Summary report on the seventh meeting of the research dialogue Bonn, Germany, 4 June 2015

Note by the Chair of the SBSTA

30 October 2015

I. Introduction

A. Mandate

1. As requested by the Subsidiary Body for Scientific and Technological Advice (SBSTA) at their twenty-sixth session, the secretariat will organize regular research dialogues in collaboration with invited regional and international climate change research programmes and organizations to inform the SBSTA of developments in research activities relevant to the needs of the Convention.

2. In response to this mandate, the seventh meeting of the research dialogue (RD7) was convened on 4 June 2015 in Bonn, Germany, during SBSTA 42. This report provides a summary of the presentations made and the ensuing discussions between Parties and representatives from research programmes and organizations.

B. General objective and approach for the meeting

3. By decision 16/CP.17,[1] the COP encouraged Parties, in particular developing country Parties, and regional and international research programmes and organizations active in climate change research to utilize the research dialogue as a forum for discussion and conveying research findings and lessons learned.

4. At its fortieth session, the SBSTA invited submissions from Parties and research programmes and organizations on lessons learned and good practices for knowledge and research capacity building, in particular in developing countries. The SBSTA also invited submissions from Parties on possible topics for consideration as part of the research dialogue (RD), taking into account the findings of the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).[2]

5. At its forty-first session, the SBSTA invited the IPCC and relevant international and regional research organizations to inform Parties on efforts undertaken to address the information gaps identified in the AR5, including in developing countries, especially in Africa, and on emerging issues, such as the links between climate change and desertification, for example, at the meeting of the research dialogue at SBSTA 42.[3]

6. The goal of the meeting, in response to the above-mentioned mandates (paragraphs 3–5), was to (a) address data and information gaps, including from the AR5, such as in regards to climate change and desertification, and (b) to identify lessons learned and good practices for knowledge and research capacity building, in particular in developing countries.

II. Summary of the proceedings

7. The RD7 was held on 4 June 2015 (3:00–6:00 p.m.) at the World Conference Center Bonn, Germany.[4]

8. An information note prepared in advance of the meeting by the Chair of the SBSTA outlined the goal, approach and organization of the meeting and included an analysis of topics covered in previous research dialogues, as well as guiding questions to steer the discussions.[5]

[1] FCCC/CP/2011/9/Add.2, page 47.
[2] FCCC/SBSTA/2014/2, paragraphs 58–59.
[3] FCCC/SBSTA/2014/5, paragraph 31.
[4] <http://unfccc.int/9292.php>.

III. Summary of the dialogue

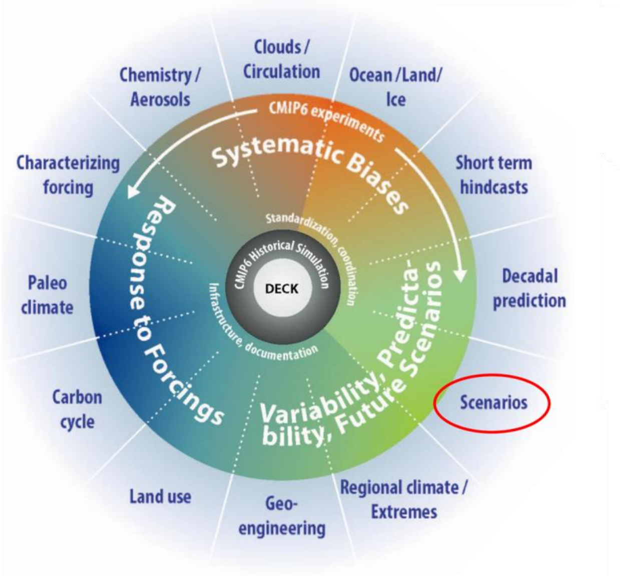
A. Part 1: Addressing data and information gaps, including from the IPCC

1. Presentations by experts

9. Part 1 of the meeting opened with a brief overview by Mr. Thomas Stocker, Co-Chair IPCC Working Group I AR5, of current efforts being undertaken to address the information gaps identified in the AR5. He described the AR5 as "a major six-year effort strengthening the link across scientific communities." He explained that it involved more than 1,000 scientists, produced more than 7,000 printed pages and is summarized in the AR5 Synthesis Report.[6]

10. Mr. Stocker described the scenario development for the IPCC's next assessment cycle. He identified the "huge scientific community effort" involved in one of the major features of the fifth assessment cycle, namely the Coupled Model Intercomparison Project 5 (CMIP5),[7] which was carried out under the direction of the World Climate Research Program (WCRP). He indicated that the new round of scenario development for CMIP6 is already underway, based on experience drawn from the AR5 and expert meetings. It includes identification of the core experiments and scientific topics (figure 1).

Figure 1
Coupled Model Intercomparison Project (CMIP6)

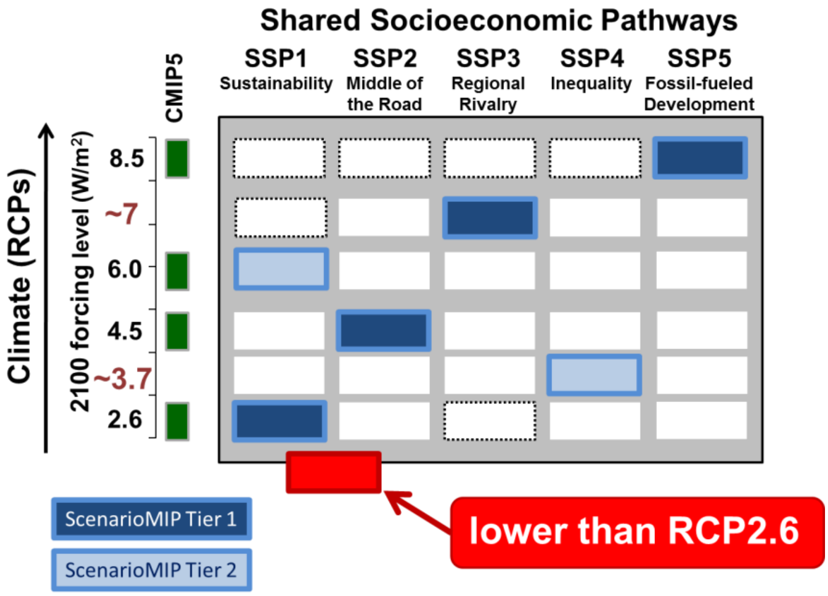


Source: Slide 3 of the presentation by Mr. Thomas Stocker (Intergovernmental Panel on Climate Change (IPCC)), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/1._stocker_unfccc.pdf>.
The figure shows the components of the Coupled Model Intercomparison Project 6. The centre of the figure shows the core experiments required, and the margins identify, in blue text, the scientific topics that are addressed. 'Scenarios' is one of the 12 scientific topics that are of interest to all working groups of the IPCC.

11. An important element of CMIP6 is the future scenarios, which will include analysis in two dimensions. The Representative Concentration Pathways (RCPs) will be considered across new shared socioeconomic pathways, which look at different storylines for the future (figure 2). Mr. Stocker highlighted that the scientific community has discussed a lower-than-RCP 2.6 scenario, which could be undertaken as part of CMIP6, although not in Tier 1 due to the limitation of computational resources (Tier 1 is limited to a maximum of four runs).

[5] Available at <http://unfccc.int/files/science/workstreams/research/application/pdf/rd7_infnote.pdf>.
[6] <http://www.ipcc.ch/report/ar5/syr/>.
[7] <http://cmip-pcmdi.llnl.gov/cmip5/>.

