REPORT ON THE GLOBAL WEATHER ENTERPRISE SEMINAR

Introduction

A Global Weather Enterprise (GWE) Seminar, organised by the World Bank Group in collaboration with the World Meteorological Organisation (WMO), was held in Washington DC on 28 November 2017. Participants from across the public, private and academic sectors were invited to the Seminar to discuss the opportunities and risks associated with the future of the GWE. Around 70 GWE leaders from the three sectors participated in the event with World Bank staff acting as rapporteurs. The Seminar was facilitated by the American Meteorological Society.

This report on the Seminar provides a summary of the discussions that took place on 28 November 2017. It does not provide contextual and background information about the Global Weather Enterprise such as was provided on the Trellis website[1] and made available to participants prior to the Seminar. Nor is it a statement of policies or of how the GWE should evolve over the coming decades. It provides an aide memoire of what was discussed. With this approach, the report attempts to include as many distinct points made by participants without editing; this means that naturally some comments may appear contradictory or even out of context. Because it is not a verbatim account some précising of the discussion has had to be carried out.

The plenary "next steps" discussion in the afternoon of the Seminar attempted to isolate a number of key points and a number of possible actions that could be pursued following the Seminar. This report provides a summary of these points and actions; after the Seminar a draft of this report was circulated to participants and this final text has greatly benefitted from their feedback. The organisers take responsibility for this Seminar report and whilst every effort has been made for accuracy and clarity any remaining errors will be theirs alone.

[1] https://www.trelliscience.com/#/group-home/1745

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Opening Remarks

In opening the Seminar James Close, Director of Climate Change Global Theme (World Bank) said: "The Global Weather Enterprise is going through a major structural change due to: rapid development of technologies; public-sector funding being under pressure; the needs of the society requiring more accurate and reliable hydro-meteorological information to protect people and property from increasing hazards and climate change. All these factors suggest that the Global Weather Enterprise should grow substantially over coming years. Recognizing the importance of this sector for strengthening resilience and adaptation to climate change, the World Bank has significantly increased its support to national meteorological and hydrological services in developing countries. Since 2010 our hydro-met portfolio increased from 25 projects with total funding $270 million to 67 projects with funding reaching $900 million. Still it is not enough and we believe that larger scale and more efficient engagement between the public and private sectors is essential, and inclusion of academia in this process is critical too."

In his opening remarks Petteri Taalas, the Secretary-General of the World Meteorological Organisation, said: "WMO is an organization of 191 Members, which have given WMO mandate to be the global authoritative organization specializing in weather, climate and water. The WMO permanent representatives are appointed by the governments to represent the interest of their countries including the private sector. The success of WMO has been based on free exchange of high quality standardized observations and of scientific and technical know-how worldwide.

The private sector has always been a part of the WMO, and is expected to be so in the future. WMO is interested in playing a leading role in engaging private sector service and measurement actors in its activities. This engagement is expected to speed up within the coming months. WMO has a dedicated secretariat and consultant resources to accomplish this. WMO is Interested in hearing concrete proposals from private sector on how to become more engaged in WMO activities."

On behalf of the organisers, David Rogers and Alan Thorpe welcomed participants to what they referred to as a landmark event. They noted that this was perhaps the first gathering of its kind of the leaders in the global weather enterprise from across the public, private and academic sectors who are responsible for the provision of the world's weather information. They described the motivation for holding the Seminar and that participants would be discussing the opportunities and risks associated with the future of the global weather enterprise with an emphasis on collaboration between the public, private and academic sectors. Time was devoted to discussion of the next steps that participants believe should be taken following the Seminar.

William Hooke from the American Meteorological Society facilitated the Seminar. He opened proceedings by describing the modus operandi reminding participants that, aside from the opening remarks, it was being held under the Chatham House rule.

The GWE Seminar discussed a number of key characteristics of the enterprise as follows:

- The goal of the Global Weather Enterprise is to provide accurate, reliable and timely weather and climate related information that contributes to the safety of life and property, poverty reduction, and the promotion of economic development. This goal is fully aligned with the requirements of the universally-agreed Sustainable Development Goals and Agenda 2030[2].

- The GWE is contributed to by organisations and individuals in the public, private and academic sectors. Enhanced cooperation and partnership between the different players is recognized as being needed to realise the socio-economic benefits produced by the GWE.

