nature climate change

SUPPLEMENTARY INFORMATION

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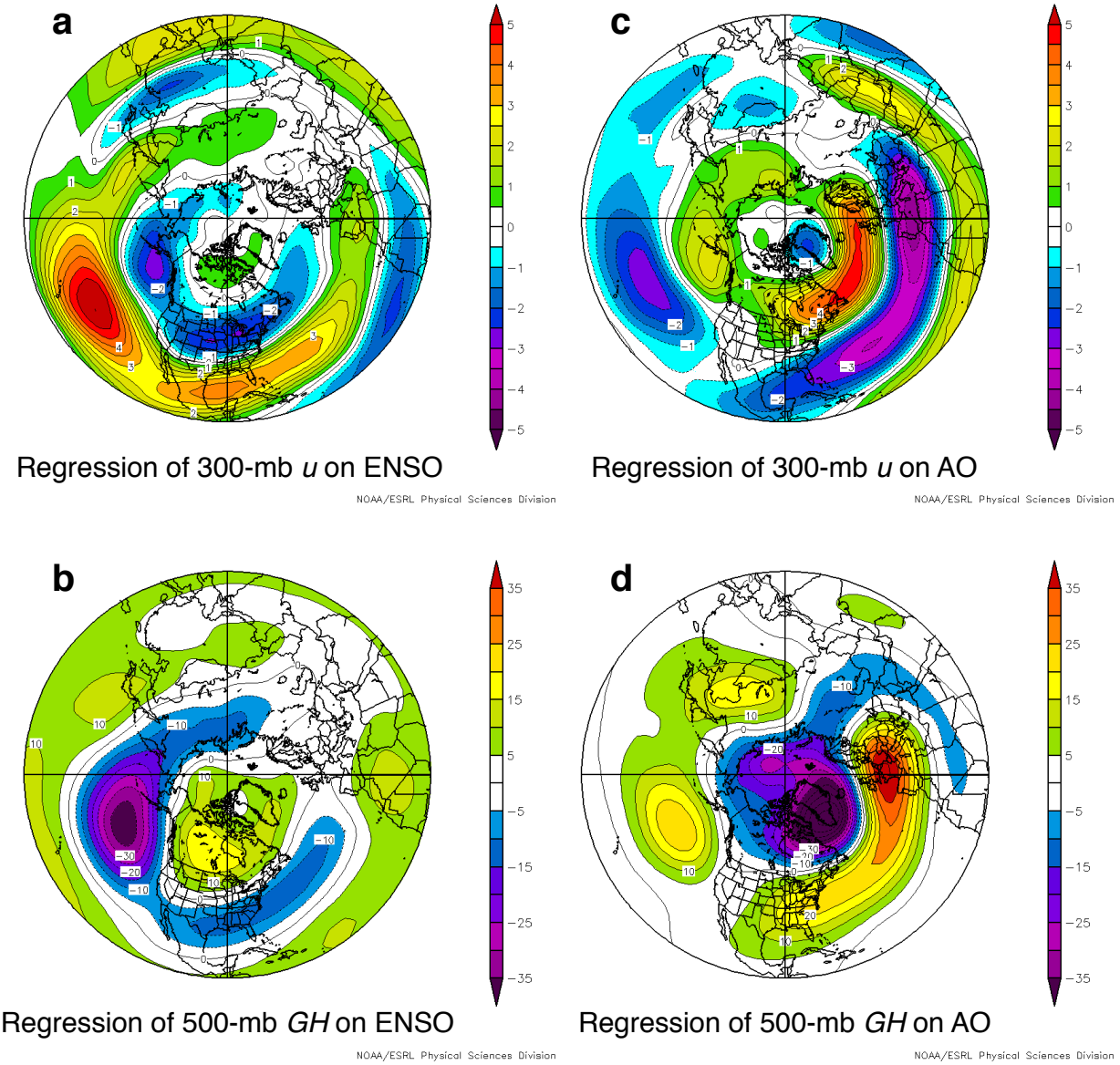
Coupling between air travel and climate

Title: Supplementary Figure 1 (Jet_FigS1.pdf)
Summary: **ENSO and Arctic Oscillation.** Regression of Northern Hemisphere wintertime **a**, 300–mb zonal wind (m s^{-1}) and **b**, 500–mb geopotential height (m) on the NINO3.4 index from the NCEP/NCAR Reanalysis (1949–2010). **c**, **d**, As in **a**, **b** but for the Arctic Oscillation (AO) index. Plots created on NOAA/ESRL website (http://www.esrl.noaa.gov/psd/data/correlation/).
Format: PDF
Size: 519 KB



