WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR ATMOSPHERIC SCIENCES

CAS/THORPEX ICSC/
GIFS-TIGGE 10 Report of the meeting

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THORPEX ICSC
GIFS TIGGE Working Group
Tenth Meeting

Boulder, CO USA
25-27 June 2012

Original: ENGLISH

REPORT OF THE MEETING

1. Organisation of the meeting

1.1. Aims of the meeting

Richard Swinbank outlined the aims of the meeting which included consolidating and completing the work so far and looking at future arrangements post THORPEX i.e. after 2014.There were two key aspects to the work – the first was the TIGGE databases which were a real success. More needs to be done to expand the research use although this was now substantial. The second area was product development for demonstration and evaluation. The aim was to increase collaboration with the SWFDPs. It was hoped to add new products to the SWFDP website later in the year. Operational implementation will be, however, a matter for CBS.

1.2. Adoption of the agenda

The agenda was discussed and agreed with addition on an item (7.3) on the use of TIGGE data in hydrology.

1.3. Working arrangements

The working arrangements were agreed.

2. Report and actions from previous meetings

2.1. Status of actions from the ninth GIFS-TIGGE meeting (R. Swinbank)

The actions were reviewed:
P1 – (archive usage statistics) updated in February
P2 – (update TIGGE references) completed
P3 – (model descriptions on website) ongoing, is now fairly up to date
P4 – (reports on previous actions) completed
9.2.1 – (contact with polar project) done
9.2.2 – (contact with subseasonal to seasonal project) done
9.2.3 – (report to WWRP/JSC on SWFDP collaboration) done
9.2.4 – (TIGGE review article) on the agenda for this meeting
9.3.1 – (supply T+0 data) ongoing
9.3.2 – (supply data to WMO lead centre on verification) completed, NCEP is starting the work, Met Office is a little behind
9.3.3 – (invitation to join SNAP project) ongoing
9.3.4 – (add training materials to data portals) not much progress, carried over.
9.4.1 – (report from European interoperability project) carried over
9.5.1 – (attend SWFDP SG meeting) done, Young-Youn Park attended

9.6.1 – (MRI questionnaire on TC website) on the agenda for this meeting
9.6.2 – (invitation to contribute products to MRI website) on the agenda for this meeting
9.6.3 – (invite HFIP expert to WG meeting) done
9.6.4 – (use of high res models for TC intensity forecasting) email contact with CMA and JMA has been established. Carried over.
9.6.5 – (addition of central pressure & intensity to CXML) ongoing
9.6.6 – (encourage TC forecast verification) ongoing
9.7.1 – (invite submission of La Plata basin proposal to WWRP) done
9.7.2 – (report on EPS application to hydrology) on the agenda for this meeting
9.7.3 – (documentation for severe weather products website) done
9.7.4 – (SWFDP RSMCs invited to evaluate prototype products) on the agenda for this meeting
9.8.1 – (session on EPS improvement) done; covered by Wednesday afternoon session
9.8.2/9.8.3 – (nominations to focus groups on TC and precipitation products) have not been implemented, the co-chairs decided to abandon these actions due to poor response
9.10.1 – (nomination for CPTEC representative) done

2.2 IPO update, (J. Caughey)

Jim Caughey provided an update on THORPEX activities. The main meeting schedule was outlined and the plans for ICSC 10 (Geneva 3-5 Oct) outlined. The THORPEX progress report was being reviewed by the WWRP JSC with comments requested by the 30th June. The THORPEX Executive Committee met in March to consider possible post THORPEX arrangements and developed a short paper which contains three options for the way ahead. These were outlined and it was noted that the EC prefers Option C.

2.3 Outcome of THORPEX ICSC-9 and EC meetings (R. Swinbank, J. Caughey)

The actions arising form the ICSC 9 for the attention of the GIFS-TIGGE WG were discussed,
ICSC 9(11) – (strengthen links with SWFDPs and continue product development) this is progressing in conjunction with the SWFDPs
ICSC 9(12) – (consider process for operational implementation of products) ongoing
ICSC 9(13) – (WG membership changes) done

2.4 Outcome of WWRP/JSC5 meeting (R. Swinbank, J. Caughey)

The two actions from the WWRP JSC 5 meeting for the GIFS-TIGGE WG were reviewed,
WWRP JSC 5(13) – (TIGGE archive post THORPEX) on the agenda for this meeting
WWRP JSC 5(14) – (raise profile of TIGGE) ongoing

2.5 Outcome of SWFDP SG (R. Swinbank)

Young-Youn Park attended the meeting on behalf of the GIFS-TIGGE WG and gave a presentation on ensemble TC products and other MRI products. The main concern of the SG was the delay in receiving the products which tended to handicap assessment and evaluation which were best carried out nearer to real time. There

were also concerns about the complexity of the information. It was better to present only the best and most useful information. A more general questionnaire than that developed by MRI was needed for feedback purposes.

