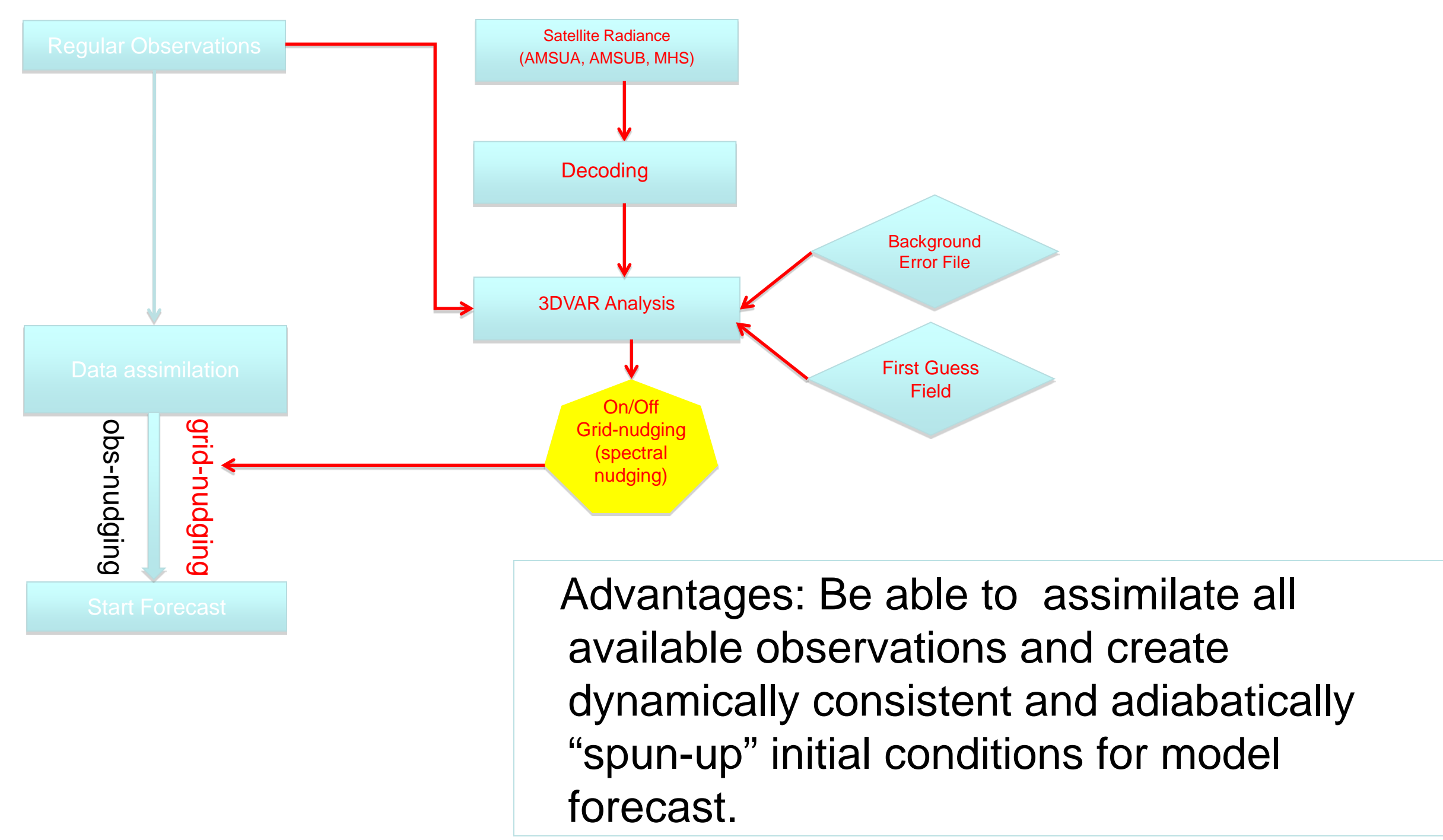


A hybrid 3DVAR and FDDA modeling system for mesoscale weather prediction

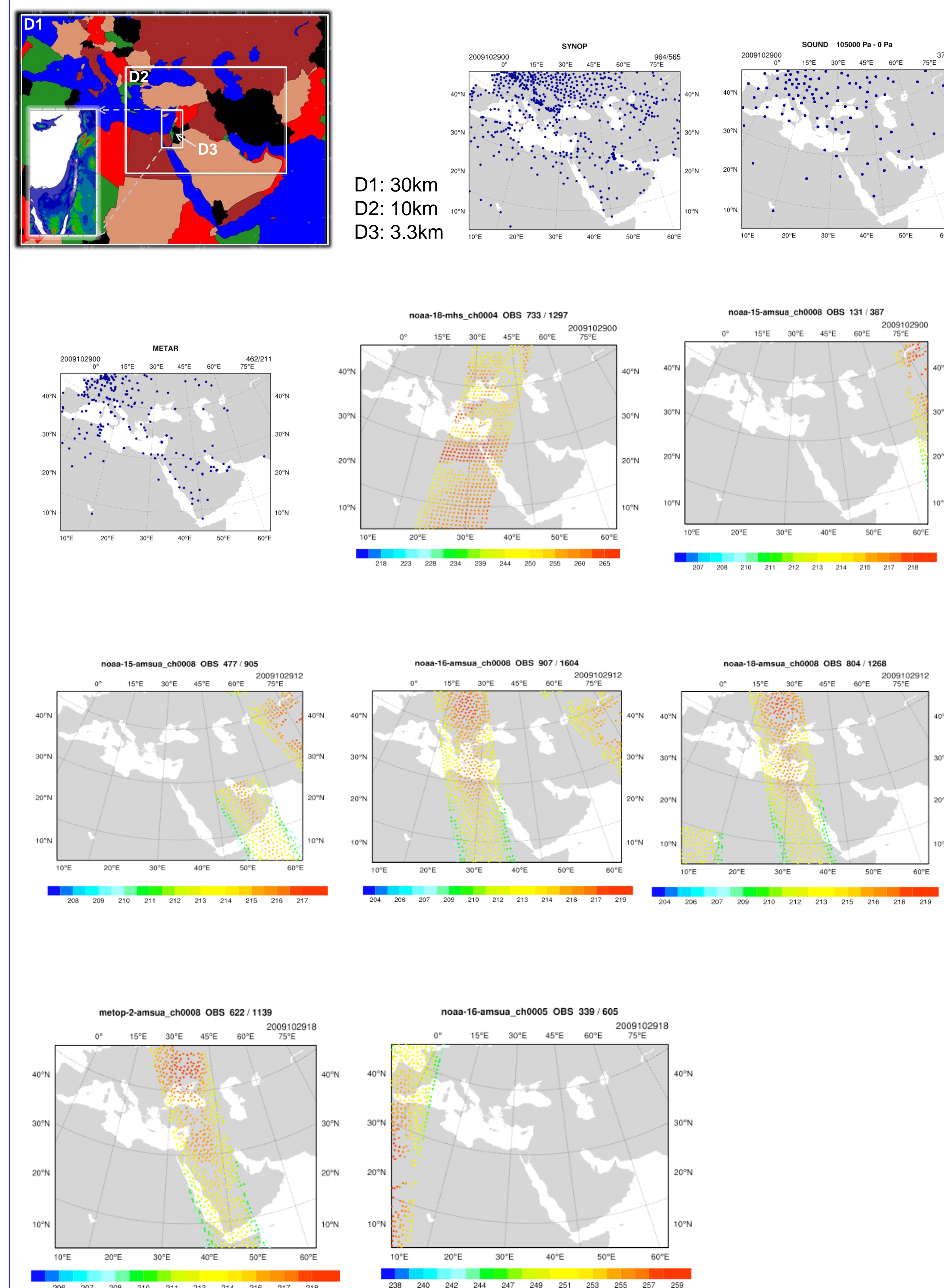
Wei Yu, Yubao Liu, Zhiqian Liu, Craig Schwartz, , National Center for Atmospheric Research (NCAR), Boulder, Colorado, U.S.A.
 Dorita Rostkier-Edelstein, Israel Institute for Biological Research, Ness-Ziona, Israel
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1. Hybrid System Flow Chart

