

Diurnal Cycle Characteristics during TiMREX

Disturbed vs. Undisturbed

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Research Interest and Motivation

- Research interests:
 - Mesoscale meteorology
 - Tropical meteorology
 - General geosciences
- Currently pursuing a Bachelor's degree in Meteorology. Minor in Geoscience.
- Current research:
 - Mesoscale convective systems
 - Impacts of topography on mesoscale surface flows
- Motivation:
 - Born in Taiwan
 - Interested in studying something about my birthplace.

TiMREX Background

- A part of Southwest Monsoon Experiment (SoWMEX).
- Terrain_influenced Monsoon Rainfall Experiment 2008 in Taiwan.
- Utilized a high resolution dataset documenting the prevailing southwesterly monsoon flows.
- Aimed to study the physical processes of orographical lifted rainfall (CWB/SoWMEX, 2008).
- Famous extreme orographical rainfall event: Aug. 2009 [Typhoon Morakot](#). Nearly **100** inches (Taiwan Association of Hydraulic Engineers, 2010) of rain over southern Taiwan in just 3 days. Caused a landslide that buried a village of 600 residents in matter of minutes.

Field Setup

- Dropsondes, rawinsondes, ship soundings, S-band radar, X-band radar, micro-rain radar, and surface observations.

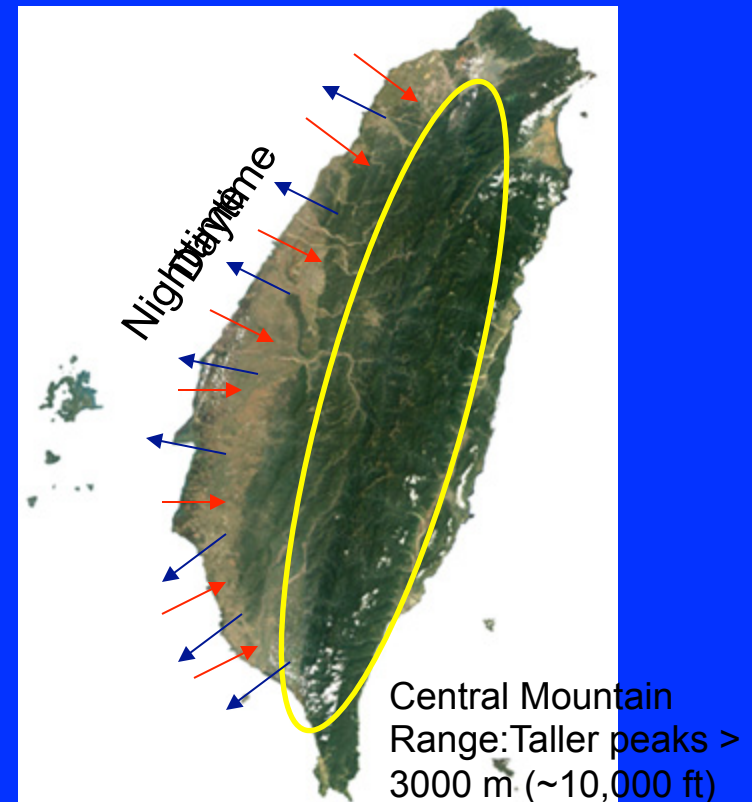


Courtesy of SoWMEX/Central Weather Bureau
sowmex.cwb.gov.tw

My Project Objectives

- To study the effects of cloud cover on surface heating over the island...
- and in turn how would these effects modify the diurnal surface flow, vertical motion, divergence, and precipitation pattern during the monsoon period.

The topography of Taiwan has a major influence on weather.

