

行政院所屬各機關出國報告
(出國類別：考察)

考察美國氣象研究機構及出席
「亞太經合會之氣象及水文合作研討會」
出國報告

服務機關：交通部中央氣象局
出國人：職 稱：局 長、主 任
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摘 要

中央氣象局於公元 2000 年 10 月與 11 月，分別與美國海洋暨大氣總署全球計畫辦公室與在紐約之哥倫比亞大學完成簽約程序，三個單位共同為「國際氣候預測研究院」之創始會員，一起為推動氣候研究、預測與應用而努力，並以「有效利用氣候資訊創造實質經濟效益」造福人類社會為目標。為求合作夥伴相互瞭解以促進合作默契和效率，氣象局謝局長特別利用受邀出席「亞太經合會之氣象及水文合作研討會」之機會，率同本局氣象科技研究中心鄭主任正式訪問紐約哥倫比亞大學地球學院與國際氣候預測研究院總部，期間並順道訪問有多年成功合作夥伴關係的預報系統實驗室。本報告敘述此行之經過、見聞與心得。

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一、目的

此次考察行程包括美國紐約之哥倫比亞大學地球學院 (Earth Institute, Columbia University at New York)、國際氣候預測研究院 (International Research Institute for Climate Prediction, IRI-CP)總部、美國海洋暨大氣總署預報系統實驗室 (Forecast Systems Laboratory, NOAA)、及參加亞太經合會之氣象與水文合作研討會「Workshop on Meteorological and Hydrological Cooperation within APEC」。

我中央氣象局、紐約哥倫比亞大學、及美國國家海洋暨大氣總署全球計畫辦公室 (Office of Global Programs, National Oceanic and Atmospheric Administration)，同為國際氣候預測研究院之創始會員，其中哥倫比亞大學並為國際氣候預測研究院之宿主單位 (hosting institute)。基於增進合作夥伴關係及創始會員間之互動，特別安排訪問紐約哥倫比亞大學地球學院，以進一步瞭解該校對國際氣候預測研究院的定位、期望與支持程度，以求在未來合作關係上得以相輔相成，取得本局在合作過程中的最高效益。

考察國際氣候預測研究院總部之目的，在瞭解 IRI 現有人力、設施及運作情形，日常工作內容及推展國際化之規劃及進度，以評估對本局發展最有利之合作項目與合作進行方式。其次也要瞭解本局人員在該總部工作情形，及未來前往國際氣候預測研究院受訓或執行合作案人員之工作環境與生活安排，並檢討進行中合作案之進度及雙方配合事項。

在本局氣象預報作業現代化過程中，和美國海洋暨大氣總署預報系統實驗室合作發展並成功建置的兩代「氣象資料整合即時預報系統」，對作業型態及作業效率的改進有根本

性的影響，該系統相關技術之引進並落實至實際作業應用，可說是氣象局現代化的重要里程碑。此次訪問預報系統實驗室的目的是與其主管級人員交換過去合作案執行心得、現階段業務規劃狀況、人員配置，及研究發展上的關鍵技術之實際進度，並進一步討論未來合作案雙方之期望。討論重點為本局下一期計畫相關項目，尤其是有關劇烈天氣監測預報系統發展事項，包括下一代超級電腦的可能特色。

「亞太經合會之氣象與水文合作研討會(Workshop on Meteorological and Hydrological Cooperation Within APEC)」係由美國氣象局(National Weather Services)發起，配合美國氣象學會第八十一次年會而選在新墨西哥州阿布科基(Albuquerque, New Mexico, USA)舉行。亞太經合會(Asia Pacific Economic Cooperation, APEC)為我國與中國大陸可對等參與之組織，參加亞太經合會氣象與水文會議的目的，係著眼評估在此組織架構下推動與環太平洋國家氣象合作交流的可行性。此外，氣象科技已發展至一個強調應用並足以創造實質經濟效益的階段，在以經濟為主體的「亞太經合會」架構下推動氣象及水文合作，實有其階段性發展的指標作用，也契合氣象與水文科技順應社會脈動而發展的大趨勢，因此我中央氣象局以積極而正面的態度參與此研討會。

二、過程

謝局長和鄭主任於民國九十年一月七日由中正國際機場出境，於當地時間七日晚上七時三十分抵達美國紐約市。

八日上午九時起，先拜會紐約哥倫比亞大學首席副校長 Dr. Michael Crow，並聽取哥大地球學院簡報，重點為該學院之現況、未來發展及國際氣候預測研究院在地球學院中的定位。約一小時的簡報與交換意見後，謝局長和鄭主任於十時十分離開哥大前往國際氣候預測研究院總部，到達後即刻開始一系列的討論會，內容包括我中央氣象局氣候監測與預報計畫之規劃重點，國際氣候預測研究院組織、人事、經費及國際發展現況，以及其各部門工作重點。討論的方向以相互瞭解及探討合作最適宜之合作主題為目的，會議至下午五時結束並即席做成結論。

九日由紐約飛抵丹佛市，由於飛機誤點，到達時已是當地時間下午近四時。此日原本便因時程考慮而無正式參訪安排，因此僅由謝局長抽空與當地華人學者進行非正式談話會，瞭解華人學者在當地研究工作情形。

十日參訪位於卵石城的預報系統實驗室，除了檢討過去合作成效外，也針對未來可能合作項目廣泛交換意見。議程中也安排參加該單位內部天氣討論會，實際體驗預報系統實驗室所發展之天氣預報作業系統的運作與使用情形。參觀其大量平行運算主機之機房設備也令人印象深刻，預報系統實驗室是目前世界上少數有能力開發使用大量平行運算主機技術之單位，其發展之輔助軟體值得本局進一步瞭解與評估。

十一日上午安排與預報系統實驗室主管 Dr. Alexander E. MacDonald 單獨會談。Dr. MacDonald 對本局第四期計畫規劃內容極為肯定，其本人並就預報系統實驗室定位及未來發展重點方向有很深入的剖析。同日下午，謝局長和鄭主任便由丹佛飛新墨西哥州阿布科基市。

十二日參加亞太經合會之氣象與水文會議，共有十九國之氣象作業單位代表與會，探討在亞太經合會架構下推動各經濟體間氣象與水文合作案之可行性。上午主要為主辦單位安排的相關議題報告，下午先由各經濟體代表發表立場說明，其後再針對特定提案進行討論，最後由主席作成會議結論，送交亞太經合會之工業科技工作小組(APEC/Industrial Science and Technology Working Group, APEC/ISTWG)立案。當晚在主辦單位安排的簡單聯誼茶會後會議結束。

