

# WGNE intercomparison of Tropical Cyclone Track forecast 2016



## **STANDARD VERIFICATION**

Verification of Global Models

# History of the Project

- 1991 : Commencement with 3 centres: ECMWF, UKMO and JMA. The verification area was only western North Pacific (WNP).
- 1994 : CMC joined.
- **1999 : Verification for North Atlantic (NAT) started.**
- 2000 : **DWD** joined. Verification for eastern North Pacific (ENP) started.
- 2002 : Verification for 2 regions in the Southern Hemisphere (SIO and AUR), North Indian Ocean (NIO) and central North Pacific (CPC) started.
- **2003** : NCEP and BoM joined. A website for this project was launched.
- 2004 : Meteo-France (FRN) and CMA joined.
- 2006 : CPTEC and NRL joined.

2011 : KMA joined.

2017 : 11 NWP centres (BoM, CMA, CMC, DWD, ECMWF, FRN, JMA, KMA, NCEP, NRL, UKMO) are now involved in the project.



### Data Specifications in 2016

NWP centre	Year of verification commencement	Horizontal resolution of provided data (degrees in longitude and latitude)	Model resolution as of 2016
ВоМ	2003	0.5625 x 0.3750 (~Mar. 15) 0.3516 x 0.2344 (Mar. 16~)	40kmL70 (~Mar. 15) 25kmL70 (Mar. 16)
СМА	2004	0.2813 x 0.2813	T <sub>L</sub> 639L60
СМС	1994	<b>1.0 x 1.0</b>	25km L80
DWD	2000	0.25 x 0.25	13kmL90
ECMWF	1991	0.125 x 0.125	T <sub>L</sub> 1279L137 (~Mar. 7) 01280L137 (Mar. 8~)
FRN	2004	0.5 x 0.5	T <sub>L</sub> 1198C2.2L105
JMA	1991	0.25 x 0.25	T <sub>L</sub> 959L100
КМА	2010	0.3516 x 0.2344 (~Jun. 30) 0.2344 x 0.1563 (Jul. 1~)	25kmL70 (~Jun. 30) 17kmL70 (Jul. 1~)
NCEP	2003	0.5 x 0.5	T1534L64
NRL	2006	0.5 x 0.5	T425L60
UKMO	1991	0.2344 x 0.1563	17kmL70

#### [Data missing] CMA : 11/14 - 12/31



## Verification Method using MSLP

### Target TCs

TC best track data provided by individual RSMCs are used in verification, with focus on cyclones reaching tropical storm (TS) intensity with maximum sustained winds of 34 knots or stronger. The tropical depression (TD) stage of targeted TCs is also included in this verification, and TCs remaining at TD level throughout their lifespan are excluded.

#### **Tracking Method**

TCs are tracked using mean sea level pressure data provided by participating NWP centres. Under this method, the minimum pressure point is identified as the initial or predicted TC position.

- 1) First position (FT+0hr) is searched within a 500 km radius of a best track position.
- 2) Second position (FT+6hr) is searched within a 500 km radius of the first position.
- 3) Subsequently (FT+12hr~), a TC position within a 500 km radius of a reference point determined from linearly extrapolation of the latest two positions is identified.

Tracking ends when no appropriate minimum pressure point is found.

#### Definitions



#### Detection Rate

**Detection Rate (t) = A(t)/B(t)**, where:

- A(t) : number of events in which a TC is analyzed at time t with the condition that the NWP model successively expresses the TC until time t
- B(t) : number of events in which a TC is analyzed at time t.

# TCs in 2016

#### **TC** season

Northern Hemisphere : 1 January 2016 to 31 December 2016

Southern Hemisphere : 1 September 2015 to 31 August 2016

#### Number of TCs [best track data provider]

- 26 Western North Pacific [RSMC Tokyo]
- 21 Eastern North Pacific (including Central North Pacific) [RSMC Miami, Honolulu]
- 15 North Atlantic [RSMC Miami]
- 4 North Indian Ocean [RSMC New Delhi]
- 8 South Indian Ocean [RSMC La Reunion]
- 9 Around Australia [RSMC Nadi and 4 TCWCs ]



# Improvement of models for each centres in 2016

• 2016.03.16 improve horizontal resolution(40km => 25km)

DWD

- 2016.04.13 improve physical process(convection, radiation)
- 2016.09.28 improve physical process(cloud)
- 2016.11.30 improve data assimilation method

