



新型一維雷射式雨滴譜儀及二維光學式雨滴譜儀之雨滴粒徑分佈觀測比較

101年天氣分析與預報研討會

颱風中心 曾吉暉、鳳雷

2012/09/19



前言

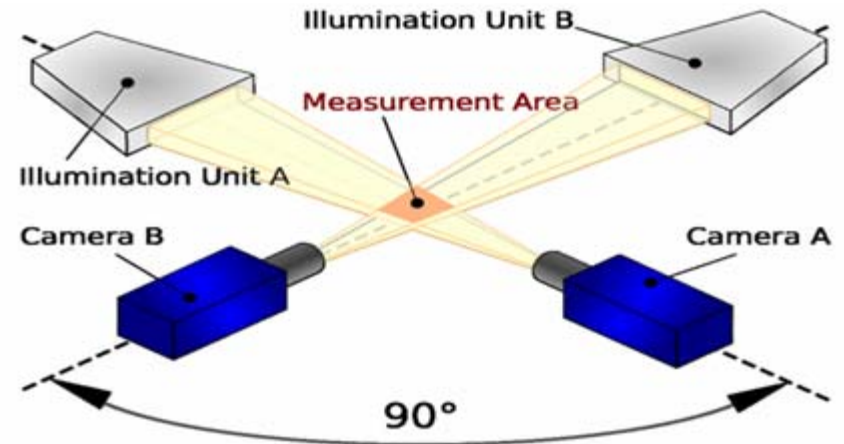
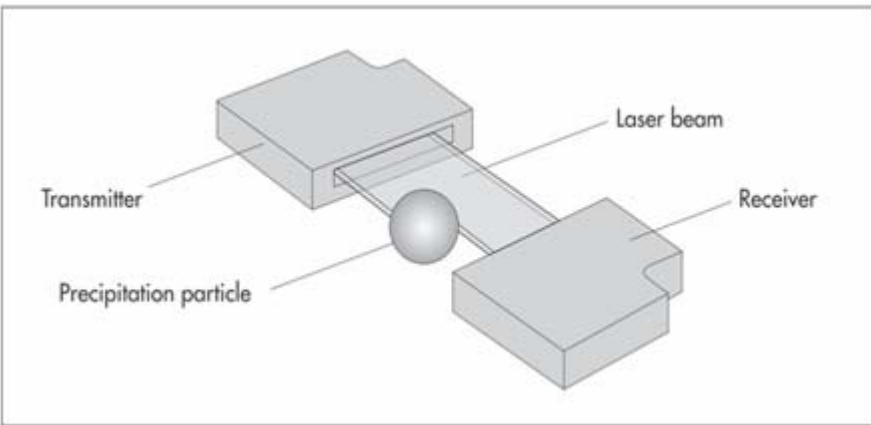
- 雨滴譜(Drop Size Distribution)觀測是對雲及降水物理觀測的重要項目之一。分析雲微物理結構特徵，將有助於對降水機制的瞭解。
- 雨滴譜研究主要有兩種方式。一是對於特定地區不同時間採取多次降雨過程的雨滴譜資料進行分析研究。這對於瞭解一個地區的降雨特徵與形成機制有所幫助。
- 另一是對特定的天氣系統進行分析研究，通常經由相同的天氣系統在不同水平地點的雨滴譜儀觀測資料分析，對於整個系統的微物理變化過程可以有所瞭解。

雨滴譜儀及觀測原理

一維雷射式 (Parsivel)



二維光學式 (2DVD)



雨滴譜儀觀測實驗


- 2011/5/18接收雨滴譜儀並安裝至中央大學
 - 2DVD及P001
- 2011/5/26安裝至氣象局嘉義氣象站
 - 2DVD及P001
- 2011/7/12安裝至中央大學
 - 2DVD及P001
- 2011/8/25安裝至阿里山國小
 - 2DVD及P002
- 2011/10/31安裝至中央大學
 - 2DVD及P001、P002




Parsivel於2011/9/15之前大部份僅有圖像資料



雨滴譜儀簡介






一維光學式雨滴譜儀
Parsivel



二維光學式雨滴譜儀
2D Video Distrometer

觀測原理：
利用雨滴落下時透過光學影像記錄器所產生的影像計算出不同大小直徑的雨滴在單位時間通過探區的個數。

用途：
描述降雨的雨滴譜，即單位體積中不同直徑雨滴的顆粒數。

一維光學式雨滴譜儀紀錄的雨滴數及雨滴落速分佈圖

二維光學式雨滴譜儀紀錄的雨滴扁平率分佈圖

西南氣流實驗(SOMEX)期間，二維光學式雨滴譜儀在北山觀測到8mm直徑巨型雨滴，造成頻雷達回波明顯衰減現象

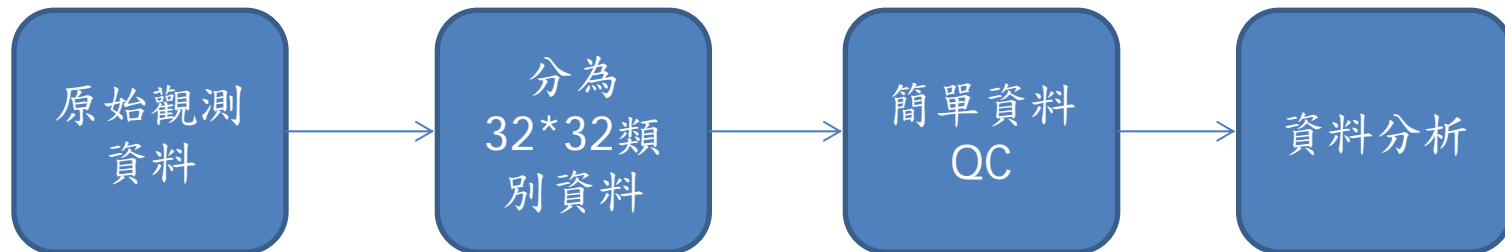
資料處理

Parsivel資料：

- 取樣時間解析度0.1 ms，輸出資料時間解析度5 secs~24 hrs
- 最小可解析粒徑0.025 mm，最小終端落速解析度0.1 m/s
- 粒徑及終端落速各分為32類記錄雨滴譜

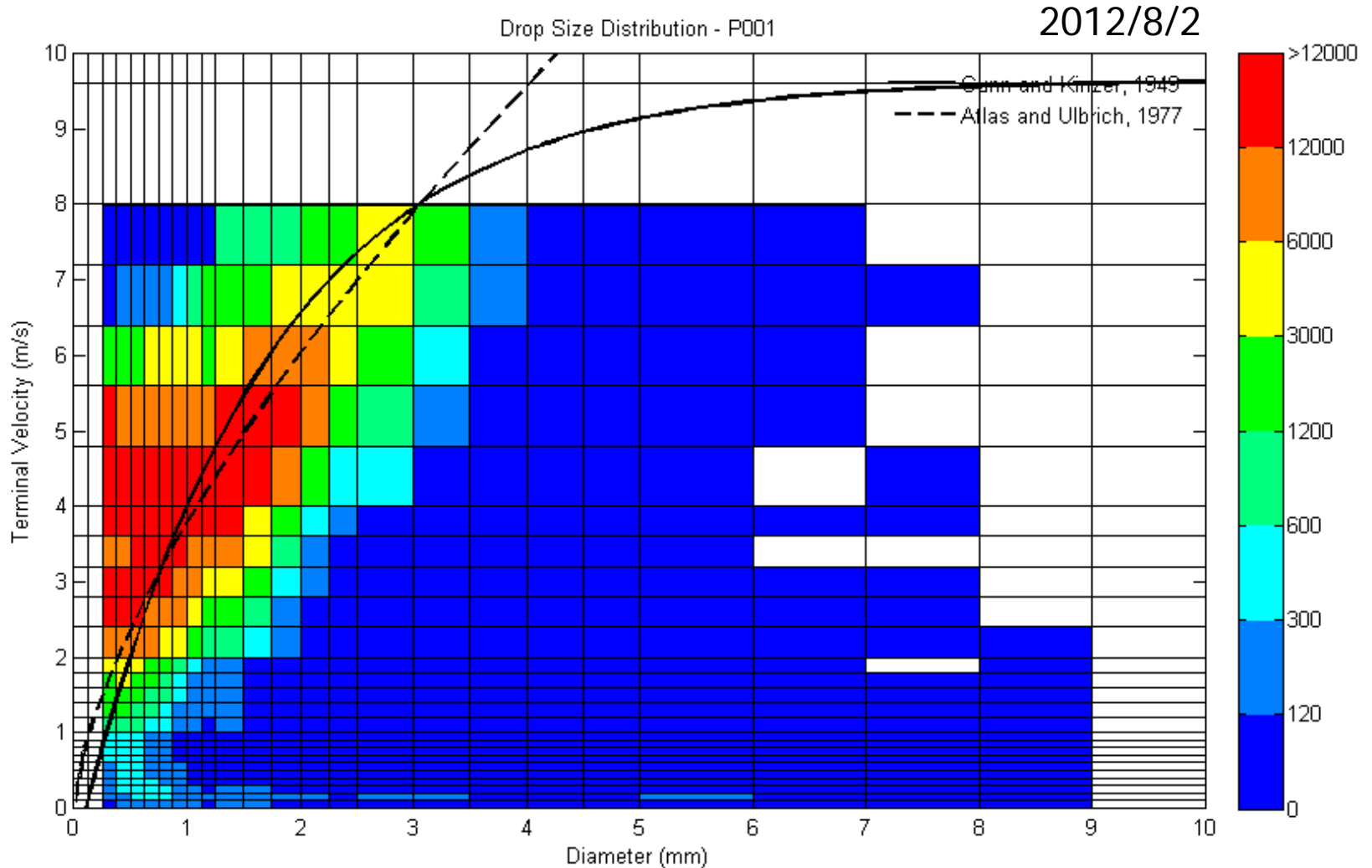
2DVD資料：

- 取樣時間解析度0.1 ms，輸出時間解析度3 secs
- 最小可解析粒徑0.01 mm，最小終端落速解析度0.01 m/s
- 每個雨滴單獨記錄資訊，無分類



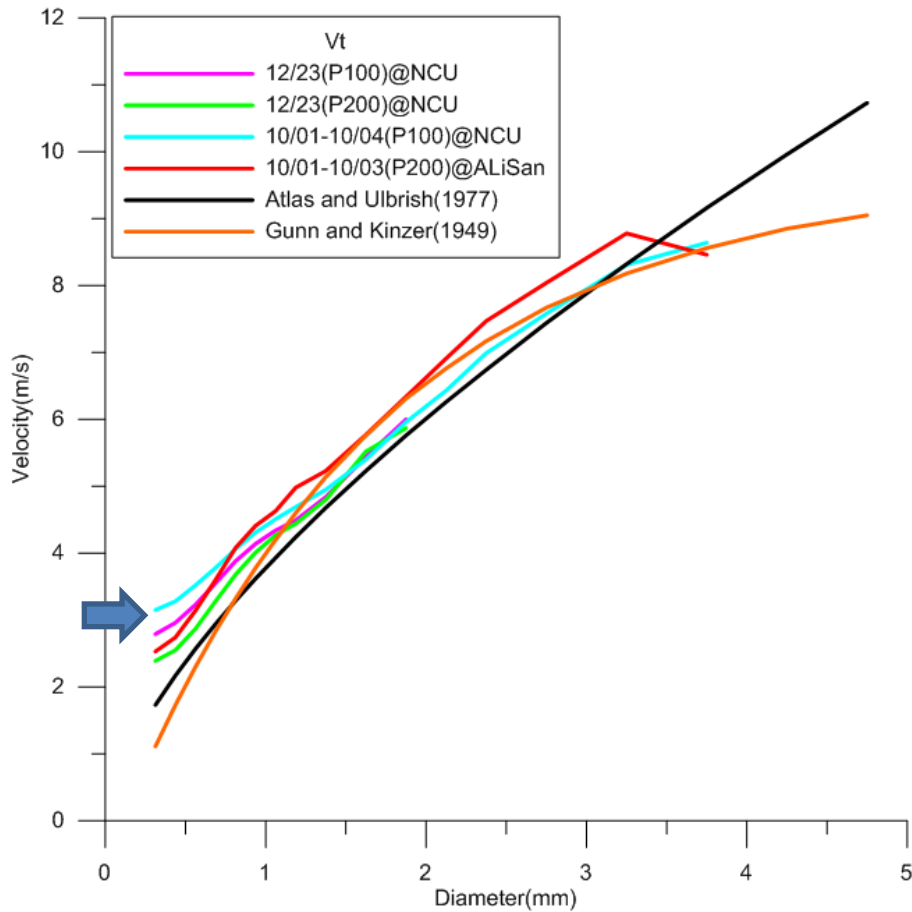
雨滴譜分析分類

-粒徑及終端落速各分為32類

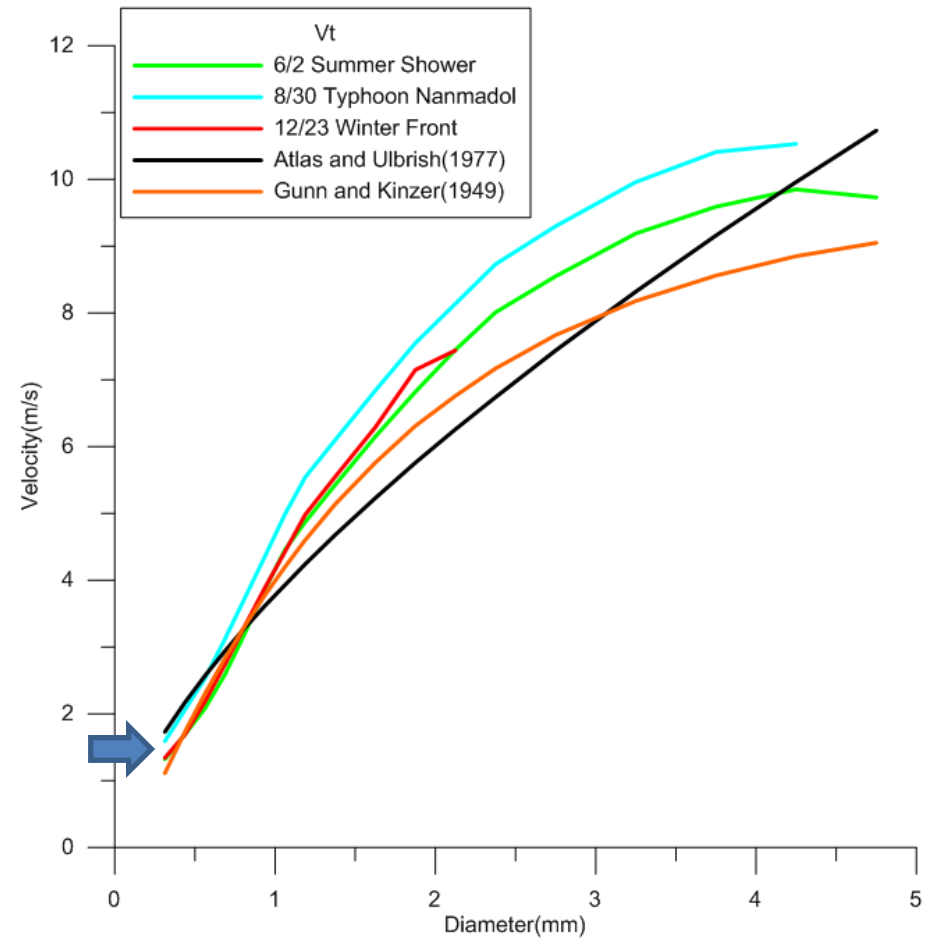


觀測資料-Vt(終端落速)