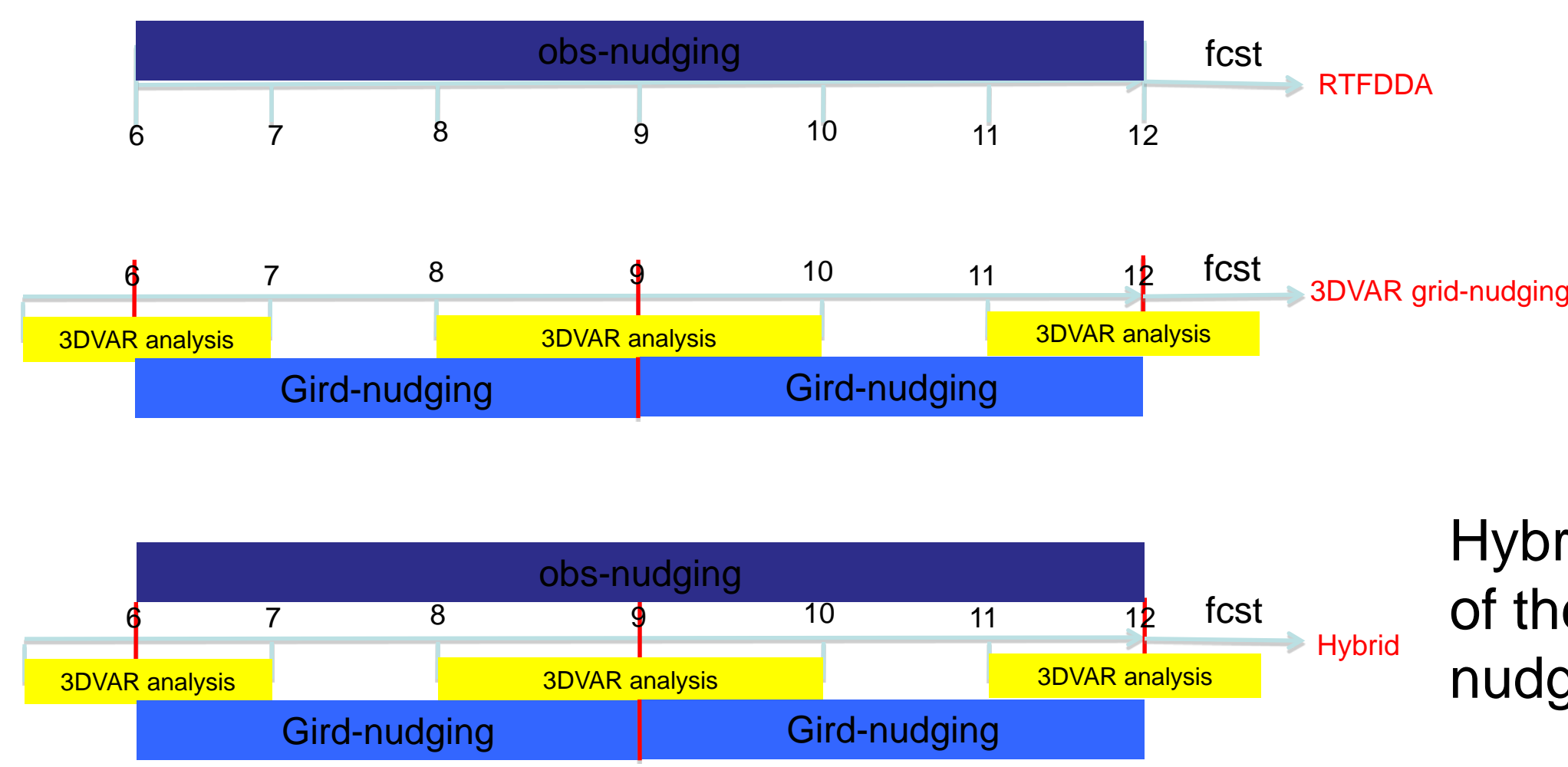


2. Model Domain and Data Set

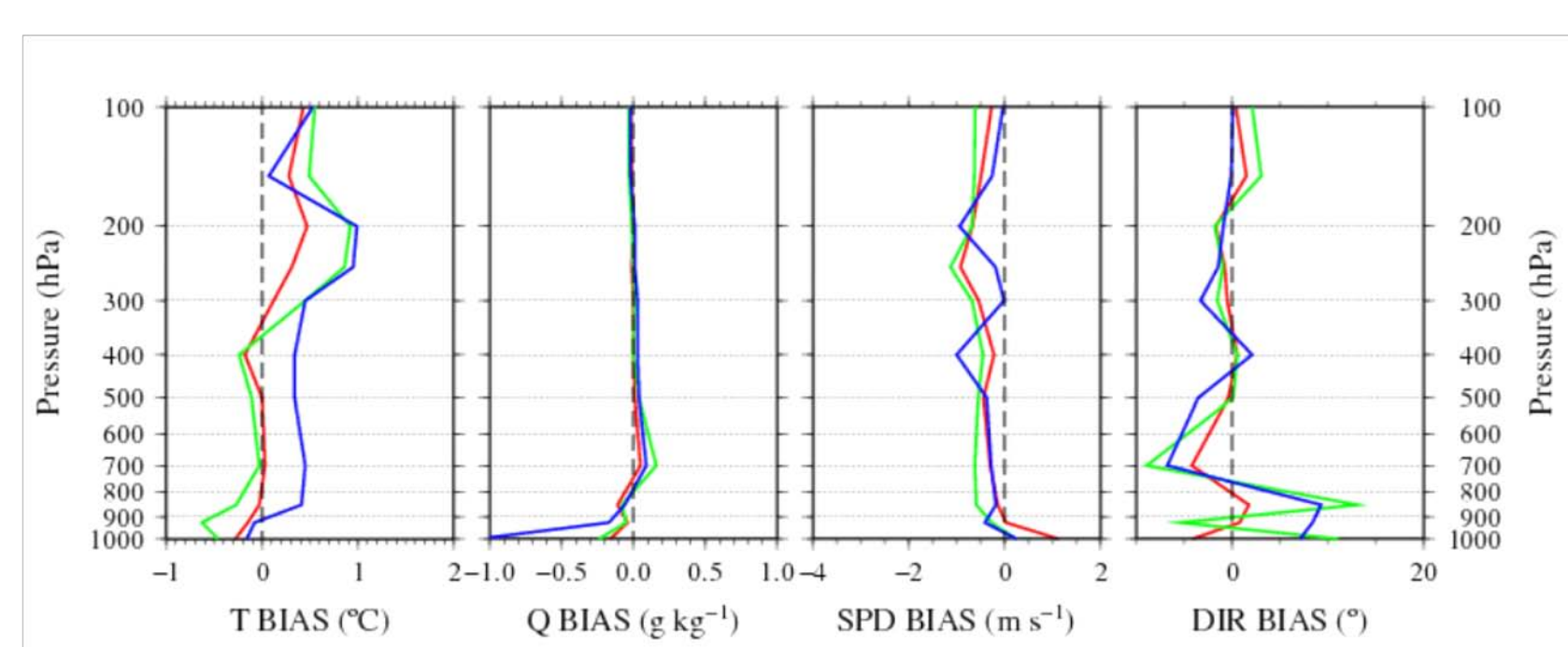


The challenge is that we do not have sufficient routine observations to cover this area. It is thus critical to set up a data assimilation system that incorporates all available observations.

