

- 一、請閱讀 Science Magazine 的報導 "A Drier Future" (如附件一)。並試作下列問題，回答請用中文，並假設閱讀者為臺灣一般大眾。
- (a) 請為文中之圖下一個標題。(5 分)
 - (b) 請寫一段圖的文字說明(100 字以內)。(15 分)
 - (c) 請寫一段短文(300 字以內)，假設你要在 Facebook 粉絲頁介紹此研究新聞稿，吸引一般大眾有興趣點選，而深入閱讀。(15 分)
 - (d) 請你用譬喻或故事等文學的手法，延伸(c)中新聞稿的內容，以增易讀性。(15 分)
- 二、臺北市 2014/2/19 凌晨發生地震，引起許多民眾的疑慮，相關報導如附件二。請你『規劃』一個專題，深入探討此次事件。
- (a) 請下一個標題。(5 分)
 - (b) 段落結構。(10 分)
 - (c) 計畫採訪人物及原因。(5 分)
 - (d) 查詢管道。(5 分)
 - (e) 時程規劃。(5 分)
- 三、你認為自然科學相關的新聞報導，應該是站在啦啦隊的角色還是監督者者的角色？請論述，並條列支持你論點的理由。(20 分)

見背面

附件 - (5-1)

A Drier Future?

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Global temperature increases affect the water cycle over land, but the nature of these changes remains difficult to predict. A key conceptual problem is to distinguish between droughts, which are transient regional extreme phenomena typically defined as departures from a local climatological norm that is presumed known, and the normal or background dryness itself. This background dryness depends on precipitation, but also on how fast water would evaporate. As the planet warms, global average rainfall increases, but so does evaporation. What is the likely net impact on average aridity?

Most studies of dryness focus on droughts rather than on the background aridity or changes thereto. They tend to rely on relatively simple measures that are useful for analyzing temporary anomalies but may not properly account for factors that govern the background state. Failure to explicitly account for changes in available energy, air humidity, and wind speed can cause some indices commonly used for identifying droughts to diagnose an artificial trend toward more drought in a warming climate (1). Recognition of this problem has undone past claims that drought is on the rise globally, and led to weaker claims about observed drought trends in the most recent Intergovernmental Panel on Climate Change report (2). However, that does not mean that conditions will not get drier (3, 4).

A different way of approaching the problem is to try to capture the changes in background state, rather than temporary anomalies such as droughts. This can, for example, be done using the ratio of precipitation (P) to potential evapotranspiration (PET) based on the Penman-Monteith equation (1, 5). PET is the evaporative demand of the atmosphere, calculated as the amount of

附件一 (5-2)

