Chun-Chieh Wu (吳俊傑)

2014/08

Department of Atmospheric Sciences, National Taiwan University
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Date of Birth: 30 July, 1964

Education:

Graduate: Massachusetts Institute of Technology, Ph.D., Department of Earth Atmospheric, and Planetary Sciences, May 1993

Thesis under the supervision of Professor Kerry A. Emanuel on "Understanding hurricane movement using potential vorticity: A numerical model and an observational study."

Undergraduate: National Taiwan University, B.S., Department of Atmospheric Sciences, June 1986

Recent Positions:

Associate Dean

College of Science, National Taiwan University

November 2013 to present

Distinguished Professor

Department of Atmospheric Sciences, National Taiwan University

August 2009 to present

Distinguished Professor and Chairman

Department of Atmospheric Sciences, National Taiwan University

August 2009 to July 2014

President
Atmospheric Science Section, Asia Oceania Geosciences Society
August 2009 to July 2013

Professor and Chairman
Department of Atmospheric Sciences, National Taiwan University
August 2008 to July 2009

Director
NTU Typhoon Research Center
January 2009 to present

Adjunct Research Scientist
Lamont-Doherty Earth Observatory, Columbia University
July 2004 - present

Professor
Department of Atmospheric Sciences, National Taiwan University
August 2000 to 2008

Visiting Fellow
Geophysical Fluid Dynamics Laboratory, Princeton University
January – July, 2004 (on sabbatical leave from NTU)

Associate Professor
Department of Atmospheric Sciences, National Taiwan University
August 1994 to July 2000

Visiting Research Scientist
Geophysical Fluid Dynamics Laboratory, Princeton University
August 1993 – November 1994; July to September 1995

Honor and Awards:

Editor's Award for the Journal of the Atmospheric Sciences, American Meteorological Society (AMS), 2014

The Academic Award, Ministry of Education Republic of China (Taiwan), 2013

Science Vanguard Research Program, National Science Council (NSC)

2013~2017

Fellow, Meteorological Society of ROC (Taiwan), 2013

「New 100 Glories of Taiwan」, **"**Global Views Monthly" magazine, 2010

「50 Scientific Achievements」, National Science Council (NSC) 50th Anniversary, 2009

Gold Bookmarker Prize

Wu Ta-You Popular Science Book Prize in Translation
Wu Ta-You Foundation, 2008

Outstanding Teaching Award, National Taiwan University, 2008

Outstanding Scholar Research Program, National Science Council, 2009

Outstanding Research Award, National Science Council, (three times: 2007, 2009, 2012)

Research Achievement Award, National Taiwan Univ., 2004

University Teaching Award, National Taiwan University, 2003, 2005, 2006

Academia Sinica Research Award for Junior Researchers, 2001

Memberships:

Member of the American Meteorological Society.
Member of the American Geophysical Union.
Member of AOGS
Member of the Chinese Meteorological Society (Taiwan).
Member of the Chinese Geoscience Union (Taiwan).

Professional Services:

Assistant Secretary General, Asia Oceania Geosciences Society (AOGS), 2013/08 – present
Editor, Journal of the Atmospheric Sciences (JAS) – American Meteorological Society (AMS), 2013/07 - present

Vice President, Meteorological Society of ROC (Taiwan), 2013/03 - present

Member, Committee on Tropical Meteorology and Tropical Cyclones, American Meteorological Society, 2012/01 – present

Associate Editor, Asia-Pacific Journal of Atmospheric Sciences, 2011/11 — 2013/12

President, Atmospheric Science Section, Asia Oceania Geosciences Society (AOGS), 2009/08 – 2013/07

Editor-in-Chief, Terrestrial, Atmospheric and Oceanic Sciences, 2009/08 – 2012/07

Advisory committee member, Atmos. Sci., Div. of Natural Sciences, National Science Council, Taiwan, 2008/01 – 2010/12

Chairman, Panel committee, Atmos. Sci., Div. of Natural Sciences, National Science Council, Taiwan, 2005/01 –2007/12

Principal Investigator, Priority Typhoon Research Project (including the DOTSTAR program, 追風計畫) National Science Council, Taiwan, 2002/08 – 2008/07

Editor, Terrestrial, Atmospheric, and Oceanic Sciences (an SCI journal), Chinese Geoscience Union, 2005/08 — 2009/07

Member of the Council, Meteorological Society of ROC, 2007/03 – present

Associate Editor, Terrestrial, Atmospheric, and Oceanic Sciences (SCI), Chinese Geoscience Union, 2004/12 – 2005/07

Chief Editor, Atmospheric Sciences, Meteorological Society of ROC, 2002/01 – 2003/12

Associate Editor, Monthly Weather Review, American Meteorological Society, 2002/01 – 2003/01

Managing Editor, Terrestrial, Atmospheric, and Oceanic Sciences (SCI), Chinese Geoscience Union, 1997/06 – 2003/12

Panel committee member, Atmos. Sci., Div. of Natural Sciences, National Science Council, Taiwan, 2002/01 – 2004/12

Referee of journals (*J. Atmos. Sci., Mon. Wea. Rev.,J. Climate, JGR, GRL, Tellus, …*)

Publication List (up to 2014/11):

(A) Refereed Publications (▲: number of citation ; IF : Impact Factor)

Career publications in SCI Journals

Number of published papers: 75

Total citations: 2121

Average Citations per paper: 28.28

H-Index: 26

90. Ko D.-S.*, S.-Y. Chao, C.-C. Wu, and I.-I. Lin, 2014: Impacts of Typhoon Megi (2010) on the South China Sea. *J. Geophys. Res.* 1-16.doi: 10.1002/2013JC009785.

89. Montgomery, T. M., S. F. Abarca, R. K. Smith, C.-C. Wu, and Y.-H. Huang, 2014: Comments on: How does the boundary layer contribute to eyewall replacement cycles in axisymmetric tropical cyclones? by J. D. Kepert. *J. Atmos. Sci.* (accepted)

88. D'Asaro, E. A., P. G. Black, L. R. Centurioni, Y.-T. Chang, S. S. Chen, R. C. Foster, H. C. Graber, P. Harr, V. Hormann, R.-C. Lien, I.-I. Lin, T. B. Sanford, T.-Y. Tang, and C.-C. Wu, 2014: Impact of Typhoons on the Ocean in the Pacific: ITOP. *Bull. Amer. Meteor. Soc.* 1405-1418. DOI:10.1175/ BAMS-D-12-00104.1

87. Choi, K.S., C.-C. Wu*, and Y. Wang, 2014: Seasonal prediction for tropical cyclone frequency around Taiwan using teleconnection patterns. Theor. Appl Climatol. 1-14. DOI 10.1007/s00704-013-0954-5. (SCI, IF=1.759)

