Santé et climat….
Les enjeux médicaux

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Climate change and human health: present and future risks

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There is near unanimous scientific consensus that greenhouse gas emissions generated by human activity will change Earth's climate. The recent (globally averaged) warming by 0·5°C is partly attributable to such anthropogenic emissions. Climate change will affect human health in many ways—mostly adversely. Here, we summarise the epidemiological evidence of how climate variations and trends affect various health outcomes. We assess the little evidence there is that recent global warming has already affected some health outcomes. We review the published estimates of future health effects of climate change over coming decades. Research so far has mostly focused on thermal stress, extreme weather events, and infectious diseases, with some attention to estimates of future regional food yields and hunger prevalence. An emerging broader approach addresses a wider spectrum of health risks due to the social, demographic, and economic disruptions of climate change. Evidence and anticipation of adverse health effects will strengthen the case for pre-emptive policies, and will also guide priorities for planned adaptive strategies.

Lancet 2006; 367: 859–69

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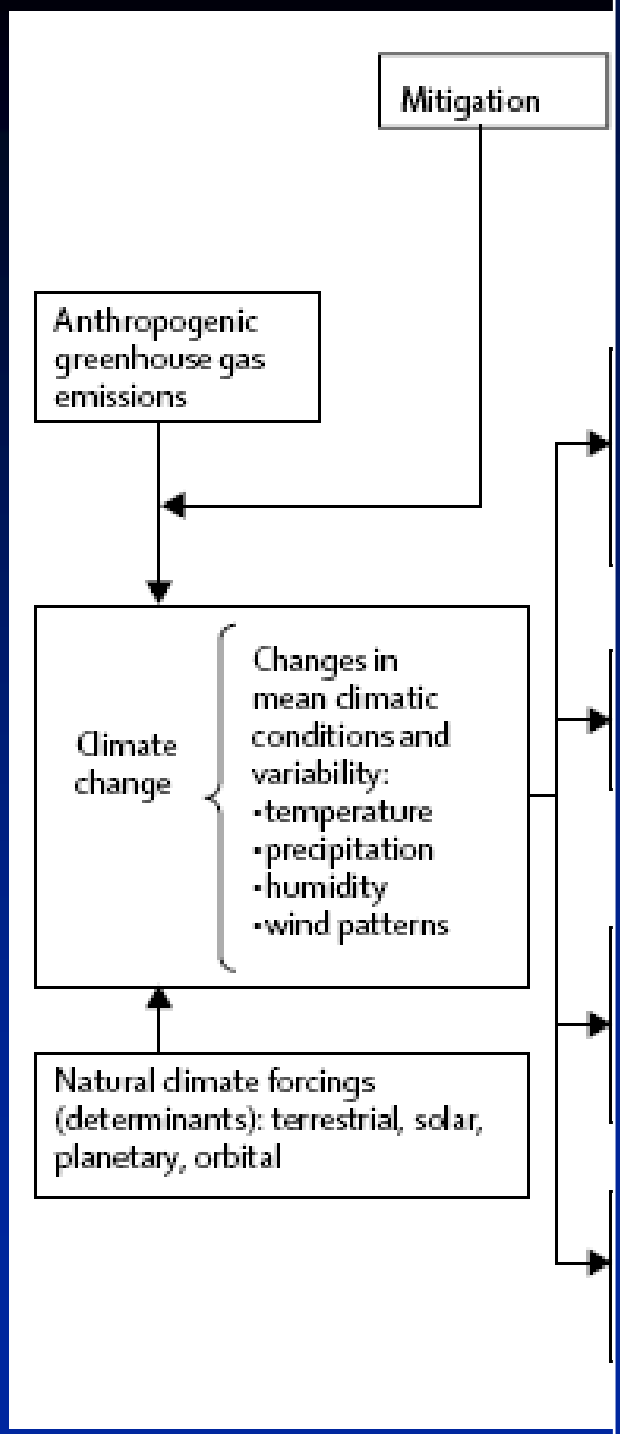
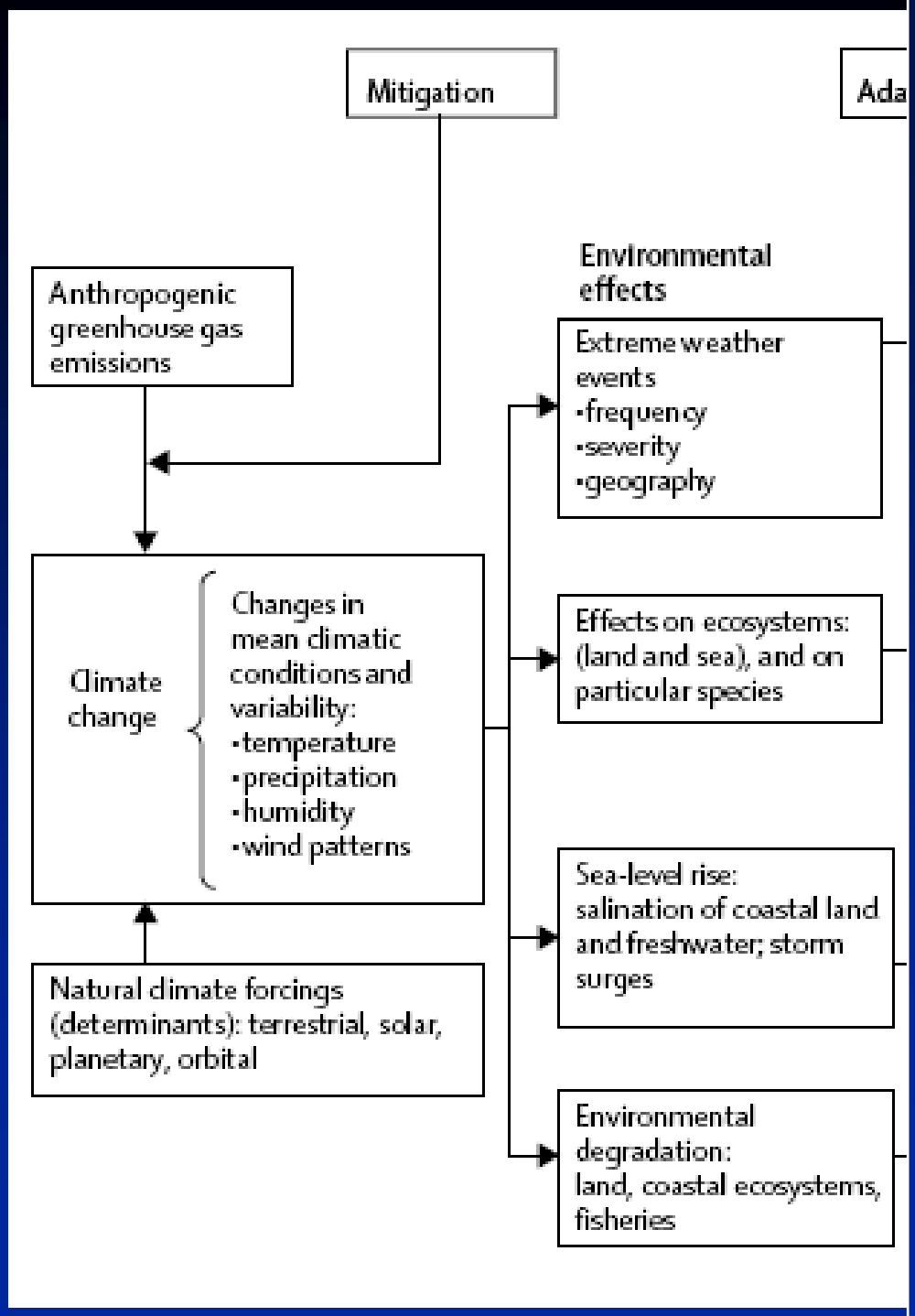
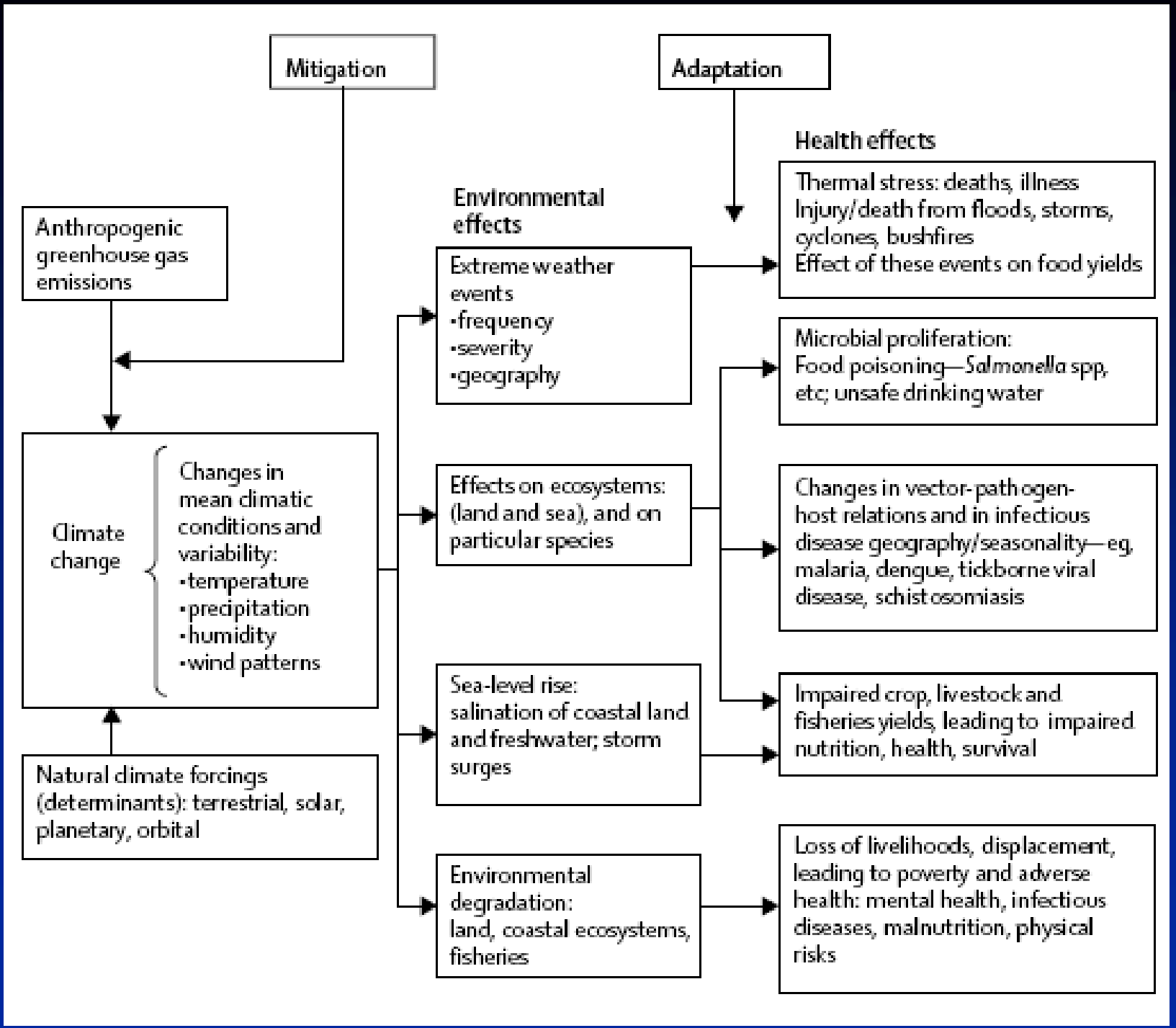

