

Sky2Soil: From Satellites to Sustainable Farming



Sky2Soil is an interactive web application that bridges satellite technology with sustainable agriculture. Powered by NASA's Earth observation data, it educates users on how remote sensing tools like SMAP (soil moisture), MODIS (vegetation health), and climate datasets can empower farmers to make data-driven decisions for a greener planet. Whether you're a student, educator, or aspiring farmer, Sky2Soil offers engaging simulations, stories, and tools to explore precision agriculture.

Built with a focus on accessibility and mobile responsiveness, the app features a clean, nature-inspired UI with green gradients and intuitive navigation. Dive into virtual farming, chat with an AI advisor, or explore real NASA datasets—all in your browser!



Features

Home Dashboard: A welcoming overview with quick-access cards to all modes, highlighting the app's mission.

Story Mode: An embedded interactive narrative on itch.io following Hasan's journey in transforming a family farm using NASA data. (Powered by [Sky2Soil itch.io game](#)).

Sandbox Farm Simulator: Hands-on virtual farming where you plant, irrigate, fertilize, and harvest crops on a 8x6 grid. Integrates simulated NASA data (soil moisture, NDVI, temperature, precipitation, drought risk) to influence growth and decisions. Track budget, yield, and farm days in real-time.

AI Farm Advisor: A conversational chatbot trained on NASA agricultural datasets. Ask about SMAP, NDVI, irrigation strategies, drought monitoring, or sustainable practices. Powered by a Hugging Face Spaces API for dynamic responses.

Data Explorer: Browse and visualize NASA datasets via a sidebar menu. Categories include Soil Data (SMAP, texture), Vegetation (NDVI, EVI, LAI), Climate (temperature, precipitation, drought), and Crop Analysis (crop types, yield prediction). Features placeholders for interactive charts (e.g., via AppEEARS API integration).

Learning Hub: Six modular lesson cards on satellite basics, soil moisture, vegetation indices, climate data, precision agriculture, and sustainable practices. Each includes a "Start Lesson" button for future expansions (e.g., quizzes or videos).

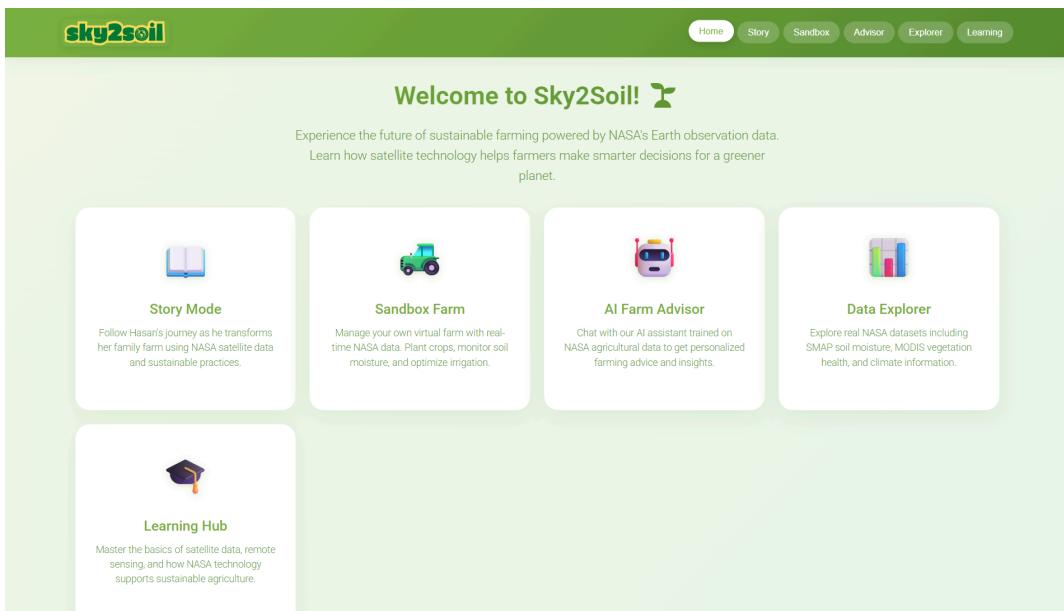
Responsive Design: Fully mobile-optimized with media queries for screens down to 480px. Sticky header, smooth animations, and touch-friendly interactions.

NASA Data Simulation: Real-time updates in Sandbox mode mimic live feeds; expandable to actual API pulls (e.g., AppEEARS, GPM).



