Goals for Workshop

- Focus: Ecological Models for Management (via research)
  - Subtext: Predictive Modeling of invasive species, public health issues, & biodiversity from biological & physical environmental data
- Bring Together NASA Ecological Modeling Community
  - Awareness → New Teams & Approaches
- Find Model Approaches Common to 3 Programs
  - Ingest NASA RS/Earth Observation Data
  - Useful for Decision Support
  - Bridging Spatial (& Temporal) Scales
  - Goal: Scenarios of responses to changing climate, land cover, management actions, policies, etc.
- Future Needs/Issues/Threats (data, models, research & DSS themes, systems of systems)
- If you had a million $$…?
- Next Steps: building on what we heard here

Workshop Products

- Report
- Other Publications
- Working Groups for Applied Programs
  - e.g.: Biodiversity & Ecological Forecasting Team
- New Directions
- Ideas?

Themes Day 1

- Challenge of linking with decision support systems
- Problem of the pixel → must generate & test null hypotheses
- Importance of addressing uncertainties
- Power of recurrent observations for identifying anomalies; gets to issue of continuity

Themes Day 1 #2

- When does higher resolution of data lead to higher accuracy of model? (Rama & Ed Wiley/David Stockwell) → research opportunity?
- Ecosystem productivity (energy) forecasts species richness (tends to peak at intermediate levels) &, in conjunction with land use data, can demonstrate where hotspots are threatened to influence planners' decisions = decision support
- General principles are area specific need to craft management to local/regional conditions, e.g.: mesic vs. harsh & low vs. high land use intensity

Themes Day 1 #3

- Long-term data sets allow for the detection of natural cycles
- Tools for individual-based structural models of virtual plants can be coupled in GIS to create virtual fields showing interactions at scales meaningful to RS
- GARP a powerful tool for hindcasting invasions
- Can NASA catalyze the merging of process & correlative niche modeling approaches
- Need better formats (HDF “no”), subsetting options, & coordinate-based tools for accessing NASA data

Themes Day 1 #4

- Need for model parsimony = identifying a limited number of data inputs that maximize accuracy
- Use model consensus to build robustness
- Look for high impact observations or model outputs, using RS & in situ data, that could revolutionize a field of inquiry
- Modeled energy balances can define climate space for organisms & seasonal climate variation can drive models to simulate migration or other movement on the landscape

Themes Day 1 #5

- Can model biodiversity outcomes for different “if-then” scenarios
- Important to capture patterns of biodiversity (aka beta & gamma diversity) along with species richness; can aggregate data from multiple species to analyze patterns of biodiversity distribution (e.g., generalized dissimilarity modeling)

Themes Day 1 #6

- Collect RS data & biological data at common sites (e.g., approach NSF about collaboration at LTERs or via NEON → joint solicitations)
- Opportunities for s/w development activities via ROSES; also time on Columbia
- Important to get “supply side” researchers together to discuss inputs to applications
- Promote access to international data sets
- Higher-resolution thermal imagery critical
- Need lidar data (of forests especially) to capture 3rd dimension

Common Approaches to Modeling

- NPP
- GARP/WhereWhy
- Pattern “Models” (e.g., GDM)
- Physiological/Energetics Modeling
- Integration with Molecular Biology (phylogeography, etc.)
- NDVI still has legs
- ET, LATI/NVWI
- Agent-based/movement models (dispersion, migration)
- Ecological data assimilation

Common Approaches to Modeling (cont)

- Challenges: how to link agent-based models to habitat; how to link individual models to community models/trophic models
- Problem of linking point locations of events to model (point vs. polygon problem)
- How to capture uncertainty in models and communicate model uncertainty in risk estimates (e.g., fire risk)

Common Approaches to Modeling (cont 2)

- Three categories of models: Geostatistical pattern models, process models which incorporate system knowledge, data assimilation models
- Data layers:
- Scale issue: need for small scale / fine resolution data for some applications

Common Approaches to Modeling (cont 3)

- Invasive species and vector-borne disease interested in perturbations vs. biodiversity and equilibrium; rates of change is common thread between the two
- Phenology
- Dynamic structural modeling

