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Disparate energy sources for slow and fast Dansgaard–Oeschger cycles

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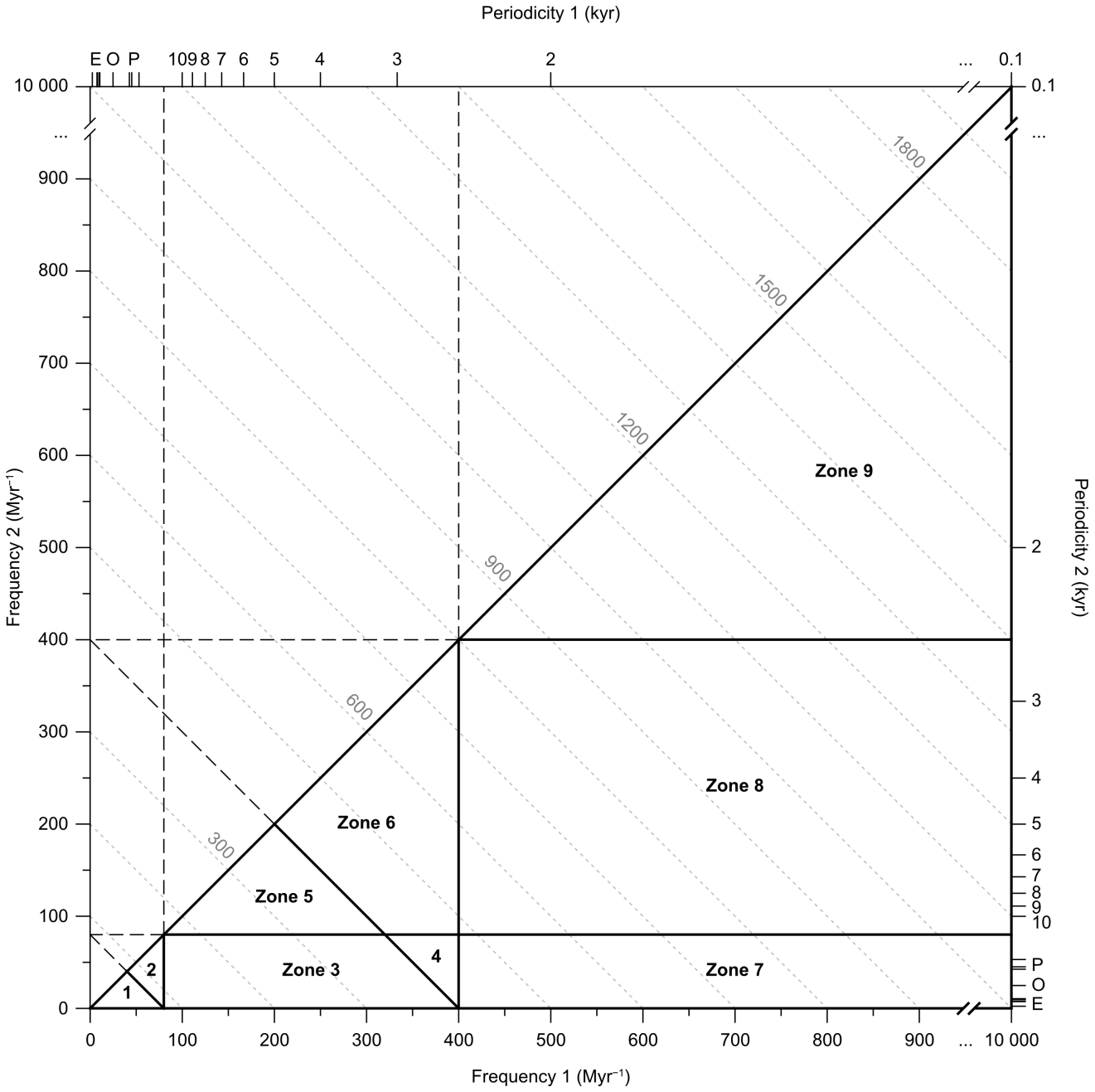
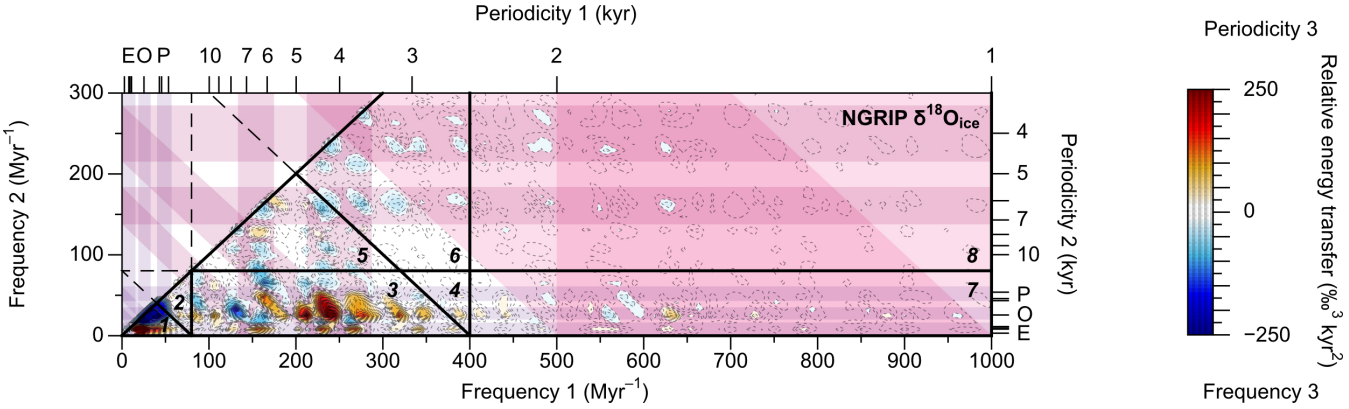


