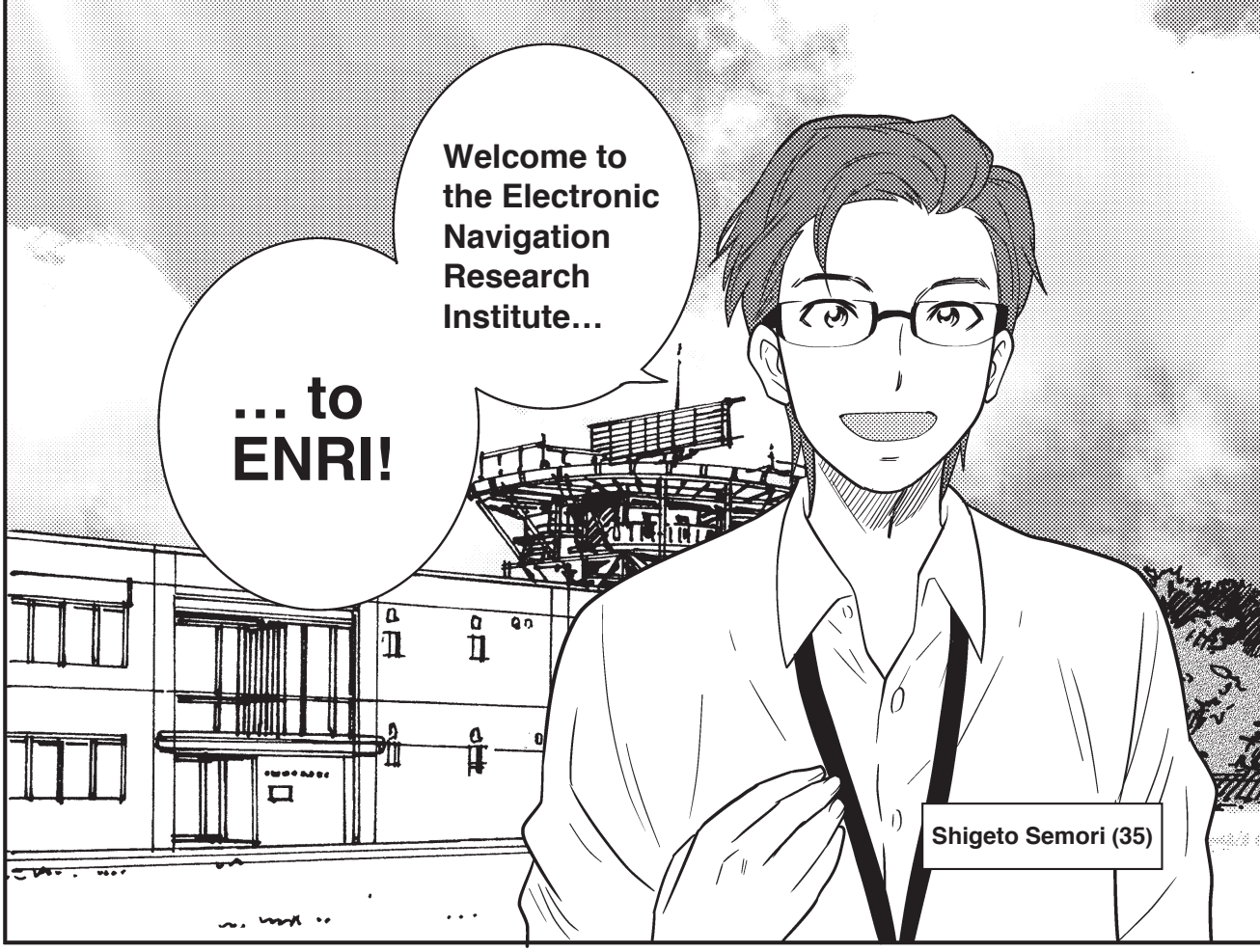

電子航法研究所
交通
A few days later
Chofu City, Tokyo
That's the radar, right!?
They're conducting experiments on advanced air traffic surveillance radar.
This research institute uses "Secondary Surveillance Radar (SSR)" mode S radar.
Yeah

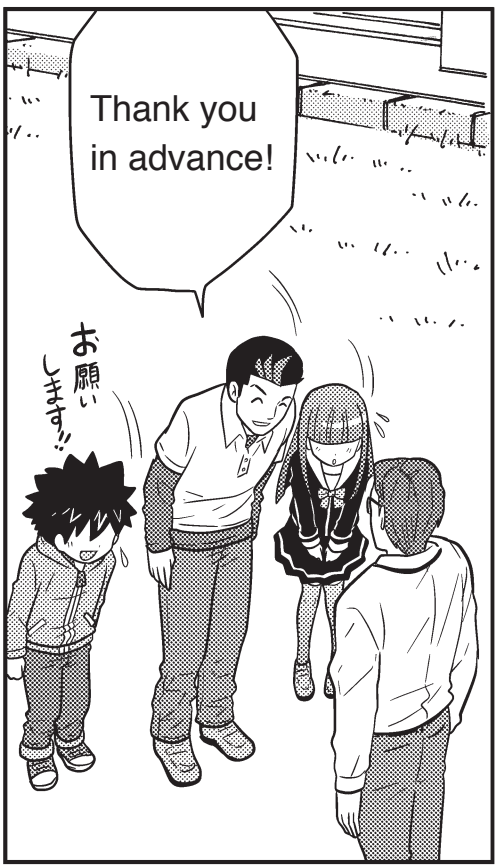

And at the Iwanuma branch office in Sendai Airport...

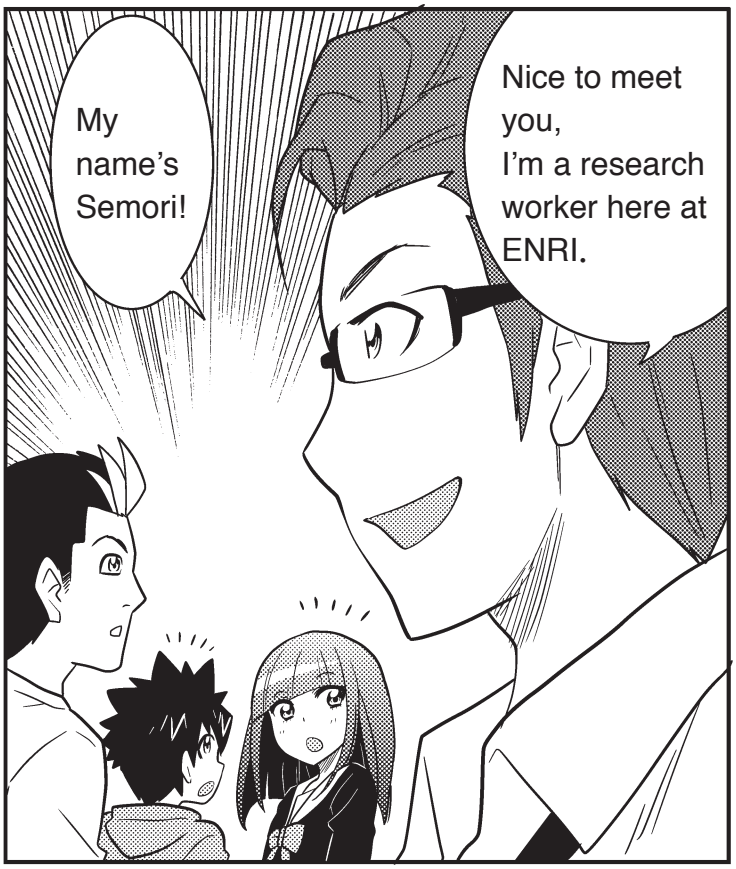

Wow!
They're experimenting with real aircraft!!

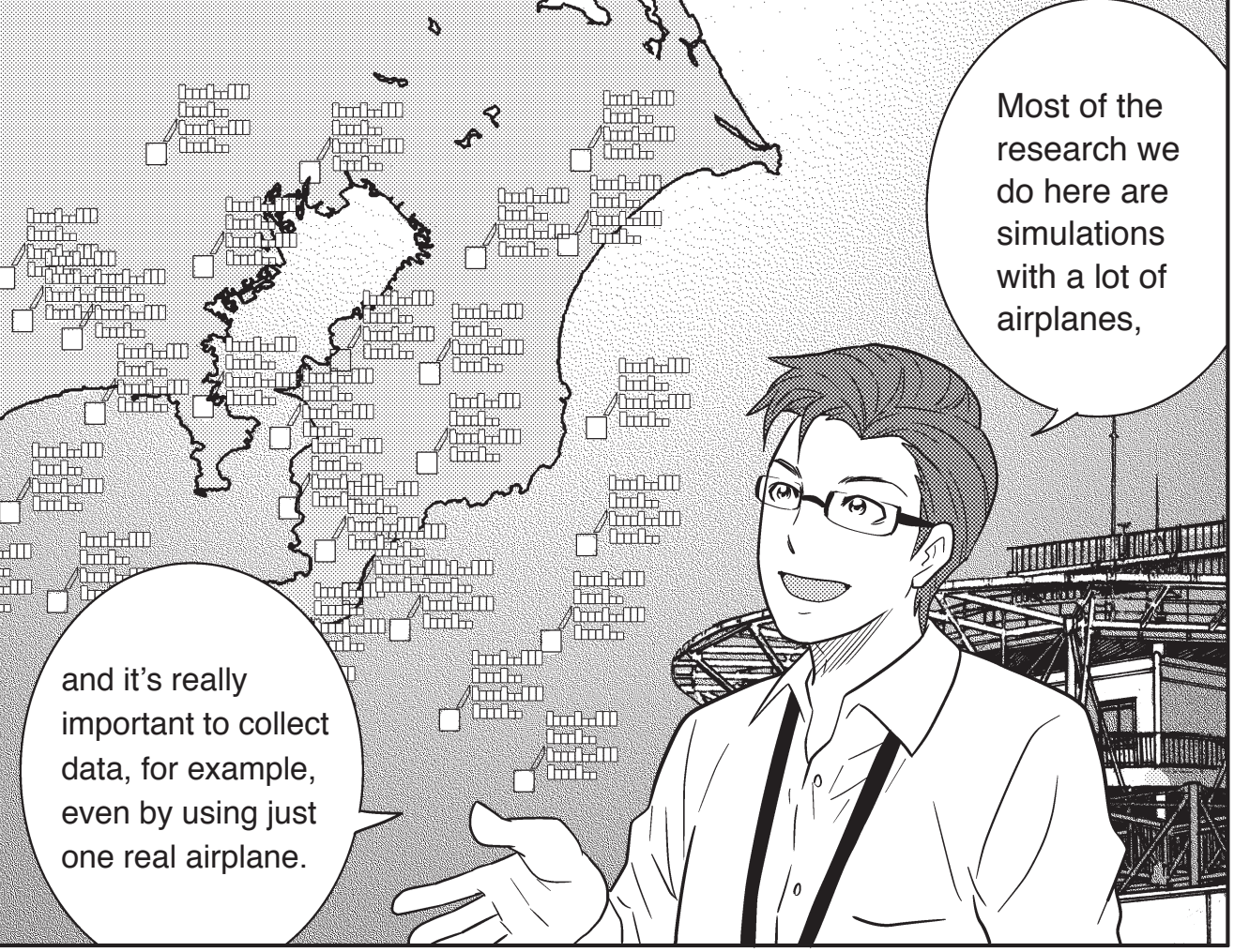

...using "Yotsuba" experimental aircraft put into operation in 2013,
they can collect a lot of data.


But don't you think that experimenting with only one airplane isn't enough?
ホホホ
ムムム
Even just one airplane can perform beneficial experiments.


Welcome to the Electronic Navigation Research Institute…
… to ENRI!
Shigeto Semori (35)


Thank you in advance!
お願いします!!

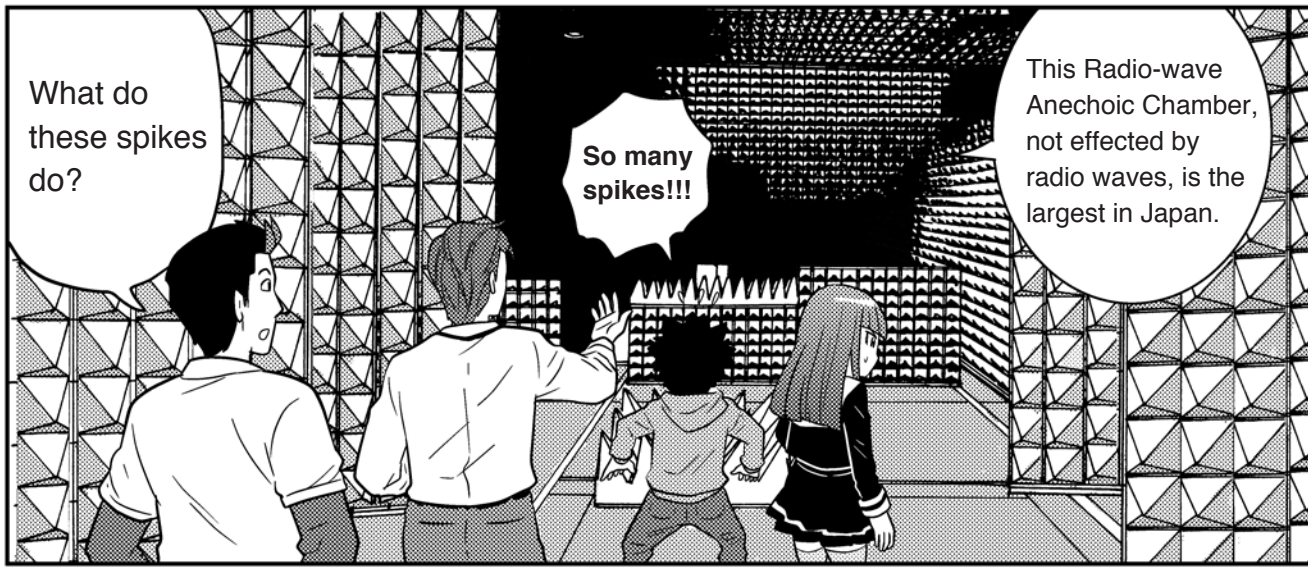

My name's Semori!
Nice to meet you, I'm a research worker here at ENRI.

