THORPEX

THORPEX
A World Weather Research Programme

GIFS-TIGGE prototype products

GIFS: Global Interactive Forecast System

TIGGE: The THORPEX Interactive Global Ensemble

Young-Youn Park,

with thanks to

Dr. Richard Swinbank, the GIFS-TIGGE working group,

Dr. Tesuo Nakazawa, Dr Mio Matsueda

SG-SWFDP meeting, Zeneva, 28 February-2 March 2012

WMO
OMM

Outline

- TIGGE, GIFS-TIGGE
- GIFS plan
- GIFS links with SWFDPs
- 1st GIFS-TIGGE products: TC tracks
- Development of other GIFS-TIGGE products

TIGGE

THORPEX Interactive Grand Global Ensemble

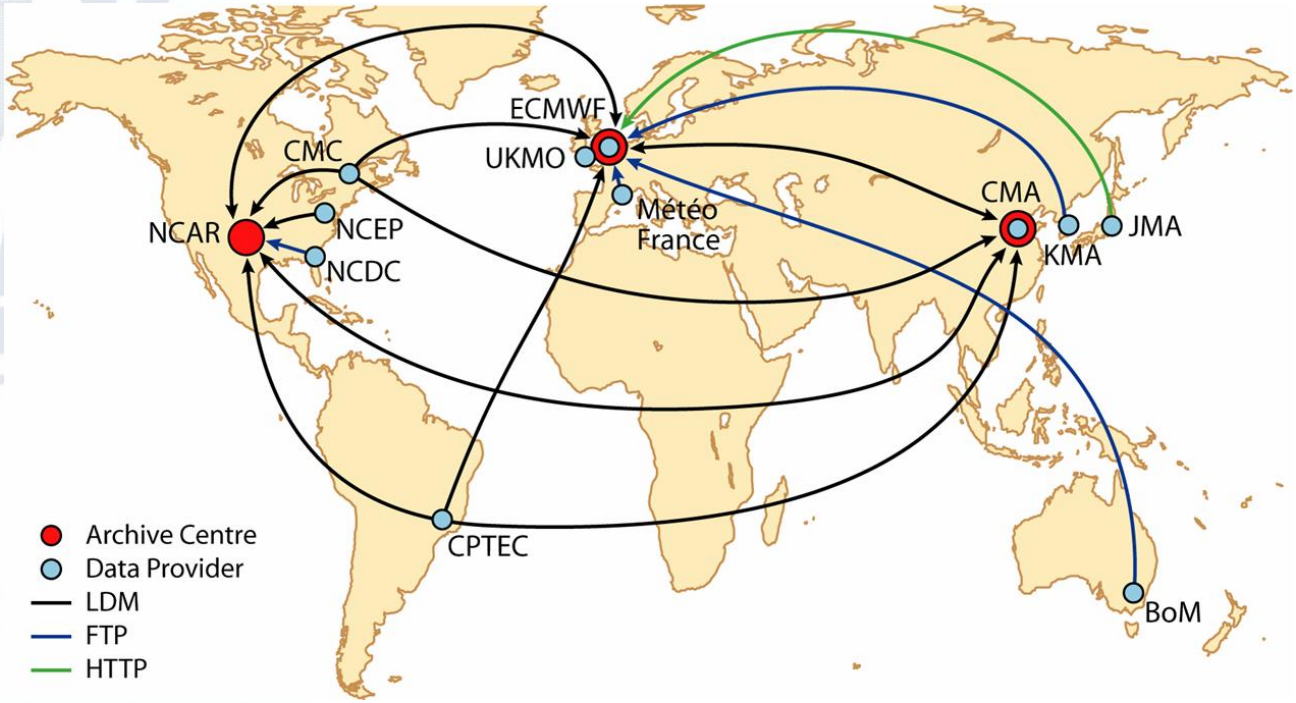
- A major component of THORPEX: a World Weather Research Programme to accelerate the improvements in the accuracy of 1-day to 2-week high-impact weather forecasts
- GEO task WE-06-03 – "TIGGE and the Development of a Global Interactive Forecast System for Weather"

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"

TIGGE data

- Ten of the leading global forecast centres are providing regular ensemble predictions to support research on predictability, dynamical processes and the 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.

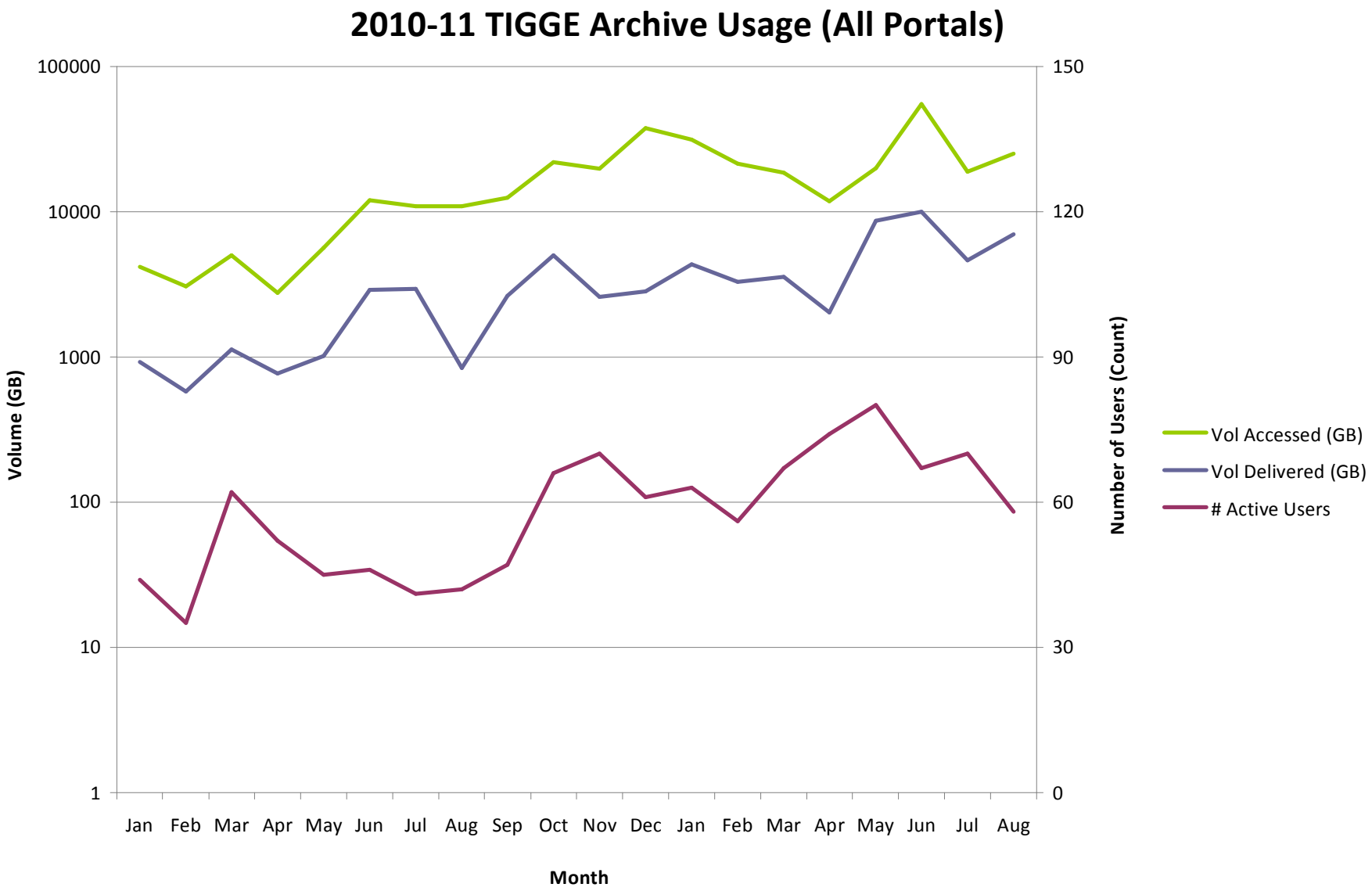


Summary of TIGGE database (Nov 2011)

Centre	Ensemble members	Output data resolution	Forecast length	Forecasts per day	Fields (out of 73)	Start date
BOM*	24	-	10 day	2	55	3 Sep 07
CMA	15	60km	10 day	2	60	15 May 07
MSC	21	66km	16 day	2	56	3 Oct 07
CPTEC	15	0.94º x 0.94º	15 day	2	55	1 Feb 08
ECMWF	51	32km (Reduced Gaussian) 64km after day 10	15 day	2	70	1 Oct 06
JMA	51	60km	9 day	1	61	1 Oct 06
KMA*	24	40km	10 day	2	54	28 Dec 07
Météo-France	35	15km to 90km	4.5 day	2	62	25 Oct 07
NCEP	21	70km	16 day	4	69	5 Mar 07
UKMO	24	60km	15 day	2	72	1 Oct 06

* Delivery of BoM data currently suspended; KMA resumed Aug 2011

TIGGE Archive Usage



TIGGE Research

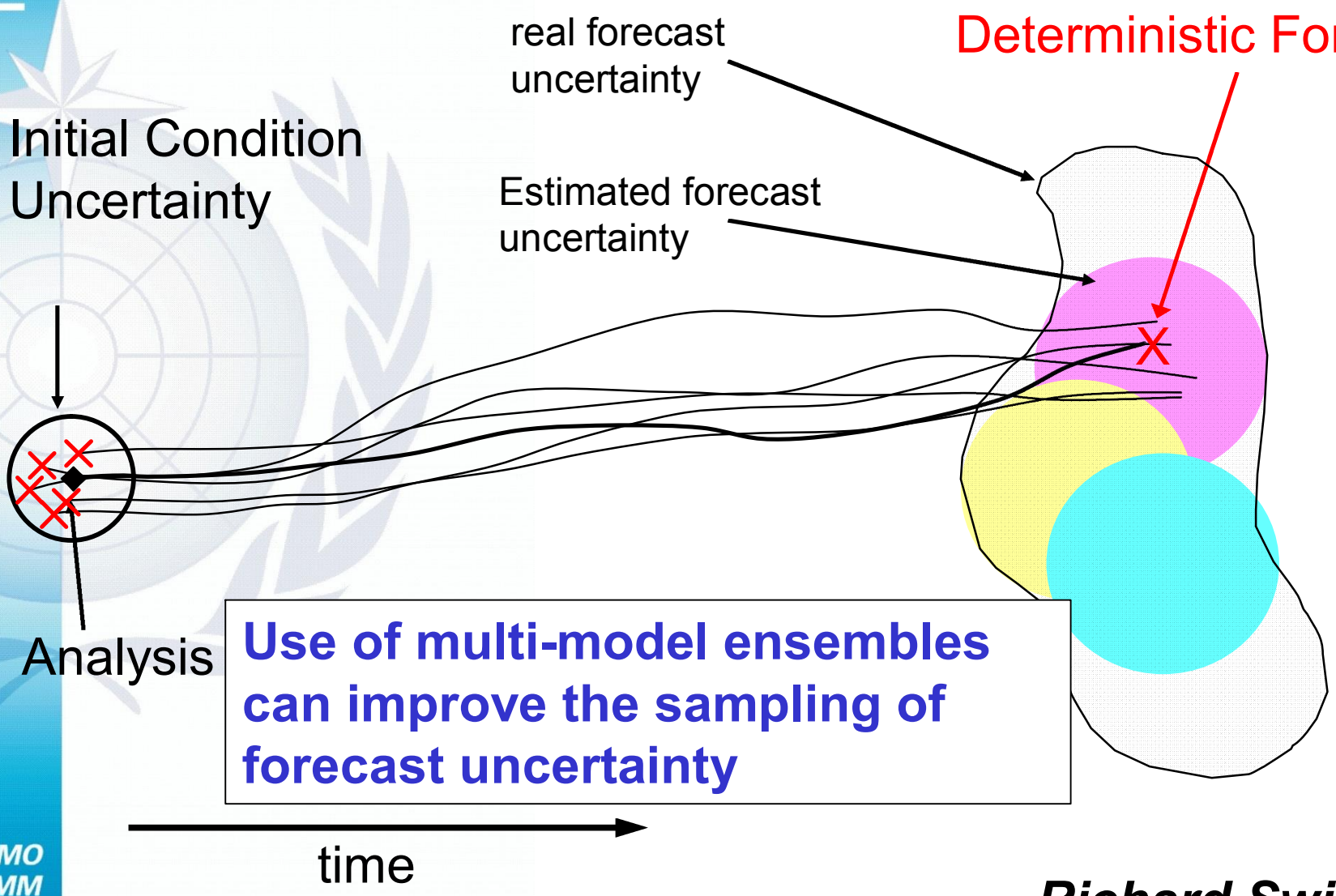
- Following the successful establishment of the TIGGE dataset, the main focus of the GIFS-TIGGE working group has shifted towards research on ensemble forecasting. Particular topics of interest include:
  - *a posteriori* calibration of ensemble forecasts (bias correction, downscaling, etc.);
  - combination of ensembles produced by multiple models;
  - research on and development of probabilistic forecast products.
- TIGGE data is also invaluable as a resource for a wide range of research projects, for example on dynamical processes and predictability.
- Up to the end of 2011, 51 articles related to TIGGE have been published in the scientific literature

