

# Establishing a baseline precipitation & temperature regime for the Guianas from observations and reanalysis data

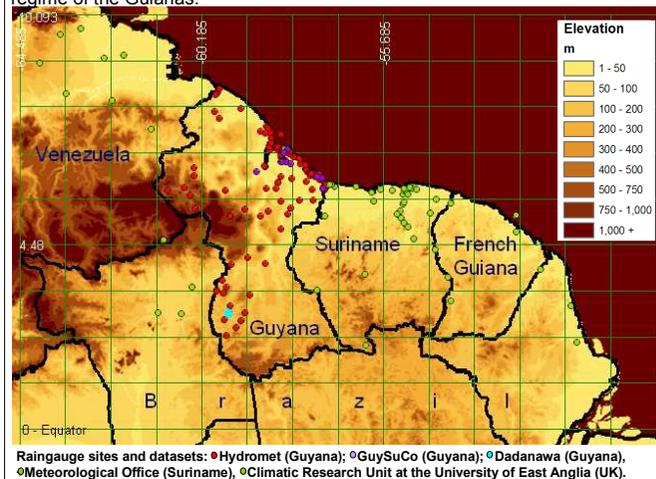
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## Introduction

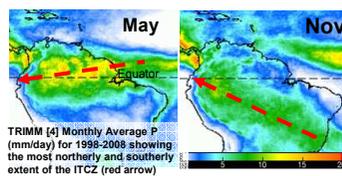
The dense, intact rainforests of the Guianas and northern Amazonia (South America) are important for the regulation of the local and regional climate. However access is limited so there is a large hydroclimatic data-gap inland [1]. The few existing observations are unevenly distributed and temporally discontinuous but show the climate to be highly spatially variable across the region. The rainforests and adjacent savannah regions may be particularly vulnerable to climate change and to increasing pressures from exploitation of the ecosystem. It is therefore important to establish a climatic baseline against which the effects of future environmental change can be compared.

To overcome the limitations in the observations, we make use of the ECMWF ERA40 reanalysis model dataset [2] which provides a spatially consistent global climate for the period 1958-2001 at a 1.125° resolution. Here, we (1) examine the limited precipitation (P) and temperature (T) datasets for the region and (2) make use of ERA40 following validation against observations, to establish the P and T regime of the Guianas.

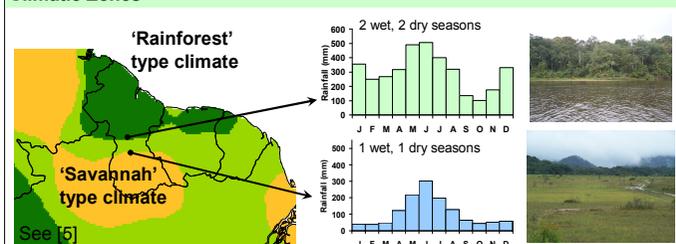


## Regional Climatic Influences

The seasonal movement of the rain-bearing Inter-Tropical Convergence Zone (ITCZ) is greater over land than sea and follows but lags the migration of the sun (see diagrams, right). The El-Niño Southern Oscillation also affects the region (resulting in drought conditions on the Guyana coast [3]).

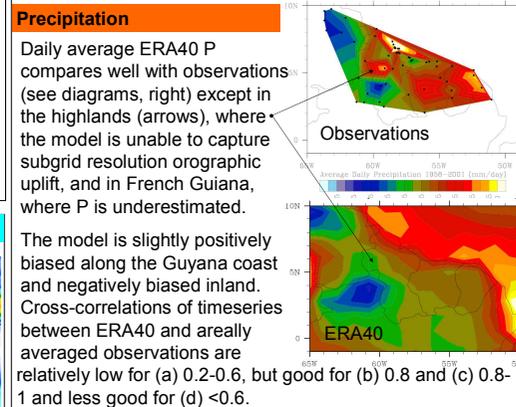
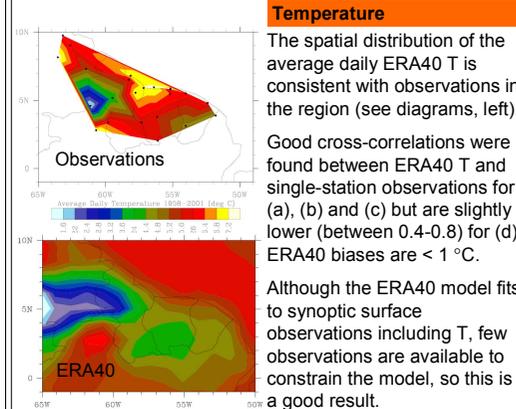


## Climatic Zones



## Comparison of ERA 40 with Observations

Validating the use of the ERA40 model for the region was carried out by comparing ERA40 T & P against observations. Specifically, cross-correlations and mean differences (biases) between ERA-40 timeseries and areally averaged P & T observations were examined for each model grid cell for (a) each year (1958-2001), (b) each month (1958-2001), (c) monthly averages (Jan-Dec), and (d) averaged monthly anomalies (b-c) timeseries. Results of the validation are summarised below.



## Summary of Validation

ERA40 is found to be able to capture the observed annual and seasonal T variation across the region well. Annual and interannual P is modelled less accurately but the model is skilful in modelling the averaged monthly P, in particular the timings, length and severity of the dry periods. This is useful for delineating growing seasons and for investigating climate-vegetation interactions and transitions.