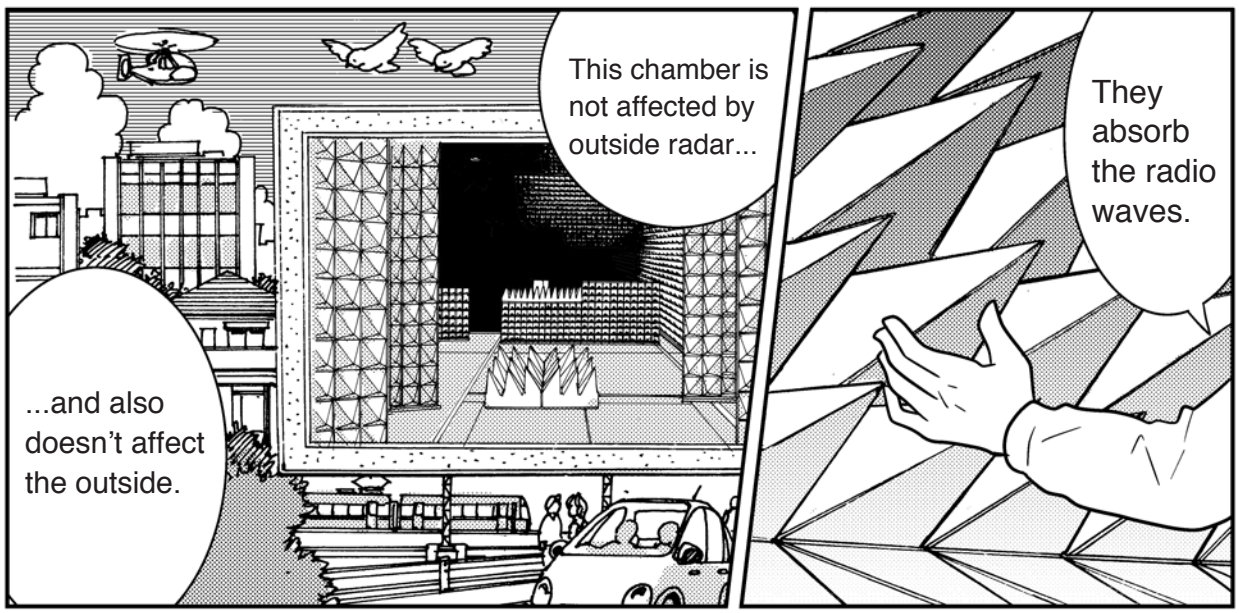

Most of the research we do here are simulations with a lot of airplanes,
and it's really important to collect data, for example, even by using just one real airplane.

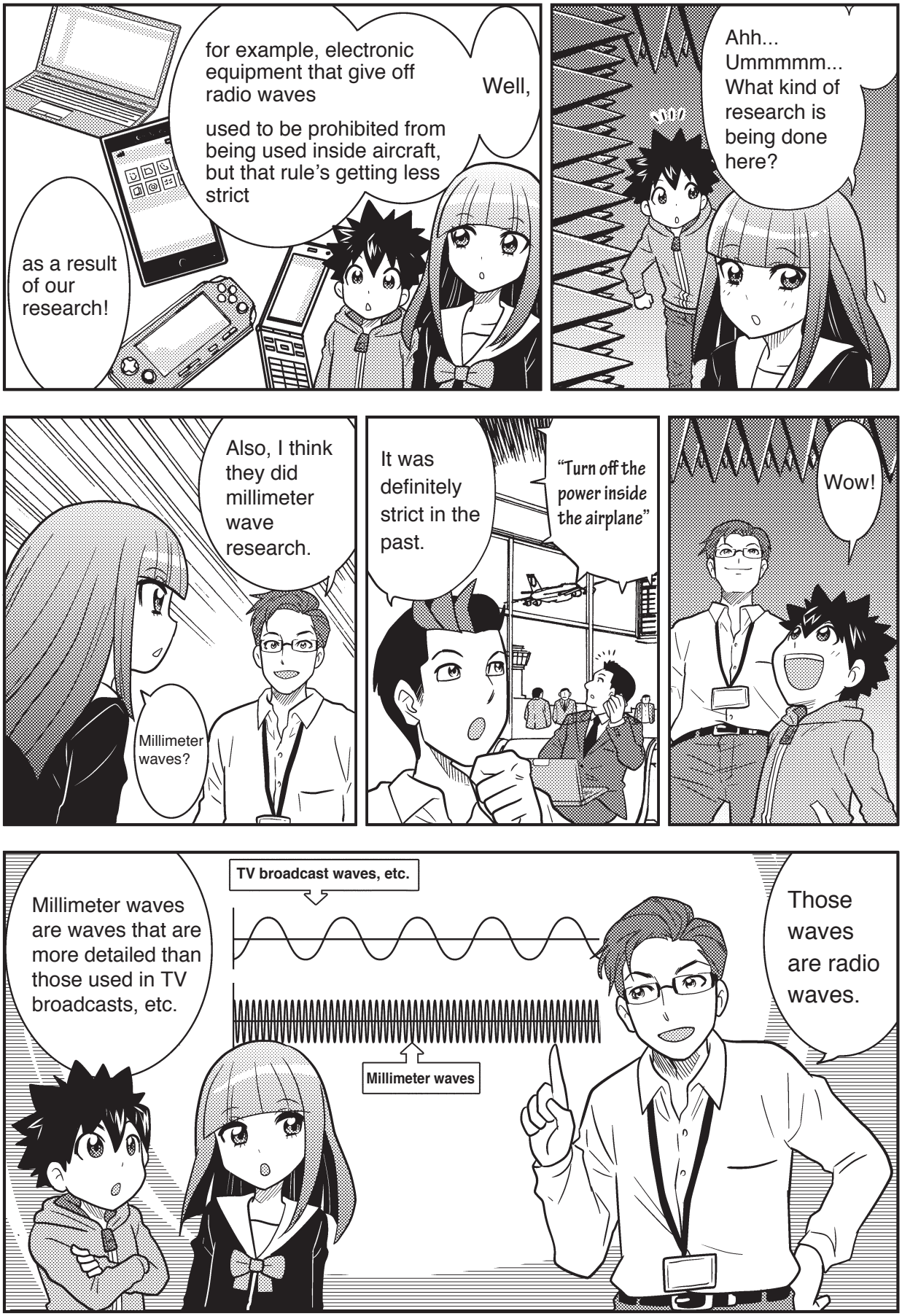

Yes, please!
Do you want to take a look?
Yes, of course!

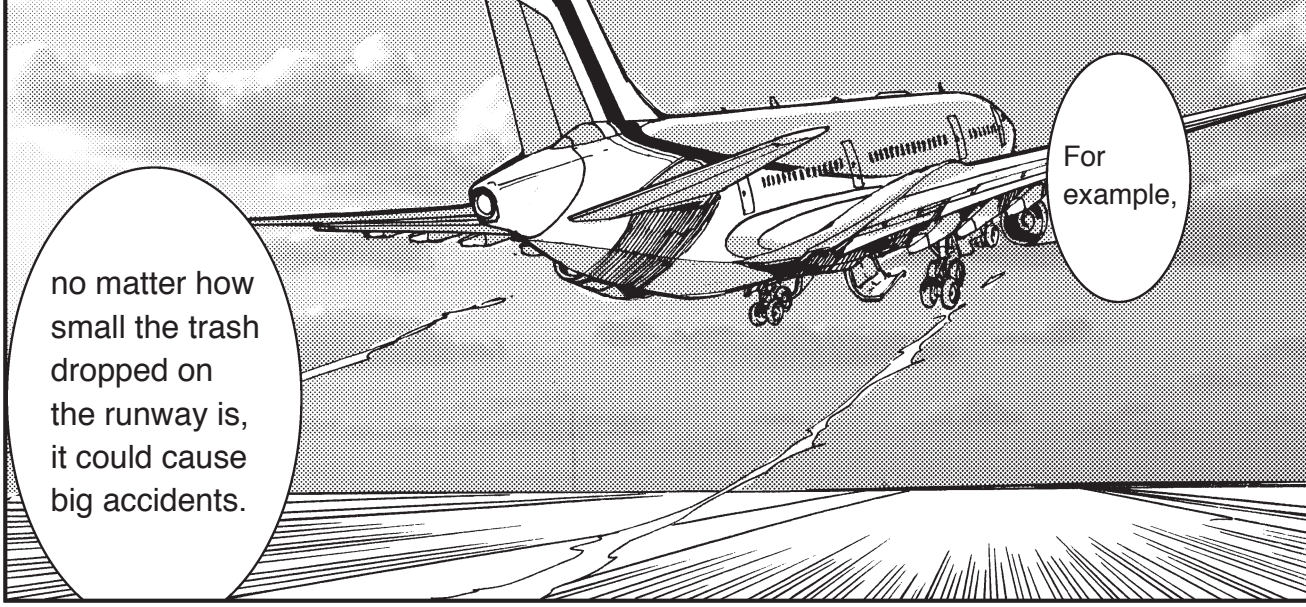

but there are so many exceptional research facilities!
Unfortunately, there's no real airplane here,

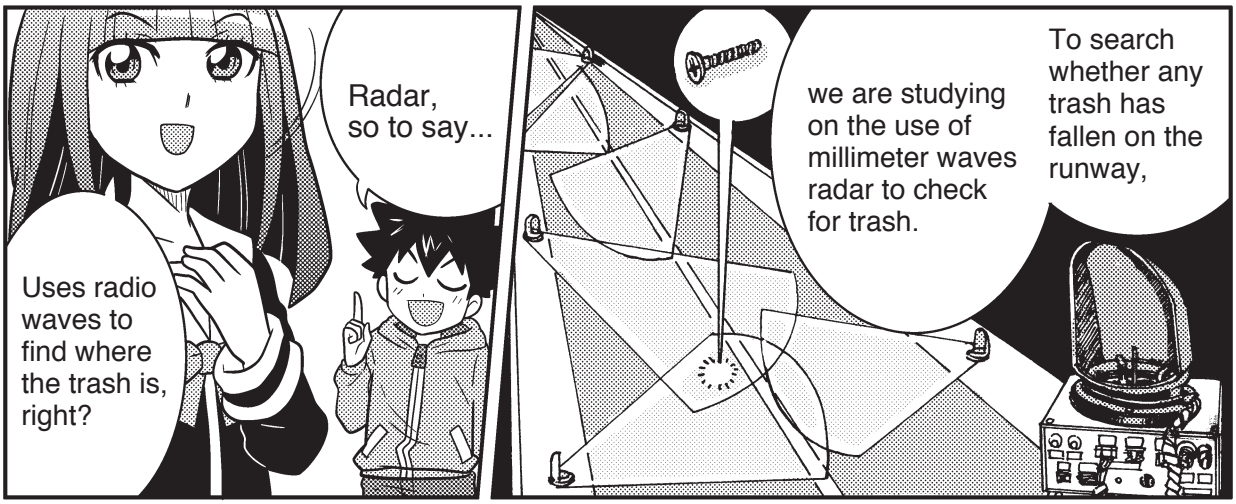

———!
Wow!
電子航法研
Electronic Navigatio
8号棟
Building No,8
電波無響室
Radio Anechoic Cha

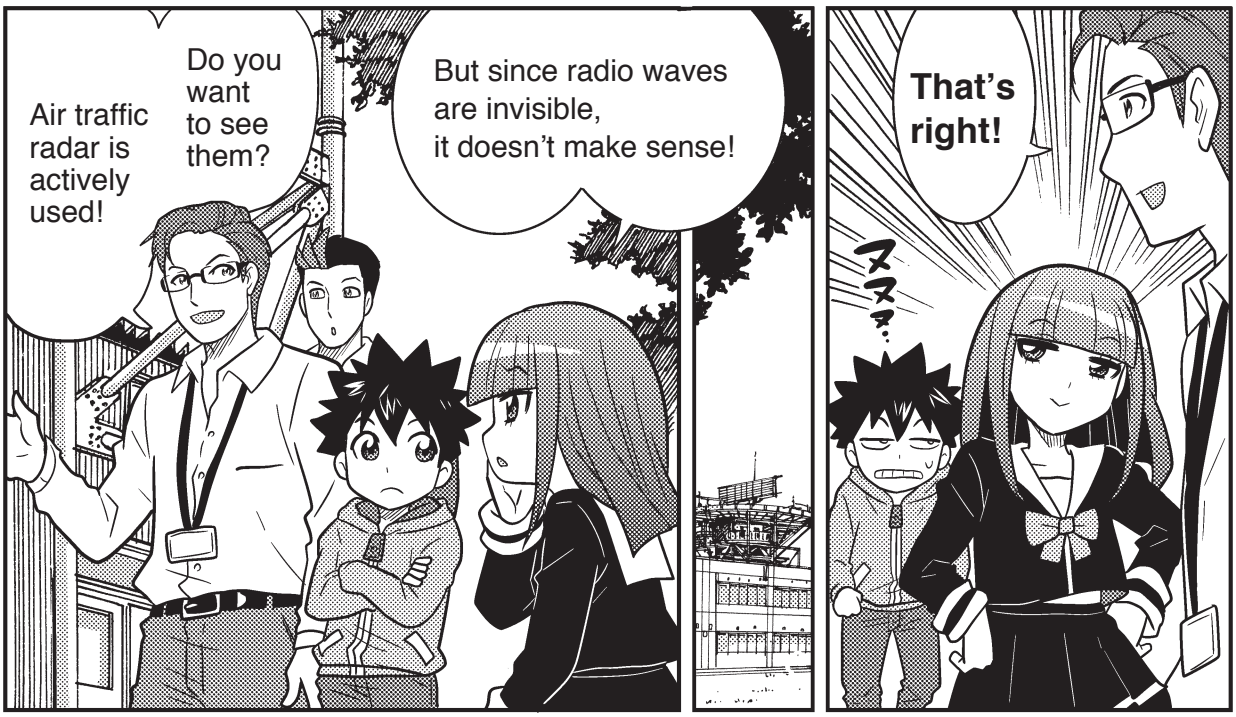

What do these spikes do?
So many spikes!!!
This Radio-wave Anechoic Chamber, not effected by radio waves, is the largest in Japan.


This chamber is not affected by outside radar...
...and also doesn't affect the outside.
They absorb the radio waves.

