GoAmazon Forcing Data Development: Methods, Issues, and Applications

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Acknowledgments

DOE ARM Program
GoAmazon group

Method: Constrained Variational Analysis

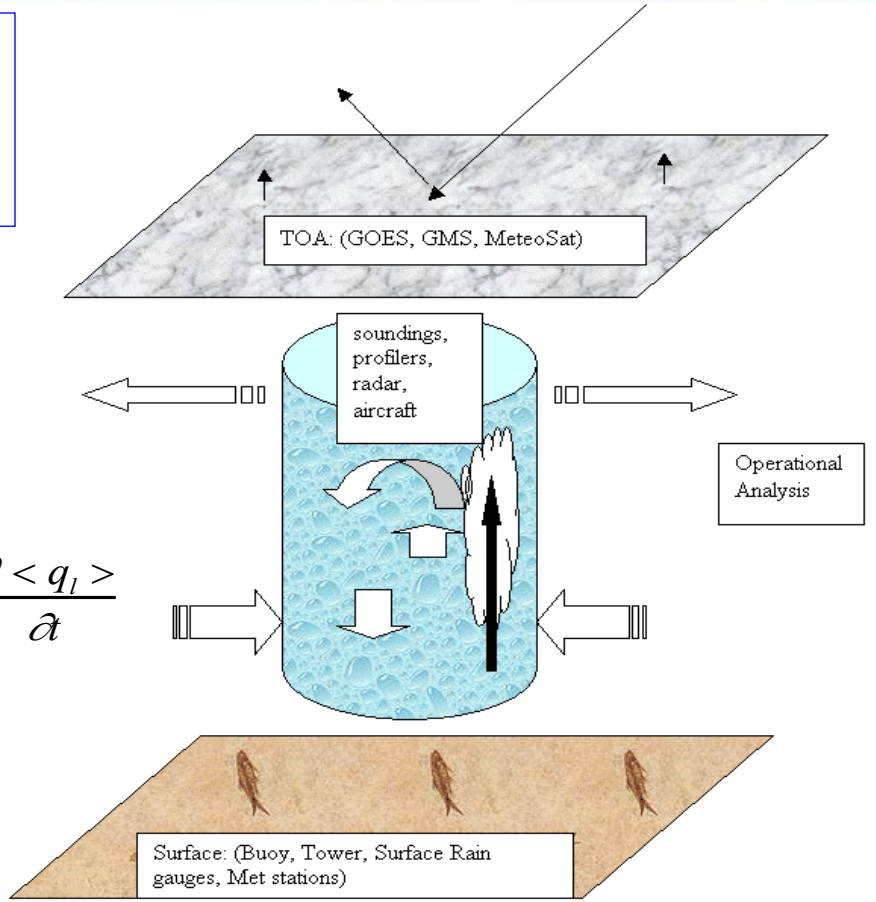
Constrained Variational Analysis (*Zhang and Lin, 1997*) – Mass, Moisture, Energy, and Momentum are conserved

$$< \nabla \cdot \vec{V} >= -\frac{1}{gp_s}\frac{dp_s}{dt}$$

$$\frac{\partial < q >}{\partial t} + < \nabla \cdot \vec{V}q >= E_s - Prec - \frac{\partial < q_l >}{\partial t}$$

$$\frac{\partial < s >}{\partial t} + < \nabla \cdot \vec{V}s >= R_{TOA} - R_{SRF} + LPrec + SH + \frac{\partial < q_l >}{\partial t}$$

$$\frac{\partial < \vec{V} >}{\partial t} + < \nabla \cdot \vec{V}\vec{V} > -f\vec{k} \times < \vec{V} > -\nabla < \phi >= \vec{\tau}_s$$



- **IOP1 (wet season)**: 15 Feb. – 26 Mar. 2014
- **IOP2 (dry season)**: 1 Sep. – 10 Oct. 2014
- 110km radius domain
- 3 hours, 25mb resolution