86. Cohn, S. A., Terry H., P. Cocquerez, J. Wang, F. Rabier, D. Parsons, P. Harr, C.-C. Wu, P. Drobinski, F. Karbou , S. Vénel, A. Vargas, N. Fourrié, N. Saint-Ramond, V. Guidard , A. Doerenbecher, H.-H. Hsu, P.-H. Lin, M.-D. Chou, J.-L. Redelsperger, C. Martin, J. Fox, N. Potts, K. Young, and H. Cole, 2013: Driftsondes: Providing in-situ long-duration dropsonde observations over remote regions. *Bull. Amer. Meteor. Soc.* 1661-1674. (SCI, ▲: 1; IF=6.026)

85. Chou, K.-H.*, C.-C. Wu, and S.-Z. Lin, 2013: Assessment of the ASCAT wind error characteristics by global dropwindsonde observations. J. Geophys. Res., 118, 9011–9021, doi:10.1002/jgrd.50724, 2013. (SCI, ▲: 2; IF=3.082)

84. Lin, I.-I.*, P. Black, J. F. Price, C.-Y. Yang, S. S. Chen, C.-C. Lien, P. Harr, N.-H. Chi, C.-C. Wu, and E. A. D'Asaro, 2013: An ocean coupling potential intensity index for tropical cyclones. *Geophys. Res. Lett.*, **40**, 1878-1882, doi:10.1002/grl.50091. (SCI, ▲: 8; IF=3.204)

83. Wu, C.-C.*, S.-G. Chen,, S.-C. Lin, T.-H. Yen, and T.-C. Chen, 2013: Uncertainty and predictability of tropical cyclone rainfall based on ensemble simulations of Typhoon Sinlaku (2008). *Mon. Wea. Rev.* **141**, 3517-3538. (SCI, IF=2.238)

82. Ito, K., and C.-C. Wu*, 2013: Typhoon-position-oriented sensitivity analysis. Part I: Theory and verification. *J. Atmos. Sci.* **70**, 2525-2546. (SCI, IF=2.911)

81. Wu, C.-C. *, 2013: Typhoon Morakot (2009): Key findings from the Journal TAO for improving prediction of extreme rains at landfall. *Bull. Amer. Meteor. Soc.* 94, 155-160. DOI:10.1175/BAMS -D-11-00155.1 (SCI, IF=6.026) (SCI, ▲: 5; IF=6.026)

80. Huang, S.-M., R.-R. Hsu, L.-J. Lee, H.-T. Su, C.-L. Kuo, C.-C. Wu, J.-K. Chou, S.-C. Chang, Y.-J. Wu, and A. B. Chen*, 2012: Optical and radio signatures of negative gigantic jets – cases from Typhoon Lionrock (2010). *J. Geophys. Res***., 117**, A08307, Doi:10.1029/2012JA017600 (SCI, ▲: 1; IF=3.021)

79. Wu, C.-C.*, S.-G. Chen, C.-C. Yang, P.-H. Lin, and S. D. Aberson, 2012: Potential vorticity diagnosis of the factors affecting the track of Typhoon Sinlaku (2008) and the impact from dropwindsonde data during T-PARC. *Mon. Wea. Rev.*, **140**, 2670-2688. (SCI, ▲: 5; IF=2.238)

78. Kim, J.-H.*, C.-C. Wu, C.-H. Sui, and C.-H. Ho, 2012: Tropical cyclone contribution to interdecadal change in summer rainfall over South China in the early 1990s. Terr. Atmos. Ocean. Sci., 23, 49-58. doi: 10.3319/TAO.2011.08.26.01(A) (SCI, ▲: 2; IF=0.883)

77. Wu, C.-C.*, R. Zhan, Y. Lu, and Y. Wang, 2012: Internal variability of the dynamically downscaled tropical cyclone activity over the western North Pacific by the IPRC Regional Climate Model. *J. Climate*., **25**, 2104-2122. (SCI, ▲: 3; IF=4.097)

76. Choi, K.-S., C.-C. Wu, and H.-R. Byen*, 2012: Possible connection between summer tropical cyclone frequency and spring Arctic oscillation over East Asia. *Clim. Dynam.* **38,** 2613-2629. **(**SCI, ▲: 3; IF=4.602)

75. Jung, B.-J., H. M. Kim*, F. Zhang, and C.-C. Wu, 2012: Effect of targeted dropsonde observations and best track data on the track forecasts of Typhoon Sinlaku (2008) using an ensemble Kalman filter. *Tellus A.*, **64**, 1-19. doi: 10.3402/tellusa.v64i0.14984 (SCI, ▲: 6; IF=2.136)

74. Huang, Y.-H., M. T. Montgomery, and C.-C. Wu*, 2012: Concentric eyewall formation in Typhoon Sinlaku (2008) – Part II: Axisymmetric dynamical processes. *J. Atmos. Sci.*, **69**, 662-674. (SCI, ▲: 33; IF=2.911)

73. Wu, C.-C.*, Y.-H. Huang, and G.-Y. Lien, 2012: Concentric eyewall formation in Typhoon Sinlaku (2008) – Part I: Assimilation of T-PARC data based on the Ensemble Kalman Filter (EnKF). *Mon. Wea. Rev.*, **140**, 506-527. (SCI, ▲: 23; IF=2.238)

72. Wu, C.-C.*, and M.-J. Yang, 2011: Preface to the Special Issue on "Typhoon Morakot (2009): Observation, Modeling, and Forecasting". *Terr. Atmos. Ocean. Sci.*, **22**, 533-533, doi: 10.3319/TAO.2011.10.01.01 (TM). (SCI, ▲: 3; IF=0.883)

71. Tao, W.-K.*, J. J. Shi, P.-L. Lin, J. Chen, S. Lang, M.-Y. Chang, M.-J. Yang, C.-C. Wu, Christa P.L., C.-H. Sui, and Ben J.-D. Jou, 2011: High-resolution numerical simulation of the extreme rainfall associated with Typhoon Morakot. Part I: Comparing the impact of microphysics and PBL parameterizations with observations. *Terr. Atmos. Ocean. Sci*., **22**, 673-696. doi: 10.3319/ TAO.2011.08.26.01(TM) (SCI, ▲: 14; IF=0.883)

70. Liang, J., L. Wu*, X. Ge, and C.-C. Wu, 2011: Monsoonal influence on Typhoon Morakot (2009). Part II: Numerical study. *J. Atmos. Sci.*, **68**, 2222-2235. (SCI, ▲: 18; IF=2.911)

69. Wu, L.*, J. Liang, and C.-C. Wu, 2011: Monsoonal influence on Typhoon Morakot (2009). Part I: Observational analysis. *J. Atmos. Sci.*, **68**, 2208-2221. (SCI, ▲: 17; IF=2.911)

68. Choi, K.-S., C.-C. Wu*, and Y. Wang, 2011: Effect of ENSO on landfalling tropical cyclones over the Korean Peninsula. *Asia-Pac J. Atmos. Sci.* **47(3)**, 391-397. (SCI, ▲: 3; IF=0.42)

