Synergy between ballooning and satellite missions - validation and instrument development

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Outline

- Balloon measurements are a very valuable part of the development and operation of a satellite mission
 - Pre-launch testing of instruments / observation scenarios
 - Post-launch validation of results and cooperative studies
- How this can be incorporated in future missions...
 - APOCC: Atmospheric Processes of Climate and its Change
 - PHEMOS: Polar Highly Elliptical / Molniya Orbit Science on Polar Communication and Weather (PCW) Mission

Instrument Development and Testing

Ballooning provides access to space for testing of satellite instruments

- For all missions, need a well-tested engineering model
 - To understand instrument and its performance
- For new concepts, flying a proto-type on a balloon can be used to reduce risk
 - Increases technology readiness level TRL
- Also, can fly new instrument with well-characterized instruments to better understand measurement performance
 - Comparing different techniques when measuring simultaneously

Validation of Satellite Measurements

Ballooning provides a complementary view of the atmosphere for validation measurements

- Provides atmospheric profiling capability at float altitude or during ascent
 - Higher vertical resolution than is possible from ground
- Regular flights with well-characterized set of instruments can be used to assess aging process of satellite instruments
- Flying complementary instruments to sample same air mass
 - Investigating differences between techniques

APOCC: Atmospheric Processes of Climate and its Change

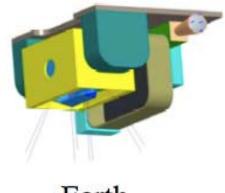
Goal: Missions that will lead to new scientific understanding of atmospheric processes that regulate Earth's climate and thereby lead to reduced uncertainty in climate forecasts

- Six selected in mid-2008 for one-year concept studies
 - STEP Stratosphere-Troposphere Exchange Processes
 - MCAP Mission for Climate and Atmospheric Pollution
 - SOAR Solar Occultation for Atmospheric Research
 - MEOS Miniature Earth Observing Satellite
 - TICFIRE Thin Ice Clouds in a Far IR Experiment
 - SnowSat Clouds, snowfall and light precipitation (EC)
 (four missions build from current satellite mission heritage)

APOCC Example: TICFIRE

Risk mitigation for new instrument - TICFIRE

- Nadir-viewing radiometer operating in FIR
- Focus on polar regions with global view
- Pointing to switch from measurement to calibration views of deep space / blackbody



Earth

- Balloon flight for testing proto-type
 - ~30 kg instrument; 25 km altitude
 - Launch locations: Arctic; mid-latitudes for initial testing?

PHEMOS: Polar Highly Elliptical / Molniya Orbit Science Mission

PHEMOS on Polar Communication and Weather Mission

- Two satellites in one orbital plane to provide continuous GEO-like imagery 50-90 N
- One of three types of instrument payloads for PHEMOS to be complementary to primary meteorological payload
- Atmospheric Remote Sensing instruments to observe chemistry, dynamics and other processes of neutral atmosphere

Proposals for Phase 0 studies (with possible continuation to Phase A) were submitted in February 2010

"Needs" for Satellite Instrument Development and Validation

- Mass: ~10 50 kg for single instrument; up to several hundred kg for multi-instrument (payload-level) testing
- Altitude: stratosphere ~25-35 km
- Location: mobile capability would be advantageous; Arctic capability required for PHEMOS and some APOCC
- **Duration of Flights:** on order of 24(?) hours
- **Schedule:** estimate over next 5 years for pre-launch activities but depends on mission selection timelines
- Funding / International Collaborations: To be developed
- Student Involvement: High potential in these projects to bring students into satellite mission with suitable timeline