- Crucial for delivery of the GWE goals is advancing the science and technology and equipping the next-generation with appropriate skills. The academic sector, strongly supported by both the public and private sectors, plays a major role in these areas.

- There is agreement that a pathway for the GWE to grow in size and scope over the period to 2030 and beyond is both an essential and realistic goal: essential because of the growing societal needs for weather information (as described *inter alia* by Agenda 2030) and realistic given recent trends and new (scientific and technological) opportunities emerging.

- Whilst the enterprise is fundamentally global and collaborative in nature, regional and national variations need to be factored into any actions related to the GWE.

- The GWE fundamentally involves a value chain linking observations, numerical weather prediction, analyses and forecasts, and the end use of derived weather information. The GWE has been very successful in delivering increasing quality weather information that helps save lives and property. It is a goal of the GWE to maximize value for all along the value chain.

- There is a discernible move from the provision of capital-based infrastructure (e.g., observing technology hardware) to a service-based approach (e.g., provision of data services); this will have a significant impact on the GWE.

- There are a number of opportunities and risks associated with the advancement of the GWE and delivery of its goals. The integrity and success of the GWE is threatened without action being taken to realise the many opportunities and mitigate risks that lie ahead.

[2] http://www.un.org/sustainabledevelopment/development-agenda/

The GWE Seminar identified some key actions that need to be taken:

1. *Improving collaboration and building trust within GWE:* Any lack of clarity in the respective roles and responsibilities of the different actors would contribute to mistrust and will need to be resolved if the full potential of the GWE is to be realised. Consequently, the threat of the GWE not delivering what society needs will be greatly diminished by enhancing the mutual respect and trust across the sectors; this will come from greater dialogue and understanding leading to action. In this regard, the GWE stakeholders need to act quickly – they have been too slow in the past to address issues that would improve the collaboration between the public, private and academic sectors.

2. *WMO process on the GWE:* The World Meteorological Organisation committed itself to accelerate its process aimed at enabling better integration and collaboration of the public, private and academic sectors that contribute to the GWE, including preparation of a relevant policy act for consideration by the World Meteorological Congress in 2019.

3. *Working Group on the GWE:* Arising from the seminar, an ad-hoc Working Group should be created that would provide the public, private and academic sectors with a neutral forum to help improve dialogue and understanding across the sectors as they pursue the goals of the GWE. It would be fully aligned with the WMO process. The appropriate model is being progressed by World Bank, WMO and other parties following the Seminar. Input from Seminar participants is being solicited. The WMO session at the AMS meeting in January 2018 will be an opportunity to refine the model.

4. *Socio-economic scenarios:* Not least because there are sources of finance that now exist and are as yet untapped, it is important to investigate economic incentives and disincentives for the GWE. For this a socio-economic study is needed carried out by reputable experts to analyse potential scenarios for the successful growth and development of the GWE.

5. *Data access and exchange:* As wide as possible access and exchange are needed for both public and private sources of data; in this context, review of WMO Resolutions 25, 40 and 60 is probably needed. A goal for the GWE is to make weather information as freely available as possible to those who currently do not have access or cannot otherwise afford it, such as in low and middle-income countries.

6. *Business models for data services:* Business models (and their risks for different actors) for sustainability of public and private data services need to be explored; within that an issue to be addressed is exploration of the consequences of the ownership of data.

7. *Diversity amongst countries:* Actions such as devising suitable partnership scheme(s) should take into account the heterogeneity amongst countries using the principle that no-one is left behind.

ANNEX: Opportunities and Risks for the Future of the Global Weather Enterprise

This is an unedited list of views expressed by Seminar participants; as such they do not necessarily represent agreement or consensus by the Seminar as a whole.