Parsivel



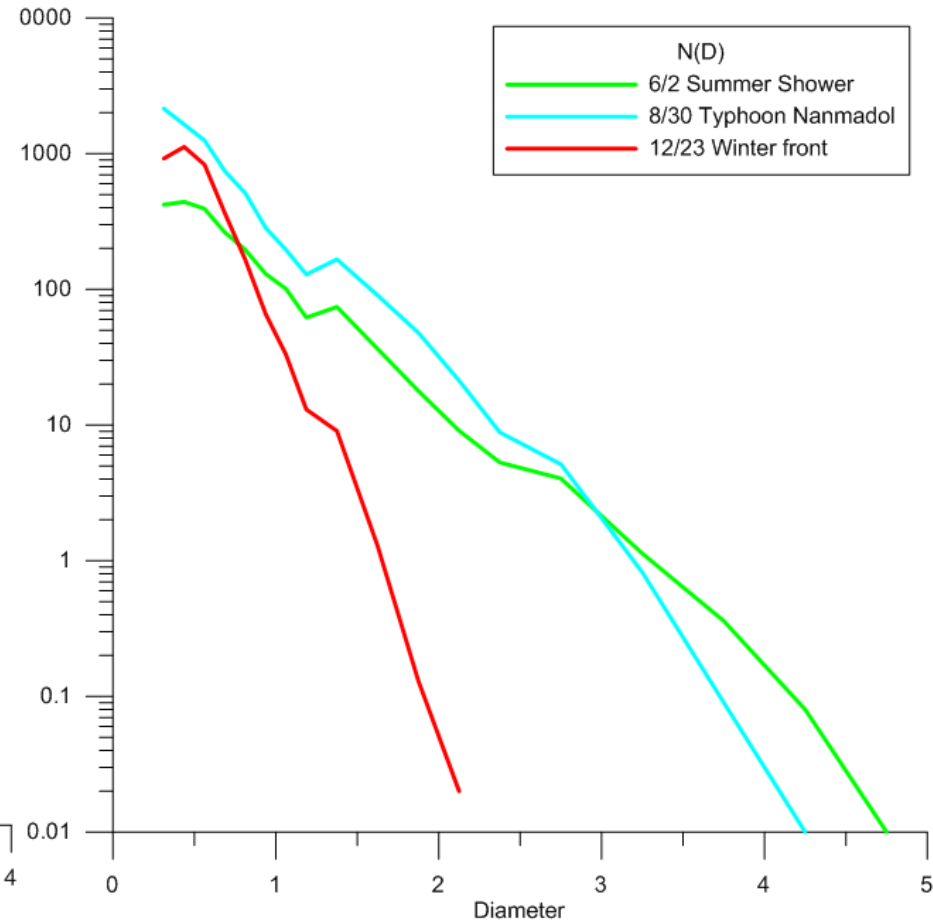
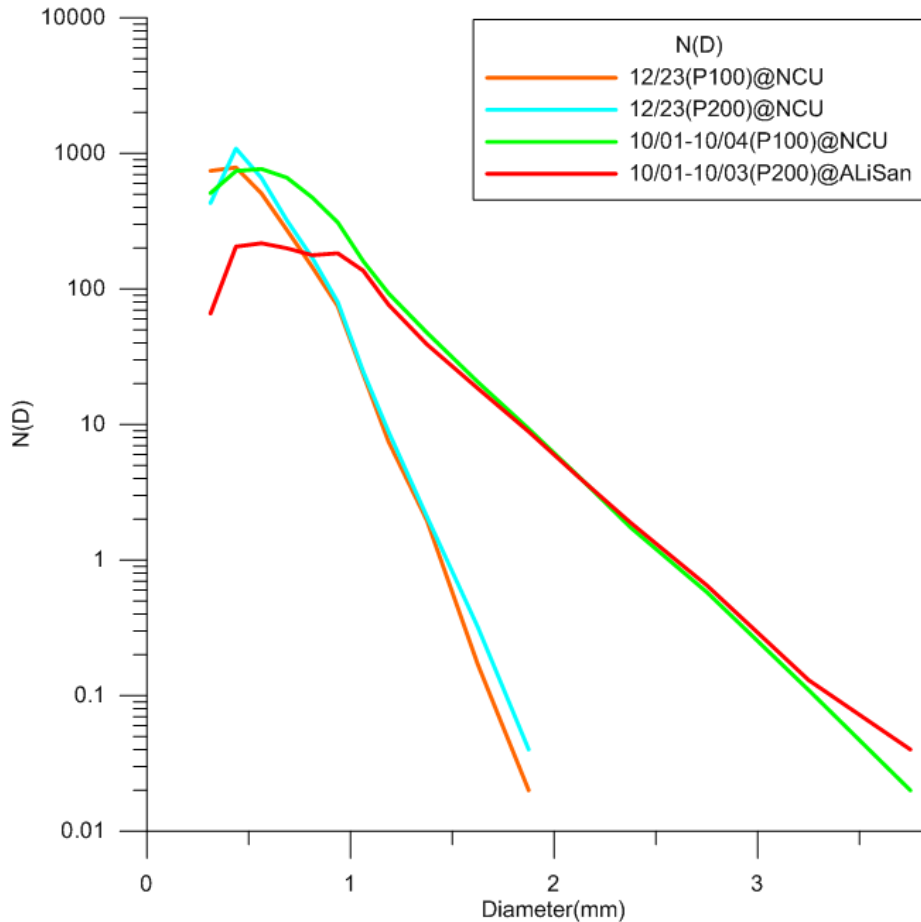
2DVD



觀測資料-N(D)(雨滴譜分佈)

Parsivel

2DVD

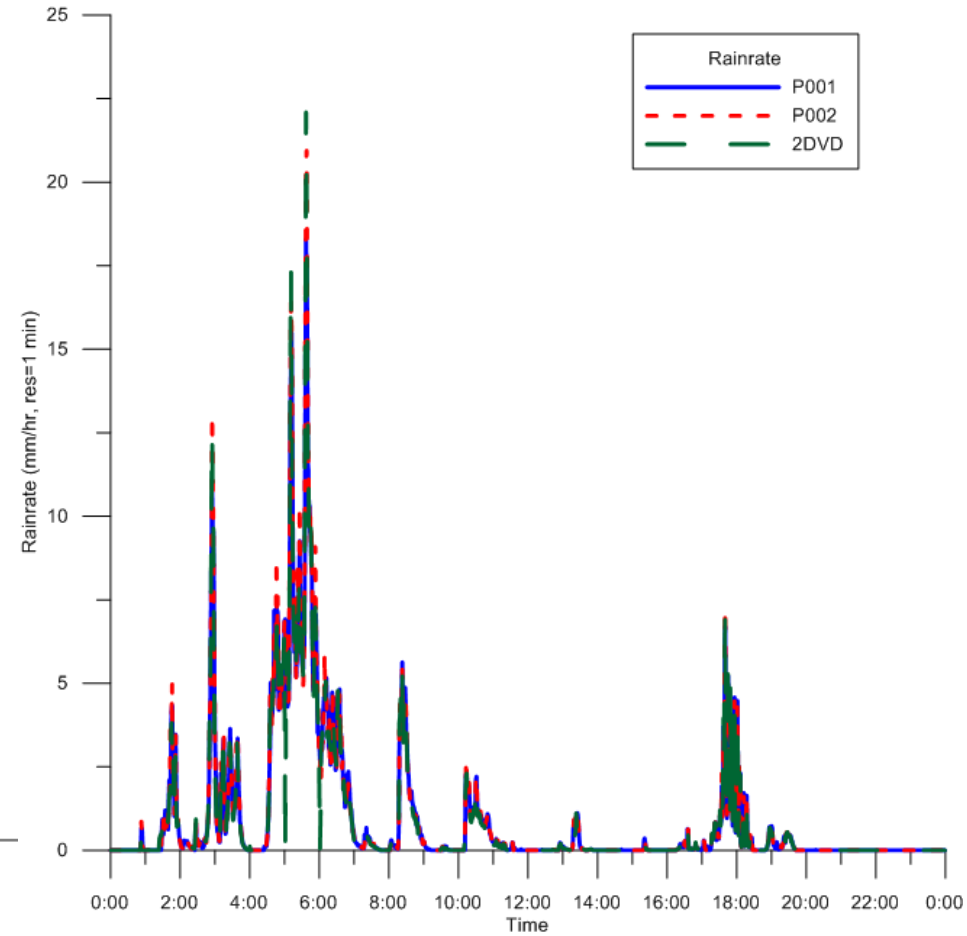
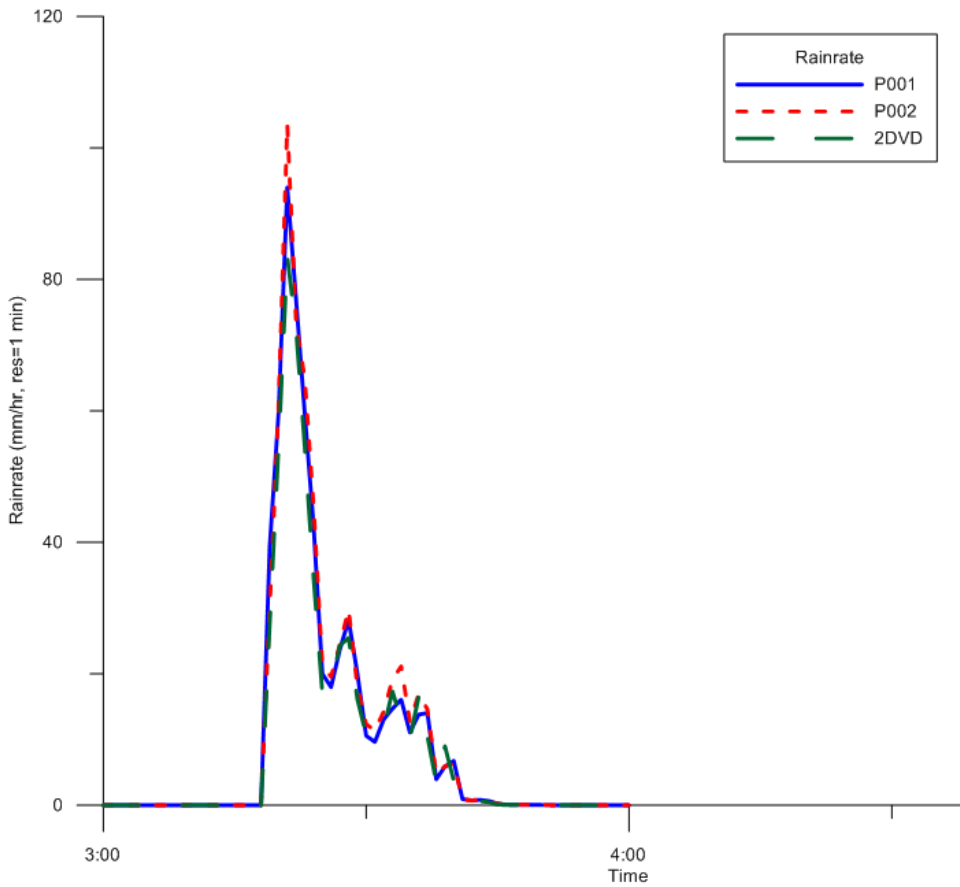


