

***Availability, Quality, and Optimization of Use of
Surface and Physiographic Data in Mesoscale
Modeling and Assimilation***

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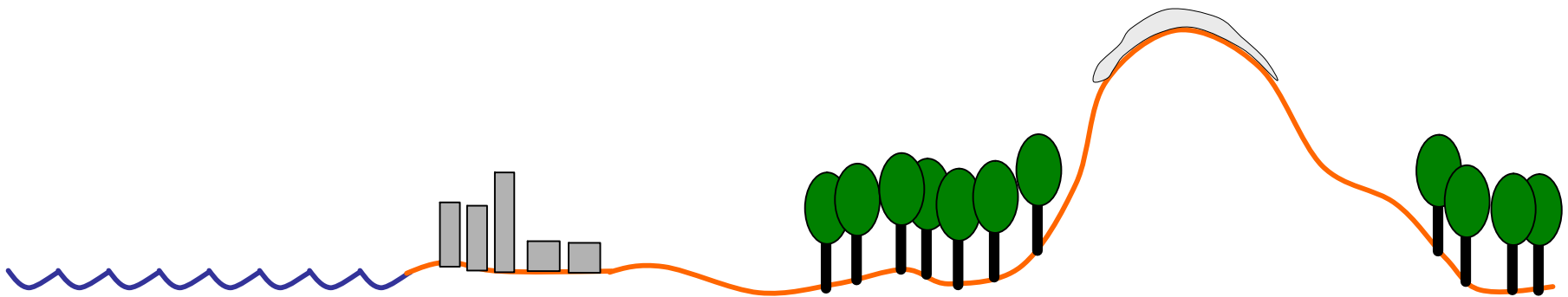
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Surface Processes in Mesoscale Systems

- **Surface fluxes of heat, vapor, and momentum can have a significant impact on mesoscale predictions**
- **Important for near-surface predictions (air temperature, wind, ...)**
- **Important for the evolution of the boundary layer (mixing, air quality, PBL clouds, ...)**
- **Could generate mesoscale circulations, related to orography or to spatial distribution of surface fluxes**
- **Influence on condensation and precipitation (e.g., orography)**

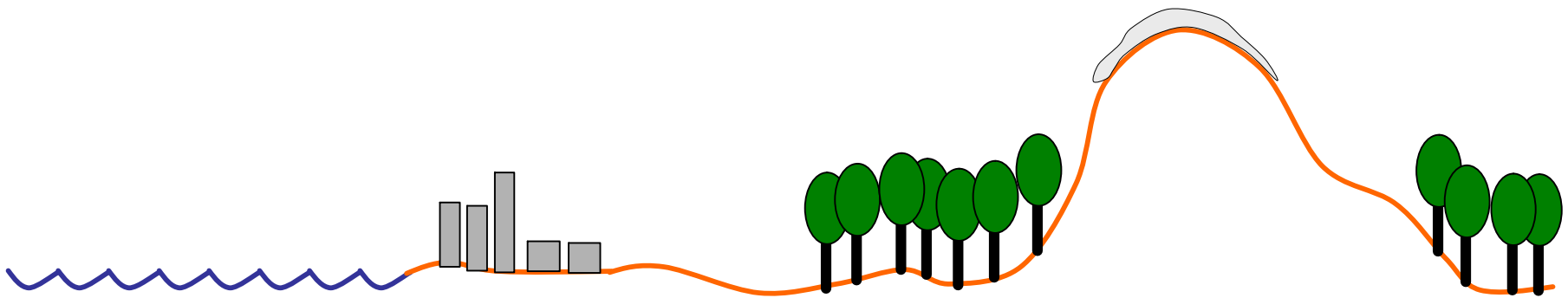




Types of Surfaces

- *Land (or natural covers)*
- *Urban*
- *Water (lakes, oceans)*
- *Sea-ice*
- *Glaciers*

Note that snow can be present on all these types of surfaces (except water of course)