Mitigation
Anthropogenic greenhouse gas emissions
Climate change
Changes in mean climatic conditions and variability:
•temperature
•precipitation
•humidity
•wind patterns
Natural climate forcings (determinants): terrestrial, solar, planetary, orbital


Mitigation
Ada
Anthropogenic greenhouse gas emissions
Environmental effects
Extreme weather events
•frequency
•severity
•geography
Climate change
Changes in mean climatic conditions and variability:
•temperature
•precipitation
•humidity
•wind patterns
Effects on ecosystems: (land and sea), and on particular species
Sea-level rise: salination of coastal land and freshwater; storm surges
Natural climate forcings (determinants): terrestrial, solar, planetary, orbital
Environmental degradation: land, coastal ecosystems, fisheries


Mitigation
Adaptation
Health effects
Environmental effects
Anthropogenic greenhouse gas emissions
Thermal stress: deaths, illness
Injury/death from floods, storms, cyclones, bushfires
Effect of these events on food yields
Extreme weather events
•frequency
•severity
•geography
Microbial proliferation:
Food poisoning—Salmonella spp, etc; unsafe drinking water
Climate change
Changes in mean climatic conditions and variability:
•temperature
•precipitation
•humidity
•wind patterns
Effects on ecosystems: (land and sea), and on particular species
Changes in vector-pathogen-host relations and in infectious disease geography/seasonality—eg, malaria, dengue, tickborne viral disease, schistosomiasis
Sea-level rise: salination of coastal land and freshwater; storm surges
Impaired crop, livestock and fisheries yields, leading to impaired nutrition, health, survival
Natural climate forcings (determinants): terrestrial, solar, planetary, orbital
Environmental degradation: land, coastal ecosystems, fisheries
Loss of livelihoods, displacement, leading to poverty and adverse health: mental health, infectious diseases, malnutrition, physical risks

	Adverse effect	Beneficial effect	References	
			Climate variability	Climate change
Temperature extremes (more very hot days, possibly fewer very cold days)	More daily deaths and disease events—primarily due to more very hot days	Reduced winter deaths and disease events in (at least some) temperate countries	11–13, 14, 15–18, 19–29	30–36
Floods	More injuries, deaths and other sequelae (infectious disease, mental health disorders)		37–44	2, 34, 45–47
Aero-allergen production	Increased allergic disorders (hay fever, asthma) due to longer pollen season	Reduced exposure to aero-allergens in some regions due to lesser production or shorter season of pollen circulation	48	
Food-poisoning (diarrhoeal disease)	Greater risks at higher temperature (especially salmonellosis)		40, 49–55	34
Water-borne infection	Cholera risk might be amplified by coastal/estuarine water warming, local flooding	Less risk where (heavy) rainfall diminishes	40, 56–61	62–64
Vector-borne infections	Mosquito-borne infections tend to increase with warming and certain changes in rainfall patterns: heightened transmission. Likewise tick-borne infections, although via more complex ecological changes	Mosquito reproduction and survival could be impaired by altered rainfall and surface water and by excessive heat: reduced transmission. Similar determinants may apply to ticks, snails and other vectors.	65–76	34, 60, 77–95
Regional crop yields	Reductions in many low-latitude and low-rainfall regions	Increases in currently too-cold regions (might not be sustained with continuing climate change)		34, 96, 97
Fisheries	Declines or shifts in local fisheries: protein shortages (in poor populations). Possible increased contamination	Latitudinal shifts of fisheries, with ocean warming, may benefit new host populations		98–100
Sea-level rise	Health consequences of population displacement, lost livelihood, exposure to coastal storm surges and floods. Salinisation of freshwater and coastal soil.			101

Table: Main known and probable health hazards of climate variability and climate change

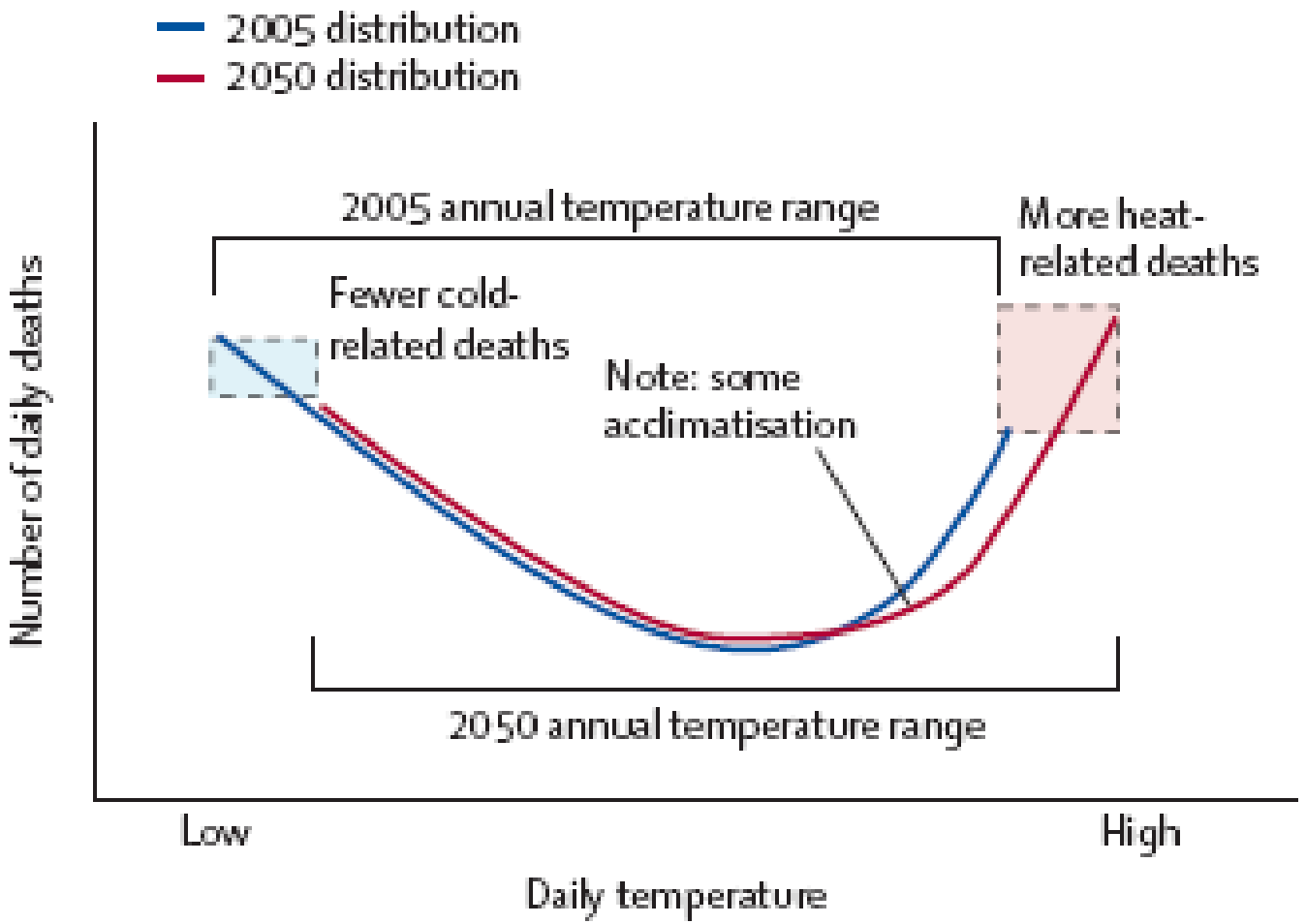


Figure 2: Schematic representation of how an increase in average annual temperature would affect annual total of temperature-related deaths, by shifting distribution of daily temperatures to the right
Additional heat-related deaths in summer would outweigh the extra winter deaths averted (as may happen in some northern European countries). Average daily temperature range in temperate countries would be about 5–30°C.

