

# NOGAPS Deterministic Forecast Setup

- Navy Operational Global Atmospheric Prediction System (Hogan and Rosmond 1991, Peng et al. 2004)
- T239L30 resolution
- Run off 00Z and 12Z analysis (twice daily) to seven days
- NRL Atmospheric Variational Data Assimilation System (Daley and Barker 1991) 3DVAR

## NOGAPS Deterministic Forecast Products

- Gif images of many fields available on EOL TPARC/TCS-08 catalogue
- Reanalysis and data denial experiments at T239L42 with NAVDAS-AR (4DVAR, Xu and Rosmond 2004) currently ongoing at NRL

# NOGAPS Experimental Ensemble Setup

- Navy Operational Global Atmospheric Prediction System (Hogan and Rosmond 1991, Peng et al. 2004)
- T119L30 10-day forecasts
- 32 Members + control
- Run off 00Z analysis only (once daily)
- Ensemble Transform initial perturbations (McLay et al. 2008) using analysis error variance estimates from NRL Atmospheric Variational Data Assimilation System (NAVDAS) 3DVAR
- No accounting for model error in ensemble design. Post-time run of ensembles with stochastic convection (Teixeira and Reynolds 2008, Reynolds et al. 2008) used for research on TC genesis prediction (with Snyder and Pu, Univ. of Utah)
- We know that the ensembles are under-dispersive in the tropics.
- No special TC-focused perturbations

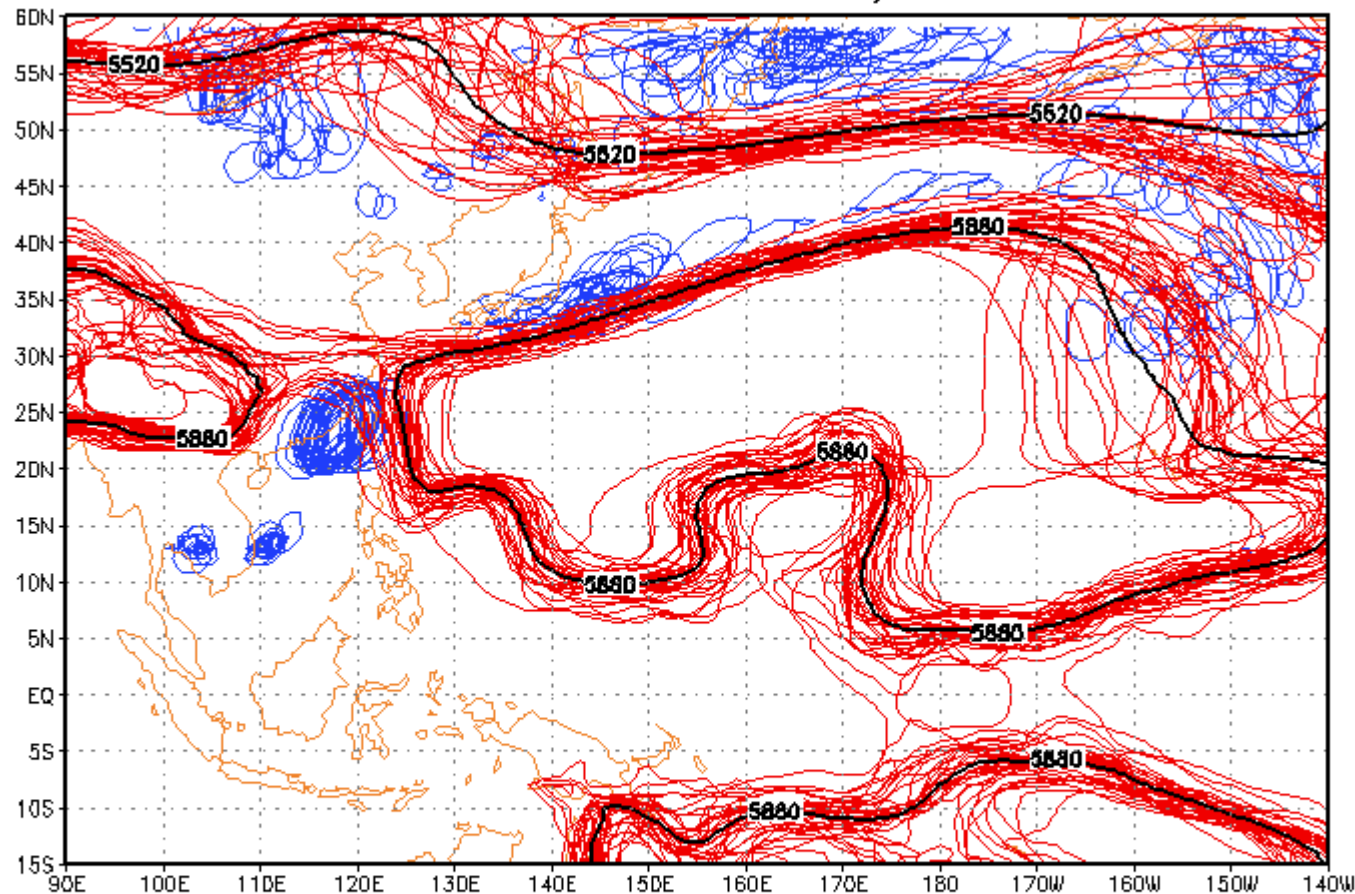
# NOGAPS Experimental Ensemble Products

- Gif images available on EOL TPARC/TCS-08 catalog
- Subset of digital data archived at NAVO MSRC HPC
- Most products available for full experimental time period
- Products include
  - Spaghetti plots of SLP, 500-hPa Z, and 850-hPa vorticity every 12 hours
  - Stamp plots (SLP, 500-hPa, 850-hPa vorticity)
  - Time-longitude plots of 500-hPa Z and 200-hPa V
  - Probability plots of low shear and large vorticity
  - Okubo Weiss from control forecast with ensemble spread
  - 500-hPa height with ensemble spread