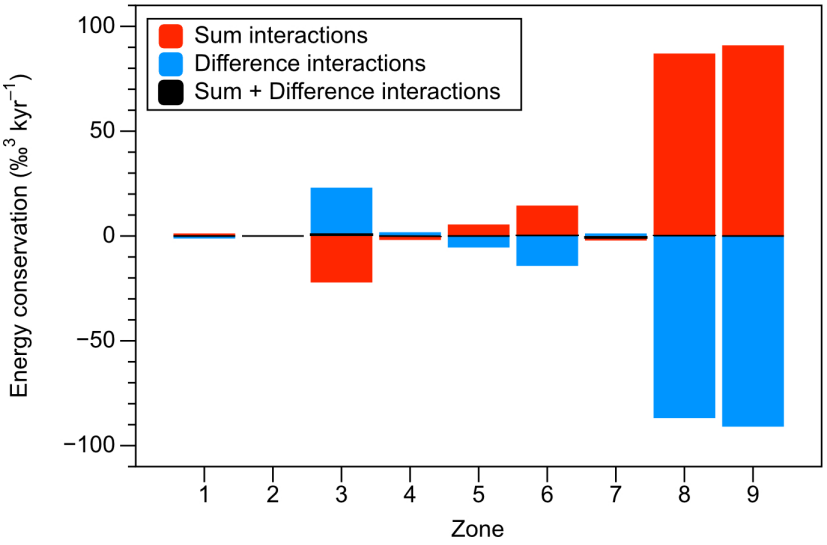
Supplementary Figure S1. Bispectral zonation scheme. Zone 1: B^{Im}(A, A, A), Zone 2: B^{Im}(A, A, $\mathrm{DO_S}$), Zone 3: B^{Im}($\mathrm{DO_S}$, A, $\mathrm{DO_S}$), Zone 4: B^{Im}($\mathrm{DO_S}$, A, $\mathrm{DO_F}$), Zone 5: B^{Im}($\mathrm{DO_S}$, $\mathrm{DO_S}$, $\mathrm{DO_S}$), Zone 6: B^{Im}($\mathrm{DO_S}$, $\mathrm{DO_S}$, $\mathrm{DO_F}$), Zone 7: B^{Im}($\mathrm{DO_F}$, A, $\mathrm{DO_F}$), Zone 8: B^{Im}($\mathrm{DO_F}$, $\mathrm{DO_S}$, $\mathrm{DO_F}$), and Zone 9: B^{Im}($\mathrm{DO_F}$, $\mathrm{DO_F}$, $\mathrm{DO_F}$). "A" stands for astronomical periodicities, "$\mathrm{DO_S}$" stands for slow DO periodicities, and "$\mathrm{DO_F}$" stands for fast DO and centennial periodicities. The boundary between astronomical and slow DO cycles is set at f = 80 $\mathrm{Myr^{-1}}$ (i.e. p = 12.5 kyr), and between slow DO and fast DO (and centennial) cycles at f = 400 $\mathrm{Myr^{-1}}$ (i.e. p = 2.5 kyr). Frequency 3 (i.e. f_3) is represented as diagonal lines in the bispectrum on the linear–linear scale, and f_3's values can be read off by summing f_1 and f_2 at any point along a diagonal.