2.6 Report on THORPEX Africa RC meeting (R. Swinbank, J. Caughey)

A summary of this meeting was provided. The focus now falls on completing and publishing the 4 case studies with the help of the THORPEX WGs. These comprise severe flooding events across Africa, all of which had major socio-economic impacts. Details are to be found on the AfClix website.

3. TIGGE archive

3.1. Updates from the archive centres (reps from archive centres)

NCAR: An overall summary of recent developments and data stored was given including 220 GB CXML TC data. There is a 740 TB copy of the complete TIGGE archive. The TIGGE model validation data portal (http://tigge.ucar.edu/model-validation.htm), giving access to global upper air and surface observations, has been completed. A CMORPH precipitation analysis has been added. This is satellite based and contains 3 hourly data from 2002 to the present. TIGGE data is supplied earlier to the NCAR Research Applications Lab. for the African meningitis project with the approval of the IPO.
The data volume being accessed was going up but the number of active users was stable. More people were looking at historical data and larger volumes of CXML data were being used. Various improvements were planned – including improved computing and better supporting services in 2013. NCAR plans to only support the legacy data archive at the conclusion of 2014. The future of the legacy archive will be decided in 2016. A strong case will be needed to persuade NCAR to continue supporting ingest of new data into the archive after 2014, and to continue maintaining the legacy data archive after 2016.

Action 10.3.1: Doug Schuster, David Richardson, Jiandong Gong to advertise the NCAR model validation portal on the other archive data portals and TIGGE website.

Action 10.3.2: **Yuejian Zhu** to establish the possibilities and practicalities of providing the NCEP data to the ECMWF archive centre in the event that the NCAR archive centre ceases to function in the post THORPEX era.

ECMWF: There are around 70-80 active users of the database with similar archive data volumes to those of NCAR. A potential future problem of expanding data volumes as model resolutions constantly increase was flagged. It may be that the limit of what can be moved around is approached. In discussion it was noted that if this occured it may be possible to limit the problem by reducing the resolution of the archived data especially at the higher levels or just to reduce the number of fields.

CMA: The LDM system has been upgraded. Missing data in the system is being greatly reduced. New service improvements are being made especially to the TIGGE processing software. However, further funding support from CMA is needed for both future hardware and software developments.

3.2. News from the data providers, (reps from data providers)

ECMWF: The ocean model has been changed (to NEMO) and the EPS is now coupled to the ocean after 10 days for both the 00 as 12 UTC forecasts; no major changes to ensemble configuration, although the initial EDA perturbations have been redefined to use the EDA ensemble mean instead of the EDA control as the reference. The reforecasts have been extended from 18 to 20 years and a new surface reanalysis is used to initialize the reforecast surface fields It was noted that re-forecast data will be available in the new sub-seasonal to seasonal project.

Canada: There have not been any significant changes to the EPS systems. Data transfer appears to be OK. The vertical resolution of the model is being increased.

CMA: There has been no change to the operational system. The CMA was acrtive witin the SE Asia SWFDP. The Asian Regional Committee has now established a TIGGE WG with a membership of 7 people and topics similar to the GIFS-TIGGE WG. A 4th Asian THORPEX Science Symposium was planned for Kunming at the end of Oct. 2012. China was developing a position on possible post THORPEX arrangements.

NCEP: The horizontal resolution of the model has been improved to around 50-55km. As a result hurricane forecasts were improved with a 10-20% improvement in track prediction. Initial condition improvements were responsible for another 5% improvement. NAEFS was showing good promise with a gain of 1 day from the combined ensemble. However, a lot of work had been devoted to setting this up operationally although this is now regarded as justified. Bandwidth is an issue and high capacity lines have a high cost.

JMA: There were no changes to the EPS but a new computer was now installed. TIGGE data was at 1.25 degrees whilst the EPS was at 0.75 degrees – so a gap has emerged. It seems some centres have kept in line with the model resolution whilst others have left it fixed.

CPTEC: The computer system has been upgraded to a massively parallel Cray machine. There are no changes to the EPS system but the perturbation method is being improved.

