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TI: A Common Mechanism of Multi-timescale Abrupt Global Change
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AB: The La Nina phase of the El Nino/Southern Oscillation (ENSO) is known to cause global cooling on inter- annual timescales through changes in deep convection patterns and reduced supply of water vapor to the tropical atmosphere. Two distinct means are presented here by which this mechanism may also act on timescales exceeding 100,000 years. Firstly, the hypothesis of millennial tidal forcing is revisited with the view that equatorial buoyancy frequencies and steep internal waves in the Pacific Equatorial Undercurrent make vertical mixing in the equatorial Pacific uniquely susceptible to incremental changes in tidal energy. Hourly Tropical Ocean Array subsurface temperature data show a resonant response to extreme tides associated with the 1997 and 2000 ENSO events. Complimenting the known 1,800 year peak tide cycle, a 550-600 year cycle of three-fold variation in the frequency of deep central eclipses (gamma < 0.05) is consistent with the timing of the Little Ice Age. Fortnightly eclipse triples (FET's) associated with this eclipse cycle are shown to coincide with both warm and cold phase Southern Oscillation Index (SOI) inflection points between 1876 and 2007, and notably the cold phase maxima of 1904 and 1917. In the second proposed trigger, southward migration of the intertropical convergence zone (ITCZ) in the central and eastern Pacific may periodically shift the rising branch of the Hadley circulation over the equatorial cold tongue. The resulting winter monsoon system develops an equatorially symmetric La Nina (ESLN) mode through a positive feedback between diverging surface winds and meridional rather than zonal SST gradients. Exchange of latent heat in the winter monsoon contracts the Hadley Cell, draws circumpolar westerly winds equatorward, and expands high latitude ice volume, as demonstrated in 1998. A three million year record of obliquity and August 10°N minus 10°S insolation (AUG10N-S) shows an ice volume dependence upon the mutual direction of change of these signals (rather than upon their quantity). This suggests an orbitally driven north-south ITCZ oscillator in which increasing August insolation at 10°N steepens the cross-equator meridional temperature gradient and strengthens the annual cycle when damped by southern hemisphere thermal inertia, and vice-versa. Increasing Aug10N-S is shown to constrain rapid ice loss (ESLN off). Conversely, declining AUG10N-S coupled with declining obliquity less than 23.5° triggered or maintained glaciation in 44 of 49 cases (ESLN on). The above tidal forcing means may additionally act on precessional timescales because the FET cycle has a seasonal maximum at aphelion, with a possible greatest effect when combined with equinoctial tides. Also, the lunar day at new moons is shorter (closer to 24 hours) at each equinox, thereby extending periods of luni-solar resonance at those peak tides. Tidal forcing may vary further with 100,000 and 400,000 year eccentricity cycles, both directly and by perturbation of the Moon's orbit, and through possible secular changes in the Saros cycle. It is proposed that an equatorially symmetric ITCZ is the necessary condition for a cold phase response to tidal forcing.
UR: http://www.johnduke.com
DE: 1605 Abrupt/rapid climate change (4901, 8408)
DE: 4490 Turbulence (3379, 4568, 7863)
DE: 4522 ENSO (4922)
DE: 4901 Abrupt/rapid climate change (1605)
DE: 4946 Milankovitch theory
SC: Paleoceanography and Paleoclimatology [PP]
MN: 2008 Fall Meeting