67. Lin, I-I*, M.-D. Chou, and C.-C. Wu, 2011: Warm ocean eddy's impact on Typhoon Morakot (2009) – A preliminary study from satellite observations and numerical modeling. *Terr. Atmos. Ocean. Sci*., **22**, 661-671. doi: 10.3319/ TAO.2011.08.19.01(TM) (SCI, ▲: 6; IF=0.883)

66. Yen, T.-H., C.-C. Wu*, G.-Y. Lien, 2011: Rainfall simulations of Typhoon Morakot with controlled translation speed based on EnKF data assimilation. *Terr. Atmos. Ocean. Sci*., **22**, 647-660. doi: 10.3319/ TAO.2011.07.05.01(TM) (SCI, ▲: 12; IF=0.883)

65. Zhan, R., Y. Wang*, and C.-C.Wu, 2011: Impact of SSTA in East Indian Ocean on the frequency of Northwest Pacific tropical cyclones: A regional atmospheric model study. *J. Climate*., **24**, 6227-6242. (SCI, ▲: 11; IF=4.097)

64. Lee, C.-S., C.-C. Wu, T.-C. Chen Wang, and R. L. Elsberry*, 2011: Advances in understanding the "Perfect monsoon-influenced typhoon": summary from international conference on Typhoon Morakot (2009). *Asia-Pac J Atmos Sci*. **47(3)**, 213-222. doi: 10.1007/s13143-011-0010-2. (SCI, ▲: 9; IF=0.42)

63. Chou, K.-H.*, C.-C.Wu, Y. Wang, and C.-H. Chih, 2011: Eyewall evolution of typhoons crossing the Philippines and Taiwan: An observational study. *Terr. Atmos. Ocean. Sci*., **22**, 533-548. doi: 10.3319/ TAO.2011.05.10.01(TM) (SCI, ▲: 3; IF=0.883)

62. Chou, K.-H., C.-C. Wu*, P.-H. Lin, S. D. Aberson, M. Weissmann, F. Harnisch, and T. Nakazawa, 2011: The impact of dropwindsonde observations on typhoon track forecasts in DOTSTAR and T-PARC. *Mon. Wea. Rev.* **139**, 1728–1743. (SCI, ▲: 28; IF=2.238)

61. Huang, Y.-H., C.-C. Wu*****, and Y. Wang, 2011: The influence of island topography on typhoon track deflection. *Mon. Wea. Rev.* **139**, 1708–1727. (SCI, ▲: 8; IF=2.238)

60. Chen, S.-G., C.-C. Wu*, J.-H. Chen, and K.-H. Chou, 2011: Validation and interpretation of Adjoint - Derived Sensitivity Steering Vector as targeted observation guidance. *Mon. Wea. Rev.* **139**, 1608–1625. (SCI, ▲: 3; IF=2.238)

59. Majumdar, S. J.*, S. -G. Chen, and C.-C. Wu, 2011: Characteristics of Ensemble Transform Kalman Filter adaptive sampling guidance for tropical cyclones. *Quart. J. Roy. Meteor. Soc.* **137**, 503-520. (SCI, ▲: 9; IF=2.522)

58. Weissmann M.*, F. Harnisch, C.-C. Wu, P.-H. Lin, Y. Ohta, K. Yamashita, Y.-K. Kim, E.-H. Jeon, T. Nakazawa, and S. Aberson, 2011: The influence of dropsondes on typhoon track and mid-latitude forecasts. *Mon. Wea. Rev*. **139**, 908-920. (SCI, ▲: 32; IF=2.238)

57. Wu, C.-C.*, C.-Y. Huang, M.-J. Yang, F.-C. Chien, J.-S. Hong, and T.-H. Yen 2010: Typhoon Morakot (2009) and a special review on the current status and future challenge of tropical cyclone simulation. *Atmos. Sci.* (in Chinese with an English abstract), **38**, 99-134.

56. Wu, C.-C.*****, G.-Y. Lien, J.-H. Chen, and F. Zhang, 2010: Assimilation of tropical cyclone track and structure based on the Ensemble Kalman Filter (EnKF). *J. Atmos. Sci.*, **67**, 3806-3822. (SCI, ▲: 23; IF=2.911)

55. Choi, K.-S., C.-C. Wu*, E.-C. Cha, 2010: Change of tropical cyclone activity by Pacific-Japan teleconnection pattern in the western North Pacific. *J. Geophys. Res.* **115**, D19114, doi:10.1029/2010JD013866. (SCI, ▲: 8; IF=3.082)

54. Lee, L.-J.*, A. B. Chen, S.-C. Chang, C.-L. Kuo, H.-T. Su, R.-R. Hsu, C.-C. Wu, P.-H. Lin, H. U. Frey, S. Mende, Y. Takahashi, and L.-C. Lee, 2010: The controlling synoptic-scale factors for the distribution of the transient luminous events (TLEs). *J. Geophys. Res*. **115**, A00E54, doi:10.1029/2009JA014823. (SCI, ▲: 8; IF=3.082)

53. Wu, C.-C.*, K. K.-W. Cheung, J.-H. Chen, and C. C. Chang, 2010: The impact of Tropical Storm Paul (1999) on the motion and rainfall associated with Tropical Storm Rachel (1999) near Taiwan. *Mon. Wea. Rev*. **138**, 1635-1650. (SCI, ▲: 3; IF=2.238)

52. Chou, K.-H., C.-C. Wu*, P.-H. Lin, and S. Majumdar, 2010: Validation of QuikSCAT wind vectors by dropwindsonde data from Dropwindsonde Observations for Typhoon Surveillance Near the Taiwan Region (DOTSTAR), *J. Geophys. Res*., **115**, D02109, doi:10.1029/2009JD012131. (SCI, ▲: 8; IF=3.082)

51. Wu C.-C.*, S.-G. Chen, J.-H. Chen, K.-H. Chou, and P.-H. Lin, 2009: Reply to comments on "Typhoon-trough interaction from both Adjoint-Derived Sensitivity Steering Vector (ADSSV) and potential vorticity (PV) perspectives". *Mon. Wea. Rev*., **137**, 4425–4432. (SCI, ▲: 0; IF=2.238)

50. Chen, J.-H.*, M. S. Peng, C. A. Reynolds, and C.-C. Wu, 2009: Interpretation of tropical cyclone forecast sensitivity and dynamics from the NOGAPS singular vector perspective. *J. Atmos. Sci.*, **66**, 3383-3400. (SCI, ▲: 18; IF=2.911)

49. Lin, I-I*, C.-H. Chen, I.-F. Pun, W. T. Liu., and C.-C. Wu, 2009: Warm ocean anomaly, air sea fluxes, and the rapid intensification of tropical cyclone Nargis. *Geophys. Res. Lett.*, **36**, L03817, doi:10.1029/2008GL035815. (SCI, ▲: 43; IF=3.204)

