NEに基づく変分同化法を使った2015年台風18号事例への衛星雲・降水観測データの同化実験

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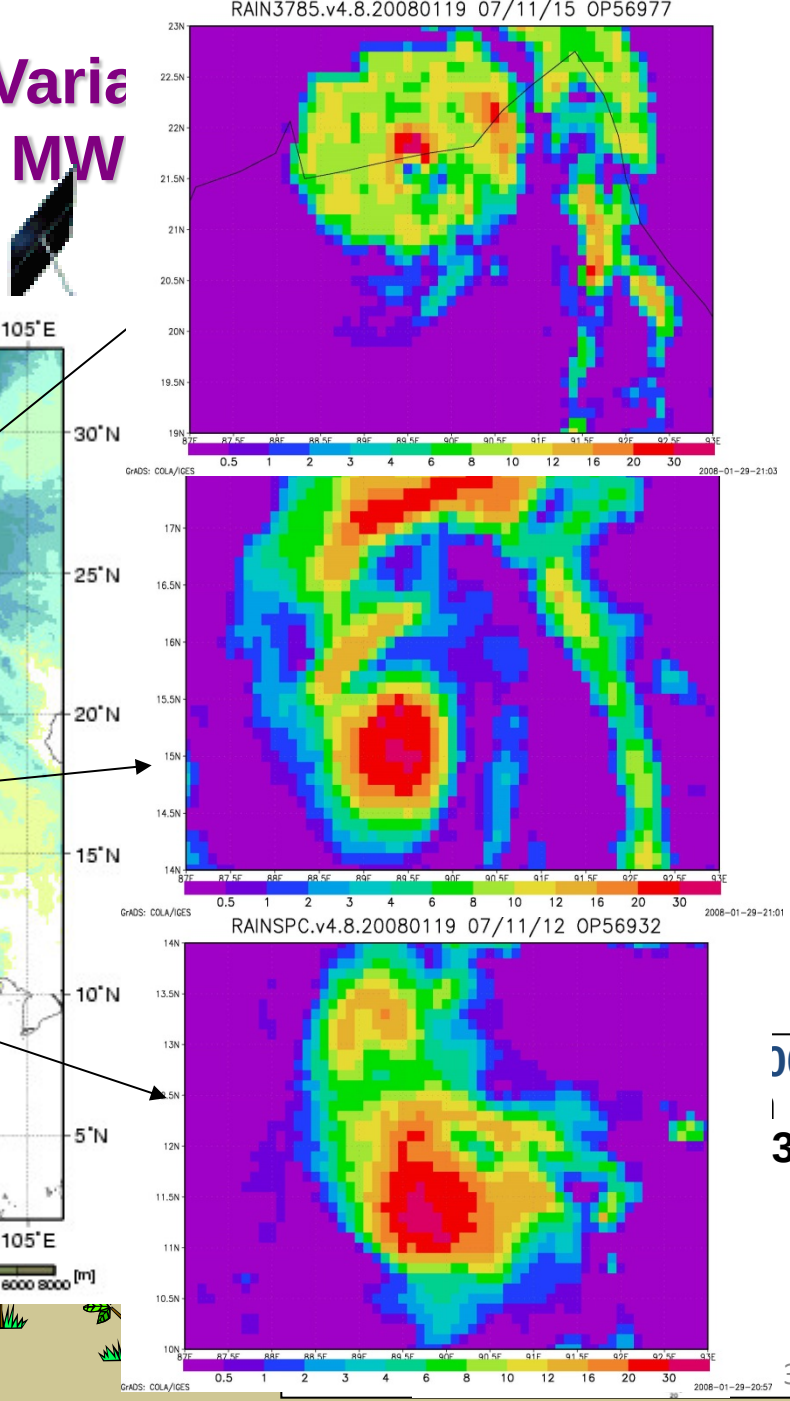
OUTLINE

- Introduction
- Ensembleを用いた変分同化法
  - Ensembleを用いた予報誤差共分散推定
  - Multi-regimeの仮定
- 対象事例、用いたCRM、MWI TB
- 同化実験
  - 実験の方法（1時刻のTB同化・FA cycle）
  - 解析値
  - アンサンブル平均の解析値からの降水予報
  - アンサンブルの各メンバーの降水予報
- まとめ

GOAL: Ensemble-based Varia
System to incorporate MW

MWR TBs are functions



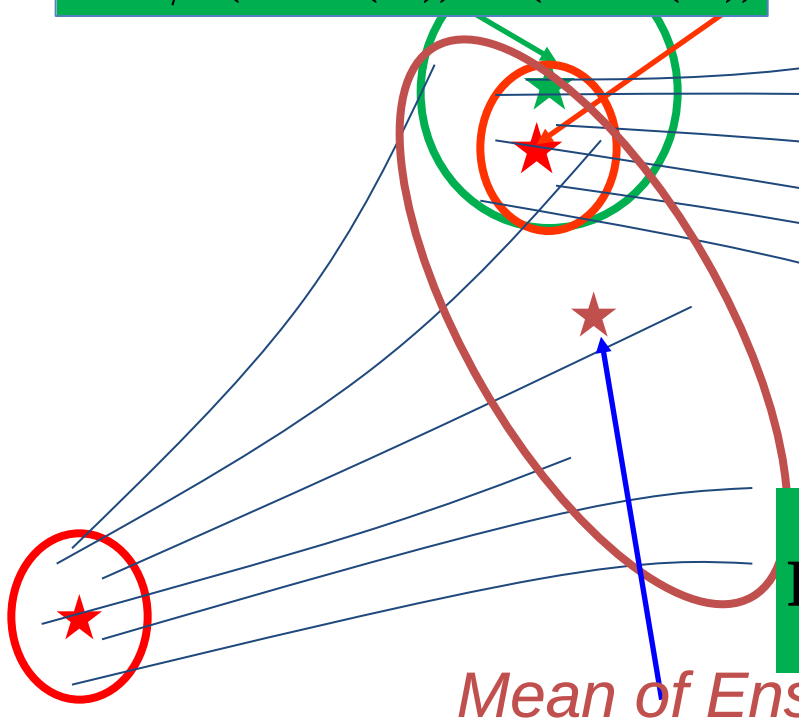
Ensemble-based Variational Assimilation

$$J_x = 1/2(\vec{X} - \bar{X}_f)P_f^{-1}(\vec{X} - \bar{X}_f) + 1/2(Y - H(\vec{X}))R^{-1}(Y - H(\vec{X}))$$

Calculation of analysis of Ensemble mean

Calculation of analysis of error cov. and Ensemble member.

$$\mathbf{P}_e^f \approx \frac{\delta\mathbf{X}_{t1}^f(\delta\mathbf{X}_{t1}^f)^T}{N-1}$$



