Notes of the Plenary of IAH Commission on Managing Aquifer Recharge at ISMAR10

22 May 2019, 17:30-19:00 in Auditorium, La Nave Convention Centre, Madrid, Spain

Attendees: estimated 100 people and 30 countries represented

Attendees included: Alice Aureli (UNESCO IHP), Bruce Misstear (IAH Sec Gen), Jose Luis Martin Bordes (UNESCO IHP), Weiping Wang (co-chair, China), Enrique Fernández Escalante (co-chair and WG leader – MAR to MARket, Spain), Yan Zheng (WG leader –sustainability), Catalin Stefan (WG leader-inventory, Germany), Andrew Ross (WG leader-economics, Australia), Russell Martin (WG Leader –clogging, Australia), Manuel Sapiano (WG leader-regulations, Malta), Jose Bonilla (WG leader-MAR suitability mapping, Costa Rica), Peter Dillon (co-chair and WG co-leader- 60 year history of MAR, Australia), Pieter Stuyfzand (WG co-leader- 60 year history of MAR, NL), Arnaud Sterckx (IGRAC, NL), Karen Villholth (GRIPP-Sth Africa/Denmark), Greg Woodside (USA), Doug Bartlett (USA), Dan Goode (USA), Michael Milczarek (USA), David Pyne (USA), Xue Yan Lee (China), Cui Ruijuan (China), He Xuan Zhang (China), ShiSong Qu (China), Uwe Troeger (Germany), Rudy Rossetto (Italy), Koen Zuurbier (NL), Saroj Sharma (NL), Bob Bower (NZ), Yoncheol Kim (Korea), Thomas Grischek (Germany), Cornelius Sandu (Germany), Jana Sallway (Germany), Ralf Junghanns (Germany), RC Jain (India), Jon San Sebastian (Spain), Daniel Conde Ocoňa (Spain), Judit Madl-Slonyi (Hungary), Zsoka Szabo (Hungary), Gabriel de Los Cobos (Switzerland), Ahmed Hadidi (UAE?), Anis Chekirbane (Tunisia), Edmundo Claro (Chile), Tatsuo Shubo (Brazil), Declan Page (Australia), Dennis Gonzalez (Australia) …and many many more who the signup sheets missed

Apologies: Antonio Chambel (IAH President), Dave Kreamer (IAH Vice President Science and Programs), Adam Hutchinson, Basant Maheshwari, Joanne Vanderzalm, Karen Barry,

Agenda:

1. Welcome and Introductions – Peter Dillon
2. Objectives of Commission - Peter Dillon
3. UNESCO IHP VIII 2014-2021 context for IAH-MAR role – Alice Aureli:
    1. UNESCO Travel Scholars – Alice Aureli
    2. Exemplary case studies publication with IAH and GRIPP – Alice Aureli
4. Progress reports and plans of Working Groups
    1. Economics of MAR – Andrew Ross
    2. MAR for Development – Yan Zheng
    3. Global MAR Inventory – Catalin Stefan
    4. 60 years history of MAR – Peter Dillon and Pieter Stuyfzand
    5. Management of clogging– Russell Martin
    6. MAR to MARket – Enrique Fernández Escalante (PPTs)
    7. MAR Regulations and Guidelines – Manuel Sapiano
    8. MAR opportunity mapping - Jose Bonilla and Catalin Stefan
5. Outcomes of ISMAR9, Mexico City, June 2016
6. Invitation to ISMAR11, 2022 – Greg Woodside
7. Comments by Bruce Misstear (IAH) and Weiping Wang (retiring co-chair)
8. Election of IAH-MAR Co-chairs – IAH Executive Returning Officer
9. IAH Certificates of Appreciation – IAH Executive
10. Best Poster Prize – Enrique Fernández
11. Information Sharing
    1. IGRAC MAR Portal – Arnaud Sterckx
    2. MARSOLUT – PhD education in MAR – 12 scholarships – Enrique Fernández
    3. GRIPP GW Solutions Initiative for Policy & Practice –Karen Villholth
    4. MAR-NET activities in China – / Germany / Denmark – Yan Zheng
    5. MARVI - MAR and Village level interventions for sustaining livelihoods – Rajasthan and Gujarat, India - from Basant Maheshwari,
    6. 8th International Groundwater Conference, Roorkee, India, 21-24 Oct 2019 – Dr Thangarajan

