Predictability of tropical cyclone tracks: a multi-model multi-analysis approach

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CPS, Kobe University

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Doshisha University

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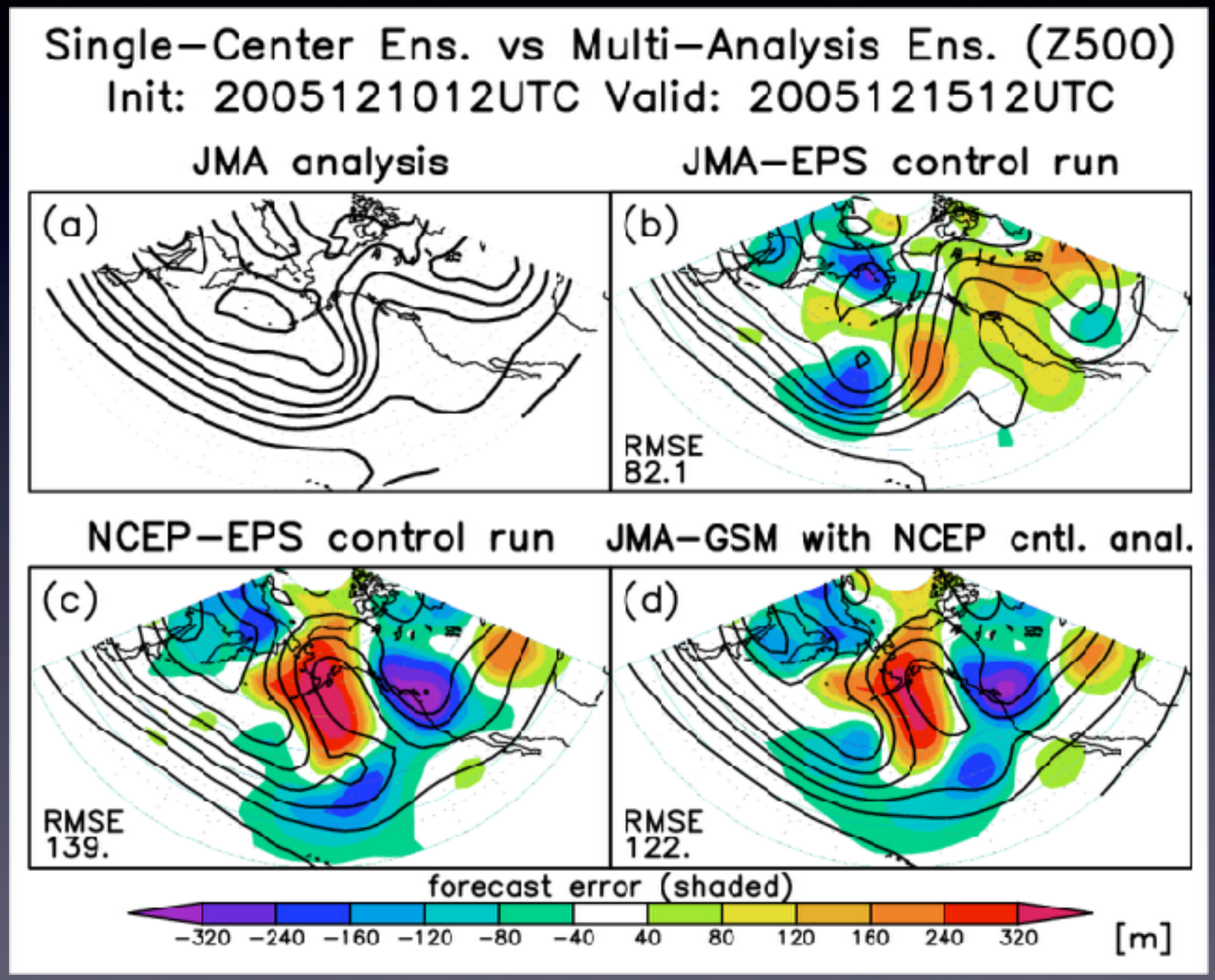
- Typhoon track forecast
- Positional errors for 2009
- T0920 Lupit
- T0917 Parma
- T1303 Yagi