十三日由阿布科基經鳳凰城到洛杉磯，休息一晚後由洛杉磯直飛台北，於台北時間十五日下午八時三十分返抵國門，為此行劃下完美句點。

三、訪問紐約哥倫比亞大學地球學院

訪問紐約哥倫比亞大學(以下簡稱哥大)地球學院，係由該學院副院長 Dr. John C. Mutter 陪同哥大首席副校長 Dr. Michael M. Crow 親自接待並簡報。

哥大稱其地球學院為「以地球為焦點的全校性跨系所企業體」，以進行新學院組織概念的試驗，滿足社會對學術界增進人類福祉的企盼，及做為學術界持續追求卓越的策略。在人類社會發展過程中，知識份子常扮演推動及引領社會進步的角色，但是現代的科學將我們所認知的世界不斷地切割，世界成了物理、生物、社會...等等片段的組合，科學的效率可能增加了，科學對人類環境的衝擊變大了，科學可能為人類帶來許多好處，但片段段的科學之間卻漸漸失去了協調性，逐漸地一些有識之士開始由人口問題、環境變遷問題、永續問題等不同角度，對人類的未來發出警訊。哥大地球學院便是在這種背景下成立，試圖從人本的角度重新以科學的基礎審視地球，以人類永續為目的而探索地球上，包括人類的所有物種與整體物理世界的互動關係，便稱為「星球管理(Planetary Management)」。

地球學院探討的是星球管理的問題，其目標在於：1. 藉由全球觀點的深入剖析人類力量與地球系統的關係，以進一步瞭解如何達成地球可永續的未來；2. 推動跨所有時間和空間尺度，包含物理、生物和社會科學的整合計畫；3. 研究區域、國家及國際層面之決策過程和政策推行的模式，以便研究成果能更有效的納入決策過程。地球學院的內涵包括科學管理、觀測及教育，其探討對象可以是一個國家或地區的氣候系統、生態系統或經濟體系，中心議題包括碳化物管制、人類行為、及各類無機物種對探討對象的影響。設立地球學

院不僅是要對人類永續問題提出解答，更希望能對人類未來發展產生實際而正面的影響，因此如國際氣候預測研究院的組織，便成了地球學院與社會聯繫的理想窗口。另由簡報中還特別指出位於亞利桑納州的第二生物圈實驗室，為地球學院對外教育宣導的另一重要窗口。

四、考察國際氣候預測研究院總部

「氣候預測應用」本質上是人類行為力量與自然環境變化的折衝與調適問題，執行得當通常可獲致可觀之經濟效益。近年來國際上更有將「氣候預測應用」，視為永續議題下全球變遷調適之「測試」或「實踐」場的趨勢。一些與「全球變遷」議題相關的國際組織，不約而同的將「氣候預測應用」明列為組織目標之一，而「國際氣候預測研究院」是唯一以「氣候預測應用」為單一訴求，而且已有成效的組織。

此行目的之一在增進彼此之瞭解，在辦公環境及設施介紹後，與國際氣候預測研究院主管人員之座談會，由上午十一時起在其總部之簡報室舉行。首先由鄭主任簡報我中央氣象局氣候監測與預報作業現況與展望，鄭主任由氣象局網站現有氣候監測與預報資料介紹起，再談到現行長期天氣預報之內容、預報方法、及技術得分。其次由分析現行預報作業面臨之困難問題，引出本局下一期業務計畫之規劃背景、規劃內容、及本局之期望。最後以分析本局和國際氣候預測研究院可能合作領域為總結，短期合作強調的是資料交流與氣象局之國際參與。

國際氣候預測研究院的簡報也是由其全新網站首頁開始，上面列有「臺灣參與」的醒目標題，臺灣是國際氣候預

測研究院的第一個國際夥伴(核心會員)，臺灣的支持對國際氣候預測研究院的發展意義深遠，他們以「興奮」、「鼓舞」形容其幹部同仁的感受。國際氣候預測研究院從約一年半前開始擴編，由十七人成長到目前超過五十位全職的技術與行政人員，可以說現在才是國際氣候預測研究院正式出發的時候。而訪問學者除外，未來還有十人左右的成長空間，算是為未來發展規劃保留的彈性。人力分配上，30%是預報模式及技術發展，40%人力置於應用研究，其餘30%為計畫整合、推動及行政支援人力。經費分配比例則為：43%應用計畫、25%預報及預報技術發展、10%為旅費、9%行政支援、8%技工支出、5%設備。

在國際氣候預測研究院的人力、設備及經費逐漸步入正軌後，依據其組織運作規劃，未來推動業務運作的三大架構：秘書處、董事會、及科技顧問委員會，即將於未來幾月內正式成立並運作。秘書處以國際事務發展為主體，配合院長建立國際氣候預測研究院的國際與美國國內合作夥伴，以維持研究院的長期穩定運作與適度的再發展；董事會為國際氣候預測研究院最高決策及策略研擬單位，由主要資助單位和傑出專家組成，包含一位專任主席及十五位成員，採共識決策運作模式，臺灣則保有一常任席位，第一次董事會議預定於四月初召開；科技顧問委員會由雙主席加上十五位專業個人及組織代表組成，負責協助維持國際氣候預測研究院運作水準，協調與整合計畫，策略性規劃與計畫優先性決策，及拓展對外聯繫窗口。第一次科技顧問委員會議已決定於三月二十六和二十七日，假國際氣候預測研究院總部大樓召開，臺灣有國立中央大學劉校長兆漢受聘為科技顧問。

在我們所關心的國際發展方面，除臺灣外，與國際氣候

預測研究院正式簽訂合作備忘錄或合作協議的單位包括：非洲的 African Centre for Meteorological Applications for Development；巴西的 State of Ceará，FUNCEME，CPTEC/INPE；埃及的 Government water agencies；法國的 Institute for Research on Development；印尼的 BPPT；日本的 Frontier Research System for Global Change；斯里蘭卡的 Mahaweli Authority；美國的 NOAA/NCEP、Applied Research Center；及 WMO、UNESCO 等。其他尚有許多未簽署文件，但已有實際合作計畫進行之單位，包括政府組織、學校、及法人研究機構。在臺灣之外的其他合作單位，主要是以計畫合作的方式表達對國際氣候預測研究院的支持，其中仍有部分經費及人力直接支援其總部。哥大的策略是以實際行動，爭取國際氣候預測研究院立足國際氣候預測與應用舞臺，初步以利用國際開發銀行經援基金，推動少數具指標性的應用計畫，在建立適度國際聲譽後，再開始下一階段擴展合作夥伴，包括核心及外圍會員之行動。