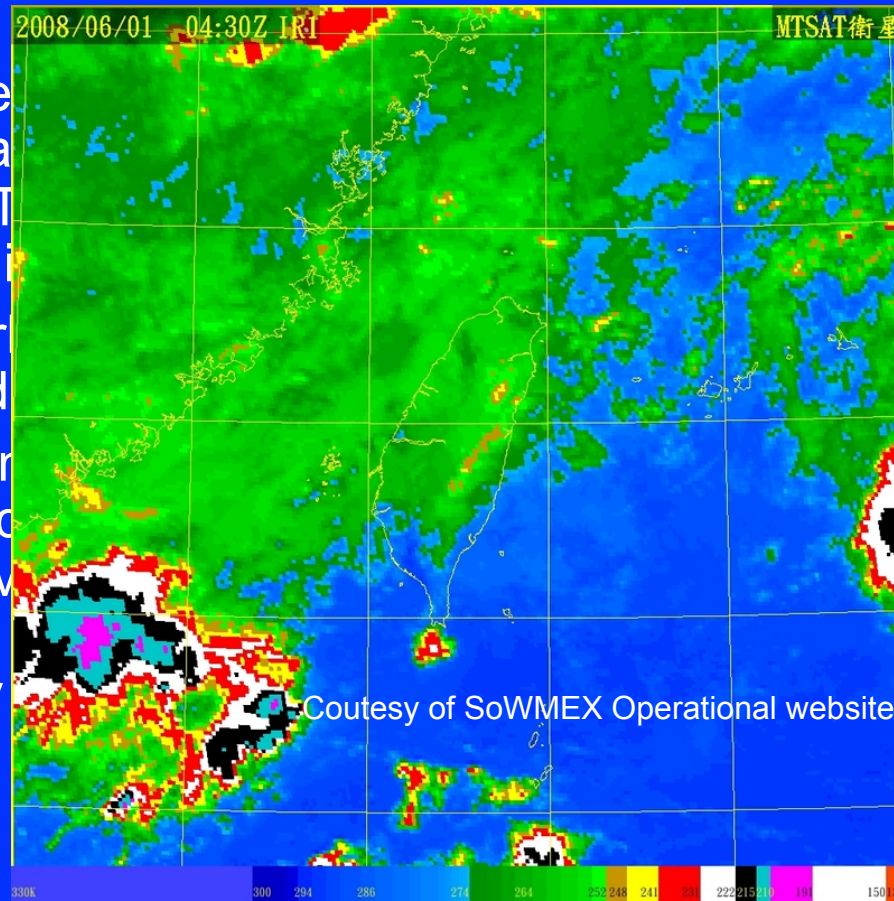


Courtesy of National Space Organization

www.nspo.org.tw

Methods

- Estimated the cloud cover over Taiwan by examining MTSAT enhanced IR images.
- A list of disturbed and undisturbed days.
- The instrument used within the field during the TiMEX catalog using the algorithm developed by Wang et al. (2010).

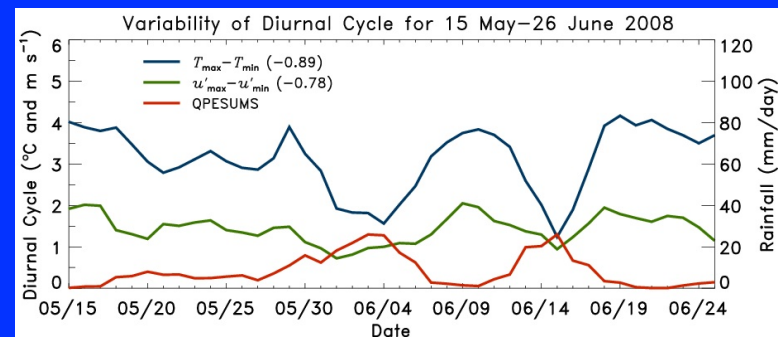
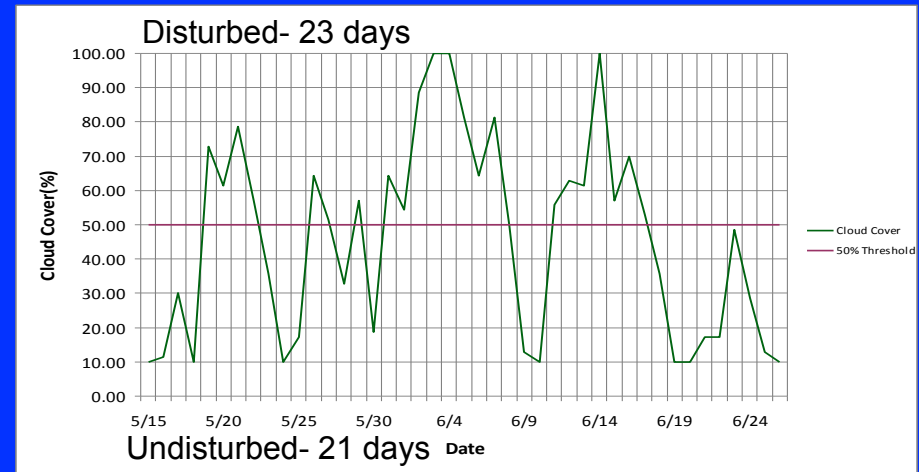


on interpolated to
latitude/
25-hPa
using
interpolation
developed by Nuss
(2004)
potential
changes, surface
motion,
and TRMM 3B42
analyzed for the

of these
meteorological fields.

Cloud Cover

- Amount of cloud cover (in percent) was examined hourly from 00-06Z.
- The hourly percentages were averaged into one value.
- Average cloud cover below 50% was considered as undisturbed.
- Above 50% was considered as disturbed.



