

Identifying the timescales of model error: NACP inter-comparison wavelet analysis

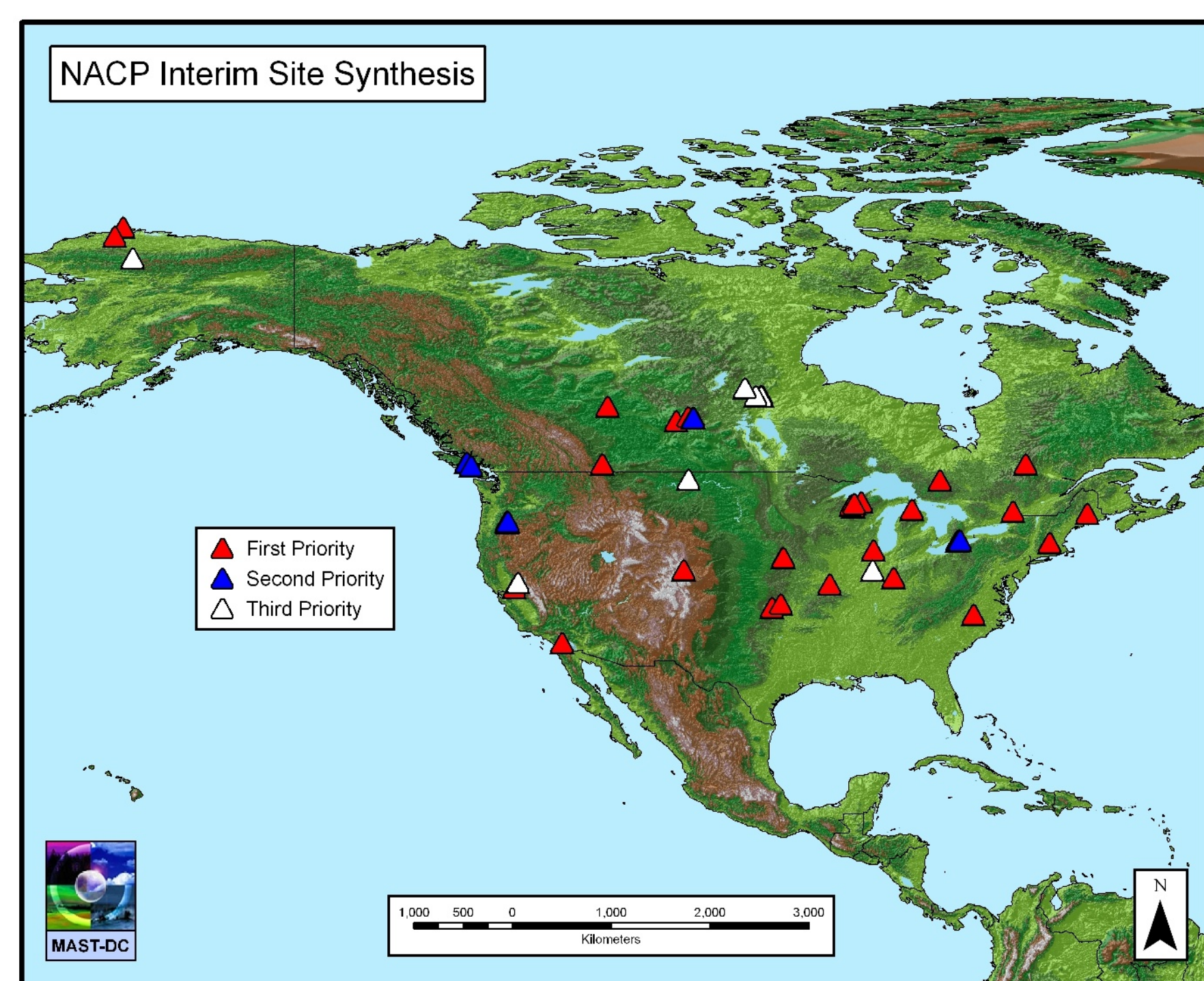
M. C. Dietze¹; R. Vargas²; P. C. Stoy³; A. D. Richardson⁴

1. Plant Biology, University of Illinois at Urbana-Champaign, Urbana, IL, United States. mdietze@illinois.edu
2. Departamento de Biología de la Conservación. Centro de Investigación Científica y de Educación Superior de Ensenada. Mexico.
3. Montana State University, Bozeman, MT, United States.
4. Organismic and Evolutionary Biology, Harvard University, Cambridge, MA, United States.