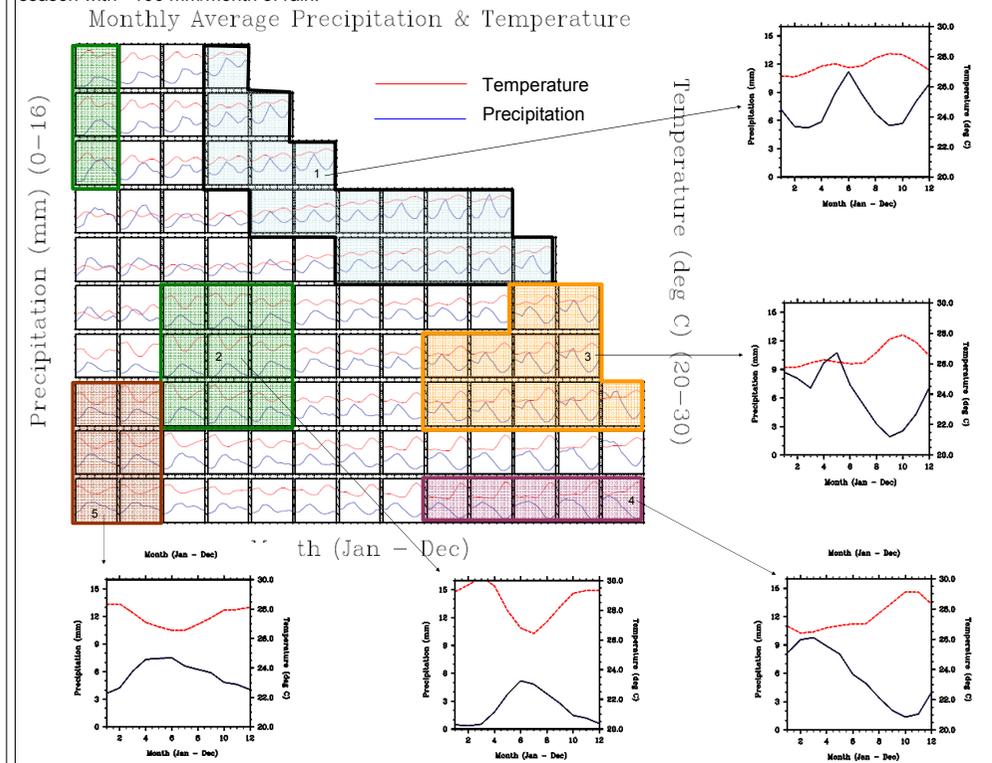
## References

[1] Bovolo C. I., Parkin G., Wagner T. 2009 Initial assessment of the climate of Guyana and the region with a focus on Iwokrama: a report for the Commonwealth Secretariat. School of Civil Engineering & Geosciences, Newcastle University, Newcastle upon Tyne, UK; [2] Uppala S. M. et al 2005 The ERA-40 re-analysis. Quarterly Journal of the Royal Meteorological Society, 131, 612, 2961-3012; [3] Wardlaw R., Jaigopal D., Rahman R. 2007 Influence of El Niño on rainfall in Guyana and Uganda. Proceedings of the Institution of Civil Engineers, Water Management 160, September, issue WM3 p135-143 [4] [http://trmm.gsfc.nasa.gov/trmm\\_rain/Events/trmm\\_climatology\\_3B43.html](http://trmm.gsfc.nasa.gov/trmm_rain/Events/trmm_climatology_3B43.html); [5] Peel M. C., Finlayson B. L., McMahon T. A. 2007 Updated world map of the Köppen-Geiger climate classification. Hydrol. Earth Syst. Sci. 11, 1633-1644;

## Averaged Monthly P and T across the region

The annual mean daily T variation over the region (approximately 25 - 27 °C +/- 3 °C) is not very large. As P has the most variation, both in annual amounts and in seasonal distribution, it is therefore used as the basis for determining regions. The following analysis therefore concentrates on P. The figure below highlights the varied regional averaged monthly P distribution on a grid-cell basis. Similar regions have been grouped and examples from each area shown.

Generally, average monthly peak P (coinciding with the average minimum T) shows a consistent spatial trend with earlier timing in the E and S linked with the twice-yearly passage of the ITCZ over the region. Coastal Guyana has a bi-modal P distribution with 2 wet seasons peaking in Jun and Dec and dry seasons in Sep-Oct and Feb-Mar. French Guiana has peak P in May but lacks the Feb-Mar dry season as the influence of the ITCZ is still strong in the area at this time. The savannah region in NE Brazil and S Guyana has a single wet season peaking in May-Jun and a dry season with <100 mm/month of rain.



## Conclusion

With the exception of sub-grid resolution mountain environments, reanalysis data is shown to provide a consistent and relatively accurate spatial distribution of key climate variables for the Guianas. The ERA40 grid-cell by grid-cell analysis of averaged monthly T and P for the Guianas is consistent with known broad climatic mapping in the region, however provides more consistent and quantitative details on the spatial variations in seasonality, particularly in areas lacking observations, thereby advancing beyond previous studies. Spatially, the seasonal distribution of P is highly variable in the region so care must be taken when averaging modelled data over large geographical areas for comparisons with gridded datasets based on few observations. This is the first comprehensive study of the recent historical climate and its variability in this area.