

Moisture Sources, moisture transport and continental recycling in the East Asian Monsoon

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South East China has some of the most important climate proxy records on the past monsoon. Knowledge about moisture sources, transport and recycling is important when interpreting stable isotope concentrations from such speleothems as proxy data for past hydroclimate. Even though speleothems usually have annual resolution, the seasonal transition contributes to the annual signal and its variability also needs to be considered in their interpretation.

Using the Lagrangian model FLEXPART and the diagnostic tool WaterSip with wind and humidity from ERA Interim reanalysis as input, the moisture transport to three regions of China where rainfall is dominated by the East Asian Monsoon is diagnosed from evaporation to precipitation for each rain event in the period 1979-2013. Through calculation of moisture budgets along the air parcel trajectories on a 6h time scale we obtain a quantitative estimate for contribution of surface evaporation to the target region precipitation.

We find that the differences of moisture sources between months belonging to different seasons are large in the 34 year climatology. Both moisture sources and transport characteristics change strongly with the seasonal progression of the East Asian Monsoon. The westernmost and farthest source regions contribute during the peak of the monsoon. In July the mean transport distance for South China is 2400 km, compared to a whole year mean of 2100 km in this region. The transport time over these distances is rather short with close to 4 days from evaporation to precipitation. Land contributions (continental recycling) vary strongly with season and subregions, with values as low as 35% for an autumn month in South China, compared to 98% in a spring month in the upper reaches (west) of the Yangtze River. The important role of continental recycling partly explains the short average transport distances and atmospheric transport times.

A key result from our approach is that local land areas are important sources for all months and regions; albeit the amount varying with season and region. While most moisture is supplied from surrounding land areas, the contributions from land generally increase with distance away from the coast. This study thus suggests that precipitation in the interior of China is to an increasing degree recycled with the atmosphere on its way from an oceanic source to the precipitation region. We discuss potential implications for the interpretation of paleo monsoon records.