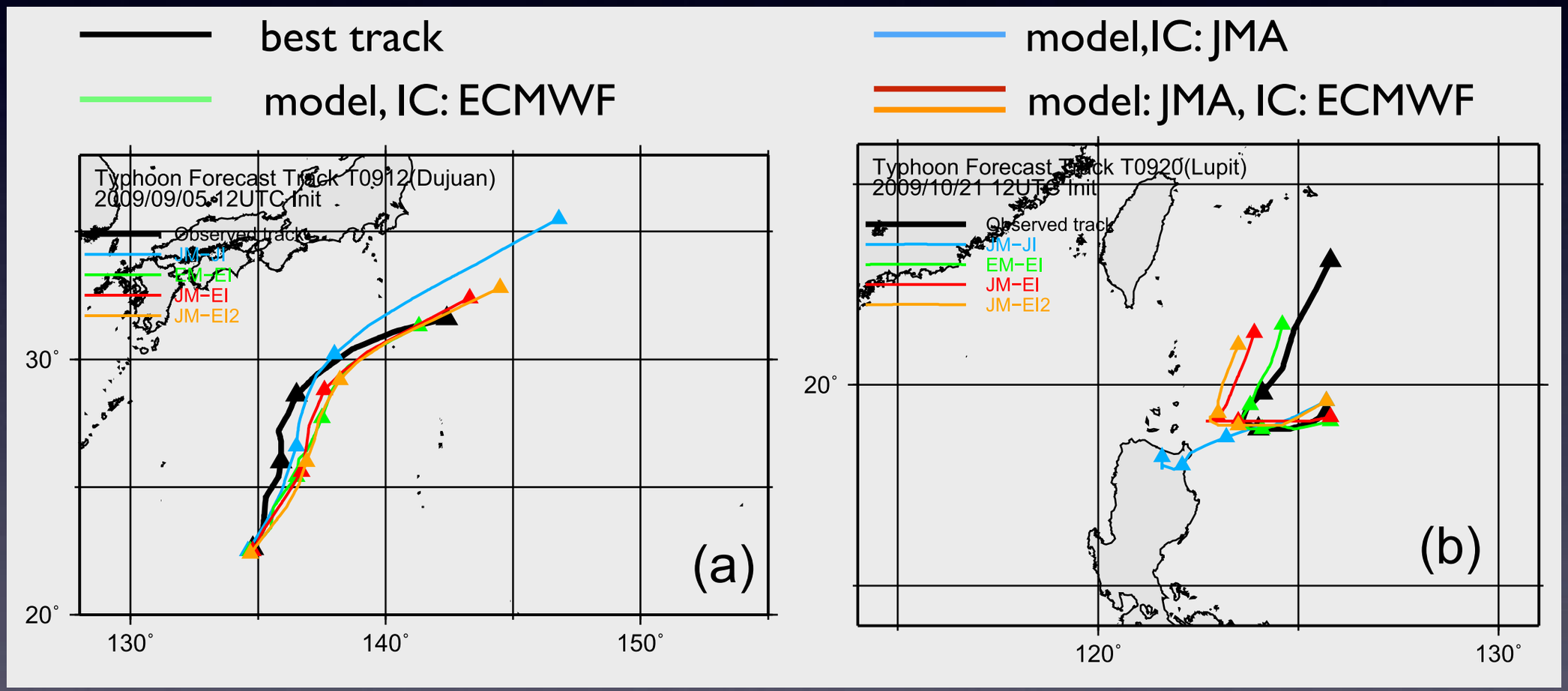
Multi-model multi-analysis

Failure of blocking forecast



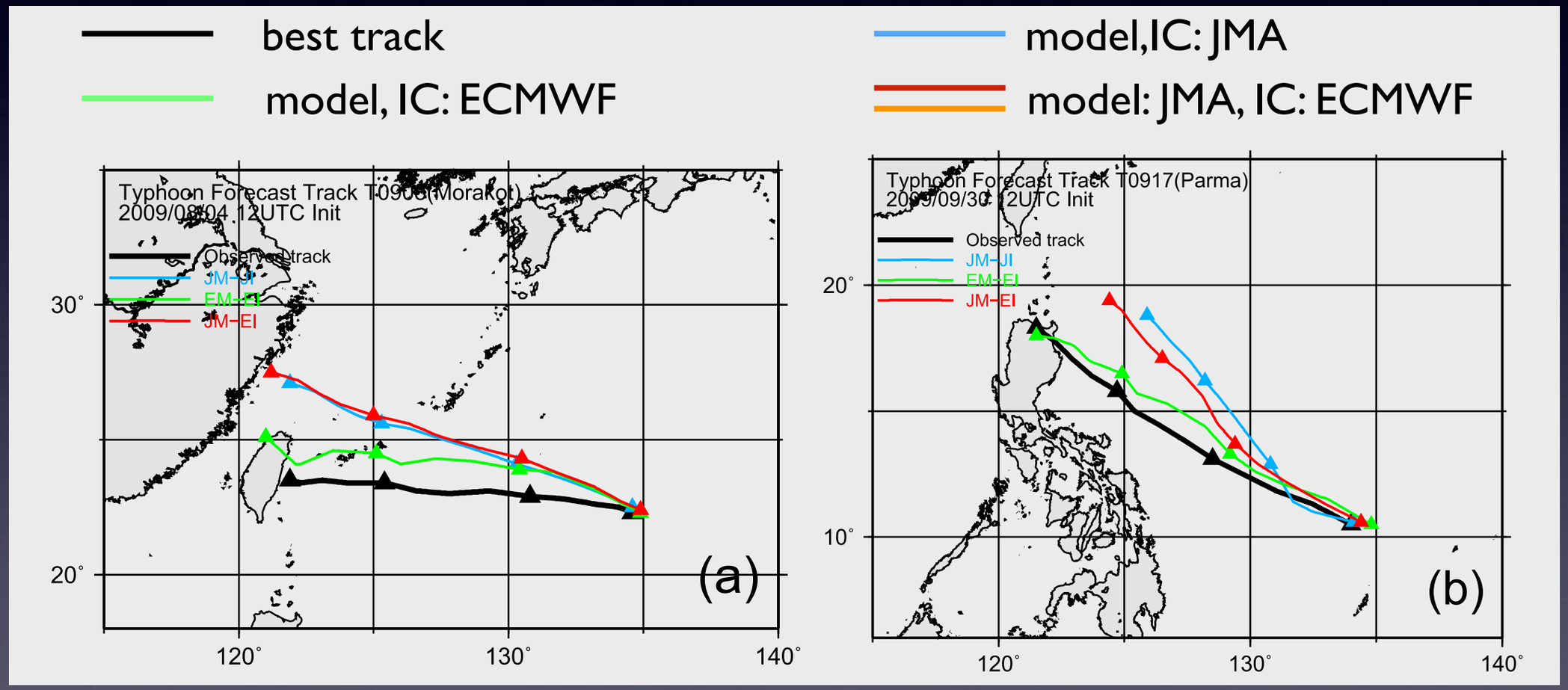
Matsueda et al. 2011

Sensitivity to initial conditions



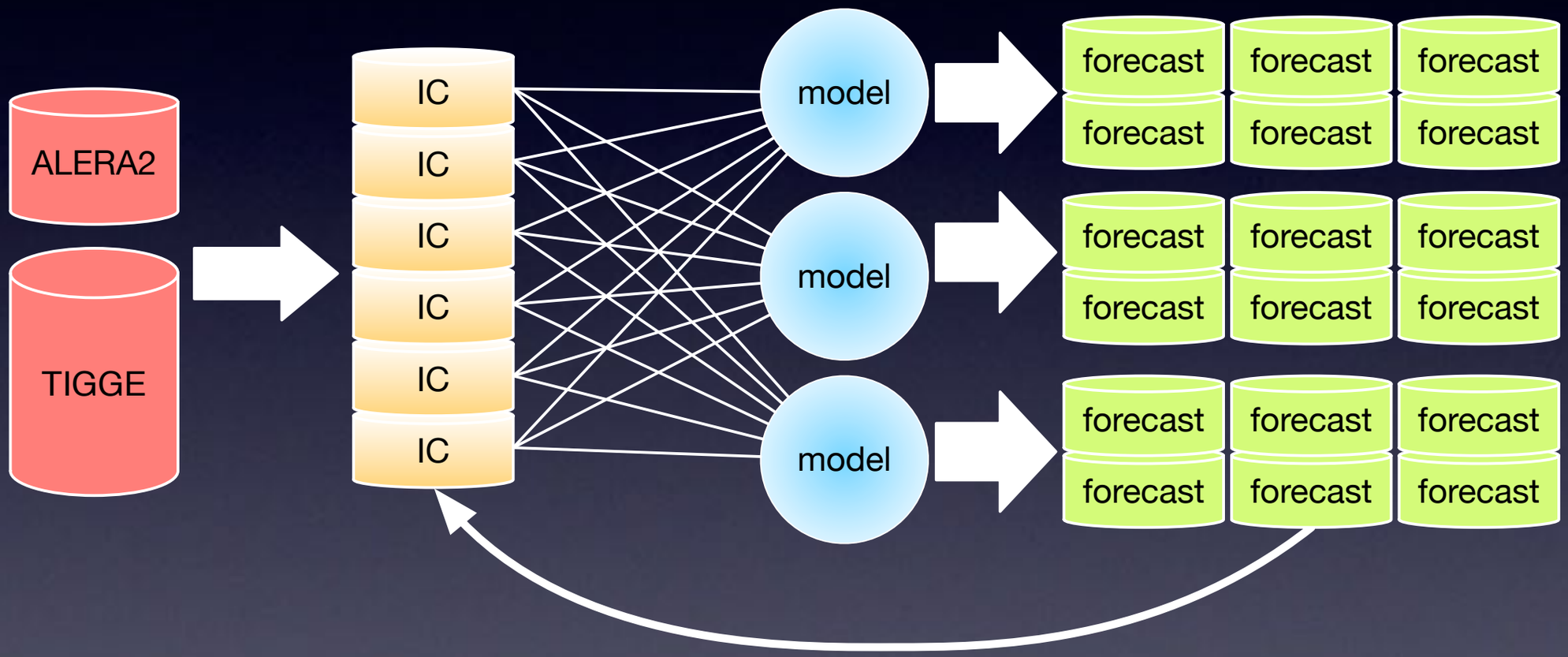
Yamaguchi et al. 2012

Insensitivity to initial conditions



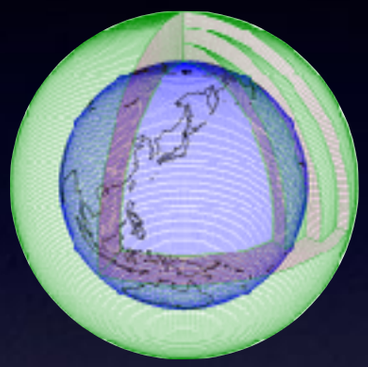
Yamaguchi et al. 2012

Multi-model multi-analysis



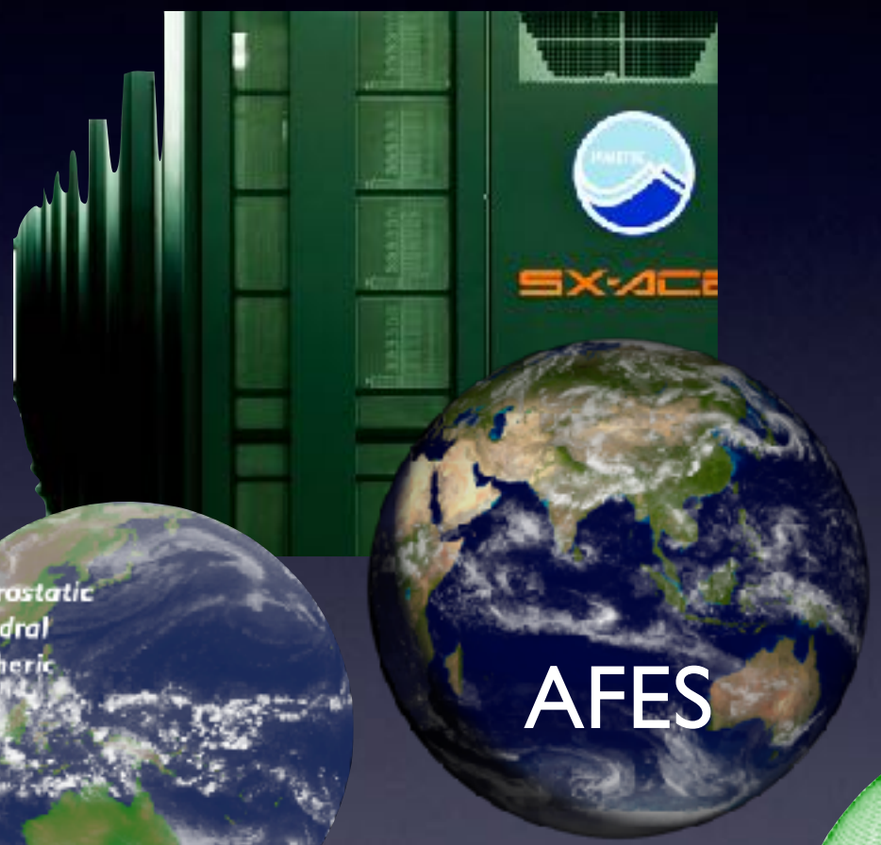
Ensemble-based
Forecast Sensitivity Analysis

Operational NWP models

	JMA	Research purpose No redistribution Feedback any modifications	with contract 2001~ NWP platform 2008~
	NCEP	Unknown	
	ECMWF	Education and Research No real-time No redistribution	2011~

Multi-models

JAMSTEC



Kyoto U

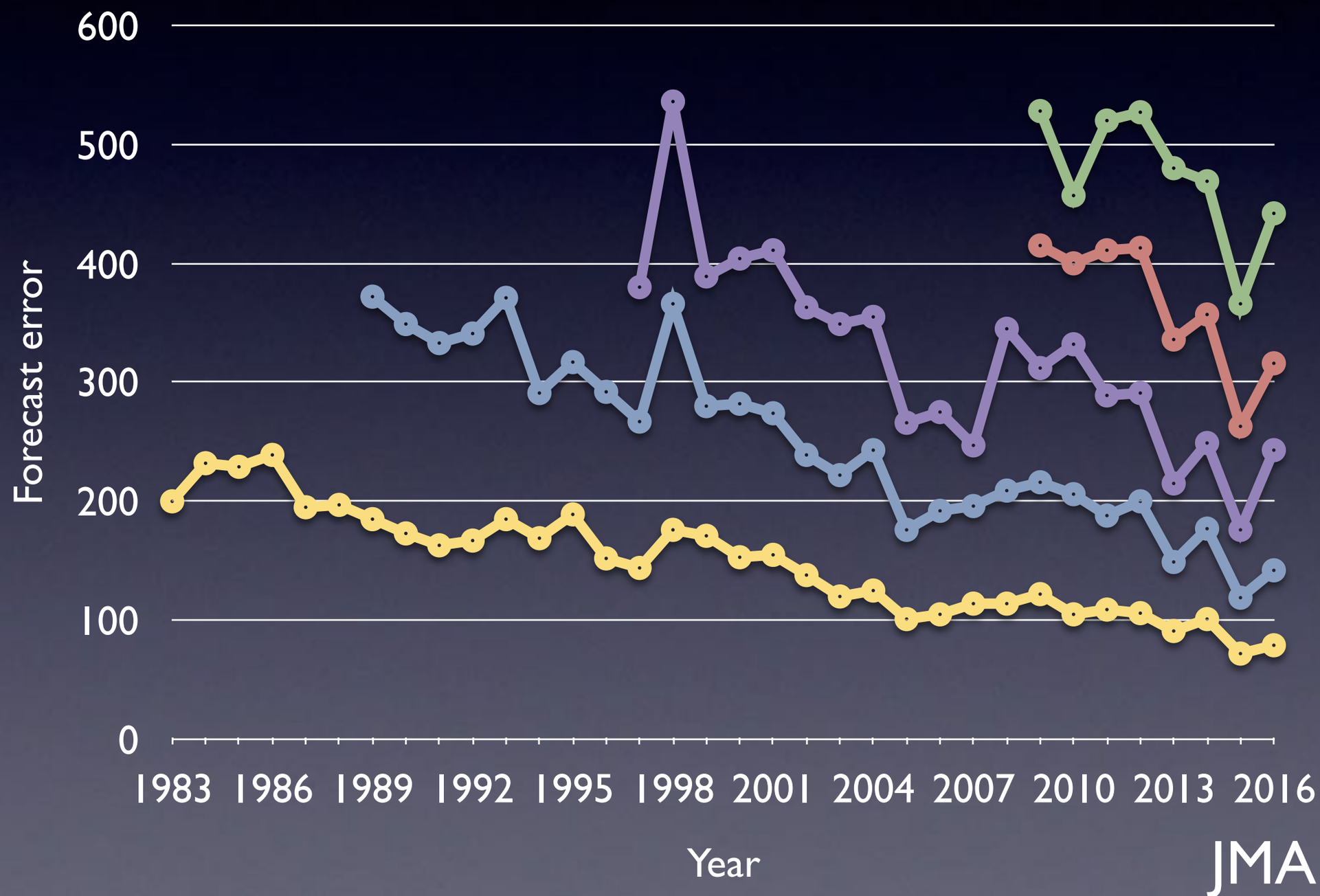
AFES

JMA GSM

MRI, JMA

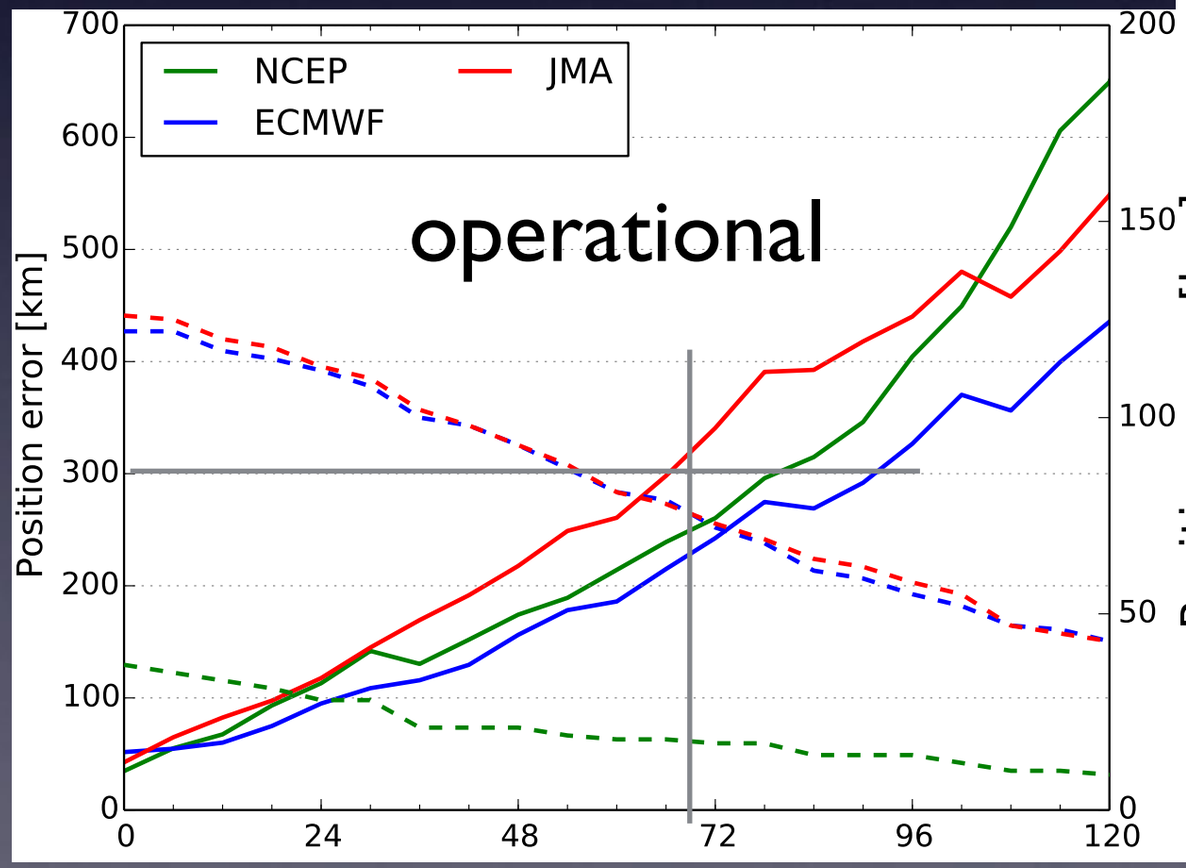
Typhoon track forecast

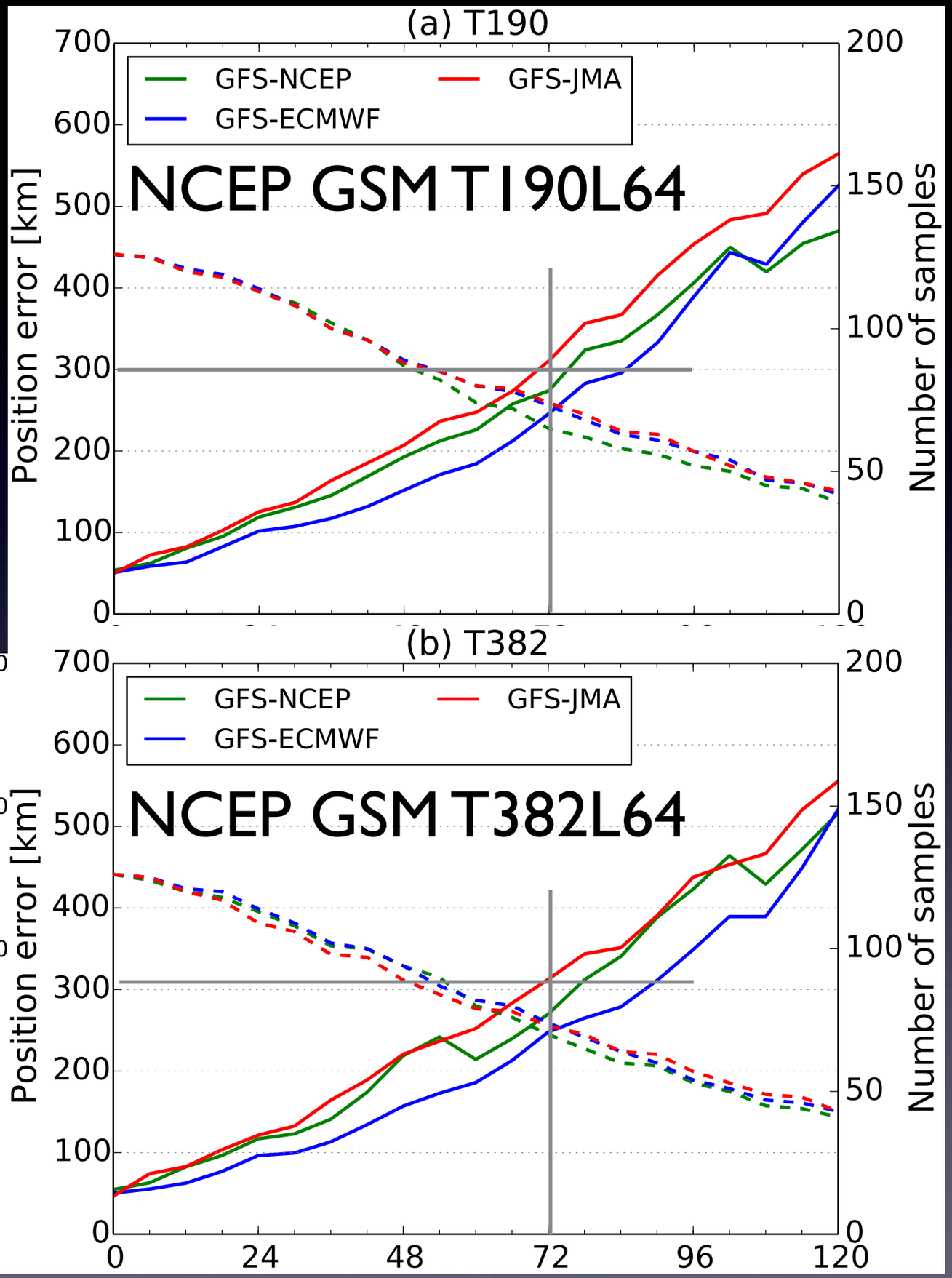
Annually averaged error of typhoon track forecasts by JMA



