PROJECT TITLE:	MITTS
PRINCIPAL INVESTIGATOR:	J. McFadden
RAF PROJECT LEADER:	C. Wolff
PROJECT SAFETY OFFICER:	A. Steinbach, B. Kidd, G. Albright
RESEARCH PERIOD:	8/30 – 9/30/2016
LOCATION:	Tampa, FL and Kona, HI

I. PROJECT SPECIFIC FACTORS

A. HAZARDOUS MATERIALS (see attachment for special handling procedures):

- Compressed nitrogen

B. OVER WATER OPERATIONS:

- Yes

C. PENETRATION OF STRONG CONVECTIVE SYSTEMS:

- Not planned, turbulence expected over tops of convection

D. OPERATION UNDER PROBABLE ICING CONDITIONS:

- Possible short encounters

E. HAZARDS ASSOCIATED WITH FOREIGN BASES OF OPERATION:

- None

F. MISCELLANEOUS HAZARDS:

- Diverting of aircraft is possible if threatened by a tropical storm or hurricane

II. GENERAL FACTORS

A. All RAF field deployments will have a designated Project Safety Officer – separate from the Project Manager - to oversee the implementation of these safety guidelines. Any safety related issues that come up during the course of the payload integration or field deployment should be raised directly with that individual. The responsibilities of the PSO are outlined in the UCAR Safety Manual available online.

B. All RAF operations are carried out under applicable OSHA regulations. Any questions regarding general safety procedures or reports on safety concerns should be referred to the RAF Project Manager or the Project Safety Officer. OSHA regulations will be made available upon request.

C. Each deployment will have a designated "Station Chief". Typically this will be either the lead RAF technician or the lead RAF mechanic. That individual will be directly responsible for any safety actions necessary while personnel are actively working on the aircraft at the deployment site. This responsibility will include monitoring local weather conditions and halting ramp activity during a severe weather event.

D. Normal risks involved in working on or near both propeller and jet aircraft. (For example: noise, moving machine parts, blown dust or particles, equipment racks and other floor mounted hardware, etc.)

E. Only members of the flight crew or trained observers necessary to complete the scientific mission may be carried on board.

F. Flying research profiles onboard the RAF aircraft require a certain level of physical fitness – particularly for work around severe weather or for extended durations. Legal limitations prevent RAF from screening potential crew members directly so it is the responsibility of each individual participant to determine their fitness for inclusion in the list of potential onboard observers. A summary of common issues that should be taken into account in your assessment of your fitness is appended to this document.

G. While the aircraft are maintained and operated within rigorous guidelines, all NCAR aircraft are officially designated as "PUBLIC AIRCRAFT" and are not subject to the same certification requirements as civil aircraft. However, the GV is certified to civil standards. Certain life insurance policies have coverage exemptions for flying on non-airline flights. RAF recommends that all flight participants check with your individual insurance companies to see if you are covered. NCAR does maintain blanket liability coverage for all crew members. See the Disclosure Statement for Government Aircraft for details.

H. All ground operations, including the installation, testing and maintenance of scientific equipment, application of electrical power, aircraft maintenance, loading, fueling and aircraft movements will only be conducted by, or under the supervision of qualified RAF personnel.

I. The installations of all user-supplied equipment must be performed in compliance with the aircraft specific RAF Investigator's Handbook. These documents set forth the procedures to be followed in the design, fabrication, and RAF approval of user-supplied equipment to be flown on board an NCAR aircraft.

J. Each group will document the integration and layout of their equipment on the aircraft using the standard "RACK BOOK" forms provided by the RAF.

K. The entire research payload must undergo a complete safety inspection (SAR) by representatives of the three RAF technical support groups (aeronautical engineering,

technicians and mechanics) prior to the first test flight. This inspection must be documented using the RAF "Equipment Installation Form" and be accepted by RAF's Chief Pilot. A copy of this form will be kept, on file, by the RAF Aeronautical Engineer.

L. Once the SAR is completed, the temporary removal of any component from its secured position for maintenance or repair must be documented in the assigned RACK BOOK. 90 minutes prior to any flight, the RACK BOOKs will be examined to determine which if any systems were affected. Those installations must be re-examined for adequate integration prior to proceeding with pre-flight preparations. If any system has not completed this examination by the 90 minute deadline, the flight will be delayed to maintain the inspection timeline.