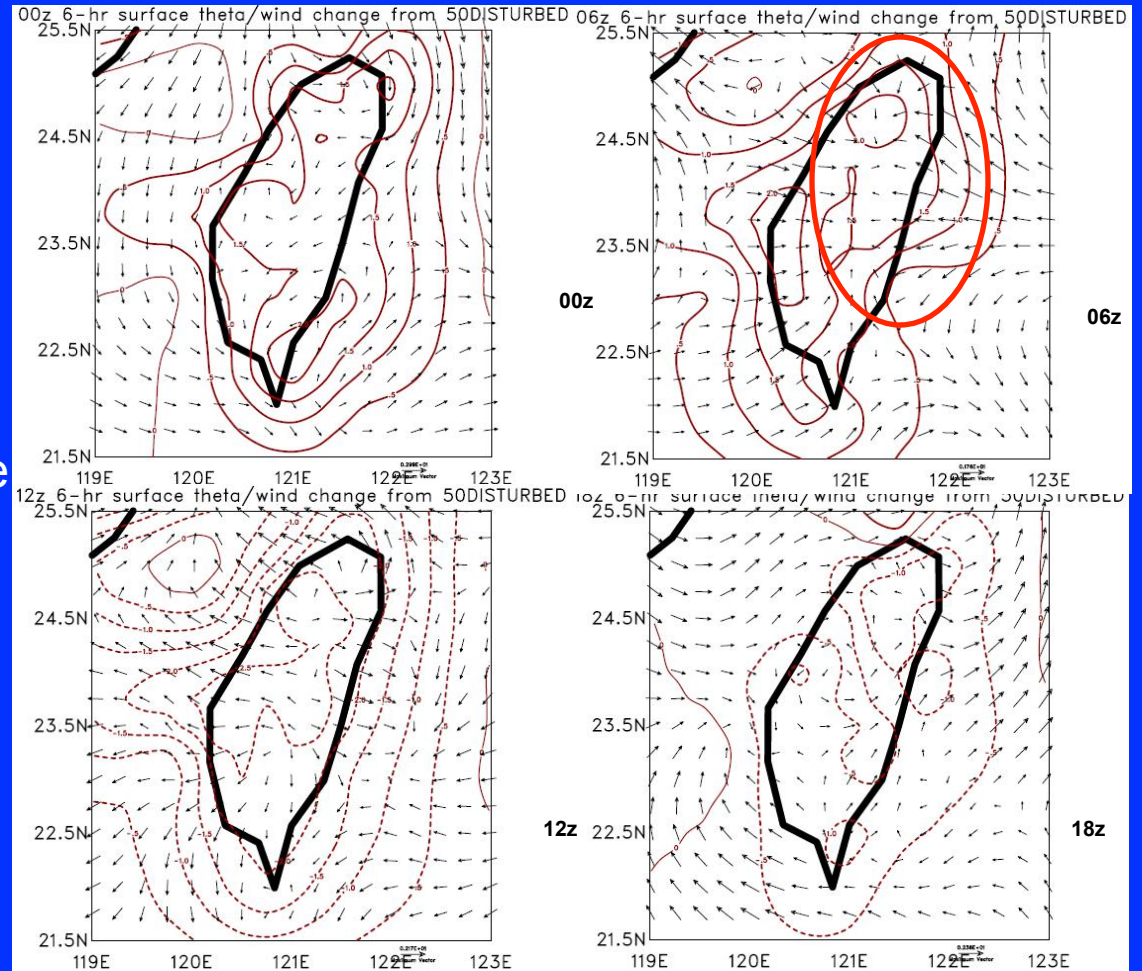
Courtesy of James Ruppert

Potential Temperature

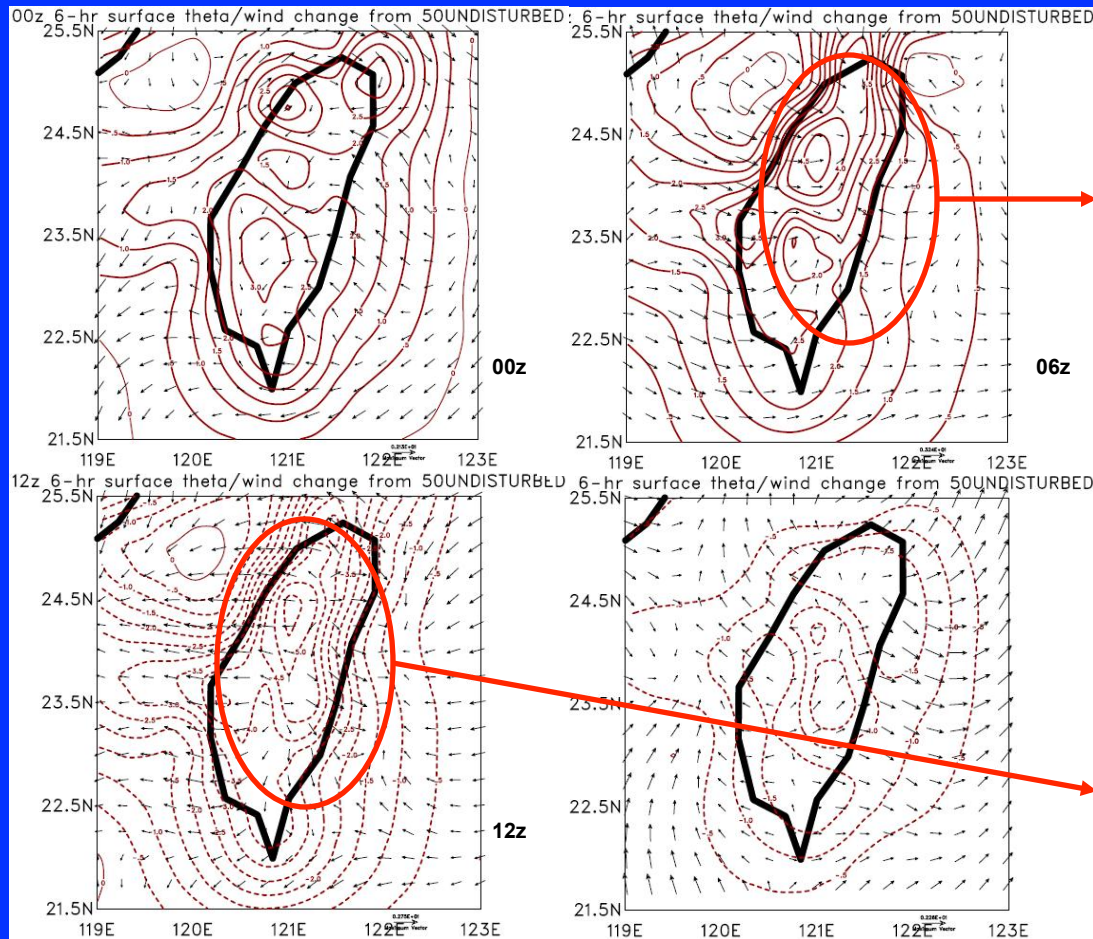
Investigate the degree of warming.