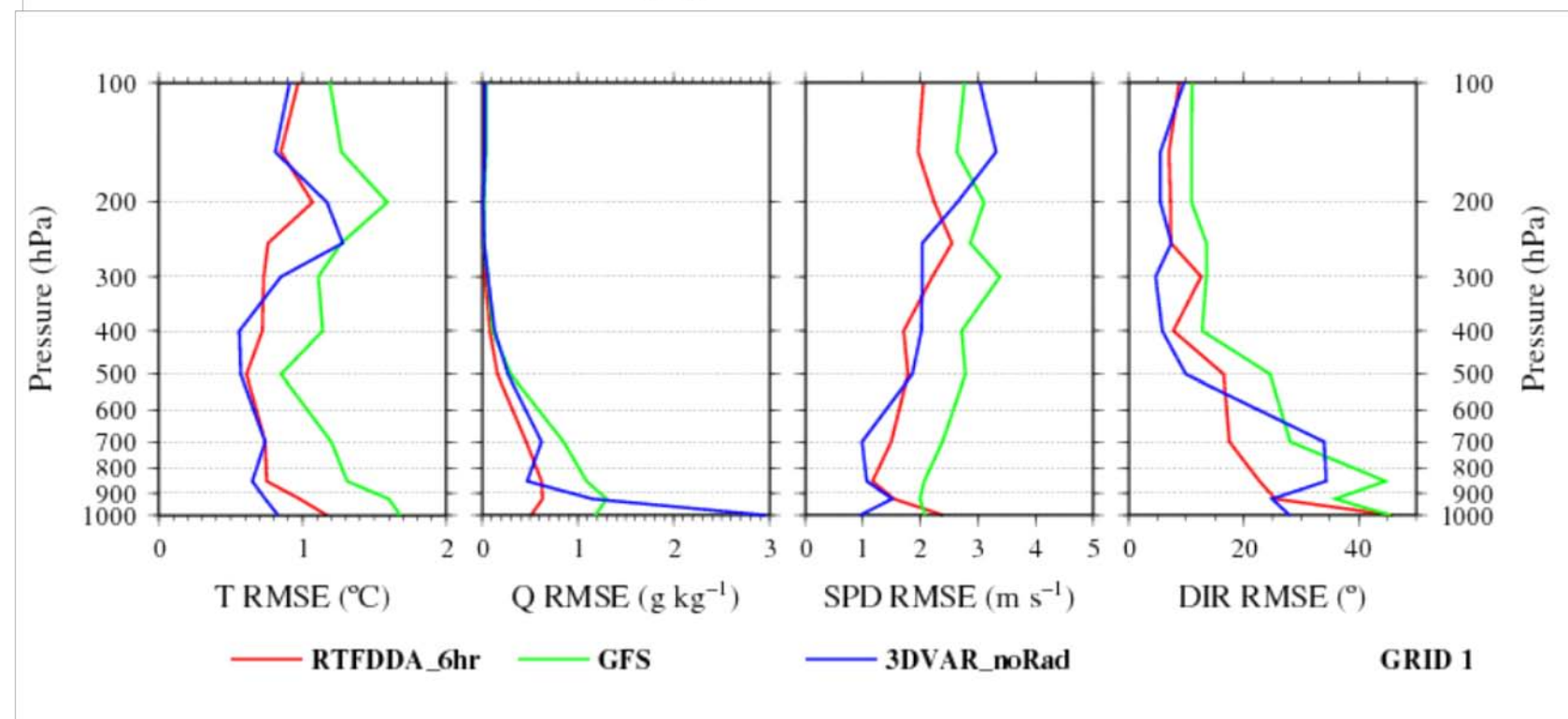
3. Data Analysis and Assimilation



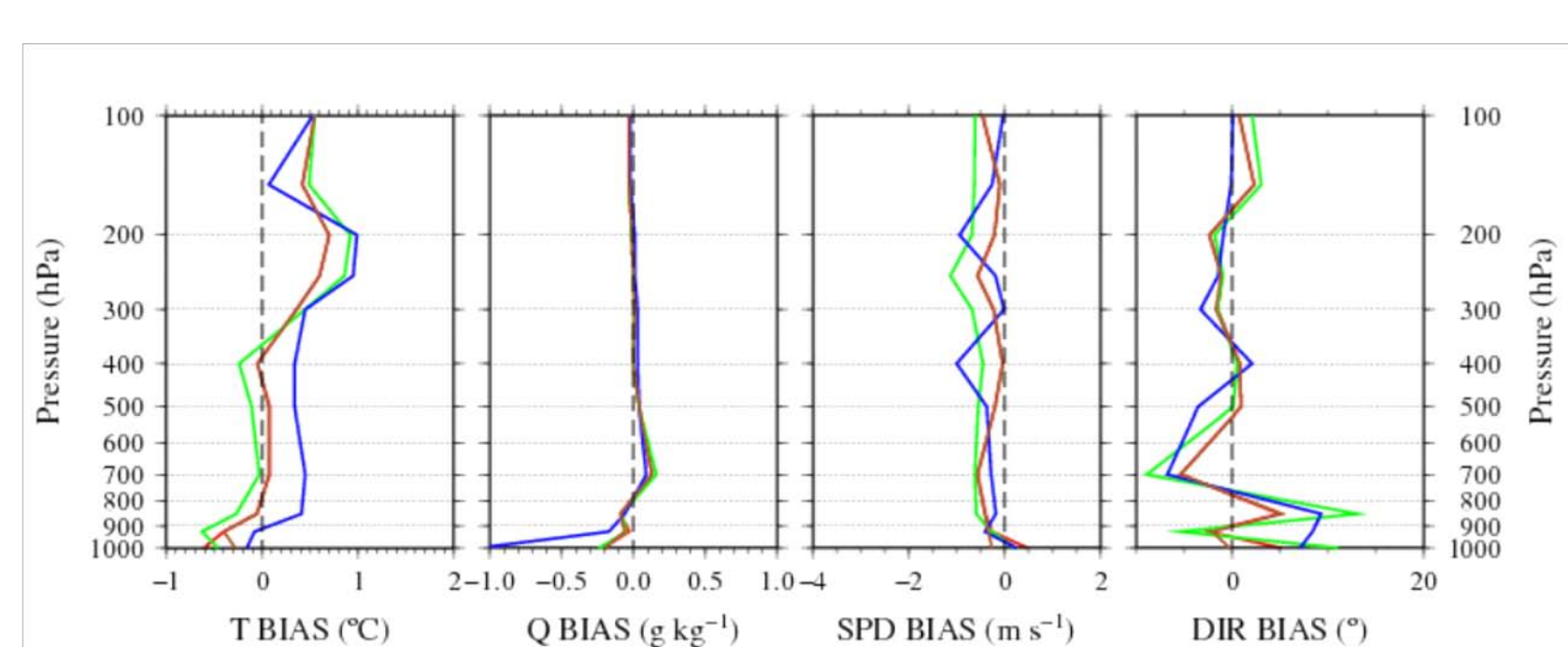
Hybrid system is the combination of the RTFDDA and 3DVAR grid-nudging.