# NOGAPS Experimental Ensemble Products

## 500-hPa Z and 850-hPa Vorticity Spaghetti Plot

EXPERIMENTAL NOGAPS ENSEMBLE: ET W/O STOCHASTIC CUMULUS

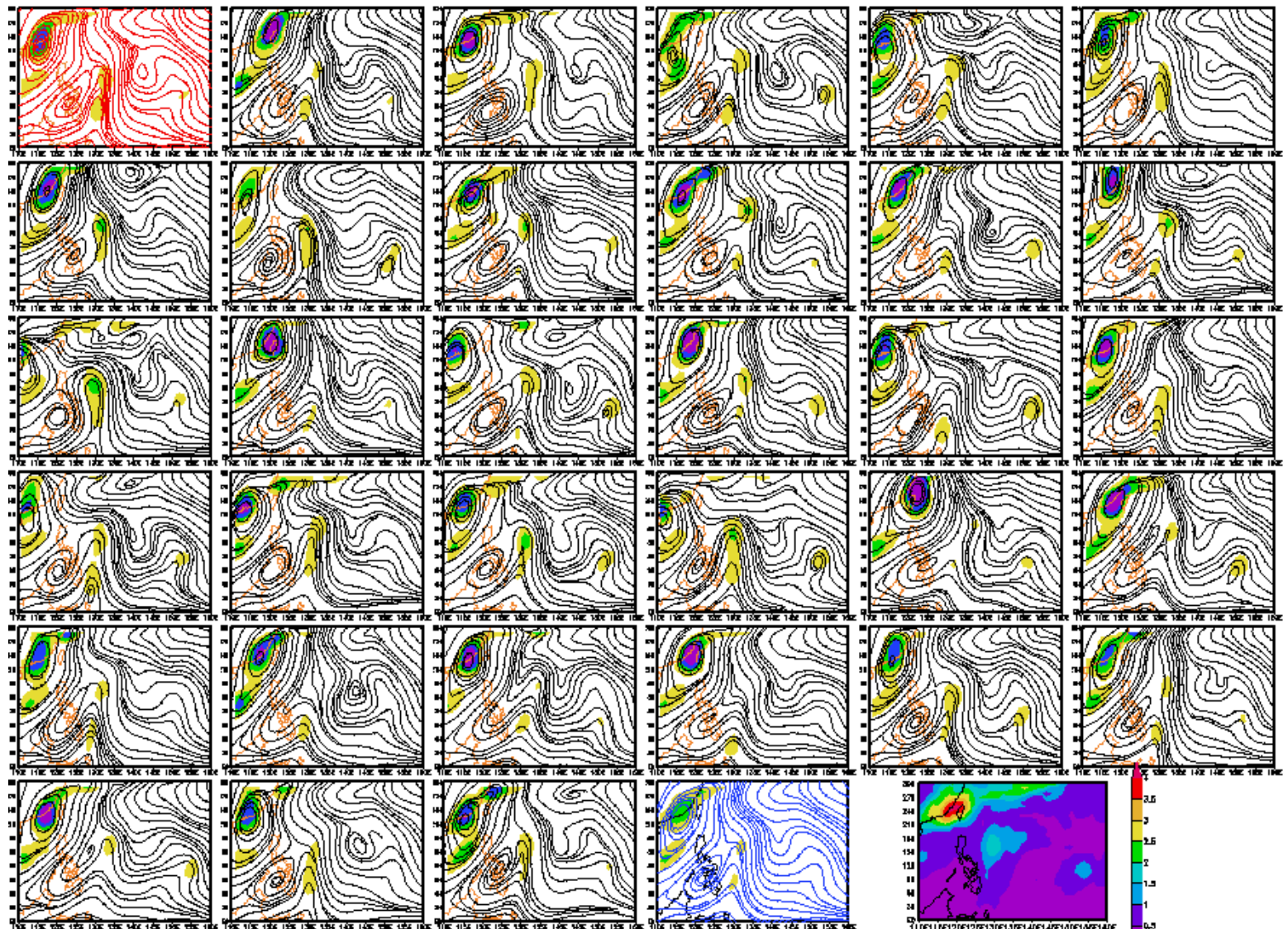


096hr FORECAST FROM 2008092600, valid 2008093000

850-Vor Members, blue, (at  $5 \times 10^{-5}$  c.i.), 500-hPa Z (red)