EPS & multi-model ensembles

- Ensembles are valuable for forecasting the risks of exceeding thresholds (e.g. for high-impact weather events).
- But forecasts often need calibration to correct both biases and variability (e.g. to correct under-estimates of forecast spread).
- The best approach is to address the systematic errors, i.e. reduce model biases and improve the representation of model errors in the EPSs.
- That is a long-term goal. In the mean time….
  - Use of multi-model ensembles is a pragmatic approach that reduces calibration errors, especially where models have similar skill but different types of systematic error
  - Reforecasts (forecasts of past cases with current NWP models) can be used to estimate, and then correct, model biases

Richard Swinbank

Multi-model ensemble forecast



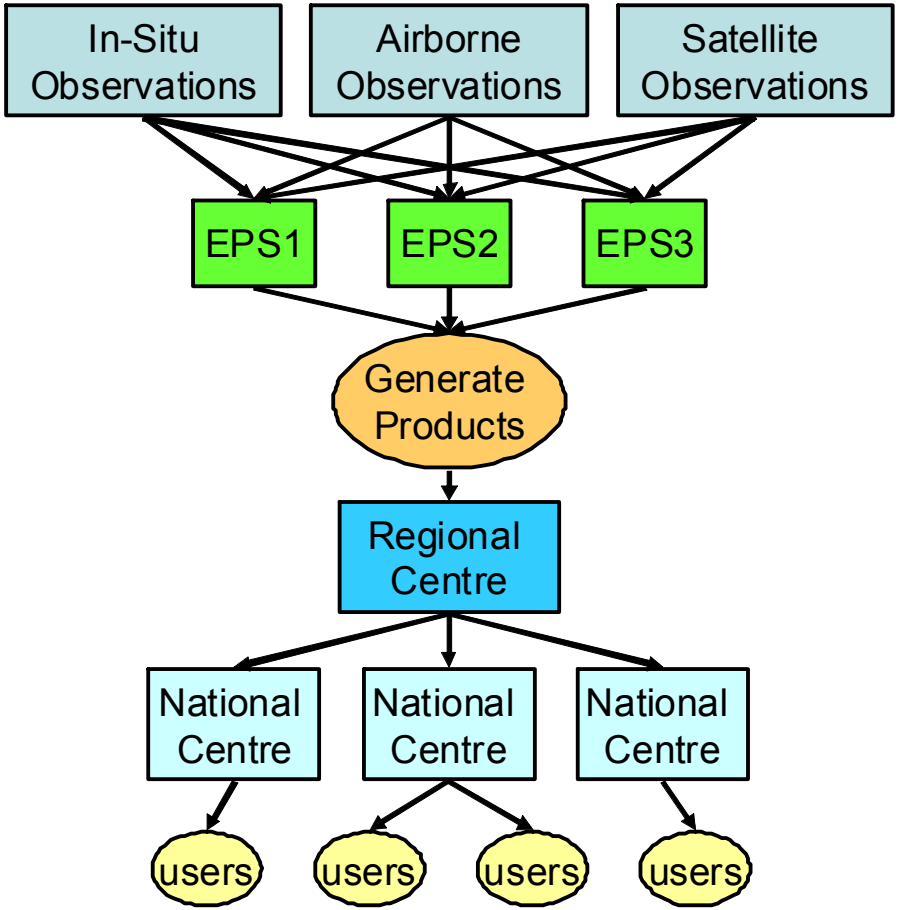
Richard Swinbank

Towards the Global Interactive Forecast System (GIFS)

- Many weather forecast situations are low probability but high risk – unlikely but potentially catastrophic. Probabilistic forecasting is a powerful tool to improve early warning of high-impact events.
- 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-TIGGE WG has initiated a GIFS development project to develop & evaluate products, focused on
  - Tropical cyclones
  - Heavy precipitation
  - Strong winds

GIFS links with SWFDP

- GIFS will collaborate with WMO Severe Weather Forecast Demonstration Project (SWFDP) and other FDPs and RDPs
  - to ensure that products address needs of operational forecasters and end users;
  - to provide an environment for the evaluation of prototype products.
- GIFS will use global-regional-national cascade pioneered by the SWFDP. No single "GIFS centre".
- Use of web-enabled technology for generation and distribution of products.



1st GIFS-TIGGE DP : Exchange of Tropical Cyclone Tracks

- 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.

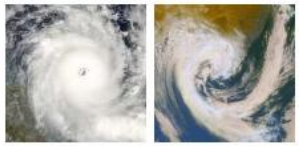
- Tropical Cyclones Tracks from 7 centres
  - to support T-PARC(THORPEX Pacific-Asian Regional Campaign) during summer 2008, almost real time
  - Provision of CXML data continues since the end of T-PARC
  - The data is being used by other research projects(NW Pacific TC Ensemble Forecast Project, Typhoon Landfall FDP)
  - and several centres are using the data as the basis for developing TC forecast products and assessing their value

- In the Future:
  - Add information on intensity, and size(wind), genesis?
  - Apply other regions than Pacific-Asian?

CXML track exchange

(http://cawcr.gov.au/projects/THORPEX/TC/index.html)

Cyclone Exchange



THORPEX
A World Weather Research Programme

Introduction

The Sixth WMO International Workshop on Tropical Cyclones recommended that all tropical cyclone-related Numerical Weather Prediction (NWP) products, including full set of ensemble forecasts, be made available to all operational and research users in real-time. Meanwhile, the THORPEX GIFS-TIGGE Working Group is developing plans for the Global Interactive Forecast System (GIFS) for the real time dissemination of ensemble data and products in support of high impact weather prediction, including prediction of tropical cyclones. A pilot project has been established by the TIGGE Working Group to test the real-time exchange of ensemble TC track forecasts; the format for TC data exchange will be Cyclone XML (CXML). Exchange of real-time TC forecasts was done in the THORPEX Pacific-Asian Regional Campaign (T-PARC) (August 2008-March 2009), designed to study the lifecycle of tropical and extratropical cyclones over the northern Pacific. CXML is being used in the North Western Pacific Tropical Cyclone (TC) Ensemble Forecast project which provides near real time ensemble forecasts of TCs based on the TIGGE dataset. Ongoing exchange of TC tracks in real time is expected to lead to improved tropical cyclone prediction, benefiting society in general.

Data

The table below lists FTP sites from which it is possible to download real-time ensemble tropical cyclone track forecasts. A more sophisticated web interface will be developed in due course.

Producing center	Center code	FTP site	More information about ensemble system and/or track forecasts
Canadian Meteorological Centre (CMC)	cwao	ftp://ftp.emc.ncep.noaa.gov/gmb/rwobus/tigge/beta/cxml/ (via NCEP) Click here for an important notice concerning wind speeds	http://www.weatheroffice.gc.ca/ensemble/index_e.html
China Meteorological Administration (CMA)	babj	ftp://tgftpusr:tigge@tigge-cma-ncar.cma.gov.cn/	http://www.typhoon.gov.cn/en/other/about.php
European Centre for Medium Range Weather Forecasts (ECMWF)	ecmf	ftp://tigge:tigge@tigge-ldm.ecmwf.int/cxml/	http://www.ecmwf.int/products/forecasts/d/charts/medium/tropcyclones/Forecast/
Japan Meteorological Agency (JMA)	rjtd	(no longer available)	http://www.jma.go.jp/en/typh/
Korea Meteorological Administration (KMA)	rksl	ftp://cxml:cxml@210.107.255.35	http://web.kma.go.kr/eng/abo/abo_05_02.jsp
Meteo-France	lfpw	ftp://user:@ftp.meteo.fr - request login from laurent.descamps@meteo.fr or nicole.girardot@meteo.fr	http://tigge.ecmwf.int/models.html
Shanghai Typhoon Institute (STI) of CMA	shtm	ftp://ftp.typhoon.gov.cn - request login from tany@mail.typhoon.gov.cn	http://www.typhoon.org.cn/en/
United Kingdom Met Office (UKMO)	egrr	ftp://ftp.metoffice.gov.uk - request login from piers.buchanan@metoffice.gov.uk	http://www.metoffice.gov.uk/research/nwp/ensemble/prob-examples.html
US National Centers for Environmental Prediction (NCEP)	kwbc	ftp://ftp.emc.ncep.noaa.gov/gmb/rwobus/tigge/beta/cxml/ Click here for an important notice concerning wind speeds	http://www.emc.ncep.noaa.gov/gmb/tpm/emchurr/tcgen/ http://www4.emc.ncep.noaa.gov/gmb/ens/index.html

These data are also available at the Research Data Archives at NCAR at http://dss.ucar.edu/datasets/ds330.3/ under 'Data Access' and 'Internet Download'.

z_tigge_c_*cccc_yyyyMMddhhmmss_nnn_mmmm_vvvv_pppp_bbb*.xml[.compression] (to be confirmed)

Tropical cyclone products

from MRI/JMA (http://tparc.mri-jma.go.jp/cyclone/)

Tropical Cyclone Ensemble Forecast Information HomePage

User
Password login

1. Purpose

The purpose of this homepage is to provide a guidance of tropical cyclone forecasts in near real-time for the ESCAP/WMO Typhoon Committee Members, based on the TIGGE (THORPEX Interactive Grand Global Ensemble) Cyclone XML (CXML) data, under the joint project of World Weather Research Program (WWRP) and Tropical Cyclone Program (TCP); North Western Pacific Tropical Cyclone (TC) Ensemble Forecast (NWP-TCTEF) Project. The data providers are shown here. The homepage is also set up for interested researchers to develop the TIGGE related applications/products for tropical cyclone studies. The homepage is password protected. You can send a request with your information to get ID and password to thorpex@mri-jma.go.jp.

2. Background

A WWRP-RDP project "North Western Pacific Tropical Cyclone (TC) Ensemble Forecast (NWP-TCTEF) Project" intends to build on the TIGGE concept and take advantage of the TIGGE CXML data provided by multiple organizations for improving TC track forecast skill over the North western Pacific, starting from 2009, as a five-year project. The objectives of the NWP-TCTEF Project are

- to explore and develop effective ways of obtaining and utilizing the track forecast data from TIGGE data providers to improve medium range forecast of TC track forecast

The North Western Pacific Tropical Cyclone Ensemble Forecast Project is a WMO WWRP Research and Development Project (RDP) and a joint project with WMO TCP. The project provides a guidance of tropical cyclone ensemble forecasts in near real-time for the ESCAP/WMO Typhoon Committee Members, to explore the utility of ensemble forecast products through the TIGGE CXML data and thus promote application of the products to the operational forecasting of tropical cyclones in the region.

- Deterministic and Ensemble TC track forecasts.

- Strike Probability Map (if a TC will approach within 120 km range in certain periods (currently 4 days) , based on Ebsemble TC track forecasts, with three different ways ("In 4 days", "each time", and "time series at cities")

- For verification purposes, the best track data by JMA are enbedded on the forecast track and strike probability maps.

Track | Strike Prob. | Prev. | 2009 | Oct | 20 | 12UTC | Next

Tetsuo Nakazawa

Tropical Cyclone Ensemble Track Information HomePage

Forecasts: Ensemble | Deterministic

Center: All Centers | Each Center

Track | Strike Prob.

