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東アジアにおけるSLCPコベネフィット・アプローチ  
- BC vs. PM<sub>2.5</sub>; 対流圏オゾン vs. 地表オゾン -

SLCP Co-benefit Approach in East Asia  
- BC vs. PM<sub>2.5</sub>, Tropospheric O<sub>3</sub> vs. Surface O<sub>3</sub> -



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SLCPコベネフィットを気候、大気汚染のどちらを重視して考えるか？

気候変動の側から  
Climate Change Side

BC  
OC, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup> (negative RF)

tropospheric ozone  
CH<sub>4</sub>  
NO<sub>x</sub> (negative RF)

CH<sub>4</sub>, HFC (LLGHG)

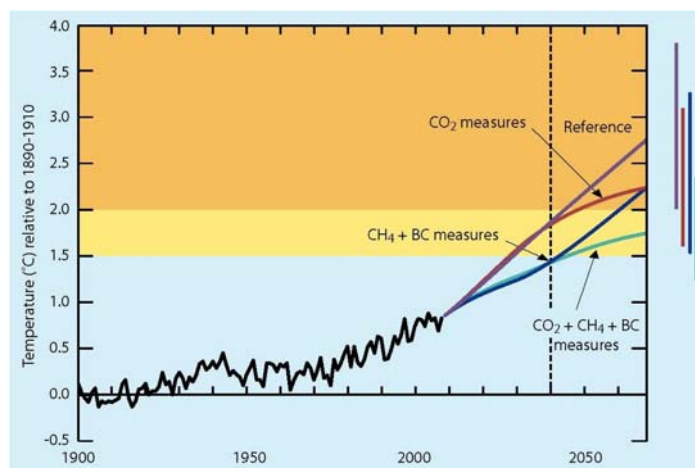
大気汚染の側から  
Air Quality Side

PM<sub>2.5</sub>  
(All of EC≈BC, OC, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>)

surface ozone  
NO<sub>x</sub>/NMVOC  
CH<sub>4</sub>

### UNEP 報告書:

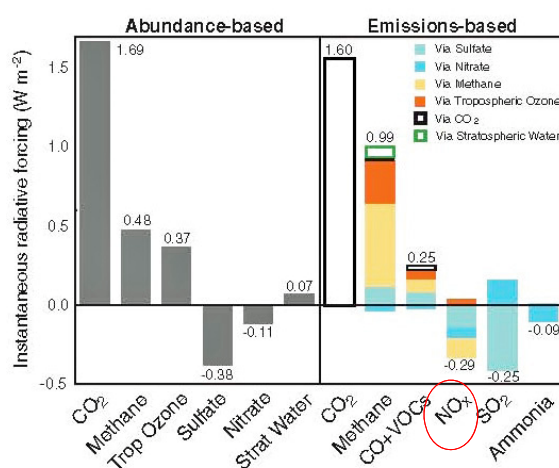
BC, CH<sub>4</sub>のみがSLCPの対象、NO<sub>x</sub>/NMVOCは対象外  
 BC and CH<sub>4</sub> as SLCPs and not NO<sub>x</sub>/NMVOC are targeted.



Deviation of temperatures from 1900 and future projection under various scenarios. (UNEP/WMO, 2011)

SLCP対策になぜNO<sub>x</sub>削減をとり入れないか？

NO<sub>x</sub>のみの削減はNO<sub>3</sub>を減少させるほか、OHの減少によりCH<sub>4</sub>を増加させ、SO<sub>4</sub><sup>2-</sup>を減少させることによってRFの増加をもたらす。



Shindell et al.,  
 Science, 2009

Instantaneous radiative forcing due to the abundance-based and emission-based increase of each chemical species

