

WORLD METEOROLOGICAL ORGANIZATION
COMMISSION FOR ATMOSPHERIC SCIENCES

CAS/THORPEX ICSC/
GIFS-TIGGE and PDP WGs
Joint Meeting

**THORPEX - Joint meeting of the GIFS-TIGGE and
PDP Working Groups**

Meeting Report
Original: ENGLISH

WMO, Geneva
19/20 March 2014

Report of the joint GIFS-TIGGE & PDP working group meeting

1. Organisation of the meeting

1.1 Aims of the meeting

Richard Swinbank welcomed the members of the two WGs to the meeting. He noted that the main aim was to prepare the ground for the new PDEF WG. It is necessary to consider and refine the draft Terms of Reference, the scientific foci, links with the other WWRP WGs and WGNE, how the new group can support the THORPEX legacy and other projects, etc. The membership will also need to be considered in relation to the envisaged role and the expertise required to carry it out. In addition it will be useful to look at current predictability research and future plans for field campaigns e.g., T-NAWDEX. The TIGGE review paper will also be briefly considered.

1.2 Adoption of the agenda

The agenda was agreed. The item on links with WGNE was deferred for discussion in conjunction with the plans for the new PDEF WG.

1.3 Working arrangements.

The working arrangements were agreed. All presentations are available on the THORPEX website.

2. Report and actions from previous meetings

2.1 IPO update and post-THORPEX plans

Dr Tetsuo Nakazawa thanked all present for their contributions to THORPEX activities over the course of the programme. A comprehensive review of the programme written by participants and edited by the IPO is available on the website. Three legacy projects have emerged. These are the S2S, PPP and (the proposed) HIWeather projects. A summary of the programme is being prepared for publication in BAMS.

The THORPEX programme will be closed at the end of 2014 and the IPO and Trust Fund wound up. It is planned that the final ICSC will take place in Geneva during mid-Nov. A small celebration to mark the achievements of the programme is also being considered.

The WWOSC is expected to be a major scientific event and will take place from the 16-21 August in Montreal, Canada. To date about 1200 abstracts have been submitted. Young scientists are being strongly encouraged to attend the WWOSC. Key speakers are now being identified. It is planned to have some WG meetings in association with the WWOSC. The intention is to have another short joint meeting of the GIFS-TIGGE and PDP WGs from 6-8 pm on the 18th August.

2.2 Outcome of THORPEX ICSC-11, CAS-16 meetings

Dr Tetsuo Nakazawa spoke about the outcomes from CAS 16. CAS 16 looked at the reorganisation of the WWRP, including the proposed merger of the GIFS-TIGGE and PDP WGs. This merger was approved in principle. The plans will now go to the WMO EC meeting in June for final approval. CAS also agreed that the THORPEX Regional Committees could continue within the WWRP on the basis that they are self-organising and self-funding. The technical conference that preceded the CAS-16 meeting and the side event, on "The TIGGE Project and its achievements", during the meeting both proved useful for publicising the TIGGE databases. 3. Links with other WMO & WWRP groups

3.1 Links with WGNE

(Discussed under item 6.1)

3.2 HIWeather project

Richard Swinbank introduced the proposals for this new project which are currently being finalised and will be presented to the WMO EC in June for approval. Links between this project and TIGGE-LAM will be very important not least for supporting specific RDPs/FDPs but using the LAM database for predictability studies. The question of how HIWeather can benefit from TIGGE-LAM will be one of the topics covered by a workshop in June in the USA. One possibility might be to flag events of interest to HIWeather in the TIGGE-LAM archive so generating a sequence of interesting extreme events. These same events could then be identified in the TIGGE database. It might also be of use to flag some carefully selected non-extreme events. Such flagged non-extreme events could be used to test that any new forecasting systems arising from the HIW project can successfully discriminate between extreme and non-extreme events. The non-extreme events might include "nearly-extreme" events for which an ensemble member had forecasted an extreme event which did not eventuate as well as randomly selected non-extreme events.

