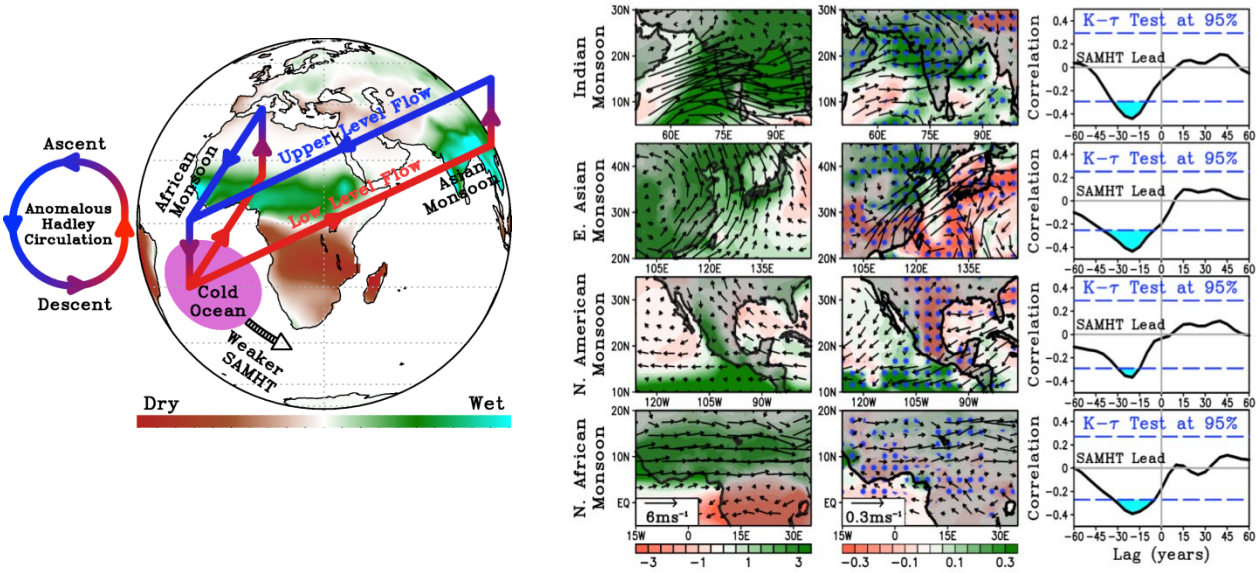
Meridional heat Transport in the South Atlantic reveals links with global monsoons

Hosmay Lopez, Shenfu Dong, Sang-Ki Lee and Gustavo Goni

Although the majority of efforts to understand the dynamics of the Atlantic Meridional Overturning Circulation (AMOC) and its climate and weather impact are focused on the North Atlantic, recent studies have suggested the possibility of the southern origin of the anomalous AMOC and associated meridional heat transport in the Atlantic. The objective of this study is to illustrate that multi-decadal variability of South Atlantic meridional heat Transport (SAMHT) plays a key role in modulating global atmospheric circulation via its influence on interhemispheric redistributions of momentum, heat, and moisture. Weaker SAMHT at 30°S produces anomalous ocean heat divergence over the South Atlantic, resulting in cooler ocean surface temperature about 20 years later. This drives an anomalous Hadley circulation, transporting atmospheric heat from the Northern Hemisphere (NH) to the Southern Hemisphere (SH) and moisture from the SH to the NH, thereby modulating global monsoons. This study illustrates that decadal variations of SAMHT could modulate the strength of global monsoons with about 20 years in advance, suggesting that SAMHT is a potential predictor of global monsoon variability. In summary, all NH summer monsoons are enhanced during a weaker SAMHT. The results presented in this study highlight the need and value of sustained ocean observational efforts, necessary to improve our knowledge of the complex interaction between the South Atlantic Ocean and global climate variability and monsoons.

a) *b)*



a) *Illustration of the role of weaker-than-normal SAMHT in atmospheric circulation at 20 years lead-time. Weakened SAMHT is shown by thick black arrow. This results in a cooler than normal South Atlantic Ocean (purple shade) which produce an anomalous Hadley circulation labeled by counterclockwise circulation. The lower branch of the circulation (red arrow) brings warm and moist air from the Southern Hemisphere (SH) to the Northern Hemisphere (NH). This circulation sense produces ascent and precipitation in the NH thus enhancing the NH monsoons.* ***b)*** *(left-column) seasonality of precipitation and 850mb winds for the monsoon regions. (middle-column) composite difference of JJAS precipitation (shaded) and 850mb wind for each monsoon region with respect to weak minus strong SAMHT at lead-time 20 years after the anomalous SAMHT. Blue stipples indicate regions where n differences are significant at 95% confidence level. (right-column) Lag-lead Spearman ranked correlation between SAMHT and NH monsoon index. The blue dashed lines depict the 95% significance level. Negative lag indicates periods when SAMHT leads the NH monsoon index. Periods with significant correlation between the SAMHT and monsoon are shaded blue.*