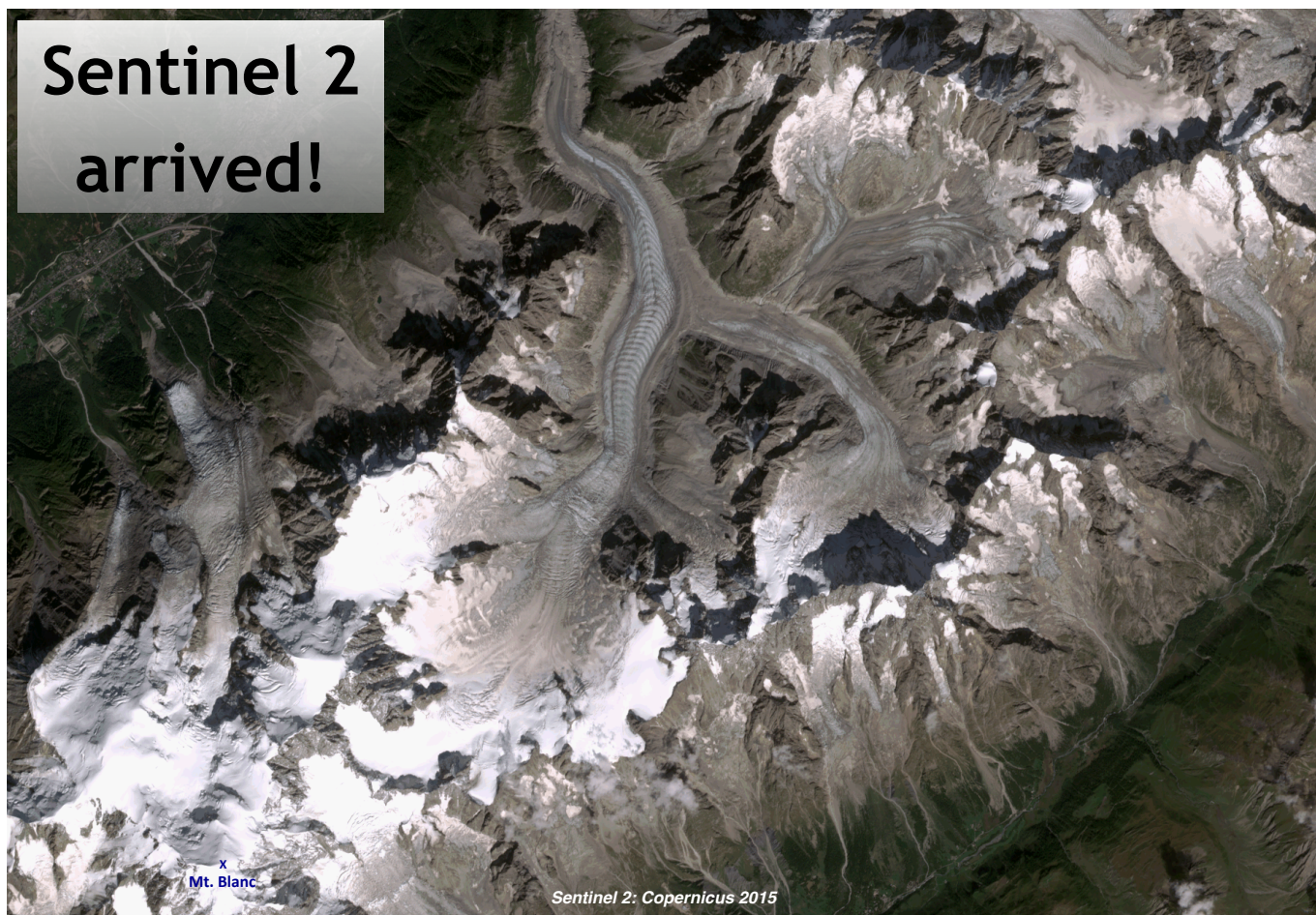




**Project Status March 2016**

***F. Paul (GIUZ) for the Glaciers\_cci consortium***

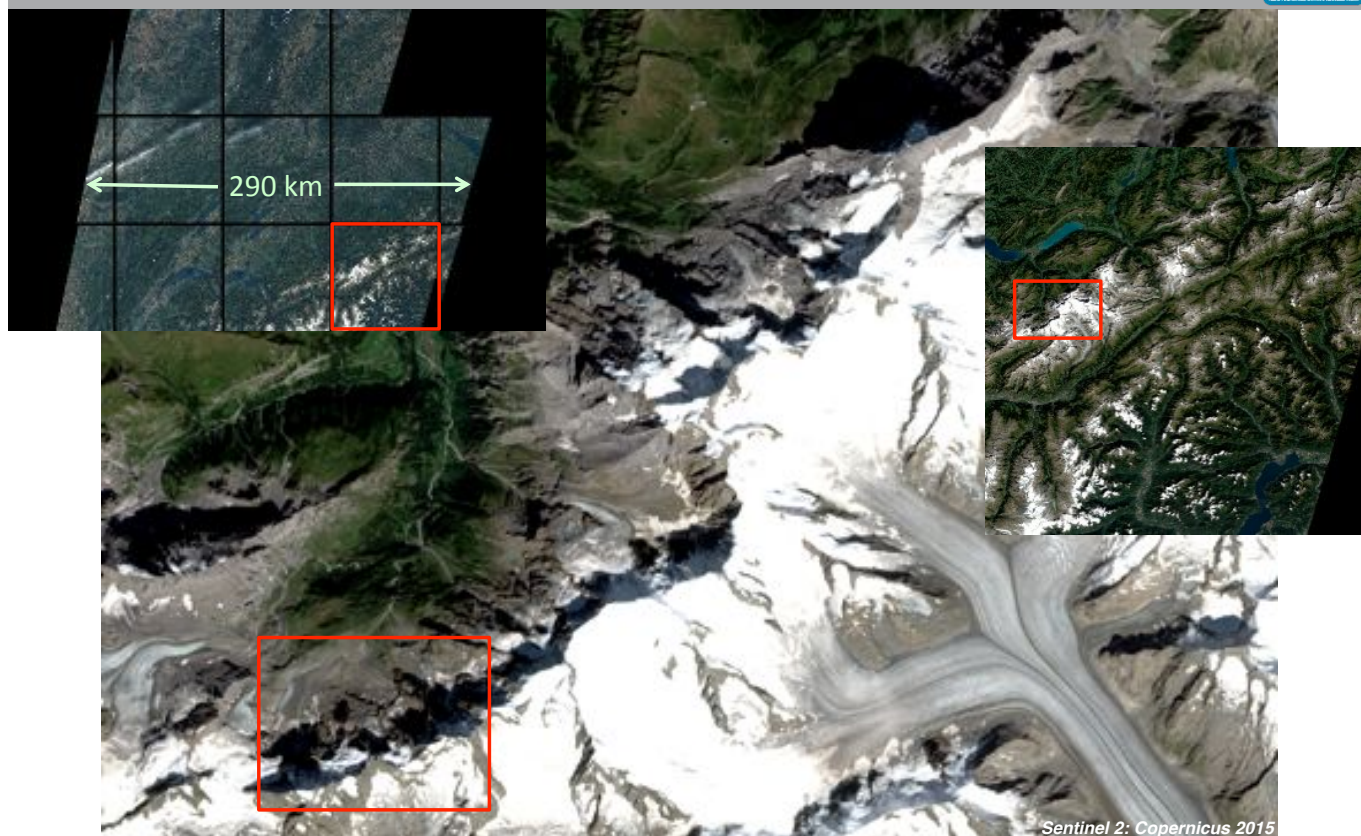


**Sentinel 2  
arrived!**

x  
Mt. Blanc

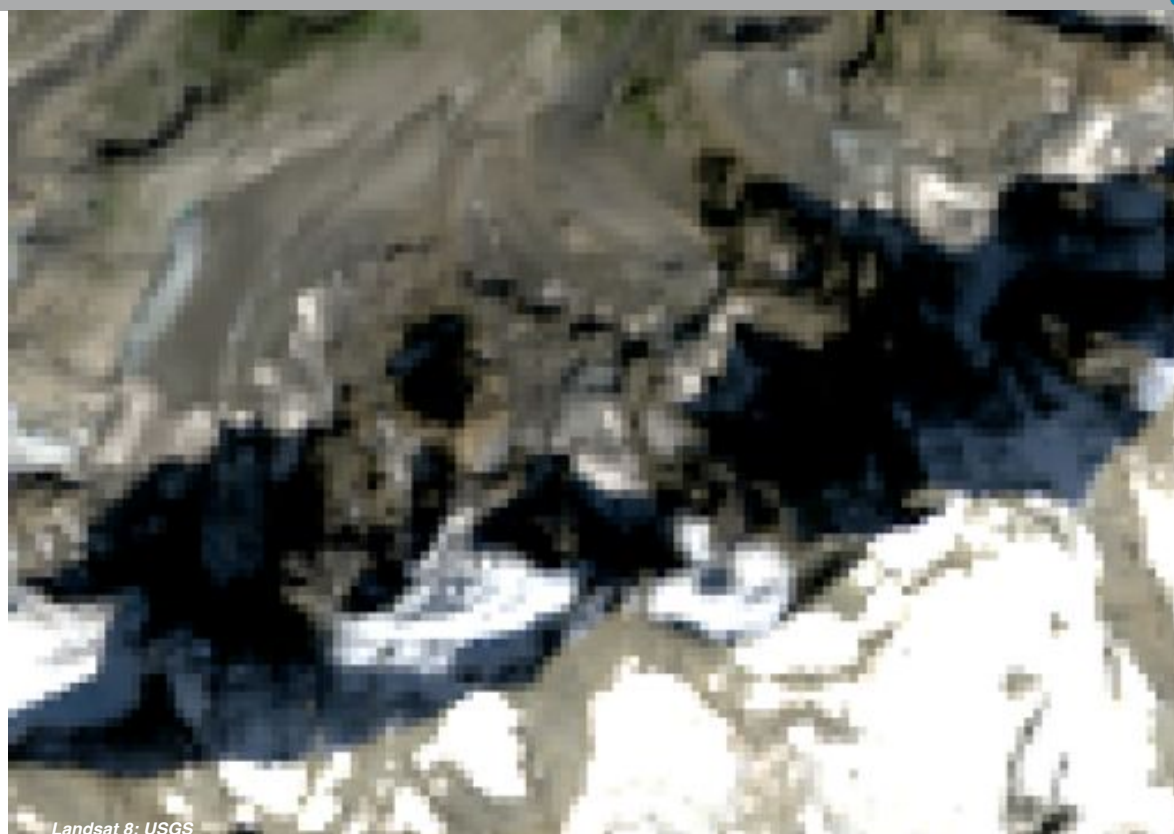
Sentinel 2: Copernicus 2015

## Sentinel 2 tiles and test region



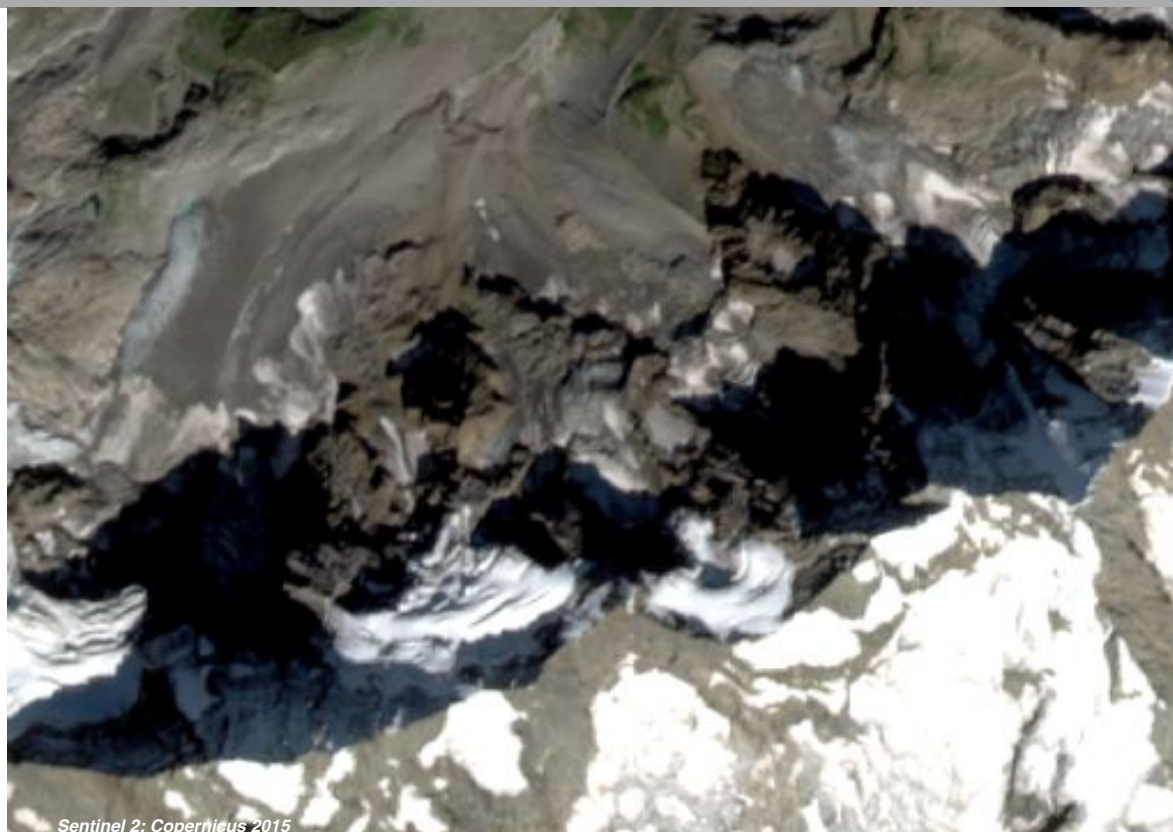
Sentinel 2: Copernicus 2015

## Spatial resolution Landsat OLI (30 m)

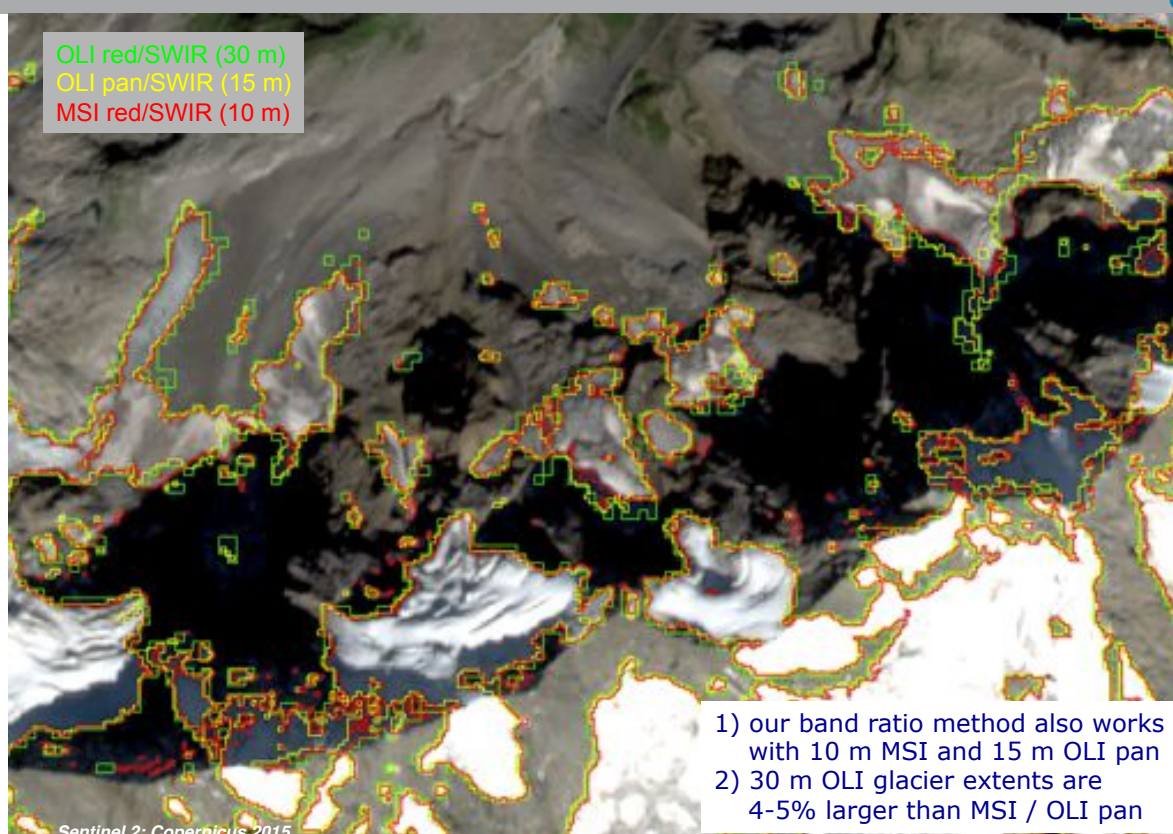


Landsat 8: USGS

## Spatial resolution Sentinel 2 MSI (10 m)



## Glacier outlines from OLI and MSI

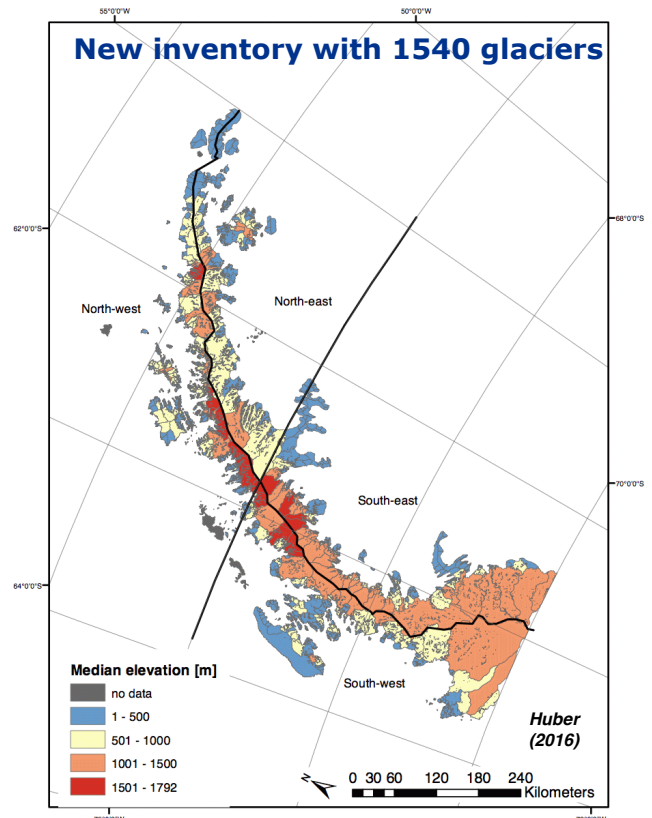
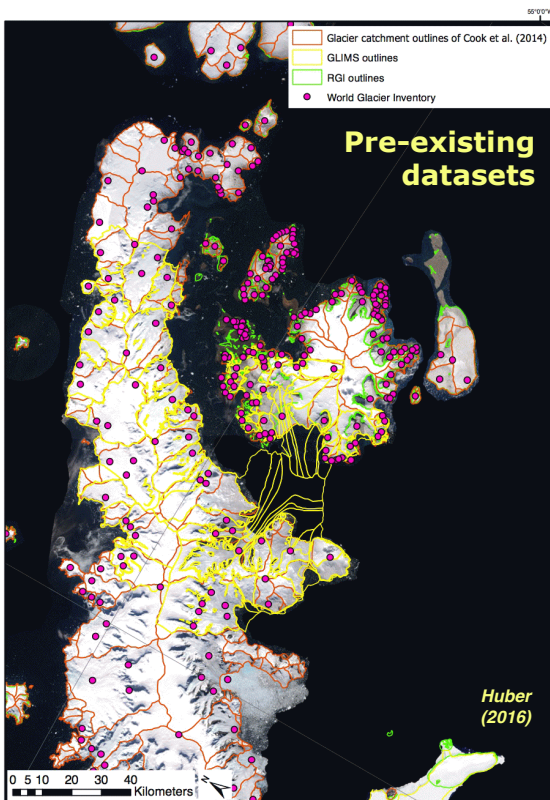


# Data production overview: Key regions



The selection of regions is based on: excluding ongoing work, considering data / quality gaps (e.g. RGI), performing change assessment, providing data for options (IV for O1), answering science questions (IPCC), improve process understanding through joint science (e.g. SEC-IV dependence), & perform X-comparison

