

OPAG-WWRP

Thorpex Progress Report

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Purpose of Document and Major Decision(s) Requested

This document provides a progress report on the development of THORPEX and highlights in particular:

- i. The establishment of an African Regional Committee and the publication of plans for THORPEX activities in Africa
- ii. Major recommendations for future THORPEX field experiments
- iii. The significant progress achieved with TIGGE
- iv. Completion of the Summer Phase of TPARC
- v. The establishment of a major international programme on the studies of tropical convection (YOTC)

The Management Group is requested to:

- i. Encourage and support the activities of a reconstituted WWRP/SERA Working Group.
- ii. Include THORPEX as a major element of the Technical Conference planned for Seoul in November 2009
- iii. Continued encouragement and support of key THORPEX activities (e.g., the research utilization of the TIGGE data set and the development of forecast demonstration projects using TIGGE, YOTC, up-coming winter phase of T-PARC and implementation of the African Regional Plans).

Summary of Activity

1. Introduction

THORPEX, an element of the WMO World Weather Research Programme, is a major contribution to the WMO Natural Disaster Reduction and Mitigation Programme and a key goal of WWRP/THORPEX is to accelerate improvements in the accuracy of 1-day to 2-week high-impact weather forecasts.

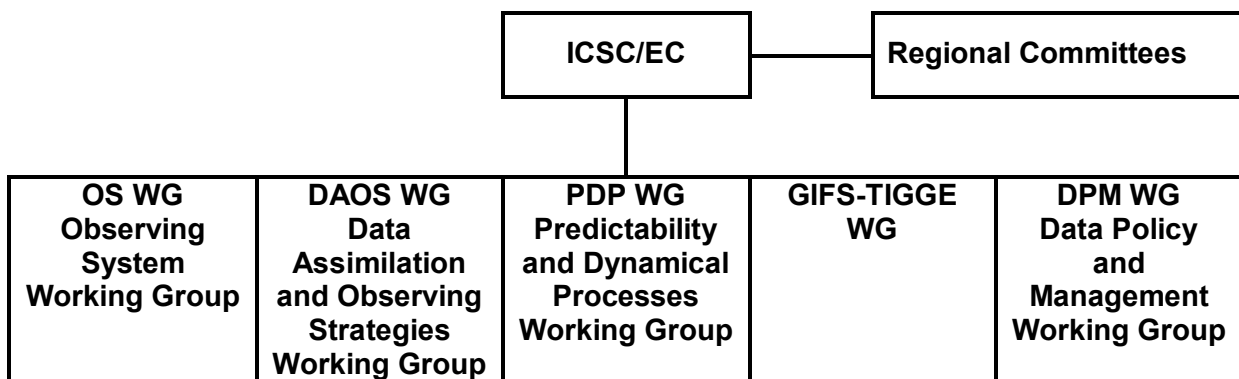
The THORPEX International Science Plan was published in November 2003 and this was followed by a THORPEX International Research Implementation Plan in December 2004 (both plans are available on www.wmo.int/thorpex/plans.html).

The international THORPEX activities are supported and coordinated by the THORPEX International Programme Office (IPO) which in turn is supported through voluntary contributions of the governments of the WMO Members participating in THORPEX, including donations to the THORPEX Trust Fund established by WMO. The Director of THORPEX IPO, and the THORPEX Working Groups and Regional Committees, report to a THORPEX International Core Steering Committee (ICSC).

The sixth meeting of the THORPEX International Core Steering Committee (ICSC 6) took place in Geneva (25 to 27 March 2007) and the report from ICSC 6 is available on the THORPEX website (www.wmo.int/pages/prog/arep/thorpex/documents/ICSC-6.pdf) or as document (WMO/TD No. 1389; WWRP/THORPEX No. 8).

At ICSC 6 it was agreed that the Chief of the WWRP would assume the responsibility for directing the THORPEX IPO. In addition, the Executive Board (EB), the Science Advisory Board (SAB) and the Technical Advisory Board (TAB) (boards which were established in 2005) were disbanded, the ICSC was reconstituted and an Executive Committee (EC) was established.