BOM: AGREPS (Australian version of MOGREPS) has now been running for over 1 year in research mode using a 60km global grid, 24 members and 40 to 24 km regionally. There is no commitment to go operational at this time. The experimental data will not be placed in the TIGGE archive until a decision about going operational has been taken. The necessary support is not available at this time.

Met Office: Plans for EPS developments will be presented during the Wednesday afternoon workshop. There are only minor planned changes to the TIGGE data with no change to resolution (60km) or the number of EPS members (24). It was noted that an error was recently introduced, setting all the CIN output to zero; that will be corrected in due course.

KMA: In the absence of a representative from KMA, Richard Swinbank provided a brief update. The KMA global EPS now uses a higher resolution (40km) than that

used by the Met Office, with 24 members and 70 levels. Ensemble TC tracks from the new system were very good using an effective bogusing system.
It was noted that three Unified Model based systems will generate ensemble forecasts for TIGGE – UKMO, KMA and (in due course) BoM.

Meteo-France: no report was available.

4. Research using TIGGE data

4.1. New reforecast dataset (T. Hamill)

The GEFS (Global Ensemble Forecast System) changed to T254 in Feb. 2012. Reforecasts have been produced for 00Z with 11 members from 1984 to the present. Archives exist at ESRL (fast access to 99 variables at 1 degree and 28 "special" variables (e.g., surface temp and winds, precipitation) at native resolution, ~0.5 degrees) and at DOE/Berkeley Lab. (slow, tape access to the full archive). Web links to download data from these archives are expected soon. The status is that daily ensemble reforecasts for 1985-2010 have been completed for u,v,q,T, etc., as well as Northern Hemisphere hurricane tracks; 2011 and 2012 data will be available in the next few months (real-time data is already available from NCEP via their NOMADS server).. For the raw numerical guidance, there is a roughly 1.5 to 2.5 day gain in skill compared with the first generation reforecasts. There is some evidence of less accurate forecasts in the early years (1980's) because of poorer observations networks.

For post-processed precipitation forecasts, the gain in skill relative to first-generation reforecasts is 1-1.5 days. Some case studies have been conducted on "atmospheric rivers" along the west coast of the US. For a case when the predictability of mid-latitude cyclones was limited, the post-processed precipitation forecasts of western US rainfall was limited at 6 days, and somewhat even at 2 days. For another case where there was high predictive skill of the associated cyclone, the post-processed forecasts indicated high probabilities of an extreme rainfall event even 6 days prior.

At the DOE/Berkeley lab's archive, the full model states are available, and for users seeking to run regional reforecasts, these global reforecasts may be useful for providing initial and lateral boundary conditions. An example was shown of a regional reforecast of hurricane Rita (2005), which was improved both in track and intensity in the regional reforecast.

In summary, a reforecast data set has been created for the operational NCEP GEFS. The reforecast data set is useful for statistical calibration of the real time forecasts. The reforecast data may be a good companion to the TIGGE data sets – useful for comparisons e.g. multi-model versus single model with calibration.

4.2. Model dependence and an idea for post processing of multi-model ensemble forecasts (C. Bishop)

This work is based around climate models and the use of various different models so could be applied to non-homogeneous EPS data. 24 CMIP3 models were being considered over a period of 29 years. Ensemble post processing based on a Replicate Earth paradigm led to lower prediction errors (monthly mean RMS errors were much reduced from around 1.9C to 1.3C), and flatter rank histograms. NWP models change much more rapidly than CMIP models and so there is a need to get

enough data between updates to apply the techniques. It is difficult to beat the multi-model mean for TCs.

4.3. Spatial verification methods and application to ensembles (B. Brown)

There is areal challenge to arrive at verification methods for high resolution forecasts. The RMS errors don't reflect better forecasts. It is important not to ignore the structure in the forecast fields. Also verification methods should be diagnostic. New spatial approaches can be neighbourhood based, look at scale separation, be feature based or consider field deformation. They all measure different things. Feature based methods are easier. There are two main types – CRA (Contiguous Rain Area) and MODE (Method for Objective based Diagnostic Evaluation). CRA looks at displacement (translation to best fit) – finally it provides a pattern error (displacement and volume error).

MODE provides some smoothing of the precipitation field and identification of which features go together i.e., pairing up so that locations, intensity and areas can be compared.

The various approaches for applying spatial methods to ensemble forecasts were reviewed. It would be interesting to apply these to the TIGGE data. A big drawback is that homogenous gridded fields for observational data are not available in Europe.