In Europe TIGGE-LAM is now being archived routinely at ECMWF.

The Lake Victoria project is expected to involve several models predicting strong winds and storms over the lake and is expected to provide a good check of model performance which will be of interest to the HIWeather project.

Some details of the HIWeather project were then presented including an example of severe weather in Senegal. The main motivation for the new project is the need to better address shorter space and time scales than considered by THORPEX. The role of model errors, their non-linear growth and saturation will be primary areas of interest. It is intended that the project will be 'application' driven and specifically address the future needs of WMO members. The mission is therefore to consider high impact events on the timescale from minutes to two weeks. Five hazard areas have been identified. These are extreme winds, wildfires, urban flooding, extreme urban heat/air quality and disruptive winter weather. The general strategy will be to follow the 'ready, set, go' approach i.e. providing refined, more reliable, predictions of the expected event as the timescale shortens.

For each hazard it will be necessary to consider the user community, stakeholders, the information needed, impacts as well as vulnerabilities and risk. The strategy will include exploiting established research databases, forming links with the WCRP and other relevant WGs e.g. the Nowcasting Research WG and Mesoscale Weather Forecast Research WG.

3.3 S2S project

This project, which is already running, is envisaged as bridging the gap between weather and climate research and providing a valuable framework for international collaboration on this topic. An Implementation Plan is approved, a Trust Fund has been set up and an International Co-ordination Office hosted by Korea established in Jeju Island. The mission statement for the project was outlined. It addresses service orientated research and verification. A 'ready, set, go'

approach has been adopted. The 'ready' is seen as the seasonal timescale with 'set' as mid-range and 'go' on the short range.

There is a set of sub-projects addressing the monsoon, MJO, African extreme weather, droughts and verification. Some extreme sub-seasonal events have already been identified such as the exceptionally cold start to the spring in 2013 in Europe.

A database similar to TIGGE has been established but at a fixed (lower) grid resolution. It will be populated with a roughly three weeks lag. ECMWF will be an archiving centre.

A SERA component is under consideration but the emphasis at present is on improvement of the models and forecasts.

During discussion it was recognised that the new PDEF WG will have a lot of possible contributions to make to the S2S project on issues such as predictability studies, optimal perturbations for ensembles, the best way to initialise coupled systems, dynamical problems etc.,

3.4 Polar Prediction Project.

Some of the major issues that the project will address were outlined including sea ice prediction (coupled systems), linkages between polar and lower latitudes, improved observations from polar regions, planning for the proposed Year of Polar Prediction (YOPP), etc., A Trust Fund has been set up and an ICO hosted by Germany has been established at the AWI.

The YOPP is expected to be a major event involving significantly improved observational cover in polar regions, running OSEs, stimulating model development, constructing community datasets, and pushing forward modelling techniques. The preparation phase is from 2013 to 2017, with the YOPP expected to run from 2017 to 2019 and a consolidation phase following from 2019 to 2022. Discussion followed on how the new PDEF WG might contribute to the PPP project. Initially a review of the YOPP Implementation Plan would be valuable. It was also recognised that the TIGGE datasets should be of value and that new parameters might be needed. It was noted that the GIFS-TIGGE WG was happy to discuss requests from the PPP project for new parameters. Ice prediction is seen as the most challenging part of coupled prediction. Capturing uncertainty is also a major issue. It is expected that PDEF WG will advise on initialising ensemble forecasts including uncertainties in the initial conditions. It would be advisable for the PDEF and DAOS WGs to work closely together on these topics.

Action J.3.1: The joint group agreed to review and provide feedback on the YOPP implementation plan, by end of April.

Action J.3.2: Heini Wernli to liaise with PPP over linkages between polar regions and mid-latitudes.

3.5 Other WWRP WGs inc. verification, mesoscale
The subject of linking effectively with other WGs was discussed. It was felt that occasional joint meetings would be helpful. Also cross-representation should be considered, for example similar to the arrangement in which WGNE has a member on the current PDP WG.