This resulted in the following simplified structure for the THORPEX element of the WWRP.



The original Societal Economic Research and Applications Working Group (SERA WG) was moved by the CAS in February/March 2006 to the WWRP in order to serve the interests of the whole WWRP including THORPEX. However, since then the group has not met and is currently being reconstituted. This has probably hampered the development of THORPEX societal and economic applications.

In addition, THORPEX benefits in a number of ways from GEO through GEO's support for a number of THORPEX projects (MG3 Doc 5.5).

1.1 Activities of the Executive Committee

Since its establishment, the EC has met twice in Geneva (7 February 2008 and 25 to 26 September 2008). During the first meeting, the EC reviewed progress reports and plans provided by the Regional Committees and the Working Groups. Whereas, at its second meeting the EC also attended a joint session of all THORPEX Working Groups during which plans for future activities were discussed (ref:- sub-section 3.2 of this report). Amongst other things, the EC has proposed a number of revisions to the THORPEX management structure and has recommended that the DPM WG be disbanded and that the OS WG and DAOS WG be merged and that the resulting new DAOS WG work more closely with the CBS OPAG-IOS. These EC proposals and recommendations will be discussed by the ICSC in November 2008.

2. Regional Activities

The Regional THORPEX Committees have continued to coordinate activities of regional groups of nations. Currently, there are Regional Committees for Africa, Asia, Europe, North America and the Southern Hemisphere. Since ICSC-6 the IPO has expended considerable efforts to encourage the development of THORPEX activities in Africa and has organised three meetings which have resulted in the publication of Science and Implementation Plans and the establishment of an African Regional Committee.

The four established Regional Committees are making major contributions to the work to build and maintain the THORPEX Interactive Grand Global Ensemble (TIGGE) data-base (see section 4.1 below), to the planning of the Year Of Tropical Convection (YOTC – section 4.4 below and MG3 Doc 8.3) campaign, and the three northern hemisphere regions have made major contributions to the TPARC (section 4.2 below and MG3 Doc 4.3) observation field campaign which is to take place in two phases (Summer TPARC - 1 August to 6 October 2008) and (Winter TPARC - January-March 2009).

All the regional committees are involved in overseeing and contributing to the management of research activities, including societal research on the applications of weather forecasts, and in efforts to implement mature techniques into operational practice. A great deal of the work on regional data assimilation strategies and the deployment of additional observations for process studies are now carried out under the auspices of THORPEX.

3. THORPEX Working Groups

3.1 Working Group Meetings

Since ICSC 6 (March 2007), the THORPEX Working Groups have met as follows:

OS WG 2	2 to 4 May, 2007 (Louisville, Colorado)
GIFS TIGGE WG 5	11 to 13 March 2008 (Pretoria, South Africa)
OS WG 3	22 to 26 September (Geneva) – all the meetings took place in parallel and were embedded within a 5-day Workshop (see the following sub-section for details)
DAOS WG 2	
PDP WG 2	
GIFS-TIGGE WG 6	

In addition, informal meetings took place in Landshut in December 2006 during the Second THORPEX International Symposium.

3.2 Workshop and Working Group Meetings (Geneva, 22 to 26 September 2008)

The primary objectives of the Workshop and the Working Group meetings were to report on progress and agree and publish a planned set of activities. Additionally, it was expected that the Workshop would result in the development of better links between the Working Groups and the Regional Committees and between all groups and the developing WWRP-SERA Working Group.

Working Group and Regional Co-Chairs gave 30-minute lectures in an opening plenary session which focussed on recent achievements and provided sketch plans for activities for the next two years. These plans were “fleshed-out” during the Working Group sessions and were presented, to the THORPEX EC, during the second plenary session which began on the afternoon of Thursday 25 September. A summary of planned activities will eventually form a chapter of the WWRP Implementation Plan to be published later in 2008. Over the next few years there will be number of opportunities to report on progress including the occasion of the Third THORPEX Science Symposium in 2009 and the ICSC 8 in 2009.

