Analysis and Forecasts of a Historic Rain and Flood Event

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Overview

- ***We will examine a major Flood event***
  - *Significant impact on North Korea*
  - *Devastated crops in mid-August*
- **Ideal to see what happened**
  - *Examine aspects of a major flood→ where did it rain*
  - *Analysis and forecast issues can be addressed→*
    - *What did the pattern look like and was it forecast as such?*
- **Ideal application of ensembles**
  - *Precipitation amounts (Probabilities) and timing*
  - *Meteorological setting*
    - *Intensity of key features associated with heavy rainfall.*
    - *Key features associated with heavy rains events*
- **Put features in a context→ Climate anomalies of key features**

RHG

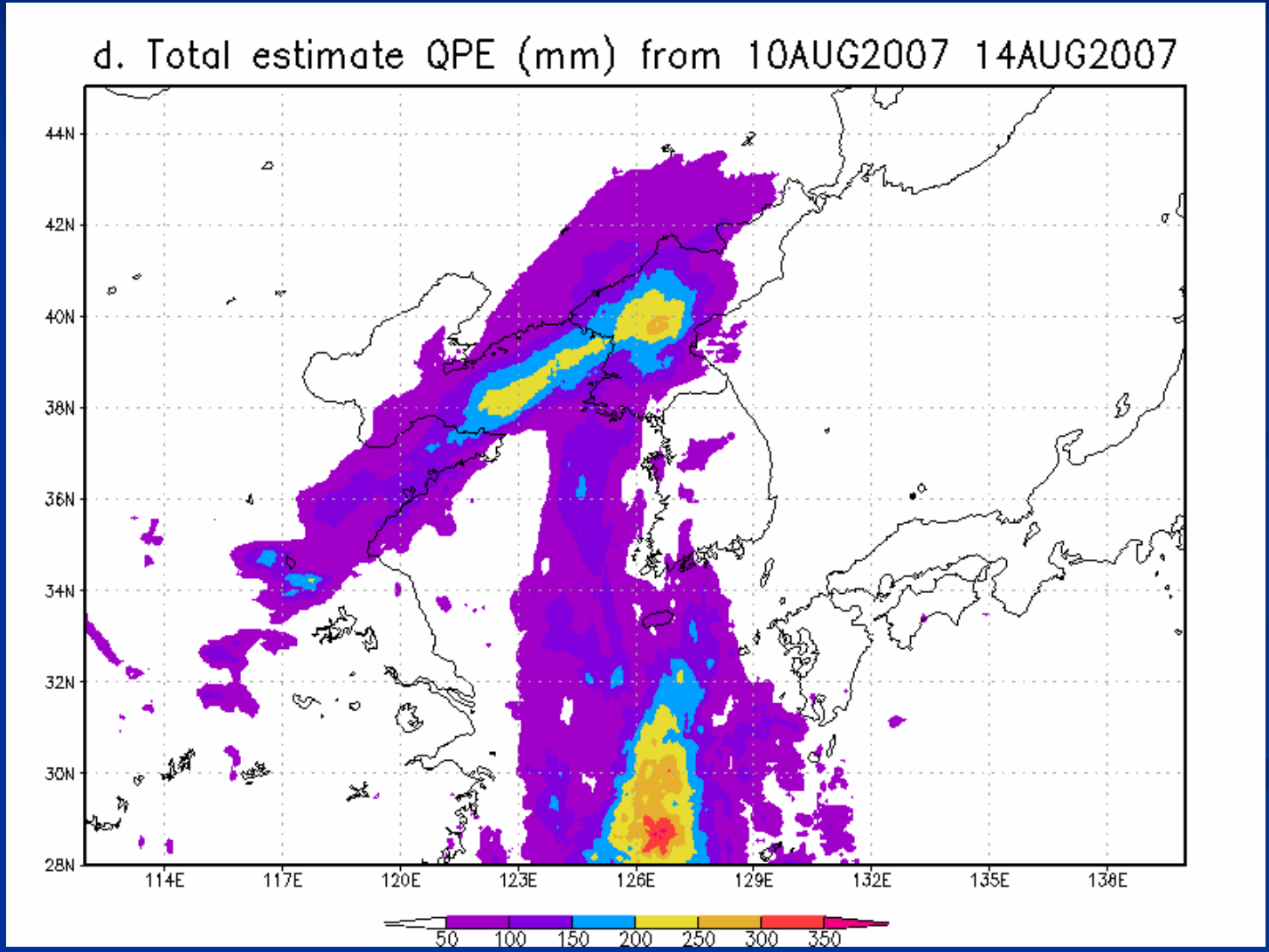
Slide 2

RHG1 We do not know the truth and are slaves to our analysis of choice/record.
Richard Grumm, 11/11/2007

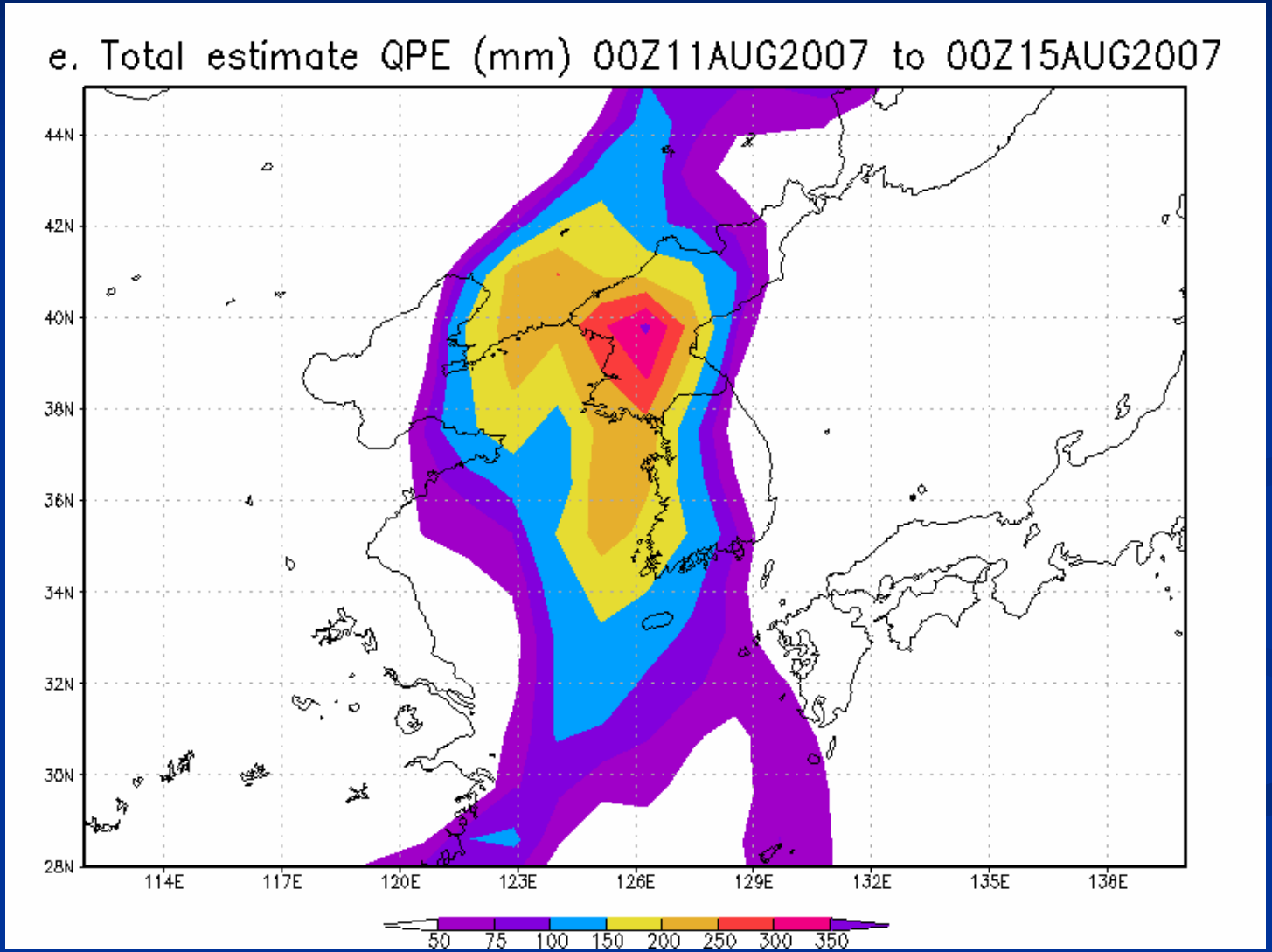
A few points

- *Some key characteristics*
  - *Anomalously high PW values in affected region*
  - *Strong and anomalous low-level southerly winds*
  - *Tropical Moisture streams*
  - *A pattern often seen in the eastern United States*
- *Blend EPS and Climatic Data can*
  - *Define areas of high confidence → poorman's RMOP*
  - *In this case the GEFS was remarkable in the amounts of rain forecast*
  - *What would an good mesoscale ensemble have done?*

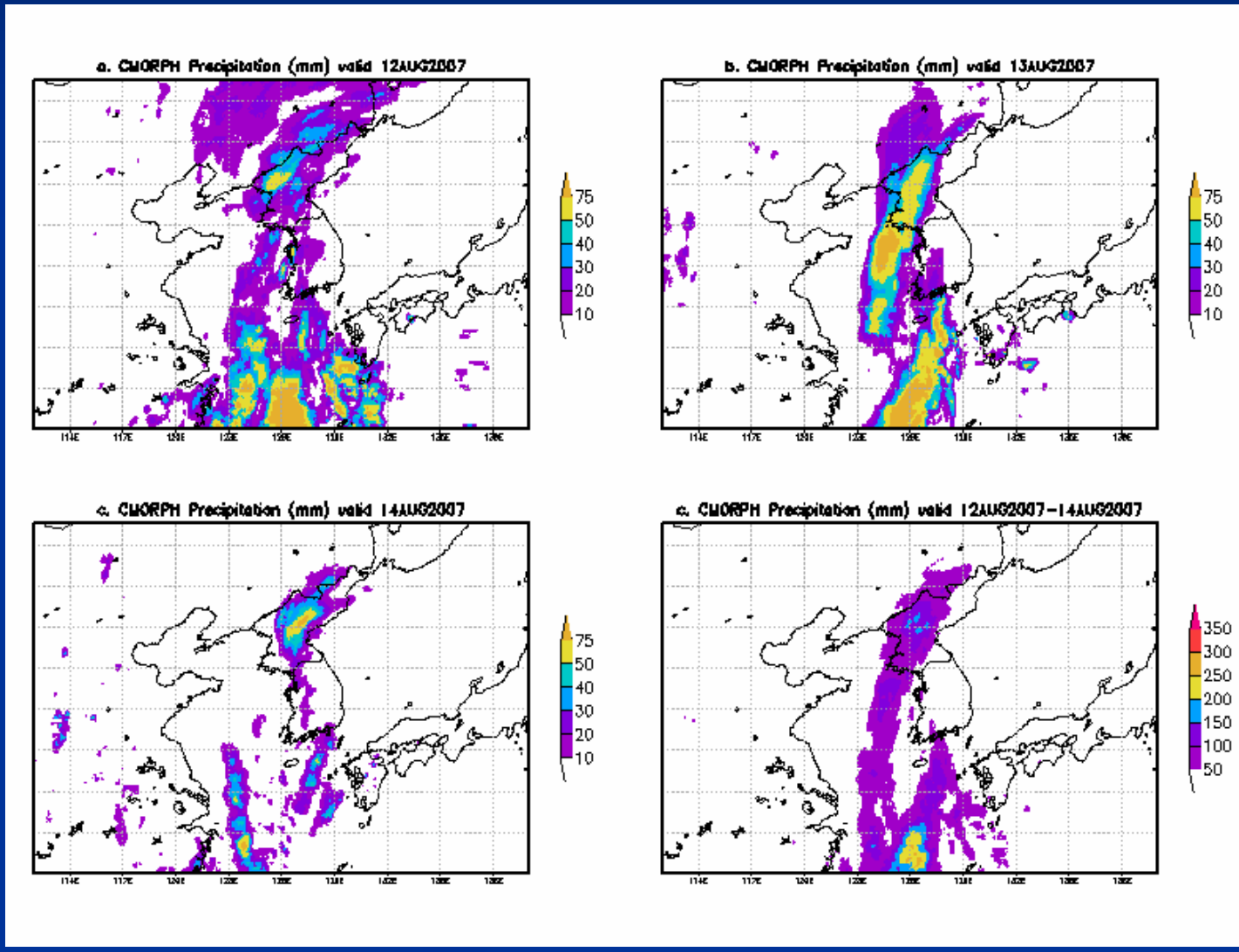
Estimate Rainfall valid 0000 UTC 10-14 August 2007



