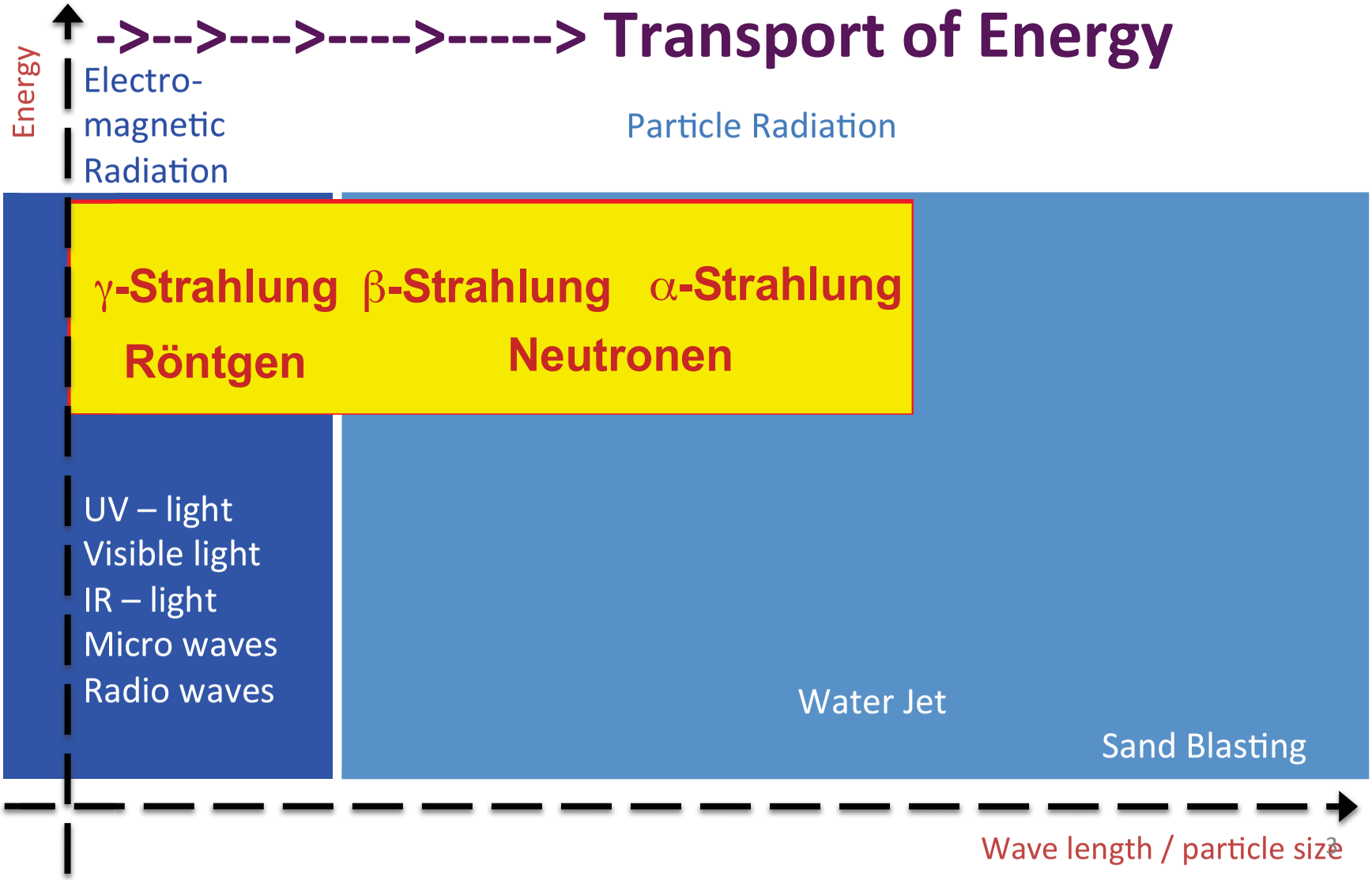
Radiation Exposure
Radiation Protection

39. EAGOSH meeting
11.-12. Nov. 2015

Klaus W. Rose

- Scientific Background
- Legal Requirements
- Exposure of Air Crews
- Exposure of general Population
- Conclusion

What is radiation?