3.3 Highlights and recommendations (OS WG, DAOS WG and PDP WG)

OS WG

The web page www.wmo.int/pages/prog/arep/thorpex/7_ec_meeting.html contains a full report of OS WG 2 and includes a major review of the state of the Chinese Observing network which has proven useful to the CMA.

DAOS WG

During the last 18 months, the emphasis has been on the evaluation of the impact of observations, including targeted observations, based on results from field experiments, OSEs and OSSEs. The main outcomes from these impact studies may be summarised as follows.

- The value of extra-tropical targeted data has been found to be positive but small on average
 - ❖ Observations taken in sensitive areas have more value than observations deployed randomly
 - ❖ Past experiments do not provide evidence of a major impact obtained from just a few observations (when averaged over a large sample of cases)
 - ❖ There are limitations due to the current assimilation methodologies (spatial structure functions which control the use of observations in data assimilation are not yet fully flow-dependent)
 - ❖ The methods employed to characterize sensitive areas does not appear to be the major problem
- Additional observations for tropical cyclones have proven to be useful

These DAOS WG sponsored studies also suggest that additional benefit may be obtained from:

- Optimization of existing operational resources
- Regional (vs highly localized) and systematic targeting during low predictability flow regimes on a continuous basis (periods of days to weeks)
- Adaptive processing and data selection of satellite data

Based on the above it is recommended that:

- Observation campaigns should be based on science plans that take into consideration assimilation issues
- Expensive observation campaigns should not be justified based on current targeting strategies alone
- Decision to undertake observational field campaigns would benefit from pre-campaign evaluation of expected value (e.g., using OSSEs or OSEs)

The DAOS will continue to co-ordinate the use of OSSEs for the evaluation of data impacts, targeting studies for longer-range forecasts but in this regard notes that issues for targeting at shorter range remain and should be addressed before getting into longer range forecasts.

DAOS WG members have also been involved with the *WMO WWRP-THORPEX Workshop on 4D-Var and Ensemble Kalman Filter Intercomparisons* to be held in Buenos Aires, Argentina (10-13 November 2008) and preparations for the *5th WMO Symposium on data assimilation in meteorology and oceanography* to be held in Melbourne in 2009.

Predictability and Diagnostic Processes Working Group (PDP WG)

The PDP WG has prepared, for the publication in the BAMS, an overview of a selection of key PDP research topics based upon the summary reports from the eight PDP Interest Groups. The full reports will be published in the THORPEX report series.

Members of the working group have been involved with the preparation of TPARC, planning for the YOTC, HyMeX and T-NAWDEX (a THORPEX field campaign being developed for 2001 by the European Regional Committee).

4. Major international projects and campaigns

4.1 TIGGE

The THORPEX Interactive Grand Global Ensemble (TIGGE) is a key component of THORPEX which in turn is a major component of the World Weather Research Programme (WWRP) of the World Meteorological Organization. The highest priority data accumulated in the TIGGE archive are the ensemble forecasts generated routinely (operationally) at major forecast centres around the world. This core data stored in the TIGGE archive is accumulating at a daily rate of approximately 300GB from ten providers around the world. Additional special datasets will be added in the future for specific research and applications.

The TIGGE project is developed under the leadership of the GIFS-TIGGE Working Group, under THORPEX. Phase I databases are developed by three archive and distribution centres, ECMWF, the US National Centre for Atmospheric Research and the China Meteorological Agency. The operational forecasting centres supplying daily forecasts are:- BMRC (Australia), CMA (China), CPTEC (Brazil), ECMWF, JMA (Japan), KMA (Korea), Météo-France, MSC (Canada), NCEP (USA), and Met Office (UK). In addition, the TIGGE web site is maintained by ECMWF, the meta-data centre by NCAR, and the verification web by JMA. The WGNE/WWRP joint working group on verification advises the project on verification methodology. In addition the WMO Expert Team on Ensemble Prediction Systems advises the project on a number of issues, for instance, metadata formulation.

