出國報告（出國類別：參加國際會議）

2010 歐洲地質科學學會

(European Geosciences Union General Assembly 2010)

服務機關：經濟部中央地質調查所
姓名職稱：謝有忠 技士
派赴國家：奧地利
出國期間：99 年 5 月 1 日起至 5 月 10 日止
報告日期：99 年 8 月 4 日

出國報告審核表

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☑2.格式完整（本文必須具備「目的」、「過程」、「心得及建議事項」）
☑3.無抄襲相關出國報告
☑4.內容充實完備
☑5.建議具參考價值
☑6.送本機關參考或研辦
□7.送上級機關參考
□8.退回補正，原因：□不符原核定出國計畫 □以外文撰寫或僅以所蒐集外文資料爲內容 □內容空洞簡略或未涵蓋規定要項 □抄襲相關出國報告之全部或部分內容 □電子檔案未依格式辦理 □未於資訊網登錄提要資料及傳送出國報告電子檔
□9.本報告除上傳至出國報告資訊網外，將採行之公開發表：
□辦理本機關出國報告座談會（說明會），與同仁進行知識分享。
□於本機關業務會報提出報告
□其他____________________
□10.其他處理意見及方式：</td></tr>
<tr><td rowspan="2">審核人</td><td colspan="2">一級單位主管</td><td>機關首長或其授權人員</td></tr>
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</table>

說明：

一、 各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

二、 審核作業應儘速完成，以不影響出國人員上傳出國報告至「政府出版資料回應網公務出國報告專區」爲原則。

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<tr><td>謝有忠</td><td>經濟部中央地質調查所</td><td>環境與工程地質組</td><td>技士</td><td>薦任</td><td>聯絡人
hsiehyc@moeacgs.gov.tw</td></tr>
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<tr><td>報告書頁數</td><td colspan="6">32頁</td></tr>
<tr><td>報告內容摘要</td><td colspan="6">歐洲地質科學學會(EGU)係歐洲地區地球科學學門的最大國際學術組織。每年吸引全球各地地球科學領域超過萬名專家學者一同與會，觀摩與發表研究成果，爲地球科學界發表研究成果及心得交流討論的重要會議。
光達技術爲近年來發展的新興技術，不同載具、不同雷射波段都具有不同功能和效益，對於地質、水利、水土保持、國土資訊的研究發展有很深遠的影響，更可應用於防救災資訊上。本次利用本所於2008年，在颱風季節前後不同時間測製蘭陽溪地區的光達數值地形資料，藉以比較颱風暴雨事件對蘭陽溪流域地形特徵之影響。參加2010歐洲地質科學大會是發表本所前述計畫研究之成果，同時藉由參與會議的機會，獲取新知及技術交流。會後攜回相關領域於展場所展示的相關成果資訊，作爲增益本所光達測製計畫執行之參考，並吸取國外相關領域之研發經驗，提升臺灣的研發能量，進而獲取最佳的研究與分析成果。</td></tr>
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目錄

摘要

歐洲地質科學學會(EGU)係歐洲地區地球科學學門的最大國際學術組織。每年吸引全球各地地球科學領域超過萬名專家學者一同與會，觀摩與發表研究成果，爲地球科學界發表研究成果及心得交流討論的重要會議。

光達技術爲近年來發展的新興技術，不同載具、不同雷射波段都具有不同功能和效益，對於地質、水利、水土保持、國土資訊的研究發展有很深遠的影響，更可應用於防救災資訊上。本次利用本所於2008 年，在颱風季節前後不同時間測製蘭陽溪地區的光達數值地形資料，藉以比較颱風暴雨事件對蘭陽溪流域地形特徵之影響。參加 2010 歐洲地質科學大會是發表本所前述計畫研究之成果，同時藉由參與會議的機會，獲取新知及技術交流。會後攜回相關領域於展場所展示的相關成果資訊，作爲增益本所光達測製計畫執行之參考，並吸取國外相關領域之研發經驗，提升臺灣的研發能量，進而獲取最佳的研究與分析成果。

壹、前言

歐洲地質科學學會（EGU，European Geosciences Union）係歐洲地區地球科學學門的最大國際學術組織。每年大致於春末夏初時期舉行年度大會，除了歐洲各國地球科學專家學者參加外，同時也會吸引全球各地地球科學領域的專家一同與會，每年吸引超過萬名的地球科學家前往觀摩與發表研究成果，為地球科學界發表研究成果及心得交流討論的重要會議。本年度自 5/2-5/8 在奧地利維也納 ACV 舉行，來自全球 94 個國家超過萬名的科學家以口頭或壁報方式發表約 1 萬 3 千餘篇科學論文，包含 22 個主要地球科學研究領域（大氣科學 Atmospheric Sciences、生物地質學 Biogeosciences、氣候變遷 Climate: Past, Present, Future、冰凍圈科學 Cryospheric Sciences、能源,資源與環境 Energy, Resources & the Environment、空間科學資訊 Earth & Space Science Informatics、大地測量 Geodesy、地球動力學 Geodynamics、地質科學儀器分析及資料系統 Geosciences Instrumentation & Data Systems、地形 Geomorphology、地球化學,礦物學,岩石和火山 Geochemistry, Mineralogy, Petrology & Volcanology、水文科學 Hydrological Sciences、同位素儀器在地質科學上的分析及應用 Isotopes in Geosciences: Instrumentation and Applications、磁學,古地磁,岩石物理與岩土 Magnetism, Palaeomagnetism, Rock Physics & Geomaterials、自然

