Preflight Interview: Kevin Kregel

Before we get into details about this flight, I want to know a little bit about you. Why did you want to become an astronaut?

Growing up on Long Island, I was inspired by the early astronauts that were going to the moon in the Apollo, the Gemini and the Mercury missions. Grumman Aerospace is big on Long Island and so it was covered very highly there. So it's something I've always wanted to do since I was a little child. I aspired to go the same route as the original astronauts and that is why I became an Air Force test pilot, got an engineering degree, and applied to the program.

Give me an overview of your career that got you to where you are right now.

I started off by going to the Air Force Academy and graduated in 1978. I went on to pilot training and flew F-111s over in England. I did an exchange tour with the Navy and flew 86s at Whidbey Island and did a carrier tour on the USS Kitty Hawk. The Air Force selected me to go to test pilot school, but they sent me to the Navy test pilot school at Patuxent River. I did that for a year, and then I went down to Eglin Air Force Base and did flight tests on F-15, F-15E and F-111 airplanes. Then in 1990 I left the service and got hired by NASA as an instructor pilot and test pilot here at the Johnson Space Center flying in aircraft ops, flying T-38s and the Shuttle Training Aircraft. Then I was fortunate enough in 1992 to be selected as an astronaut.

Summarize for me what you'll be doing during this flight. What are your primary responsibilities as the Commander?

As the Commander, my primary responsibility is to make sure that we get into orbit safely and get home safely and that the mission is conducted in a very thorough and efficient manner. Those are my prime responsibilities. This is, as you know, a 24-hour mission, so we're splitting ourselves up into Red and Blue Shift. There will be myself on the Red Shift, My Pilot, Dom Gorie, will be on the Blue Shift. We have some maneuvers that we have to do to keep ourselves in a circular orbit, so we'll each be performing those various times throughout the mission.

This shuttle mission will look back at the Earth using radar interferometry to acquire topographic data. What is radar interferometry?

If you want to think of that in simplistic terms, we're trying to get a 3D image of the Earth to build a three-dimensional topographic view of the Earth. How we will do that is we have one big radar in the payload bay and then we have two antennas; the one in the payload bay and one that's on a boom 200 feet away. By getting these two images returned from the radar, we'll be able to infer, to get a 3D-type image. Sort of like using two eyes to get depth perception.

Why is this flight important? Is there really more to be learned about the surface of the Earth?

One of the things I found fairly fascinating when I was assigned to this mission is that we've got a better 3D map of Venus and Mars than we do of the Earth. To the accuracy that we're looking at, which is about 30 meters, we right now only have about 3 to 5 percent of the Earth mapped to this kind of accuracy. Of course, we've been trying to map the Earth for ages and we're just trying to do it a little bit better on this mission. And in eleven days we can get a lot more than 3 to 5 percent.

The Shuttle Imaging Radar-C, or SIR-C, and the X-band Synthetic Aperture Radar, or X-SAR, flew in the shuttle in April and October of '94. What are the innovations for SRTM that separate it from those missions?

This mission is different from the previous Space Radar Lab missions because we've got this boom out and we've got two antennas. So instead of just taking the one picture, we're taking two pictures 200 feet apart and that gives us the capability to get the 3D image. On this one we're using the C-band radar, which is U. S., and the X-band, which is German.

What kind of resolution do you expect, and how does this compare to other forms of spaceborne imaging?

We're looking to get about a 30-meter resolution for the C-band or about 15-meter resolution on the X-band. That means that every 30 meters we'll be able to get a height above the ground to a very good accuracy, and some of the areas will be a little bit better, some will be a little bit worse. As I said, for what we're doing for covering the Earth, we only have 3 to 5 percent of the Earth. There are things that can get more accurate using different techniques but certainly not the area of coverage that we're looking at.

You've got a unique piece of hardware flying - the mast. Could you explain the process of deploying the mast? What exactly happens? How long does it take?

The mast is 200 feet long. It is about twice the size of any structure that we've put out in space before. It's a very clever device. It folds in upon itself in about a 10-foot by 4-foot canister. And then it has a little screw nut that unwinds these batons. It's a hollow type cube, and we have 86 of these different sections to make a very rigid structure. And at the end of this structure is where we have the second antenna. And it'll take us about 17-20 minutes to go ahead and fully deploy the mast.

What happens if the mast doesn't fully deploy? Could you do an EVA to fix the problem?

If the mast does not fully deploy or, for that matter, if it doesn't fully retract, we have contingencies to go ahead and do a spacewalk and try to fully retract it or fully deploy it. And also, the design of the mast is redundant in a lot of different ways, so the likelihood of that happening is very low. But we are trained and prepared to do that if necessary.

We keep harping on the problems here, but does the mast need to be fully deployed to get acceptable science? Can you get any information at all if it only partially deploys?

