

Report of GIFS-TIGGE WG
(Submitted by Philippe Bougeault and Zoltan Toth)

1. Summary

Currently all ten global weather prediction centres are providing ensemble forecasts to the three TIGGE data archive centres. All three global archive and data portal centres are operational. The URL for the third centre at the Chinese Meteorological Administration (CMA) is <http://wisportal.cma.gov.cn/tigge>. The archives now contain data for more than two years from some providers. Under a simple registration process access is given with a delay of 48 hours after the initial time of the forecast. Real time access is granted in some cases e.g. for field experiments and projects of special interest. Registration for real time access is handled by the WWRP-THORPEX International Programme Office at the WMO. The number of users is currently reaching about 200 (combining users of all three archive centres). A general announcement that the TIGGE capability and service is available to users is planned for the near future – see Annex 1. A TIGGE User Meeting will be held during the May 2009 THORPEX science conference.

Early science results indicate that multi-model forecasts are in general better than the forecasts of the best component system. However the gain is highly variable depending on component systems, parameters, forecast ranges and bias corrections applied. More research is needed to establish the cost/benefits of operational multi-model systems. Several papers will be published in peer-reviewed journals soon.

A TIGGE-LAM expert panel has been set up to define arrangements for TIGGE-LAM databases, building on the global TIGGE arrangements as much as possible. The priority here is to develop standard formats enhancing the interoperability of the existing systems. Another objective is to facilitate the use of lateral boundary conditions from various global systems by limited-area models.

TIGGE is paving the way towards a Global Interactive Forecasting System (GIFS). An urgent development to make GIFS a reality is to accelerate data exchange between the partners and a phased approach has been adopted. A pilot project has been defined, based on the real-time exchange of tropical cyclone tracks during the T-PARC field programme. This has been extremely successful. Later on, dedicated communications lines will be needed to realize the full benefits of the system. Limited-area ensemble prediction systems will also form an important component of the GIFS.

2. 5th meeting of the GIFS-TIGGE Working Group

The working group held its 5th meeting in Pretoria in March 2008, at the invitation of SAWS. The meeting was attended by all data providers (except Meteo-France), the archive centres, and all regular members. The following is a list of decisions and statements from the meeting.

Recommendations of the THORPEX ICSC

The working group:

- Reiterated its request to have representatives from all Thorpex WGs attending TIGGE meetings. Craig Bishop is already PDP rep. Suggested to have Tom Hamill as DAOS rep. and Barbara Brown as SERA rep.
- In addition welcomed offer by Laurie Wilson to attend SERA meetings as TIGGE rep. and requested that Laurie be invited to future meetings of SERA

- Requested to be informed regularly about activities and membership of the WWRP/SERA WG
- Expressed interest in having a representative in the new Executive Committee of THORPEX

Progress of TIGGE Phase 1

The working group:

- Welcomed the excellent progress of Phase 1 and congratulated the archive centres and the data providers
- Requested the data providers to continue best effort to deliver the missing fields to the archive by end 2008
- Requested the archive centres to complete the development of Phase 1 functionalities, with the following priorities:
 - 1) spatial sub-setting functionalities in the access portal
 - 2) provide meta-data information to document e.g. changes in all systems
 - 3) distribution of data in NetCDF format
- Noted the need to advertise the database and increase number of users
- Recommended to build upon the current NCAR TUG (TIGGE User Group) to develop a TIGGE-wide user group
- Thanked Ken Mylne (ET-EPS) for helping defining the content of the metadata files, and noted that this will be finalized soon
- Noted the requirement expressed by WMO that TIGGE Phase 1 metadata system strictly conform to WIS rules
- Tasked a subgroup to explore the precise meaning of it and cost the effort
- Will decide at the next meeting if the requirement can be met

Verifications

The working group:

- Reaffirmed the need for standardized verifications against both analyses and observations, being fair to all systems (e.g. avoid using observations that have been influenced by quality control embedded into one particular data assimilation system, and use of own/consensus analysis)
- Urged all data providers to undertake to compute verification tables (against their own analysis), following the CBS-recommended rules, and deliver data to JMA for posting on their password-protected Internet site
- Welcomed the generous offer of JMA to temporarily compute verification tables for some systems and for the multi-model system, following the same rules, and post results on their Internet site
- Recommended that verifications against surface observations be developed on a regional basis, using observations available at NCAR, NCDC and other places
- Requested the IPO to task the THORPEX regional committees to organize such verifications using regionally available observations and more generally to encourage the use of TIGGE data

Report of the TIGGE-LAM expert panel

The working group:

- Congratulated the TIGGE-LAM group for its initial results
- Noted that convergence on the content and format of an archive of LAM-EPS data had been nearly achieved
- Noted that the Phase 1 archive centres have offered to archive these LAM-EPS data during Phase 1 (subject to conditions that likely will be met) and acknowledged this additional effort from the archive centres

- Noted strong interest from South Africa, Brazil, Italy, and North-America (and possibly others) to become regional data distribution and possibly archiving centres in due time, and agreed to take this into account in its future discussions
- Noted that convergence on the best format for IC/BC data exchange between global and limited-area models has not yet been achieved
- Encouraged the TIGGE-LAM group to continue consultations with the European "Interoperability" project on these formats
- Noted however that several centres running LAMs may want to use data in pressure levels (with high vertical resolution) without waiting for a "perfect" solution
- Tasked the TIGGE-LAM group to conduct a precise survey of such requests, and reserved the possibility to recommend to the global forecast providers to develop quickly such service, should the number of such requests be significant
- Agreed that a full meeting of the TIGGE-LAM group is necessary and timely and recommended the IPO to support such a meeting
- Encouraged the members of TIGGE-LAM group to participate the B08RDP/WWRP /WMO.

GIFS position paper

The working group was presented with an early version of the GIFS position paper prepared by Zoltan Toth, Richard Swinbank, Beth Ebert and Warren Tennant. It

- Formulated several important comments to the position paper and tasked the subgroup to produce a revised version
- Welcomed several existing efforts by various partners to develop products or software that are relevant for Phase 2 and the GIFS
- Decided to form two discussion groups on the following subjects
 - 1) WIS Compliance and technical aspects of Phase 2 (real-time data exchange, common web interface and archiving)
 - 2) Common toolbox to develop GIFS products
- Invited all TIGGE partners to appoint representatives to these two groups
- Noted that additional funding will be needed to carry out these activities
- Decided to conduct a general discussion on the scope of Phase 2 at its next meeting
- Requested IPO to arrange a presentation on the WIS at the next GIFS-TIGGE meeting
- Noted the success of the SWFDP under CBS and the need for the GIFS activities to be developed in full coordination with such projects (thanked Eugene Poolman for his presentation)

Tropical cyclone tracks exchange pilot exercise

The working group:

- Noted that consensus has been reached for the use of a new CXML format for ensemble TC tracks,
- Encouraged all TIGGE data providers to prepare data in this format and thanked Beth Ebert for her efforts
- Noted that such data exchange programme will help meeting the requirements of IWTC-6
- Agreed that, in order to meet T-PARC requirements by July 2008, the most effective approach will be for each data provider to open a real-time access to these data from a password protected ftp site
- The Phase 1 archive centres were requested to take charge of long-term archiving and distribution of these data, and will prepare a proposal. This will likely impose some constraints (e.g. that data exchange mechanisms and file name conventions adhere strictly to protocols agreed under Phase 1)