Positional error NW Pacific 2009

NCEP excluding April, May and September





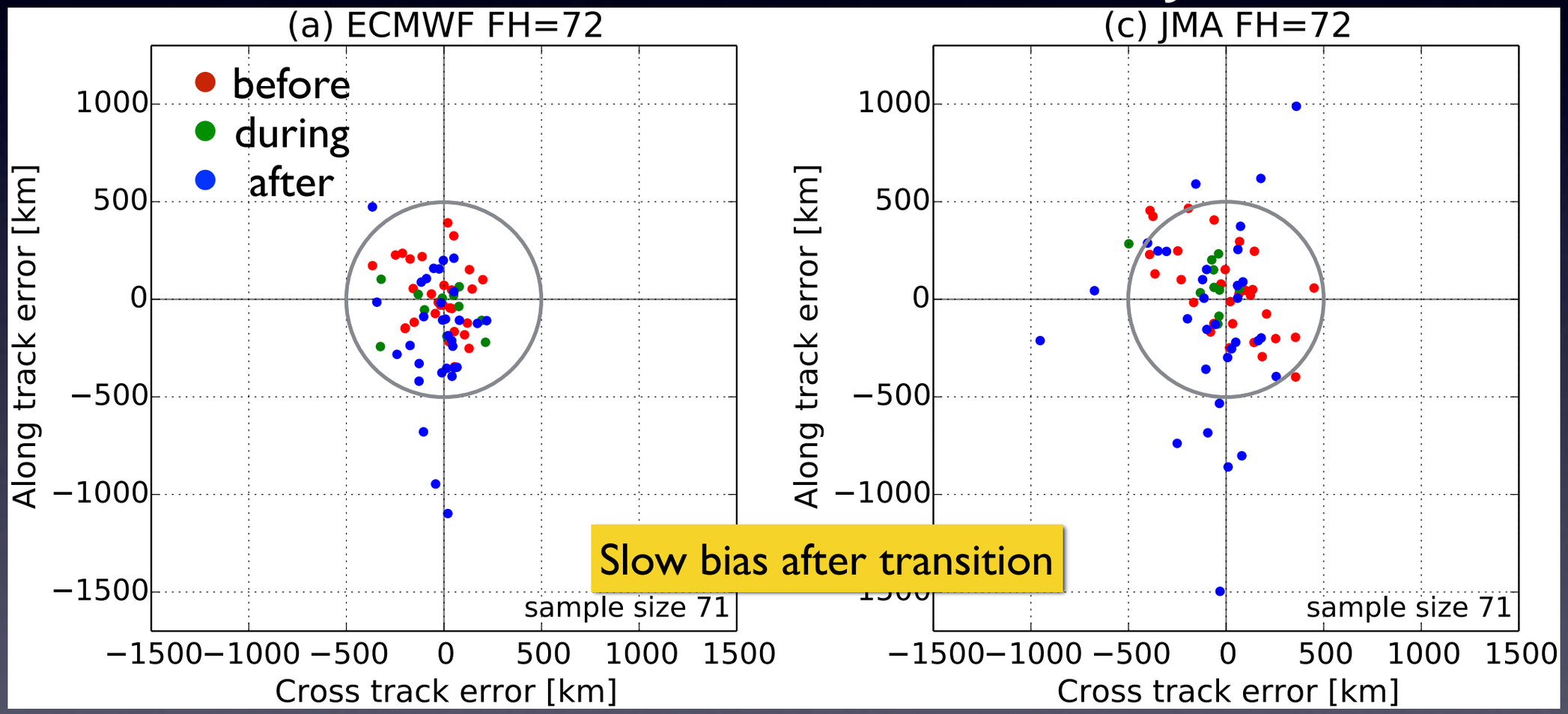
Miyachi 2014, master thesis

Along track/cross track error

operational positional error for 72 h forecast

ECMWF

JMA



4 cases > 500 km

16 cases > 500 km

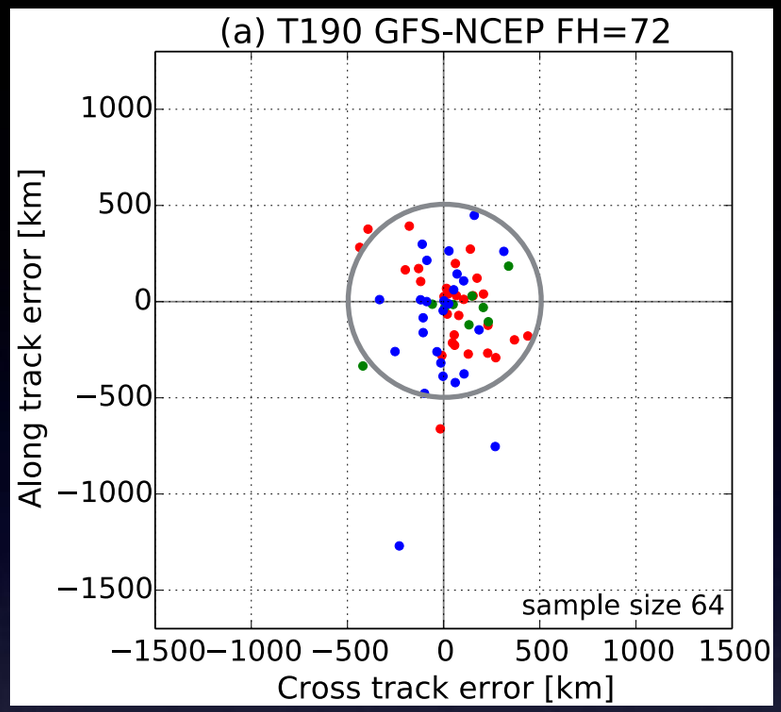
Miyachi 2014, master thesis

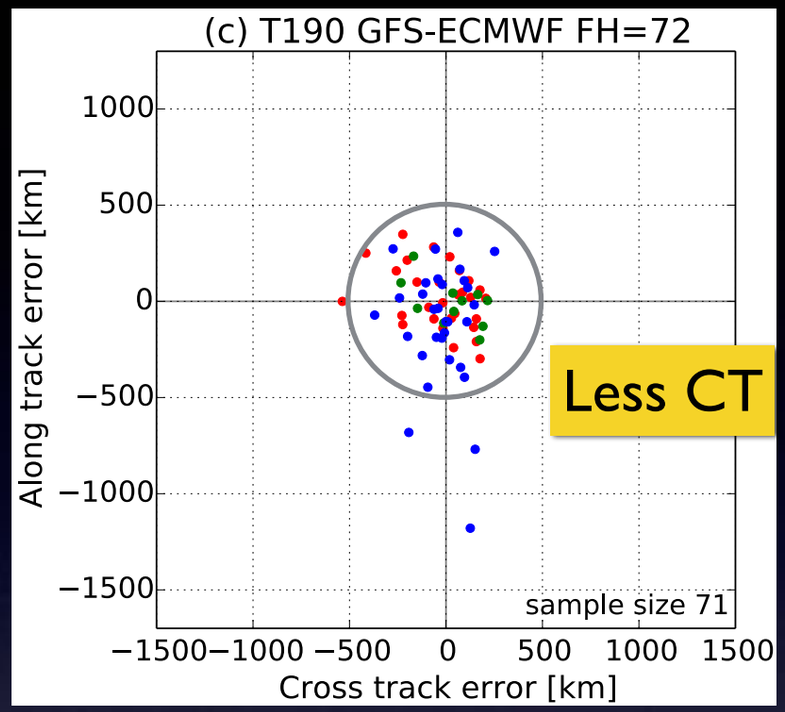
NCEP GSM T190L64

NCEP

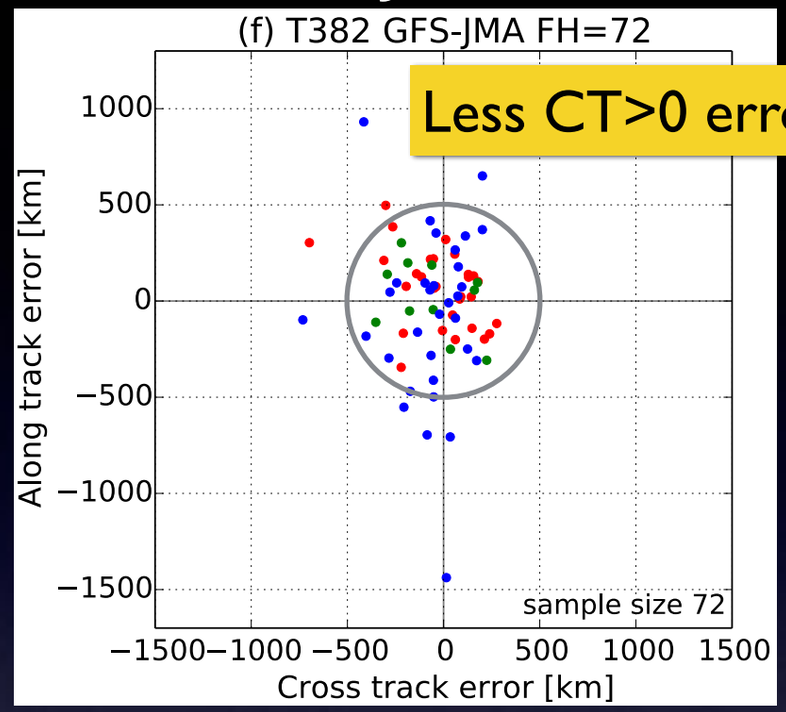
ECMWF

JMA





Less CT



Less CT>0 error

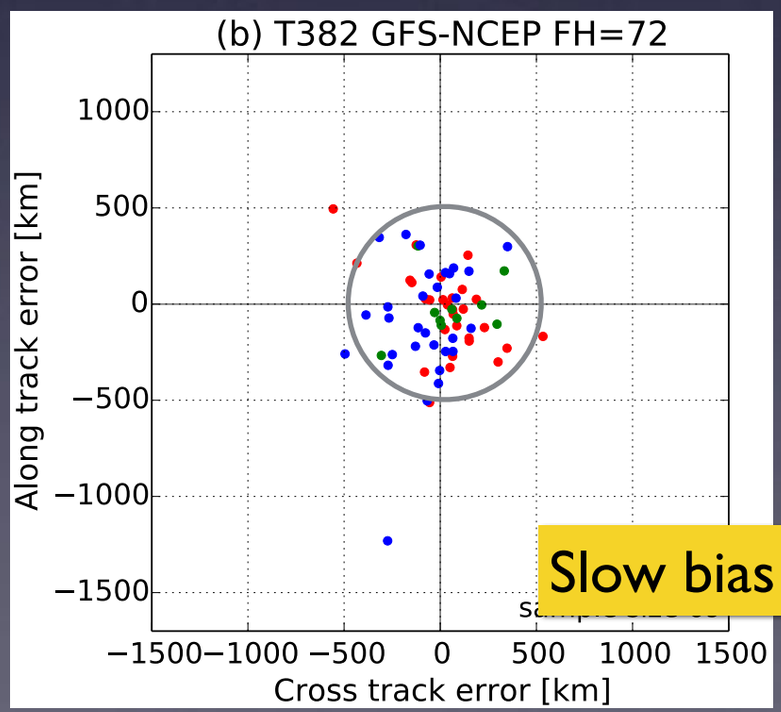
NCEP GSM T382L64

