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

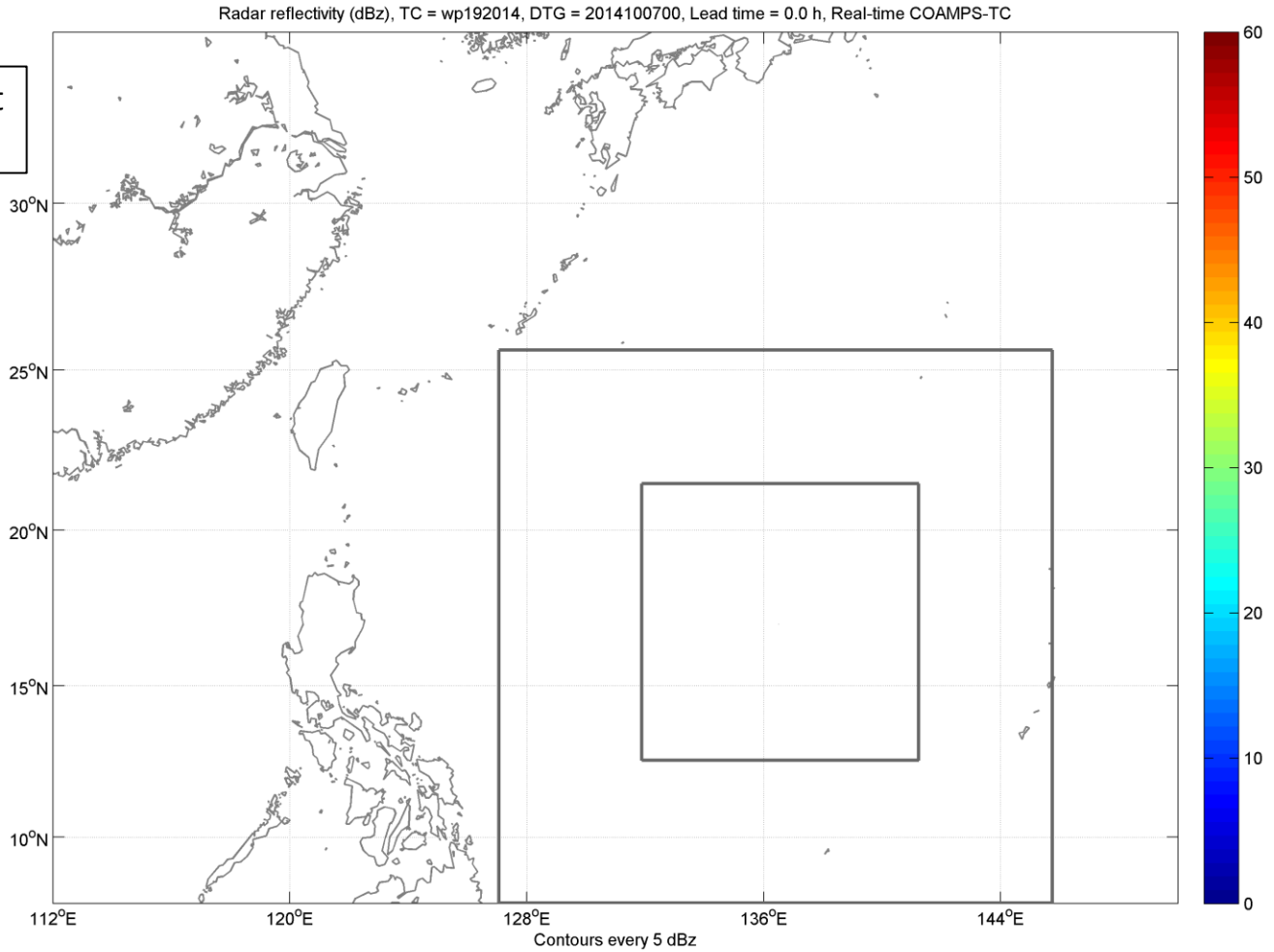
- COAMPS-TC
- COAMPS-TC ensemble
- COAMPS adjoint

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

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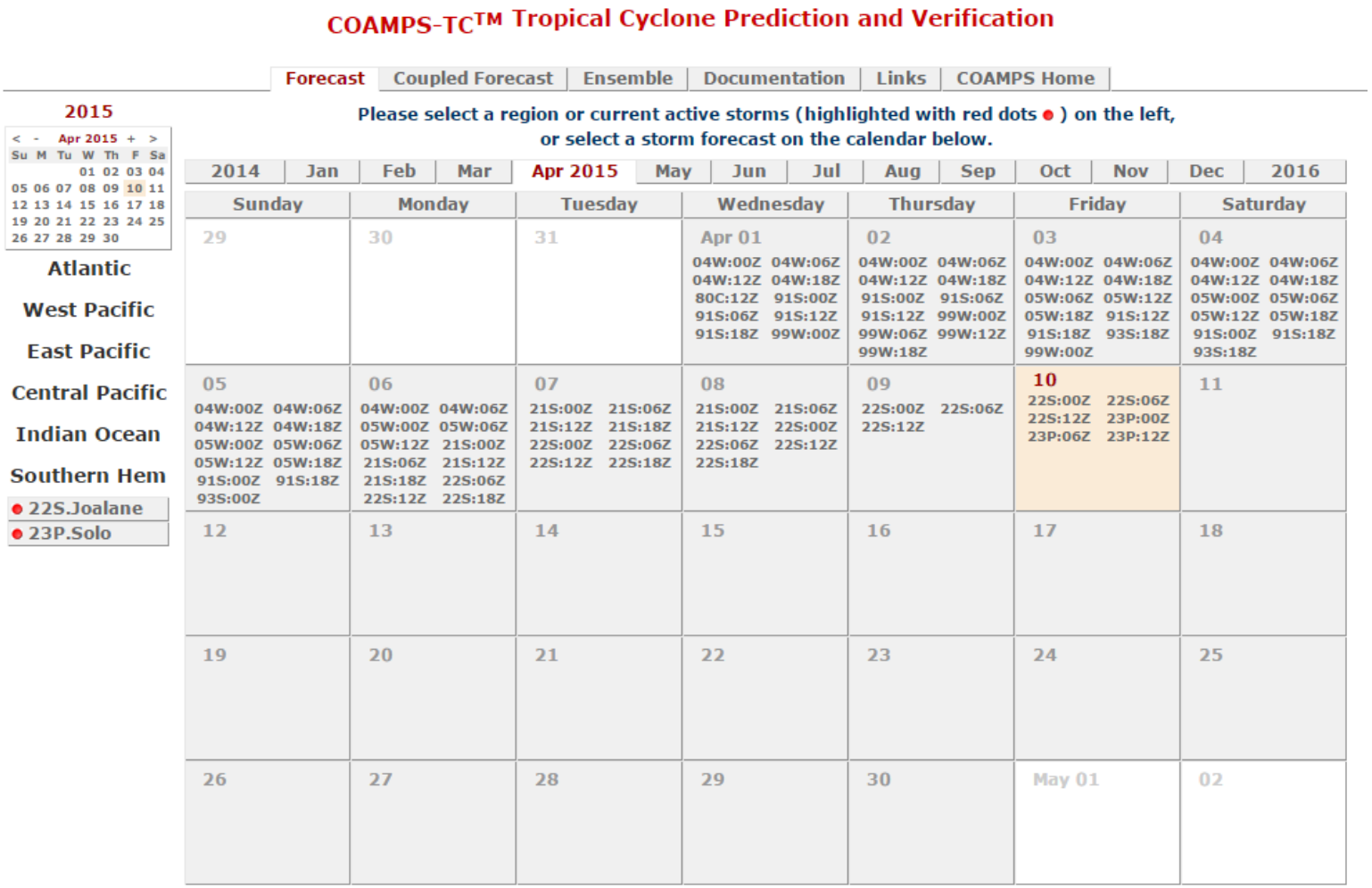

