



行政院環境保護署

Environmental Protection Administration
Executive Yuan, R.O.C.(Taiwan)

Taiwan Can Help

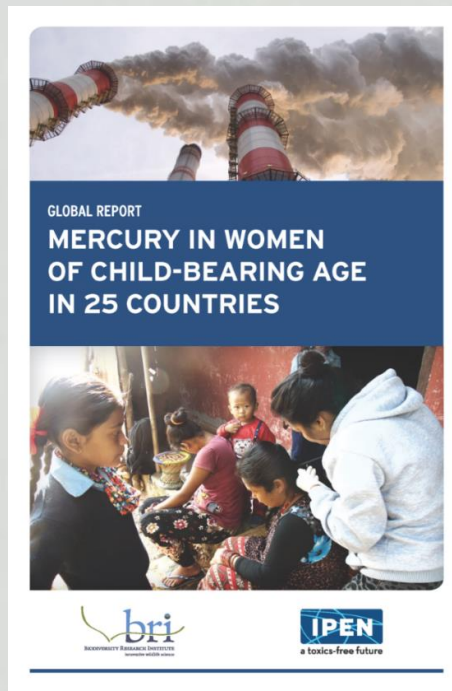
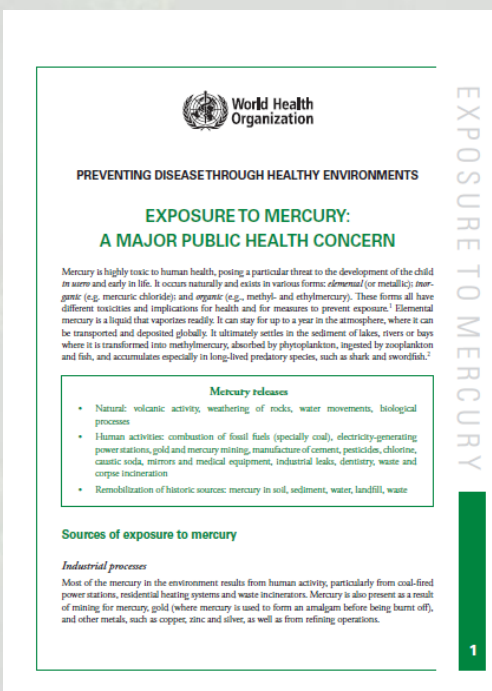
因應水俣公約我國環境汞監測成果

環保署監資處
張志偉高級環境技術師

為何汞議題持續受關注？

時至今日汞仍是廣受關注的**全球性污染物**

- 敏感族群(育齡婦女與嬰幼兒)的慢性暴露影響
- 低濃度甲基汞長期暴露對人體健康之衝擊



KEY FINDINGS

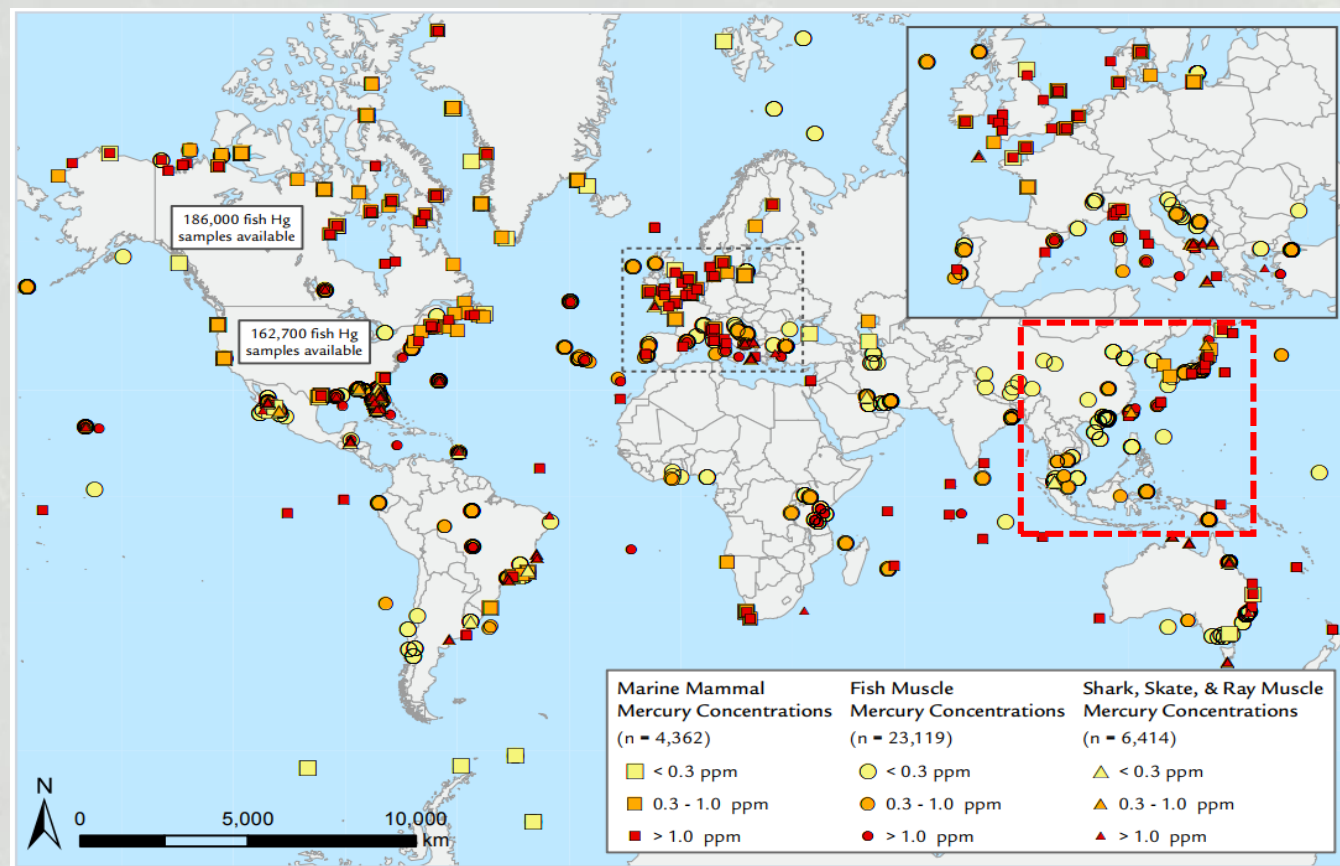
- 1044 women of child-bearing age from 25 countries participated in the study. 42% of them had mercury levels greater than 1 ppm – the level that approximately corresponds to the US EPA reference dose.³ 55% of the women had mercury levels greater than 0.58 ppm mercury, a more recent, science-based threshold based on data indicating harmful effects at lower levels of exposure. Mercury is a health threat to women and the developing fetus.
- Women of the Pacific Islands have elevated mercury levels, likely due to a fish-rich diet. Distant air emissions of mercury from coal-fired power plants, cement kilns and other industries contaminate ocean fish that serve as a primary protein source for Pacific Islanders.
- Artisanal small-scale gold mining results in high mercury body burdens in women from Indonesia, Kenya, and Myanmar. Two likely mercury exposure sources are burning mercury amalgam and eating contaminated fish.
- Industrial mercury emissions contaminate local fish and elevate mercury levels in Thai women living nearby.
- Indigenous women in Alaska have mercury levels of concern due to their subsistence diet of sea mammals and fish. Consumption of seals may be a key source of mercury exposure.
- Women from locations in Albania, Chile, Nepal, Nigeria, Kazakhstan, and Ukraine have mercury levels of concern due to localised pollution of waterways and suspected fish contamination.
- Women using mercury to gold plate statues in Nepal have elevated mercury levels.

