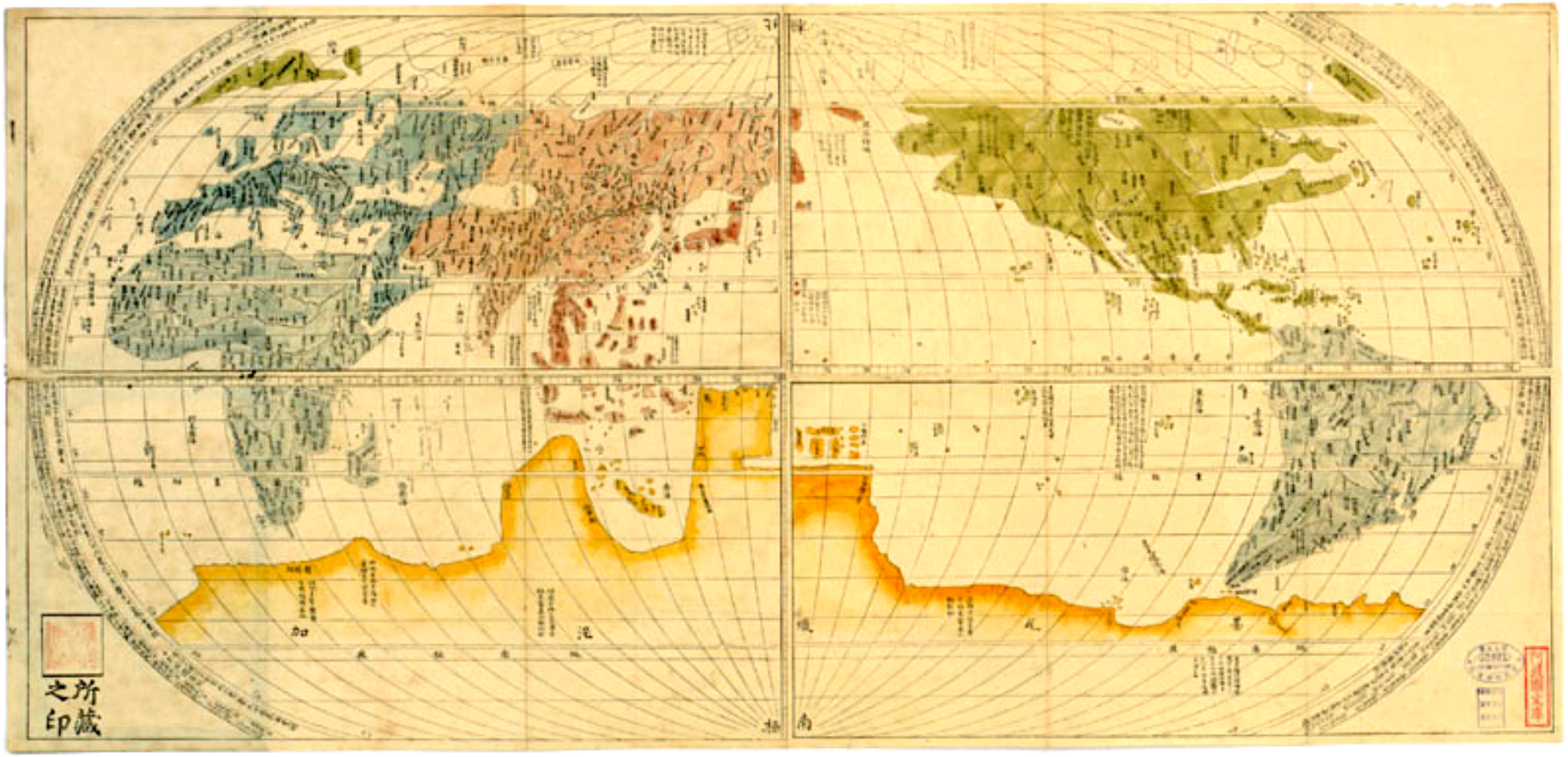
Solar Pole Research at NSO

J. Harvey & NSO Staff

Terra Incognita



Justification

- Strong influence on heliosphere
- Nearly permanent coronal hole
- Large scale flows are different
  - Small rotational effects
  - Convergence of meridional flow
- Help diagnose solar cycle dynamo

What to Observe?

