Assessment of Remote Sensing Based ET Estimates Over the Amazon

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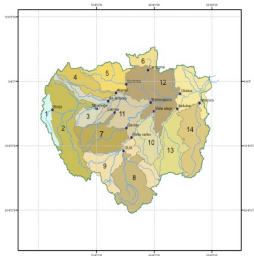
1. Introduction: The components of the Amazon water budget and their spatio-temporal variability are diagnosed using monthly-averaged remote-sensing based data products for the period September 2002-December 2006. The large Amazon basin is divided into 14 smaller watersheds, and for each of these sub-basins, fresh water discharge is estimated from the water balance equation using satellite data products. We use several combinations of RS estimates including total water storage changes, precipitation and evapotranspiration. The results are compared to gauge-based measurements and the best spatio-temporal agreement between estimated and observed runoff is found for the combination of precipitation from the GPCP and the Montana evapotranspiration product (RMSE =1.0 mm/d). Mean annual precipitation, evapotranspiration and runoff for the whole basin are estimated to be 6.3, 2.27 and 3.02 mm/d respectively but also show large spatial and temporal variations at sub-basin scale. Using the most consistent data combination, the seasonal dynamics of the water budget within the Amazon system is examined. Agreement between satellite based and in-situ runoff is significantly improved when lag-times between sub-basins are accounted. We estimate these lag times based on satellite inferred inundation extent verifications. The results reveal not only variations of the sub-basin forcing but also the complex response of the inter-connected sub-basin water budgets. EOF analysis are tried to investigate inter-annual and inter-basin variation of the water components and shows that the aggregate behavior of the whole Amazon is more complex than can be represented by a simple integral of the forcing over the whole river system.

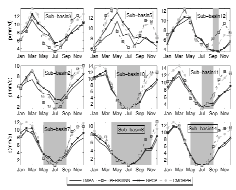
2. Amazon Basin and Sub-basins Delineation



- Largest drainage Area more complicated dynamics
- Gauge runoff data are collected for 14 sub-basins as seen.
- Topography data from SRTM and river network used to delineate the sub-basins.

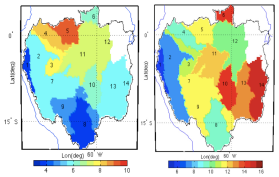
3. Water Budget Components Seasonal Cycle Analysis

- Precipitation

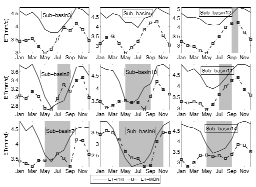


-TMPA
-PERSIAN
-GPCP
-CMORPH

Annual Mean | Seasonal Variability

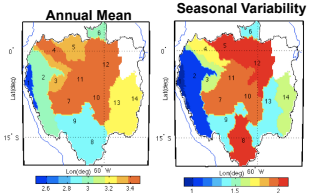


- Evapotranspiration

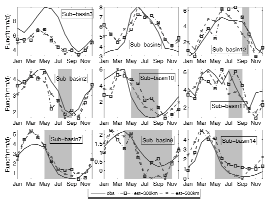


ET- MON

Annual Mean | Seasonal Variability

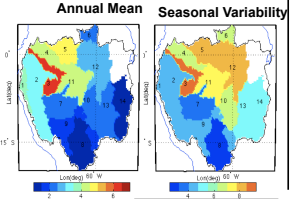


- Runoff

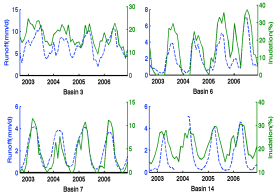


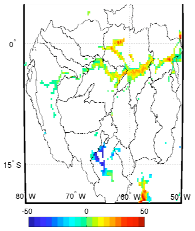
Gage

Annual Mean | Seasonal Variability



4. Variation of Runoff and Inundation



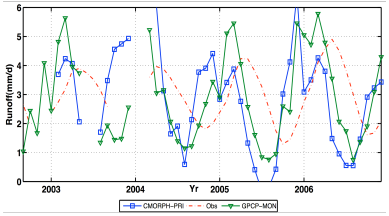


5. Water Balance Using Different Products Combinations

Data combination	Mean	RMS
TMPA-PRI	-1.45	1.35
PERSIANN-PRI	-0.55	2.76
GPCP-PRI	-0.75	1.30
CMORPH-PRI	0.21	1.05
TMPA-MON	-0.73	1.63
PERSIANN-MON	0.18	2.97
GPCP-MON	0.01	1.51
CMORPH-MON	0.51	2.31

$$P-ET-\Delta S=R$$

6. Monthly Variation of Estimated and Observed Runoff

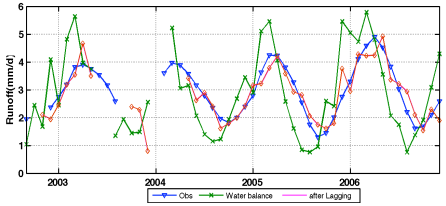


7. Estimating The Lag Time

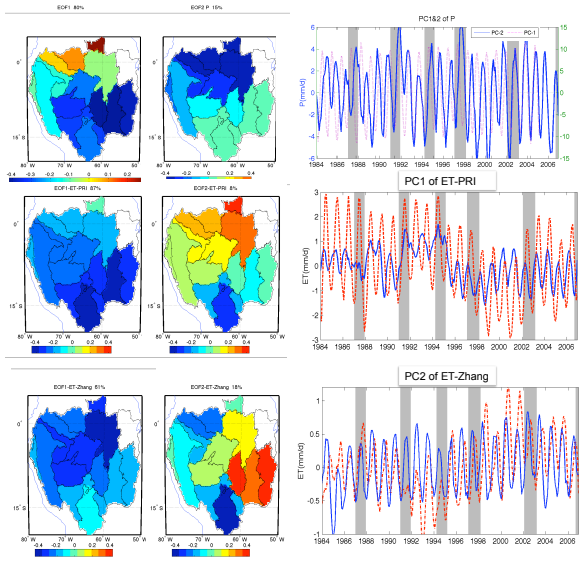
Lag correlation analysis based on the time series of inundation and estimated runoff for each sub-basin

Sub-basin	Distance (km mouth-to-mouth)	Travel time range (v=0.45-0.9 m/s) days	Total lag-time (months)
1	3300	43- 86	3
2	2200	29 – 58	3*
3	1800	24 – 48	2
4	1650	22 – 44	1
5	1350	17 – 35	1
6	1400	18 – 36	1
7	1800	23 – 47	2
8	1850	24 – 48	1
9	1450	18 – 38	1
10	780	10 – 20	0
11	750	10 – 20	1
12	0	0	0
13	0	0	1*
14	0	0	1*

8. Runoff Estimation Using the Proposed Method



9. EOF Analysis of Inter-annual Variation of Two ET Data sets



10. Conclusions

ET-PRI has larger seasonal cycle in comparison to ET-MON.

ET-Mon has larger estimates in northern sub-basins while ET-PRI exhibits larger estimates in southern basins

The two estimates have opposite signed variation during 1992-1994 period.

This study was supported and monitored by National Oceanic and Atmospheric Administration (NOAA) under grant- CREST # NA06OAR4810162