

WMO, Geneva (17-18 November 2014)

**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 develop the TIGGE (THORPEX Interactive Grand Global Ensemble) data set of ensemble predictions, and second to foster research and development on ensemble prediction and the application of ensemble forecasts in order to contribute towards a future Global Interactive Forecast System (GIFS).

Since the TIGGE archive was launched in October 2006, the usage of TIGGE data has increased substantially, both in terms of the number of users and the amount of data downloaded – see Figure 1.

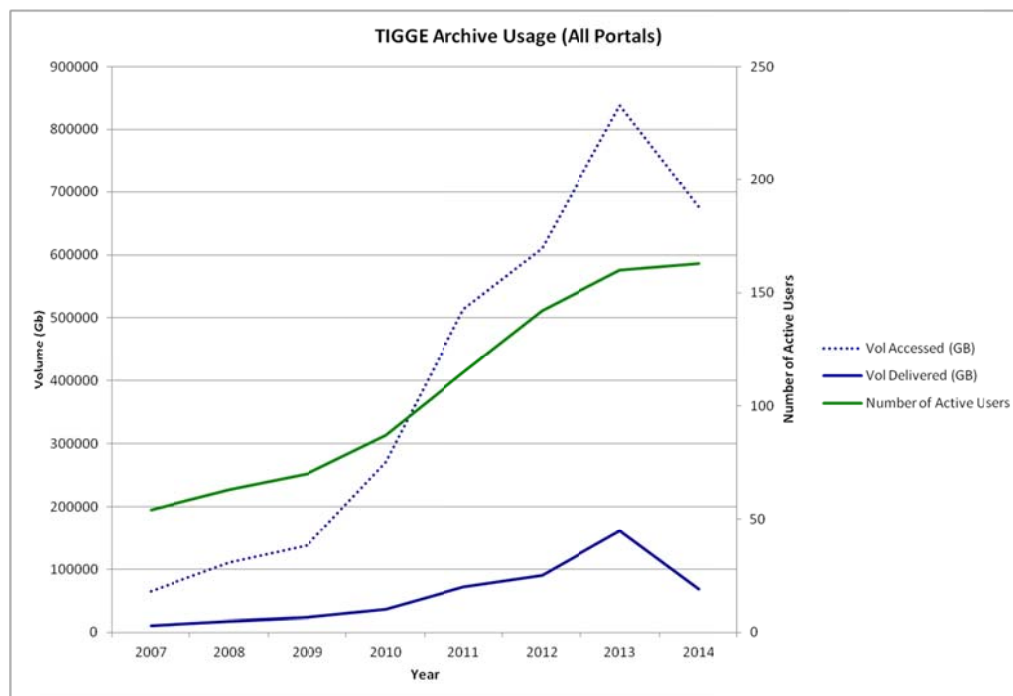


Figure 1 – Time series of annual usage of all TIGGE archive portals from 2007 through 2014. Data volumes are annual totals (10 months for 2014), and the number of active users is the average per month, or total number for CMA.

## 2. Meetings relevant to TIGGE and GIFS

Members of the GIFS-TIGGE working group contributed to several meetings and conferences since the ICSC11 meeting, including:

### 2.1 CAS-16

Both co-chairs attended the CAS-16 meeting in November 2013 at Antalya, Turkey where the post-THORPEX plans were discussed, including the proposal for the new WWRP

working group on Predictability, Dynamics and Ensemble Forecasting (PDEF) and the continuation of the TIGGE archive beyond the end of the THORPEX programme. A side meeting was held to inform the meeting delegates about TIGGE and its achievements.

### *2.2 GIFS-TIGGE 12 and joint meeting with PDP*

The twelfth working group meeting was held at WMO headquarters in March 2014, plus a joint meeting with the Predictability and Dynamical Processes (PDP) working group. The joint meeting included a detailed discussion of the proposed terms of reference of the PDEF working group, and the initial scientific challenges that the group should address, with input from Jean-Noel Thépaut, co-chair of the Working Group on Numerical Experimentation (WGNE).