Opportunities

Observational data and its access

- Good decisions require good data—should be the backbone of all decisions going forward.
- Managing/optimizing global observation system – what are the respective relevant roles for public and private sectors and business models that work, while due attention should be paid to underlying mechanisms to drive each sector (and both sectors) - how to optimize the observations for NWP, how to ensure re-investment to public infrastructure, how to manage shareholders' interests?
- Need to develop principles around the use by public good meteorological services of privately collected data; a challenge is who will pay for private observation data. More data are creating more opportunities.
- Nobody can stop technological development, policy makers should balance interests of all 3 sectors, government can buy data from private sector
- Usability, importance of metadata, sharing of weather data can be incomparable without appropriate metadata, do we not have a model for data sharing with private sector?
- We have a lot of data, but it isn't necessarily usable or accessible to important players. Access to operational weather data via one or more global centre is an opportunity.
- Data usability is more important than standardization, which is often unattainable. We need to encourage growth of metadata: data exchange needs to be active to promote the best quality and is only possible with trust between sectors. Metadata: we haven't found a way to find an effective data sharing model between sectors
- One of the greatest opportunities is standardization of observations and data
- Systematic data sharing, standardization and quality control ("known quality") can be used to leverage all observations being made. Without this, and with public investment in many countries insufficient, private entities are dis-incentivized and bypass the public system, not seeing an opportunity to benefit from data sharing. Various effective business models are needed to provide right incentives for both sides to exchange data.
- We need to change the way we deal with data: too much data is being accumulated, many companies and national services are using the same data and storing it many times. Can we develop a way to store some core data in a few central places and give all actors controlled access?
- WMO global systems that represent the next step of the World Weather Watch (WWW), namely, the WMO Integrated Observing System (WIGOS) and the WMO Information System (WIS) provide global functionality and access, as well as standards for data and metadata that could cover most of the GWE data/information flows.
- Observing systems are often focused on few large investments in new tech. This might only be possible with public/private partnerships. Smaller, efficient well-known tech is often ignored.

Weather modelling

- Opportunity comes from further improving modelling leading to better decisions based on better information. Improving modelling is more and more difficult for individual NMHSs. Opportunity comes from pulling public and private "brains" together to improve modelling.
- This is a most contentious issue between public and private sectors.
- Infrastructure: creating it is in one of the opportunities. At the same time, infrastructure creates additional risks of not having sufficient resources to maintain it. Sustainability must be planned for from the beginning. It cannot be an afterthought.
- Need to sustain diversity of models.
- The need for less competitive hubris in forecast inter-comparisons would accrue from agreed head-to-head evaluation on relevant targets and agreement on standardised skill metrics (a set of them, which together cover the needs of each member of the enterprise).

Partnership models

- Current modes of Public/Private partnerships are very transactional; we need more models that promote sharing and co-development; leaders in all sectors need to maintain a level of altruism, which is common within the Global Weather Enterprise. Yet partnerships must also be realistic and achieve a win-win for all sides.
- The partnership model between the (meteorological) public and private sectors has, in the past, been very transactional (i.e., you give we take, we sell you buy) whereas new business models are becoming more service oriented (e.g., private sector establishes cloud computing and the meteorological service buys a service); more models of joint research and production are needed, working together is the key.
- Working together, sum should be more than individuals, altruism, what benefit help to NMHS will bring to private sector, executive leadership cooperation. Code of ethics is critical for interaction.
- Many opportunities to collaborate, but common rules of engagement needed to unlock these.
- All sides need to understand the needs and motivations of the other sides in a partnership.

Societal engagement

- Social communications are important and their role in society is growing. Growth in demand will come from advances in social sciences and not technological developments. We have a poor understanding of how social communications are changing; partnership models are needed.
- There are a lot of large companies which are sensitive to weather conditions, which should offer more business opportunities for GWE to grow. Opportunities come from overlapping interests of private sector and public sector (coca cola expanding its production facilities will require weather data, but at the same time can share the specialized data with met services (??), similar to airline industries).
- Promote public awareness of issues at hand
- Disasters can be opportunities for the GWE, synergies are possible.

Financing

- Finance: a lot of opportunities come from funding for resilience, climate funds, etc.

- Optimization of public investment and policy can be used to incentivize private investment that supports public systems. This can reduce the risk that a private company pursues the whole value chain bypassing public services.
- Applied research increasingly driven by profit motive, but basic research is suffering from lack of public funding. Can increased private investment in academic research free up public funding for basic research? The risk of government reducing funding of basic research is an opportunity for bringing in more private investment.
- Investments will grow, but no guarantee that returns will grow.
- Financial sources exist for innovation; this is a huge mismatch and missed opportunity.
- Best investment is in management, good return is on the leading edge
- Investment opportunities such as food security are important driver and can be an opportunity for development.
- World Bank has provided funds to sectors (e.g., agriculture) for hydrometeorology without engaging NMHS, create unsustainable business; an opportunity to be grasped in future.