- Motions
  - Rotation
  - Meridional flow
  - Convective flows
- Magnetic field
  - Long-term flux budget
  - Properties of network and emerging flux features
- Limb darkening

Observational Challenges

- Severe foreshortening/complete obscuration
- Nearly horizontal ray paths through features
- Variation of line formation height
- Need years of regular observations
- Require high cadence for some studies
- Global helioseismology is poor near poles

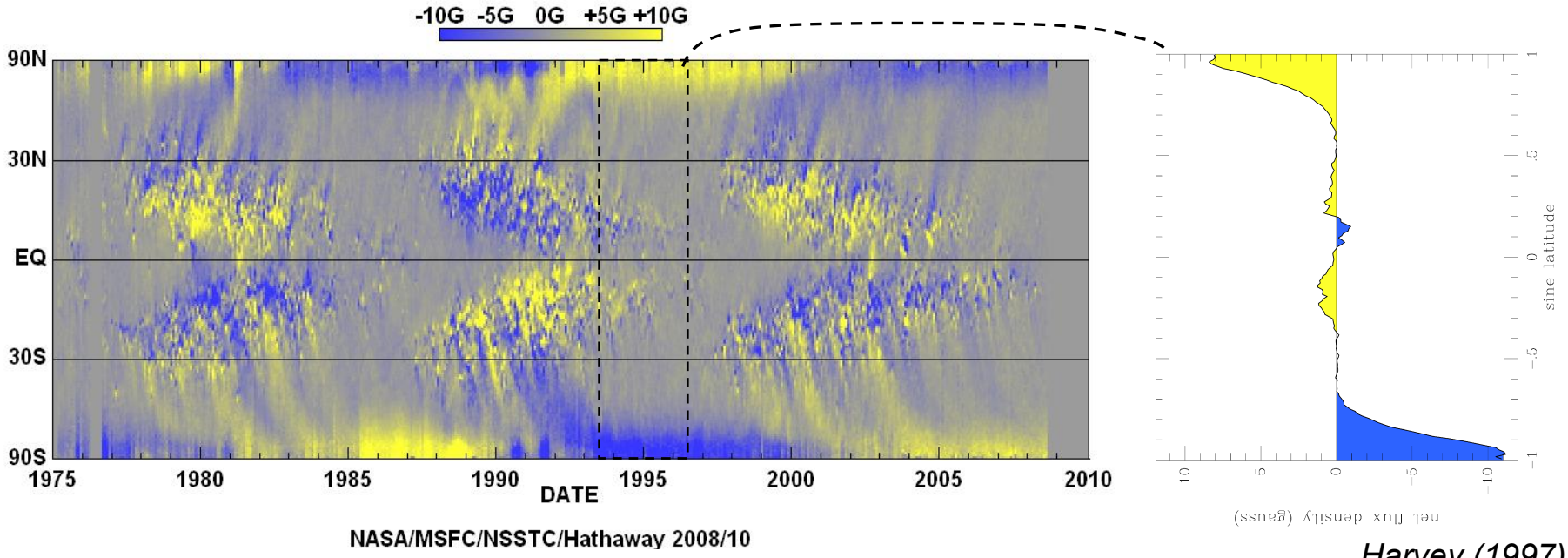
➢ *Hard to get useful, definitive results*

Polar Work at NSO

- Magnetic flux budget
- Polar coronal hole evolution
- Tracer rotation
- Distribution of ephemeral regions
- Latitude distribution of flux
- Intranetwork B_{horiz}
- Chromospheric field
- Comparison with coronal jets and plumes
- Vector field observations
- GONG helioseismology
- Limb darkening at various wavelengths

Sampling of Results
(as time permits)

