Ultraviolet Radiation

in Switzerland

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IACETH

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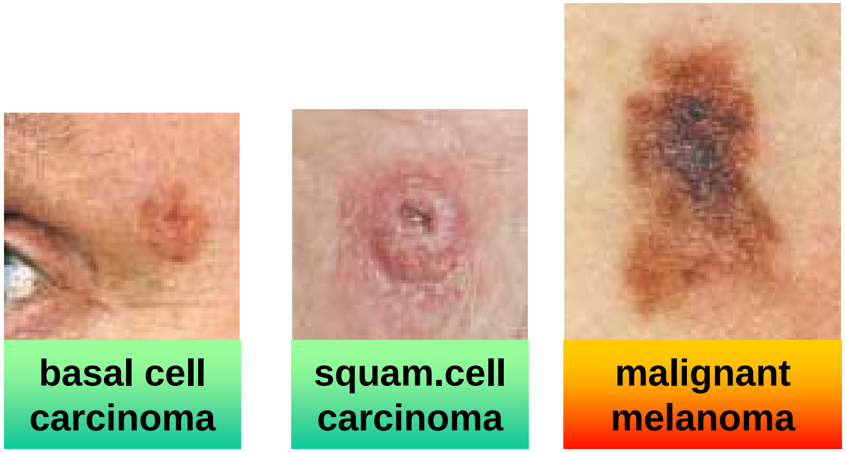
Swiss Confederation

Federal Department of Home Affairs FDHA
Federal Office of Meteorology and Climatology
MeteoSwiss

Motivation for our studies:

- UV impacts public health:
  - skin
  - eyes
  - immune system
  - Vitamin D production



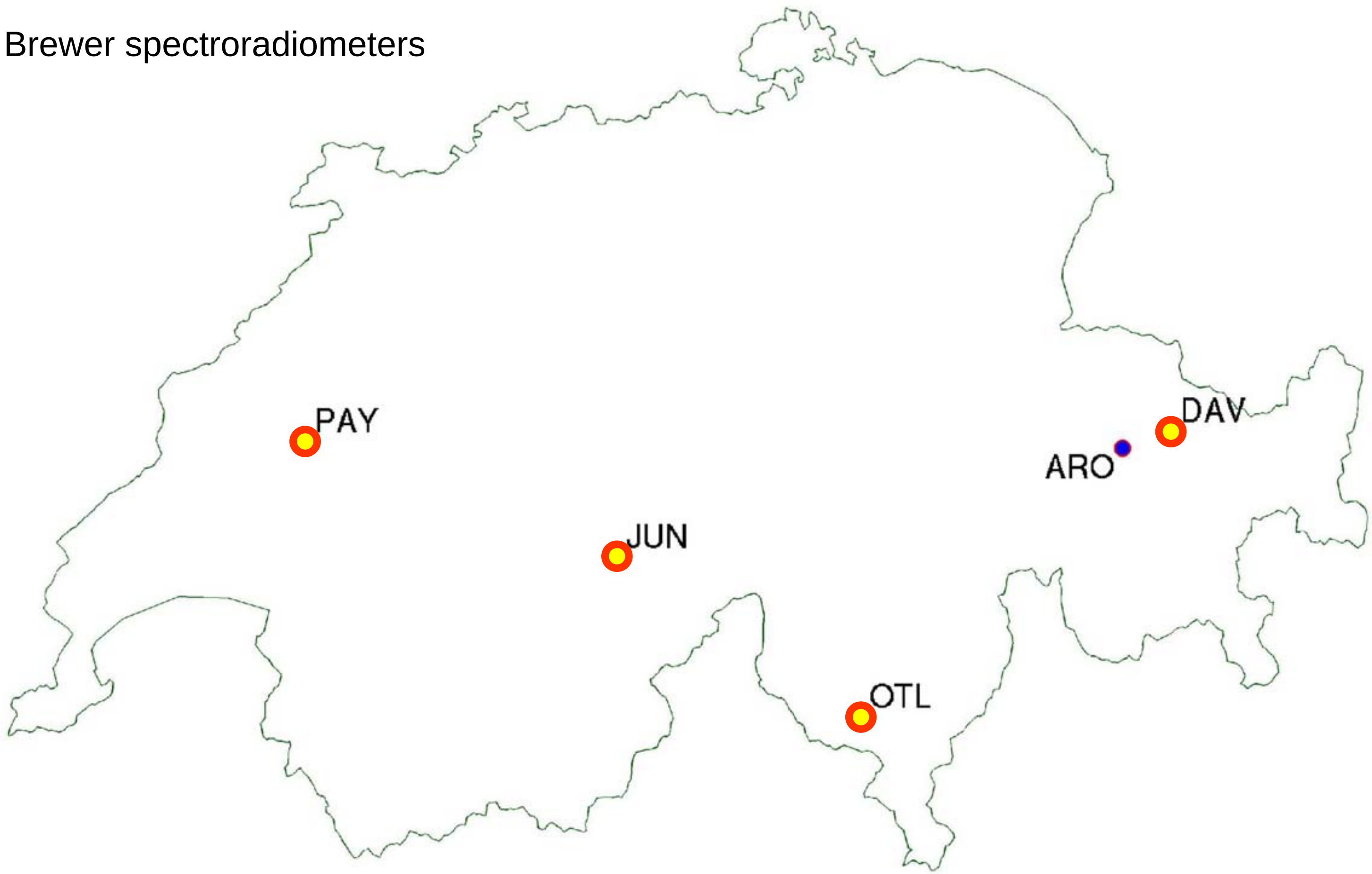
Images: "Global Solar UV Index: A Practical Guide, WHO"