Technology

- Supercomputing opportunity, needs to get access of HPC capability to developing counties, public and private should work together on this issue, through Platform as a Service (PaaS) and Software as a Service (SaaS) approaches. Only relatively few players (countries and companies) have the most powerful computing power as a dedicated resource.
- Rapid advancement of technology is creating opportunities though such technology is not necessarily fully embraced due to slow adoption (mostly at the public side)
- "Disruptors"—how can we extract the positive outcomes, using them to our advantage, versus letting them prohibit growth?
- We need to examine emerging technologies (i.e. internet of things, quantum computing, etc.) and identify where to invest. GWE needs to identify opportunities for investment noting that the capacity for investment across countries varies greatly and that there's more money than there are good ideas, as long as that money can be appropriately accessed.

Service delivery

- There is currently a substantial gap between meteorological operations and people making decisions, i.e., in the provision of information and decisions made by the service users; the opportunity is to better fill this gap.
- Private sector engagement in service delivery is rapidly accelerating – not just in back office number crunching like it was in the recent past; need to re-evaluate existing business models in the private sector — e.g., by viewing equipment as a service, such as with "time-share" HPC and similar computing and storage services.
- Marketing of the GWE: while there are hints of service delivery in the oft-quoted value-chain, it is under-represented. There is an opportunity to increase demand and capacity to produce tailored services (often to be delivered by the private sector).
- Service delivery, communication and social science are important opportunities in an era with diverse means for forecast delivery such as social media.
- Service delivery is missing opportunities such as from emerging technologies (e.g., quantum computing). Infrastructure is needed to provide services; this opens opportunities for private sector as public funding is not enough.

- Practitioners advocacy needed to give profile to novel, specialised, high- value R&D, for a specific societal-sectors (DRR, energy, health, finance …).

Risks

General issues

- The whole value chain depends on a number of things: observations, models, delivery etc. There is a risk that the enterprise fails on one part and then everyone suffers.
- There is a huge risk in not acting globally now, because local solutions will be developed and possibly interfere with broader ones.
- A risk is the lack of quality assurance and transparency, legitimacy and predictability. This impacts the information circulating within the GWE—focus is placed on low price, which is not always consistent with high quality.
- Inability to work together will prohibit growth within the GWE → some other entity will take over. We need a wider net of engagement within the weather community. All groups need to be represented in this discussion.
- Deliberate delivery of poor quality information, or misuse of forecasting (for example information that accelerates use of a certain agricultural input even though it is not needed).
- Risks will be materialized only if no action is taken.
- Public sector has certain obligations and standards for sharing information, but the private sector has the right and often the ethical obligation to remain entirely confidential. Too much private control might prevent healthy knowledge sharing between sectors.
- Speed of technology transition varies between sectors, resulting in progress occurring very slowly. Public sector moves so slowly because there's large emphasis on not making any mistakes (emphasis is placed on quality of information). Private sector places emphasis on quantity of innovation ($$), which requires speed.
- Maybe the public sector has a natural pace that shouldn't be altered; the steadiness of the public sector and the speed of the private sector can complement each other.
- A view is that when the private sector comes into play, it tends to drive up the price. While others are of the opinion that the private sector are experts in developing things in the most cost-effective manner, whereas when the public sector is involved the cost is always increased.
- NMHSs don't know how to negotiate with "the private sector", because there are so many players involved.
- Money is not the issue; the dearth of good sustainable ideas is.
- Options for specific products for specific users (high value information either dollar wise or humanitarian wise) are often not taken up.

Low and middle-income countries

- Developing countries are lagging behind, private sector is going in and can make NMHS irrelevant. This could happen anywhere in the world unless the GWE learns to work together.
- An adequate business model is necessary to tap into technological advancement effectively in developing countries. The lack of an adequate business model is a risk for low middle-income countries to be left out from the GWE advancement.
- Low/middle income countries don't have any/enough data. Gap is worsened by destructive competition between public and private sectors. Transmission of data is very slow even in highly developed countries—lots of bureaucracy to overcome. Unwillingness to change and adapt business models exacerbates data gaps.