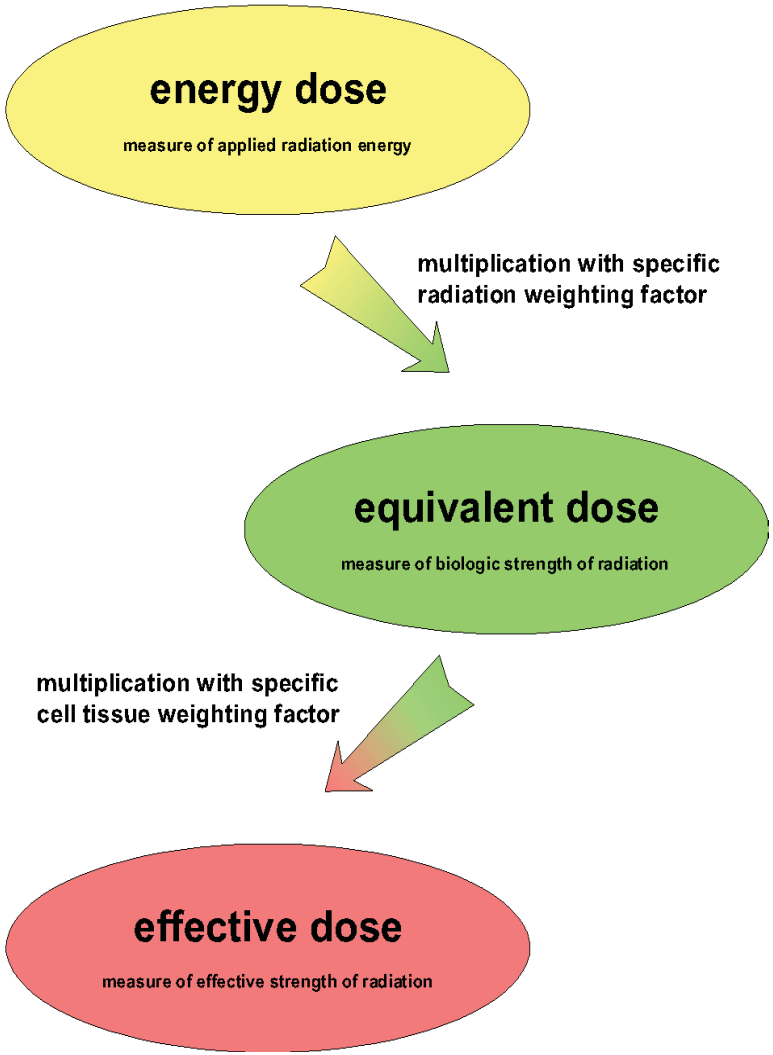


What is dose?

Energy Dose can be measured directly.

Equivalent Dose can be measured with calibrated equipment or has to be calculated.

Effective Dose has to be calculated.



