

TCI Model Summary

Model	Type	Source	Horizon Res (km)	Fcst Length	Freq./day	Purpose
GFS	Global	UM	13	240 h	4x	Medium range
ECMWF IFS	Global	UM	16	240 h	2x	Medium range – high alt GWs
NAVGEM	Global	NRL	37	120 h	4x	Medium range
COAMPS	TC	NRL	45/15/5	48h	4x	Track, intensity, Outflow fields
COAMPS	Ensemble	NRL	27/9/3	48h	4x	Probabilistic Track, intensity, Outflow fields
COAMPS Adjoint	Targeting	NRL	45/15	60h, 84h	4x	Targeting
Model Tracks/ Intensity	Ops Models (HWRF, GFS, IFS..)	NCAR RAL		5 day		

NRL real-time TC modeling products

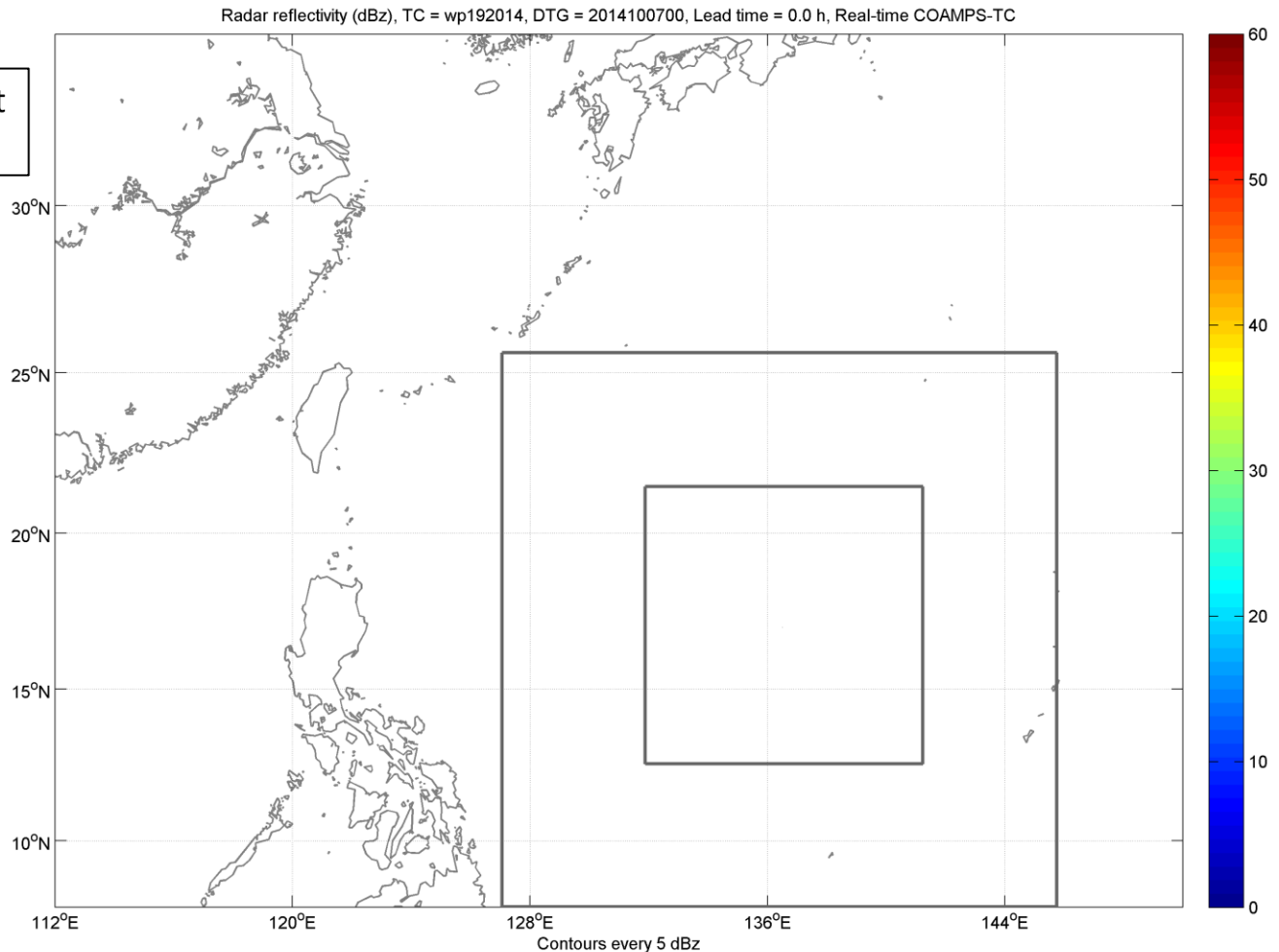
- COAMPS-TC
- COAMPS-TC ensemble
- COAMPS adjoint

COAMPS-TC

- COAMPS-TC is an operational dynamical TC prediction system (running at FNMOC in 2013)
 - COTC = FNMOC ops run, NAVGEM IC/BCs; CTCX = NRL real-time run, GFS IC/BCs
- 45/15/5 km resolution with storm-following inner grids. Forecasts to tau = 120 h, 4x daily

Example real-time forecast
for Vongfong (19W, 2014)

*Simulated radar reflectivity,
forecast track (black) and
best track (pink)*



NRL real-time COAMPS-TC: CTCX

Main web site: <http://www.nrlmry.navy.mil/coamps-web/web/tc>

COAMPS-TC™ Tropical Cyclone Prediction and Verification

[Forecast](#)
[Coupled Forecast](#)
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2015

<	-	Apr 2015	+	>		
Su	M	Tu	W	Th	F	Sa
			01	02	03	04
05	06	07	08	09	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Please select a region or current active storms (highlighted with red dots ●) on the left, or select a storm forecast on the calendar below.

