Publications of the Korean Astronomical Society
30: 039 ∼ 043, 2015 September

pISSN: 1225-1534
eISSN: 2287-6936
http://dx.doi.org/10.5303/PKAS.2015.30.2.039

THE IAU TODAY AND THE ASIAN-PACIFIC REGION

Norio Kaifu
National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan
E-mail: norio.kaifu@nao.ac.jp
(Received November 30, 2014; Reviced May 31, 2015; Aaccepted June 30, 2015)

ABSTRACT

We overview and discuss the IAU today from the viewpoint of its regions based on historical and statistical data, and consider the status and future of astronomy in the Asian-Pacific region. New activities of the IAU, the Office of Astronomy for Development (OAD) and the Office for Astronomy Outreach (OAO) for the future evolution of astronomy are introduced. We also review the recent developments in astronomy in the Asian-Pacific region, and emphasize the importance of regional cooperation and coordination for the future.

Key words: regions of IAU: IAU regional meetings: Asian-Pacific region: regional cooperation and coordination

1. INTRODUCTION: APRIM AND IAU REGIONS

The International Astronomical Union (IAU) started its regional meetings (RIM) with the first European Regional IAU Meeting held in 1974. The Asian-Pacific Regional IAU Meeting (APRIM) and the Latin-American Regional IAU Meeting (LARIM) followed from 1978 in parallel. The European RIMs were conducted under the support of the European Astronomical Society and were concluded at its 11th meeting in 1990.

Until now, the APRIM and LARIM have been held on an invitational basis by institutes and/or national committees of host countries every three years between the IAU General Assemblies (see Figure 1). In addition to discussing scientific topics in wide areas of astronomy, the important aim of these RIMs was to develop contacts and exchanges among astronomers within the regions. Therefore, attendance were considerably larger than that of IAU symposia. The number of attendees at the past several APRIMs was roughly 300 to 450 from 20 to 30 countries. The Middle-East & African Regional IAU Meeting (MEARIM) also started in 2008.

IAU does not have a definition of its "regions", but these RIMs provide a pretty good idea of the practical geographical distribution of "regional" countries for IAU. They are; European (including all Russia), North American (no RIM was held but geographically clear), Latin American, Asian-Pacific, and Middle-East & African. This practical definition of regions is slightly different from that of United Nations which includes Middle-East in Asia. However, the above-mentioned IAU regions seem to fit well for the current conditions of regional exchange of astronomy, and therefore we try some statistics in the following discussion based on the above "practical" definition of regions of the IAU.

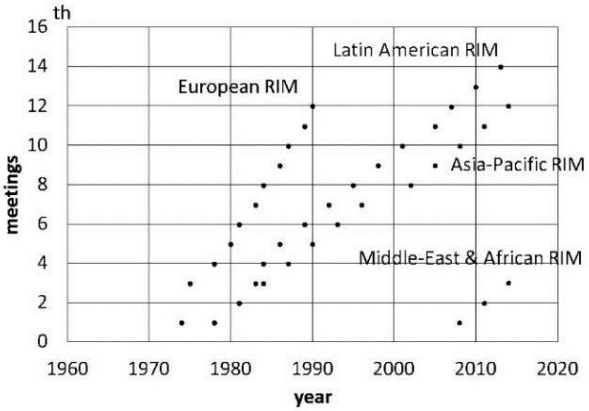

Figure 1. History of four Regional IAU Meetings

2. ASIAN-PACIFIC REGION IN THE IAU

Table 1 lists some characteristic measures of the five IAU regions based on 2012 data. The number of IAU national member countries per number of all countries in each region (column D = C/A) provides us a rough idea of the regional average development level of astronomical research. Highly developed regions (North America and Europe, 100% and 83% respectively), moderately developed region (Latin America and Asian-Pacific, 55% and 36%), and under development regions (Middle-East & Africa, 11%). Note that for the number of countries in each region (column A) we counted only member countries of the United Nations with population larger than

	A	B	C	D	E	F
Region	Number of Countries in the Region (population > 1 million)	Total Population in the Region (2011) (million)	IAU National Members in the Region (2012-2015)	Rate of IAU National Member in the Region C / A	IAU Individual Members in the Region (2012-2015)	IAU Individual Member per million of Regional Popuration E / B
Mid-East & Africa	46	1,060	5	**11 (%)**	160	**0.15**
Asia-Pacific	52	4,394	22	**36 (%)**	2,181	**0.5**
Europe	36	743	32	**83 (%)**	4,836	**6.5**
Latin America	22	604	12	**55 (%)**	579	**0.96**
North America	2	355	2	**100 (%)**	2,860	**8.1**
Total	158	7,156	73	**46 (%)**	10,616	**1.48**