M. All compressed gas cylinders brought into the facility must be secured when not in use. Individual loose cylinders must be stored in the storage room in the old hangar. Groups of cylinders can be secured as blocks or on pallets in the open hangar. During the installation, removal or exchange of all cylinders on/from one of the aircraft, a safety cap must be in place protecting the valve.

N. The RAF has an extensive sheet metal shop on site at JeffCO. Users are only allowed access to this equipment after they have been judged qualified for its use by the RAF Maintenance staff.

O. Open toed shoes may not be worn on the aircraft during project cabin preparation or research flight operations due to the likely presence of various types of floor mounted hardware.

P. Prior to departing for the field site, all project personnel will receive a "Climate Briefing" from the assigned project leader on possible local weather hazards. Such items as the frequency of severe storms (hail, tornados, etc.), exposure to extreme cold, or the likelihood of extended intervals with high ambient temperatures will be addressed.

Q. There will be no smoking within the RAF facility or within 50 feet of the aircraft on the ramp.

R. All personnel working around the aircraft must familiarize themselves with the location of fire extinguishers within the aircraft and in the vicinity of the aircraft. Consult with an RAF aircraft mechanic.

S. Aircraft fuses or circuit breakers will be replaced or reset only with the consent of qualified RAF personnel.

T. At the completion of each day's activities, all liquids, refuse and litter will be removed from the aircraft and ramp areas.

U. There will be no electrical power left on the aircraft without RAF supervision.

V. Users are not allowed to operate any of the maintenance lifts at JeffCO or during field deployments. An RAF operator will be required to get access to this equipment.

III. FLIGHT PERSONNEL (FLIGHT CREW AND SCIENTIFIC OBSERVERS)

A. The cabin will normally be pressurized to cabin altitudes below 10,000 feet. Research flight operations with cabin pressures above 12,000 feet will not be conducted unless this requirement has been stated at the time of the OFAP request. Specialized training and more restrictive physical requirements for flight crews and observers are needed for such operations.

B. The project manager has the responsibility to ascertain that everyone onboard is familiar with normal and emergency procedures, and the use of the following equipment as pertinent to the flight: oxygen system and masks; the interphone system; emergency exits; and emergency survival equipment. This is accomplished through a pre-flight safety briefing, which must be documented prior to participation in a flight as a crew member.

C. Supplemental emergency oxygen is available for all persons aboard and must be used when the aircraft is operating at cabin altitudes above 10,000 feet.

IV. FLIGHT OPERATIONS

A. All flight operations will be conducted in accordance with Federal Aviation Administration Regulations Part 91 Subpart B.

B. The pilot-in-command is responsible for the safe conduct of all flight operations.

C. Any malfunction in scientific equipment, mechanical or electrical, will be immediately reported to the pilot-in-command. No in-flight repairs will be permitted without permission from the pilot-in-command.

D. No in-flight handling of toxic chemicals or gases, or other hazardous materials, will take place until specifically authorized by the pilot in command. The pilot shall assess the current flight conditions prior to authorizing such activities.

E. Safety belts will be worn by all personnel during taxi, takeoff and landing and at such times as instructed by the flight crew.

F. Research flight profiles often call for low altitude flying. RAF flight operations conform to the minimum altitudes established in the appropriate FAR's (1000 ft AGL except for takeoff and approach). When FAR's are not restrictive (over water missions) or when the restrictions have been waived for specific flights, RAF operations will be permitted to use the following guidelines:

i. Daylight, visual flight rule (VFR) conditions / level legs: 100 feet AGL
ii. Daylight, visual flight rule (VFR) conditions / turning: 300 feet AGL
iii. Nighttime, visual flight rule (VFR) conditions: 500 feet AGL

G. Adequate rest for onboard personnel, both flight crew and scientific observers, is essential to the safe and efficient operations of NCAR aircraft in support of research programs. RAF has established specific crew duty limits as follows:

i. Maximum Crew Duty Period: 14 hours
ii. Any 24-hour period: 10 flight hours
iii. Any consecutive 7 day period: 40 flight hours / 60 duty hours
iv. Any 30 day period: 120 flight hours
v. Consecutive working days: 6 days
vi. Consecutive work days over 10 hours: 2 days
vii. Minimum crew rest period: 12 hours

All scientific observers are strongly encouraged to comply with these limits. Any onboard observers who are deemed to be unfit for flight at the time of the pre-flight briefing will be barred from participating in that particular flight.

