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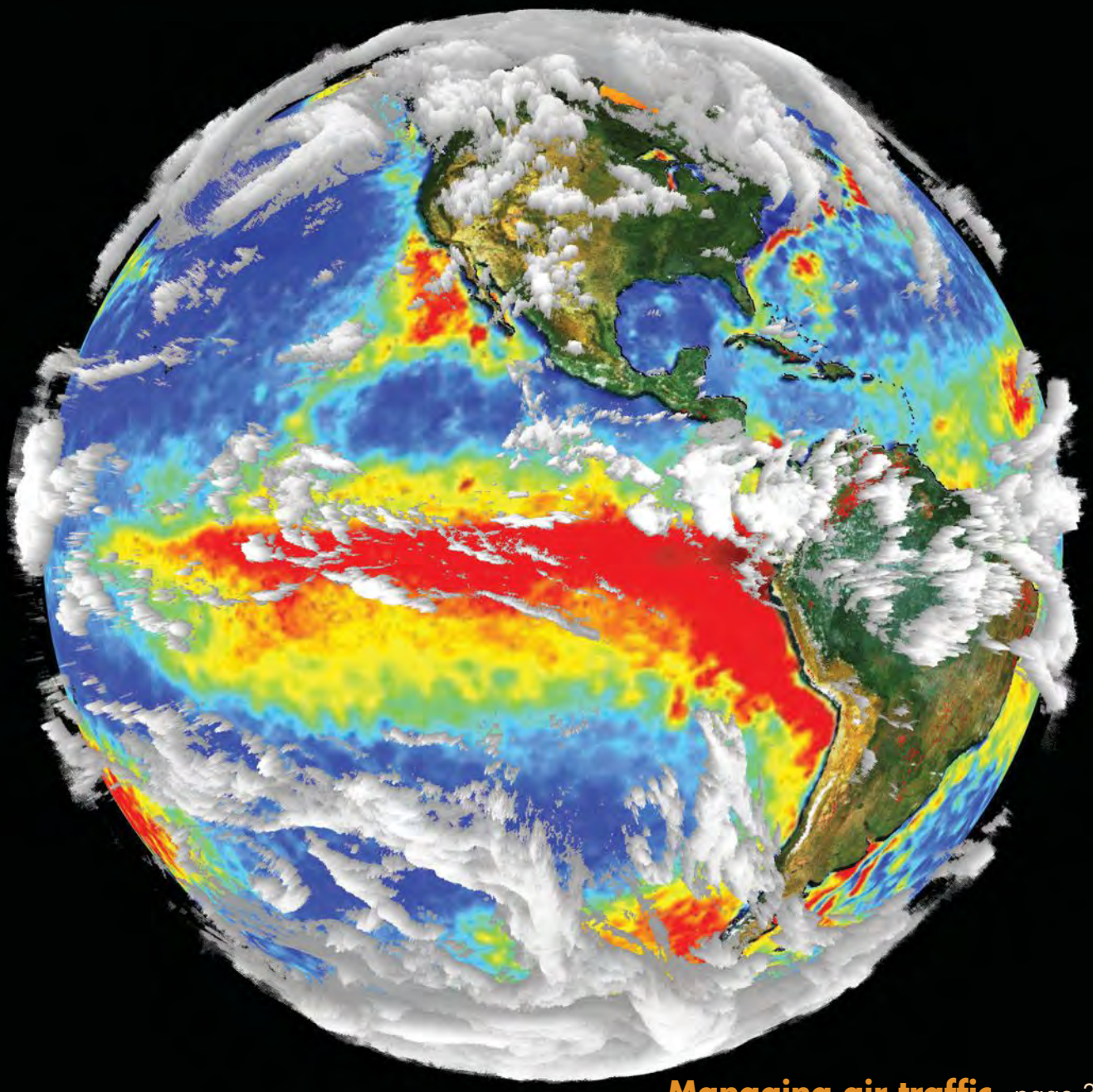

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Grading "Gravity"

Hollywood got a lot right in the blockbuster "Gravity," which in March will vie for 10 Academy Awards. There are spectacular scenes of Earth, intricate spacesuit details, and lots of can-do attitude. But, alas, it seems as if the film's main character, Dr. Ryan Stone, might have skipped a few classes in astronaut training. Veteran spacewalker Tom Jones explains.