4.4. Proposed review paper on TIGGE research

There was a general discussion about the objectives and best approach to this work. More papers were appearing in the literature. Also, the structure of the paper needs to be decided e.g. by identifying the main themes. It is also important to capture the current and planned future use of the archives and not just the historical use. This could bear directly on the future maintenance of the archives.

Following discussion Richard Swinbank agreed to prepare an outline of the paper in consultation with Istvan Synogh and Heini Wernli. Laurie Wilson agreed to assist.

Action 10.4.1: :**Co-Chair** to contact PDP Co-Chairs to agree the structure of a TIGGE research review paper in consultation with **Laurie Wilson**, with the intention of a good draft available by the next WG meeting. Subsequently, a version of the paper should be submitted for publication in the scientific literature

5. SWFDP

5.1. Current status & feedback received on current & prototype products (M. Kyouda)

Support is being provided to the S E Asia SWFDP by JMA. There are two main types of products – TC tracks and heavy rainfall predictions. Support is also given to the NW Pacific TC EPS project. This involves deterministic and ensemble forecasts as well as strike probability and point strike probability. The process is production of products at MRI which are then transferred to the WMO regional Centre at Hanoi and so onto the NMHSs. Feedback at various levels is an important part of the overall process.

This is along the lines of current support to the SWFDPs generally i.e. multi-model products delivered to the regional centres and then onto the individual national centres. General results show that the multi-model ensemble severe weather products beat the best single-model (ECMWF) version and there is a better relationship between observed and forecast probabilities.

More evaluation is gradually taking place each season as additional scores are added.
Products are now being produced at Oxford University so the data flow is ECMWF to Oxford and then MRI/JMA – which is quicker than the original methods of transferring all the data to Japan. Products are plotted for various regions, including the SWFDPs; they could be produced for the La Plata basin project.

Action 10.5.1: Co-chair & Christopher Cunningham to request Mio Matsueda to generate severe weather products for the La Plata Basin as soon as possible.

5.2. Questionnaire and feedback on current and prototype products

It was noted that the MRI questionnaire was generated some time ago and distributed by the Typhoon Committee Secretariat to the member countries; it was mainly aimed at obtaining feedback on TC products on the WWRP/TCP website from forecasters in the Typhoon Committee region. After that became clear, a more general GIFS-TIGGE questionnaire on the current and desired usage of severe weather products was compiled, and has now been sent out by Richard Swinbank to the regional SWFDP centres. Responses have been requested by the end of July, to help to determine which products should be supplied to the SWFDP websites for evaluation.

5.3 Plan for the introduction of GIFS products to the SWFDP and their evaluation

The multi-model ensemble approach shows increased skill over the single ensemble for surface temperature, precipitation and TC tracks. So, the main focus of GIFS product development is planned to be on the multi-model approach, but could also include innovative products based on single model ensembles. The next steps in the GIFS development process will include the generation of multi-model versions of ensemble TC track products and closer to real time versions of severe weather products. Priorities for further development should reflect the responses to the questionnaire sent to the SWFDP centres. There is also need to engage the verification WG in evaluation of products.

5.4 Possible development of real-time versions of gridded products

It was recognised that ECMWF EPS data could be used by the Met Office to generate near real time multi-model products for the SWFDPs. The NCEP data could form a third component. If possible, JMA data should also be included, to allow a real-time product based on the same four ensembles as the prototype product developed by MRI. The WG recognised that the Met Office could and should take the lead and implement real time support to the SWFDPs within existing data policies.

Action 10.5.2: **Met Office, JMA** and **MRI** to develop a joint proposal for delivery of products in near real time to the SWFDPs, in consultation with ECMWF and NCEP, by October 2012. The Met Office is the lead organisation under the GEOWOW project. This proposal should consider calibration, verification and feasibility issues and establish timescales for implementation.

6. Tropical Cyclones

6.1. US. Hurricane Forecast Improvement Program (Bob Gall)

The vision is to organise the hurricane community to dramatically improve numerical forecast guidance to NHC in 5-10 years. Targets involve reducing track and intensity errors by 20% in 5 years and 50% in 10 years, extending useful predictions to 7 days and increasing the probability of detecting rapid deepening at day 1 to 90% and at day 5 to 50%. This is a major programme with annual expenditure of around 23M$. Intensity is the biggest challenge – the NHC official intensity errors show little or no improvement. Funding is distributed across a number of areas e.g. DA, ensembles, verification, applications, societal impacts etc.
The general strategy is to use global models at high resolution for track forecasts out to 7 days and then regional models at 1-3km resolution for intensification predictions. A hybrid DA system will be used for the both global and regional scales using as much satellite and aircraft data as possible. Statistical post-processing will be used to increase skill.
Big efforts are being made to engage and organise the US community i.e., Navy/ONR, NCAR, NOAA/OAR, NRL, Universities, etc. Global models outperform regional for track – after 2 days a global model is needed. A global model is also needed for prediction of genesis. The track error for 2010 -2011 is similar to that of ECMWF.
Intensity is controlled by inner core convective processes and so a high resolution regional model is then essential. Also, high resolution inner core observational data is necessary for good predictions.
The project uses the NOAA Jet computer system (phase 4 SJet). In 2012 improvements will be made to HWRF with expected gains in track and intensity predictions.

