

TIGGE, TIGGE LAM and the GIFS

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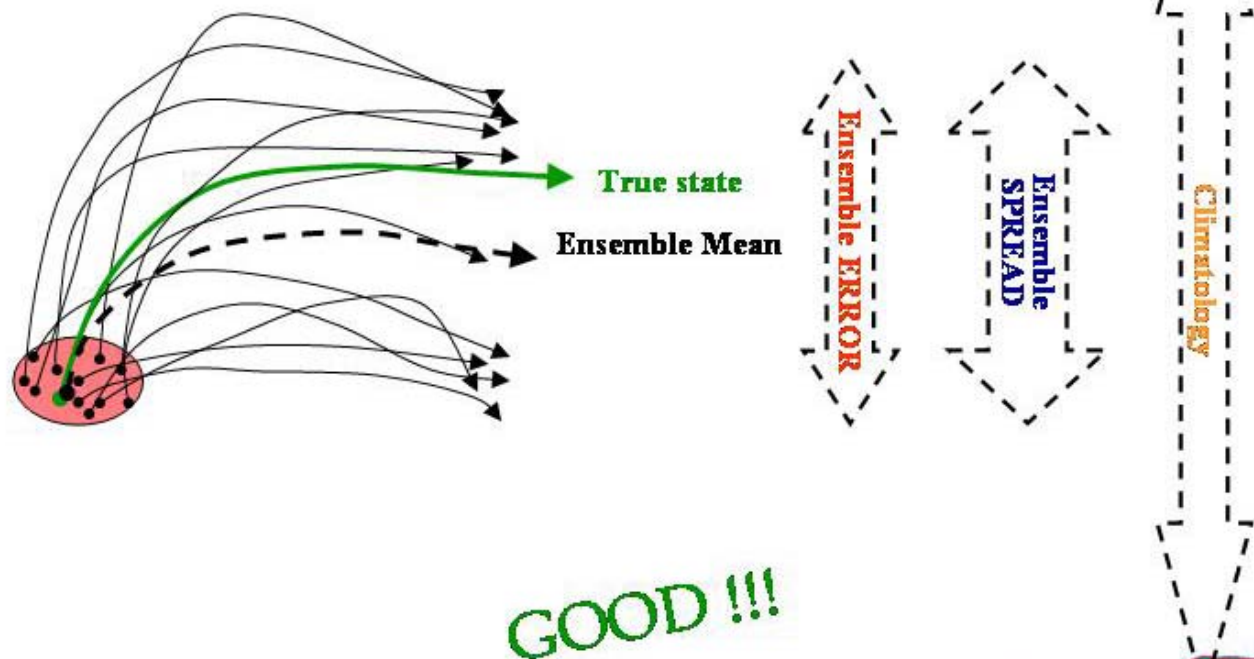
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S. Worley - NCAR, USA

- ❑ The Ensemble Prediction concept
- ❑ TIGGE
 - TIGGE Database
 - TIGGE archive characteristics
 - A “taste” of research based on TIGGE data
- ❑ TIGGE LAM
- ❑ Toward the GIFS
- ❑ Summary

- EPS is based on the knowledge of the chaotic behaviour of the atmosphere and on the awareness of the limitation (errors, approximations) in our Forecasting Systems (analysis/assimilation & models). These limitations induce uncertainty in our forecasts.
- Ensemble prediction is aimed to quantify this uncertainty by producing a sample of alternative/possible future atmospheric states obtained by simulating the effects of our errors.