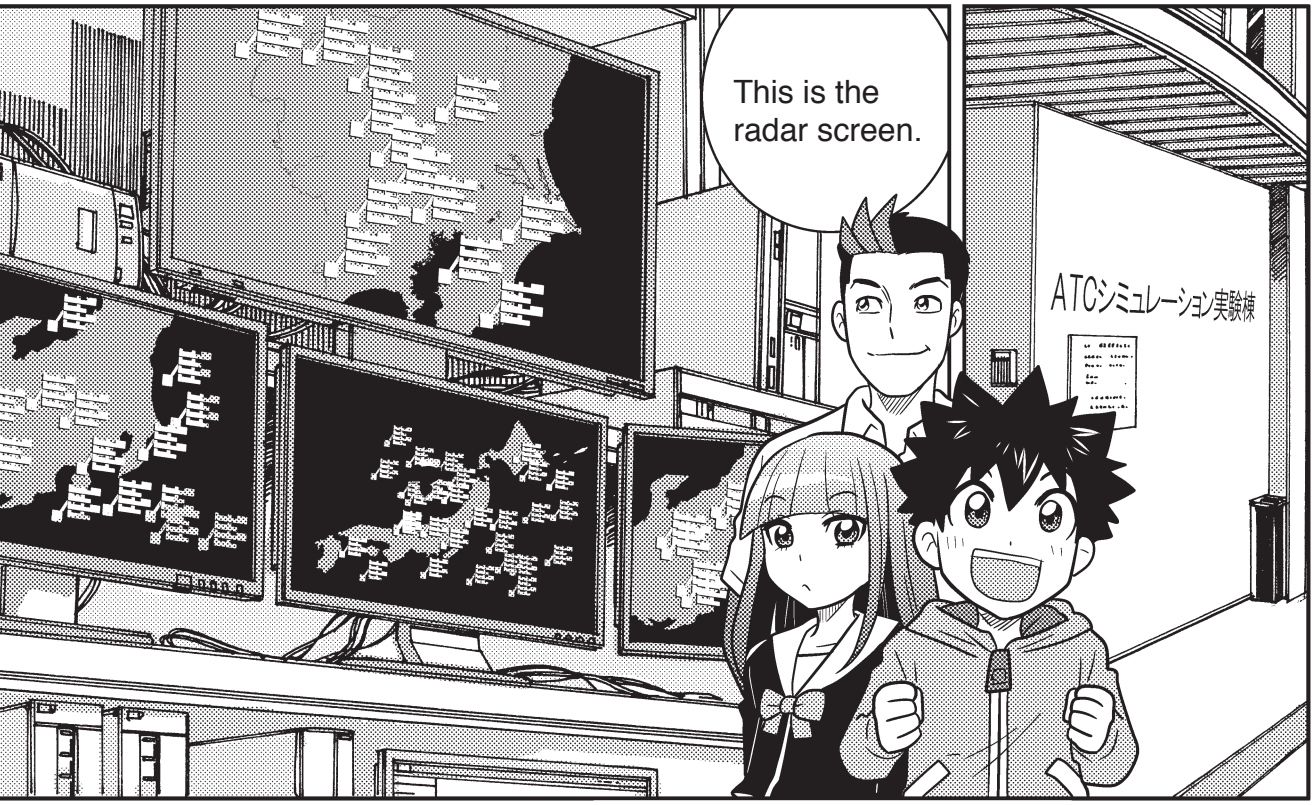

Well,
for example, electronic equipment that give off radio waves
used to be prohibited from being used inside aircraft, but that rule's getting less strict
as a result of our research!
Ahh... Ummmmm... What kind of research is being done here?
Also, I think they did millimeter wave research.
Millimeter waves?
It was definitely strict in the past.
"Turn off the power inside the airplane"
Wow!
Millimeter waves are waves that are more detailed than those used in TV broadcasts, etc.
TV broadcast waves, etc.
Millimeter waves
Those waves are radio waves.

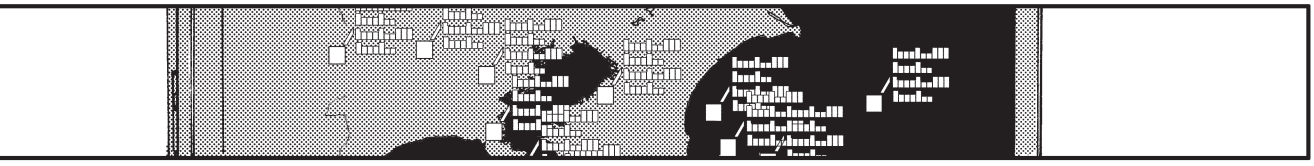

For example,
no matter how small the trash dropped on the runway is, it could cause big accidents.

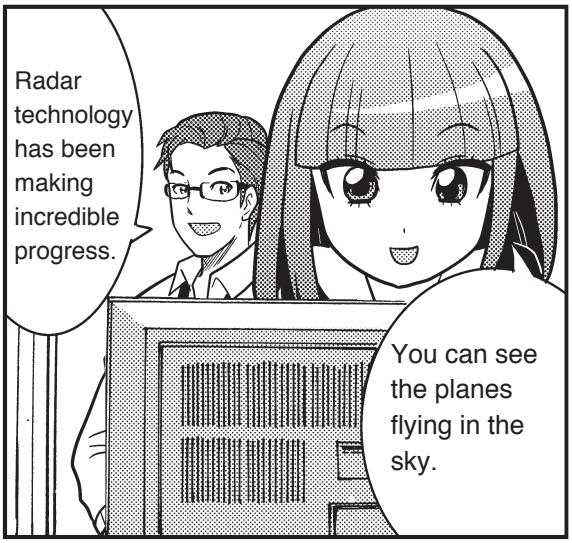

Radar, so to say...
Uses radio waves to find where the trash is, right?
To search whether any trash has fallen on the runway,
we are studying on the use of millimeter waves radar to check for trash.

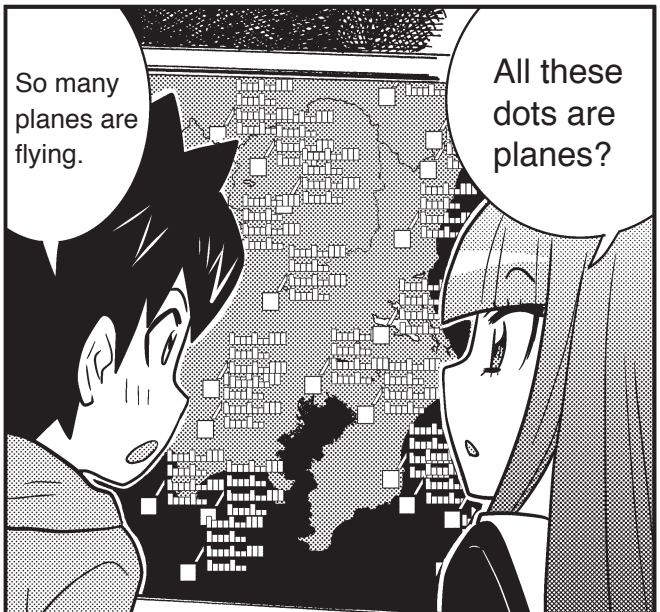

Air traffic radar is actively used!
Do you want to see them?
But since radio waves are invisible, it doesn't make sense!
That's right!
ﾒｽｯ

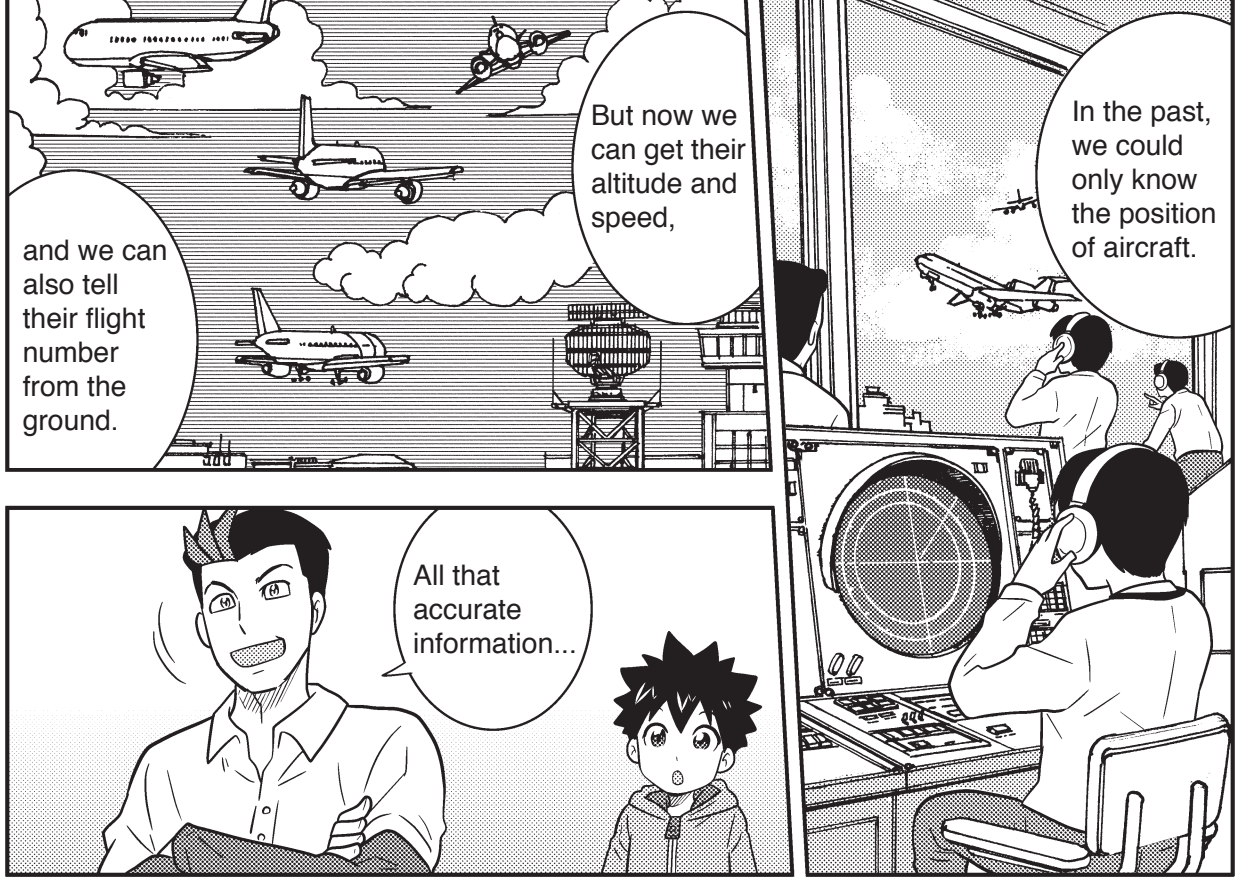

やったー
Yay! We can get to see the radar!