- Atlantic
- West Pacific
- East Pacific
- Central Pacific
- Indian Ocean
- Southern Hem
- 22S.Joalane
- 23P.Solo

2014	Jan	Feb	Mar	Apr 2015	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	2016
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday							
29	30	31	Apr 01	02	03	04							
			04W:00Z 04W:06Z 04W:12Z 04W:18Z 80C:12Z 91S:00Z 91S:06Z 91S:12Z 91S:18Z 99W:00Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 91S:00Z 91S:06Z 91S:12Z 99W:00Z 99W:06Z 99W:12Z 99W:18Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 05W:06Z 05W:12Z 05W:18Z 91S:12Z 91S:18Z 93S:18Z 99W:00Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 05W:00Z 05W:06Z 05W:12Z 05W:18Z 91S:00Z 91S:18Z							
05	06	07	08	09	10	11							
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12	13	14	15	16	17	18							
19	20	21	22	23	24	25							
26	27	28	29	30	May 01	02							

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2015

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			04W:00Z 04W:06Z 04W:12Z 04W:18Z 80C:12Z 91S:00Z 91S:06Z 91S:12Z 91S:18Z 99W:00Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 91S:00Z 91S:06Z 91S:12Z 99W:00Z 99W:06Z 99W:12Z 99W:18Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 05W:06Z 05W:12Z 05W:18Z 91S:12Z 91S:18Z 93S:18Z 99W:00Z	04W:00Z 04W:06Z 04W:12Z 04W:18Z 05W:00Z 05W:06Z 05W:12Z 05W:18Z 91S:00Z 91S:18Z							
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2015

[Regional Scale](#)
[Mesoscale](#)
[Vortex Scale](#)
[Verification](#)

<	-	Apr 2015	+	>		
Su	M	Tu	W	Th	F	Sa
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[Surface](#)
[Pressure Level](#)
[Diagnosis](#)
[CrossSection](#)
[Track&Intensity](#)
[Diagnostic Data](#)
[Multi-Models](#)

	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop	
10m Winds																							
850hPa TPW&Wind																							
700hPa TPW&Wind																							
Wind Shear																							
850hPa Divergence																							
200hPa Divergence																							
Average RH&Wind																							
SLP,Wind&THickness																							
850RV,500GH&200W																							
700hPa RH&GH																							
850hPa RV&GH																							
500hPa RV&GH																							
200hPa RV&GH																							

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- 04S.Four
- 05S.Five
- 06S.Six
- 07P.Seven
- 08S.Diamondra
- 09S.Eunice
- 10P.Ola
- 11S.Fundi
- 12P.Lam
- 13P.Marcia
- 14S.Glenda
- 15S.Fifteen
- 16S.Haliba
- 17P.Pam
- 18P.Nathan
- 18S.Nathan
- 19S.Olwyn
- 20P.Reuben
- 21S.Ikola
- 22S.Joalane
- 23P.Solo
- 2015041000
- 2015041006
- 2015041012

NRL real-time COAMPS-TC: CTCX

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2015

Regional Scale Mesoscale Vortex Scale Verification

<	-	Apr 2015	+	>		
Su	M	Tu	W	Th	F	Sa
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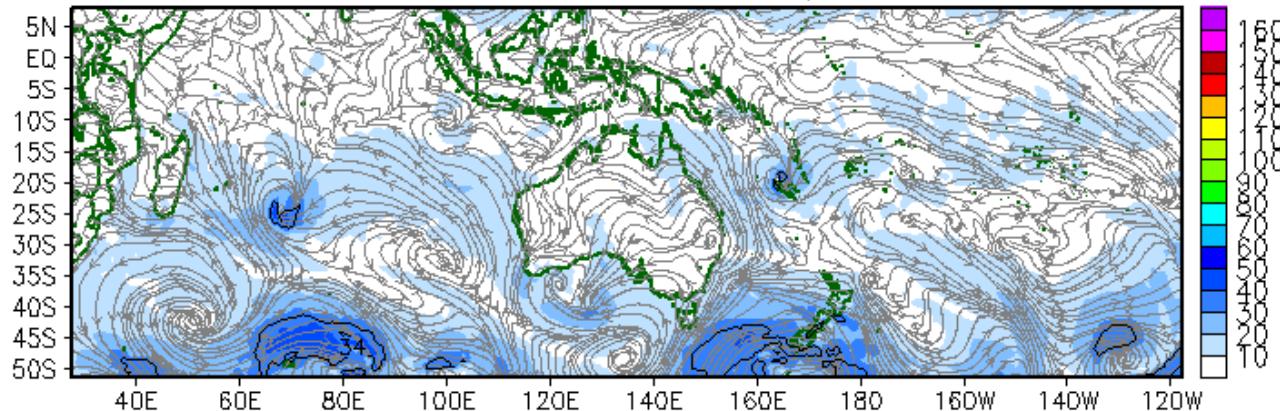
Surface Pressure Level Diagnosis CrossSection Track&Intensity Diagnostic Data Multi-Models

Surface	Pressure Level	Diagnosis	CrossSection	Track&Intensity	Diagnostic Data	Multi-Models
10m Winds	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
850hPa TPW&Wind	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
700hPa TPW&Wind	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
Wind Shear	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
850hPa Divergence	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
200hPa Divergence	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
Average RH&Wind	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
SLP, Wind&THickness	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
850RV, 500GH&200W	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
700hPa RH&GH	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
850hPa RV&GH	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
500hPa RV&GH	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				
200hPa RV&GH	0h 6h 12h 18h 24h 30h 36h 42h 48h 54h 60h 66h 72h 78h 84h 90h 96h 102h 108h 114h 120h	Loop				

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10m Winds (kt) of 48h, valid at 0000 UTC 12 APR 2015
COAMPS FCST from 2015041000, 45km



