Stratospheric Balloons – Serving the Space Industry
Elias Aboutanios
Stratospheric Balloons

• Launch balloons to altitudes of 40km+
• Payload 2,500kg
• Flight duration ranging from hours to days
• Parachute descent, Recover payload
Temperature Profile

Temperature ranges from 25 degrees at sea level to less than -60 degrees at the tropopause.
Air Density Profile

- Air density drops rapidly with altitude
- At 30 km balloon is above 99.9% of the atmosphere
Lift Capacity and balloon size

• 1 m$^3$ of air weighs 1.3 kg at sea level
• To lift 1.3 kg payload requires
  – 1 m$^3$ at sea level
  – 15 m$^3$ at 20 km altitude
  – 330 m$^3$ at 40 km altitude
• 15 kg requires approximately
  – 15 m$^3$ at sea level, radius 1.4 m
  – 225 m$^3$ at 20 km, radius 3.78 m
  – 15,000 m$^3$ at 42 km, radius 15.3 m

This information is courtesy of A/Prof Ravi Sood
Balloon Launches

• Consideration of:
  – Launch location
  – Launch time
  – Flight Duration (and direction)

• Regulatory requirements
  – Light, medium or heavy balloon
  – CASA requirements
  – AirServices Australia
Balloons for Space

• Putting hardware in space is expensive
• Hardware is not recoverable making testing not practical
• Balloons offer a way to test hardware in near space conditions
• Payload experiences temperature variations and near vacuum
• Payload is recoverable using parachute, hence can be inspected
Functionality tests

- Communications links: footprint radius is approximately 500 km
- Power subsystem
- Attitude determination and control (although a slightly different problem)
- Experimental payload testing: e.g. the reflectometry experiment that we have on UNSW-EC0
Stratospheric Balloons

- Launch balloons to altitudes of 35km+
- Carry payload of 2kg
- Flight duration approximately 2 hours
- Parachute descent
- Recover payload
- Two successful missions, one in the planning stage
Skyblue Missions

• Capability-building missions
• Verify launch and recovery systems and procedures
• Altitude reached: 25km
• Mission successful – payload recovered
• Identified a number of areas of improvement:
  – The separation mechanism
  – The recovery systems needed improvements
Skyblue 1
Skyblue 2
High Altitude Balloon Borne SAR

• New project: collaboration with the University of Pisa (Italy)
• NATO funded (approximately $420k), 3 years
• Low-cost
• Rapidly-deployable
Launching from Balloons

- Balloon borne rockets – rockoons
- Dating back to the 50s
- At 20km, rocket is above 99% of the atmosphere
- Reduced drag hence reduced fuel requirements
- Smaller size rocket or larger payload