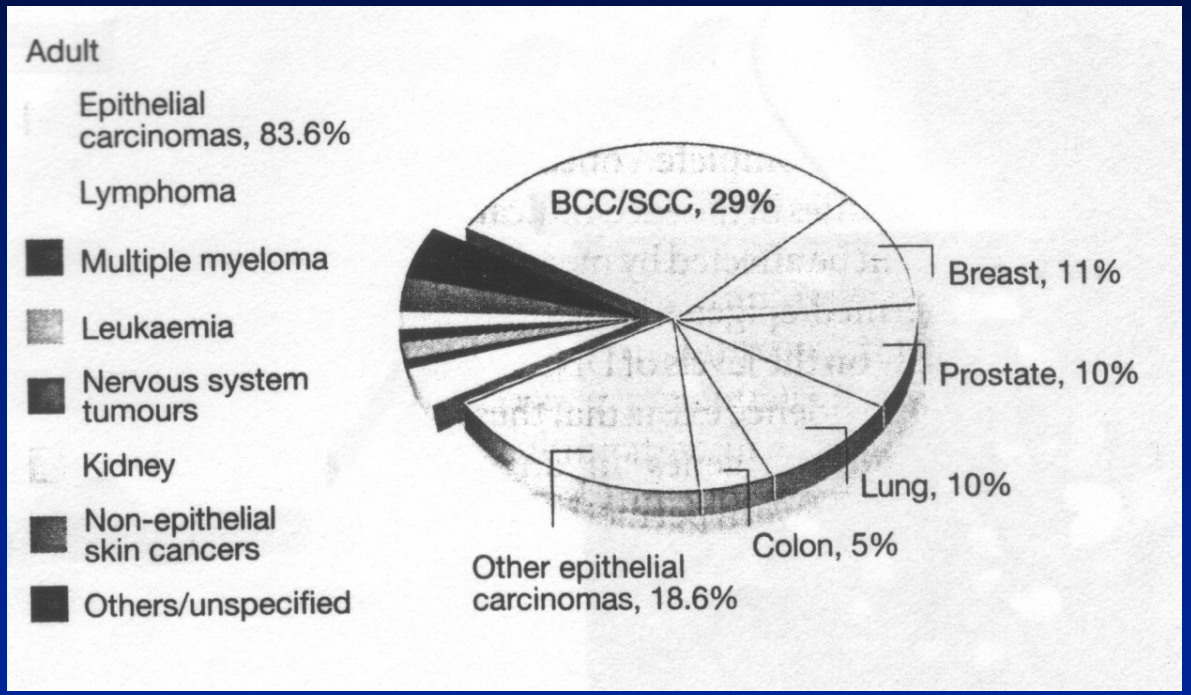
Maladies de la peau liées aux UV: une épidémie?

Le mélanome n ’est pas le seul K des dermatologues

Carcinome baso-cellulaire (1 Français sur 4, rarement grave)

Carcinome spino-cellulaire (1 F sur 15, parfois grave)

= liés aux expositions solaires chroniques

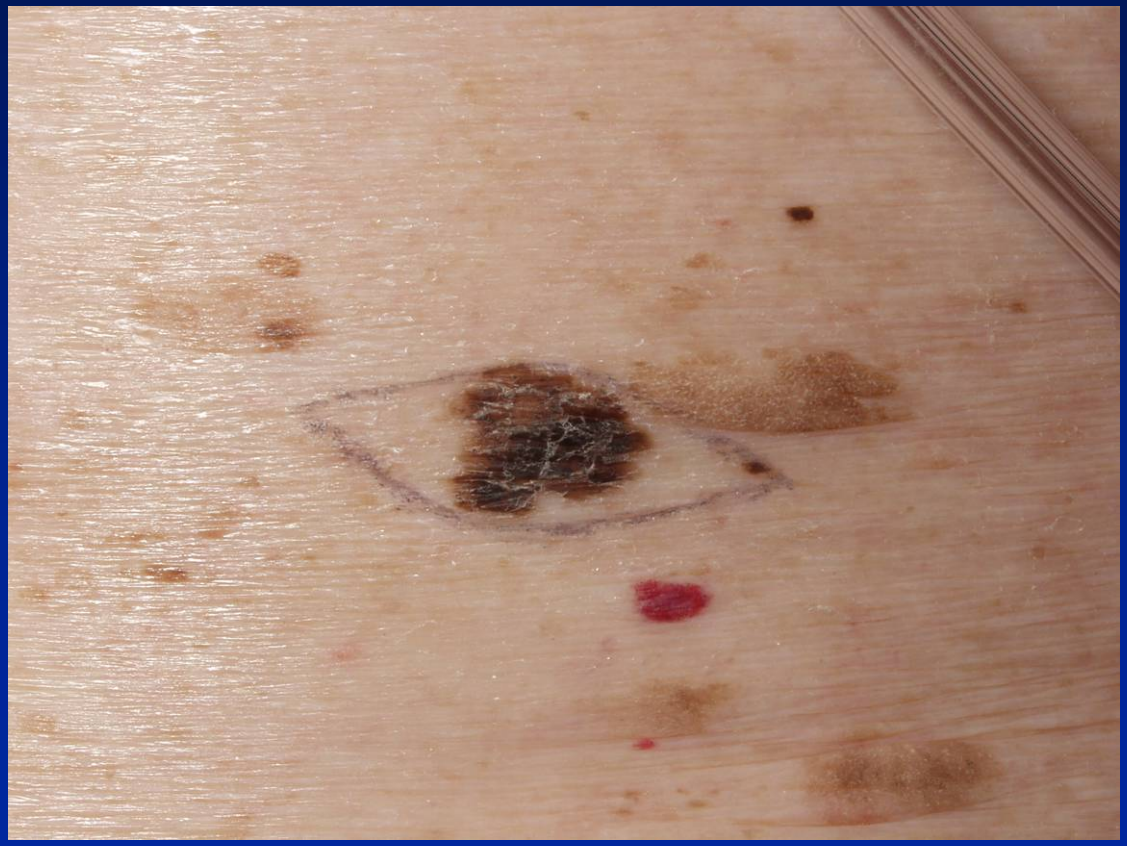


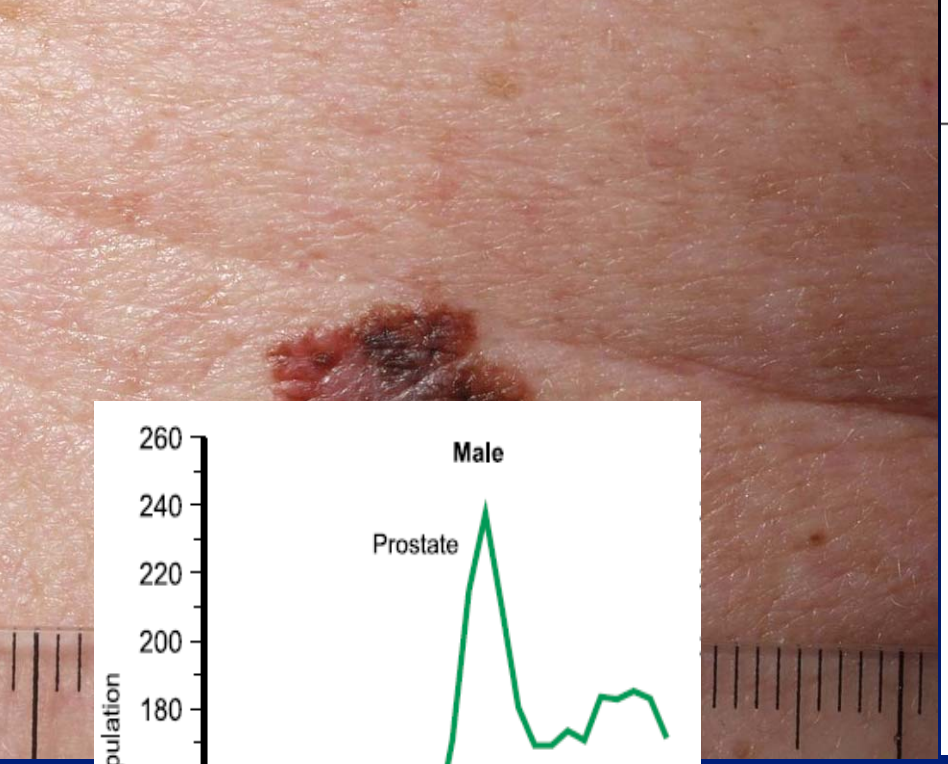
Pourcentage des cancers de l ’adulte, y compris les spino et basocellulaires

Depinho RA. The age of cancer. Nature, 2000;408:248-54

Mélanome

K développé à partir des mélanocytes (fabriquent la mélanine)

