

# Foundation of the Asia-Oceania VLBI Group for Geodesy and Astrometry

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**Abstract** The Asia-Oceania VLBI Group for Geodesy and Astrometry (AOV), which is a group of scientists in the Asia-Oceania region supporting geodetic and astrometric Very Long Baseline Interferometry (VLBI), was newly established in 2014. Like the European VLBI Group for Geodesy and Astrometry (EVGA), it is a subgroup of the International VLBI Service for Geodesy and Astrometry (IVS). This article traces the beginning and progress toward the inauguration of the AOV.

## 1 Background

The International VLBI Service for Geodesy and Astrometry (IVS) is an international collaboration of organizations which operate or support Very Long Baseline Interferometry (VLBI) components. Since its foundation in 1999, the IVS has provided a service to support geodetic and astrometric research and operational activities, promoted technology development for VLBI and facilitated interaction between individuals in the VLBI community.

However two decades before the establishment of the IVS, European countries had organized the European VLBI Group for Geodesy and Astrometry (EVGA) and held the first European VLBI meeting in April 1980 in Bonn, Germany [1]. The EVGA was

mainly devoted to geodetic, or rather geodynamic, and astrometric research, but was open also to subjects of general interest that were relevant to VLBI. It is safe to say that the EVGA was the prototype of today's IVS. The EVGA has implemented regional VLBI observations on a regular basis with a permanent network of fixed stations (now called EUROPE session) and encouraged cooperation and personnel exchanges among member organizations through holding a biennial meeting. Their approach has paid off and they continue to play a leading role in the international VLBI community.

In the Asia-Oceania region, there has been cooperation between relevant VLBI organizations in each country, but less international collaboration. Up until the early days of the IVS, there were few VLBI telescopes devoted to geodetic observations in this region. According to the 1999 IVS Annual Report, only five organizations from the region (one from China and four from Japan) were listed as the IVS Member Organizations. In the last ten years or so, several organizations from Australia, New Zealand, and South Korea became IVS Member Organizations and many telescopes for geodesy such as the AuScope array, Warkworth, and Sejong were newly erected. Today, the IVS Member Organizations in Asia-Oceania play a crucial part in geodetic and astrometric VLBI activities in the world. In 2013 we proposed that Asia-Oceania should also establish a regional community for geodetic and astrometric VLBI along the lines of the EVGA.

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## 2 Progress

In March 2013, several researchers from East Asian countries participated in the 21st EVGA Meeting held at Aalto University in Finland. Junggho Cho, Fengchun Shu, and Shinobu Kurihara discussed the idea of regional collaboration on geodetic VLBI among South Korea, China, and Japan sitting at the same table in the dinner of the meeting (Figure 1). We concurred on the need for establishing a new regional community for VLBI and discussed what action should be taken to fulfill the idea. We three brought it back home and encouraged VLBI colleagues in each country to agree with the plan and to be involved in the community. In subsequent further discussions, we came to the conclusion that the involvement of VLBI institutions in Oceanian countries was also necessary for more effective cooperation in this region.

We solicited colleagues in Australia and New Zealand to take part in the regional VLBI community. They already have started a series of VLBI sessions called AUSTRAL with a network including AuScope, Warkworth, and HartRAO and organized a cooperative framework in the Southern Hemisphere. Oceanian colleagues were interested in the plan and favored being involved in the new regional community with East Asian countries.

In September 2013, colleagues from several VLBI institutions in Australia, New Zealand, and Japan met after the IAG Scientific Assembly held at Potsdam, Germany. We agreed on the foundation of a regional VLBI community and confirmed that it should be a subgroup of the IVS in the same way that the EVGA is. The community was named the Asia-Oceania VLBI Group for Geodesy and Astrometry, and its acronym was tentatively called AOV. Jim Lovell undertook to draft the Terms of Reference. In the IVS Directing Board Meeting on September 7th, Shinobu Kurihara reported that Asian and Oceanian countries intended to establish a regional VLBI group similar to the EVGA, and the Board fully approved this notion.

Though the Terms of Reference are similar to those of the EVGA, they focus on issues particular to the region. In particular, the Terms of Reference stipulate that the AOV plays an important role through measurement of tectonic plate motion, atmospheric variation and the determination of the Geodetic Reference Frame for the region in order to better understand the risks and

reduce the effect of destructive earthquakes, tsunamis, typhoons and cyclones which frequently cause serious damage to the region.