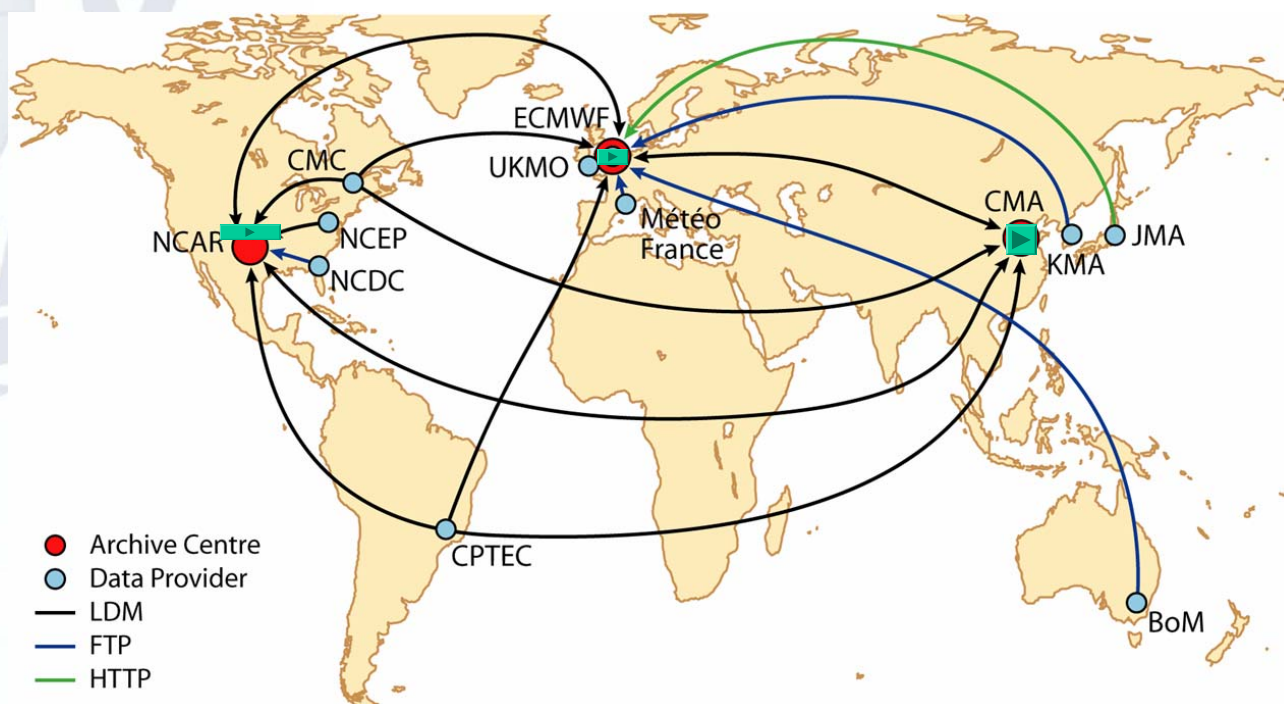


- ❑ A major component of THORPEX: a World Weather Research Programme to accelerate the improvements in the accuracy of 1-day to 2-week high-impact weather forecasts
- ❑ GEO task WE-06-03 – “TIGGE and the Development of a Global Interactive Forecast System for Weather”

Objectives:

- Enhance collaboration on ensemble prediction, both internationally and between operational centres & universities.
- Facilitate research on ensemble prediction methods, especially methods to combine ensembles and to correct systematic errors
- Enable evolution towards a prototype operational system, the “Global Interactive Forecast System”

- ❑ A phased approach was chosen beginning with mirrored data collections of global medium-range ensemble forecasts at three TIGGE Archive Centres: **CMA**, **ECMWF**, and **NCAR**.
- ❑ Ten of the leading global forecast centres are providing regular ensemble predictions to support research on predictability, dynamical processes and development of probabilistic forecasting methods.
- ❑ TIGGE data is made available for research after a 48-hour delay. Near real-time access may be granted for specific projects through the THORPEX International Project Office. Data access portals are available at CMA, ECMWF and NCAR.