Figure 2
Future Scenarios in CMIP 6



Source: Slide 5 of the presentation by Mr. Thomas Stocker (Intergovernmental Panel on Climate Change), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/1._stocker_unfccc.pdf>.
The matrix shows the Representative Concentration Pathways (RCPs) and Shared Socio-economic Pathways (SSP) that will be considered under CMIP6, and the models that currently will be run at Tier 1 and Tier 2 level.
The SSPs explore future worlds and storylines with: SSP1 = Environmentally Friendly; SSP2 = Intermediate emissions and cooperation; SSP3 = High Emissions/ Low Cooperation; SSP4 = Low Emissions/Low Cooperation; SSP5 = High Emissions/ High Cooperation (see also Slide 6 of the presentation by Mr. Carlson (World Climate Research Programme), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/2._carlson_wcrp.pdf >)
The information on the gaps in the matrix will be filled with simpler models and this information will also be made available to policy makers. The scientific community is also envisaging Tier 2 level models at RCP<2.6.

12. Mr. Stocker then presented examples of new scientific knowledge that have become available since the AR5 cycle, focusing on the long-term goal, climate processes, human exposure and ecosystem services. Further ongoing work in the scientific community includes increased regionalization of climate projections and simulations and reduction of uncertainties, which will further enhance the policy-relevance of the scientific inputs. However, he pointed out that signal to noise ratio, such as for precipitation measurements, can make regional identification of impacts difficult for low warming scenarios.

13. New scientific findings include:

a) The large and significant increase in the probability of heavy-precipitation events and high-temperature extremes with a global average temperature rise of 2 °C compared to 1.5 °C (figure 3);

b) Improved identification of the drivers of sea-level rise, in particular analysis of mass balance that shows sustained mass loss from the Greenland ice sheet;[8]

c) The increased uptake of heat at different layers in the ocean in the last eight years (figure 4), which is relevant for ecosystems health and sea level rise;

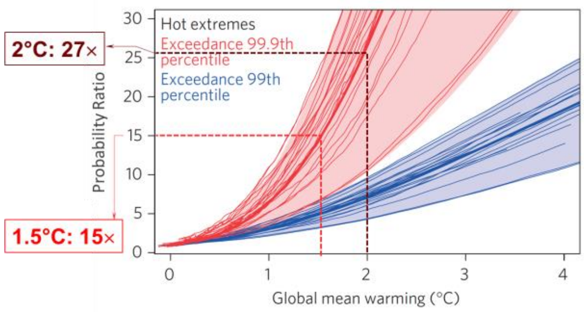
d) The links between global human exposure to tropical storms and risk of mortality shown on a map basis;[9]

[8] Khan SA, Kjær KH, Bevis M, Bamber JL, Wahr J, Kjeldsen KK, Bjørk AA, Korsgaard NJ, Stearns LA, van den Broeke MR, Liu L, Larsen NK and Muresan IS (2014). *Sustained mass loss of the northeast Greenland ice sheet triggered by regional warming*. Nature Climate Change 4, 292–299 (2014). <http://dx.doi.org/10.1038/nclimate2161>.

[9] Peduzzi P, Chatenoux B, Dao H, De Bono A, Herold C, Kossin J, Mouton F and Nordbeck O (2012). *Global trends in tropical cyclone risk*. Nature Climate Change 2, 289–294. <http://dx.doi.org/10.1038/nclimate1410>.

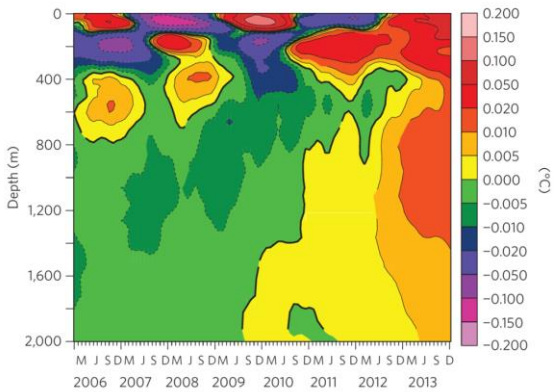
e) The Agricultural Model Intercomparison and Improvement Project (AgMIP), cutting across information used by all three IPCC working groups, to identify impacts on yield for different food staples and estimate costs of climate change.[10]

Figure 3
Rapidly increasing global fraction of attributable risk of high-temperature extremes over land



Source: Slide 8 of the presentation by Mr. Stocker (Intergovernmental Panel on Climate Change), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/1._stocker_unfccc.pdf>. The figure illustrates the difference between the probability ratio of extreme events for a global warming of 1.5 °C and 2 °C (adapted from E.M. Fischer and R. Knutti, 2015).[11]

Figure 4
Ocean observations: Distribution of heat uptake up to 2000 m depth, 2006–2013



Source: Slide 10 of the presentation by Mr. Stocker (Intergovernmental Panel on Climate Change), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/1._stocker_unfccc.pdf>. The figure illustrates the depth dependence of temperature change 2006-2013 (globally averaged temperature anomaly (colour scale) versus the depth of the ocean).[12]

14. Mr. David Carlson, Director of the World Climate Research Programme (WCRP), and on behalf of Future Earth partners DIVERSITAS, the International Geosphere-Biosphere Programme (IGBP) and the International Human Dimension Programme on Global Environmental Change (IHDP), presented on confronting urgent climate challenges. He explained that the WCRP provides the research that drives the IPCC climate change assessments. WCRP aims to understand all aspects of the atmosphere, land, ocean and ice, and the exchanges of heat, carbon and water within and among them on different time scales ranging from weeks to seasons, to decades and centuries. The tools used by the WCRP are observations and models, and WCRP runs the CMIP projects. He stated that the scientific topics in CMIP (Figure 1) are defined by the WCRP community to provide relevance and are linked to the WCRP Grand Challenges.[13] The WCRP Grand Science Challenges represent major areas of scientific research, modelling, analysis and observations for WCRP and its affiliate projects in the ensuing decade. These Challenges are the following: clouds, circulation and climate sensitivity; melting ice and global consequences; climate extremes; regional sea-level change and coastal impacts; and water availability.

15. The new CMIP6 scenarios (figure 2) aim to cover the emission and scenario projections in the best way possible and provide continuity from AR5. There are 24 model inter-comparison projects proposed by the scientific community as part of CMIP6, with the Scenario Model Intercomparison Project (ScenarioMIP) just one of these. On the ability to consider a lower emission scenario, Mr. Carlson supported Mr. Stocker's statement on the ability of the science community to consider such an emission scenario, but stressed the need to consider the limits of the computing resources available.

[10] Rosenzweig C, Elliott J, Deryng D, Ruane AC, Müller C, Arneth A, Boote KJ, Folberth C, Glotter M, Khabarov N, Neumann K, Piontek F, Pugh TAM, Schmid E, Stehfest E, Yang H and Jones JW (2014). *Assessing agricultural risks of climate change in the 21st century in a global gridded crop model intercomparison*. Proceedings of the National Academy of Sciences of the United States of America, 111 (9), 3268–3273. <http://dx.doi.org/10.1073/pnas.1222463110>.

[11] Fischer EM and Knutti R (2015). *Anthropogenic contribution to global occurrence of heavy-precipitation and high-temperature extremes*. Nature Climate Change 5, 560–564. <http://dx.doi.org/10.1038/nclimate2617>.

[12] Roemmich D, Church J, Gilson J, Monselesan D, Sutton P and Wijffels S (2015). *Unabated planetary warming and its ocean structure since 2006*. Nature Climate Change 5, 240–245. <http://dx.doi.org/10.1038/nclimate2513>.

[13] <http://www.wcrp-climate.org/grand-challenges>.