JRA25 Accumulated Rainfall



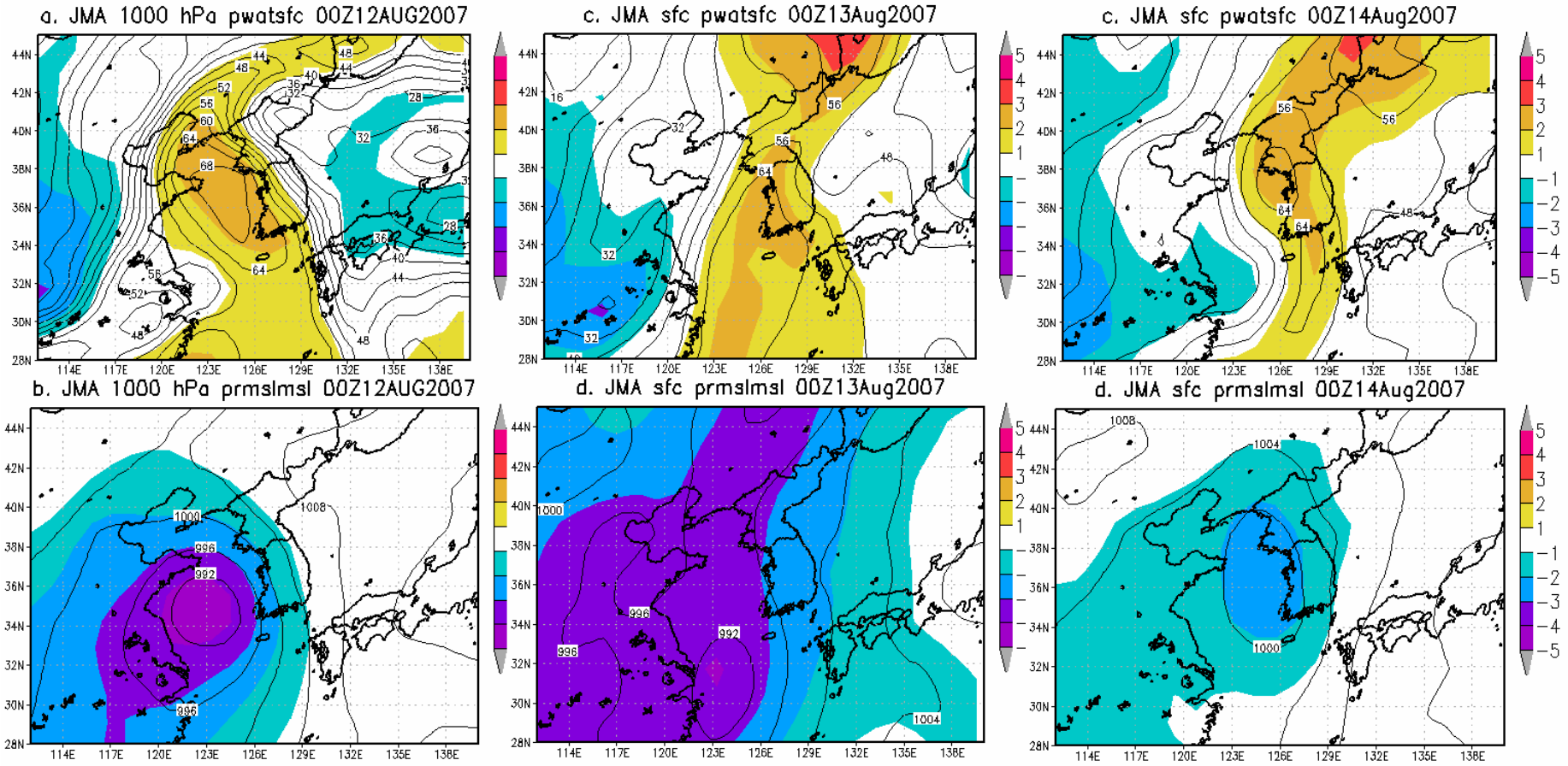
Biggest Days and totals



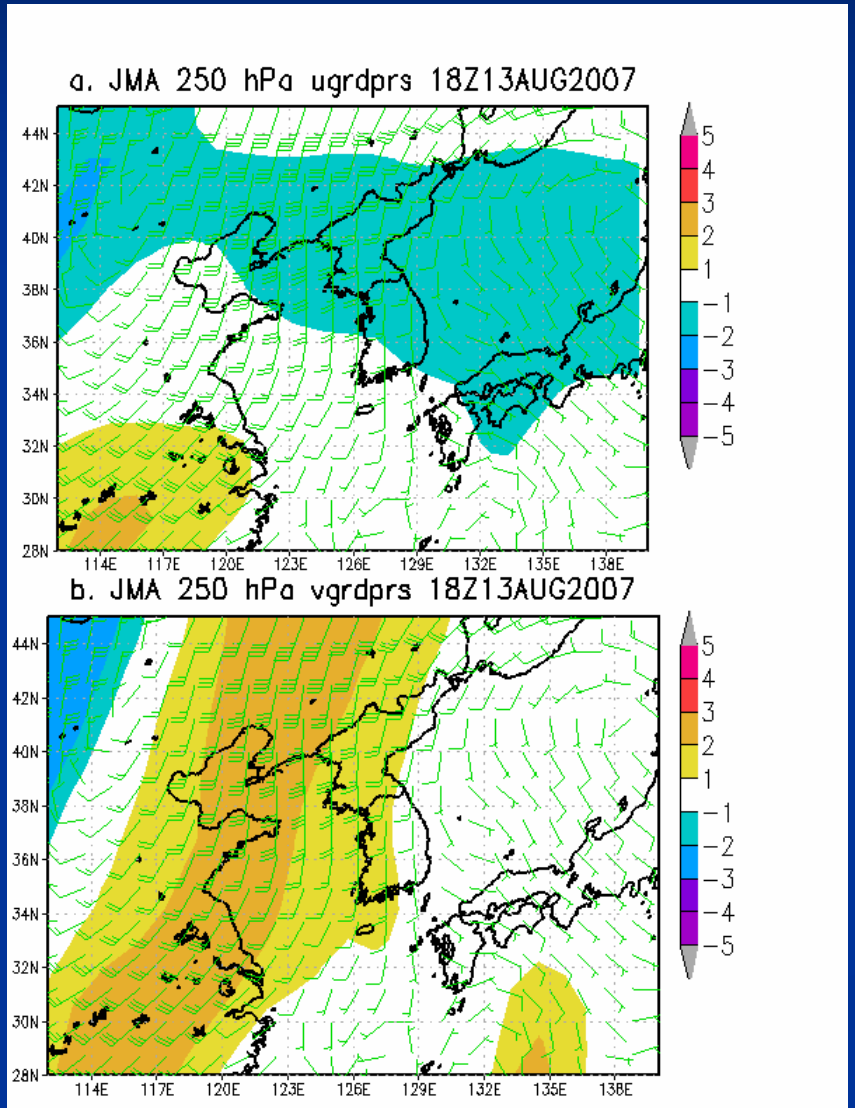
Rainfall Summary

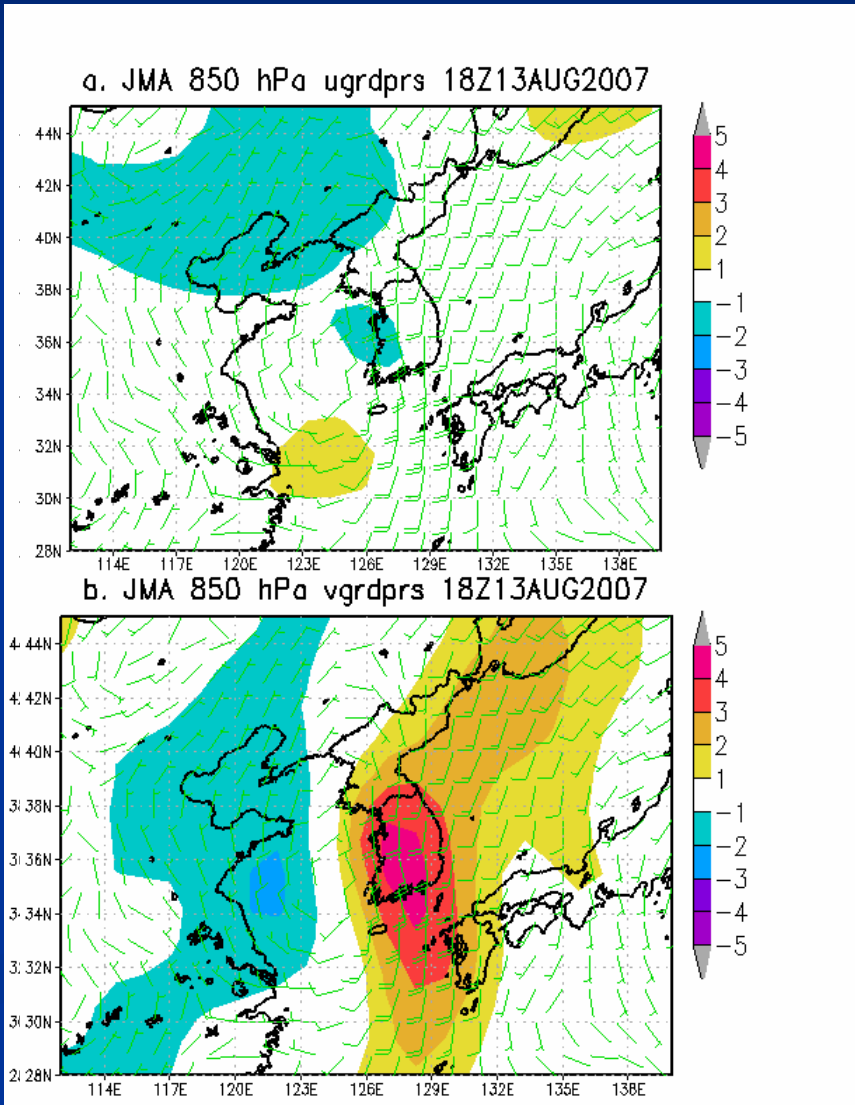
- Period ending 0000 UTC 14 August was a big event
- So was the period ending 0000 UTC on 12 August
- JRA and CMORPH data
  - showed the same affected areas
  - Similar amounts over similar time periods.
  - 350 mm is ~14 inches biggest report was 17in.
- We lack definitive rainfall data!

What the pattern looked like JRA25 perspective



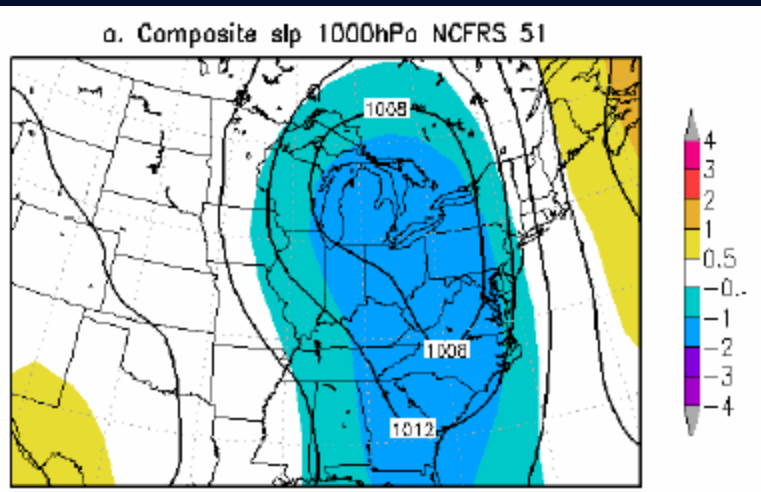
About the Peak→ 850 winds too!





The Pattern

- **Classic quasi-stationary North-South frontal system**
  - *Maddox Synoptic Type*
  - *Similar to US of same pattern (next Slide)*
- **Generalized Pattern**
  - *N-S front*
  - *Above normal PW in warm sector → with tropical connection*
  - *Strong southerly flow into region of heavy rainfall.*



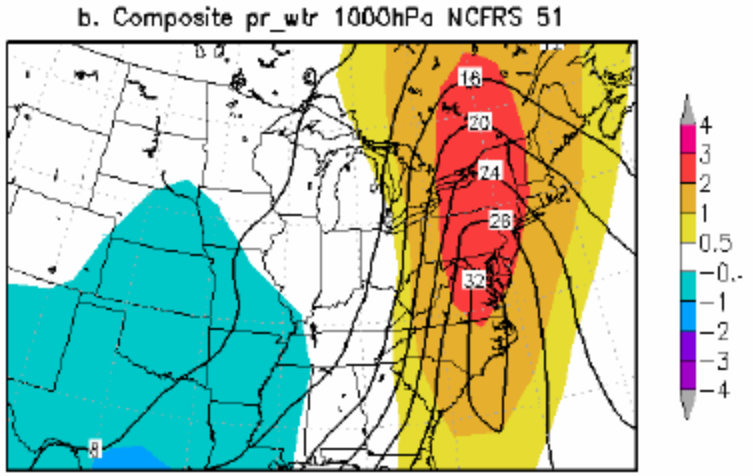
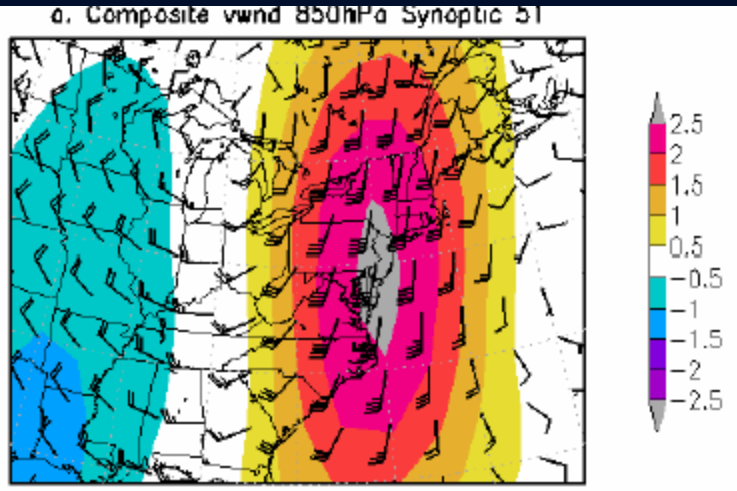


Figure 1. Composite of all cold season Synoptic events showing the a) the composite mean sea-level pressure (hPa) and the mean standardized anomaly and b) the composite precipitable water (mm) and