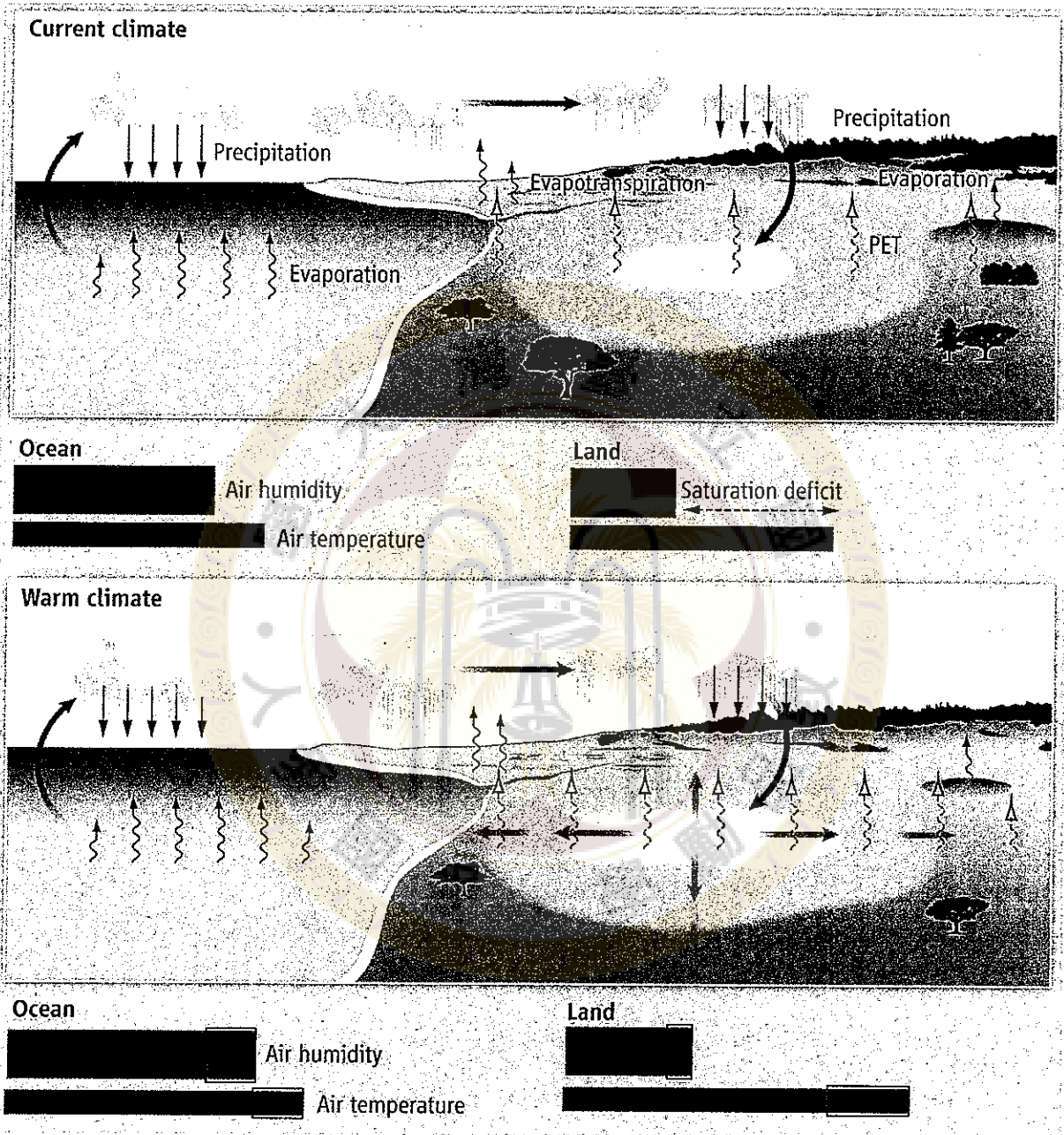
evaporation one would get, with given air properties, from a completely wet surface. Over a body of water PET equals the true evaporation, but on land, the true evaporation will be less than PET unless the soil is saturated with water. The P/PET ratio may be near zero in a desert but can exceed unity in wet climates. If the P/PET ratio falls, it means that conditions get drier; if it rises, conditions are getting wetter.

Recent observational studies have shown that P/PET is decreasing on average as the globe warms (5, 6). Climate model simulations (see fig. S1, panel A) (5) predict that by 2100 under a high-emissions scenario, when climate is projected to be several degrees warmer than it is now, P/PET will drop much further in most tropical and mid-latitude land regions (see the figure). Such drops can shift a region to the next drier climate category among humid, subhumid, semiarid, arid, and hyperarid conditions (the latter four together are denoted dryland). In one simulation, the area of global dryland is projected to expand by ~10% by 2100 (5). Models predict that India and northern tropical Africa will become wetter, but nearly all other land regions are predicted to become drier. Under most scenarios, the drying would further intensify during the 22nd century.

Global averages of precipitation and evaporation must remain equal to each other on climate time scales. The observed and predicted drying tendency in P/PET over land thus implies that PET there increases faster than does global evaporation (noting that precipitation changes similarly on land and oceans). If there were no land on Earth, PET globally could not increase faster than P; they would always be equal. Thus, the increase in P/PET must be peculiar to land surfaces. One might expect complex land-surface responses involving soils or vegetation to be responsible, but recent research (7-12) suggests that the overall drying trend on land is rooted in relatively simple atmospheric thermodynamics.