- Situation in Switzerland:
  - CH shows the 2nd highest incidence rate of malignant melanoma in Europe (worldwide 5th)
  - around 250 yearly die as a result of skin cancer (Schweizer Krebsliga, 2004)

Medics and policy maker request more information about the spatial distribution and temporal development of UV radiation

Data Problem:

- broadband instruments
- Brewer spectroradiometers



Aim of our studies:

investigate the influence of clouds on UV radiation and therewith describe its short-term variability

- UV modeling:
  - using libRadtran as radiative transfer model (RTM)
  - works well for clearsky conditions
  - achieve rmse: 4.6 - 7.2 %

- Cloud influence:
  - treating cloud effects by the use of a SW_{glo} as proxy (Koepke et al. 2006, SPIE 6362)
  - investigate the relationship between SW and erythemal UV radiation

Our Model:

Cloud modification factor:

– estimating cloud effect by cloud modification factors (CMFs)

$$CMF = \frac{irradiance_{\text{allsky}}}{irradiance_{\text{clearsky}}}$$

$$CMF_{\text{UV}} = \frac{UV_{\text{obs}}}{UV_{\text{mod}}}, \quad CMF_{\text{SW}} = \frac{SW_{\text{obs}}}{SW_{\text{mod}}}$$

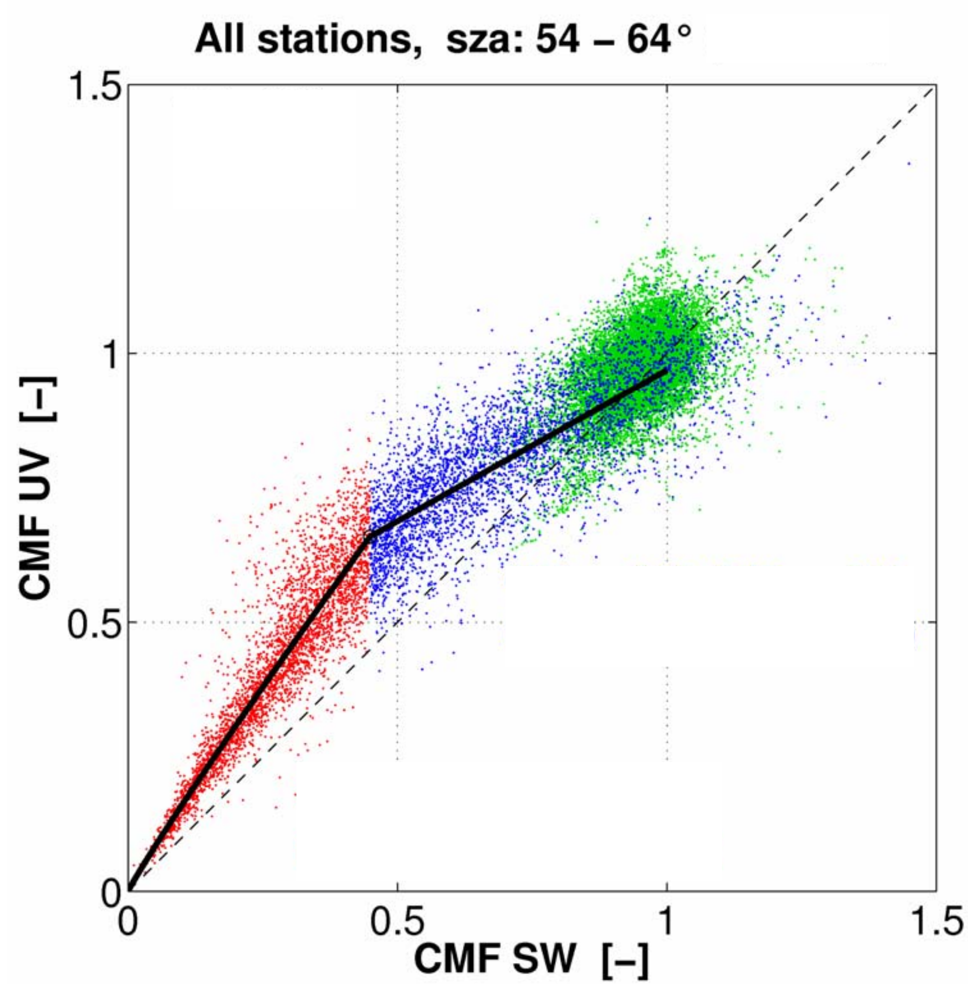
Relationships CMF_{UV} and CMF_{SW}:

$$UV_{\text{allsky}} = f\left(UV_{clearsky}, CMF_{\text{SW}}\right)$$

