

## When remote sensing went alpine – the 10 international HMRSC symposia 1990 - 2008

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*Schon immer haben Berge in der Geschichte der Menschheit, sowohl wirtschaftlich als auch kulturell eine wichtige Rolle gespielt.*

*Durch die wachsende Bedeutung einer nachhaltigen Umweltpolitik und das immer größer werdende Potential von Fernerkundungs- und GIS-Technologien für die Kartierung von Hochgebirgen seit den 1980er Jahren, wurden 1990 die Reihe der internationalen Symposien „High Mountain Remote Sensing Cartography“ (HMRSC) begründet. Darauf folgten in einem Zwei Jahres Intervall neun weitere Symposien, mit mehrtägigen Exkursionen als integrativer Bestandteil.*

*Bei der Arbeit mit Fernerkundungsdaten in Hochgebirgsregionen entstehen Probleme, deren Lösung unter Anderem zu den Hauptthemen der HMRSC Symposien zählte. Die Verwendung von Fernerkundungsbildern zur Informationsextraktion und deren kartographische Umsetzung wurden angesprochen und diskutiert.*

*Die erzielten Ergebnisse sind in den HMRSC-Tagungsbänden veröffentlicht.*

### 1 The idea

Mountains, independent of their altitude, have always played an important role in the culture and history of mankind. They are sacred places in all religions of our world, the home of Gods. Moreover, they provide the water supply to more than one-sixth of the global population based on the melt from the mountain glaciers. Against the background of an increasing importance of a sustainable environmental management and the rising potential of remote sensing and GIS techniques for the mapping of high-alpine terrain since the 1980s a series of international symposia on High-Mountain Remote Sensing Cartography (HMRSC) was established in 1990. The very first symposium was held in Schladming, Austria.

The motivation to organise such a reunion of experts arose from the success of a multi-year research project on “High-Mountain Remote Sensing Cartography. The TADAT Research Project in the International Tauern Dachstein “Testsite” funded by the Austrian Research Council FWF (Project P 8048 GEO). The findings of this project are published in a two-volume report of 747 pages total and an executive summary of 13 pages plus two A4 maps and two A3 maps (Buchroithner & Kostka 1994a and 1994b).

Within this project exactly 25 scientists explored the potential of integrative remote sensing using multisensoral approaches for high-mountain cartography. Furthermore, many international contacts, with both western and eastern remote sensing experts were established. This gave reason to bring all those interested in the outcome of the – meanwhile well-known – TADAT Project together at the location of the test site, in the Austrian mountain town of Schladming in September 1990. An integrative constituent of this symposium were the two scientific excursions, supported by topographic maps and satellite imagery, to the glaciers of the

