應用多時期正射影像於大規模崩塌潛勢區變形量判釋

-以桃園復興 T002 為例

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儘管接觸式監測儀器可直接且持續量測地表變形狀況，但受限其監測點數量、設置位置之可行性、以及變形過大時可能破壞等因素，非接觸式監測成果亦具有重要參考價值。位於桃園市復興區之大規模崩塌潛勢區 (編號：桃園復興 T002)，自 2012 年開始發生滑動，根據長期監測結果顯示，該邊坡之變位速率於 2021 年初有加速的趨勢。本研究透過水土保持局建置之巨量空間資訊系統 (BigGIS) 於T002邊坡整合自2018年2月起，逾50期之無人航空載具 (Unmanned aerial vehicle, UAV) 拍攝成果，進行多時期正射影像的地表變形特徵判釋，並探討其邊坡地表變形量與雨量變化之關連性。最後，結合現地調查、室內判釋以及透過人工構造物的檢核成果，瞭解該大規模崩塌滑動體之活動性。

經由多時期正射影像判釋及時間序列顯示，該邊坡之日平均變形量於 2021 年 2 月起明顯增加。然觀察其地表變形速率變化之時間點與雨量事件之間，似無明顯相關性。最後，藉由現地調查檢核，7 月以後其邊坡地表變形雖有減緩，但仍持續向坡趾方向滑動。本研究所使用之 BigGIS 平台，已提供逾 8 萬幅之歷年衛星、航照及 UAV 等航遙測影像，除可應用於多時期正射影像判釋，亦可作為後續相關研究之基礎。(桃園復興 T002 於 BigGIS 平台的影像整合連結 ：https://gis.swcb.gov.tw/map/?leftmenu_PID=Landslide_P6)

關鍵字：大規模崩塌、BigGIS、UAV 正射影像、現地調查

Applied the Multi-Temporal Orthoimages interpreted the Displacement of Potential Large-scale Landslide Area (T002) in Fuxing, Taoyuan

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Although the contact monitoring could measure the deformation immediately and continuously, some factors may limit the achievements such as the monitoring points, the installation location and the damage occurred. Thus, the non-contact monitoring has more certain reference value than contact monitoring. The potential large-scale landslides (Slope number T002) had started to displace where located in Fuxing Taoyuan since 2012. According to the long-term monitory results, the displacement rate has accelerated at the beginning of 2021. For this reason, this study operates the Big Geospatial Information System (BigGIS) build from SWCB which captured more than 50 times of UAV orthoimages, and used those multi-temporal orthoimages of T002 to interpret the preliminary landslide surface features, also exploring the relevance of displacement rate and rainfall events. Moreover, the study integrates the field trip, image analysis and structure inspection to comprehend the activity of landslide.

From the multi-temporal orthoimages and time series analysis, it can be seen that the average of daily displacement has accelerated in February. However, the results indicate the relativity between rainfall and average daily displacement is not obvious. Even though the displacement rate has retarded in July, activates and expands are still continuing to the slope toe. It is also worth noting that BigGIS stores and supports the great quantity of completely aerial photographs, satellite imageries, UAV images and historical relative remote sensing. Consequently, this study applies the BigGIS to interpret the orthoimages of potential landslide and expect the various images could be the basis and references for the relative researches. (The information link of BigGIS for T002: https://gis.swcb.gov.tw/map/?leftmenu_PID=Landslide_P6)

Keywords:Large-scale Landslide, BigGIS, UAV Orthoimages, Field Trip

Applied the Multi-Temporal Orthoimages Interpreted the Displacement of Potential Large-scale Landslide Area (T002) in Fuxing, Taoyuan