Relationship: Shortwave ↔ Ultraviolet:

$$CMF_{UV} = f(CMF_{SW})$$

$$\left(\frac{UV_{all-sky}}{UV_{clear-sky}}\right) = f\left(\frac{SW_{all-sky}}{SW_{clear-sky}}\right)$$



– separating data into **three different** clusters

– applying **two linear regressions** (red / blue) depending on the atmospheric attenuation

Validation:

- Time resolution:
  - for model derivation: 10' - data used
  - this allows flexibility to aggregate 10'-1h-1d
- Findings:
  - performance of the method is depending on solar zenith angle
  - better correspondence for high sun elevation
  - skill is better for daily values than for 10'-data

	22°-42°	42°-54°	54°-64°	64°-72°
Payerne	10.2%	10.3%	10.6%	12.6%
Davos	9.1%	9.8%	10.9%	11.6%
Locarno	9.0%	**8.9%**	10.0%	**12.8%**
Jungfraujoch		7.7%	22.0%	9.4%

well then…

- **PhD thesis in the framework of COST-726**
- **derived an all-weather UV model**
- **high degree of generalization**
- **validation confirms accuracy (9-13% on 10')**
- **model capable to:**
  - **reconstruct UV in CH back to 1980**
  - **high time resolution (10') → we keep flexibility**
  - **minimum input-information (SW_{obs}, model data)**
  - **independent of station**
  - **estimation at any location where input data available**

Thank you for your attention