國際氣候預測研究院應用研究的重點包括農業與糧食安全、漁業發展與漁獲承受、氣候與流行疾病、及水資源規劃等。其參與推動之執行中計畫列舉如下：(Climate and Agriculture) A Network for Harmonization of Climate Prediction for Mitigation of Global Change Impact in Sudan-Sahelian West Africa, Assessing Current and Potential Use of Seasonal Climate Forecasts for Communal Farm Management in Zimbabwe, Improving Climate Forecast Communications for Farm Management in Zimbabwe, Management Responses to Seasonal Climate Forecasts in Cropping Systems of South Asia's Semi-Arid Tropics, ENSO and Rice Production, Sri Lanka, R&D on Global Food and

ENSO; (Climate and Fishery) Linking Anchovy Catch and Climate, The Potential Uses of Satellite Information for Fisheries Management; (Climate and Hazard) Identifying Potential Uses of Seasonal-to-Interannual Climate Forecasts for Improved Indonesian Forest [Fire] Management, Early ENSO Predictions, Caribbean/Central American; (Climate and Human Health) A Dengue Early-Warning System; (Climate and Water Resource) Nile River Streamflows and ENSO, Pilot Study at Itaipu Binacional, Paraná, Grater Horn of Africa.

在緊密的六個小時討論後，雙方同意立即辦理的事項包括：1.國際氣候預測研究院將立即檢討改進其資料接收與傳輸之備援與不斷電系統，以達即時資料供應作業之標準；2.建立雙方資料處理及系統管理負責人之聯繫管道，於四月以前評估作業資料傳輸及部分計算機(電腦)資源共享之可行性；3.評估發展動力預報模式之合作形式，包括提出模式輸出資料交換之經濟可行方案；4.準備三月在台北進行第一次氣象局和國際氣候預測研究院聯合氣候預報作業。

長期推動策略上雙方的共識包括：1.台灣的气候應用計畫將商請中央大學校長劉兆漢先生協助推動，國際氣候預測研究院將直接洽劉校長討論氣候在水資源規劃、農業、漁業、及公共衛生相關議題上的合作事項；2.逐步推動分析台灣的水資源規劃、農業、漁業、及公共衛生對氣候的敏感度與問題現況；3.建立常態化技術人員互訪機制；4.建立台灣全面參與氣候預測技術研發之模式，以包括資料完全開放等措施，使台灣得以在合作過程中獲得最佳效益；5.建立高解析度氣候模式發展之合作管道，進行氣候降尺度及颱風長期預測研究；6.利用動力降尺度訓練課程的機會、協助氣象局

建立台灣地區降尺度作業預報能力；7.長期持續進行氣候聯合預報，截長補短以提供最佳預報產品。

合作案的三個重要查核點定為：1.網際網路可靠度評估工作，在一個月內提出評估報告；2.三月底前決定是否由 IRI 提供氣象局作業觀測及網格資料；3.三月前完成聯合預報之先期準備工作，包括軟硬體之作業設定。

一般而言，透過區域性國際組織或合作計畫推動的「氣候預測應用」，通常規模大，問題複雜度也高，往往需要整合自然、人文及社會科學研究成果，配合高科技氣象作業系統，在政府的適當決策宣示與動員下，始得以有效施行。因此，在「國際氣候預測研究院」架構下的國際合作案，往往會發展至國家的層次，由基礎研究的「前端」至應用執行的「終端」的全面性合作模式。因此雖然在現階段合作內容的討論中，我們主要焦點是資料交換與聯合預報作業，我們期望長期參與「國際氣候預測研究院」，最終不只是為改進本局的業務，長期發展上我們也期望能為國內學者個人或單位、氣象局本身、國家經濟、甚至外交關係等之發展，爭取最高整體效益。

五、訪問預報系統實驗室

中央氣象局與預報系統實驗室已有多年的合作經驗，過去主要的合作重點，包括天氣整合暨即時預報系統，以及數值天氣預報三維變分資料同化技術發展兩項。未來本局希望將合作重心轉移至非傳統高解析觀測資料應用、新一代服務系統、及大量平行運算技術發展等主題，這些主題是預報系統實驗室在觀念及技術發展方面領先的領域。

非傳統高解析觀測資料的應用係架構在「區域分析與預報(Local Analysis and Prediction System, LAPS)」系統下，它的設計目標在於建立單一作業系統，利用最先進顯示技巧，開發所有可用資料，以提供最佳區域氣象網格分析與預報資料，並能進一步製作特定天氣預報應用產品。LAPS 於 1987 年便已有雛型系統發展，最初以診斷分析為主，至 1990 年後才逐漸具有即時分析並進行天氣監測能力，近幾年則已達作業化標準。整體而言，LAPS 的優點在於針對中小尺度天氣監測作業需求設計，因此對天氣現象的部分細節分析有其獨到之處，是提供精緻化天氣預報產品的一大利器。預報系統實驗室正規劃加強 LAPS 之高解析資料四維同化能力，將來配合高解析非靜力平衡模式之使用，將使 LAPS 具有更高的實用價值。

在非傳統資料的開發方面，現階段預報系統實驗室最積極參與的是 GPS/IPW(GPS Integral Precipitable Water)計畫。該計畫嘗試擴建美國境內地面 GPS 訊號接收站，並加入氣象變數即時觀測，分析大氣可降水量供氣象作業及研究之用。理想上，預報系統實驗室希望推動 GPS 接收站擴增至平均每四十公里設一站的密度，以改善現行作業系統對水汽場的分析能力，提升定量降水預報的準確度。在台灣，均勻分布的

GPS 接收站，只要有約二十站便可將平均距離減至四十公里以內，因此我們要考慮的是，更密集的 GPS 接收站是否能有更高的相對效益。

現代化的氣象服務正朝著多元化與精緻化的方向發展，氣象作業單位所能提供的資訊也因此越來越豐富，傳達這些豐富的資訊將面臨兩個瓶頸。首先，使用者如何在廣大的資訊汪洋中快速的找到所需要的訊息？更根本的問題，我們可以假設使用者知道最適用於他們需求的資訊是什麼嗎？其次，如何增進傳輸效率以減輕資訊傳輸網路的負擔？前一個問題直到最近才引起氣象資訊提供者的注意，美國氣象局也明確強調，「氣象資訊是否被有效利用」是氣象服務思考上有待克服的盲點。在本局第四期發展計畫中，已包含使用者和資訊提供者雙向溝通功能的服務系統規劃，在觀念上便頗受預報系統實驗室人員的稱許。預報系統實驗室在提升服務系統傳輸效率方面，則有具體的構想與初步成效。他們認為未來服務系統應有區域伺服中心的架構，區域中心可充分利用離峰時段，將必要及高使用率的資訊先行接收並儲存，部分產品更可在區域中心產出，如此便可降低網路使用成本，提升網路使用效率。其次，預報系統實驗室也相當成功的發展影像及網格資料壓縮技術，大部分情況壓縮比可以高達二百分之一而不造成目視可判別的誤差，這是一項相當實用的技術，值得本局考慮引進或發展。