H. There will be no smoking on any NCAR aircraft. Smoking is only permitted in designated areas. No smoking is permitted within 50 feet of parked aircraft, or flammable liquid storage points.

I. Whenever an engine or the Auxiliary Power Unit is in operation, hearing protection will be worn near the aircraft. Hearing protection will also be required within the C130 aircraft.

J. In the event of fire, the crewmember observing the fire will warn the other crew members by shouting, “FIRE-FIRE” and reporting the location of the fire. If smoke, fumes or fire are present within the personnel compartment, all occupants regardless of altitude will don pressure demand oxygen masks and select “100% OXYGEN” on his/her respective oxygen regulators. All available means will be used to extinguish the fire. The RAF technician has the primary responsibility for fighting the fire and directing the actions of other personnel.

K. Research electrical power will normally be available at all times. All power changes will be coordinated between the scientific observer and flight crew. Any fuse replacement or circuit breaker reset in the primary power supply system will be performed only by or with the consent of the pilot-in-command.

L. It will be the duty of the scientific crew aboard to properly adjust or secure research and related equipment prior to takeoff and landing. However, it is the responsibility of

the pilot-in-command to specifically check and ascertain that such duties have been satisfactorily completed.

M. The operation of user-supplied research equipment onboard the aircraft will only be permitted under the supervision of, or with the approval of the RAF and the scientist concerned.

V. HAZARDOUS MATERIALS, ENERGIES AND TOXIC GASES

Hazardous materials, non-eye safe lasers, compressed inert gases or toxic gases will not be carried aboard NCAR aircraft without review and permission from the RAF Safety Committee. Applicable Federal and OSHA regulations regarding both onboard and ground support activities will be adhered to in each case. Provisions for dealing with said materials or gases will be defined by the RAF Safety Committee in coordination with the NCAR Safety Office and applicable regulations. All hazards will be declared and listed by each participant on the RAF's Hazardous Materials and Devices Form. (See appendix This form includes a section on special "handling" procedures to be followed in order to limit the dangers associated with the various hazards. A copy of each HMD form will be submitted to the NCAR Office of Safety. The appropriate Material Safety Data Sheets (MSDS) for each chemical hazard will be carried aboard the aircraft.

VI. EMERGENCY EQUIPMENT AND PROTECTIVE CLOTHING

Emergency equipment and protective clothing will be carried aboard NCAR aircraft for the following purposes:

- To cope with air and ground emergencies.
- To sustain crew members' lives in case of forced landings.

Emergency equipment is divided into two categories as listed below. Emergency equipment is considered a part of the aircraft and will not be carried by individual crew members. Scientific crew may carry tools necessary for airborne maintenance and specialized research equipment. Crew judgment is the paramount factor deciding emergency equipment needs.

A. CATEGORY I EQUIPMENT

Category I equipment is a part of the basic aircraft inventory and will be carried aboard NCAR aircraft at all times.

- Fire Extinguishers
- Ax
- First Aid Kit
- Tool Kit- Pliers, screw drivers, wrenches, fuses, tape, allen set and knife
- Flashlight

B. CATEGORY II

Category II equipment is primarily crew survival equipment and will be carried during specialized operations, over water, desert, mountains, arctic areas, etc.

C. CATEGORY II A

Category II A equipment will be aboard NCAR aircraft for all operations conducted over desert and over water beyond gliding distance of land.

- One life preserver for each crew member
- Multiple life rafts to safely carry all crew members
- Water in addition to that carried in the survival kit
- Emergency radio
- Survival kit

D. CATEGORY II B

Category II B equipment will be carried on all flights where operations are to be conducted over mountainous terrain and arctic areas.

- Emergency radio
- Survival kit
- Exposure suits, sleeping bags, or blankets, as appropriate

E. PROTECTIVE CLOTHING

Prior to any deployment, local conditions will be examined to determine whether or not protective clothing will be required appropriate to conditions which may be encountered. This issue will be discussed in the mandatory "Climate Briefing" discussed above. It will be the responsibility of the project manager & the pilot-in-command to ensure that non-NCAR and other aircrew members wear appropriate clothing.