7. 36th International Geological Congress, to be held in New Delhi, 2-8 March 2020 – Dr Jain
8. Record MAR papers in IAH 45th Congress Daejeon, Korea, Sept 2018 Peter Dillon
9. IAH 46th Congress Malaga, Spain, Sept 2019 & IAH/NCGRT Australasian Groundwater Conference 2019, Brisbane 24-27 Nov 2019
10. New ASCE/EWRI Guidelines on Managed Aquifer Recharge – Doug Bartlett
12. Suggestions for new activities – anyone
13. Volunteers to participate in existing and new activities – anyone
14. Close of Plenary (Next Plenary tbd by co-chairs)

Notes of meeting

1. Welcome and Introductions - Peter Dillon

Peter welcomed all to the meeting. Many attendees at their first meeting of the Commission were especially welcome. It was a particular pleasure to welcome Alice Aureli (UNESCO) and Bruce Misstear (IAH) to their first ISMAR and IAH-MAR Plenary. Our hope is that all will find the meeting informative and useful and it creates opportunities for your involvement in productive activities. The email list and resources of the Commission are free to everyone, and we hope that many will appreciate the benefits and choose to join IAH to widen the benefits, including receipt of Hydrogeology Journal and the broader networking available from IAH Congresses and Newsletters.

2. Objectives of Commission - Peter - as per our web site: https://recharge.iah.org/

The Commission was established in 2001 by IAH with the encouragement of UNESCO IHP, and has subsequently been periodically reviewed and renewed:

- to promote the securing and expanding of water resources and improving water quality in ways that are appropriate, environmentally sustainable, technically viable, economic and socially desirable.
- to encourage research, development and adoption of improved practices for management of aquifer recharge
- to improve knowledge, skills and capabilities of practitioners, water resources managers and regulators.
- to facilitate international exchange of information between members (e.g. via a web page and an email list), by disseminating results of research and practical experience (e.g. via conferences and workshops and producing useful publications), raising awareness of MAR among IAH members, related professions and the community, and its members undertaking projects and activities identified in plenaries as important.

3. UNESCO IHP VIII 2014-2021 context for IAH-MAR role

Alice Aureli informed that IAH-MAR was integral with the Strategic Plan of UNESCO IHP-VIII (2014-2021) "WATER SECURITY: RESPONSES TO LOCAL, REGIONAL, AND GLOBAL CHALLENGES" Specifically:
Focal Area 2.2 - Addressing strategies for management of aquifers recharge
http://en.unesco.org/themes/water-security/hydrology/ihp-viii-water-security

UNESCO had supported the Commission from the outset with a formative meeting in Paris with the key organisations in this field, and subsequently through the development of a summary document on *MAR strategies in semi-arid countries*, developed by Ian Gale (a founding co-chair of IAH-MAR), by conducting UNESCO workshops on MAR in Vietnam, Egypt, Pakistan, and South Africa, advocated for the role of MAR at a high level within the UN and recently assisted the commission to give open access to a key Hydrogeology Journal paper arising from a working group (60 years global progress in MAR). Since UNESCO regards climate change as a globally vital issue, and MAR is one of the adaptive strategies which will have far greater use in future, this is a matter of critical importance, along with transboundary groundwater resources management, that has deep and ongoing engagement by UNESCO. Two other specific joint activities are mentioned below

1. UNESCO Travel Scholars – these have been important in ISMAR symposia since ISMAR4 in Adelaide in 2002,

and UNESCO is pleased to be assisting 8 early career professionals and postgraduate students from developing countries to attend ISMAR10. Travel scholarships were provided on a competitive basis and the winners are José Bonilla, Prahlad Soni, Ma Meng, Alam Mohammad, Lucila Fernandes, Zhang Hexuan, Victor Coelho & Piya Mohasin.

