

Report of GIFS-TIGGE WG

(Submitted by Richard Swinbank and Masayuki Kyouda)

1. Introduction

The GIFS-TIGGE working group was established in 2005, first to manage the TIGGE (THORPEX Interactive Grand Global Ensemble) project to support research on ensemble prediction, and second to support the application of ensemble forecasts as the basis of a future Global Interactive Forecast System (GIFS).

The initial focus of the working group has been the establishment of the TIGGE data set, comprising regular ensemble forecasts from ten of the leading global numerical weather prediction centres. These data are made available for use by the international research community through three archive centres at ECMWF, NCAR and CMA. The archives start in October 2006, so over 5 years of data are now available from some of the data providers. During that period, a number of improvements have been implemented by the data providers, which are reflected in the TIGGE archive contents.

The working group also takes a strong interest in research related to ensemble prediction, including: development of improved ensemble prediction systems; calibration of ensemble forecasts (including bias correction and downscaling); combination of ensemble members produced by multiple prediction systems; and development of probabilistic forecast products. The TIGGE data are also invaluable for a wide of research and development work, including the fields covered by the two other THORPEX working groups - Data Assimilation and Observing System (DAOS) and Predictability and Dynamical Processes (PDP) - and other WWRP working groups, including the Working Group on Numerical Experimentation (WGNE), Socio-economic Research and Applications (SERA) and the Joint Working Group on Forecast Verification Research (JWGFVR).

2. Meetings to progress TIGGE and GIFS

Members of the GIFS-TIGGE working group contributed to several meetings and conferences during 2011/12. The following are of particular note:

SWFDP Steering Group meeting

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 preferable to present only the best and most useful information. It became clear that a more general questionnaire than that previously developed by MRI was needed to provide feedback to guide future GIFS product developments.

Africa Regional Committee meeting, May 2012

Richard Swinbank attended the Africa regional committee meeting, together with representatives from other THORPEX working groups. The priority of the meeting was to decide the research priorities of the group for the next few years. It was agreed to focus on completing and publishing four 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.

10th GIFS-TIGGE WG, Boulder, June 2012

One aim of the meeting was to review and consolidate recent progress with GIFS-TIGGE project. The success in establishing the TIGGE archive has enabled a range of research projects to be carried out; the meeting included several presentation of research related to TIGGE. A particular focus was the development of new ensemble-based products which will be evaluated in conjunction with the Severe Weather Forecast Demonstration Project (SWFDP). The working group spent time to discuss the future of TIGGE and GIFS, and discussing possible arrangements for a future programme to follow THORPEX after the end of 2014.

The future membership of the group was considered, and the proposed list of members is shown in Annex A. Annex B lists the actions that were agreed at the meeting.

An afternoon workshop on developments in Ensemble Prediction Systems was arranged in conjunction with the working group meeting. It included presentations by both members of the working group and ensemble scientists from NCAR and NOAA.

ICDM 2012 workshop on 'Dynamics and Predictability of High-impact weather and extreme climate events', August 2012.

Richard Swinbank was co-chair of the scientific organising committee for this workshop, which was sponsored by WWRP-THORPEX, WCRP, IAMAS, IUGG and a range of Chinese sponsors. The workshop was designed to bring together scientists from both weather forecasting and climate prediction communities to discuss the dynamics and predictability of severe events at all timescales. The presentations covered a range of topics relevant to THORPEX including tropical and mid-latitude cyclones and the use of ensembles for probabilistic predictions of severe weather events. The workshop included a panel discussion of the THORPEX legacy and priorities for future research, chaired by Tetsuo Nakazawa.

3. TIGGE activities

Researchers can readily access the data set after a simple registration process. Normally access is granted with a delay of 48 hours after the initial time of the forecast. There are a large number of registered users across the three archive centres, but a more meaningful statistic is that there are almost 100 active archive users each month – see Figure 1. This is thought to underestimate the number of active users of TIGGE data, since some users may access the data on behalf of several colleagues, for example.