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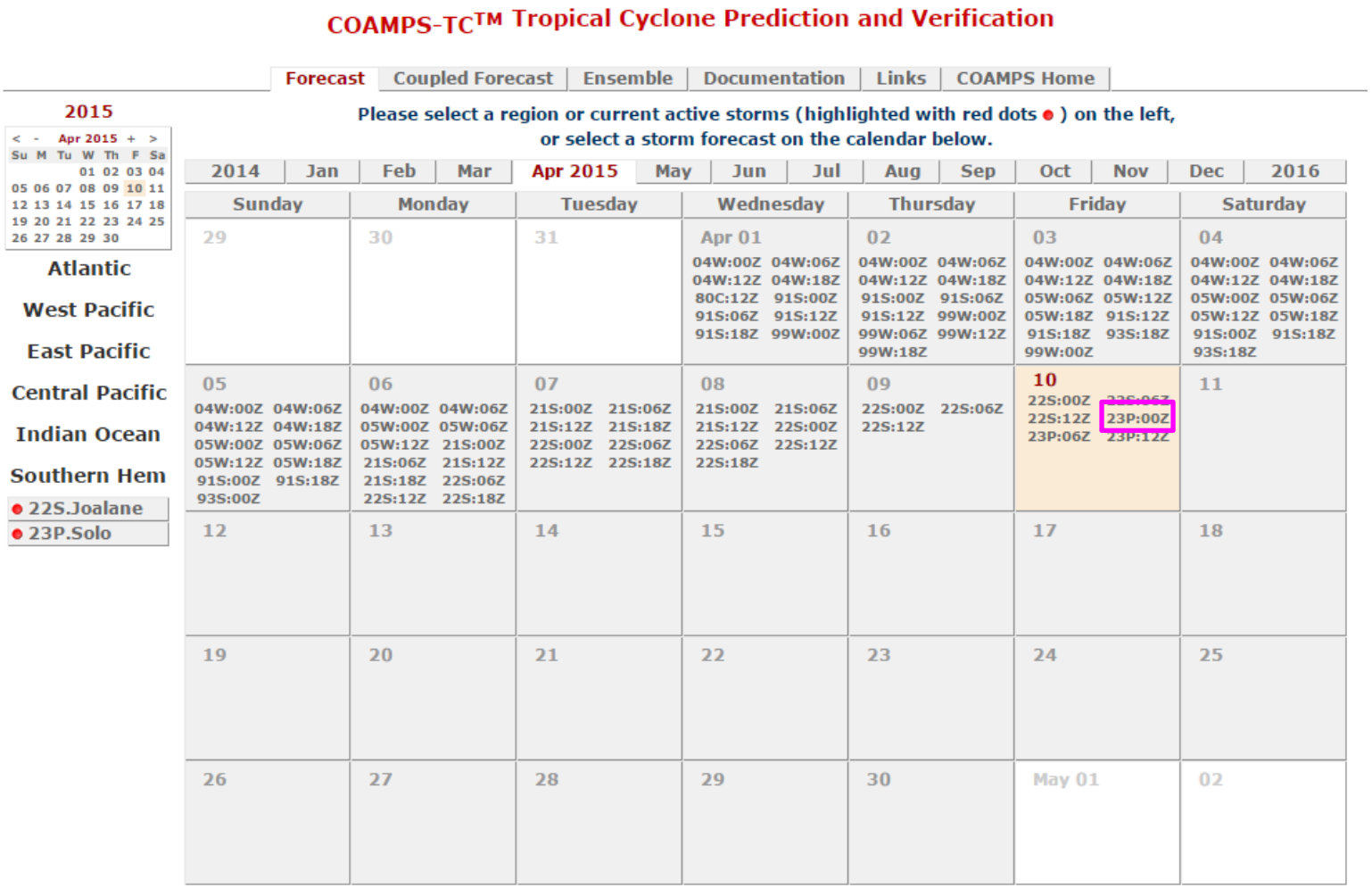

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Forecast | Coupled Forecast | Ensemble | Documentation | Links | COAMPS Home

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< - Apr 2015 + >

Su	M	Tu	W	Th	F	Sa
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05	06	07	08	09	10	11
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2015041000
2015041006
2015041012

Regional Scale | Mesoscale | Vortex Scale | Verification

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	0h	6h	12h	18h	24h	30h	36h	42h	48h	54h	60h	66h	72h	78h	84h	90h	96h	102h	108h	114h	120h	Loop
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
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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
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Forecast | Coupled Forecast | Ensemble | Documentation | Links | COAMPS Home