48. Wu, C.-C.*, K. K. W. Cheung and Y.-Y. Lo, 2009: Numerical study of the rainfall event due to interaction of Typhoon Babs (1998) and the northeasterly monsoon. *Mon. Wea. Rev*, **137**, 2049-2064. (SCI, ▲: 22; IF=2.238)

47. Wu, C.-C.*, J.-H. Chen, S. J. Majumdar, M. S. Peng, C. A. Reynolds, S. D. Aberson, R. Buizza, M. Yamaguchi, S.-G. Chen, T. Nakazawa , and K.-H. Chou, 2009: Intercomparison of targeted observation guidance for tropical cyclones in the North western Pacific. *Mon. Wea. Rev*., **137**, 2471-2492. (SCI, ▲: 37; IF=2.238)

46. Yamaguchi M.*, T. Iriguchi, T. Nakazawa, and C.-C. Wu, 2009: An observing system experiment for Typhoon Conson (2004) using a singular vector method and DOTSTAR data. *Mon. Wea. Rev*., **137**, 2801-2816. (SCI, ▲: 22; IF=2.238)

45. Lin, I-I*, I.-F. Pun, and C.-C. Wu, 2009: Upper ocean thermal structure and the western North Pacific category-5 typhoons. Part II: Dependence on translation speed. *Mon. Wea. Rev*., **137**, 3744-3757. (SCI, ▲: 44; IF=2.238)

44. Wu C.-C.*, S.-G. Chen, J.-H. Chen, K.-H. Chou, and P.-H. Lin, 2009: Interaction of Typhoon Shanshan (2006) with the mid-latitude trough from both Adjoint-Derived Sensitivity Steering Vector and potential vorticity perspectives. *Mon. Wea. Rev*., **137**, 852–862. (SCI, ▲: 20; IF=2.238)

43. Wu C.-C.*, H.-J. Cheng, Y. Wang, and K.-H. Chou, 2009: A numerical investigation of the eyewall evolution in a landfalling typhoon. *Mon. Wea. Rev.*, **137**, 21-40. (SCI, ▲: 15; IF=2.238)

42. Yang, C.-C., C.-C. Wu*, K.-H. Chou, and C.-Y. Lee, 2008: Binary interaction between Typhoons Fengshen (2002) and Fungwong (2002) based on the potential vorticity diagnosis. *Mon. Wea. Rev*., **136**, 4593-4611. (SCI, ▲: 13; IF=2.238)

41. Lin, I-I*, C.-C. Wu, F. Pam, and D.-S. Ko, 2008: Upper ocean thermal structure and the western North Pacific category-5 typhoons. Part I: Ocean features and category-5 typhoon's intensification. *Mon. Wea. Rev.*, **136**, 3288-3306. (SCI, ▲: 68; IF=2.238)

40. Hsu, H.-H.*, C.-H. Hung, A.-K. Lo, C.-C. Wu, and C.-W. Hung, 2008: Influence of tropical cyclone on the estimation of climate variability in the tropical western North Pacific. *J. Climate*, **21**, 2960-2975. (SCI, ▲: 23; IF=3.363)

39. Jian, G.-J.*, and C.-C. Wu, 2008: A numerical study of the track deflection of Supertyphoon Haitang (2005) prior to its landfall in Taiwan. *Mon. Wea. Rev.,* **136**, 598-615. (SCI, ▲: 29; IF=2.238)

38. Chou, K.-H., and C.-C. Wu*, 2008: Development of the typhoon initialization in a mesoscale model – Combination of the bogused vortex with the dropwindsonde data in DOTSTAR. *Mon. Wea. Rev*., **136**, 865-879. (SCI, ▲: 23; IF=2.238)

37. Zang, X.*, T. Li, F. Weng, C.-C. Wu, and L. Xu, 2007: Reanalysis of Western Pacific typhoons in 2004 with multi-satellite observations. *Meteorol. Atmos. Phys.*, DOI: **10**.1007/s00703-006-0240-5., 3-18. (SCI, ▲: 5; IF=0.872)

36. Wu, C.-C.*, C.-Y Lee, and I-I Lin, 2007: The effect of the ocean eddy on tropical cyclone intensity. *J. Atmos. Sci*., **64**, 3562-3578. (SCI, ▲: 47; IF=2.911)

35. Wu, C.-C.*, K.-H. Chou, P.-H. Lin, S. D. Aberson, M. S. Peng, and T. Nakazawa, 2007: The impact of dropwindsonde data on typhoon track forecasts in DOTSTAR. *Weather and Forecasting*, **22**, 1157-1176. (SCI, ▲: 56; IF=1.663)

34. Wu, C.-C.*, J.-H. Chen, P.-H. Lin, and K.-S. Chou, 2007: Targeted observations of tropical cyclones based on the adjoint-derived sensitivity steering vector. *J. Atmos. Sci*., **64**, 2611-2626. (SCI, ▲: 65; IF=2.911)

33. Zeng, Z.* and Y. Wang, and C.-C. Wu, 2007: Environmental dynamical control of tropical cyclone intensity – An observational study. *Mon. Wea. Rev*., **135**, 38-59. (SCI, ▲: 41; IF=2.238)

32. Galewsky, J.*, C. P. Stark, S. Dadson, C.-C. Wu, A. H. Sobel, and M.-J. Hong, 2006: Tropical cyclone triggering of sediment discharge in Taiwan. *J. Geophysical Research*. **111**, F03014, doi:10.1029/2005JF000428. (SCI, ▲: 23; IF=3.082)

31. Wu, C.-C.*, K.-H. Chou, Y. Wang and Y.-H. Kuo, 2006: Tropical cyclone initialization and prediction based on four-dimensional variational data assimilation. *J. of Atmos. Sci*., **63**, 2383–2395. (SCI, ▲: 26; IF= 2.911)

30. Lin, I-I, C.-C. Wu*, K. A. Emanuel, I-H. Lee, C. Wu, and F. Pan, 2005: The interaction of Supertyphoon Maemi (2003) with a warm ocean eddy. *Mon. Wea. Rev*., **133**, 2635–2649. (SCI, ▲: 66; IF=2.238)

29. Wu, C.-C.*, P.-H. Lin, S. Aberson, T.-C. Yeh, W.-P. Huang, K.-H. Chou, J.-S. Hong, G.-C. Lu, C.-T. Fong, K.-C. Hsu, I-I Lin, P.-L. Lin, C.-H. Liu, 2005: Dropwindsonde Observations for Typhoon Surveillance near the Taiwan Region (DOTSTAR): An overview. *Bulletin of Amer. Meteor. Soc*., **86**, 787-790. (SCI, ▲: 84; IF=6.123)

28. Wu, C.-C.*, P.-H. Lin, I-I Lin, T.-C. Yeh, 2004: A Review on "Dropsonde Observation for Typhoon Surveillance near the TAiwan Region (DOTSTAR)" and "Typhoon-Ocean-Bio-Geochemistry Interaction" research projects. *Atmos. Sci*. **32**, 275-292. (in Chinese *with an English abstract)*

27. Wu, C.-C.*, T.-S. Huang, and K.-H. Chou, 2004: Potential vorticity diagnosis of the key factors affecting the motion of Typhoon Sinlaku (2002), *Mon. Wea. Rev*., **132**, 2084-2093. (SCI, ▲: 19; IF=2.238).