³ This is the daily exposure that US EPA considers "likely to be without an appreciable risk of deleterious effects during a lifetime."

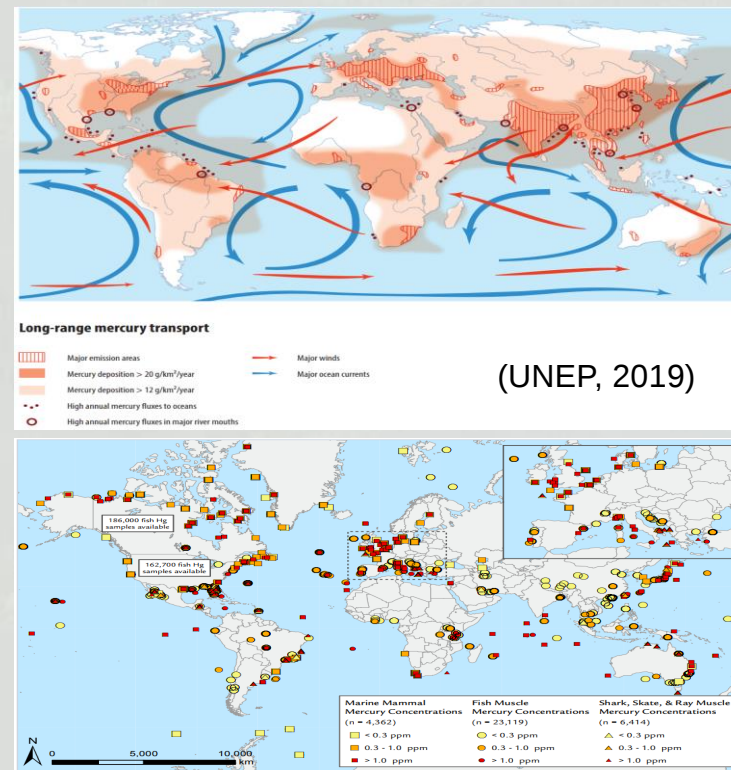
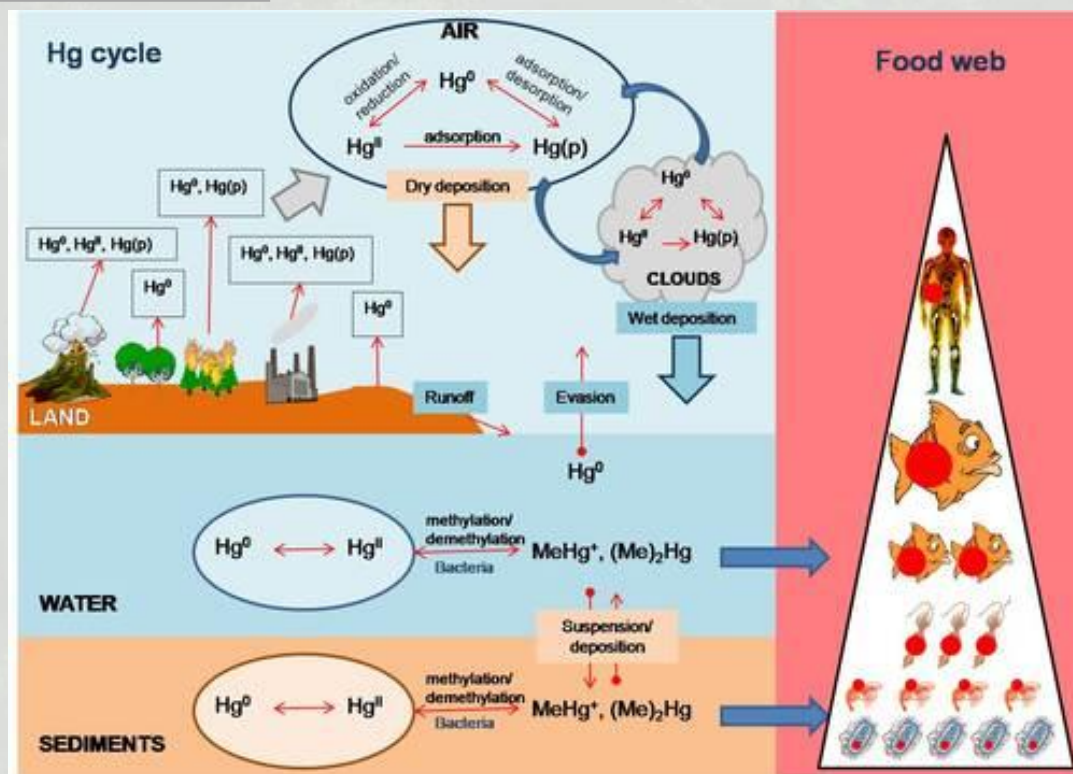