Some warming (average: 1.3 K from 8-12 LT) evident during the disturbed period. However...

DISTURBED



Potential Temperature



Much stronger warming (average: 2.1 K) starting from 00-06 UTC during the undisturbed period.

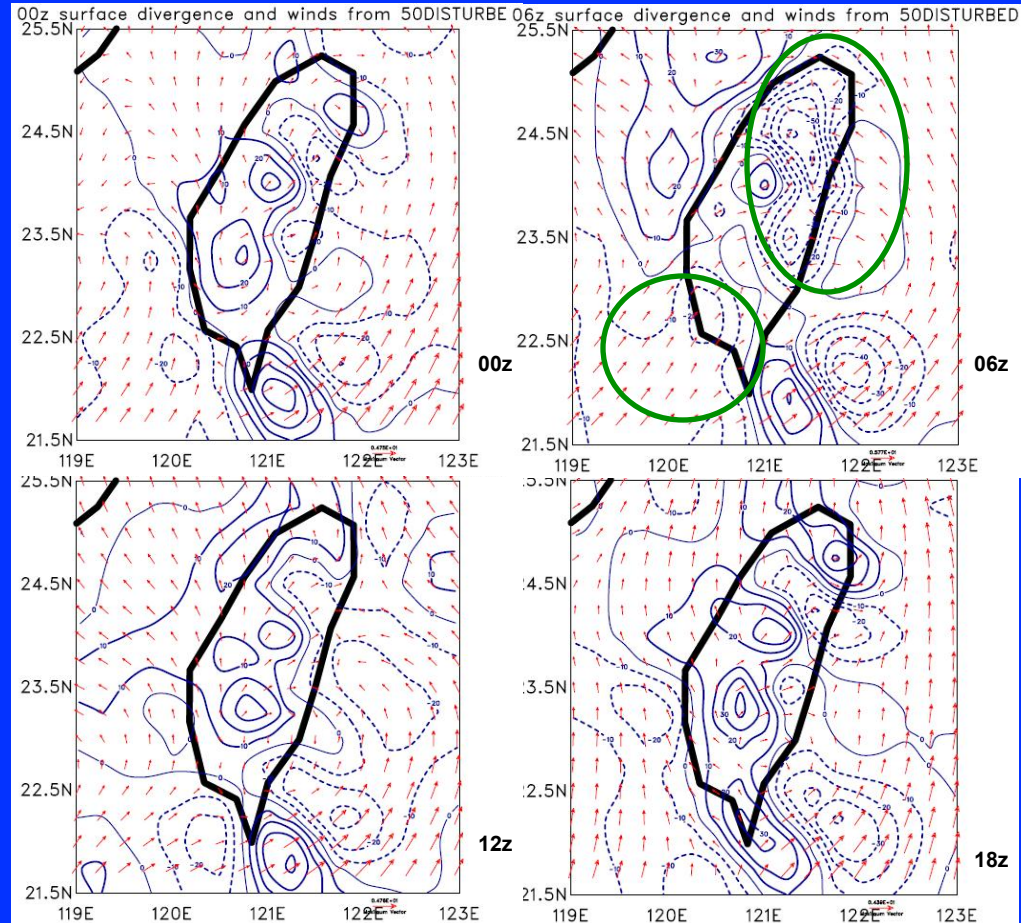
The winds blown toward/away from areas of greatest warming/cooling.

Stronger cooling during the evening too.

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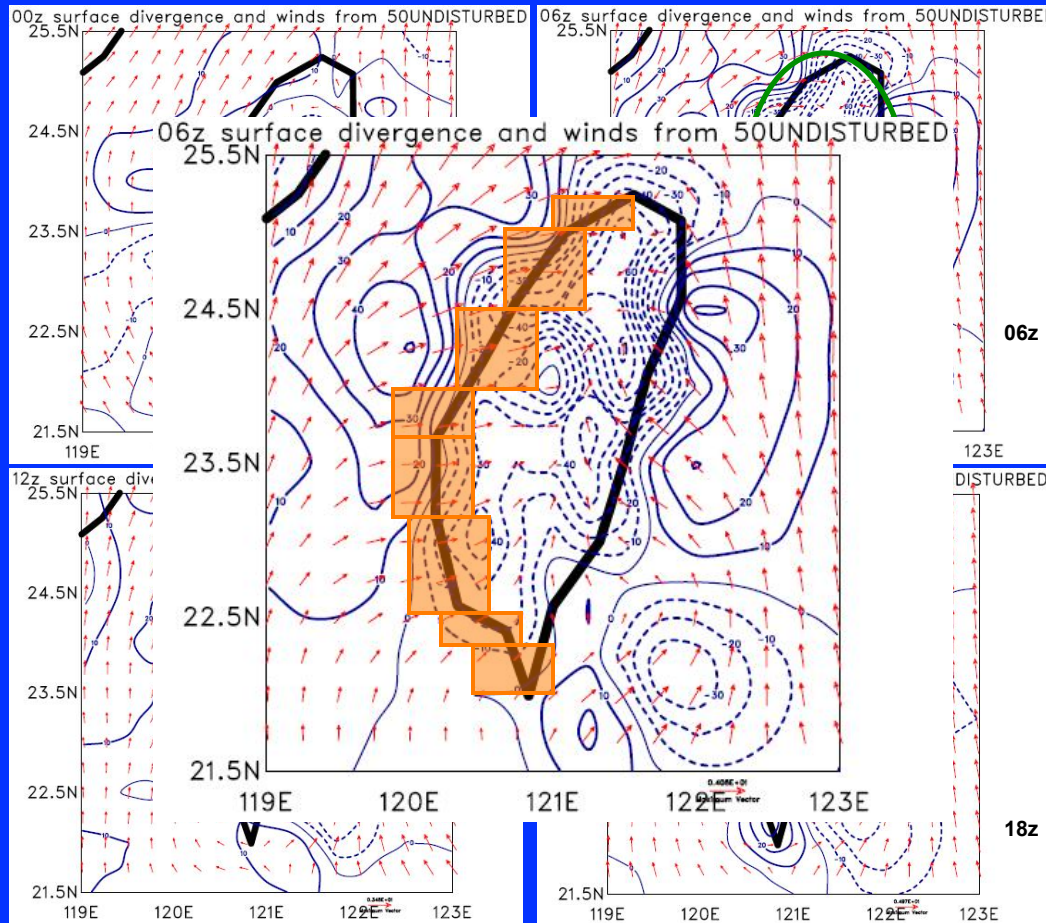
Divergence