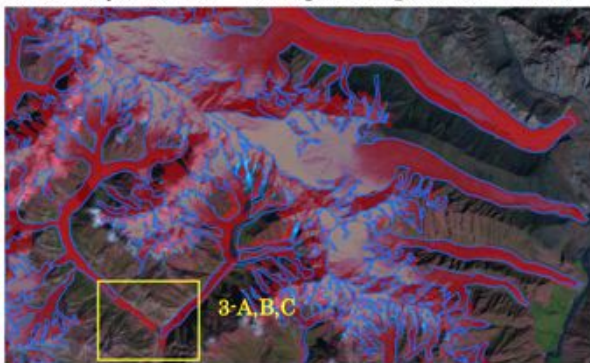
# New inventory: Antarctic Peninsula



# Glacier inventory cross comparison

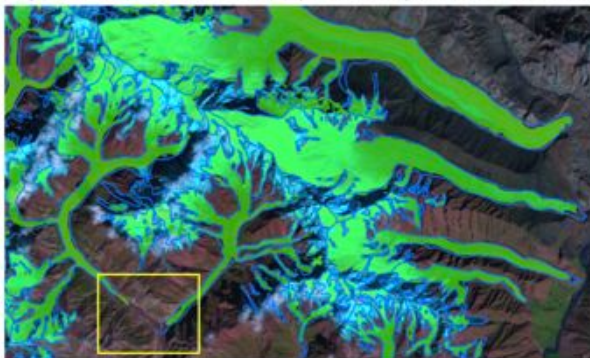


Landsat WRS2 path 149 row 35 Back image L71149035\_03520000911 (9/11/2000)



Red color: CCI2(9/16/1999) Blue line: GAMDAM(8/16/2002)

Large difference are found at head walls. Only southwestern glaciers have different terminus



Green color: ICIMOD (Indus) (This area overlap path149 row35 and path150 row35)



**Compared inventories: CCI, GAMDAM, CGI2, ICIMOD**

Different problems in accumulation and ablation regions:

Abl: debris cover, dead ice, rock glaciers

Acc: seasonal snow, steep ice fields, ice aprons

All images: A. Sakai

# Delicate decisions (accumulation region)



Photo: Ann Rowan

