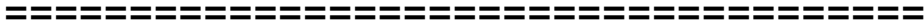


WORLD METEOROLOGICAL ORGANIZATION



COMMISSION FOR ATMOSPHERIC SCIENCES

**INTERNATIONAL CORE STEERING COMMITTEE FOR
THORPEX**

THIRD SESSION

FINAL REPORT



MONTREAL, CANADA, 16 - 17 DECEMBER 2003

EXECUTIVE SUMMARY

The CAS International Core Steering Committee (ICSC) met in Montreal, Canada on 16 – 17 December 2003 to proceed with the work assigned by CAS, the WMO Executive Council and the Fourteenth World Meteorological Congress Resolution 12 (Cg-XIV). This included (a) review of the progress and planning of further development of THORPEX: a Global Atmospheric Research Programme, including financial and administrative matters related to the THORPEX International Programme Office and Trust Fund.

The ICSC recognized notable progress in the THORPEX programme development since its establishment by the Fourteenth World Meteorological Congress in May 2003. That included progress in international organization and coordination of the programme, its North American and Asian regional activities, establishment of the European Regional Committee, accomplishment of the field phase of the North Atlantic experiment, expanding and strengthening cooperation with the WMO Commission for Basic Systems, establishment of a International Programme Office (IPO) in WMO headquarters in Geneva and a Trust Fund.

Important step forward was development of a THORPEX International Science Plan and ICSC approved its second version. Preparation of a detailed THORPEX International Research Implementation Plan (TIP) was considered as a first priority in the programme development. Another priority was sustainable funding for the IPO. The ICSC decided to focus efforts on preparation in 2004 of a THORPEX International Research Implementation Plan (TIP). ICSC approved outlines and terms of reference for TIP and decided to establish an ad-hoc group of experts for THORPEX implementation planning. Cooperation with CBS was significantly expanded in all programme areas.

ICSC initiated relevant actions in support of priority activities and to follow-up outcomes of the Cg-XIV. It urged its members to submit their proposals for contribution to THORPEX implementation and to actively support programme activities including in kind contributions, secondment of experts to the IPO and cash donations to the THORPEX Trust Fund.

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GENERAL SUMMARY OF THE WORK OF THE SESSION

1. ORGANIZATION OF THE MEETING (*Agenda item 1*)

1.1 Opening of the meeting (*Agenda item 1.1*)

The third session of the CAS International Core Steering Committee for THORPEX (ICSC) was opened by its Chairman Dr. Michel Bèland at 09 am on Tuesday, 16 December 2003 in the Crowne Plaza Montréal Centre Hotel, Montréal (Quebec), Canada.

The list of participants is attached as Annex I.

Dr. Bèland welcomed the participants to Montreal on behalf of Meteorological Service of Canada. He especially welcomed new members of the ICSC, namely Dr. Eric Brun (not attended the ICSC-3) and Jean Pailleux representing France, Dr. Louis Uccellini, representing the USA, Mr Keiichi Kashiwagi, acting representative of Japan, Mrs Angele Simard, representing CBS on behalf of the president of CBS. The Chairman also welcomed Dr. Philippe Bougeault, representing the ECMWF, which joined the ICSC as an observer on an invitation of the president of CAS.

Dr. Bèland noted that the most important decisions of the session were to approve the 2nd Version of the THORPEX International Science Plan and to start development of THORPEX International Research Implementation Plan.

1.2 Adoption of the agenda (*Agenda item 1.2*)

The agenda as adopted by the session is given in Annex II.

1.3 Working arrangements (*Agenda item 1.3*)

The meeting agreed on working arrangements and adopted a tentative work plan for consideration of the various agenda items.

2. REVIEW OF CG-XIV, ICSC, SSC/WWRP AND WGNE RECOMMENDATIONS AND RESOLUTIONS. STATUS OF PROGRAMME IMPLEMENTATION. REPORT OF THE CHAIRMAN (*Agenda Item 2*)

2.1 The Chairman, Dr. Michel Bèland, presented a comprehensive report covering main activities of the ICSC since its establishment in 2002 and on progress in organization and implementation of the THORPEX with regard to resolutions and recommendations made by Cg-XIV, previous ICSC meetings, SSC-WWRP and WGNE. In summary, the main milestones and results are contained in items 2.2 – 2.16.

2.2 The ICSC was established by the president of Commission for Atmospheric Science (CAS) in 2002 The First Inaugural meeting (ICSC-1), convened in Oslo, Norway in October 2002. ICSC-1 adopted the ICSC Terms of Reference including its membership and elected Dr. Michel Bèland as its first Chair. THORPEX members were Australia, Canada, China, France, Germany, India, Japan, Korea, Russia, South Africa, UK and USA. ICSC-1 agreed on the programme's name THORPEX: a Global Atmospheric Research Programme, endorsed its rationale, basic ideas and organizational principles. The ICSC-1 decided to set up a THORPEX programme office in Geneva with the understanding that this office would have to be jointly supported by the THORPEX participants. The programme was established under the auspices of CAS as a part of WMO World Weather Research Programme (WWRP). International coordination of its activities is being conducted through ICSC, SSC/WWRP, WGNE and the CBS.

2.3 Since the ICSC-1 notable progress in the organization of THORPEX has been achieved, including meetings of the ICSC and the International Science Steering Committee for THORPEX (ISSC), the establishment of THORPEX regional committees, the establishment of the THORPEX International Programme Office (IPO) with associated trust fund, development of partnerships with

other WMO Programmes and international organizations. A start was made towards a comprehensive website www.wmo.int/thorpex. Cooperation with CBS was established. The development of a THORPEX International Science Plan was an important step and the programme moved forward to the next phase of development. Preparation of a detailed THORPEX International Research Implementation Plan was considered as a first priority in the programme development. The plan would amongst other things clearly identify the uniquely-THORPEX related deliverables, and a timeline for its major activities. Another priority was sustainable funding for the IPO, and for supporting important THORPEX initiatives.

2.4 In 2003, the following THORPEX international sessions were held, alone or in conjunction with the following events: Second ICSC Session (ICSC-2, 11 April 2003, Paris, France), 14th World Meteorological Congress (Cg-XIV, May 2003, Geneva, Switzerland), 6th Session of SSC/WWRP (15-19 September, Oslo, Norway) and 19th Session of WGNE (11 to 14 November 2003, Salvador, Brazil). THORPEX was presented and discussed at these sessions and a number of recommendations and resolutions were adopted.

2.5 In particular, the ICSC-2 discussed presentation of THORPEX to the Cg-XIV. ICSC-2 urged ISSC to issue by May 2003 an Executive Summary of International Science Plan and to prepare a full version of the Plan by September 2003 taking into account recommendations of SSC/WWRP and WGNE. ICSC-2 discussed member's contributions to international and regional activities and decided that a trust fund should be established in WMO. ICSC-2 also urged WMO to set up an International Programme Office (IPO) at the WMO Secretariat in Geneva, which would be jointly supported by the THORPEX members. USA committed an annual contribution of US \$ 200,000 (US \$150, 000 for the first year of 2003), Canada - Can \$ 50,000 and France - Euro 10,000. ICSC-2 urged members to continue to seek sponsorship for THORPEX.

2.6 Cg-XIV fully endorsed the rationale and basic ideas of THORPEX, and the establishment of the CAS ISSC and ICSC to lead planning and implementation of the programme. Cg-XIV requested the Secretary General to set a THORPEX International Programme Office funded by THORPEX participating countries. The Congress encouraged efforts of the ICSC and ISSC to seek sponsorships for THORPEX from WMO Members and international bodies. Congress decided to encourage WMO Members to actively participate to THORPEX; to assist WMO Members in the international coordination of THORPEX; to assist WMO Members from developing countries in their utilization of THORPEX-related forecast products; to coordinate THORPEX with CBS, JCOMM, WCRP and other WMO programmes; to facilitate the participation in THORPEX of other international bodies. In that connection, Congress adopted Resolution 12 (given in Annex III) establishing THORPEX as a ten-year long international Global Atmospheric Research Programme under the WMO Commission for Atmospheric Sciences and as a part of World Weather Research Programme, in order to accelerate improvements in weather forecasting on short-, medium and extended-range time scales.

2.7 SSC/WWRP-6 and WGNE-19 noted steady progress in the organization of THORPEX, including considerable efforts made by the ISSC co-chairmen to respond to the 2002 joint resolution of the WWRP/WGNE and effectiveness of the co-chairmen in bringing THORPEX to the attention of a broader community is both important and widely appreciated. The development of a succinct and visionary THORPEX International Science Plan was considered as a positive step forward. The inclusion of plans for specific societal and economics research was especially welcomed. Draft joint resolution was not made available to ICSC before the meeting and was still under consideration by WGNE and SSC/WWRP. Dr. R. Carbone informed ICSC on some issues specified for THORPEX entities to address and ICSC-3 held an informal discussion of these issues.

2.8 In particular, SSC/WWRP and WGNE noted that THORPEX is building on many existing R&D activities and it should focus on problems, the solutions for which require international and academic-operational collaboration. Field campaigns, addressing clear scientific objectives, are a good example of this. The Committees commended the regional committee structure, which

enables such campaigns to be planned to fit in with existing R&D needs. The main focus of THORPEX has been on improving understanding of predictability (i.e. of the sources and growth of errors), and on the application of this understanding to improving forecasts and their utility. The Committees recommend that this theme should be retained and sharpened; they commend the Science Plan for showing it is relevant to very many aspects of the forecast process. However the plan should make it clearer that in many cases this builds upon and accelerates established R&D efforts.

THORPEX Trust Fund

2.9 The ICSC Chair reported that the THORPEX Trust Fund was established in WMO in May 2003 to support the THORPEX International Programme Office and major international programme activities. The matters related to the fund are summarised under item 8.

International Programme Office (IPO)

2.10 To provide direction and support for the programme implementation THORPEX International Programme Office (IPO) was established in WMO headquarters (Geneva, Switzerland) in May 2003 as an integral part of the WMO Secretariat under supervision of the Director of Atmospheric Research and Environment Programme Department. The summary of ICSC decisions related to the IPO is presented under item 8.

THORPEX Regional Committees

2.11 The THORPEX Asian Regional Committee (ARC) has been established at the First Asian THORPEX planning meeting (February 2003, Tokyo, Japan). Research foci were determined and international collaboration on conducting observation projects and research was discussed. A second meeting was planned for Spring 2004.

2.12 The THORPEX European Regional Committee (ERC) was established under co-chairmanship of George Craig (Germany) and David Richardson (UK). It was expected that following the Atlantic THORPEX Regional Experiment (A-TOST), the co-chairs would start formal planning activities for Europe.

2.13 The THORPEX North American Regional Committee (NARC) has been formally established, with David Parsons (USA) and Pierre Gauthier, (Canada) named as co-chairs. Its first meeting in Baltimore, USA in August 2003 discussed the formulation of regional plan. Reports by the Regional Committees are summarized below under subsequent items.

2.14 The Chair informed the ICSC that a number of countries expressed their interest in contributing to THORPEX (i.e. Brazil, Chile, Morocco, South Africa). More consultations with Members needed to facilitate understanding of THORPEX objectives and possibility for particular countries participation. In North America, Europe and Asia this is being led by the Regional Committees, and Australia is well presented in ICSC. That was not yet the case for other WMO Regions and establishment of other Regional Committees was considered as an important and urgent need. It was felt appropriate to actively invite WMO Members to contribute to THORPEX Programme and to provide them with a statement of guidance on how it can be done. The ICSC requested its Chair to prepare a statement on guidance on possibilities of NMHSs involvement and contribution to THORPEX implementation, depending of national resources and capabilities, taking into account that this guidance will be circulated to all WMO Members as soon as possible to allow integration of responses to a implementation plan.

Action ICSC-3/01: ICSC Chair to prepare statement of guidance for WMO Members on possibilities of their involvement and contribution to THORPEX implementation. IPO to circulate it to WMO Members.

