

**SolarMetrics**  
SMART Aerospace

**Space Weather Effects on Human Health**



Bryn Jones<sup>1,2,3</sup>

1. SolarMetrics Limited  
2. Mullard Space Science Laboratory  
3. Virgin Atlantic Airways Limited

ESA Space Weather Workshop:  
Developing a European Space Weather Service Network  
(3-5 November 2003, ESTEC, Noordwijk, The Netherlands)

**SolarMetrics**  
SMART Aerospace

- Legislation
- Dose limits
- Research
- Medical Studies
- Conclusions

ESA Space Weather Workshop: Developing a European Space Weather Service Network  
(3-5 November 2003, ESTEC, Noordwijk, The Netherlands)

**SolarMetrics**  
SMART Aerospace

Aircrew are more likely to die from cancer due to increased radiation exposure during flight than they are of dying in an air accident.

ESA Space Weather Workshop: Developing a European Space Weather Service Network  
(3-5 November 2003, ESTEC, Noordwijk, The Netherlands)

**SolarMetrics**  
SMART Aerospace

**Legislation**

- EU Directive – Aircrew
  - Assessment of exposure
  - Adjust crew scheduling (if required)
  - Inform & Educate
  - Apply Article 10 to Pregnant crew

ESA Space Weather Workshop: Developing a European Space Weather Service Network  
(3-5 November 2003, ESTEC, Noordwijk, The Netherlands)

**SolarMetrics**  
SMART Aerospace

## Dose Limits

- ICRP Dose Limits
  - 100mSv per 5 year period
  - Max 50mSv in any 1 year
  - 20mSv per year
  - 1mSv per year (Pregnant crew)
  - 6mSv (Action Level)

**ALARA**  
As Low As Reasonably Achievable within social and economic constraints

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

**SolarMetrics**  
SMART Aerospace

## Projected global dose rate at 35,000 ft

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

**SolarMetrics**  
SMART Aerospace

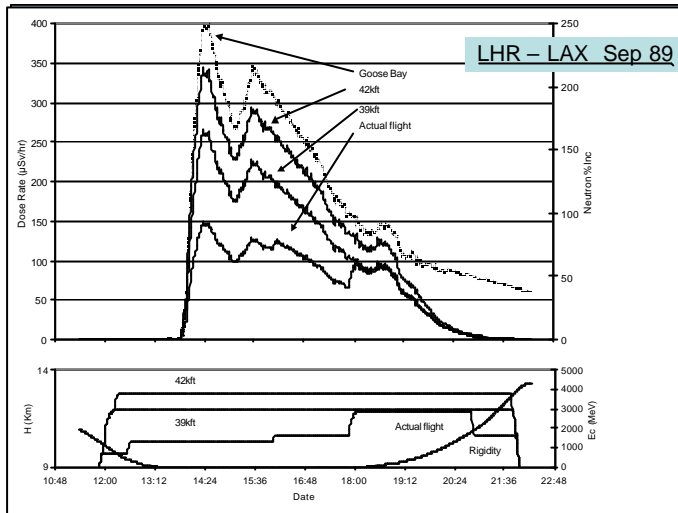
ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

**SolarMetrics**  
SMART Aerospace

## Dose Limits

- Doses from Galactic Cosmic Radiation
  - Background sea level ~2.2mSv/yr (UK)
  - **Average** Annual Occupational Exposure (UK)
    - Short Haul ~ 2mSv/yr
    - Long Haul ~ 4mSv/yr
- Doses from Solar Flares (Dyer et al)
  - September 1989 2mSv
  - February 1956 10mSv

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands



**SolarMetrics**  
SMART Aerospace

**Research**

- MSSL-Virgin In-flight Monitoring
- EU funded - EURADOS, DOSMAX
- ESA SOARS SDA
  - UK CRAG SPE sub-group
- Other Projects Worldwide

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

**SolarMetrics**  
SMART Aerospace

**Medical Studies**

- European ESCAPE mortality study
- US Cabin Crew Breast study
- Swedish
- Icelandic

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

**SolarMetrics**  
SMART Aerospace

**Conclusions**

- Potential Health Risks
- So far, inconclusive medical data
- Poor SEP & other SW event doses
- Inaccurate Flight Data is used
- Permanent installation of Monitors
- Real-time Monitoring
- Discriminatory Legislation

ESA Space Weather Workshop: Developing a European Space Weather Service Network | 3-5 November 2003, ESTEC, Noordwijk, The Netherlands

# QUESTIONS