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Visualizing the physics of the invisible atmosphere - the role of lidars and radiometers

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In this talk, the "role of physics" is taken to be synonyms with "first-principles" way of looking at the atmospheric structures. The presentation will focus on the role of physics in the development of lidars (and microwave radiometers). A brief discussion of the history of the physics behind these techniques, their atmospheric application and highlights of their use in atmospheric instrumentation will be presented. A major portion of the atmosphere is then dedicated to the application of lidars in bringing out the invisible atmosphere. In the geosciences (specifically meteorology and atmospheric science) – atmospheric water vapor and aerosol concentration are among the key ingredients. Phenomena that one hears about in print and visual daily life media: pollution, cloud development, precipitation, climate change, floods, draught etc are all mainly (or greatly) influenced by water vapor and aerosols that are around us at all times. The concentration of these quantities spans a large dynamic range and humans are privy (visually) only to a very small portion of that range. Visualization of the water vapor concentration and aerosols has opened our eyes to the abundance and structure of these quantities in the atmosphere. Lidars play a principal role in revealing the everyday atmosphere - its dynamic structure and evolution. We will present examples of "every day" atmospheric phenomenon and demonstrate the hidden treasure that lidars reveal. What is the physics behind lidars, what physics controls of the atmosphere do lidars reveal, how can we use them to check numerical models representation of the atmosphere and forecasts? What is the future? These are some of the questions that this talk will discuss.