

Comparison of ERA-Interim and ERA-40 reanalyses with observations over river basins

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23rd AMS Conference on Hydrology

Phoenix, AZ, Jan 12-15, 2009

Recorded presentation available at

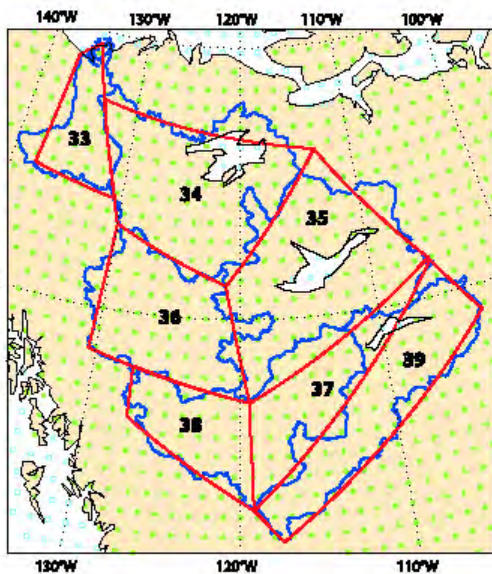
http://ams.confex.com/ams/89annual/techprogram/paper_142640.htm

Themes

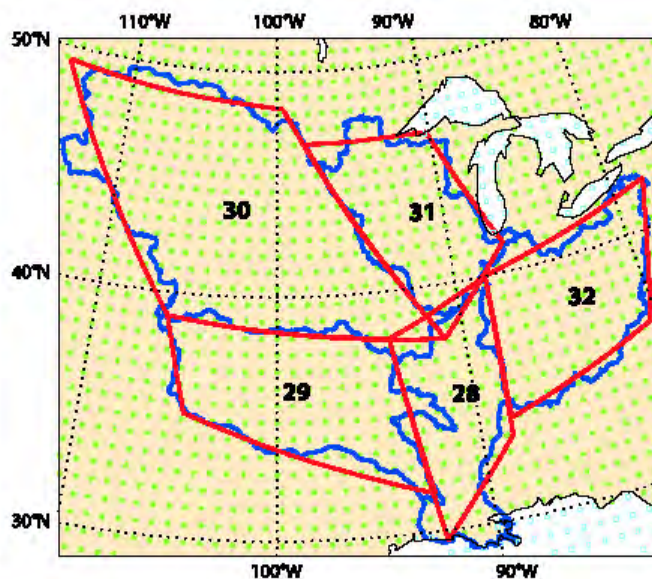
- **Evaluating reanalyses**
 - **against independent data**
- Annual cycle, diurnal cycle, daily mean
- *Temperature and humidity*
- *Precipitation and evaporation*
- *SW Cloud radiative impacts*
- *Betts, A. K., M. Köhler and Y-C. Zhang, 2009: Comparison of river basin hydrometeorology in ERA-Interim and ERA-40 with observations. J. Geophys. Res., 114, D02101, doi:10.1029/2008JD010761. [ECMWF [tm568.pdf](#)]*

River basin archive

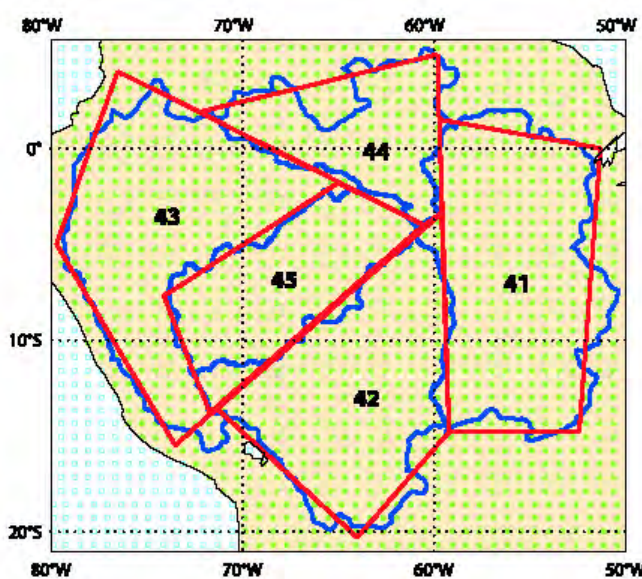
ERA-40 and ERA-Interim



Mackenzie



Mississippi

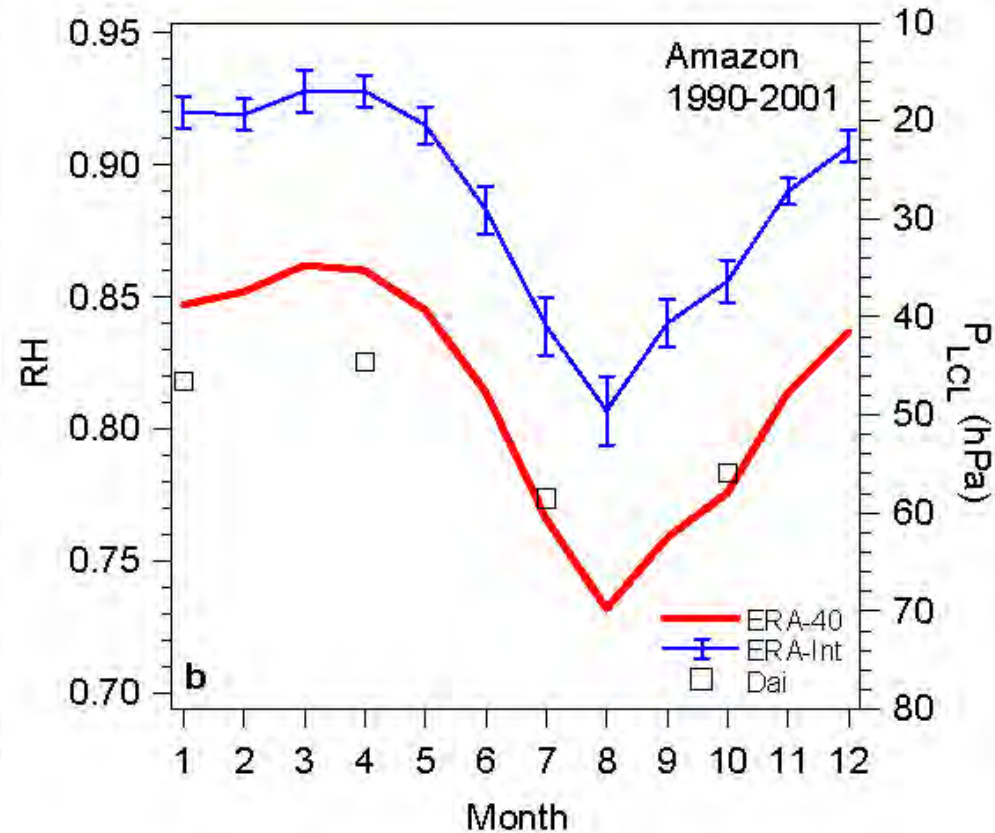
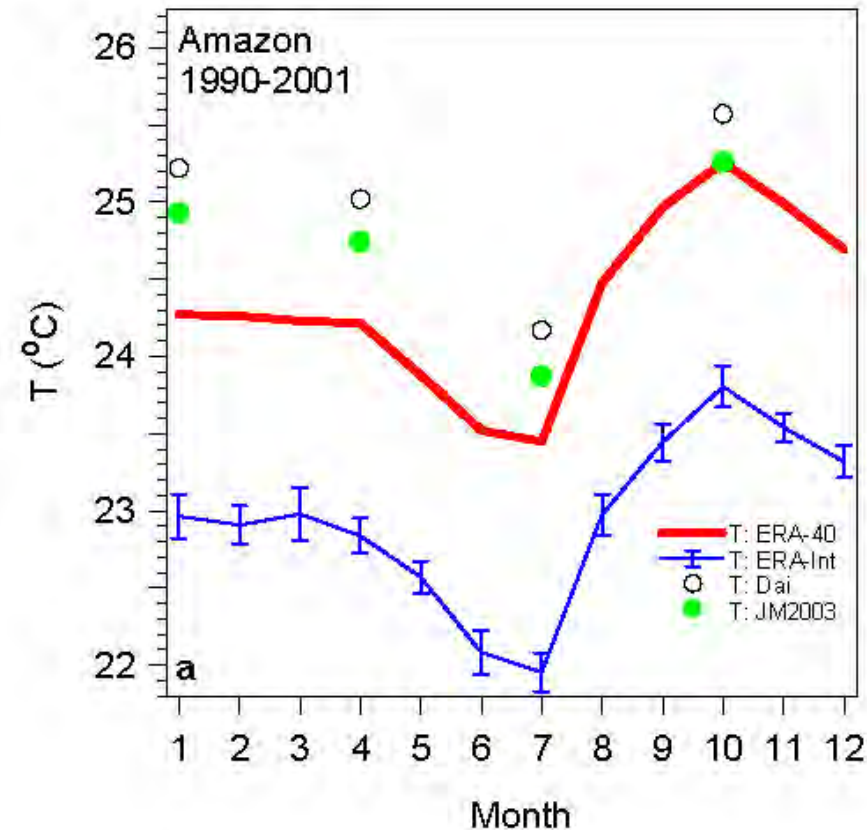