# NOGAPS Experimental Ensemble Products

## Vorticity Stamp Plot with Ensemble Spread (lower right)

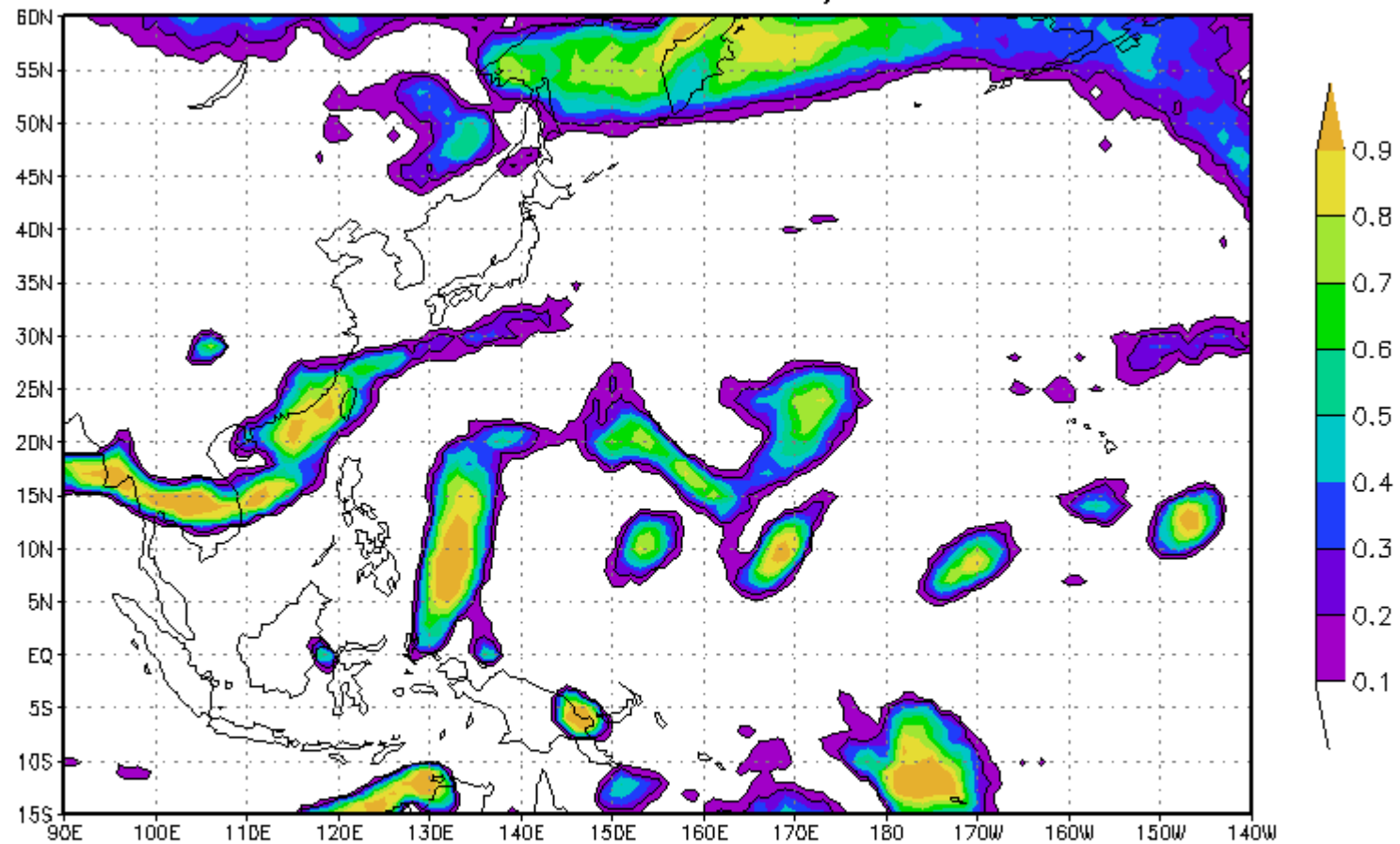


EXP NOGAPS ENS; ET W/O STOCHASTIC CONV; 120hr FORECAST FROM 2008092600, valid 2008100100  
850 streamlines and vor at 2(yellow), 4(green), 6(blue), and 8(purple)\*1e-5; Control member upper left  
CTL (red strmlines); Ens Mean (blue strmlines); Ens STDV of Vor (shaded)

# NOGAPS Experimental Ensemble Products

## Fraction of ensemble with low shear and high vorticity

EXPERIMENTAL NOGAPS ENSEMBLE: ET W/O STOCHASTIC CUMULUS



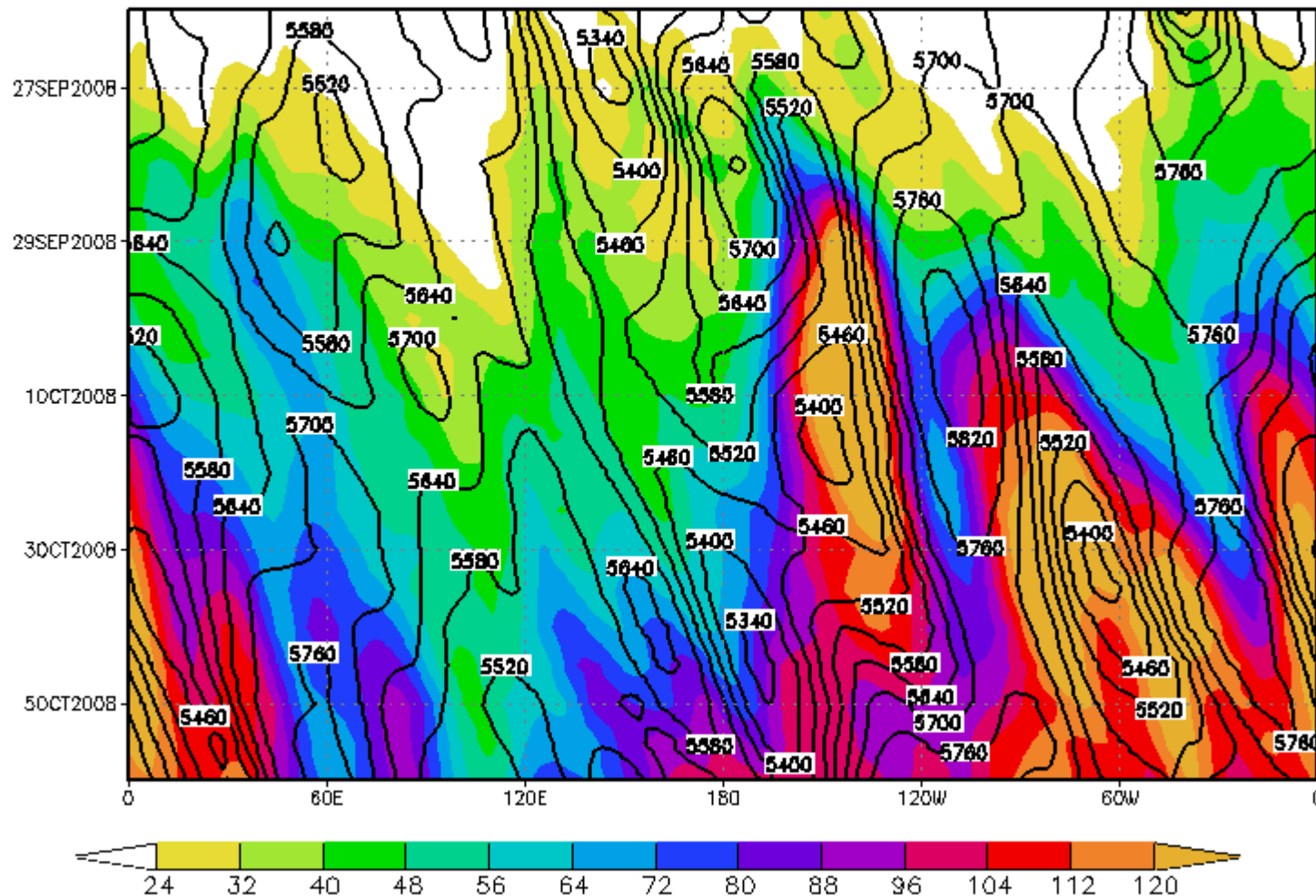
096hr FORECAST FROM 2008092600, valid 2008093000