16. Mr. Carlson then presented examples of new scientific knowledge that addresses data and infromation gaps and has become available since the AR5 cycle, focusing on work under the WCRP Grand Challenges, including:

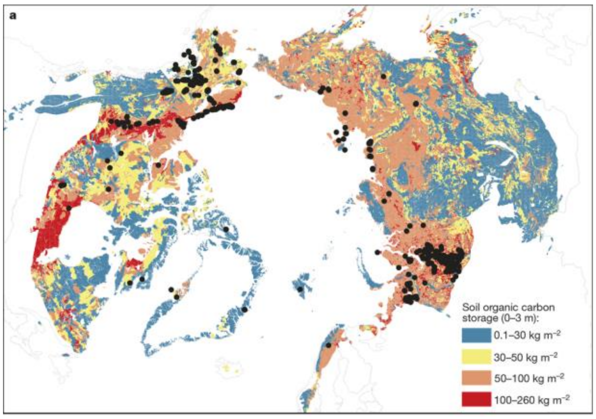
(a) The uptake of heat at different layers in the ocean, also described by Mr. Stocker. Mr. Carlson highlighted that, for the first time, scientists have understood the heating that has occurred in the ocean in the last eight years, down to deep ocean depths of 2,000 m, using very recent data of 900,000 data points (figure 4).

(b) Under the permafrost carbon Grand Challenge, recent research has shown that the best estimates of cumulative emissions from the northern circumpolar permafrost zone (figure 5) that could be released under RCP 8.5 by 2100 are approximately 100 gigatons of carbon;[14]

(c) Under the regional sea level Grand Challenge, from a global ocean impact point of view, there are regional differences in sea level rise projected under climate change with lower levels around Antarctica and the Greenland ice sheet and about 30 per cent higher than average levels projected (under RCP 4.5) for the equatorial oceans. These differences must be considered for planning purposes;[15]

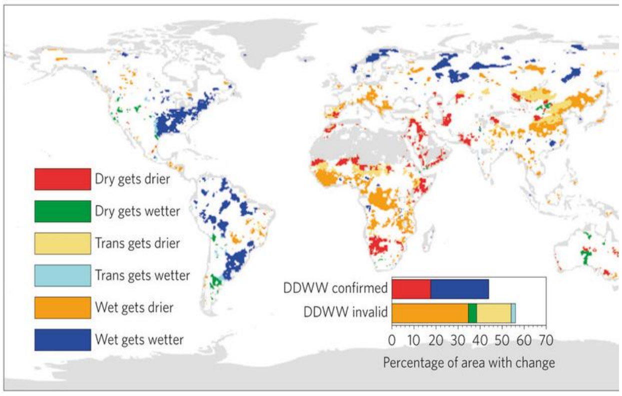
(d) Under the water availability Grand Challenge, a new study based on precipitation observations from 1948 to 2005 shows that changes in precipitation over land varies by location and have not followed a simple intensification of existing patterns (the so-called "dry gets drier, wet gets wetter" paradigm mentioned in AR5) (figure 6).[16]

Figure 5
Soil organic carbon contained in the northern circumpolar permafrost zone



Source: Slide 11 of the presentation by Mr. David Carlson (World Climate Research Programme), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/2._carlson_wcrp.pdf>. The figure illustrates soil organic carbon pool (kg C m^{-2}) contained in 0–3 m depth. Colours show carbon concentration and black dots show field site locations for 0–3 m depth carbon inventory measurements; field sites with 1 m carbon inventory measurements number in the thousands and are too numerous to show.

Figure 6
Global assessment of trends in wetting and drying over land - investigating the dry gets drier, wet gets wetter (DDWW) paradigm



Source: Slide 14 of the presentation by Mr. David Carlson (World Climate Research Programme), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/2._carlson_wcrp.pdf>. The figure illustrates an evaluation of the 'dry gets drier, wet gets wetter' paradigm. Red/dark blue colours indicate regions where the paradigm is found to be valid. Wet areas getting drier (orange) are widely found. White areas do not show any marked changes in dryness. Grey areas are areas where there are not enough observations to evaluate changes.

17. Mr. Sergio Zelaya, United Nations Convention to Combat Desertification (UNCCD), delivered a presentation on the linkages between climate change and land degradation. He identified important aspects of the linkages between climate change and land degradation, stressing the need to address land degradation at the regional level. He indicated that the agriculture, forestry and other land uses (AFOLU) sector produces 25 per cent (10–12 Gt CO_2 eq per year) of the global anthropogenic greenhouse gas

[14] Schuur EAG, McGuire AD, Schädel , Grosse G, Harden JW, Hayes DJ, Hugelius G, Koven CD, Kuhry P,Lawrence DM,Natali SM, Olefeldt D, Romanovsky VE, Schaefer K, Turetsky MR, Treat CC and Vonk JE (2015). Climate change and the permafrost carbon feedback, Nature 520, 171–179. <http://dx.doi.org/10.1038/nature14338>.

[15] Slangen ABA, Carson M, Katsman CA, van de Wal RSW, Köhl A, Vermeersen LLA and Stammer D (2014). Projecting twenty-first century regional sea-level changes, Climatic Change 124 (1), 317-332. <http://dx.doi.org/10.1007/s10584-014-1080-9>.

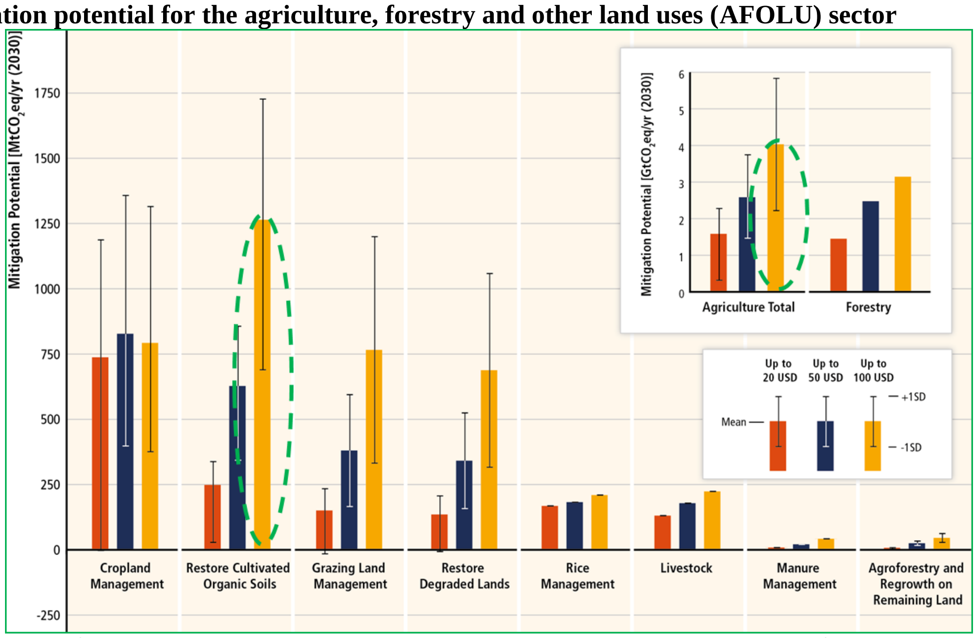
[16] Greve P, Orlowsky B, Mueller B, Sheffield J, Reichstein M and Seneviratne SI (2014). Global assessment of trends in wetting and drying over land, Nature Geoscience 7, 716–721. <http://dx.doi.org/10.1038/NGEO2247>.

emissions.[17] The world's eight major emitters (the United States, China, the European Union, Brazil, the Democratic Republic of the Congo, India, Indonesia and Mexico) are responsible for 57 per cent of these AFOLU emissions. AFOLU emissions are the main source of greenhouse gas emissions in many developing countries with limited fossil fuel use. However, the AFOLU sector is unique in that it is the only sector with the potential for both emission reductions and carbon sequestration. So far, this potential remains mostly untapped as land-related mitigation has focused on forests (REDD, the Clean Development Mechanism (CDM) afforestation/reforestation, etc.).

18. Between 10-20 per cent of drylands are degraded and 24 per cent of globally usable land is degraded, with an estimated economic annual loss of USD 40 billion. Mr. Zelaya explained that the UNCCD has embraced the concept of land degradation neutrality (LDN). LDN is a state whereby the amount and quality of land resources that are necessary to support ecosystem functions and services and to enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems. He added that sustainable land management (SLM), to restore productive capacity and other ecosystem services, can support LDN and reduce the rate of land degradation and newly occurring degradation.