Research Aviation Facility

Medical Information for Airborne Research[1]

The following information should assist you in identifying potential problems that could interfere with your ability to participate in research in NCAR/NSF aircraft. The information contained herein is in no way designed to be comprehensive. If you have any concerns about your ability to fly on NCAR/NSF aircraft, please consult your physician.

There is a possibility that you may be in situations that would require you to take care of yourself including such activities as evacuating the aircraft, dealing with turbulence, opening doors, and wearing an oxygen mask. It is important to identify conditions that may interfere with your performance of such duties. If you feel you cannot perform any duty or feel there may be an issue that could affect any aspect of your participation, do not continue without first consulting your physician.

The following medical conditions and policies could affect your safety and ability to participate in research in NCAR/NSF aircraft. Should you feel that you possess any of the conditions listed below or if you are unable to comply with any of the policies listed, you should NOT participate in NCAR/NSF aircraft at this time.

1. Any medical condition that would not allow you to continuously walk for 10 minutes or up two flights of stairs.

2. Any medical condition that would inhibit your ability to be able to lift 40 pounds.

3. Interruption of your normal activities because of difficulty breathing, conditions such as asthma, or other lung/heart problems that interrupt your normal activities.

4. Ear or sinus problems when flying.

5. Motion sickness when flying.

6. Problems with hearing and speech that would interfere with the ability give and receive instructions in a room with moderate background noise.

7. Taking any medication that gives side effects of drowsiness or difficulty in maintaining alertness.

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[1]1 Prepared with the assistance of Dr. Warren Jensen, FAA Senior Medical Examiner, Director of Aeromedical Research, University of North Dakota.

Medical Information (page 2)

8. Any condition, illnesses or injuries that would interfere with the ability to perform duties on research flights and to evacuate the aircraft if necessary.

9. Any condition, illnesses or injuries that might require the assistance of a RAF crewmember.

10. RAF policy limits flying for 24 hours after immunizations, dental work, and SCUBA diving.

11. Pregnancy beyond the 20th week as well as any other concerns related to the health of a pregnant mother or baby.

12. RAF policy prohibits carrying any person suffering effects from alcohol consumption on a flight, regardless of when it was consumed, and also restricts flight if alcohol has been consumed within 8 hours prior to flight.

13. Symptoms of upset stomach, gas, or diarrhea prior to flight.

Project Name: MITTS

Safety Briefing Attendance

Date: _____ Time: _____

I understand and agree to comply by the RAF safety provisions as described above or as communicated in the formal project safety briefing by RAF flight crew or project managers. I understand that failure to comply with RAF safety provisions may disqualify me from flying on RAF research missions.

Print Name: _____ Date: _____

Signature:_____

Emergency contact information - All personnel must fill out:

Name and phone number of emergency contact / next of kin (several names are ok):

_____

_____

_____

Address(es):

_____

_____

_____

_____

Special notes for contacting the above persons in case of emergency:

_____

_____

_____

Flight Operations Risk Assessment

The risk level matrix is a 3 by 3 matrix assessing the combined effect of the hazard severity and the likelihood of occurrence. The following definitions apply:

Hazard Severity

High (1): Major injury or loss of life, loss of aircraft.
Medium (2): Serious injury, major damage to aircraft.
Low (3): Minor injury, minor damage to aircraft.

Likelihood of Occurrence

High (1): Common or frequent chance of occurrence.
Medium (2): May occasionally occur.
Low (3): Improbable or remote chance of occurrence.

Risk: Hazard Severity × Likelihood of Occurrence

High (1, 2): Must be reduced to at least medium risk level
Medium (3, 4): Either mitigation required to reduce level to low or organizational decision to accept risk level.
Low (6, 9): No additional mitigation required.

The risk ranking matrix is then given by:

Risk Ranking Matrix (Severity × Likelihood)		**Hazard Severity**		
		High (1)	Medium (2)	Low (3)
Likelihood of Occurrence	High (1)	High (1)	High (2)	Medium (3)
	Medium (2)	High (2)	Medium (4)	Low(6)
	Low (3)	Medium (3)	Low (6)	Low (9)

Based on the above criteria, the hazard severity, likelihood of occurrence, and general risk level (ranking) are shown in the following table for each identified hazard.