2. Exemplary case studies UNESCO publication with IAH and GRIPP – Following a meeting of leaders of the Commission, its Working Groups and GRIPP in September 2017 at IAH Congress Dubrovnic, UNESCO requested a proposal on a publication addressing exemplary case studies that brought together key information on economics and sustainability of MAR projects together with the stories of the evolution of MAR. This is intended to fill a gap that will help accelerate the uptake and benefits of MAR where it can be of most value. A meeting of case study authors and editors was held on 19 May helping progress towards publication later this year. The Commission is to provide a draft in July and a final report by end of Oct 2019.

4. Progress reports and plans of Working Groups

These working groups are described on the IAH-MAR web site: https://recharge.iah.org/working- groups
Brief descriptions of activities were presented by working group leaders.

1. *Economics of MAR – Andrew Ross (Aust. National University)*

The Working Group program is being developed in two stages:
Stage 1: 2016-18: Collection & analysis of financial (cost) data for selected MAR schemes
Stage 2: 2018 onwards: Cost effectiveness and cost benefit analysis of selected MAR schemes
Outputs: Financial analysis of MAR costs of 21 schemes in 6 countries completed and published:
Ross, A and Hasnain, S (2018) Factors affecting the cost of managed aquifer recharge schemes, Sustainable Water Resources Management 4:179-190
https://recharge.iah.org/swarm-vol-4-issue-2-june-2018

Next steps: A key part of the UNESCO Exemplary case studies document is the compilation and synthesis of cost and benefit information for about 30projects for which volunteers have provided case study descriptions. Levelised costs are being estimated for these projects, and benefits are being estimated by the cost of the next best alternative source of water supply, increased production owing to the MAR project or alternative methods. Andrew is the key contact to submit case studies, and these should be sent to him at a.ross@anu.edu.au Information on a wide range of MAR types is being collected from developed and developing countries.

Andrew would be pleased to receive information about the cost and benefits of any MAR projects which could be included in planned academic publications in 2019-20. He will represent Commission at a meeting of USDA on Economics of MAR 26 June in Washington DC.
https://marworkshop.uark.edu/

2. *MAR for Sustainable Development – Yan Zheng (SUSTech, China)*

Collective Role was discussed in a workshop at ISMAR9, 2016.

At a workshop in ISMAR9, this working group formed a plan to develop a set of fact sheets (initially say about 5) on a variety of successful MAR projects that have been in operation for say >10 years, of different types in varied settings, covering developing and developed countries. Yan aims to develop a matrix of measures of sustainability and success of MAR projects, to include in these fact sheet stories. These plans have subsequently been incorporated into the plans for the proposed UNESCO publication. This has become an iterative task, and the first phase was completed at the workshop in Madrid on 19 May, where a draft list of sustainability indices were evaluated by case study authors. A subset of nine were found to be meaningful, measured, and covered the breadth of topics for which indicator measures were needed. The next phase is for Yan to contact case study authors giving more texture on the shortlisted indices and seeking their specific inputs that would also enable presentation and synthesis of the indicators for these case studies.

Most case studies are already reported in the IGRAC MAR Portal on the web (see Global Inventory Working

Group Report) and several are listed under a GRIPP natural groundwater-based infrastructure document, web-published in Sept 2018 (see GRIPP report later).

Volunteers with access to MAR site information have written the case studies using a format template and further case studies presented at ISMAR10 could allow authors to extend their oral paper to also become co-authors of the UNESCO report.

ACTION: UNESCO Exemplary case study authors are sought to respond to Yan's request for specific information on sustainability indices by 30 June 2019.

3. Global MAR Inventory – Catalin Stefan (TU Dresden, Germany) and Arnaud Sterckx (IGRAC, in The Netherlands)

The Global MAR Inventory Group has finished the task it set itself and mounted the information on the IGRAC MAR Portal – https://www.un-igrac.org/special-project/global-mar-inventory The MAR Portal now contains detailed information on 1200 Managed Aquifer Recharge sites around the world as well as regional MAR suitability maps. Outputs of the working group activities are uploaded and maintained here. It is intended to overlay the MAR layer on other thematic maps such as groundwater stress.