2.15 The Chairman also mentioned a number of scientific lectures and presentations on THORPEX, meetings and workshops held and publications issued in 2003.

2.16 The ICSC reviewed actions from previous meetings and status of their implementation. It noted that the most of the action items had been accomplished and that permanent actions were well underway. The Chair was commended for his efforts to complete the action items. Some of outstanding actions related to financial matters were further discussed under item 8 (administrative and financial matters) and agreed to keep on a permanent basis (P12, P13 and P14).

Decision 1: The ICSC approved the report of the Chairman and closed accomplished actions from previous meetings. It requested members to pursue in fulfilling permanent actions as listed in Annex XIV.

3. THORPEX INTERNATIONAL SCIENCE PLAN (*Agenda item 3*)

3.1 The ICSC appreciated the work done by the ISSC on development the THORPEX International Science Plan. The Executive Summary was prepared in April and distributed to all WMO Members at the Cg-XIV. The First Version of the THORPEX International Science Plan was prepared in July 2003 and ICSC reviewed it by correspondence. On 22 August 2003 the Second Version of the THORPEX International Science Plan was circulated and has been reviewed by the SSC/WWRP, WGNE and ICSC. CBS was also invited to review the Plan and Intended to provide its views. Executive Summary of the plan is given in Annex IV.

3.2 An extensive effort by the international community has gone into devising the plan. In particular, the ICSC recommended THORPEX should focus on improving high-impact weather forecast skill over forecast periods of between 1 and 14 days. The removal of the 0 to 1 day period was suggested so that THORPEX does not duplicate efforts of shorter-range WWRP forecasting and nowcasting programmes. Much effort has gone into the development of the Societal and Economic Applications Sub-programme of THORPEX. Extensive engagement of the satellite observations was made.

3.3 Several participants noted that in Europe THORPEX was a galvanizing effort directed at examining high impact weather events. It is a focus for determining what additional societal benefits might be obtained through better forecasts. Others highlighted that THORPEX could be a significant support to the various observing systems, especially the space observing system.

3.4 Several ICSC members indicated that the THORPEX objectives are clearly stated in the context of the plan, however these are not sufficiently reflected in the mission statement. Dr. Frolov noted that it was not yet clear what would be the outcomes of the THORPEX. Similarly, it was not clear what additional support will be forthcoming just because of THORPEX. ICSC agreed that it is necessary to identify what makes THORPEX unique from other programs and give better definition of the goals of THORPEX. Dr. Uccellini noted that THORPEX objective to demonstrate significant acceleration in the rate of improvement of forecast skill was of most importance for the USA and this goal should be respectively reflected in its mission statement. In this connection, the question was raised on how one measures forecast improvement. The ICSC therefore agreed that a stronger mission statement needed to be formulated.

3.5 Mrs Simard pointed out that from the CBS standpoint additional emphasis needed to be put on the total system required to obtain the data, generate the forecasts and deliver the products to the users. She highlighted that the WWW could have a significant role to play in THORPEX. Discussion on this issue is summarised in more details under item 4.

3.6 The ICSC agreed that it was needed to accommodate several comments on THORPEX in the THORPEX Implementation Plan, including such points as verifying the rate of forecast improvement and targeted observations.

Decision 2: The ICSC approved second version of the THORPEX International Science Plan with some slight modifications, including the strengthened mission statement, In doing so, the ICSC noted that the plan would be a living document and it would be reviewed as needed in a course of the programme implementation to adapt the changes in technology, forecast capabilities and societal needs. The ICSC requested co-chairs of ISSC to incorporate last modifications and to make the plan available for printing in March 2004. The IPO was subsequently requested to publish the plan in a series of WMO WWRP THORPEX publications in April 2004.

Action ICSC-3/02: Co-chairs of ISSC to review and update THORPEX mission statement by 15 March 2004.

Action ICSC-3/03: Co-chairs of ISSC to incorporate last slight modifications in the second version of the THORPEX International Science Plan and to make the plan available for printing in March 2004.

Action ICSC-3/04: The IPO to publish the plan in a series of WMO WWRP THORPEX publications in April 2004.

4. COOPERATION WITH OTHER PROGRAMMES AND ORGANISATIONS (*Agenda item 4*)

4.1 Co-operation with WMO WWW (*Agenda item 4.1*)

4.1.1 Representative of CBS Mrs Simard briefed the ICSC on the major components of WWW: the Global Observing System (GOS), the Global Telecommunication System (GTS) and the Global Data-processing and Forecasting Systems (GDPFS). These systems are managed by the WMO Commission for Basic Systems (CBS, Acting President Mr. A. Gusev) through its Open Programme Area Groups (OPAG): OPAG on Integrated Observing Systems (IOS, Chair Dr. J. Purdom), OPAG on Information Systems and Services (ISS, Chair Prof. G.-R. Hoffmann), OPAG on Data Processing and Forecasting Systems (DPFS, Chair Mrs A. Simard) and OPAG on Public Weather Services (PWS, Chair Mr K. O'Loughlin).

4.1.2 The ICSC was pleased to learn about the progress achieved in strengthening collaboration between CBS and CAS on THORPEX and on both Commissions efforts to appropriately involve WWW in planning and implementing THORPEX. The ICSC noted that CBS Management Group (MG) unanimously expressed high appreciation of THORPEX as potentially very relevant to the WWW research needs in all its programme areas. Since all CBS OPAGs were to be involved in THORPEX, it was agreed that the CBS vice-president would be the most suitable high-level link. Until the election of the vice-president (IV quarter 2004), the president of CBS would act as the link to THORPEX. On behalf of the president of CBS Mrs A. Simard represented the Commission at the ICSC-3 meeting.

4.1.3 The CBS-MG particularly agreed that THORPEX provides opportunity, in particular, to exploit targeted in-situ and space-based observations, the ability to test efficacy of a multi-model global ensemble system (with leading role of WMCs, ECMWF and in collaboration of NWP centres world-wide) and to assess the value of new decision support tools, thus having great potential to contribute to future GOS and NWP system. From the other side, THORPEX success would be assured through matching its efforts with well defined operational forecasting requirements, and transforming its scientific opportunities into specific implementation and transition plans. In this connection it was noted that that a significant role for the WWW will be in the implementation of the results from THORPEX. Therefore, evolution of the THORPEX would lead to the integration of scientific results into operational practices of NMHSs.

4.1.4 The ICSC welcomed the CBS MG decision to call for OPAGs' contribution to the 2nd version of the International Science Plan. The ICSC noted with appreciation that CBS MG decided to take part in the development of THORPEX International Research Implementation Plan.

4.1.5 The TOSTs efforts will be strongly supported by the WWW and their results are considered as substantial input to CBS efforts on redesigning GOS. The CBS-MG encouraged THORPEX to make its experimental data sets available to major NWP centers (through GTS and other means) to allow their use in real time or for sensitivity studies and to other interested NHMSs for research. The ICSC noted that CBS MG emphasized the need to involve all WMO Regions in THORPEX experiments and that Southern Hemispheric THORPEX Observing-System Tests (TOSTs) (including South America, Africa, Australia and South Pacific) were essential components of a global campaign.

4.1.6 The ICSC noted with pleasure further progress achieved in collaboration with CBS. The Expert Team on the Observational Data Requirements and the Redesign of the Global Observing System strongly supported the THORPEX activities. It was felt that THORPEX could make important contributions to the redesign of a cost-effective GOS including strategies on how to introduce observation targeting into operations. The Expert Team prepared a set of questions (see Annex XI) that THORPEX could help to answer.

Decision 3: The ICSC requested that co-chairs of ISSC lead effort in examining CBS questions to respond, which issues THORPEX would address in a course of its implementations.

Action ICSC-3/05: Co-chairs of the ISSC to examine, in consultation with THORPEX experts, the CBS OPAG-IOS ET-ODRRGOS questions.

4.1.7 The ICSC noted with appreciation that CBS will encourage NWP centres to actively support THORPEX researches and experimentations. The Global Data-Processing and Forecast System centres are in the forefront for operational data assimilation, model development and ensemble forecasting. Each of these activities is important to achieving the goals of THORPEX.

Decision 4: The ICSC agreed that a link with the OPAG-DPFS Expert Team on Ensemble Predictions Systems was needed.

4.1.8 The Global Telecommunications System provides the primary facilities for the dissemination of observations and products. It links the several forecast centres and could be instrumental in exchanging information on many aspects of THORPEX. ICSC was invited to provide THORPEX requirements for input to development of the future WMO Information System, in particular with respect to the exchange of large volume of data (e.g. satellite observations, multi model ensembles data).

4.1.9 ICSC agreed that it would be also feasible to establish link with the OPAG PWS to join efforts on assisting NHMSs in providing reliable weather services in support of safety of life and property.

Decision 5: The ICSC agreed that a link with the OPAG-PWS would be feasible.

Action ICSC-3/06: Chair of ICSC to consider a suitable links between THORPEX and the OPAG-DPFS Expert Team on Ensemble Predictions Systems as well as with the OPAG-PWS and to make subsequent recommendation to the president of CAS.

4.1.6 The ICSC emphasized an important role of CBS in THORPEX research implementation and a major role of CBS in further operational implementation of THORPEX research results. It therefore invited CBS experts to take active part in planning of THORPEX implementation.

Decision 6: To ensure active involvement of CBS in THORPEX planning and implementation and to facilitate further operational implementation of THORPEX results.

Action ICSC-3/07: Chair of ICSC to invite CBS experts to take part in THORPEX implementation planning activities.

4.2 Linkage to International Polar Year 2007-2008 (*Agenda item 4.2*)

4.2.1 The ICSC recalled Resolution 34(Cg-XIV) by which Congress approved the idea of holding an International Polar Year 2007-2008 (IPY). Dr. Frolov briefed the ICSC on the progress in the preparation for the International Polar Year 2007-2008. WMO established a Steering Committee on the IPY, with a Task Team that developed an outline of programme activities to be implemented as contributions of WMO Programmes to the IPY. WMO activities for the IPY are focused on the following areas:

- Improvement and further development of the WWW GOS in the polar regions, including re-activation of existing and establishing new surface and upper-air synoptic stations, increasing the number of drifting buoys, VOS, and ASAP, particularly in the Southern Ocean, extending the AMDAR programme over the polar regions, and the use of existing components of the space-based subsystem, as well as new operational polar-orbiting satellite series flying with new observational capabilities for polar regions;
- Enhancement of monitoring of the ozone layer, with an increased spatial and temporal coverage, using ground-based optical remote sensing instrumentation and ozone sondes. Stratospheric aircraft campaigns should be made at both poles with a full complement of measurements necessary to study the chemical and physical properties throughout an entire one to two year period;
- Intensification of long-term integrated measurement/modelling of the transport of greenhouse gases and aerosols, particularly to the Arctic, including campaign to study of processes of atmospheric chemical components related to climate to minimise impact of ecosystem-related chemicals on the polar ecology;
- Assessment of global-to-regional influences on initiation, evolution and predictability of high impact weather events of polar circulation within the framework of the WWRP component programme THORPEX: a Global Atmospheric Research Programme;
- Intensification of polar climate addressing the role of studies of stratosphere-troposphere coupling, cryospheric processes and feedbacks through which the cryosphere interacts within the climate system; assessment of the impacts of past and future climatic variability and change on components of the cryosphere and their consequences, particularly for global energy and water budgets, frozen ground conditions, sea level change, and the maintenance of polar sea-ice covers in the framework of the WCRP Projects CliC, CLIVAR and SPARC;
- Establishment of a common database of polar climate data to carry out specialized studies of current, and assessment and projection of future, climate change in polar regions, as well as investigation of connections between polar regions and the lower latitudes, in an effort to improve implementation of climate prediction, through CLIPS, for the more populous areas;
- Investigation of physical processes in polar oceans, such as the formation of deep water, sea ice formation and melting, iceberg discharge, atmosphere–ocean interaction as well as the role of polar oceans in climate change. Establishment of Arctic Ocean and Southern Ocean Observing Systems, including the reactivation of existing and the establishment new sea level measurements stations as part of GLOSS, deployment of ocean moorings,

strengthening of the IABP and IPBA ice drifter networks, Upward Looking Sonars for ice drift and Argo floats in Southern Ocean, establishing of research stations on drifting ice and conducting marine expeditions on board ships, icebreakers, submarines, national airborne visual and radar patrols, supplemented by satellites with active and passive microwave sensors, optical scanners and sounding instruments;

- Further development of capabilities to observe and model or parameterise the hydrological cycle of regions with cold climate, and to achieve quantitative understanding of fresh water input to the Arctic Basin and Southern Ocean. The implementation of an ARCTIC-HYCOS project should provide data on river input to the Arctic basin over the entire Arctic drainage area.