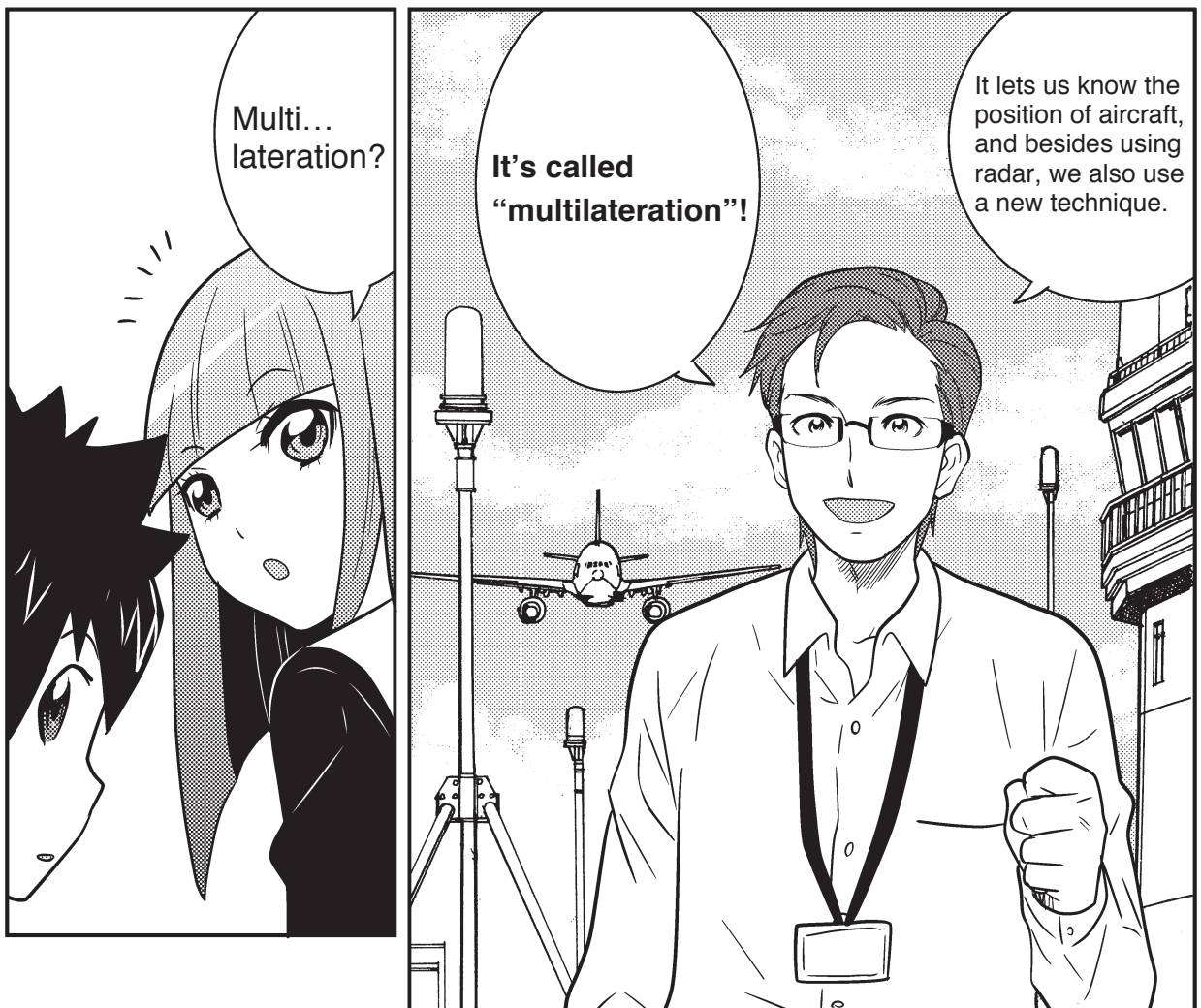

This is the radar screen.
ATCシミュレーション実験棟

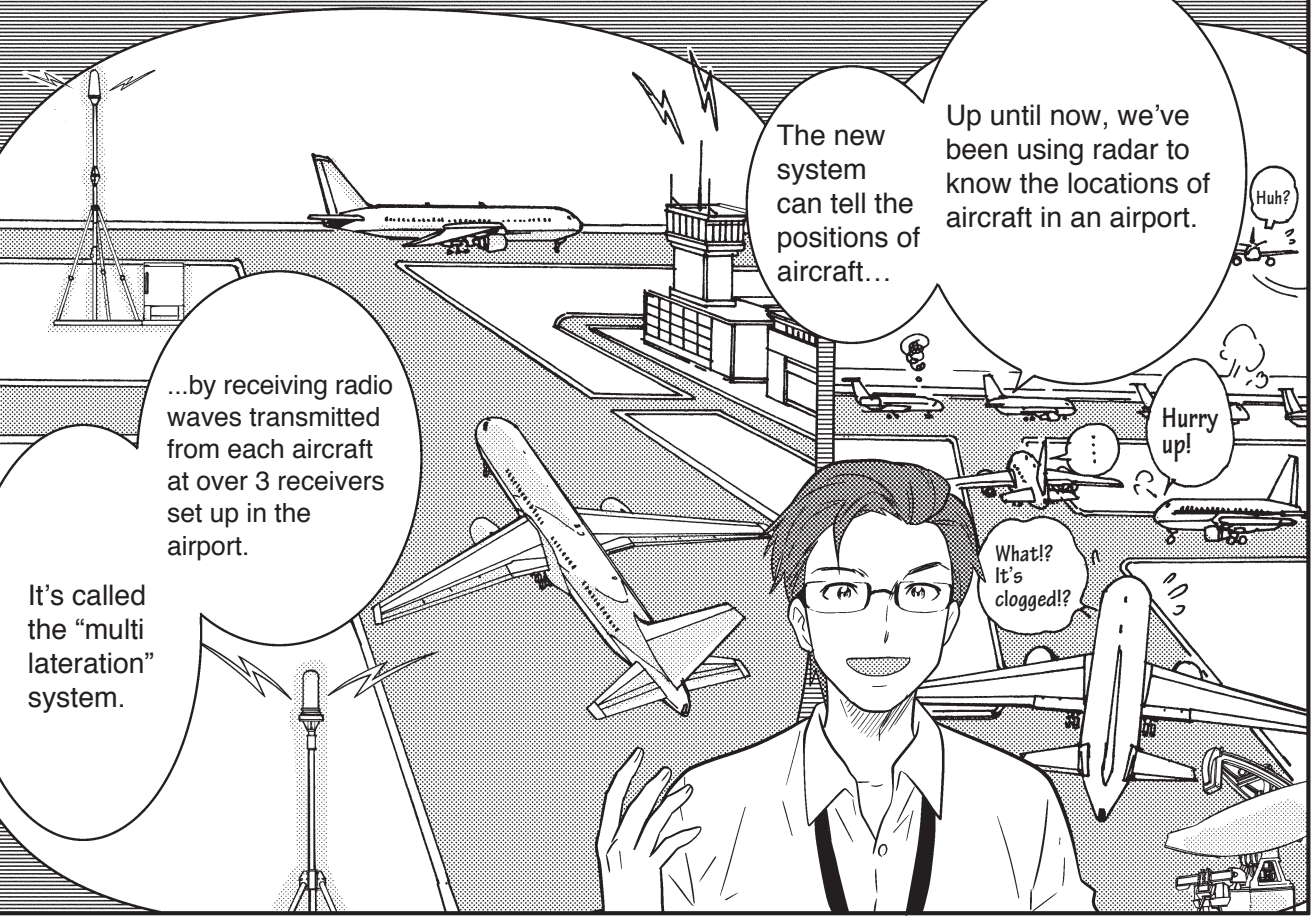


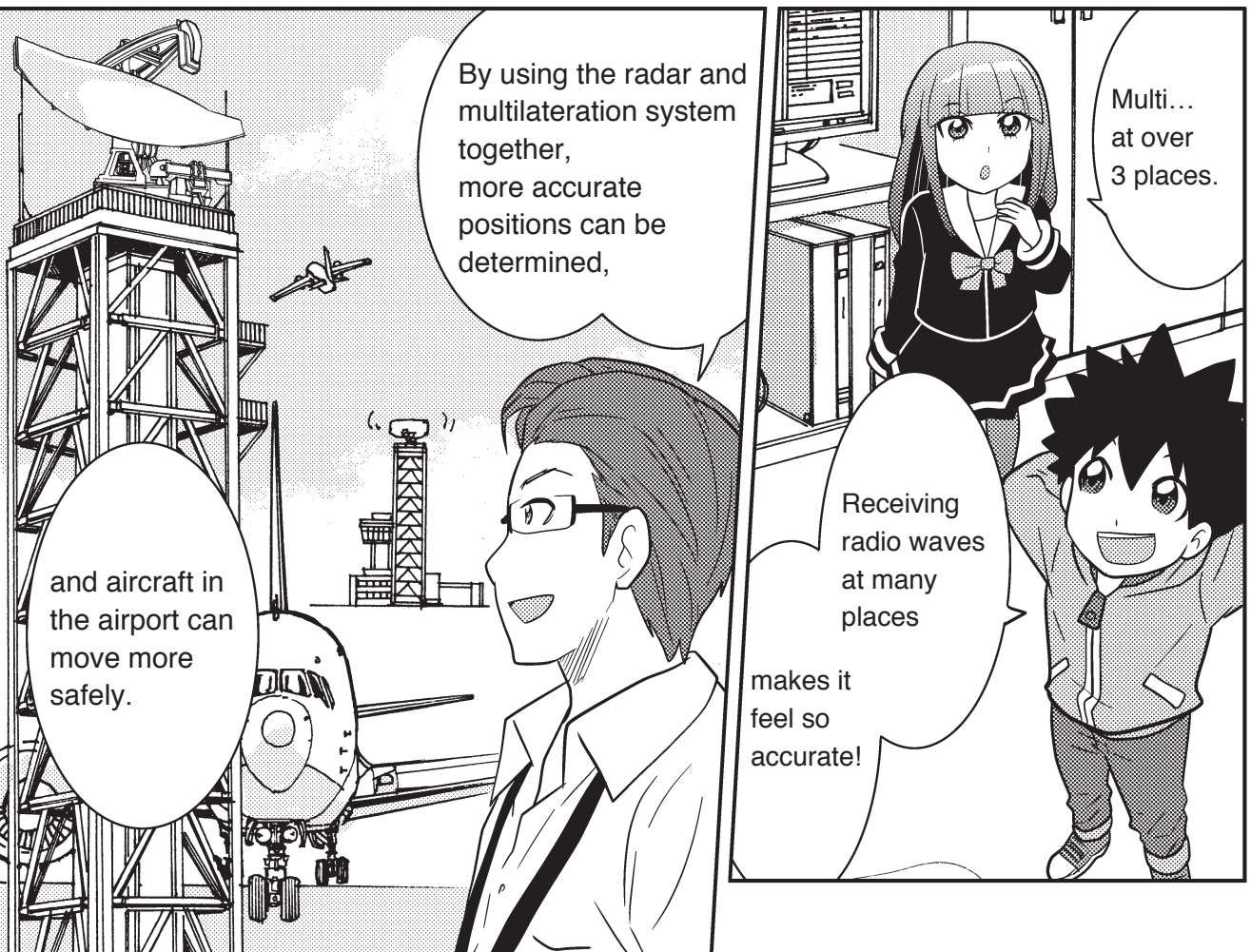

Radar technology has been making incredible progress.
You can see the planes flying in the sky.


So many planes are flying.
All these dots are planes?

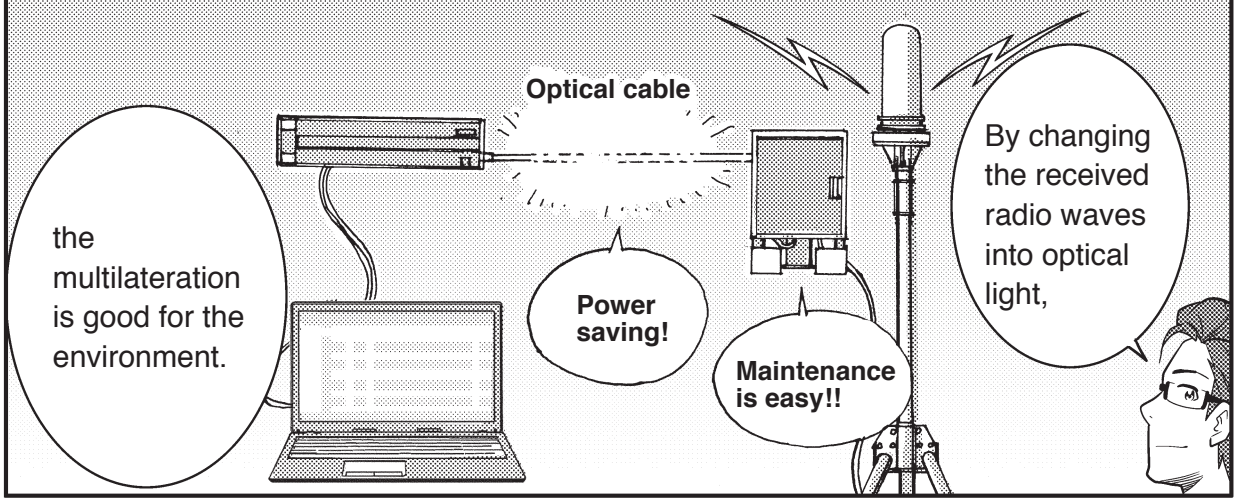

and we can also tell their flight number from the ground.
But now we can get their altitude and speed,
In the past, we could only know the position of aircraft.
All that accurate information...

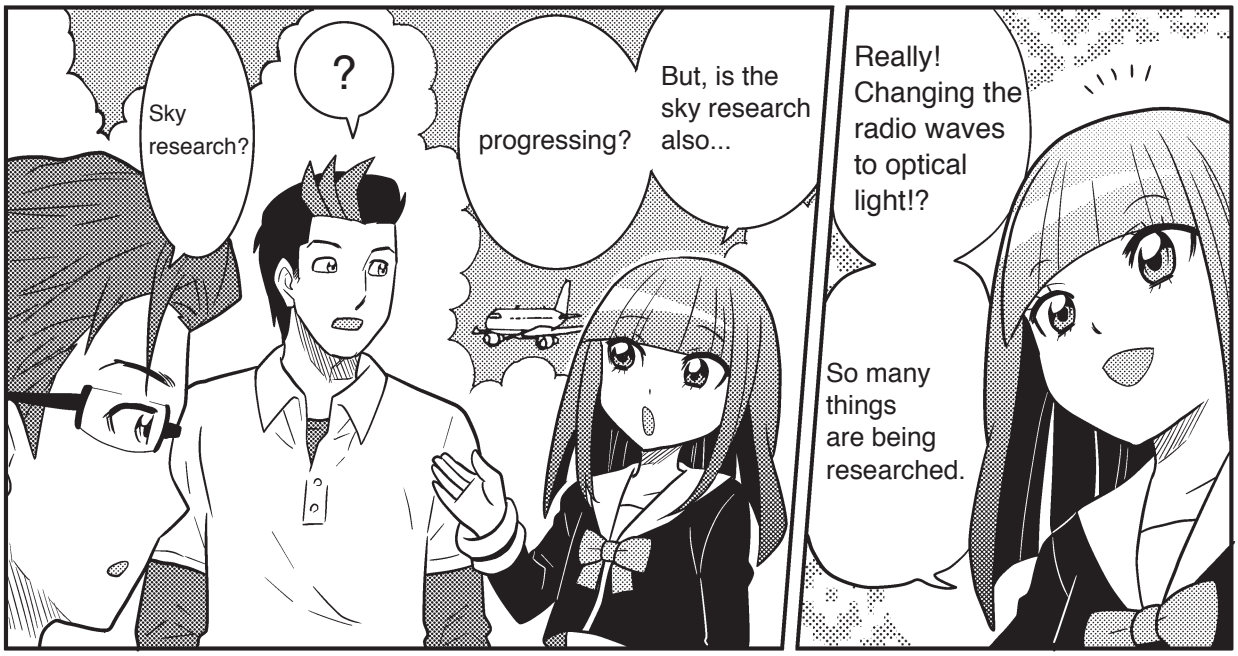

Multi… lateration?
It's called "multilateration"!
It lets us know the position of aircraft, and besides using radar, we also use a new technique.


Up until now, we've been using radar to know the locations of aircraft in an airport.
The new system can tell the positions of aircraft…
Huh?
Hurry up!
What!? It's clogged!?
...by receiving radio waves transmitted from each aircraft at over 3 receivers set up in the airport.
It's called the "multi lateration" system.

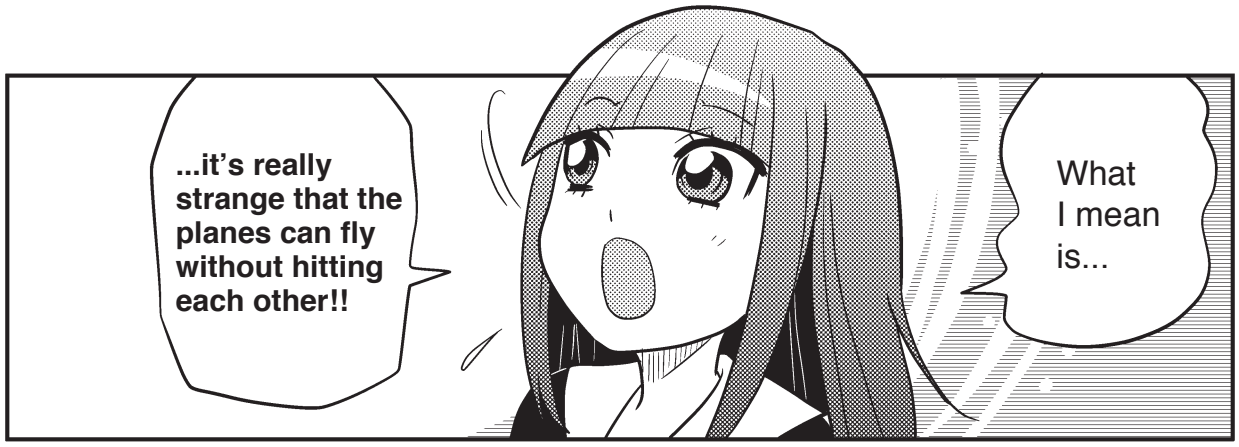

By using the radar and multilateration system together, more accurate positions can be determined,
and aircraft in the airport can move more safely.
Multi… at over 3 places.
Receiving radio waves at many places
makes it feel so accurate!


I guess that too saves a lot.
That's right. It also reduces the amount of fuel used while aircraft are waiting.
It's also important to control the aircraft waiting to take off.
We're also continuing research on **"wide-area multi lateration".**
The multilateration system will not just be used on the ground, but also up in the air.
Besides that, the **OCTPASS** system is also being assessed.
We can also reduce the waiting time by skillfully shifting the departure time.
OCTPASS!? What?
Octo-pus?
どよよよ
はっはっは
It's not an octopus, but the name of the system.