- Agreed to consider alternative archiving solutions, for instance at RSMCs and/or in the T-PARC community

TIGGE User Workshop

The working group:

- Confirmed User Workshop to take place in conjunction with TIGGE science meeting in May 2009, California
- Ideally the workshop should be integrated in the main conference, e.g:
 - TIGGE science results on Tuesday pm
 - on Wednesday an overview of the Phase 1, followed by a tutorial on the access to data from the 3 archive centres, a user feedback session and a prospective discussion on Phase 2 and the GIFS
 - On Thursday am a session on SERA type applications
- Should be prepared by a questionnaire distributed to the users
- Should have a presentation on the guidelines for presentation of uncertainty (check exact title)
- Appointed a subgroup for organization (Richard Swinbank, Laurie Wilson, Ken Mylne, Craig Bishop, Mio Matsueda, chaired by Richard Swinbank)
- Plans for workshop will be reviewed at the next meeting
- Will offer PDP/SERA/GEO to join in the preparation of the user workshop

Outreach activities

The following outreach activities were agreed to augment the visibility of the TIGGE database and attract more research use:

- Quick submission of short paper to EOS (target publication in June, Worley, Bougeault)
- Submission to BAMS of a "richer" version (Bougeault, Swinbank, Park)
- Send representatives at various conferences (EGU April 2008, AGU May 2008, EMS October 2008, AMS January 2009, IAMAS August 2009)
- Agreed to participate to 22 September week joint THORPEX event in Geneva. Will need 1 day for a TIGGE WG meeting and 1-2 days for a TIGGE-LAM meeting as part of this event
- User workshop May 2009 California (plus a meeting of the WG)

Finally the working group was delighted to hear about the successful final preparations for B08RDP and thanked Dr. Gong for his presentation. The project of B08RDP has been successfully conducted with the participants of NCEP, CMS, JMA, Meteo-France/ZAMG and CMA in Beijing during the period of the 29th Olympic Games from 8-26 August 2008. The interoperability of the multicenter's regional EPS have been demonstrated. The experience will be helpful for the future development of TIGGE-LAM group.

A detailed list of actions of the working group agreed at the 5th meeting is appended to this report.

3. 6th meeting of the GIFS-TIGGE working group

The 6th meeting took place during the general THORPEX Workshop organized by the IPO in WMO on week 22-26 september 2008.

A full list of decisions and statements from the meeting is not yet available, but the list of actions is appended to this report. The following is a summary of the main points.

The requirements for metadata compliance with WIS rules has finally been clarified and the issue is now resolved. Most data providers have now made available the necessary

metadata information and the users have access to detailed characteristics of the forecasting systems including precise dates and nature of upgrades, etc...

Subsetting functionalities are now available from both ECMWF and NCAR.

Seven data providers made TC tracks available in CXML format in real time from their ftp sites from early Summer 2008. In addition, NCAR was able to start a new archiving and distribution service for these data. Altogether the pilot TC CXML project represented a very significant effort from the TIGGE partners and the working group is looking forward to see results of research using these additional data. The WG congratulated Beth Ebert on the success of the TC track exchange programme during the summer and thanked NCAR for the archiving service. It was agreed that the real-time exchange of data would continue at least until the end of T-PARC (Spring 2009).

Additional pilot projects for real-time forecast exchanges were discussed (quantitative precipitations and extra-tropical cyclones tracks/frontal features). Richard Swinbank will further explore possibilities with the help of experts from several centres.

The WG reviewed the GIFS position paper and approved it subject to few final revisions. At the time of writing of this report, these revisions are being incorporated. The ICSC will be presented with the latest version of the paper.

The survey of the requirements of the various partners for Phase 2 and the GIFS led to the idea that TIGGE-Phase 2 may no longer be needed. The service offered by the TIGGE archive centres is excellent and plans of data providers to substitute it with distributed archives have not yet materialized. It was therefore decided to disconnect the development of the GIFS from the Phase 2 of TIGGE, which had originally been thought to be a prerequisite. References to TIGGE Phase 2 have been removed from the GIFS position paper. The main activities towards the GIFS will therefore be the exchange of real-time forecasts and the development of common toolkits to elaborate multi- or single ensemble products. Archiving may still be achieved by a limited number of archiving centres. A general data portal unifying access methods to real-time and archived data will still be needed. The WG confirmed the creation of two focus groups in order to examine these aspects and invited all partners to nominate their representatives to these focus groups.

The WG reviewed the preparation of the TIGGE User meeting and formulated recommendations in view of ensuring that user engagement will be optimal.

The WG reviewed the progress of the TIGGE-LAM expert panel. It appeared that final convergence on the format of the TIGGE-LAM archives has not yet been reached. An agreement has been found as regards the archiving of European systems at ECMWF. The adoption of the same rules at the two other archiving centres is still under discussion. As regards the format of the Initial and Boundary conditions from the Global systems, the TIGGE LAM group conducted the survey requested during the previous meeting in Pretoria. There is a wider consensus for the provision of ICs and BCs on the model levels to preserve the full information content, The cooperation with the EUMETNET/SRNWP Interoperability Programme, lead by the Met Office, will be discussed and defined in the next months. The TIGGE LAM group stressed the interest in the definition of specific projects to initiate the relocation of existing LAM-EPS systems in other regions such Africa or South America. This activity should be discussed and planned with the Thorpex Regional Committees to focus on the regional relevant issues. The WG recommended that a physical meeting of the TIGGE-LAM community be supported by the IPO. The meeting is currently planned in Bologna, January 19-21, 2009.

ANNEX I

THE THORPEX INTERACTIVE GRAND GLOBAL ENSEMBLE (TIGGE) CONCEPT AND CURRENT STATUS

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Abstract: Ten operational weather forecasting centres producing daily global ensemble forecasts to 1-2 weeks ahead have agreed to deliver in near-real-time a selection of forecast data to the TIGGE data archives at CMA, ECMWF and NCAR. This is offered to the scientific community as a new resource for research and education. The objective of TIGGE (GEO task WE-06-03) is to establish closer cooperation between the academic and operational worlds by encouraging larger use of operational products for research, and to explore actively the concept and benefits of multi-model probabilistic weather forecasts, with a particular focus on severe weather prediction. The TIGGE data policy is to make each forecast accessible via the internet 48h after it was initially issued by the originating centre. Quicker access can also be granted for field experiments or projects of particular interest to WWRP-THORPEX. The future evolution of TIGGE will comprise archiving additional datasets for limited periods, based on requests from WWRP-THORPEX working groups, and transitioning to a distributed archive concept. The future operational use of the TIGGE infrastructure as part of a “Global Interactive Forecasting System” will be considered, subject to positive results from research undertaken with the TIGGE data archives.

Keywords – WWRP-THORPEX, WMO, TIGGE, Multi-model forecasts

1. OBJECTIVES AND CONCEPT

The THORPEX Interactive Grand Global Ensemble (TIGGE) is a key component of THORPEX which in turn is a major component of the World Weather Research Programme (WWRP) of the World Meteorological Organization. A key goal of WWRP-THORPEX is to accelerate improvements in the accuracy of 1-day to 2-week high-impact weather forecasts for the benefit of humanity. TIGGE was initiated in 2005 at a workshop hosted by the European Centre for Medium-Range Weather Forecasts (ECMWF). The workshop report has been published in the WMO series WMO/TD-No. 1273 WWRP-THORPEX No. 5 (www.wmo.int/thorpex).

