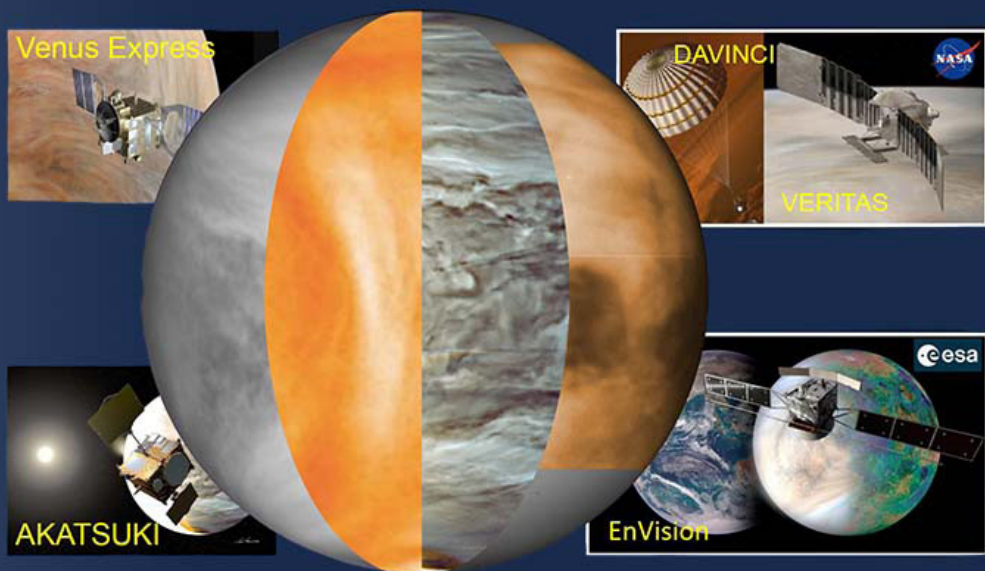


# VARIABILITY AND STABILITY OF THE VENUS ATMOSPHERE

IN VARIOUS SPATIOTEMPORAL SCALES INFERRED  
FROM SPACE MISSIONS AND NUMERICAL  
SIMULATIONS



## WORKSHOP HANDBOOK

JUNE 02-06, 2025



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## ABOUT ISSI-BJ

The International Space Science Institute in Beijing (ISSI-BJ) was jointly established by the National Space Science Center (NSSC) and the International Space Science Institute (ISSI) with the support of the International Cooperation Bureau and the Space Science Strategic Project of the Chinese Academy of Sciences (CAS). ISSI-BJ is a close cooperation partner of ISSI in Bern. The two institutes share the same Science Committee, the same study tools, and other information of mutual relevance and interest. However, both use independent operational methods and different funding sources.

ISSI-BJ is a non-profit research institute. Our main mission is to contribute to the achievement of a deeper scientific and technological understanding of future space missions as well as of the scientific results from current and past missions through multidisciplinary research, possibly involving, whenever felt appropriate, ground-based observations, modelling, numerical simulations and laboratory experiments, using the same tools as ISSI, i.e. Forums, International

Teams, Workshops, Working Groups or individual Visiting Scientists. The Program of ISSI-BJ covers a widespread spectrum of space science disciplines, including astrophysics, solar and space physics, planetary science, astrobiology, microgravity science and Earth observation from space.

ISSI-BJ is an independent and politically neutral institute. We offer generous financial support to the scientists that come to Beijing: we offer coffee breaks, snacks, lunches and dinner at our institute, as well as travel and hotel expenses for the conveners of Workshops and Forums, and the leaders of the International Teams. After each meeting, we also offer support for publishing and promoting articles, essays and peer-reviewed papers.



# ISSI-BJ CALL FOR PROPOSALS

## ISSI-BJ Activities

ISSI-BJ organizes a wide range of activities, such as Forums, Workshops, Working Groups, and International Teams. Applications to join our programs are always welcome. More information available at [www.issibj.ac.cn](http://www.issibj.ac.cn).