觀測資料-降雨率

Time Res.=1 min

2012/05/28

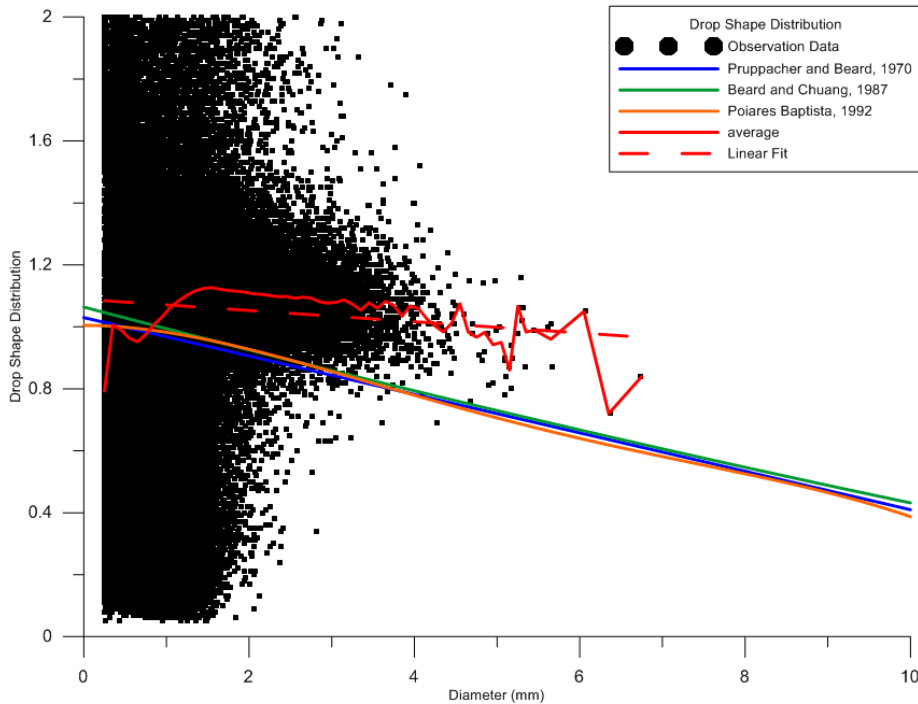
2012/05/10



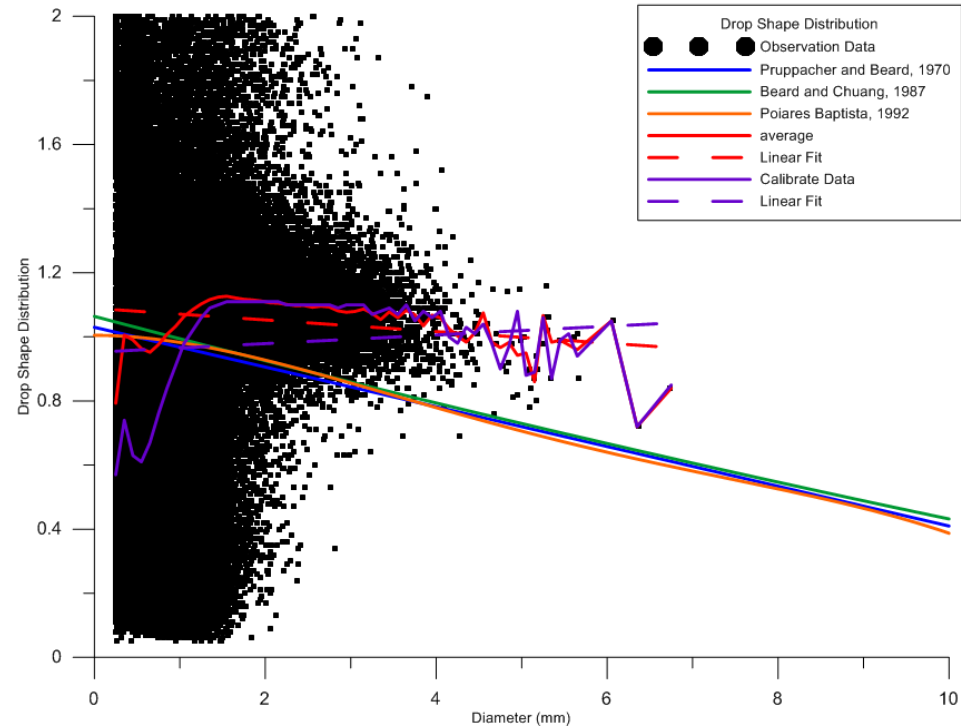
2DVD觀測資料-OBL(扁平度)

Drop Shape Distribution

Drop Shape Distribution (0225)



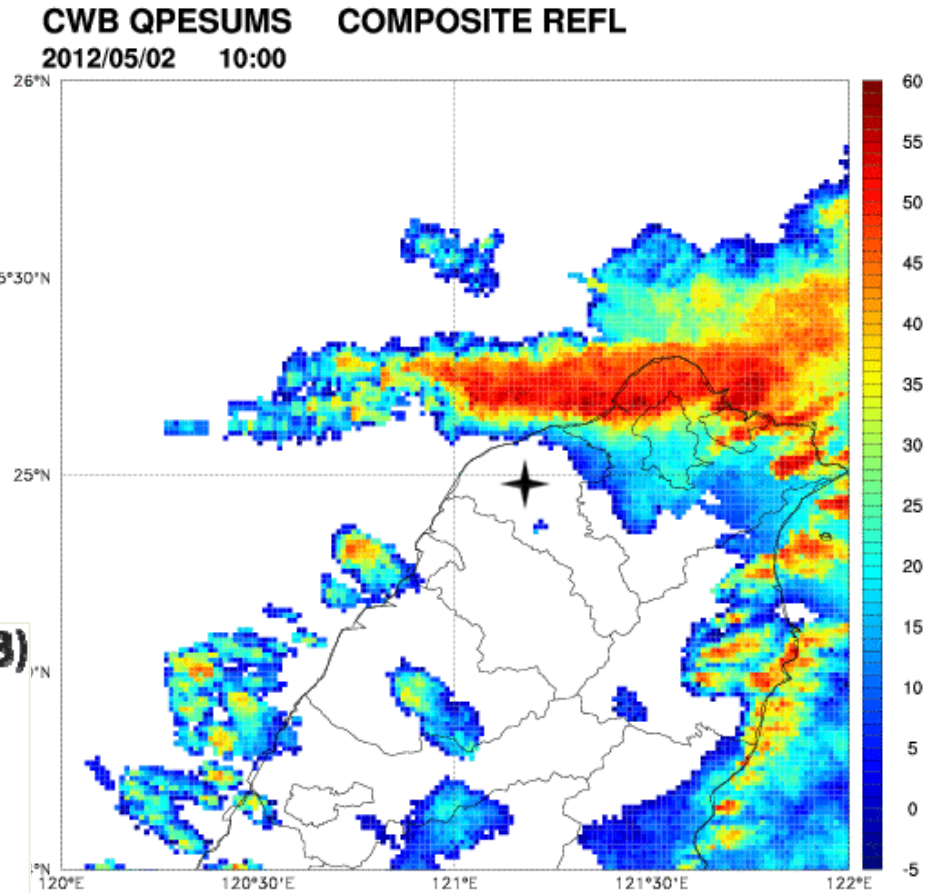
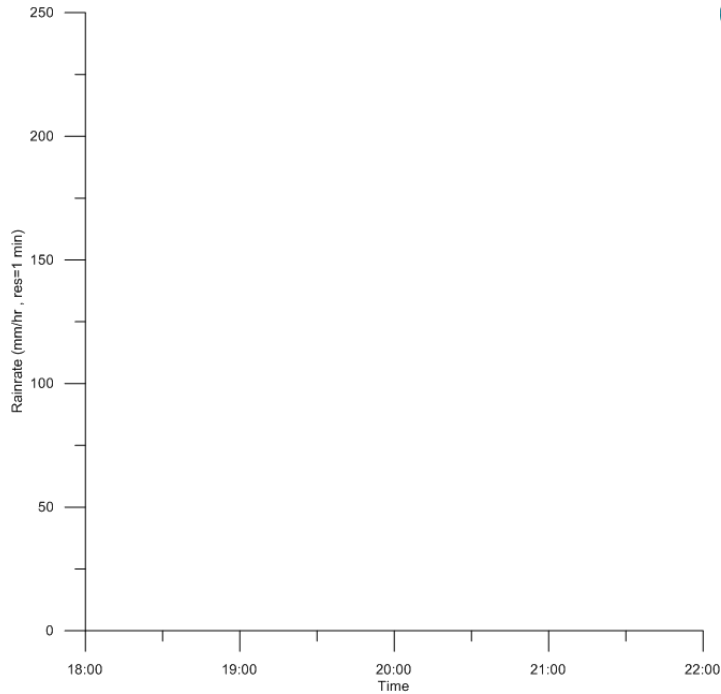
Drop Shape Distribution (0225)



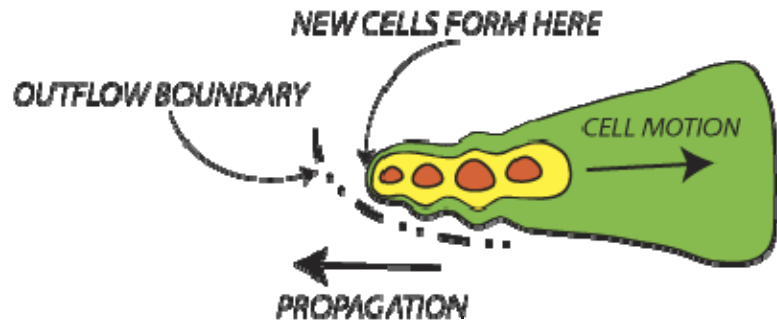
出廠參數

修正參數

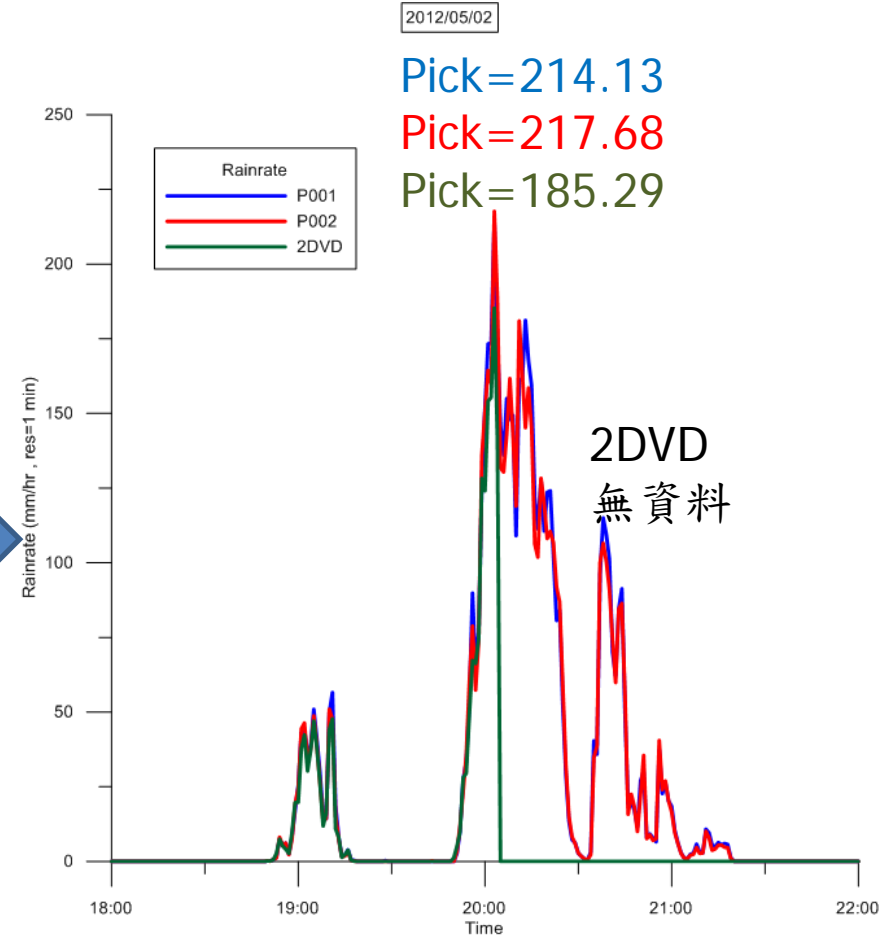
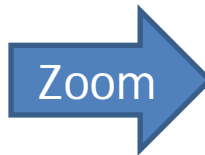
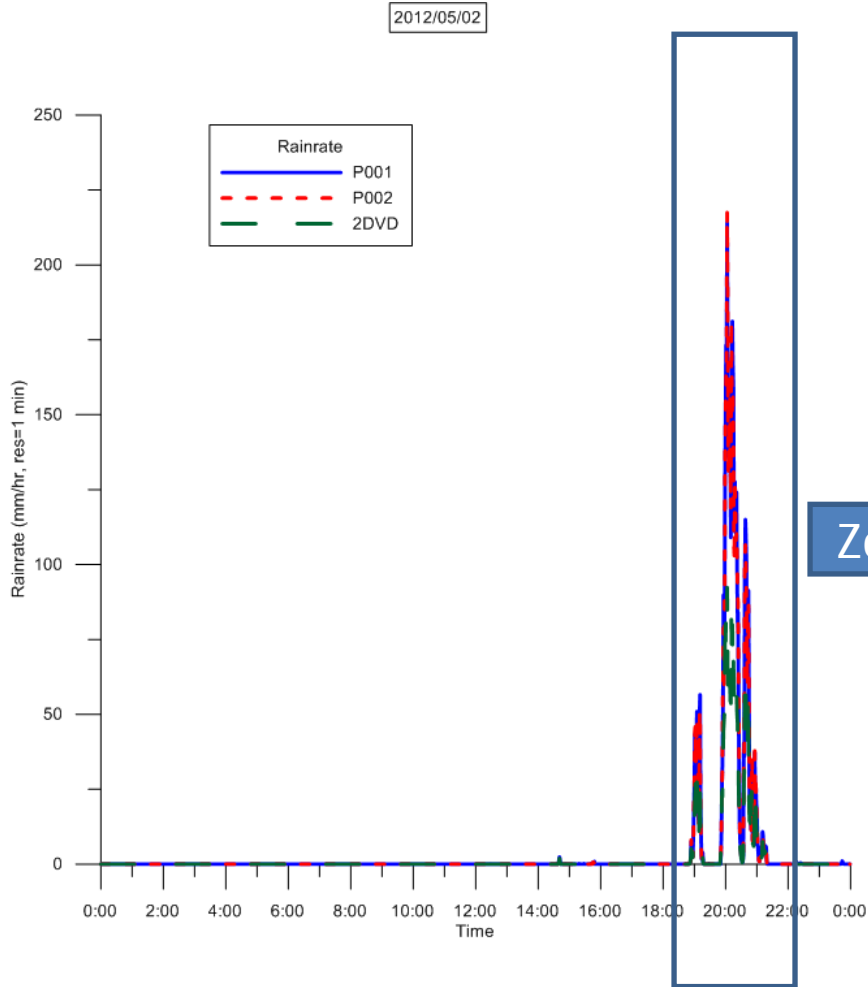
強降水個案 (2012/05/02)



B) BACKBUILDING / QUASI-STATIONARY (BB)