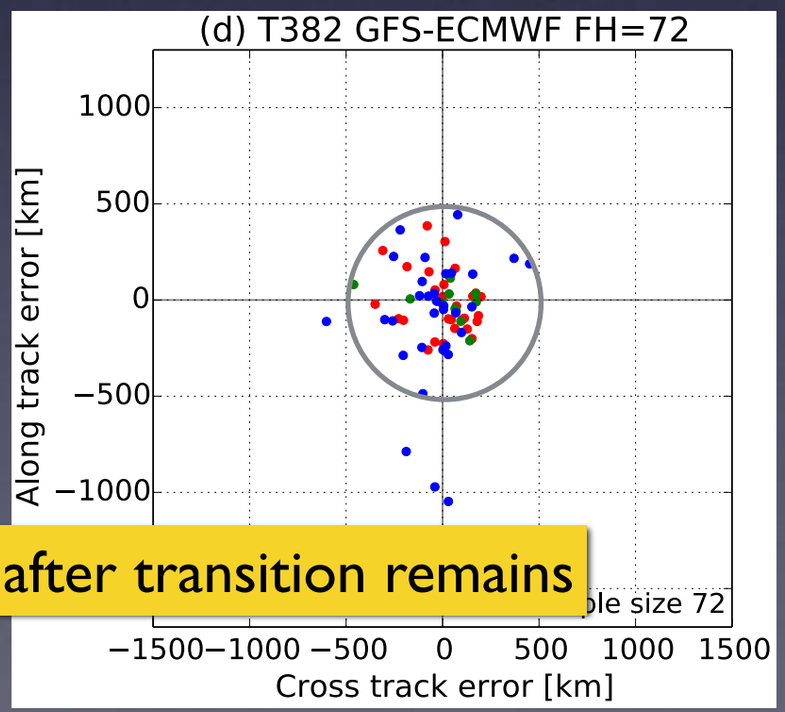
Miyachi 2014, master thesis

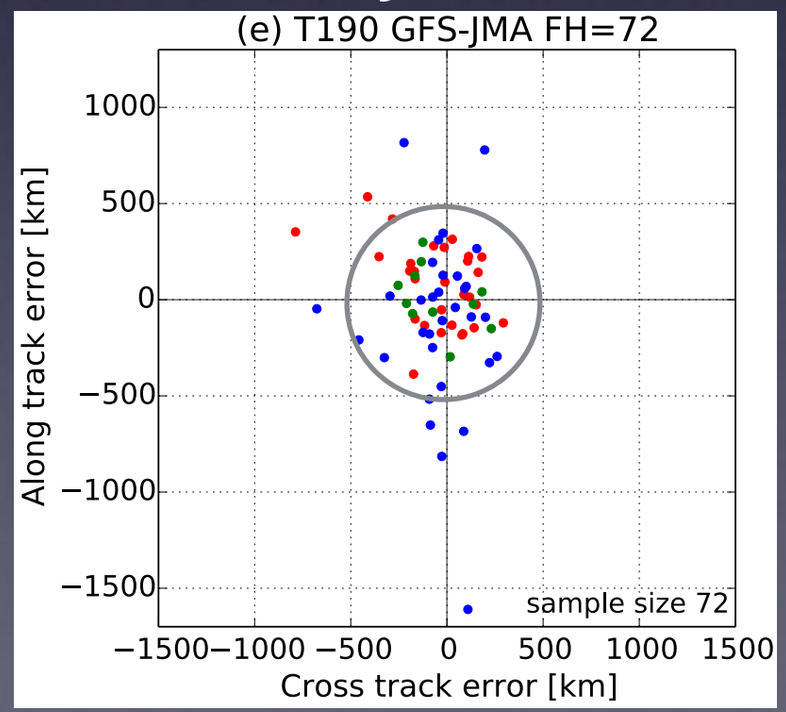
NCEP

ECMWF

JMA



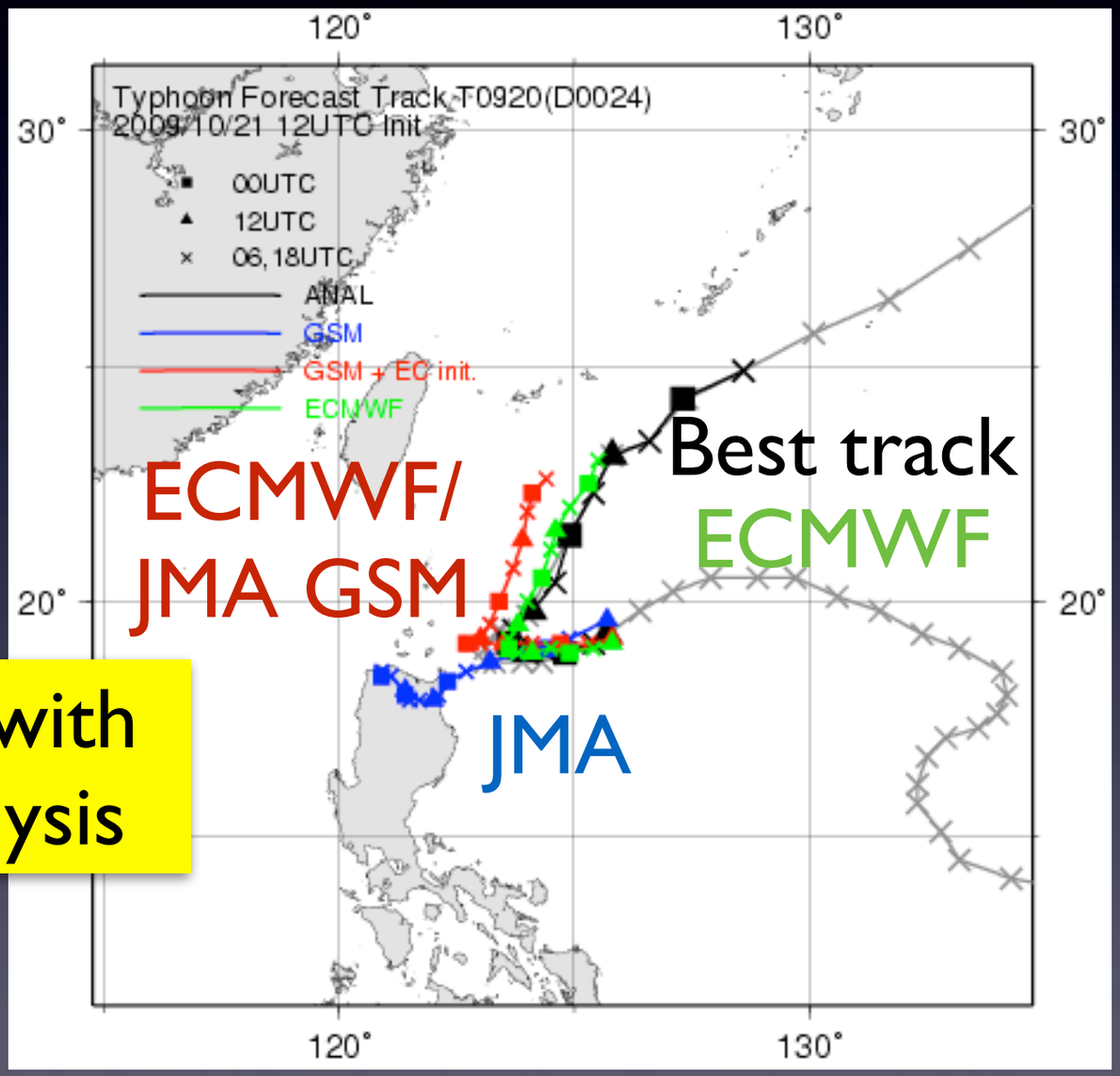




Slow bias after transition remains

T0920 Lupit

Lupit 2009: multi-analysis runs with JMA GSM



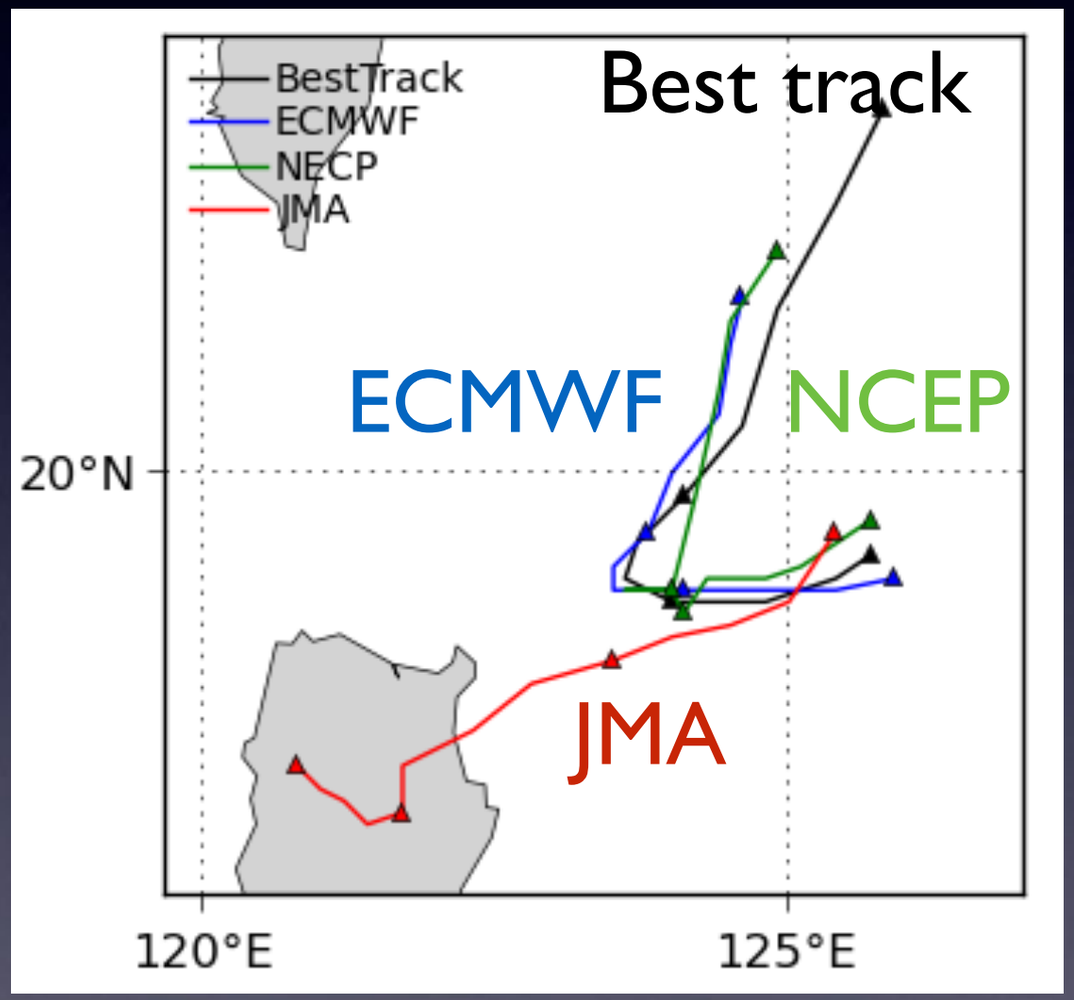
Recurvature with ECMWF analysis

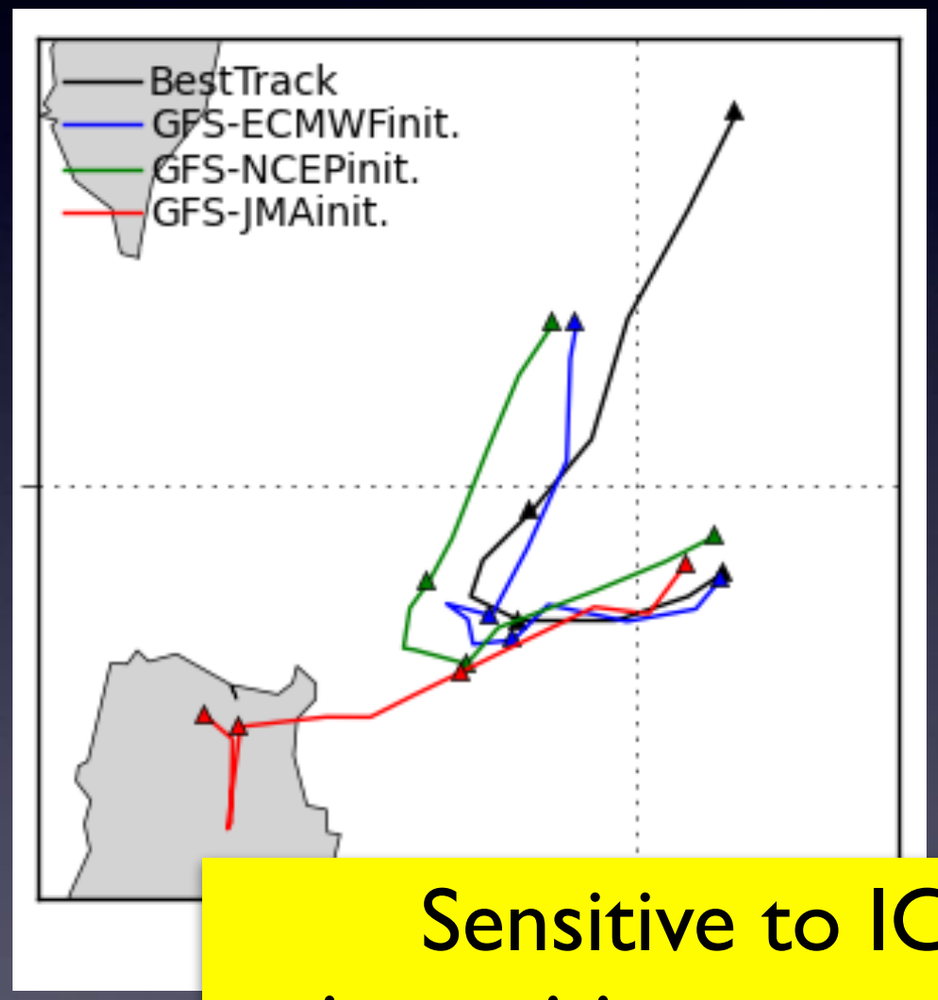
Yamaguchi et al. 2012

Parma 2009: multi-analysis runs with NCEP GSM

Operational

NCEP GSM T382L64





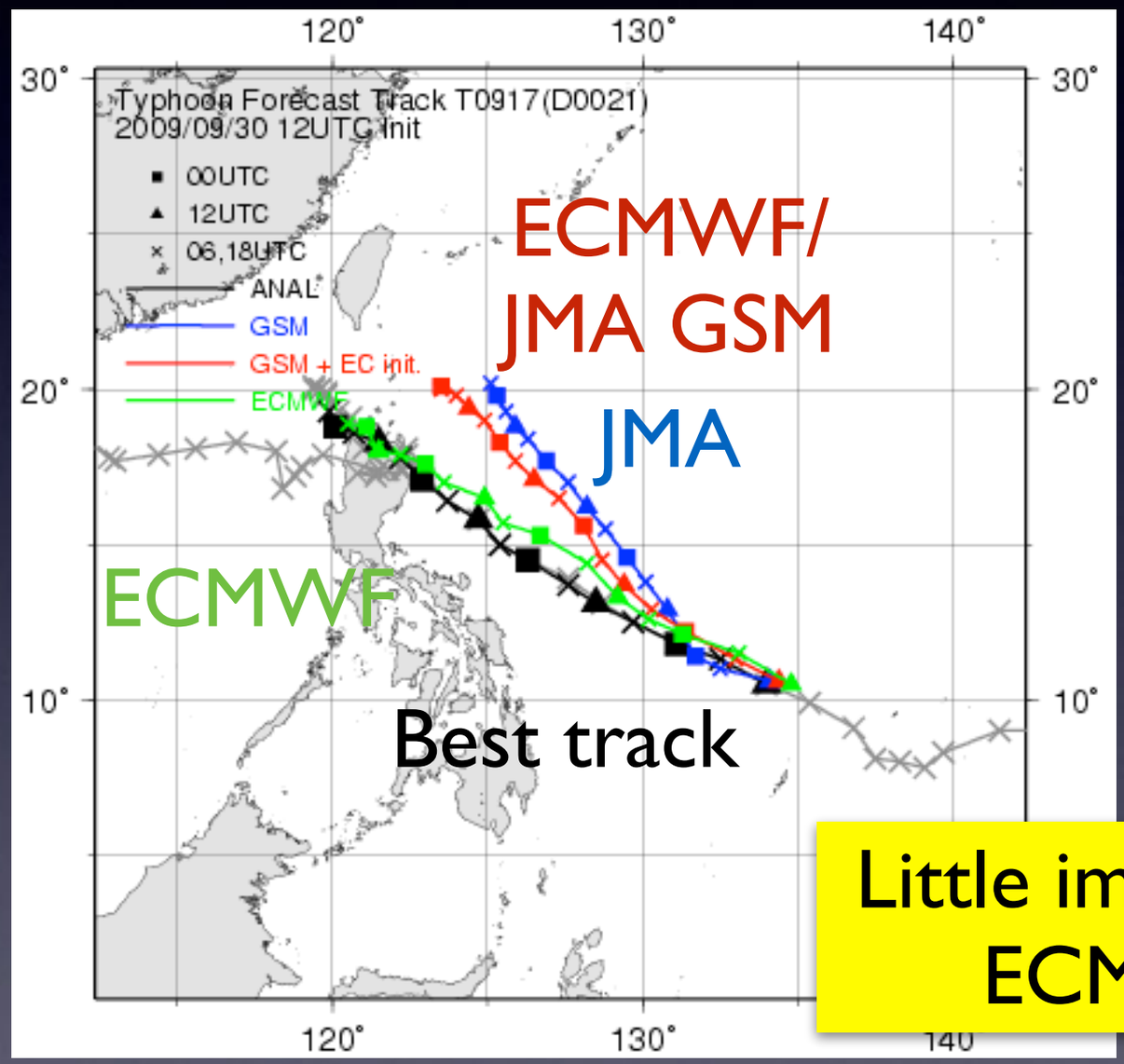
Sensitive to IC
insensitive to model