Cosmic Radiation on Flight Altitudes

Flights …

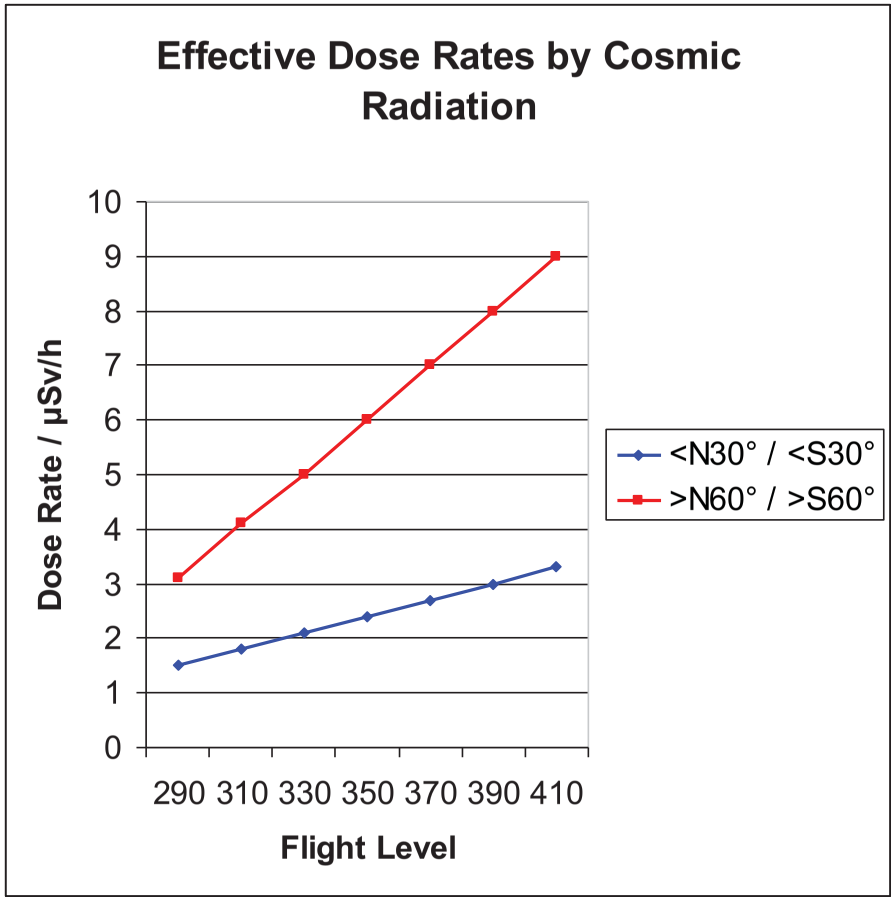
… in the **equatorial area** will result in lower doses.

… at the **polar areas** will result in higher doses.

