Spatio-temporal modeling 1

The general theme for this breakout session will be aspects of space-time statistical modeling that have received little attention from the statistical community. A subsidiary theme will be recent developments in measuring processes in space-time may change the kinds of questions we might want to ask or can answer about space-time statistical models.

Here are two examples of aspects of space-time modeling that, as far as I am aware, have gotten little attention from the statistical community and how new data products might help advance the field:

1. Models on time scales in which dynamics matters. For example, while there has been some recognition that fully symmetric space-time covariance functions

   - Gneiting, Tilmann, Marc G. Genton, and Peter Guttorp. "Geostatistical space-time models, stationarity, separability, and full symmetry." Monographs On Statistics and Applied Probability 107 (2006): 151.
   - Stein, Michael L. "Space–time covariance functions." Journal of the American Statistical Association 100.469 (2005): 310-321.
   - Jun, Mikyoung, and Michael L. Stein. "An approach to producing space–time covariance functions on spheres." Technometrics 49.4 (2007): 468-479.

   are inadequate for, say, atmospheric processes on time scales of days or shorter, the proposed models for capturing such asymmetries are fairly simple and there is not much out there on whether these or more recent approaches are adequate.

   Part of the problem here may be that it would really help to have observations that are dense in both space and time in order to examine space-time dependencies on shorter time scales. New geostationary satellites that produce frequent high-resolution images should provide a valuable source of this kind of data, see

   https://www.nasa.gov/press-release/nasa-successfully-launches-noaa-advanced-geostationary-weather-satellite

2. Is there any meaningful statistical literature that seriously treats space-time processes including the vertical dimension? In both oceans and the atmosphere, the nature of circulation patterns is fundamentally different near the Earth's surface than away from it, so just adding the vertical as a third spatial component to existing models will not be adequate. Lidar data may provide the kind of data needed to look at these kinds of questions. Different types of lidar can measure things like aerosols, cloud base height and winds, and can provide information about variation in all directions. The ARM program run by DOE makes use of a number of lidar instruments, including Doppler lidar (https://www.arm.gov/capabilities/instruments/dl) and and Raman lidar (https://www.arm.gov/capabilities/instruments/rl) among others. Go to https://www.arm.gov/capabilities/instruments/ to see the entire list of 174 instruments that have been used as part of the ARM program.