Negative divergence
(convergence) near the
surface during the afternoon
of about $9.3 \times 10^{-6} \text{ s}^{-1}$.



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Divergence



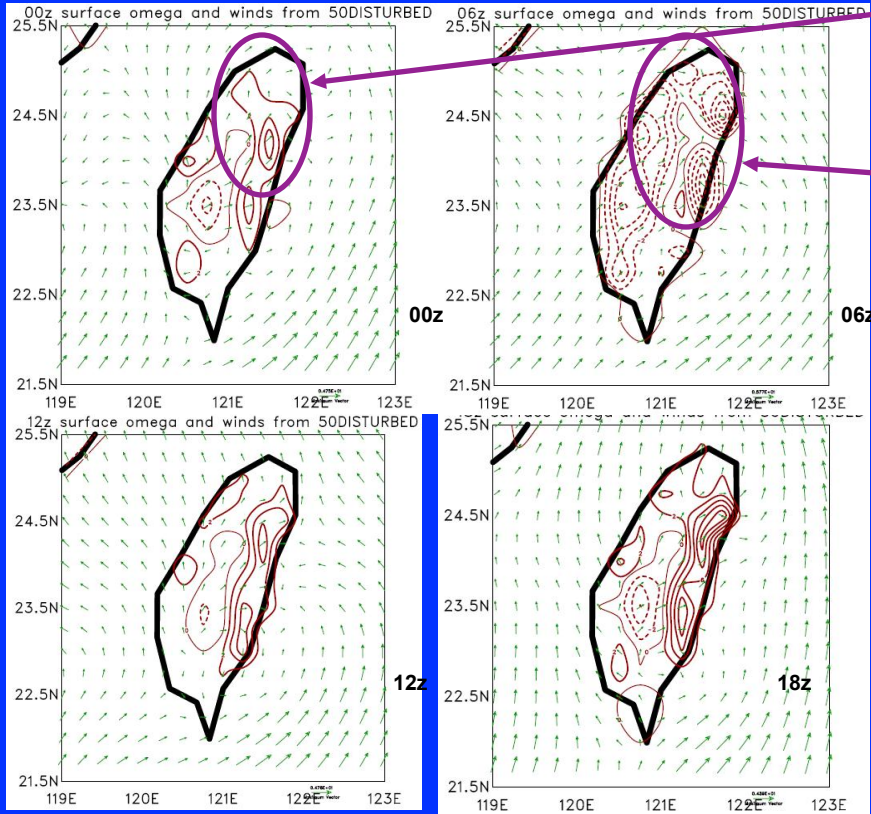
Stronger afternoon surface convergence of around $14.9 \times 10^{-6} \text{ s}^{-1}$.

Winds normal to the coastline was about 109% stronger than the disturbed period.

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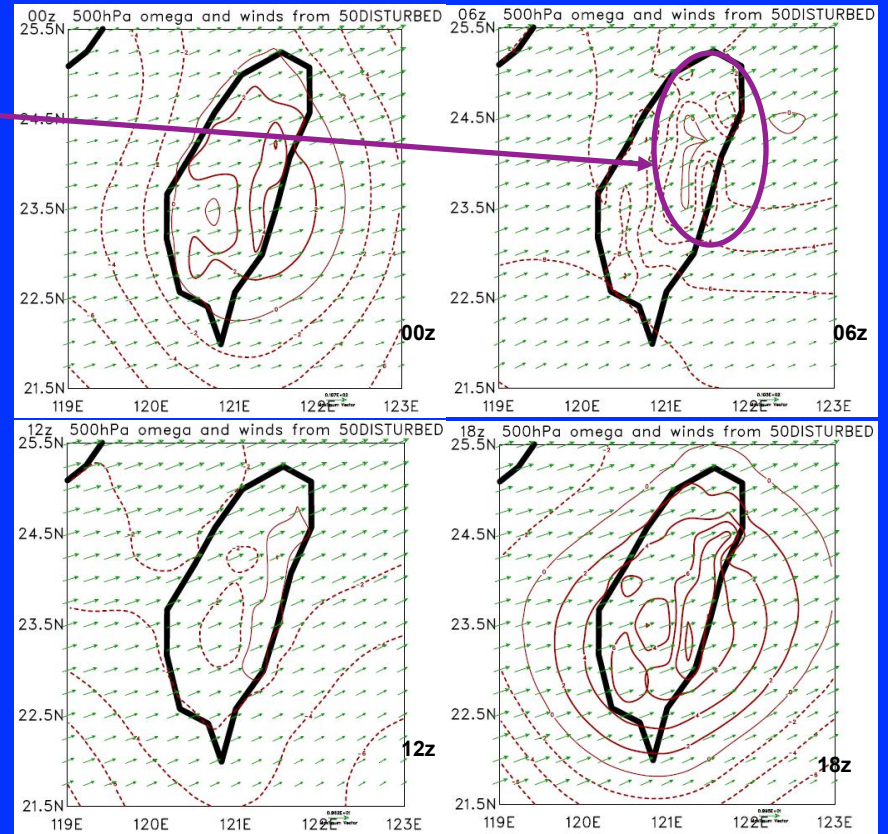
Vertical Motion