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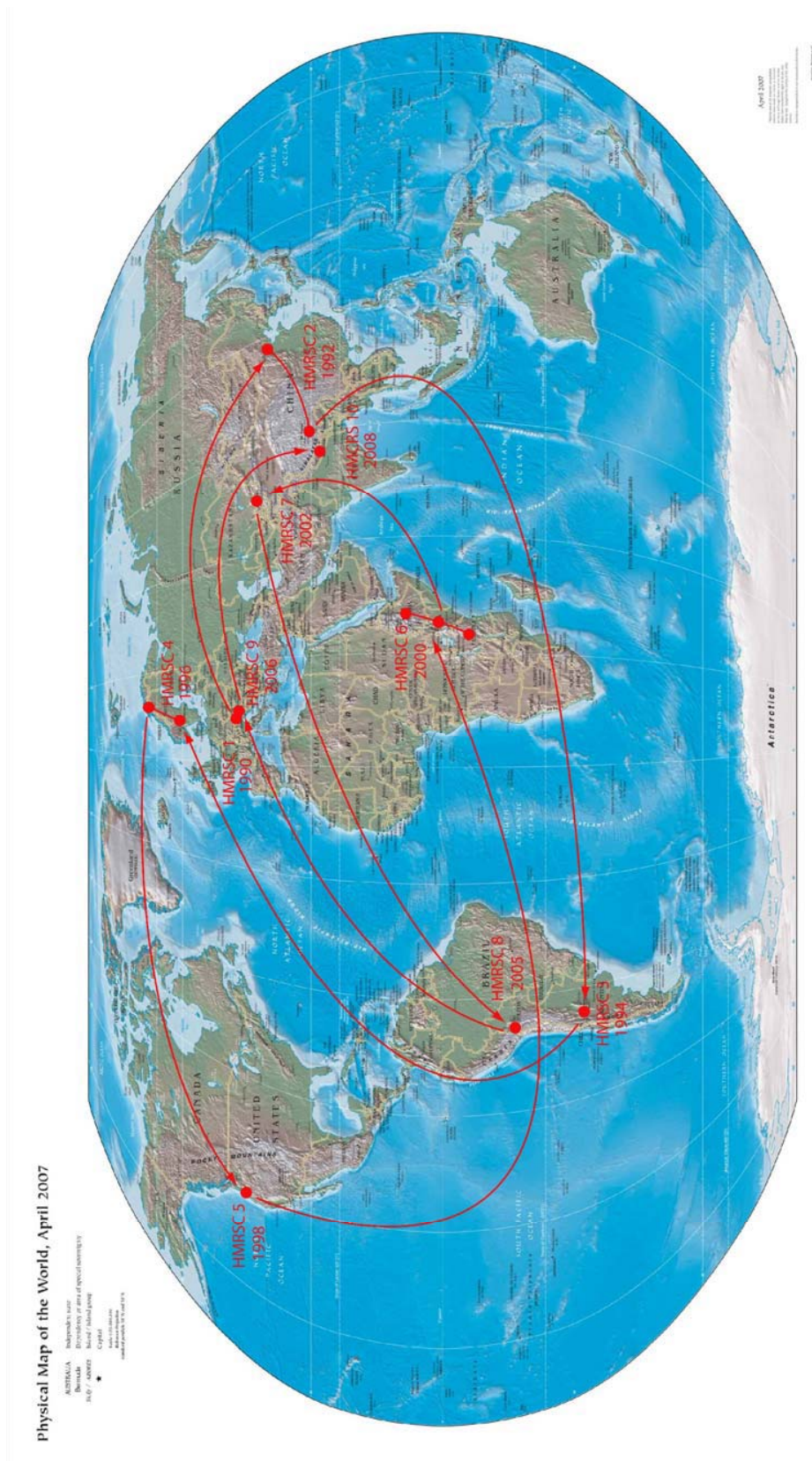


Figure 1: Chronological order of the HMRSC symposia

carboniferous Dachstein Massif in the so-called Northern Alps and the crystalline Schladming Tauern Range in the Central Alps. This well-received – and later much extended - introduction should further on be one of the “trade marks” of the HMRSC symposia (cf. figure 1).

## **2 1<sup>st</sup> Symposium on High Mountain Remote Sensing Cartography**

The year of birth of satellite-based earth observation for civil applications is 1972. In July of this year NASA launched its first Earth Resources Technology Satellite, ERTS-1, later named Landsat-1. The earth observation satellite SPOT-1, developed by the French, was launched in 1986. Due to the purpose of a sustainable management of the mountain's resources and other applications remote sensing and GIS became techniques whose potential for the mapping of high-alpine terrain was exploited more and more and finally became an important tool for high mountain cartography with the passing of the years. Various drawbacks caused by the high mountain relief, however, significantly hamper the application in handy accessible regions: many geometric and radiometric problems had first to be solved; operational methods of data treatment had to be developed. Therefore, in order to generate a discussion platform for experts dealing with the use of remote sensing data for high mountain cartography a small, workshop-like symposium was announced for autumn 1990. From September 26 to 28, an international group of 35 participants (cf. table 1) gathered in the small town of Schladming, which is located at the foot of the Dachstein massif in Austria.