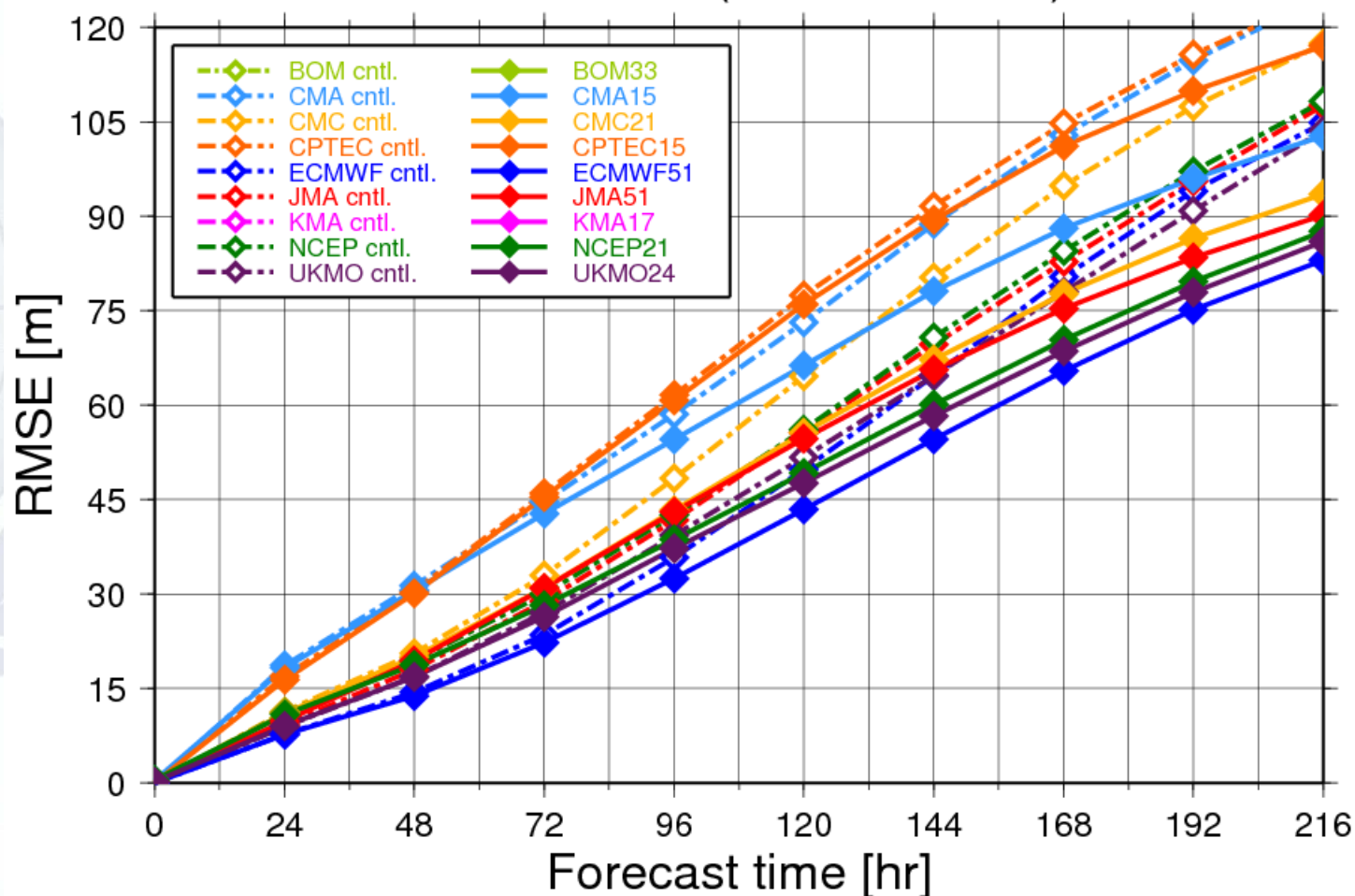
TIGGE ARCHIVES CHARACTERISTICS

- ❑ The ICT systems run **24 hours per day x 7 days per week**, collecting data from the providers, validating the data integrity and completeness, and supporting user access.
- ❑ Currently, the TIGGE archive is growing with more than over 1.7 M fields and **500 GB per day**.
- ❑ Fast user access to the complete archive, **now 500 TB**, is a technical challenge.
 - Delivery systems at ECMWF are fairly well suited to this challenge, while NCAR has found it necessary to place more data online and boost server side computational power.
 - A new validation data portal is being designed and will be coupled to the TIGGE access portal at NCAR. Having the forecast fields and observations available from the same interface will further support the TIGGE program objectives.
 - Data can be obtained either in GRIB2 or NETCDF format (only from NCAR at the moment)

A “taste” of research based on TIGGE data

Comparison of RMS errors

TIGGE medium-range ensemble forecasts
Z500 RMSE (2011DJF: NH)



A “taste” of research based on TIGGE data

Multi-model combination: MSLP & T2m

Brier skill-scores of multi-model combination of bias-corrected ECMWF, Met Office and NCEP forecasts.

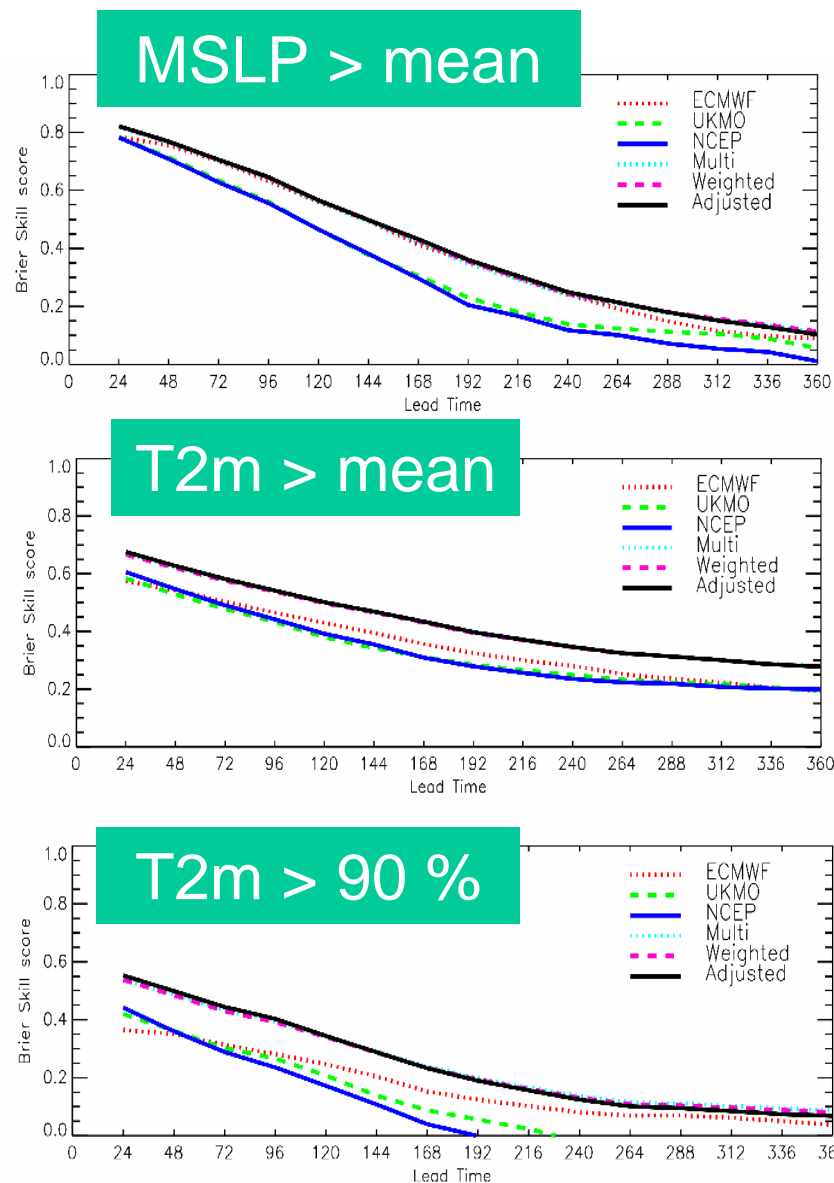
Mean Sea Level Pressure and 500 hPa (not shown) show only small benefits from combining different models