Two summary papers were produced and both are now available from:
https://recharge.iah.org/swarm-vol-4-issue-2-june-2018:

Stefan, C and Ansems, N. (2018). Web-based global inventory of managed aquifer recharge applications. Sustain. Water Resour. Manag. Vol 4 (2) p153-162. https://doi.org/10.1007/s40899-017- 0212-6 (open access) - *300 reads a month since published on line !!!!! – This is the most widely read paper on MAR of all time.*

Bonilla Valverde, J.P., Stefan, C., Palma Nava, A., da Silva, E.B. and Pivaral Vivar, H.L. (2018). Inventory of managed aquifer recharge schemes in Latin America and the Caribbean. Sustain. Water Resour. Manag. Vol 4 (2) 163-178 https://doi.org/10.1007/s40899-018-0231-y

Although the working group has disbanded as it has now completed what it set out to do, there will be an ongoing need to update the inventory and IGRAC is taking responsibility to upload information provided by site owners or operators who use its template. IGRAC also makes available through this portal maps on MAR suitability (see Working Group on MAR Suitability maps, later). It is suggested that each ISMAR could be a focal point to stimulate the effort to update this web site.

ACTION: Volunteers are sought to register some basic details on their MAR site(s) via the portal which has an upload form that is easy to complete. Check first on the portal to see whether your site is already included. https://marportal.un-igrac.org

4. 60 years history of MAR – Peter Dillon (CSIRO/NCGRT Aust) and Pieter Stuyfzand (KWR Water and Delft UT, The Netherlands)

This working group completed its assignment with the publication in the Hydrogeology Journal, on line on 7 September 2018 and in print in January 2019, a summary paper "60 years global progress on MAR" as an open access paper supported by UNESCO as a contribution to IHP VIII.

Dillon, P., Stuyfzand, P., Grischek, T., Lluria, M., Pyne, R.D.G., Jain, R.C., Bear, J., Schwarz, J., Wang, W., Fernández, E., Stefan, C., Pettenati, M., van der Gun, J., Sprenger, C., Massmann, G., Scanlon, B.R., Xanke, J., Jokela, P., Zheng, Y., Rossetto, R., Shamrukh, M., Pavelic, P., Murray, E., Ross, A., Bonilla Valverde, J.P., Palma Nava, A., Ansems, N., Posavec, K., Ha, K., Martin, R. and Sapiano, M. (2019). **Sixty Years of Global Progress in Managed Aquifer Recharge**. Hydrogeology Journal 27 (1) 1-30. (Published on-line 7 Sept 2018). https://doi.org/10.1007/s10040-018-1841-z .

Current reported annual volume of MAR is 10 cu.km which is about 1% of total annual groundwater extraction, or about 7% of current rate of global groundwater storage decline but only 0.07% of natural recharge. The paper summarises a wide body of recent research on various aspects of MAR.

At the link above you can download the paper and two electronic supplementary material files (ESM1) national summaries for 16 countries (see below), and (ESM2) pictures and cations of MAR examples. All these are free thanks to UNESCO covering the open access author charge.

Countries or regions whose history of development of MAR have been documented in https://recharge.iah.org/60-years-history- mar are: Australia, China, Croatia, Finland, France, Germany, Israel, Italy, Jordan, Korea, Latin America & Caribbean, The Netherlands, Qatar, South East Asia, Southern Africa and Spain. A common element is a table of average MAR annual volumes by decade since the mid 1960's. Further national/regional contributions may be uploaded, following review, at the IAH-MAR web site along with a web- link to the paper.

ACTION: Volunteers who are able to write national summaries for countries not yet covered are welcome to submit these. Any received will be reviewed and mounted on IAH-MAR web site.