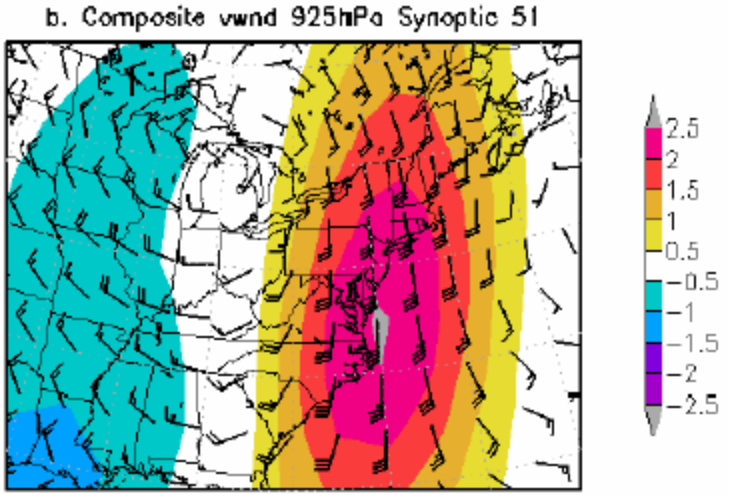
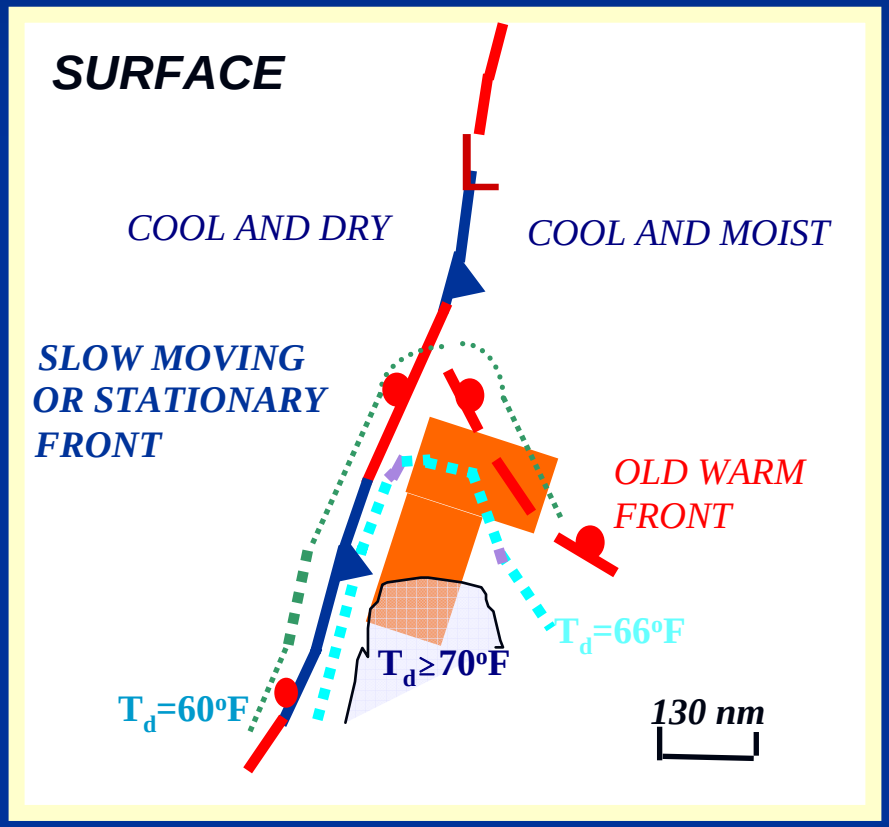
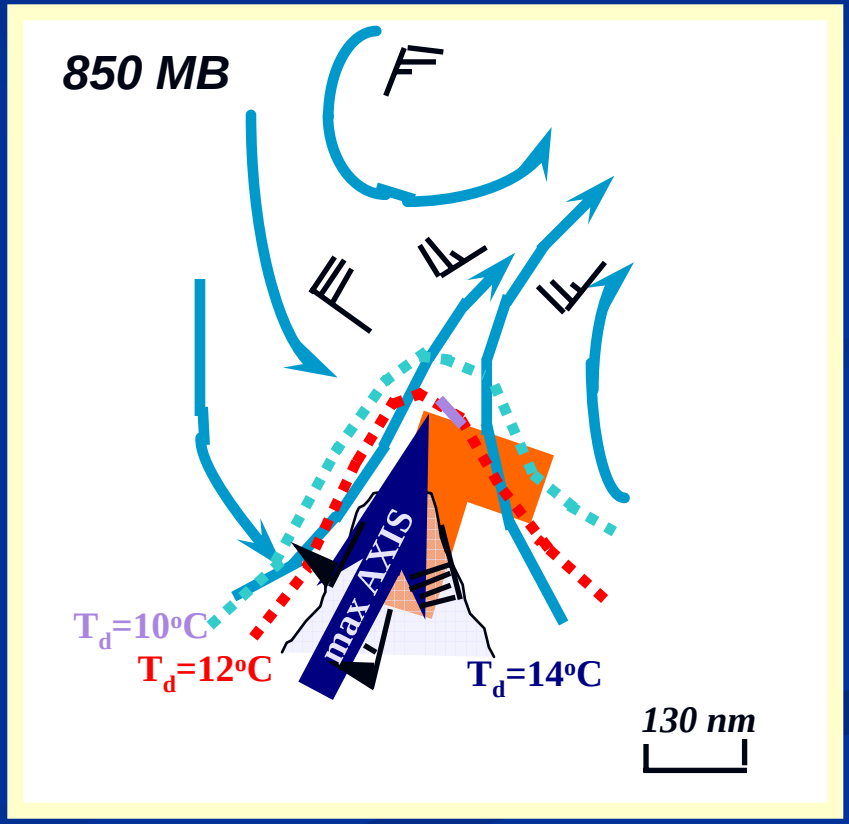


Figure 2 Composite of all cold season Synoptic events showing the a) 850 hPa mean winds and 850 hPa v-wind anomalies and b) 925 hPa winds and v-wind anomalies. Winds are in knots and anomalies in standard deviations from normal.

Synoptic Type schematic





A POTENT LOW-LEVEL JET IS PRESENT

EPS data to Forecast these events

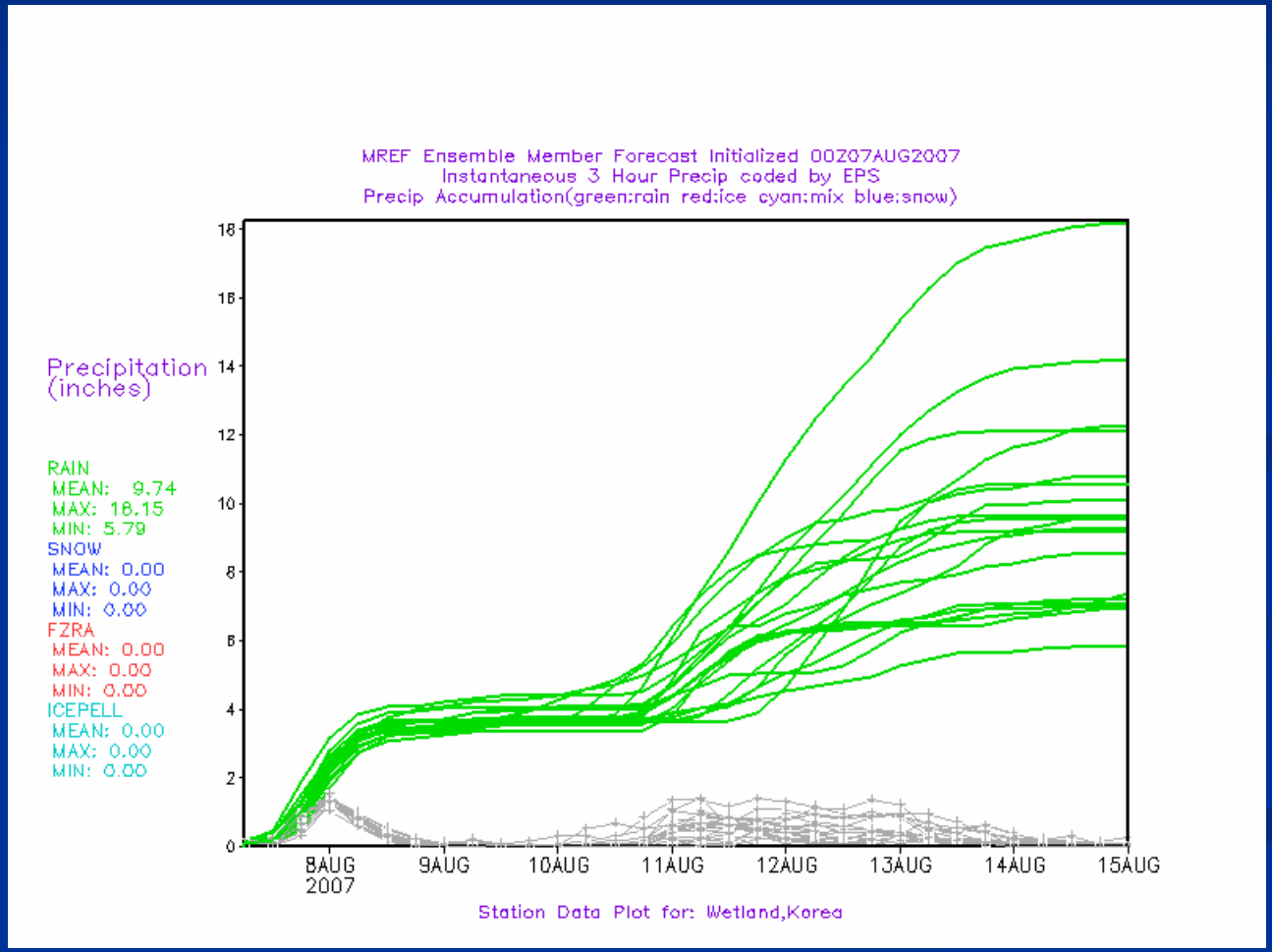
- **Data:** NCEP GEFS data
- **Focus on key features**
  - *Anomalies of key predictants*
  - *Probabilities of QPF over discrete time intervals and values*
  - *SREF and GEFS have history of success with this event type!*
- **Salient points:**
  - *Uncertainty and probabilities are the strengths of ensemble system,*
  - *The future of forecasting is linked to the strengths of the EPS,*
  - *Ensembles add the most value in cases of high uncertainty,*
  - *Never try to chose a member in a high uncertainty event,*
  - *In quiescent weather or areas of high confidence, the ensemble has minimal value*.*
- **Heavy rain we need probabilities of key threshold values!**