Large Scale Polar Flux

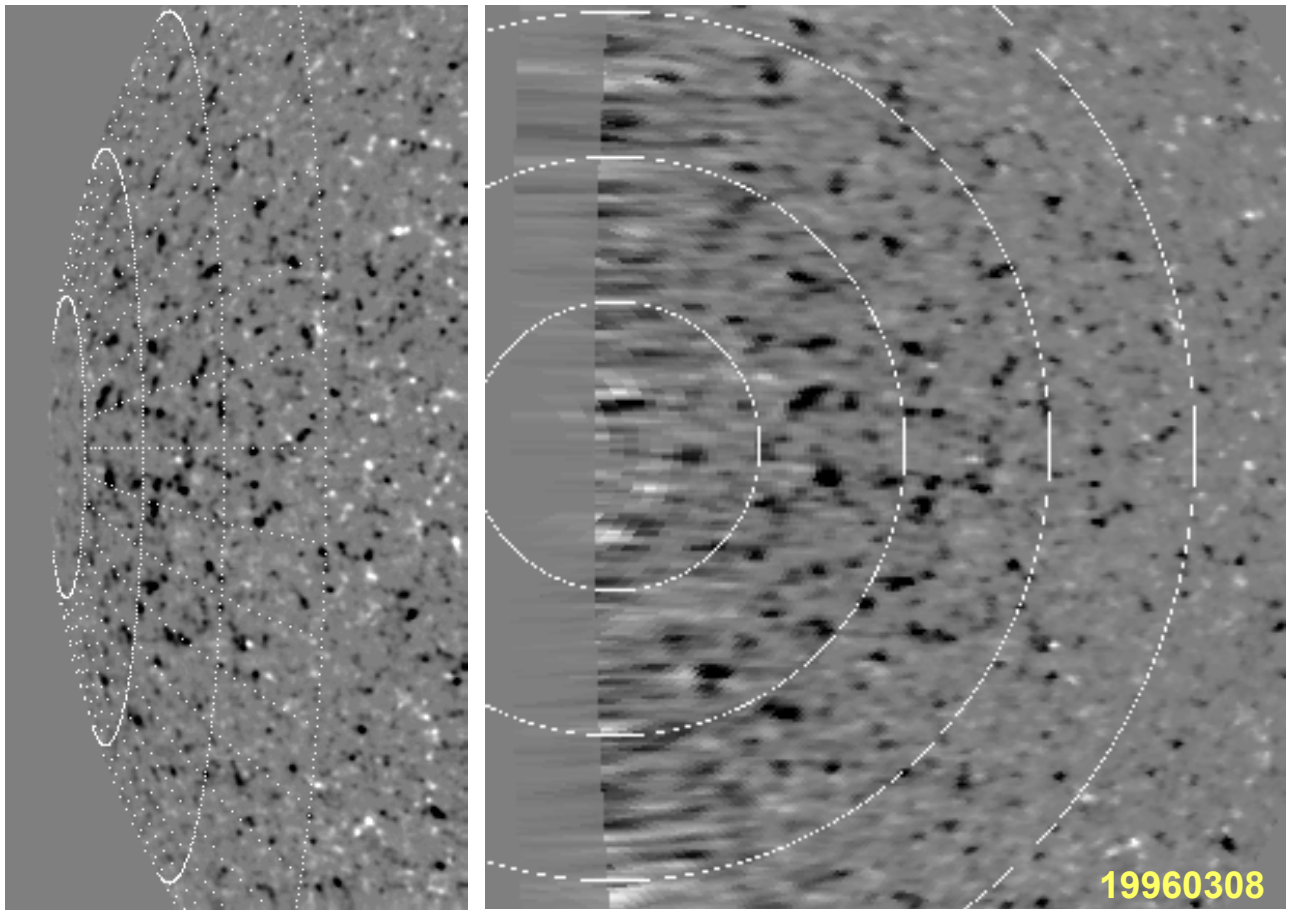


Harvey (1997)

