Southward Moisture Transport from Amazonia and Rainfall in SE South America

Josefina Arraut and Carlos Nobre
CCST/INPE, Av. dos Astronautas, 10758, São José – SP 12227-000

Telefone: *+55-12-3945-7120*
Email: *josefina.arraut@cptec.inpe.br*

Introduction

South America has humid subtropics with voluminous rivers and, once extensive, rainforests. A very important pathway of moisture flow towards the region is from the tropical Atlantic, into Amazonia and southwards east of the Andes to the subtropics. When over the tropical forest this moisture takes part in its hydrological cycle. The role of this flow in fuelling the development of important weather systems and their precipitation in the subtropics in southern summer is well documented in literature (see Arraut and Satyamurty 2009 and references therein).

Deforestation in Amazonia would affect the local hydrological cycle potentially altering the moisture content of the southward flow that leaves it, and the flow itself, since a change in local precipitation would alter heat release with impacts over large scale atmospheric dynamics.

Here is presented an exploratory study of the inter-relation between the moisture flow leaving Amazonia and subtropical South American rainfall in present day climate, throughout the year. The potential effects of deforestation are an important background concern to this work. This renders the dry season particularly interesting because it is when deforestation may have its largest impact over the moisture content of the southward flowing air, since the forest's evapotranspiration rates are almost constant all year round, while pastureland and commercial crops show a large decrease when the rains are less frequent (Da Rocha et al. 2009).

Data and Calculations

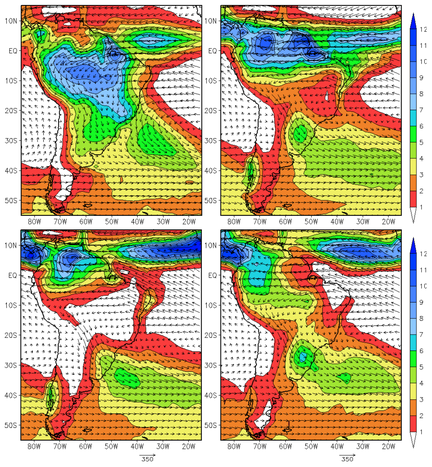
A twenty two year period was studied, from 1980 to 2001. Wind and specific humidity data were taken from ECMWF ERA40 reanalysis, at 1.125x1.125 degree spatial resolution and 6hr intervals. Vertically integrated moisture transport was calculated using:

$$QV = \int_{P_S}^{100hPa} q\vec{v}\frac{dP}{g}.$$

and monthly means calculated from 6 hourly values.

Monthly precipitation is from the Global Precipitation Climatology Project (GPCP) version II combined precipitation data set.

Preferential Pathways of Moisture Flow to Subtropical Precipitation



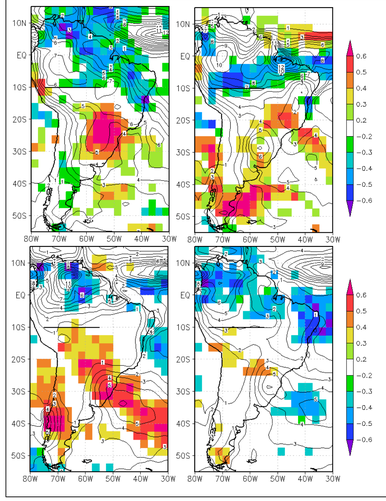
Long term mean precipitation and moisture transport for Nov-Mar, Apr-Jun, Jul-Aug, Sept-Oct.

Intense local maxima of rainfall over the continent are places of large scale moisture convergence.

If a long term mean field of moisture transport shows a preferential pathway leading into the high rainfall region, one knows that flow converges there, without calculating the (unreliable) convergence field. It is therefore often the most important pathway of moisture flow during rainfall events. In this way the weather and climate time scales are linked.

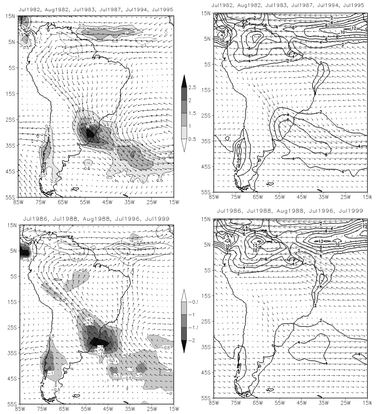
- Using long term monthly means the year was divided according subtropical rainfall patterns.
- All year round a northerly/northwesterly flow to the east of the Andes is the main pathway of moisture to subtropical precipitation.
-The contribution of flow from Amazonia varies throughout the year. During the warm season a continuous pathway forms all the way from the tropical Atlantic.

Moisture Transport from Amazonia and Subtropical Rainfall: exploratory investigation



- Moisture leaving Amazonia was represented by the mean southward flow across 10S, from 75W to 55W.
- Deseasonalized monthly values were correlated to rainfall at each point.
- Correlations above 0.95 significance level are shown in colors. For reference long term mean rainfall is shown in contours.
- Both in the rainiest and in the driest seasons correlations are above 0.5 and 0.6 in the areas of highest long term mean rainfall.
- In the two transition seasons correlations are not statiscally significant. This does not mean that moisture from Amazonia is not important, but only that it is not the limiting condition.
- The reasonably high correlations were expected in the rainiest season but less so in the driest.

Regimes of Large Scale Moisture Transport in South America?



- Rainfall and moisture transport anomalies were considered for each of the 44 months of the 22 dry seasons.
- The aim was to see what the situations giving rise to the high correlation looked like.
- Six (five) months were found when more (less) moisture transport from Amazonia was due to an intensification (weakening) of the large scale pattern of flow from the tropical Atlantic all the way to the subtropics, which in turn showed more (less) rainfall.
- **We now ask**: what gives rise to these large scale anomaly patterns? It is known that the tropical and subtropical low level winds are subject to distinct influences.
- Would the characteristics and frequency of occurrence of these situations be affected by deforestation?

Bibliography

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