Paths to Rocket Piloting

Intro for panel discussion
presented by Ian Kluft
Space Access 2008 Conference
Phoenix, Arizona
March 27-29, 2008

Where can you see the curvature of the Earth?

- How high do you have to go?
- It's a common question
- Answer: minimum 60,000', the higher the better
- Does not require space flight
- First seen from stratospheric balloons in 1920's
- Concorde flew at that altitude
- Military jets fly above that

That's where the dream begins, right?

Commercial astronaut wings First awarded in 2004

Photo by FAA

FAA AST awards first commercial astronaut wings to Mike Melvill, June 21, 2004

Commercial space flight piloting

- In US airspace...
  - Since 2005, there are Federal Aviation Regulations which apply to Commercial reusable launch vehicle (RLV) pilots or remote operators
  - An RLV launches and re-enters using the same National Airspace System as airplanes
- Pilot training for spacecraft can currently only be obtained in aircraft

FAA spaceflight pilot requirements

- Relevant rules are in 14 CFR (FAR) Part 460 “Human Space Flight Requirements”
- Pilot requirements including remote operators:
  - FAA pilot certificate with instrument rating (legal minimum is private pilot with instrument)
  - FAA second class medical certificate or better
  - Knowledge and experience to fly your RLV
  - FAA does not require a commercial pilot license *but the spacecraft manufacturer can require it*

Why learn to fly an airplane first?

- Some have questioned why an RLV pilot needs to learn to fly an airplane (or other aircraft) first
- One big reason: situational awareness for atmospheric phases of flight
- Experience working with Air Traffic Control
  Don't think like “us vs. them”
  They offer a service – learn to use it
- You'll get a far greater quantity of flight experience than available in space operations alone, even by high expectations of NewSpace industry flight rates

Passing through Class A airspace

- An instrument rating was already required to fly in Class A airspace (18,000' – 60,000' altitude)
- FAA made no exception for space flights
- Launch and re-entry must go through Class A
- Therefore regulations say spacecraft pilots must be at least a Private Pilot with an instrument rating

Becoming a civilian astronaut

- Only two pilots have done this so far: Mike Melvill and Brian Binnie of Scaled Composites
- FAA AST was thrilled to grant astronaut wings
- In order to fly an RLV, you'll need to join a company who has plans to build or fly them
- official definition of space is 100km / 62 miles
- FAA astronaut wings are only for pilots, minimum altitude 50 miles
- Space tourism operators will make certificates for ~~passengers~~ “space flight participants”

Unmanned Aerial Vehicle piloting

- FAA regulates Unmanned Aircraft Systems (UAS)
- Also known as Unmanned Aerial Vehicles (UAV)
- Requires FAA design review, except for models
- Must be controlled by appropriately licensed pilot
- To fly in Class A airspace, need instrument rating
- UAS registration may be an alternative to Temporary Flight Restrictions (TFRs) which close airports for current unmanned rocket launches
- We can't close the airport under orders from DC for every flight if we want commercial flight rates!

Pursuing the dream
Become a pilot first

- To start on your pilot license, find a certified flight instructor (CFI) at any general aviation (GA) airport near where you live
- Introductory flights are available at most GA airports
- Get a pilot log book before any flight with an instructor – have them log it as instruction time
- Expect cost $8000+ in metro areas for Private Pilot
- More ratings = more $$$
- There is currently a pilot shortage in aviation ...but obviously not in NewSpace

Pursuing the dream
Piloting a rocket in the atmosphere

- Civilian piloted rockets so far
  - Rocket-boosted R/C gliders at high-power rocketry hobby launches everywhere
  - XCOR EZ-Rocket
  - Scaled Composites SpaceShipOne atmospheric tests
  - Armadillo Aerospace (remote operated)
  - XCOR X-Racer
- Rocket Racing League will fly XCOR X-Racers
- Spacecraft in development are tested in the atmosphere first