OBJECTIVES

- Evaluate the performance of ecosystem models at different time-periods at Ameriflux & Fluxnet Canada sites using wavelet decomposition
- Identify dominant time scales of model error

North American Carbon Program Site-Level Inter-comparison



- 21 ecosystem models were run at 40+ eddy covariance tower sites
- Focus here on 9 “high-priority” sites
- Compare modeled vs data net ecosystem exchange (NEE) of carbon
- Most assessments have focused on a single time scale

Biome	Site ID	Name	Years	AgroIBIS	BFPIS	BIOME_BGC	can.Bis	CNGLASS	DLEM	ED2	ED2M	EPIC	ISOLSM	LoTEC_DA	LPI	ORCHIDEE	SIB	SIB_CASA	SIB_COP	SSiB	TICO	TRIPLEX
CRO	US-NE3	Mead com/soy	02-04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GRA	CA-Let	Lethbridge	99-07	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DBF	CA-Oas	BERMS Aspen	97-06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DBF	US-Ha I	Harvard Forest	92-05	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
DBH	US-UMB	Univ. of Michigan	99-03	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ENFB	CA-Obs	BERMS Spruce	00-06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ENFT	US-Ho I	Howland Forest	96-04	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ENFT	CA-Ca1	Campbell River	98-06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WET	CA-Mer	Mer Bleue	99-06	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 1: Sites and models used in intercomparison. Biomes: CRO = crop, GRA = grassland, ENFB = Evergreen needleleaf forest – boreal, ENFT = evergreen needleleaf forest – temperate, DBF = deciduous broadleaf forest, WET = wetland