Ensemble forecasts

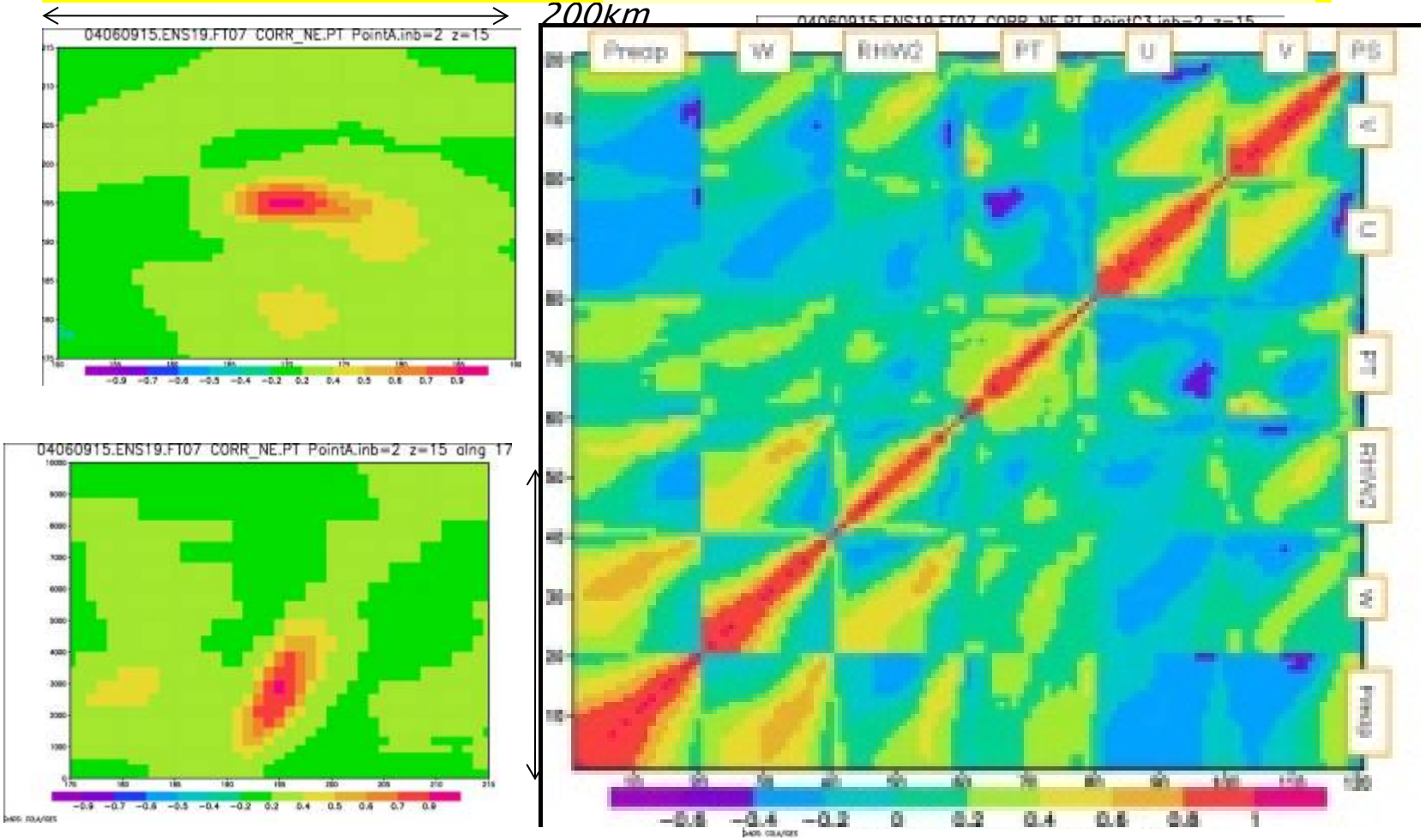
Mean of Ensemble forecasts

$T=t0$ $T=t1$ $T=t2$

Why Ensemble-based method?:

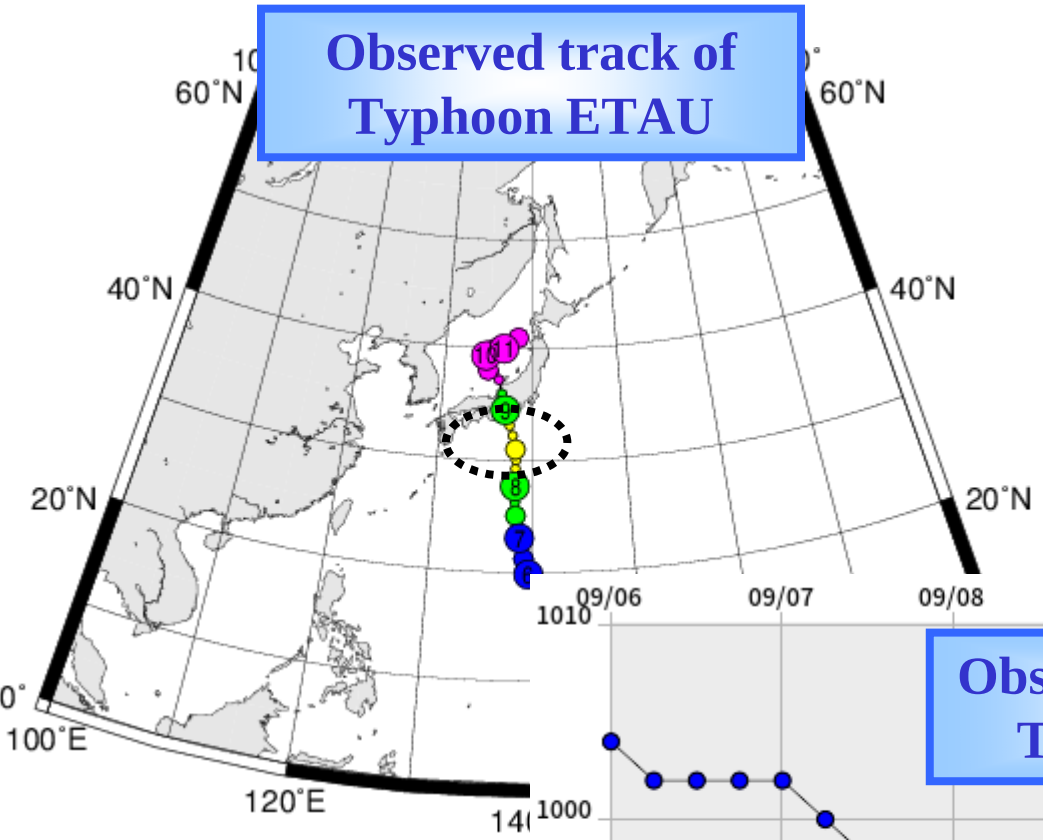
To estimate the flow dependency of the error cov

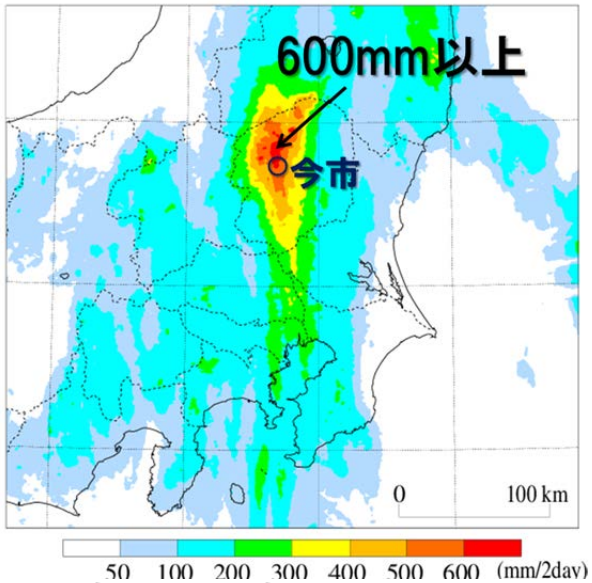
Vertical Cross-correlation in heavy rain areas

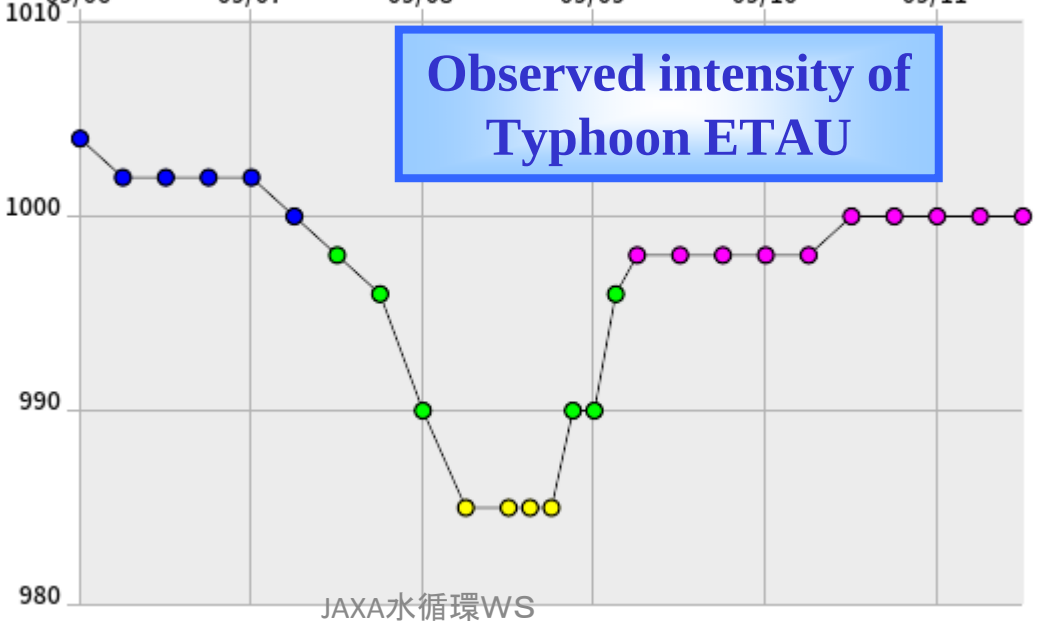


Ensemble forecast error corr. of PT (04/6/9/22 UTC)

Typhoon ETAU (T1518)