2m temperature shows more benefit (1-5 days improvement in lead time)

More sophisticated weighting led to only small additional skill

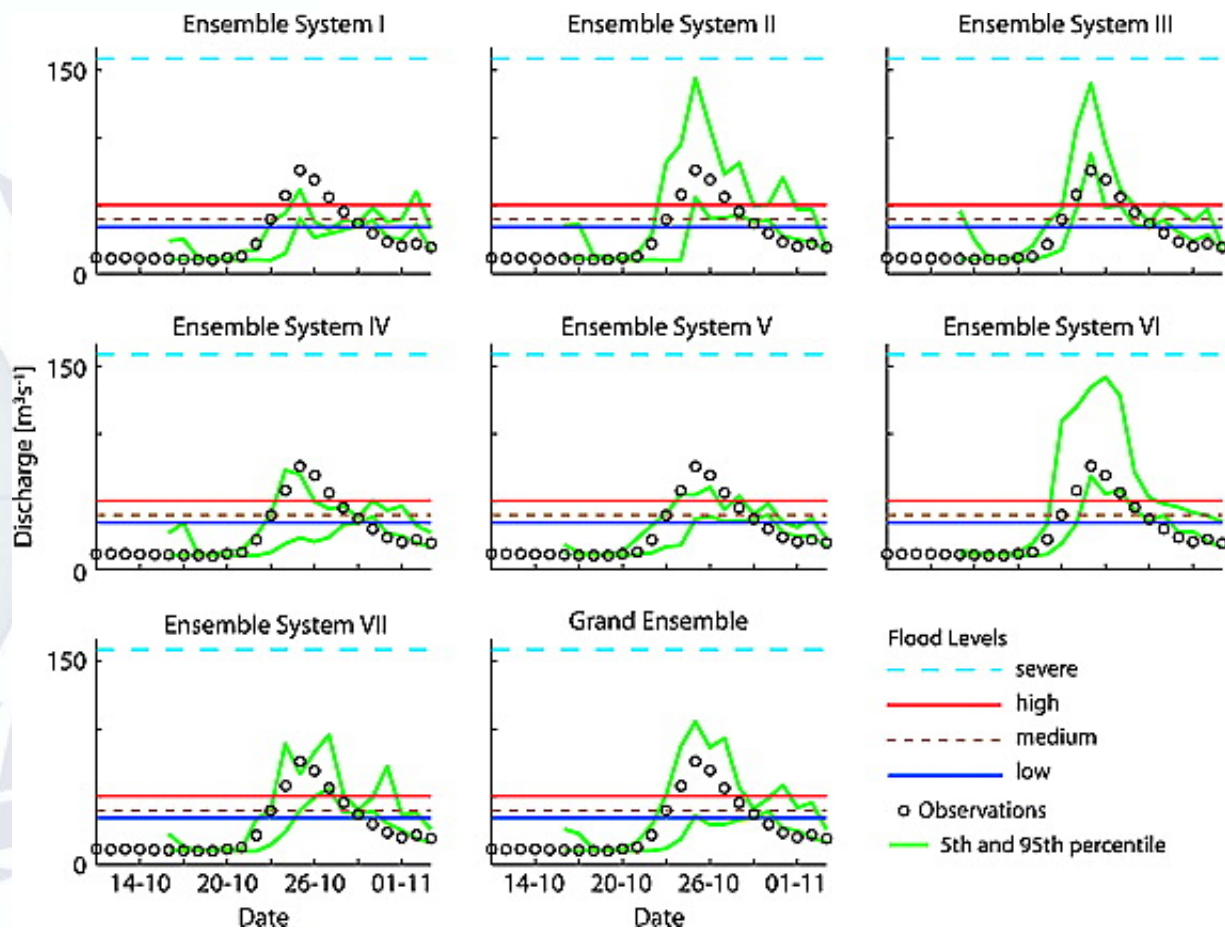
Courtesy Christine Johnson

http://www.ecmwf.int/newsevents/meetings/workshops/2007/ensemble_prediction/presentations/johnson.pdf