NRL real-time COAMPS-TC: CTCX

Main web site: <http://www.nrlmry.navy.mil/coamps-web/web/tc>

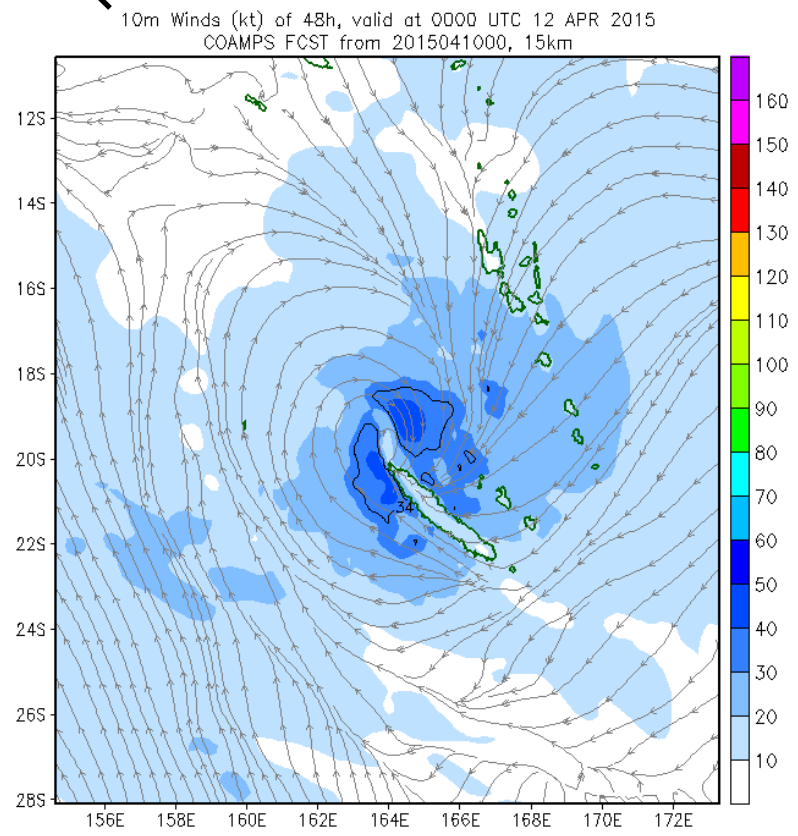
Forecast Coupled Forecast Ensemble Documentation Links COAMPS Home

2015
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Atlantic
 West Pacific
 East Pacific
 Central Pacific
 Indian Ocean

- Southern Hem**
- 04S.Four
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	Regional Scale		Mesoscale		Vortex Scale		Verification															
	Surface	Pressure Level	Diagnosis		CrossSection		Track&Intensity		Diagnostic Data		Multi-Models											
10m Winds	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
850hPa TPW&Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
700hPa TPW&Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
Wind Shear	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
850hPa Divergence	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
200hPa Divergence	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
Average RH&Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
SLP,Wind&Thickness	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
850RV,500GH&200W	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
700hPa RH&GH	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
850hPa RV&GH	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
500hPa RV&GH	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h											
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Atlantic

West Pacific

East Pacific

Central Pacific

Indian Ocean

Southern Hem

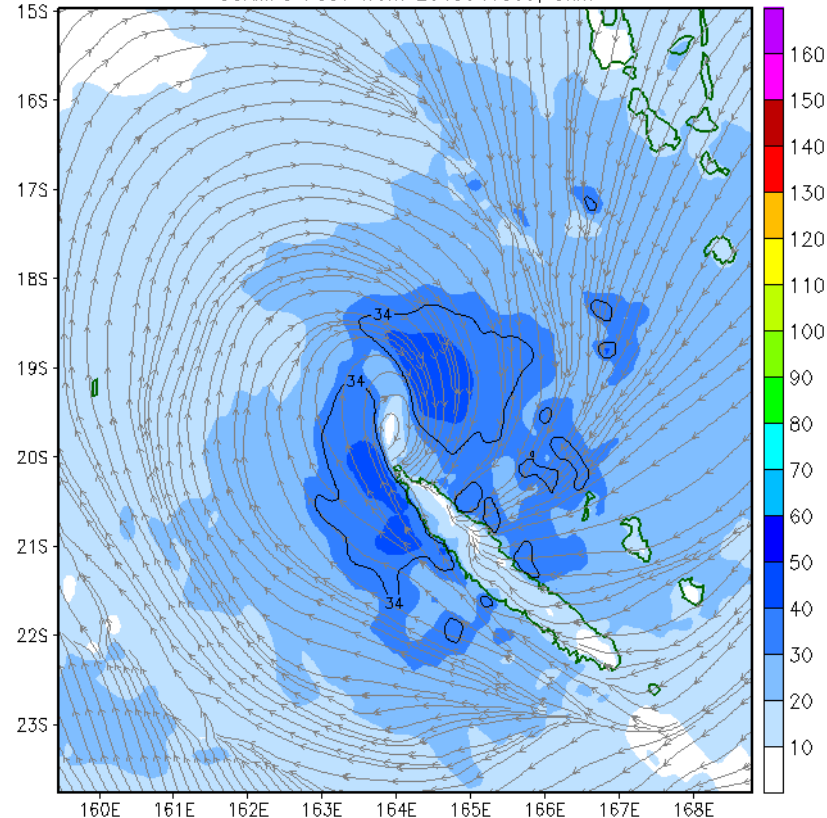
- 04S.Four
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Regional Scale Mesoscale Vortex Scale Verification

Surface Pressure Level Diagnosis CrossSection Track&Intensity Diagnostic Data Multi-Models

	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop		
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850hPa RV&GH																								Loop
500hPa RV&GH																								Loop
200hPa RV&GH																								Loop

10m Winds (kt) of 48h, valid at 0000 UTC 12 APR 2015
COAMPS FCST from 2015041000, 5km