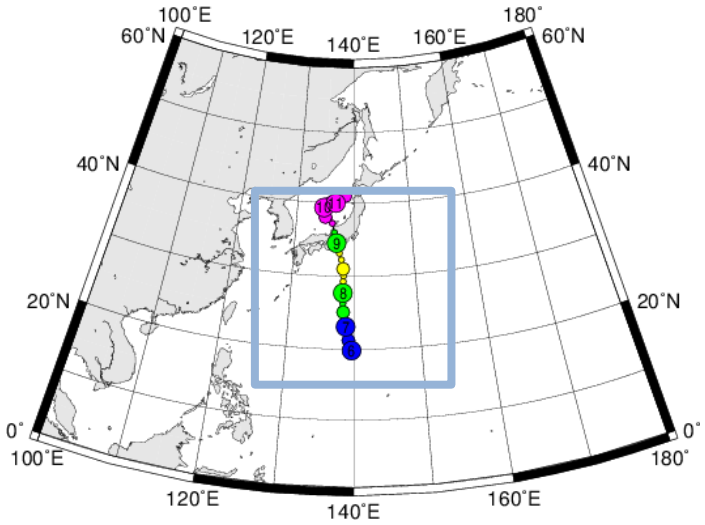


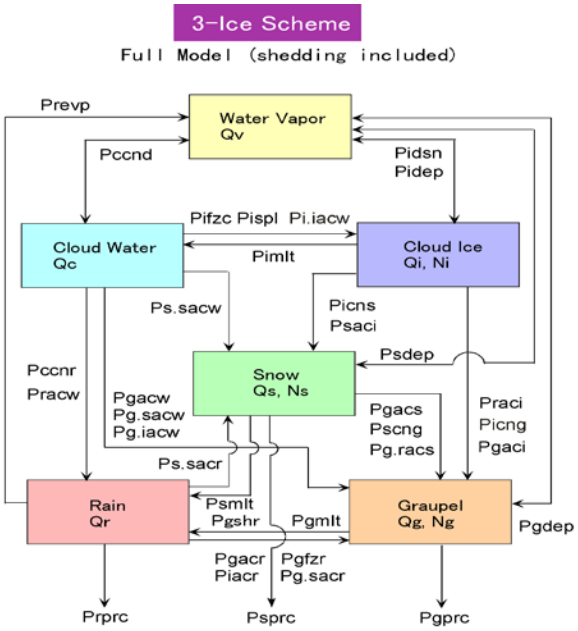


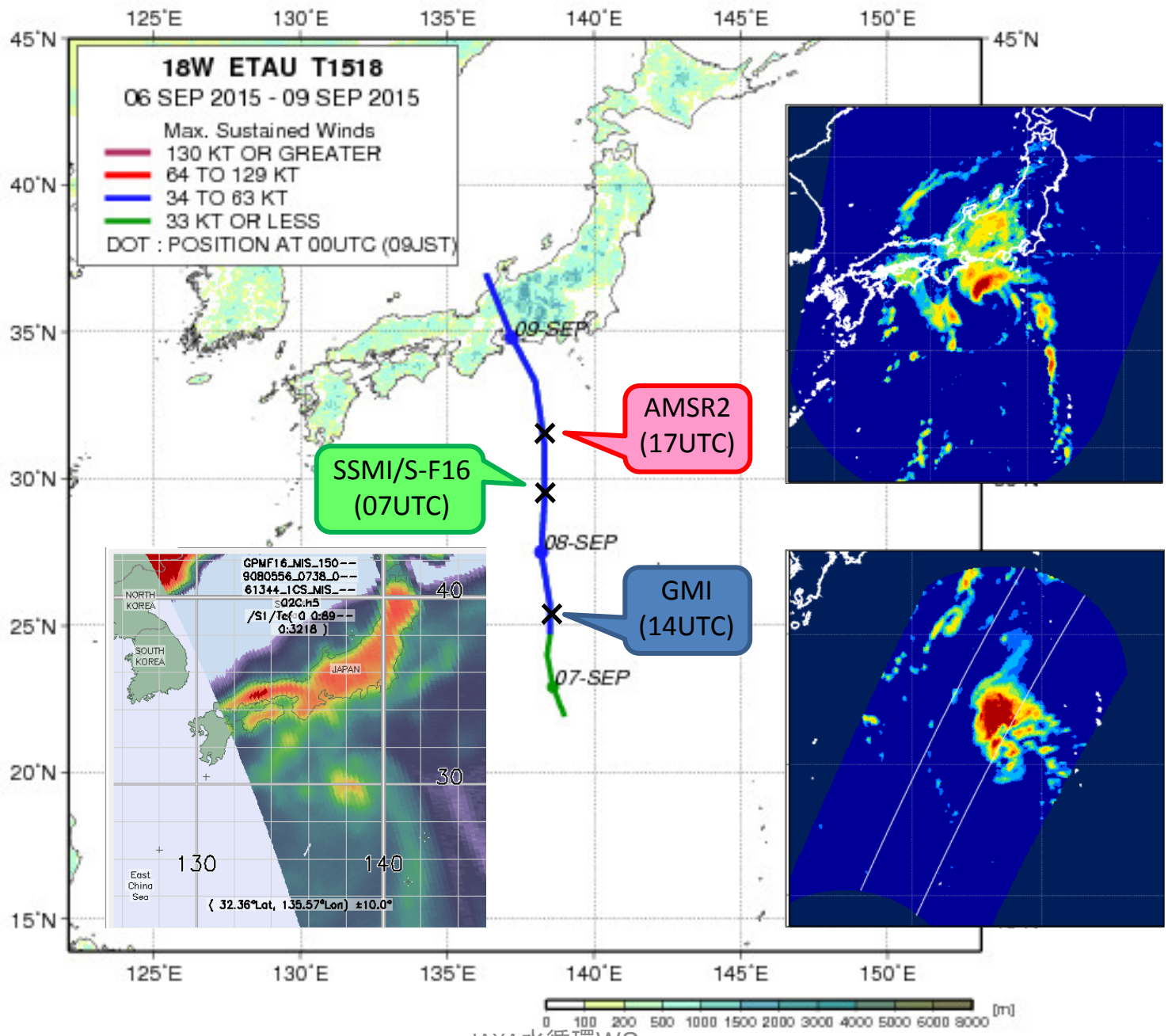


用いたCRM, Ensemble 予報

- CRM
  - JMANHM: 5km, (481x481x50)
  - 6種の水物質を予報する
  - コントロールランの初期・境界条件は6hourlyのGANAL
- Ensemble予報
  - 52 members
  - 初期・境界に週間Ensembleの摂動