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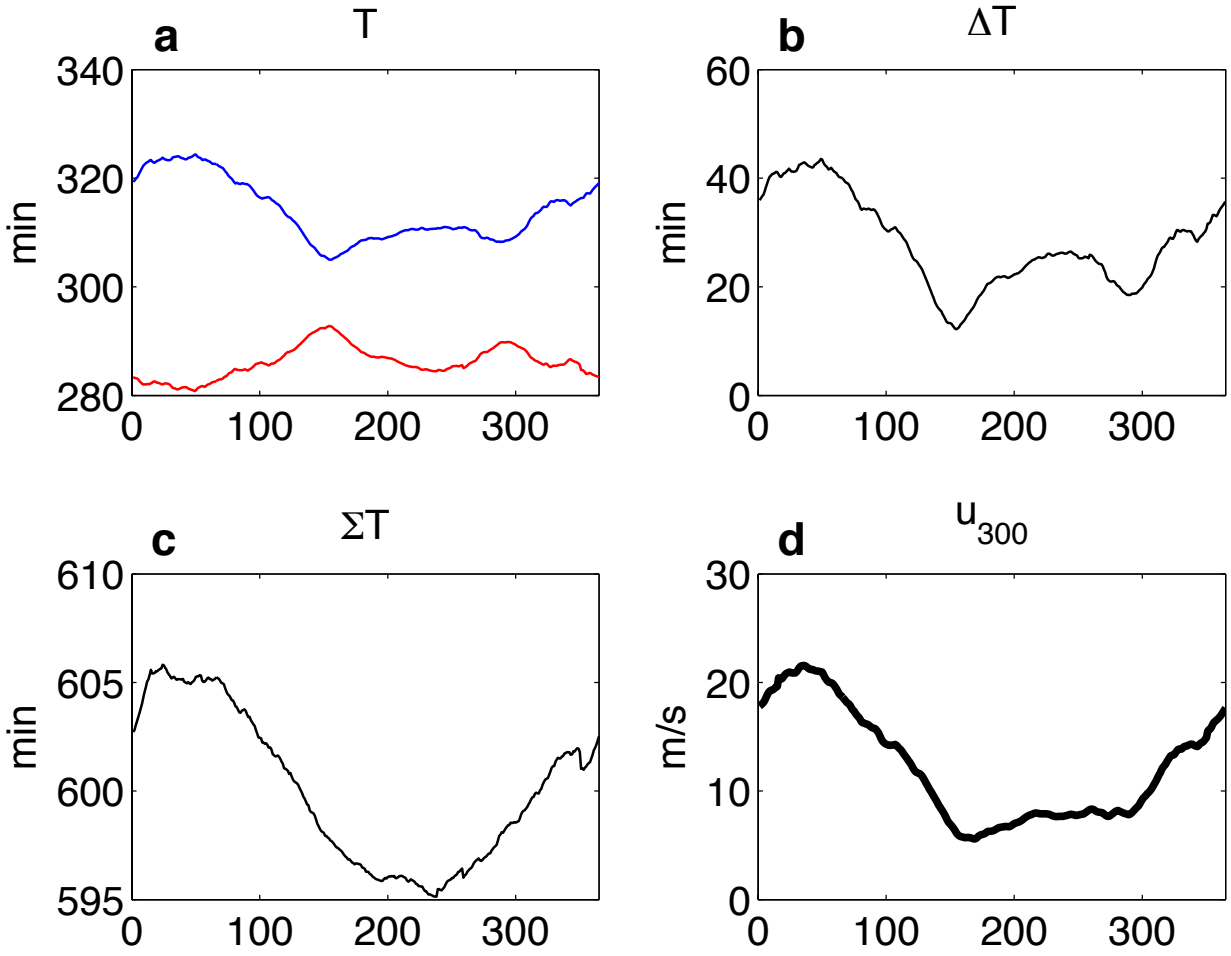
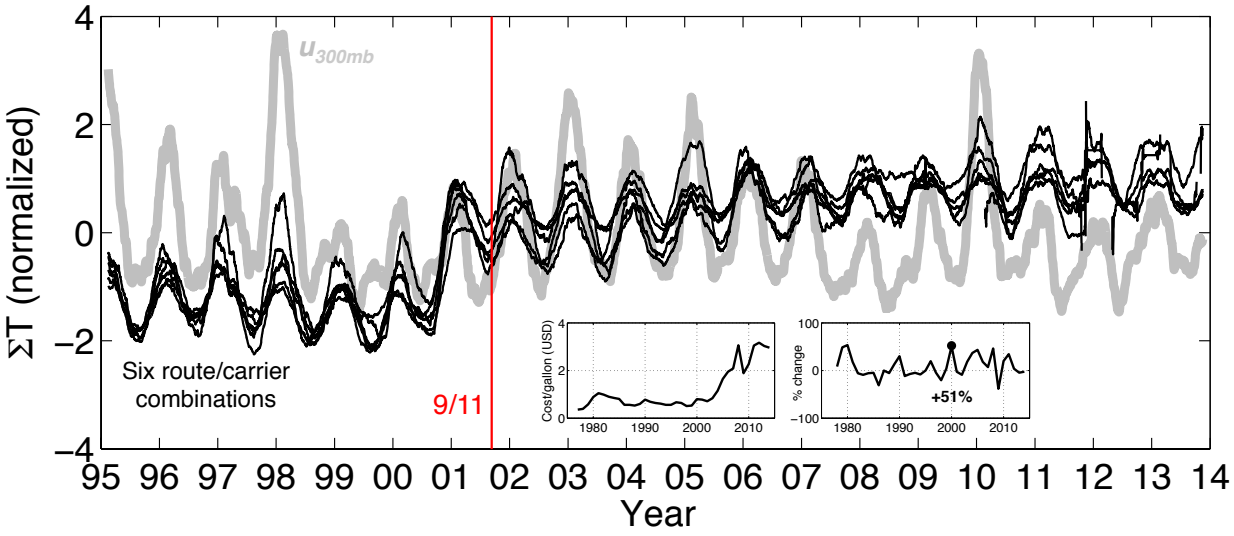
Title: Supplementary Figure 2 (Jet_FigS2.pdf)
Summary: **Annual cycles. a**, Annual cycle of westbound (blue) and eastbound (red) flight time (T) between HNL and LAX (United). **b**, Annual cycle of the flight time difference between westbound and eastbound legs (ΔT) for the HNL–LAX route (United). **c**, As in **b** but for the total round–trip flying time (ΣT). **d**, Annual cycle of the 300–mb zonal wind averaged between Hawaii and the continental U.S. (u_{300mb} index). Quantitatively similar results are found for other routes.
Format: PDF
Size: 108 KB