Screenshots

Home Dashboard



The screenshot shows the Sky2Soil home dashboard. At the top, there's a green header bar with the "sky2soil" logo on the left and a navigation menu with links for Home, Story, Sandbox, Advisor, Explorer, and Learning. Below the header, a large green banner features the text "Welcome to Sky2Soil! 🌎". Underneath the banner, it says "Experience the future of sustainable farming powered by NASA's Earth observation data." and "Learn how satellite technology helps farmers make smarter decisions for a greener planet." The main content area contains five cards arranged in two rows. The top row includes four cards: "Story Mode" (with a book icon), "Sandbox Farm" (with a tractor icon), "AI Farm Advisor" (with a robot icon), and "Data Explorer" (with a bar chart icon). Each card has a brief description below it. The bottom row contains one card, "Learning Hub" (with a graduation cap icon), which also has a description below it.

Story Mode
Follow Hasan's journey as he transforms her family farm using NASA satellite data and sustainable practices.

Sandbox Farm
Manage your own virtual farm with real-time NASA data. Plant crops, monitor soil moisture, and optimize irrigation.

AI Farm Advisor
Chat with our AI assistant trained on NASA agricultural data to get personalized farming advice and insights.

Data Explorer
Explore real NASA datasets including SMAP soil moisture, MODIS vegetation health, and climate information.

Learning Hub
Master the basics of satellite data, remote sensing, and how NASA technology supports sustainable agriculture.

View link: <https://arefin-nibir.github.io/Nasa-apps/>
(Quick mode selection with engaging cards)

Story Mode



View link: <https://arefin-nibir.github.io/Nasa-apps/>
(Interactive grid with NASA data panel and controls)

Sandbox Farm

A screenshot of the Sandbox Farm Simulator in the sky2soil game. The interface includes a green header bar with the sky2soil logo and navigation links for Home, Story, Sandbox, Advisor, Explorer, and Learning. The main area features a 10x10 grid of farm plots. Some plots contain small green plants. On the right side, there's a "NASA Data (Live)" panel showing soil moisture (32%), vegetation index (0.45), temperature (24°C), precipitation (5mm), and drought risk (Low). Below that is a "Farm Actions" section with buttons for Plant (\$50), Irrigate (\$20), Fertilize (\$30), and Harvest. There's also a "Time Control" button for "Next Day". A "Tips" section at the bottom right provides a tip: "Great! Your crop is planted. Monitor soil moisture and water when needed."

View link: <https://arefin-nibir.github.io/Nasa-apps/>
(Interactive grid with NASA data panel and controls)

AI Advisor Chat

The screenshot shows the 'AI Farm Advisor' section of the sky2soil website. At the top, there's a navigation bar with links for Home, Story, Sandbox, Advisor (which is highlighted in blue), Explorer, and Learning. Below the navigation is a large white chat area with rounded corners. On the left side of the chat area, there's a sidebar with a green header that says 'Ask about NASA data, farming practices, or sustainable agriculture...'. Inside the sidebar, there's a text input field and a 'Send' button. The main chat area has two messages. The first message is from the AI Farm Advisor, which says: 'Hello! I'm your AI Farm Advisor, powered by NASA's agricultural data. I can help you with: • Understanding satellite data (SMAP, MODIS, AppEEARS) • Irrigation scheduling based on soil moisture • Crop health monitoring using vegetation indices • Climate adaptation strategies • Sustainable farming practices'. Below this message is a placeholder text: 'What would you like to know?'. The second message is from a user, which says: 'How is the weather today?'. The AI Farm Advisor responds: 'I'm an assistant designed to help with agricultural questions, and I'm unable to provide real-time weather updates. I would recommend checking a reliable weather forecast source for this information.' At the bottom right of the chat area, there's a small copyright notice: '© 2025 Sky2Soil. Empowering sustainable farming with NASA technology. 🌎'.

View link: <https://arefin-nibir.github.io/Nasa-apps/>
(*Conversational interface for farming queries*)

Data Explorer

The screenshot shows the 'NASA Data Explorer' section of the sky2soil website. At the top, there's a navigation bar with links for Home, Story, Sandbox, Advisor, Explorer (which is highlighted in blue), and Learning. Below the navigation is a sidebar with a green header that says 'Ask about NASA data, farming practices, or sustainable agriculture...'. Inside the sidebar, there's a text input field and a 'Send' button. The main content area has a sidebar on the left with various dataset categories: 'Soil Data' (selected), 'Vegetation', 'Climate', and 'Crop Analysis'. Under 'Soil Data', there are three items: 'SMAP Soil Moisture' (selected), 'Soil Texture Maps', and 'MODIS NDVI'. Under 'Vegetation', there are three items: 'Enhanced VI (EVI)', 'Leaf Area Index', and 'Temperature'. Under 'Climate', there are three items: 'Precipitation', 'Drought Monitor', and 'Crop Type Maps'. Under 'Crop Analysis', there is one item: 'Yield Prediction'. To the right of the sidebar, there's a detailed view of the 'SMAP Soil Moisture Data'. It includes a title 'SMAP Soil Moisture Data', a description 'The Soil Moisture Active Passive (SMAP) mission provides global soil moisture measurements at 0-5cm depth. This data helps farmers optimize irrigation schedules and predict drought conditions.', and an 'Interactive Data Visualization' section. This section features a small icon of a graph with a grid, the text 'Interactive Data Visualization', and the note 'Real NASA data would be fetched from AppEEARS API'. Below this, it says 'Select different datasets from the sidebar to explore'.