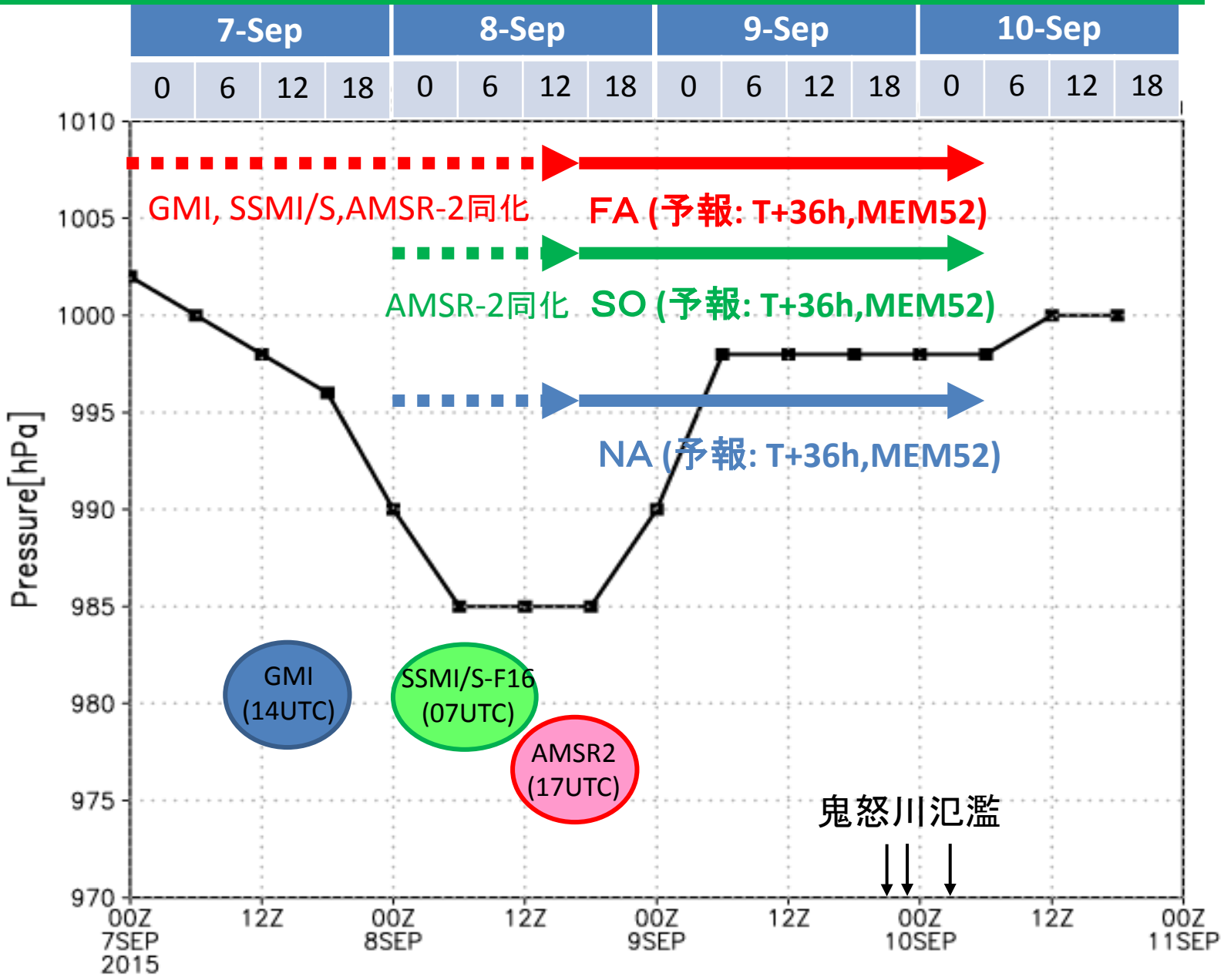




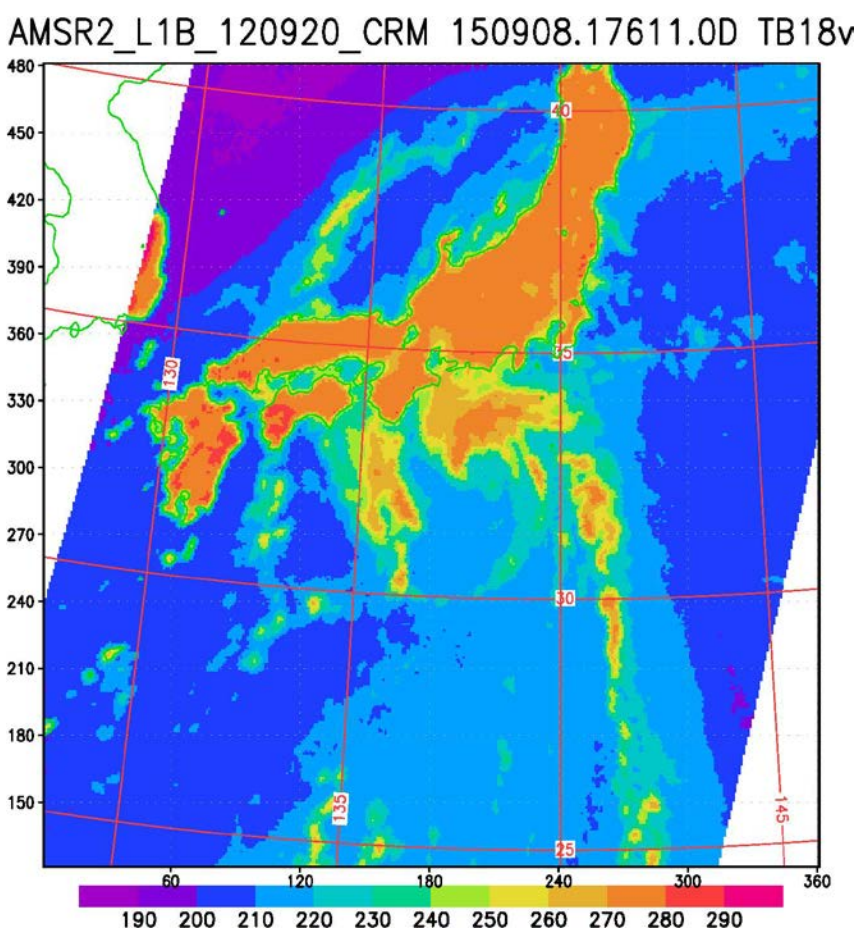


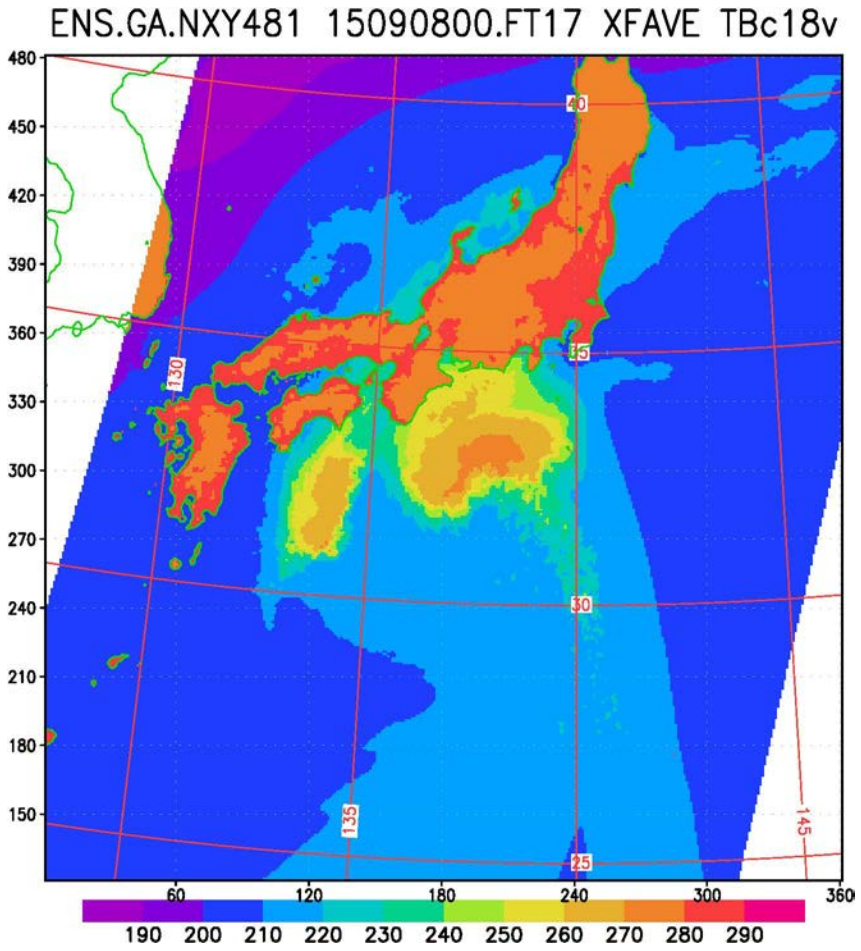
AMSR-2,GMI画像：JAXA/EORC台風データベースより引用

同化実験の方法

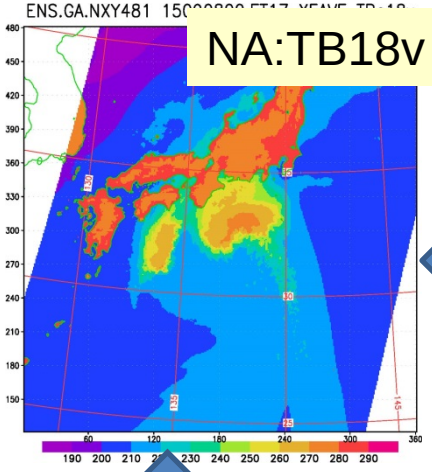

7-Sep
8-Sep
9-Sep
10-Sep
0
6
12
18
1010
1005
1000
995
990
985
980
975
970
Pressure[hPa]
GMI, SSMI/S,AMSR-2同化
FA (予報: T+36h,MEM52)
AMSR-2同化
SO (予報: T+36h,MEM52)
NA (予報: T+36h,MEM52)
GMI
(14UTC)
SSMI/S-F16
(07UTC)
AMSR2
(17UTC)
鬼怒川氾濫
00Z
7SEP
2015
12Z
00Z
8SEP
12Z
00Z
9SEP
12Z
00Z
10SEP
12Z
00Z
11SEP

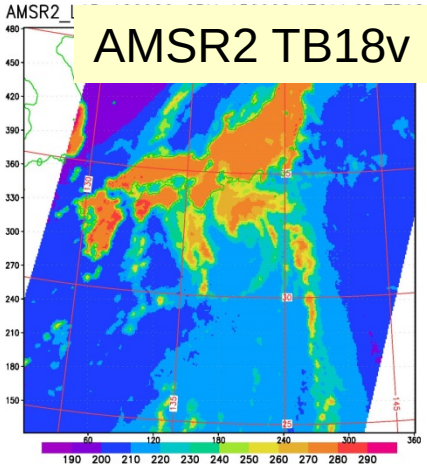
TB18v (2015/9/8/17 UTC)
Observation and NA(mean of ens. forecasts)

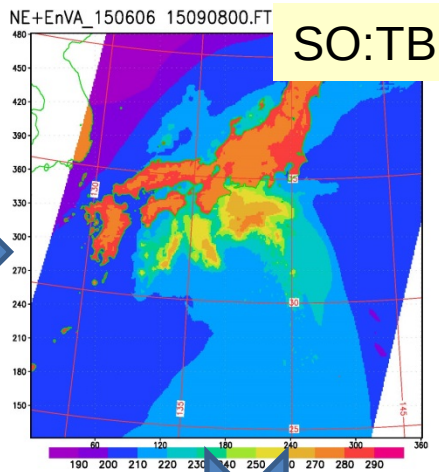




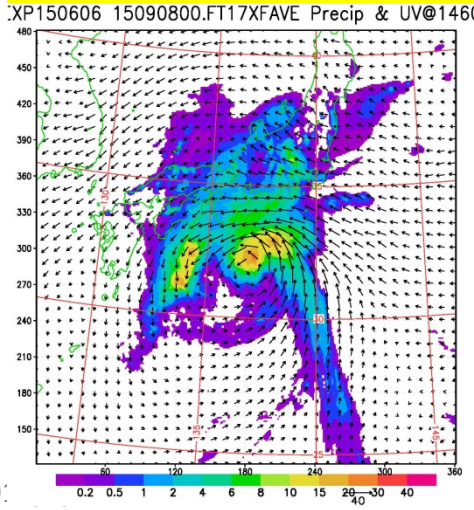
Ensemble-based variational assimilation of AMSR2 TBs for 15/9/8/17UTC





