Flux Rope Eruptions Over a Solar Cycle

Anthony Yeates

with thanks to

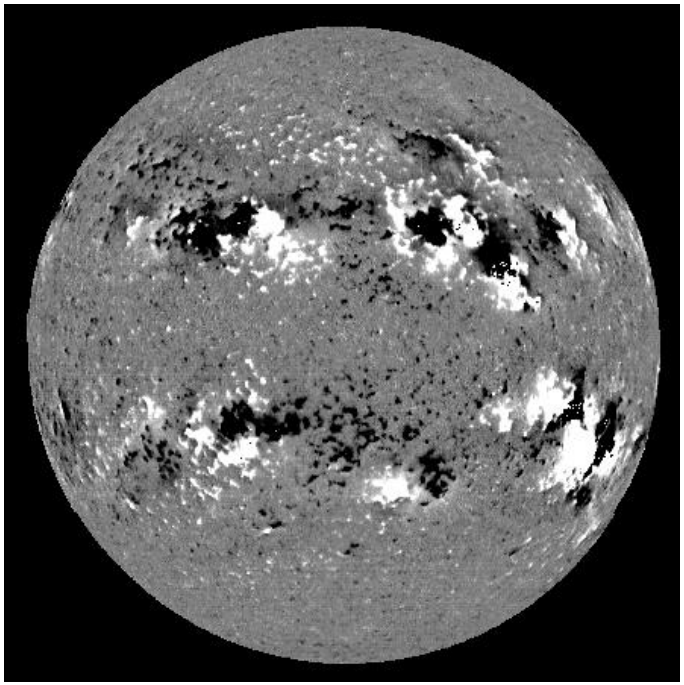
D.H. Mackay (St Andrews)
A.A. van Ballegooijen (Harvard-Smithsonian CfA)
J.A. Constable (now Kentucky)