View link: <https://arefin-nibir.github.io/Nasa-apps/>
(*Sidebar navigation for dataset selection*)

Learning Hub

The screenshot shows the 'Learning Hub' section of the sky2soil website. At the top, there's a green navigation bar with the 'sky2soil' logo and links for Home, Story, Sandbox, Advisor, Explorer, and Learning. The 'Learning' link is currently active. Below the navigation is a white 'Learning Hub' card with six lessons arranged in a grid:

- Satellite Basics**: Learn how satellites observe Earth and collect data about soil, vegetation, and climate from space. [Start Lesson](#)
- Soil Moisture & SMAP**: Understand soil moisture measurement, why it matters for farming, and how to use SMAP data for irrigation decisions. [Start Lesson](#)
- Vegetation Indices**: Discover NDVI, EVI, and LAI - key indicators of crop health that can be monitored from space. [Start Lesson](#)
- Climate Data**: Explore temperature, precipitation, and drought monitoring tools to plan your farming calendar. [Start Lesson](#)
- Precision Agriculture**: Learn how combining multiple data sources enables precision farming and resource optimization. [Start Lesson](#)
- Sustainable Practices**: Master conservation techniques, crop rotation, and sustainable farming methods supported by data. [Start Lesson](#)

View link: <https://arefin-nibir.github.io/Nasa-apps/>

🛠️ Technologies Used

- **Frontend:** HTML5, CSS3 (with CSS Grid, Flexbox, and custom variables for theming), Vanilla JavaScript (no frameworks for lightweight performance).
- **Styling:** Google Fonts (Roboto), Gradient backgrounds, Box shadows, and keyframe animations for a modern, eco-friendly feel.
- **Integrations:**
 - itch.io Embed for Story Mode.
 - Hugging Face Spaces API (<https://psy-mnh14-sky2soil-farmbot-api.hf.space/ask>) for AI chatbot.
 - Simulated NASA data; ready for AppEEARS/GPM API hooks.
- **Tools:** Responsive design with media queries; no build tools required—pure static site.

🚀 Quick Start

Prerequisites

- A modern web browser (Chrome, Firefox, Safari, Edge).

- Internet connection for the AI chatbot and itch.io embed (offline mode works for Sandbox and Learning).

Running Locally

Clone the repository:

```
text
git clone https://github.com/yourusername/sky2soil.git
```

1. cd sky2soil
2. Open index.html in your browser:
 - Double-click the file, or use a local server like Live Server (VS Code extension) or Python's python -m http.server.
3. Navigate modes via the header buttons or home cards.

Deployment

- Host on GitHub Pages (enable in repo settings > Pages > Deploy from main branch).
- Or use Netlify/Vercel: Drag-and-drop the folder or connect your GitHub repo.
- Custom domain support via hosting platforms.

Note: The AI API may have rate limits; for production, consider a backend proxy or your own HF Space.

Customization & Development

Project Structure

```
text
sky2soil/
├── index.html      # Main app file
├── images/         # Logo and assets (add your logo.png)
├── screenshots/    # Demo images
├── README.md       # This file!
└── styles/          # (Optional: Extract CSS for modularity)
```

Key Scripts

- **Navigation:** switchMode() handles section switching with fade animations.
- **Sandbox:** initFarm(), handleCellClick(), nextDay() manage grid state, actions, and simulated data updates.
- **Chatbot:** sendMessage() and farmbotAPIcall() integrate with the HF API; fallback to predefined responses.
- **Data Explorer:** selectData() updates UI based on dataInfo object.

To extend:

- Replace placeholders in Data Explorer with Chart.js or D3.js for real visualizations.
- Hook Sandbox NASA data to live APIs (e.g., fetch from <https://appears.earthdata.nasa.gov/>).
- Add lesson modals/videos to Learning Hub cards.

Chatbot API Details

The Chatbot is hosted on Huggingface, and connected via API calls.