Zone	Difference Frequency 1	Difference Frequency 2	Sum Frequency 3	Bispectral notation
Zone 1	Astronomical cycles	Astronomical cycles	Astronomical cycles	B(A, A, A)
Zone 2	Astronomical cycles	Astronomical cycles	Slow DO cycles	B(A, A, DO_S)
No zone	Astronomical cycles	Astronomical cycles	Fast DO and centennial cycles	N/A
No zone	Slow DO cycles	Astronomical cycles	Astronomical cycles	N/A
Zone 3	Slow DO cycles	Astronomical cycles	Slow DO cycles	B(DO_S, A, DO_S)
Zone 4	Slow DO cycles	Astronomical cycles	Fast DO and centennial cycles	B(DO_S, A, DO_F)
No zone	Slow DO cycles	Slow DO cycles	Astronomical cycles	N/A
Zone 5	Slow DO cycles	Slow DO cycles	Slow DO cycles	B(DO_S, DO_S, DO_S)
Zone 6	Slow DO cycles	Slow DO cycles	Fast DO and centennial cycles	B(DO_S, DO_S, DO_F)
No zone	Fast DO and centennial cycles	Astronomical cycles	Astronomical cycles	N/A
No zone	Fast DO and centennial cycles	Astronomical cycles	Slow DO cycles	N/A
Zone 7	Fast DO and centennial cycles	Astronomical cycles	Fast DO and centennial cycles	B(DO_F, A, DO_F)
No zone	Fast DO and centennial cycles	Slow DO cycles	Astronomical cycles	N/A
No zone	Fast DO and centennial cycles	Slow DO cycles	Slow DO cycles	N/A
Zone 8	Fast DO and centennial cycles	Slow DO cycles	Fast DO and centennial cycles	B(DO_F, DO_S, DO_F)
No zone	Fast DO and centennial cycles	Fast DO and centennial cycles	Astronomical cycles	N/A
No zone	Fast DO and centennial cycles	Fast DO and centennial cycles	Slow DO cycles	N/A
Zone 9	Fast DO and centennial cycles	Fast DO and centennial cycles	Fast DO and centennial cycles	B(DO_F, DO_F, DO_F)

Supplementary Table S1. Bispectral zones. Zones correspond to Supp. Fig. S1. Certain combinations between the three periodicity bandwidths are listed but do not occur in the bispectrum. These interactions, marked by "N/A", can be excluded as potential energy-transfer pathways.



Supplementary Figure S2. Bispectrum of the NGRIP $\delta^{18}O_{ice}$ record. The imaginary part of the bispectrum of the NGRIP $\delta^{18}O_{ice}$ record. As in main Fig. 2, but here plotted on a linear–linear scale.



Supplementary Figure S3. Energy conservation (i.e. conservativity) of sum and difference interactions for each zone of the imaginary part of the bispectrum of the NGRIP $\delta^{18}O_{ice}$ record.