Research Plan Outline

* Overview
  + Improving the understanding of cloud precipitation processes is essential to characterizing how those processes contribute to deviations from modeled state values
  + LWC and droplet distributions are vital for understanding several essential cloud processes
    - Droplet activation/formation processes
      * Condensational growth
    - Primary precipitation processes
      * Collection/coalescence
        + Highly correlated with droplet size spectra
      * Bergeron
    - Secondary precipitation processes
      * Crystal impact splintering
      * Hallett–Mossop
    - Dynamic processes
      * Entrainment/mixing
* Significance
  + CDP useful for retrieving relevant parameters but large uncertainty values are introduced by…
    - Sample area uncertainty
    - Coincidence error
* Background
  + CDP
    - Lance, 2010
      * Basis for droplet generator setup
      * Found significant CDP retrieval uncertainty due to…
        + Coincidence error

Droplet oversizing

Droplet undercounting

* + - * + Heterogeneous particle counting/sizing within sample area
  + Nevzorov LWC
    - Korolev, 1997
      * Significant baseline drift due to deviations in…
        + Airspeed
        + Pressure
      * Negligible uncertainty due to non-unity collection efficiency in 5-20 um VMD range
    - Strapp, 2003
      * Nevzorov subject to uncertainty due to sensor saturation
        + Incomplete evaporation leads to 30% LWC uncertainty > 50 um MVD
    - Schwarzenboeck, 2009
      * Negligible uncertainty due to non-unity collection efficiency in 20-35 um VMD range
    - COPE data analysis
      * Developed algorithms to minimize uncertainty caused by airspeed/pressure deviations
      * Characterized/confirmed sources of negligible uncertainty
        + Aircraft orientation
        + Unity collection efficiency assumption
        + Fixed latent heat of vaporization assumption
* Objectives
  + Improve LWC/droplet distribution retrieval by characterizing CPD uncertainty sources/instrument limitations using…
    - Nevzorov for independent LWC measure
      * Using improved uncertainty estimation
      * COPE dataset
    - Assist in droplet generator development
    - Better characterize CDP uncertainty employing droplet generator
      * Characterize sample area size
      * Characterize position dependent particle sizing performance
      * Test single point concentration dependent CDP performance (can’t directly test coincidence error)
* Timeline
  + By 2016 fall semester
    - Droplet generator producing drops within acceptable tolerances
    - Completed Nevzorov uncertainty characterization
    - Nevzorov algorithms finalized for in-department use
  + By 2017 spring semester
    - Completion of CDP drop generator data collection
    - Thesis writing in initial stages
  + By mid 2017 spring semester
    - Initial thesis draft complete
  + By end of 2017 spring semester
    - Thesis approved by committee