Wavelet Analysis

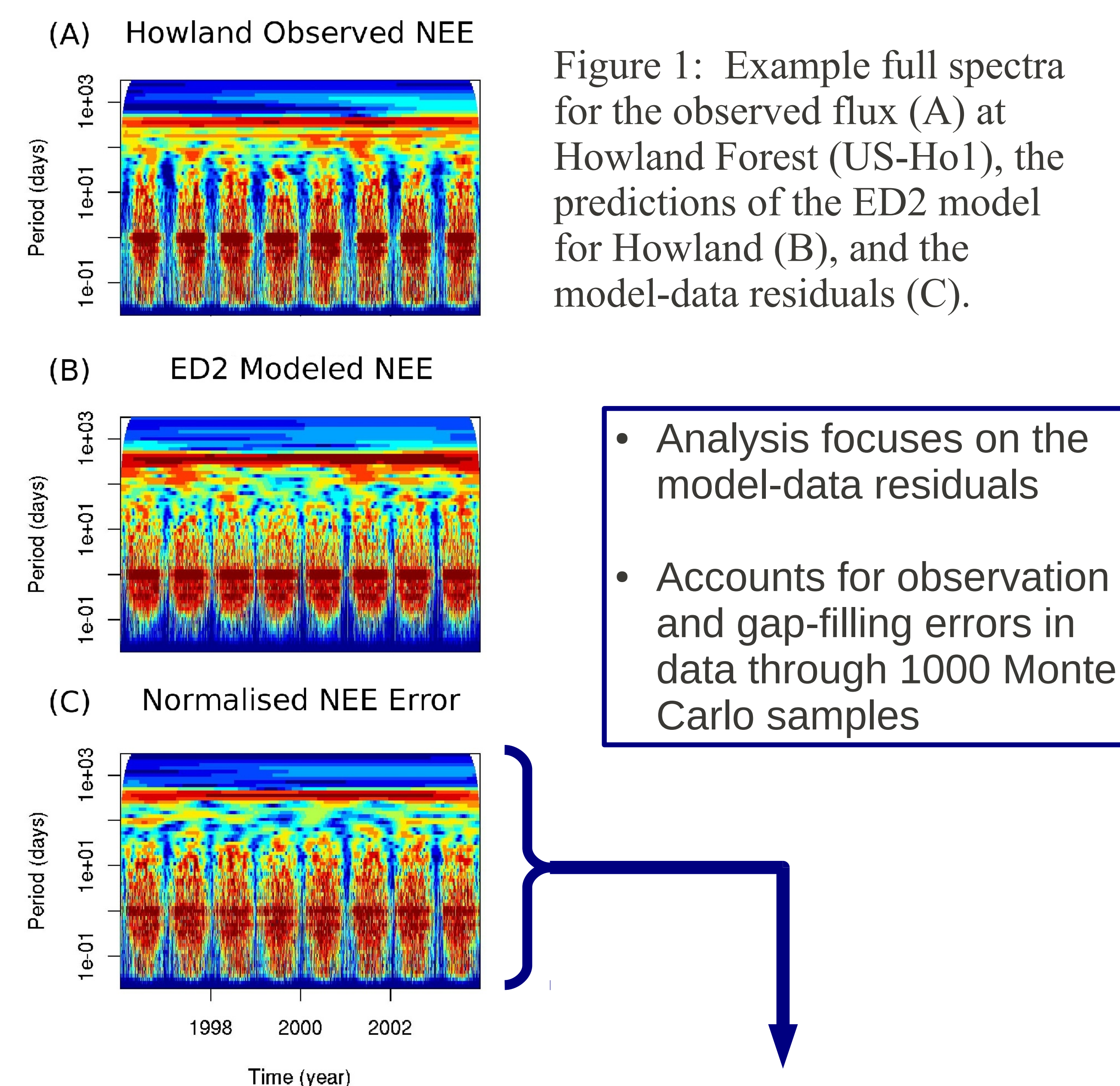