Prev. 2011 Jul 26 0UTC Next

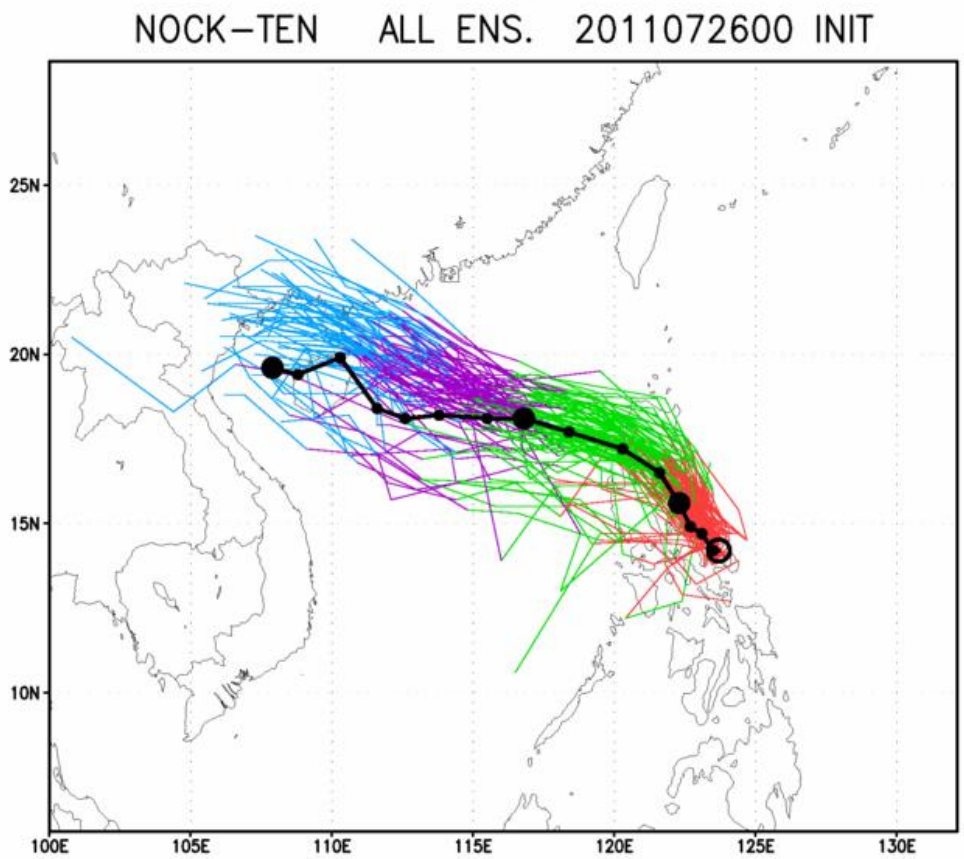
Update Display

Cyclone Name

Year 2011

- May AERE
- May SONGDA
- Jun SARIKA
- Jun HAIMA
- Jun MEARI
- Jul MA-ON
- Jul TOKAGE
- **Jul NOCK-TEN**
- Jul MUIFA
- Aug MERBOK
- Aug NANMADOL
- Aug TALAS
- Sep NORU
- Sep KULAP
- Sep MARIA
- Sep ROKE
- Sep SONCA
- Sep NESAT
- Sep HAITANG
- Sep NALGAE
- Oct BANYAN
- Dec WASHI

NOCK-TEN



Discussion

Link

Read Me

Data

Original CXML

Parsed Text

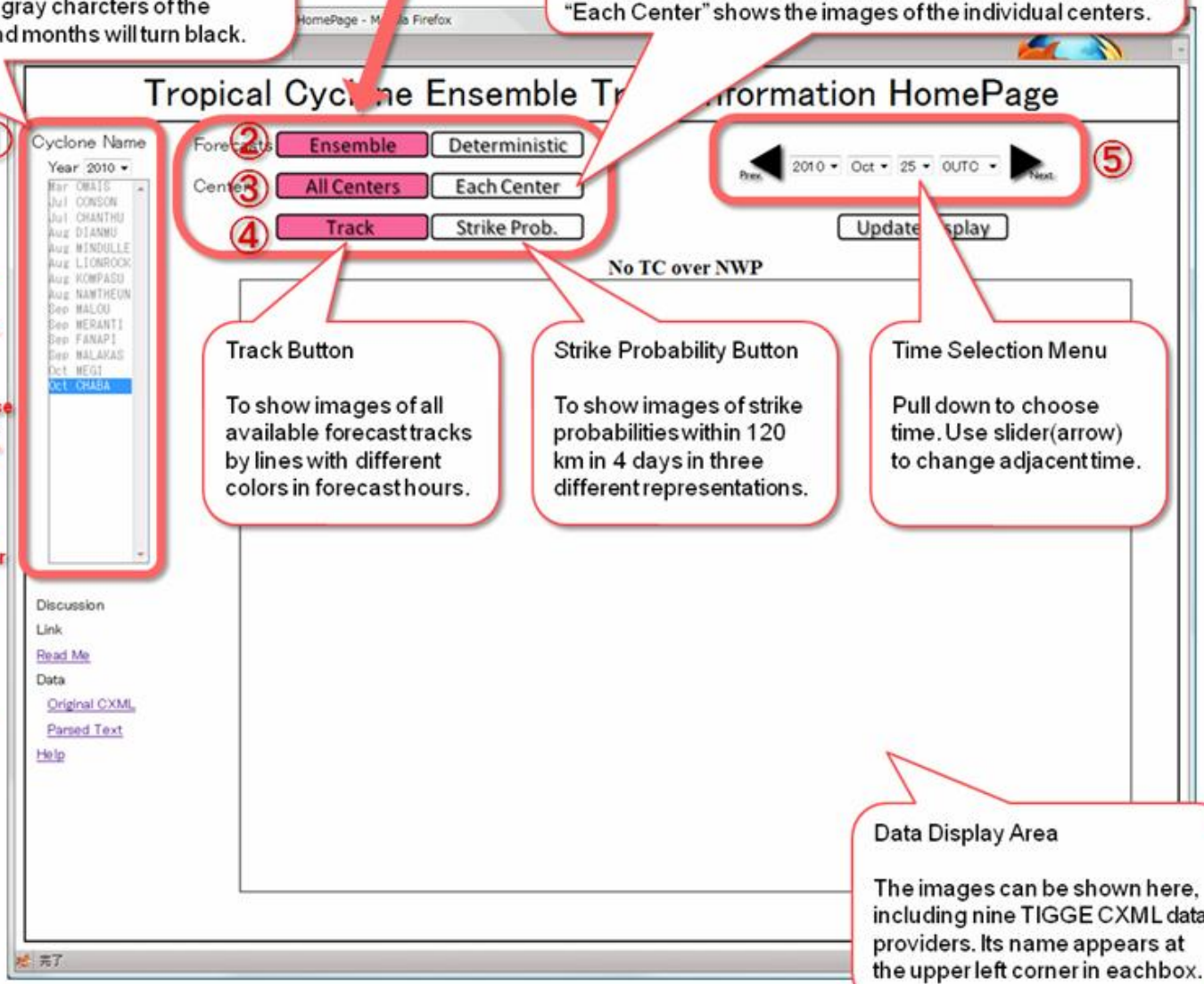
Help

Earlier version

Help

Tetsuo Nakazawa

Overview



① First, Choose "Year" and Cyclone Name.

② Second, Choose "Ensemble" or "Deterministic"

③ Third, Choose "All Centers" or "Each Center"

④ Fourth, Choose "Track" or "Strike Prob"

⑤ Then, Choose the time

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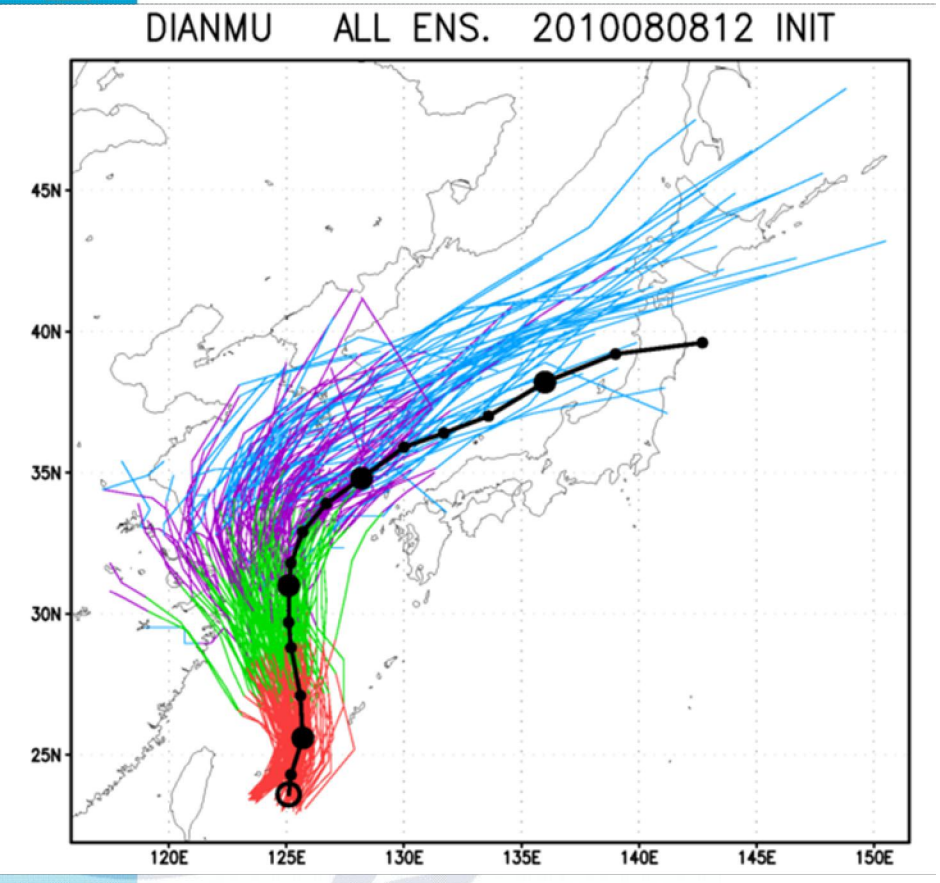
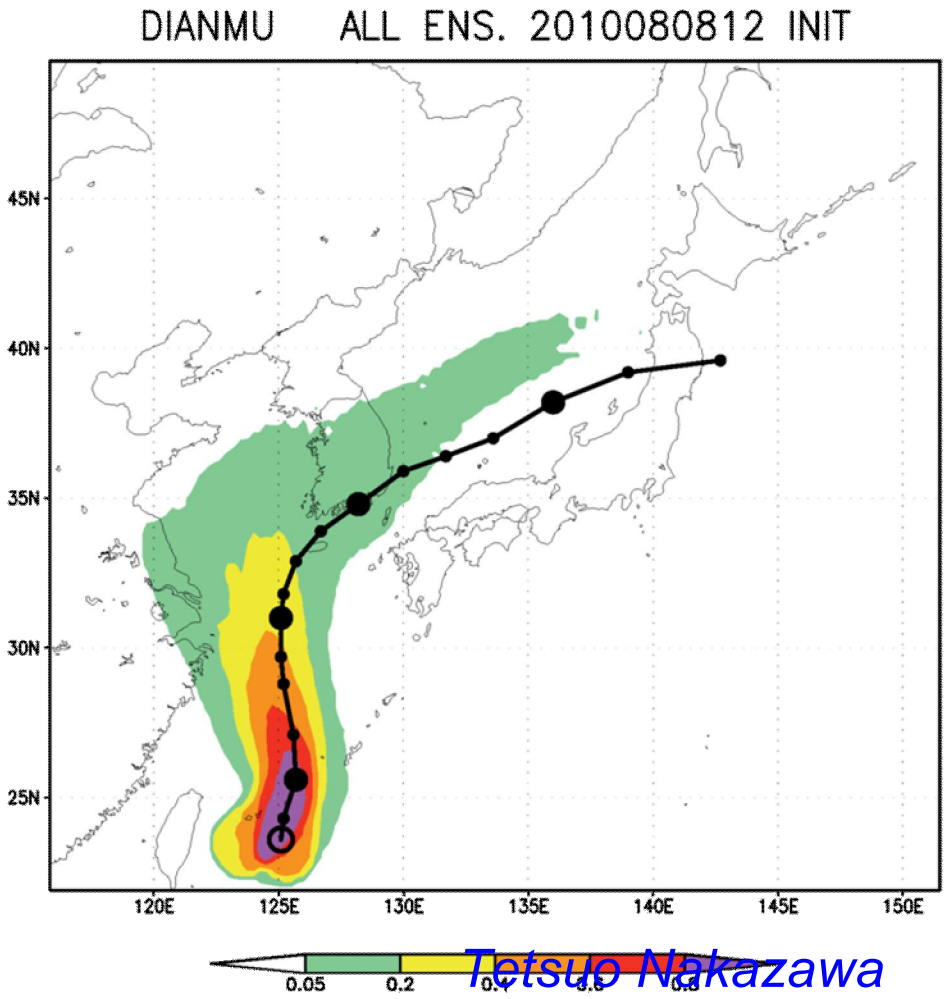
Track/ Strike probability