FRACTION with 850 VOR  $> 1e-5$  and 200-850 SHEAR  $< 15\text{m/s}$

# NOGAPS Experimental Ensemble Products

## 500-hPa Z Time-Longitude Diagram

EXP NOGAPS ENS; ET W/O STOCHASTIC CONV  
000hr FORECAST FROM 2008092600  
35–60N 500 Z Ens. Stdv (shaded); Ctl member (contour)



# NOGAPS Singular Vector Setup

- Navy Operational Global Atmospheric Prediction System (Hogan and Rosmond 1991, Peng et al 2004)
- T79 Dry TLM and Adjoint calculations off of T239 operational forecast trajectory (Rosmond 1997, Peng and Reynolds 2006, Majumdar et al. 2007, Reynolds et al. 2008, Wu et al. 2009)
- 3 SVs using total energy metric
- 5 fixed regions twice daily,
- Usually 48-h optimization time, with 48-h lead time off 00Z run and 60-h lead time off 12Z run (longer optimization time for North Central Pacific region)
- Shorter lead-time SVs available during high-interest periods

# NOGAPS Singular Vector Products

- Gif images available on EOL TPARC/TCS-08 catalog, NRL TCS-08 web site, and Preview site.
- Digital data archived at NAVO MSRC HPC
- Most products available for full experimental time period
- Products include
  - Vertically-integrated SV total energy at initial (observation) time, with 500-hPa streamlines and 850-hPa vorticity of background flow, along with verification box.
  - Vertically-integrated SV total energy at final (verification) time
  - Summary plots of location and altitude layer of strongest temperature and vorticity sensitivity
  - Daily (almost) NOGAPS targeting blog on EOL TPARC/TCS-08 catalog

# NOGAPS SVs: 5 Fixed Regions, Twice Daily

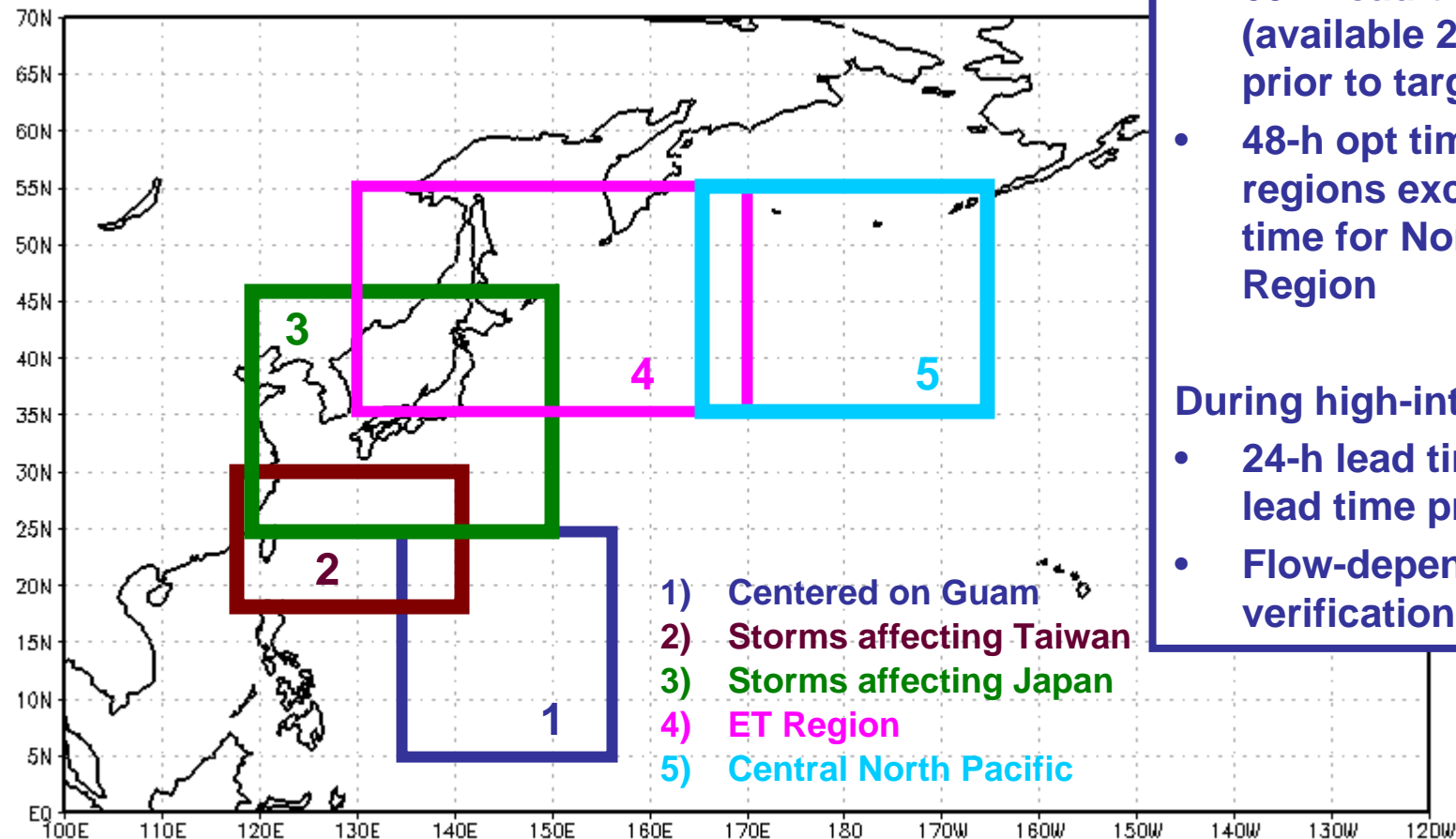
- T79L30 adjoint/TLM resolution
- T239L30 (operational) trajectory
- Dry Total Energy norm