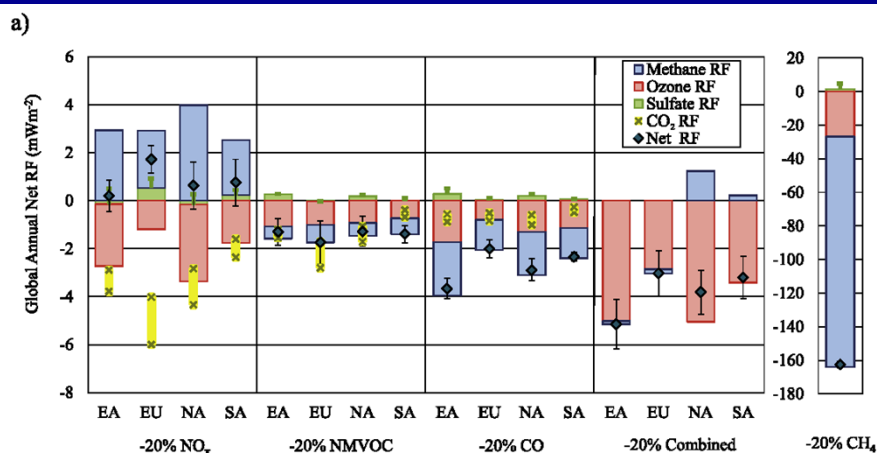
SLCPコベネアプローチを(東)アジアに適用するのであれば SCLPとしてのNO<sub>x</sub>の評価を変える必要がある。

Regional and urban ozone pollution In East Asia is much more serious than in Europe and North America, and the social incentive for the short-term mitigation is much stronger.

It has been well established that the reduction of simultaneous reductions of NO<sub>x</sub>/NMVOC emissions are much more effective than CH<sub>4</sub> reduction for alleviating urban/regional ozone pollution in short-term.

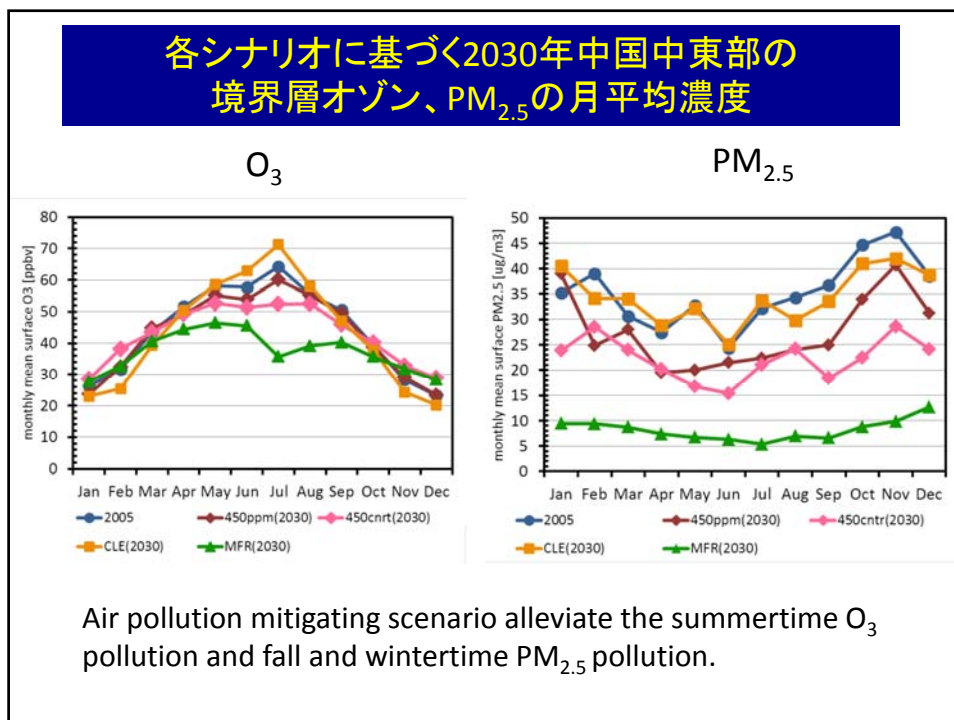
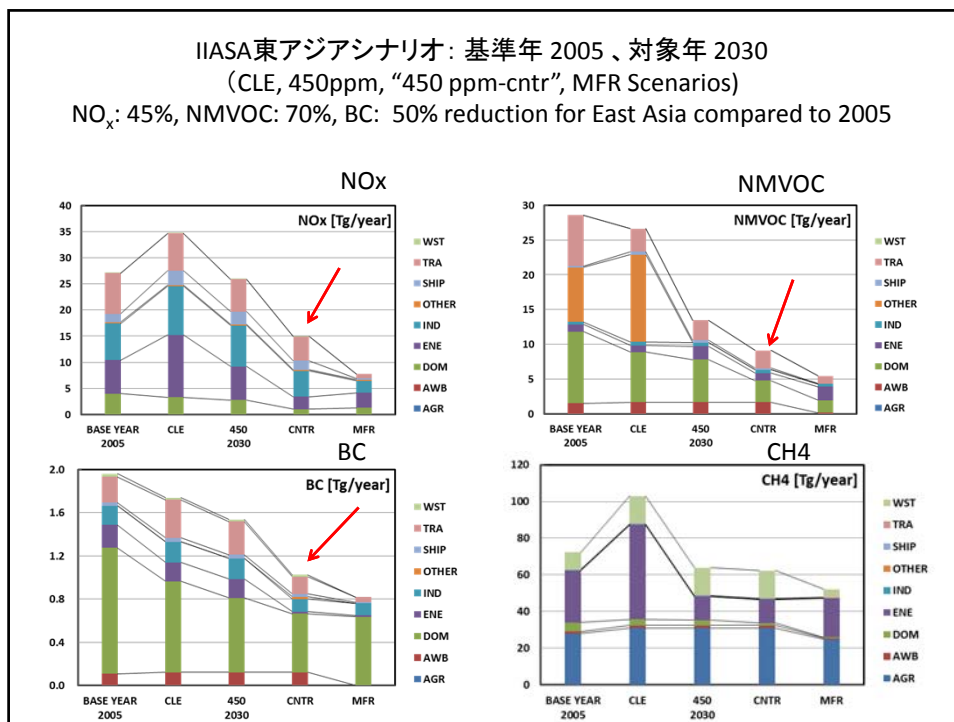
In the real world, control of NO<sub>x</sub> is likely to be accompanied by control of NMVOC and CO and their combined effects for RF is quite different from the NO<sub>x</sub> control alone. (Derwent et al., 2008)

