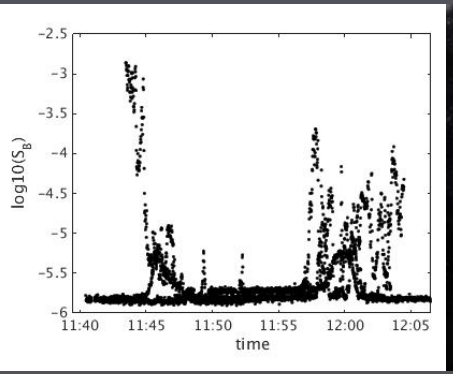
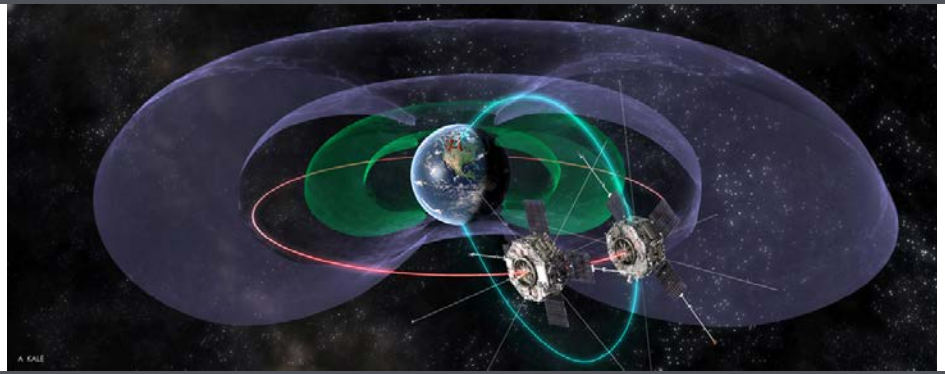
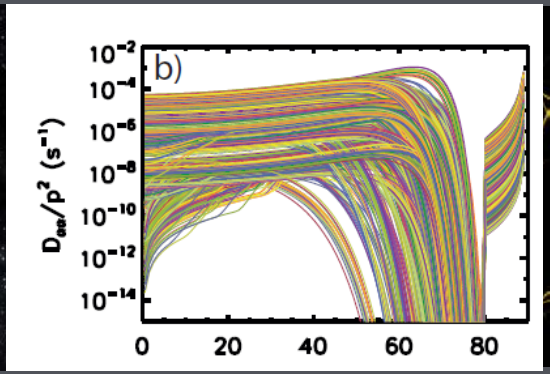
VARIABILITY OF QUASILINEAR DIFFUSION COEFFICIENTS FOR PLASMASPHERIC HISS