A “taste” of research based on TIGGE data

Applications: flood prediction



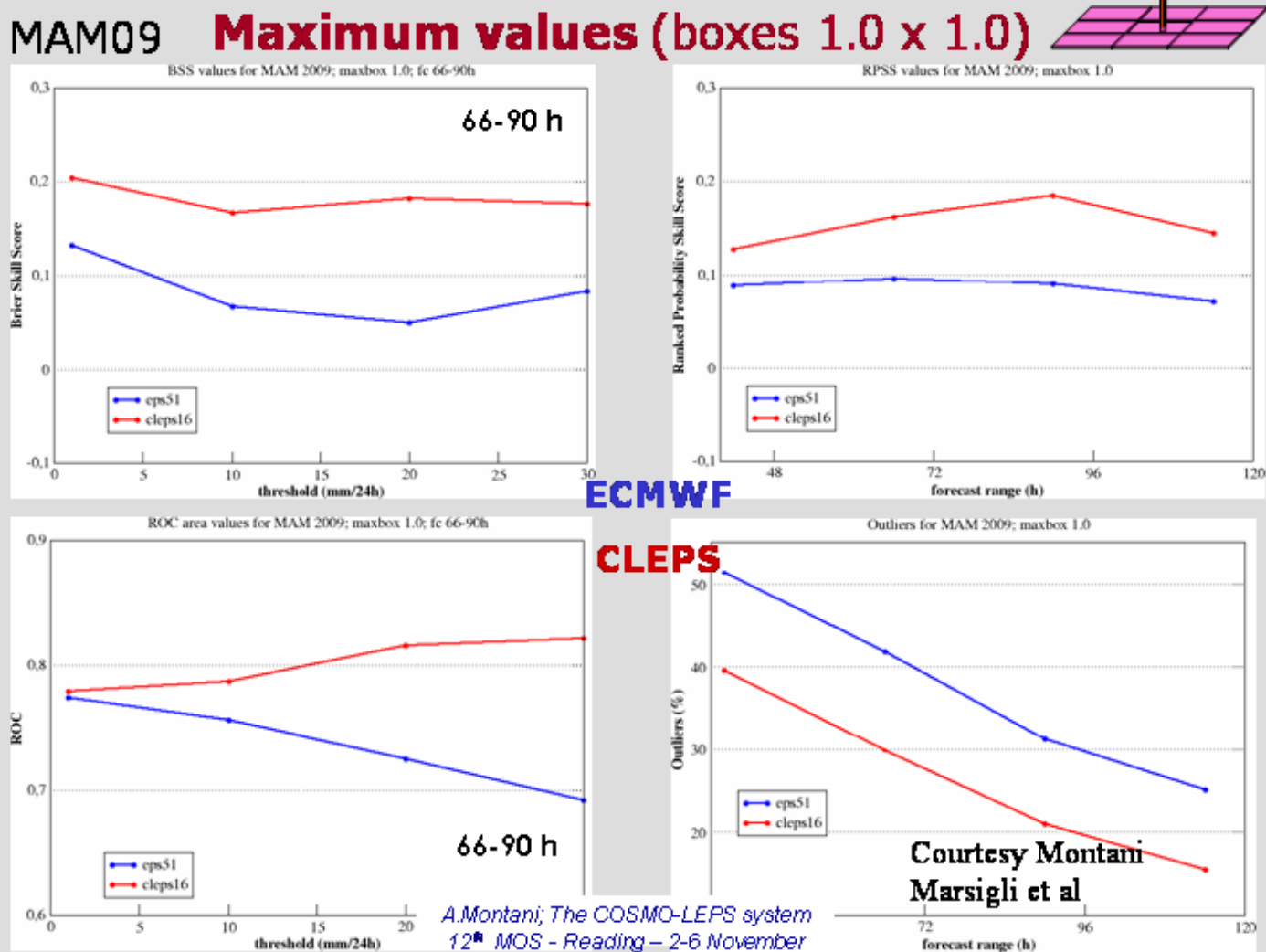
Predictions with a 5-day lead-time for a flood event on River Jiu in Romania

from Pappenberger et al, 2008. New dimensions in early flood warning across the globe using GRAND

Ensembles, *Geophysical Research Letters*, 35(10): Art No. L10404,

LAM EPS & TIGGE LAM

High Impact/ Severe Weather events are usually characterized by a Mesoscale or Convective scale component. Higher horizontal resolution, typical of LAM, is usually crucial to improve the capability to predict such events.



TIGGE LAM is intended to support the coordination of research and demonstration actions to evaluate when LAM EPS is needed and how best to implement ensemble prediction systems to address specific high-impact weather types.

A TIGGE-LAM Panel was established to coordinate the LAM EPS contribution to TIGGE and to the GIFS system.

The Panel has been recently re-organized in regional sub-groups:

- Better coordination with the Thorpex Regional Committees
- Better link with regional initiatives
- Better focus on scientific issues, actions/activities

TIGGE LAM Panel

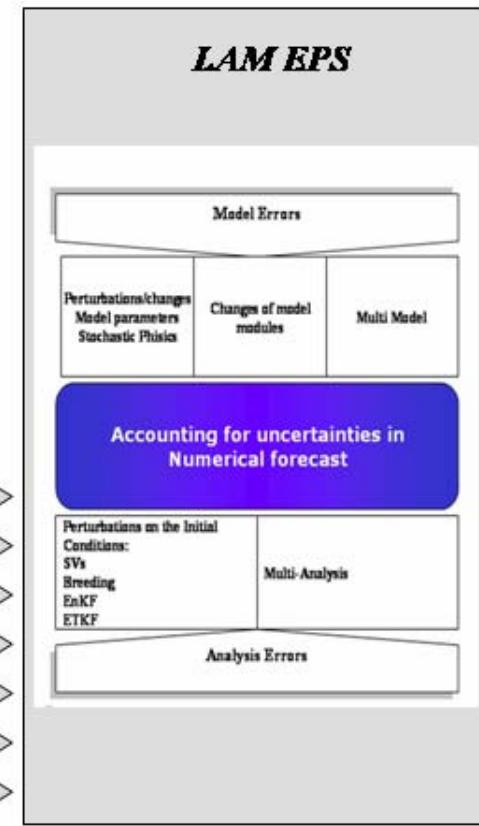
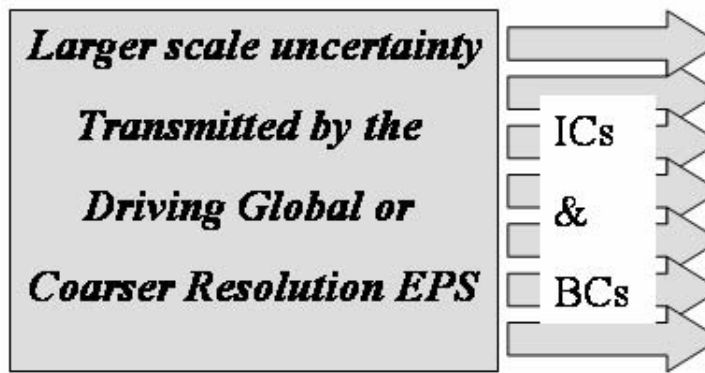
TIGGE LAM Panel – March 2011

