The total-field geomagnetic coast effect in southeast Australia

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REFERENCES

- Lilley, F., White, A., and Heinson, G., 2000. The total-field geomagnetic coast effect: The CICADA97 line from deep Tasman Sea to inland New South Wales. Exploration Geophysics, 31, 52-57.

- Parkinson,W. D. and Jones, F. W., 1979, The geomagnetic coast effect: Rev. Geophys.and Space Phys., 17, 1999-2015.

OUTLINE

- Introduction
- The CICADA97 Experiment
- Result
- Transfer function
- Conclusion

INTRODUCTION

- Generally speaking, the geomagnetic field is unaffected by the distribution of continents and oceans.
- This is true of the time-varying fields of external origin, the sources of which are currents flowing in the ionosphere or magnetosphere.
- However, there are three ways in which the continent-ocean interface can influence the geomagnetic field

INTRODUCTION

- First, there is a systematic difference in the magnetic history of the rocks below oceans and continents.
- Second, ocean currents moving in the main field produce a field by dynamo action.
- Third, the electrical conductivity of both seawater and material under the oceans differs considerably from that of the continents.

INTRODUCTION

- The CICADA project
  (Clarifying Induction Contributions to
  Aeromagnetic Data)
- The purpose of the experiment was to investigate the effect of electrical conductivity structure near a coastline on natural time-variations in Earth's magnetic field.

