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Anomalies of evaporation over the oceanic moisture sources of Atmospheric Rivers reaching the Arctic

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It is know that there are several mechanisms related to ice melting in which the transport of moisture is involved. In the last decade, some papers showed that there is an enhancement of the poleward moisture transport, and this fact is related with the ice melting. The reduction in the ice cover reaches its maximum during September. So, those processes, which occur previously to this month or during it, could be related with the phenomena. An anomalous intrusion of cyclones thought the Arctic has been pointed as one of the mechanism that produce an anomalous moisture transport to the region. The major mechanism that transport moisture from lower latitudes to the northern ones are the Atmospheric Rivers (ARs). In this work, we try to understand the role of ARs in the transport of moisture to the Arctic.

Based on an automated AR detection algorithm we identified the systems that reach the Arctic from 1997 to 2014 during August-September, and we used a Lagrangian analysis to identify the main areas where the moisture uptake was anomalous. We detect the ARs that occur between 55N-65N (centered in 60N –typical Arctic limits), and then we select those areas (domains) where the occurrence were higher (applying a 75th percentile threshold).

The Lagrangian analysis is based on FLEXPART (FLEXible PARTicle dispersion) model global simulation from 1979 to 2015 and was forced by ERA-Interim reanalysis (1º resolution, and 61 vertical-levels). The approach tracks atmospheric moisture along trajectories. A 3-D wind field moves a large number of air parcels resulting from the homogeneous division of the atmosphere. The specific humidity (q) and the position of all the particles are recorded at 6-h intervals. The model then calculates increases (e) and decreases (p) in moisture along each trajectory at each time step by means of variations in (q) with time: e-p=mdq/dt. The (E-P) is calculated for a given area by adding (e-p) for all particles, where E and P are the rates of evaporation and precipitation. The particles are tracked, and a database is created with values of E-P averaged and integrated over 10 days of transport (the average residence time of water vapour in the atmosphere).

This Lagrangian analysis was applied in order to identify the main areas where the moisture uptake was anomalous and contributed to the ARs. We computed the uptake of moisture for all individual ARs at all time steps, retaining only positive values of (E-P) every 6 h during the 10-days. To check whether these áreas (where the ARs take on moisture) differ from the climatology, we computed for each AR the anomaly between (E-P)>0 of the ARs and the climatology for the corresponding AR dates.