*Derived from Jun Du-NOAA/NCEP 08 November 2007

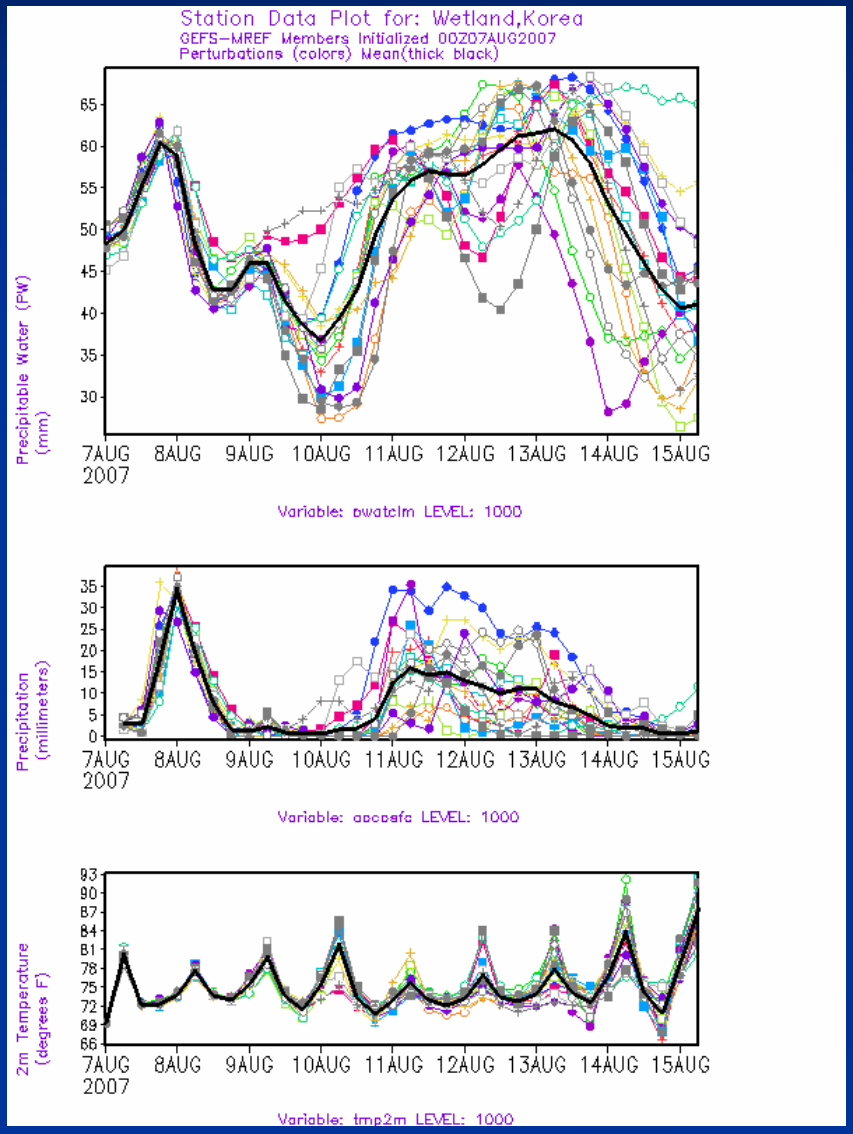
EPS Forecasts

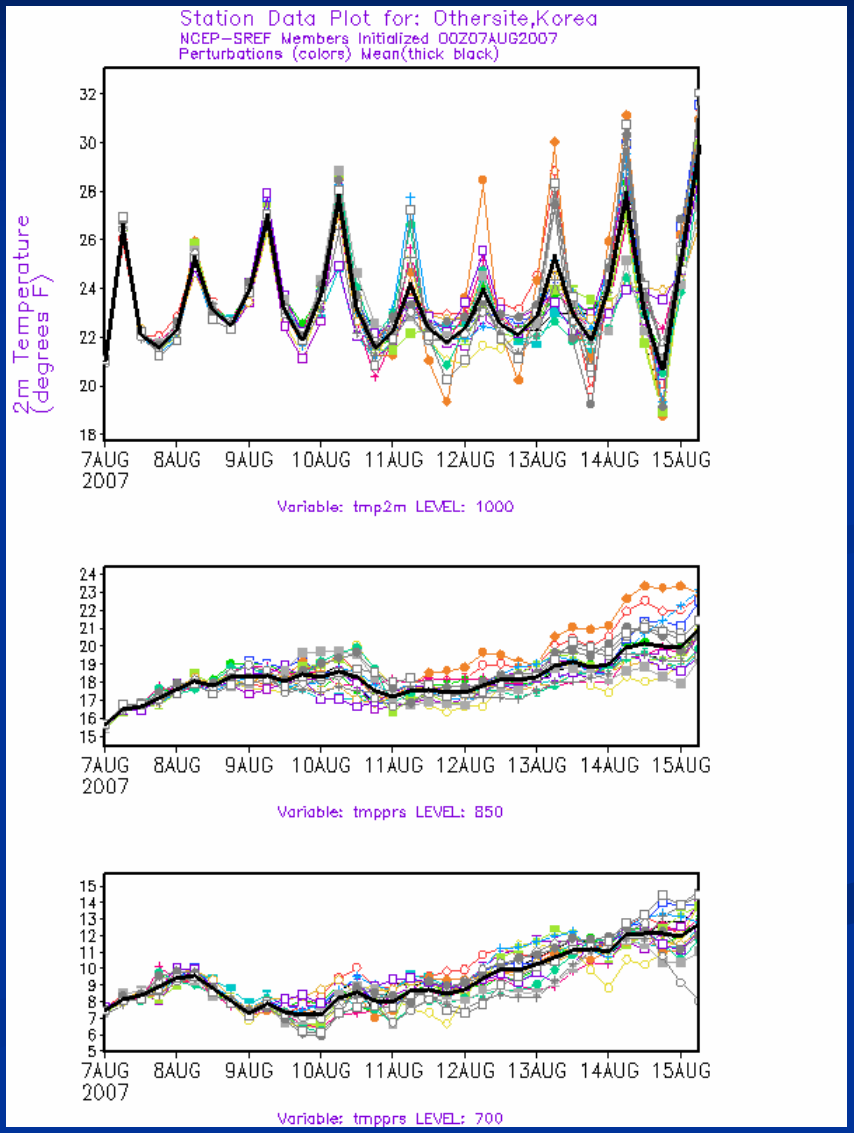
- Plumes showed period of heavy rains
- Patterns were well forecast too
- Probabilities with patterns gave some measure of confidence