Two days of interesting and efficient information exchange were followed by a field excursion, which had become an integrative constituent of the following symposia. As it is shown in figure 4, 85% of the subjects of this first symposium were about methodology and only 15% deals with application, especially glaciers and permafrost areas. One important conclusion was that high mountain regions must not only be studied by means of remotely sensed imageries but they must be investigated in situ for gathering ground truth data and field evidence. This idea was implemented in the subsequent biannual nine HMRSC symposia located in various parts of the world (cf. figure 1 and figure 2).

## **3 The 1990ies**

In the 1990ies the second till the fifth symposium were held in Beijing / Lhasa (China), Mendoza (Argentina), Karlstad / Kiruna (Sweden) and Arcata (USA). While participants from Argentina, Austria, Germany and the USA were represented in all gatherings other countries had a various number of representatives depended on the particular location of the symposia. Presented case studies were most time related to the appropriate mountains where the symposium was held. During this period ten satellites were launched (figure 3) which had a high-impacted influence on the development of remote sensing cartography. Via Satellite images, especially Landsat images, receiving information from hardly accessible regions became possible for the first time. This fact is also reflected in the discussed subjects of these symposia. In comparison with the first symposium where the remote sensing technologies were the major subject from 1992 till 1998 the focus switched on data processing and analysis. With the passing