預報系統實驗室的大量平行運算主機完全由量產的個人電腦組成，在未來數月中節點數將達千數以上，外形上相當壯觀。在計算速率表現上也有相當出色的數據，目前已有中尺度分析與預報系統在此機器上進行常態作業，預報結果並直接顯示在機房外的中型顯示面板上，令人印象深刻。預

報系統實驗室預期，分散式儲存記憶的大量平行運算主機終將成為主流，因此對於程式轉換的輔助性軟體研發一直未曾間斷。本局在富士通電腦主機引進之前，曾與預報系統實驗室在平行運算技術上有所聯繫，後來程式轉換重心逐漸移至富士通的技術人員上。由於平行運算程式撰寫之難度高，費時費力，因此氣象局自行培養這方面專長的技術人員，從成本效益上考量並不經濟，因此未來若有需求，委外的可行性仍佔優勢。只是為了避免受制於他人，本局仍應掌握相關資訊與發展趨勢，預報系統實驗室在這方面的經驗與技術水準，或許可做為本局參考的主要基準線，因此未來仍有合作空間。

在超級電腦發展趨勢預估上，預報系統實驗室有其通暢之資訊管道。訪談中我們獲得告知，富士通公司已正式對外宣佈，該公司將改變向量運算式的主機發展策略，下一階段將投入分散記憶式之大量平行運算主機的開發。本局現行作業主機可能成為富士通公司 VPP 系列主機的末代產品，顯然本局下一代主機的選擇將又是全新機型，而非升級式的中央處理器擴充的型式。不過，縱使預報系統實驗室很重視超級電腦的發展趨勢，他們還是無法預測五年後可能的市場行情。由於歐洲中期天氣預報中心也是採用富士通主機，本局自應密切注意其電腦主機後續採購規劃。

預報系統實驗室的主管 Dr. MacDonald 在敘述未來發展方向時，很自然的令人感受到他對研發工作的樂觀與熱誠，那就像他們嶄新的辦公環境一樣，充滿著朝氣與活力。Dr. MacDonald 個人的興趣可歸納為三個主軸：1.利用區域數值模式研究最佳觀測系統應有的條件，以做為設計新觀測平台的構思方向；2.發展全球觀測系統，包括地面 GPS 訊號接收、

導向觀測氣球和遙控飛機觀測等；3.分散式大量平行運算主機的使用，發展平行運算模式技巧。仔細分析，我們發現整個預報系統實驗室的發展方向，似乎是架構在 Dr. MacDonald 個人的興趣上，他個人的三個主軸也是預報系統實驗室的主要研發方向。其它如，WRF(Weather Research and Forecasting) 模式系統的發展，由資料四維同化、模式發展、至作業考慮，正好可以整合上述三研發方向的成果，而預報系統實驗室一貫努力的預報作業工作站，則是總其成的工具。在此我們深刻體會一位傑出領導人的抱負可以主導整個研究團隊，這種影響力既深且遠。

Dr. MacDonald 個人在近年投入最深的研究為地面 GPS 訊號接收反演水氣的技術，他用三維變分分析的技巧，評估此反演技術對數值天氣預報的可能效益。由於議題上的相關性，他對台灣的華衛三號計畫深感興趣，該計畫又稱為 COSMIC (Constellation Observing Systems for Meteorology, Ionosphere, and Climate)，為利用 GPS 訊號接收反演水汽技術演生的新觀測方式，是一種相對低成本的衛星觀測全球溫度及水汽場垂直分布的計畫，同時並有監測電離層參數的能力。COSMIC 計畫符合 Dr. MacDonald 新觀測平台開發的思考方向，同時平流層水汽觀測也是現階段極需克服的作業瓶頸。

六、出席亞太經合會之氣象及水文合作研討會

亞太經合會之氣象及水文合作研討會(Workshop on Meteorological and Hydrological Cooperation Within APEC)係由美國氣象局具名發起，出席的有十九經濟體(國)及部分相關組織代表共 51 人，其中東南亞經濟體代表幾乎都是各國氣象局局長，充分具有代表性。有關本次會議之議程、大會紀錄及出席代表個人資料，詳見附錄。

此次會議召開的動機係以區域經濟穩定為訴求，近年亞洲金融風暴明確顯示了 APEC 各經濟體間的緊密關聯，因此任何一地區的經濟穩定都是全部經濟體所關心的議題。而長久以來世人都瞭解，因氣象與水文變化導致的自然災害對區域經濟有很大的影響，會議目的便是希望藉由 APEC 經濟體間的氣象與水文合作，共同保護此區人民生命財產的安全，同時減輕自然災害對個別經濟體的衝擊。美國因此倡議，APEC 應由鼓勵此區氣象水文作業單位的資訊交流做起，提升整體氣象水文作業水準，並進一步發展氣象水文應用計畫，積極支持本區各經濟體的穩定發展。

大會安排的報告分為三大項，首先是 APEC 組織與背景介紹，包括氣象水文合作案在 APEC 組織下運作的可能架構，重點是 APEC Working Group II，又稱為 ISTWG (Industry, Science and Technology Working Group)；其次是 APEC 現行相關計畫簡介，包括韓國主持的 APEC Climate Network (APEC CN)及印尼主持的 Short-term Climate Forecasts and Their Application for Social and Economic Development；最後是一系列的專題報告，由防災、水資源規劃、跨國際污染擴散監測、氣候之經濟應用、及數據與資訊自由流通等議題，提供可能合作領域的思考方向。