7 August GEFS Plume for Central N. Korea….

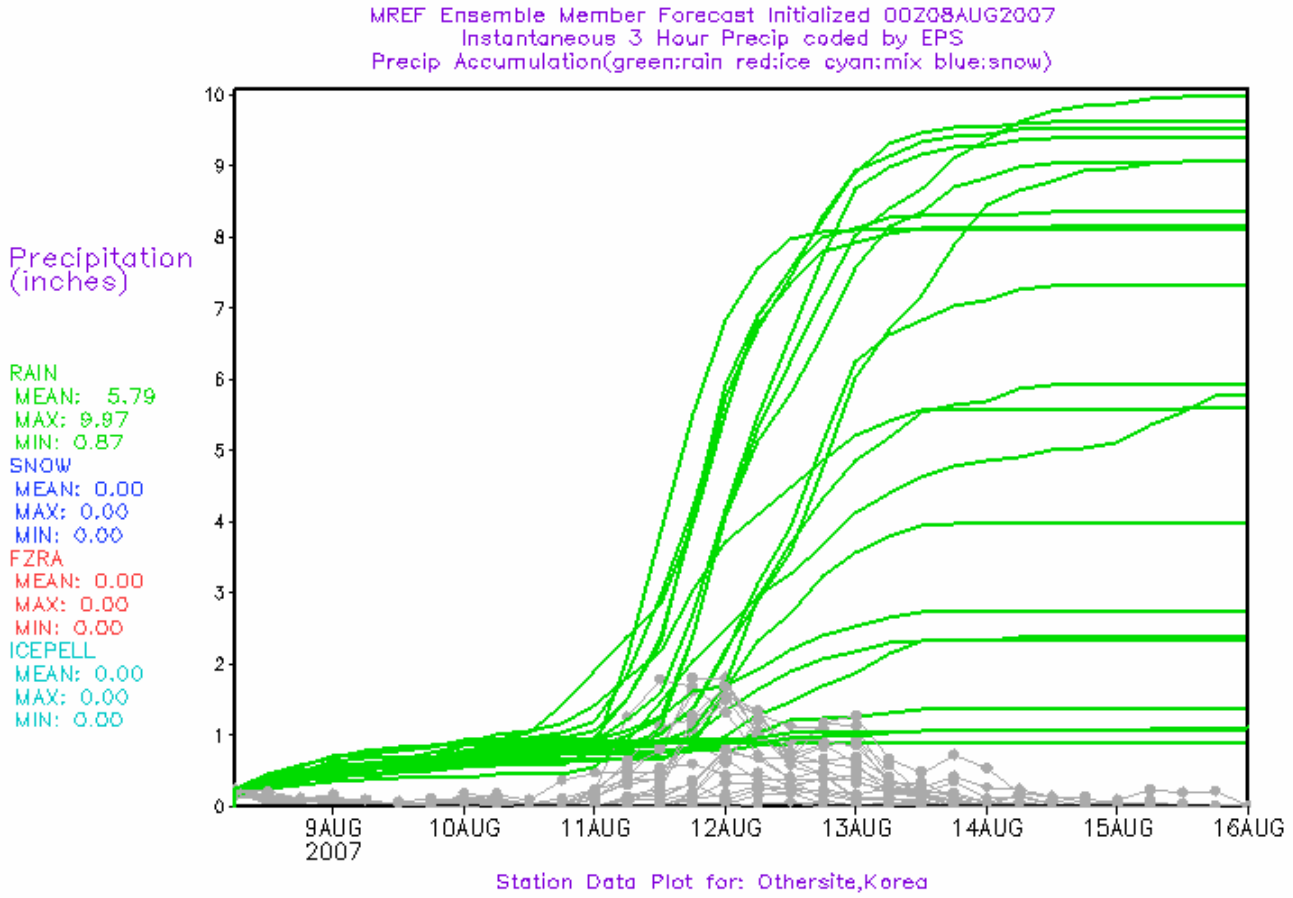


Prolonged high PW forecast



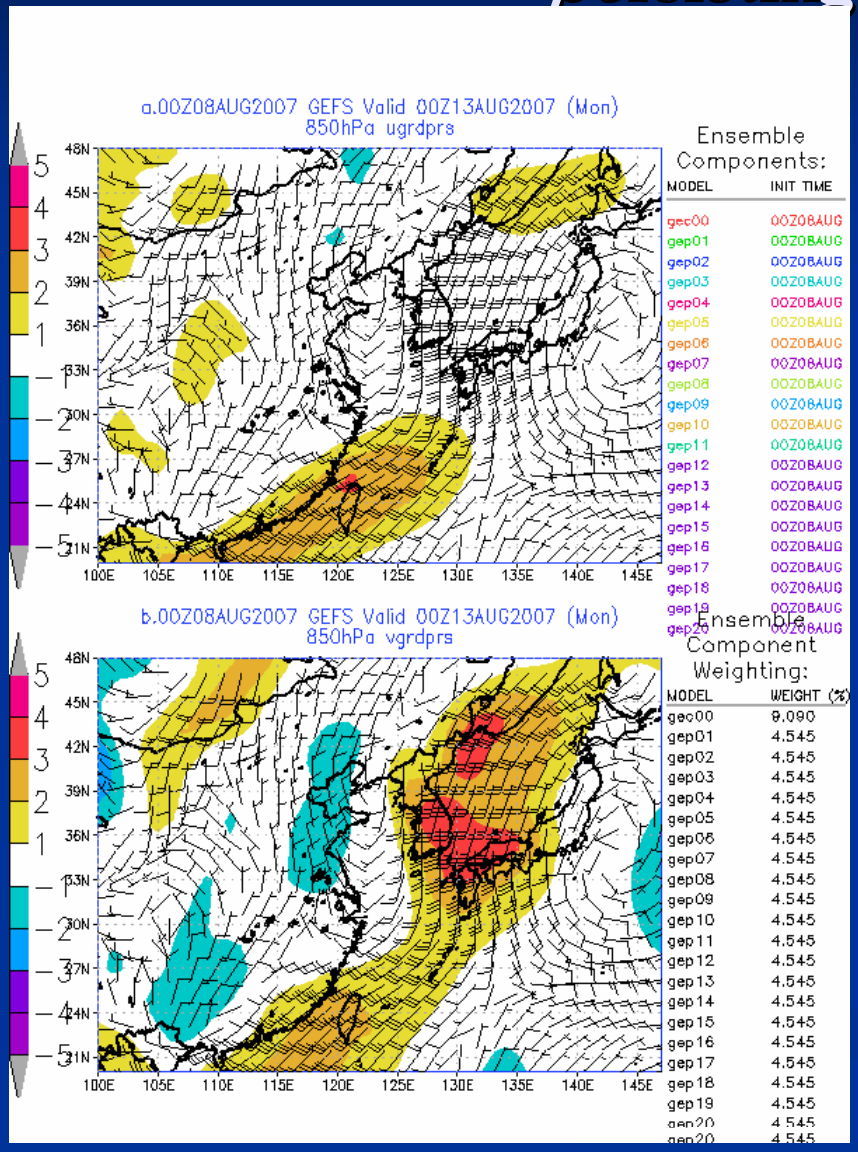


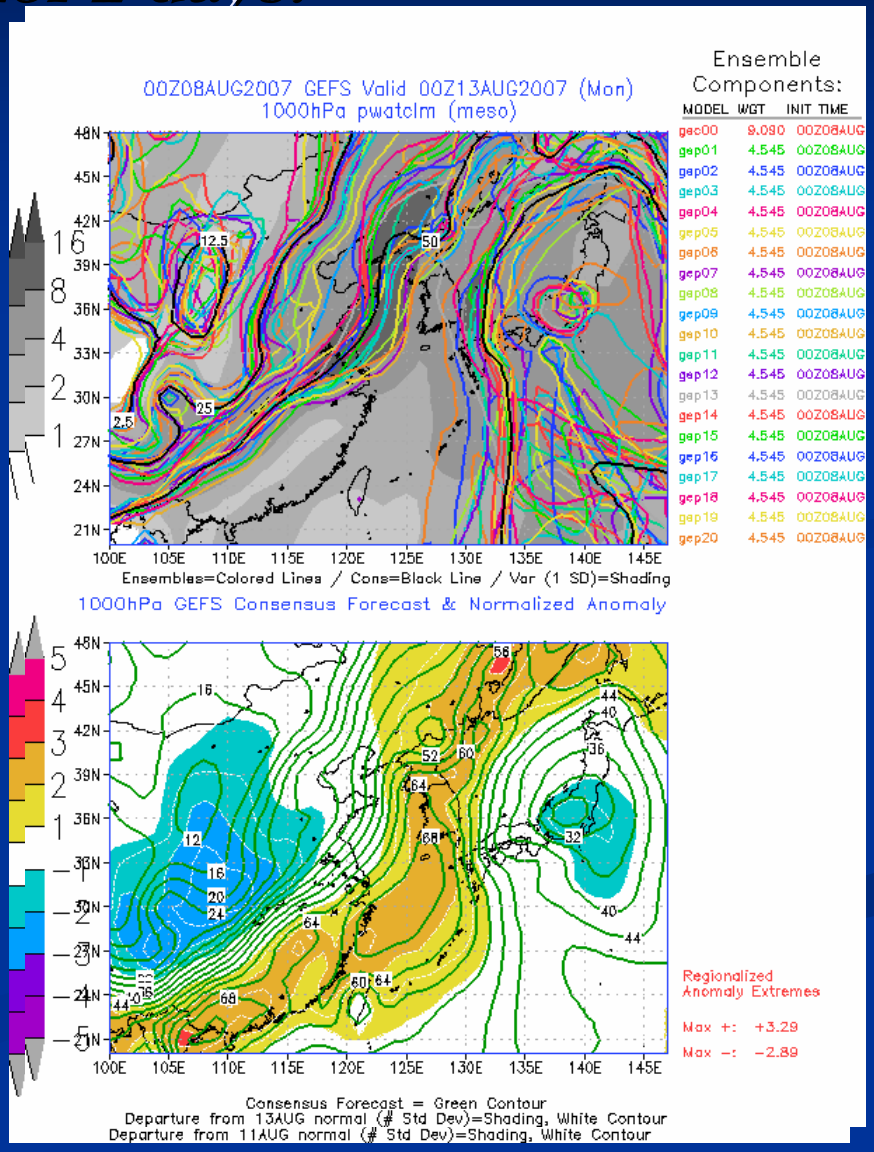
One Day Closer



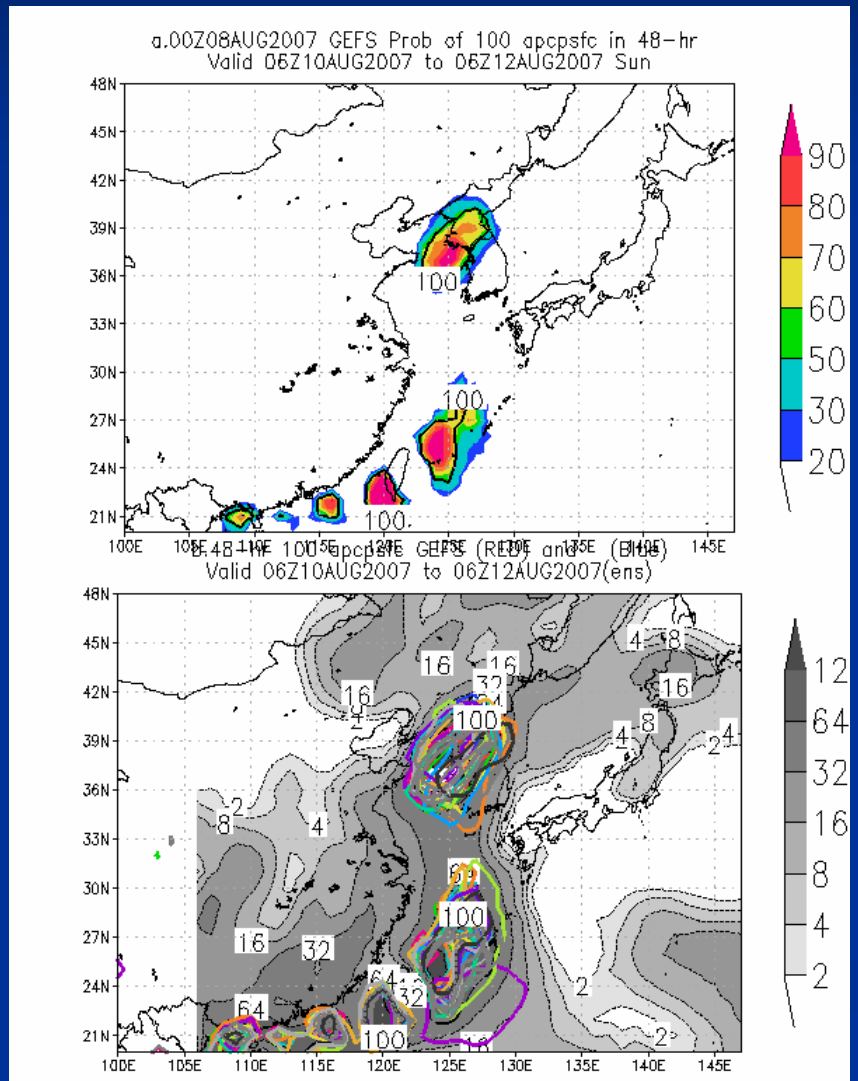
Classic Heavy Rain Pattern→

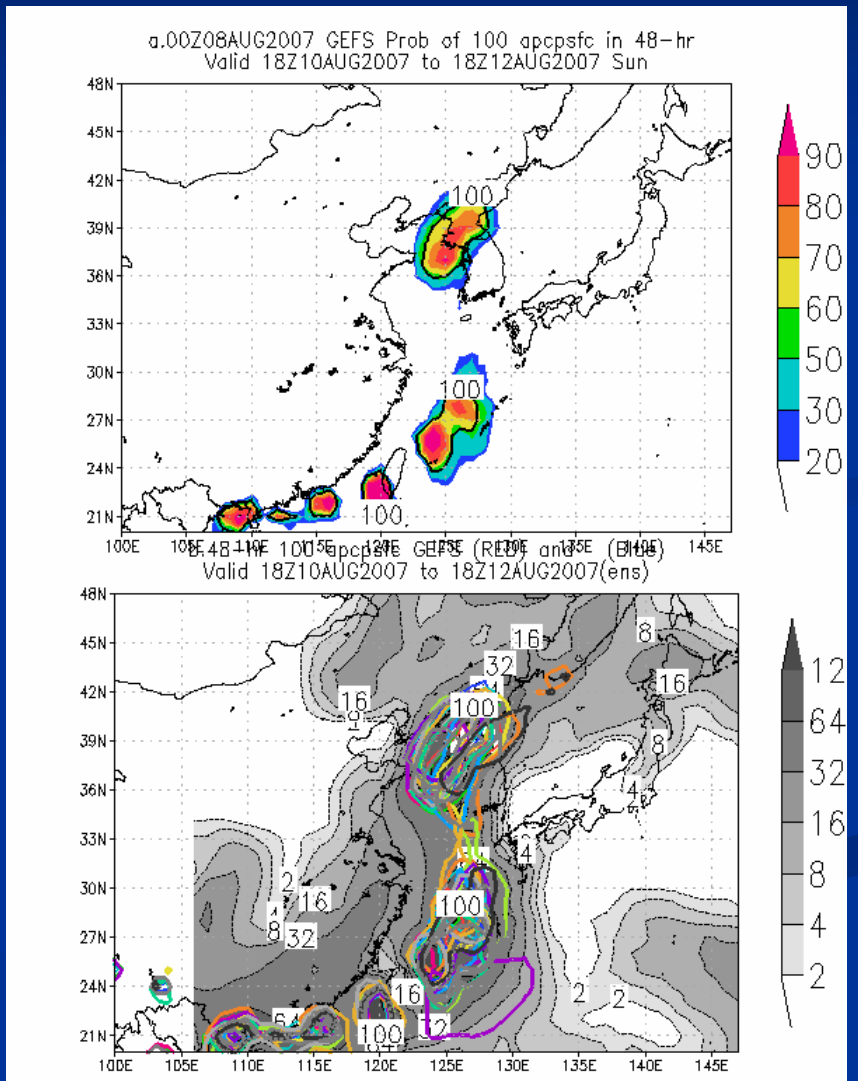
persisting for 2 days!





PROB 100mm 48 hrs

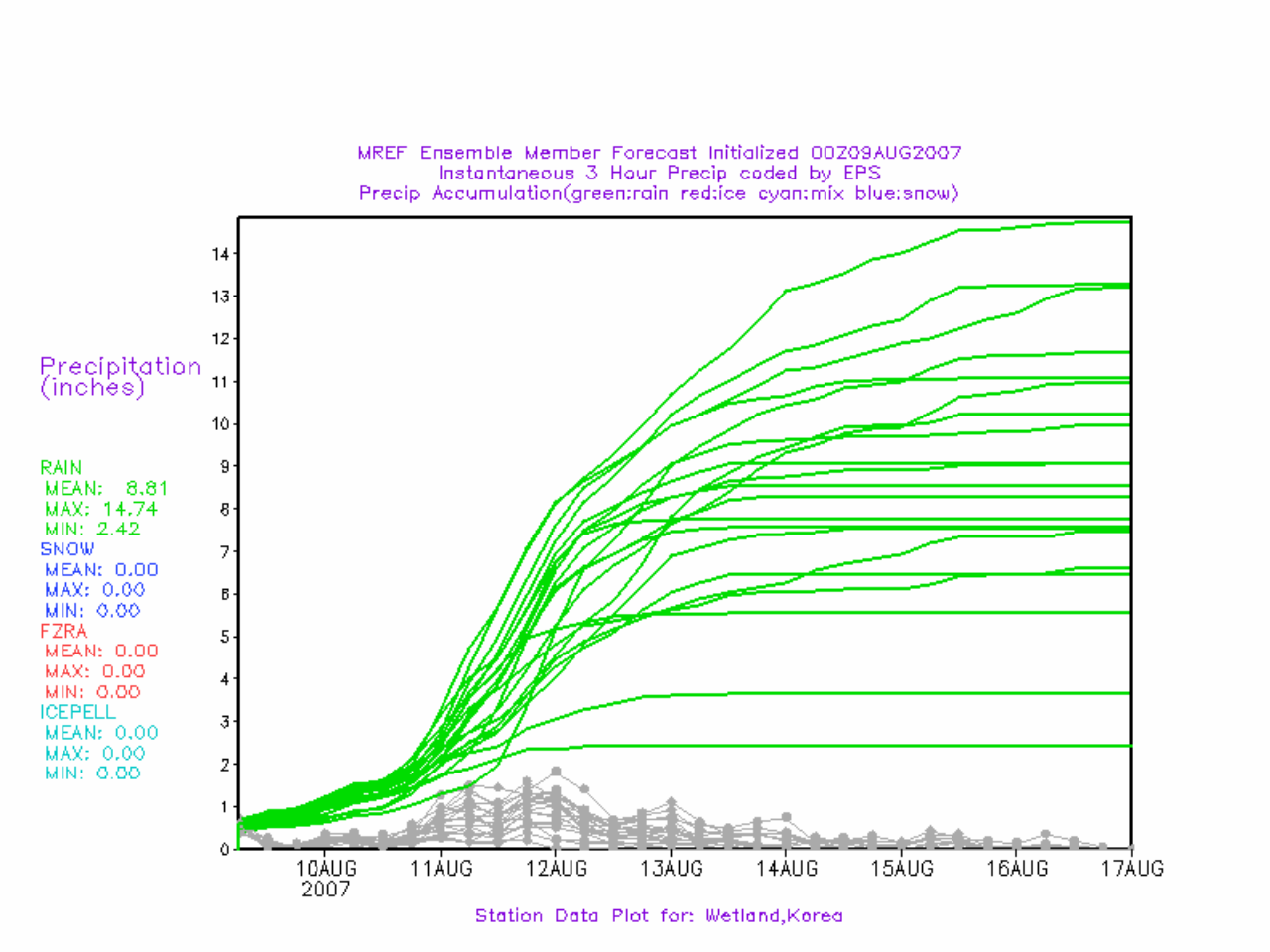




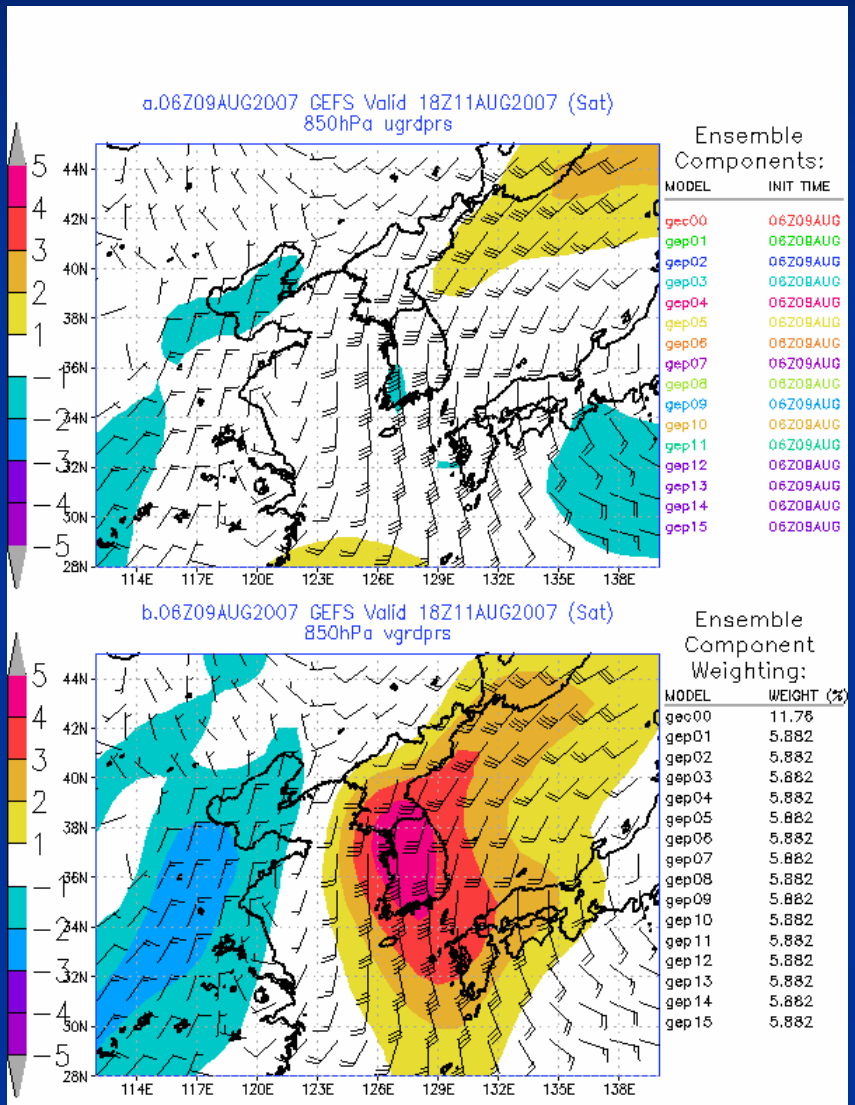
0000 UTC 9 August