5. Monograph on clogging and its management – Russell Martin (Wallbridge Gilbert Aztec, Australia)

The Working group's first monograph was published in 2013 (Martin (Ed) see https://recharge.iah.org/working-groups/clogging-and- its-management). A second volume is underway and more contributions are needed. Russell aims to have Volume 2 ready 12 months after ISMAR10 – Madrid May 2019

Option 1: New material seeking papers on

- Low cost low tech applications to reduce/manage clogging
- MAR clogging indicators
- Standardization of investigation methods
- Case studies on management of clogging during MAR operations

Option 2 Synthesis of clogging papers from previous ISMAR proceedings.

ACTION: Papers or reports on management of clogging are invited immediately for consideration for inclusion in Volume 2. Please contact Russell if you wish to contribute, or are aware of relevant open access material: rmartin@wga.com.au

6. MAR to MARket – Enrique Fernández Escalante (Tragsa, Spain)

Details of many activities in Europe and South America are described in https://recharge.iah.org/mar-to-market

This working group was associated with a European Commission Environmental Innovation Network on MAR, which has now concluded. Enrique has recommended the closure of this IAH-MAR Working Group. The extensive activities and outputs of the working group are reported at the web site above.

7. ***MAR Regulations and Guidelines – Manuel Sapiano (Malta Energy and Water Agency)***

Manuel had made a contribution to the governance part of the 60 year history of MAR paper
He is preparing a paper for ISMAR10 to list and compare existing state and national water quality guidelines and regulations for MAR, and has worked on an European Commission project to do this for Europe.

ACTION: Volunteers are invited to inform Manuel concerning the existence of such a guideline in their country to send him the web link or a copy to add to those on the web site, to allow a comparative analysis: https://recharge.iah.org/mar-regulations

8. ***MAR suitability mapping - José Bonilla (AyA Costa Rica) and Catalin Stefan(TU Dresden)***

This is a newly formed working group led by José and Catalin whose initial membership is Arnaud Sterckx (IGRAC), Daniel Goode (USGS), and Jana Sallwey (TU Dresden), and seeks to grow by being joined by all those with an interest in this topic.

It seeks to initiate a network of scientists and stakeholders to share experiences on MAR suitability maps (criteria, scales, objectives, applications etc.) A workshop was held in IGME at ISMAR10 on 20 May 2019 to progress dialogue and help set specific targets set for the outputs of the working group.

It will evaluate the range of methods in use, many of which are multi-criteria analysis of mapped parameters, each with a range indicative of suitability and with a weighting factor. There is considerable subjectivity and apparently inconsistent methodology for GIS-based selection of suitable sites for MAR. The group will consider primarily hydrogeological suitability and also availability of source water and demand for water. All three factors are required to assess actual opportunities. However the focus will be on MAR Suitability which is governed by the hydrogeology and is expected to be an enduring indicator. A starting point for the group will be to standardize terminology. Maps have different purposes, scale, and are based on a range of data types and densities, and there are different requirements for different MAR methods. There will be an effort to put this onto a scientific footing, which may result in different types of maps under different settings, but useful for the purpose intended, able to be validated, and ideally also capable of international comparison.

As a starting point an initial review paper is: Jana Sallwey, José Pablo Bonilla Valverde, Felipe Vásquez López, Ralf Junghanns, and Catalin Stefan (2019). Suitability maps for managed aquifer recharge: a review of multi-criteria decision analysis studies. Environmental Reviews, *Vol 27, 138-150.* https://www.nrcresearchpress.com/doi/pdf/10.1139/er-2018-0069

ACTION: Volunteers are invited to inform José of their interest, whether they have case studies, concerning the existence of such maps in their country to send him the web link or a copy to add to those on the web site. A LinkedIn Group has been formed called 'MAR Suitability Mapping'. To join contact: José Bonilla bonilla.jp@gmail.com

5. Outcomes of ISMAR9, Mexico City, June 2016

2 special issues of journals each with 18 papers- all papers downloadable at no cost from https://recharge.iah.org/thematic-issues-journals and links within:

Water quality considerations for MAR systems - MDPI **J Water** 2017 eds: Pieter Stuyfzand and Niels Hartog.