災害 Natural Hazards、地球物理非線性研究 Nonlinear Processes in Geophysics、海洋科學 Ocean Sciences、行星與太陽系科學 Planetary & Solar System Sciences、地震學 Seismology、地層學,沉積學及古生物學 Stratigraphy, Sedimentology & Palaeontology、土壤系統科學 Soil System Sciences、太陽地球科學 Solar-Terrestrial Sciences、大地構造與構造地質學 Tectonics & Structural Geology），其中再細分成近 600 個精采的科學議題、大師級的主題演講及簡短課程等，加上各種科學獎章的頒獎典禮及問題辯證，讓整個大會精采豐富，目不暇給。

本論文在本次大會地形學領域（GM），有關「技術方法在地形學上的應用（GM2）」子題，『空載與地面光達在地形學之遠景、問題和解答（Airborne and Terrestrial Laser Scanning and geomorphology: possibilities, problems, and solutions，GM2.2）』的次議題中發表，提出發表之論文題目爲「Flood-Induced Riverbed Changes and Sediment Yields Revealed by Twice LiDAR Surveys」(「由颱風季節前後之光達數值地形探討河床地形與土砂量之變化」)。

貳、目的

數值地形模型在地質與地形學的領域，可以提供極佳的應用。可依需要呈現平面或立體的模型，有效展現不同角度的地形特徵。亦易於推衍各種地表地形參數，如：坡度、坡向、曲率、剖面、集水區、水系等，可用於地質災害分析、水文分析與模擬、土壤侵蝕研究、以及其他生態環境之模擬與分析等。近年來利用新興的技術，國內在活動斷層與構造地形等地質災害研究方面已有相當的進展。此類新興的技術包括大地測量、衛星遙測、地理空間資訊系統、與活動構造定年等。然而鑑於此類地質災害常因地表可供判斷的高程資料有限，仍然有相當多研究調查之空間。目前以空載光達（Airbone LiDAR）技術所製成的數值地形，具有足夠可靠的解析度、精度、便利性，更重要的是此項技術可以濾除建物與樹木遮蔽，還原原始地面形貌，能確實符合地質與地形之分析研究。

中央地質調查所「大台北地區特殊地質災害調查與監測」施政計畫，自 94 年度開始進行高精度空載雷射掃描(LiDAR)地形測製與構造地形分析，目前為止共完成工作範圍約 3910 平方公里，包括 647 幅五千分之一像片基本圖範圍，主旨即為利用空載雷射掃描技術(Airborne LiDAR)，產製大台北地區、蘭陽地區及花東地區平面解析度二公尺網格之數值地形，包括數值地面模型(Digital Topographic Model or Digital Terrain Model, DTM)與數值表面模型(Digital Surface Model, DSM)，並據此進行地形分析與構造地形分析，以作爲更進一步環境防災的基礎。本計畫 95 年度相關成果已於 2006 年度美國地球物理學會秋季年會（AGU Fall Meeting）發表（Eos Trans. AGU Fall Meet. Suppl. T33D-0541），該年會也是國際上地球物理和地質專家每年聚集討論發表研究成果心得場所，也於 2007 年度 AGU Fall Meeting 成果發表:LiDAR 於火山地區地滑之應用及台灣北部可能之斷層系統（Eos Trans. AGU Fall Meet. Suppl. T43B-1335:Evolution of large scale paleo-landslides in volcanic area reconstructed based on LiDAR technology、OS53A-0973:The possible fault system in north Taiwan）。

本所大台北地區特殊地質災害調查與監測計畫於 2008 年颱風季節前後，利用空載光達測製蘭陽溪地區的數值地形，藉以比較颱風暴雨事件對蘭陽溪流域地形特徵之影響。參加 2010 歐洲地質科學大會是發表本所計畫研究之成果，同時藉由參與會議的機會，獲取新知及技術產品交流。會後攜回相關領域於展場所展示的相關成果資訊，作爲增益本所 LiDAR 測製計畫執行之參考。

參、過程

一、出國行程

本次出國計畫之工作會議行程如表 3-1 所示，行程自 99 年 5 月 1 日起至 10 日止， 為期 10 天。

表 3-1 出國行程表

日期	星期	往返地點	住宿地點	活動內容
99/5/1	六	台北-奧地利維也納	飛機上	啓程赴奧地利維也納
99/5/2	日	台北-奧地利維也納	維也納	註冊、報到參加歐洲地質科學年會
99/5/3	一	維也納	維也納	參加歐洲地質科學年會
99/5/4	二	維也納	維也納	參加歐洲地質科學年會
99/5/5	三	維也納	維也納	參加歐洲地質科學年會
99/5/6	四	維也納	維也納	參加歐洲地質科學年會
99/5/7	五	維也納	維也納	參加歐洲地質科學年會
99/5/8	六	維也納	維也納	參加歐洲地質科學年會
99/5/9	1	維也納-台北	飛機上	會議結束返回臺灣
99/5/10	1	維也納-台北		會議結束返回臺灣

二、會議議程

2010 年歐洲地質科學年會（EGU General Assembly 2010）是在奧地利維也納 Austria Center Vienna (ACV)舉行(圖 1)，會議議程包括報到(圖

2、3）、論文發表（口頭或壁報）；報到時本次會議所領取之相關資料（圖 4），包含議程手冊、論文摘要（以隨身碟形式）、會議收據及會議名牌。論文口頭發表共有 44 個場地，遍佈整個會議中心各樓層，有容納百人的大型會議室（圖 5），也有約 30 人左右之小型會議室，壁報發表主要為會議中心地下室（圖 6）及會議中心 3 樓（圖 7）。