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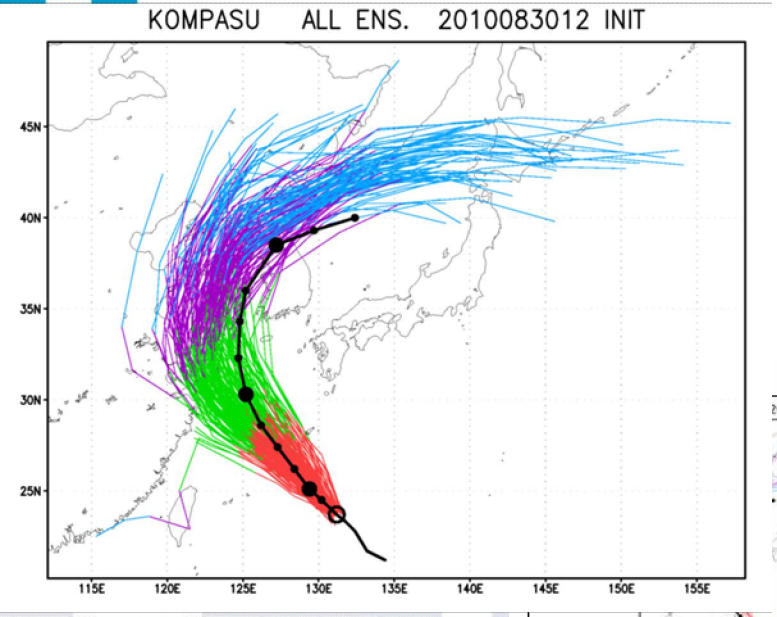
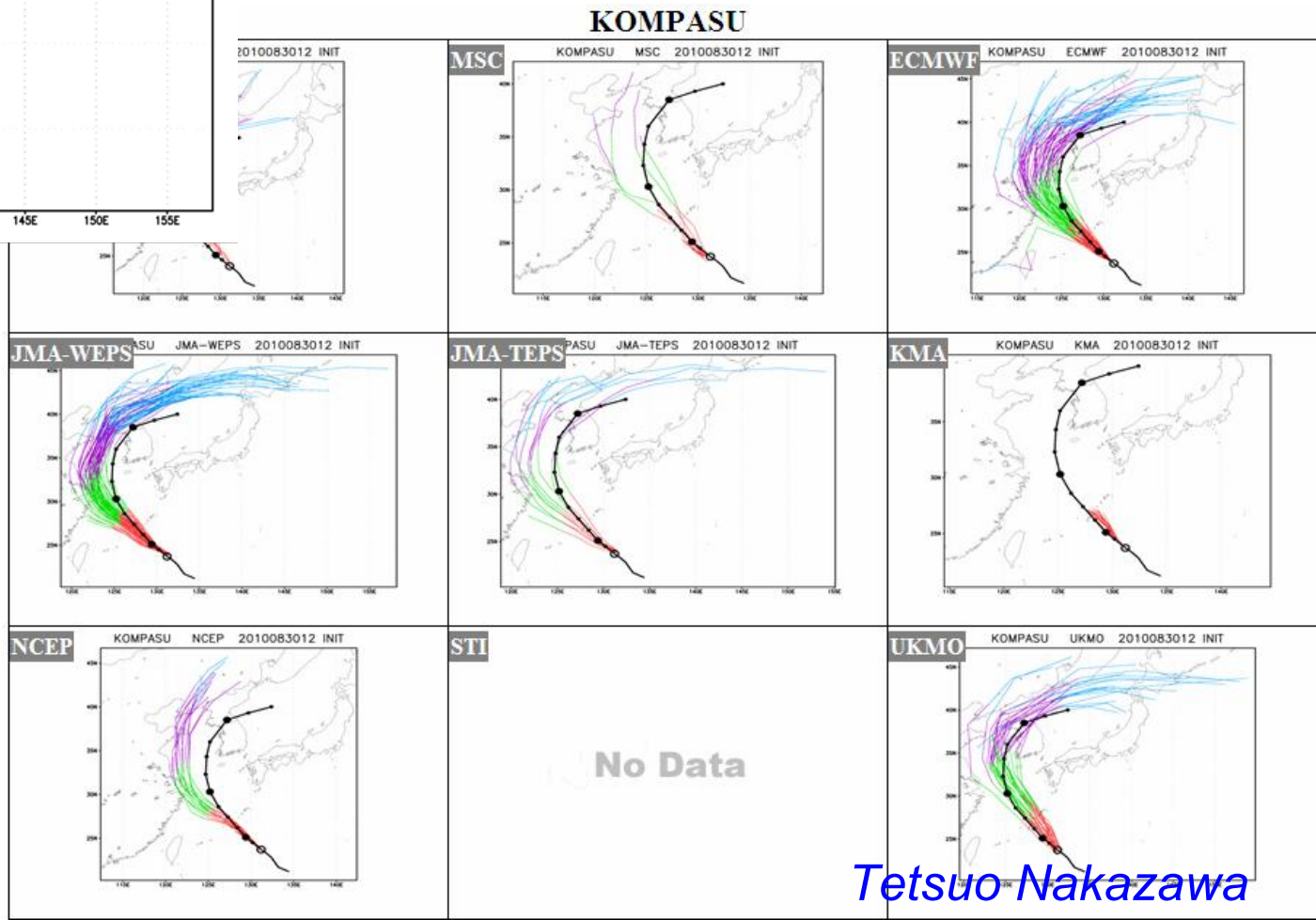


All centers/each center



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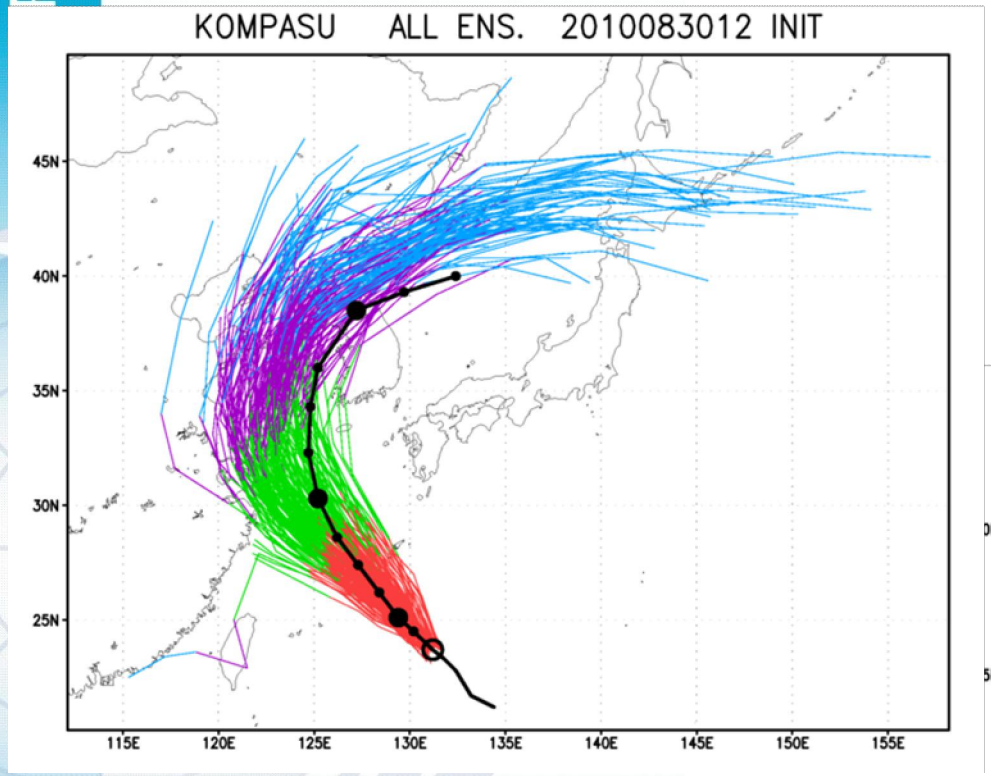
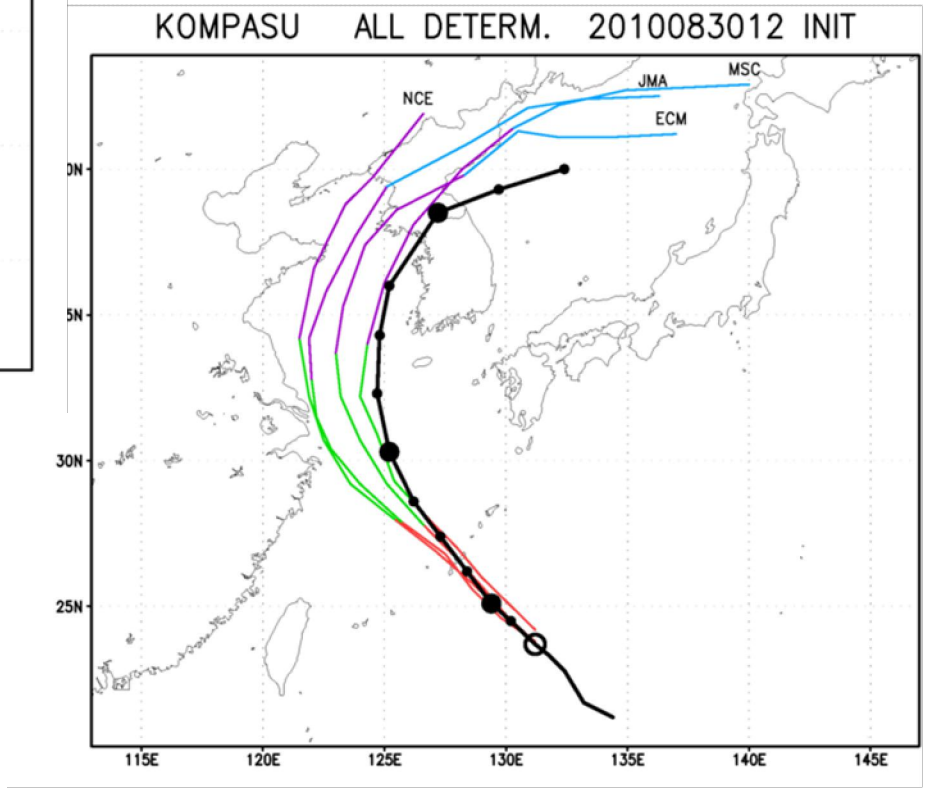


Ensemble /Deterministic



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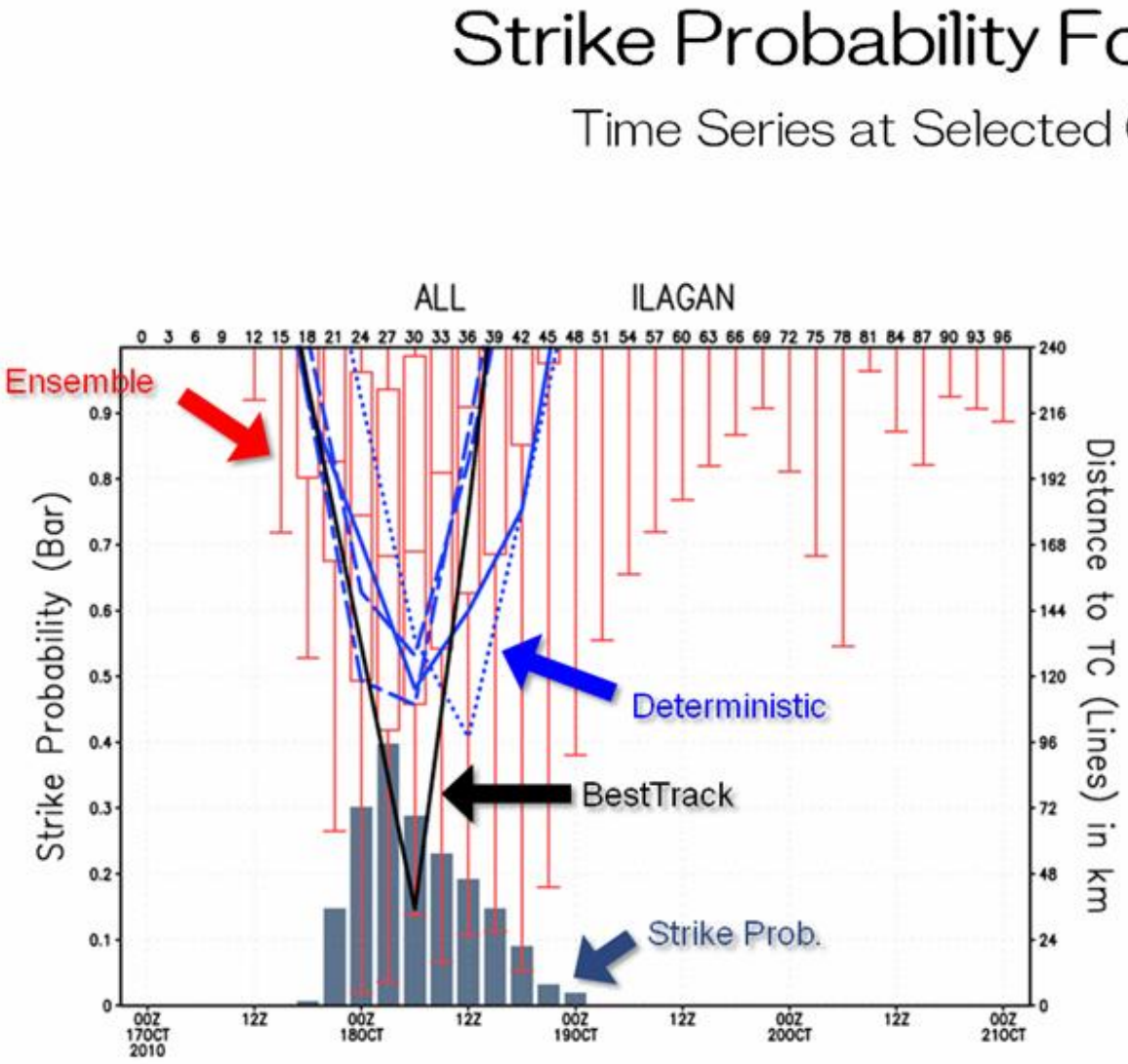
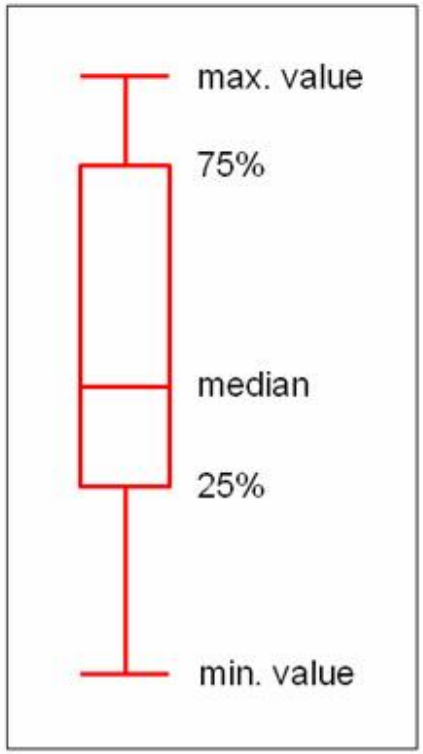
New TC product:





Box plot of Ensemble forecast

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Verification (from ppt 23-)

GIFS-TIGGE Products for SWFDP

8th Asian THORPEX Regional Committee Meeting

Tokyo, Japan

9 December 2011

Munehiko Yamaguchi[1], Mio Matsueda[2], Shunsuke Hoshino[1], Masaomi Nakamura[1], Tadashi Tsuyuki[3], Tetsuo Nakazawa[4]

1: Typhoon Research Department, Meteorological Research Institute, Japan Meteorological Agency

2: Japan Agency for Marine-Earth Science and Technology (JAMSTEC)

3: Forecast Research Department, Meteorological Research Institute, Japan Meteorological Agency

4: World Weather Research Division, Research Department, World Meteorological Organization

GIFS-TIGGE products for extreme weather events: heavy rainfall, strong wind

- No active progress from GIFS-TIGGE WG yet, but
- Prototype products have been developed
  - For Ensemble-based warnings for extreme weather events using TIGGE
  - Developed by MRI/JMA (Dr ***Mio Matsueda)***
  - Available after~3days (2 days delay for the data)
  - Documents are available
  - Very extensive products, can be used for normal weather too as well as for extreme weather
- For application to real-time forecasting, promising products will be selected, and used as the basis for developing real-time products, which will then be evaluated in the context of the SWFDP and other regional projects

Realtime Monitoring of TIGGE(http://tparc.mri-jma.go.jp/TIGGE/)

THORPEX
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Welcome to a museum of THORPEX Interactive Grand Global Ensemble (TIGGE)!

The TIGGE is a key component of the THORPEX project, which provides operational global ensemble forecast data quasi-operationally (2-day delay). The TIGGE portals provide the TIGGE data freely only for research and education purposes. For details, visit the WMO THORPEX website or the TIGGE website. This page is operated for an advertisement of TIGGE by Dr. Mio MATSUEDA (JAMSTEC, Japan) in cooperation with Dr. Tetsuo NAKAZAWA (WMO). This page is updated every day with a 3-day delay.

If you want to use TIGGE data, sample scripts would help you. Enjoy the TIGGE data!

LastUpdate:01/11/2012 23:05:40

About TIGGE data

- Latest details of operational global ensemble prediction system in TIGGE portals as of December 2010 [pdf]

Real-time monitor of TIGGE forecasts Updated every day!

- Spaghetti diagram, ensemble mean, and ensemble spread for Z500
- MJO forecast
- Ensemble-based warnings for extreme weather events [normal style or Google Map style] New! (a short guide [pdf])
- Ensemble-based occurrence probability of extreme events New! (a short guide [pdf])
- Ensemble-based occurrence probability of blocking over the NH
- EPS meteogram (around Japan and South Korea)

Verifications of TIGGE forecasts Updated every month or season!

- Daily RMSE and ensemble spread for Z500, T850, T2m, U850, V850, U200, and V200 (verification scores [pdf])
- Seasonal-mean RMSE and ensemble spread for Z500, T850, T2m, U850, V850, U200, and V200
- Scatter diagram between daily RMSE and ensemble spread for Z500 over the NH
- Seasonal-mean Z500 bias
- Predicted blocking frequency over the NH (blocking index [pdf])

THORPEX

WMO OMM

Real-time monitor of TIGGE forecasts (Updated every day!)

- Spaghetti diagram, ensemble mean, and ensemble spread for Z500
- MJO forecast
- Ensemble-based warnings for extreme weather events
  [normal style or Google Map style] New! (a short guide [pdf])
- Ensemble-based occurrence probability of extreme events
  New! (a short guide [pdf])
- Ensemble-based occurrence probability of blocking over the NH
- EPS meteogram (around Japan and South Korea)

Mio Matsueda

TIGGE Medium-range Ensemble

THORPEX

WMO OMM

TIGGE Medium-Range Ensemble

- (•) Spaghetti stamp (NH)
- ( ) Ensemble Spread (NH)
- ( ) Ensemble Mean (NH)
- ( ) Spaghetti stamp (SH)
- ( ) Ensemble Spread (SH)
- ( ) Ensemble Mean (SH)

Initiated time :

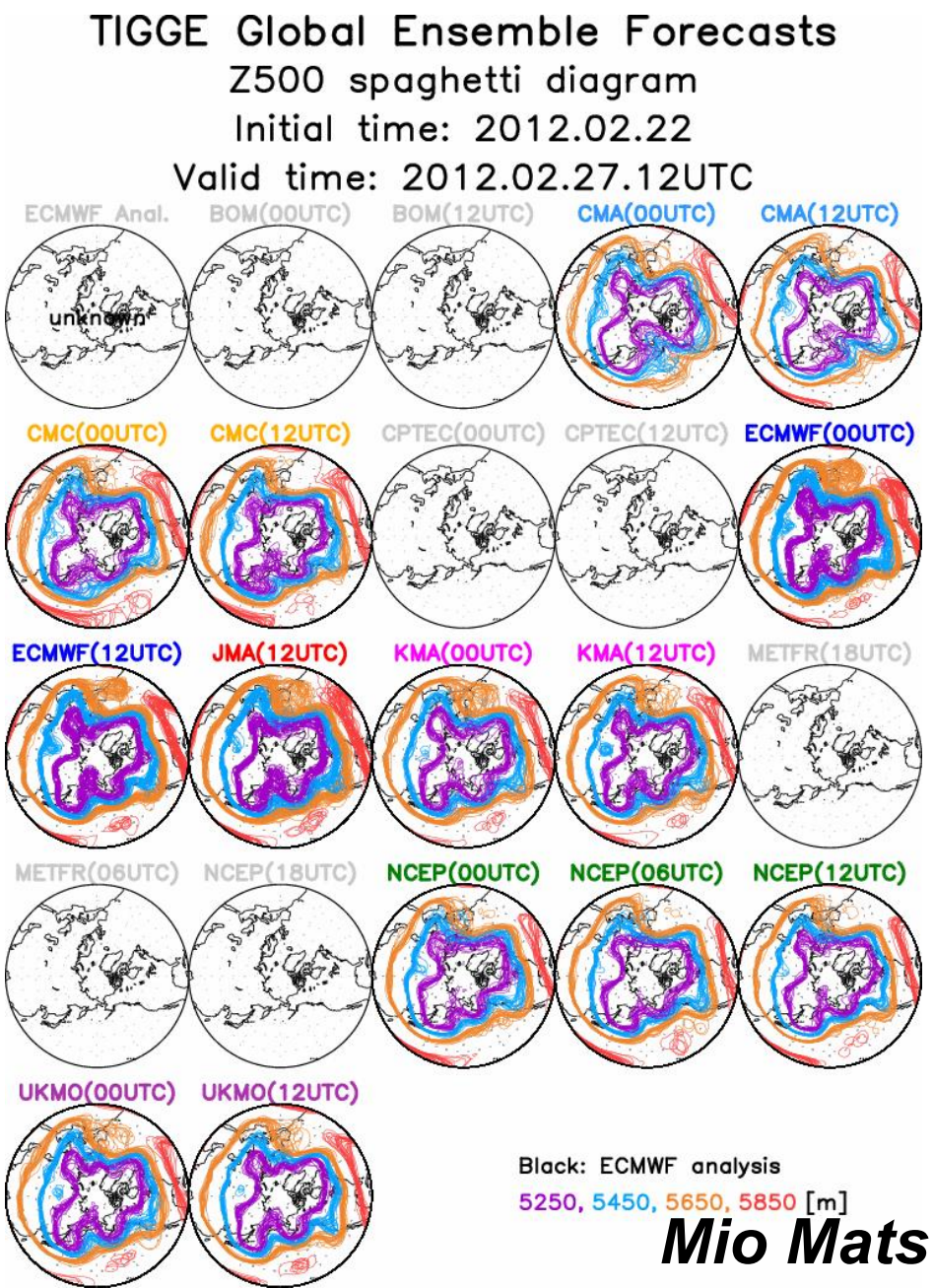
Year.Month 2012.02

Day 22

[-1 Day] [+1 Day] [latest]

Forecast hour:

( ) 000	( ) 012	( ) 024
( ) 036	( ) 048	( ) 060
( ) 072	( ) 084	( ) 096
( ) 108	(•) 120	( ) 132
( ) 144	( ) 156	( ) 168
( ) 180	( ) 192	( ) 204
( ) 216	( ) anime	



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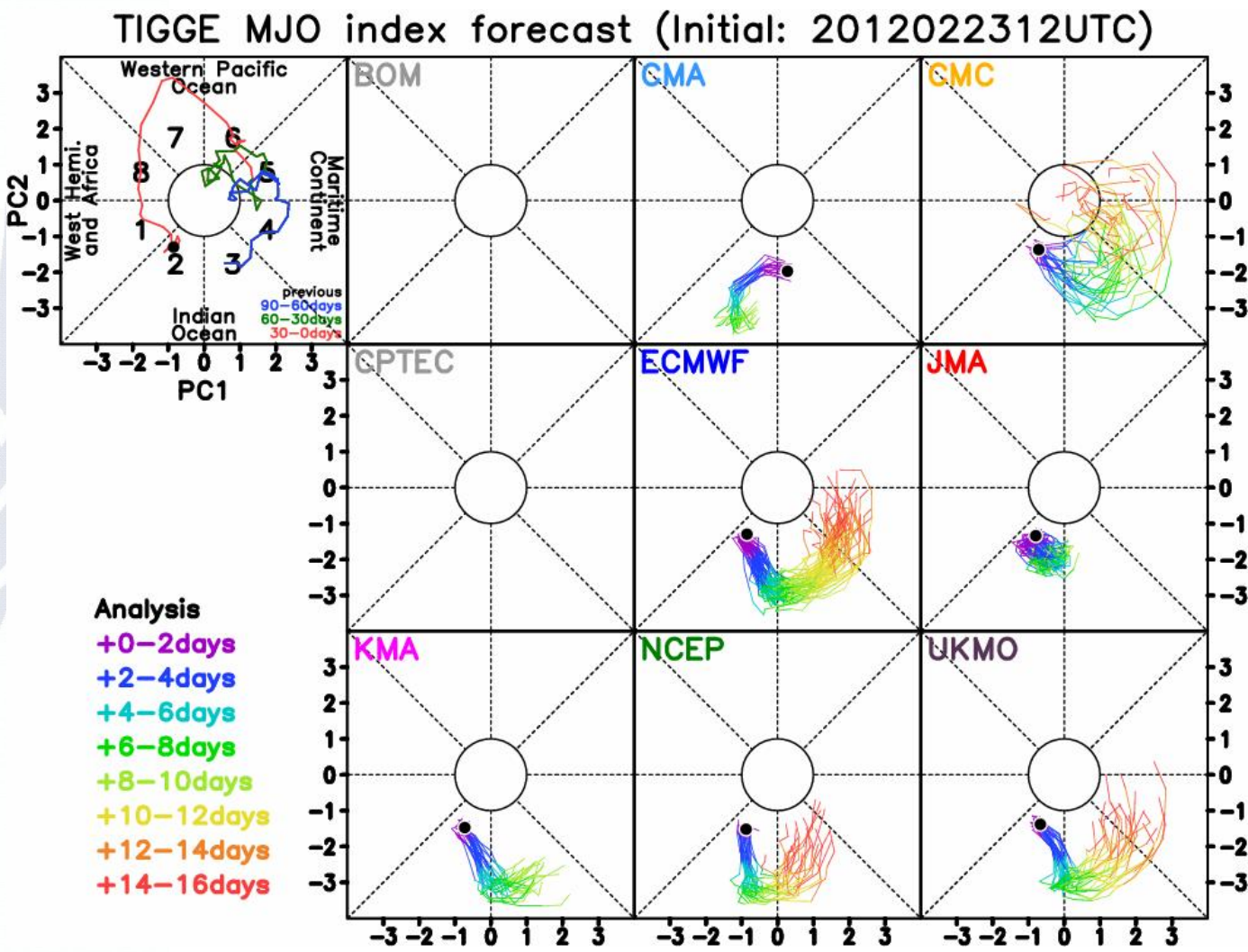
TIGGE MJO forecast