### International Teams

Annual Call in January

Goal: Research focus, 10-15 scientists

Duration: 5 days each time

Result: Publications

Support: Living costs while in Beijing, travel support to team leader



### Workshops

Goal: Research focus, 30-40 scientists

Duration: 5 days

Result: Book

Support: Living costs while in Beijing



### Forums

Goal: Open discussion among 20-30 scientists

Duration: 2 days

Result: Taikong Magazine

Support: Living costs while in Beijing



### Working Groups

Goal: Specific tasks, 8-12 scientists

Duration: As long as needed

Result: Springer ISSI Scientific Report Series (SR)

Support: Living costs while in Beijing, travel support if needed

## ORGANIZER

The Workshop “Variability and Stability of the Venus' Atmosphere in Various Spatiotemporal Scales Inferred from Space Missions and Numerical Simulations” is organized by International Space Science Institute-Beijing (ISSI-BJ).

### Conveners

- Takehiko Satoh, Institute of Space and Astronautical Science/Japan Aerospace Exploration Agency, Japan
- Hiroki Ando, Kyoto Sangyo University, Japan
- Takeshi Imamura, The University of Tokyo, Japan
- Jun Yang, Peking University, China
- Yeon Joo Lee, Institute for Basic Science, Republic of Korea
- Silvia Tellmann, University of Cologne, Germany
- Itziar Garate Lopez, University of the Basque Country, Spain
- Kevin McGouldrick, University of Colorado Boulder, USA

### Sponsor



### More Information



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## WORKSHOP PROGRAM

### Context

Venus, while being called often times as the earth's twin sister, has distinctly different environment from ours: the atmosphere consists mostly of carbon dioxide with ~90 atmospheric pressures at the ground surface, hence the extreme greenhouse effect maintains high temperature of the surface, ~730 K. The globe is completely shrouded by the thick clouds (primarily sulfuric acid droplets) at about 50 – 70 km altitudes, making it difficult, if not impossible, to obtain 3-dimensional views of atmospheric dynamics (chemistry as well). In the 20th century, however, several entry probe missions from USSR and from USA enabled to partially study the sub-cloud atmospheric conditions. Still, our knowledge about the dynamics remained limited due to the lack of long-term continuous data with sufficient spatial coverage.

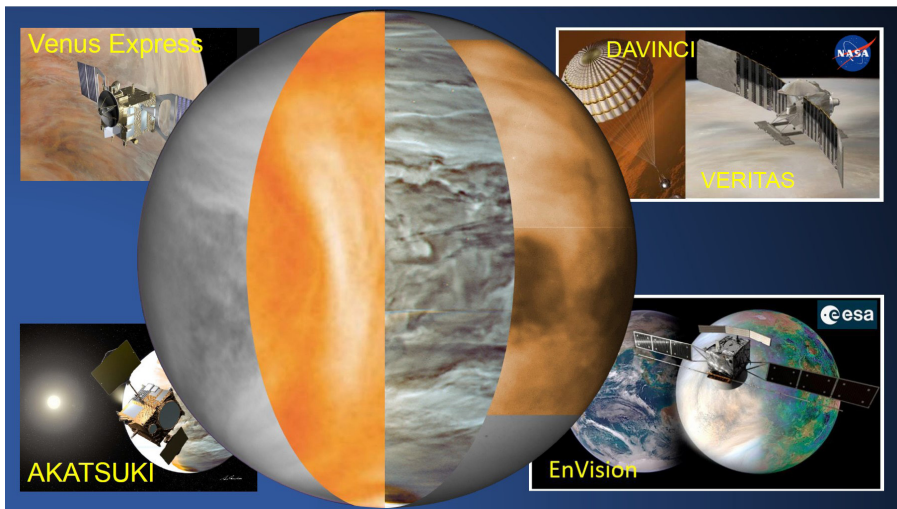
The situation has been improved in this 21st century by three major factors: the

first one is the discovery of near-infrared transparency windows in the Venus' atmosphere in 1983, which opened possibility to sense the sub-cloud atmosphere from the remote (partially utilized by NASA's Galileo mission when it flew by Venus); the second one is ESA's Venus Express mission which was in Venus orbit for over 8 years (2006 – 2014); and the third one is JAXA's Akatsuki mission which was inserted to Venus orbit in December 2015 and is still actively acquiring the data (the mission extension approved until March 2029). Venus Express and Akatsuki together enhanced our knowledge about the atmospheric dynamics, not only limited to the cloud-top level but to some extent to sub-cloud regions. In addition, the observing duration from 2006 to 2024 (or even to 2029) provides an opportunity to study long-term variability from the data set of assured quality.