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Introduction

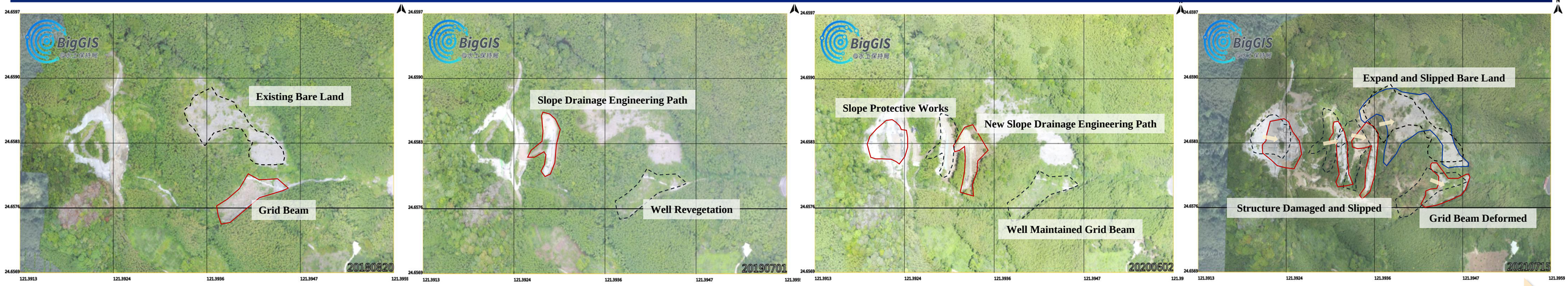
- Although the contact monitoring could measure the deformation immediately and continuously, some factors may limit the achievements such as the installation points and location. Thus, non-contact monitoring has also been valued.
- The potential large-scale landslides (Slope T002) has displaced where located in Fuxing Taoyuan since 2012. According to the long-term monitory results, the displacement rate has accelerated at the beginning of 2021.
- This study operates the **Big Geospatial Information System (BigGIS)** build from SWCB which captured more than 50 times of UAV orthoimages, and used those multi-temporal orthoimages of T002 to interpret the landslide surface features preliminary, also exploring the relationship between displacement rate and rainfall events.