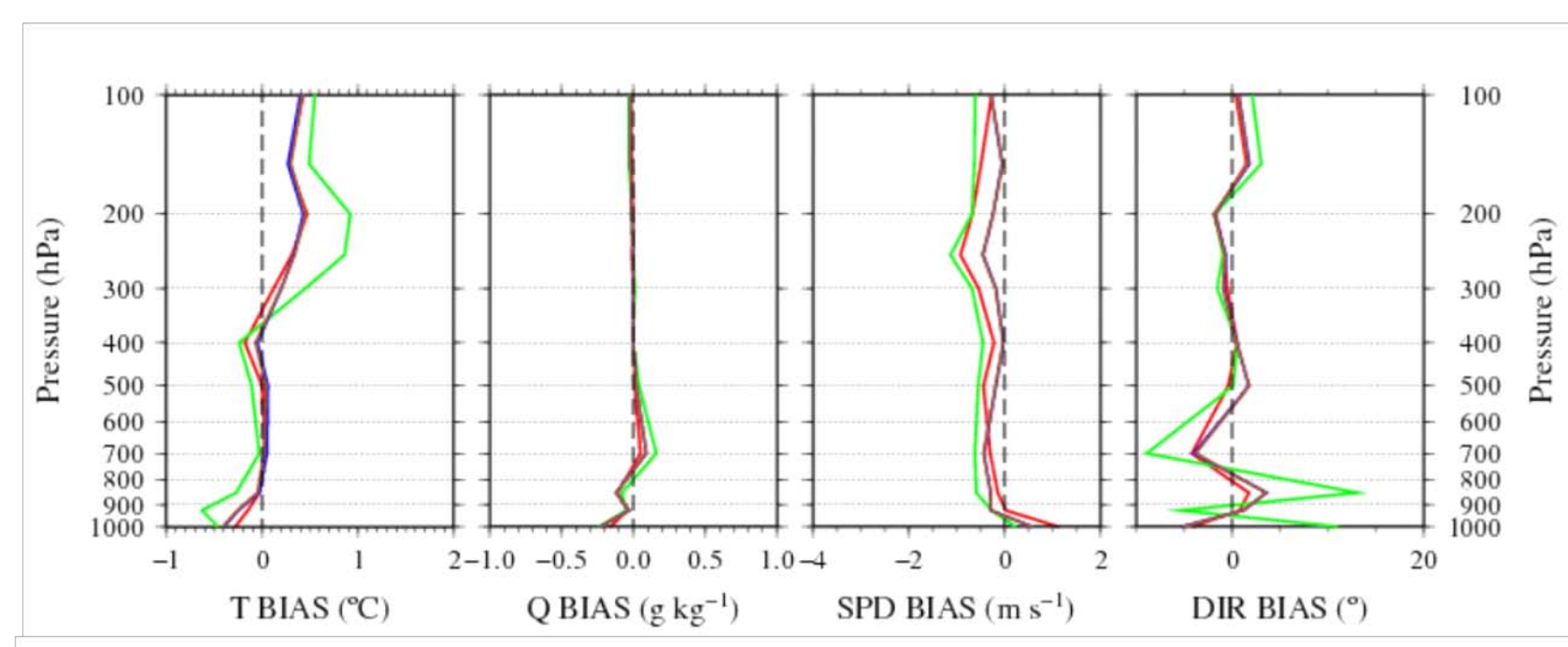
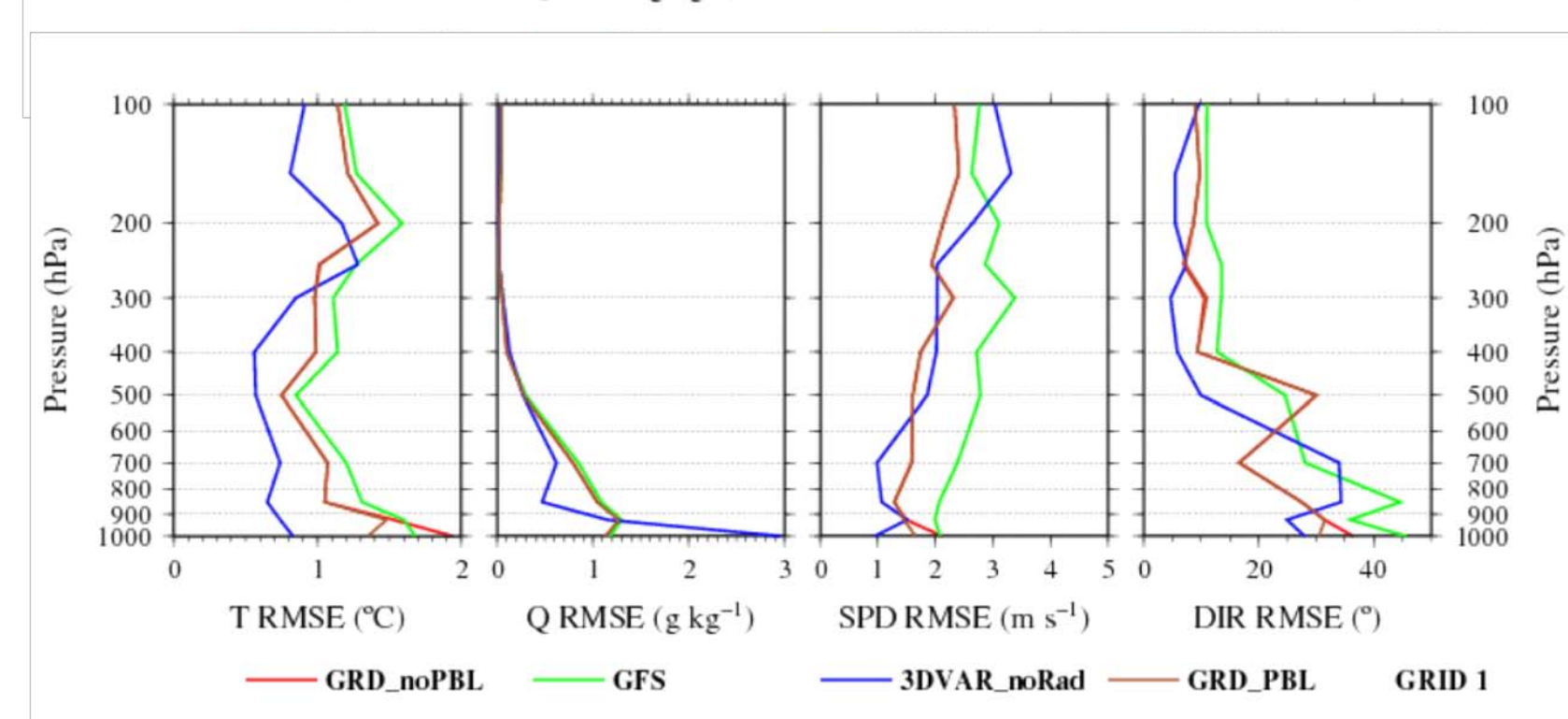
- RTFDDA_6hr: RTFDDA system with 6 hr data assimilation, valid at 2009103000.
- GFS: model initial conditions interpolated from GFS analysis at 2009103000.
- 3DVAR_noRad: 3DVAR analysis at 2009103000 using GFS as the first guess field. No radiance data are assimilated.



