CCI and the Sea Ice ECV

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Layout

- Sea Ice in GCOS-IP 2016;
- Highlights from CCI;
- The associated SealIceScape in Europe;
- Plans in CCI+ (Phase 1);
- Cross-ECV considerations.
Sea Ice in GCOS-IP 2016

The primary parameters that define the state of sea ice include: concentration, area and extent, ice type, motion, deformation, age, thickness and volume.

The presence of sea ice strongly modifies surface waves and air-sea exchanges of heat, momentum, moisture and gasses. Sea ice also has a distinct influence on the Earth’s albedo. In addition, the water masses and properties below the sea ice are transformed through freezing and melting.

<table>
<thead>
<tr>
<th>Sea Ice</th>
<th>Sea Ice Concentration</th>
<th>Weekly</th>
<th>10 km to 15 km</th>
<th>5% ice area fraction</th>
<th>5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sea Ice Extent/Edge</td>
<td></td>
<td>Weekly</td>
<td>1 km to 5 km</td>
<td>5 km</td>
<td>unspecified</td>
</tr>
<tr>
<td>Sea Ice Thickness</td>
<td></td>
<td>Monthly</td>
<td>25km</td>
<td>0.1 m</td>
<td>unspecified</td>
</tr>
<tr>
<td>Sea Ice Drift</td>
<td></td>
<td>Weekly</td>
<td>5 km</td>
<td>1 km/day</td>
<td>unspecified</td>
</tr>
</tbody>
</table>

Table: GCOS Product Requirements for the Sea Ice ECV (GCOS-200)
Highlights from CCI

**Phase 1:**
- SIC RRDP (Pedersen et al., 2018)
- Intercomparison of 30+ SIC algos. (Ivanova et al., 2015)

**Phase 2:**
Design new algorithms. (Lavergne et al., 2019)

CCI and OSISAF CDRs documented in Lavergne et al. (2019)
Highlights from CCI

Algorithm developments to bring Envisat and CS2 freeboards to 25km [Paul et al. 2018].

At the end of CCI Phase 2: Envisat + CS2 time-series, 2002-2017 (NH + SH). Also full error propagation.
The associated SealIceScape (in Europe)
Plans in CCI+

- Continued R&D on Sea-ice Concentration and Thickness

- For Thickness:
  - Extend with ERS-1 and -2 (1993->);
  - Algorithms improvements;
  - Better uncertainties.

- For Concentrations:
  - Use higher frequency channels (1992->)
  - Extend with ESMR Nimbus-5 (1972-77)
  - Better uncertainties;

- User Reqs, Validation, and Climate Assessment activities.
SIT in CCI+: ERS 1 and 2
SIT in CCI+ : Algorithm improvements

- Focus on ERS 1&2 and the overlap to Envisat (continuity);

- Improve on the propagation of uncertainties, especially to L3 (monthly) : separate the random and systematic contributions.

- Define a Level-4 product, filling the polar observation hole (needed for Sea Ice Volume estimates / indicators).

- Small improvements:
  - Ocean swell in MIZ
  - Retracking, surface type classification etc.
SIC in CCI+ : high-frequency channels

- GCOS requires “10-15 km” spatial resolution. This is not achieved by the long-term CDRs from US NSIDC, OSI SAF, nor CCI.

- “near 90 GHz” frequency channels provide better resolution (~15km), and are available since 1991 (F10) (soon 30 years).

- BUT: ~90 GHz means (substantially) more retrieval noise: -> new/improved algorithms.

- A “draft” CDR using ~90 GHz was processed in CCI, but considered not mature enough.
SIC in CCI+ : ESMR Nimbus-5

- ESMR was a pre-cursor imaging radiometer flown on U.S. Nimbus-5 (and -6) missions.

- L1 calibrated Nimbus-5 ESMR data (1972-1977) were recently released (data rescue).

- ESMR is quite different from the later radiometers:
  - cross-track scanning (geometry variation);
  - single frequency (~19 GHz) blending polarizations.

- In CCI+, we will see what can be achieved with ESMR, aiming first at weekly sea-ice extent (ice/no-ice) maps.

- Why care for just 5 years? e.g. Weddell Sea Polynya (winters 1974-1976).
Sea Ice and the other ECVs

- For most Ocean ECVs, sea ice is just a land mask…. *but it moves every day!*

- These can/should access to the most recent SIC data record (luckily it starts early, 1978).
  - Often used as ice/no-ice mask.
  - Sometimes as area fraction?

- Ocean ECVs from Vis/IR sensors (e.g. SST, OC) have higher resolution (~1 km) than the SIC data record (~ 25-50 km). Mismatch in scale (interest for the CCI+ developments, and for ice masks derived directly from Vis/IR data… not a CCI_Sea_Ice task).

- Many Atmosphere retrievals will break over sea ice surface (albedo, emissivity). Here again, is mismatch in spatial scale an issue?

- The Sea Ice ECV team is looking forward to dialogue on this, to help cross-ECV consistency.
Extra

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References:


