



Radiation belt modeling: today, tomorrow, next decade

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Radiation belt modeling

Outline of presentation

- Needs
- Achievements
- Problems
- Future

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Radiation belt modeling - Needs

On the long run (for operational use):
need of integrated
environment and effects models
that can be used for
typical engineering applications

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Radiation belt modeling - Needs

Such programme suites already exist:

AF-GEOSpace
CREME96
SPENVIS

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Radiation belt modeling - Needs

Need for:

- Long-term environmental models
- “Crisis management” models

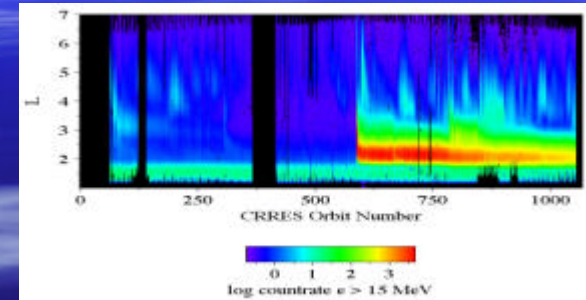
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Radiation belt modeling - Needs

“Crisis management” (flux dynamics)



(CRRES, Bernie Blake)

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Radiation belt modeling - Achievements

Currently, the NASA AE-8 and AP-8 models are used to estimate mission-long parameters

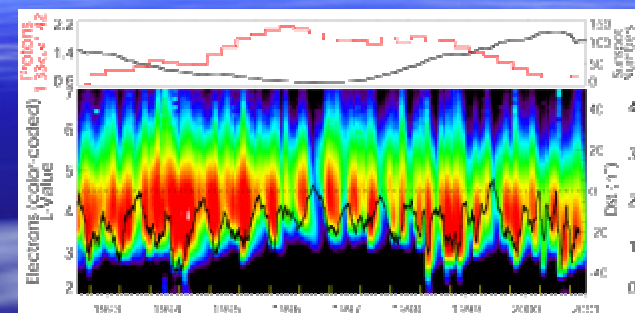
Worst-case models are being created on a case by case basis.

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Radiation belt modeling - Achievements



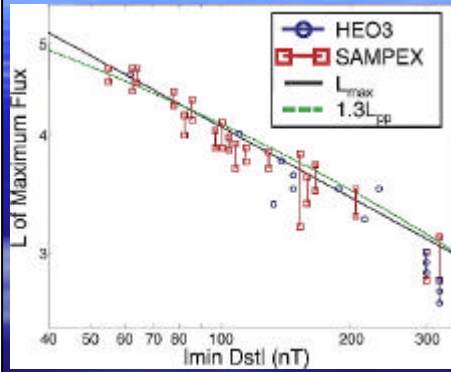
Li et al. 2001

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Radiation belt modeling - Achievements



Location of the peak electron flux as a function of minimum Dst moves to lower L

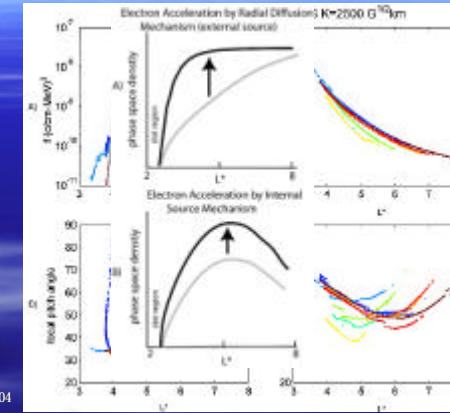
O'Brien et al., JGR2003

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Radiation belt modeling - Achievements

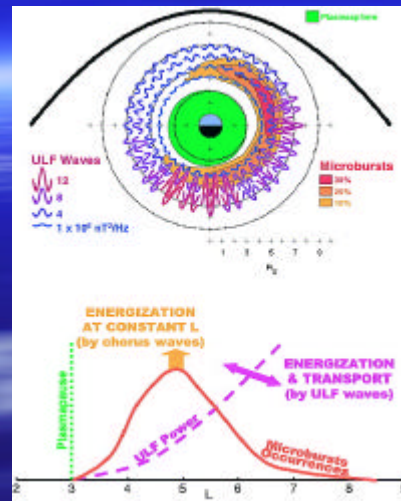


Green and Kivelson, 2004

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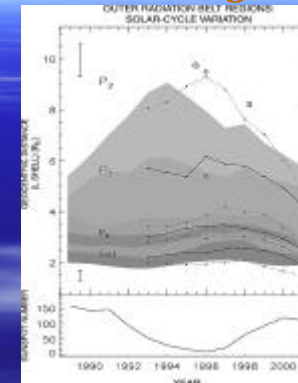
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Achievements