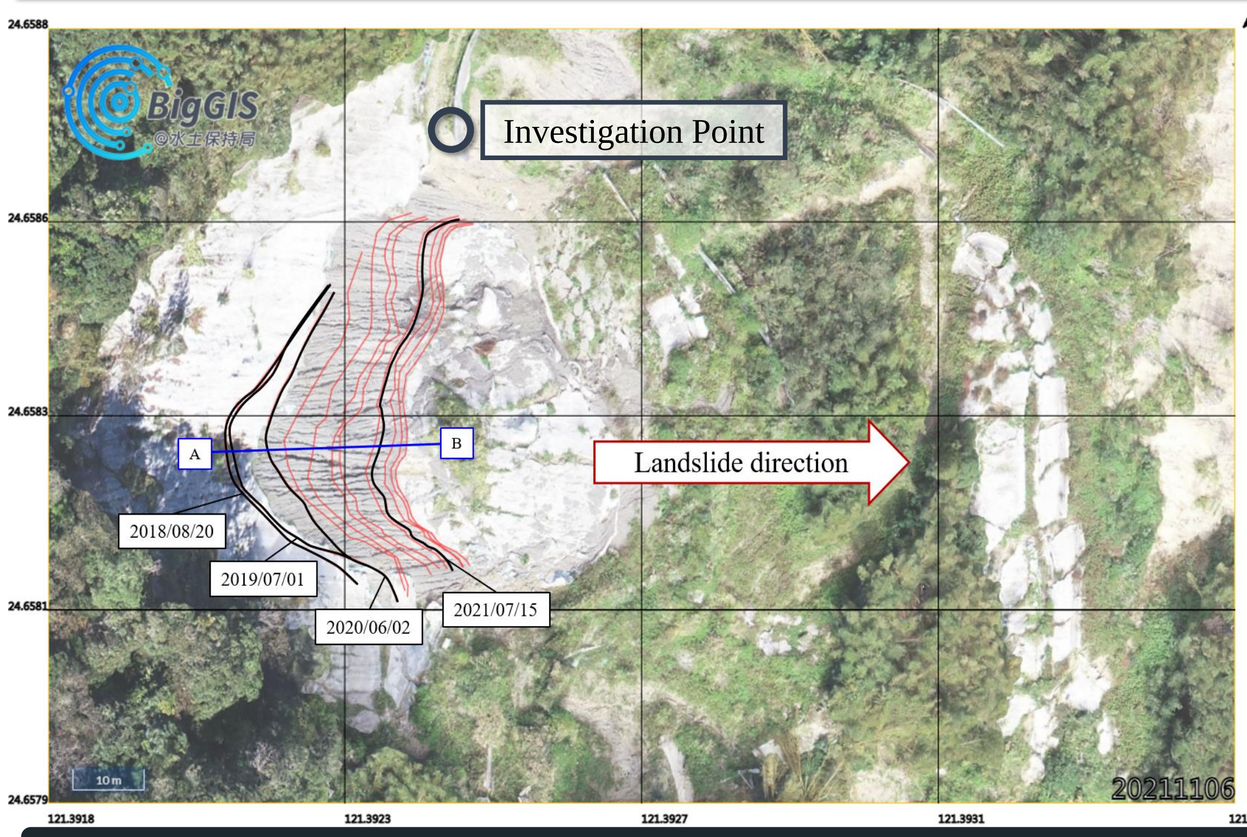
Material and Method

Problem Finding → **Information Collection**
1. Multi-Temporal Orthoimages (BigGIS)
2. Rainfall data (Station ID: 21C070)
3. Field Investigation (2021)

→ **Multi-Temporal landslide line (Scarp)** + **Cumulated Daily Displacement Calculation (A-B Cross Line)** → **Daily Displacement and Rainfall Analysis** → **Conclusion**

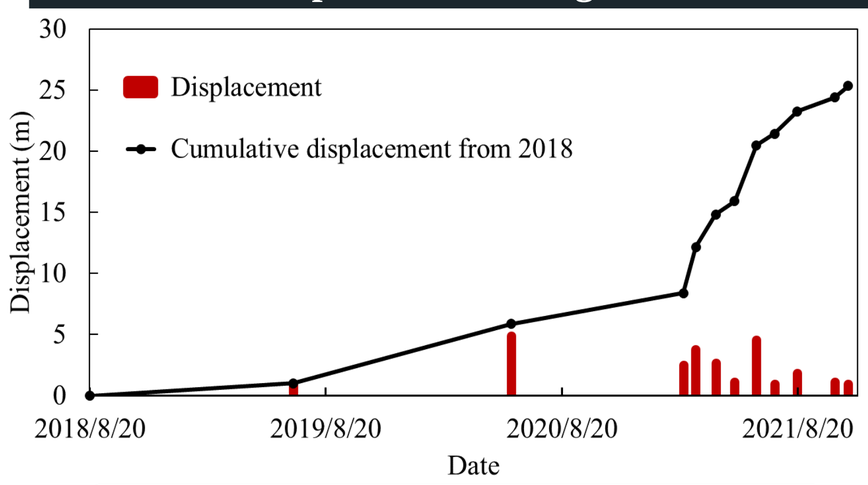
Result and Discussion



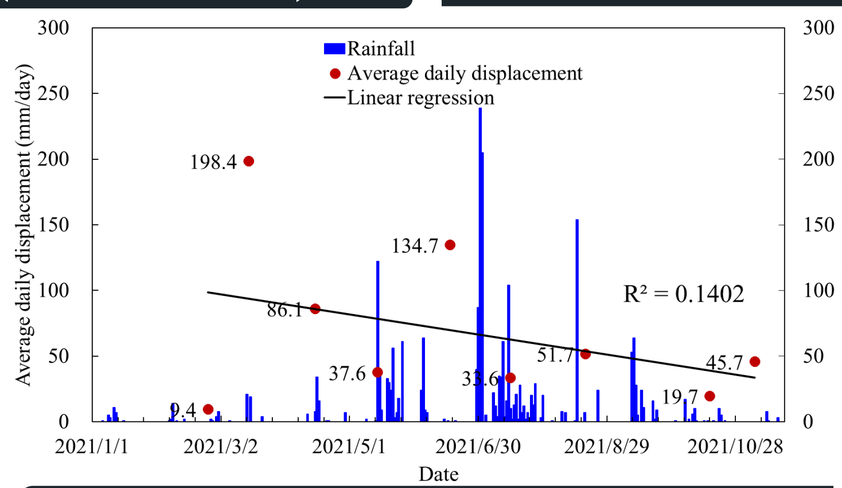


Multi-Temporal Orthoimages of landslides (2018/08 - 2021/11)

Field Results of Investigation Point (2021/02 - 2021/06)



Multi-Temporal Cumulated Displacement (2018/08 - 2021/11)



Multi-Temporal Displacement and Rainfall Distribution (2021/01 - 2021/11)

$$\text{Average daily displacement (mm/day)} = \frac{\Delta D_n \text{ (mm)}}{\Delta t_n \text{ (day)}}$$

ΔD_n (mm): Displacement between date n and n-1.
Δt_n (day): Day between date n and n-1.
n: Time of the date, n =1, 2, 3,…, 11.