TIGGE has strong links with the North American Ensemble Forecasting System (NAEFS). Although NAEFS is initially an operational project, TIGGE and NAEFS share many technical aspects, and NAEFS plans to implement results from TIGGE. It is believed that TIGGE and the NAEFS will ultimately evolve into a single operational system.

TIGGE is registered as GEO Task WE-06-03. It has general relevance to GEO societal benefit areas that will benefit from access to advanced multi-model global weather forecasts and the derived products, especially in areas related to risk management, disaster mitigation, energy, health etc.

TIGGE Users

It is expected that TIGGE will accelerate meteorological research at large and in particular the scientific programmes of WWRP-THORPEX. Much of this research will be conducted in Universities and other academia.

The forecast demonstration projects of WWRP-THORPEX (e.g. Beijing 2008 FDP/RDP or the sand and dust-storm project), TPARC, the future field campaigns on adaptive observations and the IPY projects will be active users of TIGGE. This research will, in turn,

lead to targeted applications reducing societal risk to severe weather through better forecasts (health, energy, flood warning, fire weather, etc. The hydrological community (e.g. through HEPEX) is also expected to be a strong user of TIGGE data.

Current status of the TIGGE database

A complete list of data requested from the data providers can be found at the TIGGE Internet site <http://tigge.ecmwf.int> .

All ten providers are delivering data, with initial dates varying from Autumn 2006 to Autumn 2007. The archive length is therefore reaching one year in some cases.

Access to TIGGE data for research and education

Data providers supply their products to the TIGGE archive centres under an agreed set of rules, which include re-distribution rights. Access is provided for Research & Education through a simple electronic registration process, with valid e-mail address and acknowledgment of conditions of supply. Under the simple registration process, access is given with a delay (48 hours) after initial time of the forecast. Real-time access is granted in some cases, e.g. for field experiments and projects of special interest to THORPEX. Registration for real-time access is handled via the THORPEX IPO.

Data access is operated via the TIGGE data portals. The NCAR portal URL is: <http://tigge.ucar.edu> and the ECMWF portal URL is <http://tigge-portal.ecmwf.int/>. The CMA portal is also available now and the URL is <http://wisportal.cma.gov.cn/tigge/>. The current functionalities of the data portal are (i) registration; (ii) Search, discover, and download files; (iii) Select data by initialization date/time, data provider, file type and forecast time; (iv) Check volume and download data. Both portals also provide selection of parameter subsets. ECMWF offers grid interpolation and a limited amount of spatial sub-setting. NCAR plans to offer these expanded services in the future

Outlook

TIGGE is paving the way towards a Global Interactive Forecasting System (GIFS). Currently users can access TIGGE data with a delay of 12 to 18 hours, which make them unsuitable for some applications. A phased approach will be necessary to resolve this issue. In the upcoming Phase 2 of TIGGE, which is still subject to funding, requirements for massive data transfers will be alleviated by the distributed archive concept. Later on, it will be necessary to rely on dedicated telecommunication lines to realize the full benefits of the system.

It is also anticipated that limited-area ensemble prediction systems will also form an important component of the Global Interactive Forecasting System, GIFS whose development is dependent upon TIGGE. The priority requirement here is to develop standard formats enhancing the interoperability of the existing systems. One key objective is to facilitate the use of lateral boundary conditions from various global systems by various limited-area systems. A panel of experts called TIGGE-LAM has recently been set-up to organize the limited-area-model component of TIGGE.

4.2 THORPEX Pacific Asian Regional Campaign (TPARC) 2008

The concept of a THORPEX Pacific Asian Regional Campaign (TPARC) 2008/9 developed as a result of a workshop held in Seattle in June 2005 and the subsequent continuing dialogue between the North American, Asian and European THORPEX Regional Committees (MG3 Doc 4.3).

Summer TPARC - 1 August to 6 October 2008

The Summer TPARC campaign, to advance the understanding and prediction of tropical cyclone genesis, intensity, track and structures, extra-tropical transitions, and down-stream propagation, has been completed. The summer campaign provided monitoring and evaluation of initial tropical convection cloud clusters through to genesis, further development, structural changes, re-curvedure, track prediction and land-fall and extra-tropical transition.