The way our rules are and the way we've designed everything, we need to have the mast fully deployed to get a successful mission. And the big reason is we want to make sure it's certified to fly around with it fully deployed. Partially deployed it has different strength properties. So if it's not fully deployed and we can't determine it's fully deployed, then, more than likely, we'll retract it and try to figure out what the problem is.

I understand the length of the boom creates its own special problems. What is the gravity gradient force and how does the boom affect it? What do you do to counteract it?

Well, gravity gradient is just a natural position that any kind of spacecraft that doesn't have any thrusters would want to go to. We've got a specific attitude that we want to point the radar at the Earth, and we want to stay that way all the time. With this big mast out there, there's a natural tendency for the body to move out of the position that we want to. So, we'd have to constantly fire jets using propellant to stay in the proper attitude. The folks at the Jet Propulsion Lab have designed a very small cold gas thruster on the tip of the boom which counteracts the gravity gradient force so that we don't have to use precious onboard propellant.

What is the fly cast maneuver and why are you using that?

The fly cast maneuver is what we are using to maintain a circular orbit. Again, in order to maintain the accuracy of the radar data, we need to maintain a fairly circular orbit. And, of course, because of our boom out there, there is a little bit of drag, and our orbit decays gradually over time. So, about once a day, we'll want to raise up the orbit. We've got this antenna on this 200-foot mast out there, and if we just used our normal thrusters in a normal manner, the mast would oscillate and possibly break, which of course we don't want. So the engineers here, between Johnson Space Center and the Jet Propulsion Lab and the folks at the Draper Labs, have designed a system where we'll put in an impulse, the mast will start moving, we'll stop the impulse. Right before the mast starts coming back and swinging back to its natural position, we'll add some more impulse, and it will kind of freeze the mast right there. This way we'll proceed and raise our orbit, and then, we'll stop the jets. The mast will go back towards the neutral position, and it comes in the neutral position. We'll put one more pulse in there to kind of freeze it so the mast doesn't ring out and also doesn't go outside the limits of its structural certification.

What is the process of mast retraction? Is it just simply a reverse of the deploy?

It certainly is. We will flip the antenna, and then we will retract the mast. Obviously, we will be looking at it very carefully, making sure that it rotates into the canister very nicely and precisely.

What if there is trouble with the retraction? What if it gets stuck? Can the mast be jettisoned?

Yes. Before we would jettison the mast, we'll try everything we can to use different motors and get it in and see what the real problem is. We could do a spacewalk if the problem was something mechanical, but we can if all else fails because we cannot come back with that mast hanging out there. We can safely jettison the canister and the mast.

On the surface, this has similarities to the Tethered Satellite Systems flights. You've got this long system coming out of the cargo bay. Do you anticipate having any concerns similar to the issues associated with those flights?

Well, just like Tether, anytime you have something that we've not done before (and we haven't done a mission like this before), you have to have concerns on what may happen. You don't expect them, but you have to expect the unexpected. One of the things is, if we do have a failure with the mast and how [will we] safely get away. We've trained hard, and we've also talked to the engineers, and we have flight rules in place to keep us safe.

Do you have any specific mapping targets on the Earth's surface as they did on the SRL missions?

Yes. Every piece of landmass between 60 degrees north and 60 degrees south is our targets.

Quite a big target there.

It certainly is.

Is the radar on for the entire flight? Are you collecting data as you fly over the oceans?

We're not collecting data when we fly over the oceans. The radar is just for landmass and the radar also uses a lot of energy. We only have a certain amount that we can carry on this flight. So, whenever we're not taking data, we'll have the radar on a standby mode so we're not using up our process energy.

Why is the data being recorded instead of downlinked live?

The rate of our recorders is four times faster than the rate that we can downlink. So, we can't downlink the data real time [and] get the accuracy that we need. We're doing some playbacks. We'll actually slow down the tapes to a quarter of the natural speed so that the folks on the ground can get snapshots of what we're seeing in orbit and making sure that the recorders and the radar [are] working properly. But all told, we will have nine terabytes worth of data which, I'm told, is equivalent to 15,000 CDs.

Obviously you're gathering a lot of data there. How long will it take to process all this data?

In order to process the data, it probably will take a couple of years. You know, they'll get snapshots out in a year, but it really will be a tremendous amount of data that will be analyzed by a lot of different folks around the world. There will be years as this data comes out and is available to different agencies and to the public.

Are the X-band data and the C-band data processed similarly?

They are processed very similarly. Of course, as I said the X-band data is going to the Germans. The C-band data is going to NIMA or the National Imagery and Mapping Agency.

There's something interesting on this flight. The two ASTRO astronomical observation flights used the Star Tracker, and SRTM utilizes it in a new way. Can you tell me about the Star Tracker and how it is that you're using it?