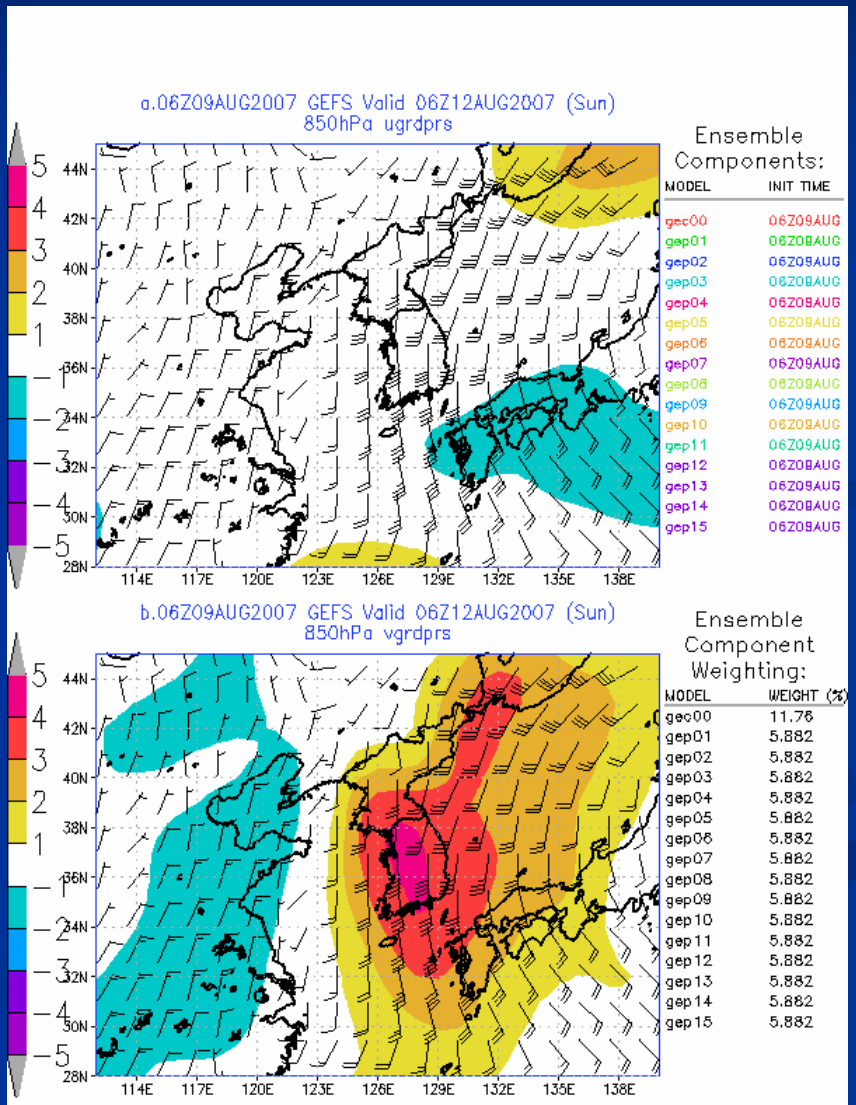
- **GEFS showed a strong signal**
  - *We can see the overall pattern of heavy rainfall*
  - *PW and v-wind anomalies*
- **There was some uncertainty**
  - *Timing and amounts of QPF*
  - *location and intensity of key features*
- **Useful data in the probabilities of QPF values**
  - *Big rain look at 25 mm, 50mm, and 100mm*
  - *We need a good feel for model/EPS climo → what is an historic event in the model atmosphere?*