The GEOWOW project, funded under the EU FP7 programme, was started in autumn 2011. This project is supporting ongoing developments to TIGGE, including improved treatment of time-series data and the provision of data in NETCDF format as an alternative to GRIB2. The main focus of GEOWOW is the development of GEOSS (Global Earth Observation System of Systems) which will facilitate the multi-disciplinary use of TIGGE data.

The TIGGE dataset is a rich resource for a range of research studies, and the number of scientific publication based on TIGGE data continues to grow. Some notable recent publications include a comparison of the prediction of southern hemisphere cyclones (Froude, 2011), the prediction of the Madden-Julian Oscillation (Matsueda and Endo, 2011) and a study of the impact of extra-tropical transition of tropical cyclones (Keller et al, 2011). There is a continuing interest in the use of reforecast datasets to improve the calibration of ensemble forecasts; recent comparisons between multi-model and reforecast-calibrated techniques have been published by Hagedorn et al (2012) and Hamill (2012).

The number of scientific studies that are based on TIGGE illustrate the increasing acceptance by universities and funding agencies of the value of the TIGGE dataset.

Feedback received, via colleagues on the PDP WG and from scientific meetings such as the ICDM2012 workshop, underline the value of maintaining and adding to the dataset.

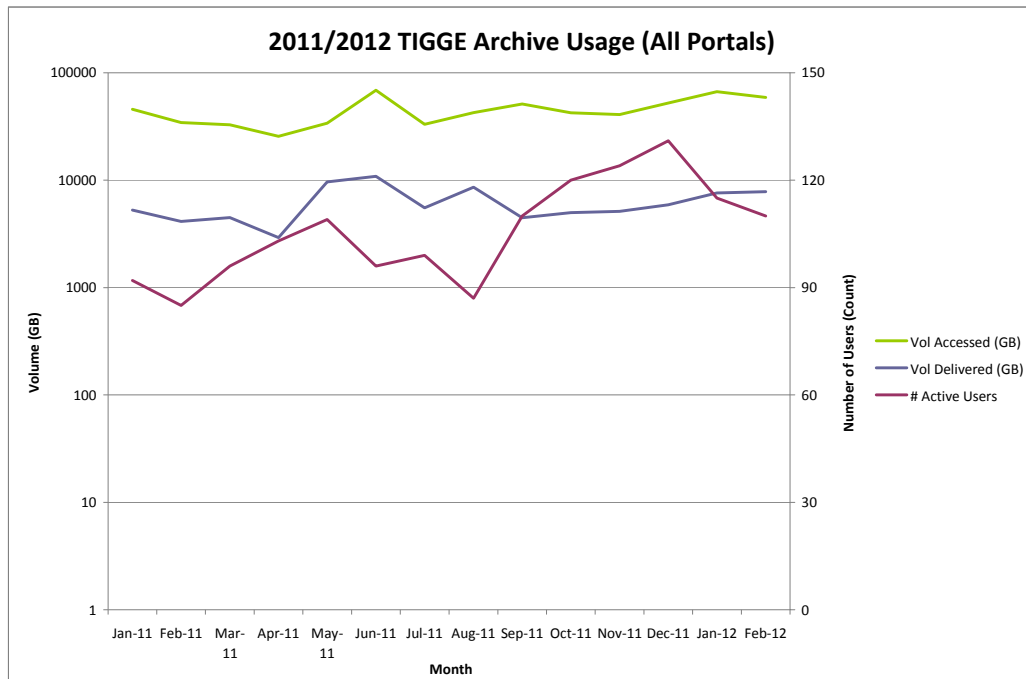


Figure 1 – Time series of monthly usage of TIGGE archive portals through 2011/12

To complement the global focus of the GIFS-TIGGE WG, a TIGGE-LAM expert panel has been established to focus on regional ensemble forecasting. The panel facilitates the interoperability of the different regional modelling systems contributing and coordinates the archiving of limited-area ensemble forecasts. The three TIGGE archive centres have agreed to host a sub-set of high priority TIGGE-LAM data; the development of that capability at ECMWF is supported through the GEOWOW project. The TIGGE-LAM group has established a strong working relationship with the WWRP/MWFR (Mesoscale Weather Forecasting Research) group, but also needs to maintain strong technical and scientific links with the GIFS-TIGGE working group.