Hazard	Severity	Likelihood	Risk Level
Hail	2	3	6
Graupel/frozen drops/large drops	3	2	6
High altitude turbulence/wind shear	3	1	3
Low altitude turbulence/wind shear	3	2	6
Lightning	2	2	4
Icing	2	3	6

HAZARD DESCRIPTION:	Hail
RISK LEVEL:	6

HAZARD/EFECT: Flight into hail can cause serious airframe and/or engine damage.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.

C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category.

C3 – Areas where the risk is high and scientific operations will not be planned.

MITIGATION PROCEDURES:

1. Aircraft airborne radar must be operable for flight into known or forecast IMC conditions.
2. The airborne radar will be periodically scanned up and down (+ 2º) when in the vicinity of convective weather and along the track to detect hail falling from above.
3. Planned flight tracks must take into account radar attenuation. Operations through or around any radar return must consider that intense echoes may lie behind it and may be undetected. Deviate around the return to accurately orient aircraft operations prior to penetrating the echo.
4. Use an incremental approach when approaching potentially hazardous weather. Start sampling at a conservative distance from the return and gradually decrease the distance to the return until the scientific goals are met or the pilot in command decides to terminate the maneuver.
5. When operating in the vicinity of convective weather the use of an airborne mission coordinator with the appropriate ground support is highly recommended.

HAIL OPERATING THRESHOLDS:

C1. No overhead cloud cover, good visibility and farther than 20 NM from any level 2 echo.

C1. Operations permitted no closer than 10 NM on the upwind side and on the upshear side (judged by visual appearance) of level 2 echoes when in good visibility with no cloud cover above the flight track.

C2. Caution is advised when penetrating within 2,000'of the visual tops of modestly rising cells of any echo intensity when the cell is isolated or the larger storm intensity is everywhere less than level 3.

C2. Flight within 30 NM downwind/downshear of any level 3 echo may encounter hail. Proceed with caution.

C3. Flight should be avoided within 5NM of any level 3 echo on the airborne radar.

C3. Flight should be avoided within 10 NM of any level 3 echo on the downwind/downshear side of the echo.

HAZARD DESCRIPTION:	Graupel/frozen drops/large drops
RISK LEVEL:	6

HAZARD/EFFECT: Flight into graupel, frozen drops, and large drops can erode the aircraft radome, leading edges, engine inlets, and can damage exterior airframe paint.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.

C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category.

C3 – Areas where the risk is high and scientific operations will not be planned.

MITIGATION PROCEDURES:

1. The damage to aircraft is cumulative process; i.e. a few graupel particles or frozen raindrops are not a significant cause for damage. However, extensive regions are to be avoided.
2. High-density graupel may occur frequently in and below continental cumulus (moderate to thunderstorm size), below cumulus at temperatures colder than +5 deg C.
3. High-density graupel and frozen drops may occur in the upper parts of the tropical cumulus; the cores of these should be avoided.

GRAUPEL/FROZEN DROPS/LARGE DROPS OPERATING THRESHOLDS:

C1. Regions with low radar reflectivity (level 1 and below)

C2. Cumulus cores and outflow regions from cumulus clouds with high radar reflectivity (above level 1) and warmer than -5 deg C as these regions may contain either snow/aggregates or the more damaging graupel and frozen drops.

C3. Cellular tropical clouds with cloud top temperature colder than -5 deg C (generally 25,000 ft or more) and reflectivity above level 1.

HAZARD DESCRIPTION:	High altitude turbulence/wind shear
RISK LEVEL:	3

HAZARD/EFFECT: Turbulence can cause severe damage to the aircraft and/or major injury to personnel on board. Rapidly changing airspeed may cause the aircraft to dangerously approach its' stall speed with subsequent departure of controlled flight.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.

C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category.

C3 – Areas where the risk is high and scientific operations will not be planned.

MITIGATION PROCEDURES:

1. While flying at altitude, the PIC will assure that at least Vref +10 knots be maintained. If turbulence is experienced that eradicates this margin, the need to descend will be required to regain safe airspeed margins. Pilot discretion will be the deciding factor.
2. Air and science crew must be seated with seat belts fastened when turbulence is anticipated. Exceptions must be approved by the pilot in command.
3. Crew will use all tools available (SIGMETS, GTG for CONUS, location of (110K) jet-streams, and any other forecast products available through the mission coordinator).
4. Aircraft Flight Manual guidance will be used when operating in areas of forecast or reported turbulence.