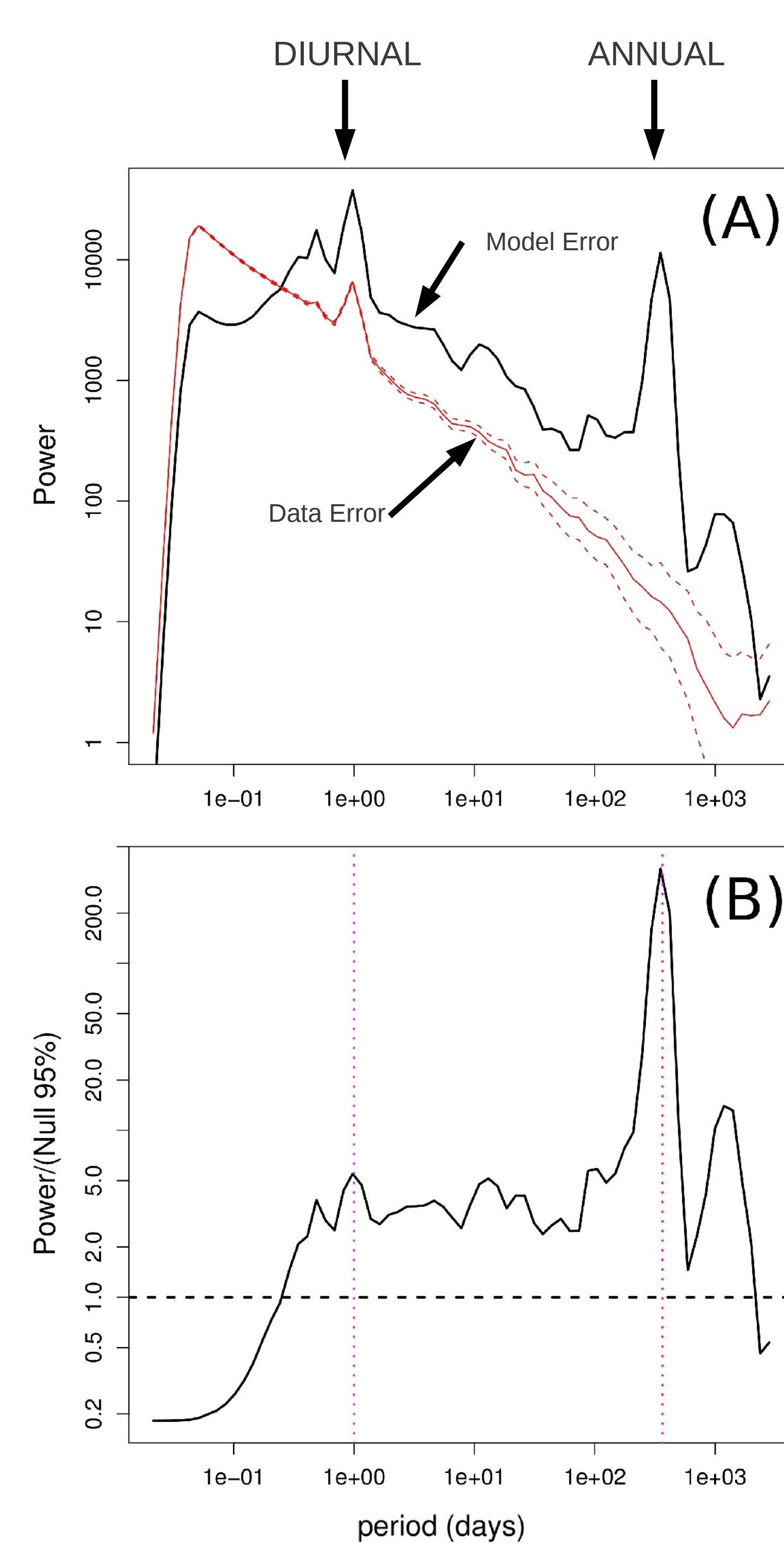