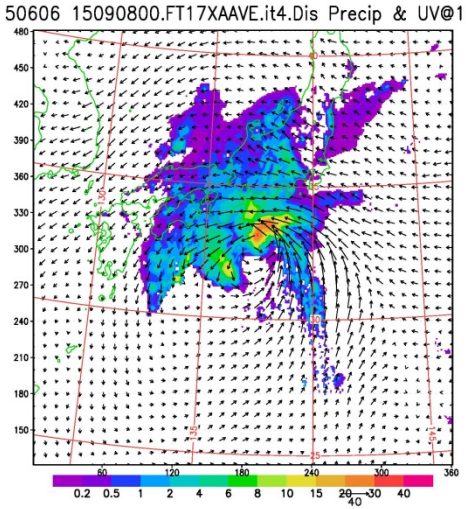


NA: Precip &UV@1460m



Assimilate 5 channel TBs:
TB10v, TB18v, TB23v,
TB36v, TB89v

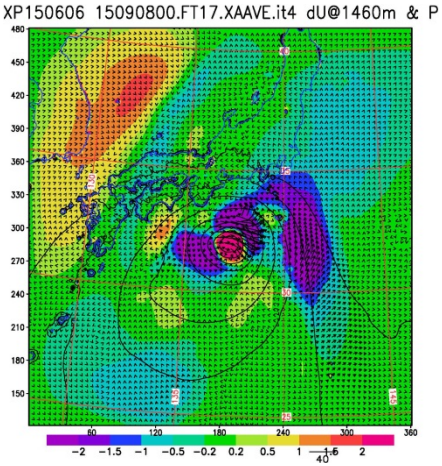
SO: Precip &UV@1460m



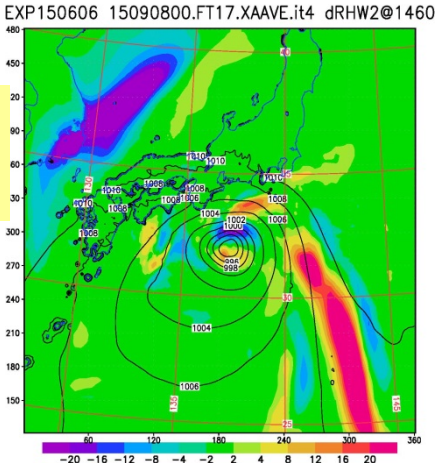
Analysis increments (SO-NA) by NE+EnVA_20150606 for '15/9/8/17 UTC

SO analysis - NA

Psurf & U,V@1460m



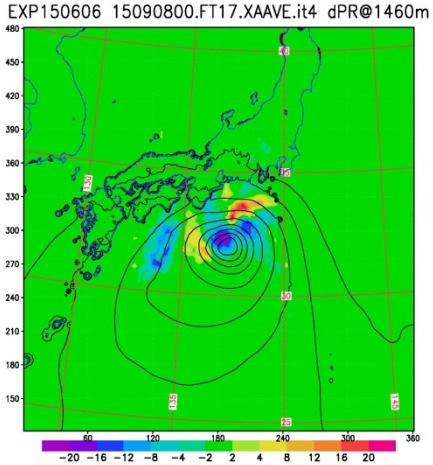
RHw2 @1460m



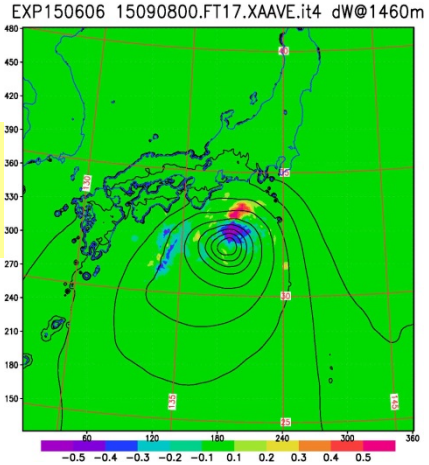
Moisten SE of TY center

Displace TY to NE

Precip @1460m

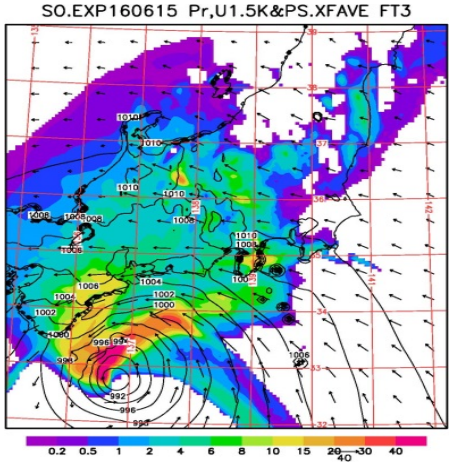


W @1460m

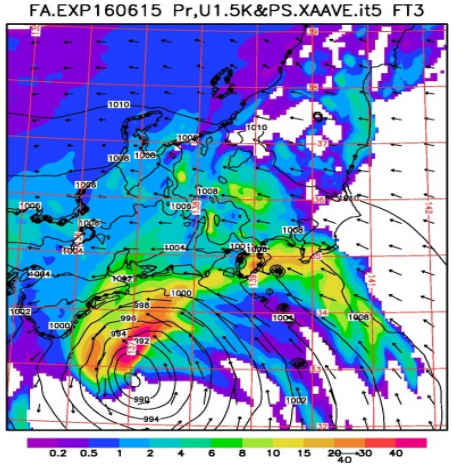


Hourly Precip, Wind@1460m, Ps FT3 (20 UTC 8th)

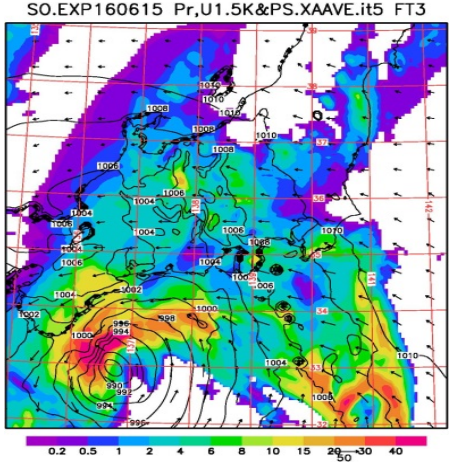
Without Assim. (NA)



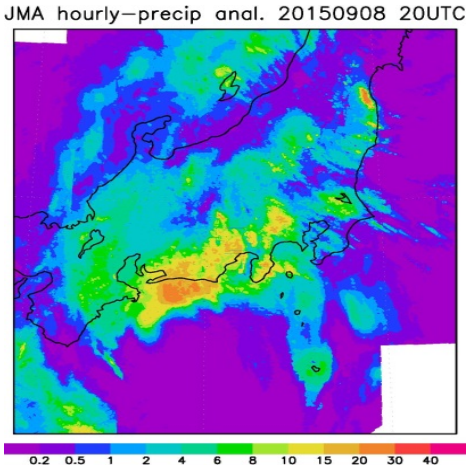
FA cycle Assim.



Single Obs Assim.

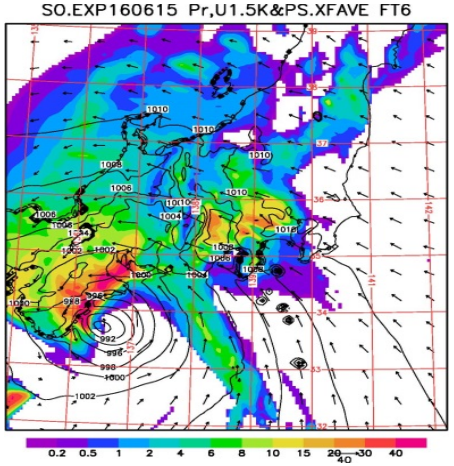


Hourly Precip. Anal

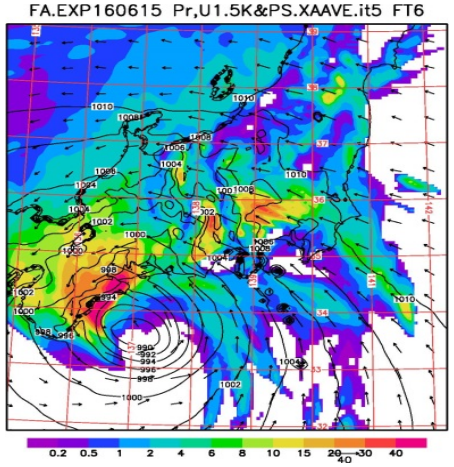


Hourly Precip, Wind@1460m, Ps FT6 (23 UTC 8th)