### *2.3 WWOSC and joint GIFS-TIGGE/PDP meeting*

Many working group members attended the World Weather Open Science Conference in Montreal during August 2014. Tom Hamill and Richard Swinbank convened a well-attended session on “Stochastic Forcing, Ensemble Prediction and TIGGE”. There was a further brief joint meeting of the GIFS-TIGGE and PDP working groups mainly to discuss the proposed terms of reference of a future technical liaison group (TIGGE panel).

## **3. TIGGE activities**

The TIGGE dataset is a rich resource for a range of research studies, with about 120 publications based on TIGGE data, as of early 2014. This illustrates the increasing acceptance by universities and funding agencies of the value of the TIGGE dataset, underlining the value of maintaining and adding to the dataset.

### *3.1 GEOWOW project*

The 3-year EU-funded GEOWOW project was completed at the end of August 2014. The funding provided by the project has enabled enhancements to the TIGGE archive and supported further research and development using TIGGE data, including:

- Establishment of the TIGGE-LAM archive for Europe (see below);
- Improved ability to get time-series data from TIGGE;
- Application of TIGGE data to prediction of river outflow;
- Development & validation of ensemble calibration methods;
- Use of large-scale flow to enhance prediction of heavy precipitation events;
- Probabilistic forecast products for the CBS Severe Weather Forecast Demonstration Project (SWFDP, see below)

### *3.2 TIGGE-LAM*

The European TIGGE-LAM archive was launched in March 2014, at the GIFS-TIGGE WG meeting in Geneva. TIGGE-LAM complements the original TIGGE archive and enables research users to have easy access to a range of European regional EPS data. The forecasts provided detailed short-range forecast information at high resolution (between about 2 and 12km grid spacing).

Information about TIGGE-LAM is given on the TIGGE website at <http://tigge.ecmwf.int/lam>, and data are available from the portal at [http://apps.ecmwf.int/datasets/data/tigge\\_lam/](http://apps.ecmwf.int/datasets/data/tigge_lam/)

Figure 2 illustrates the range of ensemble prediction data that are available via the TIGGE-LAM portal. It is envisaged that TIGGE-LAM will provide valuable data to support future research activities on high-resolution probabilistic forecasting, including the new WWRP High-impact Weather (HIWeather) project. Although TIGGE-LAM currently only covers Europe, there are several other initiatives addressing high-resolution forecasts for severe weather events, notably the US Hazardous Weather Testbed that has been running for more than a decade (see Clark et al, 2012). In the future, TIGGE-LAM could be extended to support WWRP Forecast Demonstration Projects (FDPs) or Research and Development Projects (RDPs) for limited periods, provided that resources to allow that are included in the relevant project budgets.