13th January 2012

RAS Discussion Meeting: Solar Eruption Models

Durham University

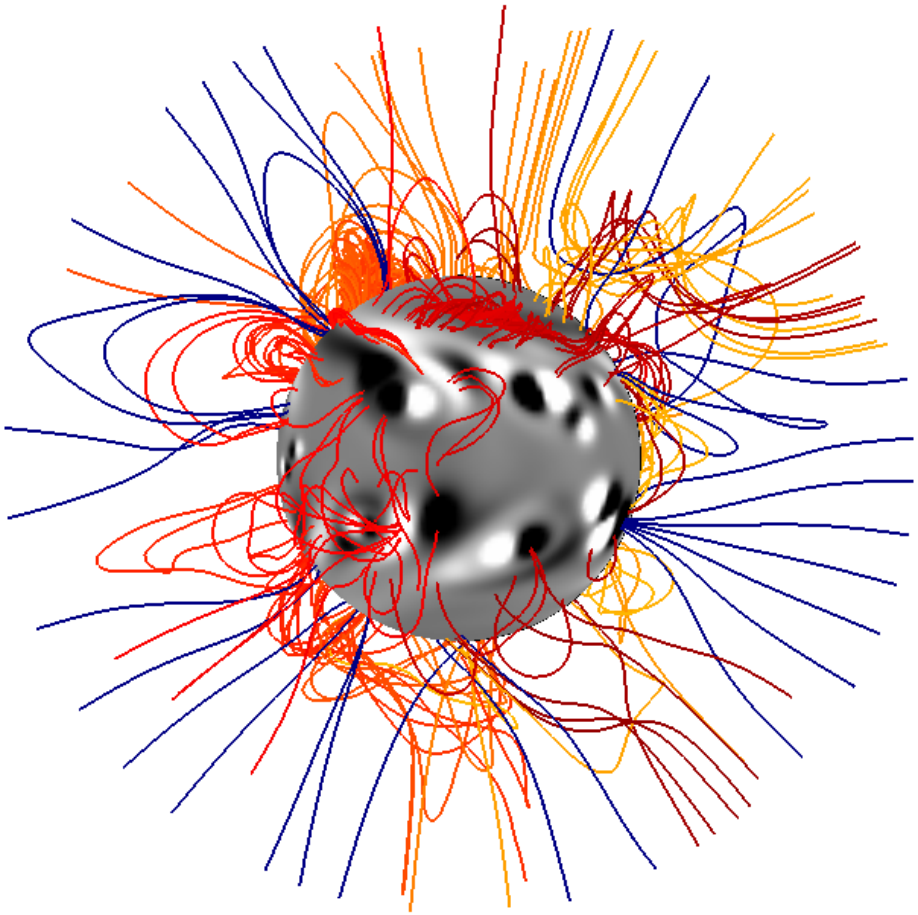
Mean-field coronal magnetic model

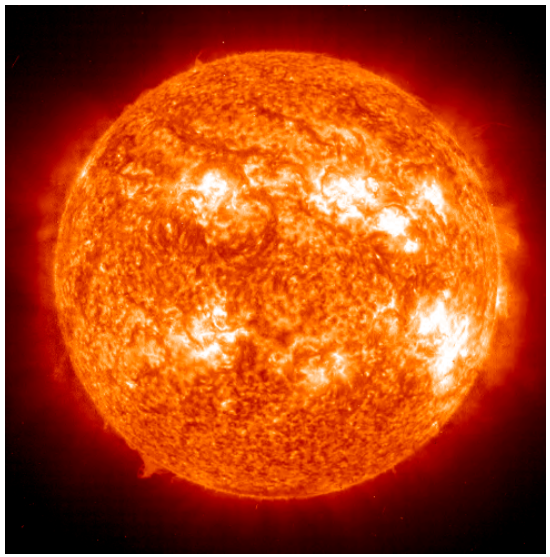


NSO Kitt Peak, 22-May-2000.

- Surface flux transport + magneto-frictional relaxation
- Influence of small-scale field:
  1. supergranular diffusion (surface)
  2. turbulent diffusion (coronal volume)

Mean-field coronal magnetic model





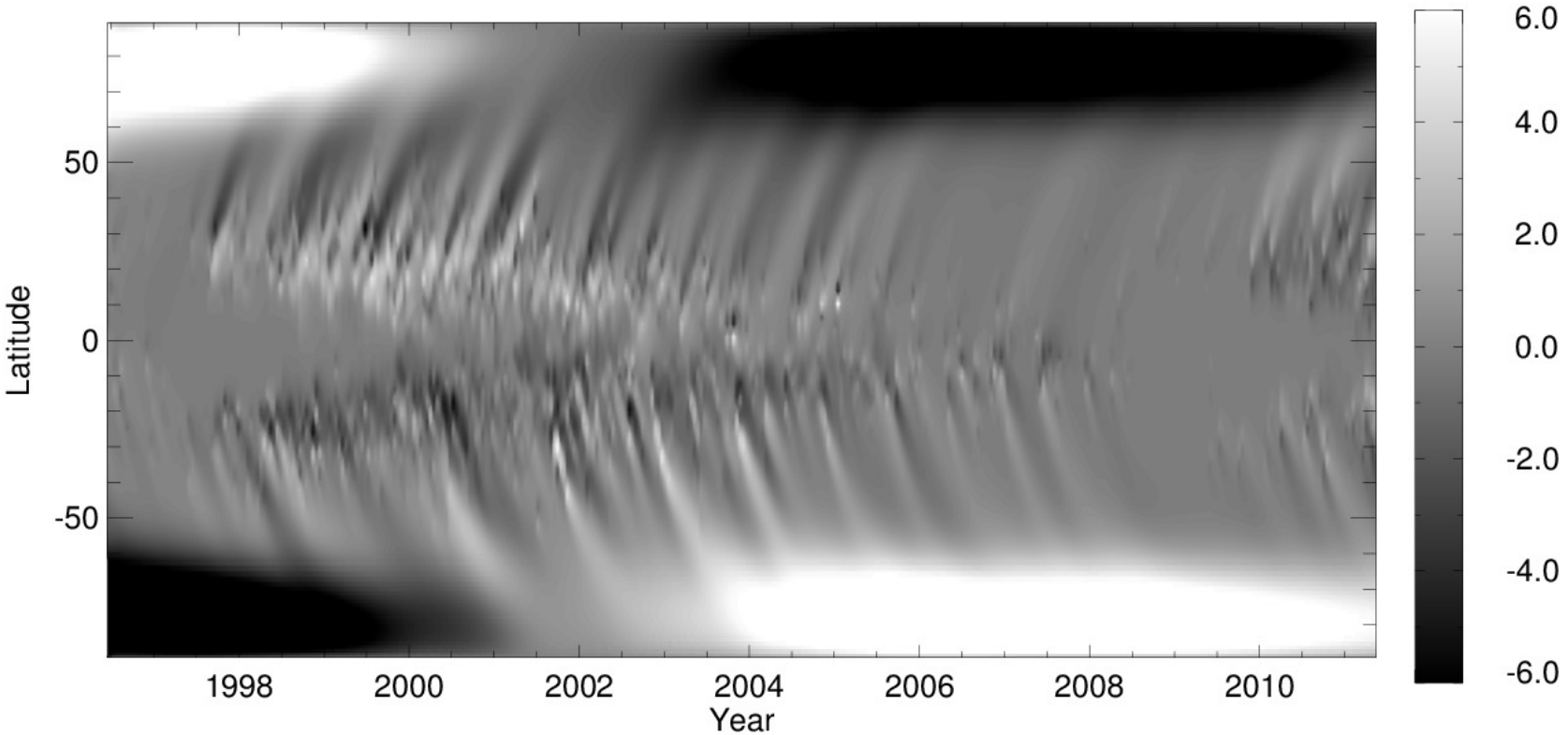
SOHO EIT 304Å.