# Time series 1990-2015: Karakoram surges



## Big online media echo on animations



EGU 24 NOVEMBER 2015 Planet Press WWW.EGU.ORG

### Studying glaciers with animated satellite images

Glaciers are large bodies of ice that can be found near the Poles and in some mountainous regions. They are formed when snow falls, freezes and gets compressed. The weight of the ice forces the glacier to flow. As they move very slowly, the best way to study how they move and change is by looking at glaciers from above and over long time periods.

Frank Paul, a scientist from the University of Zurich in Switzerland, has now come up with a simple method that allows us to easily see glacier movements and changes, using the Karakoram mountain range in central Asia as an example. He started by gathering satellite images of the region taken between 1990 and 2015, which are available for free on the US Geological Survey website. He then displayed them in sequence, using freely available software to create animated pictures in simple GIF format – the type that is very popular for animations on the Internet.

The animations he has now published, available on The Cryosphere website, compress 25 years of satellite images into just one second.

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- Proba-1 overview
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26 November 2015 Animations that compress 25 years of satellite images into just one second reveal the complex behaviour and flow of glaciers in the Karakoram mountain range in Asia.

Frank Paul, a glaciologist at the University of Zurich in Switzerland, used images from 1990 to 2015 captured by three different Landsat satellites to create timelapse sequences of four regions in the central Karakoram: Baltoro, Parman, Skarni-Sargo Lago and Shaligam.