Table 1
Comparison of basic measures of the five IAU regions

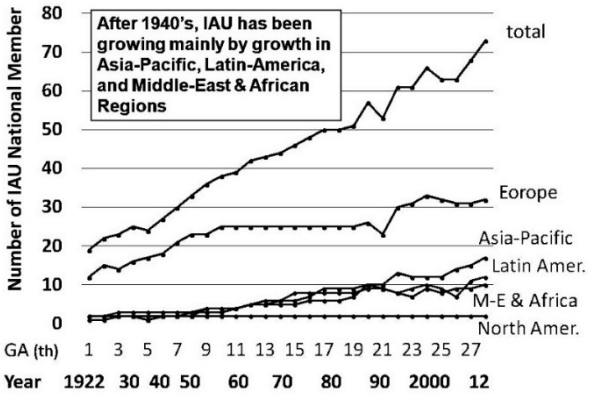

Figure 2. Growth history of the numbers of IAU national members in the five regions

1 million. We can see similar tendencies in the ratios of regional numbers of IAU individual members to regional total populations (column F = E/B), too.

Figure 2 shows the growth history of the IAU national members in five regions. The flat curves of North American and European regions show the saturation effect of number of IAU national members in these regions. A small jump in the European curve around GA21 (1991) is an effect of the change from USSR to Russian FDR and related East European countries. We see a slow but continuous increase of national members in the other three regions; Asian-Pacific, Latin American and Middle-East & African. Apparently the main part of the constant growth of national members in the whole IAU since 1950's has been supplied by these "moderately developed" and "under development" regions. Especially after 1990 growth in the Asian-Pacific region is prominent, reflecting the growth of the economy and scientific activities in this region.

The growth history of the IAU individual members (Figure 3) tells us a slightly different story. This figure shows the history since 1961, the year of the next GA after the IAU formally accepted the current definition and nomination system of "individual members" in the 1958 GA (Blaauw, 1994).

It is impressive to see how the number of IAU individual members has grown rapidly and constantly since the 1970's, and how it has been supported by the growth of the number of astronomers in 1) European, 2) North American, and 3) Asian-Pacific regions. In the European and North American regions the numbers of astronomers in member countries are still constantly increasing. This fact proves the high-rate evolution of astronomy in "developed" regions. We note that relatively flat curve of North American region reflects an "artificial" effect to some extent. The Asian-Pacific region also maintains a high increase rate in parallel with the European region, and now the number of individual members in the Asian-Pacific region consists of 20% of the total individual members of the IAU (see Table 1). Such an increase of Asian-Pacific individual members came from the rapid growth of astronomy in Japan, China Nanjing, and Australia. South Korea, Chinese Taipei, and recently Thailand as well.

We discuss the average measure of the evolution of astronomy in the IAU regions briefly. Figure 4 shows the correlation between the number of IAU individual members and the rate of individual members per total population for four regions. Each dot represents a correlation in each national member country. The number of IAU individual members (i.e. number of astronomers) per population gives us some kind of measure for the status of astronomy in each country and also in each region.

As shown in the figure for the European region (top-left), 10 astronomers per population of 1 million seems to be a reasonable criteria of the development level of astronomy, because that point stands within the horizontal axis nearly at the highest value of individual members, and also near the higher outskirt of the distribution of individual numbers per population. This "standard point of the development of astronomy" is shown as a downward arrow in each regional figure to compare region to region. We see some systematic differences among regions; the position of the arrow in the horizontal axis shifts from relatively close (Asian-Pacific) to farther (Latin American), and to pretty far (Middle-East & African) from average distribution of countries in each region. Such a difference of distribution in these regional figures indicates the current average status of evolution of astronomy in each region, compared with the European region, which is regarded as a "well developed region" on average. Such separation between the arrow and the distribution of countries indicates, on the other hand, a large capacity for the future development of regional astronomy.