NRL real-time COAMPS-TC: CTCX

Main web site: <http://www.nrlmry.navy.mil/coamps-web/web/tc>

Forecast Coupled Forecast Ensemble Documentation Links COAMPS Home

Regional Scale Mesoscale Vortex Scale Verification

Track&Intensity Diagnostic Data Multi-Models

Track MaxWind MSLP

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Atlantic

West Pacific

East Pacific

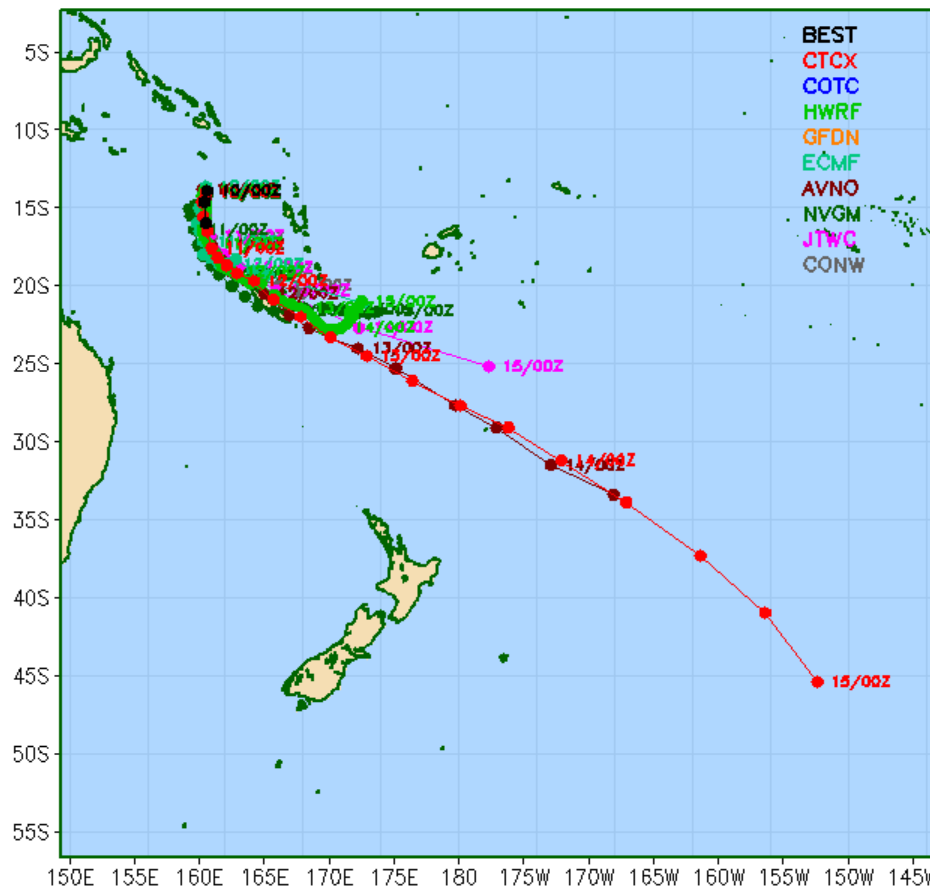
Central Pacific

Indian Ocean

Southern Hem

04S.Four
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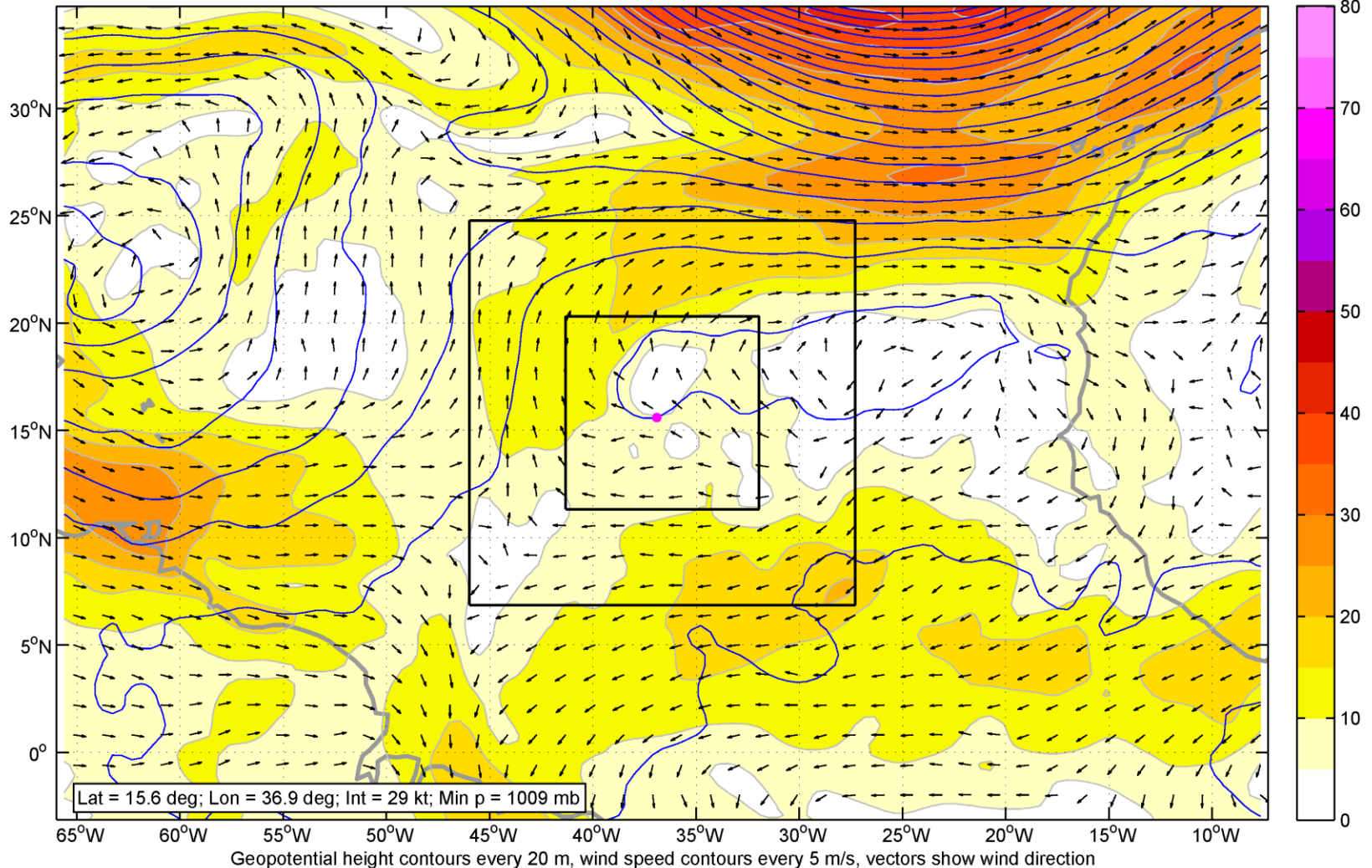
23P Tracks from 0000 UTC 10 APR 2015



NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products

200 mb wind and geopotential height, TC = aI062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC

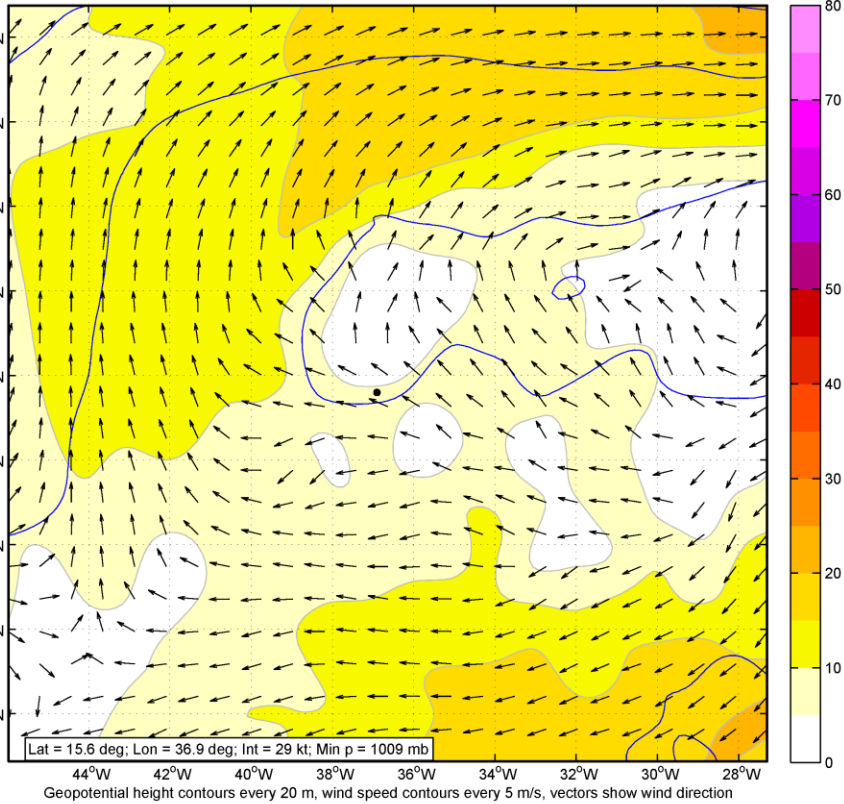


Grid 1: 200 mb wind speed (color shading), wind direction (unit vectors) , geopotential height (blue contours) TC center (pink dot) and vitals (lower left), inner grid positions (black boxes)

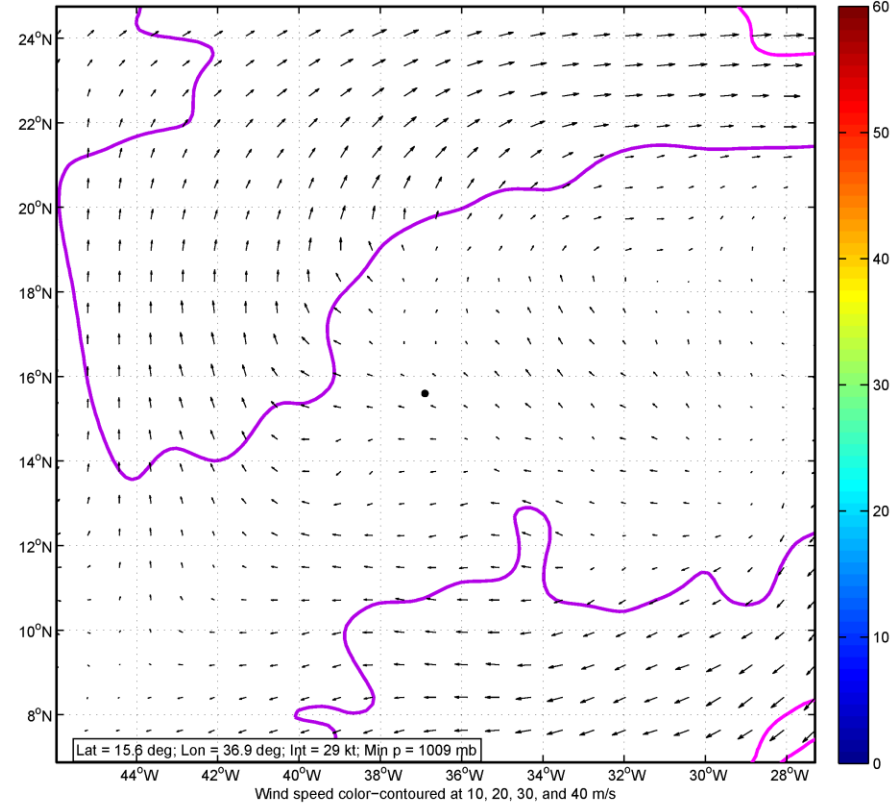
NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products

200 mb wind and geopotential height, TC = al062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC



200 mb wind and radar, TC = al062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC



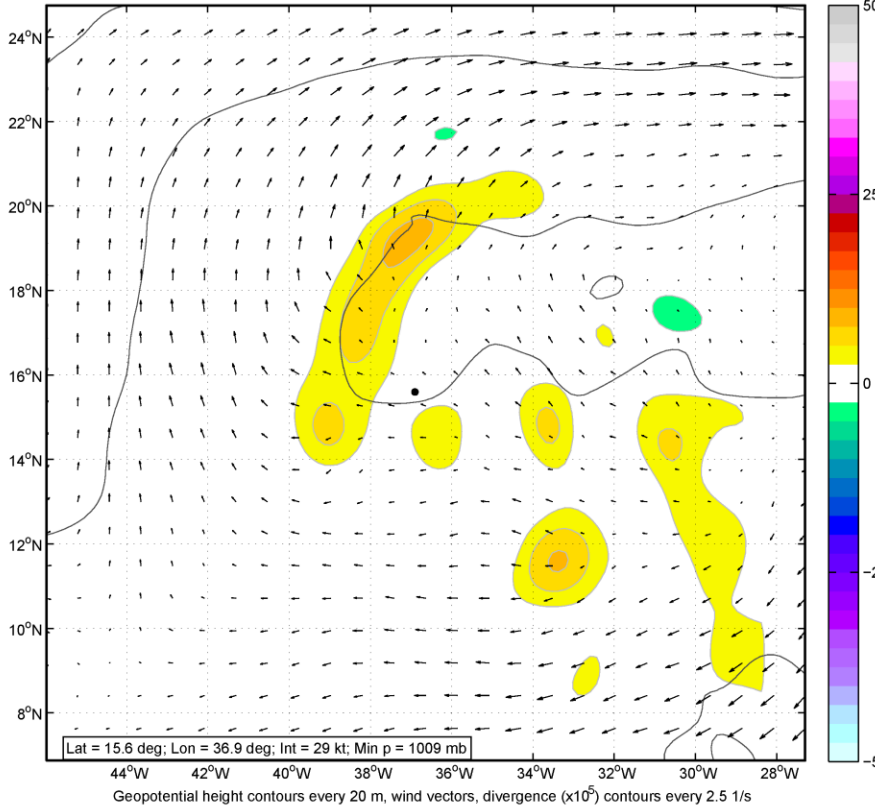
**Grid 2: 200 mb wind speed (color shading),
200 mb wind direction (unit vectors) ,
200 mb geopotential height (blue contours)
TC center (black dot) and vitals (lower left)**

**Grid 2: Composite radar reflectivity (color shading),
200 mb wind (vectors) ,
200 mb wind speed (thick contours)
TC center (black dot) and vitals (lower left)**

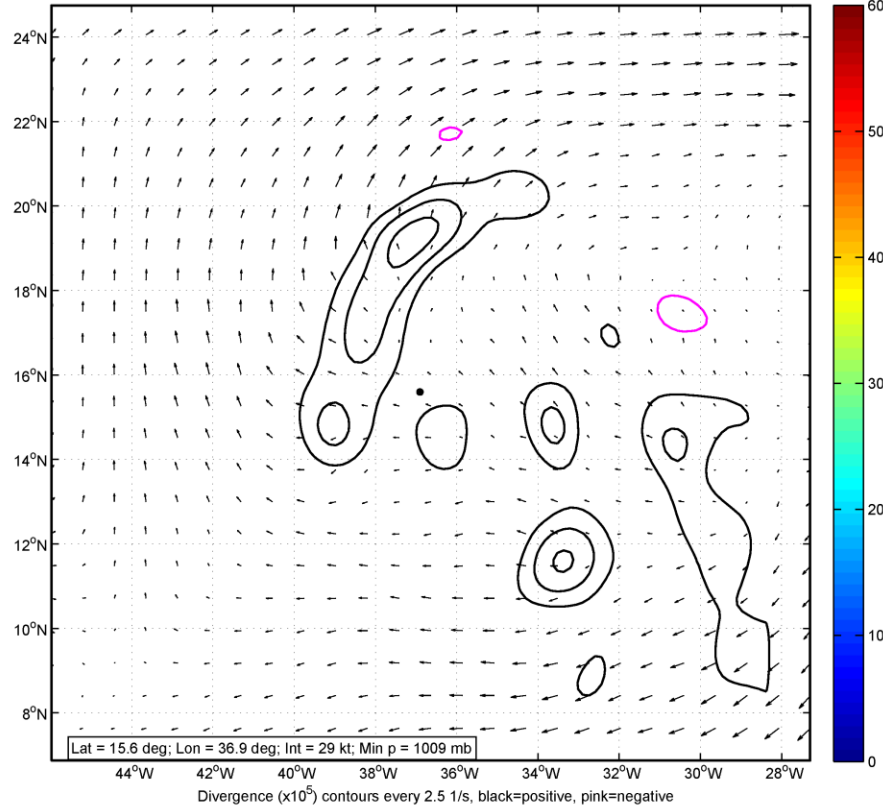
NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products

200 mb wind, smoothed divergence, and geo. height, TC = a1062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC



200 mb wind, smoothed divergence, and radar, TC = a1062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC



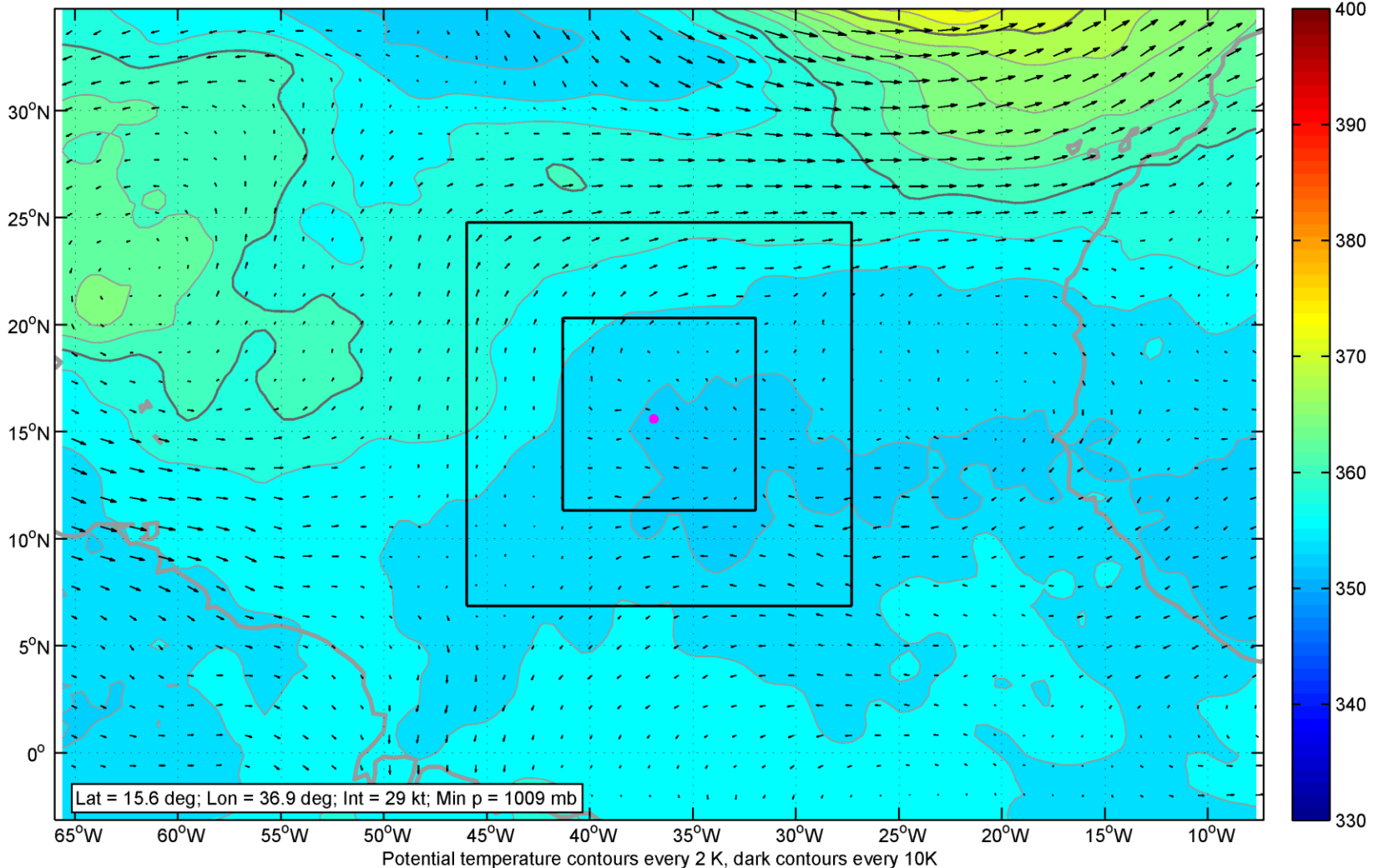
**Grid 2: 200 mb divergence (color shading),
200 mb wind (vectors),
TC center (black dot) and vitals (lower left)**

**Grid 2: Composite radar reflectivity (color shading),
200 mb divergence (thick contours),
200 mb wind (vectors)
TC center (black dot) and vitals (lower left)**

NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products

150 mb wind and potential temperature, TC = al062014, DTG = 2014091112, Lead time = 0 h, Real-time COAMPS-TC

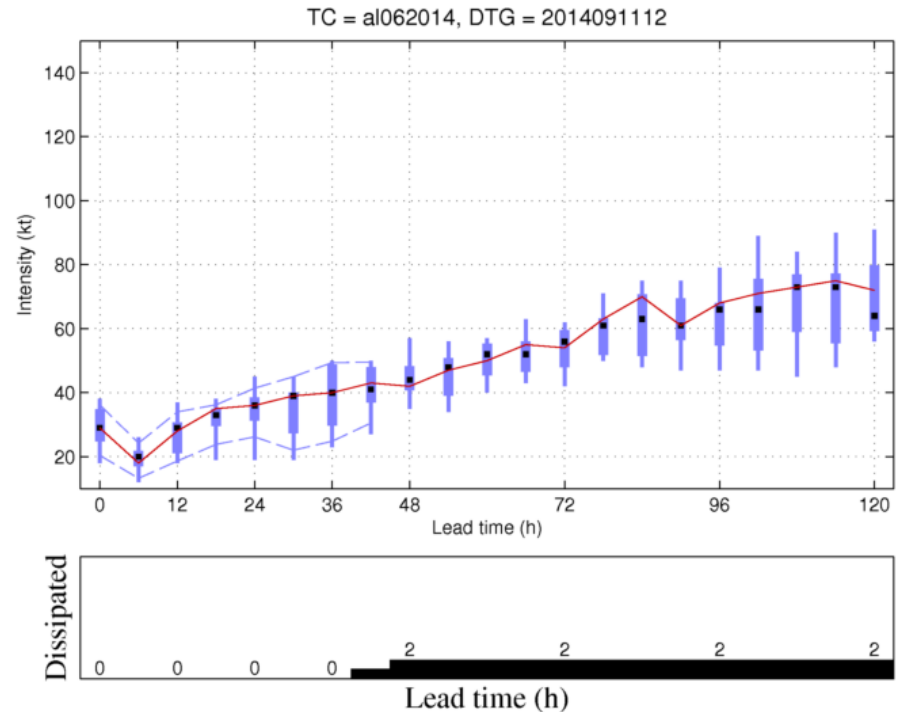
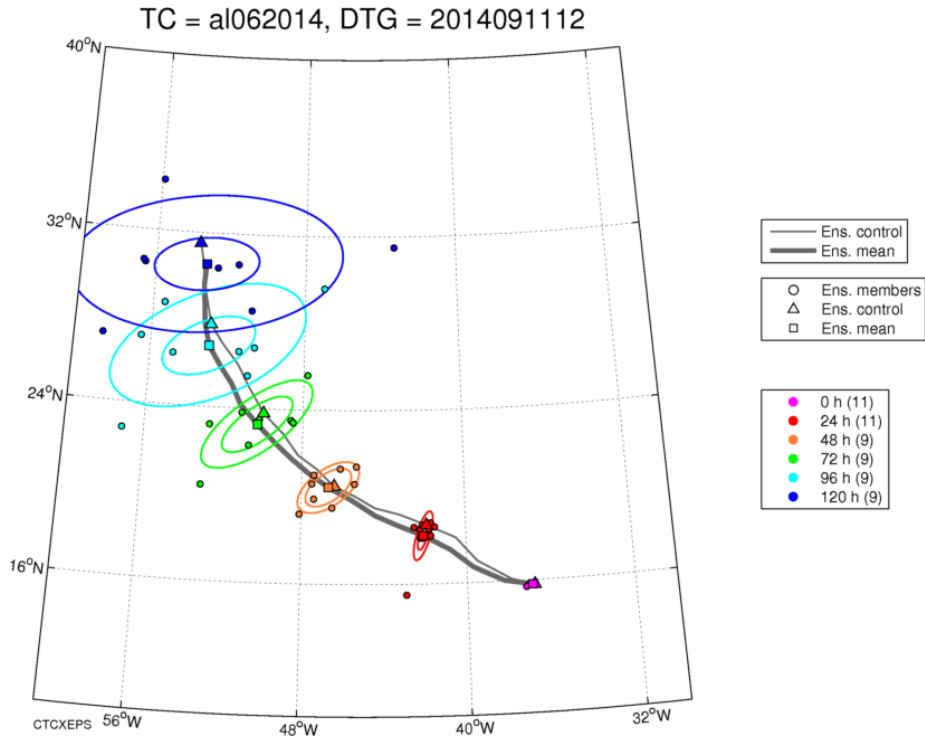