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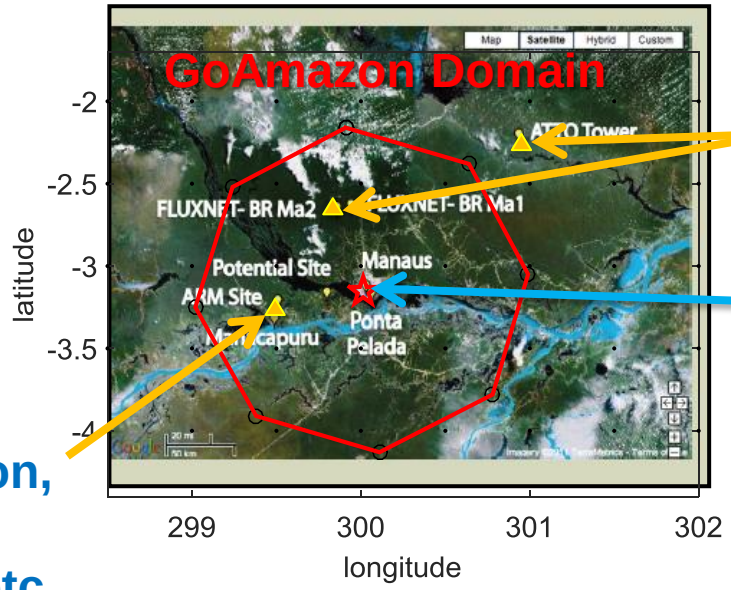
Surface and TOA Data Issues