initial: 12 UTC 21 October

Miyachi 2014, master thesis

T0917 Parma

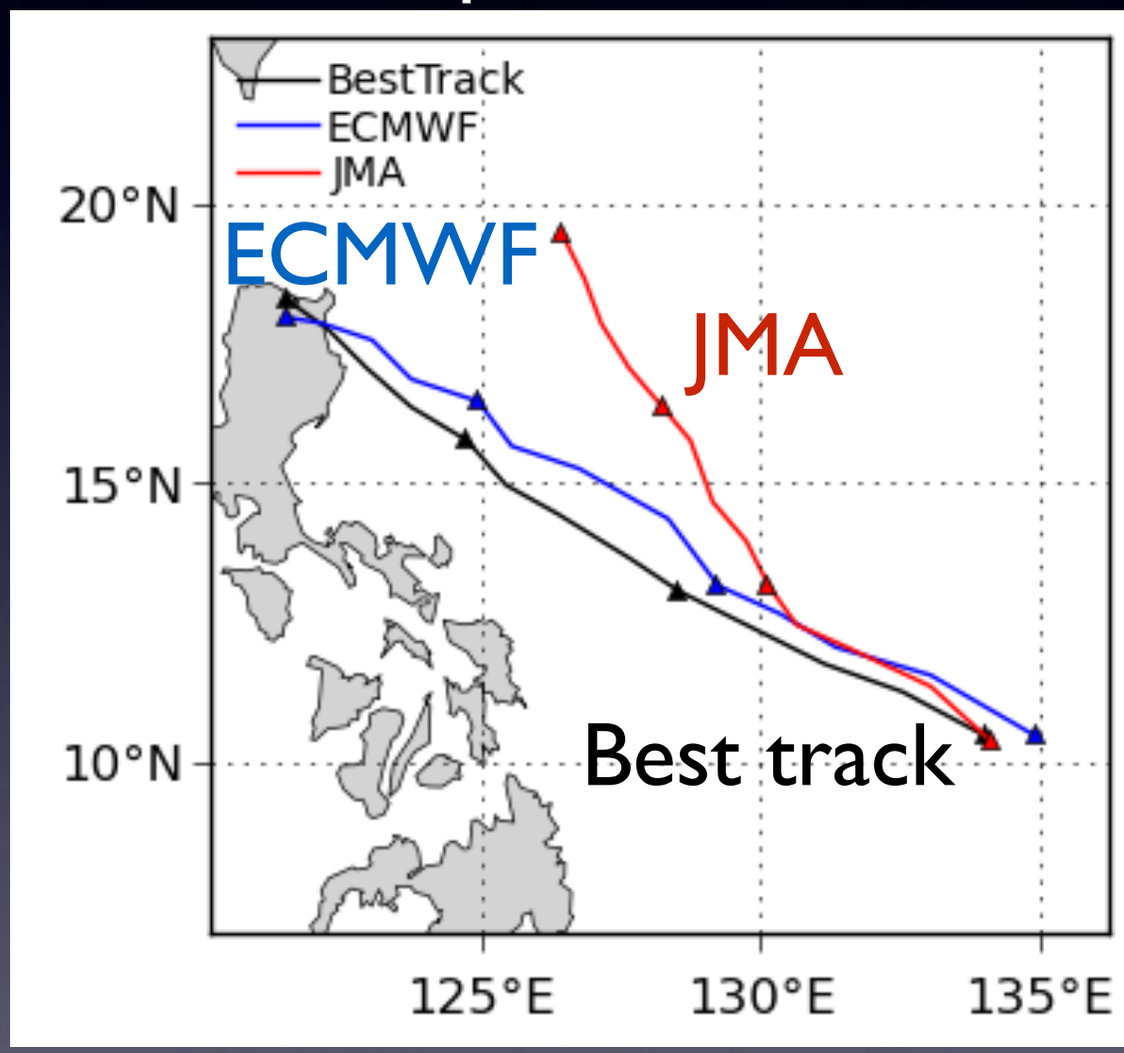
Parma 2009: multi-analysis runs with JMA GSM



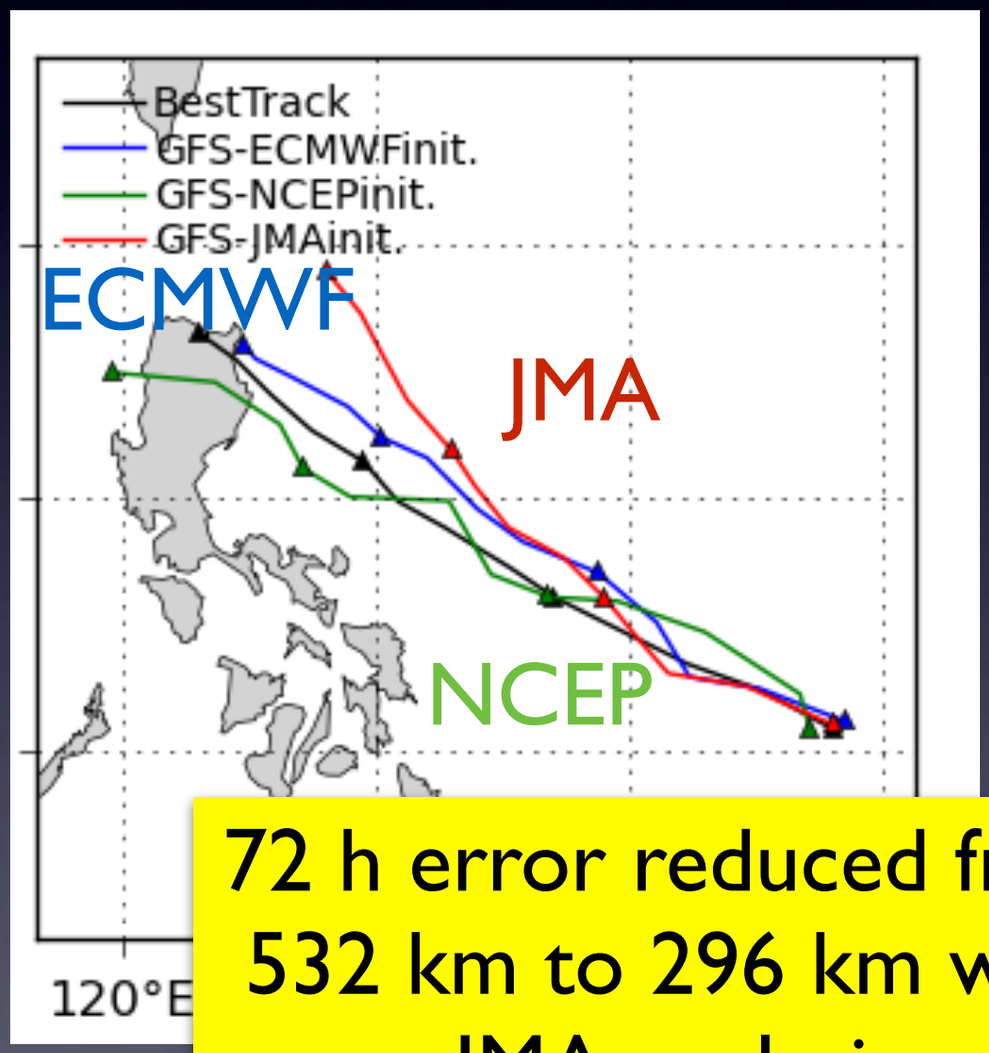
Yamaguchi et al. 2012

Parma 2009: multi-analysis runs with NCEP GSM

Operational



NCEP GSM T382L64



72 h error reduced from 532 km to 296 km with JMA analysis

initial: 12 UTC 30 September

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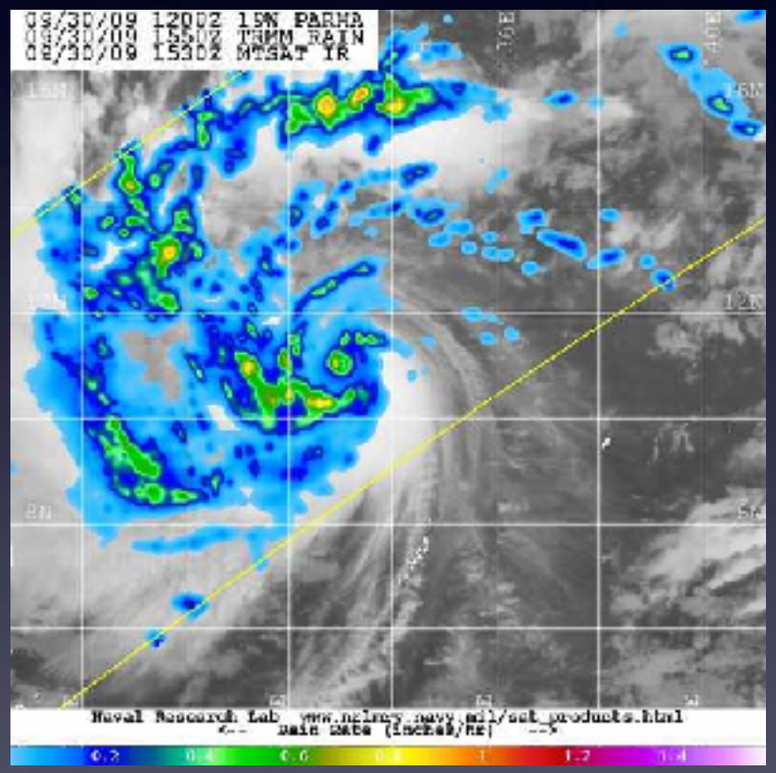
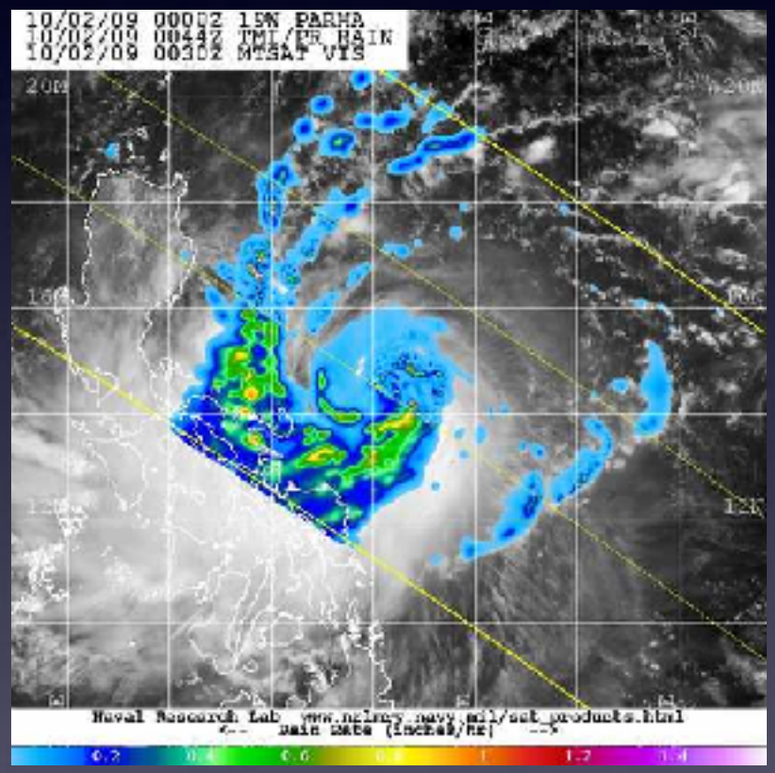
Non-axisymetric convection