圖 1 本次會議舉行地點奧地利維也納 Austria Center Vienna (ACV)。

圖 2 本次會議舉行報到及壁報場館外觀。

圖 3 會議首日報到處場景，由參與會議人員自行利用會場網路登錄後，至工作人員櫃臺領取會議相關資料。

圖 4 本次會議所領取之相關資料，包含議程手冊、論文摘要集（以隨身碟形式）、會議收據及會議名牌。

圖 5 位於 ACV 場館大型會議室。

圖 6 位於主場館 3F 之論文壁報發表處。

圖 7 位於主場館地下室之論文壁報發表處。圖中爲本次所發表之壁報內容。

三、論文發表

本論文在本次大會地形學領域（GM），有關「技術方法在地形學上的應用（GM2）」子題中，議程如附錄 1。『空載與地面光達在地形

學之遠景、問題和解答（Airborne and Terrestrial Laser Scanning and geomorphology: possibilities, problems, and solutions，GM2.2）』的次議題中，以壁報形式發表，發表之論文題目爲「Flood-Induced Riverbed Changes and Sediment Yields Revealed by Twice LiDAR Surveys」(「由颱風季節前後之光達數值地形探討河床地形與土砂量之變化」)（圖 8）。

發表論文內容主要爲國內首次應用空載光達系統在大流域面積測製河道地形，並於颱風季節前後產製不同時期之數值地形資料，並應用高程差值之地形計量方法，來計算蘭陽溪在颱風季節前後地形之變化，研究結果顯示空載光達高解析數值地形模型資料應用在河道地形變遷以及沈積物變化量計算可以得到極佳的成果。

蘭陽溪河道在 2008 年歷經四次颱風事件後，利用颱風季節前後兩次飛航任務的測製結果，經由飛航規劃、掃瞄測製以及點雲資料處理後，所產生研究區域範圍之數值地形模型(DTM)資料直接計算分析，使用 ESRI ARCGIS 軟體，將兩次飛航掃瞄測製之資料，運用兩次不同時間所獲取之高程資料推估地形變化量，數值地形模型資料以 2X2m 網格方式運算，本研究區域內侵蝕體積量共約七百三十餘萬立方公尺，堆積體積量共約四百九十餘萬方立方公尺，整個體積共減少約兩百三十餘萬立方公尺，蘭陽溪河道主要受侵蝕搬運所影響，顯示在研究區域內主要仍受侵蝕影響，而搬運流失高達兩百三十餘萬立方

公尺之土石量。

以每公里為單位劃分研究區域內河道範圍，大致劃分出河道中侵蝕與搬運之約略特性，可以瞭解每一區段之變化。利用不同網格大小重新計算地形高程差值平均，將原始 2m 網格放大 5 倍計算，相當於以 10X10m 網格方式運算。原來 2X2m 網格表示解析度高之地形變化趨勢，而將網格範圍加大時，雖然解析度降低，但可以適時反應較大範圍之地形變化判釋。與 2X2m 之高程差值成果及每公里劃分範圍之侵蝕堆積比值圖等比對，10X10m 網格大小之高程差值之成果，似乎較可以表現出河道中局部範圍內之土石搬運特性，包含受到大規模侵蝕或堆積、或是局部侵蝕都可以明顯判釋出。

由研究區域橫剖面高程差值和資料顯示，13a 以上河道屬於上游侵蝕段及中游搬運段之特性，而 13b 以下則以中游搬運段之特性為主，蘭陽溪之下游堆積段應該自牛鬥以下至出海口範圍。河道搬運特性由所有橫剖面來看，應該主要受到河道坡度、河道寬度、河流曲率、河道兩側岩性等因素影響。河道搬運主要影響控制因素應為河道坡度，河道坡度越大，侵蝕作用越明顯；局部則受河道寬度、及河流曲率影響，而岩性分佈也影響包含受限河谷及河道兩岸侵蝕、搬運之特性。

論文壁報內容如附錄 2 所示。本所壁報展示參與之主題，大會安

排發表日期爲 5 月 4 日，討論及回答問題的時間爲當日下午 5 點 30 至 7 點。發表當日閱覽者踴躍，除討論回答問題外，亦同時閱覽相鄰近之壁報，並與作者討論。