- Photosphere
- LOS corrected to flux
- CR averages

- Flux streams to poles
- ~Cos^{10} θ; asymmetric
- Cycle 23 ≈ ⅔ ∗Cycle 22

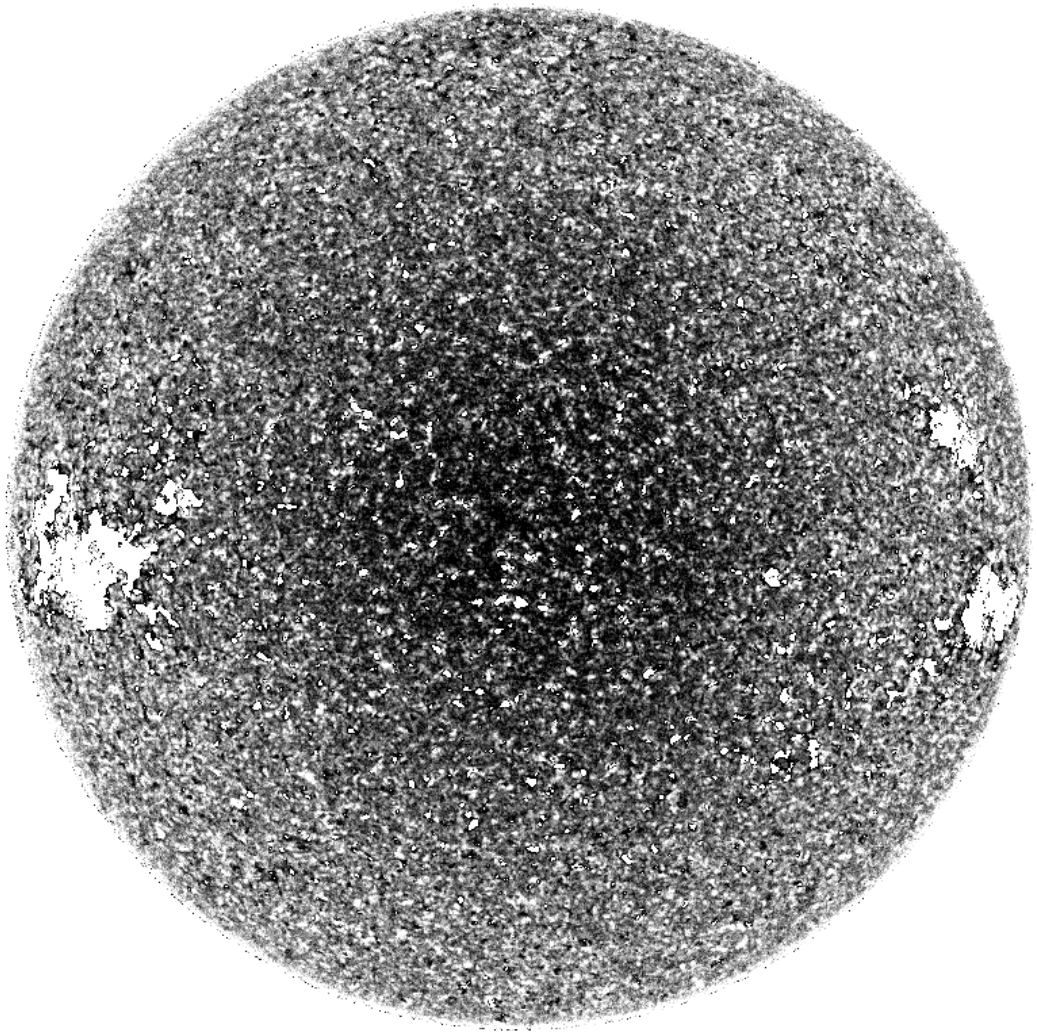
Flux Feature Latitude Distribution



Harvey (1997)

- Photosphere
- LOS field
- cos(ρ) division
- Polar projection
- Larger elements concentrated ~70º
- Nearly unipolar
- Only 1 sample
- Uncertain limb effects
- Need more studies