為何汞議題持續受關注？

研究顯示全球魚體汞濃度普遍偏高，各國普遍規範魚體總汞或甲基汞濃度不應高於 **0.3 – 1.0 mg/kg (ppm)**。



汞的生化循環與生物累積途徑



人體甲基汞主要來源是攝食水生生物，
而海洋的汞來源主要來自大氣沉降。





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The Minamata Convention on Mercury (2017.8.16)

Article 19 Research, development and monitoring

(e) Information on the environmental cycle, transport (including long-range transport and deposition), transformation and fate of mercury and mercury compounds in a range of ...

環境監測：魚體/飲用水



(環管處)

Since 2006	Fish (15 fresh water rivers, 2019)
Mercury	ND-0.169 mg/kg-wet weight
Methly-Mercury	ND-0.103 mg/kg-wet weight



(水保處)

Since 1998	2019 Sample #
	All < D.L. (1ng/L)
自來水	608
小型飲用水系統	33



環境監測：河川／海洋／底泥／地下水



Mercury	河川 (監資處)	海洋 (監資處)	底泥 (環管處)	地下水 (監資處)
Since	2001	2002	2006	2011
Site #	303	105	15 rivers	447
採樣頻率	每季	每季	每年	每季
Measure Range (2019)	ND-3.0 (ng/L)	ND (ng/L)	ND-2.8 (mg/kg-dry weight)	ND-4.0 (ng/L)



環境監測：大氣



背景/ 長程傳輸
2006

工廠/ 都市
2007

雨水汞
2008

被動式汞採樣
2018



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環境監測：鹿林山背景測站



為東亞唯一大氣汞長期高山背景監測站。

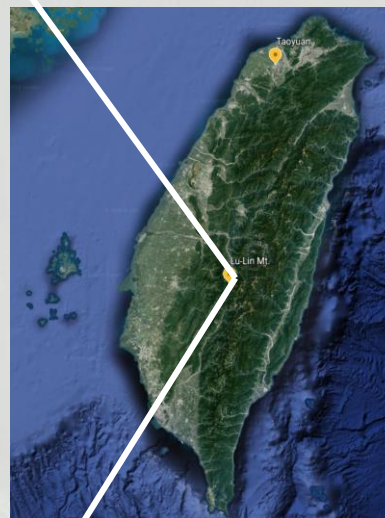
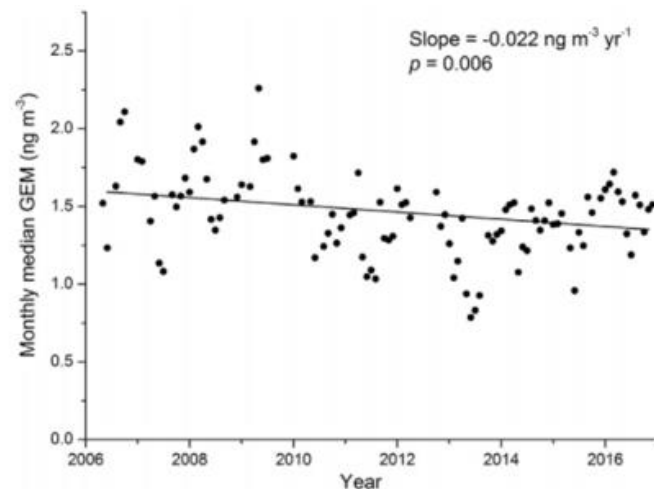
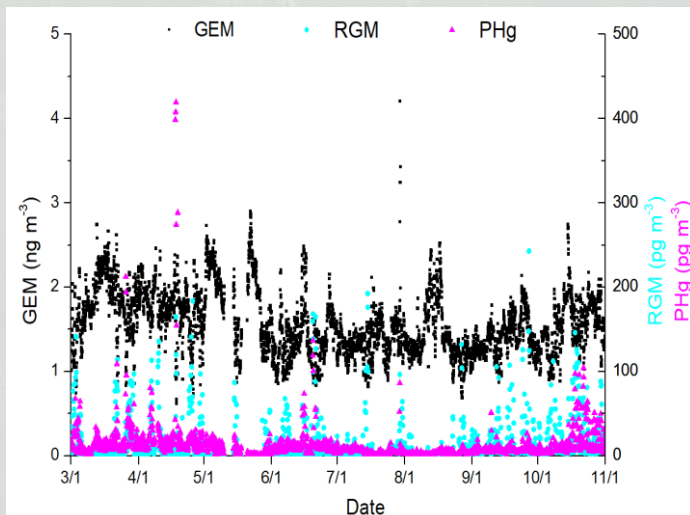
氣態元素汞(gaseous elemental mercury, GEM)

