

Evaluation of the Atmospheric Water Cycle Predicted by MAP D-PHASE Models using GOP Observations

(Work Progress ...)

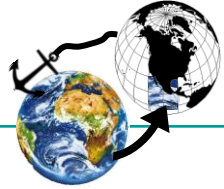
Suraj Polade and Felix Ament

Meteorological Institute, University of Hamburg, Germany



- All the variables reported (We consider for verification)
- should cover at least 95% of D-PHASE domain

Model	Grid Spacing [km]	Forecast Range [h]	Runs /day	Remarks Nested in	Driven By
COSMO-DE	2.8	21	8	COSMO-EU	GME
COSMO-EU	7	78	4		GME
COSMO-2	2.2	24	6	COSMO-7	ECMWF
COSMO-7	7	72	2		ECMWF
COSMO-IT	2.8	30	1	COSMO-ME	IFS Global Model
COSMO-ME	7	72	1		IFS Global Model
AROME	2.5	30	1		
ALADIN	9.5	30	1		
MM5_15	15	72	2	MM5_60	NOAA GFS
MM5_60	60	72	2		NOAA GFS
QBOLAM_11	11	48	1	QBOLAM33	ECMWF
QBOLAM_33	33	60	1		ECMWF



GPS:

Integrated Water Vapor - temporal resolution 15 minute

Ceilometer:

Low Cloud Base Height - temporal resolution 10 minute

MSG:

Cloud Occurrence Probability - temporal resolution 1 hour

Cloud Top Pressure

- temporal resolution 1 hour

- spatial resolution 5 km

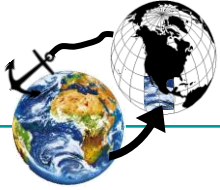
Precipitation Data

- temporal resolution 1 hour

- spatial resolution 7 km

(Matthias Zimmer, University of Mainz)





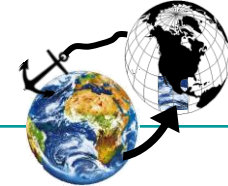
Highlights of Previous Work

Diurnal Cycles

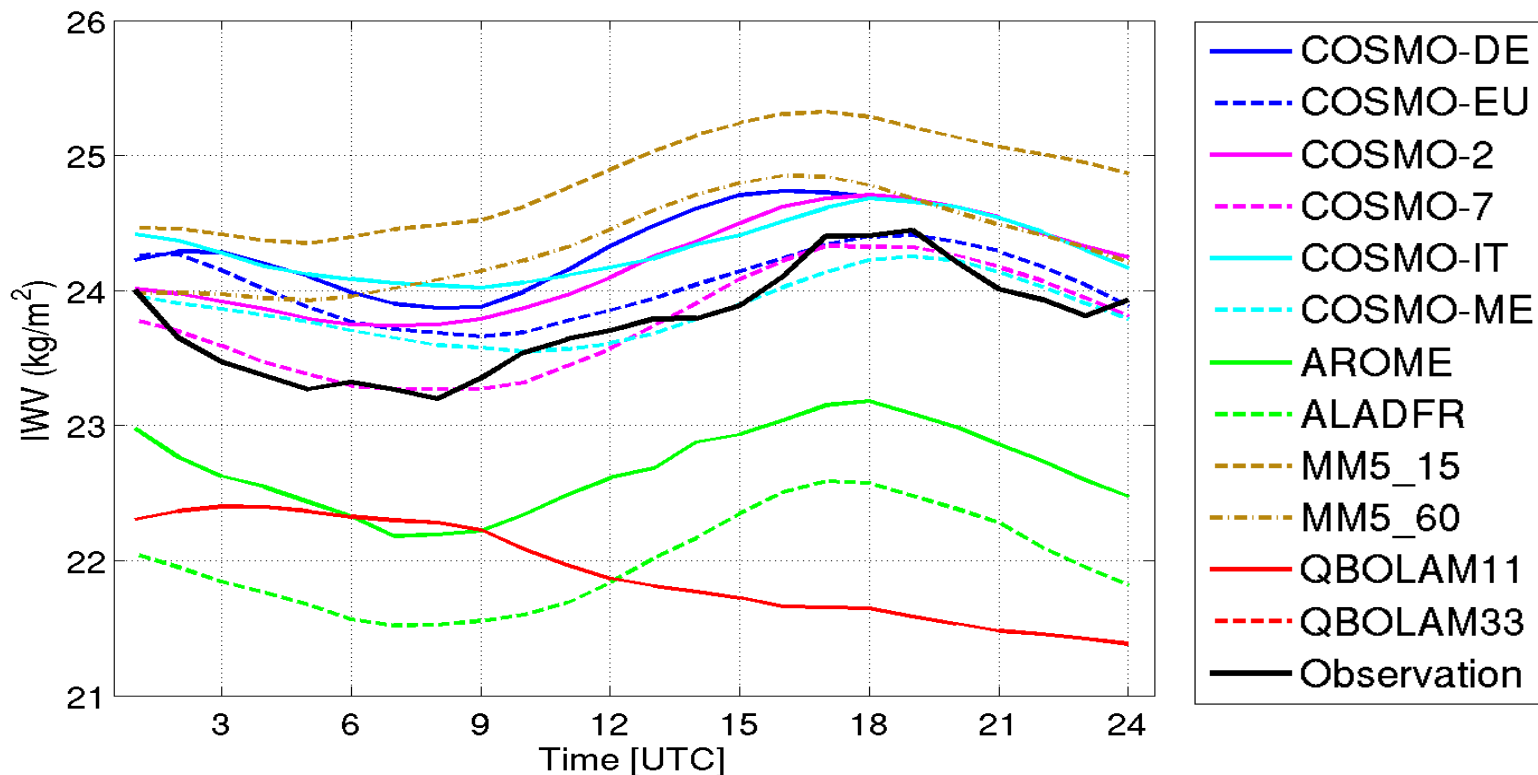
Verification performed only for Summer
Jun – Aug 2007



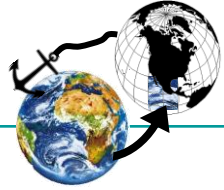
Mean IWV Diurnal Cycle (00 UTC Runs)



- High Resolution model
- - - Corresponding Low Resolution model
- . - . Corresponding Very Low Resolution model



- Observed diurnal cycle well represented by most of the models
- Maximum before 00 – 03 hour of observation



Ceilometer Low Cloud Cover

Low Cloud Cover \implies Ceilo cloud base height $< 1200\text{m} = 1$

Ceilo cloud base height $> 1200\text{m} = 0$

MSG High Cloud Cover

High Cloud Cover \implies cloud occurrence probability
(cloud top pressure $< 400\text{ hPa}$)

high cloud cover $> 50\% = 1$

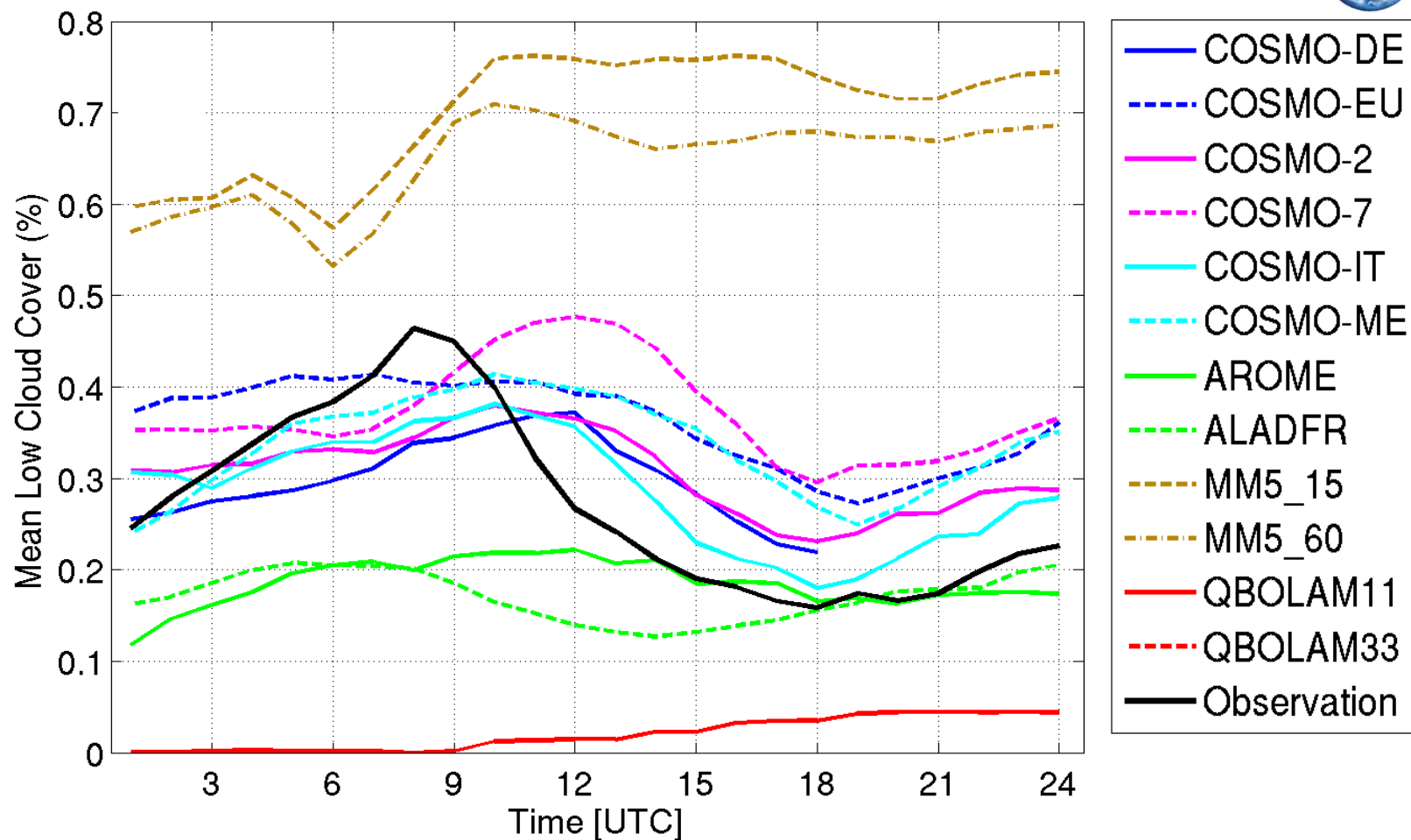
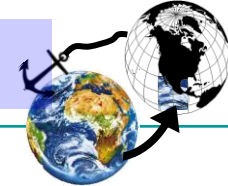
high cloud cover $< 50\% = 0$