見背面

附件 - (5-3)



附件 - (5-4)

Aridity increases in warmer climates, leading to expansion of dry climate zones. Evaporation and precipitation increase modestly, but on land, evaporative demand (broken wavy arrows) increases faster than precipitation, because the strong increases in air temperature and consequently saturated water vapor concentration over land (red bars at lower right) exceed growth in actual water vapor concentration (blue bars). Increases in sensible and latent heat (associated, respectively, with temperature and water vapor, and represented by the area of each bar) have the same sum over land and ocean, with sensible heat increasing more over land than oceans and latent heat increasing more over oceans. Relative humidity (ratio of blue to red bar length) decreases over land.

"CREDIT: ADAPTED BY P. HUEY/SCIENCE"

The key factor causing drying is that land surfaces (and the air just above them) warm, on average, about 50% more than ocean surfaces (7). There is a simple and plausible explanation for this long-remarked phenomenon, at least for low and mid-latitudes. The atmosphere keeps convective instability (which gives rise to cumulus clouds) small over both land and ocean regions. This instability depends on the total latent and sensible heat in air near the surface. Because the latent heat (determined by atmospheric water vapor concentration) is smaller over land and changes less upon warming (see the figure), sensible heat (determined by air temperature) must change more, explaining the enhanced land warming (7, 8). Indeed, if this enhanced warming did not happen, air over land would become less able to sustain clouds and precipitation, thus drying and warming the land via increased sunshine. Enhanced warming of land surfaces relative to oceans thus occurs simply because continental air masses are drier than maritime ones, which in turn is a consequence of the limited availability of surface water.

The second factor ensuring drying is that water vapor content over land does not increase fast enough relative to the rapid warming there. Nearly all water vapor in the atmosphere comes from the oceans, where the water vapor content of the overlying air increases by ~6% per degree Celsius of ocean surface temperature (9, 10). When this air moves onto land, its typical water vapor content (though reduced) reflects the amount that it held originally (11). Because the land warms faster than the oceans, however, the humidity of the arriving air does not increase enough to maintain a constant relative humidity. The latter must therefore fall on average (see the figure), as indeed seen in model simulations (11, 12) and observed on all continents (10). Therefore, the saturation deficit (gap between actual and saturation water vapor concentration; see the figure), which is the key factor controlling PET, grows much faster in percentage terms than do other hydrological quantities. This increases the aridity.

附件 - (5-5)

A map of the predicted change in annual mean near-surface relative humidity (see fig. S1, panel B) (13) not only confirms a general decrease over most land regions, but also shows a pattern nearly identical to that of the change in P/PET. These similarities show that regional changes in near-surface humidity, soil moisture, and precipitation are tightly coupled. Increases in PET are mainly attributable to overall land warming rather than relative humidity change (14), but the P/PET ratio on land is reduced largely by the enhanced land warming relative to oceans (see the figure) and by the decreases in relative humidity on land. The latter are negative over most land areas despite being slightly positive over oceans. Positive feedback from soil moisture changes is not needed to explain enhanced land warming, but likely amplifies it in some regions (15).

Regional variations in simulated aridity change may still be unreliable, or may reflect other changes such as poleward shifts of climate zones (5). But the general trend toward a drier land surface appears to rest on relatively firm foundations. The predicted drying would be sufficient to shift large portions of the Earth to new, drier climate categories (although the richer atmospheric CO₂ might mitigate the impact on some plants). The background drying is separate from, but may be compounded by, the expected trend toward more intermittent rainfall for a given mean rain rate (16).

As the above considerations show, focusing on changes in precipitation, as typical in high-profile climate reports (2), does not tell the whole story—or perhaps even the main story—of hydrological change. In particular, it obscures the fact that in a warmer climate, more rain is needed. Many regions will get more rain, but it appears that few will get enough to keep pace with the growing evaporative demand.