4.2.2 The ICSC was informed that the idea of holding an International Polar Year in 2007-2008 was also considered by the International Council of Science (ICSU), which established its Planning Group in February 2003 to explore the possibility for IPY and formulate a set of IPY objectives. Close collaboration has been further established between WMO and ICSU, which would jointly sponsor and plan the IPY 2007-2008 with participation of other relevant organizations such as IOC, UNEP, Arctic Council, ATCM, IASC, SCAR, FARO, COMNAP.

4.2.3 Dr. Frolov emphasised that the IPY 2007-2008 comes at a time of increasing sensitivity of the Polar Regions to climate change indicated as melting of the permafrost, retreat of glaciers and longer periods of ice-free ocean conditions and other impacts of environmental changes on the Polar Regions. The Polar Regions are the origins of much of the severe weather. One should also determine if the Polar Regions are actually a major source of the uncertainty in forecasts.

4.2.4 The ICSC agreed with Dr. Uccellini who pointed out the importance of coordination between THORPEX and IPY in the scope of planning of THORPEX implementation. Several participants supported the development of a polar regional THORPEX programme as a component the IPY.

Decision 7: The ICSC decided that a special polar regional observing and research THORPEX programme consistent with overall THORPEX scientific objectives should be considered during the International Polar Year 2007-2008.

Action ICSC-3/08: The ICSC to consider a THORPEX polar regional programme as a part of the International Polar Year 2007-2008.

4.3 Positioning THORPEX in GEO (Agenda item 4.3)

4.3.1 Given the potential contribution of future Global Earth Observation System of Systems (GEOSS) to THORPEX objectives the ICSC was pleased to be briefed on the recent Earth Observation Summit (EOS) held in Washington DC, 31 July 2003, and the subsequent establishment of the ad hoc Group on Earth Observations (GEO). The EOS adopted a declaration that affirmed the need for timely, quality, long-term, global information as a basis for sound decision making. In order to monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes, to enhance prediction of the Earth system, and to further implement our environmental treaty obligations, the Summit recognized the need to support: improved coordination of strategies and systems for observations of the Earth and identification of measures to minimize data gaps, with a view to moving towards a comprehensive, coordinated, and sustained Earth observation system or systems; a coordinated effort to involve and assist developing countries in improving and sustaining their contributions to observing systems, as well as their access to and effective utilization of observations, data and products, and the related technologies by addressing capacity-building needs related to Earth observations; the exchange of observations, recorded from *in-situ*, aircraft, and satellite networks, dedicated to the purposes of the Declaration, in a full and open manner with minimum time delay and minimum cost,

recognizing relevant international instruments and national policies and legislation; and the preparation of a 10-year Implementation Plan, building on existing systems and initiatives, with the Framework being available by the Tokyo ministerial conference on Earth observations to be held during the second quarter of 2004, and the Implementation Plan being available by the ministerial conference to be hosted by the European Union during the fourth quarter of 2004. To achieve these objectives, the Summit established an *ad hoc* Group on Earth Observations taking into account the existing activities aimed at developing a global observing strategy. The ICSC was further informed of the five GEO Sub Groups (Architecture, International Cooperation, Capacity Building, Data Utilization and Data Requirements), their Terms of Reference and a status of ongoing activities.

4.3.2 The ICSC was pleased to note the strong participation of the WMO Secretariat in all of the Sub Groups and GEO Secretariat ensuring input from all WMO and supported Programmes. The ICSC noted that THORPEX input to GEO is recognized through contribution to the WMO process, led by WMO CBS (OPAG IOS ET-ODRRGOS), of determining of observational data requirements and Redesign of the Global Observing System, a core component of future Global Earth Observation System of Systems (GEOSS). The ICSC indicated a strong desire that THORPEX continue to be provided for consideration in the relevant GEO deliberations, including 10 year GEOSS implementation plan, and encouraged ICSC members to promote THORPEX requirements for the GEOSS through both national and WMO inputs to GEO process.

Action ICSC-3/09: ICSC members to pursue national inputs to GEO framework and Implementation Plan. ICSC with assistance of IPO to provide when appropriate related THORPEX input for consideration in relevant GEO deliberations.

5. REGIONAL ACTIVITIES. REPORTS OF CHAIRS OF REGIONAL COMMITTEES *(Agenda item 5)*

5.1 North American Committee *(Agenda item 5.1)*

5.1.1 The ICSC noted with appreciation the report on the activities of the North American Committee presented by Dr. Parsons, co-chair of the committee. The first part of the presentation dealt with the progress in planning and implementation, while the second portion dealt with a brief overview of those science topics deemed of primary interest to the North American operational and research communities.

5.1.2 The progress to date of this regional committee included:

- Late winter 2003 - US conducted the first THORPEX Observing Systems Test (TOST) over the central Pacific;
- Spring 2003 - North American Dr. David Parsons and Dr. Pierre Gauthier formally selected as co-chairs and agreed to serve;
- Spring 2003 - NOAA science plan produced and the NOAA Announcement of Opportunity released in the US;
- Web site for the regional committee established at the following URL:
<http://www.mmm.ucar.edu/uswrp/programs/nathorpex.html>;
- Summer 2003 - North American Committee was named and met to discuss strategies for implementing THORPEX vision. Summary document produced;
- Fall 2003 – Canadian group met to begin formal proposal to Canadian Foundation for Climate and Atmospheric Sciences;
- Fall 2003 - US and Canada participated in the first Atlantic THORPEX Regional Campaign THORPEX Regional Campaign (TReC);

- December 2003 – first version of North American Research and Implementation Plan completed;
- January 2004 - plans for first versions of the Canadian proposal to CFCAS.

5.1.3 The second part of the presentation was essentially a brief overview of the North American plan. The first aspect of this plan is the importance of weather to North American society and the economy. Basically, the continent experiences some of the most diverse and severe weather in the world. High impact events in North America include flash floods, droughts, fog, tropical storms, hurricanes, hail, tornadoes, damaging winds, snow storms, blizzards, freezing rain, heat waves, fire weather and episodes of stable stagnant air that leads to poor air quality. One third of the economies of the US and Canada are sensitive to weather. The intent of THORPEX is a strong match for the needs of North America for improved weather information.

5.1.4 Aspects of the operational prospective of THORPEX in North America were summarized as follows:

- Greater operational cooperation between Canada and the US, which includes the implementation of a North American (multi-center) global ensemble system;
- New US operational deliverables within the context of accelerating forecast skill including;
 - Detailed and skilful precipitation forecasts for 3-7 days in probabilistic form;
 - Daily weather forecasts for 8-14 days in probabilistic form;
- Greater cooperation between national centers in North America with different strengths;
 - Environment Canada has 3-D Var, the Ensemble Kalman Filter for its ensemble prediction system and a 4-D Variational techniques available for research and these systems will be available for operational data sets in the fall of 2004;
 - In the US, NOAA has extensive experience in “targeting” with both hurricanes and winter cyclones. NOAA vision for THORPEX includes an adaptive, interactive forecast system.

5.1.5 North American region is expected to contribute strongly to all four subprogrammes of THORPEX. The planning process of North America includes a call for a Pacific Regional Campaign in either the winter of 2005-2006 or 2006-2007 focusing on aspects of targeting and observing strategies.

5.2 European Committee (Agenda item 5.2)

5.2.1 The ICSC noted with appreciation that THORPEX European Regional Committee was established under co-chairmanship of Dr. Craig (Germany) and Dr. Richardson (UK). The co-chairs started formal planning activities for Europe and the first meeting of the planning group was planned in the spring of 2004.

5.2.2 The main activity of the European region in 2003 has been the Atlantic THORPEX Regional Campaign described under item 5.3 below. The ICSC was informed that a proposal for investigating the risks from severe weather has been made to the European Union. The status of that proposal was not known at the moment.

5.2.3 Dr. Schumann further noted that Germany was organizing a special observing period to investigate quantitative precipitation forecasting in 2007. That program will investigate primarily the moisture fields in the troposphere. It will extend the investigations that occurred during the International H₂O Program in the US during 2003.

5.3 Summary results of Atlantic THORPEX Regional Campaign (TReC) (Agenda item 5.3)

5.3.1 Dr. Caughey introduced the discussion on the recently completed Atlantic-THORPEX Regional Campaign (A-TReC) and gave a brief overview of the activities. A Special Operating Period (SOP) was arranged from the 13th October to the 12th December 2003. During this interval following activities were undertaken:

- Sensitive area predictions were prepared;
- Suitable targetting cases were identified;
- Target regions were defined;
- Additional observations were generated from these regions.

5.3.2 Two planning meetings have been held. The first took place at the ECMWF and considered the Project Plan. The second a few months later in Montreal reviewed the Operations Plan. In addition to EUCOS observational resources (AMDAR, ASAP and the European radiosonde network) the experiment had access to selected Canadian radiosonde sites, NOAA, NASA and DLR research aircraft and to GOES-12 rapid scan data. Four research aircraft joined the campaign, three of which could deploy dropsondes.

5.3.3 From the outset the observational response was good. The decision making process despite relying on international conference calls proved very effective. The TReC combined a range of both operational and research systems. Case selection was coordinated from the Met Office at Exeter. The identification of the cases to be studied was made during daily conference calls. Simple tools (ftp servers) were used to exchange information and although basic were found most suitable. Sensitive area predictions were made by MeteoFrance, the Met Office, ECMWF and made available on the ECMWF web site linked to WMO THORPEX home page. Other predictions from NCEP and NRL were posted locally.

5.3.4 Despite the short time to plan the TReC, the program was considered to be a major success. Overall 31 cases were considered and 21 were viewed interesting enough to target. A number of storms were targeted from the East Coast of North America through the Mediterranean including European storms as well as East Coast snowfall events. Work now focuses on documenting the SOP in detail, creating the experimental data sets and organizing a third TReC meeting in Toulouse in March 2004. It was hoped that at this meeting an assessment and analysis programme would be developed and agreed.

5.4 Asian Committee (*Agenda item 5.4*)

5.4.1 The THORPEX Asian Regional Committee has been established in February 2003 under chairmanship of the late Dr. Nakamura. Co-chairs Dr. Chen Dehui (CMA) and Dr. Chun-Ho Cho (KMA) presented the report on the committee activities. At the First Asian THORPEX planning meeting (February 2003, Tokyo, Japan) research foci were determined and international collaboration on conducting observation projects and research was discussed. A second meeting is planned for Spring 2004.

5.4.2 Asian THORPEX research targets are focused on the large-scale phenomena for Asian THORPEX but small-scale disturbances could be investigated, if necessary, in relation to a large-scale phenomena in which the small-scale one is embedded. The following were agreed as research foci for the Asian THORPEX:

- Summer monsoon (Baiu front, Indian monsoon and flooding events);
- Typhoon (track, intensity, precipitation and land fall);
- Winter monsoon (cold air outbreak);
- Dust storms;
- Interaction between tropics and extra-tropics (Rossby wave energy dispersion, western disturbance);
- Madden-Julian Oscillation.