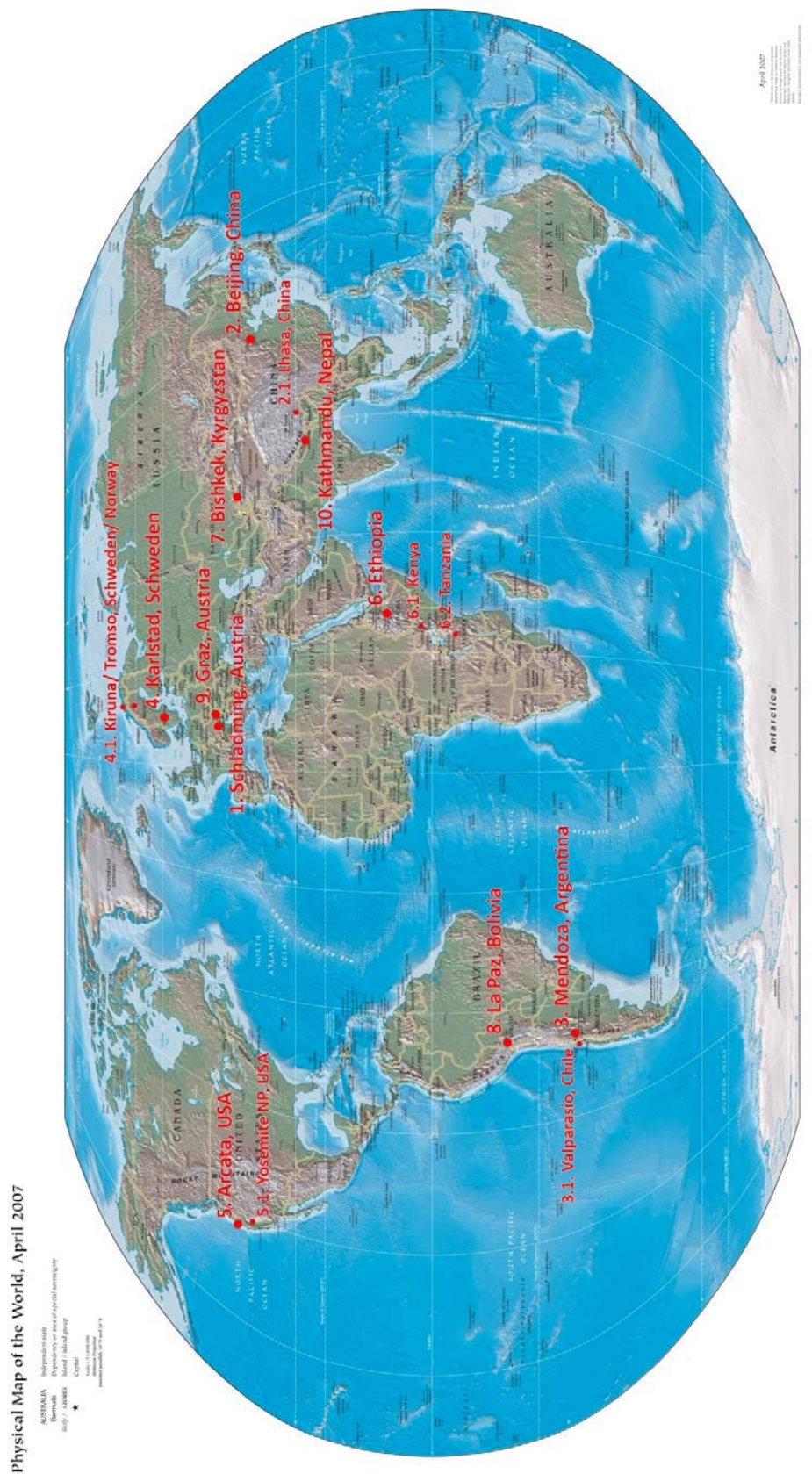


Figure 2: Location of the HMRSC symposia

of the years the application of space-borne remote sensing took on greater significance (cf. figure 5). The increasing number of papers and participants was an evidence for the growing importance of the HMRSC symposia in general. The field excursions after the oral presentations were each time impressive and spectacular events for every participant. After the presentations of the second symposia in Beijing the field excursion started in Lhasa and became an adventure through the Himalaya range due to mountain hazards. Within the third symposium in Argentina the Highlight of the field excursion was the crossing of the Central Andes south of the highest mountain of the Americas, the 6959 m high Mt. Aconcagua, which brought the group to the capital of Chile, Santiago. The field excursion of the fourth symposium led the participants to the northern parts of Scandinavia, north of the polar circle. Moreover, receiving stations of satellite data and research facilities were visited. The final field excursion in the 1990ies was a trip through the different landscapes of Northern California. Every excursion was an opportunity to compare the available images and maps with the ground truth data.

## 4 The Zeros

As can be seen in Figure 3, in the zeros there were much fewer satellites launched compared to the 1990ies. This decreasing research into methodologies and techniques of High Mountain remote sensing is also reflected in the symposia. Therefore, e.g. at the Sixth symposium these topics only had a share of less than 20%, and applications like tourism all of a sudden scored 40%. The research focuses changed and remain similarly until recent. Moreover, the Sixth symposium on HMRSC set a "milestone" within the HMRSC symposia series, marking 10 years (1990-2000) of fruitful cooperative work in high mountain remote sensing cartography. It was held in three different countries of East Africa. The oral presentations took place in Addis Abbaba, Ethiopia, as well as Nairobi, Kenya, and the following field excursion led the participants to the High Mountains of Kenya and Tanzania. The Seventh Symposium was held in Bishkek, Kyrgyz Republic, a country which is to 94% covered by high-mountain terrain and is thus an ideal venue for meetings of this type. Moreover, with 43 it represents the highest number of papers amongst all symposia. At this occasion the field excursion was a nine-day field-trip to the highest part of the Central Tian Shan. The natural phenomena of global atmospheric warming obviously influenced the subjects of the contributions to the Eighth (La Paz, Bolivia) and Ninth symposium (Graz, Austria). Figure 4 clearly shows that the number of papers dealing with glaciers and permafrost increased and reached a value of 50% and 31% respectively.