19. Addressing land degradation and adopting SLM practices could deliver up to USD 1.4 trillion in increased crop production, with a total mitigation potential by 2030 of: 7.1–10.6 Gt CO_2 eq per year (figure 7), including 0.7 Gt CO2 eq per year for the restoration of degraded soils and 1.25 Gt CO_2 eq per year for the restoration of organic soils. Mr. Zelaya indicated that other multiple benefits include improved livelihoods in terms of food and water security, productivity increase, or employment options. He specified that while these benefits primarily target one billion people living in dryland areas, addressing land degradation leads to benefits for all.

Figure 7
Mitigation potential for the agriculture, forestry and other land uses (AFOLU) sector



Source: Slide 7 of the presentation by Mr. Sergio Zelaya (United Nations Convention to Combat Desertification), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/3._zelaya_unccd.pdf >.
The figure, from IPCC AR5 Working Group III Figure 11.13,[18] illustrates the mitigation potential for the AFOLU sector, plotted using data from IPCC AR4 (Nabuurs et al., 2007; Smith et al., 2007). Whiskers show the range of estimates (+/- 1 standard deviation) for agricultural options for which estimates are available.

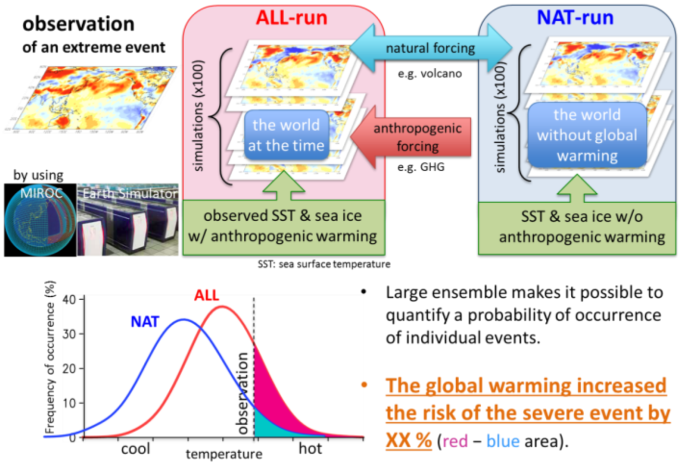
20. The UNCCD uses three indicators to report on LDN: trends in land use and cover (land cover change can be used as a proxy for land-use change); trends in land productivity (to identify and prioritize areas with high magnitude and extent of land degradation); and trends in soil organic carbon stocks (SOC) (with positive trends in SOC reflecting the impact of SLM). These indicators could be used by the

[17] Smith et al, 2014: Agriculture, Forestry and Other Land Use (AFOLU). In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.
[18] <http://ar5-syr.ipcc.ch/resources/htmlpdf/ipcc_wg3_ar5_chapter11> page 849.

UNFCCC to consider desertification, land degradation and drought trends more explicitly when addressing adaptation and mitigation within the 2 °C limit of global warming.

21. Mr. Masato Mori, Japan, presented on the human influence on extreme events and a new approach by Probabilistic Event Attribution (PEA). He described the evolving scientific work being undertaken to identify the contribution of climate change to extreme climatic events. Using comparisons between observations and large-ensemble simulations, he indicated that it is possible to evaluate how anthropogenic forcing affects the probability of the occurrence of individual extreme events, an approach called PEA. These large ensemble simulations enable a comparison between observed actual events occurring at current anthropogenic warming with the probability of the event without anthropogenic warming, and can identify the increased percentage of risk (figure 8).

Figure 8
Probabilistic event attribution (PEA)



Source: Slide 3 of the presentation by Mr. Masato Mori (Japan), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/4._mori_japan.pdf>. The figure illustrates how probabilistic event attribution (PEA) is determined. The conditions at the time of the extreme event are fed into the ALL-run to identify the probability of occurrence of the event. This is compared to the NAT-run, which is the probability of the event occurring without the presence of anthropogenic global warming. The probability of the global temperature can thus be calculated with and without global warming and, from this comparison, the increase in the risk of the extreme event can be calculated.

22. Mr. Mori outlined remaining challenges in the simulations. In this regard, he pointed to the assessment of boundary conditions, and noted that the amount of change in risk by anthropogenic forcing depends on how the model evaluates the world in the absence of global warming (NAT-run). He stated that the outcomes of PEA are beneficial for understanding physical climate changes, extreme events risk assessment and adaptation requirements and provided specific cases of extreme events that have been investigated by his research group:

(a) Anthropogenic global warming increased the risk of heat-wave in South Japan in July and August 2013 by 10 per cent.[19]

(b) The risk of severe winters in Eurasia in recent years has more than doubled due to global warming. This is due to Arctic sea ice loss driving the cold winters. Using simulations and future projections, the effect of severe winters may be temporary in the long term during a transitional phase and are unlikely to dominate in a warming future climate.[20]

23. Mr. Claas Teichmann, Coordinated Regional Downscaling Experiment European Domain (EURO-CORDEX), detailed some of CORDEX's ongoing work on downscaling of CMIP for regional climate modelling.[21] The CORDEX vision is to advance and coordinate the science and application of regional climate downscaling through global partnerships, including by providing consistency for regional projections and guidance for use of these projections. CORDEX has a number of domains,[22] and the first

[19] Imada Y, Shiogama H, Watanabe M, Mori M. Ishii M and Kimoto M (2013). *The contribution of anthropogenic forcing to the Japanese heat waves of 2013*, Bulletin of the American Meteorological Society 09/2014; 95(9):S52-S54. <http://dx.doi.org/10.1175/1520-0477-95.9.S1.1>.
[20] Mori M, Watanabe M, Shiogama H, Inoue J and Kimoto M (2014). *Robust Arctic sea-ice influence on the frequent Eurasian cold winters in past decades*. Nature Geoscience 7, 869–873. <http://dx.doi.org/10.1038/ngeo2277>.
[21] <http://www.cordex.org>.
[22] <http://www.cordex.org/index.php/community/domains>

focus of support has been on Africa, where several downscaling models are available. This information is available to be used and advise other domains.

24. Mr. Teichmann provided examples of new knowledge emerging from ongoing work under EURO-CORDEX and MED-CORDEX, including:

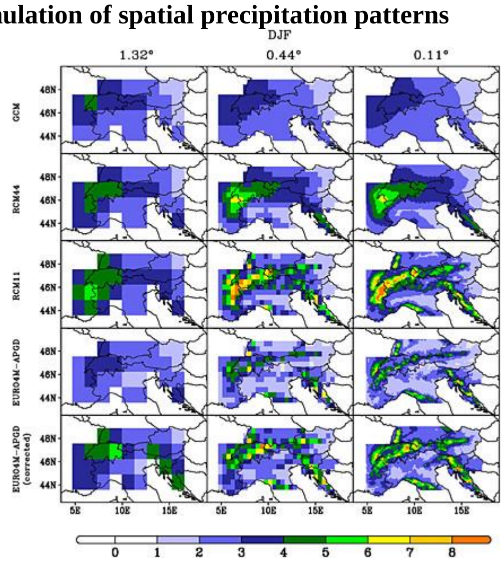
(a) Representation of heat waves by regional climate models (RCMs) was compared at resolutions of 25 km and 12.5 km. It was found that, in Europe, using the higher resolution was not necessary for correct representation.[23] This may be different in other regions.