氣態氧化汞(gaseous oxidized mercury, GOM)

顆粒汞(particulate-bound mercury, PBM)

每五分鐘可得到一筆GEM監測資料，

每三小時可得到一筆GOM與PBM資料。

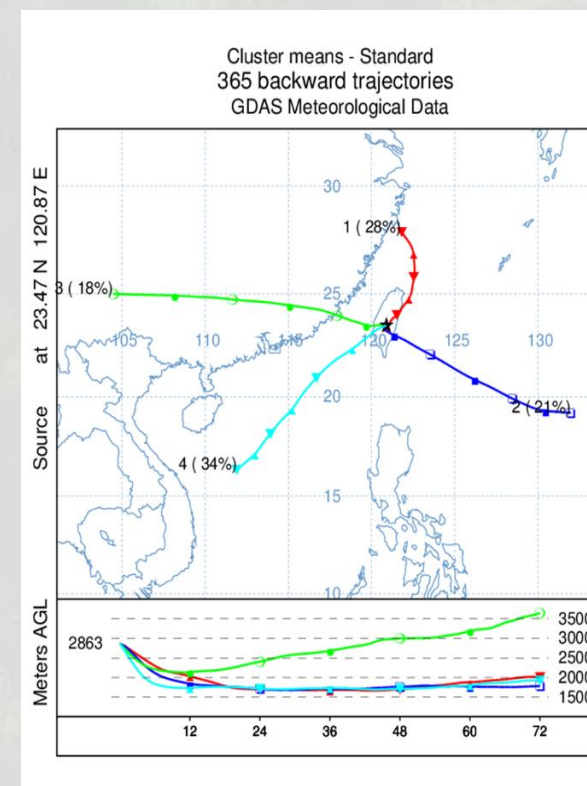
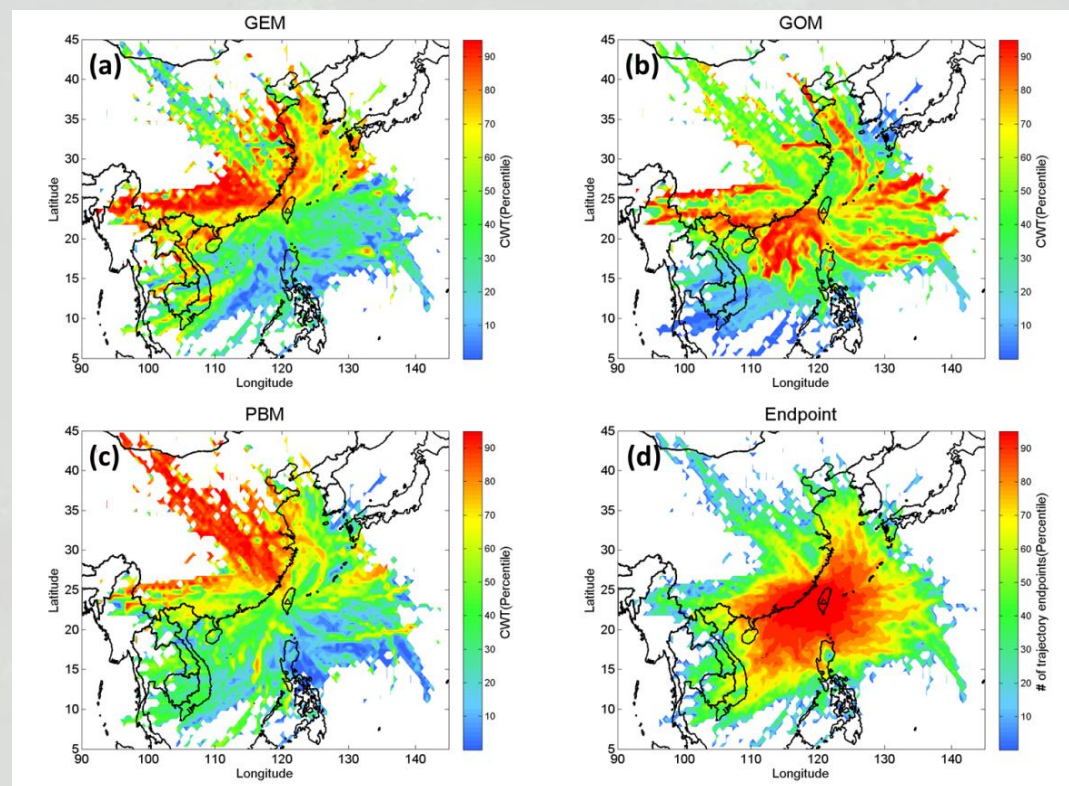