Regional Scale | Mesoscale | Vortex Scale | Verification

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Wind Shear	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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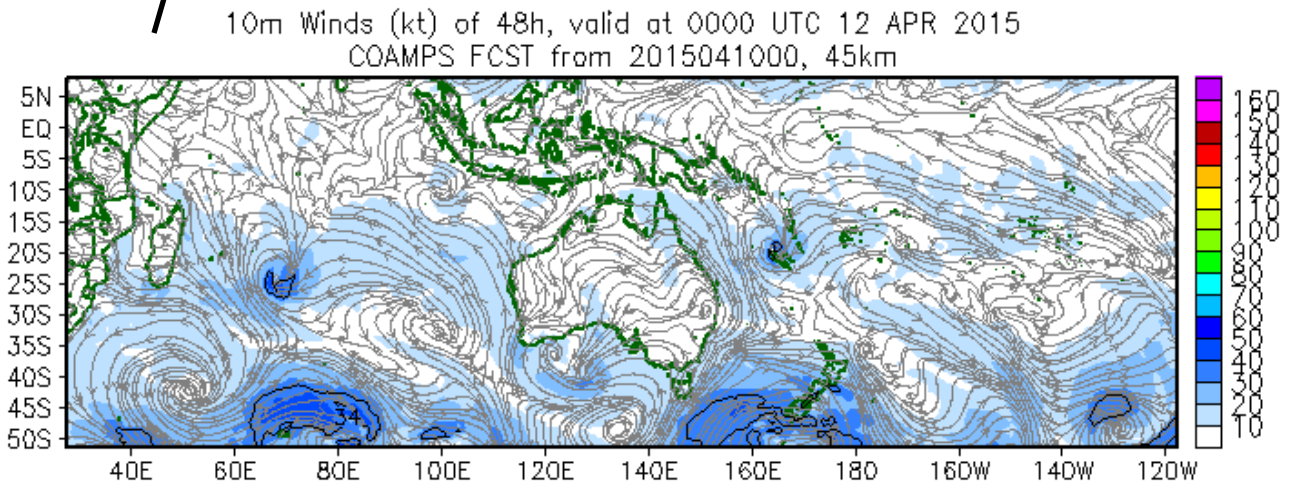

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Regional Scale | Mesoscale | Vortex Scale | Verification

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< - Apr 2015 + >

Su	M	Tu	W	Th	F	Sa
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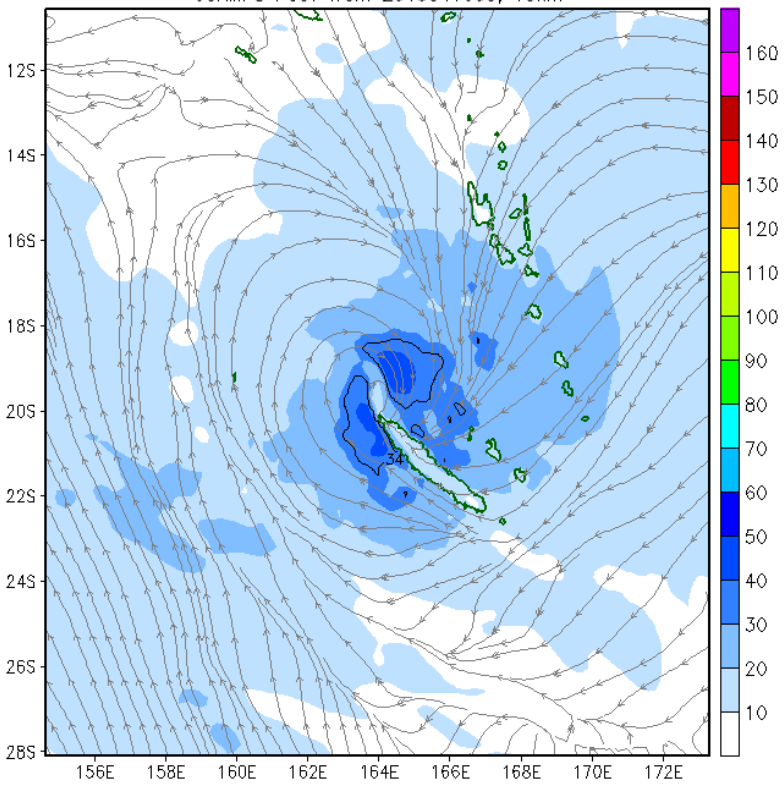
10m Winds (kt) of 48h, valid at 0000 UTC 12 APR 2015
COAMPS FCST from 2015041000, 15km



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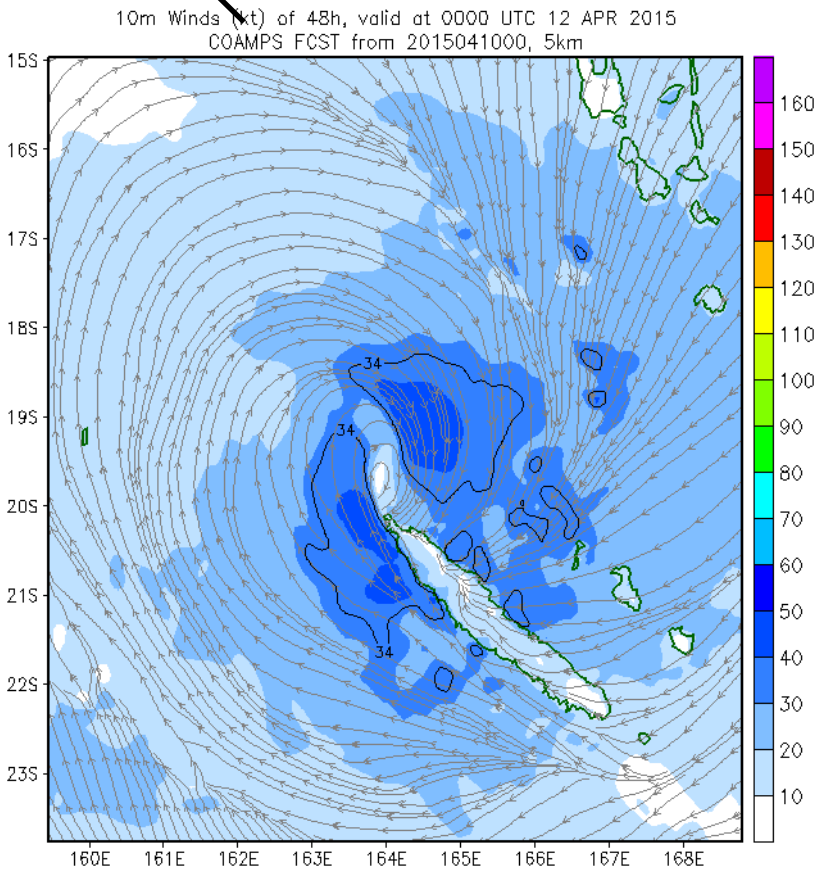
SLP,Wind&THickness																						
850RV,500GH&200W																						
700hPa RH&GH																						
850hPa RV&GH																						
500hPa RV&GH																						
200hPa RV&GH																						