Model Cloud Cover

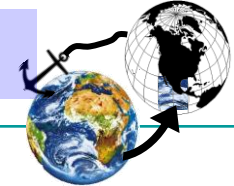
Model cloud cover $> 50\% = 1$

Model cloud cover $< 50\% = 0$



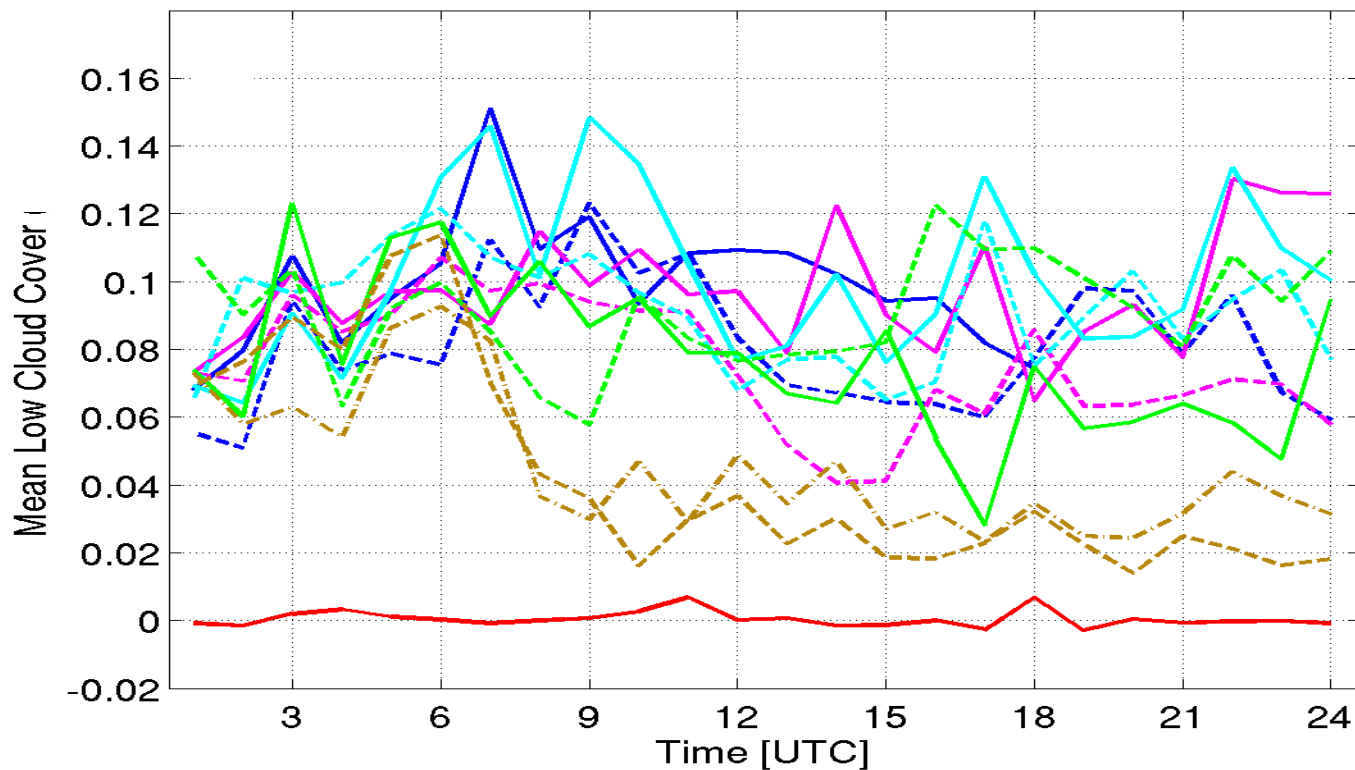


- Observed diurnal cycle well represented by most of the models
- Maximum after 02 - 04 hour of observation

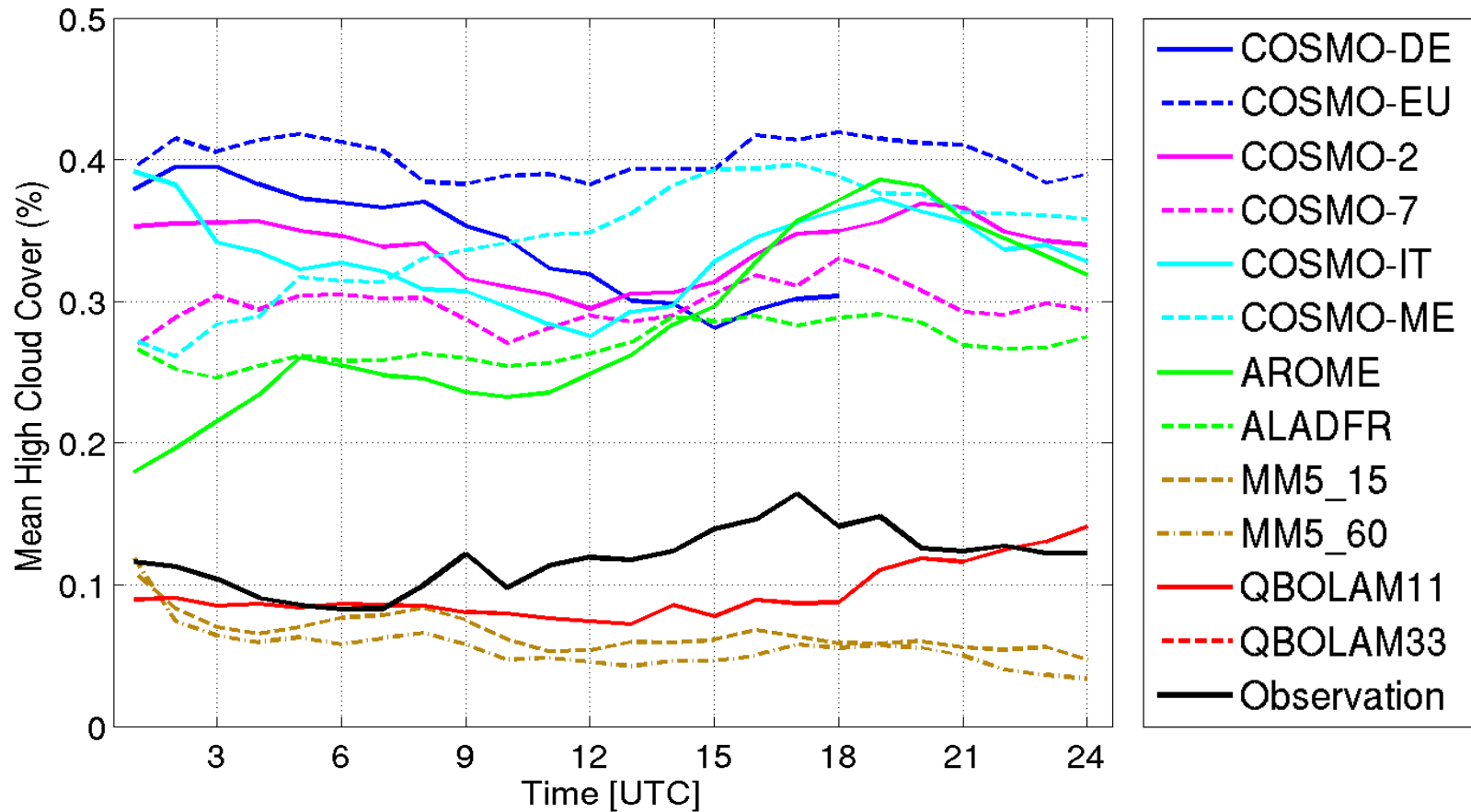
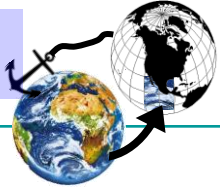


$$\text{ETS} = (H - H_{\text{RAN}}) / (H + M + F - H_{\text{RAN}}),$$

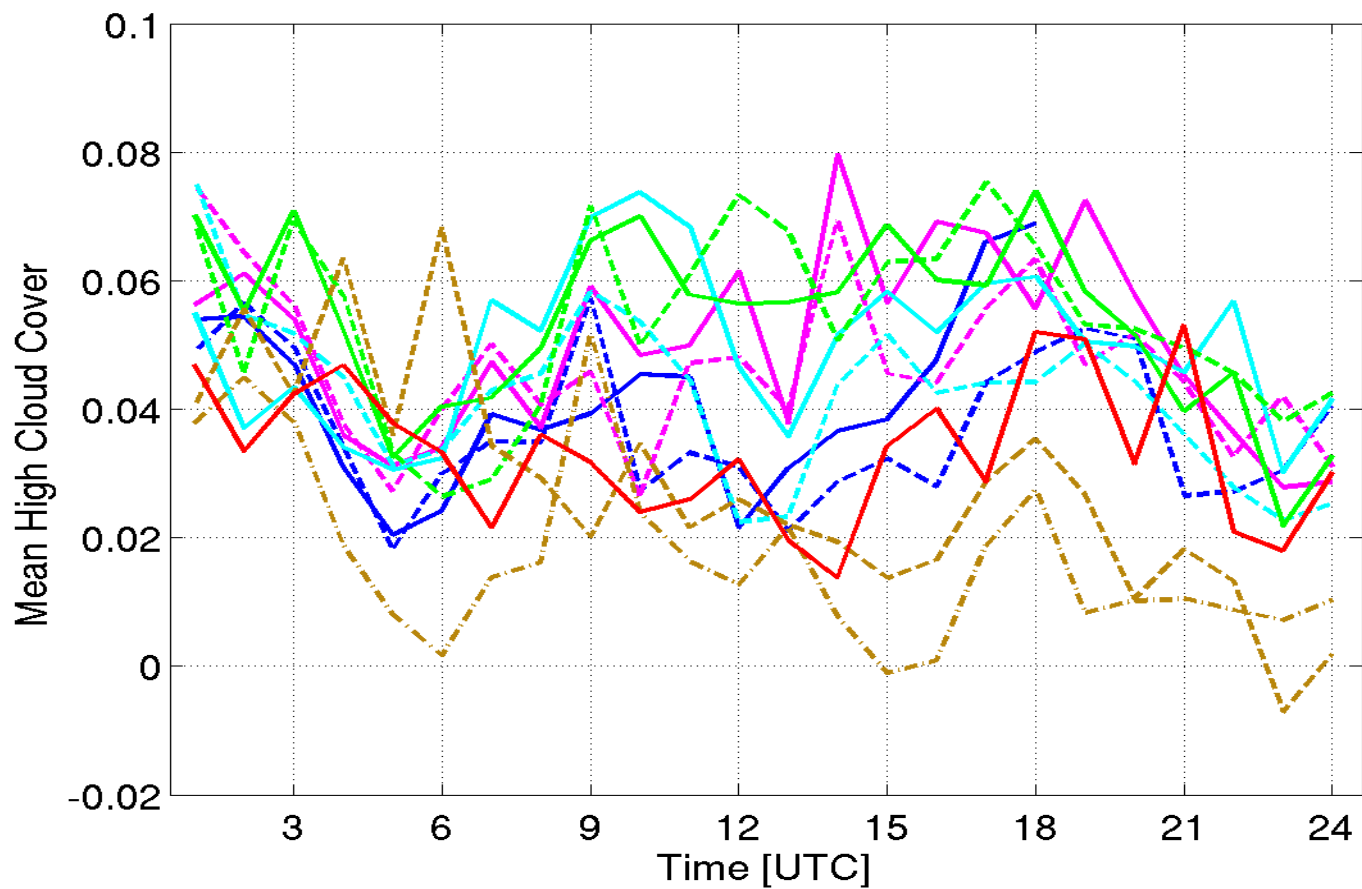
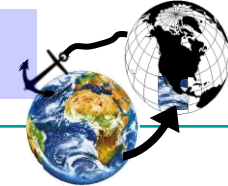
where H_{RAN} is number of hits by chance.



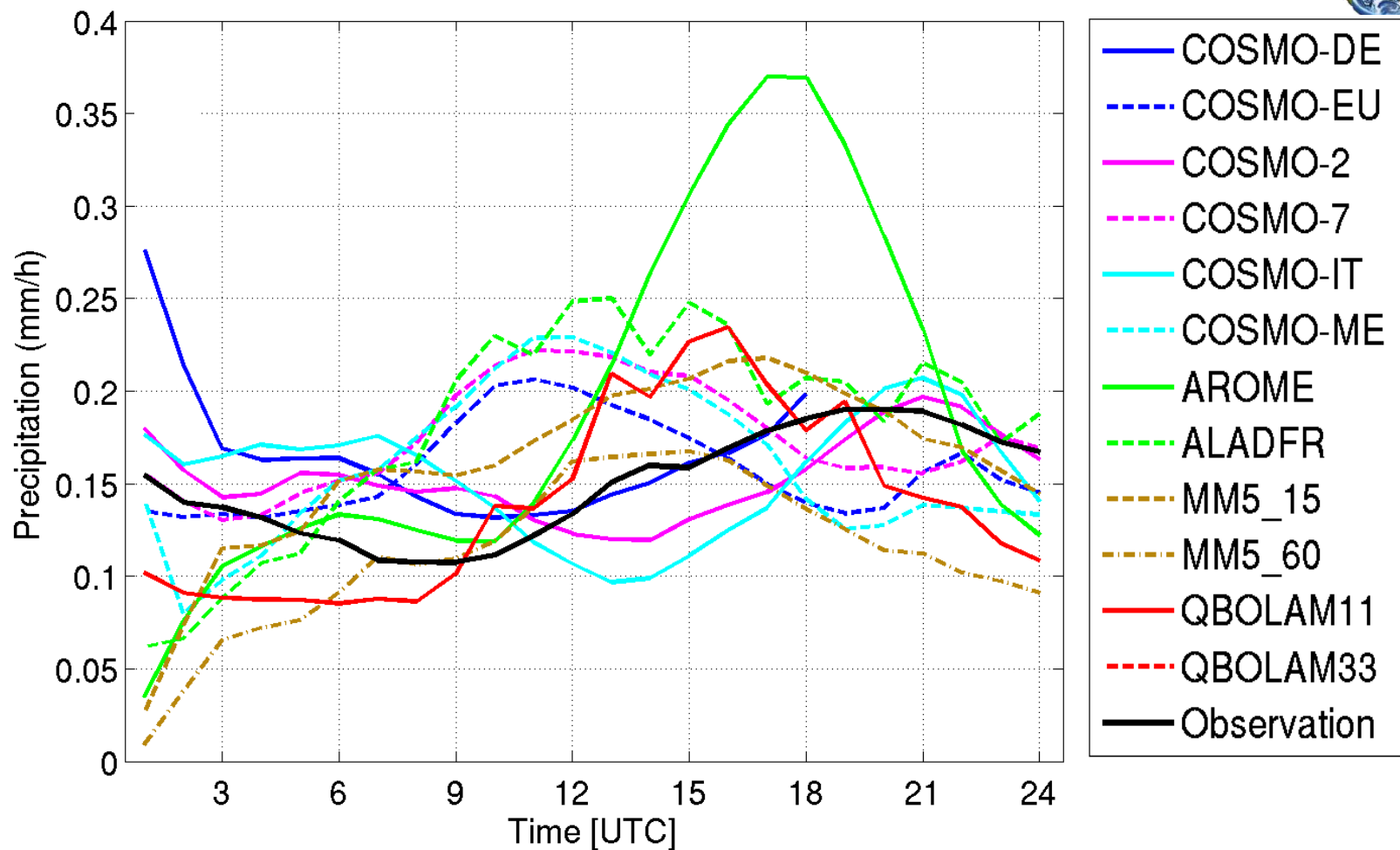
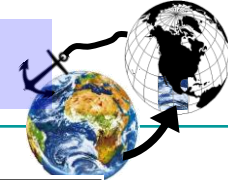
- No significant diurnal variation in ETS
- ETS ranges from 0.07 – 0.09