## Objectives

The aim of the Workshop is to intensively discuss the variability and stability of the Venus' atmosphere based on the analysis of data from space missions, as well as the numerical simulations. Since the duration of Akatsuki after the orbit insertion is becoming comparable to the one of the Venus Express', the data from both missions can be analyzed individually or by combination. During the Workshop, participants will identify points in common and differences in these two missions and interpret them in terms of mechanisms. Specific interests include the followings:

- Stability and variability of the zonal wind (super rotation) speed
- Albedo (in ultraviolet) changes and the energy budget
- Changes in SO<sub>2</sub> abundance at the cloud-top level with related chemistry
- Changes in atmospheric vertical structure (inferred from radio occultation)





## Program

### Monday 02 June 2025

#### **Session 1: 20th Century Knowledges & Remaining Enigmas About Venusian Atmosphere (Chairs: Takehiko Satoh, Ashimananda Modak)**

09:00-09:10	Welcome & Introduction	Xiaolong Dong
09:10-09:35	USSR Missions (Historical Challenges)	Dmitrij Titov
09:35-10:00	Mariners & Pioneer Venus Orbiter	Sanjay Limaye
10:00-10:30	Coffee Break	
10:30-10:55	Novel Cloud Aerosol Composition from Pioneer Venus Large Probe Data	Rakesh Mogul (online)
10:55-11:20	Current Status of Japanese Venus Climate Orbiter Akatsuki	Masato Nakamura
11:20-12:00	Space-age Discoveries & How to Address the Unsolved Mysteries of the Venus Atmosphere	Larry Esposito (online)

#### **12:00-13:00 Lunch Break**

#### **Session 2: Overviews of the Latest Venus Missions: Venus Express & Akatsuki (Chairs: Kevin McGouldrick, Rommy Aliste Castillo)**

13:00-13:30	Venus Express Achievements (excl. VeRa)	Dmitrij Titov; Silvia Tellmann
13:30-13:55	Venus Atmospheric Dynamics from the Lowest Clouds to the Mesosphere from Venus Express	Ricardo Hueso
13:55-14:20	Possible Evidence of Crustal Magnetic Field on Venus: Results from Venus Express	Zhaojing Rong
14:20-14:50	Coffee Break	
14:50-15:20	Akatsuki Achievements (excl. RS)	Takeshi Imamura; Takehiko Satoh

15:20-15:40	Cloud Discontinuity	Takehiko Satoh
15:40-16:00	Hydraulic Jump Model	Takeshi Imamura
16:00-16:20	Discussion	
16:20-17:20	Preparation for the Drafting of the Review Papers	Xiaolong Dong; Takehiko Satoh

## Tuesday 03 June 2025

### Session 3: Atmospheric Structure (Chairs: Yeon Joo Lee, Dexin Lai)

09:00-09:25	VEx/VeRa Overview	Silvia Tellmann
09:25-09:50	Akatsuki/RS Overview	Takeshi Imamura
09:50-10:10	Polar Region Structure	Hiroki Ando ( <i>online</i> )
10:10-10:25	Exploring Super-rotation & Zonal Wind Dynamics in Venus' Middle Atmosphere: Insights from Akatsuki Radio Occultation Data	Ancy Jerald
10:25-10:45	Coffee Break	
10:45-11:05	Repeat Pass Interferometry & SO <sub>2</sub> Variability in the Lower Atmosphere	Scott Hensley ( <i>online</i> )
11:05-11:25	Research on Passive Microwave Remote Sensing of the Atmosphere Below & Within the Sulfuric Clouds of Venus	Zijin Zhang; Wenyu Wang
11:25-11:40	Venusian Polar Tropopause Variations Using Radio Occultation	Miyu Sugiura
11:40-12:05	Oxygen, Reduced Sulfur Species & UV Absorption in the Venusian Atmosphere	Franklin Mills ( <i>online</i> )
12:05-12:25	Prospects for Future Trace Species Detections at UV Wavelengths, Lessons from Hubble	Kandis Lea Jessup ( <i>online</i> )
12:25-13:25	Lunch Break	