The objectives of TIGGE are: (i) enhancing collaboration on ensemble prediction, internationally and between operational centres and universities; (ii) developing new methods to combine ensembles from different sources and to correct for systematic errors (biases, spread over-/under-estimation); (iii) achieving a deeper understanding of the contribution of observation, initial and model uncertainties to forecast error; (iv) exploring the

feasibility and the benefit of interactive ensemble systems responding dynamically to changing uncertainty; (v) enabling evolution towards an operational system, the “Global Interactive Forecast System (GIFS)”.

The highest priority data accumulated in the TIGGE archive are the ensemble forecasts generated routinely (operationally) at major forecast centres around the world. This core data stored in the TIGGE archive is accumulating at a daily rate of approximately 300GB from ten providers around the world. Additional special datasets will be added in the future for specific research and applications.

The plan is to implement TIGGE in two steps. In the current *Phase-1* data are collected in near-real time at a small number of central data archives using existing network and storage capabilities. In *Phase-2*, envisaged as soon as possible, data archives will be distributed over a larger number of centres, instead of all being held centrally, while maintaining efficient and transparent access to users. This more flexible solution has the potential to eliminate routine transfers of large data volumes and to reduce running costs at archiving centres, but will require substantial software development, specific funding and coordination with the evolving WMO Information System.

2. PARTNERS AND LINKAGES

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

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

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

3. TIGGE USERS

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

The forecast demonstration projects of WWRP-THORPEX (e.g. Beijing 2008 FDP/RDP or the sand and dust-storm project), the future field campaigns on adaptive observations and the IPY projects will be active users of TIGGE. This research will, in turn, lead to targeted applications reducing societal risk to severe weather through better forecasts (health, energy, flood warning, fire weather, etc..). The hydrological community (e.g. through HEPEX) is also expected to be a strong user of TIGGE data.

4. TIGGE TECHNICAL SOLUTIONS

The data exchange technique is based on the Internet Data Distribution/Local Data Manager from Unidata. The new WMO standard GRIB2 for gridded data was agreed by all partners to support data exchanges between the data providers and the archiving centres. The database is composed of GRIB2 records. The units, the names of the various fields, the accumulation periods, etc... are identical for all data providers. The data providers provide data on grids of their own choosing, which are as close as possible to the native grid employed to carry out the predictions. The data are archived on the same grid as received. The data providers must ensure that appropriate software is available to the archiving centres to enable users to interpolate data to latitude/longitude grids and locations of their choosing. They must also ensure that when revisions to their systems are made, revised interpolation software is communicated to the archiving centres immediately. The archiving centres maintain a user-friendly interface based on the interpolation software supplied by the data providers. This allows the TIGGE users to retrieve easily data at single points or on regular lat-lon grids of their own choosing. Special effort will be made to provide quick access to long series of data at a single point, as this is a frequent request for many applications. Automatic regular requests will also be possible. In Phase 1, each Archive Centre provides data through its own proprietary user interface. However, the supplied data are of course the same. In Phase 2, the user interface will be unified.

Some by-products of TIGGE have already appeared, for instance, the acceleration in implementing various components of the new WMO Information System such as GRIB2.

5. CURRENT STATUS OF THE TIGGE DATABASE

A complete list of data requested from the data providers can be found at the TIGGE Internet site <http://tigge.ecmwf.int>. The data from operational global ensemble forecasts are divided in fields in pressure levels and single level fields. They are listed in the following tables.

Pressure level fields comprise geopotential height, temperature, specific humidity and wind components at 1000, 925, 850, 700, 500, 300, 250, and 200 hPa. Additional fields at the tropopause level are potential vorticity on the 320K potential temperature surface, and potential temperature and wind on the 2PVU potential vorticity level. Other single level fields are listed in the table below.

Pressure level fields

Name	Abbreviation	Unit	Pressure Level (hPa)
Geopotential height	gh	gpm	1000, 925, 850, 700, 500, 300, 250, 200, 50
Specific humidity	q	kg kg ⁻¹	1000, 925, 850, 700, 500, 300, 250, 200
Temperature	t	K	1000, 925, 850, 700, 500, 300, 250, 200
U and V velocity	u	m s ⁻¹	1000, 925, 850, 700, 500, 300, 250, 200
V velocity	v	m s ⁻¹	1000, 925, 850, 700, 500, 300, 250, 200

Single level fields

Name	Abbreviation	Unit
10 meter u-velocity	10u	m s^{-1}
10 meter v-velocity	10v	m s^{-1}
Convective available potential energy	cape	J kg^{-1}
Convective inhibition	ci	J kg^{-1}
Field Capacity	cap	J kg^{-1}
Land-sea mask	lsm	Proportion
Mean sea level pressure	msl	Pa
Orography	orog	gpm
Skin temperature	skt	K
Snow depth water equivalent	sd	kg m^{-2}
Snow fall water equivalent	sf	kg m^{-2}
Soil moisture	sm	kg m^{-3}
Soil temperature	st	K
Sunshine duration	sund	s
Surface air dew point temperature	2d	K
Surface air maximum temperature	mx2t6	K
Surface air minimum temperature	mn2t6	K
Surface air temperature	2t	K
Surface pressure	sp	Pa
Time-integrated outgoing long wave radiation	ttr	$\text{W m}^{-2} \text{ s}$
Time-integrated surface latent heat flux	slhf	$\text{W m}^{-2} \text{ s}$
Time-integrated surface net solar radiation	ssr	$\text{W m}^{-2} \text{ s}$
Time-integrated surface net thermal radiation	str	$\text{W m}^{-2} \text{ s}$
Time-integrated surface sensible heat flux	sshf	$\text{W m}^{-2} \text{ s}$
Total cloud cover	tcc	%
Total column water	tcw	kg m^{-2}
Total precipitation	tp	kg m^{-2}
Wilting point	wilt	Proportion
Potential vorticity at 320K	pv	$\text{K m}^2 \text{ kg}^{-1} \text{ s}^{-1}$
Potential temperature at 2PVU	pt	K
U-velocity at 2PVU	u	m s^{-1}
V-velocity at 2PVU	v	m s^{-1}

Currently ten providers (BMRC, CMA, CPTEC, ECMWF, Meteo-France, MSC, NCEP, JMA, KMA and UKMO) are delivering data, with initial dates varying from Autumn 2006 to Spring 2008. The archive length is therefore reaching two years in some cases. Pressure level data are available from all providers, with very few exceptions. Production of single level fields has proven to be a tough challenge and availability varies widely between providers. However the more useful single level fields (such as the description of basic weather parameters at the surface) are available from all providers. A detailed list of available data can be found from the data portals.