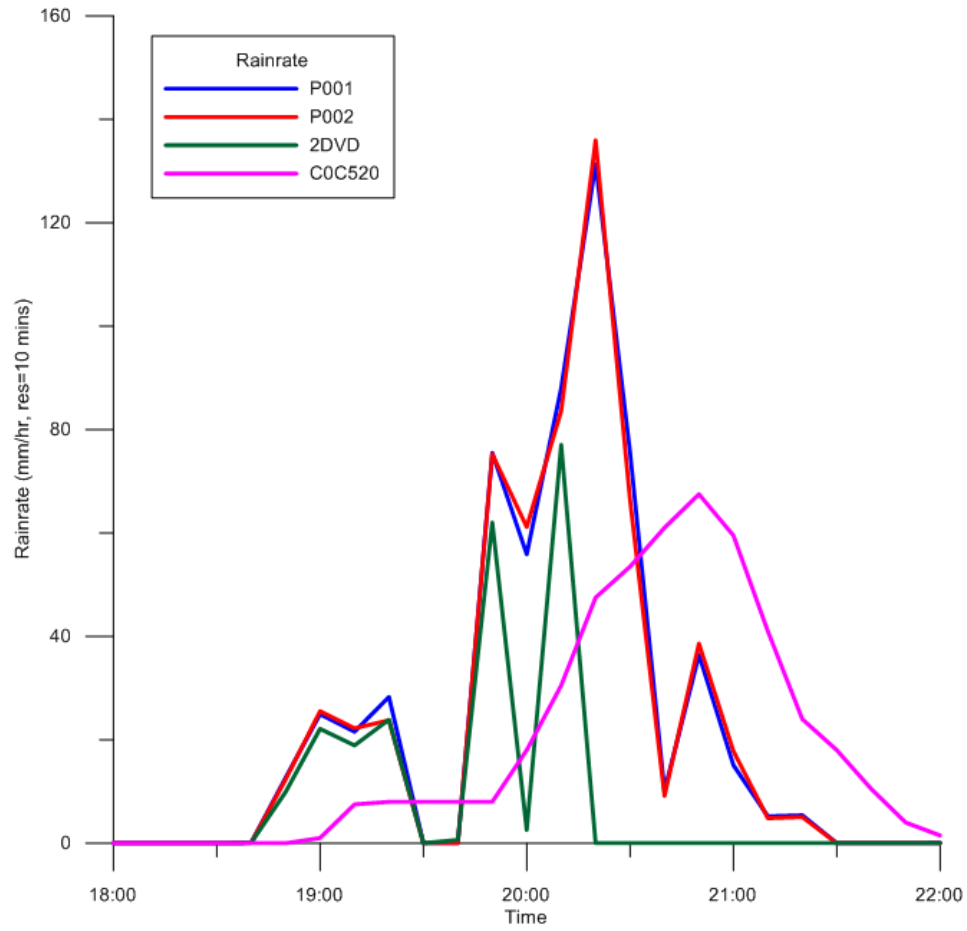
降雨率



降雨率

2012/05/02

Res=10 mins

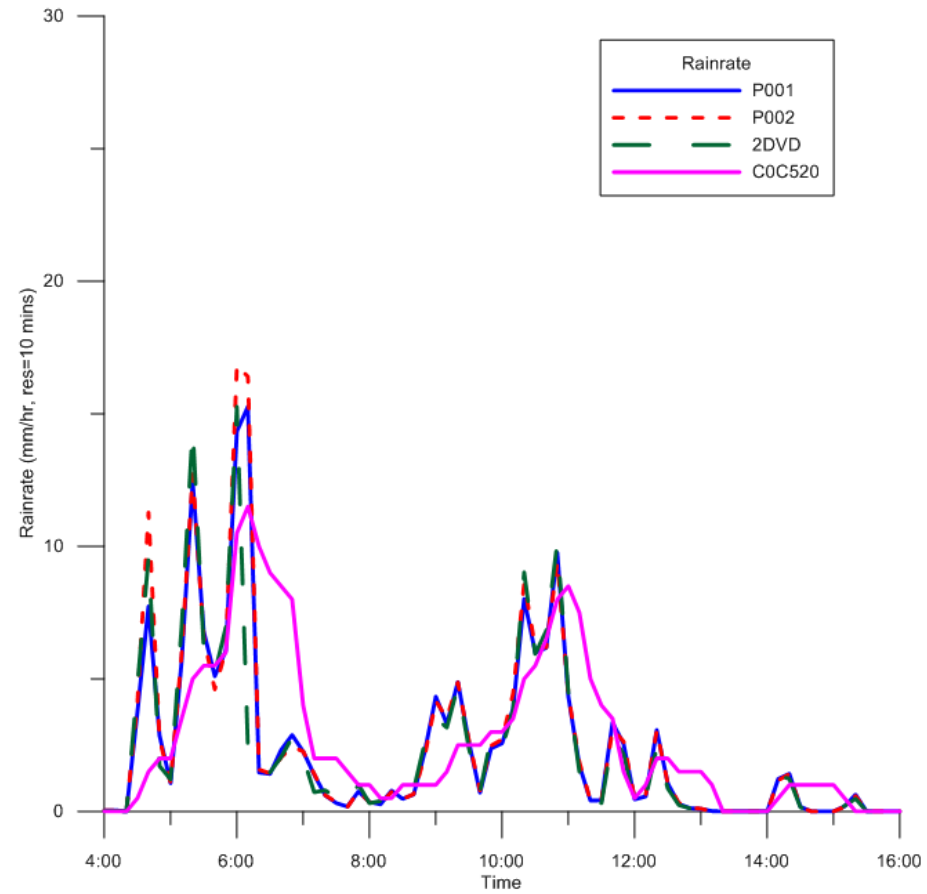
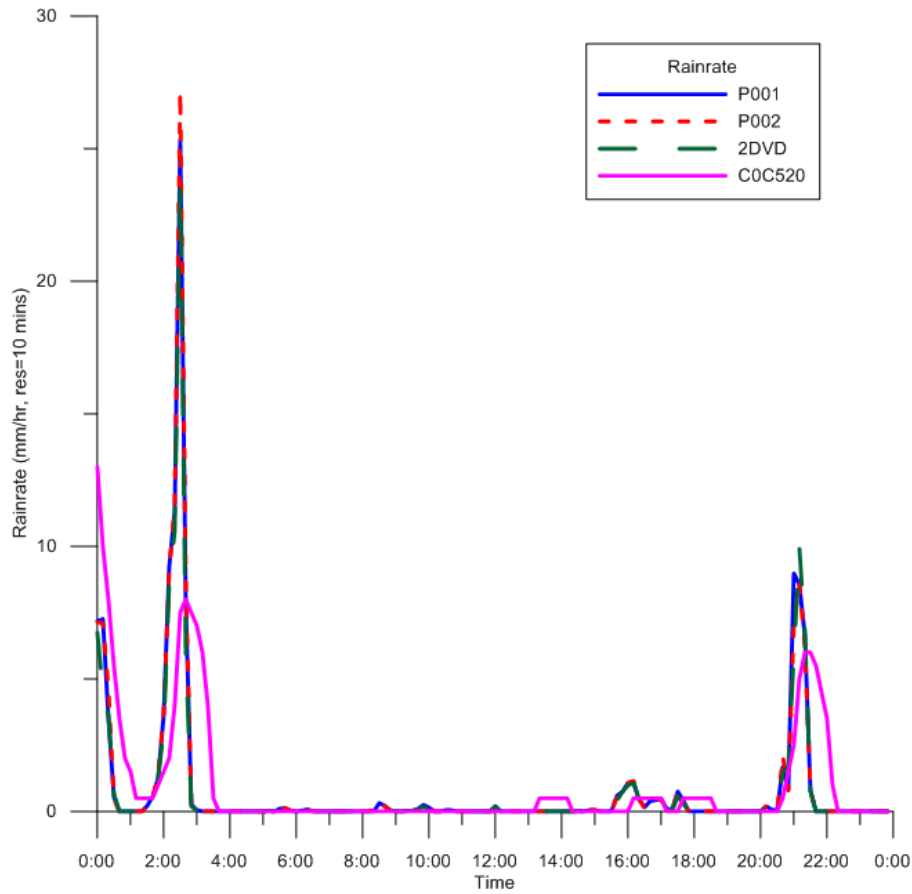


降雨率

Res=10 mins

2012/05/19

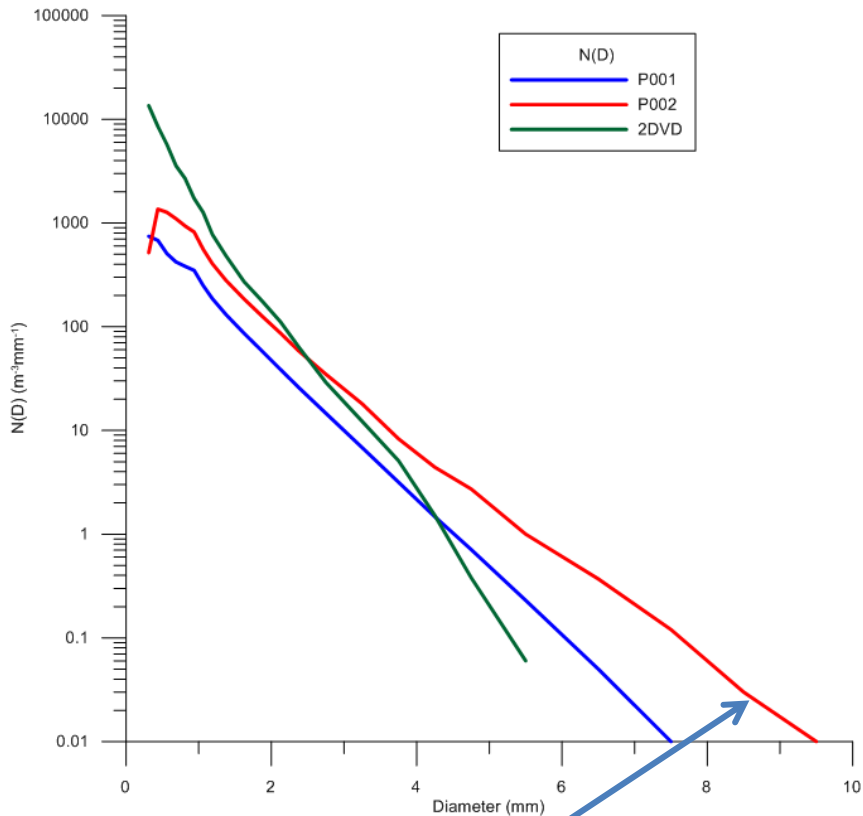
2012/05/20



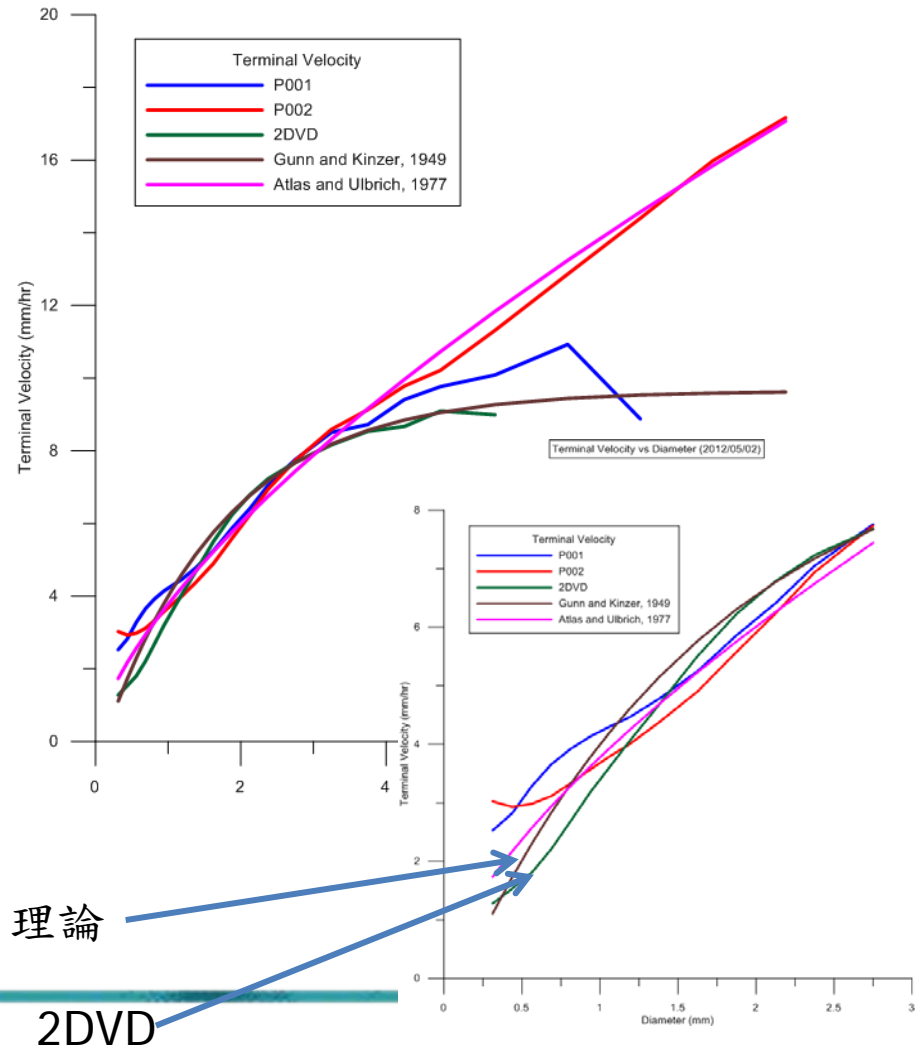
粒徑顆粒及終端落速

N(D) vs Diameter (2012/05/02)

Terminal Velocity vs Diameter (2012/05/02)