INTRODUCTION

Instrument

→ three-component magnetometer

$$f(t) = h(t)\cos I + z(t)\sin I$$

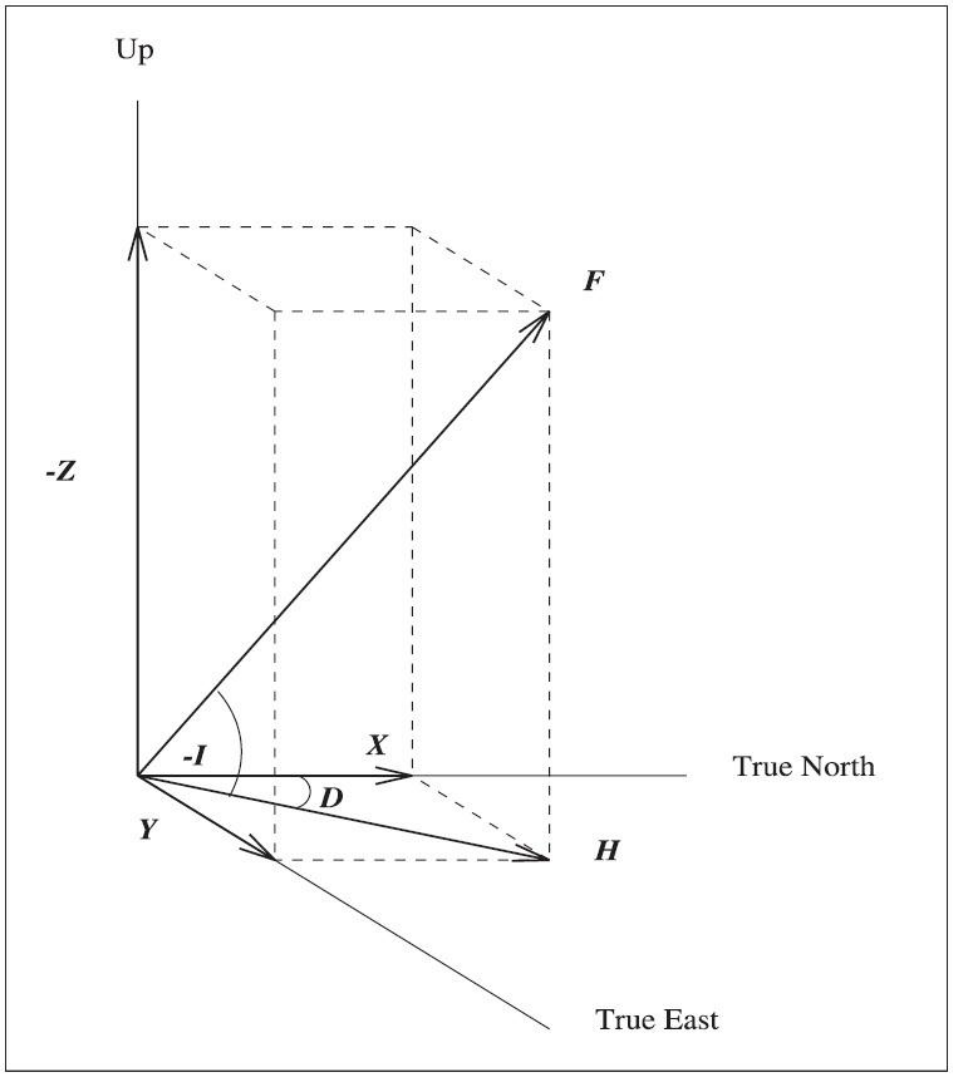
f(t) = F

h(t)= H

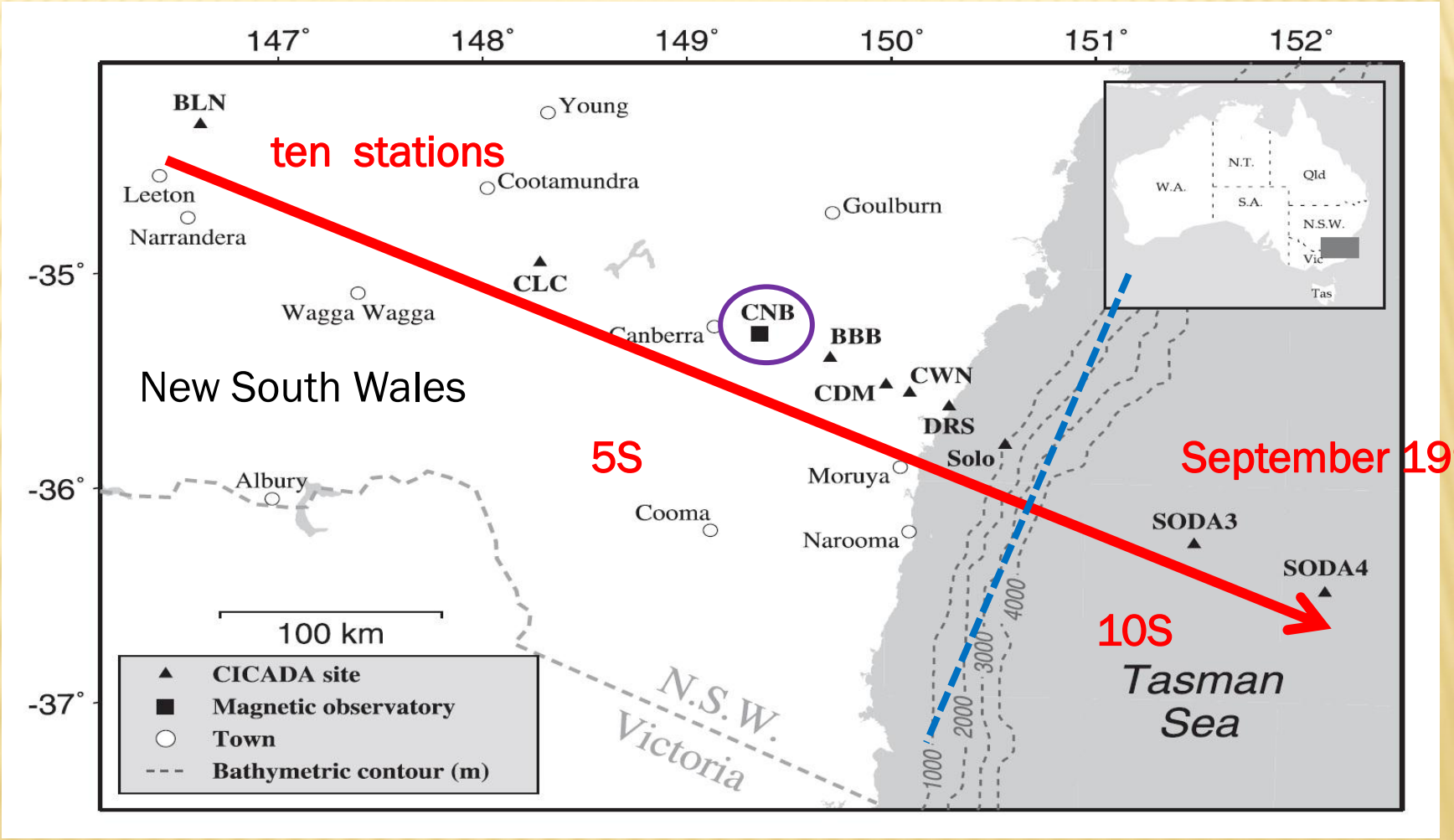
z(t) = Z

D : declination

I : inclination



EXPERIMENT



least-count resolution：0.1nT

EXPERIMENT

Station	Code	Longitude	Latitude	Elevation
Barellen	BLN	146°36.5'E	34°19.0'E	208m
Coolac	CLC	148°16.2'E	34°58.9'E	313m
