

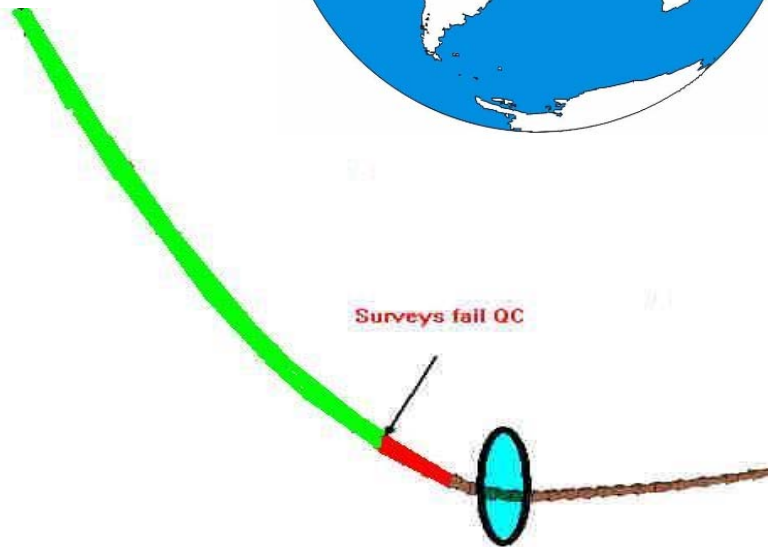
Practical consequences of Earth's ring current and how to deal with them

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Magnetic survey QC issue

- Location: Brazil
- Drilling at 60deg inclination & 60deg magnetic azimuth
- Surveys not corrected for drillstring interference
- Surveys start to fail magnetic QC test



Magnetic survey QC issue

- **The tool has been working OK for 1000m and all surveys have passed QC**
 - IFR geomagnetic values are used.
 - Rotational check shots have been taken- good result.
 - Surveys are analysed with multistation software.

- **The surveys suddenly start to fail the magnetic QC parameters**
 - No nearby steel.
 - Drilling fluid unchanged
 - Check shot performed at last good survey station, still failing QC limits.
 - No real-time observatory magnetogram data available for the area.