Surface



Air was still sinking at 8 AM LT...

500 hPa

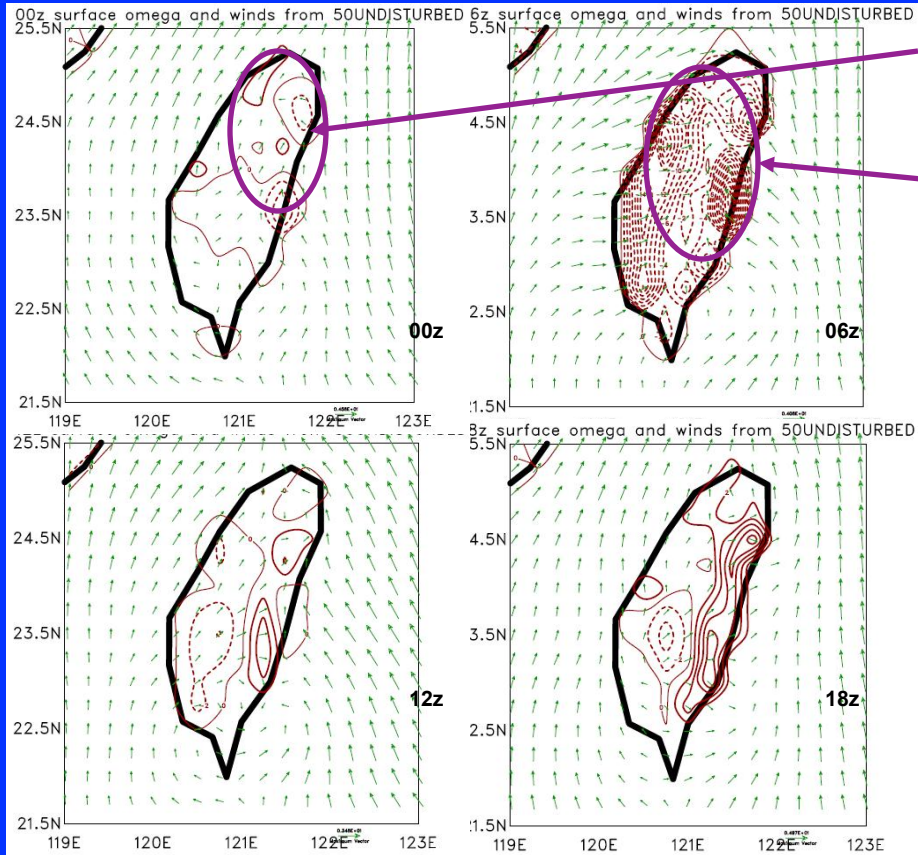


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Less well defined vertical motion signatures at 500 hPa in the afternoon.