Canberra	CNB	149°21.8'E	35°18.9'E	859m
Bombay Bridge	BBB	149°42.8'E	35°25.6'E	667m
Clyde Mtn.	CDM	149°59.6'E	35°33.0'E	213m
Currowan	CWN	150°08.9'E	35°35.7'E	50m
Durras	DRS	150°17.2'E	35°39.4'E	10m
Solo	Solo	150°34.9'E	35°49.3'E	-523m
SODA3	SODA3	151°33.2'E	36°16.3'E	-4807m
SODA4	SODA4	152°13.2'E	36°29.1'E	-4772m

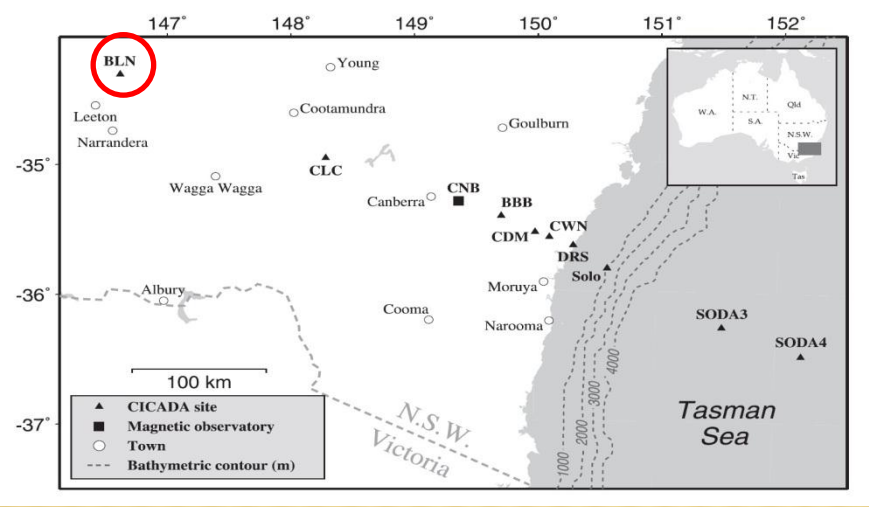
The SODA3 and SODA4 data have been recorded below almost 5 km of ocean.