6.2. Typhoon Landfall FDP and NW Pacific TCEFP (B. Brown)

The TCEFP website is hosted by JMA/MRI. Improvements are being made to include training in the use of products, surveys of utility and further improvements to products. It is intended to add wind speed and precipitation.
The TLFDP seeks to demonstrate the performance of the most advanced forecasting techniques for landfall typhoons. Actions in 2012 include providing real time products to all members, extending the verification system and organising a workshop to discuss progress. The TLFDP is to be extended to 2015 with enhanced goals. It was noted that the TLFDP already uses some regional models. Liaison with TIGGE-LAM would be helpful.
A new proposal to address TC formation, and seeking to use TIGGE data, had been proposed by Prof Elsberry. It is now anticipated that that work will be included in the extended NWP TCEFP and TLFDP projects.
It was noted that using a consistent tracker code was not possible because centres use their own individual systems.

Action 10.6.1: Tiziana Paccagnella to contact the Shanghai Typhoon Institute concerning the use of regional models in the TLFDP and assessment of the skill of TC intensity forecasts in high resolution models

6.3. 2012 Tropical Cyclone Genesis Ensemble Forecast (Y.Zhu)

This work considers TC genesis probability forecasts using various global EPS systems (ECMWF, NCEP, Canada, etc.) to get some idea of how likely a storm is to form. The main focus is on TC genesis at 48h ahead. The track after genesis is then evaluated.

Future work will investigate getting more reliable TC genesis criteria for each EPS system and in generating multi-model TC genesis products.
At present there is a strong tendency for models to generate TCs too often i.e. there is a high false alarm rate.

6.4. Enhancements to the CXML content and data exchange

The CXML exchange is well established. However, there is the question of what additional information about TCs might be included in messages? Every centre produces forecast tracks, some include central pressure. ECMWF also sends maximum wind for the system. The US would like to some "size" information included e.g. radius of tropical storm force winds or radius of maximum winds.
The WG agreed that future action should be guided by the response to the questionnaire.

Action 10.6.2: Co-chair to review the completed SWFDP questionnaires to see if there are any implications for the content of CXML messages.

Action 10.6.3: The WG encourages **providing centres** to include information on forming storms in CXML messages (initially using location / time as identification and subsequently discuss a naming convention).

Action 10.6.4: IPO to check the original letter issued on CXML messages and the replies from the centres

7. Rainfall & Gridded Products

7.1. La Plata Basin project (C. Cunningham)

The La Plata Basin Research and Development Project (LBP-RDP) considers forecasting of heavy rainfall over the La Plata Basin. The project is at the pre-study and planning stage. This includes quantifying the skill of state of the art models over the LPB and seeking ways to anticipate extreme events (EPS approach).
The sources of errors in models are also being considered, to feed into model development. Similarly the impact of additional observational data is being evaluated as is the use of TIGGE data. A large group of people is being assembled. Publicity activities are underway and a formal letter of commitment has been sent to CAS. A presentation has been made to the WWRP JSC and also to the CHUVA Workshop. A forecast demonstration is being planned to link with the next CHUVA observational campaign.
Funding remains an issue and a funding proposal has been made, A meeting has taken place with ONS who operate the hydro-electric power system in Brazil. They have agreed to become a part of the project. They also have an interest in forecasting extended dry spells.

Action 10.7.1: Christopher Cunningham to consult with **Tiziana Paccagnella** to ensure transfer of the benefits from the TIGGE-LAM work to the La Plata Basin Project

7.2. Possible use of TIGGE products in other projects (e.g. Sochi 2014)

There was a need to establish how the WG could better support this project. It is not clear what the requirements really are.