WIRED

featuring **René Redzepi**

INSIDE THE WORLD'S BEST RESTAURANT

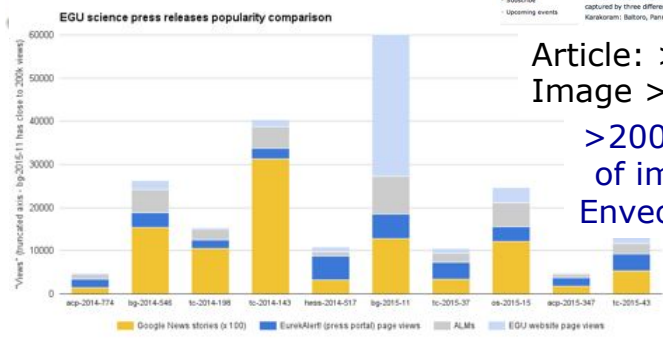
the Future of food

A FEAT OF THE END OF THE END OF MEAT (CLOSED-LOOP CIRCULAR FOOD SYSTEMS) FOR THE FUTURE

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Article: >12400 views  
 Image > 14000 views  
 >200 downloads of images from Enveo Cryoport

### Watch glaciers PULSE as they surge and rise: Time-lapses filmed from SPACE show 25 years of changing ice in just one second

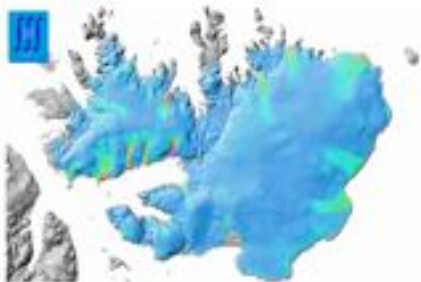
- Animations show glacier movements accelerated by 800 million times
- Satellite images taken over 25 years were combined to create time-lapses
- Many glaciers in the Karakoram range are actually increasing in size
- Curious 'surge' behaviour makes them move 100 times faster than usual

By SARAH GRIFFITHS and RUSS SWAN FOR MAILONLINE  
 PUBLISHED: 13:37 GMT, 26 November 2015 | UPDATED: 15:57 GMT, 27 November 2015

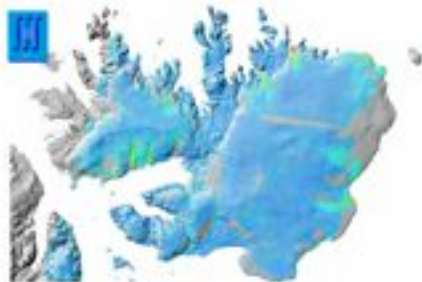
# Velocity: longest possible time series (FCDR)



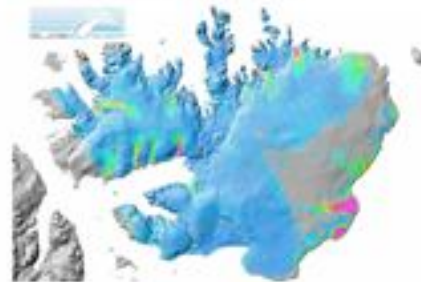
ERS-1/2 1995/1996  
InSAR & offset-tracking



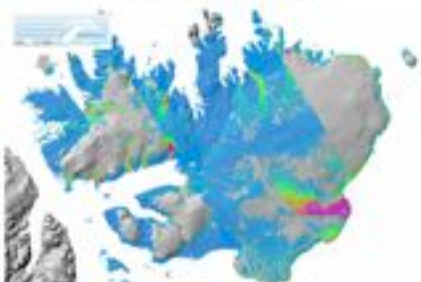
JERS-1 1997  
offset-tracking



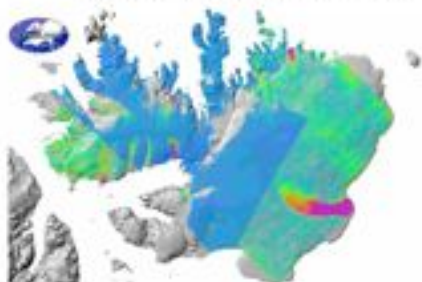
ALOS PALSAR 2008  
offset-tracking



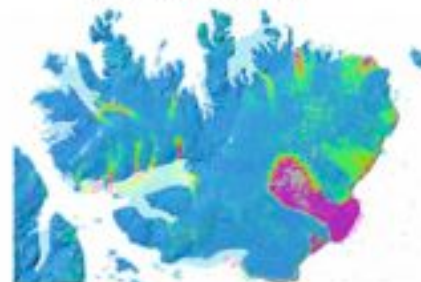
ALOS PALSAR 2010  
offset-tracking



ERS-2 2011  
InSAR & offset-tracking



Sentinel-1 2015  
offset-tracking

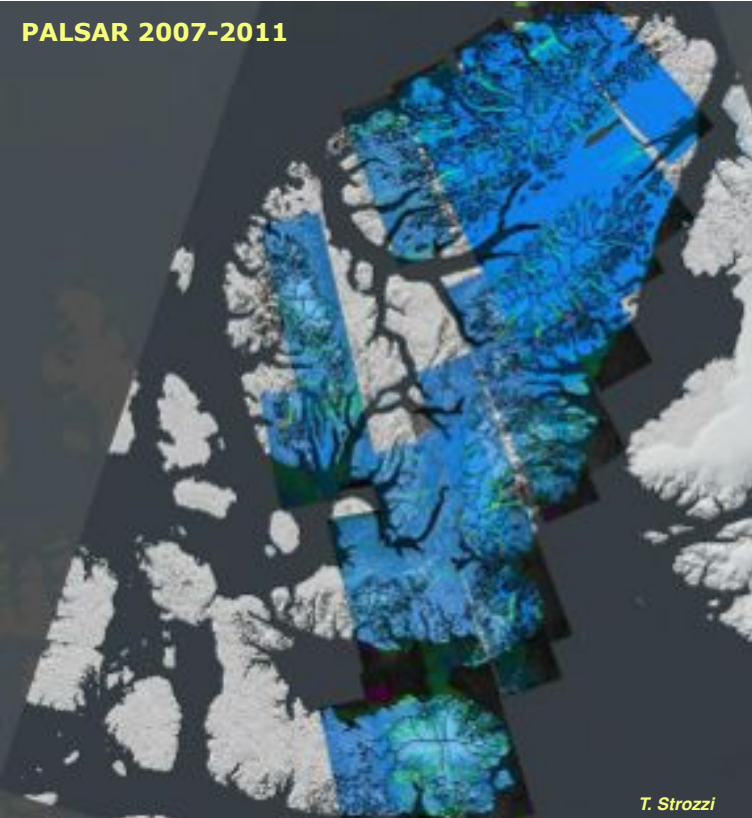


T. Strozzi

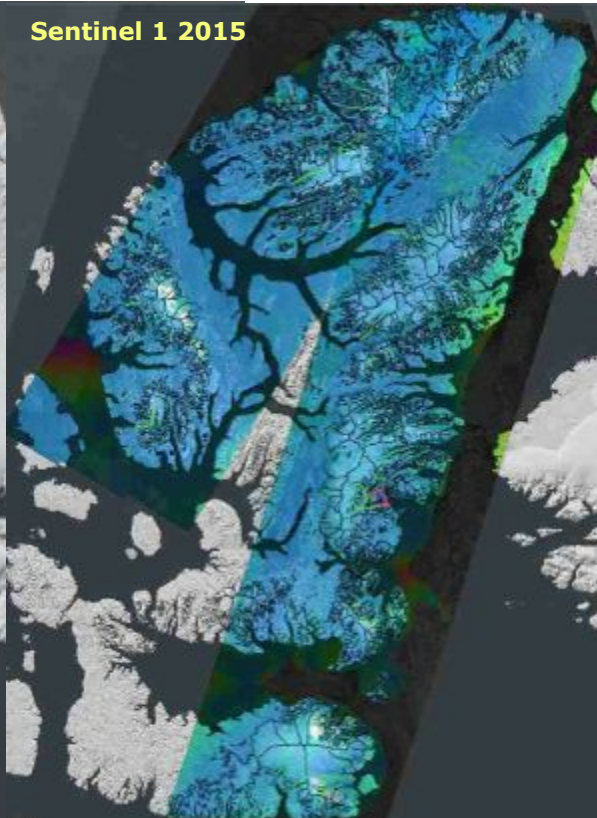
# Velocity: Repeat large-area coverage



PALSAR 2007-2011

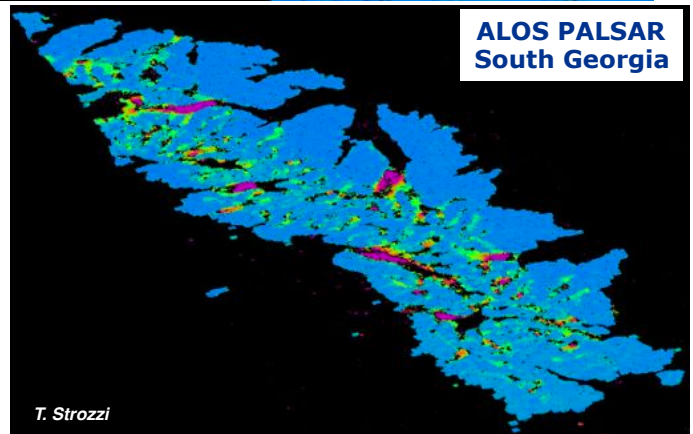
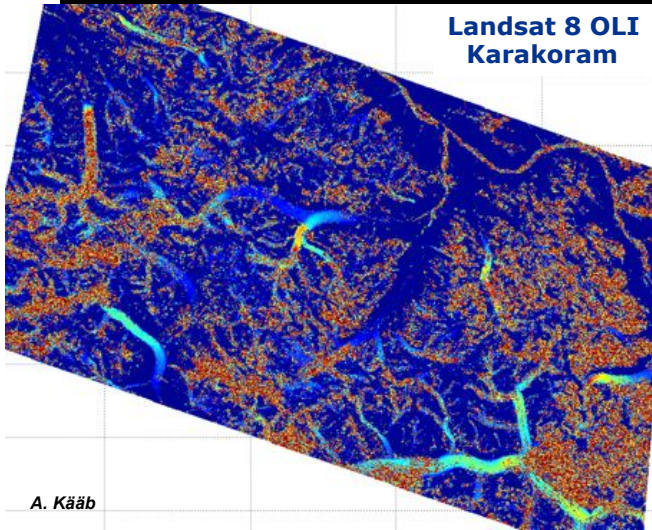
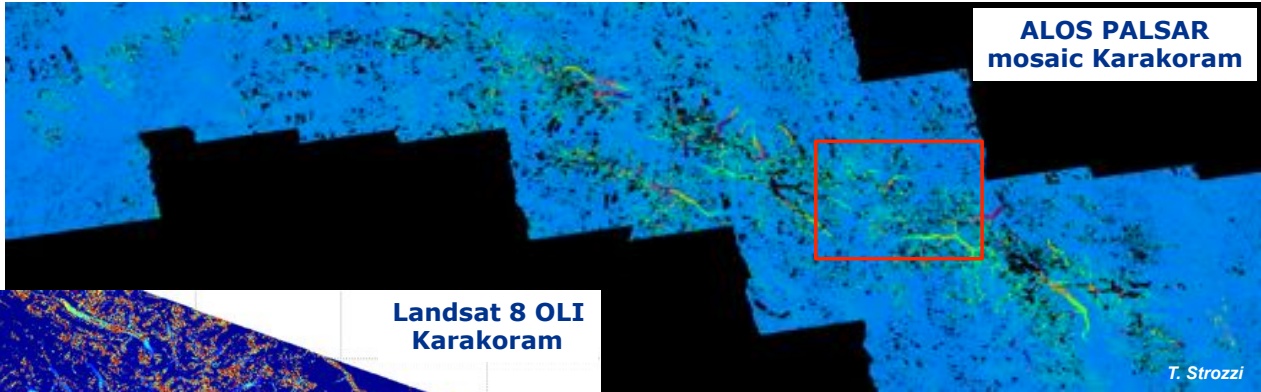