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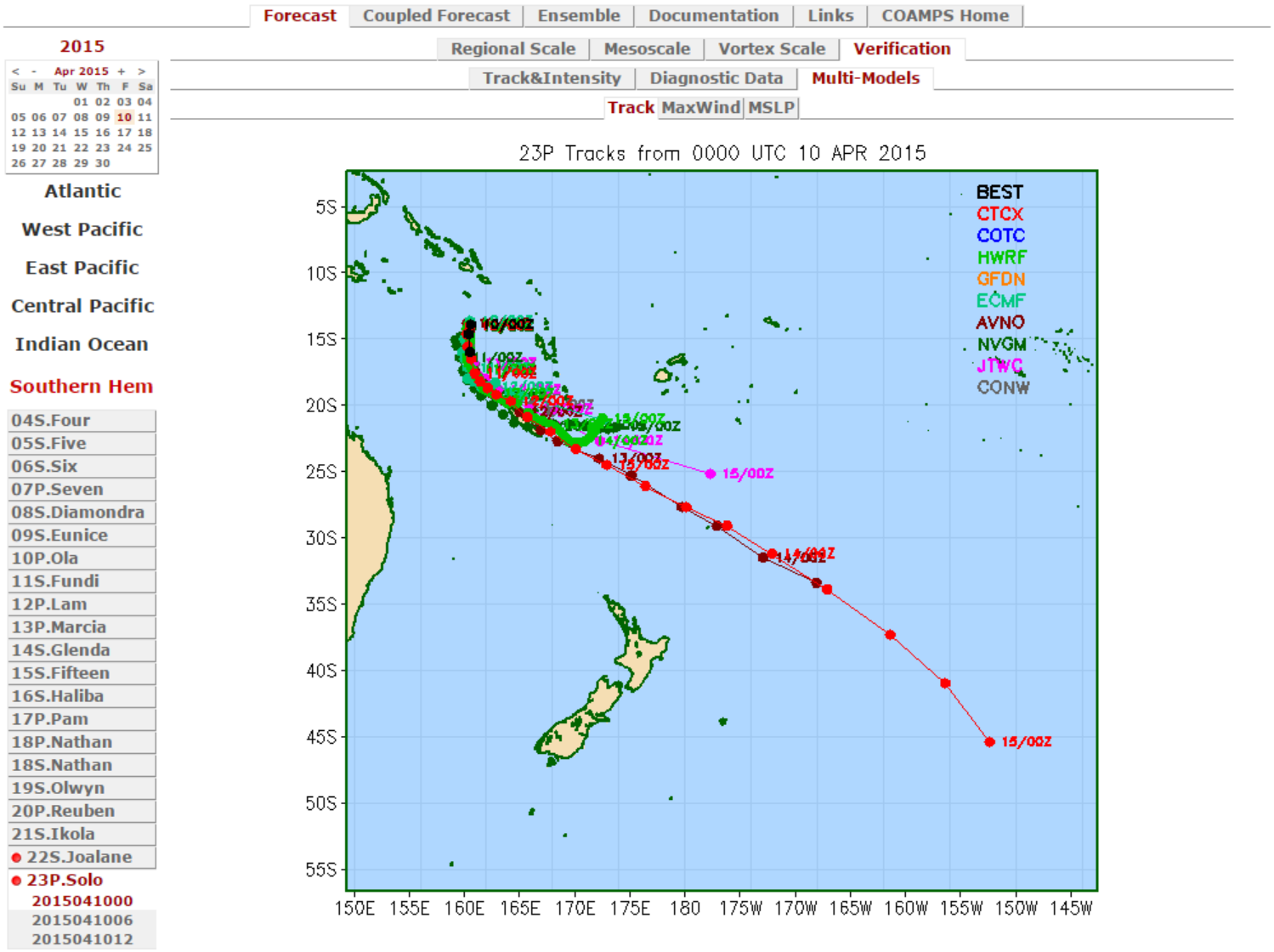
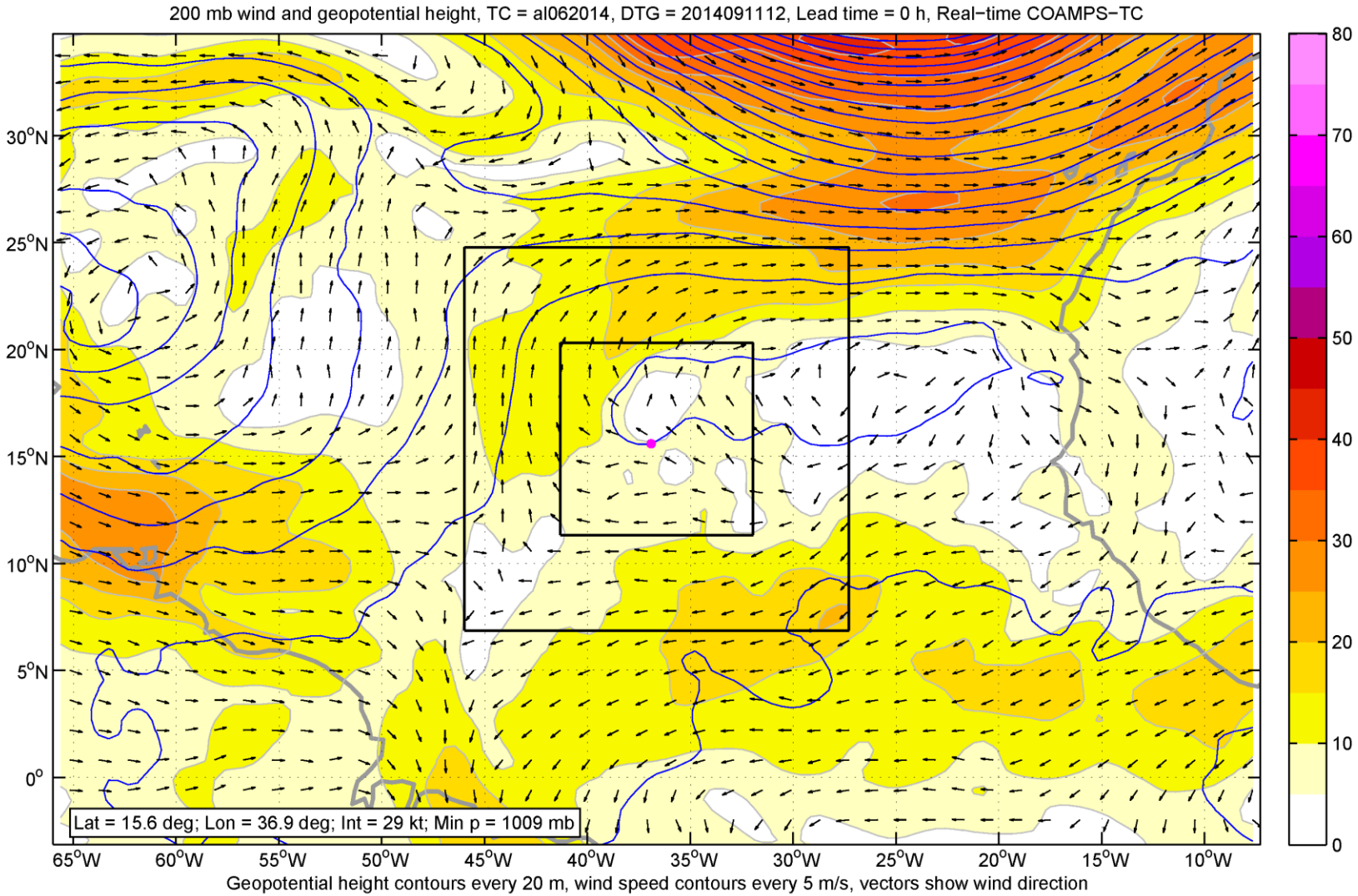