附件 = (5-1) Yahoo奇摩新聞

士林地震 立委籲持續監測

(中央社記者曾盈瑜台北14日電) 民進黨籍立委田秋堇今天說，政府單位應該持續關注日前士林地震對山腳斷層是否造成影響。地調所說，持續監測中。

民主進步黨籍立法委員田秋堇上午在立法院舉行記者會表示，12日台北發生芮氏規模4.0地震，氣象局強調震央離山腳斷層6公里，但仍不免令人擔憂是否牽動山腳斷層。氣象局應該繼續調查，並好好請教國內地質學者。

海洋大學應用地球科學研究所名譽教授李昭興說，台北盆地地震不斷，今年1月2日到3日，台北士林地區就有40幾個測到的地震，其中15個規模超過1.5；而去年10月汐止有規模5.2的地震。讓人懷疑台北市比鄰的大屯火山安不安全。

李昭興說，國內學者陳中華曾表示，外界都認為大屯火山最近一次爆發是在10萬年前，但其實經他測試，大屯火山到5500年前都還有爆發的跡象；台北市的人口密度之高，是全世界火山城市中數一數二，但對大屯火山的認知卻相當不足。

經濟部中央地質調查所構造與地震地質組長謝凱旋出席記者會表示，很關切士林地震，持續監測。至於山腳斷層部分，也陸續蒐集資料彙整，分析沉積物的性質。1030214

附件二 (5-2) 中央社即時新聞 CNA NEWS

士林地震 北市26年來最大

(中央社記者蔡和穎台北12日電)台北士林區凌晨發生芮氏規模4.0地震，根據氣象局地震測報中心資料，這是26年來，台北士林大屯火山區域發生最大的地震。

台北市士林區今天凌晨0時31分發生芮氏規模4.0地震，震央在台北市政府北方11.8公里，地震深度6.3公里，陽明山最大震度4級，新北市五股、桃園縣桃園市3級，台北市、基隆市2級。

根據中央氣象局地震測報中心資料，這次地震是台北士林大屯火山區域26年以來發生的最大地震。

地震測報中心以這次地震的震央為中心，半徑5公里為範圍搜尋，自1980年來，範圍內共有19個規模3以上地震，平均1至2年即有一起規模3以上的地震，最大的一起是在1988年，地震規模達5.3，當時陽明山花鐘發生倒塌。

中央氣象局地震測報中心主任郭鎧紋表示，凌晨這起地震的震央位於士林區的大屯火山區，是岩漿冷卻過程中會出現「應力調整」。

郭鎧紋解釋，這是指在岩漿冷卻過程中，因熱脹冷縮原理，岩漿體積縮小產生空隙，上方岩石往下掉，造成塌陷，才發生地震。

郭鎧紋說，地震震央位於大屯火山區，專家學者認為大屯火山是活火山，根據地震測報中心監測，近期大屯火山區每天小地震約3至5個，一般要到每天約200個小地震，且由深層變淺層，才達火山活動活躍的第一級標準。

他說，火山爆發可事先預測掌握，初步判斷凌晨地震不是大屯火山要爆發的跡象。1030212

※你可能還想看：

[凌晨地震晃動整個台北 並非大屯火山要「爆發」](#)

[你家耐震程度高不高？這裡線上直接測！](#)

[地震心理學 / 地震後：你第一個想到的是...](#)

附件二 (5-3)

NOWnews 今日新聞

士林地震 經部：與山腳斷層無關 大屯火山處穩定狀態

記者顏真真 / 台北報導

針對日前在台北市士林地區發生有感地震，因近大屯火山群，引發關注，經濟部中央地質調查所14日表示，從地震特性來看，解釋斷層面的走向與山腳斷層不一致，研判應與山腳斷層無太大關連性，而且大屯火山地區的火山噴氣及溫泉水質等指標的長期監測數據並沒有明顯變化，目前大屯火山仍處於穩定的狀態，未來也將持續監測大屯火山群及山腳斷層活動性。

地調所表示，山腳斷層是北部地區附近唯一的活動斷層，為正斷層型式，呈東北(北50度東)走向，斷層自樹林經關渡至金山出海。根據中央氣象局的地震分析結果，這次地震雖為正斷層型式的破裂，但由於地震解釋斷層面方向(北38度西及北18度東)與鄰近的山腳斷層並不一致，初步排除與山腳斷層的活動相關，後續仍會持續分析微震觀測資料確認。