Surface and Physiographic Data

- ***Constant characteristics (or very slowly evolving)***
 - ***Specified using static databases***
- ***Evolving variables***
 - ***Specified using static databases, in-situ data, and/or space-based remote sensing***
 - ***Often involves data assimilation***



Constant characteristics – Physiographic Data

DATABASES

- ***Orography***
- ***Land use and land cover (including cities)***
- ***Land / water fractional coverage***
- ***Soil texture***

PARAMETERS

- *Albedo*
- *Emissivity*
- *Thermal parameters (conductivity, capacity)*
- *Evaporation resistance*
- *Sky view factor*
- *Vegetation coverage fraction*
- *Infiltration parameters*
- *Soil water retention parameters*
- *Canopy density (leaf area index)*
- *Slope*
- *Root depth*
- *... and others*



Analysis of Evolving Variables

- ***Vegetation*** (remote sensing - spectral)
- ***Soil moisture*** (microwave remote sensing)
- ***Snow coverage and snow water equivalent*** (surface networks, optical and microwave remote sensing)
- ***Surface temperatures (water, land, snow)*** (Infrared remote-sensing)

Note that other parameters such as surface albedo and emissivity also evolve, and could be specified using remote sensing



Interesting Questions

1. *Which databases should be used to specify surface characteristics in order to optimize the meteorological performance of mesoscale models ?*
2. *How should these databases be used to specify surface parameters in mesoscale models ?*
3. *What are the best techniques to analyze surface variables such as soil moisture, snow, and surface temperatures ?*
4. *In the absence of surface assimilation or analysis systems, which datasets should be used to specify these evolving surface variables in mesoscale models ?*
5. *How does orography and subgrid-scale orography impacts meteorology at the mesoscale ? And how should this impact be represented in mesoscale models ?*
6. *How does the land surface influences convective activity in weakly-forced environments ? And how should this influence be represented in mesoscale models ?*
7. *How do urban areas influence mesoscale meteorology ? How to represent it ?*
8. *What role does the surface play in polar meteorology ? How to represent it ?*
9. *To what extent do more detailed land-sea mask improved coastal mesoscale meteorology ? How to represent this ?*
10. *To what degree can we predict dust storms arising from arid or semi-arid regions by improving surface processes in mesoscale models ? How can we represent this ?*



Questions of General Interest Not Specific to Mesoscale Modeling

1. Which databases should be used to specify surface characteristics in order to optimize the meteorological performance of mesoscale models ?
2. How should these databases be used to specify surface parameters in mesoscale models ?
3. What are the best techniques to analyze surface variables such as soil moisture, snow, and surface temperatures ?
4. In the absence of surface assimilation or analysis systems, which datasets should be used to specify these evolving surface variables in mesoscale models ?
5. How does orography and sub-grid-scale orography impacts meteorology at the mesoscale ? And how should this be represented in mesoscale models ?
6. How does the presence of convective activity in weakly forced environments ?

Although these questions are not specific to mesoscale NWP, they are important to mesoscale modelers (and not always in their area of expertise)

ACTIVITY: a document could be written to describe the state of this art in the mesoscale community.

SCIENTIST(S): TBD, but this should not be difficult to find someone willing to do this (this could be a group of scientists in fact)

How can we improve surface processes in mesoscale models ? How can we represent this ?



Focus on Mesoscale NWP and Modeling

Some of these questions were examined more extensively than others (e.g., effect of orography and SGO on mesoscale systems and precipitation, polar meteorology with IPY).

Other interesting questions which are not listed ? Which ones seem more promising for our working group ?