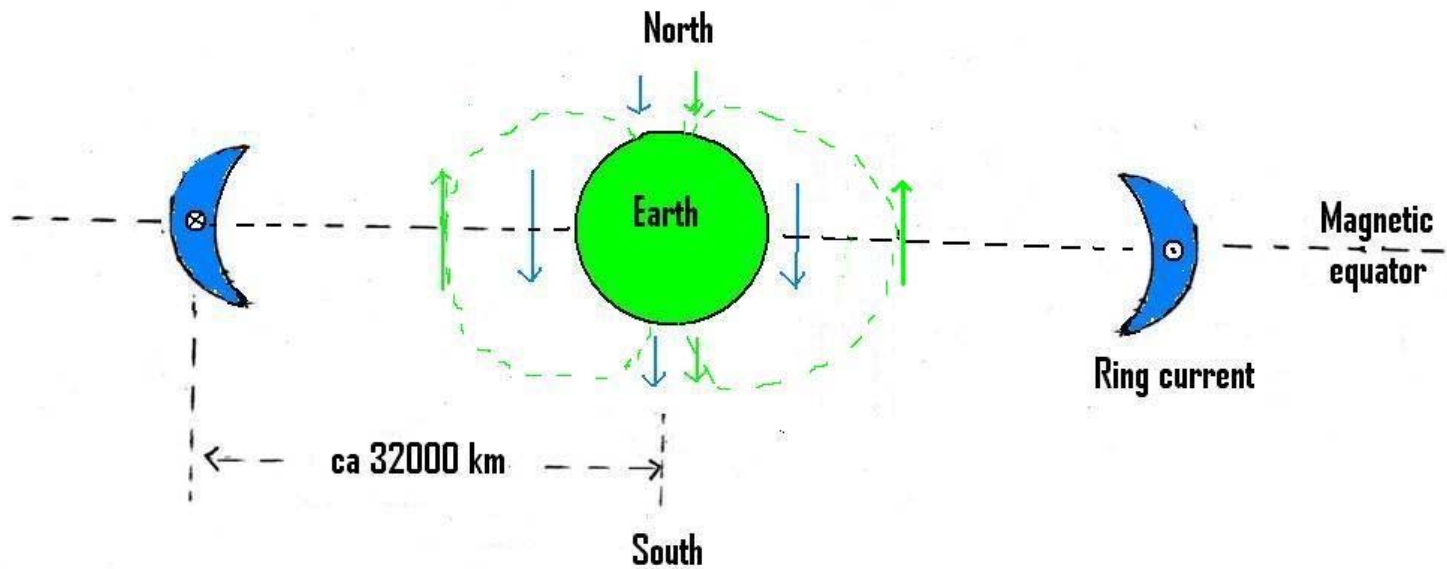


Options ?

- POOH ?
- Run EMS ?
- Run gyro ?

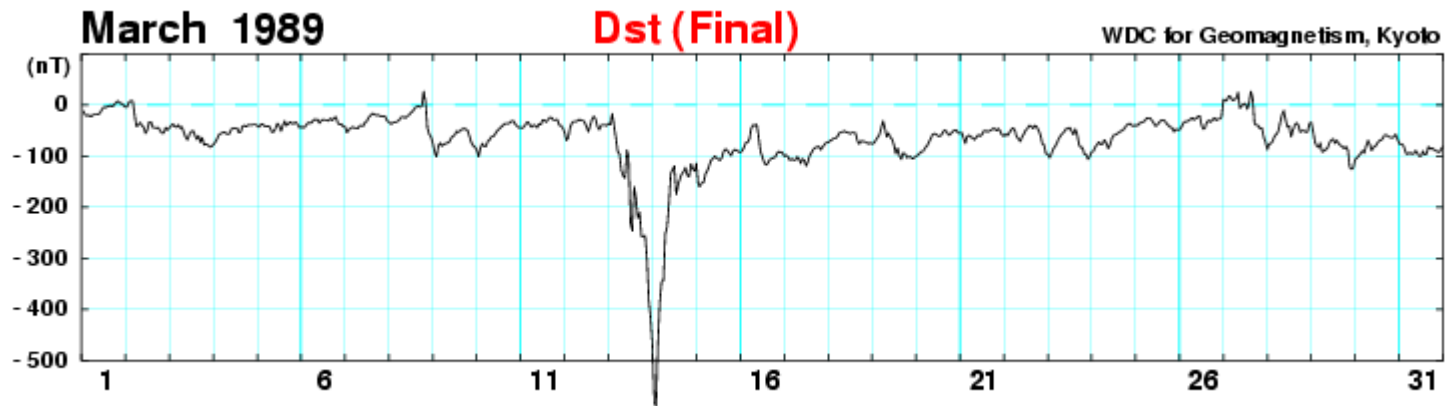
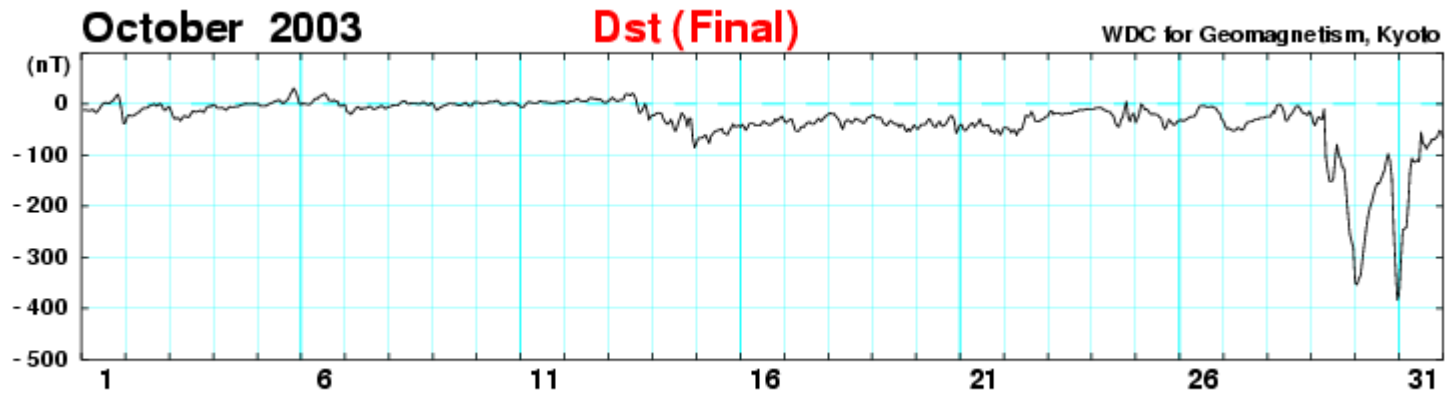
- Call Truls !