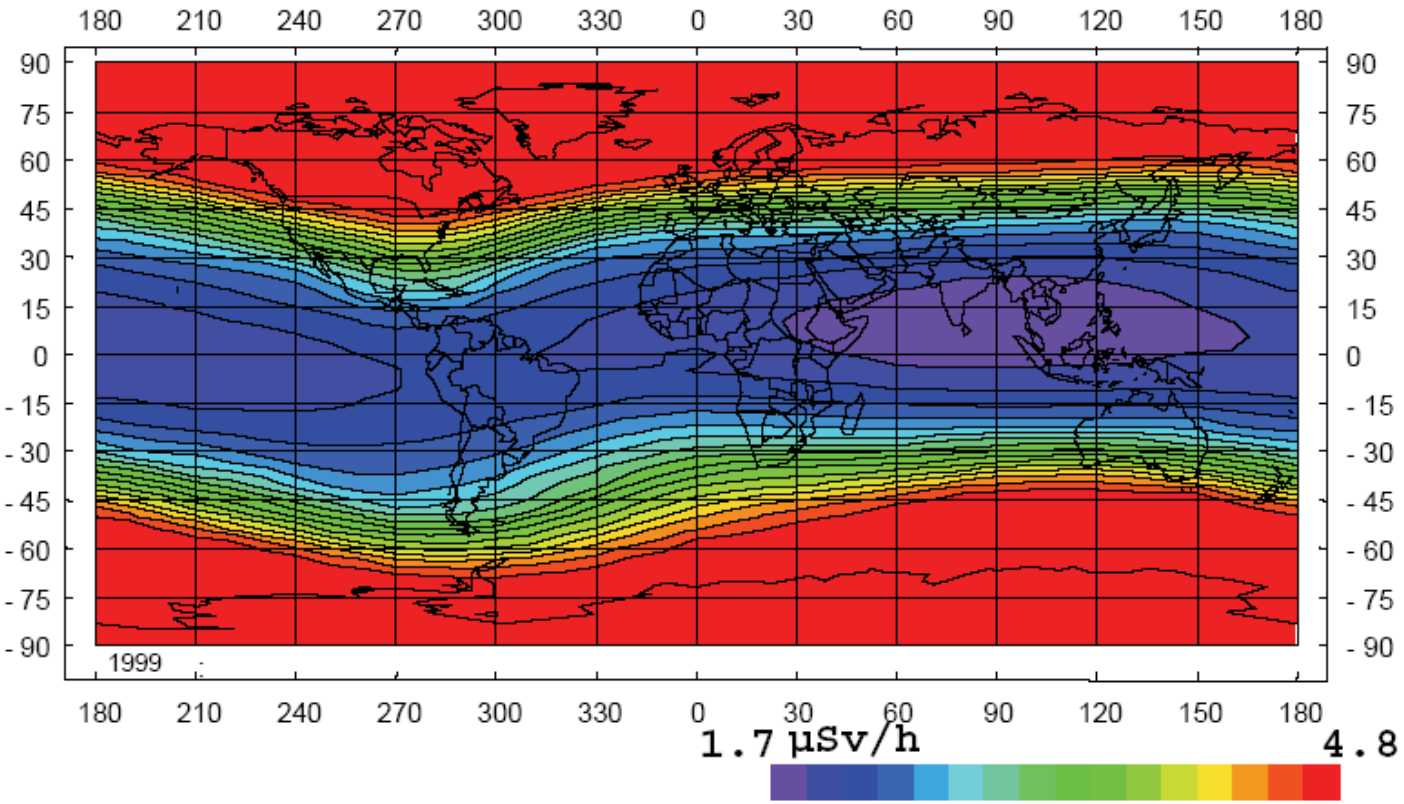
Solar Activity and

Flight Level

affects the strength of radiation.



Cosmic Radiation Intensity



EU Legal Requirements

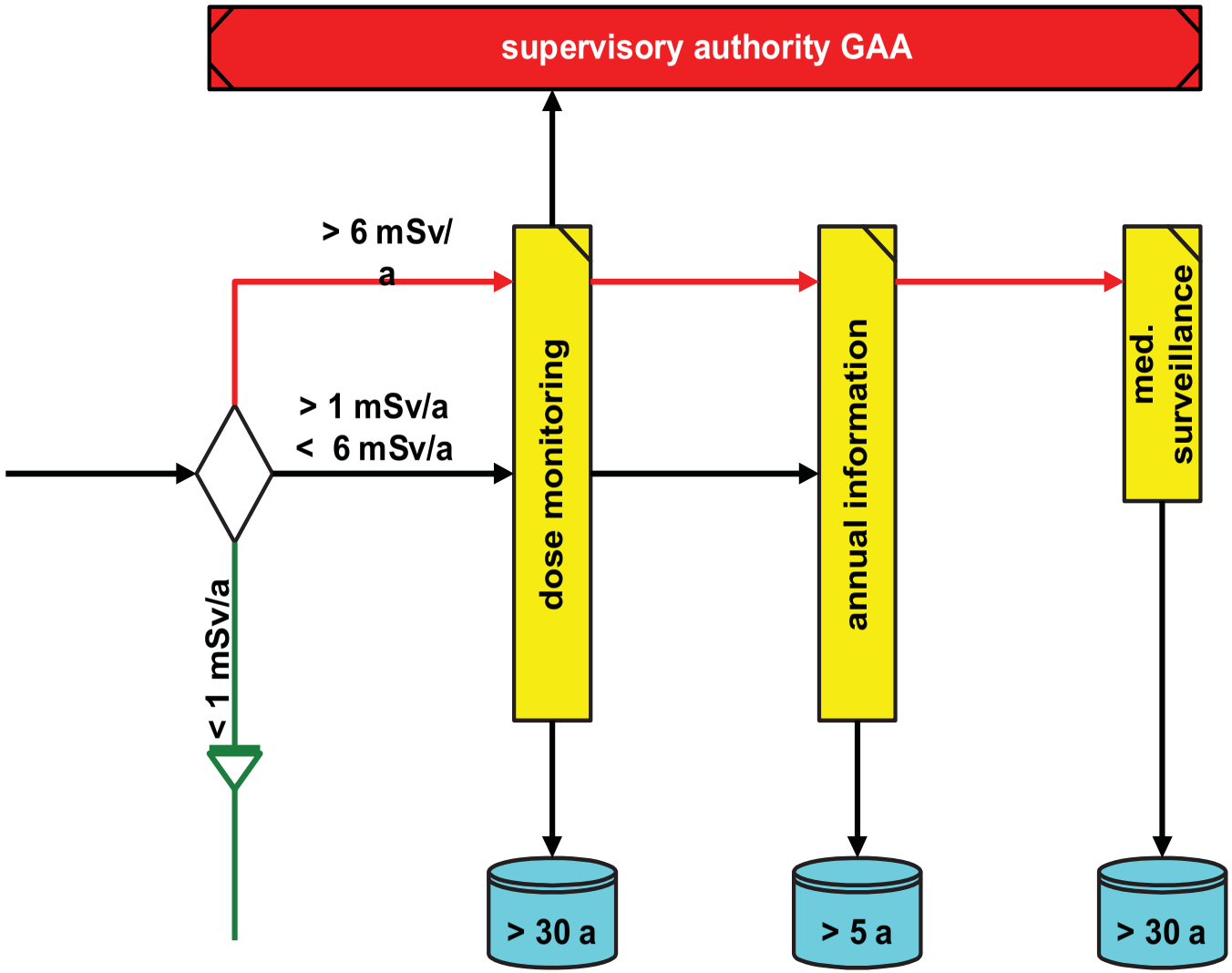
European Council Directive 96/29/Euratom
issued 13 May 1996