- Observed diurnal cycle well represented by most of the models
- Maximum after 00 – 03 hour of observation

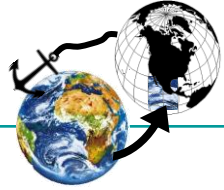


- No significant diurnal variation in ETS
- ETS ranges from 0.01 – 0.05



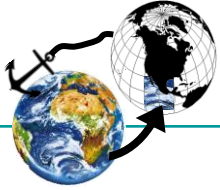
- Observed diurnal cycle is well represented by most of the models
- Phase shift: High Resolution Models 2 – (-2) h

Low Resolution Models 2 – 8 h



Model	IWV	Low Cloud Cover	High Cloud Cover	Precipitation
COSMO-DE	2	-2	-3	-2
COSMO-EU	0	-4	-1	8
COSMO-2	1	-2	-3	-2
COSMO-7	2	-4	-1	8
COSMO-IT	1	-2	-3	-2
COSMO-ME	0	-2	0	7
AROME	1	-4	-2	2
ALADIN	2	3	-2	6
MM5_15	2	---	---	2
MM5_60	3	---	---	4
QBOLAM_11	---	---	---	3
QBOLAM_33	---	---	---	3

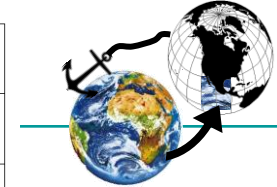
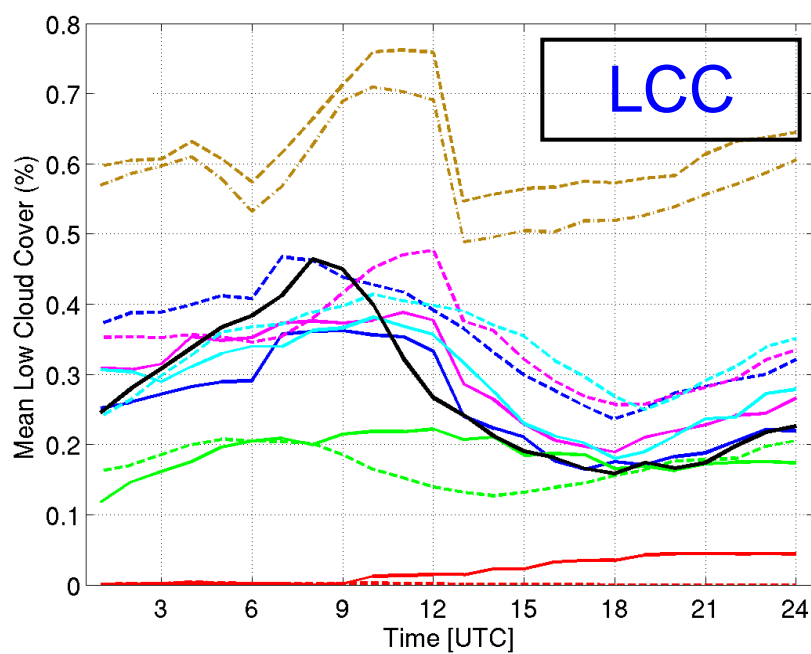
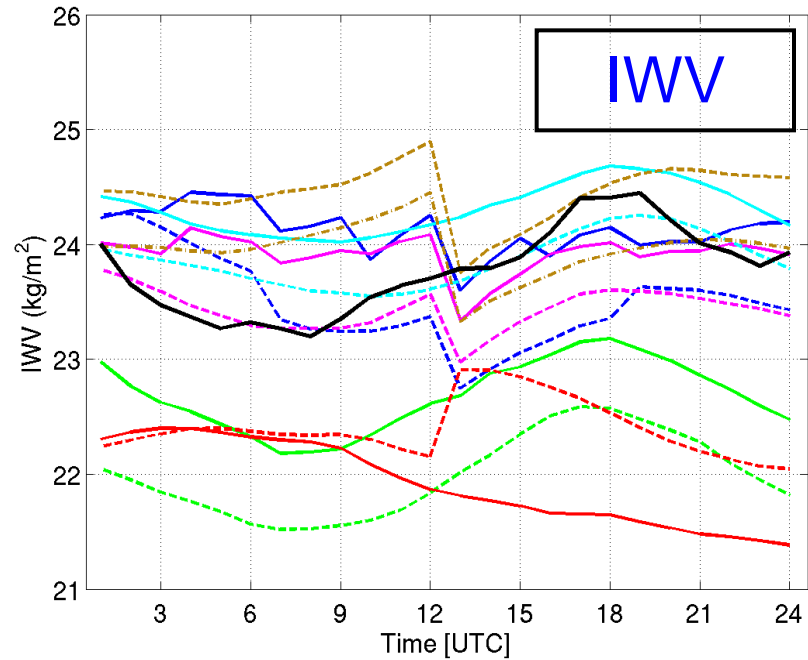




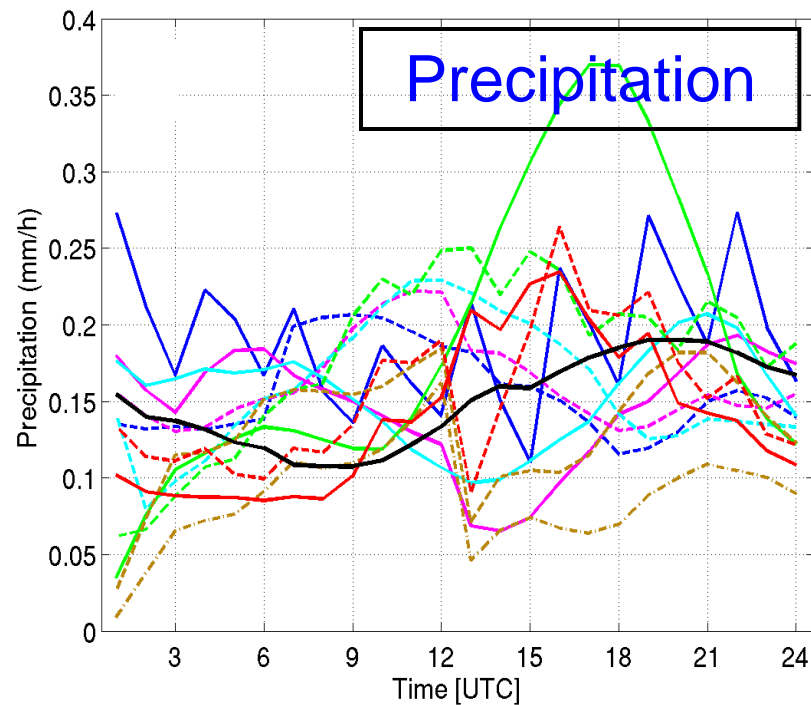
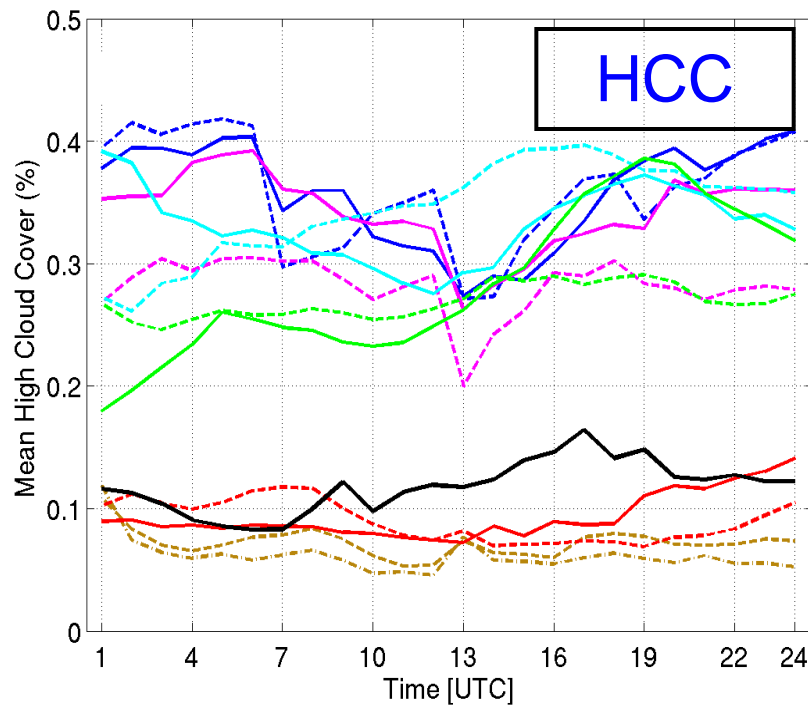
Effect of Data Assimilation

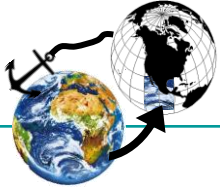
For Recent Run





- COSMO-DE
- - COSMO-EU
- COSMO-2
- - COSMO-7
- COSMO-IT
- - COSMO-ME
- AROME
- - ALADFR
- - MM5_15
- - MM5_60
- QBOLAM11
- - QBOLAM33
- Observation

