Introduction:
The freeze-thaw (F/T) status of the landscape is closely linked to surface energy budget and hydrological activity, the seasonal dynamics of vegetation growing seasons, terrestrial carbon budgets and land-atmosphere trace gas exchange. Satellite microwave radars and radiometers are well suited for global F/T monitoring due to insensitivity to signal degradation by atmospheric contamination and solar illumination effects, are uniquely capable of detecting the distinct change in landscape dielectric properties between predominantly frozen and thawed states, and provide a surrogate measure of a range of biophysical processes associated with the F/T signal, especially at high latitudes.

Data and Methods:

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Passive</th>
<th>Active</th>
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<tbody>
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<td>SSM/I</td>
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<td>AMSR-E</td>
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<td>SeaWinds</td>
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Global F/T classification criteria:
- The STA based SSM/I and AMSR-E AM/PM F/T classifications are produced as discrete frozen (0) or non-frozen (1) daily values;
- The combined SSM/I and AMSR-E F/T classifications are determined as frozen (0) or non-frozen (1) where the same F/T classification value occurs for both AM and PM retrievals, as daily output; as transitional (2) where AM frozen and PM non-frozen values occur, and inverse transitional (3) where AM non-frozen and PM frozen results occur;
- The SeaWinds daily F/T classification (frozen or non-frozen) is derived using the BYU daily global sigma-0 browse product from QuikSCAT L1B data.

FT global accuracy assessment using NCDC stations:

Global mean annual F/T classification accuracy (%) between 1988 and 2007

Conclusions:
- The various microwave sensors produce similar FT spatial & temporal patterns, with 72-93% mean annual classification accuracy relative to NCDC stations, while global SSM/I/FT time series and corresponding annual frozen/non-frozen periods were quantified over a 20 year record;
- Approx. 66 million km² of the global land area are constrained by seasonally frozen temperatures; the average (1988-2007) seasonal progression of SSM/I derived frozen area ranges from 0.48 (±0.03) million km² (August) to 34.6 (±0.9) million km² (January);
- Daily F/T transitional areas occupy from 3.2 ±0.27 million km² (February) to 16.5 ±0.44 million km² (July);
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- Daily F/T transitional areas occupy from 3.2 ±0.27 million km² (February) to 16.5 ±0.44 million km² (July);
- These results are being used to construct a consistent, systematic long-term (>20 yr) global daily record of F/T dynamics with well defined accuracy; - The F/T ESDR will be available online at (http://freezethaw.ntsg.umt.edu/) and archived to the NSIDC DAAC.

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