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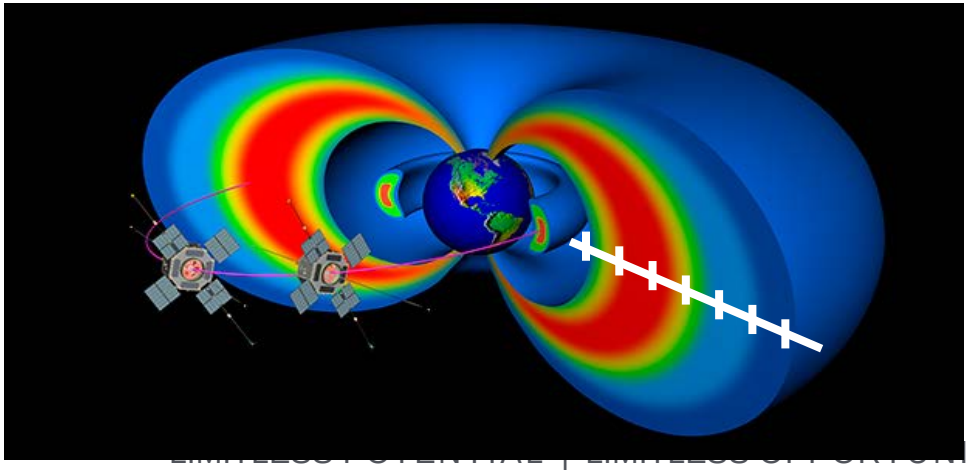
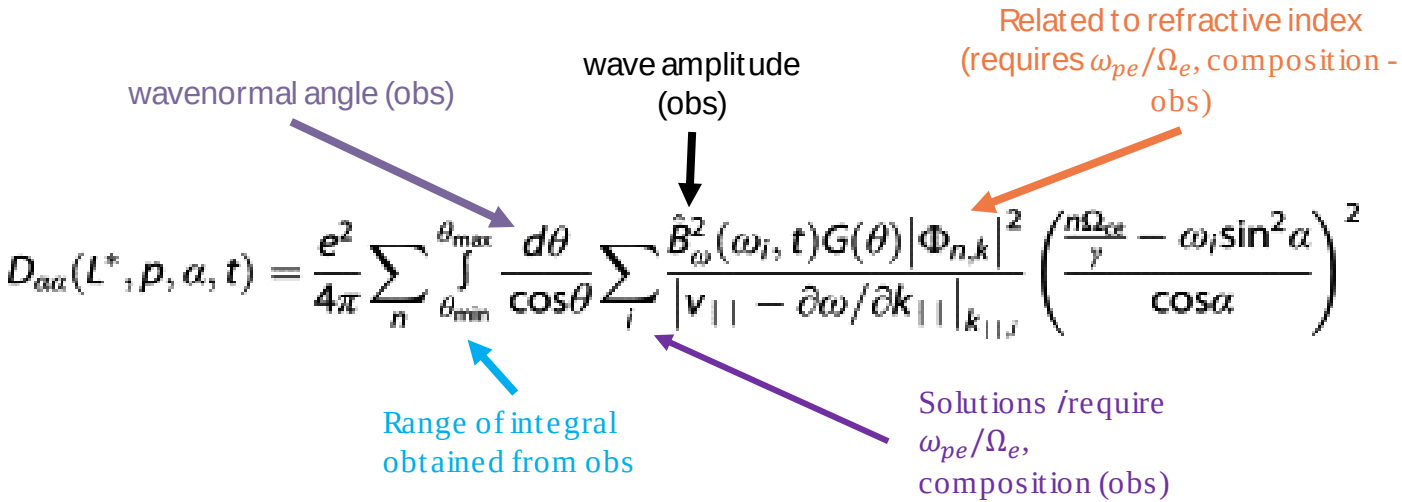
RADIATION BELT MODELS

- Behaviour of high-energy Radiation Belt electrons controlled in part by wave-particle interactions
- In Radiation Belt Diffusion Models, all physics is “sub grid”
- Wave-particle interactions are captured in diffusion coefficients



MODELLING WAVE-PARTICLE INTERACTIONS



- Parameterized models of diffusion coefficients required
  - Drift and bounce averaging required
  - Van Allen Probes will not last forever.

appropriate reference for Daa

VARIABILITY OF WAVE-PARTICLE INTERACTIONS

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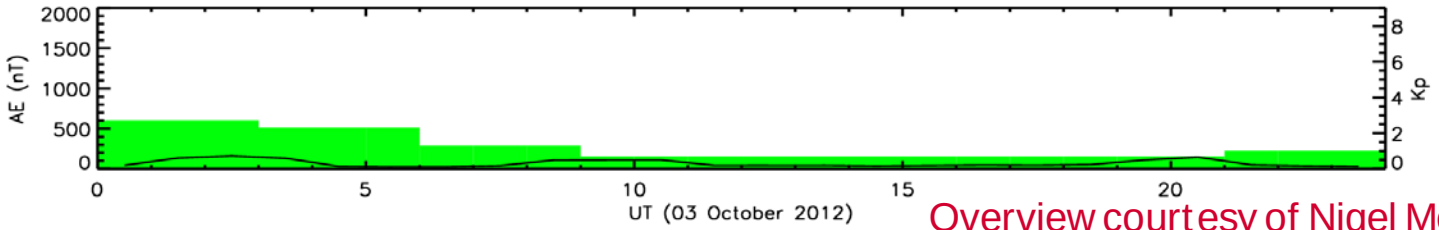
Van Allen Probes A, 3rd October 2012

- Large variability of wave properties and ambient plasma properties observed throughout magnetosphere
- Causes of variability

- Data visuals to aid discussion of variability of wave amplitudes



Overview courtesy of Nigel Meredith, BAS

HOW DIFFUSION COEFFICIENTS CAN BE APPLIED IN MODELS

Deterministic methods:

- Parameterize diffusion by e.g. geomagnetic index to capture temporal variation
- One single value of $D_{XY}(L,E,\alpha)$ for each value of parameter
- Run model once for a single event

Stochastic methods:

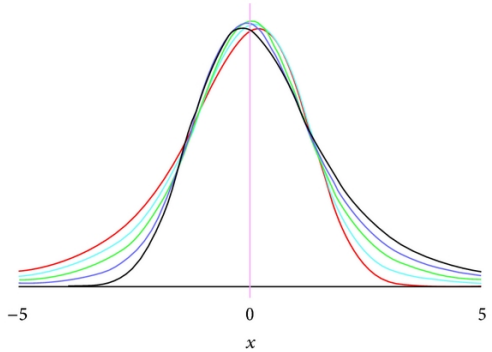
- Construct probabilistic models of diffusion coefficients that include variability
- Run ensembles of diffusion models to obtain realistic range of behaviour*

*Berner et al., BAMS, 2017

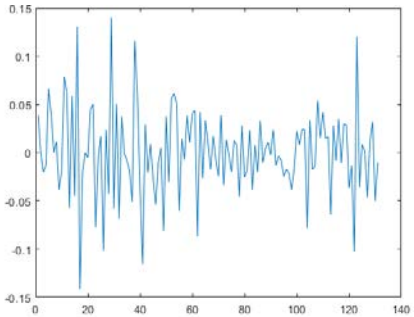
IMPORTANT VARIABILITY DESCRIPTIONS:

SEE THOMPSON ET AL POSTER THIS AFTERNOON!

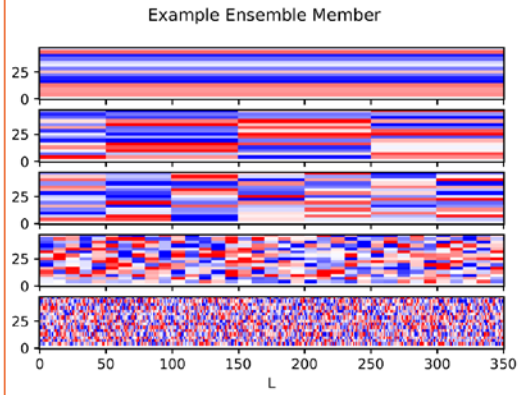
- Underlying distribution



- Temporal scales



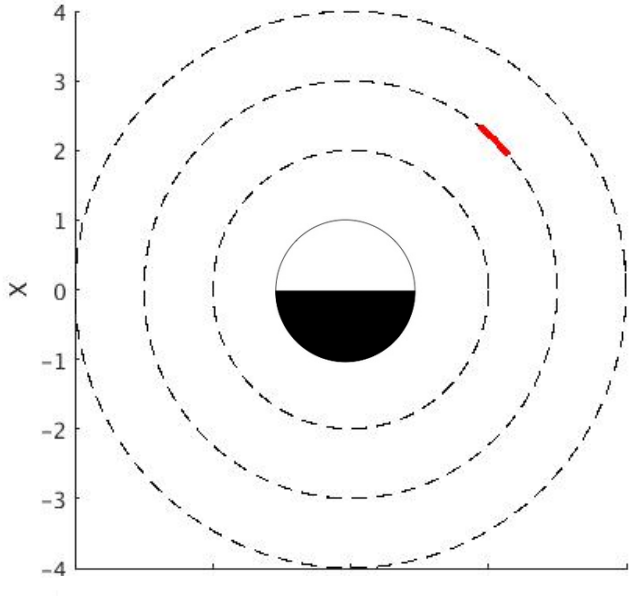
- Spatial scales



Thompson et al, manuscript in preparation

PITCH-ANGLE DIFFUSION FROM PLASMASPHERIC HISS

- Plasmaspheric hiss is near-ubiquitous in high density inner magnetosphere
- Diffusion mainly in pitch-angle
  - Wave characteristics
  - Number density
  - Composition
  - Magnetic field strength
- Van Allen probe A from 2012-2016*
- 9<MLT<10, latitude<5deg, 2.95<L*<3.05*