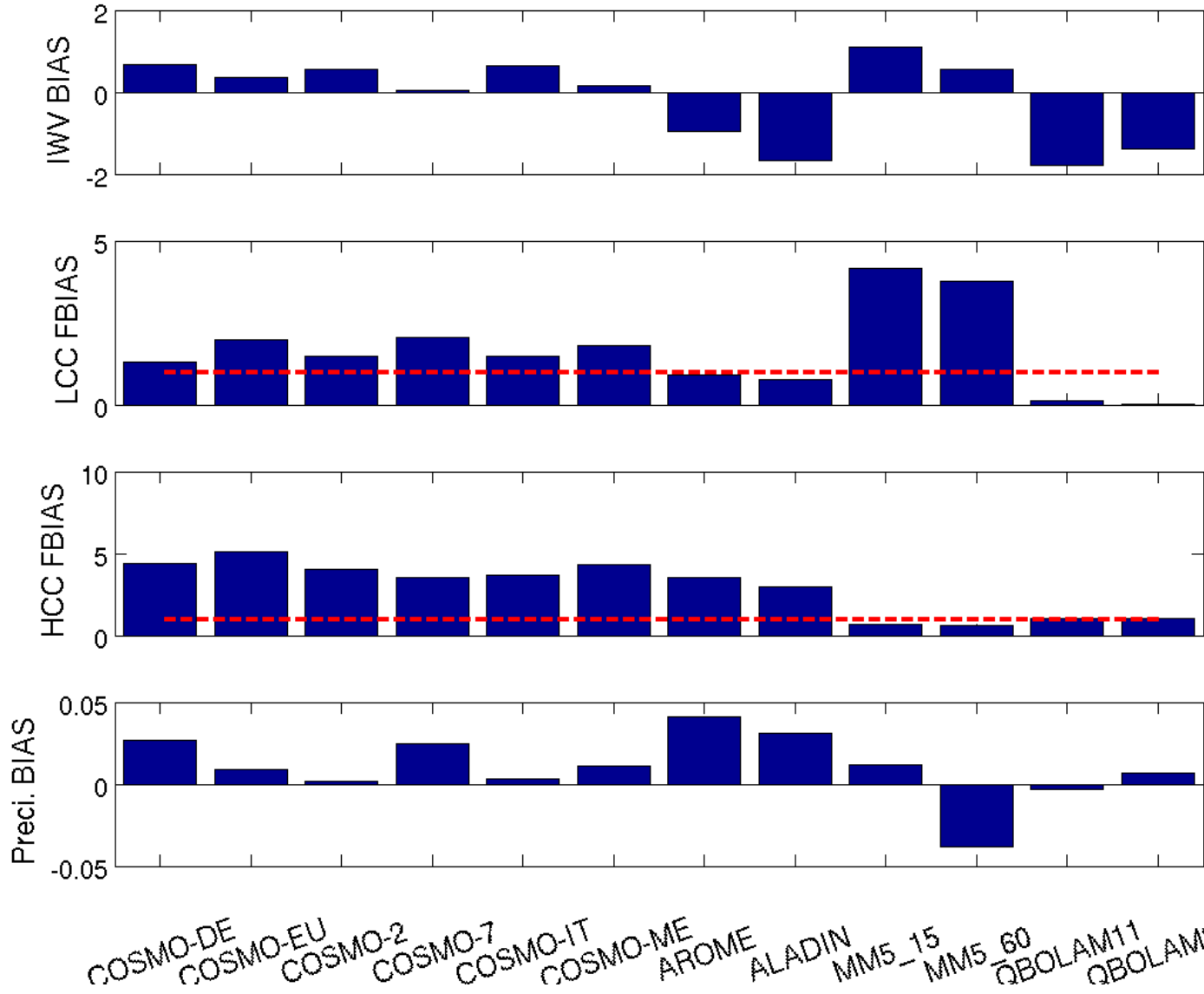
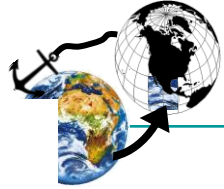


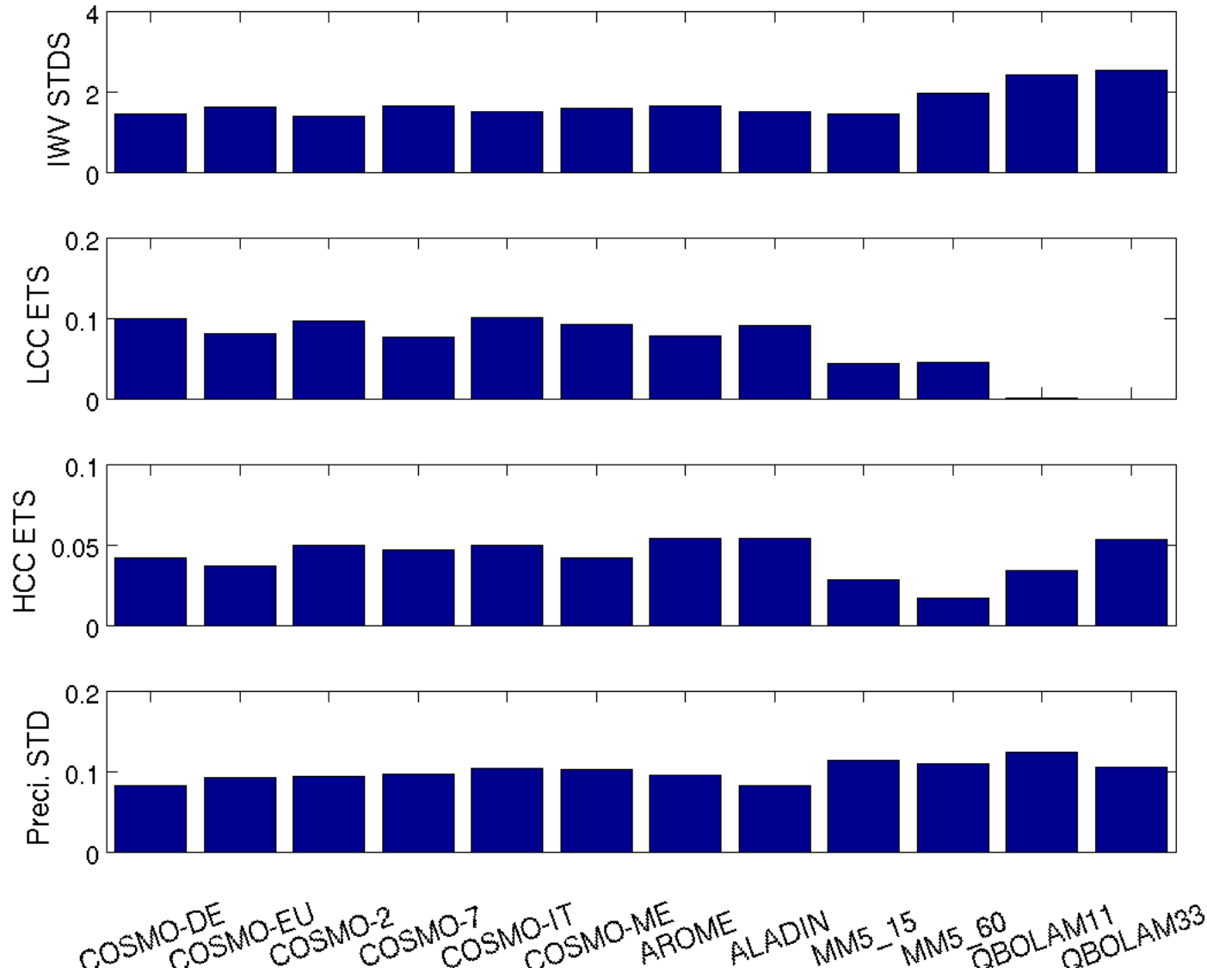
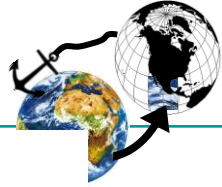


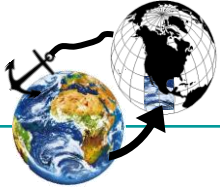
Domain Average



BIAS





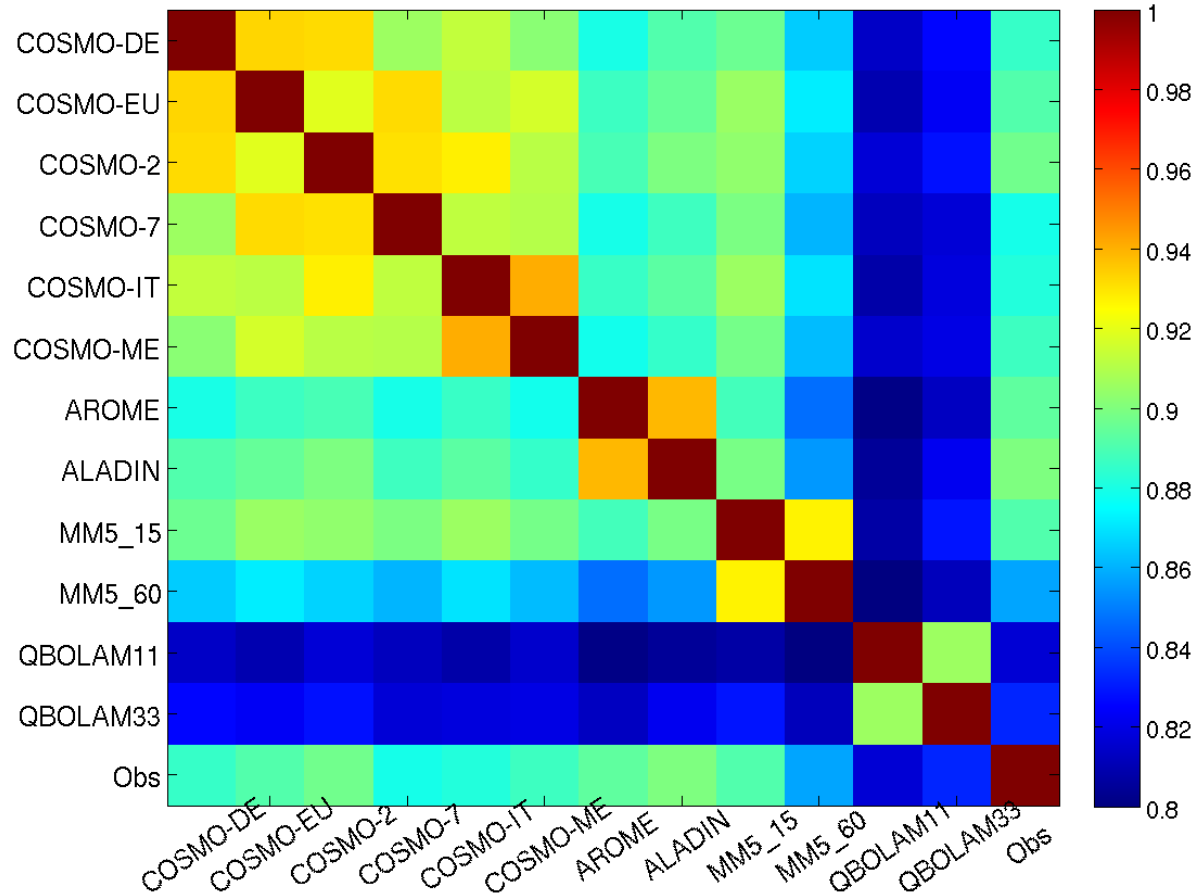
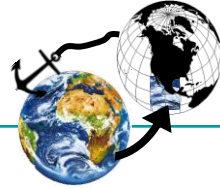


Correlation Map

Correlation (IWV, LCC, HCC): Calculated for each stations
average over the whole domain

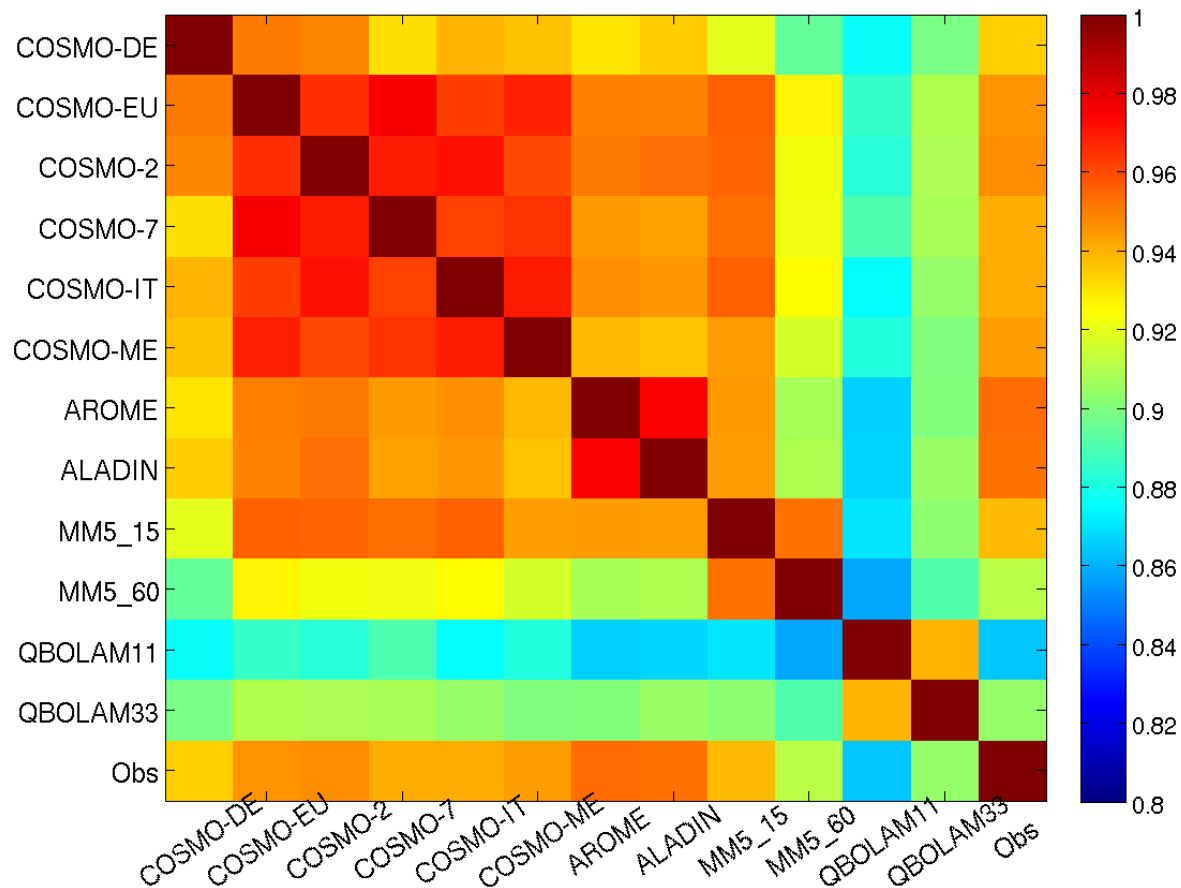
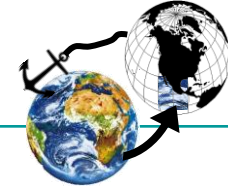
Correlation (Precipitation): Calculated for domain average
models and Observation