Sentinel 1 2015



T. Strozzi

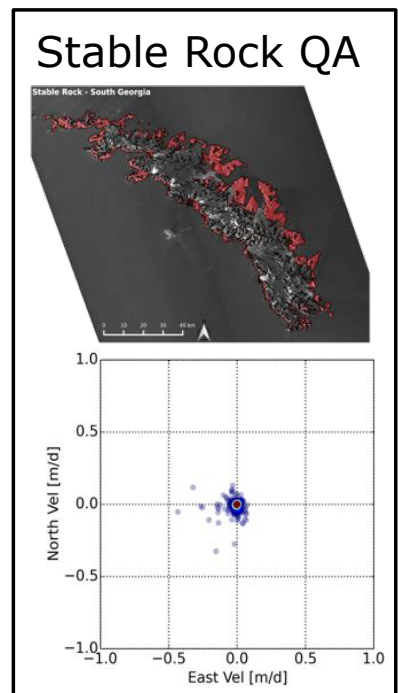
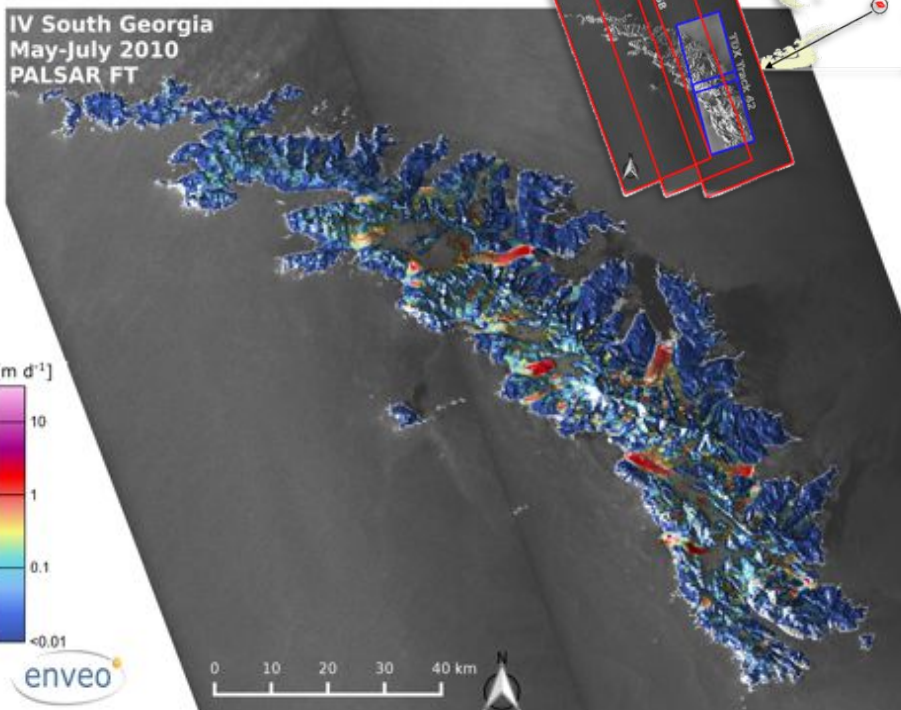
# New velocity products