Figure 2: (A) Example global power spectra for ED2 model at Howland Forest (US-Ho1)

(B) The global power spectra are then divided by the upper CI of the null spectra. When the model-data error spectra is greater than 1 (dashed line) this indicates that the model error has significantly more spectral power at these periods than would be expected based on observation error.



Global Power Spectra

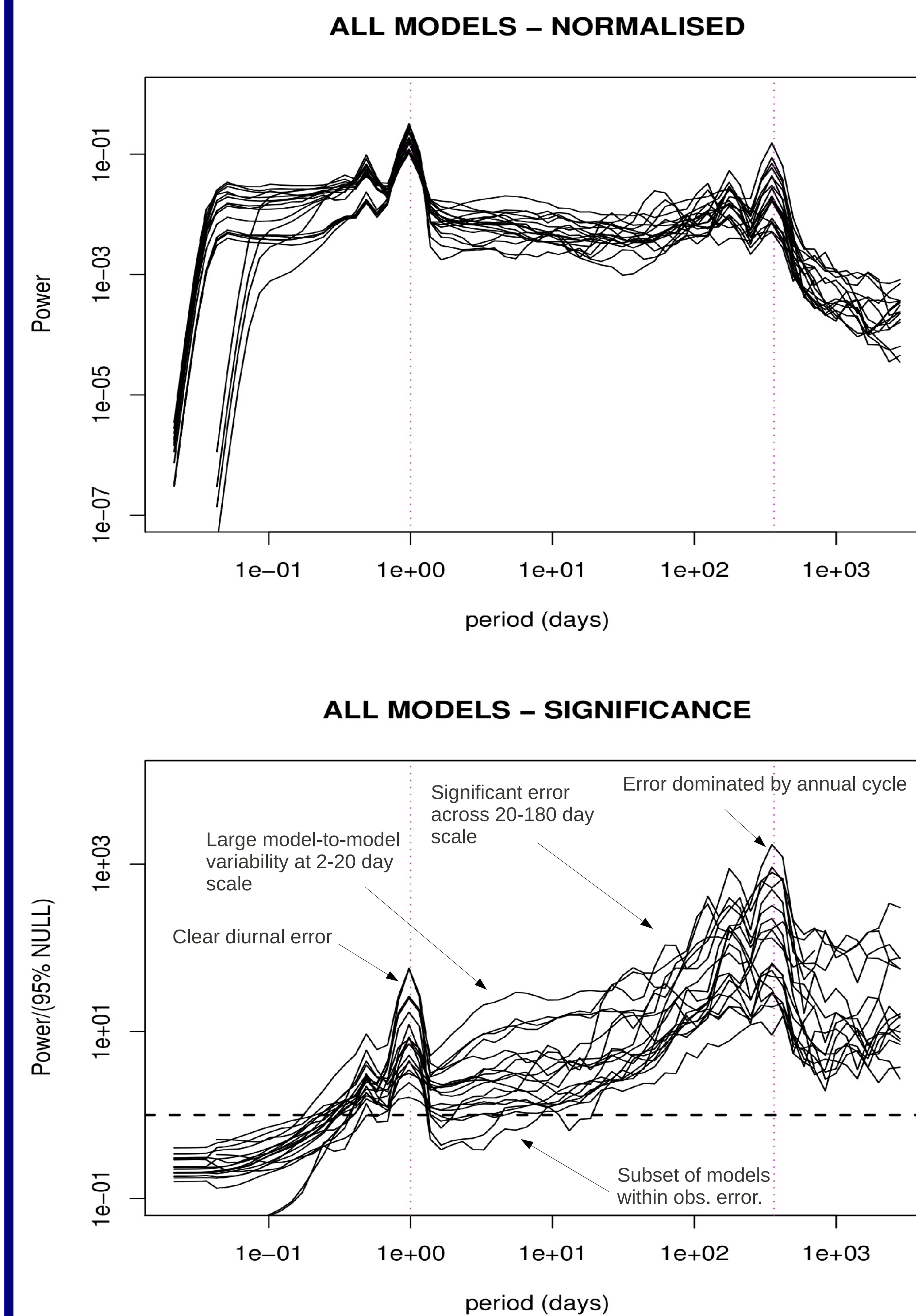


Figure 3: (A) Global power spectra across all models and the median spectra for each model averaging across all sites. (B) Comparison of the global spectra to the null spectra.

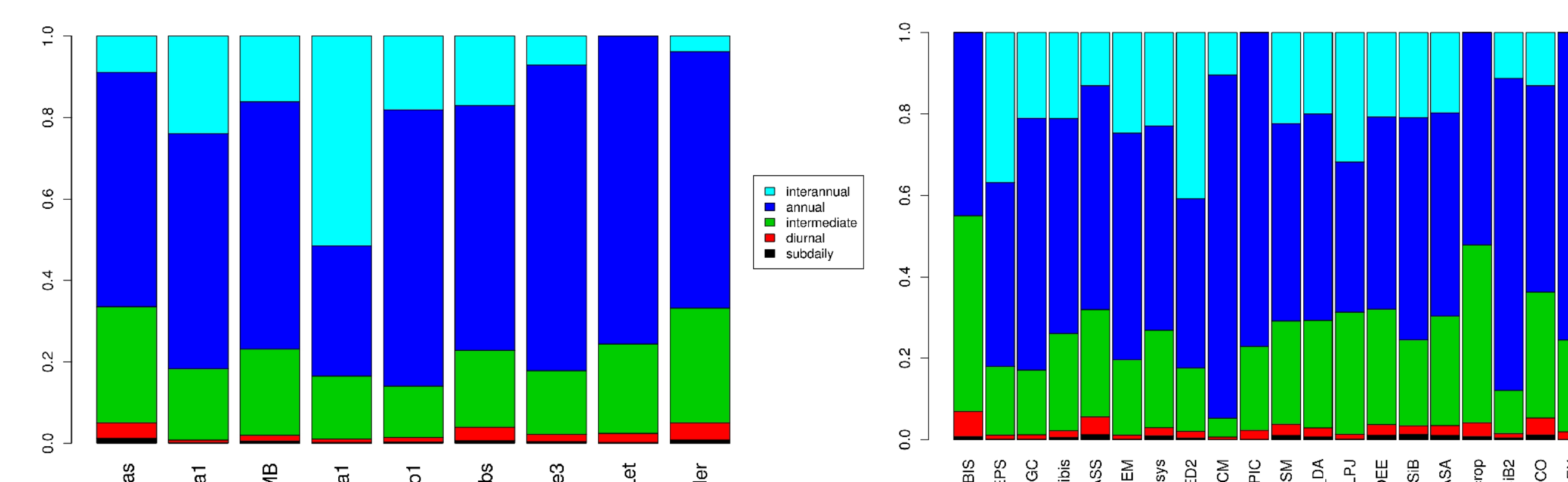


Figure 4: Proportion of model error at different periods by site (A) and by model (B)

- Significant model by band effect but a non-significant model by site effect suggests models show consistent error patterns.
- Consistent site and site by band effects but not a clear biome or spatial pattern to the cross-site variability