4. Research work

4.1 Progress with TIGGE review paper

Richard Swinbank noted that a first draft of the review paper has been written but it is too long for a BAMS article and needs to be reduced. The target length is about 5000 words. The co-authors are currently working on shortening the first draft. The intention is to focus on the headline results. A longer report will be published by the WMO after the BAMS article appears. Some of this material will be used by David Parsons when drafting the overall THORPEX review paper.

4.2 Plans for T-NAWDEX

Heini Wernli and John Methven gave a joint presentation of plans for T-NAWDEX. T-NAWDEX already has a ten year history but there is now greater confidence that it will actually take place. In January 2014 a submission was made for the USA component (DOWNSTREAM) to NSF. The submission to NERC for the UK component took place in March 2014.

The scientific scope relates to the behaviour of the jet stream and the N Atlantic waveguide. The different processes occurring cause systematic errors in the model representation of wave guide perturbations. None of the models maintain a sharp enough troposphere. Some factors that modify wave guide disturbances include warm conveyor belts, ET and polar vortices. Issues to be studied include wave breaking sensitivity to upstream disturbances, wave breaking as a precursor to HI weather and the evolution of Rossby waves along the waveguide.

The field campaign is scheduled for Sept/Oct. 2016 and will involve aircraft from Canada, USA, Germany and the UK. It is hoped to build upon the success of previous campaigns e.g. T-PARC. The work is seen as unique since it will be the first experiment to consider forecast errors on the transatlantic scale, study the physical processes occurring and have G5 aircraft available on both sides of the Atlantic. A final decision about a final go-ahead is expected in about one years' time.

4.3 Heteroscedastic ensemble post-processing and a new method for smoothing ensemble variances

Craig Bishop introduced this talk and presented a new method of ensemble post-processing that allows for a distribution of error variances (not a single value) to be associated with each forecast. The main conclusions were:

- A new ensemble post-processing technique has been introduced, which accounts for *distributions* of error variances given an ensemble variance.
- Unlike previous approaches, it allows climatological information to be incorporated in the forecast in a way that takes advantage of the best available estimate of the distribution of true error variances given an ensemble variance. It also implicitly incorporates aspects of Eckel's "Shift and Stretch" calibration, Non-homogeneous Gaussian Regression and the Bayesian Processor of Forecasts.
- Application to synthetically generated data and 500hPa forecasts of virtual temperature from the operational FNMOC ensemble demonstrates that ignoring *any* aspect of the distribution of true error variances given an imperfect error variance prediction degrades the quality of probabilistic forecasts.
- Further work needs to be done to optimize the training period and address less idealized cases (non-Normal distributions, bimodal distributions, bias)

4.4 Some diagnostic results for TIGGE and thoughts on future research directions

Istvan Szunyogh presented this research topic. The main conclusions drawn were:

- The different ensemble systems are obviously tuned to satisfy different optimality conditions (the performance measures used were not used by the centers for the tuning of their systems)
- Operational ensembles do a good job in capturing the overall magnitude and the main patterns, which does not mean that they correctly capture the propagation of the forecast uncertainty to the synoptic scale (ECMWF's own research shows that they do not)

He also presented some thoughts on changes to the datasets and other questions that should be addressed,

- Data should be collected on the verification metrics used by the different centers for tuning. (Even if they use similar sets of metrics, their emphases must be on different metrics.)

- The global systems struggle at short forecast times, when the upscale (nonlinear) propagation of uncertainties play a relatively important role. What does this mean for limited area ensemble forecasting?
- What can we say about the theoretical skill of a limited area ensemble? What do we expect these systems to add to the global ensemble forecasts? Do we simply expect them to downscale the global ensemble information? (Do these models have a $-5/3$ spectrum?)

The discussion that followed the presentation showed that the descriptions provided for the data from different ensembles on the TIGGE web site are not up-to-date, although this matter is the subject of GIFS-TIGGE WG **Action P.3**. A good scientific documentation of the data set is essential for its usefulness for both basic predictability and applied ensemble research.