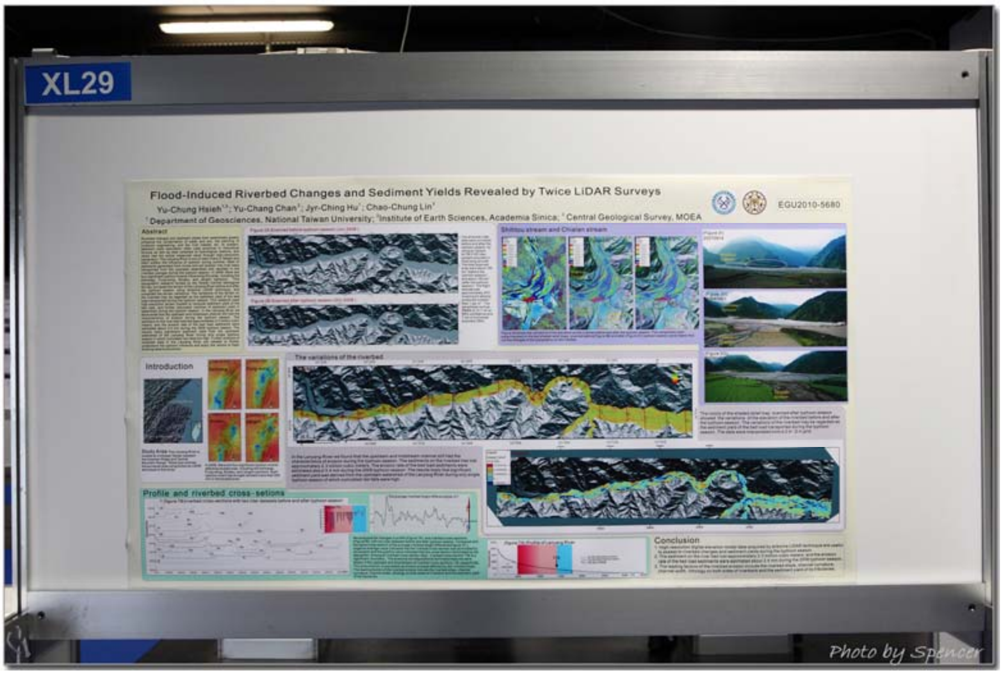

圖 8 本次發表壁報論文。

肆、心得

一、光達技術蓬勃發展

光達(Light Detection And Ranging，簡稱 LiDAR)或稱雷射測距掃描技術(Laser Scanner; Laser Swath Mapping)，為利用雷射光束測距原理進行掃描式測距之系統。目前發展主要可以包含以空載（Airbone laser scanning）及地面（terrestrial laser scanning）兩種系統，近年來又發展車載系統（Mobile Lidar），都是以雷射測距系統和定位系統，搭配不同的載具而組成，利用搭載航空具後以飛航測製為空載光達系統，以車輛、船舶、小型運輸機具搭載在地面上施測為車載光達系統，而直接以雷射儀器在地面定點測量為地面光達系統，空載光達系統和地面光達系統，此兩種都已經在國內發展多年，也在很多領域有極佳的應用成果，車載系統近年也開始在國內開始發展應用。會場中可看到許多應用在不同系統的光達成果發表，也出現各種不同類型光達技術的論文發表，光達技術也分為測距光達、測深光達、全波形光達等，其中全波形（Full-waveform）光達為目前最新發展之技術，不同於以往記錄回波的測距光達，全波形光達可完整紀錄發射後，整個雷射光反射的波形，由會場論文已經有實際應用的論文發表，利用全波形光達掃瞄地表後，所得到的全波形紀錄可以判釋地表物體的粗糙度和起伏狀況，此種光達技術可以更清楚分辨出地表狀況，可改善 DSM 和 DEM

的製作。

二、光達技術之應用日漸廣泛

在會場中，有關光達技術的應用，在幾個主題中，至少 9 個子題議程都可以看到利用光達技術的應用成果，包括火山、自然災害、地貌、水文、行星、大氣科學等之應用，有關火山、自然災害、地貌等之研究更與本所業務息息相關。其中議題包括「利用空載和地面光達技術發展的遠景、問題及解決方案」,「高精度地形資料的獲取和分析」、「利用高解析度地形、光達技術等在山崩調查監測之應用」，如以調查區域爲較小範圍的論文主題，應用地面光達系統短時間蒐集精確地形資料後，配合現地調查或結合 RTK 地面測量，進而討論地面變形監測狀況，包括對山崩監測、落石監測，以及活動斷層之監測，本次會議中所發表之論文更以自然災害爲大宗，所以有關光達技術應用在山崩、落石等方面更是有許多文章發表。空載光達的部份，因利用航空器爲載具，調查範圍多屬大面積範圍，有數篇都是利用空載光達可以大範圍調查冰川地形，描繪出冰川的地形特徵，並利用兩次空載光達掃瞄資料，計算冰川的變化。另會議場館裡安排有研究機構或廠商設置攤位，提供地質研究、書籍、應用軟體和其他相關服務，其中有關 LiDAR 儀器設備、資料處理或測製服務等機構，也在現場展示提供有關 LiDAR 之訊息。

伍、建議

一、光達(LiDAR)技術為近年來發展的新興技術，不同載具、不同雷射波段都具有不同功能和效益，對國土基本資料的蒐集調查，可以達到很大的功效，尤其國土基本地形資料建立更是一個重要基礎工作，對於地質、水利、水土保持、國土資訊的研究發展有很深遠的影響，更可應用於防救災資訊上，故建議政府相關部門應儘早重視，且支持此項技術在台灣發展及應用。

二、光達(LiDAR)掃描測製數值地形建議儘速建置全臺灣高解析度地形資料，針對台灣地區許多地質敏感區域，光達掃瞄測製數值地形具備高解析度及多重回波特性等等幾項優點，對於在台灣地區應用於地形與地質構造，尤其災害性地質問題解析，研判災害之地質地形特徵等，利用此項基本地形資料繪製相關圖資，可以建立陸地地質構造、山崩、土石流及落石等基本特性與分布，提供地質災害作用機制之資訊，而減低地質災害之威脅。

三、歐洲地質科學學會 EGU（European Geosciences Union）係歐洲地區地球科學學門的最大國際學術組織。除了歐洲各國地球科學專家學者參加外，同時也會吸引全球各地地球科學領域的專家一同與會，每年吸引超過萬名的地球科學家前往觀摩與發表研究成果，為地球科學界發表研究成果及心得交流討論的重要會議，而