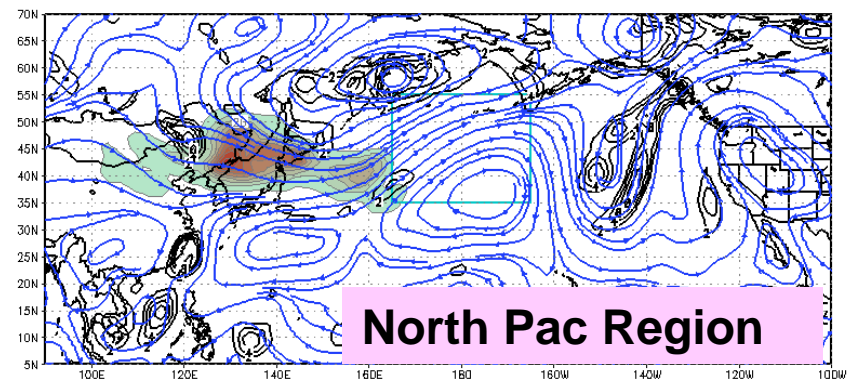
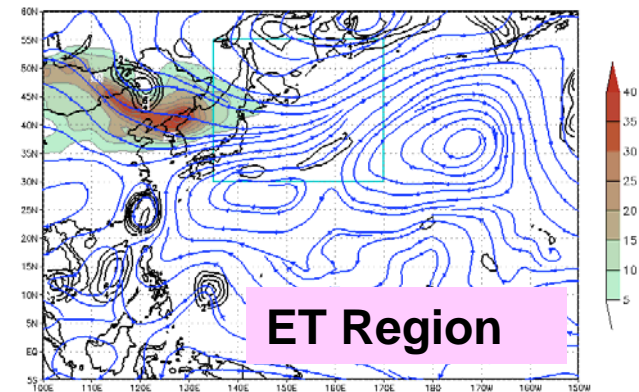
## Details:

- 48-h lead-time off 00Z run (available 09 UTC, 39-h prior to target time)
- 60-h lead-time off 12Z run (available 21 UTC, 51-h prior to target time)
- 48-h opt times for all regions except 72-h opt time for North Pacific Region

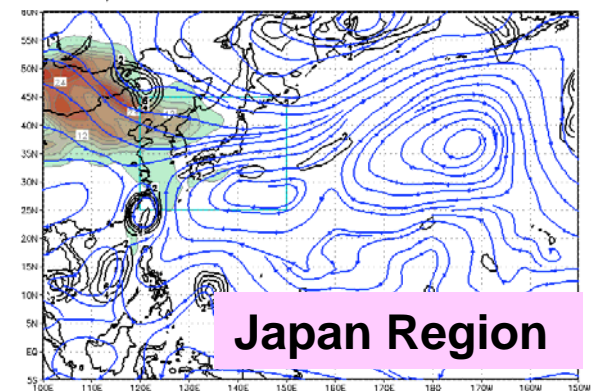
## During high-interest periods:

- 24-h lead time and 36-h lead time products
- Flow-dependent verification regions



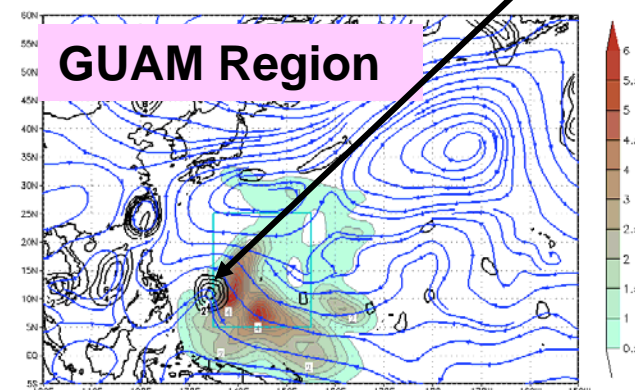
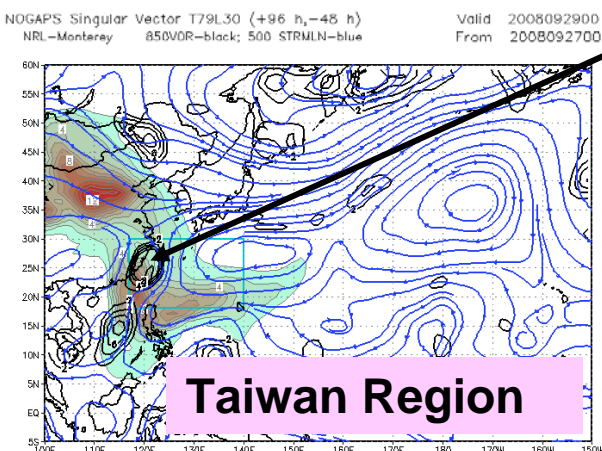


**NOGAPS SV Examples for Targets on 2008092900:**  
SV total energy (shaded) with 500-hPa streamlines (blue) and 850-hPa vorticity (black).