Optical cable
the multilateration is good for the environment.
Power saving!
Maintenance is easy!!
By changing the received radio waves into optical light,

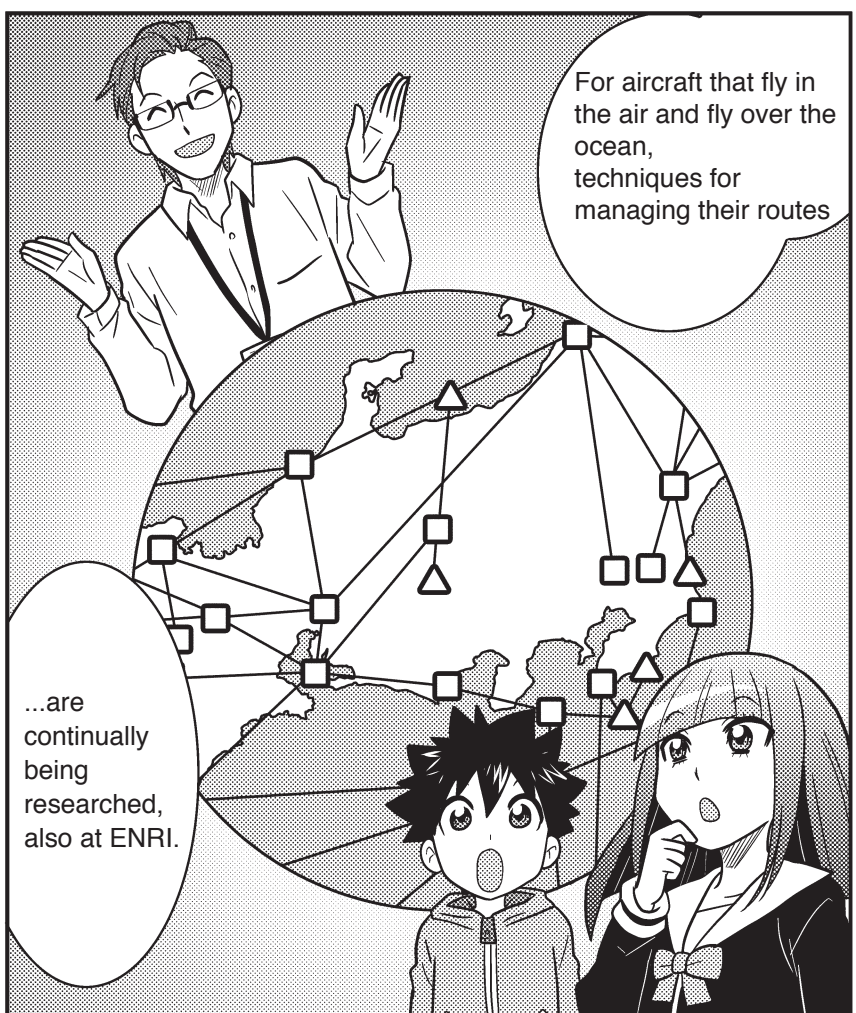

Sky research?
?
But, is the sky research also...
progressing?
Really! Changing the radio waves to optical light!?
So many things are being researched.

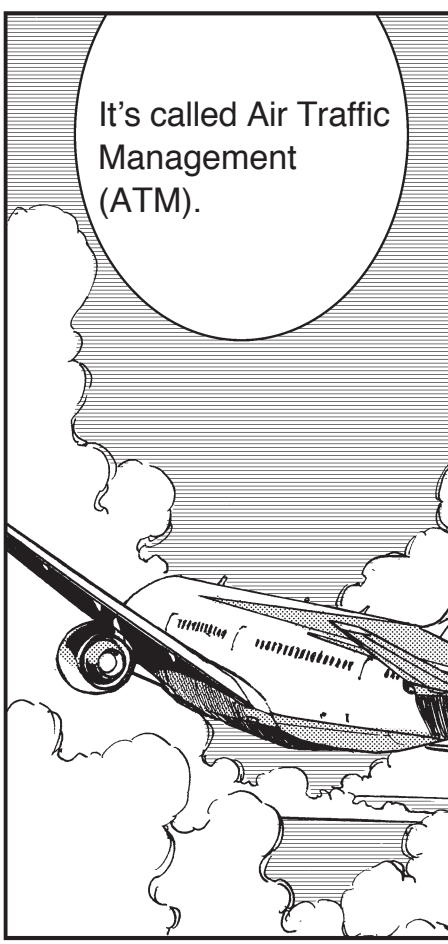

Don't come this way!
So dangerous!
Watch out!
I can't stop!
In the sky, so many aircraft fly at the same time.
Get out of the way!
あぁ…!
I'm really worried that they can safely fly without crashing into each other.

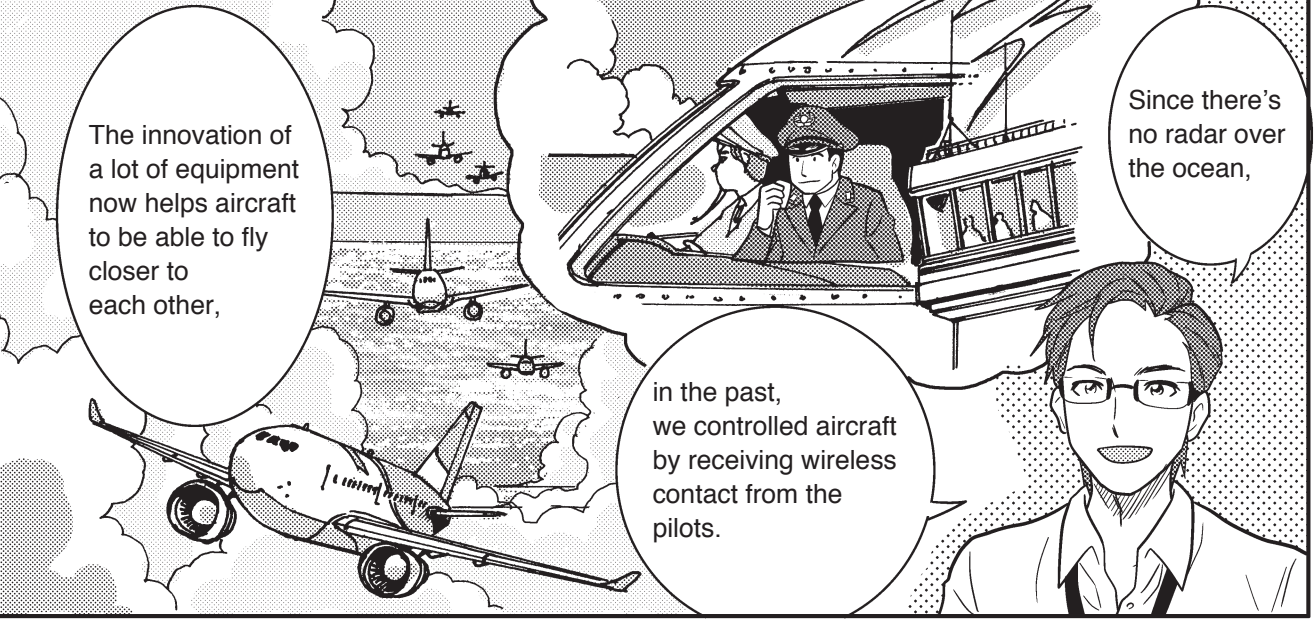

...it's really strange that the planes can fly without hitting each other!!
What I mean is...

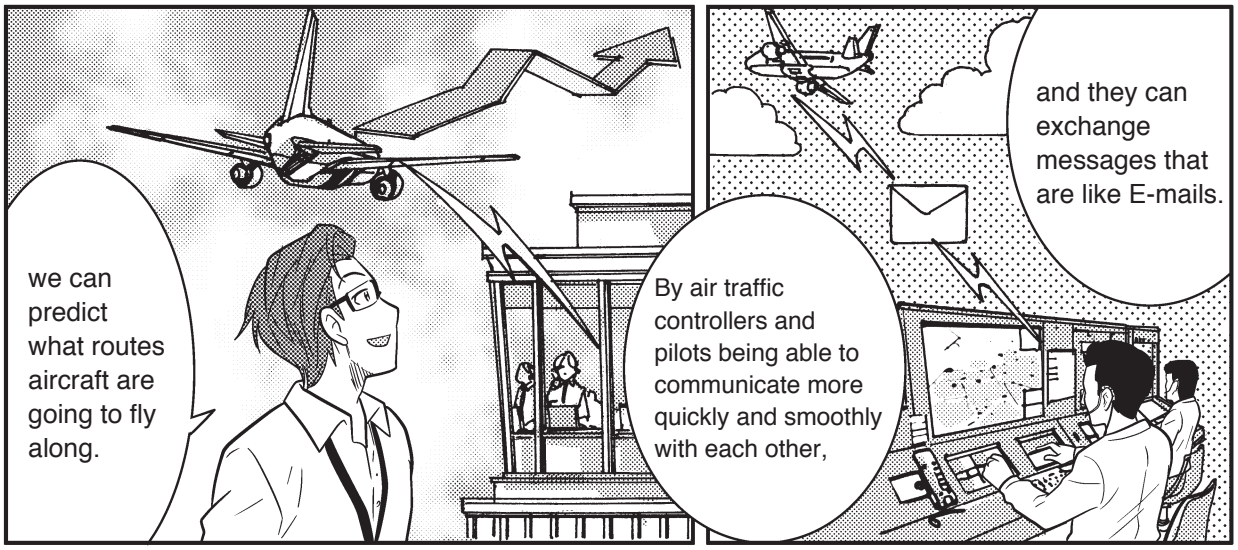

air traffic control is also evolving.
By using electronic techniques,

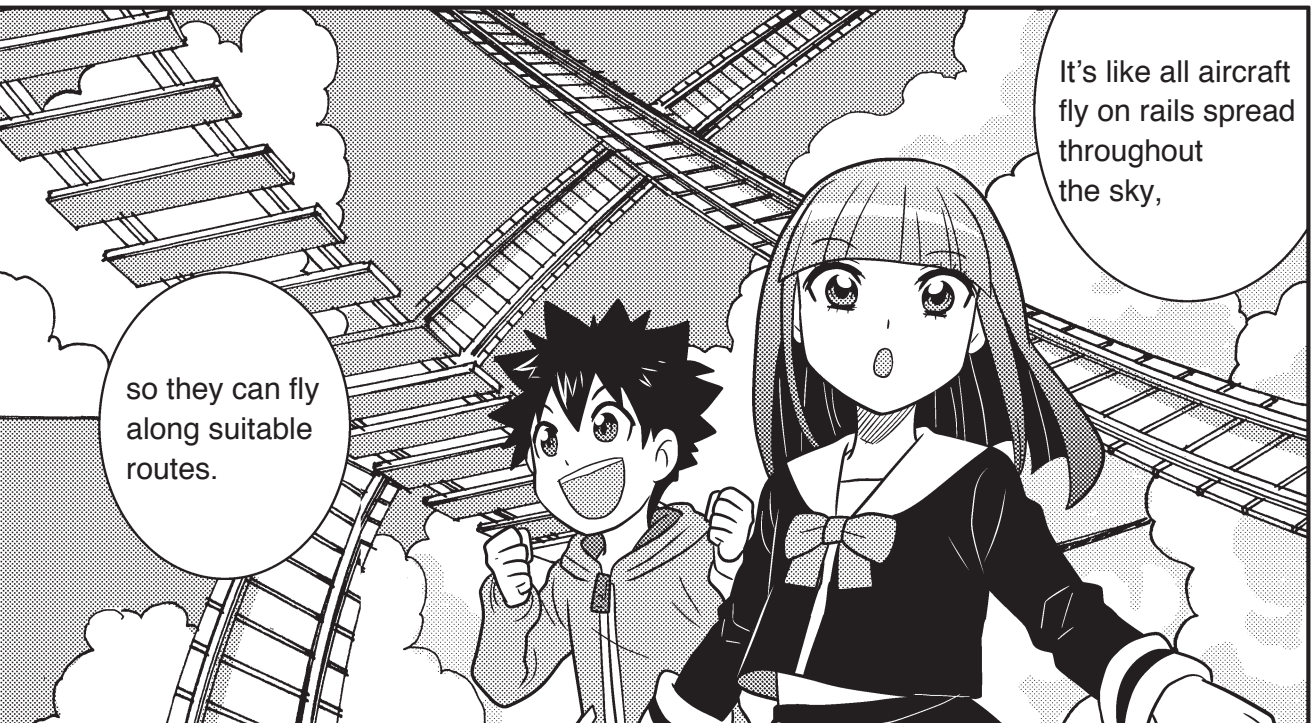

I know what you mean.

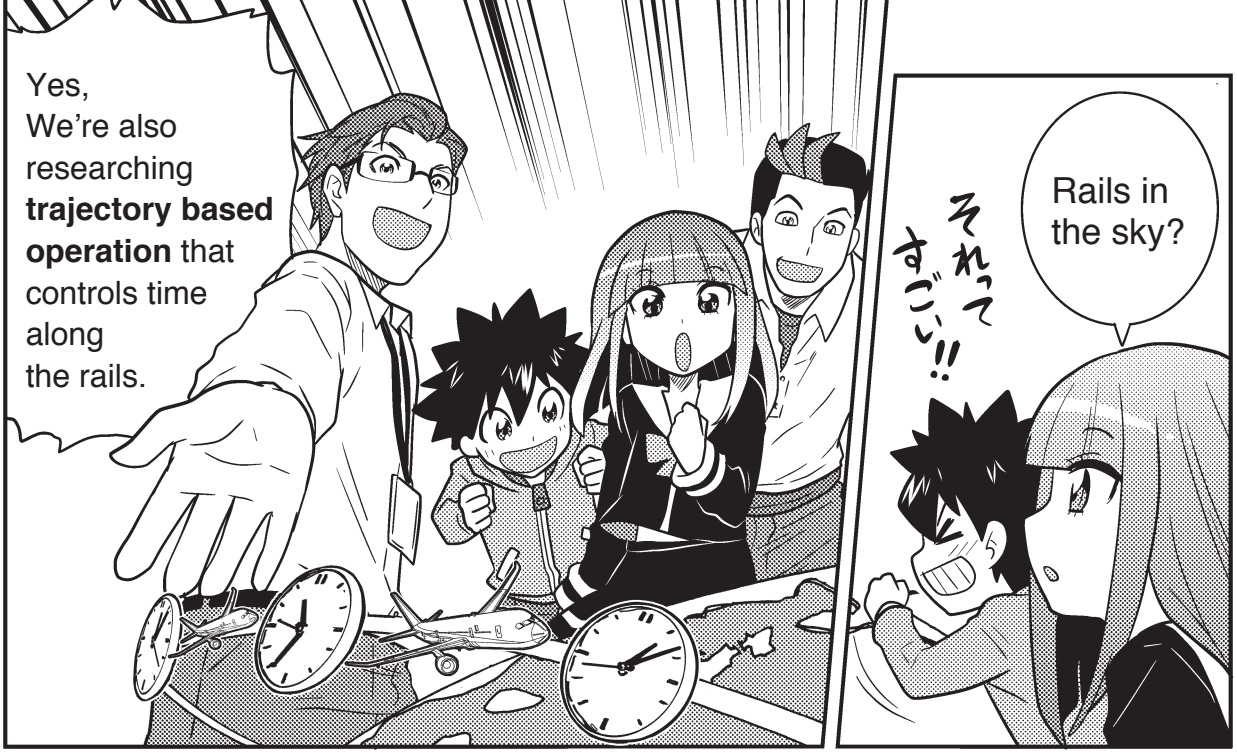

For aircraft that fly in the air and fly over the ocean, techniques for managing their routes
...are continually being researched, also at ENRI.