來自全球近百國家超過萬名的科學家以口頭或壁報方式發表超過 1 萬篇以上的科學論文，包含地球科學各個領域和學門，其中細分近 600 個精采的科學議題、大師級的主題演講及簡短課程，加上各種科學獎章的頒獎典禮及問題辯證，因此參加此會議可以儘速吸取國外相關領域之研發經驗，提升臺灣研發能量，可獲取最佳的研究與分析成果，故值得政府機關派員參加此會議，瞭解地球科學界最新研發趨勢與動態。建議本所未來也能派員參加此大會。

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附錄一、參與之研討會議程

EMS 2009: Session GM2.2 on 2010-05-04

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GM2.2

Airborne and Terrestrial Laser Scanning and geomorphology: possibilities, problems, and solutions

Convener: Bal?zs Sz?kely | Co-Conveners: Norbert Pfeifer, Bernhard H?fle

Oral Programme   Poster Programme

In the recent years laser scanning (also called LiDAR) became a very effective tool for high-resolution data acquisition of geomorphic surfaces. Airborne Laser Scanning (ALS) is a straightforward and very precise tool for creating digital surface models (DSM) up to sub-meter resolution. However, DSMs contain the surface of man-made structures as well as the effect of the canopy cover, therefore their direct application in geomorphology needs sophisticated preprocessing. The creation of digital terrain models (DTMs) of sub-meter scale often requires specific geomophological knowledge to avoid creation of artefacts. The resolution and accuracy provided by ALS DTMs are especially valuable in low-relief areas like floodplains. The application possibilities of such DTMs, for instance, in flood control are widespread. Repeated ALS surveys may also contribute to the understanding and monitoring of the floodplain sedimentation processes, river dynamics, and quantification of erosion and sedimentation. Likewise, for high-relief areas, e.g., in Alpine environment the ALS surveys may also contribute to the monitoring of mass movements, erosional processes and incipient motion of slopes. Terrestrial Laser Scanning (TLS) is also increasingly applied for fast data capture of the surface, e.g., in detection and monitoring of mass movements and in other geomorphic studies requiring high accuracy and frequent repetition. The application of both laser scanning technique results in data sets characterised by enormous data sizes, extremely high accuracy (up to cm-scale) and very high resolution. These properties compensate for the efforts invested in the data processing, however it means new challenges for the geomorphic evaluation. The wealth of laser scanning-derived DTMs can be used for geomorphic analyses in various forms (point cloud, TIN, grid) for analysis in flood-endangered regions, for natural hazard analyses like mass movements and are almost unbeatable in surface modelling of mountainous and karstic areas. They are also highly applicable in environmental change studies concerning the change in snow and ice coverage, soil creep, etc. Contributions concerning processing techniques as well as geomorphic application examples are welcome. Case studies of problematic data sets, studies on applicability of laser scanning-derived DSMs and DTMs in various environments, like geomorphic application in urban areas, are also covered by the session.

Oral Programme EMS 2009 – GM2.2

Airborne and Terrestrial Laser Scanning and geomorphology: possibilities, problems, and solutions

Convener: Bal?zs Sz?kely | Co-Conveners: Norbert Pfeifer, Bernhard H?fle

> Session Details   > Poster Programme

Public Information: Poster Summaries and Discussion: Tue, 04 May 13:00-13:45 Scheduled poster walk-through: Tue, 04 May 17:45

Tuesday, 04 May 2010

Room 22

10:30-10:45 EGU2010-15176

Paolo Tarolli, Giulia Sofia, Francesco Pirotti, and Giancarlo Dalla Fontana

Semi-automatic methods for landslide features and channel network extraction in a complex mountainous terrain: new opportunities but also challenges from high resolution topography

10:45-11:00 EGU2010-14063

Paola Passalacqua and Efi Foufoula-Georgiou

Automatic channel network extraction from lidar through nonlinear diffusion and geodesic paths

11:00-11:15 EGU2010-12401

George Heritage, David Milan, and Neil Entwistle

Linking water surface roughness to velocity patterns using terrestrial laser scanning and acoustic doppler velocimetry

11:15-11:30 EGU2010-9959

Niels S. Anders, Arie C. Seijmonsbergen, and Willem Bouten

Stratified object-based image analysis of high-res laser altimetry data for semi-automatic geomorphological mapping in an alpine area

11:30-11:45 EGU2010-6845

Alessandro Corsini, Eleonora Bertacchini, Lisa Borgatti, Alessandro Capra, Federico Cervi, Alexander Dahne, and Francesco Ronchetti

Geomorphological mapping and mass-wasting analysis in complex landslides using Terrestrial and Airborne LiDAR

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11:45-12:00 EGU2010-3642

Karen Anderson, Jonathan Bennie, and Andrew Wetherelt

Terrestrial Laser Scanning of Peatland Surface Morphology for Eco-Hydrological Applications

Poster Programme EMS 2009 – GM2.2

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> Session Details > Oral Programme

Public Information: Poster Summaries and Discussion: Tue, 04 May 13:00-13:45 Scheduled poster walk-through: Tue, 04 May 17:45