26. Liu, C.-M.*, M.-T. Yeh, L.-Z. Peng, C.-C. Wu, and S. C. *Liu, 2004:* S**im**ulation comparison of winter continental air mass and summer maritime air mass on background ozone near Taiwan. *Atmos. Sci.* (in Chinese with an English abstract), **32**, 1-22.

25. Wang Y.*, and C.-C. Wu, 2004: Current understanding of tropical cyclone structure and intensity changes - A review. *Meteor. and Atmos. Phys*., **87**, 257-278, DOI: 10.1007/s00703-003-0055-6. (SCI, ▲: 109; IF=0.872)

24. Wu, C.-C.*, K.-H. Chou, H.-J. Cheng, and Y. Wang, 2003: "Eyewall Contraction, Breakdown and Reformation in a Landfalling Typhoon", *Geophys. Res. Let.*, **30** (17), 1887, doi:10.1029/2003GL017653. (SCI, ▲: 19; IF=3.204)

23. Lin, I.-I.*, W. T. Liu, C.-C. Wu, G. Wong, C. Hu, Z. Chen, W.-D. Liang, Y. Yang, and K.-K. Liu, 2003: New evidence for enhanced ocean primary production triggered by tropical cyclone. *Geophys. Res. Lett.*, **30** (13), 1718, doi:10.1029/2003GL017141. (SCI, ▲: 62; IF=3.204)

22. Wu, C.-C.*, T.-S. Huang, W.-P. Huang, and K.-H. Chou, 2003: A new look at the binary interaction: Potential vorticity diagnosis of the unusual southward movement of Typhoon Bopha (2000) and its interaction with Typhoon Saomai (2000). *Mon. Wea. Rev*., **131,** 1289-1300. (SCI, ▲: 31; IF=2.238)

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Biographical Research Sketch

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Over the past 18 years, I have dedicated my full efforts to typhoon-related scientific research. My thesis work at MIT (Wu and Emanuel 1993, 1994, 1995a, b) involved the understanding of hurricane movement from the perspective of potential vorticity, which I believe is the very pioneering achievement in proposing and identifying the baroclinic effect on hurricane motion, and in quantitatively evaluating the typhoon steering flow and its connection to the large-scale dynamical systems. During my post-doctor tenure at Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton University, my attention was drawn to the development of the GFDL hurricane model, especially its initialization. Based on this model, a hurricane-environment interaction problem was demonstrated (Wu and Kurihara 1996).

After joining the faculty of Department of Atmospheric Sciences, National Taiwan University (NTU) in 1995, I started to put together a research laboratory, the Typhoon Dynamics Research Center (see http://typhoon.as.ntu.edu.tw) within the department. With a strong will to conduct top-notched typhoon research, I have always had high hopes for the center to improve our understanding of the dynamics, the physics, as well as the forecast of typhoons. Currently I am leading the "Prioroty Typhoon Research Project", specially funded by the Division of Natural Science, National Science Council (NSC) of Taiwan from 2002-2008. The research team is making steady progress in the observation, modeling and theoretical aspects of typhoon research.

The following is a sketch of my current research foci and the proposed research issues, primarily funded by the National Science Council (NSC), Central Weather Bureau (CWB) of Taiwan, NTU, and the Office of Naval Research (ONR) of U.S. Navy.

1. DOTSTAR (Dropwindsonde Observations for Typhoon Surveillance near the TAiwan Region) and targeted observation research

The DOTSTAR (Dropwindsonde Observations for Typhoon Surveillance near the Taiwan Region) program has been successfully carried out in the past eight years (Wu et al., 2004, MWR; Wu et al., 2005, BAMS; Wu et al., 2006, JAS; Wu et al., 2007a, Wea. Forecasting, b, JAS; Chou and Wu, 2008, MWR; Chen et al., 2009, JAS; Yamaguchi et al., 2009, MWR; Wu et al., 2009a, b, c, MWR; Chou et al., 2010, JGR; Wu et al., 2010, JAS; Chen et al., 2011, MWR; Chou et al., 2011, MWR; Liang et al., 2011, JAS; Weissmann et al., 2011, MWR; Yen et al., 2011, TAO; Huang et al., 2012, JAS; Jung et al., 2012, Tellus A.; Wu et al., 2012a, b, JAS, MWR). A special collection (issue) on "Targeted Observation and Data Assimilation for Improving

Tropical Cyclone Predictability" headed by myself has been published in the Monthly Weather Review in 2009 and 2010.

In total, 57 surveillance flight missions have been conducted for 44 typhoons, with 300 flight hours and 932 dropwindsondes released in the DOTSTAR project. The result is a robust 20% improvement in numerical models (such as NCEP GFS) that represents significant contribution to the study of typhoons (Chou et al. 2011 MWR).

Multiple techniques have been used to help design the flight path for the targeted observations in DOTSTAR. Wu et al. (2007b JAS)) developed a new theory to identify sensitive areas for tropical cyclone (TC) targeted observations based on the adjoint model. By appropriately defining the response functions to represent typhoon's steering flow at the verifying time, a unique new parameter, the Adjoint-Derived Sensitivity Steering Vector (ADSSV) was designed to clearly demonstrate the sensitivity locations at the observing time. The ADSSV has been implemented and further examined in the case of Typhoon Shanshan (2006) (Wu et al. 2009b MWR) where the recurvature of the typhoon caused by the approaching mid-latitude trough is precisely captured by the signal of ADSSV, and is effectively verified by the potential vorticity diagnosis. This is the first paper in which targeted methods have been interpreted dynamically from the potential vorticity perspective. Validataion and interpretation of the ADSSV and the ensemble transform Kalman filter (ETKF) as guidance for targeted CT observations have been further examined in Chen et al. (2011, MWR) and Majumdar et al. (2011, QJRMS).

An inter-comparison study (Wu 2009c MWR) has been conducted to examine the common features and differences among all the targeting techniques, such as the Singular Vectors of JMA, NOGAPS and ECMWF, ADSSV, and ETKF. This work involved tremendous international efforts, headed and coordinated by myself, and integrating inputs from 11 co-authors from NTU, NRL, JMA/MRI, NCEP, ECMWF, NOAA/HRD. The results provided valuable insights into the dynamic features of each targeted technique, and their potential applications in real-time targeted observations. This work was well recognized in WMO's third THORPEX Science Workshop in Monterey in September 2009, in which Drs. Istvan Szunyogh and Rolf Langland described and commented on its contribution. In 2010, I was invited to give a talk on targeted observation and to serve as the rapporteur for the Seventh WMO International Workshop on Tropical Cyclones (IWTC-VII), La Reunion, France.