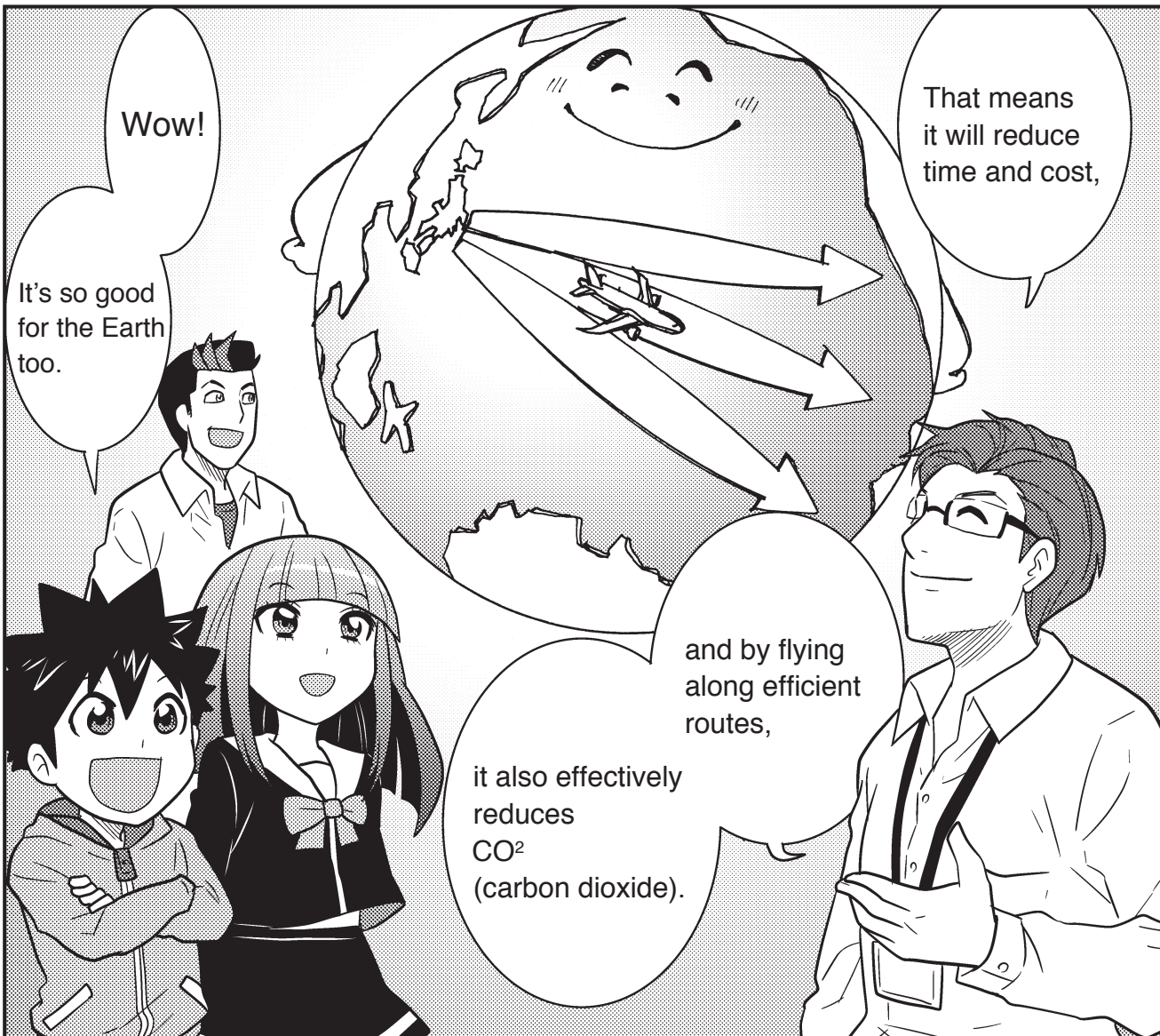

It's called Air Traffic Management (ATM).

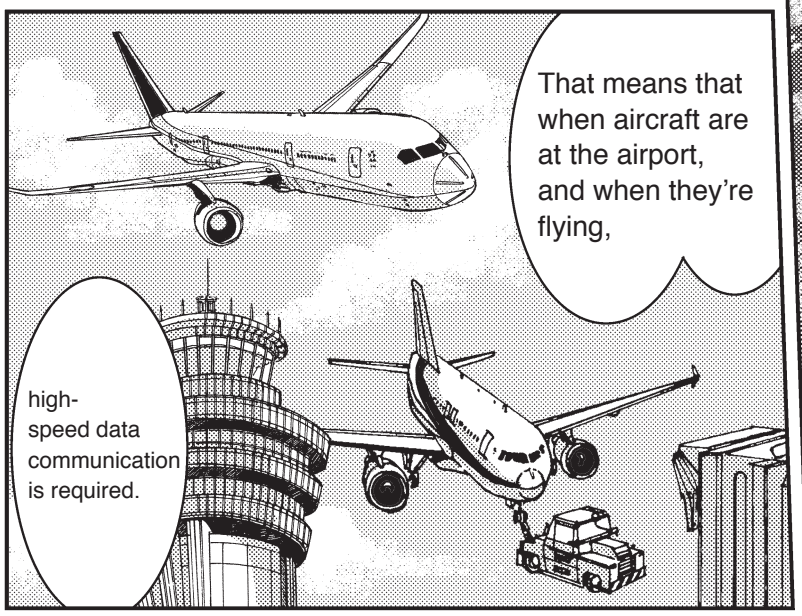

The innovation of a lot of equipment now helps aircraft to be able to fly closer to each other,
in the past, we controlled aircraft by receiving wireless contact from the pilots.
Since there's no radar over the ocean,

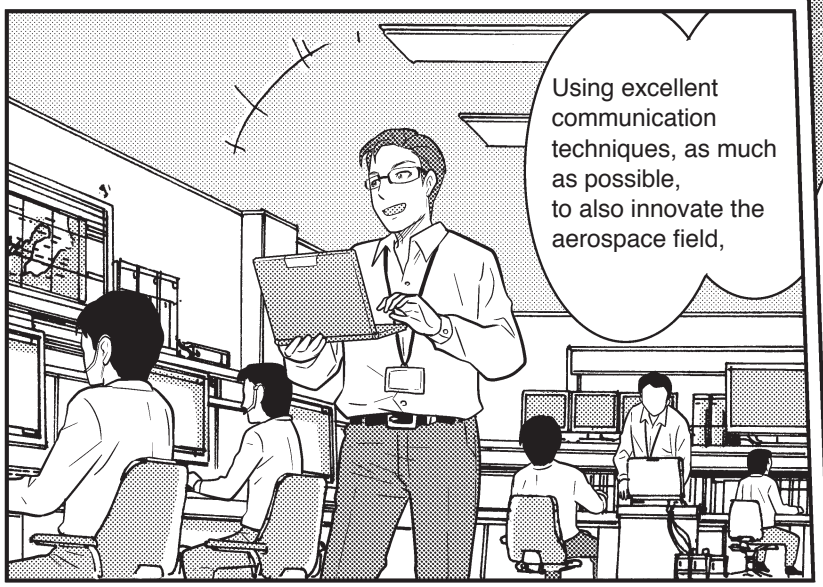

we can predict what routes aircraft are going to fly along.
By air traffic controllers and pilots being able to communicate more quickly and smoothly with each other,
and they can exchange messages that are like E-mails.

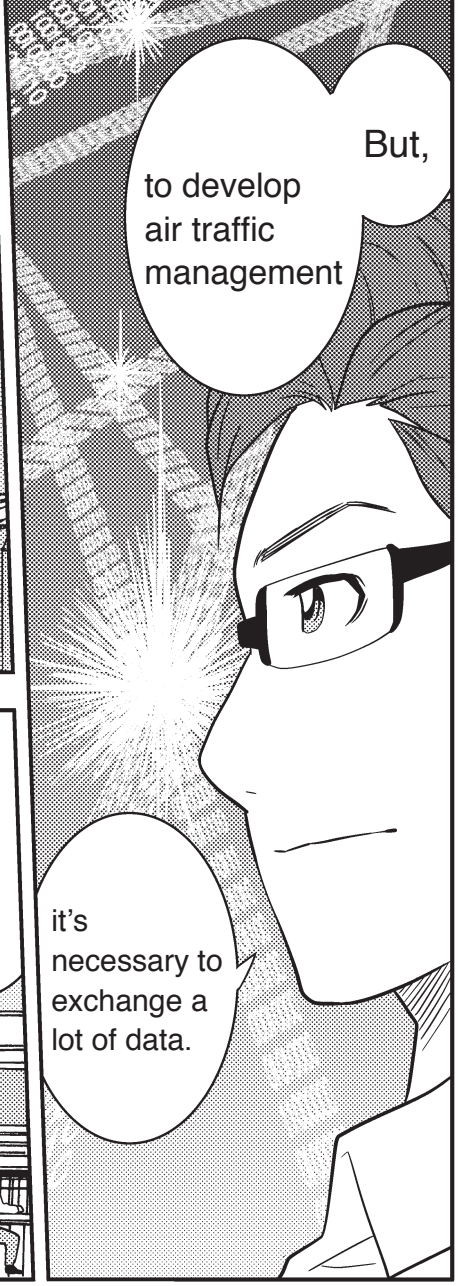

so they can fly along suitable routes.
It's like all aircraft fly on rails spread throughout the sky,


Yes,
We're also researching **trajectory based operation** that controls time along the rails.
それってすごい!!
Rails in the sky?


Wow!
It's so good for the Earth too.
That means it will reduce time and cost,
and by flying along efficient routes,
it also effectively reduces CO^2 (carbon dioxide).

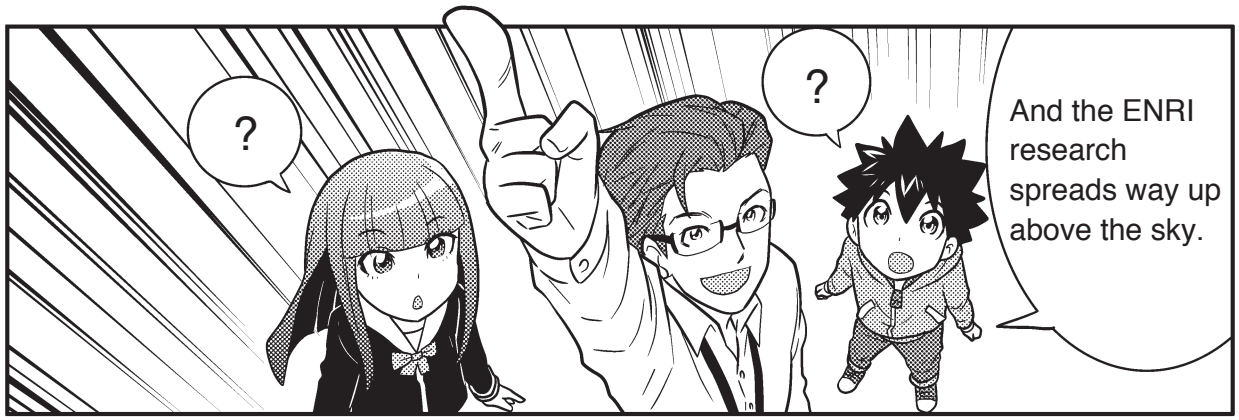

That means that when aircraft are at the airport, and when they're flying,
high-speed data communication is required.

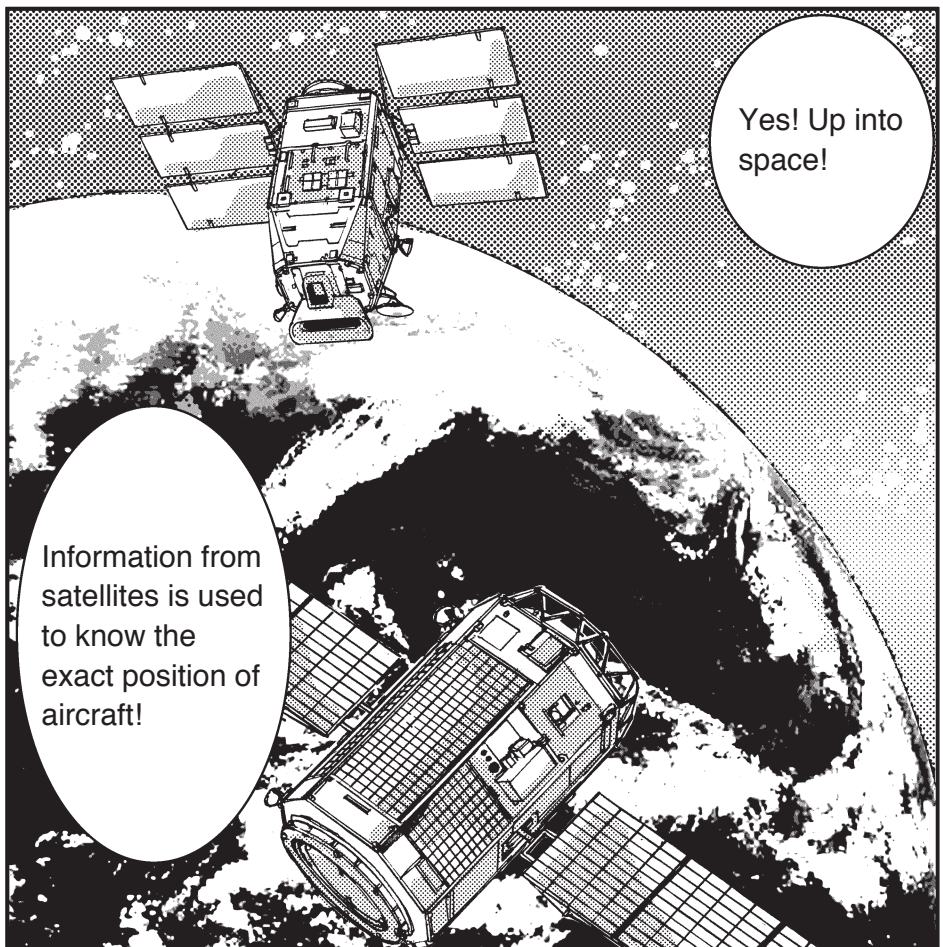

Using excellent communication techniques, as much as possible, to also innovate the aerospace field,

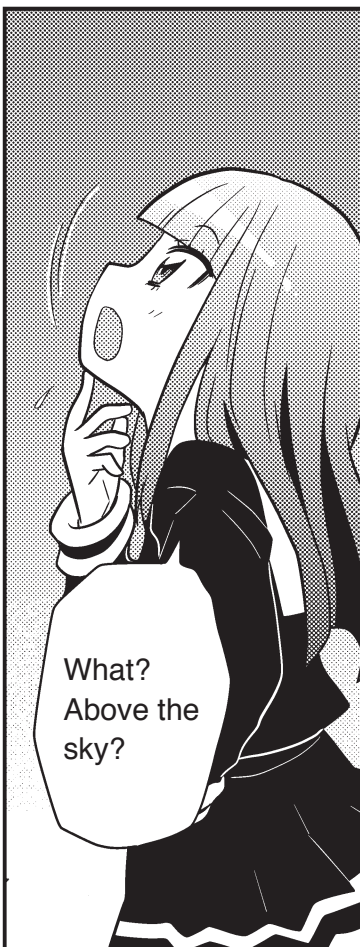

But,
to develop air traffic management
it's necessary to exchange a lot of data.