最大粒徑=8.5mm~10.5mm



理論

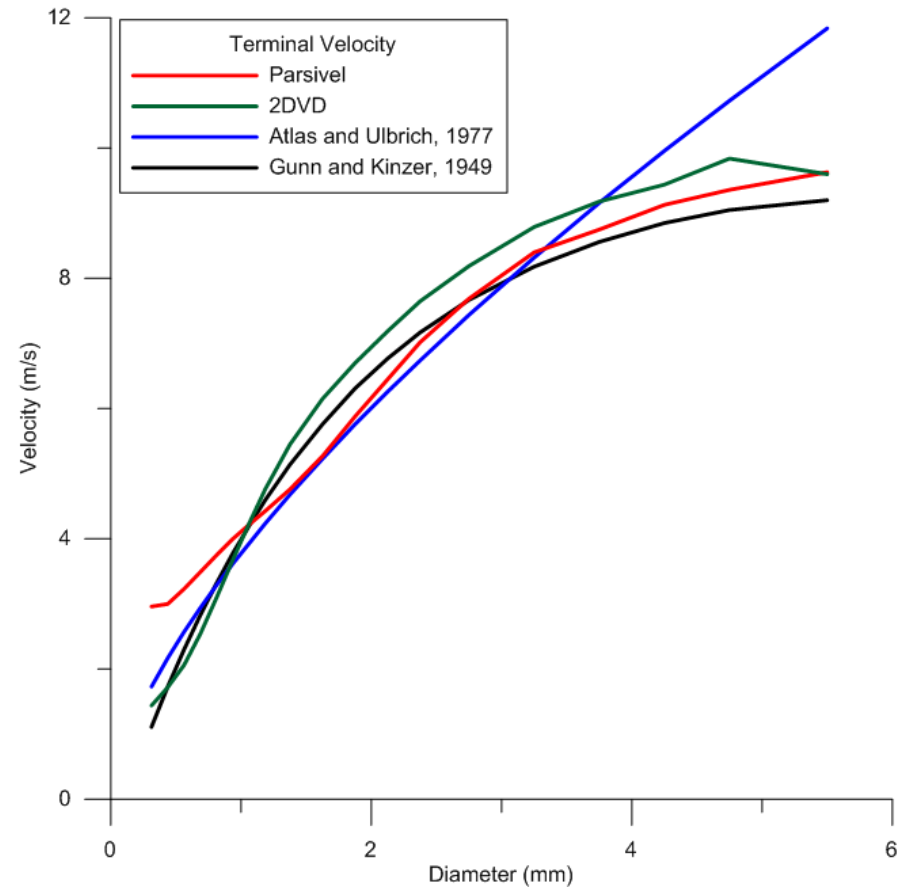
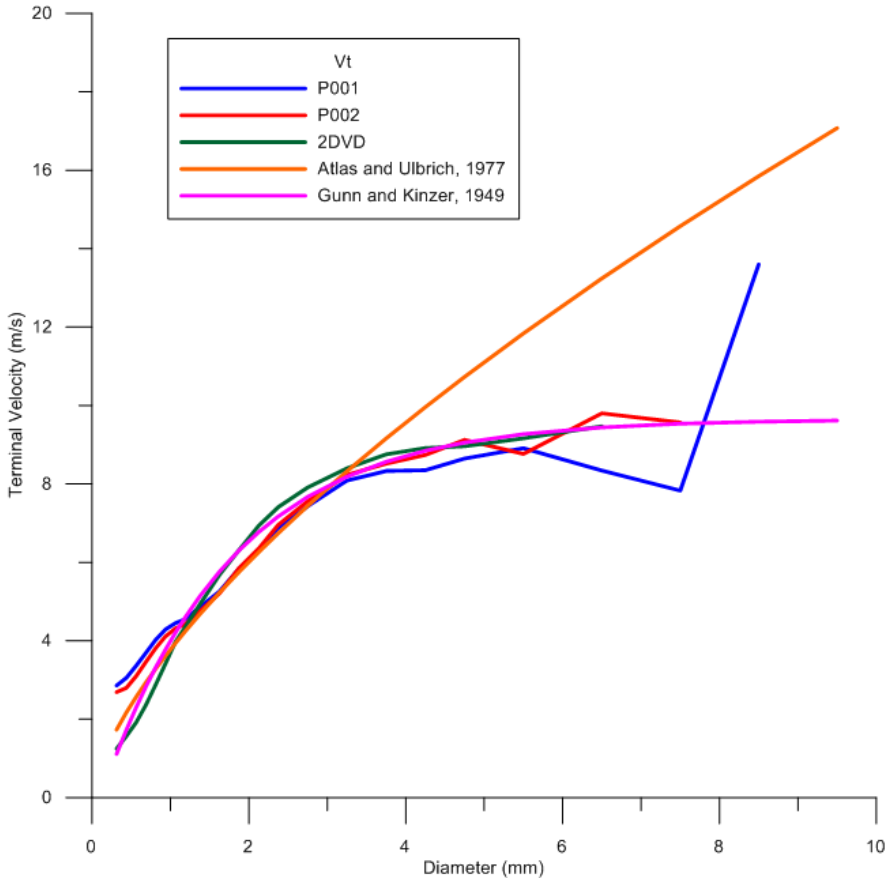
2DVD

終端落速

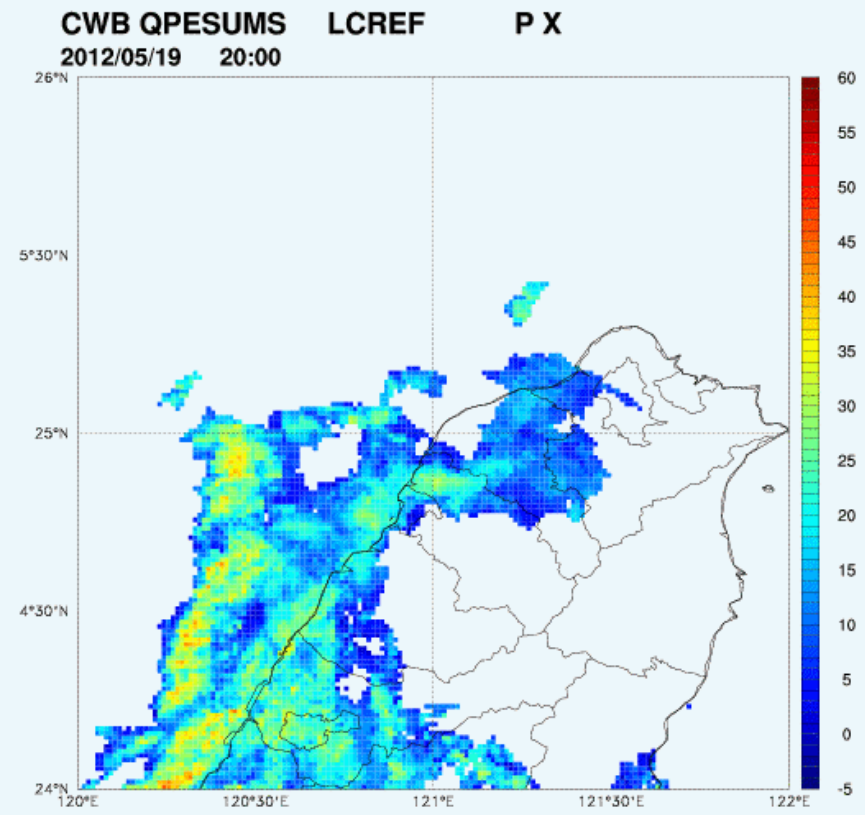
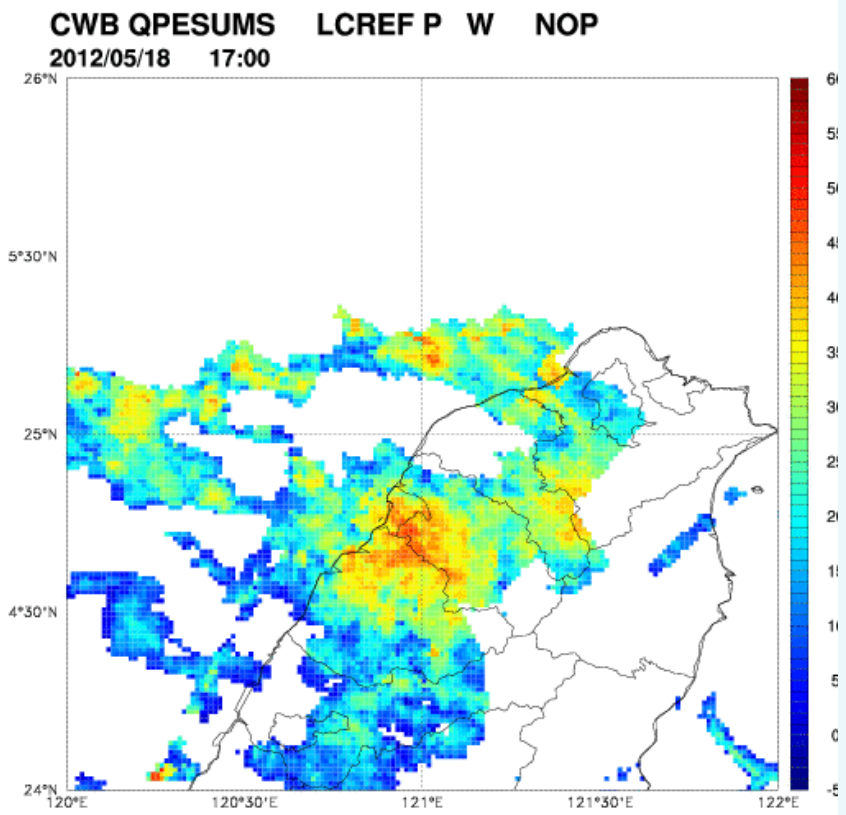
2012/05/10

2012/02/25, All Rainrate

冬天



強降水個案 (2012/05/19-20)



0519

RCWF=OOF

0520

降雨率

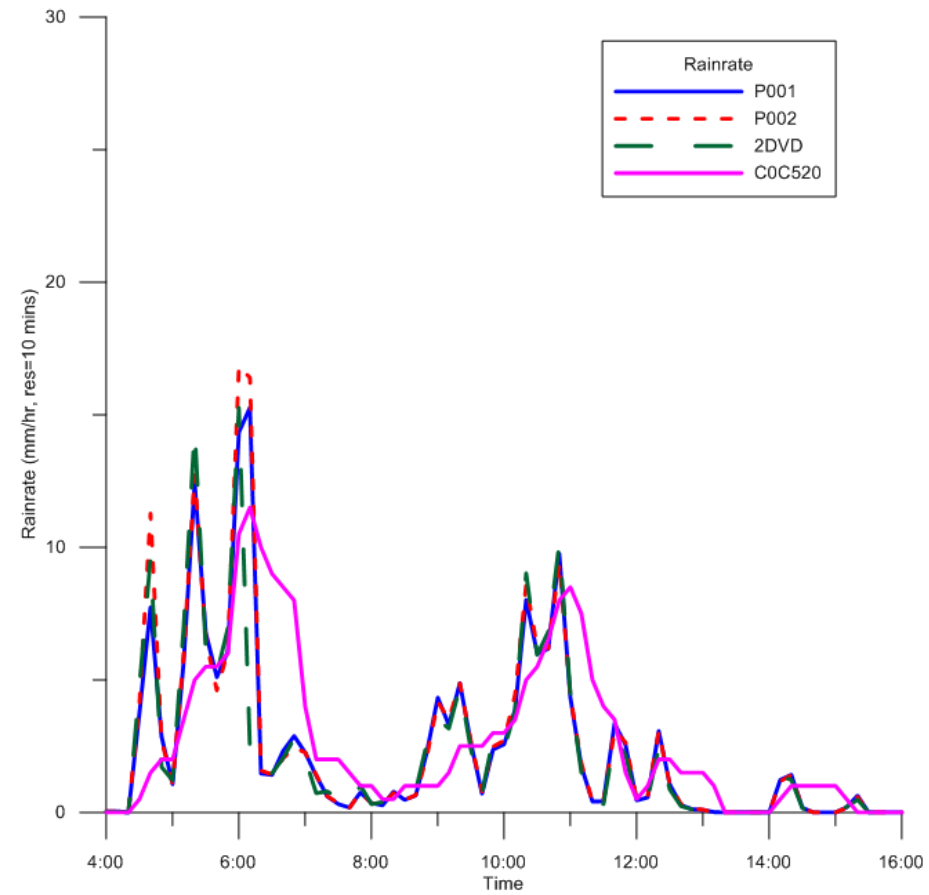
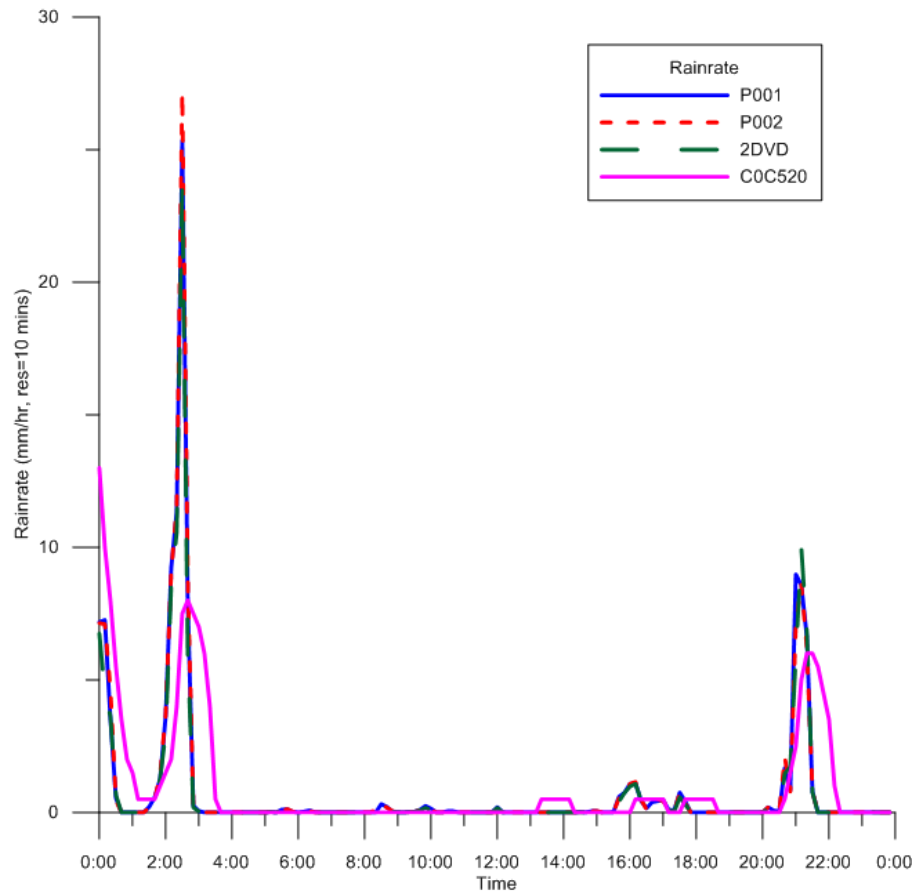
Res=10 mins