Action 10.7.2: The Co-Chair to contact Dmitry Kiktev (Sochi 2014) to discuss possible requirements in detail

7.3 Hydrology (D. Richardson)

The Hydrological use of Ensembles (HEPEX) project was outlined. Information can be found on the website www.hepex.org. The main objectives include demonstrating the reliability of hydrological ensembles and providing a platform for exchange of ideas and results. Important questions relate to what adaptations are needed to EPSs for hydrological applications and how should hydrological EPSs be modified to account for uncertainty.
HEPEX has written two white papers on links with THORPEX. These include access to TIGGE data, providing feedback and helping HEPEX use TIGGE data. Some scientific questions have been identified e.g. how important is the feedback from hydrological processes for the atmospheric circulation?
It seems that around 15 hydrological centres, mostly in Europe, are using EPSs. There are over 50 publications in the literature and some review articles. This area of work also links into the GEOWOW project.

8. Links with other THORPEX & WWRP groups

8.1. DAOS working group (T. Hamill)

The objectives and membership of the DAOS WG were outlined. The WG has considered the impact of data in different NWP systems. AMSU-A has the dominant effect. A review report on targeted observations has been written and published by the WMO. This indicates that in the tropics the effects on the accuracy of assimilations and forecasts are positive, but vary from model to model whereas in the extra-tropics the results are more open to question. There were no impacts from targeted observations in a re-run of the WSR 2011 data over broader areas, though research is ongoing to evaluate the impact in smaller, selected target areas.
Concordiasi was a major international experiment focusing on use of observations in the Antarctic. Additional observations were gathered from driftsondes and dropsondes etc. The impact was positive with improvements in forecasts.
Data assimilation systems are also considered by the group including Hybrid 4D-VAR; see J. Whitaker's workshop presentation for a review of this topic.
Some problems with data sharing remain, e.g. related to precipitable water observations from GPS. The European programme is E-GVAP but data are not exchanged with the US and vice versa, due to US problems in dealing with different data formats. ECMWF finds assimilating the US radar rainfall data has a small positive effect on forecasts in the US and there may ne some positive downstream benefits as well. There is a potentially serious gap in polar-orbiting satellite data coming up if the NPP ceases to operate before the JPSS- 1 comes on-line. This would leave only Metop in service. Other satellite data may help alleviate the problem, and a hyper-spectral sounder has now been agreed for Meteosat 3rd generation. Concerning the future it is expected that DAOS will become a WG of the WWRP after THORPEX ends. The WG should develop and/or maintain close links with WMO programs ET-EGOS, GLASS and SPARC.

8.2. PDP working group (C. Bishop)

The PDP WG would like to see more interaction with the TIGGE WG. It is now acknowledged that the TIGGE data set is being used extensively for dynamical process research. At the recent PDP meeting forecast busts were discussed – associated with too weak warm conveyor belts. ECMWF had also been looking at busts over Europe. A large data set was available and showed a pattern emerging at 3 days i.e. a trough over the Rockies and CAPE over the eastern US.
The results from T-PARC are being reviewed with emphasis now on process and genesis questions rather than data impacts.
Understanding model error remains a large part of the PDP role.
The DIAMET and PANDOWAE projects were then outlined.
Systematic errors in typhoon forecasts at ECMWF and the Met Office are being addressed – the former is too dry whilst the latter is too wet.
A good point of interaction between the two WGs could be to focus on busts and errors in forecasts.

8.3. Links with TIGGE-LAM (T. Paccagnella)

The TIGGE-LAM plan has been published. The TIGGE-LAM Panel is now organised in a regional structure and focal points identified. Work to archive the European LAM EPSs at ECMWF has just started as part of the GEOWOW project.
There are active projects at CMA related to severe convective events and heavy rainfall. The N American EPS test bed is proceeding and also links to a hydrometerological test bed. In S America a super model ensemble system is being developed involving 54 members from several models. In S Africa a high resolution EPS forecast system is being developed based upon the WRF model with boundary conditions from NCEP. In Europe the SRNWP project is running and it is likely that Eur EPS will be approved. This will be for a 1 year feasibility study of convective permitting ensembles starting on the 1 Jan. 2013.
FROST 2014 is an RDP/FDP for the Sochi Olympics. It includes 5 models at the convective scale (1km) and a number of ensemble systems e.g. COSMO-LEPS, ALADIN-LAEF, GLAMEPS and TIGGE. There is strong involvement of the Verification WG
The possible move of TIGGE-LAM to the Mesoscale WG was disussed. The WG was not in favour at this time.

Decision 10.8.1. The WG supports close links between TIGGE-LAM panel and the Mesoscale WG but it does not support any organisational changes concerning TIGGE-LAM at this time, in view of the impending completion of THORPEX.