"Gravity," the dazzling space thriller from Golden Globe-winning director Alfonso Cuarón, centers on the fate of a star-crossed astronaut whose mission to repair the Hubble telescope takes what I will call a dramatic turn.

Sandra Bullock as Dr. Ryan Stone and co-star George Clooney as veteran shuttle commander Matt Kowalski gamely hang on for a Mach-25 adventure whose tensions are made even more believable by superb technical execution and eye-popping production values.

The film's photorealistic depiction of space—astronauts, spacecraft, Earth, cosmos—was so well done that one can be forgiven for suspecting the filmmakers shot their story "on location." And despite some shocking plot twists, I was eager to have my wife watch with me, so she could get a better sense of the stunning vistas astronauts experience in orbit. The film digitally imitates the best views from the ISS and shuttle in recreating achingly beautiful impressions of Earth from space.

Although we can't see stars above Earth's daylit hemisphere, and a few orbits could never encompass the array of stunning sights compressed into this film, Clooney's veteran astronaut strikes the right tone of reverent awe when he tells Bullock, "You should see the sunlight on the Ganges." These views alone will have you slapping your money down for a future tourist ticket off the planet.

"Gravity" does deserve to rake in a constellation of production, special effects and sound awards—I went to see it three times. Yet to serve its fast-moving plot, the film doesn't hesitate to finesse some inconvenient realities of spaceflight and physics. We learn early on that Bullock's Dr. Stone got just six months of astronaut training; here are some lessons she missed (*Spoiler alert—plot elements are discussed below.*):

Space junk facts

Kicking off the film's survival challenges is a shuttle crew's deadly encounter with space junk. Astronauts certainly worry about this hazard, which on long missions ranks right up there with launch and landing risks. As we operated the space radar lab on shuttle Endeavour in 1994, we spotted a BB-sized crater in the outer pane of the side hatch window, which was not an uncommon shuttle experience. In 2001, the U.S. Destiny Lab that I helped install at the ISS was armored with Kevlar and metal shielding to break up and absorb hits from micrometeoroids and orbital debris.

Space debris doesn't travel in killer swarms as it does in the movie, and when junk does come, it's closing so fast—several thousand miles per hour—that the human eye would never spot its approach. It would be like trying to catch a glimpse of a rifle bullet coming at you—it either hits you or it doesn't. The good news: Softball-sized and larger pieces are tracked on ground radar, usually giving the ISS time to maneuver away from a worrisome "conjunction."

Although terrifying to watch, the film's anti-satellite-initiated debris shower could never cause the cascading chain of disasters confronting the movie's astronauts. Space is big—and it's achingly empty. Debris might destroy a single spacecraft, but could not plausibly take out both low- and geostationary-Earth-orbit comsats in rapid succession. The dangers of space junk are real, but the film's setup is over the top.

Formula One maneuvering unit

George Clooney's Matt Kowalski flies an Indy 500 version of the 1980s Manned Maneuvering Unit, the MMU. Kowalski is a virtuoso MMU jockey, nonchalantly pirouetting and swooping within a few feet of his orbiter, its robot arm and the Hubble Space Telescope. But he forgot to read the ops limitations, particularly those describing the negative effects of thruster exhaust on the Hubble's delicate optical surfaces and sensors. Clooney earns a ticket for reckless driving.

Photo credits: Warner Bros.

His MMU also has a nearly inexhaustible fuel supply. Kowalski uses the extra juice to capture the tumbling Stone, then chase down the space station (which the writers have conveniently placed in the same orbit as Hubble). The real MMU's total delta-V—its ability to change velocity—was just 80 feet per second, barely enough for sedate fly-arounds of the shuttle. This MMU version is a complete invention, but hey, it's a movie, not a documentary on historic space hardware.

EVA emergencies

To survive, Bullock's Dr. Stone must conduct three separate extravehicular activities, or EVAs. The spacewalk visuals are truly impressive, even to my experienced eye: Tools, tethers and suit exteriors are crisply rendered in nearly every respect. I found myself leaning forward, staring at the screen, trying to wring every last detail out of the 3D EVA scenes so reminiscent of my own experiences. Director Cuarón's team members did their homework well.