6. ACCESS TO TIGGE DATA FOR RESEARCH AND EDUCATION

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

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

7. OUTLOOK

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

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

Acknowledgements: *The TIGGE-Working Group is composed of representatives from the forecasting centres and of the academic community and has held several meetings to agree on the formats and the content of the initial archive. The IT teams at ECMWF, NCAR and CMA have invested considerable work to initiate the routine exchange and accumulation of data in good technical conditions. Baudouin Raoult of ECMWF and Doug Schuster of NCAR are especially acknowledged for their contribution to the project. The willingness and diligence of the ten providing centres to share their ensemble forecast data is also acknowledged. Jim Caughey and Len Barrie provided useful comments on an early draft of this paper.*

ANNEX 2

GIFS/TIGGE WG 5th MEETING ACTION ITEMS
 Mar 14, 2008

- 1 Information on generation procedures for TIGGE global ensemble metadata:
 - a) Agree on information content - Z. T. coordinates with Ken Mylne, circulate to WG members before it is finalized (K.Mylne, Z.Toth, Apr. 15,)
 - b) Study WIS-compliance aspects and related costs, study xml; set up xml template if appropriate, recommend other format otherwise (B. Ebert, W. Almeida, possibly with some help from ECMWF, Apr 30)
 - c) Producing centers prepare info sheet in table format (marked with implementation date), post this on their web site, send url info to TIGGE webmaster(s) (All producing centers, May 31,)
 - d) TIGGE web master(s) create links to producing center url's (TIGGE webmaster(s), June 30)
 - e) Producing centers add new table every time their system is changed; old tables are to be kept on web for reference (All producing centers, ongoing)
- 2 TIGGE-LAM subgroup to strengthen links with THORPEX Regional Committees (Sep 2008, T. Paccagnella). TIGGE-LAM group to conduct a precise survey of LAM-EPS groups interested in IC/BC in pressure levels in real-time (T.Paccagnella, Sep 2008)
- 3 Regarding EC0-1 from THORPEX EC Febr. 7, 2008 meeting: TIGGE / GIFS WG finds the representation of THORPEX WGs and Regional Committees insufficient with only one co-chair from all WGs and RCs on the EC. This may not allow efficient information exchange between ICSC meeting. A co-chair from each WG and RC would provide much better representation. Note that most EC business could possibly be done via e-mail (co-chairs of TIGGE/GIFS WG will report on this to ICSC, Nov 2008)
- 4 Barbara Brown and Tom Hamill to be moved to SERA & DAOS WGs as recommended by March 2007 TIGGE / GIFS WG meeting (co-chairs report to ICSC, Nov 2008). L. Wilson to represent TIGGE at SERA meetings (co-chairs, IPO)
- 5 Even though SERA WG assumed wider role, we request that for proper collaboration with THORPEX WG, their activities, membership, etc be listed as before under THORPEX in reports etc (ZT report to IPO, Mar. 2008)
- 6 Collect information on usage of TIGGE Phase-1 archive from the three archive centers, share info with WG members (Steve Worley, Sep 2008)
- 7 Advertise TIGGE web forum accessible from NCAR archive site, add links to the forum from other TIGGE access sites (Steve Worley, May 2008)
- 8 Invite a WIS expert to next TIGGE / GIFS WG meeting (co-chairs, IPO, Sep 2008)
- 9 Consider addition of new records into TIGGE Phase-1 data exchange/archive (in format similar to existing variables) depending on more concrete requests from TIGGE-LAM subgroup and PDP WG. For example NWP experiments need more complete information on IC (on continual basis; JMA request, MUMMA-type research) and BC (for preselected periods, ~30 days per year, TIGGE-LAM support) facilitating ensemble experiments (Y. Takeuchi / C. Bishop consult with PDP WG, T. Paccagnella consult with TIGGE-LAM subgroup to develop list of added variables – May 31; producing centers / archive centers consider including additional variables, not to exceed a total of 10% increase in data volume per year – Nov 2008).
- 10 GRIB2 precip encoding/decoding problem noted by JMA; detailed description of problem to be sent to archive centers (Y. Takeuchi, Apr 2008)
- 11 ECMWF web page expanded with list of TIGGE-related publications (P. Bougeault, May 31)

- 12 Explore what observational data readily accessible through NCAR, NCDC/NOAA and possibly other web sites may be relevant for TIGGE verification efforts; add useful information to TIGGE-related web sites (Laurie Wilson, June 2008)
- 13 JMA to continue and expand its WMO-sponsored verification activities following recommendations by Ensemble Expert Team. Final verification of selected upper level grids against each center's own analysis to be provided by each producing center to JMA (All producing centers, ongoing); missing statistics to be computed and posted by JMA (Y. Takeuchi, Jul 2008). JMA to consider verification of a combined, 10-center TIGGE ensemble (Y. Takeuchi, Oct 08) (verifying analysis to be selected after consultation with experts). Verifying analysis for, and verification of precipitation ensembles to be considered later
- 14 Encourage THORPEX Regional Committees & RSMCs in use and user specific verification of TIGGE data against observations or other relevant data (co-chairs, L. Wilson, & IPO, May 2008)
- 15 Prepare draft letter to be sent by WWRP to JMA Intl Affairs Office & KMA (and possibly other producing centers if needed) with request to provide TC data in CXML format on ftp site for research applications during TPARC. Access can be limited to registered users. Request consideration of continued access to data after T-PARC, under conditions defined by data providers (Z. Toth and IPO, April 2008)
- 16 Contact colleagues at CMA (Shanghai) engaged with TC forecasting to explore their interest and willingness to contribute to CXML TC data exchange (J. Gong, May 2008)
- 17 Proposed CXML format and content for real time exchange of TC (and later ETC) accepted by WG with minor changes. CMA, JMA, KMA, ECMWF, CMC (through NCEP), UKMETOFFICE, and NCEP expressed an interest and readiness to make files with TC info in cxml format available through their individual ftp sites in real time by July 2008 for TPARC (Aug-Sep 08, Jan-Mar 09), and with 48-hr delay if desired by any producing center, beyond TPARC Tracking algorithms / software voluntarily shared among centers (7 contributing centers, July 2008).. BOM & METEOFRENCE to explore possibility to contribute later.
- 18 Producing centers to provide ftp site and access info to B. Ebert for inclusion on CXML T-PARC & TIGGE web sites (Contributing centers, June 2008)
- 19 CXML proposal to be augmented by content & name of files to be made available by producing centers (Proposal by B. Ebert, 31 March, final version after consultation with all producing and archive centers, 15 April)
- 20 CPTEC expressed an interest in tracking subtropical and extratropical lows, explores use of cxml format, report on experience to cxml team, and in its ensemble to be processed by other parties for TC tracks (P. Silva Dias, B. Ebert, Sep 08)
- 21 NCAR, and possibly ECMWF could create cxml archive, contingent on appropriate file naming and data transmission protocols. Access / interrogation methods to archived data unclear until further specifications are given. Archiving of TC information to be explored, either at phase-1 archive center(s), and/or in distributed phase-2 framework, in conjunction with focal group addressing phase-2 archiving issues (B. Ebert, Sep 2008)
- 22 WG discussed Phase-2 / GIFS draft plan, including concept of real time data exchange (Phase-2) and product generation (GIFS) as new elements in TIGGE / GIFS, and agreed with general structure of plan. Content needs to be revised; revisions based on specific recommendations (eg, NCAR conditions to link their archive with future common user web interface; interactivity) to be included before document is presented to IPO & ICSC. Archiving to be discussed further at Sep 08 meeting. (Revised plan circulated to WG – Apr 30; WG feedback, May 31; Final version, June 30)
- 23 WG identified archiving of ensemble data and derived products during Phase-2 and GIFS as an area that will need further consideration and discussion. Options to consider include:

For ensemble forecast data:

- a) Continue Phase-1 archive system (3 central locations, with identical copies of data. NCAR & ECMWF expressed a willingness and interest to continue with current archive system
- b) Distributed archiving
 - i) Data archived by 3 centers partitioned, avoiding duplication (eg, each center collects and holds data from 3-4 different producing centers)
 - ii) Data archived by producing centers (Some expressed interest)
 - iii) Combination of (i) & (ii), ie, some centers archive their own data, while others send their data to central archives