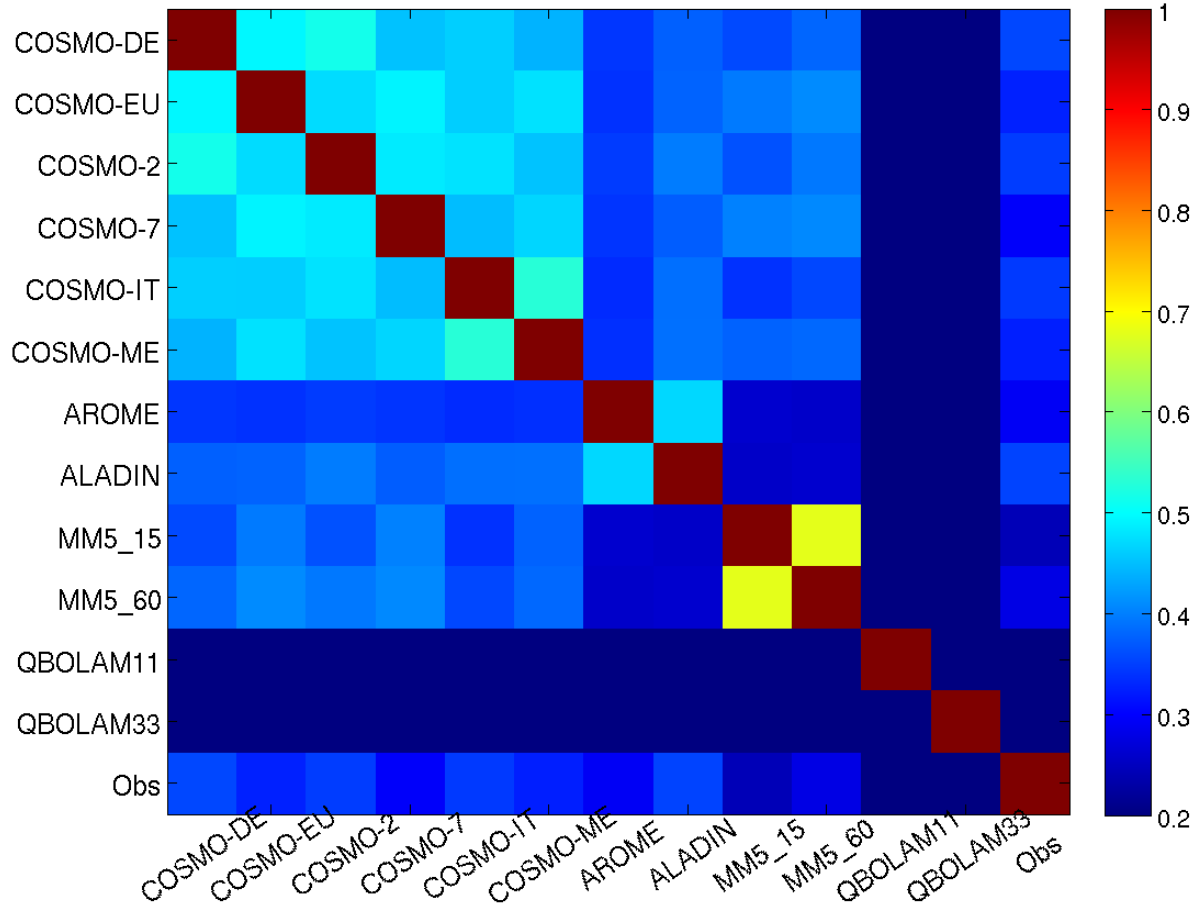
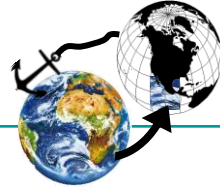
- Models with same boundary condition didn't show any similarity
- Models nested in each other are similar





- Correlation increases with averaging
- Models with the same formulation are similar

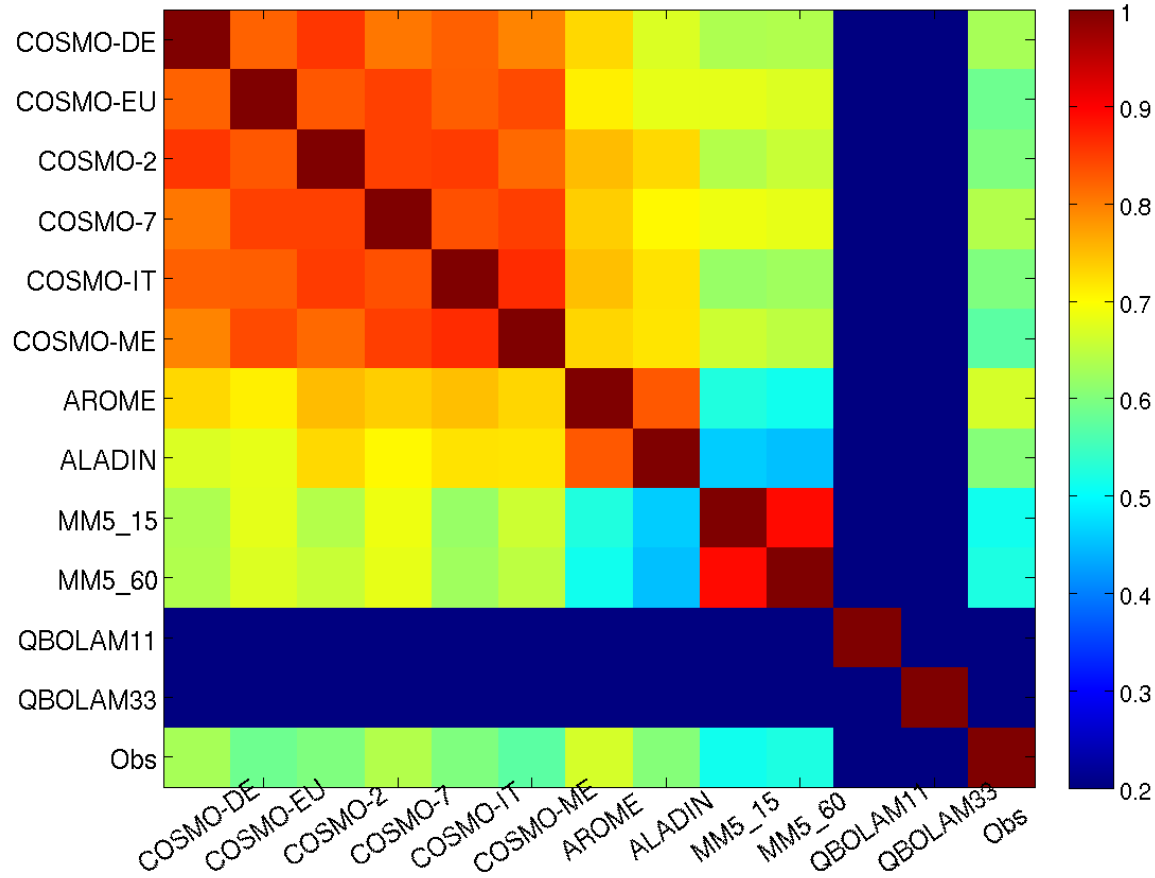
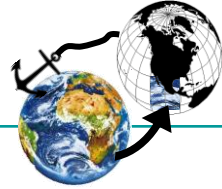




- Low correlation of all models with observation
- Models nested in each other show similarity

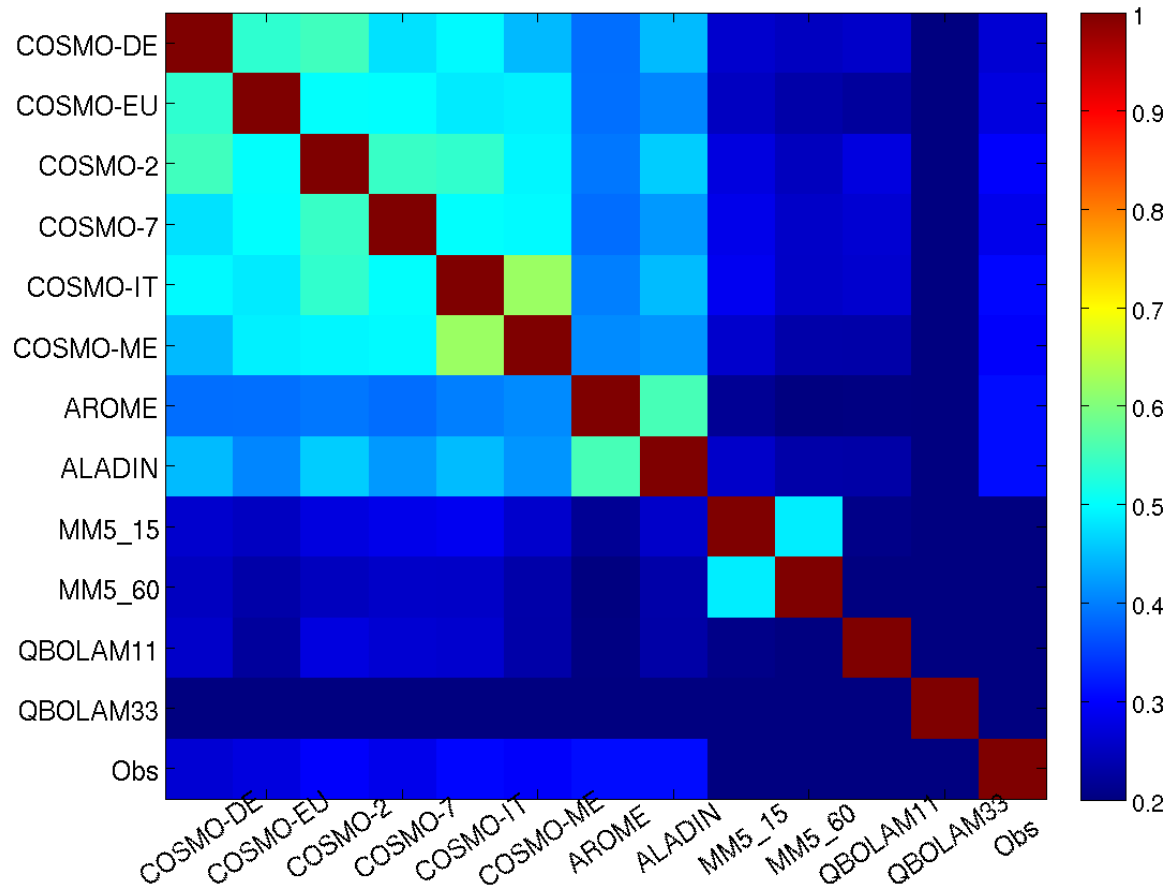
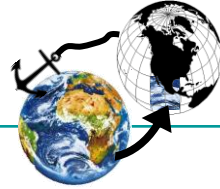


Correlation of Models and Obs in LCC (24 h Avg)



- Significant increase of correlation with averaging
- Models with the same formulation are similar