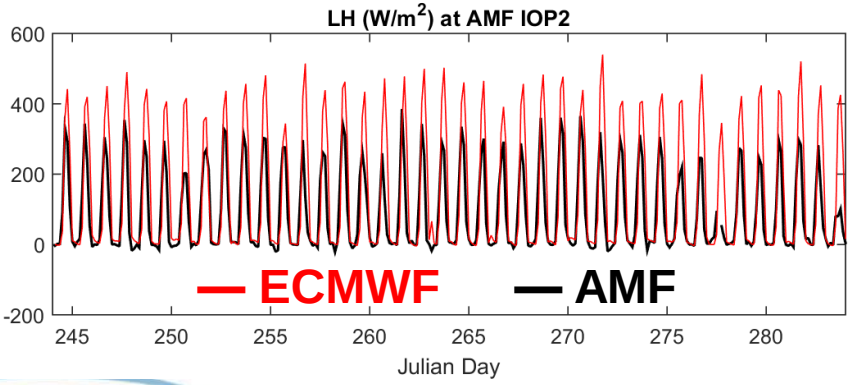


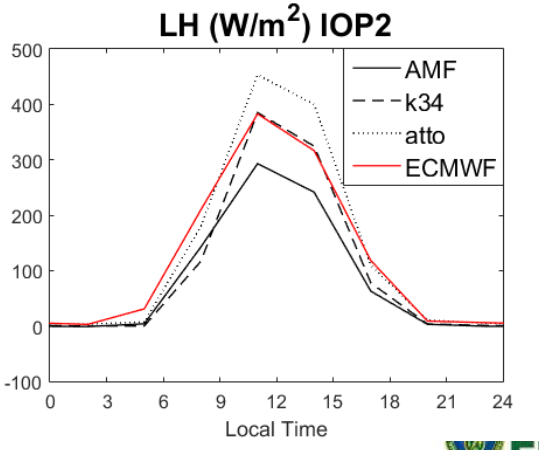
LH, SH

Radar Rainfall

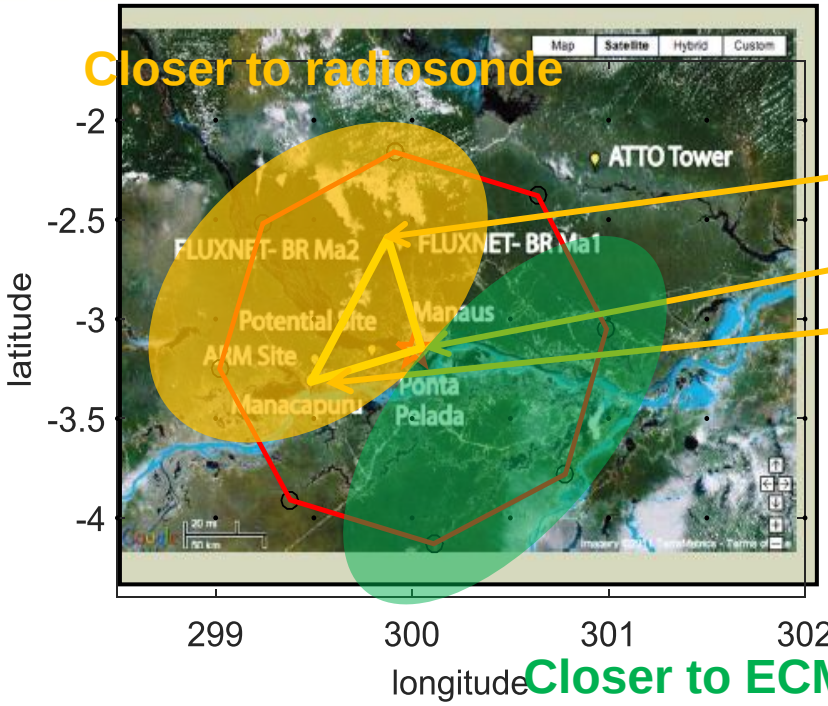
Radiation, LH, SH, cloud, etc.

- GOES TOA radiative fluxes
- SIPAM radar precipitation.
- Surface stations (AMF, K34, ATTO). ECMWF surface analysis data are combined with station obs. to obtain the domain-mean fields.





Upper-level Data Issues



Radiosonde:

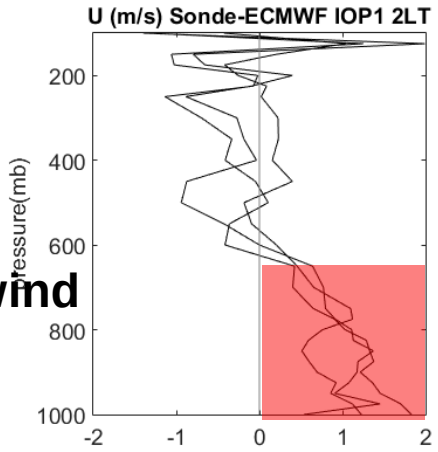
ZF2

PontaPolada

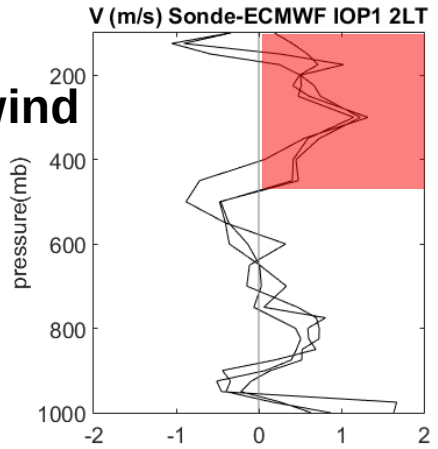
AMF

Sonde – ECMWF
(6 UTC or 2 LT)

U wind



V wind



- Larger U wind at lower-level: more convergence
- Larger V wind at upper-level: more divergence
- Combine: stronger rising motion due to the inconsistency between radiosonde and ECMWF