**Session 4: Atmospheric Chemistry, Albedo & Aerosols**  
**(Chairs: Itziar Garate Lopez, Ancy Jerald)**

13:25-13:50	Venus UV Albedo (Korean Cubesat)	Yeon Joo Lee
13:50-14:05	Local Time Dependence of UV Albedo of Venus	Rommy Aliste Castillo
14:05-14:20	Investigating FeCl <sub>3</sub> from Meteoric Iron as a Near-UV Absorber in Venusian Clouds	Joanna Egan ( <i>online</i> )
14:20-14:40	Variability of Aerosol Properties in the Upper Haze of Venus from SPICAV-UV, SPICAV-IR & SOIR Solar Occultation Observations Onboard Venus Express	Mikhail Luginin
14:40-14:55	A Microphysics Model of Multicomponent Venus' Clouds with a High-Accuracy Condensation Scheme	Hiroki Karyu
14:55-15:15	Coffee Break	
15:15-15:35	Microphysical Modeling	Kevin McGouldrick
15:35-15:50	Radiative Transfer Modeling Study to Retrieve SO <sub>2</sub> Abundance & Unknown Absorbers on Venus	Ashimananda Modak
15:50-16:10	Water and Sulfur Dioxide Thermal Mapping on Venus: Long-term Monitoring & Vertical Distribution of SO <sub>2</sub> Within & Above the Clouds	Therese Encrenaz ( <i>online</i> )
16:10-16:25	1D Model Study of Venusian Sulfur Cycles in the Clouds & Atmospheric Chemistry	Longkang Dai
16:25-16:40	Temporal & Spatial Variability of Cloud Properties & Temperature Profiles from VIRTIS-M Data	Jaime Reyes Guerrero
16:40-17:00	Discussion	
18:00	Social Dinner at Second Floor Park Plaza Hotel	

## Wednesday 04 June 2025

### Session 5: Atmospheric Dynamics: Stability & Variability of the Zonal Wind & Atmospheric Waves (Chairs: Jun Yang, Jaime Reyes Guerrero)

09:00-09:25	What Can Venus's Clouds Tell us About the Atmospheric Circulation & its Evolution?	Javier Peralta
09:25-09:50	Venus Atmospheric Circulation & its Variations from VMC/Venus Express & UVI/Akatsuki Imaging	Marina Patsaeva
09:50-10:15	Variability of Winds at Around the Cloud Top of Venus	Takeshi Horinouchi
10:15-10:25	Group Photo	
10:25-10:45	Coffee Break	
10:45-11:00	Mountain Waves & Thermal Tides of the Venusian Atmosphere Analyzed through Thermal Infrared Images & Radio Occultation	Zhuan Guo
11:00-11:25	How Do Planetary-scale Waves Drive Venus Cloud-layer Superrotation?	Tao Li
11:25-11:50	Dynamics of the Venus Polar Vortices	Itziar Garate Lopez
11:50-12:15	A Possible Explanation on the Dynamics of Venusian Binary Polar Cyclones	Tao Cai
12:15-12:30	Discussion	
12:30-13:30	Lunch Break	
	Free Afternoon	