鹿林山測站
海拔2881公尺



環境監測：鹿林山東亞大氣汞輸出模擬

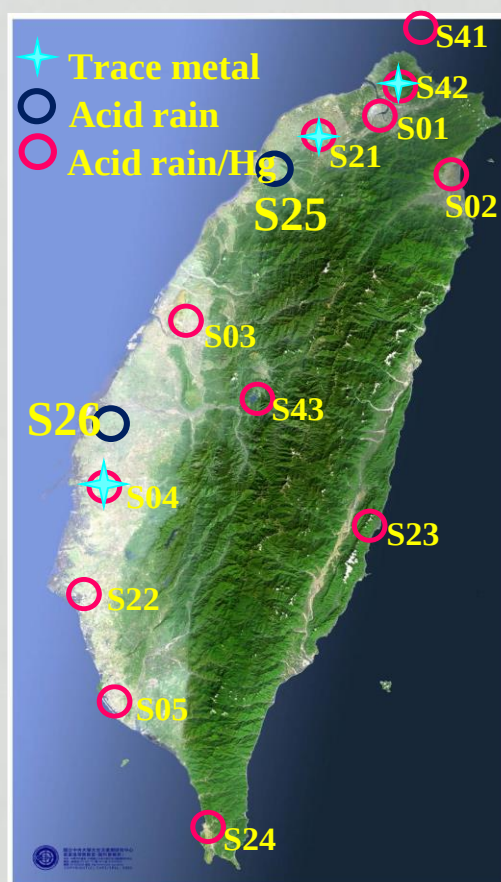
以2018年鹿林山大氣背景測站大氣汞監測數據搭配濃度權重後推軌跡法顯示，**中南半島北部、中國西南、華南及華東沿岸地區是GEM主要源區**，**中國華中及華東則是PBM主要源區**。



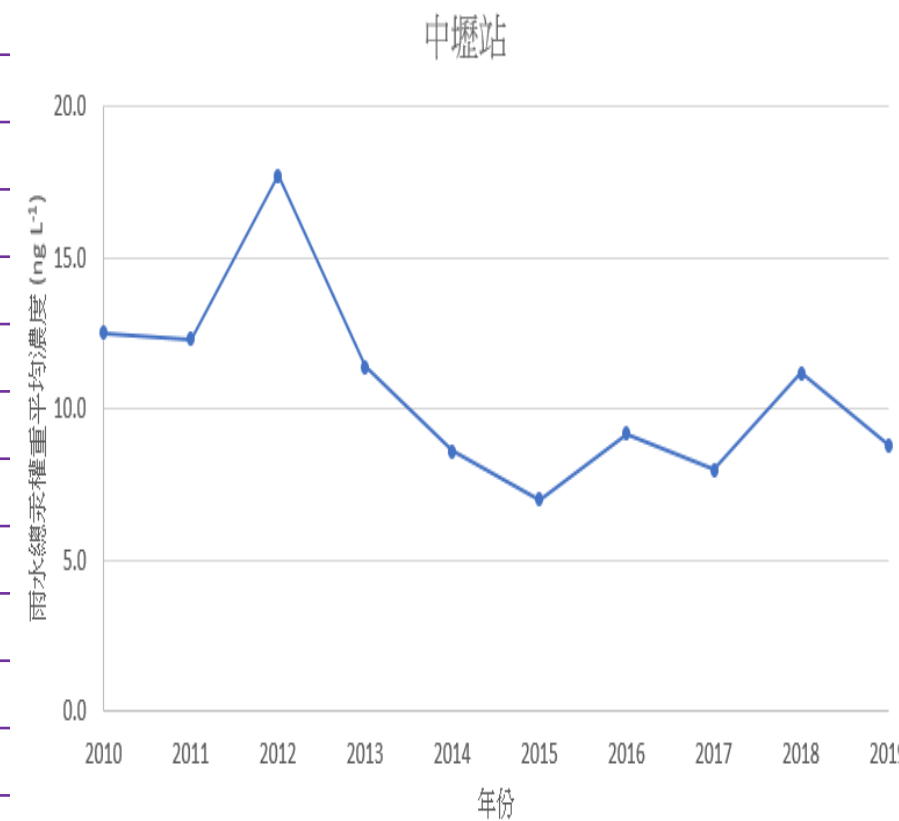


環境監測：雨水汞

全台12個雨水汞測站(空保處、2008)



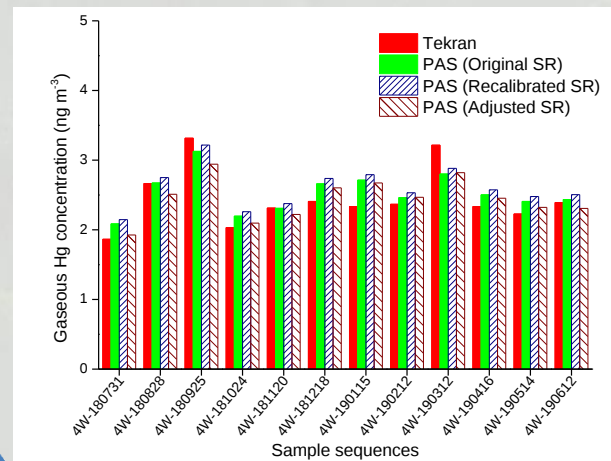
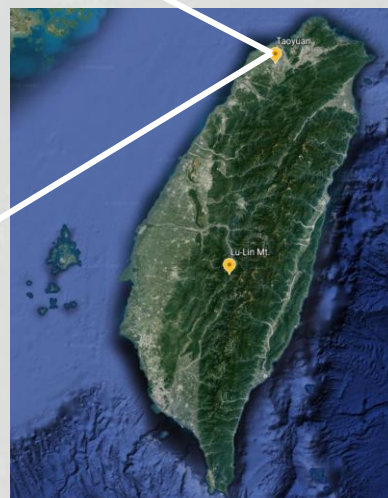
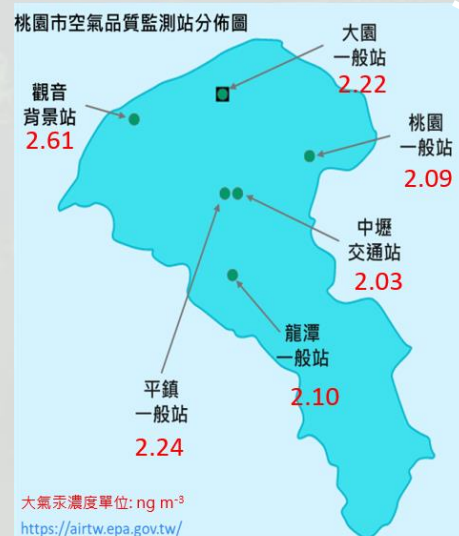
Site No.	Site Name	Charateristics
S01	Taipei	Urban
S02	Yilan	Urban
S03	Taichung	Urban
S04	Chiayi	Urban/Agriculture
S05	Kaohsiung	Urban/Coastal
S21	Jhongli	Suburb/Industrial
S22	Tainan	Suburb
S23	Chenggong	Suburb/Coastal
S24	Hengchun	Suburb/Coastal
S41	Pengjiayu	Remote/Island
S42	Anbu	Rural/Mountain
S43	Sun Moon Lake	Rural/Mountain