For derived products – first assess what needs to be archived, then:

- a) Archive at producing centers
 - b) Archive at RSMCs who use the data
 - c) Archive at data distribution centers (GISC)
 - d) Archive at TIGGE Phase-1 archive centers
 - e) Combination of above, ie, find most suitable solution for each type of data
- Prepare for discussion of archiving issues for duration of Phase-2 & GIFS at next WG meeting (Phase-2 / GIFS Planning sub-group to prepare discussion material for Sept WG meeting, Zoltan Toth & sub-group members, Sept 2008; WG members to report about their center's archiving interest/willingness, Sept 2008)
- 24 Continue current archiving practices at 3 centers until new arrangements are developed and accepted for data archiving,. (Reps from archiving centers, ongoing)
 - 25 For detailed planning, start two focus groups for initial Phase-2 & GIFS planning with volunteers from WG members, technical experts from producing & archive centers, and invited experts on WIS etc (co-chairs, Apr 30):
 - a) Real time data exchange, product generation, web interface, archiving issues
 - b) Tool box (shared development and use of algorithms/software – Mohan Ramamurthy)
 - 26 Focus groups report to full WG (Sep 08 WG meeting, focus group leaders)
 - 27 Start exploring real time exchange of gridded precipitation data as prototype for Phase-2 real time data exchange and GIFS product generation; coordinate with real time data exchange focal group (L. Wilson, P. Dias, Sep 2008)
 - 28 After discussion, WG found YOTC data request lacks some details. Also, it is not clear how wide the potential user base of the new data would be. Further, it was not clear if for the studies foreseen, whether ensemble data would be needed or data from a single high resolution integration may be best. Also, since the generation of the data may require significant resources, it may be preferable to derive the data from special off-line integrations, as opposed to operational forecasts. Overall, the WG felt the request may be better addressed by WGNE, and suggest YOTC contact the WGNE group. (Z. Toth, March 08)
 - 29 The WG briefly discussed the issue of timeliness of data access from TIGGE Phase-1 archives during demonstration projects like T-PARC. It was noted that though the normal 2-day delay for data access is waived for such periods, there is an unavoidable delay of around 36 hrs due to the transmission procedures used to transfer large amounts of data on a regular basis from the 10 producing centers to the 3 archive centers. The WG encouraged interested T-PARC participants to take advantage of the TC track/intensity information that the producing centers plan to make available in real time during T-PARC. Once Phase-2 of TIGGE is developed, real time access to ensemble data will be feasible (Z. Toth, info item for IPO, March 2008)
 - 30 WG agrees to organize TIGGE workshop (or TIGGE sessions) as part of Science Symposium in March 2009. Request IPO to position TIGGE sessions in middle of meeting. Example: Tue pm: TIGGE research results (jointly organized with PDP); Wed morning: overview of TIGGE Phase 1 (~1 hr), followed by tutorial on 3 archive centers (in poster area with 3 PCs, 1 hr), then user feedback on phase-1 (3 hrs); Phase-2 & GIFS plan overview, followed by discussions (3 hrs in

- afternoon); Thurs am: Sera applications (R. Swinbank, Y. Takeuchi, Laurie Wilson volunteered as members of organizing group, along with K. Mylne from Ensemble ET CB from PDP - ongoing; JMA appointed Mio Matsueda as member of the organizing group shortly after the meeting. The co-chairs will appoint a leader for the organizing group)
- 31 Short PR paper on TIGGE Phase-1 to be published in EOS, after NCAR upgrades to its archive in ~June (P. Bougeault, July 08)
- 32 Longer paper with some science results to be published in BAMS (P. Bougeault, Dec 08)
- 33 Presentations at meetings on TIGGE; encourage science results (PDP, SERA, etc):
- a) AMS Annual meeting Feb. 08, New Orleans (Y. Zhu)
 - b) EGU, Vienna, Apr 08, Z. Toth
 - c) AGU, Fort Lauderdale, May 08, Glenn Rutledge
 - d) EMS, Oct 08, P. Bougeault
 - e) Asian TIGGE / THORPEX science workshop J. Gong, Oct 08
 - f) AMS 09, S. Worley
 - g) Brazil, Apr 09, control theory / TIGGE. P. Dias
 - h) IAMAS, summer 09 R. Swinbank
- 34 Suggest to other groups the addition of links on their web pages to TIGGE archive sites (B. Ebert, June 08)
- 35 TIGGE / GIFS WG wishes to participate at Geneva, Sept 22- meeting, request at least 1-2 day separate meeting (co-chairs & IPO, Mar 08)
- 36 TIGGE-LAM sub-group meeting to be organized for Geneva Sep 22- week, 1-2 days, with opportunity for sub-group to join some of TIGGE / GIFS WG discussions (T. Paccagnella, co-chairs, IPO, Mar 08)
- 37 Invite GEO user committees to co-organize and attend THORPEX Symposium and TIGGE workshop/sessions (L. Wilson, IPO, Apr 08, after time/location finalized)

ANNEX 3

GIFS/TIGGE WG 6th MEETING ACTION ITEMS Outstanding action items from 5th meeting listed first Updated Oct 2, 2008

Actions from Mar 08 meeting

- 1 Information on generation procedures for TIGGE global ensemble metadata:
 - f) Agree on information content - Z. T. coordinates with Ken Mylne, circulate to WG members before it is finalized (K.Mylne, Z.Toth, Apr. 15,)
 - g) Study WIS-compliance aspects and related costs, study xml; set up xml template if appropriate, recommend other format otherwise (B. Ebert, W. Almeida, possibly with some help from ECMWF, Apr 30)
 - h) Producing centers prepare info sheet in table format (marked with implementation date), post this on their web site, send url info to TIGGE webmaster(s) (All producing centers, May 31,)
 - i) TIGGE web master(s) create links to producing center url's (TIGGE webmaster(s), June 30)
 - j) Producing centers add new table every time their system is changed; old tables are to be kept on web for reference (All producing centers, ongoing)
 - k) Finish by mid Oct , send to 3 archive centers web link with file
- 38 TIGGE-LAM subgroup to strengthen links with THORPEX Regional Committees (Sep 2008, T. Paccagnella).
Contact made, no specific feedback
TIGGE-LAM group to conduct a precise survey of LAM-EPS groups interested in IC/BC in pressure levels in real-time (T.Paccagnella, Sep 2008)
Efforts made, not all contacts respond; full resolution preferred for BC
- 39 Completed
- 40 Barbara Brown and Tom Hamill to be moved to SERA & DAOS WGs as recommended by March 2007 TIGGE / GIFS WG meeting (co-chairs report to ICSC, Nov 2008). L. Wilson to represent TIGGE at SERA meetings (co-chairs, IPO)
other WGs to be formally notified by THORPEX IPO
- 41 Completed
- 42 Collect information on usage of TIGGE Phase-1 archive from the three archive centers, share info with WG members (Steve Worley, Sep 2008) Not done, delayed until NCAR phase 1 was complete and now need some more time to see if usages increase. CMA was not contacted. Expect ECMWF represents a majority of usage at this point. Carry over objective into '09.
Asking for end of Oct if possible
- 43 Advertise TIGGE web forum accessible from NCAR archive site, add links to the forum from other TIGGE access sites (Steve Worley, May 2008)
Done – WG was cc'd and reinvited to join the TUG. We placed several NCAR announcements there. Not much activity- very few threads of communication.
WG needs to start this going
- 44 Invite a WIS expert to next TIGGE / GIFS WG meeting (co-chairs, IPO, Sep 2008) - Completed
- 45 Consider addition of new records into TIGGE Phase-1 data exchange/archive (in format similar to existing variables) depending on more concrete requests from TIGGE-LAM subgroup and PDP WG. For example NWP experiments need more complete information on IC (on continual basis; JMA request, MUMMA-type research) and BC (for preselected periods, ~30 days per year, TIGGE-LAM support) facilitating ensemble experiments (Y. Takeuchi / C. Bishop consult with PDP WG
Dr Sato pursue this (Dec 08)

T. Paccagnella consult with TIGGE-LAM subgroup to develop list of added variables – May 31; producing centers / archive centers consider including additional variables, not to exceed a total of 10% increase in data volume per year – Nov 2008).