此次會議的討論過程相當熱烈，各經濟體代表的正式立場宣讀也進行的相當慎重，與會代表對會議的價值顯然均持正面肯定的態度。最後主席歸納會議結論如下：1.大會優先支持現有相關計畫，包括韓國與印尼個別主持的計畫；2.成立工作小組研擬可行計畫送各經濟體代表複閱；3.工作小組成員包括加拿大、日本、韓國、紐西蘭、菲律賓、和美國，而由美國代表擔任第一屆召集人；4.新計畫研擬方向以氣候變化、防災整備、資訊自由化、及增進與非氣象水文領域溝通為優先議題；5.會議結論提報 ISTWG 會議確認並轉 APEC Business Advisory Council 備案。

在 APEC 架構下推動氣象及水文合作是個新嘗試，但是類似會議的召開並不令人意外。除了由防災與區域經濟穩定的觀點可以說明會議的動機外，氣象及水文作業水準也到了一個前人可能想像不到的境界，值得慎重考慮利用氣象及水文資訊創造實質經濟效益。因此，氣象水文作業與經濟圈的交流互動已是遲早的事情，而 APEC 是環太平洋地區最活躍的經濟組織，在這個組織下運作氣象水文合作，可說是水到渠成的理想規劃。就我國之國際發展而言，APEC 也是承認我國和中國大陸具完全對等地位的最具規模國際組織。雖然 APEC 定位為非政府間組織，但 APEC 以非正式領袖會議為決策宣示機制，參與階層高，極適於推動國際合作案。

最近二十年，先進氣象作業單位在預報能力提升上成效卓著，逐日天氣預報能力由八十年代初期的不足三天，在二十年間持續穩定的提升，時至今日，部分地區已有接近十天的預報能力。本局在氣象作業全面電腦化計畫的努力下，逐日天氣預報能力也和先進國家幾乎同步的提升，配合本局獨特而成功的服務系統發展，氣象資訊普遍而深入的傳達至社

會各階層，使得民眾能接觸並清楚感受到氣象預報的進步。當一般人心中仍存在強烈「天有不測風雲」的觀念下，突然發覺大部分時候，天氣竟如氣象局描述一樣的起了變化，這種感受已足夠使作業氣象界的努力獲得完全的肯定。從天氣變化的「渾沌」特性或是由科技的發展趨勢而言，對於傳統定性描述的逐日天氣預報作業，先進氣象作業或研究單位都已不再樂觀的預期，準確度可以再持續長時間穩定而顯著的提升。因此，作業氣象應未雨綢繆，思考如何持續貢獻社會，避免業務的停滯不前。

事實上，科技發展已為傳統天氣預報開出了一條新路，現行天氣預報所能掌握的資訊不只是準確度的提升，精密度也同時大幅增加。於是強調量化、強調小區域的差異、和強調使用者導向的精緻天氣預報作業型態便應運而起，預報者和使用者的雙向溝通，將成為下一階段使用者導向產品開發的基礎，氣象業務的發展將進入敞開大門的階段。而隨著資訊流通方便性與效率的提升，網路資訊將打破政治和自然的藩籬，再加上系集預報(ensemble forecast)的明顯效益，國際合作或甚至於國際聯合天氣預報都是可能的發展。此次在APEC 組織下倡議氣象及水文合作，從作業氣象發展的角度來說，也是一件順乎潮流的前瞻性安排。

雖然目前談精緻天氣預報，頂多只是一個嘗試階段，有待預報的再精進，精緻化預報產品始能逐漸為社會大眾所接受。我們預期不久的將來，量化預報技術成熟而且可信度確立後，直接衝擊的應是防災應用觀念的改變。當有了量化的預報，使用者將可能進行系統性的風險評估。有了風險評估，防災決策便得以客觀化，抉擇行為將脫離主觀判斷行動與否的模式。無客觀風險評估支持的主觀抉擇，常使得決策

者背負主要的行為責任，因此決策過程往往趨於保守，預報的價值將大打折扣。反之，客觀化損益分析後的決策過程，幕僚作業將分攤部分風險責任，決策者將更勇於採取最有潛在效益的決策，防災應用也將可以客觀的計算出效益值。此次 APEC 會議的主軸便是防災應用的合作，我們應觀察的是合作案是否能示範出客觀的決策模式，那是氣象資訊應用新階段的重要指標。此外，國際合作更可降低個別作業單位的責任分攤，減少主觀因素干擾決策的機會，對客觀化決策模式的建立，將有正面的助益。

短期氣候預報是氣象作業發展的另一條新路，雖然目前最可靠的預報能力係建立在聖嬰預報的基礎上，一般相信動力氣候觀念的應用及動力模式的再精進，大氣自然背景擾動中，將有更多的長周期訊號可以被分離出來，也就是所謂短期氣候的可預報度將逐漸被開發出來。在季節至年際尺度間的短期氣候變化，常直接衝擊農業、漁業、水資源規劃、及流行疾病防治等重要經濟活動。因此，「經濟效益」一辭常如影隨形的和「短期氣候預報」出現在一起，在 APEC 架構下來談短期氣候預測與應用，似乎更是理所當然。「防災」應用使作業氣象從「提升生活品質」的抽象訴求，落實成「保護民眾生命財產」。如果氣象作業能再進一步「創造實質經濟效益」，氣象將自然而然的成為國家決策的重要影響因子，氣象作業將有更深一層的效益。短期氣候預報與應用為作業氣象刻劃出美好願景，在 APEC 代表發言中，我們便聽到了相當一致的期待推動氣候預測應用的建議，因此加強與非氣象及水文領域交流，也成為本次會議的重要結論。

七、心得與建議

氣象作業的資料來源一直都是建立在全球合作的基礎上，而隨著網路資訊流通的便利與低成本化，國際性的氣象作業合作將逐漸成形。其中具有經濟誘因，又有系集預報為明確合作理由的短期氣候預測作業與應用，將是國際間嘗試緊密氣象作業聯盟的首選主題。

這次考察行程中我們深深覺得 APEC 是個極適宜的國際合作舞台，此組織成員有密切的經濟往來，成員國又都普遍的深受太平洋海溫引起的短期氣候變化之影響，經濟與氣象科技條件，均有足夠的動機促成區域合作案的成立。雖然國際合作實務推動困難，但是強而明顯的動機遲早會化為實際行動。而我國地位特殊，必須在國際合作趨勢醞釀階段及早規劃因應，以期掌握有利條件，在機會成熟時，為本局的業務發展，也為國家的國際政治經濟空間，爭取最佳整體利益。我們認為最佳策略為，以 APEC 為舞台，扮演亞太氣候(或環境)資訊中心的角色；以「國際氣候預測研究院」為後盾，推動亞太地區短期氣候預測與應用，發掘此區氣候應用之經濟誘因，將合作案提升至國家層次。

本局網路資訊設施水準一流，這是參與國際活動的一大助力。在國際合作過程中，掌握最多資訊與資源的單位最能主導合作方向，而主導單位也往往能為本國爭取最高利益。因此本局在既有先進網路設施上，應該更進一步充實自主的網路資訊，以亞太氣候資訊中心為目標，將本局網站國際化。此外，攸關本局氣候監測與預報能力提升的四期計畫，也應動員人力與物力，務必如期執行，以作為本局推動國際交流合作的基礎。綜合上述，我們歸納下列幾點建議。

氣象作業的進步係國際合作的成果，而國際合作的內涵已不只是觀測，為因應此氣象作業國際合作趨勢，具體建議如下：

- 一、配合中央氣象局「氣候變異與劇烈天氣監測預報系統發展計畫」的推展，應繼續加強與美國海洋暨大氣總署預報系統實驗室(NOAA/FSL)技術合作，並積極參與國際氣候預測研究院的運作，引進氣候預測新技術，以使氣象防災及預報能力繼續再精進。
- 二、密切注意 APEC 氣象及水文合作案之後續發展，主動與相關國際氣象作業單位聯繫，爭取參與相關國際活動的機會，以展現我國的實力。
- 三、充實中央氣象局現有英文版網頁的內容，使氣象局網站能朝向國際化。

附 錄

Meteorological and Hydrologic Cooperation Within APEC: “Today’s Challenges, Tomorrow’s Opportunities”

WORKSHOP AGENDA DOUBLETREE HOTEL, SALON 1 January 12, 2001

Friday Morning

Continental Breakfast (8:00 AM - 8:30 AM)

Opening Session (8:30 AM - 9:30 AM)

1. **Welcome and Purpose of Workshop**
*John J. Kelly, Jr., Assistant Administrator for Weather Services,
U.S. National Weather Service*
2. **Introduction of Facilitator**
3. **Asia-Pacific Economic Cooperation (APEC): Introduction and Background
(Industrial Science and Technology Working Group)**
*Cathleen A. Campbell, Director, International Technology Policy and Programs,
Technology Administration, Department of Commerce*
4. **Summary of existing APEC Meteorological & Hydrologic Activities:**
 - **APEC Climate Network**
Chung-Kyu Park, Korean Meteorological Administration
 - **Indonesia Climate Project: Short-Term Climate Forecasts and Their Application for Social and Economic Development**
R. Sri Dilharto, Indonesian Meteorological and Geophysical Agency

Topic Presentations (9:30 AM -10:00 AM)
(15 minutes each)

- **Reduction of Vulnerability to Natural Disasters**
Dr. William Hooke, American Meteorological Society
- **Flood Forecasting**
Curt Barrett, U.S. National Weather Service

Break (10:00 AM – 10:30 AM)

Topic Presentations (10:30 AM -12:00 Noon)
(15 minutes each)

- **Transboundary Atmosphere Pollution**
Bruce Hicks, U.S. Oceanic and Atmospheric Research
- **Economic Implications of Climate Variability**
*Dr. Ants Leetmaa, U.S. National Weather Service Candyce Clark,
U.S. Office of Global Programs*
- **Open and Unrestricted Exchange of Data Public/Private Partnership**
John Lumsden, New Zealand Meteorological Service
- **Distribution and Use of Environmental Satellite Data**
*Timothy Stryker, U.S. National Environmental Satellite, Data, and
Information Service*
- **Unidata Technology: A Rapid Data-Flow Foundation to Support Economic and Social Decision Making**
Dave Fulker, University Corporation for Atmospheric Research

Luncheon (12:00 Noon - 1:30 PM)

Friday Afternoon

Participant Statements Representing APEC Member Economies
(1:30 PM - 3:15 PM) (Five minutes each)

Points to be addressed

- ✧ Comments on issues already addressed
- ✧ New issues
- ✧ Pros and cons of working within the APEC framework

Coffee break (3:15 PM - 3:45 PM)

Open Discussion (3:45 PM - 4:45 PM)

Summary of Workshop and Closing Remarks (4:45 PM - 5:30 PM):
Facilitator

Friday Evening

Reception - DoubleTree Hotel, Salon 2
(6:30 PM - 8:30 PM)

**Workshop on Meteorological and Hydrological Cooperation
within the Asia-Pacific Economic Cooperation (APEC)
12 January 2001
Albuquerque, New Mexico, USA**

Meeting summary:

1. Gen. Jack Kelly, Director of the U.S. National Weather Service, opened the Workshop and welcomed all participants (list attached) to Albuquerque, noting the opportunity participants will have to interact next week with international scientists and the private sector associated with the American Meteorological Society's 81st Annual Meeting. He encouraged participants to join in the discussions during this Workshop in order to make it a success.
2. Gen Kelly noted the purpose of the Workshop was to determine whether there were areas in meteorology and hydrology where the Meteorological and Hydrological Services within APEC could usefully cooperate, to protect the safety of life and property and also to enhance the economic well-being of the respective economies. Gen. Kelly also stressed the interconnection of all the APEC economies and how the services provided by a Meteorological and Hydrological Service in one place affects other places. He also emphasized the need for all Services to share data and information for the improvement of their operations and national economies.
3. Dr. Hung Kwan Lam agreed to act as facilitator for the Workshop. He began by asking everyone to stand for a minute of silence in remembrance of Dr. Sung-Eui Moon, former Administrator of the Korea Meteorological Administration, who died on January 9th. He noted Dr. Moon was very active in encouraging regional cooperation, having recently been elected as President of the World Meteorological Organization's Regional Association for Asia.
4. Dr. Lam said he hoped the Workshop would be conducted on an informal basis with questions or comments welcome at any time. He outlined the Workshop structure of presentations during the morning and open discussion in the afternoon, with a concluding statement expected by the end of the day.
5. Ms. Cathleen Campbell and Mr. William Herrmann, International Policy and Programs, Technology Administration, Department of Commerce presented background information of APEC and its structure and procedures. Ms. Campbell noted the relevant goals for this Workshop of APEC's economic and technical cooperation included developing human capital, promoting environmentally sustainable economic growth, and harnessing technologies for the future. Mr. Herrmann noted the opportunity to interact with the APEC Industry, Science and Technology Working Group (ISTWG) at its Spring or Fall meetings through presentation of the results of this Workshop and, if available, a specific project for their concurrence. He also noted any project undertaken within APEC required only three economies support before approval.
6. Dr. Chung-Kyu Park, Korean Meteorological Administration, presented the APEC Climate Network (APCN) project, approved by ISTWG in 1999. He

noted the goal of APCN was to exchange real-time climate information amongst APEC economies in order to reduce the impact of climate-related natural disasters. He outlined the steps underway to implement APCN, beginning with working with scientists of APEC economies to conduct an experimental multi-model ensemble activity.