- Globalization is an issue, ECMWF improve services over their territories, not all national data is going to GTS, product availability is getting worse for these remote regions
- A big risk is that low and middle-income countries will be left behind. The objectives/driving vision of these services may need to change as well as their underlying business model. Move from Cap Ex to Op Ex models with the private sector providing such things as cloud computing and observations.
- Speed is important for developing countries, all low-income countries will lose because existing NMHS are below requirements. Government may get this information from elsewhere.
- There is diversity amongst the private sector; sometimes in small countries the best expertise resides in NMHSs and sometimes it resides in the private sector.
- Some companies are interested in putting a network into a less developed country but they need a return. WMO/WB should back this up with an appropriate financing methodology to enable such a PPP to be successful, while still providing for data sharing via Resolution 40.

GWE sectoral interactions

- The cost of insufficiently accurate and reliable weather forecast is increasing, if GWE does not step-up some large private companies can take over the business. A company with $100B could take over this whole enterprise creating an entirely private system which will be shared with others for cost.
- The private and public sector move at different speeds. Whilst the public sector is moving slowly trying to follow regulations, the private sector is driven by competition and it is faster. But not convinced that speed in public sector should increase; there is a need to consider whether NMHS are enabling other parties enough to improve delivery.
- Being smart about private-public collaboration - there should be an open and transparent way to engage with private sector, which should make a win-win situation.
- A risk arises from resource constraints such as: financial and expertise, long-term capacity building, O&M, and sustainability.
- Unscrutinised business practice is a risk; self-governance/regulation of the commercial sector is needed. The same is also true of some governmental organizations. Complete transparency is necessary for the GWE to be able to make solid progress.
- In the balance between speed and risk aversion, market forces may or may not work. If you have a product that is tested every day, the market does quality control. For solutions that do not have a market control, results will come in 30 years. Speed vs Risk Averse is different in different segments.
- It is up to the government to decide what is the level of acceptable risks; actions may not involve private sector if they are considered too risky.
- The public sector is risk averse while the private is opposite but this is not always true, e.g., NWP would not happen without public sector.
- There is a risk of not sharing the results in the private sector which becomes more and more capable. Lack of data sharing of data and knowledge is a risk
- If public-private-academic sectors are not cooperating all will lose. If this is not addressed at the global level, there will be national schemes that might prevent the creation of a level playing field.
- Easier to communicate face to face; there is a need for a code of conduct. WMO is ready to move faster.
- Multiplier effect of wealth creation through multiple use of public data. Private sector has a different perspective – more about multiple payments for single data. Not so much about fragmentations; its more about aligning approaches. Different and unaligned data use and

financing models. “Forced cost sharing” model that reduces costs by limiting sharing opportunities.
- A view: private sector treats knowledge as an asset only to be shared when it delivers a return. Maintaining the open exchange of intellectual capacity is important.

Enterprise structure and policies

- Self-governance and self-regulation is required. While some market self-regulation will occur, risks have emerged e.g., health care—big pharma driving up prices.
- Could there be certificates that verify both the quality of observations and of products to build trust within the enterprise and the consumer?
- Development of value chain, development of strategies is required, adherence to good practice rules are required. New age of NWP emerging.
- Is WMO a right forum to lead GWE strengthening? WMO needs to take responsibility of GWE as part of their government mandate, what should be done to generate the growth? How do we define what are conditions for the success of the GWE. There is a need to have other communities in this dialogue.
- If the public, private and academic sectors don’t work well together we all lose. The WMO must tackle the issue and find a mechanism to assist the collaboration and develop the principle/guidelines for the sectors to work together.
- How would private sector see their role in organizing the GWE, good to hear about content of cooperation from private sector
- There are cascading risks. What is societal risk in failure of GWE, national enterprise should survive to build GWE, have to reach sustainability of national weather enterprise.
- Variable perspectives among nations and sustainability of service delivery is an issue; meteorological learned societies are important parties. AMS and InterMET Asia 2018 could be important next opportunities for dialogue and engagement.
- While providers of poor weather services are likely to go out of business fairly quickly there is a risk that providers of climate services for such purposes as climate change adaptation and disaster preparedness are unlikely to be identified by the market as poor performers in time to avoid serious misallocation of resources. So, we may need some authority certifying climate service providers.