defining basic safety standards

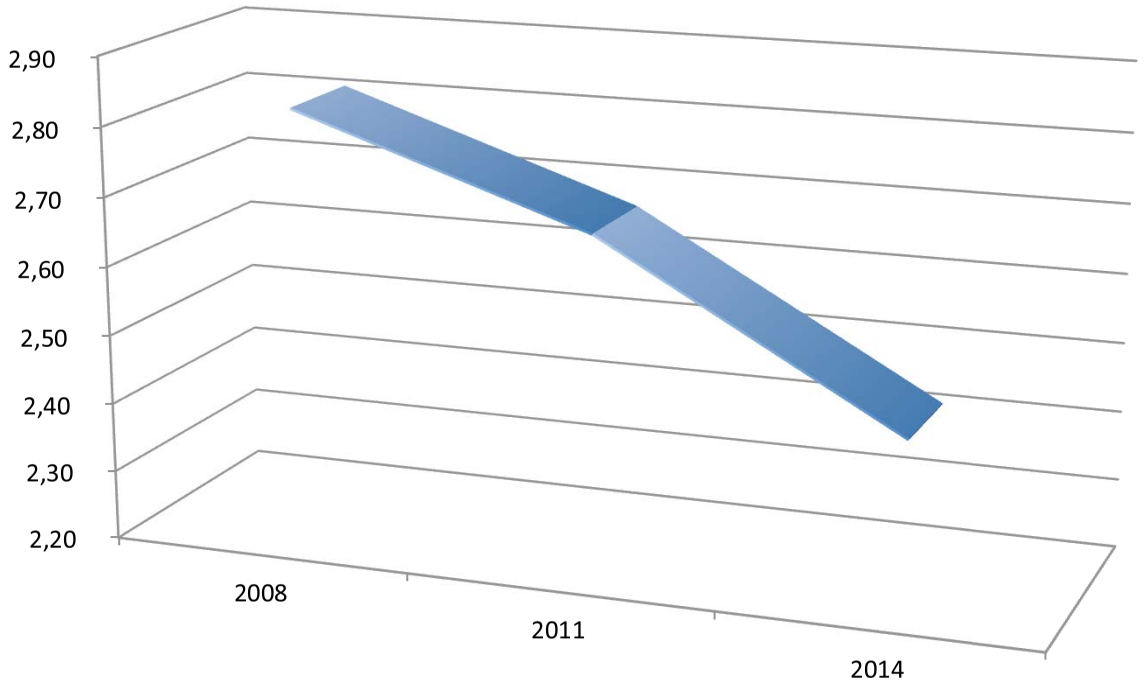
protection of the health of workers and the general public against the dangers arising from ionizing radiation

