# User Process Flow Documentation

## NASA Farm Navigators

### Document Information

- **Version:** 2.0
- **Date:** September 2025
- **Purpose:** Comprehensive user journey mapping
- **Focus:** Resolution awareness, depth understanding, context adaptation

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## 1. Executive Overview

NASA Farm Navigators transforms complex satellite data into actionable farming insights through carefully designed user journeys that progressively teach data resolution limitations, soil depth variations, and farming context adaptations. Each flow is optimized to bridge the gap between NASA's powerful but complex data and practical farming decisions.

## 2. User Personas and Their Unique Journeys

### 2.1 Primary Personas

**Maria - Agricultural Student (Age 20)**

- **Background**: Studying precision agriculture
- **Tech Skills**: High
- **NASA Data Experience**: None
- **Primary Goal**: Understand how satellite resolution affects farming decisions
- **Key Challenge**: Connecting abstract data to field reality

**John - Smallholder Farmer (Age 48)**

- **Background**: 5-hectare family farm, traditional methods
- **Tech Skills**: Low-Medium
- **NASA Data Experience**: None
- **Primary Goal**: Reduce water costs while maintaining yield
- **Key Challenge**: Limited resources and technology access

**Dr. Williams - Extension Agent (Age 42)**

- **Background**: County agricultural advisor

- **Tech Skills**: Medium
- **NASA Data Experience**: Basic
- **Primary Goal**: Train farmers on NASA data applications
- **Key Challenge**: Simplifying complex concepts for diverse audiences

**Carlos - Industrial Farm Manager (Age 35)**

- **Background**: 2,000-hectare operation
- **Tech Skills**: High
- **NASA Data Experience**: Some
- **Primary Goal**: Optimize precision agriculture ROI
- **Key Challenge**: Integrating NASA data with existing systems

## 3. Core User Journey - First-Time Experience

### 3.1 Discovery and Understanding Phase

```
START → Discovery → Understanding → Registration → Context Selection → Tutorial → First Decision
```

**Step 1: Discovery - "What Can NASA Data Do?"**

**Entry Points:**

- NASA Space Apps Challenge website
- Educational institution recommendation
- Agricultural extension referral
- Social media discovery
- Peer recommendation

**Landing Page Experience:**

```
Hero Message: "See Your Farm Through NASA's Eyes"
Sub-message: "Learn what 30m vs 9km resolution really means for your decisions"

Visual Demo:
[Interactive slider showing same field at different resolutions]
30m (Landsat): Individual field boundaries visible
250m (MODIS): Field clusters visible
9km (SMAP): Regional average only

Call-to-Action: "Discover Your Data Resolution" [Start Free]
```