NRL real-time COAMPS-TC: CTCX

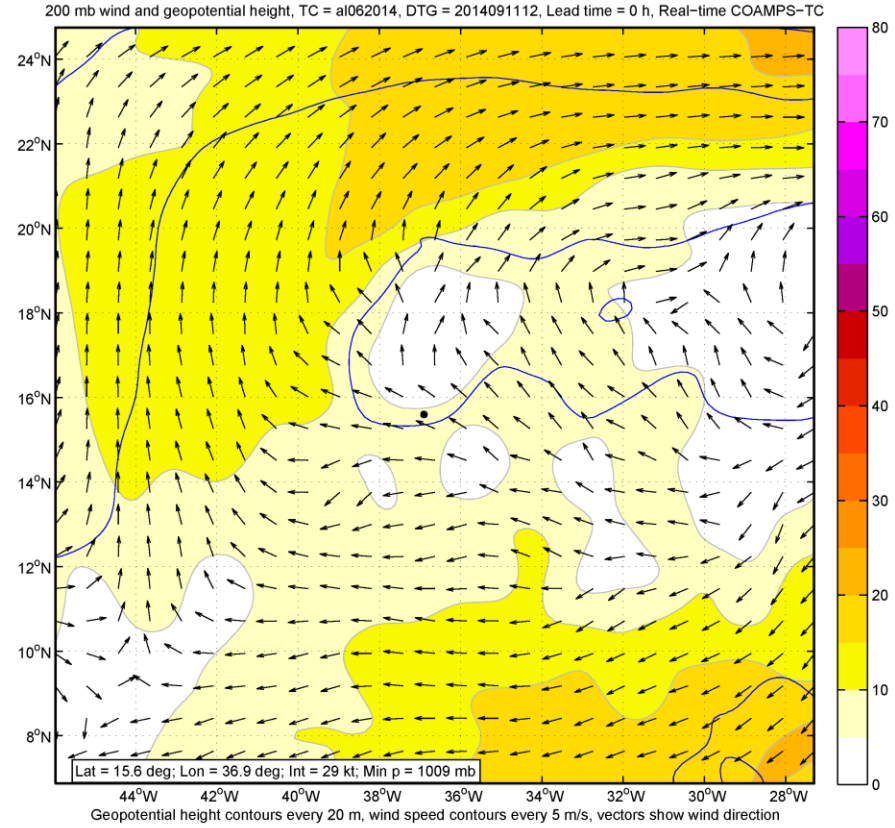
Specialized outflow prediction products



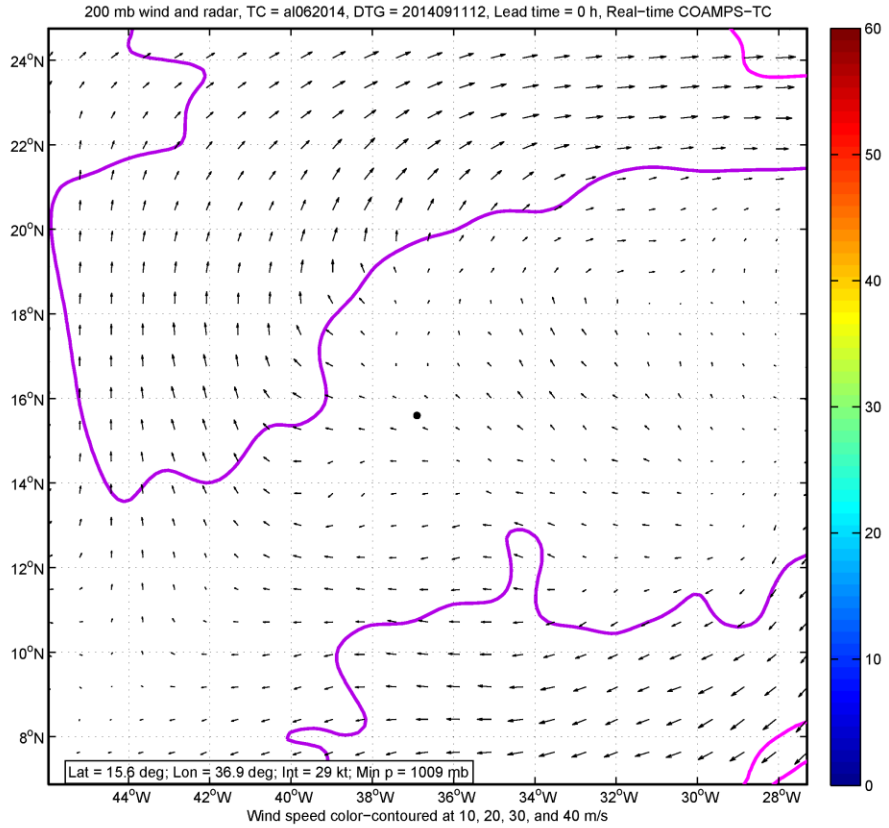
Grid 1: 200 mb wind speed (color shading), wind direction (unit vectors) , geopotential height (blue contours)
TC center (pink dot) and vitals (lower left), inner grid positions (black boxes)

NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products