MAR in Integrated Water Resources Management - Springer **J of Sustainable Water Resources Management,** Vol 4 (2) eds: Peter Dillon, Paul Pavelic, Weiping Wang and Adriana Palma Nava. Journal format from https://link.springer.com/journal/40899/onlineFirst/page/1 and with Springer's permission, in author-format as open access from IAH-MAR web site above.

Poster papers on IAH-MAR Spanish website www.dina-mar.es/

'*A Call to Action for Groundwater Management'* based on workshops at ISMAR9, from Wkg Gp led by Tim Parker, & communicated through IAH-MAR and GRIPP. https://recharge.iah.org/call-to-action-on-groundwater-management

6. Invitation to ISMAR11 – Greg Woodside (Orange County Water District)

Peter, representing the selection committee comprising IAH, UNESCO and ASCE, congratulated Groundwater Resources Association of California, Arizona Hydrological Society and the Orange County Water District for their successful combined bid to host ISMAR11. Greg Woodside (OCWD) came to the podium to give a warm invitation to all to attend the 11th ISMAR in Long Beach, California, April 2022. He represented the ISMAR11 chair, Adam Hutchinson, and co-chair, Doug Bartlett, in issuing the welcome. This is very close to the site of what is now termed ISMAR1 (then called Artificial Recharge of Groundwater Symposium) held at Anaheim, California in 1988. Orange County, along with many other water managers in California have been highly innovative in developing MAR. With the Groundwater Resources Management Act coming into effect, MAR is expected to grow rapidly in California to meet increasing stress on water resources. This will be an outstanding symposium. More information will follow in due course.

There is a process for bidding to host ISMARs that starts a year before the previous ISMAR. For anyone interested in hosting ISMAR12 in 2025 please contact the co-chairs of the commission to give yourself time to submit a competitive proposal.

7. Comments by Bruce Misstear and Weiping Wang.

Bruce Misstear (Sec Gen IAH) expressed appreciation to the organisers of ISMAR10 for a well-run and well-attended Symposium. IAH has a number of Commissions and Networks, that give IAH members an opportunity to work and link together to advance the science and practice of hydrogeology. The Commission on MAR is one of eight commissions, and is among the more active entities of IAH, and is one that has a strong engagement with UNESCO. It was established as a working group in 2000, aided by the late Ivan Johnson (USGS) and in 2001 upgraded to a Commission with Peter Dillon and the late Ian Gale as founding co-chairs. IAH-MAR has been renewed twice on review by the IAH Executive, owing to the ongoing need for scientific leadership and coordination in this field that at its heart involves hydrogeologists, working closely with chemists, microbiologists, health scientists, water treatment engineers, groundwater modellers, economists and policy makers. This is an ongoing need with ongoing declines in global groundwater storage and changing climate.

Weiping Wang (co-chair 2012-2019) expressed his enjoyment and satisfaction in carrying out this role and also in hosting ISMAR8 in Beijing in 2013. He is warmed by the enthusiasm for MAR by those who become involved and see the real opportunities it presents to contribute, alongside demand management, to sustaining groundwater resources and for benefitting groundwater users.

He thanked IAH for the opportunity to participate and expressed appreciation to Ian Gale, Peter Dillon and Enrique Fernández, and importantly to all the Working Group Leaders who make the Commission dynamic and productive. He expressed his confidence in the three nominees for co-chair, and wished them well, as he and Peter retire.

8. Election of IAH-MAR Co- chairs – Bruce Misstear, representing IAH Exec as returning officer

Bruce reminded that at the co-chair elections at ISMAR9, Peter and Weiping announced they would retire at the next election. Nominations had been sought for all positions in several emails to the IAH-MAR email list in the last 6 months. That process led to three nominations, each with a seconder, for these positions which would run until the next election at an IAH-MAR plenary at ISMAR11:

1. **Enrique Fernández Escalante** - TRAGSA, Madrid, Spain - a current co-chair and convenor of ISMAR10 – seconded by Luis Martinez Cortina

2. **Catalin Stefan** – TU Dresden, Germany, Leader of INOWAS group- a working group leader (global inventory, and MAR Suitability mapping) - seconded by Russell Martin

3. **Yan Zheng** – Southern University of Science and Technology, Shenzhen, China - a working group leader (MAR for sustainable development) –seconded by Weiping Wang.