5.4.3 The ICSC was informed on progress in national activities of THORPEX members in Asia summarised in Annex XII. The report of the Asian Committee was appreciated by the ICSC.

5.5 Other regional activities (Agenda item 5.5)

5.5.1 As the representative of Australia was unable to attend the session the ICSC chair presented the proposal on possible Australian contribution to THORPEX submitted by Dr. K. Puri. Combining adaptive observation networks and predictability studies in the Tropics has not yet tested and were considered as a priority task for the region (apart from Tropical Cyclones). Darwin 2006 was considered as a suitable candidate for a preliminary campaign to test key components for a full TOST around 2008. In this respect following relevant activities would be accomplished in the framework of the THORPEX Programme:

- Conducting studies to validate and assess the accuracy/performance of observing systems in the Tropics;
- Using Darwin network to design key experiments with BoM tropical NWP system;
- Assessing feasibility of targeting in the Tropics, which would require further development of tropical FC system (EKF)
- Conducting studies into enhancing tropical FC quality, such as monsoon onset, MJO etc.;
- Conducting preliminary studies on economic/societal impact by using BoM in-house expertise.

6. DEVELOPMENT OF THORPEX INTERNATIONAL RESEARCH IMPLEMENTATION PLAN (Agenda item 6)

6.1 Outlines for THORPEX International Research Implementation Plan (Agenda item 6.1)

6.1.1 The ICSC Chair introduced the outlines for development of a THORPEX International Research Implementation Plan (TIP). The ICSC agreed that this was a priority and urgent step in the programme development. The TIP should ensure the overall success of THORPEX. The purpose of the TIP was to guide the execution of THORPEX during the course of the life of the programme. TIP should build on the International Science Plan, the THORPEX regional plans and new opportunities to rapidly accelerate improvements in forecasting and the use of improved forecasts in social and economic decision-making. The TIP should be a dynamic document, evolving as the science opportunities change. It should consist of research, management and financial plans.

6.1.2 The ICSC discussed and agreed on general objectives for TIP development as follows:

- Define THORPEX deliverables based on the expectations of the operational meteorological community, research scientific opportunities and the availability of resources;
- Follow the THORPEX International Science Plan and the regional science plans for Asia, Europe, North America and other regions or nations whenever their contribution to THORPEX is defined;
- Define milestones and deliverables from each of the THORPEX participants;
- Identify opportunities for collaboration between THORPEX and other programmes;
- Define decision points and the necessary steps to carry out THORPEX research and development;
- Facilitate the transition of results to operations within the Members' organizations.

6.1.3 Specific objectives for TIP development were agreed as follows:

- Connect the science opportunities of the International Science Plan with validated future operational requirements;
- Determine a key set of requirements from the operational community;

- Identify regional priorities that are consistent with the THORPEX International Science Plan and the operational NWP requirements and reconcile the regional programs to the international plan;
- Identify and compensate for gaps in the science planning;
- Identify funding requirements and funding of key programme elements, including personnel, equipment for field programmes and other research activities;
- Establish a roadmap for THORPEX activities;
- Integrate THORPEX with other relevant programs and initiatives, such as WWW, WCRP, WMO Space Programme, WMO Programme on Natural Disasters Reduction and Mitigation, International Polar Year 2007-2008, Asian Pacific Climate Programme, as well as with other organizations (ICSU, IOC) and cooperative programmes identified;
- Ensure coincidence between THORPEX and GEO framework;
- Establish clear roles and responsibilities for all of the actors in THORPEX;
- Identify national commitments to key THORPEX activities;
- Assess risks associated with the project and develop a mitigation strategy to ensure that the THORPEX goals are met.

6.2 Organization of work (*Agenda item 6.2*)

6.2.1 The ICSC discussed and agreed on a plan of organisation of work on TIP preparation presented by Dr. Rogers. Mrs Simard reaffirmed that CBS will take active part in preparation of the TIP. She noted that CBS would require time to provide coordinated input. The ICSC decided that the draft TIP should be made available for ICSC revision by August and the final draft of TIP be prepared by November 2004 for revision at the next session of the ICSC.

6.2.2 The ICSC considered several options on organisation of work and agreed that the most feasible was an expert group composed of senior and well-recognized members of THORPEX community, including CBS, actively participating in planning and development of the programme. The ICSC agreed that an ad hoc group of experts for THORPEX implementation planning should be established. This group should work in close cooperation with THORPEX members, Regional Committees, IPO and other contributing organisations. The group should report to the ICSC. The ICSC Chair was authorized to form this group, select a chairman and members in consultation with co-chairs of the ISSC and the IPO. The expenses associated with the work of TIP planning group and TIP preparation should be covered from the THORPEX Trust Fund.

6.2.3 The ICSC further agreed that, if required, contractors for assisting this work should be engaged in accordance with the WMO Rules and Regulations and in consultation with the chair of ICSC.

Decision 8: The ICSC decided that development of a THORPEX International Research Implementation Plan should be started as priority and urgent step. The ICSC approved Terms of Reference for development of a THORPEX International Research Implementation Plan as given in Annex V. The ICSC requested that TIP be prepared by November 2004.

Decision 9: The ICSC agreed to establish an ad hoc group of experts for THORPEX implementation planning. The ICSC Chair was authorized to form this group, select a chairman and members in consultation with co-chairs of the ISSC and the IPO.

Action ICSC-3/10: The ICSC chair to form an ad hoc group for THORPEX implementation planning, select a chairman and members in consultation with co-chairs of the ISSC and the IPO.

6.2.4 The ICSC stressed that Regional Committees should identify national and regional priorities consistent with the THORPEX International Science and Implementation Plans and to accommodate in regional plans these priorities and broad opportunities of international and

academic-operational collaboration provided by THORPEX framework. The ICSC requested Regional Committees to develop their plans in a coordinated manner with ISSC and ICSC to ensure that overall success of THORPEX. In this connection ICSC authorized a cross regional meeting to be held in 2004 with limited support up to US \$ 10,000 from THORPEX Trust Fund.

Action ICSC-3/11: The Regional Committees to ensure that regional plans are developed in coordination with ICSC, ISSC and between regions, and are consistent with the international plans.

6.2.5 The ICSC highly appreciated the initiative of Dr. Bougeault to provide the ECMWF commitments for contribution to THORPEX implementation. It urged all participating international and national centres of THORPEX members to indicate their priorities and definite contributions to THORPEX implementation in all its four subprogrammes. These contributions should be submitted to the ICSC chair and TIP planning group by April 2004 or as soon as possible to allow timely preparation of the TIP.

Action ICSC-3/12: All contributing organizations of THORPEX members to submit definite plans on contribution to THORPEX implementation to the chair of ICSC and TIP planning group by April 2004 or as soon as possible thereafter.

6.2.6 The ICSC further urged its members to seek wider participation in THORPEX on relevant organisations and to take active measures to mobilise national resources as well as international funds in support of THORPEX implementation.

7. OTHER BUSINESS (Agenda item 7)

7.1 THORPEX International Conference (Agenda item 7.1)

7.1.1 The ICSC was informed on preliminary plans on organisation of the First THORPEX International Conference. The ICSC urged regional committees to agree on venue and proceed, with support of IPO, with further arrangements and organisation of the conference to be held in late 2004 – beginning 2005.

Action ICSC-3/13: Regional Committees with support of IPO to organize First THORPEX International Conference in late 2004 – beginning 2005.

7.2 THORPEX related meetings planned in 2004 (Agenda item 7.2)

7.2.1 The ICSC was informed on a number of meetings organised by WMO, which are related to THORPEX. In particular, Dr. Pailleux noted that the Third Workshop on Data Impact Studies is being organized by CBS (March 2004, Alpbach, Switzerland). The ICSC noted that a number of ICSC members are involved in this workshop. The ICSC further noted that WCRP was organising a Workshop on Ensemble Prediction Systems (October 2004, Exeter, UK) and that WGNE invited THORPEX to co-sponsor it. The ICSC agreed on THORPEX involvement and co-sponsorship.

7.3 Vaisala 2004 THORPEX Award (Agenda item 7.3)

7.3.1 The ICSC recalled that Vaisala awarded two THORPEX Vaisala Cooperative Fellowships in June 2003 providing the start of industrial co-sponsorship for THORPEX. It noted with appreciation that two 2004 Vaisala THORPEX Post Graduate Fellowships Awards have been recently announced. The session encouraged members to approach other organisations, which could establish similar programmes.

7.4 Development of Driftsondes (Agenda item 7.4)

7.4.1 The session was informed by Dr. Parsons on a programme of development of driftsones. It agreed that driftsones would be a specific and direct contribution to the THORPEX useful in targeted observations. Cost of the expendables would be reduced.

8. ADMINISTRATIVE AND FINANCIAL MATTERS (*Agenda item 8*)

8.1 International Programme Office (IPO) (*Agenda item 8.1*)

8.1.1 The ICSC noted that the THORPEX International Programme Office (IPO) was established at WMO Secretariat headquarters (Geneva, Switzerland) in May 2003 as an integral part of the WMO Secretariat under supervision of the Director of Atmospheric Research and Environment Programme Department. The main objective of the IPO was to provide direction and secretarial support to the programme planning and implementation. The ICSC discussed the structure and responsibilities of IPO and approved the IPO Terms of Reference as given in Annex VI.

Decision 10: The ICSC approved the Terms of Reference of the THORPEX International Programme Office.

8.1.2 The ICSC recalled that the IPO activities should be financially supported by the THORPEX participating countries through the Trust Fund. It recalled that staffing of the IPO was envisaged through secondment. The ICSC noted that in 2003 the IPO functions have been partially maintained by WMO AREP staff, and that the staffing situation in AREP did not allow full support of all necessary functions. As for secondment, USA delegated, on a part-time basis, Dr. Pai-Yei Whung (NOAA) starting from 01/08/03, to serve in support of IPO activity and her support and contribution to international coordination of THORPEX activities was appreciated.

8.1.3 In discussing the structure of the IPO the ICSC agreed that it should be composed of highly qualified professionals and general staff. The ICSC was convinced that regarding the 2004 IPO workload at least one scientific officer was required in 2004 at full time and two others on a part time basis. General staff services at minimum 50% occupancy were also needed as well as services of consultants. Recognising the urgent need in staffing of the IPO the ICSC urged members to consider secondment of experts to the IPO and to inform the ICSC Chair and WMO on any progress by 1 April 2004. It was noted that seconded experts could work in both Geneva and in their current duty places. The country should support expenses associated with secondment including travel to Geneva and salary; however, the incremental cost of staying in Geneva could be covered by the Trust Fund.

Action ICSC-3/14: All THORPEX members to consider secondment of experts to the IPO and to inform the ICSC Chair and WMO on progress by 1 April 2004.

8.1.4 The ICSC noted that the external recruitment could be initiated when necessary funds are secured in the Trust Fund. In this respect the ICSC members should make sure that their commitments and current year contributions are timely.

8.2 Status of the THORPEX Trust Fund (*Agenda item 8.2*)

8.2.1 The ICSC noted that THORPEX Trust Fund was established in WMO in May 2003 to support the THORPEX International Programme Office and major international programme activities. The ICSC reaffirmed its approval made by correspondence on the THORPEX Trust Fund Terms of Reference and Rules (Annex VII), which has been duly approved by the WMO Secretary General.

Decision 11: The ICSC approved the THORPEX Trust Fund Terms of Reference and Rules.

8.2.2 The ICSC recalled 2003 year commitments made on the on the second session of the ICSC by USA (US \$ 150,000), France (Euro 10,000) and Canada (Can \$ 50,000). It noted the USA contribution to the fund has been received in July 2003 (SFR equivalent 204,000). It also noted that Canadian contribution for the financial year 2003 were expected to be made in February 2004.