**User Actions:**

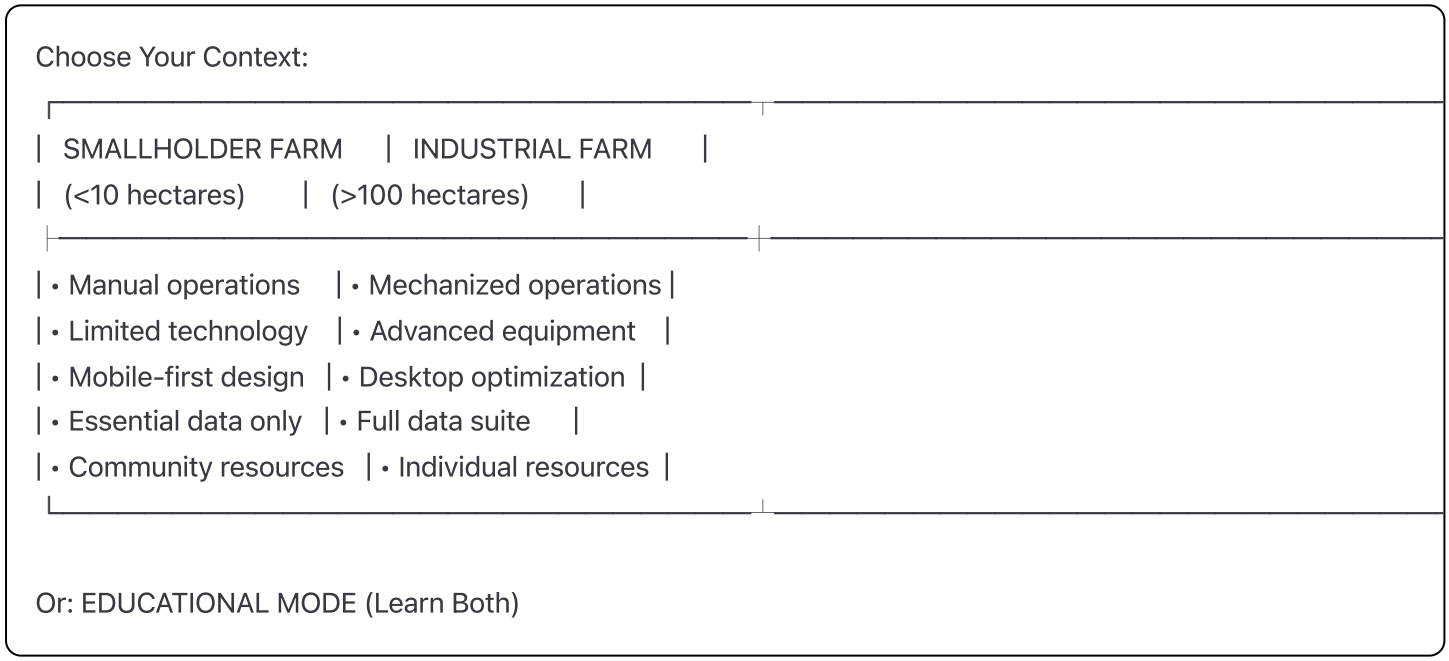
1. Interacts with resolution slider
2. Sees immediate visual impact
3. Reads "Why This Matters" tooltips
4. Watches 60-second explainer video
5. Clicks "Start Free"

**System Response:**

- Logs interaction patterns
- Customizes onboarding based on interests
- Pre-loads relevant tutorials

**Step 2: Context Selection - "What's Your Farming Reality?"**

**Critical Decision Point:**




**Adaptive Interface Based on Selection:**

**Smallholder Path:**

- Simplified dashboard with 3 key metrics
- Voice-guided tutorials in local language
- Offline-first design
- Community sharing features
- Low-bandwidth optimization

**Industrial Path:**

- Advanced analytics dashboard
- Multi-field management tools
- Integration with farm management systems
- Prescription map generation
- Financial ROI calculators

## 3.2 Progressive Learning Journey

### Step 3: Resolution Reality Check Tutorial

**Learning Objective**: Understand what different resolutions can and cannot detect

**Interactive Tutorial Flow**:

```
Stage 1: "The Pixel Problem" (2 minutes)
├── Show user's actual location on map
├── Overlay 30m pixel grid
├── Ask: "Can you see your house?" [Usually yes]
├── Overlay 250m pixel grid
├── Ask: "Can you still see it?" [Maybe]
├── Overlay 9km pixel grid
├── Ask: "How about now?" [Definitely no]
└── Lesson: "Bigger pixels = less detail"

Stage 2: "Feature Detection Challenge" (3 minutes)
├── Present aerial photo of farm
├── Task: "Find the irrigation canal" (10m wide)
├── Try with 30m data [Visible]
├── Try with 250m data [Barely visible]
├── Try with 9km data [Invisible]
└── Lesson: "Feature must be > pixel size"

Stage 3: "Mixed Pixel Reality" (3 minutes)
├── Show field with 60% crops, 40% trees
├── 30m resolution: Distinguishes both
├── 9km resolution: Shows average
├── Calculate actual vs measured crop area
└── Lesson: "Large pixels mix different surfaces"
```

**Knowledge Check**:

1. "Your pond is 50m wide. What's the minimum resolution to detect it?"
   - [30m] ✓ Correct!
   - [250m] ✗ Too large