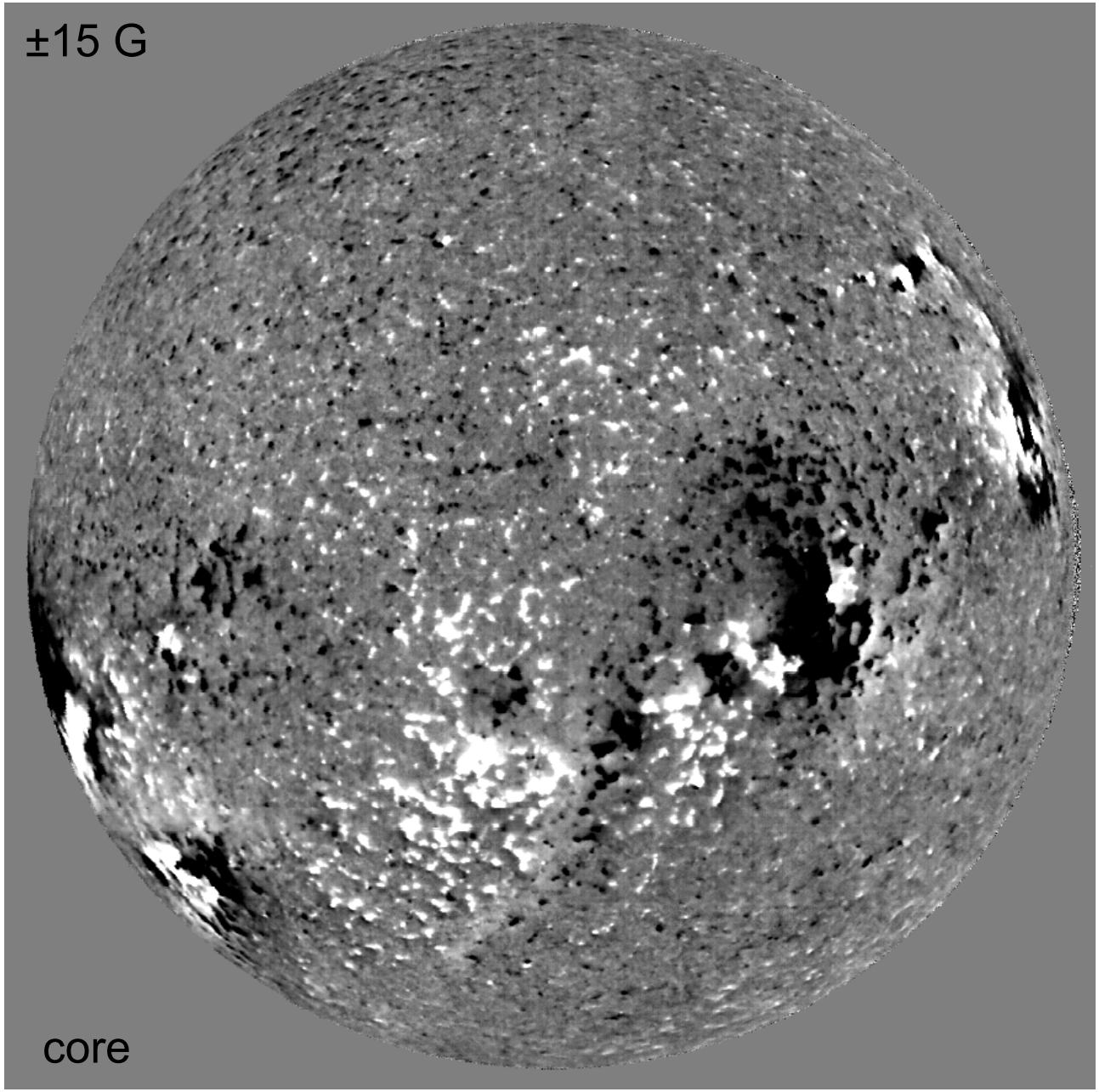
Uniform Intranetwork B_{horiz}



- 7 h of 10 m LOS
- σ of average
- No latitude variation
- Random polarities
- Only 1 study
- Low resolution
- Expected if local?
- Need more studies

Harvey et al. (2007)