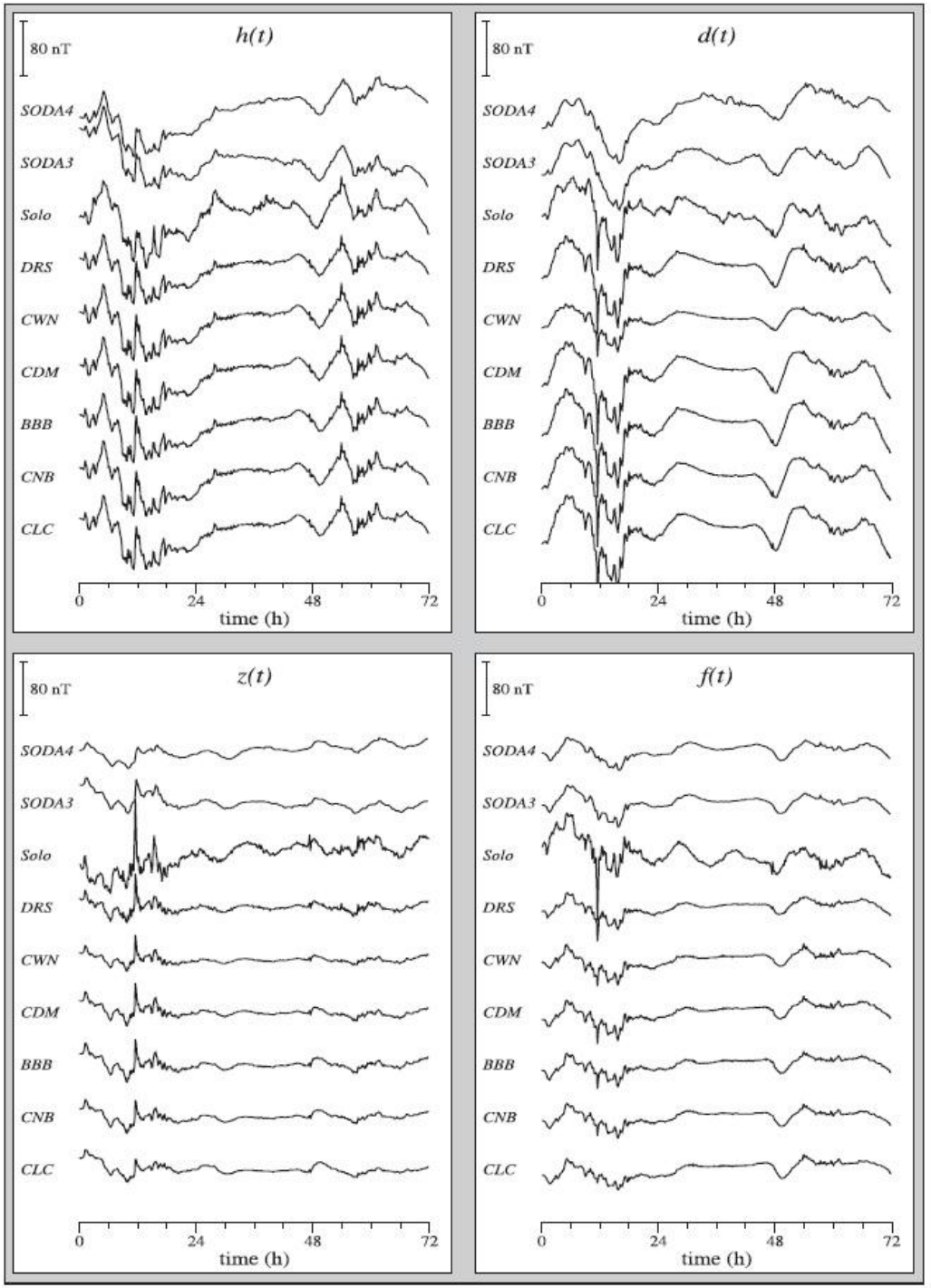
RESULT

9

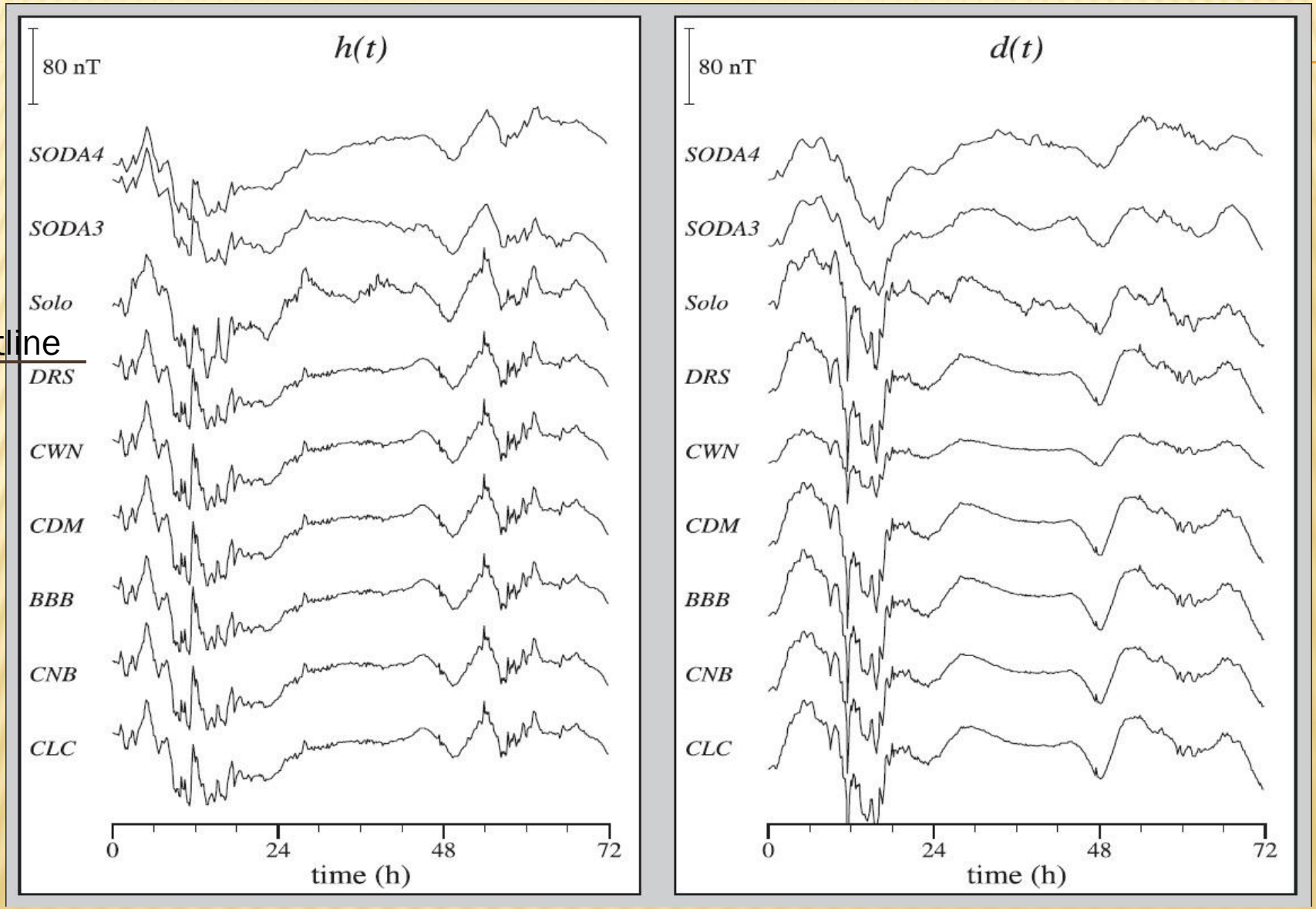
Three days(274 to 276)