Display Time: Tuesday, 04 May 2010 08:00-19:30

Attendance Time: Tuesday, 04 May 2010 17:30-19:00

Hall XL

XL27	EGU2010-3982 **Adrian Cov?snianu**, Ovidiu-Gelu Tudose, Marius-Mihai Cazacu, Iulian Nichersu, Michel Memier, and Ioan Balin R.E.E.L.D. (Economical and Ecological Reconstruction of the Danube Flood Plain) Campaign: airborne LIDAR data and GIS technique outputs
XL28	EGU2010-12048 **Gez Foster**, Jonathan Turner, Colman Gallagher, and Helen Lewis Digital elevation model based geomorphological mapping in the lower River Boyne valley, Ireland
XL29	EGU2010-5680 **Yu-chung Hsieh**, Yu-Chang Chan, Jyr-Ching Hu, and Chao-Chung Lin Flood-Induced Riverbed Changes and Sediment Yields Revealed by Twice LiDAR Surveys
XL30	EGU2010-8169 **Michael Vetter**, Bernhard H?fle, Gottfried Mandlburger, and Martin Rutzinger Change detection of riverbed movements using river cross-sections and LiDAR data
XL31	EGU2010-13645 **Rainer Bell** and Helene Petschko New potentials of laser scanning in landslide hazard assessments
XL32	EGU2010-10856 **Rudolf Sailer**, Erik Bollmann, Christian Briese, Andrea Fischer, Karl Krainer, Norbert Pfeifer, Lorenzo Rieg, and Johann St?tter

Airborne LiDAR based Mapping of Alpine Permafrost Distribution

XL33 EGU2010-9875

Andr?s Z?molyi, Bal?zs Sz?kely, G?bor Moln?r, Andreas Roncat, Peter Dorninger, Angelika Pocsai, Marek Wyszy?ski, and Peter Drexel

Comparison of LiDAR-derived directional topographic features with geologic field evidence: a case study of Doren landslide (Vorarlberg, Austria)

XL34 EGU2010-15221

Andreas Ahl, R. Supper, K. Motschka, and I. Schattauer

Alternative analysis of airborne laser data collected within conventional multi-parameter airborne geophysical surveys

XL35 EGU2010-12997

Magnus Bremer, Oliver Sass, Michael Vetter, and Martin Geilhausen

Combined application of airborne and terrestrial laserscanning for quantifying sediment relocation by a large debris flow event

XL36 EGU2010-15115

Andreas Roncat, Peter Dorninger, Thomas Melzer, G?bor Moln?r, Norbert Pfeifer, Bal?zs Sz?kely, Andr?s Z?molyi, and Peter Drexel

Effect of the acquisition geometry of Airborne and Terrestrial Laser Scanning on high-resolution outlining of microtopographic landforms

XL37 EGU2010-2528

Bernhard H?fle and Markus Hollaus

Roughness Parameterization Using Full-Waveform Airborne LiDAR Data

XL38 EGU2010-15059

Werner M?cke, Markus Hollaus, and Christian Briese

Segmentation-based determination of terrain points from full-waveform airborne laser scanning data

XL39 EGU2010-7110

Mark Bulmer and David Finnegan

Topography Data on Mars: Optimizing its Collection and Application Using Laser Scanning.

XL40 EGU2010-14544

Christopher Crosby, Viswanath Nandigam, Ramon Arrowsmith, and Chaitan Baru

Enabling Access to High-Resolution Lidar Topography for Earth Science Research

XL41 EGU2010-14286

Peter Dorninger, Christian Briese, Clemens Nothegger, and Armin Klauser

Towards Automation in Landcover Mapping from LiDAR Data in Alpine Environment

XL42 EGU2010-13613

Peter Dorninger, Bal?zs Sz?kely, Andr?s Z?molyi, and Clemens Nothegger

Automated Detection of Geomorphic Features in LiDAR Point Clouds of Various Spatial Density

XL43 EGU2010-15170

Patrick Fritzmann, Erik Bollmann, Rudolf Sailer, Johann St?tter, and Michael Vetter

Multi-temporal surface classification of high mountain environments

XL44 EGU2010-14833

Kourosh Khoshelham and Dogan Altundag

Influence of laser scanner range measurement noise on the quantification of rock surface roughness

XL45 EGU2010-14837

Paulo Jorge Mendes Cerveira, Klaus Schuszter, and Klaus Legat

A Pivoted Airborne Laser Scanning System for Alpine Areas

XL46 EGU2010-2246

Martin Rutzinger, **Bernhard H?fle**, Michael Vetter, Johann St?tter, and Norbert Pfeifer

Classification of breaklines derived from airborne LiDAR data for geomorphological activity mapping

XL47 EGU2010-14528

Bal?zs Sz?kely, Peter Dorninger, Robert Faber, and Clemens Nothegger

Do we need a voxel-based approach for LiDAR data in geomorphology?

XL48 EGU2010-10419

Angela Celeste Taramasso, Massimiliano Degiorgis, Silvia Gorni, and Giorgio Roth

Digital Terrain Model's resolution influence on flood scenario design

附錄二、發表之壁報論文內容

Geophysical Research Abstracts
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Flood-Induced Riverbed Changes and Sediment Yields Revealed by Twice LiDAR Surveys