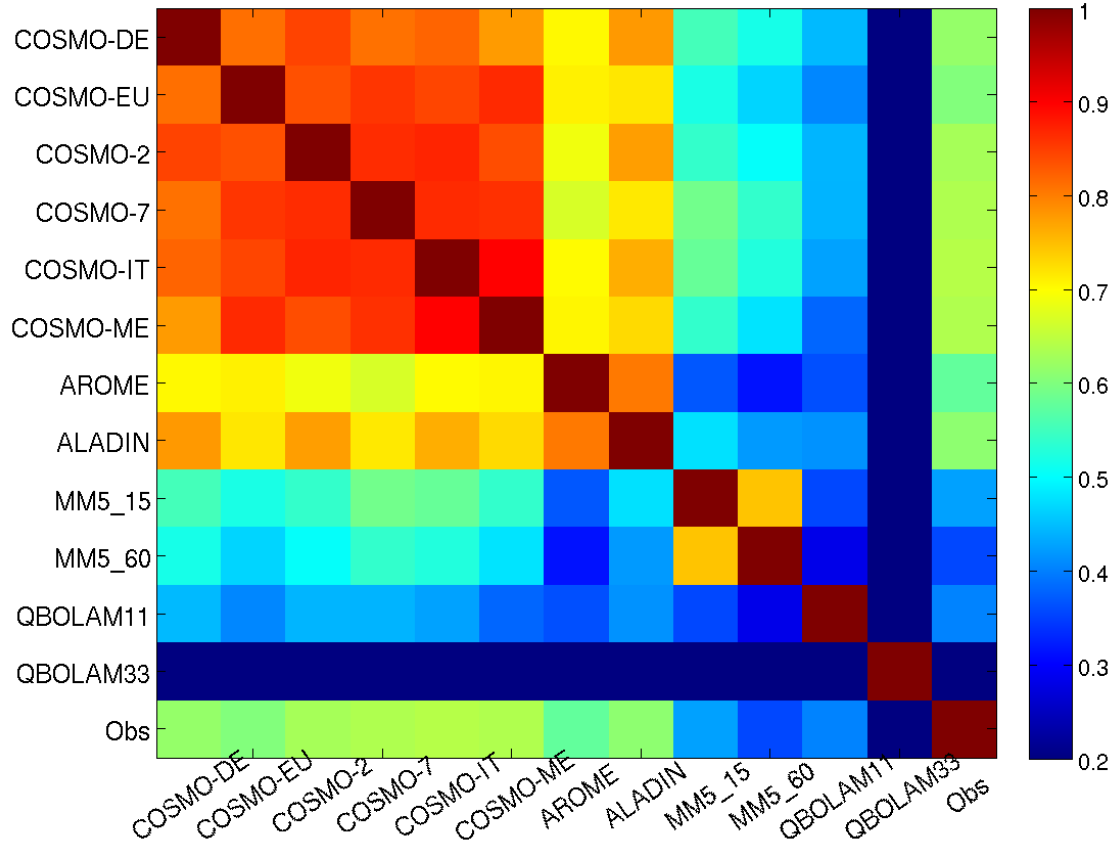
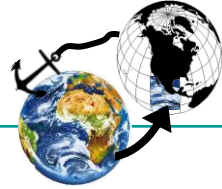




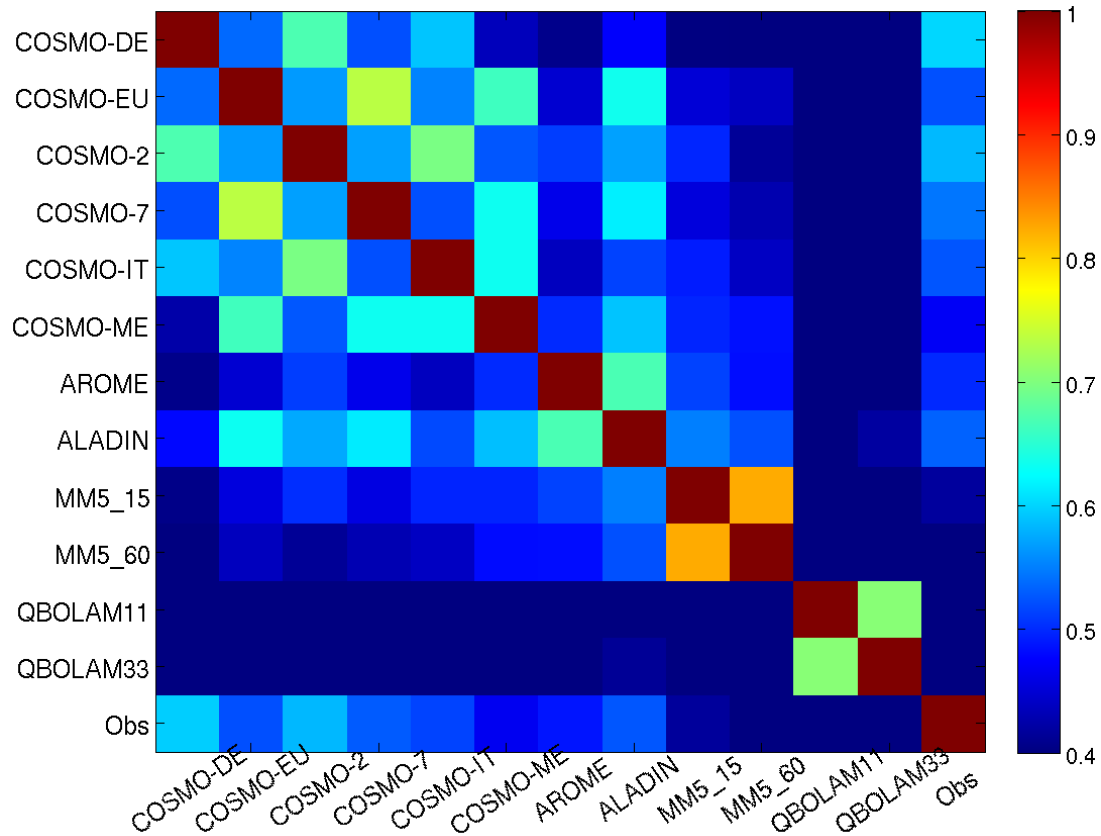
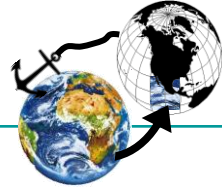
- Low correlation of all models with observation



Correlation of Models and Obs in HCC (24 h Avg)

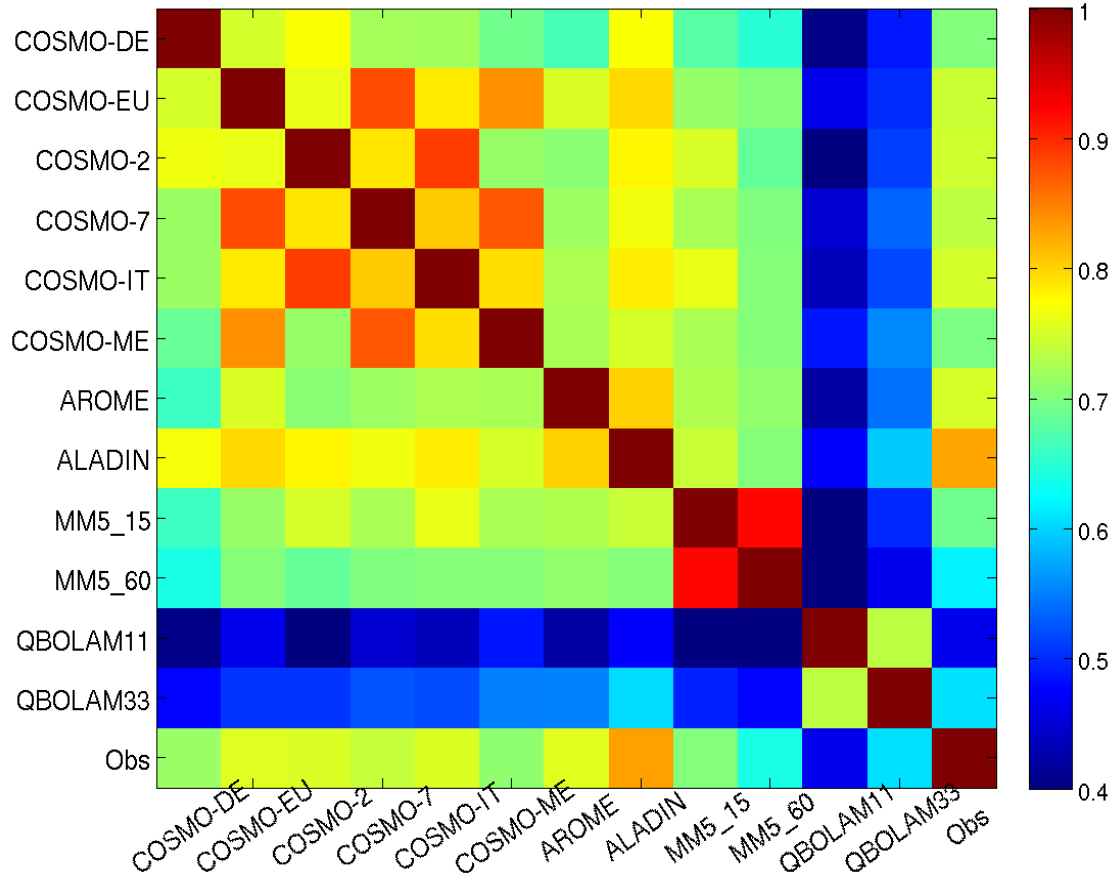
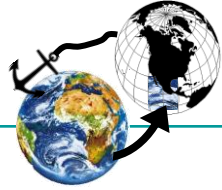


- Significant increase of correlation with averaging
- Models with the same formulation are similar



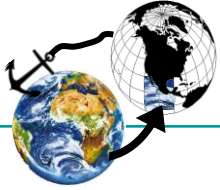
- Clear dependency on models resolution rather than models formulation





- Increase of correlation with averaging

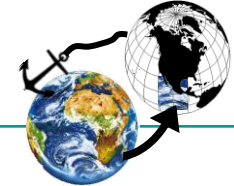




Diurnal Cycle (D-Phase Domain)

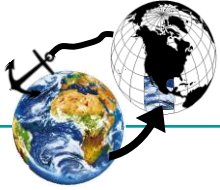
- Diurnal cycle in all variables are fairly well represented by most of the models but with the phase shift with obs.
- Diurnal cycle in precipitation shows clear dependency on the models resolution.
- The impact of data assimilation is clearly seen in all variables.





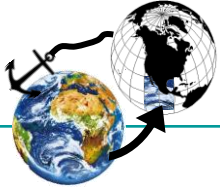
Domain Average

- Model with dry bias in IWV, underestimated the low cloud cover and vice versa.
- No clear relationship with high cloud cover and precipitation.
- Models with same boundary condition didn't show any similarity.
- Models with same formulation are grouped together for IWV, LCC, and HCC.
- For precipitation, models are grouped with their resolution