8.2.3 As regards expenditures, the session noted that a total of SFR 13,490 has been used to support the ICSC-3 session. The balance of the fund stood at SFR 189,346. The statement of account of revenue and expenditure as given on the Annex VIII was accepted by the ICSC.

Decision 12: The ICSC accepted the statement of account of THORPEX Trust Fund for 2003.

8.3 Budget for the year 2004 (Agenda item 8.3)

8.3.1 Recognising that the overall Trust Fund expenditures should be authorized by the ICSC the Committee agreed that the provisional budgets should be prepared and approved annually by the end of October (WMO fiscal year as from 1 January to 31 December). The ICSC requested members to make annual contributions to the THORPEX Trust Fund no later than 31 March each year, and to make provisions and to allocate sufficient funds for next year before 31 October.

Decision 13: The ICSC agreed that the provisional budgets should be prepared and approved annually by the end of October (WMO fiscal year as from 1 January to 31 December).

Action ICSC-3/15: All THORPEX members to make annual contributions to the THORPEX Trust Fund in accordance with the approved budget not later than 31 March.

Action ICSC-3/16: All THORPEX members to make provisions and ensure allocation of necessary funds for next year before 31 October.

8.3.2 Consideration was given to the prospective expenditures and contributions for the 2004. Dr. Uccellini committed USA contribution of US \$ 150,000, Dr. Béland committed contribution of Canada of Can \$ 50,000 and Dr. Pailleux committed contribution of France of Euro 10,000.

8.3.3 Noting requirements for the IPO and major international programme activities discussed during the session the ICSC agreed on the priority programme activities and needs in support of the IPO to be funded by the Trust Fund in 2004. The ICSC approved projected expenditures and accounts as given in Annex IX and X.

Decision 14: The ICSC approved projected expenditures and accounts for THORPEX Trust Fund for 2004.

8.4 Other matters (Agenda item 8.4)

8.4.1 The ICSC encouraged all Members to sponsor THORPEX activities and regularly report on their activities to the IPO and the ICSC Chair. The Regional Committees were requested to submit their reports to the Chair of ICSC and IPO not later than 6 weeks prior the next session of the ICSC.

Action ICSC-3/17: ICSC members and Regional Committees to provide quarterly progress reports on activity and plans to the Chair of ICSC and IPO. Regional Committees to submit reports to the Chair of ICSC and IPO not later than 6 weeks prior the session of the ICSC.

8.4.2 The ICSC approved the list of actions (Annex XIV) and requested members to ensure fulfilling of the actions, to regularly update status of implementation and inform the IPO.

Action ICSC-3/18: ICSC members to regularly update status of implementation of actions and inform the IPO.

9. DATE AND PLACE OF FOURTH ICSC SESSION (*Agenda item 9*)

The date and place of the fourth session of the ICSC will be determined by the ICSC Chair in consultation with the ICSC members and the IPO.

10. CLOSURE OF THE SESSION (*Agenda item 10*)

In closing the session, the ICSC noted the absence of representatives of Australia and India. It requested the Chair to ensure that these members are informed on the outcomes of the session and urge them to participate in the work of the Committee. The ICSC also urged the Chair to seek participation of other WMO Regions (RA I, RA III and RA IV) in the work of the Committee.

The whole ICSC expressed its great appreciation to the ICSC Chair, Dr. Béland and through him, to the Meteorological Service of Canada and the Government of Canada for hosting the session and for providing the supporting services.

The session was closed at noon on 17 December 2004.

ANNEX I

CAS INTERNATIONAL CORE STEERING COMMITTEE FOR THORPEX THIRD SESSION MONTREAL, CANADA 16-17 December 2003

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ANNEX II

AGENDA

- 1. ORGANIZATION OF THE SESSION**
 - 1.1 Opening of the session
 - 1.2 Adoption of the agenda
 - 1.3 Working arrangements for the session
- 2. REVIEW OF CG-XIV, ICSC, SSC/WWRP AND WGNE RECOMMENDATIONS AND RESOLUTIONS. STATUS OF PROGRAMME IMPLEMENTATION. REPORT OF CHAIRMAN**
 - 2.1 Cg-XIV Resolution and summary of recommendations on THORPEX
 - 2.2 Review of actions from previous ICSC meetings
 - 2.3 SSC/WWRP and WGNE joint Resolution on THORPEX
- 3. THORPEX INTERNATIONAL SCIENCE PLAN**
 - 3.1 Revision of 2nd version of the THORPEX International Science Plan
- 4. COOPERATION WITH OTHER PROGRAMMES AND ORGANISATIONS**
 - 4.1 Co-operation with WMO WWW
 - 4.2 Linkage to International Polar Year 2007-2008
 - 4.3 Positioning THORPEX in GEO
 - 4.4 Other organizations
- 5. REGIONAL ACTIVITIES. REPORTS OF CHAIRS OF REGIONAL COMMITTEES**
 - 5.1 North American Committee
 - 5.2 European Committee
 - 5.3 Summary results of Atlantic TReC
 - 5.4 Asian Committee
 - 5.5 Other regional activities
- 6. DEVELOPMENT OF THORPEX INTERNATIONAL RESEARCH IMPLEMENTATION PLAN**
 - 6.1 Outlines for THORPEX International Research Implementation Plan
 - 6.2 Organization of work
- 7. OTHER BUSINESS**
 - 7.1 THORPEX International Conference
 - 7.2 THORPEX related meetings planned in 2004
 - 7.3 Vaisala 2004 THORPEX Award
 - 7.4 Development of Driftsondes
- 8. ADMINISTRATIVE AND FINANCIAL MATTERS**
 - 8.1 International Programme Office
 - 8.2 Status of the THORPEX Trust Fund
 - 8.3 Budget for the year 2004
 - 8.4 Other matters
- 9. DATE AND PLACE OF THE NEXT SESSION**
- 10. CLOSURE OF THE SESSION**

ANNEX III

FOURTEENTH WORLD METEOROLOGICAL CONGRESS (GENEVA, 5-24 MAY 2003)

Extract from General Summary

3.3.3 World Weather Research Programme

THORPEX: A Global Atmospheric Research Programme

3.3.3.6 Congress noted that THORPEX: A Global Atmospheric Research Programme was being developed as a ten-year international research programme, under the auspices of the Commission of the Atmospheric Science, and its World Weather Research Programme (WWRP), to accelerate improvements in short-range (up to 3 days), medium-range (3 to 7 days) and extended-range (week-two) weather predictions and the social value of advanced forecast products. THORPEX would examine global-to-regional influences on the predictability of high-impact weather and establish the potential to produce significant statistically-verifiable improvements in forecasts of those time scales. Therefore, Congress fully endorsed the rationale and basic ideas of THORPEX, and the establishment of an International Science Steering Committee and an International Core Steering Committee for THORPEX to lead the planning and implementation of the programme.

3.3.3.7 Congress noted that THORPEX would not address directly the overall question of the optimization of the WWW Global Observation System, but rather demonstrate through regional projects that by adding observations in specific areas, by using new observing techniques including targeting observations, by applying advanced data assimilation systems, the numerical weather prediction products could be improved. Research results of THORPEX would serve as advice and recommendations to CBS to facilitate the overall coordination of the Global Observing Systems. Congress therefore considered it to be essential to have a strong link between CAS and CBS on that question, and requested that an expert designated by the president of CBS serves as a member of the ICSC.

3.3.3.8 Congress noted that THORPEX would emphasize improvements in the observing strategy over sparse areas of the globe and especially the oceans. Therefore, in addition to coordination with CBS, THORPEX should maintain strong links with JCOMM to coordinate oceanic and atmospheric measurements. In that connection, Congress supported the plan for carrying out Pacific, Atlantic, Asian and other THORPEX Observing System Tests (TOSTs) and regional forecast demonstrations, and urged Members for active participation in those tests.

3.3.3.9 Congress noted that THORPEX and the WCRP, particularly in the design and complementary objectives to improve predictability with THORPEX, focused on timescales of two weeks and shorter. Congress considered it essential for close cooperation between THORPEX and the WCRP particularly in the design and implementation of Global Observing System Tests and numerical model development.

3.3.3.10 Congress endorsed the decision of the ICSC to set a THORPEX International Programme Office in Geneva, with the understanding that the Office would have to be jointly financed by the THORPEX participants, and encouraged the continued efforts of the ISSC, WWRP and ICSC to seek sponsorship for THORPEX from Members and international bodies.

3.3.3.11 In order to ensure that the full benefits of the programme were realized, the Congress emphasized that it would be essential for THORPEX to address science and technology transfer issues, and coordinate its activities with other WMO Programmes and a number of existing international research and application programmes.

3.3.3.12 In that connection, Congress adopted Resolution 3.3/1 (Cg-XIV).

FOURTEENTH WORLD METEOROLOGICAL CONGRESS (GENEVA, 5-24 MAY 2003)

RESOLUTION 12 (Cg-XIV)

THORPEX: A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME

THE CONGRESS,

NOTING that the skilful prediction of high-impact weather is one of the greatest scientific and societal challenges of the twenty-first century,

CONSIDERING:

- (1) The substantial increase in the forecast skill achieved by improvements in atmospheric observing technology, data-assimilation methods, new numerical model formulations, the use of ensemble techniques and transferring these advances for the benefit of society and the economy,
- (2) That despite these improvements, the ability to forecast high impact weather events falls below that required by society,

DECIDES to establish THORPEX as a ten-year long international Global Atmospheric Research Programme under the Commission for Atmospheric Sciences as part of the World Weather Research Programme, in order to accelerate improvements in weather forecasting on short-, medium- and extended-range time scales;

REQUESTS the Secretary-General:

- (1) To encourage WMO Members to actively participate in the implementation of THORPEX;
- (2) To assist WMO Members in the international coordination of THORPEX;
- (3) To establish at the WMO Secretariat a THORPEX International Programme Office funded by THORPEX participating countries;
- (4) To assist WMO Members from developing countries in their utilization of THORPEX-related forecast products;
- (5) To assist THORPEX in coordination with CBS, WCRP, JCOMM and other WMO programmes as appropriate;
- (6) To facilitate the participation in THORPEX of other international bodies;

REQUESTS the president of CAS to facilitate the activities of the International Core Steering Committee and International Science Steering Committee of THORPEX.

ANNEX IV

THORPEX INTERNATIONAL SCIENCE PLAN 2ND VERSION OF 22 AUGUST 2004

EXECUTIVE SUMMARY

By Dr. Melvyn A. Shapiro and Prof. Alan J. Thorpe

Prepared on behalf of the CAS International Science Steering Committee for THORPEX
Approved by the CAS International Core Steering Committee for THORPEX

MISSION STATEMENT

THORPEX: a Global Atmospheric Research Programme is an international research programme to accelerate improvements in the accuracy of 1 to 14-day weather forecasts for the benefit of society and the economy. The programme builds upon ongoing advances within the basic-research and operational-forecasting communities. It will make progress by enhancing international collaboration between these communities and with users of forecast products.

EXECUTIVE SUMMARY

The success of numerical weather prediction represents one of the most significant scientific, technological and societal achievements of the 20th century. Despite the notable increase in forecast skill over the past quarter century (Fig.1.1), there is a necessity for further improvements, particularly, in high-impact weather forecasts and in the use of weather information. High-impact weather forecasts are defined by their effect on society and the economy. They are typically associated with forecasting cyclones of extratropical and tropical origin that contain significant embedded mesoscale weather, such as localized flooding by convective and orographic precipitation; blizzard snows; destructive surface winds; dust-storms. They also encompass meteorological conditions affecting air quality, periods of anomalous high/low temperature and drought, and non-extreme weather with high-societal impact. Improving the skill of high-impact weather forecasts is one of the great scientific and societal challenges of the 21st century. THORPEX is a response to this challenge.