0519

2012/05/19

2012/05/20

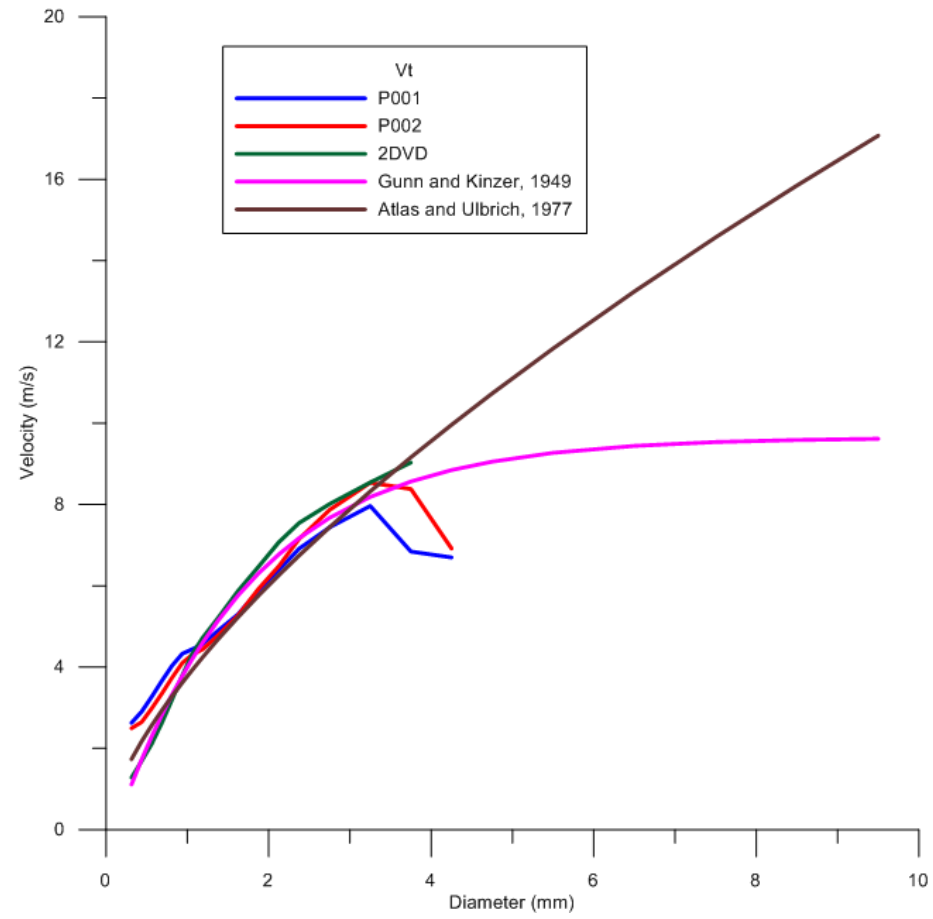
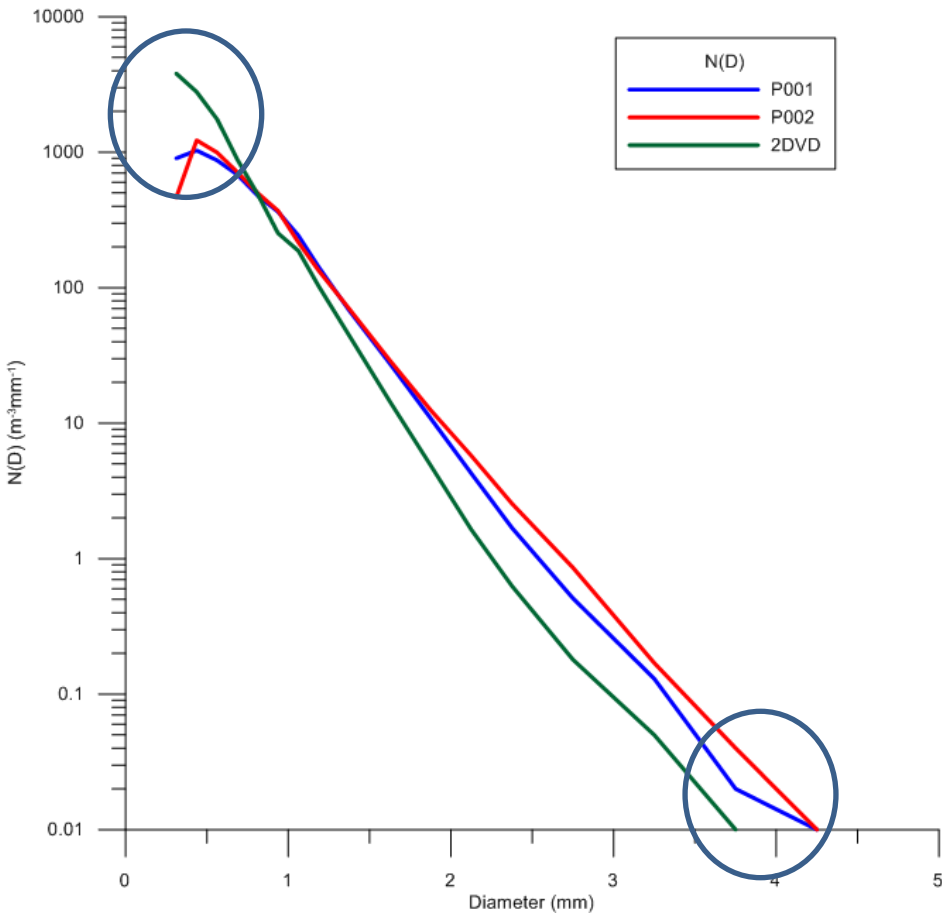
0520



粒徑顆粒及終端落速

2012/05/19-2012/05/20

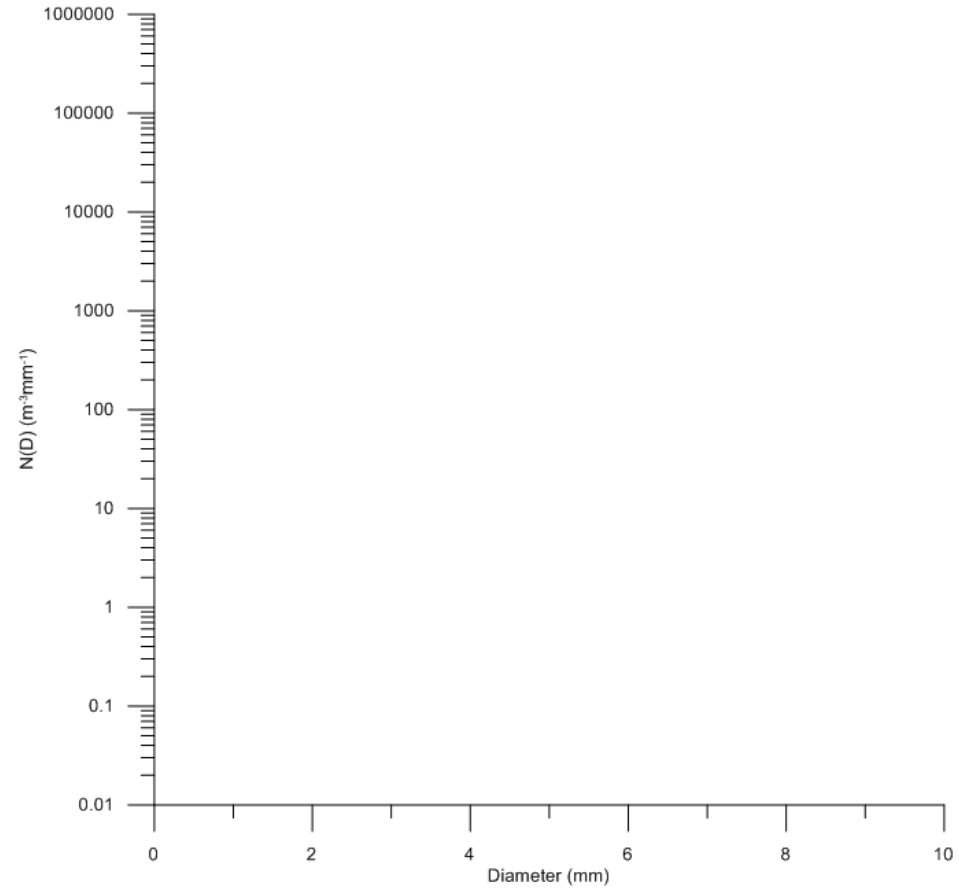
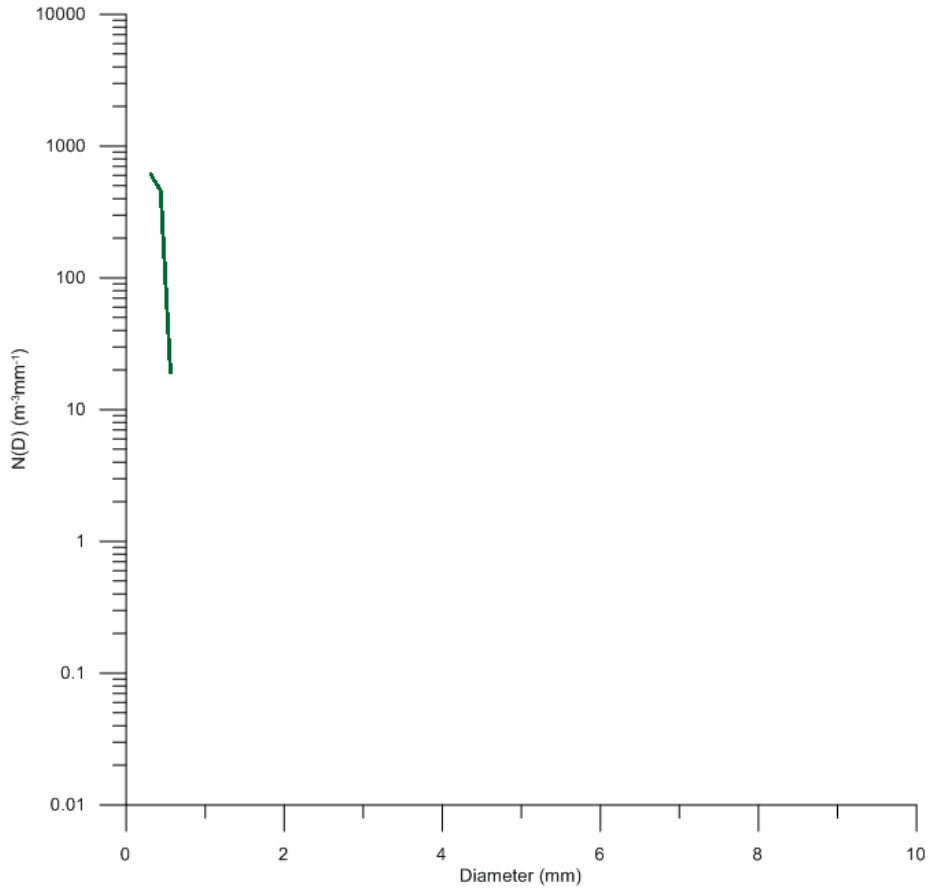
2012/05/19-2012/05/20