(b) For areas with complex topographical features, such as the Alps, increased resolution was shown to improve simulation of precipitation spatial patterns and extremes (figure 9). RCMs were identified as important tools for climate studies over complex topographical regions.[24]

(c) The new increased resolution model ensemble under EURO-CORDEX has been shown to provide added value for regional climate simulations.[25]

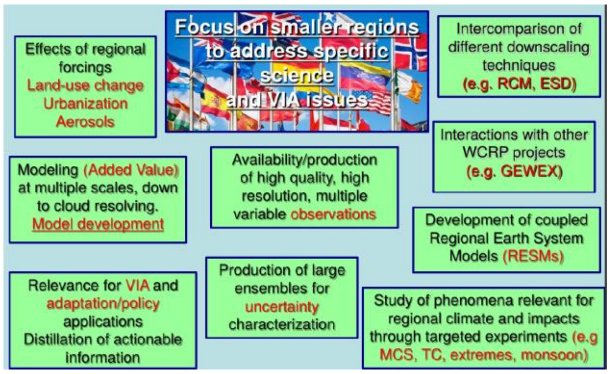
25. Pilot studies are currently underway to further the opportunities for CORDEX, including in vulnerability, impact and adaptation assessments (figure 10).

Figure 9
Simulation of spatial precipitation patterns



Source: Slide 7 of the presentation by Mr. Claas Teichmann (EURO-CORDEX), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/5._teichmann_cordex.pdf>. The figure illustrates the simulation of spatial precipitation patterns across Central Europe. Mean (1976–2005) winter precipitation (December-January-February(DJF)) is interpolated on the three resolution grids of the ensembles of driving general circulation models (GCMs), regional climate model (RCM) 44, and RCM11 (top three rows, respectively) simulations and the Alpine precipitation grid dataset (EURO4M-APGD) observations without and with correction for wind-induced undercatch by precipitation gauges. Units are millimeters per day.

Figure 10
CORDEX-Flagship pilot studies



Source: Slide 12 of the presentation by Mr. Claas Teichmann (EURO-CORDEX), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/5._teichmann_cordex.pdf>. The figure illustrates the plans in place for the next round of CORDEX development.

[23] Vautard R, Gobiet A, Jacob D, Belda M, Colette A, Déqué M, Fernández J, García-Díez M, Goergen K, Güttler I, Halenka T, Karacostas T, Katragkou E, Keuler K, Kotlarski S, Mayer S , van Meijgaard E, Nikulin G, Patarčić M, Scinocca J, Sobolowski S, Suklitsch M, Teichmann C , Warrach-Sagi K , Wulfmeyer V, Yiou P (2015). The simulation of European heat waves from an ensemble of regional climate models within the EURO-CORDEX project, Climate Dynamics 41 (9-10), 2555-2575. <http://dx.doi.org/10.1007/s00382-013-1714-z>.

[24] Torma Cs., Giorgi F, and Coppola E (2015). Added value of regional climate modeling over areas characterized by complex terrain–Precipitation over the Alps, J. Geophys. Res. Atmos., 120, 3957–3972. <http://dx.doi.org/10.1002/2014JD022781>.

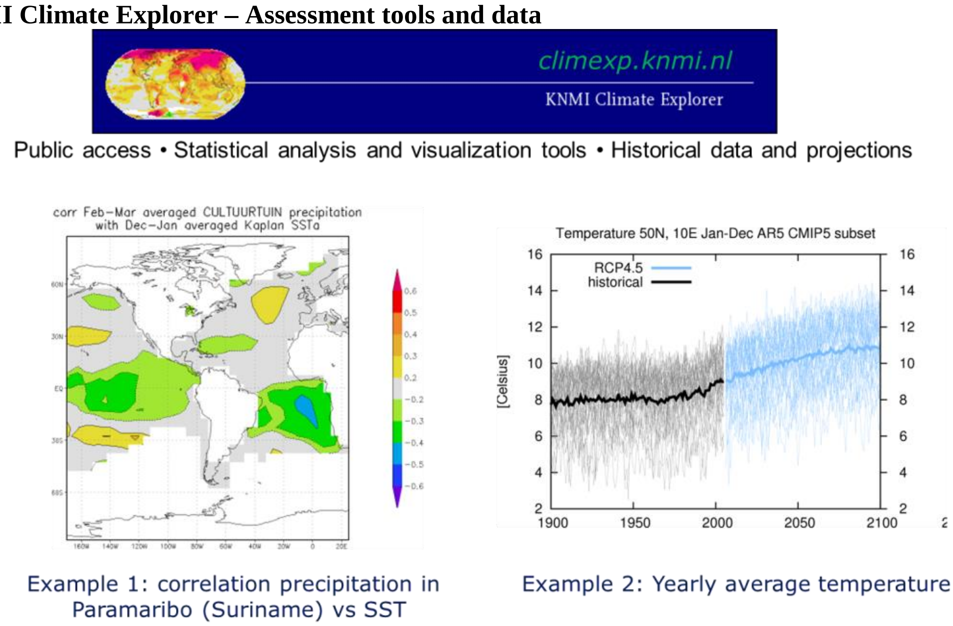
[25] Jacob D, Petersen J, Eggert B, Alias A, Christensen OB, Bouwer LM, Braun A, Colette A, Déqué M, Georgievski G, Georgopoulou E, Gobiet A, Menut L, Nikulin G, Haensler A, Hempelmann N, Jones C, Keuler K, Kovats S, Kröner N, Kotlarski S, Kriegsmann A, Martin E, van Meijgaard E, Moseley C, Pfeifer S, Preuschmann S, Radermacher C, Radtke K, Rechid D, Rounsevell M, Samuelsson P, Somot S, Soussana JF, Teichmann C, Valentini R, Vautard R, Weber B and Yiou P (2014). EURO-CORDEX: new high-resolution climate change projections for European impact research, Regional Environmental Change, 14 (2), 563-578. <http://dx.doi.org/10.1007/s10113-013-0499-2>.

26. Mr. Gé Verver, Royal Netherlands Meteorological Institute (KNMI), provided an overview of the KNMI Climate Explorer and of the International Climate Assessment & Dataset (ICA&D). He highlighted that while there is a large amount of climate data available, there is a need to provide order and be able to select data for different uses. The Climate Explorer enables users to access and manipulate the large amount of climate data available for their own needs and requirements. The website is publicly available, includes statistical analysis and visualization tools, and enables access to historical data, analysis, model data and projections.[26]

27. Mr. Verver demonstrated the KNMI Climate Explorer and gave examples of products that could be used, such as the Climate Atlas that presents the data available in the Explorer and was created using the statistical tools available (slide 6).

28. Mr. Verver then described the ICA&D, which is connected to the KNMI Climate Explorer and is an initiative of KNMI. The ICA&D provides observational daily climate data from climate stations, which can be plotted into time series and correlated with the information on the KNMI explorer. The data set was first collected for Europe and is now available for other regions, namely Southeast Asia, Western South America and West Africa. KNMI is currently encouraging countries in West Africa to put data into datasets to later enable the ICA&D to provide quality checks.[27]

Figure 11
KNMI Climate Explorer – Assessment tools and data



Source: Slide 3 of the presentation by Mr. Gé Verver (KNMI Climate Explorer), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/6._verver__knmi.pdf>. The figure illustrates two example products using statistical tools on the Explorer. Example 1 is a correlation of precipitation with sea surface temperatures using data from a weather station in Suriname; Example 2 is a model output of yearly average temperature under RCP 4.5.

2. Summary of the discussion

29. The discussion was opened by a Party highlighting the link between climate change and desertification. Desert dust particles constitute over 60 per cent of atmospheric aerosol particles. Sandstorms, short-term and long-term transport of dust particles are a global issue. Because dust affects and interacts in climate change in many ways, a number of disciplines are required to evaluate its sources, impacts and global effects. Particular attention needs to be provided to examine the impacts of dust particles on radiative balance of the atmosphere and climate change, human infrastructure and human health as well as the impact of iron-containing dust particles on ocean plankton growth. The Party called on SBSTA to further deliberate and for the IPCC to draft a special report on this issue.