The statistics of average daily displacement

Period in 2021		Average daily displacement (mm/day)
Max	02/24 - 03/15	198.4
Min	08/19 - 10/16	19.7
Mean	02/24 - 11/16	66.5

Conclusion and Suggestion

- From the multi-temporal orthoimages and time series analysis, the average daily displacement has accelerated obviously in February and retarded after July, but the activities and expansion are still continuing towards the slope toe.
- The results indicate the relativity between rainfall and average daily displacement is not significant.
- The surface displacement of field investigation of slope is consistent with the interpretation of the orthophotos.
- This study applies the BigGIS to interpret the orthoimages of potential landslide and expect the various images could be the basis and reference for the relative research.

The information link of T002 on BigGIS

優質・效率・團隊

應用多時期航拍影像於大規模崩塌潛勢區判釋 -以桃園復興T002崩塌地為例

莊承穎(1)(2)、施佩昱(1)(2)、陳昭岑(3)、黃奉琦(4)、陳振宇(1)

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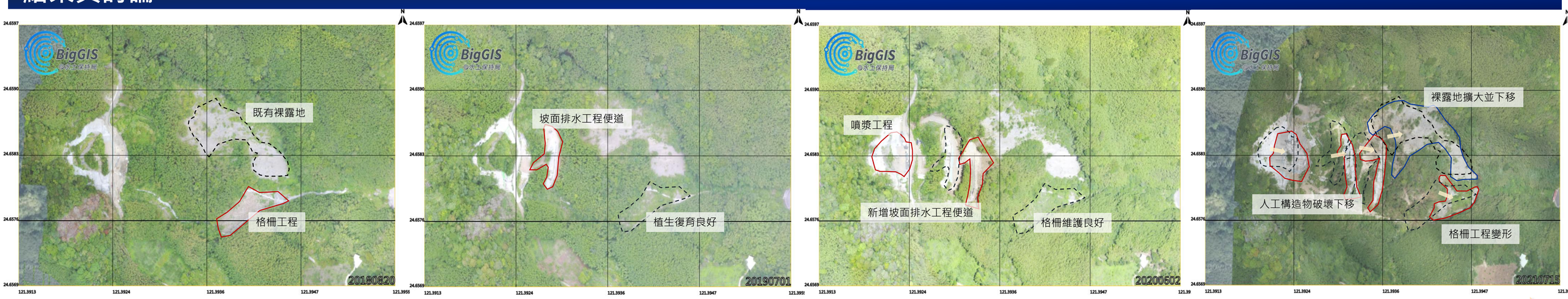
[4] 中原大學土木工程學系