Initiated time :
Year.Month 2012.02
Day 23

-1 Day | +1 Day
latest

EOFs used here are based on Wheeler and Hendon (2004, MWR), but with U200 and U850. See EOFs

WH04's EOFs are here



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Ensemble-based Warning for extreme weather events

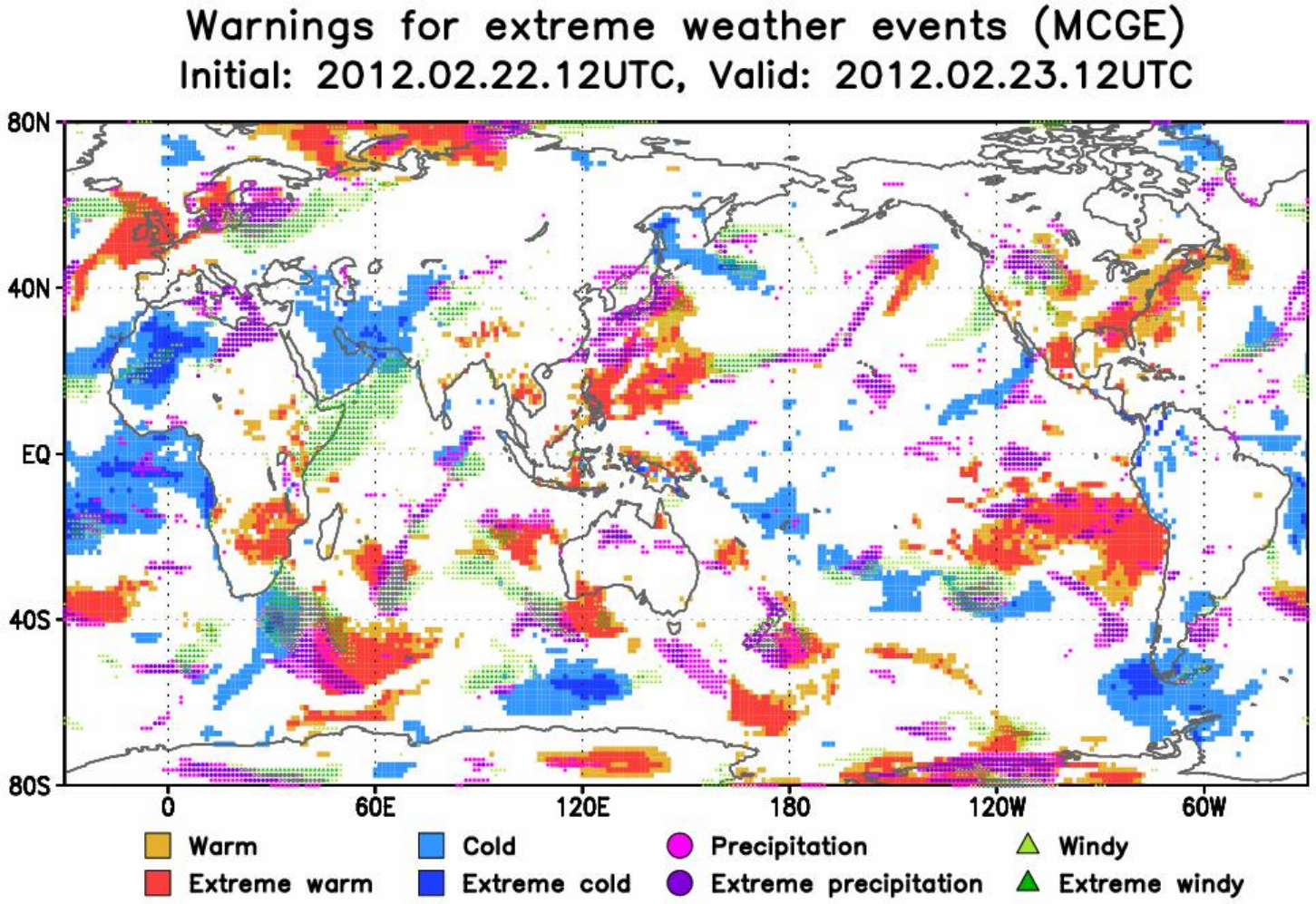
[A short guide (pdf)]

Google Map style

Area
Global

Ft:
- Grand Ensemble
- ECMWF
- JMA
- NCEP
- UKMET
- All

Ft:
- +0-1 days
- +1-2 days
- +2-3 days
- +3-4 days
- +4-5 days
- +5-6 days
- +6-7 days
- +7-8 days
- +8-9 days



global, EU, AF, Ru, Indian Ocean, As, AU&NZ, NA, SA

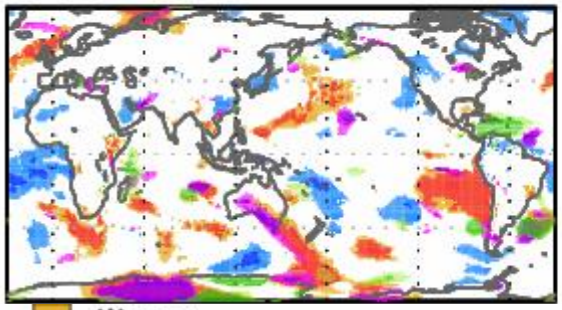
4 SWFDP areas

Mio Matsueda

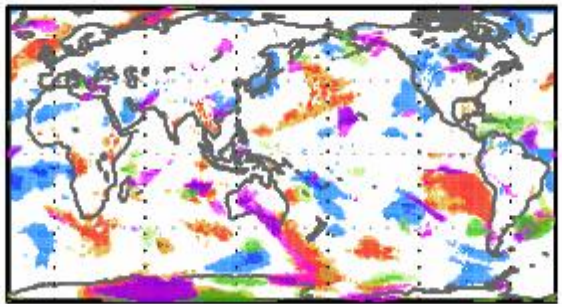
Warnings for extreme weather events

Initial: 2012.02.22.12UTC, Valid: 2012.02.27.12UTC

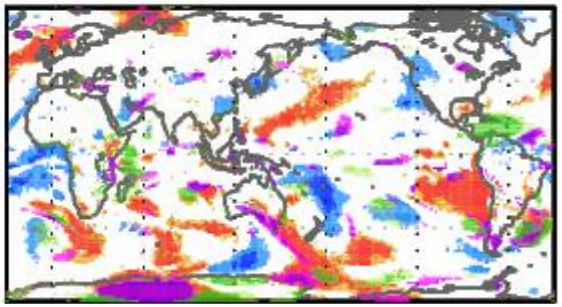
MCGE



ECMWF

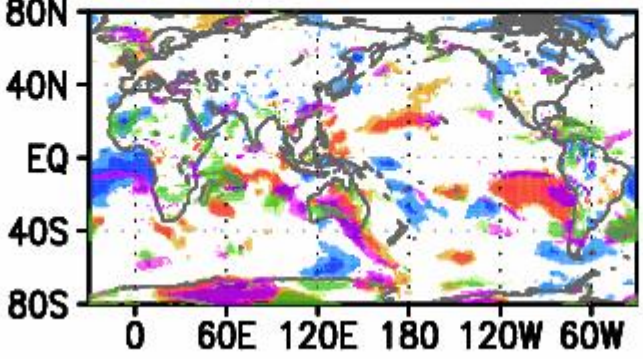


JMA

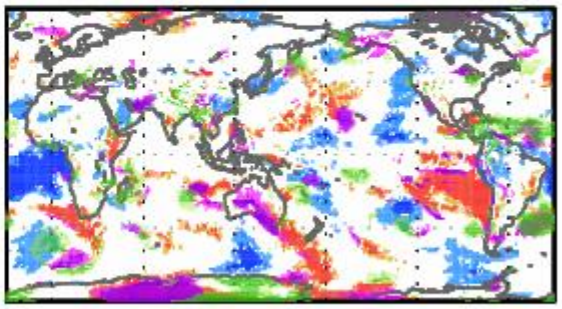


- Warm
- Extreme warm
- Cold
- Extreme cold
- Precipitation
- Extreme precipitation
- Windy
- Extreme windy

NCEP



UKMO



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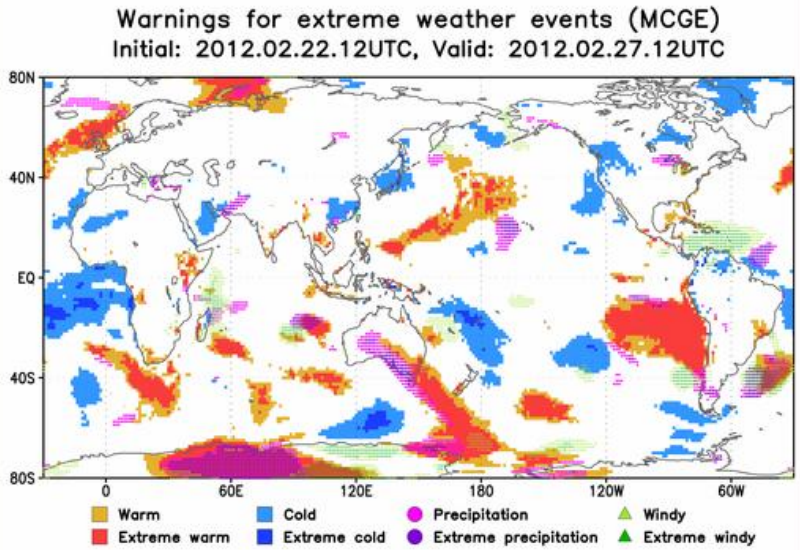
Ensemble-based warning for extreme weather events

[A short guide (pdf)] Percentiles Normal style Go to main page

Centre: ◉ Grand ensemble ○ ECMWF ○ JMA ○ NCEP ○ UKMO

Ft: ○ +0-1 days ○ +1-2 days ○ +2-3 days ○ +3-4 days ◉ +4-5 days ○ +5-6 days ○ +6-7 days ○ +7-8 days ○ +8-9 days

Zoom out Zoom in



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GMapImgCutter CASA - 이용약관

WMO OMM

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Ensemble-based occurrence probability of extreme events

Extreme events:
- (•) heavy precipitation
- ( ) strong wind
- ( ) warm
- ( ) cold