Let us briefly look into some details in Figure 4. In the Asian-Pacific region (top-right) we see the general distribution is well below the "standard point" indicated by an arrow including Japan (5 astronomers per population of 1 million), while New Zealand and Australia stand nearly at the arrow (about 8 and 11, respectively). In the case of the Latin American region (bottom-left), we see Chile and Argentina at the points of roughly 6 and 3 each, and in the Middle-East & African figure

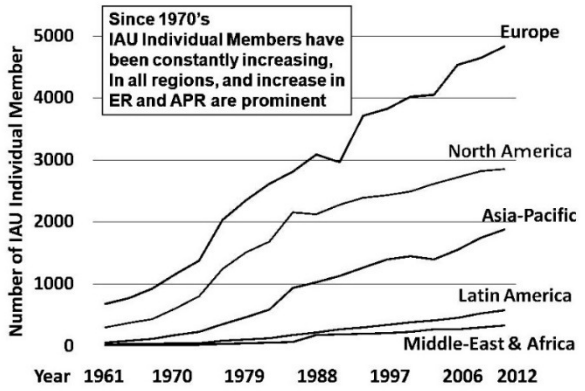

Figure 3. History of growth of IAU individual members in the five regions (since 1961)

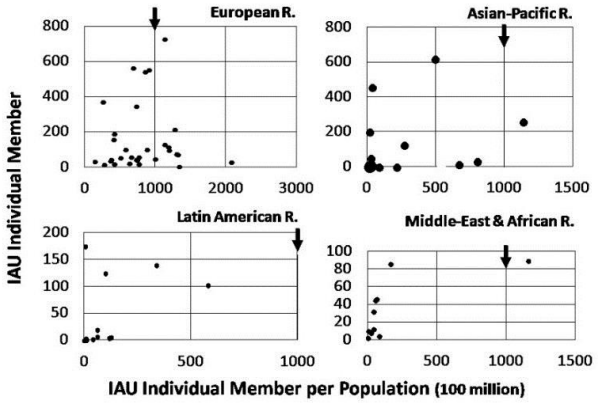

Figure 4. Correlation between the number of IAU individual members and the population in each region. Each dot represents a correlation in each national member country. Down arrows show 1000 individual members per population of 100 million, i.e. 10 individual members per 1 million of population, which is a characteristic outskirt of distribution of correlation in the European region (see the text).

(bottom-right) Israel stands alone at a high point (about 12) in the horizontal axis. I did not include the North American region in Figure 4, as it is a highly developed region and is composed of only two countries (Canada and the USA).

The above-mentioned brief statistical analysis demonstrates the bright future of astronomy. With its very large population (more than 60% of the world) and growing scientific activities the role of Asian-Pacific region is expected to be much larger in the near future.

3. EDUCATIONAL AND OUTREACH ACTIVITIES OF THE IAU AND ASIAN-PACIFIC REGION

The IAU is unique among many international scientific unions, due to its structure with many individual members together with national members. Most other unions have only national members typically represented by national committees of member countries. The powerful global activity of the IAU in science, education and outreach is another character of the IAU, and such activity is due to the tremendous leadership and effort by those individual members. Such IAU activity in education and outreach has a many year long tradition, especially by Commission 46 (Education and Developments) and Commission 55 (Communicating Astronomy with the Public).

In addition, the great success of IYA2009, International Year of Astronomy 2009, gave a huge positive impact to IAU activities in these areas. The number of national nodes participating in IYA2009 was 148, compared with the 73 current IAU national members and about 190 countries of the United Nations. We should note that there are very few or no professional astronomers in those non-IAU-member countries which participated in IYA2009, and therefore a tremendous number of IYA2009 activities were led by teachers and amateur astronomers. This fact indicates the huge capacity for the future development of astronomy, and also indicates the importance of cooperation among professional astronomers, teachers and amateur astronomers.

The 10-year's strategic plan of the IAU, "Astronomy for Development", had been prepared based on Commission 46 and was highly accelerated by the IYA2009. The "Astronomy for Development" plan formally started in 2010, and the Office of Astronomy for Development (OAD) was established at the South African Astronomical Observatory (SAAO) under a partnership between the IAU and the South African National Research Foundation (NRF). The OAD is now implementing some 20 programs selected on a proposal basis under the support of three Task Forces every year. These are; TF1) Astronomy for University and Research, TF2) Astronomy for Children and Schools, and TF3) Astronomy for Public Outreach. The yearly IAU budget for these programs is about 100 K Euro. We have a pretty good geographical distribution of the location of accepted proposers, but is still relatively scanty outside European and African regions. The reason may partly be language problems, but partly because of geographic distance (far from central location of activity, the OAD in South Africa).