Grid 1: 150 mb potential temperature (color shading and contours), wind (vectors), TC center (pink dot) and vitals (lower left), inner grid positions (black boxes)

COAMPS-TC ensemble

- Likely configuration for Atlantic and Eastern Pacific TCs
 - 1 unperturbed control and 10 perturbed members
 - 27/9/3 km resolution
 - Forecast to 120 h, 4x daily

Web site: <http://www.nrlmry.navy.mil/coamps-web/web/ens>



COAMPS-TC Adjoint System

Adjoint allows for the mathematically rigorous calculation of forecast **sensitivity** of a response function to changes in **initial state**

Sensitivity of response function (J) at time t_n to the state at time t_0

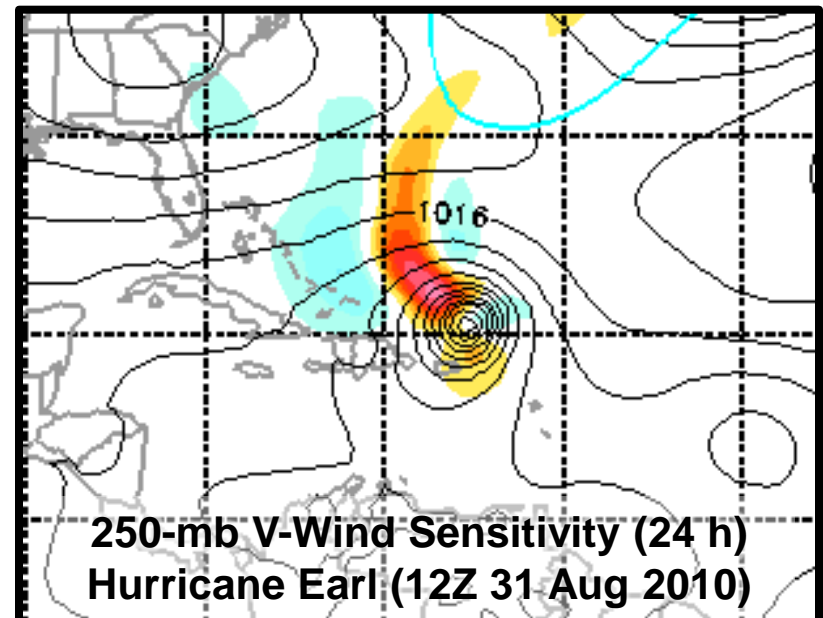
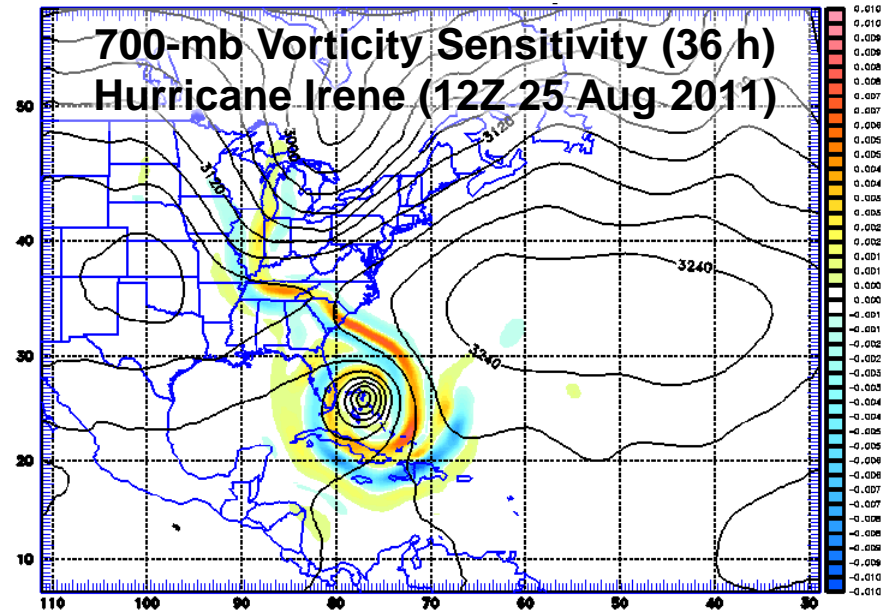
$$\frac{\partial J}{\partial \mathbf{x}(t_0)} = \mathbf{M}^T \frac{\partial J}{\partial \mathbf{x}(t_n)}$$

COAMPS-TC Adjoint

Dynamics: Nonhydrostatic, nested

Physics: PBL, fluxes, microphysics, Kuo

J: Kinetic energy in box (~1 km)



COAMPS-TC Adjoint System

COAMPS® Real-Time Adjoint84h Forecasts for HS3

[HS3 84h](#)

[Archive](#)

[COAMPS Home](#)

[HS3HI 60h](#)

[HS3LO 60h](#)

Forecast starting at 2013092612 (outout every 6 hour)

[Forward](#)

[Adjoint](#)

SLP & 10m Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
850mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
700mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
500mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
300mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
250mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
200mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
150mb Wind	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
850mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
700mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
500mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
300mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
250mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
200mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
150mb Relative Vorticity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
850mb Relative Humidity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
700mb Relative Humidity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
500mb Relative Humidity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
300mb Relative Humidity	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop
Sea Surface Temperature	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	Loop