Amazon

Evaluation on river basin scale, starting from **hourly archive**

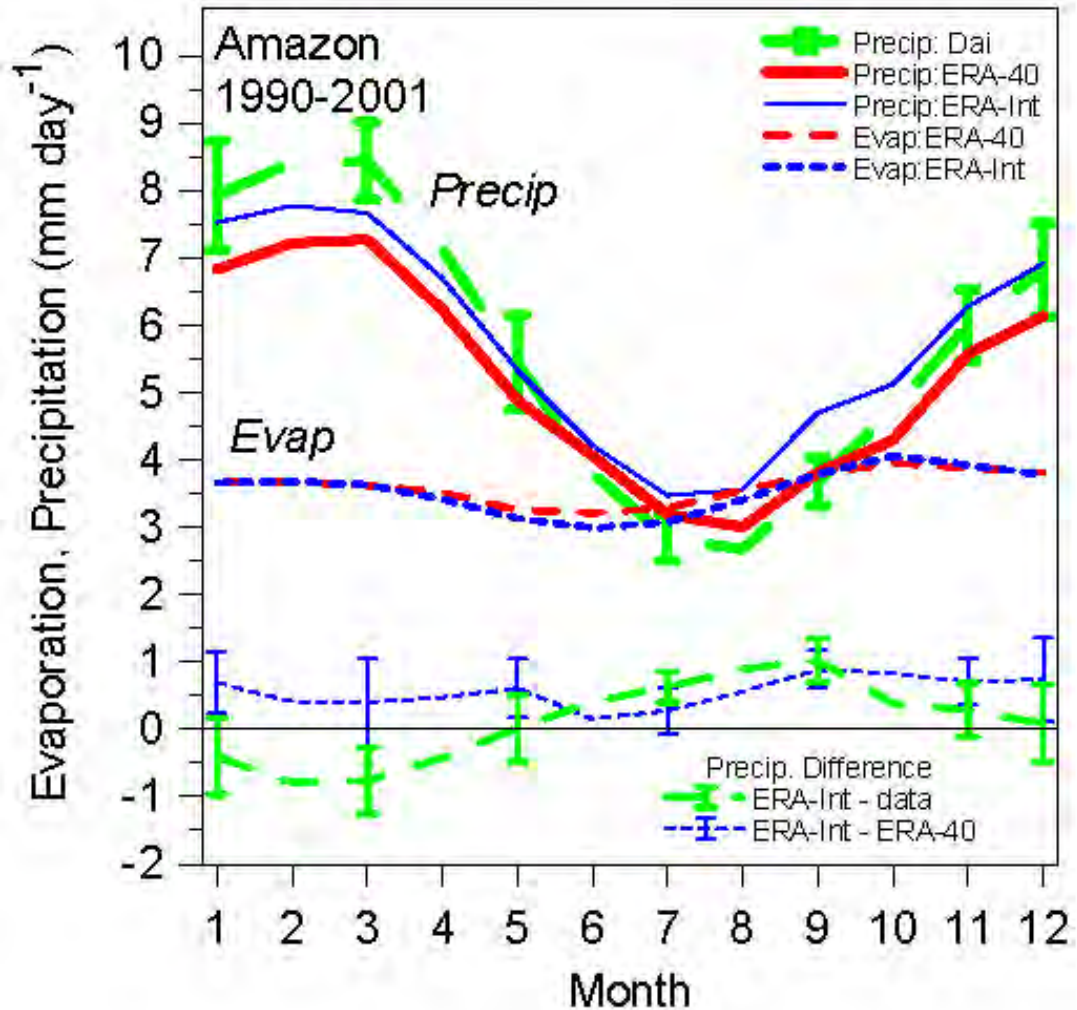
Amazon: ERA-40 & ERA-Int

Annual T, RH and LCL



- ERA-Interim has
 - larger cold bias
 - high bias of RH and low bias of cloud-base

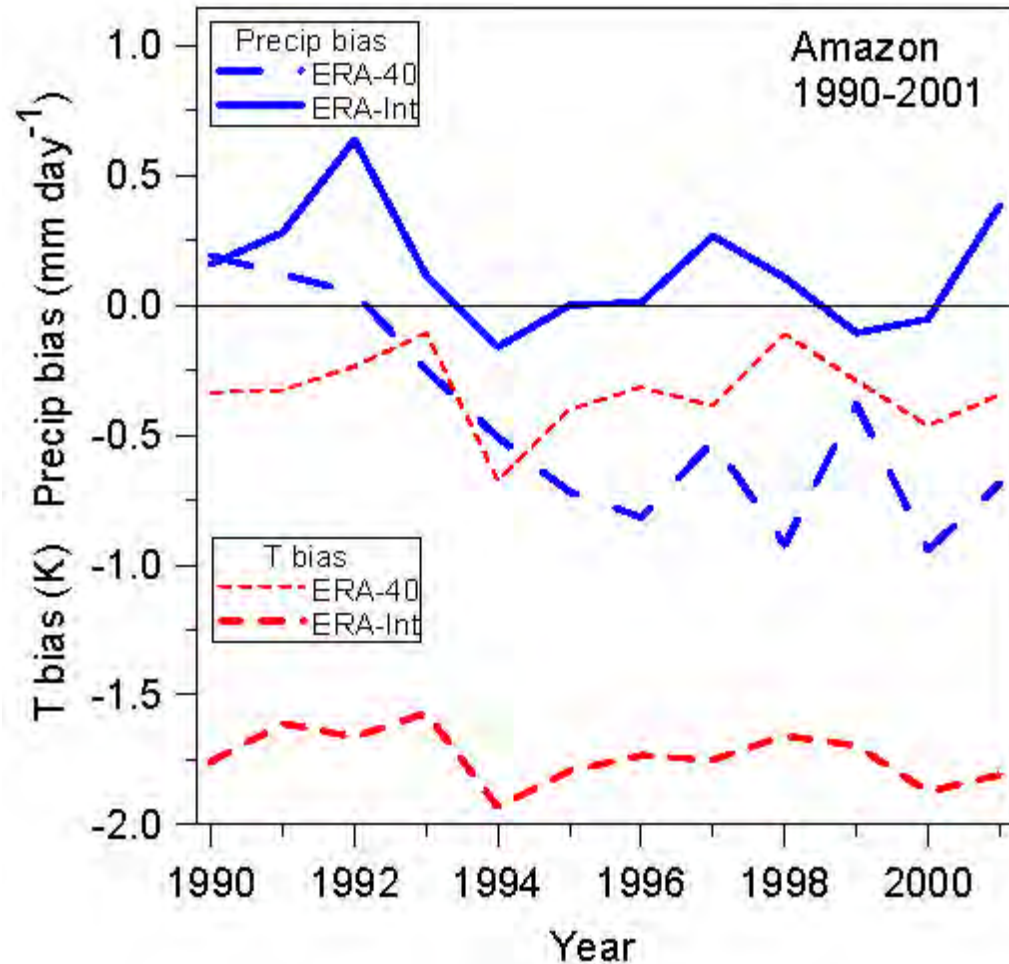
Amazon Precipitation & Evaporation Data ERA-Int ERA-40



- ERA-Interim precipitation increased
- Seasonal amplitude remains too small

Annual biases

Precip
Temp



- Interannual drift of precipitation reduced
 - annual precipitation largely unbiased
 - from improved humidity analysis [Uppala et al., 2008]
- Cold temperature bias increased substantially