Evolution of forecast skill for northern and southern hemispheres

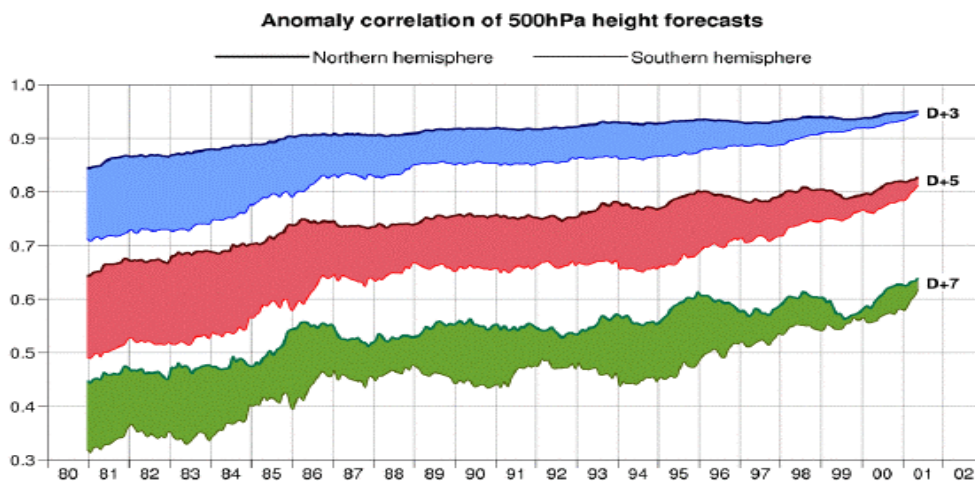


Fig. 1.1: Evolution of forecast skill for the northern and southern hemispheres: 1980-2001. Anomaly correlation coefficients of 3, 5, and 7-day ECMWF 500-mb height forecasts for the extratropical northern and southern hemispheres, plotted in the form of running means for the period of January 1980-august 2001. Shading shows differences in scores between hemispheres at the forecast ranges indicated (from Hollingsworth, *et al.* 2002).

Emerging developments in atmospheric science and technology provide the opportunity for dramatic improvements in weather forecasts and in their use and value to society. These developments include: i) advances in the knowledge of the theoretical and practical limits of atmospheric predictability, including the influence of inter-annual and intra-seasonal climate variability on forecast skill; ii) expanding observations of the Earth System with satellite, airborne, marine and land-based observing technologies; iii) weather forecast systems capable of assimilating observations from the above diverse technologies; iv) advanced forecast procedures aided by improvements in numerical techniques, parameterised and explicit representations of physical processes, ensemble forecast techniques, and exponential increases in the speed and memory of supercomputers; v) innovative approaches to the design and implementation of forecast systems that optimise the societal and economic utilisation of weather information. In the same way that the atmosphere encompasses the globe, the expertise to exploit and further these advances resides across many nations, international organisations, and different scientific disciplines.

THORPEX establishes a contemporary organisational framework to address global weather research and forecast problems whose solutions require international and academic-operational collaboration. This will include engagement with other international programmes within the World Meteorological Organization (WMO), the International Council of Scientific Unions (ICSU) and the Intergovernmental Oceanographic Commission (IOC). In this regard, THORPEX aspires to be a successor of the Global Atmospheric Research Programme (GARP); building on the accomplishments of the First GARP Global Experiment (FGGE).

The core research objectives of THORPEX are to:

- Contribute to the design and demonstration of *interactive forecast systems* that allow information to flow interactively between forecast users, numerical forecast models, data-assimilation systems and observations. Interactive forecast systems include the new concept of targeted observations, referred to as *targeting*. Targeting incorporates dynamical information from the numerical forecast model itself to identify when, where, and what types of observations would provide the greatest improvement to specific weather forecasts.
- Advance the knowledge of global-to-regional influences on the initiation, evolution, and predictability of high-impact weather. This will include research into: i) the degree to which predictive skill is limited by observations, data assimilation, model uncertainty, or ensemble prediction system design at various forecast lead-times; ii) the excitation of Rossby wave-trains by extratropical cyclogenesis, large-scale topography, continent/ocean interfaces, and organised tropical and extratropical convective flare-ups, and the consequent initiation of high-impact weather; iii) the dependence of predictive skill on inter-annual and intra-seasonal climate variability, e.g., El Nino Southern Oscillation (ENSO); Pacific North-Atlantic oscillation (PNA); North-Atlantic Oscillation (NAO); monsoon circulations.
- Collaborate with numerical forecast centres in the development of advanced data-assimilation and forecast model systems. Research will include: i) improving the assimilation of existing and experimental observations, including observations of physical processes and atmospheric composition; ii) developing adaptive data-assimilation and targeted-observing strategies; iii) incorporating model uncertainty into data-assimilation systems and in the design of ensembles.
- Develop and apply new methods to enhance the utility of improved weather forecasts through: i) the use of new user-specific probabilistic forecast products; ii) the introduction of interactive procedures that make the forecast system more responsive to user needs; iii) the design of and training in the use of user-specific forecast products. This research will identify and assess the societal/economic costs and benefits of THORPEX recommendations for implementing interactive forecast systems and improvements in the global observing system.

- Perform THORPEX Observing-System Tests (TOSTs) and THORPEX Regional field Campaigns (TReCs). TOSTs will: i) test and evaluate experimental remote-sensing and *in-situ* observing systems, and when feasible, demonstrate their impact on weather forecasts; ii) explore innovative uses of operational observing systems. TReCs are quasi-operational forecast demonstrations contributing to the design, testing and evaluation of all components of interactive forecast systems. They will be organised and coordinated by regional consortia of nations under their respective THORPEX Regional Committees (European, Asian, North-American, and Southern Hemispheric) TReCs will address regional high-impact weather events, e.g., arctic storms and cold-air outbreaks; cool-season extratropical cyclones over Europe, Asia, and North America; warm-season heavy precipitation over Asia; organized equatorial convection flare-ups; tropical-to-extratropical cyclone transformations.
- Demonstrate the full potential of THORPEX research results for improving operational forecasts of high-impact weather on time-scales out to two weeks. This demonstration includes the **THORPEX Global Prediction Campaign (TGPC)**. The TGPC will: i) deploy and/or activate the full suite of experimental and operational observing systems over the globe for a season to one year; ii) establish the utility of interactive forecast systems to improve the utility of weather forecasts and user products; iii) provide guidance, through the WMO/World Weather Watch (WWW) to agencies responsible for optimising the design and implementation of the fixed and adaptive components of the existing regional and global observing systems; iv) coordinate the transfer and application of THORPEX research and operational results to developing countries.

THORPEX is unique, in that:

- It establishes an organisational framework that addresses today's global weather research and forecast problems whose solutions require international and academic-operational collaboration. Its research domain spans global-to-regional influences on the prediction of high-impact weather. It considers those mesoscale weather systems that form in response to the larger-scales and not those arising from purely local influences.
- It has at its heart, the contemporary paradigm in which weather forecasting is addressed as an *interactive* system with information flowing between forecast users, forecast models, data assimilation and global and regional observing systems.
- It will conduct regional and global campaigns as demonstrations and assessments of new observing technologies and interactive forecast systems. Thereby, THORPEX will provide guidance to the World Weather Watch and forecast centres on improvements to forecast systems, and to the relevant bodies, such as the WMO Commission for Basic Services Open Programme Areas Group, concerning optimisation of global and regional observing-systems.
- It addresses the influence of intra-seasonal time scales on week-two high-impact forecasts, and therefore aspires to bridge the "middle ground" between medium-range weather forecasting and climate prediction. This provides a link with other programmes addressing the improvement of global climate-change prediction systems.

Research objectives are developed under four Sub-programmes:

Predictability and Dynamical Processes;
 Observing Systems;
 Data Assimilation and Observing Strategies;
 Societal and Economic Applications.

These Sub-programmes have the responsibility to: i) coordinate the research activities envisaged in the THORPEX International Science and Research Implementation Plans; ii) collaborate with other international programmes when relevant expertise is required and mutual benefit is derived.

THORPEX is a component programme of the WMO World Weather Research Programme (WWRP). The international co-ordination for THORPEX was established under the auspices of the WMO Commission on Atmospheric Sciences (CAS). The CAS International Core Steering Committee (ICSC) and the International Science Steering Committee (ISSC) lead THORPEX in coordination with the CAS Science Steering Committee for the WWRP (SSC/WWRP), joint CAS/JSC Working Group on Numerical Experimentation (WGNE) and the WMO Commission for Basic Sciences.

Nations and consortia of nations have established Regional Committees (North American, European and Asian) that define regional priorities for participation in THORPEX within the framework of the THORPEX International Science and Research-Implementation Plans.

ANNEX V

WORLD METEOROLOGICAL ORGANIZATION

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DEVELOPMENT OF THORPEX INTERNATIONAL RESEARCH IMPLEMENTATION PLAN

Terms of Reference

BACKGROUND

Cg-LIV established THORPEX as a ten-year long international Global Atmospheric Research Programme under the Commission for Atmospheric Sciences as part of the World Weather Research Programme, in order to accelerate improvements in weather forecasting on short-, medium- and extended-range time scales.

CAS International Core Steering Committee (ICSC) leads planning and implementation of the THORPEX programme. The THORPEX International Programme Office (IPO) is established by WMO as an integral part of the Atmospheric Research and Environment Programme (AREP) Department of the WMO Secretariat and under the supervision of the Director of AREP Department.

The THORPEX programme activities on THORPEX development and implementation, as specified by the ICSC, are supported through voluntary contributions of the Governments of the WMO Members participating to THORPEX including donations to the THORPEX Trust Fund established by WMO.

The ICSC, on its third session (16-17 December 2003, Montreal, Canada) approved the second version of THORPEX International Science Plan and decided that a THORPEX International Research Implementation Plan be prepared by November 2004. The ICSC approved this Terms of Reference (TOR) for development of TIP.

1. GENERAL CONDITIONS

The development of the THORPEX Research Implementation Plan (TIP) shall be undertaken by an ad hoc group of experts selected from the members of THORPEX community actively participating in planning and development of the programme. The ICSC Chair is authorized to form this group, select a chairman and members of the group. The TIP group shall work in close cooperation with THORPEX members, Regional Committees, International Programme Office and will report to ICSC.

THORPEX Trust Fund shall be used to engage expert assistance and to provide support to members of this group to enable them to complete their task in a timely manner in accordance with Terms and Reference of TIP specified hereunder.

2. GENERAL OBJECTIVES

The THORPEX TIP should ensure the overall success of THORPEX. The purpose of the TIP is to guide the execution of THORPEX during the course of the programme. The TIP shall:

- (a) Define THORPEX deliverables based on the expectations of the operational meteorological community, research scientific opportunities and the availability of resources;
- (b) Follow the THORPEX International Science Plan and the regional science plans for Asia, Europe, North America and other regions or nations whenever their contribution to THORPEX is defined;
- (c) Define milestones and deliverables from each of the THORPEX participants;

- (d) Identify opportunities for collaboration between THORPEX and other programmes;
- (e) Define decision points and the necessary steps to carry out THORPEX research and development;
- (f) Facilitate the transition of results to operations within the Members' organizations.

The TIP shall be a dynamic document, evolving as the science opportunities change.

3. SPECIFIC OBJECTIVES

The TIP shall chart the THORPEX course for the next decade. It must:

- (a) Connect the science opportunities of the International Science Plan with validated future operational requirements,
- (b) Determine a key set of requirements from the operational community;
- (c) Identify regional priorities that are consistent with the THORPEX International Science Plan and the operational NWP requirements and reconcile the regional programs to the international plan;
- (d) Identify and compensate for gaps in the science planning;
- (e) Identify funding requirements and funding of key programme elements, including personnel, equipment for field programmes and other research activities;
- (f) Establish a roadmap for THORPEX activities;
- (g) Integrate THORPEX with other relevant programs and initiatives, such as WWW, WCRP, WMO Space Programme, WMO Programme on Natural Disasters Reduction and Mitigation, International Polar Year 2007-2008, Asian Pacific Climate Programme, as well as with other organizations (ICSU, IOC) and cooperative programmes identified;
- (h) Ensure coincidence between THORPEX and GEO framework;
- (i) Establish clear roles and responsibilities for all of the actors in THORPEX;
- (j) Identify national commitments to key THORPEX activities;
- (k) Assess risks associated with the project and develop a mitigation strategy to ensure that the THORPEX goals are met.