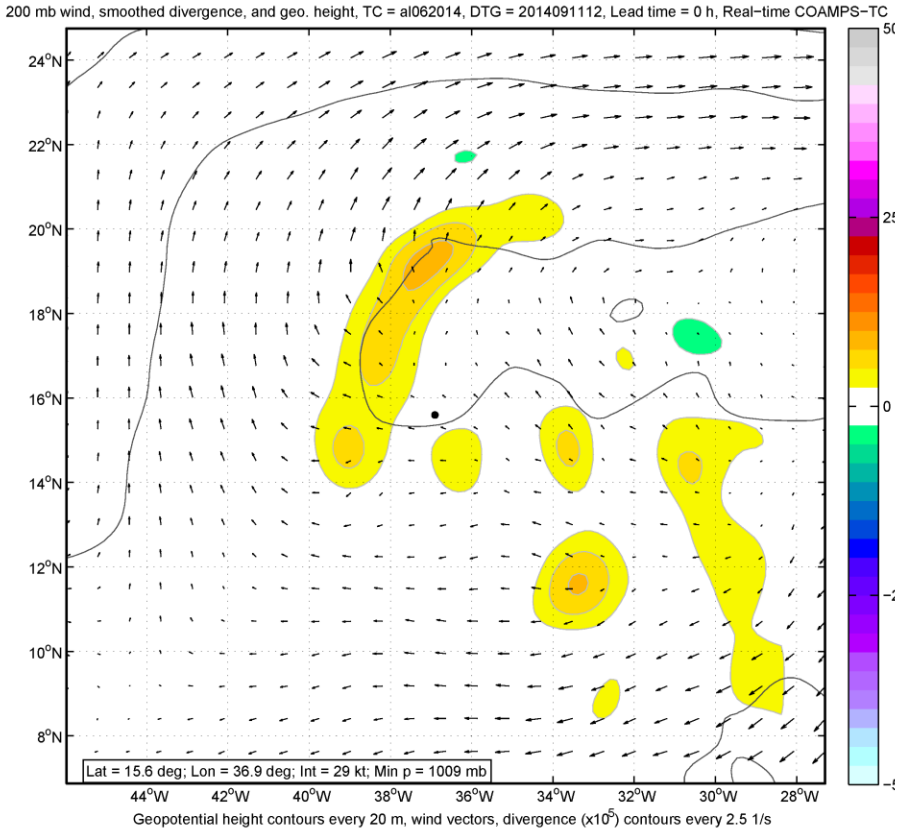
Grid 2: 200 mb wind speed (color shading),
200 mb wind direction (unit vectors) ,
200 mb geopotential height (blue contours)
TC center (black dot) and vitals (lower left)



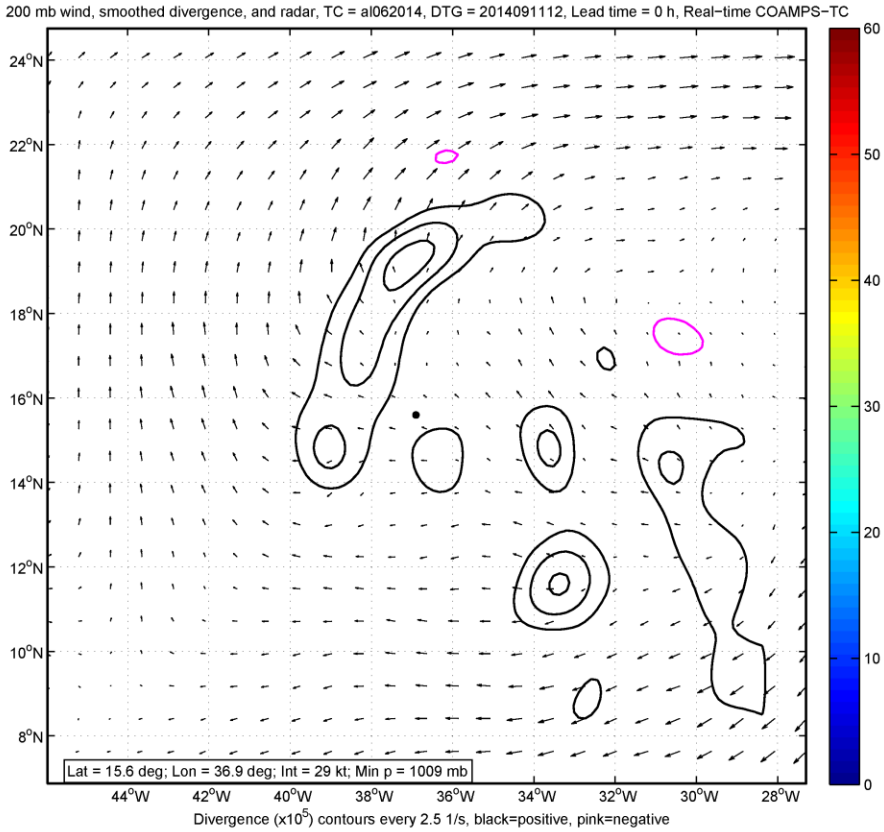
Grid 2: Composite radar reflectivity (color shading),
200 mb wind (vectors) ,
200 mb wind speed (thick contours)
TC center (black dot) and vitals (lower left)

NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products



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),
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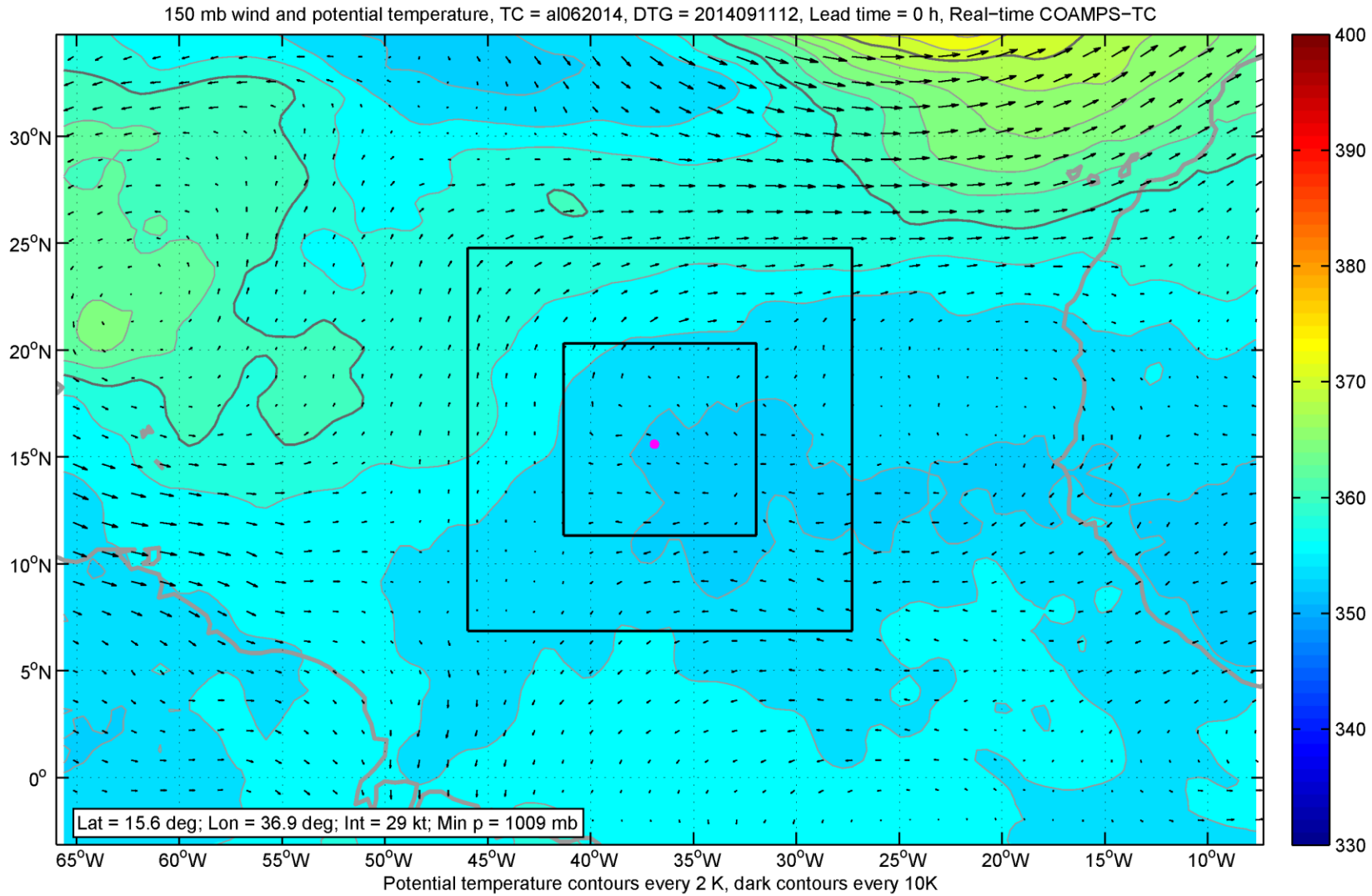
NRL real-time COAMPS-TC: CTCX