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Impact of the Observations

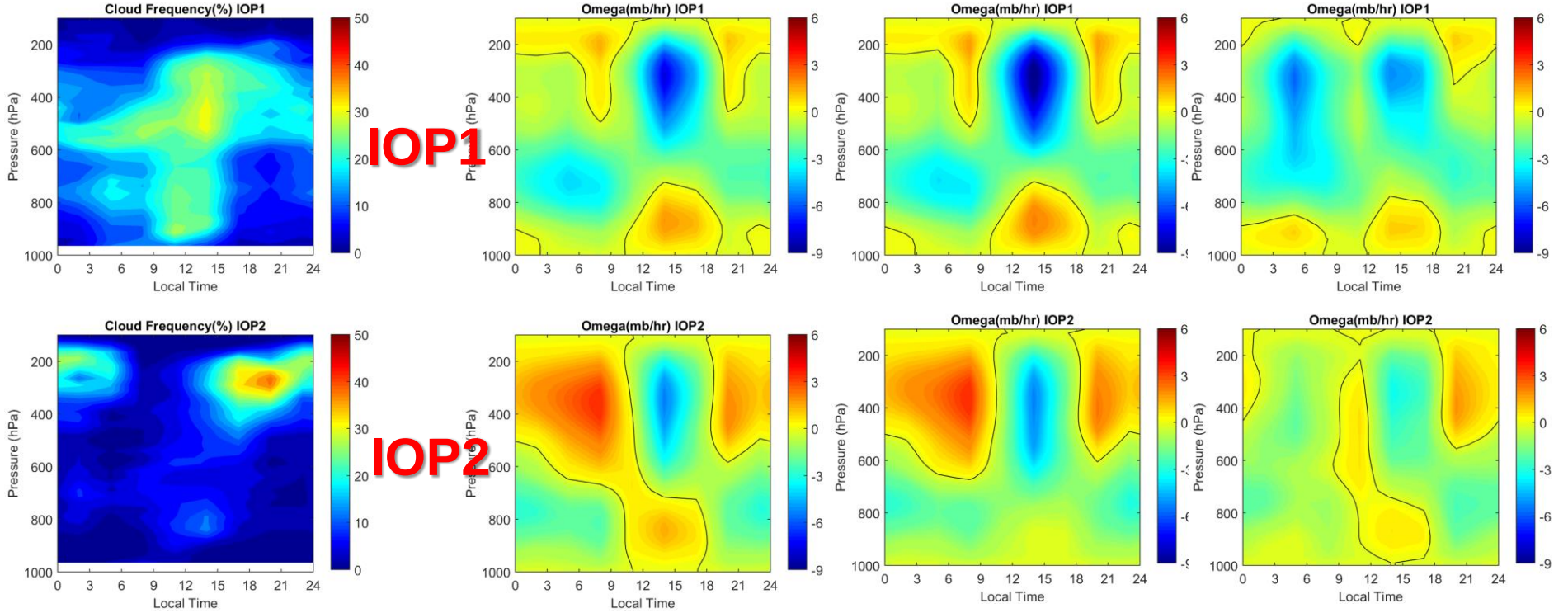
Omega (mb/hr)

Observed Cloud (%) at ARM site

ECMWF with SIPAM precip.

With surface&TOA fluxes

With Radiosonde



- Surface and TOA fluxes have small impacts to the large-scale forcing data.
- Inconsistency of radiosonde and ECMWF brings in unrealistic rising motion in the morning.

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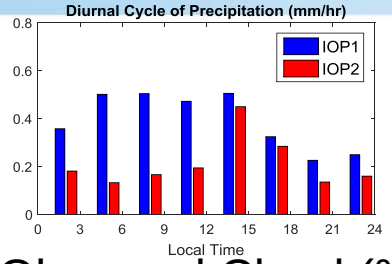
Large-Scale Forcing Data Corresponding to the Diurnal Cycle



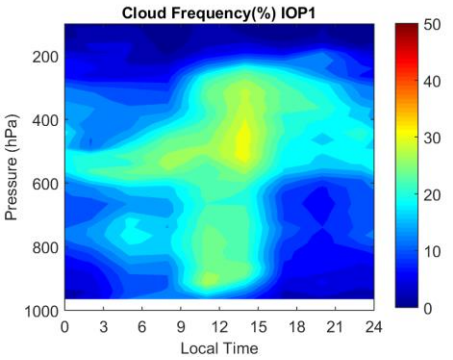
The large-scale forcing data has large seasonal contrast in the morning.

Observed Cloud (%) at ARM site

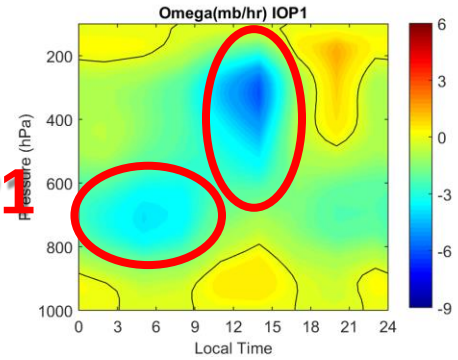
Omega (mb/hr)