Tiziana Paccagnella	ARPA-SIM / Italy	Chair
Tiziana Paccagnella (FP)	ARPA-SIM / Italy	TIGGE – LAM Panel Europe Sub-group
Jose A Garcia Moya	INM / Spain	
Yong Wang	ZAMG / Austria	
Ken Mylne	MO / UK	
Trond Iversen	Univ Oslo / Norway	
Laurent Descamps	Meteo-France / France	
Marco Arpagaus	MeteoSwiss	
Andrea Montani	ARPA-SIMC	
Jan Barkmeier	KNMI	
Xiao Hua Yang	DMI	
Susanne Theis	DWD Germany	
Máté Mile	HMS Hungary	
Inger-Lise Frogner	MetNO	TIGGE – LAM Panel N. America Sub-group
Chiara Marsigli	ARPA-SIMC	
Josh Hacker (FP)	UCAR / USA	
Brian Etherton	Renaissance Comput. Inst.	
Bill Gallus	Iowa State U.	
Fuqing Zhang	Penn State U.	
Ming Xue	Univ Oklahoma	
Xuguang Wang	U. of Oklahoma	
Ryan Tom	SUNY Albany	
Greg Hakim	Univ Washington / USA	
Brian Colle	SUNY Stonybrook	
Jun Du	NWS/EMC	TIGGE – LAM Panel ASIA Sub-group
Steve Mullen	Univ Arizona / USA	
Xuguang Wang	NOAA / USA	
Martin Charron	MS / Canada	
Isidora Jankov	CIRA, NOAA/ESRL	TIGGE – LAM Panel S. America Sub-group
Jing Chen (FP)	CMA / China	
Jiandong Gong	CMA / China	TIGGE – LAM Panel AFRICA Sub-group
Vo Van Hoa	Vietnam Weather Service	
Kazuo Saito	Japan Met. Res. Institute	TIGGE – LAM Panel AFRICA Sub-group
Chou Sin Chan	CPTEC / Brazil	
Celeste Saulo	Univ. Buenos Aires	TIGGE – LAM Panel AFRICA Sub-group
Stephanie Landman	WeatherSA South Africa	
Galebonwe Ramaphane	Botswana Weather Service	TIGGE – LAM Panel AFRICA Sub-group

LAM EPS: Scientific Issues

Many in
common with
Global EPS

- Mesoscale predictability
- Mesoscale model inadequacy
- Interactions between larger scale perturbations given by the driving global systems and "local" perturbations generated specifically for the LAM EPS.
- Domain size and "local" perturbations on initial conditions
- Perturbations associated to soil/surface description
- Cycling short-range uncertainty for initial perturbations
- Multi Model EPS
- Quantify the additional benefit of Multi-LAM EPS
- Evaluate the performance of convective permitting EPS systems and their benefit over restricted integration domains versus the combination of lower resolution ensemble systems
- Predictability at the convection-resolving scale to support the design of the future LAM EPS systems.
- ✓ Biases in deterministic models and calibration
- ✓ Verification methods
- ✓ Assess the probability of rare meteorological events
- Probabilistic forecasts for other modelling applications
- ❖ LAM EPS and Data Assimilation: which are the key characteristics of a LAM EPS to best represent short-range forecast error co variances for use in DA?



Writing of a TIGGE LAM Plan

- ✓Under writing

Provision and exchange of LAM EPS products in format compliant with GIFS-TIGGE directives

- ✓Products list and coding specifics have been defined

Set up of the TIGGE-LAM Database

- ✓A sub-set of High Prior. Param. Should be archived at the three TIGGE archiving centres
- ✓The possibility to implement a regional European archive of LAM EPS products on the native grids is under evaluation (included in a EU project proposal)

Implementation of regional analyses datasets based on dense observational networks for objective verification of Mesoscale Deterministic and Ensemble forecasting.

- ✓The possibility to implement an European archive of high resolution precipitation analyses based on high density network data is being explored. Contacts are established with ECMWF and with other European groups and initiatives with the same objective.

Define standards to exchange meteorological fields required as Initial and Boundary conditions – Interoperability

- ✓A good link with the SRNWP Interoperability Programme has been established. The outcome of this Programme will be naturally accepted and adopted by the European LAM EPS community. These standards will be also proposed to the other TIGGE LAM groups outside Europe.

Support the participation of LAM EPS groups to projects, RDPs and FDPs.

- ✓HYMEX (HYdrological cycle in the Mediterranean EXperiment)
- ✓FROST 2014 (Sochi Olympics FDP and RDP)

Activate link with major mesoscale applications (hydrology).