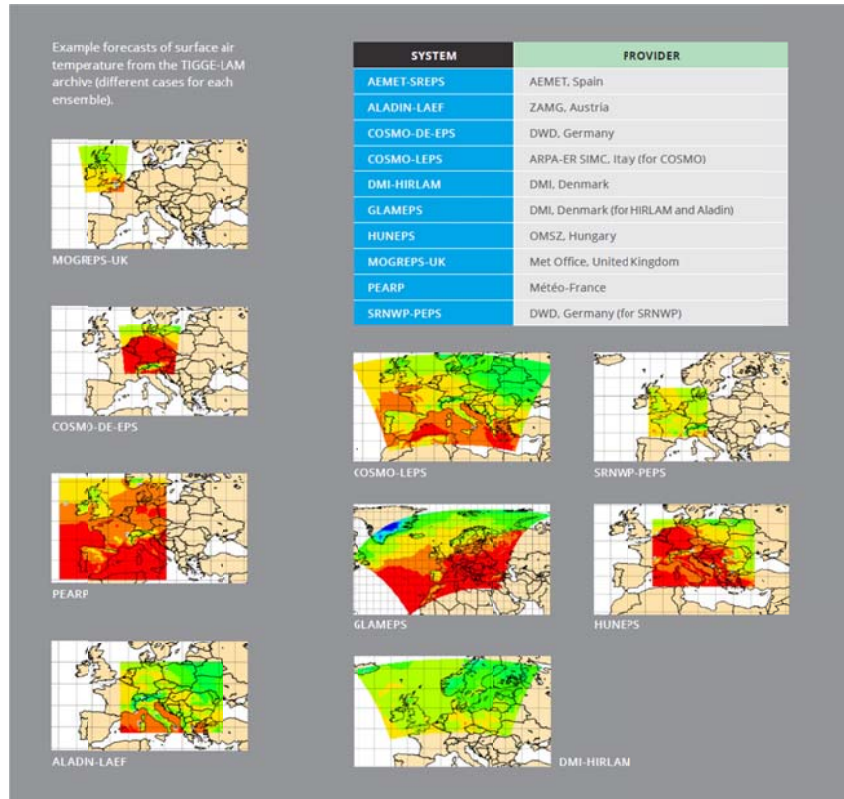


Figure 2 Illustration of the datasets available from the TIGGE-LAM archive (figure adapted from the TIGGE-LAM publicity leaflet)

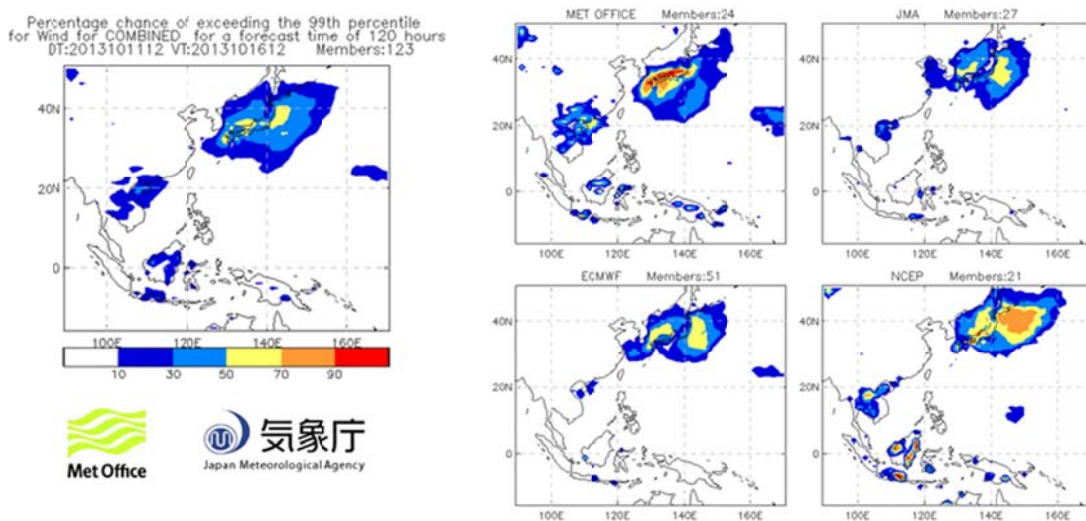


Figure 3 Example of a set of plots from the real-time system to produce severe weather products for the SWFDP. This example, for typhoon Wipha in October 2013, shows the probability of wind strength exceeding each model's climatological 99<sup>th</sup> percentile, with a forecast time of 5 days.

### 3.3 Product development & SWFDP support

The GEOWOW project has enabled development of additional products that are now available for use by forecasters participating in the severe weather. The products include multi-model grand ensemble forecasts of tropical cyclones and real-time

version of the severe weather products developed by Matsueda and Nakazawa (2014). In collaboration with the Japan Meteorological Agency (JMA), the Met Office has set up a system that acquires ensemble prediction data from four of the leading global NWP centres to generate plots to support warnings of heavy rainfall and strong winds up to 5 days ahead. An example is shown in Figure 3. Further development of real-time ensemble tropical cyclone forecast products, including prediction of cyclone formation, has been discussed by the CBS/DPFS expert team on operational weather and forecasting process and support,.