mag. helicity → polarity inversion lines → flux ropes → loss of eqm.

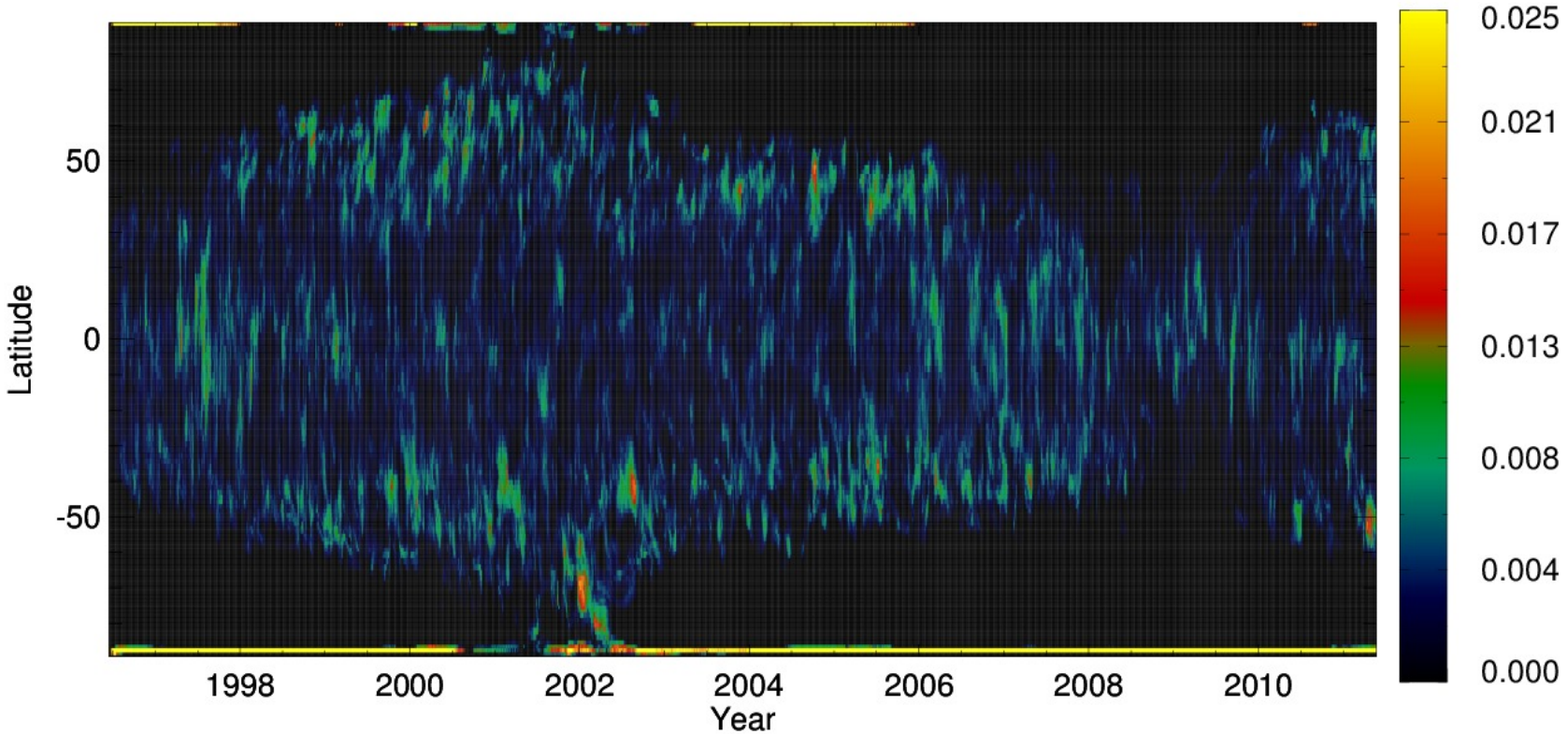
van Ballegooijen & Martens (1989), Mackay & van Ballegooijen (2001,2005,2006), Yeates & Mackay (2009)