O'Brien et al., JGR2003

Radiation belt modeling - Achievements



Vassiliadis et al. 2003 (Akebono, SAMPEX, GPS 33)

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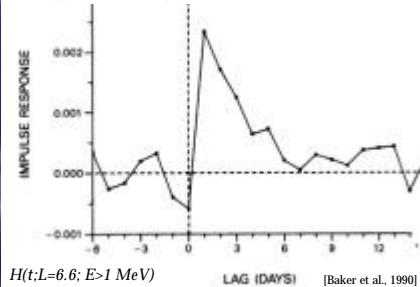
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Radiation belt modeling - Achievements

Finite-Impulse-Response Model:

$$j_e(\xi; L; E) = \int_0^{\tau} H(t; L; E) V_{sw}(t - \tau) dt$$

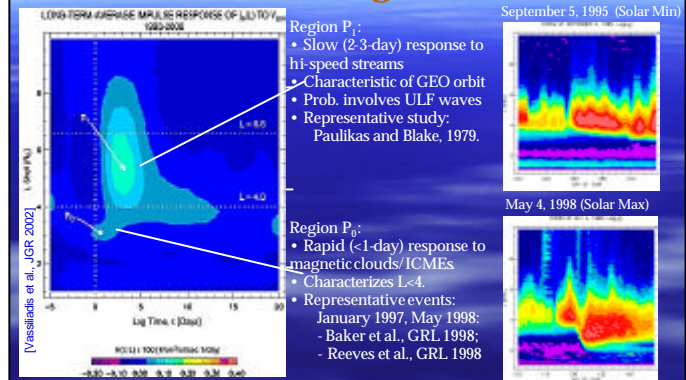


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Radiation belt modeling - Achievements



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Radiation belt modeling - Problems

Known problems:

- AE8 models overestimate electron doses: shown by measurements in HEO, MEO orbits and by CRRES (Gussenhoven et al., 1992). Also by POLE model for GEO.



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Radiation belt modeling - Problems

Known problems:

- AE8 models do not specify lower energy environment. Low energy electron (< 100 keV) flux intensity much higher than extrapolation of AE spectra.



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Radiation belt modeling - Problems

Known problems:

- Magnetic field models are not accurate for disturbed times
- Radial diffusion models: What is the source population? / Can r.d. transport particles efficiently enough to low L?



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Radiation belt modeling – Future

Use knowledge to optimize models and
to relate the flux variability
to changes in IM and conditions in MS



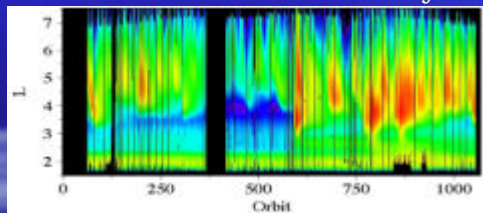
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Radiation belt modeling – Future

Fully understand and specify
radiation belt variability



(CRRES, Bernie Blake)



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Radiation belt modeling – Future

- Develop accurate energetic electron model!
- Explain rapid acceleration of electrons to relativistic energies
- Identify loss mechanisms
- Understand RC dynamics



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Radiation belt modeling – Future

RB models need better satellite measurements:

- Particle measurements with full pitch-angle information
- Comprehensive magnetic field measurements
- Wave measurements
- Particle measurements in inner zone



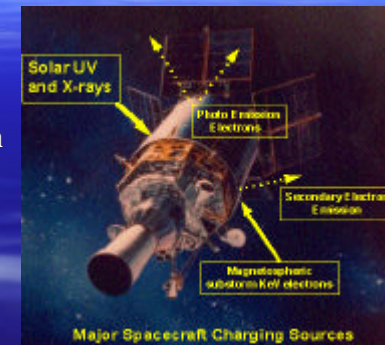
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Radiation belt modeling – Future

Critical need to extend both electron and ion models down to 1 keV



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