We could chose to pick one or a few of these subjects. See the details in the following slides for mesoscale urban modeling, convection in weakly forced environments, and dust storms

1. *Why* **met**
2. *How*
3. *What* **surf**
4. *In th* **specify these evolving** *s in mesoscale models ?*
5. **How does orography and subgrid-scale orography impacts meteorology at the mesoscale ? And how should this impact be represented in mesoscale models ?**
6. **How does the land surface influences convective activity in weakly-forced environments ? And how should this influence be represented in mesoscale models?**
7. **How do urban areas influence mesoscale meteorology ? How to represent it ?**
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Mesoscale Urban Meteorology

1. Why is mesoscale urban meteorology important? How to represent the urban environment in mesoscale models?
2. How does the urban environment influence mesoscale meteorology? How to represent it?
3. What are the key processes in mesoscale urban meteorology? How to represent them in mesoscale models?
4. In the context of mesoscale urban meteorology, what are the key processes? How to represent them in mesoscale models?
5. How does the urban environment influence mesoscale meteorology? How to represent it?
6. How does the land surface influence mesoscale meteorology? How to represent it?
7. How do urban areas influence mesoscale meteorology? How to represent it?
8. What role does the surface play in polar meteorology? How to represent it?
9. To what extent do more detailed land-sea mask improved coastal mesoscale meteorology? How to represent this?
10. To what degree can we predict dust storms arising from arid or semi-arid regions by improving surface processes in mesoscale models? How can we represent this?

Mesoscale urban modeling is an emerging theme, with a rapidly growing community. Important for most countries. Several field campaigns have been and are still being done on this subject. Important links with air quality and emergency response. Strong connection with microscale modeling.

ACTIVITY: Sessions at conferences, Symposiums, maybe modeling exercise such as intercomparisons

SCIENTISTS: Fei Chen (NCAR) ? Sue Grimmond (London's College) ? Masson / Lemonsu (Meteo-France) ?



Convective Activity in Weakly-Forced Environments

1. *Why do land surface fluxes (and its heterogeneity – at different scales) have been shown to influence convection and mesoscale structures in weakly-forced environments (flat regions, with weak dynamical forcing). This is important in countries such as Canada and USA (and probably others). Results from some field experiments has been used to study this subject (IHOP, and soon in Canada with the UNSTABLE field campaign)*
2. *How do land surface fluxes influence convection and mesoscale structures in weakly-forced environments (flat regions, with weak dynamical forcing). This is important in countries such as Canada and USA (and probably others). Results from some field experiments has been used to study this subject (IHOP, and soon in Canada with the UNSTABLE field campaign)*
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4. *In the context of the workshop, what activities should be undertaken?*
ACTIVITY: Sessions at conferences, Symposiums, maybe modeling exercises
SCIENTISTS: IHOP scientists ? Canadian scientists ?
5. *How do land surface fluxes influence convection and mesoscale structures in weakly-forced environments (flat regions, with weak dynamical forcing). This is important in countries such as Canada and USA (and probably others). Results from some field experiments has been used to study this subject (IHOP, and soon in Canada with the UNSTABLE field campaign)*
6. **How does the land surface influences convective activity in weakly-forced environments ? And how should this influence be represented in mesoscale models?**
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Dust Storms

1. Which databases should be used to specify surface characteristics in order to optimize the meteorological performance of mesoscale models ?
2. How should these databases be used to specify surface parameters in mesoscale models?
3. What are the best techniques to analyze surface variables such as soil moisture, snow, and surface temperatures ?
4. In the context of dust storms, what are the key surface processes that need to be used to specify surface parameters in mesoscale models?
5. How can we improve the representation of surface processes in mesoscale models? Extreme weather directly related to surface processes (i.e., saltation, extraction of small particles from the surface). Links with air quality and atmospheric chemistry. Weather events important in arid and semi-arid regions (Middle East, Africa, China, Australia)
6. How can we improve the representation of surface processes in mesoscale models? **ACTIVITY:** Sessions at conferences, Symposiums, maybe modeling exercise
7. How can we improve the representation of surface processes in mesoscale models? **SCIENTISTS:** Great investments recently from the Chinese. This could be a subject they would be willing to support. Scientists and institutes TBD (Institute of Atmospheric Physics, National Meteorology Center , ... ?)
8. What are the key surface processes that need to be used to specify surface parameters in mesoscale models?
9. To what degree can we predict dust storms arising from arid or semi-arid regions by improving surface processes in mesoscale models? How to represent this?
10. To what degree can we predict dust storms arising from arid or semi-arid regions by improving surface processes in mesoscale models ? How can we represent this ?