- ✓Links with HEPEX and EFAS.

Set-up of cross-working group discussion and cooperation programmes

- ✓WWRP Mesoscale Research Working Group
- ✓WWRP WG on Societal and Economic Research Applications (SERA)
- ✓Joint WWRP/WGNE Working Group on Forecast Verification

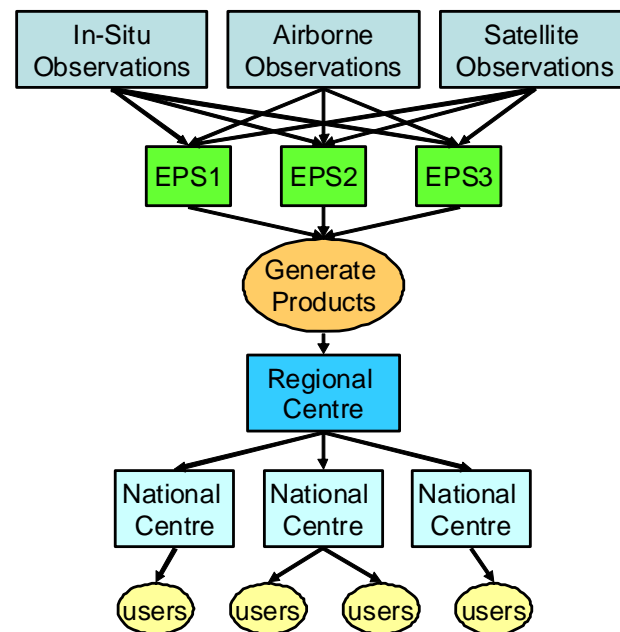
Towards the Global Interactive Forecast System (GIFS): the GIFS concept

- ❑ GIFS-TIGGE WG has initiated a GIFS development project
- ❑ The objective of the GIFS is to realise the benefits of THORPEX research by developing and evaluating probabilistic products to deliver improved forecasts of high-impact weather.
- ❑ GIFS will be based on:
 1. real time access to ensemble forecast data;
 2. statistical post-processing and combination of such data from several ensemble providers;
 3. generation of products and services for WMO nations in particular in developing regions.

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 3. generation of products and services for WMO nations in particular in developing regions.

- ❑ GIFS is planned to use global-regional-national cascade pioneered by the WMO Severe Weather Forecast Demonstration Project (SWFDP)



WMO Strategy for Improving Severe Weather Forecasting in Developing Countries

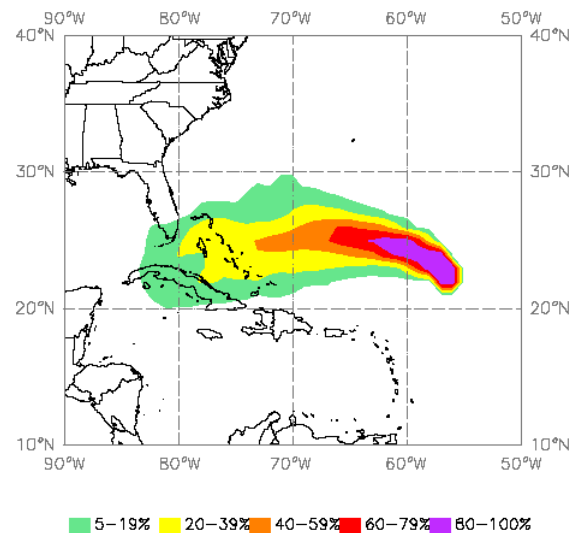
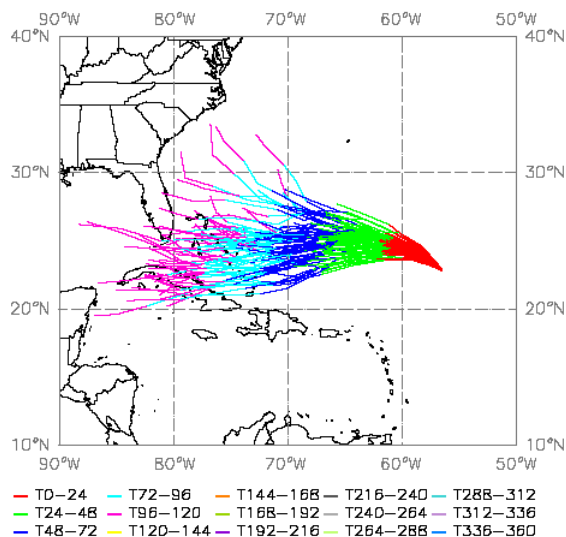
Severe Weather Forecasting Demonstration Project (SWFDP)
Lessons learnt, Opportunities for the future

Peter Chen
Chief, Data-processing and Forecasting

EC WG on Disaster Risk Reduction and Service Delivery
Second Session
Geneva, 24-26 February 2010

Towards the Global Interactive Forecast System (GIFS)

- As a first step, the GIFS-TIGGE working group set up a pilot project for the exchange of real-time tropical cyclone predictions using “Cyclone XML” format.