30. The assessment by the IPCC of the wider implications of geochemical cycles and chapter 7 of the AR5 WGI report on clouds and aerosols was highlighted by an expert. On a possible IPCC special report,

[26] <http://climexp.knmi.nl/>.
[27] <http://www.ecad.eu/icad.php>.

he stated that Parties had submitted several proposals to the IPCC. A panel will review proposals at the IPCC's next session in October 2015.

31. Another expert pointed out that UNCCD has carried out a number of studies on ecosystem function and services to understand the interaction of climate change and land degradation. These are highlighted in the *UNCCD Impulse report, Climate change and desertification: Anticipating, assessing & adapting to future change in drylands*.[28]

32. During the discussion, a number of Parties stressed the importance for the scientific community to include a climate scenario looking at a rise of 1.5 °C by the end of the century in CMIP6, as was raised by Mr. Stocker and Mr. Carlson in their presentations.[29]

33. One expert responded that the scientific community has taken this into consideration. He also explained that the scientific community has a whole hierarchy of models (not just CMIP) that can look at low-emission scenarios, such as scenarios examining the active removal of carbon dioxide. He agreed that more information on low-emission scenarios would be useful, including links to the work of IPCC WGIII.

34. One Party pointed out that CORDEX currently does not consider many States in the Pacific and that the current resolution offered is not sufficient for national planning, and whether a higher resolution would be available in the future. The expert responded that the current plans for the CORDEX standard regions are to downscale to a grid size of 25 and 12.5 km. Some flagship studies for comparatively small regions will also downscale to higher resolution, such as for certain coastal cities. However, gaps exist that are due to the availability of computer resources. He suggested that if there is strong interest from Parties, CORDEX may be able to support them.

35. One Party asked whether the IPCC in its next assessment cycle will examine globally challenging phenomena such as the variability of the Asian monsoon, on which a large number of people rely. An expert noted that the most recent IPCC assessment is not yet able to inform how the frequency, character and intensity of this event will change due to climate change. Another expert stressed the importance of linking global to regional research in this regard, as a lot of monsoons inject energy into the stratosphere, and thus regional events cause global hemispheric system change.

36. One Party highlighted the capacity needs of developing countries with regards to access to better data for better adaptation interventions. Challenges include lack of finance for scientific research and scarcity of observational data. He highlighted that models fail to take into account socioeconomic aspects and called for: integrating "the human voice" and practical experience in adaptation planning; increasing integrated research not only looking at adaptation costs, but also at time frames for adaptation. He noted that collaboration networks can provide a means to support capacity building. He also asked about the likely costs of impacts and adaption for the future. An expert drew the group's attention to ongoing work by modelers examining adaptation costs.

37. A Party asked the IPCC to consider how it will report on small success stories on adaptation in its next assessment. He also requested user-specific technical guidance for applying the information coming out of the IPCC assessment reports.

38. One Party asked how well the probability of extreme events and their attribution to climate change is communicated. An expert responded from the WCRP's experience and highlighted that it is still unclear what type of communication works with whom, stressing the need for partnerships to improve communication.

[28] <http://3sc.unccd.int/documents-outputs/preparatory-documents/impulse-report>.
[29] Requested in the SBSTA 42 conclusions, see FCCC/SBSTA/2015/L.4.

B. Part 2: Lessons learned and good practices for knowledge and research capacity building, in particular in developing countries

1. Presentations by experts

39. Ms. Vera Stercken (Germany) spoke about climate knowledge and innovation and the importance of taking policy decisions based on science to avoid risks and find solutions. She explained that the research strategies in Germany are part of national strategies and many science disciplines are involved in policy decision making. The German Federal Ministry of Education and Research has recently published its new research framework programme, Research for Sustainable Development (FONA), and the climate research strategy is part of this programme.[30]

40. The climate research strategy aims to broaden knowledge and deliver actions under four key areas:

(a) The national climate modeling initiative, a coordinated approach to improve future climate trends and risks. An example includes the research programme 'MiKLip,' which aims to create a model system that can provide reliable decadal forecasts on climate and weather that is useful for industry and society, including on extreme weather events;[31]

(b) Regionalization (within Germany) of climate knowledge, to provide regional and local information on climate impacts for integration into policy, planning and processes, as well as the development of regional climate services. An example is the research project 'KLIMZUG' (Managing climate change in the regions for the future), which is developing innovative strategies for adaptation;[32]

(c) Integrated assessment for climate politics and innovation, with reliable assessment for costs, risks and opportunities related to adaptation and mitigation, for example ISI-MIP (Inter-Sectoral Impact Model Intercomparison Project)[33] and economics of climate change;[34]

(d) International cooperation and responsibility to build research capacity with partners around the world. For example the regional science service centres for climate change and adapted land use in Africa, West African Science Service Center on Climate Change and Adapted Land Use (WASCAL)[35] and Southern African Science Service Centre for Climate Change and Adaptive Land Use (SASSCAL),[36] and the Future MegaCities programme.[37]

41. Ms. Stercken highlighted lessons learned (as a response to the questions from the RD7 information note):

(d) Access to scientific data and information can be improved to enhance research and innovation capacity through climate services and stakeholder dialogues;

(e) Regional and local capacity can be improved to support decision making through: co-design - stakeholders participation in the design of research programmes; and co-production - inter- and trans-disciplinary research;

(f) The opportunities for delivering consistent data and model outputs to support decision making include the design of research infrastructures and coordinated initiatives in support of systematic approaches.

42. Mr. Peter Horvath, European Commission (EC), presented on how the EC is addressing global societal challenges through EU research funding. He highlighted the conflicting needs of scientists and policy makers in the design of research programmes, underlining that the EC is supporting dialogue and exchange with all stakeholders to ensure the optimum programme design. The EC research programmes have contributed to the IPCC AR5 and other major international reports.

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[30] <http://www.fona.de/en/framework>.
[31] <http://www.fona-miklip.de/en/>.
[32] <http://www.klimzug.de/en/>.
[33] <http://wcrp-climate.org/modelling-wgcm-mip-catalogue/modelling-wgcm-mips/504-modelling-wgcm-isimip>
[34] <http://www.fona.de/en/9908>.
[35] <http://www.wascal.org>.
[36] <http://www.sasscal.org>.
[37] <http://future-megacities.org>.

43. Mr. Horvath explained that the current EU research framework programme (2014-2020) is called 'Horizon 2020'.[38] He added that climate action in Horizon 2020 is challenge-driven and solution-oriented. Expenditure on climate-related actions will be tracked throughout. The programme focuses on:

(a) Developing climate services in Europe and worldwide, including actions to help the climate services market grow. A roadmap has recently been developed with EU member States to co-design and co-develop services with users;

(b) Designing realistic and cost-effective decarbonization pathways, linking stakeholders and working across sectors to understand the pathways of action and socio-economic impacts;

(c) Addressing critical climate change hot-spots, such as the Arctic;

(d) Supporting Earth observation, including through the Copernicus Climate Change Service programme,[39] to provide free access to climate data for a range of initiatives.

44. Mr. Horvath highlighted lessons learned from the EU framework programme, including:

(a) The "general opening" of the EU research framework programme to third countries is an asset but sometimes has not been helpful enough to support countries concerned and must be complemented with targeted actions;

(b) It is important to involve local stakeholders from the design phase to raise ownership and dedication for action;

(c) At the European level, there is a need to coordinate between research funding and development aid. Recent work aims to embed research modules into development programmes in order to grow impact and relevance;

(d) The need for coordination among international capacity building programmes, as well as (when appropriate) with the private sector, in order to increase impact and sustainability.

45. Good practices for EU research include:

(a) Climate services co-development with the involvement of the Directorate General for Research and Innovation, the EU aid office and potential local stakeholders;

(b) Copernicus Climate Change Service;[40]

(c) Framework Programme 7 (FP7) Africa call - a cluster of projects with numerous African participants, cutting across several sectors;

(d) Joint renewable technology development and deployment through collaborative projects, with embedded PhD training programmes, workshops and summer schools.