- [9km] ✕ Much too large

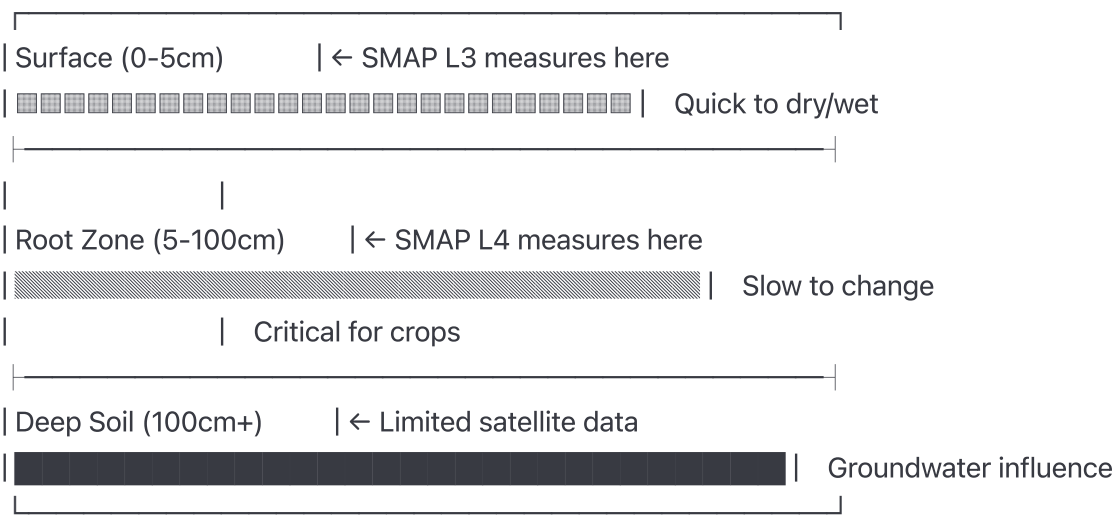
2. "SMAP moisture data is 9km resolution. Good for:"
    - [Individual field] ✕ Too coarse
    - [Regional planning] ✓ Correct!
    - [Precision zones] ✕ Too coarse

**Step 4: Depth Diving Tutorial**

**Learning Objective**: Differentiate surface vs root zone moisture

**Interactive Depth Profile:**

Soil Cross-Section Visualization:




Crop Roots Overlay:
- Lettuce: ←15cm→ (Surface critical)
- Wheat: ←←←100cm→→→ (Deep critical)
- Trees: ←←←←←200cm+→→→→→ (Very deep)

**Scenario Practice:**

Scenario 1: "Surface Dry, Deep Wet"
├── Crop: Mature corn (roots at 120cm)
├── Surface (SMAP L3): 15% moisture
├── Root zone (SMAP L4): 45% moisture
├── Decision: ☐ Irrigate / ✓ Don't irrigate
└── Feedback: "Correct! Deep roots have water"

Scenario 2: "Surface Wet, Deep Dry"
├── Crop: Young corn (roots at 30cm)
├── Surface (SMAP L3): 40% moisture
├── Root zone (SMAP L4): 20% moisture
├── Decision: ✓ Deep irrigate / ☐ Surface irrigate
└── Feedback: "Correct! Roots will soon need deep water"

## 4. Daily Gameplay Flow - Data-Driven Decisions

### 4.1 Morning Routine - Check NASA Updates

User Login → Data Sync → Alert Review → Dashboard → Analysis → Decision → Action

**Data Update Notifications:**

🛰️ New Data Available:
├── SMAP Moisture: Updated 2 hours ago
├── MODIS NDVI: New 8-day composite ready
├── Weather: GPM precipitation forecast updated
└── Alert: Moisture stress detected in Field 3

**Dashboard View (Adaptive by Context):**

**Smallholder Dashboard:**

┌─────────────────────────────────────────┐
| Today's Priority Actions |
├─────────────────────────────────────────┤
| 1. Check Field 2 - Dry Alert 🚨 |
| 2. Rain forecast tomorrow ☔ |
| 3. Harvest window in 3 days 🌾 |
└─────────────────────────────────────────┘

**Industrial Dashboard:**

```
┌──────────────────────────────────────────────────────────────────────┐
| Precision Management Console                                         |
├──────────────────────────────────────────────────────────────────────┤
| Fields Requiring Action: 12/47                                       |
| Prescription Maps Generated: 3                                       |
| Water Savings This Week: 32%                                         |
| Yield Forecast Confidence: 87%                                       |
└──────────────────────────────────────────────────────────────────────┘
```