The impact of targeted observations from DOTSTAR data during T-PARC has been further evaluated in Harnisch and Weissmann (2011), Weissmann et al. (2011), Chou et al. (2011), Jung et al. (2012), and Wu et al. (2012b). The positive impacts of targeted observations by DOTSTAR were frequently demonstrated and highly recognized in these studies. DOTSTAR has played a pivotal role in several international field experiments, including T-PARC (THORPEX/PARC; The Observation System Research and Predictability Experiment Pacific-Asian Regional Campaign, T-PARC) in 2008 and ITOP (Impact of Typhoons on the Ocean in the Pacific) in 2010.

Widely recommended as a fully-developed program, DOTSATR has been included in the international THORPEX/PARC initiative under the World Meteorological Organization (especially in collaboration with the Japanese program, Typhoon Hunting 2008, TH08, led by Dr. Tetsuo Nakazawa of JMA/MRI; and the US program, "Tropical Cyclone Structure 2008, TCS-08, led by Dr. Patrick Harr of Naval Postgraduate School). This is the first case in which four airplanes (two jets for surveillance, and a P-3 and a C-130 for reconnaissance) were used to observe typhoons in the western North Pacific. The unprecedented data collected are valuable for understanding the physics and dynamics of the genesis, structure change, recurvature, extra-tropical transition, targeting observation, and predictability of tropical cyclones. National Geographic even made a one-hour documentary featuring the DOTSTAR and T-PARC programs in 2009 which has been aired over 135 countries.

In ITOP, abundant data had been collected by ASTRA (DOTSTAR), two C130 aircrafts (US Air Force), in addition to numerous buoy and ship observations during the lifetime of Typhoons Fanapi, Malakus, and Megi. The EnKF data assimilation system I developed in Wu et al. (2010 JAS) provided a comprehensive high-resolution atmospheric model dataset for further study, especially for physical oceanographers to drive their ocean models in ITOP.

The continuing work in DOTSTAR has shed light on typhoon dynamics, improved the understanding and predictability of typhoon track through the targeted observations, placed the DOTSTAR team at the forefront of international typhoon research, and has made a significant contribution to the study of typhoons in the northwestern Pacific and East Asia region.

Starting from 2013, DOTSTAR has been coordinated by Prof. Po-Hsiung Lin, along with CWB (Central Weather Bureau) and TTFRI (Taiwan Typhoon and Flood Research Institute), with detailed information available at http://typhoon.as.ntu.edu.tw/DOTSTAR/en/.

2. A new vortex initialization method based on the ensemble Kalman filter (EnKF) data assimilation system

A new TC vortex initialization method was developed in Wu et al. 2010 (JAS) based on the EnKF data assimilation system, which effectively provides well-balanced initial TC vortex structure dynamically consistent with the model. Three special observational parameters of TCs, including TC center position, storm motion vector and a single-level (either surface of flight level) axisymmetric wind profile, were innovatively adopted and assimilated via the EnKF methodology. This newly developed vortex initialization method has been deployed to numerical simulations of different typhoons, such as Typhoons Fung-wong (2008; Wu et al, 2010, JAS), Sinlaku (2008; Wu et al. 2011 MWR), Morakot (2009; Yen et al. 2011, TAO) and other typhoons, in particular, those with aircraft surveillance observations from DOTSTAR (2003-), T-PARC (2008), or ITOP (2010). Results of these studies show improvement of typhoon simulations and forecasts when this vortex initialization method is applied.

Meanwhile, the ensemble members created from the EnKF data assimilation system provides information for predicting typhoon evolution, including the movement, intensity, structure and the associated precipitation.

This newly proposed vortex initialization has facilitated advancement in the dynamical research on typhoons in many aspects, such as in the formation and evolution of the concentric eyewall structure (Wu et al. 2012a MWR; Huang et al. 2012, JAS), and the impact of typhoons' translation speed on the associated precipitation (Yen et al. 2011, TAO). This EnKF vortex initialization methodology is now applied to studies of different issues on different typhoons [e.g., Typhoon-Ocean interaction in Typhoon Fanapi (2010) using ITOP data], and can be used to help the design of idealized numerical experiments. This method will continue to shed light on the scientific understanding of typhoons, and most importantly to improve typhoon forecasting.

A new sensitivity analysis method has been proposed for the ensemble prediction system in which a TC-position is taken as a metric. (Ito and Wu 2013, JAS)

3. Dynamics of typhoon (concentric) eyewall evolution:

A new study on the role of the diabatic process in affecting eyewall evolution has been carried out in Wu et al. 2009a (MWR), which highlights how the moist processes enhance the potential vorticity structure and support eyewall evolution. This study points out the deficiency of the dry barotropic model in describing detailed eyewall dynamical processes, and provides new insights into the eyewall physics. Idealized numerical experiments have been conducted (Wei and Wu 2012) to highlight the role of moist heating in affecting the eyewall dynamics. It is shown that when the diabatic heating and 3-D flows are taken into account, the resultant vortex evolution paths are very different from those in the 2-D barotropic model.

In Wu et al. (2012a MWR) and Huang et al. (2012 JAS), a new paradigm of the dynamics controlling the secondary eyewall formation (SEF) in TCs was presented. A deeper understanding of the underlying dynamics of SEF has been obtained based on recently developed insights on the axisymmetric dynamics of tropical cyclone intensification. This is an attractive paradigm on the physical grounds because of its simplicity and consistency with the 3-D numerical simulations presented. Application of the two spin-up mechanisms set the scene for a progressive boundary layer control pathway to SEF. The unbalanced boundary layer response to an expanding swirling wind field is an important mechanism for concentrating and sustaining deep convection in a narrow supergradient-wind zone in the outer-core region of a mature TC. The findings point to a sequence of structural changes in the outer-core region of a mature TC, which culminates in the formation of a secondary eyewall.

A series of follow-up works is recently proposed to provide complete dynamical analyses of SEF. We believe this series of studies will further bring considerable dynamical insights into SEF, and thus will reveal the critical physical processes that need to be adequately represented in a numerical model, which will in turn facilitate further understanding of TC dynamics and improvement in typhoon forecasting. Based on this series of research, a new and generalized theoretical framework/model for SEF is slated to be constructed, interpreting the axisymmetric/asymmetric and balanced/unbalanced vortex dynamics involved. This work is expected to improve the forecast of SEF (the timing and preferred radial intervals) and the evolution of a concentric eyewall cycle (including the associated structure and intensity changes, and the cycle's duration), as well as the general forecast of a typhoon. In all, the works of Wu et al. (2012a MWR) and Huang et al. (2012 JAS) have received high attention from the TC community, and many research groups (e.g., UCLA、SUNY Albany、Univ. of Washington 、 Univ. of Miami 、 Pennsylvania State Univ. 、 Naval Postgraduate school、Melbourne Univ.、Nanjing Univ.) have been following this new paradigm in interpreting the SEF dynamics.