Clouds & Surface SW_{net}

$$SW_{net} = SW_{down} - SW_{up} = (1 - \alpha_{surf})(1 - \alpha_{cloud}) SW_{down}(clear)$$

- *surface albedo*

$$\alpha_{surf} = SW_{up} / SW_{down}$$

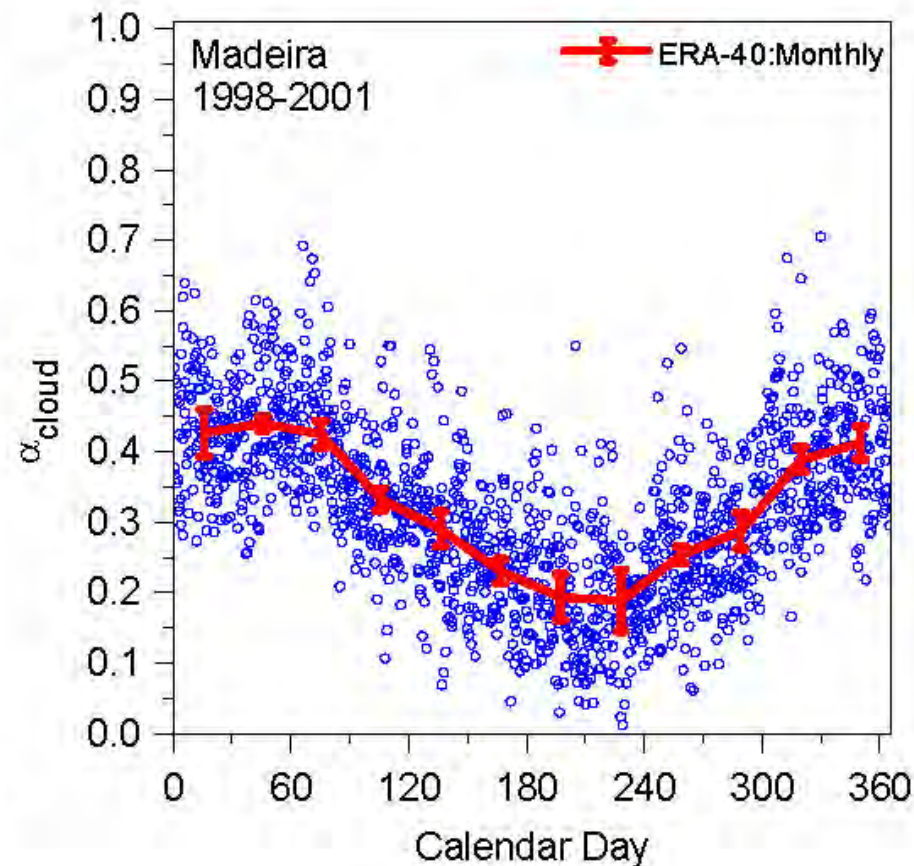
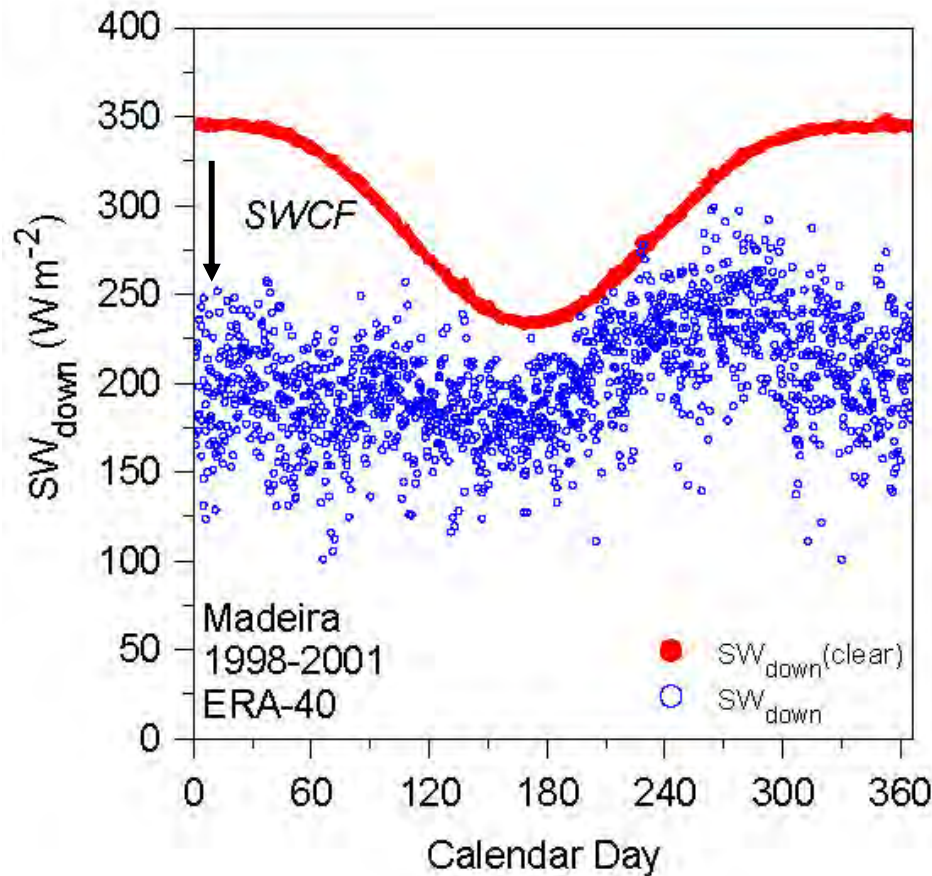
- *effective cloud albedo*