- **Architecture:** The system is running on a **RAG** (Retrieval-Augmented Generation) architecture. **FAISS** (Facebook AI Similarity Search) is used for its vector database. For the embedding, the **sentence-transformers/all-MiniLM-L6-v2** model is used. For the LLM, the **mistralai/Mixtral-8x7B-Instruct-v0.1** model is used.
- **Data Source:** for building the vector database, data was scrapped for different websites to make the LLM model knowledgeable on NASA's influence on Agriculture. Conceptual Data was scrapped from these websites. Used sources:
 - <https://www.earthdata.nasa.gov/topics/human-dimensions/agriculture-production>
 - https://appliedsciences.nasa.gov/sites/default/files/2024-07/Drought_Part1_FINALFinal.pdf
 - <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2024GL111187>
 - <https://www.sciencedirect.com/science/article/abs/pii/S0034425724005959>
 - https://ntrs.nasa.gov/api/citations/20210023414/downloads/Anyamba_et_al_2021_remotesensing-13-04227.pdf
 - <https://nsidc.org/news-analyses/news-stories/smap-data-helps-dig-dirt-unexpected-droughts>
 - <https://www.drought.gov/data-maps-tools/crop-condition-and-soil-moisture-analytics-tool-crop-casma>
 - <https://smap.jpl.nasa.gov/mission/why-it-matters/>
 - <https://www.frontiersin.org/journals/big-data/articles/10.3389/fdata.2020.00010/full>
 - <https://esto.nasa.gov/nasa-agricultural-digital-twin-will-help-farmers-improve-crop-yield-forecasts/>
 - <https://www.spaceappschallenge.org/nasa-space-apps-2024/challenges/leveraging-earth-observation-data-for-informed-agricultural-decision-making/?tab=resources>
 - <https://gpm.nasa.gov/applications/water/satellite-data-empowers-farmers>
 - <https://www.stlpr.org/2024-05-10/nasa-acres-helps-farmers>
 - <https://www.agmatix.com/blog/climate-resilient-agriculture-nasa-agmatix-for-sustainable-agriculture/>
 - <https://www.nasa.gov/centers-and-facilities/ames/ames-science/farming-with-data-openet-launches-new-tool-for-farmers-and-ranchers/>
 - <https://www.earthdata.nasa.gov/dashboard/stories/sat-data-agriculture>
 - <https://eos.com/blog/ndvi-faq-all-you-need-to-know-about-ndvi/>
 - https://ntrs.nasa.gov/api/citations/20210021328/downloads/2021Sum_GA_MidwestAgII_TechPaper_FD-final.docx.pdf
 - <https://www.frontiersin.org/journals/sustainable-food-systems/articles/10.3389/fsufs.2022.959681/full>
 - <https://www.earthdata.nasa.gov/topics/land-surface/normalized-difference-vegetation-index-ndvi>
 - <https://www.nasaacres.org/>
 - <https://nasaharvest.org/>

- <https://www.nasa.gov/nasa-acres/>
- <https://appliedsciences.nasa.gov/get-involved/training/english/arset-fundamentals-remote-sensing>
- <https://modis.gsfc.nasa.gov/about/>
- <https://appliedsciences.nasa.gov/what-we-do/food-security-agriculture>
- <https://www.cropprophet.com/satellite-crop-monitoring-ndvi-vhi/>
- <https://www.sciencedirect.com/science/article/pii/S1470160X20310633>
- <https://www.earthdata.nasa.gov/learn/pathfinders/agricultural-and-water-resources-data-pathfinder>
- **API details:** the Chatbot makes POST call to
 - url: <https://psy-mnh14-sky2soil-farmbot-api.hf.space/ask>
 - Body: { "question": "User query" }
 - Response: { "answer": "AI response" }
- <https://psy-mnh14-sky2soil-farmbot-api.hf.space/docs> for checking out the API directly on your browser.

The chatbot POSTs to:

```
text
POST
Body:
Response: { "answer": "AI response" }
```

Handle errors gracefully as shown in the code.

Contributing

Contributions welcome!

1. Fork the repo and create a feature branch (git checkout -b feature/amazing-feature).
2. Commit changes (git commit -m 'Add amazing feature').
3. Push to the branch (git push origin feature/amazing-feature).
4. Open a Pull Request.

Please add tests for new JS logic and update docs. Focus on sustainability themes!

License

This project is licensed under the MIT License - see the LICENSE file for details.

Acknowledgments

- NASA Earthdata and missions (SMAP, MODIS, GPM) for inspiring datasets.
- itch.io for hosting the Story Mode game.

- Hugging Face for the FarmBot API.
 - Built with love by [Your Name](#) – Questions? Open an issue!
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Empowering sustainable farming, one satellite at a time.  

Last updated: October 03, 2025