環境監測:被動式大氣汞監測

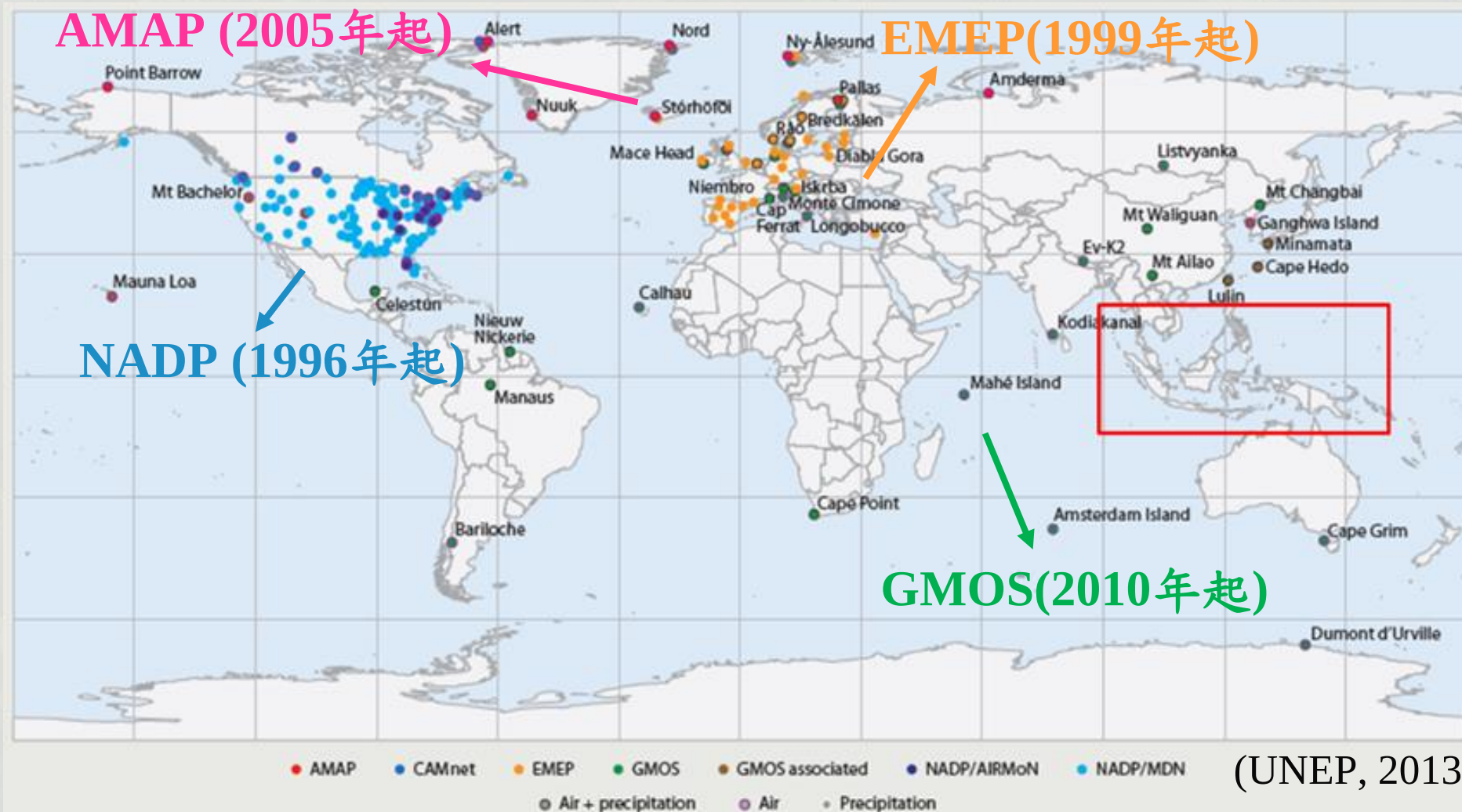
桃園市空氣品質監測站分佈圖



項目	被動式大氣汞監測	主動式大氣汞監測
電力需求	不需用電	穩定電力
人力需求	低	高，需有專業技術人員操作維護
載氣需求	不需要	需要99.999%高純度氬氣
時間解析度	低，約7天至30天	高，氣態元素汞5分鐘一筆數據
空間解析度	高	低
經費需求	低	高