4. EXPECTED RESULTS

- | | |
|---|---|
| 1) 1 st draft TIP | April 2004 |
| 2) 2 nd draft TIP | August 2004 |
| 3) Final TIP | November 2004 |
| 4) Recommendations on TIP adjustments to schedules, deliverables and outcomes as necessary resulted from periodic assessment of the TIP | every 6 month for first 3 years and once a year after |

5. ACCEPTANCE CRITERIA

Drafts and final TIP shall be reviewed and approved following any necessary revisions by the ICSC.

ANNEX VI

WORLD METEOROLOGICAL ORGANIZATION

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THORPEX INTERNATIONAL PROGRAMME OFFICE

Terms of Reference

1. The THORPEX International Programme Office (IPO) is established in the WMO Atmospheric Research and Environmental Programme (AREP) Department in May 2003 in response to the Resolution 12 of the Fourteenth World Meteorological Congress.
2. The primary function of the IPO is to provide direction and support to planning and implementation of THORPEX programme, to ensure appropriate international coordination between THORPEX participating Members and collaboration with related WMO programmes and other international programmes.
3. The IPO consists of qualified professionals and general staff. Subject to the overall policy directives of the Secretary-General and under the supervision of the Director of AREP Department the IPO works as an integral part of the WMO Secretariat. The IPO is located at the WMO Secretariat headquarters (Geneva, Switzerland).
4. The IPO is supported by members of THORPEX through secondment of experts and contributions to the WMO THORPEX Trust Fund.
5. The IPO has the following responsibilities:
 - (a) To support and coordinate planning and implementation of THORPEX;
 - (b) To provide technical and scientific support to the activities of the THORPEX International Science Steering Committee (ISSC), International Core Steering Committee (ICSC) and its subsidiary bodies;
 - (c) To coordinate regional THORPEX activities;
 - (d) To assist in cooperation between THORPEX and other WMO programmes;
 - (e) To assist in preparation of the WMO THORPEX inputs into the activities of other UN agencies and international organisations such as Intergovernmental Oceanographic Commission (IOC) of UNESCO, International Council for Science (ICSU);
 - (f) To assist in the organisation of appropriate meetings, conferences and other activities relevant to THORPEX.
 - (g) To draft correspondence and prepare publications,
 - (h) To manage THORPEX website and data base;
 - (i) To assist in fund raising;
 - (j) To assist in management of the THORPEX Trust Fund.

ANNEX VII

WORLD METEOROLOGICAL ORGANIZATION

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TRUST FUND FOR THORPEX: A GLOBAL ATMOSPHERIC RESEARCH PROGRAMME

Terms of Reference and Rules

1. The purpose of the THORPEX Fund is to support the THORPEX: A Global Atmospheric Research Programme (THORPEX), established by the Fourteenth World Meteorological Congress under the Commission for Atmospheric Sciences as a part of World Weather Research Programme;
2. THORPEX Fund is established by the WMO Service Note No. 16/2003 of 9 May 2003. THORPEX Fund is a Trust Fund within the provisions of Articles 9.7, 9.8 and 9.9 of the WMO Financial Regulation (1991 edition);
3. The Fund shall be managed according to an annual budget adopted by the CAS International Core Steering Committee (ICSC). The budget will be constructed according to a format agreed by the ICSC and the WMO Secretariat in which income and expenditures will be identified;
4. The unit of account shall be the Swiss Franc. When commitments are made, the appropriate funds will be converted, as necessary, to the currency of commitment;
5. The income of the Fund will include:
 - (i) Voluntary contributions by the Members and international organizations;
 - (ii) Awards, grants, donations;
 - (iii) Funds deposited for specific purposes, hereafter referred to as deposits;
 - (iv) Other contributions;
 - (v) Interest on investment as may be made by the Secretary-General of WMO in accordance with the provisions of Financial Regulation 12.2.
6. The Fund will be used as agreed by the ICSC and the Secretary-General of WMO:
 - (i) To finance THORPEX International Programme Office (IPO) established in WMO Secretariat (cost of staff);
 - (ii) To purchase specified items of equipment and software;
 - (iii) To support programme activities on THORPEX implementation specified by the ICSC (e.g. consultants, workshops, website, preparation and publishing newsletters and reports, meetings, travel, communication charges, etc.);
 - (iv) To meet appropriate administrative costs incurred by WMO in providing support to IPO and other THORPEX activities and administration of the Fund (e.g. bank charges and/or commissions, drafting, typing, registry, mailing, budget control, accounts, internal and external audit, etc.), which represent 10 per cent of direct expenditures incurred.
7. The Fund will be administered in accordance with WMO Financial Regulations.
8. Any amendment to the present Terms of Reference shall require the acceptance in writing by the chairperson of the ICSC and the Secretary-General of the WMO or his representative.

9. The Fund shall be maintained on a continuous basis and amounts standing to the credit of the Fund at the end of any annual period shall remain in the Fund for use in the subsequent period;

10. Financial reports on the Fund will be made at the end of each annual period, in Swiss Francs. The UN rate of exchange prevailing on the date of the transaction or report will apply for the conversion into Swiss francs of contributions or income received and payments made or charges incurred in any other currency. WMO shall submit an annual financial report to the ICSC, covering the exercise of the previous calendar year concerned. Notwithstanding the above, a status report should be provided upon request at any point in time.

11. Upon liquidation of the Fund for any reason, the ICSC shall make provision for the payment of unliquidated obligations and estimated expenses of winding-up business. It shall then arrange for payment – to the extent that funds are available and according to the depositors' instructions – of deposits for which no equipment or services have been received;

12. At the closure of Fund:

- (i) The chairperson of ICSC will notify the Secretary-General of WMO, three months in advance, on its decision of closure the Fund in writing;
 - (ii) The chairperson of ICSC will designate in writing of the entity(ies) to which any cash balance of the Fund is to be transferred.
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ANNEX VIII

WORLD METEOROLOGICAL ORGANIZATION

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THORPEX TRUST FUND

Status of the account as at 13.XII.2003

(In Swiss Francs)

	<u>SFR</u>	<u>SFR</u>
Balance at 1 July 2003	0	
Contributions received:		
USA	204,000	
Interest earned	185	
Total revenue	<hr/>	204,185
Obligations incurred:		
ICSC-3 meeting support	13,490	
Administrative support	1,349	14,839
Balance of Fund at 13 December 2003	<hr/>	<u>SFR 189,346</u>
Represented by:		
Cash at bank		193,460
Less:		
Prior year obligations	0	
Current year unliquidated obligations	4,114	
Accounts payable	0	4,114
	<hr/>	<u>SFR 189,346</u>

ANNEX IX

WORLD METEOROLOGICAL ORGANIZATION

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THORPEX TRUST FUND

Projected expenditures January 2004 – December 2004

(in Swiss Francs)

	<u>SFR</u>
Support of International Programme Office (cost of staff, consultants, seconded experts incremental cost, travel, office equipment, communication and consumables)	272,900
Preparation and partial support (travel and/or per diem for needy members) of 3 meetings of the ICSC ad-hoc group of experts on THORPEX implementation planning	62,500
Preparation and partial support (cost of facilities) of ICSC-4 meeting	10,000
THORPEX International Conference (co-sponsorship)	37,500
THORPEX cross regional meeting (co-sponsorship)	12,500
Related meetings (co-sponsorship)	12,500
Publications (ICSC-3 report, Science plan and executive summary, brochures)	18,750
Total projected expenditures	426,650

ANNEX X

WORLD METEOROLOGICAL ORGANIZATION

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THORPEX TRUST FUND

Projected accounts January 2004 – December 2004

(in Swiss Francs)

	<u>SFR</u>	<u>SFR</u>
Beginning balance	189,346	
Deposits expected		
Contribution USA 2004	187,500	
Contribution Canada 2003-2004	47,710	
Contribution Canada 2004-2005	47,710	
Contribution France 2004	15,605	
Accumulated Interest	22,722	
Subtotal:*	<hr/>	497,080
Budget obligations:		
Projected expenditures	426,650	
Administrative support	42,665	
Subtotal:	<hr/>	SFR 469,315
Projected balance on December 2004:		<hr/> SFR 41,278

*as on 1 January 2004 UN currency conversion rate is 1,25 SFR and 0,801 Euro and 1,31 \$ Can per 1 \$ US.

ANNEX XI

SCIENCE QUESTIONS WHERE THORPEX CAN HELP THE CBS OPAG IOS ET-ODRRGOS FIND ANSWERS

The ET-ODRRGOS put forward for consideration the following questions or suggestions for investigation or research in relation to THORPEX:

1. What are the specific observing requirements for high-impact weather?
 2. How should we specify the adaptive (“on the day”) component of the GOS?
 3. What are the optimal spatial and temporal resolutions of AWS observation networks (e.g. value of 1-minute resolution data)?
 4. Regarding AMDAR:
 - What are the geographic areas where AMDAR has most input/value?
 - What is the optimal vertical resolution of AMDAR profiles?
 5. What constitutes validation of a “good” forecast for mesoscale NWP?
 6. What is the contribution of the Siberian Rawinsonde network to NWP and what alternative network configurations should be considered?
 7. What are the key observation system configurations that would help to identify the sources of cyclogenesis in tropics?
 8. What is the contribution of stratospheric data on tropospheric forecasting skill?
 9. What is the contribution of stratospheric in situ observation systems on tropospheric forecasting skill?
 10. What is the contribution of surface soil moisture data on tropospheric forecasting skill?
 11. What are the forecasting capabilities in relation to high intensity rainfall (e.g. flooding of Yangtze River)?
 12. What are the global downstream effects of observation targeting?
 13. What is the impact in improved assimilation in numerical models of improved cloud characterization.
 14. What strategies can CBS learn from THORPEX on how to introduce observation targeting in to operations, in particular if more than one WMO member is to be involved in the decision making process about the deployment of the special observations.
-

ANNEX XII

REPORT ON PROGRESS IN NATIONAL ACTIVITIES OF ASIAN THORPEX MEMBERS

China

A scientist team has been set up in order to formulate the Chinese THORPEX plan, and some numerical research on the adaptive observation are underway. An enhanced field observation on Meiyu frontal heavy rain events was carried out in summer season from June to August 2003 over Yangtze river. Prof. Yunqi Ni has conducted this campaign with collaboration of several provincial meteorological bureau and research agencies.

The experiment on the monitoring and forecasting of the landed cyclonic disasters was launched in 2003. It is being conducted by Prof. Lianshou Chen. The field observation experiment covers the South China-Sea and the West-Northern Pacific Ocean.

Radial wind of Radar impact on a landed typhoon. Based on the reflective intensity of a Doppler Radar, a new concept «seeing wind speed» was proposed by Qilin Wan and Jishan Xue. The «seeing wind speed» was used in combination of radial wind to reduce uncertainty when one only information on a radial wind was introduced to determine two unknown variables of u and v components. In fact, the preliminary results showed that the improvements were obvious in the landed position and intensity of the typhoon by using the «seeing wind speed» in combination with radial wind.

Sensitivity impact studies in 2003. Previously, the position of the observation station was used as the same position of a radiosond observation. That means that the position of a radiosond observation is unchanged during its updrifting. Based on the wind speed, an up drifting effect of a radiosond balloon was taken into account to correct the position error of the radiosond. Some positive impact results were obtained with 3D-VAR scheme (Hongya Liu, Jishan Xue et al.). China started to investigate the sensitivity of radiosonds on different severe weather events with GRAPES_3D-VAR method. Based on climatological statistics and numerical tests, the sensitive impacts were investigated in Beijing Meteorological Bureau for design of an intensified mesoscale observation network. It is a composite network with Doppler Radar wind-profiler, automatic weather stations and conventional observation instruments, and specified for Beijing-2008 Olympic Games.