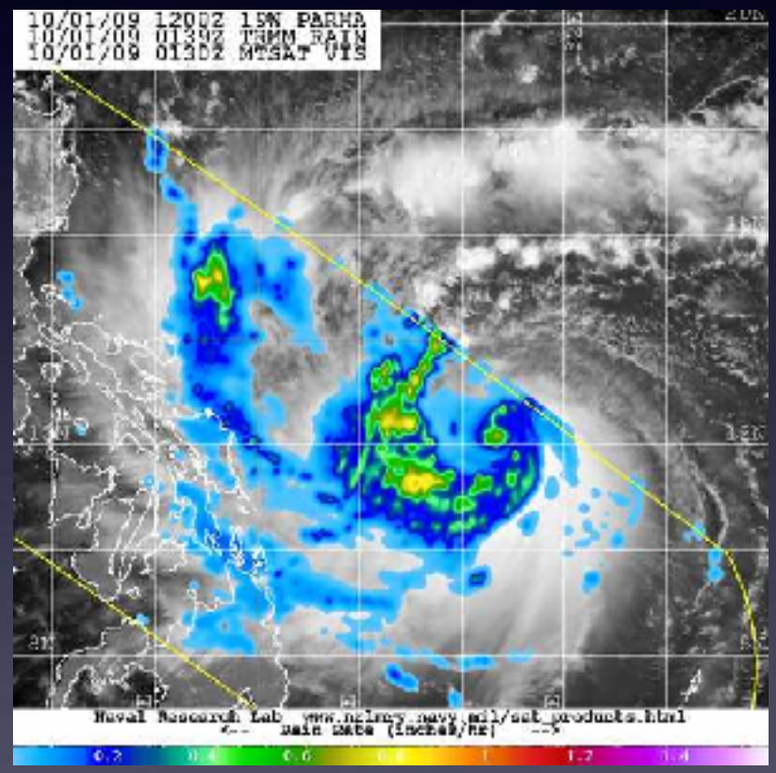
30 September



1 October



2 October

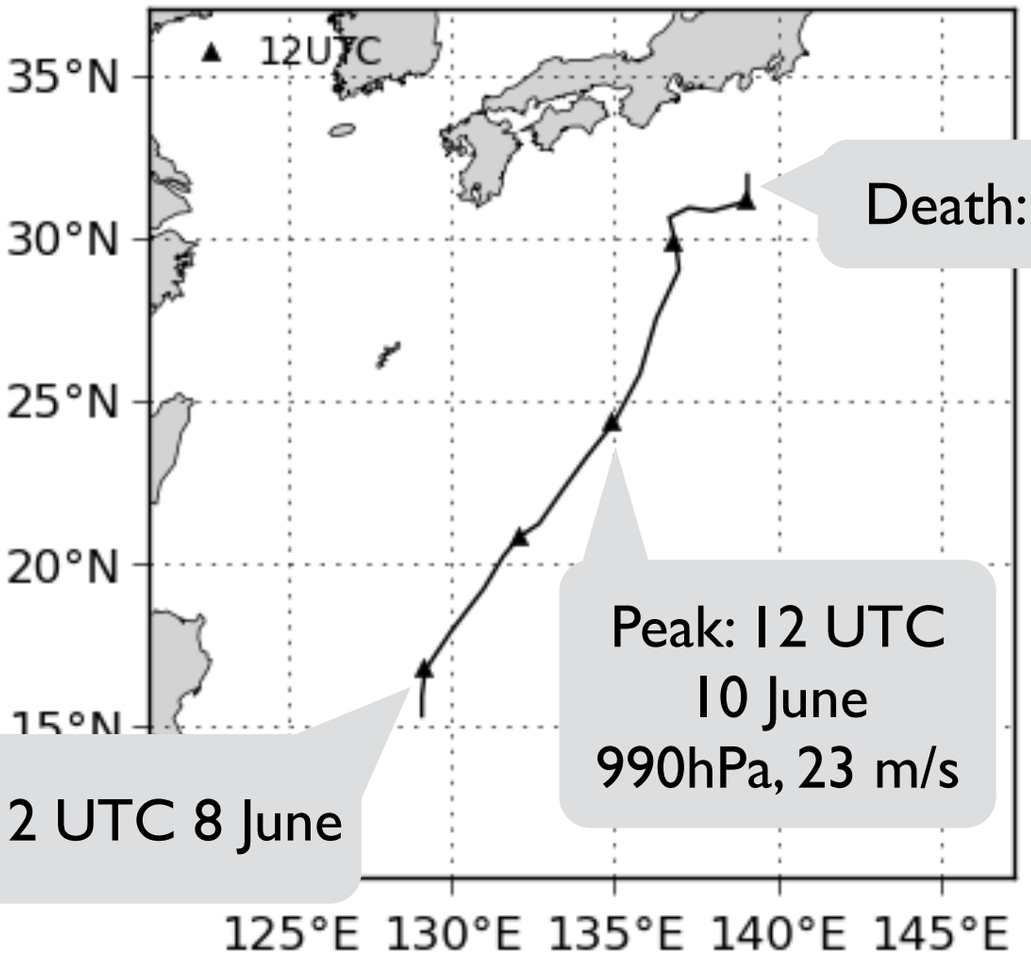


NRL

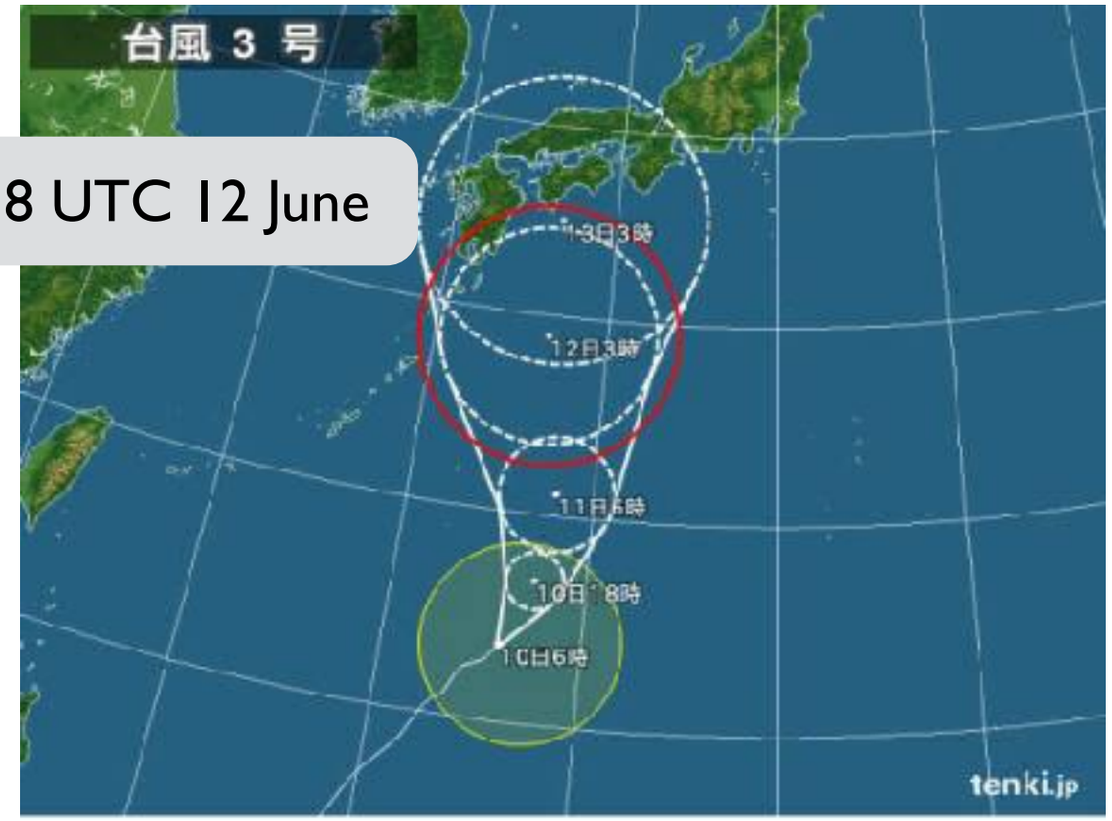
T1303 Yagi

T1303 Yagi

T1303 Typhoon YAGI 13/06/08-13/06/12



Forecast from 21 UTC 9 June 2013



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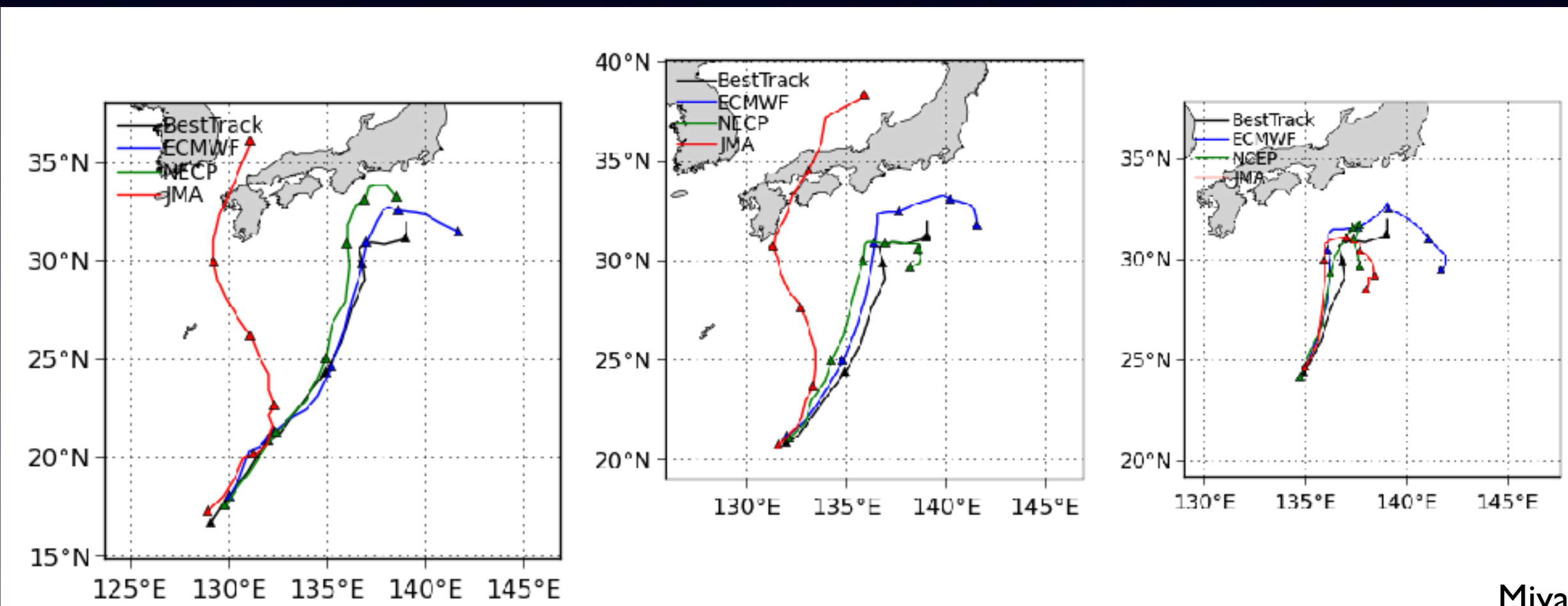
Deterministic forecast

From 12 UTC 8 June 9 June 10 June



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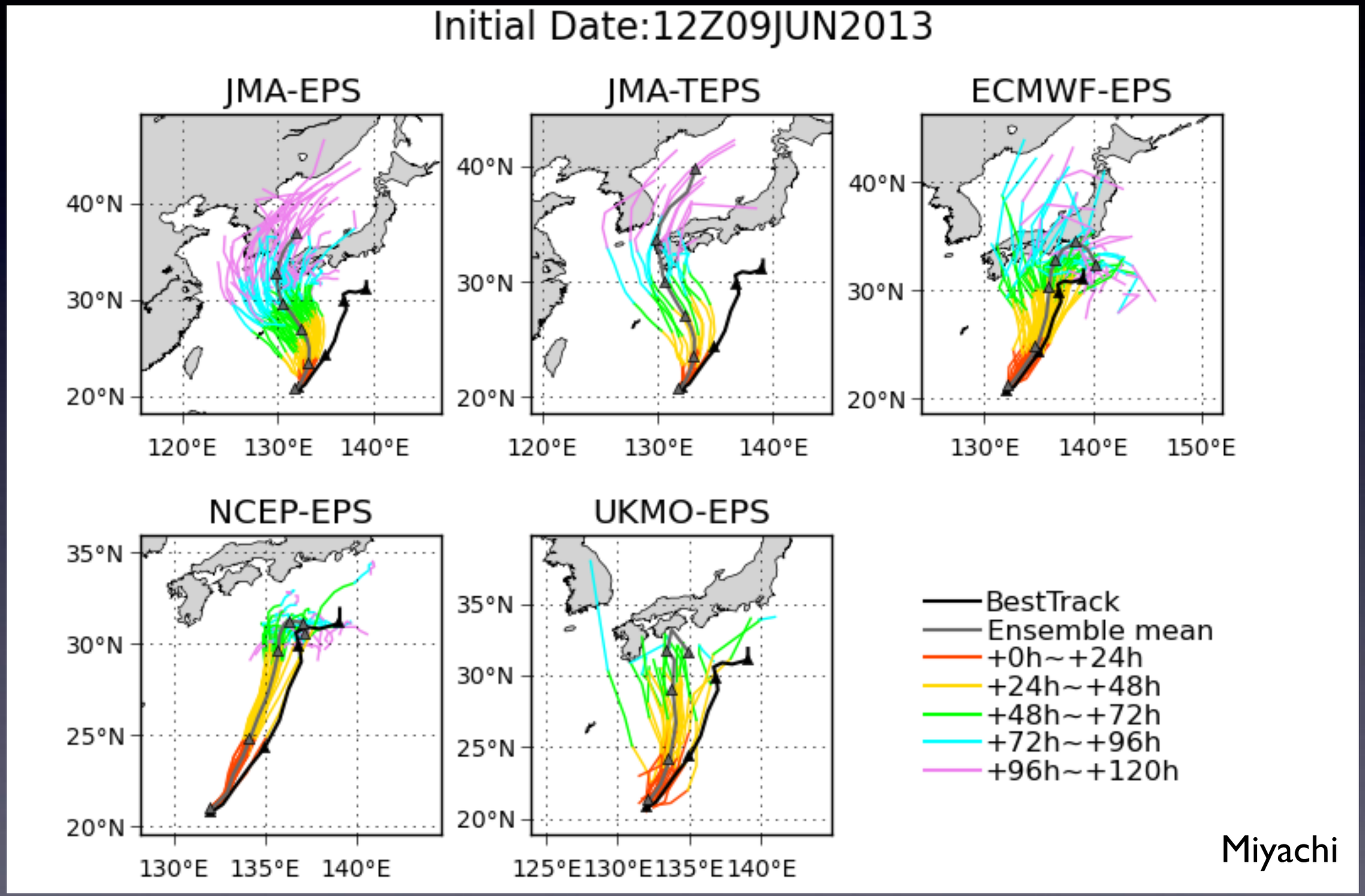
ECMWF TL1279L91 (~16km) NCEP T574L64 (~27km) JMA TL959L60 (~20km)

Ensemble forecast



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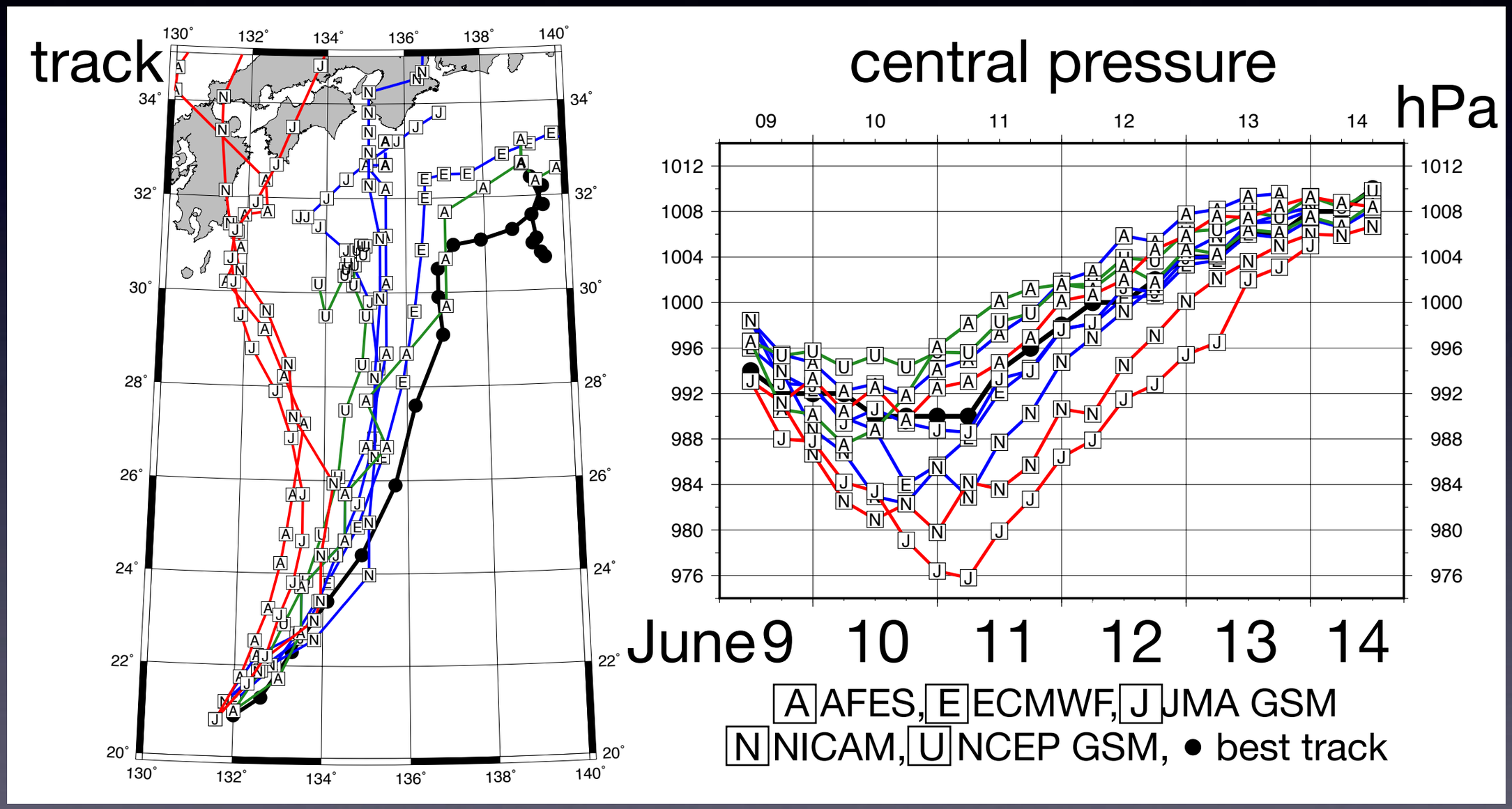
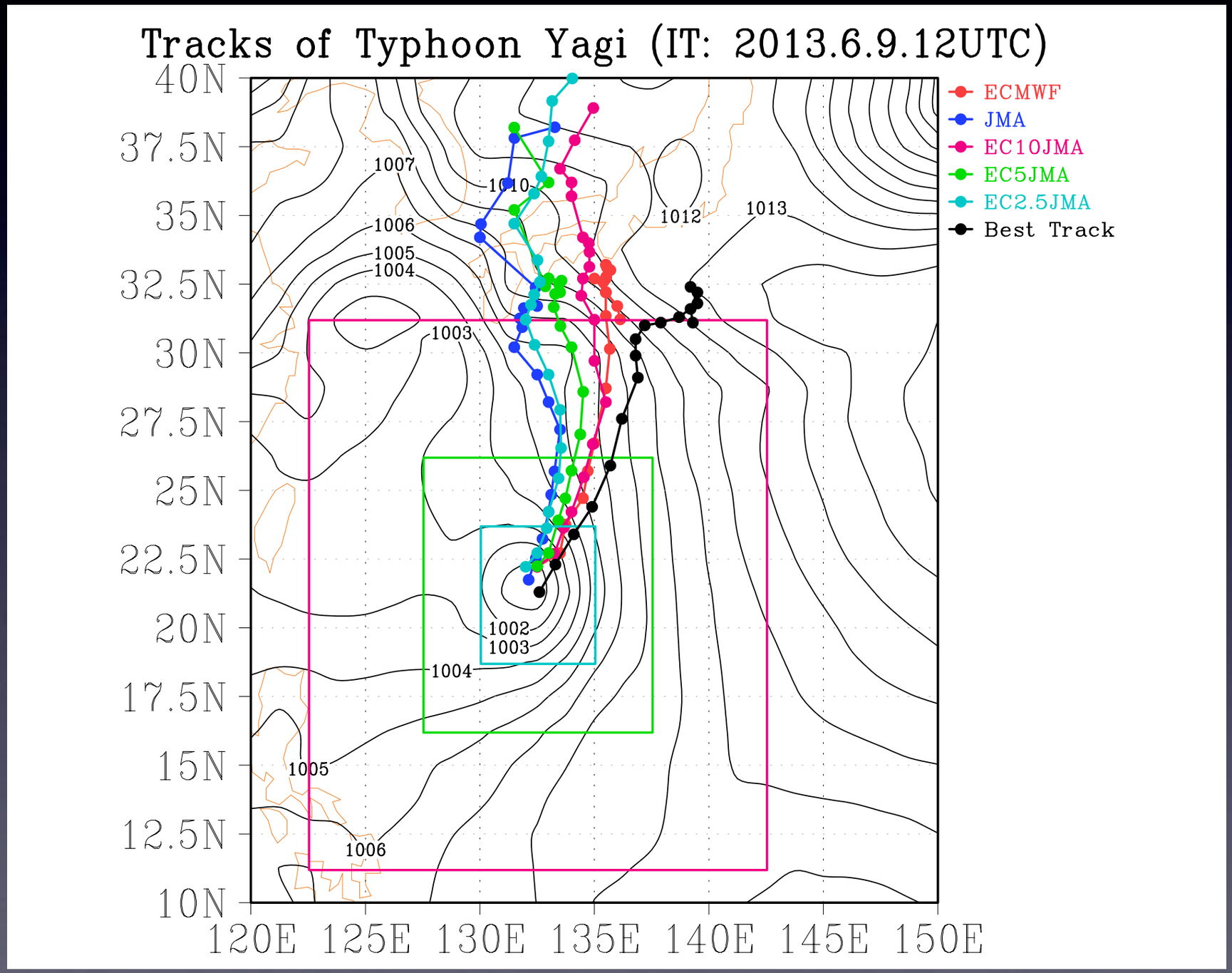
Multi-model experiments