5. Plans for TIGGE and TIGGE-LAM developments

5.1 Possible changes to TIGGE fields and resolution

Any changes would be linked to the needs of the THORPEX legacy projects. At this point in time no specific proposals have been received. There is certainly the possibility to add a few new fields at ECMWF. It is also the case that a few current fields could be dropped. From samples taken in January 2013 and January 2014 it has been established that some have only been requested about 10 times. The three least popular fields are field capacity, wilting point and the potential temperature at PV=2, however the first two fields are reference fields that are needed to complement the soil moisture data, and the latter is dynamically important. The low use fields concerned suggest that TIGGE is perhaps not being used much for dynamical research, though it is possible that some fields may be accessed once from the archive, but re-used many times. It was suggested that the sunshine duration field could perhaps be removed. It seems too that the current fields provide a weak link to SERA research.

Decision: It was agreed that a few new parameters could be added to the fields archived in the TIGGE database to support the THORPEX legacy projects and it is not necessary to drop any fields.

Action J.5.1: Co-chairs to approach leaders of legacy projects to consider a limited number of new fields to be added to the TIGGE database.

5.2 Future coordination between archive that centres and data providers

Official letters have been sent from WMO to the data providers. At present five positive replies have been received i.e., these centres are willing to continue to provide TIGGE data post THORPEX. A positive reply is also expected from the Australian BOM.

A practical issue arises concerning how the centres will interact with the archive centre(s) and the new PDEF WG. There was a general consensus around the formation of a TIGGE panel by the ECMWF archive centre.

5.3 TIGGE-LAM

Tiziana Paccagnella introduced recent developments in TIGGE-LAM. The TIGGE LAM panel has in effect been replaced by regional groups. These groups collect and exchange news about LAM activities. For example the groups reported on the GRAPES –PEPS system in CMA which should be operational in 2014. Korea and JMA are also making progress so it is expected that there will be several EPS systems in this region with overlapping domains hence providing the opportunity for intercomparisons etc., In S. America the multi model EPS is still working operationally. There is no recent news from S. Africa. However, there is some cooperative work between the KIT and DWD (under GEOWOW) concerning the use of TIGGE data in Africa. In N. America a workshop has been sponsored by NSF. This concerned Earthcube – an initiative to promote the exchange of GEO data around the world. Proposals are being formed to set up a grand ensemble on common infrastructure in N. America. The resolution would be 10km over the CONUS with 3-5 sub-domains at 3.5km. A white paper is being written.

In Europe most collaboration on LAMs is through the EUMETNET programme SRNWP. A number of RDPs/FDPs are running including HyMEX and FROST 14. The ECMWF is now archiving European TIGGE-LAM data through the GEOWOW project. The archive is in GRIB2 using the latest technology. High priority parameters are now being archived operationally from five LAM EPS systems: COSMO DE-EPS, Aladin –LAEF, COSMO-LEPS, HUNEPS and MOGREPS-UK. There is good overlap between the model domains in central Europe so predictability studies are possible. Some of the challenges relate to missing parameters, varying forecast lengths, different model domains, varying ensemble size and different run times. Time series data will be generated at GTS synoptic station locations and other selected sites. It was seen as very important to publicise the fact that the European TIGGE-LAM archive is open for business, so it was agreed to prepare a press release and publicity leaflet. Since the LAM-EPS systems tend to change quickly there are likely to be big demands on the archive centre. It could also be desirable to add data from RDPs and FDPs.

Action J.5.2: WMO secretariat and ECMWF to arrange for a press release to publicise the launch of TIGGE-LAM.