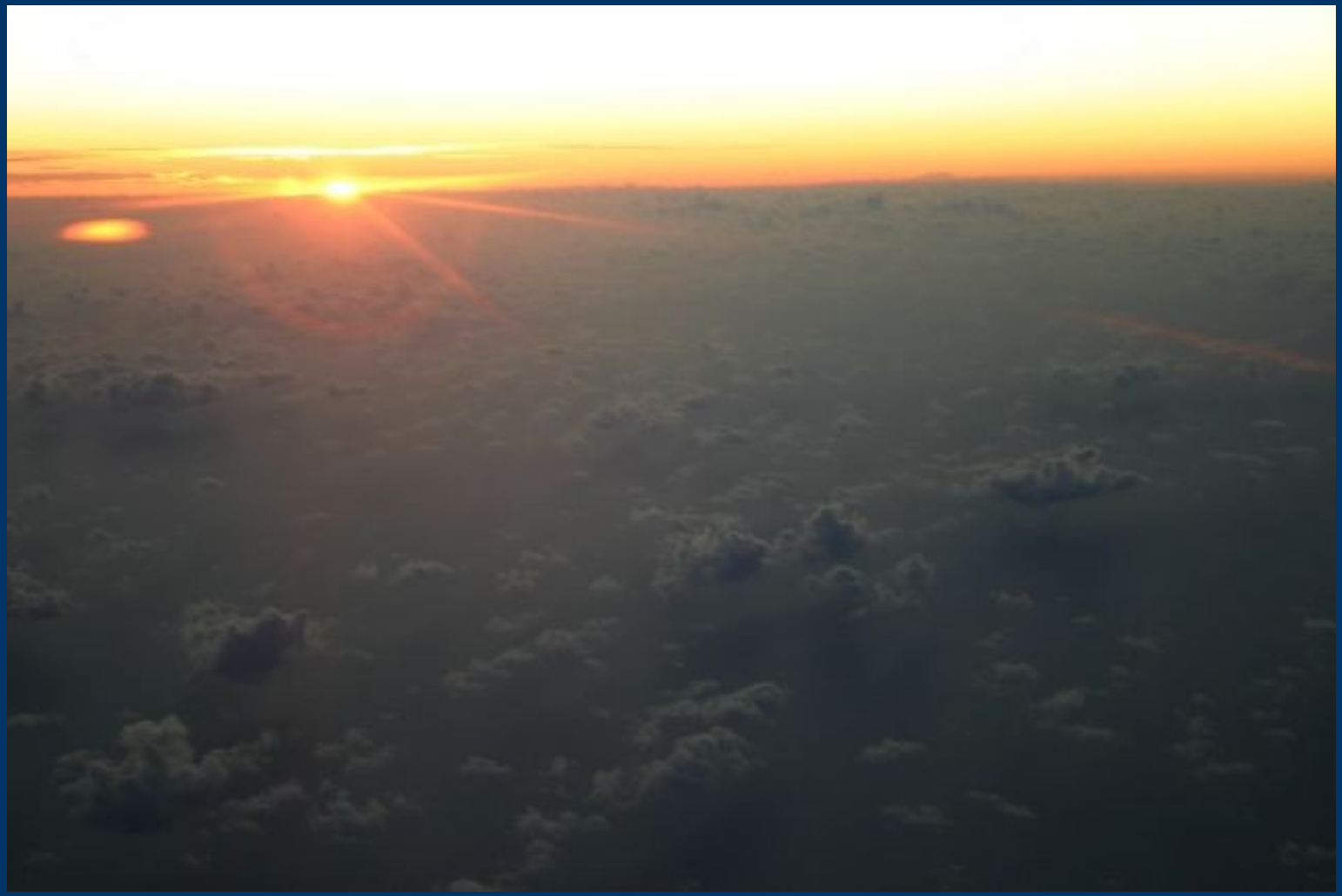
Pursuing the dream
Community of NewSpace Pilots

- In other topics, NewSpace industry players have banded together to help each other at times when it isn't necessary to compete
- This industry has shown surprising examples of generous help
- Pilots who have a common interest to fly the NewSpace industry's spacecraft can help each other pursue the dream
- Let's set up an ongoing discussion forum

Pursuing the dream
What's coming for the industry?

