Reflections on the 2014 ECMWF Annual Seminar
on 'Use of Satellite Observations in Numerical Weather Prediction'
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I would like to thank the European Meteorological Society for providing me with a Travel Award to attend the ECMWF annual seminar. As well as learning more about satellite data I have benefited from being be introduced to data assimilation techniques, something that I knew little about as my own work entails the use of CALIPSO, CloudSat and MODIS satellites retrievals for the development and validation of cloud and precipitation parameterizations in global climate models and high-resolution models.

I have chosen to present a short synopsis of one presentation each day that I found particularly interesting. The seminar series began with an excellent overview by John Derber. John provided a brief history of satellite data assimilation, and described how challenges of using satellite data for assimilation has changed over time from its introduction in the 1980s. It was also shown how improvements in the background error specification and forward model transforms are vital to the assimilation of satellite observations. It was also mentioned that understanding satellite and instrument characteristics is increasingly important for eliminating biases.

On the second day, Dick Dee presented upcoming re-analysis products and the role of satellite data rescue. He introduced ERA-Clim (1900-2010), which only employs surface pressure observations with either a Kalman filter or 4D-var technique to capture the large-scale flow at 500hPa. There are also several variations of ERA-Clim which use ensembles, assimilation of surface observations, and high resolution land surfaces. Dick also mentioned that ERA5 will be introduced in January 2015, which will replace ERA-Int as it was using an IFS model circa 2006 and there has been significant model development in the mean time.

On the third day, Marta Janiskova presented her work on radar and lidar cloud assimilation. As we found out through the other presentations, oftentimes cloud-affected observations are discarded from data assimilation because of the need to use linearized versions of non-linear processes in the calculations. Marta showed how a combination of 1D+4D-Var technique can be used for data assimilation of active instruments; building upon experience with precipitation assimilation. While this technique is still too computationally expensive for operational applications, it shows great promise. There are several challenges which remain when considering the assimilation of active instruments, including: sufficiently accurate observational operators, how linearization of physical parameterizations are treated, appropriate quality control and bias correction schemes, and observational error definition that accounts for spatial representativeness of space-borne retrievals.

On the fourth day, Thomas Auligne presented a particularly interesting talk on convective-scale satellite data assimilation. Thomas mentioned that as NWP models move towards higher resolutions, moist processes (including clouds and precipitation), orographic effects and surface properties (such as skin temperature and surface emissivity) have a greater influence on forecasts. As such, the roles of cloud and precipitation radiances, the accuracy and efficiency of radiative transfer, influence of non-linear observation operators, and Jacobian calculations all play a greater role in the assimilation of all-sky radiances. In addition, one must consider the influence of a satellites field of view and the interpolation method used during assimilation. One highlight of Thomas's presentation was the demonstration of grid-warping and how displacement assimilation can be used in conjunction with additive assimilation to reduce the influence of highly non-gaussian tails of innovation PDFs.

One of the greatest challenges of accounting for an increase in a model's spatial and temporal scales is balancing the timeframe of valuable observations, with model spin-up settling, and yielding a skilled forecast. This will be particularly difficult as models become multi-scaled with nested grids.

Of course there were many other interesting presentations in the seminar, but here I have just highlighted a few which I found particularly fascinating.