9 August→ shorter forecasts more rainfall

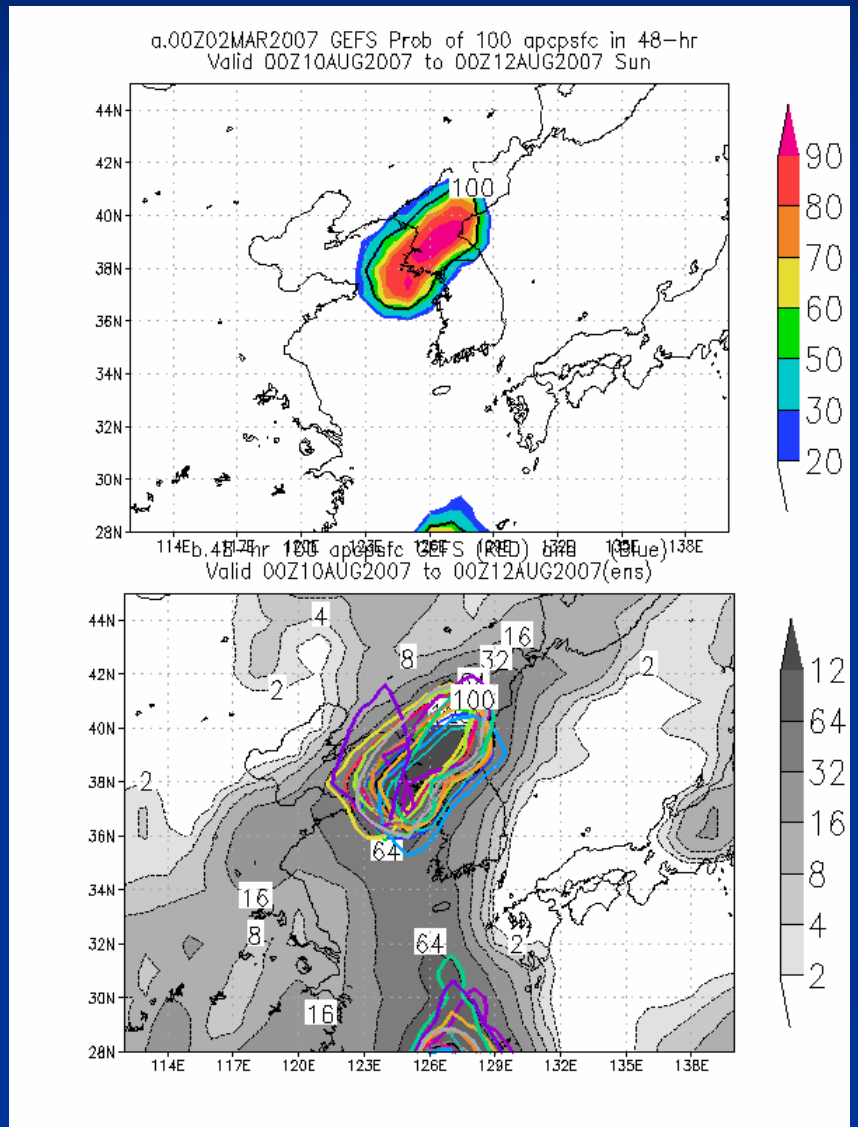


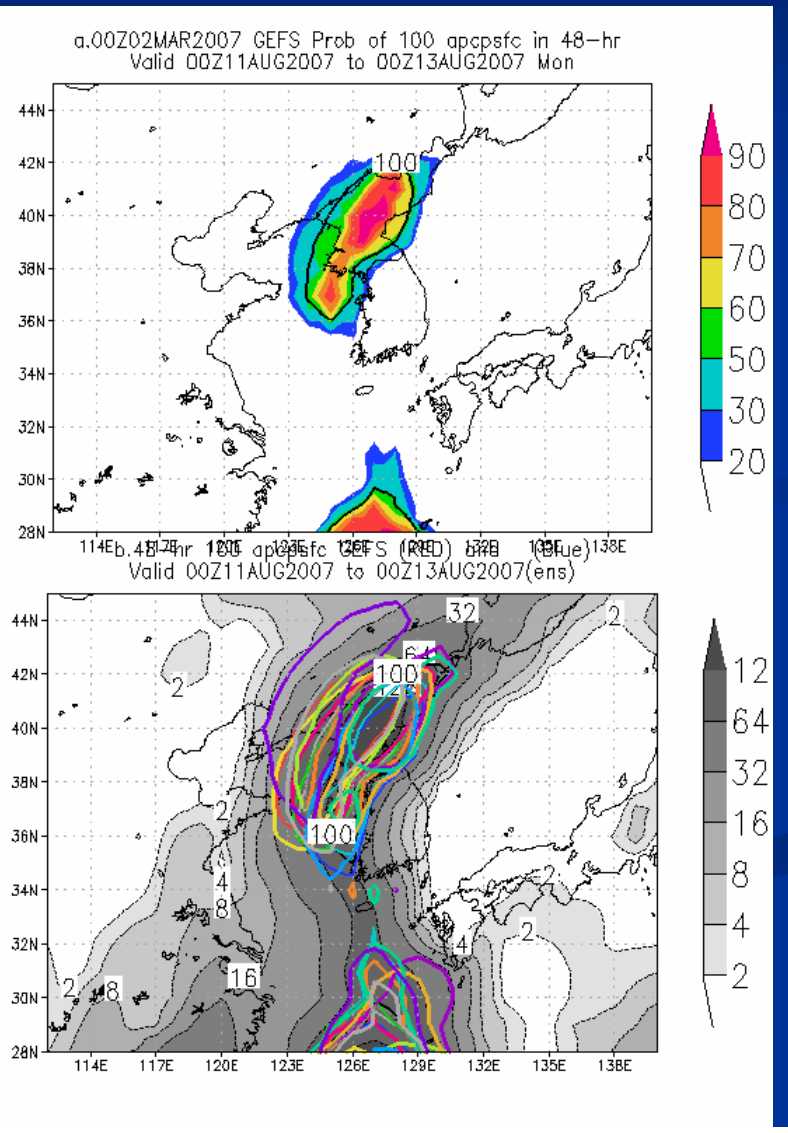
Strong Low-level winds



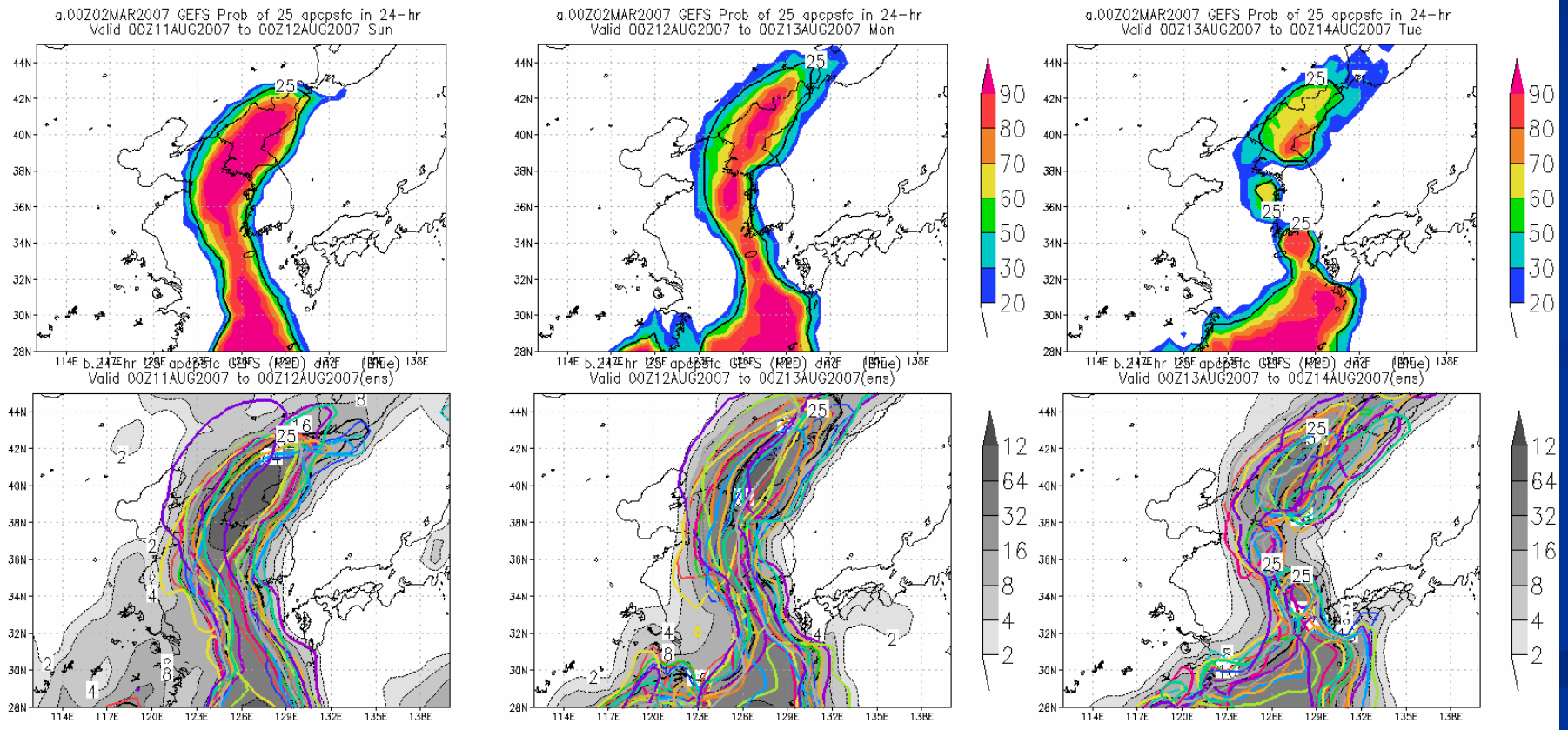


48-hour heavy rainfall





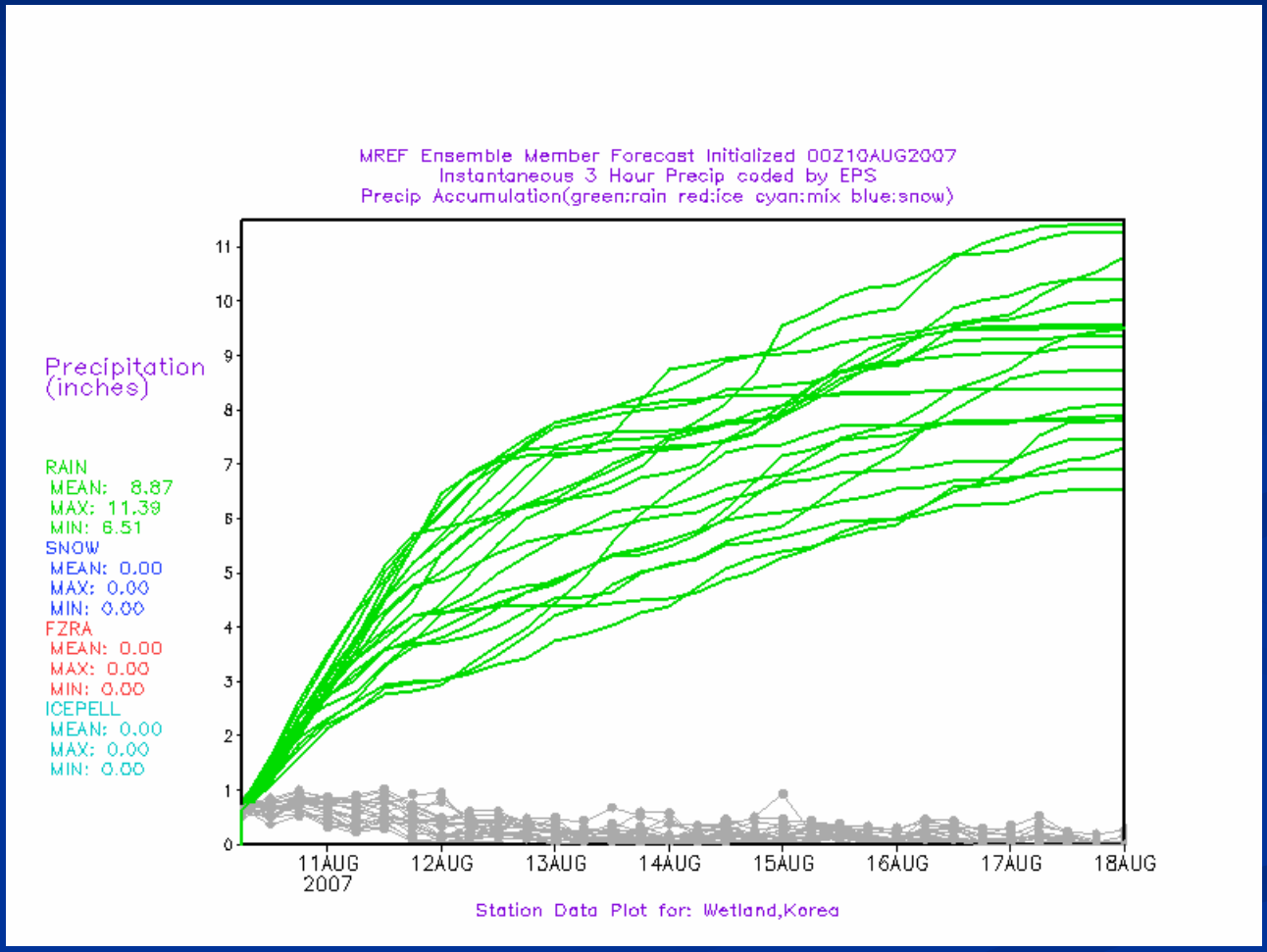
24-hour heavy rainfall



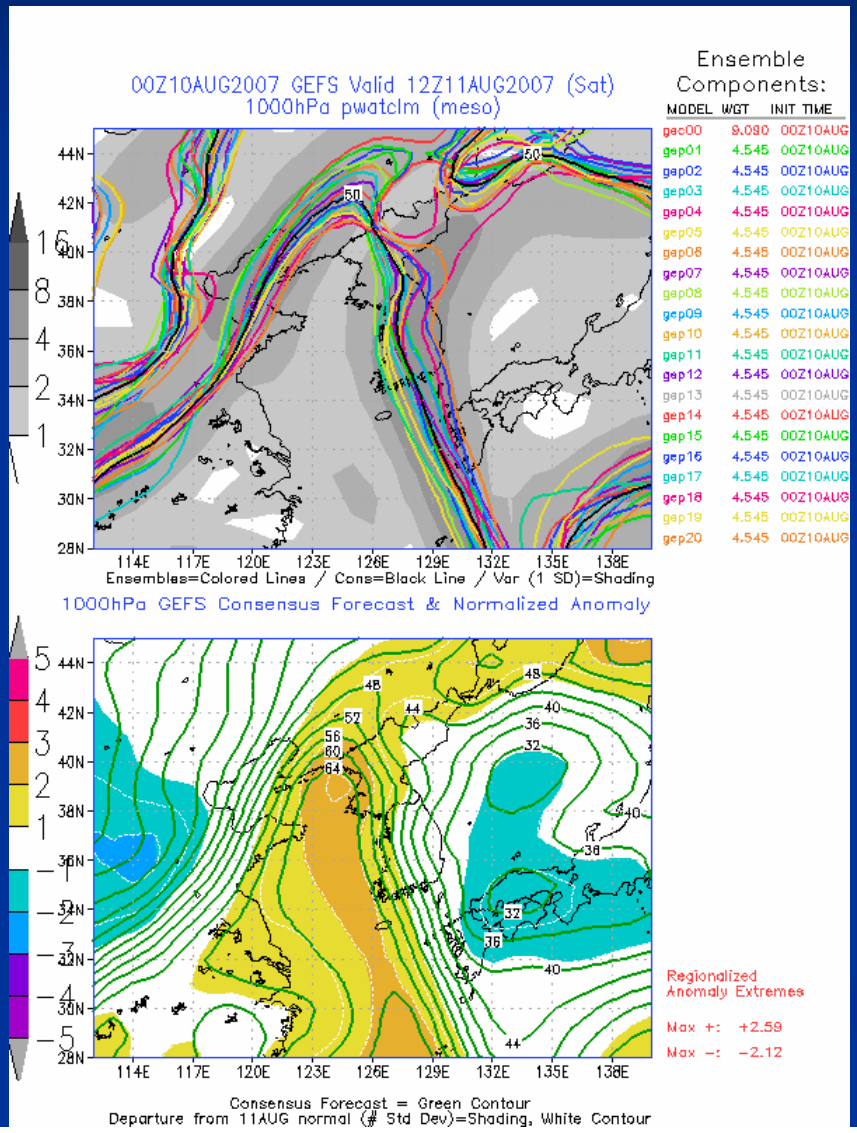
0000 UTC 10 August

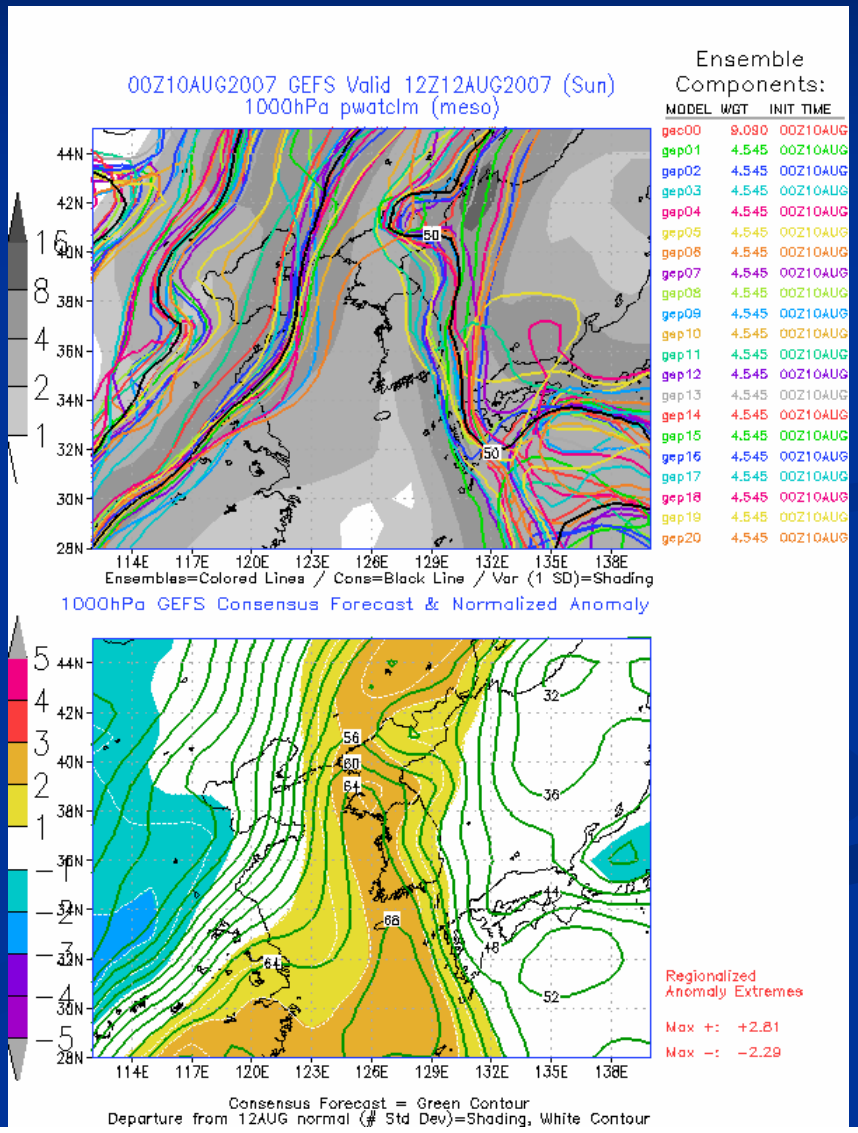
- **GEFS showed a strong signal**
  - *We can see the overall pattern of heavy rainfall*
  - *PW and v-wind anomalies*
- **There was some uncertainty**
  - *Timing and amounts of QPF*
  - *location and intensity of key features*
- **Useful data in the probabilities of QPF values**
  - *Big rain look at 25 mm, 50mm, and 100mm*
  - *We need a good feel for model/EPS climo → what is an historic event in the model atmosphere?*