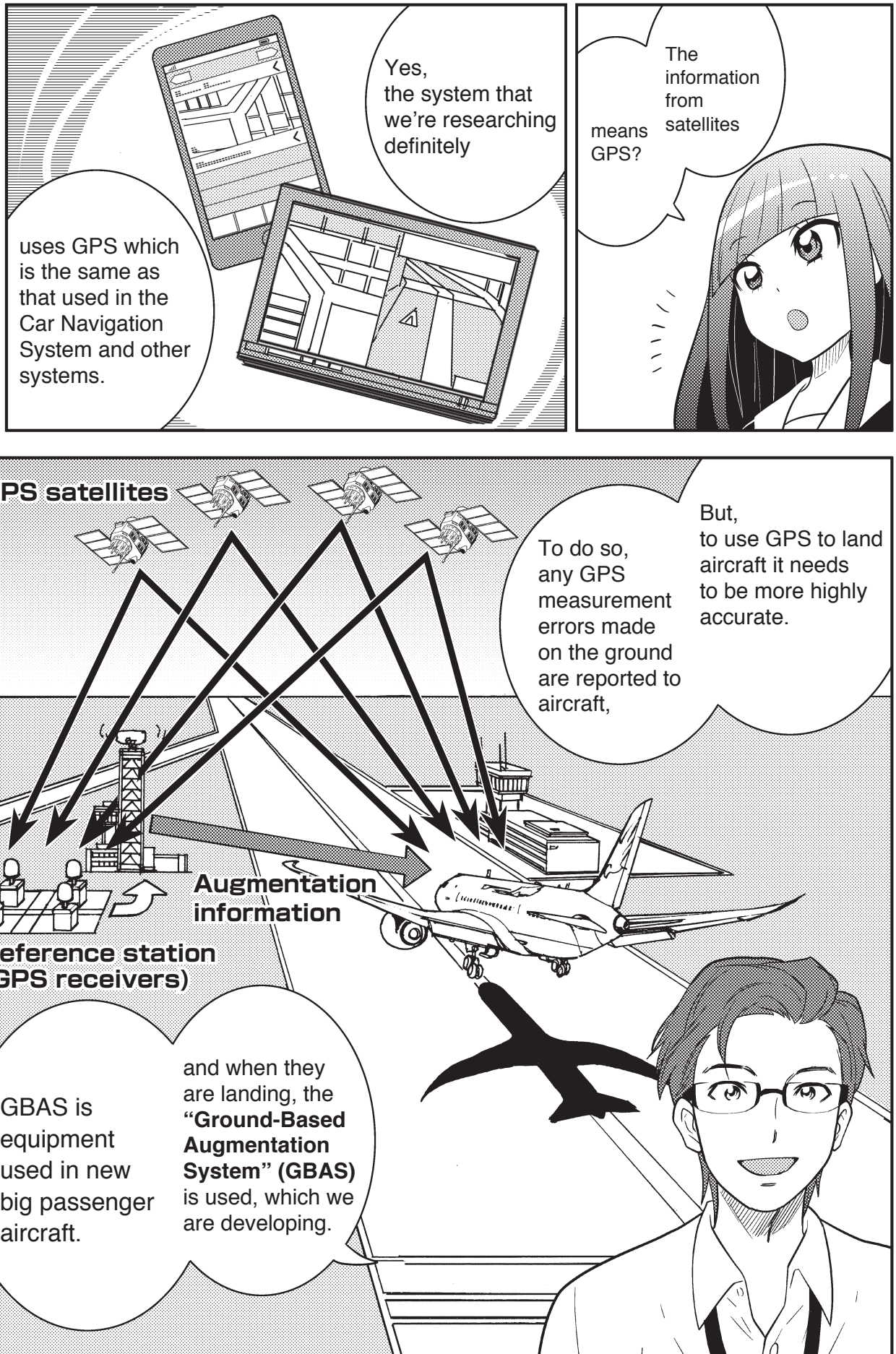

based on that thought,
we continue to research every day!

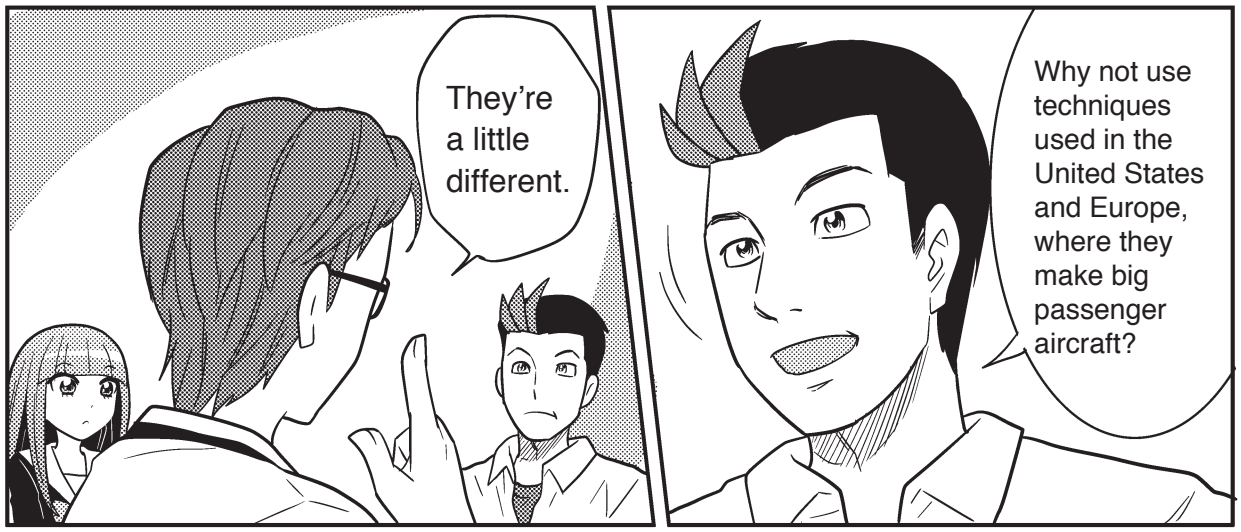

Hmm mmm
You do so much important research, so it seems real difficult.
That's great!

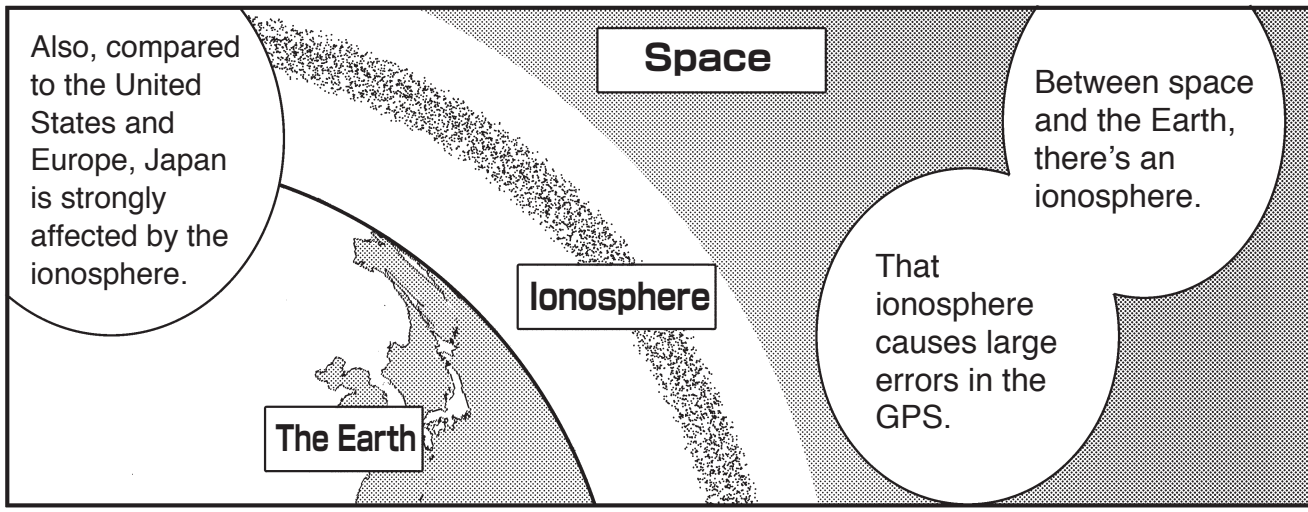

?
?
And the ENRI research spreads way up above the sky.

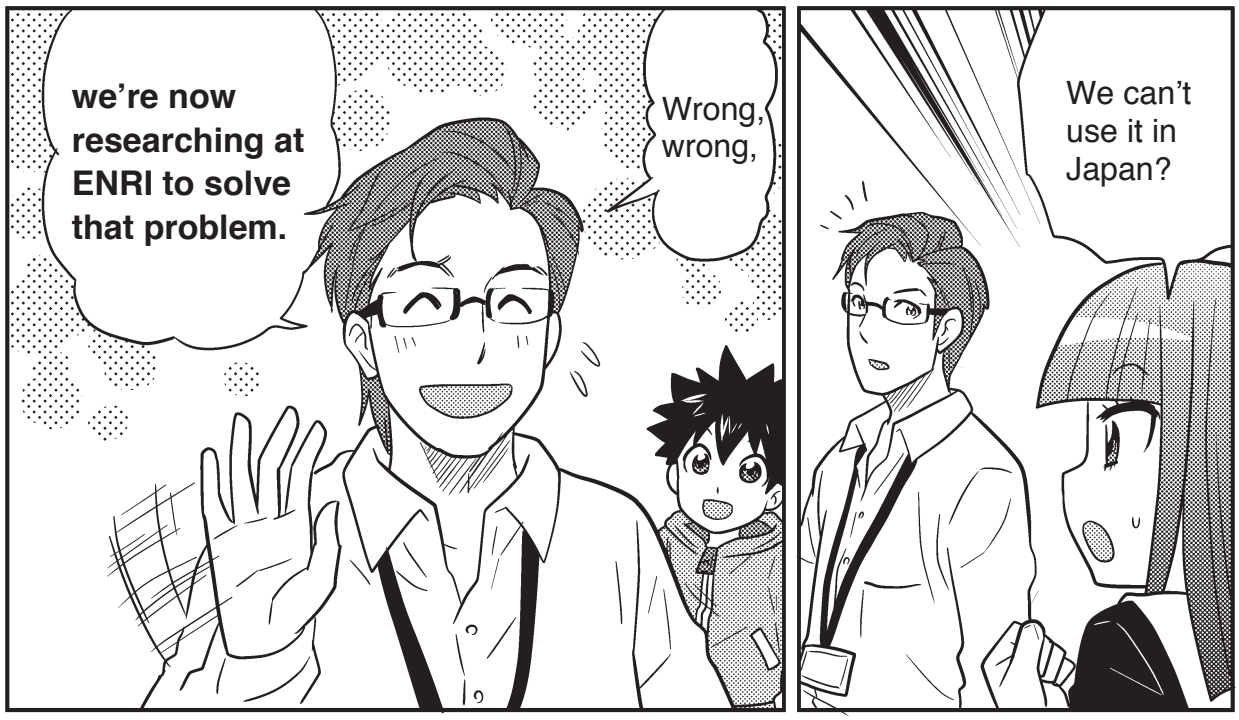

Yes! Up into space!
Information from satellites is used to know the exact position of aircraft!