Simulation of Cycle 23

- 1996 to 2011
- 1838 magnetic bipoles from NSO/Kitt Peak magnetograms

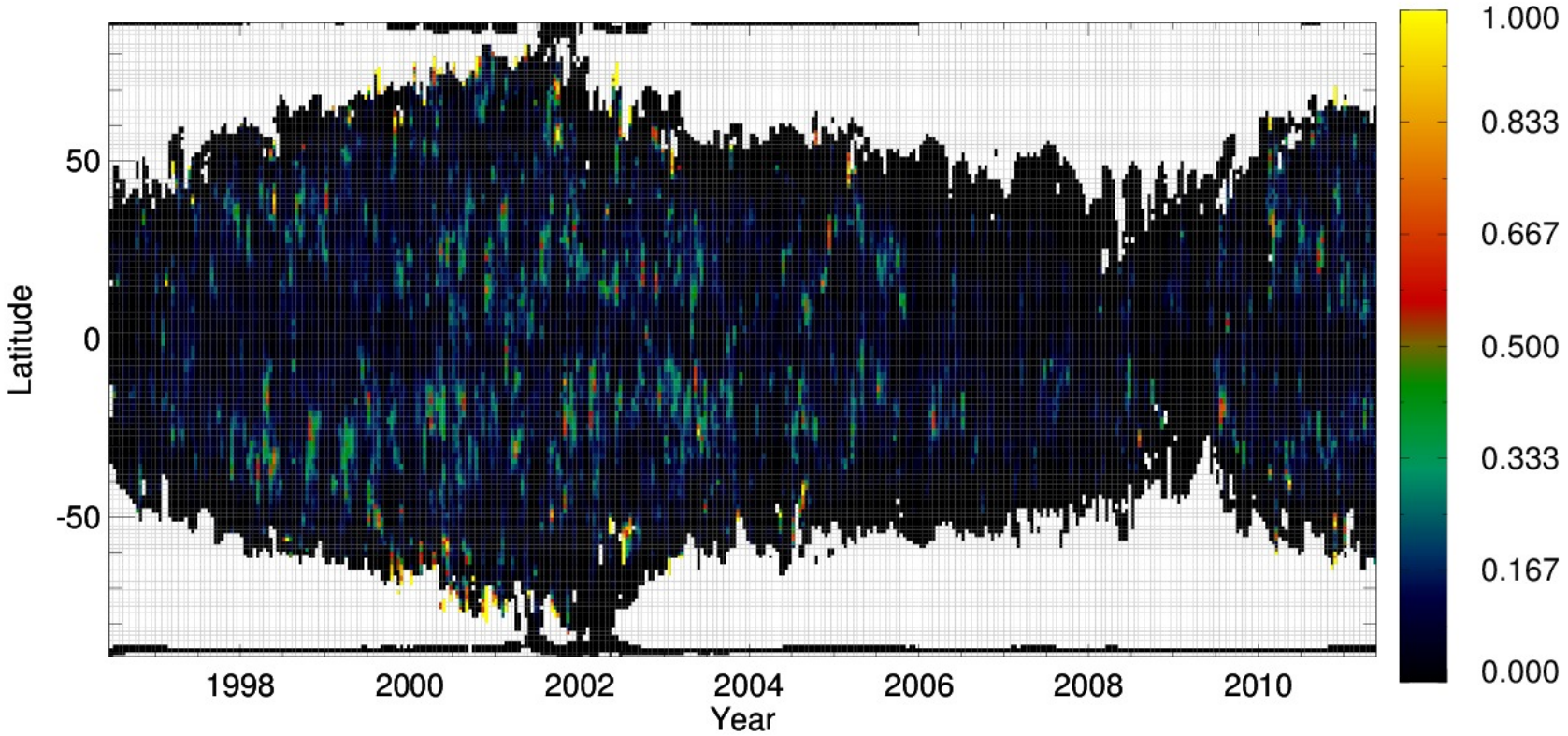


