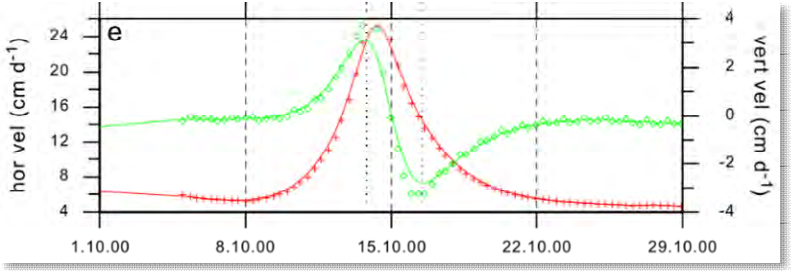
Science goal: Glacier Dynamics

- Glacier velocities and mass balance respond in a complex manner to variations in meltwater input and rainfall, depending on basal friction, the intra-glacial and basal hydraulic system, and water pressure.
- The current knowledge on the driving processes regarding short-term velocity fluctuations is based on a few local in situ experiments.



Rapid flow acceleration due to rainfall

Observation needs:

Precise measurements of surface velocity at daily and sub-daily timescale, providing comprehensive area-wide data on short-term velocity variations -

- Advancing the understanding and modelling of the response to changing boundary conditions
- Observe fast glaciers without aliasing.

Ref: J. Helbing VAW-ETHZ (2006)

Additional Science Opportunities

Primary science focusses on the water cycle

- Measurements expected for this should enable significant additional science

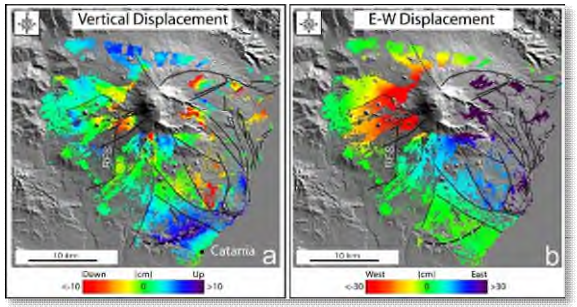
Solid Earth – Ground Motion

- Landslides (acceleration phase; *often triggered by rain*)
- Volcanoes (lava flows and seismicity)

Big Sur landslide (USGS)

Complements Sentinel and other missions

- Temporal context for Sentinel-1 images
- GEO radar provides N-S view (E-W for Sentinel-1)
- Synergy with Meteosat (complementary spectral bands)



Mount Etna (Neri et al.,2009)

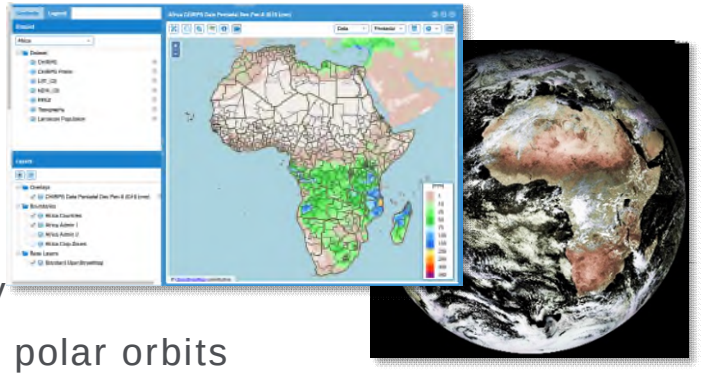
Other opportunities / early stage hypotheses

- Ionosphere, vegetation physiology, …

Societal Impacts

The water cycle has huge impacts on society:

Water resources – for agriculture, human health, commerce and industry



Water cycle related hazards

- Flood, landslide (*with improved predictive models*)
- Drought, fire-risk

Africa and other low latitude regions could benefit especially

- Geosynchronous orbit gives much better access than polar orbits
- Greater relative impact where there is limited surface infrastructure, e.g. much of Africa

Emergency response

- Timeliness needed for the science enables much more rapid response to emergencies

Science Requirements – Mission Requirements

New science requires significantly improved temporal sampling – every few hours or better

Summary of geophysical measurement needs:

- Tropospheric water vapour
  - 5-10 km (reducing to ~1 km by 2030?)
  - Every 30-60 min (reducing to ~15 min?)
- Soil moisture
  - Sub-km, every ~3 hours
- Intercepted precipitation, irrigation
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- Snow: snow-mass change during a day (~10^2 m)
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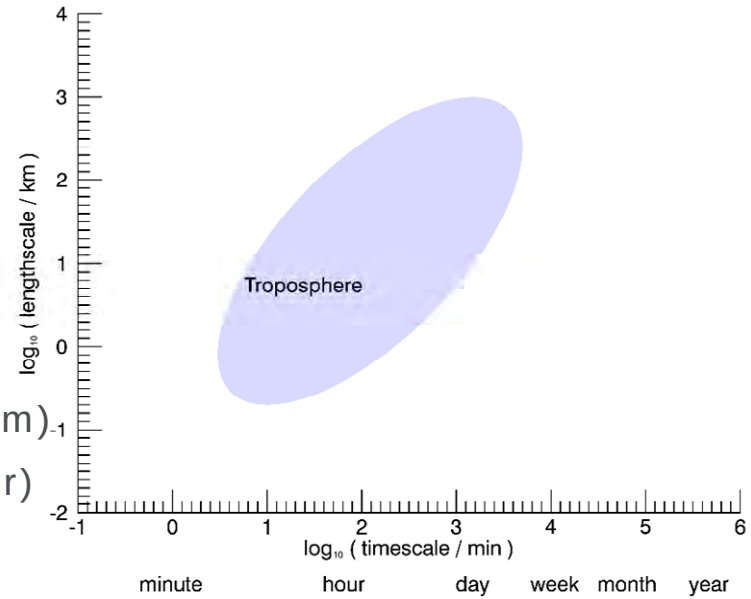
- Glaciers – velocity every ≤24 hr



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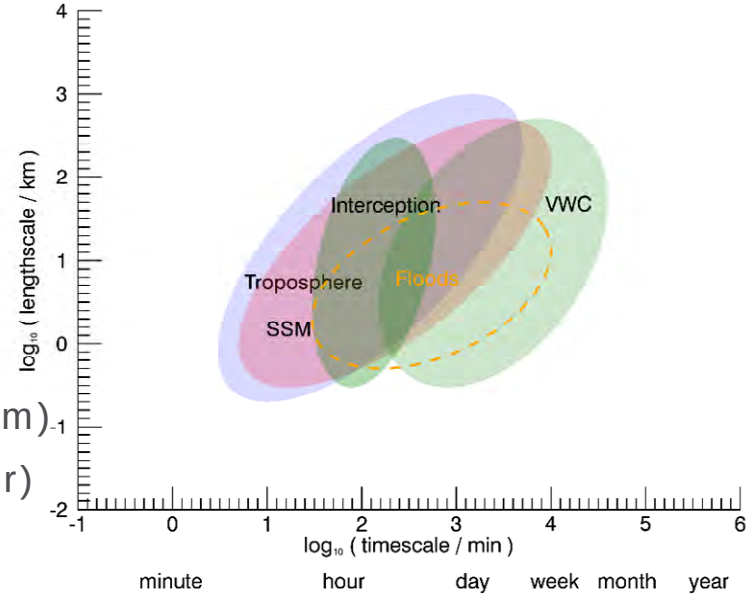

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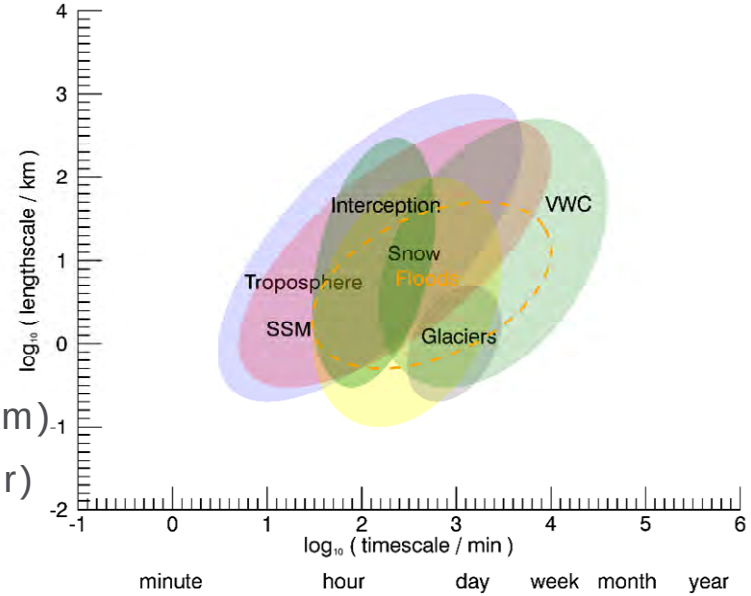