## 4.2 Critical Decision Flow - Irrigation Management

```
Moisture Alert → Resolution Check → Depth Analysis → Context Application → Decision → Execution
```

**Detailed Decision Process:**

### Step 1: Moisture Alert Triggered

```
Alert: "Field 5 showing moisture stress"
Source: SMAP L3 (9km resolution)
Confidence: Medium (large pixel averaging)
```

### Step 2: Resolution Reality Check

```
User Action: "Zoom to Field Level"
System Response: "Note: 9km pixel covers multiple fields"

Resolution Comparison:
├── Your field: 2 hectares
├── SMAP pixel: 8,100 hectares
├── Coverage: Your field = 0.02% of pixel
└── Recommendation: "Check adjacent fields too"
```

### Step 3: Depth Analysis

```
Depth Profile for Field 5:
├── Surface (0-5cm): 18% [Low] 🔴
├── Root Zone (0-100cm): 35% [Adequate] 🟡
├── Crop: Corn (60 days old)
├── Root depth: Currently ~80cm
└── Recommendation: "Monitor - roots have water"
```

### Step 4: Context-Specific Options

**Smallholder Options:**

```
Available Actions:
1. Wait for tomorrow's rain (70% chance)
2. Share water with neighbor cooperative
3. Apply limited irrigation to critical areas
Resource constraint: 1000L available
```

**Industrial Options:**

```
Available Actions:
1. Generate VRT prescription map
2. Schedule pivot for 15mm application
3. Adjust fertigation mixture
4. Update yield forecast model
Resources: Unlimited water rights
```

# 5. Advanced User Flows

## 5.1 Expert Mode - Multi-Resolution Analysis

```
Expert Dashboard → Layer Stacking → Resolution Comparison → Decision Optimization
```

**Multi-Resolution Layer Stack:**

```
Active Layers (Toggle On/Off):
☐ Landsat 30m - Field boundaries
☑ MODIS 250m - Vegetation health
☑ SMAP 9km - Soil moisture
☐ GPM 10km - Precipitation
☑ Sentinel-2 10m - Crop classification

Transparency Slider: [====|------] 40%
Blend Mode: Multiply
Time Range: Last 30 days
```

**Advanced Analysis Tools:**

1. **Pixel Drill-Down**: Click any location for all resolutions
2. **Uncertainty Visualization**: Show confidence intervals
3. **Temporal Analysis**: Animation over time
4. **Cross-Resolution Validation**: Compare predictions

### 5.2 Educator Flow - Classroom Management

```
Educator Login → Class Creation → Scenario Assignment → Progress Monitoring → Assessment
```

**Scenario Assignment Interface:**

```
Create Learning Scenario:
┌─────────────────────────────────────────────────────────┐
│ Scenario: "Resolution Challenge"                        │
├─────────────────────────────────────────────────────────┤
│ Learning Objectives:                                    │
│ ☑ Identify resolution limitations                       │
│ ☑ Select appropriate data source                        │
│ ☑ Apply to farming decision                             │
├─────────────────────────────────────────────────────────┤
│ Constraints:                                            │
│ • Limited to MODIS & SMAP data                          │
│ • Must explain pixel size impact                        │
│ • Complete in 30 minutes                                │
├─────────────────────────────────────────────────────────┤
│ Success Criteria:                                       │
│ • Correct resolution selection: 10pts                   │
│ • Proper interpretation: 10pts                          │
│ • Practical application: 10pts                          │
└─────────────────────────────────────────────────────────┘
```

**Student Progress Tracking:**

```
Class Overview:
├── Completed Tutorial: 28/30 students
├── Average Resolution Score: 78%
├── Average Depth Score: 82%
├── Context Adaptation: 71%
└── Ready for Certification: 22/30
```

## 6. Error Recovery Flows

### 6.1 Data Accuracy Warning Flow

```
Suspicious Data → Warning Display → User Verification → Alternative Options
```

**Example: Anomalous NDVI Reading**

⚠️ Data Quality Alert:
├── NDVI shows sudden 50% drop
├── Possible causes:
│ • Cloud contamination
│ • Sensor malfunction
│ • Actual crop stress
├── Confidence: Low (40%)
└── Recommended Actions:
1. Check weather history (was it cloudy?)
2. Compare with previous week
3. Wait for next update
4. Use alternative data source