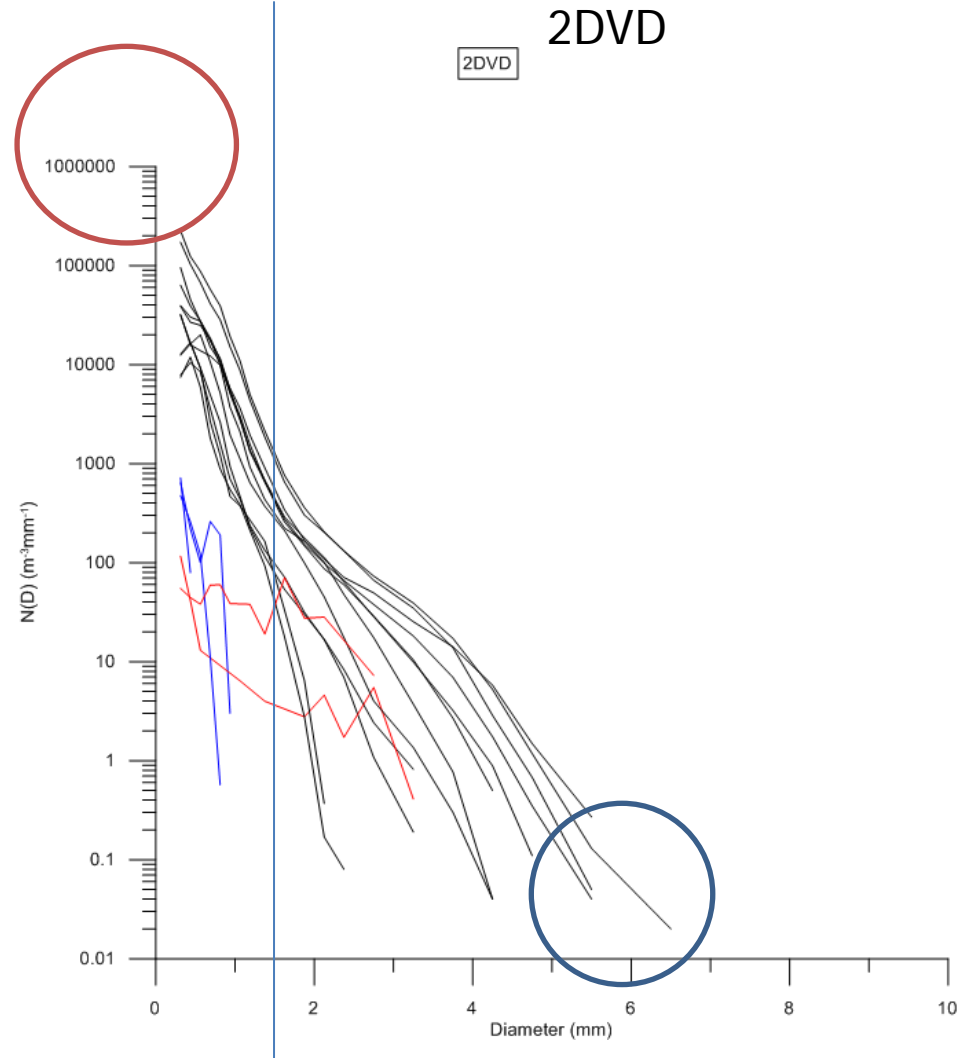
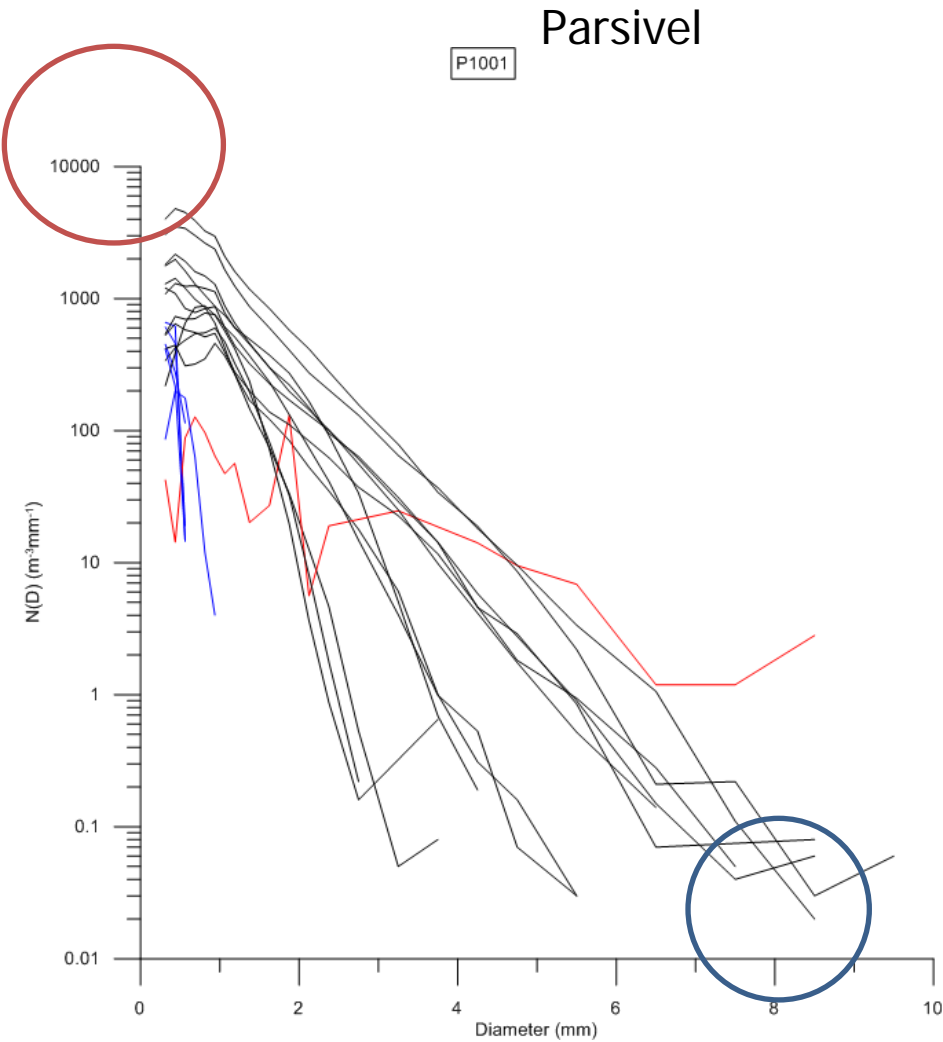
粒徑顆粒分佈逐時變化

2012/05/02

2012/05/02



每10分鐘粒徑顆粒分佈

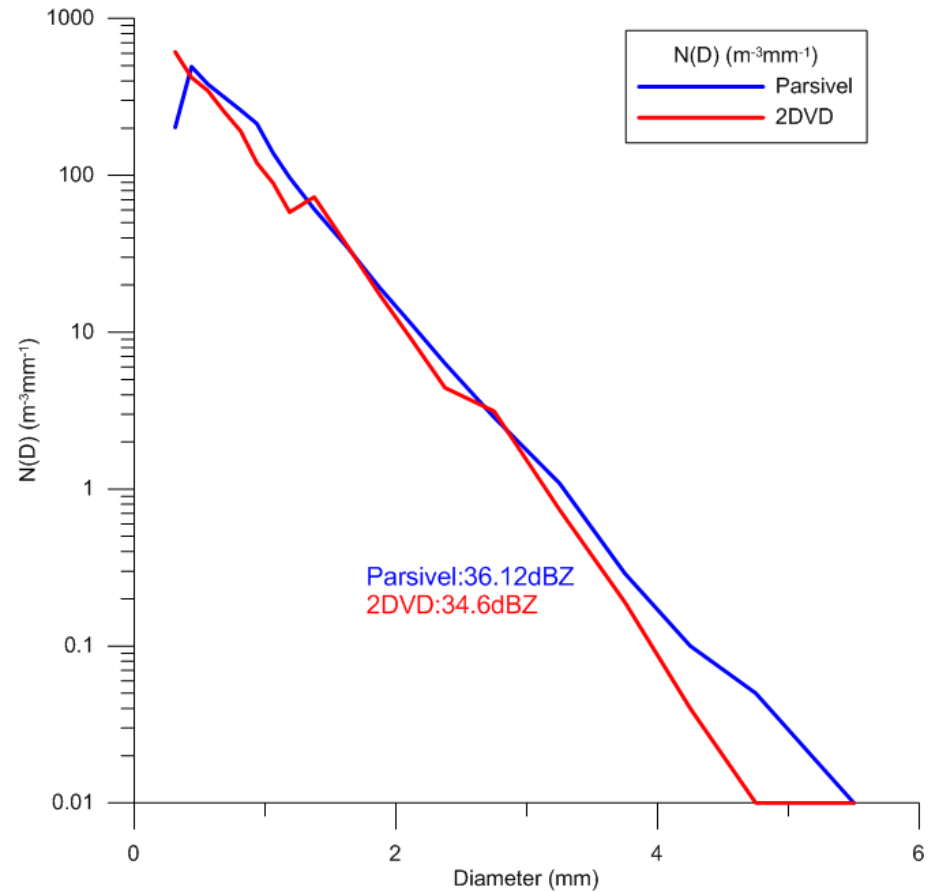
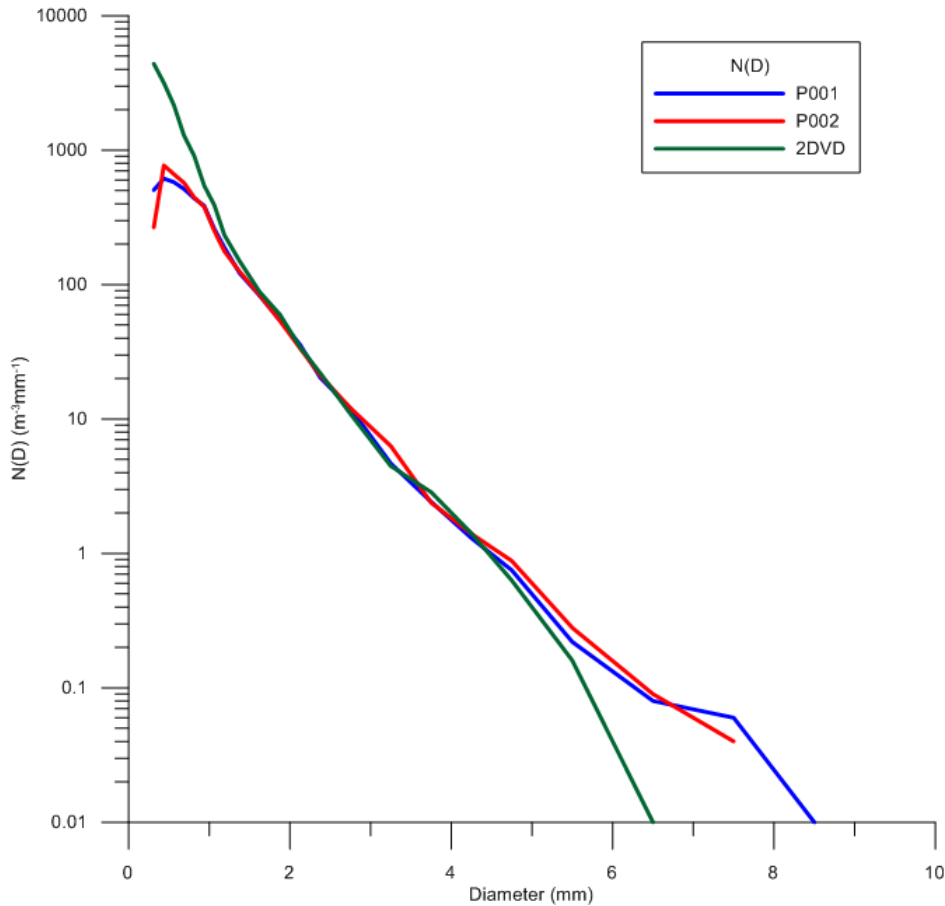


小雨滴顆粒數差異

2012/05/10

2012/02/25, All Rainrate

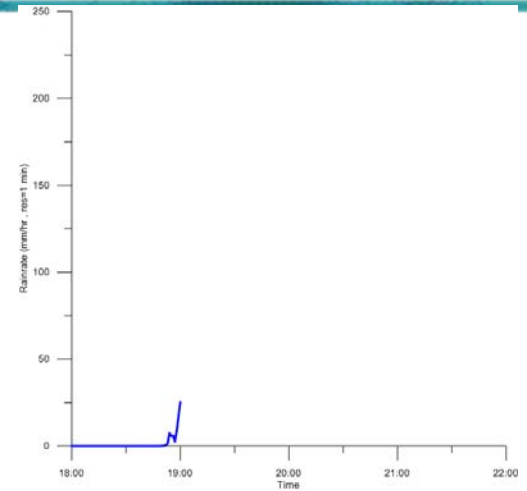
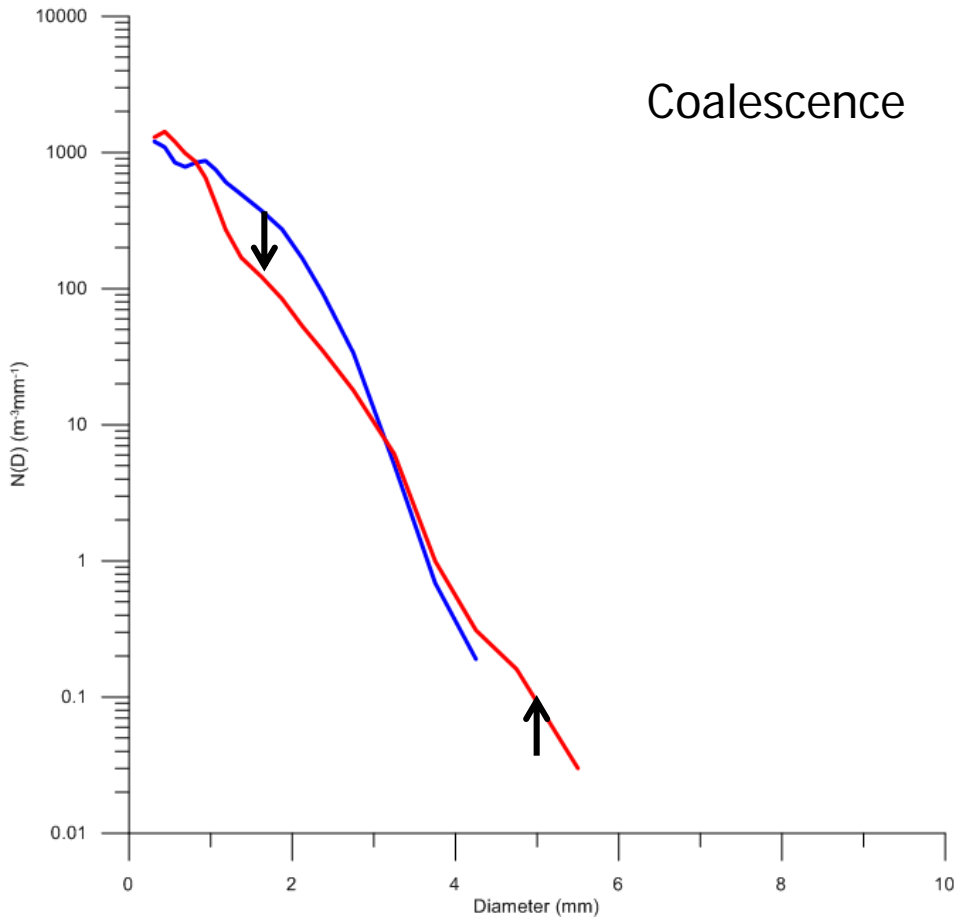
冬天