The ring current geometry



Ring current storms.

The index Dst equals the strength of the ring current field



Simple model: Earth rotational axis and magnetic axis coincide, Earth's field a dipole

φ - geographic latitude

m - dipole moment (30000 nT)

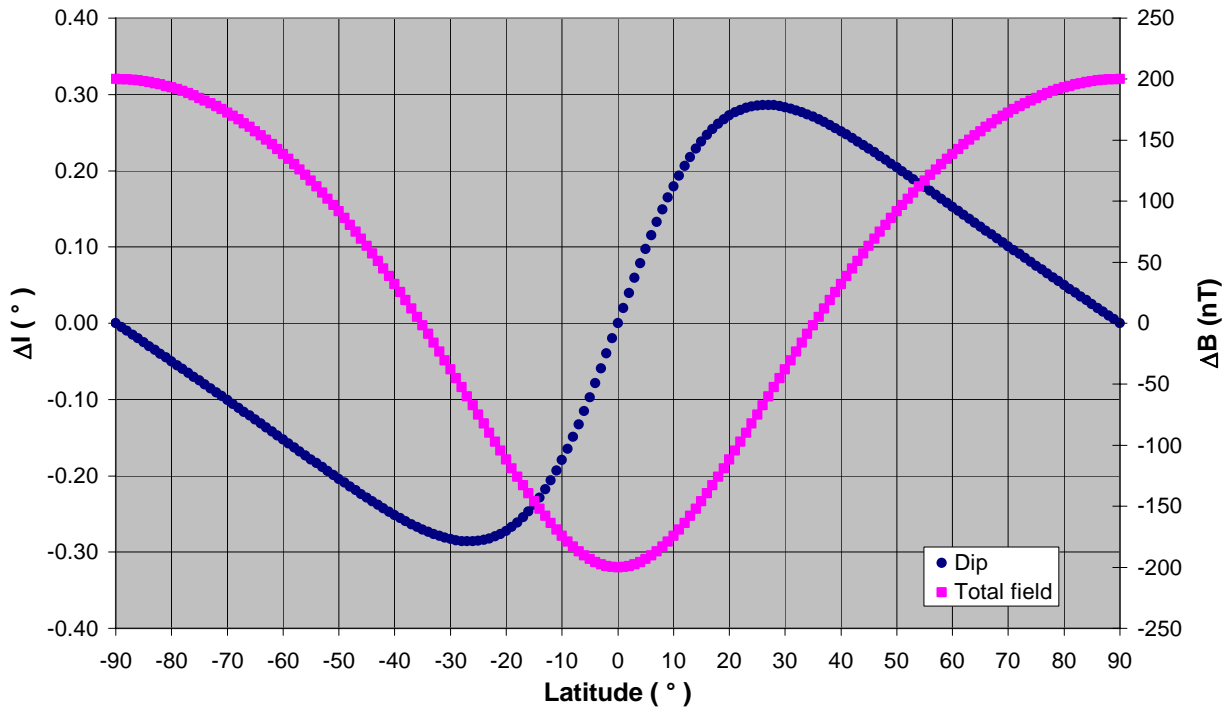
$B_R = -Dst = 200$ nT

$$\Delta I = \frac{B_R}{B_0} \sin(\varphi + I_0)$$

$$\Delta B = -B_R \cos(\varphi + I_0)$$

$$B_0 = m \sqrt{1 + 3 \sin^2 \varphi}$$

$$I_0 = \text{Arctg}(2 \text{Tg} \varphi)$$



Frequency of ring currents events

-Dst	Solar minimum	Solar maximum
> 100 nT	18 per year	3 per year
> 200 nT	6 per year	1 per year
> 300 nT	1 per year	0
> 400 nT	1 per solar cycle	0