4. Dynamics of typhoon-terrain interactions:

Understanding how the Taiwan terrain affects the track, intensity, wind structure, and precipitation distribution is one of my key research thrusts. Both observational and numerical studies have been conducted to address this issue (Wu and Kuo 1999, BAMS; Wu 2001, MWR; Wu et al. 2002, Wea. & Forecating; Jian and Wu 2007, MWR; Galewsky et al. 2006, JGR). A paper studying the effects of the terrain on the eyewall dynamics and Vortex-Rossby waves of landfalling typhoons (Wu et al. 2003, GRL) has been introduced in the "news and views in brief" column of Nature Magazine in September 2003. The role of the adiabatic process in affecting the eyewall evolution has also been examined in details in another paper (Wu et al. 2009a, MWR), which highlights how the moist processes enhance the potential vorticity structure and support the eyewall evolution. This study points out the deficiency of the dry barotropic model in describing the detailed eyewall dynamical processes, and provides new insights into the eyewall physics that is consistent with the new theories as described in Montgomery et al. (2008, 2009). The role of terrain in affecting the looping motion of typhoons (channel effect) near the terrain has been demonstrated in Jain and Wu (2008 MWR). This study indicates how the terrain-induced channel effect leads to the unusual looping motion of Typhoon Haitang. The looping motion of typhoons has been further investigated in Huang et al. (2011). The numerical simulations of Typhoon Krosa's looping (2007) and an idealized set of numerical experiments were carried out to study the terrain-induced typhoon track deflections. The study shows consistent results with Jian and Wu (2008) that the distinct southward track deflection prior to landfall can be attributed to the northerly jet enhanced by the channel effect at the narrow pathway between the high topography of Taiwan and the eyewall with high inertial stability of Krosa. Such findings in Huang et al. (2011) have recently been recognized in the 2011 UCAR magazine. This series of research provides clear insights into the physics of typhoon-terrain interactions, which is also observed in many similar typhoon events near Taiwan. A further study with idealized experiments under a wider spectrum of flow regimes has been ongoing to more thoroughly investigate the dynamics of such processes. New flow regimes have also been identified (Li and Wu 2012).

5. Typhoon rainfall:

Typhoon-induce rainfall has been an important research theme especially in Taiwan, considering the mountainous nature of its typography and the disastrous impact heavy rainfall can have on people's lives and property. One of the flagship studies my team has conducted on this issue is rainfall associated with TC-monsoon-terrain interaction. A heavy rainfall event in the Taiwan area associated with the interaction between Typhoon Babs (1998) and the East Asia winter monsoon is studied (Wu et al. 2009 MWR). Typhoon Babs is a case in point demonstrating the often-observed phenomenon that heavy rainfall can be induced in the eastern and/or northeastern region of Taiwan in late typhoon season. Such heavy rainfall was caused by the joint convergent flow associated with the outer circulation of typhoons and the strengthening northeasterly monsoon in late typhoon season, even though Babs remained distant from Taiwan when it moved through the island of Luzon in the Philippines and stayed over the south. It is shown that the terrain plays a key role in changing the low-level convergence pattern between typhoon circulation and monsoonal northeasterlies. This is the first paper published in an international SCI journal that discusses the rainfall mechanism associated with the TC-winter monsoon-terrain interaction, which is well illustrated in the schematic diagrams of the paper (Wu et al. 2009 MWR).

Based on the EnKF data assimilation (Wu et al. 2010, 2011), Yen et al. (2011) showed in a simulation with nearly-doubled translation speed of Morakot that the 55% increase of the translation speed (12->19 km/h; 36 % less duration time) leads to a 33% reduction in the maximum accumulated rainfall (1800->1207 mm), while the rainfall distribution over Taiwan remains similar. Futhermore, the 28 ensemble members provide abundant information on their spread and other statistics, which reveal the usefulness of the ensemble simulation for the quantitative precipitation forecast. It is also suggested that the ensemble simulations with coherent high model and terrain resolutions are valuable in assessing the issue of terrain-induced heavy rainfall, one of the most critical forecast issues in Taiwan. The paper was awarded "The Dr. Shiah-Shen Huang Outstanding Paper Award" in 2012 by ROC Meteorological Society.

Typhoon Morakot (2009) was one of the deadliest typhoons that have impacted Taiwan in the past 50 years. Since this extreme rainfall event, there have been extensive studies focusing on its record-breaking amount of rainfall from various scientific and forecast perspectives. To communicate and discuss various aspects of this deadly typhoon, a conference named "The International Workshop on Typhoon Morakot (2009)," co-organized by myself was held from March 25-26, 2010, in Taipei, Taiwan. The conference specifically aimed to identify gaps in our understanding of TCs, and to discuss advanced forecast guidance tools required to improve warnings of these extreme precipitation and flooding events. The community (headed by myself, as the Editor in Chief of TAO Journal) went a step further to propose a special issue to the journal Terrestrial, Atmospheric and Oceanic Sciences (TAO) in order to provide a comprehensive summary of Morakot and other extreme rainfall events associated with landfalling TCs. The special issue, "Typhoon Morakot (2009): Observation, Modeling, and Forecasting Applications," was published in December 2011 and covered observation analyses of circulations and structures, mesoscale model simulations, data assimilation techniques, and practical forecast verification and guidance. Another paper highlighting the significance of this special issue was published in Wu (2013, *BAMS*).

6. Typhoon-Climate Study:

I have broadened my research field to the study of TC-climate problems, one emerging important issue in our research community. My post-doctoral research fellows from Shanghai Typhoon Research Institute, Zhan et al. (2011 J. Climate) showed that the EIO SSTA affects TC genesis frequency in the entire genesis region over the western North Pacific (WNP) by significantly modulating both the western Pacific summer monsoon and the equatorial Kelvin wave activity over the western Pacific, two major large-scale dynamical controls of TC genesis over the WNP. Additional sensitivity experiments were performed for two extreme years: one (1994) with the highest and another (1998) with the lowest TC annual frequencies in the studied period.

The effect of ENSO on landfalling TCs over the Korean Peninsula is examined by another of my post-doctoral fellow researcher from Korea (Choi et al. 2011 *Asia-Pac J. Atmos. Sci.)*. It is found that although difference in landfalling frequency is not statistically significant between different ENSO phases, the landfalling tracks are shifted northward in response to the decrease in Niño-3.4 index. In the neutral ENSO phase, many TCs pass through (mainland) China before making landfall on the Korean Peninsula due to the westward expansion of the western North Pacific subtropical high.

Another visiting scientist to our group, Kim et al. (2011 TAO) investigated the contribution of TC rainfall (PTC) to the interdecadal change in summer (June, July and August) rainfall (PTotal) over southern China between 1981 - 1992 (ID1) and 1993 - 2002 (ID2). In an area-averaged sense, the interdecadal change in PTotal was largely attributed to non-TC rainfall for the summer total and the months of June and July, while PTC became comparable in August. When the month-to-month spatial variability was considered, noticeable negative PTC contributions appeared over the southeastern coast, Hainan Island, and Taiwan in June and over the southern coastal regions in July, where less TC activity was observed. In June, the condition was attributed to reduced basin-wide TC activity due to unfavorable large-scale environments in ID2, whereas in July, an enhanced cyclonic circulation centered at Taiwan in ID2 limited the number of TCs from the Philippine Sea.