Observational data

- Lack of high quality data, no quality control. Lack QA/QC has an impact on services. At times cost of quality control of data received is as high as getting data from automated weather station (example of farmers in France who were providing data that required massive and costly quality control).
- Risk that data are not preserved or easily accessible for research and other public-good purposes.
- Fragmentation of the entire value chain is a risk, not only the observation system. This leads to data not being properly integrated (scattered about sectors), thus, the need for data exchange between major players. The private sector runs the risk of possessing data that’s too expensive. Fragmentation is the risk globally but also at country level.
- Observations have risks, price escalation, not convinced that private sector can sustain NWP, how they will develop and maintain NWP is a risk.
- No integration in public and private sector observations, fragmentation happens also on the national level.

- Involvement of private sector in observations may lead to price increase, this is a risk to consider, but this is a matter of competition in the market place**.**
- WIGOS is not being delivered at the ground level as much as needed. Stronger push is needed for implementing WIGOS systematically and across government agencies.
- There is a large risk that the spirit of WMO resolution 40 will be lost if too much is developed privately and not shared well enough. On the other hand, the private sector needs to be both profitable and sustainable, even though their funding source is different.
- Purchasing observational data from a company, the company was bought out, prices go up dramatically, have to close the contract. To expand this risk - independently developed data to fit specific business purpose can be cut loose at any moment. Collaborative partnership would be an alternative solution to data production.

Next Steps – Plenary

Reflections on the morning discussion

- The overall driver of the GWE should be: "to satisfy societal needs". Agenda 2030 may be limiting. Alternative: Global compact—powerful financial signal.
- One of the reasons the weather enterprise works, the public sector has established a standard of sharing the knowledge they obtain, including to those who can't afford it. The driving force behind this model is the public good and safety, versus monetary, which is why it works.
- Free exchange of data is a non-issue. There can be a consensus reached between players for freer exchange of data. Resolution 40 is an issue. Free exchange of data of the private sector should be enabled if it is of value to the society. Open data, both public and private. Making data available, not only locally but also globally, is important.
- Long lead times between investment and pay-out in the past only allowed public investments in the past.
- Most investment in meteorology has been by the public sector because the returns are too uncertain, and too long term for the private sector to invest. Can new/different data ownership models change this? We require a business model (maybe models) for private and public data ownership that enables the best possible data set for public interest purposes.
- How urgent is it to have a business model for private data services? Ownership of data – how the public sector will ensure the access to data if the data ownership is moving more towards the private side. ("selling privately owned data to private sector" model would have negative implications to developing countries).
- Guiding principles would be needed in these business models – securing the safety of the citizens was the underlying principle of the resolution 40, for example. Risk assessment of business models. It doesn't have to have a global unified single model for data sharing/data rights policy. Different business models can co-exist but need to understand the involved risks.
- Open-dialogue is more important than jumping to the conclusion. Bilateral agreements will not work, a multi-lateral agreement is needed for data policy. Capturing experiences of different countries important.
- The private sector wants to sell data services multiple times, which might lead to the risk that only wealthy governments will be able to purchase these services.
- Historical investments in the public sector had (very) long lead time to materialize the return of the investment. Technological development makes it possible to expect the return of investments with short lead time, less uncertain, which attracts more private capitals creating different dynamics.
- We have to acknowledge international diversity. We shouldn't leave out developing countries in the discussion; more regionally based discussions would be needed. The discussion should

not “lose” developing and least developed countries from sight. In developed countries, there is no industry to be represented. How can one represent the interest of industries that are still to be developed? Can the World Bank provide examples of projects, which produced insufficient return because of limited collaboration between sectors? Maybe, we can explore future World Bank projects to showcase successful partnerships.

- In principle it is easy to get funding for the GWE, but quite difficult to provide a return to investors. Public provides funds that return societal economic returns, business provides funding that requires financial return.
- Those who run the models need access to as much data as possible, this is typically easier for the public sector than the private sector.

