Climate variability and change and the role of Earth's energy budget

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Introduction
A range of satellite products are used to monitor and assess current changes in the global energy and water cycles and evaluate climate simulations

1. Monitoring global temperature, water vapour, precipitation & energy budget
Global mean deseasonalised anomalies of (a) surface temperature, (b) atmospheric water vapour (column integrated, \( W \) and surface specific humidity, \( q \)), (c) precipitation and (d) net downward top of atmosphere radiative energy imbalance for a range of surface/satellite-based products & atmosphere-only simulations after Allan et al. (2014)

2. Energy budget response to volcanic eruptions

3. Atlantic heat transport
Satellite/reanalysis surface energy flux product (right, \( \text{Wm}^{-2} \)) indicates heat transport north of 1.2 PW (Liu et al., above).

4. Southern ocean climate model biases
Comparing AMIP/CMIP simulations with satellite/reanalysis derived surface energy fluxes allows climate model biases to be traced back to the atmosphere component involving clouds and ocean/wind feedbacks (Hyder et al. 2018, above).

5. Small indirect aerosol-cloud water interactions?
Aqua/MODIS satellite data indicate volcanic aerosol haze brightens low altitude clouds, a cooling influence on the climate (top), but further indirect effects on cloud water are undetectable (bottom). Results can help to improve the accuracy of climate change projections of importance for policy decisions (Malavelle et al. 2017)

References
Schmidt et al. (2018) Volcanic radiative forcing from 1979 to 2015, submitted to JGR

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