VARIABILITY OF PLASMA, WAVES AND DIFFUSION COEFFICIENT

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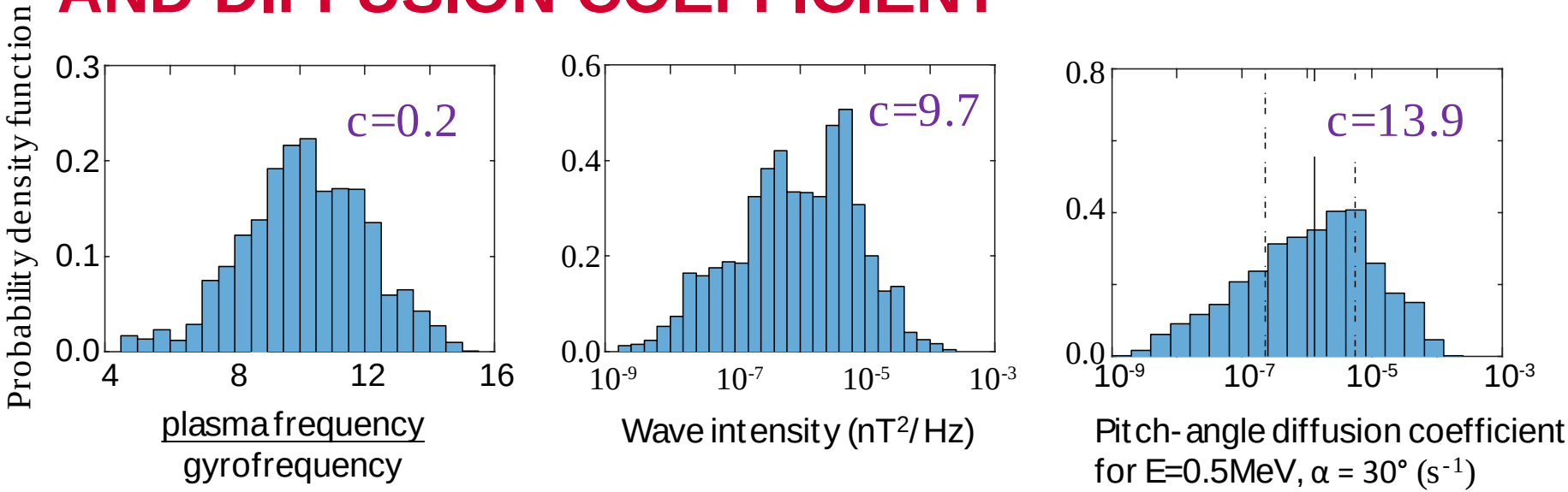

- Underlying distribution of $D_{\alpha\alpha}$ is log-skew-normal, with large variance
- Coefficient of variance (c, roughly standard deviation/mean or equivalent)
- $c < 1 \rightarrow$ low variance; $c > 1 \rightarrow$ high variance

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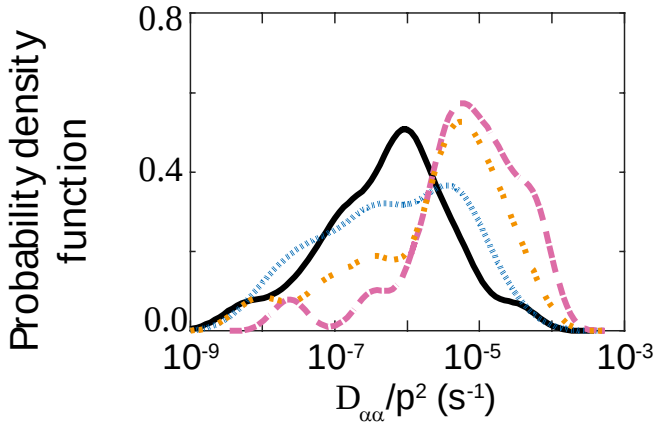
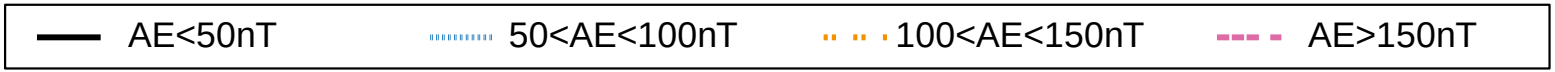
DIFFUSION COEFFICIENTS SPLIT BY GEOMAGNETIC ACTIVITY





- Would parameterization ever be perfect?
- How much natural variability exists?

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CONCLUSIONS

- Variability important for descriptions of wave-particle interactions in magnetosphere
  - See Thompson poster this afternoon
- Diffusion coefficients should be calculated from contemporaneous measurements and we need to know:
  - underlying distribution + variance
  - spatial coherence scales
  - temporal coherence scales
- How “good” can our parameterizations be? Variability may be inevitable.
  - Bentley next for parameterizations of ULF waves

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