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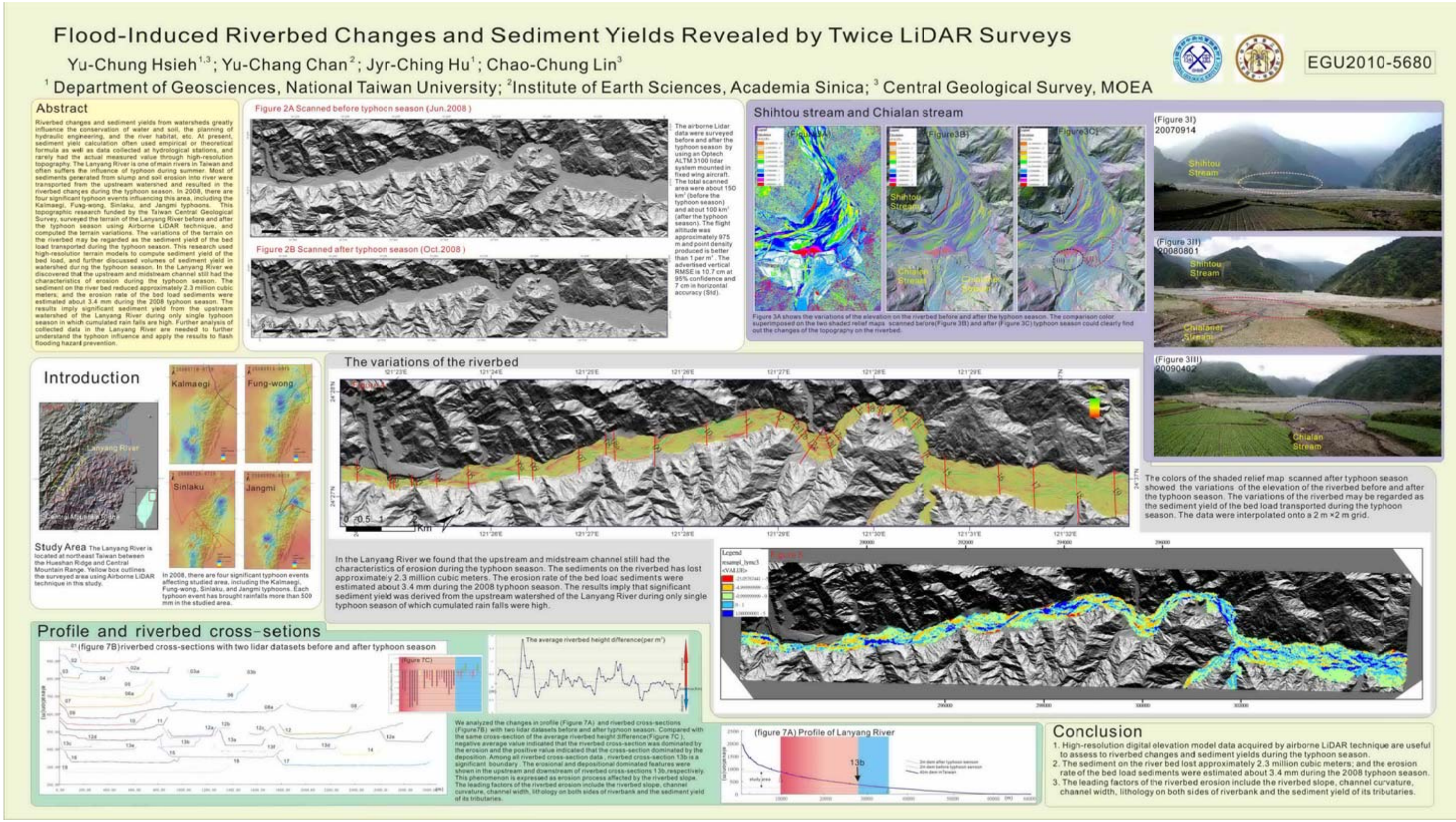
Riverbed changes and sediment yields from watersheds greatly influence the conservation of water and soil, the planning of hydraulic engineering, and the river habitat, etc. At present, sediment yield calculation often used empirical or theoretical formula as well as data collected at hydrological stations, and rarely had the actual measured value through high-resolution topography. The Lanyang River is one of main rivers in Taiwan and often suffers the influence of typhoon during summer. Most of sediments generated from slump and soil erosion into river were transported from the upstream watershed and resulted in the riverbed changes during the typhoon season. In 2008, there are four significant typhoon events influencing this area, including the Kalmaegi, Fung-wong, Sinlaku, and Jangmi typhoons. This topographic research funded by the Taiwan Central Geological Survey, surveyed the terrain of the Lanyang River before and after the typhoon season using Airborne LiDAR technique, and computed the terrain variations. The variations of the terrain on the riverbed may be regarded as the sediment yield of the bed load transported during the typhoon season. This research used high-resolution terrain models to compute sediment yield of the bed load, and further discussed volumes of sediment yield in watershed during the typhoon season. In the Lanyang River we discovered that the upstream and midstream channel still had the characteristics of erosion and transportation during the typhoon season. The sediment on the river bed reduced approximately 2.3 million cubic meters; and the erosion rate of the bed load sediments were estimated about 3.4 mm during the 2008 typhoon season. The results imply significant sediment yield and transportation from the upstream watershed of the Lanyang River during only single typhoon season in which cumulated rain falls are high. The leading factors of the riverbed erosion include the riverbed slope, channel curvature, channel width, lithology on both sides of riverbank and the sediment yield of its tributaries. Further analysis of collected data in the Lanyang River are needed to further understand the typhoon influence and apply the results to flash flooding hazard prevention.


