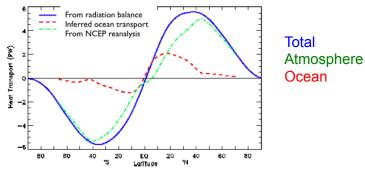


Actual Ocean Currents 90 Ocean current Summary 60 If we know the zonal winds, we know the ocean currents The zonal winds are mainly set by Planet rotation rate (24 hrs) Distance to the Sun 30 Gross greenhouse gas concentration (within a factor of 10 or so of today's concentration) Smaller contributions due to large mountains (Rockies, Tibet, Andes) and E-W differences in land/ocean heating 40 m/s -20

Circulation moves excess energy from Equatorial to polar regions

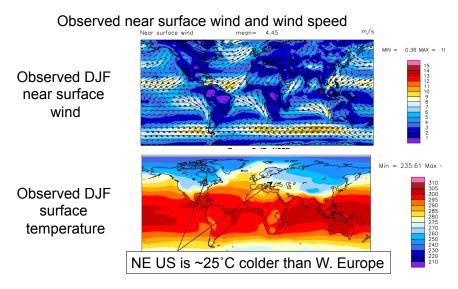
Northward Energy Transport



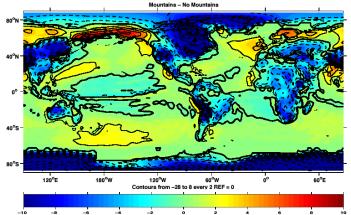
Ocean does most of the transport in the deep tropics (15°S-15°N)

Atmosphere (midlatidue storms) does most of the transport poleward of 30°N,S

Role of the Major Mountain Ranges



The impact of mountains on DJF temperature



Without the Rockies, the Northeast US would be ~ 12 $^{\circ}\text{C}$ warmer and Alaska would be 8-10 $^{\circ}\text{C}$ colder

Europe is "warm" in winter because of the Rockies and *atmospheric* heat transport Seager et al 2002

Why is Europe warm in winter (compared to New England)?

Europe minus NE Temperature (DJF)

Observed	25°C
The Rockies	12°C
Westerlies blowing over wet motionless ocean	12°C
Gulf Stream (ocean currents)	1°C
Total	25°C

Mountains and Rotation of Earth Matter

DJF Climate on a Backward Rotating Earth