7. Dr. Sri Dihartha, Director-General, Indonesian Meteorological and Geophysical Agency, presented the project on Short-term Climate Forecasts and their Application for Social and Economic Development, approved by ISTWG in 1997 for five years. He noted the goal of the project was to relate short-term climate forecasts with food production, and then, to share the information with others for possible wider application. While the project has had a slow start, Mr. Dihartha said, with support, plans were in place to complete the project as originally planned.
8. Dr. William Hooke, American Meteorological Society, discussed reducing natural disasters in the APEC region, noting disasters are inherently international. He challenged APEC economies to find out how much economic loss to Gross Domestic Product (GDP) is caused by natural disasters each year. He mentioned a previous study showing 1% to 2% loss globally from natural disasters. Dr. Hooke gave several suggestions for priority areas for cooperation between Meteorological and Hydrological Services within APEC in order to build resilience to natural hazards and to accelerate the investment in the meteorological and hydrological infrastructure. During discussion, Mr. Yan Hong, China Meteorological Administration, noted GDP loss in the People's Republic of China was 3%-6%. Gen Kelly noted meteorological and hydrological information is not being fully used in decision making, sometimes because of scepticism in its accuracy. He felt there was great potential in informing others of the capabilities which we now possess.
9. Mr. Curt Barrett, National Weather Service, NOAA, discussed the global water crisis, and how linking meteorological and hydrological information can greatly reduce the impact of this crisis. He said a loss of US\$92 billion occurred in 1998 due to floods and droughts. Mr. Barrett covered the meteorological and hydrological tools we have, or could have, to detect and predict river and weather hazards. He also mentioned the need to consider both the production of accurate meteorological and hydrological information as well as getting the information out to users in a timely manner.
10. Mr. Bruce Hicks, Office of Oceanographic and Atmospheric Research, NOAA, described areas where it is important for APEC economies to work together to improve models for transboundary atmospheric pollution, such as accidental radiation release, volcanic ash dispersion, and low-level smoke. He showed how atmospheric pollution affects oceans and inland seas. He also noted the importance of ground truth information to complement model development. He said working together with APEC could help make improvements in this area.
11. Dr. Ants Leetma, National Weather Service, NOAA and Ms. Candyce Clark, Office of Global Programs, NOAA talked about work underway in the Pacific region to study and understand climate with the goal to improve climate forecasts

and their use. Dr. Leetma stressed the economic impact of being able to forecast climate during El Niño, La Niña, and “normal” years. He also mentioned the importance of providing support for the Argo program for observing the oceans. Ms Clark noted the need to build a bridge between information and its use, entailing both real-time efforts and research. She also stressed the need to have procedures in place before extreme climate events occur. Ms. Clark noted there was a program already underway within APEC on emerging infectious diseases and how it could usefully be linked with APEC climate projects.

12. Mr. John Lumsden, Director, New Zealand Meteorological Service, recounted the history of his Service’s strong support for unrestricted exchange for meteorological and hydrological data and products, despite its need to show a yearly profit. He felt open access to public sector data helped national economies overall. He equated meteorological data to air, it has value but no price and it needs to be freely available.
13. Mr. Timothy Stryker, National Environmental Satellite, Data, and Information Service, NOAA informed the Workshop about the Asia Pacific Satellite Data Exchange and Utilization Group which has met twice thus far. He said the *ad hoc* Group, which is still in the formation stage, involved both national meteorological satellite developers and operators, and was focused on real-time use of satellite data. Among the interested economies were Australia, Canada, China, including Hong Kong, Japan, Republic of Korea, New Zealand, Singapore, and the United States. In the future, the Group is expected to improve data availability for regional forecast centers, expand telecommunications links (both within and outside the Global Telecommunications System) to serve user’s needs, and foster full and unrestricted use of these data.
14. Dr. David Fulker, University Corporation for Atmospheric Research (UCAR), described the existing UNIDATA program in the U.S. which supports rapid data flow for meteorological research and education. He said the UNIDATA model relied on Internet distribution of large amounts (about 20Gigabytes per day) of data and products from multiple sources to 160 cooperative Universities. He also mentioned the COMET program at UCAR which develops distance learning modules for meteorological and hydrological training. He noted the modules are available over the Internet for worldwide educational needs. Dr. Fulker went on to describe a concept for an Internet-based “learning community” for APEC economies. This concept would improve access to environmental data across all economies and assist with human capacity development.
15. Before closing the morning session, Dr. Lam described how he hoped to proceed during the afternoon session, asking each participant to comment on the morning presentations, on other issues which they felt should be mentioned, and on the pros and cons of working together as Meteorological and Hydrological Services within APEC.
16. During the afternoon, a discussion was held involving each Workshop participant.

17. Australia: Felt it was important to advance the science of meteorology and hydrology in the Pacific basin, especially in the area of weather and climate services and natural disaster reduction. Considered that any new mechanisms should be complementary to those that are already effective and not dilute them. Are generally willing to work within the APEC framework, recognizing the need to have support at home at higher levels in the government.
18. Canada: APEC provides an opportunity to speak to a different community (an economic one) and with an eye to data exchange and involvement of the private sector. Would be supportive of some project development with this framework. But, we should be selective and focused on what we decide to do.
19. Chile: Important to have feedback to models which are being used in the region. Support free and unrestricted exchange of meteorological data between Meteorological and Hydrological Services, but need regulations for weather business. Also need to recognize the commercial activities of Meteorological Services.
20. People's Republic of China : Actively supports activities in the framework of APEC and feels that we need to select climate variability and change as well as natural disaster reduction as top priority. The secretariat set up to administer joint projects should follow carefully the terminology and procedures of Asia-Pacific Economic Cooperation
21. Hong Kong, China: Supports working within the APEC framework, but only on topics not already covered by other regional and international bodies. Perhaps, in the future, an APEC center for weather prediction could be developed.
22. Indonesia: Supports cooperative projects under APEC, especially sharing resources amongst members to solve mutual problems. Mentioned historical data rescue from tropical countries as an important project to consider including under APEC cooperation. Also, there is a need to improve operational data quantity and quality. Perhaps, a journal could be prepared to highlight areas of new research and capabilities.
23. Japan: Especially interested in cooperation in climate analysis and prediction as well as education and training. Activities should not duplicate those activities already done under WMO, but they should complement them. While there can be an APEC group to look at meteorological and hydrological issues, is there a possibility to have some connection with ongoing activities of WMO ?
24. Republic of Korea: Already involved with APEC through the APEC Climate Network. Feel we need some forum, such as this grouping to carry out regional projects including unrestricted data and information exchange.
25. Malaysia: Supports cooperation amongst APEC economies in the area of natural disaster reduction. Already working with others in Southeast Asia to study and forecast low-level smoke and haze. Sees advantages in cooperation

in the area of technical development and technology use, in building human resources and in increasing public awareness.