- Explore in details error structures
- Start with D-PHASE Ensemble systems

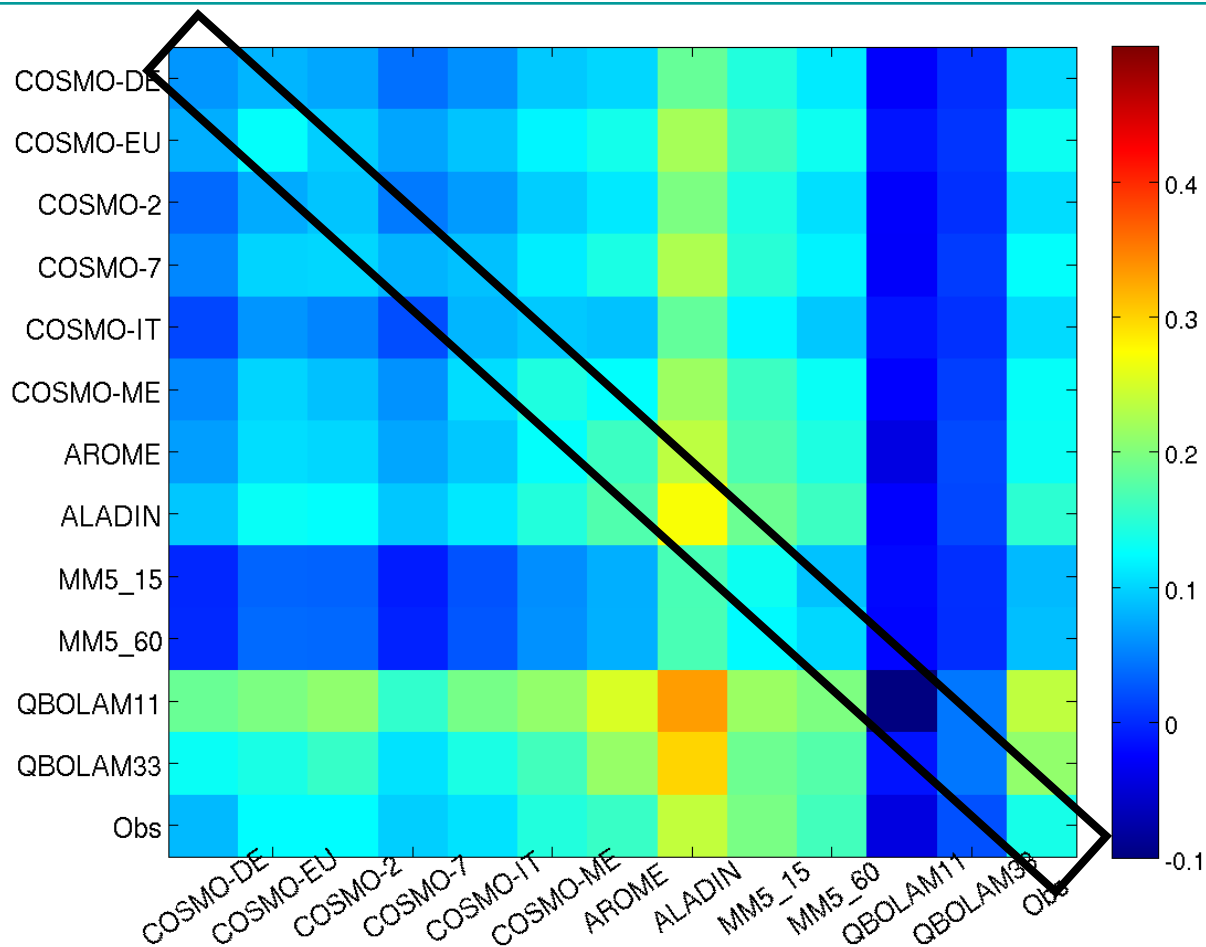
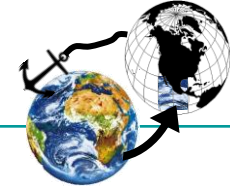




Thank You

A decorative graphic in the bottom-left corner, consisting of a light blue square with a white wavy line at the bottom edge, resembling a water surface or a stylized wave.

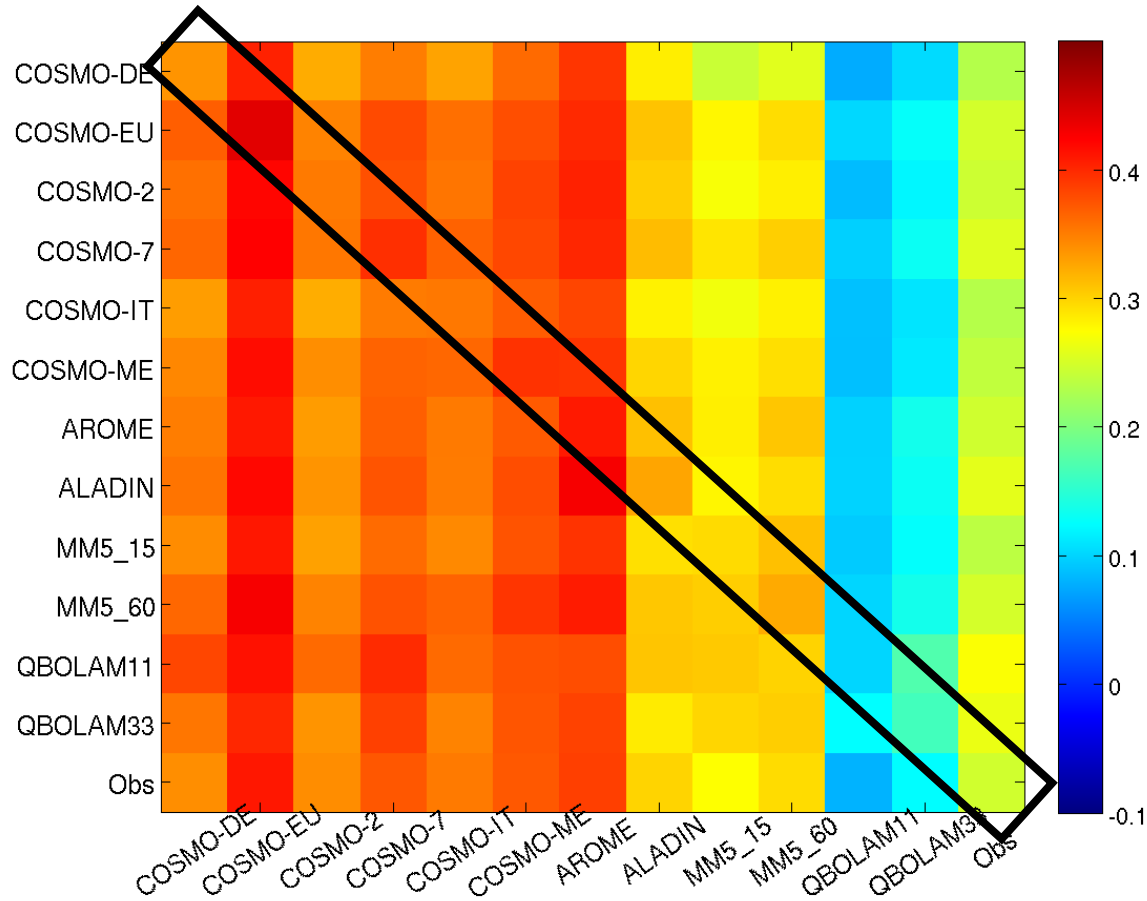
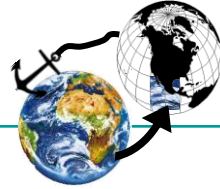
Correlation of IWV and LCC



- ALADIN have stronger relationship of IWV and LCC, compared to observation
- QBOLAM showed weaker relationship



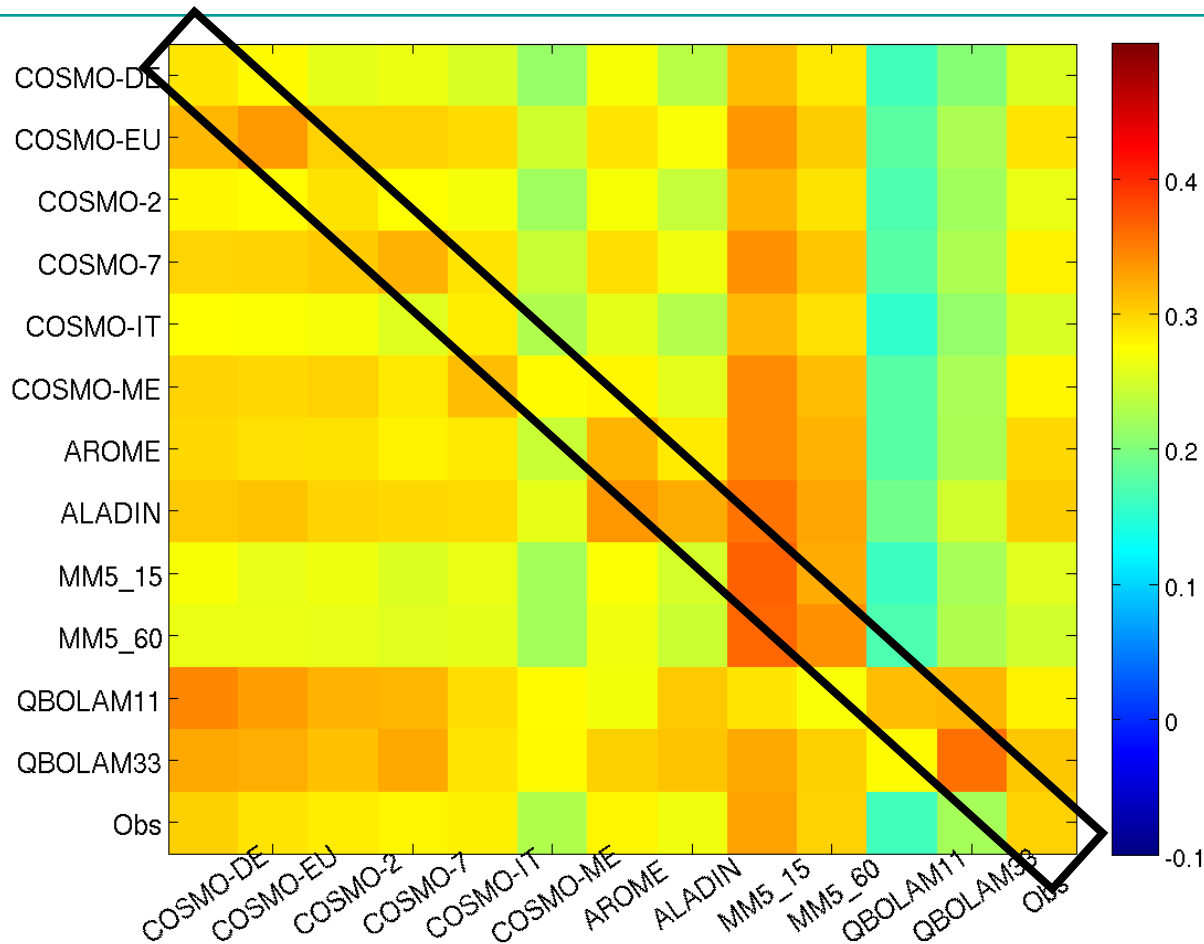
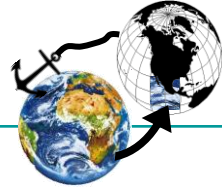
Correlation of IWV and HCC



- All Models have stronger relationship of IWV and HCC, compared to observation, except QBOLAM
- Coarse resolution models show stronger relationship compared to their high resolution models



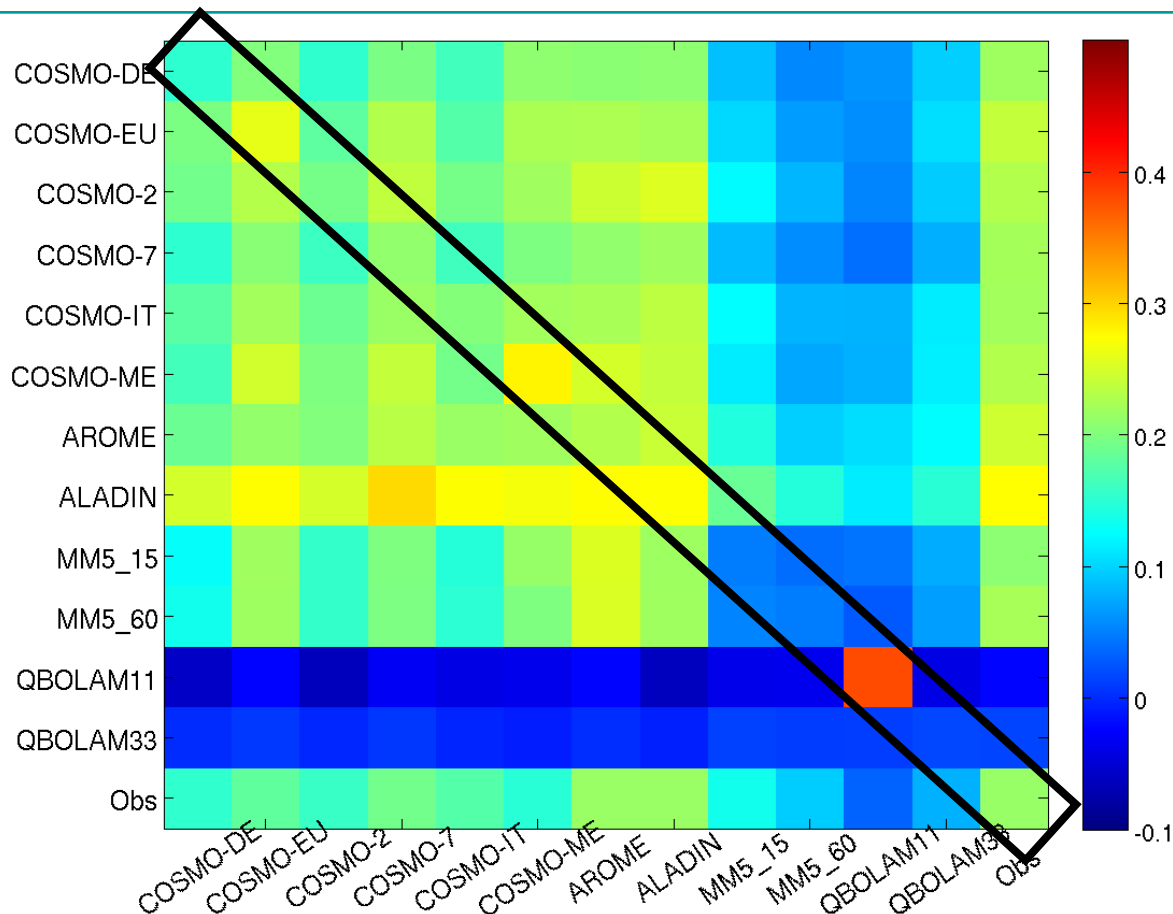
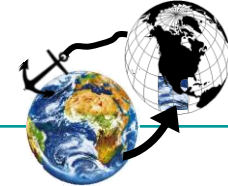
Correlation of IWV and Precipitation