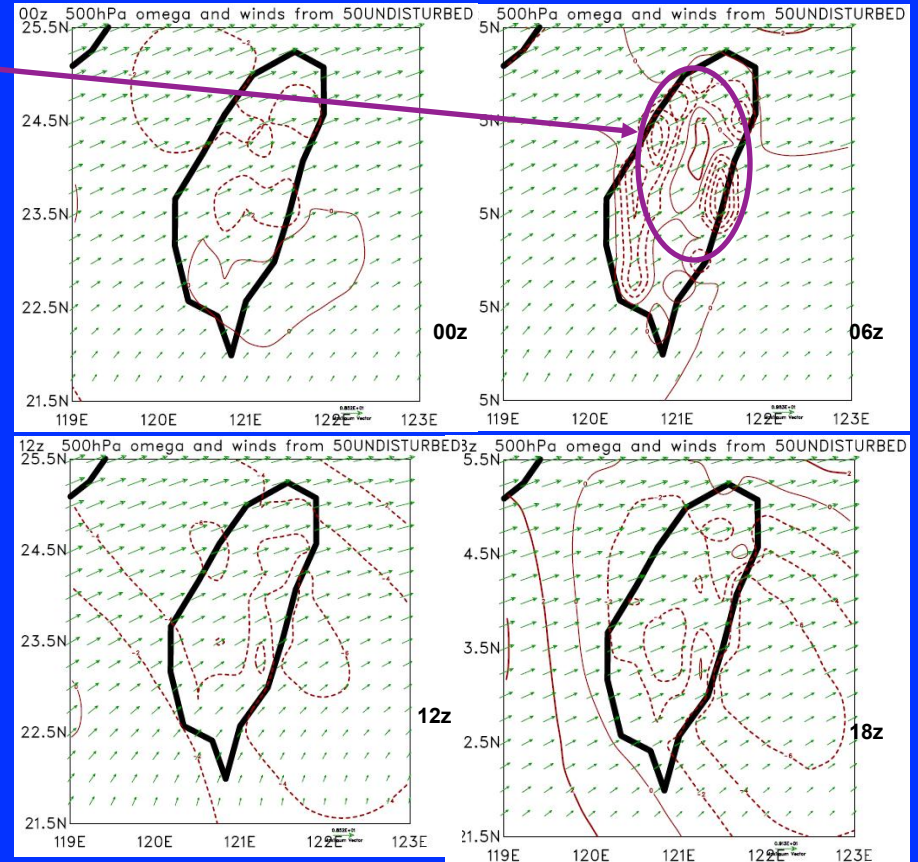
Vertical Motion

Surface



Earlier initiation of upward motion in the east due to morning heating.

500 hPa



Vertical motion well evident even at the 500 hPa level. Indicative of deeper convections.

(Max: -3.4 mb/hr)

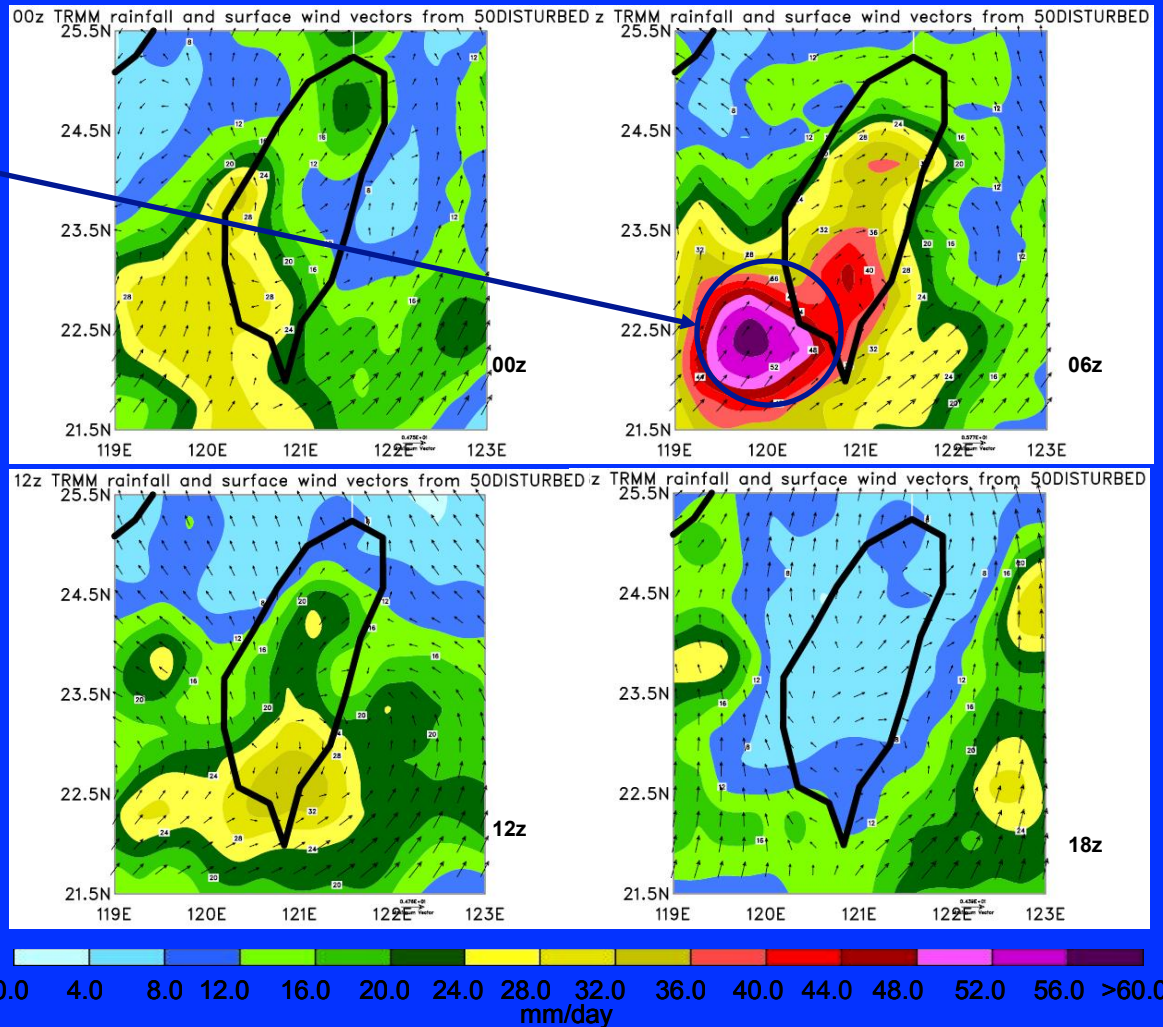
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Diurnal Surface winds and Rainfall rates

Max rainfall rates off southwest shore around 2 PM LST.