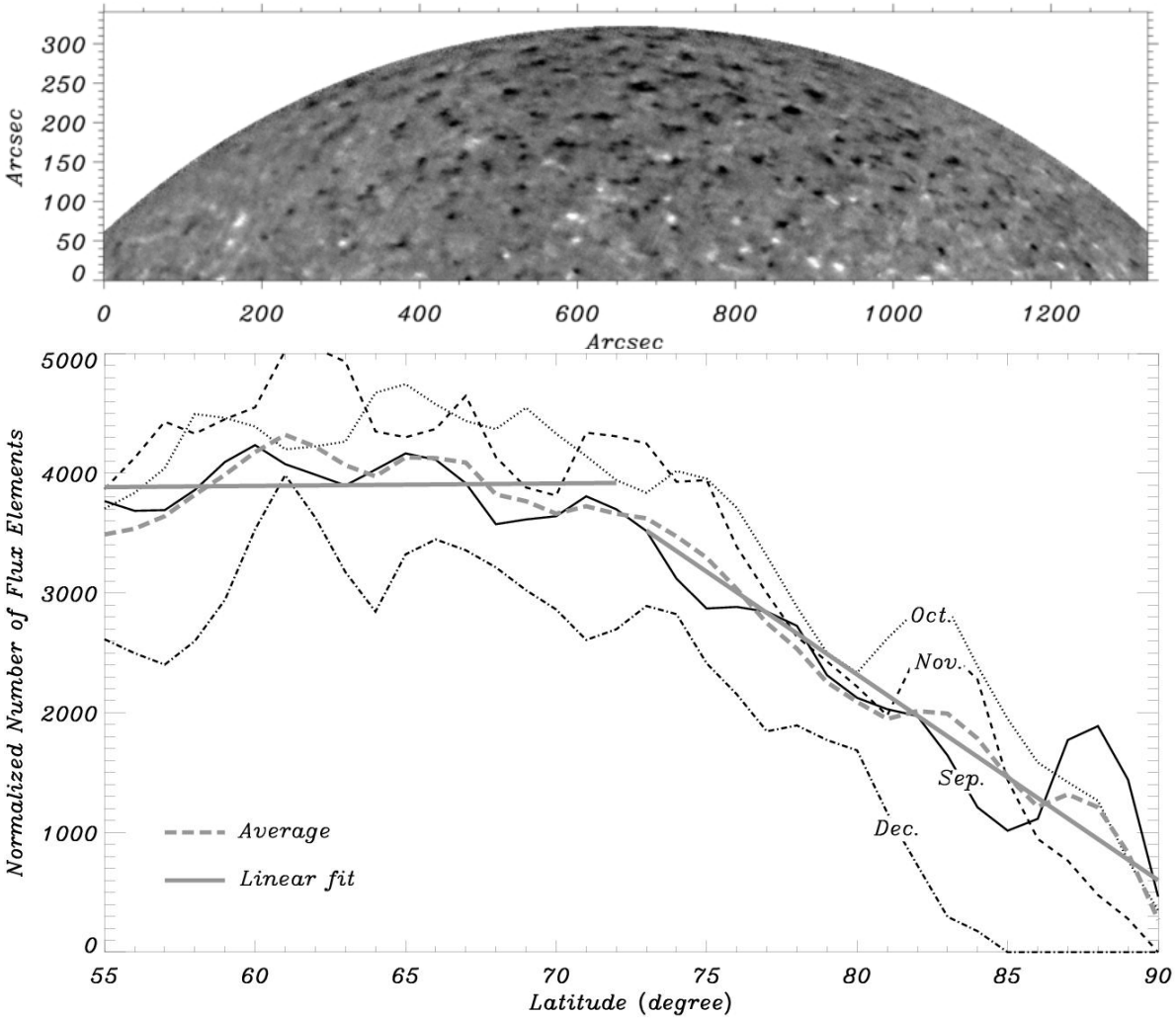
Polar Field in Chromosphere



- CaII λ8542 Å
- Wing ~250 km
- Core ~1100 km
- Strong canopy
- Less seething B_{hor}
- Better S/N
- Line profile varies
- Little studied yet

NSO/SOLIS 20041006

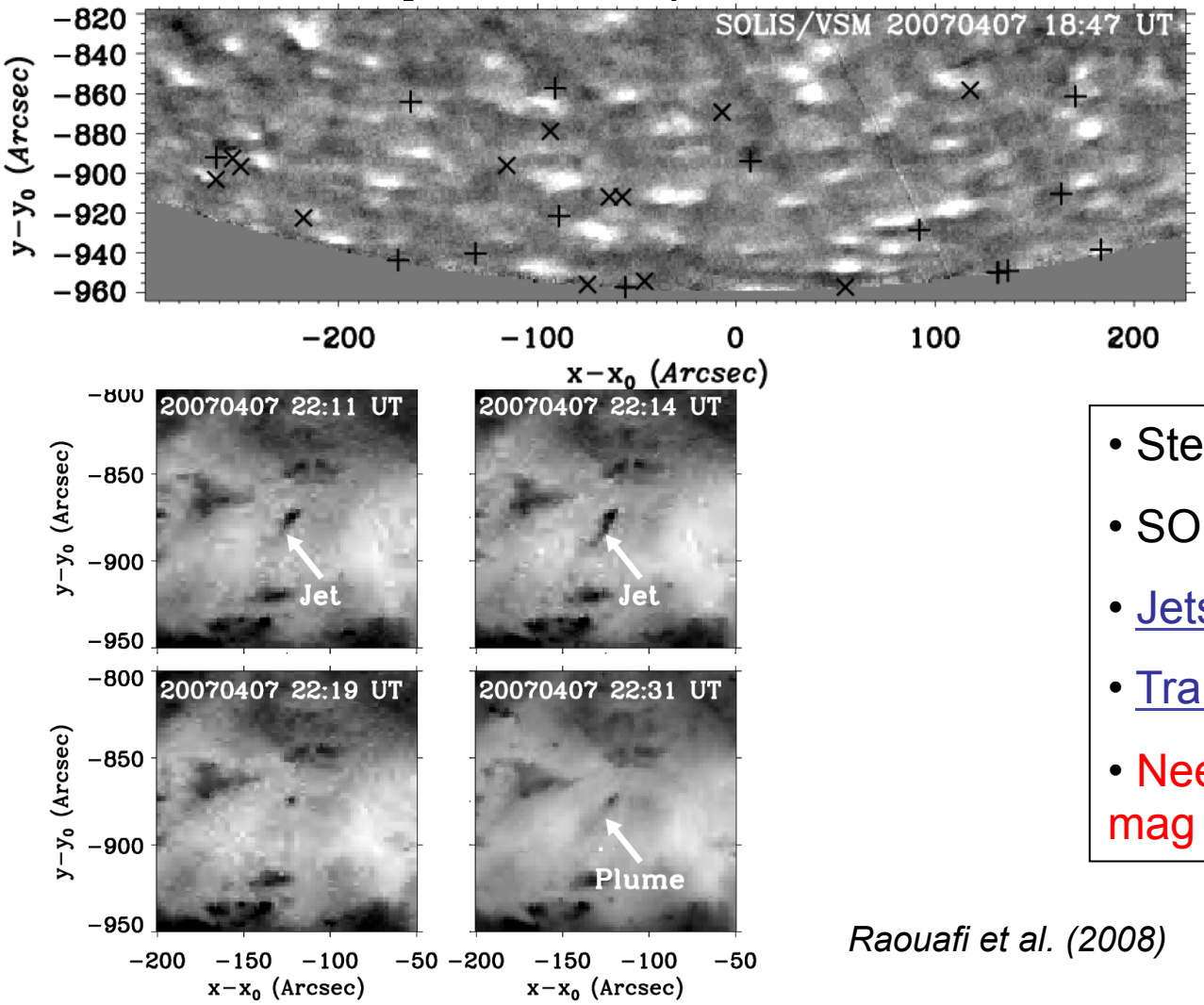
Flux Feature Latitude Distribution



- Chromospheric $B_{\parallel}$
- Fall 2006 & 2007
- ρ visibility corrected
- Normalized by area
- Larger features only
- Like photosphere
- Needs more work