- All COSMO coarse resolution models MM5 and QBOLAM33 show stronger relationship of IWV and Preci, compared to observation
- All high resolution models have approximately same relationship as observation

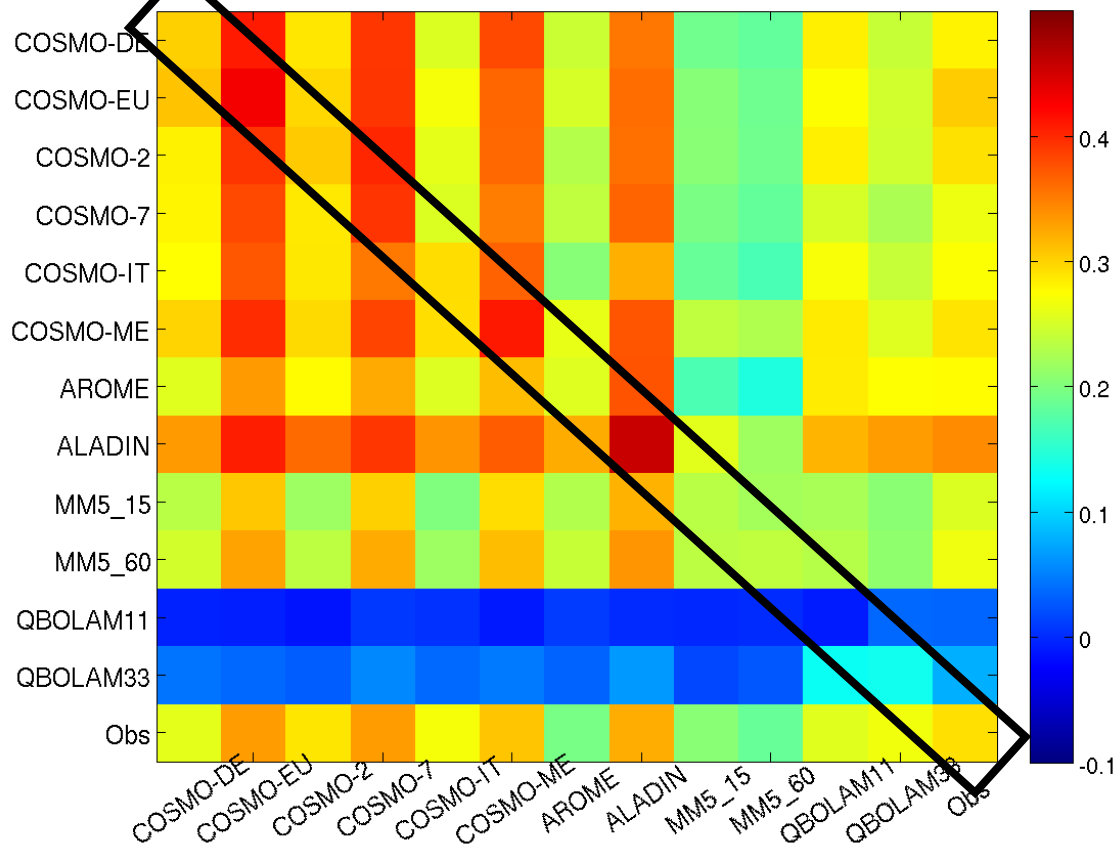
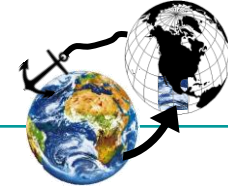


Correlation of LCC and HCC



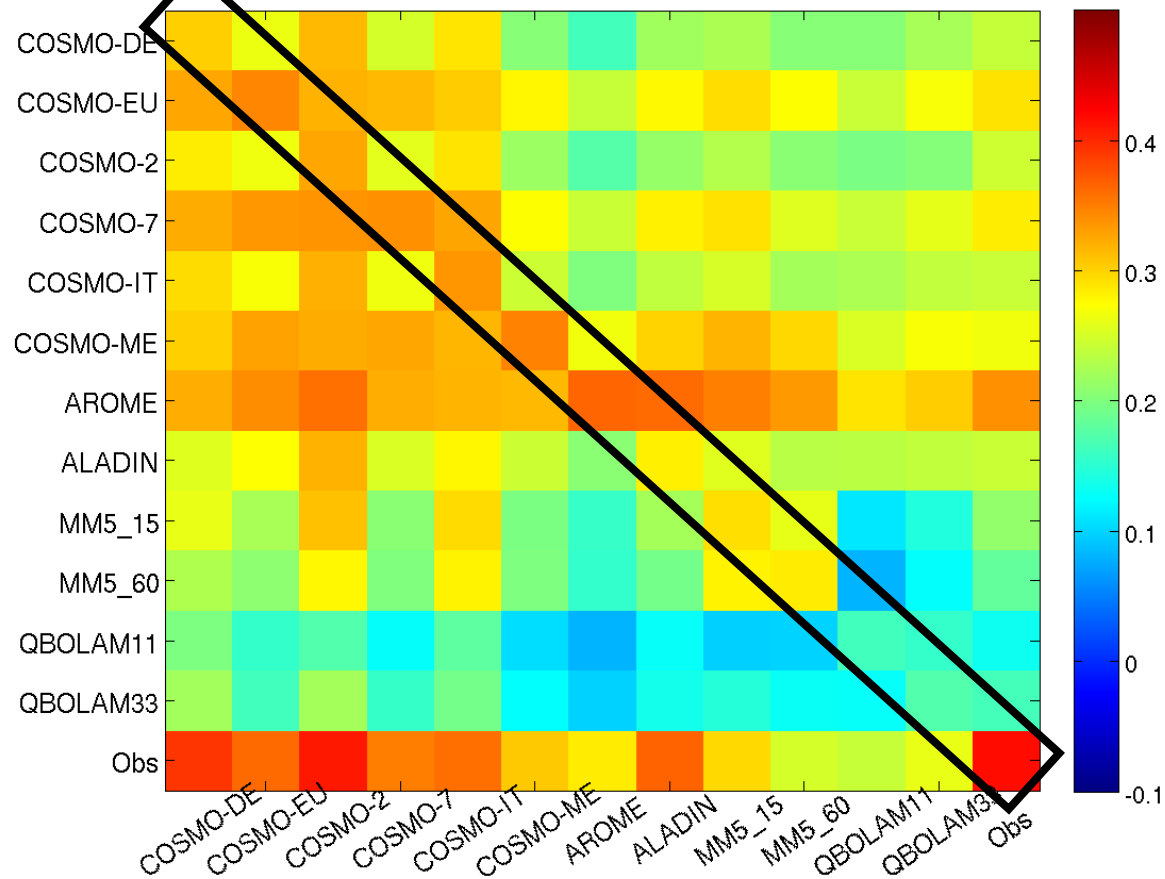
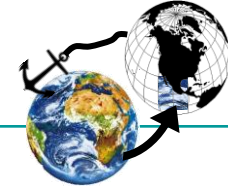
- Coarse resolution models show stronger relationship compared to their high resolution models
- MM5 and QBOLM33 showed weaker relationship, while QBOLAM11 showed very strong relationship

Correlation of LCC and Preci.



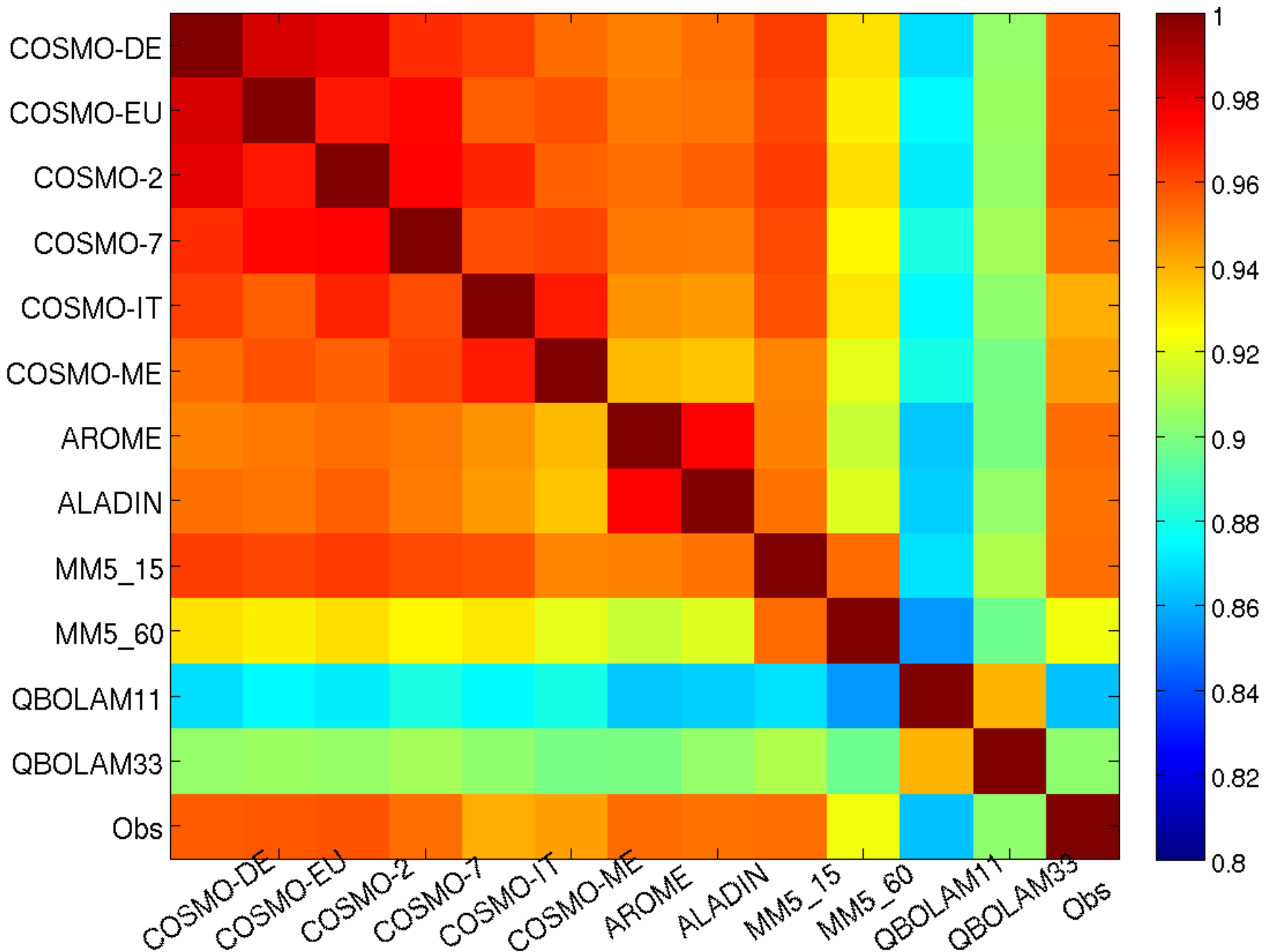
- Coarse resolution models show stronger relationship compared to their high resolution models
- QBOLAM showed weaker relationship

Correlation of HCC and Preci.



- All models showed weaker relationship compared to the observation
- QBOLAM showed weakest relationship

24Corr Obs and model IWV



0 Corr Obs and model IWV