To help the global activities of the OAD four Regional Offices for Astronomy Development (ROADs) were established; the East Asian ROAD in China, the South-East Asian ROAD in Thailand, the East African ROAD in Ethiopia, and the Southern African ROAD in Zambia. (After the fifth APRIM, the Andean ROAD, was established in Columbia). Also, to overcome language gaps, a Language Expertise Center was established in China.

The establishment of the Office for Astronomy Outreach (OAO) is another important legacy of the IYA2009. As the effect of the network of collaboration among worldwide science communicators, amateur astronomers and astronomy clubs were huge, the IAU decided to establish the OAO as a dedicated core of an IAU global outreach activity network. Thanks to the contribution of many Asian astronomical institutes to a significant part of the funding, the OAO was established in 2012 at the National Astronomical Observatory of Japan (NAOJ) in Mitaka, Tokyo under the partnership between the IAU and NAOJ.

year of establish-ment	Institute	country /regions	major observing facilities
1961	Parkes	Australia	64 m Radio Telescope
1974	AAO*	Australia	3.9 m AAT
1982	NRO	Japan (TAO)	45 m Mm-w. Telescope & Mm-Array
1988	NAOJ*	Japan	NRO, Subaru, VERA, ALMA
1990	ATNF*	Australia	Parkes, ATCA, ASKAP
1993	ASIAA*	Taiwan	SMA, AMiBA, ALMA
2000	NCRA	India	Giant M-w. Radio Telescope (GMRT)
2001	NAOC*	China	LAMOST, 21CMA
2004	KASI*	Korea	Korean VLBI Network (KVN)
2008	NARIT*	Thailand	2.4 m TNO Telescope

Table 2
Major or National Institutes in Asian-Pacific Region. Institutes with *marks indicate standalone "National" Institutes.

Figure 5. History of Large Observing Facilities in the Asian-Pacific region. The plot starts from the center (Parks Radio telescope, Australia, 1961) and goes out following a spiral pattern toward the bottom-left (21CMA, China, 2014).

As shown in the IAU webpages the OAO is conducting a number of important projects like cooperation with the worldwide physics community for the "International Year of Light in 2015 (IYL2015)", and the "Naming of Exoplanets (NameExoWorld)" campaign to name important exoplanetary system and exoplanets through the proposals from astronomy clubs and general public votes in the world. Other than this, the OAO is conducting many activities including the establishment of a world-wide network of amateur astronomers through "IAU Astro Clubs Portal" and "National Outreach Contacts", etc.

The work of the OAO is rapidly evolving with close cooperation with OAD activities. I would like to emphasize that the IAU has added real global activities as an international science organization by establishing these two new organizations, the OAD in South Africa, and the OAO in East Asia.

4. GROWTH, COOPERATION AND FUTURE OF ASIAN-PACIFIC ASTRONOMY

The first world-leading large telescope in Asian-Pacific region, the 64-m Parkes telescope in Australia, started operation in 1961. The 3.9m Anglo-Australian Telescope followed in 1974. World-level astronomy in Asia was then lead by a series of establishments of "National Observatories/Institutes", to catch up with the forerunners in western world. The first of the Asian "National Observatories/Institute" was the Nobeyama Radio Observatory (NRO, established in 1982) with the 45-m mm-wave telescope and the mm-array, and the subsequently established National Astronomical Observatory (NAOJ) in Japan. China Taipei (Taiwan), China Nanjing (Mainland China) and Korea also established "National Institutes/Observatories" by the early 2000's, and promoted development and construction of their own cutting-edge telescopes representing the whole community of astronomers in each nation, as shown in Table 2. As the first South-East Asian country, Thailand established the National Research Institute of Thailand (NARIT) in 2008, with the 2.4m optical telescope (TNO). Generally speaking, establishment of such core or national observatories with world-level telescopes which are open for use of whole national community were a very efficient way to realize rapid growth of astronomy. Figure 5 shows a graphic history of this evolution of Asian-Pacific astronomy through this half century.