Since glacier retreat does not only change the visible appearance of the mountains and their environment, but most importantly, it also affects the supply of water for nutrition, irrigation and hydro-electric power generation, it certainly is a topic of eminent importance. Another highlight of the zeros was the conferment of the "HMRSC Award of Appreciation" in 2006. At the Ninth symposium four people were honoured for their outstanding contributions to the advancements of the ideas of High Mountain Remote Sensing Cartography:

Prof. Dr. Hubertus L. Bloemer, Prof. Dr. Manfred F. Buchroithner, Prof. Dr. Robert Kostka and Prof. Dr. Saturnino Leguizamón were the laureates receiving a laser-engraved glass cube depicting a high-resolution 3D model of the Glockner Group with Austria's highest peak, Großglockner (3798 m) and the largest glacier of the Eastern Alps, Pasterze.

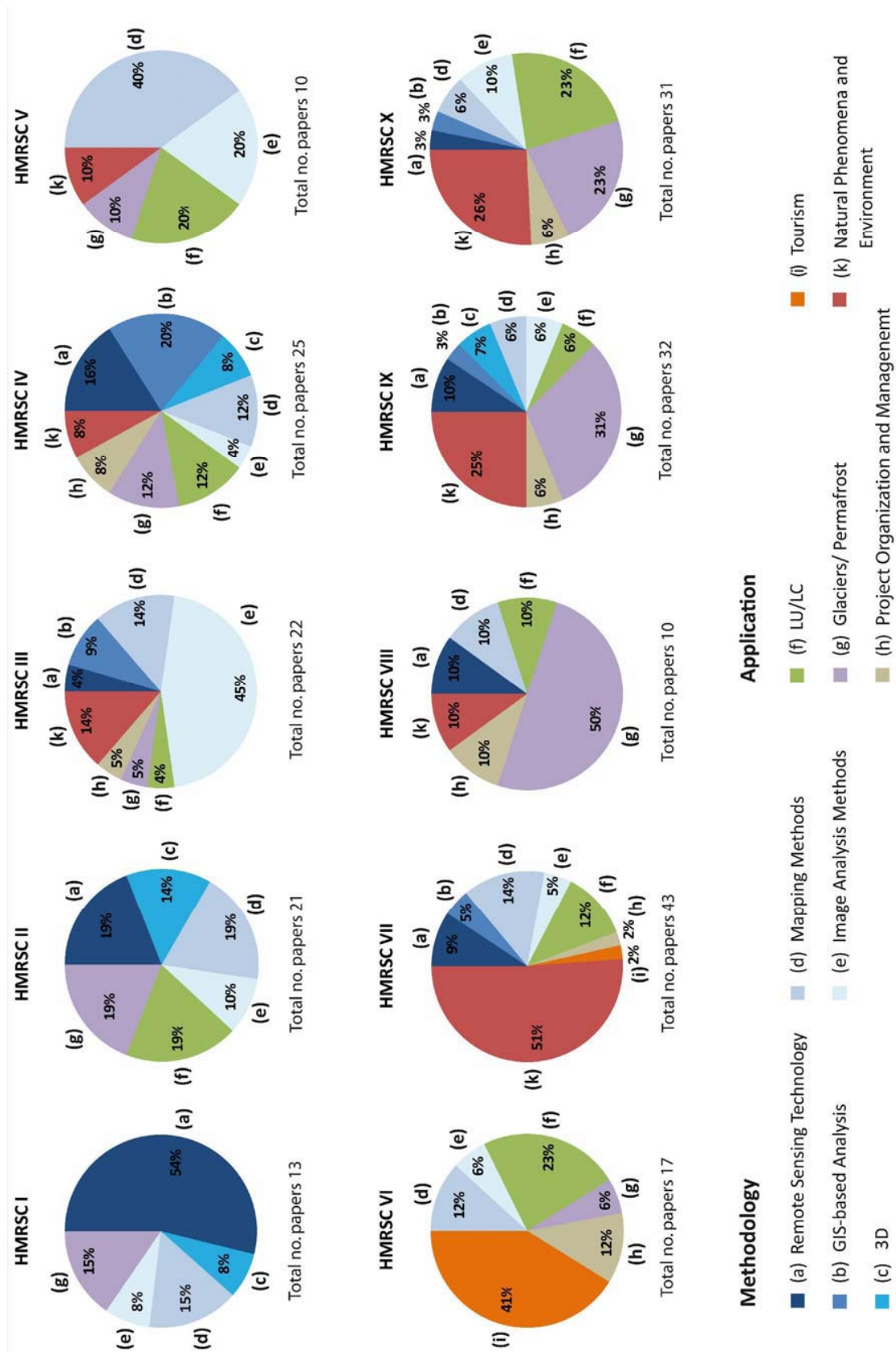


Figure 3: Total and percentage number of the particular HMRSC symposia



After the Tenth Symposium in Kathmandu, Nepal, with excursions to the Tibetan border at Kodari and to Khumbu Himal, the core group of HMRSC under the leadership of Robert Kostka and Manfred Buchroithner decided that the time might be mature to conclude this successful symposium series.

## 5 Conclusions

Satellite and airborne remote sensing systems are valuable sources of data for studying and monitoring mountain ecosystems around the globe. The problems which have to be overcome when working with remote sensed data in mountainous regions did not change significantly over the last 20 years. Problems concerning geometry and radiometry of remote sensing data, the development of operational methods of data treatment are still relevant nowadays. The general topics addressed in the HMRSC symposia included: application of remotely sensed imagery for information extraction in high mountain areas; cartographic representation of this information in maps and within GIS-based environments as well as application-oriented analysis.

In times when the mastery of remote sensing techniques and data exploration had not yet reached the level of today and the coping with the various geometric and atmospheric problems in high-mountain terrain was still far from being standard, this international series of symposia represented a platform for the exchange of knowhow and skills concerning the methodologies to tackle these problems. Being far from the spreading of symposium series like Pecora, ERIM or IGARSS, the proceedings of these meetings, nevertheless, gained a wide distribution within the pertinent scientific community and beyond.

Until their 10<sup>th</sup> event in 2008, the HMRSC symposia represented a platform for old and young scientists from all over the world and from various disciplines studying mountain areas by means of remote sensing with a rigid cartographic approach. Their presented results were published in the HMRSC volumes. Volume 10, containing the results of the 10<sup>th</sup> and last HMRSC symposium in Kathmandu 2008, will be published in summer 2010.

