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The lunar semidiurnal air pressure tide in in-situ data and ECMWF reanalyses

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A gridded empirical model of the lunar semidiurnal air pressure tide L_2 is deduced through multiquadric interpolation of more than 2000 globally distributed tidal estimates from land barometers and moored buoys. The resulting climatology serves as an independent standard to validate the barometric L_2 oscillations that are present in ECMWF's (European Centre for Medium-Range Weather Forecasts) global atmospheric reanalyses despite the omission of gravitational forcing mechanisms in the involved forecast routines. Inconsistencies between numerical and empirical L_2 solutions are found to be small even though the reanalysis models typically underestimate equatorial peak pressures by 10–20% and produce slightly deficient tidal phases in latitudes south of 30°N. Through using a time-invariant reference surface over both land and water and assimilating marine pressure data without accounting for vertical sensor movements due to the M_2 ocean tide, ECMWF-based tidal solutions are also prone to strong local artifacts. Additionally, the dependency of the lunar tidal oscillation in atmospheric analysis systems on the meteorological input data is demonstrated based on a recent ECMWF twentieth-century reanalysis (ERA-20C) which draws its all of its observational constraints from in-situ registrations of pressure and surface winds. The L_2 signature prior to 1950 is particularly indicative of distinct observing system changes, such as the paucity of marine data during both World Wars or the opening of the Panama Canal in 1914 and the associated adjustment of commercial shipping routes.