- scaled surface **short-wave cloud forcing, SWCF**

$$SWCF = SW_{down} - SW_{down}(clear)$$

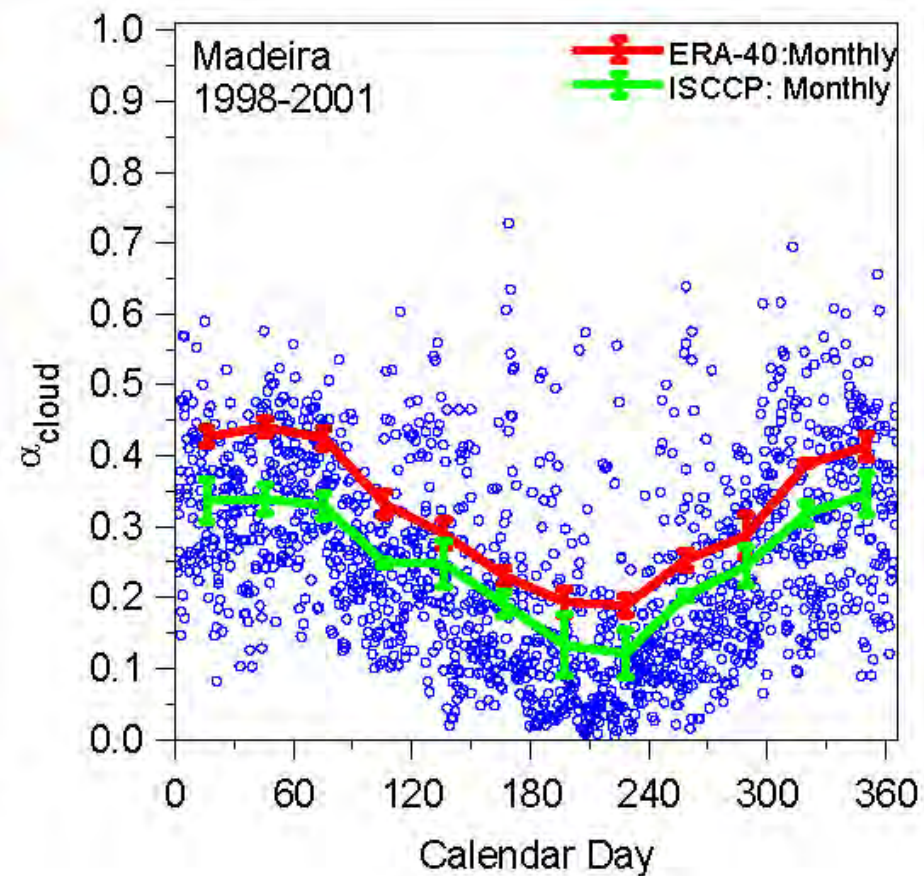
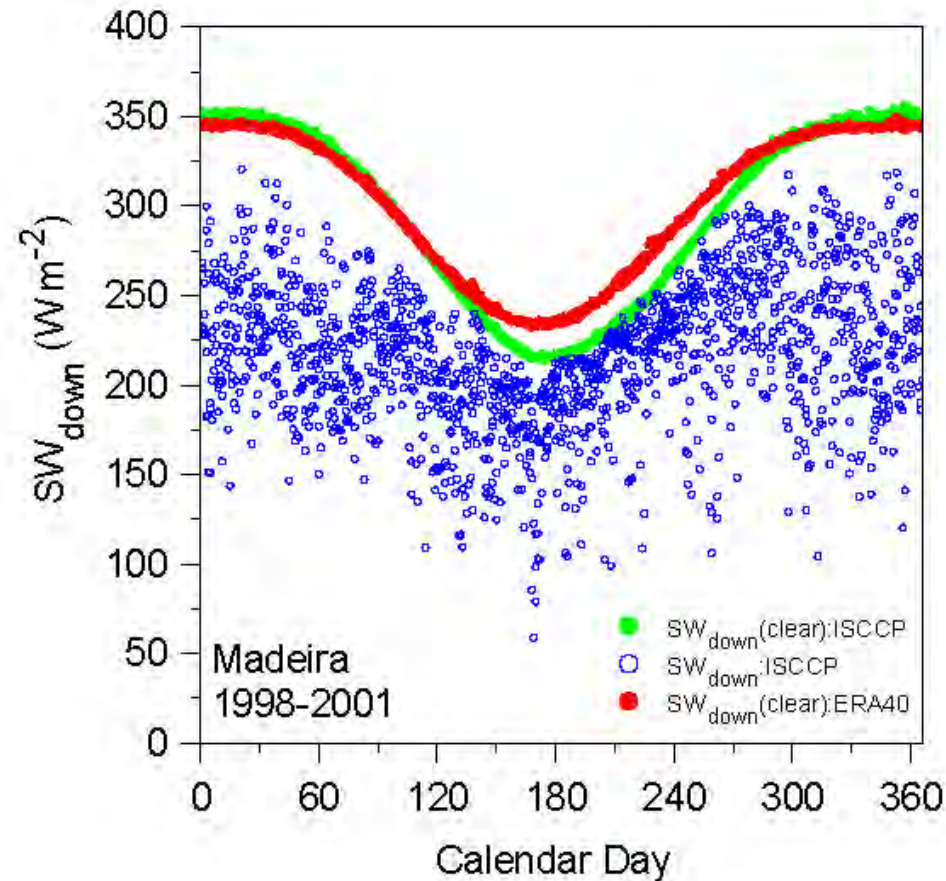
$$\alpha_{cloud} = - SWCF / SW_{down}(clear)$$

“Cloud albedo”: *ERA-40 data*



- Transformation: $\alpha_{\text{cloud}} = \text{SWCF} / \text{SW}_{\text{down}}(\text{clear})$
- Seasonal cycle OK: small daily variability: **Is it biased?**

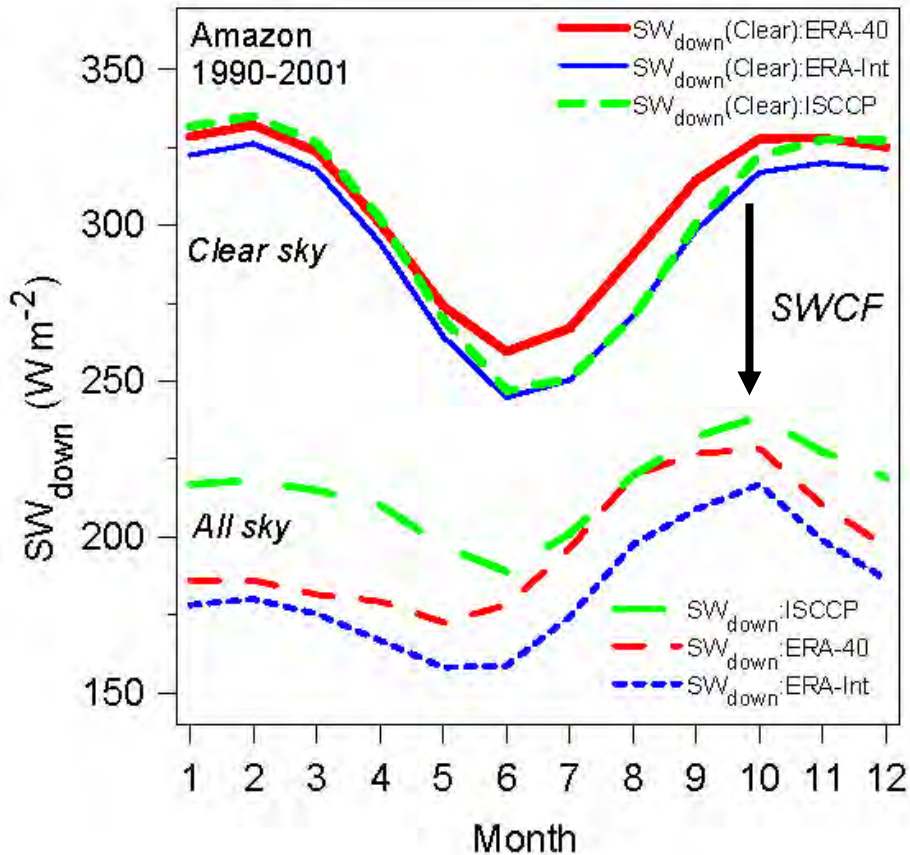
Cloud albedo: *ISCCP* data



- Different clear-sky flux: **Aerosol differences**
- ERA-40 systematic high bias in $\alpha_{cloud} \approx +7\%$
- ISCCP has more daily variability