BLN- data is not enough

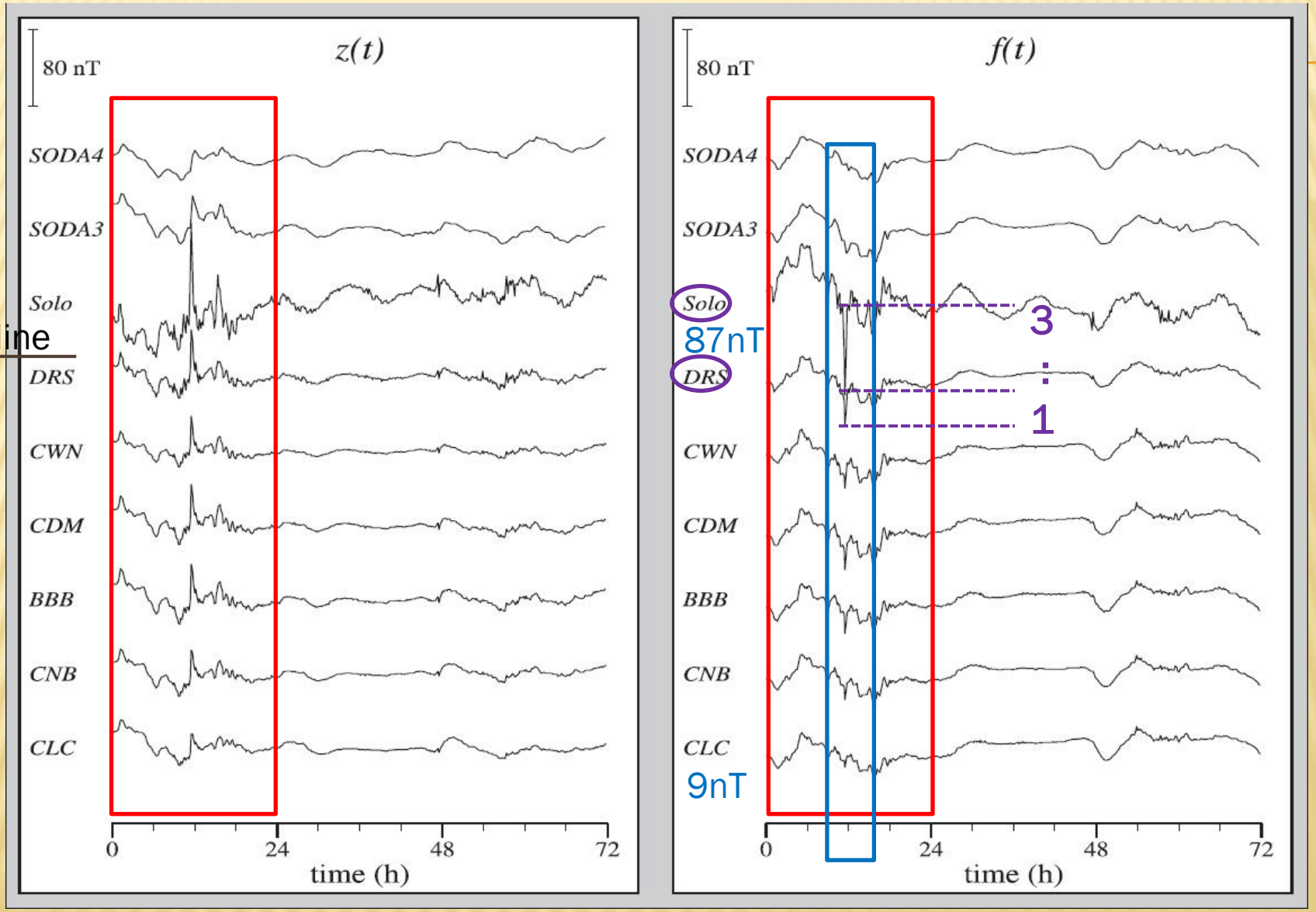




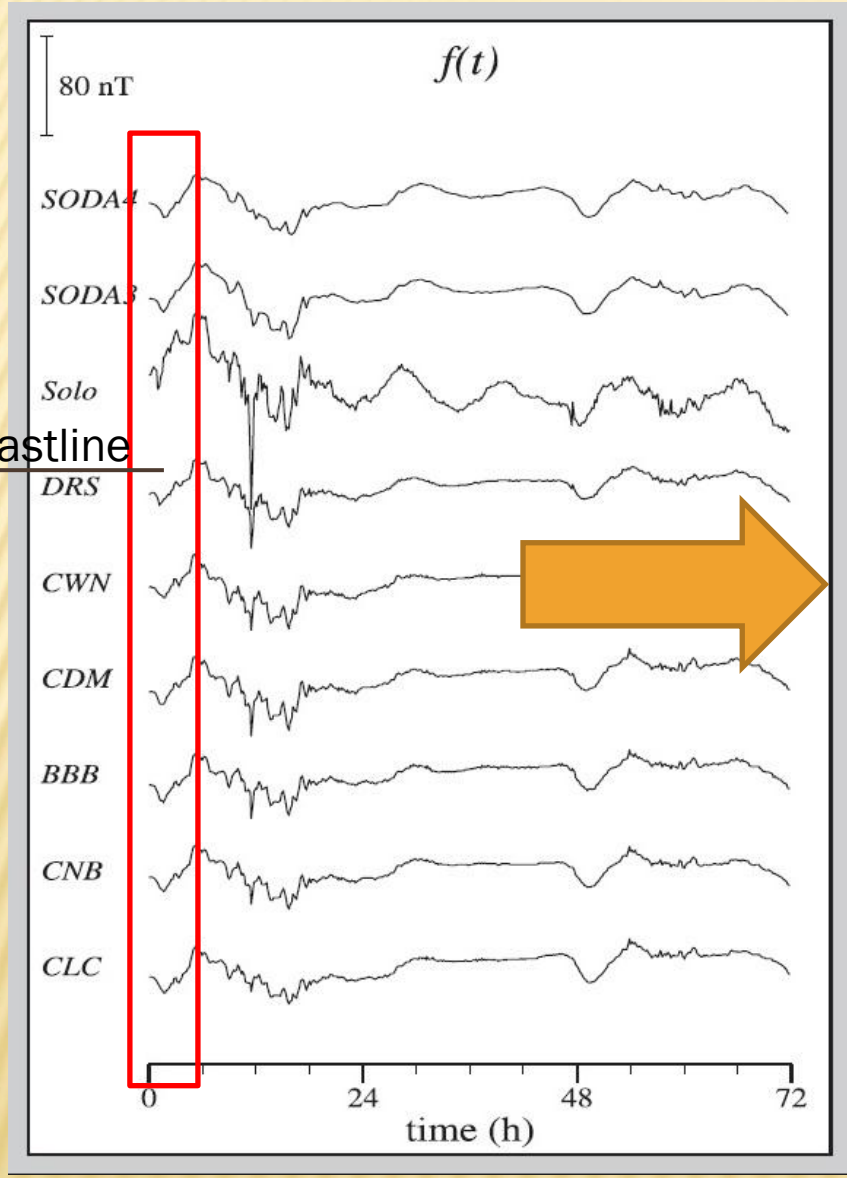
coastline


h(t)
80 nT
SODA4
SODA3
Solo
DRS
CWN
CDM
BBB
CNB
CLC
0
24
48
72
time (h)
d(t)
80 nT
SODA4
SODA3
Solo
DRS
CWN
CDM
BBB
CNB
CLC
0
24
48
72
time (h)