Flood-Induced Riverbed Changes and Sediment Yields Revealed by Twice LiDAR Surveys
Yu-Chung Hsieh[1,3]; Yu-Chang Chan[2]; Jyr-Ching Hu[1]; Chao-Chung Lin[3]
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EGU2010-5680
Abstract
Riverbed changes and sediment yields from watersheds greatly influence the conservation of water and soil, the planning of hydraulic engineering, and the river habitat, etc. At present, sediment yield calculation often used empirical or theoretical formula as well as data collected at hydrological stations, and rarely had the actual measured value through high-resolution topography. The Lanyang River is one of main rivers in Taiwan and often suffers the influence of typhoon during summer. Most of sediments generated from slump and soil erosion into river were transported from the upstream watershed and resulted in the riverbed changes during the typhoon season. In 2008, there are four significant typhoon events influencing this area, including the Kalmaegi, Fung-wong, Sinlaku, and Jangmi typhoons. This topographic research funded by the Taiwan Central Geological Survey, surveyed the terrain of the Lanyang River before and after the typhoon season using Airborne LiDAR technique, and computed the terrain variations. The variations of the terrain on the riverbed may be regarded as the sediment yield of the bed load transported during the typhoon season. This research used high-resolution terrain models to compute sediment yield of the bed load, and further discussed volumes of sediment yield in watershed during the typhoon season. In the Lanyang River we discovered that the upstream and midstream channel still had the characteristics of erosion during the typhoon season. The sediment on the river bed reduced approximately 2.3 million cubic meters; and the erosion rate of the bed load sediments were estimated about 3.4 mm during the 2008 typhoon season. The results imply significant sediment yield from the upstream watershed of the Lanyang River during only single typhoon season in which cumulated rain falls are high. Further analysis of collected data in the Lanyang River are needed to further understand the typhoon influence and apply the results to flash flooding hazard prevention.
Figure 2A Scanned before typhoon season (Jun.2008)
Figure 2B Scanned after typhoon season (Oct.2008)
The airborne Lidar data were surveyed before and after the typhoon season by using an Optech ALTM 3100 lidar system mounted in fixed wing aircraft. The total scanned area were about 150 km² (before the typhoon season) and about 100 km² (after the typhoon season). The flight altitude was approximately 975 m and point density produced is better than 1 per m². The advertised vertical RMSE is 10.7 cm at 95% confidence and 7 cm in horizontal accuracy (Std).
Shihtou stream and Chialan stream
Figure3B
Figure3C
Shihtou Stream
Chialan Stream
Figure 3A shows the variations of the elevation on the riverbed before and after the typhoon season. The comparison color superimposed on the two shaded relief maps scanned before(Figure 3B) and after (Figure 3C) typhoon season could clearly find out the changes of the topography on the riverbed.
(Figure 3I)
20070914
Shihtou Stream
(Figure 3II)
20080801
Shihtou Stream
Chialan Stream
(Figure 3III)
20090402
Chialan Stream
Introduction
Lanyang River
Kalmaegi
Fung-wong
Sinlaku
Jangmi
Study Area The Lanyang River is located at northeast Taiwan between the Hueshan Ridge and Central Mountain Range. Yellow box outlines the surveyed area using Airborne LiDAR technique in this study.
In 2008, there are four significant typhoon events affecting studied area, including the Kalmaegi, Fung-wong, Sinlaku, and Jangmi typhoons. Each typhoon event has brought rainfalls more than 500 mm in the studied area.
The variations of the riverbed
121°23'E
121°24'E
121°25'E
121°26'E
121°27'E
121°28'E
121°29'E
121°30'E
121°31'E
121°32'E
24°28'N
24°27'N
0 0.5 1 2 Km
The colors of the shaded relief map scanned after typhoon season showed the variations of the elevation of the riverbed before and after the typhoon season. The variations of the riverbed may be regarded as the sediment yield of the bed load transported during the typhoon season. The data were interpolated onto a 2 m ×2 m grid.
In the Lanyang River we found that the upstream and midstream channel still had the characteristics of erosion during the typhoon season. The sediments on the riverbed has lost approximately 2.3 million cubic meters. The erosion rate of the bed load sediments were estimated about 3.4 mm during the 2008 typhoon season. The results imply that significant sediment yield was derived from the upstream watershed of the Lanyang River during only single typhoon season of which cumulated rain falls were high.
Legend
Profile and riverbed cross-setions
(figure 7B)riverbed cross-sections with two lidar datasets before and after typhoon season
(figure 7C)
The average riverbed height difference(per m²)
We analyzed the changes in profile (Figure 7A) and riverbed cross-sections (Figure7B) with two lidar datasets before and after typhoon season. Compared with the same cross-section of the average riverbed height difference(Figure 7C), negative average value indicated that the riverbed cross-section was dominated by the erosion and the positive value indicated that the cross-section dominated by the deposition. Among all riverbed cross-section data, riverbed cross-section 13b is a significant boundary. The erosional and depositional dominated features were shown in the upstream and downstream of riverbed cross-sections 13b,respectively. This phenomenon is expressed as erosion process affected by the riverbed slope. The leading factors of the riverbed erosion include the riverbed slope, channel curvature, channel width, lithology on both sides of riverbank and the sediment yield of its tributaries.
(figure 7A) Profile of Lanyang River
13b
Conclusion
1. High-resolution digital elevation model data acquired by airborne LiDAR technique are useful to assess to riverbed changes and sediment yields during the typhoon season.
2. The sediment on the river bed lost approximately 2.3 million cubic meters; and the erosion rate of the bed load sediments were estimated about 3.4 mm during the 2008 typhoon season.
3. The leading factors of the riverbed erosion include the riverbed slope, channel curvature, channel width, lithology on both sides of riverbank and the sediment yield of its tributaries.