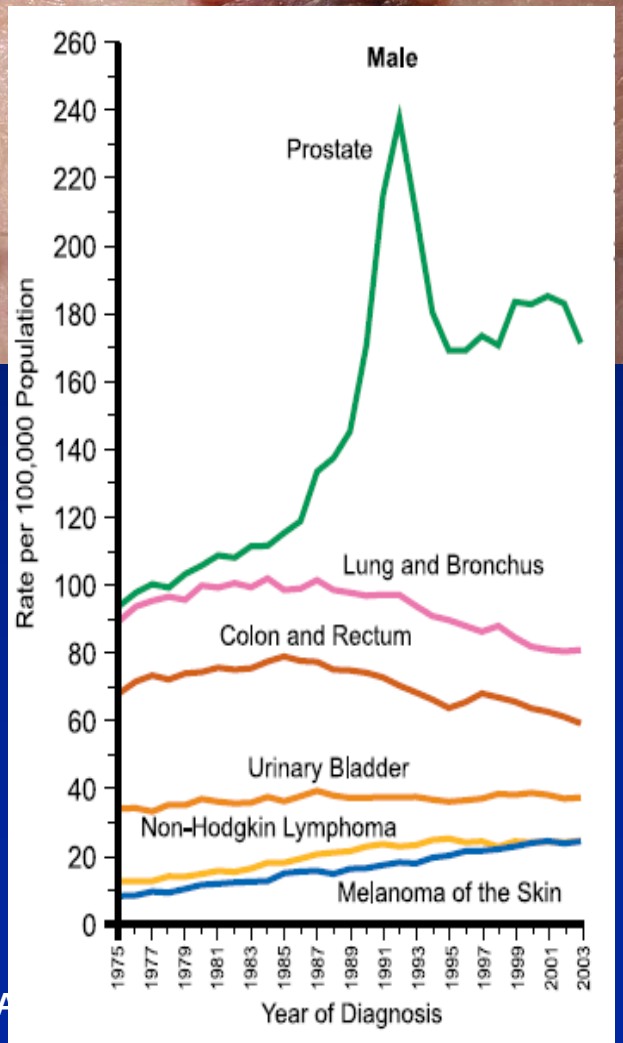




CA Cancer J Clin 2007;57:43–66

Estimated New Cases*

	Males			Females		
Prostate	218,890	29%		Breast	178,480	26%
Lung & bronchus	114,760	15%		Lung & bronchus	98,620	15%
Colon & rectum	79,130	10%		Colon & rectum	74,630	11%
Urinary bladder	50,040	7%		Uterine corpus	39,080	6%
Non-Hodgkin lymphoma	34,200	4%		Non-Hodgkin lymphoma	28,990	4%
Melanoma of the skin	33,910	4%		Melanoma of the skin	26,030	4%
Kidney & renal pelvis	31,590	4%		Thyroid	25,480	4%
Leukemia	24,800	3%		Ovary	22,430	3%
Oral cavity & pharynx	24,180	3%		Kidney & renal pelvis	19,600	3%
Pancreas	18,830	2%		Leukemia	19,440	3%
					678,060	**100%**



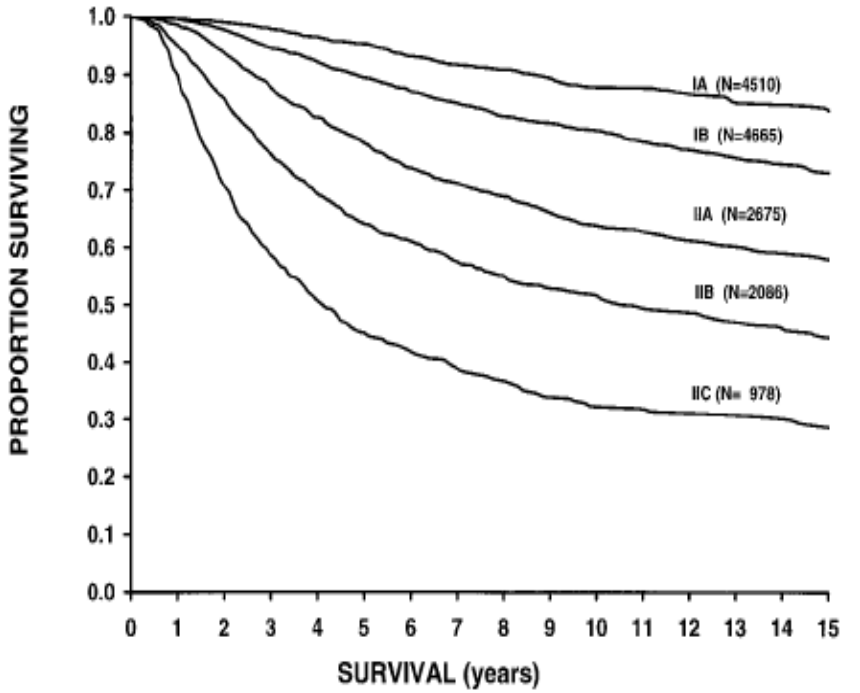
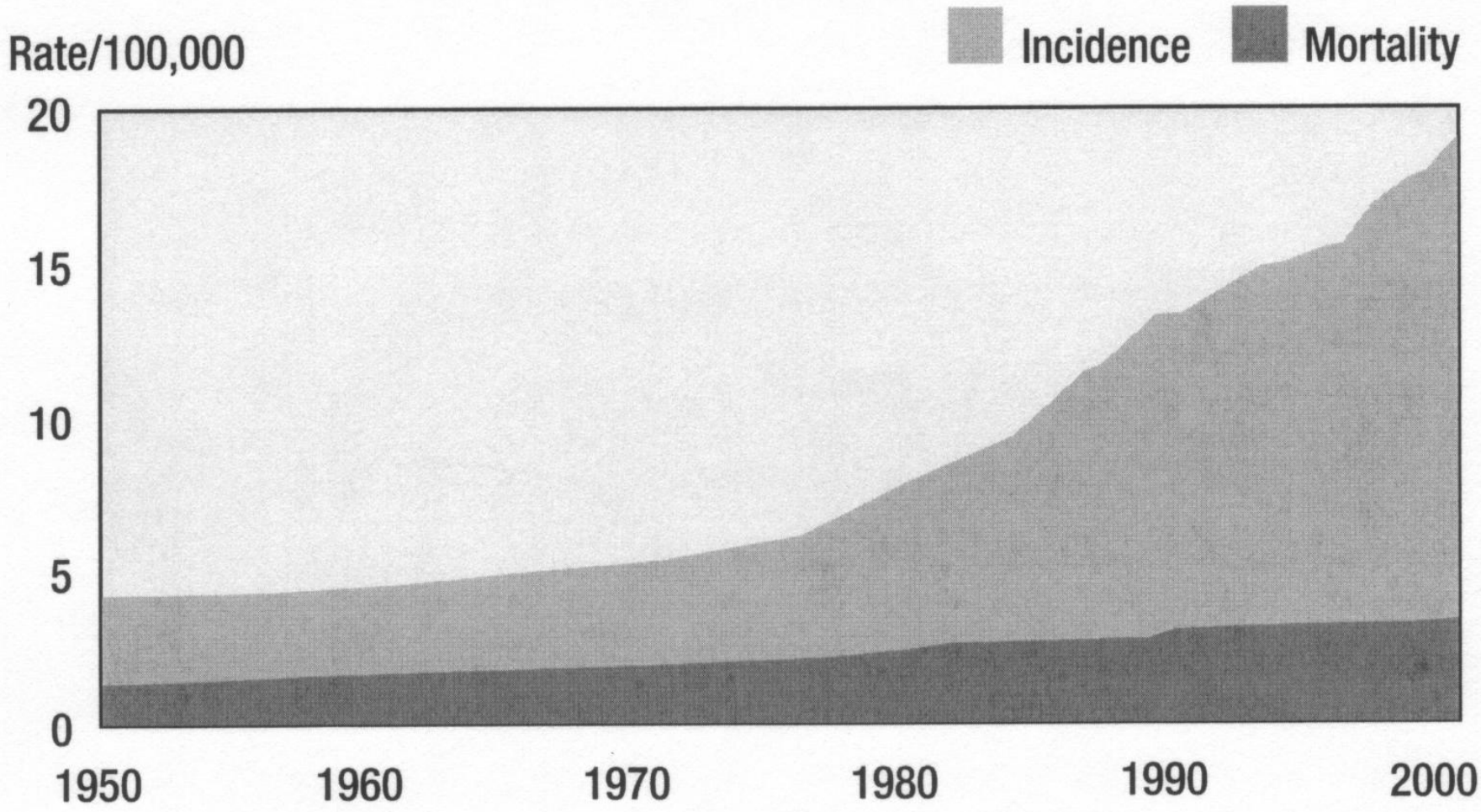