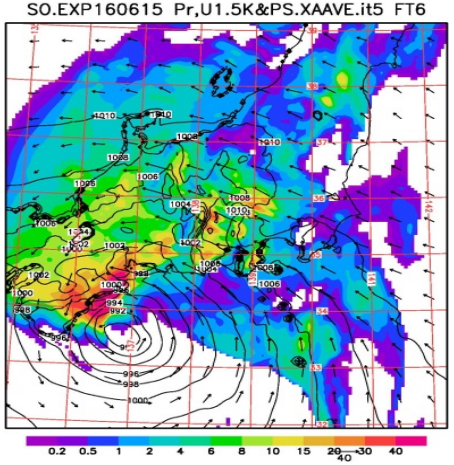
Without Assim. (NA)



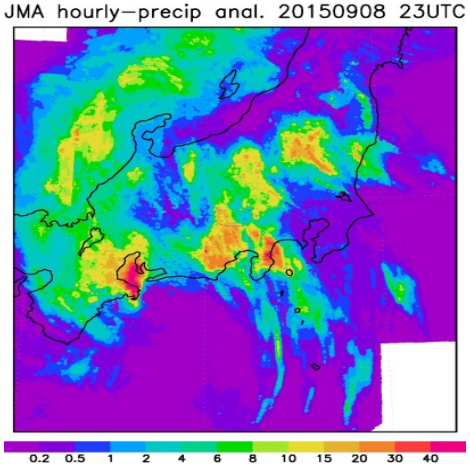
FA cycle Assim.



Single Obs Assim.

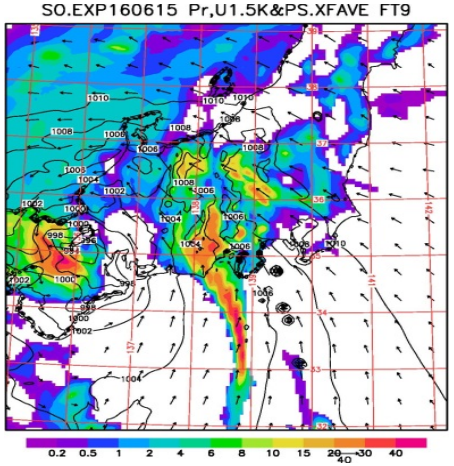


Hourly Precip. Anal

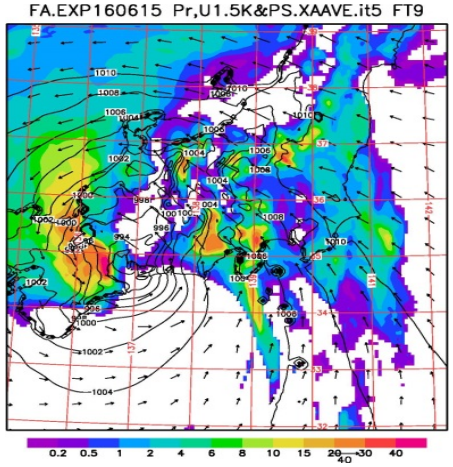


Hourly Precip, Wind@1460m, Ps FT9 (02 UTC 9th)

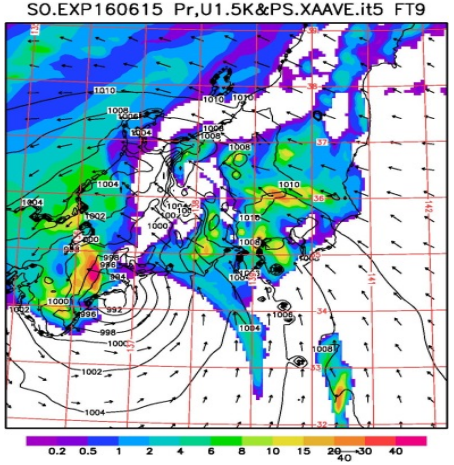
Without Assim. (NA)



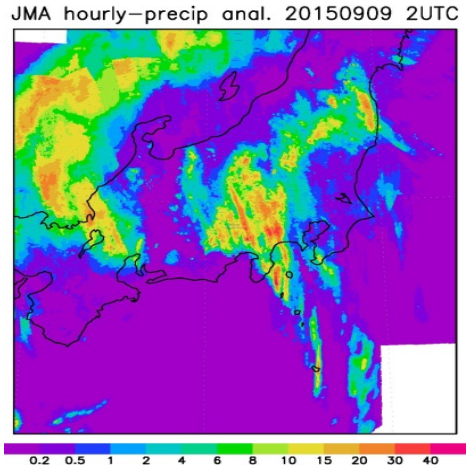
FA cycle Assim.



Single Obs Assim.

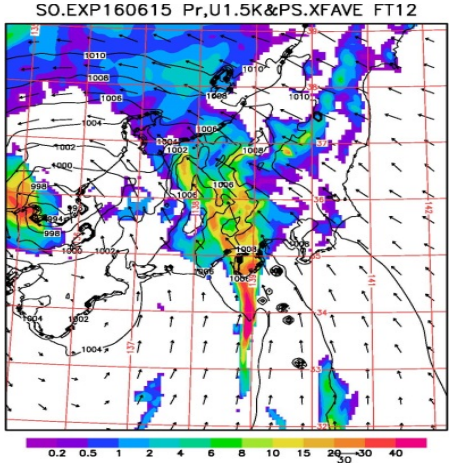


Hourly Precip. Anal

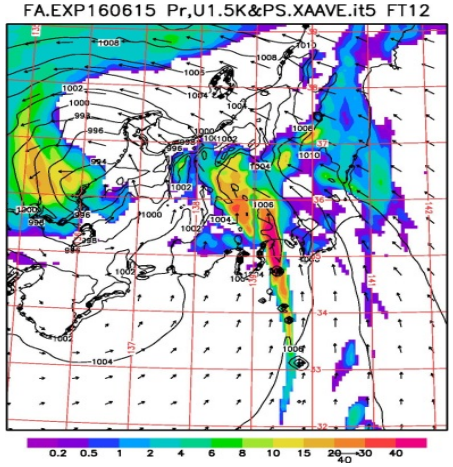


Hourly Precip, Wind@1460m, Ps FT12 (05 UTC 9th)

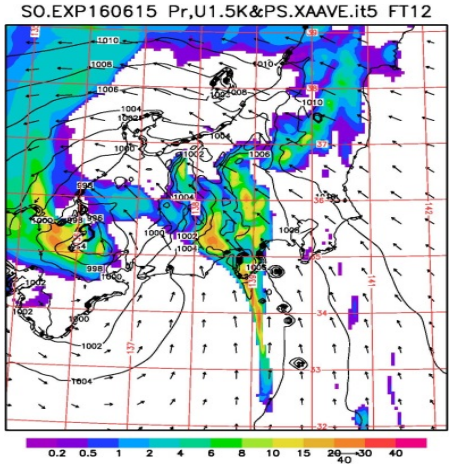
Without Assim. (NA)



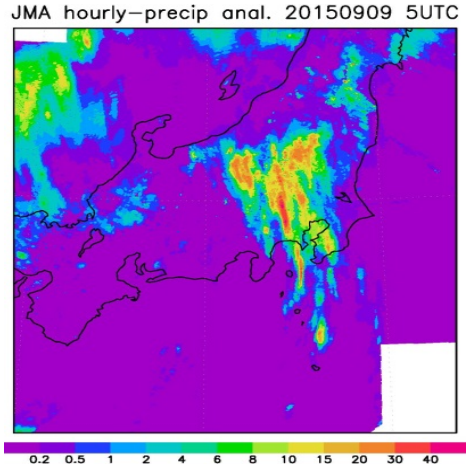
FA cycle Assim.



Single Obs Assim.