## Thursday 05 June 2025

### Session 6: Atmospheric Dynamics (Continued); Ionosphere & Aeronomy (Chairs: Silvia Tellmann, Hiroki Karyu)

09:00-09:25	Observation of a 5-day Transient Wave at the Cloud Top of Venus by Akatsuki	Masataka Imai (online)
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09:25-09:50	Atmospheric Heat Transport on Terrestrial Exoplanets: from Exo-Mercuries to Exo-Venuses	Daniel Koll
09:50-10:15	Venus' Atmospheric Studies: AGW (Akatsuki UVI) & Doppler Winds, Volcanic Plumes (Modelling)	Pedro Machado
10:15-10:30	How Thermal Tides Contribute to Venus Cloud-Layer Superrotation	Dexing Lai
10:30-10:50	Coffee Break	
10:50-11:15	Formation of Meteor Layer (V0) in Venusian Ionosphere Due to Interplanetary Dust Ablation	Jayesh Pabari
11:15-11:40	Hydrogen escape on Venus driven by protonated chemistry	Hao Gu
11:40-11:55	The Response of the Venusian Upper Atmosphere During the Passage of Interplanetary Coronal Mass Ejections	Diptiranjana Rout (online)
11:55-12:20	The Variability of the Topside Ionosphere of Venus as Seen by VEX VeRa	Kerstin Peter (online)
12:20-13:20	Lunch Break	
<b>Session 7: Numerical Simulations, Including Data Assimilation (Chairs: Takeshi Imamura, Miyu Sugiura)</b>		
13:20-13:35	Dynamics & Variability of the Venusian Atmosphere: Insights from Models & Observations	Jayadev Pradeep (online)
13:35-13:55	Modelling the Atmospheric Dynamics in Terrestrial Planets	Yoshiyuki Hayashi
13:55-14:15	Model Development & Simulation Applications for the Martian Atmosphere	Yiyuan Li
14:15-14:35	Formation & Quasi-Periodic Variation of Equatorial Jet Caused by Planetary-Scale Waves in the Venusian Lower Cloud Layer	Masahiro Takagi (online)

14:35-14:55	Planetary-scale Waves in a Venus AORI GCM	Masaru Yamamoto (online)
14:55-15:15	Coffee Break	
15:15-15:35	Stably Stratified Layer in the Lower Atmosphere of Venus	George Hashimoto
15:35-15:55	Status of the Venus PCM, Results & Needs for Improvements	Sebastien Lebonnois (online)
15:55-16:10	Towards In-droplet Sulphur Chemistry in the Venus Clouds with the Venus Planetary Climate Model (PCM)	Alberto Mendi (online)
16:10-16:30	Recent Improvements & Results of AFES-Venus & ALEDAS-V	Norihiko Sugimoto
16:30-16:45	Unveiling Energy Conversions of the Venus Atmosphere by the Bred Vectors	Jianyu Liang
16:45-17:05	Science Activities Related to VenSpec-U/EnVision	Emmanuel Marcq (online)
17:05-17:25	Discussion	

## Friday 06 June 2025

Session 8: Outstanding Problems & Future Missions (Chairs: Xiaolong Dong, Jianyu Liang)		
09:00-09:20	Sources of Hydrogen in the Primordial Atmosphere of Venus	You Zhou
09:20-09:40	Climate Evolution of Early Venus: Two Different Scenarios	Jun Yang
09:40-10:00	Retention of Surface Water on Rocky Planets in the Venus Zone	Feng Ding
10:00-10:20	Photochemistry & Haze in Chemically Reducing Terrestrial Atmospheres	Siteng Fan
10:20-10:40	From Lab to Cosmos: Simulating Planetary Atmospheric Chemistry	Chao He

10:40-11:00	Coffee Break	
11:00-11:20	Life on Venus	Sanjay Limaye
11:20-11:40	LEAVES: Exploring Tricky Questions with New Paradigms	Kandis Lea Jessup (online)
11:40-12:00	VERITAS: Providing the Next Generation of Geologic & Geophysical Measurements of Venus	Scott Hensley (online)
12:00-13:00	Lunch Break	
<b>Session 8: Session Continued (Chairs: Takehiko Satoh, Zhuan Guo)</b>		
13:00-13:20	EnVision	Silvia Tellmann
13:20-13:40	Indian VOM	Maria Antonita
13:40-14:00	The Venera-D Mission for a Comprehensive Study of Venus	Dmitry Gorinov
14:00-14:20	Japanese CROVA	Hiroki Ando (online)
14:20-14:40	Coffee Break	
14:40-15:20	Chinese Venus Mission	Xiaolong Dong; Representatives from DSEL
15:20-15:40	Discussion	
15:40-15:50	Concluding Remarks	Xiaolong Dong
15:50	End of Workshop	

## PRACTICAL INFORMATION

### Venue

The Workshop will be held in the Earth Hall (A0401), NSSC building A, 4th Floor.