Partnership Opportunities for Decision Support

- NSF/LTER
- NSF/NEON
- USGS Geog. & Bio.—define models for habitat suitability work: test for accuracy with RS data and also for parsimony
- NOAA Fisheries Management ala Barber & Roffer (as well as State and Regional fisheries groups, e.g., CDFG); Ocean & Atmospheric Research Labs (17, Pacific Marine Env. Lab, AMOL); NOSMPO, NOS (National Marine Sanctuaries Regional Programs); Marine Protected Area Program; NOPP

Partnership Opportunities for Decision Support (cont)

- NGOs (e.g., Pew, Packard, Moore, etc.)
- Links to ocean observing systems (ecological component is needed)
- USDA, USFS, BLM, USFWS and NPS (refuge systems)
- CDC/NCID
- Association for State Territorial Epidemiologists (link to State Health Dept's.)
- PAHO

Partnership Opportunities for Decision Support (cont 2)

- NIH (Allergies & infectious disease, Env. Health); NIH is a research, as opposed to operational/decision support, agency
- Minerals Management Service (MMS)
- DOE and DOD (for invasive spp and large land holdings)
- FAO and/or USAID (food security)
- Oakridge DAAC working on documenting metadata for DSS
- Partnerships with regional/local branches may be more effective place to start

Observation Data Needs

- Land Cover (15m to 1km)—continuity, with improved temporal resolution!!
- SST
- Ocean Color (chlorophyll a), turbidity
- Terrain
- Vegetation Structure (lidar, radar, etc.)
- Wind
- Sea surface height
- Salinity
- Thermal at 30-60m

Observation Data Needs (cont)

- Landscape ecology models
- Organism and disease movements
- Biological data
- Having working groups in each application area develop recommendations for data needs? – currently in progress
- Abundance data in addition to distribution data
- Operational hyperspectral sensor

Next Steps

- Important to disseminate ideas and results from meeting
- Explore opportunities for education outreach, ties to ESSE and undergraduate education (Bioscience Education Network, http://sicb.org/dl/biomechanics.php3)
- Organize special sessions at conferences (AGU, ESA, epidemiological society meetings, SCB, IGARRS, AMS)
- Manuscript submissions from all participants may be unrealistic--a summary paper or set of papers may be more effective (New England Journal of Medicine, Emerging Infection Diseases, Bioscience, Science)

Next Steps (cont)

- Publish news pieces in a number of journals in each discipline; direct different communities to the summary article(s)
- Outreach to application user communities may be more important than outreach to RS community (Park Service publications, etc.)
- NASA press release should be issued from HQ or Ames
- Use of imagery to attract attention to the topic

Next Steps (cont 2)

- Provide input to IPCC or other high visibility efforts
- Steve Running is seeking contributions for IPCC report N. America chapter describing climate change impacts on public health
- Inclusion of imagery/movies in publications is important to attract attention

Next Steps (cont 3)

- At this point, what we really have to report on is the start of a process. Also interested in how to continue process and maintain cohesion of group. How to continue communication (email lists?) between disciplines and application areas to achieve potential of group.
- Public health has not yet begin to use remote sensing extensively; would be great to submit publication or request special issue demonstrating/focusing on use of RS in public health journal (EID, Env. Health Perspectives)

Next Steps (cont 4)

- Develop white paper or other synthesis document for distribution within NASA and other agencies?
- Fund postdoc opportunities / NASA fellowships in cross-disciplinary modeling
- NASA ESSE is meeting in May to complete 10-year road map; ESSE 21 meeting in August—opportunities for in-reach to NASA education community

Next Step (cont 5)

- Strength of meeting is in bringing communities together
- MODIS data access has to be a priority for NASA
- Edited book bringing together major contributions from ecological forecasting, invasive species, and public health would help carry momentum from the meeting

Next Step (cont 6)

- Matt Fladeland will be following up with email to all participants to identify interest in different types of publications
- Funding of fellowships is critical to continuing to move interdisciplinary work forward to bridge different communities