We continued to work toward establishing the AOV and held our inaugural meeting in conjunction with the 8th IVS General Meeting in Shanghai, China in March 2014. As of the end of 2013, while the draft of the Terms of Reference were almost completed, we determined the need for strong leadership from a publicly elected Chair and Secretary so as to formally inaugurate the group. Since the election took a couple of months, we decided to hold the election after the Shanghai meeting. The announcement of the Shanghai meeting was sent out to all the IVS Associated Members in the Asia-Oceania region (more than 80 individuals) at the beginning of January, and many researchers and engineers expressed their interest. At the Shanghai meeting on March 1st, more than 30 participants discussed the draft of the Terms of Reference, the process to appoint the Chair and Secretary and their duties, and plans for initial AOV activities (Figure 2).

At the opening of the IVS General Meeting on March 2nd, Dr. Axel Nothnagel, the Chair of the IVS Directing Board, introduced the foundation of the AOV to the IVS community in general as one of the three important activities with GGOS, together with the UN Global Geospatial Information Management (UN-GGIM) and data referencing through Digital Object Identifiers (DOI) initiatives.

In September 2014, the election of the first AOV Chair was held, led by five members of the Election Committee (Shinobu Kurihara, Stas Shabala, Fengchun Shu, Sergei Gulyaev, and Junggho Cho). The call for nomination was sent out to all AOV members, and a special web site for the election was set up at the Shanghai Astronomical Observatory. There were two candidates for the Chair position, and 12 institutions (Table 1) cast one vote each. But it ended in a tie, thus the final decision went to the vote by the Election Committee. As a result, Jim Lovell from the University of Tasmania was elected as the first Chair of AOV. According to the Terms of Reference approved on September 1st, the Chair is to appoint the Secretary, and considering geographical balance, if the Chair is from Oceania, the Secretary must be appointed from Asia – and vice versa. Jim appointed Ryoji Kawabata from the Geospatial Information Authority of Japan (GSI).



**Fig. 1** The dinner time discussion in Finland on March 6th, 2013.



**Fig. 2** The meeting at Shanghai Astronomical Observatory on March 1st, 2014.

The Chair and Secretary held a face-to-face meeting at Tsukuba, Japan just after the inauguration ceremony of the Ishioka VGOS Station and discussed how to organize and coordinate regional VLBI obser-

**Table 1** Member Organizations of the Asia-Oceania VLBI Group for Geodesy and Astrometry. Shanghai and Xinjiang are registered as CAS in the list of IVS Member organizations, but in consideration of balance of population they are counted as two institutes in AOV.

Name of Member Organizations	Country
Geoscience Australia	Australia
University of Tasmania	Australia
Commonwealth Scientific and Industrial Research Organisation	Australia
Shanghai Astronomical Observatory	China
Xinjiang Astronomical Observatory	China
Geospatial Information Authority of Japan	Japan
National Astronomical Observatory of Japan	Japan
National Institute of Information and Communications Technology	Japan
National Institute of Polar Research	Japan
Auckland University of Technology	New Zealand
Korea Astronomy and Space Science Institute	South Korea
National Geographic Information Institute	South Korea

vations. It was decided that a survey to grasp resources of telescopes, correlators, and analysis centers in the Member Organizations would be carried out.

As a result of the survey sent in December, the representatives of the AOV Member Organizations offered their resources including three schedulers, 16 network stations, three correlators, and two analysis centers to the observations for AOV. The first regional VLBI observations by the Asia-Oceanian VLBI network will commence early in 2015.

### 3 Expected Activities of the AOV

Here we describe the expected activities of the AOV that have been discussed in past meetings and in some email discussion.

#### 3.1 Regular Regional VLBI Observations

Regional VLBI observations in Asia-Oceania on a regular basis will produce the most tangible and practical results in the initial activities of the AOV. Until now, the international VLBI sessions have been implemented under the IVS. However the Asia-Pacific Space Geodynamics program (APSG), which has two sessions in a year, is the only VLBI series optimized to Asia-Oceania region. We will conduct six 24-hour sessions in a year. A large number of AUSTRAL sessions have

already been planned for 2015 and so our strategy is to expand six of these to include as many Northern Hemisphere Asia-Oceania telescopes as possible. These sessions should be renamed AOV sessions. Details such as frequency sequence, bandwidth, rate of sampling, and time of the session start are to be determined as soon as possible. The observed data should be correlated at one of the correlators in this region. The Shanghai VLBI Correlator, the Tsukuba VLBI Correlator, and the National Geographic Information Institute have offered to process the AOV data. The observed data will be e-transferred to the correlator via network, not media shipping. For the baseline between Hobart and Tsukuba, the real-time data transferring and near real-time data processing are available at the Tsukuba Correlator [2].