Winter TPARC - January-March 2009

The Winter TPARC element of the campaign will investigate adaptive measurement strategies within the context of propagating Rossby waves and will continue the campaign to March 2009.

4.3 European TReC (ETReC)

The **ETReC 2007** campaign took place over 5 weeks in July 2007, in conjunction with the meso-scale experiment COPS and the MAP D-PHASE forecast demonstration project (www.pa.op.dlr.de/cops/etrec_docs.html). Sensitive regions were calculated daily at Météo-France, ECMWF and the Universitat de les Illes Balears (Spain). Special observations were made for seven events, using combinations of the DLR Falcon with wind and water vapour lidars and dropsondes, and additional radiosonde and AMDAR measurements provided by EUCOS.

4.4 The Year Of Tropical Convection (YOTC)

The realistic representation of tropical convection in our global atmospheric models is a long-standing grand challenge for numerical weather prediction and climate projection. To address this challenge, WCRP and WWRP/THORPEX propose a Year of coordinated observing, modelling and forecasting of organized tropical convection and its influences on predictability as a contribution to the United Nations Year of Planet Earth to complement the International Polar Year (IPY).

This effort is intended to exploit the vast amounts of existing and emerging observations, the expanding computational resources and the development of new, high-resolution modelling frameworks, with the objective of advancing the characterization, diagnosis, modelling, parameterization and prediction of multi-scale convective/dynamic interactions, including the two-way interaction between tropical and extra-tropical weather/climate. This activity and its ultimate success will be based on the coordination of a wide range of ongoing and planned international programmatic activities (e.g., GEWEX/CEOP/GCSS, THORPEX/TIGGE, EOS, GOOS), strong collaboration among the operational prediction, research laboratory and academic communities, and the construction of a comprehensive data-base consisting of satellite data, in-situ data sets and global/high-resolution forecast and simulation model outputs relevant to tropical convection.

The proposed timing, focus year (beginning on 1 August 2008) approach and integrated framework of this effort is intended to leverage the most benefit from recent investments in Earth Science infrastructure as well as entrain a new generation of young scientists into tackling the outstanding problems in the field of weather and climate prediction.

The first steps to establish the global data-base comprise:

- High-resolution (T799/25km grid) ECMWF analysis and deterministic forecast data complete with all relevant quantities
- An analogous data set from NCEP

- Modest enhancement of the routine TIGGE archive
- Selected quantities from multi-sensor satellite platforms

Archiving of the High-resolution (T799/25km grid) ECMWF analysis and deterministic forecast data complete with all relevant quantities has been done in real-time for some time and access to the data stored to date is available through the ECMWF website. Contacts have been made with the Committee on Global Meteorological Satellites (CGMS) to facilitate access to the multi-sensor data and a Science Meeting is planned for 2009 in Asia to encourage Asian participation.

4.5 The IPY-THORPEX project cluster

The IPY-THORPEX project cluster currently includes 10 individual IPY projects from nine countries with the following main objectives:

- Explore the use of satellite data and optimized observations to improve high-impact weather forecasts (for Polar THORPEX Regional Campaigns (TReCs) and/or provide additional observations in real-time over the WMO Global Telecommunication System
- Better understand physical/ dynamical processes in Polar Regions
- Achieve a better understanding of small -scale weather phenomena
- Utilize improved forecasts to the benefit of society, the economy and the environment
- Utilize the THORPEX Interactive Grand Global Ensemble (TIGGE) of weather forecasts for polar prediction

A Research and Implementation Plan has been written to help coordinate overall activities. The projects span a number of scientific issues from climate research to weather prediction. Progress is reported in MG3 Doc 4.4.

5. The Third THORPEX International Science Symposium

The "Third THORPEX International Science Symposium" (TTISS) will be held in Monterey (California) from 4 to 8 May 2009. The first and further announcements and information may be found at <http://wmo.int/thorpex>. A TIGGE User Workshop, organised by the GIFS-TIGGE WG, will also take place during the Symposium week.