8.4. Update on new sub-seasonal & polar projects (R. Swinbank)

The sub-seasonal to seasonal project is intended to fill the gap between medium range and seasonal forecasting and is a collaborative project between the WWRP and WCRP. A planning group has been formed and a project plan written.
Applications are envisaged in areas such as agriculture, warning systems, disease control, etc. Scientific issues include heavy rainfall and extreme events, the MJO and stratospheric effects. The project will address a variety of modelling issues including resolution, systematic errors, ensemble generation and verification. The potential predictability of sub-seasonal events will be evaluated.
The database will follow the example of TIGGE model using GRIB2 but the ability to provide data NetCDF for the WCRP community, as well as GRIB2, is crucial. It is expected to be only about 10% of the size of the TIGGE archive.

It is expected that the project will run initially for 5 years with a Project Office established and Steering Group in place.

The WWRP Polar Prediction project was outlined. It arose from a recommendation by CAS. An Implementation Plan has been written around various themes. These include predictability/diagnostics, exploiting EPS systems, improving perturbation methods, including sea ice and ocean and land surface models. A Year Of Polar Prediction (YOPP) is suggested – this would be held in about 5 years time and involve intensive observations and modelling.

9. Future plans

9.1. THORPEX legacy

The WG discussed the THORPEX legacy and post possible THORPEX arrangements. A paper has been commissioned by the ICSC from the THORPEX EC for discussion at ICSC 10 in Oct. 2012. THORPEX WGs and ICSC members are invited to submit a one-page document setting out their view, which will be included as an annex to the ICSC paper. It is expected that the WWRP will be organised into a series a WGs addressing long term fundamental issues and a series of specific projects supported by Trust Funds. It is envisaged that the DAOS WG will become a WG of the WWRP. The consensus of the WG was that the PDP and TIGGE groups might merge to form another "Predictability and Ensembles" WG in the WWRP. The WG strongly supported the continuation of TIGGE beyond the end of THORPEX. The TIGGE data set is an invaluable resource for: scientific research on predictability and dynamics; EPS validation and verification; development of probabilistic forecast products; benefiting from enhancements and wider use resulting from the GEOWOW project. It was recognised that the continuation of TIGGE will require support from at least one of the archive centres. The WG felt that the ongoing management of TIGGE could be accomplished with the minimum of effort.

Action 10.9.1: **Co-chair** to draft a one-page summary on WG input concerning the post-THORPEX arrangements to the ICSC, then circulate to WG members and PDP co-chairs, before submission to the IPO by 15 July.

10. GEO

10.1. GEO-WOW EU project (D. Richardson)

This project aims to improve the TIGGE archive at ECMWF and provide wider access through the GEOSS Common Infrastructure (GCI). The project began in Sept. 2011 but real work started just a few weeks ago when staff where in place. The project is led by ESA, with about one half devoted to the GCI and the other half is split equally between the Water, Weather and (Ocean) Ecosystem SBAs (societal benefit areas).

There are three main threads. The first is enhancing the TIGGE archives by adding European LAM EPSs, creating time series data sets and providing TIGGE in NetCDF to reach a wider community. The second seeks to improve data quality and integration by looking at bias and calibration, combination techniques and reducing forecast errors. Finally the third topic includes development of products and applications for high impact weather and supporting the SWFDPs.

The project is multi-disciplinary and so modelling of river discharge data using TIGGE is being explored using the observed data from the Global Runoff Data Center.
The project will run for 3 years and is currently on track.

Action 10.10.1: Laurie Wilson to contact **David Richardson** concerning the selection of locations for time-series data from the ECMWF TIGGE archive for the GEOWOW project

10.2. Report on on-going activities and future opportunities (J. Caughey)

The TIGGE work remains an important element of the GEO Workplan. Some examples of the work appeared in the recent GEO publication "Crafting Geo Information". The TIGGE Task Sheet can be inspected by visiting the GEO website. Regular updates take place.
The current GEO Director, Jose Achache, has retired and been replaced by Barbara Ryan who was previously the Director of the WMO Space programme.

11. Membership

The Co-Chair vacancy was discussed. The Co-Chair and IPO will consider the matter further in the near future and make a recommendation to ICSC 10.

Action 10.11.1: Co-chair & IPO to identify a new co-chair and submit the nomination, with any other recommended WG membership changes, to ICSC-10.