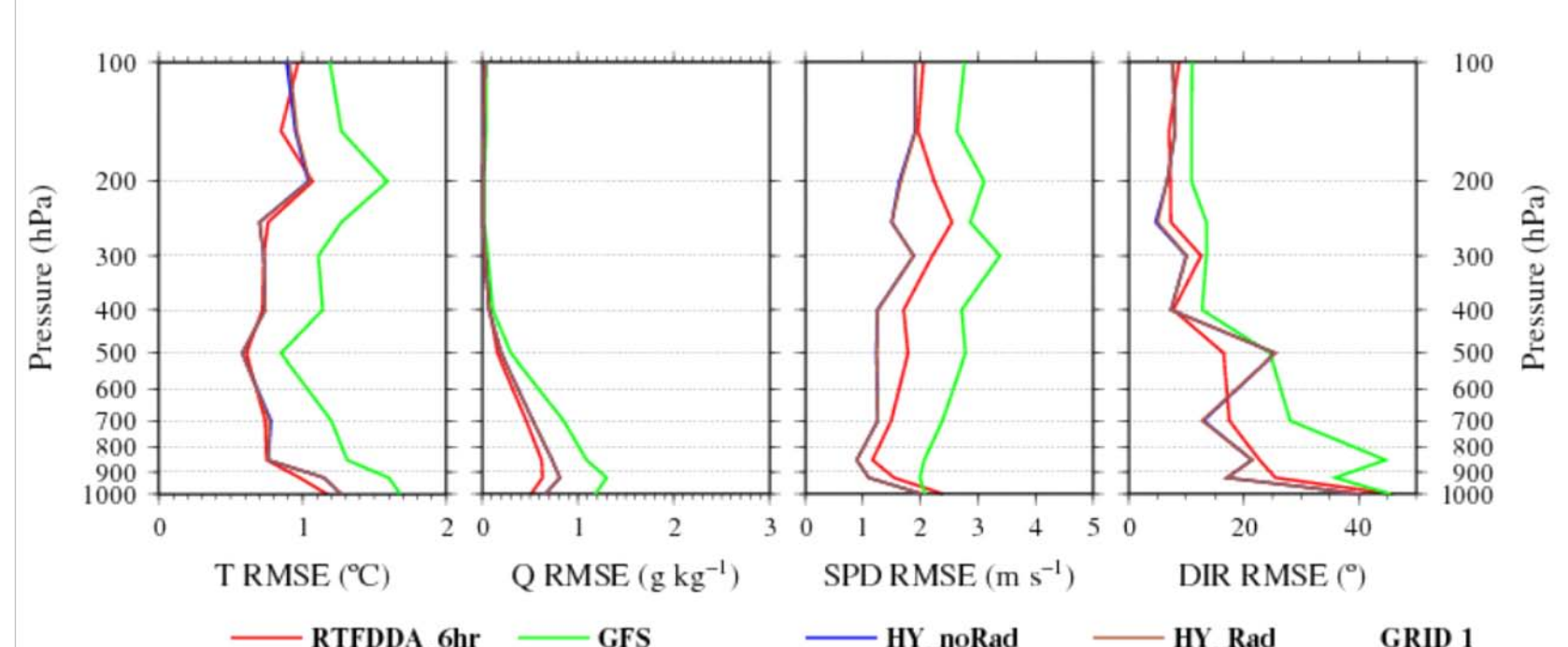
- Both 3DVAR and RTFDDA show improvement in initial conditions when compared to the interpolated GFS field.
- 3DVAR also shows improvement in wind speed when compared to RTFDDA.
- Only RTFDDA does not have the "spin-up" issue.



- GRD_noPBL: "grid-nudging" is applied to incorporate 3DVAR analysis at all model levels except in the PBL.
- GRD_PBL: same as GRD_noPBL except that nudging is applied at all model levels.
- Grid-nudging can effectively assimilate 3DVAR analysis in WRF mode with positive effects on model simulations.