Percentiles:
- (•) 90th or 10th
- ( ) 95th or 5th
- ( ) 99th or 1st

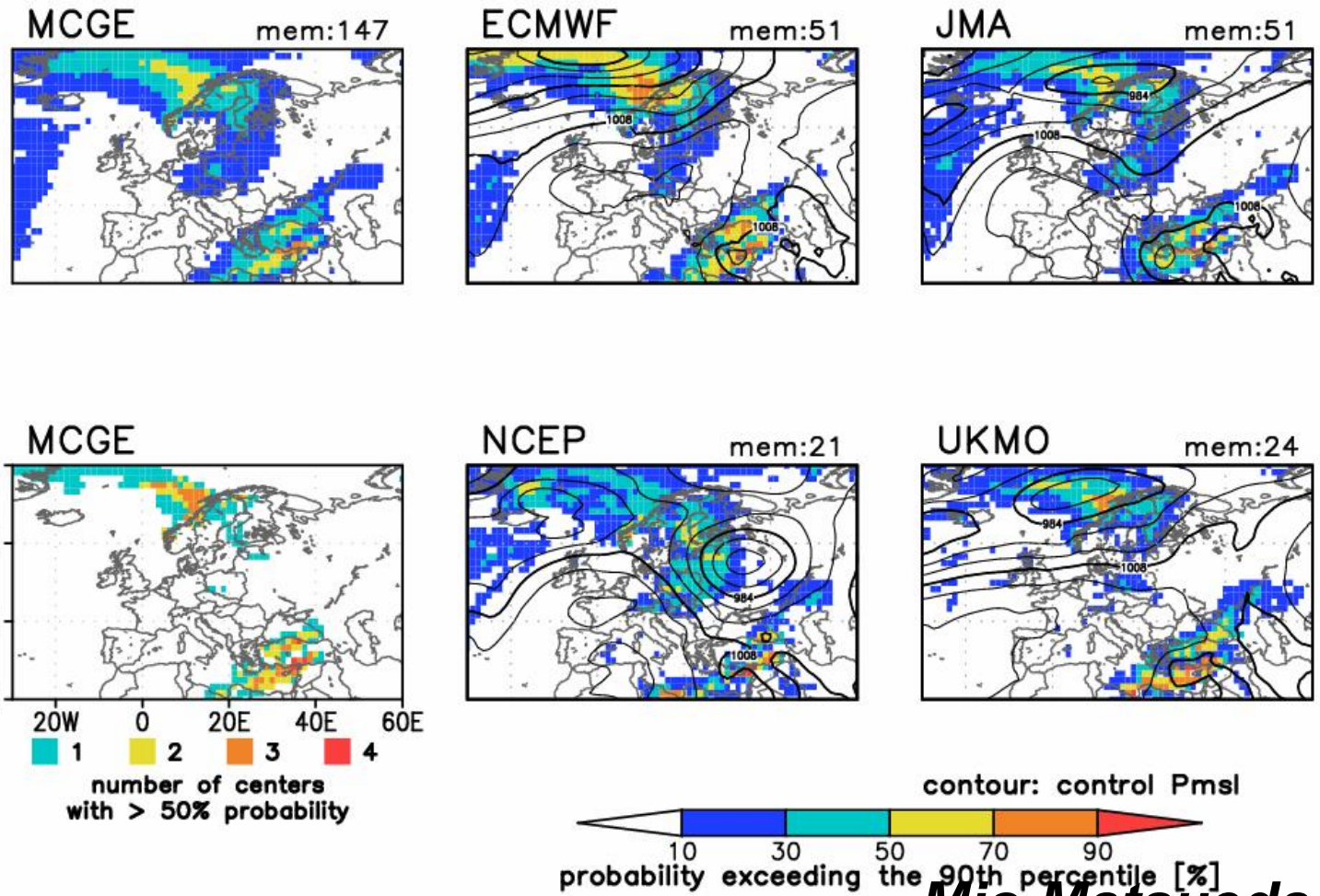
Area: Europe

Initiated time :
Year.Month 2012.02
Day 22

-1 Day | +1 Day | latest

Ft:
- ( ) +0-1 days
- ( ) +1-2 days
- ( ) +2-3 days
- ( ) +3-4 days
- ( ) +4-5 days
- (•) +5-6 days
- ( ) +6-7 days
- ( ) +7-8 days
- ( ) +8-9 days
- ( ) +9-10 days
- ( ) +10-11 days
- ( ) +11-12 days
- ( ) +12-13 days
- ( ) +13-14 days
- ( ) +14-15 days

Occurrence probability of extreme 24-hr precipitation
Valid: 2012022212UTC +5-6days



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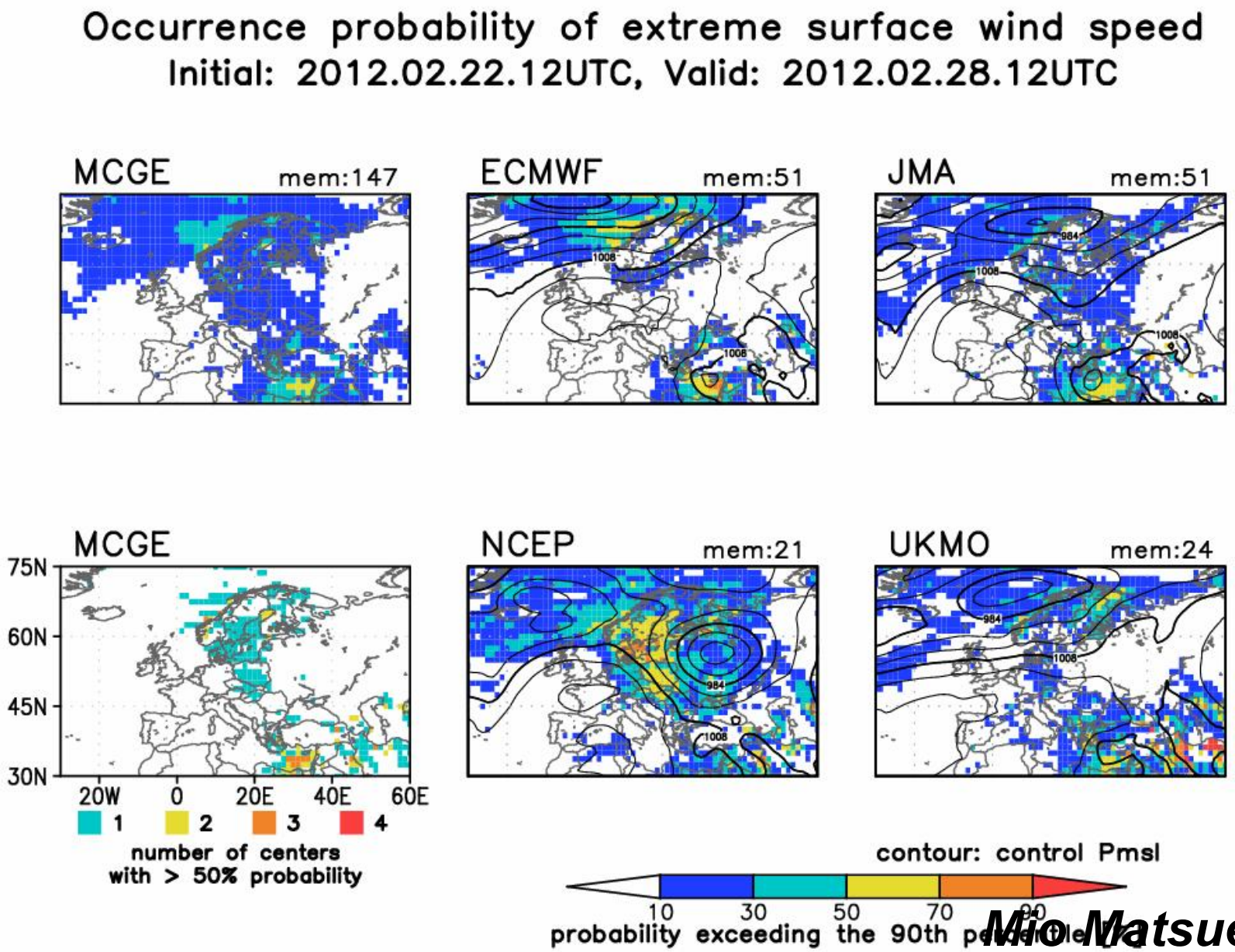
Extreme surface wind



THORPEX

WMO OMM

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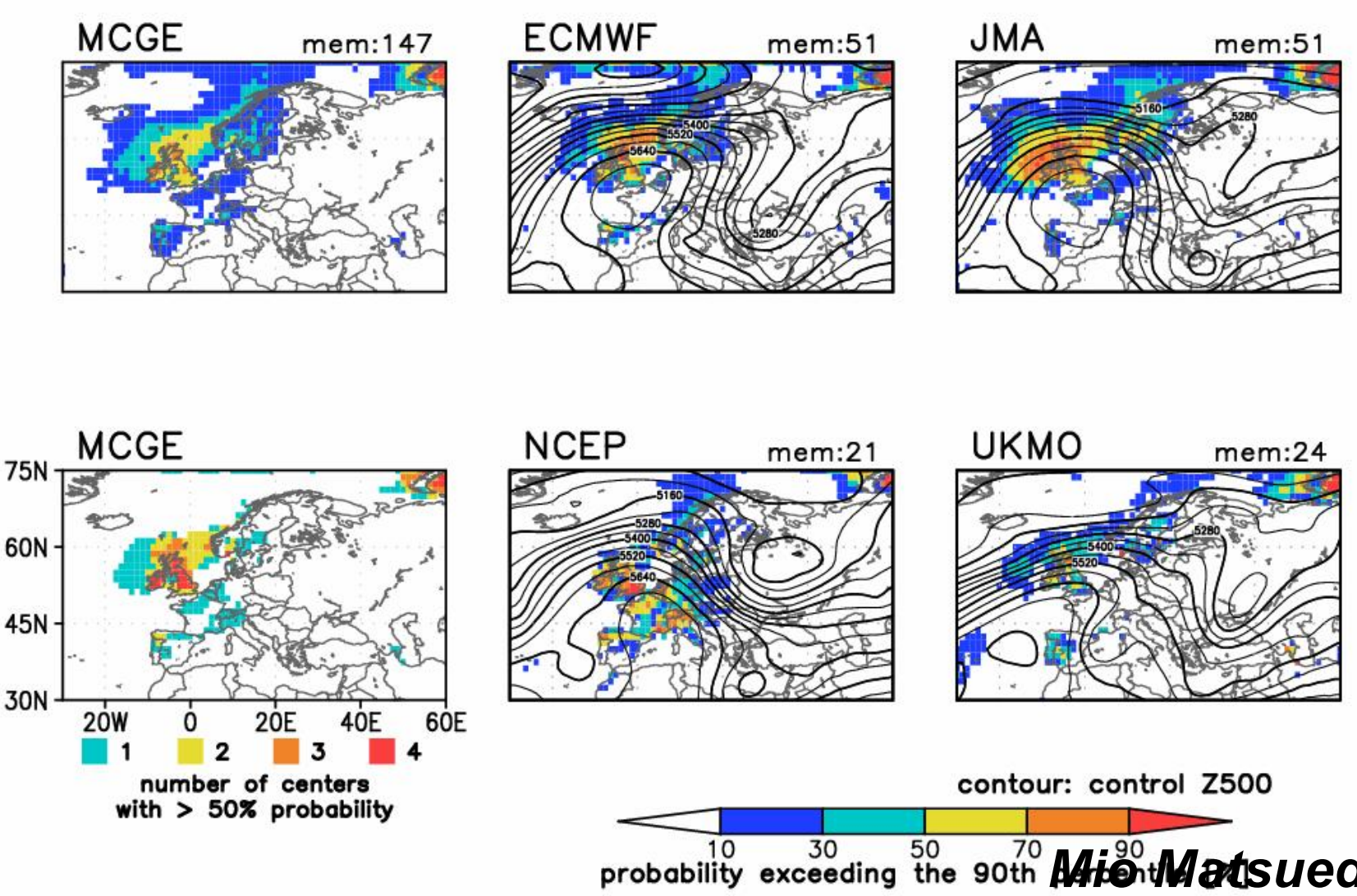
Extreme warm T2m



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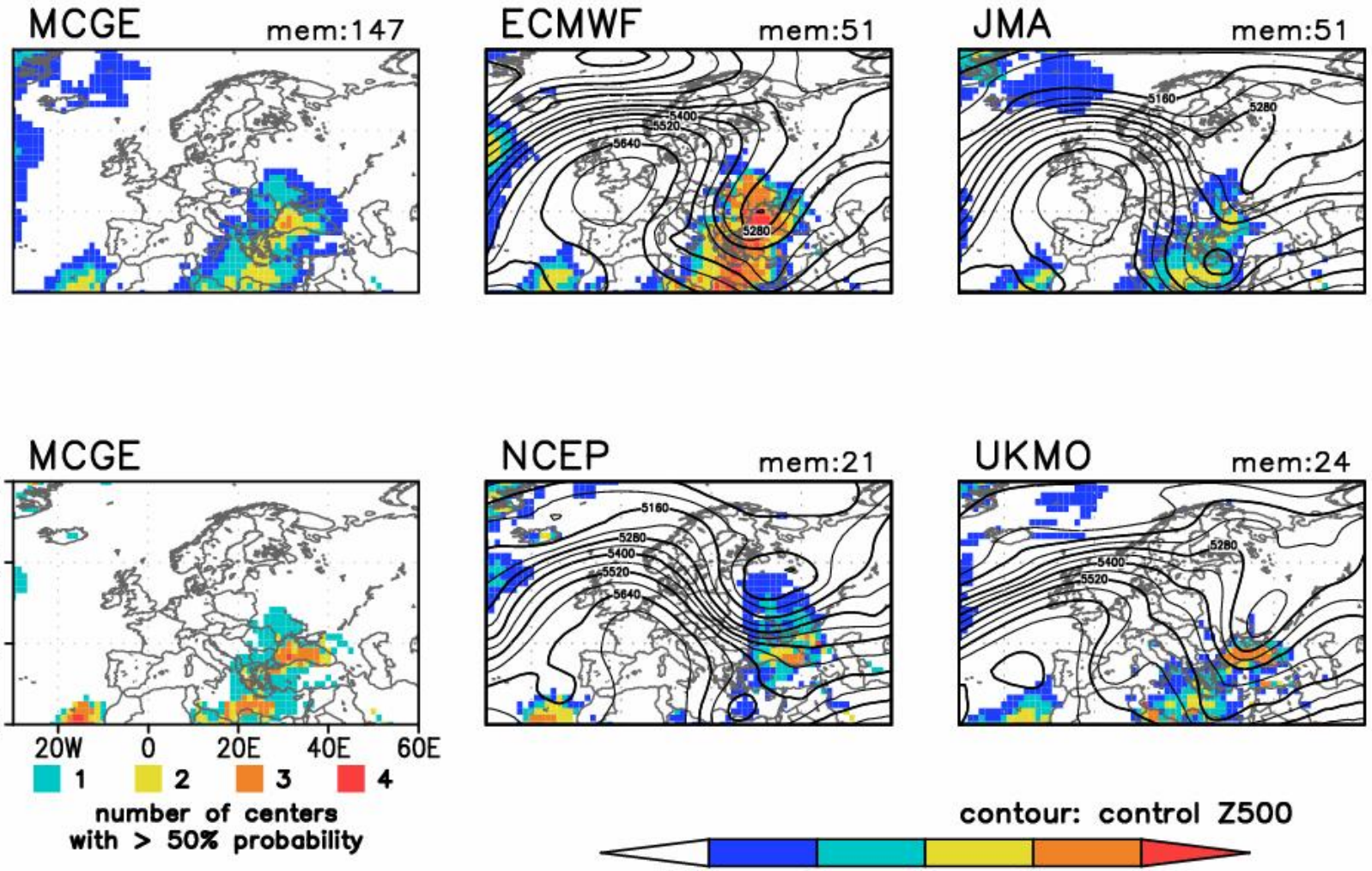
Extreme cold T2m