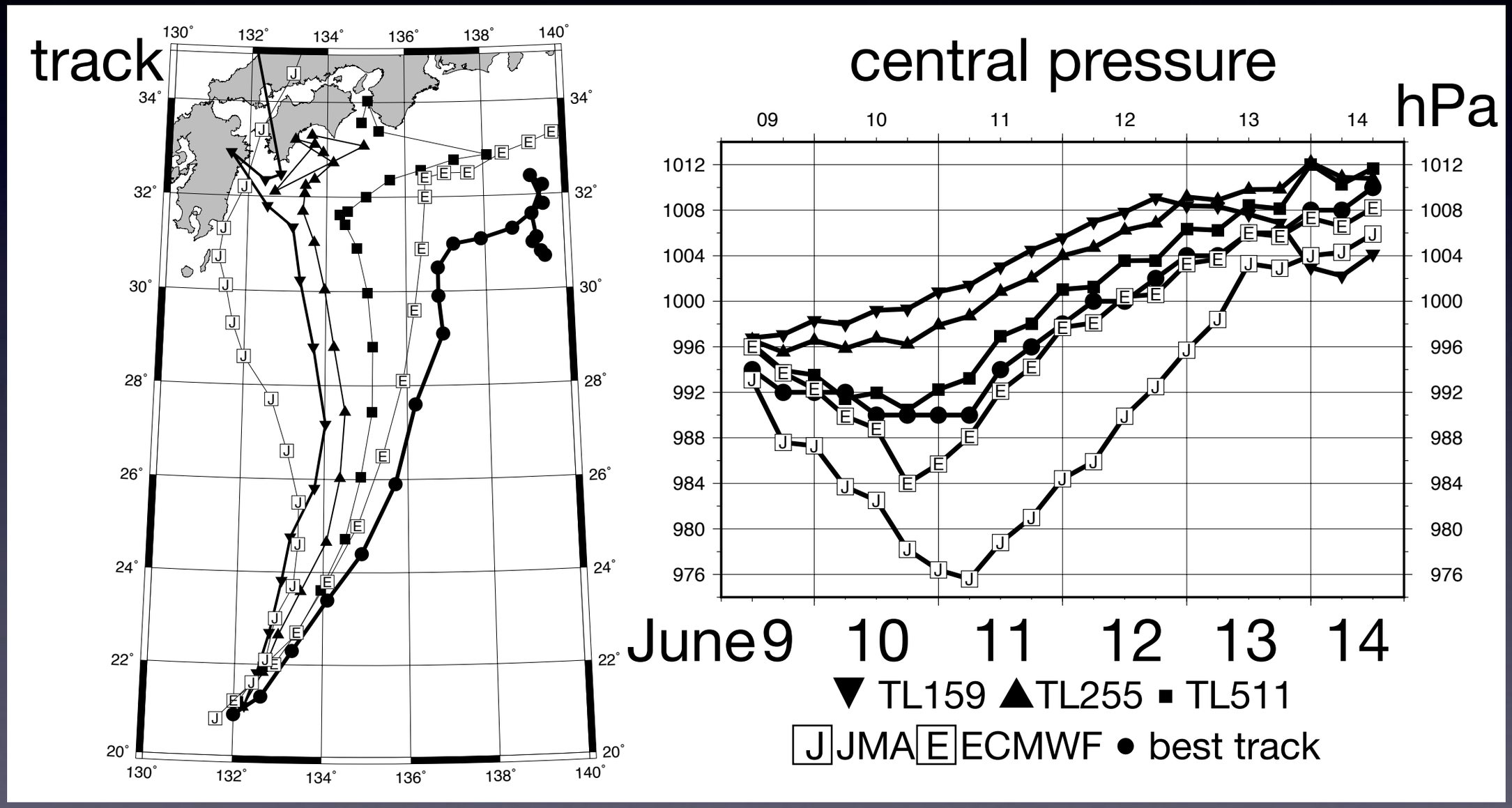
initial time 12 UTC 9 June 2013

ECMWF embedded in JMA



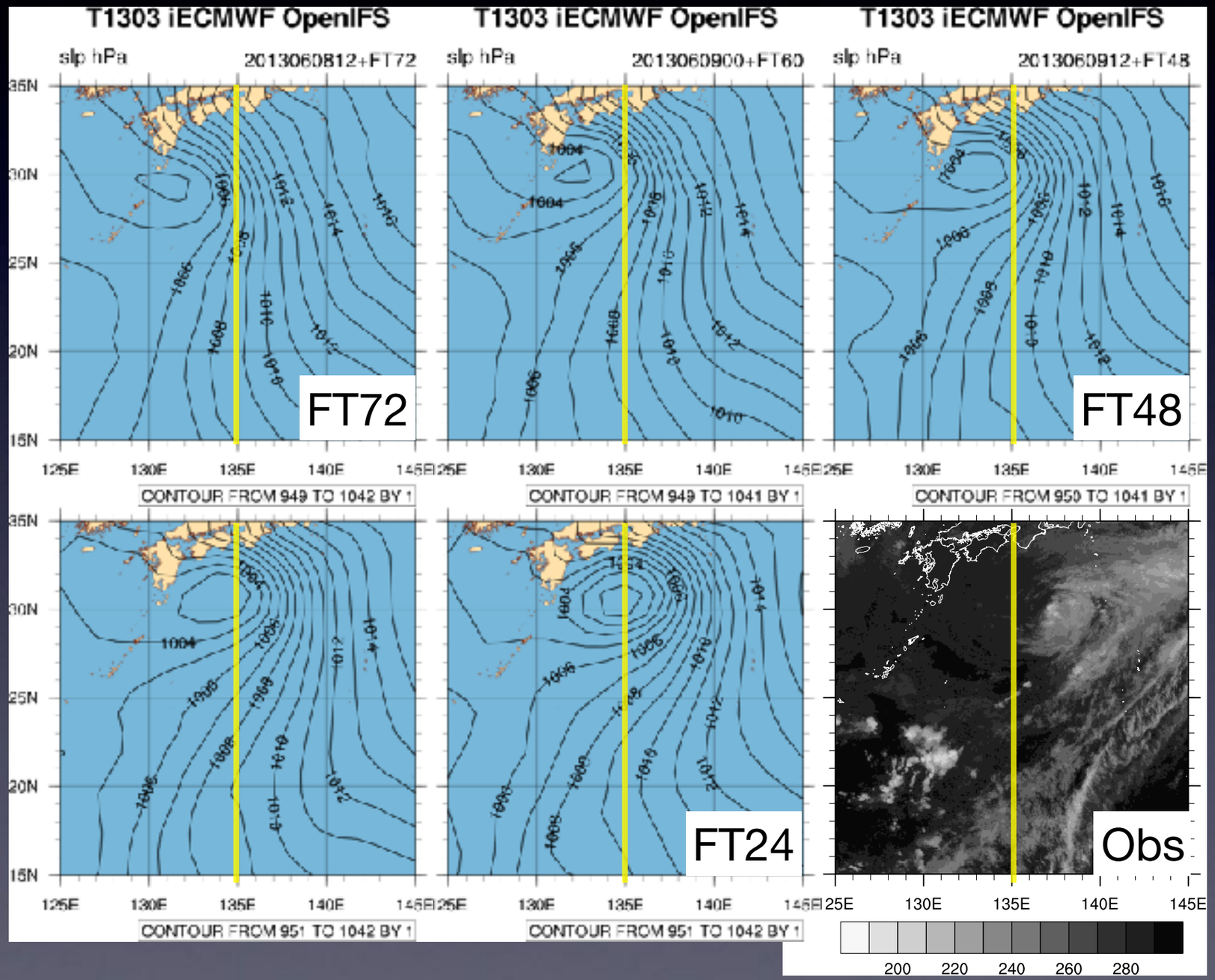
Yoshida

Sensitivity to resolution

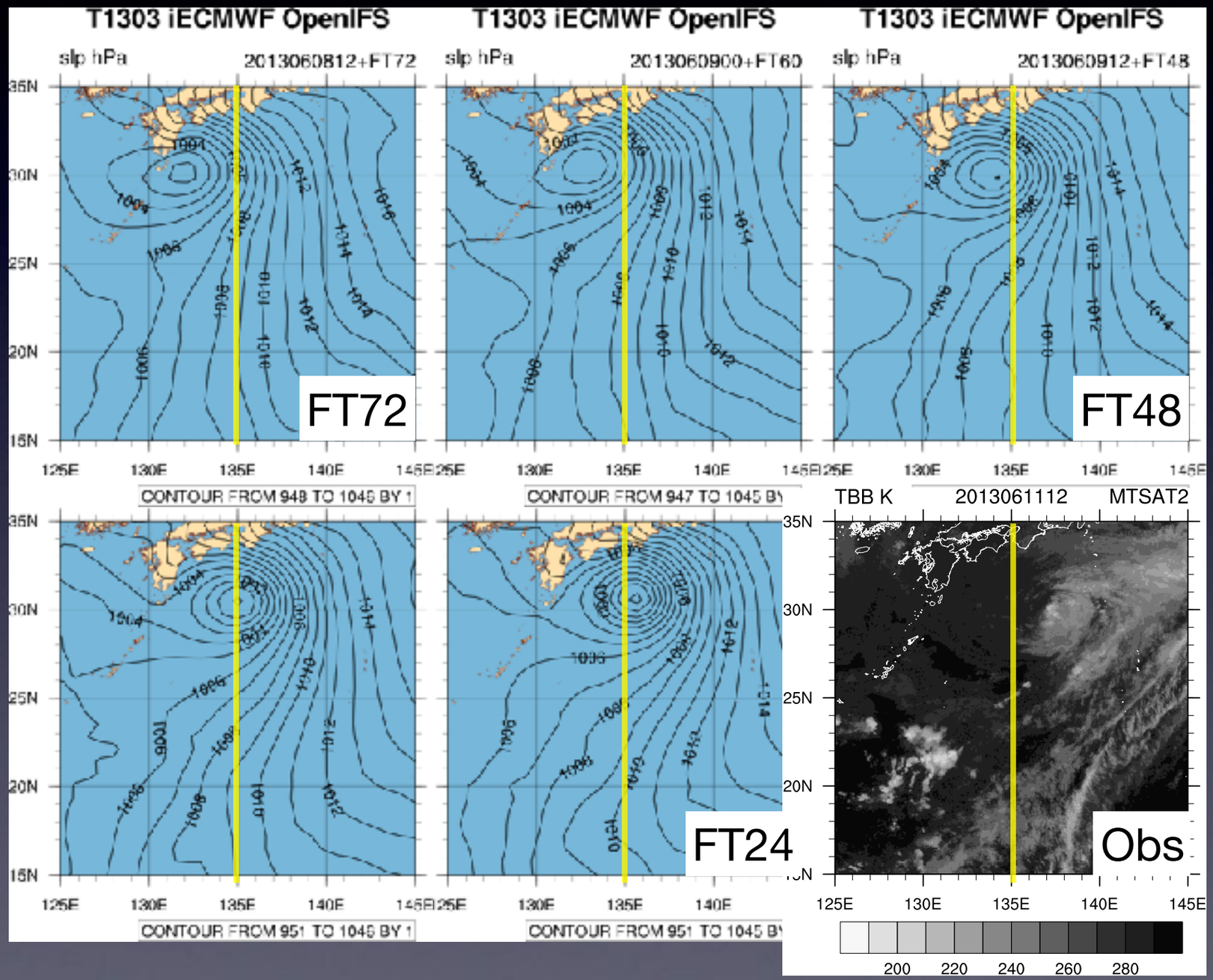


initial time 12 UTC 9 June 2013

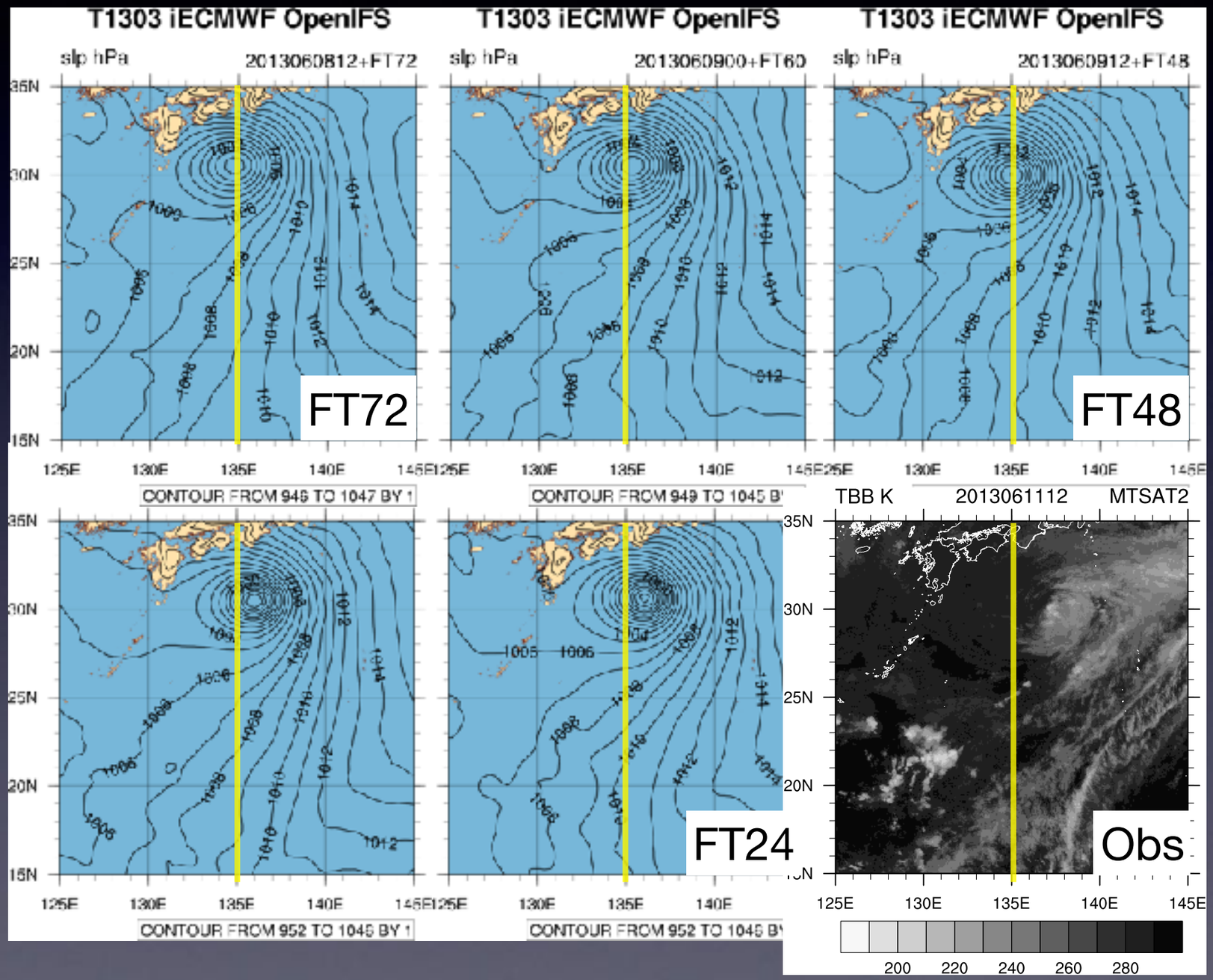
Sensitivity to initial time: TL159



Sensitivity to initial time: TL255



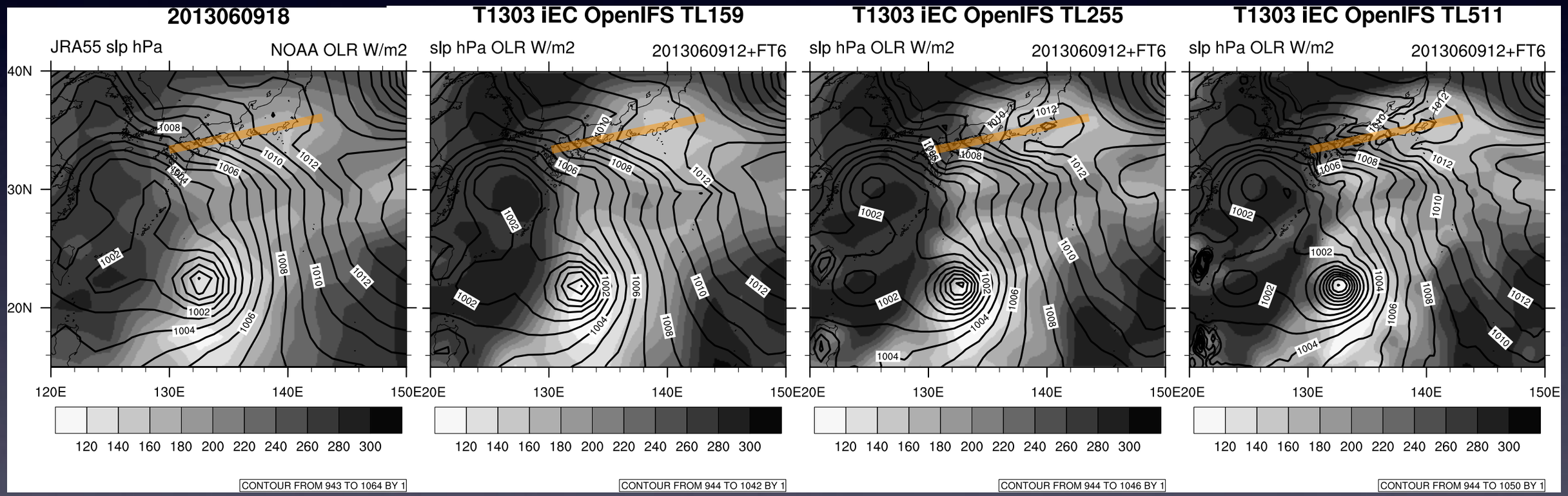
Sensitivity to initial time: TL511



Representation of the front

FT6

analysis TL159 TL255 TL511



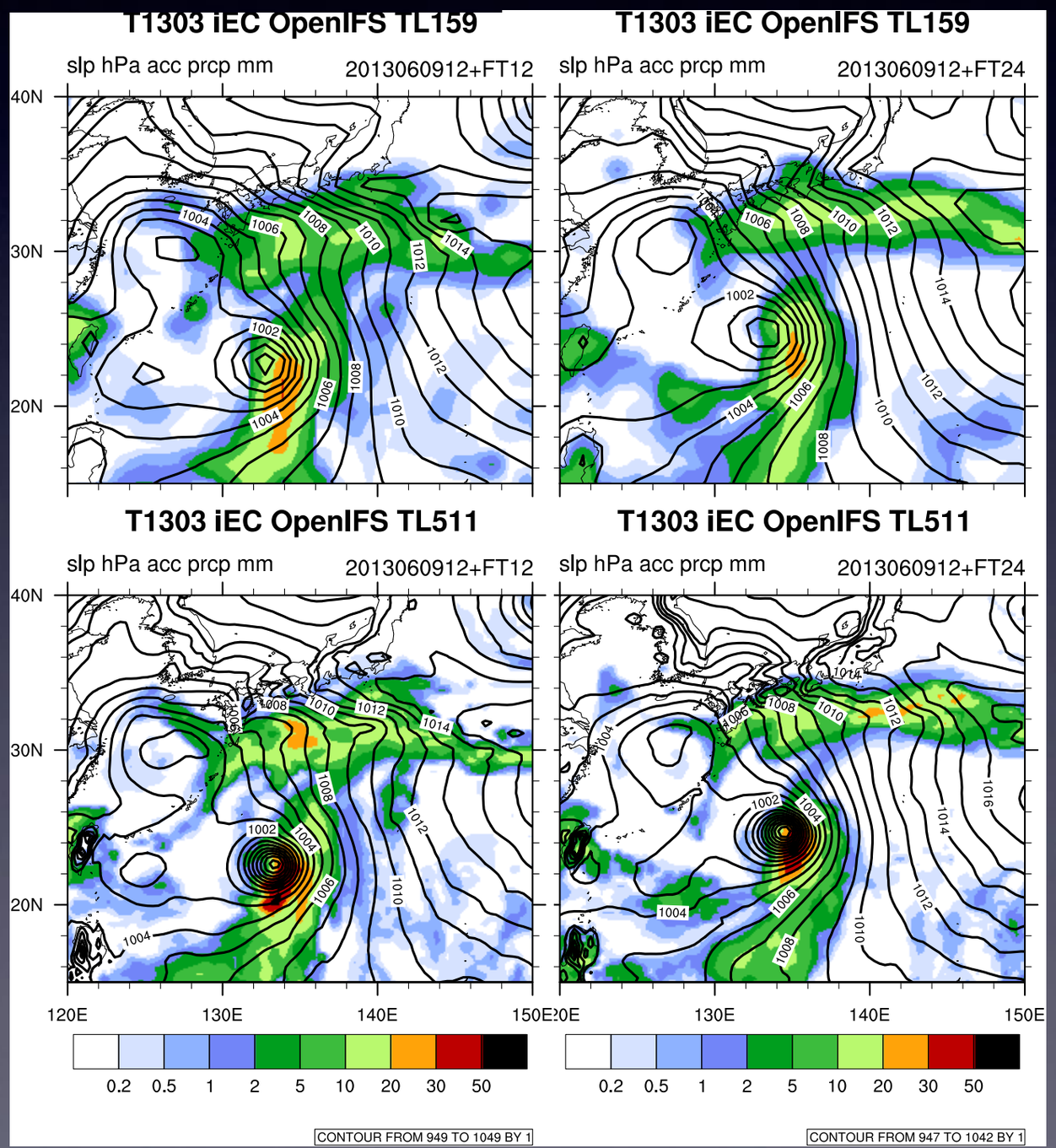
initial time 12 UTC 9 June 2013

Eastward migration of mesoscale lows

6h accumulated precipitation

TL159

TL511