Amazon – Shortwave & α_{cloud}

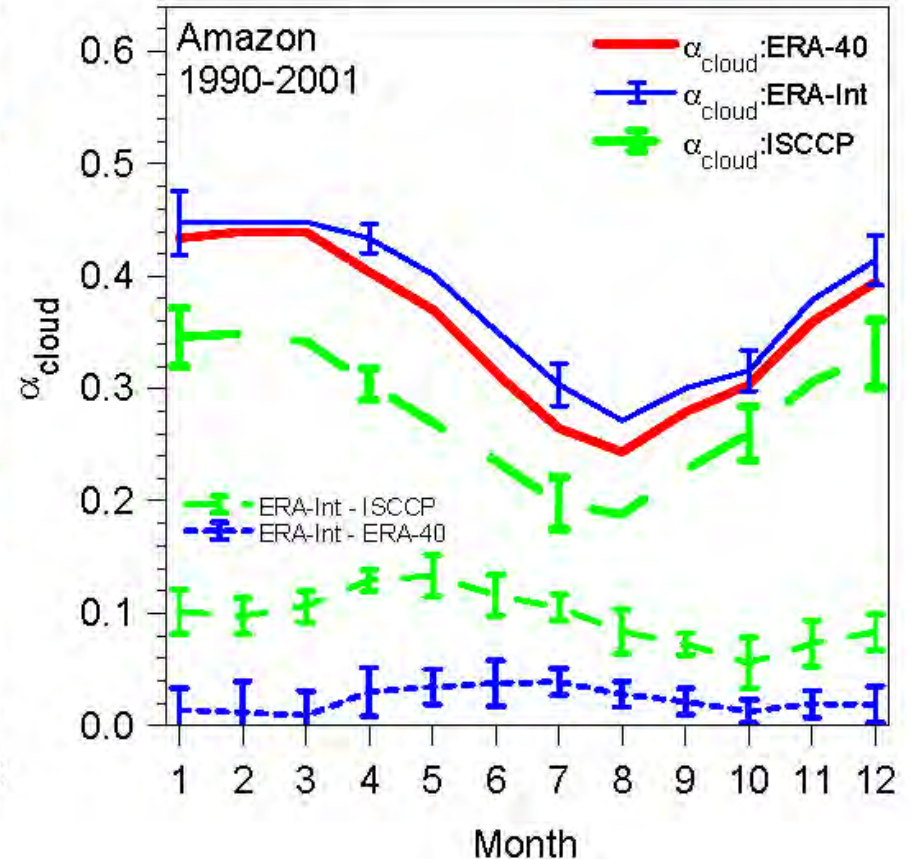
SW_{down}



Clear-sky differences

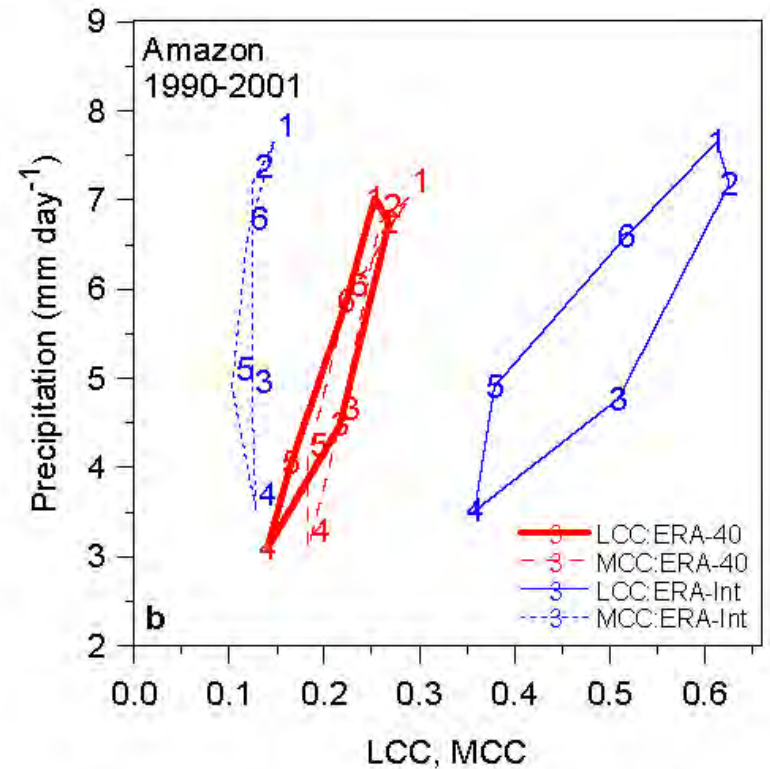
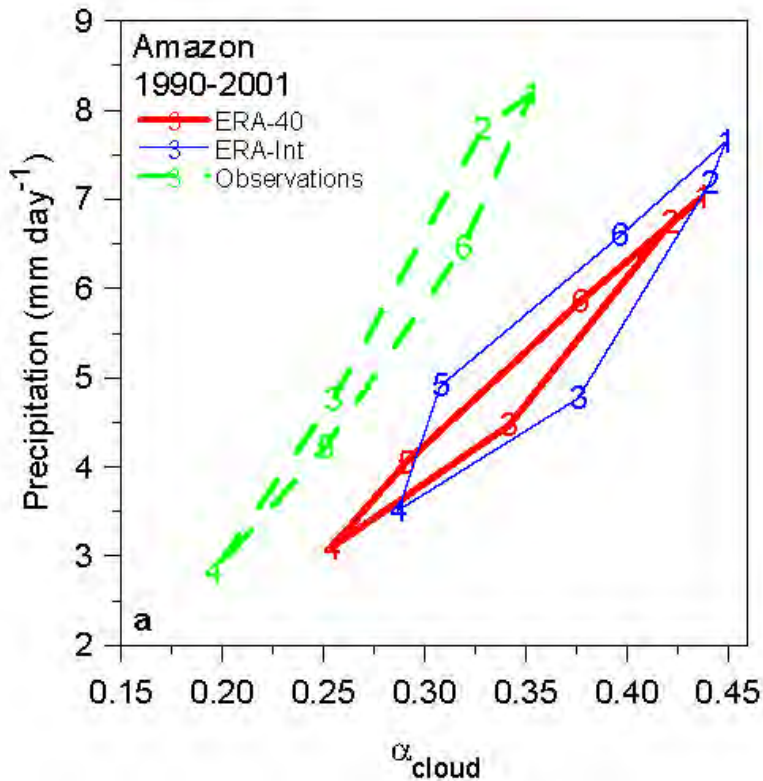
All-sky differences are larger

Cloud albedo



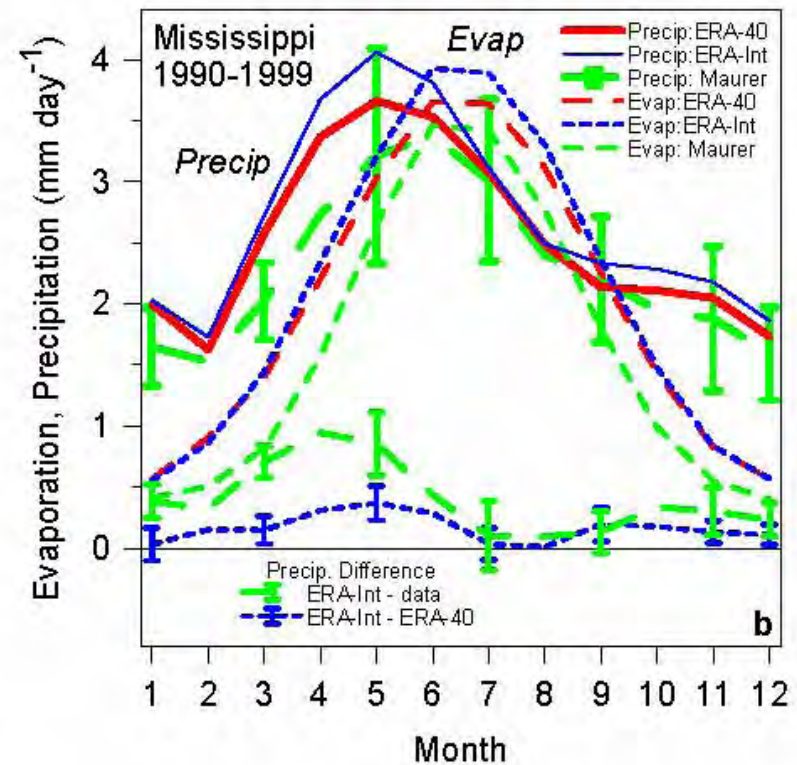
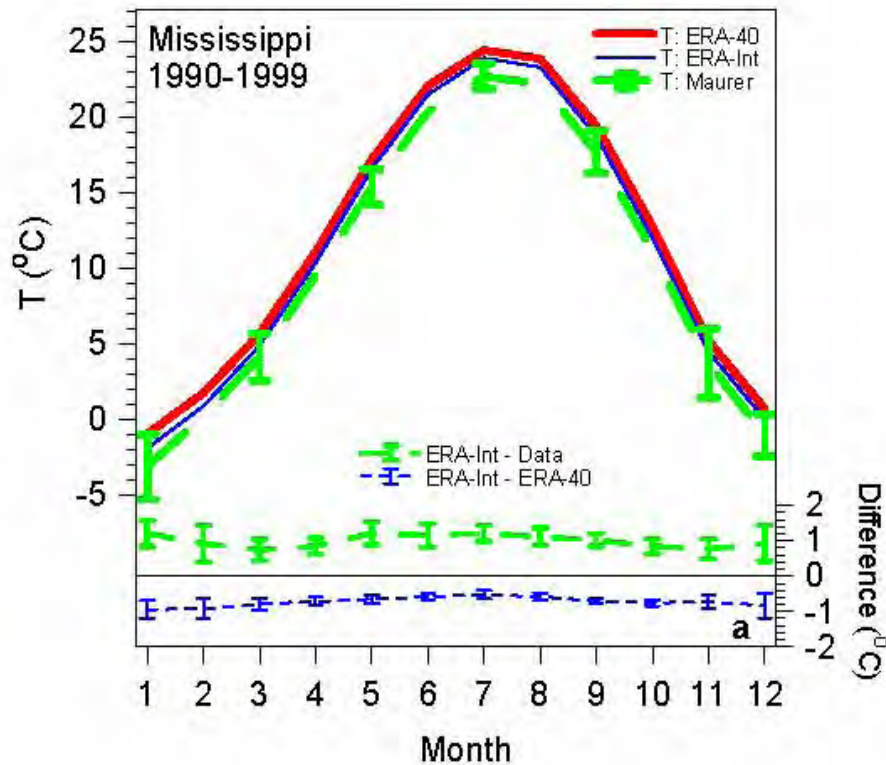
ERA-Int > ERA-40 > ISCCP