TIGGE-LAM discussion deferred – Paccagnella (Feb 09)

- 46 GRIB2 precip encoding/decoding problem noted by JMA; detailed description of problem to be sent to archive centers (Y. Takeuchi, Apr 2008) – Completed, problem was on JMA side
- 47 ECMWF web page expanded with list of TIGGE-related publications (P. Bougeault, May 31) – done
- 48 Explore what observational data readily accessible through NCAR, NCDC/NOAA and possibly other web sites may be relevant for TIGGE verification efforts; add useful information to TIGGE-related web sites (Laurie Wilson, June 2008)
Possibly refine the list by asking for review and additions from NCDC? Research done, need to discuss & put on web (Wilson, Dec 08)
- 49 JMA to continue and expand its WMO-sponsored verification activities following recommendations by Ensemble Expert Team. Final verification of selected upper level grids against each center's own analysis to be provided by each producing center to JMA (All producing centers, ongoing); missing statistics to be computed and posted by JMA (Y. Takeuchi, Jul 2008). JMA to consider verification of a combined, 10-center TIGGE ensemble (Y. Takeuchi, Oct 08) (verifying analysis to be selected after consultation with experts). Verifying analysis for, and verification of precipitation ensembles to be considered later

Only ecmwf sent and cptec, kma ready. Send verification data to JMA on regular basis (All, ongoing)

- 50 Encourage THORPEX Regional Committees & RSMCs in use and user specific verification of TIGGE data against observations or other relevant data (co-chairs, L. Wilson, & IPO, May 2008)

Needs continued attention (All, ongoing)

- 51 Prepare draft letter to be sent by WWRP to JMA Intl Affairs Office & KMA (and possibly other producing centers if needed) with request to provide TC data in CXML format on ftp site for research applications during TPARC. Access can be limited to registered users. Request consideration of continued access to data after T-PARC, under conditions defined by data providers (Z. Toth and IPO, April 2008) - completed
- 52 Contact colleagues at CMA (Shanghai) engaged with TC forecasting to explore their interest and willingness to contribute to CXML TC data exchange (J. Gong, May 2008)

Check (Z. Toth, Oct 08)

- 53 Proposed CXML format and content for real time exchange of TC (and later ETC) accepted by WG with minor changes. CMA, JMA, KMA, ECMWF, CMC (through NCEP), UKMETOFFICE, and NCEP expressed an interest and readiness to make files with TC info in cxml format available through their individual ftp sites in real time by July 2008 for TPARC (Aug-Sep 08, Jan-Mar 09), and with 48-hr delay if desired by any producing center, beyond TPARC Tracking algorithms / software voluntarily shared among centers (7 contributing centers, July 2008).. BOM & METEOFRENCE to explore possibility to contribute later.
- 54 Producing centers to provide ftp site and access info to B. Ebert for inclusion on CXML T-PARC & TIGGE web sites (Contributing centers, June 2008) – Done by 7 centers
- 55 CXML proposal to be augmented by content & name of files to be made available by producing centers (Proposal by B. Ebert, 31 March, final version after consultation with all producing and archive centers, 15 April)
Name convention adopted with an optional alternative to include “tigge” in filename
- 56 CPTEC expressed an interest in tracking subtropical and extratropical lows, explores use of cxml format, report on experience to cxml team, and in its

ensemble to be processed by other parties for TC tracks (P. Silva Dias, B. Ebert, Sep 08) - outstanding

NCAR, and possibly ECMWF could create cxml archive, contingent on appropriate file naming and data transmission protocols. Access / interrogation methods to archived data unclear until further specifications are given. Archiving of TC information to be explored, either at phase-1 archive center(s), and/or in distributed phase-2 framework, in conjunction with focal group addressing phase-2 archiving issues (B. Ebert, Sep 2008) –Simple archive was established and is running now, contains all TC that have been produced. It is also backed up on the NCAR MSS. Without any advertisement, more than dozen users already.

- WG members noted ECMWF CXML data is available only with ~24 hr delay – check reasons and if it could be made available in closer to real time (Bougeault, Nov 08)
- Sera WG asks about extratropical cyclones – see among new action items

57 WG discussed Phase-2 / GIFS draft plan, including concept of real time data exchange (Phase-2) and product generation (GIFS) as new elements in TIGGE / GIFS, and agreed with general structure of plan. Content needs to be revised; revisions based on specific recommendations (eg, NCAR conditions to link their archive with future common user web interface; interactivity) to be included before document is presented to IPO & ICSC. Archiving to be discussed further at Sep 08 meeting. (Revised plan circulated to WG – Apr 30; WG feedback, May 31; Final version, June 30) - Done

58 WG identified archiving of ensemble data and derived products during Phase-2 and GIFS as an area that will need further consideration and discussion. Options to consider include:

For ensemble forecast data:

- a) Continue Phase-1 archive system (3 central locations, with identical copies of data. NCAR & ECMWF expressed a willingness and interest to continue with current archive system
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 - iv) Data archived by 3 centers partitioned, avoiding duplication (eg, each center collects and holds data from 3-4 different producing centers)
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- a) Real time data exchange, product generation, web interface, archiving issues
- b) Tool box (shared development and use of algorithms/software – Mohan Ramamurthy)