26. Mexico: Have already begun to cooperate with other APEC economies to improve natural disaster reduction, but still need to concentrate on getting the information out to the people affected before, during and after disasters. Locally, there are effects from El Niño and La Niña, although on the average it does not show clearly. It is important to concentrate on local applications of climate forecasting. There should be a practical proposal on how to cooperate with other APEC economies.
27. New Zealand: Felt there is some possibility for cooperation, but cautioned our deliberations should focus on users' needs more than just those of Meteorological and Hydrological Services needs. Might consider using severe weather forecasting as a topic to try to build an awareness project. Believe by identifying something specific to work together on, it would be easier to begin our cooperation.
28. Papua New Guinea: Need cooperative assistance to improve its human resources as well as advance meteorological observation and technical systems for efficient and cost effective services. Improving forecasting capability is also important.
29. Republic of the Philippines: APEC seems to be related, not just to business, but also to meteorological and hydrological activities in the region. Agree it worthwhile to cooperate as far as resources are available. Natural disasters are especially important (up to 1.5% of GNP are affected by tropical cyclones alone). Transboundary air pollution is another important area. The concept of UNIDATA for APEC economies has great potential in the area, as well as making better use of environmental satellite data. Supports real unrestricted exchange of data and products as well as capabilities to make full use of them. APEC should concentrate on how meteorology and hydrology contribute to economic development and sustainable environment.
30. Russia: Supports the need to concentrate on climate variability and change, especially the APCN project. Need also to show users how to get benefits from climate information. Also, feels natural disaster reduction is important. New and improved meteorological informational systems should be developed. They must have an integrated approach to meet the requirements of automatic collection and dissemination of observed data and products as well as *ad hoc* information requests. Supports idea of using Internet to get large volumes of data exchanged amongst APEC economies.
31. Singapore: There is increasing pressure for some Meteorological Services to recover full costs from users. Programs without immediate and direct benefits are becoming more difficult to justify. We have a challenge to continuously enhance our capabilities as users' demands and expectations usually grow whenever services improve. The important areas for cooperation among APEC economies are related to information gathering, processing and delivery: (1) sharing of advanced remote sensing technology, (2) sharing of training resources, (3) emphasis on product interpretation and automatization, not just model

development, and (4) increased use of Internet and related information technology for exchanging data and information.

32. Chinese Taipei: Important for Meteorological and Hydrological Services within APEC to emphasize their benefit to national and regional economic development. Development of meteorological services followed stages: (1) improvement of forecasting skills, (2) getting the information out, (3) having proper actions taken in response to forecasts. Perhaps we could concentrate on the application side of meteorological and hydrological forecasts, especially exchange of experiences.
33. Thailand: Recent flooding has caused 3%-4% reduction in GDP and highlighted the need to increase the leadtime for prediction of natural disasters. Support the idea of a regional prediction center.
34. United States: Feel we should not limit our thinking but try to take full advantage of the APEC, especially the fact APEC includes high-level individuals. We should think big and make the case of the economic impact of meteorology and hydrology should not be underestimated. Assimilating more satellite data into models is an emerging issue which we all must face. Without duplicating what is already being done by WMO, we can leverage projects, especially in increased Internet usage, to improve our joint activities, such as sharing typhoon forecasts for the Pacific from all APEC economies on one Website.
35. Vietnam: Can cooperate in the areas of natural disaster reduction. Feel capacity building, especially human capacity building, is one of the most important areas in which we could cooperate. Support concept of working with APEC framework.
36. The Workshop heard remarks from other participants as well. Dr. Richard Anthes, UCAR, noted that the societal needs for weather and climate services have never been greater and, at the same time, the scientific and technical opportunities for advances are enormous. However, while the paths to the advances in science and technology are relatively straight forward, the social issues restricting effective use of weather and climate products are great and it is not clear how to resolve them. Dr. Ron McPherson, AMS, noted the need to link the private, public and academic sectors and to continue unrestricted data exchange. He emphasized the need to communicate better with people outside our own community in order to facilitate the expansion of meteorological and hydrological applications in economic sectors which are sensitive to weather and climate. Dr. McPherson felt natural disaster reduction and climate variability should be the top priorities for APEC economies.
37. The floor was open for general discussion. A proposal was made to form a small working group to try to develop proposals for consideration by ISTWG. The procedure for beginning a cooperative process was outlined by Mr. Herrmann, starting with contacts with each individual economy's ISTWG representative. He noted any three economies can submit a proposal to the ISTWG using the detailed guidance available on the APEC Website.

38. It was noted our cooperative efforts should capture the attention of the APEC Business Advisory Council and Mr. Herrmann said working under ISTWG would do so.
39. Canada, Japan, Republic of Korea, New Zealand, Republic of Philippines, and the USA volunteered to form the small working group following this meeting to develop possible areas for future cooperation and to coordinate with others before going forward to the ISTWG. The USA agreed to convene the group.
40. Dr. Lam asked the Workshop what projects should be given priority in developing cooperative projects under APEC. The Workshop felt the first priority should be to support the existing projects in climate, being led by Indonesia and the Republic of Korea. As for other priorities, the Workshop noted projects in climate variability, natural disaster preparedness, free and open exchange of data and products, and better ways to communicate with others outside our community.
41. A discussion was held on the confusion which can arise when different sources of meteorological and hydrological data was available on the Internet. Dr. Lam noted the WMO Commission for Basic Systems was considering this issue through a task force to look into on how to assure official weather information and forecast were available over the Internet.
42. As regards data exchange, some expressed the view APEC economies should continue to follow WMO Resolution 40 (Cg-XII), taking into account the full text of the Resolution, including annexes.
43. In conclusion, Dr. Lam thanked everyone for their participation, noting remarks made earlier about the usefulness of meeting together to discuss common issues on a formal and informal basis.
44. The Workshop ended at 16h45.

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