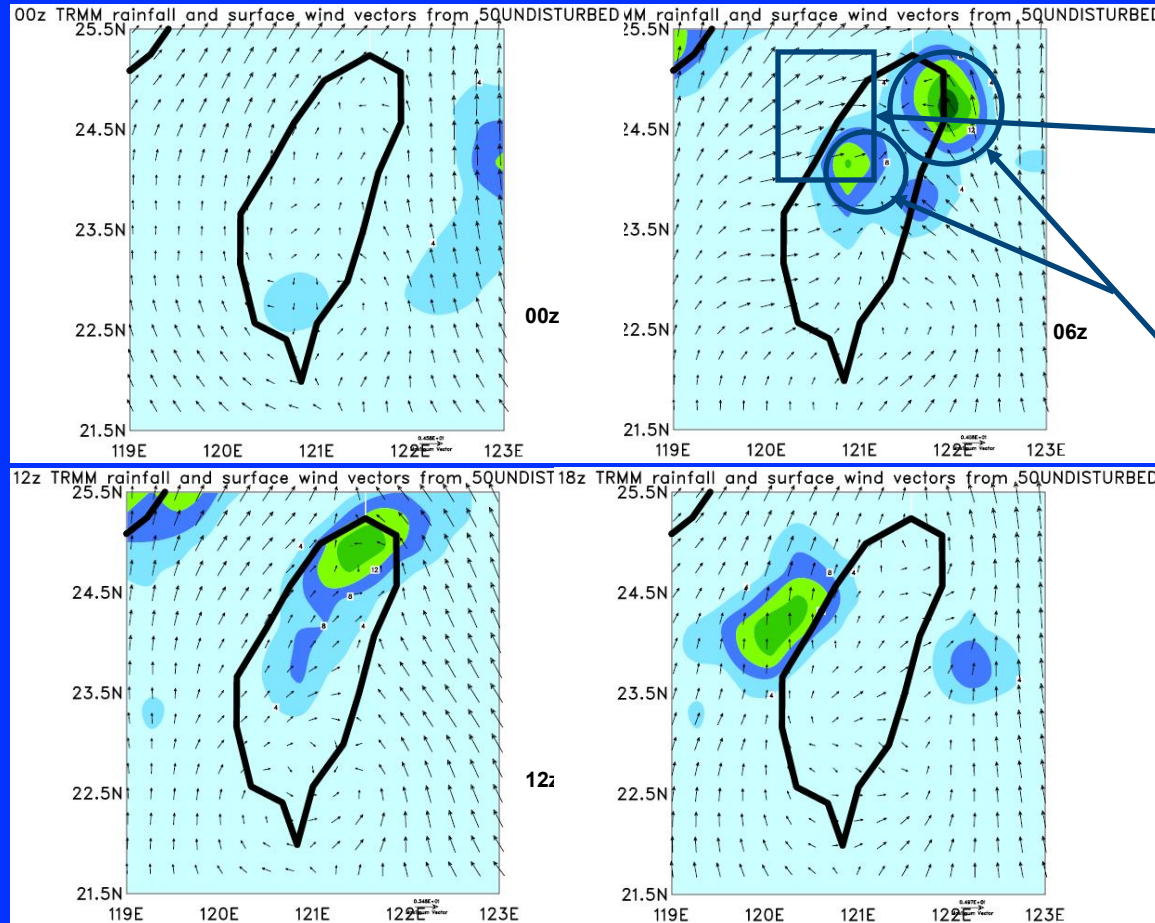
Diurnal cycle?

The rainfall rates not well correlated with areas of max. convergence or upward motion. However, maybe some just off the SW shore. Due to flow blocking?



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Diurnal Surface winds and Rainfall rates



Clear converging winds (about 109% stronger than during the disturbed period) toward the coastline in the afternoon.

Multiple rainfall rate maxima.



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Summary

- Diurnal cycles were present in both cases
- The undisturbed days showed stronger diurnal characteristics. Featured greater potential temperature changes, vertical motion, and surface convergence.
- Limited amount of data (40 days) not enough for statistically significant results. Use 2009 and 2010 TiMREX data catalogs?
- The rainfall rates were the greatest during the disturbed period.
- The differences cannot be entirely attributed to cloud cover.
- Have to take the effects of synoptic features (e.g Mei-yu front) into account in future studies.
- Could incorporate more sophisticated surface heat flux, cloud cover, and surface types data in the future for better numerical modeling of surface flows.

References

- An introduction of SouthWest Monsoon Experiment/Terrain-influenced Monsoon Experiment (SoWMEX/TiMREX). Central Weather Bureau.
<http://sowmex.cwb.gov.tw/index.php>
- Taiwan Association of Hydraulic Engineers. 2010. 降雨量重現期推估之探討—以莫拉克颱風甲仙雨量站為例. Online PDF document retrieved 3 Aug. 2011.
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- Ciesielski, P. E., W. M. Chang, S. C. Huang, R. H. Johnson, J. D. Jou, W. C. Lee, P. H. Lin, C. H. Liu, and J. Wong., 2010; Quality controlled upper-air sounding dataset for TiMREX/SoWMEX: Development and Corrections, Journal of Atmospheric and Oceanic Technology. V27. 1802-1821
- Nuss, W. A., and D. W. Titley, 1994; Use of multiquadratic interpolation for meteorological objective analysis. Monthly Weather Review. V122, 1611-1631

Credits

- Plots were created by using backbone FORTRAN program code for NCARGraphics provided by Paul E. Ciesielski.

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- This work has been supported by the National Science Foundation Science and Technology Center for Multi-Scale Modeling of Atmospheric Processes, managed by Colorado State University under cooperative agreement No. ATM-0425247.

This is a questions slide...