Title: Supplementary Figure 3 (Jet_FigS3.pdf)
Summary: **Shift in mean *ΣT*.** Each black line is a seasonally smoothed (91–day running mean) time series of the total round–trip flying time (ΣT) for one route/carrier combination. The routes and carriers shown are HNL/SFO (UA), HNL/SFO (AA), HNL/LAX (AA), HNL/LAX (DL), HNL/DFW (AA), and HNL/ORD (AA). All time series are individually normalized (subtract the mean, divide by the standard deviation) to illustrate that the timing of the shift in mean ΣT was systematic and synchronous regardless of route or carrier. The red line marks September 11, 2001, shown to illustrate that the systematic shift in mean ΣT (toward net longer round–trips) occurred roughly one year prior to that date. Also shown is the seasonally smoothed u_{300mb} index (gray line), to illustrate that the shift in mean ΣT was not caused by a shift in the mean strength of upper–level winds. The annual price per gallon (and percent change) of jet fuel is shown as inset on the bottom–right of the figure. Historical fuel cost and consumption data from TranStats, Bureau of Transportation Statistics, Research and Innovation Technology Administration, U.S. Department of Transportation (http://www.transtats.bts.gov/FUEL/Fuel_Hist.aspx).
Type: PDF
Size: 411 KB



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Title: Supplementary Figure 4 (Jet_FigS4.pdf)
Summary: **Changes in variability. a**, Observed daily–scale u_{300mb} for 1995–1999 (to show detail). Daily–scale is defined as the departure from the 7–day running mean. **b**, as in **a** but for the flight time from LAX to HNL (United). **c**, Annually smoothed AO index (inverted). **d**, Annually smoothed 90–day running variance of daily–scale u_{300mb}. **e**, Histogram of CMIP5 projected trends in 10–year running variance of monthly u_{300mb} under the IPCC AR5 RCP8.5 future forcing experiment (2006–2100). **f**, As in **e** but for monthly u_{300mb} anomalies (mean seasonal cycle removed). **g**, Mean seasonal cycle of u_{300mb} in CMIP5 models (thin lines) and the multi–model mean (thick line). **h**, Projected trends in u_{300mb} by CMIP5 models as a function of calendar month (thin lines) and the multi–model mean (thick line).
Type: PDF
Size: 564 KB