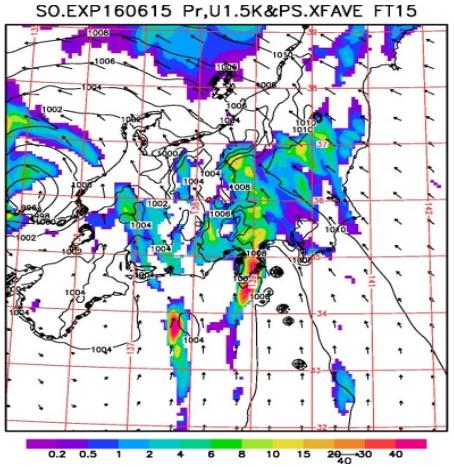


Hourly Precip. Anal

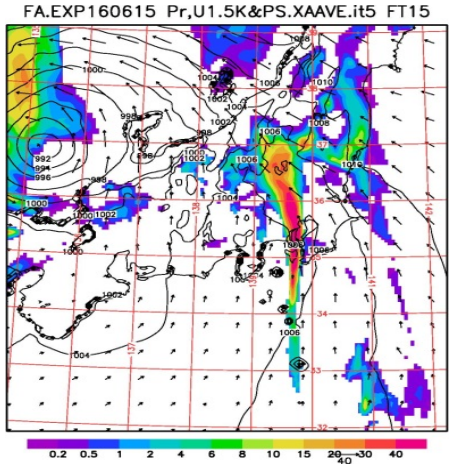


Hourly Precip, Wind@1460m, Ps FT15 (08 UTC 9th)

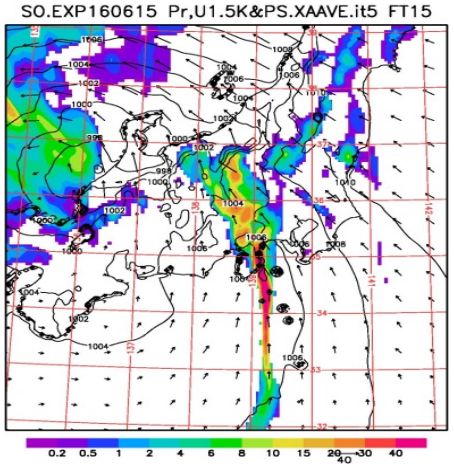
Without Assim. (NA)



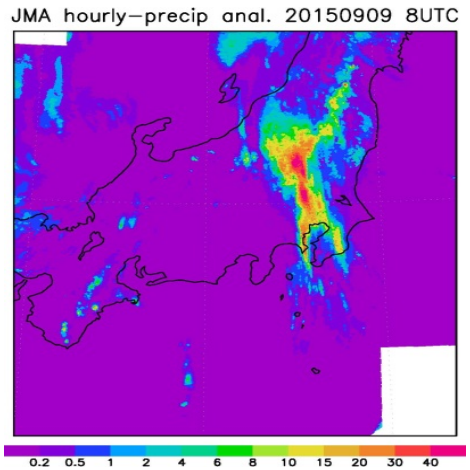
FA cycle Assim.



Single Obs Assim.

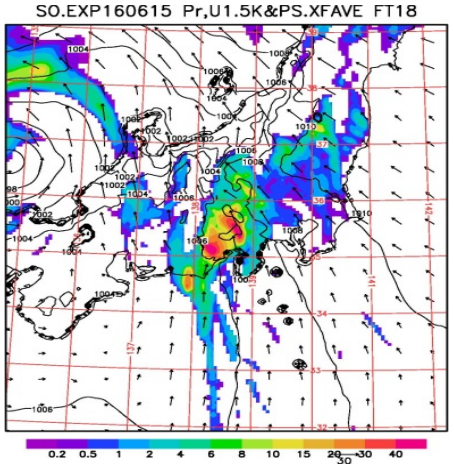


Hourly Precip. Anal

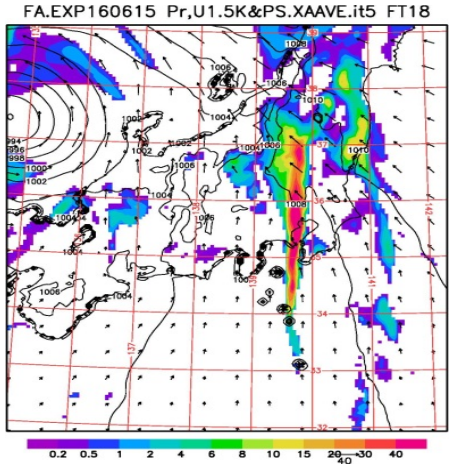


Hourly Precip, Wind@1460m, Ps FT18 (11 UTC 9th)

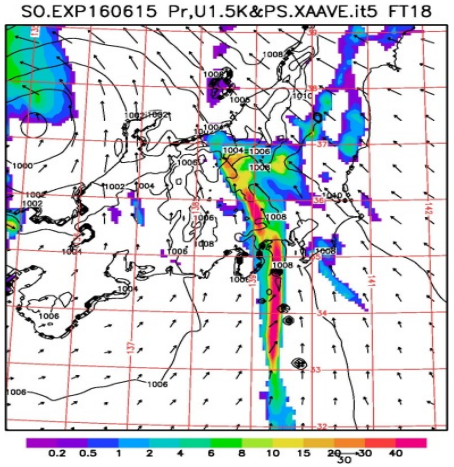
Without Assim. (NA)



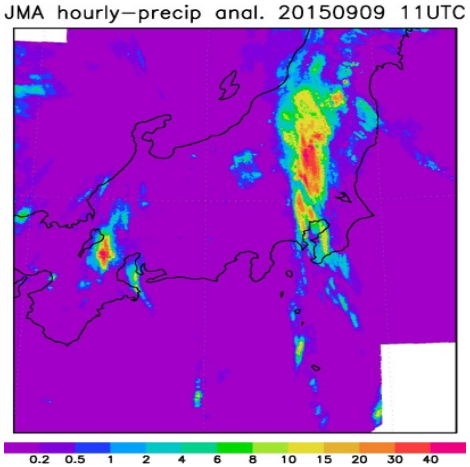
FA cycle Assim.



Single Obs Assim.

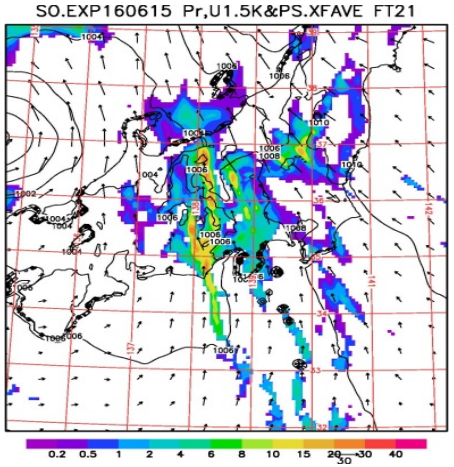


Hourly Precip. Anal

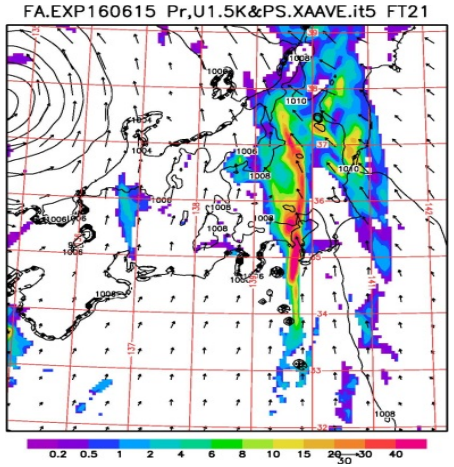


Hourly Precip, Wind@1460m, Ps FT21 (14 UTC 9th)

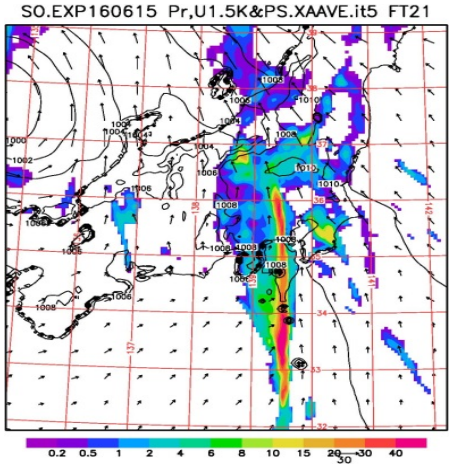
Without Assim. (NA)



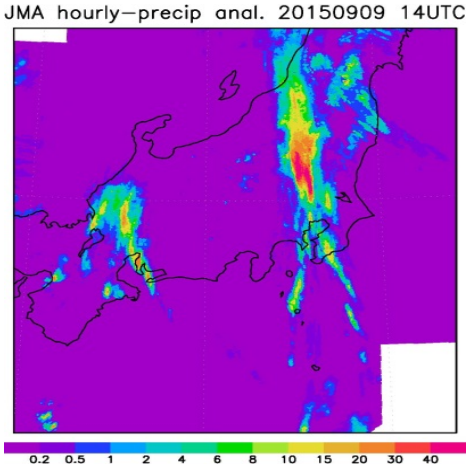
FA cycle Assim.



Single Obs Assim.