Specialized outflow prediction products

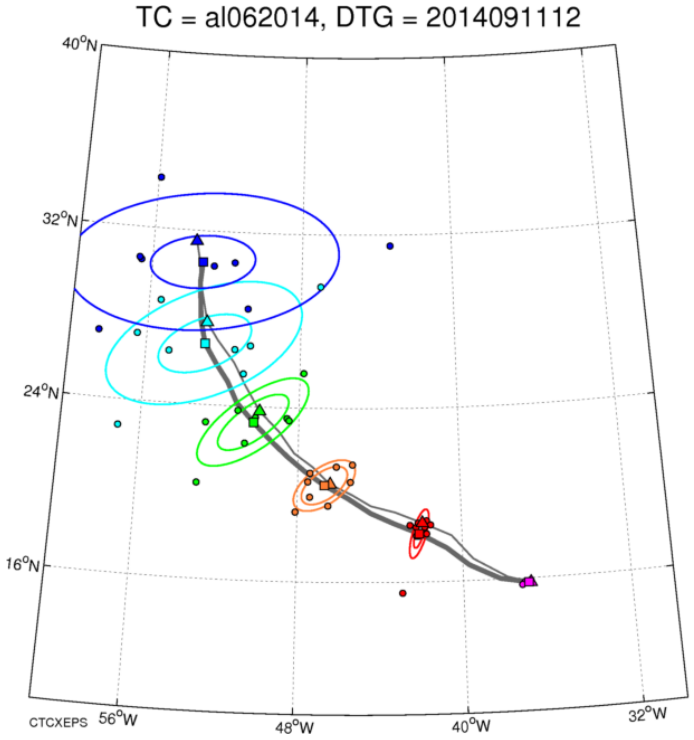


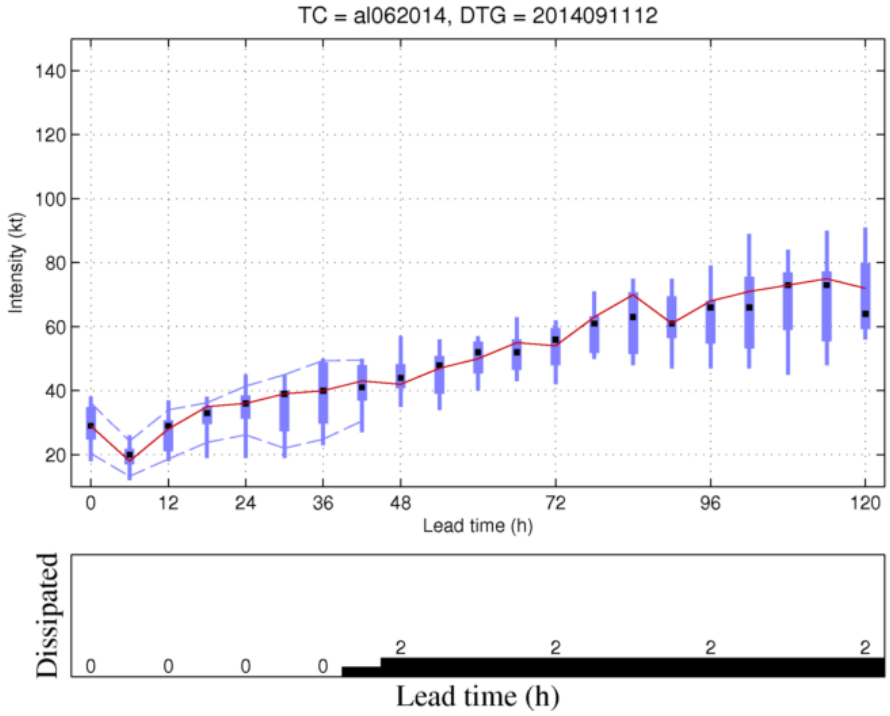
Grid 1: 150 mb potential temperature (color shading and contours), wind (vectors) , TC center (pink dot) and vitals (lower left), inner grid positions (black boxes)

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

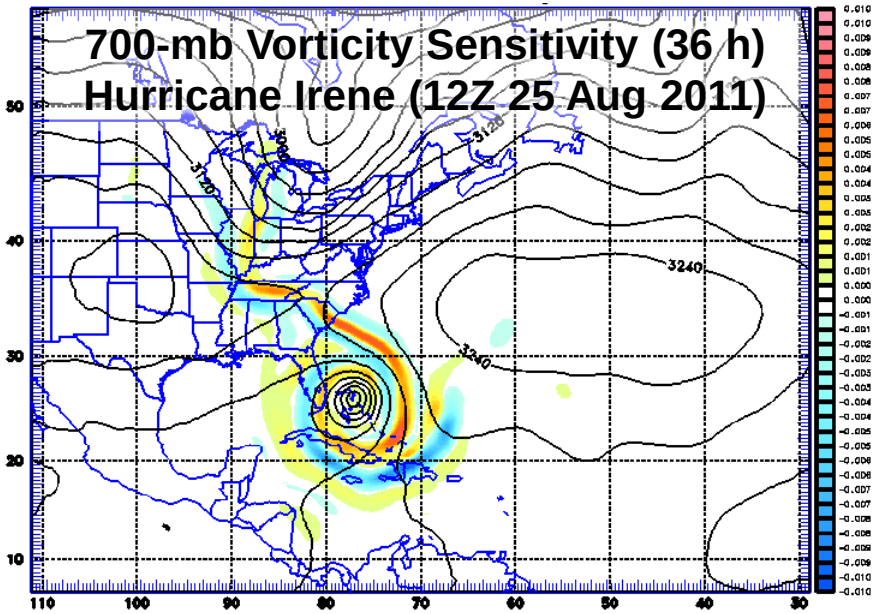
$$\frac{\partial J}{\partial \mathbf{x}(t_0)} = \mathbf{M}^T \frac{\partial J}{\partial \mathbf{x}(t_n)}$$

COAMPS-TC Adjoint

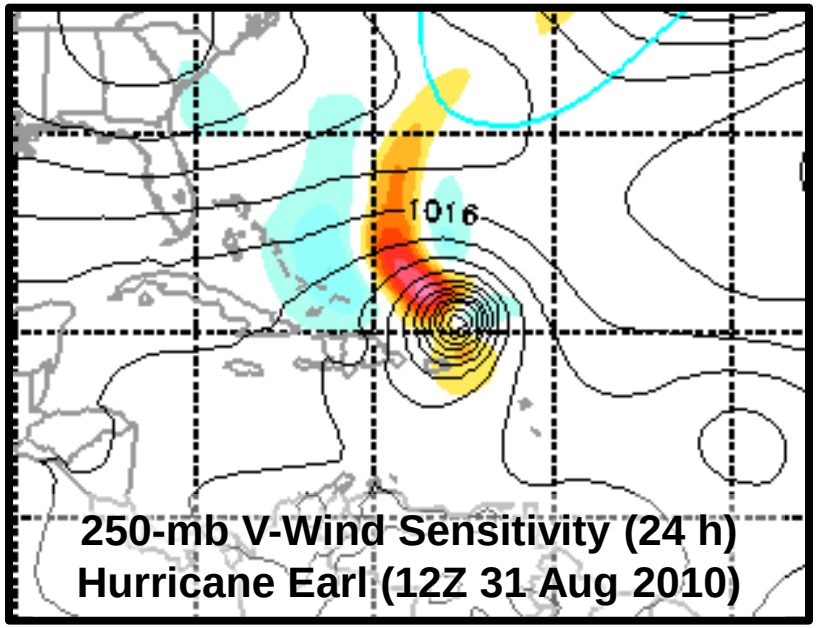
Dynamics: Nonhydrostatic, nested

Physics: PBL, fluxes, microphysics, Kuo

J: Kinetic energy in box (~1 km)



700-mb Vorticity Sensitivity (36 h)
Hurricane Irene (12Z 25 Aug 2011)



250-mb V-Wind Sensitivity (24 h)
Hurricane Earl (12Z 31 Aug 2010)

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