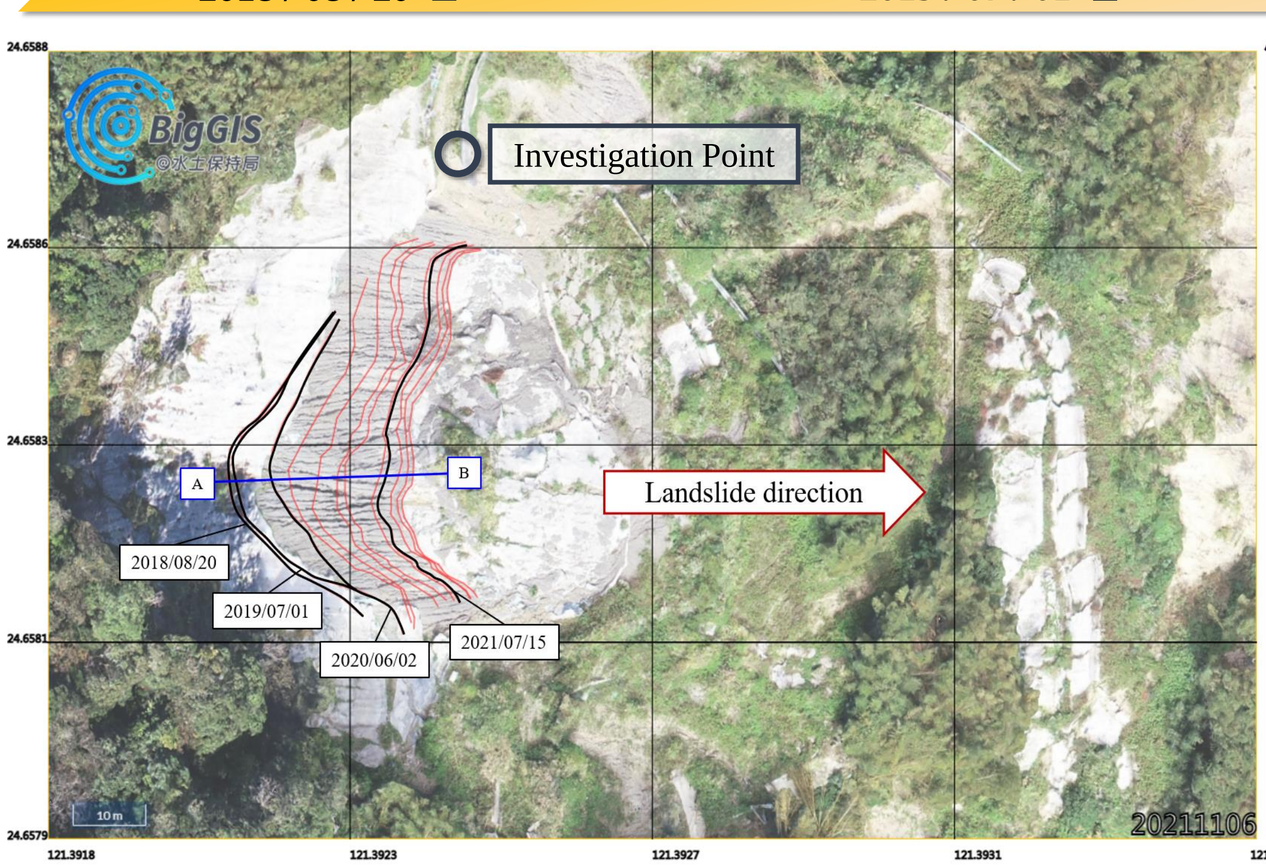
前言

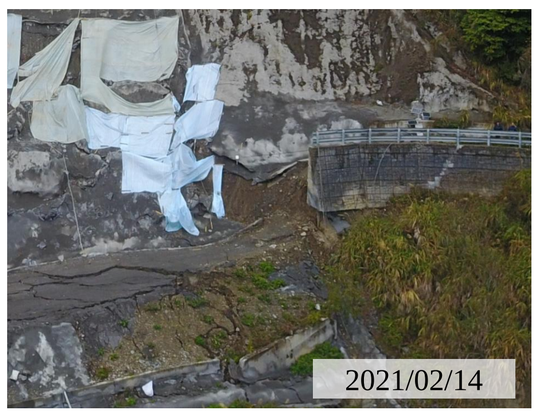
- 儘管接觸式監測可直接且持續量測地表變形，但常因監測點數量、設置位置可行性等限制，需以非接觸式輔助監測。
- 桃園復興T002大規模崩塌潛勢區，自2012年開始發生滑動，長期觀測結果顯示該邊坡之變位速率於2021年初有加速的趨勢。
- 本研究使用水土保持局建置之巨量空間資訊系統 (BigGIS)，整合桃園復興T002自2018年2月起，逾50期之無人航空載具 (UAV) 拍攝成果，以非接觸式監測進行多時期正射影像的地表變形特徵判釋，並探討其邊坡地表變形量與雨量變化之關連性。