Cloud differences



- More cloud in reanalyses for same precip.
- Much more low cloud in ERA-Interim

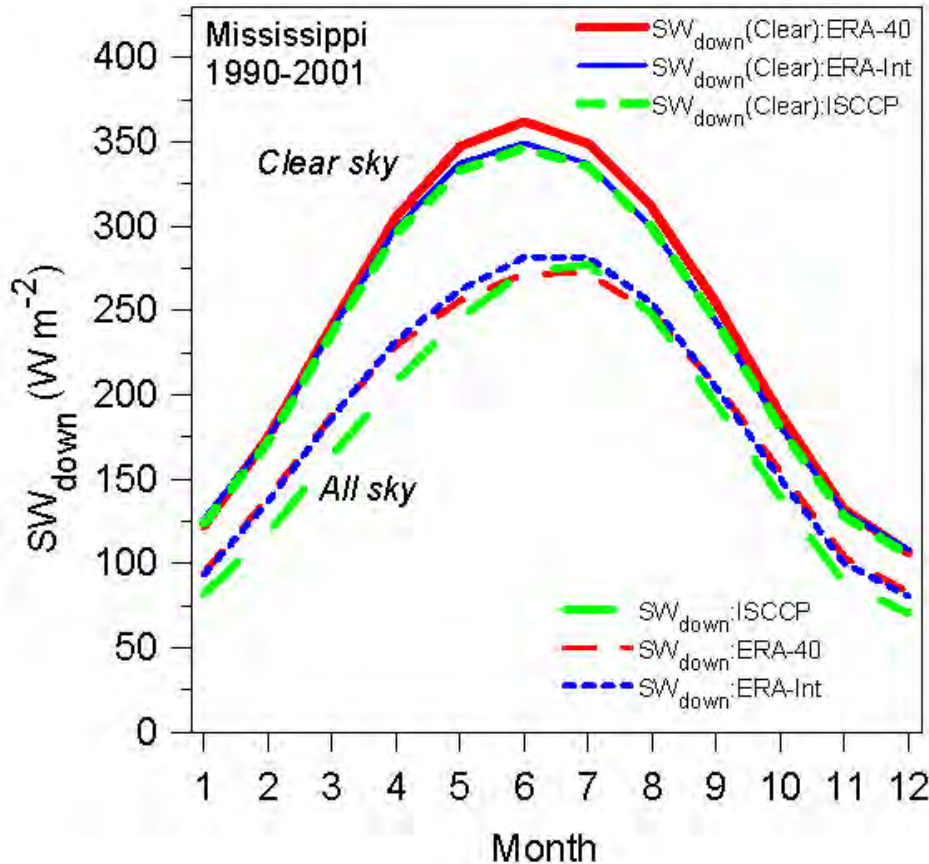
Mississippi: T , $Precip$ & $Evap$



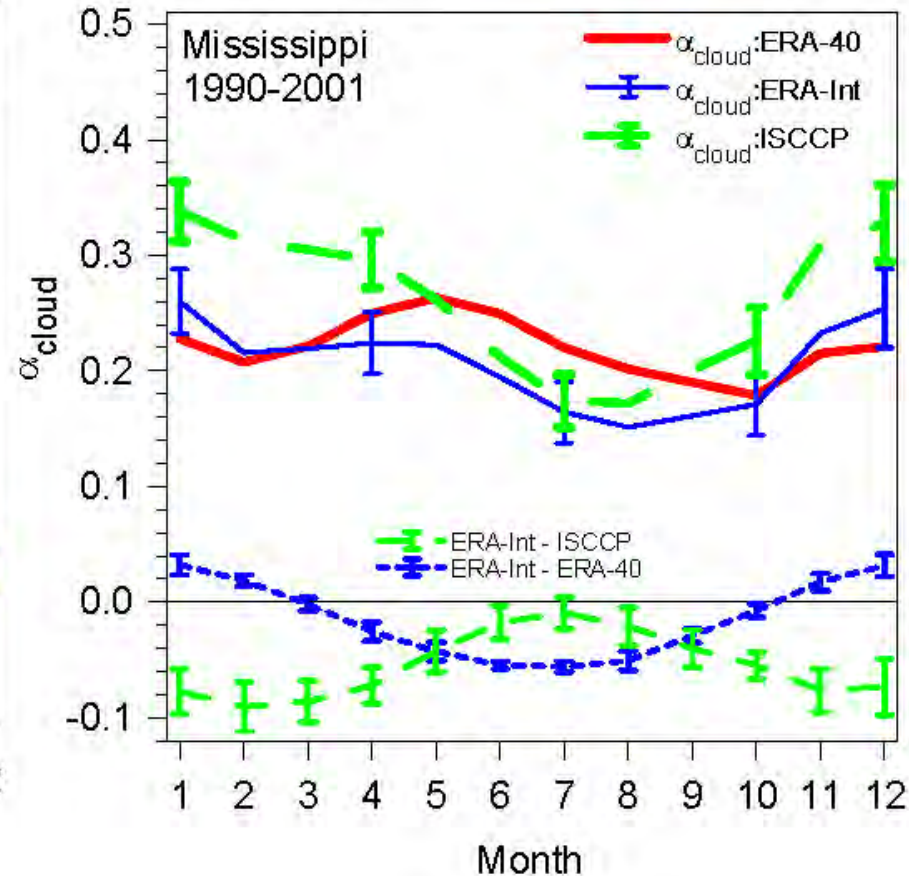
- ERA-Int a little cooler: still warm bias
- ERA-Int more precip. & evap: larger wet bias

Mississippi – Shortwave & α_{cloud}

SW_{down}



Cloud albedo

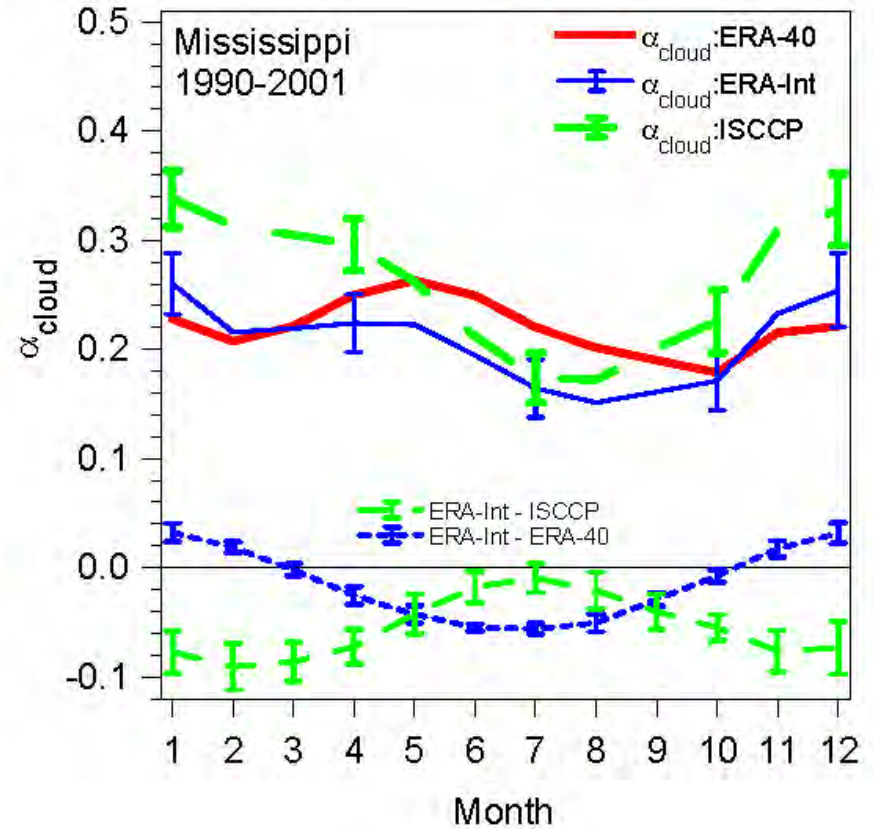
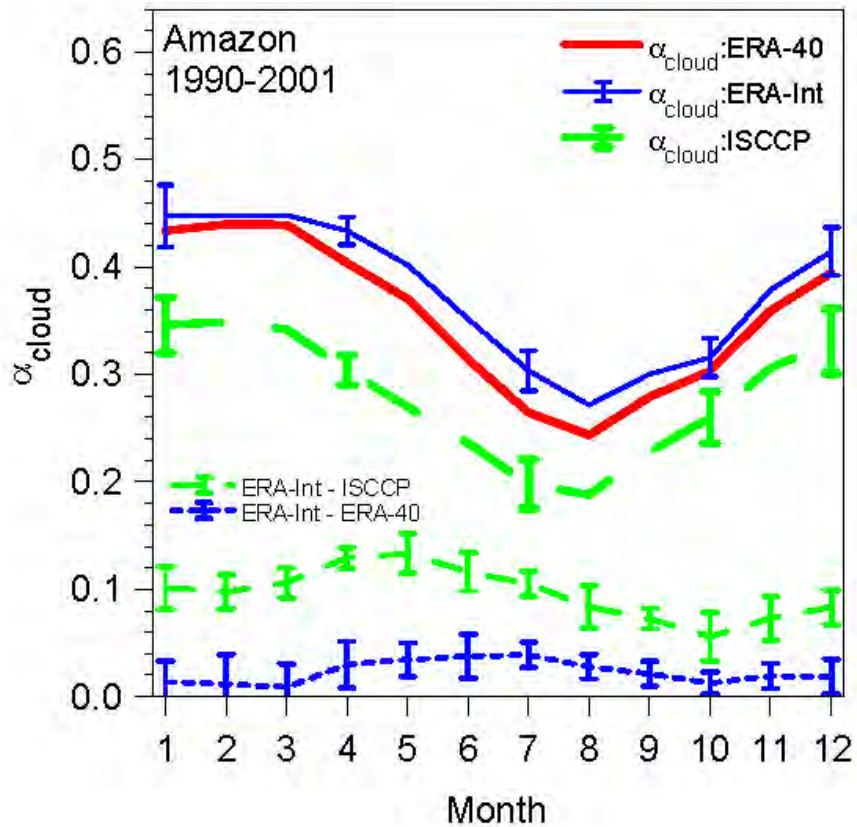