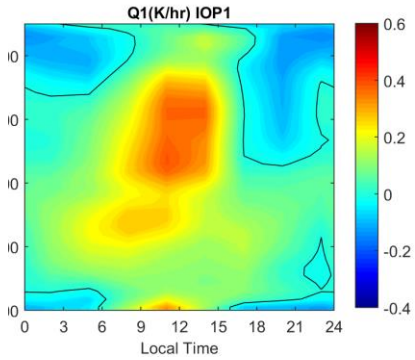
Q1 (K/hr)

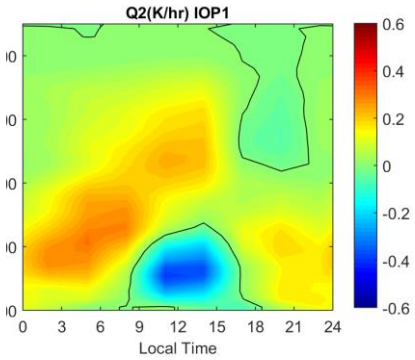
Q2 (K/hr)

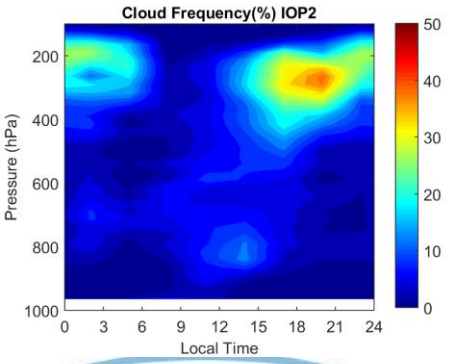


IOP1

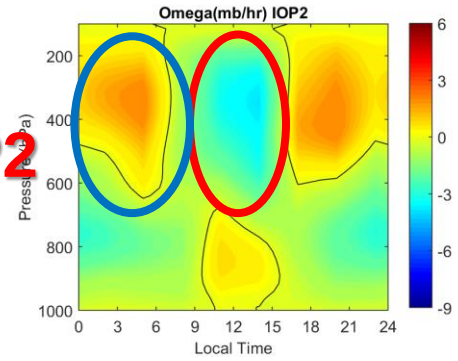


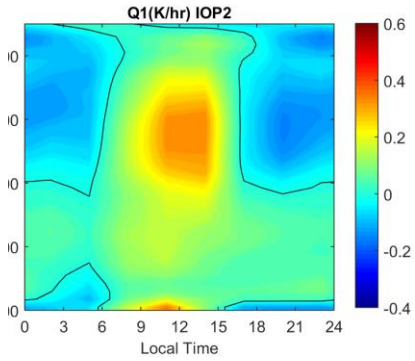


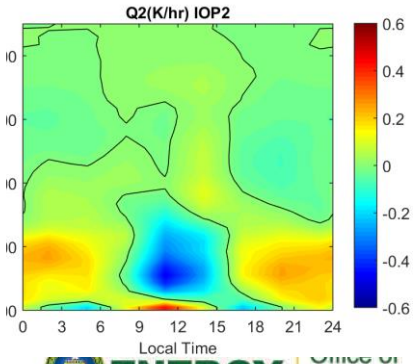




IOP2







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Morning Convective Systems have Larger Seasonal Contrast

	IOP1		IOP2	
	Morning	Afternoon	Morning	Afternoon
Local Occurring Systems (LOS, afternoon scattered)	0	**19**	0	**14**
Coast Occurring Systems (COS, westward propagate)	**7**	6	**0**	3
Basin Occurring Systems (BOS, eastward propagate)	**3**	3**	**2***	0

* the two cases are both Basin Occurring MCSs but propagating westward.
** the afternoon eastward propagating systems are continued from the morning time.

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LOS, COS and BOS: *Greco et al., 1990*

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Conclusion

- Observations are merged with ECMWF analysis to derive the large-scale forcing data for GoAmazon.
- The inconsistency between radiosonde and ECMWF analysis brings in large errors in large-scale forcing data
- The impacts of surface and TOA observations are relatively small to the large-scale forcing data.
- More applications and analysis of the large-scale fields will be shown in my poster at **Tuesday afternoon**.