Effect of ring current at selected locations for Dst=-200 nT using actual field.
 (Baker Hughes acceptance limits for 60/60 deg. well and IFR)

Location	Latitude (deg)	Long. (deg)	B ₀ (nT)	ΔD (deg)	ΔI (deg)	ΔB (nT)
Qatar	25N	51E	43100	0.06	0.22 (0.47)	-103 (396)
Angola	5S	12E	32500	0.04	-0.25 (0.76)	-143 (280)
GoM	27N	90W	46100	0.12	0.25 (0.41)	-9 (406)
Brazil	-23S	41W	23400	-0.19	-0.39 (0.98)	-108 (293)

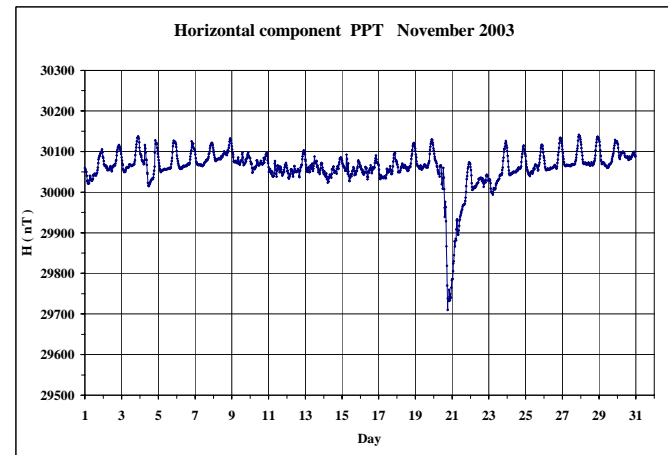
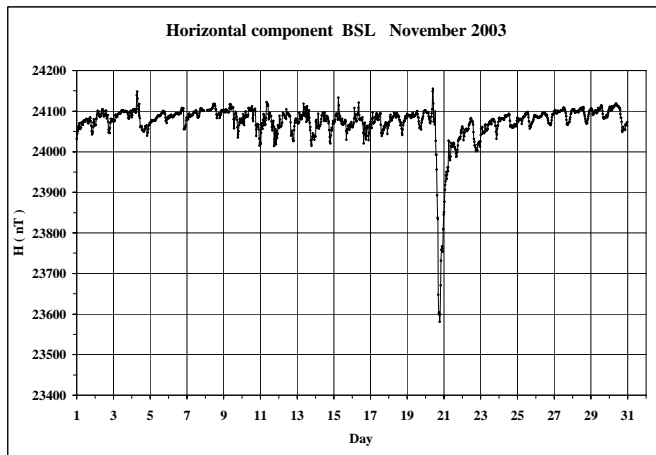
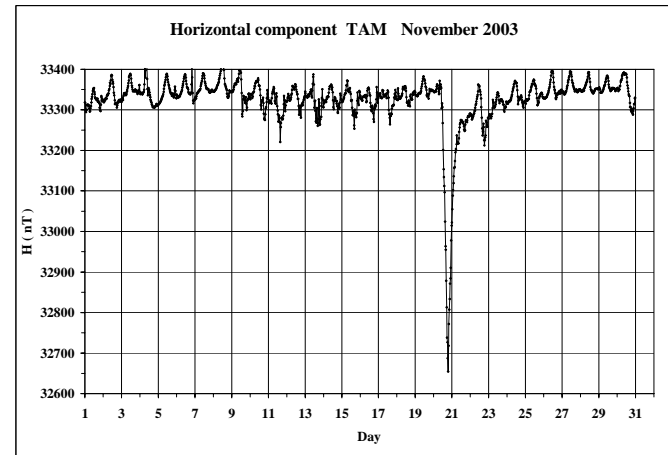
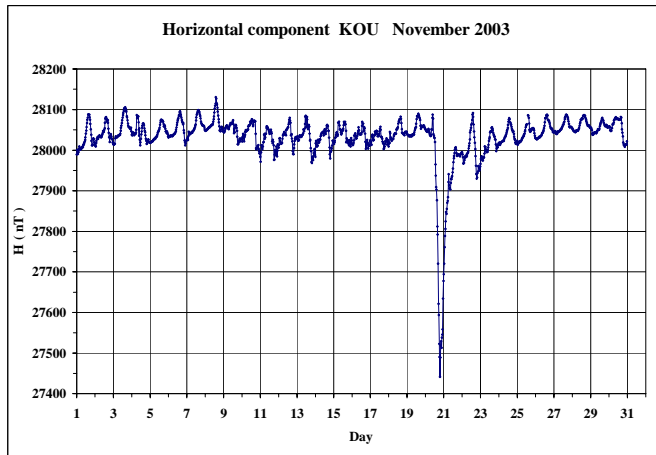
Williamson's 3-sigma for irregular field: dip 0.13 deg., tot.field 135 nT