The correlated data in these AOV sessions will be analyzed and compared by more than two analysis centers and these results will be fed back to the schedulers to improve the quality of data products in following AOV sessions. The results will also contribute to the construction of the regional reference frames in this area.

#### 3.2 Scientific Meeting

It is essential to hold a plenary scientific meeting on VLBI like the EVGA meeting and the IVS General Meeting for sharing and discussing technical matters and giving researchers a chance to get to know each

other. A new inter-agency and international project might happen from such an opportunity. In many cases, meetings connected to VLBI and other related areas have been held in Europe and America. If we can hold such a meeting in Asia-Oceania, we expect many researchers from the region will be able to participate given the relatively smaller travel budgets and given the fact that they will not be exhausted by long flights or suffer from jet lag.

### 3.3 Regular Working Meeting

Additionally, more frequent regular working meetings by the Chair, Secretary, and representatives from each Member Organization will be required. A teleconference might be convenient because of less time difference. The progress of VGOS projects in each country should also be shared in these meetings.

### Acknowledgements

The AOV has now formally started a year and a half after initial discussion. This would not have been possible without contributions from all individuals and institutions in Asia-Oceania, and its future growth will not be possible without their further contributions. We wish to extend many thanks to them and hope that the AOV can contribute to the promotion of VLBI operations, research, and technology development in this region.

### References

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## Terms of Reference for the Asia-Oceania VLBI Group for Geodesy and Astrometry (AOV)

The AOV is a group of scientists in the Asia-Oceania region supporting geodetic and astrometric Very Long Baseline Interferometry (VLBI). It is a subgroup of the International VLBI Service for Geodesy and Astrometry (IVS).

The Asia-Oceania region is highly dynamic in geophysics and climate, with a large number of destructive earthquakes, tsunamis, typhoons and cyclones. Many countries in the region will experience the effects of climate change much sooner or to a greater degree than other regions, due to more frequent extreme weather events and rising sea levels for example. In order to better understand the risks and reduce the effects of these phenomena, the AOV has an important role to play through measurement of tectonic plate motions, atmospheric variations and determination of the Geodetic Reference Frame for the region. The AOV seeks to:

1. foster the use of VLBI, with a particular focus on producing high quality data and science results in geodesy and astrometry from the Asia-Oceania region.
2. form and strengthen links between the different Asia-Oceania VLBI components in technology development and from observations to data analysis.
3. promote and represent Asia-Oceania geodetic and astrometric VLBI within the broader international scientific communities.
4. provide and archive information and scientific results of Asia-Oceania geodetic and astrometric VLBI.
5. organize regular working meetings to improve communication and cooperation between members of the AOV.

6. support and promote education and training in geodetic and astrometric VLBI and related technology in the region.

Membership of the AOV is naturally comprised of IVS Member Organizations and IVS Associate Members in the Asia-Oceania region.

The AOV also accepts applications for (non-voting) Corresponding Membership from individuals working on geodetic and/or astrometric VLBI at non-IVS Member Organizations in the Asia-Oceania region.

Membership is institution-based with each institution carrying one vote in the election of a Chair. Upon election, the Chair will appoint a Secretary of their choice. If the Chair is from Asia, the Secretary must be from Oceania and if the Chair is from Oceania, the Secretary must be from Asia. The Chair and Secretary must be from AOV Member Organizations or be Corresponding Members. These appointments are for a term of 4 years each. There is no cost for membership.

## Roles of AOV Chair and Secretary

The Chair will:

- Set agendas and chair AOV meetings
- Arrange face-to-face meetings and regular telecons
- In consultation with Members, set the science goals of the AOV
- Seek funding for AOV activities
- Represent the AOV within other related groups (IVS, EVGA etc)
- Organize regional observations

The Secretary will be responsible for management and coordination, including:

- Collating and maintaining information on the range of expertise and people within the AOV for purposes of collaboration.
- Management of the AOV website

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