In order for Asian countries to try hard to quickly catch up with the world level, systematic cooperation and coordination symbolized by "national institutes/observatories" as shown in Table 2 was especially important. Practically, 1) building-up of "one-voice" of the astronomers' community of the nation for important directions like future plans, and 2) good cooperation among national (core) institutes and universities, are two important key components.

In Japan, for example, the establishment of NAOJ was an extremely important step. The mission of NAOJ is to 1) Promote cutting edge astronomy representing whole community of Japanese astronomy and astrophysics, and to 2) Support all Japanese astronomers, especially in universities. The coordination of "one voice" of the community for national-level future plans was also established through astronomers' meetings in several fields of astronomy and astrophysics, users' committees for NAOJ, and finally by open discussion and decision by the National Committee for Astronomy, which is composed of about 20 astronomers and belongs to the Science Council of Japan (SCJ). The NAOJ leadership always closely cooperates with this coordination system.

Another important issue for future of Asian-Pacific astronomy is regional cooperation and coordination. From long years of activity of East Asian Astronomer's Meeting (EAMA), for example, many astronomer-level continuous exchanges have been produced; the East Asian Young Astronomers Meeting (EAYAM), the East Asia Numerical Astrophysics Meeting (EANAM), etc. Furthermore, scientific cooperation programs like KAVA (KVN and VERA VLBI Array) and East Asian VLBI including Chinese antennas, and East Asian ALMA Re-

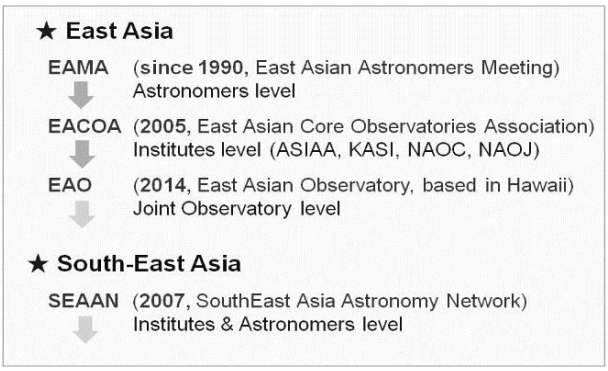

Figure 6. Simplified flows of regional cooperation in East Asia and in South-East Asia, from past to future.

search Center (EA-ARC) are running. The APT, Asian-Pacific VLBI by Australia, China, Japan and others is another existing regional cooperation program.

Now we see larger, even global-scale cooperation projects in the Asian-Pacific region; the TMT (Japan, China, India), GMT (Australia, Korea), SKA (Australia, New Zealand, China, India), SPICA (Japan, Korea, Taiwan), Antarctic Astronomy (China, Australia, Japan), and Mauna Kea (EACOA: China, Japan, Korea, Taiwan), etc.

Observational facilities are becoming larger and larger, and we astronomers are already in the global cooperation era. Still, we need more powerful promotion of regional cooperation in parallel. Any high-level cooperation in astronomy should be based on competition also, because equal-level cooperation would produce excellent results for both sides of cooperation, and vise-versa. Close regional coordination among countries in a local group will be a possible element of such productive global cooperation, and such regional coordination could be a good platform for mutual cooperation in the region. As well known among astronomers, ESO provides us a good success model for such regional coordination. The economical and political situation in the Asian-Pacific region is different from that in Europe, still, we could proceed toward establishment of a future "Regional Observatory" like ESO. Such a possibility in the East Asian region has been discussed in EAMA, and it proposed the establishment of EACOA (East Asia Core Observatories Association) as the first step toward an "East Asian Observatory". The EACOA was established in 2005 by NAOC, KASI, ASIAA and NAOJ based on a MOU signed by the four directors, and is working to coordinate cooperation and exchange including EACOA fellowships, and many joint programs.

In 2014 the EACOA agreed to take over the operation of JCMT on Mauna Kea from the JAC, UK, for joint operation. For this purpose EACOA established the "East Asian Observatory (EAO)", tentatively based in Hilo, Hawaii. This big step toward the future full-dress EAO is reported by Paul Ho in his plenary talk. We are looking forward to seeing the realistic evolution of the EAO toward the future, as shown in Figure 6.

In addition, a new platform for regional cooperation was established in South-East Asia. This South-East Asian Astronomy Network (SEAAN) will be a base for further grow of astronomy in the SE-Asian and Asian-Pacific regions.

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