Site-level Spectra

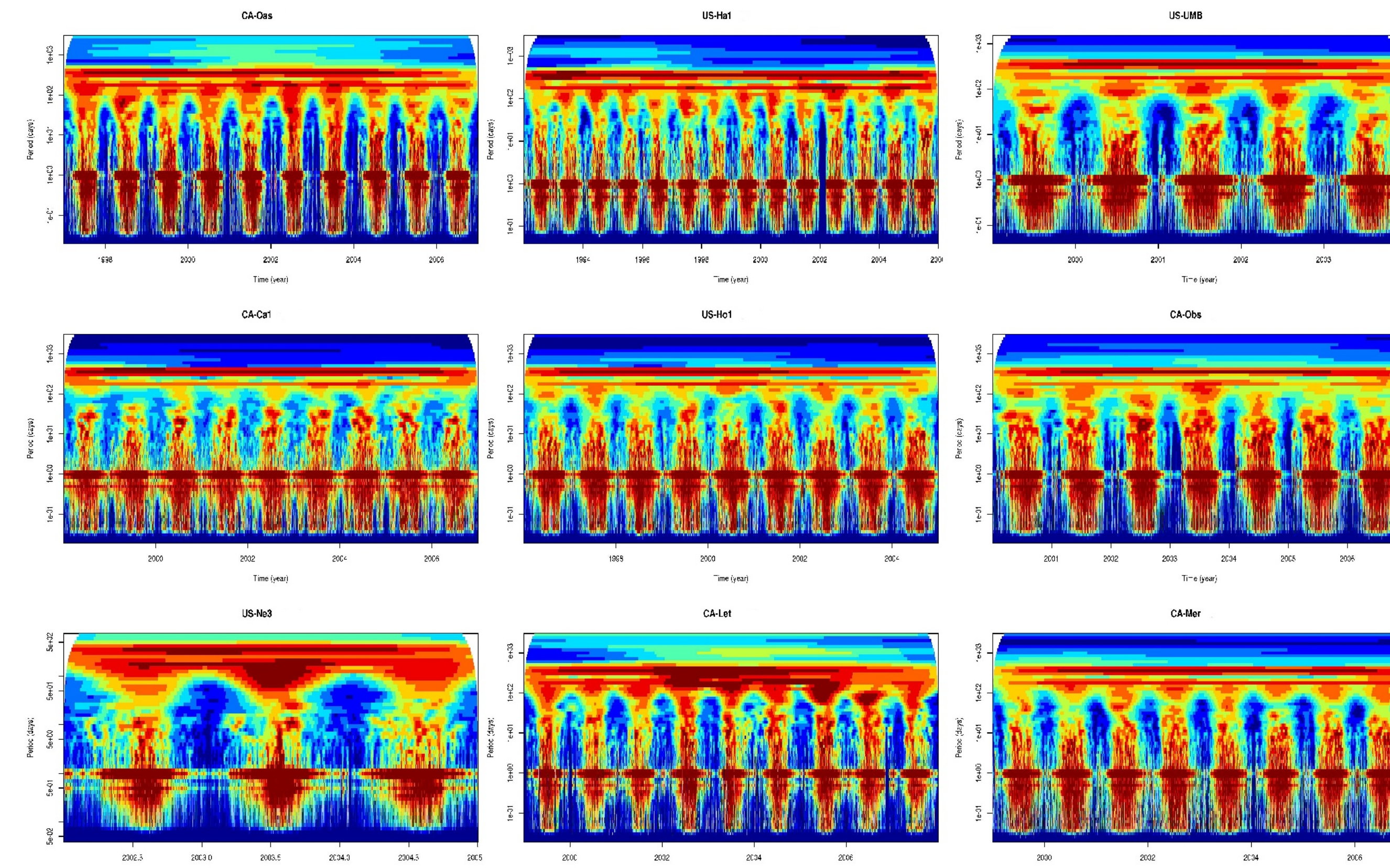


Figure 5: Normalized full spectra for each site averaging across all models

- Spectra show that errors at intermediate time scales are “event driven” and shared among models.
- Diurnal errors are primarily in the growing season

Conclusions

Spectral analysis helps clarify when and where models fail, and provides guidelines for prioritizing efforts to improve our collective modeling capacity. Modeling priorities are:

- 1) Annual cycle
- 2) Growing season diurnal cycles
- 3) Identification and attribution of synoptic error events

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