#### Address:

No. 1 Nanertiao, Zhongguancun, Haidian District, Beijing, 100190  
北京市海淀区中关村南二条一号

#### ISSI-BJ Office:

The ISSI-BJ office is located at NSSC, Building A, 4th Floor. It is equipped with a printer, connected to staff members' computers. If you need to print something, you can send the file both via email or USB transfer.

### WIFI Access

To access WIFI, please connect to NSSC-Guest, and then fill in the information as shown here down below:

NSSC-Guest  
10.10.0.3

NSSC 中国科学院国家空间科学中心  
National Space Science Center, CAS

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Code Auth

\* 姓名:  
(Name) YOUR NAME

\* 单位:  
(Department) ISSI-BJ

\* 邀请码:  
(Invite Code) 531017

☒ 我已阅读并同意网络使用规定 (I Agree)

提交  
Submit

重置  
Reset



## Accommodation

ISSI-BJ covers the cost of the accommodation and breakfast. Please kindly note that all the other expenses in hotel will be deducted from your check-in deposit.

Park Plaza Hotel Beijing Science Park No. 25, Zhichun Road, Haidian District, 100083, Beijing China

北京市海淀区知春路25号

**Directions:** Turn right when going out of Park Plaza Hotel and walk straight for 3 minutes, there is road

“DAYUNCUN LU” (大运村路) in front of the Exit F of ZHICHUNLU (知春路) subway station, then keep going north along “DAYUNCUN LU” (大运村路) for 7-8 minutes, there is JINGZHANG RAILWAY PARK (京张铁路遗址公园) on your left, pass by the football field in the park, and follow the sign (down below) towards the National Microgravity Laboratory Tower, then cross the path, NSSC (国家空间科学中心) is located at the end of the path.



## Lunches

Lunches for all participants of the ISSI-BJ Workshop will be

available at the canteen on the -1 floor of the NSSC Building A.

## Coffee Breaks

Coffee breaks will be provided by ISSI-BJ just in front of Earth Hall.

See the Program section to check the coffee break times.

## Useful Information

*Credit Cards:* credit and debit cards can be used in ATMs displaying the appropriate sign. Credit cards are increasingly becoming accepted in major shopping zones and high level restaurants.

You can find an ATM at the NSSC lobby of Building A.

*Currency:* Chinese Yuan Renminbi (RMB)  
(1 USD = approx. 7.2 RMB)  
(1 EUR = approx. 7.8 RMB)

*Electricity:* 220 volts AC

*Cash and Eletronic Payment:* since cash is not usually accepted, we suggest you to connect your credit card to Wechat and Alipay, which can also be used to purchase subway tickets.

*Drinking Water:* Avoid drinking tap water directly. Bottled water and mineral water can be found in convenience stores and drink stalls. The price is 2-10 yuan RMB per bottle.

## Emergency Contacts in China

Ms. Lijuan EN +86-136 9912 1288

Ms. Francesca GARFAGNOLI +86-195 6873 9884

## Dinner on June 03

Dinner offered by ISSI-BJ on Tuesday, June 03, 2025 at 18:00.

**Restaurant:**

Amber 6, 2nd Floor of Park  
Plaza Beijing Science Park  
丽亭华苑酒店2楼金辉6厅

**Address:**

No. 25 Zhichun Road,  
Haidian District, Beijing  
北京市海淀区知春路25号



## PARTICIPANTS

No.	Name	Affiliation
-----	------	-------------

### CONVENERS

1	Hiroki Ando ( <i>online</i> )	Kyoto Sangyo University, Japan
2	Takeshi Imamura	The University of Tokyo, Japan
3	Itziar Garate Lopez	University of the Basque Country, Spain
4	Yeon Joo Lee	Institute for Basic Science, Republic of Korea
5	Kevin McGouldrick	University of Colorado Boulder, USA
6	Takehiko Satoh	Institute of Space and Astronautical Science/Japan Aerospace Exploration Agency, Japan
7	Silvia Tellmann	University of Cologne, Germany
8	Jun Yang	Peking University, China