KOU: French Guyana

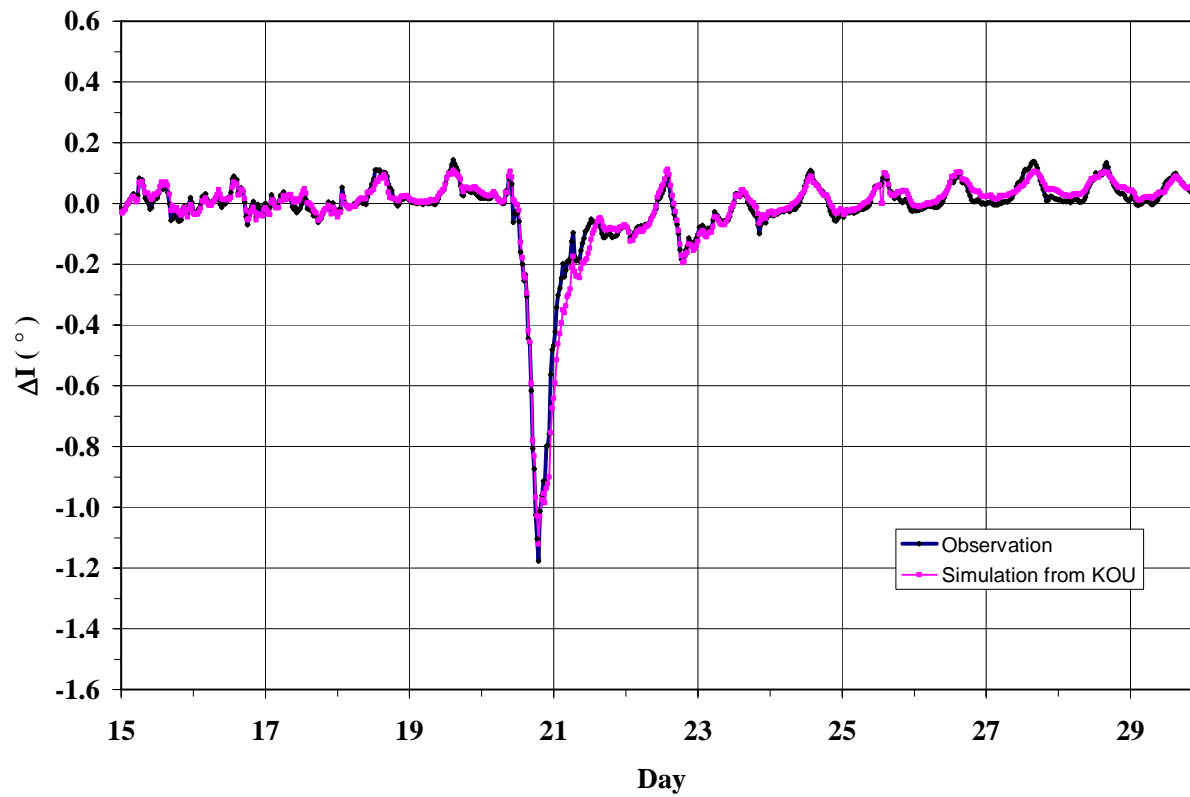
BSL: Louisiana

TAM: Algeria

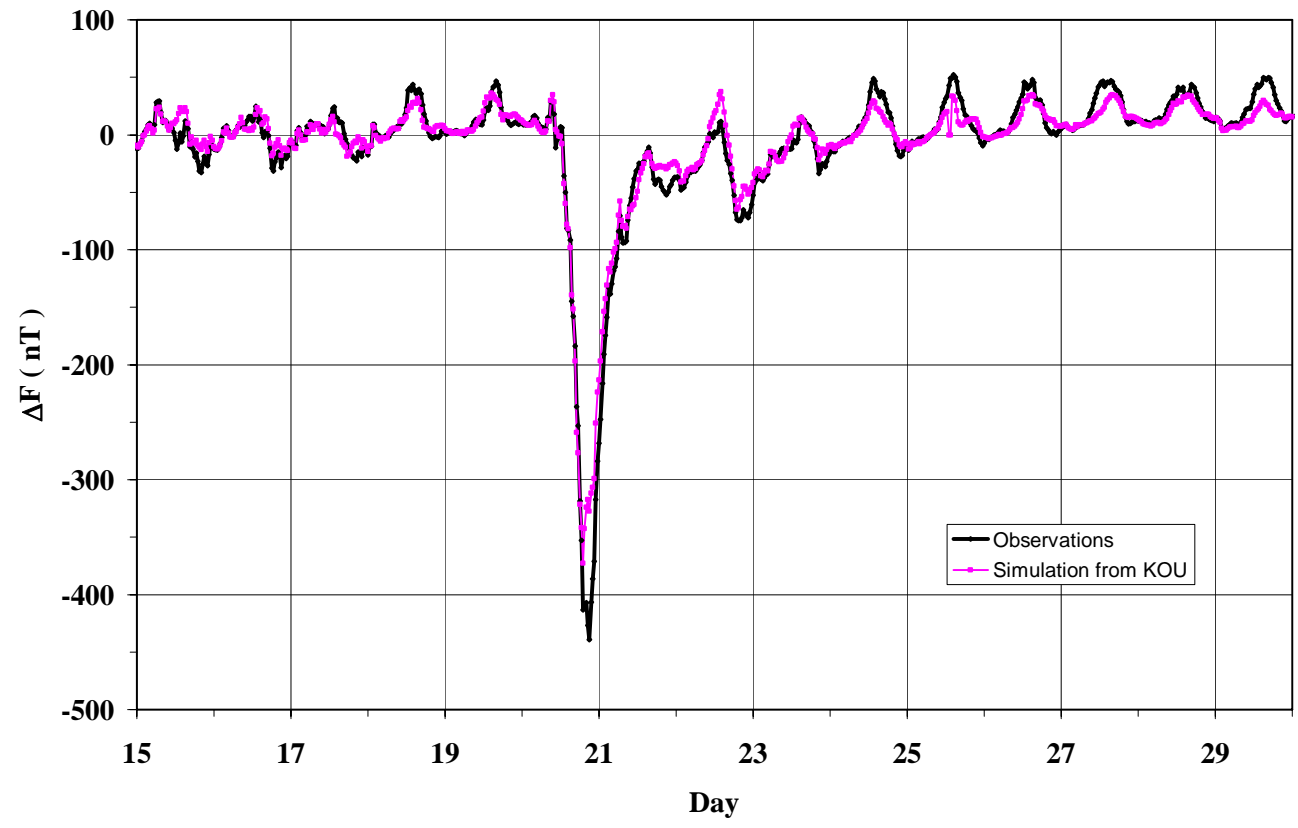
PPT: Tahiti



Perturbation of Inclination VSS November 2003



Perturbation of Total field VSS November 2003



Conclusion

At times of high solar activity,
keep an eye on Earth's magnetic field
even at low latitudes.