Choi et al. (2013 Theor. Appl Climatol.) used teleconnection patterns to make seasonal predictions for tropical cyclone frequency around Taiwan, and further stated that the frequency of summer TCs in the areas of Japan, Korea, and Taiwan (JKT) has a positive correlation with the Arctic Oscillation (AO) in the preceding spring, while summer TC frequency in the Philippines (PH), located in the low latitudes, has a negative correlation with the AO of the preceding spring (Choi et al., 2012 Climate Dynamics). During a positive AO phase, when the anomalous anticyclone forms over the mid-latitudes of East Asia, other anomalous cyclones develop not only in the high latitudes but also in the low latitudes from the preceding spring to the summer months. With such a difference, while southeasterlies in the JKT area derived from the mid-latitude anticyclone plays a role in steering TCs toward this area, northwesterlies strengthened in the PH area by the low-latitude cyclone prevents TC movement toward this area. Also because of this pressure systems developed during this AO phase, TCs occur, move, and recurve in further northeastern part of the western North Pacific than they do during a negative AO phase.

I successfully implemented the International Pacific Research Center (IPRC) Regional Climate Model (iRAM) in my research and examined the internal variability of dynamically downscaled TCs over the WNP based on four simulations of 20 typhoon seasons (1982– 2001) initialized on four successive days using iRAM (Wu et al. 2012d *J. Climate*). The results showed that on both seasonal and interannual timescales, the initial conditions significantly affect the downscaled TC activity, with the largest internal variability occurring in August on the seasonal timescale. The spreads between any of the individual simulations and the ensemble mean are comparable to and in some circumstances greater than the interannual variation of the observed TC frequency. These works have established solid foundation for my approach to study the TC-climate problems.

7. Dynamics of typhoon intensity change:

One of the most difficult problems which remain unsolved to date in typhoon research is identifying the physical mechanisms that determine changes in typhoon intensity. We conducted an observational analysis (Wu and Cheng 1999, MWR) to show the roles of eddy momentum flux and vertical shear in affecting the intensity change of two different types of typhoons. Both idealized and real-case numerical simulations were set up to address this critical issue, with a review paper published in MAP (Wang and Wu 2004), while an observational study has also been conducted to assess the influence of the environmental factors on typhoon intensity (Zeng et al. 2006, MWR).

8. Dynamics of typhoon-ocean interaction:

This part of work was conducted in collaboration with Dr. I-I Lin. The cooling of the ocean due to the passage of typhoons has been documented from satellite-retrieved SST data, while response to the wind change has also been demonstrated (Lin et al. 2003a, GRL). Meanwhile, a striking interdisciplinary issue on the dramatic bio-response and ocean primary production due to typhoons has also been raised (Lin et al.

2003b, GRL). The above two papers have been introduced in the "news and views in brief" column of Nature Magazine in the 2003 March and August issues, respectively. We have also combined the Sea Surface Height Anomaly data with a simple coupled model (CHIPS) to investigate the role of warm ocean eddies in the intensity change of Typhoon Maemi (2003) (Lin. et al. 2005, MWR). It is shown that the warm eddy plays a critical role as an efficient insulator that prevents the storm-induced SST cooling, thus enabling Maemi to maintain its intensity as a super typhoon. This research project has received notable attention in the typhoon research community. The intensification of Hurricane Katrina (2005) is a case in point to highlight the role of warm ocean eddies and the warm Loop Current as depicted in our paper. Inspired by our recent observations, I have been working on a simple yet comprehensive, typhoon-ocean coupled model to study the influence of the ocean mixed-layer structure and the warm current on such feedback problems (Wu et al. 2007a, JAS), and to study the influence of the typhoon-induced SST cooling on the regional climate. Further work has been ongoing to understand the role of warm and deep ocean gyre and warm eddies as "Super-typhoon Boosters" in the NW Pacific (Lin et al. 2008a, b, MWR; 2009 GRL; 2011. TAO).

Based on detail in situ air-deployed ocean and atmospheric measurement pairs collected during the Impact of Typhoons on the Ocean in the Pacific (ITOP) field campaign, Lin et al. (2013, GRL) modified the widely used Sea Surface Temperature Potential Intensity (SST_PI) index by including information from the subsurface ocean temperature profile to form a new Ocean coupling Potential Intensity (OC_PI) index.

9. Numerical simulation and data assimilation of typhoons:

As described in Wu and Kuo (1999, BAMS), our understanding of typhoon dynamics and typhoon forecasting in the Taiwan area hinges very much on our ability to incorporate available data into high-resolution numerical models through advanced data assimilation techniques. Our team has thus made considerable efforts on data assimilation research. We have completed simulation experiments based on the 4-dimensional variational data assimilation to help understand the key variables affecting the initialization and simulation of typhoons (Wu et al. 2006, JAS). The follow-up adjoint sensitivity study can play an important role in identifying important areas and parameters, which should help construct strategies for adaptive observations. Work has been done to identify the best approach to incorporate dropwindsonde data and the bogused vortex based on 3D-VAR and 4D-VAR methods in order to improve the track and intensity simulations of typhoons (Chou and Wu, 2008, MWR). This work gives rise to a new method to optimally combine the bogused vortex and dropwindsonde data for improving the track and intensity forecast of typhoons. A new scheme to improve typhoon initialization has also been developed based on the Ensemble Kalman Filter (EnKF) (Wu et al. 2010).

10. Potential vorticity diagnostics of typhoons:

The potential vorticity diagnostics have been designed to understand the controlling factors affecting typhoon movements. To highlight the binary interaction between two typhoons, the track of one typhoon is plotted as centroid-relative, and with its position weighting based on the steering flow induced by the PV anomaly associated with the other typhoon (Wu et al. 2003, MWR; Yang et al. 2008, MWR). More detailed research is underway to evaluate and quantify the physical factors leading to the uncertainty of typhoon movements, such as for Typhoons Nari (2001) and Sinlaku (2002) (Wu et al. 2004, MWR). This methodology has been adopted by the Central Weather Bureau (CWB) both for research and analysis, and for diagnosing biases in the Bureau's model forecasts. Further work has been proposed to gain more insight into the physics of the statistical behavior of typhoon tracks in the entire north-western Pacific region. The impacts of the ITCZ and other large scale circulations on the typhoon tracks were also quantified.

A quantitative analysis of the steering flow based on the PV diagnosis indicates that the Pacific subtropical high to the east of Sinlaku is a primary factor that advects Sinlaku northwestward, while the monsoon trough plays a secondary role. (Wu et al. 2012, MWR)