Plume Diagram

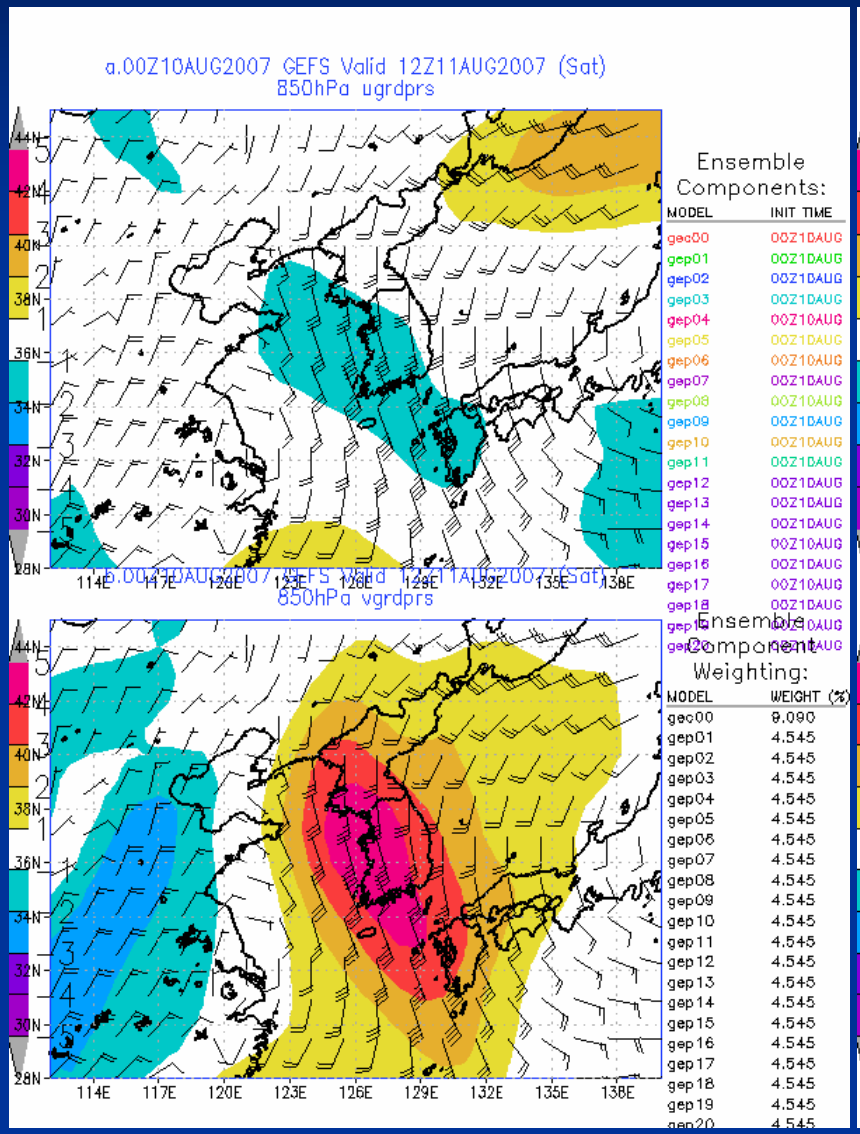


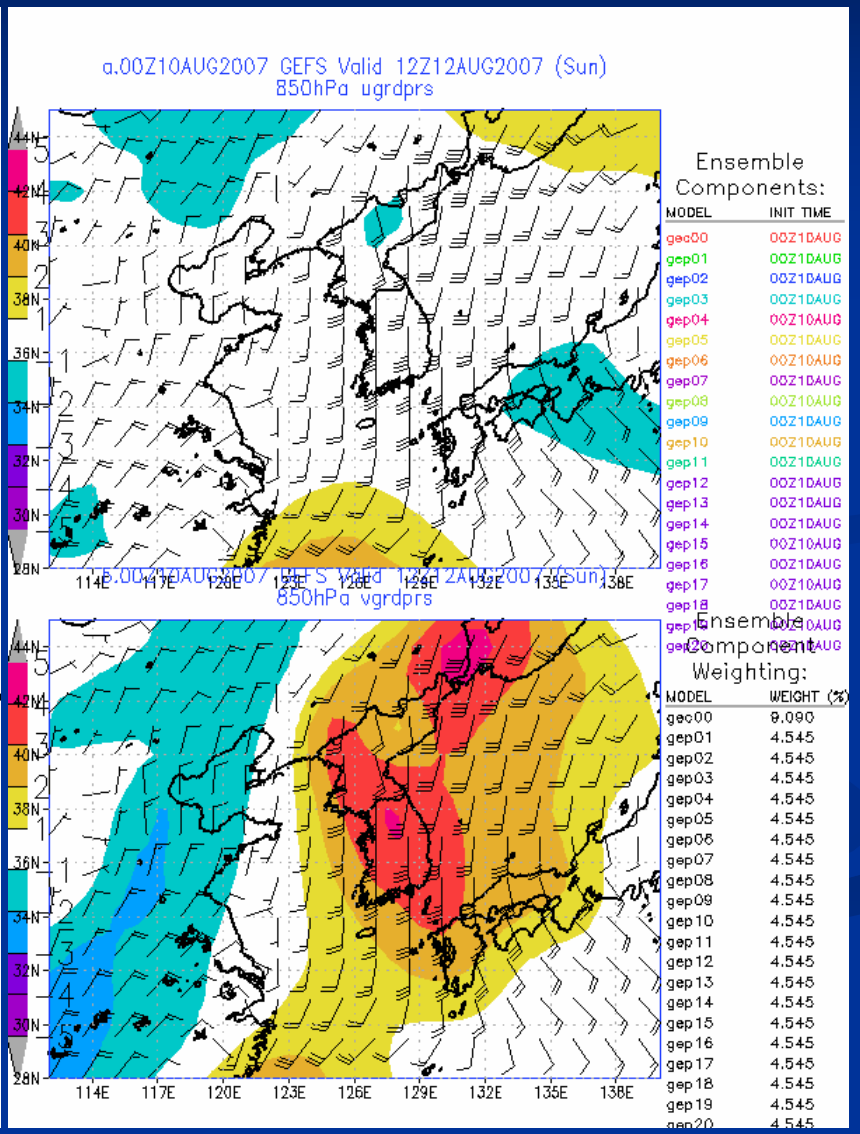
High PW N-S frontal Zone



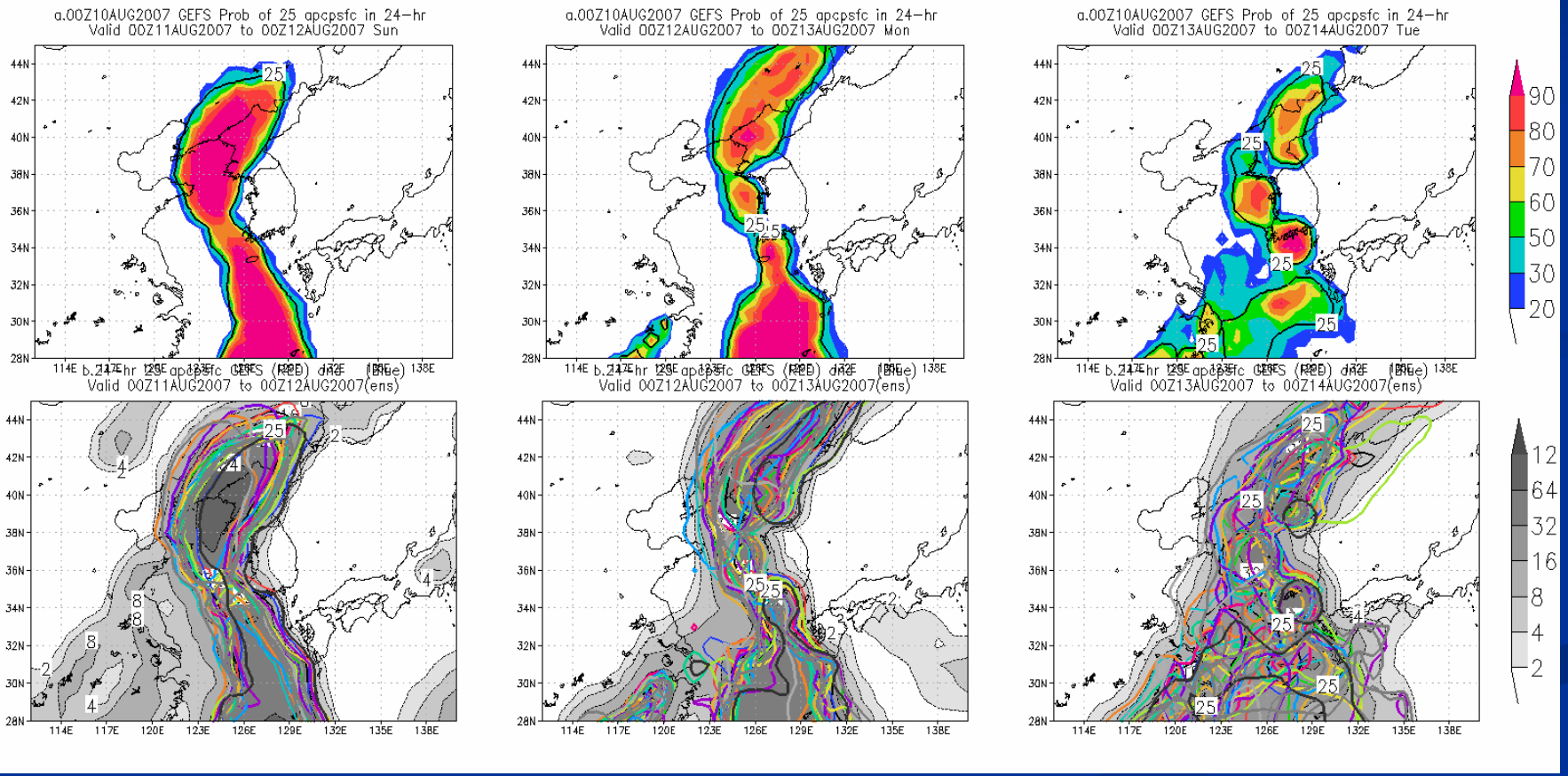


Low-level winds

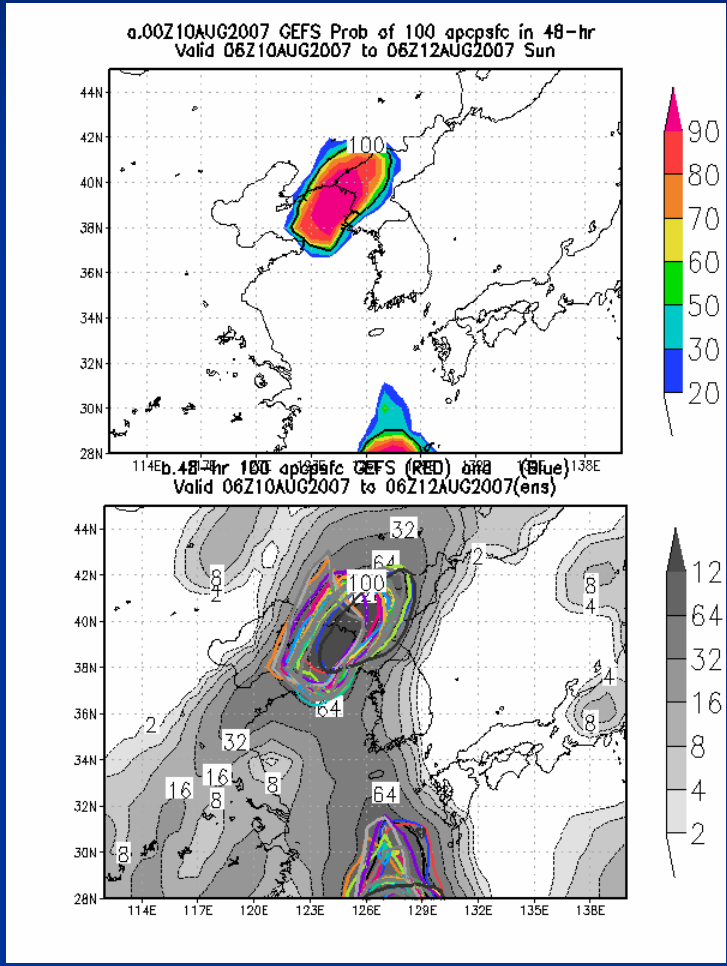




Heavy rain over 24 hour periods



48-hour QPF


a.00Z10AUG2007 GEFS Prob of 100 apcpsfc in 48-hr
Valid 06Z10AUG2007 to 06Z12AUG2007 Sun
90
80
70
60
50
30
20
b.48-hr 100 apcpsfc GEFS (RED) and (Blue)
Valid 06Z10AUG2007 to 06Z12AUG2007(ens)
12
64
32
16
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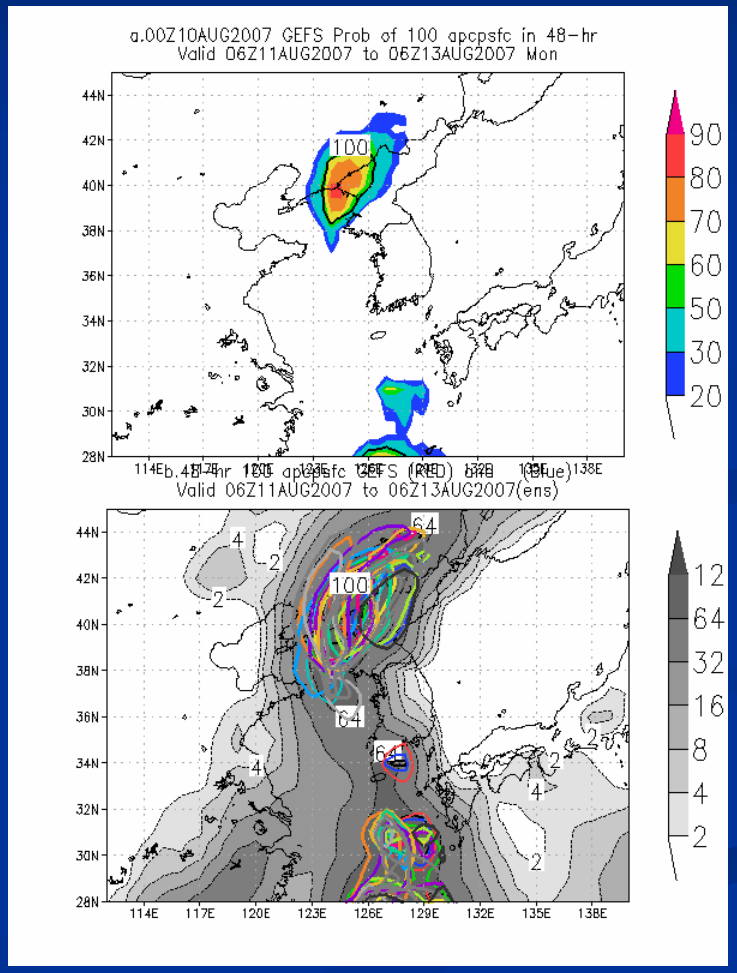
a.00Z10AUG2007 GEFS Prob of 100 apcpsfc in 48-hr
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b.48-hr 100 apcpsfc GEFS (RED) and (Blue)
Valid 06Z11AUG2007 to 06Z13AUG2007(ens)
12
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32
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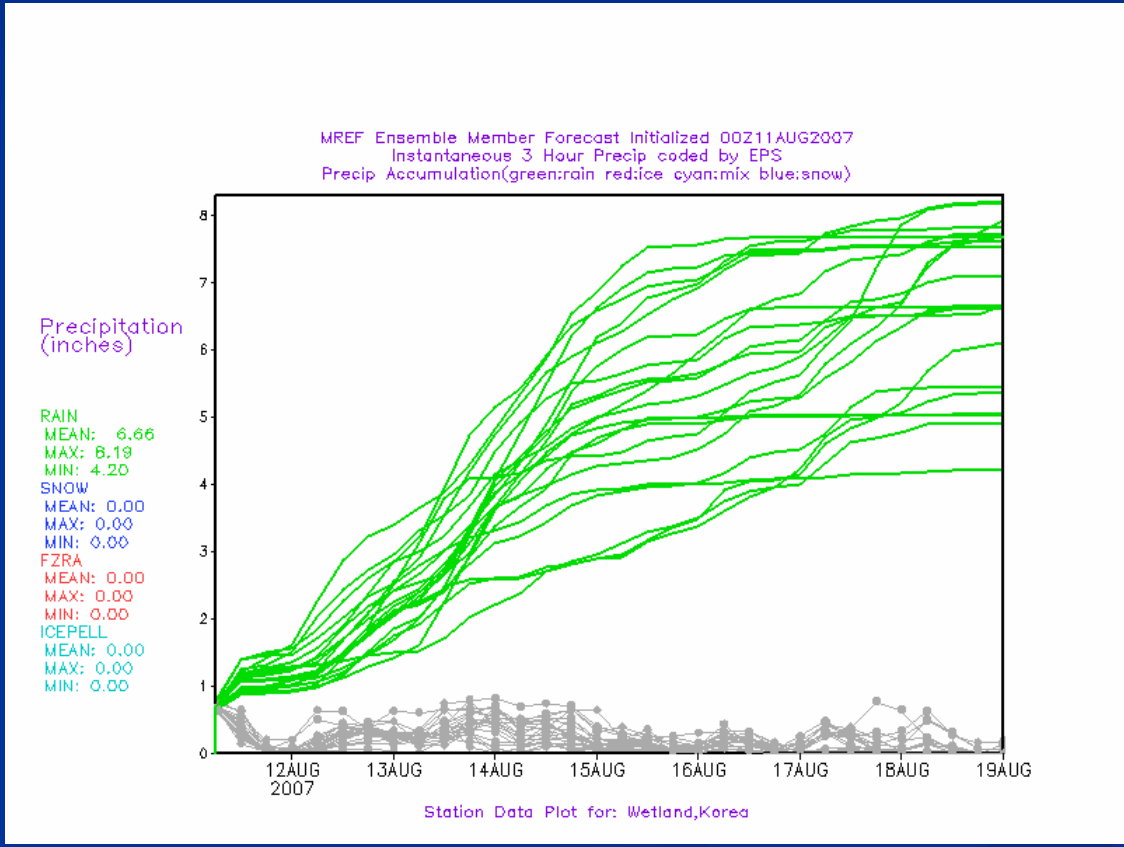
11 August already raining….
Same signal as earlier forecasts



Review

- We examined a major Flood event over North Korea
  - *Devastated crops in mid-August*
  - *Did it have other implications?*
- **This historic case was used to**
  - *Examine aspects of a major flood events and*
  - *Issues related to both the analysis and forecast of such significant events*
    - *We do not really know the ground truth and each analysis gives us a different answere*
    - *The forecasts were quite good*
- **It was an Ideal application of ensembles**
  - *Precipitation amounts (Probabilities) and timing*
  - *Meteorological setting →Features associated with significant flood events.*
- **The event seemed to put the features in a context→ Climate anomalies of key features associated with heavy rainfall.**

Acknowledgements

- *NCEP for the data GEFS and GEFS bias corrected*
- *CPC for the CMOPRH data*
- *Robert Hart and Jeremy Ross of climatic anomalies and anomalies data base.*

Wet Reference

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