coastline

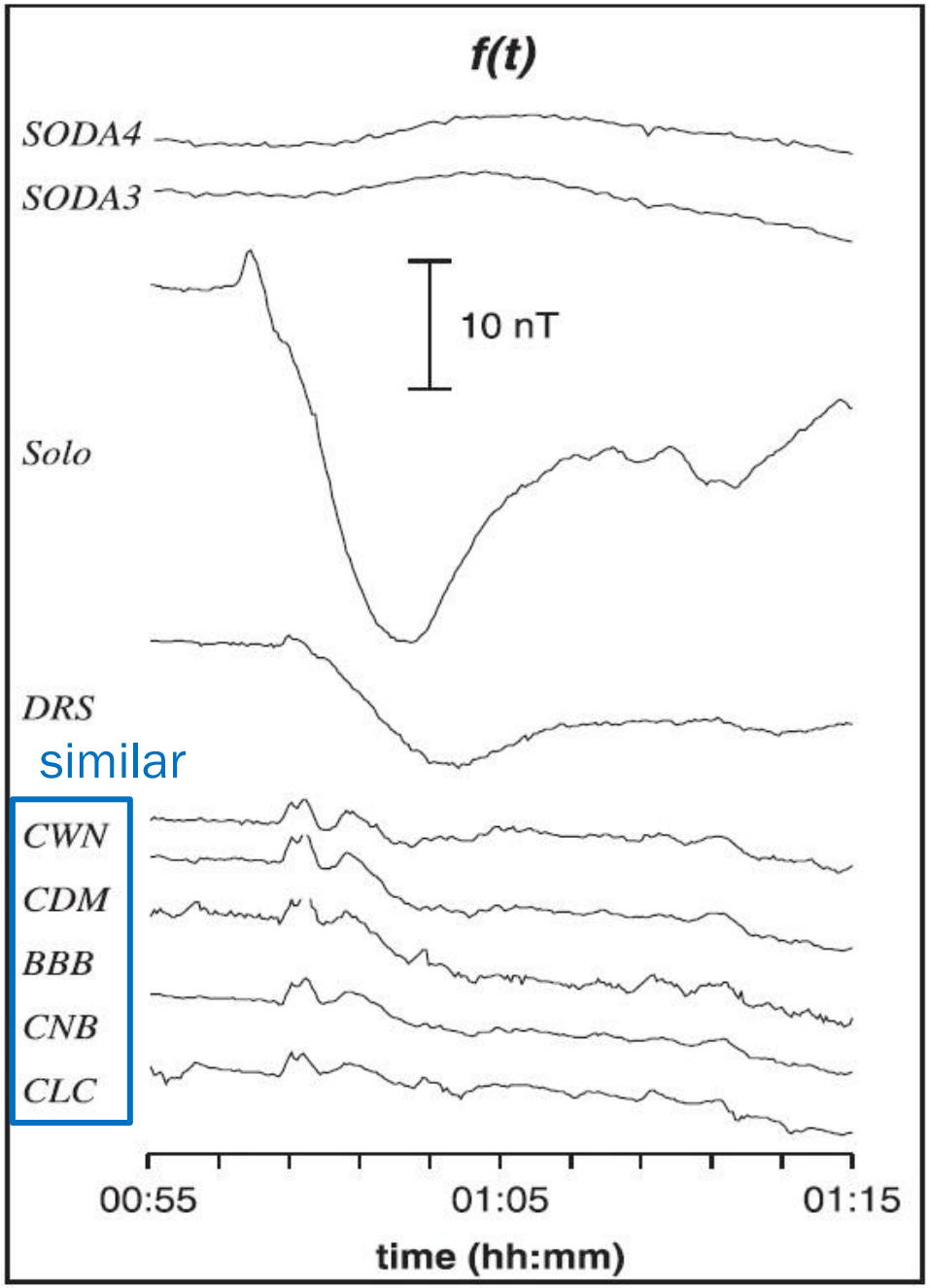


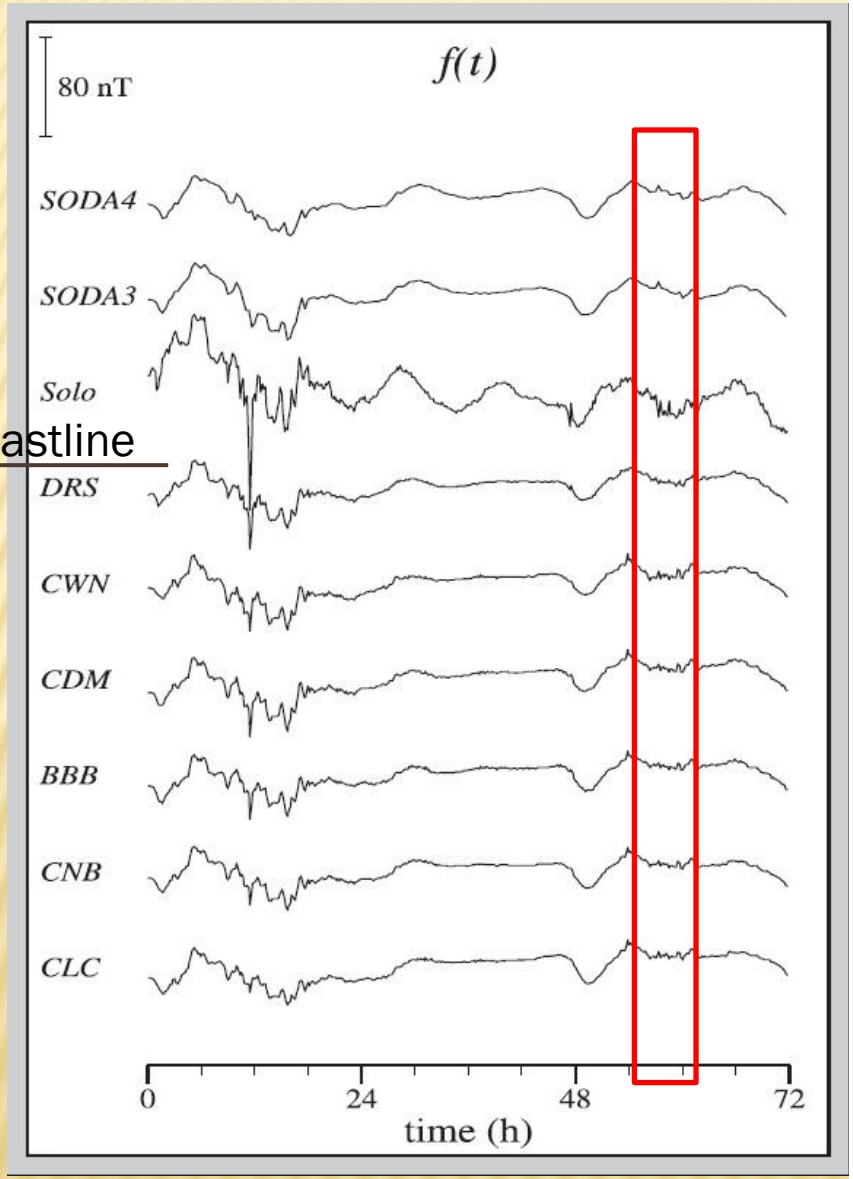
12:00 day 274



coastline

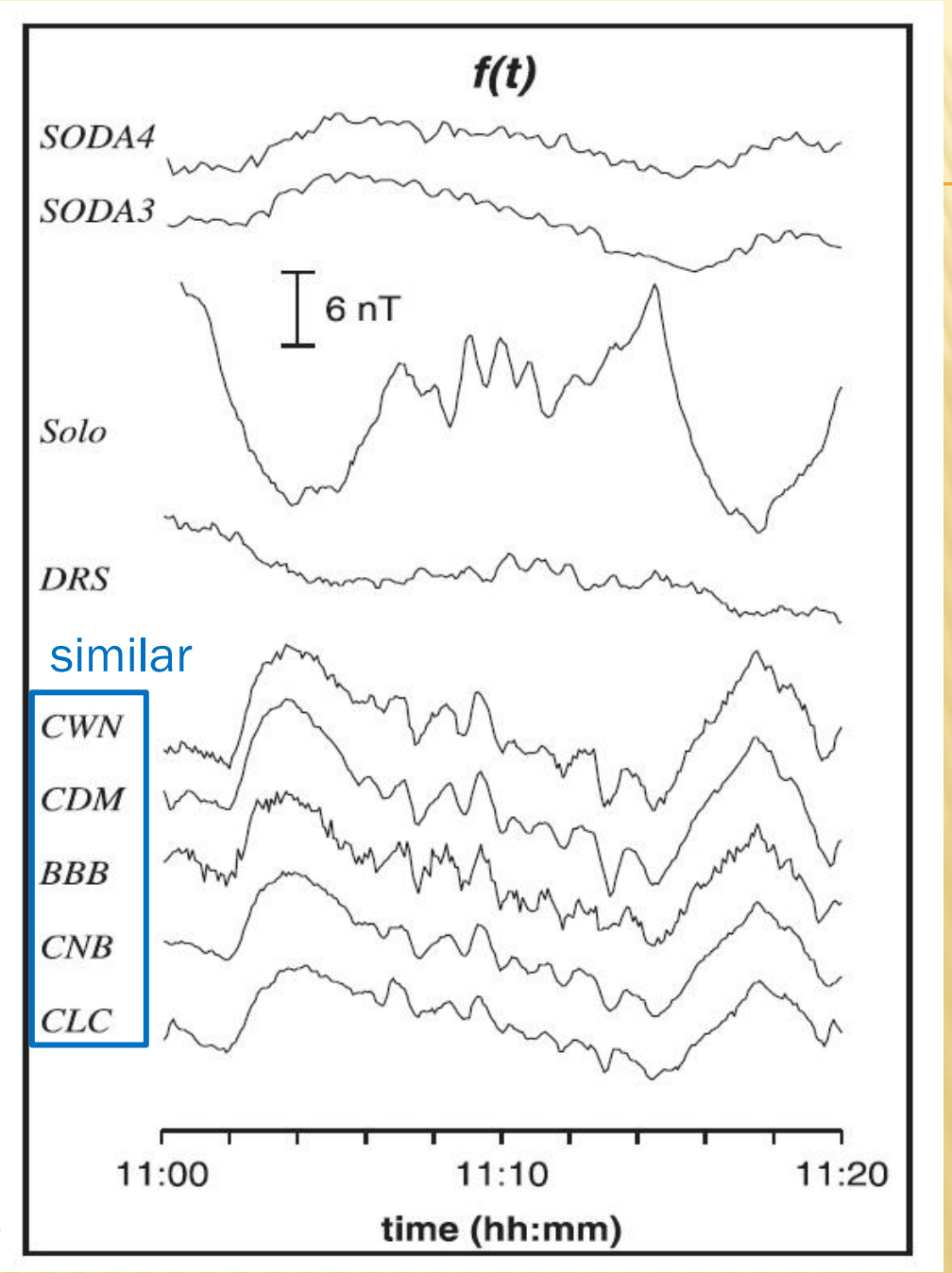
01:00 day 274





coastline

11:00 day 276

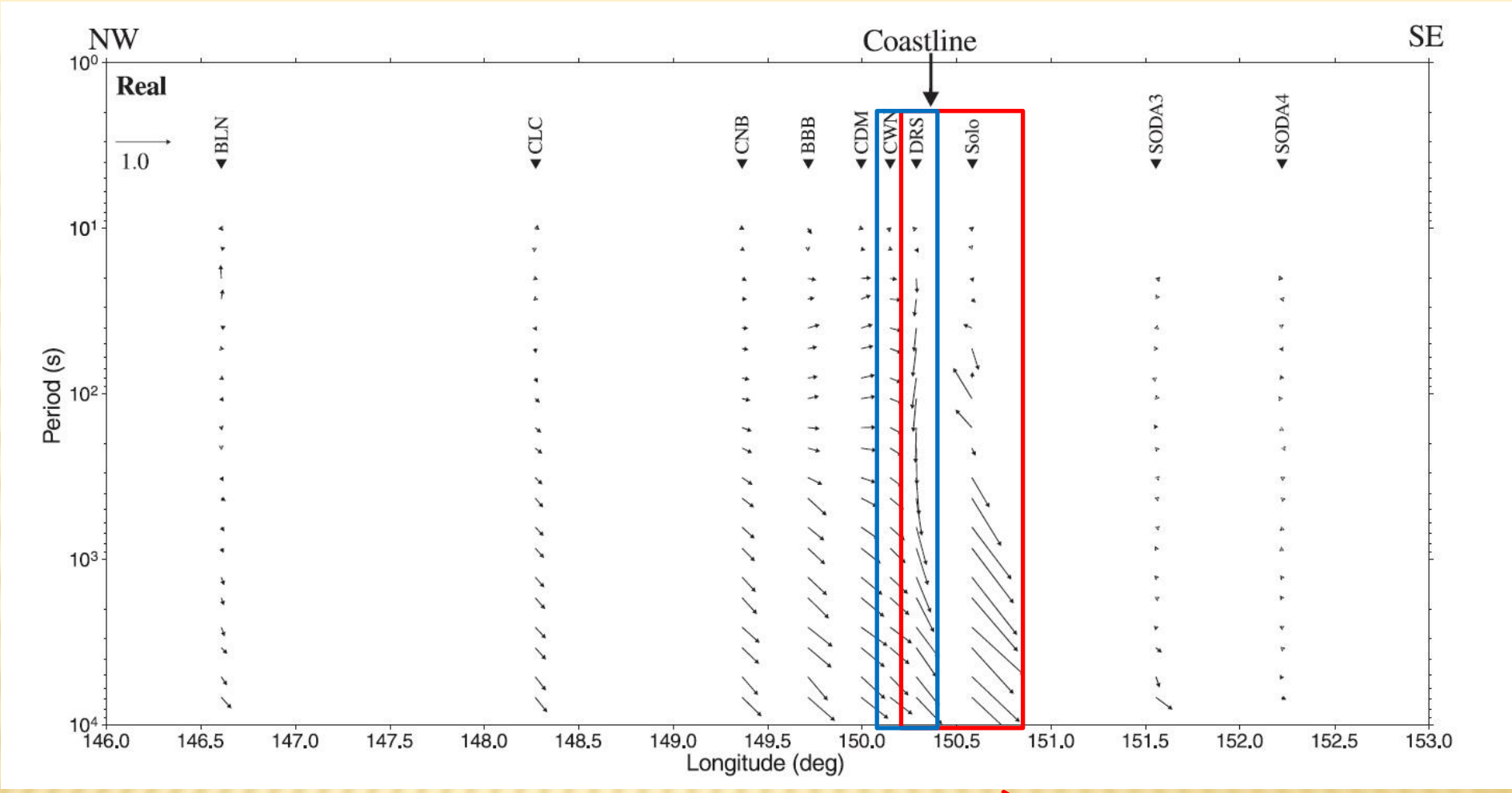


TRANSFER FUNCTION

- The tendency for short-period vertical variations (*Z*) to result from induction by *H* and *D* is expressed in this equation

$$Z(w) = A(w)\ H(w) + B(w)\ D(w)$$

- All parameters are complex, having real and imaginary parts.
- *A* and *B* are dependent on the underlying electrical conductivity structure.