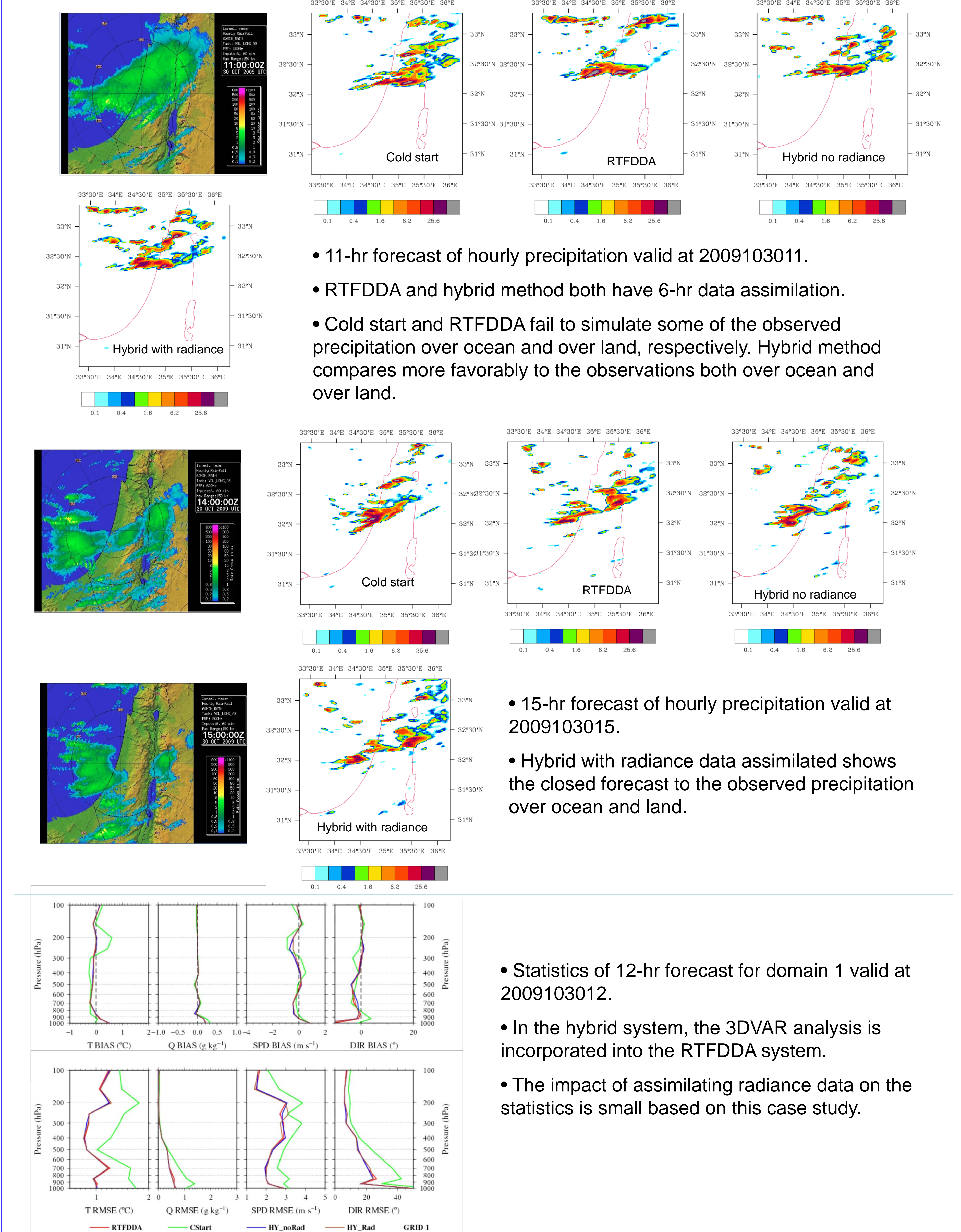


- HY_noRad: hybrid method with 6-hr data assimilation, valid at 2009103012. No radiance data are assimilated.
- HY_noRad: hybrid method with radiance data assimilated.



- Both RTFDDA and hybrid method show improvement in model initial conditions when compared to the interpolated GFS field. The hybrid method further shows smaller wind speed errors than RTFDDA.
- The impact of assimilating radiance data on model simulations appears to be small based on this case study.

4. Model Forecast Results



- 11-hr forecast of hourly precipitation valid at 2009103011.
- RTFDDA and hybrid method both have 6-hr data assimilation.
- Cold start and RTFDDA fail to simulate some of the observed precipitation over ocean and over land, respectively. Hybrid method compares more favorably to the observations both over ocean and over land.

- 15-hr forecast of hourly precipitation valid at 2009103015.
- Hybrid with radiance data assimilated shows the closest forecast to the observed precipitation over ocean and land.

- Statistics of 12-hr forecast for domain 1 valid at 2009103012.
- In the hybrid system, the 3DVAR analysis is incorporated into the RTFDDA system.
- The impact of assimilating radiance data on the statistics is small based on this case study.

5. Conclusions and Future Work

- The hybrid 3DVAR-RTFDDA modeling system produces encouraging results when validated against the observations.
- The hybrid 3DVAR-RTFDDA modeling system retains the advantages of RTFDDA for creating dynamically consistent and adiabatically "spun-up" initial conditions for model forecast.
- More experiments are needed to fully understand the performance of the hybrid system as well as to examine in detail the impact of radiance data assimilation.