ERA-Int Clear-sky closer to ISCCP

ERA-Int closer to ISCCP

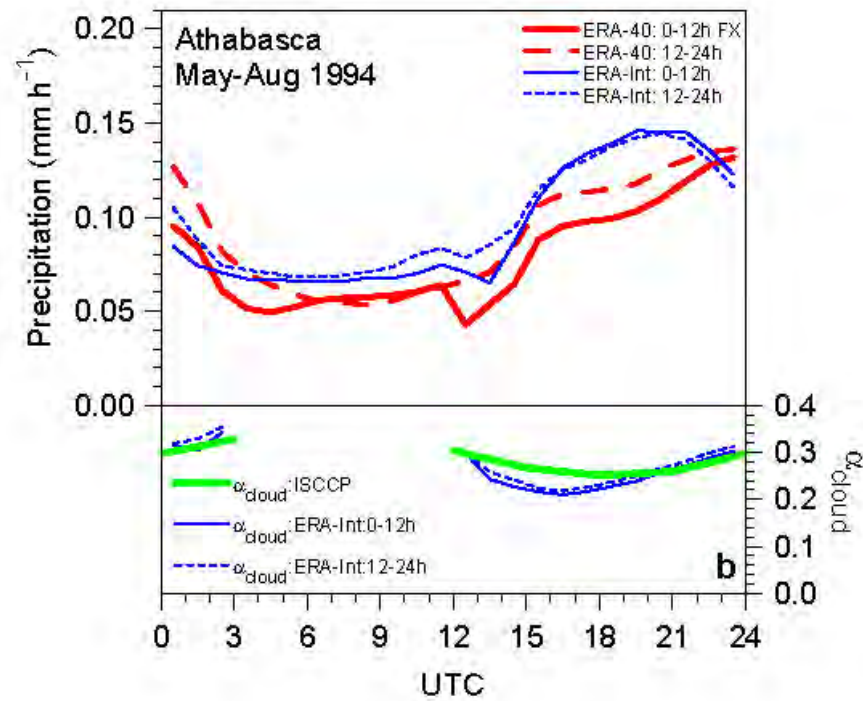
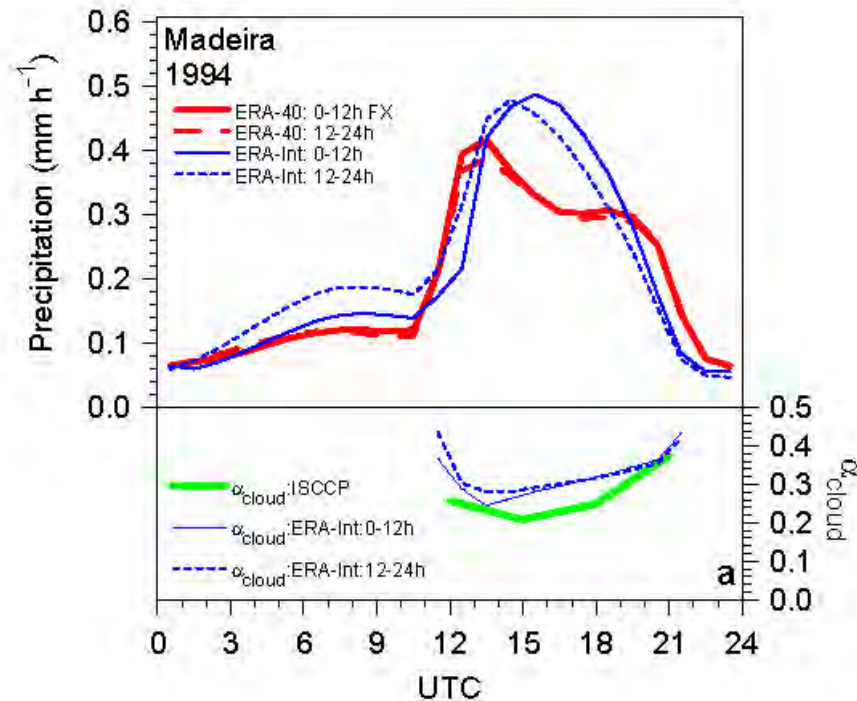
All-sky differences are small

Tropics vs. mid-latitudes



- Amazon: reanalyses α_{cloud} biased high
- Mississippi: different bias signature

Diurnal cycle: reanalyses



- ERA-Int has lost spurious early morning tropical peak, but precip. still too early
- ERA-Int has near-noon peak at all latitudes