Action J.5.3: TP, RM, RS & WMO secretariat to prepare a leaflet to publicise TIGGE-LAM in time for distribution at GEO & EGU meetings in April.6. Plans for new PDEF working group

6.1 Terms of reference

Richard Swinbank introduced the emerging plans for the new PDEF WG. He noted that during THORPEX the GIFS-TIGGE and PDP WGs had in some ways converged as the former took an increasing interest in the science of ensemble prediction. The new group is intended to provide a centre of expertise on predictability and dynamics as well as ensemble forecasting. The proposed revised matrix structure for the WWRP WGs and projects was presented and discussed. There is a clear scale separation between S2S (large scale) and PPP and especially HIWeather which will focus on somewhat smaller scales. The new WG will address dynamical processes, ensemble forecasting and predictability on all relevant scales. Its role should be to foster research on these topics, provide a bridge between the operational and academic communities, support the projects and provide general guidance concerning EPS data bases. It is expected that a representative of the TIGGE archive centre(s) will be on the new WG. In general the focus should be on understanding and improving probabilistic predictive skill.

Clear links with WGNE and the WWRP WGs and projects will be essential. It is hoped at this meeting to refine the terms of reference (ToR) for the new group and consider appropriate membership. The CAS 16 generic ToR for a WWRP WG were outlined and noted. The draft ToR for the new group were then briefly outlined.

Jean-Noel Thépaut then addressed the link with WGNE. He noted that the WGNE ToR have not changed for a considerable time and can be found on the website. Activities relate to CAS and the WCRP. WGNE maintains a portfolio of workshops and organises numerical experiments. These may be general or specific e.g., to look at the impact of aerosols in NWP. It is recognised that WGNE cannot do everything. WGNE sees a number of possible important roles for PDEF e.g., conducting predictability research using TIGGE data, assessing multi-model ensembles, engaging the academic and operational communities, concentrating on specific complimentary areas to WGNE, considering stochastic physics and possibly being a champion for the grey zone problem (i.e. space scales between those which can resolve convective motions and those where the motions can be satisfactorily parameterized). It seems relatively easy to define clear boundaries. WGNE would also wish to be represented at PDEF WG meetings.

The draft PDEF WG ToR were reviewed and it was recognised that some specific references were needed to stochastic physics, verification, quantitative evaluation, bringing the operational and research communities together etc., The ToR were then discussed line by line and a final draft version agreed by the meeting – see Annex 2.

6.2 Possible future PDEF science projects / foci

Some suggestions for the scientific priorities of the new group include,

1. Dynamics and physics of flow instabilities
2. Predictability research using TIGGE data
3. Assessment of multi-model ensembles and calibration techniques
4. Interaction of diabatic processes with meso/synoptic scale dynamics
5. Development of probabilistic forecast products
6. Ensemble based methods
7. Stochastic representation of the effects of sub-grid scale uncertainty in numerical models
8. Construction of ensemble initial conditions and interpretation of ensembles including coupled models.
9. Evaluation

The meeting agreed that a good strategy would be to seek 'champions' for each of these topics. The following people volunteered to act as champions for some of the items listed above.

Topic 1 - J. Methven

Topic 3 - Y. Zhu

Topic 7 - R. Swinbank

Topic 8 - C. Bishop

The need to identify 'champions' for at least some of the remaining topics was noted.

7. Membership

7.1 Membership of PDEF working group

Richard Swinbank introduced this item. He noted that a resolution from CAS 16 advises how WG members should be selected i.e. with regard to gender balance, an operational meteorological or academic background, geographic balance, etc., Each WG may also contain ex-officio members and representatives from major projects. Members are appointed by the Chair of the WWRP SSC (Scientific Steering Committee) and serve a 4 year term with the possibility of a maximum of one renewal.

The meeting considered and endorsed a 'strawman' proposal for membership which directly reflected the expertise needed by the new PDEF WG to carry out its role.

Action J.7.1: Taking account of:

- (a) The 'strawman' list of expertise of members,***
- (b) The list of scientific topics and champions,***
- (c) The CAS-16 guidance***

The current co-chairs and WMO secretariat to propose co-chairs and members for the new PDEF working group, for discussion at the next working group meeting during the WWOCS and for final approval by WWRP/SSC in November 2014 in Geneva.