61 Focus groups report to full WG (Sep 08 WG meeting, focus group leaders)

- 62 Start exploring real time exchange of gridded precipitation data as prototype for Phase-2 real time data exchange and GIFS product generation; coordinate with real time data exchange focal group (L. Wilson, P. Dias, Sep 2008) – Discussed at Sept meeting, see new action items
- 63 After discussion, WG found YOTC data request lacks some details. Also, it is not clear how wide the potential user base of the new data would be. Further, it was not clear if for the studies foreseen, whether ensemble data would be needed or data from a single high resolution integration may be best. Also, since the generation of the data may require significant resources, it may be preferable to derive the data from special off-line integrations, as opposed to operational forecasts. Overall, the WG felt the request may be better addressed by WGNE, and suggest YOTC contact the WGNE group. (Z. Toth, March 08) – Done, YOTC contacted WGNE
- 64 The WG briefly discussed the issue of timeliness of data access from TIGGE Phase-1 archives during demonstration projects like T-PARC. It was noted that though the normal 2-day delay for data access is waived for such periods, there is an unavoidable delay of around 36 hrs due to the transmission procedures used to transfer large amounts of data on a regular basis from the 10 producing centers to the 3 archive centers. The WG encouraged interested T-PARC participants to take advantage of the TC track/intensity information that the producing centers plan to make available in real time during T-PARC. Once Phase-2 of TIGGE is developed, real time access to ensemble data will be feasible (Z. Toth, info item for IPO, March 2008) - Done
- 65 WG agrees to organize TIGGE workshop (or TIGGE sessions) as part of Science Symposium in March 2009. Request IPO to position TIGGE sessions in middle of meeting. Example: Tue pm: TIGGE research results (jointly organized with PDP); Wed morning: overview of TIGGE Phase 1 (~1 hr), followed by tutorial on 3 archive centers (in poster area with 3 PCs, 1 hr), then user feedback on phase-1 (3 hrs); Phase-2 & GIFS plan overview, followed by discussions (3 hrs in afternoon); Thurs am: Sera applications (R. Swinbank, Y. Takeuchi, Laurie Wilson volunteered as members of organizing group, along with K. Mylne from Ensemble ET CB from PDP - ongoing; JMA appointed Mio Matsueda as member of the organizing group shortly after the meeting. The co-chairs will appoint a leader for the organizing group) - Done
- 66 Short PR paper on TIGGE Phase-1 to be published in EOS, after NCAR upgrades to its archive in ~June (P. Bougeault, July 08)
Published Sept. 2, took longer than expected
- 67 Longer paper with some science results to be published in BAMS (P. Bougeault, Dec 08)
- check
- 68 Presentations at meetings on TIGGE; encourage science results (PDP, SERA, etc):
- a) AMS Annual meeting Feb. 08, New Orleans (Y. Zhu) - Done
 - b) EGU, Vienna, Apr 08, Z. Toth - Done
 - c) AGU, Fort Lauderdale, May 08, Glenn Rutledge - Done
 - d) EMS, Oct 08, P. Bougeault - Done
 - e) Asian TIGGE / THORPEX science workshop J. Gong, Oct 08, postponed to February 2009
 - f) AMS 09, S. Worley
Paper submitted
 - g) Brazil, Apr 09, control theory / TIGGE. P. Dias
check
 - h) IAMAS, summer 09 R. Swinbank
- 69 Suggest to other groups the addition of links on their web pages to TIGGE archive sites (B. Ebert, June 08)
- check

- 70 TIGGE / GIFS WG wishes to participate at Geneva, Sept 22- meeting, request at least 1-2 day separate meeting (co-chairs & IPO, Mar 08) - Done
- 71 TIGGE-LAM sub-group meeting to be organized for Geneva Sep 22- week, 1-2 days, with opportunity for sub-group to join some of TIGGE / GIFS WG discussions (T. Paccagnella, co-chairs, IPO, Mar 08) – due to conflicts, this meeting is delayed till Jan 2009, see new actions
- 72 Invite GEO user committees to co-organize and attend THORPEX Symposium and TIGGE workshop/sessions (L. Wilson, IPO, Apr 08, after time/location finalized) – Ongoing, Swinbank & Wilson to discuss with IPO (Caughy), Oct 08

New Actions Geneva Sep 22-26 2008

- 1 Peter Chen suggested GIFS focus on practical products, week-2 extension of forecasts, precip, temp, and consider feedback, verification, evaluation (All, ongoing)
- 2 Minor revisions to GIFS plan following WIS presentation (R. Swinbank & Z. Toth, Sept 2008)
- 3 WG benefitted from attendance of experts from other WGs & RCs, including comments on GIFS plan
- 4 Prepare review of existing extratropical cyclone tracking methods (UK Met Office, NCEP (Mike Charles), KMA; R. Swinbank leads, consults with others, is there a possible common ground we could recommend for all centers? – Dec 08)
- 5 CXML data archived at NCAR – 12 users already without advertisement; include CXML in all future TIGGE presentations (all – continuing)
- 6 CXML used in real time at KMA, BOM, NCEP, UKMO; what is summer T-PARC use, how will winter T-PARC use it? (Z.. Toth, Oct 08)
- 7 CXML track combination & verification – collect info from scientists (Beth Ebert – Dec 08)
- 8 CXML user outreach to operational centers using data (Neil Gordon – May 2009)
- 9 Web interface issue for cxml not resolved, include in Focus groups 1-2 discussion items (Co-chairs, Oct 08)
- 10 CXML to be covered in BAMS TIGGE paper (P. Bougeault, Dec 08)
- 11 CXML notes included in next THORPEX newsletter (Beth Ebert, Sept 08)
- 12 No decision on introduction of gml into cxml; Beth to explore issue further and report to WG at next meeting (Feb 2009)
- 13 BOM may contribute cxml by 2010 (Beth Ebert); MeteoFrance by ? (Jean Nicolau)
- 14 Share all cxml-related software, please, using CXML web page (all, continuing)
- 15 CMC CXML data missing (check NCEP processing, Z. Toth, Sept 08)
- 16 CXML availability from ECMWF is late, compared with others? (Y. Park, P. Bougeault, Oct 08). This has been corrected now.
- 17 ECMWF CXML goes out to 5 days only, consider requesting extension? (P. Bougeault, Oct 08). This is because ECMWF operational production of TC tracks stops at day-5. Extension will be considered based on results of T-PARC.
- 18 All centers to include track for hires unperturbed forecast (all, Dec 08)
- 19 Though some centers may set up an archive for their own ensemble data, plans for a distributed Phase-2 TIGGE archive have been withdrawn from TIGGE & GIFS plans. If producing centers decide to develop their own archive, they are encouraged to make their data available through common web interface that will be set up as part of GIFS developments to serve both real time data from producing centers and archived data from 3 central archive centers
- 20 Draft GIFS Plan reviewed in details. Several useful suggestions made. Plan accepted by WG subject to suggested changes being made by R. Swinbank & Z. Toth (Sept 08)
- 21 Co-chairs to distribute and request feedback from other THORPEX & WWRP WGs (comments by 25 Oct 08)
- 22 GIFS Planning sub-group & co-chairs incorporates comments into final version, Nov 10, 08)