材料與方法

結果與討論

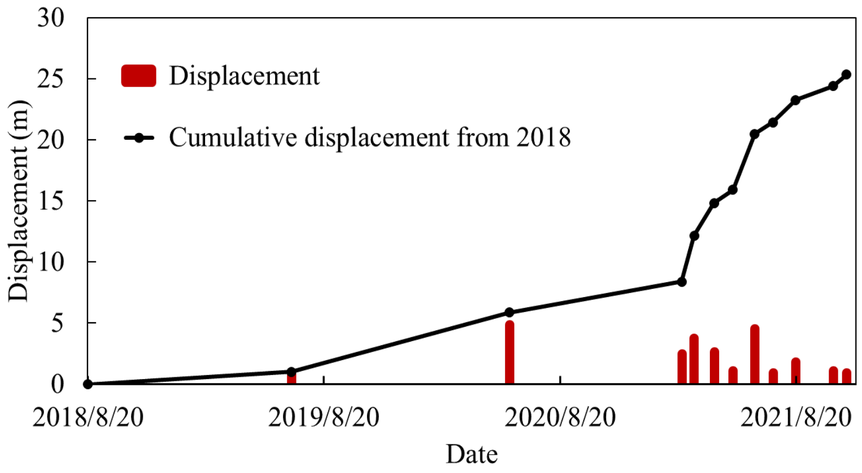




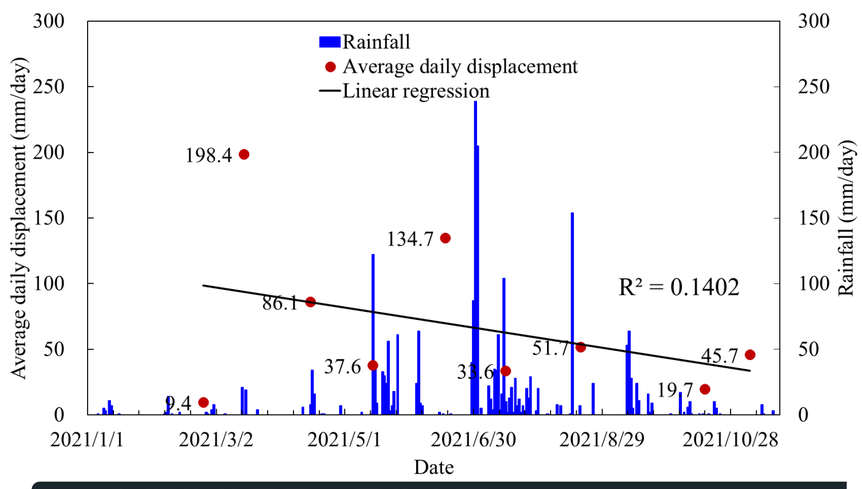


多期正射影像繪製多時期崩塌界線 (2018/08 - 2021/11)

調查點 (Investigation Point) 多期現勘結果 (2021/02 - 2021/06)



各期及累積位移量圖 (2018/08 - 2021/11)



各期位移量及雨量分布圖 (2021/01 - 2021/11)

$$\text{Average daily displacement (mm/day)} = \frac{\Delta D_n \text{ (mm)}}{\Delta t_n \text{ (day)}}$$

ΔD_n (mm): Displacement between date n and n-1.
Δt_n (day): Day between date n and n-1.
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The statistics of average daily displacement

Period in 2021		Average daily displacement (mm/day)
Max	02/24 - 03/15	198.4
Min	08/19 - 10/16	19.7
Mean	02/24 - 11/16	66.5

結論與建議

- 經多時期正射影像判釋及時間序列顯示，該邊坡之日平均變形量於2021年2-3月間明顯增加後持續減緩。
- 藉由現地調查檢核結果顯示，邊坡地表變形情況與正射影像判釋相符，調查點於2-3月及5-6月間有較大變形發生。
- 觀察變形速率變化之時間點與雨量事件，似無明顯相關性；惟7月後地表變形雖有減緩，但仍持續向坡趾方向滑動。
- 本研究使用之BigGIS平台，已提供逾8萬幅之歷年衛星、航照及UAV等航遙測影像，除可應用於多時期正射影像判釋，亦可作為後續相關研究之基礎。

桃園復興T002於BigGIS
影像整合連結QR-Code