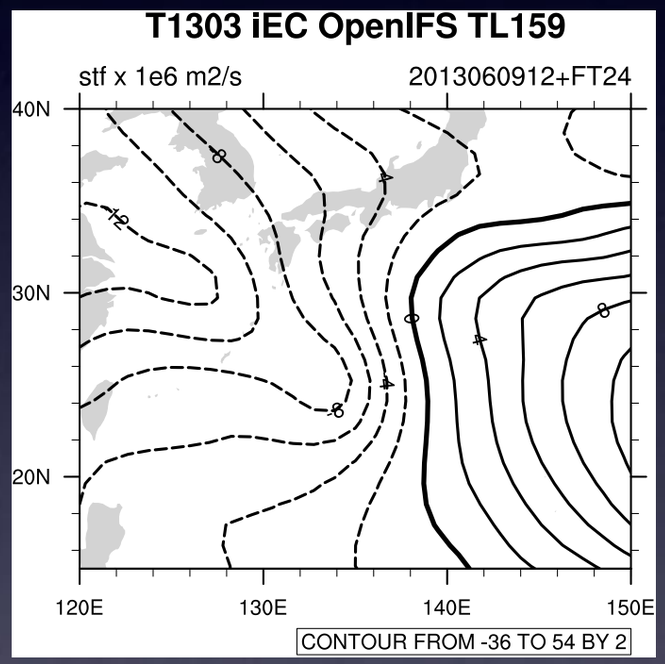


initial time
12 UTC
9 June 2013

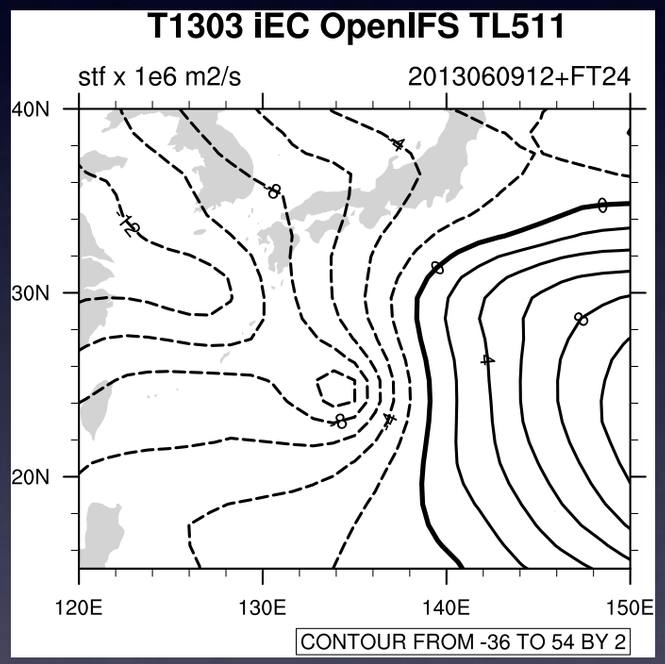
streamfunction at 700 hPa

FT24

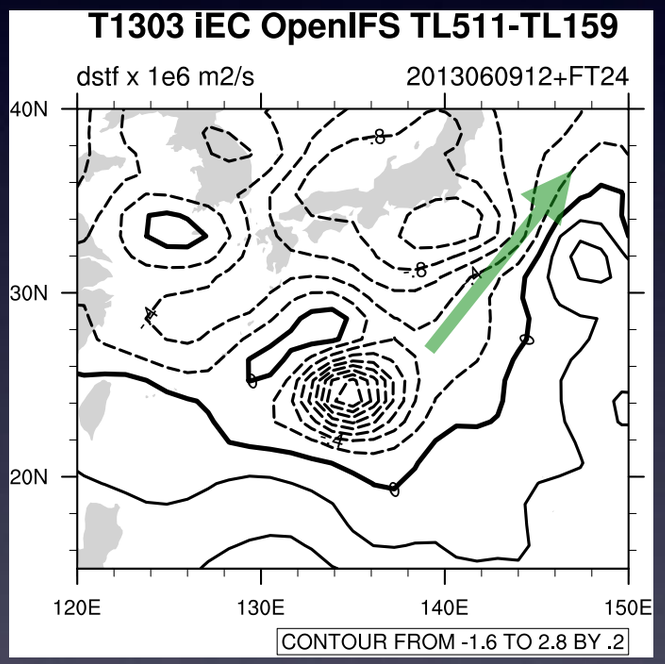
TL159



TL511



TL511–TL159



initial time 12 UTC 9 June 2013

Summary

- Explore predictability with a multi-model multi-analysis approach.
- # of cases with large positional errors that deteriorate skills can be reduced by improving the model.
- Lupit 2009 is sensitive to IC consistently among models indicating importance of the steering flow.
- Both IC and models are important with Parma 2009 implying influence from diabatic heating.
- In Yagi 2013 track is sensitive to IC but intensity is not.