New generation of NWP system in 2003. A significant progress was made for development of new generation of Numerical Weather Prediction system of GRAPES (Global/Regional Assimilation Prediction System) in CMA in 2003. A research version of GRAPES 3D-VAR. Some case studies on direct use of Radial wind and TREC wind of Radars, and ATOVS (AMSU-A, AMSU-B) were conducted by Jishan Xue and his group. Some idealized tests (balanced flow, density current and mountain waves) were correctly completed for GRAPES dynamic core. Some real case studies on heavy rain processes and typhoons were conducted by Dehui Chen and his group, with real topography and optimised full physical package.

Prof. Zhemin Tan and his group pursued in Nanjing University investigations on mesoscale predictability which was started in NCAR in 2002. A high-resolution convection resolving experiment was conducted to further study the limits of predictability associated with initial error growth dynamics.

Japan

The Japan Meteorological Agency (JMA) has established its THORPEX Committee in April 2002 to develop an implementation plan of THORPEX over Asia/Pacific region and to promote collaboration between JMA and Japanese science community, and between JMA and foreign meteorological organizations. Researchers of JMA, universities and a research institute in Japan applied for a competitive funding of the government for research activities in November 2003 under joint signature to increase funding for activities on THORPEX.

Trough this process the collaboration between JMA and science community has been greatly enhanced and the Japanese national THORPEX Committee will be established soon.

The staff of Meteorological Research Institute (MRI)/JMA perform Observation Sensitivity Experiments using intensified observation data of Baiu Hunter 2003 to investigate mesoscale severe weather systems in Baiu front. Scientists of Korea and Japan agreed to exchange intensified observation data for the KEOP and the Baiu Hunter project on a non-real time basis as a bi-lateral collaboration between Korea and Japan. The staff of MRI/JMI was making preparations to record these data on CD-ROMs

Ensemble forecast members have been successfully exchanged between KMA and JMA and between NOAA and JMA through the Internet and ftp servers on a near-real time basis. This collaboration considerably promotes the research of "predictability and dynamic/physical processes". Researchers of JMA and Japanese science community plan to implement some OSEs using observation data of the North Atlantic TOST.

Korea

Forecast Research Laboratory at METRI/KMA has implemented intensive observation in the South-Western part of Korea from June 22 to July 3, 2003. Mesoscale phenomena associated with Asian summer monsoon front were observed using 2 additional sounding systems, S-band radar, wind profiler and micro rain radar.

An International Conference will be held March 22-26, 2004 in Seoul, Korea, in commemoration of the centennial anniversary of modern meteorological observation in Korea Meteorological Administration and the 40th anniversary of the Korean Meteorological Society. Subsession for Asian THORPEX was planned.

Russia

Several scenarios were substantiated for optimal Siberian sonde network. As criteria, the root mean squares of H500 objective analyses and short-term forecasts in high and mid-latitude belt of Northern Hemisphere were implemented. Key sensitive areas in Pacific basin, Japan, and North America were found. (O.M. Pokrovsky).

The ability of stochastic models to represent state-dependent model (tendency) errors of non-linear atmospheric and oceanic models is investigated. Using the shallow-water equations as a system (simulated truth) and the barotropic vorticity equation as a forecast model, the space-time covariance structure of vorticity errors is studied. It is found that the white-noise model (zero order) and even a red-noise model (a vector Ornstein-Uhlenbeck process, first order) are inappropriate as model-error stochastic models in this case. A model based on a second-order stochastic differential equation is proposed and estimated. (M.D. Tsyroulnikov).

Data assimilation experiments with the simplified Kalman filter for the baroclinic adiabatic regional model were carried out. The following "hybrid" model was used. For the calculation of the forecast error covariances of first large-scale vertical normal modes, the linearized quasigeostrophic equation is used. For other normal modes, we use the model that consists of the advection equation for the coefficients of the height-field vertical normal modes. (E.G. Killmova).

Some new results of probabilistic interpretation of ice thickness forecast growth in Kara, Laptev, East-Siberian and Chukchi Seas were obtained. A method of the interpretation was based on the conditional forecast errors distribution approach was formulated. It was shown that the forecast errors have one and the same distribution (Kolmogorov-Smirnov criteria) that allowed combining data from different points in the seas mentioned above in one sample. (V.G. Dmitriev).

ANNEX XIII

LIST OF ICSC-3 DECISIONS

Decision 1: The ICSC approved the report of the Chairman and closed accomplished actions from previous meetings. It requested members to pursue in fulfilling permanent ICSC actions as listed in Annex XIV.

Decision 2: The ICSC approved second version of the THORPEX International Science Plan with some slight modifications, including the strengthened mission statement. In doing so, the ICSC noted that the plan would be a living document and it would be reviewed as needed in a course of the programme implementation to adapt the changes in technology, forecast capabilities and societal needs. The ICSC requested co-chairs of ISSC to incorporate last slight modifications and to make the plan available for printing in March 2004. The IPO was subsequently requested to publish the plan in a series of WMO WWRP THORPEX publications in April 2004.

Decision 3: The ICSC requested that co-chairs of ISSC lead effort in examining CBS questions to respond, which issues THORPEX would address in a course of its implementations.

Decision 4: The ICSC agreed that a link with the OPAG-DPFS Expert Team on Ensemble Predictions Systems was needed.

Decision 5: The ICSC agreed that a link with the OPAG-PWS would be feasible.

Decision 6: To ensure active involvement of CBS in THORPEX planning and implementation and to facilitate further operational implementation of THORPEX results.

Decision 7: The ICSC decided that a special polar regional observing and research THORPEX programme consistent with overall THORPEX scientific objectives should be considered during the IPY.

Decision 8: The ICSC decided that development of a THORPEX International Research Implementation Plan should be started as priority and urgent step. The ICSC approved Terms of Reference for development of a THORPEX International Research Implementation Plan as given in Annex V. The ICSC requested that TIP be prepared by November 2004.

Decision 9: The ICSC agreed to establish an ad hoc group of experts for THORPEX implementation planning. The ICSC Chair was authorized to form this group, select a chairman and members in consultation with co-chairs of the ISSC and the IPO.

Decision 10: The ICSC approved the Terms of Reference of the THORPEX International Programme Office.

Decision 11: The ICSC approved the THORPEX Trust Fund Terms of Reference and Rules.

Decision 12: The ICSC accepted the statement of account of THORPEX Trust Fund for 2003.

Decision 13: The ICSC agreed that the provisional budgets should be prepared and approved annually by the end of October (WMO fiscal year as from 1 January to 31 December).

Decision 14: The ICSC approved projected expenditures and accounts for THORPEX Trust Fund for 2004.

ANNEX XIV

PERMANENT THORPEX ICSC ACTIONS

No.	Ref.	Action	Responsible
ICSC-P/01	Cg-XIV ICSC-2	To encourage WMO Members to actively participate in implementation of THORPEX	ICSC, RCs, IPO
ICSC-P/02	Cg-XIV ICSC	To assist WMO Members in the International coordination of THORPEX	ICSC, IPO, SSC-WWRP, WGNE, CBS
ICSC-P/03	Cg-XIV	To assist WMO Members from developing countries in their utilization of THORPEX-related forecast product	ICSC, ISSC, RCs, CBS, IPO
ICSC-P/04	Cg-XIV	To assist THORPEX in coordination with CBS, WCRP, JCOMM and other WMO programmes as appropriate	ICSC, IPO
ICSC-P/05	Cg-XIV	To facilitate the participation in THORPEX of other international bodies	ICSC, IPO
ICSC/P06	ICSC TOR	To provide the regional and national priorities with respect to the THORPEX sub-programmes	ICSC, RCs
ICSC-P/07	ICSC TOR	To provide guidance to the NMHSs on the timely transition of THORPEX research and development to operations	ICSC, RCs, CBS
ICSC-P/08	Cg-XIV ICSC TOR	To identify and mobilize national and international resources, financial, technical and human, to support THORPEX activities	ICSC, RCs, IPO, all members
ICSC-P/09	ICSC-3/17	ICSC members and Regional Committees to provide quarterly progress reports on activity and plans to the Chair of ICSC and IPO. Regional Committees to submit reports to the Chair of ICSC and IPO not later than at least 6 weeks prior the session of the ICSC	ICSC Chair, members, RCs, IPO
ICSC-P/10	ICSC-2/02 ICSC-3/15	All THORPEX members to make annual contributions to the THORPEX Trust Fund in accordance with the approved budget and not later than 31 March	All THORPEX members
ICSC-P/11	ICSC-2/02 ICSC-3/16	All THORPEX members to make provisions and ensure allocation of necessary funds for next year before 31 October	All THORPEX members
ICSC-P/12	ICSC-2/04 ICSC-3/14	ICSC members to consider secondment of experts to serve at the THORPEX IPO and to inform the Chair of the ICSC and WMO/AREP on any progress	Chair ICSC, all THORPEX members
ICSC-P/13	ICSC-3/18	ICSC Members to regularly update status of implementation of actions and inform the IPO	ICSC, IPO

2004 THORPEX ICSC ACTIONS

No.	Action	Responsible	Deadline
ICSC-3/01	ICSC Chair to prepare statement of guidance for WMO Members on possibilities of their involvement and contribution to THORPEX implementation. IPO to circulate it to the WMO Members	Chair ICSC IPO	April
ICSC-3/02	Co-chairs of ISSC to review and update THORPEX mission statement by 15 March 2004	Co-chairs ISSC	March
ICSC-3/03	Co-chairs of ISSC to incorporate last slight modifications in the second version of the THORPEX International Science Plan and to make the plan available for printing in March 2004	Co-chairs ISSC	March
ICSC-3/04	The IPO to publish the plan in a series of WMO WWRP THORPEX publications in April 2004	IPO	April
ICSC-3/05	Co-chairs of ICSC to examine, in consultation with relevant THORPEX experts, the CBS OPAG-IOS ET-ODRRGOS questions	Co-chairs ISSC	April
ICSC-3/06	Chair of ICSC to consider a suitable link between THORPEX and the OPAG-DPFS Expert Team on Ensemble Predictions Systems as well as with the OPAG-PWS and to make subsequent recommendation to the president of CAS	Chair ICSC	September
ICSC-3/07	Chair of ICSC to invite CBS experts to take part in THORPEX implementation planning activities	Chair ICSC	January
ICSC-3/08	The ICSC to consider a THORPEX polar regional programme as a part of the International Polar Year 2007-2008	ICSC	November
ICSC-3/09	ICSC members to pursue national inputs to GEO framework and Implementation Plan. ICSC with assistance of IPO to provide when appropriate related THORPEX requirements for consideration in relevant GEO deliberations	ICSC, IPO	December
ICSC-3/10	The ICSC Chair to form an ad hoc group for THORPEX implementation planning, select a chairman and members in consultation with co-chairs of the ISSC and the IPO	Chair ICSC	February
ICSC-3/11	The Regional Committees to ensure that regional plans are developed in coordination with ICSC, ISSC and between regions, and are consistent with the international plans	RCs, ISSC, ICSC	August
ICSC-3/12	All contributing organizations of THORPEX members to submit definite plans on contribution to THORPEX implementation to the chair of ICSC and TIP planning group by April 2004 or as soon as possible thereafter	THORPEX members	March
ICSC-3/13	Regional Committees with support of IPO to organize First THORPEX International Conference in late 2004 – beginning 2005	RCs, IPO	December
ICSC-3/14	THORPEX members to consider secondment of experts to the IPO and to inform the ICSC Chair and WMO on progress by 1 April 2004	THORPEX members	March