Figure 2
Melanoma in the US: Incidence and Mortality



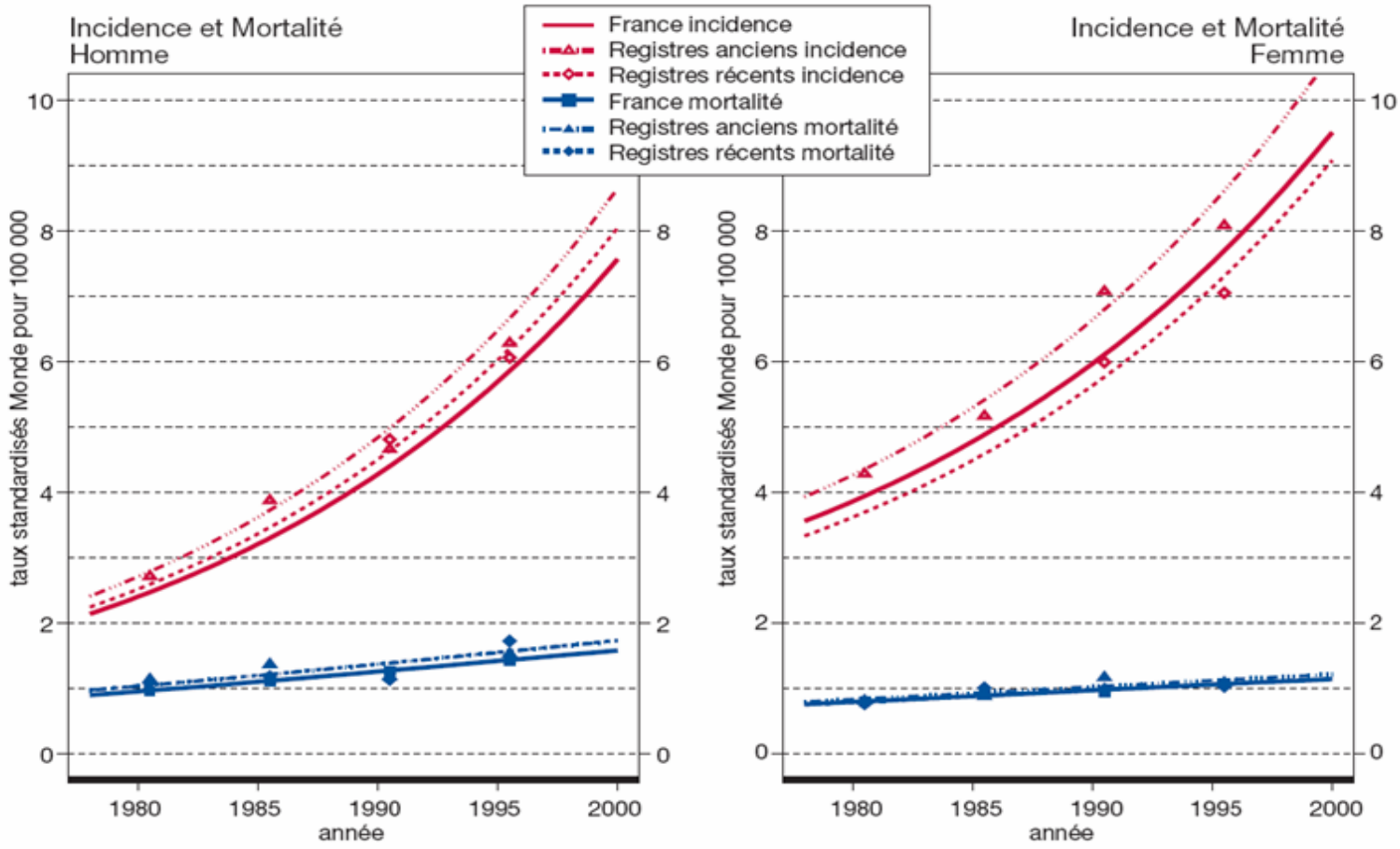
Both incidence and mortality rates from melanoma are increasing in the US. From Rigel et al, NYU Melanoma Cooperative Group, 2000.

Melanoma incidence in France

Rises +++

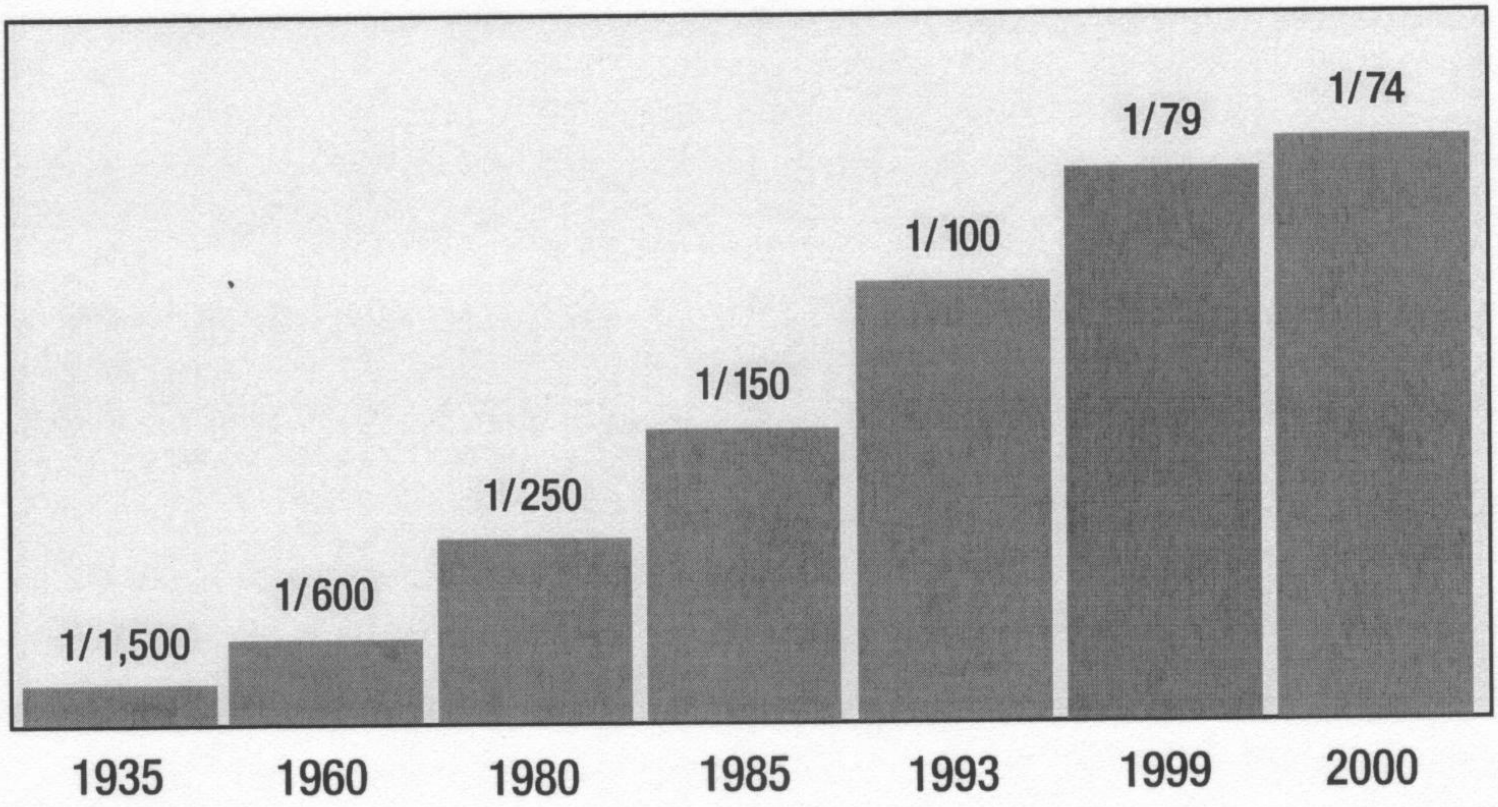
Poor effects of prevention campaigns done (mainly using mass media, parent-oriented)

Figure 3 : Tendance chronologique



Augmentation d'incidence du mélanome

Figure 1
Lifetime Risk of Developing Invasive Melanoma (US)