Every astronaut I watched the film with was amused, though, at some startling EVA exaggerations. One exuberant spacewalker flings himself, spread-eagled, out to the end of his tether; any real astronaut violating flight rules so blatantly would be enjoying his last EVA. Bullock and Clooney survive some high-impact EVA collisions: with each other, with the shuttle, with ISS structure, and with a disintegrating Chinese space station. Real spacesuits are not nearly so bullet proof, and the first of these EVA smack-downs would likely have ruptured both pressure suits. But that would have made for a much shorter movie.

Perhaps the most laughable latitude taken in the film is the ease with which Bullock's astronaut doffs her spacesuit in the ISS airlock. Near suffocation, she executes a few quick clicks, twists and wriggles, and off come her helmet, gloves, trousers and suit upper torso. A butterfly exiting her cocoon, Bullock is wearing not long-johns, wool socks, and a liquid cooling and ventilation garment—her flattering tank top and skin-tight volleyball shorts could not possibly conceal a spacewalker's diaper. One detail that's spot on target is Bullock's obvious physical fitness, a generous recognition of the high athleticism required of EVA crews.

Flying your fire extinguisher

The movie's special effects excel in depicting the free-fall behavior of shuttle orbiters, EVA tethers and equipment, station hardware, and even astronauts adrift. I'm told the film's creators built Sir Isaac Newton's equations of motion right into the graphics software, predicting the trajectories of any weightless objects in view. But to heighten tension and hurry the survival story along, the filmmakers toggled a figurative ON-OFF switch to shunt that nettlesome Sir Isaac aside when necessary.

Hence we get the Hubble, ISS, and a fictional Chinese space station all cruising the same orbit like so many cosmic beads on a string. We watch Clooney's "Lieutenant Commander" Kowalski (a curiously low pay grade for a shuttle commander) hanging precariously at the end of a taut tether when his surroundings are all in free fall—purely to pump up the drama. And we watch novice astronaut Bullock expertly pilot her Soyuz to a station rendezvous using nothing more than her own eyes and a generous lick of what sharpshooters like to call Kentucky windage. With Sir Isaac's rules operative, she would have blasted herself into a higher, slower orbit, watching helplessly as her Chinese target inexorably pulled away.

Bullock's best MacGyver moment comes when she grips the handle of a salvaged ISS fire extinguisher. Wielding it so it always exhausts on a line between her center of gravity and the Chinese station, she manages a brute-force rendezvous; her tough-as-nails Russian spacesuit survives bone-jarring impacts and collisions with pointy antennas long enough to get her aboard. Even as aerodynamic forces shake and start to shred the reentering station, Stone slips off those draggy forces and secures one last shot at getting home. Bravissima!

Major malfunctions

The film blithely takes another dozen or so technical shortcuts, making for a lively post-screening debrief, best conducted over a beer. Yet despite the exaggerations, the core of the story rings true: space is a hostile, unforgiving environment, and humans must pay extraordinary attention to detail to work and survive there.

All of our shuttle orbit simulations, or sims, had us crewmembers thumbing through our yellow emergency checklists and the well-worn volumes of the "Mal" book, the malfunction response bible for astronauts and Mission Control. "Gravity" easily qualifies as the sim from hell: It assaults its protagonists with every deadly emergency a space traveler could conceivably face: collision, decompression, hypoxia, fire, toxic gases and broken tethers. Not even the most diabolical of our simulator instructors would put together such a no-win scenario; there was little training value in what we called "practicing dying." But such an avalanche of disasters makes for a ripping good survival tale. Bullock hardly gathers her wits from one catastrophe before another rears its head.

Jerked along like a child's balloon behind the unflappable Kowalski, Bullock's character justifiably complains, "I hate space." But she never gives up, never submits to the remorseless power of a cold, indifferent cosmos. Technically implausible at times, "Gravity" is a winning tale, an uplifting lesson for astronaut and Earthling alike.

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Tom Jones flew on the shuttle four times, led three spacewalks to help build the International Space Station and attended most of his astronaut candidate classes.