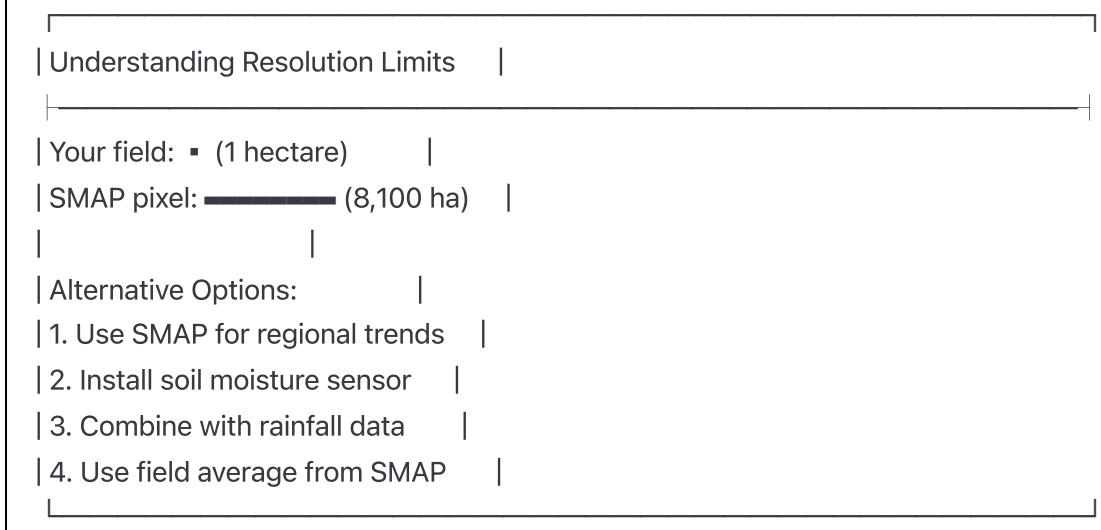
## 6.2 Resolution Mismatch Recovery

User Expectation → Reality Check → Education → Alternative Solution

### Scenario: User Expects Field-Level Data from SMAP

User: "Show moisture for my 1-hectare field"
System: "SMAP resolution is 9km - too large for your field"

Educational Intervention:




# 7. Offline Mode Flows

## 7.1 Offline Transition

Connection Lost → Detection → Cache Check → Feature Limitation → Offline Mode

### Offline Capability Matrix:

| Feature | Online | Offline |
|---|---|---|
| View historical data | ✓ | ✓ |
| Run simulations | ✓ | ✓ |
| Access tutorials | ✓ | ✓ |
| Fetch new NASA data | ✓ | ✗ |
| Save progress | ✓ | ✓(local) |
| View resolution examples | ✓ | ✓ |
| Practice depth scenarios | ✓ | ✓ |

Offline Duration: ▓▓▓▓▓▓▓▓▓▓▒▒ 72 hours remaining

### 7.2 Sync Recovery Flow

Connection Restored → Change Detection → Conflict Resolution → Data Merge → Confirmation

**Sync Process Visualization:**

Syncing Changes:
├── Local Changes: 15 actions
├── Server Updates: 3 new data points
├── Conflicts: 1 (irrigation timing)
│
Conflict Resolution:
├── Your Action: Irrigated Field 3 at 10:00
├── Server Data: Rain detected at 10:30
├── Resolution: ○ Keep your action
│ ○ Use server data
│ ● Merge (irrigate less)
└── [Apply] [Review Details]

## 8. Achievement and Progression Flows

### 8.1 Learning Milestone System

Action → Progress Check → Milestone → Reward → Next Challenge

**Resolution Mastery Path:**

Level 1: Pixel Pioneer
├── Understand pixel size concept ✓
├── Identify 3 resolution limits ✓
└── Reward: Resolution Compass Tool

Level 2: Resolution Expert
├── Compare 5 different resolutions ✓
├── Solve mixed pixel problem ✓
└── Reward: Multi-Resolution Viewer

Level 3: Scale Master
├── Optimize decisions across scales ☐
├── Teach another player ☐
└── Reward: NASA Certification