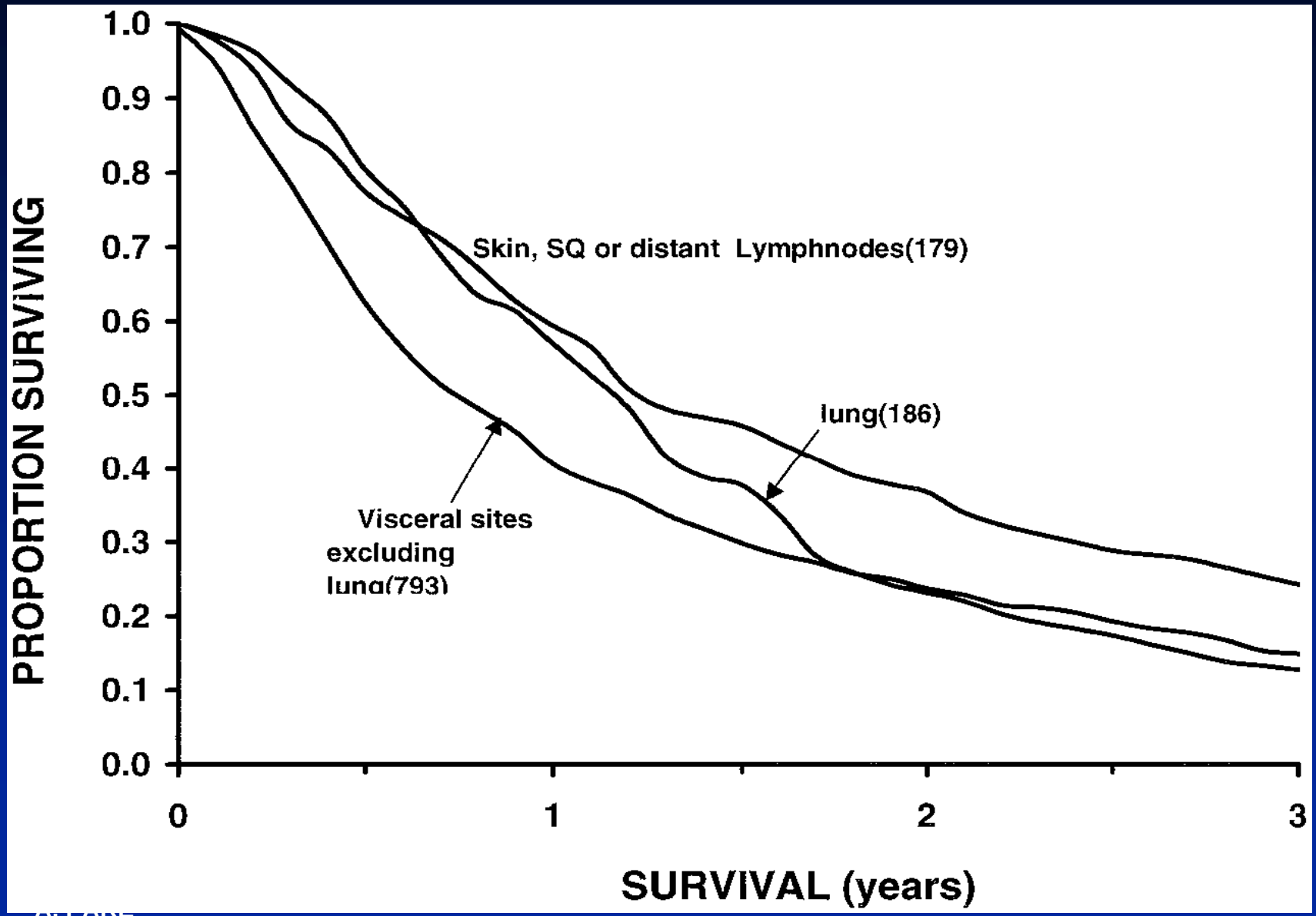


The lifetime risk of an individual American developing invasive melanoma has been steadily increasing since 1935.

En 2006,

1 américain sur 64 !!

Survival curves of 1,158 patients with metastatic melanoma at distant sites subgrouped by their presenting clinical staging



Survival differences are significantly greater for skin, subcutaneous, and distant lymph node metastases compared with lung metastases (P=0,003) or other visceral sites of metastases (P < .0001)

Balch CM, et al. J Clin Oncol 2001; 19: 3622-34

Mélanome: un cancer du sujet jeune

- Âge médian au diagnostic : 50 ans
- USA: la 2ème cause de mortalité par cancer des patients en âge de travailler (<65 ans)

Mélanome: arguments en faveur du rôle joué par le soleil

Arguments :	Soleil	Expositions intermittentes plus que par expositions régulières ou cumulatives	Particulièrement par expositions dans l'enfance
– géographiques (irradiation ambiante)	l'incidence augmente quand la latitude baisse		
– phénotypiques (origine ethnique, capacité à bronzer)	risque plus élevé chez les sujets à peau blanche		
– anatomiques	risque plus élevé sur les régions du corps exposées au soleil que non exposées	risque plus élevé sur les zones exposées occasionnellement qu'en permanence	
– chronologiques (âge)		l'incidence n'augmente pas avec l'âge	risque plus élevé chez les sujets ayant émigré tôt en pays très ensoleillé
– sociologiques (mode de vie)	risque lié aux expositions en cabine de bronzage	risque – non lié aux expositions solaires professionnelles – lié aux expositions de loisirs – lié à la fréquence des coups de soleil	risque lié aux antécédents de coups de soleil pendant l'enfance

Radiations UV et pathologies peau

L’exposition aux UV est clairement associée à

1. Mélanome (CMM)
2. Carcinome spino-cellulaire (SCC)
3. Carcinome baso-cellulaire (BCC)
4. Cataracte corticale
5. Vieillissement cutané
6. Baisse présentation antigènes au système immunitaire
7. Kératoses actiniques

Interactions médecins-spécialistes du climat

Facteurs influencant ces problèmes

Quantité d'UV produite

Transmittance dans l'atmosphère (ozone, nuage, aerosols)
Latitude et altitude, saison, horaire, surface type

UV index

Comportement des populations
- Vacances au soleil
- Loisirs à l'extérieur
- Travail à l'extérieur
- Type et temps d'exposition solaire
- Habitudes vestimentaires
- Degré de photoprotection (crèmes, vétements)