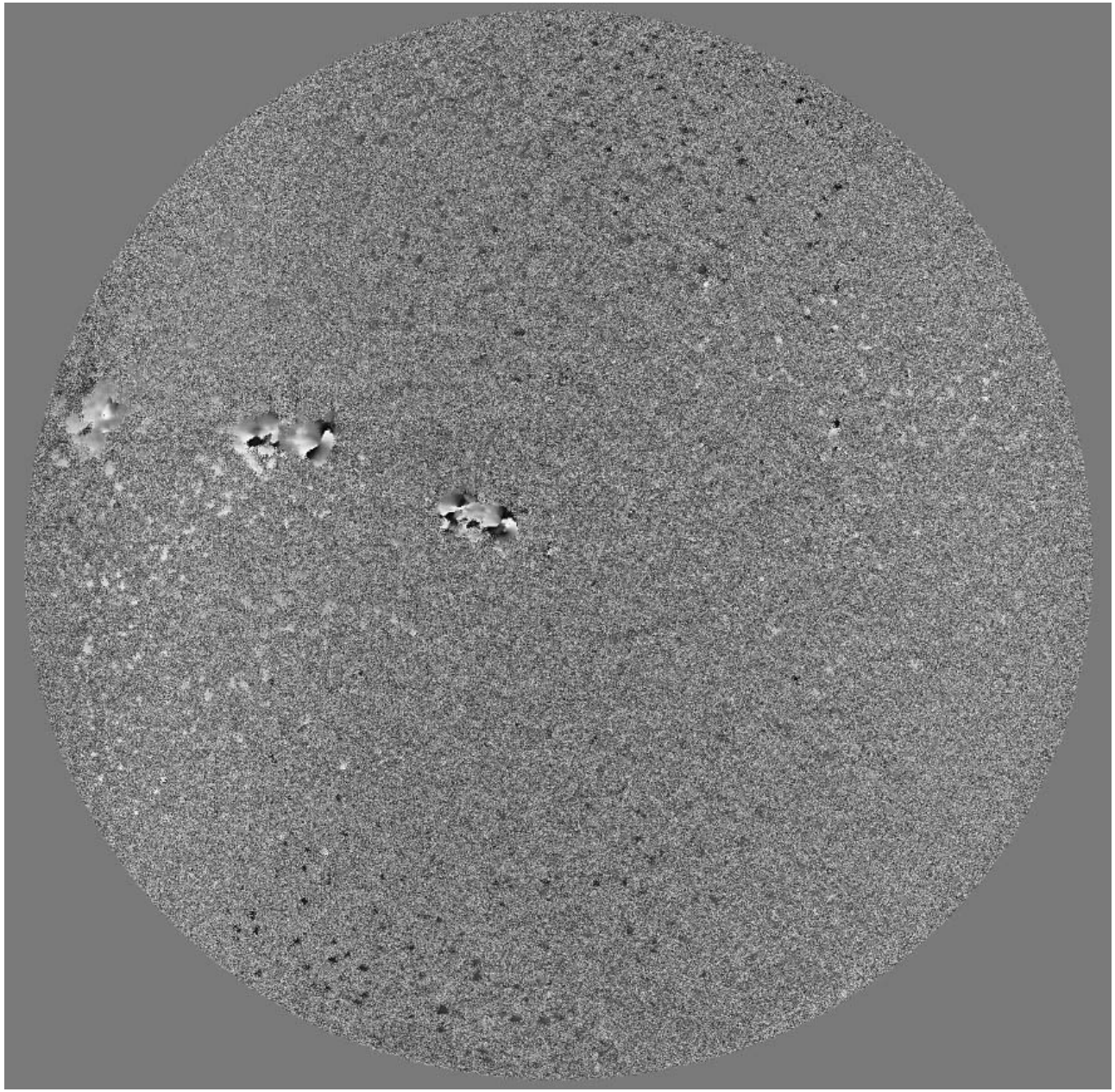
Raouafi et al. (2007, 2008)

Bipoles, Jets & Plumes



- Stereo/Secchi EUV
- SOLIS $\underline{B_{\parallel}}$ chrom
- Jets → plumes
- Transient bipoles
- Need much better mag cadence