- 23 GIFS Plan to be presented to ICSC for their approval (Nov 08, co-chairs)
- 24 TIGGE-LAM planned Jan 09 meeting in Bologna, Italy welcomed by WG; T. Pacagnella to prepare detailed outline and contact IPO with cc to GIFS-TIGGE co-chairs by Sep 30
- 25 TIGGE-LAM developments include coordination with SRNWP Interoperability Project of European nations; Meeting on European TIGGE-LAM archive specifications (Sept 4 2008)
- 26 No decisions yet on specifics of TIGGE LAM boundary and initial condition perturbations (model level / grid / variable vs. standard pressure / lat/lon grid – Pacagnella to bring issue to TIGGE-LAM meeting (Jan 09)
- 27 Precip as next pilot project accepted.
- 28 Need for real time exchange of info to involve forecasters and developers at global and regional centers. Global centers requested to consider making their global precip data available in real time to GIFS product developing centers; data / derived products not to be further distributed without permission of contributing data provider centers (all producing centers inform co-chairs about their ability to contribute, Dec 2008, centers may turn on data distribution as their technical abilities permit)
- 29 Suggestion to work on products initially for 4 regions in parallel: the current and planned CBS SWFDPs of Southern Africa, South America, Southern Pacific, and the disaster prone regions of Southern Asia; design / develop products derived from the combination of ensembles for high impact events specific for each region, eg PQPF for high amounts of precipitation, in collaboration with SERA & RCs, as the distribution of such derived products may have fewer restrictions. Producing centers to notify co-chairs regarding which region(s) GIFS product developments they will be interested to contribute to (All, Dec 08)
- 30 Consider statistical correction of precipitation using regionally available observational data; consider influence on precip of other factors such as MJO (All, ongoing, report at next WG meeting)
- 31 Centers noted expected upcoming changes in next 1-2 yrs:
- MeteoFrance 30-40 members, nonlinearly evolved SVs (computed for 4 regions of globe), 2/day out to 108 hrs
 - KMA MOGREPS ensemble by end of 2010 – question asked about overlap with UKMET & BOM (reduced membership at higher resolution?)
 - BOM MOGREPS ensemble in 2-3 yrs
 - NCEP T126 => T190, stochastic perturbations, 8th order diffusion lead to increased spread (Dec 2008); enhancements in statistical correction methods also in 2009 (precip, US in 2009-10 based on radar & gage estimates, extrapolar globe in 2010-11 based on combined satellite/gage estimates, “RMORPH”)
 - JMA Reduced Gaussian grid – no other change in next 3 yrs
 - UKMET Physics changes soon, 90 => 60 km resolution, 38 => 70 levels in summer 2009
 - CMC Vertical resolution to 58 levels and physics changes by early 2009; Raise model top to 1 hPa and introduce vertical staggered grid for temperature and moisture by late 2009
 - ECMWF Ensemble Data Assimilation should be introduced early 2009, resulting in better spread in the tropics.
 - CMA pls provide input (J. Gong)
 - CPTec Expected changes are: (1) additional EOF perturbations in the extratropics (temperature and wind), surface pressure and specific humidity and use the last 12-hours lagged forecasts to generate products (December 2008); (2) increase the number of ensemble members (20-30 per run), increase the resolution (T170L42), stochastic perturbations, and bias correction on probabilistic forecasts (mid 2009)
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- 32 R. Swinbank reported about draft outline for TIGGE User Workshop (May 2009, part of Science Symposium, Monterey, CA). WG asked R. S. to closely liaise with

I. Szunyogh and J. Hansen and request 2 timeblocks (half day) for TIGGE Intro talk by P. Bougeault, followed by TIGGE science talks (invite T. Hamill & B. Ebert); Another time block of science talks (depending on # of contributions), ending with joint talk (~45 mins) by 3 archive centers (one intro, other 2 shorter descriptions of all 3 archives); this is followed immediately by user tutorials during poster session; last segment of 2 time blocks (half day) opened by GIFS plan talk by Z. Toth, followed by SWFDP SA talk (invite E. Poolman), SERA TIGGE/GIFS application type talks, ending with talk introducing charge for 2 focus groups. This session ends with 1-hour discussion on GIFS, applications, focus groups. R. Swinbank to prepare updated outline, present to Symposium organizers (Oct 7); contact J. Hansen (or other colleagues in local organizing group) about internet access requirements (30 Sept)

- 33 WG discussed links with other THORPEX & WWRP WGs:
- Mesoscale WG – TIGGE-LAM subgroup to cultivate link (T. Paccagnella, continuing)
 - Verification WG – 2 GIFS-TIGGE members on Verification WG act as liaisons, Verification WG Chair also invited to attend GIFS-TIGGE WG meetings; B. Brown also emphasized need for comprehensive evaluation of TIGGE data
 - SERA WG – Measuring value added by GIFS – for forecasters and others; S. Worley to assist B. Mills on accessing and making TIGGE data distributed within SERA community (S. Worley, Nov. 2008); L. Wilson to continue acting as liaison to SERA (L. Wilson, continuing)
 - PDP – no representatives present; Following workshop, I. Szunyogh, co-chair of PDP WG suggested to hold a joint PDP – GIFS-TIGGE WG session focusing on ensemble forecasting related research issues one evening at the Monterey Science Symposium; R. Swinbank to insert 2-hour evening joint WG session into Symposium program (Oct 2008); Encourage PDP to promote use of TIGGE archive (co-chairs consult with co-chairs of PDP, Dec 2008)
 - RCs – Three RCs represented (NA, Africa, SH) – very useful for GIFS-TIGGE WG discussions; Suggestion for different RCs hosting GIFS-TIGGE WG meetings (next either South America or SH, co-chairs discuss with IPO, Dec 2008); Africa RC co-chairs express interest working with GIFS-TIGGE WG on product development; they also noted critical role of NCEP Africa Desk in outreach efforts; SH RC representative offered help with outreach in South Pacific GIFS Prototype TC outreach; NA co-chair noted need for NA region outreach to Central America and Caribbean
 - WGSIP – Need for discussing linkages between GIFS and seasonal ensemble forecasting. WG noted the lack of report on subject from P. DaSilva, asked Z. Toth to pursue matter with successor of TFSP (CHFP?) (Dec 2008)
 - ET-EPS – suggested they keep abreast of GIFS activities and focus on GIFS-related training; critical to keep that group abreast of GIFS product developments for early engagement (Z. Toth & R. Swinbank to liaise with Chair of ET-EPS, ongoing)

ANNEX 4**Beijing 2008 Olympics Mesoscale Ensemble Prediction Research and Development Project (B08RDP)**

Beijing 2008 Olympics Meso-scale Ensemble Prediction Research and Development Project (B08RDP) was preliminarily endorsed at the 7th session of WWRP Science Steering Committee (SSC), as a five-year (2005-2009, with 3-4 years of research and development, data transfer test, EP system establishment, etc, and with 1-2 years for demonstration, analysis of results, and inter-comparison.) international research and development programme to improve short-range and very short-range weather forecasts of high-impact weather phenomena with high-resolution and cloud-resolving ensemble prediction methods, in support of the Beijing 2008 Olympic Games.

✧ **Core Research Objectives**

- To improve understanding of the high-resolution and very short range probabilistic prediction processes through numerical experimentation, to identify error sources and methods to reduce forecast errors.
- To share experiences on the development of the real-time MEP systems.
- To demonstrate how meso-scale EPS can improve HIW short-range and very short-range forecasts.
- To assess the skill of MEP systems, and to inter-compare the performance of different types of MEP forecasting systems.
- To train forecasters for the utilization of meso-scale ensemble prediction products, and if possible, to provide weather forecasting service for 2008 Beijing Olympic Games.
- To set up shareable database for future research in the community.

✧ **Participate systems**

- NCEP new version SREF (WRF based with NMM dynamic core).
- MSC regional EP system.
- JMA global/meso-scale EP system.
- ZAMG and France global/regional EP system.
- CMA WRF/GRAPES meso-scale EP systems.

✧ **Products and verification**

Products are divided into 3 levels according to forecast needs: level-1 products are for the surface variables, level-2 is related to upper levels, and the Level-3 products are special products associated with HIW process.

For ensemble prediction system verification, Different variables, and different methods(such as mean, spread, bias, Brier Score and Brier skill score,crps,ROC,etc) are carried out. The objective is to find some common and individual points or questions in different ensemble prediction systems to improve the performance of the each system.

✧ **Support of Olympics**

RDP products automatic data processing and display platform were running in real-time every day during the summer of 2008, and ensemble products (such as ensemble/mean, probability, stamps, plumes, etc) were produced for all 6 participating systems. The special products were developed to support the meteorological services for Olympic Games, for example, the sauna index, the CAPE and CIN index. The products were distributed to 17 Olympic venues.