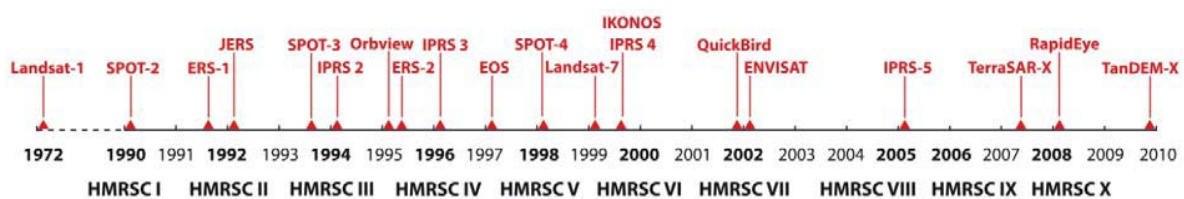


Figure 4: Relation between launched satellites and the HMRSC symposia

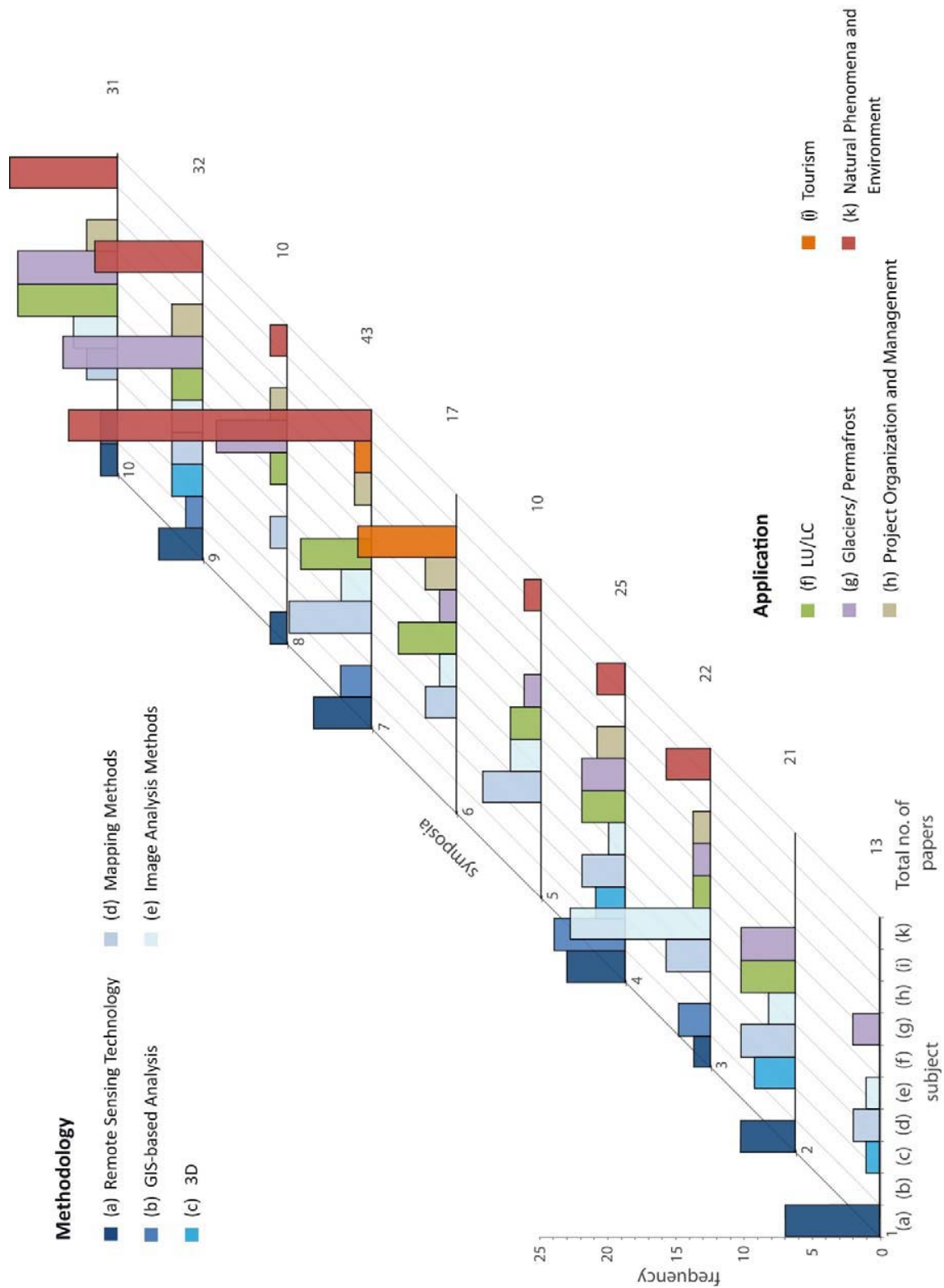


Figure 5: Time line diagram



|                 | Symposium |   |   |   |   |   |   |   |   |    |
|-----------------|-----------|---|---|---|---|---|---|---|---|----|
| Country         | 1         | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Argentina       | x         | x | x | x | x | x | x | x | x |    |
| Armenia         |           |   |   |   |   |   | x |   |   |    |
| Australia       |           |   |   |   |   |   |   |   |   | x  |
| Austria         | x         | x | x | x | x | x | x | x | x | x  |
| Bolivia         |           |   |   | x |   |   |   | x |   |    |
| Canada          |           |   |   |   |   |   |   |   | x | x  |
| Chile           |           |   | x |   |   |   |   |   |   |    |
| China           |           | x |   | x |   |   |   |   |   |    |
| Denmark         |           |   |   |   |   |   |   |   | x |    |
| Ethiopia        |           |   |   |   |   | x |   |   |   |    |
| France          | x         |   | x | x |   |   |   |   | x | x  |
| Germany         | x         | x | x | x | x | x | x | x | x | x  |
| India           | x         | x |   |   |   |   |   |   |   | x  |
| Italy           | x         | x | x | x |   |   |   |   | x | x  |
| Kyrgyz Republic |           |   |   |   |   |   | x |   |   |    |
| Mexico          |           |   |   |   |   |   |   |   | x |    |
| Nepal           | x         |   |   | x |   |   | x |   | x | x  |
| Netherland      |           |   |   |   |   |   |   |   |   | x  |
| Norway          |           |   |   |   |   |   |   |   | x | x  |
| Pakistan        |           |   |   |   |   |   |   |   |   | x  |
| Peru            |           |   | x |   |   |   |   |   |   |    |
| Romania         |           |   |   |   |   |   |   |   |   | x  |
| Russia          | x         |   |   | x |   |   | x |   |   |    |
| Spain           |           |   |   |   |   |   |   |   | x |    |
| Sweden          |           | x | x | x |   | x | x |   |   | x  |
| Switzerland     |           |   |   |   |   |   |   |   | x |    |