Raouafi et al. (2008)

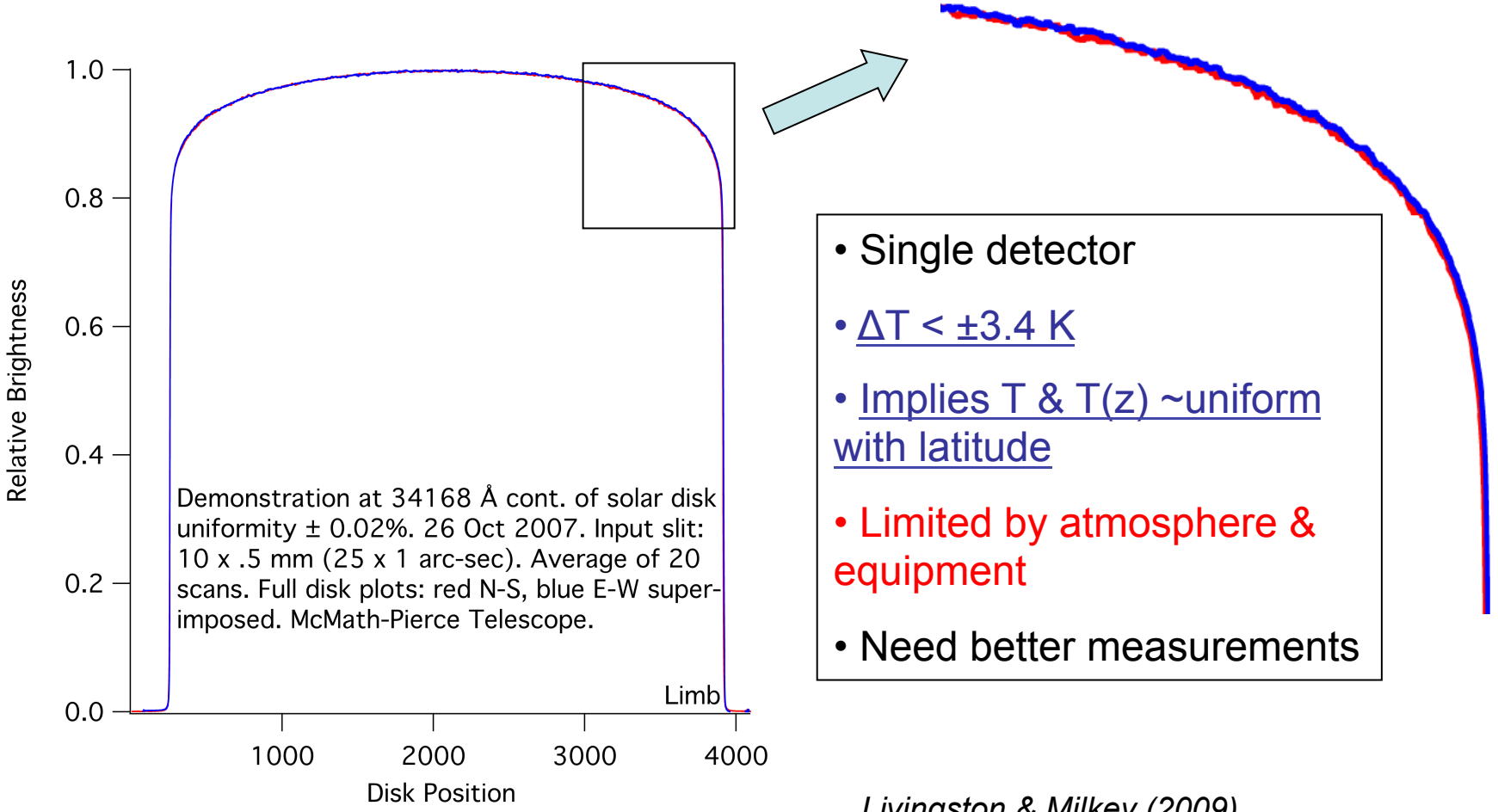


Vector Field

- $B_{\parallel}$ weak @ poles
- $B_{\perp}$ strong @ poles
- Network strong
- Network is ~radial
- Need more sensitivity

SOLIS 20080326

Equator-Pole Limb Darkening



- Single detector
- ΔT < ±3.4 K
- Implies T & T(z) ~uniform with latitude
- Limited by atmosphere & equipment
- Need better measurements

Livingston & Milkey (2009)

Conclusion

- Plan A high-latitude view of poles would provide new (unique) and far better information than we presently have about a mysterious region. It is the bolder, more adventurous path.
- Plan A or B for Solar-C would each be very valuable – we can be happy with either choice.