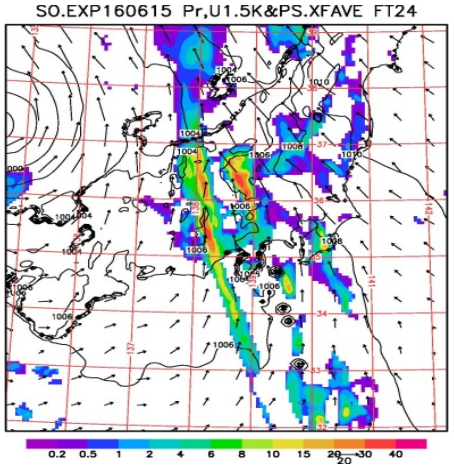


Hourly Precip. Anal

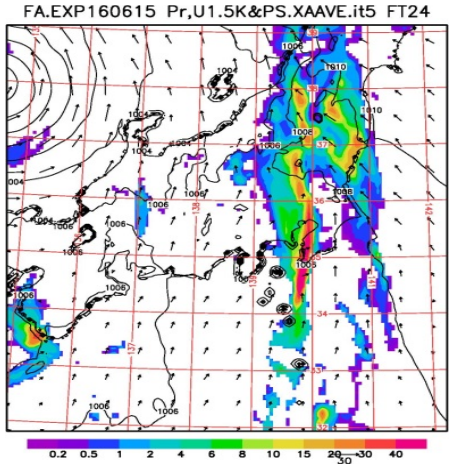


Hourly Precip, Wind@1460m, Ps FT24 (17 UTC 9th)

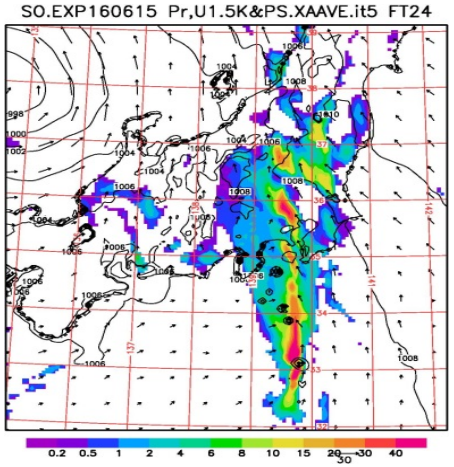
Without Assim. (NA)



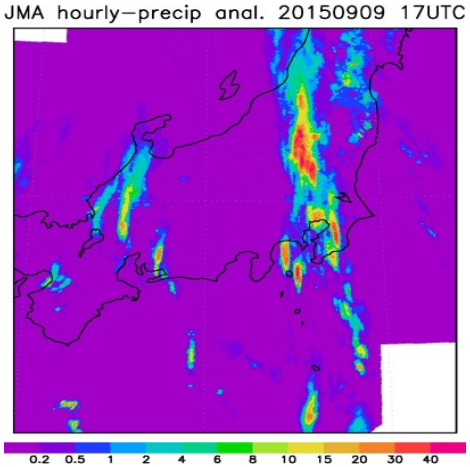
FA cycle Assim.



Single Obs Assim.

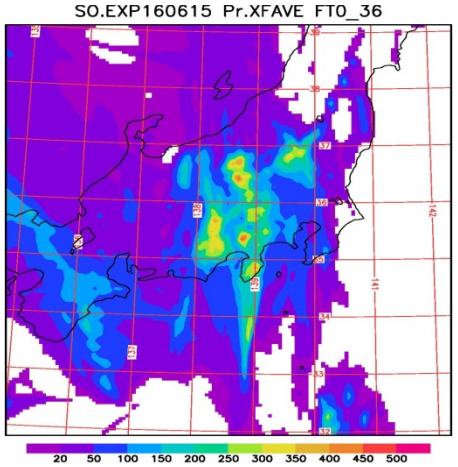


Hourly Precip. Anal

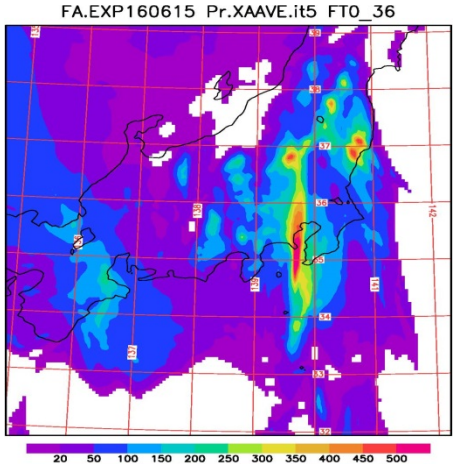


36 hour Precip
FT0-36 (17 UTC 8th -05 UTC 10th)

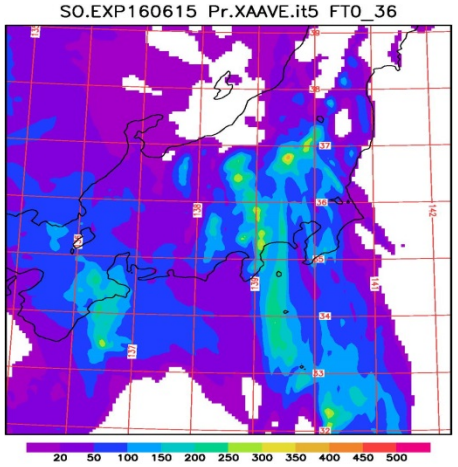
Without Assim. (NA)



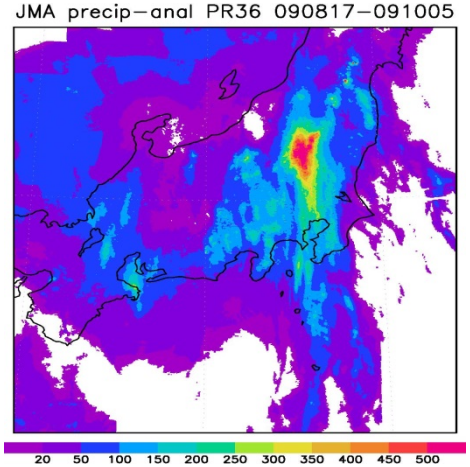
FA cycle Assim.



Single Obs Assim.

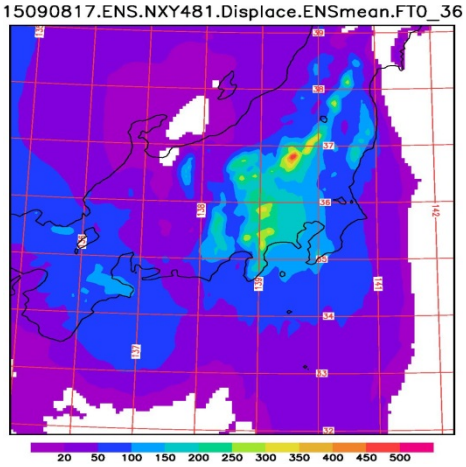


Hourly Precip. Anal

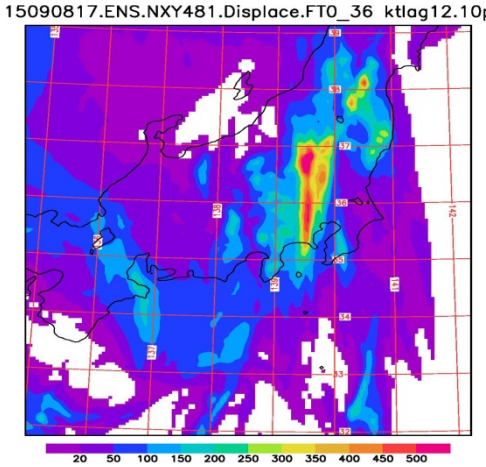


36 hour Precip
FT0-36 (17 UTC 8th -05 UTC 10th)

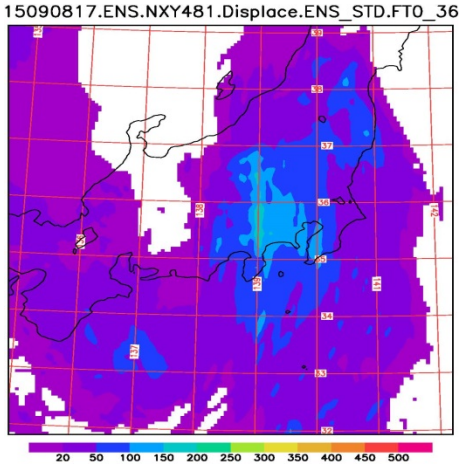
Ens Mean (FA)



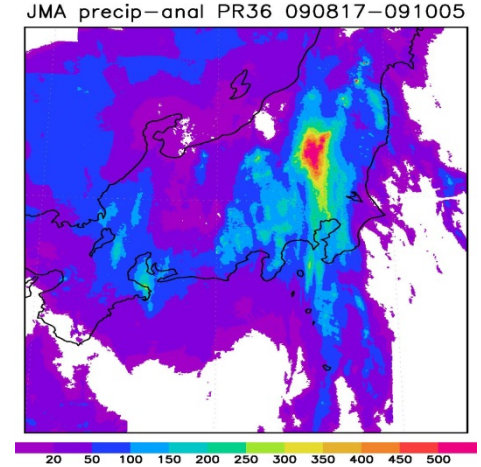
Best Member (FA)



Ens STD (FA)



Hourly Precip. Anal



まとめ

（１）実観測データを用いたNE+EnVA

2015/9/8/17 UTC AMSR2 （台風中心位置）

2015/9/7/00 UTCからの予報解析サイクル

（２）予報へのインパクト

インパクトが～30時間程度顕著である

南北走向の降水帯が東にずれ強化される

FAからの予報で、関東付近に降水帯が停滞する

今後の方針

- 降水と相関の高い物理量は？
- アンサンブルを使った予報の改善（重み付平均）
- TB観測誤差共分散のチェック