Flux rope filling factor



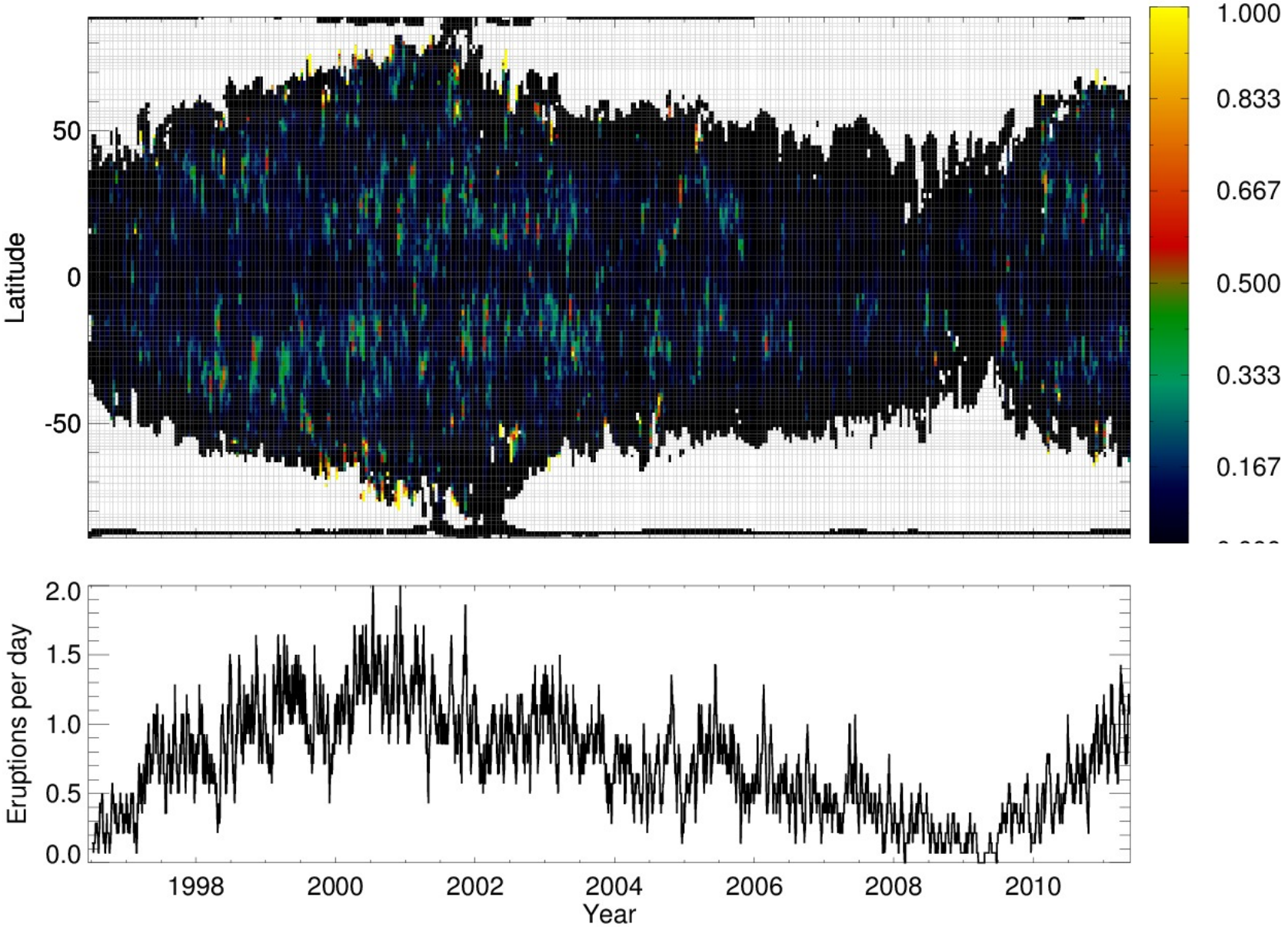
1. latitude range varies over cycle
2. more flux ropes outside active regions

