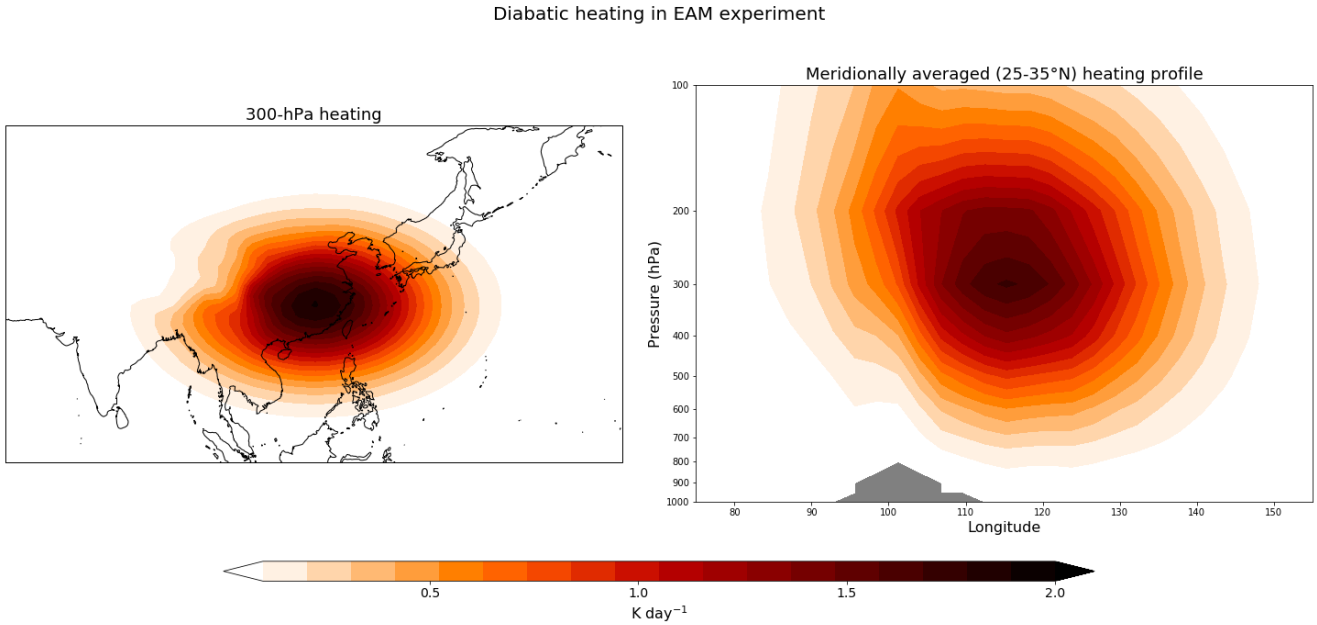
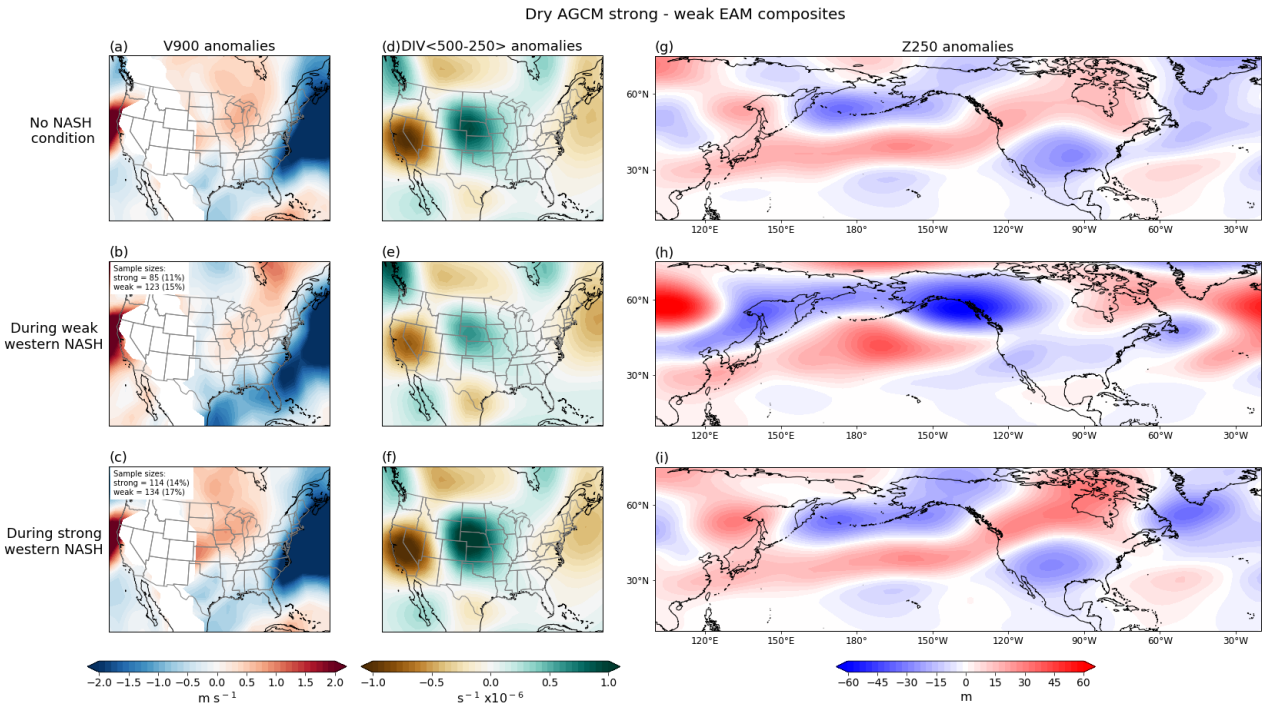
Supplementary Material

Supplementary Table 1: List of months that went into Figure 1 and 2 difference composites, with red (blue) font color distinguishing between El Niño (La Niña) months defined by the Oceanic Niño Index (ONI) centered around previous month (e.g. June linked with April-May-June ONI value). No color indicates neutral ENSO conditions.

	Weak EAM	**Strong EAM**
Weak NASH	6/1979, 6/1981, 7/1981, 6/1997, 7/2000, 7/2004, 6/2005, 8/2006, 8/2007, 7/2008, 6/2009, 8/2011, 6/2012	8/1979, 7/1980, 6/1983, 7/1983, 7/1984, 7/1987, 6/1988, 6/1995, 8/1998, 7/2005, 7/2007, 8/2008
Strong NASH	7/1988, 6/1990, 7/1994, 8/1994, 8/1997, 7/2002, 6/2004, 8/2004, 6/2013, 7/2017, 6/2018, 7/2018, 8/2018	7/1986, 7/1991, 7/1992, 8/1993, 7/1996, 6/1998, 6/2000, 7/2003, 8/2003, 6/2015, 6/2016, 7/2019



Supplementary Figure 1: Diabatic heating in strong EAM experiment (left) at 300 hPa and (right) meridionally averaged between 25°N and 35°N. Weak EAM experiment has equivalent structure, but of the opposite sign (negative diabatic heating).



Supplementary Figure 2: Same format as Fig 2, but with 500-250-hPa layer-averaged divergence anomalies instead of precipitation anomalies.