WMO engagement process

- WMO is willing evolve to open itself to the other sectors. WMO might have only one more shot to take on the leadership role in this conversation.
- Convening power of WMO: Historically, the emphasis was on public sector entities—they feel ‘at home’ with the WMO. Academia is not sufficiently represented and private sector does not feel at home in WMO. Their trust in WMO is not as strong as that of the public sector Private and academic entities need to feel the same kind of legitimacy and trust in order to encourage a sense of unity between all three sectors.
- Resolutions 25,40, 60. 25 needs further development, 60 is very important, resolution 40 may require some modifications, but we shouldn’t rush as it has withstood for 22 years of the “historical test.” Resolution 40 (for atmospheric data) – some adjustments are required. Current ambiguity is deliberate; Resolution 45 (for hydrological data) – very little substance in it; Resolution 60 (on climate data) – real pillar of substance is missing.
- PRs should represent public, private and academia – otherwise, parallel organizations/processes need to be established to engage with those sectors. WMO should be more open minded to facilitate the dialogue between public and private sectors. Co-creation of concepts is important.
- The private sector could organize and establish formal relationships with WMO. It’s important for the private sector to decide how it would like to be represented. HMEI is already doing some of that. HMEI – WMO relationship has allowed a constructive dialogue between public and private sectors. Is HMEI sufficient? How does it have to evolve?
- WMO is aiming for a Resolution for Congress 18 in 2019. Should we align with this time scale? Some thought this too slow. Should the WMO be the forum for working through this issue or do we need a new structure? No real consensus.
- WMO should maintain an open mind moving forward. Every reform of this size needs real resources to succeed.

Next steps

- Coordinate with researchers in future decisions—research is essential to science and tech, which are essential to quality information. Increase dialogue between the academic community and the private and public sectors to ensure that educational and training practices recognize and anticipate the changes in the GWE that are likely to occur in the coming decades.
- Identify a compelling vision that all sectors can agree upon.
- The argument was advanced that we need a small, agile group (9 persons – 3 from each sector, Public, Private, Academic) to work quickly and report back frequently. So, a group for

discussion, equally represented by three sectors, needs to be created. Their discussions should feed into the WMO process vs. concern about creating parallel processes to WMO's. Create a steering group with equal leadership representation from each sector.

- This would create a forum for major players to have an open dialogue about pressing issues, i.e. establish a working group for interested parties There was acceptance that this was the most likely way forward. It was agreed that from the WMO side John Hirst would be a part of the process. It was suggested that this group should have the task of organizing InterMET Asia along with developing an economic case for the GWE that addresses the Agenda 2030 goals.
- Try to create a task force to help the WMO move forward rather than replace it. It's critically important to define goals/targets to find the right representatives. Possible first targets: data exchange issues, improve warnings and their communication, need to engage young people. Find concrete issues: future of satellite data, adequate business models concerning international cooperation and private/public interaction and data access for developing countries.
- The World Bank could facilitate the creation of the task force. The different regions will have to be represented in some way (separate groups).
- Participants to this Seminar should let it be known if they want to be part of the working group.
- WMO needs to receive input from this group to make sure other sectors will not just respond to the reform, but be a part of it.
- Ensure that no one feels left out in next steps (i.e. private sector being excluded from government decisions, low/middle income countries being excluded from important dialogue, etc)
- The GWE should identify best practices—focus on what's working versus what's not working. Re-evaluate current cooperative structure—adapt as needed. Then set realistic goals. Examine what people in other enterprises (i.e. energy, telecommunications) have done regarding public private and academic partnerships—see what worked for which market participants and what didn't.
- GWE needs a clear endpoint—the weather, water, climate aspects need to be addressed, specifically water and climate. If we create a roadmap, we need to define what the 'beginning' and what the 'end' is of the collective 'mission'. Weather, water and climate – water and climate part should be given more focus in the future discussion. Getting a better grip on water will get GWE into other sectors much faster (health, for example). Reinforce weather-water-climate linkage.
- Commission an authoritative economic study. This could serve as an important milestone of the roadmap. A holistic approach to the "authoritative economic study" is needed – should look at social, economic, development and environmental aspects, for example: elaborate on Agenda 2030. Provide more concrete examples within the discussions, i.e. the economic study needs to be specific, for example, to different domains. Learn from other socio-economic sectors' experience in public private engagement including good practices and failures (e.g. electricity and pharmaceutical markets).
- Focus on what is working/has worked – e.g. private sector companies help disseminate warning to wider audience.
- Involvement of young blood is important.
- Categorize business cases on how public and private sectors can work together, e.g. equipment suppliers, data or service providers, integrators, etc.; this would help the working group with concrete cases.