The meeting agreed that the TIGGE LAM Panel should be disbanded. Tiziana Paccagnella was asked to take the necessary steps to do this.

Decision: It was agreed to wrap up the current TIGGE-LAM panel at the end of THORPEX.

Action J.7.2: Tiziana Paccagnella to inform current TIGGE-LAM panel members of the decision to wrap up TIGGE-LAM panel.

The need for a TIGGE panel, noted earlier in the meeting, was confirmed and ECMWF was invited to take the necessary steps to set it up.

Action J.7.3: ECMWF is invited to form a TIGGE panel comprising all TIGGE partners and regional representatives of TIGGE-LAM. Co-chairs & ECMWF to propose brief ToR for the TIGGE panel.

8. Any other business

The meeting agreed that the acronym TIGGE should be retained post THORPEX but that the meaning should become 'The International Grand Global Ensemble'.

9. Review of meeting outcomes, decisions and actions; next meeting

9.1 Discuss report to ICSC-12/WWRP-SSC

The meeting noted that a report would need to be prepared for the final ICSC meeting and the WWRP SSC which are expected to be held at the same time (mid-Nov. 2014).

9.2 Review decisions and actions

The meeting reviewed and agreed the actions and decisions arising (see Annex1).

9.3 Next meeting

The intention to meet at the WWOSC from 6-8pm on Monday the 18th August was confirmed.

Annex 1 Actions and decisions arising from the joint meeting of the GIFS – TIGGE and PDP WGs

Action J.3.1: The joint group agreed to review and provide feedback on the YOPP implementation plan, by end of April.

Action J.3.2: Heini Wernli to liaise with PPP over linkages between polar regions and mid-latitudes.

Decision It was agreed that a few new parameters could be added to the fields archived in the TIGGE database to support the THORPEX legacy projects and it is not necessary to drop any fields.

Action J.5.1: Co-chairs to approach leaders of legacy projects to consider a limited number of new fields to be added to the TIGGE database.

Action J.5.2: WMO secretariat and ECMWF to arrange for a press release to publicise the launch of TIGGE-LAM.

Action J.5.3: TP, RM, RS & WMO secretariat to prepare a leaflet to publicise TIGGE-LAM in time for distribution at GEO & EGU meetings in April.

Action J.7.1: Taking account of:

(d) The strawman list of expertise of members,

(e) The list of scientific topics and champions,

(f) The CAS-16 guidance,

The current co-chairs and WMO secretariat to propose co-chairs and members for the new PDEF working group, for discussion at the next working group meeting during the WWOSC and for final approval by WWRP/SSC.

Decision: It was agreed to wrap up the current TIGGE-LAM panel at the end of THORPEX.

Action J.7.2: Tiziana Paccagnella to inform current TIGGE-LAM panel members of the decision to wrap up TIGGE-LAM panel.

Action J.7.3: ECMWF is invited to form a TIGGE panel comprising all TIGGE partners and regional representatives of TIGGE-LAM. Co-chairs & ECMWF to propose brief ToR for the TIGGE panel.

Annex 2 Proposed Terms of Reference of the PDEF Working Group as agreed by the joint GIFS-TIGGE /PDP WG meeting

WG on Predictability, Dynamics and Ensemble Forecasting (PDEF)

- a) To advance the science of dynamical meteorology and predictability research, and their application to ensemble forecasting
- b) To encourage scientific investigations to improve ensemble predictions by better accounting for analysis, model and forecast uncertainties
- c) To promote research on the evaluation of ensembles
- d) To foster collaboration between the academic community and operational centres
- e) To promote the development of ensemble applications and the transition into operations
- f) To support WWRP projects and field experiments, including Forecast Demonstration Projects and Research and Development Projects
- g) To promote the use of TIGGE, TIGGE-LAM and other ensemble datasets
- h) To facilitate and encourage training in the science of predictability, dynamics and ensemble forecasting
- i) To provide the scientific direction to the development of the TIGGE and TIGGE-LAM archives