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Interannual, synchronized oscillations over the North Atlantic, Eastern Mediterranean and Ethiopian Plateau

Y. Feliks (1), **M. Ghil (2)**

(1) Department of Mathematics, Israel Institute for Biological Research, P.O.Box 19, Ness Ziona, Israel; feliks@iibr.gov.il, (2) Department Terre-Atmosphere-Ocean, Ecole Normale Superieure, and Laboratoire de Meteorologie Dynamique (CNRS and IPSL), Paris, France, ghil@lmd.ens.fr; and Department of Atmospheric and Oceanic Sciences and Institute of Geophysics and Planetary Physics, University of California, Los Angeles, CA 90095-1565

We examine climatic teleconnections between the North Atlantic (NA), Eastern Mediterranean (EM) and Ethiopian Plateau by cross-spectral analysis of climate proxies from these regions. The records analyzed include: the NA oscillation index (NAOI) (175 yr), the Nile River's annual high-water marks (1300 yr), the monthly precipitation amounts for Jerusalem (133 yr) and Beirut (80 yr), and tree-ring widths in Northern Israel (209 yr). The last three records are clearly affected by and represent EM climate variations, while Nile River water levels represent mostly precipitation over the Ethiopian Plateau. Several periodicities are prominent and statistically significant in these records: (i) 2.2 and 4 yr in all the records examined here; (ii) 7.8 yr in the Nile River records, Jerusalem precipitation, tree rings and the NAOI; (iii) 9.2 and 4.5–5 yr in Beirut precipitation and tree rings, with the 5-yr peak also found in the NAOI; (iv) 14 yr in Jerusalem precipitation and tree rings; and (v) 3.1 yr in the Nile River records, NAOI and Jerusalem precipitation.

The teleconnectivity between climate variability in the three regions of interest is analyzed in terms of synchronization between nonlinear oscillators. The 7.8-yr oscillatory mode found in the NAOI, Nile records, Jerusalem precipitation and tree rings is completely synchronized, indicating strong coupling between the climate over the NA, EM and Ethiopian Plateau at this frequency. We assume that this oscillatory mode is induced in the NA by the 7–8-yr oscillation in the meridional position of the Gulf Stream front. Possible teleconnection mechanisms between these regions will be discussed.

The 4-yr oscillatory mode in the NAOI and the Nile river records is completely syn-

chronized, indicating fairly substantial coupling between the NA and the Ethiopian Plateau, probably via an Indo-Pacific–ENSO mode. On the other hand, the phase difference in this frequency band between the NA and EM records changes randomly and the correlation between their amplitudes is small, indicating only weak coupling between these two regions at this frequency. The 14-yr oscillation found in Jerusalem precipitation and tree rings is completely synchronized, indicating the rain's strong influence on tree growth in the EM. In the tree-ring records, the interdecadal oscillations are stronger than the interannual oscillations, suggesting that the tree's growth processes act like a low-pass filter.