TC Jangmi

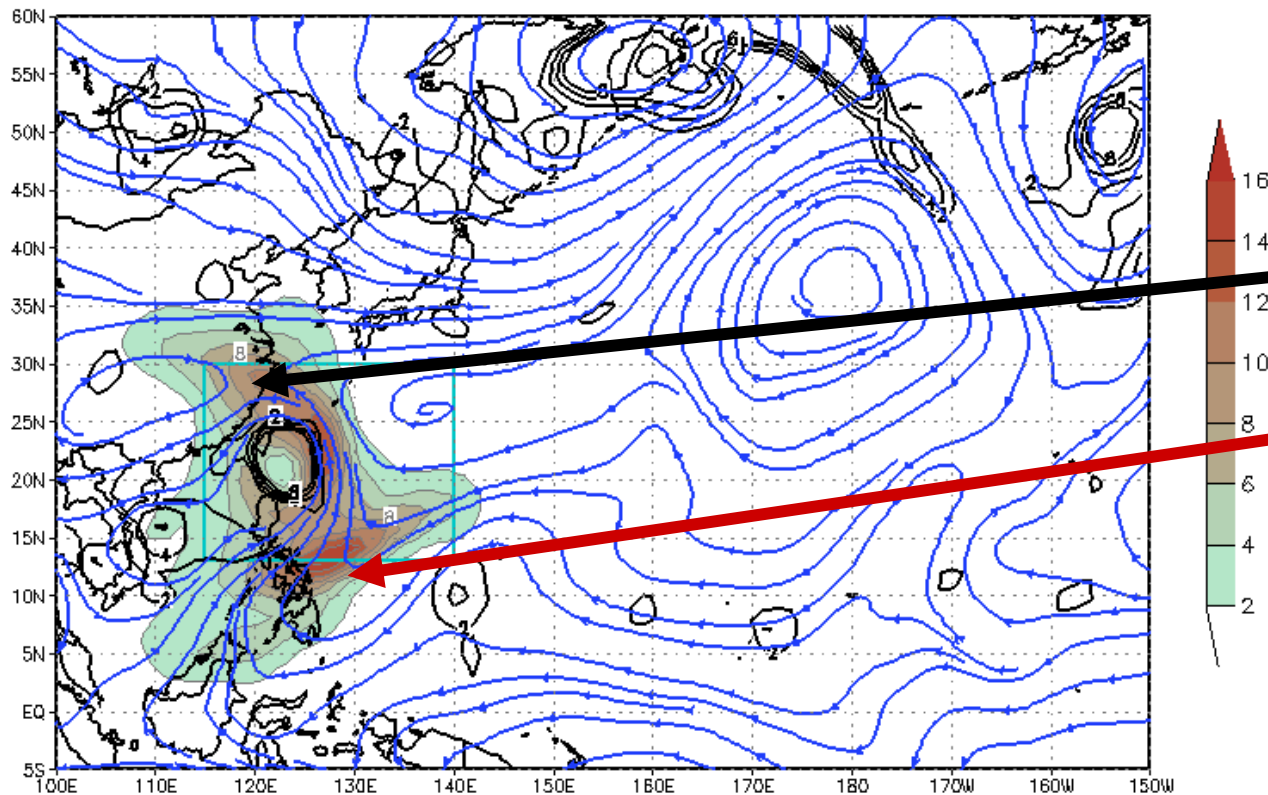
Pre-TC Higos



# NOGAPS SVs for Jangmi (2008092800)

500-hPa streamlines help relate sensitivity to steering dynamics

Singular Vector Sensitivity Summary  
SVs 1– 3 Vertically Integrated Sensitivity( $10^2 \text{ Jkg}^{-1}$ )



SVs related to TC dynamics.

Associated with weakness in the ridge on the north side of storm and peripheral high to southeast of storm.

