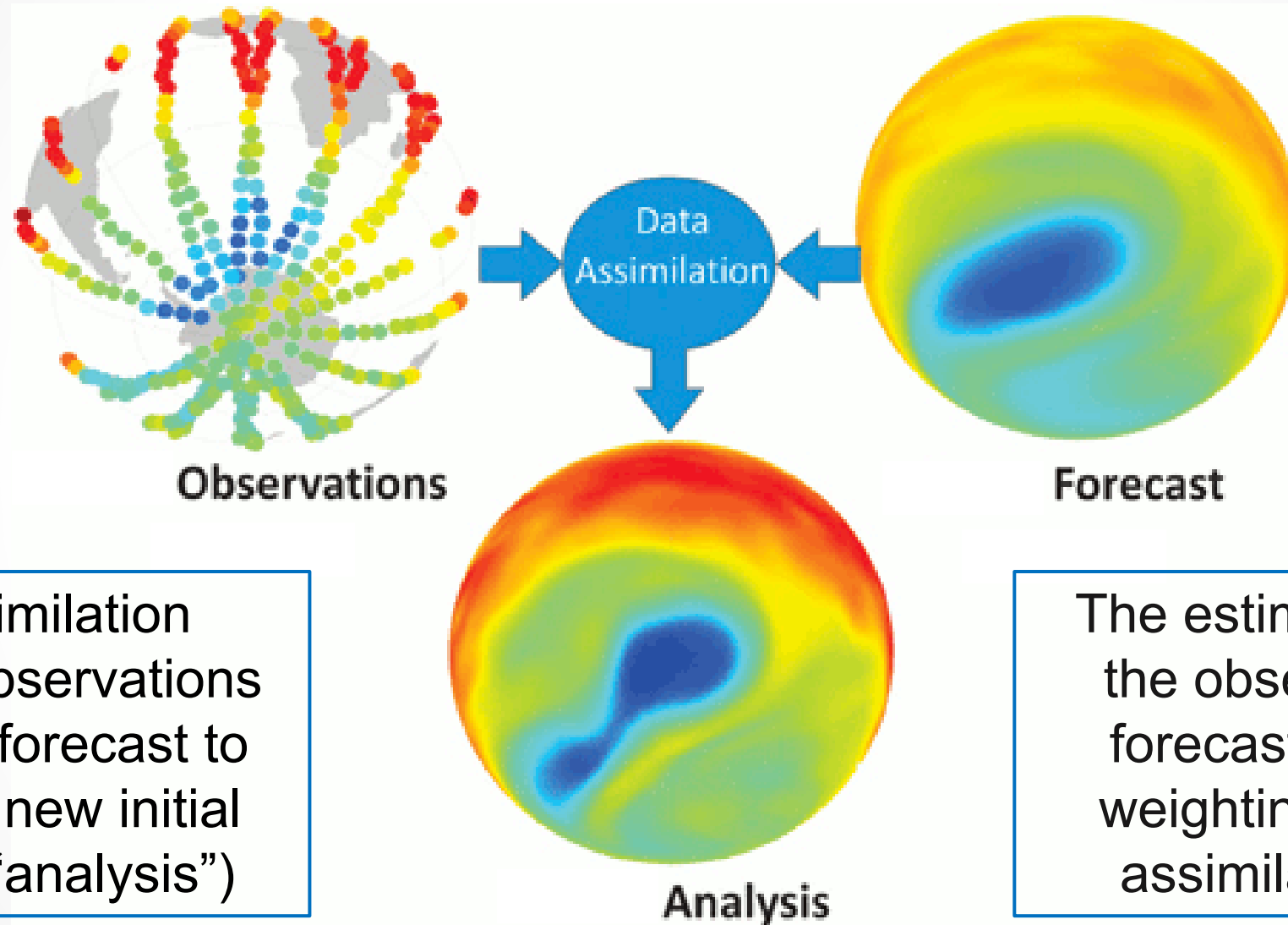


OSSEs – Lessons Learned in the Troposphere

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How NWP Uses Observations



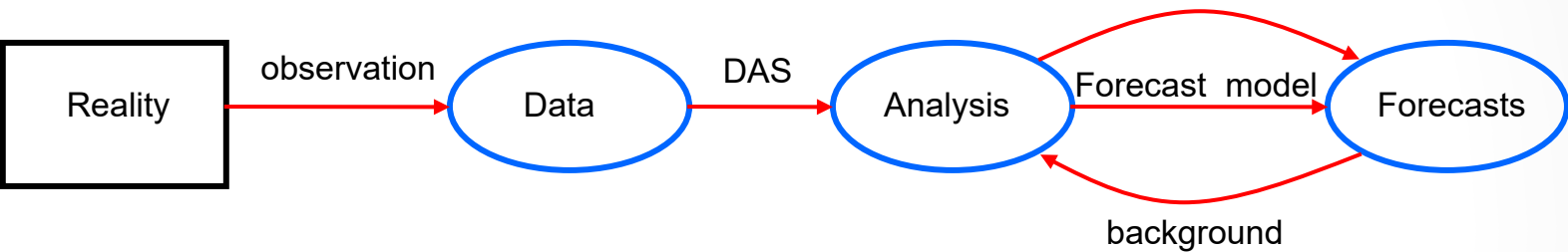
Data assimilation combines observations and a prior forecast to generate a new initial condition (“analysis”)

The estimated errors of the observations and forecast are used as weighting by the data assimilation system

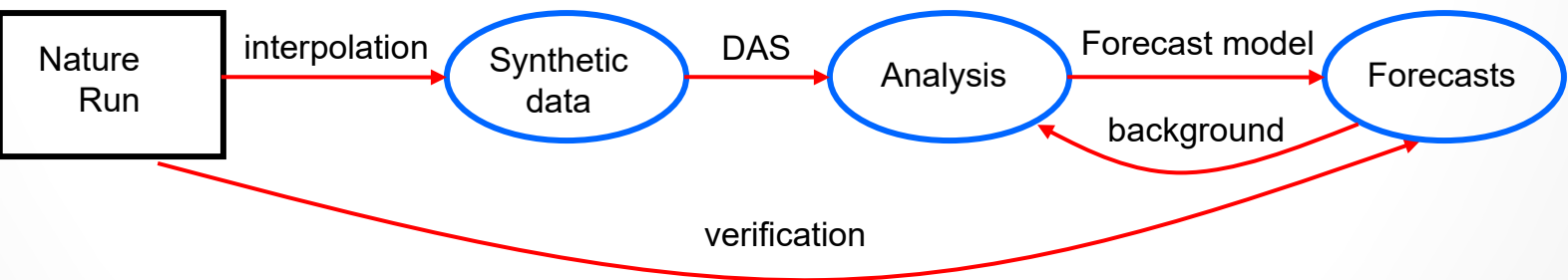
Image: Lahoz, W. and P. Schneider, *Front. Environ. Sci.*, 2014, with permission from the author

OSSEs vs the Real World

Real world forecasts



OSSE forecasts



Why Do an OSSE?

1. You want to find out if a new observing system will add value to NWP analyses and forecasts
 - Most common goal
2. You want to make design decisions for a new observing system
 - Can compare many different configurations; determine instrument requirements
 - Early involvement in instrument design process
3. You want to investigate the behavior of data assimilation systems in an environment where the truth is known. The availability of a complete true state of the atmosphere allows the explicit calculation of some quantities not possible in the real world:
 - Analysis error
 - Short-term forecast error
 - Efficacy of the data assimilation system

When Not to Run an OSSE

- When you can't model the phenomena you are interested in
- When you can't simulate your new observations
- When you can't assimilate your new observations

Challenges with Nature Runs

- Identical or fraternal twins
 - Same model (identical) or similar model (fraternal) used for the Nature Run as for experiments
 - Lack of model error complicates every aspect of the OSSE process
 - **Mitigation:** use different model bases and resolutions for the NR and experiment model; use alternative options for parameterizations; Nature Runs as community resources
- Gigantic output files and huge computational resource requirements
 - Need both high spatial and high temporal resolution
 - I/O is the heaviest burden
 - **Mitigation:** integrate observation simulators into the Nature Run model to reduce I/O and space requirements

General OSSE Challenges

- Results only apply within the OSSE system – no concrete connection to the real world
 - **Mitigation:** validation of the OSSE behavior and performance compared to the real world – both overall and specific to the particular experiments at hand
- Observation simulation – achieving realism including observation errors
 - **Mitigation:**
 1. Make sure the Nature Run produces realistic fields needed to simulate the observations
 2. Use different “operators” to simulate observations than for assimilation
 3. Build capability for simulating realistic observation errors
 4. New instruments – test a range of simulated observation errors and/or observation operators
- By the time the new instrument is deployed, both the global observing network and the forecast models/DAS will be different