Occupational Exposure Limits

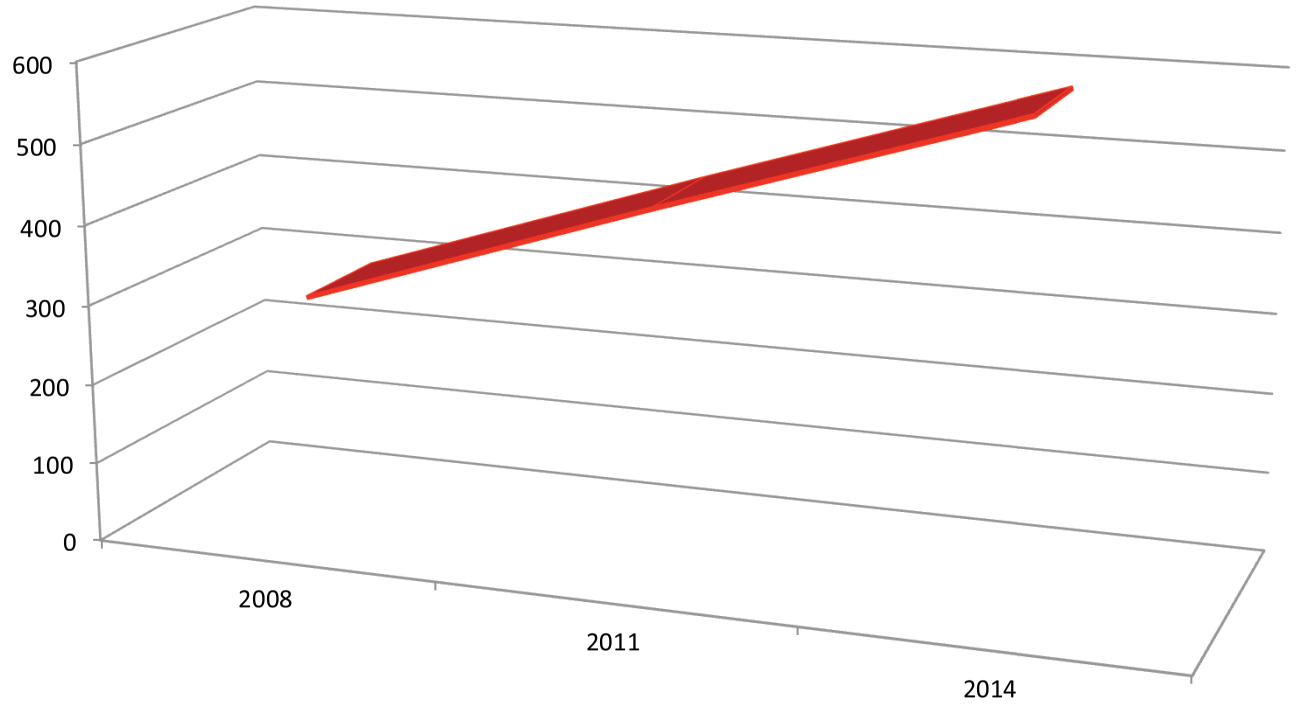
0 mSv/a < D < 1 mSv/a	non classified worker
1 mSv/a < D < 6 mSv/a	classified worker
6 mSv/a < D < 20 mSv/a	higher exposed worker
max. annual dose:	**20 mSv**
live time dose:	**400 mSv**


supervisory authority GAA
> 6 mSv/ a
> 1 mSv/a
< 6 mSv/a
< 1 mSv/a
dose monitoring
annual information
med. surveillance
> 30 a
> 5 a
> 30 a