**Depth Understanding Path:**

Level 1: Surface Skimmer
├── Differentiate surface moisture ✓
├── Apply surface irrigation ✓
└── Reward: Depth Profile Tool

Level 2: Root Zone Ranger
├── Master root zone concepts ✓
├── Optimize deep irrigation ☐
└── Reward: Crop Root Library

Level 3: Depth Expert
├── Predict depth interactions ☐
├── Create irrigation prescriptions ☐
└── Reward: Advanced Modeling Tools

# 9. Social and Collaborative Flows

## 9.1 Community Learning

Join Community → Share Experience → Learn from Peers → Collaborative Challenges

**Community Features by Context:**

**Smallholder Communities:**

```
Water Sharing Cooperative:
├── Members: 12 local farmers
├── Shared Resource: 10,000L/day
├── Decision Model: Consensus
├── Data Sharing: Regional SMAP
└── Success: 35% water saved together
```

**Industrial Networks:**

```
Precision Ag Forum:
├── Members: 200+ operations
├── Shared: Best practices
├── Benchmarking: Yield/efficiency
├── Data Exchange: Anonymized
└── Innovation: Testing new methods
```

# 10. Performance Analytics Flow

## 10.1 Learning Analytics Dashboard

```
User Actions → Data Collection → Analysis → Insights → Recommendations
```

**Personal Progress Report:**

```
Your NASA Data Mastery:
├── Resolution Understanding: ████████▒▒ 85%
├── Depth Comprehension: ███████▒▒▒ 72%
├── Context Adaptation: ██████▒▒▒▒ 63%
├── Practical Application: ████████▒▒ 89%
│
Key Achievements:
├── Water Saved: 2,500L (simulated)
├── Correct Decisions: 45/50
├── Challenges Completed: 8/10
│
Next Steps:
├── Try 10km GPM precipitation data
├── Practice deep irrigation timing
└── Complete Industrial Context tutorial
```

# 11. Retention and Re-engagement Flows

## 11.1 Smart Notifications

Time-Based → Context-Aware → Personalized → Actionable

### Notification Examples:

24 hours inactive:
"🛰️ New SMAP data shows your field is at 20% moisture"

3 days inactive:
"🌧️ Rain forecast changed - check your irrigation plans"

7 days inactive:
"🏆 You're 2 decisions away from Resolution Master badge"

Seasonal:
"🌾 Planting season starting - new NASA data available"

## 11.2 Re-onboarding Flow

Return After Break → What's New → Refresher → Resume Progress

### Welcome Back Experience:

Welcome Back! Here's What You Missed:
├── New Feature: 10m Sentinel-2 data now available
├── Your Fields: 2 need attention
├── Community: Your group saved 50,000L
├── Quick Refresher: [Resolution] [Depth] [Skip]
└── Continue where you left off → Field 3 Irrigation

# 12. Accessibility and Inclusivity Flows

## 12.1 Adaptive Interface Flow

Accessibility Check → Preference Setting → Interface Adaptation → Validation

### Accessibility Options:

```
Visual Adaptations:
├── Color Blind Mode: [Protanopia ▼]
├── High Contrast: [ON/OFF]
├── Text Size: [-----|++++]
├── Motion Reduction: [ON/OFF]

Interaction Adaptations:
├── Voice Commands: [Enable]
├── Keyboard Only: [Enable]
├── Touch Gestures: [Customize]
├── Reading Speed: [-----|++++]
```

### 12.2 Language and Cultural Adaptation

```
Language Selection → Cultural Context → Localized Content → Community Connection
```

**Localization Example:**

```
Region: East Africa
├── Language: Swahili
├── Crops: Maize, beans, coffee
├── Rainfall Pattern: Bimodal
├── Farm Size: Typically <2 hectares
├── Local Data: RCMRD integration
└── Community: Connect with 500+ local users
```

## Appendices

### Appendix A: Complete User Action Matrix

All possible user actions mapped to system responses.

### Appendix B: Resolution Reference Guide

Quick lookup for all NASA data resolutions and applications.

### Appendix C: Depth Profile Library

Crop-specific root depths and water requirements.

### Appendix D: Context Adaptation Patterns

Detailed breakdowns of smallholder vs industrial interfaces.