#### *3.4 BAMS Paper*

Following earlier encouragement from the WWRP JSC and THORPEX ICSC, a paper describing TIGGE and its achievements has been submitted for publication in the Bulletin of the American Meteorological Society (BAMS). The article confirms that the combination of data, from several single-model ensembles to create a multi-model grand ensemble, produces forecasts that are an improvement over any single-model ensemble. This result holds for forecast parameters including rainfall and near surface temperatures, and also for tropical cyclone track predictions. A range of studies of dynamical processes and predictive skill that have been carried out using TIGGE data are also summarised. The paper also describes forecast products developed using TIGGE data, including hydrological forecast applications.

The paper has recently been revised, following the reviewers' comments, and re-submitted to the BAMS editors.

#### **4. Future Plans**

During the year, we have obtained agreement of most of the TIGGE partners to continue to support the TIGGE project beyond the completion of THORPEX, with review after 5 years. Both the European Centre for Medium-range Weather Forecasts (ECMWF) and the China Meteorological Administration (CMA) will continue to host TIGGE archive centres. To reflect the completion of THORPEX, it is planned to change the name of TIGGE to "The International Grand Global Ensemble". It is planned that the new WWRP PDEF group will take over the scientific direction of TIGGE from 2015, with technical support from a TIGGE panel. Further information about the plans for PDEF is given in document 2.3.x.

The continuation of TIGGE will provide support to the THORPEX legacy projects as well as WWRP FDPs and RDPs. The GIFS-TIGGE working group has agreed, in principle for (small) extensions to the contents of TIGGE, where needed to support the THORPEX legacy projects, provided that resources can be found.

#### **References**

Clark, A. J., and coauthors, 2012: An overview of the 2010 Hazardous Weather Testbed experimental forecast program spring experiment. *Bull. Amer. Meteor. Soc.*, **93**, 55–74.

Matsueda, M. and T. Nakazawa (2014): 'Early warning products for extreme weather events derived from operational medium-range ensemble forecasts', *Meteor. Apps.* doi: 10.1002/met.1444

## **Annex A: Actions from GIFS-TIGGE WG meetings**

### **Actions from the 12<sup>th</sup> meeting of GIFS-TIGGE working group (Geneva, 18 March 2014)**

**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 on all actions, plus relevant progress reports.

**Action P.5:** 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 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 11.3.4:** JMA and CMA are requested to consider extending CXML tropical cyclone forecast data to all ocean basins.

**Action 11.3.5:** WMO secretariat to send a formal letter to NCDC to convey appreciation of their work and to request continuation of the provision of NCEP data to the TIGGE archive.

**Action 12.3.1:** CMA is requested to confirm whether they will continue to host a TIGGE archive centre after the conclusion of THORPEX, by the time of the WWOSC.

**Action 12.3.2:** Co-chairs to check with CAWCR over the version(s) of CXML schema that should be used for TC data exchange

**Action 12.3.3:** NCDC, ECMWF, NCEP and NCAR to make arrangements for processed NCEP TIGGE data to be sent to ECMWF instead of NCAR, to complete the transition by the end of 2014

**Action 12.3.4:** Data providers to reply to the WMO letter to confirm their future participation in TIGGE as soon as possible.

**Action 12.4.1:** Richard Swinbank & Tiziana Paccagnella to liaise with ECMWF about the inclusion of additional information about TIGGE-LAM and the transition of the TIGGE website to a new web/wiki framework.

### **Actions and decisions from the joint meeting of the GIFS-TIGGE and PDP WGs (Geneva, 19-20 March 2014)**

**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 midlatitudes.

**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:

- (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 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

#### **Actions and decisions from the joint meeting of the GIFS–TIGGE and PDP WGs (Montreal, 18 August 2014)**

**Action M.2.1:** David Richardson to check which regions are going to be included in the CBS precipitation forecast verification work.

**Action M.3.1:** Comments on the draft TORS for the TIGGE panel to be provided to Richard Swinbank and David Richardson by the end of September.

**Action M.3.2:** Gong Jiandong is asked to inform the members of both WGs about what TIGGE LAM data is currently archived by CMA and especially whether LAM data from other countries (e.g. Japan, Korea etc.) is included.

**Action M.3.3:** David Richardson and Tetsuo Nakazawa to draw up a list of the TIGGE archive contact points who would become members of the future TIGGE panel.