Bruce asked for those in agreement that these three people be elected as co-chairs of the commission to raise their hand. He also checked for those in dissent, and the agreement was unanimous. Bruce declared these three to be elected and said IAH was looking forward to working with them.

9. IAH Certificates of Appreciation – Bruce Misstear, representing IAH Executive

Bruce informed that Antonio Chambel (IAH President) and he (as IAH Secretary General) had signed five certificates of appreciation to people active in the Commission who had given distinguished service to the advancement of MAR. Bruce gave certificates and shook the hands of recipients present. Their certificates read as follows:

The International Association of Hydrogeologists wishes to record its appreciation of the exceptional services given to advance the objectives of its Commission for Managing Aquifer Recharge by

Catalin Stefan and IGRAC - Catalin led the MAR Global Inventory working group liaising with IGRAC to produce the most widely read paper in MAR (SWARM) and update the MAR Portal.

Adriana Palma Nava - Adriana initiated and led ISMAR9 Mexico City and co-edited one of two special issue journals (SWARM) arising from this symposium.

Yan Zheng - Yan leads the working group on Sustainable MAR - including workshops in Beijing in 2015 and 2018, at ISMAR9, and fostering the Chinese MAR network.

Andrew Ross - Andrew leads the working group on Economics of MAR producing a quantitative paper and developed standardised approaches.

Doug Bartlett - Doug led ISMAR6 and several BSMARs for AHS contributed to ISMAR9, and over many years led the production of the new ASCE/EWRI MAR Standards.

IAH recognised that there were many people making magnificent contributions to MAR beside those who received these certificates, but we hope you agree with us that these are particularly deserving candidates. Three copies of the certificate for Catalin and IGRAC were provided for IGRAC one each for Nienke Ansems, Arnaud Sterckx and Neno Kukuric.

10. ISMAR10 Best Poster Prize – Enrique Fernández

Enrique announced there was a tie for the best poster paper award from the ISMAR10 Organising Committee. The two winners are :

Piya Mohasin - (63) Assessment of novel aquifer recharge technology: A case study in Nanoor, West Bengal, India

Marie Pettenati – (150) Combined natural and engineered systems (cNES) for MAR &Soil aquifer treatment with water storage and quality improvement.

Enrique presented them with certificates for the ISMAR 10 best poster´s co-winners.

11. Information Sharing

1. IGRAC MAR Portal – Arnaud Sterckx

Arnaud advised that the IGRAC MAR Portal housed the Inventory of MAR sites containing more than 1200 entries, that are searchable and give key information and references for each site. There is a growing set of MAR suitability maps. If you have MAR sites not yet uploaded, please use the template on the web site to upload these. If you have a MAR suitability map that is not yet uploaded please contact Arnaud or Jose Bonilla.

*2. **Marsolut** – PhD education in MAR- 12 PhD scholarships – **Enrique Fernández***

12 PhD scholarships are on offer in the field of MAR by various European Universities and applications close on 15 June. For more information: https://www.marsolut-itn.eu/

3. GRIPP - Groundwater Solutions Initiative for Policy & Practice – led by ***Karen Villholth (IWMI)*** hosted a session at Stockholm World Water Week on Groundwater Based Natural Infrastructure. A series of case studies was prepared and many members of IAH-MAR developed these. See list at: www.gripp.iwmi.org/natural-infrastructure/ As mentioned earlier GRIPP is contributing to the UNESCO MAR Case Studies document.