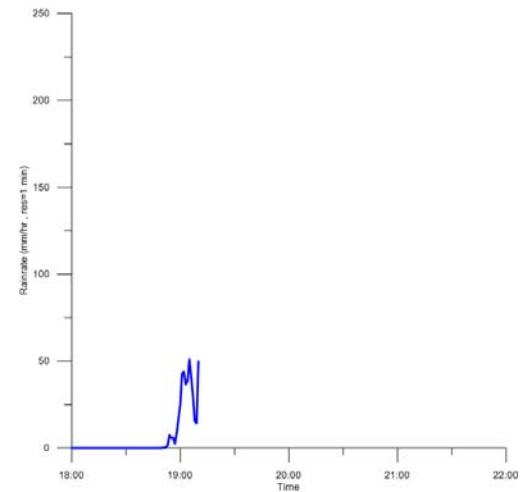
雲微物理現象

P1001

Coalescence

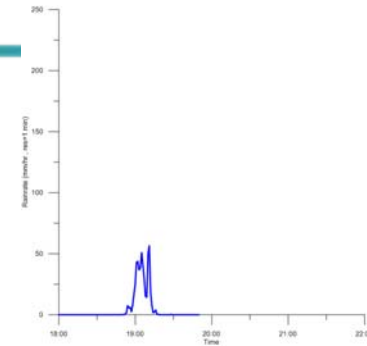
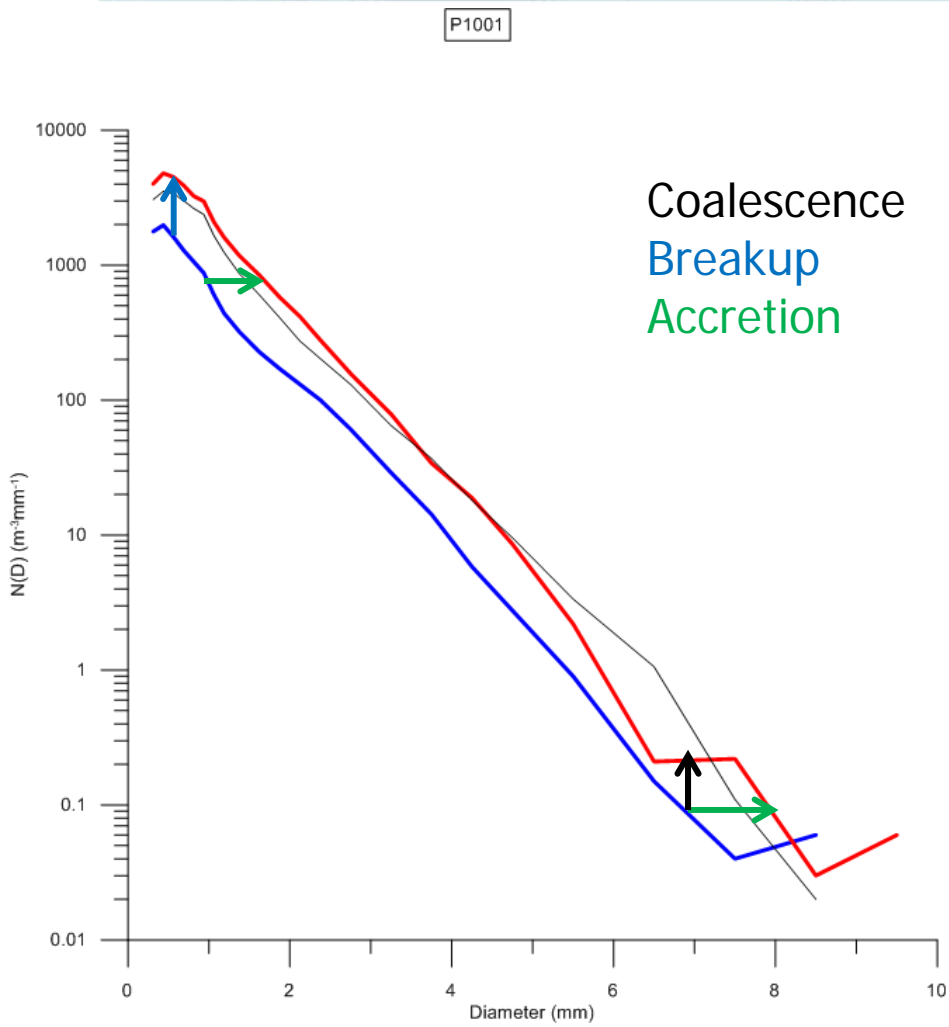


1900

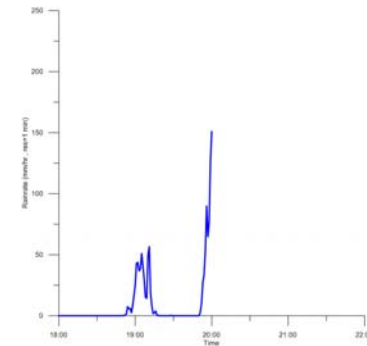


1910

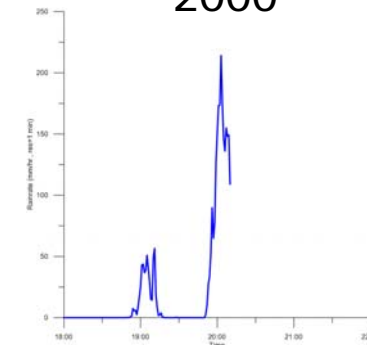
雲微物理現象



1950



2000

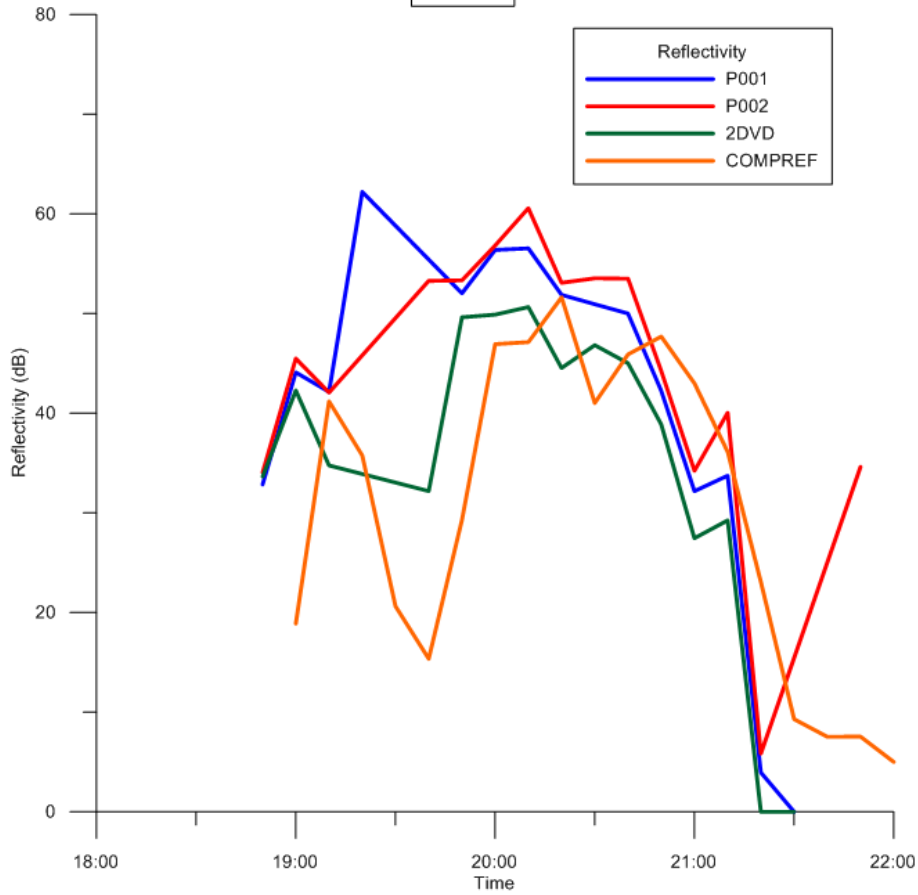


2010

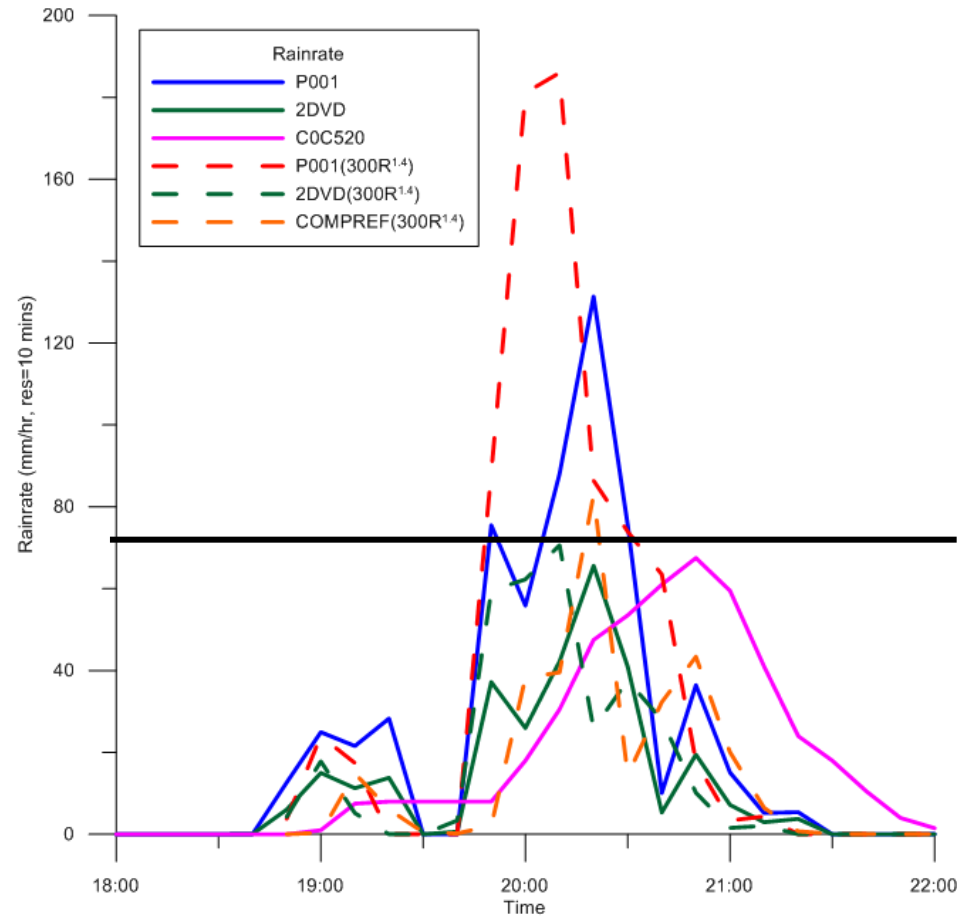
回波強度反演

Reflectivity

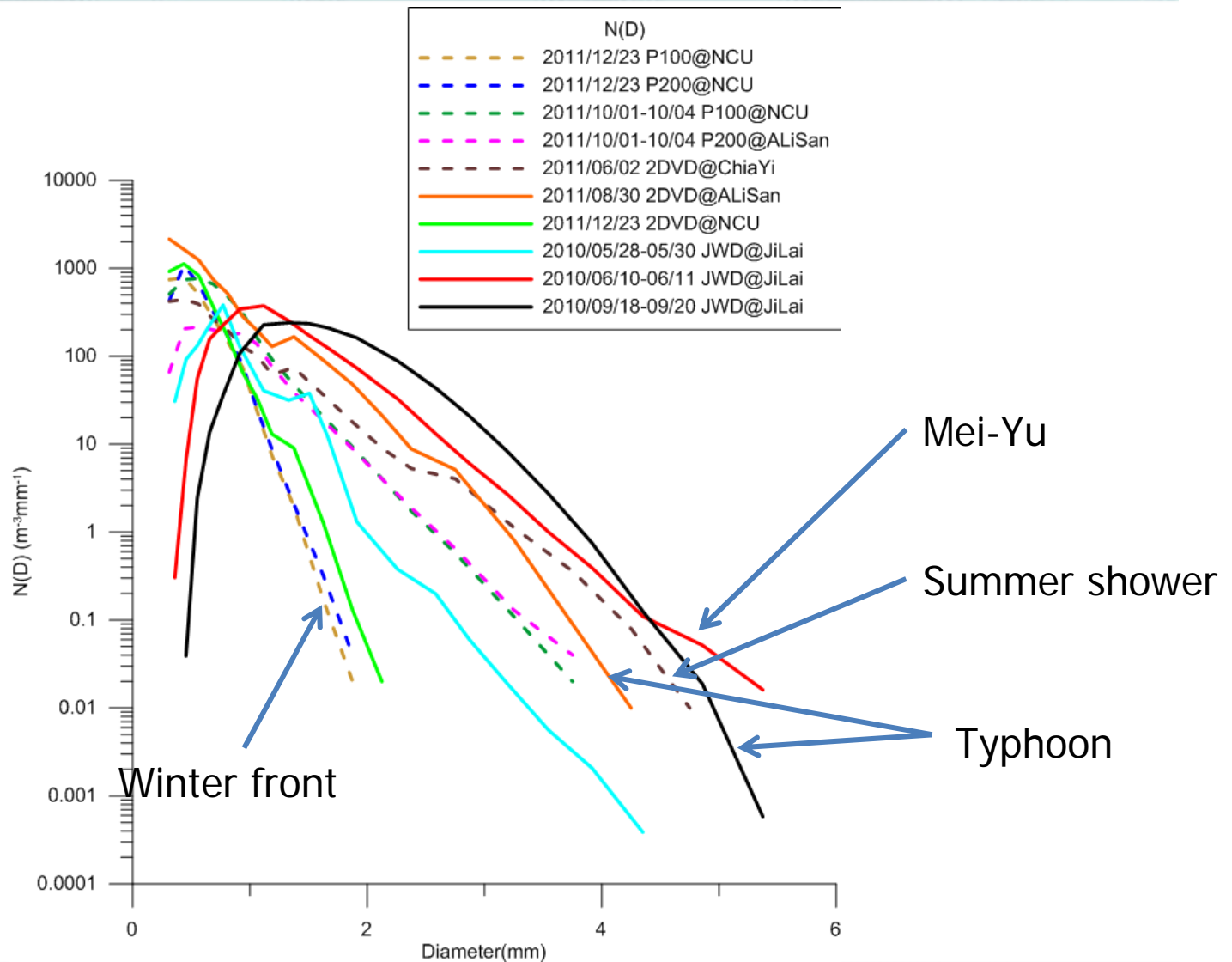
2012/05/12



Rainrate (ZR)



不同天氣型態粒徑顆粒分佈



初步結論

- 兩種雨滴譜儀所觀測到的降雨率相近，但是與傾斗式雨量計的資料則有較大的不同。
- 粒徑顆粒分佈資料分析發現，2DVD觀測到的小雨滴數量較多，而Parsivel觀測到的小雨滴數量較少，但同時大雨滴的數目通常較多。
(與Tokay研究團隊不同)
- 終端落速資料分析則指出Parsivel所觀測到小雨滴終端落速偏高，而2DVD所觀測到的小雨滴終端落速偏低。(與Tokay研究團隊一致)
- 目前觀測資料樣本數仍太少。已分析資料偏冬春案例。仍需要長期收集更多的樣本。

Thanks for your attention!

Status

- From 2011/05/18 ~ 2012/05/20
 - P001 : 367 (total) / 31(7 times) (oof) / 15 (shutdown)
 - 2011/05/18~2011/06/07: no data
 - 2011/06/07~2011/09/06: no raw data
 - P002 : 367 (total) / 12(4 times) (oof) / 100 (shutdown)
 - 2011/08/25~2011/09/14: no raw data
 - 2DVD : 367 (total) / 85(27 times) (oof) / 30 (shutdown)
-