Typhoon Sinlaku during T-PARC: Sensitivity of Re-intensification and Downstream Development to the Track Following RecurvATURE

Patrick A. Harr, Elizabeth R. Sanabia, and Andrew B. Penny
Naval Postgraduate School
TY Sinlaku T-PARC/TCS-08 aircraft sampling strategy including forward deployment (9-21 Sept 2008)
Tropical Cyclone Intensity/Structure Changes, Extratropical Transition, and Downstream Impacts

TY Sinlaku recurves to move east-northeast under strong westerly shear
Despite the strong shear, Sinlaku re-intensified to typhoon strength.
Predictability Challenges during the ET of TY Sinlaku

- Compare forecast and analyzed impacts of the ET on NH midlatitudes
- Identify sources of variability downstream of the ET
- Examine physical characteristics of the TC relative to reduced predictability
Extratropical Transition as part of the TC Lifecycle

Figure adapted from Klein et al. (2000); TY Man-yi track courtesy Digital Typhoon: http://agora.ex.nii.ac.jp/digital-typhoon/summary/wnp/s/200704.html.en
Downstream Development in the context of a local Eddy Kinetic Energy (EKE) Analysis

The decaying tropical cyclone provides an additional source of EKE that continues to feed the downstream development process.

(after Orlanski and Sheldon 1995)
GFS 1200 UTC 16 Sep EKE Forecast and Analysis by Area

Date (ddhh): 1500, 1512, 1600, 1612, 1700, 1712, 1800, 1812, 1900, 1912, 2000, 2012, 2100, 2112, 2200, 2212, 2300, 2312, 2400, 2412, 2500

EKE (10^17 J): 0, 5, 10, 15, 20, 25, 30, 35, 40

Areas:
- WPAC
- CPAC
- EPAC

Max values:
- WPAC Max
- CPAC Max
- EPAC Max

Legend:
- WPAC ANL
- CPAC ANL
- EPAC ANL
- GFS WPAC 1612
- GFS CPAC 1612
- GFS EPAC 1612
Diagnosing Downstream Development through the downstream propagation of EKE following the TC-midlatitude interaction

EXAMPLE: GFS Forecast
AT: 1200 UTC 16 Sep 08

GFS 1200 UTC 16 Sep EKE Forecast and Analysis by Area

Date (ddhh)
WPAC  CPAC  EPAC
GFS Analysis indicates minimal downstream development

1200 UTC 16 Sep 08
GFS Forecast from 1612 at time of max CPAC EKE
ECMWF Forecast from 1612 at time of max CPAC EKE
ECMWF Forecasts EKE CPAC Region

Date (ddhh)

EKE (10^17 J)

CPAC 1500
Cpacs 1512
Cpac 1600
Cpac 1612
Cpac 1700
Cpac 1712
Cpac 1800
Cpac 1812
ANALYSIS
Post-recurviture Sinlaku

Tropical Transformation Extratropical

SLP (mb)

Step 1 Step 2 Step 3 End ET

Time (h)

16 Sep / 1800 UTC

17 Sep / 0200 UTC

18 Sep / 0200 UTC
Highest wind speed = 67% of the individual forecasts were in the top 25% of the wind speed value

Lowest wind speed = 67% of the individual forecasts were in the lowest 25% of the wind speed value
Summary

• **RESULTS:**
  
  – REDUCED PREDICTABILITY FOLLOWING THE RECURVATURE OF TYPHOON SINLAKU
    
    • **TRANSFORMATION STAGE:** Weakening of the tropical cyclone; rapid re-intensification in the subtropics.
    • **EXTRATROPICAL STAGE:** False alarms in multiple forecasts from 3 global models

  – **REDEVELOPMENT OF TY SINLAKU WAS CRITICAL TO ET:** Redevelopment of TY Sinlaku SW of Japan as a warm core tropical system enabled the dissipating system to reach the midlatitudes and begin extratropical transition east of Japan.

  – GREATEST VARIABILITY/ERRORS IN FORECAST DD IN THE CENTRAL NORTH PACIFIC
    
    • Over-forecast TC during the extratropical stage over the western North Pacific
    • Excess EKE propagation from the western North Pacific

• **CURRENT WORK:**

  – Sensitivity of DD to Track using the ensemble members
  – Mechanisms by which Sinlaku re-intensified
  – INVESTIGATE SENSITIVITIES OF THE DD TO THE RE-INTENSIFICATION OF THE TC
    
    • Identify mechanisms that were poorly forecast resulting in false reintensification and DD:
      
      – Vertical wind shear, upper-level outflow, diabatic influences, upstream trough, etc.
    • Detailed analysis of aircraft and ELDORA radar data

  – **WRF SIMULATIONS WITH AND WITHOUT SINLAKU**
Acknowledgments:
Funding agencies in Germany, U.K., France, South Korea, Canada, Japan, Taiwan, and the U.S.
WMO/WWRP/THORPEX
WMO/WWRP/TMRP
Many Operators, PIs, Students.