Conclusions

- **Tropics**

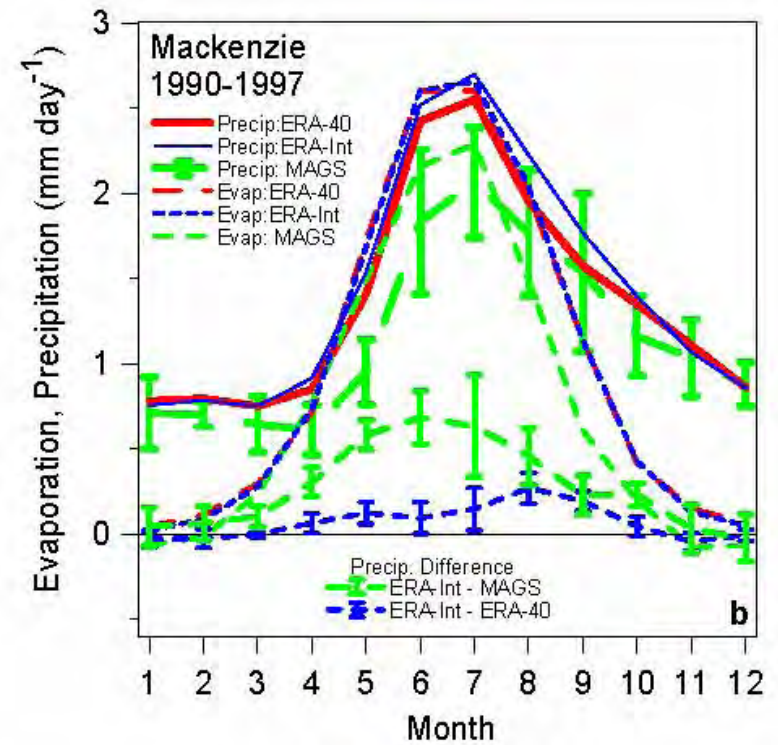
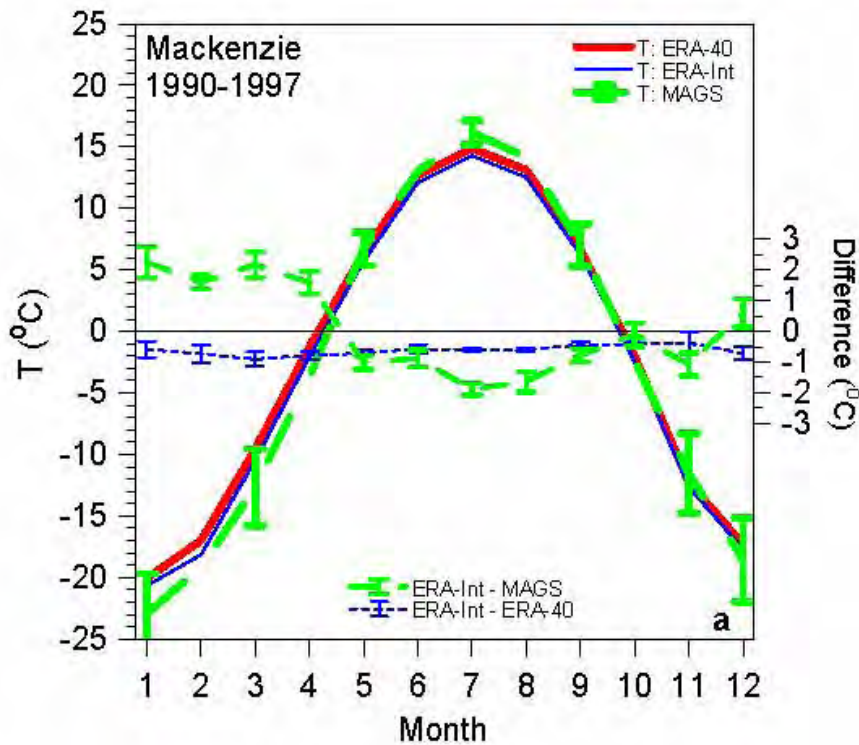
- Amazon: interannual drift of precipitation reduced In ERA-Interim
- Annual precipitation improved: seasonal amplitude of precipitation remains too small.
- ERA-Interim has increased low cloud and large cold 2-m temperature bias [Positive bias in SWCF is worse]
- Diurnal cycle of precipitation better, but still rains too early in day

- **Mississippi (& Mackenzie)**

- Temperature biases are small in both reanalyses
- Summer precipitation and evaporation too high
- ERA-Interim has less reflective cloud cover in summer and more in winter – an improvement
- Spinup of precipitation in 24h forecasts greatly reduced in ERA-Int

- *[More recent model cycles have improved Amazon seasonal precipitation, and cloud cover]*

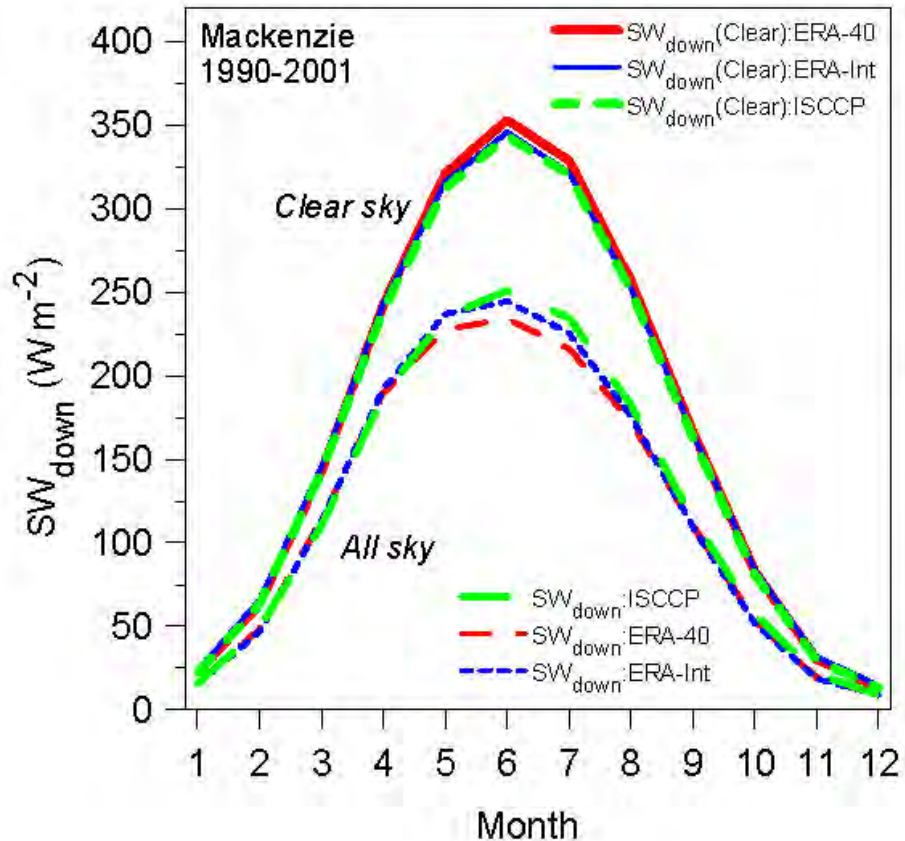
Mackenzie: T , $Precip$ & $Evap$



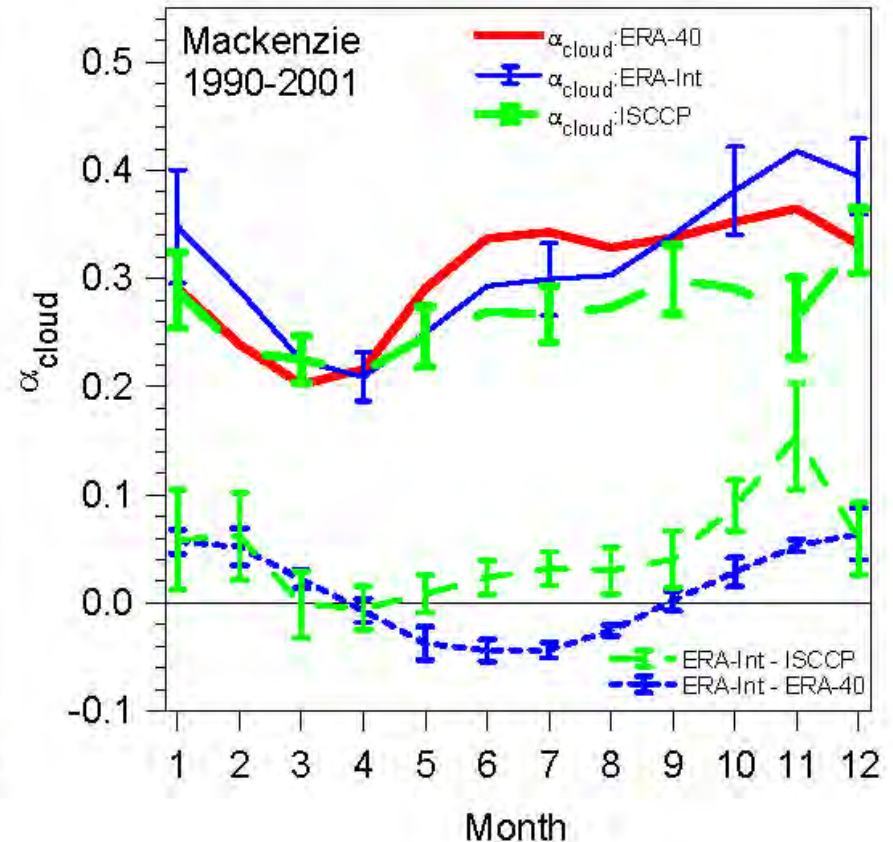
- ERA-Int a little cooler: still warm bias in winter
- ERA-Int more precip. & evap: larger wet bias

Mackenzie – Shortwave & α_{cloud}

SW_{down}



Cloud Albedo



ERA-Int Clear-sky closer to ISCCP

ERA-Int closer to ISCCP in summer

All-sky differences are small