Occurrence probability of extreme cold T2m
Initial: 2012.02.22.12UTC, Valid: 2012.02.28.12UTC



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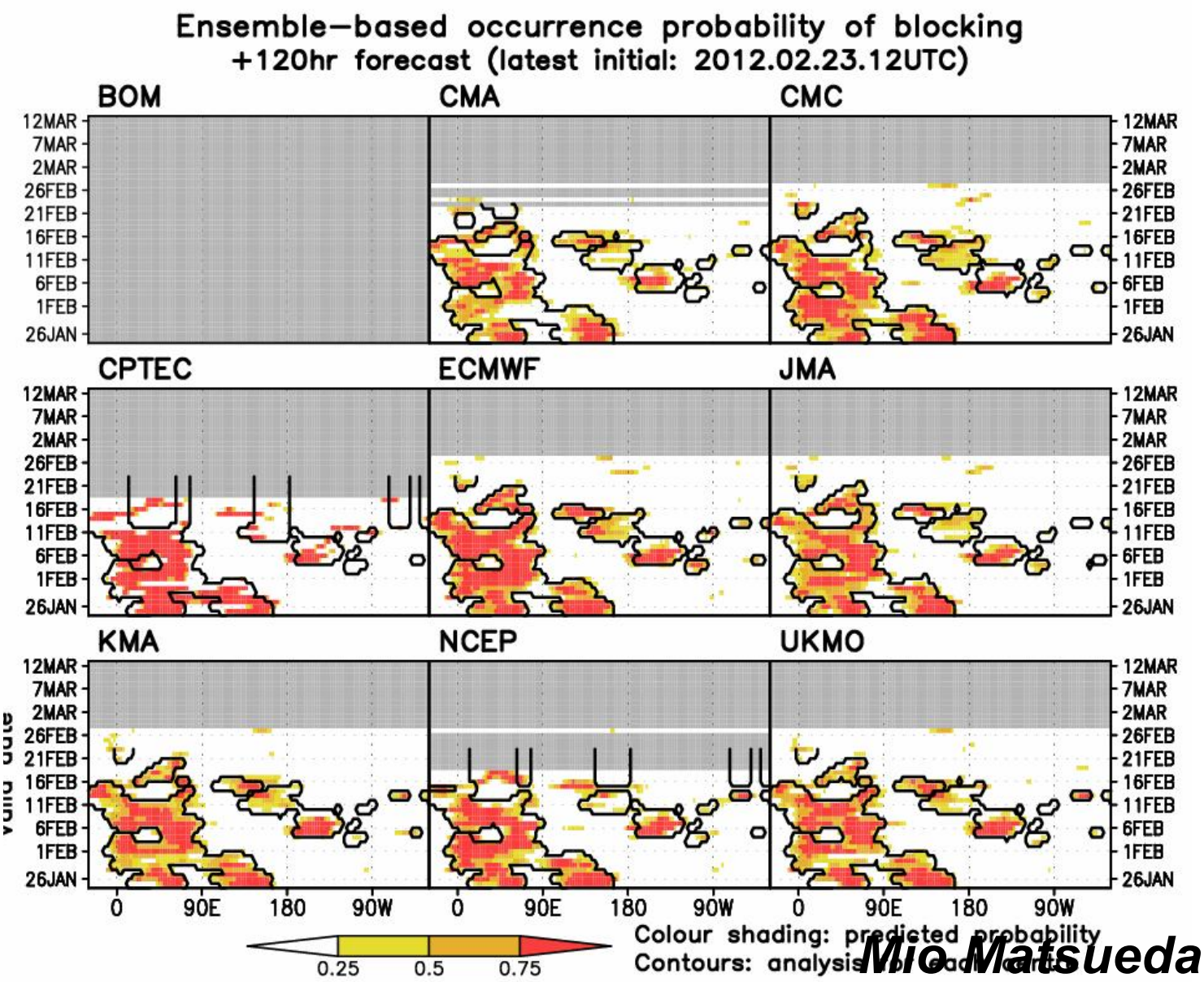
THORPEX

Ensemble-based occurrence probability of blocking

Ft:

- +000 hr
- +024 hr
- +048 hr
- +072 hr
- +096 hr
- (•) +120 hr
- +144 hr
- +168 hr
- +192 hr
- +216 hr
- +240 hr
- +264 hr
- +312 hr
- +336 hr
- +360 hr

How the probability is calculated



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OMM

Blocking Predictability in Operational Medium-Range Ensemble Forecasts

Mio Matsueda[1)]

1) Advanced Earth Science and Technology Organization/MRI

(Received: June 17, 2009)
(Accepted: July 14, 2009)

Abstract:
This study assesses the forecasting performance of operational medium-range ensemble forecasts: BOM, CMA, CMC, CPTEC, ECMWF, JMA, KMA, NCEP, and UKMO, in terms of atmospheric blocking during DJF (December-January-February) of 2006/07, 2007/08, and 2008/09.
The state-of-the-art medium-range ensemble forecasts performed well in simulating the frequencies of Euro-Atlantic (EA) and Pacific (PA) blockings, even after 216-hr lead time, whereas they did not simulate well the frequencies of Greenland and Ural blockings, even in the middle of the forecast range. The ensemble forecasts are not always able to capture the blockings with high probability in the latter half of the forecast range. During this latter half, blocked flows were frequently predicted with low probability during the active blocking period, whereas they were seldom predicted with similar probability during the non-active blocking period. This result might suggest that the active blocking period is more chaotic than the non-active blocking period. In addition, it was more difficult to predict an onset of EA blocking than to predict an onset of PA blocking, and probabilistic blocking forecasting over the PA sector was more skillful than that over the EA sector. These results suggest that PA blocking has a higher predictability than does AT blocking.

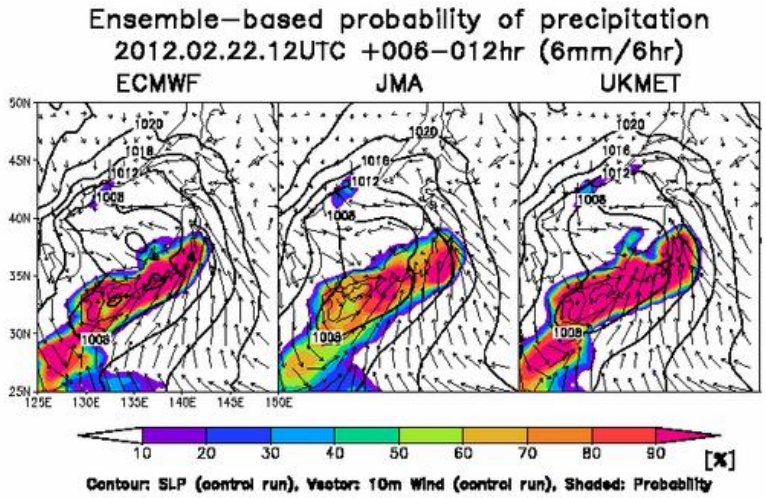
Meteogram by medium-range ensemble forecasts (31 cities)

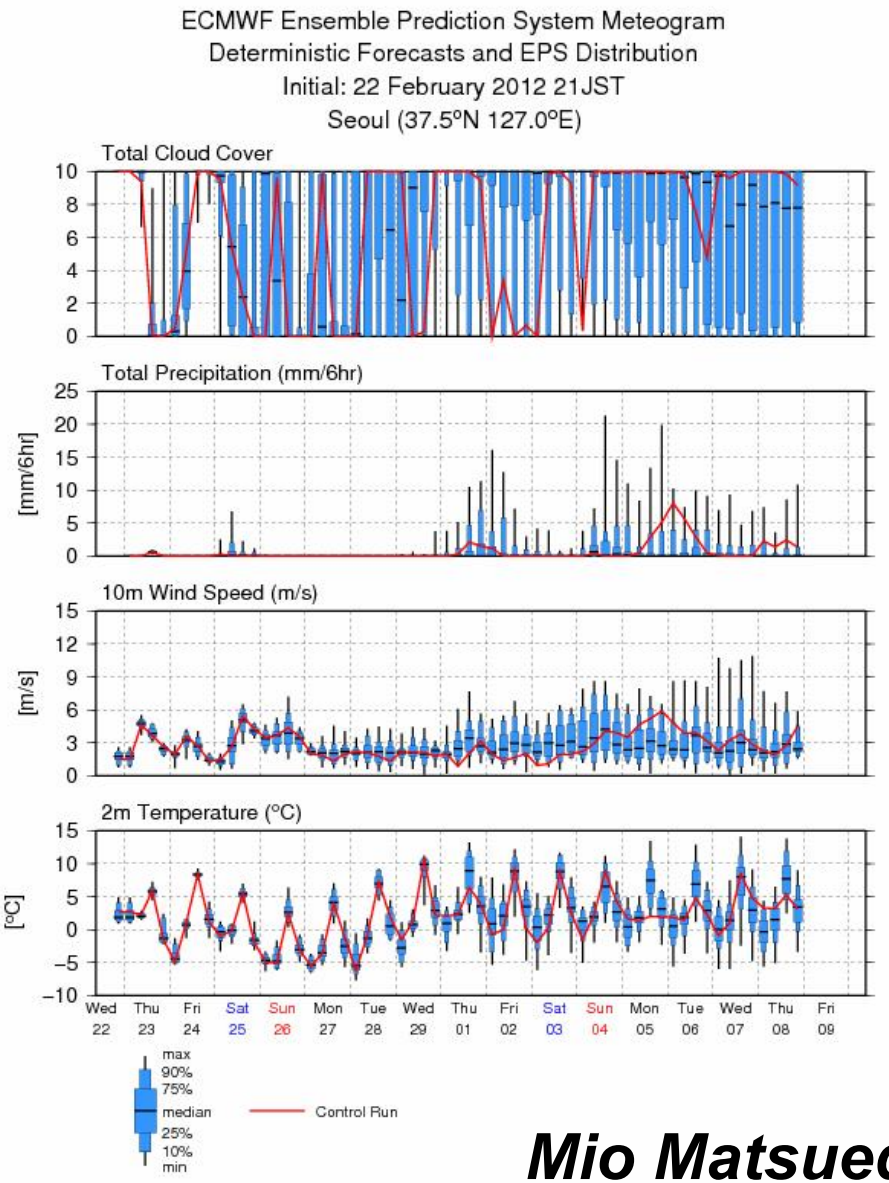
NWP centers: ◉ECMWF ○JMA ○UKMET

Cities: Seoul

Forecast hour:

○006	◉012	○018	○024	○030	○036	○042	○048
○054	○060	○066	○072	○078	○084	○090	○096
○102	○108	○114	○120	○126	○132	○138	○144
○150	○156	○162	○168	○174	○180	○186	○192
○198	○204	○210	○216	○222	○228	○234	○240
○246	○252	○258	○264	○270	○276	○282	○288
○294	○300	○306	○312	○318	○324	○330	○336
○342	○348	○354	○360	○anime			





Mio Matsueda

Feedback from SWFDP

- Focal points for each region/program ?
  - **SWFDP in Southern Africa(*Eugene Poolman*)**
  - **SWFDP in South-west Pacific(Steve Ready)**
  - **SWFDP in Eastern Africa(*James Kongoti*)**
  - **SWFDP in Southeast Asia(Yiki Honda)**
  - **SWFDP in Bay of Bengal(*Roy Bhowmik)***
- Visit the prototype products page,
  - evaluate the products(useful?, need another product?, need improvement?)
  - and give feedback to GIFS-TIGGE WG
- It will be discussed during the next WG meeting(late June)

Afterward

- Once GIFS developments have been demonstrated, they would need to be taken forward as enhancements to the operational weather forecasting system.
- Arrangements will need to be made for sustainable production and distribution of products under the auspices of WMO/CBS, rather than in the context of the CAS research programme.
- Additional investments to support these developments may include telecommunication upgrades, and international agreements on data exchange policy and the use of products.
- A future system will follow CBS guidelines on operational systems and requirements, using the WIS infrastructure and would undergo thorough pre-implementation testing and evaluation period.
- In due course, the GIFS developments could lead to improved advanced warnings for tropical cyclones, and extreme precipitation, winds and temperature by operational weather forecasting centres across the world.