4. MAR-Net China - Yan Zheng

A MAR in the North China Plain Workshop, will be held in Beijing, 17 September 2018 by Danish and Chinese collaborators in a DANIDA project : http://www.mar-china-gues.dk

Sino-German MAR Workshop, 23 June 23 2017 –MARChina a project to initiate cooperation on MAR, and enable Ph.D. student and post-doctoral trainee exchanges

5. MARVI - MAR and Village level interventions for sustaining livelihoods – Rajasthan and Gujarat, India - from Basant Maheshwari, Univ of Western Sydney

MARVI was one of the topic areas presented last week at the World Water Forum 2018 in Stockholm, Sweden You can see the MARVI case study at the following link: http://gripp.iwmi.org/natural-infrastructure/water-storage/

MyWell version 2.0 is under development: - a mobile phone app for crowd sourcing rainfall, groundwater level and check dam water level measurements. Will allow eg calculation of infiltration rates, cropping areas based on post-monsoon groundwater levels.

Several journal papers included in SWARM Special Issue on MAR in Integrated Water Management. Farmer training completed and village groundwater cooperatives have been formed and regarded as a model for participatory gw management: See https://recharge.iah.org/marvi

6. 8th International Groundwater Conference, Roorkee, India, 21-24 Oct 2019

More information: http://igwc2019.com/ There will be a MAR Theme within the Conference. Peter Dillon is on scientific committee for this Theme.

7. 36th International Geological Congress, to be held in New Delhi, 2-8 March 2020

There will be a hydrogeology symposium within the Congress. Dr Jain is speaking with Dr Catalin Stefan. More information: https://eventegg.com/igc-2020/

8. MAR papers in IAH 45th Congress Daejeon, Korea, Sept 2018

Rm 107: 11:30am - 12:30pm Mon 10th (4)
Rm 106: 11:15am - 12:30pm Tues 11th (3)
Rm 107: 4.00pm - 5.45pm Tues 11th (7)
Rm 101: 11:15am - 12:30pm Fri 14th (2)
Plus MAR papers in other sessions (8)
Total (25)

Plus 2 poster papers on MAR, and a number of papers closely related to MAR (eg ATES and injection induced seismicity keynote address).
This is a likely a record for the number of MAR papers in an IAH Congress.

9. IAH 46th Congress Málaga, Spain, Sept 2019 / IAH/NCGRT Australasian Groundwater Conference 2019, Brisbane 24-27 Nov 2019

The Congress this year will be in Spain. Normally the Commission holds a Plenary, but given close proximity to ISMAR10, it would be up to new co-chairs to determine the merits.

10. Australasian Groundwater Conference will also feature some MAR papers. Both

conferences are found at: https://iah.org/events/page/2

10. New ASCE/EWRI Guidelines on Managed Aquifer Recharge – Doug Bartlett, Arizona

Although not presented in the Plenary, Doug Bartlett presented in an ISMAR10 technical session the new ASCE Guidelines for MAR, which have now passed the strict balloting procedure within ASCE and will be published later in 2019. For more information contact : dbartlett@geo-logic.com

12. Suggestions for new activities – Anyone

Anis Chekirbane of Tunisia suggested launching an IAH-MAR network in Tunisia and northern African region. Peter suggested they could talk with others assess the interest and if help is needed then contact the new co-chairs. A web page on IAH-MAR site could be made available for this network.

A MAR network is under consideration in Latin America, arising from a workshop on 20 May. At this stage its up to its leaders to establish the interest, to identify useful actions such a consortium could take, and proceed with whatever they agree.

13. Volunteers to participate in existing and new activities –anyone

All working groups are looking to assimilate information globally on well-defined topics to help answer questions and improve MAR design and operation. If you have information that you think could be useful to any working group, please contact the WG leader. Their emails are listed on the website under: https://recharge.iah.org/working-groups

14. **Close of Plenary** (Next Plenary to be determined by new co-chairs

Peter thanked all for attendance in a lively meeting that demonstrated how fortunate the commission is to have dynamic and persistent working group leaders some of whom are becoming the next generation of co-chairs. We look forward to a new phase of innovation, networking and achievements that the commission will stimulate.