4. GIFS developments

Ensemble forecast data in the TIGGE database provides a valuable resource to develop prototype products to support forecasts of high-impact weather. The working group established a GIFS development project to support the development of additional forecast products to contribute to the regional subprojects of the SWFDP. This will enhance links between WWRP-THORPEX and the operational weather forecasting community, and allow products based on multi-model ensemble forecasts from the GIFS-TIGGE partners to supplement the data available from the SWFDP to operational forecasters.

Several of the partners have developed products to support forecasts of high-impact weather. These developments started with products based on the exchange of tropical cyclone track forecasts, using a new XML-based format (known as CXML), which was initiated during the T-PARC field programme. The exchange of tropical cyclone forecasts has been maintained, for the ongoing North West Pacific Tropical Cyclone Project and other regional demonstration projects. More recently, some prototype products have been developed to highlight the risks of heavy rainfall, string winds and extreme temperatures.

In order to guide future developments, a questionnaire was distributed via the SWFDP. The results from the survey confirmed that probabilistic products focused on tropical cyclones, heavy precipitation and strong winds are particularly important to forecasters, but other

issues including predictions of sea state also need to be addressed. The main focus of forecasters is on the short-range, underlining the need to be able to provide ensemble-based products as close to real time as possible.

5. Future Plans

Following the discussion at the working group meeting, a submission was prepared for the ICSC consultation on a possible THORPEX follow-on programme. The paper reiterates the benefit of continuing the archiving of TIGGE data. The GIFS-TIGGE WG proposes a future Predictability and Ensemble Forecasting working group, to strengthen the scientific focus on ensemble forecasting as part of the core WWRP programme. For further details, please see the GIFS-TIGGE WG submission, which is included as an annex to the ICSC-10 THORPEX legacy paper.

References

Froude, L. S. R., 2011: TIGGE: Comparison of the Prediction of Southern Hemisphere Extratropical Cyclones by Different Ensemble Prediction Systems. *Weather and Forecasting*, 26,388-398.

Hagedorn, R., Buizza, R., Hamill, T. M., Leutbecher, M. and Palmer, T. N., 2012, Comparing TIGGE multimodel forecasts with reforecast-calibrated ECMWF ensemble forecasts. *Q.J.R. Meteorol. Soc.* doi: 10.1002/qj.1895

Hamill, Thomas M., 2012, Verification of TIGGE Multi-model and ECMWF Reforecast-Calibrated Probabilistic Precipitation Forecasts over the Contiguous US Monthly Weather Review. 140, 2232-2252

Keller, J. H., S. C. Jones, J. L. Evans, and P. A. Harr, 2011: Characteristics of the TIGGE multimodel ensemble prediction system in representing forecast variability associated with extratropical transition, *Geophys. Res. Lett.*, 38, L12802, doi:10.1029/2011GL047275

Matsueda, M., H. Endo, 2011: Verification of medium-range MJO forecasts with TIGGE. *Geophys. Res. Lett.*, 38, L11801, doi:10.1029/2011GL047480.

Annex A: Proposed GIFS-TIGGE WG membership, for endorsement by ICSC

Richard Swinbank, co-chair,	Met Office, UK
Masayuki Kyouda, co chair	JMA, Japan
Philippe Arbogast	Météo-France, France
Jiandong Gong	CMA, China
Seung-Woo Lee	KMA, Korea
Oswaldo Moraes	CPTEC, Brazil
Michael Naughton	BoM, Australia
Tiziana Paccagnella	ARPA-SIM, Italy
David Richardson	ECMWF, UK
Doug Schuster	NCAR, USA
Laurie Wilson	EC, Canada
Yuejian Zhu	NOAA/NCEP, USA

The entries in **bold italics** are changes since ICSC-9 and require approval by ICSC.

Annex B: Actions from 10th meeting of GIFS-TIGGE WG

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, active 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 on all 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

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.