- The transfer functions are usually displayed by plotting on a map the two-dimensional vectors (A_r, B_r) and (A_i, B_i).



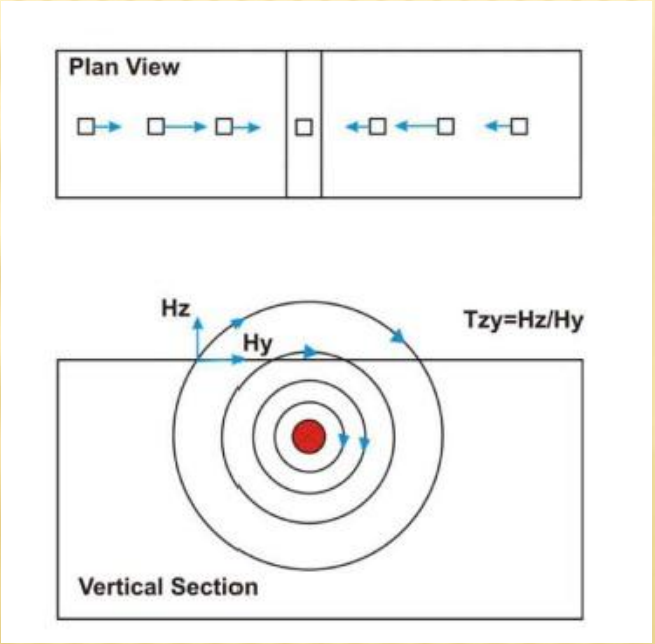
- First, the coast effect influences variations with progressively shorter period at stations progressively nearer the coastline.
- Second, the increasing length of the arrows indicates that the induced vertical field is stronger near the coast.

CONCLUSION

- The coast effect causes significant enhancement of variations of the vertical magnetic field. At mid to high latitudes, these vertical fields are an important component of total-field variations.
- This study has highlighted the potential for significant heterogeneity in spatial patterns of total-field variations near coastlines.

Thank you!

- 磁場感應指針向量(Induction arrows)
- 主要是導因於當地下介質之側向導體變化所產生強度不一的垂直磁場分量，透過此特性分析可作為判斷地下介質的高電阻體與高導體之間強烈對比的差異的邊界
- Parkinson 於1959 年所訂定的規範，
- Parkinson 將實數部分的磁場感應指針定義成指向內部電流集中的導體的區域



上圖為俯視圖，藍色箭頭代表磁場感應指針指向與距離的強度變化；
下圖為正視圖，圖中紅色實心圓代表導體，藍色箭頭代表磁場方向。

- 集膚效應
  因為電磁波在介質中傳播時會逐漸衰減。
  考慮介質對電磁波的吸收作用；
  為了瞭解電磁波衰減訊號的可信度，必需探討其有效的探測深度
- 集膚深度(skin depth)
  週期約10S附近的感應指針，反應上部地殼構造；
  週期1,000S時，則反應下部地殼構造