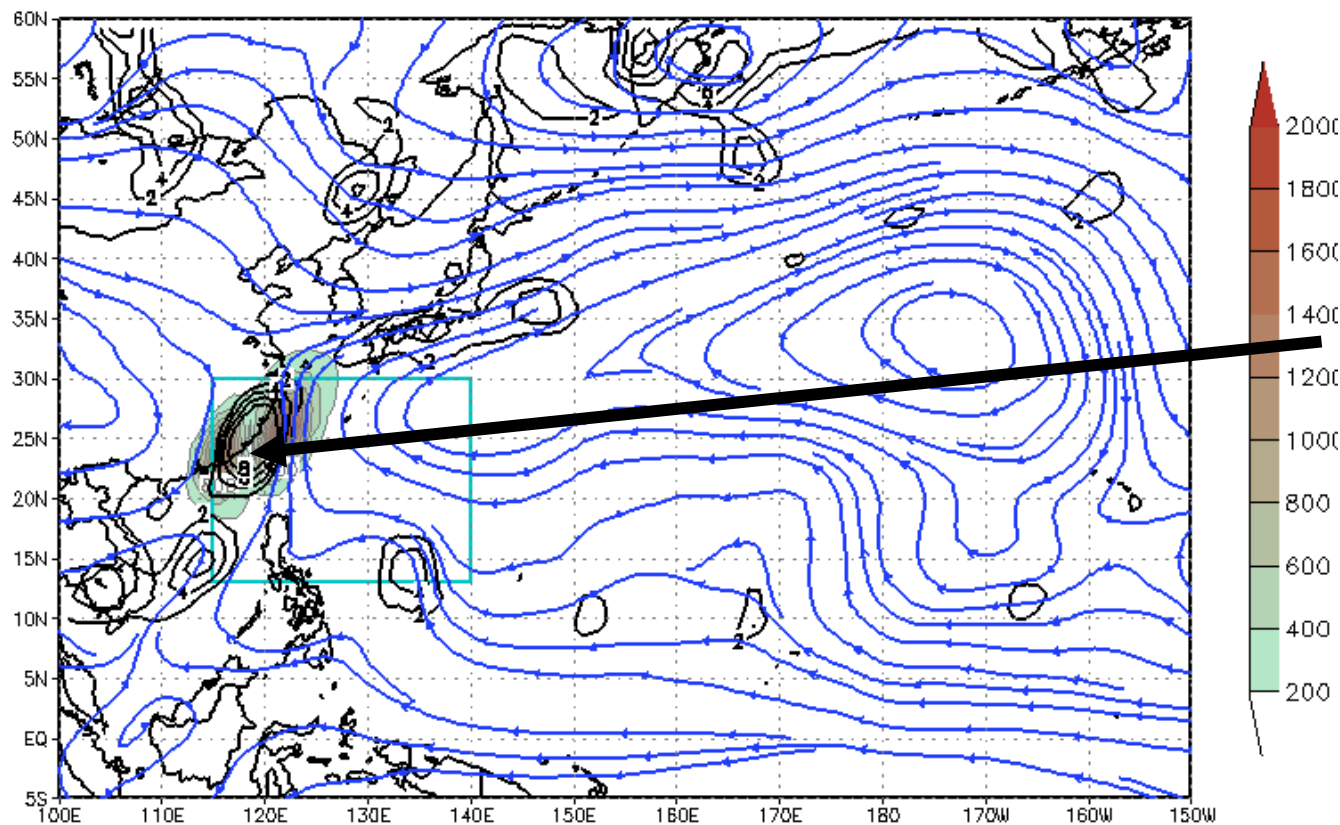
NOGAPS Singular Vector T79L30 (+96 h, -48 h)  
NRL-Monterey 850VDR-black; 500 STRMLN-blue

Valid 2008092800  
From 2008092600

# NOGAPS SVs for Jangmi (2008092800)

## Final-time SVs confirm relevance to storm

Singular Vector Sensitivity Summary  
SVs 1– 3 Vertically Integrated Sensitivity( $10^2 \text{ Jkg}^{-1}$ )



**Final-time SVs indicate uncertainty in the position of the storm in the the northeast-southwest direction.**

NOGAPS Singular Vector T79L30 (+96 h, -48 h)  
NRL-Monterey 850VDR-black; 500 STRMLN-blue

