# Prep and Landing
## Christmas in July:  The Effects Snow Process

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figure 1:(a) Snow Globe     (b) Gentle Snow          (c) Snow Interaction          (d) Painted Ski Tracks          (e) gpuFX Snow

## 1. Introduction

**Prep and Landing** had some variant of snowfall in a large number of shots - ranging from gentle falling snow outside windows, to near blizzard-like conditions 1(b,c). Snowfall was required to support the characters by helping to make the world they inhabit believable.

## 2. Managing Snow Shots

The best way to manage the volume and varying type of snowfall was to completely automate the effects snow setups as shots were built.  This turned out to be much more of a practical approach than attempting to simulate everything from scratch for each shot.  Time was spent up front creating a stylized look that could be defined by a library of cached snow simulations. Categories for the various snow types were created and could be previewed as movies for artist reference. As shots came into the department, an artist could select the type of snowfall, then position the red,  green  and blue snow layers through the shot camera. Depth was based on this color coding and allowed the characters to be sandwiched between the layers in the composite without the need for complex character holdout mattes. The benefits of working in layers were a reduction of character matting issues and significantly faster renders. If the directors called out for a "flurry here" or a "gust there", the modular nature of the snowfall libraries allowed for quick import and approval iteration.   Sprite based snowflakes could be seen and adjusted interactively using OpenGL texture proxies and caching to speed playback.  If there wasn't a pre-created snow type that worked well in shot, the original simulation rigs could be imported into a scene for resimulation and caching.

## 3. The Pipeline

A python scripted pipeline was created that could build the snow shots from published libraries. Text based meta-data files could be edited to swap in blizzard conditions or import gently falling snow per shot.  The snow pipeline had the ability to work autonomously across a broad number of shots each night with fully auto-rendered "snow dailies" viewable the next morning. GpuFX 1(e), our GPU based hardware accelerated renderer, was utilized across a dedicated farm of machines for rapid render iterations.  This setup made it possible to render multiple takes of snowfall until we had exactly what was called for by our show Directors.

## 4. Snow Interaction

A technique for ground interaction was developed to allow complete control over the snow surface generated as characters slid, jumped, or fell face first into the fluffy white powder 1(c,d).   Surface displacement was created using a particle simulation to push points onto a cropped higher resolution copy of the ground geometry.  Holdout mattes were generated local to the displaced regions and allowed us to seamlessly blend the rendered displaced surfaces with non-displaced snow renders.  Kicked up snow chunks were created using a separate particle simulation, which was instanced with chunk geometry at render time. These chunks could collide with the displaced snow geometry in scene, which is typically not easy to do when using height fields or z-depth maps to generate a ground surface.   At any time during the process, it was possible to override the displacement sim and add in keyable target shapes to achieve a specific look if requested.  In certain instances, it was more efficient to hand animate or paint in snow interaction 1(d) and reveal matte the painted element over time.

## 5. The Snow Globe

Thousands of swirling snowflake particles were required to create the snow globe effect 1(a).  Initial tests of particles in a fluid container proved this would be no easy task.  This was due to the fact that the fluid volume containing them had to be animated and shaken through space - typically recipe for an unstable dynamic result. Completely breaking from physical reality proved key. The snow particles were animated at the world origin and timed to the character's hand motions.  The resulting cached simulation was then parented to the globe translations and rendered with motion blur.

## 6. Conclusion

Deadlines motivate creativity. This was certainly the case for the *Prep and Landing* effects department. In this 22-minute television Christmas special, nearly 300 shots contained some kind of effects animation – all completed on schedule by a handful of effects artists... no quality compromised. From up front research and element reuse, to hand drawn snow interaction – if it helped to create a plausible world for our characters in a reasonable amount of time, that was the *best*  way to do it.