HIGH ALTITUDE TURBULENCE/WINDSHEAR THRESHOLDS:

C1. No SIGMET for turbulence or convection, GTG product showing less than severe for altitude within 3,000 ft of flight level, greater than 150 NM from jet-stream winds exceeding 110 kts, or greater than 20 NM from deep convective towers.

C2. Flight within 150 NM of jet-stream winds exceeding 110 kts if there is no SIGMET in effect for turbulence or convection and GTG forecast is moderate or less at +/- 3,000 ft of altitude.

C2. Use AFM turbulence penetration guidance/speeds when there is a SIGMET for turbulence in effect but GPG is moderate or less at +/- 3,000 ft of altitude.

C3. Flight should not be planned within a region where a turbulence SIGMET is in effect and GPG forecast is for severe or extreme turbulence at +/- 3,000 ft of altitude.

HAZARD DESCRIPTION:	Low altitude turbulence/wind shear
RISK LEVEL:	6

HAZARD/EFFECT: Encountering moderate to severe turbulence/wind shear can deteriorate aircraft performance rapidly and consequently cause major injury, loss of life, and loss of aircraft.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.

C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category. There can be some variation in these thresholds depending on flight operations location in the mid-latitudes or tropics

C3 – Areas where the risk is high and scientific operations will not be planned

MITIGATION PROCEDURES:

1. NCAR aircraft flight manual wind shear avoidance and escape procedures will be followed when required.
2. Visual confirmation of wet/dry microburst events (rain shafts with rapid horizontal spreading/blowing dust near the ground) and avoid these areas.
3. Visual confirmation of low level turbulence using cloud structure (e.g. arcus clouds, shelf clouds), blowing dust and avoid these areas
4. Information from cockpit weather avoidance radar (spectrum width) suggesting turbulence and avoid these areas.
5. Pilots will use all available sources to include PIREPS, forecasts, ATC and on-board INS wind indications.
6. Air and science crew must be seated with seat belts fastened when turbulence is anticipated (seat belt sign illuminated).
7. If scientific personnel must be up and moving about the PIC will direct a climb out of the turbulence prior to the seatbelt sign being turned off.

LOW ALTITUDE TURBULENCE/WINDSHEAR OPERATING THRESHOLDS:

C1. Low altitude turbulence, up to and including forecast or reported/observed moderate, not associated with convective action (thermals, winds, etc.) is permitted above 1,000 AGL or on approach to an airfield as long as the above mitigation procedures are in effect.

C1. Overwater night time operations down to 500 ft AGL are permitted only in areas outside of cloud regions or turbulence.

C1. Operations are permitted no closer than 5 NM from low level cloud structure, precipitation shafts and blowing dust reported visually as described above

C2. Caution is advised for low level flight <1000 ft AGL and should be avoided when turbulence or wind shear reports are received or visual clues are present within 5 NM.

C2. Operations beneath/near convective clouds should be approached with care, and avoided if cellular cloud tops exceed 25000 ft. If operations are unavoidable ensure a clear escape route is present prior to continuing flight operations.

C2. Proceed with caution anytime INS winds shift more than 30 degrees or wind velocity changes by more than 15 knots.

C2. Caution is advised when operating in strong wind/turbulence conditions, hurricanes,

extreme cold air outbreaks, and low level jets.

C2. NCAR will exercise caution when operating in close proximity to thunderstorm gust fronts. Recommended operational altitude is 1,500 ft AGL min.

C3. Low altitude flight operations (<1000 AGL) should be avoided in the vicinity of forecast, observed or reported severe turbulence or known wind shear

C3. Low altitude flight operations (<1000ft AGL) should be avoided in the vicinity of squall lines (level 3 echo or cloud tops >25000

HAZARD DESCRIPTION:	Lightning
RISK LEVEL:	4

HAZARD/EFFECT: An aircraft lightning strike can cause serious damage to onboard equipment and the airframe.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.
C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category.
C3 – Areas where the risk is high and scientific operations will not be planned.

MITIGATION PROCEDURES:

1. Aircraft airborne radar must be operable for flight into known or forecast convective weather.
2. A working onboard lightning detection system, working field mill or cockpit access to the National Lightning Detection System (NLDN) is recommended.
3. When operating in the vicinity of convective weather the use of an airborne mission coordinator with the appropriate ground support is highly recommended.