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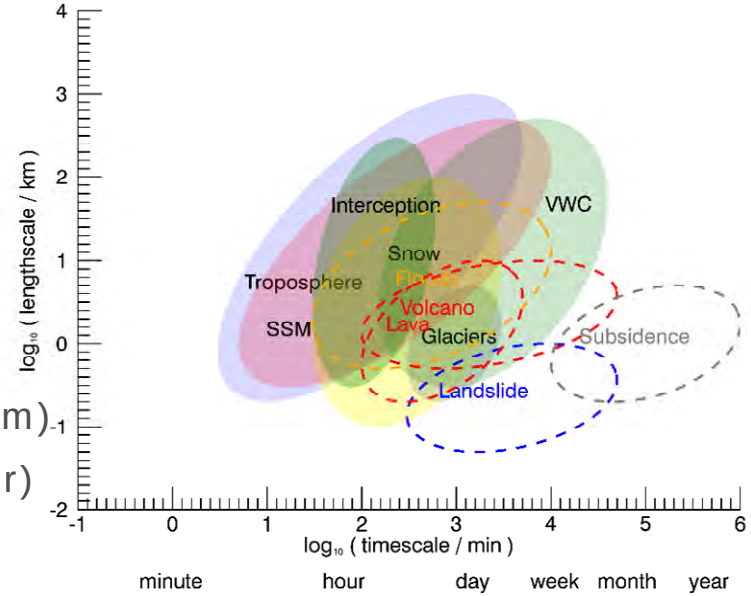

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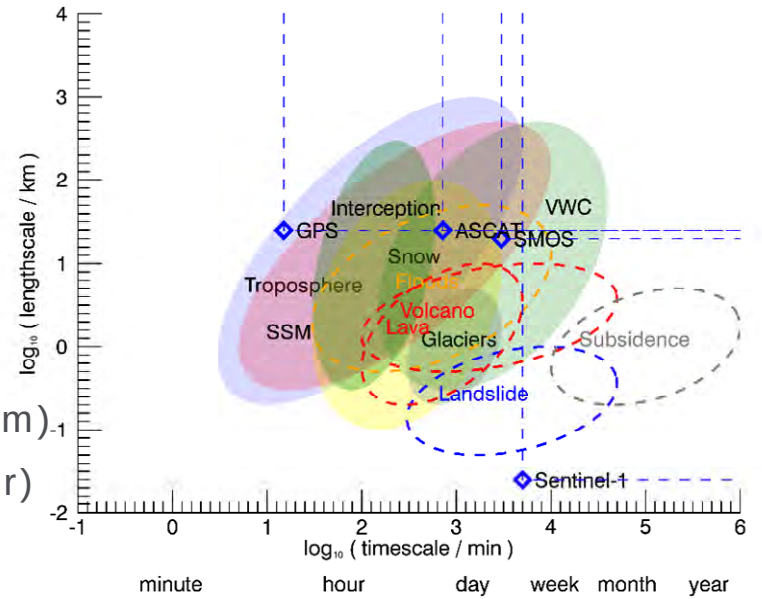

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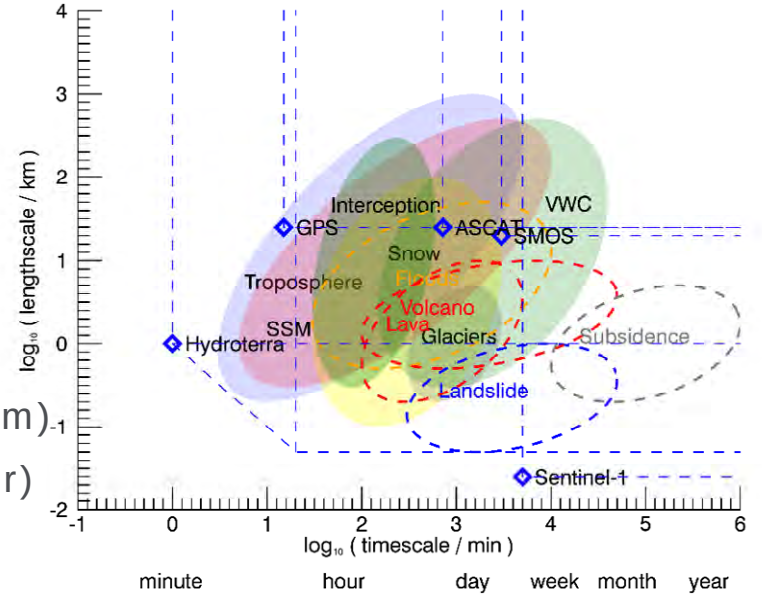

Conclusions

Water cycle science is core to Earth system science -

- An improved understanding of processes on fine temporal and spatial scales is needed to respond to demands due to climate and global change

There is a clear need for vastly improved temporal sampling –

- Every few hours or better (and at ~km or finer resolution)
- Of surface and atmospheric moisture for a better understanding of processes related to intense rain, water resources, snow and ice

Hydroterra meets current and expected needs (for next 10-20 yr)

- Science capability also enables secondary science objectives e.g. ground motion, landslides, bistatic SAR, ionosphere, etc.

Hydroterra will focus on dedicated regions in Europe and Africa

- And aims to be a pioneer for a global network of GEO radars