| Turkey          |           |   |   |   |   |   | x | x |   |    |
| UK              |           | x |   | x |   |   |   |   | x | x  |
| USA             | x         | x | x | x | x | x | x | x | x | x  |

Table 1: Home country of the participants

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## 6 References

- BAX, G. (Ed.) 1997: Proceedings of the 4<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, The University of Karlstad Research Report, 261 pp.
- BAX, G. & BUCHROITHNER, M. F. (Eds.) 2002: Proceedings of the 5<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, Karlstad University Studies, 120 pp.
- BUCHROITHNER, M. F. (Ed.) 1996: Proceedings of the 1<sup>st</sup> International Symposium on High Mountain Remote Sensing Cartography, KB, Technische Universität Dresden, 144 pp.
- BUCHROITHNER, M. F. (Ed.) 2004: Proceedings of the 7<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, KB, ICA, Technische Universität Dresden, 222 pp.
- BUCHROITHNER, M. F. & KOSTKA, R. (Eds.) 1994a: TADAT Endbericht, Volume I+II, total 747 pp.
- BUCHROITHNER, M. F. & KOSTKA, R. (Eds.) 1994b: TADAT Final Report. Executive summary. 13 pp.
- LIU, J. & BUCHROITHNER, M. F. (Eds.) 1993: Proceedings of the 2<sup>nd</sup> International Symposium on High Mountain Remote Sensing Cartography, Astronautic Publishing House, Beijing, 263 pp.
- KAUFMANN, V. & SULZER, W. (Eds.) 2002: Proceedings of the 6<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, Grazer Schriften, Universität Graz, 195 pp.
- KAUFMANN, V. & SULZER, W. (Eds.) 2006: Proceedings of the 8<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, Grazer Schriften, Universität Graz, 110 pp.
- KAUFMANN, V. & SULZER, W. (Eds.) 2007: Proceedings of the 9<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, Grazer Schriften, Universität Graz, 291 pp.
- KAUFMANN, V. & SULZER, W. (Eds.) 2010: Proceedings of the 10<sup>th</sup> International Symposium on High Mountain Remote Sensing Cartography, Grazer Schriften, Universität Graz, 246 pp.
- LEGUIZAMÓN, S. (Ed.) 1994: Proceedings of the 3<sup>rd</sup> International Symposium on High Mountain Remote Sensing Cartography, IIACE, 220 pp.

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