46. Mr. Adrian Simmons, Global Climate Observing System (GCOS), delivered some research-related messages from the evaluation of the status report of GCOS,[41] due by COP 21 (November-December 2015) in response to the questions from the RD7 information note.

47. He explained that GCOS concentrates on observations, and specifically on the Essential Climate Variables (ECVs) taken from both *in situ* and satellite measurements and model assisted data assimilation, which provide integrated data products from a range of sources and quality control for observations. There has been an improvement in observations for many ECVs. An example of good practice is the measurement of deep ocean temperature by *in situ* ocean floats (figure 4). These floats are now being further developed through the addition of new sensors so as to also measure ocean acidification and oxygen concentration.

48. Mr Simmons suggested that decision making could be better supported by the delivery of consistent data and model outputs through the improvement of data measurement and consistency as well as models. In this regard, he identified the need for increased dialogue to ensure effective and efficient messaging; guidance for decision makers on how to use all types of data (in-situ, satellites and model-assisted); and improved understanding of the reliability of data.

[38] <https://ec.europa.eu/programmes/horizon2020/en>.
[39] <http://www.copernicus.eu/main/climate-change>.
[40] <http://www.copernicus.eu/main/climate-change>.
[41] <http://www.wmo.int/pages/prog/gcos/>

49. Mr. Simmons stated that a number of initiatives are supporting regional and local capacity building for systematic observation. As examples of bilateral support, he cited: the Capacity Building and Twinning for Climate Observing Systems (CATCOS) Summer School[42] funded by the Swiss Government; and the United Kingdom's collaboration with India and the Republic of Korea on regional re-analyses, building on the development of the European capacity for Copernicus. He added that capacity could be improved to support decision making through better coordination of the existing capacity building programmes, including the GCOS Cooperation Mechanism[43] and the Global Framework for Climate Services (GFCS).[44]

50. Mr. Simmons underlined that scientific data tends to be grouped by types, with *in situ* data held (in principle) by international data centers, and satellite and reanalysis products are hosted primarily by producers. He stressed that data can be difficult to find, and may not be comprehensive or in the appropriate format. While recognizing that data can be found on a number of portals, he pointed to the difficulty of identifying the best data once it is accessed. He underlined that access to scientific data and information "can and should be improved" to enhance research and innovation capacity through increased collaboration and better synergies. He mentioned that the Copernicus programme is addressing several of these issues.

51. Mr. Andrew Matthews, Asia-Pacific Network for Global Change Research (APN), presented on the APN's work on capacity development in developing States in the Asia-Pacific region. Noting that the APN is in its 20th year, Mr. Matthews highlighted the new APN action agenda (2015-2020) for research, capacity development and science policy.[45] In the last five years, APN has supported over 60 capacity building projects on a range of issues to support local and national stakeholders' understanding of climate change issues and to find effective ways of communicating and influencing decision and policy making (figure 12). Examples of successful capacity development initiatives include:

(a) Climate Change and Variability Implications on Biodiversity - Youth Scenario Simulations and Adaptations in Fiji, Tuvalu and Solomon Islands,[46] which innovatively reached communities through engaging youth and using cultural drama;

(b) Enhancing the climate change adaptation capacity of local government units and scientists in the Philippines[47], which: increased the involvement and capacity of local leaders in vulnerability assessments and adaptation; improved dissemination of project outcomes at the science, policy and community levels; influenced local level policy makers to integrate climate risk management and climate change adaptation plans into annual investment and land-use plans for municipalities; and built partnerships among local institutions;

(c) Promoting sustainable use of waste biomass in Cambodia, Lao PDR and Thailand - combining food security, bio-energy and climate protection benefits,[48] which built capacity for collaboration at different levels as well as across language and cultural barriers.

52. Mr Matthews suggested a number of actions to enhance capacity development in the Asia-Pacific region, which include:

(a) Understanding: regional and cultural diversity; traditional knowledge is powerful (West-knows-best practices are too common and one size does not fit all);

(b) Educating: providing better opportunities for young (early career) scientists through training and engaging youth, especially in social networking;

(c) Creating: opportunities for informal dialogues with stakeholders at sub-regional levels (addressing common issues builds trust and a sense of ownership and is less intimidating);

(d) Engaging: in activities that involve all stakeholders from beginning to end of the project and engaging with, and listening to, those who are most at risk;

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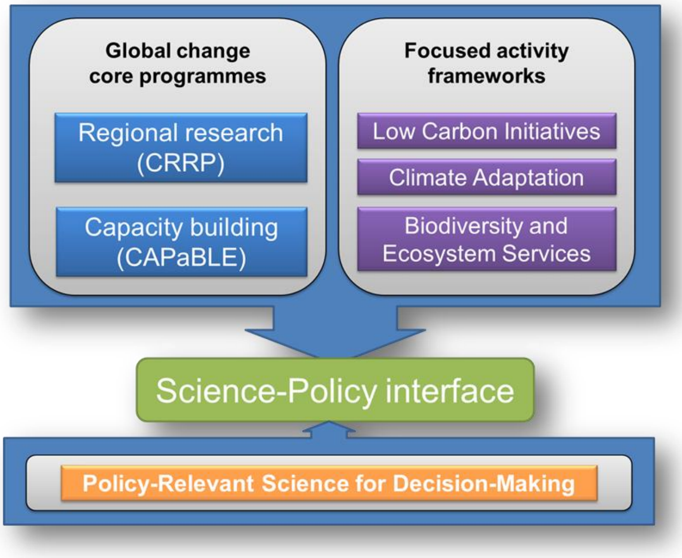
[42] <http://www.meteoschweiz.admin.ch/home/service-und-publikationen/publikationen.subpage.html/de/data/publications/2015/5/Capacity%20Building%20and%20Twinning%20for%20Climate%20Observing%20Systems.html>.
[43] <http://www.wmo.int/pages/prog/gcos/index.php?name=GCOSCooperationMechanism>.
[44] <http://gfcs.wmo.int>.
[45] <http://www.apn-gcr.org/resources/items/show/1999>.
[46] <http://www.apn-gcr.org/resources/items/show/1633>.
[47] <http://www.apn-gcr.org/resources/items/show/1646>.
[48] <http://www.apn-gcr.org/resources/items/show/1662>.

(e) Sharing and communicating: the most important factor across the region is the human factor: sharing information and data; transferring knowledge; experiences and best practices. The nuance needs to be explored to support media understanding and how to link and share information between policy makers and scientists.

Figure 12
Asia Pacific Network – key activities



Source: Slide 7 of the presentation by Mr. Andrew Matthews), available at <http://unfccc.int/files/science/workstreams/research/application/pdf/10._matthews_apn.pdf>. The figure illustrates the key activities of the Asia Pacific Network (APN), covered by the three agendas of the APN: capacity development agenda (such as the core programmes); research agenda (such as the focused activity frameworks that include climate adaptation); and the science-policy agenda.

