Table S4.1. Summary of some existing trajectory/dispersion models and their application in invasion ecology– with additional information.

| | - | | • | | Spatial | Spatial | Temporal resolution | Geographical | |
|---|---|---|---|--|--|--|---------------------------------|--|--|
| Trajectory/ dispersion model | Study subject | Application | Country and institute of origin | Meteorological data used | resolution of simulation (horizontal) | resolution of simulation (vertical) | of simulation (time step) | area where model has been applied | Availability of model |
| SILAM (Leskinen et al., 2011) http://silam.fmi.fi/ | Pest: Bird cherry- oat aphid (Rhopalosiphum padi); diamondback moth (Plutella xylostella) | Early warning of pest arrival via long-distance dispersal events | Finland, Finnish Meteorological Institute (FMI) | HIRLAM and ECMWF numerical weather prediction (NWP). Other NWP data may be used to give a wider geographical area for application of the model | 30 km | Modelled up to 2 km | 15 min | Europe | Free and open source |
| HYSPLIT (Garner et al., 2006; Zhu et al., 2006; Kim and Beresford, 2008; MacRae et al., 2011; Eagles et al., 2013; Otuka, 2013) http://ready.arl. noaa.gov/ | Pathogen: Wheat stripe rust (Puccinia striiformis); FMDV Pathogen/vector: Bluetongue/ Culicoides Pest: Green peach Aphid (Myzus persicae); rice planthoppers (Laodelphax striatellus, Sogatella furcifera and Nilaparvata lugens) | Identification of sites at which rust spores are likely to be deposited after transit from Australia to New Zealand Risk assessment of windborne spread of FMDV, to allocate activities like surveillance and vaccination on a risk basis Relate spring low-level jet streams to intensity of M. persicae flight activity and spread of PLRV and PVY Migration source of rice planthoppers | USA, National Atmospheric and Oceanic Administration (NOAA) | NCEP/NCAR re-analysis data (wheat stripe rust and Culicoides), LAPS (FMDV). Can also use a range of other data sources | 0.1° × 0.1° NCEP/NCAR re-analysis = 2.5° ×2.5° | Model output field resolution varies according to the model, anywhere from standard pressure levels (1000, 925, 850 hPa) to every 25 hPa intervals for the regional models | 6 hourly | Global (NCEP/ NCAR) | Free (use of forecast meteorological data requires registration and permissions) |
| PMTRAJ (Rochester et al., 1996; Deveson et al., 2005; Anderson et al., 2010; Parry et al., 2011; Eagles et al., 2012) | Pest: Helicoverpa punctigera and Helicoverpa armigera; Australian plague locust (Chortoicetes terminifera); planthopper (Eumetopina flavipes) Pest/vector: Aphid (Rhopalosiphum padi) Pathogen/vector: Bluetongue/ Culicoides | and Culicoides The basis of a system for forecasting moth migrations from inland habitat to coastal cropping regions The identification of dispersal mechanisms which facilitate particular biological invasions Tracing locust pest outbreak | Australia, CSIRO | LAPS, replaced in late 2010 by ACCESS-based models http://www.bom. gov.au/nwp.doc/ access/ NWPData.shtml | 0.75° LAPS. ACCESS provides finer resolution, to 0.11° for Australia or coarser at global (80 km approx) | LAPS: 29 vertical levels ACCESS: 35 pressure levels, 29 sigma levels, 50 vertical hybrid-height levels | 6 hourly | With LAPS, data = Australasian region (65S–16.75N, 65–184.25E) With ACCESS, data = from Australia to global | Free (licence required from CSIRO) |
| TAPM (Hurley et al., 2005; Savage et al., 2010) | Fungal pathogen (generic) | source Determine whether changes to the seasonal and circadian timing of propagule release can have a significant effect on the area covered by resulting aerial dispersal | Australia, CSIRO | LAPS, to be replaced in late 2010 by ACCESS-based models http://www.bom. gov.au/nwp.doc/ access/ NWPData.shtml | 0.75° LAPS or GASP | LAPS: 29 vertical levels | 6 hourly | Global (with limits). Restricted to 1500 km × 1500 km domain | Licence required from CSIRO at cost |

| Trajectory/ dispersion model | Study subject | Application | Country and institute of origin | Meteorological data used | Spatial resolution of simulation (horizontal) | Spatial resolution of simulation (vertical) | Temporal resolution of simulation (time step) | Geographical area where model has been applied | Availability of model |
|--|---|---|--|---|---|---|---|--|--------------------------|
| CMC (LRTAP) (Hopkinson and Soroka, 2010) | Pest: Diamondback moth (<i>Plutella</i> <i>xylostella</i>) | Use of both forward and back trajectories to identify likely sources of pest outbreaks | Canada, Canadian Meteorological Centre (CMC) | Meteorological Service of Canada's Global Environmental Multiscale (GEM) model | 0.9° | 28 vertical levels | 3 hourly | Global | Contact CMC |
| CALPUFF (Pfender et al., 2006) http://www.src. com/calpuff/ calpuff1.htm MM5 (Hu et al., 2013) | Pathogen: Grass stem rust (<i>Puccinia</i> <i>graminis</i>) Pest: Brown planthopper (<i>Niiaparvata</i> <i>lugens</i>) | Estimation of dispersal and deposition of grass stem rust at a landscape scale | USA, TRC, Lowell, Massachusetts | MM5, RUC OT NAM/ WRF real-time forecast data | MM5: 12 km RUC: 13 km NAM/WRF: 8–40 km | MM5: 40 vertical half-sigma levels RUC: 50 isentropic- sigma hybrid vertical levels NAM/WRF: surface, 1000— 200 hPa, 9 levels | MM5: hourly | Only MM5 global (with limits). Others USA region only | Free limited-use license |
| NAME (Ågren et al., 2010; Chapman et al., 2010) (now NAME III) http://www.met office.gov.uk/ research/ modelling- systems/ dispersion- model | Pest: Autographa gamma moths Pathogen: Culicoides midges/ Bluetongue virus, FMDV | Trajectory analysis in combination with radar data showed that moth behaviours alter migration distances and directions of seasonal migration Estimation of likely source of bluetounge introduction to Sweden from Europe and likely points of introduction of introduction of seasonal migration | UK, Met Office | The model uses archives of wind fields and other meteorological data generated by the Met Office's NWP model, the Unified Model | As of 2010, the resolution is now: Global: 25 km North Atlantic/ Europe: 12 km UK: 4 km | As of 2010: 70 vertical levels | 10 min | Global | Contact UK Met Office |

FMDV, foot-and-mouth disease virus; PLRV, potato leafroll virus; PVY, potato virus Y; NCEP/NCAR, National Center for Environmental Protection/National Center for Atmospheric Research; LAPS, Limited Area Prediction System; ACCESS, Australian Community Climate and Earth-System Simulator.