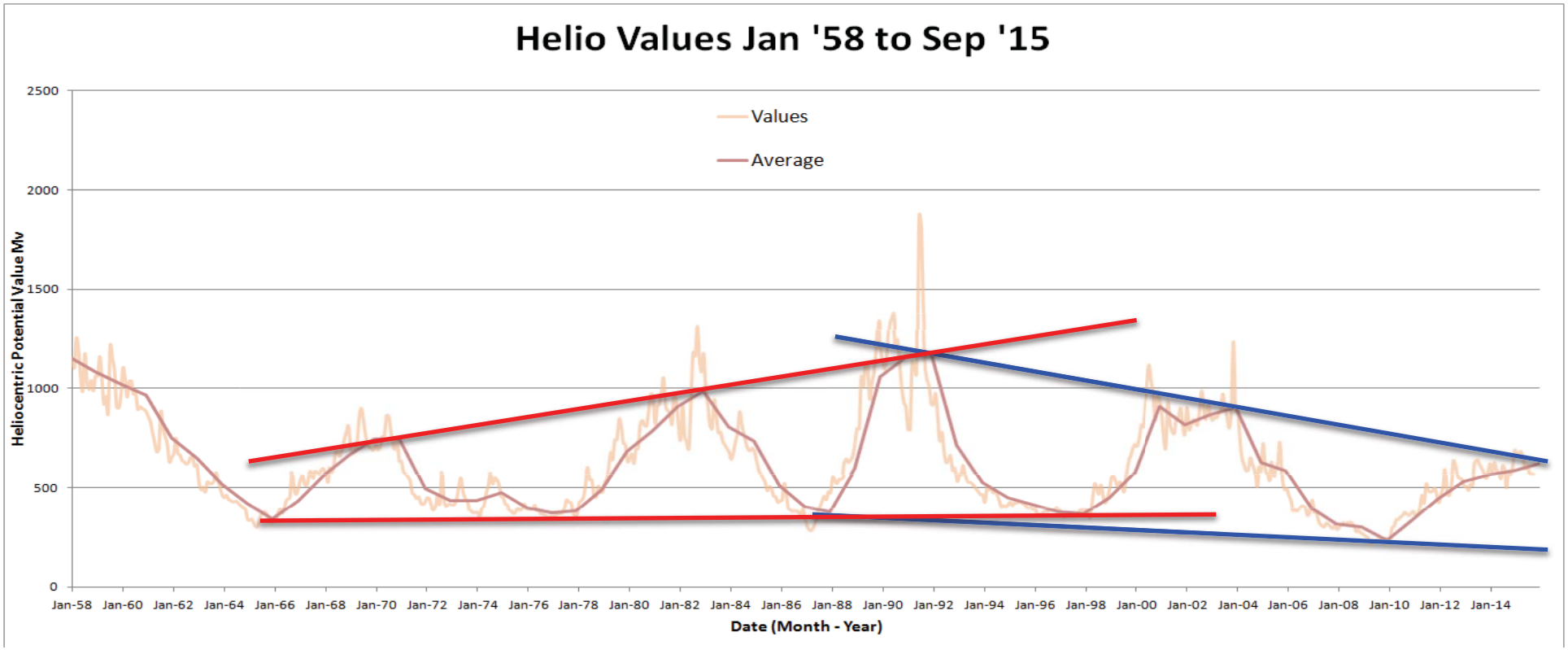
Average Exposure



Average Solar Activity



Historic Solar Activity



Natural Radiation Exposure

- **Natural Sources** **~2,1 mSv/a**
  - Cosmic ~0,3 mSv/a
  - Terristic ~0,4 mSv/a
  - Ingestion ~0,3 mSv/a
  - Radon ~1,1 mSv/a
- **Civilisation Sources** **~2,0 mSv/a**
  - Medical ~1,9 mSv/a
  - NPP ≤0,01 mSv/a
  - Chernobyl ≤0,01 mSv/a
  - Others ≤0,02 mSv/a

Average exposure Germany ~4,1 mSv/a

Medical Diagnostic / Therapy

✧X-Ray (Thorax)	~0,1 mSv
✧Mammography	~0,4 mSv
✧CT Chest	6 – 8 mSv
✧CT abdominal	10 – 25 mSv

✧Radiotherapy (tissue)	20.000 – 80.000 mGy
✧Iodine Therapy (thyroid)	120.000 – 400.000 mGy

Letal Dose 50 (acute whole-body)	5.000 mSv
Letal Dose 100 (acute whole-body)	7.000 mSv

Radiation Intense Places

Trivandrum, India 10 – 40 mSv/a

Radiation Intense Places

Guarapari, Brasil 8 – 200 mSv/a

Radiation Risk (1)

- In general the mortality of Air Crews is comparable to the general population.
- Higer risk on skin and breast cancer may cause in reduced Melatonin sekretion due Circadian Rhythm Sleep Disorder (Jetlag)
- Lower risk on cardiovascular causes due mandatory medical surveillance (Healthy Worker Effect)
- No accumulation of typical radiation consequential damages

Source: Strahlenschutzpraxis, Heft 2/2014, Stand der epidemiologischen Forschung beim fliegenden Personal

Radiation Risk (2)

- UV radiation is the risk factor for malignant melanoma with the highest proportion of new cases in the general population and air crews.
- Flying staff occupationally got more often an opportunity than other people to reside in sunny places and to be UV exposed.
- Increased evidence of the importance of UV protection can make a practical contribution to prevention.

Source: Strahlenschutzpraxis, Heft 2/2014, Stand der epidemiologischen Forschung beim fliegenden Personal