LIGHTNING OPERATING THRESHOLDS:

C1. Sampling of cloud regions that meet other risk criteria and are at least 15NM from active regions of the thunderstorms as determined by level three returns on the airborne radar is allowed.

C2. Sampling 5 to 15NM distance from active regions of thunderstorms may be allowed provided other risk criteria are met and the above mitigation procedures are available.

C2. With the onboard lightning detection system, aircraft will not get closer than 8NM to the point indicated by a lightning symbol on the onboard display. Additionally, aircraft will maneuver to avoid headings toward areas of “horizontal lightning” (lightning identified but not ranged by the system).

C2. With operable electric field mills installed and with the above mitigation procedures the aircraft may approach within 5NM of points indicated by lightning symbols, but will depart areas when the electric field exceeds 10 kV/m or when electrical discharges are noted in the field mill signature.

C3. Sampling within 5NM to regions of active lightning or sampling in regions that exhibit strong electric fields is not recommended.

C3 Sampling in regions near active lightning when reflectivities above, below or along the flight track are in excess of level 2.

C3. Sampling within 15NM to an active thunderstorm is discouraged without an operable onboard lightning detection system or without access to the NLDN.

MITTS PROJECT SAFETY DOCUMENT

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HAZARD DESCRIPTION:	Icing
RISK LEVEL:	6

HAZARD/EFFECT: Ice formation on an aircraft disrupts the flow of air over the airfoil increasing weight and stall speed. The accumulation of ice on exterior movable surfaces also affects the control of the aircraft. Another significant hazard comes from ice accumulation on propellers resulting in disastrous vibrations. Ice can also form in an engine's intake, disrupting air flow needed to support combustion, or ice may break off and be ingested into the engine causing foreign object damage (FOD). Finally, ice formation on exterior pods will significantly degrade the collection of scientific data. The above can cause an aircraft stall/loss of control; sever engine damage and, in the worst case, loss of life/injury.

GUIDELINES: Operational guidelines/thresholds are divided into three categories

C1 - Areas where risk is relatively low operations are permitted.

C2 – Areas where risk is moderate and operations must proceed carefully in a phased manner to allow incremental risk assessment for each phase. Aircrew experience and judgment will play a predominate role in this category.

C3 – Areas where the risk is high and scientific operations will not be planned.

MINIMIZING PROCEDURES:

1. All onboard anti/deicing systems will be operable and will be turned on prior to entering icing conditions if able.
2. Crew will maintain constant vigilance when flying in potential icing conditions and will be alert for vibrations, buffet, changes in attitude or heading characteristics.
3. At all times air crew will follow applicable Aircraft Flight Manual guidance/procedures for flying in icing conditions.
4. Use all forecasting tools available for a particular region (SIGMETS, icing forecast maps, PIREPS, soundings, and synoptic charts).
5. Ensure adequate preflight planning is accomplished. Review icing prerequisites and conditions where the flight is planned. Get a specialized briefing from available meteorological personnel who are involved with the project.
6. Measure and survey cloud conditions using information from both the aircraft and the research data systems so that an estimate of the degree of risk can be determined.
7. Pilots will be familiar with procedures to identify super cooled large droplets and will maintain a visual watch to ensure ice is not forming on unprotected surfaces. If ice is accumulating with the onboard systems on and functional the aircraft will depart icing conditions.

ICING OPERATING THRESHOLDS:

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C1. Flight risks are relatively low and operations are permitted when in clear air.
C1. Cloud penetration is generally permitted provided that the OAT is not between -5 and - 20º C.
C2. Use caution when operating in areas of forecast/reported light or moderate icing. When operating in this environment reduce exposure as much as possible by limiting initial cloud penetration to ascents and descents or limiting time of exposure
C2. When operating in forecast/known icing a pre-encounter escape route will be identified.
C3. Cloud penetrations should not be planned or accomplished in regions where forecasts and/or PIREPS indicate severe icing**.**
C3. Research flights should not be planned where ground anti/deicing is required as the scientific instrumentation can be badly affected by de-icing fluids.
C3. Cloud sampling will be terminated when severe conditions are encountered or onboard systems will no longer keep surfaces clear