Doses annuelles UV

Espérance de vie

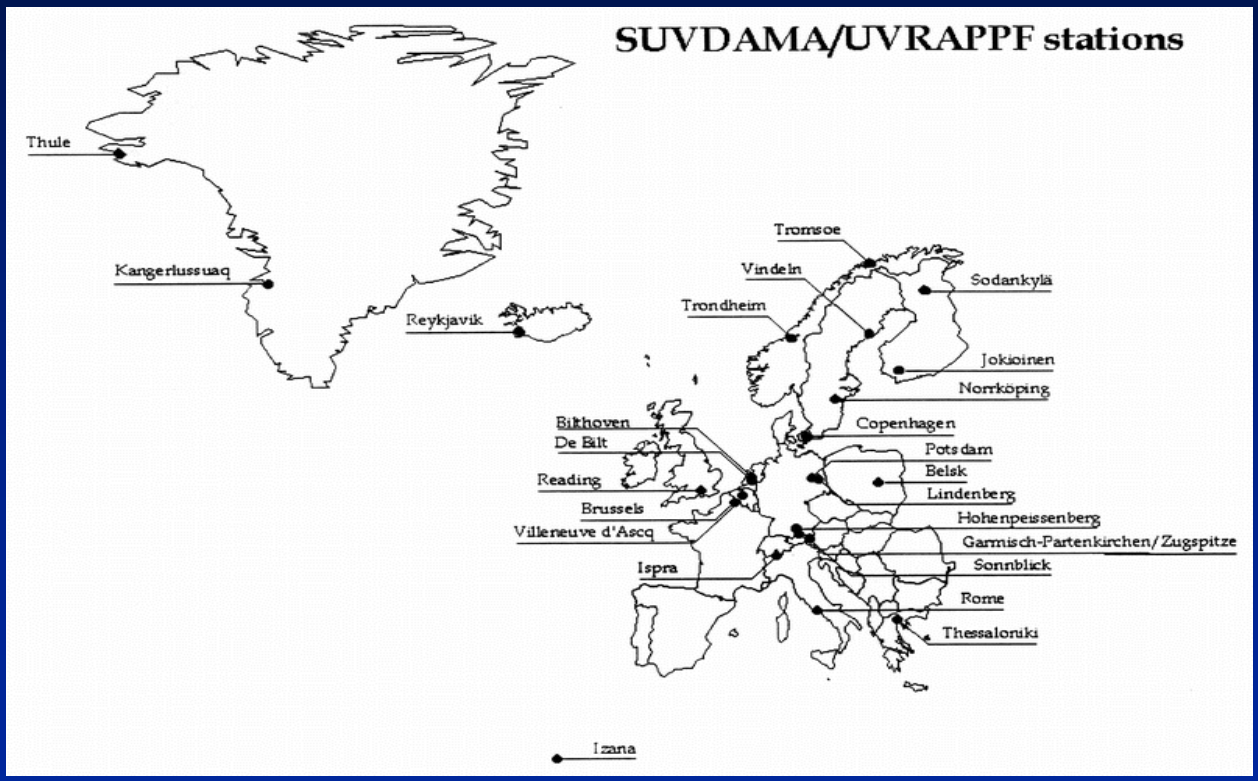
Doses cumulées d'UV

Détection améliorée, reporting plus fidèle

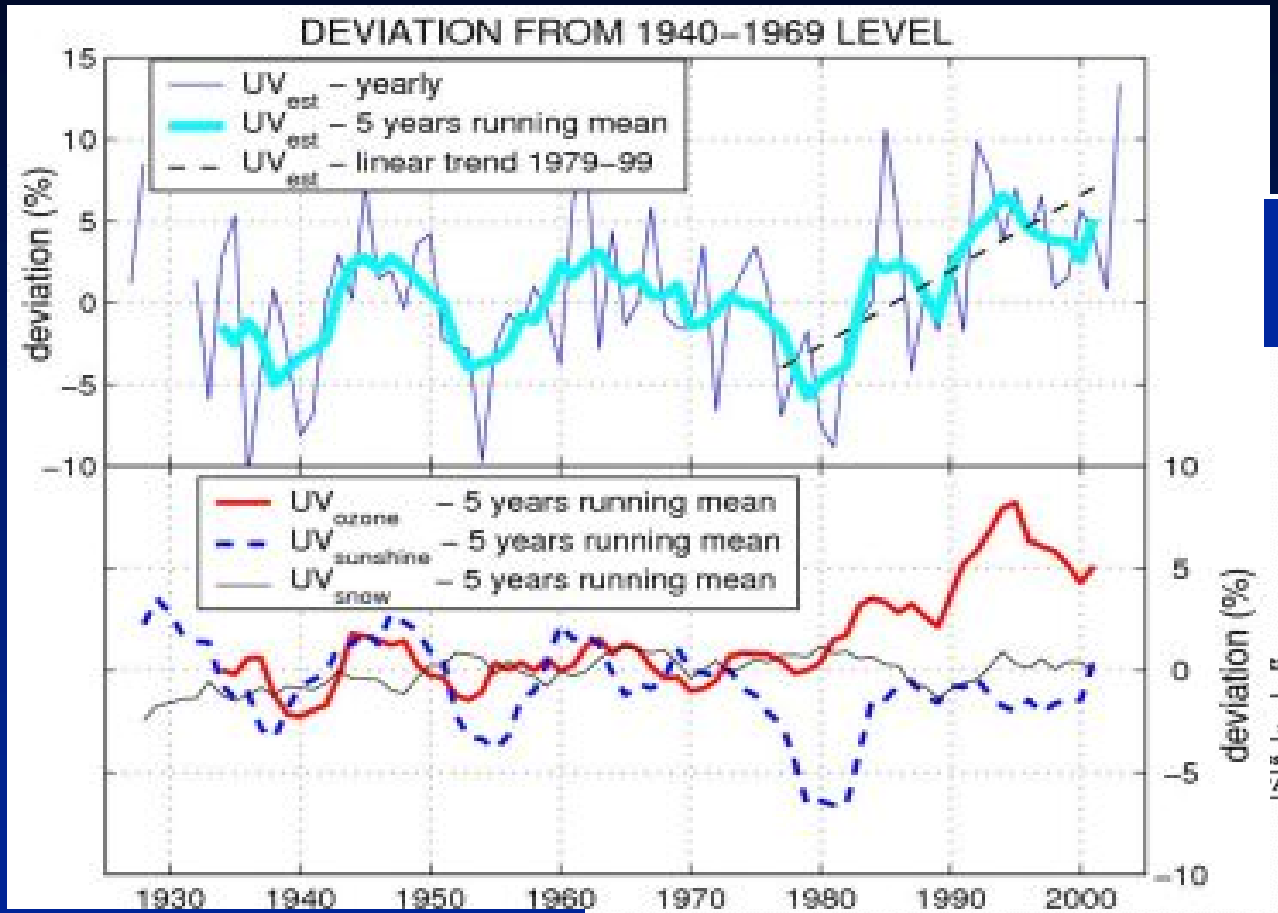
Incidence croissante des pathologies liées au soleil

Observed trends in surface UV

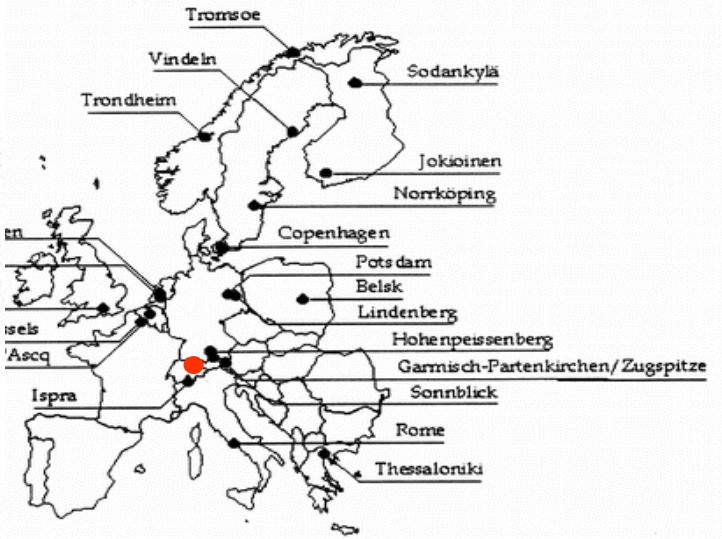
- Broadband and spectral UV fluxes are difficult measurements to do
- There are issues with long-term calibration of the instruments
- As a result, there have been very few reliable long-term measurements
- The monitoring network is now in place



Trends in UV at Davos



Erythemal UV at Davos (Switzerland)

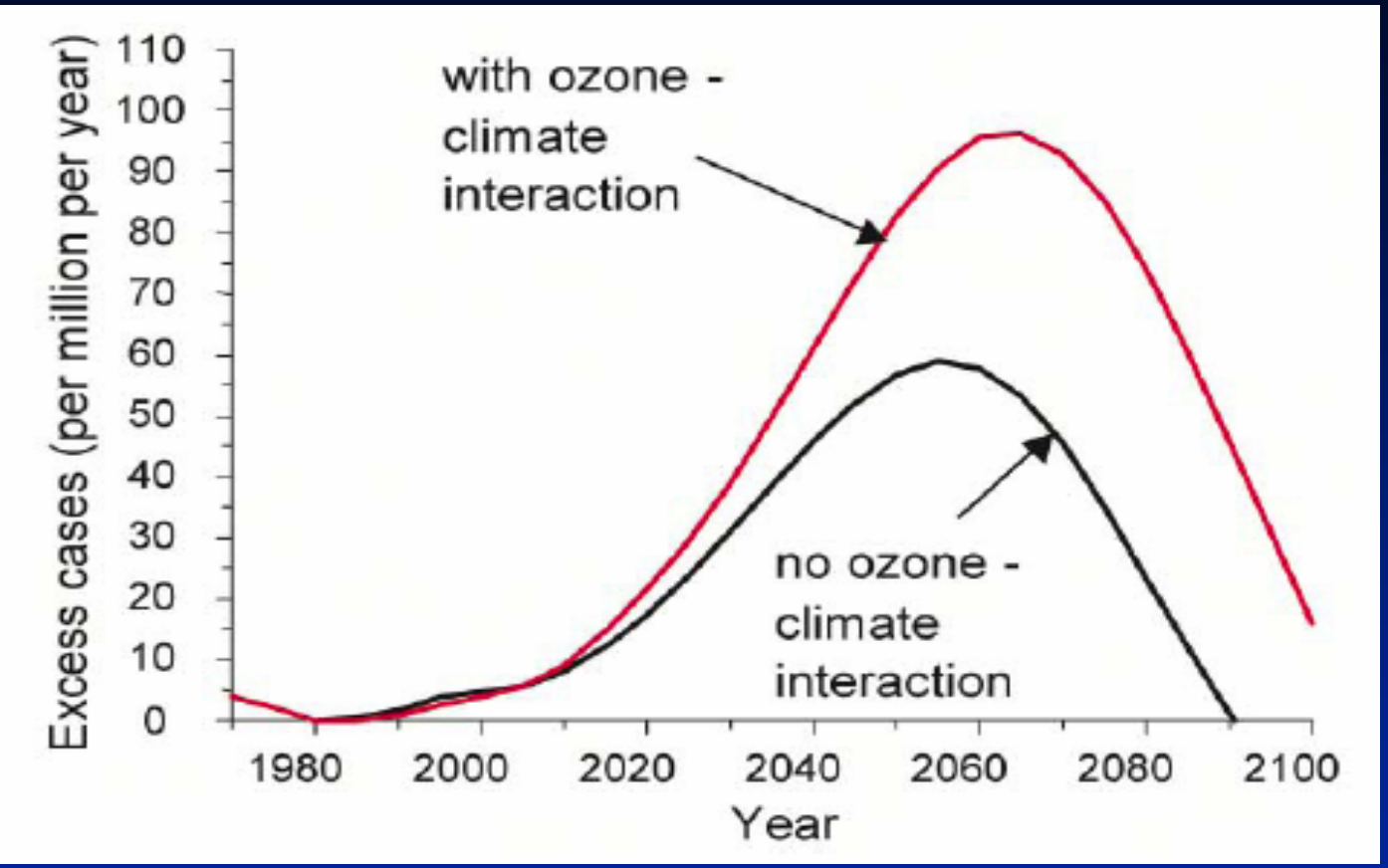


Can we predict what future levels of surface UV radiation will be?

In order to do so, we need to predict how each of the parameters influencing surface UV radiation will change in the future:

- Stratospheric ozone: further implementation of the Montreal protocol will eventually lead to recovery of the ozone layer by 2050 (2006 WMO-UNEP ozone assessment)
- Clouds: the water cycle responds to climate change but it is still fairly uncertain how (UKCIP, 2002)
- Aerosols, tropospheric O_3, SO_2, NO_x: increasing air quality control (CAFE programme of the European Commission)
- Snow is likely to decrease because of climate change