ECMWF

- 2016.03.08 improve horizontal resolution(16km => 9km: Octahedral grid), convection scheme, etc (Cycle 41r2)
- 2016.11.22 improve data assimilation method, method of using observation data, and physical process (Cycle 43r1)

JMA

- 2016.03.17 start to use Himawari-8 AMV, CSR data
- 2016.03.24 improve physical process and start to use GPM microwave imager data
- 2016.09.28 improve tropical cyclone bogus data

#### KMA

• 2016.07.01 improve horizontal resolution(25km => 17km)

#### NRL

• 2016.10 model update

#### UKMO

2016.03.15 impliment bias correlation of variational method for satellite observation data

### (a) Western North Pacific (WNP) Position Error



### (a) WNP Detection Rate







### (a) WNP Central Pressure Scatter Diagram (FT=0)



### (a) WNP Central Pressure Scatter Diagram (FT=72)



#### (a) WNP Error Map (FT=72) 2016\_NWP\_CMA\_72\_ermap 2016\_NWP\_CMC\_72\_ermap 2016\_



### (a) WNP Error Map (FT=72)



### (b) North Atlantic (NAT)



### (c) Eastern North Pacific (ENP)



### (d) "around Australia" (AUR)



### (e) South Indian Ocean (SIO)



### Visualization with "Pie-chart"

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Western North Pacific Eastern North Pacific North Atlantic South Indian Ocean Around Australia detection rate



### Transition of FT=72 Position Error over Decade(s)



# TC intercomparison website will be available soon!

WGNE Intercomparison of Tropical Cyclone Track Forecasts Using Operational Global Models

Updated: 28 August 2018

NAT

Forecast Verification Verification (regional) Introduction Read Me Data Data (regional) Contact Link

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#### Verification Result

Click on a region of the map to show a pop-up verification.

<http://nwp-verif.kishou.go.jp/wgne\_tc/index.html> Login ID: verif Password: wgne2018 (beyond 15 October 2018) Contact: globalnwp@naps.kishou.go.jp

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# PRELIMINARY SLIDE

### **AT-CT Bias**

### [Before, During, After] Recurvature







### (a) WNP AT-CT Bias (FT +72) In 2015



### (a) WNP AT-CT Bias (FT=72)



### (b) NAT AT-CT Bias (FT=72)



### (c) ENP AT-CT Bias (FT=72)



### (d) AUR AT-CT Bias (FT=72)



### (e) SIO AT-CT Bias (FT=72)



# **Central Pressure Scatter Diagram**



### (a) WNP Central Pressure Scatter Diagram (FT +0)



### (a) WNP Central Pressure Scatter Diagram (FT +72)



### (a) WNP Central Pressure Scatter Diagram (FT +0)



### (a) WNP Central Pressure Scatter Diagram (FT +72)



### (b) NAT Central Pressure Scatter Diagram (FT +0)



### (b) NAT Central Pressure Scatter Diagram (FT +72)



### (c) ENP Central Pressure Scatter Diagram (FT +0)



### (c) ENP Central Pressure Scatter Diagram (FT +72)



### (d) AUR Central Pressure Scatter Diagram (FT +0)



Japan Meteorological Agency

### (d) AUR Central Pressure Scatter Diagram (FT +72)



Japan Meteorological Agency

### (e) SIO Central Pressure Scatter Diagram (FT +0)



### (e) SIO Central Pressure Scatter Diagram (FT +72)



### **Error Map**

### (a) WNP Error Map (FT=72)



### (b) NAT Error Map (FT=72)



















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### (c) ENP Error Map (FT=72)







Shading : central pressure error (hPa) **Red** : forecast is shallow **Blue:** forecast is deep Arrow : average position error

> Forecast position

# (d) AUR Error Map (FT=72) CMA CMC DWD 2016 AUR CMA 72 errors 2016 AUR CMA 72 errors 2016 AUR CMA 72 errors

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### (e) SIO Error Map (FT=72)





### Visualization with "Pie-chart" in 2015



ECMWF, NCEP, UKMOは各領域で精度が良い(UKMOはFT=120ではNAT, AURで誤差やや大)。JMAはWNP以外で予測 初期の誤差が大きめ。

# (a) TCtrack (WNP) TC1610(LIONROCK)



### (a) TCtrack (WNP) TC1610(LIONROCK)

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