12. Any other business

There was no other business

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

The actions and decisions were reviewed and agreed. An invitation was extended for the WG to meet in the first half of June 2013 at the Met Office

PARTICIPANTS

1) GIFS-TIGGE WORKING GROUP

Richard Swinbank (Co-chair)
David Richardson
Gong Jiandong
Mike Naughton (via teleconference)
Christopher Cunningham (for Osvaldo Moraes)
Laurie Wilson
Masayuki Kyouda
Doug Schuster
Yuejian Zhu
Tiziana Paccagnella

3) WWRP / THORPEX WG REPRESENTATIVES

Tom Hamill (DAOS Working Group)
Craig Bishop (PDP Working Group, via teleconference)
Barbara Brown (JWGFVR)

4) INVITED EXPERTS

Zoltan Toth (ESRL)
Brian Etherton (ESRL)
Bob Gall (NOAA, HFIP)

5) WMO SECRETARIAT

Jim Caughey

Annex 1

Actions and Decisions GIFS-TIGGE WG 10

Permanent Actions

Action P.1: All **archive centres** to update statistics on TIGGE data users on an annual basis (end of each year), using similar statistics for users, actives users, etc. Doug Schuster to coordinate.

Action P.2: **Yuejian Zhu** to carry out literature search for papers based on TIGGE data on an annual basis (end of each year), and summarise results. Archive centres to ask users to inform them when TIGGE papers are written, to enable the list of TIGGE publications to be kept up to date.

Action P.3: All **data providers** to provide model descriptions in agreed Excel format and to update the files after significant changes and send to ECMWF.

Action P.4: **Co-chairs** to request reports before each WG meeting onall actions, plus relevant progress reports.

Actions carried forward from GIFS-TIGGE 9

Action 9.3.4: **WG members** to consider adding to training material on the TIGGE data portals, including data access and manipulation examples, to help potential users of the TIGGE archive.

Action 9.4.1: **Tiziana Paccagnella** to arrange for report on European TIGGE-LAM interoperability to be circulated for the benefit of related activities in other regions by Dec 2012.

Actions from GIFS-TIGGE 10

Action 10.3.1: **Doug Schuster, David Richardson, Jiandong Gong** to advertise the NCAR model validation portal on the other archive data portals and TIGGE website.

Action 10.3.2: **Yuejian Zhu** to establish the possibilities and practicalities of providing the NCEP data to the ECMWF archive centre in the event that the NCAR archive centre ceases to function in the post THORPEX era.

Action 10.4.1: **Co-chair** to contact PDP co-chairs to agree the structure of a TIGGE research review paper in consultation with **Laurie Wilson**, with the intention of a good draft available by the next WG meeting. Subsequently, the paper should be submitted for publication in the scientific literature

Action 10.5.1: **Co-chair & Christopher Cunningham** to request Mio Matsueda to generate severe weather products for the La Plata Basin as soon as possible.

Action 10.5.2: **Met Office, JMA** and **MRI** to develop a joint proposal for delivery of products in near real time to the SWFDPs, in consultation with ECMWF and NCEP, by October 2012. The Met Office is the lead organisation under the GEOWOW project. This proposal should consider calibration, verification and feasibility issues and establish timescales for implementation.

Action 10.6.1: **Tiziana Paccagnella** to contact the Shanghai Typhoon Institute concerning the use of regional models in the TLFDP and assessment of the skill of TC intensity forecasts in high resolution models

Action 10.6.2: **Co-chair** to review the completed SWFDP questionnaires to see if there are any implications for the content of CXML messages.

Action 10.6.3: The WG encourages **providing centres** to include information on forming storms in CXML messages (initially using location / time as identification and subsequently discuss a naming convention).

Action 10.6.4: **IPO** to check the original letter issued on CXML messages and the replies from the centres.

Action 10.7.1: **Christopher Cunningham** to consult with **Tiziana Paccagnella** to ensure transfer of the benefits from the TIGGE-LAM work to the La Plata Basin Project

Action 10.7.2: **Co-Chair** to contact Dmitry Kiktev (Sochi 2014) to discuss possible requirements in detail

Decision 10.8.1: The WG supports close links between TIGGE-LAM panel and the Mesoscale WG. But it does not support any organisational changes concerning TIGGE-LAM at this time, in view of the impending completion of THORPEX.

Action 10.9.1: **Co-chair** to draft a one-page summary on WG input concerning the post-THORPEX arrangements to the ICSC, then circulate to WG members and PDP co-chairs, before submission to the IPO by 15 July.

Action 10.10.1: **Laurie Wilson** to contact **David Richardson** concerning the selection of locations for time-series data from the ECMWF TIGGE archive for the GEOWOW project

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