We use the Star Tracker to know the exact position of the outboard antenna. We also have some Global Positioning System receivers on the outboard antenna because it's very critical to know where that position is, so when you get the return signal you know that it's a true signal, and it's not just the fact of the antenna bouncing up and down. This is another way the Jet Propulsion Lab shows its innovation. They have these Star Trackers that they have from previous missions. They were sitting around. They said let's go use them.

What will we learn about the Earth from the data you do acquire on this mission?

We will learn the 3-D, three-dimensional, topographic map, which, of course, can be used for national security. It can also be used to, perhaps, look at earthquakes. A lot of the areas in Central America and Africa are covered by clouds. We know very little about their topographic area. Perhaps it can be used by governments to decide where not to put folks that are susceptible to landslides. You can use it for urban planning. You can use it for farmers' fields, and I'm sure as folks see this data come out, there will be lots and lots of other uses that I'm not even thinking about and that folks haven't thought about.

While you're up there, if a volcano erupts or there's some other type of natural disaster, will you be able to pay any special attention it?

Our track is pretty much set before we launch, and that's because we have to go over the same area twice in order to get the accuracy that we want for this data. So [the] only maneuvering that we will be doing to change our orbit is to get the data and the world coverage that we want. If it so happens that we have a world event and we're going over that track, obviously, we'll take pictures of it, but we won't alter our track in order to take pictures of hurricanes, or volcanoes, or the like.

Now once the payload is functioning just fine, the crew kind of slips into a regular routine. Do you think the work will get boring or tiring for you?

I can't see how anyone who's spent any time in space would say it would be boring. I can spend two weeks easily there just looking out the window. We're going to be kept pretty busy. We've got to do maneuvers every 45 minutes to maintain the accuracy that's required. We have to change out the tapes. We're there to back up when ground commanding is not available, to go ahead and start taking the data. Any time we go over land, if we're not taking data, it's data that we've missed and we cannot recoup on the rest of the flight. So, it will be the same thing, but I don't think it will be boring. It will keep us busy the whole time.

This mission includes international partners. What exactly are they contributing?

International partners Gerhard Thiele and Mamoru Mohri are both full-up Mission Specialists that are doing the same jobs as the Americans onboard. It's really showing us how far we've come towards the International Space Station. We don't have the folks doing just experiments from their own country. They're full-up crewmembers just like everybody else.

What is the National Imagery and Mapping Agency and how are they involved in the flight? Then, just describe for me the relationship between NASA and NIMA.

NIMA, or the National Imagery and Mapping Agency, is really a sponsor for this mission. They are the customer that said that they were willing to spend the money to get the data to map the majority of the Earth. The Jet Propulsion Lab are the folks that built the equipment, and they were looking for a sponsor. NIMA is the agency that said yes, they would like this data. NIMA was just formed a few years ago and is combined through several different agencies. The intelligence community and the military community, they form maps for our government and also maps for airplanes, when you go flying around on the airways throughout the United States and throughout the world.

Does NIMA get digital topographic data from their own satellites, and, if they do, why do they need this flight?

NIMA has several different ways to get data, and a lot of them I'm not privy to. But our mission is a lot different. They've been trying specifically for ten years using other resources that they have to get to this data to this kind of accuracy. In the last ten years, they got three to five percent. We can get most of the landmass between 60 degrees north and 60 degrees south in ten to eleven days. Probably money well spent.

Tell me about EarthKam; is it comparable in any way at all to the flight's primary payload?

Really EarthKam is comparable to the payload in that [they're] both looking at the Earth, and EarthKam is a project set up by the folks at [the] University of California, San Diego to help kids get involved in space. We've got a camera that is mounted in our overhead window, and that camera will be commanded by different schools that the folks in California have selected throughout the United States and throughout Germany and Japan. In the future, it will be other countries. So, these students will decide what pictures they want to take. So, they'll see when the orbiter's flying over different landmasses, and they'll say, "Okay, we'd like a picture taken at this time." They'll be able to get feedback (because it will come down through the downlink) and see how their picture turned out. So, it's an interactive way of getting kids involved in space.

Now summing up, how would you characterize the long-term importance to science of the work you and your crewmates will be doing on STS-99?

I think the data that we get from STS-99, mapping the Earth will change a lot of the way we do things in terms of any kind of geography, Urban planning, mission planning, looking at earthquakes, looking at farms. We'll just be the start of it, but we will hopefully, in ten or eleven days, multiply many times our knowledge of our Mother Earth. And I think that will be really important. It will take a while to crank out that data, but I think [it] will keep a lot of scientists busy for a long, long time.

Greetings

Click on the image to hear Kevin's greeting.
Commander, STS-99

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