Ozone layer recovery

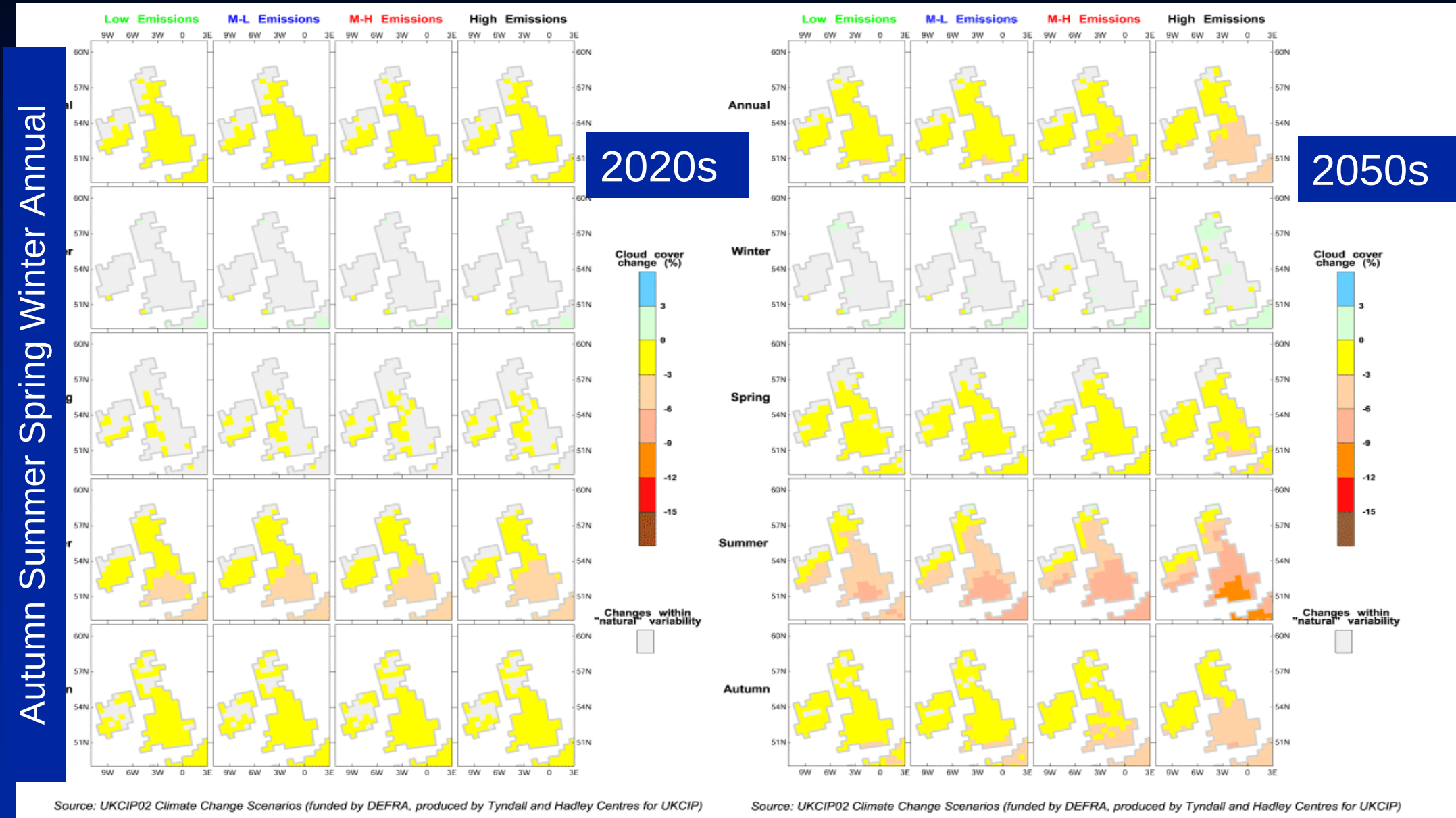


Global warming heats the troposphere but cools the stratosphere, thus delaying the recovery of the stratospheric ozone layer.

It may however hasten the full recovery in NH mid-latitudes.

This could result in a larger rate of skin cancer incidence and a time delay in the peak rate. However, change in behaviours and mitigation factors will be important

Future trends in cloud cover



Conclusions (adapted from Bouchet, Tyndall I.)

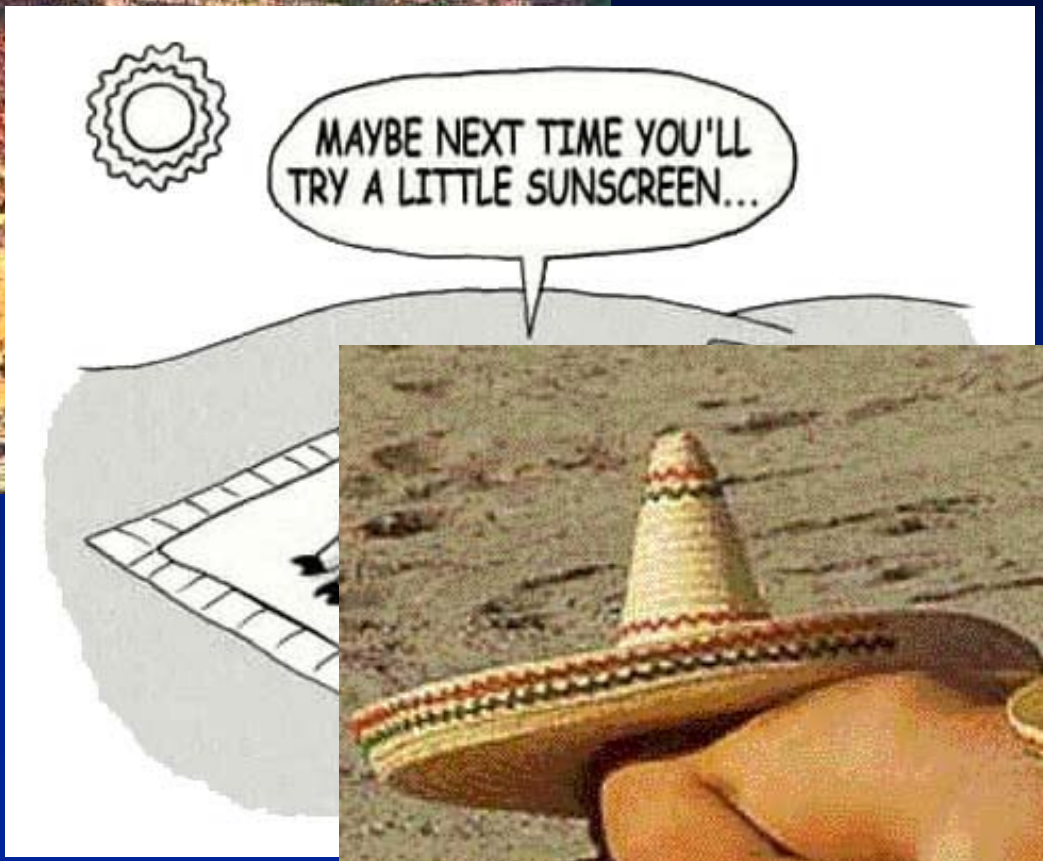
- Observed increase in skin cancer incidence has to involve changes in behaviour (sun-seeking holidays, outdoors activities, minimal clothing) and cannot be attributed alone to changes in UV levels
- So will we survive the impact of climate change on skin cancer incidence?
  - The ozone layer will ultimately recover
  - Climate change may pose new threats:
    - reduced cloudiness and changes in behaviour
- Interactions between scientists and clinicians is difficult. We could help in
  - Implementing behavioral changes of populations toward sun exposure
  - Better implementation of medical variables in your prediction models

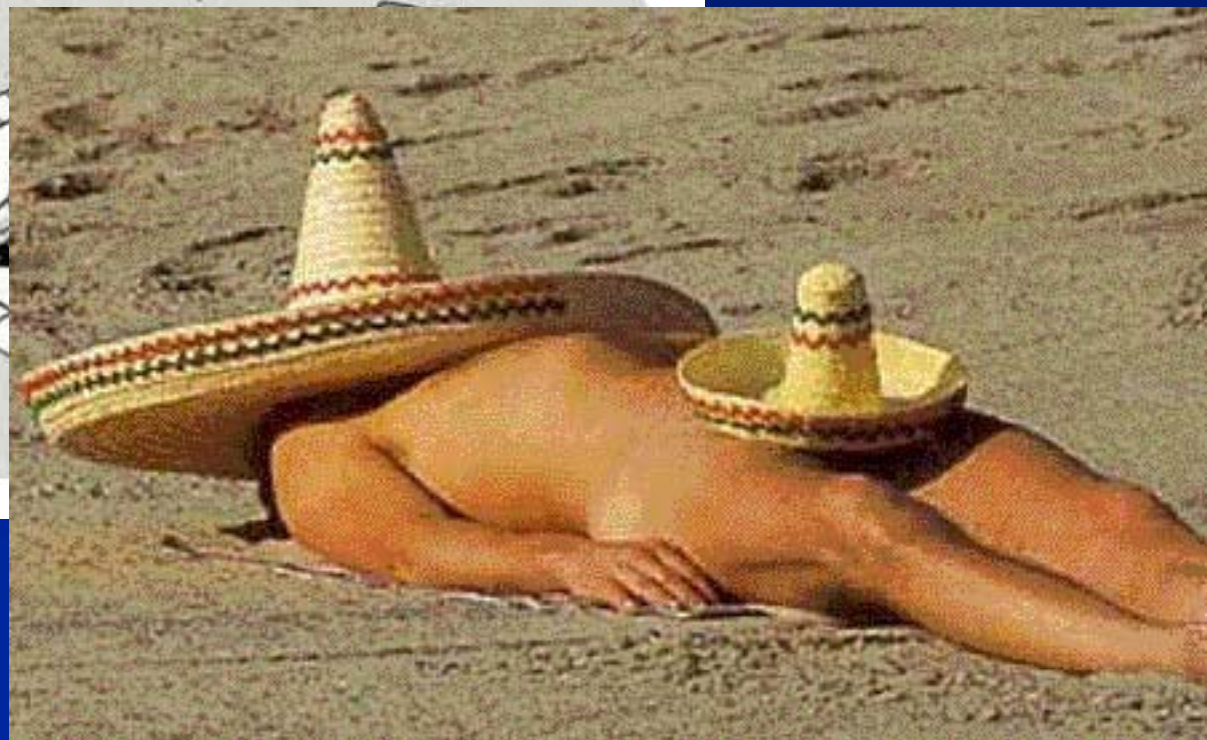
You could help in:

Providing easy UV measurements to implement in epidemiological models

Relation with mass media

Complexicity of the topic: ex VitD and cancer prevention and the sun industry





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