NO<sub>x</sub>をNMVOC/COと同時削減した場合、OHラジカル濃度は減少せず、CH<sub>4</sub>の増加をもたらさないため、O<sub>3</sub>の減少によりRFの減少に寄与する。



Global annual average RF (mW m<sup>-2</sup>) for the HTAP ensemble of multiple models

Fry et al. J. Geophys. Res., 2012.



## Conclusion

- SLCPコベネフィットアプローチの政策的意義は、その地域の気候変動と大気汚染への相対的社会的関心の高さによって世界の各地域で異なる。一般に先進国では気候変動への関心が、アジアの途上国では大気汚染への社会的関心がより高い。
- 都市及び大陸規模の地表オゾンの短期間の削減にはNO<sub>x</sub>/NMVOC削減がより効果的であり、メタンの削減はオゾンの長期的減少に有効である。東アジアにおけるSLCP共制御政策としては、NO<sub>x</sub>/NMVOCとCH<sub>4</sub>の同時削減を目標とすべきである。

## Conclusion

- It is noted that the policy implication of SCLPs co-benefit/co-control approach is much dependent by region of the world since the relative social concern on climate change and air quality is much different from a region to another. In short, climate change is of more concern in developed countries while air quality is much more concern in many developing countries in Asia.
- For the immediate reduction of urban/regional surface O<sub>3</sub>, NO<sub>x</sub>/NMVOC reduction is more effective, and CH<sub>4</sub> reduction is more effective for long-term reduction of O<sub>3</sub>. Both of NO<sub>x</sub>/NMVOC and CH<sub>4</sub> control should be targeted under SLCP co-benefit, co-control approach in East Asia.