- Near term
  - Suborbital space tourism
  - Limited pilot opportunities
- Medium term
  - Suborbital point-to-point freight and passengers
  - Rapidly increasing demand for trained pilots
- After that?
  - Next obvious step is orbital
  - Current commercial launches are not piloted
  - No time frame yet on piloted commercial orbital
  - Probably will continue to increase demand for pilots

Begin panel discussion



Sunset viewed from 40,000' over the South Pacific near New Caledonia
as high a view as most of us can get today

Extra slides for Q&A

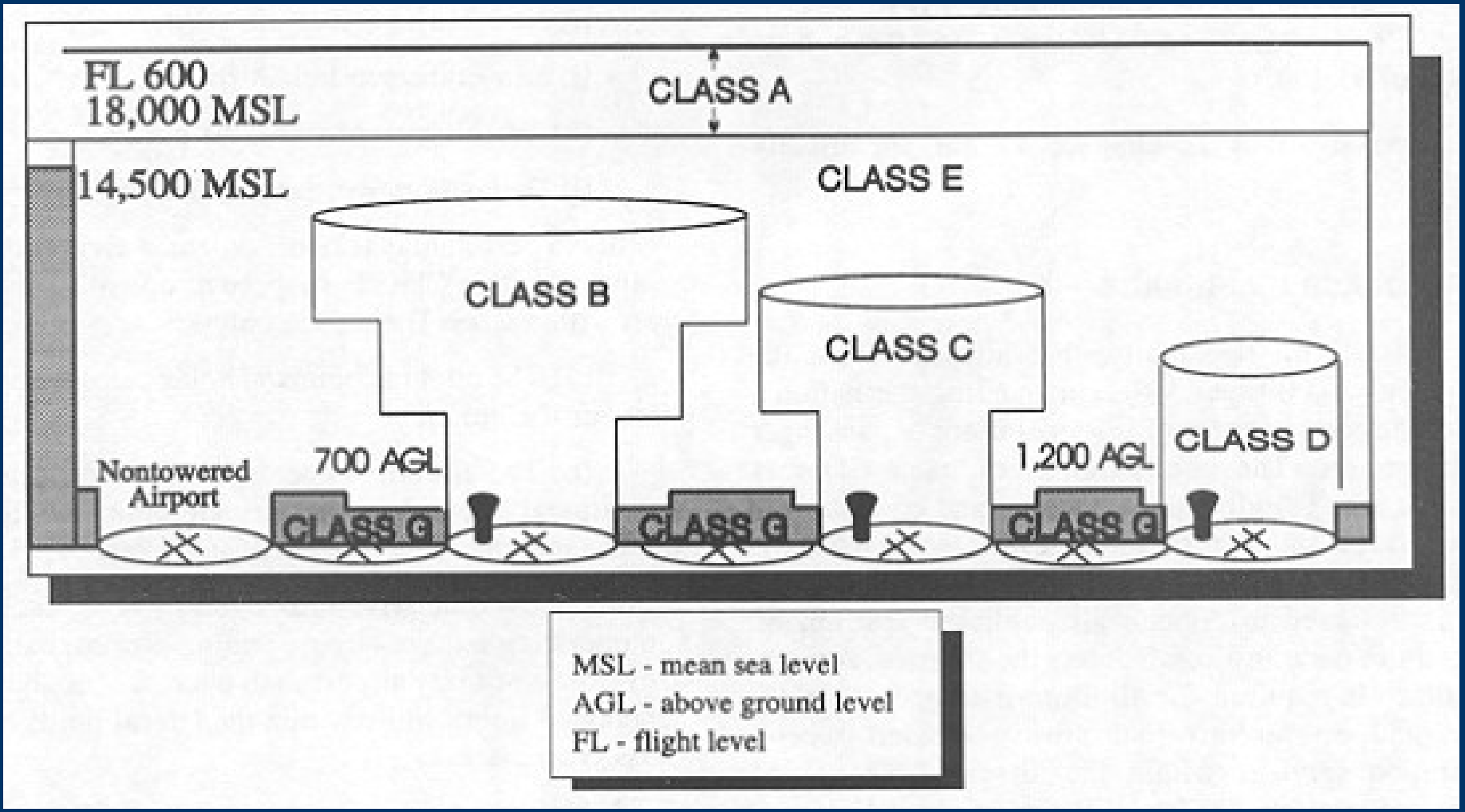
Five levels of US pilot licenses

- **Sport Pilot** (introduced 2004)
  light-sport and ultralight aircraft
- **Recreational Pilot** (introduced 1989)
  fly in rural areas, only where ATC not required
- **Private Pilot**
  access to all public airspace, not for profit
- **Commercial Pilot**
  carry passengers & freight for hire
- **Airline Transport Pilot (ATP)**
  scheduled passenger flights

Classes of Airspace in the US

- **Class A** – “above it all”
  18,000'-60,000' - Instrument Flight Rules only
- **Class B** – busiest airports
  entry requires clearance
- **Class C** – congested airports
  entry requires 2-way communications with ATC
- **Class D** – dialog required with tower
  any other tower-controlled airport
- **Class E** – “everywhere else” controlled airspace
- **No Class F in the US**
- **Class G** - “go!”, uncontrolled airspace

Classes of Airspace in the US



FAA diagram of US airspace classes

Private Pilot

- Responsibilities/Training
  - Operation of the aircraft
  - Navigation and flight planning
  - Communication with Air Traffic Control
- Privileges
  - Carry passengers
- Restrictions
  - Not allowed to make money from flying

Instrument Rating

- Responsibilities/Training
  - Flight and navigation by instruments only
  - More communications with ATC
  - Follow published approach/departure procedures
- Privileges
  - Fly under Instrument Flight Rules
  - Fly in clouds and weather below VFR minimums
  - Fly in Class A airspace, 18,000' – 60,000'
- Restrictions
  - Weather minimums still affect takeoff, landing, icing

Commercial Pilot