此外，根據地調所的監測結果顯示，近年來大屯火山地區每天均會產生次數不等，且規模2以下的微震，一般而言，每天會產生的微震數量多在10個以下，最高值約為每天產生40個微震。

地調所說，這次地震後8小時內，已偵測到百餘個微震，其形態目前尚在解析當中，但後續微震活動明顯趨緩，而其他火山活動觀測值並無明顯變化，研判大屯火山群之活動處於相對穩定的狀態。

地調所也強調，自民國93年起於大屯火山地區監測火山活動，並與中央研究院、中央氣象局及陽管處等相關單位的資料共同彙整到大屯火山觀測站。地調所未來將持續監測大屯火山群及山腳斷層的活動性，可於發現火山活動徵兆異常變化時及時通報相關單位。

關鍵字: 地震 陽明山 士林 財經 生活 經濟部 中央地質調查所 大屯火山

自由電子報

附件 = (5-4)

自由電子報 - 平等國小水塔震歪 士林耆老第一次感震

〔記者謝佳君、吳亮儀、林曉雲、湯佳玲、蔡亞樺、宋小海 / 綜合報導〕地牛翻身，鄰近震央的北市平等國小一座五噸重的水塔昨早被發現傾斜，還有磁磚剝落，由於這座水塔供應餐廚使用，學校昨天緊急請廠商調其他單位的桶餐應急。教職人員說，過去沒發生過這麼大的地震，有小朋友則說：「睡夢中以為是幻覺！」

這次震央罕見出現在台北士林區，平等國小在陽明山區，由於校舍已有三、四十年歷史，校方昨天一早發現，五噸重的水塔傾斜，無法供應廚房用水，這週恐怕都得從其他學校或單位調桶餐應急，校舍與校舍間的伸縮縫也出現磁磚、水泥剝落，通報災損金額為六萬元。

平等國小學生董家伶說，地震發生時睡得很熟，但被媽媽驚叫聲嚇醒，天花板一直晃，連電視都壞掉了。

六十三歲的北市士林區平等里里長陳添地說，剛要睡覺就發生地震，嚇了一跳，且震動很明顯、感受很深，是九二一大地震以來印象最深刻的地震。

六十七歲的當地耆老陳先生也說，從小在士林長大，沒聽過震央在士林區的地震，第一次碰到「這麼有感覺」的地震。

北市無災情 核廠系統正常

北市消防局昨天說，北市1999市民熱線整天無人通報及詢問地震事宜，市民滿冷靜。工務局大地工程處昨也進行全市山地坡巡查，截至目前為止未發現任何災情。

這場地震也觸動核二廠地震儀發出警訊，核二廠震度為核一廠將近十倍，所幸派員巡視廠房後，確認各核電廠機組穩定運轉，設備系統正常。

附件 = (55) 中時電子報

士林地震 郭鎧紋：岩漿冷卻凹陷 偶發

台北市士林區凌晨零時31分發生芮氏規模4.0地震，氣象局地震測報中心主任郭鎧紋指出，今天凌晨的地震初判與大台北活動斷層山腳斷層無關，也不是大屯火山爆發的跡象，而屬岩漿冷卻過程中出現的「應力調整」。郭鎧紋表示，這是指在岩漿冷卻過程中，因熱脹冷縮原理，岩漿體積縮小產生空隙，上方岩石往下掉，造成塌陷，才發生地震。凹陷的地方是在內寮。

士林區凌晨零時31分發生芮氏規模4.0地震，震央在台北市政府北方11.8公里，地震深度6.3公里，陽明山最大震度4級，新北市五股、桃園縣桃園市3級，台北市、基隆市2級。

郭鎧紋表示，地震震央位於大屯火山區，大屯火山被認為是活火山，根據地震測報中心監測，最近大屯火山區每天小地震約3至5個，一般要到每天1、200個小地震，且由深層變淺層，才達火山活動活躍的標準。

他說，火山爆發可預測，凌晨的地震也不屬大屯火山要爆發的跡象。