Eruption fraction



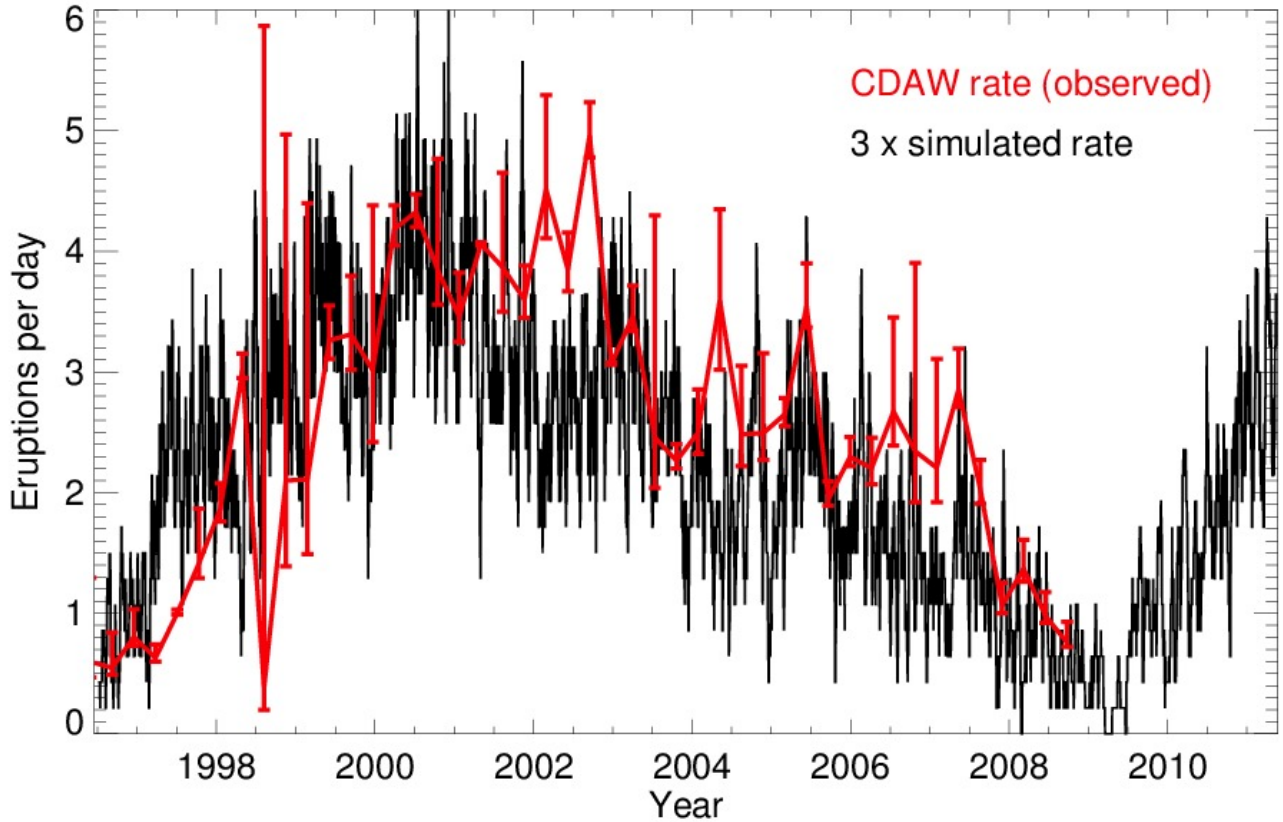
3. greater fraction of flux ropes erupt at active latitudes

Eruption rate



Eruption rate

4. eruption rate varies over cycle, peaks at 1.5 per day
5. accounts for $\approx$ third of observed CMEs



SOHO/LASCO data

Publications

- Yeates & Mackay, *ApJ* **699**, 1024 (2009).
  Parameter study, 6-month period; automated rope/eruption detection.
- Yeates *et al.*, *ApJ* **709**, 1238 (2010).
  Detailed comparison with EIT observations of CME sources.
- Yeates, Constable & Martens, *Sol Phys* **263**, 121 (2010).
  Preliminary version of current work using 6-month "snapshots".

`http://www.maths.dur.ac.uk/~bmjg46/`