### PARTICIPANTS

9	Rommy Aliste Castillo	Institute for Basic Science, Republic of Korea
10	Tao Cai	Macau University of Science and Technology, China
11	Longkang Dai	Southern University of Science and Technology, China
12	Xiaolong Dong	National Space Science Center, Chinese Academy of Sciences, China
13	Feng Ding	Peking University, China
14	Siteng Fan	Southern University of Science and Technology, China

15	Dmitry Gorinov	Space Research Institute, Russian Academy of Sciences, Russia
16	Hao Gu	Sun Yat-sen University, China
17	Zhuan Guo	The University of Tokyo, Japan
18	George Hashimoto	Kobe University, Japan
19	Yoshiyuki Hayashi	Kobe University, Japan
20	Chao He	University of Science and Technology of China, China
21	Takeshi Horinouchi	Hokkaido University, Japan
22	Ricardo Hueso	University of the Basque Country, Spain
23	Ancy Jerald	Mahatma Gandhi College, University of Kerala, India
24	Hiroki Karyu	Tohoku University, Japan
25	Daniel Koll	Peking University, China
26	Dexin Lai	University of Science and Technology of China, China
27	Tao Li	University of Science and Technology of China, China
28	Yiyuan Li	Institute of Atmospheric Physics, Chinese Academy of Sciences, China
29	Jianyu Liang	RIKEN Center for Computational Science, Japan
30	Sanjay Limaye	University of Wisconsin, USA
31	Mikhail Luginin	Space Research Institute, Russian Academy of Sciences, Russia
32	Pedro Machado	Institute of Astrophysics and Space Sciences, Portugal

33	Ashimananda Modak	Institute for Basic Science, Republic of Korea
34	Masato Nakamura	Institute of Space and Astronautical Science/Japan Aerospace Exploration Agency, Japan
35	Jayesh Pabari	Physical Research Laboratory, Ahmedabad, India
36	Marina Patsaeva	Space Research Institute, Russian Academy of Sciences, Russia
37	Javier Peralta	University of Seville, Spain
38	Jaime Reyes Guerrero	University of the Basque Country, Spain
39	Zhaojin Rong	Institute of Geology and Geophysics, Chinese Academy of Sciences, China
40	Norihiko Sugimoto	Keio University, Japan
41	Miyu Sugiura	The University of Tokyo, Japan
42	Maria Antonita Thithonis	Indian Space Research Organization, India
43	Dmitrij Titov	Sun Yat-sen University, China
44	Wenyu Wang	National Space Science Center, Chinese Academy of Sciences, China
45	Zijin Zhang	National Space Science Center, Chinese Academy of Sciences, China
46	You Zhou	Chengdu University of Information Science and Technology, China

## ONLINE SPEAKERS

47	Joanna Egan	University of Leeds, UK
48	Therese Encrenaz	Laboratory of Space and Instrumental Studies for Astrophysics, France
49	Larry Esposito	University of Colorado Boulder, USA
50	Scott Hensley	NASA Jet Propulsion Laboratory, USA
51	Masataka Imai	The University of Tokyo, Japan
52	Kandis Lea Jessup	Southwest Research Institute, USA
53	Sebastien Lebonnois	Sorbonne University, France
54	Emmanuel Marcq	Atmospheric Space Observations Laboratory, France
55	Alberto Mendi	The Institute of Astrophysics of Andalusia, Spain
56	Franklin Mills	The Australian National University, Australia
57	Rakesh Mogul	California State Polytechnic University, Pomona, USA
58	Kerstin Peter	University of Cologne, Germany
59	Jayadev Pradeep	Vikram Sarabhai Space Centre, India
60	Diptiranjana Rout	National Atmospheric Research Laboratory, India
61	Masahiro Takagi	Kyoto Sangyo University, Japan
62	Masaru Yamamoto	Kyushu University, Japan

## NOTES









# THE PRIME NETWORKING VENUE FOR SPACE SCIENTISTS IN EAST ASIA

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