Wildland Fire Information and Technology Program
Project Idea Initiation Request

Date: September 26, 2018

Project Idea Name	*WindNinja*
Project Idea Point of Contact	*Natalie Wagenbrenner, nwagenbrenner@fs.fed.us*
Project Idea Sponsor *(if any)*	*Paul Schlobohm, pschlobo@blm.gov* *Robyn Heffernan, robyn.heffernan@noaa.gov*

Business Area Supported	*Operational Wildland Fire*
Intended User (s)	*Wildland Fire Managers (e.g., IMETs, FBANs)*
Business/User Needs Met	*Provides high-resolution wind predictions in complex terrain for operational wildland fire support.*

Description
Please provide a detailed description of the project. <Who, what, where, why, benefits, training requirements>

WindNinja is a microscale wind model specifically designed for wildland fire support. WindNinja has been developed and supported by a group of researchers at the Missoula Fire Sciences Lab over the last 10 years. Substantial effort has gone into making sure the WindNinja framework is fast, easy-to-use, stable, and accessible for users without technical meteorological or computational expertise. There are now both desktop and mobile versions available.

Background:
WindNinja is designed to simulate winds in mountainous terrain for operational wildland fire support. WindNinja has seen sustained development over the last decade and is now widely used by operational wildland fire management both in the U.S. and abroad. Development and maintenance of the model is costly and we currently have no dedicated support for this purpose.

Usage Statistics
- 20+ peer-reviewed articles
- **7+ million model runs** in 2017 by 3056 unique users in **70 countries**
- Used by WFDSS, FlamMap, Prometheus, Wildfire Analyst, IMETs, FBANs, ARAs
- Non-fire: training search and rescue dogs, simulating canyon incision on Mars, wind erosion, paragliding conditions (https://weather.firelab.org/windninja/publications/)

Development Statistics
- 73,000 lines of C/C++ code
- 6 core contributors (lifetime)
- 180 code commits by 4 contributors in last 12 months (+14,624/-8573)
- Estimated cost/effort: $980K and 18 person-years (code only)*
- Estimated cost for research to support development of science behind code (field validation, theoretical work, research): $400K
- **Total cost: $1.4M**

OpenHub reporting: https://www.openhub.new/p/windninja

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Release/Bug Fix Statistics
- 41 issues repaired in the last year
- 4 version releases in the last year
- 40+ user support requests in the last year

Mobile App
- Cost: $70K (to-date); $10-20K/year for development and maintenance
- 2000 unique downloads
- 10-20 simulations per day

WindNinja Team
- **Jason Forthofer**, Mechanical Engineer (Missoula Fire Sciences Lab)
- **Natalie Wagenbrenner**, Research Meteorologist (Missoula Fire Sciences Lab)
- **Kyle Shannon**, Software Engineer (contractor)
- **Tanner Finney**, Engineering Student (part-time Missoula Fire Sciences Lab)
- **Bret Butler**, Research Mechanical Engineer (**Team Lead**, Missoula Fire Sciences Lab)

How the Team Supports WindNinja
- **Development** – new code and documentation
- **Code re-design** – to manage integration of new features and ensure maintainability
- **Issue resolution** – bug fixes
- **Distribution** – packaging for installation on various platforms, versioning, promotion
- **Operational work** – website maintenance, IT infrastructure, issue tracking, version control of code, end-user support, trainings
- **Science** – research to support the science behind the code; this includes field validation, investigation of new/improved numerical techniques, presentations at conferences, workshops, and trainings.

Proposal:

WindNinja is now widely used by the operational wildland fire community and is integrated into several operational systems. Targeted support is needed to ensure sustainable model development and maintenance. Regular maintenance is required to ensure WindNinja is able to communicate with third-party libraries and data and that the software is compatible with hardware and software updates. Additionally, we envision new developments in the WindNinja framework to further enhance the user experience and facilitate use by operational fire managers. Some of these enhancements include an improved graphical user interface which allows users to view output and overlay additional spatial layers directly in the application, faster simulation times, and the potential for incorporating smoke transport and fire behavior models within the framework.

Consistent, targeted funding of $150K/year would support WindNinja on its current trajectory.

Importance	*WindNinja is important for operational wildland fire applications. Fire behavior is very sensitive to changes in surface wind speed and direction. In complex terrain, where wildland fires often occur, the mechanical and thermal effects of the terrain substantially alter the near-surface wind. These terrain effects can be difficult to*

	anticipate, even for experts. WindNinja is designed to simulate these terrain-affected winds.
Similar Products:	*None*
Data Type:	*Software*

Anticipated Final Product	*WindNinja is mature software. It has been developed over the last 10 years and has been embedded in operational systems, including WFDSS, FlamMap, and FARSITE, for several years. It is widely used operationally by FBANs, IMETs, and ARAs for support on wildland fire incidents.*
Estimated Timeline *(if known)*	We plan to continue maintenance of the model to ensure WindNinja is able to communicate with third-party libraries and data and that the software is compatible with hardware and software updates. We also have plans for new development in the WindNinja framework to further enhance the user experience and facilitate use by operational fire managers. Some of these enhancements include an improved graphical user interface which allows users to view output and overlay additional spatial layers directly in the application, faster simulation times, and the potential for incorporating smoke transport and fire behavior models within the framework.
Estimated Budget *(if known, indicate if any funding is available)*	*$150K/year* *Currently, there is no targeted funding for WindNinja development or maintenance.*

Additional Information
https://weather.firelab.org/windninja/
https://github.com/firelab/windninja

For any questions completing this form, please contact the Emerging Technologies Group via Lisa Elenz, Chair lelenz@fs.fed.us or 208-387-5658.