GIFS development

- ❑ **Develop products, based on TIGGE ensembles, focused on forecasts of**
 - Tropical cyclones
 - Heavy precipitation
 - Strong winds
- ❑ **Collaborate with WMO Severe Weather Forecast Demonstration Project (SWFDP) and other FDPs and RDPs to provide an environment for the evaluation of prototype products**
- ❑ **Need to engage with users to ensure products address needs of operational forecasters and end users.**

GIFS development

- ❑ Products based on LAM EPS systems, where available, will supplement products available from the global TIGGE data, and demonstrate the additional benefit obtainable from higher resolution ensembles.
- ❑ The GIFS system will follow CBS guidelines on operational systems and requirements, using the WIS infrastructure.
- ❑ Subject to positive scientific results, data policy agreements and future additional investment, GIFS could form the basis of a future operational global forecasting system.

Summary

- ❑ Since October 2006, the TIGGE archive has been accumulating regular ensemble forecasts from leading global NWP centres.
- ❑ The archive is a tremendous resource for the research community at large, and in particular the science working groups of THORPEX.
- ❑ A TIGGE-LAM Panel was established to coordinate the LAM EPS contribution to TIGGE and to the GIFS system.
- ❑ Products to enhance the prediction of high-impact weather, starting with tropical cyclones, will form the basis of the development of the Global Interactive Forecast System.
- ❑ GIFS products will be developed & evaluated in conjunction with SWFDP and other regional projects.
- ❑ The GIFS system will follow CBS guidelines on operational systems and requirements, using the WIS infrastructure.



Thank you!

The challenge is the huge diversity, even though many standards were agreed upon: varying ensemble members, resolutions, forecast length, etc

Summary of TIGGE database

Centre	Ensemble members	Output data resolution	Forecast length	Forecasts per day	Fields (out of 73)	Start date
BOM	33	1.50° x 1.50°	10 day	2	55	3 Sep 07
CMA	15	0.56° x 0.56°	10 day	2	60	15 May 07
CMC	21	0.9° x 0.9°	16 day	2	56	3 Oct 07
CPTEC	15	0.94° x 0.94°	15 day	2	55	1 Feb 08
ECMWF	51	N200 (Reduced Gaussian) N128 after day 10	15 day	2	70	1 Oct 06
JMA	51	0.56° x 0.56°	9 day	1	61	1 Oct 06
KMA	17	1.00° x 1.00°	10 day	2	46	28 Dec 07
Météo-France	11	1.50° x 1.50°	2.5 day	2	62	25 Oct 07
NCEP	21	1.00° x 1.00°	16 day	4	69	5 Mar 07
UKMO	24	0.83° x 0.55°	15 day	2	71	1 Oct 06

TIGGE Data Portals: ECMWF, NCAR, CMA

TIGGE Data

HOME SERVICES

TIGGE at CMA

Running as one of the three TIGGE Data Exchange To access TIGGE Data Directory To access TIGGE Product To view historical TIGGE Reanalysis To get offline data, click here Recent news and events Related Links

ECMWF TIGGE Archive CMA

http://bridge.cma.gov.cn:8080/tigge/index.jsp

File Modifica Visualizza Preferiti Strumenti ?

eps testbed ensemble ... GEO - Group on Earth ... QPE_QPF-III http--www.nrbook.com...

Preferiti TIGGE portal - BRIDGE Proj

http://tigge-portal.ecmwf.int/d/tigge/levtype=sfc/type=cf/

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Home > TIGGE > Portal >

http://tigge.ucar.edu/data/subsetWizard.htm

TIGGE Data Retrie

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Preferiti NCAR - T... New Group ... Cud Annuale JSC4_prese... 4.5 Science ... http://ww

THORPEX Interactive Grand Global Ensemble

TIGGE Data Archive Portal

National Center for Atmospheric Research
Computational and Information Systems Laboratory

Home Get Forecast Data Tools Help Documentation Logout

Data Subset Selection

TIGGE Portal for Sub-setting

You must select at least one variable.

Select Centers

Australia Bureau of Met.	China Met. Administration	Met. Service of Canada	ECMWF	United Kingdom Met. Office	USA NCEP	Met. France	Japan Met. Agency	Korea Met. Administration	Brazil CPTEC
<input type="checkbox"/> AMMC	<input checked="" type="checkbox"/> BABJ	<input type="checkbox"/> CWAO	<input checked="" type="checkbox"/> ECMF	<input checked="" type="checkbox"/> EGRR	<input type="checkbox"/> KWBC	<input type="checkbox"/> LFPW	<input type="checkbox"/> RJTD	<input type="checkbox"/> RKSL	<input type="checkbox"/> SBSJ

Select Forecast Initialization Hour(s)

☒ 00z ☒ 12z

Select Forecast Initialization Date Range

Start Date Forecast (yyyy-mm-dd hh:mm:ss) 2011-01-06 00:00:00 End Date Forecast (yyyy-mm-dd hh:mm:ss) 2011-01-17 12:00:00

Select Variables

Variable	Long name	Units	Level Type	Level Values Highlight desired level(s)	Forecast Hours Highlight desired hour(s)
<input type="checkbox"/> gh	geopotential_height	gpm	PL	200 250 300 500	0 6 12 18
<input checked="" type="checkbox"/> q	specific_humidity	kg kg ⁻¹	PL	mb	hrs
<input type="checkbox"/> t	temperature	K	PL	200 250 300	0 6 12
<input checked="" type="checkbox"/> u	u_velocity	m s ⁻¹	PL	200 250 300	0 6 12

Smart user interfaces
reveal the commonalities
between centers