# Quality assessment of generated products

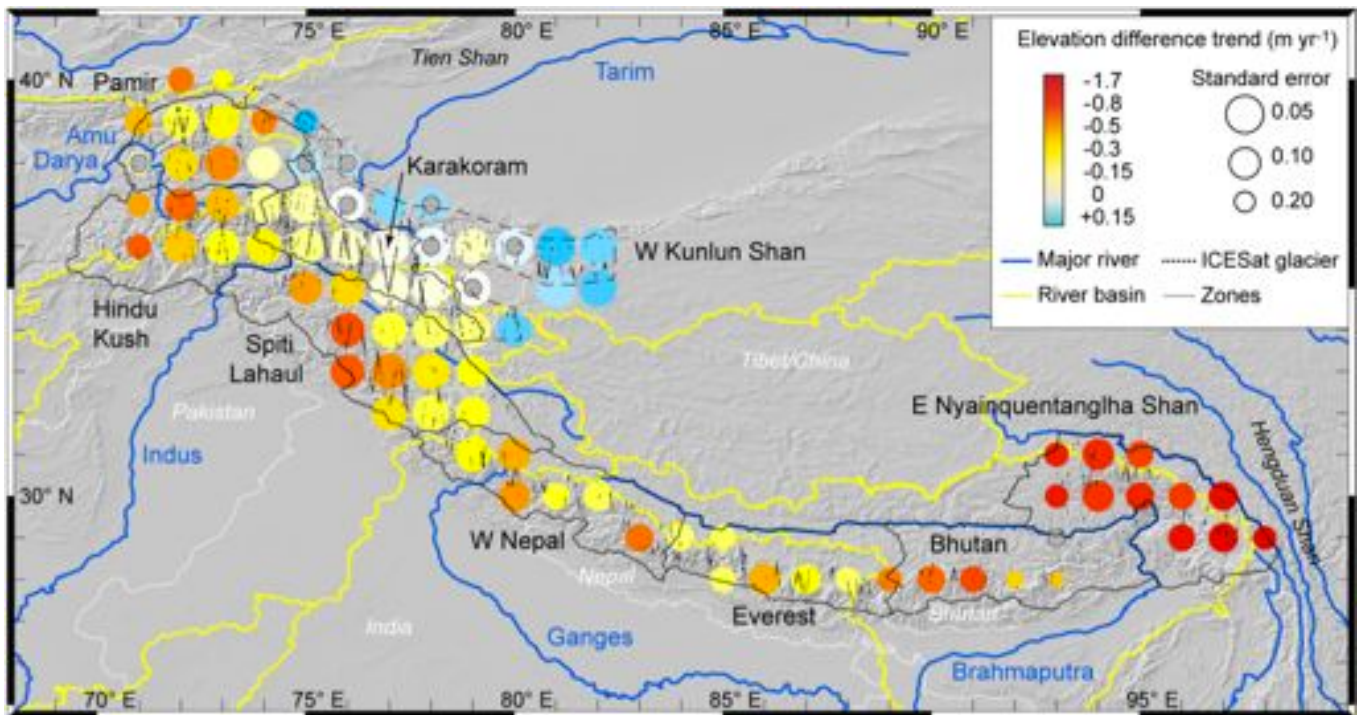


## ALOS PALSAR 2010



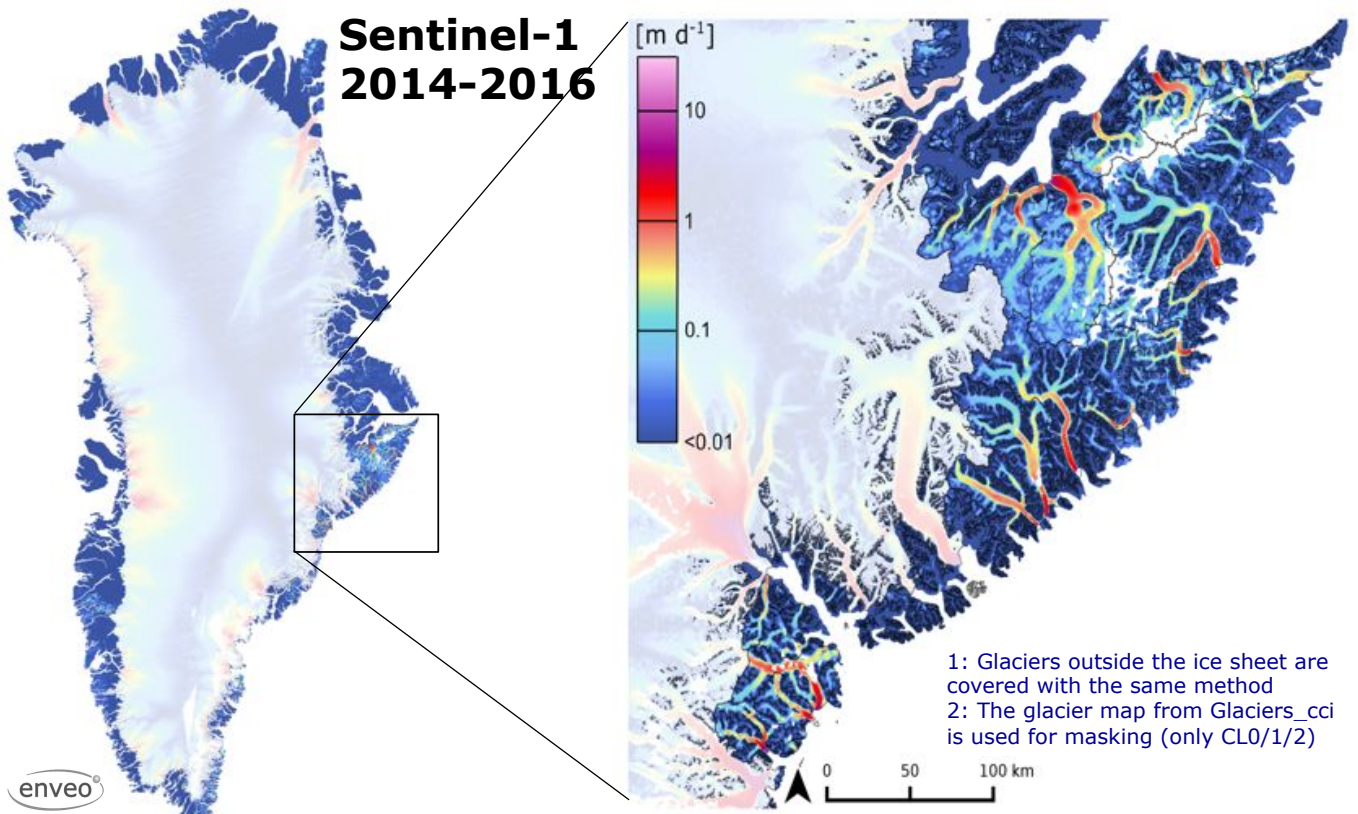


# Elevation changes ICESat- SRTM DEM



Kääb et al. (2015)

# Cross-ECV data production: Velocity Greenland



- 1: Glaciers outside the ice sheet are covered with the same method
- 2: The glacier map from Glaciers\_cci is used for masking (only CL0/1/2)

# Big media echo on unprecedented glacier decline



Journal of Glaciology, Vol. 41, No. 238, 2015. doi:10.3189/2015jgl13017 743

## Historically unprecedented global glacier decline in the early 21st century

Michael ZEMP<sup>1</sup>, Helene FRIY<sup>1</sup>, Isabelle GÄRTNER-ROGER<sup>1</sup>, Samuel U. NUSSBAUMER<sup>1</sup>

### SonntagsZeitung



## Die Gletscher schmelzen so schnell wie noch nie

Der weltweite Schmelzwasserspiegel erreicht einen historischen Höchstwert. Die Folgen für die Schweiz sind instabile Hänge, weniger Wasser für Landwirtschaft und Stromerzeugung

Die Gletscher schmelzen so schnell wie noch nie. Der weltweite Schmelzwasserspiegel erreicht einen historischen Höchstwert. Die Folgen für die Schweiz sind instabile Hänge, weniger Wasser für Landwirtschaft und Stromerzeugung.

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the guardian

## Glacier retreat worldwide 'unprecedented', says report

led rapid rises in meltwater and alarming rates of glacial retreating at a pace double that of a decade ago

70

47 000

35

3785

3019

0,5

730 000

1415

100

in retreat. The great tongues of ice high in the Himalayas, the Rockies are going back uphill at ever greater speeds, according

th accelerating and "historically unprecedented", say the Journal of Glaciology.

searchers have identified rapid rises in meltwater and retreat in Greenland, West Antarctica, the Canadian and ins, in Europe and in the Himalayan massif. They have also speed downhill. One satellite-based study, confirmed by on-nts, of the Jakobshavn glacier in Greenland, confirms that the g at the rate of 46 metres a day, 17 kilometres a year, which is d in 2003, which in turn was twice as fast as measured in 1997.

oring Service, based at the University of Zurich in Switzerland countries, has been compiling data on changes in glaciers over it has just compared all known 21st century observations with nents, aerial photography and satellite observations and and written sources. Altogether, the service has collected 5,000 : volume and changes in mass since 1850, and 42,000 records onts from records dating back to the 16th century.

r: the glaciers are in retreat, worldwide, and the retreat is

currently lose between half a metre and one metre of ice his is two to three times more than the corresponding average ys the study's lead author, Michael Zemp, who directs the act measurements of this ice loss are reported from a few owever, these results are qualitatively confirmed from field is for tens of thousands of glaciers around the world."

## Summary



- **Data production (velocity Arctic, inventory API) for the selected key regions continued (=> CRDP2)**
- **New sensors (Sentinel 1/2, Landsat 8, Cryosat 2, PALSAR 2, Radarsat, TSX) were further investigated (algorithms)**
- **Change assessment for Karakoram glaciers and surge descriptions**
- **Clarification of inventory differences (RGI, GAMDAM, ICIMOD, CGI) described in draft document (RGI meetg. @ AGU: please finish soon)**
- **A large number of workshops/conferences with Glaciers\_cci contributions took place (S2A, IGS, PSTG-5, SGM, AGU, AGM)**
- **Intense outreach activities (press releases & media feedback)**
- **CCI data portal & toolbox, Copernicus Climate Change Service (C3S)**
- **intense discussion on GLIMS executive board ('Core team')**