東南亞、南亞及西太平洋地區缺乏長期背景大氣汞監測



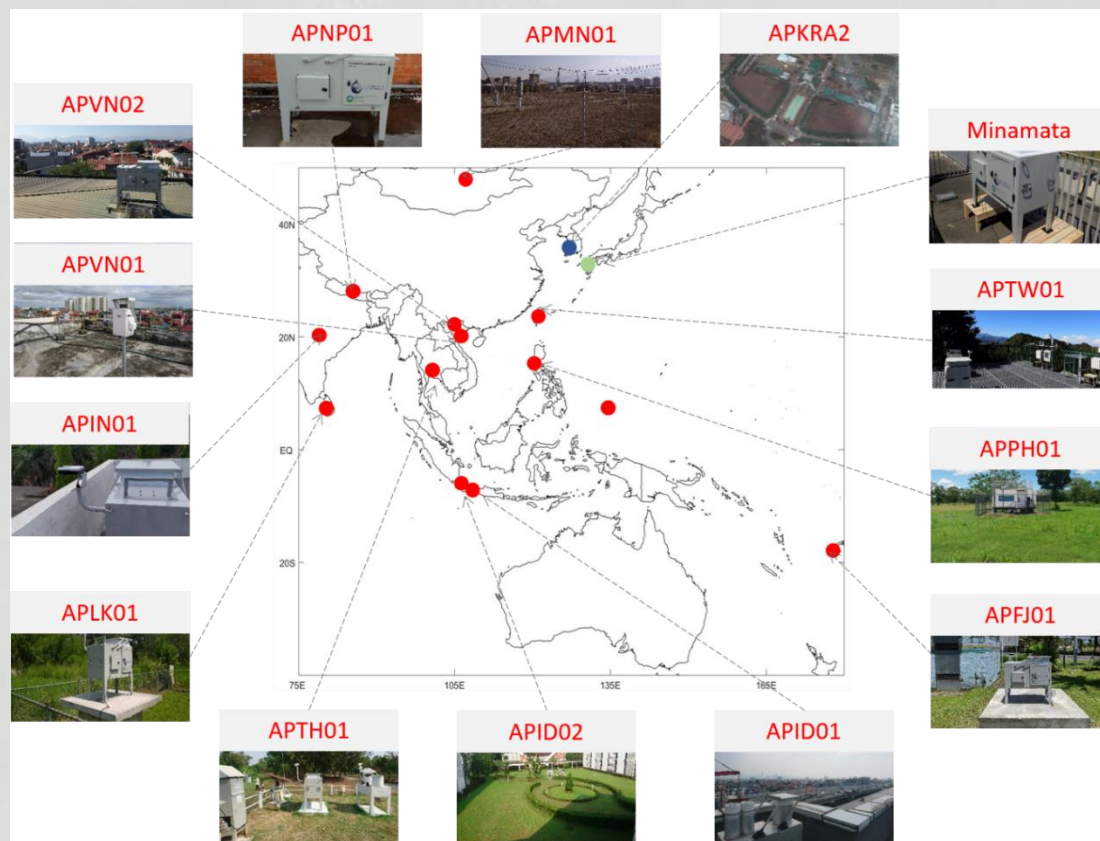
國際合作：亞太地區汞監測網路



我國具有國際水準的超微量汞監測與分析技術，自「台美環保技術合作協定第6號執行辦法計畫(93-94年)」開始迄今，**鹿林山大氣汞監測**一直是重要工作項目；而2012年「大氣汞監測國際合作暨亞太地區環境資訊研討會專案工作計畫」為亞太汞監測合作之開端，2014年啟動的「**國際環境夥伴計畫(International Environmental Partnership, IEP)**」也設有**亞太汞監測網路專案**。



國際合作：亞太地區汞監測網路



環保署已協助11個亞太汞監測網夥伴國家建置13處雨水汞監測站，另有韓國一處協力測站加入亞太汞監測網，夥伴國家收集之雨水汞樣本皆寄送回台灣進行總汞分析。



國際合作：亞太地區汞監測網路



第6屆亞太汞監測網年會(曼谷)