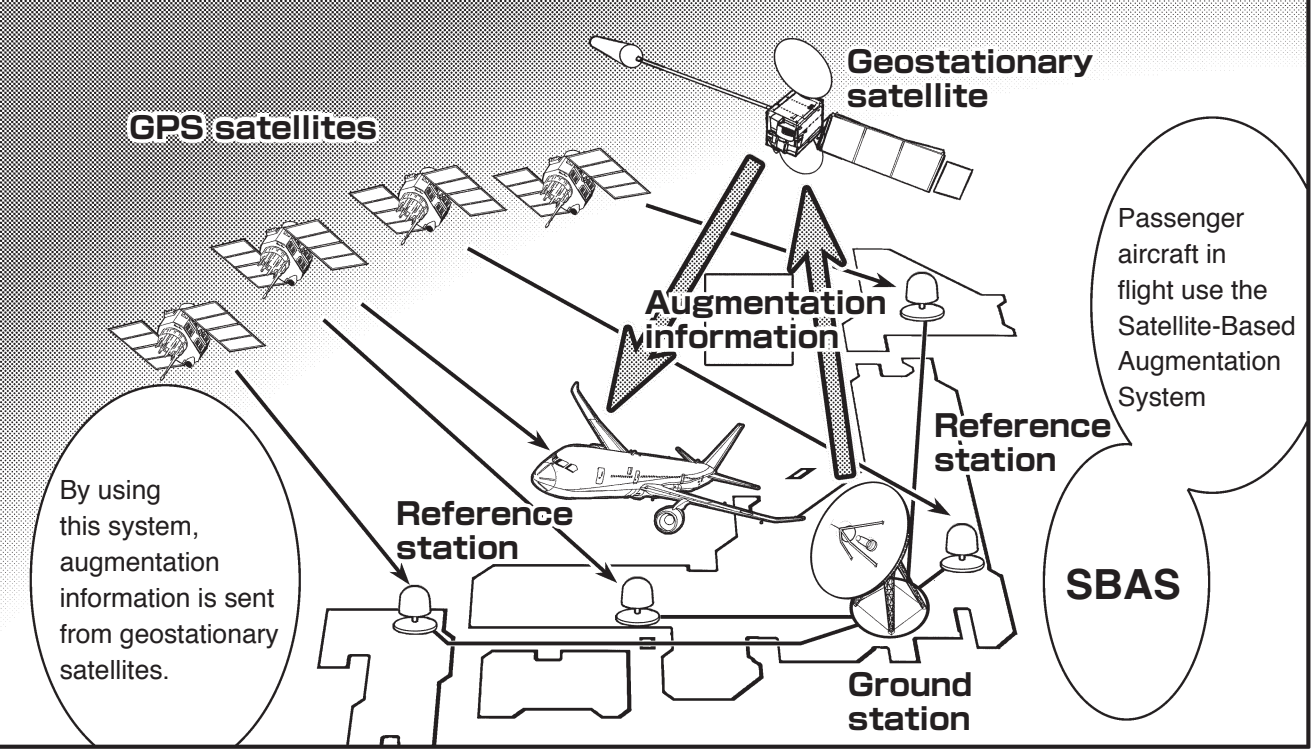

What? Above the sky?

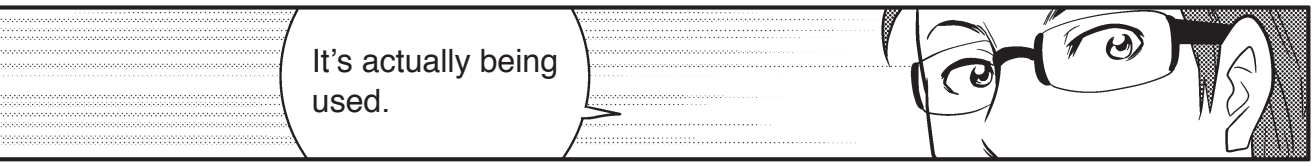

Yes,
the system that we're researching definitely
uses GPS which is the same as that used in the Car Navigation System and other systems.
The information from satellites
means GPS?
GPS satellites
To do so, any GPS measurement errors made on the ground are reported to aircraft,
But,
to use GPS to land aircraft it needs to be more highly accurate.
Augmentation information
Reference station (GPS receivers)
GBAS is equipment used in new big passenger aircraft.
and when they are landing, the **"Ground-Based Augmentation System" (GBAS)** is used, which we are developing.

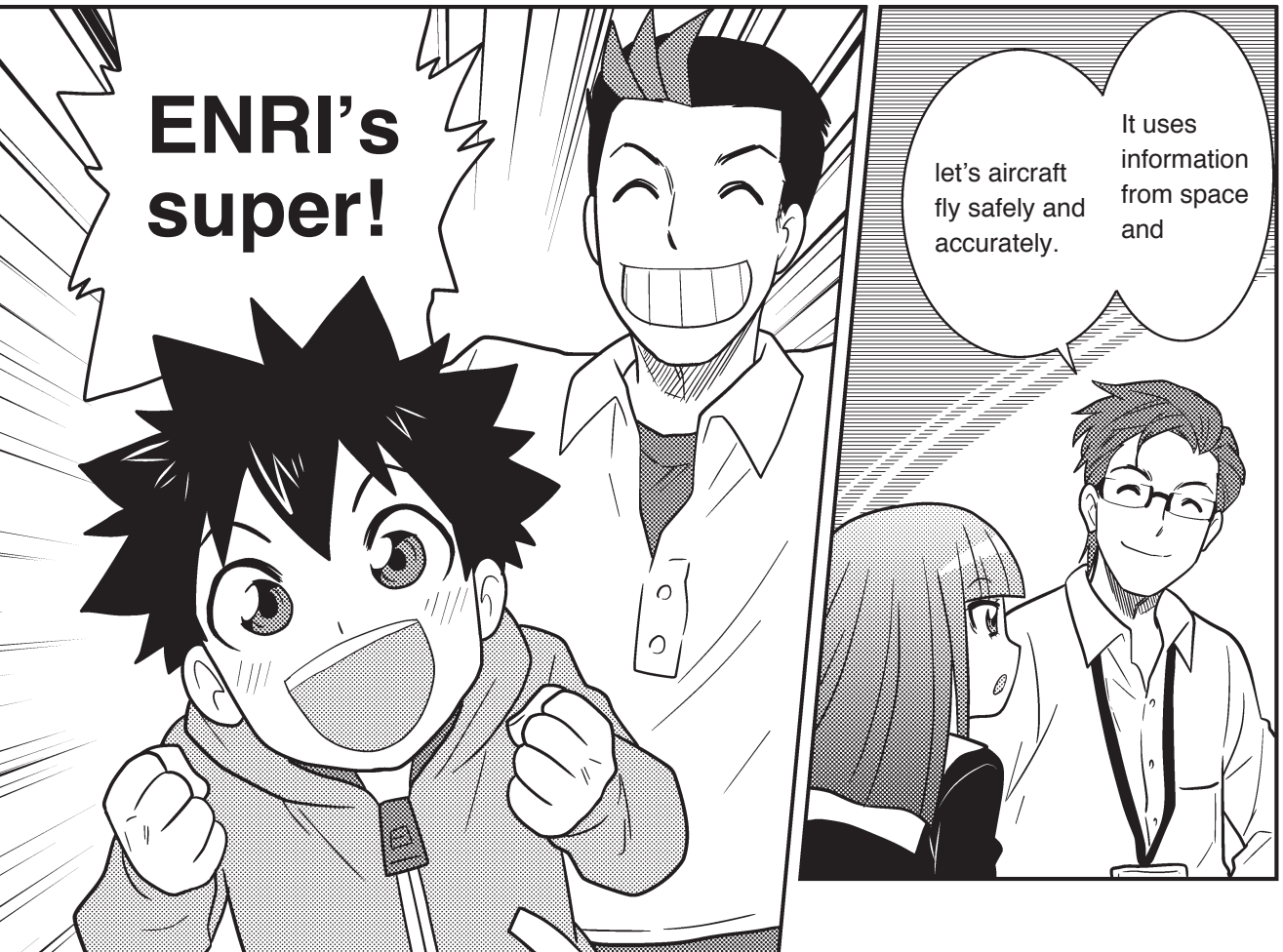

They're a little different.
Why not use techniques used in the United States and Europe, where they make big passenger aircraft?

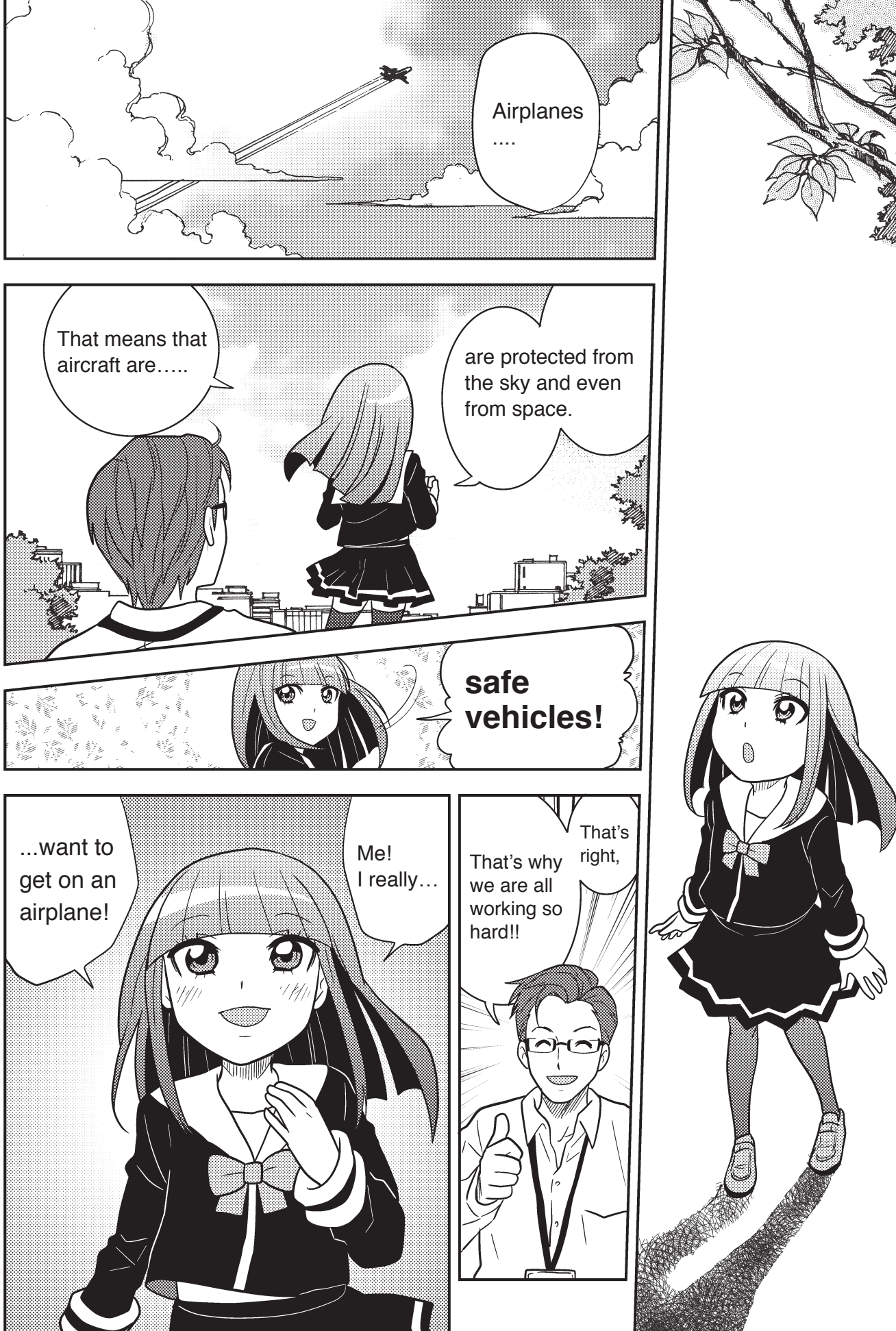

Also, compared to the United States and Europe, Japan is strongly affected by the ionosphere.
Space
Between space and the Earth, there's an ionosphere.
Ionosphere
That ionosphere causes large errors in the GPS.
The Earth


we're now researching at ENRI to solve that problem.
Wrong, wrong,
We can't use it in Japan?


GPS satellites
Geostationary satellite
Augmentation information
Reference station
Reference station
Ground station
By using this system, augmentation information is sent from geostationary satellites.
Passenger aircraft in flight use the Satellite-Based Augmentation System
SBAS


It's actually being used.


ENRI's super!
let's aircraft fly safely and accurately.
It uses information from space and


Airplanes ....
That means that aircraft are…..
are protected from the sky and even from space.
safe vehicles!
...want to get on an airplane!
Me! I really…
That's why we are all working so hard!!
That's right,


Dad, let's go on a trip by plane next summer vacation!
Aoi!
Me too!
I really understood that airplanes are protected by many people...
and the most advanced technology, and the researchers at ENRI...
...are doing their best to make it even better.


I'll teach you too!
Sure!!
Dad! Kaito!! Let me learn more about airplanes!
Wow, I feel so good!
Where should we go!? What should we get on?
Great!
Great! I'm really looking forward to it!!
OK, Let's take a plane!
To somewhere in the country? Or overseas!?
Would everyone like to come to the Electronic Navigation Research Institute to experience cutting-edge technology?

Introduction of the Research Facilities

The Electronic Navigation Research Institute (ENRI) facilities are located at 2 places, one in Chofu City, Tokyo, which is the head facility, and one at the Iwanuma branch at Sendai Airport in Miyagi Prefecture. The head facility has an SSR mode S antenna which is also called the symbol of ENRI and the largest domestic radio-wave anechoic chamber, and the Iwanuma branch takes pride in having “Yotsuba” experimental aircraft which is exclusive to ENRI, and an SSR mode S antenna.

“Yotsuba” Experimental Aircraft

ENRI is conducting experiments on actual aircraft.
This aircraft is nicknamed “Yotsuba”

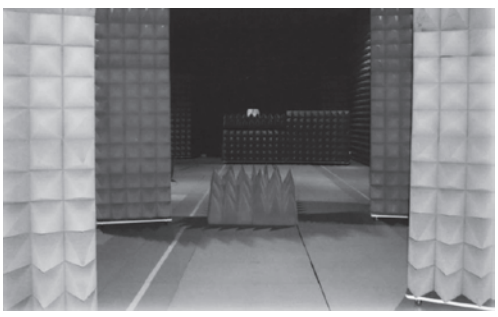
Call sign	JA35EN
Aircraft type	King Air 350
Flying altitude(capability)	over 10,000m
Flying speed (capability)	over 500km per hour
Aircraft length	14.2m
Aircraft width	17.7m
Aircraft height	4.4m
weight when fully fueled	6.8t

SSR Mode S Antennas

These new antennas are used to determine the position of flying aircraft. ENRI has 1 antenna each in both Tokyo (Chofu City) and in Miyagi Prefecture (Iwanuma branch). Only ENRI is equipped with these antennas in research institutes in Japan.

Radio-wave Anechoic Chamber

The room has spiked walls that absorb radio-waves. Radio-waves don’t enter the room from outside, and radio-waves produced inside the room disappear into the walls, so experiments can be carried out in this ideal environment. It’s the largest domestic radio-wave anechoic chamber.



The more you learn, the more you'll want to know!

At the Electronic Navigation Research Institute (ENRI)

Published on March 6, 2017

Planner : Electronic Navigation Research Institute (ENRI)
public working Division

Producer : TREND-PRO Co. Ltd.
2-12-5 Shinbashi, Minato-ku, Tokyo
Tel: ＋81-3-3519-6769
URL: http://www.ad-manga.com/

Author : Takeo Aoki

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Published by : Electronic Navigation Research Institute (ENRI)
Research Planning Division
7-42-23 Jindaijihigashi-machi, Chofu, Tokyo
Tel : ＋81-422-41-3165 (representative)
URL : http://www.enri.go.jp/

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