53. Mr. Carlos Fuller, Caribbean Community Climate Change Centre (CCCCC), spoke on lessons learned from climate modelling in the Caribbean and the need for downscaling. He explained that global climate models provide resolution at a 300–500 km resolution. Many Caribbean Islands have very varied topography and are the size of one grid on these models. Effective climate models therefore need to be downscaled to at least 50km or 35 km. He said that in order to produce effective impact models in the Caribbean, resolution is needed at 10 km, 1 m, and even at point resolution. In order to be able to supply member States with high resolution data, the CCCCC convened two workshops in 2006, with the assistance of the Hadley Centre, to establish a regional network of modelling centres (University of the West Indies in Barbados and Jamaica, the Meteorological Institute of Cuba (INSMET) and the Water Center for the Humid Tropics of Latin America and The Caribbean (CATHALAC) in Panama). The network subsequently completed 11 experiments in three domains at two different resolutions (figure 13) and can produce a range of outputs (Figure 14). He indicated that all data and models are freely available on the CCCCC website database where the user can choose the model, scenario and parameter for an individual country of the region.[49]

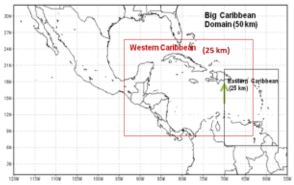
54. Mr. Fuller explained that the CCCCC is now in the process of finalizing the Caribbean Weather Impacts Group (CARIWIG) project. This project is a weather generator that provides: data similar to that in the KNMI Climate Explorer for all stations in the Caribbean; and a range of historical and future climate data and information and analysis tools, including for extreme weather events. For example, CARIWIG could identify what the impacts would be if a hurricane with the force of Hurricane Gilbert (which devastated Jamaica in 1988) were to hit one of the Caribbean islands at current warming conditions.

55. Mr. Fuller then described the work of the CCCCC on the Global-Local Caribbean Climate Change Adaptation and Mitigation Scenarios (GoLoCarSce) Project to develop consistent regional scenarios/storylines for AR5 RCPs for impact studies. The project is downscaling RCP 4.5 and RCP 8.5 to 10 km for four GCMs for selected Caribbean islands. He indicated that it is projected that GoLoCarSce, in association with CORDEX, will be expanded to Central and South America.

[49] <http://www.caribbeanclimate.bz>.

Furthermore, the CCCCC has entered into memorandums of understanding with partners in the Indian and Pacific Oceans to expand the downscaling work in the Caribbean and support work on downscaling in these regions.

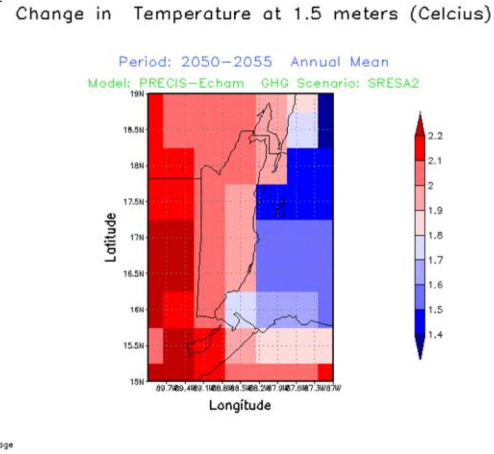
Figure 13
Downscaling experiments for the Caribbean



No.	Driving conditions		Domain	Resolution	Period
	GHG Scenario	LBCs Data			
1		ERA15	Big Caribbean	50 km	1979-1983
2		ERA40	Big Caribbean	50 km	1979-1993
3		HadAM3H	Big Caribbean	50 km	1961-1990
4	SRES A2	HadAM3H	Big Caribbean	50 km	2071-2100
5	SRES B2	HadAM3H	Big Caribbean	50 km	2071-2100
6	SRES A2	ECHAM4	Big Caribbean	50 km	1961-2100
7	SRES B2	ECHAM4	Big Caribbean	50 km	1961-2100
8	SRES A2	ECHAM4	Eastern Caribbean	25 km	1961-2100
9	SRES B2	ECHAM4	Eastern Caribbean	25 km	1961-2100
10	SRES A2	ECHAM4	Western Caribbean	25 km	1961-2100
11	SRES B2	ECHAM4	Western Caribbean	25 km	1961-2100

Source: Slide 4 of the presentation by Mr. Carlos Fuller, available at <http://unfccc.int/files/science/workstreams/research/application/pdf/11._fuller_ccccc.pdf>. The figure illustrates the 11 experiments completed for regional modelling by the Caribbean modelling network in three domains (Big Caribbean, Eastern Caribbean and Western Caribbean) and at two resolutions (50 km and 25 km).

Figure 14
Differences between coastline and interior temperatures in Belize



Source: Slide 6 of the presentation by Mr. Carlos Fuller, available at <http://unfccc.int/files/science/workstreams/research/application/pdf/11._fuller_ccccc.pdf>. The figure illustrates an example of the data available as a result of the downscaling work in the Caribbean, showing differences in temperature between coastline and interior in Belize in 2050 using the PRECIS model and Scenario SRESA2 (from AR4).

2. Summary of the discussion

56. Several Parties noted the importance of the issues raised by Mr. Matthews regarding the APN's stakeholder engagement. Particularly noted were: the practical approach to the interaction between policy makers and scientists; how translating the research had enhanced understanding by communities and policymakers that encouraged the research community to further engage; the examples given of difficulties and challenges. Japan cited its submission which references collaboration with stakeholders for international collaboration and transdisciplinary research.[50]

57. Several Parties pointed to the need for more scientific information to support decision making on adaptation and build climate resilience. They urged closing the dialogue gap among science, policy makers and community leaders to enable downscaling for impact assessment and a better understanding of the required adaptation measures. One Party provided an example of coastal impacts of climate change that have occurred in its country but have not been fully considered at a policy level to enable protection of the infrastructure and economy.

58. Parties praised the work carried out by the CCCCC and stressed the importance of downscaling to better enable adaptation planning and implementation. One Party noted the requirement for similar home-initiated downscaling activities in the Pacific and the need to support this work. Parties also noted the importance of dialogue between the scientific community, decision makers and community leaders to determine how best to use data and high-resolution data to improve current and future adaptation. One expert highlighted that Copernicus would be globally available to support downscaling although it must consider how data can be made accessible and useful for local application.

59. One Party highlighted its policy on open access to data, including data sets on a range of sectors,[51] as well as the NASA Climate Change resource, which was released in June and provides a detailed dataset of regional climate change projections.[52] The work of the Arctic Council was highlighted including planned work on the development of useful data products on climate change impacts.

[50] <http://www4.unfccc.int/submissions/Lists/OSPSubmissionUpload/112_81_130740056614559528-JPN_Views%20on%20the%20Research%20Dialogue.pdf>.
[51] <http://www.data.gov/climate/>.
[52] <http://www.nasa.gov/press-release/nasa-releases-detailed-global-climate-change-projections>.

60. One Party asked if the experience of CCCCC was similar to the APN in the process of working with stakeholders and different groups of people. The expert highlighted that the CCCCC also faced difficulties in ensuring that policy makers fully understand the issues at hand. He noted a need to pursue dialogue at the regional to national levels to develop policy-level understanding and promote decision making based on scientific data. He cited a recent online risk assessment tool developed by CCCCC for the ministries of finance and economic development in the Caribbean.

61. One Party highlighted the increasing need for researchers to focus research efforts on building developing countries' climate resilience and for capacity building for region-specific climate research on food security, water resources, sea level rise and coastal inundation. The Party identified the importance of scientific research to identify those natural resources particularly in Asia and Africa that are vital for communities but are also climate vulnerability hotspots.

62. One Party pointed out that the scarcity of available climate information in developing countries is due to a lack of high-quality instruments and of calibration for quality assurance. He identified the difficulties of developing countries' scientists to access these types of instruments, stressing the need for international efforts to offer early-stage and senior scientist training. He called for: international platforms with open access to instruments and supercomputers; international collaboration to support students; and 'open doors' policies for established scientists to build joint research projects.

63. One Party underlined the need to better understand climate hazards, which would help understand regional exposure and vulnerability. He suggested that this effort be supported by a research focus on sea level rise, regional coastal impacts, expansion of sea level monitoring and ocean acidification measurements.

64. An expert responded to the latter two issues (paragraphs 62 and 63) by saying that there is a general mismatch between some variables and instrumentation in developed and developing countries. On tide gauges, he noted that very few advances have been made in the monitoring community but this is flagged as a requirement for capacity building by the upcoming GCOS report. One Party described its successful provision of a weather-based agro-advisory service on medium-range scale to 10.2 million farmers across the country.