大氣汞監測訓練研習會

Billboard
Taiwan donates equipment to help mercury
© 1 week ago Admin

帛琉



斯里蘭卡



斐濟



日本



協助夥伴國家建置雨水汞採樣能力



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國際合作：亞太地區汞監測網路

ICMGP 2017 in Providence, USA



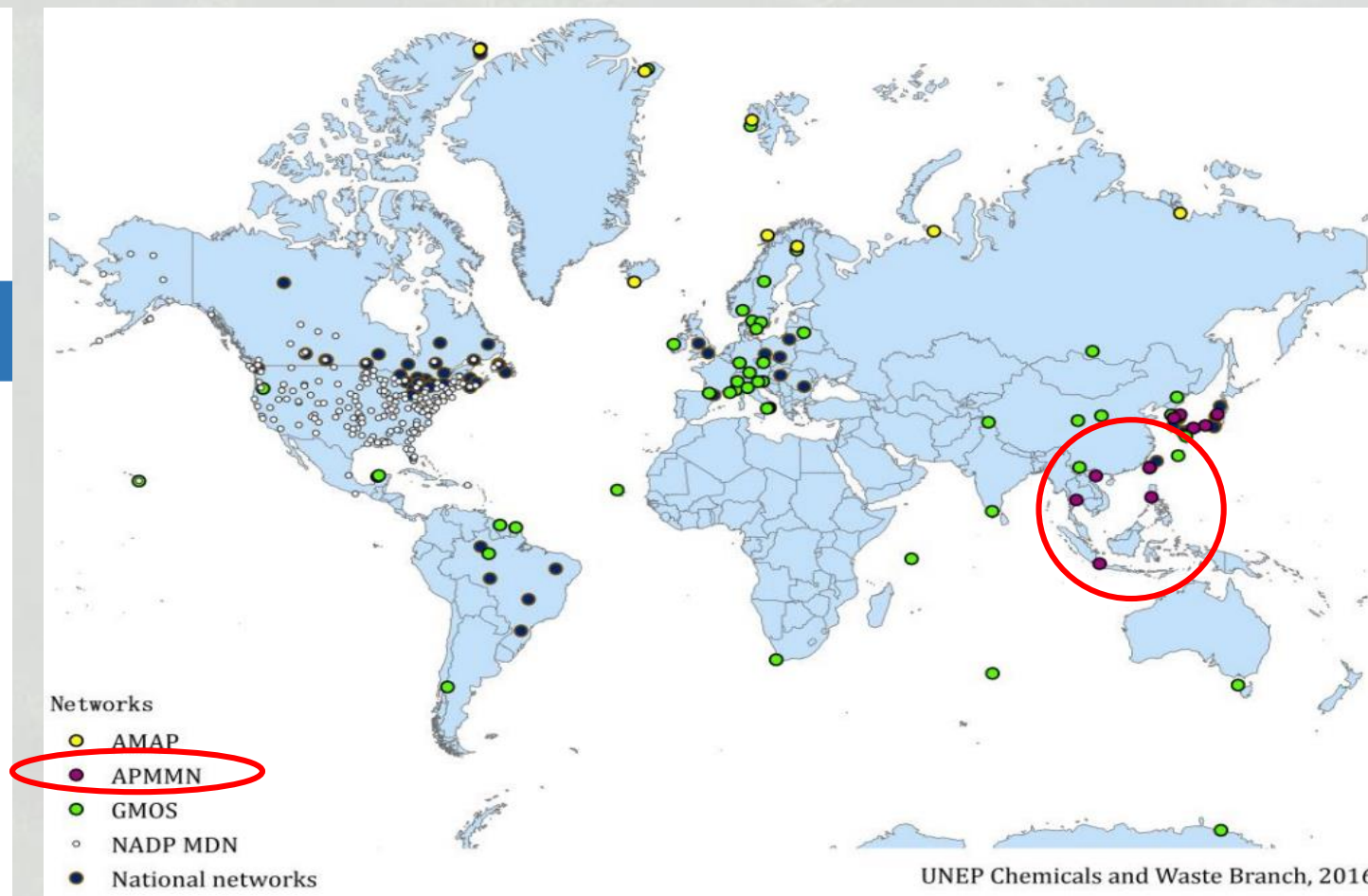
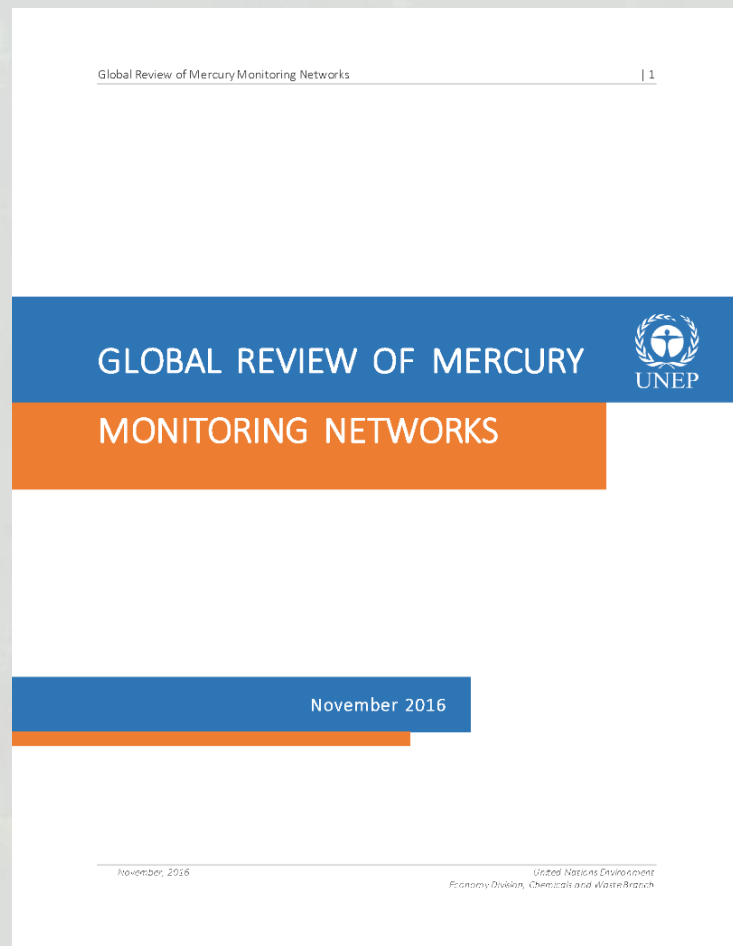
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國際合作：亞太地區汞監測網路

UNEP Report



國際合作：亞太地區汞監測網路年會



- 2012 in Taipei (1st)
- 2013 in DC (2nd)
- 2014 in Hanoi (3rd)
- 2015 in Minamata (4th)
- 2016 in Bangkok (5th)
- 2017 in Taoyuan (6th)
- 2018 in Manila (7th)
- 2019 in Jakarta (8th)
- 2020 Online (9th)





Taiwan Can Help with Mercury Monitoring

THANK YOU