- Responsibilities/Training
  - Knowledge of aircraft systems
  - Performance maneuvers
- Privileges
  - May carry passengers and freight for hire
  - Some services can be offered directly/alone
    - instruction, ferry flights, banner towing, crop dusting
- Restrictions
  - May not make scheduled passenger flights
  - Pilot may work for a commercial operator but the license alone doesn't let you be a commercial operator

Pursuing the dream
Private Pilot training

- Start with aircraft controls and airport operations
- Instructor signs you off for solo flight
- Then you learn about navigation
- Instructor signs you off for solo non-local (“cross country”) flights
- Then you'll learn flight maneuvers which help you master the control of the aircraft
- You'll also learn a little about instrument flight
- Instructor signs you off for the FAA “check ride”

Pursuing the dream
Private Pilot requirements

- Before your check ride, you'll need...
  - 40 hours total flight time
  - 20 hours with an instructor
  - 20 hours solo flight
  - And lots of other requirements which mean it'll take more than 40 hours unless you have a lot of unlogged practice time
  - 60-70 hours or more is normal

Pursuing the dream
Advanced ratings

- It's all in 14 CFR (FAR) Part 61
- Instrument rating
  - 50 hours “cross country” flight (flights of 50nm+)
  - 40 hours simulated or actual instrument time
  - Training should start in a “flight training device”
- Commercial Pilot/single engine
  - 250 hours total time
  - Various flight requirements including a 300nm flight
- Commercial Pilot/multi engine
- Commercial Pilot/glider
  - SpaceShipOne was an experimental glider

Pursuing the dream
Accelerated flight training

- Every stage of the training is available somewhere as an (intense) accelerated program
  - Private Pilot in ~4 weeks
  - Instrument rating in ~2 weeks
  - Commercial Pilot in ~1 week
  - Multi-engine rating in 3 days
  - One school has sidewalk to airline interview in 90 days
- Written exams need to be done before starting
- You can forget anything as fast as you learn it
- Make sure you'll have time afterward to practice and reinforce what you learned