Valid 2008093000  
From 2008092600

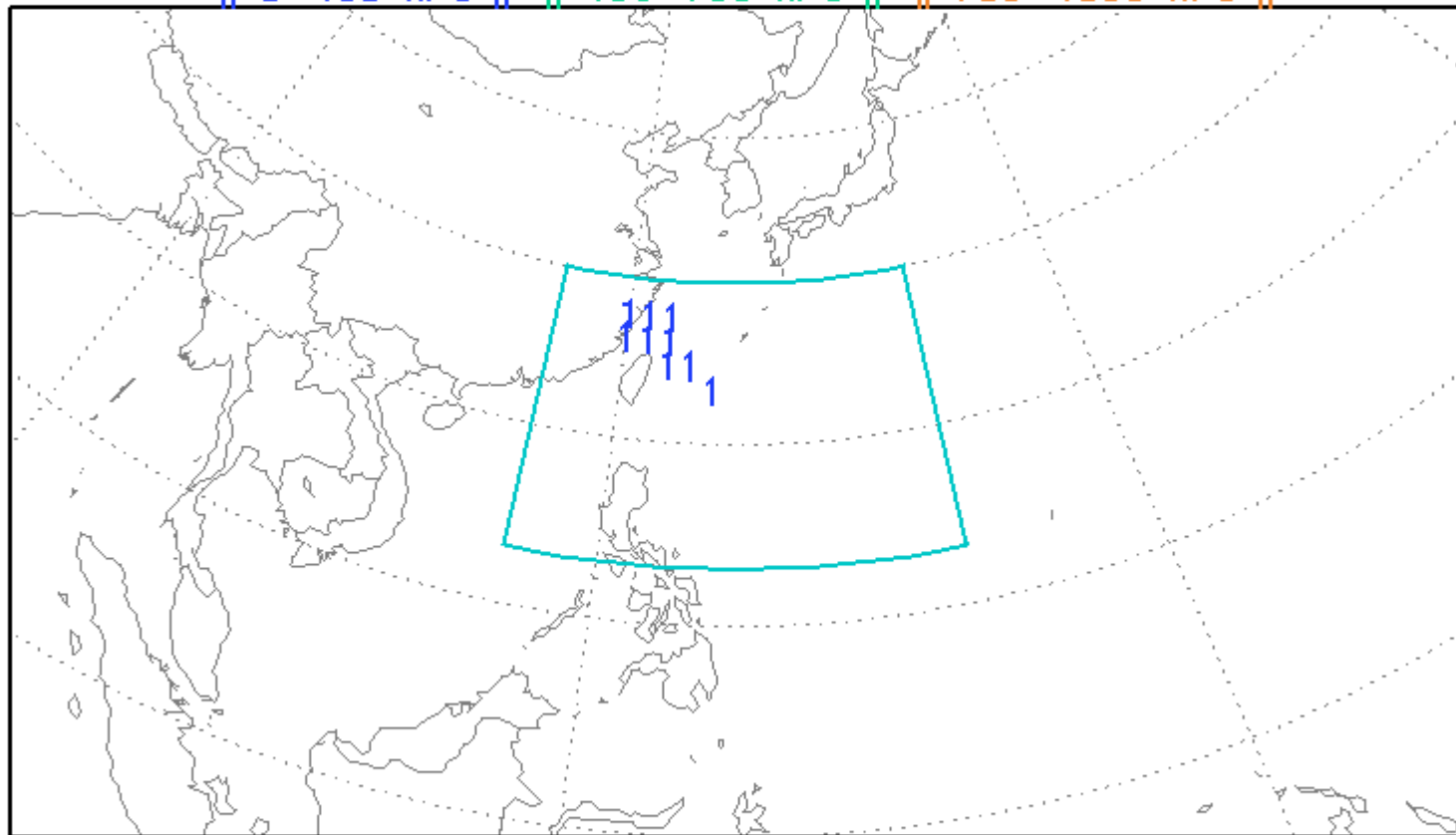
# NOGAPS Singular Vector Products

## Temperature Summary Plot

### TARGET AREAS OF MAXIMUM TEMPERATURE SENSITIVITY

- \* Value Indicates Singular Vector Number
- \* Color Indicates Pressure Layer of Max Sensitivity

|| 0-400 hPa || || 400-700 hPa || || 700-1000 hPa ||



NOGAPS Singular Vector T79L30 (+96 h,-48  
NRL-Monterey/FNMOC

Valid 2008092800  
From 2008092600

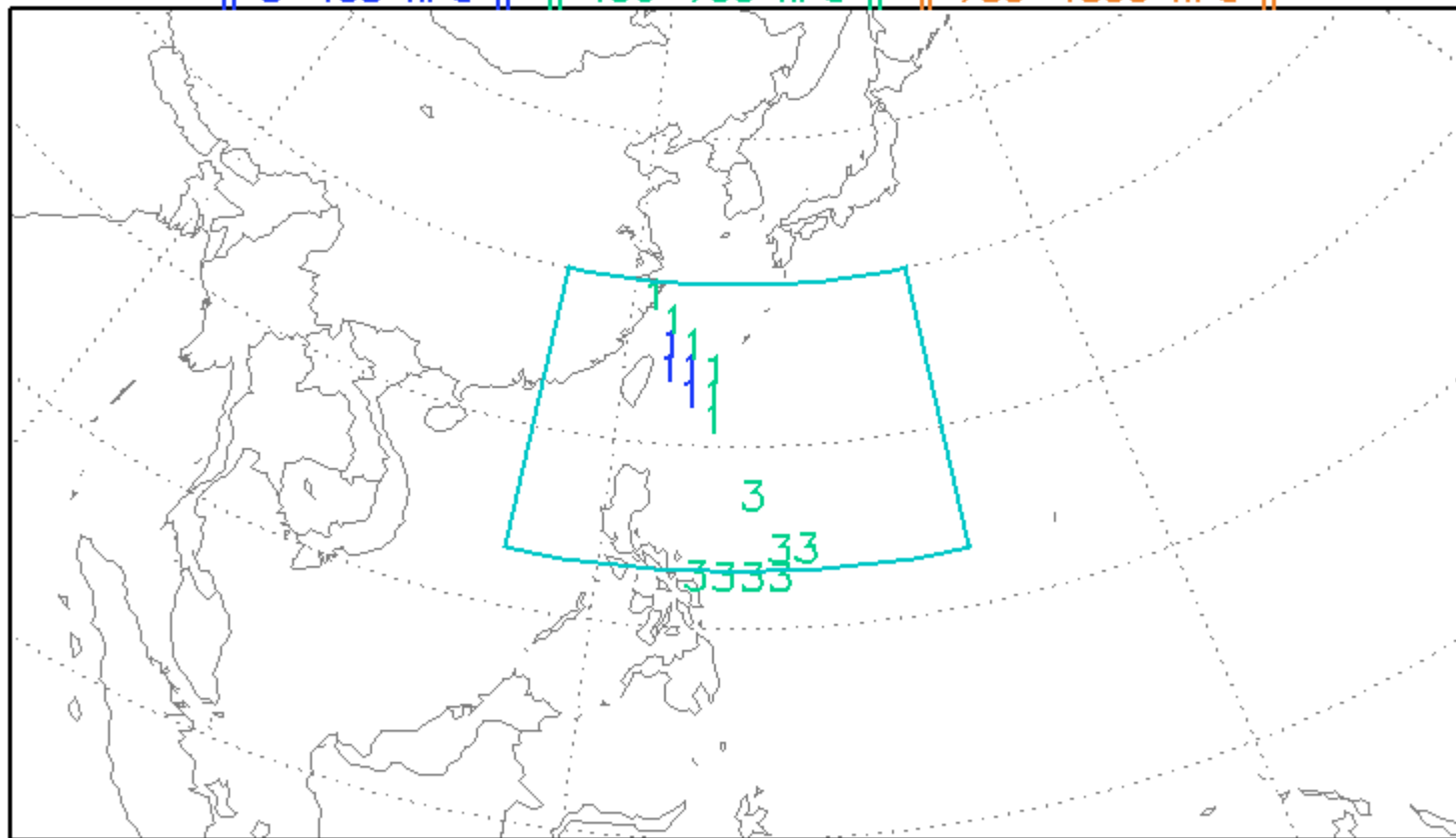
# NOGAPS Singular Vector Products

## Vorticity Summary Plot

TARGET AREAS OF MAXIMUM VORTICITY SENSITIVITY

- \* Value Indicates Singular Vector Number
- \* Color Indicates Pressure Layer of Max Sensitivity

|| 0-400 hPa || || 400-700 hPa || || 700-1000 hPa ||



NOGAPS Singular Vector T79L30 (+96 h,-48  
NRL-Monterey/FNMOC

Valid 2008092800  
From 2008092600